SOURCE WATER PROTECTION PLAN

GALEN CAMPUS WATER SYSTEM

PWSID # MT0000223
MAY 2002

PREPARED BY
ROBERT PECCIA & ASSOCIATES
HELENA, MONTANA

TABLE OF CONTENTS

APPENDICES

LIST OF FIGURES

LIST OF TABLES

STEP 1 – INTRODUCTORY INFORMATION

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Introduction

The purpose of this report is to meet the technical requirements for the completion of the delineation and assessment report for the Galen Campus Water System as required by the Montana Source Water Protection Program (MSWPP) and the federal Safe Drinking Water Act (SDWA) Amendments of 1996 (P.L. 104-182).

The Montana Source Water Protection Program is intended to be a practical and cost-effective approach to protect public drinking water supplies from contamination. A major component of the MSWPP is delineation and assessment . Delineation is a process of mapping source water protection areas, which contribute water used for drinking. Assessment involves identifying locations, or regions in source water protection areas where contaminants may be generated, stored, or transported, and then determining the relative potential for contamination of drinking water by these sources. The primary purpose of this source water delineation and assessment report is to provide information that helps the Galen Water System complete a source water protection plan to protect its drinking water source.

Water Quality

Galen's water is routinely monitored for compliance with drinking water standards. Bacteriological monitoring occurs monthly. Compliance with other drinking water standards is based on additional sampling on a variety of schedules. Galen has not had any non-compliance problems for exceeding regulated contaminant levels in the last five years. Results from the most recent testing of the existing well source have been provided in the Appendix.

The Community

This Source Water Protection Plan (SWPP) is for the Galen Campus located just off Interstate 15 between the communities of Anaconda and Deer Lodge. The campus is located in Deer Lodge County and is the site of a former state owned hospital. The site is now owned by Montana

Behavioral Health, (MBH) which is a partnership between AWARE, the Montana Economic Revitalization and Development Institute (MERDI) is association with the Anaconda Local Development Corporation (ALDC). The majority of the campus buildings, (including the main hospital) have been abandoned and will eventually be demolished. The campus is currently occupied by AWARE which oversees several group homes and five apartments occupied by private individuals. Future plans for the campus include 19 additional apartments and a new Juvenile Corrections Center (JCC). The JCC is currently under construction is slated for completion in October. The JCC will house 48 juveniles and 45 employees. The existing AWARE group homes house 45 tenants that are served by 45 employees. It is anticipated that the campus will see additional growth in the future with the addition of new commercial or institutional buildings.

Geographic Setting

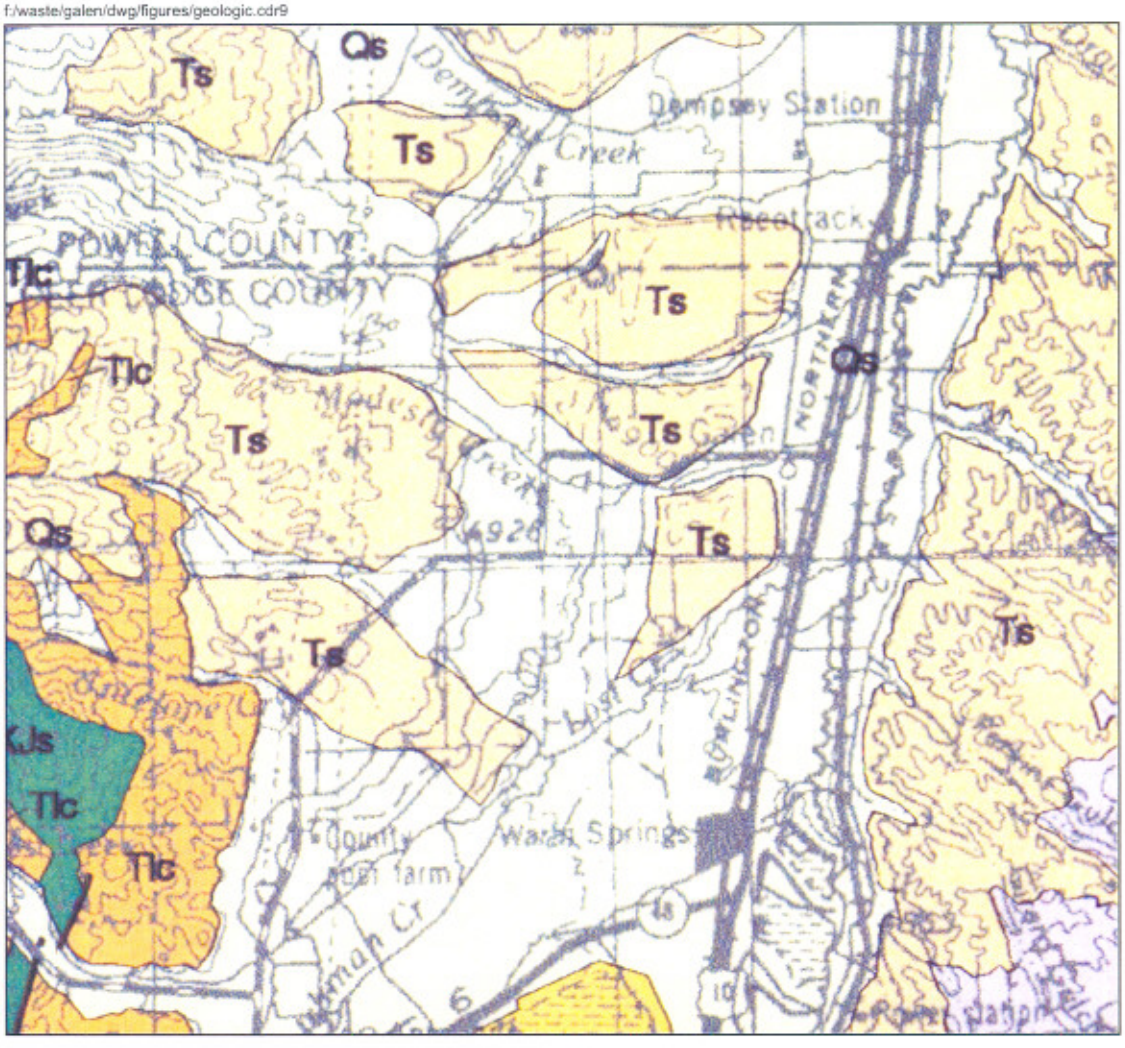
The Galen Campus is located in the Modesty Creek Drainage. The campus is located in an area consisting of surficial sedimentary deposits (Pleistocene and Holocene) and sedimentary deposits and rocks (Eocene through Pliocene) based on the Geologic Map of the Butte 1 x2 Quadrangle (Montana Bureau of Mines and Geology; Reed S. Lewis 1998). The surficial sedimentary deposits consist of Alluvium, fan and terrace gravel, gravel deposits on pediment surfaces, and landslide and travertine deposits (Pleistocene and Holocene); till, glacial lake and outwash deposits (Pleistocene). The sedimentary deposits and rocks consist of fan and gravel deposits on pediment surfaces (Pliocene); conglomerate, sandstone, mudstone, and volcanic ash beds (Eocene, Oligocene, or Miocene). Well logs from the campus confirm the presence of sedimentary deposits at a depth of over 200 feet. A copy of the above referenced map showing the area around the Galen Campus is provided in **Figure 1**. Additional geologic and soils information has been provided in the Environmental Site Assessment performed by MSE located in **Appendix A.**

Source Water and Public Water Supply

As stated above the campus is located in the Modesty Creek drainage. There are two existing wells on campus. Only one of these wells is currently in service and it provides the source water for the existing campus. It is classified as a public water supply. It is approximately 207 feet deep, with a 12-inch diameter casing. The well is screened from 159 to 169 ft, 179 to 189 ft and 197 to 207 ft. A 50 hp vertical turbine pump and pump house has been installed over the well. The pumps capacity is 500 gpm and it pumps to an existing 60,000-gallon elevated storage tank located on the south end of the campus. Static water level ranges from 10 to 35 feet with a drawdown of approximately 65 feet below ground surface. The source water is currently disinfected with chlorine gas. Improvements are slated to be made to the well this summer including a new telemetry system to control the pump based on storage tank level and a new liquid chlorination system. Chlorine gas will no longer be used because of fire code restrictions. A new 200,000-gallon storage tank will also be constructed. The existing 60,000-gallon tank will be taken off line and used only in an emergency. The location of this well is shown on **Figure 2**.

