Form No. 630 R05/2014

# PETITION FOR CONTROLLED GROUNDWATER AREA

This form can be filed by a state or local public health agency for identified public health risks; a municipality, county, conservation district, or local water quality district formed under Title 7, chapter 13, part 45; or by at least one third of the water right holders in an area proposed for designation of a controlled groundwater area. An incomplete or non-qualifying petition will be returned.

A fee of $1500 must accompany this petition. Petitioners must also pay reasonable costs of giving notice pursuant to MCA § 85-2-506 and A.R.M. 36.12.103

*Make checks payable to "DNRC"*

**Filing Fee: $1500.00**

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**FOR DEPARTMENT USE ONLY**

Application # 30110019 Basin 43Q
Date 01-18-2017
Time 11:00 AM / PM
Rec'd By JL
Fee Rec'd $ 1500.00 Check # 9739
Deposit Receipt # BLS1715717
Payor Tasman Geosciences
Refund $ ______ Date ______

Contact Person: ☒ Contact is Petitioner ☐ Contact is Consultant ☐ Contact is Attorney ☐ Contact is Other

Contact Name Marilyn Tapia, Director - RiverStone Health

Mailing Address 123 South 27th Street

City Billings State MT Zip 59101

Phone Numbers: Home ______ Work 406-256-2770 Cell ______

Email Address marilyn.tap@riverstonehealth.org

**General Location of Proposed Controlled Groundwater Area:**

Outskirts of Billings, Montana (Lockwood), Yellowstone County

**TYPE OF DESIGNATION OR PROVISIONS REQUESTED:** Is the petition for a permanent or temporary designation?

☒ **Permanent**. If permanent, proceed to Section 1.

☐ **Temporary**. If temporary, proceed to Section 2.

**Section 1. PERMANENT DESIGNATION PROPOSED** *Please provide the following:*

A. MCA § 85-2-506 requires that this petition must contain analysis prepared by a hydrogeologist, a qualified scientist, or a qualified licensed professional engineer concluding that one or more of the following criteria:

☐ Current or projected reductions of recharge to the aquifer or aquifers in the proposed controlled ground water area will cause ground water levels to decline to the extent that water right holders cannot reasonably exercise their water rights;

☐ Current or projected ground water withdrawals from the aquifer or aquifers in the proposed controlled ground water area have reduced or will reduce ground water levels or surface water availability necessary for water right holders to reasonably exercise their water rights;

☒ Current or projected ground water withdrawals from the aquifer or aquifers in the proposed controlled ground water area have induced or altered or will induce or alter contaminant migration exceeding relevant water quality standards;

☐ Current or projected ground water withdrawals from the aquifer or aquifers in the proposed controlled ground water area have impaired or will impair ground water quality necessary for water right holders to reasonably exercise their water rights based on relevant water quality standards;

☒ Ground water within the proposed controlled ground water area is not suited for beneficial use; or public health, safety, or welfare is or will become at risk.

B. Please attach all supporting information, including the name, address and qualifications of the person who prepared the analysis. See attached

C. Explain why the condition occurring or likely to occur cannot be appropriately mitigated. See attached

D. Describe the kind of corrective controls or provisions you are requesting. A controlled ground water area may include but is not limited to the following control provisions:

☒ A provision closing the controlled ground water area to further appropriation of ground water;

☐ A provision restricting the development of future ground water appropriations in the controlled ground water area by flow, volume, purpose, aquifer, depth, water temperature, water quality, density, or other criteria that the department determines necessary;

☐ A provision requiring measurement of future ground water or surface water appropriations;

☒ A provision requiring the filing of notice on land records within the boundary of a permanent controlled ground water area to inform prospective holders of an interest in the property of the existence of a permanent controlled ground water area.

☐ A provision for well spacing requirements, well construction constraints, and prior department approval before well drilling, unless the well is regulated pursuant to Title 82, chapter 11;

☐ A provision for mitigation of ground water withdrawals;

☐ A provision for water quality testing;

☐ A provision for data reporting to the department

***Proceed to Section 3.***

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**Section 2. <u>TEMPORARY DESIGNATION PROPOSED</u>** *Please provide the following:*

A. A study plan that may include measurement, water quality testing, and reporting requirements for new and/or replacement wells during the period of the temporary closure.

B. Include information on funding for any proposed investigations including any plans for pursuing funding under the renewable resource grant and loan program, and any planned investigation under the ground water investigation program.

C. Describe how any necessary investigations can be completed in a timely fashion not to exceed 6 years.

***Proceed to Section 3.***

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**Section 3. PERMANENT OR TEMPORARY DESIGNATION PROPOSED** *Please provide the following:*

A. **Map:** A U.S. Geological Survey quadrangle map, or one of similar size, scale and detail level **must** accompany the petition. In addition to the information provided on the USGS map, the map **must** also show the following:

a. north direction;

b. township and range numbers;

c. section corners and numbers;

d. accurate outline of the proposed controlled area;

i. location of any known groundwater recording equipment;

ii. points of diversion of all groundwater users, including wells and developed springs.

See attached

B. **Land Ownership:** Attach a list to this petition of all the landowners within the proposed boundaries of the controlled groundwater area. Land ownership may be found at the county assessors office or at http://svc.mt.gov/msl/mtcadastral/ The list must include the name and complete mailing address of the property owner. See attached

---

## WATER RESOURCES OFFICES

**BILLINGS:** AIRPORT INDUSTRIAL PARK, 1371 RIMTOP DR., BILLINGS MT 59105-1978
PHONE: 406-247-4415 FAX: 406-247-4416
SERVING: Big Horn, Carbon, Carter, Custer, Fallon, Powder River, Prairie, Rosebud, Stillwater, Sweet Grass, Treasure, and Yellowstone Counties

**BOZEMAN:** 2273 BOOT HILL COURT, SUITE 110, BOZEMAN MT 59715
PHONE: 406-586-3136 FAX: 406-587-9726
SERVING: Gallatin, Madison, and Park Counties

**GLASGOW:** 222 6TH STREET SOUTH, PO BOX 1269, GLASGOW MT 59230-1269
PHONE: 406-228-2561 FAX: 406-228-8706
SERVING: Daniels, Dawson, Garfield, McCone, Phillips, Richland, Roosevelt, Sheridan, Valley, and Wibaux Counties

**HAVRE:** 210 6TH AVENUE, PO BOX 1828, HAVRE MT 59501-1828
PHONE: 406-265-5516 FAX: 406-265-2225
SERVING: Blaine, Chouteau, Glacier, Hill, Liberty, Pondera, Teton, and Toole Counties

**HELENA:** 1424 9TH AVE., PO BOX 201601, HELENA MT 59620-1601
PHONE: 406-444-6999 FAX: 406-444-9317
SERVING: Beaverhead, Broadwater, Deer Lodge, Jefferson, Lewis and Clark, Powell, and Silver Bow Counties

**KALISPELL:** 655 TIMBERWOLF PARKWAY, SUITE 4, KALISPELL MT 59901-1215
PHONE: 406-752-2288 FAX: 406-752-2843
SERVING: Flathead, Lake, Lincoln, and Sanders Counties

**LEWISTOWN:** 613 NORTHEAST MAIN ST., SUITE E, LEWISTOWN MT 59457-2020
PHONE: 406-538-7459 FAX: 406-538-7089
SERVING: Cascade, Fergus, Golden Valley, Judith Basin, Meagher, Musselshell, Petroleum, and Wheatland Counties

**MISSOULA:** 2705 SPURGIN RD. BLDG. C, PO BOX 5004, MISSOULA MT 59806-5004
PHONE: 406-721-4284 FAX: 406-542-5899
SERVING: Granite, Mineral, Missoula, and Ravalli Counties

**MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION**
*Water Resources Division - Water Rights Bureau*
*1424 9th Avenue, PO Box 201601, Helena, MT 59620-1601*
*Phone: 406-444-6610 Website:* http://dnrc.mt.gov/wrd/

# SIGNATURES

This form must be filed by a state or local public health agency for identified public health risks; a municipality, county, conservation district, or local water quality district formed under Title 7, chapter 13, part 45; or by at least one third of the water right holders in an area proposed for designation of a controlled groundwater area. **Print or type** the full name of the water user and mailing address and sign on the appropriate line. Attach additional sheets if necessary.

WE THE UNDERSIGNED GROUNDWATER USERS IN THE PROPOSED CONTROLLED AREA PETITION THE DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION FOR A CONTROLLED GROUNDWATER AREA IN ACCORDANCE WITH § 85-2-506, MCA AND THIS PETITION.

| Printed Name | Signature |
|---|---|
| 1. John Felton, Health Officer | / [signature] |
| Mail Address RiverStone Health 123 S. 27th Street Billings, MT 59101 | Phone 406-651-6434 |
| 2. | / |
| Mail Address | Phone |
| 3. | / |
| Mail Address | Phone |
| 4. | / |
| Mail Address | Phone |
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| Printed Name | Signature |
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| Mail Address | Phone |
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# CONTROLLED GROUNDWATER AREA PETITION
# SUPPORTING INFORMATION
# LOCKWOOD SOLVENT GROUNDWATER PLUME SITE
# BILLINGS, MONTANA

Prepared for:

**Yellowstone City/County Health Department**
**dba RiverStone Health**
123 South 27th Street
Billings, Montana 59101

Prepared by:

Tasman Geosciences, Inc.
917 1st Avenue N., Suite 3
Billings, Montana 59101
(406) 259-1033

**January 11, 2017**

Tasman Project No. Z051000003

TASMAN
GEOSCIENCES

TABLE OF CONTENTS



TABLES



FIGURES



APPENDICES

## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| µg/L | Micrograms per liter |
| ARM | Administrative Rules of Montana |
| ATC | ATC Associates Inc. |
| ATSDR | Agency for Toxic Substances and Disease Registry |
| Beall | Beall Trailers of Montana, Inc. |
| bgs | Below ground surface |
| Cardno | Cardno ATC |
| CGA | Controlled groundwater area |
| *cis*-1,2-DCE | *cis*-1,2-Dichloroethene |
| COC | Contaminant of concern |
| DEQ | Montana Department of Environmental Quality |
| DNRC | Department of Natural Resources and Conservation |
| EPA | U.S. Environmental Protection Agency |
| ft/day | Feet per day |
| ft/ft | Feet per foot |
| ft/year | Feet per year |
| gpm | Gallons per minute |
| LSGPS | Lockwood Solvent Groundwater Plume Site |
| LWSD | Lockwood Water and Sewer District |
| MAROS | Monitoring and Remediation Optimization System |
| MCA | Montana Code Annotated |
| MCL | Maximum contaminant level |
| mg/kg | Milligrams per kilogram |
| OU1 | Operable Unit 1 |
| OU2 | Operable Unit 2 |
| PCE | Tetrachloroethene |
| RDA | Remedial Design Assessment |
| RI | Remedial Investigation |
| ROD | Record of Decision |
| Soco | Soco West, Inc. |
| TCE | Trichloroethene |
| TtEMI | Tetra Tech EM Inc. |
| VC | Vinyl chloride |
| VOC | Volatile organic compound |

## 1.0 INTRODUCTION

This report presents supporting information for the petition to designate a permanent controlled groundwater area (CGA) for the Lockwood Solvent Groundwater Plume Site (LSGPS) located near Billings, Montana of Yellowstone County. This supporting documentation to the CGA petition has been prepared for RiverStone Health, Yellowstone County's public health agency, for submittal to the Montana Department of Natural Resources and Conservation (DNRC).

The LSGPS has been found to have chlorinated solvent contamination in soil and groundwater. The contaminants of concern (COCs) are tetrachloroethene (also known as perchloroethene or PCE), trichloroethene (TCE), *cis*-1,2-Dichloroethene (*cis*-1,2-DCE), and vinyl chloride (VC). Chlorinated solvents are a large family of chemical compounds that contain chlorine. They are used for a wide variety of commercial, residential and industrial purposes, including degreasers, cleaning solutions, paint thinners, pesticides, resins, glues, and a host of other mixing and thinning solutions. Their chlorine-containing chemical structure helps them to efficiently dissolve organic materials like fats and greases and to serve as raw materials or intermediates in the production of other chemicals. Exposure to chlorinated solvents can occur through inhalation, ingestion, and skin contact or skin absorption. Inhalation and ingestion are the most common forms of exposure, because the solvents can readily evaporate. PCE, TCE, *cis*-1,2-DCE and VC are known or are suspected to cause cancer, in both humans and animals.

Chlorinated solvents have been detected in alluvial groundwater samples at levels that exceed human health standards (also known as federal maximum contaminant levels drinking water standards[1]) and require remediation. The permanent CGA for LSGPS is a remediation component specified in the Record of Decision (ROD [EPA/DEQ, 2005]) that is designed to protect human health. The CGA is being requested pursuant to Montana Code Annotated (MCA) 85-2-506(5)(c), (e) and (f) in order to prevent:

- Exposure to COCs in groundwater where the performance standards (cleanup levels), as specified in the ROD (EPA/DEQ, 2005), are exceeded; and

- Groundwater withdrawals from the CGA alluvial and bedrock aquifers that may induce or alter contaminant migration.

The performance standards specified in the ROD are the same values as the federal maximum contaminant levels (MCLs) and state of Montana DEQ-7 human health standards. Groundwater performance standards of 5 µg/L for PCE and TCE, 70 µg/L for *cis*-1,2-DCE, and 2 µg/L for VC, will meet the performance standards identified as chemical specific Applicable or Relevant and Appropriate Requirements, as stated in the ROD (EPA/DEQ, 2005).

Because of the size of LSGPS and the need to delineate responsibility between two liable parties (Soco West and Beall Trailers), the LSGPS site consists of two operable units[2]. Operable Unit 1 (OU1) is associated with impacts related to the former Beall Trailers, Inc. facility (Beall) and Operable Unit 2 (OU2) generally is associated with impacts related to Soco West, Inc. (Soco). The location and boundary of the LSGPS is shown on Figure 1. The location and boundaries of OU1 and OU2 are shown on Figures 2 and 3, respectively.

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[1] The Maximum Contaminant Levels (MCLs) are established by EPA. MCLs are the maximum concentration of a chemical that is allowed in public drinking water systems.

2 During cleanup, a site can be divided into a number of distinct areas depending on the complexity of the problems associated with the site.

Based on current data, one lobe of the contaminated groundwater plume in OU1 is estimated to extend from the Beall property westward to the intersection of US Highway 87 and Lockwood Road, while the second lobe extends from the Beall Source Area to the northwest, crossing Interstate 90 and the Montana Rail Link railroad tracks, and comingles with the OU2 plume, north of Taylor Place (Figure 2). The contaminated groundwater plume in OU2 is contained within the area bounded by the Yellowstone River on the north and west, Klenck Lane on the east, and Taylor Place to the south (Figure 3).

Land use within and around the LSGPS is categorized as light industrial, commercial and residential. The commercial and light industrial facilities include trucking, vehicle repair, tank manufacturing, chemical repackaging, petroleum pipelines, machine shops and auto salvage. There are 81 commercial and light industrial businesses, and an estimated 75 residential single-family residences, two trailer parks, and one apartment complex located within the LSGPS boundary.

Although the ROD identified institutional controls as a remediation component to restrict domestic groundwater use, there are currently no administrative or institutional controls prohibiting the use of groundwater for domestic purposes within the LSGPS. Some of the commercial facilities have historically utilized groundwater for toilet and hand washing facilities as well as vehicle washing and other industrial uses (EPA/DEQ, 2005). Currently, all residences with wells that are impacted with contaminant concentrations above ROD performance standards and have used these wells for domestic purposes, have been provided with public water supply by the Lockwood Water and Sewer District.

## 1.1 CGA Description

The proposed permanent LSGPS CGA boundary is based on the current areal extent of COC impacts to groundwater exceeding MCLs and buffer zones encompassing the OU1 and OU2 contaminant plumes where significant withdrawals of groundwater may cause contaminant migration. The buffer zone will help ensure the plume does not expand through significant withdrawals of groundwater near the plume boundaries and provides a zone of protection. Groundwater monitoring will evaluate the extent and concentration of COCs in groundwater until performance standards are met. The proposed boundary for the LSGPS CGA is shown on Figure 4. A discussion of how the buffer zone was developed is included in Section 4.3.

The proposed CGA encompasses approximately 336 acres, including all or portions of Sections 26 and 35, Township 01 North, Range 26 East. The following section provides a brief history of the site, and Section 2.0 presents site characteristics relevant to the CGA petition.

## 1.2 Site History

In June 1998, the Montana Department of Environmental Quality (DEQ) performed an integrated assessment focusing on the collection of samples upgradient of the Lockwood Water and Sewer District (LWSD) Treatment Plant wells and numerous petroleum release sites. Based on results from this study and subsequent sampling, the United States Environmental Protection Agency (EPA) and DEQ preliminarily identified Beall as a potential source for TCE and its chemical breakdown product of *cis*-1,2-DCE in the groundwater. Beall manufactured and repaired tanker truck trailers, primarily to transport asphalt. From 1978 to 1990, trailers were cleaned with a solution of dissolved TCE and steam prior to maintenance and/or repair. The wastewater from the steam clean bay was discharged to a septic system and drain field (EPA/DEQ, 2005).

After the June 1998 investigation, the DEQ immediately provided bottled water to residents whose wells contained groundwater contaminants exceeding or approaching MCLs (TtEMI, 2003). The DEQ tentatively identified 21 additional residential wells and 10 commercial wells that were affected by volatile organic compounds (VOCs); however, the well water from those locations were not used for potable use. Figure 4 shows the known private wells located within the proposed CGA.

A series of assessments, performed between 1998 and 1999, were conducted or overseen by DEQ to identify the source of VOC contamination in the Lomond Lane area (Figure 3). Data collected during these investigations identified a potential PCE source and its chemical breakdown products of TCE, *cis*-1,2-DCE, and VC in the groundwater on and downgradient of the Soco property (OU2). Under previous owners, operations began in 1972 at the Soco property, which historically was operated as a chemical re-packaging and distribution company. Historic releases of PCE and possibly TCE, as well as petroleum products such as toluene and other organic compounds, occurred on the Soco property (EPA/DEQ, 2005).

At the request of the DEQ (May 1999), the Agency for Toxic Substances and Disease Registry (ATSDR) completed a health consultation and determined there was a short-term exposure risk for people showering or bathing in the contaminated groundwater (ATSDR, 1999). The ATSDR recommended that residents be provided with alternative whole-house water within one year.

EPA proposed the LSGPS for placement on the National Priorities List in May 2000 and listed the LSGPS on December 1, 2000. The National Priorities List is the list of hazardous waste sites in the United States eligible for long-term remedial action (cleanup) financed under the federal Superfund program. During the summer of 2000, EPA's Emergency Removal Program extended the public water supply line to the Lomond Lane area and 14 residences with contaminated wells above MCLs were connected by August 2000 (TtEMI, 2003).

DEQ began the Remedial Investigation (RI) during the summer of 2002, which included surface and subsurface soil sampling, monitoring well construction and groundwater sampling, aquifer testing, and surface water and sediment sampling. In June 2003, DEQ released the Final Remedial Investigation Report which defined the nature and extent of the site contamination and risks. (TtEMI, 2003).

Baseline human health and ecological risk assessments were conducted as part of the RI following EPA guidelines. The Baseline Human Health Risk Assessment (TtEMI, 2003a) concluded the groundwater pathway poses significant risks to human health through ingestion, bathing, and routine industrial activities. Currently, all residences with wells that are impacted with contaminant concentrations above ROD performance standards have been provided the public water supply by the Lockwood Water and Sewer District (EPA/DEQ, 2005).

Using the RI results, EPA and DEQ evaluated potential remedial alternatives and a detailed analysis was presented in the Final Feasibility Study (TtEMI, 2004). The Proposed Cleanup Plan (Proposed Plan), issued by DEQ in November 2004 (DEQ, 2004), provided background information about LSGPS site conditions, human health risks, activities performed to date, and the preferred cleanup response actions. EPA and DEQ held a public meeting during the Proposed Plan public comment period and received comments and information on the Proposed Plan. In August 2005, DEQ and EPA released the ROD (EPA/DEQ, 2005), detailing DEQ's and EPA's final determination for the components of the Selected Remedy for cleanup at the LSGPS.

On October 3, 2011, a Remedial Design/Remedial Action Consent Decree for the Soco property was entered in United States District Court for the District of Montana (EPA/DEQ, 2011b). The

Consent Decree and accompanying attachments outline the procedures, tasks, requirements, and schedule for the work to be performed at OU2 (EPA/DEQ, 2011b). As required by the Consent Decree, Soco is responsible for the development of all information (descriptions, data, modeling and rationale) necessary to support the petition for the CGA. Soco is required to provide the supporting information needed to allow EPA, DEQ and the Yellowstone City/County Health Department (dba RiverStone Health) to prepare a petition to the DNRC to establish a CGA under 85-2-5 MCA for the LSGPS.

Attempts were made by EPA to negotiate a Remedial Design/Remedial Action Consent Decree for the Beall property. However, Beall entered the bankruptcy process in 2012 and subsequently ceased operations at this location. The EPA is the lead for the remediation at the former Beall facility; working cooperatively with DEQ and the current tenants, MAC LTT.

## 2.0 SITE CHARACTERISTICS

### 2.1 Physical Setting

The LSGPS is located in south-central Montana, and is predominantly underlain by Cretaceous shale and sandstone deposited in an inland sea environment. The cliffs surrounding the Billings area and along the Yellowstone River are composed of Eagle Sandstone. These units, along with younger sedimentary deposits associated with the Yellowstone River floodplain, comprise the principal geologic units at the site.

### 2.2 Regional Geology

Alluvial and colluvial deposits within the greater Yellowstone floodplain consist of variable thickness of clay, silts, sand, and gravel. Alluvial deposits contain gravel of variable lithology derived from sources in the Yellowstone River drainage area while colluvial deposits are from locally derived bedrock sources, such as the Eagle Sandstone.

### 2.3 LSGPS Geology

The LSGPS is situated on Quaternary alluvium and alluvial terrace deposits. Upper Cretaceous Eagle Sandstone bedrock is exposed and present near the surface in the south portion of the LSGPS; however, most bedrock exposures are covered by colluvium deposits or have been buried by construction fill. The general contact between alluvium and bedrock follows the trace of the Lower Lockwood irrigation ditch from the Yellowstone River to the Beall property in OU1. This contact also marks the approximate extent of the shallow alluvial aquifer at the LSGPS. South of the Lower Lockwood Irrigation Ditch, bedrock is encountered at very shallow depths while north of the ditch alluvium in the upper alluvial terrace area averages 65 feet deep. Alluvium thickness in the lower terrace area averages approximately 40 feet. In the area of OU2, the alluvium is approximately 30 to 35 feet deep from the original ground surface. A geologic cross-section of the LSGPS, constructed from boring log information collected during RI drilling activities, shows the relationship between surface topography, shallow aquifer, alluvium thickness, groundwater flow, and bedrock (TtEMI, 2003). Figure 8 shows the map view location of the geologic cross-section (TtEMI, 2003).

### 2.4 Surface Water

Five surface water features are located within the proposed CGA: the Yellowstone River, the Coulson Irrigation Ditch (which has been out of service since approximately 2008), the AJ Gravel Pond, the Corcoran Pond and the Lower Lockwood Irrigation Ditch (EPA/DEQ, 2005). The surface water features are shown on Figure 7.

The Yellowstone River is the main surface water feature in the LSGPS, and the centerline of the channel marks the western and northern boundaries of the LSGPS. The river is approximately 4,600 feet downgradient of the Beall Source Area and 2,000 feet downgradient of the Soco Source Areas. The Yellowstone River is expected to intercept the alluvial groundwater discharging from the LSGPS (EPA/DEQ, 2005). As discussed in the ROD, a groundwater-surface water mixing model was used to evaluate the impact of contaminated groundwater on surface water quality of the Yellowstone River. The modeling indicated that discharge of contaminated groundwater has negligible impact to the Yellowstone River.

