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REVISED ADDENDUM 01
TO THE REVISED REMEDIAL DESIGN ASSESSMENT
WORK PLAN FOR THE DELINEATION AND PHYSICAL CHARACTERIZATION OF FINE-GRAINED SOURCE SOILS
SAMPLING AND ANALYSIS PLAN AND FIELD SAMPLING PLAN
OPERABLE UNIT 2
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE
BILLINGS, MONTANA

Prepared for:

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Tasman Project No. Z05100003

TASMAN GEOSCIENCES

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Prepared for:

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

APPROVAL

As required in Section X, Paragraph 36 of the Consent Decree, Remedial Design/Remedial Action for Operable Unit 2 at the Lockwood Solvent Superfund Site, all documents, other than progress reports, which purport to document Soco's compliance with the terms of this Consent Decree shall be signed by an authorized representative of Soco.

Raj Mehta Soco West, Inc. President	4/3/2018 Date

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REVIEWS AND APPROVALS

Roger Hoogerheide EPA Remedial Project Manager	3/21/18 Date
Richard Sloan DEQ Project Officer	3/22/2018 Date
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ACRONYMS AND ABBREVIATIONS

bgs	Below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cis-1,2-DCE	*cis*-1,2-Dichloroethene, also known as *cis*-1,2-Dichloroethylene
CD	Remedial Design/Remedial Action Consent Decree
COC	Contaminant of concern
DEQ	Montana Department of Environmental Quality
DNAPL	Dense non-aqueous phase liquid
DQI	Data quality indicator
DQOs	Data quality objectives
Energy	Energy Laboratories, Inc.
EPA	U.S. Environmental Protection Agency
HASP	Health and Safety Plan
IDW	Investigation-derived waste
JSA	Job safety analysis
Keller	Keller Transport, Inc.
Kuck	Kuck Trucking Inc.
LSGPS	Lockwood Solvent Groundwater Plume Site
LTC	Landfarm treatment cell
mg/kg	Milligram per kilogram
MRL	Method reporting limit
MS	Matrix spike
MSD	Matrix spike duplicate
NPL	National Priorities List
OU2	Operable Unit 2
PARCCS	Precision, accuracy, representativeness, completeness, comparability, and sensitivity
PCE	Tetrachloroethene (also known as perchloroethene or tetrachloroethylene)
PID	Photoionization detector
ppm	Parts per million
PO	Project Officer
QA	Quality assurance
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QA/QC	Quality assurance/quality control
RAWP	*Revised Remedial Action Work Plan for Fine-Grained Source Soils*

ACRONYMS AND ABBREVIATIONS (Continued)

RD	Remedial Design
RDA	Remedial Design Assessment
RDAQAPP	Remedial Design Assessment Quality Assurance Project Plan
RDAWP	Remedial Design Assessment Work Plan
RDWP	Remedial Design Work Plan
RPM	Remedial Project Manager
ROD	Record of Decision
Soco	Soco West, Inc.
SOP	Standard operating procedure
SOW	Statement of Work
Tasman	Tasman Geosciences, Inc.
TCE	Trichloroethene (also known as trichloroethylene)
USCS	Unified Soil Classification System
VOC	Volatile organic compound
VC	Vinyl chloride

DISTRIBUTION LIST

The following individuals will receive a copy of this Revised Addendum 01 to the Revised Remedial Design Assessment Work Plan for the Delineation and Physical Characterization of Fine-Grained Source Soils upon approval, and will receive copies of any subsequent revisions:

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1.0 INTRODUCTION

Tasman Geosciences, Inc. (Tasman) has prepared this *Revised Addendum 01 to the Revised Remedial Design Assessment Work Plan for the Delineation and Physical Characterization of Fine-Grained Source Soils* (Work Plan) on behalf of Soco West, Inc. (Soco) for additional delineation of fine-grained source soils at Operable Unit 2 (OU2) of the Lockwood Solvent Groundwater Plume Site (LSGPS) near Billings, Montana (see Figures 1 through 3). In general, the delineation will be conducted primarily in the area immediately north of Coulson Ditch on the Kuck Trucking Inc. (Kuck) property. Additional delineation will also be conducted to refine fine-grained source area boundaries south of Coulson Ditch, including areas around Excavation Area 1 (Figures 3 and 4).

This assessment will supplement the data collected during the primary August 2016 fine-grained soils assessment (Tasman, 2017c). The purpose of this assessment is to delineate additional fine-grained soils that exceed contaminant of concern (COC) performance standards established in the *Record of Decision* (ROD; EPA/DEQ, 2005). The COCs at OU2 are the following volatile organic compounds (VOCs): tetrachloroethene, commonly known as perchloroethene (PCE); trichloroethene (TCE); *cis*-1,2-dichloroethene (*cis*-1,2-DCE); and vinyl chloride (VC), which are commonly referred to as chlorinated solvents.

The primary delineation and physical characterization of fine-grained source soils was conducted in August 2016, under the approved *Revised Remedial Design Assessment Work Plan for the Delineation and Physical Characterization of Fine-Grained Source Soils* (Fine-Grained Soils Work Plan; Tasman, 2016). The delineation was conducted from the area immediately south of the former tank farm area on the Soco property to Coulson Ditch (Figure 2). During the primary August 2016 assessment, over 400 soil samples were collected from 148 boring locations and analyzed by EPA Method 8260B for VOCs. Additionally, to help determine soil properties and characteristics of the fine-grained soils, five soil samples were opportunistically collected for sieve analysis and Atterberg limits/plasticity analysis in October and December 2016.

The source soil outlines shown on Figure 3 are an interpretation of data collected during the August 2016 primary fine-grained soils delineation and historic soil data collected during previous investigations (Tasman, 2017a). The slope pit source area, shown on Figure 3, was excavated in November 2017 as part of Excavation Area 1, which also included a buffer area. The extent of Excavation Area 1 is shown on Figure 4. Three composite sidewall soil confirmation samples, collected after excavation, exceeded the performance standards for PCE, indicating that not all fine-grained source soils had been removed from Excavation Area 1.

During this second phase of fine-grained soils assessment, soil samples will be collected from initial proposed boring locations, shown on Figure 4. The soil samples will be analyzed by EPA Method 8260B for VOCs, utilizing a 24-hour turnaround time. As soil sample and field screening results become available, the data will be used in real-time to determine, if, and where, additional borings and samples are needed to more accurately delineate fine-grained soils that exceed ROD performance standards. As the data are evaluated on an on-going basis throughout the assessment, cooperatively with the Environmental Protection Agency (EPA) and Montana Department of Environmental Quality (DEQ), soil boring locations will be added and potentially removed from the proposed initial soil boring locations shown on Figure 4.

This Work Plan is part of the broader remedial design assessment (RDA) for OU2 and was developed in response to the selected remedy set forth in the ROD (EPA/DEQ, 2005) and Statement of Work (SOW; EPA/DEQ, 2011a) for OU2 in accordance with requirements of the

Remedial Design/Remedial Action Consent Decree (CD; EPA/DEQ, 2011b), and the *Remedial Design Work Plan* (RDWP; ATC, 2012), as well as EPA guidance (EPA, 1992b).

All work performed under this Work Plan will be performed in accordance with Revision 2 of the OU2 project approved *Remedial Design Assessment Quality Assurance Project Plan* (RDAQAPP; Cardno, 2013a), included in Revision 2 of the *Remedial Design Assessment Work Plan* (RDAWP; Cardno, 2013b).

Additionally, all field activities performed under this Work Plan will be conducted in a manner consistent with the procedures set forth in the project standard operating procedures (SOPs) included in Appendix A and the RDAQAPP (Cardno, 2013a). Likewise, all work performed under this Work Plan will be performed in accordance with the OU2 *Health and Safety Plan* (HASP) included in Appendix B.

2.0 PROJECT TECHNOLOGY DESCRIPTION

Ex situ soil treatment of vadose zone soil is one of several remedial technologies identified in the ROD as potentially feasible to address subsurface chlorinated solvent impacts at OU2 (EPA/DEQ, 2005). This section presents summary background information on LSGPS and OU2. A complete site history, including physical settings, summary of previous investigations, and a conceptual site model of OU2 are detailed in the RAWP (Tasman, 2017c).

2.1 Site Description and Site History

LSGPS is a 568-acre EPA National Priorities List (NPL) site located in an unincorporated suburb of and on the east side of Billings, Montana, known as Lockwood (Figure 1). As a result of chlorinated solvent impacts at the site, EPA proposed placing LSGPS on the National Priorities List (NPL) in May 2000 and subsequently listed LSGPS on December 1, 2000.

Based on sources of subsurface impacts, the LSGPS has been divided into two separate Operable Units, OU1 and OU2. OU2 has been defined as a 246-acre geographic area where contaminated soil associated with the Soco property and impacted groundwater emanating from this source area have come to be located (Figure 3).

The COCs at OU2 are the following VOCs: PCE; TCE; *cis*-1,2-DCE; and VC. COC concentrations in source area groundwater and soils are compared to performance or remediation goal standards listed in Table 1, as specified in the ROD (EPA/DEQ, 2005).

Figure 3 illustrates the extent of known and suspected source soil at OU2, based on the current OU2 site knowledge. There are two primary fine-grained soil source areas, the northwest source area and the former tank farm source area, and two minor source areas, the slope pit source area and the former acid tank farm source area, shown on the figure. The source soil outlines are an interpretation of data collected during the August 2016 primary fine-grained soils delineation and historic soil data collected during previous investigations (Tasman, 2017a).

Excavation Area 1 (slope pit source area) and the buffer area (approximately 20 feet), included on Sheet 3 of Appendix B of the RAWP (Tasman, 2017c), were excavated during November 2017. The soils were transported to the landfarm treatment cell (LTC) for treatment.

Following excavation, 10 composite sidewall soil samples were collected and submitted for laboratory analysis. The purpose of the sidewall sampling was to demonstrate that all fine-grained source soils in the area of Excavation Area 1 had been removed. As shown on Figure 4, three of the 10 samples exceeded the performance standards for PCE, indicating that not all fine-grained source soils had been removed. The sidewall soil confirmation sample results for Excavation Area 1 are shown on Figure 5.

Soil borings SB561, located in the slope pit source area, and SB564, located in the northwest source area near the slope pit source area, were step-out borings collected on the final day of the August 2016 primary fine-grained soils assessment (Figure 4). Soil samples collected from both soil borings exceeded the performance standards for PCE (Tasman, 2017a). However, due to the conclusion of the primary August 2016 primary fine-grained soils assessment, no further step-out borings could be performed. Therefore, additional delineation will be conducted to further refine the slope pit source area/Excavation Area 1 boundary.

The extent of Excavation Area 1 and the location of the LTC is shown on Figure 4. Additional excavation of the slope pit source area will be conducted in 2018, following this additional delineation of fine-grained source soils. The remaining phased excavations of OU2 fine-grained source soils (Excavation Areas 2 through 6) will continue to be sequenced during subsequent summers with the goal of completing one excavation area per summer over a six-year period (Tasman, 2017c).

Based on current data, the OU2 contaminated groundwater plume sourced at Soco is estimated to extend from the Soco property to the northwest then north to the Yellowstone River. Figures 6A through 6C illustrates estimated groundwater PCE concentration contours at OU2 for October 2016, the latest groundwater monitoring event for which data have been reported. Concentration contours for the other three COCs follow similar trends although at different concentrations (Tasman, 2017b).

2.2 Hydrogeology

Three principal hydrogeologic units have been identified at OU2 during previous investigations: a fine-grained (silty clay and silty sand) unit, a sand and gravel unit, and shale/sandstone bedrock. These units are displayed graphically in a southeast-northwest oriented cross-section, as shown on Figure 7A and in west-northeast oriented cross-sections, as shown on Figures 7B and 7C. The thickness of the vadose zone generally decreases from south to north across OU2. Vadose zone thickness in the southern part of the Soco property (MW001) is approximately 15 feet bgs, decreasing to approximately 10 feet bgs at the main tank farm, and decreasing to approximately 7 feet bgs near the Montana Terrazzo and Kuck properties.

Five to six feet of impermeable compacted fly ash fill material is present in the vicinity of the former acid tank farm. This material was placed as a base material for the acid tank farm during construction in the 1980's.

The potentiometric surface is generally observed in the moderate- to low-permeability silty clay and silty sand unit, sometimes referred to as the fine-grained section. The upper portion of the saturated interval over the majority of the Soco source area is the fine-grained silty clay/sand unit. The underlying alluvial gravel and sand unit varies in thickness from approximately 12 to 25 feet. The sand and gravel unit is derived from bed-load channel deposition of the Yellowstone River and is composed of silty sands with gravels and cobbles. Average thickness of the gravel and sand unit across OU2 is approximately 15 feet.

The sand and gravel unit is saturated throughout the area. Permeability characteristics of the unit are variable, but monitoring wells generally exhibit little or no drawdown during purging and sampling activities (TtEMI, 2004). Based on the apparent disparity in hydraulic conductivity between the fine-grained section and the sandy gravel unit, it is believed that alluvial groundwater flows occur primarily through the sandy gravel. Alluvial aquifer potentiometric surface maps (Figures 8A and 8B), prepared using data collected during the October 2016 groundwater sampling event, indicated a general northwest flow of groundwater at the Soco property. The potentiometric surface gradient for October 2016 was approximately 0.007 feet per foot, which is consistent with historic groundwater gradients (Tasman, 2017b).

2.2.1 Saturated Zone Impacts

COC-impacted subsurface soils are sourcing a groundwater plume that leaves the Soco property on an axis flowing northwest then shifting more northerly and ultimately discharging into the

Yellowstone River. Confirmed groundwater COC concentrations – those detected above both the detection and reporting limits – have been measured as high as 120,000 µg/L for PCE (PT-06, April 2002)[1], 1,020 µg/L for TCE (PT-05, May 2003), 18,700 µg/L for *cis*-1,2-DCE (MW102, October 2006), and 2,460 µg/L for VC (MW102, April 2007).

In contrast, during the October 2016 groundwater sampling event, the latest groundwater monitoring event for which data has been reported, the highest groundwater COC concentrations reported were 17,900 µg/L for PCE in PT-06; 363 µg/L for TCE in MW404-D; 3,590 µg/L for *cis*-1,2-DCE in MW405-I; and 322 µg/L for VC in MW405-I (Tasman, 2017b). The estimated groundwater PCE concentration contours from October 2016 are illustrated on Figures 6A through 6C. Concentration contours for the other three COCs follow similar trends, although at different concentrations (Tasman, 2017b).

2.3 Historic Soil Data

All available existing soil data from OU2 from 1999 to 2016, compiled in AutoCAD, was used to guide the proposed initial boring locations shown on Figure 4. Data from the following investigations were used to generate Figure 4:

- "DP" borings (Lockheed-Martin, 1999);
- "BH" borings (Maxim, 2000);
- "PT" monitoring wells (SECOR, 2002);
- "MW" wells (TtEMI, 2003a);
- "MP" borings (TtEMI, 2003b);
- "PZ" piezometers and "SB" soil borings (ATC, 2003);
- "MW" 400 series borings/wells (Cardno, 2013b);
- "MW" 400 series borings/wells and co-located "PT" borings (Cardno, 2014); and
- "SB" soil borings (Tasman, 2017a).

The soil sample locations presented on Figure 4 are the most recent data collected from each location. Data related to specific sampling locations, such as concentrations, lithologic data, water level data, field parameter data, etc., may be available in the respective installation reports referenced above.

The data presented is not intended to represent current conditions, and the data must be interpreted within the context of the collection methodology, the collection date, and pilot testing and/or changing site conditions that may have occurred since collection. As such, the detections/responses posted on the figure may not be indicative of current COC concentrations at OU2.

[1] In addition to the PCE measured at 120,000 µg/L in PT-06 in April 2002, a PCE concentration of 72,000 µg/L was reported in PT-02 during the same sampling event. Both of those wells are located in the northwest source area. Those concentrations exceed EPA's "rule-of-thumb" in which groundwater concentrations greater than 1 percent of pure phase solubility, i.e., 1,500 µg/L for PCE at 20°C may indicate the presence of dense non-aqueous phase liquid (DNAPL; EPA, 2009 and 1992a).

3.0 SOILS DELINEATION OBJECTIVES

The objectives of the additional fine-grained source soils delineation include:

- Evaluate the nature and extent of soil COC concentrations within the fine-grained section north of Coulson Ditch on the Kuck property, and further refine source area excavation boundaries south of Coulson Ditch, including areas around Excavation Area 1 (Figure 4).
- Delineate soil impacts in three dimensions within the fine-grained section, where COCs exist above ROD performance standards (Table 1);
- Evaluate spatial changes in the thickness of the fine-grained section;
- Collect data for treatment and/or excavation of additional fine-grained source soils; and
- Collect data to estimate location and volume of additional soils with COC concentrations above ROD performance standards.

3.1 Data Quality Objectives

To achieve the overall objectives, the following detailed data quality objectives (DQOs) for the additional delineation of fine-grained source soils have been developed based on the EPA's seven-step DQO process (EPA, 2006).

Step 1: Problem Statement

VOCs have been released to soil and groundwater. COC impacted groundwater, exceeding ROD performance standards (Table 1), is sourced at the Soco property. Soils continuing to source groundwater exceedances are located within the RDA Study Area (Cardno, 2013a).

Step 2: Identify the Goals of the Study

- Chemically characterize the fine-grained section in the area immediately north of Coulson Ditch on the Kuck property and further refine source area excavation boundaries south of Coulson Ditch, including areas around Excavation Area 1 (Figure 4).
- Understand the fine-grained soils spatially, based on the lithology of each boring and chemical laboratory analytical data.
- Collect data necessary to develop an addendum to the RAWP (Tasman, 2017c) for future treatment and/or excavation, if any additional fine-grained source soils are located north of Coulson Ditch.
- Collect data necessary to better define source area excavation boundaries (Excavation Areas 1 and 3 through 6), defined in the RAWP (Tasman, 2017c).

