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GROUNDWATER MONITORING PLAN
AND
GROUNDWATER SAMPLING AND ANSLYSIS PLAN

BRIDGETON LANDFILL

BRIDGETON, MISSOURI

Prepared For:

Bridgeton Landfill, LLC
13570 St. Charles Rock Rd
Bridgeton, MO 63044

May 24, 2018

Prepared By:

Feezor Engineering, Inc.
406 East Walnut Street
Chatham, Illinois 62629

Engineering for a Better World
FEEZOR
ENGINEERING, INC.

May 24, 2018

Ms. Charlene Fitch
Chief, Engineering Section
Solid Waste Management Program
Division of Environmental Quality
Missouri Department of Natural Resources
1730 East Elm Street
Jefferson City, Missouri 65101

RE: Bridgeton Landfill
Groundwater Evaluation Report

Dear Ms. Fitch:

On behalf of Bridgeton Landfill, LLC, Feezor Engineering, Inc. (FEI) has prepared the enclosed *Groundwater Monitoring Plan and Groundwater Sampling and Analysis Plan.* This plan has been prepared as a follow-up to the December 26, 2017 *Groundwater Evaluation Report* and to the May 8, 2018 Bridgeton Landfill, LLC responses to the MDNR's April 27, 2018 comment letter.

Should you have any questions or comments, please contact the undersigned at your convenience.

Sincerely,

Andrew Wyatt
Senior Hydrogeologist / Residuals Management Team Member

Attachments: Groundwater Monitoring Plan and Groundwater Sampling and Analysis Plan

Cc: Justin Barker – United States Environmental Protection Agency (electronic)
Steve Jett – Jett Environmental Consulting (electronic)
Jessie Merrigan – Lathrop Gage LLP (electronic)
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Chatham, Illinois 62629

Project BT-179

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1 INTRODUCTION

On behalf of Bridgeton Landfill, LLC (Bridgeton Landfill), Feezor Engineering, Inc. (FEI) has prepared this Groundwater Monitoring Plan (GWMP) and Groundwater Sampling and Analysis Plan (GWSAP) for the facility.

This plan describes the groundwater detection monitoring program that the facility is required to maintain pursuant to Title 10 of the Code of State Regulations (CSR) 80-3.010(11)(C)4. The plan also describes the procedures to be used when collecting samples from the facility's groundwater monitoring wells (the GWSAP). These sampling procedures are applicable to 1) the detection monitoring program required by 10 CSR 80-3.010(11)(C)4 and described in this GWMP; 2) the assessment monitoring program required by 10 CSR 80-3.010(11)(C)6 and described in the companion *Assessment Monitoring Plan*; and 3) corrective action monitoring required by 10 CSR 80-3.010(12).

The following documents were consulted during the preparation of this GWMP/GWSAP: Subpart E of the United States Environmental Protection Agency's (USEPA) *Solid Waste Disposal Facility Criteria* (USEPA 1993); the Missouri Department of Natural Resources (MDNR) fact sheet *Collection, Handling, and Reporting Procedures for Groundwater Samples* (MDNR 2014a); USEPA Region I's *Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells* (USEPA 2017); the USEPA's *Methods for Chemical Analysis of Water and Wastes* (UESPA 1983); and the USEPA's *Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods* (a.k.a. SW-846) (USEPA 2014).

This document constitutes an update to the facility's September 1995 GWMP (Golder 1995a) and its November 1998 GWSAP (Herst 1998). This GWMP/GWSAP updates the groundwater detection monitoring program to reflect revisions made to the well network and sampling schedule. The plan also includes revisions intended to enhance clarity, update terminology, and reflect changes in standard industry practice.

2 PHYSICAL SETTING

This section presents a general description of the geographic location and physical setting of the Bridgeton Landfill.

The Bridgeton Landfill is an approximately 52-acre closed municipal solid waste landfill. The facility is located in the City of Bridgeton, St. Louis County, Missouri. The facility's physical address is 13570 St. Charles Rock Road, St. Louis, Missouri 63044. The landfill is operated under the terms of MDNR Solid Waste Disposal Area Operating Permit Number #118912, issued on November 18, 1985. The facility formerly accepted household, commercial, and industrial solid waste.

The site located on the eastern edge of the Missouri river floodplain. The Missouri River is located approximately two miles to the west of the site. The area is transitional between the alluvial floodplain immediately to the west of the site and the loessial bluffs approximately a half-mile to the east. The edge of the alluvial valley is oriented north to south, roughly through the western side of the site. The natural topography of the area is gently rolling. However, the site's topography has been significantly altered by quarrying activities in the eastern portion of the site and the placement of mine spoils and landfill materials in the western portion of the site.

The site's use was agricultural until 1939, when a limestone quarry and crushing operation was initiated at the site. The limestone quarry was operated between 1939 and 1988, and was closed when economically recoverable reserves were exhausted. The quarry consists of two pits which were excavated to a maximum depth of approximately 240 feet below ground surface, an approximate elevation of 240 feet above mean sea level (ft/msl).

The landfill was operated within the former limestone quarry. Landfilling operations were initiated within the northern pit (North Quarry) in 1979. Expansion of the landfill into the southern pit (South Quarry) was proposed in 1984 and authorized under Permit #118912 in November 1985. Landfilling with the pits continued until December 31, 2004.

3 GEOLOGY

This section presents a general description of the geologic setting of the Bridgeton Landfill. The site's geology has been described in detail in reports previously submitted to the MDNR, including the 1995 *Hydrogeologic Characterization Report* (Golder 1995b). The descriptions presented in this section are partly adapted from that report and others.

For the purposes of groundwater monitoring, the geology underlying the Bridgeton Landfill can be divided into five units of interest, from oldest to youngest: the Keokuk formation bedrock, the Warsaw formation bedrock, the Salem formation bedrock, the St. Louis formation bedrock, and unconsolidated materials consisting of alluvium and loess. Of these, the Warsaw formation is not a groundwater-bearing unit and is therefore not discussed in the description of the site's hydrogeology in **Section 4** below.

The former quarry pits were constructed to a depth consistent with the upper portion of the Salem formation. Accordingly, portions of the Salem formation, St. Louis formation, and unconsolidated materials are absent in those areas where the landfill was constructed.

3.1 Keokuk Formation Bedrock

The Keokuk formation is a part of the Osagean series, which is in turn a part of the Mississippian system. The formation is a fresh to slightly- or moderately-weathered, thinly- to medium-bedded, medium-strong limestone. The color of the formation is generally very light gray to light olive. The limestone is dolomitic, with members that are variously described as siliceous and arenaceous, as well as porous and vuggy. The formation is characterized by chert layers and nodules. Fractures are rare in the Keokuk formation, generally occurring at frequencies of up to two fractures per foot. Where they occur, these fractures are generally irregular and rough, or — alternately — bedded and planar.

The top of the Keokuk formation is encountered at an elevation of approximately 115 to 126 ft/msl in the eastern portion of the landfill and approximately 115 ft/msl in the western portion of the landfill. The Keokuk formation is underlain by the Burlington formation and overlain by the Warsaw formation.

3.2 Warsaw Formation Bedrock

The Warsaw formation is a part of the Meramecian Series, which is in turn a part of the Mississippian system. The formation is a fresh, thickly-bedded, weak to medium-strong, microcrystalline to coarsely crystalline calcareous claystone and limestone. The formation includes abundant interbedding of dolomite, claystone, siltstone, clayey siltstone, and silty claystone. The lower portion of the Warsaw formation is predominantly thinly- to medium-bedded limestone, grading into the upper portion of the Keokuk formation, with thin chert layers and small chert nodules. The upper portion of the Warsaw formation is characterized

by an approximately 2.5- to 10-foot thick claystone or siltstone layer, commonly referred to as the Warsaw Shale. The color of the formation is generally dark greenish gray to olive black. Formation members are variously described as arenaceous or argillaceous, as well as porous and vuggy. Fractures are rare in the Warsaw formation, generally occurring at frequencies of up to one fracture per foot. Where they occur, these fractures are generally jointed, either irregular or planar, and either rough or smooth.

The top of the Warsaw formation is encountered at an elevation of approximately 240 ft/msl in the eastern portion of the landfill and approximately 250 to 260 ft/msl in the western portion of the landfill. The thickness of the Warsaw formation ranges from approximately 130 to 145 feet. The Warsaw formation is underlain by the Keokuk formation and overlain by the Salem formation. As noted above, the Warsaw formation is not a groundwater-bearing unit, and is therefore not monitored under the facility's groundwater monitoring programs.

3.3 Salem Formation Bedrock

The Salem formation is a part of the Meramecian Series, which is in turn a part of the Mississippian system. The formation is a fresh, thinly- to thickly-bedded, medium-strong limestone. The color of the formation is generally pale yellowish brown to light olive gray. The limestone is dolomitic and fossiliferous. The formation is also characterized by widespread interbedded dolomite layers and scattered chert clasts, nodules, and layers. Fractures are rare in the Salem formation, generally occurring at frequencies ranging from zero to one fracture per foot in the lower portion of the formation and up to two fractures per foot in the upper portion of the formation. Where they occur, these fractures are generally jointed, irregular, and rough, or — alternately — jointed, planar, and smooth.

The top of the Salem formation is encountered at an elevation of approximately 320 ft/msl in the eastern portion of the landfill and approximately 328 to 340 ft/msl in the western portion of the landfill. The thickness of the Salem formation ranges from approximately 67 to 83 feet. Portions of the Salem formation were removed during quarrying activities, and as such the unit is partly absent in those areas where the landfill was constructed. The Salem formation is underlain by the Warsaw formation and overlain by the St. Louis formation.

3.4 St. Louis Formation Bedrock

The St. Louis formation is a part of the Meramecian series, which is in turn a part of the Mississippian system. The formation is generally a fresh to slightly-weathered, thinly- to very thickly-bedded, microcrystalline to medium crystalline, medium-strong to strong limestone. The color of the formation is generally very light gray to olive gray. The limestone is dolomitic, and the upper units of the formation are brecciated, stylolitic, and fossiliferous. The St. Louis formation is also characterized by periodic claystone and siltstone beds and layers. The upper units of the formation contain occasional iron-oxide

concretions and chert nodules. Fractures generally occur in the St. Louis formation at a frequency of zero to ten fractures per foot. Where they occur, these fractures are generally jointed, irregular, rough, and infilled with clay.

The top of the St. Louis formation is encountered at an elevation of approximately 425 to 460 ft/msl in the eastern portion of the landfill and approximately 379 to 445 ft/msl in the western portion of the landfill. The thickness of the St. Louis formation ranges from approximately 65 to 130 feet. Portions of the St. Louis formation were removed during quarrying activities, and as such the unit is absent in those areas where the landfill was constructed. The St. Louis formation is underlain by the Salem formation and overlain by unconsolidated materials.

3.5 Unconsolidated Materials

The unconsolidated materials that overlie the St. Louis formation at the Bridgeton Landfill are comprised primarily of alluvium overlain by loess. The alluvium ranges from a silty clay and clayey silt to a sand, and the loess ranges from a silty clay to a clayey silt. The loess was redeposited from braided glacial melt-out drainages by westerly winds during the late Pleistocene. The thickness of the loess is greatest in the eastern portion of the landfill. In the eastern portion of the landfill, the thickness of the loess is approximately 13 to 22 feet, and the thickness of the alluvium is approximately 12 to 32 feet. The loess is thinner in the western portion of the site, and occasionally absent, due to quarrying and landfilling activities, as well as erosion within the floodplain. In the western portion of the site, the thickness of the loess (where present) is approximately 10 to 15 feet, and the thickness of the alluvium is up to approximately 110 feet. Portions of the alluvium and loess were removed during quarrying activities, and as such these materials are absent in those areas where the landfill was constructed.

4 HYDROGEOLOGY

This section presents a general description of the hydrogeologic setting of the Bridgeton Landfill. The site's hydrogeology has been described in detail in reports previously submitted to the MDNR, including the 1995 *Hydrogeologic Characterization Report* (Golder 1995b). The descriptions presented in this section are partly adapted from that report and others.

An extensive discussion of the site's groundwater elevations, hydraulic conductivity, secondary permeability, and hydraulic gradients – as well as the spatial and seasonal variation in these parameters – was previously presented in the November 28, 2016 *Groundwater Technical Report* (GWTR) (Feezor 2016). Select data and findings from that report are referenced in this section. The complete details can be found in the GWTR.

Four hydrogeologic zones are monitored at the Bridgeton Landfill, roughly corresponding to the four geologic units of interest described in **Section 3**, above: the Keokuk Zone, the Deep Salem Zone, the St. Louis / Upper Salem Zone, and the Alluvial Zone. Groundwater elevations in these four zones are monitored via a network of monitoring wells (which are sampled under the facility's detection and/or assessment monitoring programs) and piezometers (which are used for groundwater elevation monitoring). The entirety of the facility's groundwater monitoring network is illustrated on **Figure 4-1**.

As noted in **Section 3**, above, the Warsaw formation is not a groundwater-bearing unit, and is therefore not monitored under the facility's groundwater monitoring programs.

4.1 Keokuk Zone

Four wells and piezometers near the Bridgeton Landfill are completed in the Keokuk formation:

- PZ-100-KS
- PZ-104-KS
- PZ-106-KS
- PZ-111-KS

The Keokuk Zone monitoring network is illustrated on **Figure 4-2**.

Horizontal groundwater flow in the Keokuk Zone is generally from the southeastern side to northwestern side of the landfill. Groundwater elevations in the Keokuk Zone ranged from 458.35 to 468.60 ft/msl in 2015 - 2016 (Feezor 2016). Given that the top of the Keokuk formation occurs at approximately 115 to 126 ft/msl, these groundwater elevations indicate confined aquifer conditions in the Keokuk Zone. Based on the results of Packer tests and slug tests conducted as a part of the facility's hydrogeologic characterization, the mean hydraulic conductivity of the Keokuk Zone is 5.5×10^{-6} cm/sec (Golder 1995b).

Horizontal hydraulic gradients in the Keokuk Zone ranged from 0.0048 to 0.0050 in 2015 – 2016, with a mean gradient of 0.0049 (Feezor 2016). Vertical groundwater gradients between the Keokuk and Deep Salem Zones are consistently negative, i.e., upward from the Keokuk into the Deep Salem. The vertical gradient ranged from -0.030 to -0.167 in 2015 – 2016, with a mean gradient of -0.078 (Feezor 2016).

4.2 Deep Salem Zone

Nine wells and piezometers near the Bridgeton Landfill are completed in the deep portions of the Salem formation:

- MW-1204
- PZ-100-SD
- PZ-104-SD
- PZ-106-SD
- PZ-111-SD
- PZ-209-SD
- PZ-210-SD
- PZ-211-SD
- PZ-212-SD

The Deep Salem monitoring network is illustrated on **Figure 4-3**.

Within the limits of the landfill, infiltrated groundwater originating from the Deep Salem Zone (and other zones) is removed via pumping from the quarry, along with landfill leachate. Groundwater elevations in the Deep Salem Zone are generally highest on the southern and southeastern side of the landfill and lowest on the northwestern side of the landfill.

Groundwater elevations in the Deep Salem Zone ranged from 432.06 to 472.65 ft/msl in 2015 – 2016 (Feezor 2016). Given that the top of the Keokuk formation occurs at approximately 240 to 260 ft/msl, these groundwater elevations indicate confined aquifer conditions in the Deep Salem Zone. Based on the results of Packer tests and slug tests conducted as a part of the facility's hydrogeologic characterization, the mean horizontal hydraulic conductivity of the Deep Salem Zone is 1.1×10^{-6} cm/sec (Golder 1995b).

Horizontal hydraulic gradients in the Deep Salem Zone ranged between 0.0167 to 0.0176 in 2015 – 2016, with a mean gradient of 0.0170 (Feezor 2016). This is approximately three to four times greater than the mean gradients observed in the Keokuk Zone (0.0049).

Vertical groundwater gradients between the Deep Salem and St. Louis / Upper Salem Zones vary in orientation (upward or downward) throughout the site. At two well pairs — PZ-106-SS / PZ-106-SD and PZ-116-SS / MW-1204 — vertical gradients are consistently negative, i.e., upward from the Deep Salem into the St. Louis / Upper Salem. Vertical gradients are consistently positive, (i.e., downward from the St. Louis / Upper Salem into the Deep Salem) at the other five well pairs: PZ-100-SS / PZ-100-SD, PZ-104-SS / PZ-104-SD, PZ-209-SS / PZ-209-SD, PZ-210-SS / PZ-210-SD, and PZ-211-SS / PZ-211-SD (Feezor 2016).

The downward vertical gradient (where it occurred) between the St. Louis / Upper Salem and Deep Salem Zones ranged from 0.006 to 0.021 in 2015 - 2016, with a mean gradient of 0.014. The upward vertical gradient (where it occurred) ranged from 0.000 to -0.042 in

2015 -2016, with a mean gradient of -0.013. In general, the vertical gradients observed between the Deep Salem and St. Louis / Upper Salem Zones (0.019 downward mean, -0.013 upward mean) are smaller in magnitude than those observed between the Keokuk and Deep Salem Zones (-0.078 upward mean) (Feezor 2016).

4.3 St. Louis / Upper Salem Zone

Although the St. Louis formation and upper Salem formation are geologically distinct, they are generally regarded as a single hydrogeologic unit at the Bridgeton Landfill site. Twenty-seven wells and piezometers near the Bridgeton Landfill are completed in the St. Louis formation and upper portions of the Salem formation:

- PZ-100-SS
- PZ-101-SS
- PZ-102-SS
- PZ-102R-SS
- PZ-103-SS
- PZ-104-SS
- PZ-105-SS
- PZ-106-SS
- PZ-107-SS
- PZ-109-SS
- PZ-111-SS
- PZ-113-SS
- PZ-115-SS
- PZ-116-SS
- PZ-200-SS
- PZ-201A-SS
- PZ-202-SS
- PZ-203-SS
- PZ-204-SS
- PZ-204A-SS
- PZ-205-SS
- PZ-206-SS
- PZ-208-SS
- PZ-209-SS
- PZ-210-SS
- PZ-211-SS
- PZ-212-SS

The St. Louis / Upper Salem monitoring network is illustrated on **Figure 4-4**.

Within the limits of the landfill, infiltrated groundwater originating from the St. Louis / Upper Salem Zone (and other zones) is removed via pumping from the quarry, along with landfill leachate. Groundwater elevations in the St. Louis / Upper Salem Zone are generally highest on the southern and eastern sides of the landfill and lowest on the northern and western side of the landfill, although there is some local variation in this pattern.

Groundwater elevations in the St. Louis / Upper Salem Zone ranged from 430.90 to 472.76 ft/msl in 2015 – 2016 (Feezor 2016). Given that the top of the St. Louis formation occurs at approximately 379 to 460 ft/msl, these groundwater elevations indicate semi-confined aquifer conditions in the St. Louis / Upper Salem Zone. Based on the results of Packer tests and slug tests conducted as a part of the facility's hydrogeologic characterization, the mean horizontal hydraulic conductivity of the St. Louis / Upper Salem Zone is 1.0×10^{-6} cm/sec (Golder 1995b).

Horizontal hydraulic gradients in the St. Louis / Upper Salem Zone ranged from 0.0283 to 0.0332 in 2015 - 2016, with a mean gradient of 0.0304 (Feezor 2016). This is approximately six times greater than the mean gradient observed in the Keokuk Zone (0.0049) and two times greater than the mean gradient observed in the Deep Salem Zone (0.0170).

Vertical groundwater gradients between the St. Louis / Upper Salem and Alluvial Zones vary in orientation (upward or downward) throughout the site. At two well pairs — PZ-113-AD / PZ-113-SS and PZ-114-AS / PZ-115-SS — vertical gradients are consistently negative, i.e., upward from the St. Louis / Upper Salem into the Alluvial. However, vertical gradients are consistently positive, (i.e., downward from the Alluvial into the St. Louis / Upper Salem) at well pair PZ-205-AS / PZ-205-SS (Feezor 2016).

The upward vertical gradient (where it occurred) between the Alluvial and St. Louis / Upper Salem Zones ranged from -0.003 to -0.093 in 2015 - 2016, with a mean gradient of -0.044. The downward vertical gradient (where it occurred) ranged from 0.036 to 0.093 in 2015 - 2016, with a mean gradient of 0.064. In general, the vertical gradients observed between the St. Louis / Upper Salem and Alluvial Zones (0.064 downward mean, -0.044 upward mean) are greater in magnitude than those observed between the Deep Salem and St. Louis / Upper Salem Zones (0.019 downward mean, -0.013 upward mean) but smaller than those observed between the Keokuk and Deep Salem Zones (-0.078 upward mean) (Feezor 2016).

4.4 Alluvial Zone

Thirteen wells and piezometers near the Bridgeton Landfill are completed in unconsolidated materials at the Bridgeton Landfill site:

- D-85
- D-87
- I-67
- I-68
- I-73
- LR-103
- PZ-112-AS
- PZ-113-AS
- PZ-113-AD
- PZ-114-AS
- PZ-205-AS
- PZ-207-AS
- S-84

The Alluvial Zone monitoring network is illustrated on **Figure 4-5**.

As shown on this figure, the monitorable extent of the Alluvial Zone is limited to the west-central, northwestern, and northern sides of the landfill. These correspond to the areas where the alluvium is thickest and where perched (unconfined) groundwater occurs consistently and continuously at the interface between the St. Louis formation bedrock and unconsolidated materials. Some perched groundwater is present within the unconsolidated materials on the eastern side of the landfill, but this groundwater is discontinuous and thin (generally less than two feet of saturated thickness).

Within the limits of the landfill, infiltrated groundwater originating from the Alluvial Zone (and other zones) is removed via pumping from the quarry, along with landfill leachate. Groundwater elevations in the Alluvial Zone are generally highest on the west-central side of the landfill and lowest on the northern and northwestern sides of the landfill, but there is substantial local and seasonal variation in this pattern.

Groundwater elevations in the Alluvial Zone ranged from 431.20 to 435.71 ft/msl in 2015 – 2016 (Feezor 2016). Based on the results of slug tests and laboratory permeability tests conducted as a part of the facility's hydrogeologic characterization, the mean horizontal hydraulic conductivity of the Alluvial Zone is 8.4×10^{-5} cm/sec (Golder 1995b).

Horizontal hydraulic gradients in the Alluvial Zone ranged from 0.0010 to 0.0027 in 2015 - 2016, with a mean gradient of 0.0021 (Feezor 2016). This is less than half the mean gradient observed in the Keokuk Zone (0.0049) and substantial lower than the mean gradients observed in the Deep Salem Zone (0.0170), and St. Louis / Upper Salem Zone (0.0328).

5 GROUNDWATER MONITORING WELLS

This section describes the groundwater monitoring well network that is used to evaluate the Bridgeton Landfill. The detection monitoring program is the primary focus of this section, but the assessment monitoring program is also briefly summarized. Further details on the assessment monitoring program can be found in the companion *Assessment Monitoring Plan* (AMP).

5.1 Detection Monitoring Network

The groundwater detection monitoring network for the Bridgeton Landfill is comprised of 38 wells, screened within four separate hydrogeologic zones:

Alluvial Wells

- D-85[(A)]
- I-68
- I-73[(A)]
- PZ-112-AS[(A)]
- PZ-113-AS*
- PZ-113-AD*
- PZ-114-AS[(A)]
- PZ-205-AS[(A)]
- PZ-207-AS[(A)]
- S-84[(A)]

St. Louis / Upper Salem Wells

- PZ-100-SS
- PZ-101-SS[(A)]
- PZ-102-SS
- PZ-102R-SS
- PZ-103-SS[(A)]
- PZ-104-SS[(A)]
- PZ-105-SS
- PZ-106-SS
- PZ-107-SS[(A)]
- PZ-109-SS
- PZ-111-SS
- PZ-113-SS
- PZ-115-SS
- PZ-116-SS[(A)]
- PZ-200-SS*
- PZ-201A-SS
- PZ-202-SS[(A)]
- PZ-203-SS
- PZ-204-SS
- PZ-204A-SS*
- PZ-205-SS
- PZ-206-SS

Deep Salem Wells

- MW-1204[(A)]
- PZ-100-SD
- PZ-104-SD[(A)]
- PZ-106-SD
- PZ-111-SD

Keokuk Wells

- PZ-104-KS[(A)]

Wells indicated with [(A)] are currently under assessment monitoring. When assessment monitoring is no longer required at one of these wells, pursuant to 10 CSR 80-3.010(11)(C)6.G, routine detection monitoring will be reinstated at that well.

Wells indicated with * are currently utilized as detection monitoring wells but may require additional monitoring in the future, based on historic inorganic exceedances of federal primary drinking water standards (maximum contaminant limits, or MCLs).

Table 5-1 summarizes the basic as-built information for the facility's groundwater detection monitoring wells. **Figure 5-1** illustrates the layout of the detection monitoring network.

When available, borehole logs and as-built construction diagrams that were prepared for the wells at the time of installation are presented in **Appendix A.** The borehole logs present information on the geologic materials encountered during well drilling. The as-built diagrams present well construction specifications, such as diameter, total depth, screened interval depth, and screen slot size.

The wells are equipped with dedicated low-flow bladder pumps that will be utilized for purging and sampling of groundwater. Each well has historically yielded sufficient water volume to allow for laboratory analysis of the full suite of analytical constituents (see **Section 5.1.2**, below), and it is anticipated that the wells will continue to do so in the future.

5.1.1 Sampling Frequency

At most solid waste landfills, detection monitoring is performed on a semi-annual basis in May and November in accordance with 10 CSR 80-3.010 (11)4. However, per a July 30, 2014 comment letter from the SWMP (MDNR 2014b), the Bridgeton Landfill is currently sampled on a quarterly basis. Quarterly sampling is normally performed in the months of February, May, August, and November, although a sampling event may be extended into the preceding or following month if necessary due to logistical constraints.

The sampling schedule for the detection monitoring program is summarized on **Table 5-2**. Most of the facility's detection monitoring wells are sampled on a quarterly basis. However, one well is sampled on an annual basis in May: Alluvial well PZ-114-AS.

As described in the GWTR (Feezor 2016) and December 26, 2017 *Groundwater Evaluation Report* (GWER) (Feezor 2017), it has previously been acknowledged by both Bridgeton Landfill, LLC and the SWMP that organic constituent detections observed at well PZ-114-AS are likely attributable to an off-site source. This source originates from the Virbac Animal Health (formerly PM Resources, Inc.) property located across St. Charles Rock Road from the facility (MDNR 2003). In an April 27, 2018 comment letter, the MDNR approved a reduction in sampling frequency at PZ-114-AS from quarterly to annual sampling (MDNR 2018).

5.1.2 Analytical Constituents

During each quarterly detection monitoring event, the detection monitoring wells listed in **Section 5.1** will be analyzed for the constituents specified in 10 CSR 80-3.010(11)(C)4.B, including those listed and Appendix I to 10 CSR 80-3.010. **Appendix B** presents a summary of these routine quarterly analytical constituents and suggested analytical methods.

5.2 Assessment Monitoring Network

The current groundwater assessment monitoring network for the Bridgeton Landfill is comprised of 22 wells, screened within four separate hydrogeologic zones:

Alluvial Wells

- D-85(D)
- I-73(D)
- PZ-112-AS(D)
- PZ-114-AS(D)
- PZ-205-AS(D)
- PZ-207-AS(D)
- S-84(D)

St. Louis / Upper Salem Wells

- PZ-101-SS(D)
- PZ-103-SS(D)
- PZ-104-SS(D)
- PZ-107-SS(D)
- PZ-116-SS(D)
- PZ-202-SS(D)
- PZ-209-SS
- PZ-210-SS
- PZ-211-SS

Deep Salem Wells

- MW-1204(D)
- PZ-104-SD(D)
- PZ-209-SD
- PZ-210-SD
- PZ-211-SD

Keokuk Wells

- PZ-104-KS(D)

Wells indicated with (D) are a part of the facility's detection monitoring network, but are also currently used as wells to evaluated the rate and extent of impacts under the assessment monitoring program. When assessment monitoring is no longer required at one of these wells, pursuant to 10 CSR 80-3.010(11)(C)6.G, routine detection monitoring will be reinstated at that well.

Table 5-1 summarizes the basic as-built information for the facility's groundwater assessment monitoring wells. **Figure 5-2** illustrates the layout of the assessment monitoring network. The facility's assessment monitoring program – including sampling frequencies, analytical constituents, and groundwater protection standards – is discussed in greater detail in the companion AMP.

5.3 Piezometer (Groundwater Elevation) Network

On a quarterly basis – typically as a part of the detection sampling event – a depth to static groundwater measurement is made at each of the facility's monitoring wells and piezometers (see the Groundwater Sampling and Analysis Plan in **Section 6**, below). The facility's piezometers are monitoring locations that are not routinely sampled, but are still used for the purposes of this determination of depth to static groundwater (and groundwater elevation).

The piezometer network for the Bridgeton Landfill is comprised of nine wells, screened within four separate hydrogeologic zones:

Alluvial Wells

- D-87
- I-67
- LR-103

St. Louis / Upper Salem Wells

- PZ-208-SS
- PZ-212-SS

Deep Salem Wells

- PZ-212-SD

Keokuk Wells

- PZ-100-KS
- PZ-106-KS
- PZ-111-KS

Table 5-1 summarizes the basic as-built information for the facility's groundwater piezometers. **Figure 5-3** illustrates the piezometer network.

6 SAMPLING AND ANALYSIS PLAN

This section and **Section 7** present the groundwater sample collection, handling, and reporting procedures for the Bridgeton Landfill. This section constitutes an update to the facility's November 1998 GWSAP (Herst 1998).

The facility or its designated sampling consultant will adhere to these methods when conducting groundwater monitoring events. These methods are intended to yield representative and comparable groundwater analytical results from each monitoring well during each monitoring event. All field activities will be conducted in a manner that is consistent with the facility's *Health and Safety Plan* (Bridgeton Landfill, LLC 2016).

Laboratory analysis of groundwater samples shall be performed by each laboratory according to their established standard operating procedures. Each laboratory shall produce and maintain complete documentation of its analytical work.

The sampling of a groundwater monitoring well generally consists of the following steps, which are described in more detail in **Sections 6.1** through **6.3**, below:

- Determination of static groundwater elevation;
- Well purging; and
- Collection of samples.

6.1 Determination of Static Groundwater Elevation

A depth to static groundwater measurement will be performed at each groundwater monitoring well prior to purging. Static groundwater elevation will be determined for each well by subtracting the measured depth to static groundwater from the surveyed elevation of the top of the well riser (inner casing).

In addition, a total well depth measurement will be performed annually at each groundwater monitoring well and piezometer. For wells with dedicated pumps installed, a depth to top of pump measurement may be performed in lieu of a total well depth measurement. In such cases, the total well depth may be determined by referencing as-built construction diagrams.

Depth measurements will be recorded to the nearest 0.01 foot, measured from a permanent reference mark located on the top of the well riser. Immediately following the water level measuring device's use at each well, those parts of the device that come into contact with groundwater will be cleaned with a non-phosphate detergent and then rinsed with deionized water. This cleaning is performed to minimize the potential for cross-contamination.

6.2 Well Purging

Purging of monitoring wells prior to sample collection is necessary to remove stagnant or thermally stratified groundwater from the well casing and sandpack that may not be representative of groundwater within the aquifer. If possible, purging of a well should be performed at a rate at or below the well's recovery rate, to minimize the migration of groundwater above the well screen. Purged groundwater water will be containerized and disposed of in the facility' leachate treatment system.

Throughout the purging process, the purged groundwater will be monitored for field parameters: pH, specific conductance, temperature, turbidity, dissolved oxygen, and oxidation-reduction potential (ORP). Field parameter values will be monitored and recorded at regular intervals, with a minimum interval of five minutes. Field instruments utilized for parameter monitoring will be calibrated according to the manufacturers' recommendations.

Regardless of purging method, purging will continue until field parameter equilibrium is achieved. Equilibrium is achieved when parameters exhibit variation equal to or less than the following, for a minimum of three consecutive field parameter readings:

- pH (0.1 standard pH units)
- Specific conductance (10%)
- Temperature (0.5 °C)

Allowances may be made regarding the definition of equilibrium based on the aquifer's characteristics at individual wells. Turbidity, dissolved oxygen, and ORP will be monitored and recorded, but not used for the determination of equilibrium.

If a well purges dry prior to the achievement of field parameter equilibrium, the well will be purged to the lowest reasonable groundwater elevation, permitted to recover, and then sampled within 24 hours of the completion of purging.

If dedicated or disposable purging equipment is not utilized, the equipment will be cleaned following its use at each well, to minimize the potential for cross-contamination (see **Section 6.4** below).

6.2.1 Low-Flow Purging via Pump

If possible, a pump will be utilized to perform purging of groundwater monitoring wells. Low-flow purging is the recommended method of pump purging at the Bridgeton Landfill. This method utilizes a pump that is set within the well's screened interval and is capable of relatively low pumping rates. During low-flow purging, a pumping rate of 200 to 450 mL/min is typically utilized at the Bridgeton Landfill.

During low-flow purging via pump, pumping rates will be regulated or controlled to minimize turbulent flow, prevent damage to monitoring well components, and minimize the introduction of sediments into the well. Prior to recording field parameters, a minimum groundwater volume will be purged from the well, equal to two times the volume of the pump and its associated tubing. Field parameter measurements will be recorded at regular time intervals. A flow-through cell will be used for all field parameter measurements other than turbidity, to ensure that each instrument's sensor is in contact with flowing purge water. When utilizing low-flow purging methods, purging will continue until field parameter equilibrium has been achieved (if possible). Approximate pumping rates and the approximate volume of groundwater removed from the well will be recorded on the well's field log.

6.2.2 Volumetric Purging via Pump

Pump purging may still be utilized when low-flow purging methods are not feasible, due to pump limitations. Some pumps are incapable of running at very low rates without damaging pump components or heating the groundwater sample. In such instances, higher pumping rates may be utilized.

In those instances when pump purging is performed without utilizing low-flow methods, the static volume (*V*) of groundwater within the well (including the volume within the well sandpack) will be determined for each well prior to purging. This volume is utilized to determine the target purging volume.

The height (*H*) of the groundwater column is first determined by subtracting the measured depth to static groundwater from the total well depth. The static well volume (*V*) is then calculated as:

$$V = 5.875 \times \{[D_1{}^2 \times H_1] + [(D_2{}^2 \times H_2 \times n) - (D_1{}^2 \times H_2)]\}$$

Where:

5.875 = coefficient incorporating cross-section area calculation coefficients and ft^3 to gal volume conversion;
V = static groundwater volume (gal);
D_1 = inside well diameter (ft);
H_1 = height of groundwater column (ft);
D_2 = diameter of borehole (ft);
H_2 = saturated height of sandpack (ft); and
n = assumed porosity of sandpack = 0.30

When volumetric purging via pump is utilized, purging will continue until at least three static well volumes have been purged and field parameter equilibrium has been achieved (if possible). If volumetric purging via pump is used as the purge method, the use of a flow through cell as described in **Section 6.2.1**, above, is not possible due to potential damage

to field instrument sensors. Field parameters will be measured from a purge water portion that has been collected into in a separate container not used for laboratory sample collection.

6.2.3 Volumetric Purging via Bailer

In those instances where it is necessary to utilize manual bailing as a purging method, the following procedures will be utilized. The bailer will be slowly lowered into the water column within the monitoring well until the top of the bailer is below the groundwater surface. The bailer will then be slowly retrieved up the water column. Contact between the bailer's tie line and the ground or other surfaces should be avoided. Field parameters measurements will be performed and recorded at regular volume intervals. If volumetric purging via bailer is used as the purge method, the use of a flow-through cell as described in **Section 6.2.1**, above, is not possible. Field parameters will be measured from a purge water portion that has been collected into in a separate container not used for laboratory sample collection. The approximate volume of groundwater removed from the well will be recorded.

Bailer purging will continue until at least three static well volumes have been purged and field parameter equilibrium has been achieved (if possible). See **Section 6.2.2**, above, for the determination of static well volume. Allowances may be made in the case of wells with very slow recovery times. In such instances, bailer purging will continue until at least one static well volume (rather than three volumes) has been purged and field parameter equilibrium has been achieved, or until the well is dry.

In those instances when bailer purging is utilized as a purging method, disposable bailers will be utilized. One bailer per monitoring well will be utilized to minimize the potential for cross-contamination. Only bailers and tie line made of materials that will not affect groundwater quality (i.e., inert materials) will be utilized.

6.3 Sample Collection

A groundwater monitoring well may be sampled as soon as field parameters have stabilized, or, if purged to dryness, as soon as it has recovered sufficiently, but typically no more than 24 hours after purging. The same methods utilized for well purging may be utilized for sample collection, as is appropriate and feasible. Regardless of method, the groundwater sample will be transferred to sample containers in such a manner as to minimize agitation and aeration. If samples collected via pump, the sample bottles will be filled directly from the pump's discharge tube. Field parameters will be measured and recorded at the time of sampling. If the well is sampled immediately after purging, the final set of purging parameter values may be used for this purpose. If the well is sampled later, a new set of parameter values will be measured and recorded concurrently with sampling.

Individual sample containers will be filled in order of decreasing sensitivity to potential volatilization of the analytical constituents, as specified on **Table 6-1**. This table is organized according to the preservation methods associated with the suggested analytical methods listed in **Appendix B**.

Sample containers (vials) for volatile organic compound (VOC) analysis should be filled in such a manner as to eliminate head space within the container. If bladder pumps are used for the collection of VOC samples, the pump setting should be set so that one pulse will deliver sufficient water to fill a 40 mL VOC vial.

6.4 Equipment Cleaning

If utilized, non-dedicated, non-disposable purging and sampling equipment — such as pumps and bailers — will be cleaned following use at each monitoring well. Cleaning will consist of a wash with a non-phosphate detergent solution, followed by a rinse, both inside and out, with distilled water. Disposable equipment will not be reused after its initial use, and will be placed in a trash bag and disposed of properly on-site.

6.5 Sample Handling

As soon as possible after collection, groundwater samples should be placed in a laboratory-provided cooler out of direct sunlight. Sample bottles will be received pre-preserved from the laboratory. Preservation methods include pH adjustment, chemical addition, and cooling of the sample to a minimum temperature. The specific preservation methods associated with the suggested analytical methods are presented with the detection monitoring constituent list in **Appendix B**.

6.6 Sample Documentation and Chain-of-Custody

6.6.1 Field Logs

Field logs will be prepared for each groundwater monitoring event conducted at the facility. In the event that an unexpected or apparently anomalous groundwater analysis result occurs, the logs may assist in determining if the result is attributable to the circumstances of sample collection rather than a true change in groundwater quality. It is recommended that a discrete field log sheet be prepared for each groundwater monitoring well that is sampled. The following information should be recorded on each field log sheet:

- Facility name and location;
- Well name or designation;
- Names and affiliation(s) of sampling personnel;
- Well purging method and equipment (including whether equipment is dedicated or non-dedicated);

- Depth to static groundwater prior to purging, total well depth (measured or as-built), and depth to top of pump (if applicable);
- Calculated groundwater elevation;
- Depth to groundwater and groundwater elevation from the previous measurement/sampling event;
- Well inner casing diameter and calculated static well volume (if volumetric purging is performed);
- Purging/sampling equipment settings (e.g., pressure);
- Date and time of well purging (start and end time);
- Approximate well purging rate (if applicable);
- Approximate volume of groundwater purged, including tubing volume;
- Depth to groundwater immediately after purging;
- Field parameter readings;
- Make, model, and serial number of field parameter instruments;
- Documentation of field instrument calibration procedures and calibration checks (if not documented in site field book);
- Sample collection method and equipment (including whether equipment is dedicated or non-dedicated);
- Depth to groundwater at time of sampling (if sampling is not performed immediately after purging);
- Date and time of sample collection;
- Field parameter readings at time of sampling (if different from final set of field parameters from purging);
- Appearance of sample;
- Weather conditions and other field observations at the time of sample collection;
- Number of bottles collected; and
- Type of monitoring event (e.g., detection, assessment, resample, special, etc.)

6.6.2 Sample Labels

A label will be affixed to each sample container to assist in proper sample identification. Sample labels will be sufficiently durable to remain legible even when wet. The following information should be included on each sample label:

- Well name or designation, or other identifying description (e.g., "Trip Blank");
- Name or initials of sampling personnel;
- Date and time of sample collection (if applicable);
- Preservatives utilized (if applicable); and
- Constituents and/or methods requested for analysis (space permitting) or laboratory code designating same.

6.6.3 Chain-of-Custody Record

A chain-of-custody (CoC) record will accompany each shipment of groundwater samples to the analytical laboratory. The CoC record documents the history of the collection, transfer, and transport of each sample. The record facilitates the tracing of the possession of each groundwater sample from collection through laboratory analysis. Each individual responsible for the samples from the time of field collection through the time of receipt by the analytical laboratory will be consecutively documented on the CoC record. Each sample that is shipped, including quality assurance / quality control samples (see **Section 6.7**, below), will be identified on the CoC record. The CoC record should include sufficient copies such that each individual involved in the chain of possession receives their own copy.

The following information should be included on the CoC record:

- Facility name and location;
- Well name or designation, or other identifying description (e.g., "Trip Blank") for each sample;
- Names, affiliation(s), and signature of sampling personnel;
- Date and time of sample collection (if applicable) for each sample;
- Sample type or matrix (e.g., "Groundwater") for each sample;
- Number of containers for each sample;
- Constituents and/or methods requested for analysis;
- Preservatives utilized (if applicable) for each sample;
- Names and signatures of all persons involved in the chain of possession;
- Inclusive dates and times of possession;
- Internal temperature of shipping container when opened at laboratory (if applicable);
- Comments regarding any unusual circumstances or conditions (e.g., containers that could be filled only partially due to groundwater volume limitations); and
- Any applicable time constraints (e.g., 48-hour turnaround time for sample analysis).

6.7 Field Quality Assurance / Quality Control Samples

The collection and analysis of field quality assurance / quality control (QA/QC) samples allows for verification that the collection and handling process has not affected the quality of the groundwater samples. Quality control relates to the integrity of samples during collection and shipping. QC is addressed through the incorporation of trip blanks, field blanks, and equipment blanks into the analytical program. Quality assurance relates to the accuracy and repeatability of the analytical results. QA is addressed through the incorporation of field duplicate and matrix spike / matrix spike duplicate (MS/MSD) samples into the analytical program.

Field QA/QC samples will be prepared in the same manner as groundwater samples from monitoring wells with respect to sample volume, containers, and preservation.

6.7.1 Trip Blanks

A trip blank is utilized to document potential sample contamination attributable to shipping and handling procedures — specifically, to assess potential contamination associated with VOCs. A trip blank typically consists of deionized water placed into appropriate sample containers by the analytical laboratory. The trip blank is placed in the shipping container with the other (empty) sample containers and shipped to the site. The trip blank is then shipped with the collected groundwater samples and other QA/QC samples back to the laboratory. Trip blanks are not opened during sampling activities. One trip blank sample will be shipped to the analytical laboratory on each day that VOC samples are shipped.

6.7.2 Field (Atmospheric) Blanks

A field (or atmospheric) blank is utilized to document the potential influences on sample quality that are attributable to site conditions at the time of sample collection. A field blank consists of deionized water poured into sample containers at the facility during field sampling activities and under the same general environmental conditions as groundwater monitoring well samples. A minimum of one field blank will be collected and shipped to the analytical laboratory per week during the sampling event.

6.7.3 Equipment Blanks

An equipment (or rinsate) blank is utilized to document adequate decontamination procedures for non-dedicated purging and sampling equipment (this does not apply to water level measuring devices). Following decontamination of equipment (see **Section 6.4**, above), an equipment blank is prepared by pouring deionized water into or over the decontaminated equipment and then collecting this water into sample containers. Equipment blanks are not required if dedicated purging and sampling equipment is utilized, as it typically is at the Bridgeton Landfill. If non-dedicated equipment is used, a minimum of one equipment blank will be collected and shipped to the analytical laboratory per day.

6.7.4 Field Duplicates

A field duplicate sample (or co-located sample) is utilized to document the precision of the sampling procedures. A field duplicate sample consists of an independent sample collected as close as possible to the primary groundwater monitoring well sample in both location and time. The primary and field duplicate sample are collected from the same groundwater monitoring well, stored in separate sample containers, and analyzed independently by the same analytical methods and laboratory. A minimum of one field duplicate will be collected and shipped to the analytical laboratory for every 20 samples shipped.

6.8 Field Logbook

Field logbook(s) will be maintained on an ongoing basis for the facility's groundwater monitoring program. Each day of field activities will be documented in the field logbook,

which will serve as a record of general field observations, significant events, and any information not otherwise documented on the individual sampling field log sheets (see **Section 6.6.1**, above). The following information may be included in the field logbook:

- Facility name and location;
- Names and affiliation(s) of sampling personnel;
- Work start and end times;
- Weather conditions, including changes throughout the sampling day;
- Documentation of field instrument calibration procedures and calibration checks (if not documented on field log sheets);
- Observations of any damage to or suspected tampering of monitoring wells;
- Observations indicating a need for well development; and
- Details regarding any unusual or unexpected occurrences during the monitoring event.

7 REPORTING

For each detection monitoring event, the results generated by field activities and laboratory analysis of samples will be evaluated to determine whether a statistically significant increase (SSI) over background has occurred, in accordance with 10 CSR 80-3.010(11)(C)5. The sampling results and the statistical evaluation will be presented in a groundwater detection monitoring report.

The quarterly depth to static groundwater measurements performed concurrently with groundwater sample collection will be utilized to prepare a set of four potentiometric surface maps for the monitoring event, corresponding to the Alluvial, St. Louis / Upper Salem, Deep Salem, and Keokuk Zones. These potentiometric surface maps will be included in the detection monitoring report.

In accordance with 10 CSR 80-3.010(11)(C)4.C, the detection monitoring report for each sampling event will be submitted to the MDNR within 90 days of the date on which the first sample was collected. In accordance with 10 CSR 80-3.010(11)(C)4.E, an electronic deliverable of the analytical results will also be submitted to the MDNR. The deliverable will be formatted and submitted as described in the MDNR's online instructions:

https://dnr.mo.gov/env/swmp/gdwtrsub.htm

The statistical methods used to evaluate results from the Bridgeton Landfill are described in detail in the companion *Statistical Analysis Plan*.

8 REFERENCES

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TABLES

5-1 Groundwater Monitoring Wells and Piezometers
5-2 Detection Monitoring Schedule
6-1 Recommended Order of Groundwater Sample Container Collection

Table 5-1
Groundwater Monitoring Wells and Piezometers
Bridgeton Landfill, LLC - Bridgeton, Missouri

Well Designation	Alias	Well Type	Installation Date	Original Ground Surface Elev. (ft/msl)	Ref.	Current Location Northing	Current Location Easting	Current Ground Surface Elevation (ft/msl)	Current Top of Riser Elevation (ft/msl)	Survey	Inner Casing Diam. (in.)	Riser Material	Screen Material	Screen Length (ft)	Depth to Top of Screen (ft)	Depth to Bottom of Screen (ft)	Top of Screen Elevation (ft/msl)	Bottom of Screen Elevation (ft/msl)	Screen Ref.	Comments
Keokuk Zone																				
PZ-100-KS	1209	P	2/17/1995	483.80	AB	1,068,842.1	517,211.6	485.22	486.36	8/12	2	PVC	PVC	9.80	374.00	383.80	109.80	100.00	AB (Depth)	
PZ-104-KS	1215	D / A	6/19/1995	482.30	AB	1,066,993.0	516,820.5	482.24	484.60	8/12	2	PVC	PVC	9.80	397.37	407.17	84.93	75.13	AB (Depth)	
PZ-106-KS	1219	P	3/23/1995	461.80	AB	1,066,703.7	515,432.2	462.55	464.73	8/12	2	PVC	PVC	9.77	363.75	373.52	98.05	88.28	AB (Depth)	
PZ-111-KS	1225	P	5/6/1995	459.20	AB	1,068,621.0	515,850.5	461.74	465.80	8/12	2	PVC	PVC	9.81	357.15	366.96	102.05	92.24	AB (Depth)	F-1-D is upper geology reference.
Deep Salem Zone																				
MW-1204	1204	D / A	4/5/1991	483.30	AB	1,066,420.2	515,824.3	475.80	478.04	4/16	2	PVC	PVC	10.00	213.50	223.50	269.80	259.80	AB (Depth)	No log available.
PZ-100-SD	1208	D	2/23/1995	484.40	AB	1,068,851.8	517,195.3	484.89	486.49	8/12	2	PVC	PVC	9.80	234.80	244.60	249.60	239.80	AB (Depth)	
PZ-104-SD	1214	D / A	6/17/1995	482.10	AB	1,067,013.2	516,834.6	481.88	484.15	8/12	2	PVC	PVC	9.80	235.20	245.00	246.90	237.10	AB (Depth)	
PZ-106-SD	1218	D	3/26/1995	461.50	AB	1,066,714.7	515,416.0	461.82	463.84	8/12	2	PVC	PVC	9.80	190.79	200.59	270.71	260.91	AB (Depth)	
PZ-111-SD	1224	D	4/21/1995	459.20	AB	1,068,637.2	515,834.3	462.35	466.58	8/12	2	PVC	PVC	9.80	199.40	209.20	259.80	250.00	AB (Depth)	
PZ-209-SD		A	10/4/2013	487.24	AB	1,067,075.7	517,104.4	487.24	489.58	10/13	2	PVC	PVC	10.00	240.00	250.00	247.24	237.24	AB (Depth)	
PZ-210-SD		A	10/16/2013	484.48	AB	1,066,824.0	516,773.1	484.48	487.00	10/13	2	PVC	PVC	10.00	238.00	248.00	246.48	236.48	AB (Depth)	
PZ-211-SD		A	10/8/2013	484.83	AB	1,067,056.7	517,016.6	484.83	487.46	10/13	2	PVC	PVC	110.00	237.00	347.00	247.83	137.83	AB (Depth)	
PZ-212-SD		P	10/21/2013	480.48	AB	1,067,495.7	517,980.4	480.48	482.72	10/13	2	PVC	PVC	10.00	234.00	244.00	246.48	236.48	AB (Depth)	
St. Louis / Upper Salem Zone																				
PZ-100-SS	1207	D	2/25/1995	484.40	AB	1,068,867.8	517,175.0	485.24	486.55	8/12	2	PVC	PVC	19.64	73.96	93.60	410.44	390.80	AB (Depth)	
PZ-101-SS	1210	D / A	3/6/1995	474.90	AB	1,068,473.1	516,622.3	491.68	493.08	1/17	2	PVC	PVC	9.80	129.48	139.28	345.42	335.62	AB (Depth)	
PZ-102-SS		D	3/12/1995	482.10	AB	1,068,087.7	516,887.9	482.46	484.65	8/12	2	PVC	PVC	9.80	79.70	89.50	402.40	392.60	AB (Depth)	
PZ-102R-SS	1211	D	6/18/1995	484.46	AB	1,068,131.6	516,858.4	486.20	488.56	1/17	2	PVC	PVC	9.80	79.83	89.63	404.63	394.83	AB (Depth)	
PZ-103-SS	1212	D / A	2/27/1995	477.80	AB	1,067,660.3	516,723.1	480.31	484.21	8/12	2	PVC	PVC	9.80	134.70	144.50	343.10	333.30	AB (Depth)	
PZ-104-SS	1213	D / A	6/4/1995	481.60	AB	1,067,027.8	516,847.3	482.05	484.00	8/12	2	PVC	PVC	9.80	134.50	144.30	347.10	337.30	AB (Depth)	
PZ-105-SS	1216	D	5/24/1995	481.20	AB	1,066,421.2	516,230.4	481.21	484.04	8/12	2	PVC	PVC	9.80	138.50	148.30	342.70	332.90	AB (Depth)	
PZ-106-SS	1217	D	4/5/1995	461.00	AB	1,066,726.1	515,399.9	461.35	463.12	8/12	2	PVC	PVC	9.80	155.30	165.10	305.70	295.90	AB (Depth)	
PZ-107-SS	1220	D / A	5/22/1995	462.60	AB	1,067,163.1	515,254.6	463.25	465.41	8/12	2	PVC	PVC	9.80	92.60	102.40	370.00	360.20	AB (Depth)	
PZ-109-SS	1222	D	4/25/1995	456.80	AB	1,068,012.0	516,114.1	457.65	460.19	11/14	2	PVC	PVC	9.80	125.70	135.50	331.10	321.30	AB (Depth)	
PZ-111-SS		D	8/29/2017	464.63	AB	1,068,591.0	515,814.7	462.11	464.63	9/17	2	PVC	PVC	10.00	103.00	113.00	361.63	351.63	AB (Depth)	
PZ-113-SS	1229	D	5/20/1995	460.00	AB	1,069,242.0	515,776.6	460.06	462.66	8/12	2	PVC	PVC	9.80	148.57	158.37	311.43	301.63	AB (Depth)	
PZ-115-SS	1231	D	5/21/1995	450.60	AB	1,069,408.7	516,755.2	450.62	453.00	8/12	2	PVC	PVC	9.80	74.68	84.48	375.92	366.12	AB (Depth)	
PZ-116-SS	1232	D / A	6/20/1995	483.10	AB	1,066,410.5	515,843.7	475.80	478.21	4/16	2	PVC	PVC	9.60	151.40	161.00	331.70	322.10	AB (Depth)	
PZ-200-SS		D	2/28/1995	483.60	AB	1,068,496.1	516,971.9	483.95	486.23	8/12	2	PVC	PVC	88.02	9.62	97.64	473.98	385.96	AB (Depth)	
PZ-201A-SS	1233	D	4/23/1995	478.40	AB	1,067,831.8	516,846.5	480.27	482.33	8/12	2	PVC	PVC	9.80	80.00	89.80	398.40	388.60	AB (Depth)	PZ-201-SS is upper geology reference.
PZ-202-SS	1234	D / A	3/12/1995	479.00	AB	1,067,320.2	517,101.4	479.88	481.82	8/12	2	PVC	PVC	48.90	40.20	89.10	438.80	389.90	AB (Depth)	
PZ-203-SS	1235	D	6/3/1995	484.20	AB	1,066,661.4	516,607.8	484.53	487.19	8/12	2	PVC	PVC	9.80	99.60	109.40	384.60	374.80	AB (Depth)	
PZ-204-SS		D	3/10/1995	467.00	AB	1,066,429.5	515,556.6	465.28	465.28	8/12	2	PVC	PVC	78.40	10.95	89.35	456.05	377.65	AB (Depth)	Flush mount surface completion.
PZ-204A-SS	1236	D	6/22/1995	466.70	AB	1,066,426.3	515,533.8	463.09	463.09	8/12	2	PVC	PVC	9.60	79.50	89.10	387.20	377.60	AB (Depth)	Flush mount surface completion.
PZ-205-SS	1238	D	5/21/1995	459.50	AB	1,067,483.7	515,477.0	461.68	465.18	9/17	2	PVC	PVC	9.80	88.57	98.37	370.93	361.13	AB (Depth)	
PZ-206-SS	1239	D	4/24/1995	458.40	AB	1,068,031.0	515,809.1	460.20	463.42	11/14	2	PVC	PVC	9.80	115.00	124.80	343.40	333.60	AB (Depth)	

Table 5-1
Groundwater Monitoring Wells and Piezometers
Bridgeton Landfill, LLC - Bridgeton, Missouri

Well Designation	Alias	Well Type	Installation Date	Original Ground Surface Elev. (ft/msl)	Ref.	Current Location Northing	Current Location Easting	Current Ground Surface Elevation (ft/msl)	Current Top of Riser Elevation (ft/msl)	Survey	Inner Casing Diam. (in.)	Riser Material	Screen Material	Screen Length (ft)	Depth to Top of Screen (ft)	Depth to Bottom of Screen (ft)	Top of Screen Elevation (ft/msl)	Bottom of Screen Elevation (ft/msl)	Screen Ref.	Comments
St. Louis / Upper Salem Zone (Continued)																				
PZ-208-SS	1241	P	6/18/1995	472.50	AB	1,069,219.2	517,169.4	472.88	475.19	8/12	2	PVC	PVC	9.80	88.70	98.50	383.80	374.00	AB (Depth)	
PZ-209-SS		A	10/5/2013	487.39	AB	1,067,071.5	517,108.6	487.39	489.68	10/13	2	PVC	PVC	10.00	140.00	150.00	347.39	337.39	AB (Depth)	
PZ-210-SS		A	10/16/2013	484.53	AB	1,066,828.4	516,777.4	484.53	486.90	10/13	2	PVC	PVC	10.00	138.00	148.00	346.53	336.53	AB (Depth)	
PZ-211-SS		A	10/8/2013	485.06	AB	1,067,060.8	517,012.2	485.06	487.41	10/13	2	PVC	PVC	10.00	137.00	147.00	348.06	338.06	AB (Depth)	
PZ-212-SS		P	10/18/2013	480.16	AB	1,067,491.0	517,976.5	480.16	482.79	10/13	2	PVC	PVC	10.00	134.00	144.00	346.16	336.16	AB (Depth)	
Alluvial Zone																				
D-85	WL-105A	D / A	8/22/1984	453.10	BHL	1,069,626.3	516,430.5	454.66	457.67	8/12	2	PVC	PVC	20.00	62.00	82.00	391.10	371.10	BHL (Depth)	No as-built available.
D-87		P	8/10/1984	460.00	BHL	1,069,211.4	515,404.7	461.62	464.41	8/12	2	PVC	PVC	20.00	91.00	111.00	369.00	349.00	BHL (Depth)	No as-built available.
I-67	N-6	P	Oct 1983	436.50	WS	1,070,101.4	516,234.8	439.74	441.78	8/12	2	PVC	PVC	10.00	25.40	35.40	411.10	401.10	WS (Elev)	No log or as-built available.
I-68	N-7	D	Oct 1983	440.90	WS	1,069,572.0	516,686.5	447.81	450.60	8/12	2	PVC	PVC	10.00	21.20	31.20	419.70	409.70	WS (Elev)	No log or as-built available.
I-73	38	D / A	6/23/1978	458.90	WS	1,067,695.2	515,570.7	459.44	461.96	11/14	2	PVC	PVC	3.00	43.20	46.20	415.70	412.70	WS (Elev)	No as-built available.
LR-103		P	10/20/1995	460.10	AB	1,068,526.6	515,217.5	467.27	470.64	8/12	2	PVC	PVC	9.80	28.60	38.40	431.50	421.70	AB (Depth)	
PZ-112-AS	1226	D / A	4/10/1995	457.90	AB	1,069,002.0	515,674.8	458.60	462.29	4/13	2	PVC	PVC	4.80	29.60	34.40	428.30	423.50	AB (Depth)	
PZ-113-AS	1227	D	4/11/1995	459.90	AB	1,069,224.0	515,747.7	459.98	462.19	8/12	2	PVC	PVC	9.80	28.90	38.70	431.00	421.20	AB (Depth)	
PZ-113-AD	1228	D	5/3/1995	459.90	AB	1,069,233.0	515,759.8	459.87	462.24	8/12	2	PVC	PVC	9.80	98.60	108.40	361.30	351.50	AB (Depth)	
PZ-114-AS	1230	D / A	4/20/1995	449.80	AB	1,069,419.0	516,768.3	449.97	452.14	8/12	2	PVC	PVC	9.80	19.90	29.70	429.90	420.10	AB (Depth)	
PZ-205-AS	1237	D / A	5/6/1995	459.30	AB	1,067,463.1	515,462.8	461.48	464.77	11/14	2	PVC	PVC	9.80	38.55	48.35	420.75	410.95	AB (Depth)	
PZ-207-AS	1240	D / A	4/10/1995	461.90	AB	1,069,645.0	516,037.6	460.38	462.17	4/13	2	PVC	PVC	4.80	34.90	39.70	427.00	422.20	AB (Depth)	
S-84		D / A	8/24/1984	452.90	WS	1,069,633.3	516,439.6	454.64	457.45	8/12	2	PVC	PVC	10.00	20.90	30.90	432.00	422.00	BHL (Depth)	No as-built available.

Notes
D: Detection monitoring well.
A: Assessment monitoring well.
P: Piezometer (groundwater elevation monitoring point).
AB: Original as-built diagram.
BHL: Original borehole log.
WS: Well Summary Table. 1997. Original document and author unknown.

Surveys
8/12 - Survey performed on 8/13, 8/21-22, 8/29, and 8/31/12.
4/13 - Survey performed on 4/17/13.
10/13 - Survey performed on 10/21 - 10/22/13.
11/14- Survey performed on 11/12/14.
4/16 - Survey performed on 4/7/16.
9/16 - Survey performed on 9/18/16.
1/17 -Survey performed on 1/30/17.
9/17 - Survey performed on 9/6/17.

Table 5-2
Detection Monitoring Schedule
Bridgeton Landfill, LLC - Bridgeton, Missouri

Well	Sampling Frequency
D-85	Q
I-68	Q
I-73	Q
MW-1204	Q
PZ-100-SS	Q
PZ-100-SD	Q
PZ-101-SS	Q
PZ-102-SS	Q
PZ-102R-SS	Q
PZ-103-SS	Q
PZ-104-SS	Q
PZ-104-SD	Q
PZ-104-KS	Q
PZ-105-SS	Q
PZ-106-SS	Q
PZ-106-SD	Q
PZ-107-SS	Q
PZ-109-SS	Q
PZ-111-SS	Q
PZ-111-SD	Q
PZ-112-AS	Q
PZ-113-AS	Q
PZ-113-AD	Q
PZ-113-SS	Q
PZ-114-AS	A
PZ-115-SS	Q
PZ-116-SS	Q
PZ-200-SS	Q
PZ-201A-SS	Q
PZ-202-SS	Q
PZ-203-SS	Q
PZ-204-SS	Q
PZ-204A-SS	Q
PZ-205-AS	Q
PZ-205-SS	Q
PZ-206-SS	Q
PZ-207-AS	Q
S-84	Q

Notes

Q: Quarterly sampling in Feb, May, Aug, and Nov.

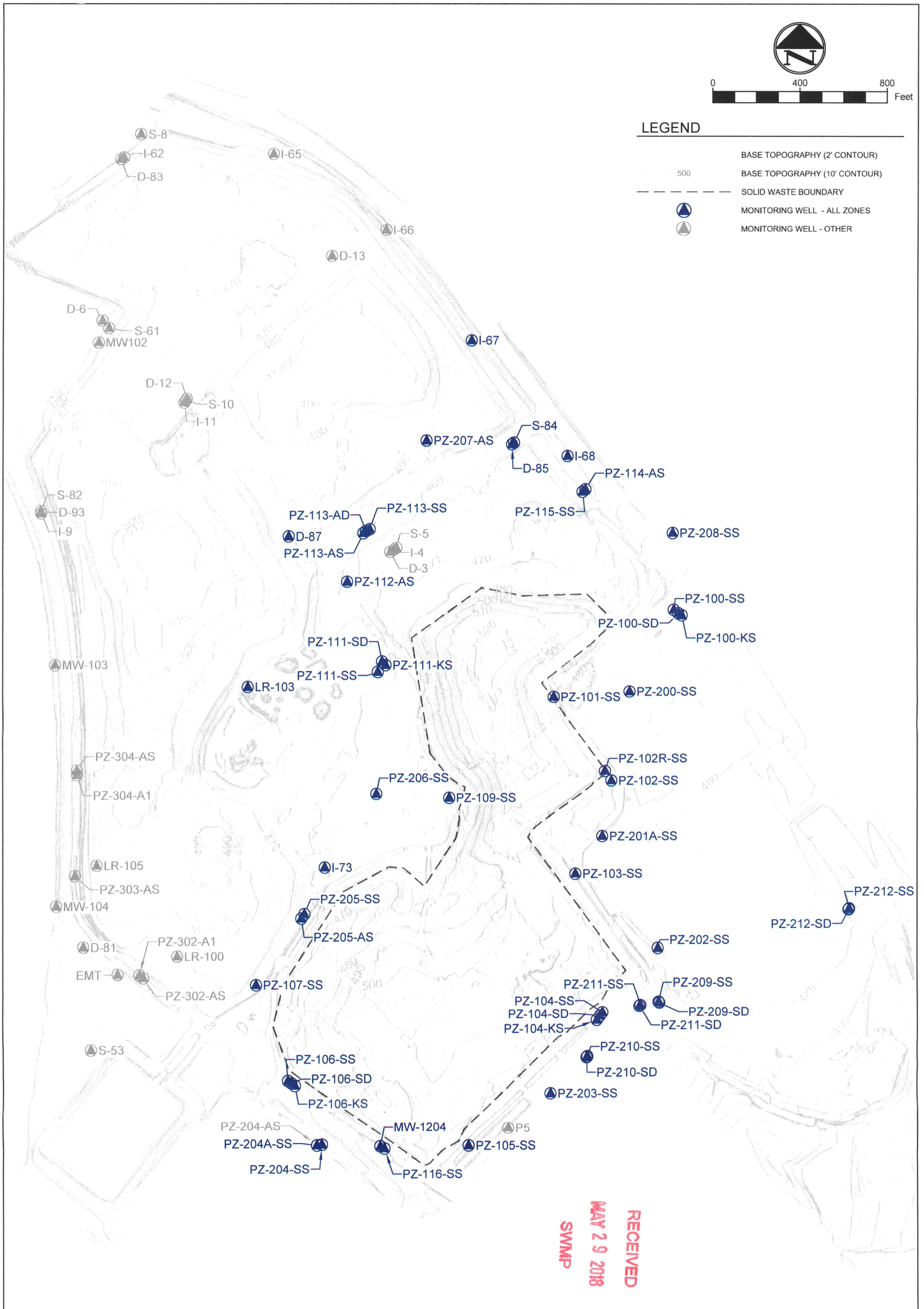
A: Annual sampling in May.

Table 6-1
Recommended Order of Groundwater Sample Container Collection
Bridgeton Landfill, LLC - Bridgeton, Missouri

Sample Order	Constituents	Suggested Analytical Methods	Preservation Methods for Suggested Analytical Methods
1	VOCs	SW-846 8260	Cooled to ≤ 6 °C; HCl to pH < 2
2	Metals	SW-846 6010; SW-846 6020	HNO_3 to pH < 2
	Mercury	SW-846 7470	
	Hardness (Calculated as $CaCO_3$)	SM 2340	
3	Phosphorus	EPA 365.1	Cooled to ≤ 4 °C; H_2SO_4 to pH < 2
	Total Organic Carbon (TOC)	SM 5310C	
4	Ammonia (as Nitrogen)	SM 4500-NH_3 G	Cooled to ≤ 4 °C; H2SO4 to pH < 2
	Chemical Oxygen Demand (COD)	EPA 410.4	
	Nitrate + Nitrite (as Nitrogen)	EPA 353.2	
5	Chloride	SW-946 9056	Cooled to ≤ 6 °C (≤ 4 °C for SM)
	Fluoride		
	Sulfate		
	Total Dissolved Solids (TDS)	SM 2540C	

FIGURES

4-1 Groundwater Monitoring Network (All Zones)
4-2 Keokuk Zone Monitoring Network
4-3 Deep Salem Zone Monitoring Network
4-4 St. Louis / Upper Salem Zone Monitoring Network
4-5 Alluvial Zone Monitoring Network
5-1 Detection Monitoring Network (All Zones)
5-2 Assessment Monitoring Network (All Zones)
5-3 Piezometer Network (All Zones)



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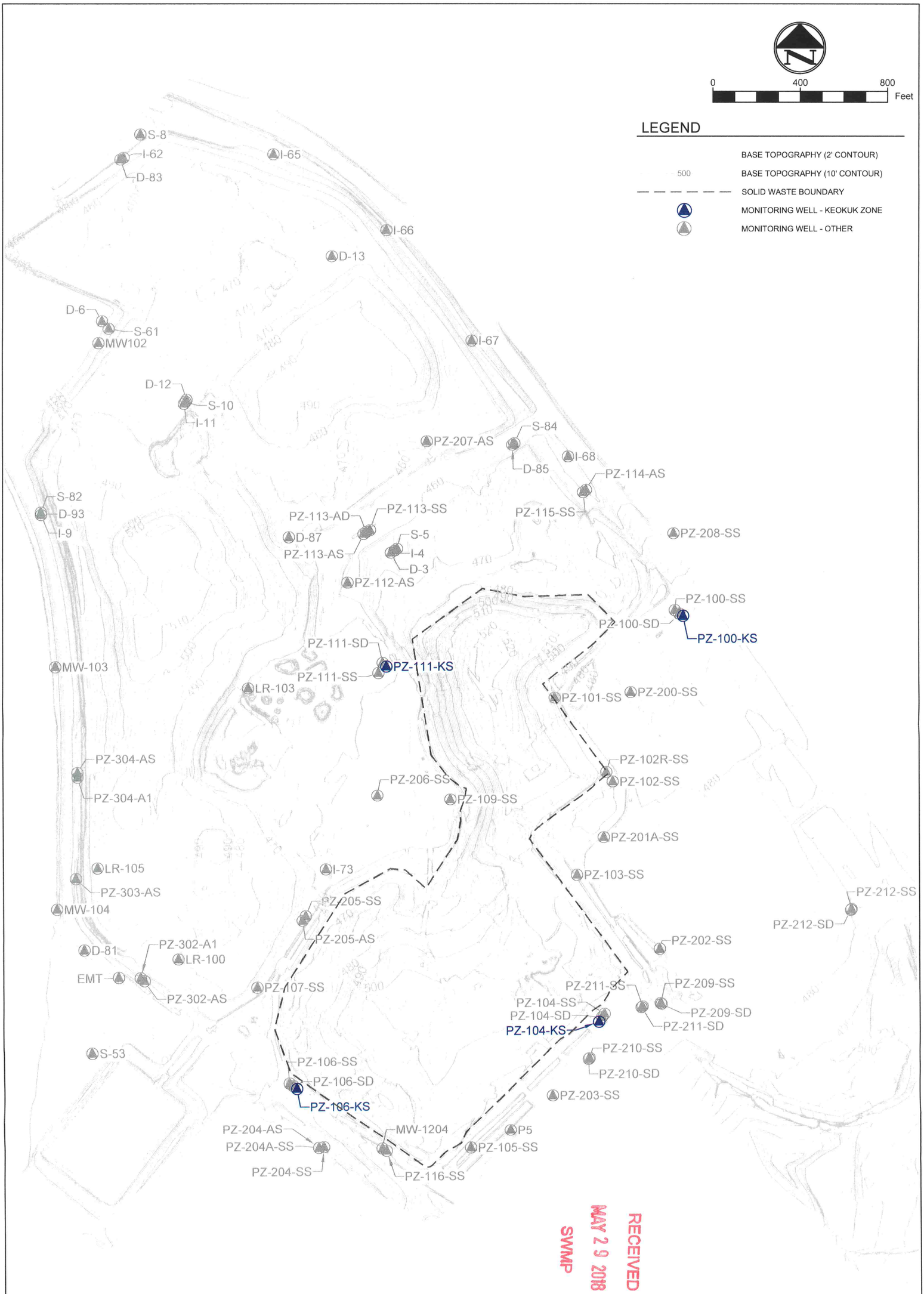
GROUNDWATER MONITORING NETWORK (ALL ZONES)			REVISION DATE	
PROJECT NUMBER: BT-179	FILE PATH: C:\Users\plins\Dropbox (Feezor Engineering)\Bridgeton\BT-179 (Groundwater Sampling And Analysis Plan)\drawing\working\BT-179_4-1 Groundwater Monitoring Network (All Zones).dwg			



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KEOKUK ZONE MONITORING NETWORK				
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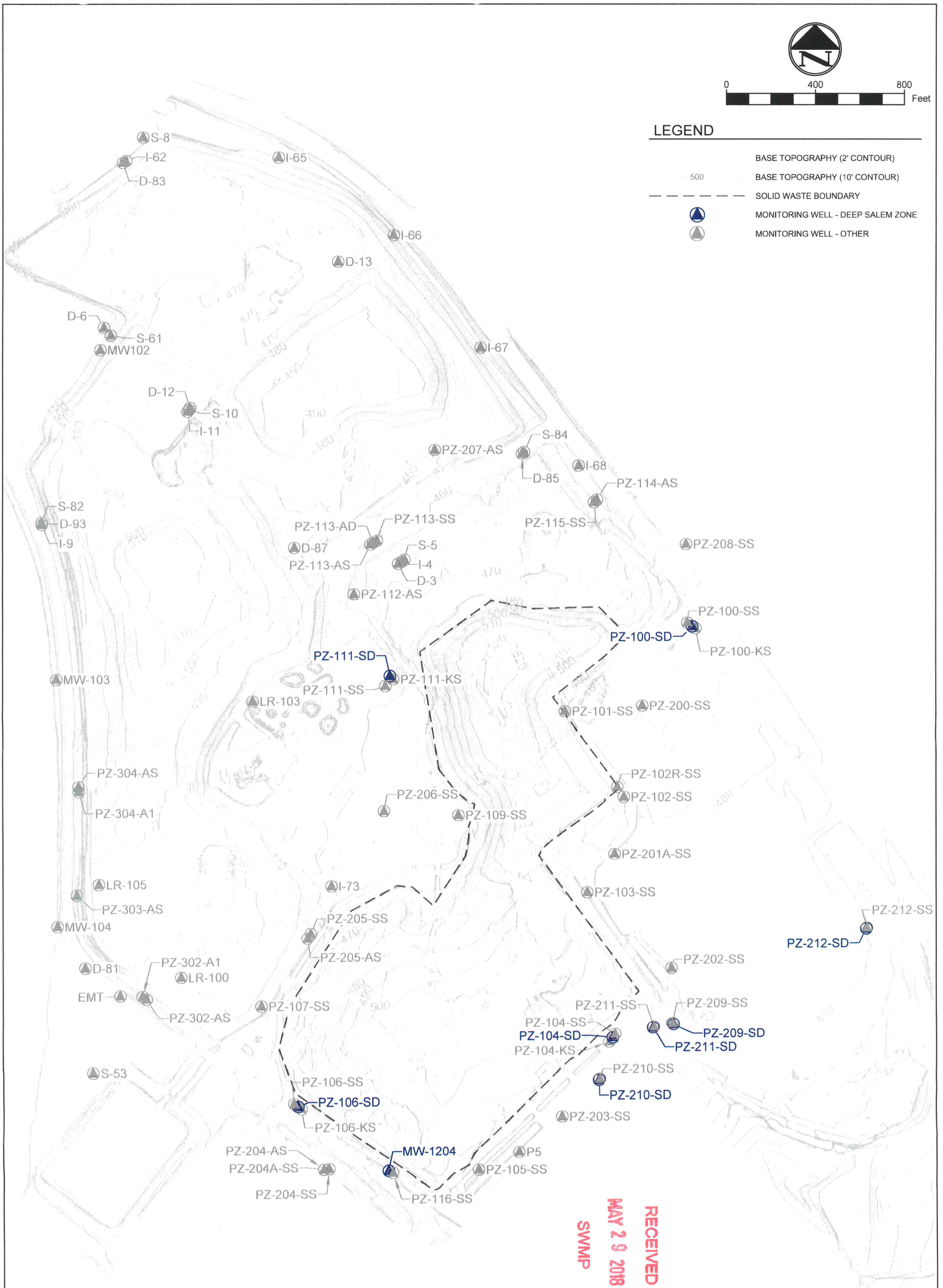

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DEEP SALEM ZONE MONITORING NETWORK				
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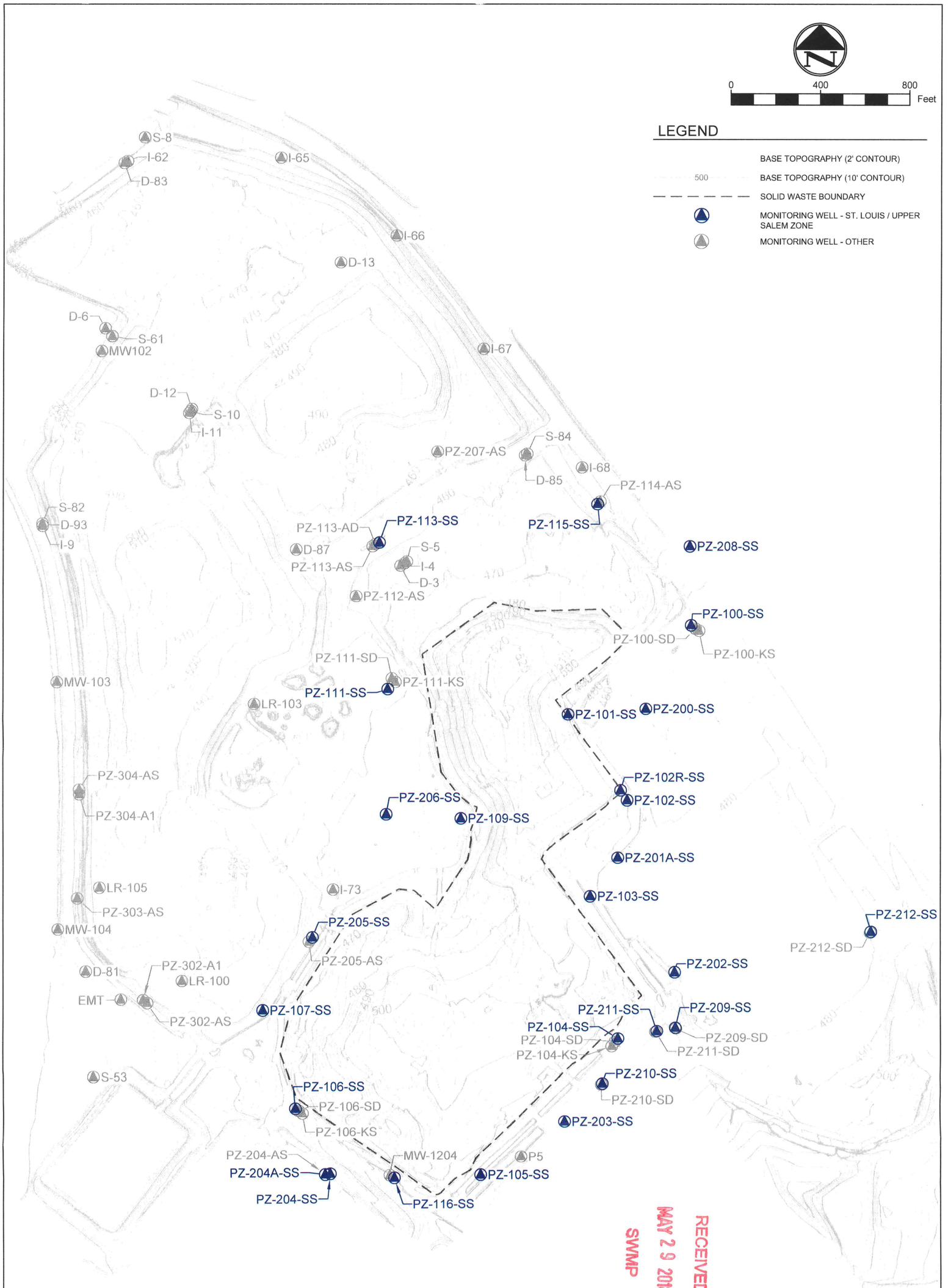

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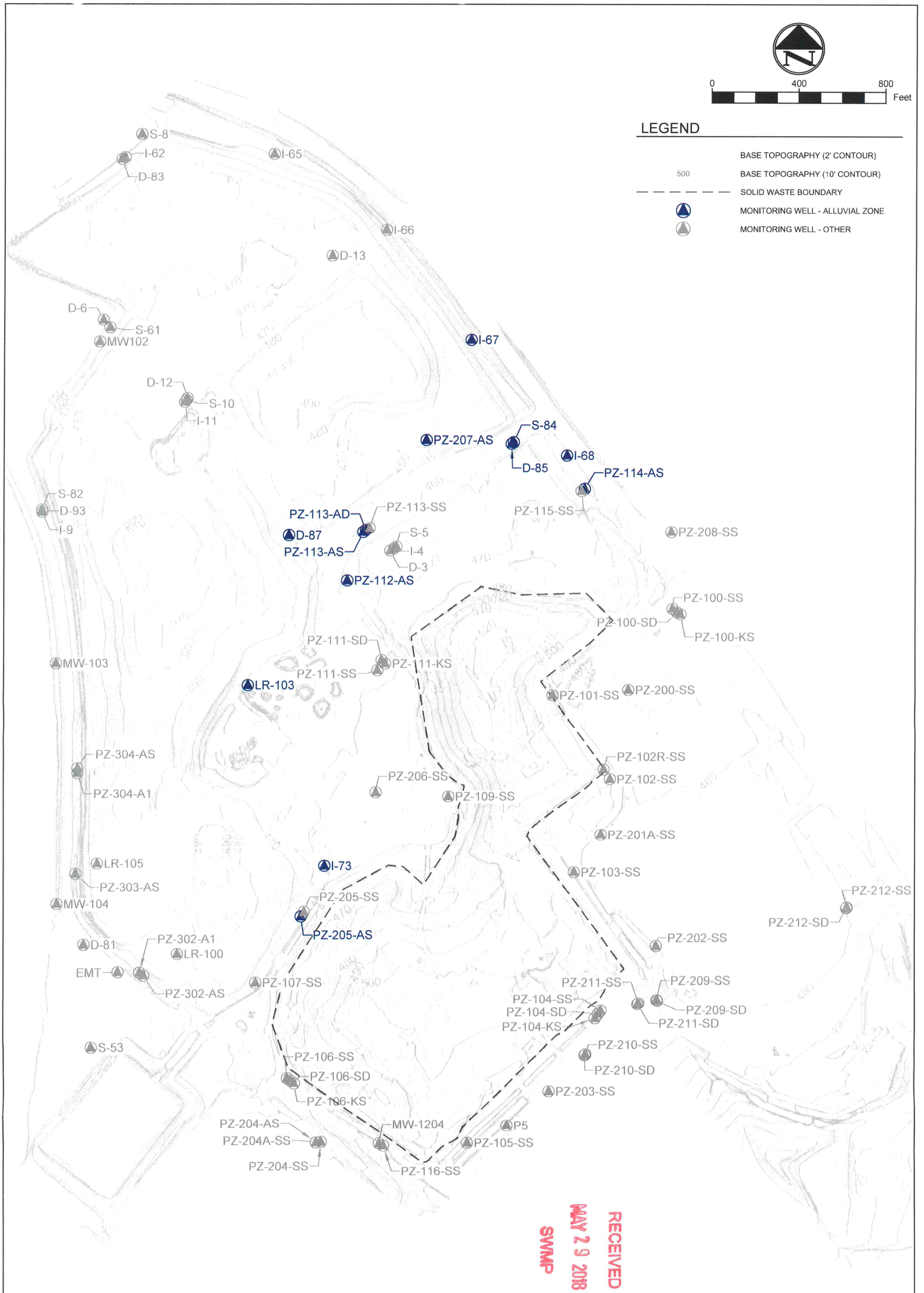
ST LOUIS / UPPER SALEM ZONE MONITORING NETWORK			REVISION DATE	
PROJECT NUMBER: BT-179	FILE PATH: D:\Dropbox\BT-179 (Groundwater Sampling And Analysis Plan)\drawing\working\BT-179_4-4 St Louis_Upper Salem Zone Monitoring Network.dwg			



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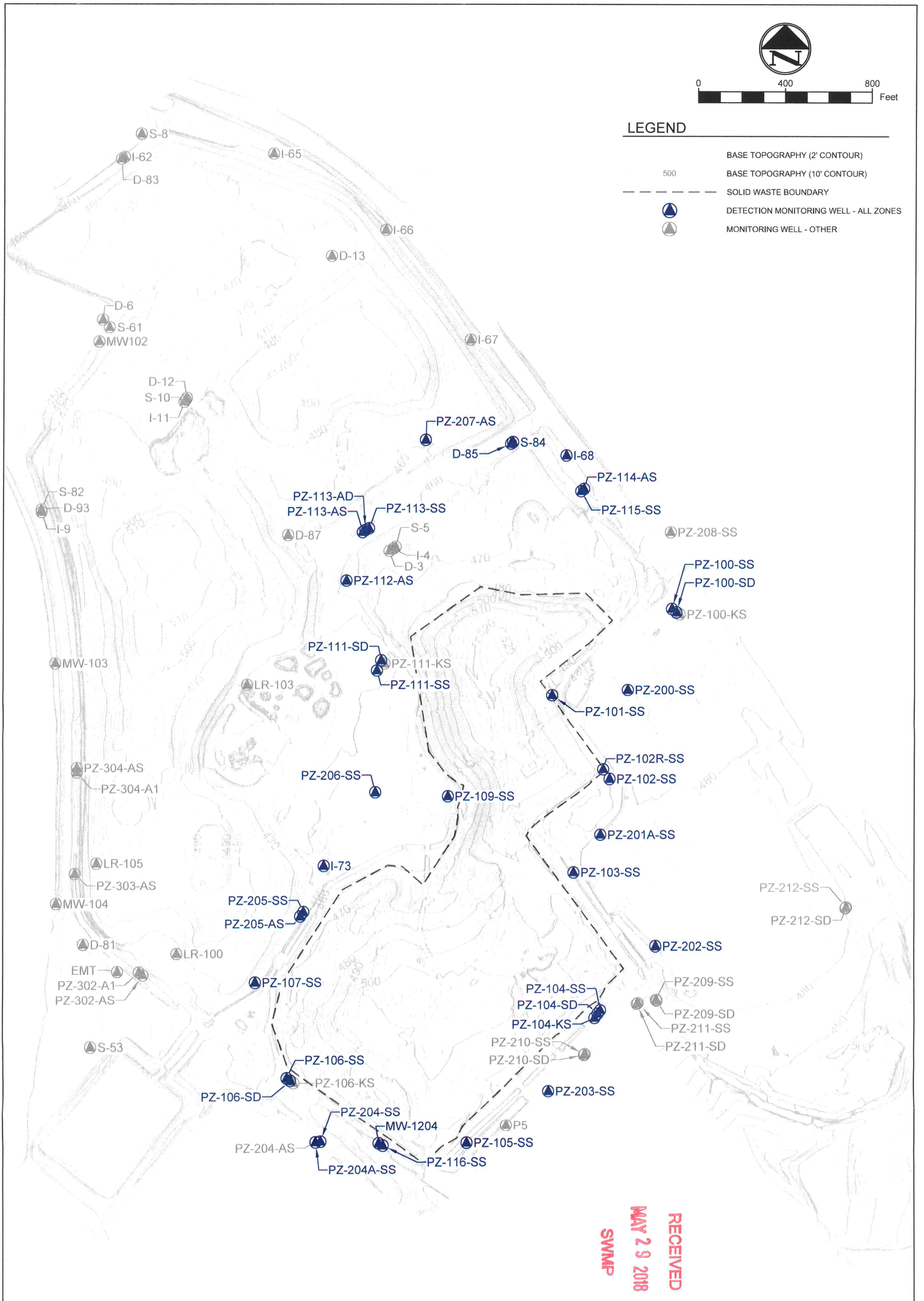
ALLUVIAL ZONE MONITORING NETWORK			REVISION DATE
PROJECT NUMBER: BT-179	FILE PATH: D:\Dropbox\BT-179 (Groundwater Sampling And Analysis Plan)\drawing\working\BT-179_4-5 Alluvial Zone Monitoring Network.dwg		DRAWING NO.: **4-5**



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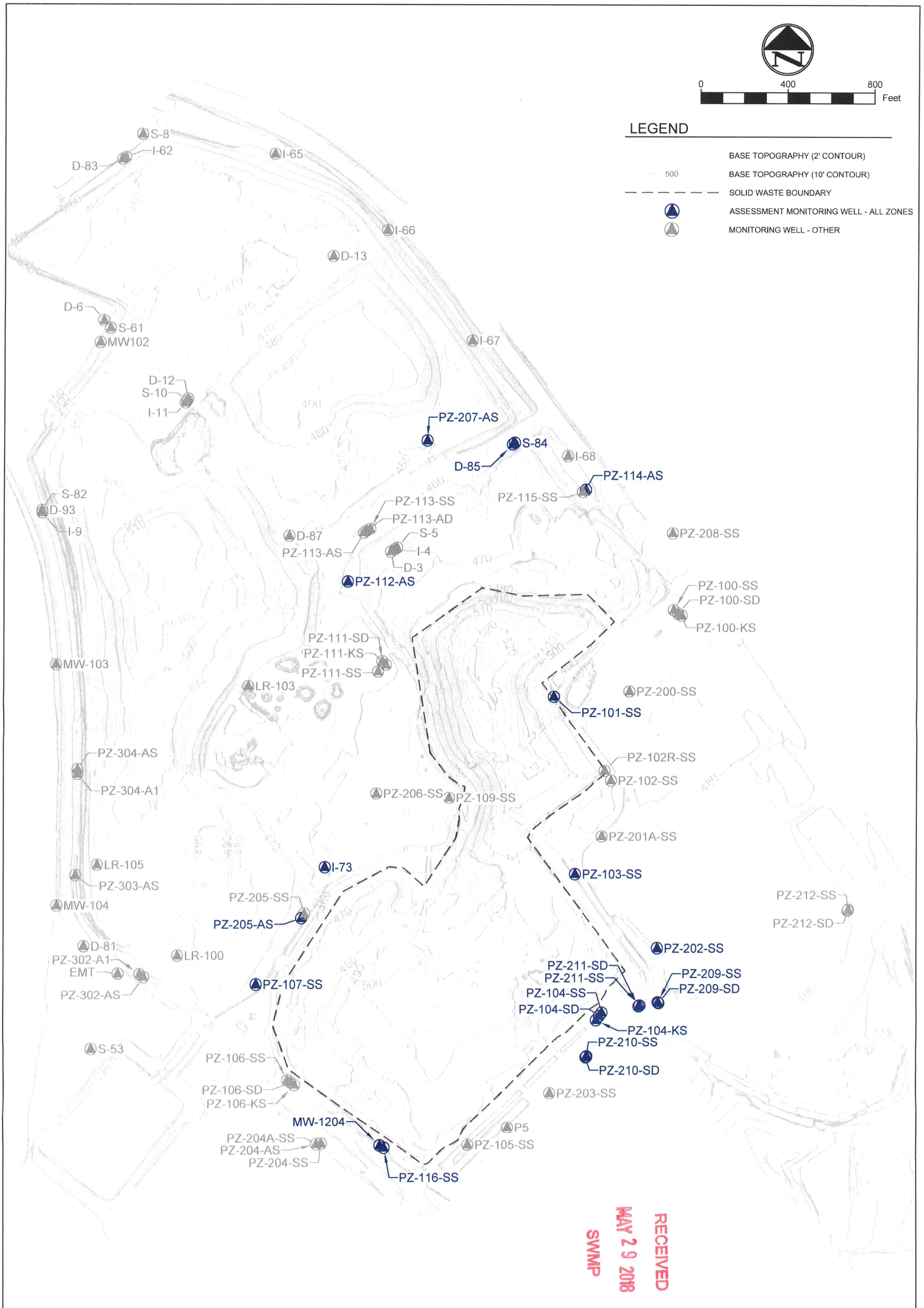
DETECTION MONITORING NETWORK (ALL ZONES)			REVISION DATE	
PROJECT NUMBER: BT-179	FILE PATH: C:\Users\plins\Dropbox (Feezor Engineering)\Bridgeton\BT-179 (Groundwater Sampling And Analysis Plan)\drawing\working\BT-179_Figures 5-1 5-2 5-3.dwg			



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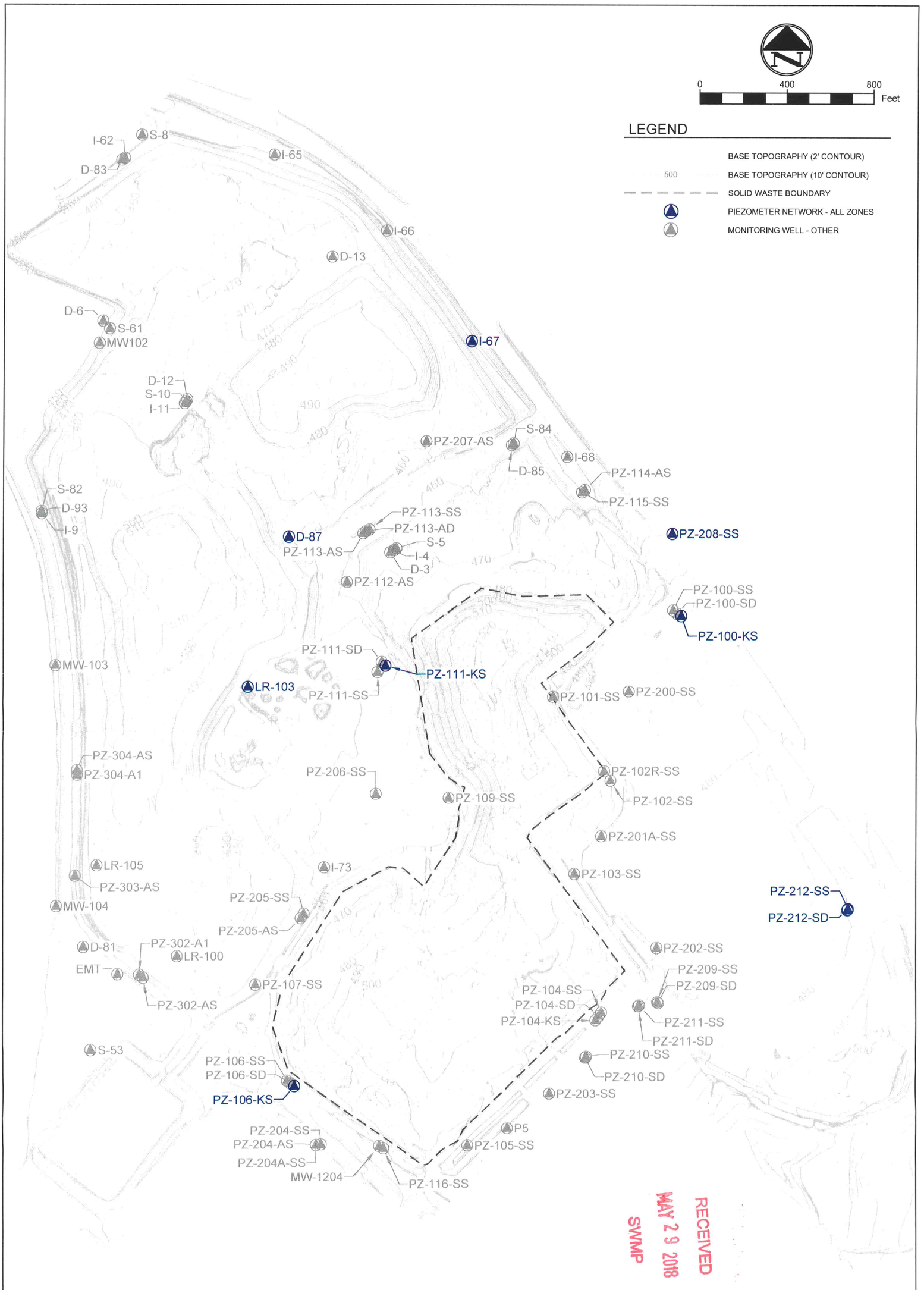
ASSESSMENT MONITORING NETWORK (ALL ZONES)			REVISION DATE	
PROJECT NUMBER: BT-179	FILE PATH: C:\Users\plins\Dropbox (Feezor Engineering)\Bridgeton\BT-179 (Groundwater Sampling And Analysis Plan)\drawing\working\BT-179_Figures 5-1 5-2 5-3.dwg			



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PIEZOMETER NETWORK (ALL ZONES)				
PROJECT NUMBER: BT-179	FILE PATH: C:\Users\plins\Dropbox (Feezor Engineering)\Bridgeton\BT-179 (Groundwater Sampling And Analysis Plan)\drawing\working\BT-179_Figures 5-1 5-2 5-3.dwg			

APPENDIX A

WELL BOREHOLE LOGS AND AS-BUILT DIAGRAMS

Drilling Log

Project Name: WESTLAKE						Boring No.: D - 85	
Project No.: 84-075-4-002						Page: 1 of 6	
Ground Elevation: 453.1	Location: NE section of Site; Figure I-2					Total Footage: 84.1'	
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
SEE REMARKS	SEE REMARKS	83.5	0.6	12	0	SEE REMARKS	—

Drilling Co.: WABASH DRILLING CO.		Driller (s): DORL THORNTON	
Drilling Rig.: ACKER MP-5, TRUCK		Type of Penetration Test: STANDARD	
Date: 8-21-84	To: 8-22-84	Field Observer (s): GLEN ERNSTMANN	

Depth	Description	Class.	Blow Count	Recov.	Sample or Box No.	Remarks
1	LIGHT BROWN SAND, SILT AND GRAVEL, DAMP TO DRY (FILL)					5" SOLID AUGERS 0' TO 10'
2						
3						
4	GREENISH-GRAY TO DARK GRAY SILTY FINE SAND, VERY LOOSE, DAMP (FILL)					
5					5.0	
6			3/2/3	7"/18"	SS-1	
7					6.5	
8						
9						
10					10.0	4½" TRI-CONE WASH BORE 10.0' TO 84.1',
11			1/1/1	18"/18"	SS-2	
12					11.5	STOPPED 8-21-84 RESUMED 8-22-84
13	GRAY CLAYEY SILT, AND FINE SAND, LOW PLASTICITY, STIFF, MOIST (FILL)	A-25				

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

Boring No. B-85
Page 2 of 6p
Project Name WESTLAKE
Project No. 84-075-4-002
Date 8-21-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
15	GRAY CLAYEY SILT, AND FINE SAND, LOW PLASTICITY, STIFF, MOIST (FILL)		3/4/5	12" / 18"	15.0	SS-3	
16					16.5		
17							
18							
19							
20			2/4/4	10" / 18"	20.0	SS-4	
21					21.5		SATURATED MATERIAL ENCOUNTERED BETWEEN 18' AND 25'.
22	GRAY-BROWN SILTY FINE SAND, MOIST TO SATURATED						
23							
24							
25					25.0		
26				17" / 18"		ST-5	Q_T = NOT OBTAINABLE
27	GRAY FINE TO COARSE SAND, TRACE SILT, MEDIUM DENSE TO VERY DENSE, SATURATED				26.5		
28	PRIMARILY SUBROUNDED QUARTZ GRAINS						
29							
30		A-26	10/10/10	18" / 18"	30.0	SS-6	

Drilling Log, continued

Boring No. D-85

Project Name WESTLAKE

Page 3 of 6

Project No. 84-075-4-002

Date 8-21-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
32	GRAY FINE TO COARSE SAND, TRACE SILT, MEDIUM DENSE TO VERY DENSE, SATURATED			31.5	SS-6	
33	PRIMARILY SUBROUNDED QUARTZ GRAINS					
34						
35				35.0		
36			21/27/26	13"/18"	SS-7	
37				36.5		
38						
39						
40	GRAY TO GRAY-BROWN COARSE SAND, SOME FINE TO MEDIUM SAND, FEW FINE GRAVELLY GRAINS, DENSE, SATURATED			40.0		
41			16/23/21	8"/18"	SS-8	
42				41.5		
43						
44						
45						
46						
47		A-27				

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

Boring No. D-85

Project Name WESTLAKE

Page 4 of 6

Project No. 84-075-4-002

Date 8-21-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
49	GRAY TO GRAY-BROWN COARSE SAND, SOME FINE TO MEDIUM SAND, FEW FINE GRAVELLY SEAMS, DENSE, SATURATED					
50	GREENISH GRAY TO GRAY FINE TO MEDIUM SAND, TRACE SILT AND COARSE SAND, VERY DENSE, TO DENSE, SATURATED		26/34/24	13"/18"	50.0 SS-9 51.5	
51	.... 90% QUARTZ, SUBROUNDED TO SUBANGULAR					
52						
53						
54						
55						
56						
57						
58						
59						
60			14/16/22	8"/18"	60.0 SS-10 61.5	
61						
62						
63						
64		A-28				

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

Boring No. D-85

Project Name WESTLAKE

Page 5 of 6

Project No. 84-075-4-002

Date 8-21-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
66	GREENISH GRAY TO GRAY FINE TO MEDIUM SAND, TRACE SILT AND COARSE SAND, VERY DENSE TO DENSE, SATURATED					
67	90% QUARTZ, SUBROUNDED TO SUBANGULAR					
68						
69						
70						
70.0			17/20/27	15" / 18"	SS-11	
71						
71.5						
72						
73						
74						
75						
76						
77						
78						
79						
80						
80.2			17/21/34	15" / 18"	SS-12	VERY SLIGHT LEACHATE LIKE OR ORGANIC ODOR
81		A-29				
81.5						

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

Boring No. D-85
Page 6 of 6
Project Name WESTLAKE
Project No. 84-075-4-002
Date 8-21-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
83	GRAVEL, COBBLES AND SAND, SATURATED					A 2" dia. PVC piezometer was installed to 82'. PVC is flush-jointed, threaded couplings. Bottom 20' is .010" machine slotted screen. Gravel pack from 84.1' to 59.7' with a 2.2' thick bentonite pellet seal above. Anulus is grouted from seal to ground surface. T.O.P. is 5.0' above ground surface.
84	CREAM TO LIGHT BROWN LIMESTONE					
	TOTAL DEPTH 84.1'					
85						
86						
87						
88						
89						
90						WATER LEVEL IMMEDIATELY AFTER PIEZOMETER INSTALLATION 20.05' BELOW T.O.P. 10:00am 8-29-84
						WATER LEVEL IS 24.09' BELOW T.O.P. 7:15am 8-27-84.
		A-30				

Drilling Log

Project Name: WESTLAKE			Boring No.: D - 87
Project No.: 84-075-4-002			Page: 1 of 7
Ground Elevation: 460.0	Location: N 114.45, E. 903.6487		Total Footage: 111.7

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
SEE REMARKS	5" @ THE SURFACE	111.0	0.7	22	0	SEE REMARKS	—

Drilling Co.: WABASH DRILLING CO.		Driller (s): DORL THORNTON	
Drilling Rig: ACKER MP-5, TRUCK		Type of Penetration Test: STANDARD	
Date: 8-9-84	To: 8-10-84	Field Observer (s): GLEN ERNSTMANN	

Depth	Description	Class.	Blow Count	Recov.		Sample or Box No.	Remarks
1	LIGHT BROWN FINE TO COARSE SAND, SOME SILT AND GRAVEL, DAMP (FILL)						5" SOLID AUGERS 0' TO 30.0'
2	LIGHT GRAY GRAVEL (2" MAX. DIA.) SOME SAND, VERY DENSE, DAMP (FILL)						
3							
4							
5			50/3"	2"/3"	5.0 / 5.3	SS-1	
6	MOTTLED LIGHT GRAY TO DARK GRAY TO BROWN SANDY SILTY CLAY, MEDIUM PLASTICITY, STIFF, MOIST (FILL						
7	TRACE GRAVEL (2" MAX. DIA.)						
8							
9							
10			2/3/4	12"/18"	10.0	SS-2	
11							
12					11.5		
13							

Drilling Log, continued

Boring No. D-87
Project Name WESTLAKE
Page 2 of 7
Project No. 84-075-4-002
Date 8-9-84

Depth	Description	Log or Class	Blow Counts	Core Recov. & Loss		Box or Sample No.	Remarks
15	MOTTLED LIGHT GRAY TO DARK GRAY TO BROWN SANDY, SILTY CLAY, MEDIUM PLASTICITY, STIFF MOIST (FILL				16.0		
16	TRACE GRAVEL (2" MAX. DIA.)			23"/24"		ST-3	Q_p = 1.5 TSF
17					17.0		
18							
19							
20	DARK GRAY SILTY CLAY, MEDIUM TO HIGH PLASTICITY, VERY STIFF, MOIST				20.0		
21				21"/24"		ST-4	Q_p = 2.75 TSF
22					22.0		
23							
24	DARK GRAY SANDY SILT AND SILTY SAND INTERBEDS, SAND IS FINE TO MEDIUM, LOW TO NON-PLASTIC, WET TO SATURATED						
25					25.0		
26				4"/24"		ST-5	Q_p = N.A.
27					27.0		
28							SATURATED MATERIAL FIRST ENCOUNTERED @ APPROXIMATELY 27.0' BELOW G.S.
29							
30	BROWN TO GRAY-BROWN SILTY FINE SAND, MEDIUM DENSE SATURATED, SLIGHTLY MICACEOUS		3/7/8	10"/18"	30.0	SS-6	

Drilling Log, continued

Project Name	WEST LAKE
Project No.	84-075-4-002
Boring No.	D-87
Page	3 of 7
Date	8-9-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
32	BROWN TO GRAY-BROWN SILTY FINE SAND, MEDIUM DENSE SATURATED SLIGHTLY MICACEOUS				31.5	SS-6	NOTE: HOLE COLLAPSED TO 26.7' AFTER SAMPLE SS-6 WAS OBTAINED. NO FREE WATER OCCURS ABOVE THIS DEPTH.
33							
34	— — — — — — —						BEGAN ROTARY WASH BORING W/ 4½" DIA. TRI-CONE BIT @ 30.0'
35	BROWN FINE TO MEDIUM SAND, TRACE SILT, ~~SOME~~ HIGHLY QUARTZOSE, DENSE, SATURATED		12/14/20	4" / 18"	35.0	SS-7	
36					36.5		
37	— — — — — — —						
38	LIGHT BROWN FINE TO COARSE SAND INTERBEDDED WITH THIN (3" TO 10" THICK) GRAVEL SEAMS, TRACE SILT, DENSE TO VERY DENSE, SATURATED						
39							
40					40.0		
41			15/25/25	8" / 18"		SS-8	
42					41.5		
43							
44							
45					45.0		
46			17/23/14	8" / 18"		SS-9	
47					46.5		

Drilling Log, continued

Boring No.	D-87
Project Name	WEST LAKE
Page	4 of 7
Project No.	84-075-4-002
Date	8-9-84

Depth	Description	Log or Class	Blow Counts	Core Recov. & Loss	Box or Sample No.	Remarks
49	LIGHT BROWN FINE TO COARSE SAND INTERBEDDED WITH THIN (3" TO 10" THICK) GRAVEL SEAMS, TRACE SILT, DENSE TO VERY DENSE, SATURATED					
50			14/29/50	10"/18"	50.0	
51					SS-10	
52					51.5	
53	DARK GREENISH GRAY FINE TO MEDIUM SAND, TRACE SILT, DENSE TO VERY DENSE, SATURATED					
54						
55					55.0	
56			12/17/23	9"/18"	SS-11	
57					56.5	
58						
59						
60					60.0	
61			32/35/50/4"	12"/18"	SS-12	
62					61.5	
63						
64						

Drilling Log, continued

Boring No. D-87

Project Name WESTLAKE

Page 5 of 7

Project No. 84-075-4-002

Date 8-9-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
66	GREENISH DARK GRAY FINE TO MEDIUM SAND, TRACE SILT, DENSE TO VERY DENSE, SATURATED		24/25/36	13"/18"	SS-13	
67				66.5		STOPPED 8-9-84 RESUMED 8-10-84
68						
69						
70			30/23/24	14"/18"	SS-14	
71				71.5		
72						
73						
74						
75	GRAY TO DARK GREENISH GRAY FINE TO COARSE SAND, HIGHLY QUARTZOSE, SUBROUNDED GRAINS, VERY DENSE TO MEDIUM DENSE, SATURATED FEW THIN (3" TO 6") GRAVEL SEAMS		22/29/34	14"/18"	SS-15	
76				76.5		
77						
78						
79						
80				80.0		
81			27/37/26	11"/18"	SS-16	
				81.5		

Drilling Log, continued

Boring No. D-87
Project Name: WESTLAKE
Page: 6 of 7
Project No.: 84-075-4-002
Date: 8-9-84

Depth	Description	Log or Class	Blow Counts	Core Recov. & Loss		Box or Sample No.	Remarks
83	GRAY TO DARK GREENISH GRAY FINE TO COARSE SAND, HIGHLY QUARTZOSE, SUBROUNDED GRAINS, VERY DENSE TO MEDIUM DENSE, SATURATED						
84							
85	FEW THIN (3" TO 6" THICK) GRAVEL SEAMS AT INTERVALS OF 1' TO 5'.		15/16/14	9" / 18"	85.0	SS-17	
86					86.5		
87							
88	NOTE: SAND IS PREDOMINANTLY COARSE WITH TRACE FINE GRAVEL THROUGHOUT BELOW APPROXIMATELY 88'.						
89							
90					90.0		
91			15/17/22	8" / 18"		SS-18	
92					91.5		
93							
94							
95					95.0		
96			19/15/18	7" / 18"		SS-19	
97					96.5		
98							

Drilling Log, continued

Boring No. D-87
Project Name WESTLAKE
Page 7 of 7
Project No. 84-075-4-002
Date 8-9-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
100	GRAY TO DARK GREENISH GRAY FINE TO COARSE SAND, HIGHLY QUARTZOSE SUBROUNDED GRAINS, VERY DENSE TO MEDIUM DENSE, SATURATED		24/50/6"	6"/12"	100.0	
101					SS-20 101.0	
102	FEW THIN (3" TO 6" THICK) GRAVEL SEAMS AT INTERVALS OF ROUGHLY 1' TO 5'.					
103	NOTE = SAND IS PREDOMINANTLY COARSE WITH TRACE FINE GRAVEL THROUGHOUT BELOW APPROXIMATELY 88'.					
104						A 2" dia. PVC piezometer was installed to 111'.
105			24/31/48	9"/18"	105.0	PVC is flush-joint, threaded couplings.
106					SS-21	Bottom 20' is .010" machine slotted screen.
107					106.5	Bottom 24' is gravel packed with a 3' thick bentonite pellet seal above.
108						Annulus is grouted from seal to ground surface.
109						
110			17/30/50/4"	10"/16"	110.0 SS-22a	T.O.P. is 3' above ground surface.
111	GRAY TO CREAM LIMESTONE, MEDIUM STRONG TO STRONG, SLIGHTLY TO MODERATELY WEATHERED				111.3 SS-22b	
112						111.7'
113	TOTAL DEPTH 111.7'					WATER LEVEL IMMEDIATELY AFTER PIEZOMETER INSTALLATION 8-10-84 IS 4.46 BELOW T.O.P.
114						WATER LEVEL @ 26.05' BELOW T.O.P. 8:15am 8-14-84
115						

SUBSURFACE EXPLORATION DA

by

WABASH DRILLING COMPANY

110 Angelica St. • St. Louis, Mo. 63147 • 421-2460

Date of Drilling:
Started 6-22-78
Finished 6-23-78

Boring No. 38
Coordinates Sheet 1 of 2
Surf. Elev.
Gr. Water Elev. --

Client Westlake Quarry & Material Co.

Job Name Westlake Landfill Client's Job No.

Job Location St. Charles Rock Road City Bridgeton State Mo.

Casing O.D. I.D.

Sampler O.D. 2" I.D. 1-3/8"

Casing Hammer lbs. fall

Sampler Hammer 140 lbs. 30" fall

W. D. Co. Foreman Gary Johanning Client's Inspector

Depth Below Ground Surface	Blows On Casing	Sample Number	Blows On Sampler	Penetration Of Sampler (inches)	FIELD IDENTIFICATION OF SOIL (Include relative firmness, relative moisture, color, mention all soil constituents, etc.)	REMARKS
					Trash & white chat	Used 6" H.S. auger
1'6"					White chat 1" minus	
7'0"					Moist, yellowish-tan, medium stiff clay	
13'0"					Moist, brown, firm, silty-clay with traces of fine sand	
19'0"					Moist, gray, medium stiff, plastic clay with traces of rust stains	
26'6"					Moist to wet, brown, loose, fine sand with traces of gravel	
31'0"					Wet, gray, medium dense, fine sand	(Cont'd.)

AUG 04 '93 08:38AM FYD STL

SUBSURFACE EXPLORATION D A

by

WABASH DRILLING COMPANY

110 Angelica St. • St. Louis, Mo. 63147 • 421-2460

Date of Drilling:
Started 6-22-78
Finished 6-23-78

Boring No. 38
Coordinates Sheet 2 of 2
Surf. Elev.
Gr. Water Elev. --

Client Westlake Quarry & Material Co.

Job Name Westlake Landfill Client's Job No.

Job Location St.Charles Rock Road City Bridgeton State Mo.

Casing O.D. I.D. Sampler O.D. 2" I.D. 1-3/8

Casing Hammer lbs. fall Sampler Hammer 140 lbs. 30" fall

W. D. Co. Foreman Gary Johanning Client's Inspector

Depth Below Ground Surface	Blows On Casing	Sample Number	Blows On Sampler	Penetration Of Sampler (inches)	FIELD IDENTIFICATION OF SOIL (Include relative firmness, relative moisture, color, mention all soil constituents, etc.)	REMARKS
					Wet, gray, medium dense, fine sand	Set bottom of well point @ 50'0" and back filled with ½" minus rock.
50'0"					Total depth of boring 50'0"	

AUG 04 '93 08:38AM FYD STL P.14

DRILLING LOG

McLaren Hart

SB/MW #: I-73
Log #:
Page 1 of 2
Geoscientist:

PROJECT: Westlake
PROJECT #: 11.0800556
LOCATION: Bridgeton, Missouri
TOC ELEVATION: 462.6
SAMPLING DATE(S): 6/22/78 6/23/78 START: FINISH:
SAMPLING METHOD: MONITORING DEVICE:
SUBCONTRACTOR/EQUIPMENT: /
DRILLING METHOD: NOTES:

Depth Below Surface (ft.)	Sampler Interval/ Recovery	Sample ID #	PID reading (ppm)	Soil Description Color, Texture, Moisture, Etc.	Unified Classification	Graphic Log	Well Construction Details
0				TRASH & white CHAT (FILL)			
2				CHAT; white, 1" minus			
4							
6							
8				CLAY; yellowish tan, med stiff, moist			
10							
12							
14				Silty CLAY; tr fine Sand, brown, firm, moist	CL ML		
16							
18							
20				CLAY; gray, med stiff, tr rust stains, moist			
22							
24							
26							
28 ▼				SAND; brown, loose, fine, tr Gravel	SM GM		
30							
32							
34							
36				SAND; gray, med dense, fine, wet			
38							
40							
42							
44							
46							
48							
50				See Following Page...			