The Coulson Irrigation Ditch, which was formerly used to convey irrigation water, originates at a diversion structure on the Yellowstone River south (upriver) from the LWSD water treatment plant, winds to the northeast, then passes along the north boundary of the Soco property. The ditch exits the LSGPS beneath Klenck Road and continues through open fields east of OU2. The bottom of the ditch intercepts the water table so groundwater influx or seepage may occur even though there is no flow. Comparisons of water elevation data in the Coulson Irrigation Ditch to water elevations in monitoring wells adjacent to the ditch indicate portions of the Coulson Irrigation Ditch are below the groundwater table (EPA/DEQ, 2005).

The AJ Gravel Pond and Corcoran Pond are located south of the Yellowstone River at the north end of OU2. The ponds are about 1,500 and 1,800 feet downgradient of the Soco property, respectively, and are the result of former sand and gravel mining activities. The water elevations in the ponds are a reflection of water table elevations (EPA/DEQ, 2005).

The Lower Lockwood Irrigation Ditch, located at the south end of OU1, does not interact with the groundwater at the LSGPS and does not affect the site (EPA/DEQ, 2005).

One additional surface water feature is located within the OU1 and OU2 boundaries, but outside of the proposed CGA boundary. A permanent wetlands area, with small open ponds, is located about 4,300 feet downgradient of the Beall property in the west portion of the LSGPS. The wetlands extend from east of Cerise Road northeast toward the Sandy-Lomond Lane area. The wetlands were formed in a former chute channel originating from the Yellowstone River and likely receive groundwater year-round (EPA/DEQ, 2005). The surface water features are shown on Figure 7.

### 2.5 Groundwater Recharge/Discharge

Recharge of groundwater to the alluvial aquifer at LSGPS is likely occurring though two processes: (1) infiltration from surface features, such as ditches, and precipitation on unpaved surfaces, and (2) groundwater flow from the bedrock at the upgradient alluvial aquifer boundary. Closer to the Yellowstone River, localized recharge to the aquifer is likely dominated by groundwater travelling through the Yellowstone Valley in alluvial sands and gravels. Although not quantified during the RI, net infiltration from the surface within the LSGPS is likely limited by the low net precipitation in the area, controlled stormwater runoff, and by paved cover and buildings. Recharge from the bedrock aquifer is likely occurring along most of the alluvial aquifer boundary with saturated bedrock. Groundwater recharge for the LSGPS is occurring in the bedrock hills to the south and southeast of the LSGPS. Groundwater from this area flows downgradient toward the Yellowstone River and enters the alluvial aquifer at the contact (alluvial aquifer boundary) with the bedrock aquifer (TtEMI, 2003). Irrigation water is supplied by both the Lower and Upper Lockwood Irrigation Ditches, which flow through moderately permeable sediments 40 to 50 feet above the water table and are likely losing water at variable rates along the length of the channels (TtEMI, 2003). The Coulson Ditch intercepts the static groundwater level, indicating that the ditch would lose water during irrigation season. However, the Coulson Ditch is not currently operated, limiting groundwater recharge from the ditch to occasions when the ditch conveys significant amounts of stormwater runoff from roadside ditches and the railroad right-of-way. Ephemeral drainages and roadside ditches may also contribute to localized recharge, but these surface conveyances flow intermittently, and are often interconnected, e.g. unnamed drainages discharge to the Lower Lockwood Irrigation Ditch from the southeast (TtEMI, 2003).

## 2.6 Groundwater Flow

Previous investigations documented aspects of the groundwater flow regime in the vicinity of the LSGPS. Ongoing mitigation efforts (Section 6) include groundwater gauging and sampling to monitor the status of each plume. However, the monitoring well networks included in the current monitoring programs for OU1 and OU2 are significantly smaller (i.e. fewer wells) than the LSGPS site-wide network used for the 2003 RI to evaluate groundwater flow. The network of monitoring wells has been reduced over time as the data indicates stability in groundwater flow and COC concentration levels. For this CGA petition, the more spatially encompassing RI data provides a more comprehensive overview of groundwater conditions at the LSGPS. A comparison of data collected during the RI to recently collected data from the same wells indicates that no significant differences in COC concentrations exist between the data sets. Thus, contamination in the groundwater has reached equilibrium and is likely to see further reductions once cleanup commences.

In general, existing data suggest that the shallow, sandy gravel aquifer is the preferential pathway for migration of contaminants. Additionally, sorption of COCs to the silty clay and silty sand unit could provide a long-term source of contamination to groundwater because of back or matrix diffusion for many years after cleanup of the source areas has been completed. The lower-permeability bedrock unit likely impedes downward vertical groundwater flow and contaminant migration. The predominant groundwater flow direction is northwest toward the Yellowstone River. Depth to groundwater is approximately 9.5 to 14 feet below ground surface (bgs) near the river up to Taylor Place (Cardno, 2015). The water table in the Beall Source Area is at approximately 42 feet bgs (EPA, 2014a).

The general groundwater gradient across the LSGPS is toward the northwest, with localized variations, including a more northerly flow component near the Beall Source Area, and a westerly flow component near the southern boundary of the site. The overall site gradient has been measured at 0.009 feet/foot (ft/ft), with a lower gradient in the OU1 plume (0.0052 ft/ft) compared to the gradient in the OU2 plume (0.006 ft/ft) (TtEMI, 2003). Water level gradient maps from the 2003 RI are included in Appendix A. Due to the delineation of responsibility between liable parties for OU1 and OU2, groundwater level measurements are not collected from both operable units at the same time; therefore, a more recent potentiometric surface map is not available.

Estimates of hydraulic conductivity vary between the two Operable Units, due to differences in the alluvial sediment underlying the two source areas. In OU1, the medium coarse-grained sediments have an estimated hydraulic conductivity of 1.63 feet per day (ft/day), resulting in a calculated groundwater flow velocity of approximately 13 feet per year (ft/year). This estimate was based on an average hydraulic gradient of 0.0059 ft/ft, and an effective porosity of 0.27. In the lower alluvial terrace of OU2, the hydraulic conductivity was estimated at 70 ft/day, representative of coarse-grained sediments. Based on this average hydraulic conductivity, a hydraulic gradient of 0.006 ft/ft, and an effective porosity of 0.27, the calculated groundwater flow velocity for the OU2 area is 558 ft/year (TtEMI, 2003).

The boundary of the proposed CGA accounts for these differences in the flow regimes affecting the OU1 and OU2 plumes, as well as differences in the source areas and plumes discussed in the following sections.

## 2.7 Source Areas

Concentrations of the COCs in groundwater can be compared to the performance standards of 5.0 µg/L for PCE and TCE, 70 µg/L for *cis*-1,2-DCE and 2.0 µg/L for VC, as specified in the ROD

(EPA/DEQ, 2005). Soil contamination is a concern as the contaminants continue to leach from the soil to the groundwater, causing the groundwater contamination. Modeling performed for the Remedial Investigation (TtEMI, 2003) produced cleanup values for the contaminants in soil for the protection of the groundwater. The site-specific cleanup levels for these contaminants in soil will prevent or minimize further migration of contaminants from soil to groundwater and protect groundwater cleanup goals (EPA/DEQ, 2005).

The differences between the OU1 and OU2 source areas was considered significant enough to establish separate soil cleanup levels for each area. For OU1, concentrations of the COCs in soil can be compared to the soil performance standards of 0.22 milligrams per kilogram (mg/kg) for PCE, 0.24 mg/kg for TCE, 1.64 mg/kg for *cis*-1,2-DCE and 0.05 mg/kg for VC, as specified in the ROD (EPA/DEQ, 2005). For OU2, the ROD specified COC concentrations in soil can be compared to the performance standards of 0.65 mg/kg for PCE, 0.72 mg/kg for TCE, 4.90 mg/kg for *cis*-1,2-DCE and 0.16 mg/kg for VC. These site-specific soil cleanup levels are based on COC contaminants leaching to groundwater and establish estimated vadose soil contaminant concentrations that would ensure that groundwater performance standards are not exceeded (EPA/DEQ, 2005).

### 2.7.1 Operable Unit 1 (OU1)

Previous investigations of OU1 indicate the source area of COC impacts is around the former steam-cleaning bay drainfield and oil-water separator piping on the Beall property (Figure 5). In 2002, maximum concentrations of TCE in groundwater at wells located closest to the Beall Source Area were 1,867 and 1,850 micrograms per liter (µg/L). Soil samples collected in the unsaturated zone around the drain at the center of the steam-cleaning bay have exhibited TCE concentrations up to 120 mg/kg in the interval from 5.0 to 12.2 feet bgs and up to 11 mg/kg in the interval from 33.0 to 41.5 feet bgs (EPA, 2014a).

Groundwater contamination at OU1 occurs in two lobes as shown on Figure 2:

- A western lobe (West Lobe) most likely the result of historical groundwater flow to the west caused by the hydraulic influences of a former LWSD water supply well (closed in 1986); and

- A northern lobe (North Lobe) that is consistent with the natural groundwater flow directions (EPA, 2014a).

### 2.7.2 Operable Unit 2 (OU2)

Based on investigations conducted to date, several source areas of COC impacts have been identified on and near the Soco property in OU2. There are two primary source areas 1) the northwest source area and 2) the former tank farm source area, as shown on Figure 6. COC impacts identified in OU2 soil range as high as 4,670 mg/kg for PCE, 129 mg/kg for TCE, 50 mg/kg for *cis*-1,2-DCE, and 1.7 mg/kg for VC. The COC impacts to soil source a groundwater plume that flows northwest from the Soco property. Downgradient of the Soco property, the axis of the plume shifts to a more northerly direction, and the plume ultimately discharges into the Yellowstone River. Dissolved COC concentrations detected in groundwater within the OU2 plume have historically been as high as 120,000 µg/L for PCE, 1,020 µg/L for TCE, 18,700 µg/L for *cis*-1,2-DCE, and 2,460 µg/L for VC.

During the summer of 2015, an ozone sparge system was installed to evaluate the treatment of COCs in impacted groundwater within the northwest source area at the Soco property in OU2.

Ozone is a strong oxidizing agent capable of reacting with VOCs in the gas and water phases. The sparging component is essentially in situ air stripping, in which bubbles containing air and ozone are injected into the subsurface and move upward through the water column via buoyancy. As the air/ozone bubbles come into contact with groundwater contaminated with strippable VOCs, the VOCs become entrained in the bubbles and are oxidized upon contact with ozone (ATC, 2003).

The ozone sparge system, operated in conjunction with a vapor recovery system, is designed to function as a barrier and treat inaccessible vadose zone soils in the source area. Contaminated groundwater passing through the system is currently being treated to reduce VOC concentrations. Ozone sparge/vapor recovery remediation was selected based on the demonstrated success of previous treatability testing activities and the high permeability of the sandy-gravel aquifer at OU2.

### 2.8 Plumes & Plume Status

The current status of the plumes from the OU1 and OU2 source areas determines, in part, the boundary of the proposed CGA and proposed restrictions on groundwater use. Plume status has been evaluated during optimization reviews conducted by the EPA Office of Superfund Remediation and Technology Innovation at the request of the Region 8 Remedial Project Manager (EPA, 2014a and 2014b). Total dissolved mass estimates of the plume conducted using Monitoring and Remediation Optimization System (MAROS) modelling during the 2014 remedy optimization indicate largely stable values, indicating that mass discharge from the source is balanced by mass discharge to surface water and natural attenuation mechanisms. Further information from these reports regarding plume status is included in the following paragraphs. Monitoring well locations for the LSGPS are shown on Figure 7.

Groundwater monitoring was conducted at OU1 on an annual or semi-annual basis from 2002 through 2014. TCE concentrations above the MCL are present in both plume lobes (West and North), and are present above laboratory detection limits, but below ROD performance standards at locations between the lobes. Statistical trend analyses of COC concentrations in Beall Source Area wells indicates the West Lobe plume is stable with fairly elevated concentrations near the source. Individual well concentration trends in the West Lobe are stable to decreasing and estimates of total dissolved mass and center of mass are also stable, indicating the West Lobe plume is stable under current conditions. Statistical concentration trends in the North Lobe are largely stable to decreasing, as are estimates of the total dissolved mass and center of mass for the plume (EPA, 2014a).

A source of uncertainty for delineating the proposed CGA is the effect of variability in groundwater flow direction on the shape of the plumes in OU1. A westerly component of groundwater flow appears to remain even after termination of pumping at the municipal supply well to the west of the Beall Source Area. The groundwater gradients across OU1 appears to have a stronger northerly component, but is fairly flat, so small differences in local gradient may impact the geometry of the plume. The long-term presence of a northward flow component of the West Lobe could cause residual contamination to migrate north (for example, from monitoring well MW212 to MW213; Figure 7) into the area between the West and North Lobes (EPA, 2014a).

Groundwater in the OU2 area has been monitored via sampling and analysis of up to 48 wells and piezometers between 1998 and 2016. The highest dissolved contaminant concentrations were detected from wells installed to monitor the ozone sparging/soil vapor extraction system pilot test in the northwest source area (Figure 6). For the time period of 2000 to 2016, wells PT-02, PT-05 and PT-06 (Figure 7), located in the northwest source area, show stable to decreasing concentration trends for PCE (Note: PT wells were not sampled from 2004 to 2011).

A groundwater plume in the alluvial aquifer extends to the northwest from the Soco Source Areas, ultimately discharging to the Yellowstone River approximately 2,000 feet downgradient of the Soco Source Areas (Figure 7).

## 3.0 CGA PETITION CRITERIA

The DNRC can designate a permanent CGA by rule if one or more of the criteria specified in Section 85-2-506 MCA are met. The following criteria apply to the LSGPS CGA petition:

- Current or projected groundwater withdrawals from the aquifer or aquifers in the proposed CGA have induced or altered or will induce or alter contaminant migration exceeding relevant water quality standards (Section 85-2-506 (5)(c)) MCA; and

- Groundwater within the proposed CGA is not suited for beneficial use; or public health, safety, or welfare is or will become at risk (Section 85-2-506 (5)(e) and (f)) MCA.

Development of new pumping wells adjacent to and/or downgradient of the groundwater plumes has the potential to lower groundwater levels, alter groundwater flow patterns, and cause the groundwater plumes and associated contaminants to migrate into currently unaffected areas. Historic information supports this scenario – the West Lobe plume in OU1 is most likely the result of historical hydraulic influences of a former LWSD water supply well. There was also a slight modification in groundwater flow patterns near the Yellowstone River when the gravel pit was operational. AJ Gravel ceased operations in the early 2000's.

Furthermore, dewatering activities during construction of a LSWD sewer line along Taylor Place in 2012 also demonstrated the ability of pumping to cause plume migration within OU2. Based on changes in COC concentrations observed from groundwater sampling conducted during the dewatering activities, the EPA requested that the dewatering contractor cease pumping. This potential indicates that the criteria presented in Section 85-2-506 (5)(c) MCA should be considered in the designation process.

Based on extensive groundwater sampling and monitoring over the past two decades, COC impacts continue to exceed the ROD performance standards in the LSGPS. Concentrations of the COCs in groundwater can be compared to the performance standards of 5.0 μg/L for PCE and TCE, 70 μg/L for *cis*-1,2-DCE and 2.0 μg/L for VC, as specified in the ROD (EPA/DEQ, 2005). This data shows groundwater quality in the LSGPS is not suitable for beneficial use; or public health, safety, or welfare is or will become at risk. Historic analytical results are available through the EPA Superfund Records Center Montana Office in Helena or Montana State University – Billings Library.

Based on the above information, groundwater quality north and west of the former Beall property, and northwest of the Soco property, is not suitable for all intended beneficial uses and exceeds ROD performance standards, meeting the CGA petitioning criteria listed in Section 85-2-506 (5)(c), (5)(e), and 5(f) MCA.

## 4.0 CGA BOUNDARY AND PROPERTY OWNERSHIP

The Lockwood CGA boundary is based on the horizontal and vertical extents of contaminants in the groundwater plumes, potential future changes in groundwater flow patterns, and projected plume stability. The boundary is intended to meet CGA objectives of preventing unacceptable exposure to groundwater-borne contaminants or spreading of the groundwater plumes due to groundwater pumping, while minimizing the impacts of groundwater usage restrictions on property owners to the extent practicable.

The proposed boundary for the LSGPS CGA is located near the outskirts of Billings, in Yellowstone County, Montana, as shown on Figure 4. The CGA includes portions of Sections 26 and 35 in Township 01 North, Range 26 East. A description of the LSGPS CGA boundary is included in Appendix D.

### 4.1 Permanent CGA Boundary

The proposed permanent CGA encompasses approximately 336 acres in area, which includes those areas with or PCE (OU2) or TCE (OU1) and their corresponding breakdown product concentrations that exceed MCLs due to conditions at the Soco and former Beall properties. The proposed CGA also includes those areas in the vicinity of the groundwater plumes where, based on currently available data, concentrations are below MCLs, but future commercial or industrial development could include completion of non-exempt (greater than 35 gallons per minute [gpm]) water supply wells. The permanent CGA is intended to account for possible near-term changes in groundwater flow directions and plume migration patterns, and uncertainty in the precise contaminant boundary locations and to address areas where higher groundwater pumping rates could cause plumes to migrate into currently un-impacted areas, or where other changes in the hydrologic system could cause changes in the groundwater plume migration patterns in the future.

### 4.2 Vertical Boundary

The proposed LSGPS CGA includes the vertical boundary of the alluvial and bedrock aquifers. The vertical boundary is defined for the permanent CGA to meet the CGA objective of preventing vertical migration of contaminant plumes into the bedrock aquifer. A confining layer separates the alluvial aquifer from lower aquifers. The confining layer that exists between the alluvial aquifer and lower aquifers has been shown to prevent vertical movement of the plumes.

Two sets of alluvial/bedrock paired monitoring wells were installed in 2002 and sampled for several years. There are only two known exceedances of TCE concentrations in groundwater in the bedrock aquifer above MCLs. The exceedances occurred in 2002 and 2004 in samples collected from bedrock well MW219 (Figure 7), located in OU1, with no known exceedances since. There have been no known exceedances in the bedrock aquifer in OU2.

The depth to the saturated zone varies from ten feet or less north of the Soco property (OU2) near the Coulson Ditch, to approximately 40 feet or more on the former Beall property (OU1). Depth to bedrock within the LSGPS varies from less than 10 feet near the Yellowstone River to greater than 65 feet southeast of Interstate Highway 90 in the vicinity of Beall (OU1).

### 4.3 Basis for CGA Boundary

The proposed boundary for the LSGPS CGA is based on the delineation of COCs in the OU1 and OU2 groundwater plumes, and analysis of the designation criteria in Section 85-2-506 MCA. Other factors considered in defining the boundary include information on groundwater flow and contaminant transport processes, and potential affects to the area hydrology from development of new wells.

The boundary accounts for the potential for groundwater pumping to alter plume extents, causing contaminant migration into areas not currently affected by the plumes.

- In OU1, Calculated Fixed Radius calculations were used to estimate the capture zone radius, or lateral distance that a pumping well will draw water. The modeled scenario used a residential water supply well pumping at the maximum allowable rate of 35 gpm or an annual total volume of 10 acre-ft/year (equivalent to pumping 6.2 gpm continuously for one year). A second simulation was run using a non-exempt well pumping at 100 gpm continuously for one year. The model results show that new residential wells should not be located within 150 feet of the OU1 plume, and non-exempt wells should not be located within 600 feet of the plume. This approach is appropriate for the lower hydraulic conductivity (1.63 ft/day) and calculated groundwater flow velocity (13 ft/year) associated with the medium coarse-grained aquifer materials in OU1. The Calculated Fixed Radius Model for OU1 is included in Appendix B.

- In OU2, the USGS MODFLOW and MODPATH flow and particle transport models were used to simulate residential withdrawals (35 gpm maximum) adjacent to the Soco plume. Two pumping wells were placed on each side of the plume in the model to be conservative. A conservative hydraulic conductivity of 230 ft/day was used, consistent with more coarse-grained aquifer materials in OU2, while recognizing that heterogeneity in the soil profile has led to hydraulic conductivity estimates ranging from 70 ft/day to 624 ft/day. The model was run until steady-state conditions were achieved. Under these conditions, wells could be installed on the proposed CGA boundary and pumped 35 gpm until steady-state conditions were achieved and, according to the model output, the plume would never reach the pumping wells. Model results indicate that residential wells should not be located within 650 feet of the plume in the southern portion of OU2. This buffer zone has been extended downgradient to the Yellowstone River and upgradient to encompass the North Lobe of the OU1 plume. The OU2 CGA Buffer Zone Modeling is included in Appendix C.

### 4.4 Property Ownership

Table 1 lists property ownership within the LSGPS CGA boundary. Properties within the CGA consists of 208 parcels, which include numerous business and residential properties.

## 5.0 PROPOSED GROUNDWATER USAGE RESTRICTIONS

The following groundwater usage restrictions are proposed for the LSGPS CGA to prevent exposure to COCs in potable water and to prevent groundwater withdrawals from the CGA aquifer that may cause, induce, or alter contaminant migration. Groundwater usage restrictions within the proposed LSGPS CGA would include:

- A complete moratorium on all new water supply wells, including but not limited to: private, community or municipal water supply wells, irrigation wells and industrial use wells. These restrictions would apply within the lateral boundaries of the LSGPS CGA, which is shown on Figure 4.
- Groundwater monitoring wells, test wells and remediation wells will be allowed within the LSGPS CGA.
- Replacement wells will be allowed within the LSGPS CGA, as long as the original well was within the CGA and the property owner, where the well resides, has a water right filed with DNRC.
- No change of purpose will be allowed for any existing or replacement well within the LSGPS CGA boundary.

## 6.0 MITIGATION OF APPLICABLE PETITIONING CRITERIA AND MONITORING

As detailed in the referenced documents, assessment, remedial design, and treatability-test work has been completed to date to reduce environmental impacts within OU1 and OU2, with additional remedial actions being implemented and/or planned in the near future to address groundwater and soil contamination. Site remediation at both operable units is currently being addressed under the Superfund program, as mandated by the 2005 LSGPS ROD (EPA/DEQ, 2005). The Remedial Design (RD) process is underway, with the goal of addressing contamination associated with the Beall Source Area (OU1) and the Soco Source Area (OU2). Various remedial actions are currently being evaluated for effectiveness at controlling contaminant sources and meeting remedy performance standards, which include achieving appropriate media cleanup standards in groundwater and soil, as well as reducing ongoing contaminant loading to groundwater from the source areas, to the extent practicable.

The proposed permanent CGA is critical component of the remedy presented in the 2005 LSGPS ROD. Its purpose as an institutional control is to prevent unacceptable exposure to contaminated groundwater and/or potential contaminant migration resulting from additional groundwater withdrawals, while the selected remedies are being implemented and before the performance standards specified in the ROD are met. Given the presence of persistent contaminant source materials on the Soco and former Beall properties, the remedy performance phase of the project is expected to extend for a number of years. Groundwater monitoring will continue in the coming years to assess the effectiveness of remedial activities on the contaminant sources and downgradient groundwater quality, and to evaluate the need for additional remedies and/or modifications to the CGA boundary and/or provisions. Groundwater monitoring will evaluate the extent and concentration of COCs in groundwater until performance standards are met. The proposed boundary for the LSGPS CGA is shown on Figure 4.