Step 3: Identify Information Inputs

The information input necessary to meet the goals listed in Step 2 will consist of soil environmental field data and chemical laboratory analytical data.

Step 4: Define Study Boundaries

Study boundaries are defined by the extent of soil impacts in the fine-grained section north of Coulson Ditch on the Kuck property and areas south of Coulson Ditch, including areas around Excavation Area 1 (Figure 4). The lateral extent of the assessment will be limited to the area of vadose zone soils that exceed performance standards. The extent will be determined using direct-push borings, field screening of soil samples and rapid turnaround time of laboratory soil analyses. The assessment will be conducted on the Soco, Keller and Kuck properties. The temporal boundary of the delineation assessment will continue until soil excavation is completed under the RAWP (Tasman, 2017c) and any subsequent RAWP revisions.

Step 5: Develop the Analytic Approach

Decisions will be made based on the results and analytical data defined in Step 3. As soil sample results are available, utilizing 24-hour turnaround time, the data will be used in real-time to determine, if, and where, additional borings and samples are needed to more accurately delineate additional fine-grained soils that exceed ROD performance standards (Table 1). Preliminary tabulated analytical data and TOV concentration data will be submitted to EPA and DEQ upon receipt for discussion and decision-making purposes throughout the field assessment activities. It is anticipated that approximately 35 borings will be necessary to fully characterize the fine-grained soils.

Step 6: Specify Performance or Acceptance Criteria

Performance and acceptance criteria for the environmental field and laboratory analytical data are identified in Section 5.0, Quality Control.

Step 7: Develop Data Acquisition Plan

All data will be acquired in accordance with the provisions of this Work Plan, the SOPs included in Appendix A and the OU2 project approved RDAQAPP (Cardno, 2013a).

4.0 FIELD INVESTIGATION AND PROCEDURES

Field activities will be conducted in a manner consistent with the procedures set forth in the SOPs included in Appendix A and the RDAQAPP (Cardno, 2013a). Activities will be performed in accordance with the ROD (EPA/DEQ, 2005), SOW (EPA/DEQ, 2011a), and in accordance with the requirements of the CD for OU2 (EPA/DEQ, 2011b). Likewise, all work performed under this Work Plan will be performed in accordance with the OU2 HASP, included in the RAWP (Tasman, 2017c).

The following sections describe the tasks involved in conducting the additional fine-grained soil delineation, including the proposed sampling and analysis activities.

4.1 Pre-Investigation Activities

4.1.1 Site Access

To implement the scope of work presented in this Work Plan, access to two non-Soco-owned properties, Keller Transport, Inc. and Kuck Trucking Inc., will be necessary.

4.1.2 Utility Clearance

All underground utilities will be located and marked prior to beginning intrusive field activities. If necessary, a private utility locator will be used. Overhead utilities are located on the Kuck property. If borehole positions must be adjusted, the positions will be adjusted to the minimal extent necessary to adequately clear utilities and still maintain, to the extent possible, the locations shown on Figure 4. No overhead utilities are expected to be encountered during drilling operations on the Soco or Keller properties.

4.2 Field Data Generation and Acquisition

4.2.1 Boring Installation

Prior to installation, the proposed initial boring locations shown on Figure 4 will be surveyed and marked in the field. If borehole positions must be adjusted, the positions will be adjusted to the minimal extent necessary to adequately clear physical obstructions, utilities, existing wells, sparge points, vapor recovery trenches, conveyance piping, slopes and other physical obstructions while still maintaining, to the extent possible, the locations shown on Figure 4. Any modifications will be noted in the site-specific dedicated field notebook or Borehole Lithologic Log (Appendix C), following SOP 051-102 Field Forms (Appendix A).

Borings will be advanced using direct-push technology with each continuous core/sample interval being approximately four feet. Borings will be advanced until the clay/sand gravel is clearly defined, which varies from approximately 12 to 18.5 feet bgs. Soil samples will be collected from each four-foot core during boring installation with adequate recovery of fine-grained soils for field screening and/or laboratory analysis – although not all samples will be submitted for laboratory analysis. Soil samples will be collected according to SOP-051-301 included in Appendix A and protocols presented in the RDAQAPP (Cardno, 2013a).

During boring installation:

- After opening the disposable plastic soil sample sleeve (core liner), field personnel will log each sample interval and complete a borehole lithologic log (Appendix C) for each boring in general accordance with ASTM Method D 2488-90. The lithology will be described according to the Unified Soil Classification System (USCS), including color, consistency, and evidence of impacts, sheen and moisture content. Additionally, each core will be visually screened for the presence of dense non-aqueous phase liquid (DNAPL).

- Representative soil samples will then be collected from each four-foot continuous core/sample interval for field screening and potential laboratory analysis. A portion of each core/interval will be immediately transferred by hand from the open core liner into a re-sealable plastic bag and sealed, labeled, and exposed to direct sunlight for approximately 10 to 15 minutes to allow for the volatilization of organic vapors, in accordance with SOP-051-400, Organic Vapor Headspace Measurement (Appendix A). If no obvious change in the core is observed, a composite sample from the entire four-foot core will be collected for field screening or if any obvious change in the core is observed, such as change in lithology, staining, or suspected presence of DNAPL, individual sections of each core/interval will be collected, and field screened separately. Following equilibration, the soil samples will be field-screened for the presence of organic vapors by inserting the probe of a PID into the headspace of each field screening sample bag. The total organic vapor (TOV) headspace concentrations will be measured in parts per million by volume (ppm) for each sample and recorded on the field Borehole Lithologic Log (Appendix C).

- During field screening of each continuous core, soil samples will simultaneously be collected by hand from the opened core liner and placed in laboratory-supplied 125 mL labeled sample jar until full to minimize headspace – although not all samples will be submitted for laboratory analysis. Up to three soil samples may be submitted for laboratory analysis per boring based on field screening results and visual observations. Until it can be determined from field screening and visual observation of the entire boring, all potential soil samples will be jarred simultaneously to minimize the potential for loss of VOCs. After field screening for a boring is completed, soil samples that exhibited the highest associated TOV concentrations and/or visual change in lithology or staining will be submitted for laboratory analysis. If no apparent impacts are observed and/or all TOV concentrations are non-detect for a boring, at a minimum, a soil sample will be collected from the bottom of the fine-grained section and submitted for laboratory analysis.

- Soil samples will be placed in labeled laboratory-supplied sample containers in accordance with SOP-051-105 Sample Packaging and Shipping presented in Appendix A. Soil samples will be documented on a chain-of-custody form, packed in iced coolers and transported to Energy Laboratories Inc. (Energy) using chain-of-custody procedures presented in SOP-051-105. At approximately 12 pm each business day, Energy personnel will pick up samples on site and Tasman personnel will deliver samples to Energy at the end of each business day, prior to 5 pm. The soil samples will be analyzed by EPA Method 8260B for VOCs within approximately a 24-hour turnaround time, as discussed in Section 5.1.

- As soil sample results are available, in concurrence with the EPA and DEQ, the data will be used in real-time to determine if and where additional borings and samples are needed,

or not needed, to more accurately delineate fine-grained soils that exceed ROD performance standards (Table 1). Preliminary tabulated analytical data and TOV concentration data will be submitted to EPA and DEQ upon receipt, for discussion and decision-making purposes, throughout the field assessment activities. It is anticipated that approximately 35 borings will be necessary to fully characterize the additional fine-grained soils.

- All boreholes will be sealed from the bottom of the boring to the ground surface with bentonite following procedure outlined in SOP-051-301 Subsurface Soil Sampling: Well/Borehole Installation, included in Appendix A.

- Investigation-derived waste (IDW) soil cuttings generated during drilling will be containerized in drums in accordance with SOP-051-502 Management of Solid Matrix Investigation-Derived Wastes (Appendix A). Any liquid collected from decontamination procedures will also be properly contained and managed in accordance with SOP-051-501 Management of Liquid Matrix Investigation-Derived Wastes. IDW solids and liquids will be managed as discussed in Section 8.0.

Per Section IX, paragraph 26.a.(4) of the CD, if the EPA, DEQ, or individual property owners request a split sample, they must supply all necessary sample bottles, supplies and materials required for sampling, as well as arrange and pay for laboratory analyses of all split samples collected. However, there is a limited amount of soil available during boring installation and there may be an insufficient volume to collect soil for PID readings, laboratory samples, and split samples.

After intrusive activities are complete, locations of all direct-push soil borings will be surveyed as discussed in Section 4.2.2.

4.2.2 Borehole Location Survey

The direct-push borehole locations will be surveyed by a professional engineer registered in the State of Montana for location and elevation. Horizontal locations will be surveyed to an accuracy of ±0.1 foot with the State Plane NAD83 HARN Coordinate System as the horizontal datum. The vertical elevation of all boreholes and excavations will be surveyed to an accuracy of ±0.01 foot.

4.3 Sample Documentation and Shipment

Field documentation and sample handling procedures are detailed below, including sample identification and labeling, documentation, chain-of-custody and shipping. All documentation will also be conducted in accordance with the RDAQAPP (Cardno, 2013a).

4.3.1 Field and Sample Documentation

Recording of notes on field data sheets or in a field notebook will follow SOP 051-102 Field Forms, included in Appendix A. Field personnel will use permanently-bound field notebooks to record and document field activities. The field notebooks will identify project name, names of subcontractors and project personnel. All field entries will be written in black or blue indelible ink. All corrections will be made utilizing a single line through the error, along with the date the correction was made, and the field personnel's initial. At a minimum, the following information will be recorded in the field notebook:

- Date and time initiating work and weather conditions during the field activity;
- Documentation will be completed in permanent blue or black ink;
- All entries will be legible;
- Errors will be corrected by crossing out the error with a single line and then dating and initialing the lineout; and
- Unused portions of pages will be crossed out, and each page will be signed and dated.
- Name and affiliation of all on-site personnel or visitors;
- Notes of conversations with coordinating officials;
- Description of site conditions and any unusual circumstances or problems encountered and the associated resolution;
- References to other field notebooks or forms that contain specific information;
- Equipment ID numbers, if relevant;
- Details of actual work effort, particularly any deviations from this Work Plan or other governing documents;
- Field observations; and
- Any field measurements made (e.g., pH), description of any photographs taken, etc. that are not recorded on project or task specific field data sheets.

Field personnel are responsible for ensuring that sampling activities are properly documented. The field team will also use the various field forms included in Appendix C of this addendum to record field activities.

4.3.2 Sample Identification

Each sample collected will be assigned a unique sample identification. The sample identification system is designed to be compatible with the existing database which includes results from previous investigations conducted at OU2 of the LSGPS. The sample numbering system allows each sample to be uniquely identified and provides a means of tracking the sample from collection through analysis.

Borings installed as part of this Work Plan, will be sequentially numbered beginning with 600. Beginning with the 600 series will indicate soil borings installed as part of this additional delineation, similar to the 400 and 500 series soil borings of the initial primary fine-grained source soil delineation in August 2016 (Tasman, 2017a). Each sample will be assigned a distinctive identification number with alpha characters indicating the station type followed by three numeric characters identifying the station number. For each sample location that is representative of a sample depth, numeric characters indicating the depth of the sample collected will follow the station number. For daily equipment rinsate blank samples, numeric characters indicating the

date of the sample collected will follow the station number. Two letters indicating the sample media type for liquid matrix IDW samples will follow the station number. The unique sample identification system will be followed for the collection of duplicate samples, although the series number assigned will be a 700 number if the sample is collected.

Possible station types include:

- SB - Soil Boring
- RB - Equipment Rinsate Blank
- IDW - Investigation-Derived Waste

Possible sample media include:

- LM - Liquid Matrix IDW

Any soil matrix IDW generated will be transferred to drums then transported to the LTC, for treatment, as discussed in Section 8.1.

Example sample identifications include:

- Soil sample collected from borehole SB601 four to eight feet bgs: SB601-4-8.
- Soil sample collected from borehole SB602 four to eight feet bgs: SB602-4-8.
- Duplicate soil sample collected from borehole SB601 four to eight feet bgs: SB701-4-8.
- Duplicate soil sample collected from borehole SB610 four to eight feet bgs: SB710-4-8.
- Daily equipment rinsate blank collected on May 14, 2018: RB-05142018.
- The first liquid matrix IDW sample: IDW001LM.

Field quality control samples are discussed further in Section 5.3.

4.3.3 Sample Labels

A sample label will be affixed by Energy to all sample containers. The label will be completed with the following information written in indelible ink:

- Sample identification number;
- Date and time of sample collection; and
- Preservative used, if applicable.

4.3.4 Chain-of-Custody

Tasman will use standard sample custody procedures to maintain and document sample integrity during collection, transportation, storage, and analysis in accordance with the Sample

Documentation SOP-051-104, included in Appendix A. An example of a chain-of-custody and analytical request record is included in Appendix C.

A sample will be considered to be in custody if one of the following statements applies:

- The sample is in a person's physical possession or view;
- The sample is in a secure area with restricted access; or
- The sample is placed in a container and secured with an official seal such that the sample cannot be reached without breaking the seal.

Chain-of-custody procedures provide an accurate written record that traces the possession of individual samples from the laboratory, to collection in the field, to the time of acceptance at the laboratory. Chain-of-custody records also will be used to document all samples collected and the analysis requested. Information that the field personnel will record on the chain-of-custody record includes:

- Project name;
- Name and signature of sampler;
- Sample location/identification number;
- Date and time of collection;
- Number and type of containers filled;
- Analysis requested;
- Preservatives used (if applicable);
- Sample designation (grab or composite);
- Signatures of individuals involved in custody transfer, including the date and time of transfer; and
- Project contact and phone number.

4.3.5 Sample Packaging and Shipment

In general, field personnel will follow sample shipment procedures provided in SOP-051-105 Sample Packaging and Shipping, included in Appendix A. However, because samples will be hand-delivered to Energy or picked up by Energy personnel from OU2, not all shipping procedures are necessary. The following procedures will be implemented for VOC samples collected for this project and hand-delivered to Energy:

- The cooler will be filled with bubble wrap, sample bottles and packing material. Sufficient packing material will be used to prevent sample containers from breaking during delivery.

Enough ice will be added to maintain the sample temperature at ≤6ºC for coolers containing soil and water samples to be analyzed for VOCs, as noted in Table 2.

- When the cooler is hand-delivered to the analytical laboratory or picked up by Energy personnel from OU2, laboratory personnel will sign the chain-of-custody record to document transfer of samples.

4.4 Sample Containers, Preservation and Holding Times

The type of sample containers to be used for each analysis, the sample volumes required, the preservation requirements and the maximum holding times for sample extraction and analysis are presented in Table 2 for soil, water (equipment blanks) and liquid IDW samples. A summary of the estimated total number of liquid matrix samples is included in Table 3 (based on a boring/sampling period of approximately one week).

4.5 Decontamination

Decontamination procedures will be used in conjunction with safe-handling methods to prevent sample contamination, including minimizing contact with wastes, and maximizing worker protection. Proper personal protective equipment (PPE) will be used in accordance with the OU2-specific HASP, included in Appendix B. Water derived from decontamination will be collected and temporarily stored on Soco-owned property as liquid IDW. Personnel will decontaminate all reusable equipment (core barrels and drilling rod) between boring or sampling locations and before leaving OU2 to prevent off-site transport of contamination in accordance with SOP 051-101 Sample Equipment Decontamination – Organic Contamination, included in Appendix A. Equipment decontamination is not required when disposable equipment is used.

All reusable sampling equipment will be decontaminated following each use. Decontamination will be performed in an area southeast of the former tank farm area so as to prevent cross-contamination of other field equipment. Drilling core barrels and rods will be decontaminated by using Liquinox or an equivalent degreasing detergent, scrub brushes and a pressure washer supplied with clean (tap) water to thoroughly rinse the equipment. The drilling equipment will be decontaminated over a collection trough. The liquid IDW decontamination water will then be pumped from the trough, as needed, into a polyethylene holding tank and treated by air sparging, as discussed in Section 8.2.

Following decontamination of equipment, rinsate blanks will be collected at a frequency of one equipment blank per day, as discussed in Section 5.3.2. Equipment rinsate blanks are collected by pouring or running distilled water over or through the equipment and into sample containers (i.e., VOA vials). Equipment rinsate blanks will be submitted to Energy for VOC analysis according to EPA Method 8260B.

5.0 QUALITY CONTROL

Tasman will assess the quality of field data through regular collection of field QC samples in accordance with the RDAQAPP (Cardno, 2013a) and SOPs (Appendix A). Soil laboratory QC samples will also be analyzed in accordance with the RDAQAPP-referenced analytical method protocols to ensure that laboratory procedures and analyses are conducted properly and that the quality and usability of the data is known.

5.1 Analytical Methods

Soil samples collected will be analyzed for VOCs according to EPA Method 8260B (see RDAQAPP for method details) by Energy with a rapid turnaround time. To utilize a normal extraction process, a standard method reporting limit (MRL) of 0.1 mg/kg will be used for VOCs in solid media (with the exception of 4.0 mg/kg for methyl ethyl ketone). Section 1.4.2 of the RDAQAPP discusses the QA objectives and Section 2.7 of the RDAQAPP discusses control limits (Cardno, 2013a). Appendix D of the Fine-Grained Soils Work Plan (Tasman, 2017a) includes a copy of Section 1.4.2 and Section 2.7, along with the associated subsections, from the RDAQAPP.