SIGNATURE OF FIELD SUPERVISOR

Assistant Geoscientist
TITLE

SIGNATURE OF REVIEWER

Project Manager
TITLE

DRILLING LOG

McLaren Hart

SB/MW #: I-73
Log #:
Page 2 of 2
Geoscientist:

PROJECT: Westlake PROJECT #: 11.0800556

Depth Below Surface (ft.)	Sampler Interval/ Recovery	Sample ID #	PID reading (ppm)	Soil Description Color, Texture, Moisture, Etc.	Unified Classification	Graphic Log	Well Construction Details
50.0				Total depth = 50.0'			

SIGNATURE OF FIELD SUPERVISOR

Assistant Geoscientist
TITLE

SIGNATURE OF REVIEWER

Project Manager
TITLE

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 4.25 inch I.D./8.25 inch O.D. Hollow Stem Auger	BORING NO. LR-103
		SHEET 1 OF 3
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING START / FINISH

WATER LEVEL	26.74 FT				TIME	TIME
TIME	9:16				14:00	9:00
DATE	10/20/95				DATE	DATE
CASING DEPTH	38.0 FT.				10/19/95	10/20/95

DATUM NORTHING: 1068527.38 EASTING: 515217.07 ELEVATION 460.1

DRILL RIG CME 750 SURFACE CONDITIONS

ANGLE 90° BEARING NA

SAMPLE HAMMER

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	2 4 6 8	1.0' / 2.0' (50%)			(0.0-2.5 ft.) Stiff, moderate yellowish brown (10YR 5/4), CLAYEY SILT, trace fine Gravel, occasional cobbles, NR, dry, (CL-ML), (FILL)	SP 1	
2	17 12 13 16	1.3' / 2.0' (65%)			(457.6) 2.5 (2.5-3.5 ft.) Very stiff, medium gray (N5), SANDY SILT, little c-f Gravel, occasional cobbles, SR, damp, (ML), (FILL)	SP 2	
3							
4	9 10 8 11	0.7' / 2.0' (35%)			(3.5-7.5 ft.) Very stiff, medium bluish gray (SB 5/1), SILT, little c-f Sand, WR, damp, (ML), (FILL)	SP 3	
5							
6	3 8 5 4	1.2' / 2.0' (60%)				SP 4	
7							
8	3 5 4 4	1.1' / 2.0' (55%)			(7.5-10.0 ft.) Stiff, medium light gray (N6), SANDY SILT, little c-f Gravel, SR, damp, (ML), (FILL)	SP 5	
9							
10	2 2 3 2	1.6' / 2.0' (80%)			(10.0-19.3 ft.) Firm, medium gray (N5), SILT, little fine Sand, trace iron staining, SR, damp, (ML), (LOESS)	SP 6	
11							
12	1 2 3 3	1.4' / 2.0' (70%)				SP 7	@ 12.0 ft. Hole began making gas at low levels
13							
14	2 2 3 4	2.0' / 2.0' (100%)				SP 8	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY M. SANDFORT

DATE 10/23/95 CHK'D BY B. TILTON

JOB NO.: 943-2848

FILENAME: LR103

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MD
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1068527.38
DATUM EASTING: 515217.07 ELEVATION 460.1

DRILLING METHOD: 4.25 inch I.D./8.25 inch O.D. Hollow Stem Auger

SAMPLING METHOD:
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)

BORING NO. LR-103

SHEET 2 OF 3

		START	FINISH
WATER LEVEL	26.74 FT	DRILLING	
TIME	9:16	TIME 14:00	TIME 9:00
DATE	10/20/95	DATE 10/19/95	DATE 10/20/95
CASING DEPTH	38.0 FT.		

DRILL RIG CME 750
ANGLE 90° BEARING NA
SAMPLE HAMMER
SURFACE CONDITIONS

DRILLING CONTR LAYNE-WESTERN

LOGGED BY M. SANDFORT DATE 10/23/95 CHK'D BY B. TILTON

JOB NO.: 943-2848
FILENAME: LR103

DEPTH IN FEET (ELEVATION)	BLOW/6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16	3 3 4 5	2.0' 2.0' (100%)			(10.0-19.3 Ft.) Firm, medium gray (N5), SILT, little Fine Sand, trace iron staining, SR, damp, (ML), (LOESS)	SP 8	
17						SP 9	
18	1 2 2 4	2.0' 2.0' (100%)			From 18.0-19.0 Ft., wet zone		
19					(440.8) 19.3	SP 10	
20	2 4 6 7	2.0' 2.0' (100%)			(19.3-24.2 Ft.) Firm, grayish black (N2), SILTY CLAY, NR, damp, (CL), (ALLUVIUM)		
21						SH 11	
22	2 4 5 8	2.0' 2.0' (100%)			@ 22.3 Ft., color changes to medium dark gray (N4)		
23						SP 12	
24	6 12 17 15	2.0' 2.0' (100%)			(435.9) 24.2 (24.2-38.0 Ft.) Compact, medium gray to medium dark gray (N5 to N4), Fine SAND, trace Silt, NR, damp, (SP), (ALLUVIUM)		
25						SP 13	
26	4 4 6 15	1.2' 2.0' (60%)					@ 26.0 Ft., encountered water
27					From 27.2-27.5 Ft., CLAYEY SILT layer	SP 14	
28	8 8 15 15	2.0' 2.0' (100%)					
29						SP 15	

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MO
WEST LAKE LANDFILL
OPERABLE UNIT 2

DATUM NORTHING: 1068527.38
EASTING: 515217.07
ELEVATION 460.1

DRILLING METHOD:	4.25 inch I.D./8.25 inch O.D. Hollow Stem Auger
SAMPLING METHOD:	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
	SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)

WATER LEVEL	26.74 FT.
TIME	9:16
DATE	10/20/95
CASING DEPTH	38.0 FT.

BORING NO. LR-103

SHEET 3 OF 3

DRILLING

START	FINISH
TIME	TIME
14:00	9:00
DATE	DATE
10/19/95	10/20/95

DRILL RIG CME 750

ANGLE 90° BEARING NA

SAMPLE HAMMER

SURFACE CONDITIONS

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE		REMARKS
31	4 4 7 10	1.5' 2.0' (75%)			(24.2-38.0 Ft.) Compact, medium gray to medium dark gray (N5 to N4), Fine SAND, trace Silt, NR, damp, (SP), (ALLUVIUM)	SP	16	
32	5 11 14 27	1.3' 2.0' (65%)			From 32.3-32.5 Ft. layers of decayed vegetation	SP	17	
33								
34	6 12 15 15					SP	18	
35								
36	5 6 12 14					SP	19	
37					@ 37.0 Ft., SAND becomes medium to fine grained			
38					(422.1) 38.0 End of Soil Borehole Log at 38.0 Ft.			
39								
40								
41								
42								
43								
44								

DRILLING CONTR LAYNE-WESTERN

LOGGED BY M. SANDFORT

DATE 10/23/95 CHK'D BY B. TILTON

JOB NO.: 943-2848

FILENAME: LR103

Well No. LR-103

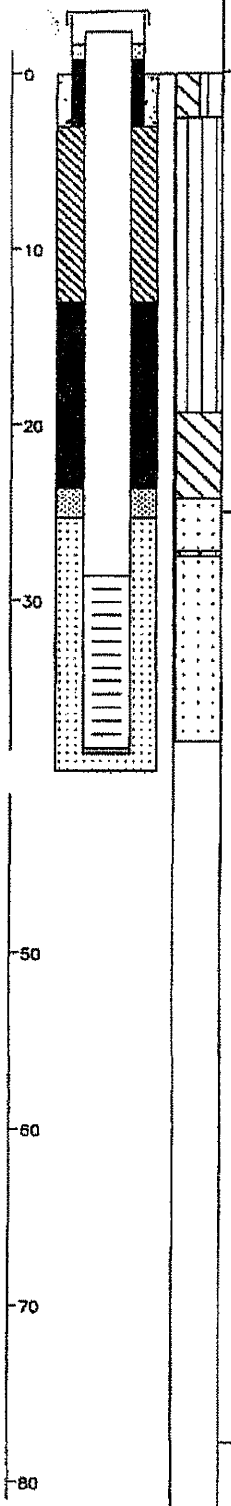
Boring No. X-Ref: LR-103

PIEZOMETER CONSTRUCTION SUMMARY

Survey Coords: Northing: 1068527 ft. Easting: 515217 ft.

Elevation Ground Level 460.1 ft. NGVD

Top of PVC Casing 461.28 ft. NGVD



Not to Scale

Drilling Summary:

Total Depth 40.0 ft.
Borehole Diameter 8 1/4" (0.0-40.0')
Casing Stickup Height 1.10 ft.
Driller Layne-Western
St. Louis, MO

Rig CME 750
Bit(s) 4 1/4" ID/8 1/4" O.D. Hollow Stem Auger Bit

Drilling Fluid None

Protective Casing 8x8" Square Steel, by 5' long

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+1.10	-	28.60	C1	461.28	-	431.50
28.60	-	38.40	S1	431.50	-	421.70
38.40	-	38.70	C2	421.70	-	421.40
	-				-	
	-				-	
	-				-	

Casing: C1 2" dia. Schedule 80 PVC, flush threaded with O-rings
C2 2" dia. threaded PVC end cap (4" long or 0.33')

Screen: S1 2" dia. Schedule 80 PVC, 0.010" machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand 25.3-39.7'

Filter Pack: 100 mesh Silica Sand 23.6-25.3'

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry 3.0-13.0'

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry 13.0-23.6'

Concrete: 0.0-3.0'

Construction Time log:

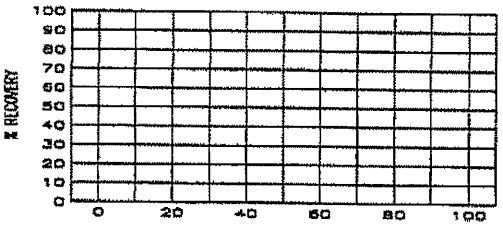
Task	Start Date	Start Time	Finish Date	Finish Time
Drilling CME 75	10/19/95	14:00	10/20/95	9:00
Geophys. Logging:				
Casing: 2" I.D. PVC	10/20/95	8:55	10/20/95	8:59
Filter Placement:	10/20/95	9:10	10/20/95	10:25
Cementing:				
Development				
Bentonite Grout	10/20/95	10:35	10/20/95	10:50
Bentonite Seal	10/20/95	10:28	10/20/95	10:35

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by M. Sandfort
Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO
File Name LR103

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF. NO. 145107	
C.R. NO.	CHECK NO.
STATE WELL NUMBER	TRANSMITTAL NO.
CHECKED BY	ROUTE
APPROVED BY	ENTERED Ph 1 Ph 2 Ph 3

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

SITE/FACILITY NAME: LAIDLAW BRIDGETON SANITARY LANDFILL
WELL NUMBER: LR-103
SITE ADDRESS: ST. CHARLES ROCK RD
CITY: BRIDGETON
STATE: Mo
ZIP CODE: 63044
OWNER NAME: LAIDLAW WASTE SYSTEMS, INC.
TELEPHONE: 314-241-3710
OWNER ADDRESS: 1838 N. BROADWAY
CITY: ST. LOUIS
STATE: MO
ZIP CODE: 63102

VARIANCE ISSUED: ☐ YES ☒ NO
DATE ISSUED:
VARIANCE NUMBER: V

DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT:
AT WEST BASE OF GRAVEL PILE FOR ASPHALT PLANT

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT
COUNTY: ST. LOUIS
SURFACE ELEVATION: 460.1
SMALLEST ¼ LARGEST ¼
SEC. ____ TWN. 47 N,RNG. 5 (E OR W)
LAT. 38 ° 46 ' 05 " LONG. 90 ° 26 ' 48 "

MONITORING WELL INSTALLATION CONTRACTOR'S NAME: LAYNE WESTERN CO., INC. — PERMIT NUMBER: 001258 WPM
DRILLING CONTRACTOR'S NAME: LAYNE WESTERN CO., INC. — PERMIT NUMBER: 001258 WPM

WELL CONSTRUCTION INFORMATION

TYPE OF WELL: ☐ MONITORING WELL ☒ PIEZOMETER ☐ OTHER
TYPE OF POTENTIAL SITE: ☐ HAZARDOUS MATERIAL ☒ LANDFILL ☐ OTHER ☐ L.U.S.T.
MONITORING FOR: (CHECK ALL THAT APPLY) ☒ V.O.C. ☐ METALS ☐ PETROLEUM PRODUCT ☐ OTHER ONLY

PROTECTIVE CASING DETAILS (IF USED): LENGTH 5 FT. | DIAMETER OF CASING 8X8 IN. | WEIGHT OR SDR # 0.188 | DIAMETER AND DEPTH OF DRILL HOLE 8¼ IN. 40 FT. | JOINTS ☐ THREADED ☐ MECHANICAL ☐ WELDED ☐ OTHER | MATERIAL ☐ THERMO PLASTIC ☒ STEEL ☐ FLUORO POLYMER TYPE | LOCKING CAP? ☒ YES ☐ NO

CAP VENTED ☒ YES ☐ NO
WEEP HOLE? ☒ YES ☐ NO
CASING GROUT DETAILS: MATERIAL ☐ CEMENT ☒ CONCRETE ☐ OTHER
DEPTH FROM THE SURFACE TO THE BOTTOM OF THE CASING GROUT SEAL: 3.0 FT.
TYPE OF SURFACE COMPLETION: ☒ ABOVE GROUND ☐ FLUSH MOUNT
DESCRIBE HOW THE FLUSH MOUNT WAS CONSTRUCTED:

CENTRALIZER USED ON RISER: ☒ NO ☐ YES LOCATED AT
MATERIAL: ☐ STAINLESS STEEL ☐ OTHER

RISER PIPE DETAILS: LENGTH 31.2 FT. | DIAMETER OF RISER PIPE 2 IN. | WEIGHT OR SDR # SCH80 | DIAMETER OF DRILL HOLE 8¼ IN. | JOINTS ☒ THREADED ☐ MECHANICAL ☐ WELDED ☐ OTHER | MATERIAL ☒ THERMO PLASTIC ☐ STEEL ☐ FLUORO POLYMER ☐ OTHER

ANNULAR SEAL: ☐ CEMENT SLURRY ☒ BENTONITE SLURRY ☐ NON SLURRY BENTONITE TYPE: ☐ CEMENT/BENTONITE SLURRY BAGS OF CEMENT USED % BENTONITE USED WATER USED/BAG GAL.
BENTONITE SEAL: MATERIAL BENTONITE ☒ SLURRY ☐ CHIPS ☐ GRANULAR ☐ PELLETS | LENGTH OF SEAL 10.6 | BENTONITE SEAL INSTALLED IN ☐ UNSATURATED ZONE ☒ SATURATED ZONE

PRIMARY FILTER PACK: TYPE ☒ SAND ☐ MANUFACTURED ☐ NATURAL | GRAIN SIZE 16-35 | LENGTH OF FILTER PACK 14.7 FT. | METHOD OF INSTALLATION H.S.A. POUR
SECONDARY FILTER PACK: TYPE ☒ SAND ☐ MANUFACTURED ☐ NONE | GRAIN SIZE 100 | LENGTH OF FILTER PACK 1.7 FT. | METHOD OF INSTALLATION H.S.A. POUR
WELL SCREEN: LENGTH OF SCREEN 10 FT. | DIAMETER 2 IN. | SLOT SIZE 10 | WEIGHT OR SDR # SCH 80 | MATERIAL ☒ PLASTIC ☐ STEEL ☐ FLUORO POLYMER
SUMP DETAILS: LENGTH OF SUMP | DIAMETER OF SUMP | MATERIAL ☐ PVC ☐ STEEL ☐ FLUORO POLYMER ☐ OTHER
BACK FILL: WAS THE WELL BACK FILLED? ☐ YES ☒ NO | MATERIAL USED | LENGTH OF BACK FILLED BORE HOLE

Information in this column to be supplied in the Feet from Surface column

	FEET FROM SURFACE	FORMATION DESCRIPTION
Depth to Bottom of Protective Casing Seat:	3.0	0-7 Gravelly clay
Depth to Base of Annular Seal:	13.0	7-26 Silty clay
Depth to Base of Bentonite Seal:	23.6	
Depth to Top of Primary Filter Pack:	25.3	
Depth to Top of the Screen:	30.0	26-40 Silty sand
Depth to Bottom of the Screen:	40.0	
Total Depth:	40.0	

STATIC WATER LEVEL: FEET FROM MEASURING POINT
DATE OF STATIC WATER LEVEL
MEASURING POINT FOR STATIC WATER LEVEL IS: ☒ TOP OF RISER PIPE ☐ OTHER
ELEVATION OF MEASURING POINT: 461.28
MULTIPLE CASED WELLS: SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.
DRILLING EQUIPMENT: ☐ AIR ROTARY ☒ AUGER TYPE 4¼ H.S.A. ☐ REVERSE ROTARY ☐ OTHER
DATE WELL DRILLING WAS COMPLETED: 10-20-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE PRIMARY CONTRACTOR/PERMIT #: [signature] — DATE: 11-15-95
SIGNATURE DRILLER/PERMIT #: [signature] — DATE: 11-15-95

MO 780-1415 (7-95)
DISTRIBUTION: WHITE/DIVISION CANARY/MONITORING WELL CONTRACTOR PINK/OWNER
MAIL WHITE COPY TO: DEPARTMENT OF NATURAL RESOURCES, P.O. BOX 250, ROLLA, MO 65402
ENCLOSE $35 PER MONITORING WELL FOR THE CERTIFICATION FEE WITHIN 60 DAYS AFTER WELL COMPLETION
RECYCLED PAPER

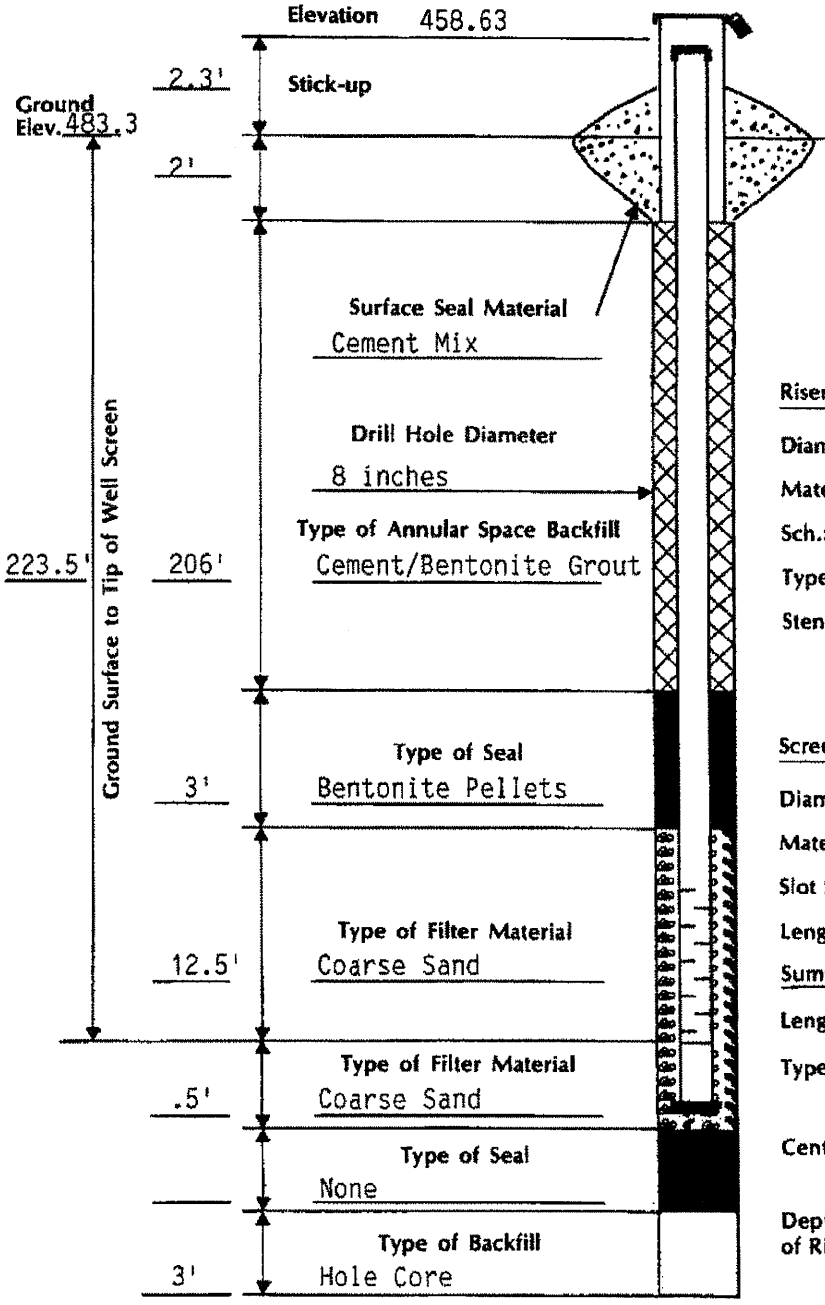
Foth & Van Dyke

Client: LAIDLAW WASTE SYSTEMS Scope I.D.: 89L46
Project: Bridgeton Monitor Wells Page: 1
Prepared by: RTB Date: 4/15/91
Checked by: RTB Date: 4/24/91

MONITORING WELL CONSTRUCTION DIAGRAM

Driller: John Mathes and Associates, Inc. Well No.: 1204
Drilling Method: Air Rotary Date Installed: 4/5/91

Coordinates: 1,066,420.96N, 515,823.27E



Protector Pipe:
Size: 4 inch
Material: Steel
Lock No.: Master

Riser:
Diameter: 2 inch
Material: PVC
Sch.: 80
Type of Joints: Flush Threaded
Stenciled? Yes

Screen:
Diameter: 2 inch
Material: PVC
Slot Size: 0.010 inch
Length: 10 feet

Sump:
Length: None
Type of Cap: PVC Flush Threaded

Centralizer: Used ☐
Not Used ☒

Depth to Water From Top of Riser at Completion: Dry

NOTE: Not to Scale

RECORD OF DRILLHOLE PZ-100-SS

Sheet 1 of 2

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 843-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/24/95
DRILL RIG: SCHRAMM

DATUM: MSL
COORDINATES N: 1068887.81
AZIMUTH: 0

COLLAR ELEV: 484.35
E: 517175.03
INCLINATION: -90

J-Joint, P-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (ft)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX: FR, SW, MW, HW, CW	STRENGTH INDEX: R6, R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): R6 1500, R5 600, R4 300, R3 150, R2 75, R1 30	TEST ORIENTATION	NOTES: WATER LEVELS, INSTRUMENTATION
64	0.0-78.9 ft. No sampling conducted See Record of Drillhole for PZ-100-KS														0.0-51.0 ft. Drilling conducted with 6 1/4 in. ID hollow stem auger, then borehole advanced to 78.9 ft. with 5 7/8 in. air rotary bit
66															
68															
70															
72															
74															
76															
78															
	405.45 78.9-81.8 ft. 78.90 Moderately weathered, medium bedded, light brownish gray (5Y 6/1), fine grained, strong, ARENACEOUS DOLOMITE, open vugs (<1/2 mm), (ST. LOUIS FORMATION)		405.45 78.90	1	100 %										
80															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-SS

Sheet 2 of 2

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/24/95
DRILL RIG: SCHRAMM

DATUM: MSL
COORDINATES N: 1088887.81
AZIMUTH: 0

COLLAR ELEV: 484.35
E: 517175.03
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FT)	ELEV	DESCRIPTION	GRAPHIC LOG	RUN NO.	CORE RECOVERY	ROD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80		ROCK TYPE													
		78.9-81.8 ft. Moderately weathered, medium bedded, light brownish gray (5Y 6/1), fine grained, strong, ARENACEOUS DOLOMITE, open vugs (<1/2 mm.), (ST. LOUIS FORMATION)													
	402.55														
82	81.80	81.8-90.6 ft. Slightly weathered, thickly bedded, light olive gray (5Y 6/1), very finely crystalline, strong ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Below 82.3 ft. Stylolites common @ 83.9 and 84.5 ft. Chert zones (<2 in.) 84.4-84.7 ft. Silicified and finely disseminated pyrite		1	100 %			0	J,I,SM					
								30	J,P,SM						
84	399.65							60	J,P,SM						
	84.70	84.7-84.9 ft. Medium gray chert zone													
	399.25	85.1-85.5 ft. Olive gray (5Y 3/2), DOLOMITIC LIMESTONE layer, low porosity, vugs (<1/4 mm)						90	J,C,SM,CL						
86	85.10								J,C,SM						
	398.85			2	86%				J,I,R						
	85.50														
88															
	395.35								Core Loss						
	89.00														
90		90.6-94.0 ft. Moderately weathered, thickly bedded, light brownish gray (5Y 6/1), f-m grained, medium strong BIOCLASTIC LIMESTONE, (ST. LOUIS FORMATION)							J,I,R						
92				3	100 %										
	390.35								J,I,R,CL						
94	94.00	End of Record of Drillhole at 94.0 ft.													2/25/95 @ 11:15 Completed drilling
	94.00														
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

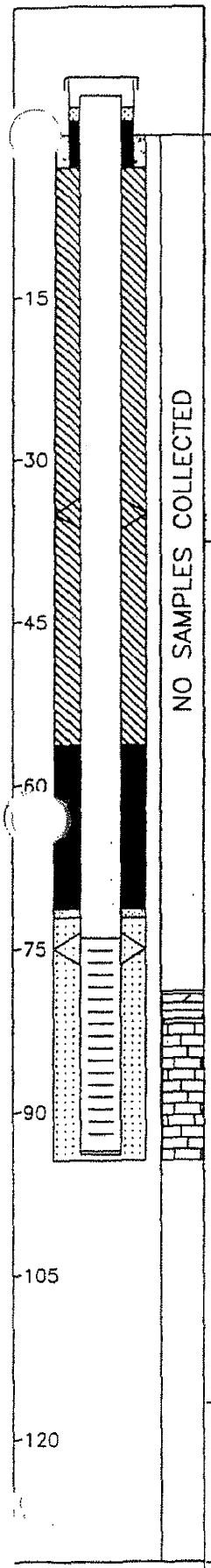
LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

Well No. PZ-100-SS

Boring No. X-Ref: PZ-100-SS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1068868 ft. Easting: 517175 ft.

Elevation Ground Level 484.4 ft. NGVD

Top of PVC Casing 485.84 ft. NGVD

Drilling Summary:

Total Depth 94.5 ft.

Borehole Diameter 10 1/4 in. (0.0-51.0 ft.) 5 7/8 in. (51.0-94.5 ft.)

Casing Stickup Height 1.49 ft.

Driller Layne-Western, St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.49	-	73.96	C1	485.84	-	410.39
73.96	-	93.60	S1	410.39	-	390.75
93.60	-	93.93	C2	390.75	-	390.42
	-				-	
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 72.1-94.5 ft.

Filter Pack: Less than 50 mesh Silica Sand, 71.3-72.1 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-56.3 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 56.3-71.3 ft.

Concrete: 0.0-3.0 ft.

Construction Time log:

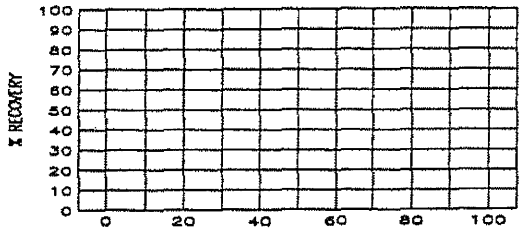
Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	2/20/95	16:00	2/20/95	18:40
Schramm Rotary	2/24/95	7:30	2/25/95	11:30
Geophys.Logging:				
Casing:	2/25/95	11:30	2/25/95	11:45
Filter Placement:	2/25/95	11:45	2/25/95	12:30
Cementing:				
Development				
Bentonite Grout	2/25/95	12:50	2/25/95	14:00
Bentonite Seal	2/25/95	12:30	2/25/95	12:50

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ100SS

661514

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 115082	CHECK NO.
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO.
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME	WELL NUMBER
LAIDLAW BRIDGETON SANITARY LANDFILL	PZ-100-35

SITE ADDRESS	CITY	STATE	ZIP CODE
ST. CHARLES ROCK RD.	BRIDGETON	MO.	63044

NAME	TELEPHONE
LAIDLAW WASTE SYSTEMS, INC.	314-341-3710

ADDRESS	CITY	STATE	ZIP CODE
1638 N. BROADWAY	ST. LOUIS	MO.	63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL SHOW LOCATION IN SECTION PLAT

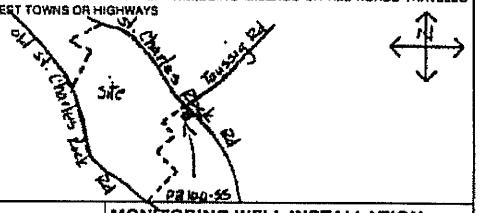
COUNTY ST. LOUIS
ELEVATION 434.35
AREA NO.

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N,RNG. 5 E OR W

LAT. 38 ° 46 ' 09 " LONG. 90 ° 30 ' 23 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO, INC

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT

MEASURING POINT IS
☐ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☒ AIR ROTARY ☒ AUGER TYPE 6¼ H.S.A.
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☒ YES, AT 3 TOTAL
☐ STAINLESS STEEL
☐ OTHER
☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

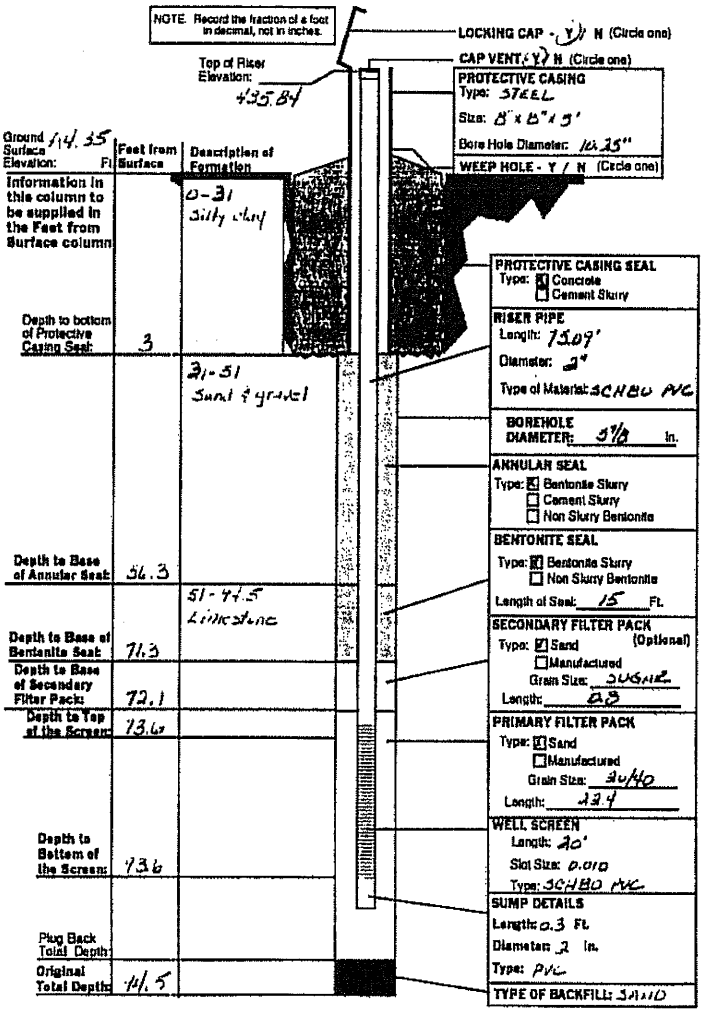
DATE WELL CONSTRUCTION WAS COMPLETED
2-25-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael J. Vogl
PERMIT NUMBER 001256 WIIA — DATE 4-11-95

SIGNATURE (DRILLING CONTRACTOR) Michael J. Vogl
PERMIT NUMBER 001256 WIIA — DATE 4-11-95

NOTE: Record the fraction of a foot in decimal, not in inches.



MO 780-1415 (2-94)

DISTRIBUTION: WHITE/DIVISION CANARY/MONITORING WELL CONTRACTOR PINK/OWNER

RECORD OF DRILLHOLE PZ-100-SD

Sheet 1 of 2

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2548
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/22/95
DRILL RIG: SCHRAMM

DATUM: MSL
COORDINATES N: 1068851.6
AZIMUTH: 0

COLLAR ELEV: 484.3
E: 517185.4
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP WRT CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR, MW, HW, CW	STRENGTH INDEX: R6, R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): R1 30, R2 150, R3 300, R4 600, R5 1500, R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
224	0.0-235.0 ft. No sampling conducted See Record of Drillhole for PZ-100-KS														0.0-34.0 ft. Drilling conducted with 6 1/4 in. ID hollow stem augers 34.0-235.0 ft. Borehole drilled with 5 7/8 in. bit using compressed air
226															
228															
230															
232															
234															
	248.00		248.00												
236	235.3-237.3 ft. 235.30 Fresh, thinly bedded, very light gray (N8) to light gray (N7), coarse grained, medium strong, ARENACEOUS LIMESTONE (SALEM FORMATION)		235.30												
238	237.3-242.4 ft. Fresh, thickly bedded, pale yellowish brown (10YR 6/2), m-c grained, medium strong, BIOCLASTIC LIMESTONE, (SALEM FORMATION)			1	97%										
	238.7-238.8 ft. Very light gray (N8), coarse grained Dolomite layer								● B,PL,SM						
40															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-SD

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/22/95
DRILL RIG: SCHRAMM

DATUM: MSL
COORDINATES N: 1066851.6
AZIMUTH: 0

COLLAR ELEV: 484.3
E: 517195.4
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE: DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (60 50 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
240	237.3-242.4 ft. Fresh, thickly bedded, pale yellowish brown (10YR 6/2), m-c grained, medium strong, BIOCLASTIC LIMESTONE, (SALEM FORMATION)								J,I,SM						
	240.9-214.3 ft. Fossiliferous, stylolitic														
242	241.3-241.7 ft. Thinly laminated														
	242.1-242.4 ft. Thinly laminated														
	242.4-245.3 ft. Fresh, thickly bedded, light gray (N7), very coarse grained, medium strong, ARENACEOUS LIMESTONE (SALEM FORMATION)			1	97%										
244									J,U,R						
			239.00 / 245.30												
	245.3-246.0 ft. Fresh, thickly bedded, olive gray (5Y 4/1), very fine grained, medium strong, (WARSAW FORMATION) 238.30 / 246.00		238.30 / 246.00	2	100 %										
248	End of Record of Drillhole at 246.0 ft.														
248															
250															
252															
254															
256															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

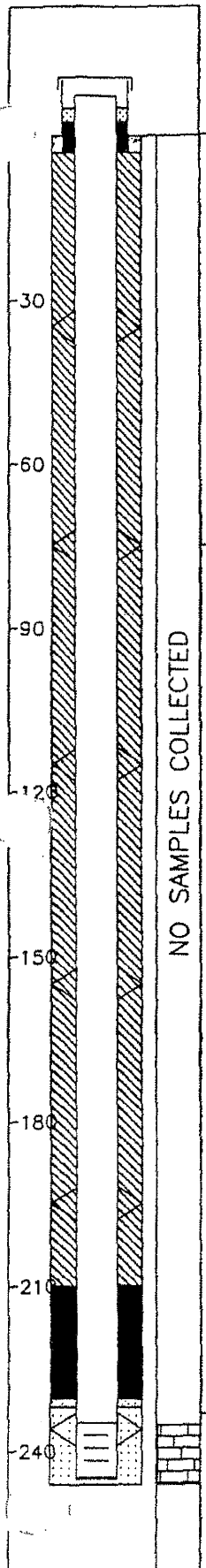
LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

Well No. PZ-100-SD

Boring No. X-Ref: PZ-100-SD

PIEZOMETER WELL CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1088852 ft. Easting: 517195 ft.

Elevation Ground Level 484.4 ft. NGVD

Top of PVC Casing 485.82 ft. NGVD

Drilling Summary:

Total Depth 246.0 ft.

Borehole Diameter 10 1/4 in. (0.0-51.0 ft.) 5 7/8 in. (51.0-246.0 ft.)

Casing Stickup Height 1.47 ft.

Driller Layne-Western, St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	1/25/95	14:00	1/25/95	14:45
Schramm Rotary	2/21/95	8:30	2/22/95	15:00
Geophys.Logging:				
Casing:	2/23/95	9:50	2/23/95	10:15
Filter Placement:	2/23/95	10:35	2/23/95	11:40
Cementing:				
Development				
Bentonite Grout	2/23/95	13:45	2/23/95	15:30
Bentonite Seal	2/23/95	13:15	2/23/95	13:45

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.47	-	234.80	C1	485.82	-	249.55
234.80	-	244.60	S1	249.55	-	239.75
244.60	-	244.93	C2	239.75	-	239.42

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 232.0-246. ft.

Filter Pack: Less than 50 mesh Silica Sand, 230.5-232.0 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-210.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 210.0-230.5 ft.

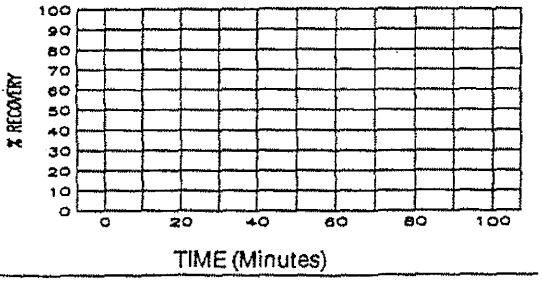
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ100SD

661574

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 15081	CHECK NO
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO.
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

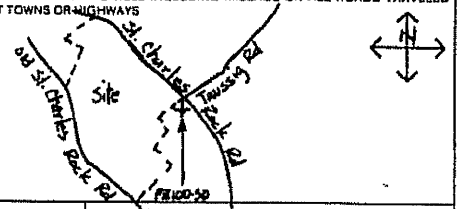
INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL
WELL NUMBER: PZ-100-3D
SITE ADDRESS: ST. CHARLES ROCK RD.
CITY: BRIDGETON
STATE: Mo
ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC.
TELEPHONE: 314-741-3710
ADDRESS: 1838 N. BROADWAY
CITY: ST. LOUIS
STATE: Mo
ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT
COUNTY: ST. LOUIS
ELEVATION: 484.35
AREA NO:
SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼
SEC. ____ TWN. 47 N,RNG. 5 (E) OR W
LAT. 38° 46' 09" LONG. 90° 26' 23"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME: LAYNE WESTERN CO., INC.

DRILLING CONTRACTOR'S NAME: LAYNE WESTERN CO., INC.

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 485.82
Ground Surface Elevation: 484.35 Ft

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
	0-13	Clay
Depth to bottom of Protective Casing Seal:	3	
	13-36	Silt
	36-88	Limestone
	88-94	Shale
	94-143	Dolomite
	143-159	Limestone
	159-165	Dolomite
	165-210	Limestone
Depth to Base of Annular Seal:	210.0	
	210-234	Dolomite
Depth to Base of Bentonite Seal:	230.5	
Depth to Base of Secondary Filter Pack:	232.0	
Depth to Top of the Screen:	234.8	
	234-246	Limestone
Depth to Bottom of the Screen:	344.8	
Plug Back Total Depth:		
Original Total Depth:	346.0	

LOCKING CAP - (Y) N (Circle one)
CAP VENT (Y) N (Circle one)
PROTECTIVE CASING Type: STEEL Size: 8"x8"x.5' Bore Hole Diameter: 10.25"
WEEP HOLE - Y / N (Circle one)
PROTECTIVE CASING SEAL Type: [X] Concrete [ ] Cement Slurry
RISER PIPE Length: 236.27' Diameter: 2" Type of Material: SCH80 PVC
BOREHOLE DIAMETER: 5 7/8 in.
ANNULAR SEAL Type: [X] Bentonite Slurry [ ] Cement Slurry [ ] Non Slurry Bentonite
BENTONITE SEAL Type: [X] Bentonite Slurry [ ] Non Slurry Bentonite Length of Seal: 20.5 Ft.
SECONDARY FILTER PACK Type: [X] Sand (Optional) [ ] Manufactured Grain Size: SUGAR Length: 1.5'
PRIMARY FILTER PACK Type: [X] Sand [ ] Manufactured Grain Size: 2440 Length: 14'
WELL SCREEN Length: 10' Slot Size: 0.010" Type: SCH.80 PVC
SUMP DETAILS Length: 0.3 Ft. Diameter: 2 In. Type: PVC
TYPE OF BACKFILL: SAND

TYPE OF INSTALLATION: [X] ABOVE GROUND [ ] FLUSH MOUNT
STATIC WATER LEVEL: FEET FROM MEASURING POINT
DATE OF STATIC WATER LEVEL:
ELEVATION OF MEASURING POINT:
MEASURING POINT IS: [X] TOP OF RISER PIPE [ ] OTHER
DRILLING EQUIPMENT: [X] AIR ROTARY [X] AUGER TYPE 6¼ H.S.A. [ ] REVERSE ROTARY [ ] OTHER
CENTRALIZERS USED: [X] YES, AT 5 TOTAL [ ] STAINLESS STEEL [ ] OTHER [ ] NO
MULTIPLE CASED WELLS: SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.
DATE WELL CONSTRUCTION WAS COMPLETED: 2-28-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Michael P. Vogt
PERMIT NUMBER: 001256 WIM DATE: 4-11-95
SIGNATURE (DRILLING CONTRACTOR): Michael P. Vogt
PERMIT NUMBER: 001256 WIM DATE: 4-11-95

MO 780-1415 (2-94)

DISTRIBUTION: WHITE-DIVISION CANARY-MONITORING WELL CONTRACTOR PINK-OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MO
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1068842.03
DATUM EASTING: 517211.63 ELEVATION 483.8

DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger

SAMPLING METHOD:
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)

					START	FINISH
WATER LEVEL					TIME	TIME
TIME					13:20	17:42
DATE					DATE	DATE
CASING DEPTH					1/25/95	1/25/95

BORING NO. PZ-100-KS

SHEET 1 OF 3

DRILLING

DRILL RIG CME 75 - TRUCK MOUNT

SURFACE CONDITIONS

ANGLE BEARING

SAMPLE HAMMER

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER

DATE 1/25/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ100KS

DEPTH IN FEET (ELEVATION)	BLOW/6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	6 3 4 6	1.6' 2.0' (80%)			(0.0-7.2 ft.) Firm, dusky yellowish brown (10YR 2/2), SILTY CLAY, little organics, NR, moist, (CL), (LOESS)	SP (1)	
2	4 6 7 8	1.8' 2.0' (90%)				SP (2)	
3							
4	2 5 5 5	1.7' 2.0' (85%)			@ 4.0 ft., color changes to moderate yellowish brown (10YR 5/4)	SP (3)	
5							
6	2 2 2 3	1.8' 2.0' (90%)				SP (4)	
7					(7.2-11.6 ft.) Firm, moderate yellowish brown (10YR 5/4), mottled SILTY CLAY, NR, moist, (CL), (LOESS)		
8	3 4 5 5	1.7' 2.0' (85%)				SP (5)	
9							
10	4 4 5 5	1.4' 2.0' (70%)				SP (6)	
11					(472.2) 11.6		
12	3 4 3 3	2.0' 2.0' (100%)			(11.6-19.2 ft.) Loose, moderate yellowish brown (10YR 5/4), mottled CLAYEY SILT, NR, moist, (ML), (LOESS)	SP (7)	
13							
14	1 3 6 7	1.8' 2.0' (90%)				SP (8)	

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MO
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1068842.03
DATUM EASTING: 517211.63 ELEVATION 483.8

DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger

SAMPLING METHOD:
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)

WATER LEVEL					START	FINISH
TIME					13:20	17:42
DATE					1/25/95	1/25/95
CASING DEPTH						

BORING NO. PZ-100-KS

SHEET 2 OF 3

DRILLING

DRILL RIG CME 75 - TRUCK MOUNT

SURFACE CONDITIONS

ANGLE BEARING

SAMPLE HAMMER

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER

DATE 1/25/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ100KS

DEPTH IN FEET (ELEVATION)	BLOW/6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16	3 4 7 10	1.2' 2.0' (60%)			(11.6-19.2 Ft.) Loose, moderate yellowish brown (10YR 5/4), mottled CLAYEY SILT, NR, moist, (ML), (LOESS)	SP 8	
17						SP 9	
18	3 4 5 7	1.9' 2.0' (95%)				SP 10	
19							
20	5 6 7 8	1.5' 2.0' (75%)			(19.2-22.4 Ft.) Loose, light olive gray (5Y 6/1), CLAYEY SILT, NR, moist, (ML), (LOESS)	SP 11	
21							
22	2 7 9 10	1.2' 2.0' (60%)			(461.4) 22.4 (22.4-28.2 Ft.) Compact light olive gray (5Y 6/1), Fine SANDY SILT, NR, dry, (SM), (ALLUVIAL)	SP 12	
23							
24	5 10 9 14	1.7' 2.0' (85%)				SP 13	
25					@ 25.4 ft., partings of light olive gray (5Y 6/1), CLAYEY SILT		
26	3 9 14 15	1.4' 2.0' (70%)				SP 14	
27							
28	3 5 7 11	0.0' 2.0' (0%)			(455.6) 28.2 (28.2-32.1 Ft.) Compact, light olive gray (5Y 6/1), mottled CLAYEY SILT, organics wet at 29.0 ft., NR, moist-wet, (ML), (ALLUVIAL)	SP 15	
29							

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MO
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1068842.03
DATUM EASTING: 517211.63 ELEVATION 483.8

DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger

SAMPLING METHOD:
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)

BORING NO. PZ-100-KS

SHEET 3 OF 3

					DRILLING START	DRILLING FINISH
WATER LEVEL					TIME	TIME
TIME					13:20	17:42
DATE					DATE	DATE
CASING DEPTH					1/25/95	1/25/95

DRILL RIG CME 75 - TRUCK MOUNT
SURFACE CONDITIONS
ANGLE BEARING
SAMPLE HAMMER

DRILLING CONTR LAYNE-WESTERN

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31	4 9 10 19	1.5'/2.0' (75%)			(28.2-32.1 ft.) Compact light olive gray (5Y 6/1), mottled CLAYEY SILT, NR, moist-wet, (ML), (ALLUVIAL)	SP (16)	
32	15 14 12 14	1.1'/2.0' (55%)			@ 31.6 ft. -1 inch of Fine SAND (451.7) 32.1 (32.1-33.9 ft.) Compact, brownish gray, (5YR 4/1), Fine SAND, NR, wet, (SM), (ALLUVIAL)	SP (17)	
33							
34	50/6"	0.6'/2.0' (30%)			(33.9 ft.) Loose, light gray (5Y 6/1), CLAYEY SILT, NR, moist, (ALLUVIAL) (449.3) 34.5 End of Soil Borehole Log at 34.5 ft. See PZ-100-KS Record of Drillhole for rock descriptions	SP (18)	Augers chatter, spoon refusal, hit bedrock at 34.5 ft.
35							
36							
37							
38							
39							
40							
41							
42							
43							
44							

LOGGED BY J. MILLER
DATE 1/25/95
CHK'D BY W. HERST

JOB NO.: 943-2848
FILENAME: PZ100KS

RECORD OF DRILLHOLE PZ-100-KS

Sheet 1 of 23

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 843-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (Feet)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR, MW, HW, CW)	STRENGTH INDEX (R5, R4, R3, R2, R1)	POINT LOAD INDEX (psi) (R1 50, R2 150, R3 300, R4 600, R5 1500, R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32	0.0-34.0 ft. See Soil Borehole Log PZ-100-KS		449.80												0.0-34.0 ft. Drilling conducted with 6.25 inch ID hollow stem augers
34	34.0-52.3 ft. Slightly weathered, very thickly bedded, very light gray (N8), medium crystalline, weak, LIMESTONE, (ST. LOUIS FORMATION) 1 mm. iron concretions common, thin calcite vein (1 cm.), irregular joints, stylolitic		34.00						J,ST,R J,I,R J,I,R (2) J,PL,R J,C,R J,I,R J,PL,R						1/27/95 Began coring
36				1	100 %				J,I,R J,I,R-CL						
38									J,I,R J,PL,R						
40			444.30 39.50						J,I,R J,PL,R J,I,R J,C,R						
42	42.9 ft. 1 in. thick clay seam			2	100 %				J,I,R J,C,R J,PL,SM-CL (2) J,C,R J,C,R						
44									J,ST,R J,ST,R J,PL,R J,PL,R						
46									J,PL,R J,C,R						
48															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

Sheet 2 of 23

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR MW HW CW	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48	34.0-52.3 ft. Slightly weathered, very thickly bedded, very light gray (N8), medium crystalline, weak, LIMESTONE, (ST. LOUIS FORMATION), 1 mm. iron concretions common, thin calcite vein (1 cm.), irregular joints, stylolitic			2	100 %				J,PL,R J,PL,R J,PL,R J,ST,R						
			434.30 49.50												
50									J,PL,R J,ST,R J,C,R J,PL,R (3)						
52									J,PL,R (2)						
54	52.3-62.5 ft. Fresh, medium bedded, light gray (N7), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, numerous clay filled discontinuities, some iron oxide staining			3	100 %				J,PL,R J,C,R						
56															
58									J,I,R						
									J,C,R J,U,R						
			424.30 59.50												
60									J,P,S (2) J,I,R J,PL,R-CL (2)						1/27/95 @ 17:15 Measured water level in hole at 34.49 ft. below ground surface 1/28/95 @ 8:18 Measured water level in hole at 36.6 ft. below ground surface
62				4	100 %				J,I,R (2)						
	62.5-67.5 ft. Fresh, medium bedded, medium light gray (N6), crypto-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)								J,C,R (2)						
64															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64	62.5-37.5 ft. Fresh, medium bedded, medium light gray (N6), crypto-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)			4	100%				J,I,R						
			418.70 / 65.10						J,C,R						1/27/95 @ 17:15 Quit drilling for the day @ 65.1 ft.
66	1-2 in. chert nodules common								J,PL,SM						
									J,I,R-CL (2)						
68	67.5-76.0 ft. Slightly weathered, medium bedded, olive gray (5Y 4/1), m-c grained, medium strong rock, CLASTIC LIMESTONE (ST. LOUIS FORMATION)								J,I,R						
									J,C,R						
70				5	98%				J,I,R (2)						
									J,C,R						
									J,I,R						
									J,C,R						
	Shaley partings common, fossiliferous								J,I,R (2)						
72									J,PL,R						
									J,ST,R						
74			408.70 / 75.10						J,PL,SM-CL (2)						
									J,C,R (2)						
76	76.0-88.5 ft. Slightly weathered, medium to thickly bedded, medium gray (N5) to light gray (N7), coarse grained, medium strong, CLASTIC LIMESTONE, (ST. LOUIS FORMATION)								J,PL,R-CL						
				6	99%				J,C,R-CL						
78									J,ST,R						
80	Stylolitic, shaley partings, sandy, more porous than above														

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

Sheet 4 of 23

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infil, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	76.0-88.5 ft. Slightly weathered, medium to thickly bedded, medium gray (N5) to light grat (N7), coarse grained, medium strong, CLASTIC LIMESTONE, (ST. LOUIS FORMATION)							90 J,C,SM							
								J,PL,SM-CL							
82				6	99%										
								J,PL,SM (2)							
84								J,I,R-CL							
								J,I,VR (2)							
			398.70												
86			85.10					J,I,R							
								J,PL,R							
				7	100 %										
88			395.30												
	88.5-94.0 ft. Slightly weathered, thickly laminated to thinly bedded, medium gray (N5), fine grained, extremely weak to very weak, SILTY CLAYSTONE and SILTSTONE, (ST. LOUIS FORMATION) Pyrite in claystone, cross-bedded, fine sandy siltstone interbeds		88.50					J,I,R							
								J,I,R-CL							
90								J,PL,SM							
			393.40												
			90.40					J,I,R (3)							
								J,I,R							
								J,I,R (3)							
				8	79%			J,I,R (2)							
92								J,ST,SM							
								J,I,SM							92.7-93.3 ft. Core Loss
			390.50												
			93.30					J,I,R							
								J,I,R							
			389.80					J,C,R							
94	94.0-98.0 ft. Slightly weathered, thickly bedded, very light gray (N8), fine grained, medium strong, DOLOMITE (ST. LOUIS FORMATION)		94.00					J,ST,R (2)							
								J,I,R							
				9	98%										
								J,PL,R-CH							
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

Sheet 5 of 23

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	ROD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: FR, SW, MW, HW, CW	STRENGTH INDEX: R6, R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): R1 30, R2 150, R3 300, R4 600, R5 1500, R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
96	94.0-98.0 ft. Slightly weathered, thickly bedded, very light gray (N8), fine grained, medium strong, DOLOMITE, (ST. LOUIS FORMATION) Vuggy, highly silicified, bioturbated								J,I,R-CL						
98	98.0-116.4 ft. Slightly weathered, very thickly bedded, light brownish gray (5Y 6/1), fine grained, medium strong, DOLOMITE, (ST. LOUIS FORMATION)			9	98%										
100	Laminae, vuggy in places, clay infilling, some silicification 101.0-103.0 ft. Vuggy								J,C,S-CL						
102			380.50												
104	104.5-106.4 ft. Vuggy, some silicification in veins, clay partings		103.30						J,PL,R						
106									J,PL,R						
108				10	99%				J,PL,R						
110									J,I,R						
112															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.6
E: 517211.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX (SW FR, AW, HW, CW)	STRENGTH INDEX (R6, R5, R4, R3, R2, R1)	POINT LOAD INDEX (psi) (R1 30, R2 150, R3 380, R4 680, R5 1500, R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
112	98.0-116.4 ft. Slightly weathered, very thickly bedded, light brownish gray (5Y 6/1), fine grained, medium strong, DOLOMITE, (ST. LOUIS FORMATION)			10	99%										
			370.40												
114			113.40						J,I,VR						
116															
	116.4-119.6 ft. Fresh, thickly bedded, medium light gray (N6), medium crystalline, medium strong, DOLOMITE, (ST. LOUIS FORMATION)														
118				11	100 %										
			364.20												
120	119.6-120.7 ft. Fresh, thinly bedded, medium gray (N5), finely crystalline, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)		119.60 363.10						J,PL,R-CL						
	Bioturbated, calcite infilling		120.70												
122	120.7-123.7 ft. Fresh, thickly bedded, medium light gray (N6), f-m crystalline, medium strong, DOLOMITE, (ST. LOUIS FORMATION)														
			360.30												
124	123.7-147.5 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine crystalline, medium strong, DOLOMITE, (ST. LOUIS FORMATION) Stylolitic		123.50						J,I,R J,I,R J,I,R						1/28/95 @ 17:32 Finish drilling for the day at 123.5 ft., we blow out hole and measure water level at 72.77 ft. below ground surface
126				12	100 %										
	126.9 ft. 1 in. clay seam, fractures at ~124.5 and 127.6 ft.								J,C,R J,I,R						
128															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

Sheet 7 of 23

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.8
INCLINATION: -90

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
128	123.7-147.5 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine crystalline, medium strong, DOLOMITE, (ST. LOUIS FORMATION) Stylolitic								J,I,R-CL,CH						
130				12	100 %				J,C,SM						
132									J,ST,R						
			351.60 / 132.20												
134									J,PL,R-CL						
									J,I,R						
138				13	100 %				J,PL,S-CL						Note: rock breaks along stylolites and clay partings
138									J,PL,S						
140															
142			341.60 / 142.20												
				14	100 %										
144															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

Sheet 6 of 23

PROJECT: LAIDLAW/Ft-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	ROD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
144	123.7-147.5 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine crystalline, medium strong, DOLOMITE, (ST. LOUIS FORMATION)														
146															
	336.30 / 147.50														
148	147.5-159.5 ft. Fresh, thickly bedded, pale yellowish brown (10YR 6/2), m-c crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION) 147.5 ft. 1 in. clay partings			14	100 %			30	J,C,R-CL						
								30	J,C,SM-CL						148.1-149.0 ft. 1 in. clay filled vertical fracture
150															
152			331.60 / 152.20					30	J,I,R						1/29/95 @ 16:06 Drillers quit drilling for the day, they blew out the hole, measured water level @ 80.4 ft. below ground surface, drilled to 152.2 ft.,
	Stylolitic							30	J,I,R						
154								30	J,I,R						1/30/95 @ 9:38 Measured water level in hole @ 48.3 ft. 1/30/95 @ 9:51 Begin Run 15
								30	J,I,R						
156	Brecciated, glauconitic, clay and silt sized infilling			15	100 %			30	J,I,VR						
								60	J,I,R-CL						
158								30	J,I,R						
	159.5-165.5 ft. Fresh, thickly bedded, greenish gray (5GY 6/1), coarsely crystalline, medium strong, DOLOMITE, (ST. LOUIS FORMATION) 324.30 / 159.50							30	J,PL,R						
160								30	J,I,R						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/8/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

Sheet 9 of 23

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1058842.0
AZIMUTH: 0

COLLAR ELEV: 483.6
E: 517211.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
160	159.5-165.5 ft. Fresh, thickly bedded, greenish gray (5GY 6/1), coarsely crystalline, medium strong, DOLOMITE, (ST. LOUIS FORMATION)			15	100 %				J,I,VR						
162			321.50 / 162.30												
	Some dark gray organic laminae														
164															
			318.30 / 165.50												
166	165.5-173.0 ft. Fresh, thickly bedded, pale yellowish brown (10YR 6/2), f-m grained, strong, LIMESTONE, (SALEM FORMATION)								J,C,R						@ 165.5 ft. Inferred contact between ST. LOUIS FORMATION and SALEM FORMATION
	167.3-169.6 ft. Brecciated, glauconite and gray clay infilling, stylolitic, some calcite filled veins			16	100 %										
168									J,C,R						
170															
172			311.50 / 172.30												
	173.0-181.2 ft. Fresh, thinly bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (SALEM FORMATION)			17	100 %										
174															
176															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR, MW, HW, CW	STRENGTH INDEX: R6, R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): R1 30, R2 150, R3 300, R4 600, R5 1500, R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
176	173.0-181.2 ft. Fresh, thinly bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (SALEM FORMATION)														
178				17	100 %										
180															
182	181.2-183.0 ft. Thickly bedded, pale yellowish brown (10YR 6/2), coarse grained, strong, (SALEM FORMATION)		301.60												
			182.20												
184	183.0-190.5 ft. Fresh, thinly laminated, pale yellowish brown (10YR 6/2), fine grained, medium strong, ARGILLACEOUS LIMESTONE (SALEM FORMATION)								J,I,R-CL						
				18	100 %										
188	185.9-186.7 ft. Clay rich horizons, becoming siltier 186.7 ft. Chert nodules, stylolitic														
188									J,I,R						
			295.30												
			188.50												
190				19	100 %				J,PL,S						
	190.5-205.5 ft. Fresh, thickly bedded, pale yellowish brown (10YR 6/2), medium grained, strong, ARENACEOUS LIMESTONE, (SALEM FORMATION)		292.80												1/31/95 @ 8:00 Measure water level in hole at 38.05 ft. @ 8:10 resume coring on Run 20
			191.00						J,I,VR						
192				20	100 %										

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

Sheet 11 of 23

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
192	190.5-205.5 ft. Fresh, thickly bedded, pale yellowish brown (10YR 6/2), medium grained, strong, ARENACEOUS LIMESTONE, (SALEM FORMATION) Silty, fine sand, fossil fragments, organic laminae, some clayey laminae, cherty, bioturbated							J,I,S						
194														
196				20	100 %									
198														
200			283.80 / 199.90											
202	202.0 ft. Silicified horizons			21	100 %									
204			278.70 / 205.10											
206	205.5-210.0 ft. Fresh, thinly bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, ARENACEOUS LIMESTONE, (SALEM FORMATION) 206.0-206.3 ft. Clay interbed Silty, cherty, some clay horizons, silicified, coarse grained interbeds			22	100 %			J,I,R-CL J,I,R (2) J,I,R J,I,R-CL						1/31/95 @ 17:15 Finish coring @ 205.1 ft., driller tried 1/2 day to get past the chert at this depth and failed
208														

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/FB-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE / DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
208	205.5-210.0 ft. Fresh, thinly bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, ARENACEOUS LIMESTONE, (SALEM FORMATION)			22	100 %										
210	Silty, cherty, some clay horizons, silicified, coarse grained interbeds 273.80 / 210.00		273.70 / 210.10												
	210.0-220.7 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS DOLOMITE (SALEM FORMATION)														
212															
214															
				23	91%										
216															
218															
									Core Loss						
220			263.70 / 220.10												
	263.10 / 220.70														
	220.7-222.5 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), medium grained, medium strong, ARENACEOUS DOLOMITE, (SALEM FORMATION) shell debris in lower .5 ft., coarser downward, organic laminae 261.30 / 222.50			24	100 %										
222	222.5-233.8 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS DOLOMITE, (SALEM FORMATION)								J,PL,SM						
224															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

Sheet 13 of 23

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
224	222.5-233.8 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS DOLOMITE, (SALEM FORMATION) Chert nodules common, bioturbated, organic laminae, some texture laminae								J,I,SM						
228				24	100 %										
230			253.50 / 230.30						J,C,SM						
232	233.7 ft. Organic clay lense			25	100 %				J,PL,SM						
234	250.00 / 233.80 233.8-241.4 ft. Fresh, thickly bedded, light gray (N7), coarse grained, medium strong, BIOCLASTIC LIMESTONE, (SALEM FORMATION)								J,I,R-CL J,PL,R						
238			247.60 / 236.20	26	100 %				J,PL,R						2/1/95 End drilling @ 16:30, 2/6/95 @ 8:26 Measure water level at 80.8 ft. below ground surface 2/6/95 @ 9:50 Begin coring Run 26
	Stylolitic, sandy, dark gray laminae		246.20 / 237.60												
238									J,PL,R						
				27	75%										
240	239.8 ft. Medium sand, 1 cm. thick layer								J,PL,S						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
240	233.8-241.4 ft. Fresh, thickly bedded, light gray (N7), coarse grained, medium strong, BIOCLASTIC LIMESTONE, (SALEM FORMATION)														
	241.4-245.6 ft. Fresh, thickly bedded, light gray (N7) to dark gray (N3), coarse grained, medium strong, ARENACEOUS LIMESTONE (SALEM FORMATION)								J,I,R						
242				27	75%				J,I,R						
	242.8 ft. Silty sand, fossiliferous, 1 in. thick clayey horizon								Core Loss						Core loss occurred due to barrel falling down hole
244			239.20												
			244.60												
	238.20		245.60												
246	245.6-249.8 ft. Fresh, thickly bedded, olive gray (5Y 4/1), fine grained, medium strong, SILTSTONE, (WARSAW FORMATION)														Run 28 recovery poor, because core barrel fell in hole and core was lost after Run 27. Run 28 core is broken up due to damage during its retrieval. Contacts @ 245.6 and 249.8 ft. are approximate because of core loss
248				28	81%										
	234.00		249.80												
250	249.8-254.5 ft. Fresh, thickly bedded, olive gray (5Y 4/1), fine grained, medium strong, CLAYSTONE, (WARSAW FORMATION) Grades to siltstone near base														
									Core Loss						
252			231.20												
			252.60												
254				29	96%										
	229.30		254.50												
	254.5-256.4 ft. Fresh, thickly bedded, medium dark gray (N4), coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (WARSAW FORMATION)														
256															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

Sheet 15 of 23

PROJECT: LAIDLAW/RI-FB
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
Pl.-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
256			227.40												
	258.4-261.3 ft. 258.40 Fresh, thickly bedded, olive black (5Y 6/1), fine grained, medium strong, SILTSTONE, (WARSAW FORMATION) Black organic laminae, slightly pitted, dolomitic														
258				29	96%										
			224.10						Minor Core Loss						2/6/95 @ 16:50 Quit for the day 2/7/95 @ 5:30 Start coring Run 30
260			258.70						J,I,SM						
	261.3-264.8 ft. 261.30 Fresh, thickly bedded, olive gray (5Y 4/1), medium crystalline, medium strong, DOLOMITE, (WARSAW FORMATION)														
262															
			219.00												
264	264.8-276.7 ft. 264.80 Fresh, thickly bedded, dark gray (N3), microcrystalline, medium strong, LIMESTONE, (WARSAW FORMATION)														
				30	100 %										
266															
268															
	Packstone, fossiliferous		213.90												
270			269.90												
				31	100 %				J,PL,VR						
272															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
272	264.8-276.7 ft. Fresh, thickly bedded, dark, gray (N3), microcrystalline, medium strong, LIMESTONE, (WARSAW FORMATION)														
274															
276				31	100 %										
	207.10														
	276.7-278.5 ft. Fresh, medium bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARENACEOUS DOLOMITE (WARSAW FORMATION)														
278	205.30														
	278.5-287.2 ft. Fresh, thickly bedded, medium light gray (N6), coarsely crystalline, medium strong, FOSSILIFEROUS LIMESTONE, (WARSAW FORMATION)		278.50												
			203.90												
280			279.90												
282									J,I,VR						
284				32	100 %										
286															
288															
	287.2-301.0 ft. Fresh, thickly bedded, olive black (5Y 2/1), coarse crystalline, medium strong, LIMESTONE, (WARSAW FORMATION)														

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 317211.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	NOTES WATER LEVELS INSTRUMENTATION
288	287.2-301.0 ft. Fresh, thickly bedded, olive black (5Y 2/1), coarse crystalline, medium strong, LIMESTONE, (WARSAW FORMATION)		32	100 %				J,PL,VR-Calcite mineralization				Possible water producer
		183.90										
290		288.90										2/7/95 @ 15:07 Start Run 33
	Stylolitic common, fossiliferous							J,I,VR-Calcite mineralization				
292												
								J,PL,VR-Calcite mineralization				
294			33	100 %								
	295.4-295.7 ft. Vuggy porosity											
296												
298												
		184.50										
		298.30						J,I,R				2/7/95 @ 16:30 Quit drilling @ 299.3 ft. after Run 33 2/8/95 @ 9:10 Start coring Run 34, measured water level @ 18.8 ft. below ground surface
300								J,I,R				
								J,I,R				
		182.50										
	301.0-304.3 ft. Fresh, thickly bedded, olive black (5Y 2/1), medium grained, medium strong, DOLOMITE, (WARSAW FORMATION) Argillaceous, vuggy	301.00	34	99%								
302	301.0-304.3 ft. Vuggy porosity											
304												

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAFLAW/RI-FS
PROJECT NO: 943-2849
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
304			179.50												
	304.3-306.1 ft. Fresh, thickly bedded, medium dark gray (N4), coarsely crystalline, medium strong, LIMESTONE, (WARSAW LIMESTONE)		304.30												
306			177.70												
	306.1-313.0 ft. Fresh, thinly bedded, grayish black (N2), fine grained, weak, CLAYEY SILTSTONE, (WARSAW FORMATION) Pyrite crystals, calcite mineralization		306.10	34	99%				J,I,SM						
308															
			174.60												
			309.20												
310															
312									J,PL,R						312.5-313.5 ft. 90 and 50 degree fractures are not open 314.5-315.5 ft. Second fracture not open
			170.80						J,I,VR						
	313.0-316.5 ft. Fresh, thickly bedded, dark greenish gray (5GY 4/1), medium crystalline, medium strong, ARENACEOUS DOLOMITE, (WARSAW FORMATION), glauconitic, stylolitic, vuggy, silty shale interbeds		313.00												
314				35	100				J,PL,SM-CL (2)						
									J,PL,R						2/8/95 Finish in Run 36, break down due to hydraulic leaks
316			167.30												
	316.5-341.0 ft. Fresh, thinly bedded, olive black (5Y 2/1), fine grained, weak, CLAYEY SILTSTONE, (WARSAW FORMATION)		316.50												
318															
			164.70												
			319.10												2/9/95 @ 7:40 Resume coring Run 36
				36	100										
320															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

Sheet 19 of 23

PROJECT: LAIDLAW/FI-FS
PROJECT NO: 843-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.6
E: 517211.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR, MW HW, CW	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
320	316.5-341.0 ft. Fresh, thinly bedded, olive black (5Y 2/1), fine grained, weak, CLAYEY SILTSTONE, (WARSAW FORMATION)														
	321.1-322.1 ft. 1-2 in. thick limey and dolomite interbeds								J,PL,SM						
322									J,I,SM						
									J,PL,SM						
									J,C,SM						
324									J,PL,SM						
				36	100 %										
326															
328	Very fine pyrite crystals, calcite infilled veins, thin (0.2-0.3 in.) dolomite interbeds		154.80												
			329.20												
330									J,ST,SM-CL						
332				37	98%										4 drill induced fractures in Run 37, especially at point core was lost
334			148.40												
			335.40	38	99%										
336															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
336	316.5-341.0 ft. Fresh, thinly bedded, olive black (5Y 2/1), fine grained, weak, CLAYEY SILTSTONE, (WARSAW FORMATION)														
338															5 drill induced fractures in upper 5 ft. of Run 38
340				38	99%				J,PL,SM						
	142.80 341.00								J,PL,SM						
342	341.0-344.6 ft. Fresh, medium bedded, greenish black (5GY 2/1), fine grained, medium strong, ARGILLACEOUS DOLOMITE, (WARSAW FORMATION)														
344	Black organic laminae, calcite filled vugs		139.50 344.30												
	139.20 344.60														Two drilling induced fractures in upper 2 ft. of Run 39
346	344.6-348.8 ft. Fresh, thinly bedded, olive black (5Y 2/1), fine grained, weak, SILTY CLAYSTONE, (WARSAW FORMATION)														
348	Calcite filled vugs			39	100 %										
	135.00 348.80														
350	348.8-352.8 ft. Fresh, medium bedded, olive gray (5Y 4/1), fine grained, medium strong, ARGILLACEOUS DOLOMITE, (WARSAW FORMATION) Vuggy, fossil fragments														
352															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

Sheet 21 of 23

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
Pl-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (Feet)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	ROD (80, 50, 40, 20)	FRACTURES PER FOOT (2, 4, 6, 8, 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0, 30, 60, 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (FR, SW, MW, HW, CW)	STRENGTH INDEX (R6, R5, R4, R3, R2, R1)	POINT LOAD INDEX (psi) (R1 30, R2 150, R3 300, R4 600, R5 1500, R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
352															
	131.00														
	352.8-357.6 ft. 352.80 Fresh, medium bedded, olive gray (5Y 4/1), medium grained, medium strong, LIMESTONE, some fossils, race thin chert layers (<1 in.), (WARSAW FORMATION)			39	100 %										
354			129.60												2/9/95 @ 15:15 Finish Run 39, quit work on the hole 2/11/95 @ 13:15 Corehole reamed out with 6 in. bit using Schramm Rotadrill to 354.5 ft.
			354.50 129.30												
	354.8-355.0 ft. and 355.4-355.7 ft. Thinly bedded, medium dark gray (N4), Claystone layers								J,I,R						
356	129.20														
	357.6-386.6 ft. 357.80 Fresh, thin to medium bedded, medium light gray (N6), very coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (KEOKUK FORMATION) Predominantly argillaceous, shaley partings common, numerous light bluish gray (5B 7/1) chert layers (1-2 in. thick), chert nodules (1-10 mm.)			40	100 %				J,I,R J,I,R						@ 357.6 ft. Inferred top of KEOKUK FORMATION
360									J,I,R						
362			121.60 362.00												363.0-372.0 ft. Numerous drilling induced fractures (2-3 per foot)
364				41	100 %										
366															
368															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

Sheet 22 of 23

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066642.0
AZIMUTH: 0

COLLAR ELEV: 483.6
E: 517211.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
368	ROCK TYPE														
370	357.6-386.6 ft. Fresh, thin to medium bedded, medium light gray (N6), very coarse grained, medium strong, FOSSILIFEROUS LIMESTONE. (KEOKUK FORMATION) Predominantly argillaceous, shaley partings common, numerous light bluish gray (5B 7/1) chert layers (1-2 in. thick), chert nodules (1-10 mm.)			41	100 %										
372			111.80 / 372.00												
374	374.2-375.2 ft. Moderately weathered, medium bedded, light olive gray (5Y 6/1), medium strong, ARENACEOUS DOLOMITE layer, (KEOKUK FORMATION)		108.60 / 374.20 / 108.60 / 375.20	42	100 %				J,I,S,CL B,I,R B,I,R (2)						
376			106.60 / 377.20						J,I,R						
378									B,C,R,CL J,R,R						
380	380.7-381.0 ft. Thinly laminated, dark greenish gray (5G 4/1), SILTY CLAYSTONE layer			43	100 %				B,PL,S B,PL,R						
382									B,U,CL						
384															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068642.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
384	357.6-386.6 ft. Fresh, thin to medium bedded, medium light gray (N6), very coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (KEOKUK FORMATION) Predominantly argillaceous, shaley partings common, numerous light bluish gray (5B 7/1) chert layers (1-2 in. thick), chert nodules (1-10 mm.)			43	100 %				B,PL,CL						
386									B,I,VR						
									J,I,VR						
	386.6-391.2 ft. Slightly weathered, thinly bedded, light gray (N7), coarse grained, medium strong to strong, ARENACEOUS LIMESTONE, (KEOKUK FORMATION), Thin dolomite layers layers (<6 in.), argillaceous in some zones, stylolitic, chert nodules (<1 in.), silicified zones (<6 in.), some joints highly weathered, fossiliferous @ 389.0 ft. Open vug with calcite crystals (1/2 in. dia.)		96.80						J,I,R						
			387.00						B,I,R						2/12/95 @ 16:00 Complete Run 43 2/13/95 @ 9:00 Resume coring Run 44
388									B,I,R						
									J,I,VR						
				44	100 %				J,I,VR						
390									J,I,R						
			392.60						J,I,R						
	End of Record of Drillhole at 391.2 ft.		391.20												
392															
394															
396															
398															
400															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

Well No. PZ-100-KS

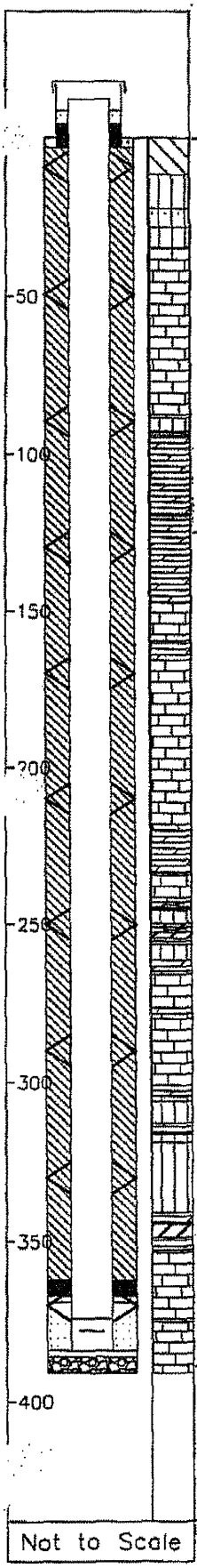
Boring No. X-Ref: PZ-100-KS

PIEZOMETER CONSTRUCTION SUMMARY

Survey Coords: Northing: 1068842 ft. Easting: 517212 ft.

Elevation Ground Level 483.8 ft. NGVD

Top of PVC Casing 485.64 ft. NGVD



Not to Scale

Drilling Summary:

Total Depth 390.0 ft.

Borehole Diameter 10 1/4 in. (0.0-34.0 ft.) 5 7/8 in. (34.0-391.0 ft.)

Casing Stickup Height 1.88 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	1/25/95	13:20	2/9/95	15:15
Schramm Rotary	2/11/95	11:00	2/13/95	15:30
Geophys.Logging:	2/9/95	16:15	2/9/95	18:15
Casing:	2/17/95	7:55	2/17/95	11:00
Filter Placement:	2/17/95	11:00	2/17/95	13:30
Cementing:				
Development				
Bentonite Grout	2/20/95	7:30	2/20/95	11:30
Bentonite Seal	2/17/95	13:30	2/17/95	13:45

Well Design & Specifications

Basis: Geologic Log X Geophysical Log X

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.88	-	374.00	C1	485.64	-	109.76
374.00	-	383.80	S1	109.76	-	99.96
383.80	-	384.13	C2	99.96	-	99.63
	-				-	
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 369.0-384.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 367.0-369.0 ft. and 384.0-386.0 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-362.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 362.0-367.0 ft.

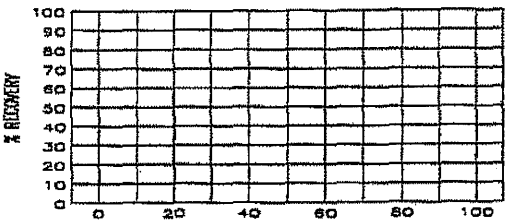
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Prior to well installation, there was about 4 ft. of slough at base of borehole which could not be removed.

Supervised by W. Herst

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ100KS

661574

OFFICE USE ONLY	DATE RECEIVED
REF NO 115080	CHECK NO.
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO.
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

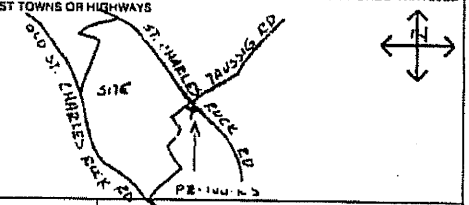
INFORMATION SUPPLIED BY OWNER

SITE NAME: LANDLAW BRIDGETON SANITARY LANDFILL
WELL NUMBER: PZ-100-KS
SITE ADDRESS: St Charles Rock Road
CITY: BRIDGETON
STATE: MO
ZIP CODE: 63044
NAME: LANDLAW WASTE SYSTEMS, INC.
TELEPHONE: 314-241-3710
ADDRESS: 1838 N BROADWAY
CITY: St. Louis
STATE: MO
ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT
COUNTY: St. Louis
ELEVATION: 433.76
AREA NO.
SMALLEST ¼ LARGEST ¼
SEC. TWN. 47 N,RNG. 5 (E) OR W
LAT. 38 ° 46 ' 09 " LONG. 90 ° 26 ' 32 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME: LAYNE WESTERN CO, INC.

DRILLING CONTRACTOR'S NAME: LAYNE WESTERN CO, INC.

NOTE: Record the fraction of a foot in decimal, not in inches

Top of Riser Elevation: 435.64
Ground Surface Elevation: 433.76 Ft

Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column	0-13 clay
Depth to bottom of Protective Casing Seal: 3	
	13-36 silt
	36-88 Limestone
	88-94 Shale
	94-143 Dolomite
	143-151 Limestone
	151-165 Dolomite
	165-210 Limestone
	210-234 Dolomite
Depth to Base of Annular Seal: 366	234-246 Limestone
	246-262 Shale
Depth to Base of Bentonite Seal: 367	262-267 Dolomite
	267-272 Limestone
Depth to Base of Secondary Filter Pack: 369	272-307 Dolomite
	307-314 Shale
Depth to Top of the Screen: 374	314-317 Dolomite
	317-343 Shale
	343-346 Dolomite
	346-351 Shale
	351-354 Dolomite
Depth to Bottom of the Screen: 384.4	354-391 Limestone
Plug Back Total Depth:	
Original Total Depth: 391.4	

LOCKING CAP: (Y) N (Circle one)
CAP VENT: (Y) N (Circle one)
PROTECTIVE CASING Type: STEEL Size: 8"x8"x5' Bore Hole Diameter: 10.25"
WEEP HOLE - Y / N (Circle one)
PROTECTIVE CASING SEAL Type: [X] Concrete [ ] Cement Slurry
RISER PIPE Length: 375.88' Diameter: 3" Type of Material: PVC SCH 80
BOREHOLE DIAMETER: 5 7/8 In.
ANNULAR SEAL Type: [X] Bentonite Slurry [ ] Cement Slurry [ ] Non Slurry Bentonite
BENTONITE SEAL Type: [X] Bentonite Slurry [ ] Non Slurry Bentonite Length of Seal: 5 Ft.
SECONDARY FILTER PACK Type: [X] Sand (Optional) [ ] Manufactured Grain Size: 30x40 Length: 2'
PRIMARY FILTER PACK Type: [X] Sand [ ] Manufactured Grain Size: 16-35 Length: 15'
WELL SCREEN Length: 10' Slot Size: 0.010" Type: SCH. 80 PVC
SUMP DETAILS Length: 6.2 Ft. Diameter: 3 In. Type: PVC
TYPE OF BACKFILL: SAND/SLURRY

DRILLING EQUIPMENT
[X] AIR ROTARY [X] AUGER TYPE 6 1/4 HSA
[ ] REVERSE ROTARY [ ] OTHER
TYPE OF INSTALLATION [X] ABOVE GROUND [ ] FLUSH MOUNT
STATIC WATER LEVEL FEET FROM MEASURING POINT
DATE OF STATIC WATER LEVEL
ELEVATION OF MEASURING POINT 435.64
MEASURING POINT IS [X] TOP OF RISER PIPE [ ] OTHER
CENTRALIZERS USED [X] YES, AT 8 TOTAL [X] STAINLESS STEEL [ ] OTHER [ ] NO
MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.
DATE WELL CONSTRUCTION WAS COMPLETED 3-20-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael J Vogt
PERMIT NUMBER UC1256WM DATE 4-11-95
SIGNATURE (DRILLING CONTRACTOR) Michael J. Vogt
PERMIT NUMBER UC1256WM DATE 4-11-95

MO 780-1415 (2-94) DISTRIBUTION: WHITE-DIVISION CANARY-MONITORING WELL CONTRACTOR PINK-OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MD
WEST LAKE LANDFILL
OPERABLE UNIT 2

DATUM NORTHING: 1068472.89 EASTING: 516622.94 ELEVATION 474.9

DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger					BORING NO. PZ-101-SS	
					SHEET 1 OF 1	
SAMPLING METHOD:					DRILLING	
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)					START	FINISH
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)					TIME 13:35	TIME 14:30
WATER LEVEL						
TIME						
DATE					DATE 2/23/95	DATE 2/23/95
CASING DEPTH						

DRILL RIG CME 75 - TRUCK MOUNT

SURFACE CONDITIONS

ANGLE BEARING

SAMPLE HAMMER

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	2 2 3 3	1.1' / 2.0' (55%)			(0.0-0.2 Ft.) Firm, olive gray (5Y 4/1), SILT, trace clay, NR, damp, (CL-ML), (LOESS) (0.2-2.7 Ft.) Firm, mottled dark yellowish brown (10YR 4/2), CLAYEY SILT, some roots, NR, damp, (CL-ML), (LOESS)	SP 1	
2	5 4 5 4	1.6' / 2.0' (80%)					
3					(2.7-8.0 Ft.) Firm, stiff, olive gray (5Y 3/2), CLAYEY SILT, NR, damp, (CL-ML), (LOESS)	SP 2	
4	1 1 3 5	1.7' / 2.0' (85%)				SP 3	
5							
6		1.7' / 2.0' (85%)				SH 4	
7							
8	1 3 6 6	1.7' / 2.0' (85%)			(8.0-8.9 Ft.) Stiff, mottled olive gray (5Y 3/2) and dark yellowish brown (10YR 4/2), CLAYEY SILT, NR, damp, (CL-ML), (LOESS) (8.9-10.3 Ft.) Stiff, mottled moderate yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/2), CLAYEY SILT, NR, damp, (CL-ML), (LOESS)	SP 5	Iron oxide staining from 8.0-14.0 Ft.
9							
10	3 5 5 5	1.7' / 2.0' (85%)			(10.3-13.2 Ft.) Stiff, mottled light olive gray (5Y 5/2) and moderate yellowish brown (10YR 4/2), CLAYEY SILT, NR, damp, (CL-ML), (LOESS)	SP 6	
11							
12	1 1 2 6	1.6' / 2.0' (80%)					
13					(13.2-14.0 Ft.) Soft, dark greenish gray (5GY 4/1), CLAYEY SILT, NR, damp, (CL-ML), (LOESS) (460.9) 14.0	SP 7	
14					End of Soil Borehole Log at 14 Ft. See PZ-101-SS Record of Drillhole for rock descriptions		Auger refusal at 14.0 Ft.

DRILLING CONTR LAYNE-WESTERN

LOGGED BY M. HIRT CHK'D BY W. HERST

DATE 2/23/95

JOB NO.: 943-2848

FILENAME: PZ101SS

RECORD OF DRILLHOLE PZ-101-SS

Sheet 1 of 9

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/23/95-2/25/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1058472.9
AZIMUTH: 0

COLLAR ELEV: 474.6
E: 518622.9
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX: SW, FR, MW, HW, CW	STRENGTH INDEX: R6, R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): RT 30, R2 150, R3 300, R4 600, R5 1500, R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
0	0.0-14.0 ft See Soil Borehole Log PZ-101-SS														
14	460.60		460.60												
	14.0-27.6 ft. 14.00 Slightly weathered to fresh, medium bedded, very light gray (N8), medium grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Brachiopod fossils, iron staining, 1 in. thick clay filled joint at 15.4 ft.		14.00	1	55%				Broken Zone Broken Zone						
16															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-101-SS

Sheet 2 of 9

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/23/95-2/25/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068472.9
AZIMUTH: 0

COLLAR ELEV: 474.6
E: 516822.9
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Heated, GRF-Gravel Filled

SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR, MW, HW, CW	STRENGTH INDEX: R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): R5 150, R4 300, R3 600, R2 1500, R1	TEST ORIENTATION	NOTES, WATER LEVELS, INSTRUMENTATION
16	14.0-27.6 ft. Slightly weathered to fresh, medium bedded, very light gray (N8), medium grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic			1	55%				Core Loss						Core loss due to highly fractured rock
			456.80												
18			18.00						J,I,R,Fe (2)						
									J,I,R,Fe (2)						
									J,I,R,Fe (2)						
									J,I,R (2)						
									J,I,R						
									J,I,R						
									J,I,R						
									J,I,R						
									J,I,R (2)						
20									J,I,R						
									J,I,R						
									J,I,R,CL (3)						
				2	100%				J,I,R,CL (2)						
									J,I,R,CL (2)						
22									J,I,R,CL (2)						
									J,I,R,CL						
									J,I,R						
									J,I,SM						
									J,I,R,CL						
24			450.30						J,I,R,CL						
			24.50						J,ST,R,Fe						
									J,I,R,CL (3)						
26									J,I,R,CL (2)						
									J,I,SM,CL (3)						
				3	96%				J,I,SM,CL						
	27.6-40.5 ft. Fresh, medium bedded, very light gray (N8), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Some brachiopod fossils								J,U,SM,CL						
28									J,I,R,CL						
									J,PL,SM,CL (2)						
									J,I,R,CL						
									J,I,SM,CL (2)						
			445.30						J,I,SM,CL (2)						
			29.50												
30									J,I,SM (2)						
									J,U,SM						
				4	98%				J,I,R						
									J,I,R,chert						
									J,PL,SM						
									J,I,R,CL (2)						
32									J,I,R (2)						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-101-SS

Sheet 3 of 9

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/23/95-2/25/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068472.9
AZIMUTH: 0

COLLAR ELEV: 474.8
E: 516622.9
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32	27.6-40.5 ft. Fresh, medium bedded, very light gray (N8), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)								J,PL,SM,CL						
	32.7 ft. Calcite and pyrite crystals								J,PL,R (2)						
	33.8 ft. Chert nodule								J,PL,SM						
34	34.1 ft. Crinoid fossils								J,PL,SM						
	35.0-35.6 ft. Moderately weathered														
				4	98%				J,PL,SM,CL						
36	36.1 ft. Stylolitic														
	37.7-40.5 ft. Large chert nodules								J,I,R (2)						
38									J,U,SM,CL						
									J,I,SM						
			435.30						J,I,SM						
			39.50												
40	40.3-40.5 ft. Joints intersecting large chert nodules, some pyrite								J,I,R (2)						
	40.5-50.2 ft. Fresh, medium bedded, very light gray (N8) to light gray (N7), m-c grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)								J,PL,R						
42	42.2-45.1 ft. Stylolitic														
				5	100 %				J,I,R						
44									J,I,R						
									J,I,R (2)						
									J,I,R (3)						
46									J,PL,R (4)						
									J,PL,R (2)						
	47.5-49.3 ft. Stylolitic														
48															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-101-SS

Sheet 4 of 9

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/23/95-2/25/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068472.9
AZIMUTH: 0

COLLAR ELEV: 474.8
E: 515822.9
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR, MW, HW, CW	STRENGTH INDEX: R6 R5 R4 R3 R2 R1	POINT LOAD INDEX (psi): R1 30, R2 150, R3 300, R4 600, R5 1500, R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48	48.5-50.2 ft. Fresh, medium bedded, very light gray (N8) to light gray (N7), m-c grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)			5	100 %				J,I,R (2)						
	49.1 ft. Brachiopoda fossil		425.30					60	J,U,R						
50			49.50						J,PL,R						
	50.2-52.7 ft. Fresh, very thinly to medium bedded, medium light gray (N6) to medium gray (N5), coarse grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)								J,I,R (3)						
52	51.2-52.2 ft. Numerous calcite veins at 20 degrees to core axis in healed fractures														
	52.7-54.5 ft. Fresh, medium bedded, light olive gray (5Y 6/1), medium grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)								J,PL,SM						
									J,PL,SM						
54									J,I,R						
			420.30												
	54.5-58.0 ft. Slightly weathered, medium light olive gray (5Y 6/1), fine to medium grained, medium strong, DOLOMITE, (ST. LOUIS FORMATION) Very porous/vuggy, vugs <1 mm. in diameter		54.50	6	98%				J,I,R						
56															
58	58.0-61.9 ft. Fresh, medium bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARENACEOUS DOLOMITE, (ST. LOUIS FORMATION)								J,I,SM						
			415.30												
	59.7-60.0 ft. Weathered, crumbly chert		59.50						J,I,R (2)						
60	60.0-61.9 ft. Porous/vuggy (vugs < 1 mm.)								J,I,R						
	61.4 ft. Calcite filled (healed) fracture		412.90	7	100 %										
62	61.9-66.3 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARENACEOUS LIMESTONE, (ST. LOUIS FORMATION)		61.90						J,PL,SM,CL						
								60	J,PL,R						
64															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HART
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-101-SS

Sheet 5 of 9

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 843-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/23/95-2/25/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068472.9
AZIMUTH: 0

COLLAR ELEV: 474.8
E: 519622.9
INCLINATION: -90

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR, MW, HW, CW	STRENGTH INDEX: R6, R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): R1, R2 30, R3 150, R4 300, R5 600, R6 1500	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64	61.9-66.3 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARENACEOUS LIMESTONE, (ST. LOUIS FORMATION)		410.30 / 64.50	7	100 %				J,U,SM,CL						
66									J,I,R,CL						
	66.3-72.7 ft. Slightly weathered, medium to thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Very stylolitic, numerous chert nodules, slightly porous/vuggy (vugs < 1 mm. in diameter)								J,ST,R,CL						
68									J,I,R						
70				8	100 %										
72									J,I,R,CL						
	402.10 / 72.70														
	72.7-78.9 ft. Slightly weathered, medium bedded, pinkish gray (5YR 8/1) to light brownish gray (5YR 6/1), coarse grained, medium strong, ARENACEOUS DOLOMITE, (ST. LOUIS FORMATION)								J,I,R,CL						
74									J,PL,SM,CL						
	74.0-74.3 ft. Crumbly texture, porous, limestone								J,I,SM						
	74.4 ft. Cross bedding		400.30 / 74.50						J,PL,SM,CL						
76	76.4-76.8 ft. Crystalline Limestone layer														
78				9	100 %										
	396.90 / 78.90														
	78.9-83.2 ft. Fresh, medium bedded, light brownish gray (5YR 6/1), medium grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic to 80.1 ft.								J,U,SM						
80									J,U,SM						
									J,I,R						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-101-SS

Sheet 8 of 9

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/23/95-2/25/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068472.9
AZIMUTH: 0

COLLAR ELEV: 474.8
E: 516822.9
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	78.9-83.2 ft. Fresh, medium bedded, light brownish gray (5YR 6/1), medium grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) 80.1-80.5 ft. Dolomite								J,PL,R,CL						
82				9	100 %										
	391.60														
	83.2-92.0 ft. Slightly weathered, thickly bedded, yellowish gray (5Y 7/2) to light olive gray (5Y 5/2), fine grained, medium strong, ARENACEOUS DOLOMITE, (ST. LOUIS FORMATION) Porous/vuggy (vugs <1 mm.)		83.20												
84			380.30												
			84.50												
86															
88															
	89.7-91.3 ft. Stylolitic 89.9-90.9 ft. Limestone (crystalline)			10	99%				J,PL,R						
90									J,PL,R						
									J,ST,SM						
									J,PL,R						
	382.80														
92	92.0-94.5 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)		92.00												
	93.9-94.1 ft. Thickly laminated														
94			380.30						J,PL,SM,CL						
	94.5-101.0 ft. Fresh, thickly bedded, pale yellowish brown (10YR 6/2), coarse to very coarse grained, strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)		94.50												
				11	100 %										
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-101-SS

Sheet 7 of 9

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2646
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/23/95-2/25/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068472.9
AZIMUTH: 0

COLLAR ELEV: 474.8
E: 516622.9
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (1 in = 5 FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR, MW, HW, CW)	STRENGTH INDEX (R6, R5, R4, R3, R2, R1)	POINT LOAD INDEX (psi) (R1 30, R2 150, R3 360, R4 600, R5 1500, R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
96	94.5-101.0 ft. Fresh, thickly bedded, pale yellowish brown (10YR 6/2), coarse to very coarse grained, strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)								J,PL,SM						
	96.3 ft. Calcite crystals								J,PL,SM,CL						
									J,PL,SM						
98	97.1-97.3 ft. Moderately weahtered zone, thickly laminated														
	98.8-99.0 ft. Chert nodules														
100				11	100 %				J,PL,SM						
	100.7 ft. Calcite crystals								J,I,R						
	101.0-119.9 ft. Fresh, medium bedded, light olive gray (5Y 6/1), micro-crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION)								J,I,SM						
102	101.7-103.0 ft. Stylolitic								J,PL,SM						
									J,PL,SM						
104	104.1-104.8 ft. Slightly weathered dolomite layer, porous/vuggy		370.30						J,PL,SM						
	104.8-106.2 ft. Stylolitic		104.50						J,I,R						
									J,I,R						
106	106.7-109.2 ft. Some arenaceous zones								J,PL,R						
	107.8-108.3 ft. Bioturbated zone, some calcite crystallization			12	100 %										
108									J,PL,SM						
110	110.1-111.5 ft. Slightly to moderately weathered dolomite, porous/vuggy								J,I,R						
112															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-101-SS

Sheet 8 of 9

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/23/95-2/25/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068472.9
AZIMUTH: 0

COLLAR ELEV: 474.8
E: 519822.9
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
Pl-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	ROD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
112	101.0-119.9 ft. Fresh, medium bedded, light olive gray (5Y 6/1), micro-crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION)												
	112.9-113.1 ft. Thinly laminated	361.20											
	113.1-113.2 ft. Bioturbated, calcite crystallization	113.60											
114	113.6-115.3 ft. Slightly to moderately weathered, dolomite, porous/vuggy	360.30	12	100 %				J,I,R,CL					
		359.50											
		115.30	114.50										
116	116.5 ft. Becoming fine to medium grained												
	116.8-117.7 ft. Some arenaceous laminae							J,PL,SM					
118	118.3-118.7 ft. Stylolitic							J,PL,SM					
		354.90	13	100 %									
120	119.9-121.7 ft. Slightly weathered, medium bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS DOLOMITE, (ST. LOUIS FORMATION) Porous/vuggy (<1 mm. in diameter)	119.90											
122	121.7-125.0 ft. Slightly weathered, medium bedded, light olive gray (5Y 5/1), fine grained, strong, DOLOMITE, (ST. LOUIS FORMATION)												
124								J,I,R,CL					
		350.30	124.50										
		349.80											
	125.0-128.3 ft. Fresh, thinly bedded, light olive gray (5Y 6/1) to olive gray (5Y 4/1), interbedded microcrystalline and m-c grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)	125.00											
126			14	99%				J,I,SM					
								J,PL,SM,CL (2)					
								J,ST,SM					
128													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-101-SS

Sheet 9 of 9

PROJECT: LAIDLAW/R-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/23/95-2/25/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1088472.9
AZIMUTH: 0

COLLAR ELEV: 474.8
E: 516822.9
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

D. SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	ROD 80 60 40 20	FRACTURES PER FOOT 2 4 6 8 10	DISCONTINUITY DATA: DIP wrt CORE AXIS 0 30 60 90	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX SW MW HW CW	STRENGTH INDEX R6 R5 R4 R3 R2 R1	POINT LOAD INDEX (psi) R1 R2 300 R3 150 R4 300 R5 600 R6 1500	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
128	ROCK TYPE														
	346.50								J,PL,SM,CL						
	128.3-130.5 ft. 128.30 Slightly weathered, medium bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARENACEOUS DOLOMITE, (ST. LOUIS FORMATION)														
	129.3-130.3 ft. *Porous/vuggy*								J,I,R						
130	344.30														
	130.5-140.5 ft. 130.50 Fresh, medium bedded, light olive gray (5Y 6/1), coarse grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)			14	99%				J,I,SM,CL						
132															
	133.5-133.9 ft. Stylolitic, bioturbated, calcite crystals 133.9-135.3 ft. Microcrystalline								J,PL,SM						
134			340.30												
			134.50												
	134.9-135.2 ft. Small pyrite crystals 135.0-135.1 ft. Large chert nodules														
	135.7-137.1 ft. Slightly weathered, some calcite crystals and stylolites								J,I,R,CL						
136									J,I,R,CL						
	137.1-138.9 ft. Stylolites 137.4-138.5 ft. Microcrystalline, arenaceous, thickly laminated			15	100%				J,I,SM						
138									J,PL,R						
140	334.30		334.30												
	End of Record of Drillhole at 140.5 ft. 140.50		140.50												
142															
144															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

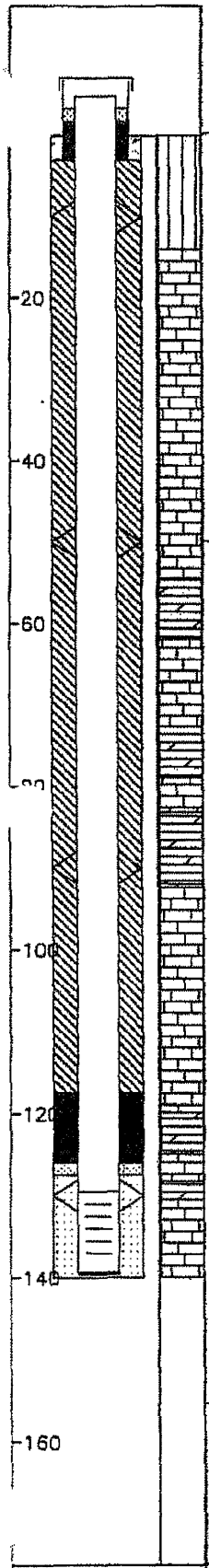
LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

Well No. PZ-101-SS

Boring No. X-Ref: PZ-101-SS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1068473 ft. Easting: 516623 ft.

Elevation Ground Level 474.9 ft. NGVD

Top of PVC Casing 476.68 ft. NGVD

Drilling Summary:

Total Depth 140.0 ft.

Borehole Diameter 10 1/4 in. (0.0–14.0 ft.) 5 7/8 in. (14.0–140.0 ft.)

Casing Stickup Height 1.79 ft.

Driller Layne-Western, St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger–None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	2/23/95	13:35	2/23/95	14:30
Schramm Rotary	3/6/95	8:15	3/6/95	9:45
Geophys.Logging:				
Casing:	3/6/95	9:50	3/6/95	10:10
Filter Placement:	3/6/95	10:20	3/6/95	10:50
Cementing:				
Development				
Bentonite Grout	3/6/95	11:30	3/6/95	12:30
Bentonite Seal	3/6/95	10:50	3/6/95	11:30

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.79	–	129.48	C1	476.68	–	345.41
129.48	–	139.28	S1	345.41	–	335.61
139.28	–	139.61	C2	335.61	–	335.28

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16–35 mesh Silica Sand, 127.5–140.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 126.0–127.5 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0–117.5 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 117.5–126.0 ft.

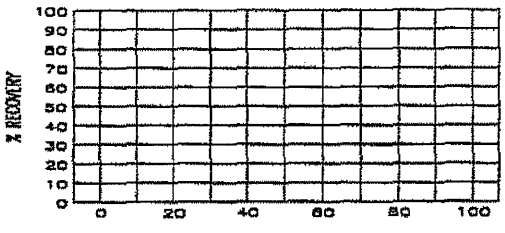
Concrete: 0.0–3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ101SS

601574

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 115086	CHECK NO.
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO.
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME	WELL NUMBER
LAIDLAW BRIDGETON SANITARY LANDFILL	PZ-101-S5

SITE ADDRESS	CITY	STATE	ZIP CODE
ST. CHARLES ROCK RD.	BRIDGETON	MO	63044

NAME	TELEPHONE
LAIDLAW WASTE SYSTEMS, INC.	314-291-3710

ADDRESS	CITY	STATE	ZIP CODE
1337 N. BROADWAY	ST. LOUIS	MO	63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL SHOW LOCATION IN SECTION PLAT

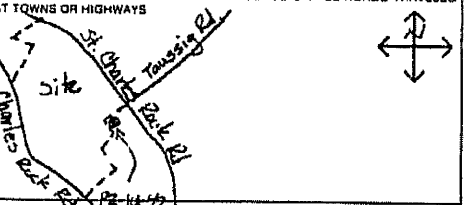
COUNTY St. Louis
ELEVATION 424.7
AREA NO

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN 47 N,RNG 5 E OR W

LAT. 38° 46' 06" LONG. 90° 16' 30"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

NOTE: Record the fraction of a foot in decimal, not in inches

Top of Riser Elevation: 427.4

LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)
PROTECTIVE CASING Type: STEEL Size: 8"x8"x5' Bore Hole Diameter: 10.25"
WEEP HOLE - Y / N (Circle one)

Ground Surface Elevation: 424.7 Ft

Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column	0-14 Silt
Depth to bottom of Protective Casing Seal: 3	14-55 Limestone
	55-62 Dolomite
	62-73 Limestone
	73-77 Dolomite
Depth to Base of Annular Seal: 117.5	77-84 Limestone
	84-93 Limestone
Depth to Base of Bentonite Seal: 122	93-120 Limestone
Depth to Base of Secondary Filter Pack: 127.5	120-125 Dolomite
Depth to Top of the Screen: 127.5	
	125-142 Limestone
Depth to Bottom of the Screen: 137.5	
Plug Back Total Depth:	
Original Total Depth: 142.5	

PROTECTIVE CASING SEAL Type: [X] Concrete [ ] Cement Slurry
RISER PIPE Length: 132 Diameter: 4 Type of Material: SCH80 PVC
BOREHOLE DIAMETER: 5 3/8 In.
ANNULAR SEAL Type: [X] Bentonite Slurry [ ] Cement Slurry [ ] Non Slurry Bentonite
BENTONITE SEAL Type: [X] Bentonite Slurry [ ] Non Slurry Bentonite Length of Seal: 8.5 FL
SECONDARY FILTER PACK Type: [X] Sand (Optional) [ ] Manufactured Grain Size: 5 KGHR Length: 1.5
PRIMARY FILTER PACK Type: [X] Sand [ ] Manufactured Grain Size: 16-35 Length: 12.5
WELL SCREEN Length: 10' Slot Size: 0.010" Type: SCH40 PVC
SUMP DETAILS Length: 0.3 FL Diameter: 4 In. Type: PVC
TYPE OF BACKFILL: GRAVEL

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO, INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO, INC.

TYPE OF INSTALLATION [X] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL ____ FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT

MEASURING POINT IS [ ] TOP OF RISER PIPE [ ] OTHER

DRILLING EQUIPMENT [X] AIR ROTARY [X] AUGER TYPE 6¼ H.S.A. [ ] REVERSE ROTARY [ ] OTHER

CENTRALIZERS USED [X] YES, AT 4 TOTAL [ ] STAINLESS STEEL [ ] OTHER [ ] NO

MULTIPLE CASED WELLS

SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED 3-06-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael J. Vogt

PERMIT NUMBER OWI256WIAA DATE 4-11-95

SIGNATURE (DRILLING CONTRACTOR) Michael J. Vogt

PERMIT NUMBER OWI256WIAA DATE 4-11-95

MO 780-1415 (2-94)

DISTRIBUTION: WHITE-DIVISION CANARY-MONITORING WELL CONTRACTOR PINK-OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MD
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1068087.67
DATUM EASTING: 516887.97 ELEVATION 482.1

DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger

SAMPLING METHOD:
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)

BORING NO. PZ-102-SS

SHEET 1 OF 3

					DRILLING START TIME	DRILLING FINISH TIME
WATER LEVEL						
TIME					15:21	17:33
DATE					DATE	DATE
CASING DEPTH					2/13/95	2/13/95

DRILL RIG CME 75 - TRUCK MOUNT
SURFACE CONDITIONS
ANGLE BEARING
SAMPLE HAMMER

DRILLING CONTR LAYNE-WESTERN
LOGGED BY J. MILLER
DATE 2/13/95 CHK'D BY W. HERST
JOB NO.: 943-2848
FILENAME: PZ102SS

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE		REMARKS
1	3 2 2 3	1.3'/2.0' (65%)			(0.0-2.6 Ft.) Firm, dark yellowish brown (10YR 4/2), homogenous, CLAYEY SILT, NR, damp, (CL-ML), (LOESS)	SP	1	2/13/95 - 15:21 Begin drilling PZ-102-SS Air monitoring 15:27 21% O2 0.0 ppm H2S 0% LEL 0.0 ppm PID
2	2 2 2 4	1.4'/2.0' (70%)						
					(479.5) 2.6			
3					(2.6-5.0 Ft.) Firm, moderate yellowish brown (10YR 5/4), homogenous, SILTY CLAY, NR, damp, (CL), (LOESS)	SP	2	
4								
		2.3'/2.0' (115%)						
					(477.1) 5.0	SH	3	
5					(5.0-13.0 Ft.) Firm, moderate yellowish brown (10YR 5/4), trace light gray (N7), homogenous, CLAYEY SILT, NR, damp, (CL-ML), (LOESS)			
6	1 2 3 4	1.6'/2.0' (80%)				SP	4	15:43 @ 6 Ft. 21.1% O2 0.0 ppm H2S 0% LEL 0.3 ppm PID
7								
8	1 3 3 5	1.9'/2.0' (95%)				SP	5	
9								
10		1.9'/2.0' (95%)				SH	6	15:49 @ 10 Ft. 21% O2 1.0 ppm H2S 0% LEL 0.3 ppm PID
11								
12	3 4 5 6	1.6'/2.0' (80%)						
					(469.1) 13.0	SP	7	
13					(13.0-15.0 Ft.) Compact, dark yellowish orange (10YR 6/6), homogenous, Fine SAND, trace Silt, NR, dry, (SP), (ALLUVIUM)			
14	5 5 7 7	1.5'/2.0' (75%)				SP	8	

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MO
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1068087.67
DATUM EASTING: 516887.97 ELEVATION 482.1

DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger					BORING NO. PZ-102-SS
					SHEET 2 OF 3
SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)					DRILLING
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)					START / FINISH
WATER LEVEL					TIME 15:21 / TIME 17:33
TIME					
DATE					DATE 2/13/95 / DATE 2/13/95
CASING DEPTH					

DRILL RIG CME 75 - TRUCK MOUNT
SURFACE CONDITIONS
ANGLE BEARING
SAMPLE HAMMER

DRILLING CONTR LAYNE-WESTERN
LOGGED BY J. MILLER
DATE 2/13/95 CHK'D BY W. HERST
JOB NO.: 943-2848
FILENAME: PZ102SS

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16	4 4 6 7	1.3' / 2.0' (65%)			(15.0-23.6 Ft.) Loose to compact, pale yellowish brown (10YR 6/2), homogenous, fine SAND, NR, dry, (SP), (ALLUVIUM)	SP (8)	16:03 @ 16 ft. 21.1% O2 1.0 ppm H2S 0% LEL 0.0 ppm PID
17						SP (9)	
18	4 4 5 5	1.4' / 2.0' (70%)				SP (10)	
19							
20	3 3 4 6	1.6' / 2.0' (80%)				SP (11)	
21							
22	6 5 4 8	1.5' / 2.0' (75%)				SP (12)	
23					(458.5) 23.6		
24	5 6 7 10	1.5' / 2.0' (75%)			(23.6-25.6 Ft.) Stiff, light gray (N7) to light brown (5YR 5/6), laminated CLAYEY SILT, trace fine Sand, some rootlets, NR, moist, (CL-ML), (ALLUVIUM)	SP (13)	16:20 @ 24 Ft. 21% O2 0.0 ppm H2S 0% LEL 0.0 ppm PID
25							
26	5 7 10 11	1.6' / 2.0' (80%)			(25.6-28.1 Ft.) Very stiff, medium gray (N5), stratified, CLAYEY SILT, some fine SAND, thin organic rootlet beds (<1 cm.), NR, moist, (CL-ML), (ALLUVIUM)	SP (14)	
27							
28	4 5 5 7	1.7' / 2.0' (85%)			(28.1-29.9 Ft.) Stiff, medium gray (N5), stratified, CLAYEY SILT and fine SAND, 1-15 cm. beds, NR, moist, (CL-ML), (ALLUVIUM)	SP (15)	16:40 @ 28 Ft. 21.1% O2 0.0 ppm H2S 0% LEL 0.0 ppm PID
29					(452.2) 29.9 (29.9-34.5 Ft.) Hard, light olive gray (5Y 6/1), fractured LIMESTONE, SR, (WEATHERED BEDROCK)		

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-102-SS
	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 3 OF 3
	WATER LEVEL / TIME / DATE / CASING DEPTH	DRILLING START TIME 15:21 DATE 2/13/95; FINISH TIME 17:33 DATE 2/13/95

NORTHING: 1068087.67
DATUM EASTING: 516887.97 ELEVATION 482.1

DRILL RIG CME 75 - TRUCK MOUNT
ANGLE BEARING
SAMPLE HAMMER
SURFACE CONDITIONS

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31	5 5 5 20	1.7'/2.0' (85%)			(29.9-34.5 ft.) Hard, light olive gray (5Y 6/1), fractured LIMESTONE, SR, (WEATHERED BEDROCK) @ 30.2 ft., wood fragments	SP (16)	
32							
33	13 23 55 31	1.1'/2.0' (55%)				SP (17)	
34					(447.6) 34.5		
35	12 18 21 18	0.5'/2.0' (25%)			(34.5-37.0 ft.) Hard, dark greenish gray (5GY 4/1), SILTY CLAY, trace to little fine sand, little fine gravel, NR, moist, (CL), (WEATHERED BEDROCK)	SP (18)	17:07 @ 35 ft. 21.3% O2 2.0 ppm H2S 0% LEL 0.0 ppm PID
36					(445.1) 37.0		
37					End of Soil Borehole Log at 37.0 ft. See PZ-102-SS Record of Drillhole for rock descriptions		
38							
39							
40							
41							
42							
43							
44							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER CHK'D BY W. HERST

DATE 2/13/95

JOB NO.: 943-2848

FILENAME: PZ102SS

RECORD OF DRILLHOLE PZ-102-SS

Sheet 1 of 4

PROJECT: LADLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/14/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1065087.7
AZIMUTH: 0

COLLAR ELEV: 482.1
E: 518887.9
INCLINATION: -90

SCALE (FEET)

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infil, CH-Chlorite, H-Healed, GRF-Gravel Filled

DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP WRT CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
0.0-37.0 ft. See Soil Borehole Log PZ-102-SS 37.0-37.8 ft. No samples collected		444.30												
444.30		37.80												
37.8-41.0 ft. Highly weathered, thickly bedded, dark yellowish orange (10YR 6/6), fine grained, extremely weak, SANDSTONE, (ST. LOUIS FORMATION)								J,PL,SM-GRF J,I,SM-CL J,PL,SM-CL (2) J,I,SM-GRF J,PL,SM-intact J,PL,SM-GRF						2/14/95 @ 8:09 Began coring Run 1
41.0-44.6 ft. Moderately weathered, dark yellowish orange (10YR 6/6), fine grained, weak, SANDSTONE, (ST. LOUIS FORMATION)			1	91%				J,PL,SM-intact J,I,SM J,I,SM J,I,SM (2) J,I,R (2)						Fractures in upper portion of Run 1, are mapped in highly weathered sandstone, very clayey, likely drilling induced
438.10		44.00						Core Loss						Core loss due to weak rock
44.6-59.6 ft. Slightly to moderately weathered, thickly bedded, light olive gray, micro-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)		437.50 44.60	2	70%				J,I,SM J,I,R-CL J,I,R-CL J,I,R-CL (2)						Fractures in Run 2, along contacts between lithologies of clay and limestone
435.10		47.00						Core Loss						
@ 47.0 ft. Solutioned, in-filled with unlithified sandy clay, in Run 2, approximately 50% competent rock		434.20 47.90	3	85%										

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-102-SS

Sheet 2 of 4

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/14/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1065087.7
AZIMUTH: 0

COLLAR ELEV: 482.1
E: 516887.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FT)	DESCRIPTION	ELEV	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48	44.6-59.6 ft. Slightly to moderately weathered, thickly bedded, light olive gray, micro-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)							J,I,R-CL					Core loss in Run 2 due to problem with barrel
								J,I,R-CL					
								J,PL,SM (2)					
								J,PL,SM					
								J,I,R					
50	48.8-49.0 ft. Glauconitic clay and limestone fragment infilled collapse zone, stylolitic							J,PL,SM					
								J,I,R					
								J,PL,R					
			3	85%				J,I,R					
								J,PL,SM-CL-intact					
								J,ST,R-Fe					
52	51.8-52.2 ft. Infilled zone 52.0-52.9 ft. Brecciated, collapsed, infilled with limestone fragments, sand and clay							J,PL,R-solutioned					
								Core Loss					Core loss due to fractures/lugging of bit, some rock recovered in this interval, but broken up
54		426.00											
		54.10						J,PL,R					
								J,PL,R-Fe					
								J,C,SM-CL-intact					
								J,PL,R					
								J,I,R-Fe					
								J,PL,R					
56								J,ST,R					
								J,I,R-CL					
								J,I,SM					
	56.9-56.9 ft. Collapse, infilling clay							J,PL,SM-CL					Numerous intact, very small, clay filled, irregular fractures 54.7-60.3 ft. Not mapped on graphic log
			4	100%				J,I,R					
	57.4-57.5 ft. Infilled fraction							J,I,R					
	57.6-59.8 ft.							J,I,R					
								J,PL,SM-Fe					
58	Solutioned, infilled with limestone fragments, glauconitic clay, sand							J,PL,SM					
								J,I,R					
								J,I,R					
								J,I,SM,CL					
								J,PL,R					
								J,PL,R-CL					
60	59.6-60.8 ft. Fresh to moderately weathered, thinly bedded, light olive gray (5Y 6/1), medium crystalline, extremely weak to medium strong, LIMESTONE, (ST. LOUIS FORMATION)	421.80						J,PL,SM-CL					
		60.30						J,I,R					
								J,I,R					
62	61.8-62.4 ft. Collapse filled with limestone fragments, clay and sand		5	98%				J,PL,R					
								J,C,VR					
								J,I,R					
64													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-102-SS

Sheet 3 of 4

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/14/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1088087.7
AZIMUTH: 0

COLLAR ELEV: 482.1
E: 516887.9
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64	59.6-60.8 ft. Fresh to moderately weathered, thinly bedded, light olive gray (5Y 6/1), medium crystalline, extremely weak to medium strong, LIMESTONE, (ST. LOUIS FORMATION)								J,PL,R						
66	64.0-65.4 ft. Collapse fraction infilled with clay, limestone fragments, sand			5	98%				J,I,R-SM						Numerous very small intact, clay and sand filled fractures 65.5-68.6 ft. Not mapped
									J,I,R						
	67.3-67.4 ft. Clay, sand and limestone fragment infilled fracture								J,I,R						
	67.9-68.0 ft. Clay and limestone framgent infilled fracture								J,I,R-CL and sand filled						
68									J,I,R-intact						
			413.50						J,I,R-CL						
			68.60						J,I,R-calcite filled						
									J,PL,R						
70	70.1-70.5 ft. Collapse infilled with limestone fragments, black clay, pyrite crystals, sand								J,I,R						
									J,C,SM						
									J,C,R						
	71.3-71.7 ft. Breccia filled zone, pyrite, limestone fragments, black clay infilling								J,I,R-Fe						
72	72.1-73.2 ft. Collapse zone			6	98%				J,I,R						
									J,I,R-CL (3)						Numerous small intact fractures not mapped 73.2-74.9 ft. Infilled clay, sand, limestone fragments
74									J,I,R (2)						
			407.20						J,I,R						
			74.90												
76									J,I,R-calcite						
				7	99%				J,I,R-calcite						
78															
									J,I,R-calcite						
80															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-102-SS

Sheet 4 of 4

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/14/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066087.7
AZIMUTH: 0

COLLAR ELEV: 482.1
E: 515687.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infil, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	ROCK TYPE 80.3-80.5 ft. Solutioned rock, infilled with limestone fragments, clay		401.30					90	J,I,R						
	80.8-82.3 ft. Moderately weathered, interbedded, light gray (N7), weak, SILTY CLAYSTONE, (ST. LOUIS FORMATION) Cherty		80.80 399.80					90	J,I,R						
82	82.3-84.0 ft. Slightly weathered, thinly bedded, light olive gray (5Y 6/1), finely crystalline, medium strong, ARENACEOUS LIMESTONE, (ST. LOUIS FORMATION)		82.30 398.10	7	99%			90	J,I,R						
								90	J,I,R						
								90	J,I,R						
84	84.0-84.4 ft. Slightly weathered, thinly bedded, very light gray (N8), fine grained, medium strong, SANDSTONE, (ST. LOUIS FORMATION)		84.00 397.70 84.40 397.50					90	J,PL,SM						
								90	J,PL,SM (2)						
	84.4-87.0 ft. Slightly weathered, thinly bedded, dark gray (N3) to medium gray (N5), weak, CLAYSTONE and SILTY CLAYSTONE, (ST. LOUIS FORMATION) Carbonaceous		84.60 395.10					90	J,PL,SM						
86								90	J,I,R						
								90	J,PL,SM (3)						
								90	J,PL,SM-CL						
	87.0-89.9 ft. Slightly weathered to fresh, light brownish gray (5YR 6/1), microcrystalline, medium strong, CRYSTALLINE LIME -STONE, (ST. LOUIS FORMATION) Upper 1 ft. and lower 3 in. bioturbated, pyrite mineralization		87.00	8	100 %			90	J,PL,SM-CL						
88								90	J,I,SM-CL						2/14/95 @ 14:25 Complete drilling
			392.20												
90	End of Record of Drillhole at 89.9 ft.		89.90 392.20												
92															
94															
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: O. MAHURIN

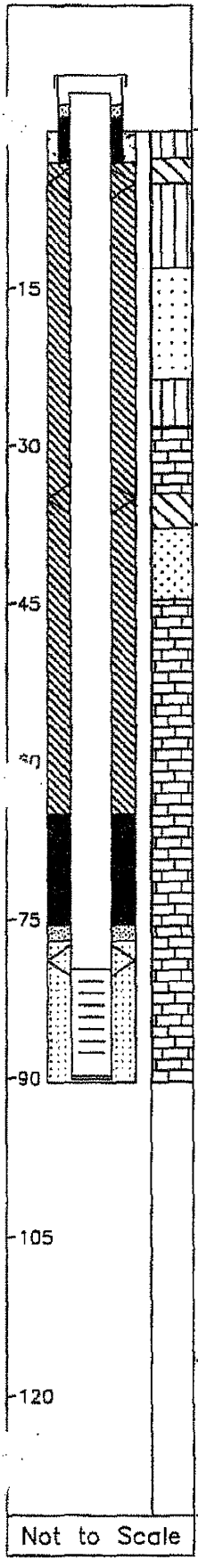
LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

Well No. PZ-102-SS

Boring No. X-Ref: PZ-102-SS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1068088 ft. Easting: 516888 ft.