## 7.0 REFERENCES


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# TABLES

TABLE 1
LAND OWNERSHIP
CONTROLLED GROUNDWATER AREA
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

| PARCEL ID | PROPERTY ADDRESS | OWNER NAME | OWNER ADDRESS | | | | |
|---|---|---|---|---|---|---|---|
| 03103335119059029 | 1385 US HIGHWAY 87 E | BUTCHER, ANDREW & ROSS | PO Box 317 | | LEWISTOWN | MT | 59457-2703 |
| 03103335119059030 | 1385 US HIGHWAY 87 E | VANDERVOORT, MARK | MAIL TO: PRICE, TIFFANY | 1385 US HIGHWAY 87 E TRLR 30 | BILLINGS | MT | 59101-6644 |
| 03103335119059030 | 1385 US HIGHWAY 87 E | FROST, KIMBERLY DAWN | 1385 US HIGHWAY 87 E TRLR 32 | | BILLINGS | MT | 59101-6644 |
| 03103335119059030 | 1385 US HIGHWAY 87 E | PARISH, MIKE & | 1385 US HIGHWAY 87 E TRLR 34 | | BILLINGS | MT | 59101-6645 |
| 03103335119059030 | 1385 US HIGHWAY 87 E | RANDALL, LUTHER F | 1385 US HIGHWAY 87 E TRLR 35 | | BILLINGS | MT | 59101-6645 |
| 03103335119059030 | 1385 US HIGHWAY 87 E | KOCSIS, LINDA | 1385 US HIGHWAY 87 E TRLR 28B | | BILLINGS | MT | 59101-6645 |
| 03103335119059037 | 1385 US HIGHWAY 87 E | HUDSON, JAMES | MAIL TO: FORSTNER, GEORGE C / FROSTNER, SHANNON L | 1385 US HIGHWAY 87 E TRLR 37 | BILLINGS | MT | 59101-6645 |
| 03103335120010000 | 4008 MELODY LN | HOUSE, RAY E & RUTH A | 4008 MELODY LN | | BILLINGS | MT | 59101-6513 |
| 03103335120020000 | 1330 BAXTER RD | WILSON, DARRYL | PO Box 50302 | | BILLINGS | MT | 59105-2658 |
| 03103335119059000 | 1385 US HIGHWAY 87 E | MYERS, RICHARD LEE | 2932 ALASKAN AVE | | BILLINGS | MT | 59101-6824 |
| 03103335119059010 | 1385 US HIGHWAY 87 E | HIXSON, NADINE T & | 1385 US HIGHWAY 87 E TRLR 10 | | BILLINGS | MT | 59101-6643 |
| 03103335119059011 | 1385 US HIGHWAY 87 E | HOFLIN, BRITTNEY | 1385 US HIGHWAY 87 E TRLR 11 | | BILLINGS | MT | 59101-6643 |
| 03103335119059012 | 1385 US HIGHWAY 87 E | HOFFMAN, CRAIG THOMAS | 1385 US HIGHWAY 87 E #12 | | BILLINGS | MT | 59101 |
| 03103335119059013 | 1385 US HIGHWAY 87 E | LARSON, BRENDON | 2355 SHADOW CANYON RD | | HUNTLEY | MT | 59037-9321 |
| 03103335119059014 | 1385 US HIGHWAY 87 E | WATERS, LYNELLE A | 1385 US HIGHWAY 87 E TRLR 14 | | BILLINGS | MT | 59101-6643 |
| 03103335119059015 | 1385 US HIGHWAY 87 E | NESS, ORIN EVANS | MAIL TO: TEMPLET, DARYL | 1385 US HIGHWAY 87 E TRLR 15 | BILLINGS | MT | 59101-6643 |
| 03103335119059020 | 1385 US HIGHWAY 87 E | PARRISH, MICHAEL JAY & | 1385 US HIGHWAY 87 E TRLR 34 | | BILLINGS | MT | 59101-6645 |
| 03103335119059020 | 1385 US HIGHWAY 87 E | REYNOLDS, LAURA BETH c/o WATSON, ROY | 821 N 27TH ST # 276 | | BILLINGS | MT | 59101-1121 |
| 03103335119059024 | 1385 US HIGHWAY 87 E | MCDONALD, DONALD R JR & LAURIE A | 1385 US HIGHWAY 87 E TRLR 24 | | BILLINGS | MT | 59101-6644 |
| 03103335119059027 | 1385 US HIGHWAY 87 E | RAY, JACKIE | MAIL TO: SILVA, IAN | 1385 US HIGHWAY 87 E TRLR 27 | BILLINGS | MT | 59101-6644 |
| 03103335119059028 | 1385 US HIGHWAY 87 E | HOLLEY, JAN & PAUL | MAIL TO: McGEE, HEATHER | 1385 US HIGHWAY 87 E TRLR 28A | BILLINGS | MT | 59101-6644 |
| 03103335120030000 | | NELSON, DAVID A | 4010 MELODY LN | | BILLINGS | MT | 59101-6513 |
| 03103335120040000 | 4010 MELODY LN | NELSON, DAVID A | 4010 MELODY LN | | BILLINGS | MT | 59101-6513 |
| 03103335120050000 | 36 MELODY LN | HARVEY, JOHNATHON & ASHLEY | PO BOX 50303 | | BILLINGS | MT | 59105-0303 |
| 03103335120080000 | 35 MELODY LN | FARMER, TAMARA L | 35 MELODY LN | | BILLINGS | MT | 59101-6513 |
| 03103335120090000 | 4012 MELODY LN | FREY, COLE M | 4012 MELODY LN | | BILLINGS | MT | 59101-6543 |
| 03103335120100000 | 4014 BAXTER RD | BAXTER, EDWARD L | 4014 BAXTER LN | | BILLINGS | MT | 59101-6538 |
| 03103335120110000 | 1425 US HIGHWAY 87 E | G&L PROPERTIES LLC | 4410 STATE AVE | | BILLINGS | MT | 59101-5060 |
| 03103335121030000 | 1430 US HIGHWAY 87 E | SECTOR CORPORATION | PO BOX 17095 | | PORTLAND | OR | 97217-0095 |
| 03103335122020000 | 124 CHERRY ST | TREFTZ, EUGENE E | 124 CHERRY ST | | BILLINGS | MT | 59101-6511 |
| 03103335122030000 | 114 CHERRY ST | GRANTHAM, KIRK A & DIANNA F | 114 CHERRY ST | | BILLINGS | MT | 59101-6511 |
| 03103335122040000 | 114 CHERRY ST | GRANTHAM, KIRK A & DIANNA F | 114 CHERRY ST | | BILLINGS | MT | 59101-6511 |
| 03103335122050000 | 110 CHERRY ST | SCHMIDT, CLARICE E | 110 CHERRY ST | | BILLINGS | MT | 59101-6511 |
| 03103335122060000 | 106 CHERRY ST | PICKETT, JOHN S JR & CLAUDINE | 24 MAIER RD | | BILLINGS | MT | 59101-6515 |
| 03103335123010000 | 48 MAIER RD | FRAKER-FOX, SHAWNA M | 48 MAIER RD | | BILLINGS | MT | 59101-6515 |
| 03103335123020000 | 30 MAIER RD | CROSS ROADS FREE WILL BAPTIST CHRCH | 30 MAIER RD | | BILLINGS | MT | 59101-6515 |
| 03103335123030000 | 24 MAIER RD | PICKETT, JOHN S & CLAUDINE | 24 MAIER RD | | BILLINGS | MT | 59101-6515 |
| 03103335123040000 | 16 MAIER RD | SEWARD, JAMES & MANA | 18 MAIER RD | | BILLINGS | MT | 59101-6515 |
| 03103335123070000 | 1534 US HIGHWAY 87 E | MILLER, ERIC A | 1534 US HIGHWAY 87 E | | BILLINGS | MT | 59101-6653 |
| 03103335203010000 | | MONTANA RAIL LINK | PO BOX 16624 | | MISSOULA | MT | 59808-6624 |
| 03103335204010000 | 1031 US HIGHWAY 87 E | STOCKTON, DANIEL E JR | 1604 4TH AVE N | | BILLINGS | MT | 59101-1521 |
| 03103335110010000 | 151 ROSEBUD LN | CHS INC | ATTN: PROPERTY TAX | PO BOX 64089 | SAINT PAUL | MN | 55164-0089 |
| 03103335111020000 | 1224 87 HWY E | HINMAN, RICK H & KAREN | PO BOX 50242 | | BILLINGS | MT | 59105-0242 |
| 03103335111030000 | 1247 ROSEBUD LN | STEINER, RICK EDWARD & | 1247 ROSEBUD LN | | BILLINGS | MT | 59101-6528 |
| 03103335111050000 | | STEINER, RICK EDWARD | 1247 ROSEBUD LN | | BILLINGS | MT | 59101-6528 |
| 03103335112010000 | 1301 ROSEBUD LN | WONDER, JOSEPH P & BOBBI J | 1301 ROSEBUD LN | | BILLINGS | MT | 59101-6527 |
| 03103335112020000 | | WOOTON, ROBERT W & SHARON J | 1213 STEFFANICH DR | | BILLINGS | MT | 59105-2650 |
| 03103335112030000 | POLEN ST | GALVIN, BRUCE | 1330 OLD HARDIN RD | | BILLINGS | MT | 59101-6654 |
| 03103335112080000 | ROSEBUD LN | AFFRODABLE CONSTRUCTION EQU. LLC | PO BOX 430 | | BIG TIMBER | MT | 59011-0430 |
| 03103335113010000 | 1330 OLD HARDIN RD | GALVIN, BRUCE F | 1330 HWY 87 E | | BILLINGS | MT | 59101 |
| 03103335113040000 | | PONDEROSA REALTY LLC | 1530 CEDAR ST STE D | | HELENA | MT | 59601-1007 |

**TABLE 1 (CONTINUED)**
**LAND OWNERSHIP**
**CONTROLLED GROUNDWATER AREA**
**LOCKWOOD SOLVENT GROUNDWATER PLUME SITE**

| PARCELID | PROPERTY ADDRESS | OWNER NAME | OWNER ADDRESS | | | | |
|---|---|---|---|---|---|---|---|
| 03103335113050000 | 1319 ROSEBUD LN | PONDEROSA REALTY LLC | 1530 CEDAR ST STE D | | HELENA | MT | 59601-1007 |
| 03103335113060000 | 1341 ROSEBUD LN | PONDEROSA REALTY LLC | 1530 CEDAR ST STE D | | HELENA | MT | 59601-1007 |
| 03103335113090000 | | PONDEROSA REALTY LLC | 1531 CEDAR ST STE D | | HELENA | MT | 59601-1007 |
| 03103335113100000 | | PONDEROSA REALTY LLC | 1532 CEDAR ST STE D | | HELENA | MT | 59601-1008 |
| 03103335114010000 | 1413 ROSEBUD LN | HARVEST EVANGELICAL CHURCH OF THE EVANGELICAL CHURCH OF NORTH AMERICA | 1235 WICKS LN W | | BILLINGS | MT | 59105-3584 |
| 03103335114020000 | 1429 ROSEBUD LN | MCCARTHY, MICHAEL S & DARCY K | 1419 ROSEBUD LN | | BILLINGS | MT | 59101-6526 |
| 03103335114030000 | 1439 ROSEBUD LN | CL ROSEBUD PROPERTIES LLC | 635 CENTRAL AVE | | BILLINGS | MT | 59102-5814 |
| 03103335114050000 | | CL ROSEBUD PROPERTIES LLC | 635 CENTRAL AVE | | BILLINGS | MT | 59102-5814 |
| 03103335115010000 | 1503 ROSEBUD LN | COCHRAN, LEONARD | 1503 ROSEBUD LN | | BILLINGS | MT | 59101-6525 |
| 03103335115200000 | 150 CHERRY ST | KINDSFATHER, RONALD | 1509 ROSEBUD LN | | BILLINGS | MT | 59101-6525 |
| 03103335116010000 | | VETTER, KARL CLAY | PO BOX 644 | | TULAROSA | NM | 88352-0644 |
| 03103335116020000 | | VETTER, KARL CLAY | PO BOX 644 | | TULAROSA | NM | 88352-0644 |
| 03103335117010000 | | POTTS, GLENN A & MICKEY J | 1249 US HIGHWAY 87 E | | BILLINGS | MT | 59101-6655 |
| 03103335117020000 | 1249 US HIGHWAY 87 E | POTTS, GLENN A & MICKEY J | 1249 US HIGHWAY 87 E | | BILLINGS | MT | 59101-6655 |
| 03103335118010000 | 1305 US HIGHWAY 87 E | KEEHN, ROBERT T & TAMARA J | 1305 US HIGHWAY 87 E | | BILLINGS | MT | 59101-6654 |
| 03103335119010000 | | NELSON, MARVIN L | 8252 OVERLOOK LN | | BOZEMAN | MT | 59715-7795 |
| 03103335119020000 | | DONNES FAMILY LLC (1/2 INT) & | 5807 FREY RD | | SHEPHERD | MT | 59079-4459 |
| 03103335119050000 | 1835 US HIGHWAY 87 E | ERIS, LLC | PO BOX 1086 | | BELLEVUE | WA | 98009-1086 |
| 03103335119059001 | 1385 US HIGHWAY 87 E | RULAND, L C | 1385 HWY 87 E #1 | | BILLINGS | MT | 59101-5216 |
| 03103335119059002 | 1385 US HIGHWAY 87 E | HEDERT, FRANCIS | 1385 US HIGHWAY 87 E TRLR 2 | | BILLINGS | MT | 59101-6643 |
| 03103335119059003 | 1385 US HIGHWAY 87 E | DEPRIEST, DUSTIN & | 1385 US HIGHWAY 87 E TRLR 3 | | BILLINGS | MT | 59101-6643 |
| 03103335119059000 | 1385 US HIGHWAY 87 E | CURETON, CORTNEY | 1385 US HIGHWAY 87 E TRLR 4 | | BILLINGS | MT | 59101-6643 |
| 03103335119059006 | 1385 US HIGHWAY 87 E | ERIS LLC | PO BOX 1086 | | BELLEVUE | WA | 98009-1086 |
| 03103335119059007 | 1385 US HIGHWAY 87 E | MAUCH, EVAN | 1385 US HIGHWAY 87 E TRLR 7 | | BILLINGS | MT | 59101-6643 |
| 03103335119059008 | 1385 US HIGHWAY 87 E | ROBISON, BARBARA M | 1385 US HIGHWAY 87 E TRLR 8 | | BILLINGS | MT | 59101-6643 |
| 03103335123140000 | 34 MAIER RD | PALMER, RONALD A & ARLEE L | 34 MAIER RD | | BILLINGS | MT | 59101-6515 |
| 03103335123200000 | CHERRY ST | PICKETT, JOHN S JR | 24 MAIER RD | | BILLINGS | MT | 59101-6515 |
| 03103335124010000 | 1208 N FRONTAGE RD | RICHARD E ROSEKELLY LIVING TRUST | PO BOX 1269 | | RED LODGE | MT | 59068-1269 |
| 03103335124020000 | 1218 N FRONTAGE RD | WOLFE, RICHARD L | PO BOX 50334 | | BILLINGS | MT | 59105-0334 |
| 03103335124030000 | 1228 N FRONTAGE RD | WOLFE, RICK | PO BOX 50334 | | BILLINGS | MT | 59105-0334 |
| 03103335124040000 | 1234 N FRONTAGE RD | MICHUNOVICH, JOHN G CO-TRUSTEE | 1303 NEZ PERCE DR | | LAUREL | MT | 59044-9645 |
| 03103335124050000 | N FRONTAGE RD | MICHUNOVICH, JOHN G & CATHERINE J- | 1303 NEZ PERCE DR | | LAUREL | MT | 59044-9645 |
| 03103335201060000 | ROSEBUD LN | EKLUND, JOHN R & RAE ANN | 5220 PRYOR MOUNTAIN VIEW DR | | BILLINGS | MT | 59101-7227 |
| 03103335202030000 | 934 US HIGHWAY 87 E | SUDS HUT OF LOCKWOOD INC | PO BOX 3445 | | BOZEMAN | MT | 59772-3445 |
| 03103335202050000 | 1092 US HIGHWAY 87 E | HOUGEN, THOMAS P | PO BOX 3445 | | BOZEMAN | MT | 59772-3445 |
| 03103335202060000 | 1028 US HIGHWAY 87 E | BILLINGS HOLDINGS LLC | 600 S MAIN ST | | BUTTE | MT | 59701-2534 |
| 03103335202070000 | | BILLINGS HOLDINGS LLC | 600 S MAIN ST | | BUTTE | MT | 59701-2534 |
| 03103335204030000 | 1140 N FRONTAGE RD | BIG HORN INDUSTRIAL PARK LLP | 1140 N FRONTAGE RD | | BILLINGS | MT | 59101-7391 |
| 03103326409020000 | 221 LOMOND LN | CORCORAN PROPERTIES LLP | 221 LOMOND LN | | BILLINGS | MT | 59101-7350 |
| 03103326409030000 | | MOLLERSTUEN, JAMES E | 400 LOMOND LN | | BILLINGS | MT | 59101-7348 |
| 03103326410010000 | 1305 TAYLOR PL | HAROLD D ANKRUM TRUST & | 1305 TAYLOR PL | | BILLINGS | MT | 59101-7356 |
| 03103326410020000 | 1323 TAYLOR PL | KELLER TRANSPORT INC | PO BOX 30197 | | BILLINGS | MT | 59107-0197 |
| 03103326411010000 | 1353 TAYLOR PL | BRENNTAG WEST INC | 100 STAMFORD PL STE 14 | | STAMFORD | CT | 06902-6747 |
| 03103326101010000 | 403 LOMOND LN | BERSCHIED, MARTIN F | 403 LOMOND LN | | BILLINGS | MT | 59101-7348 |
| 03103326101020000 | 349 LOMOND LN | KUCK TRUCKING INC | 227 GLENHAVEN DR | | BILLINGS | MT | 59105-3503 |
| 03103326101030000 | 345 LOMOND LN | JORGENSEN, FRED JR | 2956 STILLWATER DR | | BILLINGS | MT | 59102-6146 |
| 03103326101040000 | LOMOND LN | YELLOWSTONE COUNTY | PO BOX 35001 | | BILLINGS | MT | 59107-5001 |
| 03103326101060000 | 505 LOMOND LN | JORGENSEN, FRED JR | 2956 STILLWATER DR | | BILLINGS | MT | 59102-6146 |
| 03103326102010000 | 510 KLENCK LN | BERTRAM, GRAFTON L | C/O: BERTRAM DRILLING, INC | PO BOX 2053 | BILLINGS | MT | 59103-2053 |

## TABLE 1 (CONTINUED)
## LAND OWNERSHIP
## CONTROLLED GROUNDWATER AREA
## LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