Soil samples will be submitted for rush 24-hour turnaround time. As the delineation progresses and laboratory results become available, another appropriate analysis turnaround time may be used. In the interest of the expedited 24-hour turnaround time, TOV headspace concentrations from field screening for each sample will be recorded in the comments section of the chain-of-custody for Energy's review to better facilitate sample analysis. Energy will complete a basic assessment with quantitation up to 4 mg/kg and provide a preliminary report with the estimated values within approximately 24 hours of submitting soil samples. Energy will later submit a final report with all values quantified under a normal turnaround time. Appendix E of the Fine-Grained Soils Work Plan (Tasman, 2017a) includes a list of all the VOC compounds that will be analyzed.

5.2 Data Quality Indicators/Performance Measurement Criteria

Data will be evaluated in accordance with the following data quality indicators (DQIs) to ensure that DQOs, as identified in Section 4.1, are achieved: precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS). These DQIs are among those recommended by the EPA for data quality evaluation and measurement criteria (EPA, 2001a and 2001b). Section 1.4.2 and associated subsections of the RDAQAPP discuss in detail the objectives and goals relating to each of the PARCCS parameters (Cardno, 2013a).

5.3 Field Quality Control

QC samples are collected in the field and analyzed to check sampling and analytical precision and accuracy. The following section discusses the types and purposes of field QC samples that will be collected for this project. Table 4 presents the types and frequency of collection of field QC samples.

5.3.1 Field Duplicates

Field duplicate samples are collected at the same time and from the same source and then submitted as separate samples to the laboratory for analysis. Field duplicates will be collected at a frequency of one per 20 samples (five percent) for soil samples for VOC analysis. As discussed

in Section 4.3.2, samples will be assigned a unique sample identification number that is blind to the laboratory.

5.3.2 Equipment Blank Samples

Equipment blank (rinsate) samples demonstrate whether decontamination procedures are effective in removing contaminants from the field sampling equipment. The presence of contamination in equipment blank samples indicates that decontamination procedures were not effective, allowing for the possibility of cross-contamination. Equipment blank samples will be collected during soil sampling at a frequency one per day for VOC soil samples. An equipment blank is a sample collected after a sampling device is subjected to standard decontamination procedures. Water will be poured over or through the decontaminated sampling equipment, such as a core barrel or drilling rod, into a sample container and sent to the laboratory for analysis. Distilled water will be used for organic parameters. Equipment blank samples will be sent blind to the laboratory for VOC analysis according to EPA Method 8260B. During data validation, the results for the equipment blank samples will be used to qualify data or to evaluate the levels of analytes in the field samples collected on the same day.

5.3.3 Trip Blanks

A trip blank consists of a laboratory-prepared sample of reagent-grade water and provides a measure of potential cross contamination of samples by VOCs during shipment and handling. One trip blank will accompany each sample cooler containing water samples (field equipment rinsate blanks) intended for VOC analysis and will be subjected to the same handling procedures as the field samples, but will not be opened. The trip blanks will be transported back to the laboratory with the field samples. Trip blanks are required only when water samples will be analyzed for VOCs, as noted in Table 3.

5.3.4 Temperature Blanks

Temperature blanks will be used to ensure that samples remain at the proper preservation temperature prior to analysis (≤6°C). There shall be one temperature blank per cooler that is transported to the laboratory, as noted in Table 3. The blank will be used by the laboratory sample custodian to check the temperature of samples upon receipt.

5.4 Laboratory Quality Control

The laboratory quality assurance manager (QAM) is responsible for ensuring that the laboratory's data precision and accuracy are maintained in accordance with method and laboratory specifications. Details of requirements for Energy QC are presented in 1.4.2.4 of the RDAQAPP (Cardno, 2013a).

The laboratory QAM is responsible for ensuring that the laboratory's data precision and accuracy are maintained in accordance with method and laboratory specifications. Internal laboratory duplicates and calibration checks are performed at a frequency of five percent, i.e., one for every 20 samples submitted for analysis per sample delivery group (SDG). Other internal laboratory QA/QC may be performed if required by laboratory-specific QA/QC protocols.

Matrix spikes and matrix spike duplicates (MS/MSDs) measure matrix-specific method performance and will be used to assess accuracy and precision. MS/MSD samples will be used to assess the influence of the sample media (media interference) on the analysis. Samples for

MS/MSD analysis will be site specific and analyzed at a frequency of five percent or at a minimum one per SDG. Each MS/MSD sample will be spiked with the compounds specified by the analytical method prior to sample extraction or analysis in accordance with Energy's SOPs. MS recovery criteria are presented in Section 1.4.2.2.2 of the RDAQAPP (Cardno, 2013a).

5.5 Field Variances

As conditions in the field may vary, it may become necessary to implement minor modifications to sampling as presented in this Work Plan. When appropriate, the EPA and DEQ will be notified and a verbal approval will be obtained before implementing the changes. Any deviations or variances to the approved plan will be documented in the field logbooks and the report documenting the delineation and physical characterization of the fine-grained source soils.

6.0 DATA ANALYSIS AND INTERPRETATION

Data collected during the additional fine-grained soil delineation activities will be evaluated and used to supplement the RAWP (Tasman, 2017c) for soil excavation and treatment of source soils exceeding ROD performance standards with ex-situ land farming on Soco-owned property. Soil sample results will be used to determine extent and depth of contamination in the fine-grained source soils and allow for targeted excavation of soils requiring ex-situ treatment.

7.0 HEALTH AND SAFETY

All work performed under this Work Plan will be performed in accordance with the LSGPS OU2 project HASP, included in Appendix B and any associated updates. The project HASP contains emergency contact information and directions to the hospital, as well as potential hazards that may be encountered. The HASP also contains Job Safety Analysis (JSA) forms that identify the routine safety and health hazards associated with a task/operation performed. All personnel working on-site at OU2 must review and sign the HASP. Additionally, a daily tailgate safety meeting, identifying equipment, hazards, and specific job tasks, activities or operations to be performed for that day, will be conducted prior to beginning each project work day and any time there are changes to the site or operations. The daily Tailgate Safety Meeting Form to be completed is included in Appendix C. The RAWP lists the health and safety training requirements for personnel who work on-site at OU2 and are not repeated here (Tasman, 2017c). Copies of Tasman's health and safety training records are maintained in project files in the Billings, Montana office.

8.0 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

IDW will be generated during the soil delineation activities that includes, but is not limited to, solid and liquid IDW. All IDW generated will be properly stored on Soco-owned property before treatment, disposal or off-site disposal.

8.1 Soil IDW

Solid matrix IDW will include soil cuttings from soil borings. Solid matrix IDW generated will be transferred to drums then transported to the LTC, located on Soco-owned property (Figure 4). Under the RAWP (Tasman, 2017c), the solid matrix IDW will subsequently be plowed/tilled with the Excavation Area 1 fine-grained source soils (slope pit source area soils), already placed in the LTC (November 2017).

Drums containing solid matrix IDW will be clearly labeled and will identify the source of the containerized material, in accordance with SOP-051-502 Management of Solid Matrix Investigation-Derived Wastes, included in Appendix A. IDW containers will be labeled using a weather-resistant paint pen or drum label with the following information:

- Source of the soil IDW;
- Type of material;
- Sampling identification(s);
- Date the container was filled and sealed; and
- Point of contact with phone number.

8.2 Liquid IDW

Liquid matrix IDW will be temporarily stored in drums or polyethylene tanks and treated by air sparging in a storage area located on Soco-owned property. The treated IDW water will then be sampled in accordance with SOP-051-504 Sampling of Liquid Matrix Investigation-Derived Wastes, included in Appendix A. The samples will be submitted to Energy for laboratory analysis of VOCs using EPA Method 8260B to evaluate the effectiveness of treatment. When laboratory results indicate the IDW water treatment achieves the OU2 Soco-owned property disposal criteria discussed in the RDAQAPP, the water will be surface discharged on Soco-owned property (Cardno, 2013a).

If laboratory results from the IDW sample indicate the treatment did not achieve cleanup standards for VOCs, the EPA and DEQ will be notified that Tasman intends to dispose of the liquid IDW off-site or propose an alternate treatment method, based on the constituent which did not meet surface discharge standards. If off-site disposal is proposed, Tasman will select a disposal facility based on the constituent or constituents that do not meet the discharge limits and will notify the EPA and DEQ of the location where the waste will be shipped, prior to shipment.

8.3 Solid Waste IDW

Non-hazardous IDW, such as PPE and disposable investigation equipment (core liners) that is generated throughout the investigation activities will be placed in dedicated heavy-duty plastic garbage bags or containers and will be disposed of at the Billings Regional Landfill, located in Billings, Montana, in accordance with the SOP 051-502 Management of Solid Matrix Investigation-Derived Wastes, included in Appendix A. PPE and disposable investigation

equipment that have been decontaminated, if warranted, are considered refuse and do not require characterization prior to disposal as non-hazardous solid waste.

9.0 REPORTING

The results of this additional delineation of fine-grained source soils will be incorporated into a report and submitted to the EPA and DEQ for review and approval. The report will describe sampling and monitoring activities and summarize the data collected. The report will include all field and laboratory data generated including QA/QC samples and the results of the data verification and validation performed on the data. The report shall also include an appendix with all the field and laboratory data.

The report will be submitted to EPA and DEQ for review no later than 90 days after receipt of the final laboratory data/data validation packages. Following review by the EPA and DEQ, a final data report will be prepared and submitted. EPA and DEQ comments and responses to each comment on the draft report will be incorporated into the final report. The report will follow EPA guidance (EPA, 1992b) which includes, but is not limited to a discussion or presentation of the following:

- Description of activities conducted under this Work Plan;
- Deviations from this Work Plan;
- Unforeseen problems;
- General field observations;
- Field parameters measured;
- QA/QC samples and procedures;
- Tables of laboratory results for all parameters analyzed;
- Analytical results discussion;
- QA and data validation results;
- Figures showing sample location, sample number, and contaminant concentrations;
- Estimated volume of soils requiring treatment based on ROD performance standard exceedances;
- Update estimated extent of additional fine-grained soils that exceed ROD performance standards;
- Conclusions and recommendations;
- Copies of field logs and boring logs;
- Photographic log, if applicable;
- Copies of raw analytical data and data validation packages; and
- Compact disc of the updated Microsoft Access© database.

10.0 SCHEDULE

The drilling and soil sampling is tentatively scheduled to be conducted the week of May 14, 2018. Drilling and soil sampling activities will begin on the Kuck property and transition to the Soco and Keller properties. It is anticipated the assessment will take approximately three days to complete 35 borings and up to five days if additional borings are needed.

11.0 PROJECT ORGANIZATION

The project organization for management, implementation and oversight for OU2 is presented in the RAWP (Tasman, 2017c). EPA Region 8 Remedial Project Manager (RPM), Mr. Roger Hoogerheide, will coordinate with the DEQ Project Officer (PO), Mr. Richard Sloan, on oversight and management of this project. Mr. Jim Sullivan, of Tasman, will act as Soco's Project Manager. In addition, Tasman will designate an On-Site Field Supervisor to be on-site at OU2 during all field activities. The On-Site Field Supervisor need not always be the same person but will be a Tasman employee meeting all project training and experience requirements. The remaining project key personnel are listed in the RAWP and not repeated here.

11.1 Agency Oversight

Agency field oversight may be conducted during all field activities associated with this project as indicated in Section IX, paragraph 26.a.(1) of the CD (EPA/DEQ, 2011b). Agency oversight personnel will be briefed by the Tasman On-Site Field Supervisor prior to conducting oversight activities. Agency oversight personnel are required to participate in the daily tailgate safety meeting prior to beginning each project work day and any time there are changes to the site or operations and sign the tailgate safety meeting form each day that Agency personnel are on site providing oversight. Additionally, the EPA and DEQ may obtain samples from the activities at OU2, as described in Section 4.2.1.

12.0 REFERENCES

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Tables

TABLE 1
ROD CLEANUP PERFORMANCE STANDARDS
REVISED ADDENDUM 01 TO THE REVISED RDA WORK PLAN FOR THE DELINEATION AND PHYSICAL CHARACTERIZATION OF FINE-GRAINED SOURCE SOILS
OPERABLE UNIT 2
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

Contaminant of Concern	Performance Standards	
	Groundwater (µg/l)	Source Area Soil (mg/kg)
Tetrachloroethene	5.0	0.65
Trichloroethene	5.0	0.72
cis-1,2-Dichloroethene	70.0	4.90
Vinyl chloride	2.0	0.16

Source: EPA/DEQ, 2005

TABLE 2
SAMPLE CONTAINER, HOLDING TIME, AND PRESERVATIVE REQUIREMENTS
REVISED ADDENDUM 01 TO THE REVISED RDA WORK PLAN FOR THE DELINEATION AND PHYSICAL CHARACTERIZATION OF FINE-GRAINED SOURCE SOILS
OPERABLE UNIT 2
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

Matrix	Parameter	Method No.	Sample Volume	Sample Container	Containers per Sample	Preservative	Shipping Temp	Holding Time[A]
Organic Sample Analyses								
Liquid (Equipment Blanks)	VOCs	8260B	40 milliliter (mL)	VOA vial	3	Hydrochloric acid (HCl)	≤6°C	14 days
Solid	VOCs	8260B	125 mL	Wide mouth glass	1	None	≤6°C	14 days
Investigation-Derived Waste Analyses								
Liquid	VOCs	8260B	40 mL	VOA vial	3	HCl	≤6°C	14 days

Notes:
A The number refers to the maximum number of days from sampling to analysis.

TABLE 3
SUMMARY OF LIQUID AND SOLID MATRIX SAMPLES
REVISED ADDENDUM 01 TO THE REVISED RDA WORK PLAN FOR THE DELINEATION AND PHYSICAL CHARACTERIZATION OF FINE-GRAINED SOURCE SOILS
OPERABLE UNIT 2
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

Matrix	Parameters	Estimated Number of Samples	Estimated Number of Equipment Rinsate (at 1 per day)[a]	Estimated Number of Duplicates (5%)[a]	Estimated Total Number of Samples[b]
Organic Sample Analyses					
Liquid	VOCs	0	3	0	3
Solid	VOCs	35	--	2	37
Investigation-Derived Waste Analyses					
Liquid – IDW	VOCs	1	0	0	1
Solid – IDW	VOCs	0	0	0	0

Notes:
a. It is anticipated the assessment will take approximately three days to complete 35 borings and up to five days if additional borings are needed.
b. Each cooler containing water samples for VOC analysis (field equipment rinsate blanks) will also include one trip blank. Trip blanks are required only when VOCs will be analyzed for water samples. All sample coolers will contain a temperature blank.
IDW Investigation-derived waste
VOCs Volatile organic compounds

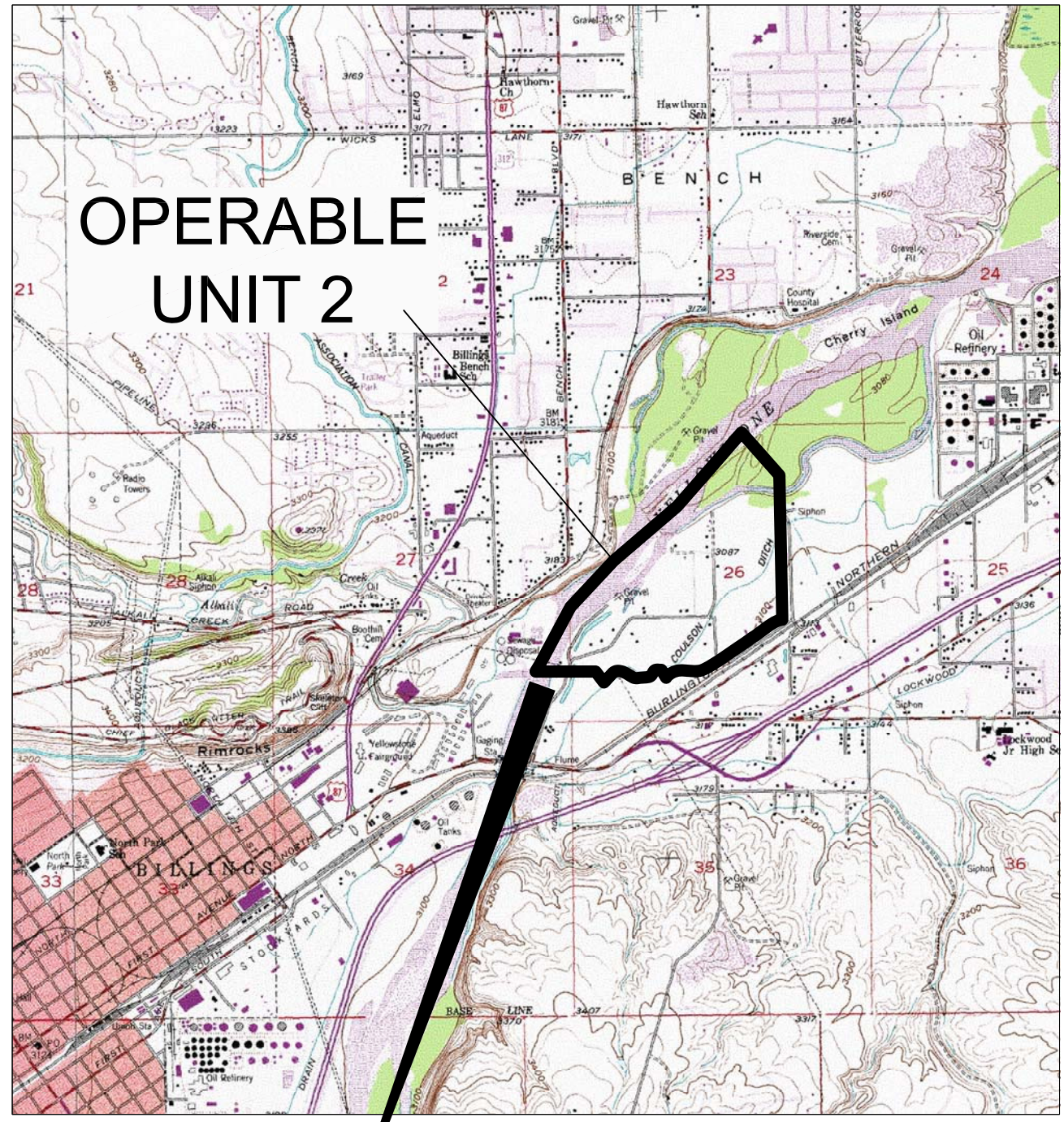
TABLE 4
QUALITY CONTROL SAMPLES FOR PRECISION AND ACCURACY
REVISED ADDENDUM 01 TO THE REVISED RDA WORK PLAN FOR THE DELINEATION AND PHYSICAL CHARACTERIZATION OF FINE-GRAINED SOURCE SOILS
OPERABLE UNIT 2
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