Elevation Ground Level 482.1 ft. NGVD

Top of PVC Casing 483.85 ft. NGVD

Drilling Summary:

Total Depth 90.4 ft.

Borehole Diameter 10 1/4 in. (0.0-37.0 ft.) 5 7/8 in. (37.0-90.4 ft.)

Casing Stickup Height 1.80 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	2/13/95	15:21	2/13/95	14:25
Schramm Rotary	3/12/95	12:45	3/12/95	13:45
Geophys.Logging:				
Casing:	3/12/95	13:40	3/12/95	13:50
Filter Placement:	3/12/95	13:55	3/12/95	14:10
Cementing:				
Development				
Bentonite Grout	3/12/95	14:15	3/12/95	14:30
Bentonite Seal	3/12/95	14:30	3/12/95	15:30

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.80	-	79.70	C1	483.85	-	402.35
79.70	-	89.50	S1	402.35	-	392.55
89.50	-	90.83	C2	392.55	-	391.22
	-				-	
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 77.0-90.4 ft.

Filter Pack: Less than 50 mesh Silica Sand, 75.5-77.0 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-65.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 65.0-75.5 ft.

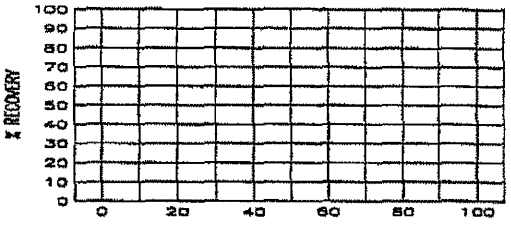
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ102SS

661574

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO. 115088	CHECK NO.
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO.
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME	WELL NUMBER
LAIDLAW BRIDGETON SANITARY LANDFILL	PZ-102-55

SITE ADDRESS	CITY	STATE	ZIP CODE
ST. CHARLES ROCK RD.	BRIDGETON	MO	63044

NAME	TELEPHONE
LAIDLAW WASTE SYSTEMS, INC.	314-341-3710

ADDRESS	CITY	STATE	ZIP CODE
1838 N. BROADWAY	ST. LOUIS	MO	63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

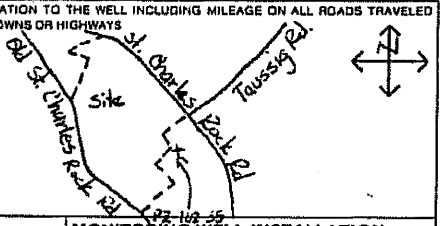
COUNTY ST. LOUIS
ELEVATION 482.0
AREA NO.

SMALLEST ¼ LARGEST ¼

SEC. ____ TWN. 47 N,RNG. 5 E OR W

LAT. 38° 46' 02" LONG. 90° 26' 27"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN Co., INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN Co., INC.

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT

MEASURING POINT IS
☐ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☒ AIR ROTARY ☒ AUGER TYPE 6¼ H.S.A.
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☒ YES, AT 3 TOTAL
☐ STAINLESS STEEL
☐ OTHER
☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
3-12-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Richard P. Vogt

PERMIT NUMBER	DATE
OO1256WIM	4-11-95

SIGNATURE (DRILLING CONTRACTOR) Richard P. Vogt

PERMIT NUMBER	DATE
OO1256WIM	4-11-95

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 484.6

LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)
PROTECTIVE CASING Type: STEEL Size: 8" x 5' x 5' Bore Hole Diameter: 10.25"
WEEP HOLE - Y / N (Circle one)

Ground Surface Elevation: 482.0 Ft

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
		0-2.5 Silt
Depth to bottom of Protective Casing Seal:	3	2.5-5 clay
		5-13 Silt
		13-24 Sandstone
		24-28 Silt
Depth to Base of Annular Seal:	65.0	28-35 Limestone
		35-38 clay
Depth to Base of Bentonite Seal:	75.5	
Depth to Base of Secondary Filter Pack:	77.0	38-45 Limestone
Depth to Top of the Screen:	79.75	
		45-90 Limestone
Depth to Bottom of the Screen:	89.75	
Plug Back Total Depth:		
Original Total Depth:	90.4	

PROTECTIVE CASING SEAL Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE Length: 72.35' Diameter: 2 Type of Material: SCHED PVC

BOREHOLE DIAMETER: 5⅞ in.

ANNULAR SEAL Type: ☒ Bentonite Slurry ☐ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite Length of Seal: 10.5 Ft.

SECONDARY FILTER PACK (Optional) Type: ☒ Sand ☐ Manufactured Grain Size: SUGAR Length: 1.5'

PRIMARY FILTER PACK Type: ☒ Sand ☐ Manufactured Grain Size: 16-35 Length: 13.4'

WELL SCREEN Length: 10' Slot Size: 0.010" Type: SCH 30 PVC

SUMP DETAILS Length: 0.3 Ft. Diameter: 2 In. Type: PVC

TYPE OF BACKFILL: SAND

MO 780-1415 (2-94) DISTRIBUTION: WHITE:DIVISION CANARY:MONITORING WELL CONTRACTOR PINK:OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	LAIDLAW/OU2 RI-FS/MD WEST LAKE LANDFILL OPERABLE UNIT 2
DRILLING METHOD:	4.25 inch I.D. Hollow Stem Auger
SAMPLING METHOD:	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)
BORING NO.	PZ-102R-SS
SHEET	1 OF 3
DRILLING START / FINISH	
WATER LEVEL / TIME / DATE / CASING DEPTH	
TIME (START)	8:30
TIME (FINISH)	10:45
DATE (START)	6/15/95
DATE (FINISH)	6/15/95
NORTHING: 1068131.86 DATUM EASTING: 516658.81 ELEVATION 484.5	
DRILL RIG	CME 75 - TRUCK MOUNT
SURFACE CONDITIONS	Flat, grass covered area
ANGLE / BEARING	
SAMPLE HAMMER	

DRILLING CONTR LAYNE-WESTERN

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	5 5 5	1.5'/2.0' (75%)			(0.0-6.0 ft.) Firm, dark yellowish brown (10YR 4/2), CLAYEY SILT, trace organics (fine roots), NR, damp, (CL-ML), (TOPSOIL)	SP ①	
2	4 5 5	1.8'/2.0' (90%)					
3						SP ②	
4	3 4 5	1.8'/2.0' (90%)			@ 4.0 ft., color changes to moderate yellowish brown (10YR 5/4)		
5						SP ③	
6	3 4 5	1.5'/2.0' (75%)			(478.5) 6.0 (6.0-14.0 ft.) Loose, mottled, moderate yellowish brown (10YR 5/4) to pale yellowish brown (10YR 6/2), SILT, NR, damp, (ML), (LOESS)		
7						SP ④	
8	5 5 5	1.4'/2.0' (70%)					
9						SP ⑤	
10	4 5 6	1.5'/2.0' (75%)			@ 10.0 ft., Silt becomes compact		
11	9					SP ⑥	
12	3 8 8	1.8'/2.0' (90%)					
13	11					SP ⑦	
14	6 8 8	2.0'/2.0' (100%)			(14.0-17.8 ft.) Compact, light olive gray (5Y 6/1), SILT, trace iron staining, NR, damp, (ML), (LOESS)	SP ⑧	

LOGGED BY B. TILTON

DATE 7/14/95 CHK'D BY W. HEAST

JOB NO.: 943-2848

FILENAME: PZ102RSS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-102R-SS
	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 2 OF 3
	WATER LEVEL / TIME / DATE / CASING DEPTH	DRILLING START TIME 8:30 DATE 6/15/95; FINISH TIME 10:45 DATE 6/15/95
DATUM NORTHING: 1068131.86 EASTING: 516858.81 ELEVATION 484.5		
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS Flat, grass covered area	
ANGLE BEARING		
SAMPLE HAMMER		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16	3 4 5 8	1.8'/2.0' (90%)			(14.0-17.8 ft.) Compact, light olive gray (5Y 6/1), SILT, trace iron staining, NR, damp, (ML), (LOESS)	SP (8)	
17					From 17.0-17.8 ft., Silt becomes wet (466.7) 17.8	SP (9)	
18	9 9 6 10	1.6'/2.0' (80%)			(17.8-22.7 ft.) Compact, pale yellowish brown (10YR 6/2), fine SAND, trace Silt, trace iron oxide staining, NR, dry, (SP), (ALLUVIUM)	SP (10)	
19							
20	4 6 7 9	1.5'/2.0' (75%)				SP (11)	
21							
22	4 4 8 6	1.8'/2.0' (90%)			(461.8) 22.7	SP (12)	
23					(22.7-24.0 ft.) Compact, pale yellowish brown (10YR 6/2), fine SANDY SILT, NR, damp, (ML), (LOESS)		
24	5 6 6 6	1.6'/2.0' (80%)			(24.0-28.0 ft.) Compact, mottled moderate yellowish brown (10YR 5/4) to light olive gray (5Y 6/1), SILT, some iron oxide staining, NR, damp, (ML), (LOESS)	SP (13)	
25							
26	5 3 5 8	1.8'/2.0' (90%)			@ 26.0 ft., color changes to olive gray (5Y 4/1) and Silt becomes moist	SP (14)	
27					(456.5) 28.0		
28	4 6 10 10	2.0'/2.0' (100%)			(28.0-30.8 ft.) Stiff, olive gray (5Y 4/1) CLAYEY SILT, NR, moist, (CL-ML), (LOESS)	SP (15)	
29					@ 29.6 ft., thin silty fine sand seam, damp (<1 in. thick)		

DRILLING CONTR LAYNE-WESTERN

LOGGED BY B. TILTON

DATE 7/14/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ102RSS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MD
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1068131.86
DATUM EASTING: 516858.81 ELEVATION 484.5

DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger

SAMPLING METHOD:
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)

					DRILLING START	DRILLING FINISH
WATER LEVEL						
TIME					9:30	10:45
DATE					6/15/95	6/15/95
CASING DEPTH						

BORING NO. PZ-102R-SS

SHEET 3 OF 3

DRILL RIG CME 75 - TRUCK MOUNT

SURFACE CONDITIONS Flat, grass covered area

ANGLE BEARING

SAMPLE HAMMER

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31	5 5 9 14	1.8' 2.0' (90%)			(28.0-30.8 Ft.) Stiff, olive gray (5Y 4/1) CLAYEY SILT, NR, moist, (CL-ML), (LOESS) (453.7) 30.8 (30.8-32.0 Ft.) Compact, olive gray (5Y 4/1), SILT, NR, moist, (ML), (LOESS) (452.5) 32.0	SP (16)	
33	47 44 26 27	1.2' 2.0' (60%)			(32.0-35.0 Ft.) Very dense, light olive gray (5Y 6/1), fine GRAVEL and SILTY f-c SAND, trace pieces of lignite, NR, wet, (GP), (WEATHERED BEDROCK)	SP (17)	@ 32.0 ft, first water encountered overlying bedrock
34	16 50/2"	0.4' 1.0' (40%)			(449.5) 35.0	SP (18)	
35					End of Soil Borehole Log at 35.0 Ft. See PZ-102R-SS Record of Drillhole for rock descriptions		
36							
37							
38							
39							
40							
41							
42							
43							
44							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY B. TILTON CHK'D BY W. HERST

DATE 7/14/95

JOB NO.: 943-2848

FILENAME: PZ102RSS

RECORD OF DRILLHOLE PZ-102R-SS

Sheet 1 of 4

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/15/95 - 6/16/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068087.67
AZIMUTH: 0

COLLAR ELEV: 482.1
E: 516887.97
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP WT CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR MW HW CW	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32	0.0-35.0 ft. See Soil Borehole Log PZ-102R-SS														
34	447.10		447.10												
36	35.0-37.0 ft. Highly weathered, thinly bedded, light olive gray (5Y 6/1), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic		35.00	1	100 %										6/15/95 @ 11:00 Began coring Highly broken rock due to weathering and drilling
			445.90												
	37.0-55.8 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)		36.20						J,I,R (6)						
38									J,I,R (6)						
				2	97%				J,PL,SM						
									J,I,R (3)						
									J,I,R (2)						
			442.60						J,I,R,CL (2)						6/15/95 @ 11:50 End Run 2
40			39.50						B,I,R (2)						
									J,I,R,CL (2)						
									J,I,R (4)						
42									J,I,R						
									J,I,R,CL						
									J,I,R (4)						
									J,I,R (3)						
				3	94%										
44									J,I,R (5)						
									J,I,R,CL						
									J,I,R (2)						
									J,I,R,CL (3) J,PL,SM						
46									J,I,R (4)						
									J,I,R,CL (4)						
									J,I,R (2)						
48									J,I,R,CL (3)						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-102R-SS

Sheet 2 of 4

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/13/95 - 6/16/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068087.67
AZIMUTH: 0

COLLAR ELEV: 482.1
E: 516887.97
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
FL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infil, CH-Chlorite, H-Healed, GRF-Gravel Filled

Depth Scale (Feet)	Description	Graphic Log	Elev / Depth (Ft)	Run No.	Core Recovery	RQD	Fractures Per Foot	Discontinuity Data: Dip w/t Core Axis	Discontinuity Data: Type and Surface Description	Graphic Log	Weathering Index	Strength Index	Point Load Index (psi)	Test Orientation	Notes, Water Levels, Instrumentation
48	37.0-55.8 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)			3	94%				B,I,R,CL						
			433.20						B,I,SM,CL						6/15/95 @ 13:45 End Run 3 Core loss possibly due to wash out of clay seams in joints
			48.90												
			432.80												
50			49.50						B,I,R (2)						
									J,I,R-intact						
									J,I,SM						
									B,PL,SM						
									J,I,R (2)						
52									J,I,R						
				4	100 %				B,I,R						
									B,I,R						
54									J,I,R						
									J,I,R (2)						
			428.30												
56	55.8-61.3 ft. Fresh, medium bedded, light olive gray (5Y 6/1), medium crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic 55.8-56.1 ft. Chert layer		55.80						B,I,R						6/15/95 @ 15:00 End Run 3
				5	100 %				B,I,R						
	57.8-58.0 ft. Hard, greenish gray (5G 6/1), Siltstone layer								B,I,R (2)						
									J,I,R-intact						
									J,I,R						
			422.60						J,I,R-intact						6/15/95 @ 16:15 End Run 5 Stop drilling for the day 6/16/95 @ 7:15 Began Run 6
60			58.50												
									B,PL,SM,CL (3)						
	61.3-70.4 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), finely crystalline, medium strong, FOSSILIFEROUS LIMESTONE, (ST. LOUIS FORMATION) Stylolitic			6	100 %				B,I,R (3) J,PL,SM,Fe						
62									J,PL,SM (2)						
64															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: C. MAHURIN

LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-102R-SS

Sheet 3 of 4

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 9/15/95 - 9/16/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068067.67
AZIMUTH: 0

COLLAR ELEV: 482.1
E: 518887.97
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel-Filled

SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX (SW, FR, MW, HW, CW)	STRENGTH INDEX (R6, R5, R4, R3, R2, R1)	POINT LOAD INDEX (psi) (R1 30, R2 150, R3 300, R4 600, R5 1500, R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64	61.3-70.4 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), finely crystalline, medium strong, FOSSILIFEROUS LIMESTONE, (ST. LOUIS FORMATION) Stylolitic								B,PL,SM						
66				6	100 %				B,PL,SM,CL						
68									J,PL,SM						
			412.60						B,PL,SM (2)						6/16/95 @ 8:25 End Run 6
70	70.4-75.2 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), finely crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic		69.50						B,I,SM						
									B,I,R						
72				7	100 %										
									B,I,SM						
74	@ 74.2 ft. Stiff, dark greenish gray (5G 4/1), clay seam, (~1/2 in. thick) 75.2-76.0 ft. Fresh, thinly bedded, medium bluish gray (5B 5/1), micro-crystalline, very strong, Silicified Limestone, (ST. LOUIS FORMATION) 406.10								J,PL,SM,CL						
			406.90						B,PL,SM						6/16/95 @ 9:15 End Run 7
			75.20						J,I,R						
76	76.0-77.4 ft. 76.00 Fresh, medium bedded, brownish gray (5YR 4/1), microcrystalline, strong, DOLOMITE, (ST. LOUIS FORMATION) Moderately porous, (open vugs <1 mm.) 404.70								B,I,SM						
	77.4-88.6 ft. 77.40 Fresh, very thinly bedded, light olive gray (5Y 6/1), very fine crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Some very thinly laminated shaley partings								J,PL,SM						
				8	98%				J,PL,SM						
78									J,I,R						
									J,I,R						
80															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-102R-SS

Sheet 4 of 4

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/15/95 - 6/16/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1059087.67
AZIMUTH: 0

COLLAR ELEV: 482.1
E: 516887.97
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR, HW, MW, DW	STRENGTH INDEX: R6, R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): RT, R2, R3, R4, R5, R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	77.4-88.6 ft. Fresh, very thinly bedded, light olive gray (5Y 6/1), very fine crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Some very thinly laminated shaley partings								B,PL,SM						
82				8	98%				J,I,R B,I,R J,I,R						
84			398.10 84.00												6/16/95 @ 12:00 End Run 8
86									J,I,SM B,I,SM J,I,R						
88				9	100 %				J,I,R (2)						
			393.50												
	88.6-90.0 ft. 88.60 Fresh, medium bedded, medium dark gray (N4), very weak, CLAYSTONE, (ST. LOUIS FORMATION)		392.10												6/16/95 @ 15:00 Completed drilling
90	End of Record of Drillhole at 90.0 ft. 90.00		90.00												
92															
94															
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

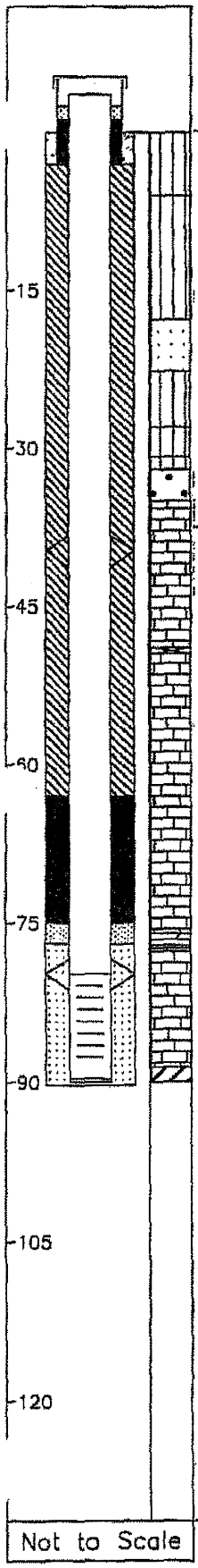
LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 7/12/95

Golder Associates

Well No. PZ-102R-SS

Boring No. X-Ref: PZ-102R-SS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1068132 ft. Easting: 516859 ft.

Elevation Ground Level 484.5 ft. NGVD

Top of PVC Casing 485.62 ft. NGVD

Drilling Summary:

Total Depth 90.3 ft.

Borehole Diameter 10 1/4" (0.0-35.0') 5 7/8" (35.0-90.3')

Casing Stickup Height 1.12 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4" ID Hollow Stem Auger Bit, NX Core, 5 7/8" Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8" Square Steel, by 5' long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	6/15/95	8:30	6/16/95	13:00
Schramm Rotary	6/18/95	13:00	6/18/95	13:45
Geophys.Logging:				
Casing:				
Filter Placement:	6/18/95	13:45	6/18/95	14:30
Cementing:				
Development				
Bentonite Grout	6/18/95	14:50	6/18/95	15:15
Bentonite Seal	6/18/95	14:35	6/18/95	14:55

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.12	-	79.83	C1	485.62	-	404.67
79.83	-	89.63	S1	404.67	-	394.87
89.63	-	89.96	C2	394.87	-	394.54

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 77.0-90.3 ft.

Filter Pack: Less than 50 mesh Silica Sand, 75.0-77.0 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-63.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 63.0-75.0 ft.

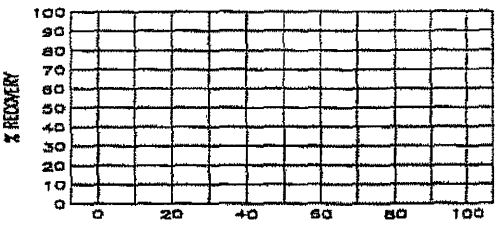
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ102RSS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122513	CHECK NO
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO.
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME	WELL NUMBER
LANDFILL BRIDGETON SANITARY LANDFILL	PZ-102-R-SS

SITE ADDRESS	CITY	STATE	ZIP CODE
ST. CHARLES ROCK RD.	BRIDGETON	MO	63044

NAME	TELEPHONE
LANDFILL WASTE SYSTEMS, INC.	314-291-3710

ADDRESS	CITY	STATE	ZIP CODE
1938 N. BROADWAY	ST. LOUIS	MO	63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL SHOW LOCATION IN SECTION PLAT

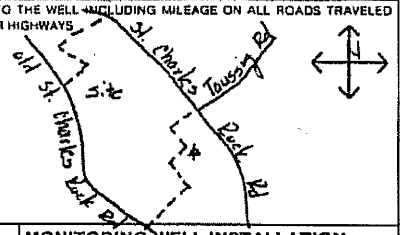
COUNTY ST. LOUIS
ELEVATION 484.46
AREA NO.

SMALLEST ¼ ____ ¼ ____ ¼ ____ LARGEST ¼

SEC. ____ TWN. 47 N.RNG. 5 E OR W

LAT. 38° 46' 01" LONG. 90° 26' 27"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN Co., Inc.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN Co., Inc.

TYPE OF INSTALLATION ☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL ____ FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT 485.58

MEASURING POINT IS ☒ TOP OF RISER PIPE ☐ OTHER

DRILLING EQUIPMENT ☒ AIR ROTARY ☒ AUGER TYPE 6¼ H.S.A. ☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED ☒ YES, AT 2 TOTAL ☒ STAINLESS STEEL ☐ OTHER ☐ NO

MULTIPLE CASED WELLS

SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED 6-18-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

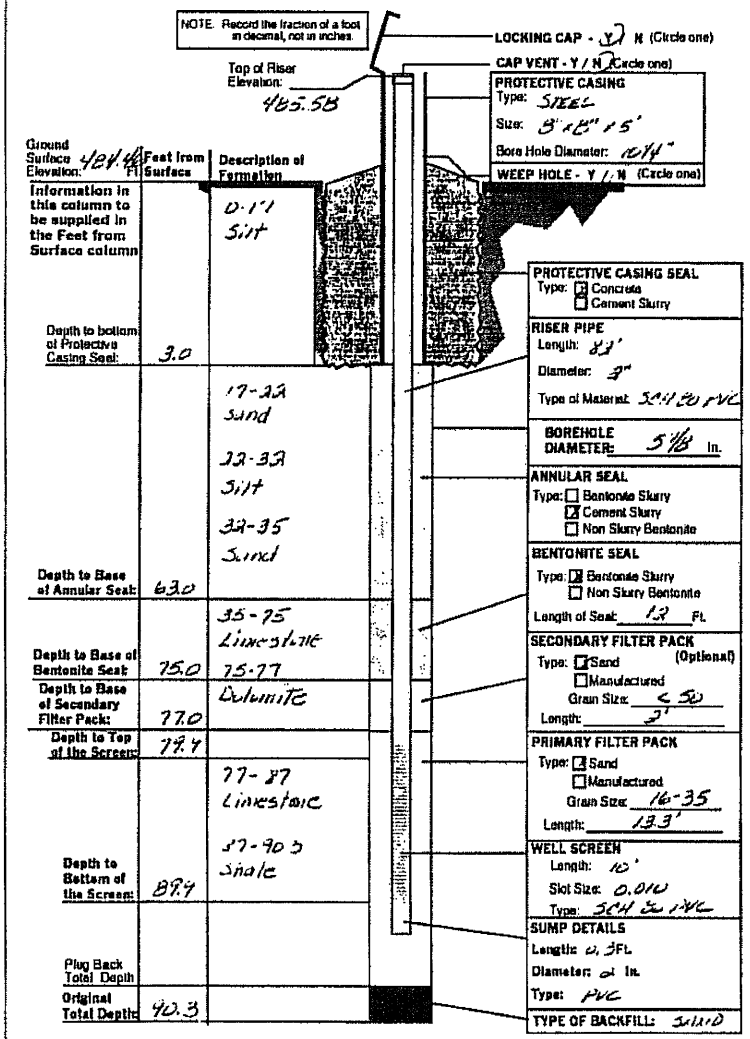
SIGNATURE (MONITORING WELL CONTRACTOR) Michael T. Vogt

PERMIT NUMBER	DATE
001356 WIM	7-07-95

SIGNATURE (DRILLING CONTRACTOR) Michael T. Vogt

PERMIT NUMBER	DATE
001356 WIM	7-07-95

NOTE: Record the fraction of a foot in decimal, not in inches



DISTRIBUTION: WHITE DIVISION CANARY MONITORING WELL CONTRACTOR PINK/OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MO
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1067660.40
DATUM EASTING: 516723.54 ELEVATION 477.8

DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger

SAMPLING METHOD:
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

BORING NO. PZ-103-SS

SHEET 1 OF 4

DRILLING START	DRILLING FINISH
TIME 07:30	TIME 12:00
DATE 2/21/95	DATE 2/23/95

DRILL RIG CME 75 - TRUCK MOUNT

SURFACE CONDITIONS

ANGLE BEARING

SAMPLE HAMMER

DRILLING CONTR. LAYNE-WESTERN

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1					(0.0-2.0 ft.) No samples collected due to coarse gravel placed for temporary road		
(475.8) 2.0							
2	1 3 4	1.6' / 2.0' (80%)			(2.0-16.0 ft.) Firm, dusky yellowish brown (10YR 2/2), CLAYEY SILT, trace fine Sand, NR, damp, (CL-ML), (LOESS)	SP ②	
3							
4	2 4 4 4	1.3' / 2.0' (65%)			@ 4.0 ft., color changes to pale yellowish brown (10YR 6/2) with moderate amount of iron oxide staining	SP ③	
5							
6	1 2 3 4	1.3' / 2.0' (65%)				SP ④	
7							
8	1 3 3 4	1.8' / 2.0' (90%)				SP ⑤	
9							
10	3 5 5 6	2.0' / 2.0' (100%)			@ 10.0 ft., intermittent moist zones (<2 inches thick)	SP ⑥	
11							
12	1 2 3 3	1.7' / 2.0' (85%)			Below 12.0 ft., increase in iron oxide staining (~50%)	SP ⑦	
13							
14		1.8' / 2.0' (90%)				SH ⑧	

LOGGED BY B. TILTON

DATE 2/21/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ103SS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MO
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1067660.40
DATUM EASTING: 516723.54 ELEVATION 477.8

DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger

SAMPLING METHOD:
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)

WATER LEVEL					
TIME					
DATE					
CASING DEPTH					

BORING NO. PZ-103-SS

SHEET 2 OF 4

DRILLING

START	FINISH
TIME 07:30	TIME 12:00
DATE 2/21/95	DATE 2/23/95

DRILL RIG CME 75 - TRUCK MOUNT

SURFACE CONDITIONS

ANGLE BEARING

SAMPLE HAMMER

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16					(2.0-16.0 Ft.) Firm, dusky yellowish brown (10YR 2/2), CLAYEY SILT, trace fine Sand, NR, damp, (CL-ML), (LOESS) (461.8) 16.0	SH 8	
16	7 11 10 11	1.3' 2.0' (65%)			(16.0-20.0 Ft.) Loose to compact yellowish orange (10YR 6/6), SILTY Fine SAND, NR, damp, (SM), (ALLUVIAL)	SP 9	
18	1 4 3 8	1.1' 2.0' (55%)			@ 18.0 ft., silty sand becomes moist	SP 10	
20					(457.8) 20.0		
20	2 6 10 10	2.0' 2.0' (100%)			(20.0-22.0 Ft.) Stiff to very stiff, pale yellowish brown (10YR 6/2) to moderate yellowish brown (10YR 5/4) CLAYEY SILT with silty fine sand layers (<2 inches), WR, moist, (CL-ML), (ALLUVIUM)	SP 11	
22	1 3 6 7	1.1' 2.0' (55%)			(22.0-28.0 Ft.) Stiff, medium dark gray (N4), CLAYEY SILT, some thin silty fine sand zones (<1 inch), SR, damp to moist, (CL-ML), (ALLUVIUM)	SP 12	
24		0.4' 2.0' (20%)				SH 13	
26	15 47 50/5"	0.9' 2.0' (45%)			@ 26.0-27.5 Ft., limestone boulder or layer encountered, first water identified in borehole	SP 14	Wet zone appears to be isolated
28	2 6 7 10	1.4' 2.0' (70%)			(28.0-32.0 Ft.) Stiff, greenish gray (5G 6/1) CLAYEY SILT, trace to little Fine Sand, NR, damp, (CL-ML), (ALLUVIUM)	SP 15	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY B. TILTON

DATE 2/21/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ103SS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-103-SS
	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 3 OF 4
	WATER LEVEL / TIME / DATE / CASING DEPTH	DRILLING START TIME 07:30 DATE 2/21/95; FINISH TIME 12:00 DATE 2/23/95
DATUM NORTHING: 1067660.40 EASTING: 516723.54 ELEVATION 477.8		
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE BEARING		
SAMPLE HAMMER		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31	2 4 7 9	1.5' 2.0' (75%)			(28.0-32.0 ft.) Stiff, greenish gray (5G 6/1) CLAYEY SILT, trace to little fine Sand, NR, damp, (CL-ML), (ALLUVIUM) @ 31.6 ft., moderate reddish brown (10R 4/6) CLAYEY medium SAND layer (~1/2 inch) (445.8) 32.0	SP (16)	
32	2 4 5 11	1.6' 2.0' (80%)			(32.0-47.5 ft.) Stiff to very stiff, pale yellowish green (10G 7/2) SILTY CLAY, trace to little medium Sand, NR, damp, (CL) @ 33.4-33.8 ft., clayey medium grained sand layer, damp, (SC)	SP (17)	
34	2 7 8 11	1.8' 2.0' (90%)				SP (18)	
36	1 3 7 11	1.5' 2.0' (75%)			@ 36.0 ft., color varies from very pale orange (10R 8/2) to moderate yellowish brown (10R 5/4) to pale green (5G 7/2), trace fine gravel	SP (19)	
38	3 4 6 15	2.0' 2.0' (100%)				SP (20)	
40	3 5 20 11	2.0' 2.0' (100%)				SP (21)	
42	9 19 50/5"	1.0' 2.0' (50%)			@ 43.0 ft., extremely weathered limestone boulder or layer encountered	SP (22)	
44	3 36 24 50/2"	0.5' 2.0' (25%)				SP (23)	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY B. FILTON

DATE 2/21/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ103SS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MO
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1067660.40
DATUM EASTING: 516723.54 ELEVATION 477.8

DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger

SAMPLING METHOD:
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)

					DRILLING START	DRILLING FINISH
WATER LEVEL					TIME	TIME
TIME					07:30	12:00
DATE					DATE	DATE
CASING DEPTH					2/21/95	2/23/95

BORING NO. PZ-103-SS

SHEET 4 OF 4

DRILL RIG CME 75 - TRUCK MOUNT

SURFACE CONDITIONS

ANGLE BEARING

SAMPLE HAMMER

DRILLING CONTR LAYNE-WESTERN

LOGGED BY B. TILTON

DATE 2/21/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ103SS

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL		SAMPLER TYPE	REMARKS
46	4 6 8 50/3"	2.0" 2.0" (100%)			(32.0-47.5 Ft.) Stiff to very stiff, pale yellowish green (10G 7/2) SILTY CLAY, trace to little medium Sand, NR, damp, (CL) @ 45.5 ft., weathered limestone boulder or layer encountered @ 47.1 Ft., thin silty fine sand layer (~1 inch), moist		SP (23)	
47						(430.3) 47.5	SP (24)	
48	23 5 2 48	1.8" 2.0" (90%)			(47.5-48.0 Ft.) Hard, dark yellowish orange (10R 6/6), weathered SILTY CLAYSTONE, NR, damp, (CH) @ 48.0 Ft., weathered limestone boulder encountered (48.0-50.0 Ft.) Hard, moderate yellowish brown (10YR 5/4) SILTY CLAY, some weathered limestone pieces (<1 inch), WR-SR, moist, (CL)	(429.8) 48.0 (427.8) 50.0	SP (25)	
49								
50					End of Soil Borehole Log at 50.0 Ft. See PZ-103-SS Record of Drillhole for rock descriptions			
51								
52								
53								
54								
55								
56								
57								
58								
59								

RECORD OF DRILLHOLE PZ-103-SS

Sheet 1 of 7

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/21/95-2/22/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1087660.4
AZIMUTH: 0

COLLAR ELEV: 477.8
E: 516723.5
INCLINATION: -90

J-Joint, P-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	ROD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 18)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30, R2 150, R3 300, R4 600, R5 1500, R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48	0.0-50.0 ft. See Soil Borehole Log PZ-103-SS 50.0-51.5 ft. No samples collected														
50															
	426.30		426.30												
	51.5-62.7 ft. 51.50 Moderately weathered, medium bedded, yellowish gray (5Y 8/1), medium crystalline, weak to medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolites with iron oxide staining		51.50						Core Loss						
52	53.4-53.9 ft. Pinkish gray (5YR 8/1), siltstone layer								J,I,R						Core loss possibly from 51.5-52.7 ft. in highly fractured rock and clay zones on top of bedrock
54	54.7 ft. Oxidized pyrite nodules (<3 mm.)			1	84%										
56	56.4 ft. Vertical calcite filled vein (4 in.) 57.0 ft. Calcite filled vein at 90 degrees (1 in. thick)														
58									J,I,R						
			418.80						J,I,R,CL						
			59.00												59.0-60.0 ft. Five breaks that had been spun
60									J,I,R (2)						
				2	69%				J,PL,R						
62	62.7-62.9 ft. Extremely weak, greenish gray (5GY 6/1), glauconite clay layer 414.90														
	62.9-71.0 ft. 62.90 Highly weathered, medium bedded, moderate yellowish brown (10YR 5/4), fine grained, weak, ARGILLACEOUS SANDSTONE, (ST. LOUIS FORMATION)														Core loss in soft formation or possible open void
64									Core Loss						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: W. HERST
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-103-SS

Sheet 2 of 7

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/21/95-2/22/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067560.4
AZIMUTH: 0

COLLAR ELEV: 477.8
E: 516723.5
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64	62.9-71.0 ft. Highly weathered, medium bedded, moderate yellowish brown (10YR 5/4), fine grained, weak, ARGILLACEOUS SANDSTONE, (ST. LOUIS FORMATION)							Core Loss					
		411.80 / 66.00											
66	66.0-66.5 ft. Highly weathered, dark yellowish orange (10YR 6/6) extremely weak, SILTSTONE layer	411.30 / 66.50	2	69%				Core Loss					Core loss in soft formation or possible open void
68		408.80 / 69.00											
70	69.6 ft. Very soft, dark yellowish orange (10YR 6/6), clay layer (2 in. thick)		3	100%									
		406.80 / 71.00											
	71.0-71.7 ft. Slightly weathered, medium bedded, dark greenish gray (5GY 4/1), very fine crystalline, medium strong, DOLOMITIC LIMESTONE, moderate porosity, (ST. LOUIS FORMATION)	406.10 / 71.70						J,PL,SM J,ST,SM J,PL,SM					Run 3 stopped short, bit plugged off in claystones
72		405.80 / 72.00											2/21/95 @ 16:00 Stopped drilling in Run 3
	71.7-78.7 ft. Highly weathered, thinly bedded, medium dark gray (N4) to grayish black (N2), very weak, CLAYEY SILTSTONE, (ST. LOUIS FORMATION) Some disseminated pyrite, some thin layers of claystone (<3 in.)							B,I,R B,I,R					2/22/95 @ 7:30 Began Run 4
74								J,I,R J,PL,SM,CL J,PL,SM					
		402.20 / 75.60	4	100%									
	75.6-76.3 ft. Brownish gray (5YR 4/1), argillaceous LIMESTONE layer	401.50 / 76.30						J,PL,SM J,PL,SM-Intact					
78								J,I,R (2) B,I,R					
	78.7-87.5 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic	399.10 / 78.70						B,I,R					
		398.60 / 79.20											
			5	100%									
80		397.60 / 80.00											

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: W. HERST
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-103-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/21/95-2/22/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067660.4
AZIMUTH: 0

COLLAR ELEV: 477.8
E: 518723.5
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	397.60 / 80.00														
	80.0-81.2 ft. Thinly laminated, olive gray (5Y 4/1), CLAYEY SILTSTONE layer														
	398.60 / 81.20														
	78.7-87.5 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic														
82				5	100 %				J,PL,SM,CL (2)						
84															
86			391.80 / 86.00												9:45 Stopped Run 5 short, bit plugged off
									B,PL,SM						
	87.3-87.5 ft. Soft, greenish gray (5GY 6/1), glauconite Clay layer								J,I,R,CL						
88	87.5-103.8 ft. Fresh, thinly bedded, light olive green (5Y 6/1) to olive gray (5Y 4/1), very fine grained, medium strong, ARENACEOUS DOLOMITE, (ST. LOUIS FORMATION) Trace disseminated pyrite								J,I,R (2)						
									J,PL,SM						
	89.0-91.5 ft. Moderate porosity, open vugs (<3 mm.), glauconite in some vugs (<1%)														
90	90.4 ft. Thin silicified zone (~1/2 in.)			6	98%										
									J,PL,SM						
92															
									J,PL,SM,CL						
94			383.30 / 94.50												
									J,I,SM (2)						
				7	98%										
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: W. HERST
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-103-SS

Sheet 4 of 7

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/21/95-2/22/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067660.4
AZIMUTH: 0

COLLAR ELEV: 477.8
E: 516723.5
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
96	87.5-103.8 ft. Fresh, thinly bedded, light olive green (5Y 6/1) to olive gray (5Y 4/1), very fine grained, medium strong, ARENACEOUS DOLOMITE, (ST. LOUIS FORMATION) Trace disseminated pyrite								J,I,R						
									J,I,SM						
									J,I,R						
98									J,I,R						
									J,P,SM						
									J,P,SM						
									J,P,SM						
100									B,I,SM,CL						
				7	98%										
	101.3-103.6 ft. Moderate porosity, open vugs (<2 mm.)														
102															
			374.00												
104	103.6-105.6 ft. Freshly medium bedded, pale yellowish brown (10YR 6/2) to light brownish gray (5YR 6/1), medium crystalline, medium strong, DOLOMITIC LIMESTONE, (ST. LOUIS FORMATION)		103.80						J,U,SM						
			373.30												
			104.50						J,PL,R						
									J,PL,SM-healed with calcite						
			372.10												
108	105.6 ft. Brownish gray (5YR 4/1), Claystone layer, (~1 in. thick)		105.70												
	105.7-107.2 ft. Fresh, thickly bedded, olive gray (5Y 4/1), finely grained, strong, ARENACEOUS DOLOMITE, (ST. LOUIS FORMATION)		370.60												
			107.20												
108	107.2-109.6 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), finely crstalline, medium strong, DOLOMITIC LIMESTONE, (ST. LOUIS FORMATION) Trace disseminated pyrite			8	100%				J,U,SM						
	109.6-128.4 ft. Fresh, medium bedded, olive gray (5Y 4/1), micro-crystalline, medium strong to strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolites common, some glauconite stringers														
110									J,I,SM,CL						
112															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: W. HERST
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-103-SS

Sheet 5 of 7

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/21/95-2/22/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067660.4
AZIMUTH: 0

COLLAR ELEV: 477.6
E: 516723.5
INCLINATION: -90

J-Joint; F-Fault; S-Shear; B-Bedding; F-Foliation
PL-Planar; C-Curved; U-Undulating; ST-Stepped; I-Irregular
P-Polished; K-Slickensided; SM-Smooth; R-Rough; VR-V. Rough
Fe-Fe Oxide; CL-Clay Infill; CH-Chlorite; H-Healed; GRF-Gravel Filled

SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
112	112.0-113.5 ft. Becomes argillaceous 109.6-128.4 ft. Fresh, medium bedded, olive gray (5Y 4/1), micro-crystalline, medium strong to strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolites common, some glauconite stringers														
114			363.30	8	100 %				J,I,R,CL						
			114.50						J,I,SM						
116															
									J,PL,SM						
									J,I,VR						
									J,PL,SM,CL						
118									J,PL,VR						
	119.2-124.0 ft. Thin chert zone generally less than 2 in. thick			9	100 %										
120	120.0-120.5 ft. Moderate siliceous								J,I,R,CL						
122									J,I,R,CL						
									J,I,SM,CL						
124			353.30												
			124.50												
	Two stylolites														
126				10	100 %				J,PL,SM (2)						
									J,P,SM						
128															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: W. HERST
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-103-SS

Sheet 6 of 7

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/21/95-2/22/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1087660.4
AZIMUTH: 0

COLLAR ELEV: 477.8
E: 516723.5
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
128	349.40														
	128.4-133.9 ft. 128.40 Slightly weathered, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARENACEOUS DOLOMITE, (ST. LOUIS FORMATION)														
130				10	100 %										
132	343.90														
134	133.9-136.5 ft. 133.90 Fresh, medium bedded, light olive gray (5Y 5/2), micro-crystalline to fine crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Trace disseminated pyrite, some thin veins of calcite (<1/4 in.)		343.50 134.30					90	J,PL,SM,CL						2/22/95 16:45 Stopped drilling on Run 10 2/23/95 7:40 Resumed drilling Measured water level at 52.15 ft. below ground surface
136								90	J,U,SM						
								90	B,PL,SM						
	341.30														
	136.5-139.7 ft. 136.50 Slightly weathered, thickly bedded, light olive gray (5Y 6/1), very fine grained, medium strong, ARENACEOUS DOLOMITE, (<1 in.), (ST. LOUIS FORMATION) Thin Limestone layers														
138				11	100 %										
	338.10														
	139.7-142.3 ft. 139.70 Slightly weathered, medium bedded, light olive gray (5Y 5/2), fine crystalline, medium strong, DOLOMITIC LIMESTONE, (ST. LOUIS FORMATION)							90	J,C,SM						
140								90	J,PL,SM						
								90	J,I,R						
142	335.50														
	142.3-144.3 ft. 142.30 Fresh, thickly bedded, light olive gray (5Y 6/1), micro-crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION) 144.0-144.2 ft. Soft, grayish green (5G 5/2), glauconitic clay layer							90	J,I,R,CL						Highly broken rock.
144															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: W. HERST
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-103-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/21/95-2/22/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067860.4
AZIMUTH: 0

COLLAR ELEV: 477.8
E: 516723.5
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infil, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
144			333.50	11	100 %				J,I,SM (2)						
	333.50 End of Record of Drillhole at 144.3 ft. 144.30		144.30												2/23/95 @ 9:00 Finish drilling corehole.
146															
148															
150															
152															
154															
156															
158															
160															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

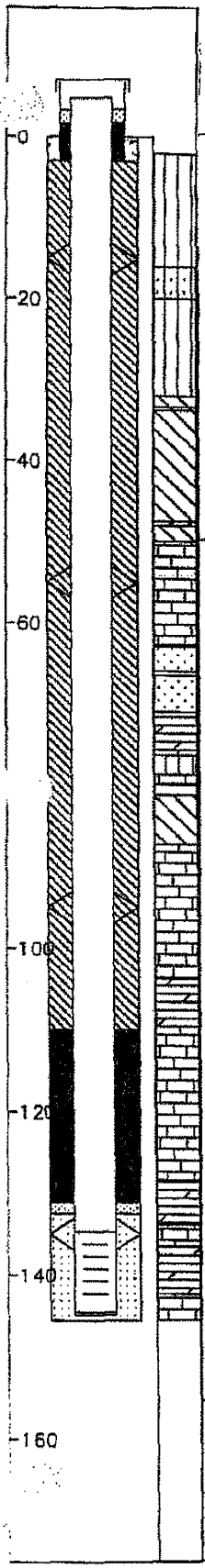
LOGGED: B. TILTON
CHECKED: W. HERST
DATE: 3/13/95

Golder Associates

Well No. PZ-103-SS

Boring No. X-Ref: PZ-103-SS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1067660 ft. Easting: 516724 ft.

Elevation Ground Level 477.8 ft. NGVD

Top of PVC Casing 480.17 ft. NGVD

Drilling Summary:

Total Depth 145.5 ft.

Borehole Diameter 10 1/4 in. (0.0–51.0 ft.) 5 7/8 in. (51.0–145.5 ft.)

Casing Stickup Height 2.39 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger–None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	2/21/95	7:30	2/23/95	9:45
Schramm Rotary	2/26/95	9:30	2/26/95	11:20
Geophys.Logging:				
Casing:	2/26/95	11:20	2/26/95	11:40
Filter Placement:	2/26/95	11:45	2/26/95	12:00
Cementing:				
Development				
Bentonite Grout	2/26/95	13:30	2/26/95	14:30
Bentonite Seal	2/26/95	12:30	2/26/95	13:00

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 2.39	–	134.70	C1	480.17	–	343.08
134.70	–	144.50	S1	343.08	–	333.28
144.50	–	144.83	C2	333.28	–	332.95
	–				–	
	–				–	
	–				–	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 132.5–145.5 ft.

Filter Pack: Less than 50 mesh Silica Sand, 131.1–132.5 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0–35.0 ft. and 60.0–110.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 110.0–131.1 ft.

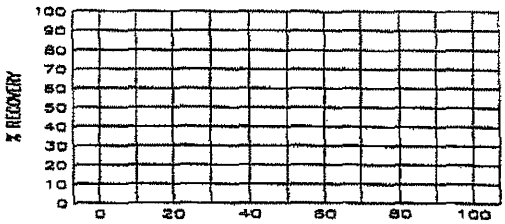
Concrete: 0.0–3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Due to grout slurry lose above 60.0 ft., bentonite chips were placed from 35.0–60.0 ft. to seal borehole. The chips were hydrated at 1 ft. intervals during placement and were monitored with a weighted tape measure.

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ103SS

661574

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	
REF NO. 15083	DATE RECEIVED
ROUTE	CHECK NO.
STATE WELL NUMBER	TRANSMITTAL NO
CHECKED BY	CROSS REFERENCE NO.
APPROVED BY	ENTERED Ph 1 Ph 2 Ph 3
	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME	WELL NUMBER
LAIDLAW BRIDGETON SANITARY LANDFILL	PZ-103-SS

SITE ADDRESS	CITY	STATE	ZIP CODE
St. CHARLES ROCK RD.	BRIDGETON	Mo	63044

NAME	TELEPHONE
LAIDLAW WASTE SYSTEMS, INC.	314-341-3710

ADDRESS	CITY	STATE	ZIP CODE
1838 N. BROADWAY	St. LOUIS	Mo.	63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL SHOW LOCATION IN SECTION PLAT

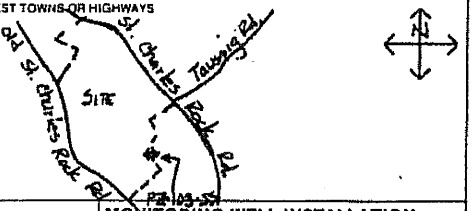
COUNTY St. Louis
ELEVATION 477.78
AREA NO.

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N,RNG. 5 (E) OR W

LAT. 30 ° 45 ' 57 " LONG. 90 ° 16 ' 29 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

NOTE: Record the fraction of a foot in decimal, not in inches

Top of Riser Elevation: 480.17

Ground Surface Elevation: 477.78 Ft

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
		0-15 Silt
Depth to bottom of Protective Casing Seal:	3	
		15-20 Sandy silt
		20-32 Silt
		32-51 Clay
		51-64 Limestone
Depth to Base of Annular Seal:	110.0	64-72 Sandy silt
		72-78 Shale
Depth to Base of Bentonite Seal:	131.1	78-87 Limestone
Depth to Base of Secondary Filter Pack:	132.5	87-111 Dolomite
Depth to Top of the Screen:	134.5	
		111-128 Limestone
		128-135 Dolomite
Depth to Bottom of the Screen:	144.5	135-137 Limestone
		137-143 Dolomite
Plug Back Total Depth:		143-144.5 Limestone
Original Total Depth:	145.5	

LOCKING CAP - (Y) / N (Circle one)
CAP VENT - (Y) / N (Circle one)
PROTECTIVE CASING Type: STEEL Size: 8" x 8" x 5' Bore Hole Diameter: 10.25"
WEEP HOLE - Y / N (Circle one)
PROTECTIVE CASING SEAL Type: [X] Concrete [ ] Cement Slurry
RISER PIPE Length: 136.67' Diameter: 2" Type of Material: SCH80 PVC
BOREHOLE DIAMETER: 5 7/8 In.
ANNULAR SEAL Type: [X] Bentonite Slurry [ ] Cement Slurry [ ] Non Slurry Bentonite
BENTONITE SEAL Type: [X] Bentonite Slurry [ ] Non Slurry Bentonite Length of Seal: 21.1 Ft.
SECONDARY FILTER PACK (Optional) Type: [X] Sand [ ] Manufactured Grain Size: SUGAR Length: 1.4'
PRIMARY FILTER PACK Type: [X] Sand [ ] Manufactured Grain Size: 20/40 Length: 13'
WELL SCREEN Length: 10' Slot Size: 0.010" Type: SCH80 PVC
SUMP DETAILS Length: 0.3 Ft. Diameter: 2 In. Type: PVC
TYPE OF BACKFILL: SAND

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN Co., INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN Co., INC.

TYPE OF INSTALLATION [X] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL ____ FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT

MEASURING POINT IS [ ] TOP OF RISER PIPE [ ] OTHER ____

DRILLING EQUIPMENT [X] AIR ROTARY [X] AUGER TYPE 6¼ H.S.A. [ ] REVERSE ROTARY [ ] OTHER ____

CENTRALIZERS USED [X] YES, AT 4 TOTAL [ ] STAINLESS STEEL [ ] OTHER ____ [ ] NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
2-27-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael P. Vogt
PERMIT NUMBER 001256 NM | DATE 4-11-95

SIGNATURE (DRILLING CONTRACTOR) Michael P. Vogt
PERMIT NUMBER 001256 NM | DATE 4-11-95

MO 780-1415 (2-94)

DISTRIBUTION: WHITE/DIVISION CANARY/MONITORING WELL CONTRACTOR PINK/OWNER

RECORD OF DRILLHOLE PZ-104-SS

Sheet 1 of 2

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 843-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 8/4/95
DRILL RIG: SCHRAMM

DATUM: MSL
COORDINATES N: 1087028.01
AZIMUTH: 0

COLLAR ELEV: 481.6
E: 516847.19
INCLINATION: -90

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
128	0.0-135.0 ft. No sampling conducted See Record of Drillhole for PZ-104-KS														0.0-38.0 ft. Drilling conducted with 6 1/4 in. ID hollow stem augers, then borehole advanced to 135.0 ft. with 5 7/8 in. air rotary bit
130															
132															
134															
			346.60												
136	135.0-138.1 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)		135.00						J,PL,R						6/4/95 @ 9:30 Begin Run 1
									J,I,R						
138									J,P,R						
	138.1-138.7 ft. Slightly weathered, finely bedded, dark greenish gray (5GY 4/1), very fine grained, very weak, CLAYSTONE, (ST. LOUIS FORMATION)		343.50 / 138.10 / 342.90 / 138.70						J,I,R,CL J,I,R,CL						
									J,PL,SM,CL J,I,VR,calcite						
	138.7-145.0 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)			1	100 %				J,C,R						
140															
142									J,PL,SM (2)						
									J,I,SM						
144															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

LOGGED: E. SWANSON
CHECKED: B. TILTON
DATE: 8/4/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/4/95
DRILL RIG: SCHRAMM

DATUM: MSL
COORDINATES N: 1067028.01
AZIMUTH: 0

COLLAR ELEV: 481.8
E: 518847.19
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE / DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP WRT CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: FR, SW, MW, HW, CW	STRENGTH INDEX: R6, R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): R6 1500, R5 600, R4 300, R3 150, R2 75, R1 39	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
144	138.7-145.0 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), very fine grained, medium strong, LIMESTONE, 336.60 (ST. LOUIS FORMATION) 145.00 End of Record of Drillhole at 145.0 ft.		336.60 145.00	1	100 %	80 60 40 20	2 4 6 8 10	0 30 50 90				R6 R5 R4 R3 R2 R1	R1 R2 R3 R4 R5 R6		
146															
148															
150															
152															
154															
156															
158															
160															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

LOGGED: E. SWANSON
CHECKED: B. TILTON
DATE: 6/4/95

Golder Associates

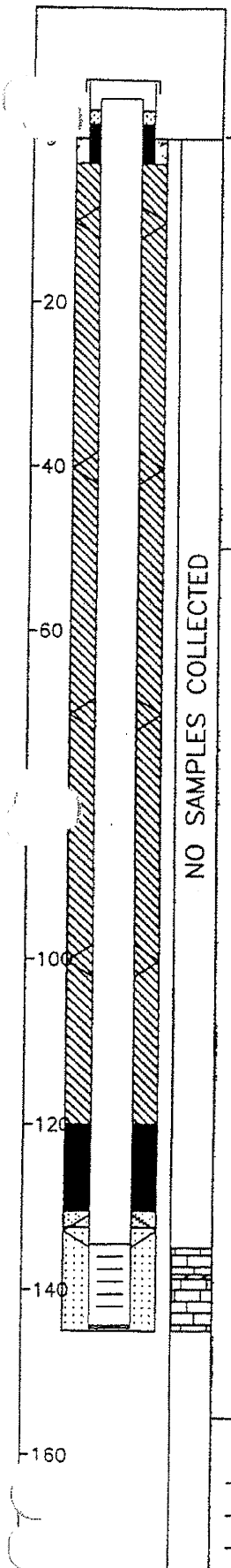
Well No. PZ-104-SS

Boring No. X-Ref: PZ-104-SS

PIEZOMETER CONSTRUCTION SUMMARY

Survey Coords: Northing: 1067028 ft.
Easting: 516847 ft.

Elevation Ground Level 481.6 ft. NGVD
Top of PVC Casing 483.63 ft. NGVD



Not to Scale

Drilling Summary:

Total Depth 145.0 ft.
Borehole Diameter 10 1/4" (0.0-37.0') 5 7/8" (37.0-145.0')
Casing Stickup Height 2.07 ft.
Driller Layne-Western
St. Louis, MO

Rig CME 75, Schramm Portadrill T660H
Bit(s) 6 1/4" ID Hollow Stem Auger Bit,
NX Core, 5 7/8" Button Bit for Reaming
Drilling Fluid Auger-None, NX Core Water,
Air Rotary
Protective Casing 8x8" Square Steel, by 5' long

Well Design & Specifications

Basis: Geologic Log X Geophysical Log ____
Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 2.07	-	134.50	C1	483.63	-	347.06
134.50	-	144.30	S1	347.06	-	337.26
144.30	-	144.63	C2	337.26	-	336.93
	-				-	
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings
C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)
Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings
Sand Pack: 16-35 mesh Silica Sand, 132.5-145.0 ft.
Filter Pack: Less than 50 mesh Silica Sand, 130.5-132.5 ft.
Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-120.0 ft.
Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 120.0-130.5 ft.
Concrete: 0.0-3.0 ft.

Construction Time log:

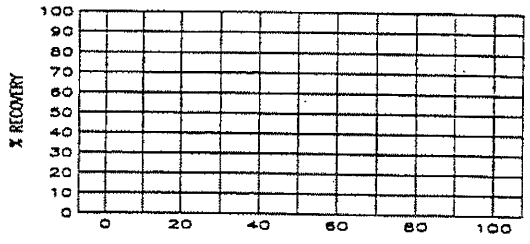
Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75				
Schramm Rotary	6/3/95	12:30	6/4/95	11:45
Geophys.Logging:				
Casing:	6/4/95	11:45	6/4/95	12:00
Filter Placement:	6/4/95	12:00	6/4/95	12:45
Cementing:				
Development				
Bentonite Grout	6/4/95	13:05	6/4/95	13:25
Bentonite Seal	6/4/95	12:45	6/4/95	13:05

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by B. Tilton
Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO
File Name PZ104SS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122511	CHECK NO
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL
WELL NUMBER: PZ-104-35
SITE ADDRESS: ST. CHARLES ROCK RD. CITY: BRIDGETON STATE: MO ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC. TELEPHONE: 314-241-3710
ADDRESS: 1638 S. BROADWAY CITY: ST. LOUIS STATE: MO ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL SHOW LOCATION IN SECTION PLAT

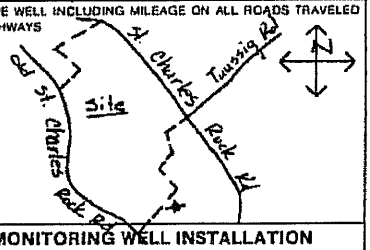
COUNTY: ST. LOUIS
ELEVATION: 481.6
AREA NO:

SMALLEST ¼ LARGEST ¼

SEC. ____ TWN. 47 N.RNG. 5 (E) OR W

LAT. 38° 45' 50" LONG. 90° 26' 27"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 483.6
Ground Surface Elevation: 481.6

Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column	
Depth to bottom of Protective Casing Seal: 3.0	
Depth to Base of Annular Seal: 120.0	
Depth to Base of Bentonite Seal: 130.5	
Depth to Base of Secondary Filter Pack: 132.5	
Depth to Top of the Screen: 134.5	
Depth to Bottom of the Screen: 144.5	
Plug Back Total Depth:	
Original Total Depth: 145.5	

LOCKING CAP - (Y) N (Circle one)
CAP VENT - Y / (N) (Circle one)
PROTECTIVE CASING Type: STEEL Size: 8" x 5" x 5' Bore Hole Diameter: 10¼"
WEEP HOLE - Y / (N) (Circle one)
PROTECTIVE CASING SEAL Type: (X) Concrete ( ) Cement Slurry
RISER PIPE Length: 136.6' Diameter: 2" Type of Material: SCH 80 PVC
BOREHOLE DIAMETER: 5 7/8 in.
ANNULAR SEAL Type: ( ) Bentonite Slurry (X) Cement Slurry ( ) Non Slurry Bentonite
BENTONITE SEAL Type: (X) Bentonite Slurry ( ) Non Slurry Bentonite Length of Seal: 10.5 Ft.
SECONDARY FILTER PACK (Optional) Type: (X) Sand ( ) Manufactured Grain Size: <50 Length: 3'
PRIMARY FILTER PACK Type: (X) Sand ( ) Manufactured Grain Size: 16-35 Length: 12.5'
WELL SCREEN Length: 10' Slot Size: 0.010" Type: SCH 80 PVC
SUMP DETAILS Length: 0.3 Ft. Diameter: 2 in. Type: PVC
TYPE OF BACKFILL: SAND

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

TYPE OF INSTALLATION: (X) ABOVE GROUND ( ) FLUSH MOUNT

STATIC WATER LEVEL: FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL:

ELEVATION OF MEASURING POINT: 483.6

MEASURING POINT IS: (X) TOP OF RISER PIPE ( ) OTHER

DRILLING EQUIPMENT: (X) AIR ROTARY (X) AUGER TYPE 6¼ H.S.A. ( ) REVERSE ROTARY ( ) OTHER

CENTRALIZERS USED: (X) YES, AT 5 TOTAL (X) STAINLESS STEEL ( ) OTHER ( ) NO

MULTIPLE CASED WELLS: SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED: 6-4-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Michael P. Vogt
PERMIT NUMBER: 001256 WM DATE: 7-07-95
SIGNATURE (DRILLING CONTRACTOR): Michael P. Vogt
PERMIT NUMBER: 001256 WM DATE: 7-07-95

MO 780-1415 (2-94)

DISTRIBUTION: WHITE DIVISION CANARY: MONITORING WELL CONTRACTOR PINK/OWNER

RECORD OF DRILLHOLE PZ-104-SD

Sheet 1 of 1

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/6/95
DRILL RIG: SCHRAMM

DATUM: MSL
COORDINATES N: 1067013.26
AZIMUTH: 0

COLLAR ELEV: 482.1
E: 516834.43
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
240	0.0-245.3 ft. No sampling conducted See Soil Borehole Log and Record of Drillhole for PZ-104-KS														0.0-38.0 ft. Drilling conducted with 6 1/4 in. ID hollow stem augers, then borehole advanced to 245.3 ft. with 5 7/8 in. air rotary bit
242															
244															
	236.80		236.80												
	245.3-252.8 ft. 245.30 Fresh, thickly bedded, medium dark gray (N4), coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (SALEM FORMATION) Coarse grained calcite crystals common		245.30												6/6/95 @ 8:30 Began coring
246	247.4-250.1 ft. Limestone is moderate yellowish brown (10YR 5/4) due to iron oxide														
248															
250				1	94%										
252															
	229.30														
	252.8-255.0 ft. 252.80 Slightly weathered, thinly bedded, moderate yellowish brown (10YR 5/4), very fine grained, weak, SILTSTONE, (WARSAW FORMATION)														
254			227.70												Core Loss due to highly weathered SILTSTONE 6/6/95 @ 11:30 Coring completed
	254.4-255.0 ft. Siltstone becomes highly weathered 227.10		254.40						Core Loss						
	End of Record of Drillhole at 255.0 ft. 255.00														
256															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 7/12/95

Golder Associates

Well No. PZ-104-SD

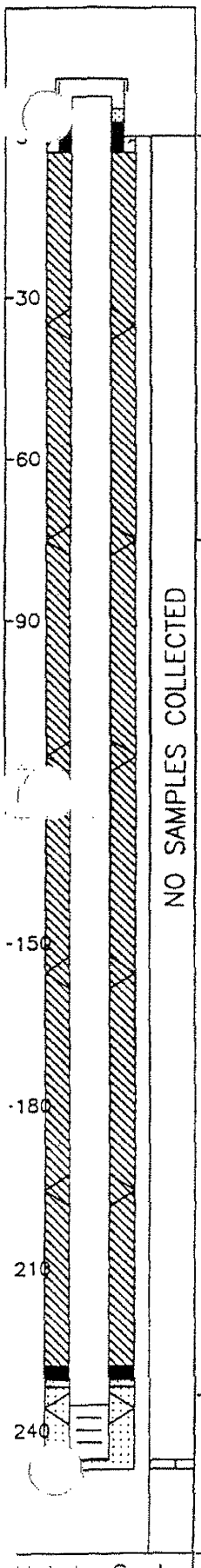
Boring No. X-Ref: PZ-104-SD

PIEZOMETER CONSTRUCTION SUMMARY

Survey Coords: Northing: 1067013 ft. Easting: 516834 ft.

Elevation Ground Level 482.1 ft. NGVD

Top of PVC Casing 483.69 ft. NGVD



Not to Scale

Drilling Summary:

Total Depth 252.5 ft.

Borehole Diameter 10 1/4 in. (0.0–38.0 ft.) 5 7/8 in. (38.0–252.5 ft.)

Casing Stickup Height 1.59 ft.

Driller Layne-Western, St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75				
Schramm Rotary	5/5/95	15:00	5/8/95	14:00
Geophys.Logging:	6/8/95	12:30	6/8/95	15:00
Casing:	6/17/95	12:10	6/17/95	12:30
Filter Placement:	6/17/95	12:30	6/17/95	13:00
Cementing:				
Development				
Bentonite Grout	6/17/95	13:20	6/17/95	15:00
Bentonite Seal	6/17/95	13:00	6/17/95	13:20

Well Design & Specifications

Basis: Geologic Log X Geophysical Log X

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.59	-	235.20	C1	483.69	-	248.90
235.20	-	245.00	S1	246.90	-	237.10
245.00	-	245.33	C2	237.10	-	236.77
	-				-	
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 231.8-247.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 230.5-231.8 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-220.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 220.0-230.5 ft.

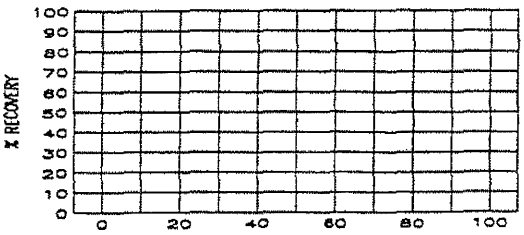
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

When PVC casing was installed, it was observed that there was about 5.0 ft. of sluff in borehole from 247.5-252.5 ft. It did not appear that the sluff could be removed from the borehole since the borehole had remained open to allow for geophysical logging and packer testing and slaking of shale units and argillaceous limestones in the borehole. Two feet of sand pack was used to seperate the bottom of the piezometer from the sluff at the bottom of the borehole.

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ104SD

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122512	CHECK NO.
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: Laidlaw Bridgeton Sanitary Landfill		WELL NUMBER: PZ-104-SD	
SITE ADDRESS: St Charles Rock Rd.	CITY: Bridgeton	STATE: Mo.	ZIP CODE: 63044
NAME: Laidlaw Waste Systems, Inc.		TELEPHONE: 314-241 3710	
ADDRESS: 1830 N Broadway	CITY: St. Louis	STATE: Mo	ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

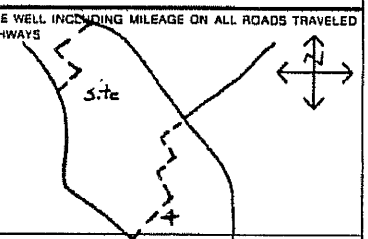
COUNTY: St Louis
ELEVATION: 483.69
AREA NO:

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼ ____ ¼

SEC. ____ TWN. 47 N,RNG. 5 E OR W

LAT. 38° 45' 50" LONG. 90° 26' 27"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS

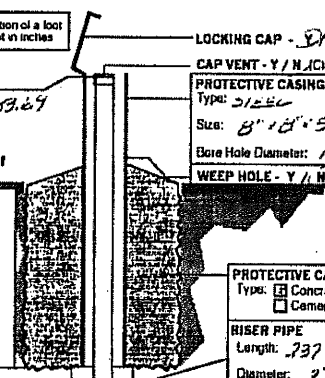


DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
Layne Western Co., Inc.

DRILLING CONTRACTOR'S NAME
Layne Western Co., Inc.

NOTE: Record the fraction of a foot in decimal, not in inches



Top of Riser Elevation: 483.69

Ground Surface Elevation: 483.69 Ft

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
Depth to bottom of Protective Casing Seal:	3.0	
Depth to Base of Annular Seal:	228.0	
Depth to Base of Bentonite Seal:	230.5	
Depth to Base of Secondary Filter Pack:	231.8	
Depth to Top of the Screen:	235.0	
Depth to Bottom of the Screen:	245.0	
Plug Back Total Depth		
Original Total Depth:	252.5	

LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)
PROTECTIVE CASING
Type: Steel
Size: 8"x8"x5'
Bore Hole Diameter: 10¼"
WEEP HOLE - Y / N (Circle one)

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 237'
Diameter: 2"
Type of Material: Sch 80 PVC

BOREHOLE DIAMETER: 5 1/8 In.

ANNULAR SEAL
Type: ☐ Bentonite Slurry ☒ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite
Length of Seal: 2.5 Ft.

SECONDARY FILTER PACK (Optional)
Type: ☒ Sand ☐ Manufactured
Grain Size: <50
Length: 1.3'

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 16-35
Length: 20.7'

WELL SCREEN
Length: 10
Slot Size: 0.010"
Type: PVC

SUMP DETAILS
Length: 0.5 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: Sand

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
483.69

MEASURING POINT IS
☒ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☒ AIR ROTARY ☒ AUGER TYPE 6¼ H.S.A.
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☒ YES, AT 6 TOTAL
☒ STAINLESS STEEL
☐ OTHER
☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
6-17-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Michael P. Vogt	
PERMIT NUMBER: 001256 WMA	DATE: 7-07-95
SIGNATURE (DRILLING CONTRACTOR): Michael P. Vogt	
PERMIT NUMBER: 001256 WMA	DATE: 7-07-95

MO 780 1415 (2 94)

DISTRIBUTION: WHITE DIVISION CANARY/MONITORING WELL CONTRACTOR PINK/OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-104-KS
	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 1 OF 3
	WATER LEVEL / TIME / DATE / CASING DEPTH	DRILLING START TIME 15:40 DATE 2/12/95; FINISH TIME 17:58 DATE 2/12/95
DATUM NORTHING: 1066993.15 EASTING: 516820.50 ELEVATION 482.3		
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE BEARING		
SAMPLE HAMMER		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE		REMARKS
1	4 5 4 4	1.6'/2.0' (80%)			(0.0-2.4 ft.) Stiff, dark yellowish brown (10YR 4/2), homogenous, CLAYEY SILT, rootlets, NR, moist, (ML-CL), (LOESS)	SP ①		2/12/95 - 15:40 Began drilling
2 3	2 2 2 2	1.2'/2.0' (60%)			(2.4-7.0 ft.) Soft to firm, dusky yellowish brown (10YR 2/2), homogenous, CLAYEY SILT, NR, moist, (ML-CL), (LOESS)	SP ②		
4 5	2 2 3 3	1.5'/2.0' (75%)				SP ③		
6 7		2.2'/2.0' (110%)			(7.0-15.4 ft.) Stiff, light olive gray (5Y 6/1) to light brown (5YR 5/6), homogenous, mottled CLAYEY SILT, NR, damp, (ML-CL), (LOESS)	SH ④		
8 9	3 4 5 8	0.9'/2.0' (45%)				SP ⑤		
10 11	3 4 5 7	1.1'/2.0' (55%)				SP ⑥		
12 13	4 4 6 7	1.1'/2.0' (55%)				SP ⑦		
14	3 5 8 9	1.2'/2.0' (60%)				SP ⑧		

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER

DATE 2/12/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ104KS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-104-KS
	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 2 OF 3
	WATER LEVEL / TIME / DATE / CASING DEPTH	DRILLING START TIME 15:40 DATE 2/12/95; FINISH TIME 17:58 DATE 2/12/95
DATUM NORTHING: 1066993.15 EASTING: 516820.50 ELEVATION 482.3		
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE BEARING		
SAMPLE HAMMER		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
			(7.0-15.4 ft.) Stiff, light olive gray (5Y 6/1) to light brown (5YR 5/6), homogenous, mottled CLAYEY SILT, NR, damp, (ML-CL), (LOESS) (466.9) 15.4	SH 8	
16		1.7'/2.0' (85%)	(15.4-20.8 ft.) Compact, light gray (N7), homogenous, SILT, NR, dry, (ML), (LOESS)	SH 9	
17					
18	6 5 6 8	1.1'/2.0' (55%)		SP 10	
19					
20	4 4 6 8	1.2'/2.0' (60%)	(461.5) 20.8	SP 11	
21			(20.8-22.4 ft.) Stiff, light olive gray (5Y 6/1), homogenous, CLAYEY SILT, SR, dry, (CL-ML), (LOESS)		
22	6 6 7 8	1.6'/2.0' (80%)	(459.9) 22.4		
23			(22.4-23.31 ft.) Compact, pale yellowish brown (10YR 6/2), homogenous, SILTY coarse SAND, NR, dry, (SM), (ALLUVIUM) (459.0) 23.3	SP 12	
24	6 5 7 9	1.1'/2.0' (55%)	(23.31-24.8 ft.) Compact, light olive gray (5Y 6/1), homogenous, SILT, NR, dry, (ML), (ALLUVIUM) (457.5) 24.8	SP 13	
25			(24.8-31.0 ft.) Compact to stiff, medium gray (N5), stratified very fine SAND and CLAYEY SILT, NR, dry, (SC), (ALLUVIUM)		
26	2 5 5 6	1.3'/2.0' (65%)		SP 14	
27					
28	4 4 5 4	1.6'/2.0' (80%)	@ 28.0 ft., 5-6 inch clayey silt layers, <0.5-2.0 inch fine SAND layers	SP 15	
29					

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER

DATE 2/12/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ104KS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-104-KS
	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 3 OF 3
	WATER LEVEL / TIME / DATE / CASING DEPTH	DRILLING START TIME 15:40 DATE 2/12/95; FINISH TIME 17:58 DATE 2/12/95
DATUM NORTHING: 1066993.15 EASTING: 516820.50 ELEVATION 482.3		
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE BEARING		
SAMPLE HAMMER		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
	4 7 7 10	1.6' / 2.0' (80%)			(24.8-31.0 ft.) Compact to stiff, medium gray (N5), stratified very fine SAND and CLAYEY SILT, NR, dry, (SC), (ALLUVIUM) (451.3) 31.0	SP (16)	
31					(31.0-33.1 ft.) Compact, medium dark gray (N4), homogenous, f-m SAND, trace Silt and Clay, NR, moist, (SP), (ALLUVIUM)		
32	10 5 4 12	0.9' / 2.0' (45%)			@ 28.0 ft., 6 inch clayey silt layer, (0.5-2.0 inch fine SAND layers (449.2) 33.1	SP (17)	
33					(33.1-36.0 ft.) Very stiff, light gray (N7), homogenous, SILTY CLAY, NR, dry, (CL), (WEATHERED BEDROCK)		
34	6 17 28 52	1.6' / 2.0' (80%)				SP (18)	
35					(446.3) 36.0		
36					End of Soil Borehole Log at 36.0 ft. See PZ-104-KS Record of Drillhole for rock descriptions		
37							
38							
39							
40							
41							
42							
43							
44							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER

DATE 2/12/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ104KS

RECORD OF DRILLHOLE PZ-104-KS

Sheet 1 of 24

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32	0.0-38.0 ft. See Soil Borehole Log PZ-104-KS 38.0-38.0 ft. No samples collected														
34															
36															
	444.30		444.30												
38	38.0-84.7 ft. 38.00 Fresh, medium bedded, pale yellowish brown (10YR 6/2), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)		38.00												5/22/95 @ 14:00 Began drilling
									J,PL,SM J,PL,R (2)						
									J,PL,R						
									J,PL,R,CL						
40				1	100 %				J,PL,R,Fe						
									J,PL,SM,CL						
42									J,PL,SM,CL J,P,R,CL						
			439.30												5/22/95 @ 14:40 End of Run 1
			43.00						J,I,R,Fe						
44									J,I,R,Fe J,PL,R,Fe						
									J,PL,R,CL						
	44.9-45.0 ft. Clay layer		437.00												
	45.3-46.6 ft. Clay layer		45.30	2	100 %										
46															
			435.70												
			46.60						J,PL,SM,CL J,I,R,CL						
48									J,C,R,Fe						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: S. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

Sheet 2 of 24

PROJECT: LAIDLAW/FI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 5/24/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 518820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48	38.0-84.7 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) 48.0-54.5 ft. Stylolites common, very thinly bedded clay layers common								J,PL,SM,CL						
50									J,PL,SM,CL (3)						
				2	100 %				J,PL,SM,CL J,I,R						
52									J,PL,SM,CL						
			429.30 53.00						J,PL,SM,CL						5/22/95 @ 16:00 End of Run 2
	53.5-63.0 ft. Joints have approximately 1/2 in. of clay								B,PL,SM (3)						
54									J,I,R (4)						
									J,PL,SM,CL (7)						
56									J,PL,SM,CL (2)						
									J,PL,SM,CL (4)						
									J,PL,SM,CL (2)						
58				3	100 %				J,PL,SM,CL (4)						
									J,PL,SM,CL (4)						
60									J,I,R,CL J,PL,R						
									J,PL,SM,CL						
62	61.9-62.6 ft. Abundant argillaceous partings														
	62.6-62.7 ft. Clay layer		419.30 63.00						J,PL,SM,CL (2)						5/22/95 @ 17:00 End of Run 3
				4	100 %										
64															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

Sheet 3 of 24

PROJECT: LAIDLAW/FI-FB
PROJECT NO: 843-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR, MW, HW, CW)	STRENGTH INDEX (R6, R5, R4, R3, R2, R1)	POINT LOAD INDEX (psi) (R1 30, R2 130, R3 300, R4 600, R5 1500, R6+)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64	38.0-84.7 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)								J,PL,SM						
66	@ 65.6 ft. Chert layer														
68	67.3-73.0 ft. Stylolites common								J,PL,SM,CL						
				4	100 %				J,PL,SM						
									J,PL,SM,CL (2)						
70									J,PL,SM,CL						
72			409.30												5/22/95 @ 17:45 End of Run 4
			73.00												
	73.4-83.3 ft. Abundant argillaceous partings								J,I,R						
74									B,I,SM						
									J,PL,SM,CL						
76				5	100 %				J,PL,SM,CL						
									J,PL,SM,CL						
78									J,PL,SM,CL						
									J,PL,SM,CL						
	79.1-79.2 ft. Clay layer								J,PL,SM,CL (2)						
80															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1056963.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	38.0-84.7 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)								J,PL,SM,CL						
82				5	100 %										
			399.30												5/22/95 @ 16:30 End of Run 5 Ended drilling for the day 5/23/95 @ 7:25 Began drilling
84			83.00						J,I,R,CL						
	84.7-84.9 ft. Medium light gray (N6), fine grained, SANDSTONE layer, (ST. LOUIS FORMATION)								J,I,R,CL						
86	84.9-91.4 ft. Slightly weathered, medium bedded, pale yellowish brown (10YR 6/2), f-m crystalline, medium strong, LIMESTONE (ST. LOUIS FORMATION) Calcite filled fractures, clay filled fractures 86.3-86.6 ft. Clay layer			6	83%				J,I,SM-intact J,I,VR J,I,R,CL J,I,R J,I,R						
88									J,I,R,CL						
			392.90												
			89.40												
90									Core Loss						Core Loss, possible soft rock
			391.60												5/23/95 @ 8:30 End of Run 6
			90.70												
	390.90														
	91.4-91.9 ft. Slightly weathered, thinly bedded, medium gray (N5), fine grained, medium strong, SANDSTONE, (ST. LOUIS FORMATION) Thickly laminated clay layers		91.40 390.40 91.90						B,PL,SM (2)						
92	91.9-103.0 ft. Slightly weathered, medium bedded, pale yellowish brown (10YR 6/2), microcrystalline to fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Abundant argillaceous layers								J,I,R,CL						
				7	100 %										
94									J,I,R						
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

Sheet 5 of 24

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2849
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY%	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR, MW, HW, CW	STRENGTH INDEX: R6, R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): RT 30, R2 150, R3 300, R4 600, R5 1500, R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
96	91.9-103.0 ft. Slightly weathered, medium bedded, pale yellowish brown (10YR 6/2), microcrystalline to fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Abundant argillaceous layers							90	J,PL,R						
				7	100 %			90	J,PL,R,CL						
98			383.10												5/23/95 @ 9:00 End of Run 7
			99.20												
100															
	101.1-103.0 ft. Abundant chert														
102															
			379.30	8	80%										
	103.0-108.0 ft. Slightly weathered, thickly laminated, medium dark gray (N4), fine grained, very weak, SILTSTONE grades to sandy SILTSTONE with depth, (ST. LOUIS FORMATION)		103.00												
104															
			376.20												
106			106.10												Core Loss, soft rock
			374.50												5/23/95 @ 10:10 End of Run 8
			107.80					90	B,PL,SM,CL						
108	108.0-118.2 ft. Fresh, medium bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Stylolites present							90	B,PL,SM,CL (5)						
								60	J,U,SM,CL						
				9	100 %										
110															
112															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068983.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
112	108.0-118.2 ft. Fresh, medium bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Stylolites present								B,PL,SM,CL						
114			386.10 / 114.20	9	100 %										5/23/95 @ 10:40 End of Run 9
116															
118	384.10 / 118.20 118.2-119.8 ft. Slightly weathered, medium bedded, olive gray (5Y 4/1), medium grained, medium strong, DOLOMITE, (ST. LOUIS FORMATION)			10	100 %				J,PL,SM,CL						
120	382.50 / 119.80 119.8-121.7 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), medium crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)								J,PL,SM,CL						
122	121.7-123.2 ft. Fresh, medium bedded, light olive gray (5Y 6/1), m-c grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)								J,PL,SM,CL (2)						
124	123.2-133.8 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), medium crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Pyrite at contact		358.10 / 124.20						J,I,R						5/23/95 @ 11:40 End of Run 10
126				11	100 %				J,PL,SM,CL						
128															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

Sheet 7 of 24

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 942-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR, MW, HW, CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 35 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
128	123.2-133.8 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), medium crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Pyrite at contact							0	J,PL,SM,CL						
130				11	100 %			0	J,PL,SM,CL						
132								0	J,I,SM,CL						
	348.80														
134	133.8-135.3 ft. Slightly weathered, thinly bedded, light olive gray (5Y 6/1) fine grained, weak, SANDSTONE, (ST. LOUIS FORMATION) Thickly laminated, argillaceous layers		348.10					0	J,I,SM,CL						5/23/95 @ 12:20 End of Run 11
	347.00		134.20					0	B,PL,SM						
	135.3-137.5 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic							0	J,PL,SM						
136															
138	137.5-140.0 ft. Fresh, thinly bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Includes fine sand and silt			12	100 %			0	J,PL,SM,CL						
140	140.0-144.7 ft. Fresh, thickly bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic							0	J,PL,SM						
142								0	J,PL,SM						
144															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: S. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1088983.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
144			338.10 / 144.20	12	100 %			90	J,PL,SM						5/23/95 @ 13:00 End of Run 12
								90	J,PL,R						
	144.7-149.2 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), f-m grained crystalline, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)														
146															
148								90	J,PL,R						
	149.2-152.2 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2) to medium gray (N5), fine crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolites and argillaceous partings common			13	100 %			90	J,PL,R						
150								90	B,PL,SM,CL (3)						
								90	B,PL,SM,CL (2)						
152	152.3-154.6 ft. Fresh, medium bedded, light olive gray (5Y 6/1), f-m grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)														
154			328.10 / 154.20												5/23/95 @ 14:10 End of Run 13
	154.6-162.3 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, argillaceous partings							90	B,PL,SM (2)						
156				14	100 %										
								90	J,PL,SM						
158															
								90	B,I,R						
160															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 843-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
160	160.2-161.2 ft. Abundant clay zones, slightly weathered rock														
162	162.3-167.6 ft. 320.00 / 162.30 Fresh, medium bedded, grayish orange (10YR 7/4), f-m crystalline, medium strong, ARENACEOUS LIMESTONE, (SALEM FORMATION)			14	100 %										@ 162.3 ft. Inferred top of SALEM FORMATION
164			318.10 / 164.20												5/23/95 @ 15:00 End of Run 14
166															
168	167.6-171.7 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), m-c grained, medium strong, ARGILLACEOUS LIMESTONE, (SALEM FORMATION)			15	100 %										
170															
172	171.7-165.0 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), f-m crystalline, medium strong, LIMESTONE, (SALEM FORMATION)								J,I,R						
174			308.10 / 174.20												5/23/95 @ 16:00 End of Run 15
				16	100 %				B,PL,SM,CL (4)						
176	175.3-190.1 ft. Abundant argillaceous layers and partings								B,PL,SM						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

Sheet 10 of 24

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
176	171.7-185.0 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine to medium crystalline, medium strong, LIMESTONE, (SALEM FORMATION)						60	J,PL,SM					
178	178.4-185.0 ft. Abundant chert layers and nodules												
180			16	100 %									
182							60	J,PL,R					
							60	J,PL,R					
184		298.10 / 184.20											5/23/95 @ 16:45 End of Run 16 Finished drilling for the day 5/24/95 @ 7:30 Began drilling Run 17 Water level before drilling @ 112.0 ft.
186	185.0-186.7 ft. Fresh, thickly bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (SALEM FORMATION) Chert nodules abundant												
	186.7-189.0 ft. Slightly weathered, thinly bedded, medium gray (N5), fine and medium grained, medium strong LIMESTONE, (SALEM FORMATION) Abundant argillaceous partings and layers						60	B,PL,SM,CL					
188			17	100 %			60	B,PL,SM,CL (2)					
190	189.0-197.2 ft. Fresh, thinly bedded to thickly bedded (with depth), pale yellowish brown (10YR 6/2), f-m grained, medium strong, ARGILLACEOUS LIMESTONE, (SALEM FORMATION) Abundant chert nodules												
192													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW, FR, MW, HW, CW)	STRENGTH INDEX (R6, R5, R4, R3, R2, R1)	POINT LOAD INDEX (psi) (R1, R2, R3, R4, R5, R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
192	189.0-197.2 ft. Fresh, thinly bedded to thickly bedded (with depth), pale yellowish brown (10YR 6/2), f-m grained, medium strong, ARGILLACEOUS LIMESTONE, (SALEM FORMATION) Abundant chert nodules			17	100 %										
194			288.10 / 194.20												5/24/95 @ 8:40 End of Run 17
196															
198	197.2-204.0 ft. Fresh, thickly bedded, pale yellowish brown (10YR 6/2) and medium gray (N5), fine grained, medium strong, LIMESTONE, (SALEM FORMATION) Abundant large, strong nodules and layers of chert			18	100 %				J,PL,SM,CL J,PL,SM,CL J,PL,SM J,I,R J,PL,R						
200			281.70 / 200.60												5/24/95 @ 10:15 End of Run 18
202															
204	204.0-222.7 ft. Fresh, medium bedded, grayish orange (10YR 7/4), medium crystalline, medium strong, LIMESTONE, (SALEM FORMATION) Silicified zones and abundant chert			19	99%				J,PL,SM (3)						
206															
208									J,PL,SM						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

Sheet 12 of 24

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068883.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 518620.50
INCLINATION: -90

DEPTH SCALE (FEET)

ROCK TYPE

DESCRIPTION

GRAPHIC LOG

ELEV / DEPTH (FT)

RUN NO.

CORE RECOVERY

RQD

FRACTURES PER FOOT

DISCONTINUITY DATA

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DIP w/r CORE AXIS

TYPE AND SURFACE DESCRIPTION

GRAPHIC LOG

WEATHERING INDEX (SW, FR, MW, HR, CW)

STRENGTH INDEX (R6, R5, R4, R3, R2, R1)

POINT LOAD INDEX (psi) (R1, R2 30, R3 150, R4 300, R5 600, R6 1500)

TEST ORIENTATION

NOTES WATER LEVELS INSTRUMENTATION

208

204.0-222.7 ft.
Fresh, medium bedded, grayish orange (10YR 7/4), medium crystalline, medium strong, LIMESTONE, (SALEM FORMATION)
Silicified zones and abundant chert

19 — 99%

273.10

209.20

J,PL,SM

J,PL,SM (2)

5/24/95 @ 11:40
End of Run 19

210

20 — 48%

J,PL,SM (2)

J,I,R

J,PL,SM (2)

270.60
270.80

211.50

212

Core Loss

Core Loss

288.40

213.90

214

Core Loss, washed out
5/24/95 @ 13:20
End of Run 20

B,PL,SM (2)

216

21 — 92%

218

263.50

216.60
263.10

219.20

Core Loss (clay ?)
5/24/95 @ 14:00
End of Run 21

220

22 — 100%

222

222.7-228.0 ft.
Slightly weathered, medium bedded, grayish orange (10YR 7/4), coarse crystalline, weak, FOSSILIFEROUS LIMESTONE, (SALEM FORMATION)
Highly silicious, argillaceous

> 10 mechanical breaks/foot

24

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

Sheet 13 of 24

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
224	222.7-228.0 ft. Slightly weathered, medium bedded, grayish orange (10YR 7/4), coarse crystalline, weak, FOSSILIFEROUS LIMESTONE, (SALEM FORMATION) Highly silicious, argillaceous										SW FR / MW / HW / CW	R5 R6 / R4 / R3 / R2 / R1	FR 20 / R2 150 / R3 300 / R4 600 / R5 1500 / R6		
226				22	100 %				J,PL,R						
228	228.0-230.7 ft. Slightly weathered, medium bedded, grayish orange (10YR 7/4), f-m crystalline, medium strong, LIMESTONE, (SALEM FORMATION)		253.10												5/24/95 @ 15:30 End of Run 22
			229.20												
230									F,U,R (2)						
	230.7-238.9 ft. Slightly weathered, medium bedded, grayish orange (10YR 7/4), m-c crystalline, medium strong, LIMESTONE, (SALEM FORMATION) Argillaceous, silicious														
232															
									J,PL,R						
234				23	100 %										
236															236.0-237.0 ft. Additional mechanical breaks
									J,PL,R (2)						
									J,PL,R						
238															
	238.9-247.4 ft. Slightly weathered, medium bedded, grayish orange (10YR 7/4), m-c crystalline, medium strong, LIMESTONE, (SALEM FORMATION) Argillaceous, silicious, includes fossiliferous zones		243.10												
			239.20												
240				24	100 %				B,PL,SM,CL						5/24/95 @ 16:00 End of Run 23

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 518820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (30 50 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (FR SW MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
240	238.9-247.7 ft. Slightly weathered, medium bedded, grayish orange (10YR 7/4), m-c crystalline, medium strong, LIMESTONE, (SALEM FORMATION) Argillaceous, silicious, includes fossiliferous zones														
242															
244				24	100 %										
246									J,PL,R						
	247.4-256.8 ft. Fresh, medium bedded, light to medium gray (N6 to N5), m-c crystalline, strong, FOSSILIFEROUS LIMESTONE, (SALEM FORMATION)														
248			233.10 / 249.20												5/24/95 @ 16:45 End of Run 24
250															
252				25	100 %										
254															
256															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068883.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
256			226.00												
	256.3-258.8 ft. Fresh, thinly bedded, medium dark gray (N4), fine grained, medium strong, SILTSTONE, (WARSAW FORMATION)		256.30												256.3 ft. Top of WARSAW FORMATION encountered
258				25	100 %				B,PL,SM,CL (2)						
			223.50												
	258.8-260.8 ft. Fresh, medium bedded, medium gray (N5), m-c crystalline, strong, FOSSILIFEROUS LIMESTONE, (WARSAW FORMATION) Argillaceous, silicious		258.80												5/24/95 @ 17:30 End of Run 25
			223.10												
260			258.20												5/26/95 6 in steel casing installed to 257.0 ft. in 9 7/8 in. borehole and sealed with cement Core drilling resumed 6/1/95 @ 11:00
	260.8-264.6 ft. Fresh, thinly bedded, olive gray (5Y 4/1), very fine grained, medium strong, SILTSTONE, (WARSAW FORMATION)		260.80												
262				26	100 %										
			217.70												
264			218.10												
	264.6-267.2 ft. Fresh, thinly bedded, medium dark gray (N4), coarse crystalline, strong, DOLOMITIC LIMESTONE, (WARSAW FORMATION) Chert nodules common (<5 mm.)		264.20						B,PL,SM (2)						
266									J,I,R						
	267.2-271.9 ft. Fresh, medium bedded, olive gray (5Y 4/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (WARSAW FORMATION)														
268				27	100 %				J,U,SM						
									J,PL,SM						
270															
	271.9-274.0 ft. Fresh, thinly bedded, medium dark gray (N4), coarse crystalline, strong, DOLOMITIC LIMESTONE, (WARSAW FORMATION) Chert nodules common (<5 mm.)														
272															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: O. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/FI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
272	271.9-274.0 ft. Fresh, thinly bedded, medium dark gray (N4), coarse crystalline, strong, DOLOMITIC LIMESTONE, (WARSAW FORMATION) Chert nodules common (<5 mm.)			27	100 %				J,PL,SM						
274	274.0-279.9 ft. Fresh, thin to medium bedded, olive gray (5Y 4/1), very fine grained, medium strong, ARGILLACEOUS LIMESTONE, (WARSAW FORMATION) Porous, (<1 mm. open vugs) 274.4-275.5 ft. Several partially calcite crystal filled voids (<2 in.)		208.10 / 274.20						J,C,SM J,I,R J,I,R J,I,R (4)						274.4-275.5 ft. Possible high porosity zone
278				28	100 %				B,I,SM						
280	279.9-295.7 ft. Fresh, medium bedded, light olive gray (5Y 6/1), coarse crystalline, medium strong to strong, DOLOMITIC LIMESTONE, (WARSAW FORMATION) Abundant chert nodules (<2 mm.), fossiliferous with some silicified zones, stylolitic								J,I,VR J,PL,SM,Fe						
282															
284	284.2-285.4 ft. Olive gray (5Y 4/1), Argillaceous Limestone layer		198.10 / 284.20												6/1/95 @ 15:25 End of Run 28
286				29	100 %				J,PL,SM						
288															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

Sheet 17 of 24

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1086993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX: SW FR MW HW CW	STRENGTH INDEX: R6 R5 R4 R3 R2 R1	POINT LOAD INDEX (psi): R1 20 R2 150 R3 300 R4 600 R5 1600 R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
288	279.9-295.7 ft. Fresh, medium bedded, light olive gray (5Y 6/1), coarse crystalline, medium strong to strong, DOLOMITIC LIMESTONE, (WARSAW FORMATION) Abundant chert nodules (<2 mm.) fossiliferous with some silicified zones, stylolitic														
290				29	100 %										
292															
294			188.10 / 294.20												6/1/95 @ 16:20 End of Run 29
296	295.7-303.7 ft. Fresh, thinly bedded, medium dark gray (N4), very fine grained, medium strong, ARGILLACEOUS LIMESTONE, (WARSAW FORMATION)														
298	297.5-299.3 ft. Partially silicified, porous (open vugs <3 mm.)								J,PL,SM						
300	299.3-303.7 ft. Rock becomes weak due to high clay content			30	100 %				J,PL,SM,CL						
302															
304	303.7-305.0 ft. Fresh, thinly bedded, medium gray (N5), coarse crystalline, medium strong, LIMESTONE, (WARSAW FORMATION)														

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1086993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	ROD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
304		178.10 / 304.20	30	100 %									6/1/95 @ 17:00 End of Run 30 Stop drilling 6/2/95 @ 8:30 Begin Run 31
	177.30												
	305.0-309.7 ft. 305.00 Fresh, thinly bedded, medium dark gray (N4), very fine grained, weak, SILTSTONE, (WARSAW FORMATION)												
306													
308			31	100 %				B,PL,SM					
	172.60												
	309.7-313.5 ft. 309.70 Fresh, thinly bedded, medium gray (N5), m-c crystalline, medium strong, LIMESTONE, (WARSAW FORMATION) Numerous clay partings, stylolitic							B,PL,SM					
310													
312								B,PL,SM,CL					
	313.5-322.0 ft. Fresh, thinly to medium bedded, light olive gray (5Y 6/1) to dark gray (N3), very fine to medium grained medium strong, alternating layers of ARGILLACEOUS LIMESTONE and SILTSTONE (2-6 in. thick) (WARSAW FORMATION)							B,U,SM,CL					
314	168.10	168.10 / 314.20											6/2/95 @ 11:30 End of Run 31 Slow drilling, a lot of rod wobble
	314.20							B,PL,SM,CL					
	167.30 315.00												
	166.30 316.00												
316								B,PL,SM (4)					
	165.30 317.00		32	98%									
	164.30 318.00												
	163.30 319.00												
320	162.30 320.00												

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

Sheet 19 of 24

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
320	162.30 320.00 313.5-322.0 ft. Fresh, thinly to medium bedded, light olive gray (5Y 6/1) to dark gray (N3), very fine to medium grained, medium strong, alternating layers of ARGILLACEOUS LIMESTONE and SILTSTONE (2-6 in. thick) (WARSAW FORMATION) 161.30 321.00 160.30 322.00 322.0-347.4 ft. Fresh, thickly bedded, dark gray (N3), very fine grained, medium strong, SILTSTONE, (WARSAW FORMATION)														
322				32	95%										
324			158.10 324.20						B,I,R						6/2/95 @ 12:40 End Run 32
326															
328				33	100 %				J,PL,SM,CL						
330															
332			148.10 333.20												6/2/95 @ 14:00 End of Run 33
334				34	100 %										
336															
338															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

Sheet 20 of 24

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 518520.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
Pl-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR / HW / RW / CW	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
336	322.0-347.4 ft. Fresh, thickly bedded, dark gray (N3), very fine grained, medium strong, SILTSTONE, (WARSAW FORMATION)											R6	R1 30		
				34	100 %							R5	R2 150		
338	338.0-347.2 ft. Siltstone becomes weak											R4	R3 360		
			143.10									R3	R4 669		
	339.3-339.5 ft. Soft, medium gray (N5), Clay seam		339.20									R2	R5 1500		
340												R1	R6		
342															
				35	100 %										
344															
346															
	134.90														
	347.4-358.3 ft. Fresh, thinly bedded, medium dark gray (N4), fine crystalline, medium strong, DOLOMITIC LIMESTONE, (WARSAW FORMATION) Argillaceous, numerous shaley partings, some thin interbeds of Siltstone (< 4 in. thick), fossiliferous, coarse chert nodules common	347.40													
348			134.10												
			348.20												
350				36	100 %										
352															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

Sheet 21 of 24

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX (SW, FR, MW, HW, CW)	STRENGTH INDEX (R6, R5, R4, R3, R2, R1)	POINT LOAD INDEX (psi) (R1 30, R2 150, R3 300, R4 600, R5 1500, R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
352	347.4-358.3 ft. Fresh, thinly bedded, medium dark gray (N4), fine crystalline, medium strong, DOLOMITIC LIMESTONE, (WARSAW FORMATION) Argillaceous, numerous shaley partings, some thin interbeds of Siltstone (<4 in. thick), fossiliferous, coarse chert nodules common														
354				36	100 %										
356															
358			124.00												
	358.3-384.7 ft. Fresh, thinly bedded, medium gray (N5), alternating fine crystalline and coarse crystalline layers, medium strong to strong, ARGILLACEOUS LIMESTONE, (KEOKUK FORMATION) Some zones fossiliferous, abundant medium bluish gray (5B 5/1), chert layers, coarse grained chert nodules common, thinly laminated, shaley partings common, trace disseminated pyrite		358.30												@ 358.3 ft. Inferred top of KEOKUK FORMATION Drilling rate slows significantly due to chert layers 6/2/95 @ 17:00 End of Run 36
360															
362									• J,I,R						
364				37	100 %										
366															
368															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 518820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
Pl.-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP WRT CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
368	357.7-384.7 ft. Fresh, thinly bedded, medium gray (N5), alternating fine crystalline and coarse crystalline layers, medium strong to strong, ARGILLACEOUS LIMESTONE, (KEOKUK FORMATION) Some zones fossiliferous, abundant medium bluish gray (5B 5/1), chert layers, coarse grained chert nodules common, thinly laminated, shaley partings, common, trace disseminated pyrite		114.00 366.30	37	100 %										6/2/95 @ 18:00 End of Run 37
370															
372				38	98%										
374			108.00 374.30												6/2/95 @ 19:15 End of Run 38 Stop drilling 6/3/95 @ 7:00 Drilling resumed
376				39	100 %										
378	Below 378.5 ft. Only occasional shaley partings		103.00 379.30						B,U,SM,CL						6/3895 @ 13:30 End of Run 39
380				40	100 %										
382															
384															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
384	384.7-393.8 ft. Slightly weathered, thinly bedded, pinkish gray (5Y 8/1) to light olive gray (5Y 6/1), f-m crystalline, medium strong to strong, LIMESTONE, (KEOKUK FORMATION) Some zones coarse grained, chert layers common (<6 in.), stylolitic, some zones silicified		98.00	40	100 %										6/3/95 @ 15:00 End of Run 40 Stop drilling 6/4/95 @ 8:00 Drilling resumed
			384.30												
386															
388				41	100 %										
390															
392	@ 392.0 ft. Three open vugs with quartz crystals (<1 in. dia.)														
			88.50												
394	393.8-408.5 ft. Moderate to highly weathered, thinly bedded, light gray (N7), f-c crystalline, medium strong to weak, SILICIFIED LIMESTONE, (KEOKUK FORMATION) Chert nodules and layers common, stylolitic		393.60												
396				42	94%										
398	398.5-399.1 ft. Highly weathered, very porous, (open vugs <5 mm.), weak rock														
400															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 843-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 518620.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	ROD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR, MW, HW, CW)	STRENGTH INDEX (R5 R6, R4, R3, R2, R1)	POINT LOAD INDEX (psi) (R5 30, R4 150, R3 300, R2 600, R1 1500, R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
400	393.8-408.5 ft. Moderate to highly weathered, thinly bedded, light gray (N7), f-c crystalline, medium strong to weak, SILICIFIED LIMESTONE, (KEOKUK FORMATION) Chert nodules and layers common, stylolitic			42	94%	80 60 40 20	2 4 6 8 10 PER FOOT	0 30 60 90							
402			79.10												
			403.20												Core Loss in highly weathered rock 6/4/95 @ 14:10 End Run 42
404	@ 403.8 ft. Highly weathered, very porous, weak rock		78.50 403.80												
408				43	95%										
408			73.50												6/4/95 @ 14:45 Drilling completed
	End of Record of Drillhole at 408.8 ft.		408.80												
410															
412															
414															
416															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

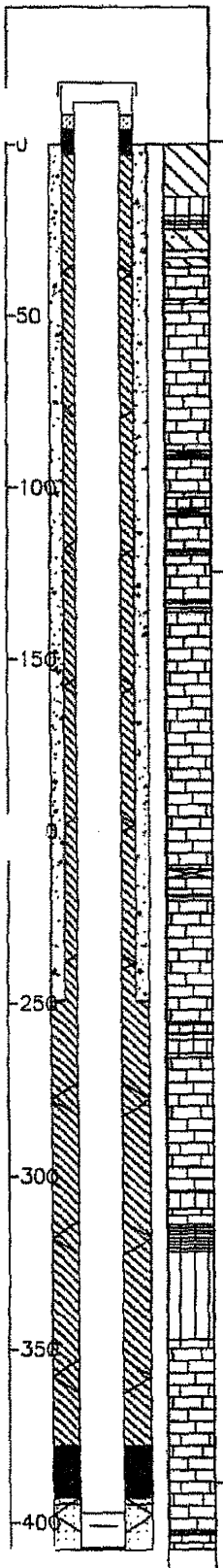
LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

Well No. PZ-104-KS

Boring No. X-Ref: PZ-104-KS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1066693 ft. Easting: 516821 ft.

Elevation Ground Level 482.3 ft. NGVD

Top of PVC Casing 484.04 ft. NGVD

Drilling Summary:

Total Depth 408.0 ft.

Borehole Diameter 10 in. (0.0–249.0 ft.) 5 7/8 in. (249.0–408.0 ft.)

Casing Stickup Height 1.72 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. and 10 in. Button Bits

Drilling Fluid Auger–None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75 (augers)	2/21/95	15:40	2/21/95	17:55
CME 75 (core)	5/22/95	14:00	5/22/95	14:45
Schramm Rotary	6/7/95	7:15	6/7/95	11:30
Geophys.Logging:	6/8/95	10:30	6/8/95	12:15
Casing:				
2" PVC	6/19/95	9:30	6/19/95	11:00
6" Steel	5/25/95	12:30	5/25/95	13:30
Filter Placement:	6/19/95	11:05	6/19/95	13:00
Cementing:				
Development				
Bentonite Grout	6/19/95	13:15	6/19/95	17:00
Bentonite Seal	6/19/95	13:00	6/19/95	13:15

Well Design & Specifications

Basis: Geologic Log X Geophysical Log X

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.72	–	397.37	C1	484.04	–	84.95
397.37	–	407.17	S1	84.95	–	75.15
407.17	–	407.50	C2	75.15	–	74.82
+ 1.00	–	249.00	C3	483.30	–	233.32
	–				–	
	–				–	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.) (C3–see comments)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16–35 mesh Silica Sand, 395.0–408.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 393.0–395.0 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0–378.0 ft., Neat cement, 3.0–249.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 378.0–393.0 ft.

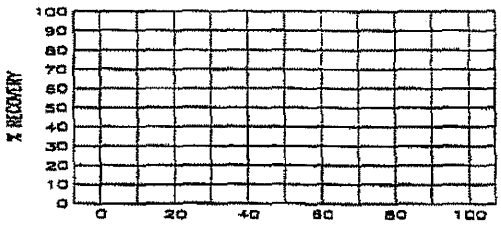
Concrete: 0.0–3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments: Surface Casing C3: 6 1/8 in. ID / 6 5/8 in. OD Steel Casing

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ104KS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122504	CHECK NO.
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO.
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME	WELL NUMBER	
LAIDLAW BRIDGETON SANITARY LANDFILL	[redacted] PZ-104-KS	
SITE ADDRESS	**CITY**	**STATE / ZIP CODE**
ST. CHARLES ROCK RD	BRIDGETON	MO 63044
NAME		**TELEPHONE**
LAIDLAW WASTE SYSTEMS, INC.		314-241-3710
ADDRESS	**CITY**	**STATE / ZIP CODE**
1838 N. BROADWAY	ST. LOUIS	MO 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL SHOW LOCATION IN SECTION PLAT

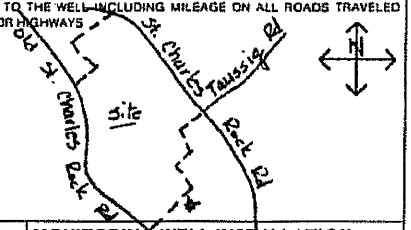
COUNTY ST. LOUIS
ELEVATION 482.32
AREA NO.

SMALLEST ¼ LARGEST ¼

SEC. ____ TWN. 47 N,RNG 5 (E) OR W

LAT. 38° 45' 50" LONG. 90° 26' 27"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
484.04

MEASURING POINT IS
☒ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☒ AIR ROTARY ☒ AUGER TYPE 6¼ H.S.A.
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☒ YES, AT 9 TOTAL
☒ STAINLESS STEEL
☐ OTHER
☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
6-19-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael P. Voigt

PERMIT NUMBER	DATE
001256 WM	7-07-95

SIGNATURE (DRILLING CONTRACTOR) Michael P. Voigt

PERMIT NUMBER	DATE
001256 WM	7-07-95

NOTE: Record the fraction of a foot in decimal, not in inches

Top of Riser Elevation: 484.04

LOCKING CAP - (Y) N (Circle one)
CAP VENT - Y (N) (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8"x6"x5'
Bore Hole Diameter: 9⅞"

WEEP HOLE - Y / N (Circle one)

Ground Surface Elevation: 482.32 Ft

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
	0-37	No sampling
Depth to bottom of Protective Casing Seal:	3.0	
	37-100	Limestone
	100-105	shale
	105-250	Limestone
	250-253	shale
	253-256	Limestone
	256-264	shale
	264-266	Limestone
Depth to Base of Annular Seal:	378.0	266-270 Dolomite
	270-297	Limestone
	297-304	shale
Depth to Base of Bentonite Seal:	343.0	304-317 Limestone
Depth to Base of Secondary Filter Pack:	345.0	317-342 shale
		342-408 Limestone
Depth to Top of the Screen:	347.5	
Depth to Bottom of the Screen:	407.5	
Plug Back Total Depth:		
Original Total Depth:	408.0	

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 349.2'
Diameter: 2"
Type of Material: SCH 80 PVC

BOREHOLE DIAMETER: 5⅞ in.

ANNULAR SEAL
Type: ☒ Bentonite Slurry 245-325
☒ Cement Slurry 3-245
☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite
Length of Seal: 15 Ft.