The other existing well is located inside of the campus shop. It is an 8-inch diameter well with a 500-gpm capacity and is 223 feet deep. The well casing was perforated at 171 to 175 feet and 210 to 214 feet. It was originally pump tested at a rate of 500 gpm with a drawdown of 80 feet. Static water level was at 30 feet. This well has been fitted with a 25 hp vertical turbine pump with a capacity of 250 gpm. This well used to serve as a backup to the main well but has been disconnected. The well was disconnected as a precaution because of a leaking underground diesel tank located outside of the shop. The tank was removed, but there is still some contaminated soil in the area around where the tank was located. This soil is scheduled for removal in the near future. The well water had an oily feel and smell when it was turned on during a site visit in the summer of 2001. As a result of this finding, the well was tested for diesel

f:/waste/galen/dwg/figures/geologic.cdr9



Scale = 1:125,000

Legend

md	Tailings, mine dumps, and slag piles (Holocene)
Qs	Surficial sedimentary deposits (Pleistocene and Holocene)
Ts	Sedimentary deposits and rocks (Eocene through Pliocene)
KJs	Sedimentary rocks (Cretaceous and Jurassic)
Tlc	Lowland Creek Volcanics (Eocene)

Source: Montana Bureau of Mines and Geology
Geologic Map of the Butte 1° x 2° Quadrangle
Reed S. Lewis 1998

Figure Title

Figure 1
Geologic Map - Galen Vicinity

Project Title

Galen Campus Improvements

ROBERT PECCIA & ASSOCIATES

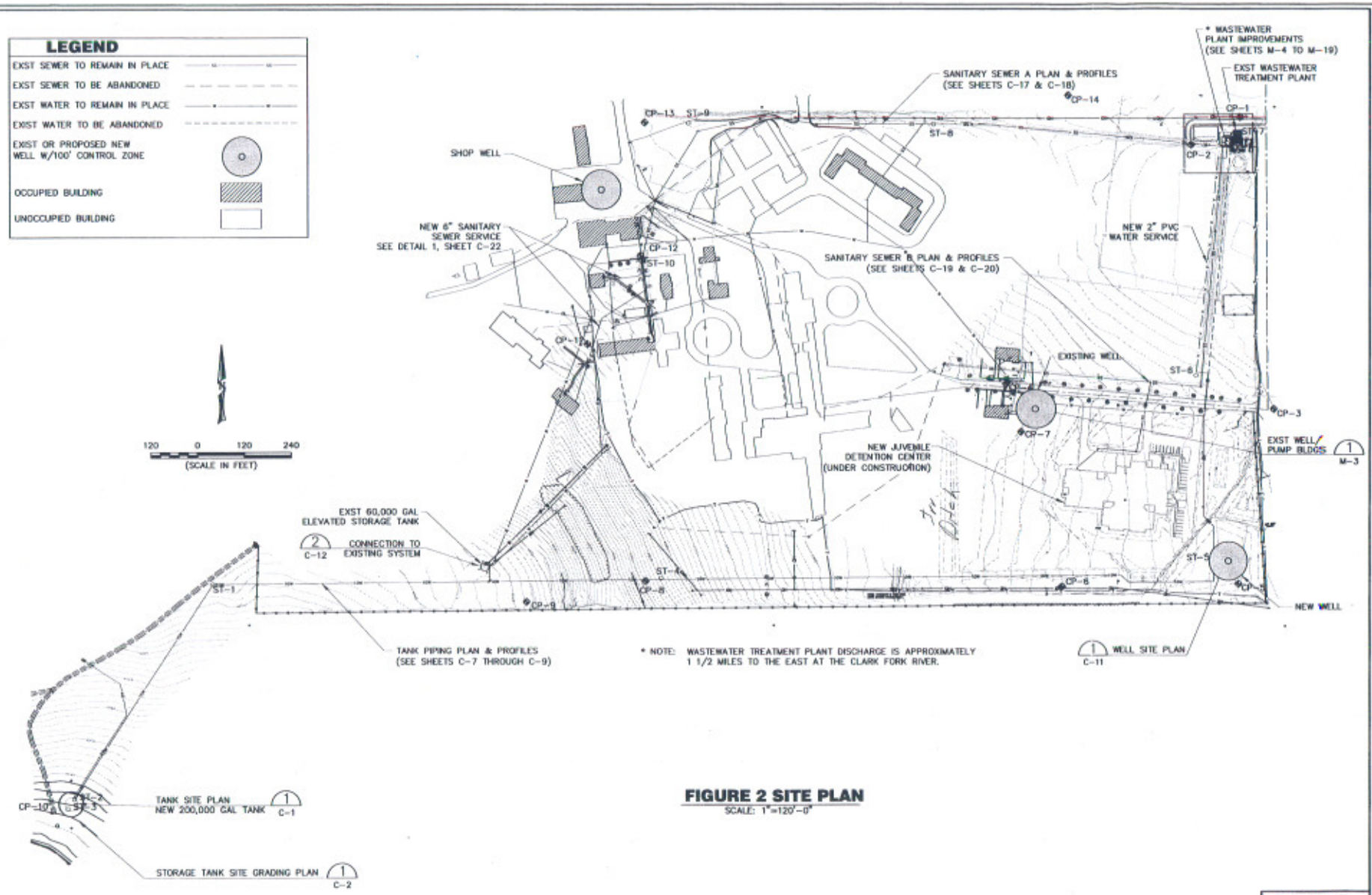


FIGURE 2 SITE PLAN
SCALE: 1"=120'-0"

VERIFY SCALES
BAR SCALE IS ONE INCH ON ORIGINAL DRAWING.
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

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SHEET TITLE
FIGURE 2 SITE PLAN

SHEET
FIG-2
OF

and gasoline and the related byproducts. The test results were below regulatory limits and it does not appear that the remaining contaminated soil will present a problem. (see Phase I Environmental Site Assessment Dec. 2001 pgs 11, 12 & 13 by MSE in **Appendix A** for further discussion). The remainder of the contaminated soil will be removed in the near future. This well will remain disconnected and will be replaced by the new well to be constructed this summer. The new well will have a capacity of 500 gpm and will be located near the new JCC. The new well will be a 12-inch diameter well approximately 200 feet deep with a liquid chlorination system to disinfect the well water. See the site map in **Figure 2** for the location of the new well and other system components.

The existing well and new well will serve the existing tenants on the campus as well as the new JCC. The wells will have to provide domestic service for approximately 100 tenants and 100 employees. The wells and new 200,000-gallon storage tank will also be capable of providing a fire flow of 1500 gpm for a two-hour period. Water Quality testing has been performed on the existing well per the requirements of the Montana Department of Environmental Quality. Copies of the most recent test results have been provided in **Appendix B**. It should be noted that domestic water demands will be only about 20,000 gallons per day (14 gpm) once the construction of the JCC is completed. The maximum future domestic demand expected to occur over the next 20 years is 100,000 gallons per day (70 gpm).

SWP Management

The SWP management team will consist of Mr. Jim Kambich, MERDI; Tom Piercy, Chief Operator and Gary Swanson, P.E. Robert Peccia and Associates. This plan was written by Gary Swanson, P.E.

STEP 2 – DELINEATION

Introduction

The area that contributes water to Galen's wells is identified in this chapter. Three management regions (the control zone, inventory region, and recharge region) are mapped. The control zone, also known as the exclusion zone, is an area at of least 100-foot radius around the well. The goal of management in the control zone is to protect against direct introduction of contaminants into Galen's wells or the immediate surrounding area.