QC Type	Precision	Accuracy	Frequency
Field QC	Field Duplicate RPD	Trip Blank Temperature Blank	Field Duplicate = 1 per 20 samples Trip Blank = Each cooler containing water samples for VOC analysis will include one trip blank. Trip blanks are required only when VOCs will be analyzed for water samples. Temperature Blanks = One per each sample cooler containing VOCs samples
Laboratory QC	LCS/LCSD RPD MS/MSD RPD Field Duplicate RPD	Method Blanks LCS or Blank Spikes MS/MSD %R Surrogate Standards %R Internal Standards %R	Method Blank = 1 per 20 samples LCS or Blank Spikes = 1 per 20 samples MS/MSD = 1 per 20 samples Every Sample Every Sample

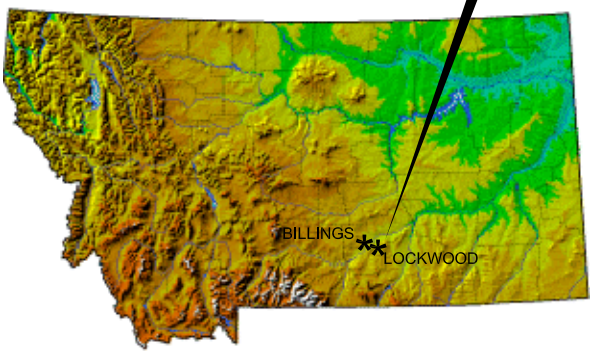
Notes:

%R	Percent recovery
LCS/LCSD	Laboratory control sample/laboratory control sample duplicate
MS/MSD	Matrix spike/matrix spike duplicate
QC	Quality control
RPD	Relative percent difference

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
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE
SOCO WEST

Billings, Montana

PROJECT NUMBER: Z051000003		DATE: 11/23/2015	FIGURE
APPROVED BY: JS		DRAWN BY: JC	1

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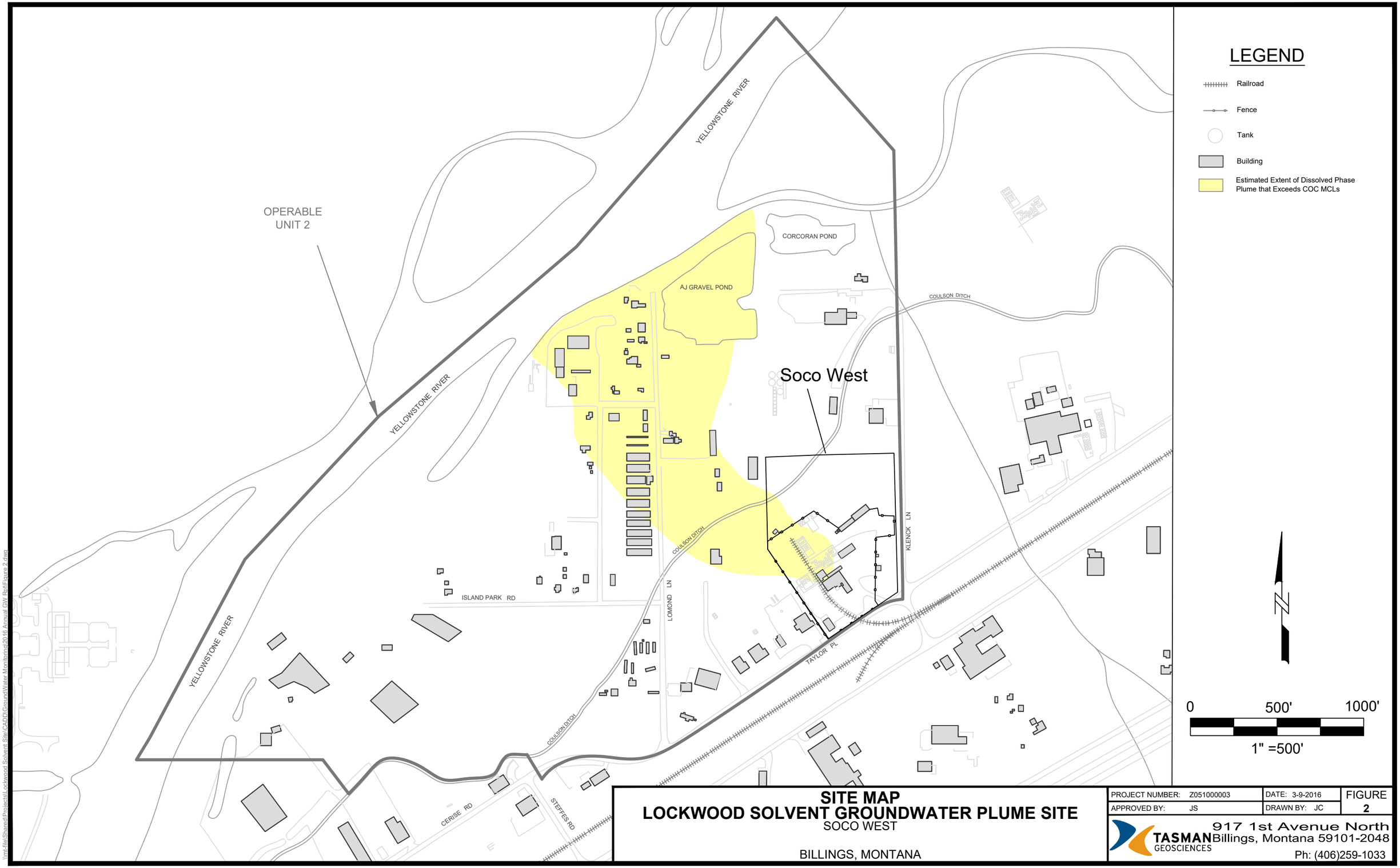
Z:\Projects\Lockwood Solvent Site\CADD\SCO PT\Figure 1.dwg



SITE MAP
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE
SOCO WEST

BILLINGS, MONTANA

PROJECT NUMBER: Z051000003		DATE: 3-9-2016	FIGURE 2
APPROVED BY: JS		DRAWN BY: JC	

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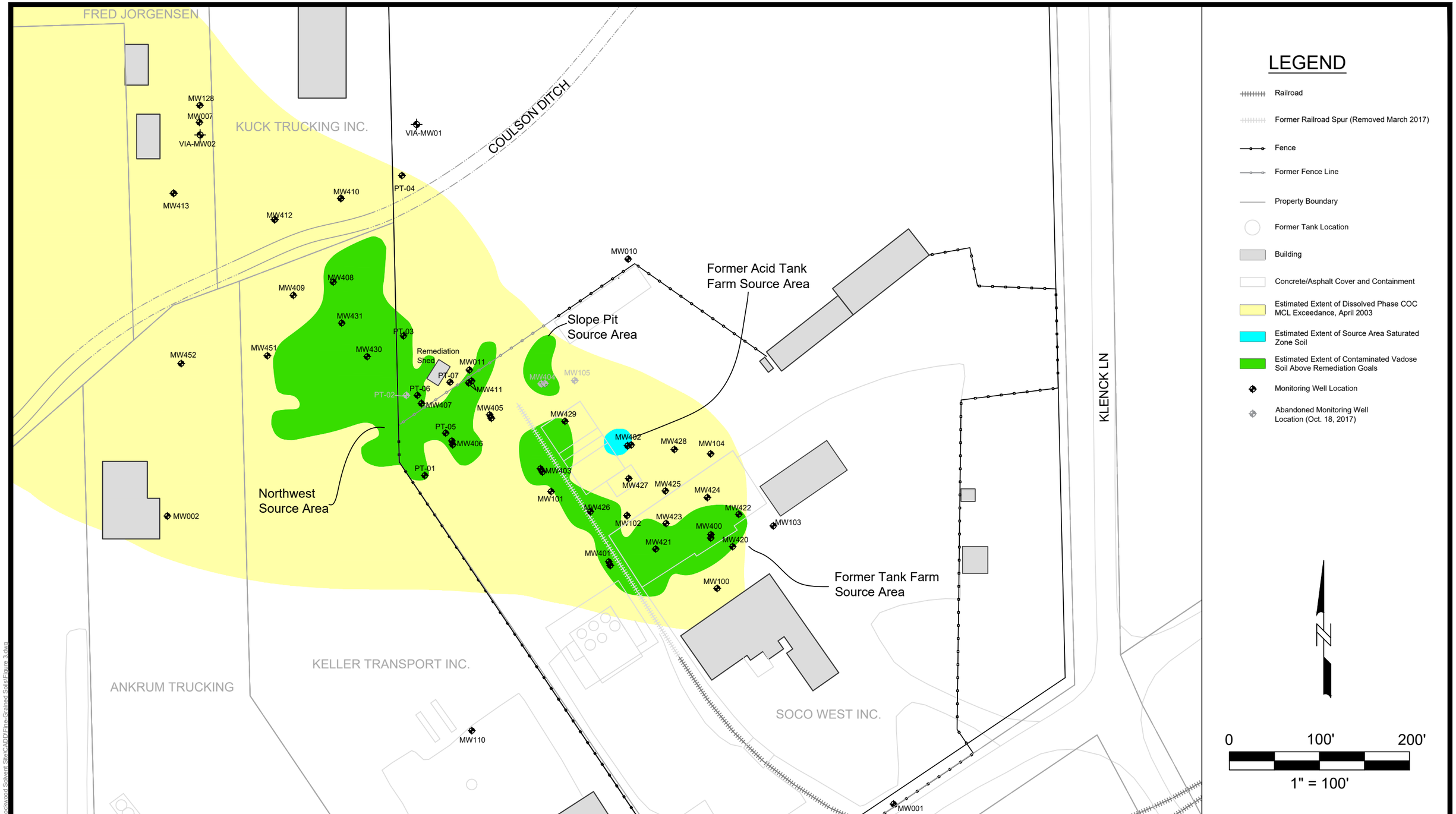
\\mrfile\Shared\Projects\Lockwood Solvent Site\CADD\GroundWater Monitoring\2016 Annual GW Rpt\Figure 2.dwg



Note: Estimated Extent of COC MCL Exceedances from Figure 7 of the LSGPS ROD, August 2005. Source Areas from August 2016 Fine-Grained Soils Delineation.

OU2 ESTIMATED EXTENT OF SOURCE SOILS
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

SOCO WEST

BILLINGS, MONTANA

PROJECT NUMBER: Z051000003	DATE: 11/21/17	FIGURE
APPROVED BY: JS	DRAWN BY: JB	3

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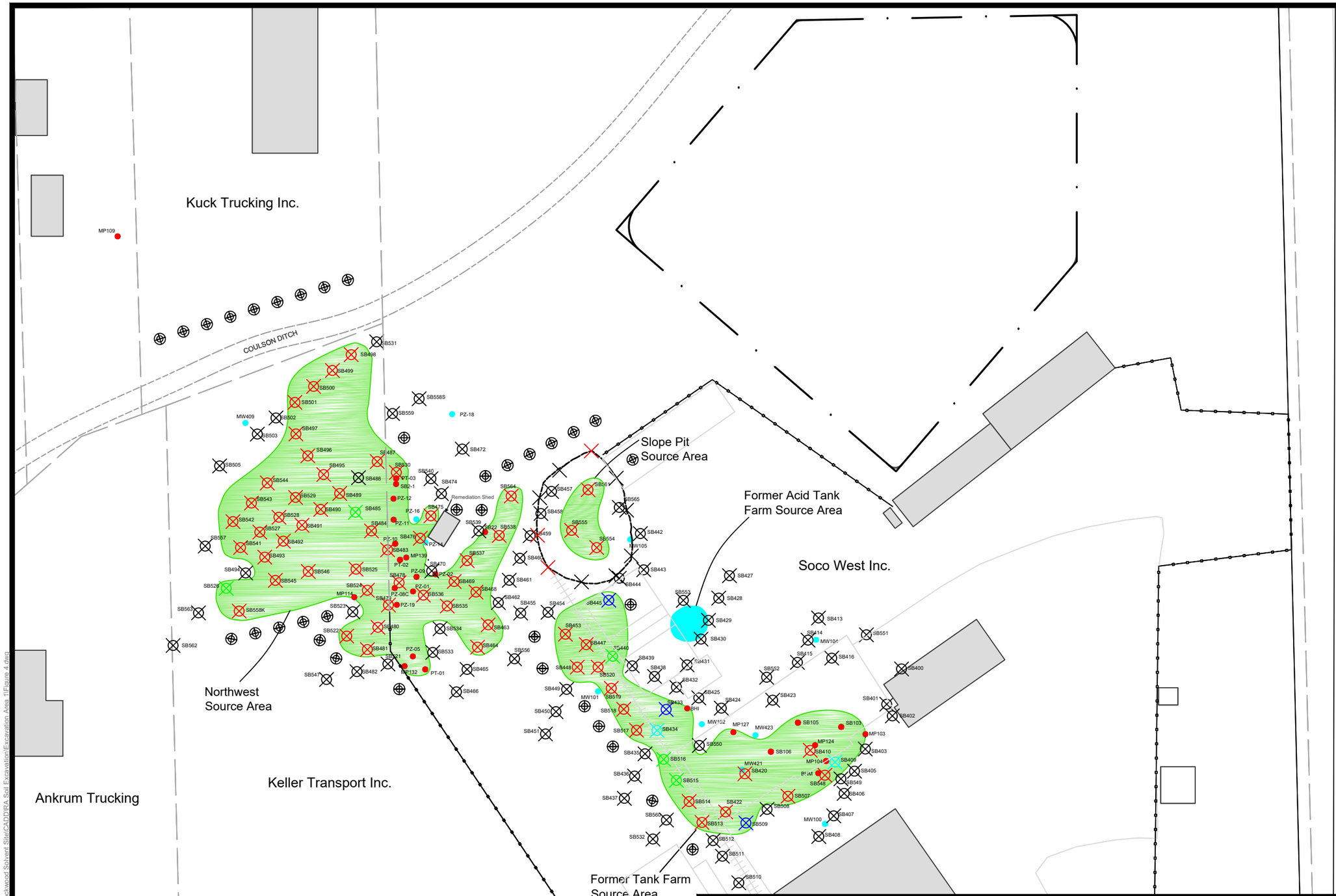
\\MT-FIL01\Shared\Projects\Lockwood Solvent Site\CADD\Fine-Grained Soils\Figure 3.dwg



LEGEND

- Property Boundary
- Railroad
- Former Railroad Spur (Removed March 2017)
- Fence
- Tank
- Building
- Concrete Tank Farm
- Proposed Fine-Grained Soil Boring Location
- Surveyed Excavation Area 1 Extent
- Sidewall Soil Sample Location, PCE Greater than ROD Performance Standard of 0.65 mg/kg (November 2017).
- Sidewall Soil Sample Location, COCs less than ROD Performance Standards(November 2017).
- Landfarm Treatment Cell Soil Berm
- Soil boring sampled, COCs less than ROD Performance Standards (August 2016).
- PCE greater than ROD Performance Standard of 0.65 mg/kg (August 2016).
- TCE greater than ROD Perfomance Standard of 0.72 mg/kg (August 2016).
- cis-1,2-DCE greater than ROD Performance Standard of 4.90 mg/kg (August 2016).
- VC greater than ROD Performance Standard of 0.16 mg/kg (August 2016).
- Historic soil sample location with detected COCs greater than ROD Performance Standards.
- Historic soil sample location with detected COCs below ROD Performance Standards.
- Estimated extent of COCs greater than ROD Performance Standards.
- Estimated extent of Source Area Saturated Zone Soil (LSGPS ROD, August 2005).