SECONDARY FILTER PACK (Optional)
Type: ☒ Sand ☐ Manufactured
Grain Size: < 50
Length: 3.0'

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 16-35
Length: 13.0'

WELL SCREEN
Length: 10'
Slot Size: 0.010
Type: SCH 80 PVC

SUMP DETAILS
Length: 0.5 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

MO 780-1419 (12-94)

DISTRIBUTION: WHITE-DIVISION CANARY-MONITORING WELL CONTRACTOR PINK-OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-105-SS
	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 1 OF 3
	WATER LEVEL / TIME / DATE / CASING DEPTH	DRILLING START TIME 14:20 DATE 5/19/95; FINISH TIME 17:15 DATE 5/19/95
DATUM NORTHING: 1066421.35 EASTING: 516230.23 ELEVATION 481.2		
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS Grassy field	
ANGLE -90 BEARING NA		
SAMPLE HAMMER		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	1 3 3 2	1.3'/2.0' (65%)			(0.0-4.4 ft.) Firm, moderate yellowish brown (10YR 5/4), SILT, with trace fine Sand, NR, moist, (ML), (LOESS)	SP 1	
2	2 2 3 2	1.8'/2.0' (90%)				SP 2	
4	2 3 5 7	2.0'/2.0' (100%)			(476.8) 4.4 (4.4-18.5 ft.) Very soft to stiff, moderate yellowish brown (10YR 5/2), SILTY CLAY, NR, moist, (CL), (LOESS)	SP 3	
6	1 2 4 5	1.5'/2.0' (75%)				SP 4	
7					From 7.0-16.0 ft., grades to include trace fine sand, color grades to light olive gray (5Y 6/1) and moderate yellowish brown (10YR 5/2) (mottled)		
8	0 2 3 2	2.0'/2.0' (100%)				SP 5	
10	1 2 1 2	2.0'/2.0' (100%)				SP 6	
12	0 0 1 3	2.0'/2.0' (100%)				SP 7	
14	2 2 5 8	1.9'/2.0' (95%)				SP 8	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY D. ALLOWAY

DATE 7/14/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ105SS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION: LAIDLAW/OU2 RI-FS/MO, WEST LAKE LANDFILL, OPERABLE UNIT 2	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-105-SS
		SHEET 2 OF 3
	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP); SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING START: 5/19/95 FINISH: 5/19/95
NORTHING: 1066421.35, DATUM EASTING: 516230.23, ELEVATION 481.2	WATER LEVEL / TIME / DATE / CASING DEPTH	TIME: 14:20 / 17:15
DRILL RIG: CME 75 - TRUCK MOUNT	SURFACE CONDITIONS: Grassy Field	
ANGLE: -90, BEARING: NA		
SAMPLE HAMMER		

DRILLING CONTR: LAYNE-WESTERN

LOGGED BY: D. ALLOWAY

DATE: 7/14/95 CHK'D BY: W. HERST

JOB NO.: 943-2848

FILENAME: PZ105SS

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16	1 4 7 8	1.9' 2.0' (95%)			From 16.0-18.5 ft. grades to little fine sand, color grades to medium light gray (N6)	SP 8	
17						SP 9	
18	5 5 8 9	1.5' 2.0' (75%)			(18.5-20.5 ft.) Stiff, olive gray (5Y 4/1), fine SANDY CLAY, NR, wet, (CL), (ALLUVIUM)	SP 10	
19							
20	3 6 9 13	1.7' 2.0' (85%)			(460.7) 20.5	SP 11	
21					(20.5-27.1 ft.) Compact, medium gray (N5), f-m poorly graded SAND, NR, wet, (SP), (ALLUVIUM)		
22	1 4 8 9	1.3' 2.0' (65%)			@ 22.5 ft., grades to less silt	SP 12	
23							
24	4 8 18 19	1.5' 2.0' (75%)			@ 24.7 ft., grades to more silt	SP 13	
25							
26	1 4 5 9	1.3' 2.0' (65%)			(454.1) 27.1	SP 14	
27					(27.1-29.6 ft.) Loose to compact, medium gray (N5), SILT with little fine Sand, NR, wet, (ML), (ALLUVIUM)		
28	1 1 3 12	1.7' 2.0' (85%)			(451.6) 29.6	SP 15	
29					(29.6-33.8 ft.) Very loose to dense, medium gray (N5), f-m poorly graded SAND, NR, wet, (SP), (ALLUVIUM)		

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger		BORING NO. PZ-105-SS
			SHEET 3 OF 3
LAIDLAW/OU2 RI-FS/MD WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)		DRILLING START: TIME 14:20, DATE 5/19/95 DRILLING FINISH: TIME 17:15, DATE 5/19/95
NORTHING: 1066421.35 DATUM EASTING: 516230.23 ELEVATION 481.2	WATER LEVEL / TIME / DATE / CASING DEPTH		
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS Grassy Field		
ANGLE -90 BEARING NA			
SAMPLE HAMMER			

DRILLING CONTR LAYNE-WESTERN

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31	2 6 18 29	2.0'/2.0' (100%)			(29.6-33.8 Ft.) Very loose to dense, medium gray (N5), f-m poorly graded SAND, NR, wet, (SP), (ALLUVIUM)	SP (16)	
32	1 10 37 33	2.0'/2.0' (100%)				SP (17)	
33							
34	45 50/3"	0.5'/1.0' (50%)			(33.8-35.0 Ft.) Very dense, light olive gray (5Y 6/1), LIMESTONE GRAVEL, SR, wet, (WEATHERED LIMESTONE BEDROCK) (446.2) 35.0	SP (18)	
35					End of Soil Borehole Log at 35.0 Ft. See PZ-105-SS Record of Drillhole for rock descriptions		
36							
37							
38							
39							
40							
41							
42							
43							
44							

LOGGED BY B. ALLOWAY

DATE 7/14/95 CHK'D BY V. HERST

JOB NO.: 943-2848

FILENAME: PZ105SS

RECORD OF DRILLHOLE PZ-105-SS

Sheet 1 of 8

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NS Core & water
DRILLING DATE: 5/20/95 - 5/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066421.35
AZIMUTH: 0

COLLAR ELEV: 481.2
E: 516230.23
INCLINATION: -90

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, R-Rough, SM-Smooth, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR, AMW HW, CW	STRENGTH INDEX: R5 R4 R3 R2 R1	POINT LOAD INDEX (psi): R1 30, R2 150, R3 300, R4 600, R5 1500	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32	0.0-35.0 ft. See Soil Borehole Log PZ-105-SS														
34	35.0-39.0 ft. Slightly weathered, thinly bedded, medium light gray (N6), fine grained, medium strong, LIMESTONE, 446.20 (ST. LOUIS FORMATION)		446.20												
	35.2-35.9 ft. 35.20 Dark yellowish orange (10YR 6/6), Claystone layer		35.00												5/20/95 @ 8:20 Began drilling Run 1
36				1	73%										
38			442.20						Core Loss						5/20/95 @ 9:00 End of Run 1
	39.0-52.9 ft. Slightly weathered, medium bedded, medium light gray (N6), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Clay filled joints and layers of Claystone		39.00												
40				2	77%										
42			436.30						Core Loss						5/20/95 @ 9:45 End of Run 2
			42.90												
44									J,I,VR,Fe (2)						43.0-44.0 ft. Healed seam at 0°
				3	83%										
46															
									J,PL,R,CL (3)						
48															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-105-SS

Sheet 2 of 6

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NS Core & water
DRILLING DATE: 5/20/95 - 5/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066421.35
AZIMUTH: 0

COLLAR ELEV: 481.2
E: 516230.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48	39.0-52.9 ft. Slightly weathered, medium bedded, medium light gray (N6), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)		432.20 / 49.00	3	93%				J,PL,R,CL Core Loss						5/20/95 @ 10:20 End of Run 3
	49.0 ft. Color grades to pale yellowish brown (10YR 6/2)														
50	50.5 ft. Pyrite present 51.0-51.2 ft. Sandstone layer			4	100 %				J,P,R (2) J,P,R (2)						
52	51.9-52.3 ft. Sandstone layer		428.30 / 52.90												
	52.9-55.2 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine to microcrystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Zones of thin clay or silicous laminations								J,PL,VR J,PL,VR						
54	54.6-54.8 ft. Chert layer														
56				5	96%				J,I,R,CL						
58	57.8-57.9 ft. Clay layer 57.9-58.6 ft. Sandstone layer		422.20 / 59.00												5/20/95 @ 12:00 End of Run 5
60									J,PL,R J,C,SM,CL						
				6	100 %				J,PL,R (3)						
62									J,PL,R (2)						
									J,PL,R						
64															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-105-SS

Sheet 3 of 8

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NS Core & water
DRILLING DATE: 5/20/95 - 5/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066421.35
AZIMUTH: 0

COLLAR ELEV: 481.2
E: 516230.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP rel CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64	52.9-65.2 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine to microcrystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) 416.00								J,PL,R						
	65.2-79.0 ft. 65.20 Fresh, medium bedded, medium gray (N5), microcrystalline to fine grained, medium strong, ARENACEOUS DOLOMITE, (ST. LOUIS FORMATION) Pyrite and calcite filled fractures								J,PL,R						
66				6	100 %				J,PL,R (2)						
68															
			412.20						J,I,R (2)						5/20/95 @ 13:00 End of Run 6
			69.00						J,ST,SM						
70															
72															
									J,ST,R						
74				7	100 %				J,I,R						
76															
	77.6-78.5 ft. Clayey layer														
78															
	79.0-80.3 ft. 402.20 Fresh, thinly bedded, light olive gray (5Y 6/1), fine grained, medium strong, SANDSTONE, (ST. LOUIS FORMATION) 79.00 Includes thickly laminated clay layers		402.20 79.00	8	99%										5/20/95 @ 14:00 End of Run 7

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 8/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-105-SS

Sheet 4 of 8

PROJECT: LAIDLAW/R-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NS Core & water
DRILLING DATE: 5/20/95 - 5/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068421.35
AZIMUTH: 0

COLLAR ELEV: 481.2
E: 518230.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infil, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR / MW / HW / CW	STRENGTH INDEX: R6 R5 R4 R3 R2 R1	POINT LOAD INDEX (psi): R1 30 / R2 150 / R3 300 / R4 600 / R5 1500 / R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80			400.90												
	80.3-89.3 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine to medium crystalline, medium strong, LIMESTONE. (ST. LOUIS FORMATION)		80.30						J,I,R						
									J,I,SM,CL						
82									J,ST,CL (2)						
									J,I,R,CL (2)						
84	84.0-86.8 ft. Abundant chert, some clay layers (green clay)			8	99%										
									J,PL,SM						
									J,PL,SM,CL						
86									J,PL,SM,CL						86.7-86.8 ft. Broken zone
									J,PL,SM,CL						
88									J,PL,SM,CL						
			392.20												
	89.3-118.6 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)		89.00						J,I,R						
90	89.3-92.7 ft. Silicified														5/20/95 @ 15:00 End of Run 8
				9	100%				J,PL,SM,CL						
92															
94															
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 8/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-105-SS

Sheet 5 of 8

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NS Core & water
DRILLING DATE: 5/20/95 - 5/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066421.35
AZIMUTH: 0

COLLAR ELEV: 481.2
E: 516230.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

Depth Scale (Feet)	Description	Graphic Log	Elev / Depth (Ft)	Run No.	Core Recovery	RQD	Fractures Per Foot	Discontinuity Data: Dip wrt Core Axis	Discontinuity Data: Type and Surface Description	Graphic Log	Weathering Index	Strength Index	Point Load Index (psi)	Test Orientation	Notes: Water Levels, Instrumentation
98	89.3-118.6 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)														
				9	100 %				J,PL,SM						
98									J,PL,SM						
			382.20												5/20/95 @ 15:30 End of Run 9
			99.00												
100									J,PL,SM						
	101.5-105.0 ft. Silicified														
102															
									F,PL,SM						
104				10	100 %										
									J,C,SM,CL						
	105.0-115.5 ft. Scattered stylolites, chert														
106															
									J,PL,SM,CL						
									J,PL,SM,CL						
108															
			372.20												5/20/95 @ 16:15 End of Run 10
			109.00												
									J,PL,R,CL						
110															
				11	100 %				J,PL,R,CL						
									J,PL,SM						
112															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-105-SS

Sheet 6 of 6

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NS Core & water
DRILLING DATE: 5/20/95 - 5/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066421.35
AZIMUTH: 0

COLLAR ELEV: 481.2
E: 516230.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW, FR, MW, HW, CW)	STRENGTH INDEX (R6, R5, R4, R3, R2, R1)	POINT LOAD INDEX (psi) (R1, R2, R3, R4, R5, R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
112	89.3-118.6 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)								J,PL,SM						
114									J,PL,SM (3)						
									J,ST,R						
116				11	100 %				J,PL,SM,CL (2)						
									J,PL,SM						
118									J,PL,SM,CL						5/20/95 @ 17:15 End of Run 11 Ended drilling for the day 5/21/95 @ 7:30 Resume drilling
	118.6-131.5 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), microcrystalline, medium strong, LIMESTONE, fossiliferous, (ST. LOUIS FORMATION)		362.20 119.00												
120	120.5-121.4 ft. Claystone layer														
122															
	123.0 ft. Calcite crystals on fracture								B,PL,SM,CL J,PL,R						
	123.7-126.3 ft. ARGILLACEOUS LIMESTONE			12	100 %										
124	124.0 ft. Calcite crystals on fractures														
126									B,PL,SM,CL						
									B,PL,SM,CL						
128	128.0 ft. Calcite crystals on fractures														

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 8/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-105-SS

Sheet 7 of 8

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NS Core & water
DRILLING DATE: 5/20/95 - 5/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066421.35
AZIMUTH: 0

COLLAR ELEV: 481.2
E: 516230.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
R-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
128	128.0 ft. Calcite crystals on fractures			12	100 %				J,PL,R B,PL,SM,CL						5/21/95 @ 8:30 End of Run 12
			352.20 129.00												
130	129.5 ft. Color grades to light olive gray (5Y 5/2)								B,PL,SM,CL (2)						
132	131.5-141.6 ft. Fresh, medium bedded, light olive gray (5Y 5/2), fine grained, medium strong, ARGILLACEOUS LIMESTONE. (ST. LOUIS FORMATION)														
134				13	100 %										
136									J,PL,SM,CL						
138									J,PL,SM,CL						
			342.20 139.00												5/21/95 @ 9:40 End of Run 13
140															
142	141.6-148.7 ft. Fresh, medium bedded, pale yellowish brown (10Y 6/2) to light olive gray (5Y 5/2), fine grained, medium strong, LIMESTONE. (ST. LOUIS FORMATION) Stylolitic, clay filled fractures			14	100 %				J,PL,SM,CL J,PL,SM,CL						
144															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: S. TILTON
DATE: 6/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-105-SS

Sheet 8 of 8

PROJECT: LADLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NS Core & water
DRILLING DATE: 5/20/95 - 5/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066421.35
AZIMUTH: 0

COLLAR ELEV: 481.2
E: 518230.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW, FR, MW, HW, CW)	STRENGTH INDEX (R6, R5, R4, R3, R2, R1)	POINT LOAD INDEX (psi) (R7 10, R6 150, R5 400, R4 800, R3 1500, R2, R1)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
144	141.6-148.7 ft. Fresh, medium bedded, pale yellowish brown (10Y 6/2) to light olive gray (5Y 5/2), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, clay filled fractures								J,PL,SM,CL (2)						
146	146.0-147.0 ft. Clay filled vugs and fractures abundant			14	100 %				J,PL,SM,CL J,PL,SM,CL						
148	148.7-149.0 ft. Slightly weathered, thinly bedded, grayish orange (10YR 7/4), fine grained, medium strong DOLOMITE, very shallow vugs, (ST. LOUIS FORMATION) 332.50 149.70 332.20		332.20						J,PL,SM,CL						5/21/95 @ 10:30 End of drilling
	End of Record of Drillhole at 149.0 ft. 146.00		146.00												
150															
152															
154															
156															
158															
80															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

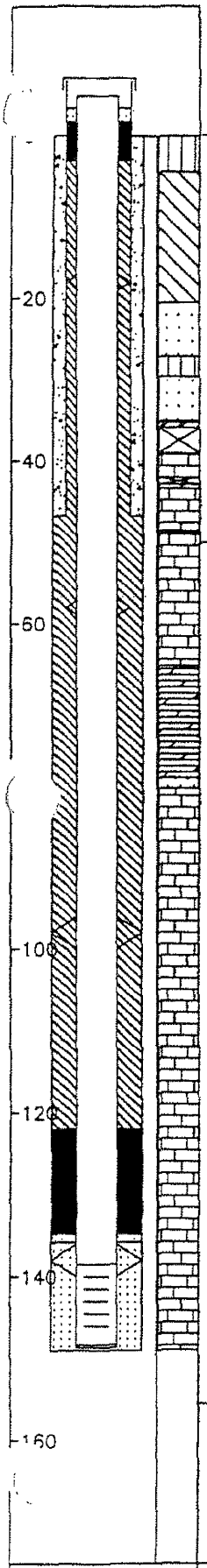
LOGGED: D. ALLOWAY
CHECKED: S. TILTON
DATE: 6/13/95

Golder Associates

Well No. PZ-105-SS

Boring No. X-Ref: PZ-105-SS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1066421 ft. Easting: 516230 ft.

Elevation Ground Level 481.2 ft. NGVD

Top of PVC Casing 483.61 ft. NGVD

Drilling Summary:

Total Depth 149.0 ft.

Borehole Diameter 9 7/8 in. (0.0–45.0 ft.) 5 7/8 in. (45.0–149.0 ft.)

Casing Stickup Height 2.39 ft.

Driller Layne-Western, St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit and 7 7/8 in. Tricone Bit

Drilling Fluid Auger-None, NX Core Water, Air and Mud Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	5/19/95	14:20	5/21/95	10:30
Schramm Rotary	5/24/95	7:45	5/24/95	12:00
Geophys.Logging:				
Casing:				
2" PVC	5/24/95	12:00	5/24/95	12:20
6" Steel	5/23/95	7:30	5/23/95	13:00
Filter Placement:	5/24/95	12:30	5/24/95	13:05
Cementing:				
Development				
Bentonite Grout	5/24/95	14:15	5/24/95	15:00
Bentonite Seal	5/24/95	14:00	5/24/95	14:15

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 2.39	-	138.50	C1	483.61	-	342.72
138.50	-	148.30	S1	342.72	-	332.92
148.30	-	148.63	C2	332.92	-	332.59
+ 1.50	-	45.00	C3	482.70	-	438.22
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.) (C3-see comments)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 135.8-149.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 134.8-135.8 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-122.0 ft., Neat cement, 3.0-45.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 122.0-134.8 ft.

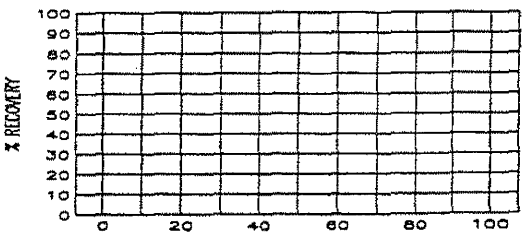
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments: Surface Casing C3: 6 1/2 in. ID / 6 5/8 in. OD Steel Casing

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ105SS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122510	CHECK NO.
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO.
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME	WELL NUMBER
LAIDLAW BRIDGETON SANITARY LANDFILL	PZ-105S5

SITE ADDRESS	CITY	STATE	ZIP CODE
31. CHARLES ROCK RD.	BRIDGETON	MO	63044

NAME	TELEPHONE
LAIDLAW WASTE SYSTEMS, INC.	314-241-3710

ADDRESS	CITY	STATE	ZIP CODE
12 SE 1 BROADWAY	ST LOUIS	MO	63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

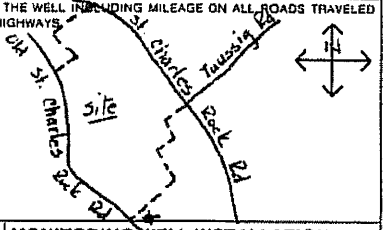
COUNTY ST LOUIS
ELEVATION 481.2
AREA NO.

SMALLEST ¼ LARGEST ¼

SEC. ____ TWN. 47 N,RNG 5 E OR W

LAT. 38 ° 45 ' 44 " LONG. 90 ° 30 ' 25 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO, INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO, INC.

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
483.6

MEASURING POINT IS
☒ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☒ AIR ROTARY ☒ AUGER TYPE 6¼ HSA
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☒ YES, AT 4 TOTAL
☒ STAINLESS STEEL
☐ OTHER
☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
5-24-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael P. Vogl
PERMIT NUMBER 001256WIM DATE 7-07-95

SIGNATURE (DRILLING CONTRACTOR) Michael P. Vogl
PERMIT NUMBER 001256WIM DATE 7-07-95

NOTE: Record the fraction of a foot in decimal, not in inches

Top of Riser Elevation: 483.6

LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)
PROTECTIVE CASING Type: STEEL Size: 8" x 6" x 5' Bore Hole Diameter: 9 7/8
WEEP HOLE - Y / N (Circle one)

Ground Surface Elevation: 481.2 Ft	Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column	0-35	no samples
Depth to bottom of Protective Casing Seal:	3.0	
	35-144	Limestone
Depth to Base of Annular Seal:	122.0	
Depth to Base of Bentonite Seal:	124.8	
Depth to Base of Secondary Filter Pack:	135.8	
Depth to Top of the Screen:	138.5	
Depth to Bottom of the Screen:	148.5	
Plug Back Total Depth		
Original Total Depth:	149.0	

PROTECTIVE CASING SEAL Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE Length: 140.7' Diameter: 2" Type of Material: SCH 80 PVC

BOREHOLE DIAMETER: 5 7/8 In.

ANNULAR SEAL Type: ☐ Bentonite Slurry ☒ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite Length of Seal: 12.8 Ft

SECONDARY FILTER PACK Type: ☒ Sand ☐ Manufactured (Optional) Grain Size: < 50 Length: 1'

PRIMARY FILTER PACK Type: ☒ Sand ☐ Manufactured Grain Size: 16-35 Length: 13.2'

WELL SCREEN Length: 10' Slot Size: 0.010 Type: SCH 80 PVC

SUMP DETAILS Length: 0.5 Ft. Diameter: 2 In. Type: PVC

TYPE OF BACKFILL: SAND

MO 780-1415 (2-94) DISTRIBUTION: WHITE DIVISION CANARY/MONITORING WELL CONTRACTOR PINK/OWNER

RECORD OF DRILLHOLE PZ-106-SS

Sheet 1 of 2

PROJECT: LAIDLAW/RI-PS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/4/95 - 4/5/95
DRILL RIG: SCHRAMM

DATUM: MSL
COORDINATES N: 1068728.3
AZIMUTH: 0

COLLAR ELEV: 461.0
E: 515399.9
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: Dip wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR MW HW CW	STRENGTH INDEX: R5 R4 R3 R2 R1	POINT LOAD INDEX (psi): R1 30, R2 150, R3 300, R4 600, R5 1500, R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
144	0.0-154.9 ft. No sampling conducted See Record of Drillhole for PZ-106-KS														0.0-30.0 ft. Drilling conducted with 6 1/4 in. ID hollow stem augers, then borehole advanced to 154.9 ft. with 5 7/8 in. air rotary bit
146															
148															
150															
152															
154															
	306.10		306.10												
156	154.9-160.3 ft. 154.90 Fresh, thinly bedded to thinly laminated, light olive gray (5Y 6/1), f-m grained, medium strong, AGILLACEOUS LIMESTONE, (SALEM FORMATION) Chert nodules, silt lenses, stylolitic, fossiliferous		154.90						J,I,R						4/4/95 @ 12:20 Begin Run 1 @ 13:30 Rig breaks down
158				1	100 %				J,C,R J,I,R						
160									J,I,SM						4/5/95 @ 7:30 Resume drilling at 159.5 ft.

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

LOGGED: J. MILLER
CHECKED: S. TILTON
DATE: 5/26/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/4/95 - 4/5/95
DRILL RIG: SCHRAMM

DATUM: MSL
COORDINATES N: 1056726.3
AZIMUTH: 0

COLLAR ELEV: 461.0
E: 815399.9
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR, MW, HW, CMP	STRENGTH INDEX: R6, R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): R1 30, R2 150, R3 300, R4 600, R5 1500, R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
160	160.3-165.0 ft. Slightly weathered, thickly laminated, yellowish gray (5Y 7/2), coarse grained, strong, ARENACEOUS LIMESTONE, (SALEM FORMATION)								J,C,SM						
162				1	100 %				J,I,R (2)						
164	Fossil fragments, sandy														
	296.00		296.00												4/5/95 @ 10:00 End Run 1
	End of Record of Drillhole at 165.0 ft. 165.00		165.00												
166															
168															
170															
172															
174															
176															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

LOGGED: J. MILLER
CHECKED: B. TILTON
DATE: 5/26/95

Golder Associates

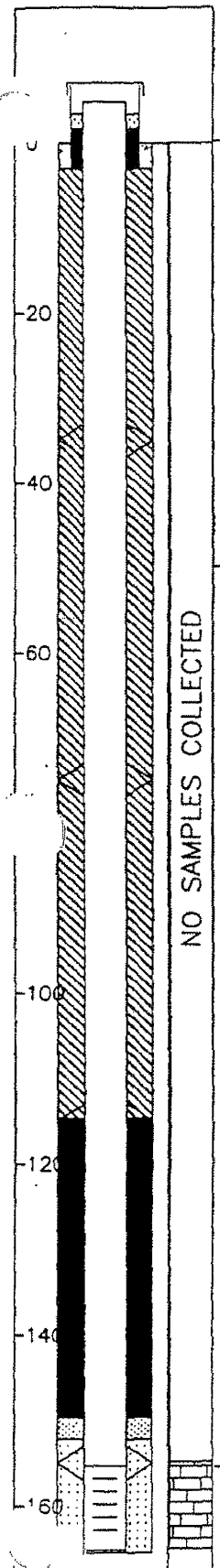
Well No. PZ-106-SS

Boring No. X-Ref: PZ-106-SS

PIEZOMETER CONSTRUCTION SUMMARY

Survey Coords: Northing: 1066726 ft.
Easting: 515400 ft.

Elevation Ground Level 461.0 ft. NGVD
Top of PVC Casing 462.70 ft. NGVD



Not to Scale

Drilling Summary:

Total Depth 165.4 ft.
Borehole Diameter 10 1/4 in. (0.0-23.0 ft.) 5 7/8 in. (23.0-165.4 ft.)
Casing Stickup Height 1.75 ft.
Driller Layne-Western
St. Louis, MO

Rig CME 75, Schramm Portadrill T660H
Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit,
NX Core, 5 7/8 in. Button Bit for Reaming
Drilling Fluid Auger-None, NX Core Water,
Air Rotary
Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75				
Schramm Rotary	4/4/95	8:25	4/5/95	10:00
Geophys.Logging:				
Casing:	4/5/95	11:45	4/5/95	12:10
Filter Placement:	4/5/95	12:15	4/5/95	12:30
Cementing:				
Development				
Bentonite Grout	4/5/95	13:05	4/5/95	13:41
Bentonite Seal	4/5/95	12:30	4/5/95	13:05

Well Design & Specifications

Basis: Geologic Log X Geophysical Log
Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.75	-	155.30	C1	462.70	-	305.65
155.30	-	165.10	S1	305.65	-	295.85
165.10	-	165.43	C2	295.85	-	295.52
	-				-	
	-				-	
	-				-	

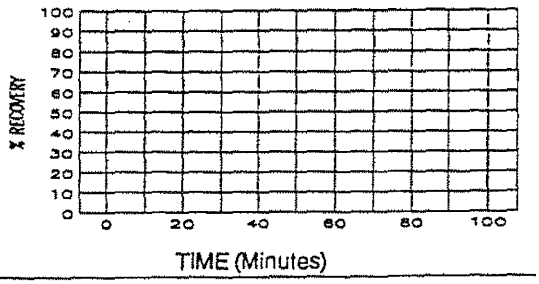
Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings
C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)
Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings
Sand Pack: 16-35 mesh Silica Sand, 152.2-165.0 ft.
Filter Pack: Less than 50 mesh Silica Sand, 149.7-152.2 ft.
Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-114.7 ft.
Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 114.7-149.7 ft.
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by J. Miller
Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO
File Name PZ106SS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122480	CHECK NO
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

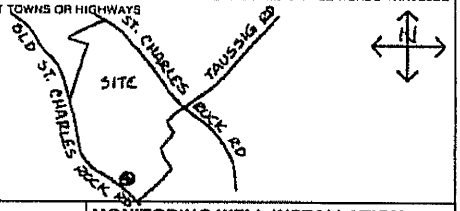
INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL
WELL NUMBER: PZ-106-SS
SITE ADDRESS: ST. CHARLES ROCK RD. | CITY: BRIDGETON | STATE: Mo | ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC. | TELEPHONE: 314-241-3710
ADDRESS: 1838 N. BROADWAY | CITY: ST. LOUIS | STATE: Mo | ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL SHOW LOCATION IN SECTION PLAT
COUNTY: ST. LOUIS
ELEVATION: 460.9
AREA NO.:
SMALLEST ¼ ____ ¼ ____ ¼ LARGEST ¼ ____ ¼
SEC. ____ TWN. 47 N,RNG 5 (E) OR W
LAT. 38 ° 45 ' 47 " LONG. 90 ° 26 ' 46 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME: LAYNE WESTERN Co., INC.

DRILLING CONTRACTOR'S NAME: LAYNE WESTERN Co., INC.

TYPE OF INSTALLATION: ☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL: FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL:

ELEVATION OF MEASURING POINT: 462.70

MEASURING POINT IS: ☒ TOP OF RISER PIPE ☐ OTHER

DRILLING EQUIPMENT: ☒ AIR ROTARY ☒ AUGER TYPE 6¼ H.S.A. ☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED: ☒ YES, AT 15', 35', 75', 115', 155' ☒ STAINLESS STEEL ☐ OTHER ☐ NO

MULTIPLE CASED WELLS: SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED: 4-05-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Michael P. Vogl
PERMIT NUMBER: 001256WIM | DATE: 5-10-95
SIGNATURE (DRILLING CONTRACTOR): Michael P. Vogl
PERMIT NUMBER: 001256WIM | DATE: 5-10-95

NOTE: Record the fraction of a foot in decimal, not in inches

Top of Riser Elevation: 462.7
LOCKING CAP - (Y) / N (Circle one)
CAP VENT - Y / (N) (Circle one)
PROTECTIVE CASING Type: STEEL Size: 5"x5"x5' Bore Hole Diameter: 10.25'
WEEP HOLE - Y / N (Circle one)

Ground Surface Elevation: 460.9 Ft

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
Depth to bottom of Protective Casing Seal:	3.0	
Depth to Base of Annular Seal:	114.7	
Depth to Base of Bentonite Seal:	147.7	
Depth to Base of Secondary Filter Pack:	152.2	
Depth to Top of the Screen:	155.1	
		Limestone
Depth to Bottom of the Screen:	165.1	
Plug Back Total Depth		
Original Total Depth:	165.4	

PROTECTIVE CASING SEAL Type: ☒ Concrete ☐ Cement Slurry
RISER PIPE Length: 156.9' Diameter: 2" Type of Material: SCH. 80 PVC
BOREHOLE DIAMETER: 5 7/8 in.
ANNULAR SEAL Type: ☒ Bentonite Slurry ☐ Cement Slurry ☐ Non Slurry Bentonite
BENTONITE SEAL Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite Length of Seal: 35 Ft.
SECONDARY FILTER PACK Type: ☒ Sand (Optional) ☐ Manufactured Grain Size: SUGAR <50 Length: 2.5'
PRIMARY FILTER PACK Type: ☒ Sand ☐ Manufactured Grain Size: 16-35 Length: 13.2'
WELL SCREEN Length: 10' Slot Size: 0.010" Type: SCH. 80 PVC
SUMP DETAILS Length: 0.3 Ft. Diameter: 2 In. Type: PVC
TYPE OF BACKFILL: SAND

DISTRIBUTION: WHITE-DIVISION CANARY-MONITORING WELL CONTRACTOR PINK-OWNER

RECORD OF DRILLHOLE PZ-106-SD

Sheet 1 of 2

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/24/95
DRILL RIG: SCRAMM

DATUM: MSL
COORDINATES N: 1068715.1
AZIMUTH: 0

COLLAR ELEV: 461.5
E: 515418.0
INCLINATION: -90

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	ROD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: 0 DIP wrt CORE AXIS 90 (35 60)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
178	0.0-189.9 ft. No sampling conducted See Record of Drillhole for PZ-106-KS														0.0-30.0 ft. Drilling conducted with 6 1/4 in. ID hollow stem augers, then borehole advanced to 189.9 ft. with 5 7/8 in. air rotary bit
176															
180															
182															
184															
186															
188															
190	271.60 189.9-199.9 ft. 189.90 Fresh, thinly laminated, light olive gray (5Y 6/1), f-m grained, medium strong, ARENACEOUS LIMESTONE, (SALEM FORMATION) Fossiliferous		271.60 189.90	1	99%				J,I,R						3/24/95 @ 11:00 Began coring
192															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 5/26/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-SD

Sheet 2 of 2

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/24/95
DRILL RIG: SCRAMM

DATUM: MSL
COORDINATES N: 1068715.1
AZIMUTH: 0

COLLAR ELEV: 461.5
E: 515416.0
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX (SW, FR, MW, HW, CW)	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
192	189.9-199.9 ft. Fresh, thinly laminated, light olive gray (5Y 6/1), f-m grained, medium strong, ARENACEOUS LIMESTONE, (SALEM FORMATION) Fossiliferous								J,I,SM			R6 R5 R4 R3 R2 R1	R1 30 R2 150 R3 350 R4 600 R5 1500 R6		
194									J,I,R						
196				1	99%										
198															
	261.60		261.60												3/24/95 @ 13:15 Finish Run 1
200	End of Record of Drillhole at 208.0 ft. 199.90		199.90												
202															
204															
206															
208															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

LOGGED: S. TILTON
CHECKED: R. BOOTH
DATE: 5/26/95

Golder Associates

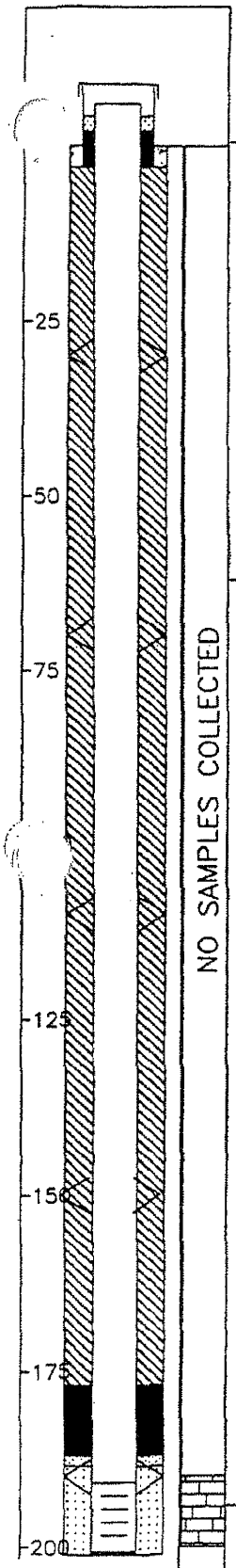
Well No. PZ-106-SD

Boring No. X-Ref: PZ-106-SD

PIEZOMETER CONSTRUCTION SUMMARY

Survey Coords: Northing: 1066715 ft.
Easting: 515416 ft.

Elevation Ground Level 461.5 ft. NGVD
Top of PVC Casing 463.42 ft. NGVD



Not to Scale

Drilling Summary:

Total Depth 201.1 ft.
Borehole Diameter 10 1/4 in. (0.0-26.0 ft.) 5 7/8 in. (26.0-201.1 ft.)
Casing Stickup Height 1.97 ft.
Driller Layne-Western
St. Louis, MO

Rig CME 75, Schramm Portadrill T660H
Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit,
NX Core, 5 7/8 in. Button Bit for Reaming
Drilling Fluid Auger-None, NX Core Water,
Air Rotary
Protective Casing 8x8 in. Square Steel, by 5 ft. long

Well Design & Specifications

Basis: Geologic Log X Geophysical Log X
Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.97	-	190.79	C1	463.42	-	270.66
190.79	-	200.59	S1	270.66	-	260.86
200.59	-	200.93	C2	260.86	-	260.52
	-				-	
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings
C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)
Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings
Sand Pack: 16-35 mesh Silica Sand, 188.5-201.1 ft.
Filter Pack: Less than 50 mesh Silica Sand, 187.0-188.5 ft.
Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-177.0 ft.
Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 177.0-187.0 ft.
Concrete: 0.0-3.0 ft.

Construction Time log:

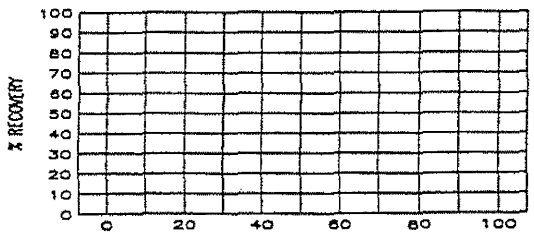
Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75				
Schramm Rotary	3/23/95	16:15	3/24/95	13:00
Geophys.Logging:	3/24/95	16:15	3/24/95	18:30
Casing:	3/24/95	12:40	3/24/95	13:00
Filter Placement:	3/24/95	13:10	3/24/95	13:40
Cementing:				
Development				
Bentonite Grout	3/24/95	14:00	3/24/95	14:45
Bentonite Seal	3/24/95	13:40	3/24/95	13:55

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by W. Herst
Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO
File Name PZ106SD

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 15091	CHECK NO.
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

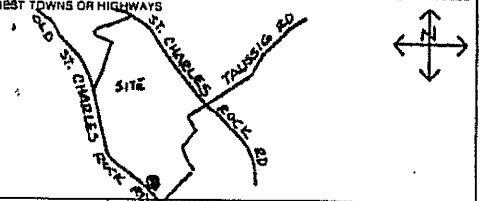
INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL
WELL NUMBER: PZ-106-SD
SITE ADDRESS: St. Charles Rock Rd. | CITY: Bridgeton | STATE: Mo. | ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC. | TELEPHONE: 314-241-3710
ADDRESS: 1838 N. Broadway | CITY: St. Louis | STATE: Mo. | ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL SHOW LOCATION IN SECTION PLAT
COUNTY: St. Louis
ELEVATION: 461.4
AREA NO.:
SMALLEST ¼ LARGEST ¼
SEC. ____ TWN. 47 N,RNG. 5 (E OR W)
LAT. 38° 45' 47" LONG. 90° 26' 46"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME: LAYNE WESTERN CO., INC.

DRILLING CONTRACTOR'S NAME: LAYNE WESTERN CO., INC.

TYPE OF INSTALLATION: [X] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL: FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL:

ELEVATION OF MEASURING POINT: 463.42

MEASURING POINT IS: [X] TOP OF RISER PIPE [ ] OTHER

DRILLING EQUIPMENT: [X] AIR ROTARY [X] AUGER TYPE 6¼ H.S.A. [ ] REVERSE ROTARY [ ] OTHER

CENTRALIZERS USED: [X] YES, AT 6 TOTAL [X] STAINLESS STEEL [ ] OTHER [ ] NO

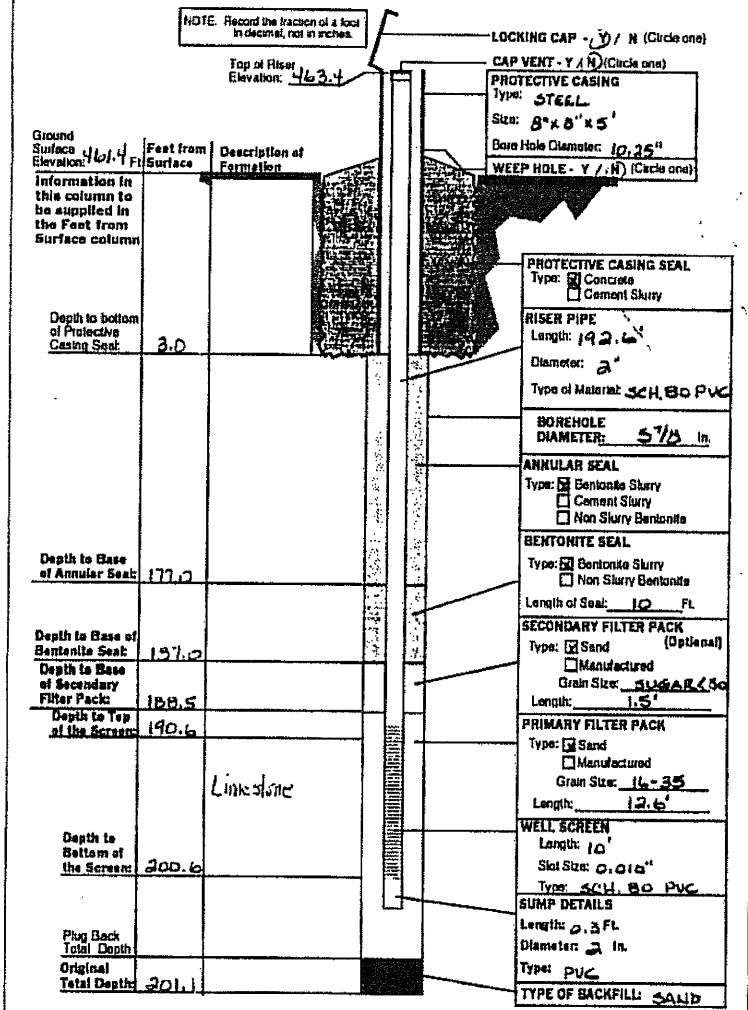
MULTIPLE CASED WELLS: SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED: 8-26-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Michael P. Vogt
PERMIT NUMBER: 001256WM DATE: 5-10-95
SIGNATURE (DRILLING CONTRACTOR): Michael P. Vogt
PERMIT NUMBER: 001256WM DATE: 5-10-95

NOTE: Record the fraction of a foot in decimal, not in inches.



MO 780 1415 (2-94) DISTRIBUTION: WHITE-DIVISION CANARY-MONITORING WELL CONTRACTOR PINK-OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION: LAIDLAW\RI-FS\MO, WEST LAKE LANDFILL, OPERABLE UNIT 2	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-106-KS
		SHEET 1 OF 2
	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP); SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING START / FINISH
NORTHING: 1066704.02	WATER LEVEL	TIME: 10:30 / 13:55
DATUM EASTING: 515431.62 ELEVATION 460.8	TIME	
	DATE	DATE: 2/28/95 / 2/28/95
	CASING DEPTH	
DRILL RIG: CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE: BEARING		
SAMPLE HAMMER		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1					(0.0-2.0 Ft.) No sample collected		Note: All depth measured from top of 1 foot thick gravel pad
					(458.8) 2.0		
2	2 2 2 4	1.5' / 2.0' (75%)			(2.0-4.7 Ft.) Firm, brownish gray (5YR 4/1), CLAYEY SILT, NR, damp, (CL-ML), (LOESS)	SP ②	
3							
4	2 4 8 10	1.7' / 2.0' (85%)			(456.1) 4.7	SP ③	
5					(4.7-8.8 Ft.) Very stiff, brownish gray (5YR 4/1), CLAY, little silt, NR, damp, (CH), (LOESS)		
6		2.0' / 2.0' (100%)				SH ④	
7							
8	3 6 8 9	1.2' / 2.0' (60%)			(8.8-11.9 Ft.) Very stiff, mottled pale yellowish brown (10YR 6/2) and moderate yellowish brown (10YR 5/4), CLAY, little silt, iron stained, NR, damp, (CL), (LOESS) @ 10.0-12.0 Ft., stiff	SP ⑤	
9							
10	4 4 6 7	0.1' / 2.0' (5%)				SP ⑥	
11							
12	1 5 5 5	0.9' / 2.0' (45%)			(448.9) 11.9 (11.9-15.0 Ft.) Stiff, light olive gray (5Y 5/2), CLAYEY SILT, iron stained, NR, damp, (CL-ML), (LOESS)	SP ⑦	
13							
14	8 13 23 19	1.0' / 2.0' (50%)				SP ⑧	

DRILLING CONTR: LAYNE-WESTERN

LOGGED BY: H. HIRT

DATE: 2/28/95

CHK'D BY: W. HERST

JOB NO.: 943-2848

FILENAME: PZ106KS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
LAIDLAW\RI-FS\MO WEST LAKE LANDFILL OPERABLE UNIT 2	4.25 inch I.D. Hollow Stem Auger	PZ-106-KS
	SAMPLING METHOD:	SHEET 2 OF 2
	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)	DRILLING
	SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	START / FINISH

WATER LEVEL					TIME	TIME
TIME					10:30	13:55
DATE					DATE	DATE
CASING DEPTH					2/28/95	2/28/95

NORTHING: 1066704.02
DATUM EASTING: 515431.62 ELEVATION 460.8

DRILL RIG CME 75 - TRUCK MOUNT

SURFACE CONDITIONS

ANGLE BEARING

SAMPLE HAMMER

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
					(15.0-15.5 Ft.) Compact, pale yellowish brown (10YR 6/2), Fine SAND, to gravel, NR, dry, (SP), (ALLUVIAL) (445.3) 15.5	SP 8	
16	50/5"	0.0'/2.0' (0%)			(15.5-21.2 Ft.) Dense, very light gray (N8), LIMESTONE GRAVEL interbedded, with medium dark gray (N4), Fine SAND, (SR gravel, NR sand), dry, (GP), (ALLUVIAL)	SP 9	
17							
18	10 26 14 15	0.8'/2.0' (40%)				SP 10	
19							
20	6 15 23 32	1.0'/2.0' (50%)				SP 11	
21					(439.6) 21.2 (21.2-27.7 Ft.) Hard, medium dark gray (N4), CLAY, NR, damp, (CH), (ALLUVIUM)		
22	8 18 24 30	0.6'/2.0' (30%)				SP 12	
23							
24	6 13 20 29	1.3'/2.0' (65%)			@ 24.7 ft., becoming dark gray (N3)	SP 13	
25							
26	9 17 38 40	0.8'/2.0' (40%)				SP 14	
27					(433.1) 27.7 (27.7-29.3 Ft.) Hard, medium light gray (N6), SILTY CLAY, NR, dry, (CL), (ALLUVIUM) (431.5) 29.3		
28	19 39 50/3"	0.9'/2.0' (45%)			(29.3-30.0 Ft.) Very dense, very light gray, (N8), LIMESTONE GRAVEL, SR, dry, (GP)	SP 15	
29					End of Soil Borehole Log at 30.0 ft. See PZ-106-KS Record of Drillhole for rock descriptions		Auger/split spoon refusal at 30.0 feet

DRILLING CONTR LAYNE-WESTERN

LOGGED BY M. HIRT

DATE 2/28/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ106KS

RECORD OF DRILLHOLE PZ-106-KS

Sheet 1 of 23

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 843-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 461.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
16	0.0-30.0 ft. See Soil Borehole Log PZ-106-KS														
18															
20															
22															
24															
26															
28															
30	431.80		431.80												
	30.0-36.5 ft. 30.00 Fresh, medium bedded, yellowish gray (5Y 8/1) to light olive gray (5Y 5/1), medium grained, medium strong, ARENACEOUS LIMESTONE, (ST. LOUIS FORMATION)		30.00	1	69%				J,I,R (2) J,ST,R J,I,R J,PL,SM						2/28/95 @ 14:45 Begin coring
32															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

Sheet 2 of 23

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.8
AZIMUTH: ° 0

COLLAR ELEV: 461.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, X-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infil, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (FR, SW, MW, HW, CW)	STRENGTH INDEX (R6, R5, R4, R3, R2, R1)	POINT LOAD INDEX (psi) (R1 30, R2 150, R3 300, R4 600, R5 1500, R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32	30.0-36.5 ft. Fresh, medium bedded, yellowish gray (5Y 8/1) to light olive gray (5Y 6/1), medium grained, medium strong, ARENACEOUS LIMESTONE, (ST. LOUIS FORMATION)							30	J,I,R						
	33.5-34.0 ft. Hard clay infilling							30	J,ST,R						
34	34.0-34.5 ft. ARENACEOUS DOLOMITE 427.30			1	69%			30	J,PL,R,CL						
	34.50														Core loss probably due to highly fractured nature of rock
36									Core Loss						
			425.30												
	36.5-37.9 ft. Highly weathered, thickly laminated, medium dark gray (N4), fine grained, medium strong, SILTSTONE. (ST. LOUIS FORMATION)		36.50												
	Cross bedded, Limestone 423.90														
38	breccia 37.90														
	37.9-41.5 ft. Completely weathered, thinly laminated, grayish black (N2), very fine grained, extremely weak, CLAYSTONE. (ST. LOUIS FORMATION)														
	38.5-38.6 ft. 60° silt crossbeds, pyrite crystals abundant			2	83%			60	B,PL,SM (3)						
40								90	J,I,SM (5)						
	41.0-41.5 ft. Greenish gray (5GY 6/1) clay layer 420.30							90	J,I,SM (2)						
	41.50							60	J,I,R						
	41.5-42.7 ft. Fresh, medium bedded, light greenish gray (5GY 8/1), medium grained, medium strong, ARENACEOUS LIMESTONE, (ST. LOUIS FORMATION) 419.10							60	B,PL,SM						
42			419.30												
	42.5-42.7 ft. Clay infilling 42.70		42.50												Bit getting plugged off
	42.7-46.4 ft. Fresh, thickly bedded, medium light gray (N6), medium grained, medium strong, SANDSTONE. (ST. LOUIS FORMATION)														
44				3	96%										
46	46.0-46.5 ft. Siltstone							90	B,I,R						
	46.7-46.8 ft. Claystone							90	J,I,R						
	46.8-47.1 ft. Chert														
	47.3-47.5 ft. Siltstone		414.50												
	47.5-48.1 ft. Clay layer		47.30	4	96%										
48															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.8
AZIMUTH: 0

COLLAR ELEV: 461.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Silkensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48	413.40 / 48.40														
	48.4-52.3 ft. Moderately weathered, medium bedded, medium light gray (N6), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic								J,I,R,CL						
50	49.6-50.6 ft. Chert nodules 50.0-50.1 ft. Claystone 50.3-50.6 ft. Claystone 51.0-51.5 ft. Claystone			4	96%										
52	52.3-55.7 ft. Slightly weathered, medium bedded, light olive gray (5Y 6/1), microcrystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, numerous pyrite crystals		409.50 / 52.30						J,I,R (2)						
									J,I,R						
									J,I,R						
									J,I,R,CL						
									J,I,R (2)						
54															
									J,I,R (2)						
56	55.7-59.6 ft. Slightly weathered, medium bedded, medium light gray (N6), fine grained, medium strong, ARENACEOUS LIMESTONE, (ST. LOUIS FORMATION) Porous/vuggy, some pyrite crystals and chert nodules, vugs <1 mm. diameter			5	99%				J,PL,R,CL						
58															
	402.20 / 59.60		402.40 / 59.40												
60	59.6-70.0 ft. Slightly weathered, medium bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARENACEOUS DOLOMITE, (ST. LOUIS FORMATION) Porous/vuggy, vugs <1 mm.														
				6	98%				J,PL,SM						
62	62.2-62.8 ft. Claystone 62.8-63.4 ft. Calcite crystals								B,PL,SM						
									B,PL,SM						
									J,I,R, calcite crystals						
									J,I,R						
64															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

Sheet 4 of 23

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.8
AZIMUTH: 0

COLLAR ELEV: 461.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	ROD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64															
	64.7-65.2 ft. calcite crystals								J,I,R calcite crystals J,I,R						
									J,I,R J,I,R calcite crystals						
66	65.9-66.9 ft. Calcite crystals and iron staining			6	98%										
			394.20 67.60												8:45 End Core Run 6
68	67.8-68.6 ft. Calcite crystals, some iron staining								J,I,SM						
									J,I,R J,I,SM						
	69.7-70.7 ft. Calcite crystals 391.80								J,PL,SM						
70	70.0-98.0 ft. 70.00 Fresh, medium bedded, light olive gray (5Y 6/1), medium grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)								J,PL,SM J,I,SM J,I,R,CL J,I,R,Fe J,I,R						
				7	99%										
72															
	72.6-73.3 ft. 0° calcite vein														
	73.4-73.6 ft. Arenaceous, slightly weathered								J,I,R,CL (2)						
74			387.40 74.40												9:30 End Core Run 7
									J,I,R (2)						
76	76.4-80.9 ft. Microcrystalline, stylolitic								J,I,R						
				8	100%				J,I,SM (3)						
78									J,I,R (2)						
	79.6-79.8 ft. Dolomite layer								J,PL,SM,CL						
80															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 461.8
E: 815432.1
INCLINATION: -90

J-Joint, F-Fault, B-Shear, S-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: FR, SW, MW, HW, CW	STRENGTH INDEX: R6, R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): R6 >1500, R5 600-1500, R4 300-600, R3 130-300, R2 30-130, R1 <30	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	70.0-98.0 ft. Fresh, medium bedded, light olive gray (5Y 6/1), medium grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)														
	80.9-82.8 ft. Fine grained, arenaceous			8	100 %				J,I,R (2)						
82			379.00 82.80												10:15 End Core Run 8
									J,PL,SM,CL J,I,R						
84	83.9-84.2 ft. Calcite filled vugs														
	85.0-87.1 ft. Microcrystalline, stylolitic								J,I,R						
86				9	100 %				J,PL,SM						
	87.1-88.3 ft. Porous/vuggy Dolomite								J,PL,SM						
88	88.3-90.6 ft. Microcrystalline, stylolitic								B,I,R J,I,R						
			372.40 89.40						J,I,R						11:05 End Core Run 9
90	90.6-92.0 ft. Porous/vuggy Dolomite														
									J,PL,R						
92	92.2-94.1 ft. Microcrystalline, some silty laminae			10	99%				J,I,R,CL J,I,SM J,I,R J,I,R						
94									J,I,R,CL						
									J,I,R,CL						
96	95.9-96.1 ft. Moderately weathered, arenaceous														

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

Sheet 6 of 23

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 481.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, B-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

LENGTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
96	70.0-98.0 ft. Fresh, medium bedded, light olive gray (5Y 6/1), medium grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)								J,PL,SM,CL						
	97.5-97.8 ft. Dolomitic		383.80	10	89%										
98	98.0-119.3 ft. Slightly weathered, medium bedded, light olive gray (5Y 6/1), fine grained, medium strong, DOLOMITE, (ST. LOUIS FORMATION) Porous/vuggy		98.00												
			382.40												
			99.40												11:55 End Core Run 10
100															
	101.2-104.3 ft. Medium grained Limestone								J,PL,SM,CL						
									J,PL,SM						
102									J,I,R						
									J,PL,R						
									J,PL,R (2)						
104															
				11	100%				J,PL,SM,CL						
106															
	107.1-108.0 ft. Interbedded Limestone and Dolomite														
108	108.0-110.9 ft. Arenaceous Limestone								J,I,R						
									J,I,SM,CL						
			352.40												
			109.40						J,I,R						13:25 End Core Run 11
110	110.0-110.3 ft. 45° healed fracture								J,I,R (2)						
									J,I,R						
				12	95%				J,I,R,CL						
	111.0-111.9 ft. Moderate to highly weathered, arenaceous Dolomite, some chert														
112															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 481.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
112	112.0-112.4 ft. Crystalline Limestone, moderately weathered								J,I,R,CL						
									J,ST,SM						
									J,I,SM (2)						
	113.2-115.0 ft. Crystalline Limestone								J,I,SM,CL (2)						
									J,PL,SM						
114									J,I,SM						
	115.0-115.3 ft. 10° calcite filled vein (2 mm. thick)								J,I,SM						
				12	98%										
116															
	117.0-119.0 ft. 10° calcite filled veins (2 mm. thick)								J,I,SM						
118															
			342.50 / 119.30												
	119.3-133.8 ft. Fresh, medium bedded, light olive gray (5Y 5/2), medium grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Some braciopod fossils		342.40 / 119.40												14:05 End Core Run 12
120															
122															
	123.1-124.9 ft. Greenish gray (5GY 6/1) to dark greenish gray (5GY 4/1). Dolomite with calcite veins and vugs			13	98%										
124									J,I,R						
	124.9-126.0 ft. 10° calcite filled veins								J,I,R,calcite						
	125.6-133.2 ft. Microcrystalline to fine grained, thinly laminated, Silt and Dolomite interbeds								J,PL,R (2)						
126									J,I,R,CL (2)						
	127.6-131.7 ft. Large chert nodules														
128															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 461.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
128	119.3-133.8 ft. Fresh, medium bedded, light olive gray (5Y 5/2), medium grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Some brachiopod fossils			13	98%				J,PL,SM						
			332.40 / 129.40												14:50 End Core Run 13
130									J,PL,SM						
									J,I,SM						
									J,I,SM (2)						
132	132.4-132.5 ft. Claystone								B,PL,SM						
			328.90 / 133.60												
134	133.6-146.6 ft. Fresh, thinly bedded, light olive gray (5Y 5/2), very coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (SALEM FORMATION)			14	100 %										@ 133.8 ft. Inferred top of SALEM FORMATION
136															
138	138.7-139.7 ft. Fine to medium grained arenaceous Limestone, cross bedded		322.60 / 139.20						J,I,SM						8:45 End Core Run 14
									J,PL,SM						
140	139.7-142.1 ft. Fine grained to microcrystalline 140.4-140.7 ft. Chert layer														
									J,PL,SM						
				15	99%				J,PL,SM,CL						
142	142.1-142.4 ft. Clay layer 142.5-142.7 ft. Chert nodules								J,I,SM,CL (2)						
	143.4-146.1 ft. Medium grained Limestone								J,I,R						
144															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

Sheet 8 of 23

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 109703.9
AZIMUTH: 0

COLLAR ELEV: 461.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
128	119.3-133.8 ft. Fresh, medium bedded, light olive gray (5Y 5/2), medium grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Some braciopod fossils			13	98%				J,PL,SM						
			332.40 / 129.40												14:50 End Core Run 13
130									J,PL,SM						
									J,I,SM						
									J,I,SM (2)						
132	132.4-132.5 ft. Claystone								B,PL,SM						
			326.00 / 133.80												@ 133.8 ft. Inferred top of SALEM FORMATION
134	133.8-146.6 ft. Fresh, thinly bedded, light olive gray (5Y 5/2), very coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (SALEM FORMATION)			14	100 %										
136															
138															
	138.7-139.7 ft. Fine to medium grained arenaceous Limestone, cross bedded		322.60 / 139.20						J,I,SM						
									J,PL,SM						8:45 End Core Run 14
	139.7-142.1 ft. Fine grained to microcrystalline														
140	140.4-140.7 ft. Chert layer														
									J,PL,SM						
				15	98%				J,PL,SM,CL						
142	142.1-142.4 ft. Clay layer														
	142.5-142.7 ft. Chert nodules								J,I,SM,CL (2)						
									J,I,R						
	143.4-146.1 ft. Medium grained Limestone														
144															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 461.8
E: 515402.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
144	144.0-144.4 ft. Chert layer														
146	146.1-146.2 ft. Chert nodule 146.2-146.6 ft. Thinly laminated, arenaceous Limestone, cross bedded 315.20 / 146.60			15	99%				J,I,R (2)						
148	146.6-152.6 ft. Slightly weathered, medium bedded, pale yellowish brown (10YR 6/2) to dark yellowish brown (10YR 4/2), fine grained, medium strong, ARGILLACEOUS DOLOMITE, (SALEM FORMATION) Slightly porous/vuggy, interbedded chert nodules		313.00 148.80												
	148.8-149.0 ft. Chert zone														9:50 End Core Run 15
150	150.4-150.7 ft. Chert zone			16	100 %				J,U,R J,I,SM J,I,R (2)						Driller reports rock is very hard
152	151.8-152.0 ft. Chert zone 152.5 ft. 1 in. diameter, black claystone clast 309.20 / 152.60								J,I,R						
	152.6-160.5 ft. Fresh, thinly laminated, light olive gray (5Y 5/2), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (SALEM FORMATION) Crossbedded, numerous chert nodules/beds		308.70 153.10						J,PL,SM						10:40 End Core Run 16
154	153.0-153.6 ft. Chert zone								J,PL,SM						
	155.5-155.6 ft. Chert zone								J,I,R						Driller reports rock is very hard
156	156.1-157.5 ft. Pale yellowish brown (10YR 6/2) to dark yellowish brown (10YR 4/2) 156.4 ft. Brachiopod fossils 157.0-157.2 ft. Chert zone			17	97%										
158	158.2-158.4 ft. Chert zone								J,I,SM J,U,SM J,U,SM (2)						
	159.0-159.4 ft. Chert zone		302.50 159.30						J,U,SM J,PL,SM J,I,SM						11:50 End Core Run 17
160	159.6-159.7 ft. Chert nodule			18	100 %										

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

Sheet 10 of 23

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 461.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
160	160.2-160.4 ft. Chert zone 160.5-174.3 ft. Fresh, thickly laminated, medium light gray (N6), coarse grained, medium strong, FOSSILIFEROUS DOLOMITIC LIMESTONE, (SALEM FORMATION)						0	J,I,SM					
162							0	J,U,R					
164			18	100 %			0	J,ST,R					
166							0	J,PL,SM					
168		292.50											13:45 End Core Run 18
170		169.30	19	100 %									
172													
174		287.50											
	174.3-178.8 ft. Fresh, thinly bedded, pale yellowish brown (10YR 6/2) to medium light gray (N6), f-c grained, medium strong, CALCAREOUS DOLOMITE, (SALEM FORMATION) Some fossils, cross bedding	174.30											
178													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

Sheet 11 of 23

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 461.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR, MW, HW, CW	STRENGTH INDEX: R6	POINT LOAD INDEX (psi): R1 30, R2 150, R3 360, R4 600, R5 1500, R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
176	174.3-178.8 ft. Fresh, thinly bedded, pale yellowish brown (10YR 6/2) to medium light gray (N6), fine to coarse grained, medium strong, CALCAREOUS DOLOMITE, (SALEM FORMATION) Some fossils, cross bedding								J,PL,SM						
									J,PL,R						
				19	100 %										
178	176.9-177.2 ft. Chert zone														
	178.3-178.5 ft. Chert zone														
	178.8-187.0 ft. Slightly weathered, medium bedded, moderate yellowish brown (10YR 5/4), medium grained, medium strong, DOLOMITE, (SALEM FORMATION) Some fossils, calcite crystals, porous/vuggy		282.50						J,I,R						
			179.30												14:30 End Core Run 19
180	180.2-180.3 ft. Chert nodule								J,PL,R						
182															
184	183.9-184.1 ft. Chert zone								J,I,R						
				20	99%				J,I,R						
186															
			274.80						J,I,SM (2)						
	187.0-189.3 ft. Fresh, thinly laminated, pale yellowish brown (10YR 5/2), medium grained, medium strong, DOLOMITIC LIMESTONE, (SALEM FORMATION) Some cross bedding, fossils		187.00												
188			272.50												
	189.3-201.3 ft. Fresh, thickly laminated, light olive gray (5Y 6/1), interbedded medium and very coarse grained, medium strong, ARGILLACEOUS FOSSILIFEROUS LIMESTONE, (SALEM FORMATION)		189.30												15:30 End Core Run 20
190	190.8-191.4 ft. Brecciated			21	98%										
192															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

Sheet 12 of 23

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/26/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 461.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEL.)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
192	189.3-201.3 ft. Fresh, thickly laminated, light olive gray (5Y 6/1), interbedded medium and very coarse grained, medium strong, ARGILLACEOUS FOSSILIFEROUS LIMESTONE. (SALEM FORMATION)														
194															
	195.4-195.7 ft. Cross bedded, brecciated			21	98%										
196															
198															
			262.50												
			199.30												16:35 End Core Run 21
200															
	200.5-201.2 ft. Cross bedded, brecciated														
			260.60												
	201.2-209.2 ft. 201.20 Fresh, thinly laminated, medium dark gray (N4), very fine grained, weak, CALCAREOUS CLAYSTONE. (WARSAW FORMATION) Brachiopod fossils								J,PL,SM,CL						
202															201.9-202.5 ft. GTS-1 collected for perm. testing at laboratory
				22	99%										
204															
	205.1-207.2 ft. Medium gray (N5), fine to medium grained														
206									J,I,R,CL						
	207.1-207.2 ft. Brecciated														
	207.3-End of Borehole Olive gray (5Y 4/1), medium strong								J,PL,SM,CL						
208															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

Sheet 13 of 23

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 108703.8
AZIMUTH: 0

COLLAR ELEV: 481.8
E: 515432.1
INCLINATION: -90

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
FL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR, MW HW, CW	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
208	201.2-209.2 ft. Fresh, thinly laminated, medium dark gray (N4), very fine grained, weak, CALCAREOUS CLAYSTONE, (WARSAW FORMATION) 252.60			22	99%										
	Brachiopod fossils 209.20		252.50												17:35 End Core Run 22
210	209.2-225.4 ft. Fresh, medium bedded, olive gray (5Y 4/1), very coarse grained, medium strong, FOSSILIFEROUS LIMESTONE. (WARSAW FORMATION)		209.30						J,PL,SM						3/11/95 @ 10:15 Begin coring Run 23 after installing 6 in. dia. casing to 204 ft.
212	212.2-213.7 ft. Slightly weathered, porous/vuggy, calcareous Dolomite, some fossils								B,PL,SM						
									J,I,SM (2)						
214									J,I,SM						
				23	98%										
216															
	217.3-218.5 ft. Medium grained														
218															
			242.50												
			219.30												12:30 End Core Run 23
220	220.1-221.9 ft. Medium grained								J,PL,R						
									J,I,R						
				24	101 %										
222															
224															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 461.6
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, B-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR, MW, HW, CW	STRENGTH INDEX: R0 R1 R2 R3 R4 R5 R6	POINT LOAD INDEX (psi): R1 30, R2 150, R3 300, R4 600, R5 1500, R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
224	209.2-225.4 ft. Fresh, medium bedded, olive gray (5Y 4/1), very coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (WARSAW FORMATION)														
	225.4-233.2 ft. Fresh, medium bedded, olive gray (5Y 4/1), fine grained, weak, CALCAREOUS CLAYSTONE, (WARSAW FORMATION) Some calcite crystals, fossils 225.4-228.3 ft. Slightly porous/vuggy (<1 mm.)		225.40												
226				24	101 %				J,ST,SM,CL						
228															
			232.50												
230			229.30												13:55 End Core Run 24 229.6-230.1 ft. GTS-2 collected for perm. testing at laboratory
232									J,I,SM,CL						
	228.60 233.2-251.3 ft. Fresh, medium bedded, olive gray (5Y 4/1), very coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (WARSAW FORMATION) Stylolitic, some calcite crystals		233.20						J,PL,SM						
234				25	98%										
236	235.9-238.3 ft. Slightly weathered								J,I,R						
238															
	239.0-240.0 ft. Slightly weathered		222.50						J,I,R						
			239.30						J,I,R						
				26	100 %				J,I,R						14:50 End Core Run 25
240															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

Sheet 15 of 23

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 481.6
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
Pl-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	ROD (60 80 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP WIT CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR, MW HW, CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30, R2 150, R3 300, R4 600, R5 1500, R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
ROCK TYPE															
240	233.2-251.3 ft. Fresh, medium bedded, olive gray (5Y 4/1), very coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (WARSAW FORMATION) Stylolitic, some calcite crystals								J,I,R						
242															
244				26	100 %										
246	246.3-246.5 ft. Fine grained, Dolomitic Limestone														
248			212.50 249.30												15:40 End Core Run 26
250	250.3-251.3 ft. Medium grained								J,I,R						
			210.50						J,I,R J,I,R						
252	251.3-257.7 ft. 251.30 Slightly weathered, medium bedded, olive gray (5Y 4/1), fine grained, weak, CALCAREOUS CLAYSTONE, (WARSAW FORMATION) Porous/vuggy (<1 mm.)			27	98%				J,PL,SM,CL (2)						
254															
256															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

Sheet 18 of 23

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 481.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
256	251.3-257.7 ft. Slightly weathered, medium bedded, olive gray (5Y 4/1), fine grained, weak, CALCAREOUS CLAYSTONE, (WARSAW FORMATION) Porous/vuggy (<1 mm.)								J,PL,SM						
	204.10 / 257.70			27	98%										
258	257.7-259.7 ft. Fresh, medium bedded, olive gray (5Y 4/1), medium grained, medium strong, FOSSILIFEROUS LIMESTONE, (WARSAW FORMATION)								J,PL,SM,CL						
			202.50												
	202.10		259.30												16:25 End Core Run 27
260	259.7-263.7 ft. Fresh, medium bedded, olive gray (5Y 4/1), fine grained, weak, CALCAREOUS CLAYSTONE, (WARSAW FORMATION)								B,I,SM,CL						
262	261.8-262.3 ft. Calcite crystals, some large vugs (>10 mm.)								J,PL,SM						
									J,I,SM brecciated						
	263.5-163.7 ft. Highly weathered														
	198.10 / 263.70								B,I,SM (4)						
264	263.7-269.3 ft. Fresh, medium bedded, olive gray (5Y 4/1), coarse grained, strong, FOSSILIFEROUS LIMESTONE, (WARSAW FORMATION)			28	98%				J,I,SM,CL						
266	266.3-266.4 ft. Claystone								J,I,SM,CL						
268	268.3-269.3 ft. Calcareous claystone								J,I,SM,CL J,PL,SM						
	192.50		192.50												
	269.3-284.2 ft. Fresh, medium bedded, medium dark gray (N4), very fine grained, very weak, CLAYSTONE, (WARSAW FORMATION) Some calcite crystals		289.30						J,PL,SM						17:15 End Core Run 28
270				29	96%										
	271.3-271.7 ft. Slightly weathered, porous								J,PL,SM (2)						
272															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

Sheet 17 of 23

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 481.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infil, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
272	269.3-284.2 ft. Fresh, medium bedded, medium dark gray (N4), very fine grained, very weak, CLAYSTONE, (WARSAW FORMATION) Some calcite crystals							80	J,PL,SM						
				29	96%										
274			187.50												
			274.30												8:45 End Core Run 29 Problems coring, drill string very wobbly due to large diameter casing
	275.1-276.0 ft. Slightly weathered, porous														
276															
	277.6 ft. Calcite filled vug (3 cm.)														
278															
				30	103 %										
280															
282	282.7-283.2 ft. Calcareous, weak														
	283.3-284.1 ft. Slightly weathered, porous														
284			177.60												
	284.2-301.4 ft. Fresh, medium bedded, medium dark gray (N4), fine grained, medium strong, CALCAREOUS CLAYSTONE, (WARSAW FORMATION)		284.20						J,I,SM						10:00 End Core Run 30 Cuttings not coming out with return; flush hole
286				31	100 %				J,PL,SM						
									J,I,SM						
288															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 461.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIR wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR, MW, HW, CW)	STRENGTH INDEX (R6, R5, R4, R3, R2, R1)	POINT LOAD INDEX (psi) (R1 30, R2 150, R3 300, R4 600, R5 1500, R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
286	284.2-301.4 ft. Fresh, medium bedded, medium dark gray (N4), fine grained, medium strong, CALCAREOUS CLAYSTONE, (WARSAW FORMATION)			31	100 %										
			172.60												
	289.2-290.6 ft. Dolomite		289.20												12:00 End Core Run 31
290															
292									J,I,SM J,I,SM,CL						
294	293.4-295.6 ft. Dolomite			32	99%										
296															
298															
			182.60												
			299.20												13:50 End Core Run 32
300															
			160.40												
	301.4-346.4 ft. Fresh, thinly bedded, medium dark gray (N4), m-vc grained, medium strong, LIMESTONE, (WARSAW FORMATION) Some Claystone partings		301.40	33	100 %										
302	302.6-304.3 ft. Dolomitic Claystone, some fossils														
304															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

Sheet 19 of 23

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 461.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW, FR, MW, HW, CW	STRENGTH INDEX: R6, R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): R1, R2, R3, R4, R5, R6	TEST ORIENTATION	NOTES, WATER LEVELS, INSTRUMENTATION
304	301.4-346.4 ft. Fresh, thinly bedded, medium dark gray (N4), m-vc grained, medium strong, LIMESTONE, (WARSAW FORMATION) Some Claystone partings		157.60 / 304.20	33	100%										14:15 End Core Run 33
306															
308	307.9 ft. Calcite filled vug (3 cm.)														
				34	99%										
310															
312															
314			147.60 / 314.20												14:50 End Core Run 34
	315.5 ft. Chert zone														
316	316.2 ft. Chert zone														
				35	100%										
318									J,U,SM,CL						
320															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

Sheet 20 of 23

PROJECT: LAIDLAW/R-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 461.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
320	301.4-346.4 ft. Fresh, thinly bedded, medium dark gray (N4), m-vc grained, medium strong, LIMESTONE. (WARSAW FORMATION) Some Claystone partings														
322				35	100%										
	323.2-323.3 ft. Chert zone														
324			137.60 / 324.20												15:45 End Core Run 35
	324.8 ft. Chert zone														
	325.3, 325.8, and 326.3 ft. Chert zones														
328															
	327.4 ft. Chert zone														
328															
	328.5 ft. Chert zone														
	329.1 ft. Chert zone			36	98%										
	329.6-329.9 ft. Chert zone														
330															
332															
	333.4 ft. Chert zone								J,I,SM,CL						
334			127.60 / 334.20						J,I,SM						16:40 End Core Run 36
				37	100%										
	335.8 ft. Chert zone														
336															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

Sheet 21 of 23

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 461.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	ROD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR / MW / HW / CW	STRENGTH INDEX: R6 R5 R4 R3 R2 R1	POINT LOAD INDEX (psi): R1 30 / R2 150 / R3 300 / R4 600 / R5 1500 / R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
336	301.4-346.4 ft. Fresh, thinly bedded, medium dark gray (N4), m-vc grained, medium strong, LIMESTONE, (WARSAW FORMATION) Some Claystone partings														
	336.6-346.4 ft. No more claystone partings														
	336.9 ft. Chert zone														
338	337.9-339.2 ft. Chert zone							45	J,I,R calcite crystals						
340	339.9 ft. Chert zone			37	100 %										
	340.9-341.3 ft. Chert zone														
342	342.0-342.2 ft. Chert zone							45	J,I,SM,chert						
	342.3-343.5 ft. Chert zone														
	343.8 ft.							90	J,I,SM						
344	Chert zone		117.60					90	J,I,SM						
			344.20												8:30 End Core Run 37
	344.6 ft. Chert zone														
								90	J,I,R,fossils						
348															
	115.40														
	346.4-363.6 ft. 348.40 Slightly weathered, thinly to medium bedded, light gray (N7), medium grained, medium strong, CALCAREOUS DOLOMITE, (KEOKUK FORMATION) Interbedded with chert zones and nodules; porous/vuggy; some filled with calcite crystals; some calcite veins							90	J,I,R,chert						
				38	98%										
350								90	J,I,SM						
352								90	J,I,SM,chert						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

Sheet 22 of 23

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 461.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
352	346.4-363.6 ft. Slightly weathered, thinly to medium bedded, light gray (N7), medium grained, medium strong, CALCAREOUS DOLOMITE (KEOKUK FORMATION) interbedded with chert zones and nodules; porous/vuggy: some filled with calcite crystals; some calcite veins			38	98%				J,I,R						
354			107.60 / 354.20						J,I,SM J,I,R						9:30 End Core Run 38
356									J,I,R						
358	358.0-361.1 ft. Moderately weathered, very vuggy								J,I,R J,I,R calcite crystals J,I,R						
360				39	95%										
362									J,I,R (2) J,PL,R (2)						Drilling rate much slower due to presence of chert
	98.80 / 363.00		98.40 / 363.40						Core Loss J,I,R (3)						362.9-363.4 ft. Core loss 11:00 End Core Run 39
364	363.6-370.1 ft. Slightly weathered, thinly bedded, light gray (N7), m-vc grained, medium strong, DOLOMITIC LIMESTONE, (KEOKUK FORMATION) Slightly vuggy, some chert nodules								J,I,SM J,I,R						
366				40	100 %										
368															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/26/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 481.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	ROD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
368	ROCK TYPE														
	363.6-370.1 ft. Slightly weathered, thinly bedded, light gray (N7), m-vc grained, medium strong, DOLOMITIC LIMESTONE. (KEOKUK FORMATION) Slightly vuggy, some chert nodules								J,I,SM,chert						
370	369.4-370.1 ft. Chert layer 91.70 370.10								J,PL,SM						
	370.1-373.4 ft. Moderately weathered, medium bedded, medium light gray (N6), fine grained, medium strong, DOLOMITE. (KEOKUK FORMATION) Porous/vuggy, some chert nodules and calcite crystals			40	100 %										
372									J,I,SM (2)						
	88.40		88.40						J,I,SM						3/13/95 @ 12:05 Core Run 40
	End of Record of Drillhole at 373.4 ft. 373.40		373.40						J,I,SM						
374															
376															
378															
380															
382															
384															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

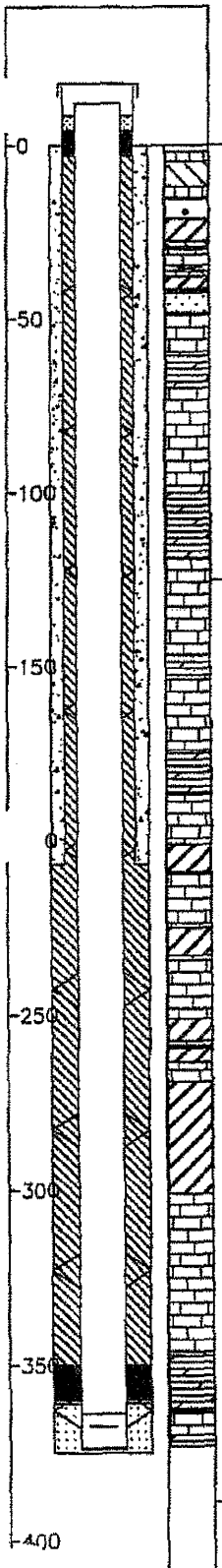
LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

Well No. PZ-106-KS

Boring No. X-Ref: PZ-106-KS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1066704 ft. Easting: 515432 ft.

Elevation Ground Level 461.8 ft. NGVD

Top of PVC Casing 464.26 ft. NGVD

Drilling Summary:

Total Depth 375.0 ft.

Borehole Diameter 9 7/8 in. (0.0-204.0 ft.) 5 7/8 in. (204.0-375.0 ft.)

Casing Stickup Height 2.49 ft.

Driller Layne-Western, St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. and 9 7/8 in. Button Bits

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	2/28/95	10:30	3/6/95	17:30
Schramm Rotary	3/20/95	7:30	3/20/95	11:30
Geophys.Logging:	3/20/95	12:45	3/20/95	16:30
Casing:				
2" PVC	3/23/95	8:30	3/23/95	9:40
6" Steel	3/9/95	11:45	3/10/95	9:00
Filter Placement:	3/23/95	9:40	3/23/95	10:45
Cementing:	3/9/95	14:15	3/9/95	9:00
Development				
Bentonite Grout	3/23/95	11:16	3/23/95	13:15
Bentonite Seal	3/23/95	10:45	3/23/95	11:15

Well Design & Specifications

Basis: Geologic Log X Geophysical Log X

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+2.49	-	363.75	C1	464.26	-	98.02
363.75	-	373.57	S1	98.02	-	88.20
373.57	-	373.90	C2	88.20	-	87.87
+1.50	-	204.00	C3	463.30	-	257.77
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.) (C3-see comments)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 361.0-375.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 360.0-361.0 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry. 3.0-350.0 ft., Neat cement, 3.0-204.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 350.0-360.0 ft.

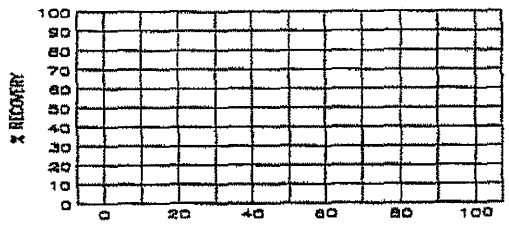
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Surface Casing C3: 6 1/8 in. ID / 6 5/8 OD Steel Casing

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ106KS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 115092	CHECK NO.
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

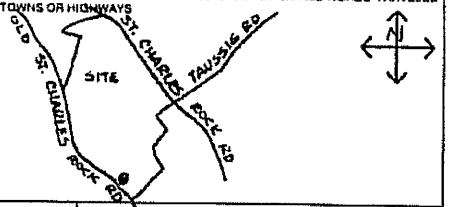
INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL
WELL NUMBER: PZ-106-KS
SITE ADDRESS: ST. CHARLES ROCK RD. | CITY: BRIDGETON | STATE: MO | ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC. | TELEPHONE: 314-241-3710
ADDRESS: 1838 N. BROADWAY | CITY: ST. LOUIS | STATE: MO | ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL SHOW LOCATION IN SECTION PLAT
COUNTY: ST. LOUIS
ELEVATION: 461.8
AREA NO.:
SMALLEST ¼ ____ ¼ ____ ¼ LARGEST ¼ ____ ¼
SEC. ____ TWN. 47 N.RNG. 5 (E) OR W
LAT. 38 ° 45 ' 47 " LONG. 90 ° 26 ' 45 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME: LAYNE WESTERN CO., INC.

DRILLING CONTRACTOR'S NAME: LAYNE WESTERN CO., INC.

TYPE OF INSTALLATION: [X] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL: FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL:

ELEVATION OF MEASURING POINT: 464.26

MEASURING POINT IS: [X] TOP OF RISER PIPE [ ] OTHER

DRILLING EQUIPMENT: [X] AIR ROTARY [X] AUGER TYPE 6¼" H.S.A. [ ] REVERSE ROTARY [ ] OTHER

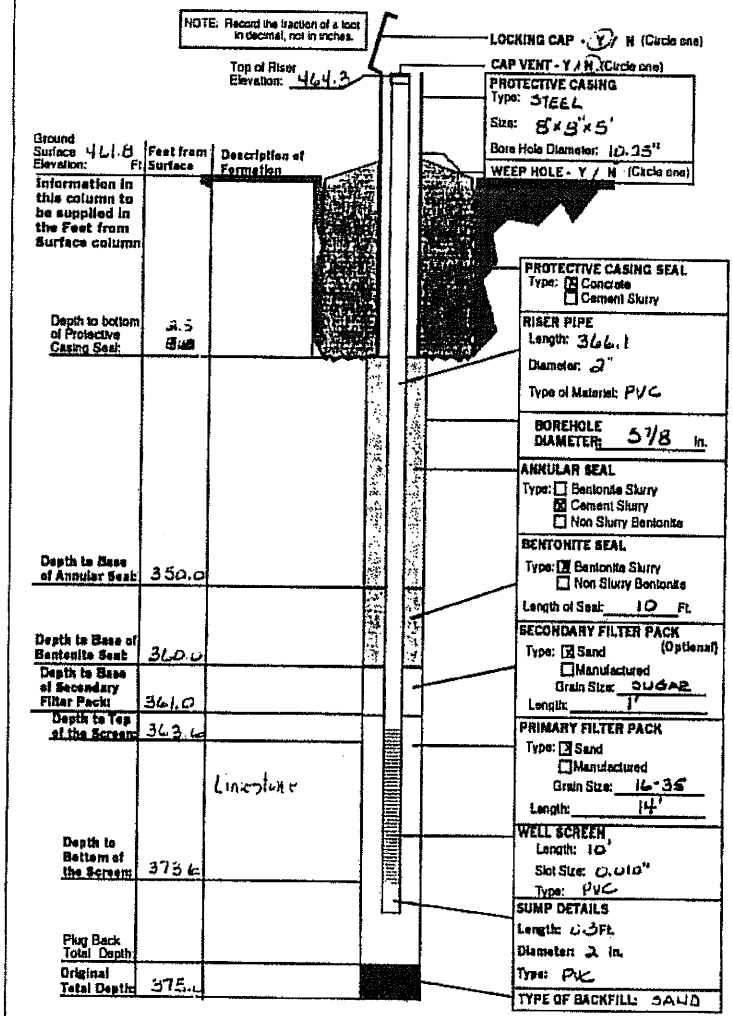
CENTRALIZERS USED: [X] YES, AT 10 TOTAL [X] STAINLESS STEEL [ ] OTHER [ ] NO

MULTIPLE CASED WELLS: SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED: 3-23-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Michael P. Vogl
PERMIT NUMBER: 001256WIM | DATE: 5-10-95
SIGNATURE (DRILLING CONTRACTOR): Michael P. Vogl
PERMIT NUMBER: 001256WIM | DATE: 5-10-95



MO 780-1415 (2-94)

DISTRIBUTION: WHITE-DIVISION CANARY-MONITORING WELL CONTRACTOR PINK-OWNER

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-107-SS
	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 1 OF 3
	WATER LEVEL / TIME / DATE / CASING DEPTH	DRILLING START TIME 13:00 DATE 3/26/95; FINISH TIME 16:25 DATE 3/26/95
DATUM NORTHING: 1067163.45 EASTING: 515254.52 ELEVATION 462.6		
DRILL RIG CME 75	SURFACE CONDITIONS	
ANGLE -90° BEARING		
SAMPLE HAMMER		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	3 5 5 5	0.9'/2.0' (45%)			(0.0-2.0 ft.) Stiff, moderate yellowish brown (10YR 5/4), SILTY CLAY, trace of very fine Sand, WR, damp, (CL), (FILL)	SP 1	
2 3	2 2 4 18	1.0'/2.0' (50%)			(2.0-4.0 ft.) Firm, yellowish brown (10YR 5/4), SILTY CLAY, little Gravel, trace amount of trash at bottom, WR, damp, (CL), (FILL)	SP 2	
4 5	3 8 11 10	1.1'/2.0' (55%)			(4.0-6.0 ft.) Very stiff, medium light gray (N5) to dark greenish gray (5GY 4/1), SILTY CLAY, some Gravel, SR, moist, (CL), (FILL) (456.6) 6.0	SP 3	
6 7	4 8 23 5	1.1'/2.0' (55%)			(6.0-8.0 ft.) Mixed damp waste and silty clay	SP 4	
8 9	7 2 4 1	0.3'/2.0' (15%)			(8.0-10.0 ft.) Trash	SP 5	
10 11	3 3 4 4	0.0'/2.0' (0%)			(10.0-12.0 ft.) Waste becomes wet (450.6) 12.0	SP 6	
12 13	8 32 15 9	0.0'/2.0' (0%)	NO RECOVERY		(12.0-14.0 ft.) No Recovery	SP 7	From 12.0-28.0 ft. no samples recovered, but drilling indicated mixed waste and silty clay layers
14	6 12 8 5	0.0'/2.0' (0%)			(14.0-15.0 ft.) No Recovery	SP 8	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY S. COSIO CHK'D BY W. HERST

DATE 6/1/95

JOB NO.: 943-2848

FILENAME: PZ107SS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MD
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1067163.45
DATUM EASTING: 515254.52 ELEVATION 462.6

DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger

SAMPLING METHOD:
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)

					START	FINISH
WATER LEVEL					TIME	TIME
TIME					1300	16:25
DATE					DATE	DATE
CASING DEPTH					3/26/95	3/26/95

BORING NO. PZ-107-SS

SHEET 2 OF 3

DRILLING

DRILL RIG CME 75

ANGLE -90° BEARING

SAMPLE HAMMER

SURFACE CONDITIONS

DEPTH IN FEET (ELEVATION)	BLOW/6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16	5 8 13 6	0.0" 2.0" (0%)	NO RECOVERY		(15.0-16.0 Ft.) No Recovery	SP (8)	
					(16.0-18.0 Ft.) No Recovery	SP (9)	
18	5 7 35 41	0.0" 2.0" (0%)			(18.0-20.0 Ft.) No Recovery	SP (10)	
20	5 5 5 3	0.0" 2.0" (0%)			(20.0-22.0 Ft.) No Recovery	SP (11)	
22	5 4 7 9	0.0" 2.0" (0%)			(22.0-24.0 Ft.) No Recovery	SP (12)	
24	6 7 7 10	0.0" 2.0" (0%)			(24.0-26.0 Ft.) No Recovery	SP (13)	
26	5 5 9 12	0.4" 2.0" (20%)			(26.0-28.0 Ft.) Waste	SP (14)	
28					(434.6) 28.0		
29					(28.0-32.0 Ft.) Stiff, dark greenish gray (5GY 4/1), SILTY CLAY, NR, wet, (CL), (LOESS)		

DRILLING CONTR LAYNE-WESTERN

LOGGED BY S. CASIO

DATE 6/1/95 CHK'D BY W. HINST

JOB NO.: 943-2848

FILENAME: PZ107SS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MD
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1067163.45
DATUM EASTING: 515254.52 ELEVATION 462.6

DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger

SAMPLING METHOD:
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

BORING NO. PZ-107-SS

SHEET 3 OF 3

DRILLING

START	FINISH
TIME 13:00	TIME 16:25
DATE 3/26/95	DATE 3/26/95

DRILL RIG CME 75

ANGLE -90° BEARING

SAMPLE HAMMER

SURFACE CONDITIONS

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31					(28.0-32.0 ft.) Stiff, dark greenish gray (5GY 4/1), SILTY CLAY, NR, wet, (CL), (LOESS)		
					(430.6) 32.0		
32					End of Soil Borehole Log at 32.0 ft.		
33					See PZ-107-SS Record of Drillhole for rock descriptions below 55.0 ft.		
34							
35							
36							
37							
38							
39							
40							
41							
42							
43							
44							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY S. COSIO

DATE 6/1/95 CHK'D BY W. HERST

JOB NO.: 942-2848

FILENAME: PZ107SS

RECORD OF DRILLHOLE PZ-107-SS

Sheet 1 of 4

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/21/95 - 5/22/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1087183.45
AZIMUTH: 0

COLLAR ELEV: 462.6
E: 515254.52
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infil, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48	0.0-32.0 ft. See Soil Borehole Log PZ-107-SS 32.0-54.0 ft. No samples collected														5/18/95 - 5/19/95 A 9 7/8 in. borehole (air rotary) was advanced through 10 1/4 in. ID hollow stem augers from 30.0-55.0 ft., and 6 in. steel was sealed in borehole from surface to 55.0 ft. with neat cement. Bedrock was encountered at 51.0 ft. BGS during drilling
50															
52															
54	408.60 54.00 54.0-59.0 ft. Fresh, medium bedded, pale yellowish brown (10YR 8/2), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)		408.60 54.00												5/21/95 @ 15:30 Began coring
56				1	92%				J,PL,SM,CL						
58									J,PL,SM						5/21/95 @ 15:50 End of Run 1
	59.0-63.5 ft. Slightly weathered, medium bedded, light olive gray (5Y 5/2), medium grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)		403.60 59.00												
60	60.0 ft. Fossiliferous								J,PL,R B,PL,SM						
62				2	98%				J,PL,SM,CL J,PL,R						
64	63.5-82.3 ft. Fresh, medium to thinly bedded, pale yellowish brown (10YR 6/2), m-c grained, medium strong LIMESTONE, (ST. LOUIS FORMATION)								B,PL,SM						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/20/95

Golder Associates

RECORD OF DRILLHOLE PZ-107-SS

PROJECT: LAIDLAW/RI-FB
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/21/95 - 5/22/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067183.45
AZIMUTH: 0

COLLAR ELEV: 462.6
E: 515254.52
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infil, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW, FR, HWY, CW	STRENGTH INDEX: R6, R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): R6 1500, R5 600, R4 300, R3 150, R2 30, R1	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64	63.5-82.3 ft. Fresh, medium to thinly bedded, pale yellowish brown (10YR 6/2), m-c grained, medium strong LIMESTONE, (ST. LOUIS FORMATION)								B,PL,SM						
									B,PL,SM,CL						
66	64.3 ft. Argillaceous layers common, stylolites common			2	98%										
									J,PL,SM						
									J,PL,SM,CL						
68									J,PL,SM,CL						5/21/95 @ 16:15 End of Run 2
			383.60												
			69.00						J,PL,R						
70									B,PL,SM,CL (5)						
72	72.1-72.6 ft. Argillaceous layer								B,PL,SM,CL						
									J,I,R						
74				3	100 %				B,PL,SM,CL						
76	76.7-77.2 ft. Argillaceous layer														
78	78.4-79.9 ft. Argillaceous layer								J,PL,SM (2)						5/21/95 @ 17:40 End of Run 3
			383.50												
			79.00	4	100 %				J,PL,SM						
80															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/20/95

Golder Associates

RECORD OF DRILLHOLE PZ-107-SS

Sheet 3 of 4

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/21/95 - 5/22/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1087183.45
AZIMUTH: 0

COLLAR ELEV: 462.6
E: 515254.52
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	83.5-82.3 ft. Fresh, medium to thinly bedded, pale yellowish brown (10YR 6/2), m-c grained, medium strong LIMESTONE, (ST. LOUIS FORMATION)								J,PL,SM (3)						
82									J,PL,SM (2)						
	82.3-84.6 ft. Slightly weathered, medium bedded, light olive gray (5Y 5/2), medium grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)														
84															
	84.6-88.5 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Thinly laminated Clay layers abundant			4	100 %				J,PL,SM,CL (2)						
86									J,C,SM						
88															
	88.5-94.1 ft. Fresh, medium bedded, light olive gray (5Y 5/2), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Stylolites abundant		373.60 / 89.00												5/21/95 @ 18:40 End of Run 4 Quit drilling for the day 5/22/95 @ 7:30 Began drilling
90															
92				5	100 %										
94	94.1-97.2 ft. Fresh, thinly bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Abundant thinly laminated Clay layers								B,PL,SM,CL (3)						
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/20/95

Golder Associates

RECORD OF DRILLHOLE PZ-107-SS

Sheet 4 of 4

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/21/95 - 5/22/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1087163.45
AZIMUTH: 0

COLLAR ELEV: 462.6
E: 515254.52
INCLINATION: -90

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
96	94.1-97.2 ft. Fresh, thinly bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, LIMESTONE,(ST. LOUIS FORMATION) Abundant thinly laminated Clay layers								B,PL,SM		SW FR HW CW	R5 R4 R3 R2 R1	R1 R2 R3 R4 R5 R6		
98	97.2-100.7 ft. Slightly weathered, medium bedded, light olive gray (5Y 5/2), fine to medium grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Calcite filled healed fractures common		363.60	5	100 %										5/22/95 @ 8:10 End of Run 5
			99.00												
100	100.7-104.0 ft. Fresh, thinly bedded, pale yellowish brown (10YR 6/2), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Abundant thinly laminated clay layers								J,PL,R,CL						
102				6	100 %				J,PL,R						
									J,PL,R						
104									J,PL,R						5/22/95 @ 8:30 Finished coring
	358.60		358.60												
	End of Record of Borehole at 104.0 ft.		104.00												
106															
108															
110															
112															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/20/95

Golder Associates

Well No. PZ-107-SS

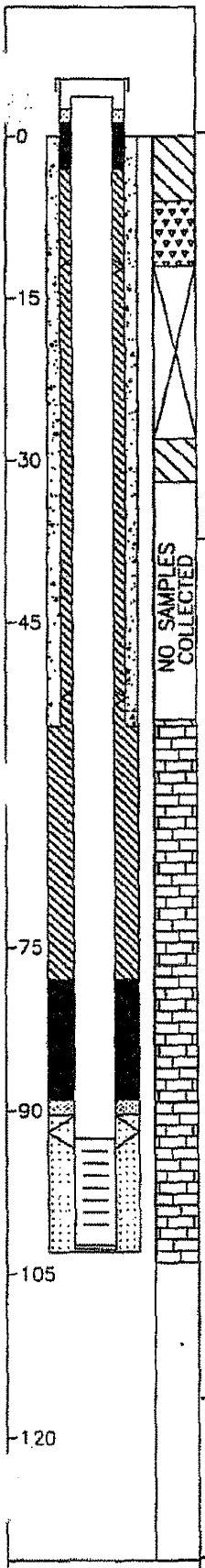
Boring No. X-Ref: PZ-107-SS

PIEZOMETER CONSTRUCTION SUMMARY

Survey Coords: Northing: 1067183 ft. Easting: 515255 ft.

Elevation Ground Level 462.6 ft. NGVD

Top of PVC Casing 464.66 ft. NGVD



Not to Scale

Drilling Summary:

Total Depth 103.0 ft.

Borehole Diameter 14 1/4 in. (0.0–32.0 ft.) 5 7/8 in. (32.0–103.0 ft.)

Casing Stickup Height 2.03 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger–None, NX Core Water, Air and Mud Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75 (augers)	3/28/95	13:00	3/28/95	16:25
CME 75 (core)	5/21/95	15:30	5/22/95	8:30
Schramm Rotary	5/22/95	11:00	5/22/95	11:30
Geophys.Logging:				
Casing:				
2" PVC	5/22/95	11:30	5/22/95	11:35
6" Steel	5/18/95	9:00	5/18/95	14:00
Filter Placement:	5/22/95	11:40	5/22/95	11:55
Cementing:				
Development				
Bentonite Grout	5/22/95	12:10	5/22/95	12:45
Bentonite Seal	5/22/95	11:55	5/22/95	12:10

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 2.03	–	92.60	C1	464.66	–	370.03
92.60	–	102.40	S1	370.03	–	360.23
102.40	–	102.73	C2	360.23	–	359.90
+ 1.00	–	55.00	C3	463.60	–	407.63
	–				–	
	–				–	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.) (C3-see comments)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16–35 mesh Silica Sand, 90.4–103.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 89.0–90.4 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0–78.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 78.0–89.0 ft.

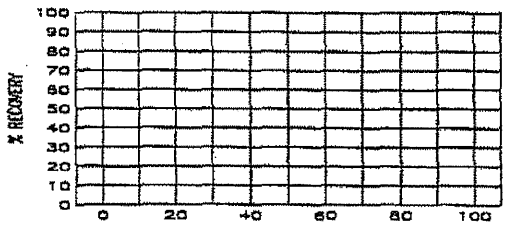
Concrete: 0.0–3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Surface Casing C3: 6 1/8 ID / 6 5/8 in. OD Steel Casing

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ107SS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122508	CHECK NO.
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME	WELL NUMBER	
LAIDLAW BRIDGETON SANITARY LANDFILL	PZ-10755	
SITE ADDRESS	**CITY**	**STATE / ZIP CODE**
ST CHARLES ROCK RD	BRIDGETON	MO 63044
NAME		**TELEPHONE**
LAIDLAW WASTE SYSTEMS, INC.		314-291-3710
ADDRESS	**CITY**	**STATE / ZIP CODE**
1838 N. BROADWAY	ST. LOUIS	MO 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL SHOW LOCATION IN SECTION PLAT

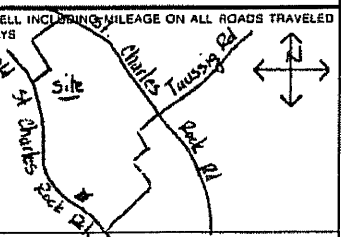
COUNTY ST. LOUIS
ELEVATION 452.6
AREA NO.

SMALLEST ¼ LARGEST ¼

SEC. ____ TWN. 47 N,RNG. 5 E OR W

LAT. 38° 45' 53" LONG. 90° 24' 48"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME

LAYNE WESTERN Co., INC.

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 464.7

Ground Surface Elevation: 463.4

Information in this column to be supplied in the Feet from Surface column.	Feet from Surface	Description of Formation
	0-5	Clay
Depth to bottom of Protective Casing Seal:	3.0	
	3-38	Trash
	38-54	Not Sampled
	54-78	Limestone
Depth to Base of Annular Seal:	78.0	
Depth to Base of Bentonite Seal:	89.0	
Depth to Base of Secondary Filter Pack:	90.4	
Depth to Top of the Screen:	93.6	
Depth to Bottom of the Screen:	103.6	
Plug Back Total Depth:		
Original Total Depth:	103.6	

LOCKING CAP - (Y) N (Circle one)
CAP VENT - Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8"x8"x5'
Bore Hole Diameter: 9½"

WEEP HOLE - Y / N (Circle one)

PROTECTIVE CASING SEAL
Type: [X] Concrete [ ] Cement Slurry

RISER PIPE
Length: 94.6'
Diameter: 2"
Type of Material: SCH. 80 PVC

BOREHOLE DIAMETER: 5⅞ in.

ANNULAR SEAL
Type: [X] Bentonite Slurry [ ] Cement Slurry [ ] Non Slurry Bentonite

BENTONITE SEAL
Type: [X] Bentonite Slurry [ ] Non Slurry Bentonite
Length of Seal: 11 Ft.

SECONDARY FILTER PACK (Optional)
Type: [X] Sand [ ] Manufactured
Grain Size: 4-50
Length: 1.4'

PRIMARY FILTER PACK
Type: [X] Sand [ ] Manufactured
Grain Size: 16-35
Length: 12.6'

WELL SCREEN
Length: 10'
Slot Size: 0.010"
Type: SCH. 80 PVC

SUMP DETAILS
Length: 0.5Ft
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SLAND

DRILLING CONTRACTOR'S NAME

LAYNE WESTERN Co., INC.

TYPE OF INSTALLATION
[X] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT 464.7

MEASURING POINT IS
[X] TOP OF RISER PIPE
[ ] OTHER

DRILLING EQUIPMENT
[X] AIR ROTARY [X] AUGER TYPE 6¼ H.S.A.
[ ] REVERSE ROTARY [ ] OTHER

CENTRALIZERS USED
[X] YES, AT 4 TOTAL
[X] STAINLESS STEEL
[ ] OTHER
[ ] NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
5-22-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael P. Vogt

PERMIT NUMBER	DATE
001256WIM	6-02-95

SIGNATURE (DRILLING CONTRACTOR) Michael P. Vogt

PERMIT NUMBER	DATE
001256WM	6-02-95

MO 780-1415 (2-94) DISTRIBUTION: WHITE DIVISION CANARY MONITORING WELL CONTRACTOR PINK/OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MO
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1068011.70
DATUM EASTING: 516144.36 ELEVATION 456.8

DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger

SAMPLING METHOD:
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)

					DRILLING START	DRILLING FINISH
WATER LEVEL						
TIME					7:48	8:48
DATE					4/7/95	4/7/95
CASING DEPTH						

BORING NO. PZ-109-SS

SHEET 1 OF 2

DRILLING CONTR LAYNE-WESTERN

DRILL RIG CME 75 - TRUCK MOUNT

ANGLE -90° BEARING NA

SAMPLE HAMMER 140 lbs.

SURFACE CONDITIONS

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	1 1 1 2	2.0' 2.0' (100%)			(0.0-2.0 Ft.) Very loose, light olive gray (5Y 6/1), SILT, trace of fine to coarse Gravel, trace very fine Sand, NR, moist, (ML), (FILL)	SP ①	
(454.8) 2.0							
2	50/4"	0.4' 2.0' (20%)			(2.0-6.0 Ft.) Very dense, light olive gray (5Y 6/1), F-c GRAVEL, little Fines, SR, damp, (GP), (FILL)	SP ②	
3							
4	50/3"	0.2' 2.0' (10%)				SP ③	
5							
(450.8) 6.0							
6	5 6 8 8	1.8' 2.0' (90%)			(6.0-12.0 Ft.) Stiff, dark yellowish brown (10YR 4/2), mottled CLAYEY SILT, NR, damp, (CL-ML), (LOESS)	SP ④	
7							
8	5 7 8 11	1.6' 2.0' (80%)				SP ⑤	
9							
10	4 5 6 8	2.0' 2.0' (100%)				SP ⑥	
11							
12	4 3 5 7	1.8' 2.0' (90%)			(12.0-16.0 Ft.) Firm, mottled moderate yellowish brown (10YR 5/4) to light olive gray (5Y 6/1), CLAYEY SILT, NR, damp, (CL-ML), (LOESS)	SP ⑦	
13							
14	4 8 39 50/2"	1.9' 2.0' (95%)			@ 14.5 Ft., little Fine Gravel	SP ⑧	

LOGGED BY S. COSIO

DATE 5/31/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ109SS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MD
WEST LAKE LANDFILL
OPERABLE UNIT 2

DATUM NORTHING: 1068011.70
EASTING: 516144.36
ELEVATION 456.8

DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger

SAMPLING METHOD:
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)

BORING NO. PZ-109-SS

SHEET 2 OF 2

					DRILLING START	DRILLING FINISH
WATER LEVEL						
TIME					7:48	8:48
DATE					4/7/95	4/7/95
CASING DEPTH						

DRILL RIG CME 75 - TRUCK MOUNT
ANGLE -90° BEARING NA
SAMPLE HAMMER 140 lbs.
SURFACE CONDITIONS

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE		REMARKS
16					(12.0-16.0 Ft.) Firm, mottled moderate yellowish brown (10YR 5/4) to light olive gray (5Y 6/1), CLAYEY SILT, NR, damp, (CL-ML), (LOESS) (440.8) 16.0	SP	8	Top of weathered bedrock encountered @ 15.7 ft.
					End of Soil Borehole Log at 16.0 ft.			
					See PZ-109-SS Record of Drillhole for rock descriptions			
17								
18								
19								
20								
21								
22								
23								
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29								

DRILLING CONTR LAYNE-WESTERN

LOGGED BY S. COSIO

DATE 5/11/95 CHK'D BY W. HENSI

JOB NO.: 943-2848

FILENAME: PZ109SS

RECORD OF DRILLHOLE PZ-109-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/7/95-4/8/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068011.70
AZIMUTH: 0

COLLAR ELEV: 456.8
E: 516144.38
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
0	0.0-15.7 ft. See Soil Borehole Log PZ-109-SS														
14	15.7-20.7 ft. Moderately weathered, thickly bedded, light olive gray (5Y 6/1), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Fossiliferous, pyrite and calcite crystals common, stylolitic, abundant clay filled intact joints 441.10 15.70		441.10 15.70	1	100 %										4/7/95 @ 9:47 Begin coring Run 1

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: R. BOOTH
DATE: 5/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-109-SS

Sheet 2 of 9

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/7/95-4/8/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068011.70
AZIMUTH: 0

COLLAR ELEV: 456.8
E: 518144.38
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR, MW HW, CW	STRENGTH INDEX: R5 R4 R3 R2 R1	POINT LOAD INDEX (psi): RT 30, R2 150, R3 300, R4 600, R5 1500	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
16	15.7-20.7 ft. Moderately weathered, thickly bedded, light olive gray (5Y 6/1), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Fossiliferous, pyrite and calcite crystals common, stylolitic, abundant clay filled intact joints								J,PL,SM (2)						
									J,I,R (2)						
									J,I,R (2)						
									J,PL,SM						
18									J,I,R (2)						
									J,U,R						
20	19.8-20.0 ft. Layer of brown chert			1	100 %				J,PL,R (2)						
	20.7-31.5 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Fossiliferous, stylolitic, pyrite and calcite crystals common, abundant argillaceous partings								J,PL,R						
									J,I,R						
22															
24			432.30 / 24.50												4/7/95 @ 10:47 Begin coring Run 2
									J,I,R						
	25.0-25.5 ft. Bioclastic Limestone								J,I,CL						
	25.5-27.2 ft. Microcrystalline Limestone								J,U,SM (2)						
									J,I,R						
26									J,I,R (3)						
									J,PL,R (3)						
									J,I,CL (2)						
28				2	100 %				J,I,CL (2)						
									J,I,R						
									J,I,CL (2)						
	29.9-31.3 ft. Dark greenish gray (5GY 4/1), intraclastic Limestone								J,I,CL (3)						
30	31.3-31.4 ft. Layer of dark greenish yellow clay								J,I,R						
									J,I,CL						
	31.5-32.5 ft. Fresh, thinly bedded, greenish black (5G 2/1), fine grained, medium strong, DOLOMITE, (ST. LOUIS FORMATION) Large (3 mm.) calcite veins		425.30 / 31.50						J,I,CL (2)						
32									J,I,CL						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: R. BOOTH
DATE: 5/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-109-SS

Sheet 3 of 9

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/7/95-4/8/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068011.70
AZIMUTH: 0

COLLAR ELEV: 456.8
E: 516144.36
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32			424.30						J,I,R						
	32.5-34.9 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Little argillaceous partings, pyrite crystals present		32.50	2	100 %				J,PL,CL J,I,CL						
34			422.30												4/7/95 @ 12:55 Begin coring Run 3
	34.9-40.5 ft. Slightly weathered, thickly bedded, grayish orange (10YR 7/4) to light olive gray (5Y 6/1), f-m grained, strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Vugs up to 2 mm., calcite crystals and veins up to 3 mm. present, little pyrite crystals		34.50												
36	35.0-38.7 ft. Very porous material								J,I,R J,I,CL						
	39.0-39.2 ft. Layer of brown chert			3	99%				J,I,R						
40															
	40.5-45.6 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Fossilliferous, chert nodules common, abundant argillaceous partings, calcite veins up to 8 mm., pyrite crystals scattered								J,I,CL						
42															
									J,I,R						
44			412.30												4/7/95 @ 13:50 Begin coring Run 4
			44.50												
	45.6-58.2 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained to microcrystalline, medium strong to strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, abundant calcite crystals and veins up to 2 mm., little pyrite crystals								J,I,CL						
46				4	99%				J,I,CL						
									J,I,R (2)						
48															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: R. BOOTH
DATE: 5/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-109-SS

Sheet 4 of 9

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/7/95-4/8/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068011.70
AZIMUTH: 0

COLLAR ELEV: 456.8
E: 516144.36
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48	48.5-51.6 ft. Abundant argillaceous partings and clay filled intact open joints 48.9-53.8 ft. *Highly brecciated Limestone*, cemented with a greenish gray clayey material							0°	J,I,R						
50				4	99%			30	J,I,CL						
								80	J,I,CL						
52	52.0-53.3 ft. Intraclastic Limestone							0°	J,PL,SM						
								0°	J,I,R						
54	53.8-54.2 ft. Greenish black (5G 2/1), fine grained Dolomite (403.00 / 53.80 / 402.60 / 54.20)		402.30 / 54.50												4/7/95 @ 14:42 Begin coring Run 5
	54.9-55.3 ft. Intraclastic Limestone 55.5-56.2 ft. Fossilliferous Limestone, abundant argillaceous partings														
58	58.2-74.6 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), f-m grained, strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Little fossils, vugs up to 8 mm., calcite veins with pyrite common, some calcite crystals 58.2-62.3 ft. Limestone shows high porosity			5	100 %			0°	J,I,CL (2)						
								0°	J,I,R						
60								0°	J,I,R						
62								0°	J,I,R						
								0°	J,I,R						
64								30	J,I,R						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: R. BOOTH
DATE: 5/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-109-SS

PROJECT: LAIDLAW/RI-PS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/7/95-4/8/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068011.70
AZIMUTH: 0

COLLAR ELEV: 458.6
E: 518144.38
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
Pl-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infil, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64			382.30 / 64.50	5	100 %										4/7/95 @ 15:30 Begin coring Run 6
	65.0-69.4 ft. Apparent low porosity Limestone, vugs <1 mm.								J,I,R						
66	65.7-66.7 ft. Stylolitic Limestone, becomes medium strong														
68															
	69.4-72.8 ft. Apparent moderate porosity Limestone, vugs 1-2 mm.			6	100 %				J,PL,SM J,I,R J,I,R J,I,R						
70															
									J,I,CL						
72	72.0-73.2 ft. Large (25 mm.) calcite crystals observed														
	72.8-74.3 ft. Apparent high porosity Limestone, vugs up to 8 mm.								J,I,CL						
74									J,I,R						
	74.6-75.7 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, strong, LIMESTONE, (ST. LOUIS FORMATION) Oolitic, little fossils, abundant calcite crystals, little chert		382.30 / 74.50						J,I,CL (2) J,I,R						4/7/95 @ 16:21 Begin coring Run 7
76	75.7-77.8 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Vugs up to 5 mm., abundant calcite crystals, glauconite in defined places, Limestone has an apparent moderate to high porosity			7	100 %										
78	77.8-90.6 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained to microcrystalline, medium strong to strong, LIMESTONE, (ST. LOUIS FORMATION) Some fossils, little chert, stylolites, large calcite crystals, some pyrite								J,I,CL						
80															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: R. BOOTH
DATE: 5/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-109-SS

Sheet 8 of 9

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/7/95-4/8/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068011.70
AZIMUTH: 0

COLLAR ELEV: 456.8
E: 516144.38
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR MW HW CW	STRENGTH INDEX: R5 R4 R3 R2 R1	POINT LOAD INDEX (psi): R1 R2 R3 R4 R5 R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	80.0-82.4 ft. Some intact joings filled with clayey material								J,I,CL						
	81.1-82.6 ft. Interbedded layers of argillaceous Limestone (5 mm.)								J,I,CL						
									J,PL,CL						
82				7	100 %										
	83.0-84.2 ft. Argillaceous Limestone, large calcite crystals, vugs up to 1 mm., relative low porosity								J,I,R						
84									J,I,R						4/7/95 @ 15:05 Stop coring
			372.30												4/8/95 @ 8:00 Begin coring Run 8
			84.50												
	85.5-87.3 ft. Limestone with numerous argillaceous partings and intact joints filled with clayey material								J,I,R						
86															
	87.3-88.2 ft. Argillaceous Limestone, bioturbated top 2 in.														
88	88.2-89.0 ft. Limestone, stylolitic microcrystalline								J,PL,CL						
	89.4-90.8 ft. Medium bluish gray (5B 5/1), fine grained, Argillaceous Limestone			8	100 %				J,I,R						
90									J,PL,SM						
	90.8-93.3 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) interbedded with Argillaceous Limestone and bluish gray Limestone, stylolites present, calcite veins and pyrite crystals observed								J,I,R						
									J,I,CL						
92									J,I,CL						
	93.3-95.3 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Few layers (up to 20 mm.) of Dolomitic Limestone, argillaceous partings present, pyrite and calcite common														
94									J,I,CL						
			362.30												4/8/95 @ 9:04 Begin coring Run 9
			94.50												
				9	100 %										
	95.3-99.8 ft. (see next page)								J,PL,SM						
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: R. BOOTH
DATE: 5/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-109-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/7/95-4/8/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068011.70
AZIMUTH: 0

COLLAR ELEV: 456.8
E: 516144.36
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	ROD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR, MW, HW, CW	STRENGTH INDEX: R6, R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): R1 32, R2 150, R3 300, R4 600, R5 1500, R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
96	95.3-99.8 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained to microcrystalline, strong LIMESTONE, (ST. LOUIS FORMATION) Stylolites not common, pyrite and calcite veins <1 mm. observed, argillaceous partings common, few open joints filled with clayey material								J,PL,CL						
98									J,PL,CL						
									J,I,CL						
									J,I,CL						
100	99.8-104.7 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Vugs up to 2 mm. present, bioturbated in places, calcite crystals common			9	100 %										
102															
									J,U,CL						
104			352.30 / 104.50												4/8/95 @ 9:52 Begin coring Run 10
	104.7-107.9 ft. Fresh, thickly bedded, olive gray (5Y 6/1), micro-crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION) Pyrite and calcite veins common, few large calcite crystals														
106	106.5-106.6 ft. Layer of olive black (5Y 2/1), clayey material, foliated 106.9-107.9 ft. Fossils common								J,C,R						
108	107.9-111.0 ft. Fresh, thickly bedded, olive gray (5Y 6/1), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolites present, vugs up to 1 mm., bioturbated in places, calcite crystals are common, more porous in bottom foot			10	100 %				J,PL,CL						
110	111.0-116.0 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, little fossils, abundant pyrite and calcite crystals, abundant argillaceous partings, intra-clasts common														
112									J,I,CL						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: R. BOOTH
DATE: 5/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-109-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 843-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/7/95-4/8/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068011.70
AZIMUTH: 0

COLLAR ELEV: 456.8
E: 518144.38
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX: SW FR, MW, HW, CW	STRENGTH INDEX: R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): R6, R5, R4, R3, R2, R1	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
112	111.0-118.0 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, little fossils, abundant pyrite and calcite crystals, abundant argillaceous partings, intraclasts common			10	100%										
			343.10 / 113.70												4/8/95 @ 10:55 Begin coring Run 11
114	115.3-115.6 ft. Layer of grayish green (10G 4/6) Shale, intraclastic							30	J,I,CL						
								60	J,I,CL						
116	116.5-117.1 ft. Slightly weathered Limestone							30	J,I,CL						
								60	J,I,CL						
								30	J,I,R						
								90	J,I,R						
								90	J,I,R						
								90	J,PL,CL						
118	118.0-123.2 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARENACEOUS LIMESTONE, (ST. LOUIS FORMATION) Banded with fine to medium grained Limestone, large crystals of calcite, few calcite veins and little pyrite			11	100%										
120								60	J,I,CL						
122			333.80 / 123.20												
	123.2-130.0 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained to microcrystalline, strong to medium strong, LIMESTONE, (SALEM FORMATION) Stylolites observed, abundant fossils, oolitic, chert nodules common, large calcite crystals, little pyrite crystals scattered, calcite veins present but not abundant 125.4-125.5 ft. Bed of chert		333.10 / 123.70					90	J,PL,SM						123.2 ft. Top of SALEM FORMATION encountered
124															4/8/95 @ 12:50 Begin coring Run 12
								90	J,I,R						
				12	99%			90	J,I,R						
126															
								90	J,I,R						
128	127.6-128.3 ft. Intraclastic Limestone cemented with dark greenish gray (5GY 4/1) clayey material														

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: R. BOOTH
DATE: 5/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-109-SS

Sheet 9 of 9

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/7/95-4/8/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068011.70
AZIMUTH: 0

COLLAR ELEV: 456.8
E: 516144.38
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infil, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR, MW, HW, CW	STRENGTH INDEX: R6, R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): R1 30, R2 150, R3 300, R4 600, R5 1500, R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
128	129.0-129.3 ft. Intraclastic Limestone and chert cemented with dark greenish gray (5Y 4/1) clayey material							30	J,I,CL						
								30	J,PL,SM						
								30	J,PL,SM						
130	130.0-135.7 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, LIMESTONE, (SALEM FORMATION)							30	J,PL,R						
				12	99%										
	Chert nodules and layers up to 15 mm. are abundant, abundant calcite crystals, pyrite common, some very thin calcite veins							30	J,PL,SM (2)						
								30	J,I,R						
132								30	J,PL,SM						
								30	J,PL,SM						
								30	J,PL,R						Fragmented rock may be drill induced
			323.10												
134			133.70												
								30	J,PL,SM						
								30	J,PL,SM						
				13	100 %			30	J,I,CL						
								30	J,I,R						4/8/95 @ 15:30 Coring completed
			321.10												
	End of Record of Drillhole at 135.7 ft.		135.70												
136															
138															
140															
142															
144															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

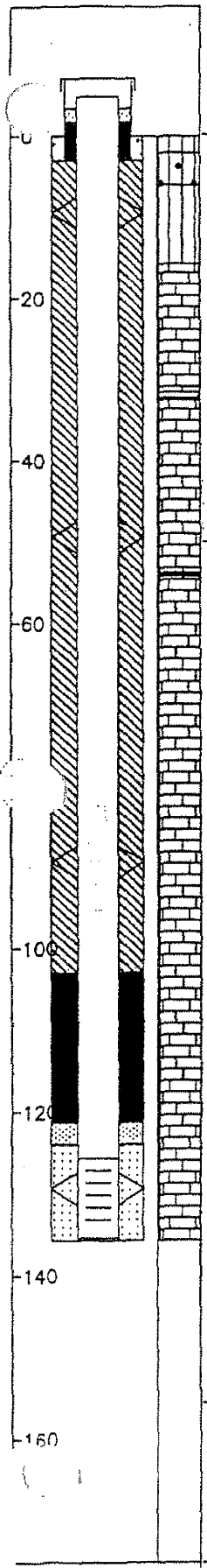
LOGGED: S. COSIO
CHECKED: R. BOOTH
DATE: 5/5/95

Golder Associates

Well No. PZ-109-SS

Boring No. X-Ref: PZ-109-SS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1068012 ft. Easting: 516144 ft.