The inventory region also known as the special protection region represents the zone of contribution to the well, which approximates a three-year groundwater time of travel. The inventory region should be managed to prevent release of contaminants that could flow to Galen's wells within a relatively short time period. The recharge region is the entire area contributing recharge to Galen's wells. The goal of management in the recharge region is to maintain and improve water quality over long periods of time.

Geologic Conditions and Aquifer Characteristics

Copies of the well logs and other relevant information for the two existing wells have been included in **Appendix C.** Additional geologic and soils information are given in the Environmental Site Assessment in **Appendix A** and in the soils reports for the site in **Appendix D**. The existing two campus wells are approximately 208 and 223 feet deep. The wells have been screened or the casing has been perforated in lower water bearing zones. The screens and perforations appear to have been placed in zones of coarse sand and gravel. The materials encountered are alluvial in nature and consist of clays, sands and gravels. Static water levels are given as 30 and 35 feet on the well logs obtained from the Montana Bureau of Mines and Geology. However, recent soils investigations have shown that groundwater is currently within 10 feet of existing ground. Access to the existing wells is not possible without pulling the pumps so it was not possible to obtain current static water measurements. Pump test information and well log information from the new well will be included in this report as an appendix when it becomes available. Well data from other nearby wells has also been included in **Appendix C.** The location of these wells has been included in **Figure 3.**

Alternate Water Sources

Once the new well is installed a total of 1000 gpm will be available to meet the needs of the campus. A domestic demand of 20,000 gallons per day (14 gpm) is anticipated once the new JCC is completed with a future maximum demand of 100,000 gallons per day (70 gpm). The wells have been sized to provide fire protection for the campus. Once the new well is completed the campus will have two wells available. Only one well will be needed to meet domestic demands. The site of the new well was selected based on it's proximity to the new JCC and it is located outside the campus gravity sewer system. The well site is a grassy field that is inside the campus fence line. It was also located away from the existing campus buildings to minimize the potential for contamination of any as yet undetected contaminants that may be located on the old campus. The 100 ft diameter control zone will lie entirely within the campus property. A source water protection area has been established for the new well as described below. Information from the existing campus wells was used in delineating the protection area for the new well.

Source Wells

The source wells for the Galen Campus will be the proposed new well and the existing main well. The well located in the campus shop will be disconnected and will no longer be used. Logs for

The existing wells are provided in **Appendix C.** The proposed location of the new well and the existing wells is given in **Figure 2.**

Delineation Method and Input Parameters

Control Zone

A control zone consisting of a circle with a 100-foot radius has been established around each of the two existing wells and the proposed well. See **Figure 2.**

Special Protection Zone(Inventory Zone)

The "Montana Source Water Protection Technical Guidance Manual" was used as a guidance document for the delineation step. Water level information was collected from existing well logs and from soils borings and soils test pits that were dug to conduct the site geotechnical investigation. Groundwater direction of flow was estimated using this information as well as the information on the Warm Springs USGS topographical map. Based on this information groundwater flows in a northeasterly direction across the campus toward the Clark Fork River. Further to the west the direction of flow is probably in a easterly direction, based on topography and the direction of flow of the surface water drainage. **Figure 4** shows the location of the soils test pits and groundwater elevations. Approximate groundwater contours and the direction of flow are shown on this figure. The direction of flow is also affected by the topography in the area as well as the direction of flow of Modesty Creek. **Figure 3** delineates the groundwater recharge area (protection zone). The special protection regions and the 100 ft control zone for each well are shown in **Figures 5A,B & C**. The 100 ft control zone is also shown on **Figure 2** Note that a special protection region and control zone has also been established for the shop well which will be disconnected from the system, but may be brought back on line after the contaminated soil in the vicinity of the well is removed and if future demands warrant it.

Time of travel was estimated using Darcy's law for unconfined conditions; $v = Ki/n$ where:

v = velocity (distance/time)
K = hydraulic conductivity
i = hydraulic gradient ft/ft
n = porosity

Hydraulic conductivity was estimated using the formula $K = T/b$ where:

K = hydraulic conductivity
T = transmissivity
B = aquifer thickness (depth of perforations or screen)

Transmissivity was estimated using the formula $T = [(Q/s)(1500)] / 7.48$ where:

T = transmissivity ($feet^2$/day)
Q = pumping rate (gpm)
s = drawdown of pumped well (feet)

Note: 1500 = factor used for unconfined aquifer value is 2000 for confined aquifer

The lateral boundary limits were calculated using the formula $Y_l = + \text{or} - Q/2Kbi$.

The distance to the downgradient Null Point was calculated using $X_l = - Q/2\pi Kbi$

Sheets showing the above calculations are presented in **Appendix E.**

The hydraulic conductivity for the aquifer was calculated by using the pump test information from the existing two campus wells. A K value was calculated for each well and averaged. **Table 1** summarizes the data that was used. Porosity was estimated using the well logs for the existing two Galen wells. A porosity value of .39 was selected from "Groundwater Hydrology Second Edition" by David Keith Todd;Table 2.1 (copy in **Appendix E**) Data from other regional wells is also presented in the table. However, the data from the other wells was not used because of their distance from the campus and because there was not enough information available on these wells.

The average calculated K value using data from the two existing wells is 41.2 feet/day (37.2 +46.6/2).

Protection (Recharge) Zone

The recharge zone has been mapped and is shown in **Figure 3**. The recharge zone was assumed to roughly correspond to the Modestry Creek Drainage and is an area of approximately 18 square miles. Groundwater flow in this zone is assumed to flow in roughly the same direction as Modesty Creek; essentially from west to east.

Limitations

The values for transmissivity (T) and hydraulic conductivity (K) were calculated using limited pump test data from the well logs (flow rate and drawdown) for the two existing Galen Campus wells. Ideally, an extended pump test with measurements from one to two observation wells or well recovery measurements should be used to calculate T and K however, this information was not available. Therefore, some conservative assumptions were made to delineate the protection zone:

1. A constant flow of 500 gpm (96,256 cubic feet/day) was used in the calculations. The actual daily flow will only be 14 gpm (20,000 gpd or 2673 cubic feet /day) with a maximum future flow of 70 gpm (100,000 gpd or 13,368 cubic feet/day)
2. The three year time of travel and the boundary limits were also calculated using a K value of 100 feet/day which results in a three year time of travel distance of over twice that of the calculated K (3500 ft vs 1450 ft).
3. Protection zones were drawn for both K values (41 and 100) as shown in **Figures 5 A and B** the protection zones for a K of 41.2 are shorter and wider than those for a K of 100. The final protection zone shown in **Figure 5 C** is based on the width calculated with K = 41 and the length with K = 100 and the protection zones of all three wells.