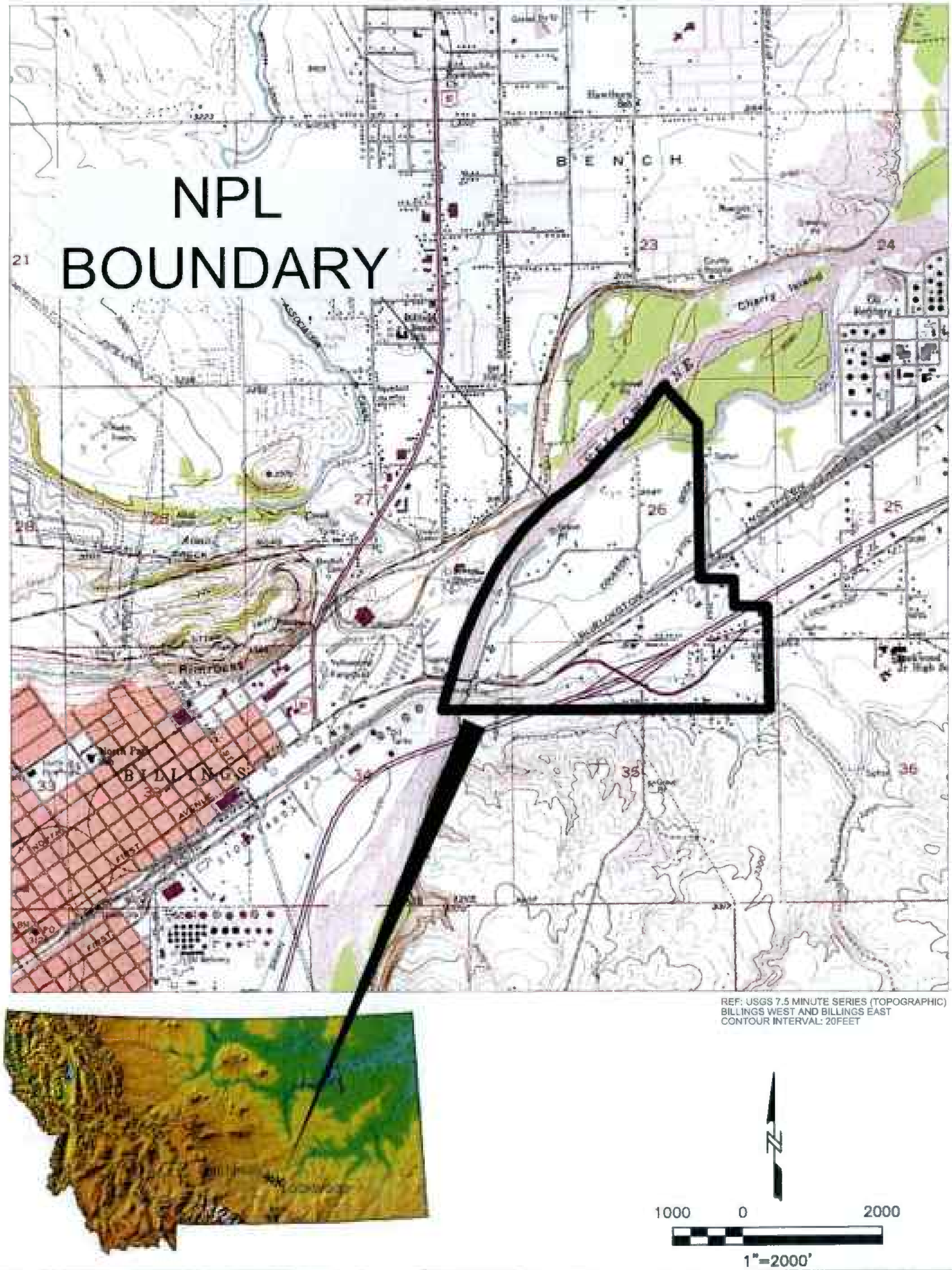
| PARCELID | PROPERTY ADDRESS | OWNER NAME | OWNER ADDRESS | | | | |
|---|---|---|---|---|---|---|---|
| 03103326102020000 | 532 KLENCK LN | CORCORAN PARTNERSHIP | 532 KLENCK LN | | BILLINGS | MT | 59101-7345 |
| 03103326102040000 | 542 KLENCK LN | ADAMS, JESSE GENE | 542 KLENCK LN | | BILLINGS | MT | 59101-7345 |
| 03103326203010000 | 516 SANDY LN | HENRY, ROGER D & SHARON L | 516 SANDY LN | | BILLINGS | MT | 59101-7357 |
| 03103326204010000 | 1117 DOON AVE | WAGENMAN, NEAL A | PO BOX 31534 | | BILLINGS | MT | 59107-1534 |
| 03103326204040000 | 1123 DOON AVE | DAVIS, WESLEY E & RHONDA L | 92 SKYLINE DR | | BILLINGS | MT | 59105-3038 |
| 03103326204060000 | 534 BONNIE LN | WAGENMAN, NEAL A & CHERYL K | 4929 STONE RIDGE CIR | | BILLINGS | MT | 59106-4417 |
| 03103326204100000 | BONNIE LN | WAGENMAN, NEAL A & CHERYL K | 4929 STONE RIDGE CIR | | BILLINGS | MT | 59106-4417 |
| 03103326204110000 | BONNIE LN | WAGENMAN, NEAL A & CHERYL K | 4929 STONE RIDGE CIR | | BILLINGS | MT | 59106-4417 |
| 03103326204120000 | BONNIE LN | WAGENMAN, NEAL A & CHERYL K | 4929 STONE RIDGE CIR | | BILLINGS | MT | 59106-4417 |
| 03103326204130000 | BONNIE LN | WAGENMAN, NEAL A & CHERYL K | 4929 STONE RIDGE CIR | | BILLINGS | MT | 59106-4417 |
| 03103326204140000 | BONNIE LN | WAGENMAN, NEAL A & CHERYL K | 4929 STONE RIDGE CIR | | BILLINGS | MT | 59106-4417 |
| 03103326204150000 | 1135 DOON AVE | WAGENMAN, NEAL A & CHERYL K | 4929 STONE RIDGE CIR | | BILLINGS | MT | 59106-4417 |
| 03103326204170000 | 504 LOMOND LN | SMITH, JOHN D & SHARON D | 522 LOMOND LN | | BILLINGS | MT | 59101-7347 |
| 03103326204180000 | 518 LOMOND LN | SMITH, JOHN D & SHARON D | 522 LOMOND LN | | BILLINGS | MT | 59101-7347 |
| 03103326204190000 | 518 LOMOND LN | SMITH, JOHN D & SHARON D | 522 LOMOND LN | | BILLINGS | MT | 59101-7347 |
| 03103326204200000 | 522 LOMOND LN | SMITH, JOHN D & SHARON D | 522 LOMOND LN | | BILLINGS | MT | 59101-7347 |
| 03103326204210000 | 528 LOMOND LN | WOLFF, TROY C | PO BOX 50149 | | BILLINGS | MT | 59105-0149 |
| 03103326204220000 | 534 LOMOND LN | WHITBY, DAN C | 534 LOMOND LN | | BILLINGS | MT | 59101-7347 |
| 03103326204230000 | LOMOND LN | WHITBY, DAN | 534 LOMOND LN | | BILLINGS | MT | 59101-7347 |
| 03103326204240000 | 546 LOMOND LN | CLEVELAND, SANDRA L | 546 LOMOND LN | | BILLINGS | MT | 59101-7347 |
| 03103326204250000 | LOMOND LN | CLEVELAND, SANDRA L | 546 LOMOND LN | | BILLINGS | MT | 59101-7347 |
| 03103326301200000 | | COPART OF WASHINGTON INC | 14185 DALLAS PKWY STE 300 | | DALLAS | TX | 75254-1327 |
| 03103326303010000 | N FRONTAGE RD | HEALOW, LINDA KILLION | 312 CLARK AVE | | BILLINGS | MT | 59101-1721 |
| 03103326303020000 | 1127 N FRONTAGE RD | HEALOW, LINDA KILLION | 312 CLARK AVE | | BILLINGS | MT | 59101-1721 |
| 03103326303030000 | 1155 N FRONTAGE RD | HOPPMAN, JOSEPH D & LINDA K | 3468 SPALDING AVE | | BILLINGS | MT | 59106-1055 |
| 03103326303040000 | 1210 LOCKWOOD RD | HOPPMAN, JOSEPH D & LINDA K | 3468 SPALDING AVE | | BILLINGS | MT | 59106-1055 |
| 03103326303300000 | 1200 LOCKWOOD RD | GTP ACQUISITION PARTNERS II LLC | C/O GLOBAL TOWER PARTNERS - PROP TAX DEPT | PO BOX 811510 | BOCA RATON | FL | 33481-1510 |
| 03103326306090000 | CERISE RD | PINNOW PROPERTIES LLC | PO BOX 30334 | | BILLINGS | MT | 59107-0334 |
| 03103326306100000 | 150 LOMOND LN | PINNOW PROPERTIES LLC | PO BOX 30334 | | BILLINGS | MT | 59107-0334 |
| 03103326306110000 | 234 LOMOND LN | CHILTON, VIRGIL | 1117 COOK AVE | | BILLINGS | MT | 59102-5504 |
| 03103326306110101 | 234 LOMOND LN | BLAIR, LORI M | 234 LOMOND LN TRLR 1 | | BILLINGS | MT | 59101-7301 |
| 03103326306110104 | 234 LOMOND LN | FEIST, KATHLEEN M | 234 LOMOND LN TRLR 4 | | BILLINGS | MT | 59101-7301 |
| 03103326306119005 | 234 LOMOND LN | TURLEY, KENNETH SHAWN, | 715 S 28TH ST APT 105 | | BILLINGS | MT | 59101-4421 |
| 03103326306119006 | 234 LOMOND LN | WILSON, WHITNEY M | 234 LOMOND LN TRLR 6 | | BILLINGS | MT | 59101-7302 |
| 03103326306120000 | 236 LOMOND LN | MORRIS, ROBERT D | 236 LOMOND LN | | BILLINGS | MT | 59101-7350 |
| 03103326307010000 | | HUSCHKA, MELVIN | PO BOX 1338 | | BILLINGS | MT | 59103-1338 |
| 03103326308010000 | 1007 ISLAND PARK RD | DAILEY, THOMAS A | 1007 ISLAND PARK RD | | BILLINGS | MT | 59101-7318 |
| 03103326308020000 | 1035 ISLAND PARK RD | MAKEEFF, TERRY A & JULIE D | 1020 KAY DR | | BILLINGS | MT | 59101-6918 |
| 03103326309010000 | 1115 ISLAND PARK RD | JACOBS, VANCE | 1115 ISLAND PARK RD | | BILLINGS | MT | 59101-7317 |
| 03103326309020000 | BONNIE LN | HANSON, DALE E & JUDITH G | 3875 JENE HELENE AVE | | BILLINGS | MT | 59101-9147 |
| 03103326309030000 | BONNIE LN | HANSON, DALE E & JUDITH G | 3875 JENE HELENE AVE | | BILLINGS | MT | 59101-9147 |
| 03103326309070000 | 327 SANDY LN | FASCHING, PAUL | 3436 BECRAFT LN | | BILLINGS | MT | 59101-7028 |
| 03103326309090000 | | FASCHING, PAUL | 3436 BECRAFT LN | | BILLINGS | MT | 59101-7028 |
| 03103326309100000 | 1107 ISLAND PARK RD | MORRIS, SANDY L | 1107 ISLAND PARK RD | | BILLINGS | MT | 59101-7317 |
| 03103326310010000 | | DUBELL, CHARLES III | 976 CALICO AVE | | BILLINGS | MT | 59105-2008 |
| 03103326310070000 | 1135 ISLAND PARK RD | HOLTON REVOCABLE TRUST | 13793 E WEIERS ST | | VAIL | AZ | 85641-5905 |
| 03103326311010000 | | ZECH, RONALD E | 366 BONNIE LN | | BILLINGS | MT | 59101-7379 |
| 03103326311030000 | 354 BONNIE LN | ZECH, RONALD E | 354 BONNIE LN | | BILLINGS | MT | 59101-7379 |
| 03103326311040000 | BONNIE LN | ZECH, RONALD | 366 BONNIE LN | | BILLINGS | MT | 59101-7379 |
| 03103326311070000 | 408 BONNIE LN | MCCHESNEY, PATRICK | PO BOX 20452 | | BILLINGS | MT | 59104-0452 |
| 03103326311080000 | 1112 DOON AVE | CARROLL, CHARLES M | 1112 DORN AVE | | BILLINGS | MT | 59101 |
| 03103326312010000 | 400 LOMOND LN | MOLLERSTUEN, JAMES E | PO BOX 50040 | | BILLINGS | MT | 59105-0040 |

TABLE 1 (CONTINUED)
LAND OWNERSHIP
CONTROLLED GROUNDWATER AREA
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

| PARCELID | PROPERTY ADDRESS | OWNER NAME | OWNER ADDRESS | | | | |
|---|---|---|---|---|---|---|---|
| 03103326312070000 | 410 LOMOND LN | STR LLC | PO BOX 81094 | | BILLINGS | MT | 59108-1094 |
| 03103326312080000 | 418 LOMOND LN | MOCK, JAMES D & SANDRA R (RLE) | 317 LINCOLN AVE S | | SIDNEY | MT | 59270 |
| 03103326312100000 | BONNIE LN | MOFFETT, DAVE W | 4103 JANSMA AVE | | BILLINGS | MT | 59101-5446 |
| 03103326312110000 | 409 BONNIE LN | STR LLC | 4431 BOWMAN DR | | BILLINGS | MT | 59101-9741 |
| 03103326312130000 | 409 BONNIE LN | TIPTON, TERRY | PO BOX 21123 | | BILLINGS | MT | 59104-1123 |
| 03103326312160000 | BONNIE LN | TIPTON, TERRY | PO BOX 21123 | | BILLINGS | MT | 59104-1123 |
| 03103326401020000 | 1217 N FRONTAGE RD | ROSEKELLY, RICHARD E TRUSTEE | PO BOX 1269 | | RED LODGE | MT | 59068-1269 |
| 03103326401030000 | 1225 N FRONTAGE RD | BAKER, ROBERT A & BETTY | 1225 N FRONTAGE RD # 8 | | BILLINGS | MT | 59101-7315 |
| 03103326401060000 | 1243 N FRONTAGE RD | STANHOPE, CLYDE | 6001 PLEASANT HOLLOW TRL | | SHEPHERD | MT | 59079-3339 |
| 03103326401070000 | 1249 N FRONTAGE RD | MCKITTRICK, JANICE RAE & KIM RENEE | 1249 N FRONTAGE RD | | BILLINGS | MT | 59101-7315 |
| 03103326401090000 | 1300 LOCKWOOD RD | CC INSULATION & URETHANE INC | 1270 LOCKWOOD RD STOP 9 | | BILLINGS | MT | 59101-7387 |
| 03103326401100000 | 1270 LOCKWOOD RD | RIDGEWOOD PROPERTIES LLC | PO BOX 20855 | | BILLINGS | MT | 59104-0855 |
| 03103326401110000 | 1220 LOCKWOOD RD | DRINKWALTER, WILLARD R | 2546 US HIGHWAY 87 E | | BILLINGS | MT | 59101-6648 |
| 03103326402010000 | | YELLOWSTONE COUNTY | PO BOX 35001 | | BILLINGS | MT | 59107-5001 |
| 03103326402020000 | | INVESTMENT PROPERTIES FINANCE GROUP LLC | PO BOX 1952 | | GREAT FALLS | MT | 59403-1952 |
| 03103326402030000 | OLD HARDIN RD | SECTOR CORPORATION | PO BOX 17095 | | PORTLAND | OR | 97217-0095 |
| 03103326402040000 | 1419 OLD HARDIN RD | LAFOUNTAIN, VICTORIA JEFFREY | PO BOX 152 | | SHEPHERD | MT | 59079-0152 |
| 03103326402050000 | 4053 OLD HARDIN RD | CROME, LEN | 2108 PHOEBE DR | | BILLINGS | MT | 59105-3741 |
| 03103326402060000 | 1445 OLD HARDIN RD | REINEKE, J MARIE | 2217 US HIGHWAY 87 E | | BILLINGS | MT | 59101-6650 |
| 03103326402070000 | 1447 OLD HARDIN RD | EDWARDS, CLYDE | 1447 1/2 OLD HARDIN RD | | BILLINGS | MT | 59101-6559 |
| 03103326402080000 | 1457 OLD HARDIN RD | EDWARDS, JUSTIN J | 1457 OLD HARDIN RD | | BILLINGS | MT | 59101-6559 |
| 03103326402090000 | 1505 OLD HARDIN RD | MIDDLESWORTH, RON DAVIS & PEGGY | 1507 OLD HARDIN RD | | BILLINGS | MT | 59101-6558 |
| 03103326402100000 | 1511 OLD HARDIN RD | SUNDERLAND, PAUL A | 729 CAVE RD | | BILLINGS | MT | 59101-7243 |
| 03103326402110000 | 1519 OLD HARDIN RD | HAWKINS INC | 2381 ROSEGATE | | SAINT PAUL | MN | 55113-2625 |
| 03103326402120000 | OLD HARDIN RD | EDWARDS, JUSTIN J | 1457 OLD HARDIN RD | | BILLINGS | MT | 59101-6559 |
| 03103326402140000 | | LAFOUNTAIN, JOHN DAVID | PO BOX 632 | | GREAT FALLS | MT | 59403-0632 |
| 03103326403020000 | 1324 LOCKWOOD RD | WS BILLINGS REAL ESTATE INC | PO BOX 296 | | WAUSAU | WI | 54402-0296 |
| 03103326404010000 | 113 BRICKYARD LN | CARON, ZITA W | 113 BRICKYARD LN | | BILLINGS | MT | 59101-7352 |
| 03103326404020000 | 105 BRICKYARD LN | ALLISON, KALYN | 105 BRICKYARD LN | | BILLINGS | MT | 59101-7352 |
| 03103326404030000 | | HICKEL, KENNETH E | 2511 1ST AVE N | | BILLINGS | MT | 59101-2320 |
| 03103326404040000 | 121 BRICKYARD LN | BEEBE, ARTHUR L & CAROLYN L | PO BOX 1852 | | BILLINGS | MT | 59103-1852 |
| 03103326404050000 | 127 BRICKYARD LN | TRUSSES INC | PO BOX 1852 | | BILLINGS | MT | 59103-1852 |
| 03103326405010000 | 131 BRICKYARD LN | STARVATION RANCH LLC | 813 3RD AVE N | | BILLINGS | MT | 59101-2502 |
| 03103326407010000 | 1430 LOCKWOOD RD | LOCKWOOD LAND LLC | 3501 US HIGHWAY 87 | | GREAT FALLS | MT | 59404-6008 |
| 03103326409010000 | 139 LOMOND LN | CORCORAN PROPERTIES LLP | PO BOX 1472 | | BILLINGS | MT | 59103-1472 |
| 03103325301010000 | 1516 OLD HARDIN RD | PRINCE INC | PO BOX 440 | | FORSYTH | MT | 59327-0440 |
| 03103326413110000 | | MARTE M NELSON TRUST | 3007 RADCLIFFE DR | | BILLINGS | MT | 59102-0728 |
| 03103326413010000 | | MARTE M NELSON TRUST | 3007 RADCLIFFE DR | | BILLINGS | MT | 59102-0728 |
| 03103326405200000 | | JONES, JAY & MARIE G | 1443 GORDON DR | | BILLINGS | MT | 59101-7353 |
| 03103326405090000 | 1443 GORDON DR | JONES, JAY & MARIE G | 1443 GORDON DR | | BILLINGS | MT | 59101-7353 |
| 03103335123080000 | 101 CHERRY ST | PICKETT, LINDSEY L & CHAD E | 101 CHERRY ST | | BILLINGS | MT | 59101-6511 |
| 03103335123200000 | CHERRY ST | PICKETT, JOHN S JR | 24 MAIER RD | | BILLINGS | MT | 59101-6515 |
| 03103335123090000 | CHERRY ST | PICKETT, JOHN S JR & CLAUDINE | 24 MAIER RD | | BILLINGS | MT | 59101-6515 |
| 03103335123100000 | 107 CHERRY ST | PICKETT, JOHN S JR & CLAUDINE | 24 MAIER RD | | BILLINGS | MT | 59101-6515 |
| 03103335123110000 | 115 CHERRY ST | GOKEY, JAMES R | 115 CHERRY ST | | BILLINGS | MT | 59101-6511 |
| 03103335123120000 | 121 CHERRY ST | KOBER, JONATHAN D | 2213 HYACINTH DR | | BILLINGS | MT | 59105-4866 |
| 03103335123130000 | 145 CHERRY ST | THORPE, NINA M | 145 CHERRY ST | | BILLINGS | MT | 59101-6511 |
| 03103326302070000 | CERISE RD | EIDEN, KEN 18.863754% INT | 120 CANDLE LN | | BOZEMAN | MT | 59715-7181 |
| 03103326302080000 | CERISE RD | MCGLONE HYDROSEEDING LLC | 1931 PHOEBE DR | | BILLINGS | MT | 59105-3744 |
| 03103326302090000 | CERISE RD | C VON ENTERPRISES LLC | PO BOX 21307 | | BILLINGS | MT | 59104-1307 |
| 03103326302100000 | CERISE RD | COTTONWOOD CENTER LLC | 5285 RIVER RD | | LAUREL | MT | 59044-8605 |
| 03103326302110000 | CERISE RD | COTTONWOOD CENTER LLC | 5285 RIVER RD | | LAUREL | MT | 59044-8605 |
| 03103326302120000 | CERISE RD | COTTONWOOD CENTER LLC | 5285 RIVER RD | | LAUREL | MT | 59044-8605 |

Note:
All property addresses are Billings, MT 59101.

FIGURES




REF: USGS 7.5 MINUTE SERIES (TOPOGRAPHIC)
BILLINGS WEST AND BILLINGS EAST
CONTOUR INTERVAL: 20FEET

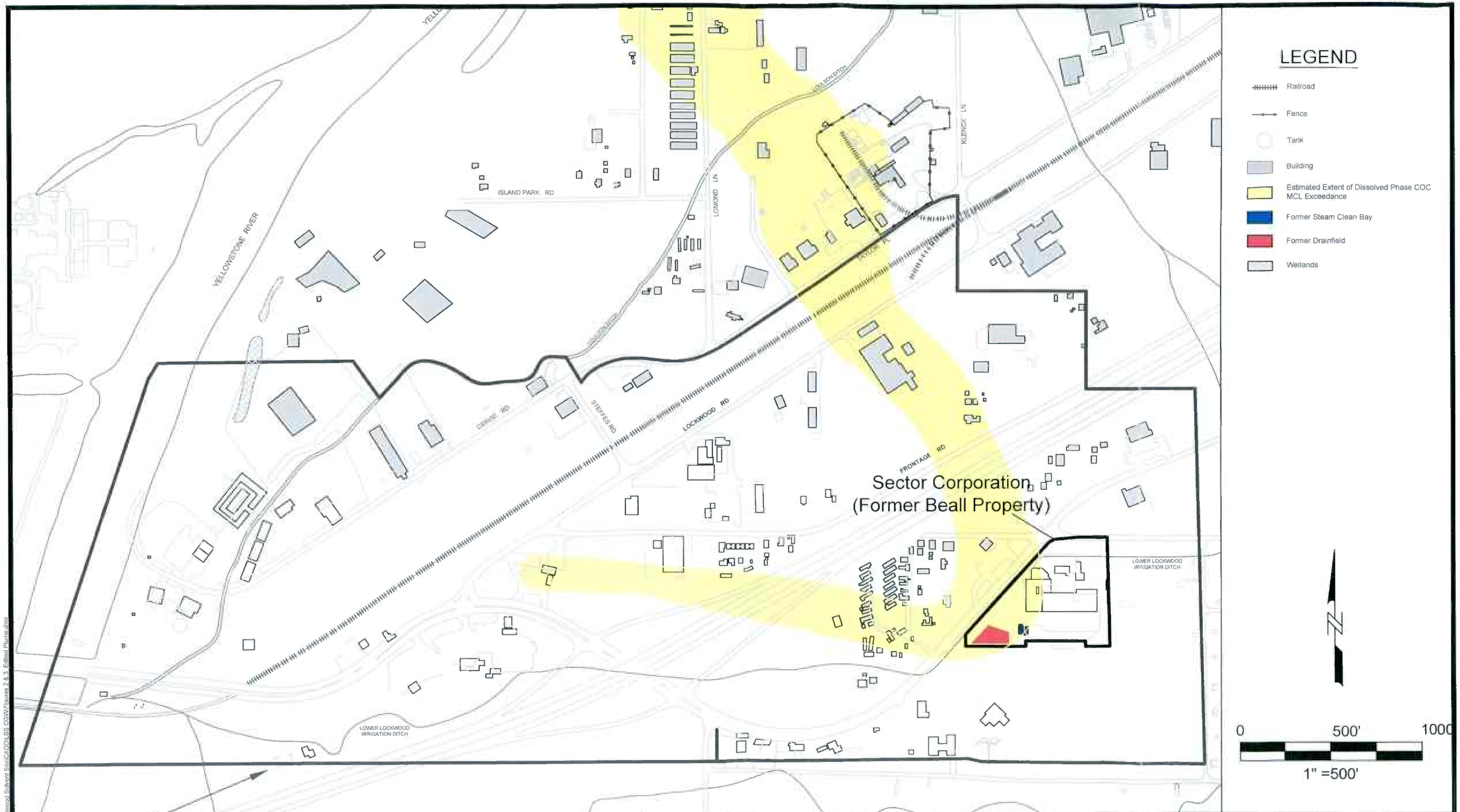
N

1000 0 2000

1"=2000'

| SITE VICINITY MAP<br>LOCKWOOD SOLVENT GROUNDWATER PLUME SITE<br><br>Billings, Montana | PROJECT NUMBER: Z051000003 | DATE: 01/20/2016 | FIGURE |
|---|---|---|---|
| | APPROVED BY: JS | DRAWN BY: JC | 1 |
| | TASMAN GEOSCIENCES | 917 1st Avenue North<br>Billings, Montana 59101-2048<br>Ph: (406) 259-1033 | |

F:\LSS CGW\Figure 1.dwg

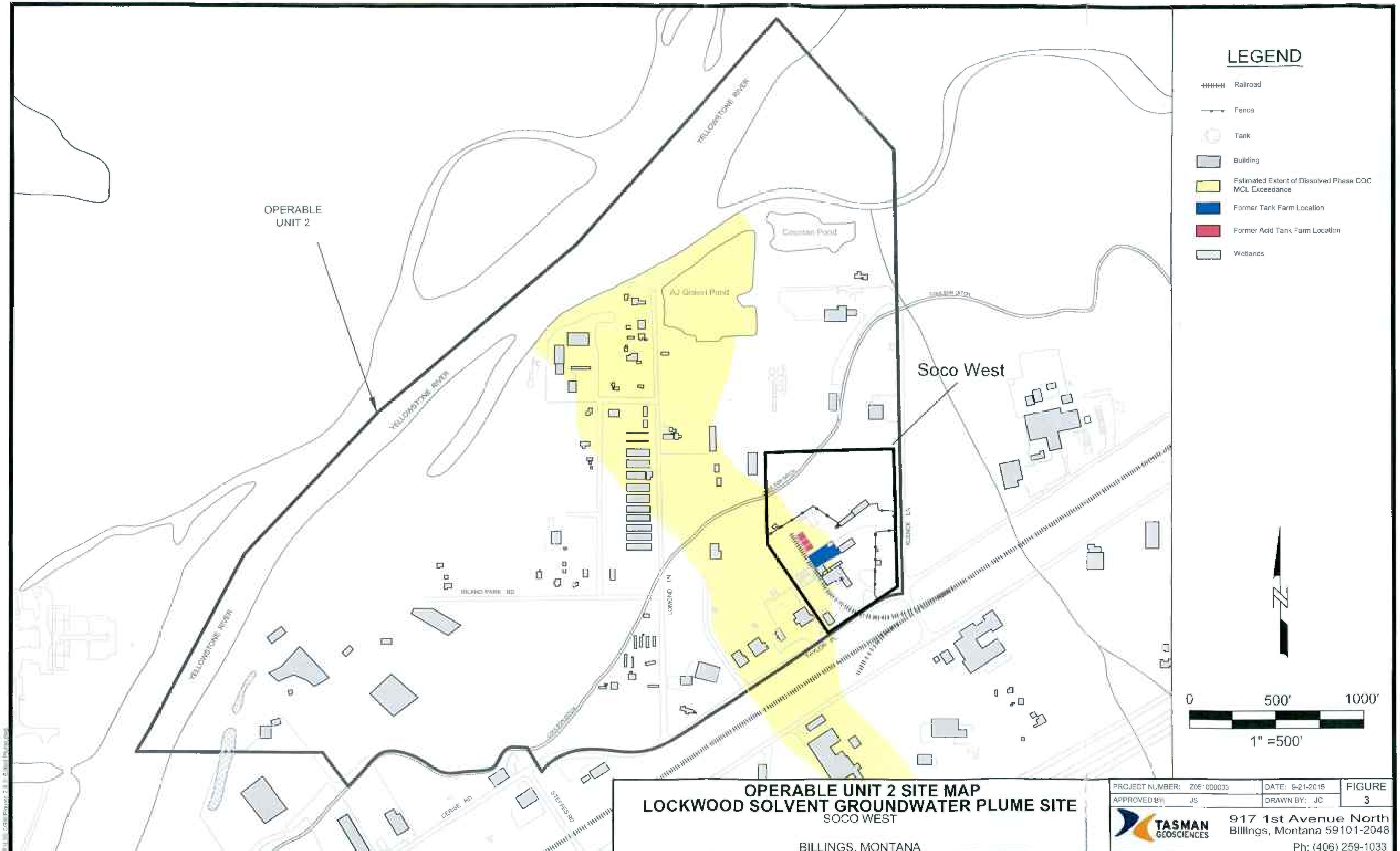



# OPERABLE UNIT 1 SITE MAP
## LOCKWOOD SOLVENT GROUNDWATER PLUME SITE
Former Beall Trailers

BILLINGS, MONTANA

| | | | |
|---|---|---|---|
| PROJECT NUMBER: | Z051000003 | DATE: 9-21-2015 | FIGURE |
| APPROVED BY: | JS | DRAWN BY: JC | 2 |