N

0 80' 160'

1" =80'

PROPOSED FINE-GRAINED SOIL BORING LOCATIONS
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

SOCO WEST
OPERABLE UNIT 2
BILLINGS, MONTANA

PROJECT NUMBER: Z051000003	DATE: 1/29/2018	FIGURE
APPROVED BY: JS	DRAWN BY: JB	4

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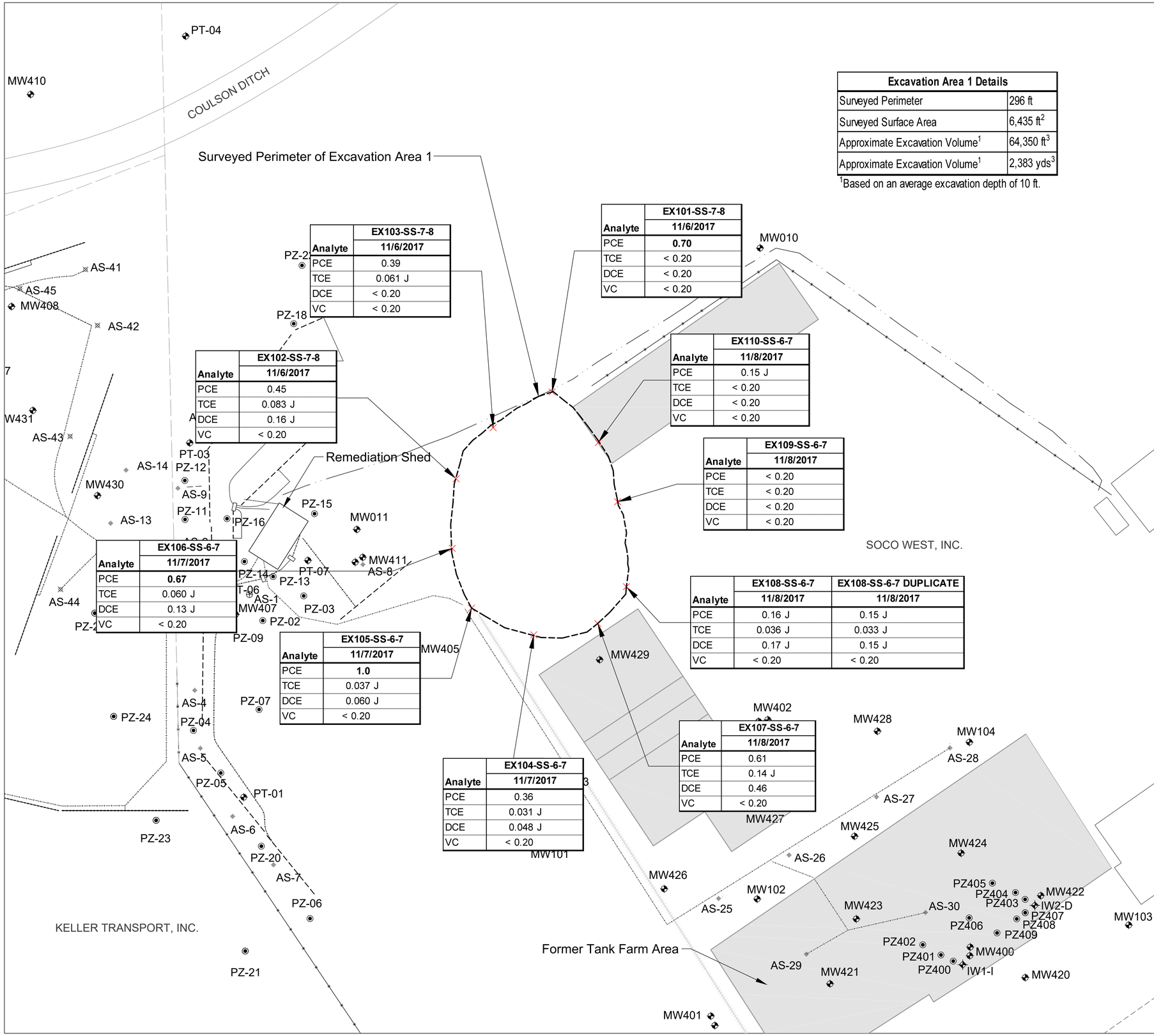
\\mt-fileShare\Projects\Lockwood Solvent Site\CAD\RA Soil Excavation\Excavation Area 1\Figure 4.dwg



Excavation Area 1 Details	
Surveyed Perimeter	296 ft
Surveyed Surface Area	6,435 ft^2
Approximate Excavation Volume[1]	64,350 ft^3
Approximate Excavation Volume[1]	2,383 yds^3

[1]Based on an average excavation depth of 10 ft.

Analyte	EX103-SS-7-8 11/6/2017
PCE	0.39
TCE	0.061 J
DCE	< 0.20
VC	< 0.20

Analyte	EX101-SS-7-8 11/6/2017
PCE	**0.70**
TCE	< 0.20
DCE	< 0.20
VC	< 0.20

Analyte	EX102-SS-7-8 11/6/2017
PCE	0.45
TCE	0.083 J
DCE	0.16 J
VC	< 0.20

Analyte	EX110-SS-6-7 11/8/2017
PCE	0.15 J
TCE	< 0.20
DCE	< 0.20
VC	< 0.20

Analyte	EX109-SS-6-7 11/8/2017
PCE	< 0.20
TCE	< 0.20
DCE	< 0.20
VC	< 0.20

Analyte	EX106-SS-6-7 11/7/2017
PCE	**0.67**
TCE	0.060 J
DCE	0.13 J
VC	< 0.20

Analyte	EX108-SS-6-7 11/8/2017	EX108-SS-6-7 DUPLICATE 11/8/2017
PCE	0.16 J	0.15 J
TCE	0.036 J	0.033 J
DCE	0.17 J	0.15 J
VC	< 0.20	< 0.20

Analyte	EX105-SS-6-7 11/7/2017
PCE	**1.0**
TCE	0.037 J
DCE	0.060 J
VC	< 0.20

Analyte	EX107-SS-6-7 11/8/2017
PCE	0.61
TCE	0.14 J
DCE	0.46
VC	< 0.20

Analyte	EX104-SS-6-7 11/7/2017
PCE	0.36
TCE	0.031 J
DCE	0.048 J
VC	< 0.20

LEGEND

- Soco West, Inc. Property Boundary
- Existing Railroad
- Former Railroad Spur (Removed March 2017)
- Perimeter Fence
- Existing Tank
- Existing Concrete Slab-on-Grade
- Existing Building
- Existing Monitoring Well Location
- Existing Piezometer Location
- Existing Injection Well Location
- Existing Ozone Sparge Point Location
- Existing Ozone Sparge/Vapor Recovery (OS/VR) Conveyance Piping
- Existing VR Trench
- Surveyed Underground Utility Location
- Surveyed Excavation Extent
- Surveyed Confirmation Soil Sample Location
- 0.61 — COC concentration (mg/kg)
- **Bold** — Indicates that analyte concentration equals or exceeds the ROD Performance Standards (EPA/DEQ, 2005)
- J — Estimated value. The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample.

Rod Performance Standards	
Contaminant of Concern	Remediation Goal (mg/kg)
Tetrachloroethene (PCE)	0.65
Trichloroethene (TCE)	0.72
cis-1,2-Dichloroethene (DCE)	4.9
Vinyl Chloride (VC)	0.16

N

0 20' 40'
1" =20'

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LOCKWOOD SOLVENT GROUNDWATER PLUME SITE - OPERABLE UNIT 2

SECTION 26, TOWNSHIP 01 NORTH, RANGE 26 EAST
YELLOWSTONE COUNTY, MONTANA

Excavation Area 1 Sidewall Confirmation Sample Results

DATE ISSUED
11-14-2017

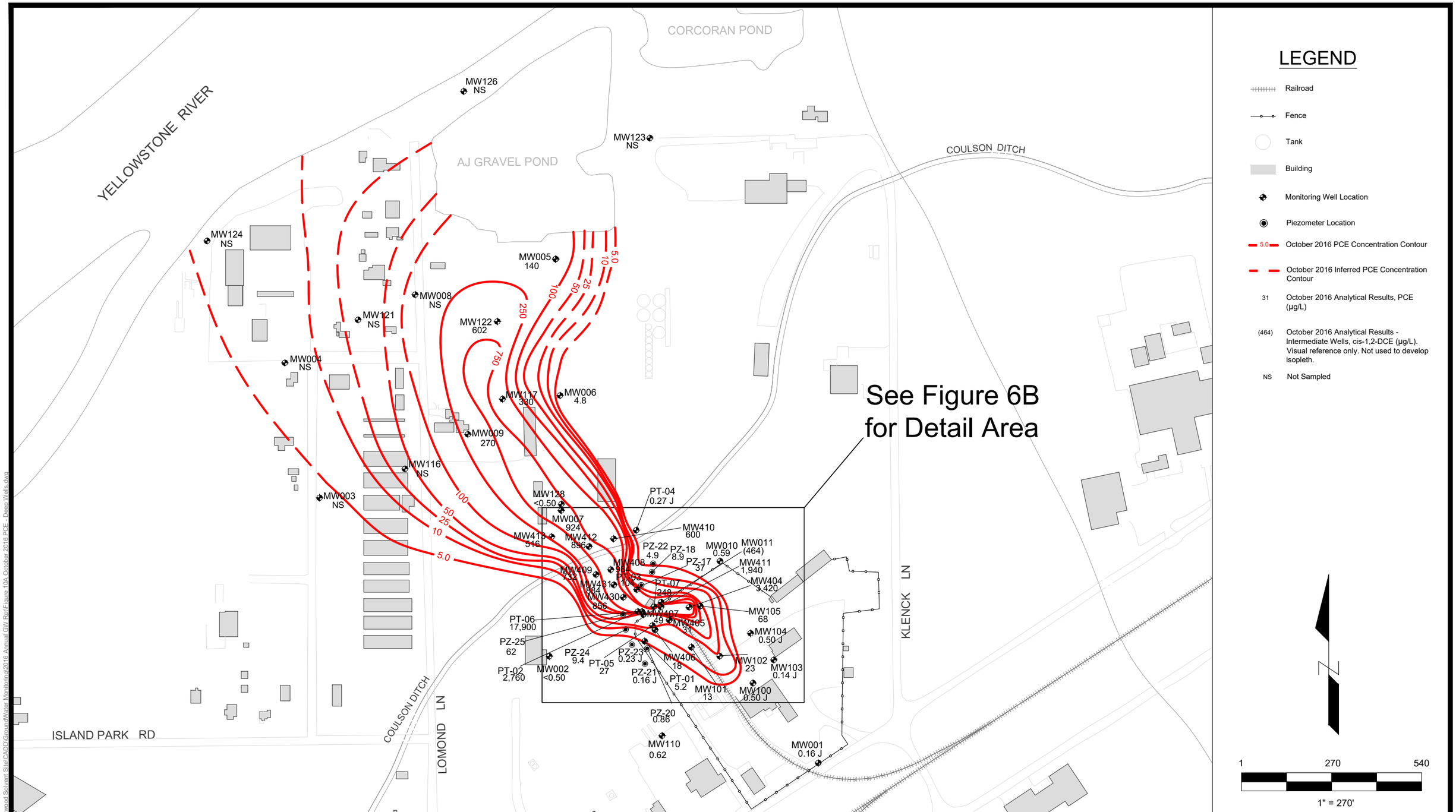
RELEASES

NO.	DATE

DRAWN BY
J. BALL

FILE NAME
Soil Confirmation Samples

FIGURE NO.
5



MW128 is for visual reference only. It is completed in the bedrock aquifer and was not used to develop the isopleth.

J - Estimated value. The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample.

ISOPLETH PCE CONCENTRATION MAP - DEEP WELLS
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

OCTOBER 2016
SOCO WEST
BILLINGS, MONTANA

PROJECT NUMBER: 51.24884.0001		DATE: 03/21/2017	FIGURE 6A
APPROVED BY: JS		DRAWN BY: RP	

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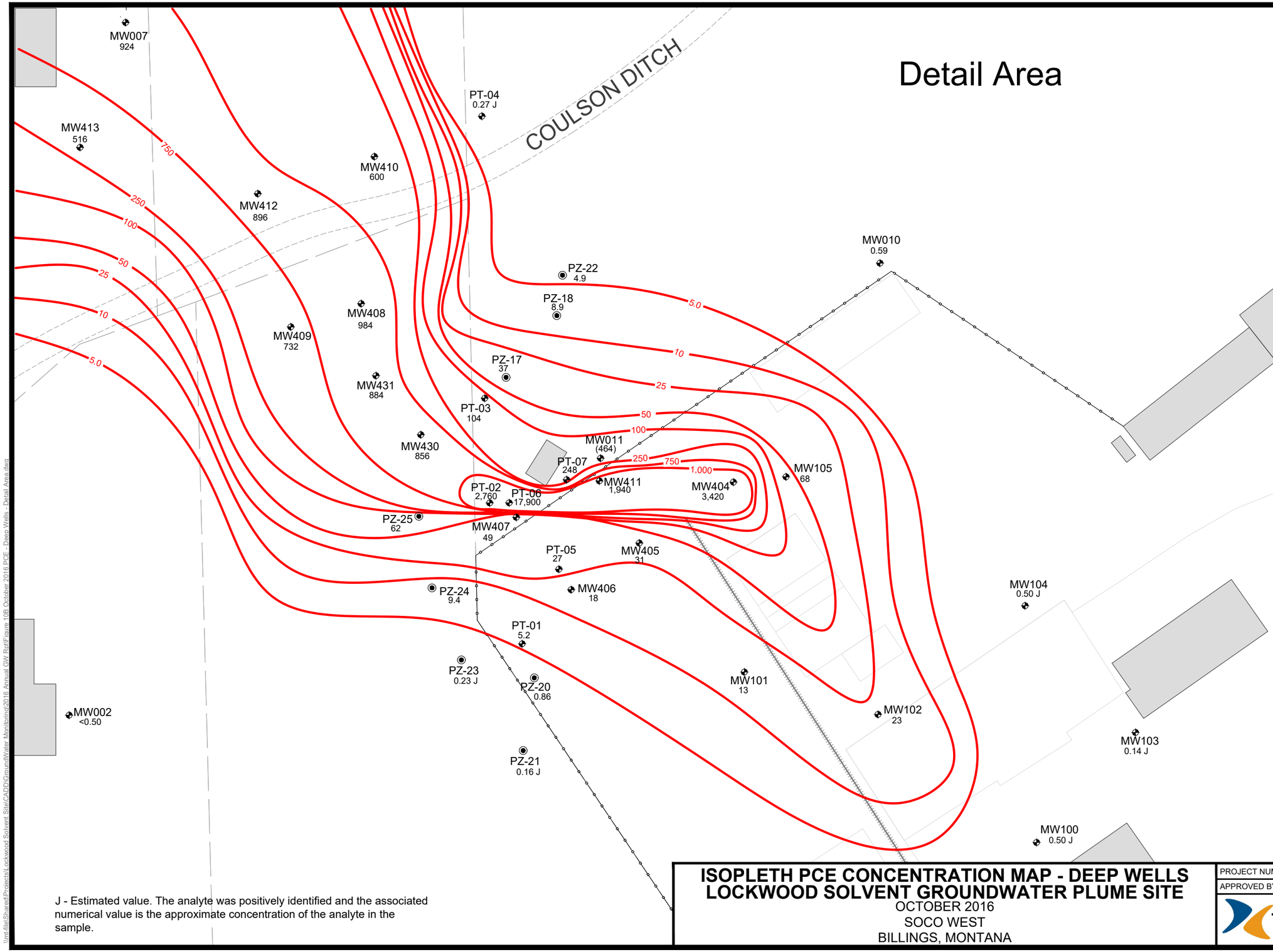
\\mt-file\Shared\Projects\Lockwood Solvent Site\CADD\GroundWater Monitoring\2016 Annual GW Rpt\Figure 10A October 2016 PCE - Deep Wells.dwg



LEGEND

- Railroad
- Fence
- Tank
- Building
- Monitoring Well Location
- Piezometer Location
- 5.0 October 2016 PCE Concentration Contour (µg/L)
- October 2016 PCE Concentration Contour (µg/L)
- 4.9 October 2016 Analytical Results, PCE (µg/L)
- (464) October 2016 Analytical Results - Intermediate Wells, PCE (µg/L). Visual reference only - not used to develop isopleth.

N

1 60 120

1" = 60'

J - Estimated value. The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample.

ISOPLETH PCE CONCENTRATION MAP - DEEP WELLS
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

OCTOBER 2016

SOCO WEST

BILLINGS, MONTANA

PROJECT NUMBER: 51.24884.0001		DATE: 02/28/2017	FIGURE
APPROVED BY: JS		DRAWN BY: RP	6B

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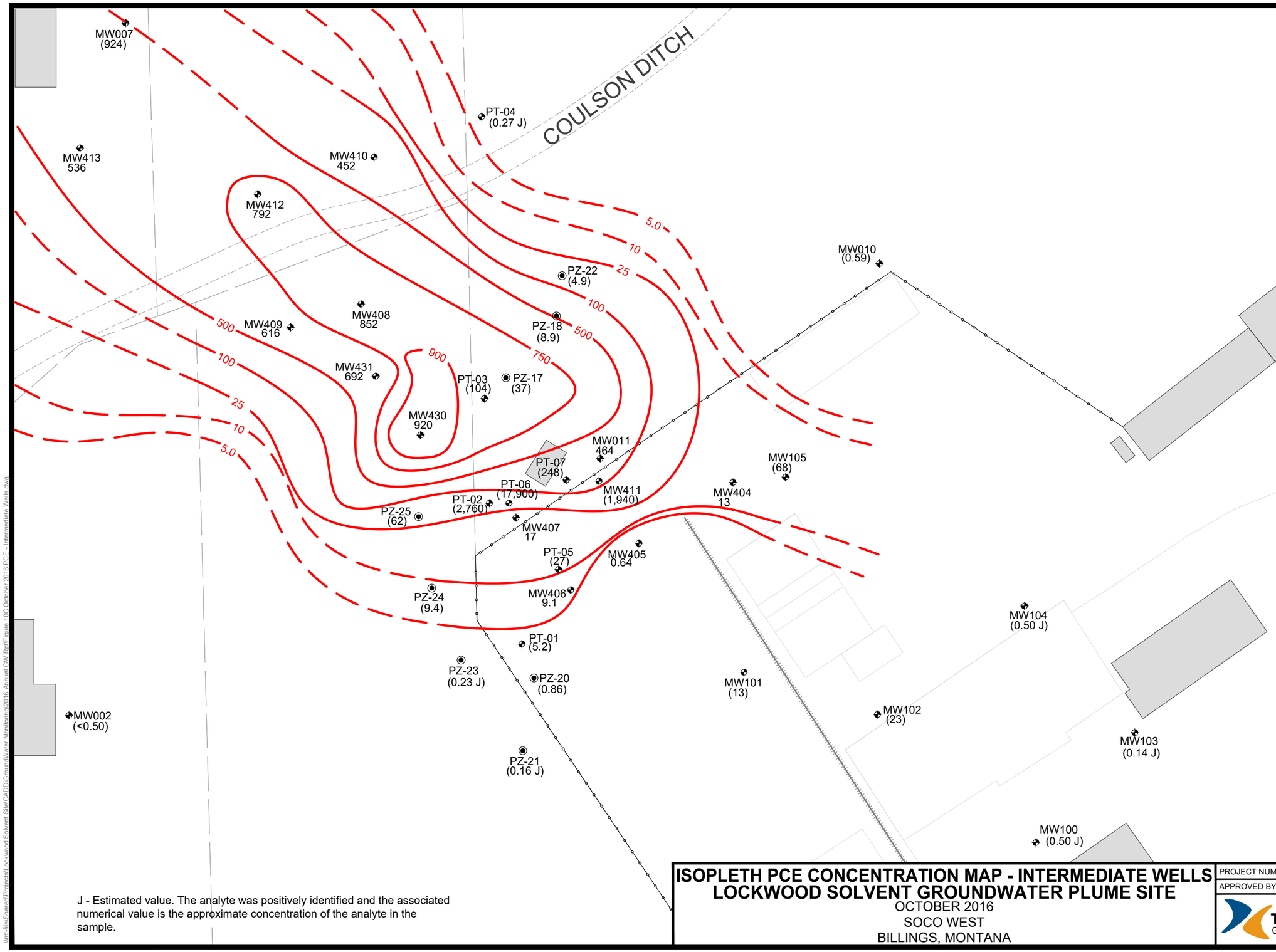
\\mt-file\Shared\Projects\Lockwood Solvent Site\CADD\GroundWater Monitoring\2016 Annual GW Rpt\Figure 10B October 2016 PCE - Deep Wells - Detail Area.dwg



LEGEND

- Railroad
- Fence
- Tank
- Building
- Monitoring Well Location
- Piezometer Location
- 5.0 October 2016 PCE Concentration Contour
- October 2016 Inferred PCE Concentration Contour
- 13 October 2016 Analytical Results, PCE (µg/L)
- (27) October 2016 Analytical Results - Deep Wells, PCE (µg/L). Visual reference only - not used to develop isopleth.