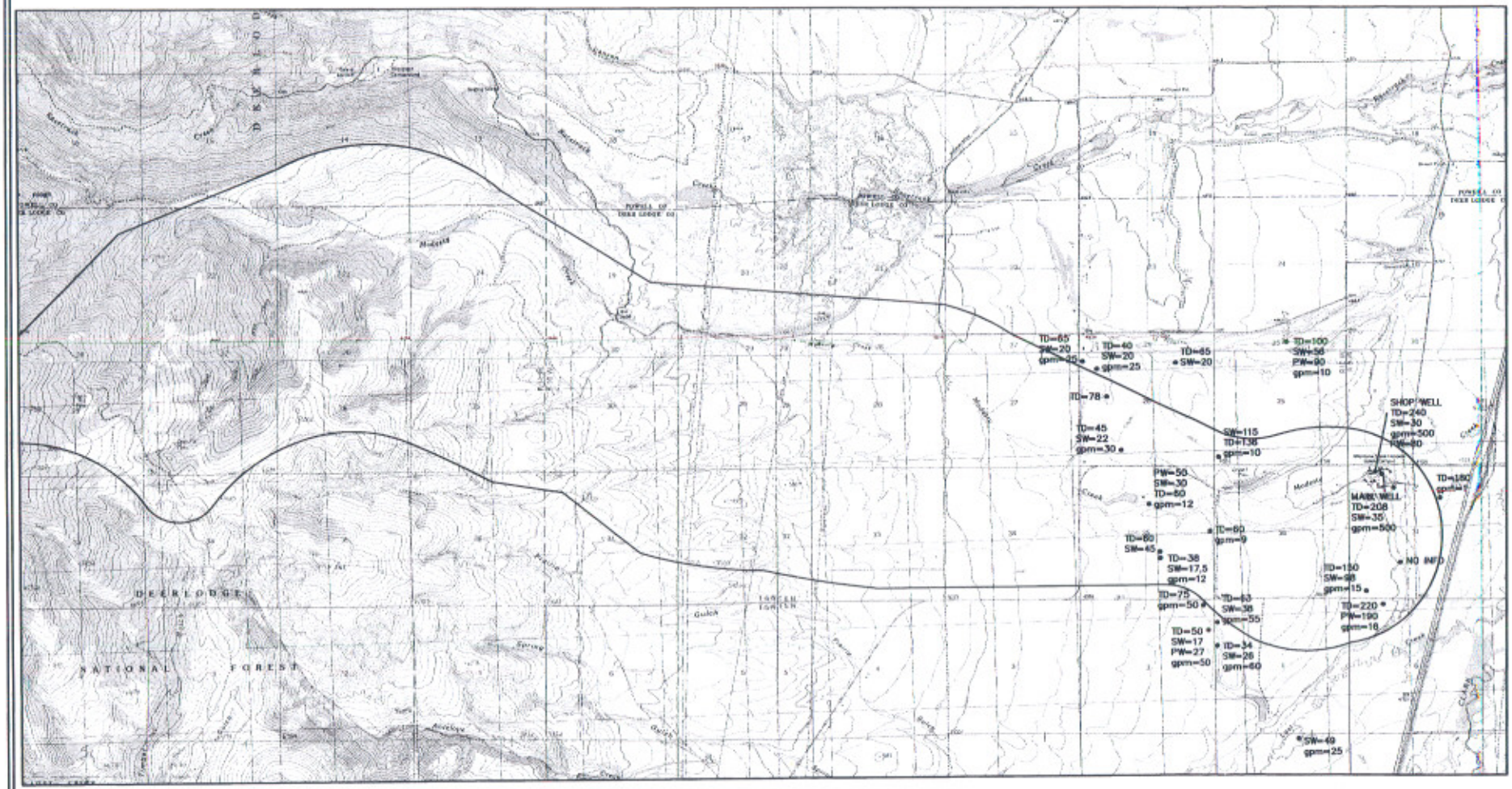
In summary the final special protection zone was drawn as a rectangle to include the protection zones for all three wells allowing for some variation in the predicted direction of groundwater flow. The three-year time of travel distance based on a K of 100 is 3500 ft, the two-year time of travel is approximately 2400 ft and the one-year time of travel 1200 ft.

Table 1. Galen Area Well Records Summary (Source MBMG, 2001)

GWIC	Site Name	Township/ Range/ Sect	Tract	Total Depth	Perf. Interval	Perf. Interval	Perf. Interval (b)	Pumping WL	Static WL	Drawdown (dh)	Yield (Q)	Specific Capacity (s)[2]	Transmissivity (T)3	Hydraulic Conductivity (K)4	Source Type[5]	Who Drilled	Completion Date
				feet bgs[1]	top, feet bgs	bot., feet bgs	feet total	feet bgs	feet bgs	feet	gpm	gpm/foot	feet²/day	ft/day			
GALEN CAMPUS WELLS																	
5409	*Galen Facility Main Well*	*06N/09W/31*	*BADB*	*207*	*159.0*	*207.0*	*48.0*	*83.0*	*25.0*	*58.0*	*517.0*	*8.9*	*1.79E+03*	*3.72E+01*	*alluvial*	*unknown*	*3/14/71*
53548	*Galen Facility Shop*	*06N/09W/31*	*BABB*	*240.0*	*171.0*	*214.0*	*43.0*	*80.0*	*30.0*	*50.0*	*500.0*	*10.0*	*2.01E+03*	*4.66E+01*	*alluvial*	*unknown*	*10/11/56*
OTHER NEARBY WELLS																	
183304	Ted Johnson	06N/09W/31	CC	220.0	209.0	218.0	9.0				16.0				alluvial	Beck	2/15/00
53547	Walter & Elsie Donich	06N/09W/31	AB	180.0							1.0				alluvial	unknown	1/1/12
188846	Ronald Johnson	06N/09W/31	CDAB												unknown	unknown	unknown
51739	Anaconda Co.	05N/10W/02	AAD	34.0					26.0		60.0				unknown	unknown	1/1/31
51738	Ueland Ranch	05N/10W/02	AAAB	75.0	65.0	75.0	10.0				50.0				alluvial	OKEEFE	1/1/67
51737	Anaconda Co.	05N/10W/02	AAA	63.0					38.0		55.0				alluvial	unknown	1/1/31
51736	Mt Haggin Livestock	05N/10W/02	AA	50.0	40.0	47.0	7.0	27.0	17.0	10.0	50.0	5.0	1.00E+03	1.43E+02	alluvial	OKEEFE	1/1/68
53585	Gayland Jones	06N/10W/26	C	45.0	38.0	43.0	5.0		22.0		30.0				alluvial	OKEEFE	10/18/73
163523	Dee Caresten	06N/10W/26	BC	78.0	68.0	78.0	10.0								alluvial	OKEEFE	7/22/97
51735	Jones Livestock	05N/10W/02	DCC						49.0		25.0				alluvial	unknown	1/1/61
53597	John Derzay	06N/10W/35	BAD	60.0				50.0	30.0	20.0	12.5				alluvial	DYNAMITE	4/17/85
156308	John Derzay	06N/10W/35		38.0	30.0	37.0	7.0		17.5		12.0				alluvial	OKEEFE	2/25/91
53596	Jim Heigby	06N/10W/35	BAD	60.0					45.0						alluvial	unknown	6/24/96
53583	Dan Kelley	06N/10W/26	BBCA	40.0					20.0		25.0				alluvial	unknown	1/1/61
53584	Dan Kelley	06N/10W/26	BBBC	65.0					20.0		25.0				alluvial	unknown	1/1/51
53582	Jack Kelley	06N/10W/26	AB	65.0	20.0				20.0						alluvial	unknown	10/1/34
178940	Lee Jacobson	06N/10W/26	ABBC	100.0	90.0	98.0	8.0	90.0	56.5	33.5	10.0	0.3	5.99E+01	7.48E+00	alluvial	BECK	9/18/99
141260	Doug Baudbaum	06N/10W/26	CCCC	136.0	126.0	132.0	6.0		115.0		10.0				alluvial	OKEEFE	5/26/93

Notes

1) bgs= below ground surface,
2) s= calculated value = Q/dh
3) T= calculated value = ((Q/dh)*1500)/7.48, unconfined = ((Q/dh)*2000)/7.48, confined
4) K = calculated value = s/b, b also = aquifer thickness
5) Determined from screen interval, WL, and well logs



LEGEND

•	WELL LOCATION
gpm	WELL PUMP RATE
SW	WELL STATIC WATER DEPTH
TD	WELL TOTAL DEPTH
PW	WELL DRAWDOWN DEPTH

NOTE:
WELL LOCATIONS SHOWN FOR
T6N, R10W, SEC 26 & 25
T6N, R9W, SEC 30 & 31
T5N, R10W, SEC 35, 36, 1 & 2
T5N, R9W, SEC 6

FIGURE 3
GROUNDWATER RECHARGE AREA PROTECTION ZONE
SCALE: 1"=2000'-0"

2000 0 2000 4000
(SCALE IN FEET)