TASMAN GEOSCIENCES
917 1st Avenue North
Billings, Montana 59101-2048
Ph: (406) 259-1033

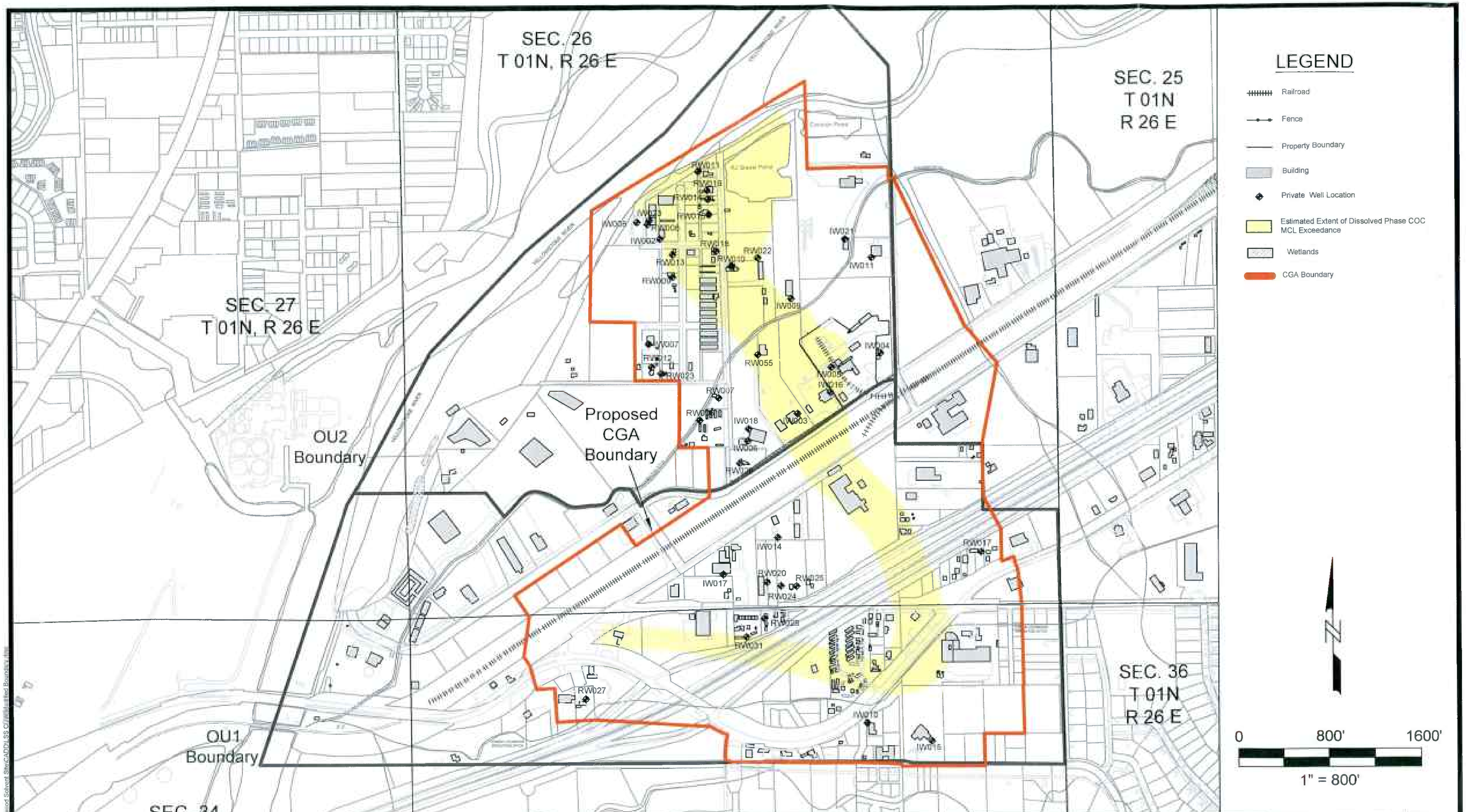



**OPERABLE UNIT 2 SITE MAP**
**LOCKWOOD SOLVENT GROUNDWATER PLUME SITE**
SOCO WEST

BILLINGS, MONTANA

| | | |
|---|---|---|
| PROJECT NUMBER: Z051000003 | DATE: 9-21-2015 | FIGURE |
| APPROVED BY: JS | DRAWN BY: JC | 3 |

TASMAN GEOSCIENCES
917 1st Avenue North
Billings, Montana 59101-2048
Ph: (406) 259-1033

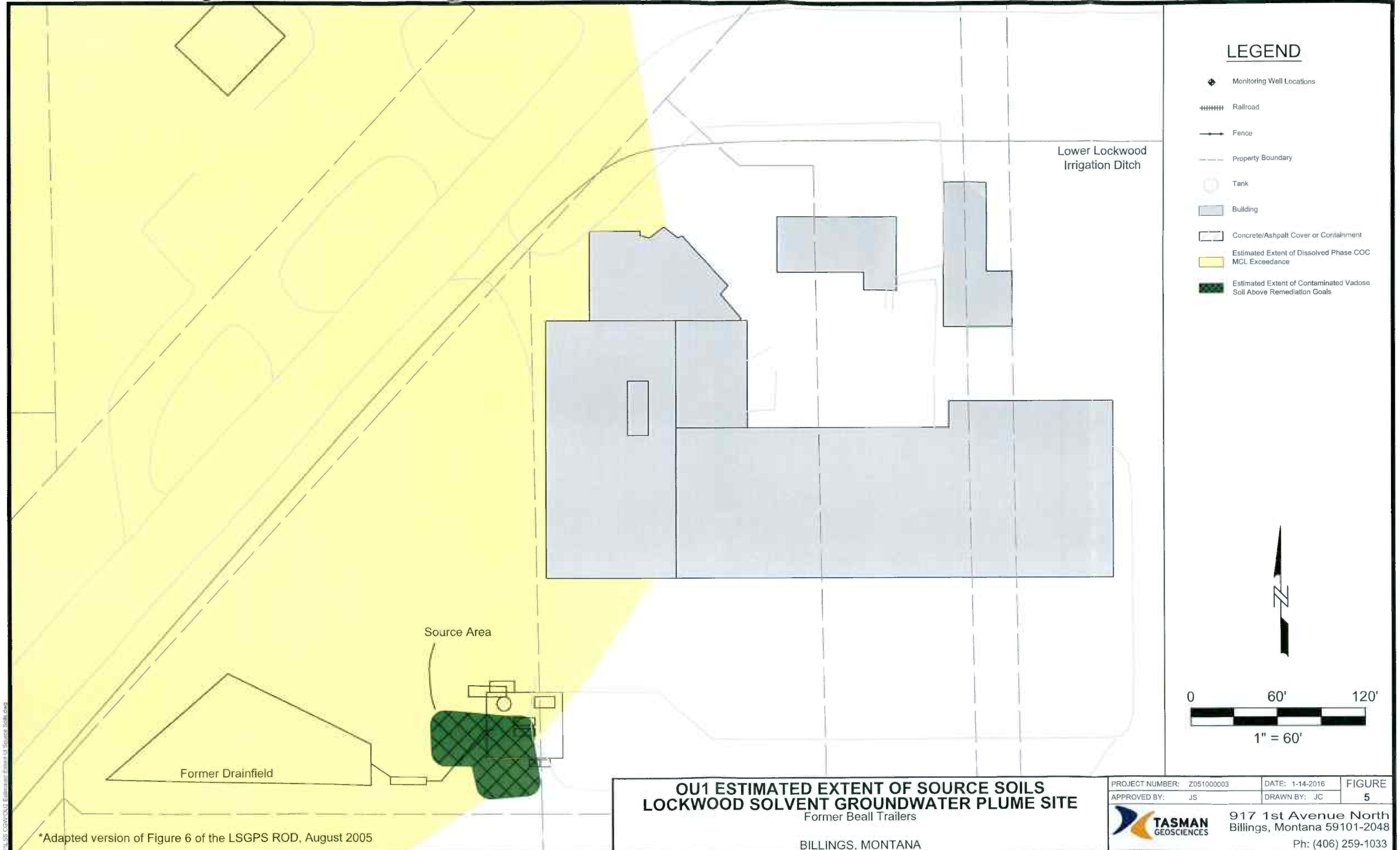



PROPOSED CGA BOUNDARY AND EXISTING WELLS
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

BILLINGS, MONTANA

| PROJECT NUMBER: Z051000003 | DATE: 11/16/16 | FIGURE |
|---|---|---|
| APPROVED BY: JS | DRAWN BY: JC | 4 |

TASMAN GEOSCIENCES
917 1st Avenue North
Billings, Montana 59101-2048
Ph: (406) 259-1033




# OU1 ESTIMATED EXTENT OF SOURCE SOILS
# LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

Former Beall Trailers

BILLINGS, MONTANA

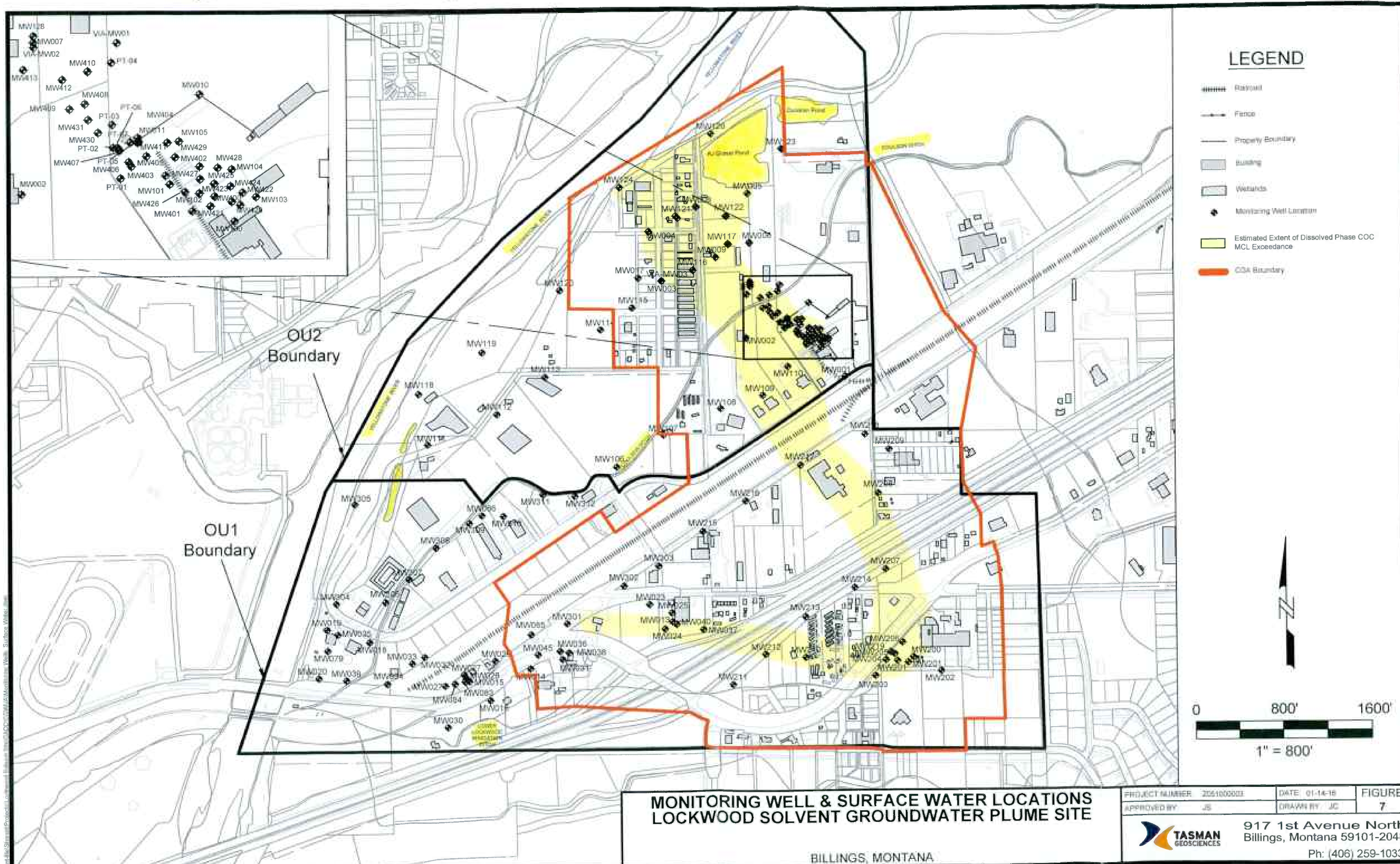
| | | |
|---|---|---|
| PROJECT NUMBER: Z051000003 | DATE: 1-14-2016 | FIGURE 5 |
| APPROVED BY: JS | DRAWN BY: JC | |

TASMAN GEOSCIENCES

917 1st Avenue North
Billings, Montana 59101-2048
Ph: (406) 259-1033


**OU2 ESTIMATED EXTENT OF SOURCE SOILS**
**LOCKWOOD SOLVENT GROUNDWATER PLUME SITE**
SOCO WEST

BILLINGS, MONTANA

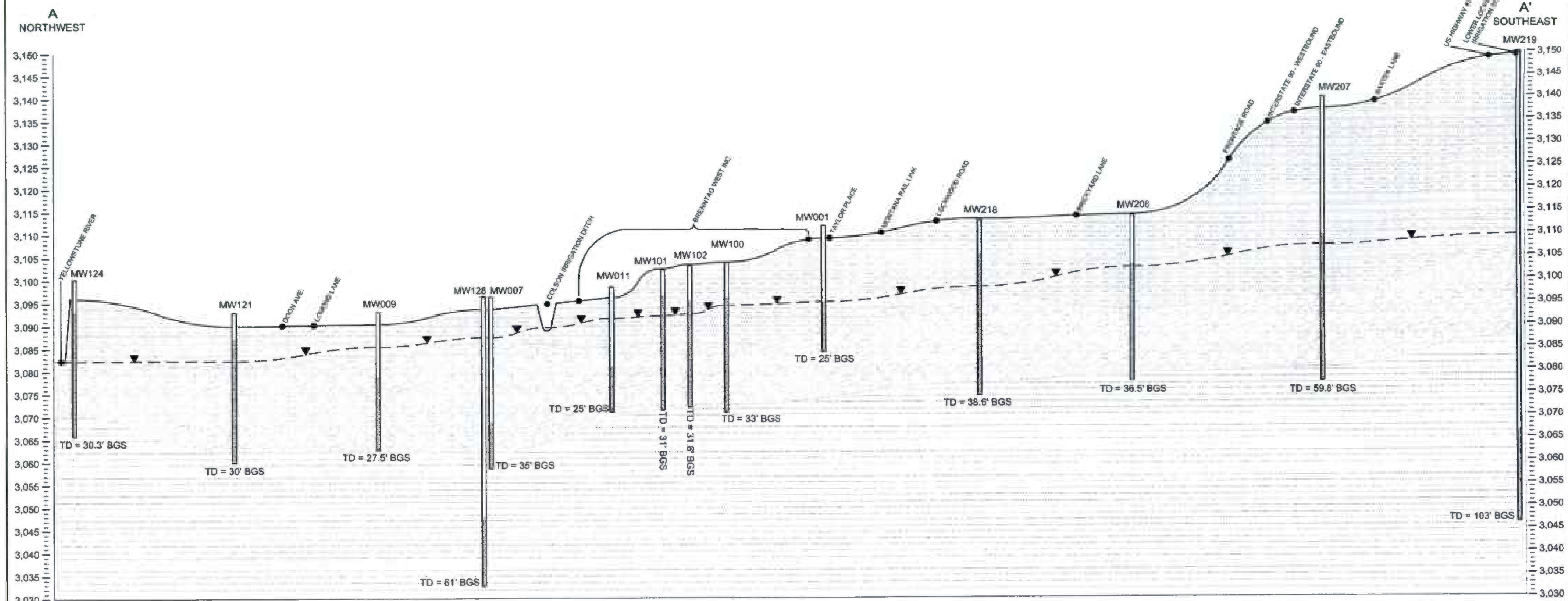



**MONITORING WELL & SURFACE WATER LOCATIONS**
**LOCKWOOD SOLVENT GROUNDWATER PLUME SITE**

BILLINGS, MONTANA

| PROJECT NUMBER | DATE | FIGURE |
|---|---|---|
| APPROVED BY: JS | DRAWN BY: JC | 7 |

TASMAN GEOSCIENCES
917 1st Avenue North
Billings, Montana 59101-2048
Ph: (406) 259-1033

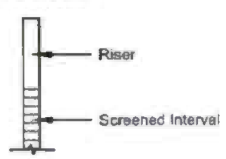



Legend

| | | |
|---|---|---|
| MW | - | Monitoring Well Locations |
| TD | - | Total Depth |
| BGS | - | Below Ground Surface |
| ▼ | - | Groundwater Level |
| | - | Silty Clay / Silt / Fine Sand |
| | - | Gravels With Sand |
| | - | Bedrock |

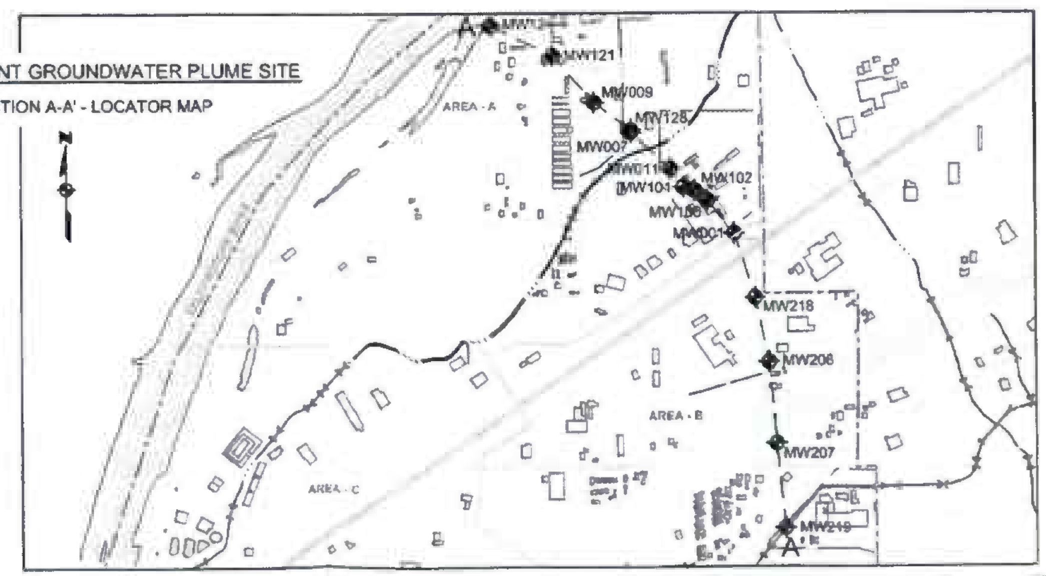
Elevations Listed In Feet Above Mean Sea Level

Well Detail




LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

CROSS SECTION A-A' - LOCATOR MAP




325 0 325 650

SCALE IN FEET - 1 inch = 325 feet
VERTICAL SCALE EXAGGERATED 15X

Source: Remedial Investigation Report, Tetra Tech E<, Inc. June 2003

# GEOLOGIC CROSS-SECTION
# LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

BILLINGS, MONTANA

| | | |
|---|---|---|
| PROJECT NUMBER: Z051000003 | DATE: 10-21-2015 | FIGURE |
| APPROVED BY: JS | DRAWN BY: JC | 8 |


TASMAN GEOSCIENCES
917 1st Avenue North
Billings, Montana 59101-2048
Ph: (406) 259-1033