J - Estimated value. The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample.

ISOPLETH PCE CONCENTRATION MAP - INTERMEDIATE WELLS
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

OCTOBER 2016
SOCO WEST
BILLINGS, MONTANA

PROJECT NUMBER: 51.24884.0001		DATE: 03/21/2017	FIGURE
APPROVED BY: JS		DRAWN BY: RP	6C

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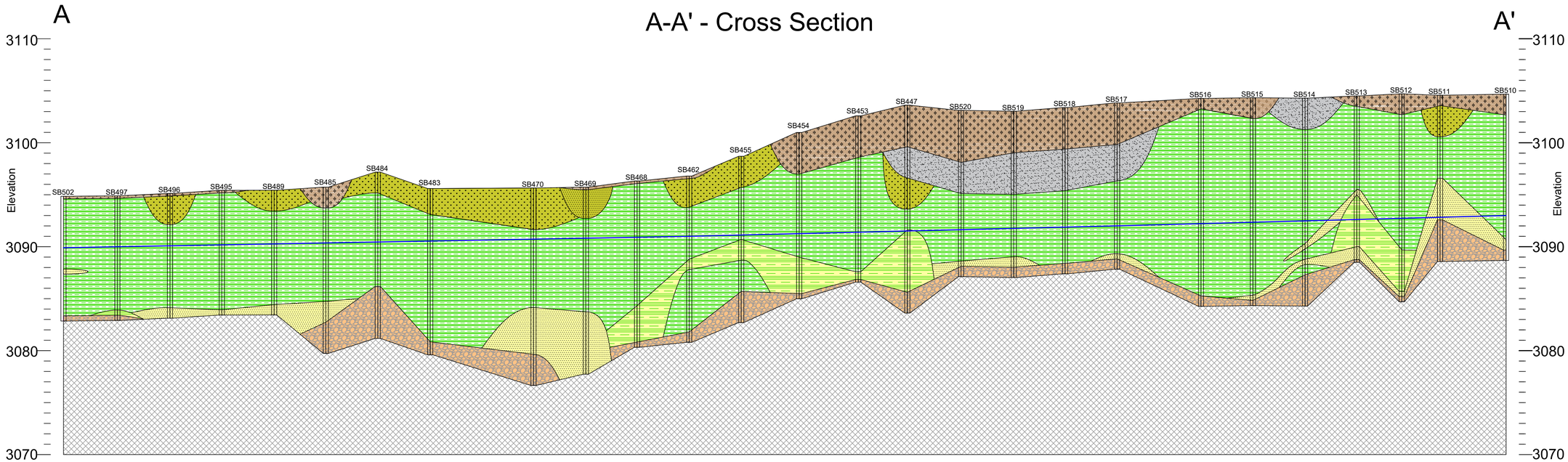
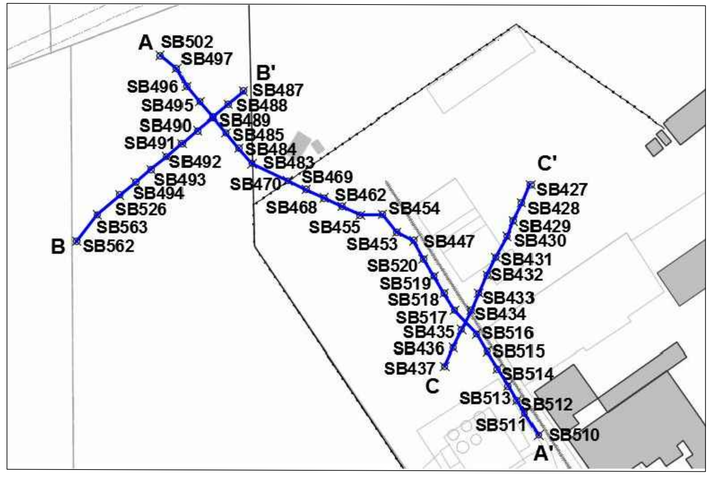
\\mt-file\Shared\Projects\Lockwood Solvent Site\CADD\GroundWater Monitoring\2016 Annual GW Rpt\Figure 10C October 2016 PCE - Intermediate Wells.dwg

A-A' - Cross Section



Top View



LEGEND

- Concrete
- Fly Ash
- Fill
- Clay
- Sand & Gravel
- Sandy Clay
- Sand
- Silty Clay
- Silty Sand
- Gravelly Clay
- No Data
- Potentiometric Surface (4/16)

0 20' 40'

Horizontal Scale 1" = 20'
Vertical Exaggeration: 4x

A-A' GEOLOGIC CROSS-SECTION
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE
SOCO WEST
OPERABLE UNIT 2
BILLINGS, MONTANA

PROJECT NUMBER: Z051000003	DATE: 11/30/16	FIGURE
APPROVED BY: JS	DRAWN BY: JB	7A

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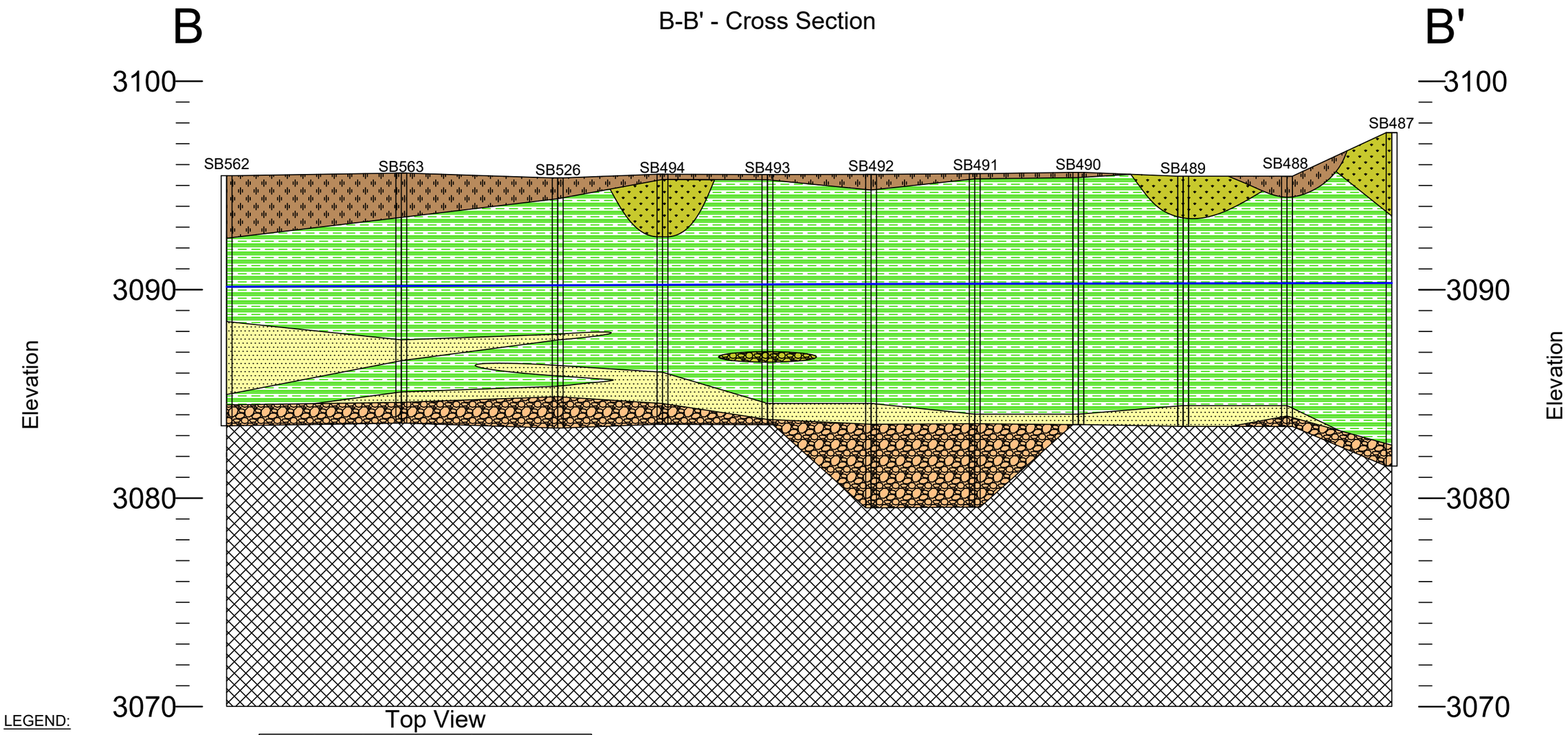
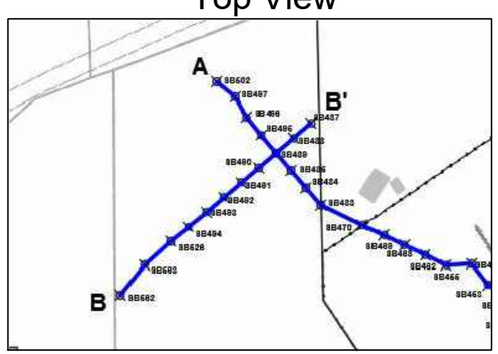
B-B' - Cross Section



LEGEND:

- Fill
- Clay
- Sand & Gravel
- Sandy Clay
- Sand
- Silty Clay
- Gravelly Clay
- No Data
- Potentiometric Surface (4/16)

Top View



0 20' 40'

Horizontal Scale: 1" = 20'

Vertical Exaggeration: 4x

B-B' GEOLOGIC CROSS-SECTION
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE
SOCO WEST

BILLINGS, MONTANA

PROJECT NUMBER: 51.24884.0001		DATE: 11/28/16	FIGURE
APPROVED BY: JS		DRAWN BY: JB	7B

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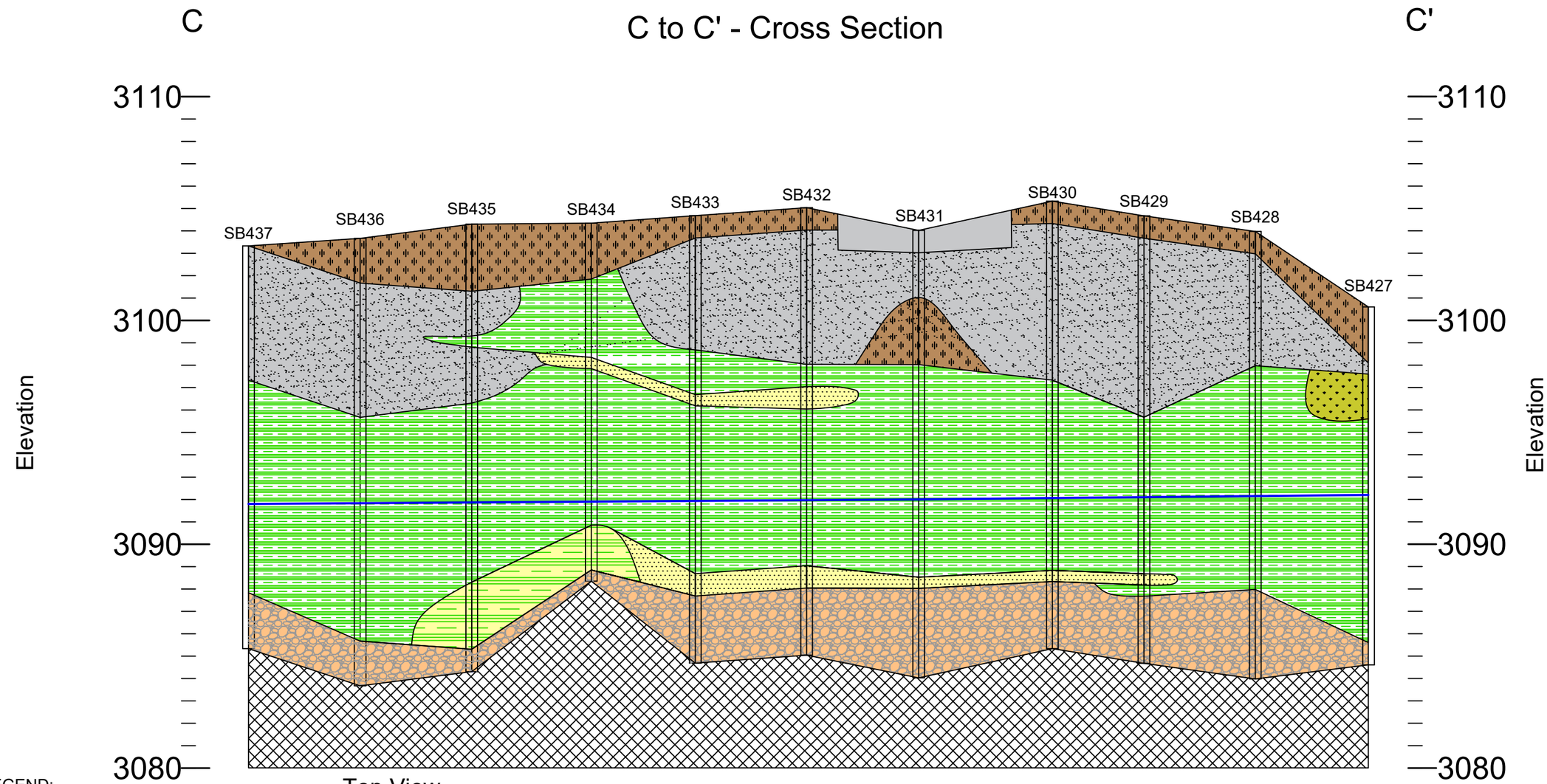
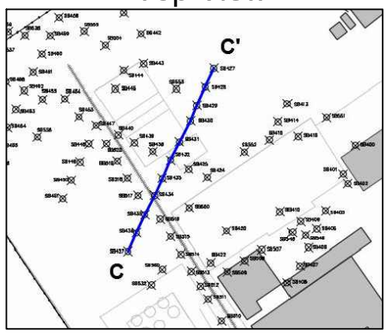
C to C' - Cross Section



LEGEND:

- Potentiometric Surface (4/16)
- Concrete
- Fly Ash
- Fill
- Clay
- Sand & Gravel
- Sandy Clay
- Sand
- Silty Clay
- No Data

Top View



0 20' 40'

Horizontal Scale: 1" = 20'

Vertical Exaggeration: 4x

C-C' GEOLOGIC CROSS-SECTION
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE
SOCO WEST