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SHEET TITLE
FIG. 3 GROUNDWATER RECHARGE AREA PROTECTION ZONE

SHEET
FIG-3
OF

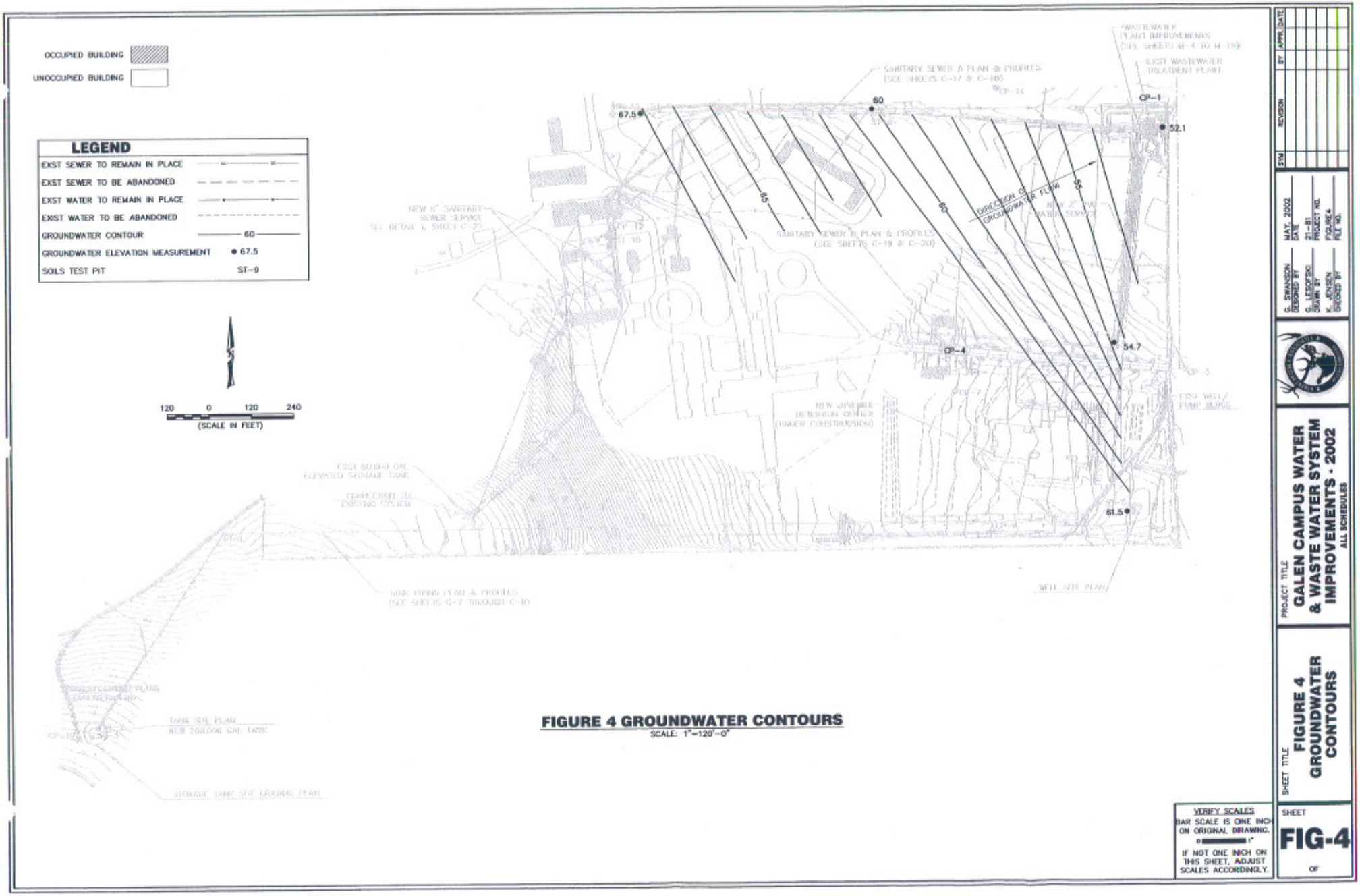

FIGURE 4 GROUNDWATER CONTOURS
SCALE: 1"=120'-0"

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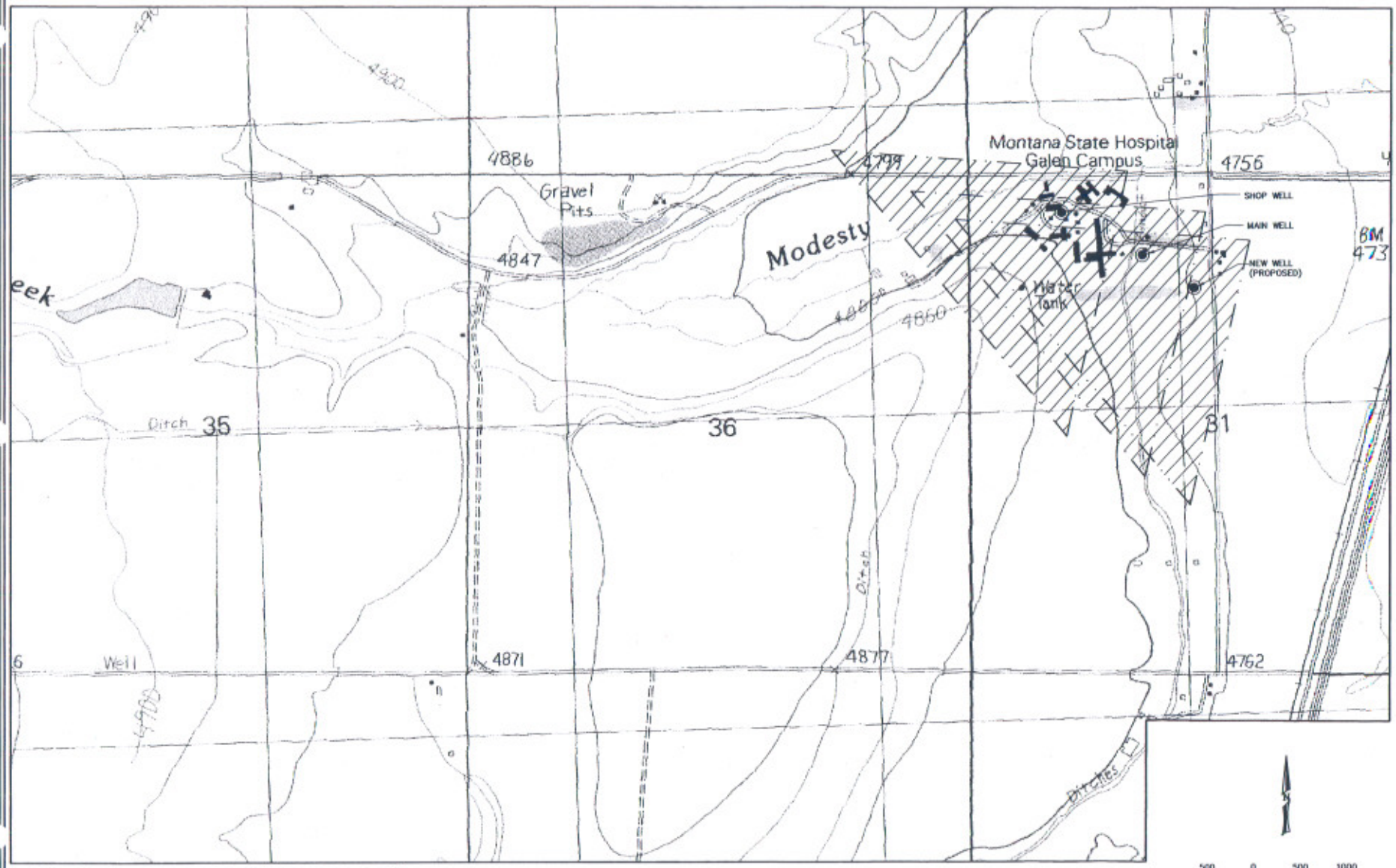
SHEET TITLE
FIGURE 4 GROUNDWATER CONTOURS

SHEET
FIG-4
OF

VERIFY SCALES
BAR SCALE IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

FIGURE 5A - SPECIAL PROTECTION ZONES

SCALE: 1"=500'-0"