Elevation Ground Level 456.8 ft. NGVD

Top of PVC Casing 458.50 ft. NGVD

Drilling Summary:

Total Depth 135.7 ft.

Borehole Diameter 10 1/4 in. (0.0–15.0 ft.) 5 7/8 in. (15.0–135.7 ft.)

Casing Stickup Height 1.73 ft.

Driller Layne-Western, St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	4/7/95	7:48	4/8/95	15:30
Schramm Rotary	4/25/95	9:30	4/25/95	11:40
Geophys.Logging:				
Casing:	4/25/95	12:00	4/25/95	12:10
Filter Placement:	4/25/95	12:10	4/25/95	12:20
Cementing:				
Development				
Bentonite Grout	4/25/95	12:45	4/25/95	13:15
Bentonite Seal	4/25/95	12:20	4/25/95	12:45

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.73	-	125.70	C1	458.50	-	331.07
125.70	-	135.50	S1	331.07	-	321.27
135.50	-	135.83	C2	321.27	-	320.94

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 124.0-135.7 ft.

Filter Pack: Less than 50 mesh Silica Sand, 121.3-124.0 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-103.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 103.0-121.3 ft.

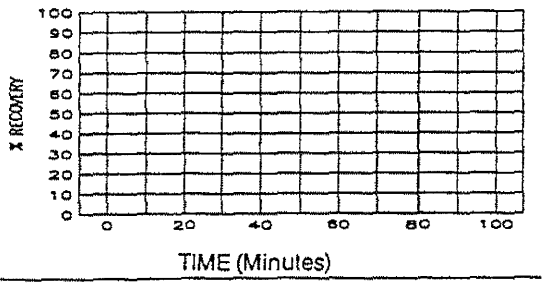
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by D. Alloway

Job Number 943-2848

Site LAID LAW/OU2 RI-FS/MO

File Name PZ109SS

6/1574

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122485	CHECK NO
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL
WELL NUMBER: PZ-109-SS

SITE ADDRESS: ST. CHARLES ROCK RD. | CITY: BRIDGETON | STATE: Mo | ZIP CODE: 63044

NAME: LAIDLAW WASTE SYSTEMS, INC. | TELEPHONE: 314-341-3710

ADDRESS: 1838 N. BROADWAY | CITY: ST. LOUIS | STATE: Mo | ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL SHOW LOCATION IN SECTION PLAT

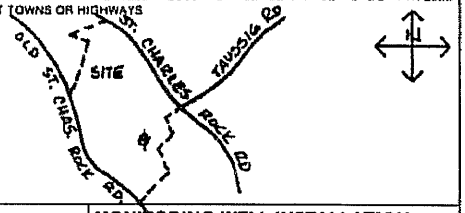
COUNTY: St. Louis
ELEVATION:
AREA NO.:

SMALLEST ¼ LARGEST ¼

SEC. ____ TWN. 47 N,RNG. 5 (E) OR W

LAT. 38 ° 46 ' 00 " LONG. 90 ° 26 ' 36 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME: LAYNE WESTERN CO., INC.

DRILLING CONTRACTOR'S NAME: LAYNE WESTERN CO., INC.

TYPE OF INSTALLATION: [X] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL: FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL:

ELEVATION OF MEASURING POINT:

MEASURING POINT IS: [ ] TOP OF RISER PIPE [ ] OTHER

DRILLING EQUIPMENT: [X] AIR ROTARY [X] AUGER TYPE 6¼ H.S.A. [ ] REVERSE ROTARY [ ] OTHER

CENTRALIZERS USED: [X] YES, AT 4 TOTAL [X] STAINLESS STEEL [ ] OTHER [ ] NO

MULTIPLE CASED WELLS: SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED: 4-25-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Michael P. Vogl
PERMIT NUMBER: 001256WM | DATE: 6-02-95

SIGNATURE (DRILLING CONTRACTOR): Michael P. Vogl
PERMIT NUMBER: 001256WM | DATE: 6-02-95

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation:

LOCKING CAP - (Y) N (Circle one)
CAP VENT (Y) N (Circle one)
PROTECTIVE CASING Type: STEEL Size: 8"x8"x5' Bore Hole Diameter: 10"
WEEP HOLE - Y / N (Circle one)

Ground Surface Elevation: Ft	Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column		0-3' silt
		3'-6' Silt & gravel
Depth to bottom of Protective Casing Seal:	3.0	
		6'-14' silt
		6'-135.7' Limestone
Depth to Base of Annular Seal:	103	
Depth to Base of Bentonite Seal:	121.3	
Depth to Base of Secondary Filter Pack:	124.0	
Depth to Top of the Screen:	125.4	
Depth to Bottom of the Screen:	135.4	
Plug Back Total Depth:		
Original Total Depth:	135.7	

PROTECTIVE CASING SEAL Type: [X] Concrete [ ] Cement Slurry

RISER PIPE Length: 127.1' Diameter: 2" Type of Material: Sch. 80 PVC

BOREHOLE DIAMETER: 5 7/8 in.

ANNULAR SEAL Type: [X] Bentonite Slurry [ ] Cement Slurry [ ] Non Slurry Bentonite

BENTONITE SEAL Type: [X] Bentonite Slurry [ ] Non Slurry Bentonite Length of Seal: 18.3 FT.

SECONDARY FILTER PACK Type: [X] Sand (Optional) [ ] Manufactured Grain Size: < 50 Length: 2.7'

PRIMARY FILTER PACK Type: [X] Sand [ ] Manufactured Grain Size: 16/35 Length: 11.7'

WELL SCREEN Length: 10' Slot Size: 0.010" Type: Sch. 80 PVC

SUMP DETAILS Length: 0.3 FT. Diameter: 2 In. Type: PVC

TYPE OF BACKFILL: SAND

DISTRIBUTION: WHITE-DIVISION CANARY-MONITORING WELL CONTRACTOR PINK-OWNER

IngenAE

BRIDGETON LANDFILL
MONITORING WELL INSTALLATION

Log of Boring

PZ-111-SS

Permit Number: MO 004440
Drilling Method: T75 Track
Drilling Contactor: Roberts Environmental Drilling, Inc.
Start Date: August 16, 2017
Finish Date: August 22, 2017
Logger: FBP

Northing (ft):
Easting (ft):
Driller: Eric Wetzal
Ground Surface Elevation (ft msl):
Water Level:
Date Logged:

Depth Below Surface (ft)	Water Level	Sample or Box Number	Recovery	Standard Penetration 6" - 6" - 6" - (N)	Rock Quality Designation	Runtime	Depth Below Surface (ft)	Sample Description / Comments
1							0-2' 10 YR 4/4 Dark Yellowish Brown Top soil w/organics	Begin Drilling@ 7:15 4 1/4" I.D. HSA 2" O.D. Split Spoon
2								
3		Bag 1	1.6/2.0	10/20 30/31			2-4 10 YR 6/2 Dense Light Brownish Gray, Sandy Clay with some Gravel, Dry $(CL)_H$	
4								
5		Bag 2	1.5/2.0	10/10 10/8			4-6 10 YR 4/2 Dark Grayish Brown, Silty Clay Trace Sand, Moist $(CL)_H$	
6								
7		Bag 3	0/2.0	>50			No Recovery	
8								
9		Bag 4	1.7/2.0	8/6 4/3			8.0-9.3 10 YR 6/1 Gray Silty Clay with some Gravel, Soft, Wet, $(CL)_H$	encountered water around 8' bgs
10							9.3-10 10YR 6/6 Brownish Yellow Silty Clay with trace Sand, Soft, Wet $(CL)_H$	
11		Bag 5	1.4/2.0	3/4 5/3				
12								
13		Bag 6	2.0/2.0	4/5 5/5			10.3-16.2 10 YR 5/2 Grayish Brown, Silty Clay, soft, moist $(CL)_4$	
14								
15		Bag 7	1.6/2.0	1/1 2/3				
16								
17		Bag 8	1.0/2.0	1/1 >50			16.2-17 10YR 6/2 Light Brownish Gray, Silty Clay Trace Sand and Gravel, Soft, Moist	
18							No splitspoon possible due to gravel. Continued splitspoon at 19' bgs.	
19							19-19.7 10YR 6/2 Light Brownish Gray, Silty Clay Trace Sand and Gravel, Soft, Moist	
20		Bag 9	1.4/2.0	3/5 3/5				

IngenAE

BRIDGETON LANDFILL
MONITORING WELL INSTALLATION

Log of Boring

PZ-111-SS

Permit Number: MO 004440
Drilling Method: T75 Track
Drilling Contactor: Roberts Environmental Drilling, Inc.
Start Date: August 16, 2017
Finish Date: August 22, 2017
Logger: FBP

Northing (ft):
Easting (ft):
Driller: Eric Wetzal
Ground Surface Elevation (ft msl):
Water Level:
Date Logged:

Depth Below Surface (ft)	Water Level	Sample: Sample or Box Number	Sample: Recovery	Sample: Standard Penetration 6"-6"-6"-(N)	Sample: Rock Quality Designation	Sample: Runtime	Sample Description: Depth Below Surface (ft)	Sample Description: Comments
21							19.0-21.3 10 YR 5/2 Grayish Brown, Silty Clay, soft, moist $(CL)_4$	
22		Bag 10	1.6 / 2.0	3/5 9/10			21.3-25.5 10 YR 6/1 Gray, Silty Clay with Trace Sand, Soft, Wet $(CL)_4$	
23								
24		Bag 11	1.6 / 2.0	3/3 5/12				
25								
26		Bag 12	1.4 / 2.0	17/10 14/19				
27								
28		Bag 13	1.6 / 2.0	14/22 20/20				
29								
30		Bag 14	1.2 / 2.0	5/10 14/21			25.5 -33.8 10 YR 5/1 Gray Fine Grained Silty Sand, Compacted,Wet (Alluvial)	
31								
32		Bag 15	1.5 / 2.0	10/14 13/10				
33								
34		Bag 16	1.6 / 2.0	1/1 3/10			33.8-34.2 10 YR 5/2 Grayish Brown, Silty Clay, soft, moist $(CL)_4$	
35							34.2-35.5 10 YR 5/6 Yellowish Brown Fine Grained Sand, Mottled with Silt, Dense, Wet (Alluvial)	
36		Bag 17	1.5 / 2.0	10/10 13/18				
37								
38		Bag 18	1.2 / 2.0	1/1 1/3			35.5-41 10 YR 4/2 Dark Yellowish Brown Fine to Medium grained sand, Dense, Wet (Alluvial)	
39								
40		Bag 19	1.3 / 2.0	0/0 0/1				

IngenAE

BRIDGETON LANDFILL
MONITORING WELL INSTALLATION

Log of Boring

PZ-111-SS

Permit Number: MO 004440
Drilling Method: T75 Track
Drilling Contactor: Roberts Environmental Drilling, Inc.
Start Date: August 16, 2017
Finish Date: August 22, 2017
Logger: FBP

Northing (ft):
Easting (ft):
Driller: Eric Wetzal
Ground Surface Elevation (ft msl):
Water Level:
Date Logged:

Depth Below Surface (ft)	Water Level	Sample: Sample or Box Number	Sample: Recovery	Sample: Standard Penetration 6" - 6" - 6" - (N)	Sample: Rock Quality Designation	Sample: Runtime	Sample Description: Depth Below Surface (ft)	Sample Description: Comments
41								
42		NA	0 / 2.0	5/6 12			No Recovery	Borehole Collapsing use tremie pipe w/water to stabilize sand.
43								
44		Bag 20	1.2 / 2.0	6/9 10/20				
45								
46		Bag 21	2.0 / 2.0	12/17 18/25			43-47 10 YR 4/2 Dark Yellowish Brown Fine to Medium grained sand, Dense, Wet (Alluvial)	see comment above
47								
48		NA	0 / 2.0	9/25 35/50			No Recovery	
49								
50		Bag 22	0.6 / 2.0	10/20 25/30				see comment above
51								
52		Bag 23	1.0 / 2.0	4/6 10/8				
53								
54		Bag 24	1.0 / 2.0	5/5 5/10			49-58 10 YR 4/2 Dark Yellowish Brown Fine to Medium grained sand, Dense, Wet (Alluvial)	
55								
56		Bag 25	0.3 / 2.0	10/15 16/20				
57								
58		Bag 26	1.0 / 2.0	0/1 0/1			58-59.5 5Y 4/1 Dark Gray, Silty Clay, Soft, Wet $(CL)_H$	
59								
60		Bag 27	2.0 / 2.0	1/2 3/5			59.5-60.5 10YR 3/1 Very Dark Gray Silty Clay, with fibrous wood, Stiff, Moist $(CH)_L$	

IngenAE

BRIDGETON LANDFILL
MONITORING WELL INSTALLATION

Log of Boring

PZ-111-SS

Permit Number: MO 004440
Drilling Method: T75 Track
Drilling Contactor: Roberts Environmental Drilling, Inc.
Start Date: August 16, 2017
Finish Date: August 22, 2017
Logger: FBP

Northing (ft):
Easting (ft):
Driller: Eric Wetzal
Ground Surface Elevation (ft msl):
Water Level:
Date Logged:

Depth Below Surface (ft)	Water Level	Sample: Sample or Box Number	Sample: Recovery	Sample: Standard Penetration 6"- 6"- 6"- (N)	Sample: Rock Quality Designation	Sample: Runtime	Sample Description: Depth Below Surface (ft)	Sample Description: Comments
61							60.5-61 10YR 3/1 Very Dark Gray, Silty Clay, Soft, Moist $(CL)_H$	
62		Bag 28	1.8 / 2.0	1/1 1/1			61-65.5 10YR 3/1 Very Dark Gray, Silty Clay, trace sand Wood Fragments, Soft, Moist $(CL)_H$	
63								
64		Bag 29	0.8 / 2.0	1/1 2/2				End drilling @ 15:38
65								
66		Bag 30	0.8 / 2.0	0/2 4/6			65.5-69 10YR 3/1 Very Dark Gray, Silty Fine Grained Sand with some 10 YR 2/1 Black Shale Partings, Loose, Moist (SM)	Resume drilling 8/17/17 around 08:34
67								
68		Bag 31	1.2 / 2.0	4/6 7/20				
69								
70		Bag 32	0.9 / 2.0	6/8 7/10			65.5-75 10YR 3/1 Very Dark Gray, Silty Fine to Medium Grained Sand, Loose, Moist (SM)	
71								
72		Bag 33	0.8 / 2.0	8/8 10/15				
73								
74		Bag 34	0.4 / 2.0	4/10 15/15				
75								
76		NA	0.0 / 2.0	6/6 8/9			No Recovery	Attempted to flush sand from borehole.
77								
78							Blind Drilled from 77' bgs to bedrock (88' bgs). Received approval from MDNR.	
79								
80								

IngenAE

BRIDGETON LANDFILL
MONITORING WELL INSTALLATION

Log of Boring

PZ-111-SS

Permit Number: MO 004440
Drilling Method: T75 Track
Drilling Contactor: Roberts Environmental Drilling, Inc.
Start Date: August 16, 2017
Finish Date: August 22, 2017
Logger: FBP

Northing (ft):
Easting (ft):
Driller: Eric Wetzal
Ground Surface Elevation (ft msl):
Water Level:
Date Logged:

Depth Below Surface (ft)	Water Level	Sample: Sample or Box Number	Sample: Recovery	Sample: Standard Penetration 6"- 6"- 6"- (N)	Sample: Rock Quality Designation	Sample: Runtime	Sample Description: Depth Below Surface (ft)	Sample Description: Comments
81								
82								
83								
84								
85								
86								
87								
88								
89		Box 1 Row 1	1.7		0	8:12	88-91 Missing Core	begin coring @ 88' bgs NQ Wireline and Water
90		Box 1 Row 2	5.0		5.0	Run # 1	91-92 N8 to N7 Very light to light Gray Coarse Grained Gravel	Light Gray to Dark Gray water return
91		Box 1 Row 3					92-92.1 5Y 6/1 Light Olive Gray Siltstone, Very Weak Moderately Weathered, Fine Grained	
92		Box 1 Row 4	4.7		1.2	8:38	92.1-93.2 Light Olive Gray Siltstone, Weak Moderately Weathered, Fine Grained	
93		Box 1 Row 5	5.0		5.0	9:19	93.2-93.7 N7 light Gray Limestone, Moderately Strong, Slightly Weathered, Fine Grained.	
94		Box 2 Row 1				Run # 2	93.7-94.0 10YR 3/1 Very Dark Gray, Silty Clay, Soft with 1" sized gravel	
95							94-99 N6 Medium Light Gray, Siltstone Weak, Moderately Weathered, Thinly Bedded	Light Gray Water Return
96								
97								
98						9:30		
99						9:45		
100						Run # 3	99-100.4 N7 light Gray Limestone, Moderately Strong, Slightly Weathered, Fine Grained. (St. Louis Formation)	

IngenAE

BRIDGETON LANDFILL
MONITORING WELL INSTALLATION

Log of Boring

PZ-111-SS

Permit Number: MO 004440
Drilling Method: T75 Track
Drilling Contactor: Roberts Environmental Drilling, Inc.
Start Date: August 16, 2017
Finish Date: August 22, 2017
Logger: FBP

Northing (ft):
Easting (ft):
Driller: Eric Wetzal
Ground Surface Elevation (ft msl):
Water Level:
Date Logged:

Depth Below Surface (ft)	Water Level	Sample: Sample or Box Number	Sample: Recovery	Sample: Standard Penetration 6"- 6"- 6"- (N)	Sample: Rock Quality Designation	Sample: Runtime	Sample Description: Depth Below Surface (ft)	Sample Description: Comments
101		Box 2 Row 2					100.4-104.8 N6 Medium Gray, Dolomitic Limestone, Moderately Strong, Slightly Weathered, Fine Grained (St. Louis Formation)	
102								
103		Box 2 Row 3						
104			10.0		5.8	Run # 3		
105		Box 2 Row 4	10.0		10.0		104.8-113.0 N7 Light Gray Limestone, Moderately Strong, Slightly Weathered, Fine to Medium Crystalline with Pyrite and calcite filled fractures (St. Louis Formation)	
106								
107		Box 2 Row 5					107.6 GLEY 1 8/1 Light Greenish Gray Shale Parting	
108						10:20		
109		Box 3 Row 1					109.7-110 missing core	
110			4.7		3.4	Run # 4		
111		Box 3 Row 1	5.0		5.0		110-110.2 GLEY 1 8/1 Light Greenish Gray Shale Parting 110.2-110.7 calcite filled fractures throughout core. 111-111.6 Stylolites	
112								
113		Box 3 Row 3				10:45		
114							End of Boring 113' bgs	
115								
116								
117								
118								
119								
120								

DRILLING CONTRACTOR: ROBERTS ENVIRONMENTAL DRILLING, INC.

DRILLING METHOD: MUD ROTARY

MO REGISTERED PROFESSIONAL GEOLOGIST: BILL ABERNATHY P.G. / R.G.

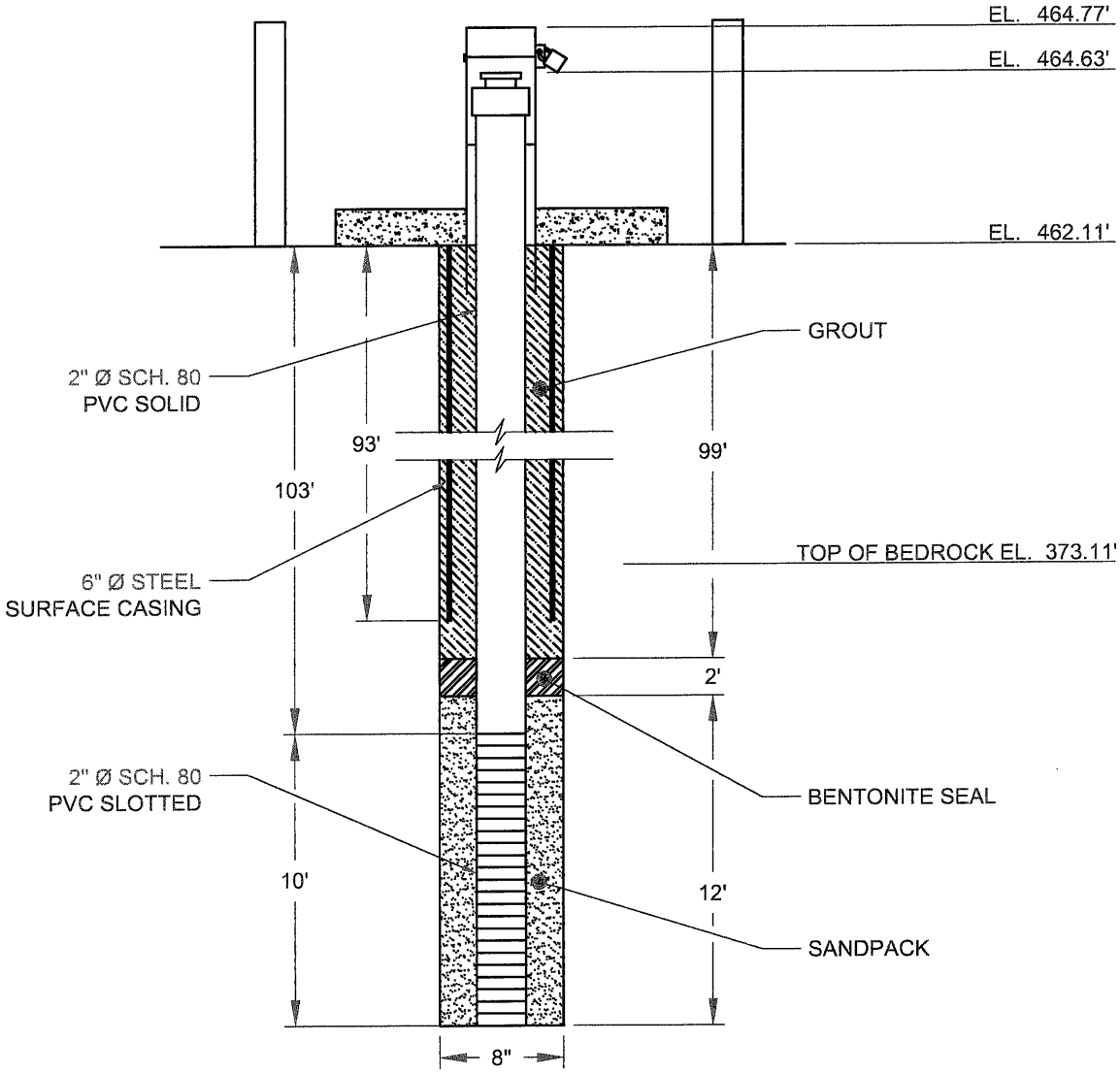
INSTALLATION SUPERVISOR: ERIC WETZEL

INSTALLATION DATE: 8/25/2017 THRU 8/29/2017

SURVEYOR: WEAVER CONSULTANTS GROUP

NORTHING: 1,068,590.96

EASTING: 515,814.70



PZ-111-SS
NOT TO SCALE

BRIDGETON LANDFILL LLC 13570 ST. CHARLES ROCK ROAD BRIDGETON, MO 63044	BRIDGETON LANDFILL PZ-111-SS INSTALLATION	Engineering for a Better World FEEZOR ENGINEERING, INC.	OCTOBER 2017 DRAWN BY: BJV APPROVED BY: WJA REVISION DATE	FIGURE: 2
PZ-111-SS AS-BUILT DRAWING				
PROJECT NUMBER: BT-163	FILE PATH: D:\Bridgeton Landfill\PZ-111-SS.dwg			

MISSOURI DEPARTMENT OF NATURAL RESOURCES
MISSOURI GEOLOGICAL SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO. 528467		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR (THIS FORM IS NOT TO BE USED FOR NESTED WELLS)

OWNER NAME	CONTACT NAME		TELEPHONE WITH AREA CODE
BRIDGETON LANDFILL (BRIDEGETON LANDFILL, LLC)	N/A		N/A
OWNER ADDRESS (MAILING ADDRESS)	**CITY**	**STATE**	**ZIP CODE**
13570 ST. CHARLES ROCK RD.	ST. LOUIS	MO	63044
SITE NAME	**REGULATORY ID NUMBER**	**WELL NUMBER**	**VARIANCE NUMBER (IF ISSUED)**
ABANDONMENT/BEDROCK WELLS BRIDGETON L/F		PZ-111-SS	
SITE ADDRESS (PHYSICAL ADDRESS IF DIFFERENT THAN MAILING)		**CITY**	**COUNTY**
13570 ST. CHARLES ROCK RD.		ST. LOUIS	ST. LOUIS

SURFACE COMPLETION

TYPE: ☑ ABOVE GROUND ☐ FLUSH MOUNT

LENGTH AND DIAMETER OF SURFACE COMPLETION: LENGTH 5 FT. DIAMETER 4X4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: DIAMETER 24sq IN. LENGTH 2 FT.

SURFACE COMPLETION GROUT: ☑ CONCRETE ☐ OTHER

LOCATION OF WELL (D/M/S FORMAT ONLY)
LAT. 38° 46 ' 12.1 "
LONG. 90° 26 ' 51.8 "

SMALLEST ¼ LARGEST ¼
SECTION TOWNSHIP NORTH
RANGE ☐ EAST ☐ WEST

MONITORING FOR: (CHECK ALL THAT APPLY)
☐ RADIONUCLIDES ☐ PETROLEUM PRODUCTS ONLY
☐ EXPLOSIVES ☑ METALS ☑ VOCS
☑ SVOCS ☐ PESTICIDES/HERBICIDES

TYPE OF WELL
☐ GAS MIGRATION WELL ☑ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☐ PIEZOMETERS ☐ INJECTION WELL
☐ DIRECT PUSH

☑ LOCKING CAP
☑ WEEP HOLE

ELEVATION FT.

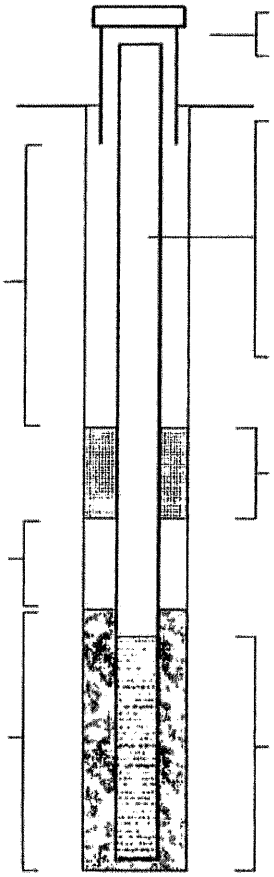
ANNULAR SEAL
LENGTH 96 FT
☐ SLURRY ☑ CHIPS
☐ PELLETS ☐ GRANULAR
☐ CEMENT/SLURRY

IF CEMENT/BENTONITE MIX:
BAGS OF CEMENT USED
% OF BENTONITE USED
WATER USED PER BAG GAL.

SECONDARY FILTER PACK
LENGTH NA FT.

DEPTH TO TOP OF PRIMARY FILTER PACK 101 FT.

LENGTH OF PRIMARY FILTER PACK 12 FT.



SURFACE COMPLETION
☑ STEEL ☐ ALUMINUM ☐ PLASTIC

RISER
RISER PIPE DIAMETER 1 IN.
RISER PIPE LENGTH 105.5 FT.
DIAMETER OF DRILL HOLE 10 IN.
WEIGHT OR SDR# 40

MATERIAL
☑ STEEL ☐ THERMOPLASTIC (PVC)
☐ OTHER

BENTONITE SEAL
LENGTH 3 FT
☑ CHIPS ☐ PELLETS ☐ GRANULAR
☐ SATURATED ZONE ☐ HYDRATED

SCREEN
SCREEN DIAMETER 1 IN.
SCREEN LENGTH 10 FT.
DIAMETER OF DRILL HOLE 6 IN.
DEPTH TO TOP 105.5 FT.

SCREEN MATERIAL
☐ STEEL ☑ THERMOPLASTIC (PVC)
☐ OTHER

DEPTH TO	DEPTH FROM	FORMATION DESCRIPTION
(REDI	JOB#	172157-AB/D-AR)
2'	0	Top Soil w/Organics
10'	2'	Silty Clay w/Gravel/Sand
34'	10'	Silty Clay w/Sand
60'	34'	Silty Clay w/Fine Sand/Silt
90'	60'	Limestone/Siltstone/
113'	90'	Grav./SiltyClay/Limestne/Shal
***1'	93'	10" CASING
***93'	113'	6" CASING
		PORTLAND TYPE III
TOTAL DEPTH:		113'

STATIC WATER LEVEL 31.98 FT.
PUMP INSTALLED ☐ YES ☑ NO

FOR CASED WELLS, SUBMIT ADDITIONAL AS-BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE & SIZE OF ALL CASING, HOLE DIAMETER & GROUT USED.

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

PRIMARY CONTRACTOR SIGNATURE (IF DIFFERENT THAN DRILLER)	PERMIT NUMBER	DATE	WELL COMPLETION DATE
		10/10/17	08/29/2017

WELL DRILLER SIGNATURE	PERMIT NUMBER	DATE	APPRENTICE SIGNATURE	PERMIT NUMBER
Eric Wetzel	4255-M			

MO 780-1415 (02-14) SEND COMPLETED FORM ALONG WITH $100 CERTIFICATION FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, MISSOURI GEOLOGICAL SURVEY, WELLHEAD PROTECTION SECTION, PO BOX 250, ROLLA, MO 65402 PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL PLUGGING REGISTRATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO. 531858	
C.R. NO. / CHECK NO. / TRANSMITTAL NO.	
STATE WELL NUMBER / APPROVED BY / DATE APPROVED	
ENTERED Ph1 Ph2 Ph3 / ROUTE	

INFORMATION SUPPLIED BY WELL OR PUMP INSTALLATION CONTRACTOR

OWNER NAME	TELEPHONE NUMBER	VARIANCE NUMBER (IF APPLICABLE)
BRIDGETON LANDFILL (BRIDGETON LANDFILL, LLC)	N/A	

OWNER ADDRESS	CITY	STATE	ZIP CODE
13570 ST. CHARLES ROCK RD.	ST. LOUIS	MO	63044

ADDRESS OF WELL SITE	CITY	STATE	ZIP CODE	REFERENCE NUMBER OF ORIGINAL WELL (IF KNOWN)
13570 ST. CHARLES ROCK RD.	ST. LOUIS	MO	63044	

SITE NAME	WELL NUMBER	DATE
ABADONMENT/BEDROCK WELLS BRIDGETON L/F	PZ 111 - SS	

LOCATION OF WELL
LAT. 38 ° 46 ' 12.2 "
LONG. 90 ° 26 ' 51.8 "

DRILL AREA: AREA 1
COUNTY: ST. LOUIS

SMALLEST ¼ LARGEST ¼ ¼
Sec. Township North Range ☐ East ☐ West

PLUGGING INFORMATION

ORIGINAL DRILLER (IF KNOWN)	DATE ORIGINALLY DRILLED	STATIC WATER LEVEL	DRILLER NOTES
N/A	N/A	N/A	N/A

☐ MONITORING WELL

DEPTH OF WELL	LENGTH OF RISER
____ FT.	____ FT. BGS

SCREEN/RISER DIAMETER	WELL SCREEN AND RISER REMOVED?
____ IN.	☐ Yes ☐ No

PUMP AND SAMPLING EQUIPMENT REMOVED?	CASING REMOVED?
☐ Yes ☐ N/A ☐ No	☐ Yes ☐ N/A ☐ No

☐ SOIL BORING(S) Boring Diameter: ____ IN.

QUANTITY	DEPTH
1	113'
TOTAL 1 BORING(S)	TOTAL 113 FT.

TYPE OF FILL MATERIAL: ☐ Gravel ☐ Sand ☐ Other

AMOUNT OF FILL USED: ____ ☐ TONS ☐ CUBIC YARDS

DEPTH TO TOP OF FILL: ____ FT.

GROUT INSTALLATION METHOD	GROUT MATERIAL USED	HOW MANY GALLONS OF WATER MIXED PER BAG OF CEMENT OR BENTONITE?	TOTAL NUMBER OF BAGS OF GROUT USED
☑ Gravity ☐ Tremie ☐ Excavation	Neat Cement Bentonite ☐ Hi-Early ☐ Slurry ☐ Granular ☐ Pellets ☐ Type 1 ☑ Chips ☐ Other ____	5 ☐ Hydrated to Saturation	6
			POUNDS OF GROUT PER BAG: 50

DATE 1st WELL PLUGGED	DATE LAST WELL PLUGGED	FINISHED SURFACE MATERIAL	SURFACE MATERIAL LENGTH
08/22/2017	08/29/2017	☑ Soil ☐ Concrete ☐ Asphalt ☐ Other	____ FT. ____ IN.

REMARKS	REASON FOR ABANDONMENT
(REDI JOB 172157-AB/D-AR)	

I hereby certify that the monitoring well herein described was plugged in accordance with the Department of Natural Resources requirements for the plugging of wells.

SIGNATURE (PRIMARY CONTRACTOR)		SIGNATURE (CONTRACTOR)	PERMIT NUMBER	DATE
		Eric Wetzel	4255-M	10/25/2017
PERMIT NUMBER	DATE	SIGNATURE (APPRENTICE)	PERMIT NUMBER	DATE

MO-780-2161 (1-12)

REMIT TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGY AND LAND SURVEY
WELLHEAD PROTECTION SECTION, PO BOX 250, ROLLA, MO 65402 573-368-2165
ENCLOSE $50 FEE WITH REGISTRATION RECORD WITHIN 60 DAYS AFTER WELL PLUGGING OR WITHIN 180 DAYS AFTER THE PLUGGING OF TEMPORARY WELLS

RECORD OF DRILLHOLE PZ-111-SD

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/11/95
DRILL RIG: Schramm

DATUM: MSL
COORDINATES N: 1068638.1
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515834.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
192	0.0-199.9 ft. No sampling conducted See Record of Drillhole for PZ-111-KS														0.0-98.0 ft. On 4/10/95 borehole advanced with 9 7/8 in. bit using mud rotary then 6 in. steel casing grouted in annulas with neat cement, at 91.0 ft. component bedrock encountered
194															
196															
198															
	259.30		259.30												
200	199.9-209.9 ft. 199.90 Fresh, very thickly bedded, medium gray (N5), coarsely crystalline, medium strong, FOSSILIFEROUS LIMESTONE Upper 0.1 ft. abundantly fossiliferous Argillaceous, arenaceous, abundantly fossiliferous, few stylolites, few calcite filled vugs		199.90						J,PL,SM (3)						4/11/95 @ 10:24 Began Run 1
202															
204				1	99%				J,PL,R						
206															
208															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

LOGGED: J. MILLER
CHECKED: S. TILTON
DATE: 5/24/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-SD

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/11/95
DRILL RIG: Schramm

DATUM: MSL
COORDINATES N: 1068638.1
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515834.6
INCLINATION: -90

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (90, 60, 40, 20)	FRACTURES PER FOOT (2, 4, 6, 8, 10)	DISCONTINUITY DATA: 0° Dip wrt CORE AXIS 90°	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW, FR, MW, HW, CW)	STRENGTH INDEX (R6, R5, R4, R3, R2, R1)	POINT LOAD INDEX (psi) (R1, 30, R2, 150, R3, 300, R4, 600, R5, 1500, R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
208	199.9-209.9 ft. Fresh, very thickly bedded, medium gray (N5), coarsely crystalline, medium strong, FOSSILIFEROUS LIMESTONE Upper 0.1 ft. abundantly fossiliferous		249.30	1	99%										4/11/95 @ 12:06 End Run 1
	249.30		249.30												
210	End of Record of Drillhole at 209.9 ft.		209.90												
	209.90														
212															
214															
216															
218															
220															
222															
224															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

LOGGED: J. MILLER
CHECKED: B. TILTON
DATE: 5/24/95

Golder Associates

Well No. PZ-111-SD

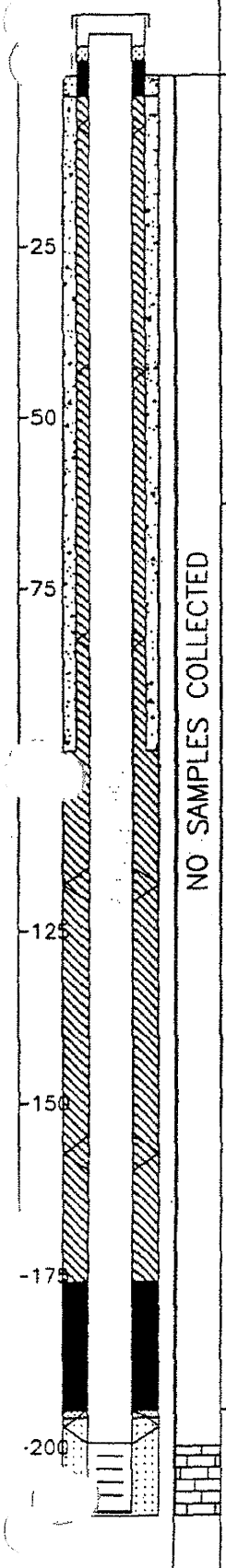
Boring No. X-Ref: PZ-111-SD

PIEZOMETER CONSTRUCTION SUMMARY

Survey Coords: Northing: 1068638 ft. Easting: 515835 ft.

Elevation Ground Level 459.2 ft. NGVD

Top of PVC Casing 461.55 ft. NGVD



Not to Scale

Drilling Summary:

Total Depth	210.0 ft.
Borehole Diameter	10 in. (0.0-98.0 ft.) 5 7/8 in. (98.0-210.0 ft.)
Casing Stickup Height	2.33 ft.
Driller	Layne-Western St. Louis, MO
Rig	CME 75, Schramm Portadrill T660H
Bit(s)	6 1/4 in. ID Hollow Stem Auger Bit, NX Core 5 7/8 in. Button Bit and 9 7/8 in. Tricone Bit
Drilling Fluid	Auger-None, NX Core Water, Air and Mud Rotary
Protective Casing	8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling CME 75 Schramm Rotary	4/10/95	9:45	4/11/95	13:38
Geophys.Logging:	4/14/95	13:00	4/14/95	16:00
Casing: 2" PVC	4/21/95	8:00	4/21/95	8:18
8" Steel	4/10/95	14:05	4/10/95	16:21
Filter Placement:	4/21/95	8:32	4/21/95	9:12
Cementing: Development				
Bentonite Grout	4/21/95	9:20	4/21/95	9:50
Bentonite Seal	4/21/95	9:15	4/21/95	9:18

Well Design & Specifications

Basis: Geologic Log X Geophysical Log X

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 2.33	-	199.40	C1	461.55	-	259.82
199.40	-	209.20	S1	259.82	-	250.02
209.20	-	209.50	C2	250.02	-	249.72
+ 0.50	-	98.00	C3	459.70	-	361.22
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.) (C3-see comments)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 195.8-210.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 194.7-195.8 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-176.0 ft., Neat cement, 3.0-98.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 176.0-194.7 ft.

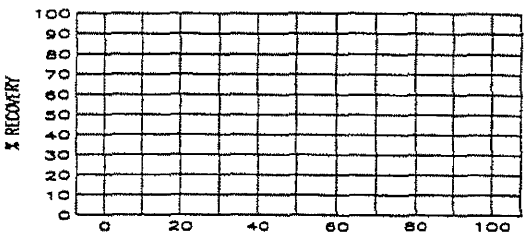
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments: Surface Casing C3: 6 1/8 in. ID / 6 5/8 in. OD Steel Casing

Supervised by J. Miller

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ111SD

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122482	CHECK NO
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO.
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME	WELL NUMBER
LAIDLAW BRIDGETON SANITARY LANDFILL	PZ-111-SD

SITE ADDRESS	CITY	STATE	ZIP CODE
ST. CHARLES ROCK RD.	BRIDGETON	Mo	63044

NAME	TELEPHONE
LAIDLAW WASTE SYSTEMS, INC.	314-241-3710

ADDRESS	CITY	STATE	ZIP CODE
1338 N. BROADWAY	ST. LOUIS	Mo.	63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

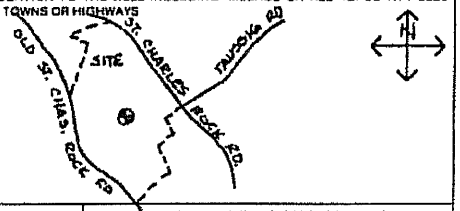
COUNTY St. Louis
ELEVATION 459.2
AREA NO.

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N,RNG. 5 (E) OR W

LAT. 38 ° 46 ' 06 " LONG. 90 ° 26 ' 39 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN Co., INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN Co., INC.

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
461.55

MEASURING POINT IS
☒ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☒ AIR ROTARY ☐ AUGER TYPE
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☒ YES, AT 5 TOTAL
☒ STAINLESS STEEL
☐ OTHER
☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
4-21-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR)
Michael P. Vogt

PERMIT NUMBER	DATE
001256WM	5-10-95

SIGNATURE (DRILLING CONTRACTOR)
Michael P. Vogt

PERMIT NUMBER	DATE

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 461.6

Ground Surface Elevation: 459.2

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
Depth to bottom of Protective Casing Seal:	2.5	
Depth to Base of Annular Seal:	176.0	
Depth to Base of Bentonite Seal:	174.7	
Depth to Base of Secondary Filter Pack:	195.8	
Depth to Top of the Screen:	199.3	Limestone
Depth to Bottom of the Screen:	209.3	
Plug Back Total Depth:		
Original Total Depth:	310	

LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)
PROTECTIVE CASING
Type: STEEL
Size: 8"x8"x5'
Bore Hole Diameter: 9 7/8"
WEEP HOLE - Y / N (Circle one)

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 201.5'
Diameter: 2"
Type of Material: SCH. 80 PVC

BOREHOLE DIAMETER: 5 7/8 in.

ANNULAR SEAL
Type: ☒ Bentonite Slurry ☐ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite
Length of Seal: 18.7 Ft.

SECONDARY FILTER PACK (Optional)
Type: ☒ Sand ☐ Manufactured
Grain Size: SUSAR C50
Length: 1.1'

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 16-35
Length: 14.2'

WELL SCREEN
Length: 10'
Slot Size: 0.010"
Type: SCH. 80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

RECORD OF DRILLHOLE PZ-111-KS

Sheet 1 of 19

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068620.76
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515850.23
INCLINATION: -90

DEPTH SCALE (FEET)

ROCK TYPE

DESCRIPTION

GRAPHIC LOG

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

ELEV / DEPTH (FT)

RUN NO.

CORE RECOVERY

RQD (60, 40, 20)

FRACTURES PER FOOT (2, 4, 6, 8, 10)

DISCONTINUITY DATA: DIP wrt CORE AXIS (0, 30, 60, 90)

TYPE AND SURFACE DESCRIPTION

GRAPHIC LOG

WEATHERING INDEX: FR, SW, MW, HW, CW

STRENGTH INDEX: R6, R5, R4, R3, R2, R1

POINT LOAD INDEX (psi): R1 30, R2 150, R3 300, R4 600, R5 1500, R6

TEST ORIENTATION

NOTES
WATER LEVELS
INSTRUMENTATION

ELEV / DEPTH (FT)	DESCRIPTION	RUN NO.	CORE RECOVERY	TYPE AND SURFACE DESCRIPTION	NOTES / WATER LEVELS / INSTRUMENTATION
80	0.0-79.5ft. No sampling conducted See Foth & Van Dyke log F-1-D dated 9/1/90 79.5-80.0 ft. No samples collected				0.0-84.0 ft. Borehole advanced with 14 3/4 in. tricone bit using mud rotary, then 10 in. steel casing set in borehole to seal off saturated alluvial deposits. Extremely weathered bedrock encountered @ ~79.0 ft. and bedrock encountered @ 84.0 ft.
82					
84	374.60	374.60			
	84.6-86.8 ft. 84.60 Slightly weathered, medium bedded, light olive gray (5Y 5/2), very fine grained, medium strong, DOLOMITE, (ST. LOUIS FORMATION) 85.1-85.3 ft. Limestone 85.7 ft. Calcite crystals	84.60		Broken Zone J,U,SM	3/15/95 @ 7:45 Began coring
86	372.40			J,PL,SM	
	86.8-91.5 ft. 86.80 Fresh, medium bedded, light olive gray (5Y 5/2), very fine grained, strong, DOLOMITIC LIMESTONE, (ST. LOUIS FORMATION)	1	96%		
88				J,PL,SM J,I,R J,PL,SM,CL	
	369.80	89.40		J,I,R	End core Run 1 @ 8:20
90	90.4-90.5 ft. Argillaceous partings			J,I,SM (2)	
	367.70	91.50			
92	91.5-96.8 ft. 91.50 Fresh, medium bedded, light olive gray (5Y 5/2), very fine grained, medium strong, DOLOMITE, (ST. LOUIS FORMATION) 92.1-93.6 ft. Slightly porous/vuggy, some calcite crystals	2	100 %		
94					

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 6/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068620.78
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 813850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

LENGTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/ CORE AXIS; TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR, MW, HW, CW	STRENGTH INDEX: R6, R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): R1 30, R2 150, R3 300, R4 600, R5 1500, R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
98														
	362.40													
	96.8-99.5 ft. 96.80 Fresh, medium bedded, light olive gray (5Y 5/2), very fine grained, strong DOLOMITIC LIMESTONE, (ST. LOUIS FORMATION)			2	100 %			J,U,SM J,PL,SM J,PL,SM,CL (2)						
98	98.7-98.9 ft. Argillaceous partings													
	359.70		359.80											
	99.5-103.7 ft. 99.50 Fresh, medium bedded, light olive gray (5Y 5/2), very fine grained, medium strong, DOLOMITE, (ST. LOUIS FORMATION) Some calcite filled veins, pyrite crystals		99.40											End core Run 2 @ 9:20
100														
102														
	355.50													
	103.7-106.9 ft. 103.70 Fresh, medium bedded, light olive gray (5Y 5/2), medium grained, medium strong, DOLOMITIC LIMESTONE, (ST. LOUIS FORMATION) Some stylolites, argillaceous partings			3	98%			J,I,SM,CL						
104														
106								J,I,R						
	106.9-110.0 ft. Fresh, medium bedded, light olive gray (5Y 6/1), micro-crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION)													
108	108.1-108.5 ft. Slightly weathered, some stylolites, argillaceous partings							J,U,SM J,I,SM,CL (2)						
			349.80											
			109.40					J,I,SM (2)						
110	110.0-112.1 ft. Fresh, medium bedded, light olive gray (5Y 6/1), medium grained, medium strong, DOLOMITIC LIMESTONE, (ST. LOUIS FORMATION)			4	100 %									End Core Run 3 @ 10:25
112														

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 6/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

Sheet 3 of 19

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068820.78
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

LENGTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
112	347.10 112.1-115.8 ft. 112.10 Fresh, medium bedded, light olive gray (5Y 6/1), very fine grained, weak, ARGILLACEOUS DOLOMITE, (ST. LOUIS FORMATION)								J,I,SM						
114															
	343.40 115.8-120.6 ft. 115.80 Fresh, medium bedded, olive gray (5Y 4/1), fine grained, medium strong, DOLOMITIC LIMESTONE, (ST. LOUIS FORMATION)			4	100 %										
116															
118	119.0-119.4 ft. Some calcite filled vugs (<2 mm) 119.4-120.3 ft. Argillaceous, weak		339.80 119.40												
120	120.6-127.0 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Some calcite crystals								J,I,SM J,I,SM J,I,R J,PL,SM,CL						
122	123.0-127.0 ft. Thinly laminated argillaceous partings			5	98%				J,U,SM,CL J,PL,SM						
124															
126									J,PL,SM J,PL,SM J,I,R						
	127.0-136.9 ft. 332.20 Fresh, medium bedded, light olive gray (5Y 6/1), fine to medium grained, medium strong, DOLOMITIC LIMESTONE, (SALEM FORMATION) 127.00 127.0-128.5 ft. Numerous chert zones														127.0 ft. Inferred top of SALEM FORMATION encountered
128															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: O. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 8/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068620.78
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
128	127.0-136.9 ft. Fresh, medium bedded, light olive gray (5Y 6/1), fine to medium grained, medium strong, DOLOMITIC LIMESTONE, (SALEM FORMATION)			5	98%										
			329.60 / 129.40												
130									J,PL,SM						
132									J,I,SM (2)						
									J,I,SM (2)						
134	134.4-135.4 ft. Chert zones (<1/2 in. thick)			6	98%										
									B,P,SM (2)						
136	136.9-144.3 ft. Fresh, medium bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) 322.00														
	137.2-137.7 ft. 137.20 ARGILLACEOUS DOLOMITE layer								J,I,R,CL						
	137.0 ft. Stylolites								J,PL,R						
138	138.0-139.4 ft. Numerous stylolites								J,I,SM,CL						
									J,I,R						
			319.80 / 139.40												
	139.4-141.8 ft. Four chert zones (1-5 in. thick)								B,PL,SM						139.4-141.8 ft. Very slow drilling
140				7	100 %				J,I,SM (2)						3/15/95 @ 15:00 Stop drilling for the day 3/20/95 @ 7:30 Began Run 8
			317.40 / 141.80												
142									B,I,R						
									B,U,SM						
	142.9 and 143.8 ft. Light olive gray (5Y 6/1), arenaceous DOLOMITE layers (<4 in. thick)			8	92%				J,I,R						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 6/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

Sheet 5 of 19

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068620.76
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515650.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
Pl-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
144		314.90	8	92%										
	144.3-147.5 ft. Fresh, thinly bedded, olive gray (5Y 4/1), fine grained, strong, CHERT, (SALEM FORMATION) Arenaceous	144.30					90	J,I,SM						
146														
	146.5 and 146.8 ft. Thin olive gray (5Y 4/1), arenaceous Dolomite layers (<3 in. thick)		9	100 %			90	J,I,R						
		311.70												
	147.5-157.5 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARENACEOUS DOLOMITE, (SALEM FORMATION) Some chert nodules (5-10 mm. dia.), some thin chert layers (<2 in. thick)	147.50					90	J,I,R						
148							90	J,I,R						
		309.90												
	149.3-149.6 ft. Chert layers	148.30												
	149.7 ft. Coarse calcite crystals (<1/2 in. dia.)													
150							90	B,PL,SM						
							90	B,I,R						
152							90	J,I,R (2)						
							90	J,I,SM						
	152.5-153.5 ft. Porous zone, open vugs (<1 in. dia.)													
	153.4 and 154.2 ft. Chert layers (<5 in.)													
154							90	J,C,SM						
			10	100 %										
156	155.6 and 156.9 ft. Chert layers (<5 in.)						90	J,I,R						
							90	J,I,R						
							90	J,I,R						
	157.5-174.5 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARENACEOUS DOLOMITE, (SALEM FORMATION) Few chert nodules, (~5 mm.), scattered chert (thin layers of chert <3 mm.)						90	J,PL,SM						
158							90	J,PL,SM						
		299.70												
	159.5-159.8 ft. Chert layer	159.50	11	100 %										

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 8/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

Sheet 8 of 19

PROJECT: LAIDLAW/R-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068920.78
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
160	157.5-174.5 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARENACEOUS DOLOMITE, (SALEM FORMATION) Few chert nodules, (~5 mm.), scattered chert (thin layers of chert <3 mm.)														Most fractures observed are characterized as drill induced
162	160.5-160.7 ft. Chert layer 161.5-161.7 ft. Chert layer			11	100 %				J,PL,SM (3)						
164	163.3-163.6 ft. Calcite crystals layer (large crystals)		294.70						J,I,R (2) J,I,R						
	294.20		164.50												
166	165.0-167.0 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (SALEM FORMATION)	165.00													165.1-169.5 ft. 4-6 breaks per foot that were drill incuded
168															
170	Scattered chert clasts throughout the sample 170.0-171.5 ft. Zone showing moderate porosity, open vugs (<2 mm.)			12	100 %										
172	172.8-173.2 ft. Conglomerate limestone with shale fragments 173.2-174.5 ft. Abundant fossil fragments replaced by silica														
174	174.5-176.6 ft. Fresh, thickly bedded, pale olive (10Y 6/2), fine to medium crystalline, strong, ARGILACEOUS LIMESTONE, (SALEM FORMATION) Abundant fossil fragments		284.70 174.50	13	100 %										
176															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 6/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

Sheet 7 of 19

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068820.78
AZIMUTH: 0

COLLAR ELEV: 458.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

Depth scale (feet)	Description	Graphic log	Elev / Depth (ft)	Run no.	Core recovery	RQD (80, 60, 40, 20)	Fractures per foot (2, 4, 6, 8, 10)	Discontinuity data: Dip wrt core axis (0, 30, 60, 90)	Discontinuity data: Type and surface description	Graphic log	Weathering index (SW, FR, MW, HW, CW)	Strength index (R5, R6, R4, R3, R2, R1)	Point load index (psi) (30, R2 150, R3 300, R4 600, R5 900, R6 1500)	Test orientation	Notes, water levels, instrumentation
178															
	176.6-179.1 ft. Fresh, medium bedded, pale olive (10Y 6/2), fine to medium grained, strong, SILICEOUS LIMESTONE, (SALEM FORMATION) Abundant fossil fragments														
178															
	179.1-184.5 ft. Fresh, thickly bedded, pale olive (10Y 6/2), fine to medium coarse, strong, ARENACEOUS LIMESTONE, (SALEM FORMATION) Abundant fossil fragments Some layers of grayish yellow (5Y 8/4), clay material			13	100 %										
180															
182															
184			274.70												
	184.5-188.5 ft. Fresh, medium bedded, yellowish gray (5Y 7/2), f-c grained, strong ARENACEOUS LIMESTONE, (SALEM FORMATION) Some fossil fragments, and some grayish yellow (5Y 2/4), clay material layers		184.50												
186															
188				14	100 %										
	188.5-194.5 ft. Slightly weathered, pale olive (10Y 6/2), medium bedded, very coarse, strong, BIOCLASTIC LIMESTONE, (SALEM FORMATION) Few chert nodules, few stylolites in bottom 4 ft., abundant layers of grayish yellow (5Y 8/4) clay, fossiliferous								B,PL,SM						
190									B,PL,SM						
192															Stopped drilling for the day

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: S. TILTON
DATE: 8/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

Sheet 8 of 19

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2948
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068620.78
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infil, CH-Chlorite, H-Healed, GRF-Gravel Filled

ELEV (FT) / DEPTH (FT)	DESCRIPTION	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
192	188.5-194.5 ft. Slightly weathered, pale olive (10Y 6/2), medium bedded, very coarse, strong, BIOCLASTIC LIMESTONE, (SALEM FORMATION) Few chert nodules, few stylolites in bottom 4 ft., abundant layers of grayish yellow (5Y 8/4) clay, fossiliferous	14	100 %									
264.70 / 194.50	194.5-197.5 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), fine grained, strong, ARGILLACEOUS LIMESTONE, (SALEM FORMATION) Few chert nodules stylolitic, abundant fossil fragments											3/21/95 @ 7:30 Water level = 20.1 ft. BGS
198	197.5-204.5 ft. Fresh, thinly bedded, light olive gray (5Y 4/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (SALEM FORMATION) Few chert nodules, few stylolites, abundant fossil fragments and abundant layers of grayish yellow (5Y 8/4) clay throughout sample	15	100 %									
254.70 / 204.50	204.5-210.6 ft. Fresh, thinly bedded, dark greenish gray (5GY 4/1), f-c grained, medium strong, LIMESTONE, (SALEM FORMATION) Few chert nodules, stylolites, few clay layers of a grayish yellow color, <3 mm. vugs, with calcite crystals	16	100 %									
208												

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: S. TILTON
DATE: 6/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068820.78
AZIMUTH: 0

COLLAR ELEV: 458.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
208	204.5-210.8 ft. Fresh, thinly bedded, dark greenish gray (5GY 4/1), f-c grained, medium strong, LIMESTONE, (SALEM FORMATION) Few chert nodules, stylolites, few clay layers of a grayish yellow color, <3 mm. vugs, with calcite crystals														
210	248.40														
	210.8-212.8 ft. Fresh, thickly bedded, dark greenish gray (5GY 4/1) to greenish black (5GY 2/1), very fine grained, weak, SILTSTONE, (WARSAW FORMATION)		210.80	16	100 %										210.8 ft. Encountered top of WARSAW FORMATION
212	246.40														
	212.8-219.7 ft. Fresh, thinly bedded, light olive gray, fine to coarse grained, medium strong, DOLOMITIC LIMESTONE, (WARSAW FORMATION) Fossiliferous, few chert nodules, stylolites		212.80												
214			214.50												
216				17	100 %										
218	239.50		239.50												3/21/95 @ 11:00 End Run 17 Drilling stopped until surface casing installed to top of WARSAW FORMATION 4/9/95 Borehole reamed out to 84.0 ft. with 14 3/4 in. tricone bit and mud rotary then 10 in. casing set in hole
220	219.70		219.70						J,PL,SM,CL						
	220.2-224.3 ft. Slightly weathered, thickly bedded, light olive gray (5Y 6/1), finely crystalline, medium strong, DOLOMITE, (WARSAW FORMATION)														
222				18	100 %										4/9/95 6 in. steel casing set to 215.3 ft. and sealed with neat cement. A 10 in. air rotary bit was used to drill borehole. 4/22/95 @ 11:02 Begin drilling Run 18 with NX core
									J,U,SM-calcite						
224															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 6/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068820.78
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

ELEV / DEPTH (FT)	DESCRIPTION	GRAPHIC LOG	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
224														
234.90														
224.30	224.3-227.4 ft. Fresh, thickly bedded, light brownish gray (5YR 6/1) to medium gray (N5), coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (WARSAW FORMATION) Not porous, sandy, fine fossil debris, clast supported							J,I,SM						
226			18	100 %				J,U,SM,CL						
231.80														
227.40	227.4-231.6 ft. Slightly weathered, thickly bedded, light olive gray (5Y 6/1), finely crystalline, medium strong, DOLOMITE, (WARSAW FORMATION) Porous-vuggy, crystallized, numerous calcite filled vugs and veins							J,I,R						
230.10														
229.10														
230														
227.60								J,I,R						
231.60	231.6-233.3 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (WARSAW FORMATION) Bioturbated													
232														
	233.3-236.1 ft. Fresh, thickly laminated, medium dark gray (N4), very fine grained, weak, ARGILLACEOUS LIMESTONE, (WARSAW FORMATION) Bioturbated, almost Claystone							J,I,SM,CL						
234			19	100 %										
223.10														
236.10	236.1-239.4 ft. Fresh, thickly laminated to thinly bedded, medium gray (N5), very fine grained, medium strong, ARGILLACEOUS CALCAREOUS DOLOMITE, (WARSAW FORMATION) Stylolitic, greenish clay infilled vug and vein @ 238.6 ft.							J,PL,SM,CL						
238														
	239.4-243.5 ft. Fresh, thickly bedded, medium dark gray (N4), coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (WARSAW FORMATION) Few stylolites, <0.1 ft. clay seams							J,PL,R-calcite						
220.10														
239.10								J,I,SM,CL						
219.80														
239.40			20	100 %										
240														

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 6/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

Sheet 11 of 19

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 843-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1088820.78
AZIMUTH: 0

COLLAR ELEV: 458.2
E: 515850.23
INCLINATION: -90

SCALE (FEET)

ROCK TYPE

DESCRIPTION

GRAPHIC LOG

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

ELEV / DEPTH (FT)

RUN NO.

CORE RECOVERY

ROD (80, 60, 40, 20)

FRACTURES PER FOOT (2, 4, 6, 8, 10)

DISCONTINUITY DATA

DIP wrt CORE AXIS (0, 30, 60, 90)

TYPE AND SURFACE DESCRIPTION

GRAPHIC LOG

WEATHERING INDEX (SW, FR, MW, HW, CW)

STRENGTH INDEX (R6, R5, R4, R3, R2, R1)

POINT LOAD INDEX (psi) (R1 30, R2 150, R3 300, R4 600, R5 1300, R6)

TEST ORIENTATION

NOTES
WATER LEVELS
INSTRUMENTATION

240

242

244

246

248

250

252

254

256

215.70
243.5-244.0 ft. Fresh, thickly bedded, medium dark gray (N4), fine grained, medium strong, ARGILLACEOUS DOLOMITE, (WARSAW FORMATION)
243.50
215.20
244.00

RUN 20, CORE RECOVERY 100 %

244.0-250.3 ft. Fresh, thickly bedded, medium dark gray (N4), coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (WARSAW FORMATION)

246.1-246.5 ft. Argillaceous Limestone, stylolitic

J,PL,SM,CL

210.00
249.20

208.50
250.7-251.3 ft. Fresh, thinly to thickly laminated, medium gray (N5), very fine grained, medium strong, ARGILLACEOUS DOLOMITE, (WARSAW FORMATION)
250.70
207.90
251.30

J,I,SM,CL

RUN 21, CORE RECOVERY 100 %

251.3-256.5 ft. Fresh, thickly bedded, medium light gray (N6) to light olive gray (5Y 2/1), coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (WARSAW FORMATION)

Fossil fragments at 255.6 ft., few Clay partings, some porosity, vugs in lower 2 in.

J,I,SM

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 8/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

Sheet 12 of 19

PROJECT: LAIDLAW/FI-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068820.76
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
256									J,I,R,CL						
	202.70														
	256.5-260.1 ft. 256.50 Slightly weathered, thickly bedded, medium gray (N5), very finely crystalline, medium strong, ARGILLACEOUS DOLOMITE, (WARSAW FORMATION)			21	100 %				J,PL,SM,CL						
258															
	Some porosity, large vug @ 258.8 ft., some smaller vugs elsewhere, some calcite filled, black organic laminae		200.10 259.10												4/22/95 @ 17:45 End Run 21 Quit drilling for the day 4/23/95 @ 7:30 Begin Run 22
260	260.1-265.5 ft. Fresh, thinly to thickly laminated, greenish black (5GY 2/1), very fine grained, weak, DOLOMITIC SILTSTONE, (WARSAW FORMATION)								J,I,SM,CL						
262															
264				22	98%										
	193.70								J,PL,SM,CL						
	265.5-269.0 ft. 265.50 Fresh, thickly bedded, medium light gray (N6) to light olive gray (5Y 6/1), coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (WARSAW FORMATION)														
268															
	190.20		190.10												
	269.0-272.8 ft. 269.00 Fresh, thickly laminated to thinly bedded, medium dark gray (N4), very fine grained, medium strong, DOLOMITIC SILTSTONE, (WARSAW FORMATION) Abundant 0.1-0.4 ft. interbeds of coarse crystalline arenaceous Dolomite		269.10												
270				23	98%				J,PL,SM,CL						
272															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 8/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

Sheet 13 of 19

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068820.79
AZIMUTH: 0

COLLAR ELEV: 458.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR, MW, HW, CW	STRENGTH INDEX: R6, R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): R1 30, R2 150, R3 300, R4 600, R5 1500, R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
272									J,PL,SM,CL						
	166.40														
	272.8-274.0 ft. 272.80 Fresh, thickly laminated, greenish black (5GY 2/1), very fine grained, weak, CLAYSTONE, (WARSAW FORMATION)														
	185.20								J,PL,SM,CL (2)						
274	274.0-290.2 ft. 274.00 Fresh, thickly laminated to medium bedded, medium light gray (N6) to medium dark gray (N4), vf-m grained, weak to medium strong, SILTSTONE, (WARSAW FORMATION) Calcite filled vugs, interbeds of Silty to Sandy Dolomitic Siltstone														
				23	98%				J,U,SM,CL						
278															
			180.20												
			279.00												
280															
282															
				24	100%										
284									J,I,SM						
288															
288															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 8/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

Sheet 14 of 19

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068820.78
AZIMUTH: 0

COLLAR ELEV: 458.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
Pl-Planar, C-Curved, U-Undulating, ST-Stepped, Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infil, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR, MW, HW, CW	STRENGTH INDEX: R6 R5 R4 R3 R2 R1	POINT LOAD INDEX (psi): R1 30, R2 150, R3 300, R4 600, R5 1500, R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
288	274.0-290.2 ft. Fresh, thickly laminated to medium bedded, medium light gray (N6) to medium dark gray (N4), vf-m grained, weak to medium strong, SILTSTONE, (WARSAW FORMATION) Calcite filled vugs, interbeds of Silty to Sandy Dolomitic Siltstone		170.30	24	100 %										
			288.90												
				25	100 %										
290			169.00												
	290.2-293.7 ft. Fresh, thickly laminated to thinly bedded, medium gray (N5), finely crystalline, medium strong, ARENACEOUS DOLOMITE, (WARSAW FORMATION) Dark gray (N3) argillaceous laminae, bioturbated		290.20												
292	165.50														
	293.7-295.2 ft. Fresh, thinly laminated, medium dark gray (N8), very fine grained, weak, SILTSTONE, (WARSAW FORMATION)														
294	164.00														
	295.2-306.8 ft. Fresh, thickly to thinly bedded, medium gray (N5), finely crystalline, medium strong, ARENACEOUS DOLOMITE, (WARSAW FORMATION) Argillaceous laminae, no porosity			26	100 %				J,U,SM						
296															
			160.20												
			299.00												
300															
				27	100 %										
302	302.8-303.6 ft. Fossiliferous Dolomite interbed														
304															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: S. TILTON
DATE: 6/6/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

Sheet 15 of 19

PROJECT: LAIDLAW/Rt-FS
PROJECT NO: 943-2948
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068620.76
AZIMUTH: 0

COLLAR ELEV: 458.2
E: 515850.23
INCLINATION: -90

DEPTH SCALE (FEET)

ROCK TYPE

DESCRIPTION

GRAPHIC LOG

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Hazed, GRF-Gravel Filled

ELEV / DEPTH (FT)

RUN NO.

CORE RECOVERY

RQD

FRACTURES PER FOOT

DISCONTINUITY DATA: DIP wrt CORE AXIS

TYPE AND SURFACE DESCRIPTION

GRAPHIC LOG

WEATHERING INDEX: SW FR, MW, HW, CW

STRENGTH INDEX: R6, R4, R3, R2, R1

POINT LOAD INDEX (psi): R5 30, R4 150, R3 300, R2 600, R1 >600, R0

TEST ORIENTATION

NOTES
WATER LEVELS
INSTRUMENTATION

304

295.2-306.8 ft.
Fresh, thickly laminated to thinly bedded, medium gray (N5), finely crystalline, medium strong, ARENACEOUS DOLOMITE, (WARSAW FORMATION)
Argillaceous laminae, no porosity

308

152.40

306.8-315.2 ft. 306.80
Fresh, thickly laminated to thinly bedded, very light gray (N8) to dark greenish gray (5GY 4/1), f-m grained, medium strong, FOSSILIFEROUS LIMESTONE and DOLOMITIC SILTSTONE, (WARSAW FORMATION)
Interbedded fossiliferous beds and shaley beds

RUN 27 — CORE RECOVERY 100 %

150.30
308.90

310

J,PL,SMC,L

312

J,PL,SM,CL

J,PL,SM,CL

314

RUN 28 — CORE RECOVERY 100 %

315.2-328.7 ft.
Fresh, thickly laminated to medium bedded, medium light gray (N6) to olive gray (5Y 4/1), ? to medium sand, medium strong, FOSSILIFEROUS LIMESTONE and CALCAREOUS SILTSTONE, (WARSAW FORMATION)

J,PL,SM

316

318

J,PL,SM,CL

140.10
319.10

RUN 29 — CORE RECOVERY 100 %

4/23/95 @ 15:02
End Run 28
Quit drilling for the day
4/24/95 @ 12:00
Begin Run 29

0

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 8/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068820.78
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW, FR, MW, HW, CW)	STRENGTH INDEX (R6, R5, R4, R3, R2, R1)	POINT LOAD INDEX (psi) (>30, R2 150, R3 300, R4 600, R5 1500, R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
320	ROCK TYPE														
	315.2-328.7 ft. Fresh, thickly laminated to medium bedded, medium light gray (N6) to olive gray (5Y 4/1), medium sand, medium strong, FOSSILIFEROUS LIMESTONE and CALCAREOUS SILTSTONE, (WARSAW FORMATION)								J,PL,R						
322															
	Calcareous Shale interbeds <0.1-0.5 ft. thick, some lithographic textures, commonly silicified														
324				29	100 %										
326															
328															
	328.7-330.8 ft. Fresh, thickly laminated, light gray (N7) to light olive gray (5Y 6/1), clay sized to coarse silt sized, medium strong, ARGILLACEOUS LIMESTONE, (WARSAW FORMATION) Chert common, calcite vugs		130.10 / 328.10						J,I,SM,CL						
330															
	330.8-336.4 ft. Fresh, thickly laminated to medium bedded, medium light gray (N6), clay sized to very coarse sand sized, medium strong, LITHOCLASTIC LIMESTONE and CALCAREOUS SILTSTONE, (WARSAW FORMATION) Interbedded <0.1-0.3 lithoclastic beds with clayey shales, silicification common, few stylolites			30	100 %				J,I,R-open						
332															
334															
									J,U,SM						
336															
338															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 6/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068620.78
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
336	336.4-343.7 ft. Fresh, thickly laminated to medium bedded, medium light gray (N6), clay sized to very coarse sand sized, medium strong, ARENACEOUS LIMESTONE and ARGILLACEOUS LIMESTONE, (WARSAW FORMATION) Highly silicified, some lithographic textures								J,PL,SM						
338				30	100 %				J,U,SM,CL						
			120.10 / 339.10												
340															
342															
			115.50 / 343.70												
344	343.7-368.8 ft. Fresh, thickly laminated to medium bedded, very light gray (N8) to medium light gray (N6), fine silt sized to coarse silt sized, medium strong, SILICEOUS LIMESTONE and ARENACEOUS LIMESTONE, (KEOKUK FORMATION) Disseminated chert abundant, calcareous dolomitic, silty Clay interbeds, differential compaction features			31	100 %										343.7 ft. Top of KEOKUK FORMATION encountered
346															
348									J,I,R						
			110.60 / 348.60												
350															
	350.5-350.9 ft. Porous			32	100 %				J,I,R						
	351.6-363.8 ft. Porous, vuggy														
352															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 6/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068620.78
AZIMUTH: 0

COLLAR ELEV: 458.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
Pl-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW, FR, MW, HW, CW	STRENGTH INDEX: R6, R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): R1 30, R2 150, R3 305, R4 600, R5 1500, R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
352	343.7-368.8 ft. Fresh, thickly laminated to medium bedded, very light gray (N8) to medium light gray (N6), fine silt sized to coarse silt sized, medium strong, SILICIOUS LIMESTONE and ARENACEOUS LIMESTONE, (KEOKUK FORMATION) Disseminated chert abundant, calcareous dolomitic, silty Clay interbeds, differential compaction features														
354				32	100 %										
356															
358									J,I,R (2)						
			100.40 / 358.80												
									J,I,VR						
360									J,I,VR						
362															
									J,PL,VR						
				33	100 %				J,PL,R						
364									J,I,R						
366															
368															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: S. TILTON
DATE: 6/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/16/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068620.78
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515850.23
INCLINATION: -90

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX: SW FR, MW, HW, CW	STRENGTH INDEX: R6, R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): R6 1500, R5 600, R4 300, R3 150, R2 30, R1	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
368				33	100 %	80 60 40 20	2 4 8 10	0 30 60 90				R5 R6			4/24/95 @ 18:45 End Run 33
	90.40		90.40												
	End of Record of Drillhole at 368.8 ft. 368.80		368.80												
370															
372															
374															
376															
378															
380															
382															
384															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 6/5/95

Golder Associates

LOG OF TEST BORING NO.: F-1-D

CLIENT: LAIDLAW/BRIDGETON
PROJECT: AUG 90 WELL INSTALL
PROJECT NUMBER: 89L46
LOCATION:

SURFACE ELEVATION:
BORING DEPTH: 79.5
DATE: 9-1-90

MSL ELEV	DEPTH FR LND SURF	SAMP DEPTH INTERVAL	TYPE	#	N	REC (ft)	DESCRIPTION OF MATERIAL	CLASS	FIELD INSTRUMENTS	DRILLING AND SAMPLING NOTES
0.0	--0									
		0-5	SB	1	-	4.8	Top 4' dark yellowish brown (10YR-4/4) lean CLAY w/ sand, some silt and little gravel; (FILL) Bottom 1' dk. grey (5Y 4/1) SILT w/ some black colored intermixing.	FILL	RAD = < 0.01 mR/hr. TIP = 0 ppm	
-5.0	--5									
		5-10	SB	2	-	3.5	Intermixed grey silt (as above) w/ gravel, sand, and some clay (FILL)		RAD = < 0.01 mR/hr. TIP = 0 ppm	
-10.0	--10									
		10-15	SB	3	-	3.5	Mottled dk. grey (5Y 4/1), greenish grey (5BG 5/1) & dk. yellowish brown (10YR 4/4) lean CLAY w/ some silt.	cl	RAD = < 0.01 mR/hr. TIP = 0 ppm	Becomes v.moist to wet at 13.5'.
-15.0	--15									
		15-20	SB	4	-	3.9	Same as above w/ increasing silt content w/ depth.		RAD = < 0.01 mR/hr. TIP = 0 ppm	
-20.0	--20							ml		
		20-25	SB	5	-	4.8	Top is dk. Grey (2.5Y 4/0) SILT w/ little clay. Bottom 2' grey (5Y 4/1), v.fine to fine, SAND stratified (lamina) w/ darker layers.		RAD = < 0.01 mR/hr.	
-25.0	--25									
		25-30	SB	6	-	2.8	Dk. grey (5Y 4/1), f. to v. fine SAND a litter coarse than above.		RAD = < 0.01 mR/hr.	
-30.0	--30	30-32	SS	7	-	1.5	Same as above.			Water added and maintained in augers to prevent sand blows.
		32.5-34.5	SS	8	38	1.1	Same as above.			
-35.0	--35	34.5-36.5	SS	9	50	1.0	Grey (5Y 5/1), f. to v.fine SAND; contains little gravel upto 1/4" in diameter botton 3".			50 blows for 6"
		37.5-39.5	SS	10	100	0.9	Grey (5Y 5/1), f. to v.fine SAND very dense (without gravel).	sp		
-40.0	--40	39.5-41.5	SS	11	11	0.8	Same as above but not as dense although density seems higher than blow counts indicate.		SAMPLE #12 OXY = 21.1% H2S = 1 ppm CO = 0 ppm EXP = 0% TIP = 0 ppm	
		42.5-44.5	SS	12	18	0.8	Grey (5Y 5/1), v.f. to c., poorly graded SAND w/ trace of f. gravel.			
-45.0	--45	44.5-46.5	SS	13	86	0.7	Same as above.			
-50.0	--50	49.5-51.5	SS	14	19	1.4	Top is same as above. Bottom 12" Dark grey (5Y 4/1) v.f. to fine SAND w/ some v. dark grey layers (?) stratified or intermixed (?).			

DRILLING DATA
START DATE: 8/6/90
COMPLETION DATE: 8/8/90
LOGGED BY: LDA
DRILLING METHOD: 4-1/4" I.D. HSA's
DRILLING CONTRACTOR: BROTCKE ENGR.

WATER LEVEL INFORMATION
DEPTH AT COMPLETION: approx. 20'
LATER TIME/DEPTH: 15 hrs / 25.2'
LATER TIME/DEPTH:
CAVE IN DEPTH:
DRILLING LOSSES:

LOG OF TEST BORING NO.: F-1-D

CLIENT: LAIDLAW/BRIDGETON
PROJECT: AUG 90 WELL INSTALL
PROJECT NUMBER: 89L46
LOCATION:

SURFACE ELEVATION:
BORING DEPTH: 79.5
DATE: 9-2-90

MSL ELEV	DEPTH FR LND SURF	SAMP DEPTH INTERVAL	TYPE	#	N	REC (ft)	DESCRIPTION OF MATERIAL	CLASS	FIELD INSTRUMENTS	DRILLING AND SAMPLING NOTES
-55.0	--55	54.5-56.5	SS	15	21	1.4	Upper 3.5" v.dark grey (2.5Y 3/0) lean CLAY w/ no to some sand. Bottom v.dark grey, v.fine to c, stratified SAND; find pc of wood.	cl		
-60.0	--60	59.5-61.5	SS	16	27	0.8	Very dark grey (2.5Y 3/0), v.fine to coarse, poorly graded SAND.	sp		
-65.0	--65	64.5-66.5	SS	17	37	2.0	2" v.f. to f. v.dark grey SAND. 2" v.f. to v.c., v.dk grey SAND. 3" v.dk grey lean CLAY. 1/2" fine GRAVEL; sub rnded. 1" v.c. to c., grey SAND. Bottom f. to v.f., v.dk grey SAND.	cl / gp		
-70.0	--70	69.5-71.5	SS	18	28	0.0	No recovery.			
-75.0	--75	74.5-76.5	SS	19	25	1.8	Top is v.dark to dark grey (2.5Y-3/0 to 4/0), m. to v.f. SAND. Middle 3" is v.f. to v.c. SAND w/ tr. to little v.f. gravel. Bottom 7" is black to v. dk. grey (2.5Y 2/0 to 3/0) v.f. to f. SAND w/ silt & organics (black color).	sp		
-80.0	--80	78.5-79.5	SS	20	100	0.9	Fine to coarse, poorly graded GRAVEL (rnded to angular) w/ v.f. to c. sand. Limestone bedrx @ 79.4	gp / ls		100 blows for last 1"
-85.0	--85						R.O.B. = 79.5'			Auger refusal at 79.5'
-90.0	--90						Piezometer F-1-D installed.			
-95.0	--95									
-100.0	--100									
-105.0	--105									

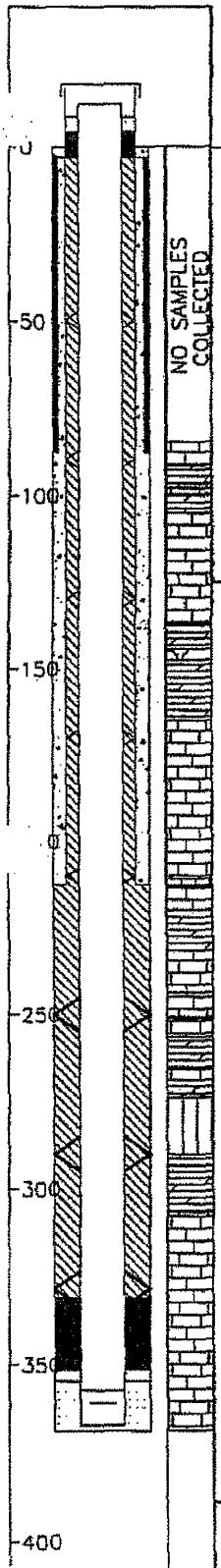
DRILLING DATA
START DATE: 8/6/90
COMPLETION DATE: 8/8/90
LOGGED BY: LDA
DRILLING METHOD: 4-1/4" I.D. HSA's
DRILLING CONTRACTOR: BROTCKE ENGR.

WATER LEVEL INFORMATION
DEPTH AT COMPLETION: approx. 20'
LATER TIME/DEPTH: 15 hrs / 25.2'
LATER TIME/DEPTH:
CAVE IN DEPTH:
DRILLING LOSSES:

Well No. PZ-111-KS

Boring No. X-Ref: PZ-111-KS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1068821 ft. Easting: 515850 ft.

Elevation Ground Level 459.2 ft. NGVD

Top of PVC Casing 460.87 ft. NGVD

Drilling Summary:

Total Depth 368.8 ft.

Borehole Diameter See comments

Casing Stickup Height 1.69 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 14 3/4 in. Tricone Bit, 10 in. and 5 7/8 in. Button Bits

Drilling Fluid Auger-None, NX Core Water, Air and Mud Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	3/15/95	7:45	4/24/95	18:45
Schramm Rotary	4/26/95	8:20	4/26/95	10:30
Geophys.Logging:				
Casing:				
2" PVC	5/6/95	7:30	5/6/95	9:00
8" Steel	4/9/95	11:00	4/9/95	15:15
10" Steel	4/8/95	8:00	4/8/95	11:00
Filter Placement:	5/6/95	9:00	5/6/95	10:15
Cementing:				
Development				
Bentonite Grout	5/6/95	10:30	5/6/95	12:30
Bentonite Seal	5/6/95	10:15	5/6/95	10:30

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.69	-	357.15	C1	460.87	-	102.03
357.15	-	366.96	S1	102.03	-	92.22
366.96	-	367.30	C2	92.22	-	91.88
+ 0.50	-	83.80	C3	459.70	-	375.36
+ 1.00	-	215.30	C4	460.20	-	243.88
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.) (C3&C4-see comments)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 354.7-368.8 ft.

Filter Pack: Less than 50 mesh Silica Sand, 351.4-354.7 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-330.97 ft., Neat cement, 3.0-215.3 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 330.97-351.4 ft.

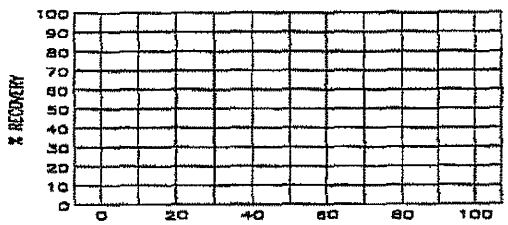
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

14 3/4 in. (0.0-84.0 ft.), 10 in. (84.0-215.5 ft.), 5 7/8 in. (215.5-368.8 ft.)

Surface Casing C3: 10 in. ID / 10 7/8 in. OD Steel Casing

Surface Casing C4: 6 1/8 in. ID / 6 5/8 in. OD Steel Casing

Supervised by D. Alloway

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ111KS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122481	CHECK NO.
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

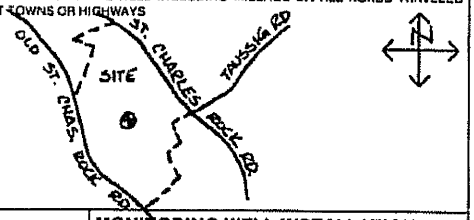
INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL
WELL NUMBER: PZ-111-KS
SITE ADDRESS: ST. CHARLES ROCK RD. | CITY: BRIDGETON | STATE: MO. | ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC. | TELEPHONE: 314-241-3710
ADDRESS: 1838 N. BROADWAY | CITY: ST. LOUIS | STATE: MO. | ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL (SHOW LOCATION IN SECTION PLAT)
COUNTY: ST. LOUIS
ELEVATION: 459.2
AREA NO.:
SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼
SEC. ____ TWN. 47 N,RNG. 5 (E) OR W
LAT. 38 ° 46 ' 06 " LONG. 90 ° 36 ' 40 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 460.57
LOCKING CAP - (Y) N (Circle one)
CAP VENT - (Y) N (Circle one)
PROTECTIVE CASING
Type: STEEL
Size: 8" x 8" x 5'
Bore Hole Diameter: 15"
WEEP HOLE - Y / (N) (Circle one)

Ground Surface Elevation: 457.0

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
Depth to bottom of Protective Casing Seal:	3.0	
		84-272 ~~Shale~~ Limestone
		272-300 Shale
		300-302 Limestone
Depth to Base of Annular Seal:	331.0	
		302-329 Shale
Depth to Base of Bentonite Seal:	351.4	
Depth to Base of Secondary Filter Pack:	354.7	329-368.8 Limestone
Depth to Top of the Screen:	357.0	
Depth to Bottom of the Screen:	367.0	
Plug Back Total Depth:		
Original Total Depth:	368.8	

PROTECTIVE CASING SEAL
Type: (X) Concrete ( ) Cement Slurry
RISER PIPE
Length: 368.7'
Diameter: 2"
Type of Material: SCH. 80 PVC
BOREHOLE DIAMETER: 5 7/8 in.
ANNULAR SEAL
Type: (X) Bentonite Slurry ( ) Cement Slurry ( ) Non Slurry Bentonite
BENTONITE SEAL
Type: (X) Bentonite Slurry ( ) Non Slurry Bentonite
Length of Seal: 20.4 Ft.
SECONDARY FILTER PACK (Optional)
Type: (X) Sand ( ) Manufactured
Grain Size: <50
Length: 3.3
PRIMARY FILTER PACK
Type: (X) Sand ( ) Manufactured
Grain Size: 16-35
Length: 14.1'
WELL SCREEN
Length: 10
Slot Size: 0.010"
Type: SCH. 80 PVC
SUMP DETAILS
Length: 0.3Ft.
Diameter: 2 In.
Type: PVC
TYPE OF BACKFILL: SAND

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

TYPE OF INSTALLATION: (X) ABOVE GROUND ( ) FLUSH MOUNT
STATIC WATER LEVEL: FEET FROM MEASURING POINT
DATE OF STATIC WATER LEVEL:
ELEVATION OF MEASURING POINT: 460.57
MEASURING POINT IS: (X) TOP OF RISER PIPE ( ) OTHER
DRILLING EQUIPMENT: (X) AIR ROTARY (X) AUGER TYPE 6¼ H.S.A. ( ) REVERSE ROTARY ( ) OTHER
CENTRALIZERS USED: (X) YES, AT 10 TOTAL (X) STAINLESS STEEL ( ) OTHER ( ) NO
MULTIPLE CASED WELLS: SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.
DATE WELL CONSTRUCTION WAS COMPLETED: 5-06-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Michael P. Vogt
PERMIT NUMBER: 001256 WM | DATE: 6-02-95
SIGNATURE (DRILLING CONTRACTOR): Michael P. Vogt
PERMIT NUMBER: 001256 WM | DATE: 6-02-95

MO 780-1415 (2-94)
DISTRIBUTION: WHITE/DIVISION CANARY/MONITORING WELL CONTRACTOR PINK/OWNER
MAIL WHITE COPY TO DEPARTMENT OF NATURAL RESOURCES P.O. BOX 250 ROLLA MO 65401

SOIL BOREHOLE LOG

LAIDLAW WASTE SYSTEMS INC.

SITE NAME AND LOCATION	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger		BORING NO. PZ-112-AS
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2			SHEET 1 OF 3
	SAMPLING METHOD:		DRILLING
	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)		START 13:20 4/10/95 / FINISH 15:29 4/10/95
	SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)		
NORTHING: 1069002.00 DATUM EASTING: 515674.01 ELEVATION 457.9	WATER LEVEL / TIME / DATE / CASING DEPTH		
DRILL RIG CME 75	SURFACE CONDITIONS		
ANGLE VERTICAL BEARING			
SAMPLE HAMMER 140 lbs.			

DRILLING CONTR LAYNE-WESTERN

LOGGED BY S. CUSID

DATE 5/31/95 CHK'D BY V. HERST

JOB NO.: 943-2848

FILENAME: PZ112AS

DEPTH IN FEET (ELEVATION)	BLOW/6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	2 2 2 7	1.1'/2.0' (55%)			(0.0-4.0 Ft.) Loose to compact, moderate yellowish brown (10YR 5/4) to dark greenish gray (5G 4/1), SILT, trace Fine Gravel, NR, damp, (ML), (FILL)	SP 1	
2	5 12 7 6	0.0'/2.0' (0%)				SP 2	
3							
4	6 50/6"	0.8'/2.0' (40%)			(453.9) 4.0 (4.0-8.5 Ft.) Very dense, medium bluish gray (5GY 5/1), f-c SAND, trace of Fine Gravel, SR, damp, (SP), (FILL)	SP 3	
5							
6					@ 5.0 ft, cobbles and rock encountered		Drilling very hard from 5.0-8.0 Ft. Split Spoons not collected
7							
8	6 7 11	1.6'/2.0' (80%)			(449.4) 8.5 (8.5-10.0 Ft.) Waste	SP 4	
9	9						
10	3 4 9	0.6'/2.0' (30%)			(447.9) 10.0 (10.0-10.6 Ft.) Compact, medium bluish gray (5B 5/1), f-c SAND, trace of Fine Gravel, SR, moist, (SP), (FILL) (447.3) 10.6	SP 5	
11	5				(10.6-20.0 Ft.) Waste		
12	4 20	0.8'/2.0' (40%)				SP 6	
13	14 9						
14	3 3 8 18	0.2'/2.0' (10%)				SP 7	

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger		BORING NO. PZ-112-AS
			SHEET 2 OF 3
	SAMPLING METHOD:		
LAIDLAW/OU2 RI-FS/MD WEST LAKE LANDFILL OPERABLE UNIT 2	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)		DRILLING
	SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)		START: TIME 13:20, DATE 4/10/95 — FINISH: TIME 15:29, DATE 4/10/95
	WATER LEVEL / TIME / DATE / CASING DEPTH		
NORTHING: 1069002.00 DATUM EASTING: 515674.01 ELEVATION 457.9			
DRILL RIG CME 75	SURFACE CONDITIONS		
ANGLE VERTICAL BEARING			
SAMPLE HAMMER 140 lbs.			

DRILLING CONTR LAYNE-WESTERN

LOGGED BY S. COSIO DATE 5/31/95 CHK'D BY W. FIRST

JOB NO.: 943-2848 FILENAME: PZ112AS

DEPTH IN FEET (ELEVATION)	BLOW/6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16	9 10 11 25	0.8' 2.0' (40%)			(10.6-20.0 Ft.) Waste	SP 7	
17						SP 8	
18	50/5"	0.1' 2.0' (5%)				SP 9	
19							
20	5 3 3 3	1.5' 2.0' (75%)			(437.9) 20.0 (20.0-20.5 Ft.) Firm, greenish black (5G 2/1), CLAYEY SILT, NR, damp, (CL-ML), (FILL)	SP 10	
21					(437.4) 20.5 (20.5-22.0 Ft.) Loose, medium light gray (N6), f-c SAND, NR, damp to moist, (SP), (FILL)		
22	3 4 6 8	0.4' 2.0' (20%)			(435.9) 22.0 (22.0-24.0 Ft.) Stiff, greenish black (5G 2/1), CLAYEY SILT, NR, wet, (CL-ML), (ALLUVIUM)	SP 11	First water encountered @ 23.0 Ft.
23							
24	12 17 16 15	2.0' 2.0' (100%)			(433.9) 24.0 (24.0-26.0 Ft.) Dense, dark greenish gray (5GY 4/1), fine SAND, NR, wet, (SP), (ALLUVIUM)	SP 12	
25							
26	4 2 3 7	1.8' 2.0' (90%)			(431.9) 26.0 (26.0-28.0 Ft.) Loose, olive gray (5Y 4/1), CLAYEY fine SAND, NR, wet, (SC), (ALLUVIUM)	SP 13	
27							
28	3 3 10 21	1.3' 2.0' (65%)			(429.9) 28.0 (28.0-36.0 Ft.) Compact to dense, olive gray (5Y 4/1), fine SAND, NR, wet, (SP), (ALLUVIUM)	SP 14	
29							

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MO
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1069002.00
DATUM EASTING: 515674.01 ELEVATION 457.9

DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger

SAMPLING METHOD:
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)

BORING NO. PZ-112-AS

SHEET 3 OF 3

					DRILLING START	DRILLING FINISH
WATER LEVEL						
TIME					13:20	15:29
DATE					4/10/95	4/10/95
CASING DEPTH						

DRILL RIG CME 75

ANGLE VERTICAL BEARING

SAMPLE HAMMER 140 lbs.

SURFACE CONDITIONS

DRILLING CONTR LAYNE-WESTERN

LOGGED BY S. CISIO

CHK'D BY W. HIRST

DATE 4/10/95

JOB NO.: 943-2848

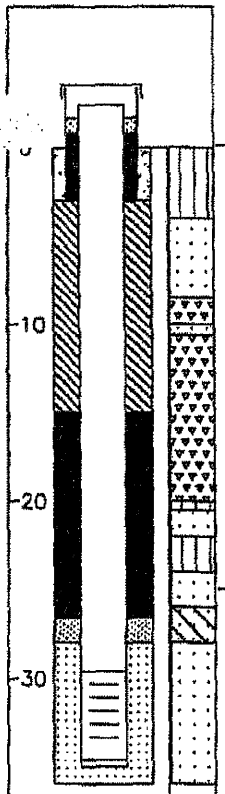
FILENAME: PZ112AS

DEPTH IN FEET (ELEVATION)	BLOW/6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31	10 30 50/6"	1.2'/2.0' (60%)			(28.0-36.0 Ft.) Compact to dense, olive gray (5Y 4/1), fine SAND, NR, wet, (SP), (ALLUVIUM)	SP (15)	
32	9 11 11 16	1.0'/2.0' (50%)			from 32.0-34.0 ft., sand becomes f-m grained	SP (16)	
33							
34	10 13 15 20	2.0'/2.0' (100%)			from 34.0-36.0 ft., sand becomes f-c grained	SP (17)	
35							
36					(421.9) 36.0 End of Soil Borehole Log at 36.0 ft.		
37							
38							
39							
40							
41							
42							
43							
44							

Well No. PZ-112-AS

Boring No. X-Ref: PZ-112-AS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1089002 ft. Easting: 515674 ft.

Elevation Ground Level 457.9 ft. NGVD

Top of PVC Casing 459.83 ft. NGVD

Drilling Summary:

Total Depth 36.0 ft.

Borehole Diameter 8 1/4 in.

Casing Stickup Height 1.90 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75

Bit(s) 4 1/4 in. ID Hollow Stem Auger Bit

Drilling Fluid Auger-None

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	4/10/95	13:20	4/10/95	15:45
Schramm Rotary				
Geophys.Logging:				
Casing:	4/10/95	16:30	4/10/95	16:40
Filter Placement:	4/10/95	16:40	4/10/95	16:59
Cementing:				
Development				
Bentonite Grout	4/10/95	17:15	4/10/95	17:40
Bentonite Seal	4/10/95	17:12	4/10/95	17:15

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.90	-	29.60	C1	459.83	-	428.33
29.60	-	34.40	S1	428.33	-	423.53
34.40	-	34.73	C2	423.53	-	423.20
	-				-	
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 28.0-36.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 26.6-28.0 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-15.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 15.0-26.6 ft.

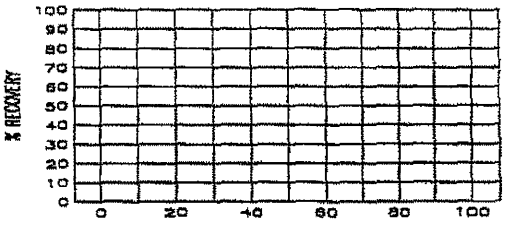
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by S. Cosio

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ112AS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122489	CHECK NO
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL		WELL NUMBER: PZ-112-AS	
SITE ADDRESS: ST. CHARLES ROCK RD.	CITY: BRIDGETON	STATE: Mo	ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC.		TELEPHONE: 314-241-3710	
ADDRESS: 1838 N. BROADWAY	CITY: ST. LOUIS	STATE: Mo	ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL SHOW LOCATION IN SECTION PLAT

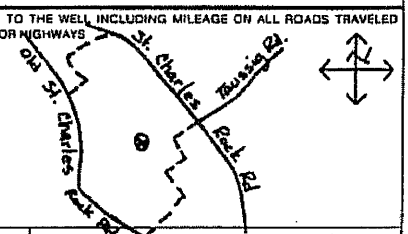
COUNTY: ST. LOUIS
ELEVATION: 457.9
AREA NO.

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N,RNG. 5 E OR W

LAT. 38° 46' 10" LONG. 90° 26' 42"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

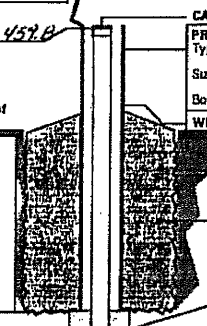
NOTE: Record the fraction of a foot in decimal, not in inches.

LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)
Top of Riser Elevation: 457.8

PROTECTIVE CASING
Type: STEEL
Size: 8"x8"x5'
Bore Hole Diameter: 8"
WEEP HOLE - Y / N (Circle one)

Ground Surface Elevation: 457.4 Ft	Feet from Surface	Description of Formation
Depth to bottom of Protective Casing Seal:	3.0	
Depth to Base of Annular Seal:	24.6	
Depth to Base of Bentonite Seal:	26.6	
Depth to Base of Secondary Filter Pack:	28.0	
Depth to Top of the Screen:	29.6	
		Alluvium
Depth to Bottom of the Screen:	34.6	
Plug Back Total Depth:		
Original Total Depth:	36.0	

Information in this column to be supplied in the Feet from Surface column



PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 31.5'
Diameter: 2"
Type of Material: SCH. 80 PVC

BOREHOLE DIAMETER: 8 In.

ANNULAR SEAL
Type: ☒ Bentonite Slurry ☐ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite
Length of Seal: 2 Ft.

SECONDARY FILTER PACK (Optional)
Type: ☒ Sand ☐ Manufactured
Grain Size: SUGAR <50
Length: 1.4'

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 16-35
Length: 18'

WELL SCREEN
Length: 5'
Slot Size: 0.010'
Type: SCH. 80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

MONITORING WELL INSTALLATION CONTRACTOR'S NAME

LAYNE WESTERN CO., INC.

DRILLING CONTRACTOR'S NAME

LAYNE WESTERN CO., INC.

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
457.83

MEASURING POINT IS
☒ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☐ AIR ROTARY ☒ AUGER TYPE 4¼ H.S.A.
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☐ YES, AT
☐ STAINLESS STEEL
☐ OTHER
☒ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
4-10-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): [signature]
PERMIT NUMBER: 00125BWPM DATE: 5-10-95

SIGNATURE (DRILLING CONTRACTOR): [signature]
PERMIT NUMBER: 00125BWPM DATE: 5-10-95

MO 780 1415 (2-94) DISTRIBUTION: WHITE/DIVISION CANARY/MONITORING WELL CONTRACTOR PINK/OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:		BORING NO.
	4.25 inch I.D. Hollow Stem Auger		PZ-113-AS
			SHEET
	SAMPLING METHOD:		1 OF 3
	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)		DRILLING
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)		START / FINISH
	WATER LEVEL		TIME / TIME
	TIME		11:07 / 14:55
	DATE		DATE / DATE
NORTHING: 1069224.31 DATUM EASTING: 515747.72 ELEVATION 459.9	CASING DEPTH		4/11/95 / 4/11/95

DRILL RIG CME 75 - TRUCK MOUNT — SURFACE CONDITIONS

ANGLE VERTICAL BEARING NA

SAMPLE HAMMER 140 lbs.

DEPTH IN FEET (ELEVATION)	BLOW/6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1					(0.0-2.5 Ft.) Asphalt		
2					(457.4) 2.5		
3	10 11 11	1.5'/1.5' (100%)			(2.5-4.0 Ft.) Compact, light olive gray (5Y 6/1), CLAYEY GRAVEL, little f-c Sand, SR, damp, (GC), (FILL)	SP ①	
4	6 10 11	1.7'/2.0' (85%)			(455.9) 4.0 (4.0-4.8 Ft.) Compact, olive gray (5Y 4/1), SILTY fine SAND, mottled NR, damp, (SM), (FILL)		
5	13				(455.1) 4.8 (4.8-10.0 Ft.) Stiff, mottled, light olive gray (5Y 6/1) to greenish black (5GY 2/1), CLAYEY SILT, mottled, NR, damp, (CL-ML), (LOESS)	SP ②	
6	5 6 7	1.7'/2.0' (85%)					
7	9					SP ③	
8	2 3 5	1.2'/2.0' (60%)					
9	6					SP ④	
10	3	1.4'/2.0' (70%)			(449.9) 10.0 (10.0-18.0 Ft.) Loose, light olive gray (5Y 4/1), mottled SILT, NR, damp, (ML), (LOESS)		
11	3 4					SP ⑤	
12	3	1.3'/2.0' (65%)					
13	2 3 6					SP ⑥	
14	4	1.3'/2.0' (65%)					
	3 3 3					SP ⑦	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER

DATE 4/24/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ113AS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MO
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1069224.31
DATUM EASTING: 515747.72 ELEVATION 459.92

DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger

SAMPLING METHOD:
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)

BORING NO. PZ-113-AS

SHEET 2 OF 3

					DRILLING START	DRILLING FINISH
WATER LEVEL						
TIME					TIME 11:07	TIME 14:55
DATE					DATE 4/11/95	DATE 4/11/95
CASING DEPTH						

DRILL RIG CME 75 - TRUCK MOUNT
ANGLE VERTICAL BEARING NA
SAMPLE HAMMER 140 lbs.
SURFACE CONDITIONS

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16	2 2 2 3	1.6' / 2.0' (80%)			(10.0-18.0 Ft.) Loose, light olive gray (5Y 4/1), SILT, mottled, NR, damp, (ML), (LOESS)	SP (7)	
17						SP (8)	
(441.9) 18.0							
18	1 2 4 2	2.0' / 2.0' (100%)			(18.0-21.3 Ft.) Firm to soft, dark greenish gray (5GY 4/1), mottled CLAYEY SILT, NR, moist, (CL-ML), (ALLUVIUM)		
19						SP (9)	
20	0 0 3 6	2.0' / 2.0' (100%)				SP (10)	
(438.6) 21.3							
21					(21.3-26.2 Ft.) Firm to stiff, greenish black (5GY 2/1), CLAY, NR, moist, (CH), (ALLUVIUM)		
22	5 6 8 9	1.6' / 2.0' (80%)				SP (11)	
23							
24	2 3 4 8	1.9' / 2.0' (95%)				SP (12)	First water encountered @ 24.5 Ft.
25							
(433.7) 26.2							
26	7 9 12 14	2.0' / 2.0' (100%)			(26.2-40.0 Ft.) Compact to dense, dark greenish gray (5GY 4/1), fine SAND, trace Silt, NR, wet, (SP), (ALLUVIUM)	SP (13)	
27							
28	8 11 11 18	1.8' / 2.0' (90%)				SP (14)	
29							

DRILLING CONTR LAYNE-WESTERN
LOGGED BY J. MILLER
DATE 1/25/95 CHK'D BY W. HERST
JOB NO.: 943-2848
FILENAME: PZ113AS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:		BORING NO.
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	4.25 inch I.D. Hollow Stem Auger		PZ-113-AS
			SHEET 3 OF 3
	SAMPLING METHOD:		DRILLING
	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)		START / FINISH
	SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)		
	WATER LEVEL		TIME 11:07 / TIME 14:55
	TIME		
	DATE		DATE 4/11/95 / DATE 4/11/95
DATUM NORTHING: 1069224.31 EASTING: 515747.72	CASING DEPTH	ELEVATION 459.92	

DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS
ANGLE VERTICAL BEARING NA	
SAMPLE HAMMER 140 lbs.	

DEPTH IN FEET (ELEVATION)	BLOW/6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31	10 14 18 21	1.8'/2.0' (90%)			(26.2-40.0 ft.) Compact to dense, dark greenish gray (5GY 4/1), fine SAND, trace Silt, NR, wet, (SP), (ALLUVIUM)	SP (15)	
32	8 12 17 15	1.4'/2.0' (60%)			From 32.0-34.0 ft., color changes to pale yellowish brown (10YR 6/2)	SP (16)	
33							
34	6 10 15 16	2.0'/2.0' (100%)			From 34.0-34.5 ft., sand becomes fine to medium grained	SP (17)	
35							
36	6 7 7 10	1.9'/2.0' (95%)			From 37.5-38.0 ft., some coarse sand	SP (18)	
37							
38							From 38.0-40.0 ft., unable to collect split spoon samples due to heaving sands
39							
40					(419.9) 40.0 End of Soil Borehole Log at 40.0 ft.		
41							
42							
43							
44							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER

DATE 1/25/95 CHK'D BY W. HERST

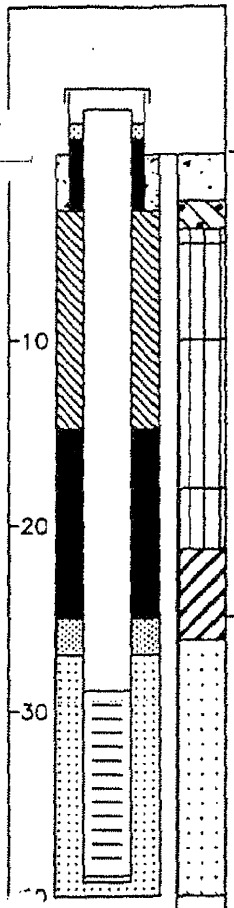
JOB NO.: 943-2048

FILENAME: PZ113AS

Well No. PZ-113-AS

Boring No. X-Ref: PZ-113-AS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1069224 ft. Easting: 515748 ft.

Elevation Ground Level 459.9 ft. NGVD

Top of PVC Casing 461.42 ft. NGVD

Drilling Summary:

Total Depth 40.0 ft.
Borehole Diameter 8 1/4 in.
Casing Stickup Height 1.50 ft.
Driller Layne-Western
St. Louis, MO

Rig CME 75
Bit(s) 4 1/4 in. ID Hollow Stem Auger Bit

Drilling Fluid Auger-None

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	4/11/95	11:07	4/11/95	14:58
Schramm Rotary				
Geophys.Logging:				
Casing:	4/11/95	15:00	4/11/95	15:10
Filter Placement:	4/11/95	15:12	4/11/95	15:29
Cementing:				
Development				
Bentonite Grout	4/11/95	15:48	4/11/95	16:20
Bentonite Seal	4/11/95	15:40	4/11/95	15:48

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.50	-	28.90	C1	461.42	-	431.02
28.90	-	38.70	S1	431.02	-	421.22
38.70	-	39.03	C2	421.22	-	420.89
	-				-	
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 27.0-40.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 25.0-27.0 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-15.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 15.0-25.0 ft.

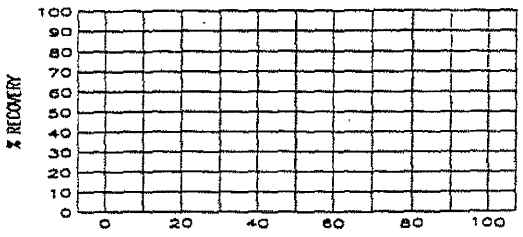
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by S. Cosio

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ113AS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122488	CHECK NO.
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME	WELL NUMBER
LANDFILL BRIDGETON SANITARY LANDFILL	P2-113-AS

SITE ADDRESS	CITY	STATE	ZIP CODE
ST. CHARLES ROCK RD.	BRIDGETON	MO	63044

NAME	TELEPHONE
LANDFILL WASTE SYSTEMS, INC.	314-241-3710

ADDRESS	CITY	STATE	ZIP CODE
1234 N. ARCHUSA WAY	ST. LOUIS	MO	63122

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL SHOW LOCATION IN SECTION PLAT

COUNTY ST. LOUIS
ELEVATION 454.4
AREA NO.

SMALLEST ¼ ____ ¼ ____ ¼ LARGEST ¼ ____ ¼

SEC. ____ TWN. 47 N.RNG. 5 E OR W

LAT. 38 ° 46 ' 13 " LONG. 90 ° 36 ' 41 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS

DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 461.4

LOCKING CAP - Y / N (Circle one)

CAP VENT - Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8"x6"x5'
Bore Hole Diameter: 8"

WEEP HOLE - Y / N (Circle one)

Ground Surface Elevation: 457.1 Ft

Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column	
Depth to bottom of Protective Casing Seal: 3.0	
Depth to Base of Annular Seal: 23.0	
Depth to Base of Bentonite Seal: 25.0	
Depth to Base of Secondary Filter Pack: 37.0	
Depth to Top of the Screen: 38.7	Alluvium
Depth to Bottom of the Screen: 58.7	
Plug Back Total Depth:	
Original Total Depth: 60.0	

PROTECTIVE CASING SEAL
Type: [X] Concrete [ ] Cement Slurry

RISER PIPE
Length: 30.4'
Diameter: 2"
Type of Material: SCH. 80 PVC

BOREHOLE DIAMETER: 8 In.

ANNULAR SEAL
Type: [X] Bentonite Slurry [ ] Cement Slurry [ ] Non Slurry Bentonite

BENTONITE SEAL
Type: [X] Bentonite Slurry [ ] Non Slurry Bentonite
Length of Seal: 2 Ft.