# APPENDIX A

# ALLUVIAL AQUIFER WATER LEVEL FIGURES

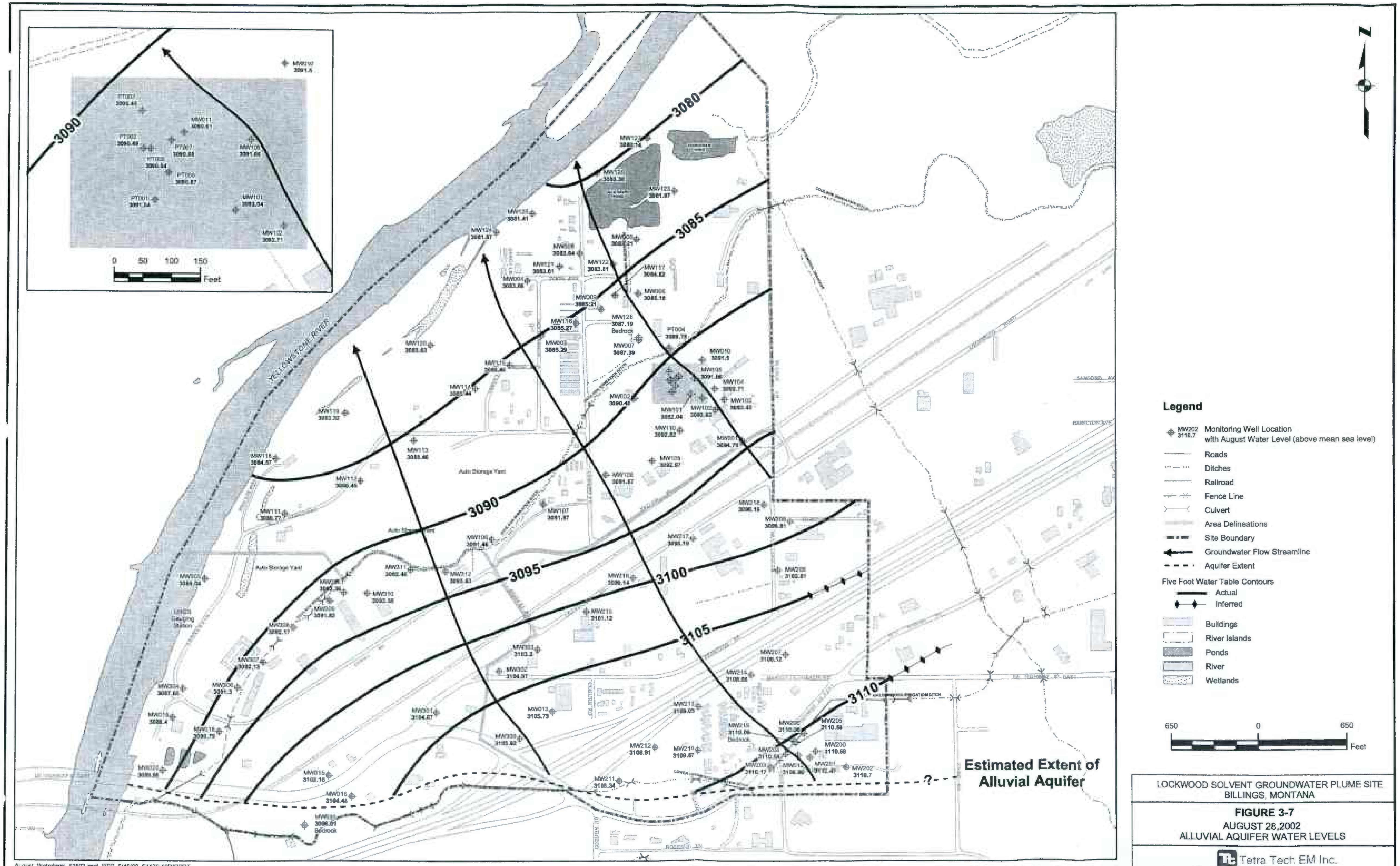
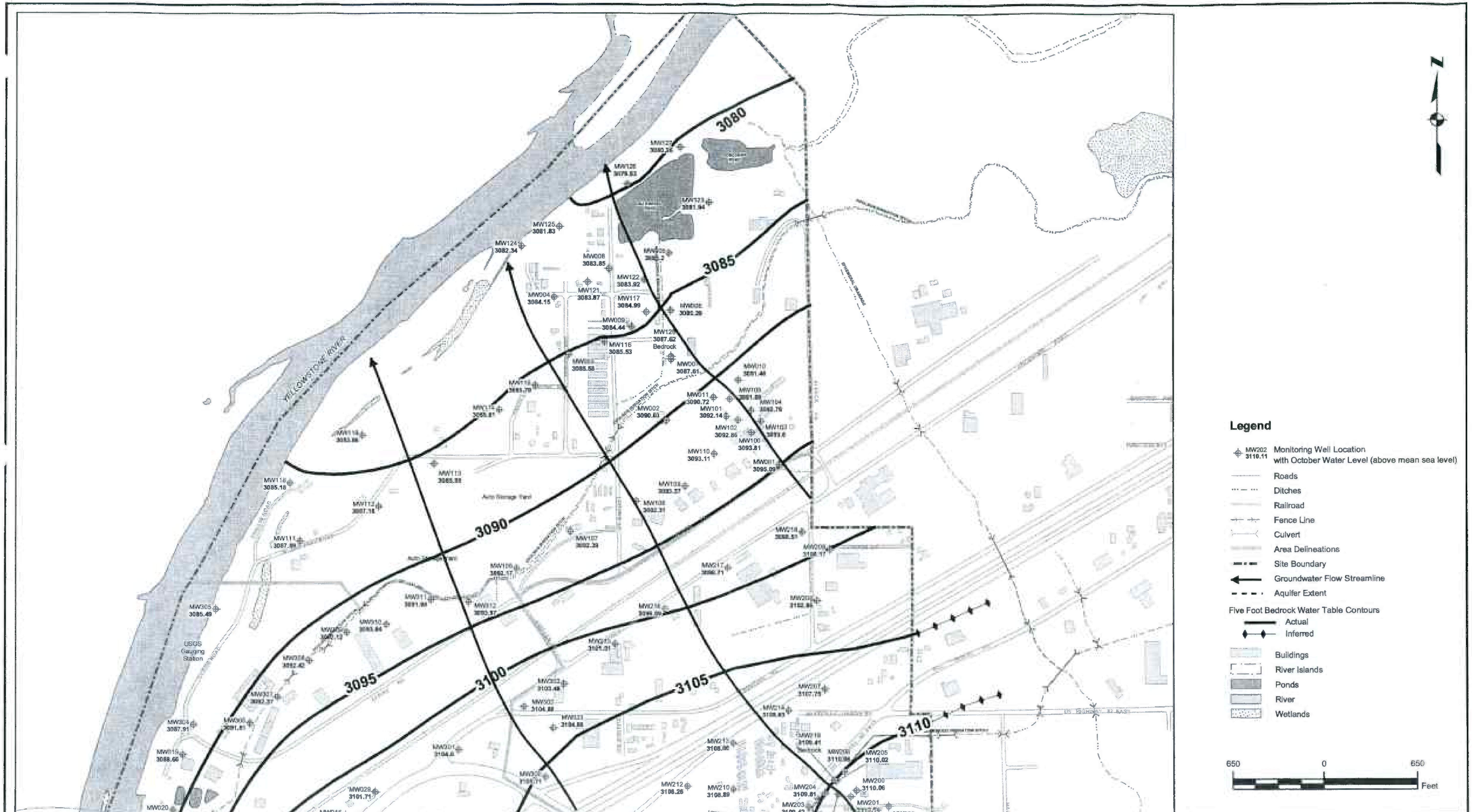


FIGURE 3-7
AUGUST 28,2002
ALLUVIAL AQUIFER WATER LEVELS




LOCKWOOD SOLVENT GROUNDWATER PLUME SITE
BILLINGS, MONTANA

**FIGURE 3-8**
OCTOBER 28, 2002
ALLUVIAL AQUIFER WATER LEVELS

Tetra Tech EM Inc.

October_Waterlevel_051503.mxd RSR 5/15/03 S1176-10RIRPRT

# APPENDIX B

# CALCULATED FIXED RADIUS MODEL FOR OU1 AND MODELER'S RESUME

# Calculated Fixed Radius (CFR) Method

$$r = \text{SQRT}\,(\,Q\,t\ /\ 7.48\,\pi\,n\,H)$$

Where:

| | |
|---|---|
| r | Radius of the Zones (1,2,3) measured from the well (feet) |
| Q | Annual average pumping rate (gallons per year) |
| *t* | Time-of-Travel (TOT); Typically 1, 5, 10 years per Zones 1, 2, 3 |
| n | Porosity of aquifer, estimated (percent) |
| H | Screened interval of well (feet) |
| $\pi$ | pi ~ 3.1416 ... |
| 7.48 | Conversion factor for gallons to cubic feet |

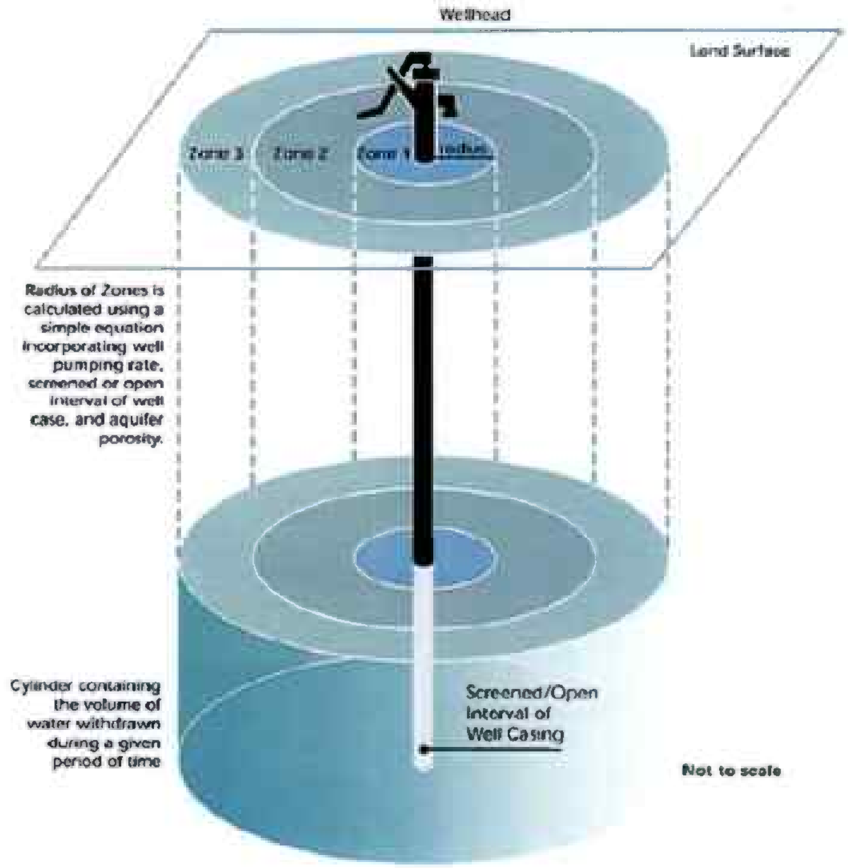
## MT Pumping Criteria

Total Volume Not to Exeed (NTE)

**10 acre-feet per year**

3,258,514 gallons per year

**Q-MAX** **35 gpm**




$$r = \sqrt{\frac{Q\,t}{\pi\,n\,H}}$$

Where:
Q = Pumping Rate of Well (cubic feet per year)
n = Aquifer Porosity = 0.22
H = Open Interval or Length of Well Screen
t = Travel Time to Well (1, 5, 10 years)

NTE Total Volume 10 **acre-feet per year** $t$ = 1 year

3,258,514 gallons per year

Q-MAX per Well 35 gallons per minute (gpm)

| | r | Q | Q | t | n | H | Total Volume Pumped minus Yearly Limit of 10 acre-ft/yr | Operational Days (full time) to meet NTE Total Volume |
|---|---|---|---|---|---|---|---|---|
| | feet | gpm | gal/year | years | porosity | feet | | |
| | ***59.8*** | 1 | 525,600 | 1 | 0.25 | 25 | (2,732,914) | 2,263 |
| | ***84.6*** | 2 | 1,051,200 | 1 | 0.25 | 25 | (2,207,314) | 1,131 |
| | ***103.6*** | 3 | 1,576,800 | 1 | 0.25 | 25 | (1,681,714) | 754 |
| | ***119.6*** | 4 | 2,102,400 | 1 | 0.25 | 25 | (1,156,114) | 566 |
| | ***133.8*** | 5 | 2,628,000 | 1 | 0.25 | 25 | (630,514) | 453 |
| Vol. Exceec | ***146.5*** | 6 | 3,153,600 | 1 | 0.25 | 25 | (104,914) | 377 |
| Vol. Exceec | ***158.3*** | 7 | 3,679,200 | 1 | 0.25 | 25 | 420,686 | 323 |
| | ***169.2*** | 8 | 4,204,800 | 1 | 0.25 | 25 | 946,286 | 283 |
| | ***179.5*** | 9 | 4,730,400 | 1 | 0.25 | 25 | 1,471,886 | 251 |
| | ***189.2*** | 10 | 5,256,000 | 1 | 0.25 | 25 | 1,997,486 | 226 |
| | ***198.4*** | 11 | 5,781,600 | 1 | 0.25 | 25 | 2,523,086 | 206 |
| | ***207.2*** | 12 | 6,307,200 | 1 | 0.25 | 25 | 3,048,686 | 189 |
| | ***215.7*** | 13 | 6,832,800 | 1 | 0.25 | 25 | 3,574,286 | 174 |
| | ***223.8*** | 14 | 7,358,400 | 1 | 0.25 | 25 | 4,099,886 | 162 |
| | ***231.7*** | 15 | 7,884,000 | 1 | 0.25 | 25 | 4,625,486 | 151 |
| | ***239.3*** | 16 | 8,409,600 | 1 | 0.25 | 25 | 5,151,086 | 141 |
| | ***246.7*** | 17 | 8,935,200 | 1 | 0.25 | 25 | 5,676,686 | 133 |
| | ***253.8*** | 18 | 9,460,800 | 1 | 0.25 | 25 | 6,202,286 | 126 |
| | ***260.8*** | 19 | 9,986,400 | 1 | 0.25 | 25 | 6,727,886 | 119 |
| | ***267.5*** | 20 | 10,512,000 | 1 | 0.25 | 25 | 7,253,486 | 113 |
| | ***274.1*** | 21 | 11,037,600 | 1 | 0.25 | 25 | 7,779,086 | 108 |
| | ***280.6*** | 22 | 11,563,200 | 1 | 0.25 | 25 | 8,304,686 | 103 |
| | ***286.9*** | 23 | 12,088,800 | 1 | 0.25 | 25 | 8,830,286 | 98 |
| | ***293.1*** | 24 | 12,614,400 | 1 | 0.25 | 25 | 9,355,886 | 94 |
| | ***299.1*** | 25 | 13,140,000 | 1 | 0.25 | 25 | 9,881,486 | 91 |
| | ***305.0*** | 26 | 13,665,600 | 1 | 0.25 | 25 | 10,407,086 | 87 |
| | ***310.8*** | 27 | 14,191,200 | 1 | 0.25 | 25 | 10,932,686 | 84 |
| | ***316.5*** | 28 | 14,716,800 | 1 | 0.25 | 25 | 11,458,286 | 81 |
| | ***322.2*** | 29 | 15,242,400 | 1 | 0.25 | 25 | 11,983,886 | 78 |
| | ***327.7*** | 30 | 15,768,000 | 1 | 0.25 | 25 | 12,509,486 | 75 |
| | ***333.1*** | 31 | 16,293,600 | 1 | 0.25 | 25 | 13,035,086 | 73 |
| | ***338.4*** | 32 | 16,819,200 | 1 | 0.25 | 25 | 13,560,686 | 71 |
| | ***343.7*** | 33 | 17,344,800 | 1 | 0.25 | 25 | 14,086,286 | 69 |
| | ***348.8*** | 34 | 17,870,400 | 1 | 0.25 | 25 | 14,611,886 | 67 |
| Q-MAX | ***353.9*** | **35** | 18,396,000 | 1 | 0.25 | 25 | 15,137,486 | 65 |

NTE Total Volume **10 acre-feet per year** *t* = 5 years

3,258,514 gallons per year

Q-MAX per Well 35 gallons per minute (gpm)

| | **r** | **Q** | **Q** | ***t*** | **n** | **H** | **Total Volume Pumped minus Yearly Limit of 10 acre-ft/yr** | **Operational Days (full time) to meet NTE Total Volume** |
|---|---|---|---|---|---|---|---|---|
| | feet | gpm | gal/year | years | porosity | feet | | |
| | ***133.8*** | 1 | 525,600 | 5 | 0.25 | 25 | (13,664,570) | 11,314 |
| | ***189.2*** | 2 | 1,051,200 | 5 | 0.25 | 25 | (11,036,570) | 5,657 |
| | ***231.7*** | 3 | 1,576,800 | 5 | 0.25 | 25 | (8,408,570) | 3,771 |
| | ***267.5*** | 4 | 2,102,400 | 5 | 0.25 | 25 | (5,780,570) | 2,829 |
| | ***299.1*** | 5 | 2,628,000 | 5 | 0.25 | 25 | (3,152,570) | 2,263 |
| Vol. Exceec | ***327.7*** | 6 | 3,153,600 | 5 | 0.25 | 25 | (524,570) | 1,886 |
| Vol. Exceec | ***353.9*** | 7 | 3,679,200 | 5 | 0.25 | 25 | 2,103,430 | 1,616 |
| | ***378.3*** | 8 | 4,204,800 | 5 | 0.25 | 25 | 4,731,430 | 1,414 |
| | ***401.3*** | 9 | 4,730,400 | 5 | 0.25 | 25 | 7,359,430 | 1,257 |
| | ***423.0*** | 10 | 5,256,000 | 5 | 0.25 | 25 | 9,987,430 | 1,131 |
| | ***443.7*** | 11 | 5,781,600 | 5 | 0.25 | 25 | 12,615,430 | 1,029 |
| | ***463.4*** | 12 | 6,307,200 | 5 | 0.25 | 25 | 15,243,430 | 943 |
| | ***482.3*** | 13 | 6,832,800 | 5 | 0.25 | 25 | 17,871,430 | 870 |
| | ***500.5*** | 14 | 7,358,400 | 5 | 0.25 | 25 | 20,499,430 | 808 |
| | ***518.1*** | 15 | 7,884,000 | 5 | 0.25 | 25 | 23,127,430 | 754 |
| | ***535.1*** | 16 | 8,409,600 | 5 | 0.25 | 25 | 25,755,430 | 707 |
| | ***551.5*** | 17 | 8,935,200 | 5 | 0.25 | 25 | 28,383,430 | 666 |
| | ***567.5*** | 18 | 9,460,800 | 5 | 0.25 | 25 | 31,011,430 | 629 |
| | ***583.1*** | 19 | 9,986,400 | 5 | 0.25 | 25 | 33,639,430 | 595 |
| | ***598.2*** | 20 | 10,512,000 | 5 | 0.25 | 25 | 36,267,430 | 566 |
| | ***613.0*** | 21 | 11,037,600 | 5 | 0.25 | 25 | 38,895,430 | 539 |
| | ***627.4*** | 22 | 11,563,200 | 5 | 0.25 | 25 | 41,523,430 | 514 |
| | ***641.5*** | 23 | 12,088,800 | 5 | 0.25 | 25 | 44,151,430 | 492 |
| | ***655.3*** | 24 | 12,614,400 | 5 | 0.25 | 25 | 46,779,430 | 471 |
| | ***668.8*** | 25 | 13,140,000 | 5 | 0.25 | 25 | 49,407,430 | 453 |
| | ***682.1*** | 26 | 13,665,600 | 5 | 0.25 | 25 | 52,035,430 | 435 |
| | ***695.1*** | 27 | 14,191,200 | 5 | 0.25 | 25 | 54,663,430 | 419 |
| | ***707.8*** | 28 | 14,716,800 | 5 | 0.25 | 25 | 57,291,430 | 404 |
| | ***720.4*** | 29 | 15,242,400 | 5 | 0.25 | 25 | 59,919,430 | 390 |
| | ***732.7*** | 30 | 15,768,000 | 5 | 0.25 | 25 | 62,547,430 | 377 |
| | ***744.8*** | 31 | 16,293,600 | 5 | 0.25 | 25 | 65,175,430 | 365 |
| | ***756.7*** | 32 | 16,819,200 | 5 | 0.25 | 25 | 67,803,430 | 354 |
| | ***768.4*** | 33 | 17,344,800 | 5 | 0.25 | 25 | 70,431,430 | 343 |
| | ***780.0*** | 34 | 17,870,400 | 5 | 0.25 | 25 | 73,059,430 | 333 |
| Q-MAX | ***791.4*** | **35** | 18,396,000 | 5 | 0.25 | 25 | 75,687,430 | 323 |

| | | | |
|---|---|---|---|
| **NTE Total Volume** | **10 acre-feet per year** | | *t* = 10 years |
| | 3,258,514 gallons per year | | |
| **Q-MAX per Well** | 35 gallons per minute (gpm) | | |

| | r | Q | Q | t | n | H | Total Volume Pumped minus Yearly Limit of 10 acre-ft/yr | Operational Days (full time) to meet NTE Total Volume |
|---|---|---|---|---|---|---|---|---|
| | feet | gpm | gal/year | years | porosity | feet | | |
| | ***189.2*** | 1 | 525,600 | 10 | 0.25 | 25 | (27,329,140) | 22,629 |
| | ***267.5*** | 2 | 1,051,200 | 10 | 0.25 | 25 | (22,073,140) | 11,314 |
| | ***327.7*** | 3 | 1,576,800 | 10 | 0.25 | 25 | (16,817,140) | 7,543 |
| | ***378.3*** | 4 | 2,102,400 | 10 | 0.25 | 25 | (11,561,140) | 5,657 |
| | ***423.0*** | 5 | 2,628,000 | 10 | 0.25 | 25 | (6,305,140) | 4,526 |
| Vol. Exceed | ***463.4*** | 6 | 3,153,600 | 10 | 0.25 | 25 | (1,049,140) | 3,771 |
| Vol. Exceed | ***500.5*** | 7 | 3,679,200 | 10 | 0.25 | 25 | 4,206,860 | 3,233 |
| | ***535.1*** | 8 | 4,204,800 | 10 | 0.25 | 25 | 9,462,860 | 2,829 |
| | ***567.5*** | 9 | 4,730,400 | 10 | 0.25 | 25 | 14,718,860 | 2,514 |
| | ***598.2*** | 10 | 5,256,000 | 10 | 0.25 | 25 | 19,974,860 | 2,263 |
| | ***627.4*** | 11 | 5,781,600 | 10 | 0.25 | 25 | 25,230,860 | 2,057 |
| | ***655.3*** | 12 | 6,307,200 | 10 | 0.25 | 25 | 30,486,860 | 1,886 |
| | ***682.1*** | 13 | 6,832,800 | 10 | 0.25 | 25 | 35,742,860 | 1,741 |
| | ***707.8*** | 14 | 7,358,400 | 10 | 0.25 | 25 | 40,998,860 | 1,616 |
| | ***732.7*** | 15 | 7,884,000 | 10 | 0.25 | 25 | 46,254,860 | 1,509 |
| | ***756.7*** | 16 | 8,409,600 | 10 | 0.25 | 25 | 51,510,860 | 1,414 |
| | ***780.0*** | 17 | 8,935,200 | 10 | 0.25 | 25 | 56,766,860 | 1,331 |
| | ***802.6*** | 18 | 9,460,800 | 10 | 0.25 | 25 | 62,022,860 | 1,257 |
| | ***824.6*** | 19 | 9,986,400 | 10 | 0.25 | 25 | 67,278,860 | 1,191 |
| | ***846.0*** | 20 | 10,512,000 | 10 | 0.25 | 25 | 72,534,860 | 1,131 |
| | ***866.9*** | 21 | 11,037,600 | 10 | 0.25 | 25 | 77,790,860 | 1,078 |
| | ***887.3*** | 22 | 11,563,200 | 10 | 0.25 | 25 | 83,046,860 | 1,029 |
| | ***907.2*** | 23 | 12,088,800 | 10 | 0.25 | 25 | 88,302,860 | 984 |
| | ***926.8*** | 24 | 12,614,400 | 10 | 0.25 | 25 | 93,558,860 | 943 |
| | ***945.9*** | 25 | 13,140,000 | 10 | 0.25 | 25 | 98,814,860 | 905 |
| | ***964.6*** | 26 | 13,665,600 | 10 | 0.25 | 25 | 104,070,860 | 870 |
| | ***983.0*** | 27 | 14,191,200 | 10 | 0.25 | 25 | 109,326,860 | 838 |
| | ***1001.0*** | 28 | 14,716,800 | 10 | 0.25 | 25 | 114,582,860 | 808 |
| | ***1018.7*** | 29 | 15,242,400 | 10 | 0.25 | 25 | 119,838,860 | 780 |
| | ***1036.1*** | 30 | 15,768,000 | 10 | 0.25 | 25 | 125,094,860 | 754 |
| | ***1053.3*** | 31 | 16,293,600 | 10 | 0.25 | 25 | 130,350,860 | 730 |
| | ***1070.1*** | 32 | 16,819,200 | 10 | 0.25 | 25 | 135,606,860 | 707 |
| | ***1086.7*** | 33 | 17,344,800 | 10 | 0.25 | 25 | 140,862,860 | 686 |
| | ***1103.1*** | 34 | 17,870,400 | 10 | 0.25 | 25 | 146,118,860 | 666 |
| Q-MAX | ***1119.2*** | **35** | 18,396,000 | 10 | 0.25 | 25 | 151,374,860 | 647 |

## PROJECT SUMMARY

**Bruce D. Peterman, PE, PG, MCSE, PMP**
1262 Cedar Street
Broomfield, Colorado 80020
Home: 303 466-3799    Cell: 303 349-9004
bdpeterman@gmail.com

**Professional Summary**

Mr. Peterman currently serves as a Senior Environmental Engineer and Chief Information Officer for Pacific Western Technologies, Ltd., in Lakewood, Colorado. He is a registered Professional Engineer in Colorado, a Microsoft Certified Systems Engineer, Certified Project Management Professional, and Professional Geologist with 20 years of professional experience. His experience includes managing information technology, computer network systems, physical security systems, geological engineering, geotechnical, mining, and environmental related projects. His formal background is in geological engineering, hydrogeology, geographical information systems, database development, and computer network systems.

Mr. Peterman has managed many projects involving investigation and remediation of hazardous, radioactive, and toxic waste sites. He has implemented projects and programs that include superfund RCRA/CERCLA regulations, underground storage tank investigations, hydrogeologic characterization, ground-water remediation, mineral exploration, mine closure design, contaminant fate and transport modeling, analytical sampling, monitoring and recovery well installations, remedial system design and installation, and report preparation.