LEGEND SPECIAL PROTECTION ZONES, K=41 ——— WELLS ◉

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FIGURE 5A SPECIAL PROTECTION ZONES

SHEET
FIG-5A
OF

FIGURE 5B - SPECIAL PROTECTION ZONES

SCALE: 1"=500'-0"

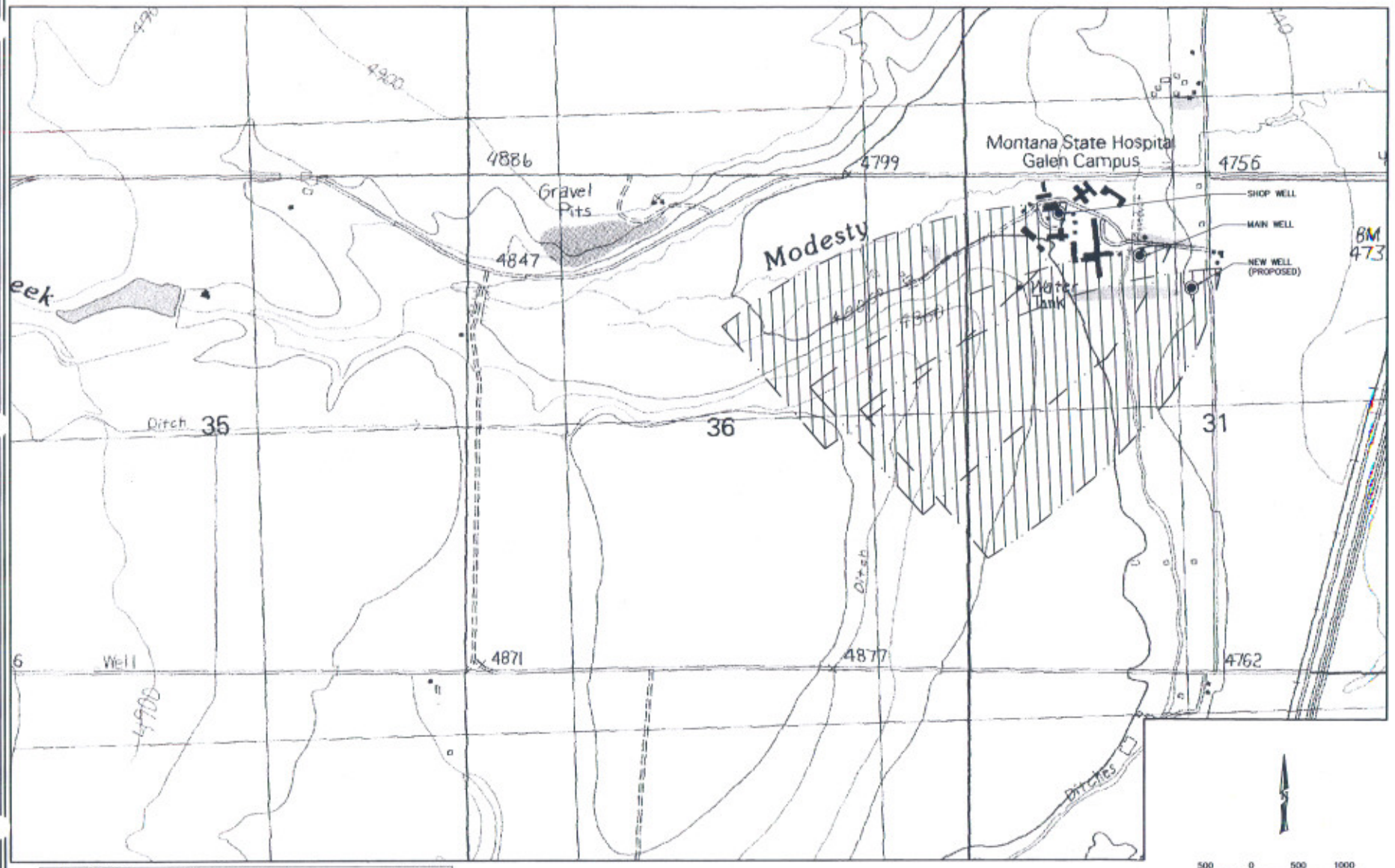

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FIGURE5B — FILE NO.

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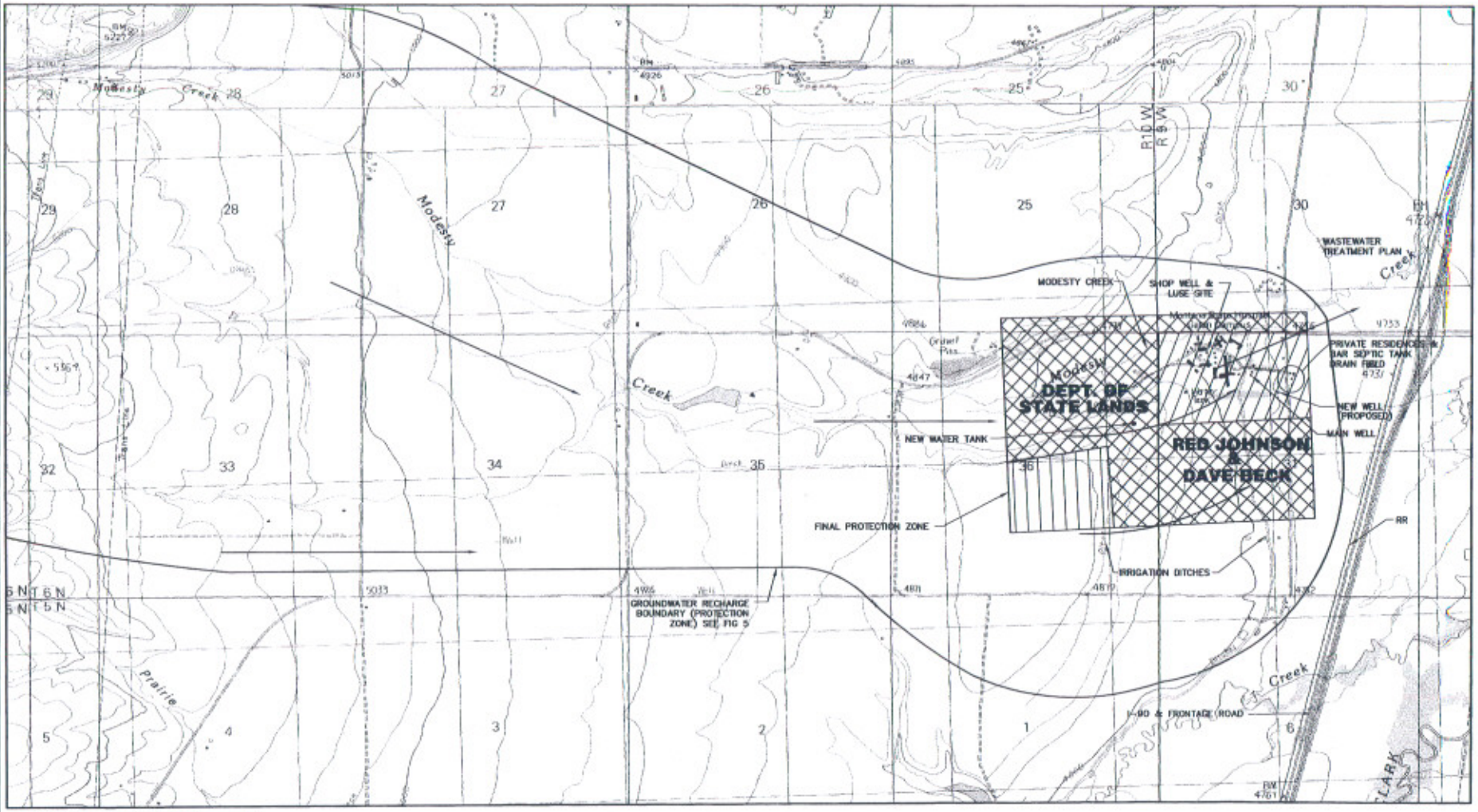
GALEN CAMPUS WATER & WASTE WATER SYSTEM IMPROVEMENTS - 2002