BILLINGS, MONTANA

PROJECT NUMBER: 51.24884.0001		DATE: 11/18/16	FIGURE 7C
APPROVED BY: JS		DRAWN BY: JB	

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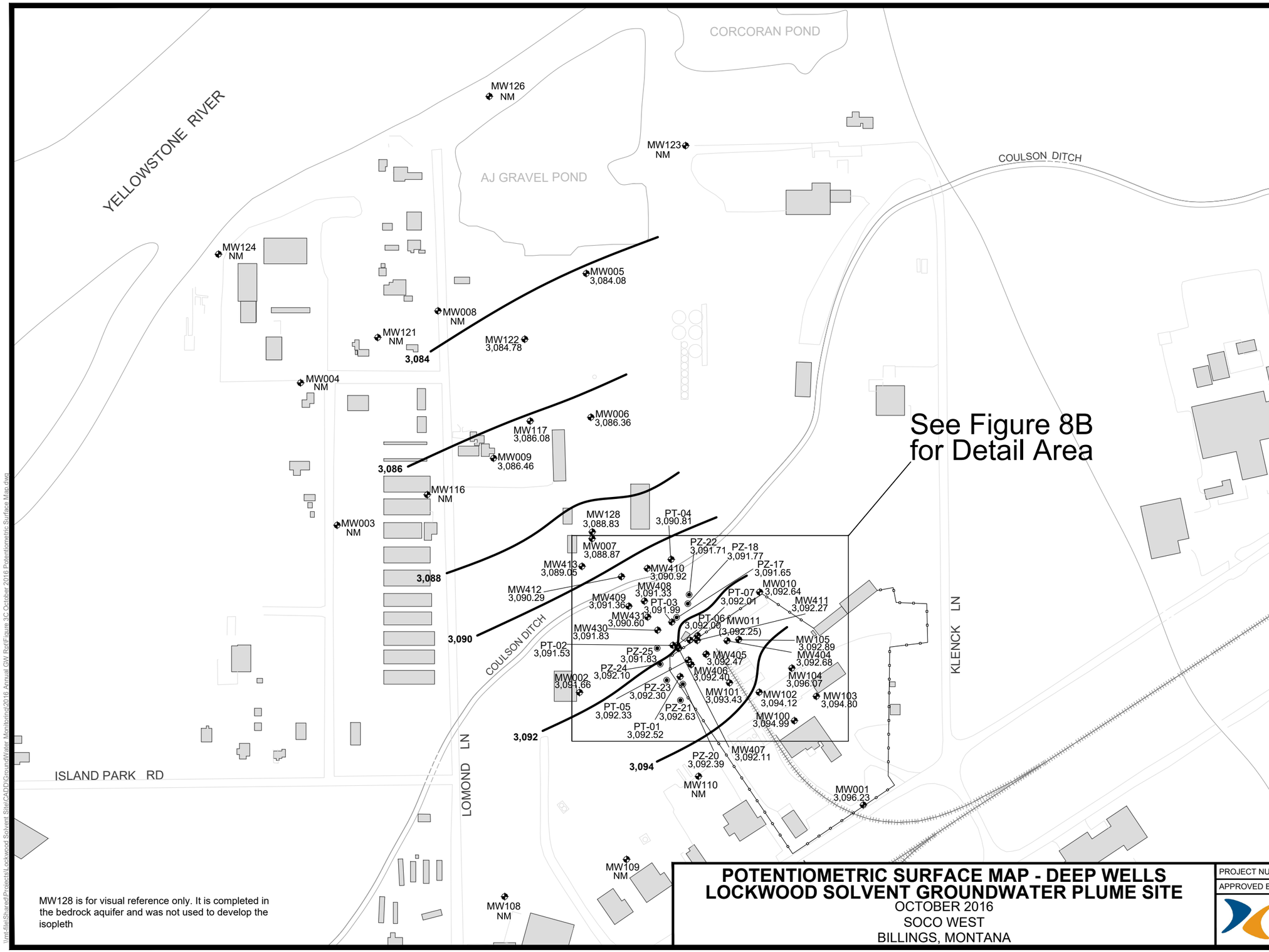
\\nrfiles\Shared\Projects\Lockwood Solvent Site\CAD\DF\Fine-Grained Soils\Fine-grained cross-sections.dwg



LEGEND

	Railroad
	Fence
	Tank
	Building
	Monitoring Well Location
	Piezometer Location
	October 2016 Groundwater Potentiometric Surface Contour
3,090.81	October 2016 Groundwater Elevation (ft)
(3,092.25)	October 2016 Intermediate Groundwater Elevation (ft). Visual reference only - not used to develop isopleth.
NM	Not Measured

MW128 is for visual reference only. It is completed in the bedrock aquifer and was not used to develop the isopleth

POTENTIOMETRIC SURFACE MAP - DEEP WELLS
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

OCTOBER 2016

SOCO WEST

BILLINGS, MONTANA

PROJECT NUMBER: 51.24884.0001		DATE: 03/21/2017	FIGURE
APPROVED BY: JS		DRAWN BY: JB	8A

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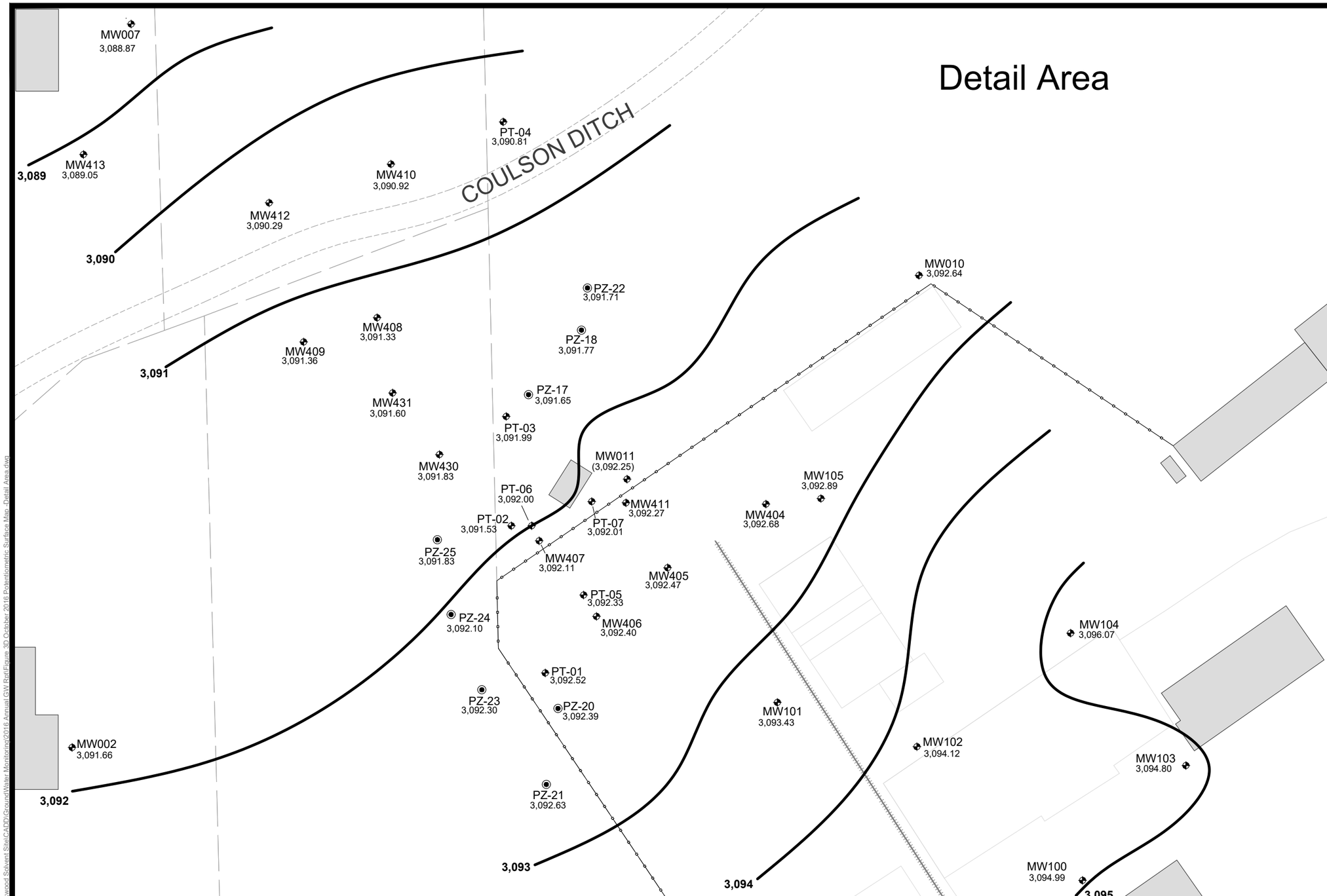
\\mt-file\Shared\Projects\Lockwood Solvent Site\CADD\GroundWater Monitoring\2016 Annual GW Rpt\Figure 3C October 2016 Potentiometric Surface Map.dwg



LEGEND

- Railroad
- Fence
- Tank
- Building
- Monitoring Well Location
- Piezometer Location
- October 2016 Groundwater Potentiometric Surface Contour
- 3092.64 October 2016 Groundwater Elevation (ft)
- (3092.25) October 2016 Intermediate Groundwater Elevation (ft). Visual reference only - not used to develop isopleth.

POTENTIOMETRIC SURFACE MAP - DEEP WELLS
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

OCTOBER 2016

SOCO WEST

BILLINGS, MONTANA

PROJECT NUMBER: Z051000003		DATE: 03/21/2017	FIGURE
APPROVED BY: JS		DRAWN BY: JB	8B

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\\mt-file\Shared\Projects\Lockwood Solvent Site\CADD\GroundWater Monitoring\2016 Annual GW Rpt\Figure 3D October 2016 Potentiometric Surface Map -Detail Area.dwg

Appendix A

Project Standard Operating Procedures (SOPs)

SOP-051-101 Sample Equipment Decontamination – Organic Contamination
SOP-051-102 Field Forms
SOP-051-103 Quality Assurance/Quality Control Sampling
SOP-051-104 Sample Documentation
SOP-051-105 Sample Packaging and Shipping
SOP-051-301 Subsurface Soil Sampling: Well/Borehole Installation
SOP-051-400 Organic Vapor Headspace Measurement
SOP-051-501 Management of Liquid Matrix Investigation-Derived Wastes
SOP-051-502 Management of Solid Matrix Investigation-Derived Wastes
SOP-051-504 Sampling of Liquid Matrix Investigation-Derived Wastes

The purpose of this standard operating procedure (SOP) is to describe general decontamination procedures for field sampling equipment in contact with vapor, soil, or water contaminated or potentially contaminated with organic compounds. Reusable sampling equipment must be decontaminated between sample collection points. Field personnel must wear appropriate personal protective equipment (PPE) for decontamination procedures in accordance with site-specific health and safety plans (HASPs), but at a minimum personnel must wear eye protection, splash protection, and disposable nitrile gloves while decontaminating equipment at the project site.

Decontamination should be performed in areas so as to prevent cross-contamination of other field equipment. Decontamination is also to be performed in areas so as to avoid any exposure to the public and the area should be cordoned off, if necessary, to prevent public access. The following three-step procedure is to be followed to ensure thorough equipment decontamination:

1. Wash equipment with Liquinox or an equivalent degreasing detergent to remove any and all contaminants.
2. Thoroughly rinse equipment with clean (tap) water
3. Rinse equipment a second time with de-ionized or distilled water rinse.

Sampling pumps and reusable tubing must be decontaminated internally by pumping wash solutions through the pump followed by appropriate rinses. The exterior of such equipment can be decontaminated using a high pressure washer with appropriate soap solution and clean water rinse. Unless prohibited or otherwise specified, decontamination rinse water can be surface applied for evaporation.

All disposable items (e.g., paper towels, gloves, etc.) are to be deposited into a garbage bags and disposed of in a proper manner. Properly dispose of the wash water per provisions of the work plan. If vehicles used during sampling become contaminated, wash both inside and outside as necessary.

Table 1 lists equipment and liquids necessary to decontaminate field sampling equipment.

Table 1
Equipment List for Organics Decontamination

5-gallon plastic buckets	Hard bristle brushes
Source of clean (tap) water	Garbage bags
De-ionized or distilled water	Nitrile gloves
Spray bottles with de-ionized or distilled water	Paper Towels
Liquinox or other degreasing detergent	

All pertinent field investigations and sampling information shall be recorded on a field form during each day of the field effort and at each sample site. The field supervisor shall be responsible for ensuring that sufficient detail is recorded on the field forms. No general rules can specify the extent of information that must be entered on the field form. However, field forms shall contain sufficient information so that someone can reconstruct all field activity without relying on the memory of the field crew. All entries shall be made in permanent ink. Each day's or site's entries will be initialed and dated at the end by the author.

At a minimum, entries on the field sheet or in field notebook shall include:

1. Date and time of starting work and weather conditions
2. Names of field supervisor and team members
3. Project name and type
4. Description of site conditions and any unusual circumstances.
5. Location of sample site, including map reference, if relevant
6. Equipment ID numbers, if relevant
7. Details of actual work effort, particularly any deviations from the field work plan or standard operating procedures
8. Field observations
9. Any field measurements made (e.g., pH)

For sampling efforts, specific details for each sample should be recorded using standardized field forms. Surface water and groundwater field forms contain fill-in-the-blank type information in order that all pertinent information shall be recorded. In addition to the items listed above, the following information is recorded on field forms during sampling efforts:

1. Time and date samples were collected
2. Sample Name and type (natural, duplicate, QA/QC) of samples collected
3. Number and size of containers used to collect sample
4. Sampling method, particularly deviations from standard operating procedures

Strict chain of custody procedures shall be maintained with the field forms. Field forms shall remain with the field team at all times, while being used in the field. Upon completion of the field effort, photocopies of the original field forms will be made and used as working documents; original field forms shall be filed in the appropriate project file.

Quality Assurance/Quality Control (QA/QC) samples are submitted along with natural samples to provide supporting laboratory data to validate laboratory results. QA/QC samples are submitted blind, and do not have any unique identifying codes that would enable the lab or others to bias these samples in any way. Usually, the time or sampling location is modified in a way which will separate blank and standard samples from the rest of the sample train. QA/QC samples are identified only on field forms and in field notebooks. The following codes are typically used:

N - Natural Sample	Soil, water, air, or other of interest material from a field site
SP - Split Sample	A portion of a natural sample collected for independent analysis; used in calculating laboratory precision
D - Duplicate Sample	Two samples taken from the same media under similar conditions; also used to calculate precision
EB or RB– Equipment (Rinsate) Blank	Deionized water run through decontaminated equipment and analyzed for Blank residual contamination and deionized water contamination
BFS - Blind Field Standard	Certified materials of known concentration; used to determine laboratory accuracy
TB -Trip Blank	Inert material (deionized water or diatomaceous earth) included in sample cooler; sent by the lab, the sample is used to determine if contamination by volatiles is present during collection or shipping

In general, selected QA/QC samples will be inserted into the sample train within a group of twenty samples. Unless otherwise specified, QA/QC samples will be prepared in the field. Deionized water blanks will be collected from carboys and cubitainers used in the field. An exception to field preparation of QA/QC samples is the preparation of some blind field standards. Since the concentration of analytes in the sample is to be mixed according to specific manufacturer's instructions, field conditions may not provide the needed laboratory atmosphere. This is especially true for volatile organic compounds, which need to be prepared just before analyzing. Under these circumstances, standards will be shipped to the laboratory for preparation, keeping the concentration or manufacturer's QA/QC Lot Number as blind as possible.

The number and types of samples submitted for each group of natural samples will be determined by the project manager and others, including state or Federal agencies, and will be defined in the project work plan. Each field supervisor will be responsible for all QA/QC samples prepared by that crew.

Methods for computing data validation statements can be found in EPA documents.

Sample documentation is an important step to ensure the laboratory, project manager, and field personnel are informed of the status of field samples. Depending on the specifics required for each project, a number of forms will need to be filled out. Most sample documentation forms are preprinted carbonless triplicates, enabling copies to be filed or mailed from labs or offices. The forms will be completed by field personnel, who have custody of the samples. The office copy will be kept in the project file and subsequent copies sent to the laboratory, or other designated parties. The responsibility for the completion of these forms will be with each field supervisor. It is important that the field supervisor is certain field personnel are familiar with the completion process for filling out forms, and that the expected information is included.

Potential documents to be completed clearly in ink for each sample generated include:

1. Field Form
2. Chain-of-Custody
3. Custody Seal
4. Field Notebook or Field Notes

If working on Superfund activities, the following additional forms will also be prepared:

1. EPA Sample Tags
2. SAS Packing Lists
3. Sample Identification Matrix Forms
4. Organic Traffic Report (if applicable)
5. Inorganic Traffic Report (if applicable)

All environmental samples collected should be packaged and shipped using the following procedures:

PACKAGING

1. Label all sample containers with indelible ink (on the side, not on the cap or lid). Place labeled sample bottles in a high quality cooler containing an adequate amount of ice and/or frozen blue ice (appropriate for the season), making sure the cooler drain plug is taped shut.

2. Place the samples in an upright position and wrap the samples with absorbent, cushioning material for stability during transport. Samples should not be loose; the cooler should be able to withstand rough handling during shipment without sample breakage.

3. Fill out the appropriate shipping forms, and place the paperwork in a Ziploc® bag and tape it to the inside lid of the shipping container. Shipping forms usually include: 1) a chain-of-custody form, documenting the samples included in the shipment; 2) an analysis request form, specifying the laboratory analyses for each sample. If more than one cooler is used per chain of custody, put a photocopy in the other coolers and mark them as a copy.

4. Close and seal the cooler using fiberglass strapping tape.

5. Secure the shipping label with address, phone number, and return address clearly visible.

SHIPPING

Samples will be delivered by hand to analytical laboratory or shipped using standard, reliable carriers. All samples will be maintained in sealed containers under chain of custody procedures for the duration of shipping. Samples which are not delivered by hand to the analytical laboratory are subject to local, state, and federal regulations regarding shipping, as well as carrier-specific requirements. Consult the project manager for additional specific shipping procedures as necessary.

DRILLING AND SOIL SAMPLING

Permits, Site Safety Plan, Utility Clearance

Tasman Geosciences (Tasman) obtains all the required permits, unless otherwise contractually directed. Tasman prepares a site specific Health and Safety Plan (HASP) detailing site hazards, site safety and control, decontamination procedures, and emergency response procedures to be employed throughout the defined phase of work. At least 48 hours prior to drilling all underground utilities will be located by an authorized utility locating service. Tasman attempts to locate all underground and aboveground utilities by site inspection (in conjunction with its subcontractors and knowledgeable site managers, if available), and review of site as-built drawings.

Drilling Equipment

All soil borings are drilled using equipment appropriate for site conditions, such as: air rotary, hollow-stem auger, sonic and direct push. If site conditions warrant and subsurface conditions permit, the first five feet of each boring is advanced using a hand-auger or an air knife. All drilling equipment is inspected daily and maintained in safe working condition by the operator. All down-hole drilling equipment is decontaminated prior to arriving on site. Working components of the drill rig near the borehole, as well as augers and drill rods are thoroughly decontaminated between each boring location. All Tasman drilling and sampling methods are consistent with ASTM Method D-1452-80 and local, state and federal regulations.