**Projects**

- ✓ **Environmental Project Oversight and Engineering Design Review; Environmental Protection Agency, Region 8, Denver, Colorado; Pacific Western Technologies, Ltd.; Senior Environmental Engineer.** Provide engineering support, design reviews, field supervision, and construction oversight for EPA Region 8 on environmental remediation projects in Colorado, Montana, and Utah. Develop responses to public comments on Proposed Plans for EPA Superfund sites as well as support subsequent development of Record of Decision documents. Perform technical document reviews on behalf of EPA for investigation and remediation projects where work is being performed by the PRPs. Coordinate field construction oversight for EPA of hazardous waste removals and engineered waste placement or treatment facilities.
- ✓ **Information Technology, Environmental Engineering, Project Management; Various Clients; Pacific Western Technologies, Ltd.; Chief Information Officer / Project Manager.** Manage projects for a variety of clients with services in environmental, engineering, geotechnical, information systems, database management, and geographical information systems. Manage corporate Information Technology (IT) assets, network infrastructure, operations, technical staff, and outside vendors. Design, implement, and support resources for corporate headquarters IT needs and operational support of new business ventures in both environmental engineering and information systems. Install, test, and approve new computer systems, network hardware, server upgrades, and software.
- ✓ **Environmental Project Oversight and Construction Review; Ogden Rail Yard Site, Ogden, Utah; Environmental Protection Agency, Region 8; Project Engineer.** Provide Remedial Action (RA) oversight at the Ogden Rail Yard site, an active railroad facility comprising 1,120 acres in an area roughly 3.5 miles long and one-half mile wide that stretches along the Weber River. The primary contaminants are sediments contaminated with DNAPL polynuclear aromatic hydrocarbons, and ground water plumes characterized by fuels, solvents, and solvent degradation products as a result from operation of a former gas plant, locomotive maintenance, and machine shop facilities. Provide oversight for EPA of the PRP's construction and implementation of the RA at the Ogden Rail Yard site, including construction of a cofferdam and cover, sampling and removal of the industrial sewer lines, and extraction of DNAPL, and other RA activities. Review all versions of the PRP contractor's construction completion report (CCR), provide briefings to EPA, the PRP, and the PRP's consultant

on the anticipated content of the CCR, review other technical memoranda, letter reports, and work-related reports prepared by the PRP.

- ✓ **Environmental Project Oversight and Engineering Design Review; Rocky Mountain Arsenal Remedial Design/Remedial Action (RD/RA) Oversight Contract, Commerce City, Colorado; EPA Region 8; Environmental Scientist.** Provide daily inspections of field construction and remediation activities to support the EPA for ongoing environmental remediation projects at the RMA Superfund Site. Field inspections are documented in daily reports as well as by photographic and video documentation. Project oversight includes monitoring excavation and waste removal activities, waste placement at onsite landfills, construction activities of RCRA equivalent covers. Site specific projects include the Basin F Waste Pile removal, construction of Shell Disposal Trenches cover and Integrated Cover System, HWL cover, ELF waste placement operations, Sand Creek Lateral soils removal, and general oversight of primary fieldwork at RMA.

- ✓ **Information Technology, Datacenter, Alarm Center, Security Systems; Department of Homeland Security – Federal Protective Service, Lakewood, Colorado; Senior Systems Administrator.** Successfully managed the computer datacenter and support systems for the Denver MegaCenter (DMC) operated by the Department of Homeland Security – Federal Protective Service. The DMC is a 24/7 mission critical central security alarm monitoring and federal police dispatch facility responsible for physical security at government owned and leased buildings throughout 19 western states and supporting a federal police force of 400 officers and 12,000 contract guards. Collaborated with three other national MegaCenters in the design of new network systems supporting agency transition and integration into the Department of Homeland Security. Researched, recommended, and performed equipment upgrades to improve operations of dispatching and the technical support helpdesk. Operated networks on Microsoft and Novell client/server systems supporting about 65 personnel on LAN platforms and connections to WAN platforms to other sister MegaCenters. Maintained database servers that support police dispatching functions, facility locations, security alarm systems, criminal background information, and technical support helpdesk operations.

- ✓ **Waste Chemical Classification, Assessment, and Disposal; Rocky Flats Environmental Technology Site, Golden, Colorado; Kaiser-Hill, LLC; Project Coordinator.** Consulting project management services to Kaiser-Hill, LLC for their Waste Chemical Program. Reported to the director of Kaiser-Hill's Waste Chemical Program and supported the director in the daily and programmatic issues of the project. The Waste Chemical Program (WCP) is a program operated by Kaiser-Hill, which supports the U.S. Department of Energy at the Rocky Flats Environmental Technology Site, in Golden, CO. The WCP provides an integrated site-wide approach for the management, collection, and disposal of waste chemicals throughout the site. The WCP effort is a $27 million program that started in 1997 and was completed by the end of 1999. The WCP involved collection of non-RCRA, RCRA, low-level, and low-level mixed radioactive wastes. Mr. Peterman provided services for cost estimating, procurement strategies, and negotiations with waste services, project technical review, site field services, and field screening equipment monitoring and operations.

- ✓ **Ground Water Extraction and Treatment System Design; Branchburg, New Jersey; Viacom International, Inc. and Taylor Forge Stainless; Project Manager.** Managed and designed a ground water extraction and soil remediation system for recovery of spent chlorinated solvents. The scope of the system was estimated at $1.5 to $2 million for installation and 1 year of operation. Completed the design and planning documentation that was submitted for technical review by the New Jersey Department of Environmental Protection. Completed costs estimates and setup equipment orders for use during system construction. Direct interface with the client providing technical and business decision services for this site.

- ✓ **Installation of Solvent Vapor Removal System; Denver, Colorado; Colorado Department of Transportation (CDOT); Project Manager.** Independent Consultant to CDOT headquarters in south Denver. Responsible for completion and installation of solvent vapor removal system for remediation of single family homes affected by solvent contaminated ground water from CDOT's materials Testing Laboratory. Worked independently with homeowners and CDOT personnel to install the systems. The systems removed solvent vapors that would build up in the home and affect indoor air quality and consequently the health of the residents. Provided the client with technical guidance and research for the installation of systems. Also, completed reports documenting the system installations and operation effectiveness. Additionally, managed project design of air handling systems for apartment buildings that were also affected by the solvents. The air handling systems were designed for central HVAC retrofits that would provide positive pressure and air removal to reduce indoor air solvent concentrations. The project was designed as a contingency to augment active soil vapor removal systems that were to be installed beneath the apartment buildings.

✓ **Industrial Area Operable Units Remedial Investigations; Rocky Flats Environmental Technology Site, Golden, Colorado; EG&G Rocky Flats, Inc. Program Manager.** Program Manager for development and integration of the technical and project management aspect of all Industrial Area OUs and presenting proposals to U.S. Department of Energy (DOE) for final concurrence. Implementation of the investigation of the Industrial Area OUs resulted in the collection of samples for confirmation of contamination and risk-based ranking. The comprehensive field program included investigation and characterization of six operable units which consisted of 207 Individual Hazardous Substance Sites. The field effort resulted in collecting 891 surface soil, 1480 soil gas, 33 asphalt, and 122 sediment samples. Also, tank and pipeline investigation and characterization were performed. Abandoned tanks and pipelines were sampled and over 40 boreholes were drilled around the old process waste system. Seventy-five percent of the tank work was performed in modified Level B PPE and many of the samples were highly radiologically contaminated that new procedures were developed to deliver and analyze the samples. Developed approaches which resulted in a consolidated plan to implement work for the Industrial Area OUs which led a cost productivity savings of $3.2 million.

✓ **Interim Measures / Interim Remedial Action Decision Document; Rocky Flats Plant, Golden, Colorado; EG&G Rocky Flats, Inc.; Project Manager.** Successfully completed an expedited Interim Measure/Interim Remedial Action (IM/IRA) Decision Document. Development of the IM/IRA was in support of OU 4 Pondcrete Low-Level Waste activities as part of a RCRA partial closure process. The IM/IRA was the definitive document to provide the regulatory permit and use of equipment and processes to facilitate waste removal from the solar ponds. Approval of the IM/IRA required extensive regulatory review, public comment period, and responsiveness summary. The completion of the final IM/IRA in April, 1992 exceeded the expectations of DOE/RFO, EG&G, and the regulators. The project was completed with minimal budget (approximately $50K) and facilitated the installation of equipment totaling approximately $5 million to proceed on schedule for the pondcrete efforts.

✓ **Environmental Investigation; Oxnard High Precision Stainless Steel Forge Facility, Oxnard California; EG&G Rocky Flats, Inc.; Project Manager.** Completed data analysis of the Oxnard environmental investigation and assessment. Provided reports to DOE Field Office and DOE Headquarters, Project Tracking Report updates, development of Activity Data Sheets, and preparation of the EM-40 Baseline to support Major System Acquisition requirements. Successfully maintained and developed baseline schedules and cost estimates to support DOE's 5-years plan.

✓ **RCRA Facility Investigation / Remedial Investigation Work Plan Operable Unit No. 8 – 700 Area; Rocky Flats Plant, Golden Colorado; EG&G Rocky Flats, Inc.; Project Manager.** Successfully developed and procured a subcontract for preparation of the Phase I RFI/RI Work Plan. The OU 8 Work Plan involved investigation under RCRA and CERCLA. The Final Work Plan was delivered ahead of schedule in November 1992. Established the baseline schedule and cost estimate for implementation of the Phase I RFI/RI Work Plan. Consistently identified areas where scope, cost, and schedule could be optimized either at the Work Plan development stages or during field implementation. Modified existing work plans to utilize more cost effective processes e.g. the observational approach to reduce upfront field work costs. Developed and maintained detailed project schedules that exceeded the requirements of the company Management Control System.

✓ **RCRA Facility Investigation / Remedial Investigation Work Plan Operable Unit No. 4 – Solar Evaporation Ponds; Rocky Flats, Golden, Colorado; EG&G Rocky Flats, Inc.; Project Manager.** Completed and obtained approval of the Phase I RCRA Facilities Investigation (RFI)/Remedial Investigation (RI) Work Plan for OU 4. The OU 4 Work Plan involved environmental investigation and closure under RCRA. The RFI/RI Work Plan provided the basis and description for field work activities regarding environmental investigation and restoration. The Work Plan was completed on schedule, under budget, and the regulatory milestones were met. Successfully coordinated the procurement process and selection of a subcontractor to implement the field activities outlined in the OU 4 Work Plan. Initiated development of a field Implementation Plan which included details regarding schedule for the OU 4 project covering multiple fiscal years through the Phase I RFI/RI field activities.

✓ **Environmental Investigations of Underground Storage Tank Sites; Various Sites in Florida, Georgia, Alabama, and Mississippi; BP Oil, Amoco, Gulf, and Chevron; Project Manager, Project Engineer, and Hydrogeologist.** Managed twenty-two environmental restoration projects related to petroleum contamination with combined budgets of approximately $6 million dollars. Directed project teams consisting of engineers, hydrogeologists, toxicologists and technicians in all phases of contamination assessment and remediation. Responsible for budgetary control, cost estimating, subcontractor management, quality control, scheduling, client and regulatory interfacing, permitting and compliance, personnel recruiting, and proposal preparation. Also, responsible for remediation system designs for environmental restoration and clean-up of petroleum contaminated sites. Projects involved oversight of staff level professionals regarding design of remedial approaches and installation of ground water recovery and soil treatment systems. Managed development of ground-water treatment system specifications and construction planning. Also, supervised field construction and remediation systems installation. Maintained training efforts for contracting issues, site health and safety, Geotechnical field considerations and site facility construction.

✓ **Hydrogeological Characterization and Siting Criteria; Superconducting Super Collider, Rapid City, South Dakota; U.S. Department of Energy and the State of South Dakota; Research Assistant.** Conducted graduate research for a Master of Science thesis concerning a hydrogeologic investigation for South Dakota's proposal to the U.S. Department of Energy to locate the Superconducting Super Collider (SSC) within the state. The investigation involved drilling and installation of monitoring wells, water quality analysis, hydraulic conductivity tests, and prediction of ground water inflow rates during SSC construction.

✓ **Abandoned Mine Land Reclamation Support; Various Sites in Colorado, Wyoming, and New Mexico; Office of Surface Mining; Remote Video Inspection System (RVIS) Operator.** Used RVIS for downhole inspection of subsurface features. Application of the RVIS was used to assess progress of ground stabilization project which primarily involved slurry or grout backfilling of abandoned coal mines. RVIS data was interpreted by the operator to assist project geologists and engineers in the identification and interpretation of subsidence and other abandoned mine hazards. Assisted in numerous abandoned mine land reclamation projects throughout Colorado, New Mexico, Arizona, and Wyoming. Tasks involved mine closure design, drilling, logging, and operation and monitoring of backfilling processes.

✓ **Quality Assurance/Quality Control and Concrete Testing; Various Construction Sites in Colorado; Commercial Clients; Geotechnical Technician and QA/QC Inspector.** Completed work involving inspection of commercial construction sites, mainly large office buildings. Inspection consisted of reconciling blueprint specifications with field as-built, testing of fireproofing application, reconciling welding and high-strength bolt installation, soil testing, and concrete testing.

✓ **Mining Exploration in Montana Gold Districts; Gold Field Mining Corporation; Geological Field Assistant.** Performed exploration field work for gold mining prospects in Montana gold districts. Field work involved geological mapping, soil and rock sampling, surveying, claim staking, sample preparation, drafting and data plotting, and sampling and logging with a reverse circulating drill rig. Also, provided oversight of mineral sample preparation lab with respect for all sample preparation activities in the field.

# APPENDIX C

# LSGPS SUMMARY OF OU2 CGA BUFFER ZONE MODELING AND MODELER'S RESUME

# LSGPS Summary of OU2 CGA Buffer Zone Modeling

Controlled Groundwater Area

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# Table of Contents



# Appendices

None

# Acronyms

| | |
|---|---|
| CGA | Controlled Groundwater Area |
| GPM | Gallons per minute |
| LSGPS | Lockwood Solvent Groundwater Plume Site |
| OU2 | Operable Unit 2 |
| USGS | United States Geological Survey |

# Executive Summary

Cardno has constructed a numerical groundwater flow and particle transport model at Operable Unit 2 (OU2) of the Lockwood Solvent Groundwater Plume Site (LSGPS). The purpose of the modeling effort was to develop the Controlled Groundwater Area (CGA) for OU2 of the LSGPS to prevent the installation of residential or industrial wells in the alluvial aquifer in areas where there might be the possibility of withdrawing contaminated groundwater, or significantly expanding the dissolved phase plume. The result of this modeling effort is the development of a buffer zone, in which the installation of residential or industrial wells will be prohibited in the alluvial aquifer. Conservative estimates for aquifer parameters, well placement and pumping conditions were used to ensure the buffer zone is protective.

The United States Geological Survey (USGS) MODFLOW model engine was used to simulate the groundwater flows and levels of the region and USGS MODPATH was used to generate the hypothetical capture zone due to pumping adjacent to OU2 of the LSGPS. A conceptual model was created to incorporate the data and existing knowledge of the site and from this conceptual model the numerical model was used. Based on the monitoring data, borehole data, and other information that has been gathered recently, a groundwater flow model was constructed.

Based on the results of the MODFLOW and MODPATH models, a buffer zone ranging from 50 meters near the Yellowstone River, to 200 meters on the southern portion of OU2 of the LSGPS was determined to be protective.

This report assumes the reader is familiar with the site, site conditions and site data.

# 1 Flow and Particle Transport Modeling

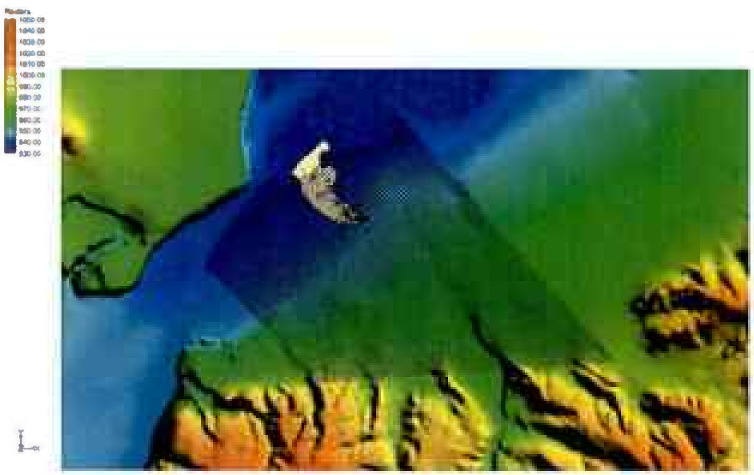
The United States Geological Survey (USGS) MODFLOW finite-difference groundwater model was used to simulate the groundwater flows and levels of the region and USGS MODPATH, a particle-tracking post-processing model, was used to generate the hypothetical capture zone due to pumping adjacent to Operable Unit 2 (OU2) of the Lockwood Solvent Groundwater Plume Site (LSGPS).

## 1.1 General Flow Model Configuration

### 1.1.1 Numerical Grid

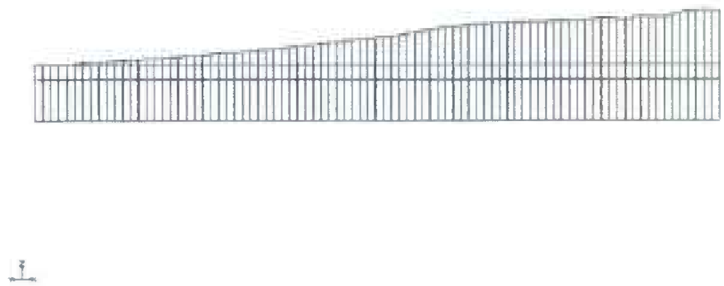
The model is based on the USGS MODFLOW finite-difference grid and consists of 3 layers with grid spacing of 25 meters by 25 meters for each model cell. The grid is rotated approximately 315 degrees to match the regional groundwater flow direction.

The top elevation values for layer 1 were taken from the USGS National Elevation Dataset (NED).



The top elevation for layer 2 was set at 940 meters above sea level. The top elevation for layer 3 was set at 933 meters above sea level. The bottom elevation for layer 3 was set at 914 meters above sea level.

This information was based on the literature that was available from the site. The following figure shows a profile with a Z magnification of 7.0.



#### 1.1.2 Boundary Conditions

Boundary conditions were assigned to the numerical model to replicate the regional groundwater flow gradients. Specified head values were placed on the southern and northern boundaries to simulate groundwater flow in a north westerly direction. A value of 949 meters was assigned along the top of the alluvium and values of 941.6 meters and 939.6 meters along the Yellowstone River. The average gradient across the model was 0.004.

All other boundaries were set to "no flow" conditions. A recharge rate of 0.00028 meters/day (approximately 4 inches per year) was the calculated infiltration rate into the top layer of the model. A value of 1.0 m/day was uniformly applied for the hydraulic conductivity for layer 1 to represent the fine-grained section (generally a silty clay). A value of 70.0 m/day was uniformly applied for the hydraulic conductivity for layer 2 to represent the alluvial aquifer (generally a sandy gravel). A value of 1.0 m/day was uniformly applied for the hydraulic conductivity for layer 3 to represent the underlying bedrock. A value of 10 was used to represent the vertical anisotropy (the ratio of horizontal conductivity to vertical conductivity Kh/Kv). This was also deemed representative of the nature of the vertical flow in the region.

### 1.1.3 Flow Solution

The groundwater flow solution is presented below.

## 1.2 General Particle Transport Model Configuration

The USGS model, MODPATH, was the model that was used to compute the reverse particle tracking of pumping wells adjacent to Operable Unit 2 (OU2) of the Lockwood Solvent Groundwater Plume Site (LSGPS). These hypothetical pumping wells were used to develop the Controlled Groundwater Area (CGA) for OU2 of the LSGPS. MODPATH uses the groundwater levels and flow solution from the MODFLOW model.

For the pumping of the alluvial aquifer, two wells were placed on each adjacent side of the OU2 plume. Simulating two wells on each side of the plume increases the level of conservatism in developing the buffer zone. The wells were pumped at a rate of 35 gallons per minute (gpm). This rate is the maximum pumping rate allowed for single well permits in the region.

The MODPATH model was set up with 10 particles placed around each of the four pumping wells and the particles were tracked backward in time moving upgradient through the groundwater flow system. A conservative effective porosity value of 0.22 was applied uniformly to all model cells.

The following figure shows the results of the backward particle tracking from MODPATH.

The buffer zone was defined by the external boundary of the modeled capture zone on each side of the OU2 plume. Wells that are installed outside the buffer zone can be pumped at up to 35 gpm and not withdraw contaminated water or affect the distribution of the dissolved phase plume.

Based on the results of the MODFLOW and MODPATH models, a buffer zone ranging from 50 meters near the Yellowstone River, to 200 meters on the southern side of OU2 of the LSGPS was determined to be protective.

Cardno
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# R. Jeffrey Davis, PE

**Current Position**
Senior Consultant

**Discipline Areas**
> Hydrogeology
> NEPA Environmental Impact Analysis
> Groundwater Modeling
> Fate & Transport Analysis
> Total Water Management
> GIS Modeling
> Software Development

**Years' Experience**
20 Years

**Joined Cardno**
2010

**Education**
> MS, Civil & Environmental Engineering, Brigham Young University, 1998
> BS, Civil & Environmental Engineering, Brigham Young University, 1993

**Professional Registrations**
> Licensed Professional Engineer (PE), Utah (189690-2202)
> Licensed Professional Engineer (PE), Florida (74838)

**Affiliations**
> National Groundwater Association(NGWA)

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## Summary of Experience

Mr. Jeffrey Davis is a Senior Hydrogeologist and licensed Professional Engineer with over 20 years of experience in the mining and oil and gas sectors in the areas of environmental engineering and groundwater and GIS modeling and software and model development. He has provided consulting services for local, national, and international clients pertaining to mining and oil and gas projects. He has extensive knowledge of groundwater flow and transport principles and has lectured and taught numerous workshops and classes worldwide. In addition, he was the chief engineer overseeing the development of the popular groundwater modeling software, GMS.

Mr. Davis is active in the mining industry in water management, remediation, NEPA activities, and other groundwater related activities. Mr. Davis has served as chair and keynote speaker for mining conferences focused on water management and presented current treatment approaches for mine wastewater. Mr. Davis is active with the National Groundwater Association (NGWA), Society for Mining, Metallurgy & Exploration (SME),Society of Petroleum Engineers (SPE) the Energy & Mineral Law Foundation (EMLF), the Rocky Mountain Mineral Law Foundation (RMMLF) and the American Bar Association (ABA) on mining and oil and gas issues as it relates to groundwater protection

## Significant Projects

*Technical Reviewer/Advisor – U.S. Environmental Protection Agency*

Mr. Davis has been an invited participant and technical reviewer for the EPA's *Study of Hydraulic Fracturing for Oil and Gas and Its Potential Impact on Drinking Water Resources*. In addition to participating in the technical roundtables and technical workshops as an advisor, Mr. Davis recently completed a peer review of the EPA's five retrospective case studies.

*Groundwater Lead – ExxonMobil Environmental Services – Southern Texas*

Mr. Davis is currently the groundwater lead for performing the fate and transport modeling and analysis of chloride contamination in Southern Texas near the Gulf of Mexico for ExxonMobil. As part of the site mitigation phase, modeling is being used to determine the potential migration of the chloride through the shallow aquifer system and nearby receptors.

*Technical Reviewer – Kennecott Utah Copper, Rio Tinto – Utah*

Mr. Davis recently completed an independent third party audit for a closure plan pit lake study for Bingham Canyon mine. To ensure the quality and correctness of the study, there was a review the consultant scope of work for the pit lake study, discussions with the consultant staff to discuss understanding of study, methodology, and pathway to completion. A report was compiled and submitted to Rio Tinto of the independent audit.