SHEET TITLE
FIGURE 5B SPECIAL PROTECTION ZONES

SHEET
FIG-5B
OF



LAND USE LEGEND

- COMMERCIAL/RESIDENTIAL
- PASTURE/HAY MEADOW
- IRRIGATED CROP LAND
- GROUNDWATER FLOW DIRECTION

FIGURE 5C
FINAL SPECIAL PROTECTION ZONE
SCALE: 1"=1000'-0"

1000 0 1000 2000
(SCALE IN FEET)

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GALEN CAMPUS WATER & WASTE WATER SYSTEM IMPROVEMENTS - 2002

SHEET TITLE
FIGURE 5C FINAL SPECIAL PROTECTION ZONE

SHEET
FIG-5C
OF

STEP 3 – INVENTORY

Inventory Method

Potential sources of contamination were inventoried to assess the susceptibility of Galen's drinking water sources to contamination. Potential sources of were identified. A detailed inventory was conducted only for potential sources of contaminants that are the greatest threat to health.

The inventory for Galen's wells focuses on all activities in the control zones, agricultural, commercial and private facilities in the inventory region, and general land uses and large facilities in the recharge region.

Inventory Method

Databases were searched to identify businesses and land uses that are potential sources of regulated contaminants in the inventory region. The following steps were followed:

Step 1: Urban and agricultural land uses, EPA CERLIS sites, EPA toxic release inventory sites, landfills, mines, active underground storage facilities, crude oil pipelines, hazardous spill sites, 2000 census population data, land ownership, wastewater discharge locations, and septic density were inventoried using the Montana Natural Resource Information System (MNRIS).

Step 2: The majority of the special protection zone was inventoried by walking and driving the area inside the zone. In addition the Galen maintenance supervisor was interviewed.

Step 3: The Phase I Environmental Site Assessment Final Report for the Galen Campus conducted by MSE in January 2002 was reviewed.

Step 5: Major road and rail transportation routes were identified throughout the inventory region.

Step 6. All land uses and facilities that generate, store, or use large quantities of hazardous materials were identified within the recharge region and identified on the base map.

Potential contaminant sources are designated as significant if they fall into one of the following categories:

1. Large quantity hazardous waste generators.
2. Landfills.
3. Underground storage tanks.
4. Known groundwater contamination (including open or closed hazardous waste sites, state or federal superfund sites, and UST leak sites).
5. Underground injection wells.
6. Major roads or rail transportation routes.
7. Cultivated cropland greater than 20 % of the inventory region.
8. Animal feeding operations.
9. Wastewater treatment facilities, sludge handling sites, or land application areas.
10. Septic systems.
11. Sewer mains.
12. Storm sewer outflows.
13. Abandoned or active mines.

Inventory Results/Control Zone

The 100-foot control zone around each well was inventoried. The control zone around the shop well contains the shop, a portion of the old fire station and a paved parking lot. A leaking underground diesel storage tank and gasoline tank were removed from this area. A complete removal and remediation was performed on the gasoline tank. The diesel tank was removed as was 5 cubic yards of contaminated soil. However, there is still contaminated soil in place that must be removed. A work plan is currently in place for removing the remainder of the soil (see MSE Phase I Environmental Site Assessment pgs 11, 12 & 13). As previously stated this well is disconnected from the system.

The main well control zone contains two homes that are being used as group homes, a paved road used to access the homes and the south part of the campus, a sewer and water main, and a grass field that is cut for hay in the summer. No contaminants were found in this zone. There is a potential for contamination from the existing sewer main should it leak. Liquid chlorine will be stored in the well house and will be used for disinfection of the well water after system improvements are completed in the summer of 2002. However, it will be stored in small quantities and secondary containment will be provided. There is a potential for a spill from vehicles using the access road but currently traffic is very light and is essentially limited to the tenants of the group homes.

The Control zone around the proposed new well will consist of a grassy field that will be cut for hay in the summer. No existing or potential contaminant sources were found in this zone. This zone is currently fenced.

All three control zones are within campus property and under direct control of the Owner and Operator.

Inventory Results Special Protection Zone

The following land uses exist in the Special Protection Zone (See Figure 5C).

Commercial/Residential	25%
Pasture/Hay Meadow	55%
Irrigated Cropland	20%

Commercial/Residential Area. The majority (90%) of the commercial/residential area is controlled by the owners of the Galen Campus. The other 10% is the residence and bar located just north of the campus and county road. Potential sources of contamination in this area include the septic tank and drainfield for the residence and bar described above. There is a potential for a spill from commercial or truck traffic entering the campus area. However, because of the institutional nature of the campus it is highly unlikely The Galen Campus is sewered and the campus wastewater treatment plant is located within the protection zone. There is a potential for sewage to leak from the various treatment processes and sewer mains and percolate to the groundwater. All of the tanks at the plant were inspected and all were found to be in good condition with no apparent leakage. The majority of the campus sewer mains are going to be replaced with PVC piping and new manholes will be installed. The Manholes will be constructed to be watertight. The discharge point for the plant is approximately 1.5 miles to the east at the Clark Fork River outside of both the recharge area and the Special Protection Zone. An irrigation ditch and Modesty Creek pass through or near the campus and have the potential to transmit

fertilizer, pesticides, pathogens and animal waste into the groundwater. No other significant existing or potential sources of contamination were found in this area other than those described above for the shop well control zone.

Pasture/Hay Meadow. These areas are located to the west and south of the Galen Campus within the Special Protection Zone. There is a potential for contamination from animal waste, fertilizers and pesticides in this area. There are also irrigation ditches located in these areas that may provide a potential collection point for spills or runoff containing fertilizers, pesticides or animal waste.

Irrigated Cropland. This area is located to the southwest of the campus and is inside the Special Protection Zone. There is a potential for contamination from animal waste, fertilizers and pesticides in this area. There are also irrigation ditches located in these area that may provide a potential collection point for spills or runoff containing fertilizers, pesticides or animal waste.

Table 2. Potential contaminant sources in the inventory region of the Galen Campus.

Potential Contaminant Source	Description of Potential Contaminant
Cropland or Pasture	Spills and excess application of herbicides and fertilizer. Runoff and ground water contaminated by pesticides, nitrate, and pathogens from animal waste.
Wastewater Treatment Plant & Sewer Mains	Nitrates and pathogens. Discharge point 1.5 miles downgradient of special protection zone.
Flood Irrigation Ditching	Irrigation ditches carry flood irrigation water. Can behave similar to storm sewer ditch during flood events. Potential contaminants include nitrates, pesticides and pathogens.
Underground Storage Tanks, (2 removed, none left in special protection zone)	Contaminated soil still exists at the diesel tank site at the maintenance shop
Septic Systems	Groundwater contaminated by septic system effluent. Only system serves residence and bar just west of the campus and inside the special protection zone.
Railway Corridor	Past rail transport of hazardous materials. Abandoned. Outside of Special Protection Zone & Downgradient
Highway Corridor	Spills of Hazardous Materials. Outside of Special Protection zone and downgradient.
Modesty Creek	Potential for pathogens or spills entering creek to percolate to groundwater

Inventory Results Protection Zone (Recharge Area)

The portion of the recharge zone outside of the Special Protection Zone consists of private agricultural land and National Forest Service Land. Potential contaminants are the same as those listed above for Pasture/Hay Meadow and Irrigated Cropland. The MNRIS database search also revealed the presence of three mine sites within the recharge area. There is a potential for contamination to occur at these mine sites due to runoff from waste piles, acid mine drainage and any hazardous substances still remaining on site. The mine sites were not visited.

Inventory Update

The certified operator should update the inventory for his records every year. Changes in land uses or potential contaminant sources should be noted and additions made as needed. A complete inventory should be submitted to DEQ every five years.