SECONDARY FILTER PACK
Type: [X] Sand (Optional) [ ] Manufactured
Grain Size: SUGAR (50
Length: 3'

PRIMARY FILTER PACK
Type: [X] Sand [ ] Manufactured
Grain Size: 16-35
Length: 13'

WELL SCREEN
Length: 10'
Slot Size: 0.010"
Type: SCH. 80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

TYPE OF INSTALLATION
[X] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
461.42

MEASURING POINT IS
[X] TOP OF RISER PIPE
[ ] OTHER

DRILLING EQUIPMENT
[ ] AIR ROTARY [X] AUGER TYPE 4¼ H.S.A.
[ ] REVERSE ROTARY [ ] OTHER

CENTRALIZERS USED
[ ] YES, AT
[ ] STAINLESS STEEL
[ ] OTHER
[X] NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
4-11-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR)
Terrence A. Tidwell

PERMIT NUMBER	DATE
OD1258WPM	5-10-95

SIGNATURE (DRILLING CONTRACTOR)
Terrence A. Tidwell

PERMIT NUMBER	DATE
OD1258WPM	5-10-95

(80 760 145 (7-93)) DISTRIBUTION: WHITE DIVISION CANARY MONITORING WELL CONTRACTOR PINK OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MO
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1069233.33
DATUM EASTING: 515759.85 ELEVATION 459.9

DRILLING METHOD:					BORING NO. PZ-113-AD
0.0-40.0 ft: 4.25 inch I.D. Hollow Stem Auger					SHEET 1 OF 7
40.0-108.3 ft: 3.875 inch Mud Rotary (Tricone)					
SAMPLING METHOD:					DRILLING
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)					START / FINISH
SPLIT SPOON: 3.0 inch O.D./.375 inch I.D. (HD)					
WATER LEVEL					TIME 11:03 / TIME 15:50
TIME					
DATE					DATE 4/26/95 / DATE 4/27/95
CASING DEPTH					

DRILL RIG CME 75 - TRUCK MOUNT
SURFACE CONDITIONS Paved road
ANGLE VERTICAL BEARING NA
SAMPLE HAMMER 140

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16					(0.0-20.0 ft.) No samples collected, see Soil Borehole Log PZ-113-AS for descriptions		
17							
18							
19							
20	2 5 9	0.9' 1.5' (60%)			(439.9) 20.0 (20.0-27.0 ft.) Stiff, olive gray (5Y 4/1), SILTY CLAY, trace very fine Sand, NR, moist, (CH), (ALLUVIUM)	SP 1	
21							
22	6 8 13	1.0' 1.5' (67%)				SP 2	
23	5 7 7	1.1' 1.5' (100%)				SP 3	
24							
25	2 7 7	1.3' 1.5' (87%)				SP 4	
26	4 6 8	1.2' 1.5' (80%)				SP 5	
27					(432.9) 27.0 (27.0-40.0 ft.) Compact, dark greenish gray (5GY 4/1), fine SAND, some Clay, NR, wet, (SC), (ALLUVIUM)		
28							
29							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER DATE 6/21/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ113AD

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:					BORING NO.
	0.0-40.0 Ft.: 4.25 inch I.D. Hollow Stem Auger					PZ-113-AD
	40.0-108.3 Ft.: 3.875 inch Mud Rotary (Tricone)					SHEET
	SAMPLING METHOD:					2 OF 7
	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)					DRILLING
	SPLIT SPOON: 3.0 inch O.D./.375 inch I.D. (HD)					START / FINISH
	WATER LEVEL					TIME / TIME
	TIME					1103 / 1550
	DATE					DATE / DATE
	CASING DEPTH					4/26/95 / 4/27/95

LAIDLAW/OU2 RI-FS/MO
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1069233.33
DATUM EASTING: 515759.85 ELEVATION 459.9

DRILL RIG	CME 75 - TRUCK MOUNT
ANGLE	VERTICAL
BEARING	NA
SAMPLE HAMMER	140
SURFACE CONDITIONS	Paved road

DEPTH IN FEET (ELEVATION)	BLOW/6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE		REMARKS
31					(27.0-40.0 Ft.) Compact, dark greenish gray (5GY 4/1), Fine SAND, some Clay, NR, wet, (SC), (ALLUVIUM)			
32								
33								
34								
35								
36								
37								
38								
39								
40	4	0.5"			(419.9) 40.0			
	8	1.5"			(40.0-41.5 Ft.) Compact, light brown (5YR 5/6) to pale yellowish brown (10YR 6/2), medium SAND, trace very Fine Sand, NR, wet, (SP), (ALLUVIUM)	SP	6	
41	9	(33%)			(418.4) 41.5			
42	6	0.2"			(41.5-44.0 Ft.) Compact, light brown (5YR 5/6) to light brown (5YR 6/4), Fine GRAVEL, NR, wet, (GW), (ALLUVIUM)	SP	7	
	6	1.5"						
	8	(17%)						
43	4	0.9"			(415.9) 44.0	SP	8	
	7	2.0"			(44.0-48.5 Ft.) Compact, dark yellowish brown (10YR 4/2), medium SAND, trace coarse Sand, trace Fine Sand, NR, wet, (SP), (ALLUVIUM)			
	11	(45%)						
44	13							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER CHK'D BY W. HERSH

DATE 6/21/95

JOB NO.: 943-2848

FILENAME: PZ113AD

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2
DRILLING METHOD:	0.0-40.0 ft.: 4.25 inch I.D. Hollow Stem Auger 40.0-108.3 ft.: 3.875 inch Mud Rotary (Tricone)
SAMPLING METHOD:	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SPLIT SPOON: 3.0 inch O.D./.375 inch I.D. (HD)
BORING NO.	PZ-113-AD
SHEET	3 OF 7
DRILLING START TIME	11:03
DRILLING FINISH TIME	15:50
DRILLING START DATE	4/26/95
DRILLING FINISH DATE	4/27/95
WATER LEVEL / TIME / DATE / CASING DEPTH	
DATUM	NORTHING: 1069233.33 EASTING: 515759.85
ELEVATION	459.9
DRILL RIG	CME 75 - TRUCK MOUNT
SURFACE CONDITIONS	Paved road
ANGLE	VERTICAL
BEARING	NA
SAMPLE HAMMER	140

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
46	5 6 9 2	0.7' / 2.0' (35%)			(44.0-48.5 ft.) Compact, dark yellowish brown (10YR 4/2), medium SAND, trace coarse Sand, trace Fine Sand, NR, wet, (SP), (ALLUVIUM)	SP (9)	
47	8 13 15 19	1.1' / 2.0' (55%)				SP (10)	
48							
49	10 10 10 11	0.9' / 2.0' (45%)			(48.5-49.5 ft.) Compact, olive gray (5Y 4/1), Fine SAND, some medium Sand, NR, wet, (SP), (ALLUVIUM)	SP (11)	
50					(49.5-53.0 ft.) Compact, olive gray (5Y 4/1), medium SAND, trace Fine Sand, trace coarse Sand and Fine Gravel, trace Silt, NR, wet, (SP), (ALLUVIUM)		
51	6 7 9 7	0.9' / 2.0' (45%)				SP (12)	
52					(406.9) 53.0		
53	3 6 5 6	0.9' / 2.0' (45%)			(53.0-61.5 ft.) Compact, olive gray (5Y 4/1), medium SAND, little Sand, trace Fine Gravel, trace Fine Sand and Silt, NR, wet, (SW), (ALLUVIUM)	SP (13)	
54							
55	6 4 5 6	0.9' / 2.0' (45%)				SP (14)	
56							
57	4 4 5 6	0.9' / 2.0' (45%)				SP (15)	
58							
59	5 6 6 7	1.0' / 2.0' (50%)				SP (16)	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER CHK'D BY W. HERST

DATE 6/21/95

JOB NO.: 943-2848

FILENAME: PZ113AD

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2
DRILLING METHOD:	0.0-40.0 ft: 4.25 inch I.D. Hollow Stem Auger 40.0-108.3 ft: 3.875 inch Mud Rotary (Tricone)
SAMPLING METHOD:	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SPLIT SPOON: 3.0 inch O.D./.375 inch I.D. (HD)
BORING NO.	PZ-113-AD
SHEET	4 OF 7
DRILLING START TIME	11:03
DRILLING FINISH TIME	15:50
DRILLING START DATE	4/26/95
DRILLING FINISH DATE	4/27/95
WATER LEVEL / TIME / DATE / CASING DEPTH	
DATUM	NORTHING: 1069233.33 EASTING: 515759.85
ELEVATION	459.9
DRILL RIG	CME 75 - TRUCK MOUNT
ANGLE	VERTICAL
BEARING	NA
SAMPLE HAMMER	140
SURFACE CONDITIONS	Paved road

DEPTH IN FEET (ELEVATION)	BLOW/6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
61	6 10 10 12	0.9' 2.0' (45%)			(53.0-61.5 Ft.) Compact, olive gray (5Y 4/1), medium SAND, little Sand, trace Fine Gravel, trace Fine Sand and Silt, NR, wet, (SW), (ALLUVIUM) (398.4) 61.5	SP 16	
62					(61.5-65.0 Ft.) Compact, dark greenish gray (5GY 4/1), >95% fine to medium grained subrounded SAND, <5% Silt, NR, saturated, (SP), (ALLUVIUM), grades finer	SP 17	
63	10 20 27 45	1.2' 2.0' (60%)				HD 18	
64							
65		1.7' 2.0' (85%)			(65.0-92.0 Ft.) Compact to very dense, dark greenish gray (5GY 4/1), 75% fine SAND, 20% medium Sand, 5% Silt, NR, saturated, (SP), (ALLUVIUM)	SP 19	
66							
67	7 20 25 28	0.9' 2.0' (45%)				SP 20	
68							
69	10 15 26 26	1.4' 2.0' (70%)				HD 21	
70							
71	8 10 14 22	1.2' 2.0' (60%)				SP 22	
72							
73	6 10 13 17	1.2' 2.0' (60%)				SP 23	
74							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER CHK'D BY W. HENRY

DATE 6/21/95

JOB NO.: 943-2848

FILENAME: PZ113AD

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MD
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1069233.33
DATUM EASTING: 515759.85 ELEVATION 459.9

DRILLING METHOD:	BORING NO. PZ-113-AD
0.0-40.0 Ft.: 4.25 inch I.D. Hollow Stem Auger	
40.0-108.3 Ft.: 3.875 inch Mud Rotary (Tricone)	SHEET 5 OF 7
SAMPLING METHOD:	DRILLING
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)	START / FINISH
SPLIT SPOON: 3.0 inch O.D./.375 inch I.D. (HD)	
WATER LEVEL	TIME: 1103 / 1550
TIME	
DATE	DATE: 4/26/95 / 4/27/95
CASING DEPTH	

DRILL RIG CME 75 - TRUCK MOUNT — SURFACE CONDITIONS Paved road

ANGLE VERTICAL — BEARING NA

SAMPLE HAMMER 140

DEPTH IN FEET (ELEVATION)	BLOW/6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
76	17, 25, 35, 36	1.1'/2.0' (55%)			(65.0-92.0 Ft.) Compact to very dense, dark greenish gray (5GY 4/1), 75% fine SAND, 20% medium Sand, 5% Silt, NR, saturated, (SP), (ALLUVIUM)	HD (24)	
77	17, 25, 34, 39	1.8'/2.0' (90%)				HD (25)	
78							
79	22, 28, 28, 31	1.3'/2.0' (65%)				SP (26)	
80							
81	15, 24, 24, 36	1.2'/2.0' (60%)				SP (27)	
82							
83	20, 48, 48, 60	1.5'/2.0' (75%)				HD (28)	
84							
85	12, 24, 34, 38	1.0'/2.0' (50%)				SP (29)	
86							
87	18, 22, 32, 50+	1.2'/2.0' (60%)				SP (30)	
88							
89	48, 50	0.6'/0.8' (75%)				HD (31)	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER

DATE 6/21/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ113AD

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	0.0-40.0 ft.: 4.25 inch I.D. Hollow Stem Auger 40.0-108.3 ft.: 3.875 inch Mud Rotary (Tricone)	PZ-113-AD
	SAMPLING METHOD:	SHEET 6 OF 7
	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SPLIT SPOON: 3.0 inch O.D./.375 inch I.D. (HD)	DRILLING START / FINISH

WATER LEVEL					TIME	TIME
TIME					11:03	15:50
DATE					DATE	DATE
CASING DEPTH					4/26/95	4/27/95

DATUM NORTHING: 1069233.33 EASTING: 515759.85 ELEVATION 459.9

DRILL RIG CME 75 - TRUCK MOUNT

SURFACE CONDITIONS Paved road

ANGLE VERTICAL BEARING NA

SAMPLE HAMMER 140

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
91					(65.0-92.0 ft.) Compact to very dense, dark greenish gray (5GY 4/1), 75% fine SAND, 20% medium Sand, 5% Silt, NR, saturated, (SP), (ALLUVIUM)		
92					(367.9) 92.0 (92.0-108.3 ft.) Dense, dark greenish gray (5GY 4/1), fine to coarse subrounded to well rounded SAND, NR, saturated, (SW), (ALLUVIUM)		
93							
94	10 15 20 22	1.0'/1.0' (100%)				SP (32)	
95							
96							
97							
98							
99	9 13 17 23	1.1'/2.0' (55%)				SP (33)	
100							
101							
102							
103							
104	10 11 14 12	0.6'/2.0' (30%)				SP (34)	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER

DATE 6/21/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ113AD

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MO
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1069233.33
DATUM EASTING: 515759.85 ELEVATION 459.9

DRILLING METHOD:					BORING NO. PZ-113-AD
0.0-40.0 Ft: 4.25 inch I.D. Hollow Stem Auger					SHEET 7 OF 7
40.0-108.3 Ft: 3.875 inch Mud Rotary (Tricone)					
SAMPLING METHOD:					DRILLING
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)					START TIME 11:03 DATE 4/26/95
SPLIT SPOON: 3.0 inch O.D./.375 inch I.D. (HD)					FINISH TIME 15:50 DATE 4/27/95
WATER LEVEL					
TIME					
DATE					
CASING DEPTH					

DRILL RIG CME 75 - TRUCK MOUNT
SURFACE CONDITIONS Paved road
ANGLE VERTICAL BEARING NA
SAMPLE HAMMER 140

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE		REMARKS
106					(92.0-108.3 ft.) Dense, dark greenish gray (5GY 4/1), fine to coarse subrounded to well rounded SAND, NR, saturated, (SW), (ALLUVIUM)	SP (34)		
107								
108					(351.6) 108.3			
109					End of Soil Borehole Log at 108.3 Ft. See PZ-113-AD Record of Drillhole for rock descriptions			
110								
111								
112								
113								
114								
115								
116								
117								
118								
119								

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER

DATE 6/21/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ113AD

Well No. PZ-113-AD

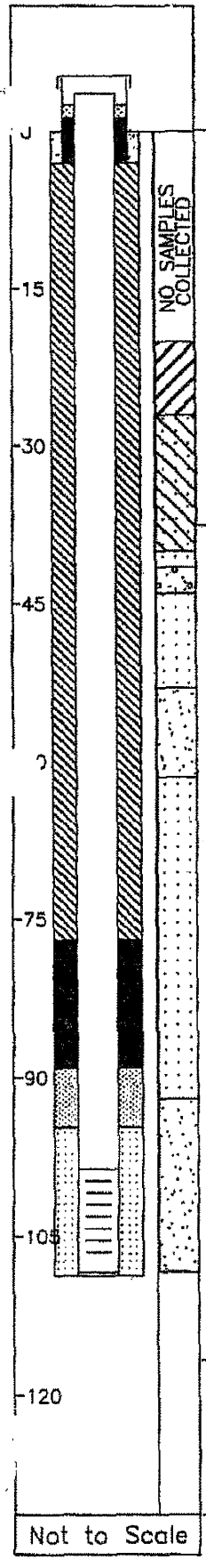
Boring No. X-Ref: PZ-113-AD

PIEZOMETER CONSTRUCTION SUMMARY

Survey Coords: Northing: 1069233 ft. Easting: 515760 ft.

Elevation Ground Level 459.9 ft. NGVD

Top of PVC Casing 461.46 ft. NGVD



Not to Scale

Drilling Summary:

Total Depth 108.7 ft.
Borehole Diameter 10 1/4 in.
Casing Stickup Height 1.60 ft.
Driller Layne-Western St. Louis, MO

Rig CME 75
Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit

Drilling Fluid Auger-None

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	5/3/95	8:00	5/3/95	9:30
Schramm Rotary				
Geophys.Logging:				
Casing:	5/3/95	13:20	5/3/95	13:30
Filter Placement:	5/3/95	13:30	5/3/95	15:10
Cementing:				
Development				
Bentonite Grout	5/3/95	15:30	5/3/95	15:30
Bentonite Seal	5/3/95	15:10	5/3/95	15:30

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.60	-	98.60	C1	461.46	-	361.26
98.60	-	108.40	S1	361.26	-	351.46
108.40	-	108.73	C2	351.46	-	351.13

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 94.7-108.7 ft.

Filter Pack: Less than 50 mesh Silica Sand, 89.1-94.7 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-77.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 77.0-89.1 ft.

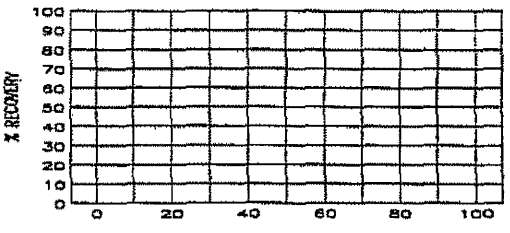
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by D. Alloway

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ113AD

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

REF. NO. 122527	CHECK NO.
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO.
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL
WELL NUMBER: P2-183-AD
SITE ADDRESS: ST. CHARLES ROCK RD. CITY: BRIDGETON STATE: MO ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC. TELEPHONE: 314-291-3700
ADDRESS: 1838 N. BROADWAY CITY: ST. LOUIS STATE: MO ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL (SHOW LOCATION IN SECTION PLAT)

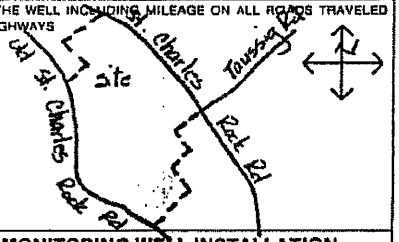
COUNTY: St. Louis
ELEVATION: 459.9
AREA NO.:

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N, RNG. 5 (E) OR W

LAT. 38 ° 46 ' 12 " LONG. 90 ° 26 ' 41 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN Co., Inc.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN Co., Inc.

TYPE OF INSTALLATION: ☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL: FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL:

ELEVATION OF MEASURING POINT: 461.46

MEASURING POINT IS: ☒ TOP OF RISER PIPE ☐ OTHER

DRILLING EQUIPMENT: ☐ AIR ROTARY ☒ AUGER TYPE 6¼ I.S.A. ☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED: ☒ YES, AT 2 TOTAL ☒ STAINLESS STEEL ☐ OTHER ☐ NO

MULTIPLE CASED WELLS: SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED: 5-03-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Lemon N. Mahurin Jr.
PERMIT NUMBER: 001258 WPM DATE: 7-31-95
SIGNATURE (DRILLING CONTRACTOR): Lemon N. Mahurin Jr.
PERMIT NUMBER: 001258WPM DATE: 7-31-95

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 461.46

Ground Surface Elevation: 459.9 Ft

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
Depth to bottom of Protective Casing Seal:	3.0	0-20 No Sample
		20-37 Clay
		37-39 Clay w/ Sand
		39-41 Sand
		41-44 Sand and gravel
Depth to Base of Annular Seal:	77.0	44-53 Sandstone
		53-66 Sand
Depth to Base of Bentonite Seal:	89.1	"
Depth to Base of Secondary Filter Pack:	94.7	66-91 Sandstone
Depth to Top of the Screen:	98.6	
		91-108.7 Sand
Depth to Bottom of the Screen:	108.6	
Plug Back Total Depth:		
Original Total Depth:	108.7	

LOCKING CAP - (Y) N (Circle one)
CAP VENT - Y / (N) (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8"x8"x5'
Bore Hole Diameter: 10¼"

WEEP HOLE - Y / (N) (Circle one)

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 100.2'
Diameter: 2"
Type of Material: SCH80 PVC

BOREHOLE DIAMETER: 10¼ in.

ANNULAR SEAL
Type: ☒ Bentonite Slurry ☐ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite
Length of Seal: 12.1 Ft.

SECONDARY FILTER PACK
Type: ☒ Sand (Optional) ☐ Manufactured
Grain Size: < 50
Length: 5.6'

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 16-35
Length: 14'

WELL SCREEN
Length: 10'
Slot Size: 0.010"
Type: SCH80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

MO 780-1415 (2-94)

DISTRIBUTION: WHITE/DIVISION CANARY/MONITORING WELL CONTRACTOR PINK/OWNER
MAIL WHITE COPY TO: DEPARTMENT OF NATURAL RESOURCES, P.O. BOX 250, ROLLA, MO 65401

RECYCLED PAPER

RECORD OF DRILLHOLE PZ-113-SS

Sheet 1 of 3

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/9/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1089242.38
AZIMUTH: 0

COLLAR ELEV: 460.0
E: 515776.57
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
112	0.0-114.6 ft. See Soil Borehole Log PZ-113-AD														0.0-114.5 ft. Borehole advanced using 9 7/8 in. diameter mud rotary bit then 6 in. casing sealed in borehole with neat cement
114	345.40		345.40												
	114.6-120.2 ft. 114.60 Fresh, thickly to medium bedded, light olive gray (5Y 6/1), very fine grained, medium strong LIMESTONE, (ST. LOUIS FORMATION) Trace fossils, trace siliclous zones		114.60						J,PL,SM J,PL,R J,PL,R						5/9/95 @ 9:30 Began coring
116									J,C,R,CL J,C,R,CL						
	117.1-118.5 ft. Increase grain size and clay fraction, medium light gray (N6)			1	71%				J,PL,R J,PL,R,CL						
118															
	118.5-120.0 ft. Medium light gray (N5) to light gray (N7)								J,C,VR (3) J,C,VR (2) J,C,VR J,ST,R (2) Core Loss						5/9/95 @ 9:50 End of Run 1
120	120.2-142.3 ft. Fresh, medium bedded, light olive gray (5Y 6/1), fine grained, strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Scattered 1 in. thick chert nodules		340.00 120.00						J,PL,R (4)						
									J,PL,R (4) J,PL,SM						
122									J,PL,R (3) J,PL,R,CL						
									J,PL,SM (5)						
124				2	100 %				J,PL,SM						
									J,PL,SM						
126									J,PL,R						
128															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: S. TILTON
DATE: 6/15/95

Golder Associates

RECORD OF DRILLHOLE PZ-113-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/9/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1069242.39
AZIMUTH: 0

COLLAR ELEV: 460.0
E: 515778.57
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
128	120.2-142.3 ft. Fresh, medium bedded, light olive gray (5Y 6/1), fine grained, strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Scattered 1 in. thick chert nodules		330.60	2	100%				J,PL,R						5/9/95 @ 11:00 End of Run 2
			129.40												
130									B,PL,SM (4)						
									B,PL,SM						
132				3	100%										
134	134.2-134.8 ft. Coarse grained		325.60												5/9/95 @ 11:50 End of Run 3
	134.8-135.4 ft. Occasional stylolites present, fine to medium grained		134.40												
136									J,C,SM						
									J,I,R						
138	137.8-139.1 ft. Silty Claystone interbedded with Limestone								J,PL,R						
				4	100%				B,I,R,CL						
									B,PL,SM (3)						
140															
	141.4-142.3 ft. Chert zone								J,PL,SM						
142			317.70												
	142.3-159.4 ft. Fresh, thickly bedded, light olive gray (5Y 5/2) to pale yellowish brown (10YR 6/2), very fine grained, medium strong, DOLOMITIC LIMESTONE, (SALEM FORMATION) Scattered 1/2 in. -1 in. chert nodules, vuggy		142.30												142.3 ft. Inferred top of SALEM FORMATION encountered
144															5/9/95 @ 12:40 End of Run 4

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 8/15/95

Golder Associates

RECORD OF DRILLHOLE PZ-113-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/9/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1069242.39
AZIMUTH: 0

COLLAR ELEV: 460.0
E: 515776.57
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
144	142.3-159.4 ft. Fresh, thickly bedded, light olive gray (5Y 5/2) to pale yellowish brown (10YR 6/2), very fine grained, medium strong, DOLOMITIC LIMESTONE, (SALEM FORMATION) Scattered 1/2 in. - 1 in. chert nodules, vuggy		315.60 / 144.40	4	100 %										5/9/95 @ 12:40 End of Run 4
146															
148															
				5	99%										
150	149.7-150.2 ft. Increased percentage of Dolomite 150.2-150.7 ft. Chert zone														
152															
	152.9-155.5 ft. Fresh, thickly bedded, medium dark gray (N4), vf-f grained, medium strong, LIMESTONE, (SALEM FORMATION)														
154			305.60 / 154.40												5/9/95 @ 14:30 End of Run 5
	304.50 / 155.50														
	155.5-155.8 ft. Fresh, thinly bedded, medium dark gray (N4), very weak, CLAYSTONE, (SALEM FORMATION) 304.20 / 155.80														
156	155.8-159.4 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine grained, strong, DOLOMITIC LIMESTONE with abundant chert nodules 157.0-159.4 ft. Scattered chert nodules			6	100 %				B,PL,SM (2) J,PL,R						
158															5/9/95 @ 15:40 Ended coring
	300.60 / 159.40		300.60 / 159.40												
	End of Record of Drillhole at 159.4 ft.														
160															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/15/95

Golder Associates

Well No. PZ-113-SS

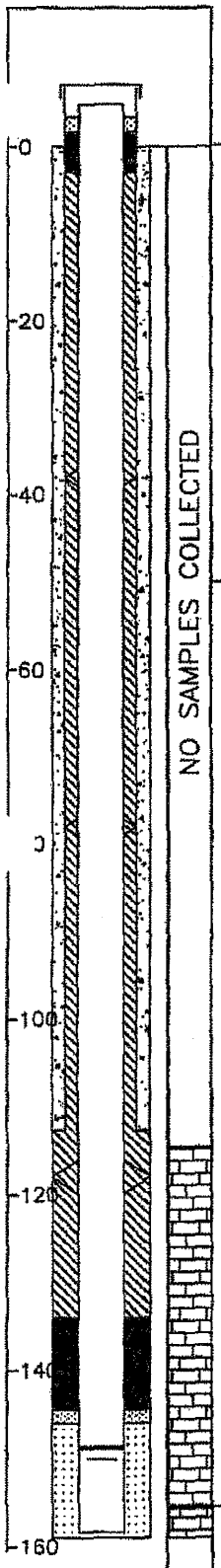
Boring No. X-Ref: PZ-113-SS

PIEZOMETER CONSTRUCTION SUMMARY

Survey Coords: Northing: 1069242 ft. Easting: 515777 ft.

Elevation Ground Level 460.0 ft. NGVD

Top of PVC Casing 461.77 ft. NGVD



Drilling Summary:

Total Depth 159.0 ft.

Borehole Diameter 9 3/4 in. (0.0–115.0 ft.) 5 7/8 in. (115.0–159.0 ft.)

Casing Stickup Height 1.81 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit and 9 3/4 in. Tricone Bit

Drilling Fluid Auger-None, NX Core Water, Air and Mud Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	5/9/95	9:30	5/9/95	15:40
Schramm Rotary	5/20/95	13:30	5/20/95	14:30
Geophys.Logging:				
Casing:				
2" PVC	5/20/95	14:35	5/20/95	14:45
6" Steel	5/7/95	7:30	5/7/95	16:00
Filter Placement:	5/20/95	14:50	5/20/95	15:40
Cementing:				
Development				
Bentonite Grout	5/20/95	16:05	5/20/95	16:30
Bentonite Seal	5/20/95	15:55	5/20/95	16:05

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.81	-	148.57	C1	461.77	-	311.39
148.57	-	158.37	S1	311.39	-	301.59
158.37	-	158.70	C2	301.59	-	301.26
+ 0.50	-	115.00	C3	460.40	-	344.96
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC and cap (4 in. long or 0.33 ft.) (C3-see comments)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16–35 mesh Silica Sand, 146.0–159.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 144.5–146.0 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0–134.0 ft., Neat cement, 3.0–115.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 134.0–144.5 ft.

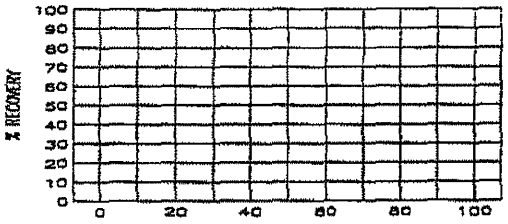
Concrete: 0.0–3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments: Surface Casing C3: 6 1/8 in. ID / 6 5/8 in. OD Steel Casing

Not to Scale

Supervised by S. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ113SS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122509	CHECK NO.
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME		WELL NUMBER	
LAIDLAW WASTE SYSTEMS SANITARY LANDFILL		PZ-1135S	
SITE ADDRESS	CITY	STATE	ZIP CODE
ST. CHARLES ROCK RD.	BRIDGETON	MO	63044
NAME		TELEPHONE	
LAIDLAW WASTE SYSTEMS, INC.		314-241-3710	
ADDRESS	CITY	STATE	ZIP CODE
1838 N. BROADWAY	ST. LOUIS	MO	63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL SHOW LOCATION IN SECTION PLAT

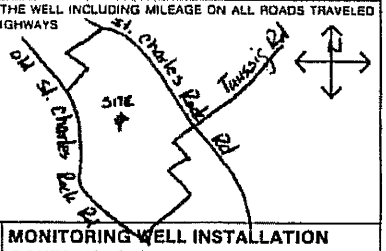
COUNTY ST. LOUIS
ELEVATION 459.4
AREA NO.

SMALLEST ¼ LARGEST ¼

SEC. ____ TWN. 47 N,RNG. 5 (E) OR W

LAT. 38 ° 46 ' 12 " LONG. 90 ° 26 ' 41 "

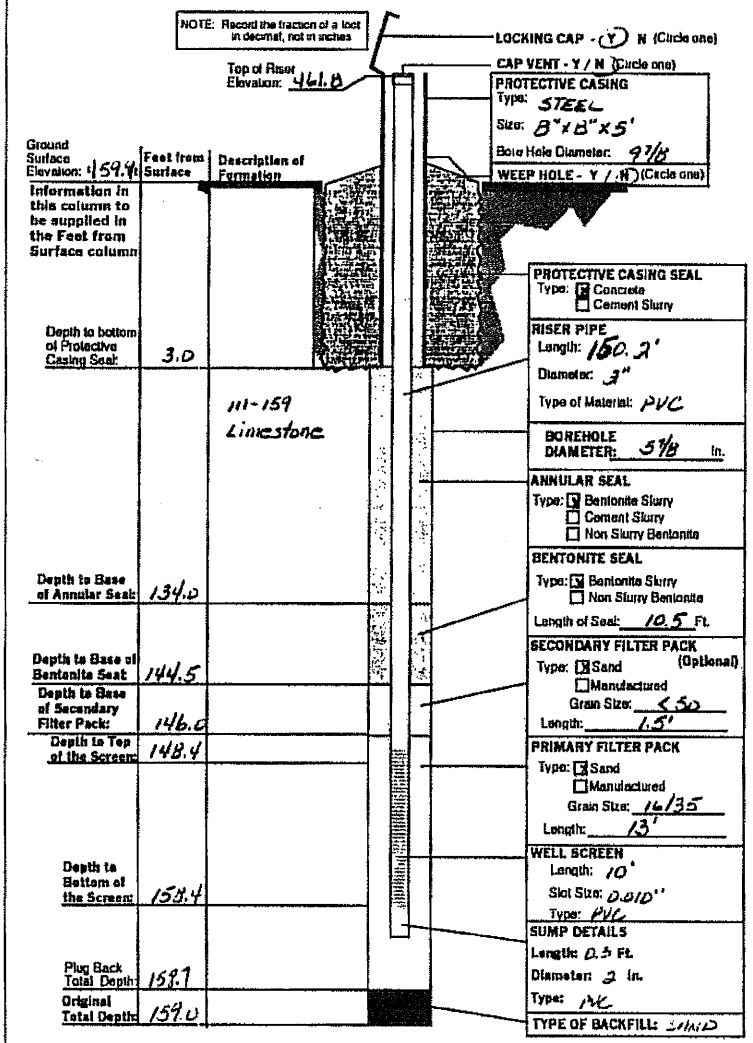
SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME

LAYNE WESTERN CO, INC.



DRILLING CONTRACTOR'S NAME

LAYNE WESTERN CO., INC.

TYPE OF INSTALLATION
(X) ABOVE GROUND ( ) FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
461.8

MEASURING POINT IS
(X) TOP OF RISER PIPE
( ) OTHER

DRILLING EQUIPMENT
(X) AIR ROTARY (X) AUGER TYPE 6¼ H.S.A.
( ) REVERSE ROTARY ( ) OTHER

CENTRALIZERS USED
(X) YES, AT 5 TOTAL
(X) STAINLESS STEEL
( ) OTHER
( ) NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
5-20-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael P. Vogt

PERMIT NUMBER	DATE
001256 WM	6-02-95

SIGNATURE (DRILLING CONTRACTOR) Michael P. Vogt

PERMIT NUMBER	DATE
001256 WM	6-02-95

MO 780-1415 (2-94) DISTRIBUTION: WHITE-DIVISION CANARY MONITORING WELL CONTRACTOR PINK-OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-114-AS
	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 1 OF 2
	WATER LEVEL / TIME / DATE / CASING DEPTH	DRILLING START TIME 11:50 DATE 4/20/95; FINISH TIME 12:40 DATE 4/20/95
DATUM NORTHING: 1069418.88 EASTING: 516768.25 ELEVATION 449.8		
DRILL RIG CME 75	SURFACE CONDITIONS Grassy	
ANGLE -90° BEARING NA		
SAMPLE HAMMER 140 lbs.		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	3 4 8 9	1.7'/2.0' (85%)			(0.0-2.0 Ft.) Compact, dark yellowish brown (10YR 4/2), F-m SAND, some clayey Silt, NR, moist, (SM), (FILL) (447.8) 2.0	SP 1	
2 3	8 14 10 5	1.3'/2.0' (65%)			(2.0-4.0 Ft.) Concrete, (FILL) (445.8) 4.0	SP 2	
4 5	2 7 7 5	1.3'/2.0' (65%)			(4.0-6.0 Ft.) Loose, moderate gray (N5), moist, f-c subrounded SAND, some clayey Silt, (SM), (FILL), lower 0.3 Ft. is concrete (443.8) 6.0	SP 3	
6 7	1 2 1 3	0.7'/2.0' (35%)			(6.0-8.0 Ft.) Soft to firm, medium dark gray (N4) to olive gray (5Y 4/1), clayey SILT, some fine and medium Sand, trace subrounded coarse Sand, (ML), (FILL) (441.8) 8.0	SP 4	
8 9	2 2 3 3	0.7'/2.0' (35%)			(8.0-12.0 Ft.) Soft, greenish black (5GY 2/1) to medium gray (N5), silty CLAY, little fine Sand, NR, moist, (CL), (FILL)	SP 5	
10 11	1 1 2 2	2.0'/2.0' (100%)				SP 6	
12 13	1 3 4 6	1.8'/2.0' (90%)			(12.0-15.5 Ft.) Firm, medium dark gray (N4), SILTY CLAY, little fine Sand, NR, moist, (CL), (ALLUVIUM) below 14.0 Ft., grades sandier with depth	SP 7	
14	1 3 4 2	1.9'/2.0' (95%)				SP 8	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY D. ALLOWAY

DATE 4/20/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ114AS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MO
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1069418.88
DATUM EASTING: 516768.25 ELEVATION 449.8

DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger

SAMPLING METHOD:
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)

BORING NO. PZ-114-AS

SHEET 2 OF 2

					DRILLING START	DRILLING FINISH
WATER LEVEL						
TIME					11:50	12:40
DATE					4/20/95	4/20/95
CASING DEPTH						

DRILL RIG CME 75
ANGLE -90° BEARING NA
SAMPLE HAMMER 140 lbs.
SURFACE CONDITIONS Grassy

DRILLING CONTR LAYNE-WESTERN

LOGGED BY D. ALLOWAY
DATE 4/20/95
CHK'D BY W. HERST

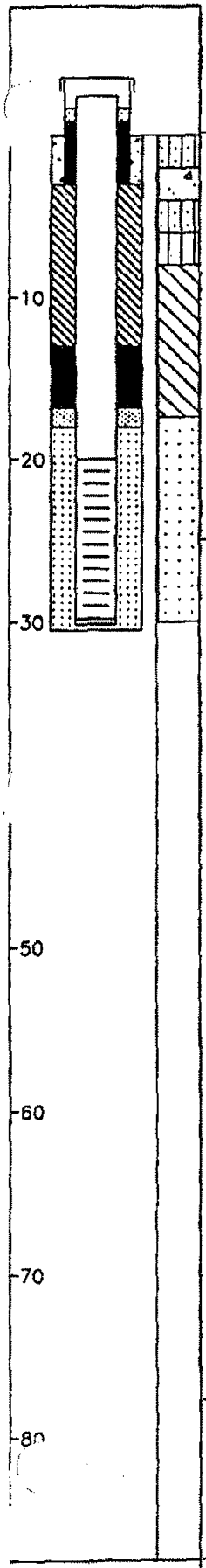
JOB NO.: 943-2848
FILENAME: PZ114AS

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16	0 1 3 4	2.0' / 2.0' (100%)			(12.0-15.5 Ft.) Firm, medium dark gray (N4), SILTY CLAY, little Fine Sand, NR, moist, (CL), (ALLUVIUM)	SP 8	
17					(15.5-17.4 Ft.) Firm, medium gray (N5), SILTY CLAY, some F-m Sand, NR, moist to wet, (CL), (ALLUVIUM), grades sandier	SP 9	
					(432.4) 17.4		
18	3 3 5 2	1.2' / 2.0' (60%)			(17.4-18.5 Ft.) Loose, medium gray (N5), F-m SAND, some silty Clay, NR, wet, (SP), (ALLUVIUM), grades sandier and coarser		
19					(18.5-30.0 Ft.) Loose to compact, medium gray (N5), F-m SAND, trace fines, thin layers of mica (<1/4" thick), NR, moist, (SP), (ALLUVIUM)	SP 10	
20	2 3 3 3	1.8' / 2.0' (90%)					
21						SP 11	
22	3 5 5 3	1.3' / 2.0' (65%)					
23						SP 12	
24	4 7 8 13	1.5' / 2.0' (75%)			@ 23.7 Ft. color changes to moderate brown (5YR 4/4) and moderate yellowish brown (10YR 5/2)		
25						SP 13	
26	9 7 4 3	0.3' / 2.0' (15%)					
27						SP 14	
28	2 6 6 7	1.6' / 2.0' (80%)					
29					@ 29.1-29.6 Ft., organics present, bits of wood and grass	SP 15	

Well No. PZ-114-AS

Boring No. X-Ref: PZ-114-AS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1069419 ft.
Easting: 516768 ft.

Elevation Ground Level 449.8 ft. NGVD
Top of PVC Casing 451.31 ft. NGVD

Drilling Summary:

Total Depth 30.5 ft.
Borehole Diameter 10 1/4 in.
Casing Stickup Height 1.53 ft.
Driller Layne-Western
St. Louis, MO

Rig CME 75
Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit

Drilling Fluid Auger-None

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	4/20/95	11:50	4/20/95	12:40
Schramm Rotary				
Geophys.Logging:				
Casing:	4/20/95	13:00	4/20/95	13:30
Filter Placement:	4/20/95	13:15	4/20/95	14:00
Cementing:				
Development				
Bentonite Grout	4/20/95	13:45	4/20/95	14:45
Bentonite Seal	4/20/95	13:30	4/20/95	13:45

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+1.53	-	19.90	C1	451.31	-	429.88
19.90	-	29.70	S1	429.88	-	420.08
29.70	-	30.03	C2	420.08	-	419.75
	-				-	
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 18.0-30.5 ft.

Filter Pack: Less than 50 mesh Silica Sand, 16.8-18.0 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-13.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 13.0-16.8 ft.

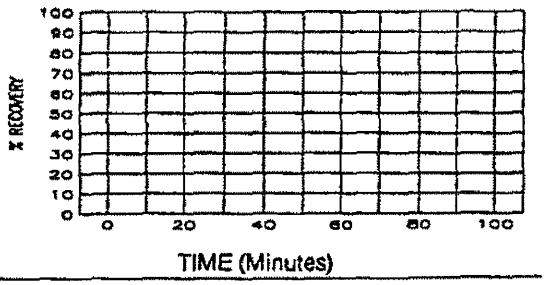
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by D. Alloway
Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO
File Name PZ114AS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	
REF NO 122487	DATE RECEIVED
ROUTE	CHECK NO
STATE WELL NUMBER	TRANSMITTAL NO
CHECKED BY	CROSS REFERENCE NO
APPROVED BY	ENTERED Ph 1 Ph 2 Ph 3
	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME	WELL NUMBER
LAIDLAW BRIDGETON SANITARY LANDFILL	PZ-114-AS

SITE ADDRESS	CITY	STATE	ZIP CODE
ST. CHARLES ROCK RD.	BRIDGETON	Mo	63044

NAME	TELEPHONE
LAIDLAW WASTE SYSTEMS, INC.	314-341-3710

ADDRESS	CITY	STATE	ZIP CODE
13350 N. BROADWAY	ST. LOUIS	Mo	63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL SHOW LOCATION IN SECTION PLAT

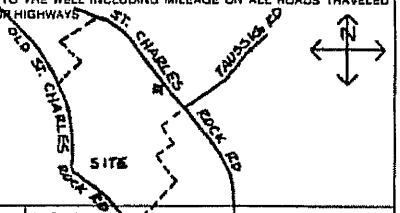
COUNTY ST. LOUIS
ELEVATION 447.8
AREA NO.

SMALLEST ¼ ____ ¼ ____ ¼ LARGEST ¼ ____ ¼

SEC. ____ TWN. 47 N.RNG. 5 (E) OR W

LAT. 38 ° 46 ' 14 " LONG. 90 ° 26 ' 38 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN Co., Inc.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN Co, INC.

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 451.3
Ground Surface Elevation: 447.8

LOCKING CAP - (Y) / N (Circle one)
CAP VENT - Y / N (Circle one)
PROTECTIVE CASING Type: STEEL Size: 8"x8"x5' Bore Hole Diameter: 8"
WEEP HOLE - Y / N (Circle one)

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
	0	0-2 Fill
Depth to bottom of Protective Casing Seal:	3.0	
		12-17.5 Clay
Depth to Base of Annular Seal:		
Depth to Base of Bentonite Seal:	16.8	
Depth to Base of Secondary Filter Pack:	18.0	17.5-18.5 Sandy silt
Depth to Top of the Screen:	19.7	
		19.5-30 Sand
Depth to Bottom of the Screen:	29.7	
Plug Back Total Depth:		
Original Total Depth:	30.0	

PROTECTIVE CASING SEAL Type: [X] Concrete [ ] Cement Slurry
RISER PIPE Length: 31.2' Diameter: 2" Type of Material: SCH. 80 PVC
BOREHOLE DIAMETER: 8 in.
ANNULAR SEAL Type: [ ] Bentonite Slurry [ ] Cement Slurry [ ] Non Slurry Bentonite
BENTONITE SEAL Type: [X] Bentonite Slurry [ ] Non Slurry Bentonite Length of Seal: 13.8 FT.
SECONDARY FILTER PACK (Optional) Type: [X] Sand [ ] Manufactured Grain Size: #4 GRADED Length: 1.3'
PRIMARY FILTER PACK Type: [X] Sand [ ] Manufactured Grain Size: 16-35 Length: 13'
WELL SCREEN Length: 10' Slot Size: 0.010" Type: SCH 80 PVC
SUMP DETAILS Length: 0.3 FT. Diameter: 2 in. Type: PVC
TYPE OF BACKFILL: SAND

TYPE OF INSTALLATION [X] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
451.31

MEASURING POINT IS [X] TOP OF RISER PIPE [ ] OTHER

DRILLING EQUIPMENT [ ] AIR ROTARY [X] AUGER TYPE 8" 1/4 HSA [ ] REVERSE ROTARY [ ] OTHER

CENTRALIZERS USED [ ] YES, AT [ ] STAINLESS STEEL [ ] OTHER [X] NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
4-20-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Kenneth H. Nicholson Jr

PERMIT NUMBER	DATE
001258 WPM	5-10-95

SIGNATURE (DRILLING CONTRACTOR) Kenneth H. Nicholson Jr

PERMIT NUMBER	DATE
001258 WPM	5-16-95

MO 780-1415 (2-94)

DISTRIBUTION: WHITE-DIVISION CANARY-MONITORING WELL CONTRACTOR PINK-OWNER
MAIL WHITE COPY TO DEPARTMENT OF NATURAL RESOURCES, P.O. BOX 250 ROLLA, MO 65401

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MO
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1069408.54
DATUM EASTING: 516755.35 ELEVATION 450.6

DRILLING METHOD:					BORING NO.	
4.25 inch I.D. Hollow Stem Auger					PZ-115-SS	
4.0 inch Tricone Bit with Bentonite					SHEET	
SAMPLING METHOD:					1 OF 1	
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)					DRILLING	
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)					START	FINISH
WATER LEVEL					TIME	TIME
TIME					8:30	9:55
DATE					DATE	DATE
CASING DEPTH					5/5/95	5/5/95

DRILL RIG CME 75 - TRUCK MOUNT
ANGLE -90° BEARING NA
SAMPLE HAMMER
SURFACE CONDITIONS

DEPTH IN FEET (ELEVATION)	BLOW/6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31	6 7 7 6	1.0' 2.0' (50%)			(0.0-30.0 ft.) No samples collected, see Soil Borehole Log PZ-114-AS for descriptions (30.0-33.5 ft.) Compact, olive gray (5Y 4/1), SILTY F-m SAND, wet, NR, (SM), (ALLUVIUM)	SP ①	0.0-30.0 ft. Drilling conducted with 4.25-inch augers Below 30.0 ft. Drilling conducted with mud rotary techniques to control heaving sands.
32	8 8 50/3"	1.0' 1.5' (67%)				SP ②	
33					(417.1) 33.5 End of Soil Borehole Log at 33.5 ft. See PZ-115-SS Record of Drillhole for rock descriptions		
34							
35							
36							
37							
38							
39							
40							
41							
42							
43							
44							

DRILLING CONTR LAYNE-WESTERN
LOGGED BY B. TILTON
DATE 6/21/95 CHK'D BY W. HERST
JOB NO.: 943-2848
FILENAME: PZ115SS

RECORD OF DRILLHOLE PZ-115-SS

Sheet 1 of 4

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2646
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/10/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1089408.54
AZIMUTH: 0

COLLAR ELEV: 450.8
E: 516755.35
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32	0.0-33.5 ft. See Soil Borehole Log PZ-115-SS 33.5-38.0 ft. No samples collected														3/9/95 9 7/8 in. mud rotary bit used to drill into bedrock then 6 in. steel casing grouted into borehole with neat cement
34															
36															
38	412.60 38.0-47.3 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)		412.60 38.00	1	98%										5/10/95 @ 8:30 Began drilling
40	40.0-41.8 ft. Scattered silica zones and veins		410.90 39.70						J,PL,VR (2) J,PL,VR (3)						5/10/95 @ 8:50 End of Run 1
42	41.2-47.7 ft. Microcrystalline, pale yellowish brown (10YR 6/2), slightly weathered 41.8-42.8 and 43.6-47.3 ft. Layers of green clay and clay filling around inplace pieces of rock								J,IR,VR (4) J,PL,VR (2) J,IR,VR (3)						
44				2	97%				J,IR,VR (7) J,IR,VR (6)						
46									J,IR,VR (7)						
48	47.7-49.0 ft. Slightly weathered, thickly bedded, pale yellowish brown (10YR 6/2), microcrystalline, strong, DOLOMITIC LIMESTONE, (ST. LOUIS FORMATION) Vuggy (1 mm. to 5 mm. in diameter), some vugs filled with calcite or quartz								J,I,VR (7)						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/15/95

Golder Associates

RECORD OF DRILLHOLE PZ-115-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 843-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/10/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1088408.54
AZIMUTH: 0

COLLAR ELEV: 450.6
E: 516755.35
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeCoat, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48	48.8-48.9 ft. Claystone layers 49.0-50.2 ft. Slightly weathered, thickly bedded, pale yellowish brown (10YR 6/2), microcrystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Dolomite and clay zones, vuggy			2	97%				J,PL,VR						5/10/95 @ 10:10 End of Run 2
			400.90												
50			49.70												
52	50.2-58.5 ft. Fresh, thickly bedded, pale yellowish brown (10YR 6/2), microcrystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) 50.2-51.4 ft. Thin clay laminations within rock visible but no preferential breaks or weak zones are associated 53.0-55.1 ft. Thin clay laminations, healed and unhealed bedding partings								B,PL,SM B,PL,SM (3) J,PL,R,CL J,PL,SM						
54				3	100 %										
56	55.1-55.4 ft. Highly weathered, extremely weak Claystone zone 55.4-58.5 ft. Thin clay laminations and healed bedding partings, trace stylolites								J,PL,SM J,PL,SM J,PL,SM						
58	58.5-64.6 ft. Fresh, thickly bedded, pale yellowish brown (10YR 6/2), very fine, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Vuggy														5/10/95 @ 11:45 End of Run 3
			390.90												
60			59.70												
62				4	100 %										
64															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/15/95

Golder Associates

RECORD OF DRILLHOLE PZ-115-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/10/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1069408.54
AZIMUTH: 0

COLLAR ELEV: 450.6
E: 516755.35
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
R-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64															
	64.6-65.8 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine grained, strong, LIMESTONE, (ST. LOUIS FORMATION) Scattered stylolites and silica replacement of stylolites								J,IR,VR J,C,SM						
66									J,PL,VR						
	65.8-66.7 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Vuggy			4	100 %				J,PL,VR						
	66.7-69.7 ft. Slightly weathered, medium bedded, pale yellowish brown (10YR 6/2), f-vf grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Zones of Claystone interbedded (1/2 in. - 1 1/2 in.)								J,PL,SM						
68									B,PL,R						
			380.90						B,PL,R,CL						5/10/95 @ 12:30 End of Run 4
	69.7-84.7 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), microcrystalline to fine grained, strong, LIMESTONE, (ST. LOUIS FORMATION)		69.70						J,PL,VR						
70	69.7-75.7 ft. Fine to medium grained, trace fossils								J,IR,R						
72	72.0-72.2 ft. Highly weathered, weak, Claystone seam 72.2-73.3 ft. Scattered chert								B,PL,SM (2) B,PL,SM						
74				5	100 %				J,C,SM (2)						
									J,PL,SM						
76	76.2 ft. Void filled with calcite crystals								J,PL,R						
	77.2-78.0 ft. Abundant stylolites								J,PL,R J,I,R J,I,R						
78									J,PL,SM						
	79.1-84.7 ft. Dolomite content increases, slightly weathered								J,I,R (2)						5/10/95 @ 13:50 End of Run 5
	79.4-81.0 ft. Abundant stylolites		370.90 79.70	6	100 %				J,I,R						
80															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/15/95

Golder Associates

RECORD OF DRILLHOLE PZ-115-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/10/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068408.54
AZIMUTH: 0

COLLAR ELEV: 450.6
E: 516755.35
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: FB, SW, MW, HW, CW	STRENGTH INDEX: R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): R1 30, R2 150, R3 300, R4 600, R5 1500, R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	69.7-84.7 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), microcrystalline to fine grained, strong, LIMESTONE, (ST. LOUIS FORMATION)								J,I,R						
									J,I,R (2)						
82				6	100 %				J,I,R						
									J,I,R (2)						
84	84.2-84.7 ft. Abundant stylolites		385.90						B,PL,R						5/10/95 @ 15:00 End of coring
	End of Record of Drillhole at 84.7 ft.		84.70												
86															
88															
90															
92															
94															
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/15/95

Golder Associates

Well No. PZ-115-SS

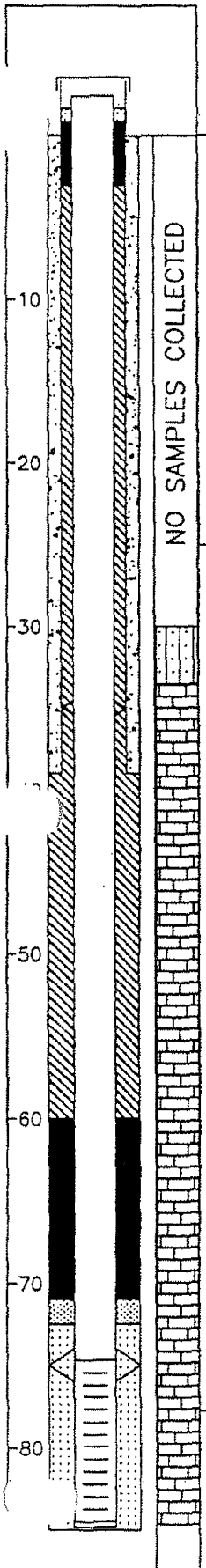
Boring No. X-Ref: PZ-115-SS

PIEZOMETER CONSTRUCTION SUMMARY

Survey Coords: Northing: 1069409 ft. Easting: 516755 ft.

Elevation Ground Level 450.6 ft. NGVD

Top of PVC Casing 452.30 ft. NGVD



Not to Scale

Drilling Summary:

Total Depth 85.0 ft.

Borehole Diameter 9 7/8 in. (0.0-39.0 ft.) 5 7/8 in. (39.0-85.0 ft.)

Casing Stickup Height 1.69 ft.

Driller Layne-Western, St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit and 9 7/8 in. Tricone Bit

Drilling Fluid Auger-None, NX Core Water, Air and Mud Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	5/5/95	8:30	5/5/95	10:00
Schramm Rotary	5/21/95	8:30	5/21/95	10:00
Geophys.Logging:				
Casing:				
2" PVC	5/21/95	10:15	5/21/95	10:20
6" Steel	5/9/95	9:15	5/9/95	12:00
Filter Placement:	5/21/95	10:40	5/21/95	11:00
Cementing:				
Development				
Bentonite Grout	5/21/95	11:10	5/21/95	11:30
Bentonite Seal	5/21/95	11:00	5/21/95	11:10

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.69	-	74.68	C1	452.30	-	375.93
74.68	-	84.48	S1	375.93	-	366.13
84.48	-	84.81	C2	366.13	-	365.80
+ 1.00	-	39.00	C3	451.60	-	411.61
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.) (C3-see comments)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 72.5-85.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 71.0-72.5 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-60.0 ft., Neat cement, 3.0-39.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 60.0-71.0 ft.

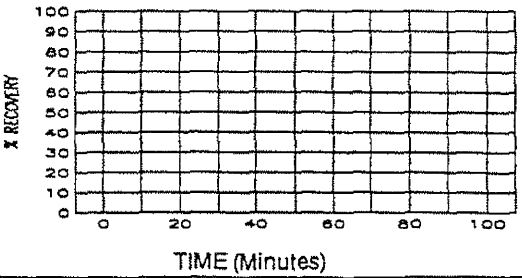
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments: Surface Casing C3: 6 1/8 in. ID / 6 5/8 in. OD Steel Casing

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ115SS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122507	CHECK NO
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL
WELL NUMBER: PZ-11555
SITE ADDRESS: ST. CHARLES ROCK RD. | CITY: BRIDGETON | STATE: MO | ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC. | TELEPHONE: 314-341-3710
ADDRESS: 1838 N. BROADWAY | CITY: ST. LOUIS | STATE: MO. | ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

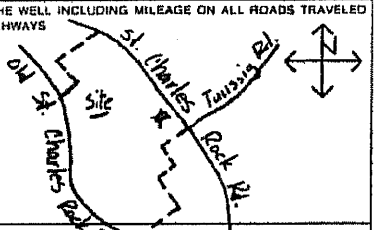
COUNTY: ST. LOUIS
ELEVATION: 450.6
AREA NO.:

SMALLEST ¼ LARGEST ¼

SEC. ____ TWN. 47 N, RNG. 5 E OR W

LAT. 38° 46' 14" LONG. 90° 26' 29"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME: LAYNE WESTERN CO., INC.

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 452.3
Ground Surface Elevation: 450.6

	Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column		
Depth to bottom of Protective Casing Seal:	3.0	
		33-85 Limestone
Depth to Base of Annular Seal:	60.0	
Depth to Base of Bentonite Seal:	71.0	
Depth to Base of Secondary Filter Pack:	72.5	
Depth to Top of the Screen:	74.7	
Depth to Bottom of the Screen:	84.7	
Plug Back Total Depth:		
Original Total Depth:	85.0	

LOCKING CAP - (Y) N (Circle one)
CAP VENT - (Y) N (Circle one)
PROTECTIVE CASING Type: STEEL Size: 8"x6"x5' Bore Hole Diameter: 9 7/8"
WEEP HOLE - Y / N (Circle one)
PROTECTIVE CASING SEAL Type: [X] Concrete [ ] Cement Slurry
RISER PIPE Length: 76.4' Diameter: 2" Type of Material: Sch. 80 PVC
BOREHOLE DIAMETER: 5 7/8 in.
ANNULAR SEAL Type: [ ] Bentonite Slurry [X] Cement Slurry [ ] Non Slurry Bentonite
BENTONITE SEAL Type: [X] Bentonite Slurry [ ] Non Slurry Bentonite Length of Seal: 11 Ft.
SECONDARY FILTER PACK (Optional) Type: [ ] Sand [ ] Manufactured Grain Size: < 50 Length: 1.5
PRIMARY FILTER PACK Type: [X] Sand [ ] Manufactured Grain Size: 16/35 Length: 12.5
WELL SCREEN Length: 10' Slot Size: 0.010" Type: Sch. 80 PVC
SUMP DETAILS Length: 0.3 Ft. Diameter: 2 In. Type: PVC
TYPE OF BACKFILL: SAND

DRILLING CONTRACTOR'S NAME: LAYNE WESTERN CO, INC.
TYPE OF INSTALLATION: [X] ABOVE GROUND [ ] FLUSH MOUNT
STATIC WATER LEVEL: FEET FROM MEASURING POINT
DATE OF STATIC WATER LEVEL:
ELEVATION OF MEASURING POINT: 452.3
MEASURING POINT IS: [X] TOP OF RISER PIPE [ ] OTHER
DRILLING EQUIPMENT: [X] AIR ROTARY [X] AUGER TYPE 6¼ H.S.A. [ ] REVERSE ROTARY [ ] OTHER
CENTRALIZERS USED: [X] YES, AT 3 TOTAL [X] STAINLESS STEEL [ ] OTHER [ ] NO
MULTIPLE CASED WELLS: SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.
DATE WELL CONSTRUCTION WAS COMPLETED: 5-31-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Michael P. Vogt
PERMIT NUMBER: 001256 WM | DATE: 6-02-95
SIGNATURE (DRILLING CONTRACTOR): Michael P. Vogt
PERMIT NUMBER: 001256 WM | DATE: 6-02-95

MO 780-1315 (2-94) DISTRIBUTION: WHITE-DIVISION CANARY-MONITORING WELL CONTRACTOR PINK-OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:		BORING NO.
	6.25 inch I.D. Hollow Stem Auger		PZ-116-SS
			SHEET 1 OF 3
	SAMPLING METHOD:		DRILLING
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)		START / FINISH
	SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)		START / FINISH
	WATER LEVEL		TIME / TIME
	TIME	12:45	15:00
	DATE	DATE	DATE
NORTHING: 1066410.28 DATUM EASTING: 515843.88 ELEVATION 483.1	CASING DEPTH	6/5/95	6/5/95

DRILL RIG: CME 75 - TRUCK MOUNT
SURFACE CONDITIONS: Edge of haul road and flat fill area.
ANGLE: BEARING:
SAMPLE HAMMER:

DRILLING CONTR: LAYNE-WESTERN
LOGGED BY: B. TILTON
DATE: 6/20/95
CHK'D BY: W. HERST
JOB NO.: 943-2848
FILENAME: PZ116SS

DEPTH IN FEET (ELEVATION)	BLOW/6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
					(0.0-1.0 ft.) No samples collected, gravel road base encountered (482.1) 1.0		
1	5	0.9' / 2.0' (45%)			(1.0-5.0 ft.) Stiff, dark yellowish brown (10YR 4/2), CLAYEY SILT, trace Gravel, WR, damp, (ML), (FILL)	SP ①	
2	6 4 5						
3	2	0.7' / 2.0' (35%)				SP ②	
4	2 4 5						
5	3	1.5' / 2.0' (75%)			(5.0-15.0 ft.) Loose, moderate yellowish brown (10YR 5/4), thinly laminated, SILT, SR, (ML), (LOESS)	SP ③	
6	3 5 5						
7	3	1.7' / 2.0' (85%)			@ 7.0 ft., color changes to mottled pale yellowish brown (10YR 6/2) to moderate yellowish brown (10YR 5/4), and silt becomes compact	SP ④	
8	5 8 9						
9	7	1.6' / 2.0' (80%)				SP ⑤	
10	8 8 9						
11	5	1.2' / 2.0' (60%)			@ 11.0 ft., color is predominantly pale yellowish brown (10YR 6/2)	SP ⑥	
12	8 9 10						
13	6	1.3' / 2.0' (65%)				SP ⑦	
14	7 7 6						

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	BORING NO. PZ-116-SS SHEET 2 OF 3
	WATER LEVEL / TIME / DATE / CASING DEPTH	DRILLING START TIME 12:45 DATE 6/5/95; FINISH TIME 15:00 DATE 6/5/95

NORTHING: 1066410.28
DATUM EASTING: 515843.88 ELEVATION 483.1

DRILL RIG CME 75 - TRUCK MOUNT
SURFACE CONDITIONS Edge of haul road and flat fill area.
ANGLE BEARING
SAMPLE HAMMER

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16	5 6 6 10	1.4' / 2.0' (70%)			(15.0-22.8 ft.) Compact, pale yellowish brown (10YR 6/2), SILT, SR-NR, damp, (ML), (LOESS)	SP (8)	
17 18	9 5 4 6	1.3' / 2.0' (65%)				SP (9)	
19 20	4 6 5 4	1.7' / 2.0' (85%)				SP (10)	
21 22	1 4 6 9	1.6' / 2.0' (80%)			(460.3) 22.8	SP (11)	
23 24	6 7 5 6	2.0' / 2.0' (100%)			(22.8-24.2 ft.) Compact, moderate yellowish brown (10YR 5/4), SILTY fine SAND, WR, damp, (SM), (ALLUVIUM) (458.9) 24.2	SP (12)	
25	8 14 22 14	2.0' / 2.0' (100%)			(24.2-25.6 ft.) Compact, medium gray (N5), SILT, trace iron oxide staining, NR, moist, (ML), (LOESS) (457.5) 25.6		
26					(25.6-27.0 ft.) Dense, pale yellowish brown (10YR 6/2), fine SAND, trace Silt, NR, damp (SP), (ALLUVIUM) (456.1) 27.0	SP (13)	
27 28	4 11 17 18	2.0' / 2.0' (100%)			(27.0-28.0 ft.) Compact, medium gray (N5), SILT, NR, moist, (ML), (ALLUVIUM) (455.1) 28.0	SP (14)	
29	8 9 11 10	2.0' / 2.0' (100%)			(28.0-32.0 ft.) Compact, medium light gray (N6), fine SAND, trace Silt, NR, moist, (SP)	SP (15)	

DRILLING CONTR LAYNE-WESTERN
LOGGED BY B. TILTON
CHK'D BY W. HERST
DATE 6/20/95
JOB NO.: 943-2848
FILENAME: PZ116SS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-116-SS
	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 3 OF 3
	WATER LEVEL / TIME / DATE / CASING DEPTH	DRILLING START TIME 12:45 DATE 6/5/95; FINISH TIME 15:00 DATE 6/5/95
DATUM NORTHING: 1066410.28 EASTING: 515843.88 ELEVATION 483.1		
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS Edge of haul road and flat fill area.	
ANGLE BEARING		
SAMPLE HAMMER		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE		REMARKS
31	15 50/5"	0.5'/1.0' (50%)			(28.0-32.0 ft.) Compact, medium light gray (N6), fine SAND, trace Silt, NR, moist, (SP) @ 30.8 ft., some black organic material in sand @ 31.5 ft., gravel size pieces of Limestone in Sand, water encountered at 31.0 ft., on top of bedrock (451.1) 32.0	SP 15 SP 16		
32					End of Soil Borehole Log at 32.0 ft. See PZ-116-SS Record of Drillhole for rock descriptions			
33								
34								
35								
36								
37								
38								
39								
40								
41								
42								
43								
44								

DRILLING CONTR LAYNE-WESTERN

LOGGED BY B. FILTON

DATE 6/20/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ116SS

RECORD OF DRILLHOLE PZ-116-SS

Sheet 1 of 9

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/5/95 - 6/14/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066410.28
AZIMUTH: 0

COLLAR ELEV: 483.1
E: 515843.68
INCLINATION: -90

ROCK TYPE
J-Joint, F-Faun, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32	0.0-32.0 ft. See Soil Borehole Log PZ-116-SS 32.0-33.4 ft. No samples collected		448.70												
			33.40												RQD of Run 1 was unassessable due to uncertainty in fracture origin. Drill bit was worn, poor quality recovery
34	33.4-60.2 ft. Fresh, thickly laminated, light olive gray (5Y 6/1), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Occasional 0.5 - 2 mm. pyrite grains, weathered and grading into fresh at depth			1	71%										
			447.10												
36			36.00												
			446.20												
			36.90						J,I,R,Fe						
	37.6-38.7 ft. Stiff, Clay layer, light olive gray (5Y 6/1)		445.50 37.60						J,I,R						
38			444.40 38.70												
				2	81%										
40									J,I,R (3)						
			440.90												
42			42.20												
			439.90												
	43.2-43.4 ft. Very stiff, Clay layer, light olive gray (5Y 6/1)		439.70 43.40												
			43.20												
44				3	95%				J,PL,R						
									J,PL,R,CL						
			436.20						J,I,R						
	45.1-45.3 ft. Soft Clay layer		437.80 45.30						J,I,R						6/8/95 @ 13:10 Began Run 4
46			436.90						J,I,R,CL						
	46.2-48.0 ft. Highly weathered, thinly bedded, medium light gray (N6), fine grained, weak, BRECCIATED LIMESTONE in medium bluish gray (5B 5/1), clay matrix, (COLLAPSE ZONE)		46.20												
			435.10	4	96%										
48			48.00												

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: E. SWANSON
CHECKED: B. TILTON
DATE: 7/12/95

== Golder Associates

RECORD OF DRILLHOLE PZ-116-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/5/95 - 6/14/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1056410.28
AZIMUTH: 0

COLLAR ELEV: 483.1
E: 515843.68
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48	435.10														
	48.0-60.2 ft. 48.00 Fresh, thinly bedded, light olive gray (5Y 6/1), micro-crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic			4	95%				J,I,R,CL						
									J,PL,SM,Fe						
			433.20												
50			48.90						J,PL,R						
									J,U,R						
52									J,PL,R						
									J,PL,R (3)						
									J,PL,R,CL						
54									J,C,R						
									J,PL,R,CL						
				5	100 %				J,I,R						
56															
									J,PL,R,CL (2)						
									J,PL,R						
58									J,PL,R,CL						
									J,PL,R (3)						
									J,PL,R (2)						
60	422.90		423.10												
	60.2-64.8 ft. 60.20 Fresh, thinly bedded, olive gray (5Y 4/1), fine grained, very strong, DOLOMITE, (ST. LOUIS FORMATION)		60.00						J,I,R						
62	61.9-62.5 ft. Light olive gray (5Y 6/1), very fine grained Limestone layer			6	100 %				J,I,R						
									J,PL,R						
									J,PL,R,CL						
									J,PL,R,CL						
64															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: E. SWANSON
CHECKED: B. TILTON
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-116-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2548
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 8/5/95 - 8/14/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066410.28
AZIMUTH: 0

COLLAR ELEV: 483.1
E: 515843.88
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation; PL-Planar, C-Curved, U-Undulating, ST-Stepped, Irregular; P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough; Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX: SW FR, MW, HW, CW	STRENGTH INDEX: R5 R6, R4, R3, R2, R1	POINT LOAD INDEX (psi): HT 30, R2 150, R3 300, R4 600, R5 1500, R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64															
	416.30														
	64.8-71.2 ft. 64.80 Fresh, medium bedded, light olive ray (5Y 6/1), very fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)														
66									J,PL,R,CL						
				6	100 %				J,PL,R,CL						
68															
			413.10												
70			70.00												
72									J,PL,R,CL						
	72.4-87.0 ft. Fresh, medium bedded, light olive gray (5Y 6/1), micro-crystaline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic 72.6-73.0 ft. Abundant chert zones (<3 in. thick)								J,PL,R,CL B,PL,R						
74									J,PL,R,CL						
	408.00														
	75.1-75.8 ft. 75.10 Hard, Clay layer			7	88%										
	407.30														
	75.80														
76									J,PL,R,CL (2)						
78									J,PL,R,CL (2)						
									J,I,R,CL						
80			403.10 80.00												

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: E. SWANSON
CHECKED: B. TILTON
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-116-SS

Sheet 4 of 9

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 843-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/5/95 - 6/14/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1058410.28
AZIMUTH: 0

COLLAR ELEV: 483.1
E: 515843.86
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	ROCK TYPE / DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	72.4-87.0 ft. Fresh, medium bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic		403.10 / 80.00						J,C,R						
82	82.2-83.3 ft. Glauconitic intraclasts, argillaceous								J,PL,R (2)						
84									B,PL,R						
86				8	100 %				J,U,R,CL J,I,R J,I,R,CL						
88	87.0-101.3 ft. Fresh, medium bedded, light olive gray (5Y 6/1), very fine crystalline, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) 87.8-91.3 ft. Porous zone, open vugs (<2 mm. dia.)								J,PL,R,CL						
90									B,C,R,CL J,I,R,CL						
92			393.00 / 90.10						J,PL,R,CL						
94				9	100 %				J,I,R						
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: E. SWANSON
CHECKED: B. TILTON
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-116-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/5/95 - 6/14/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066410.28
AZIMUTH: 0

COLLAR ELEV: 483.1
E: 515843.88
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
96	97.0-101.3 ft. Fresh, medium bedded, light olive gray (5Y 6/1), very fine crystalline, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)														
98				9	100%										
100			383.10 / 100.00						B,PL,R,CL						
102	101.3-106.3 ft. Fresh, thickly bedded, light brownish gray (5YR 6/1), medium crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)								B,PL,R,CL						
				10	98%				J,PL,R						
104									J,PL,R						
	105.1-105.7 ft. Abundant, thinly laminated, shaley partings								J,PL,R (3)						
									J,PL,R,CL						
106			376.80 / 106.30						J,PL,R,CL						
	106.3-108.8 ft. Fresh, thinly bedded, light brownish gray (5YR 6/1), fine crystalline, extremely strong, SILICIFIED LIMESTONE, (ST. LOUIS FORMATION)														
				11	100%										
108									J,I,R,SPUN						
			374.30 / 108.80						J,PL,R						
	108.8-135.5 ft. Fresh, medium bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong to strong, LIMESTONE (ST. LOUIS FORMATION) Stylolitic								J,I,R (2)						
110				12	100%										
									B,PL,SM						
									B,PL,SM						
112															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: E. SWANSON
CHECKED: B. TILTON
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-116-SS

Sheet 6 of 9

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2548
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/5/95 - 6/14/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1088410.28
AZIMUTH: 0

COLLAR ELEV: 483.1
E: 515843.88
INCLINATION: -90

J-Joint; F-Fault; S-Shear; B-Bedding; F-Foliation
PL-Planar; C-Curved; U-Undulating; ST-Stepped; I-Irregular
P-Polished; K-Slikensided; SM-Smooth; R-Rough; VR-V. Rough
Fe-FeOxide; CL-Clay Infill; CH-Chlorite; H-Healed; GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
112	108.8-135.5 ft. Fresh, medium bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong to strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic			12	100 %				J,PL,R,CL (3)						
114			369.10 / 114.00												
									J,PL,R (2)						
116									J,PL,R						
				13	100 %				J,I,R (2)						
									PL,R (6)						
118			364.10 / 119.00												
									J,I,R						6/9/95 @ 14:30 Completed Run 13 6/14/95 @ 8:00 Began Run 4 Water level in open corehole = 21.1 ft. bgs prior to drilling
120									B,I,R (3)						
									J,I,R (2)						@ 120.3, 122.8, 123.3, 125.5 and 126.7 ft., possible open intact joints, (<5 breaks/in.)
	121.2-122.2 ft. Argillaceous Limestone														
122									J,I,R						
	@ 122.5 ft. Very stiff, light olive gray (5Y 6/1), Silt layer (< 1/2 in. thick)			14	100 %										
124									J,I,SM						
	124.7-127.0 ft. Limestone becomes fine to medium crystalline								B,I,SM,CL						
									J,I,R						
126	126.4-127.0 ft. Moderately weathered zone														
									J,I,R						
128															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: E. SWANSON
CHECKED: S. TILTON
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-116-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/5/95 - 6/14/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066410.26
AZIMUTH: 0

COLLAR ELEV: 483.1
E: 515843.88
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeStain, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/t CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR, MW, HW, CW	STRENGTH INDEX: R6, R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): R1 30, R2 150, R3 300, R4 600, R5 1500, R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
128	108.8-135.5 ft. Fresh, medium bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong to strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic			14	100 %				J,PL,SM						6/14/95 @ 9:10 Completed Run 14
			354.10												
130			129.00						J,PL,SM						
132									J,PL,SM						
									J,I,R (3)						133.0-133.5 ft. Possible open intact joints, highly broken zone
134				15	98%				J,I,R						
	134.9-135.7 ft. Limestone becomes fine grained								B,I,R,CL						
			347.60												
136	135.5-139.1 ft. Fresh, thickly bedded, olive gray (5Y 4/1), very fine grained, medium strong, ARGILLACEOUS LIMESTONE, (SALEM FORMATION)		135.50												@ 135.5 ft. Inferred top of Salem Formation
138															
			344.10												6/14/95 @ 10:11 Completed Run 15
	139.1-141.8 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARENACEOUS LIMESTONE, (SALEM FORMATION)		139.00						B,PL,SM,CL						
140	@ 139.6 ft. Very stiff, olive gray (5Y 4/1), Silt layer (<1 in. thick)														
									J,PL,SM						
				16	92%				J,I,R (2)						
142	141.8-151.2 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong LIMESTONE, (SALEM FORMATION) Thin layers of glauconite Clay, surrounding Limestone matrix								J,I,R						
									J,I,R,CL (2)						
									B,I,SM						6/14/95 @ 11:00 Completed Run 16 Stopped short as bit plugged, core loss in highly broken rock
			339.10												
144			144.00												

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: E. SWANSON
CHECKED: B. TILTON
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-116-SS

Sheet 8 of 9

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/5/95 - 6/14/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066410.28
AZIMUTH: 0

COLLAR ELEV: 483.1
E: 515843.88
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infil, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
144	141.8-151.2 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong LIMESTONE, (SALEM FORMATION) Thin layers of glauconite Clay, surrounding Limestone matrix @ 144.7 ft. Vug with calcite crystals (<1/2 in. dia.) 146.0-151.2 ft. Limestone becomes argillaceous		339.10 / 144.00						B,U,R,CL; J,I,R (2); J,I,R (3)		SW FR, MW, HW, CW	R6, R5, R4, R3, R2, R1	R1 30, R2 150, R3 300, R4 600, R5 1500, R6		
146															
148															
150				17	100 %										
152	151.2-162.5 ft. Fresh, thinly bedded, olive gray (5Y 4/1), fine crystalline, medium strong, FOSSILIFEROUS LIMESTONE, (SALEM FORMATION) Thinly laminated, shaley partings common, some chert nodules (<2 in. dia.)								J,I,R						
154			329.10 / 154.00						J,I,R						6/14/95 @ 12:00 End Run 17
156	154.5-155.2 ft. Limestone becomes argillaceous								J,I,R (2); B,PL,SM,CL						
158	157.5-162.5 ft. Abundant chert zones (<2 in. thick)			18	100 %				J,I,R (2); B,I,SM; J,PL,SM; B,PL,SM						@ 157.0 and 158.8 ft. Possible open/intact joints, highly broken zone
160															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: E. SWANSON
CHECKED: B. TILTON
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-116-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 843-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/5/95 - 6/14/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066410.28
AZIMUTH: 0

COLLAR ELEV: 483.1
E: 515843.68
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX: FR, SW, MW, HW, CW	STRENGTH INDEX: R6, R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): R1, R2, R3, R4, R5, R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
160	151.2-162.5 ft. Fresh, thinly bedded, olive gray (5Y 4/1), fine crystalline, medium strong, FOSSILIFEROUS LIMESTONE, (SALEM FORMATION) Thinly laminated, shaley partings common, some chert nodules (<2 in. dia.)			18	100 %	60 50 40 20	2 4 6 8 10	0 30 60 90							
162	320.80		320.80												6/14/95 @ 13:25 End Run 18
	End of Record of Drillhole at 162.5 ft. 162.50		162.50												
164															
166															
168															
170															
172															
174															
176															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

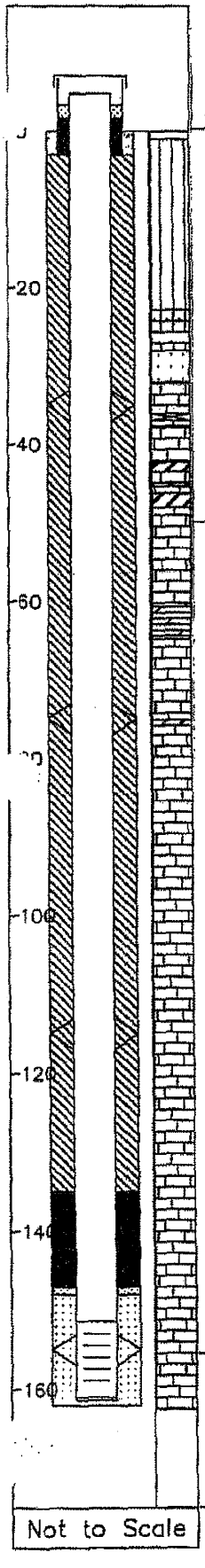
LOGGED: E. SWANSON
CHECKED: B. TILTON
DATE: 7/12/95

Golder Associates

Well No. PZ-116-SS

Boring No. X-Ref: PZ-116-SS

PIEZOMETER CONSTRUCTION SUMMARY



Survey Coords: Northing: 1066410 ft. Easting: 515844 ft.

Elevation Ground Level 483.1 ft. NGVD

Top of PVC Casing 484.87 ft. NGVD

Drilling Summary:

Total Depth 162.0 ft.

Borehole Diameter 10 1/4 in. (0.0–33.0 ft.) 5 7/8 in. (33.0–162.0 ft.)

Casing Stickup Height 1.80 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger–None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	6/5/95	7:30	6/14/95	13:25
Schramm Rotary	6/20/95	8:00	6/20/95	11:45
Geophys.Logging:				
Casing:	6/20/95	12:30	6/20/95	12:50
Filter Placement:	6/20/95	12:55	6/20/95	13:00
Cementing:				
Development				
Bentonite Grout	6/20/95	13:30	6/20/95	15:30
Bentonite Seal	6/20/95	13:15	6/20/95	13:30

Well Design & Specifications

Basis: Geologic Log X Geophysical Log ____

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.80	–	151.40	C1	484.87	–	331.67
151.40	–	161.00	S1	331.67	–	322.07
161.00	–	161.33	C2	322.07	–	321.74
	–				–	
	–				–	
	–				–	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16–35 mesh Silica Sand, 148.0–162.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 147.0–148.0 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0–135.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 135.0–147.0 ft.

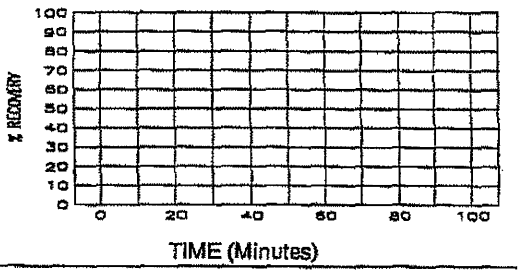
Concrete: 0.0–3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ116SS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122519	CHECK NO
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME	WELL NUMBER
LANDFILL BRIDGETON SANITARY LANDFILL	PZ-116-55

SITE ADDRESS	CITY	STATE	ZIP CODE
ST. CHARLES ROCK RD.	BRIDGETON	MO	63044

NAME	TELEPHONE
LANDFILL WASTE SYSTEMS, INC.	314-291-3710

ADDRESS	CITY	STATE	ZIP CODE
1230 N BROADWAY	ST. LOUIS	MO	63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

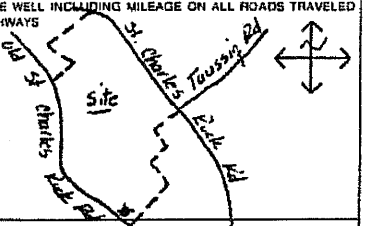
COUNTY ST LOUIS
ELEVATION 493.07
AREA NO.

SMALLEST ¼ ____ ¼ ____ ¼ ____ LARGEST ¼

SEC. ____ TWN. 47 N,RNG 5 E OR W

LAT. 38 ° 45 ' 44 " LONG. 90 ° 26 ' 40 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN Co., INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN Co., INC.

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
494.07

MEASURING POINT IS
☒ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☒ AIR ROTARY ☒ AUGER TYPE 6¼ H.S.A.
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☒ YES, AT 5 TOTAL
☒ STAINLESS STEEL
☐ OTHER
☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
6-20-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael P. Vogt
PERMIT NUMBER OWI256WM DATE 7-27-95
SIGNATURE (DRILLING CONTRACTOR) Michael P. Vogt
PERMIT NUMBER OWI256WM DATE 7-27-95

NOTE: Record the fraction of a foot in decimal, not in inches

Top of Riser Elevation: 494.07

Ground Surface Elevation: 493.07 Ft

Information in this column to be supplied in the Feet from Surface column:	Feet from Surface	Description of Formation
		0-24' Silt
Depth to bottom of Protective Casing Seal:	3.0	
		24-28 Silt w/Sand
		28-30 Silt
		30-34 Sand
		34-61 Limestone
		61-65 Dolomite
		65-162 Limestone
Depth to Base of Annular Seal:	135.0	
Depth to Base of Bentonite Seal:	147.0	
Depth to Base of Secondary Filter Pack:	148.0	
Depth to Top of the Screen:	151.0	
Depth to Bottom of the Screen:	161.0	
Plug Back Total Depth:		
Original Total Depth:	162.0	

LOCKING CAP - (Y) N (Circle one)
CAP VENT - Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8" x 5' x 5'
Bore Hole Diameter: 10¼ "

WEEP HOLE - Y / N (Circle one)

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 153 '
Diameter: 3 "
Type of Material: SCH 80 PVC

BOREHOLE DIAMETER: 5⅞ In.

ANNULAR SEAL
Type: ☐ Bentonite Slurry ☒ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite
Length of Seal: 12 Ft.

SECONDARY FILTER PACK (Optional)
Type: ☒ Sand ☐ Manufactured
Grain Size: 4-50
Length: 1'

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 16-35
Length: 14'

WELL SCREEN
Length: 10'
Slot Size: 0.010
Type: SCH 80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

DISTRIBUTION: WHITE [illegible] CANARY MONITORING WELL CONTRACTOR PINK/OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MO
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1068496.19
DATUM EASTING: 516972.30 ELEVATION 483.6

DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger

SAMPLING METHOD:
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)

WATER LEVEL					
TIME					
DATE					
CASING DEPTH					

BORING NO. PZ-200-SS

SHEET 1 OF 2

DRILLING START	DRILLING FINISH
TIME 10:56	TIME 14:05
DATE 2/10/95	DATE 2/10/95

DRILL RIG CME 75 - TRUCK MOUNT

SURFACE CONDITIONS

ANGLE BEARING

SAMPLE HAMMER

DRILLING CONTR LAYNE-WESTERN

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1							No sample 0.0-2.0 ft., due to gravel pad
2	6 8 8 6	0.8' 2.0' (40%)			(481.6) 2.0 (2.0-8.1 ft.) Very stiff, dark yellowish brown (10YR 4/2), homogenous, CLAYEY SILT, NR, moist, (CL-ML). (LOESS)	SP 2	
3							
4	3 8 12 15	1.3' 2.0' (65%)				SP 3	
5							
6		2.3' 2.0' (115%)				SH 4	
7							
8	6 8 10 13	2.0' 2.0' (100%)			(8.1-16.5 ft.) Stiff to very stiff, light olive gray (5Y 6/1) to light brown (5YR 5/6), homogenous, mottled CLAYEY SILT, NR, damp, (CL-ML). (LOESS)	SP 5	
9							
10	3 7 11 13	1.7' 2.0' (85%)				SP 6	
11							
12	8 6 7 8	1.9' 2.0' (95%)				SP 7	
13							
14		2.3' 2.0' (115%)				SH 8	

LOGGED BY J. MILLER

DATE 2/10/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ200SS

SOIL BOREHOLE LOG

LAIDLAW WASTE SYSTEMS INC.

SITE NAME AND LOCATION	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-200-SS
LAIDLAW/OU2 RI-FS/MD WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 2 OF 2 DRILLING START TIME 10:56 / FINISH TIME 14:05
NORTHING: 1068496.19 DATUM EASTING: 516972.30 ELEVATION 483.6	WATER LEVEL / TIME / DATE / CASING DEPTH	DATE 2/10/95 / DATE 2/10/95
DRILL RIG: CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE: BEARING:		
SAMPLE HAMMER:		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16	4 5 7 9	1.5'/2.0' (75%)			(8.1-16.5 Ft.) Stiff to very stiff, light olive gray (5Y 6/1) to light brown (5YR 5/6), homogenous, mottled CLAYEY SILT, NR, damp, (CL-ML), (LOESS)	SH (8)	
17					(16.5-19.7 Ft.) Stiff, light olive gray (5Y 6/1) to moderate brown (5YR 4/4), homogenous, mottled CLAYEY SILT, NR, moist, (CL-ML), (LOESS)	SP (9)	
18	3 5 15 18	1.5'/2.0' (75%)				SP (10)	
19					(463.9) 19.7		
20	5 15 14 12	0.8'/2.0' (40%)			(19.7-20.5 Ft.) Compact, moderate yellowish brown (10YR 5/4), homogenous, Fine SAND, trace Silt, NR, dry, (SM), (ALLUVIUM) (463.1) 20.5	SP (11)	
21					(20.5-25.5 Ft.) Very stiff, light olive gray (5Y 6/1) to light brown (5YR 5/6), stratified, CLAYEY SILT, mottled with black manganese stains, NR, moist, (CL-ML), (ALLUVIUM)		
22	5 6 9 9	1.2'/2.0' (60%)				SP (12)	
23							
24	8 14 26 28	1.4'/2.0' (70%)			@ 24.3 Ft., <1 inch fine sand lenses	SP (13)	
25					(458.1) 25.5		
26	14 33 40/4"	0.7'/1.3' (54%)			(25.5-27.6 Ft.) Dense, light brown (5YR 5/6), stratified, fine SAND, NR, dry, (SP), (ALLUVIUM)	SP (14)	
27					@ 27.3 Ft., <1 inch clayey silt lenses (456.3) 27.3 End of Soil Borehole Log at 27.3 ft. See PZ-200-SS Record of Drillhole for rock descriptions		2/10/95 - 14:05 Finish drilling at 27.3 ft. - hit bedrock End of soil borehole at 27.3 ft.
28							
29							

DRILLING CONTR: LAYNE-WESTERN

LOGGED BY: J. MILLER

DATE: 2/10/95

CHK'D BY: V. HERST

JOB NO.: 943-2848

FILENAME: PZ200SS

RECORD OF DRILLHOLE PZ-200-SS

Sheet 1 of 6

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX core & water
DRILLING DATE: 2/10/95 -2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1088456.2
AZIMUTH: 0

COLLAR ELEV: 483.61
E: 516972.2
INCLINATION: -90

ROCK TYPE: J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation; PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular; P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough; Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
16	0.0-27.3 ft. See Soil Borehole Log PZ-200-SS														
18															
20															
22															
24															
26															2/10/95 @ 16:12 Start Run 1 16:16 Stop-no circulation, pull core, quit for the day at 16:30
			456.31												
28	27.3-44.5 ft. Slightly weathered, medium bedded, light olive gray (5Y 6/1), medium crystalline, weak, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, iron staining, calcite mineralization, 1 in. clay parting at 30.1 ft.		27.30	1	68%				J,C,R (3) J,I,R,calcite J,PL,R-CL J,PL-J,R J,PL,R (3) J,I,R J,PL,R (3) J,PL,R (2) J,I,R						2/11/95 Measure water level in augers, dry to 27.0 ft.
30			453.11						Core Loss						
			30.50	2	100 %				J,I,R J,PL,R-CL J,I,R (4) J,I,R (3)						2/11/95 @ 10:50
32															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-200-SS

Sheet 2 of 6

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX core & water
DRILLING DATE: 2/10/95 -2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1058496.2
AZIMUTH: 0

COLLAR ELEV: 483.61
E: 516972.2
INCLINATION: -90

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
R-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32	27.3-44.5 ft. Slightly weathered, medium bedded, light olive gray (5Y 6/1), medium crystalline, weak, LIMESTONE, (ST. LOUIS FORMATION)								J,ST,R J,I,R-calcite J,PL,R-open J,PL,R						
34									J,I,R-open J,I,R (4) J,C,R J,PL,SM (2) J,C,R-CL J,C,R J,I,R						
36				2	100 %				J,PL,R J,C,R-CL						
38									J,I,R,CL (2) J,I,R-open J,I,R-CL (2) J,I,R (2) J,PL,R-open						
40			443.51 40.10						J,PL,SM J,PL,R (2) J,I,R-CL (2) J,PL,SM-open J,I,R (2)						
42									J,I,R (3) J,I,R-CL-open (5)						
44	44.5-68.7 ft. Fresh, medium bedded, light olive gray (5Y 6/1), medium crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)			3	100 %				J,I,R (2) J,PL,SM-open (3) J,I,R J,PL,R-open J,I,R (2)						
46									J,I,R J,I,R-open J,I,R (2)						
48									J,I,R-CL						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-200-SS

Sheet 3 of 6

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX core & water
DRILLING DATE: 2/10/95 -2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068498.2
AZIMUTH: 0

COLLAR ELEV: 483.61
E: 516972.2
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48	44.5-68.7 ft. Fresh, medium bedded, light olive gray (5Y 6/1), medium crystalline, medium strong. LIMESTONE, (ST. LOUIS FORMATION)			3	100 %	80 60 40 20	2 4 6 8 10	0 30 60 90	J,I,R		SW FR MW HW CW	R5 R4 R3 R2 R1	R1 30 R2 150 R3 300 R4 600 R5 1500 R6		
50	Argillaceous laminae, clay partings, stylolitic, brachiopod fossils		433.51 50.10												
52									J,PL,SM						
									J,PL,SM						
54									J,PL,SM						
				4	99%										
56									J,PL,SM						
									J,I,R						
									J,I,R						
58									J,I,R						
									J,I,R-CL (3)						
									J,I,R (2)						
									J,PL,SM-open						
60			423.51						J,PL,SM-CL (3)						
			60.10												
									J,PL,SM-CL (5)						
									J,PL,R						
									J,PL,R (2)						
62									J,PL,SM-CL (2)						
				5	85%										
									J,PL,R (2)						
									J,ST,R						
	Argillaceous laminae, clay partings, stylolitic, brachiopods								J,PL,R						
64									J,PL,SM						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-200-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX core & water
DRILLING DATE: 2/10/95 -2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1086496.2
AZIMUTH: 0

COLLAR ELEV: 483.61
E: 518972.2
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Hazed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP vert CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
84	44.5-68.7 ft. Fresh, medium bedded, light olive gray (5Y 6/1), medium crystalline, medium strong. LIMESTONE, (ST. LOUIS FORMATION)								J,PL,SM-CL						
86									J,PL,SM-CL						
				5	85%				J,I,R-open (2)						
									J,PL,SM-CL						
88									J,PL,R						
			415.01												
	414.91		68.60						J,I,R-intact						2/11/95 @ 16:30 Quit drilling for the day at 68.6 ft. after Run 5 2/12/95 @ 8:00 Begin coring Run 5
	68.7-76.0 ft. 68.70 Slightly weathered, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARENACEOUS DOLOMITE, (ST. LOUIS FORMATION)								J,I,R-intact						
90									J,I,R						
	Vuggy, fossiliferous								J,I,R-intact						
92									J,I,R-intact						
									J,PL,SM						
	73.0-74.0 ft. Medium crystalline, non-vuggy								J,I,R						
	Chert at 74.2-74.5 ft., fractured, solutionized immediately below			6	100 %				J,I,R						
94									J,I,R						
									J,I,R						
									J,I,R (2)						
									J,I,R						
	407.81								J,C,R-CL						
96	76.0-78.5 ft. 76.00 Fresh, thinly bedded, light olive gray (5Y 5/2), microcrystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)								J,I,R-intact						
									J,I,SM-CL						
98															
			404.91												
	78.5-86.0 ft. 78.70 Fresh, thinly bedded, yellowish gray (5Y 7/2), medium crystalline, weak, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)			7	100 %				J,I,R-CL						
100															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-200-SS

Sheet 5 of 6

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX core & water
DRILLING DATE: 2/10/95 -2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068486.2
AZIMUTH: 0

COLLAR ELEV: 483.61
E: 518972.2
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPT. (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	78.5-86.0 ft. Fresh, thinly bedded, yellowish gray (5Y 7/2), medium crystalline, weak, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)								J,I,R-CL						
									J,I,R						
									J,I,R						
									J,I,R-calcite						
82									J,I,R						
									J,I,R						
									J,I,R						
									J,I,R						
84				7	100 %				J,I,R-CL						
									J,I,R-CL						
86	86.0-92.0 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), microcrystalline, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)								J,I,R-CL						
									J,I,R-CL-intact						
									J,PL,SM						
88									J,I,R-CL						
			394.91												
	Stylolitic, brecciated, glauconite infillings 89.0-90.2 ft. Moderately weathered		88.70						J,I,R-CL						
90									J,I,R						
									J,I,R-CL						
				8	100 %				J,PL,SM-CL (2)						
	391.61														
92	92.0-98.7 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), microcrystalline, medium strong, ARENACEOUS DOLOMITE, (ST. LOUIS FORMATION)		92.00						J,PL,SM (2)						
			389.91												
			93.70												
94															2/13/95 @ 12:53 Measure water level at 54.3 ft. below ground surface 2/14/95 @ 8:02 Measure water level at 69.5 ft. below ground surface 2/14/95 @ 17:15 Measure water level at 70.42 ft. below ground surface
				9	100 %										
									J,I,R						
96															
98															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-200-SS

Sheet 6 of 6

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX core & water
DRILLING DATE: 2/10/95 -2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068486.2
AZIMUTH: 0

COLLAR ELEV: 483.61
E: 518972.2
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW, FR, MW, HW, CW)	STRENGTH INDEX (R6, R5, R4, R3, R2, R1)	POINT LOAD INDEX (psi) (R6, R5, R4, R3, R2, R1)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
98	92.0-98.7 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), microcrystalline, medium strong, ARENACEOUS DOLOMITE. (ST. LOUIS FORMATION)			9	100 %	80 60 40 20	2 4 6 8 10	0 30 60 90	J,I,R J,I,R-CL J,I,R J,I,R-CL J,PL,SM						
	384.91		384.91												
	End of Record of Drillhole at 98.7 ft.		98.70												
100															
102															
104															
106															
108															
110															
112															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

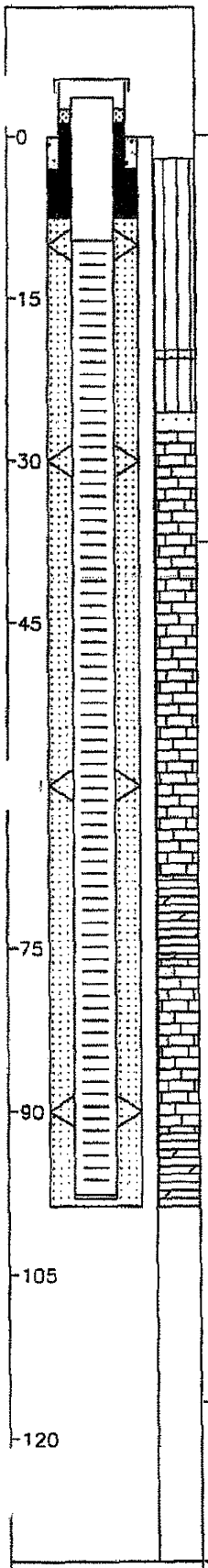
LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

Well No. PZ-200-SS

Boring No. X-Ref: PZ-200-SS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1068496 ft.
Easting: 516972 ft.

Elevation Ground Level 483.6 ft. NGVD
Top of PVC Casing 485.63 ft. NGVD

Drilling Summary:

Total Depth 98.7 ft.
Borehole Diameter 10 1/4 in. (0.0-27.5 ft.) 5 7/8 in. (27.5-98.3 ft.)
Casing Stickup Height 2.02 ft.
Driller Layne-Western
St. Louis, MO

Rig CME 75, Schramm Portadrill T660H
Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit,
NX Core, 5 7/8 in. Button Bit for Reaming
Drilling Fluid Auger-None, NX Core Water,
Air Rotary
Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	2/10/95	10:56	2/10/95	14:05
Schramm Rotary	2/28/95	7:30	2/28/95	9:30
Geophys.Logging:				
Casing:	2/28/95	9:45	2/28/95	10:10
Filter Placement:	2/28/95	10:30	2/28/95	11:30
Cementing:				
Development				
Bentonite Grout Bentonite Seal	2/28/95	11:30	2/28/95	11:45

Well Design & Specifications

Basis: Geologic Log X Geophysical Log
Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 2.02	-	9.62	C1	485.63	-	473.99
9.62	-	97.64	S1	473.99	-	385.97
97.64	-	97.97	C2	385.97	-	385.64
	-				-	
	-				-	
	-				-	

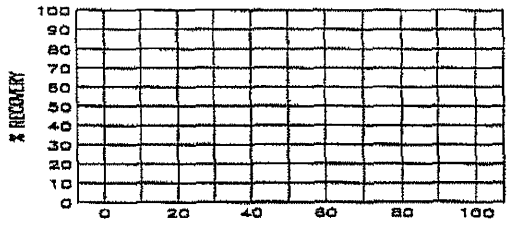
Casing: C1 2 in. Schedule 80 PVC, flush threaded with O-rings
C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)
Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings
Sand Pack: 16-35 mesh Silica Sand, 7.5-98.7 ft.
Filter Pack:
Grout Seal:
Bentonite Seal: Medium Bentonite Chips, 3.0-7.5 ft.
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by B. Tilton
Job Number 943-2848
Site LAIDLAW/OU2 RI-FS/MO
File Name PZ200SS

461574

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 115084	CHECK NO.
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO.
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME	WELL NUMBER
LAIDLAW BRIDGETON SANITARY LANDFILL	~~MW-1~~ PZ-200-SS

SITE ADDRESS	CITY	STATE	ZIP CODE
ST. CHARLES ROCK RD.	BRIDGETON	MO	63044

NAME	TELEPHONE
LAIDLAW WASTE SYSTEMS, INC.	314-241-3710

ADDRESS	CITY	STATE	ZIP CODE
1838 N. BROADWAY	ST. LOUIS	MO.	63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

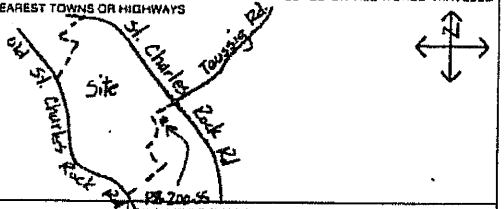
COUNTY St. Louis
ELEVATION 433.61
AREA NO

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N,RNG. 5 E OR W

LAT. 38 ° 46 ' 07 " LONG. 90 ° 26 ' 26 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
Layne Western Co, Inc.

DRILLING CONTRACTOR'S NAME
Layne Western Co, Inc.

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT

MEASURING POINT IS
☐ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☒ AIR ROTARY ☒ AUGER TYPE 6¼ H.S.A.
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☐ YES, AT 4 TOTAL
☐ STAINLESS STEEL
☐ OTHER
☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
2-28-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Richard P. Vogl
PERMIT NUMBER 001256 WIA DATE 4-11-95

SIGNATURE (DRILLING CONTRACTOR) Richard P. Vogl
PERMIT NUMBER 001256 WIA DATE 4-11-95

NOTE: Record the fraction of a foot in decimal, not in inches

Top of Riser Elevation: 435.63

Ground Surface Elevation: 433.61 Ft

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
		0-37 Silt
Depth to bottom of Protective Casing Seal:	3	
Depth to Base of Annular Seal:	3	
Depth to Base of Bentonite Seal:	7.5	
Depth to Base of Secondary Filter Pack:		
Depth to Top of the Screen:	9.6	
		27-37 Sandstone
		37-68 Limestone
Depth to Bottom of the Screen:	97.6	68-76 Dolomite
		76-93 Limestone
Plug Back Total Depth		93-95 Dolomite
Original Total Depth:	99.7	

LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)
PROTECTIVE CASING Type: Size: Bore Hole Diameter:
WEEP HOLE - Y / N (Circle one)

PROTECTIVE CASING SEAL Type: ☒ Concrete ☐ Cement Slurry
RISER PIPE Length: 11.63' Diameter: 4" Type of Material: SCHED PVC
BOREHOLE DIAMETER: 5⅞ In.
ANNULAR SEAL Type: ☐ Bentonite Slurry ☐ Cement Slurry ☐ Non Slurry Bentonite
BENTONITE SEAL Type: ☐ Bentonite Slurry ☒ Non Slurry Bentonite Length of Seal: 4.5 FL
SECONDARY FILTER PACK Type: ☐ Sand (Optional) ☐ Manufactured Grain Size: Length:
PRIMARY FILTER PACK Type: ☒ Sand ☐ Manufactured Grain Size: 16-35 Length: 91.2
WELL SCREEN Length: 10' Slot Size: 0.010" Type: SCHED PVC
SUMP DETAILS Length: 0.3 FT. Diameter: 4 In. Type: PVC
TYPE OF BACKFILL: SAND

MO 780-1415 (2-94)

DISTRIBUTION: WHITE DIVISION CANARY: MONITORING WELL CONTRACTOR PINK/OWNER

RECORD OF DRILLHOLE PZ-201A-SS

Sheet 1 of 1

PROJECT: LAIDLAW/FI-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/22/95
DRILL RIG: SCHRAMM

DATUM: MSL
COORDINATES N: 1087831.8
AZIMUTH: 0

COLLAR ELEV: 478.4
E: 516846.4
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
Pl-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	0.0-80.0 ft. 398.20 See Soil Borehole Log 80.20 PZ-201-SS 80.0-80.2 ft. Slightly weathered, thinly laminated, dark greenish gray (5GY 4/1), very fine grained, extremely weak, SILTSTONE, (ST. LOUIS FORMATION)		398.40 80.00						B,U,SM-CL						3/22/95 6 1/4 in. ID hollow stem auger advanced to 31.0 ft. then advanced borehole to 80.0 ft. with 5 7/8 in. air rotary bit 4/22/95 @ 13:45 Began coring
82	80.2-88.3 ft. Fresh, thickly bedded, light brownish gray (5YR 6/1), microcrystalline, weak, LIMESTONE, (ST. LOUIS FORMATION)								J,U,VR,CL J,I,VR,CL,Fe J,C,R,CL J,ST,R,CL J,ST,R,CL						
84									J,I,R J,ST,R						
86				1	97%				J,I,R						
88			390.10						J,U,ST,CL (3)						
	88.3-90.0 ft. 88.30 Fresh, thickly bedded, dark yellowish orange (10YR 6/6) grading to moderate yellowish brown (10YR 5/2), very fine grained, extremely weak to very weak, SILTSTONE, (ST. LOUIS FORMATION)								B,I,R						4/22/95 @ 16:30 Ended coring
90	388.40 Grades stronger with depth 90.00 End of Record of Drillhole at 90.0 ft.		388.40 90.00												
92															
94															
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

LOGGED: B. TILTON
CHECKED: B. TILTON
DATE: 5/16/95

Golder Associates

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW\RI-FS\MD
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1067819.55
DATUM EASTING: 516862.06 ELEVATION 478.0

DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger

SAMPLING METHOD:
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)

BORING NO. PZ-201-SS

SHEET 1 OF 3

					DRILLING START	DRILLING FINISH
WATER LEVEL					TIME	TIME
TIME					8:30	10:30
DATE					DATE	DATE
CASING DEPTH					2/15/95	2/15/95

DRILL RIG CME 75 - TRUCK MOUNT
ANGLE BEARING
SAMPLE HAMMER
SURFACE CONDITIONS

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	2 2 3 3	2.0' 2.0' (100%)			(0.0-3.4 Ft.) Firm, dark yellowish brown (10YR 4/2), CLAYEY SILT, NR, damp, (CL-ML), (LOESS)	SP (1)	
2	2 2 4 5	1.4' 2.0' (85%)				SP (2)	
3							
4	1 2 3 3	2.0' 2.0' (100%)			(3.4-17.4 Ft.) Soft to firm, yellowish brown (10YR 6/2), CLAYEY SILT, trace fine Sand, little iron staining and black organic nodules, NR, moist, (CL-ML), (LOESS)	SP (3)	
5							
6	1 2 3 4	2.0' 2.0' (100%)				SP (4)	Air monitoring 9:00 20% O2 0.0 ppm H2S 0% LEL 0.0 ppm PID
7							
8	2 4 3 4	2.0' 2.0' (100%)				SP (5)	
9							
10	1 2 2 2	2.0' 2.0' (100%)				SP (6)	
11							
12	1 1 1 2	2.0' 2.0' (100%)				SP (7)	Air monitoring 9:15 20% O2 0.0 ppm H2S 0% LEL 0.0 ppm PID
13							
14	1 1 2 3	2.0' 2.0' (100%)				SP (8)	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER CHK'D BY W. FIRST

DATE 2/15/95

JOB NO.: 943-2848

FILENAME: P720155

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW\RI-FS\MO
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1067819.55
DATUM EASTING: 516862.06 ELEVATION 478.0

DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger

SAMPLING METHOD:
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)

BORING NO. PZ-201-SS

SHEET 2 OF 3

					DRILLING START	DRILLING FINISH
WATER LEVEL					TIME	TIME
TIME					8:30	10:30
DATE					DATE	DATE
CASING DEPTH					2/15/95	2/15/95

DRILL RIG CME 75 - TRUCK MOUNT
ANGLE BEARING
SAMPLE HAMMER
SURFACE CONDITIONS

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16	1 5 6 7	1.3' 2.0' (65%)			(3.4-17.4 Ft.) Soft to firm, yellowish brown (10YR 6/2), CLAYEY SILT, trace fine Sand, little iron staining and black organic nodules, NR, moist, (CL-ML), (LOESS)	SP 8	
17					@ 15.5-16.0 Ft., CLAYEY SILT becomes wet	SP 9	
					(460.6) 17.4		
18		0.5' 2.0' (25%)			(17.4-20.5 Ft.) Compact, pale yellowish brown (10YR 5/4), Fine SAND, little Silt, NR, damp, (SP), (ALLUVIUM)	SH 10	
19							
20	3 3 5 6	1.5' 2.0' (75%)			(457.5) 20.5		
21					(20.5-30.0 Ft.) Firm to stiff, olive gray (5Y 4/1) to moderate yellowish brown (10YR 5/4), laminated CLAYEY SILT, NR, moist, (CL-ML), (LACUSTRINE)	SP 11	
22	3 5 5 6 7	1.2' 2.0' (60%)				SP 12	
23							
24	3 5 7 8	1.7' 2.0' (85%)			@ 23.7-24.0 Ft., medium dark gray (N4), SILTY Fine sand layer, damp, (SM)	SP 13	
25					@ 24.8, 25.2, and 25.6 Ft., thin silty fine sand layers (<1 inch)		
26		1.8' 2.0' (90%)				SH 14	
27							
28	13 50/3"	0.6' 2.0' (30%)				SP 15	
29					@ 29.0 Ft., limestone rock encountered		

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER DATE 2/15/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ201SS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:						BORING NO.	
	4.25 inch I.D. Hollow Stem Auger						PZ-201-SS	
							SHEET	
	SAMPLING METHOD:						3 OF 3	
LAIDLAW\RI-FS\MO WEST LAKE LANDFILL OPERABLE UNIT 2	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)						DRILLING	
	SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)						START	FINISH
	WATER LEVEL						TIME	TIME
	TIME						8:30	10:30
	DATE						DATE	DATE
NORTHING: 1067819.55 DATUM EASTING: 516862.06 ELEVATION 478.0	CASING DEPTH						2/15/95	2/15/95

DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS
ANGLE BEARING	
SAMPLE HAMMER	

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31	10 12 6 6	1.5' 2.0' (75%)			(30.0-30.7 ft.) Very stiff, medium gray (N4), CLAYEY SILT, some Fine Gravel, little Fine to coarse Sand, NR, moist, (CL-ML), (ALLUVIUM) (447.3) 30.7	SP (16)	Air monitoring 10:30 20% O2 0.0 ppm H2S 0% LEL 0.0 ppm PID
32	50/5"	0.3' 1.0' (30%)			(30.7-32.0 ft.) Stiff, dark greenish gray (5G 4/1), SILTY CLAY, trace fine sand, contains pieces of weathered limestone, NR-SR, damp, (CL), (ALLUVIUM) (445.0) 33.0	SP (17)	
33					End of Soil Borehole Log at 32.0 ft. See PZ-201-SS Record of Drillhole for rock descriptions		
34							
35							
36							
37							
38							
39							
40							
41							
42							
43							
44							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER CHK'D BY W. HERST

DATE 2/15/95

JOB NO.: 943-2848

FILENAME: PZ201SS

RECORD OF DRILLHOLE PZ-201-SS

Sheet 1 of 4

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/15/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1087619.55
AZIMUTH: 0

COLLAR ELEV: 481.05
E: 518882.08
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 3D, R2 150, R3 300, R4 600, R5 1500, R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32	0.0-32.8 ft. See Soil Borehole Log PZ-201-SS		448.25												
	32.8-38.7 ft. Slightly weathered, thinly bedded, light olive gray (5Y 6/1), medium crystalline, weak, CRYSTALLINE LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, calcite crystals (<1 cm.)		32.80	1	94%				J,PL,R,CL (2)						
34			448.55 34.50						J,I,R						
									J,I,R						
									J,PL,SM-intact						
36									J,I,R						
									J,I,R,CL						
									J,PL,SM,CL-intact						
				2	100%				J,I,R,CL						
									J,PL,S,CL						
38									J,PL,SM,CL						
									J,I,R,CL						
									J,PL,SM,CL-intact						
	38.7-49.5 ft. Slightly weathered, medium bedded, light olive gray (5Y 6/1) to greenish gray (5GY 6/1), fine crystalline, medium strong, CRYSTALLINE LIMESTONE, (ST. LOUIS FORMATION) Weathered, pyrite nodules (<2 mm.), stylolitic								J,I,R,CL (2)						
			441.55						J,I,R,CL						
			39.50						J,I,R						
40									J,I,R,CL						
									J,I,R						
									J,I,R,CL						
42									J,I,R,CL (3)						
									J,P,SM,CL						
									J,I,R,CL (2)						
									J,P,SM,CL (2)						
				3	100%				J,I,R,CL (3)						
44									J,PL,SM,CL						
									J,PL,SM,CL						
									J,PL,SM,CL						
									J,PL,SM,CL						
									J,PL,SM,CL						
46									J,PL,SM,CL (2)						
									J,PL,SM,CL						
									J,PL,SM,CL						
									J,PL,SM,CL (3)						
									J,PL,SM,CL (2)						
48									J,PL,SM,CL						
									J,PL,SM						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: W. HERST
DATE: 3/2/95

Golder Associates

RECORD OF DRILLHOLE PZ-201-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/15/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067819.55
AZIMUTH: 0

COLLAR ELEV: 481.05
E: 515662.08
INCLINATION: -90

ROCK TYPE: J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation; PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular; P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough; Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	ROD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48	38.7-49.5 ft. Slightly weathered, medium bedded, light olive gray (5Y 6/1) to greenish gray (5GY 6/1), fine crystalline, medium strong, CRYSTALLINE LIMESTONE, (ST. LOUIS FORMATION) Weathered, pyrite nodules (<2 mm.), stylolitic			3	100 %				J,PL,SM,CL J,PL,SM,CL						@ 49.5 ft. Drilling rate slows down
			431.55 / 49.50						J,I,R (2)						
50	49.5-59.5 ft. Fresh, medium bedded, olive gray (5Y 6/1), micro-crystalline, strong, CRYSTALLINE LIMESTONE, (ST. LOUIS FORMATION) Fossiliferous, stylolites								B,I,R						
52	50.9-51.8 ft. Argillaceous Limestone @ 51.5 ft. Light olive gray (5Y 6/1), Clay seam (~1/2 in.)								J,P,R						
54	54.0-55.0 ft. Moderately silicified Limestone			4	100 %				B,I,R (3) J,C-intact						
	55.0-55.1 ft. Light brown (5YR 5/6), chert zone								B,PL,R						
56									B,PL,SM J,PL,SM,CL (2)						
									J,PL,SM,CL (2)						
58	@ 58.4 ft. Light brown (5G 6/1), Clay seam (~1/2 in.)								J,I,R						
			421.55 / 59.50						J,P,R						2/15/95 @ 16:00 Stop drilling 2/20/95 @ 8:30 Begin drilling @ 59.5 ft.
60	59.5-69.5 ft. Fresh, medium to thinly bedded, light olive gray (5Y 6/1), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolites common, medium grained calcite crystals								J,I,VR J,I,VR (3)						
				5	100 %				J,I,R (3)						
62									J,I,R J,I,R (2)						
									J,I,R (2)						
64															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: O. MAHURIN

LOGGED: B. TILTON
CHECKED: W. HERST
DATE: 3/2/95

Golder Associates

RECORD OF DRILLHOLE PZ-201-SS

Sheet 3 of 4

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/15/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067819.55
AZIMUTH: 0

COLLAR ELEV: 481.05
E: 518862.06
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, X-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64	59.5-69.5 ft. Fresh, medium to thinly bedded, light olive gray (5Y 6/1), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolites common, medium grained calcite crystals														
66				5	100 %										
68									J,I,R,CL,Fe						
			411.55												
70	69.5-89.5 ft. Fresh, medium bedded, light olive gray (5Y 6/1), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolites common		69.50						J,I,R,Fe						
									J,I,R						
72									J,I,R						
									J,I,R						
74									J,U,K,CL						
	@ 75.0 and 76.5 ft. Medium bluish gray (5B 5/1), glauconite zones (less than 1 in.)			6	100 %				B,U,K,CL						
	75.2-75.6 ft. Medium bluish gray (5B 5/1), chert layer								J,U,SM						
76	75.6-77.1 ft. Argillaceous, moderately porous, some open vugs (<2 mm.)								B,I,R,CL						
									J,I,R						
78	78.0-79.5 ft. Moderate to highly weathered fractures								J,I,R						
									J,I,R						
			401.55						J,I,R						
			79.50	7	96%										
80															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: W. HERST
DATE: 3/2/95

Golder Associates

RECORD OF DRILLHOLE PZ-201-SS

Sheet 4 of 4

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/15/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067819.55
AZIMUTH: 0

COLLAR ELEV: 481.05
E: 516862.06
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	69.5-89.5 ft. Fresh, medium bedded, light olive gray (5Y 6/1), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolites common 81.3-81.4 ft. Medium dark gray (N4), Claystone laminae @ 81.6 ft. Becoming intermittently silceous (zones <1 in. thick), some pyritized fractures/vugs							0	J,U,R,Fe						@ 80.7 ft. Core loss
								30	J,I,R						
								60	J,PL,SM						
								90	J,I,R						
82									J,I,K						
									J,I,R						
				7	98%				J,I,R						
84									J,I,R						
									J,I,R						
									J,I,R						
	@ 85.5 and 86.5 ft. Thin zones of glauconite in fractures								J,I,R,CL						
86									J,I,R,CL						
			393.55 87.50						J,I,R						
88									J,I,R						
				8	85%				J,I,R,CL						
	391.55		391.55												
	End of Record of Drillhole at 89.5 ft. 89.50		89.50												
90															
92															
94															
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

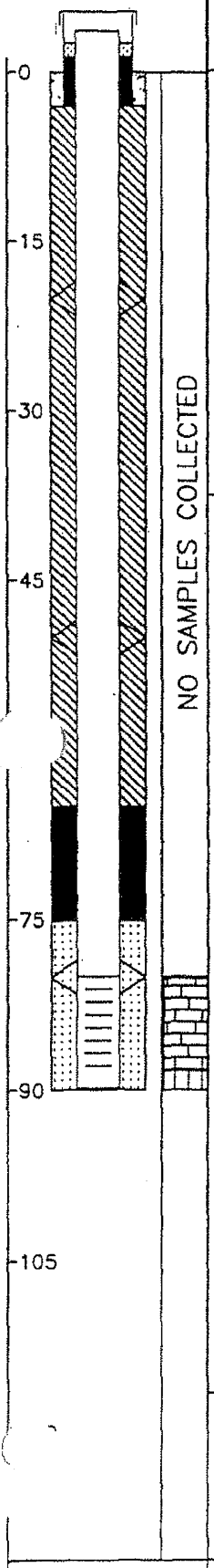
LOGGED: B. TILTON
CHECKED: W. HERST
DATE: 3/2/95

Golder Associates

Well No. PZ-201A-SS

Boring No. X-Ref: PZ-201A-SS

PIEZOMETER CONSTRUCTION SUMMARY



Survey Coords: Northing: 1067832 ft. Easting: 516746 ft.