*Groundwater Lead – Beverage & Diamond – Vandalia, Ohio*

Mr. Davis provided groundwater expertise in performing the fate and transport modeling and analysis of NaCl contamination of an aquifer. Road salt, which was temporarily stored, caused limited contamination of a shallow aquifer that supplied domestic drinking water to ~24 residential homes. Groundwater monitoring was installed to characterize both the vertical and horizontal extent of the contamination and the monitoring data was

- > Society for Mining, Metallurgy & Exploration (SME)
- > Society of Petroleum Engineers (SPE)
- > International Water Association (IWA)
- > International Mine Water Association
- > Energy & Mineral Law Foundation
- > Rocky Mountain Mineral Law Foundation
- > Society of Petroleum Engineers
- > Society for Mining, Metallurgy, & Exploration

carefully analyzed for the predictive modeling. The groundwater flow and transport model included the local domestic pumping wells, which helped determine the possible extent of the chloride impacts. Largely due to the CSM and transport modeling results, litigation was settled out of court to the satisfaction of the client.

*Modeling Technical Lead – Mosaic – Lithia, Florida*

The primary focus was to develop a contaminant and water budget and management model for Hookers Prairie Mine using the GoldSim modeling software. The purpose of the model was to evaluate the probabilities of the mine meeting its current and future nutrient NPDES loading limits for certain contaminants. The project also included an evaluation of current monitoring data within the mine operations and at discharge locations and the development of a complete monitoring plan integrated into a GIS as part of the model calibration and validation.

*Groundwater Lead – Haile Gold Mine Project – near Kershaw, South Carolina*

Mr. Davis is the groundwater leader as the third-party contractor in the development of an Environmental Impact Statement for the proposed Haile Gold Mine near Kershaw, South Carolina. The EIS will analyze the potential direct, indirect, and cumulative environmental effects of the proposed project and its alternatives. Current work includes project team coordination for geology and groundwater and surface water resource areas, review of Applicant-supplied information, agency coordination, and public involvement.

*Groundwater Lead – Four Corners Power Plant and Navajo Mine Energy Project – Fruitland, New Mexico*

Mr. Davis is the groundwater leader as the third-party contractor in the development of an Environmental Impact Statement for the Four Corners Power Plant and Navajo Coal Mine. The EIS will analyze the potential direct, indirect, and cumulative environmental effects of the proposed project and its alternatives. The groundwater portion includes analyzing field investigations, pump tests, conceptual and numerical modeling of the project and surrounding area and remediation and reclamation activities.

*Groundwater Lead – BHP Billiton – Pibara, Western Australia*

Mr. Davis was one of the groundwater leaders performing a cumulative impact assessment for BHP's plans in expanding its iron ore operations in the Pilbara, Western Australia. This assessment includes identifying the methodology and developing the conceptual models to perform the CIA. The groundwater modeling includes both quantitative and qualitative approaches.

*Groundwater Lead – Pacificorp – Southwest Wyoming*

Mr. Davis was brought in as part of a technical team to reevaluate groundwater conditions, and treatment and discharge alternatives at the Bridger Coal Mine, Southwest Wyoming. Previous studies and predicted maximum flows into the mine had been exceeded and Jeffrey was brought in as part of a team to reassess the situation and provide solutions.

*Environmental Lead – Confidential Due Diligence – Pascagoula, Mississippi*

Mr. Davis was the environmental lead, performing an environmental assessment at a chemical plant in Pascagoula, Mississippi, as part of a due diligence effort. A number of groundwater and surface water contamination issues are being addressed due to spills, leaks, and storage of hazardous materials. The chemical plant is located on the Gulf of Mexico and is sensitive to possible environmental impacts from operations of the chemical plant.

*Groundwater Lead – MSD Mercury Spill – Cincinnati, Ohio*

Mr. Davis was the groundwater lead, performing the fate and transport modeling and analysis of a mercury spill in a municipal landfill in Cincinnati, Ohio. As part of the "project management" phase, modeling was used to determine the potential migration of the mercury through the landfill to the leachate collection system. The modeling efforts examined both the spatial distribution of the mercury transport, and the temporal component as well.

*Groundwater Lead – Lockwood Solvent Groundwater Plume – Billings, Montana*

Mr. Davis is one of the groundwater leads performing groundwater modeling for the Lockwood Solvent Groundwater Plume site (LSGPS), an EPA Superfund site in Billings, Montana. The LPGPS spans 580 acres and much of the groundwater at the site is contaminated with the volatile organic compounds (VOCs) PCE, TCE, cis-1,2-dichloroethene (DCE) and vinyl chloride (VC).

*Groundwater Modeling Lead – Marco Lakes ASR System – Marco Island, Florida*

Mr. Davis was the technical advisor to a modeling study to evaluate whether the current Marco Lakes ASR system can handle future water demand projections. Various current and proposed alternatives were evaluated to meet the City's demands. The primary objectives of this modeling study were: estimate the pressure build-up in the ASR wells during future injection cycles; predict the current and future extent of the "ASR" bubble; and simulate the changes in chloride concentrations in the ASR wells during projected future cycles.

*Groundwater Modeling Lead – Latt Maxcy – Osceola County, Florida*

Cardno was contracted by the Latt Maxcy Corporation to provide hydrogeological investigations, water supply planning, alternatives analysis, and safe yield determinations for the development of large-scale agricultural operations on a 43,000-acre property located in Osceola County. Groundwater flow modeling included working with the staff of the Southwest Florida Water Management District over the course of a year on their East Central Florida Transient (ECFT) model to develop individual and regional cumulative impact assessments for the development of a 23 MGD wellfield with total conjunctive use of groundwater and surface water totaling 47 MGD.

*Groundwater Lead – Groundwater Trench Abandonment – Santa Barbara, CA*

Mr. Davis was the groundwater lead modeling and analyzing the potential changes to groundwater flow caused by abandonment of two groundwater extraction trenches at the Former ExxonMobil Station in Santa Barbara, California.

*Groundwater Modeling Advisor – Office of Surface Mining – Morgantown, West Virginia*

Mr. Davis has had a long-term relationship with the Office of Surface Mining (OSM) and worked with engineers at OSM and professors at WVU on the Watershed Characterization Modeling System (WCMS) and integrating the groundwater segment with GMS. In addition, Mr. Davis provided consulting services with groundwater modeling to understand the subsurface mining impacts on surface streams and other water bodies in West Virginia.

*Chief Hydrogeologist – Legacy Way – Brisbane, Australia*

Mr. Davis provided senior oversight and technical review for all hydrogeologic assessments related to the Legacy Way tunnel design project, a 4.6km underground tunnel in northern Brisbane, Australia. This work included evaluating field tests, geotechnical and environmental reports and modeling of the entire project area.

*Hydrogeologist Lead – Ogun Agricultural Cargo Airport Assessment – Ogun, Nigeria*

Mr. Davis developed a groundwater model for a proposed agricultural cargo airport (Ogun, Nigeria) to asses nearby well impacts and possible contaminant spill impacts from the airport. The modeling included both flow and fate and transport components

*Consultant – Kaman Aerospace RCRA site – Connecticut*

Mr. Davis was hired by GZA Environmental to provide consulting services on a remedial project in the state of Connecticut at a former military helicopter manufacturing plant. His role was to aid in the organization of the field data, perform 3d geostatistics for plume characterization and provide support in the conceptualization of the groundwater model and subsequent remediation mode.

*Groundwater Modeler Lead – Kennecott Utah Copper, Rio Tinto – South Jordan, Utah*

Mr. Davis has worked with the engineers at Kennecott (Utah) over the years, providing technical assistance with their groundwater projects. Most of the work has centered around the cleanup of a large acid mine plume. Another consulting group was involved in the initial groundwater study and Mr. Davis was brought in later for additional advice and investigation of modeling alternatives.

*Groundwater Modeler Lead – Williams Air Force Base Superfund Site – Arizona*

Mr. Davis was hired by BEM Systems to use an existing groundwater model and propose some remediation strategies for a cleanup project at Williams Air Force Base (Arizona). Modeling was used to simulate a proposed SVE system for the clean-up. The site was a designated EPA Superfund site with multiple VOC-contaminated areas.

*Groundwater Modeler Lead – Nevada Energy – Eastern Nevada*

A multi-year project, creating both regional and ocal scale groundwater models and reports of Steptoe Valley (Eastern Nevada). The models were part of an Environmental Impact Statement for the construction and operation of Ely Energy Center, a coal power plant. The project included field investigations, pump tests, conceptual and numerical modeling of the area and climate change modeling.

*Hydrogeologist Consultant – AquaHydrogeologic – Northern Nevada and Guatemala*

Mr. Davis was retained by AquaHydrogeologic for over ten years, providing groundwater consulting services to both private and public agencies in Northern Nevada. These projects have been water resource and water allocation related, as well as contaminated sites and remediation. In 2007, Mr. Davis did work on a project in Guatemala for a proposed gold mine (Cerro Blanco).

*Hydrogeologist Advisor – Council for Geoscience – South Africa*

Mr. Davis was asked to be an advisor in the development of a finite element model of a large mine in South Africa. Contamination from the mine tailings was spreading through both groundwater and surface water bodies. The model required an extensive stratigraphy model followed by flow and transport modeling.

*Training and Consulting – Codelco – near Calama Chile*

Mr. Davis was hired to provide training and consulting services to a group of engineers from Codelco. The work primarily centered on the Chuquicamata mine near Calama, Chile. The mine plan was to combine the existing mine with an adjacent mine (Mina Sur). There was also some preliminary work done on a proposed new mine (Mansa Mine).

*Groundwater Modeler Lead – City of Roseville, California*

The City of Roseville proposed to implement a citywide Aquifer Storage and Recovery (ASR) program to maintain groundwater as a sustainable resource, improve the City's water supply reliability, and meet regional conjunctive use program goals. The City is the CEQA Lead Agency and prepared a Focused Environmental Impact Report (EIR) for the project. As part of this project our role was to develop a regional scale conceptualization for the major portion of the Central Valley area in Northern California, a subsequent regional multilayer groundwater model followed by a number of local scale transport models to simulate pilot tests and understand the aquifer storage and recovery process.

*South Florida Water Management District*

Over the past several years, Mr. Davis has worked with Jayantha Obeysekera and other members in his group at SFWMD. Mr. Davis has reviewed models, provided training, and advised on their development and implementation of the Regional Simulation Model (RSM). For many years, SFWMD has collaborated with the staff at ERDC (Vicksburg, MS) and Mr. Davis has worked to provide the necessary support for this work. In the early years, it involved working with models such as FEMWATER123 and WASH.

*Suwannee River Water Management District*

Mr. Davis has had a great relationship with the engineers at the Suwannee District. He has consulted with them on numerous times on the development and application of their regional groundwater model for the entire district. Recently, Mr. Davis was part of the development an automated well permitting tool using the ArcHydro Groundwater tools. Mr. Davis recently completed working on a long term water supply assessment modeling project with SRWMD.

**Modeling Support Experience**

Mr. Davis provided detailed technical support for groundwater model development with full responsibility for all GMS technical support. Frequently involved in assisting GMS users in solving a wide range of modeling problems. Worked with model developers to create interfaces in GMS for several advanced flow and transport models in GMS, including FEMWATER, MODFLOW, MT3D, RT3D, SEEP2D, SEAM3D, UTCHEM, and several geostatistical methodologies. Developed numerous example flow and transport scenarios for these models, and worked with developers and users in testing and refining these model interfaces.

**Specific Training Experience**

For the past several years, Mr. Davis has taught groundwater modeling classes throughout the United States and across the world. These classes are often sponsored by organizations such as NGWA, ASCE, and IAH. The classes are generally attended by engineers, geologists, and hydrogeologists, and cover topics ranging from groundwater flow and transport concepts and modeling and GIS modeling and data management. Course locations include: Belgorod, Cairo, Belgrade, Prague, Liege, Pretoria, Toronto, Gothenburg, Berlin, Calama, Zacatecas, Seoul, Copenhagen, Brisbane, Hyderabad, and also many locations here in the United States (Utah, California, Nevada, Colorado, Texas, Louisiana, Maryland, Virginia, Rhode Island, Pennsylvania, Georgia, Illinois, Washington D.C., and Florida.)

**Specific GIS Experience**

Mr. Davis extensively uses GIS (namely ArcGIS) in both consulting and teaching arenas. Mr. Davis has taught numerous courses on the use of GIS with groundwater modeling and water resource modeling in general. He developed course materials for GIS and Arc

Hydro Groundwater Data Model and Tools which is a standard for storing, managing, and visualizing groundwater data.

Software Development

Mr. Davis has eight years' experience in developing the GMS (Groundwater Modeling System) at the Environmental Modeling Research Laboratory at Brigham Young University. He has worked three years as a part-time programmer and five years as a full-time software development manager, responsible for all aspects of GMS development, including leading a team of other full-time software managers and part-time programmers. GMS is a sophisticated graphical environment for groundwater model pre- and post-processing, 3D site characterization, and geostatistics. GMS is the official groundwater application of the Dept. of Defense and is widely used in the Dept. of Energy and the Environmental Protection Agency. There are thousands of commercial users in over ninety different countries.

## Presentations

CLE International

Mr. Davis has been an invited presenter for a number of seminars on hydraulic fracturing and groundwater protection and produced water treatment, beneficial reuse, and disposal. CLE International has been a provider of continuing professional education programs throughout the United States and Canada. Its seminars focus on the cutting edge of emerging legal issues of vital importance to attorneys and their clients, real estate professionals, accountants, consultants, and government agencies.

# APPENDIX D

# DESCRIPTION OF PROPOSED LSGPS CGA BOUNDARY

**Description of the Proposed Lockwood Solvent Groundwater Plume Site (LSGPS) Controlled Groundwater Area (CGA) Boundary**

Segment 1: Beginning at the south edge of the Yellowstone River due north of the NW corner of parcel 03-1033-26-1-02-04-0000 and proceeding south to the NW corner of parcel 03-1033-26-1-02-04-0000,

Segment 2: then proceeding south to the SW corner of parcel 03-1033-26-1-02-04-0000,

Segment 3: then proceeding east to the SE corner of parcel 03-1033-26-1-02-04-0000,

Segment 4: then proceeding south to the NW corner of the Klenck Lane right-of-way (parcel 03-8888-44-4-44-44-0000),

Segment 5: then proceeding northeast to the NE corner of the Klenck Lane right-of-way,

Segment 6: then proceeding south 55 feet along the Klenck Lane right-of-way,

Segment 7: then proceeding southeast to the SE corner of parcel 03-1033-26-4-13-01-0000 at the north boundary of the Montana Rail Link right-of-way,

Segment 8: then proceeding southeast across the Montana Rail Link right-of way and the Lockwood Road right-of-way to the northernmost point of parcel 03-1033-26-4-07-01-0000,

Segment 9: then proceeding southwest across parcel 03-1033-26-4-07-01-0000 to the NE corner of parcel 03-1033-26-4-05-09-0000,

Segment 10: then proceeding south to the SE corner of parcel 03-1033-26-4-04-04-0000,

Segment 11: then proceeding southeast across the U.S. Interstate 90 right-of-way to the NE corner of parcel 03-1033-26-4-02-10-0000,

Segment 12: then proceeding south to the SE corner of parcel 03-1033-26-4-02-10-0000 at the north Highway 87 right-of-way,

Segment 13: then proceeding south 27 feet along the Highway 87 right-of-way,

Segment 14: then proceeding northeast 102 feet along the Highway 87 right-of-way,

Segment 15: then proceeding southeast 41 feet along the Highway 87 right-of-way,

Segment 16: then proceeding southwest 7 feet along the Highway 87 right-of-way,

Segment 17: then proceeding southeast 70 feet along the Highway 87 right-of-way,

Segment 18: then proceeding south across parcel 03-1033-25-3-01-01-0000 and the Baxter Lane right-of-way to the NE corner of the Cherry Street right-of-way (parcel 03-8888-44-4-44-44-0000),

Segment 19: then proceeding south to the NE corner of parcel 03-1033-35-1-23-08-0000, Segment 39: then proceeding northwest to the NE corner of parcel 03-1033-26-3-02-01-0000 at the south Cerise Road right-of-way,

Segment 40: then proceeding northeast along the Cerise Road right-of-way to the NW corner of parcel 03-1033-26-3-02-12-0000,

Segment 41: then proceeding southeast to the SW corner or parcel 03-1033-26-3-02-12-0000,

Segment 42: then proceeding northeast along the southern boundary of parcel 03-1033-26-3-02-12-0000 through the easternmost point of parcel 03-1033-26-3-04-01-0000 to a point within the Cerise Road right-of-way due south of the SW corner of parcel 03-1033-26-3-06-10-0000,

Segment 43: then proceeding north to the SW corner of parcel 03-1033-26-3-06-10-0000,

Segment 44: then proceeding north to the NW corner of parcel 03-1033-26-3-06-10-0000,

Segment 45: then proceeding west to the SW corner of parcel 03-1033-26-3-06-11-0000,

Segment 46: then proceeding north across parcel 03-1033-26-3-01-20-0000 and the Island Park Road right-of-way to the SE corner of parcel 03-1033-26-3-09-02-0000,

Segment 47: then proceeding west to the SE corner of parcel 03-1033-26-3-08-02-0000,

Segment 48: then proceeding north 480 feet along the east boundary of parcel 03-1033-26-3-08-02-0000 to a corner of parcel 03-1033-26-3-08-02-0000,

Segment 49: then proceeding west across parcel 03-1033-26-3-08-02-0000 to a point on the west boundary of parcel 03-1033-26-3-08-02-0000,

Segment 50: then proceeding north along the west boundary of parcel 03-1033-26-3-08-02-0000 and ending at the south edge of the Yellowstone River.

Segment 20: then proceeding south to the SE corner of parcel 03-1033-35-1-23-13-0000,

Segment 21: then proceeding west 5 feet to the NW corner of parcel 03-1033-35-1-15-06-0000,

Segment 22: then proceeding south to the SW corner of parcel 03-1033-35-1-15-06-0000,

Segment 23: then proceeding west to the NE corner of parcel 03-1033-35-1-14-03-0000,

Segment 24: then proceeding south to the SE corner of parcel 03-1033-35-1-14-03-0000 at the south edge of Rosebud Lane,

Segment 25: then proceeding west along the south edge of Rosebud Lane to the NW corner of parcel 03-1033-35-1-05-06-0000,

Segment 26: then proceeding north to the centerline of Rosebud Lane,

Segment 27: then proceeding west along the centerline of Rosebud Lane to the midpoint of the intersection with Rosebud Lane and Coburn Road,

Segment 28: then proceeding northwest to the SE corner of parcel 03-1033-35-2-01-06-0000,

Segment 29: then proceeding along the east boundary of parcel 03-1033-35-2-01-06-0000 to the NE corner of parcel 03-1033-35-2-01-06-0000,

Segment 30: then proceeding along the north boundary of parcel 03-1033-35-2-01-06-0000 to the northernmost point of parcel 03-1033-35-2-01-06-0000 at the U.S. Interstate 90 right-of-way,

Segment 31: then proceeding west across the U.S. Interstate 90 right-of-way to the SE corner of parcel 03-1033-35-2-02-05-0000,

Segment 32: then proceeding west to the SW corner of parcel 03-1033-35-2-02-05-0000,

Segment 33: then proceeding west to a point on the east boundary of parcel 03-1033-35-2-02-08-0000,

Segment 34: then proceeding north along the east boundary of parcel 03-1033-35-2-02-08-0000 to the NE corner of parcel 03-1033-35-2-02-08-0000,

Segment 35: then proceeding west along the north boundary of parcel 03-1033-35-2-02-08-0000 to the south Highway 87 right of way,

Segment 36: then proceeding northwest across the Highway 87 right-of-way to the SE corner of parcel 03-1033-35-2-03-01-2001,

Segment 37: then proceeding northwest to the NE corner of parcel 03-1033-35-2-03-01-2001 at the south Montana Rail Link right-of-way,

Segment 38: then proceeding northeast across the Montana Rail Link right-of-way to the SE corner of parcel 03-1033-26-3-02-01-0000, 43Q-30110019

SIDE A

Form 630 Checklist N/7/2002

# Petition for
# Controlled Groundwater Area Checklist

Petition Name Lockwood Solvent GW Plume Site Reviewed by: ______

Contact Person Roger Hoogerheide - EPA Jim Sullivan - TASMAN
Hoogerheide.Roger@epa.gov. jsullivan@Tasman-geo.com

**FORM CHECK -** Facts submitted to support alleged situations exist or are likely to occur.

☐ Yes ☐ No Ground water withdrawals in the area are greater than the aquifer recharge.

☐ Yes ☐ No Excessive ground water withdrawals are likely to occur in the near future.

☐ Yes ☐ No There are significant disputes involving ground water rights in the area.

☐ Yes ☐ No Ground water levels or pressures are declining.

☐ Yes ☐ No Excessive ground water withdrawals would cause contaminant migration.

☐ Yes ☐ No Ground water withdrawals will affect ground water quality.

☐ Yes ☐ No Water quality in the ground water area is not suited for a specific beneficial use.

☐ Yes ☐ No Notice list prepared by petitioners (Must include all ground water users in DNRC records within the petition area; land owners, well drillers, agencies, local government)

☐ Yes ☐ No Petition includes request for proposed provisions.

☐ Yes ☐ No Map (showing the boundaries of the proposed CGWA & location of all ground water user's wells)

☐ Yes ☐ No Signatures (petition is filed by a representative of a state or locate public health agency OR by at least 25% or 20, which ever is less, of the ground water users in the proposed controlled area.

SIDE B

# Controlled Ground Water Area
# Processing Check

## ENVIRONMENTAL ASSESSMENT

☐ Yes ☐ No Environmental Assessment Completed Date: ______________________

## HEARING

Location: ______________________ Date and Time ______________________

**PUBLIC NOTICE -** Notice must be published once a week for 3 weeks, with the last notice being at least 30 days before the date of hearing. Public notice must include the following.

Publication Dates: ____________ ____________ ____________

☐ Yes ☐ No Names of Petitioners
☐ Yes ☐ No Legal Description of the proposed CGWA
☐ Yes ☐ No Purpose of Hearing
☐ Yes ☐ No Time and Place of Hearing

## INDIVIDUAL NOTICE

☐ Yes ☐ No Petition and Hearing Notice mailed to Well Drillers whose address in within the CGWA county
☐ Yes ☐ No Petition and Hearing Notice mailed to individuals or agencies appropriating ground water shown in department records
☐ Yes ☐ No Petition and Hearing Notice mailed to Bureau of Mines and Geology
☐ Yes ☐ No Petition and Hearing Notice mailed to mayor or presiding office of each incorporated municipality located within the proposed area
☐ Yes ☐ No Petition and Hearing Notice mailed to other entities the department feels may be interested in or impacted by the proposed CGWA designation.

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**FINAL ORDER -** Final Order must be published once a week for 3 weeks.

Publication Dates: ____________ ____________ ____________

## FINAL ORDER - INDIVIDUAL NOTICE

☐ Yes ☐ No Written Findings and Order mailed to each Petitioner
☐ Yes ☐ No Written findings and Order mailed to Well Drillers whose address in within the CGWA county
☐ Yes ☐ No Written findings and Order mailed to individuals or agencies appropriating ground water shown in department records
☐ Yes ☐ No Written findings and Order mailed to Bureau of Mines and Geology
☐ Yes ☐ No Written findings and Order mailed to mayor or presiding office of each incorporated municipality located within the proposed area
☐ Yes ☐ No Written findings and Order mailed to other entities the department feels may be interested in or impacted by the proposed CGWA designation.
☐ Yes ☐ No Copy filed with County Clerk & Recorder of each county where the petition is located. (Clerk cannot require fee.)