Inventory Limitations

The potential sources of contaminants for Galen are determined from readily available data and reports. Unregulated activities or unreported contaminant releases may have been missed. The use of multiple sources of data, however, should ensure the major threats to the source water for Galen are identified.

STEP 4 - SUSCEPTIBILITY ASSESSMENT

The susceptibility of Galen's well(s) to significant potential contaminant sources is assessed in this chapter to rank threats to Galen's drinking water source. The degree of susceptibility is determined by the hazard associated with a source and the existence of barriers to contamination (Table 7). The proximity of point contaminant sources to Clyde Park's wells, or the density of non-point sources in the inventory region, determines hazard (Table 8). For Galen, contaminant sources within a one-year time-of-travel are given a high hazard rating and all other sources in the inventory region are given a moderate or low hazard rating.

Barriers can be anything that decreases the likelihood that contaminated water will flow to Galen's well(s). Barriers can be engineered structures, management actions, or natural conditions. Examples of engineered barriers are leak detection for underground storage tanks. Emergency planning and best management practices can be considered management barriers. Thick clayey soils, a deep water table, or a thick saturated zone above the well intake can be natural barriers.

Susceptibility ratings are presented individually for each significant potential contaminant source in the inventory region. Galen 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 3. Susceptibility to specific contaminant sources as determined by hazard and the 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

Table 4. Hazard of potential contaminant sources for Galen.

	High Hazard	Moderate Hazard	Low Hazard
Point Sources of All Contaminants	Within one-year TOT	One to three years TOT	Over three years TOT
Septic Systems	More than 300 per sq. mi.	50 – 300 Per sq. mi.	Less than 50 per sq. mi.
Cropped Agricultural Land (Percent land use)	More than 50 percent of region	20 to 50 percent of region	Less than 20 percent of region
Point Sources of Nitrate or Microbes	Potential for direct discharge to source water	Potential for discharge to groundwater hydraulically connected to source water	Potential contaminant sources in the watershed region
Point Sources of VOCs, SOCs, or Metals	Potential for direct discharge of large quantities from roads, rails, or pipelines	Potential for direct discharge of small quantities to source water	Potential for discharge to groundwater hydraulically connected to source water

The results of the susceptibility assessment Galen Park are summarized in Table 9. Dilution is considered a natural barrier if the concentration of a contaminant that may discharge directly to surface water is reduced to non-significant levels. Dilution is not considered a barrier to microbial contaminants.

Following are brief descriptions of the susceptibility assessments for each significant potential contaminant source.

Rail Corridor – Hazard and susceptibility is ranked low because the rail corridor is outside and downgradient of the special protection zone.

Leaking UST (LUST) – Hazard is ranked high for the shop well as the still active LUST site is located within the control zone and there is some contaminated soil still in place (the tank & appurtenances have been removed). The hazard is ranked low for the existing main well and the future well because of the distance from the shop LUST site, the tank and appurtenances have been removed, the contamination is in the upper 10 feet of the soil, the contaminant is diesel which is not water soluble, there are clay layers above the well screens, the shop well has tested negative for contaminants and the site will undergo final remediation in the near future. Susceptibility is ranked low for the two existing wells and the new well because to date test results from the well water have been negative, the shop well is not in use and remediation of the site will be completed in the near future.

Flood Irrigation Ditching & Modesty Creek– Hazard is high because the irrigation ditch and creek are within a one-year time-of-travel distance from the wells. Susceptibility is ranked moderate because there are natural barriers to prevent contaminants from reaching groundwater at the well. Additional engineering/management barriers will include ditch rerouting and lining, irrigation scheduling to minimize excess flow rates and BMP's for upgradient areas.

Cropland or Pastureland – Hazard is ranked high because approximately 75 percent of the inventory region is irrigated cropland, hay or pasture. Susceptibility is ranked low because there are multiple barriers. Natural barriers include the clay layers above the well screens. The wells are located outside of this area on campus. Other barriers include well design (grout, casing) to minimize potential surface water contamination and a 100-foot fenced wellhead control zone.

Highway Corridor - Hazard and susceptibility is rated low because the highway corridor is located outside the special protection zone and is downgradient from the wells.

Septic Systems –The hazard associated with septic systems is low due to the density within the inventory zone being less than 50 per square mile. The only know septic system in the inventory zone belongs to the residence and bar located just north of the campus. Considering the presence of only one septic system which is located downgradient from the wells, susceptibility is low. Recommended management includes DEQ regulation enforcement of septic systems, growth management particularly near the well source and consideration can be given to hooking this site to the Galen system.

Wastewater Treatment Plant & Sewer Mains – The hazard and susceptibility associated with the WTP is low because the discharge is located approximately 1.5 miles downgradient of the special protection zone, the treatment process piping and tankage has been inspected and found to be in excellent condition with no apparent leaks and the WTP is downgradient from all of the wells and the new well. The hazard and susceptibility associated with the existing sewer collection system is low because of the low flows, the majority of the mains and manholes are going to be replaced with watertight piping and manholes.

Table 5. Susceptibility assessment for significant potential sources of contamination in the Inventory Region.

Source	Contaminant	Potential Contaminant Origin	Hazard Rating	Barriers	Susceptibility	Management
Flood Irrigation Ditching & Creek	Nitrate, fertilizer, pesticides and pathogens	Percolation of irrigation & creek water	High	Natural, Ditch Control	Moderate	Implement land use agreement. Control ditch.
LUST Sites between One- and Three-Year Times-of-Travel	VOCs	Leaching from contaminated soil	High (shop well only)	Monitoring, DEQ regs. And natural. Remaining cont. soil to be removed	low	Monitoring, removal of remaining contaminated soil
Highway Corridor	Fuels and Pesticides	Percolation to ground water	low	Emergency Planning, Spill Prevention, Distance, Downgradient Location Natural	low	Emergency Response planning
Cropland or Pasture	Herbicides (SOC's), Pathogens, Nitrate	Ground water seepage	High	Natural, Land use practices	Low	Grazing and chemical application BMPs, Implement land use agreement
Septic Systems	Nitrate and Pathogens	Ground water seepage	Low	Natural, Regs, Management	Low – Mod	Enforce regs., Growth Management, Centralized System
Wastewater Treatment Plant & Sewer Mains	Nitrates and Pathogens	Groundwater seepage	Low	Water tight tankage, distance to discharge point	Low	Periodically inspect tankage and piping.

Management Recommendations for the Inventory Region

Management recommendations are listed along with the susceptibility assessment in Table 9. Implementing these recommendations could reduce the susceptibility of Galen's source water to specific sources and contaminants. Certain sources will probably retain a moderate or high susceptibility rating regardless of management efforts so the objective of management should be to avoid circumstances where there are no barriers or even single barriers. Multiple barriers provide backup protection in case one barrier is ineffective.

For septic systems, county ordinances may be warranted to control or restrict near stream and inventory region development. For all sources, spill prevention procedures and best management practices should be encouraged through education or, if necessary, required by county ordinance. Septic contamination potential would be greatly alleviated by connecting any nearby new development to Galen's centralized wastewater treatment system.

For the wastewater treatment plant and sewermains periodic inspection to detect problems that may lead to leakage is the best management practice.

Emergency planning is the only practical barrier that will safeguard against contamination by road, rail, or pipeline spills. An emergency plan should include a list of types of chemicals and the frequency with which they are transported through the spill response region and the name of an emergency coordinator and a description of possible actions that can be taken if a problem arises. The equipment and materials, short-term replacement water supply, and source of funds necessary in case of a spill should be specified in the emergency plan. Procedures to safeguard against chemical spills at the water treatment/disinfection facilities also should be specified in an emergency plan.

GROUNDWATER UNDER THE DIRECT INFLUENCE OF SURFACE WATER

Per the Montana Department of Environmental Quality's PWS 5, Preliminary Assessment Worksheets were completed by the author for the two existing wells and the proposed well to be constructed this summer. All three wells have scores totaling less than 40. The worksheets follow.