Soil Sampling and Lithologic Description

Whenever possible and approved by the appropriate regulatory agency, the borings to be drilled at a site are continuously sampled to obtain a complete lithologic description. If copper or zinc contamination is the subject of the investigation, stainless steel liners are used instead of brass. Additional soil samples may be collected based upon significant changes in lithology or in areas of obvious soil contamination. If applicable, the soil sampler and liners are cleaned with a Liquinox® solution and rinsed with tap water prior to each sampling event.

The samples are labeled, documented on a chain-of-custody form and placed in a cooler for transport to a state-certified analytical laboratory. Soil contained in remaining liners is removed for lithologic descriptions (according to the Unified Soil Classification System). Additional soil is screened for organic vapors by placing approximately 30 grams of soil in a sealed plastic bag or a glass jar sealed with aluminum foil. The bag or jar is left undisturbed for approximately 15 minutes, in the sun if possible. The headspace in the bag is accessed in a manner to minimize entry of outside air, and is tested for total organic vapor using a calibrated photo ionization detector (PID). In addition, visual sheen screening may be conducted for each sample interval in conjunction with the PID screening to determine the possible presence (or absence) of source material. The results of the field screening are noted with the lithologic descriptions on the Field Exploratory Soil Boring Log.

On encountering an impermeable (clayey) layer three feet or more in thickness below a saturated permeable layer, where the impermeable layer is considered to be a possible confining layer for an underlying aquifer, drilling is halted until a decision to proceed is obtained from the project manager. This process minimizes the chance of introducing contamination to an underlying, clean aquifer.

Soil Waste Management

Soil cuttings are stockpiled on and covered with plastic sheeting to control runoff, or contained in 55-gallon D.O.T.-approved drums on site. Waste soil is sampled to chemically profile it for disposal, and hauled by a licensed waste hauler to an appropriate landfill or certified treatment facility. All waste stored on site is properly labeled at the time of production.

Soil Boring Abandonment

Soil borings which are not to be converted into monitor wells are sealed to the ground surface using neat cement, sand-cement slurry, or hydrated bentonite pellets or chips in accordance with federal, state and local regulations. Native soil may be used to fill the top two to three feet for cosmetic purposes, as permitted.

WELL INSTALLATION

Well Casing. Screen and Filter Pack Construction

Soil borings to be converted into single-cased monitor wells are a minimum of eight inches in diameter for 2-inch diameter wells, and a minimum of ten inches in diameter for 4-inch diameter wells. Monitor wells are constructed with schedule 40, threaded; polyvinyl chloride (PVC) casing unless site geochemistry or contamination necessitates an alternative regulatory agency approved material. The wells are constructed with factory-slotted screen and threaded end caps.

The screened interval is placed such that it extends approximately ten feet into the water bearing zone, and at least two feet above the expected maximum water level. The screened interval may extend less than two feet above the maximum water level, only to prevent intersection of the screened interval with the top of the confining layer of a confined aquifer, or where the water table is too shallow to allow this construction. A graded sand filter pack is placed in the annular space across the screened interval and extended approximately one to two feet above the screen, as site conditions permit, so as to prevent extension of the sand pack into an overlying water-bearing unit. The well screen slot size is the maximum size capable of retaining 90% of the filter pack. Typically, 0.010-inch screen is used where the formation is predominantly clay and/or silt or poorly graded fine sand. A 0.020-inch screen is used where the formation is predominantly well-graded or medium to coarse sand and/or gravel.

The filter pack grade (mean grain size) is selected according to native sediment type as follows: a) for poorly graded fine sand or silt/clay - 4 times the 70% retained grain size of the formation b)

for medium to coarse sand, gravel or well graded sediments - 6 times the 70% retained grain size. Since results of particle size analysis are not always available, Tasman often selects screen size and filter pack on the basis of general site stratigraphy, and specifically the finest significantly thick layer of sediment to be screened.

Well Seal and Completion

A minimum two-foot seal of bentonite is placed above the sand pack and extended to near the ground surface. The bentonite seal is hydrated by either formation water or potable water. A watertight locking cap and protective traffic-rated, flush mount vault box is installed on top of each well situated within or near vehicle traffic areas, or where restricted by access agreements. Elsewhere, each well will be completed with a water tight cap and steel stick-up protective cover. Well construction details are presented on the Field Soil Boring Log sheet. Following completion of a well, Tasman completes and submits, or ensures that the driller has sufficient information to complete and submit, the state-required Well Completion Report or equivalent document.

INTRODUCTION

This procedure is intended for field screening of volatile organic compounds (VOCs) in surface and/or subsurface soil samples collected as part of environmental investigations/assessments. A photoionization detector (PID) should be used for this procedure. Ensure that the lamp in the PID is of sufficient intensity to ionize all contaminants of concern.

EQUIPMENT

Photoionization Detector
Resealable plastic bags (Ziploc® or equivalent)
Field notes or sample logs
Decontamination materials

All equipment and materials shall be inspected for damage prior to traveling to the site and replaced if necessary.

GENERAL PROCEDURE

1. Place a small amount of soil into a Ziploc®or other suitable sealable plastic bag, seal tightly, then disaggregate the soil. Label the outside of the bag with the sample identification, depth, time, and date. When collecting samples where splits may be destined for laboratory analysis, collect laboratory samples in laboratory-supplied sample jars prior to collecting field screening samples to minimize the potential for loss of VOCs in laboratory samples.

2. Place the Ziploc® bag in a warm environment such as direct sunlight, on or in front of a vehicle heating vent, or in a slightly warm oven to promote volatilization of VOCs. The optimal temperature for volatilization is approximately 100°F. Allow the sample to sit for 15 minutes.

3. Place the bag on a clean work surface (plastic sheeting, etc.) upwind of any engine exhaust or VOC sources.

4. Insure that the PID has been properly calibrated prior to using. Follow the manufacturer's instruction and record the calibration on a calibration log, instrument maintenance book, or field book.

5. Open a small length of the plastic bag's zipper and insert the tip of the PID probe. Allow the meter to equilibrate, and then record the maximum measured concentration on the boring log or field book.

6. As necessary decontaminate the PID probe tip in accordance with the Equipment Decontamination SOP.

INTRODUCTION

This standard operating procedure (SOP) is for management of liquid matrix investigation-derived wastes (IDW) generated as a result of field sampling and characterization activities. The goal is to minimize the amount of waste generated while following applicable regulations. Field personnel should review and understand all applicable federal, state, and local regulations regarding IDW. Regulations may prohibit disposal of certain IDW on-site.

Prior to commencing sampling or remediation, a project team member will select an area, preferably secure, for drum or tank storage in consultation with the on-site manager, if applicable. All drums used will be, as required, U.S. Department of Transportation (DOT) approved drums. Drums will not be stacked on top of each other and will be stored in rows not larger than two drums wide, with labels facing outward for identification. Decontamination fluids and other low-volume fluids may be temporarily stored and transported in five- gallon buckets with lids.

Different residual materials (e.g., water and disposable PPE/investigation equipment) will not be drummed together, but will be placed in separate drums or containers. Field screening will be used to drum materials with similar levels of contamination together, if possible.

EQUIPMENT

Storage tanks
DOT-approved drums
Drum liners, if applicable
Funnels
Five gallon buckets and lids
Air sparge equipment
Weather-resistant paint pen
Granular activated carbon (GAC) unit

All equipment and materials shall be inspected for damage prior to traveling to the site and replaced if necessary.

GENERAL PROCEDURE

Residual Liquids

If it is determined that residual liquid such as water from well development and decontamination water must be containerized, it will be placed in a temporary holding tank or DOT-approved 55-gallon drums, as appropriate. The holding tank or drums will be sealed and labeled in accordance with labeling procedures. Liquids drums will contain removable bungs. Funnels will be used to prevent spillage when adding liquids to the drums.

Treatment and Sampling

The liquid matrix IDW temporarily placed in a tank or drum will then be treated on-site by air sparging. The treated IDW water will then be sampled in accordance with the Sampling of Investigation-Derived Wastes SOP 051-503, and the samples will be submitted for laboratory analysis per provisions defined in the work plan to evaluate the effectiveness of treatment. If laboratory results indicate the IDW water treatment achieves site-specific groundwater and surface water cleanup levels, the water will be surface discharged onsite. If the laboratory results indicate

the IDW water treatment did not achieve cleanup standards, the IDW water will be further treated with a granulated activated carbon (GAC) filter, and the sampling and analysis process continued until IDW water quality meets groundwater and surface water cleanup levels. If laboratory results indicate the IDW water treatment then achieves the site-specific disposal criteria, the water will be surface discharged on-site.

If laboratory results do not indicate the IDW water treatment meets the surface discharge criteria, the disposal procedures listed below must be followed.

Disposal

Wastes that have been drummed based on field criteria will be sampled for laboratory analysis to determine the appropriate type of disposal facility. The number of samples collected will depend on the nature of the source areas and the requirements of the disposal facility. IDW characterized or listed as hazardous waste will be disposed of in a manner consistent with all local, state, and federal guidelines.

Labeling

The holding tanks or drums will be labeled on the side using a weather-resistant paint pen. The following information will be included:

- Sampling location identification(s).
- Sampling area designation.
- Point of contact with phone number.
- Type of material.
    - GW - Groundwater from wells.
    - DW - Decontamination water.
    - DS - Disposables.
    - SO - Decontamination solvents.
- For drums containing liquids, indicate the approximate fill line on the outside of the drum. Do not fill more than two-thirds full with liquids.
- Range of field screening results and instrument type, if applicable.
- Date the tank or drum was filled and sealed.

PPE and Disposable Investigation Equipment

Non-hazardous IDW, such as personal protective equipment (PPE) and disposable investigation equipment will be disposed of at the Billings Regional Landfill, located in Billings, MT. PPE and disposable investigation equipment that is generated throughout the investigation activities shall be placed in dedicated heavy duty (minimum of 0.85 mil) plastic garbage bags or containers (e.g., drums). Potentially contaminated PPE or disposable investigation equipment will be decontaminated prior to placement in the plastic garbage bags or containers by brushing off, or using small amounts of water to scrub off, gross potential contamination. PPE and disposable investigation equipment that have been decontaminated, if warranted, are considered refuse and do not require characterization prior to disposal as non-hazardous solid waste.

INTRODUCTION

This standard operating procedure (SOP) is for management of solid matrix investigation derived wastes (IDW) generated as a result of field sampling and characterization activities. The goal is to minimize the amount of waste generated while following applicable regulations. Field personnel should review and understand all applicable federal, state, and local regulations regarding IDW. Regulations may prohibit disposal of certain IDW on-site.

Prior to commencing sampling or remediation, a project team member will select an area, preferably secure, for drum or roll-off box storage in consultation with the on-site manager, if applicable. All drums used will be, as required, U.S. Department of Transportation (DOT) approved drums. Drums will not be stacked on top of each other and will be stored in rows not larger than two drums wide, with labels facing outward for identification.

Different residual materials (e.g., soil and disposable PPE/investigation equipment) will not be drummed together, but will be placed in separate drums. Field screening will be used to drum materials with similar levels of contamination together, if possible.

EQUIPMENT

DOT-approved 55-gallon drums
Roll-off boxes
Drum liners, if applicable
PID
Drum labels
Weather-resistant paint pen
Plastic garbage bags

All equipment and materials shall be inspected for damage prior to traveling to the site and replaced if necessary.

GENERAL PROCEDURE

All residual waste must be placed in drums or roll-off boxes. IDW-filled drums or roll-off boxes will be transported to the secure staging area on-site. The IDW- filled drums or roll-off boxes must be sampled to determine the appropriate type of disposal facility.

Residual Soil

Soil cuttings and excess samples must be placed in DOT-approved drums or roll-off boxes. They will be sealed and labeled in accordance with labeling practices.

Disposal

Wastes that have been drummed based on field criteria may be sampled for laboratory analysis to determine the appropriate type of disposal facility. The number of samples collected will depend on the homogeneity of the drummed material, the nature of the source areas, and the requirements of the disposal facility. IDW characterized or listed as hazardous waste will be disposed of in a manner consistent with all local, state, and federal guidelines.

Labeling

Drums will be labeled on the side using a weather-resistant paint pen or drum label. The following information will be included:

- Sampling location identification(s).
- Sampling area designation.
- Point of contact with phone number.
- Type of material.
    - OB - Overburden soil and cuttings.
    - DS - Disposables.
    - BR - Bedrock cuttings.
    - SO - Decontamination solvents.
- Range of field screening results and instrument type, if applicable.
- Date the drum was filled and sealed.

PPE and Disposable Investigation Equipment

Non-hazardous IDW, such as personal protective equipment (PPE) and disposable investigation equipment will be disposed of at the Billings Regional Landfill, located in Billings, MT. PPE and disposable investigation equipment that is generated throughout the investigation activities shall be placed in dedicated heavy duty (minimum of 0.85 mil) plastic garbage bags or containers (e.g., drums). Potentially contaminated PPE or disposable investigation equipment will be decontaminated prior to placement in the plastic garbage bags or containers by brushing off, or using small amounts of water to scrub off, gross potential contamination. PPE and disposable investigation equipment that have been decontaminated, if warranted, are considered refuse and do not require characterization prior to disposal as non-hazardous solid waste.

INTRODUCTION

This standard operating procedure (SOP) is for the sampling of liquid matrix investigation-derived wastes (IDW) in order to characterize them for disposal. Field personnel should review and understand all applicable federal, state, and local regulations regarding IDW. Regulations may prohibit disposal of certain IDW on-site.

Prior to sampling and characterizations, IDW liquids will be drummed or stored in temporary holding tanks on-site. Different residual materials (e.g., water and disposable PPE/investigation equipment) will not be drummed together, but will be placed in separate drums or containers.

EQUIPMENT

Field log book or field sheets
Sample vials/bottles
Nitrile gloves
5-gallon buckets with lids
Resealable plastic bags: Ziploc® or equivalent
Polyethylene sheeting
Weather-resistant paint pen
Coolers with ice
Peristaltic pump and energy source
Polyethylene tubing
Flexible silicon tubing
Safety scissors
Plastic garbage bags
Traffic controls

All equipment and materials shall be inspected for damage prior to traveling to the site and replaced if necessary.

GENERAL PROCEDURE

IDW requires sampling and characterization prior to disposal.

IDW Liquids

Prior to sampling and characterization, IDW liquids are stored on-site in DOT-approved drums or held in temporary holding tanks for treatment by air sparge and/or granular activated carbon (GAC) filtration. Liquids generated as IDW must be characterized by collecting one post-treatment sample from each drum or temporary holding tank. Samples are collected using a peristaltic pump. The following steps outline the basic procedures for the sampling and characterization of IDW liquids.

- Don safety glasses. Set up any necessary traffic controls.
- Prepare vial/bottle labels with the following information: date, project identification, sample identification, laboratory analysis and preservative.
- Don nitrile gloves.
- Place plastic garbage bag or sheeting on the ground adjacent to drum or tank, if required.
- Add preservative as required to vials/bottles.

- For the peristaltic pump, cut new, clean polyethylene tubing to appropriate length and lower tubing into the drum or holding tank. Attach tubing to approximately eight to ten inches of flexible silicon tubing and connect silicon tubing to peristaltic pump. Attach an effluent polyethylene tubing line to other end of flexible silicon tubing.

- Connect the effluent line to a purge water collection bucket or purge water drum or tank. The purge water must be collected in buckets/drums during sampling of IDW liquids.

- Connect pump to energy source. If a combustion type (gasoline or diesel-driven) generator is used, it must be placed downwind of sampling area.

- Start pumping purge water at a low flow rate (100 - 500 mL/minute). Samples should be collected directly from discharge port of pump tubing. For samples collected for dissolved gases or volatile organic compounds (VOCs) analyses, the pump's tubing needs to be completely full of IDW water to prevent the IDW water from being aerated as IDW water flows through tubing.

- Fill all sample containers with minimal turbulence by allowing IDW water to flow from the tubing gently down the inside of the pre-preserved sample container.

- VOC samples will be collected by allowing pump discharge to flow gently down the inside of laboratory-supplied 40 mL volatile organic analysis (VOA) vials pre-preserved with hydrochloric acid. When filling VOAs, a meniscus must be formed over the mouth of the VOA to eliminate formation of air bubbles and head space during capping. Turn vial upside-down and check for air bubbles. If an air bubble appears, uncap and attempt to add a small volume of sample to achieve the convex meniscus without excessively overfilling vial. If this has to be repeated more than twice, discard sample and begin again with a new preserved vial.

- After filling all sample bottles, write the time of sample collection on each vial. Wrap bottles in protective wrap and place in iced cooler. Maintain a cooler temperature of ≤ 6°C.

- Record the sampling time on sampling field data sheet. Also record total volume of purge water the sample was collected from along with any other necessary information required on the sampling field data sheet. Sign sampling field data sheet and enter the necessary sample information on the chain of custody.

- Properly dispose of the purge liquid, per provisions of the work plan, by returning it to the IDW drums or holding tank until sample analysis results are received.

- Place tubing, paper towels, nitrile gloves, and any other disposables in plastic garbage bags for landfill disposal.

- Change nitrile gloves prior to sampling any additional drums or tanks of IDW liquid.

- When all samples have been collected, carefully pack cooler to avoid breakage of any samples during shipment. Sign completed chain of custody and seal it in a Ziploc® plastic bag and place in the cooler. Add sufficient ice to the cooler to maintain a cooler temperature of ≤ 6°C until the cooler arrives at the laboratory.