Elevation Ground Level 478.4 ft. NGVD

Top of PVC Casing 480.16 ft. NGVD

Drilling Summary:

Total Depth 90.0 ft.

Borehole Diameter 10 1/4 in. (0.0-33.0 ft.) 5 7/8 in. (33.0-90.0 ft.)

Casing Stickup Height 1.81 ft.

Driller Layne-Western, St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75				
Schramm Rotary	4/22/95	11:00	4/23/95	7:45
Geophys.Logging:				
Casing:	4/23/95	7:50	4/22/95	8:00
Filter Placement:	4/23/95	8:00	4/23/95	9:10
Cementing:				
Development				
Bentonite Grout	4/23/95	9:20	4/23/95	11:00
Bentonite Seal	4/23/95	9:00	4/23/95	9:20

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.81	-	80.00	C1	480.16	-	398.35
80.00	-	89.80	S1	398.35	-	388.55
89.80	-	90.13	C2	388.55	-	388.22
	-				-	
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 75.1-90.0 ft.

Filter Pack:

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-65.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 65.0-75.1 ft.

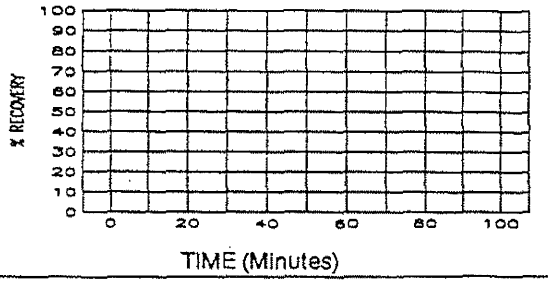
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Not to Scale

Supervised by D. Alloway

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ201ASS

LL 1574

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122484	CHECK NO
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

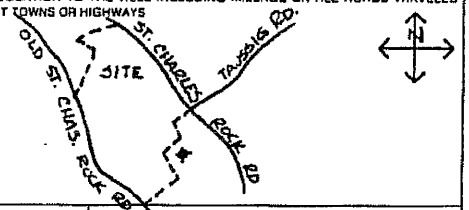
INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL
WELL NUMBER: PZ-301-A-SS
SITE ADDRESS: St. CHARLES Rock Rd. | CITY: BRIDGETON | STATE: Mo. | ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC. | TELEPHONE: 314-241-3710
ADDRESS: 1638 N. BROADWAY | CITY: ST. LOUIS | STATE: Mo | ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL SHOW LOCATION IN SECTION PLAT
COUNTY: St. Louis
ELEVATION: 472.4
AREA NO
SMALLEST ¼ LARGEST ¼
SEC. ____ TWN. 47 N.RNG. 5 (E) OR W
LAT. 38 ° 45 ' 58 " LONG. 90 ° 26 ' 28 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN Co, INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN Co, INC.

TYPE OF INSTALLATION: ☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL ____ FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT

MEASURING POINT IS: ☐ TOP OF RISER PIPE ☐ OTHER

DRILLING EQUIPMENT: ☒ AIR ROTARY ☒ AUGER TYPE 6.25" HSA, NX CORE ☐ REVERSE ROTARY ☐ OTHER

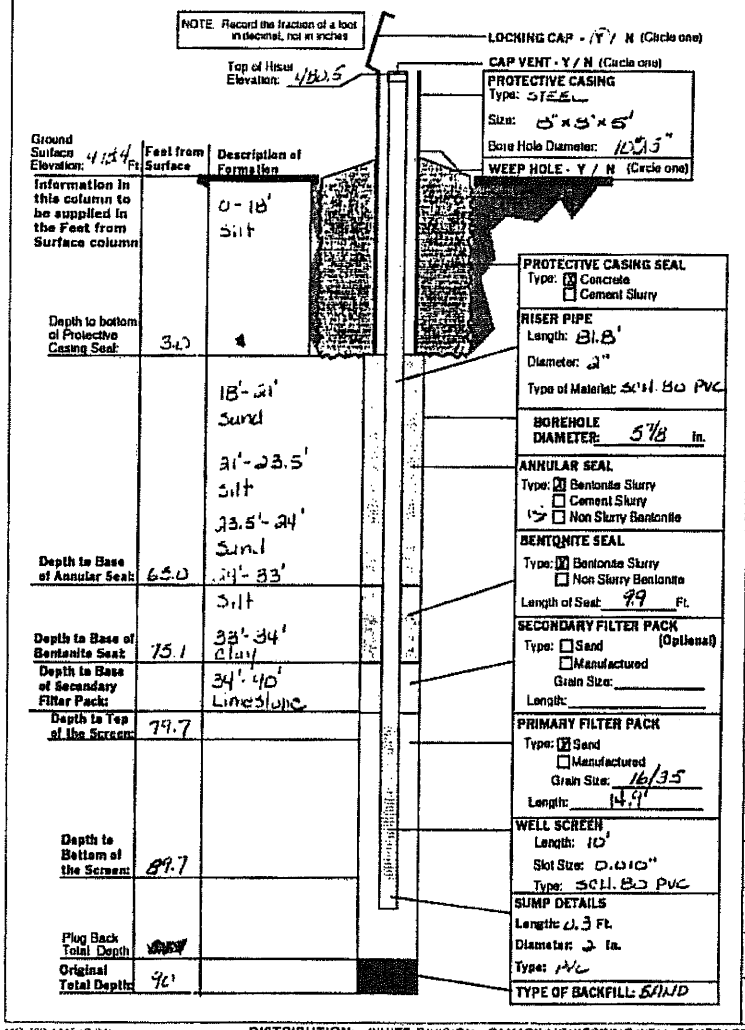
CENTRALIZERS USED: ☒ YES, AT 3 TOTAL ☒ STAINLESS STEEL ☐ OTHER ☐ NO

MULTIPLE CASED WELLS: SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED: 4-23-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Michael P. Vogl
PERMIT NUMBER: 001256WM | DATE: 6-02-95
SIGNATURE (DRILLING CONTRACTOR): Michael P. Vogl
PERMIT NUMBER: 001256WM | DATE: 6-02-95



MO 780-1415 (7-94) DISTRIBUTION: WHITE DIVISION CANARY/MONITORING WELL CONTRACTOR PINK OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:		BORING NO.
	6.25 inch I.D. Hollow Stem Auger		PZ-202-SS
			SHEET
	SAMPLING METHOD:		1 OF 3
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)		DRILLING
	SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)		START / FINISH
	WATER LEVEL		TIME / TIME
	TIME		07:50 / 09:45
	DATE		DATE / DATE
NORTHING: 1067320.25 DATUM EASTING: 517101.58 ELEVATION 479.0	CASING DEPTH		2/26/95 / 2/26/95

DRILL RIG CME 75 - TRUCK MOUNT — SURFACE CONDITIONS

ANGLE — BEARING

SAMPLE HAMMER

DRILLING CONTR LAYNE-WESTERN

LOGGED BY M. HIRT CHK'D BY V. HERST

DATE 2/26/95

JOB NO.: 943-2848

FILENAME: PZ202SS

DEPTH IN FEET (ELEVATION)	BLOW/6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	1 2 2 3	1.6' 2.0' (80%)			(0.0-4.6 Ft.) Firm, dark yellowish brown (10YR 4/2), homogenous, CLAYEY SILT, NR, moist, (CL-ML), (LOESS)	SP 1	
2	6 2 2 4	1.4' 2.0' (70%)				SP 2	
3					@ 3.4 Ft, color changes to dusky yellowish brown (10YR 2/2)		
4	1 3 6 7	1.6' 2.0' (80%)			(474.4) 4.6	SP 3	
5					(4.6-8.3 Ft.) Stiff, mottled light olive gray (5Y 5/2) and olive gray (5Y 4/1), CLAY, little Silt, trace Gravel, NR, moist, (CL), (LOESS)		
6		0.0' 2.0' (0%)				SH 4	
7							
8	1 2 4 4	1.7' 2.0' (85%)			(470.7) 8.3 (8.3-19.1 Ft.) Soft to Firm, light olive gray (5Y 6/1), SILTY CLAY, iron stained, NR, moist, (CL-ML), (LOESS)	SP 5	
9							
10	2 4 4 4	1.6' 2.0' (80%)				SP 6	
11							
12	2 2 4 6	1.1' 2.0' (55%)				SP 7	
13					@ 13.5 Ft., becoming increasingly iron stained		
14	weight of hammer for 12" 1 2	1.5' 2.0' (75%)			@ 14.0 Ft., becoming wet, very soft	SP 8	

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MO
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1067320.25
DATUM EASTING: 517101.58 ELEVATION 479.0

DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger

SAMPLING METHOD:
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)

WATER LEVEL					
TIME					
DATE					
CASING DEPTH					

BORING NO. PZ-202-SS

SHEET 2 OF 3

DRILLING START: TIME 07:50, DATE 2/26/95
DRILLING FINISH: TIME 09:45, DATE 2/26/95

DRILL RIG CME 75 - TRUCK MOUNT

ANGLE BEARING

SAMPLE HAMMER

SURFACE CONDITIONS

DRILLING CONTR LAYNE-WESTERN

LOGGED BY M. HIRT

DATE 2/26/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ202SS

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16	weight of hammer for 18"	1.4' / 2.0' (70%)			(8.3-19.1 Ft.) Soft to firm, light olive gray (5Y 6/1), SILTY CLAY, iron stained, NR, moist, (CL-ML), (LOESS)	SP 8	
17	1						
18	weight of hammer for 5"	2.0' / 2.0' (100%)				SP 9	
19	2 3 5					SP 10	
20	2 3 5	1.4' / 2.0' (70%)			(19.1-19.4 Ft.) Firm, light olive gray (5Y 5/2), SILTY CLAY, NR, moist, (CL-ML), (LOESS) (19.4-21.9 Ft.) Firm, olive gray (5Y 4/1), SILTY CLAY, iron stained, NR, moist, (CL-ML), (LOESS)		
21	6					SP 11	
22	1 3 4	0.4' / 2.0' (20%)			(21.9-24.5 Ft.) Loose, olive gray (5Y 4/1), fine SANDY SILT, NR, damp, (ML), (LOESS)		
23	5					SP 12	
24	1 5 9	1.5' / 2.0' (75%)			(24.5-25.0 Ft.) Firm, olive gray (5Y 4/1), laminated, SILTY CLAY, NR, damp, (CL-ML), (LOESS) (454.0) 25.0		
25	12				(25.0-29.5 Ft.) Compact, olive gray (5Y 4/1), laminated, fine SANDY SILT, NR, dry, (SM), (ALLUVIUM)	SP 13	
26	2 8 9	0.1' / 2.0' (5%)			@ 25.5 ft, becoming moist		
27	9					SP 14	
28	5 7 6	1.5' / 2.0' (75%)					
29	9				(29.5-30.8 Ft.) Compact, olive gray (5Y 4/1), fine SAND interbedded with SILT, NR, moist, (SM), (ALLUVIUM)	SP 15	

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:		BORING NO.
	6.25 inch I.D. Hollow Stem Auger		PZ-202-SS
			SHEET 3 OF 3
	SAMPLING METHOD:		DRILLING
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)		START: TIME 07:50, DATE 2/26/95
	SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)		FINISH: TIME 09:45, DATE 2/26/95
NORTHING: 1067320.25 DATUM EASTING: 517101.58 ELEVATION 479.0	WATER LEVEL / TIME / DATE / CASING DEPTH		
DRILL RIG: CME 75 - TRUCK MOUNT	SURFACE CONDITIONS		
ANGLE: BEARING:			
SAMPLE HAMMER			

DRILLING CONTR: LAYNE-WESTERN

DEPTH IN FEET (ELEVATION)	BLOW/6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL			SAMPLER TYPE		REMARKS
31	50/2"	0.6" 0.8" (100%)			(29.5-30.8 ft.) Compact, olive gray (5Y 4/1), fine SAND interbedded with SILT, NR, moist, (SM), (ALLUVIUM)	(448.2)	30.8	SP (16)		Split spoon and auger refusal at 30.8 ft.
32					End of Soil Borehole Log at 30.8 ft.					
33					See PZ-202-SS Record of Drillhole for rock descriptions					
34										
35										
36										
37										
38										
39										
40										
41										
42										
43										
44										

LOGGED BY: M. HIRT DATE: 2/26/95 CHK'D BY: W. HERST

JOB NO.: 943-2848

FILENAME: PZ202SS

RECORD OF DRILLHOLE PZ-202-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/26/95 - 2/27/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1087320.2
AZIMUTH: 0

COLLAR ELEV: 479.01
E: 517101.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (Feet)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: FR, SW, MW, HW, CW	STRENGTH INDEX: R6, R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): R1 30, R2 150, R3 300, R4 600, R5 1500, R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
18	0.0-30.8 ft. See Soil Borehole Log PZ-202-SS														
20															
22															
24															
26															
28															
30	30.8-44.1 ft. 448.21		448.21												
	Slightly weathered, medium bedded, light olive gray (5Y 6/1), medium grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) 30.80		30.80						Broken Zone						
32	31.4 and 31.9 ft. Iron stained clay infilling			1	83%										Some sand in return water; driller says material seems to be very rubbly

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-202-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO.

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95 - 2/27/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1087320.2
AZIMUTH: 0

COLLAR ELEV: 478.01
E: 517101.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR, MW, HW, CW	STRENGTH INDEX: R6, R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): R1 30, R2 150, R3 300, R4 600, R5 1500, R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32	30.8-44.1 ft. Slightly weathered, medium bedded, light olive gray (5Y 6/1), medium grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)							0	J,I,R (2)						
								30	J,U,R						
34	33.4-34.7 ft. Limestone becomes moderately weathered, grayish orange (10YR 7/4) with dark yellowish orange (10YR 6/6) staining and cross bedded							0	J,U,R						
								0	J,PL,SM						
				1	83%			30	J,PL,SM						
								0	J,U,R						
36															35.6 ft. Drilling is slow due to rubbly conditions
									Core Loss						
			441.41												37.0 ft. Water pump keeps shutting down, driller reports that bit is getting plugged off
38			37.60					0	J,C,SM						
								0	J,C,SM						
								0	J,I,R						
								0	J,C,SM (2)						
								0	J,PL,SM						
								0	J,I,R						
								0	J,I,R,Fe						
40								0	J,C,SM (3)						
								0	J,C,SM						
								30	J,I,SM						
				2	82%			0	J,C,SM (2)						
								0	J,I,SM (3)						
42															
									Core Loss						
			434.91												
44	44.1-59.1 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), micro-crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION)		44.10					0	J,I,R (4)						
								30	J,I,R						
	45.1-46.1 ft. Large pyrite crystals Some calcite crystals							0	J,C,R						
								0	J,U,SM,CL						
								0	J,I,SM						
								0	J,I,SM,CL						
48				3	56%			0	J,I,SM,CL						
								30	J,I,SM						
								0	J,C,SM						
								0	J,PL,SM						
								60	J,PL,SM,CL						
								0	J,I,R						
								0	J,I,SM,CL (2)						
								0	J,I,SM (2)						
48															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-202-SS

Sheet 3 of 5

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/26/95 - 2/27/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067320.2
AZIMUTH: 0

COLLAR ELEV: 479.01
E: 517101.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48	44.1-59.1 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), micro-crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION)		429.91 49.10	3	96%				J,I,SM J,I,SM J,PL,SM,CL						
	49.4-49.8 ft. Medium to coarse grained								J,I,R,CL J,C,SM,CL J,I,R						
50									J,I,R J,I,SM J,I,R J,C,R						
	51.0 ft. Iron stained nodules 51.0-51.6 ft. 0° healed fractures 51.6-52.4 ft. Slightly weathered, arenaceous, thinly laminated														
52									J,PL,R,CL						
	52.9-53.9 ft. 0° healed fracture														
54				4	99%				J,I,R						
	55.3-56.5 ft. Medium to coarse grained 55.9 ft. Chert filled vein								J,PL,R (2)						
56									J,PL,R						
									J,I,SM,CL						
58									J,I,SM,CL J,I,SM J,I,R,CL						
			419.91 59.10						J,I,R (4)						
60	59.1-67.8 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), coarse grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) 60.3-61.3 ft. Stylolitic														
				5	100%				J,I,R J,I,SM J,I,SM (2)						
62									J,I,R						
									J,I,R						
									J,I,SM,CL J,I,R J,I,R						
64	63.8-64.3 ft. 20° healed fracture														

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-202-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95 - 2/27/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067320.2
AZIMUTH: 0

COLLAR ELEV: 479.01
E: 517101.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64	59.1-67.6 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), coarse grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)								J,I,R						
66	64.5-65.1 ft. Silty interbeds 64.3-66.4 ft. Fine to medium grained			5	100%				J,PL,SM (3)						
			412.01 67.00												
68	67.0-69.7 ft. Fresh thickly bedded, light olive gray (5Y 6/1) to greenish gray (5GY 6/1), medium grained, medium strong, DOLOMITE (ST. LOUIS FORMATION) 69.0-69.2 ft. Becomes slightly weathered, dark yellowish orange (10YR 6/6) to moderate yellowish brown (10YR 5/4)								J,PL,SM (3)						
									J,I,SM						
			409.91 69.10												
70	67.6-67.8 ft. Clay infilling 69.7-78.9 ft. Moderately weathered, medium bedded, dark yellowish orange (10YR 6/6) to moderate yellowish brown (10YR 5/4), m-c grained, medium strong, ARGILLACEOUS DOLOMITE, (ST. LOUIS FORMATION)			6	94%										
72	72.5-76.1 ft. Vuggy, moderately to highly weathered, some calcite crystals								J,I,R (3)						
									J,I,R						
									J,I,R						
									J,I,R						
74			404.91 74.10						Core Loss						
									J,I,R (2)						
									J,I,R (4)						
76				7	87%				J,I,R						
									J,I,R,CL						
	76.9-77.2 ft. Chert 77.3-77.4 ft. Highly weathered 78.0-78.1 ft. Highly weathered								J,I,R						
									J,PL,R,CL						
78			400.91 78.10						J,I,R						
			400.31 78.70						Core Loss						
	78.9-89.2 ft. Fresh, medium bedded, yellowish gray (5Y 7/2), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)								J,C,R,CL						
				8	100%				J,U,SM						
80									J,I,SM						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-202-SS

Sheet 5 of 5

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95 - 2/27/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067320.2
AZIMUTH: 0

COLLAR ELEV: 478.01
E: 517101.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	78.9-89.2 ft. Fresh, medium bedded, yellowish gray (5Y 7/2), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)							90	J,PL,SM						
								90	J,PL,SM						
82	82.1-82.2 ft. Porous/vuggy							90	J,I,SM,CL						
								90	J,I,R,CL						
	83.5 ft. 1" thick clay infilling														
84	83.7-84.3 ft. Micrycrystalline			8	100 4"			90	J,I,R (3)						
	85.0-85.2 ft. Moderately weathered between joints							90	J,I,R (2)						
	85.6-87.1 ft. Pyrite crystals														
86	85.7-86.4 ft. Slightly weathered, some cross bedding							90	J,I,SM (2)						
								90	J,I,SM						
								90	J,PL,SM						
								90	J,U,R						
								90	J,I,R						
88	88.4-88.9 ft. Coarse grained		390.31												
	89.0-89.2 ft. Moderately weathered		88.70					30	J,PL,SM						
	389.81		89.20												
	89.2-89.9 ft. Moderately weathered, thinly laminated, medium dark gray (N4), very fine grained, extremely weak rock, SILTSTONE, with claystone interbeds, (ST. LOUIS FORMATION)		389.11 89.90	9	97%			90	J,I,SM,CL						
90	89.9-92.0 ft. Fresh, thickly laminated to medium bedded, medium gray (N5), fine grained, medium strong, SANDSTONE, (ST. LOUIS FORMATION)		387.01												
	387.01		92.00												
92	End of Record of Drillhole at 92.0 ft.														
94															
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

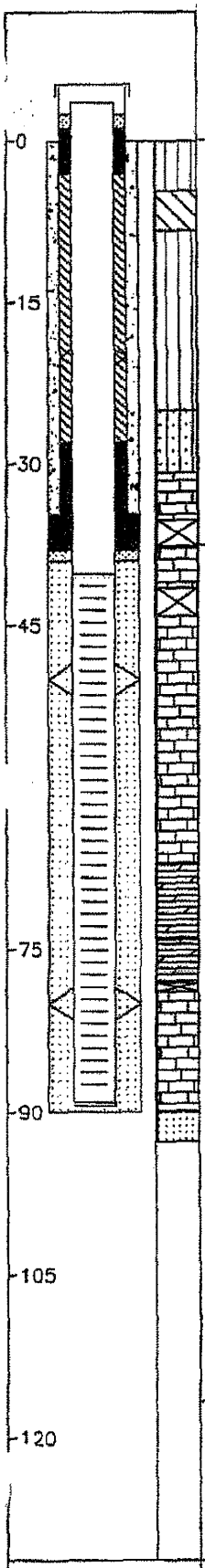
LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

Well No. PZ-202-SS

Boring No. X-Ref: PZ-202-SS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1067320 ft. Easting: 517102 ft.

Elevation Ground Level 479.0 ft. NGVD

Top of PVC Casing 481.17 ft. NGVD

Drilling Summary:

Total Depth 90.0 ft.

Borehole Diameter 10 1/4 in. (0.0–33.5 ft.) 5 7/8 in. (33.5–90.0 ft.)

Casing Stickup Height 2.16 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger–None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 2.16	–	40.20	C1	481.17	–	438.81
40.20	–	89.10	S1	438.81	–	389.91
89.10	–	89.43	C2	389.91	–	389.58
+ 1.00	–	34.00	C3	480.00	–	445.01
	–				–	
	–				–	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.) (C3–see comments)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16–35 mesh Silica Sand, 39.0–90.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 38.0–39.0ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0–28.0 ft., Neat cement, 3.0–34.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 28.0–38.0 ft.

Concrete: 0.0–3.0 ft.

Construction Time log:

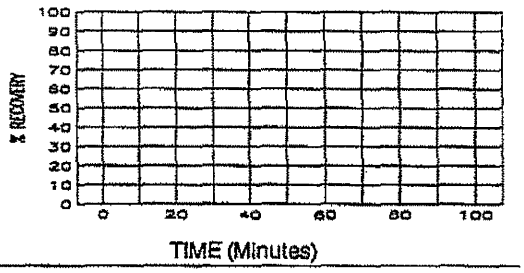
Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	2/26/95	7:50	2/27/95	11:05
Schramm Rotary	3/11/95	10:30	3/12/95	8:00
Geophys.Logging:				
Casing:				
2" PVC	3/12/95	8:10	3/12/95	8:30
6" Steel	3/11/95	14:15	3/11/95	14:30
Filter Placement:	3/12/95	8:35	3/12/95	9:10
Cementing:				
Development				
Bentonite Grout	3/12/95	9:35	3/12/95	10:30
Bentonite Seal	3/12/95	9:20	3/12/95	9:35

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments: Surface Casing C3: 6 1/8 in. ID / 6 5/8 in. OD Steel Casing

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ202SS

601574

OFFICE USE ONLY	DATE RECEIVED
REF NO 115089	CHECK NO
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO.
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

INFORMATION SUPPLIED BY OWNER

SITE NAME	WELL NUMBER
LAIDLAW BRIDGETON SANITARY LANDFILL	PZ-302-SS

SITE ADDRESS	CITY	STATE	ZIP CODE
ST. CHARLES ROCK ROAD	BRIDGETON	MO	63044

NAME	TELEPHONE
LAIDLAW WASTE SYSTEMS, INC.	314-241-3710

ADDRESS	CITY	STATE	ZIP CODE
1834 N. BROADWAY	ST. LOUIS	MO	63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL SHOW LOCATION IN SECTION PLAT

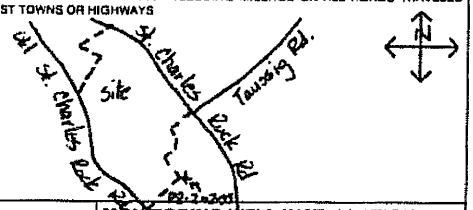
COUNTY ST. LOUIS
ELEVATION 474.0
AREA NO.

SMALLEST ¼ LARGEST ¼

SEC. ____ TWN. 47 N.RNG. 5 E OR W

LAT. 38 ° 45 ' 54 " LONG. 90 ° 26 ' 24 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 481.8

LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 6" x 8" x 5'
Bore Hole Diameter: 10.25"
WEEP HOLE - Y / N (Circle one)

Ground Surface Elevation: 474.0 Ft	Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column:	0-3	Silt
Depth to bottom of Protective Casing Seal:	3	
	3-22	Clay
	22-32	Silt
Depth to Base of Annular Seal:	38.0	
	32-67	Limestone
Depth to Base of Bentonite Seal:	38.0	
Depth to Base of Secondary Filter Pack:	39.0	
Depth to Top of the Screen:	40.2	
	67-78	Dolomite
Depth to Bottom of the Screen:	90.2	78-90.2 Limestone
Plug Back Total Depth		
Original Total Depth:	90.2	

PROTECTIVE CASING SEAL
Type: [X] Concrete [ ] Cement Slurry

RISER PIPE
Length: 43'
Diameter: 2
Type of Material: SCH80 PVC

BOREHOLE DIAMETER: 5⅞ In.

ANNULAR SEAL
Type: [X] Bentonite Slurry [ ] Cement Slurry [ ] Non Slurry Bentonite

BENTONITE SEAL
Type: [X] Bentonite Slurry [ ] Non Slurry Bentonite
Length of Seal: 10' Ft.

SECONDARY FILTER PACK (Optional)
Type: [X] Sand [ ] Manufactured
Grain Size: SUGAR
Length: 1'

PRIMARY FILTER PACK
Type: [X] Sand [ ] Manufactured
Grain Size: 16-35
Length: 51.2'

WELL SCREEN
Length: 50'
Slot Size: 0.010"
Type: SCH80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: CUTTINGS

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

TYPE OF INSTALLATION
[X] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT

MEASURING POINT IS
[ ] TOP OF RISER PIPE
[ ] OTHER

DRILLING EQUIPMENT
[X] AIR ROTARY [X] AUGER TYPE 6¼ H.S.A.
[ ] REVERSE ROTARY [ ] OTHER

CENTRALIZERS USED
[X] YES, AT 3 TOTAL
[ ] STAINLESS STEEL
[ ] OTHER
[ ] NO

MULTIPLE CASED WELLS

SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
3-12-75

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael J. Vogt
PERMIT NUMBER OOL256 WM DATE 4-11-75

SIGNATURE (DRILLING CONTRACTOR) Michael J. Vogt
PERMIT NUMBER OOL256 WM DATE 4-11-75

MO 780-1415 (2-94)

DISTRIBUTION: WHITE: DIVISION CANARY: MONITORING WELL CONTRACTOR PINK: OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MO
WEST LAKE LANDFILL
OPERABLE UNIT 2

DATUM NORTHING: 1066661.50 EASTING: 516607.70 ELEVATION 484.2

DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger

SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)

BORING NO. PZ-203-SS

SHEET 1 OF 3

					DRILLING START	DRILLING FINISH
WATER LEVEL						
TIME					15:00	18:00
DATE					5/25/95	5/25/95
CASING DEPTH						

DRILL RIG CME 75 - TRUCK MOUNT

ANGLE -90 BEARING NA

SAMPLE HAMMER 140 lb. - Falling 30 inches

SURFACE CONDITIONS

DRILLING CONTR LAYNE-WESTERN

LOGGED BY D. ALLOWAY

DATE 6/20/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ203SS

DEPTH IN FEET (ELEVATION)	BLOW/6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1					(0.0-4.2 Ft.) Soft, dark yellowish brown (10YR 4/2), fine sandy SILT, moist, (ML), (LOESS)		
2	1 2 2	1.3' / 2.0' (65%)				SP 1	
3	2						
4	1 2 3	0.8' / 2.0' (40%)			(480.0) 4.2		
5	3				(4.2-16.2 Ft.) Firm, moderate yellowish brown (10YR 5/2) to light gray (N7), silty CLAY, moist, (CL), (ALLUVIUM)	SP 2	
6	1 3 5	2.0' / 2.0' (100%)				SP 3	
7							
8	1 3 6	1.7' / 2.0' (85%)				SP 4	
9							
10	2 4 3	2.0' / 2.0' (100%)			@ 10.4-16.0 Ft., wet	SP 5	
11	5						
12	0 1 2	1.5' / 2.0' (75%)				SP 6	
13	3						
14	1 1 2	2.0' / 2.0' (100%)				SP 7	
	3						

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2
DRILLING METHOD:	6.25 inch I.D. Hollow Stem Auger
SAMPLING METHOD:	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
BORING NO.	PZ-203-SS
SHEET	2 OF 3
DRILLING	START TIME 15:00 / FINISH TIME 18:00
WATER LEVEL / TIME / DATE / CASING DEPTH	DATE 5/25/95 / DATE 5/25/95
DATUM	NORTHING: 1066661.50 EASTING: 516607.70
ELEVATION	484.2
DRILL RIG	CME 75 - TRUCK MOUNT
ANGLE	-90
BEARING	NA
SAMPLE HAMMER	140 lb. - falling 30 inches
SURFACE CONDITIONS	

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16	0 0 3 4	1.2' / 2.0' (60%)			(4.2-16.2 ft.) Firm, moderate yellowish brown (10YR 5/2) to light gray (N7), silty CLAY, moist, (CL), (ALLUVIUM) (468.0) 16.2	SP (7)	
17					(16.2-26.4 ft.) Soft to firm, medium yellowish brown (10YR 5/2) and light gray (N7), clayey SILT, trace Fine Sand, moist, (ML), (LOESS)	SP (8)	
18	2 2 5 6	1.0' / 2.0' (50%)				SP (9)	
19							
20	4 3 5 6	2.0' / 2.0' (100%)				SP (10)	
21							
22	1 2 5 6	0.9' / 2.0' (45%)			@ 22.0-25.8 ft., color changes to medium yellowish brown (10YR 5/2)	SP (11)	
23							
24	3 4 4 5	1.8' / 2.0' (90%)				SP (12)	
25							
26	1 4 6 9	1.4' / 2.0' (70%)			@ 25.8-26.4 ft., color is medium gray (N5) (457.8) 26.4 (26.4-41.2 ft.) Loose to very dense, medium gray (N5), fine SAND, trace Silt, saturated, (SP), (ALLUVIUM)	SP (13)	
27							
28	3 4 5 7	1.4' / 2.0' (70%)				SP (14)	
29					@ 29.0-41.2 ft., occasional beds of SILT interbedded		

DRILLING CONTR LAYNE-WESTERN

LOGGED BY D. ALLOWAY

DATE 6/28/95 CHK'D BY V. HERST

JOB NO.: 943-2848

FILENAME: PZ203SS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MD
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1066661.50
DATUM EASTING: 516607.70 ELEVATION 484.2

DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger

SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)

BORING NO. PZ-203-SS

SHEET 3 OF 3

					DRILLING START	DRILLING FINISH
WATER LEVEL						
TIME					TIME 15:00	TIME 18:00
DATE					DATE 5/25/95	DATE 5/25/95
CASING DEPTH						

DRILL RIG CME 75 - TRUCK MOUNT

ANGLE -90 BEARING NA

SAMPLE HAMMER 140 lb. - falling 30 inches

SURFACE CONDITIONS

DEPTH IN FEET (ELEVATION)	BLOW/6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31	5 6 7 12	1.5' 2.0' (75%)			@ 29.0-41.2 Ft., occasional beds of SILT interbedded	SP 15	
32	4 5 12 10	1.7' 2.0' (85%)				SP 16	
33							
34	1 4 5 10	1.6' 2.0' (80%)				SP 17	
35							
36	4 7 11 13	0.8' 2.0' (40%)			@ 36.0-41.2 Ft., includes little medium sand	SP 18	
37							
38	5 10 25 50	1.6' 2.0' (80%)				SP 19	
39							
40	15 30 30 50	1.9' 1.9' (100%)				SP 20	
41					(443.0) 41.2		
42					(41.2-42.0 Ft.) Hard, medium gray (N5) and dark reddish brown (10R 3/4), mottled, SILT, (ML), (ALLUVIUM) (442.2) 42.0		
43					End of Soil Borehole Log at 42.0 Ft. See Record of Drillhole PZ-203-SS for rock descriptions		
44							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY D. ALLOWAY DATE 6/20/95 CHK'D BY W. HERST

JOB NO.: 243-2848

FILENAME: PZ203SS

RECORD OF DRILLHOLE PZ-203-SS

Sheet 1 of 5

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/26/95 & 5/31/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066881.50
AZIMUTH: 0

COLLAR ELEV: 484.2
E: 518607.70
INCLINATION: -90

ROCK TYPE
J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW, FR, MW, HW, CW)	STRENGTH INDEX (R6, R5, R4, R3, R2, R1)	POINT LOAD INDEX (psi) (R6, R5, R4, R3, R2, R1)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32	0.0-42.0 ft. See Soil Borehole Log PZ-203-SS 42.0-44.8 ft. No samples collected														
34															
36															
38															
40															
42															
44			439.40												
	44.8-53.4 ft. 44.80 Hard, medium light gray (N6) to dark reddish brown (10R 3/4), SILTY CLAY, moist, (CL), (ALLUVIAL)		44.80												5/26/95 @ 9:15 Began drilling
46				1	100										
48															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-203-SS

Sheet 2 of 5

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2948
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/26/95 & 5/31/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066661.50
AZIMUTH: 0

COLLAR ELEV: 484.2
E: 516607.70
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48	46.1-57.5 ft. Pale green (10G 6/2)														
50				1	100										
	433.40 / 50.80		433.40 / 50.80												50.8-52.0 ft. and 52.3-53.7 ft. Core loss due to Clay washing out End of Run 1 @ 10:15
52									Core Loss						
			430.80												
54	53.4-73.6 ft. Moderately weathered, thickly bedded, yellowish gray (5Y 7/2), f-m grained, medium strong, BRECCIATED LIMESTONE, (ST. LOUIS FORMATION) Clay and poorly lithified Sandstone around pieces of Limestone		53.40						J,I,R,CL J,I,R						
56									J,I,R J,I,R J,P,SM						
				2	86%										
58									J,I,R J,I,R						
60			423.40						J,I,R,CL J,I,R,CL						
			60.80						J,C,SM (2)						5/26/95 @ 11:00 End of Run 2
62									J,PL,SM						
				3	97%										
64															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-203-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/26/95 & 5/31/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066661.50
AZIMUTH: 0

COLLAR ELEV: 484.2
E: 516607.70
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation; PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular; P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough; Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64	53.4-73.6 ft. Moderately weathered, thickly bedded, yellowish gray (5Y 7/2), f-m grained, medium strong, BRECCIATED LIMESTONE, (ST. LOUIS FORMATION) Clay and poorly lithified Sandstone around pieces of Limestone														
66									J,PL,SM						
				3	97%				J,PL,SM,CL						
68									J,PL,SM,CL (2)						
									B,PL,SM,CL						
70									J,I,R,CL						5/26/95 @ 12:00 End of Run 3
			413.40 / 70.80												
									J,PL,R,CL						
72									J,C,SM						
74	73.6-81.5 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2) to grayish orange pink (5YR 7/2), m-c grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic			4	100 %										
76	76.1-77.1 ft. Clay layer														
	77.6-77.9 ft. Clay layer		406.50 / 77.70												
78				5	100 %										
80															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-203-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/26/95 & 5/31/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1086661.50
AZIMUTH: 0

COLLAR ELEV: 484.2
E: 515807.70
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR, MSW, HW, CW)	STRENGTH INDEX (R6, R5, R4, R3, R2, R1)	POINT LOAD INDEX (psi) (R1 30, R2 150, R3 300, R4 600, R5 1500, R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	73.6-81.5 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2) to grayish orange pink (5YR 7/2), m-c grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic		402.70 / 81.50												
82	81.5-98.0 ft. Highly weathered, pale yellowish brown (10YR 6/2), f-c grained, very weak, LIMESTONE boulders in SILT matric (Collapse Zone)			5	100 %										81.5-98.0 ft. Collapse Zone, RQD measurements not valid
84	84.0-85.5 ft. Limestone boulder		400.20 / 84.00												
86	85.5-87.2 ft. Weak, dark gray (N3), thinly laminated Siltstone		398.70 / 85.50												
	87.2-90.0 ft. Limestone boulder		397.00 / 87.20	6	100 %										
88															
			394.20												5/26/95 @ 15:00 Stop drilling
90	90.0-90.5 ft. Weak, light olive gray (5Y 6/1), Siltstone		394.00 / 90.00												5/31/95 @ 8:30 Resume drilling after 4-day break, water level in open hole @ 34.1 ft. bgs
	90.5-92.4 ft. Limestone boulder		393.70 / 90.50												
92			392.50 / 91.70												
	92.4-95.0 ft. Very weak, medium dark gray (N4) to grayish black (N2), thinly laminated, Siltstone layer			7	82%				Core Loss						92.5-93.4 ft. Core loss in soft unit
94															
	95.0-96.0 ft. Limestone boulder		389.20 / 95.00												
				8	100 %										
96			388.20 / 96.00												

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: S. TILTON
DATE: 8/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-203-SS

Sheet 5 of 5

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/26/95 & 5/31/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066661.50
AZIMUTH: 0

COLLAR ELEV: 484.2
E: 515807.70
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: Dip wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
98	96.0-98.0 ft. Very weak, light olive gray (5Y 6/1), thinly laminated, Siltstone layer		386.20 / 98.00												
98	98.0-104.2 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)		386.20 / 98.00	8	100 %										
100	100.3-100.7 ft. Chert zone		384.20 / 100.00						J,PL,SM						
102									B,PL,SM,CL J,I,VR,Calcite						
104	104.2-110.0 ft. Slightly weathered, thinly bedded, olive gray (5Y 4/1), very fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)			9	98%				B,I,R J,I,R J,I,R J,I,VR calcite crystals						
106	104.4-105.0 ft. Highly weathered zone and weak														
108	105.0-106.8 ft. Intermittent vuggy zone (<3 mm.), zones <2 in. thick														
110	374.20 End of Record of Drillhole at 110.0 ft.		374.20 / 110.00												5/31/95 @ 11:00 Complete coring
112															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

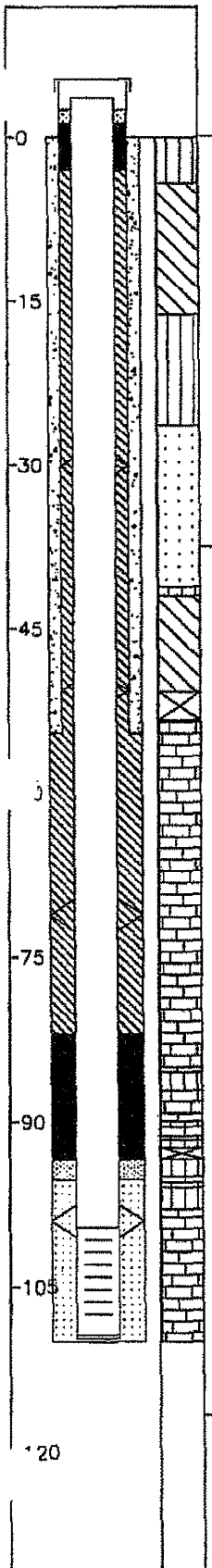
LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/13/95

Golder Associates

Well No. PZ-203-SS

Boring No. X-Ref: PZ-203-SS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1066682 ft. Easting: 516608 ft.

Elevation Ground Level 484.2 ft. NGVD

Top of PVC Casing 486.59 ft. NGVD

Drilling Summary:

Total Depth 110.0 ft.

Borehole Diameter 10 1/4 in. (0.0–56.0 ft.) 5 7/8 in. (56.0–110.0 ft.)

Casing Stickup Height 2.41 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit and 9 7/8 in. Tricone Bit

Drilling Fluid Auger–None, NX Core Water, Air and Mud Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	5/25/95	15:00	5/25/95	11:00
Schramm Rotary	6/3/95	7:20	6/3/95	8:30
Geophys.Logging:				
Casing:				
2" PVC	6/3/95	8:20	6/3/95	8:50
6" Steel	6/2/95	10:30	6/2/95	13:00
Filter Placement:	6/3/95	8:50	6/3/95	9:40
Cementing:				
Development				
Bentonite Grout	6/3/95	10:30	6/3/95	11:00
Bentonite Seal	6/3/95	9:40	6/3/95	10:30

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 2.41	-	99.60	C1	486.59	-	384.58
99.60	-	109.40	S1	384.58	-	374.78
109.40	-	109.70	C2	374.78	-	374.48
+ 0.50	-	56.10	C3	484.70	-	428.08
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.) (C3–see comments)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16–35 mesh Silica Sand, 95.3–110.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 93.5–95.3 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0–82.0 ft., Neat cement, 3.0–56.1 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 82.0–93.5 ft.

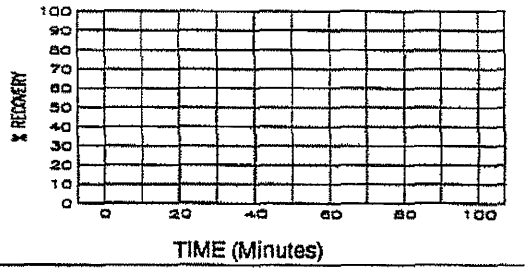
Concrete: 0.0–3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments: Surface Casing C3: 6 1/8 in. ID / 6 5/8 in. OD Steel Casing

Supervised by E. Swanson

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ203SS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122505	CHECK NO
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL		WELL NUMBER: ~~[illegible]~~ PZ-203-SS	
SITE ADDRESS: ST. CHARLES ROCK RD.	CITY: BRIDGETON	STATE: Mo	ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC.		TELEPHONE: 314-241-3710	
ADDRESS: 1838 N. BROADWAY	CITY: ST. LOUIS	STATE: Mo	ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL SHOW LOCATION IN SECTION PLAT

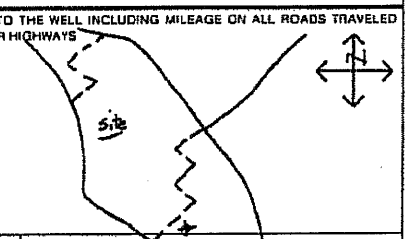
COUNTY: ST. LOUIS
ELEVATION: 484.2
AREA NO.:

SMALLEST ¼ ___ ¼ ___ ¼ ___ ¼ LARGEST ¼

SEC. ___ TWN. 47 N,RNG. 5 E OR W

LAT. 38° 45' 47" LONG. 90° 26' 30"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



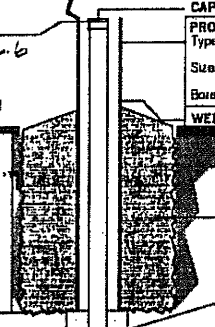
DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

NOTE: Record the fraction of a foot in decimal, not in inches

Top of Riser Elevation: 486.6

LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8"x8"x5'
Bore Hole Diameter: 9 7/8
WEEP HOLE - Y / N (Circle one)



Ground Surface Elevation: 484.2	Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column		0-44 No sampling
Depth to bottom of Protective Casing Seal:	3.0	
		44-51 Silt
		51-67 Dolomite
		67-110 Limestone
Depth to Base of Annular Seal:	82.0	
Depth to Base of Bentonite Seal:	93.5	
Depth to Base of Secondary Filter Pack:	95.3	
Depth to Top of the Screen:	99.6	
Depth to Bottom of the Screen:	109.6	
Plug Back Total Depth		
Original Total Depth:	110.0	

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 102'
Diameter: 2"
Type of Material: SCH 80 PVC

BOREHOLE DIAMETER: 5 7/8 In.

ANNULAR SEAL
Type: ☐ Bentonite Slurry ☒ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite
Length of Seal: 11.5 Ft.

SECONDARY FILTER PACK (Optional)
Type: ☒ Sand ☐ Manufactured
Grain Size: <50
Length: 1.8'

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 16-35
Length: 14.7

WELL SCREEN
Length: 10'
Slot Size: 0.010
Type: SCH 80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

MONITORING WELL INSTALLATION CONTRACTOR'S NAME

LAYNE WESTERN Co., Inc

DRILLING CONTRACTOR'S NAME

LAYNE WESTERN Co., Inc.

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
486.6

MEASURING POINT IS
☒ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☒ AIR ROTARY ☒ AUGER TYPE 6 1/4 H.S.A.
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☒ YES, AT 4 TOTAL
☒ STAINLESS STEEL
☐ OTHER
☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
6-03-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Michael P. Vogt	
PERMIT NUMBER: 001256WM	DATE: 7-07-95
SIGNATURE (DRILLING CONTRACTOR): Michael P. Vogt	
PERMIT NUMBER: 001256 WM	DATE: 7-07-95

MO 780 1415 (2-94)

DISTRIBUTION: WHITE DIVISION CANARY/MONITORING WELL CONTRACTOR PINK/OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	LAIDLAW\RI-FS\MO WEST LAKE LANDFILL OPERABLE UNIT 2
DRILLING METHOD:	6.25 inch I.D. Hollow Stem Auger
SAMPLING METHOD:	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)
BORING NO.	PZ-204-SS
SHEET	1 OF 1
DRILLING START TIME	15:50
DRILLING FINISH TIME	07:45
WATER LEVEL / TIME / DATE / CASING DEPTH	
DATE (START)	3/7/95
DATE (FINISH)	3/7/95
DATUM	NORTHING: 1066426.61 EASTING: 515533.49
ELEVATION	467.0
DRILL RIG	CME 75 - TRUCK MOUNT
SURFACE CONDITIONS	Muddy, no vegetation.
ANGLE / BEARING	
SAMPLE HAMMER	

DEPTH IN FEET (ELEVATION)	BLOW/6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1					(0.0-6.0 Ft.) CONCRETE, (FILL)		Auger from 0.0-6.5 feet with no sampling
2							
3							
4							
5							
6							
7	1 2 2	0.5' 1.5' (33%)			@ 6.5-7.9 Ft., crushed CONCRETE, (FILL)	SP ①	Begin split spoon sampling at 6.5 feet
(459.1) 7.9							
8	2 4 6 5	1.1' 2.0' (55%)			(7.9-9.3 Ft.) Stiff, mottled moderate yellowish brown (10YR 5/4) and dark yellowish orange (10YR 6/6), CLAYEY SILT, iron stained, some roots, NR, damp, (CL-ML), (LOESS)	SP ②	
9							
10	3 4 5 5	1.5' 2.0' (75%)			(9.3-10.5 Ft.) Stiff, pale yellowish brown (10YR 6/2) and medium dark gray (N4), CLAYEY SILT, some fine sand, NR, damp, (CL-ML), (LOESS)		
11					(10.5-14.6 Ft.) Stiff, medium dark gray (N4), CLAYEY SILT, little fine sand, NR, damp, (CL-ML), (LOESS) @ 11.2-11.5 Ft., silty CLAY	SP ③	
12	1 6 8 9	0.8' 2.0' (40%)					
13						SP ④	
(453.0) 14.0							
14					End of Soil Borehole Log at 14.0 Ft. See PZ-204-SS Record of Drillhole for rock descriptions		Auger/split spoon refusal at 14.0 feet

DRILLING CONTR LAYNE-WESTERN

LOGGED BY M. HIRT CHK'D BY W. HERST

DATE 3/7/95

JOB NO.: 943-2848

FILENAME: PZ204SS

RECORD OF DRILLHOLE PZ-204-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/6/95 - 3/9/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066426.81
AZIMUTH: 0

COLLAR ELEV: 467.0
E: 515533.49
INCLINATION: -90

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
Pl-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (60, 40, 20)	FRACTURES PER FOOT (2, 4, 6, 8, 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0, 30, 60, 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX (SW, FR, MW, HW, CW)	STRENGTH INDEX (R6, R5, R4, R3, R2, R1)	POINT LOAD INDEX (psi) (R1 30, R2 150, R3 300, R4 600, R5 1500, R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
0	0.0-14.0 ft. See Soil Borehole Log PZ-204-SS 14.0-14.6 ft. No samples collected														
2															
4															
6															
8															
10															
12															
14															
	452.40		452.40												
	14.6-45.1 ft. Fresh, medium bedded, light olive gray (5Y 6/1), micro-crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION) Some calcite crystal veins (<1 mm. thick), few fossils		14.60	1	89%										3/6/95 @ 8:15 Begin coring
16															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: W. HERST
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-204-SS

Sheet 2 of 6

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/6/95 - 3/9/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066426.61
AZIMUTH: 0

COLLAR ELEV: 467.0
E: 515533.49
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
16	ROCK TYPE														
	14.6-45.1 ft. Fresh, medium bedded, light olive gray (5Y 6/1), micro-crystalline, strong LIMESTONE, (ST. LOUIS FORMATION) Some calcite crystal veins (< 1 mm. thick), few fossils			1	69%				J,PL,SM,CL J,I,SM,CL J,I,SM J,I,SM,CL J,I,SM,CL J,I,SM J,ST,SM,CL J,I,SM,CL						
18									J,I,SM J,I,SM J,PL,SM,CL J,I,SM						
			447.70 18.30						Core Loss						Core loss due to highly fractured rock; core End Run 1 @ 9:50
20									J,I,SM (2)						
				2	96%				J,I,SM (2) J,I,SM,CL (3) J,U,SM,CL						
22									J,I,SM,CL (3) J,U,SM,CL (2) J,I,SM,CL (2)						
	22.6-28.0 ft. Very fine grained								J,I,SM						
24			443.00 24.00						J,I,SM,CL (2)						3/8/95 @ 10:50 End Run 2
									J,I,R						Use new bit during Run 3; slightly larger diameter, therefore hole reamed slightly
26				3	98%				J,PL,SM J,I,SM,CL J,I,SM,CL, J,I,SM J,I,SM,Fe J,U,SM						
28	28.0-30.7 ft. Medium grained 28.1-28.5 ft. 0 iron stained vein (1 mm. thick)														
	29.3-29.8 ft. Slightly weathered, iron stained		437.70 29.30						J,PL,SM,Fe						3/8/95 @ 13:15 End Run 3
30				4	98%				J,I,R J,PL,SM (2) J,I,R J,I,R						
									J,U,SM J,I,R						
32															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: W. HERST
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-204-SS

Sheet 3 of 6

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/8/95 - 3/9/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068426.61
AZIMUTH: 0

COLLAR ELEV: 467.0
E: 515533.48
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32	14.8-45.1 ft. Fresh, medium bedded, light olive gray (5Y 6/1), micro-crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION) Some calcite crystal veins (<1 mm. thick), few fossils							90	J,I,R						
34								90	J,I,R (4)						
36				4	98%			90	J,I,SM,CL (4)						
38								90	J,I,SM,CL (5)						
								90	J,I,SM,CL (2)						
			427.70 39.30					90	J,I,SM,CL						3/5895 @ 14:05 End Run 4
40								90	J,I,SM						
								90	J,I,SM,CL (6)						
								90	J,I,SM						
								90	J,I,SM,CL						
42	41.8-42.8 ft. Fine grained, calcareous dolomite														
	42.8-45.1 ft. Medium grained, dolomitic limestone			5	102 %			90	J,I,SM						
44								90	J,I,R (4)						
			421.90 45.10					90	B,U,R						
46	45.1-49.3 ft. Slightly weathered, medium bedded, light olive gray (5Y 5/2), very fine grained, medium strong, DOLOMITE, (ST. LOUIS FORMATION) Porous/vuggy (vugs ~1 mm. thick); some 10 degree calcite veins (<2 mm. thick)														
48															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: W. HERST
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-204-SS

Sheet 4 of 6

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 843-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/8/95 - 3/9/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068426.61
AZIMUTH: 0

COLLAR ELEV: 467.0
E: 515533.49
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48	46.8-49.3 ft. Fine grained, dolomitic limestone		417.70	5	102 %										3/8/95 @ 14:40 End Run 5
	417.70 / 49.30		49.30						J,I,SM (6)						
50	49.3-64.3 ft. Fresh, medium bedded, light olive gray (5Y 6/1), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)								J,I,SM (2)						
	49.3-49.8 ft. Thinly laminated														
	49.8-50.9 ft. Chert zone								J,I,R,CL						
52									J,I,R,CL						
	52.8-54.5 ft. Intricate pattern of calcite veins														
54				6	98%				J,I,R,CL						
	54.8-55.9 ft. Moderately weathered								J,I,R,CL						
56															
	56.6-58.1 ft. Moderately weathered								J,PL,SM,CL						
									J,I,R,CL						
	57.5-57.7 ft. Claystone		409.50						B,U,R,CL						
			57.70						B,U,SM,CL						
58			408.90												
	58.1-58.5 ft. Claystone		58.10						B,I,R,CL						
	58.5-59.9 ft. Siltstone, 45 degree crossbed		408.50 / 58.50						J,PL,SM,CL (2)						
									J,I,SM,CL						
			407.70												
			59.30						J,I,R						3/8/95 @ 15:35 End Run 6
									J,I,SM (2)						
			407.10						J,I,R						
60	60.0-60.4 ft. Calcareous dolomite		59.90						J,I,R						
									J,PL,SM,CL						
									J,U,SM,CL						
									J,PL,R,CL						
			405.40												
	61.6-62.4 ft. Calcareous dolomite, slightly weathered		61.60	7	100 %				J,PL,SM						
62			404.60												
			62.40						J,I,SM,CL (5)						
	63.0-64.3 ft. Microcrystalline														
64															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: W. HERST
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-204-SS

PROJECT: LAIDLAW/FI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/6/95 - 3/9/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1056426.61
AZIMUTH: 0

COLLAR ELEV: 467.0
E: 515533.49
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infil, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64			402.70												
			64.30						J,I,SM,CL (2)						
	64.3-79.9 ft. Moderately weathered, thinly bedded, pale to dark yellowish brown (10YR 6/2-10YR 4/2), very fine grained, medium strong, DOLOMITE, (ST. LOUIS FORMATION) Very porous/vuggy (<1 mm.-5 mm.)								J,U,R J,I,SM,CL						
66				7	100 %										
68															
			397.70												3/8/95 @ 16:20 End Run 7
70	69.6-70.3 ft. Slightly weathered		69.30												
72															
74				8	100 %										
76															
78			387.70												
			79.30												3/8/95 @ 16:55 End Run 8
			387.10	9	95%				J,I,R						
80			79.90												

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: W. HERST
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-204-SS

Sheet 8 of 8

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/8/95 - 3/9/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068426.61
AZIMUTH: 0

COLLAR ELEV: 467.0
E: 515533.49
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR, MW HW, CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (RT 30, R2 150, R3 300, R4 600, R5 1500, R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	79.9-90.3 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), coarse grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Some calcite crystals, stylolites														
82				9	98%				J,PL,SM,CL J,U,SM,CL J,I,SM,CL						
84			382.70												
			84.30												3/8/95 @ 17:20 End Run 9
86	85.7-89.6 ft. Microcrystalline								J,I,R J,PL,SM J,I,SM (2) J,I,SM						
				10	100%										
88									J,I,SM J,I,SM J,I,SM,CL (2) J,I,R,CL (2) J,PL,SM						
90			376.70												3/8/95 @ 17:50 End Run 10
	End of Record of Drillhole at 90.3 ft.		90.30												
92															
94															
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

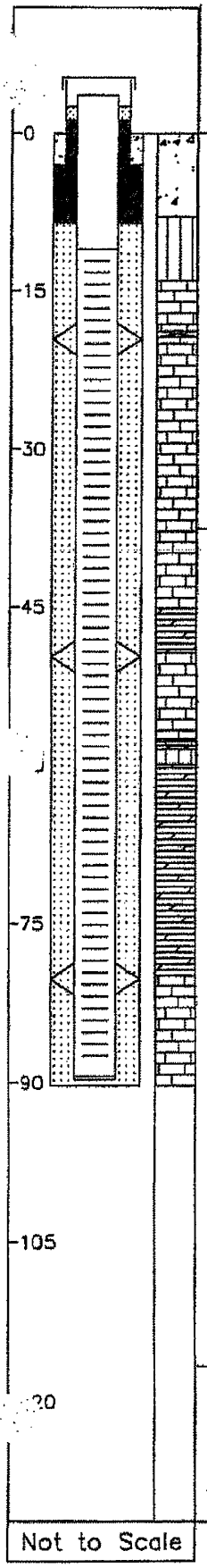
LOGGED: M. HIRT
CHECKED: W. HERST
DATE: 3/29/95

Golder Associates

Well No. PZ-204-SS

Boring No. X-Ref: PZ-204-SS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1066427 ft. Easting: 515533 ft.

Elevation Ground Level 467.0 ft. NGVD

Top of PVC Casing 469.63 ft. NGVD

Drilling Summary:

Total Depth 90.3 ft.

Borehole Diameter 10 1/4 in. (0.0–14.0 ft.) 5 7/8 in. (14.0–90.3 ft.)

Casing Stickup Height 2.60 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger–None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	3/7/95	15:50	3/8/95	7:45
Schramm Rotary	3/10/95	12:15	3/10/95	14:15
Geophys.Logging:				
Casing:	3/10/95	14:15	3/10/95	14:35
Filter Placement:	3/10/95	14:35	3/10/95	15:05
Cementing:				
Development				
Bentonite Grout Bentonite Seal	3/10/95	15:05	3/10/95	15:15

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 2.60	–	10.95	C1	469.63	–	456.08
10.95	–	89.35	S1	456.08	–	377.68
89.35	–	89.68	C2	377.68	–	377.35

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16–35 mesh Silica Sand, 8.5–90.3 ft.

Filter Pack:

Grout Seal:

Bentonite Seal: Medium Bentonite Chips, 3.0–8.5 ft.

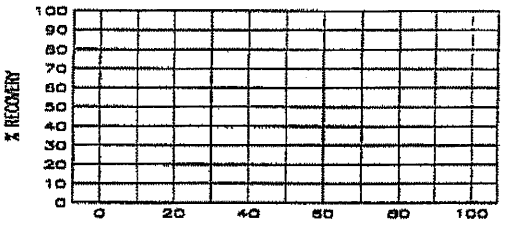
Concrete: 0.0–3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ204SS

66137H

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	
REF. NO 115087	DATE RECEIVED
ROUTE	CHECK NO.
STATE WELL NUMBER	TRANSMITTAL NO
CHECKED BY	CROSS REFERENCE NO
APPROVED BY	ENTERED Ph 1 Ph 2 Ph 3
	DATE APPROVED

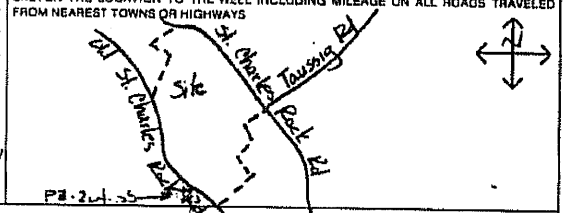
INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL
WELL NUMBER: PZ-204-SS
SITE ADDRESS: ST. CHARLES ROCK RD.
CITY: BRIDGETON
STATE: MO.
ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC.
TELEPHONE:
ADDRESS: 1438 N. BROADWAY
CITY: ST. LOUIS
STATE: MO.
ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL SHOW LOCATION IN SECTION PLAT
COUNTY: ST. LOUIS
ELEVATION: 467.0
AREA NO.
SMALLEST ¼ LARGEST ¼
SEC. TWN. 47 N.RNG. 5 (E) OR W
LAT. 38° 45' 45" LONG. 90° 36' 44"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME: LAYNE WESTERN CO, INC.

DRILLING CONTRACTOR'S NAME: LAYNE WESTERN CO, INC.

NOTE: Record the fraction of a foot in decimal, not in inches

Top of Riser Elevation: 470.25
Ground Surface Elevation: 467.0 Ft

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
	0-7	Fill
Depth to bottom of Protective Casing Seal:	3	
Depth to Base of Annular Seal:	3	
	7-14	Silt
Depth to Base of Bentonite Seal:	8.5	
Depth to Base of Secondary Filter Pack:		
Depth to Top of the Screen:	10	
	14-64	Limestone
Depth to Bottom of the Screen:	90	
	64-81	Dolomite
	81-90.3	Limestone
Plug Back Total Depth:		
Original Total Depth:	90.3	

LOCKING CAP: (Y) N (Circle one)
CAP VENT - (Y) N (Circle one)
PROTECTIVE CASING Type: STEEL Size: 8" x 8" x 5' Bore Hole Diameter: 10.25"
WEEP HOLE - Y / N (Circle one)
PROTECTIVE CASING SEAL Type: [X] Concrete [ ] Cement Slurry
RISER PIPE Length: 13.25' Diameter: 2" Type of Material: SCH 80 PVC
BOREHOLE DIAMETER: 5 7/8 In.
ANNULAR SEAL Type: [ ] Bentonite Slurry [ ] Cement Slurry [X] Non Slurry Bentonite
BENTONITE SEAL Type: [ ] Bentonite Slurry [X] Non Slurry Bentonite Length of Seal: 5.5 Ft.
SECONDARY FILTER PACK Type: [ ] Sand [ ] Manufactured (Optional) Grain Size: Length:
PRIMARY FILTER PACK Type: [X] Sand [ ] Manufactured Grain Size: 16-35 Length: 81.8
WELL SCREEN Length: 80' Slot Size: 0.010" Type: SCH 80 PVC
SUMP DETAILS Length: 0.3 Ft. Diameter: 2 In. Type: PVC
TYPE OF BACKFILL: SAND

DRILLING EQUIPMENT
[X] AIR ROTARY [X] AUGER TYPE 6¼ H.S.A.
[ ] REVERSE ROTARY [ ] OTHER
CENTRALIZERS USED [X] YES, AT 4 TOTAL [ ] STAINLESS STEEL [ ] OTHER [ ] NO
MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.
DATE WELL CONSTRUCTION WAS COMPLETED: 3-10-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Michael P. Vogl
PERMIT NUMBER: OU1256WM DATE: 4-11-95
SIGNATURE (DRILLING CONTRACTOR): Michael P. Vogl
PERMIT NUMBER: OU1256WM DATE: 4-11-95

MO 780-1415 (2-94) DISTRIBUTION: WHITE-DIVISION CANARY-MONITORING WELL CONTRACTOR PINK-OWNER

RECORD OF DRILLHOLE PZ-204A-SS

Sheet 1 of 1

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/21/95
DRILL RIG: SCHRAMM

DATUM: MSL
COORDINATES N: 1086429.82
AZIMUTH: 0

COLLAR ELEV: 466.7
E: 515556.28
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	ROD (60 80 90 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP WRT CORE AXIS (0 30 60 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW PW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 R2 30 R3 150 R4 360 R5 800 R6 1500)	TEST ORIENTATION
80	0.0-80.0 ft. See Soil Borehole Log and Record of Drillhole for PZ-204-SS 80.0-90.0 ft. Fresh, medium to thickly bedded, light olive gray (5Y 6/1), finely crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic 82.5-83.1 ft. Thinly laminated, fossiliferous 82.3-85.8 ft. Small vugs (1/4 in.) filled with glauconite @ 85.4 ft. Grades to microcrystalline Limestone		386.70 80.00						J,PL,R,CL					
82									J,PL,R,CL					
									J,C,R,CL (3)					
84				1	96%				J,C,VR-CL J,PL,R,CL					
86									J,C,SM,CL					
									J,ST,R,CL					
									J,C,R,CL					
88									J,C,R,CL (2)					
			377.10 89.60						J,P,R Core Loss					
90	End of Record of Drillhole at 90.0 ft.		376.70 90.00											
92														
94														
96														

NOTES
WATER LEVELS
INSTRUMENTATION

0.0-14.0 ft.
Borehole advanced with 6 1/4 in. ID hollow stem augers
14.0-80.0 ft.
Borehole advanced with 5 7/8 in. dia. air rotary bit
6/21/95 @ 13:00
Began coring

6/21/95 @ 15:45
Ended coring

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: R. BOOTH
CHECKED: B. TILTON
DATE: 7/12/95

Golder Associates

Well No. PZ-204A-SS

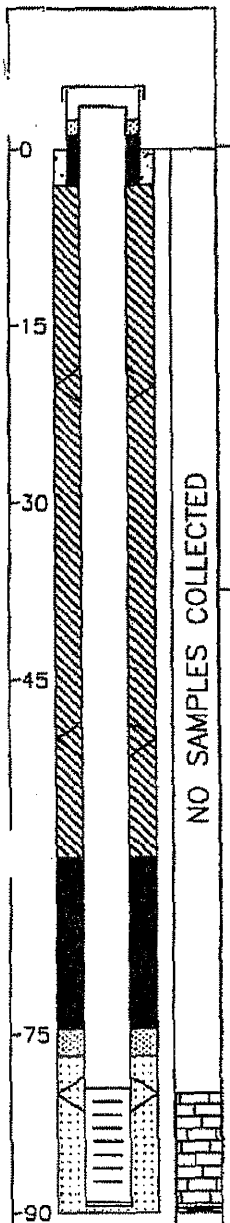
Boring No. X-Ref: PZ-204A-SS

PIEZOMETER CONSTRUCTION SUMMARY

Survey Coords: Northing: 1066430 ft. Easting: 515556 ft.

Elevation Ground Level 466.7 ft. NGVD

Top of PVC Casing 468.16 ft. NGVD



Not to Scale

Drilling Summary:

Total Depth 90.0 ft.

Borehole Diameter 10 1/4 in. (0.0–14.0 ft.) 5 7/8 in. (14.0–90.0 ft.)

Casing Stickup Height 1.50 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger–None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75				
Schramm Rotary	6/21/95	8:00	6/21/95	14:00
Geophys.Logging:				
Casing:	6/22/95	7:30	6/22/95	7:36
Filter Placement:	6/22/95	7:35	6/22/95	7:45
Cementing:				
Development				
Bentonite Grout	6/22/95	8:00	6/22/95	9:00
Bentonite Seal	6/22/95	7:45	6/22/95	8:00

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+1.50	–	79.50	C1	468.16	–	387.18
79.50	–	89.10	S1	387.18	–	377.58
89.10	–	89.43	C2	377.58	–	377.23
	–				–	
	–				–	
	–				–	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16–35 mesh Silica Sand, 76.8–90.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 74.5–76.8 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0–60.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 60.0–74.5 ft.

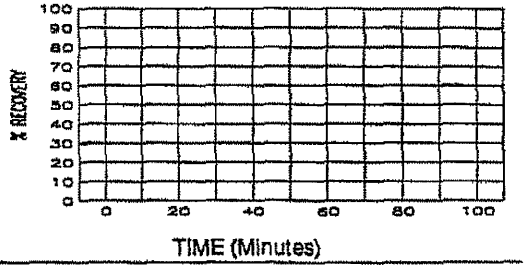
Concrete: 0.0–3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by B.. Tilton

Job Number 943–2848

Site LAIDLAW/OU2 RI–FS/MO

File Name PZ204ASS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO. 122518	CHECK NO
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME	WELL NUMBER
Laidlaw Bridgeton Sanitary Landfill	PZ-104H-55

SITE ADDRESS	CITY	STATE	ZIP CODE
St. Charles Rock Rd.	Bridgeton	Mo	63044

NAME	TELEPHONE
Laidlaw Waste Systems, Inc	314-241-3710

ADDRESS	CITY	STATE	ZIP CODE
10732 N. Broadway	St Louis	Mo	63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

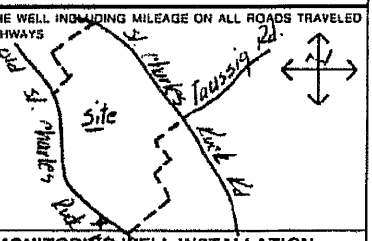
COUNTY St. Louis
ELEVATION 466.66
AREA NO

SMALLEST ¼ LARGEST ¼

SEC. ____ TWN. 47 N,RNG. 5 E OR W

LAT. 38° 45' 44" LONG. 90° 26' 44"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



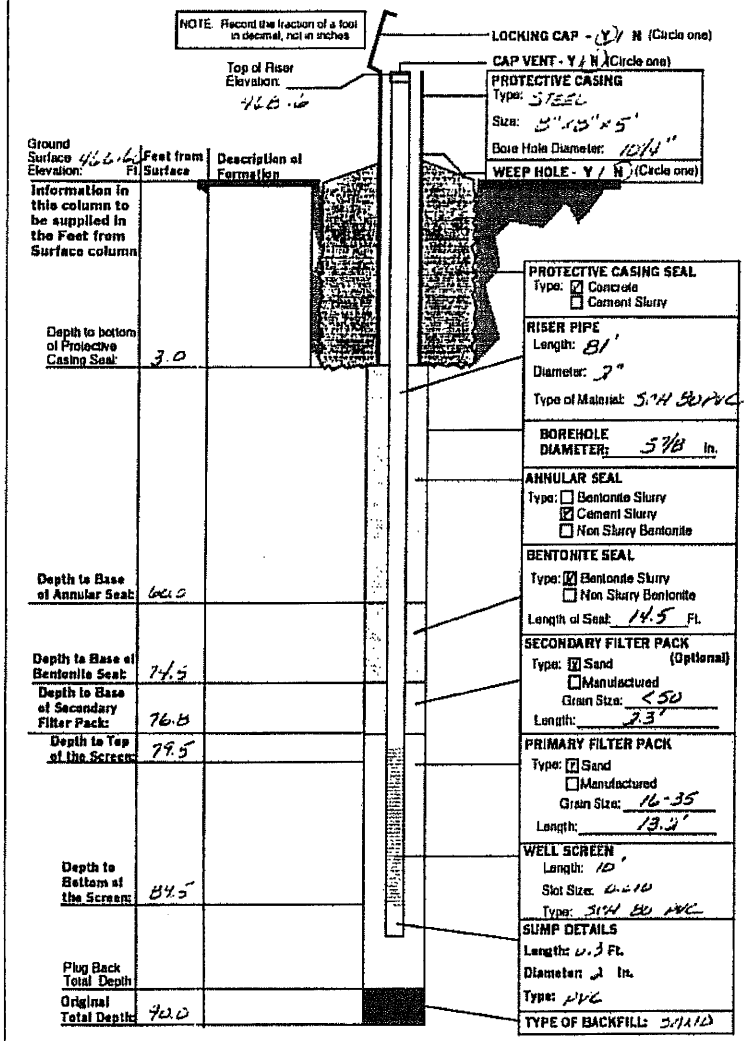
DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

NOTE: Record the fraction of a foot in decimal, not in inches

Top of Riser Elevation: 468.16

Ground Surface Elevation: 466.66 Ft.

Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column	
Depth to bottom of Protective Casing Seal: 3.0	
Depth to Base of Annular Seal: 66.0	
Depth to Base of Bentonite Seal: 74.5	
Depth to Base of Secondary Filter Pack: 76.8	
Depth to Top of the Screen: 79.5	
Depth to Bottom of the Screen: 89.5	
Plug Back Total Depth	
Original Total Depth: 90.0	



MONITORING WELL INSTALLATION CONTRACTOR'S NAME
Layne Western Co., Inc

DRILLING CONTRACTOR'S NAME
Layne Western Co., Inc

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
468.16

MEASURING POINT IS
☒ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☒ AIR ROTARY ☒ AUGER TYPE 6¼ H.S.A.
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☒ YES, AT 3 TOTAL
☒ STAINLESS STEEL
☐ OTHER
☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
6-22-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael P. Vogt

PERMIT NUMBER	DATE
001256 WIII	7-07-95

SIGNATURE (DRILLING CONTRACTOR) Michael P. Vogt

PERMIT NUMBER	DATE
001256 WIII	7-12-95

DISTRIBUTION: WHITE-DIVISION CANARY-MONITORING WELL CONTRACTOR PINK-OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MD
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1067463.60
DATUM EASTING: 515463.34 ELEVATION 459.3

DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger

SAMPLING METHOD:
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)

BORING NO. PZ-205-AS

SHEET 1 OF 4

					DRILLING START	DRILLING FINISH
WATER LEVEL					TIME	TIME
TIME					16:35	11:00
DATE					DATE	DATE
CASING DEPTH					3/25/95	3/25/95

DRILL RIG CME 75 - TRUCK MOUNT
ANGLE -90° BEARING
SAMPLE HAMMER
SURFACE CONDITIONS

DRILLING CONTR LAYNE-WESTERN
LOGGED BY S. CASIO
DATE 6/1/95
CHK'D BY V. HERST
JOB NO.: 943-2840
FILENAME: PZ205AS

DEPTH IN FEET (ELEVATION)	BLOW/6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	4 7 7 10	1.5'/2.0' (75%)			(0.0-2.2 ft.) Stiff, dark greenish gray (5GY 4/1) to olive gray (5Y 6/1), SILTY CLAY, trace Fine Sand, SR, damp, (CL), (FILL)	SP ①	
2					(457.1) 2.2		
3	1 2 2 4	0.5'/2.0' (25%)			(2.2-6.0 ft.) Soft, black (N1), CLAYEY SILT, trace Fine Sand, WR, moist to wet, (CL-ML), (FILL)	SP ②	
4	2 2 2 3	1.5'/2.0' (75%)				SP ③	Soil becomes wet @ 4.0 ft.
5							
6					(453.3) 6.0		
7	1 4 4 3	0.1'/2.0' (5%)			(6.0-12.0 ft.) Mixed wet waste and clayey silt	SP ④	
8	6 5 6 4	0.1'/2.0' (5%)			(8.0-10.0 ft.) Mixed wet waste and clayey silt	SP ⑤	
9							
10	2 2 3 3	0.6'/2.0' (30%)				SP ⑥	
11							
12					(447.3) 12.0		
13	2 9 3 2	0.0'/2.0' (0%)	NO RECOVERY		(12.0-14.0 ft.) No Recovery	SP ⑦	From 12.0-28.0 ft., no samples recovered, but drilling indicated mixed waste and silty clay layers
14	6 8 8 7	0.0'/2.0' (0%)			(14.0-15.0 ft.) No Recovery	SP ⑧	

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MO
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1067463.60
DATUM EASTING: 515463.34 ELEVATION 459.3

DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger

SAMPLING METHOD:
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)

WATER LEVEL					
TIME					
DATE					
CASING DEPTH					

BORING NO. PZ-205-AS

SHEET 2 OF 4

DRILLING: START TIME 16:35 DATE 3/25/95; FINISH TIME 11:00 DATE 3/25/95

DRILL RIG CME 75 - TRUCK MOUNT

ANGLE -90° BEARING

SAMPLE HAMMER

SURFACE CONDITIONS

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16	5 5 5 4	0.0" 24.0" (0%)	NO RECOVERY		(15.0-16.0 ft.) No Recovery	SP (8)	
					(16.0-18.0 Ft.) No Recovery	SP (9)	
18	5 2 1 5	0.0" 24.0" (0%)			(18.0-20.0 ft.) No Recovery	SP (10)	
20	1 2 3 3	0.0" 24.0" (0%)			(20.0-22.0 ft.) No Recovery	SP (11)	
22	3 2 1 4	0.0" 24.0" (0%)			(22.0-24.0 ft.) No Recovery	SP (12)	
24	3 3 23 50/1"	0.0" 24.0" (0%)			(24.0-26.0 ft.) No Recovery	SP (13)	
26	8 6 8 10	0.0" 24.0" (0%)			(26.0-28.0 ft.) No Recovery	SP (14)	
28	1 2 4 5	0.0" 24.0" (0%)			(431.3) 28.0 (28.0-30.0 ft.) Loose, dark greenish gray (5GY 4/1), SANDY SILT, NR, wet, (ML)	SP (15)	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY S. CISIN

DATE 6/1/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ205AS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-205-AS
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2		SHEET 3 OF 4
	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING START / FINISH
NORTHING: 1067463.60 DATUM EASTING: 515463.34 ELEVATION 459.3	WATER LEVEL / TIME / DATE / CASING DEPTH	TIME 16:35 / TIME 11:00 DATE 3/25/95 / DATE 3/25/95
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE -90° BEARING		
SAMPLE HAMMER		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31					(30.0-31.0 Ft.) No samples collected		5/21/95, 10.0 in. ID steel casing installed through 10.25 in. ID augers to 29.0 ft. Casing sealed in borehole with neat cement grout to surface.
					(428.3) 31.0		
31	6 5 5 8	1.2' / 2.0' (60%)			(31.0-36.5 Ft.) Stiff, medium dark gray (N4), SILTY CLAY, with thin fine sand layers (1" thick), moist, NR, (CL), (ALLUVIUM)	SP (16)	
33	9 3 5 12	1.3' / 2.0' (65%)				SP (17)	
35	7 7 9 9	1.0' / 2.0' (50%)				SP (18)	
					(422.8) 36.5		
37	7 14 21 17	1.1' / 2.0' (55%)			(36.5-39.0 Ft.) Dense, olive gray (5Y 4/1), SILTY fine SAND, wet, NR, (SM), (ALLUVIUM)	SP (19)	
					(420.3) 39.0		
39	4 3 3 4	1.4' / 2.0' (70%)			(39.0-44.2 Ft.) Firm, olive gray (5Y 4/1), SILTY CLAY, moist to wet, NR, (CL) From 40.2-40.4 Ft., wet, fine, sandy clay layer	SP (20)	
41	3 4 4 5	1.7' / 2.0' (85%)			From 41.8-42.0 Ft., wet, fine, sandy clay layer	SP (21)	
43	2 7 11 18	1.3' / 2.0' (65%)				SP (22)	
					(415.1) 44.2		
					(44.2-49.0 Ft.) Compact, olive gray (5Y 4/1), fine SAND, trace silt, wet, NR, (SM), (ALLUVIUM)		

DRILLING CONTR LAYNE-WESTERN

LOGGED BY S. COSIO CHK'D BY W. HERST

DATE 6/1/95

JOB NO.: 943-2848

FILENAME: PZ205AS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:		BORING NO.
	6.25 inch I.D. Hollow Stem Auger		PZ-205-AS
			SHEET 4 OF 4
	SAMPLING METHOD:		
	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)		DRILLING
LAIDLAW/OU2 RI-FS/MD WEST LAKE LANDFILL OPERABLE UNIT 2	SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)		START / FINISH
	WATER LEVEL		TIME / TIME
	TIME		16:35 / 11:00
	DATE		DATE / DATE
NORTHING: 1067463.60 DATUM EASTING: 515463.34 ELEVATION 459.3	CASING DEPTH		3/25/95 / 3/25/95

DRILL RIG CME 75 - TRUCK MOUNT | SURFACE CONDITIONS

ANGLE -90° BEARING

SAMPLE HAMMER

DEPTH IN FEET (ELEVATION)	BLOW/6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
46	6 8 12 16	1.6' 2.0' (80%)			(44.2-49.0 Ft.) Compact, olive gray (5Y 4/1), Fine SAND, trace silt, wet, NR. (SM), (ALLUVIUM)	SP (23)	
47	3 5 50/4"	1.1' 2.0' (55%)					
48						SP (24)	
49					(410.3) 49.0 End of Soil Borehole Log at 49.0 ft.		Top of weathered bedrock encountered @ 48.5 Ft.
50							
51							
52							
53							
54							
55							
56							
57							
58							
59							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY S. COSIO

DATE 6/1/95 CHK'D BY W. HERST

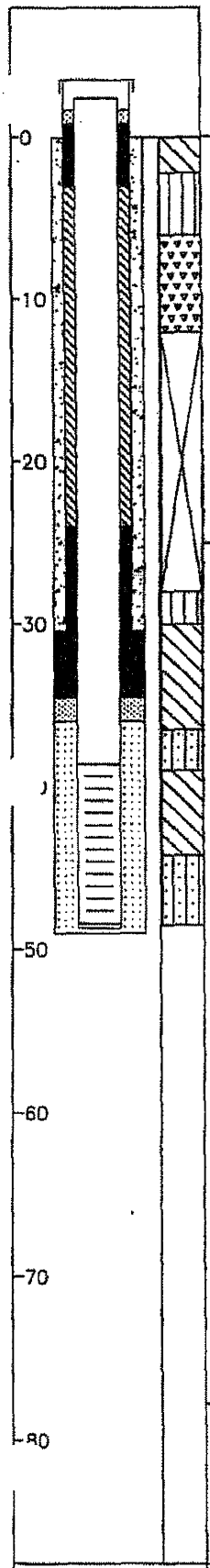
JOB NO.: 243-2848

FILENAME: PZ205AS

Well No. PZ-205-AS

Boring No. X-Ref: PZ-205-AS

PIEZOMETER CONSTRUCTION SUMMARY



Survey Coords: Northing: 1087464 ft. Easting: 515463 ft.

Elevation Ground Level 459.3 ft. NGVD

Top of PVC Casing 460.99 ft. NGVD

Drilling Summary:

Total Depth 49.0 ft.

Borehole Diameter 14 1/4 in. (0.0–29.0 ft.) 8 1/4 in. (29.0–49.0 ft.)

Casing Stickup Height 1.66 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. and 10 1/4 in. ID Hollow Stem Auger Bits

Drilling Fluid Auger-None

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	3/25/95	16:35	3/25/95	11:00
CME 75	4/21/95	14:10	4/21/95	15:30
CME 75	5/5/95	13:30	5/5/95	16:30
Geophys.Logging:				
Casing:				
2" PVC	5/5/95	16:00	5/5/95	16:05
10" Steel	4/21/95	15:29	4/21/95	16:30
Filter Placement:	5/5/95	16:05	5/5/95	16:45
Cementing:				
Development				
Bentonite Grout	5/5/95	17:00	5/5/95	17:30
Bentonite Seal	5/5/95	16:45	5/5/95	17:00

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.66	-	38.55	C1	460.99	-	420.78
38.55	-	48.35	S1	420.78	-	410.98
48.35	-	48.68	C2	410.98	-	410.65
+ 0.70	-	29.00	C3	460.00	-	430.33
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.) (C3-see comments)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 36.0-49.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 34.5-36.0 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-24.0 ft., Neat cement, 3.0-29.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 24.0-34.5 ft.

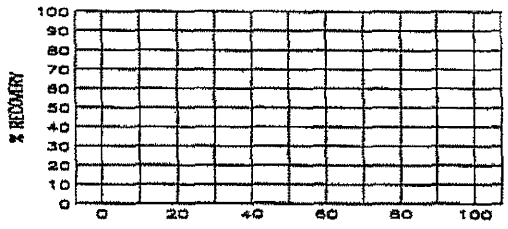
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments: Surface Casing C3: 10 in. ID / 10 7/8 in. OD Steel Casing

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ205AS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122496	CHECK NO.
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME	WELL NUMBER
LAIDLAW BRIDGETON SANITARY LANDFILL	PZ-205AS

SITE ADDRESS	CITY	STATE	ZIP CODE
ST. CHARLES ROCK RD.	BRIDGETON	MO.	63044

NAME	TELEPHONE
LAIDLAW WASTE SYSTEMS, INC.	314-241-3710

ADDRESS	CITY	STATE	ZIP CODE
1838 N. BROADWAY	ST. LOUIS	MO	63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL SHOW LOCATION IN SECTION PLAT

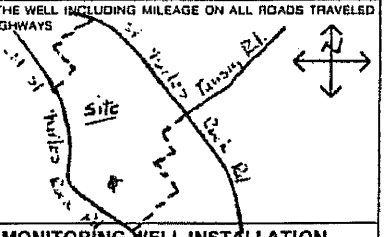
COUNTY ST. LOUIS
ELEVATION 459.3
AREA NO.

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST

SEC. ____ TWN. 47 N.RNG. 5 (E OR W)

LAT. 38 ° 45 ' 55 " LONG. 90 ° 36 ' 45 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME

LAYNE WESTERN CO, INC.

NOTE: Record the fraction of a foot in decimal, not in inches

LOCKING CAP - (Y) N (Circle one)
CAP VENT (Y) N (Circle one)
Top of Riser Elevation: 461.0
PROTECTIVE CASING Type: STEEL Size: 5"ID" x 5' Bore Hole Diameter: 14"
WEEP HOLE - Y / (N) (Circle one)

Ground Surface Elevation: 459.3 Ft

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
	0-2	clay
	2-4	silt
Depth to bottom of Protective Casing Seal:	4.0	
	4-27	Trash
Depth to Base of Annular Seal:	34.0	
	27-31	silt
Depth to Base of Bentonite Seal:	34.5	
	31-38	clay
Depth to Base of Secondary Filter Pack:	36.0	
Depth to Top of the Screen:	38.4	
	38-47	silt w/ sand
Depth to Bottom of the Screen:	48.4	
Plug Back Total Depth		
Original Total Depth:	47.0	

PROTECTIVE CASING SEAL Type: [X] Concrete [ ] Cement Slurry
RISER PIPE Length: 40.1' Diameter: 3" Type of Material: SCH. 80 PVC
BOREHOLE DIAMETER: 8 In.
ANNULAR SEAL Type: [X] Bentonite Slurry [X] Cement Slurry [ ] Non Slurry Bentonite
BENTONITE SEAL Type: [X] Bentonite Slurry [ ] Non Slurry Bentonite Length of Seal: 10.5 Ft.
SECONDARY FILTER PACK (Optional) Type: [X] Sand [ ] Manufactured Grain Size: 4 50 Length: 1.5'
PRIMARY FILTER PACK Type: [X] Sand [ ] Manufactured Grain Size: 16-35 Length: 13'
WELL SCREEN Length: 10 Slot Size: 0.020" Type: SCH. 80 PVC
SUMP DETAILS Length: 0.3 Ft. Diameter: 2 In. Type: PVC
TYPE OF BACKFILL: SAND

DRILLING CONTRACTOR'S NAME

LAYNE WESTERN CO, INC.

TYPE OF INSTALLATION [X] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL ____ FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT 461.0

MEASURING POINT IS [X] TOP OF RISER PIPE [ ] OTHER ____

DRILLING EQUIPMENT [ ] AIR ROTARY [X] AUGER TYPE 4¼ H.S.A. [ ] REVERSE ROTARY [ ] OTHER ____

CENTRALIZERS USED [X] YES, AT 2 TOTAL [X] STAINLESS STEEL [ ] OTHER ____ [ ] NO

MULTIPLE CASED WELLS

SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED 5-06-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) [signature]

PERMIT NUMBER	DATE
OW1258 WMM	6-02-95

SIGNATURE (DRILLING CONTRACTOR) [signature]

PERMIT NUMBER	DATE
OW1258 WMM-1	6-02-95

DISTRIBUTION: WHITE DIVISION CANARY MONITORING WELL CONTRACTOR PINK/OWNER

RECORD OF DRILLHOLE PZ-205-SS

Sheet 1 of 4

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2845
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/17/95 - 5/19/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067483.54
AZIMUTH: 0

COLLAR ELEV: 459.5
E: 515477.78
INCLINATION: -90

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickenided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R6 R5 R4 R3 R2 R1)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48	0.0-49.0 ft. See Soil Borehole Log PZ-205-AS 49.0-54.0 ft. No samples collected														0.0-49.0 ft. Borehole advanced with 10.25 in. ID hollow stem augers 49.0-54.0 ft. Borehole advanced with 9 7/8 in. bit using mud rotary then 6 in. steel casing grouted into annulus with neat cement Bedrock encountered @ 48.5 ft.
50															
52															
54	405.50 54.0-67.5 ft. Fresh, medium to thinly bedded, pale yellowish brown (10YR 6/2), very fine grained, weak, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)		405.50 54.00												5/18/95 @ 8:15 Began coring
56				1	93%				J,PL,SM,Fe						
58	400.50 59.00		400.10 59.40						J,PL,SM J,ST,SM J,C,SM,Fe B,PL,SM						5/18/95 @ 8:40 End of Run 1
60															
62	62.3-69.5 ft. Grain size is medium grained			2	89%				J,PL,SM (2)						
64									J,PL,SM						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/20/95

Golder Associates

RECORD OF DRILLHOLE PZ-205-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/17/95 - 5/19/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N. 1067483.54
AZIMUTH: 0

COLLAR ELEV: 459.5
E: 515477.78
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (Feet)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP rel CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64	54.0-67.5 ft. Fresh, medium to thinly bedded, pale yellowish brown (10YR 6/2), very fine grained, weak, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)							90	J,PL,R						
	65.0-75.9 ft. Scattered chert nodules														
66	65.8-66.0 ft. Claystone layer							90	B,PL,SM (2)						
				2	99%			90	J,PL,SM,Fe						
	67.5-99.5 ft. Fresh, medium to thinly bedded, pale yellowish brown (10YR 6/2), very fine grained, weak, LIMESTONE, (ST. LOUIS FORMATION)														
68	Stylolitic														5/18/95 @ 10:40 End of Run 2
			390.10					90	J,PL,R,Fe						
			69.40					90	J,PL,R						
	69.8-75.9 ft. Very fine to microcrystalline zones of thinly laminated layers of clay within the limestone, color is medium light gray (N6)							90	J,PL,R (2)						
70								90	J,I,R						
72				3	100 %			90	J,PL,R						
								90	J,I,R						
74															5/18/95 @ 11:45 End of Run 3 Ended drilling for the day due to bad weather. 5/19/95 @ 7:40 Began drilling
			385.00					90	J,I,R (3)						
			74.50					90	J,PL,R						
								90	J,PL,R,Fe						
76								90	J,PL,R						
	76.6-77.4 ft. Argillaceous layer														
				4	100 %			90	J,PL,R						
78															
								90	J,I,R						
	78.7-80.0 ft. Argillaceous zone, unfilled vugs (1-3 mm. in diameter)							90	J,PL,R						
								90	J,PL,R (2)						
80															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: S. TILTON
DATE: 6/20/95

Golder Associates

RECORD OF DRILLHOLE PZ-205-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/17/95 - 5/19/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1087483.54
AZIMUTH: 0

COLLAR ELEV: 459.5
E: 515477.78
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/t CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR, MW, HW, CW	STRENGTH INDEX: R6, R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): R1 30, R2 150, R3 300, R4 600, R5 1500, R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	67.5-99.5 ft. Fresh, medium to thinly bedded, pale yellowish brown (10YR 6/2), very fine grained, weak, LIMESTONE. (ST. LOUIS FORMATION) Stylolitic								J,PL,R (2)						
82	81.8-86.4 ft. Argillaceous zone, unfilled vugs, (1-3 mm. in diameter)			4	100 %				J,PL,R						
84									J,PL,R						
			375.00						J,PL,R J,PL,R						5/19/95 @ 9:15 End of Run 4
86	84.5-86.4 ft. Color grades to light olive gray (5GY 6/1)		84.50						S,PL,SM J,PL,SM J,PL,SM						
									J,C,SM						
88									J,PL,R						
	88.6-93.8 ft. Argillaceous, vuggy, color is light olive gray (5GY 6/1)			5	100 %										
90															
92									B,PL,SM						
94															5/19/95 @ 10:40 End of Run 5
			365.00												
	94.5-97.5 ft. Argillaceous, color is light olive gray (5GY 6/1)		94.50												
96				6	100 %				J,PL,SM						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 8/20/95

Golder Associates

RECORD OF DRILLHOLE PZ-205-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/17/95 - 5/19/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067483.54
AZIMUTH: 0

COLLAR ELEV: 459.5
E: 515477.78
INCLINATION: -90

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: SW FR, MW, HW, CW	STRENGTH INDEX: R6 R5 R4 R3 R2 R1	POINT LOAD INDEX (psi): R1 30, R2 150, R3 300, R4 600, R5 1500, R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
96	67.5-99.5 ft. Fresh, medium to thinly bedded, pale yellowish brown (10YR 6/2), very fine grained, weak, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic 97.5-99.5 ft. Thin clay laminae			6	100 %	80 60 40 20	2 4 6 8 10	0 30 60 90	J,I,R,Fe J,PL,SM,CL J,I,R			R6 R5 R4 R3 R2 R1	R1 30, R2 150, R3 300, R4 600, R5 1500, R6		
98															
	360.00		360.00												5/19/95 @ 11:30 Finished drilling
	End of Record of Drillhole at 99.5 ft. 99.50		99.50												
100															
102															
104															
106															
108															
110															
112															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/20/95

Golder Associates

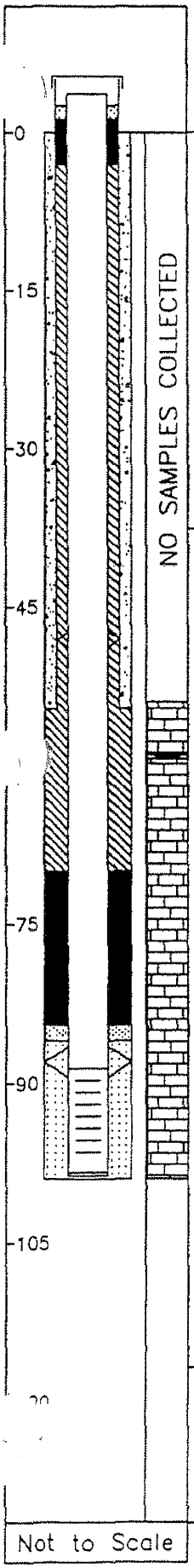
Well No. PZ-205-SS

Boring No. X-Ref: PZ-205-SS

PIEZOMETER CONSTRUCTION SUMMARY

Survey Coords: Northing: 1067484 ft.
Easting: 515478 ft.

Elevation Ground Level 459.5 ft. NGVD
Top of PVC Casing 461.78 ft. NGVD



Drilling Summary:

Total Depth 99.0 ft.
Borehole Diameter 9 3/4 in. (0.0-54.0 ft.) 5 7/8 in. (54.0-99.0 ft.)
Casing Stickup Height 1.66 ft.
Driller Layne-Western
St. Louis, MO

Rig CME 75, Schramm Portadrill T660H
Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit and 9 3/4 in. Tricone Bit
Drilling Fluid Auger-None, NX Core Water, Air and Mud Rotary
Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	5/18/95	8:15	5/19/95	11:30
Schramm Rotary	5/21/95	13:30	5/21/95	14:30
Geophys.Logging:				
Casing:				
2" PVC	5/21/95	14:25	5/21/95	14:30
6" Steel	5/11/95	7:30	5/11/95	11:00
Filter Placement:	5/21/95	14:40	5/21/95	15:15
Cementing:				
Development				
Bentonite Grout	5/21/95	15:20	5/21/95	15:35
Bentonite Seal	5/21/95	15:15	5/21/95	15:20

Well Design & Specifications

Basis: Geologic Log X Geophysical Log
Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.66	-	88.57	C1	461.78	-	370.96
88.57	-	98.37	S1	370.96	-	361.16
98.37	-	98.70	C2	361.16	-	360.83
+ 1.00	-	54.00	C3	460.50	-	405.53
	-				-	
	-				-	

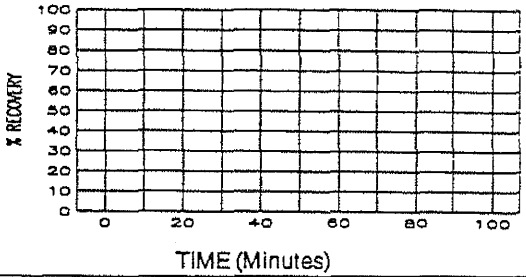
Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings
C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.) (C3-see comments)
Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings
Sand Pack: 16-35 mesh Silica Sand, 86.0-99.0 ft.
Filter Pack: Less than 50 mesh Silica Sand, 84.5-86.0 ft.
Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-70.0 ft.
Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 70.0-84.5 ft.
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments: Surface Casing C3: 6 1/8 in. ID / 6 5/8 in. OD Steel Casing

Not to Scale

Supervised by W. Herst
Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO
File Name PZ205SS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122506	CHECK NO.
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL
WELL NUMBER: PZ-20555
SITE ADDRESS: 21. CHARLES ROCK RD.
CITY: BRIDGETON
STATE: MO
ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC.
TELEPHONE: 314-241-3710
ADDRESS: 1838 N. BROADWAY
CITY: ST. LOUIS
STATE: MO
ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL SHOW LOCATION IN SECTION PLAT

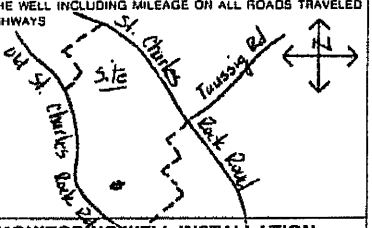
COUNTY: ST. LOUIS
ELEVATION: 454.5
AREA NO.:

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N,RNG. 5 E OR W

LAT. 38 · 45 · 35 · LONG. 90 · 36 · 45 ·

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

TYPE OF INSTALLATION: ☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL: FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL:

ELEVATION OF MEASURING POINT: 461.8

MEASURING POINT IS: ☒ TOP OF RISER PIPE ☐ OTHER

DRILLING EQUIPMENT: ☐ AIR ROTARY ☐ AUGER TYPE ____ ☐ REVERSE ROTARY ☐ OTHER ____

CENTRALIZERS USED: ☒ YES, AT 4 TOTAL ☒ STAINLESS STEEL ☐ OTHER ____ ☐ NO

MULTIPLE CASED WELLS: SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED: 5-21-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Michael P. Vogt
PERMIT NUMBER: 001256 WIM — DATE: 6-02-95
SIGNATURE (DRILLING CONTRACTOR): Michael P. Vogt
PERMIT NUMBER: 001256 WIM — DATE: 6-02-95

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 461.8

Ground Surface Elevation: 454.5

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
Depth to bottom of Protective Casing Seal:	3.0	
		30-85 Limestone
Depth to Base of Annular Seal:	60.0	
Depth to Base of Bentonite Seal:	71.0	
Depth to Base of Secondary Filter Pack:	72.5	
Depth to Top of the Screen:	74.7	
Depth to Bottom of the Screen:	84.7	
Plug Back Total Depth:		
Original Total Depth:	85.0	

LOCKING CAP - (Y) N (Circle one)
CAP VENT - (Y) N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8" x 5' x 5'
Bore Hole Diameter: 9 7/8"
WEEP HOLE - Y / N (Circle one)

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 77'
Diameter: 2"
Type of Material: SCH. 80 PVC

BOREHOLE DIAMETER: 5 7/8 in.

ANNULAR SEAL
Type: ☐ Bentonite Slurry ☒ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite
Length of Seal: 11 Ft.

SECONDARY FILTER PACK (Optional)
Type: ☒ Sand ☐ Manufactured
Grain Size: < 50
Length: 1.5'

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 16-35
Length: 13.5'

WELL SCREEN
Length: 10'
Slot Size: 0.010"
Type: SCH 80 PVC

SUMP DETAILS
Length: 0.5 Ft.
Diameter: 2 in.
Type: PVC

TYPE OF BACKFILL: SAND

DISTRIBUTION: WHITE-DIVISION CANARY-MONITORING WELL CONTRACTOR PINK-OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:					BORING NO.	
	6.25 inch I.D. Hollow Stem Auger					PZ-208-SS	
						SHEET	
	SAMPLING METHOD:					1 OF 3	
LAIDLAW\RI-FS\MO WEST LAKE LANDFILL OPERABLE UNIT 2	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)					DRILLING	
	SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)					START	FINISH
	WATER LEVEL					TIME	TIME
	TIME					14:30	8:50
	DATE					DATE	DATE
NORTHING: 1068030.83 DATUM EASTING: 515809.45 ELEVATION 458.4	CASING DEPTH					3/9/95	3/10/95

DRILL RIG CME 75 - TRUCK MOUNT

ANGLE VERTICAL BEARING

SAMPLE HAMMER

SURFACE CONDITIONS Wet to muddy sand adjacent to access road; no vegetation.

DEPTH IN FEET (ELEVATION)	BLOW/6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	23 29 20 22 (40/2)	0.8' 2.0'			(0.0-6.0 Ft.) Dense, medium light gray (N6), LIMESTONE GRAVEL and SAND, SR, dry, (GP), (FILL)	SP ①	
2	3 15 10 30 (45/2)	0.9' 2.0'				SP ②	
3							
4	33 25 16 18 (33)	0.1' 2.0'				SP ③	
5							
6					(452.4) 6.0		
6	6 5 3 4 (28/2)	0.4' 2.0'			(6.0-15.6 Ft.) Firm, moderate yellowish brown (10YR 5/4), CLAYEY SILT, little fine sand, iron stained, laminated, NR, damp, (CL-ML), (LOESS)	SP ④	
7							
8	3 3 3 5 (45/2)	0.9' 2.0'				SP ⑤	
9							
10	2 2 3 4 (55/2)	1.1' 2.0'				SP ⑥	
11							
12	1 2 3 3 (80/2)	1.6' 2.0'				SP ⑦	
13					@ 12.7 Ft., becoming moist @ 13.2-13.3 Ft., medium dark gray (N4), SILTY CLAY		
14	2 3 5 3 (40/2)	0.8' 2.0'				SP ⑧	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY M. HIRT CHK'D BY W. HIRST

DATE 3/9/95

JOB NO.: 943-2848

FII FNAME: PZ208SS

SOIL BOREHOLE LOG

LAIDLAW WASTE SYSTEMS INC.

SITE NAME AND LOCATION: LAIDLAW\RI-FS\MO WEST LAKE LANDFILL OPERABLE UNIT 2	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	BORING NO. PZ-206-SS SHEET 2 OF 3

						DRILLING START	DRILLING FINISH
WATER LEVEL						TIME	TIME
TIME						14:30	8:50
DATE						DATE	DATE
CASING DEPTH						3/9/95	3/10/95

NORTHING: 1068030.83
DATUM EASTING: 515809.45 ELEVATION 458.4

DRILL RIG CME 75 - TRUCK MOUNT
ANGLE VERTICAL BEARING
SAMPLE HAMMER

SURFACE CONDITIONS: Wet to muddy sand adjacent to access road; no vegetation.

DRILLING CONTR LAYNE-WESTERN
LOGGED BY M. HIRT
DATE 3/9/95 CHK'D BY W. HERST
JOB NO.: 943-2848
FILENAME: PZ206SS

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16	1 2 3 3 7	1.2' 2.0' (60%)			(6.0-15.6 Ft.) Firm, moderate yellowish brown (10YR 5/4), CLAYEY SILT, little fine sand, iron stained, laminated, NR, damp, (CL-ML), (LOESS) (442.8) 15.6	SP 8	
17					(15.6-17.6 Ft.) Firm, dark gray (N3), SILTY CLAY, damp, (CL), (LOESS) (440.8) 17.6	SP 9	
18	1 3 3 4	2.0' 2.0' (100%)			(17.6-18.0 Ft.) Stiff, olive gray (5Y 4/1), CLAY, little silt, NR, moist, (CL), (LOESS)		
19					(18.0-22.8 Ft.) Firm, olive gray (5Y 4/1), CLAYEY SILT, trace fine sand, NR, moist, (CL-ML), (LOESS)	SP 10	
20	hammer weight 2 4 4	1.7' 2.0' (85%)					
21						SP 11	
22	2 2 2 3 3	1.5' 2.0' (75%)			@ 22.0 Ft., becoming some fine sand		
23					(22.8-29.7 Ft.) Firm, light olive gray (5Y 5/2), CLAYEY SILT, iron stained, laminated, NR, moist, (CL-ML), (LOESS)	SP 12	
24	3 3 3 5 5	1.5' 2.0' (75%)			@ 24.5-24.8 Ft., some sand, wet		
25					@ 25.2-25.4 Ft., some sand, wet	SP 13	
26	1 1 3 5 5	1.2' 2.0' (60%)					
27					@ 27.2-29.7 Ft., wet @ 27.4-27.6 Ft., fine to medium sand layers	SP 14	
28	1 2 3 3	1.7' 2.0' (85%)					
29					@ 28.6-29.7 Ft., little sand	SP 15	
					(29.7-31.3 Ft.) Firm, medium dark gray (N4), CLAYEY SILT, NR, damp, (CL-ML), (LOESS)		

LAIDLAW WASTE SYSTEMS, INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	LAIDLAW\RI-FS\MD WEST LAKE LANDFILL OPERABLE UNIT 2
DRILLING METHOD:	6.25 inch I.D. Hollow Stem Auger
SAMPLING METHOD:	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)
BORING NO.	PZ-206-SS
SHEET	3 OF 3
DRILLING	START / FINISH
WATER LEVEL	
TIME	START: 14:30 / FINISH: 8:50
DATE	START: 3/9/95 / FINISH: 3/10/95
CASING DEPTH	
NORTHING: 1068030.83 DATUM EASTING: 515809.45	ELEVATION 458.4
DRILL RIG	CME 75 - TRUCK MOUNT
ANGLE	VERTICAL BEARING
SAMPLE HAMMER	
SURFACE CONDITIONS	Wet to muddy sand adjacent to access road; no vegetation.

DEPTH IN FEET (ELEVATION)	BLOWS/6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31	1, 4, 12, 16	1.8'/2.0' (90%)			(29.7-31.3 Ft.) Firm, medium dark gray (N4), CLAYEY SILT, NR, damp, (CL-ML), (LOESS) @ 31.1-31.3 Ft., wet (427.1) 31.3	SP 16	
32	5, 6, 7, 8	2.0'/2.0' (100%)			(31.3-36.9 Ft.) Compact to loose, moderate to dark yellowish brown (10YR 5/4-10YR 4/2), f-m SAND, trace silt, NR, wet, (SP), (ALLUVIAL)	SP 17	Split spoon wet
33							
34	0, 2, 2, 4	2.0'/2.0' (100%)			@ 34.0 Ft., becoming medium sand	SP 18	Split spoon wet
35							
36	7, 8, 7, 8	1.3'/2.0' (65%)			@ 35.9-36.9 Ft., SAND and CLAY (421.5) 36.9	SP 19	Add water to inside of augers to prevent sand blow
37					(36.9-37.7 Ft.) Stiff, olive gray (5Y 4/1), CLAYEY f-m SAND, NR, MOIST, (SC), (ALLUVIAL) (420.7) 37.7		
38	6, 2, 4, 11	0.7'/2.0' (35%)			(37.7-41.1 Ft.) Stiff, olive gray (5Y 4/1), CLAYEY SILT, trace sand, laminated, NR, wet, (CL-ML), (LOESS)	SP 20	
39							
40	6, 7, 12, 16	1.0'/2.0' (50%)			(417.3) 41.1	SP 21	
41					(41.1-43.0 Ft.) Compact, olive gray (5Y 4/1), Fine SAND, trace silt, NR, wet, (SM), (ALLUVIAL)		
42	2, 23, 50/0"	0.7'/2.0' (35%)			(415.4) 43.0	SP 22	Split spoon refusal at 43.0 feet; auger to 44.0 feet
43					End of Soil Borehole Log at 43.0 Ft. See PZ-206-SS Record of Drillhole for rock descriptions		
44	50/1"	0.0'/1.0' (0%)				SP 23	Split spoon refusal at 44.0 feet

DRILLING CONTR LAYNE-WESTERN

LOGGED BY M. HIRT CHK'D BY W. HERST

DATE 3/9/95

JOB NO.: 943-2848

FILENAME: PZ206SS

RECORD OF DRILLHOLE PZ-206-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/5/95 - 4/8/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1060830.8
AZIMUTH: 0

COLLAR ELEV: 456.4
E: 515809.5
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FT)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX: SW FR, MW, HW, CW	STRENGTH INDEX: R6, R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): R7 30, R6 150, R5 300, R4 600, R3 1500, R2	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32	0.0-43.0 ft. See Soil Borehole Log PZ-206-SS														
34															
36															
38															
40															
42	415.40														
	43.0-44.5 ft. 43.00 No samples collected		413.90												Advanced 4" diam. HW casing to 46.0 ft., begin coring on top of rubble at 44.5 ft.
44	413.90														
	44.5-51.7 ft. 44.50 Slightly weathered, medium bedded, light olive gray (5Y 6/1), microcrystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)		44.50												
46	44.5-46.1 ft. Some chlorite on broken surfaces			1	77%				J,I,SM,CL (2) J,I,SM						
	47.7-49.4 ft. Moderately weathered, porous/ vuggy								J,U,SM,Fe J,I,SM,Fe						
48															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: J. MILLER
DATE: 5/16/95

Golder Associates

RECORD OF DRILLHOLE PZ-206-SS

Sheet 2 of 8

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/5/95 - 4/6/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1060830.8
AZIMUTH: 0

COLLAR ELEV: 458.4
E: 515809.5
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW, FR, MW, HW, CW)	STRENGTH INDEX (R6, R5, R4, R3, R2, R1)	POINT LOAD INDEX (psi) (RT 30, R6 150, R5 300, R4 600, R3 1500, R2, R1)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48	44.5-51.7 ft. Slightly weathered, medium bedded, light olive gray (5Y 6/1), microcrystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)		409.40	1	77%				Core Loss						Core loss due to fractured, weathered rock Core Run 1 at 11:55
			49.00						J,I,SM (6)						
50									J,PL,SM						
									J,I,R (2)						
			408.70						J,I,SM						
52	51.7-52.7 ft. Completely weathered, thickly laminated, greenish gray (5GY 6/1), very fine grained, extremely weak, CLAYSTONE, (ST. LOUIS FORMATION)		51.70 406.10 52.30						J,I,SM,CL						
									Core Loss						Core loss due to presence of weak claystone
	52.7-59.2 ft. Slightly weathered, medium bedded, light olive gray (5Y 5/2), very fine grained, medium strong, DOLOMITE, (ST. LOUIS FORMATION) 54.2-55.3 ft. Moderately weathered, very porous/vuggy, (<1-3 mm.)			2	96%				J,I,R						
54															
56									J,I,R						
58			399.40												
	59.2-66.5 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), f-m grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) 1-2 mm. calcite veins common, stylolitic, few zones showing up to 5 mm. vugs, little pyrite crystals, few Arenaceous Limestone beds throughout up to 10 mm.		399.20 59.20 59.00						End Core Run 2 at 14:10 4/5/95 @ 13:15 Begin coring Run 3						
60									J,I,R						
				3	100 %				J,I,R						
62									J,I,R (2)						
									J,I,R						
64			394.40 84.00												4/5/95 @ 13:40 Begin coring Run 4

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: J. MILLER
DATE: 5/16/95

Golder Associates

RECORD OF DRILLHOLE PZ-206-SS

Sheet 3 of 6

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/5/95 - 4/6/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1060830.6
AZIMUTH: 0

COLLAR ELEV: 458.4
E: 515809.5
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64			394.40 64.00						J,I,CL (3) J,I,R						4/5/95 @ 13:40 Begin coring Run 4
	64.5-67.3 ft. Small (up to 1 mm.), glauconite lenses, few pyrite veins <1 mm., but abundant crystals														
66									J,I,R						
	66.5-68.5 ft. Fresh, thickly bedded, olive gray (5Y 4/1), f-m grained, medium strong, ARENACEOUS LIMESTONE, (ST. LOUIS FORMATION) Abundant calcite crystals <1 mm.								J,I,R (2)						
68	66.6 ft. A large >20 mm. calcite crystals								J,I,R						
	68.5-70.0 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Calcite crystals common, argillaceous partings observed			4	100 %				J,I,CL J,I,CL (2)						
70	70.2-71.8 ft. Arenaceous Limestone with abundant calcity crystals														
	71.8-80.0 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Calcite crystals common, fossils present but not abundant, stylolitic, pyrite crystals and veins up to 1 mm. abundant								J,I,R						
72			384.40												
74			74.00						J,I,SM,CL J,I,R J,I,SM,CL J,I,R (5)						4/5/95 @ 14:25 Begin coring Run 5
76				5	100 %				J,I,R (2) J,I,SM,CL						
	77.3-77.8 ft. Argillaceous Limestone														
78	77.8-78.1 ft. Chert nodules								J,I,SM,CL (2)						
									J,I,R (2)						
80															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: J. MILLER
DATE: 5/18/95

Golder Associates

RECORD OF DRILLHOLE PZ-206-SS

Sheet 4 of 6

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/5/95 - 4/8/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1060630.6
AZIMUTH: 0

COLLAR ELEV: 458.4
E: 515809.5
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infil, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	80.0-85.0 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), f-m grained to microcrystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Large calcite veins up to 12 mm., abundant pyrite crystals and veins up to 1 mm., argillaceous partings scattered throughout, stylolitic								J,I,R (2)						
82				5	100 %				J,I,SM,CL						
									J,I,SM,CL						
									J,I,R						
84			374.40 / 84.00												4/5/95 @ 15:24 Begin coring Run 6
86	85.0-87.5 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), finely crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolites common, calcite and pyrite veins present, trace of glauconite, few chert nodules								J,I,SM,CL (2)						
									J,I,R,CL						
88	87.5-89.5 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Calcite and pyrite crystals abundant, few calcite veins <1 mm.								J,I,R						
				6	100 %										
	89.5-93.3 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained to crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Calcite and pyrite crystals abundant, few calcite veins <1 mm.								J,I,R						
90									J,I,R,CL						
									J,I,R,CL						
92									J,I,CL (2)						
	93.3-99.1 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, bioturbated, abundant calcite veins up to 1 mm., few pyrite crystals		364.40 / 94.00												4/5/95 @ 16:16 Begin coring Run 7
94				7	100 %										
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: J. MILLER
DATE: 5/18/95

Golder Associates

RECORD OF DRILLHOLE PZ-206-SS

Sheet 5 of 6

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/5/95 - 4/6/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1060830.8
AZIMUTH: 0

COLLAR ELEV: 456.4
E: 515808.5
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
96	93.3-99.1 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, bioturbated, abundant calcite veins up to 1 mm., few pyrite crystals								J,I,R						
98															
100	99.1-102.5 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained to crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Abundant argillaceous partings, calcite veins up to 10 mm., pyrite crystals scattered			7	100 %				J,I,R,CL						
									J,I,R						
102	102.5-105.0 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, calcite and pyrite crystals common, small <2 mm. vugs/porous, calcite veins <1 mm. scattered								J,I,R,CL						4/5/95 @ 17:00 Stop coring for the day
			354.40 / 104.00												4/6/95 @ 8:13 Begin coring Run 8
104															
106	105.0-108.0 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, abundant calcite and pyrite veins up to 2 mm., fossiliferous, argillaceous partings common, few large crystals of calcite up to 8 mm.								J,I,R,CL (2)						
				8	100 %				J,I,R						
									J,I,R						
									J,I,R,CL						
108	108.0-113.0 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic abundant calcite and pyrite veins, chert nodules common								J,I,R						4/6/95 @ 9:17 Begin coring Run 9
			349.40 / 109.00												
									J,I,SM,CL						
110	109.4-110.1 ft. Bed of bluish green, clayey material, foliated, intra-clasts of Limestone								J,I,SM,CL						
				9	97%				J,I,SM,CL (2)						
									J,I,R						
112															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: J. MILLER
DATE: 5/16/95

Golder Associates

RECORD OF DRILLHOLE PZ-206-SS

Sheet 6 of 6

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/5/95 - 4/6/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1060830.8
AZIMUTH: 0

COLLAR ELEV: 458.4
E: 515809.5
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FT)	ROCK TYPE / DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR, MW, HW, CW)	STRENGTH INDEX (R5 R4 R3 R2 R1 R0)	POINT LOAD INDEX (psi) (R1 30, R2 150, R3 300, R4 600, R5 1500, R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
112									J,I,SM,CL						
	113.0-117.0 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Banded with fine to medium grained Limestone up to 8 mm. thick, calcite crystals and veins up to 1 mm. present, stylolites rare but present														
114									J,I,R,CL						
									J,I,R,CL						
				9	97%										
116															
	341.40 117.00														117.0 ft. Inferred top of SALEM FORMATION encountered
118	117.0-120.7 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, fossiliferous, pyrite and calcite veins common, oolitic, fossils are brachiopods and crinoids. Argillaceous partings from 119.0-119.7 ft.								J,I,R,CL						
			338.40 119.00												4/6/95 @ 10:23 Begin coring Run 10
									J,I,R,CL						
120															
	120.7-122.5 ft. Fresh, thickly bedded, olive gray (5Y 6/1), fine grained, strong, ARGILLACEOUS LIMESTONE, (SALEM FORMATION) Abundant argillaceous partings and calcite crystals, partings appear like spider form														
122				10	98%										
	122.5-125.0 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, LIMESTONE, (SALEM FORMATION) Beds of chert up to 60 mm., stylolitic, abundant argillaceous partings								J,I,R,CL						
									J,I,R						
									J,I,R,CL						
124									J,I,R						
	333.40		333.40						J,I,R (2)						4/6/95 @ 11:05 Coring completed
	End of Record of Drillhole at 125.0 ft. 125.00		125.00												
126															
128															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

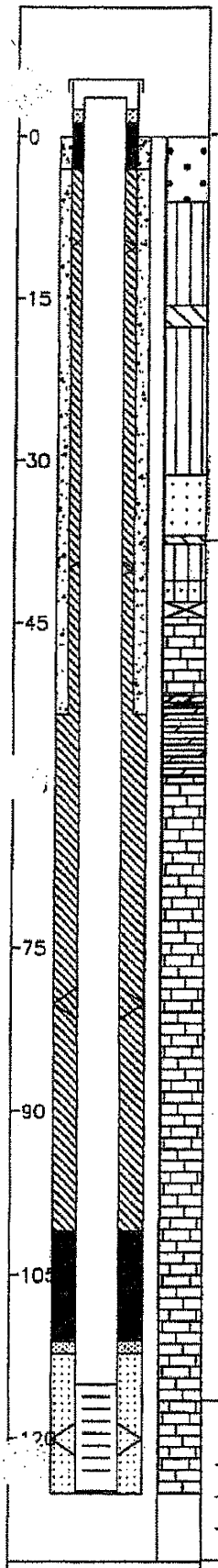
LOGGED: S. COSIO
CHECKED: J. MILLER
DATE: 5/16/95

Golder Associates

Well No. PZ-206-SS

Boring No. X-Ref: PZ-206-SS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1068031 ft. Easting: 515809 ft.

Elevation Ground Level 458.4 ft. NGVD

Top of PVC Casing 460.20 ft. NGVD

Drilling Summary:

Total Depth 125.5 ft.

Borehole Diameter 10 in. (0.0–52.0 ft.) 5 7/8 in. (52.0–125.5 ft.)

Casing Stickup Height 1.82 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. and 10 1/4 in. ID Hollow Stem Auger Bits, NX Core, 5 7/8 in. and 10 in. Button Bits

Drilling Fluid Auger–None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	3/9/95	14:30	3/10/95	11:05
Schramm Rotary	4/24/95	11:30	4/24/95	13:30
Geophys.Logging:				
Casing:				
2" PVC	4/24/95	13:45	4/24/95	14:02
8" Steel	3/27/95	9:30	3/23/95	10:15
Filter Placement:	4/24/95	14:00	4/24/95	14:15
Cementing:				
Development				
Bentonite Grout	4/24/95	14:20	4/24/95	15:30
Bentonite Seal	4/24/95	14:10	4/24/95	14:20

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.82	–	115.00	C1	460.20	–	343.38
115.00	–	124.80	S1	343.38	–	333.58
124.80	–	125.00	C2	333.58	–	333.38
+ 0.70	–	52.00	C3	459.10	–	406.38
	–				–	
	–				–	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.) (C3–see comments)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16–35 mesh Silica Sand, 112.2–125.5 ft.

Filter Pack: Less than 50 mesh Silica Sand, 111.1–112.2 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0–101.0 ft., Neat cement, 3.0–52.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 101.0–111.1 ft.

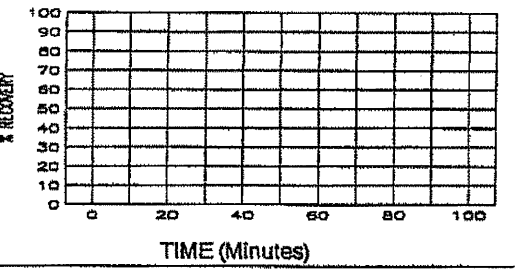
Concrete: 0.0–3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Surface Casing C3: 6 1/8 in. ID / 6 5/8 in. OD Steel Casing

Supervised by D. Alloway

Job Number 943-2848

Site LAIDLAW/OU2 RI–FS/MO

File Name PZ206SS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	
REF. NO 115096	DATE RECEIVED
ROUTE	CHECK NO.
STATE WELL NUMBER	TRANSMITTAL NO
CHECKED BY	CROSS REFERENCE NO.
APPROVED BY	ENTERED Ph 1 Ph 2 Ph 3
	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL
WELL NUMBER: PZ-206-55
SITE ADDRESS: ST. CHARLES ROCK RD.
CITY: BRIDGETON
STATE: MO. ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC.
TELEPHONE: 314-241-3710
ADDRESS: 1828 N. BROADWAY
CITY: ST. LOUIS
STATE: MO ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL SHOW LOCATION IN SECTION PLAT

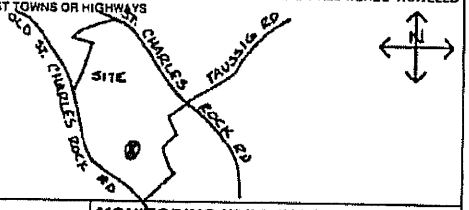
COUNTY: ST. LOUIS
ELEVATION: 458.4
AREA NO.:

SMALLEST ¼ ____ ¼ ____ ¼ LARGEST ¼ ____

SEC. ____ TWN. 47 N.RNG. 5 E OR W

LAT. 38 ° 46 ' 00 " LONG. 90 ° 26 ' 40 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

NOTE: Record the fraction of a foot in decimal, not in inches

Top of Riser Elevation: 460.2
Ground Surface Elevation: 458.4 Ft.

LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)
PROTECTIVE CASING
Type: STEEL
Size: 8" x 5" x 5'
Bore Hole Diameter: 10.25"
WEEP HOLE - Y / N (Circle one)

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
	0-6	Fill
Depth to bottom of Protective Casing Seal:	3.0	
	6-16	Clayey silt
	16-32	Sand
	32-37.5	Sandy clay
	37.5-41	Silt
	41-43.5	Sandy silt
Depth to Base of Annular Seal:	101.0	43.5-125.5 Limestone
Depth to Base of Bentonite Seal:	111.1	
Depth to Base of Secondary Filter Pack:	112.2	
Depth to Top of the Screen:	115.2	
Depth to Bottom of the Screen:	125.2	
Plug Back Total Depth:		
Original Total Depth:	125.5	

PROTECTIVE CASING SEAL
Type: [X] Concrete [ ] Cement Slurry

RISER PIPE
Length: 117.0'
Diameter: 2"
Type of Material: SCH. 80 PVC

BOREHOLE DIAMETER: 5 7/8 in.

ANNULAR SEAL
Type: [X] Bentonite Slurry [ ] Cement Slurry [ ] Non Slurry Bentonite

BENTONITE SEAL
Type: [X] Bentonite Slurry [ ] Non Slurry Bentonite
Length of Seal: 10.1 Ft.

SECONDARY FILTER PACK (Optional)
Type: [X] Sand [ ] Manufactured
Grain Size: SUGAR < 50
Length: 1.1'

PRIMARY FILTER PACK
Type: [X] Sand [ ] Manufactured
Grain Size: 16-35
Length: 13.3'

WELL SCREEN
Length: 10'
Slot Size: 0.010"
Type: SCH. 80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 in.
Type: PVC

TYPE OF BACKFILL: SAND

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

TYPE OF INSTALLATION
[X] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
460.20

MEASURING POINT IS
[X] TOP OF RISER PIPE
[ ] OTHER

DRILLING EQUIPMENT
[X] AIR ROTARY [X] AUGER TYPE 6¼ HSA
[ ] REVERSE ROTARY [ ] OTHER

CENTRALIZERS USED
[X] YES, AT 4 TOTAL
[X] STAINLESS STEEL
[ ] OTHER
[ ] NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
4-24-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Richard P. Vogt
PERMIT NUMBER: 001256 WM1 DATE: 5-10-95
SIGNATURE (DRILLING CONTRACTOR): Richard P. Vogt
PERMIT NUMBER: 001256 WM1 DATE: 5-10-95

MO 780-1415 (2-94)

DISTRIBUTION: WHITE/DIVISION CANARY/MONITORING WELL CONTRACTOR PINK/OWNER

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	BORING NO. PZ-207-AS SHEET 1 OF 3

WATER LEVEL					DRILLING START	DRILLING FINISH
TIME					TIME 12:35	TIME 17:42
DATE					DATE 4/9/95	DATE 4/9/95
CASING DEPTH						

DATUM NORTHING: 1069644.67 EASTING: 516037.64 ELEVATION 461.9

DRILL RIG CME 75 - TRUCK MOUNT

ANGLE VERTICAL BEARING NA

SAMPLE HAMMER 140 lbs.

SURFACE CONDITIONS

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
0–2	3 50/6"	0.0'/2.0' (0%)			(0.0-2.0 ft.) Concrete (459.9) 2.0	SP 1	
2–4	11 10 7 6	1.1'/2.0' (55%)			(2.0-4.0 ft.) Very stiff, mottled, moderate yellowish brown (10YR 5/4) to dark greenish gray (5GY 4/1), SILT, NR, damp, (ML), (LOESS) (457.9) 4.0	SP 2	
4–6	3 4 5 6	1.5'/2.0' (75%)			(4.0-5.8 ft.) Stiff, dark greenish gray (5GY 4/1), CLAYEY SILT, some fine Gravel, mottled, NR, damp, (CL-ML), (LOESS) (456.1) 5.8	SP 3	
6–8	16 4 1 2	0.1'/2.0' (5%)			(5.8-12.0 ft.) Waste	SP 4	
8–10	3 3 7 8	0.1'/2.0' (5%)				SP 5	
10–12	5 2 4 23	0.3'/2.0' (15%)			below 9.5 ft., waste becomes wet (449.9) 12.0	SP 6	First water encountered @ 9.5 ft.
12–13	4 14 18 3	0.7'/2.0' (35%)			(12.0-12.7 ft.) Hard, dark greenish gray (5GY 4/1), CLAY, trace fine Gravel, NR, wet, (CL), (FILL) (449.2) 12.7	SP 7	
13–14					(12.7-14.0 ft.) Waste		
14–16	4 6 1 4	0.0'/2.0' (0%)			(14.0-16.0 ft.) No Recovery	SP 8	from 14.0-20.0 ft., no samples recovered, but drilling indicates waste

DRILLING CONTR LAYNE-WESTERN

LOGGED BY S. COSIO

DATE 6/1/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ207AS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MO
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1069644.67
DATUM EASTING: 516037.64 ELEVATION 461.9

DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger

SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)

					DRILLING START	DRILLING FINISH
WATER LEVEL					TIME	TIME
TIME					12:35	17:42
DATE					DATE	DATE
CASING DEPTH					4/9/95	4/9/95

BORING NO. PZ-207-AS

SHEET 2 OF 3

DRILL RIG CME 75 - TRUCK MOUNT

ANGLE VERTICAL BEARING NA

SAMPLE HAMMER 140 lbs.

SURFACE CONDITIONS

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16					(12.7-20.0 Ft.) Waste	SP 8	
	3 1 5 7	0.0" 2.0" (0%)			(16.0-18.0 Ft.) No Recovery		
17						SP 9	
18	4 5 6 11	0.0" 2.0" (0%)			(18.0-20.0 Ft.) No Recovery		
19						SP 10	
					(441.9) 20.0		
20	6 5 5 6	1.0" 2.0" (50%)			(20.0-20.4 Ft.) Stiff, dark greenish gray (5GY 4/1), SILT, trace Fine Gravel, NR, wet, (ML), (FILL)		
					(441.5) 20.4	SP 11	
21					(20.4-20.6 Ft.) Loose, dark greenish gray (5GY 4/1), Fine SAND, NR, wet, (SW), (FILL)		
					(441.3) 20.6		
22	10 18 8 4	0.9" 2.0" (45%)			(20.6-22.0 Ft.) Waste (22.0-24.0 Ft.) No Recovery	SP 12	from 22.0-28.0 Ft. no samples recovered, but drilling indicates waste
23							
24	3 3 3 18	0.0" 2.0" (0%)			(24.0-26.0 Ft.) No Recovery	SP 13	
25							
26	30 31 14 5	0.0" 2.0" (0%)			(26.0-28.0 Ft.) No Recovery	SP 14	
27							
					(433.9) 28.0		
28	1 9 10 5	0.6" 2.0" (30%)			(28.0-32.0 Ft.) Firm to very stiff, greenish black (5G 4/1) to dusky blue-green (5BG 3/2), SILT, little Sand and Gravel, NR, wet, (ML), (FILL)	SP 15	
29							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY S. CUSID DATE 6/1/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ207AS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MO
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1069644.67
DATUM EASTING: 516037.64 ELEVATION 461.9

DRILL RIG CME 75 - TRUCK MOUNT
ANGLE VERTICAL BEARING NA
SAMPLE HAMMER 140 lbs.

DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger

SAMPLING METHOD:
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)

WATER LEVEL					
TIME					
DATE					
CASING DEPTH					

BORING NO. PZ-207-AS
SHEET 3 OF 3
DRILLING

START	FINISH
TIME 12:35	TIME 17:42
DATE 4/9/95	DATE 4/9/95

SURFACE CONDITIONS

DEPTH IN FEET (ELEVATION)	BLOW/6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE		REMARKS
31	4 1 4 4	0.1" 2.0" (5%)			(28.0-32.0 ft.) Firm to very stiff, greenish black (5G 4/1) to dusky blue-green (5BG 3/2), SILT, little Sand and Gravel, NR, wet, (ML), (FILL)	SP	16	
32					(429.9) 32.0			
33	3 10 15 20	1.1" 2.0" (55%)			(32.0-40.0 ft.) Very loose to compact, dark greenish gray (5GY 4/1), Fine SAND, NR, wet, (SW), (ALLUVIUM)	SP	17	
34	10 8 18 15	1.3" 2.0" (65%)				SP	18	
36	0 0 0 0	2.0" 2.0" (100%)				SP	19	
38	1 4 5 7	0.5" 2.0" (25%)				SP	20	
39					(421.9) 40.0			
40					End of Soil Borehole Log at 40.0 ft.			
41								
42								
43								
44								

DRILLING CONTR LAYNE-WESTERN

LOGGED BY S. COSIO

DATE 6/1/95 CHK'D BY W. HERST

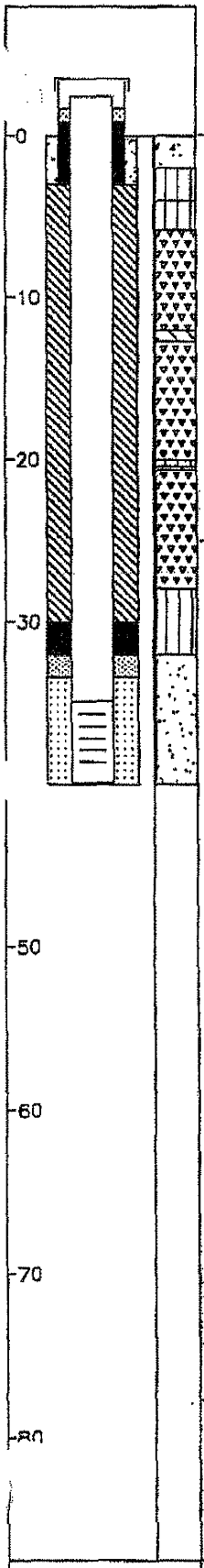
JOB NO.: 943-2848

FILENAME: PZ207AS

Well No. PZ-207-AS

Boring No. X-Ref: PZ-207-AS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1069645 ft. Easting: 516038 ft.

Elevation Ground Level 461.9 ft. NGVD

Top of PVC Casing 463.57 ft. NGVD

Drilling Summary:

Total Depth 40.0 ft.
Borehole Diameter 8 1/4 in.
Casing Stickup Height 1.69 ft.
Driller Layne-Western
St. Louis, MO

Rig CME 75
Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit,

Drilling Fluid Auger-None

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	4/9/95	12:35	4/9/95	17:45
Schramm Rotary				
Geophys.Logging:				
Casing:	4/10/95	9:45	4/10/95	10:00
Filter Placement:	4/10/95	10:00	4/10/95	10:17
Cementing:				
Development				
Bentonite Grout	4/10/95	10:35	4/10/95	11:10
Bentonite Seal	4/10/95	10:32	4/10/95	10:35

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.69	-	34.90	C1	463.57	-	428.98
34.90	-	39.70	S1	426.98	-	422.18
39.70	-	40.03	C2	422.18	-	421.85
	-				-	
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings
C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 33.4-40.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 32.0-33.4 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-20.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 20.0-32.0 ft.

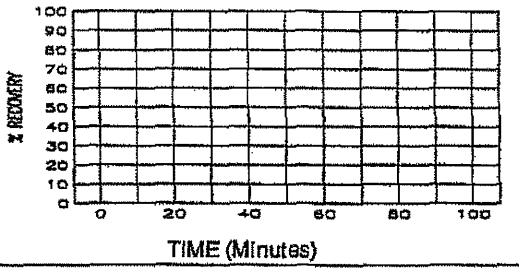
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by S. Cosio
Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO
File Name PZ207AS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122486	CHECK NO
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME	WELL NUMBER
LANDLAW BRIDGETON SANITARY LANDFILL	PZ-207-AS

SITE ADDRESS	CITY	STATE	ZIP CODE
St. Charles Rock Rd.	BRIDGETON	MO	63044

NAME	TELEPHONE
LANDLAW WASTE SYSTEMS, INC.	314-241-3710

ADDRESS	CITY	STATE	ZIP CODE
1710 N BROADWAY	ST LOUIS	MO	63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL SHOW LOCATION IN SECTION PLAT

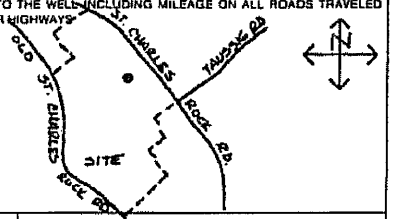
COUNTY ST. LOUIS
ELEVATION 460.7
AREA NO.

SMALLEST ¼ LARGEST ¼

SEC. ____ TWN. 47 N.RNG. 5 (E) OR W

LAT. 38 ° 46 ' 06 " LONG. 90 ° 26 ' 38 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO, INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO, INC.

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
463.57

MEASURING POINT IS
☒ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☐ AIR ROTARY ☒ AUGER TYPE 4¼ H.S.A.
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☒ YES, AT 1 PER
☒ STAINLESS STEEL
☐ OTHER
☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
4-10-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR)
Ted W. Hall Hydrologist

PERMIT NUMBER	DATE
001258 WMM	5-10-95

SIGNATURE (DRILLING CONTRACTOR)
Ted W. Hall

PERMIT NUMBER	DATE
001258WMM	5-16-95

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 463.6

LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)
PROTECTIVE CASING Type: STEEL Size: 8"x6"x5' Bore Hole Diameter: 12"
WEEP HOLE - Y / N (Circle one)

Ground Surface Elevation: 460.7 Ft.

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
Depth to bottom of Protective Casing Seal:		
Depth to Base of Annular Seal:	30.0	
Depth to Base of Bentonite Seal:	31.0	
Depth to Base of Secondary Filter Pack:	33.4	
Depth to Top of the Screen:	34.7	
		Alluvium
Depth to Bottom of the Screen:	39.7	
Plug Back Total Depth:		
Original Total Depth:	40.2	

PROTECTIVE CASING SEAL Type: ☒ Concrete ☐ Cement Slurry
RISER PIPE Length: 36.6' Diameter: 2" Type of Material: SCH 80 PVC
BOREHOLE DIAMETER: 8 In.
ANNULAR SEAL Type: ☒ Bentonite Slurry ☐ Cement Slurry ☐ Non Slurry Bentonite
BENTONITE SEAL Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite Length of Seal: 2 Ft.
SECONDARY FILTER PACK Type: ☒ Sand (Optional) ☐ Manufactured Grain Size: SUGAR 450 Length: 1.5'
PRIMARY FILTER PACK Type: ☒ Sand ☐ Manufactured Grain Size: 10-35 Length: 6.8'
WELL SCREEN Length: 5' Slot Size: 0.010" Type: SCH 80 PVC
SUMP DETAILS Length: 0.3 Ft. Diameter: 2 In. Type: PVC
TYPE OF BACKFILL: SAND

MO 780-1415 (2-94)

DISTRIBUTION: WHITE/DIVISION CANARY/MONITORING WELL CONTRACTOR PINK/OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	6.25 inch I.D. Hollow Stem Auger	PZ-208-SS
	SAMPLING METHOD:	SHEET 1 OF 2
	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)	DRILLING
	SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	START / FINISH

WATER LEVEL					START TIME	FINISH TIME
TIME					8:15	9:45
DATE					DATE	DATE
CASING DEPTH					6/17/95	6/17/95

DATUM NORTHING: 1069219.14 EASTING: 517169.45 ELEVATION 472.5

DRILL RIG CME 75 - TRUCK MOUNT

SURFACE CONDITIONS Grass covered lawn

ANGLE BEARING

SAMPLE HAMMER

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	2 2 2 3	1.1'/2.0' (55%)			(0.0-4.0 ft.) Firm, dark yellowish brown (10YR 4/2), SILT CLAY, trace organics consisting of fine roots, NR, damp, (CL), (TOPSOIL)	SP 1	
2 3	2 2 2 3	1.7'/2.0' (85%)			@ 2.0 ft., color changes to moderate yellowish brown (10YR 5/4)	SP 2	
					(468.5) 4.0		
4 5	2 2 4 4	1.7'/2.0' (85%)			(4.0-7.5 ft.) Loose, moderate yellowish brown (10YR 5/4) to pale yellowish brown (10YR 6/2), CLAYEY SILT, NR, moist, (CL-ML), (LOESS)	SP 3	
6 7	2 3 4 5	0.9'/2.0' (45%)				SP 4	
					(465.0) 7.5		
8 9	2 3 3 4	1.5'/2.0' (75%)			(7.5-15.0 ft.) Loose, pale yellowish brown (10YR 6/2), SILT, trace iron oxide staining, occasional thin, damp, fine sand seams (<1 1/2 in. thick), (ML), (LOESS)	SP 5	
10 11	4 5 3 5	1.9'/2.0' (95%)				SP 6	
12 13	1 2 5 8	0.5'/2.0' (25%)			from 12.0-14.0 ft., little fine sand throughout silt	SP 7	
14	5 6 7 7	1.8'/2.0' (90%)				SP 8	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER

DATE 7/14/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ208SS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION

LAIDLAW/OU2 RI-FS/MO
WEST LAKE LANDFILL
OPERABLE UNIT 2

NORTHING: 1069219.14
DATUM EASTING: 517169.45 ELEVATION 472.5

DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger

BORING NO. PZ-208-SS

SHEET 2 OF 2

SAMPLING METHOD:
SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)
SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)

					DRILLING START	DRILLING FINISH
WATER LEVEL						
TIME					8:15	9:45
DATE					6/17/95	6/17/95
CASING DEPTH						

DRILL RIG CME 75 - TRUCK MOUNT
SURFACE CONDITIONS Grass covered lawn
ANGLE BEARING
SAMPLE HAMMER

DRILLING CONTR LAYNE-WESTERN

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE		REMARKS
16	7 50	0.5" 1.0" (50/0)			(15.0-17.0 ft.) Compact, pale yellowish brown (10YR 6/2) to moderate yellowish brown (10YR 6/2), Fine SAND, trace Silt, trace iron oxide staining, NR, damp, (SP), (ALLUVIUM) @ 16.0 Ft., fine sand becomes wet	SP 8 SP 9		
					(455.5) 17.0			
17					End of Soil Borehole Log at 17.0 ft. See PZ-208-SS Record of Drillhole For rock descriptions			
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								

LOGGED BY J. MILLER CHK'D BY V. HERST
DATE 7/14/95
JOB NO.: 943-2848
FILENAME: PZ208SS

RECORD OF DRILLHOLE PZ-208-SS

Sheet 1 of 6

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/17/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1069219.14
AZIMUTH: 0

COLLAR ELEV: 472.5
E: 517189.45
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	ROD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR, MW HW, CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30, R2 150, R3 300, R4 600, R5 1500, R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
16	0.0-17.0 ft. See Soil Borehole Log PZ-202-SS. 17.0-17.4 ft. No samples collected		455.10												
	17.4-24.3 ft. Slightly weathered, thinly bedded, light olive gray (5Y 6/1), fine crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Some fossils		17.40												6/17/95 @ 10:15 Begain Run 1
18				1	100%				J,I,R (4)						
									J,PL,SM						
			453.30												6/17/95 @ 10:30 End Run 1
			19.20						B,I,R (2)						
20									J,PL,SM,CL						
									J,PL,SM						
									J,PL,SM (3)						
									J,I,SM						
									J,I,SM,Fe						
									J,I,R (3)						
22									J,I,R						
									J,I,SM (4)						
									J,I,R (2)						
									J,I,SM,CL						
									J,I,R (2)						
24	24.3-59.8 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Some fossiliferous zones			3	100%				J,I,R,CL						
									J,I,R,CL (4)						
									J,I,R						
									J,I,R						
									J,I,R,CL (4)						
26									J,I,R,CL						
									J,I,R						
									J,I,SM,CL (2)						
									J,I,R (3)						
									J,I,R,CL (2)						
28									J,I,R,CL (2)						
									J,I,R						
			443.30												
	Below 29.2 ft. no fossils present		29.20						J,I,R,CL						6/17/95 @ 11:00 End Run 2
									J,P,SM,CL						
									J,I,R						
30									J,I,R						
									J,I,R,CL						
				3	100%				J,I,R						
									J,I,R,CL (2)						
									J,I,SM,CL (4)						
32									J,I,R,CL						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-208-SS

Sheet 2 of 8

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2845
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 8/17/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1069218.14
AZIMUTH: 0

COLLAR ELEV: 472.5
E: 517168.45
INCLINATION: -90

DEPTH SCALE (FEET)

ROCK TYPE

DESCRIPTION

GRAPHIC LOG

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

ELEV / DEPTH (FT)

RUN NO.

CORE RECOVERY

RQD

FRACTURES PER FOOT

DISCONTINUITY DATA: DIP wrt CORE AXIS; TYPE AND SURFACE DESCRIPTION

GRAPHIC LOG

WEATHERING INDEX: SW FR, MW, HW, CW

STRENGTH INDEX: R6, R5, R4, R3, R2, R1

POINT LOAD INDEX (psi): R1 30, R2 150, R3 600, R4 3000, R5 6000, R6 15000

TEST ORIENTATION

NOTES
WATER LEVELS
INSTRUMENTATION

DEPTH (FT)	DESCRIPTION	RUN NO.	CORE RECOVERY	DISCONTINUITY DATA (DIP wrt CORE AXIS; TYPE AND SURFACE DESCRIPTION)
32	24.3-59.8 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Some fossiliferous zones Below 33.0 ft. Limestone becomes microcrystalline with intermittent zones that are very fine to fine crystalline			J,I,SM,CL J,I,R J,I,R,CL J,I,R,CL J,I,R,CL (2) J,I,R J,I,R,CL
34				J,I,R,CL J,I,R,CL J,I,R
36		3	100 %	J,PL,SM,CL (3) J,I,R,CL (6) J,U,SM,CL J,I,SM,CL (5)
38				J,PL,SM,CL (3)
	433.30			
	39.20			J,I,R J,I,SM J,C,SM
40	40.7-41.5 ft. Moderately weathered zone			J,I,R,Fe J,I,R,Fe J,PL,SM,CL J,PL,SM,CL
42	42.4-46.7 ft. Intermittent dark gray (N3) chert nodules (1/2 to 2 in. dia.)			
		4	100 %	J,PL,R,Fe
44				J,I,SM,Fe J,PL,SM
46	Below 46.5 ft, stylolites common			J,PL,SM J,PL,SM (2) J,I,R,CL
48				

6/17/95 @ 11:40
End Run 3

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-208-SS

Sheet 3 of 6

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/17/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1089219.14
AZIMUTH: 0

COLLAR ELEV: 472.5
E: 517169.45
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: Dip w/r CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
46	24.3-59.8 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Some fossiliferous zones		423.30 49.20	4	100 %				J,I,R,CL						6/17/95 @ 12:40 End Run 4
50									J,I,SM B,PL,SM B,PL,SM J,I,R,CL						
52															
54				5	100 %										
56									J,PL,SM,CL						
58									B,PL,SM J,C,SM,CL						
60	59.8-65.9 ft. Moderately weathered, thickly bedded, dark yellowish orange (10YR 6/6), fine grained, weak, ARGILLACEOUS LIME-STONE, (ST. LOUIS FORMATION) Heavy iron oxide staining		413.30 59.20						B,PL,SM,Fe						
62				6	100 %										
64															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-208-SS

Sheet 4 of 8

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/17/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1089219.14
AZIMUTH: 0

COLLAR ELEV: 472.5
E: 517169.45
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
Pl-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW, PR, MW, HW, CW)	STRENGTH INDEX (R5, R4, R3, R2, R1)	POINT LOAD INDEX (psi) (R1 30, R2 150, R3 300, R4 606, R5 1500, R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64	59.8-65.9 ft. Moderately weathered, thickly bedded, dark yellowish orange (10YR 6/6), fine grained, weak, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Heavy iron oxide staining								B,I,R,Fe						
66	65.4-65.7 ft. Very porous zone, open vugs, (<1 mm.), highly weathered								B,I,SM						
	65.9-71.4 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic			6	100 %										
68									J,I,SM						
	@ 68.8 ft. Very stiff, greenish gray (5G 6/1), glauconite clay seam (~1/2 in.)		403.50 69.00												
70									J,I,R,CL J,U,SM,CL J,PL,SM,CL						
	71.4-74.8 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong, BIOTURBATED LIMESTONE, (ST. LOUIS FORMATION) Glauconite clay seams surrounding Limestone pieces, Limestone														
72															
74				7	100 %				B,I,R,CL J,I,SM						
	74.8-76.8 ft. Slightly weathered, thinly bedded, light olive gray (5Y 6/1), very fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)								J,I,R,CL J,PL,SM,CL						
76									J,I,R,CL						
	76.8-78.5 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)								B,I,R,CL						
78									J,I,SM,CL (2) J,PL,SM,CL						
	78.5-84.5 ft. Slightly weathered, medium bedded, pale yellowish brown (10YR 6/2), fine grained, weak, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)		393.50 79.00						B,PL,SM						6/17/95 @ 15:45 End Run 7
				8	100 %										
80															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-208-SS

Sheet 5 of 6

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/17/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1089219.14
AZIMUTH: 0

COLLAR ELEV: 472.5
E: 517169.45
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX: SW FR, MW, HW, CW	STRENGTH INDEX: R6, R5, R4, R3, R2, R1	POINT LOAD INDEX (psi): R1 30, R2 150, R3 300, R4 600, R5 1500, R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	78.5-84.5 ft. Slightly weathered, medium bedded, pale yellowish brown (10YR 6/2), fine grained, weak, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)														
	81.5-83.0 ft. Low porosity zone, open vugs (<1 mm. dia.)														
82									B,PL,SM,CL						
	82.5-83.2 ft. Moderately weathered zone								J,PL,SM,CL						
									J,I,R,CL						
84				8	100 %										
	84.8-85.8 ft. Fresh, medium bedded, light olive gray (5Y 6/1), finely crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)														
86	85.8-92.8 ft. Slightly weathered, medium bedded, pale yellowish brown (10YR 6/2), very finely grained, weak, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)														
	86.0-88.0 ft. Low porosity zone, intermittent zones with open vugs (<1 mm. - 2 m. dia.) with iron oxide staining														
88	@ 88.0 ft. Firm, clay seam (~1/2 in.)								B,I,SM,CL						
			383.50 88.00												6/17/95 @ 16:50 End Run 8
90															
92				9	100 %				B,PL,SM,CL						
	92.8-99.0 ft. Fresh, medium bedded, light olive gray (5Y 6/1), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)														
94	Slightly argillaceous, stylolitic														
	94.1-94.8 ft. Argillaceous Limestone layer														
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-208-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 843-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/17/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1069219.14
AZIMUTH: 0

COLLAR ELEV: 472.5
E: 517169.45
INCLINATION: -90

Depth SCALE (FEET)

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	WEATHERING INDEX (SW FR, SW HW, HW CW)	STRENGTH INDEX (R6, R5, R4, R3, R2, R1)	POINT LOAD INDEX (psi) (R1 30, R2 150, R3 360, R4 600, R5 1500, R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
92.8-99.0 ft. Fresh, medium bedded, light olive gray (5Y 6/1), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Slightly argillaceous, stylolitic			9	100 %				B,PL,SM,CL						
96.0-99.0 ft. Limestone becomes coarsely crystalline		373.50												6/17/95 @ 17:40 Coring completed
End of Record of Drillhole at 99.0 ft.		99.00												

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

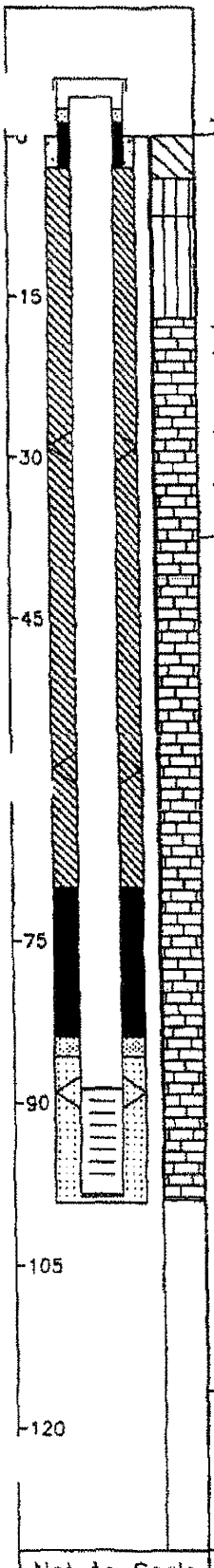
LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 7/12/95

Golder Associates

Well No. PZ-208-SS

Boring No. X-Ref: PZ-208-SS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1069219 ft. Easting: 517169 ft.

Elevation Ground Level 472.5 ft. NGVD

Top of PVC Casing 474.25 ft. NGVD

Drilling Summary:

Total Depth 99.2 ft.

Borehole Diameter 10 1/4 in. (0.0-17.0 ft.) 5 7/8 in. (17.0-99.2 ft.)

Casing Stickup Height 1.72 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	6/17/95	8:15	6/17/95	17:35
Schramm Rotary	6/18/95	8:50	6/18/95	10:00
Geophys.Logging:				
Casing:	6/18/95	10:10	6/18/95	10:20
Filter Placement:	6/18/95	10:30	6/18/95	10:55
Cementing:				
Development				
Bentonite Grout	6/18/95	11:15	6/18/95	14:00
Bentonite Seal	6/18/95	11:05	6/18/95	11:15

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.72	-	88.70	C1	474.25	-	383.83
88.70	-	98.50	S1	383.83	-	374.03
98.50	-	98.83	C2	374.03	-	373.70
	-				-	
	-				-	
	-				-	

Casing: C1 2 ft. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 ft. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 85.65-99.2 ft.

Filter Pack: Less than 50 mesh Silica Sand, 83.90-85.65 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-70.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 70.0-83.90 ft.

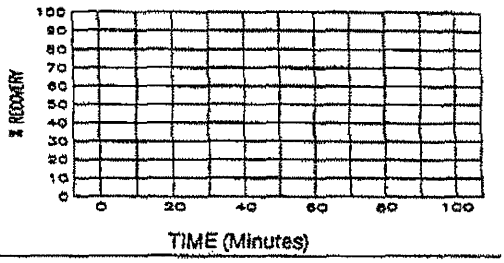
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ208SS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122514	CHECK NO
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: Lindbergh Bridgeton Sanitary Landfill
WELL NUMBER: P2-208-55

SITE ADDRESS: St. Charles Rock Rd. | CITY: Bridgeton | STATE: MO | ZIP CODE: 63044

NAME: Lindbergh Waste Systems, Inc. | TELEPHONE: 314-241-3710

ADDRESS: 7035 N. Hanley | CITY: St. Louis | STATE: MO | ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

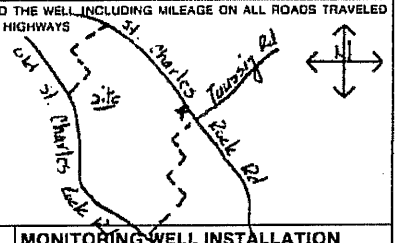
COUNTY: St. Louis
ELEVATION: 472.23
AREA NO.:

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼
LARGEST ¼

SEC. ____ TWN. 47 N,RNG 5 (E) OR W

LAT. 38 ° 46 ' 12 " LONG. 90 ° 26 ' 22 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
Layne Western Co., Inc.

DRILLING CONTRACTOR'S NAME
Layne Western Co., Inc.

TYPE OF INSTALLATION: ☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL: FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL:

ELEVATION OF MEASURING POINT: 474.25

MEASURING POINT IS: ☒ TOP OF RISER PIPE ☐ OTHER

DRILLING EQUIPMENT: ☒ AIR ROTARY ☒ AUGER TYPE 6¼ HSA ☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED: ☒ YES, AT 3 TOTAL ☒ STAINLESS STEEL ☐ OTHER ☐ NO

MULTIPLE CASED WELLS: SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED: 6-16-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Michael F. Vogt
PERMIT NUMBER: 001256 WW1 | DATE: 7-07-95

SIGNATURE (DRILLING CONTRACTOR): Michael F. Vogt
PERMIT NUMBER: 001256 WW1 | DATE: 7-07-95

NOTE: Record the fraction of a foot in decimal, not in inches.

LOCKING CAP - (Y) / N (Circle one)
CAP VENT - Y / N (Circle one)
Top of Riser Elevation: 474.25
PROTECTIVE CASING Type: STEEL Size: 8"x5"x5' Bore Hole Diameter: 10¼"
WEEP HOLE - Y / N (Circle one)

Ground Surface Elevation: 471.23 Ft

Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column	0 " Clay
Depth to bottom of Protective Casing Seal: 3.0	
	4-16 Silt
	16-97.3 Limestone
Depth to Base of Annular Seal: 70.0	
Depth to Base of Bentonite Seal: 83.7	
Depth to Base of Secondary Filter Pack: 85.7	
Depth to Top of the Screen: 88.7	
Depth to Bottom of the Screen: 98.7	
Plug Back Total Depth	
Original Total Depth: 97.3	

PROTECTIVE CASING SEAL Type: ☒ Concrete ☐ Cement Slurry
RISER PIPE Length: 82.5' Diameter: 2" Type of Material: Sch 80 PVC
BOREHOLE DIAMETER: 5⅞ In.
ANNULAR SEAL Type: ☐ Bentonite Slurry ☒ Cement Slurry ☐ Non Slurry Bentonite
BENTONITE SEAL Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite Length of Seal: 13.7 Ft.
SECONDARY FILTER PACK Type: ☒ Sand (Optional) ☐ Manufactured Grain Size: #30 Length: 18'
PRIMARY FILTER PACK Type: ☒ Sand ☐ Manufactured Grain Size: 16-35 Length: 13.5'
WELL SCREEN Length: 10 Slot Size: 0.010 Type: Sch 80 PVC
SUMP DETAILS Length: 0.3 Ft. Diameter: 2 In. Type: PVC
TYPE OF BACKFILL: SAND

MO 780-1415 (2-94)

DISTRIBUTION: WHITE/DIVISION CANARY/MONITORING WELL CONTRACTOR PINK/OWNER

HERST & ASSOCIATES, INC.®

Hole Number: PZ-209-SS

Rock Log

Local Site Coordinates: 1067071.07 N, 517108.12 E Ground Surface Elevation: 487.38

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 15, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
0.0	**0.0 to 135.0 ft.** - Blind drilled. No sample collected.									Meter: Solinst Model 107 TLC	Blind-drilled from 0 - 135 ft; no samples collected. 0 - 60 ft drilled via air rotary. O_2 (%), methane (%LEL), and VOCs (ppm) monitored at borehole. 20.9% O_2, 0% LEL, 0 ppm.
5.0										59.1	
10.0										58.7	20.9% O_2, 0% LEL, 0 ppm.
15.0										58.7	
20.0										58.7	20.9% O_2, 0% LEL, 0 ppm.
25.0										58.5	
30.0										58.5	20.9% O_2, 0% LEL, 0 ppm.
35.0										58.5	
40.0										58.2	20.9% O_2, 0% LEL, 0 ppm.
45.0										58.0	Competent bedrock encountered.
50.0										57.9	

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-209-SS

Rock Log

Local Site Coordinates: 1067071.07 N, 517108.12 E Ground Surface Elevation: 487.38

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 15, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
50.0										57.9	
	0.0 to 135.0 ft. - Blind drilled. No sample collected.										Set temporary 12-in. D casing 5 ft into bedrock. Continued drilling through casing. 20.9% O_2, 0% LEL, 0 ppm.
55.0										57.6	
60.0										57.4	Switched to sonic drilling. 20.9% O_2, 0% LEL, 0 ppm..
65.0										57.4	
70.0										57.4	
75.0										57.1	
80.0										57.1	20.9% O_2, 0% LEL, 0 ppm.
85.0										57.1	
90.0										56.9	
95.0										56.9	
100.0										56.7	20.9% O_2, 0% LEL, 0 ppm.

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-209-SS

Rock Log

Local Site Coordinates: 1067071.07 N, 517108.12 E Ground Surface Elevation: 487.38

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 15, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
100.0	**0.0 to 135.0 ft.** - Blind drilled. No sample collected.									56.7	20.9% O_2, 0% LEL, 0 ppm.
105.0										56.5	
110.0										56.5	
115.0										56.2	
120.0										56.2	20.9% O_2, 0% LEL, 0 ppm.
125.0										56.2	
130.0										56.0	
135.0										56.0	

Change in scale see sheet 4 of 5

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-209-SS

Rock Log

Local Site Coordinates: 1067071.07 N, 517108.12 E Ground Surface Elevation: 487.38

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 15, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
135.0											
	135.0 to 136.0 ft. - LIMESTONE, yellowish gray (5Y 8/1) to light olive gray (5Y 6/1) with pale yellowish brown (10YR 6/2), very light gray, (N9) and medium dark gray (N4) mottling; light bluish gray (5B 7/1) banding. Microcrystalline; massive; competent. Requires multiple hammer blows to fracture, but easily scratched with knife. Reactive with with 10% HCl solution.		1 of 2	4.8/5.0	4.8/4.8	0		FR	R4	56.0	20.9% O_2, 0% LEL, 0 ppm.
136.0										56.0	
	136.0 to 137.0 ft. - LIMESTONE, as above, but yellowish gray (5Y 8/1), light olive gray (5Y 6/1), light gray (N7), and medium gray (N5).					0		FR	R4		
137.0										56.0	
	137.0 to 138.0 ft. - LIMESTONE, as above, but laminated beginning at 137.6 ft. Large number of mechanical breaks from 137.7 - 138.8 ft.					0		FR	R3 to R4		
138.0										56.9	
	138.0 to 139.0 ft. - LIMESTONE, as above, but massive beginning at 138.8 ft.					0		FR	R3 to R4		
139.0										56.9	
	139.0 to 140.0 ft. - LIMESTONE, as above, with greenish-gray (5G 8/1) mottling.					0		FR	R4		
140.0										55.7	20.9% O_2, 0% LEL, 0 ppm.
	140.0 to 141.0 ft. - LIMESTONE, light olive gray (5Y 6/1) and greenish gray (5GY 6/1) with yellowish gray (5Y 8/1) and olive gray (5Y 4/1) mottling. With faint grayish orange (10YR 7/4) staining. Microcrystalline; massive; competent. Requires multiple hammer blows to fracture, but easily scratched with knife. Reactive with with 10% HCl solution.		2 of 2	9.9/10.0	9.9/9.9	0		FR to SW	R4		
141.0											
	141.0 to 142.0 ft. - LIMESTONE, as above, but laminated from 141.7 - 142 ft.					0		FR to SW	R4		
142.0											
	142.0 to 143.0 ft. - LIMESTONE, as above, but microcrystalline to fine-grained. Large number of mechanical breaks from 142.4 - 142.6 ft.					0		FR to SW	R3		
143.0											
	143.0 to 144.0 ft. - LIMESTONE, as above, but dark gray (N3), light olive gray (5Y 6/1), and greenish gray (5GY 6/1)					0		FR to SW	R4		
144.0											
	144.0 to 145.0 ft. - LIMESTONE, as above, but medium gray (N5) and light olive gray (5Y 6/1). No staining.					0		FR	R4		
145.0										56.0	

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
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Drilling Date(s): October 15, 2013

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough
Fe-Iron, CL-Clay, CaCO3-Calcite
FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered
R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

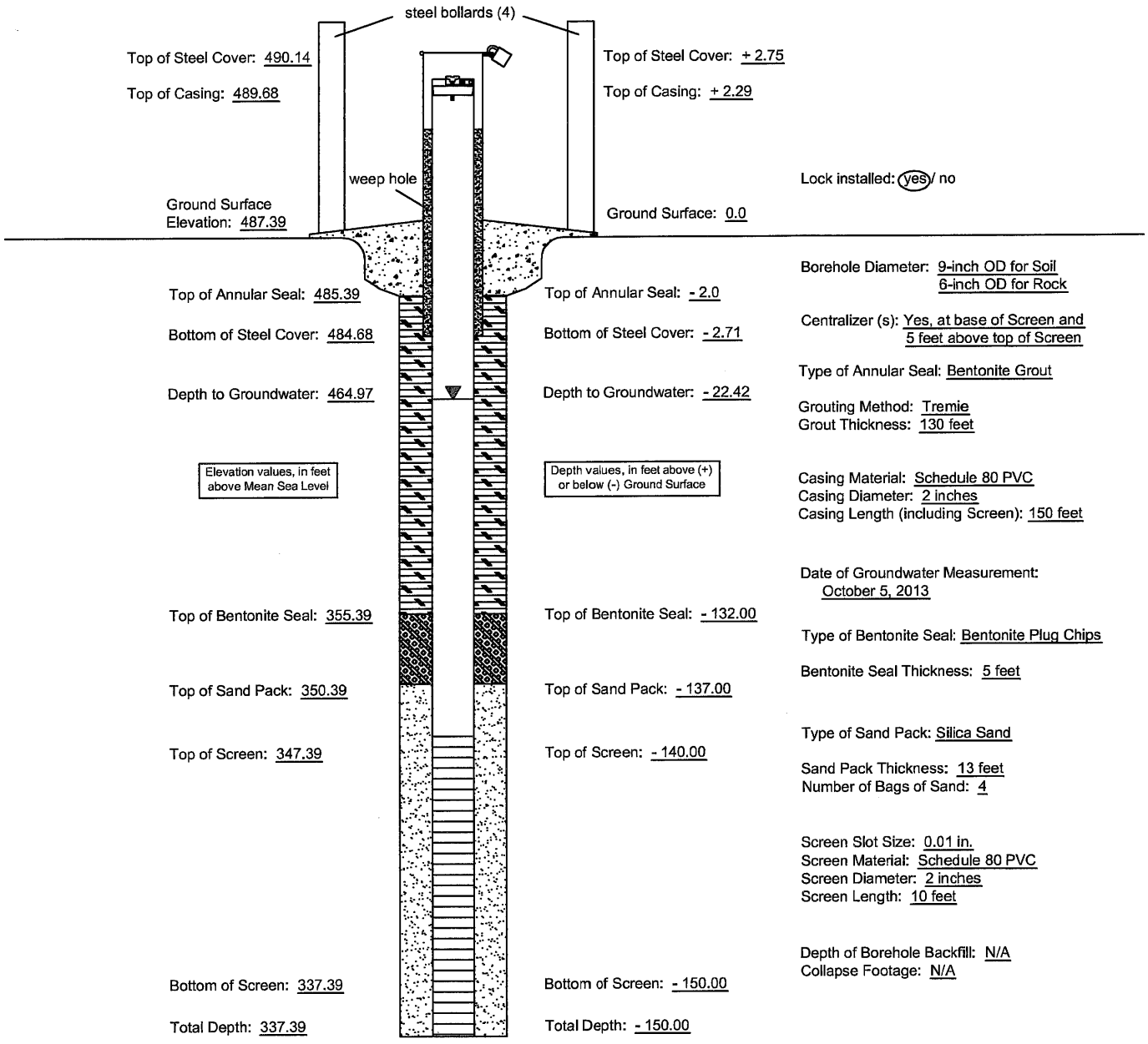
Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
145.0										56.0	
146.0	**145.0 to 146.0 ft.** - LIMESTONE, as above.					0		FR	R4		
147.0	**146.0 to 147.0 ft.** - LIMESTONE, as above, but microcrystalline.					0		FR	R4		
148.0	**147.0 to 148.0 ft.** - LIMESTONE, as above.					0		FR	R4		
149.0	**148.0 to 149.0 ft.** - LIMESTONE, as above.					0		FR	R4		
150.0	**149.0 to 150.0 ft.** - LIMESTONE, as above.					0		FR	R4	56.0	≤20.3% O_2, ≤6.3% LEL, ≤9.8 ppm. Readings fluctuating rapidly.
151.0											**Boring Depth: 150 ft. bgs.**
152.0											
153.0											
154.0											
155.0											

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

Well Coordinates:
N 1067071.541
E 517108.567

Drilling Contractor: Frontz Drilling
Lead Driller: Rob Hamilton
Drilling Dates: October 5, 2013



Top of Steel Cover: 490.14
Top of Casing: 489.68
Ground Surface Elevation: 487.39

Top of Steel Cover: + 2.75
Top of Casing: + 2.29
Ground Surface: 0.0

Lock installed: (yes) / no

Top of Annular Seal: 485.39
Bottom of Steel Cover: 484.68
Depth to Groundwater: 464.97

Elevation values, in feet above Mean Sea Level

Top of Annular Seal: - 2.0
Bottom of Steel Cover: - 2.71
Depth to Groundwater: - 22.42

Depth values, in feet above (+) or below (-) Ground Surface

Borehole Diameter: 9-inch OD for Soil
6-inch OD for Rock

Centralizer (s): Yes, at base of Screen and 5 feet above top of Screen

Type of Annular Seal: Bentonite Grout

Grouting Method: Tremie
Grout Thickness: 130 feet

Casing Material: Schedule 80 PVC
Casing Diameter: 2 inches
Casing Length (including Screen): 150 feet

Date of Groundwater Measurement: October 5, 2013

Top of Bentonite Seal: 355.39
Top of Sand Pack: 350.39
Top of Screen: 347.39

Top of Bentonite Seal: - 132.00
Top of Sand Pack: - 137.00
Top of Screen: - 140.00

Type of Bentonite Seal: Bentonite Plug Chips

Bentonite Seal Thickness: 5 feet

Type of Sand Pack: Silica Sand

Sand Pack Thickness: 13 feet
Number of Bags of Sand: 4

Screen Slot Size: 0.01 in.
Screen Material: Schedule 80 PVC
Screen Diameter: 2 inches
Screen Length: 10 feet

Bottom of Screen: 337.39
Total Depth: 337.39

Bottom of Screen: - 150.00
Total Depth: - 150.00

Depth of Borehole Backfill: N/A
Collapse Footage: N/A

(Not to Scale)

4631 North St. Peters Parkway
St. Charles, Missouri 63304
Phone (636) 939-9111
Fax (636) 939-9757
HERST & ASSOCIATES, INC.®

Bridgeton Landfill
Bridgeton, Missouri

PZ-209-SS
As-Built Diagram

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM
MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REFERENCE NO.	
C.R. NO.	CHECK NO.
STATE WELL NUMBER	REVENUE NO.
ENTERED Ph1 Ph2 Ph3	APPROVED BY / ROUTE

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR
NOTE: THIS FORM IS NOT TO BE USED FOR NESTED WELLS

OWNER NAME: Republic Services
CONTACT NAME: Bryan Sehie
VARIANCE GRANTED BY DNR NUMBER:
OWNER ADDRESS: 13570 Saint Charles Rock Rd.
CITY: Bridgeton
STATE: MO
ZIP CODE: 63044
SITE NAME: Bridgeton Sanitary Landfill
WELL NUMBER: PZ-209-55
COUNTY: Saint Louis
SITE ADDRESS: 13570 Saint Charles Rock Rd.
CITY: Bridgeton
STATIC WATER LEVEL: 29.75

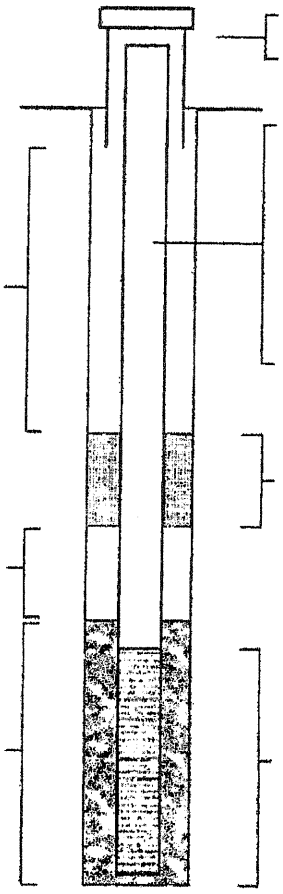
SURFACE COMPLETION
TYPE: ☑ ABOVE GROUND ☐ FLUSH MOUNT
LENGTH AND DIAMETER OF SURFACE COMPLETION: LENGTH 2.5 FT. DIAMETER 5 IN.
DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: DIAMETER 5 IN. LENGTH 2.5 FT.
SURFACE COMPLETION GROUT: ☑ CONCRETE ☐ OTHER

LOCATION OF WELL (D/M/S FORMAT ONLY)
LAT. 38 · 45 · 51.1
LONG. 90 · 26 · 24.4

SMALLEST ¼ LARGEST ¼ ¼
SECTION ____ TOWNSHIP 47 NORTH
RANGE 5 ☑ EAST ☐ WEST

MONITORING FOR: (CHECK ALL THAT APPLY)
☑ RADIONUCLIDES ☐ PETROLEUM PRODUCTS ONLY
☐ EXPLOSIVES ☑ METALS ☑ VOC
☑ SVOCS ☑ PESTICIDES/HERBICIDES

PROPOSED USE OF WELL
☐ GAS MIGRATION WELL ☑ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☐ PIEZOMETERS ☐ INJECTION WELL
☐ DIRECT PUSH



☑ LOCKING CAP
☑ WEEP HOLE
ELEVATION 489.27 FT.

ANNULAR SEAL
LENGTH 130 FT.
☑ SLURRY ☐ CHIPS
☐ PELLETS ☐ GRANULAR
☐ CEMENT/SLURRY
IF CEMENT/BENTONITE MIX:
BAGS OF CEMENT USED ____
% OF BENTONITE USED ____
WATER USED/BAG 250 GAL.

SECONDARY FILTER PACK
LENGTH 0 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK 137 FT.

LENGTH OF PRIMARY FILTER PACK 13 FT.

SURFACE COMPLETION
☑ STEEL ☐ ALUMINUM ☐ PLASTIC

RISER
RISER PIPE DIAMETER 2 IN.
RISER PIPE LENGTH 142 FT.
DIAMETER OF DRILL HOLE 6 IN.
WEIGHT OR SDR# Sch 80

MATERIAL
☐ STEEL ☑ THERMOPLASTIC (PVC)
☐ OTHER

BENTONITE SEAL
LENGTH 5 Foot
☑ CHIPS ☐ PELLETS ☐ GRANULAR
☐ SLURRY
☑ SATURATED ZONE ☐ HYDRATED

SCREEN
SCREEN DIAMETER 2 IN.
SCREEN LENGTH 10 FT.
DIAMETER OF DRILL HOLE 6 IN.
DEPTH TO TOP 140 FT.

SCREEN MATERIAL
☐ STEEL ☑ THERMOPLASTIC (PVC)
☐ OTHER

DEPTH TO	DEPTH FROM	FORMATION DESCRIPTION
0'	45'	Silty Clay
45'	150'	Limestone

TOTAL DEPTH: 150 Foot

FOR CASED WELLS, SUBMIT ADDITIONAL AS BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE & SIZE OF ALL CASING, HOLE DIAMETER & GROUT USED.

SIGNATURE (PRIMARY CONTACTOR)
PERMIT NUMBER 003839 M
DATE WELL DRILLING WAS COMPELTED 10-5-13

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS. ☐ PUMP INSTALLED

SIGNATURE (WELL DRILLER)
PERMIT NUMBER 003456-M
SIGNATURE (OF APPRENTICE)
APPRENTICE PERMIT NUMBER

MO 780-1415 (07-11)
DISTRIBUTION: WHITE/DIVISION CANARY/CONTACTOR PINK/OWNER
RETURN WHITE COPY WITH APPROPRIATE FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGY AND LAND SURVEY, WELLHEAD PROTECTION SECTION, PO BOX 250, ROLLA, MO 65402 573-368-2165

HERST & ASSOCIATES, INC.®

Hole Number: PZ-209-SD

Rock Log

Local Site Coordinates: 1067075.74 N, 517103.75 E Ground Surface Elevation: 487.24

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 2-4, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
0.0	**0.0 to 235.0 ft.** - Blind drilled. No sample collected.									Meter: Solinst Model 107 TLC	Blind-drilled from 0 - 235 ft; no samples collected. 0 - 80 ft drilled via air rotary. O_2 (%), methane (%LEL), and VOCs (ppm) monitored at borehole. 20.6% O_2, 0% LEL, 0 ppm.
5.0										59.9	
10.0										59.6	20.6% O_2, 0% LEL, 0 ppm.
15.0										59.6	
20.0										59.6	20.6% O_2, 0% LEL, 0 ppm.
25.0										59.4	
30.0										59.4	20.6% O_2, 0% LEL, 0 ppm.
35.0										59.1	
40.0										59.1	20.6% O_2, 0% LEL, 0 ppm.
45.0										59.1	Competent bedrock encountered.
50.0										59.1	

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
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50.0										59.1	
	0.0 to 235.0 ft. - Blind drilled. No sample collected.										Set temporary 8-in. D casing 5 ft into bedrock. Continued drilling through casing.
55.0										58.7	
60.0										58.7	20.9% O_2, 0% LEL, 0 ppm.
65.0										58.7	
70.0										58.7	20.9% O_2, 0% LEL, 0 ppm.
75.0										58.5	
80.0										58.5	Very difficult drilling from 80 to 100 feet, driller switched to Sonic rest of way. 20.9% O_2, 0% LEL, 0 ppm.
85.0										58.5	
90.0										58.5	
95.0										58.5	
100.0										58.5	20.9% O_2, 0% LEL, 0 ppm.

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100.0	**0.0 to 235.0 ft.** - Blind drilled. No sample collected.									58.5	20.9% O_2, 0% LEL, 0 ppm.
105.0										58.5	
110.0										58.5	
115.0										58.5	
120.0										58.5	20.9% O_2, 0% LEL, 0 ppm..
125.0										58.5	
130.0										58.2	
135.0										58.2	
140.0										58.0	20.9% O_2, 0% LEL, 0 ppm.
145.0										58.0	
150.0										58.0	

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F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
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					R1-Very Weak
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150.0	**0.0 to 235.0 ft.** - Blind drilled. No sample collected.									58.0	
155.0										57.9	
160.0										57.9	20.9% O_2, 0% LEL, 0 ppm.
165.0										57.6	
170.0										57.6	
175.0										57.6	
180.0										57.6	20.9% O_2, 0% LEL, 0 ppm.
185.0										57.4	
190.0										57.4	
195.0										57.4	
200.0										57.4	20.9% O_2, 0% LEL, 0 ppm.

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B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
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Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
200.0											
	0.0 to 235.0 ft. - Blind drilled. No sample collected.									57.4	20.9% O_2, 0% LEL, 0 ppm.
205.0										57.4	
210.0										57.1	
215.0										56.9	
220.0										56.9	20.9% O_2, 0% LEL, 0 ppm.
225.0										56.7	
230.0										56.2	
235.0										56.2	20.9% O_2, 0% LEL, 0 ppm.

Change in scale see sheet 6 of 7

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J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
235.0										56.2	20.9% O_2, 0% LEL, 0 ppm.
	235.0 to 236.0 ft. - LIMESTONE, medium gray (N6). Medium-grained; massive; competent; fresh.		1 of 2	5.0/5.0	4.5/5.0	0		FR	R5		
236.0						0		FR	R5		
237.0						0		FR	R5		
238.0						1	85°, PL	FR	R5		
	238.0 to 239.0 ft. - LIMESTONE, as above, 238.3 to 238.4 ft but more fossilized. 238.4 to 240.0 ft, gray (N5). Medium-grained; thinly to intensely bedded; competent, fresh.										
239.0						0		FR	R5		
240.0										55.7	20.9% O_2, 0% LEL, 0 ppm.
	240.0 to 241.0 ft. - LIMESTONE, as above.		2 of 2	10.0/10.0	7.2/10.0	0		FR	R5		
241.0						0		FR	R5		
242.0						0		FR	R5		
243.0						0		FR	R5		
244.0						0		FR	R5		
245.0										55.6	

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt & Steve Jett, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-209-SD

Rock Log

Local Site Coordinates: 1067075.74 N, 517103.75 E Ground Surface Elevation: 487.24

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 2-4, 2013

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough

Fe-Iron, CL-Clay, CaCO3-Calcite

FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered

R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

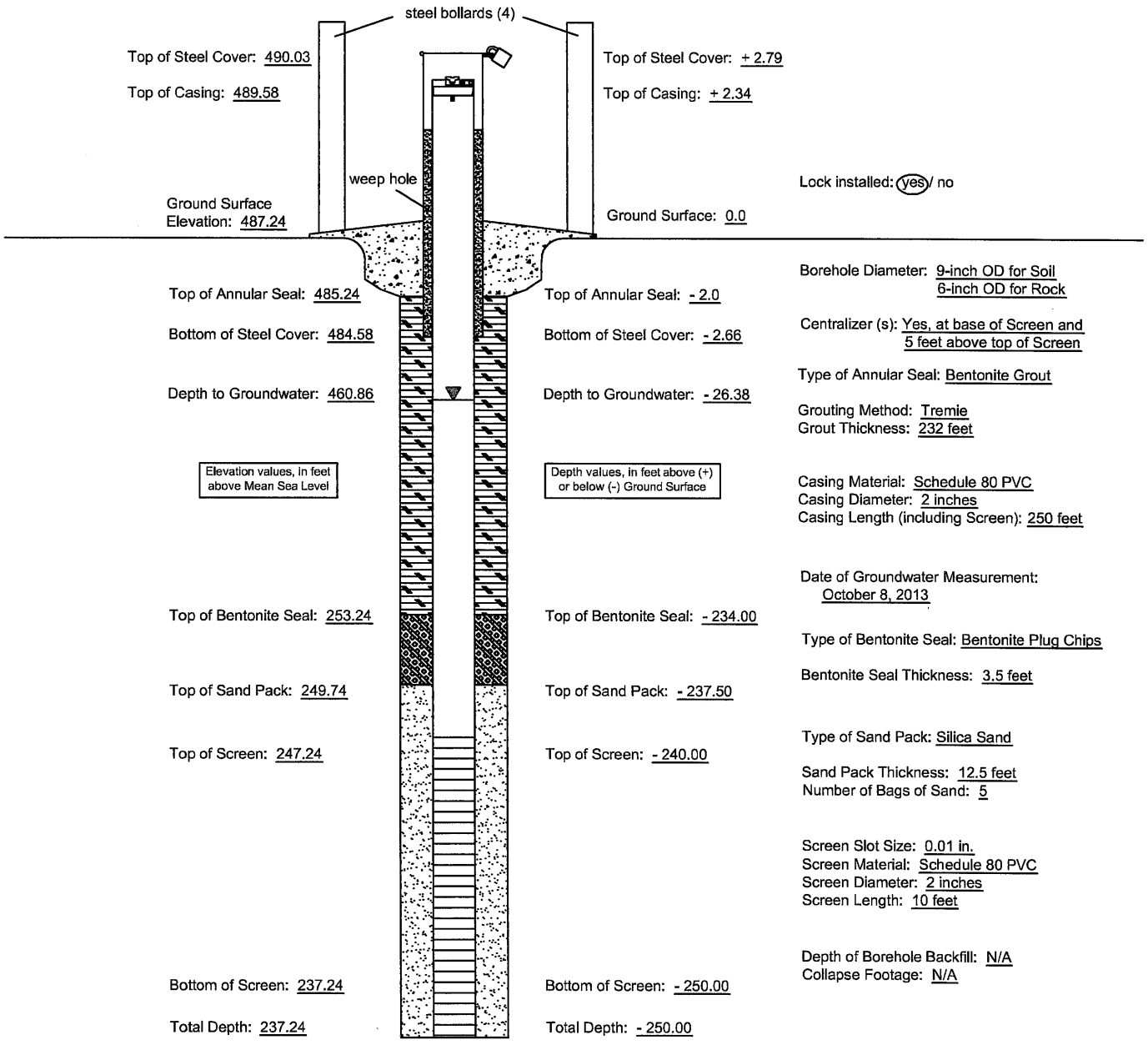
Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
245.0										55.6	
246.0						0		FR	R5		
247.0						1	45°, PL	FR	R5		
248.0						0		FR	R5		
249.0	**248.0 to 249.0 ft.** - LIMESTONE, as above, but thinly bedded.					0		FR	R5		
250.0						0		FR	R5	55.4	20.9% O_2, 0% LEL, 0 ppm.
251.0											**Boring Depth: 250 ft. bgs.**
252.0											
253.0											
254.0											
255.0											

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt & Steve Jett, Herst & Associates, Inc.

LIMESTONE

Well Coordinates:
N 1067075.739
E 517104.415

Drilling Contractor: Frontz Drilling
Lead Driller: Rob Hamilton
Drilling Dates: October 4, 2013



Top of Steel Cover: 490.03
Top of Casing: 489.58
Ground Surface Elevation: 487.24

Top of Steel Cover: + 2.79
Top of Casing: + 2.34
Ground Surface: 0.0

Lock installed: (yes) / no

Top of Annular Seal: 485.24
Bottom of Steel Cover: 484.58
Depth to Groundwater: 460.86

Elevation values, in feet above Mean Sea Level

Top of Annular Seal: - 2.0
Bottom of Steel Cover: - 2.66
Depth to Groundwater: - 26.38

Depth values, in feet above (+) or below (-) Ground Surface

Borehole Diameter: 9-inch OD for Soil
6-inch OD for Rock

Centralizer (s): Yes, at base of Screen and 5 feet above top of Screen

Type of Annular Seal: Bentonite Grout

Grouting Method: Tremie
Grout Thickness: 232 feet

Casing Material: Schedule 80 PVC
Casing Diameter: 2 inches
Casing Length (including Screen): 250 feet

Date of Groundwater Measurement: October 8, 2013

Top of Bentonite Seal: 253.24
Top of Sand Pack: 249.74
Top of Screen: 247.24

Top of Bentonite Seal: - 234.00
Top of Sand Pack: - 237.50
Top of Screen: - 240.00

Type of Bentonite Seal: Bentonite Plug Chips

Bentonite Seal Thickness: 3.5 feet

Type of Sand Pack: Silica Sand

Sand Pack Thickness: 12.5 feet
Number of Bags of Sand: 5

Screen Slot Size: 0.01 in.
Screen Material: Schedule 80 PVC
Screen Diameter: 2 inches
Screen Length: 10 feet

Bottom of Screen: 237.24
Total Depth: 237.24

Bottom of Screen: - 250.00
Total Depth: - 250.00

Depth of Borehole Backfill: N/A
Collapse Footage: N/A

(Not to Scale)

4631 North St. Peters Parkway
St. Charles, Missouri 63304
Phone (636) 939-9111
Fax (636) 939-9757

HERST & ASSOCIATES, INC.®

Bridgeton Landfill
Bridgeton, Missouri

PZ-209-SD
As-Built Diagram

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM
MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.			
C.R. NO.		CHECK NO.	
STATE WELL NUMBER		REVENUE NO.	
ENTERED Ph1 Ph2 Ph3		APPROVED BY	ROUTE

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR
NOTE: THIS FORM IS NOT TO BE USED FOR NESTED WELLS

OWNER NAME: Repulic Services
CONTACT NAME: Bryan Sehie
VARIANCE GRANTED BY DNR NUMBER:
OWNER ADDRESS: 13570 Saint Charles Rock Rd.
CITY: Bridgeton
STATE: MO
ZIP CODE: 63044
SITE NAME: Bridgeton Sanitary Landfill
WELL NUMBER: PZ-209-SD
COUNTY: Saint Louis
SITE ADDRESS: 13570 Saint Charles Rock Rd.
CITY: Bridgeton
STATIC WATER LEVEL: 27.09

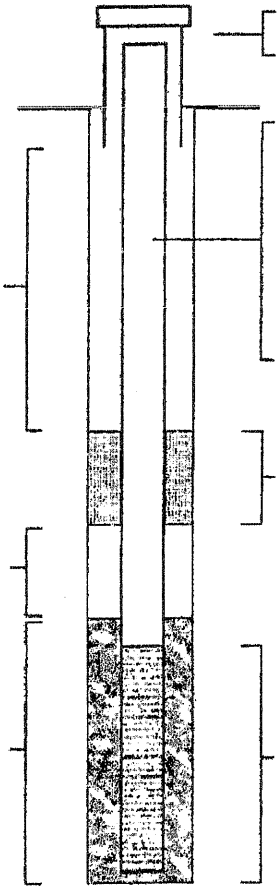
SURFACE COMPLETION
TYPE: ☑ ABOVE GROUND ☐ FLUSH MOUNT
LENGTH AND DIAMETER OF SURFACE COMPLETION: LENGTH 2.5 FT. DIAMETER 5 IN.
DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: DIAMETER 5 IN. LENGTH 2.5 FT.
SURFACE COMPLETION GROUT: ☑ CONCRETE ☐ OTHER

LOCATION OF WELL (D/M/S FORMAT ONLY)
LAT. 38 · 45 · 51.2
LONG. 90 · 26 · 24.4

SMALLEST ¼ LARGEST ¼
SECTION ____ TOWNSHIP 47 NORTH
RANGE 5 ☑ EAST ☐ WEST

MONITORING FOR: (CHECK ALL THAT APPLY)
☑ RADIONUCLIDES ☐ PETROLEUM PRODUCTS ONLY
☐ EXPLOSIVES ☑ METALS ☑ VOC
☑ SVOCS ☑ PESTICIDES/HERBICIDES

PROPOSED USE OF WELL
☐ GAS MIGRATION WELL ☑ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☐ PIEZOMETERS ☐ INJECTION WELL
☐ DIRECT PUSH



☑ LOCKING CAP
☑ WEEP HOLE
ELEVATION 487.27 FT.

ANNULAR SEAL
LENGTH 234 FT.
☑ SLURRY ☐ CHIPS ☐ PELLETS ☐ GRANULAR ☐ CEMENT/SLURRY
IF CEMENT/BENTONITE MIX:
BAGS OF CEMENT USED ____
% OF BENTONITE USED ____
WATER USED/BAG 440 GAL.

SECONDARY FILTER PACK
LENGTH 8 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK 238 FT.

LENGTH OF PRIMARY FILTER PACK 12 FT.

SURFACE COMPLETION
☑ STEEL ☐ ALUMINUM ☐ PLASTIC

RISER
RISER PIPE DIAMETER 2 IN.
RISER PIPE LENGTH 242 FT.
DIAMETER OF DRILLHOLE 6 IN.
WEIGHT OR SDR# Sch 80

MATERIAL
☐ STEEL ☑ THERMOPLASTIC (PVC) ☐ OTHER

BENTONITE SEAL
LENGTH 2 Feet
☑ CHIPS ☐ PELLETS ☐ GRANULAR ☐ SLURRY
☑ SATURATED ZONE ☐ HYDRATED

SCREEN
SCREEN DIAMETER 2 IN.
SCREEN LENGTH 10 FT.
DIAMETER OF DRILLHOLE 6 IN.
DEPTH TO TOP 240 FT.

SCREEN MATERIAL
☐ STEEL ☑ THERMOPLASTIC (PVC) ☐ OTHER

DEPTH TO	DEPTH FROM	FORMATION DESCRIPTION
0'	45'	Silty Clay
45'	250'	Limestone

TOTAL DEPTH: 250 Feet

FOR CASED WELLS, SUBMIT ADDITIONAL AS BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE & SIZE OF ALL CASING, HOLE DIAMETER & GROUT USED.

SIGNATURE (PRIMARY CONTACTOR): [signature]
PERMIT NUMBER: 003839 M
DATE WELL DRILLING WAS COMPELTED: 10-4-13

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS. ☐ PUMP INSTALLED

SIGNATURE (WELL DRILLER): [signature]
PERMIT NUMBER: 003456-M
SIGNATURE (OF APPRENTICE):
APPRENTICE PERMIT NUMBER:

MO 780-1413 (07-11)
DISTRIBUTION: WHITE/DIVISION CANARY/CONTACTOR PINK/OWNER
RETURN WHITE COPY WITH APPROPRIATE FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGY AND LAND SURVEY, WELLHEAD PROTECTION SECTION, PO BOX 250, ROLLA, MO 65402 573-368-2165

HERST & ASSOCIATES, INC.®

Hole Number: PZ-210-SS

Rock Log

Local Site Coordinates: 1066828.73 N, 516777.04 E Ground Surface Elevation: 484.52

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 16, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
0.0	**0.0 to 133.0 ft.** - Blind drilled. No sample collected.									Meter: Solinst Model 107 TLC	Blind-drilled from 0 - 133 ft; no samples collected. 0 - 50 ft drilled via air rotary. O_2 (%), methane (%LEL), and VOCs (ppm) monitored at borehole. 20.9% O_2, 0% LEL, 0 ppm.
5.0										58.2	
10.0										57.9	20.9% O_2, 0% LEL, 0 ppm. Very wet.
15.0										57.9	
20.0										57.9	20.9% O_2, 0% LEL, 0 ppm.
25.0										57.6	
30.0										57.6	20.9% O_2, 0% LEL, 0 ppm.
35.0										57.6	
40.0										57.6	20.9% O_2, 0% LEL, 0 ppm.
45.0										57.6	Competent bedrock encountered.
50.0										57.6	

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-210-SS

Rock Log

Local Site Coordinates: 1066828.73 N, 516777.04 E Ground Surface Elevation: 484.52

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Drilling Date(s): October 16, 2013

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
50.0	**0.0 to 133.0 ft.** - Blind drilled. No sample collected.									57.6	Set temporary 8-in. D casing 5 ft into bedrock. Switched to sonic drilling. Continued drilling through casing. 20.9% O_2, 0% LEL, 0 ppm.
55.0										57.6	
60.0										57.6	20.9% O_2, 0% LEL, 0 ppm..
65.0										57.6	
70.0										57.6	
75.0										57.6	
80.0										57.6	20.9% O_2, 0% LEL, 0 ppm.
85.0										57.6	
90.0										57.6	
95.0										57.6	
100.0										57.9	20.9% O_2, 0% LEL, 0 ppm.

Drilling Contractor: Frontz Drilling, Inc.
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LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-210-SS

Rock Log

Local Site Coordinates: 1066828.73 N, 516777.04 E Ground Surface Elevation: 484.52

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 16, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
100.0											
	0.0 to 133.0 ft. - Blind drilled. No sample collected.									57.9	20.9% O_2, 0% LEL, 0 ppm.
105.0										57.9	
110.0										57.6	
115.0										57.4	
120.0										57.4	20.9% O_2, 0% LEL, 0 ppm.
125.0										57.4	
130.0										57.1	
133.0											

Change in scale see sheet 4 of 5

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LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-210-SS

Rock Log

Local Site Coordinates: 1066828.73 N, 516777.04 E Ground Surface Elevation: 484.52

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Drilling Date(s): October 16, 2013

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
133.0											
134.0	**133.0 to 134.0 ft.** - LIMESTONE, light olive gray (5Y 6/1) to olive gray (5Y 4/1). With very light gray (N9) and yellowish gray (5Y 8/1) mottling and spotting. Microcrystalline to fine-grained; massive to laminated; competent. Requires one to multiple hammer blows to fracture, but easily scratched with knife. Reactive with with 10% HCl solution.		1 of 2	5.0/5.0	4.3/5.0	0	[134.2] 90°, B, PL, R [134.3]	FR	R3 to R4		
135.0	**134.0 to 135.0 ft.** - LIMESTONE, as above, but with medium bluish gray (5B 5/1) spotting. Slightly weathered from 134.1 to 134.9 ft; surface discoloration on fractures, weaker along bedding planes, can easily be broken by hand in spots. Surface discoloration of dark yellowish brown (10YR 4/2), moderate yellowish brown (10YR 5/4) on fractures. Partial healing/filling of cavities at 134.2 ft. Medium bluish gray (5B 5/1) mineralization at 134.8 ft.					5	85°, B, PL, R [134.75] 90°, B, I, R [134.8] 85°, B, PL, R	SW	R3 to R4	56.9	
136.0	**135.0 to 136.0 ft.** - LIMESTONE, as above, but yellowish gray (5Y 8/1) to light olive gray (5Y 6/1). With greenish gray (5G 6/1) mottling. Microcrystalline beginning at 135.6 ft. Flint-or chert-like. Very uniform in color. Dark greenish gray (5GY 4/1) dendritic mineralization at 135.9 ft.					0	[134.85] 90°, B, PL, R	FR	R3-R4		
137.0	**136.0 to 137.0 ft.** - LIMESTONE, as above. Moderately healed bedding plane joint at 136.6 ft.					0		FR	R3-R4		
138.0	**137.0 to 138.0 ft.** - LIMESTONE, as above. Medium dark-gray (N4) dendritic mineralization at 137.1-137.2 ft. Multiple moderatly healed bedding plane joints at 137.7 ft. Slightly weathered from 137.9-140 ft; surface discoloration on fractures. Surface discoloration of dark yellowish brown (10YR 4/2), brownish gray (5YR 4/1), medium bluish gray (5B 5/1) on fractures.					2	[137.9] 60°, B, PL, R [137.95] 80°, B, PL, R	FR to SW	R3-R4		
139.0	**138.0 to 139.0 ft.** - LIMESTONE, yellowish gray (5Y 8/1) and light gray (5Y 6/1). With very light gray (N8) and dark gray (N3) mottling. With dark yellowish brown (10YR 4/2) from 138-138.2 ft. Microcrystalline; massive to laminated; competent. Requires one to multiple hammer blows to fracture, but easily scratched with knife. Reactive with with 10% HCl solution.		2 of 2	9.7/10.0	9.1/9.7	0	[139.15] 90°, B, PL, R	FR	R3-R4		
140.0	**139.0 to 140.0 ft.** - LIMESTONE, as above, but microcrystalline to fine-grained. Slightly weathered from 139.1-139.7 ft; surface discoloration on fractures, weaker along bedding planes, can be broken by hand in spots. Surface discoloration of pale yellowish brown (10YR 6/2), brownish gray (5YR 4/1), and olive gray (5Y 4/1) on fractures. Vitreous, medium bluish gray (5B 5/1) mineralization at approx. 139.5 ft. Multiple mechanical breaks mixed with bedding plane joints, Core has little cross-sectional integrity; gravel-like. Difficult to discern individual joints.					2+	[139.65] 90°, B, PL, S Other fractures evident, but difficult to discern.	FR to SW	R3-R4	56.9	
141.0						0		FR	R4		
142.0	**140.0 to 141.0 ft.** - LIMESTONE, as above, but with little mottling. Microcrystalline, massive. **141.0 to 142.0 ft.** - LIMESTONE, as above.					0		FR	R4		
143.0	**142.0 to 143.0 ft.** - LIMESTONE, as above, 0.2 ft band of medium light gray (N6) at 142.5 ft. Laminated from 142.5 to 143 ft. With very light gray (N8) and medium dark gray (N4) mottling. Multiple mechanical breaks.					0		FR	R4 to R3		

Drilling Contractor: Frontz Drilling, Inc.
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LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-210-SS

Rock Log

Local Site Coordinates: 1066828.73 N, 516777.04 E Ground Surface Elevation: 484.52

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 16, 2013

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough
Fe-Iron, CL-Clay, CaCO3-Calcite
FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered
R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

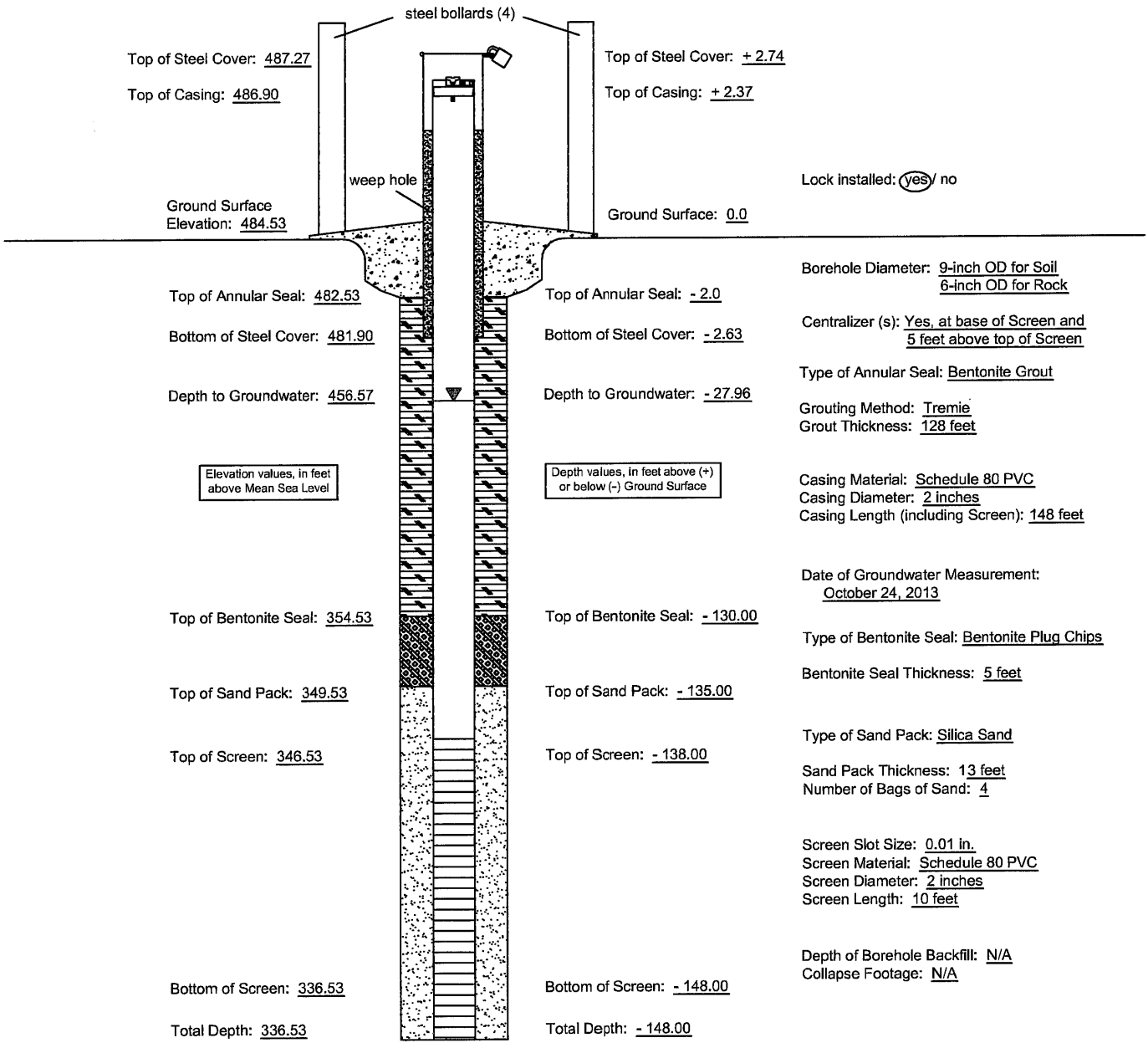
Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
143.0											
144.0	**143.0 to 144.0 ft.** - LIMESTONE, as above, but massive to laminated. Multiple mechanical breaks from 143.2 - 143.7 ft. Surface discoloration on bottom face of fracture at 143.7 ft. Medium dark gray (N4) and olive gray (5Y 4/1). (No discoloration on top face; possible mechanical destruction.)					1	[143.7] 85°, B, PL, S	FR to SW	R3 to R4		
145.0	**144.0 to 145.0 ft.** - LIMESTONE, as above, but massive; microcrystalline to fine-grained.					0		FR	R4	56.7	
146.0	**145.0 to 146.0 ft.** - LIMESTONE, as above, but yellowish gray (5Y 8/I), light olive gray (5Y 6/1), and olive gray (5Y 4/1). With greenish gray (5G 6/1) mottling at 145.5 ft. Massive to laminated. Can be broken by hand from 145.7 to 145.9 ft. Likely mechanical destruction and weakening. (No weathering evident.)					0		FR	R4 to R3		
147.0	**146.0 to 147.0 ft.** - LIMESTONE, as above, but yellowish gray (5Y 8/I) and light olive gray (5Y 6/1), massive, microcrystalline beginning 1t 146.4 ft. Slightly weathered at 146.1 ft: surface discoloration on fracture, weaker along bedding planes, can be broken by hand in spots. Vitreous, planar mineralization roughly parallel to core axis (90 to 80°) from 146.7 - 146.8 ft.					1	[146.1] 90°, B, PL, VR	FR to SW	R4 to R3		
148.0	**147.0 to 148.0 ft.** - LIMESTONE, as above.					0		FR	R4	56.7	**Boring Depth: 148 ft. bgs.**
149.0											
150.0											
151.0											
152.0											
153.0											

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

Well Coordinates:
N 1066828.381
E 516777.407

Drilling Contractor: Frontz Drilling
Lead Driller: Rob Hamilton
Drilling Dates: October 16-17, 2013



Top of Steel Cover: 487.27
Top of Casing: 486.90
Ground Surface Elevation: 484.53

Top of Steel Cover: + 2.74
Top of Casing: + 2.37
Ground Surface: 0.0

Lock installed: (yes) / no

Top of Annular Seal: 482.53
Bottom of Steel Cover: 481.90
Depth to Groundwater: 456.57

Elevation values, in feet above Mean Sea Level

Top of Annular Seal: - 2.0
Bottom of Steel Cover: - 2.63
Depth to Groundwater: - 27.96

Depth values, in feet above (+) or below (-) Ground Surface

Borehole Diameter: 9-inch OD for Soil
6-inch OD for Rock

Centralizer (s): Yes, at base of Screen and 5 feet above top of Screen

Type of Annular Seal: Bentonite Grout

Grouting Method: Tremie
Grout Thickness: 128 feet

Casing Material: Schedule 80 PVC
Casing Diameter: 2 inches
Casing Length (including Screen): 148 feet

Date of Groundwater Measurement:
October 24, 2013

Top of Bentonite Seal: 354.53
Top of Sand Pack: 349.53
Top of Screen: 346.53

Top of Bentonite Seal: - 130.00
Top of Sand Pack: - 135.00
Top of Screen: - 138.00

Type of Bentonite Seal: Bentonite Plug Chips

Bentonite Seal Thickness: 5 feet

Type of Sand Pack: Silica Sand

Sand Pack Thickness: 13 feet
Number of Bags of Sand: 4

Screen Slot Size: 0.01 in.
Screen Material: Schedule 80 PVC
Screen Diameter: 2 inches
Screen Length: 10 feet

Depth of Borehole Backfill: N/A
Collapse Footage: N/A

Bottom of Screen: 336.53
Total Depth: 336.53

Bottom of Screen: - 148.00
Total Depth: - 148.00

(Not to Scale)

4631 North St. Peters Parkway
St. Charles, Missouri 63304
Phone (636) 939-9111
Fax (636) 939-9757

HERST & ASSOCIATES, INC.®

Bridgeton Landfill
Bridgeton, Missouri

PZ-210-SS
As-Built Diagram

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM
MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.			
C.R. NO.		CHECK NO.	
STATE WELL NUMBER		REVENUE NO.	
ENTERED Ph1 Ph2 Ph3		APPROVED BY	ROUTE

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR
NOTE: THIS FORM IS NOT TO BE USED FOR NESTED WELLS

OWNER NAME: Republic Services
CONTACT NAME: Bryan Schie
VARIANCE GRANTED BY DNR NUMBER:
OWNER ADDRESS: 13570 Saint Charles Rock Rd.
CITY: Bridgeton
STATE: MO
ZIP CODE: 63044
SITE NAME: Bridgeton Sanitary Landfill
WELL NUMBER: PZ-210-SS
COUNTY: Saint Louis
SITE ADDRESS: 13570 Saint Charles Rock Rd.
CITY: Bridgeton
STATIC WATER LEVEL: 30.33

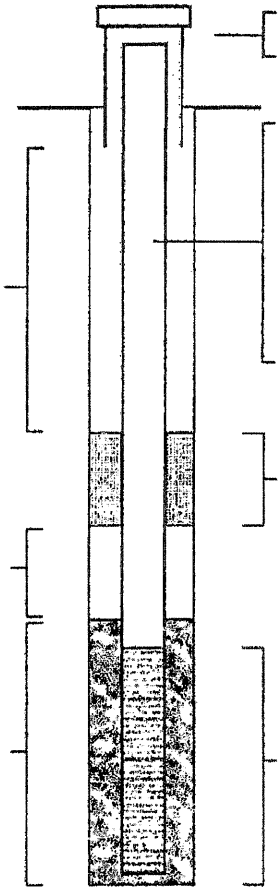
SURFACE COMPLETION
TYPE: ☑ ABOVE GROUND ☐ FLUSH MOUNT
LENGTH AND DIAMETER OF SURFACE COMPLETION: LENGTH 2.5 FT. DIAMETER 5 IN.
DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: DIAMETER 5 IN. LENGTH 2.5 FT.
SURFACE COMPLETION GROUT: ☑ CONCRETE ☐ OTHER

LOCATION OF WELL (D/M/S FORMAT ONLY)
LAT. 38 . 45 . 49.4
LONG. 90 . 26 . 25.8

SMALLEST ¼ LARGEST ¼ ¼
SECTION ____ TOWNSHIP 47 NORTH
RANGE 5 ☑ EAST ☐ WEST

MONITORING FOR: (CHECK ALL THAT APPLY)
☑ RADIONUCLIDES ☐ EXPLOSIVES ☑ METALS ☑ VOC ☑ SVOCS ☑ PESTICIDES/HERBICIDES

PROPOSED USE OF WELL
☐ GAS MIGRATION WELL ☑ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☐ PIEZOMETERS ☐ INJECTION WELL
☐ DIRECT PUSH



DEPTH TO	DEPTH FROM	FORMATION DESCRIPTION
0'	45'	Silty Clay
45'	148'	Limestone
TOTAL DEPTH:		148 Feet

FOR CASED WELLS, SUBMIT ADDITIONAL AS BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE & SIZE OF ALL CASING, HOLE DIAMETER & GROUT USED.

SIGNATURE (PRIMARY CONTACTOR)
PERMIT NUMBER 003839M
DATE WELL DRILLING WAS COMPELTED 10-16-13

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS. ☐ PUMP INSTALLED

SIGNATURE (WELL DRILLER)	PERMIT NUMBER	SIGNATURE (OF APPRENTICE)	APPRENTICE PERMIT NUMBER
	003456-M		

MO 780-1415 (07-11)
DISTRIBUTION: WHITE/DIVISION CANARY/CONTACTOR PINK/OWNER
RETURN WHITE COPY WITH APPROPRIATE FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGY AND LAND SURVEY, WELLHEAD PROTECTION SECTION, PO BOX 250, ROLLA, MO 65402 573-368-2165

HERST & ASSOCIATES, INC.®

Hole Number: PZ-210-SD

Rock Log

Local Site Coordinates: 1066824.04 N, 516772.85 E Ground Surface Elevation: 484.48

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 15, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
0.0	**0.0 to 233.0 ft.** - Blind drilled. No sample collected.									Meter: Solinst Model 107 TLC	Blind-drilled from 0 - 233 ft; no samples collected. 0 - 50 ft drilled via air rotary. O_2 (%), methane (%LEL), and VOCs (ppm) monitored at borehole. 20.6% O_2, 0% LEL, 0 ppm.
5.0										58.2	
10.0										58.2	20.6% O_2, 0% LEL, 0 ppm.
15.0										58.2	
20.0										58.0	20.6% O_2, 0% LEL, 0 ppm.
25.0										58.0	
30.0										58.0	20.9% O_2, 0% LEL, 0 ppm.
35.0										58.0	
40.0										58.0	20.9% O_2, 0% LEL, 0 ppm.
45.0										58.0	Competent bedrock encountered.
50.0										58.0	

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-210-SD

Rock Log

Local Site Coordinates: 1066824.04 N, 516772.85 E Ground Surface Elevation: 484.48

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 15, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered

R6- Extremely Strong
R5- Very Strong
R4- Strong
R3- Medium Strong
R2- Weak
R1-Very Weak
R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
50.0	**0.0 to 233.0 ft.** - Blind drilled. No sample collected.									58.0	Set temporary 8-in. D casing 5 ft into bedrock. Switched to sonic drilling. Continued drilling through casing. 20.9% O_2, 0% LEL, 0 ppm.
55.0										58.0	
60.0										58.0	20.9% O_2, 0% LEL, 0 ppm..
65.0										58.0	
70.0										58.0	
75.0										58.0	
80.0										58.0	20.9% O_2, 0% LEL, 0 ppm.
85.0										58.0	
90.0										58.0	
95.0										58.0	
100.0										58.0	20.9% O_2, 0% LEL, 0 ppm.

Drilling Contractor: Frontz Drilling, Inc.
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Hole Number: PZ-210-SD

Rock Log

Local Site Coordinates: 1066824.04 N, 516772.85 E Ground Surface Elevation: 484.48

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 15, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
100.0	**0.0 to 233.0 ft.** - Blind drilled. No sample collected.									58.0	20.9% O_2, 0% LEL, 0 ppm.
105.0										58.0	
110.0										58.0	
115.0										58.0	
120.0										58.0	
125.0										58.0	
130.0										58.0	
135.0										58.0	
140.0										58.0	20.9% O_2, 0% LEL, 0 ppm.
145.0										58.0	
150.0										57.9	

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
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LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-210-SD

Rock Log

Local Site Coordinates: 1066824.04 N, 516772.85 E Ground Surface Elevation: 484.48

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 15, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
150.0	**0.0 to 233.0 ft.** - Blind drilled. No sample collected.									57.9	
155.0										57.9	
160.0										57.9	20.9% O_2, 0% LEL, 0 ppm.
165.0										57.9	
170.0										57.6	
175.0										57.6	
180.0										57.6	20.9% O_2, 0% LEL, 0 ppm.
185.0										57.6	
190.0										57.6	
195.0										57.6	
200.0										57.6	20.9% O_2, 0% LEL, 0 ppm.

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-210-SD

Rock Log

Local Site Coordinates: 1066824.04 N, 516772.85 E Ground Surface Elevation: 484.48

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 15, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
200.0	**0.0 to 233.0 ft.** - Blind drilled. No sample collected.									57.6	20.9% O_2, 0% LEL, 0 ppm.
205.0										57.6	
210.0										57.6	
215.0										57.6	
220.0										57.4	20.9% O_2, 0% LEL, 0 ppm.
225.0										57.4	
230.0										57.4	
233.0											20.9% O_2, 0% LEL, 0 ppm.

Change in scale see sheet 6 of 7

Drilling Contractor: Frontz Drilling, Inc.
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LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-210-SD

Rock Log

Local Site Coordinates: 1066824.04 N, 516772.85 E Ground Surface Elevation: 484.48

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 15, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
233.0											
	233.0 to 234.0 ft. - LIMESTONE, light olive gray (5Y 6/1) and olive gray (5Y 4/1) with medium dark gray (N4) and yellowish gray (5Y 8/1) mottling. Microcrystalline to fine grained; massive to laminated; competent. Requires multiple hammer blows to fracture, but easily scratched with knife. Reactive with 10% HCl solution. Slightly weathered from 233.4 to 233.7 ft; moderate surface discoloration on fractures, weaker along bedding planes, can easily be broken by hand in spots. Moderate surface discoloration of dark yellowish brown (10YR 4/2) and olive gray (5Y 4/1) on fractures.		1 of 2	4.9/5.0	4.6/4.9	3	[233.4] 90°, B, PL, S [233.65] 85°, B, PL, R [233.7] 85°, B, PL, S	FR to SW	R4		20.9% O_2, 0% LEL, 0 ppm.
234.0						0		FR	R4		
235.0	**234.0 to 235.0 ft.** - LIMESTONE, as above, but light olive gray (5Y 6/1). With pale yellowish brown (10YR 6/2), light gray (N7), and olive gray (5Y 4/1) mottling. Massive. Mineralization at 234.0 ft.					0		FR	R4	57.1	
	235.0 to 236.0 ft. - LIMESTONE, as above, but pale yellowish brown (10YR 6/2), light olive gray (5Y 4/1). Light gray (N7) mineralization within cavities at 235.5 ft.					1	[236.1] 85°, B, PL, R	FR to SW	R4		
236.0	**236.0 to 237.0 ft.** - LIMESTONE, as above, but yellowish gray (5Y 8/1) to light olive gray (5Y 6/1). With light gray (N7) mottling. Slightly weathered at 236.1 ft; surface discoloration on bottom face of fracture, weaker along bedding planes, easily flakes away when scratched with fingernail. Surface discoloration of pale yellowish brown (10YR 6/2) and olive gray (5Y 4/1) on fracture. Massive with lamination around fracture at 236.1 ft.					0		FR	R4		
237.0	**237.0 to 238.0 ft.** - LIMESTONE, as above, but yellowish gray (5Y 8/1) to light olive gray (5Y 6/1). Color is uniform; little mottling, spotting, or banding.					0		FR	R4		20.9% O_2, 0% LEL, 0 ppm.
238.0											
	238.0 to 239.0 ft. - LIMESTONE, yellowish gray (5Y 8/1), light olive gray (5Y 6/1) and olive gray (5Y 4/1). With moderate yellowish brown (10YR 5/4) and light gray (N8) mottling. Microcrystalline to fine-grained; massive; competent. Requires one or multiple hammer blows to fracture, but easily scratched with knife. Reactive with 10% HCl solution. Laminated from 238.9 ft; weaker (R1 to R2) along bedding planes, easily flakes away when scratched with fingernail.		2 of 2	10.0/10.0	10.0/10.0	0		FR	R4 to R3		
239.0	**239.0 to 240.0 ft.** - LIMESTONE, as above, but with pale yellowish brown (10YR 6/2) and light gray (N8) mottling. Massive to laminated. Slightly weathered at 239.85 ft; surface discoloration on fracture, weaker along bedding planes, can easily be broken by hand in spots. Surface discoloration of brownish gray (5YR 4/1) to olive gray (5Y 4/1) on fracture.					1	[239.85] 80°, B, PL, S	FR to SW	R3		
240.0	**240.0 to 241.0 ft.** - LIMESTONE, as above, but with light gray (N8) mottling. Slightly weathered from 240.2 to 240.3 ft; weaker along bedding planes, can easily be broken by hand in spots. Moderate surface discoloration of olive gray (5Y 4/1) along planes when broken by hand.					0		FR to SW	R3	56.9	
241.0	**241.0 to 242.0 ft.** - LIMESTONE, as above. Slightly weathered at 241.35 ft; weaker along bedding planes, olive gray (5Y 4/1) discoloration on mechanical break surfaces.					0		FR to SW	R3		
242.0	**242.0 to 243.0 ft.** - LIMESTONE, as above, but fine to medium-grained. Slightly weathered at 242-242.1 ft and 242.3 ft; weaker along bedding planes, olive gray (5Y 4/1) discoloration on mechanical break surfaces.					0		FR to SW	R3		
243.0											

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-210-SD

Rock Log

Local Site Coordinates: 1066824.04 N, 516772.85 E Ground Surface Elevation: 484.48

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 15, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

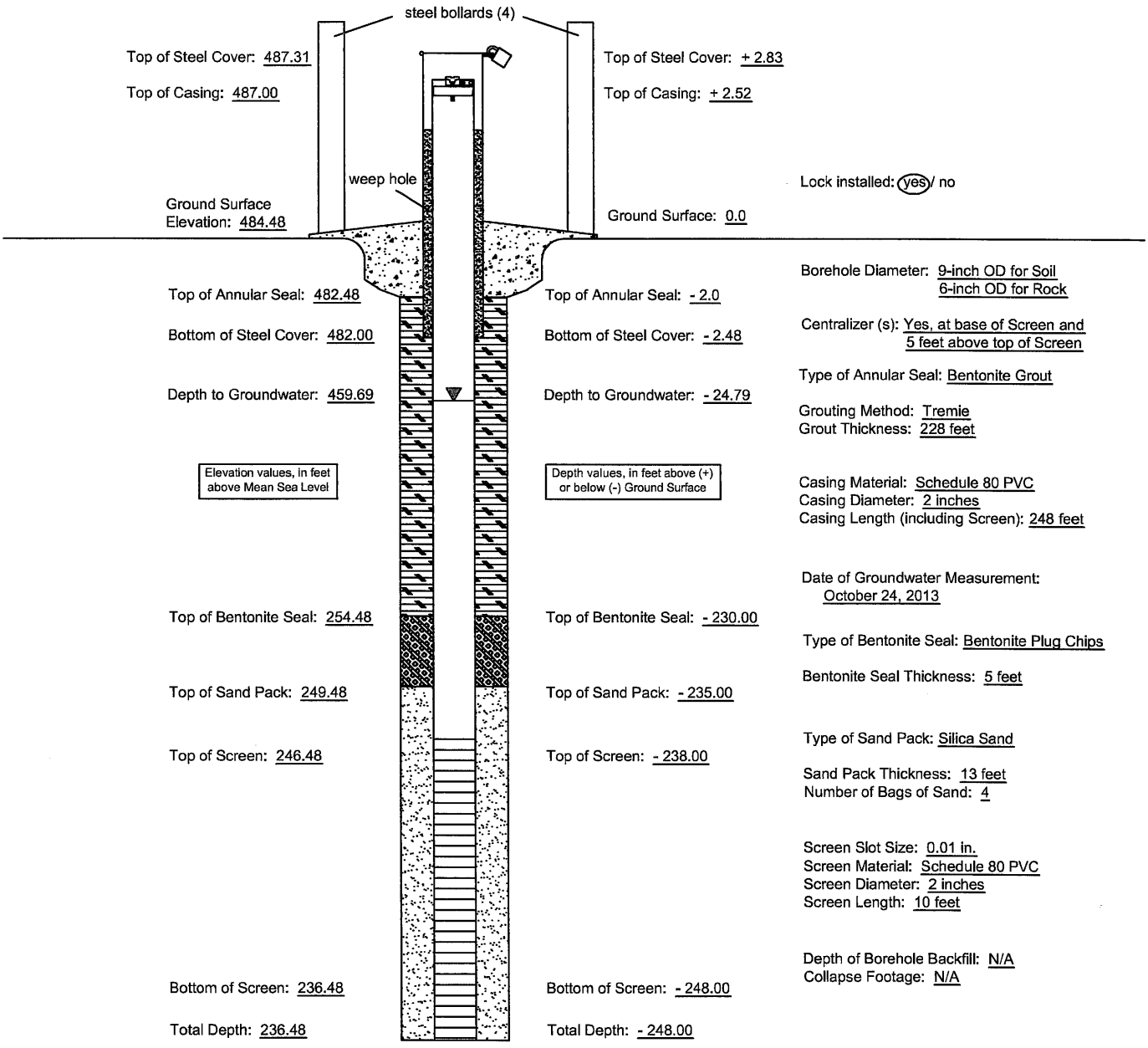
Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
243.0											
244.0	**243.0 to 244.0 ft.** - LIMESTONE, as above, but light olive gray (5Y 6/1). With pale yellowish brown (10YR 6/2), olive gray (5Y 4/1) mottling and white (N9), yellowish gray (5Y 8/1), medium bluish gray (5B 5/1) speckling.					0		FR	R3 to R4		
245.0	**244.0 to 245.0 ft.** - LIMESTONE, as above, but also with medium dark gray (N4) mottling.					0		FR	R3 to R4	56.9	
246.0	**245.0 to 246.0 ft.** - LIMESTONE, as above.					0		FR	R3 to R4		
247.0	**246.0 to 247.0 ft.** - LIMESTONE, as above.					0		FR	R3 to R4		
248.0	**247.0 to 248.0 ft.** - LIMESTONE, as above.					0		FR	R3 to R4		20.9% O_2, 0% LEL, 0 ppm.
151.0											**Boring Depth: 248 ft. bgs.**
152.0											
153.0											
154.0											
155.0											

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

Well Coordinates:
N 1066824.035
E 516773.117

Drilling Contractor: Frontz Drilling
Lead Driller: Rob Hamilton
Drilling Dates: October 15-16, 2013



Top of Steel Cover: 487.31
Top of Casing: 487.00
Ground Surface Elevation: 484.48

Top of Steel Cover: + 2.83
Top of Casing: + 2.52
Ground Surface: 0.0

Lock installed: (yes) / no

Top of Annular Seal: 482.48
Bottom of Steel Cover: 482.00
Depth to Groundwater: 459.69

Elevation values, in feet above Mean Sea Level

Top of Annular Seal: - 2.0
Bottom of Steel Cover: - 2.48
Depth to Groundwater: - 24.79

Depth values, in feet above (+) or below (-) Ground Surface

Borehole Diameter: 9-inch OD for Soil
6-inch OD for Rock

Centralizer (s): Yes, at base of Screen and 5 feet above top of Screen

Type of Annular Seal: Bentonite Grout

Grouting Method: Tremie
Grout Thickness: 228 feet

Casing Material: Schedule 80 PVC
Casing Diameter: 2 inches
Casing Length (including Screen): 248 feet

Date of Groundwater Measurement: October 24, 2013

Top of Bentonite Seal: 254.48
Top of Sand Pack: 249.48
Top of Screen: 246.48

Top of Bentonite Seal: - 230.00
Top of Sand Pack: - 235.00
Top of Screen: - 238.00

Type of Bentonite Seal: Bentonite Plug Chips

Bentonite Seal Thickness: 5 feet

Type of Sand Pack: Silica Sand

Sand Pack Thickness: 13 feet
Number of Bags of Sand: 4

Screen Slot Size: 0.01 in.
Screen Material: Schedule 80 PVC
Screen Diameter: 2 inches
Screen Length: 10 feet

Bottom of Screen: 236.48
Total Depth: 236.48

Bottom of Screen: - 248.00
Total Depth: - 248.00

Depth of Borehole Backfill: N/A
Collapse Footage: N/A

(Not to Scale)

4631 North St. Peters Parkway
St. Charles, Missouri 63304
Phone (636) 939-9111
Fax (636) 939-9757

HERST & ASSOCIATES, INC.®

Bridgeton Landfill
Bridgeton, Missouri

PZ-210-SD
As-Built Diagram

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM
MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED	
REFERENCE NO.		
C.R. NO.	CHECK NO.	
STATE WELL NUMBER	REVENUE NO.	
ENTERED Ph1 Ph2 Ph3	APPROVED BY	ROUTE

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR
NOTE: THIS FORM IS NOT TO BE USED FOR NESTED WELLS

OWNER NAME: Republic services
CONTACT NAME: Bryan Sehie
VARIANCE GRANTED BY DNR NUMBER:
OWNER ADDRESS: 13570 Saint Charles Rock Rd.
CITY: Bridgeton
STATE: MO
ZIP CODE: 63044
SITE NAME: Bridgeton Sanitary Landfill
WELL NUMBER: PZ-210-SD
COUNTY: Saint Louis
SITE ADDRESS: 13570 Saint Charles Rock Rd.
CITY: Bridgeton
STATIC WATER LEVEL: 27.31

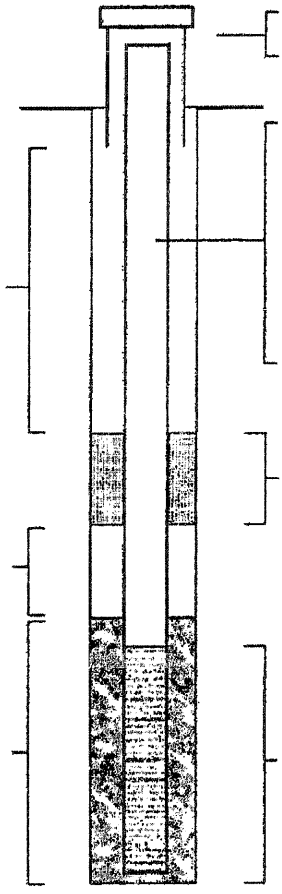
SURFACE COMPLETION
TYPE: ☑ ABOVE GROUND ☐ FLUSH MOUNT
LENGTH AND DIAMETER OF SURFACE COMPLETION: LENGTH 2.5 FT. DIAMETER 5 IN.
DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: DIAMETER 5 IN. LENGTH 2.5 FT.
SURFACE COMPLETION GROUT: ☑ CONCRETE ☐ OTHER

LOCATION OF WELL (D/M/S FORMAT ONLY)
LAT. 38 · 45 · 49.4 ·
LONG. 90 · 26 · 21.8 ·

SMALLEST ¼ ¼ LARGEST ¼
SECTION ____ TOWNSHIP 47 NORTH
RANGE 5 ☑ EAST ☐ WEST

MONITORING FOR: (CHECK ALL THAT APPLY)
☑ RADIONUCLIDES ☐ PETROLEUM PRODUCTS ONLY
☐ EXPLOSIVES ☑ METALS ☑ VOC
☑ SVOCS ☑ PESTICIDES/HERBICIDES

PROPOSED USE OF WELL
☐ GAS MIGRATION WELL ☑ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☐ PIEZOMETERS ☐ INJECTION WELL
☐ DIRECT PUSH



☑ LOCKING CAP
☑ WEEP HOLE
ELEVATION 481.29 FT.

ANNULAR SEAL
LENGTH 228 FT.
☑ SLURRY ☐ CHIPS ☐ PELLETS ☐ GRANULAR ☐ CEMENT/SLURRY
IF CEMENT/BENTONITE MIX:
BAGS OF CEMENT USED ____
% OF BENTONITE USED ____
WATER USED/BAG 360 GAL

SECONDARY FILTER PACK
LENGTH 0 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK 235 FT.

LENGTH OF PRIMARY FILTER PACK 13 FT.

SURFACE COMPLETION
☑ STEEL ☐ ALUMINUM ☐ PLASTIC

RISER
RISER PIPE DIAMETER 2 IN.
RISER PIPE LENGTH 240 FT.
DIAMETER OF DRILL HOLE 6 IN.
WEIGHT OR SDR# Sch 80

MATERIAL
☐ STEEL ☑ THERMOPLASTIC (PVC) ☐ OTHER

BENTONITE SEAL
LENGTH 5 Foot
☑ CHIPS ☐ PELLETS ☐ GRANULAR ☐ SLURRY
☑ SATURATED ZONE ☐ HYDRATED

SCREEN
SCREEN DIAMETER 2 IN.
SCREEN LENGTH 10 FT.
DIAMETER OF DRILL HOLE 6 IN.
DEPTH TO TOP 238 FT.

SCREEN MATERIAL
☐ STEEL ☑ THERMOPLASTIC (PVC) ☐ OTHER

DEPTH TO	DEPTH FROM	FORMATION DESCRIPTION
0'	45'	Silty Clay
45'	248'	Limestone
TOTAL DEPTH:		248 Foot

FOR CASED WELLS, SUBMIT ADDITIONAL AS BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE & SIZE OF ALL CASING, HOLE DIAMETER & GROUT USED.

SIGNATURE (PRIMARY CONTACTOR) | PERMIT NUMBER 003839M | DATE WELL DRILLING WAS COMPELTED 10-16-13

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS. ☐ PUMP INSTALLED

SIGNATURE (WELL DRILLER) | PERMIT NUMBER 003436-M | SIGNATURE (OF APPRENTICE) | APPRENTICE PERMIT NUMBER

MO 780-1415 (07-11)
DISTRIBUTION: WHITE/DIVISION CANARY/CONTACTOR PINK/OWNER
RETURN WHITE COPY WITH APPROPRIATE FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGY AND LAND SURVEY, WELLHEAD PROTECTION SECTION, PO BOX 250, ROLLA, MO 65402 573-368-2165

HERST & ASSOCIATES, INC.®

Hole Number: PZ-211-SS

Rock Log

Local Site Coordinates: 1067061.27 N, 517021.26 E Ground Surface Elevation: 485.05

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 7, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
0.0	**0.0 to 132.0 ft.** - Blind drilled. No sample collected.									Meter: Solinst Model 107 TLC	Blind-drilled from 0 - 132 ft; no samples collected. 0 - 50 ft drilled via air rotary. O_2 (%), methane (%LEL), and VOCs (ppm) monitored at borehole.
5.0										57.4	
10.0										57.4	20.9% O_2, 0% LEL, 0 ppm.
15.0										57.4	
20.0										57.4	20.9% O_2, 0% LEL, 0.8 ppm (peak).
25.0										57.4	
30.0										57.1	20.9% O_2, 0% LEL, 0 ppm.
35.0										57.1	
40.0										57.1	20.9% O_2, 0% LEL, 0 ppm.
45.0										57.1	
50.0										57.1	

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-211-SS

Rock Log

Local Site Coordinates: 1067061.27 N, 517021.26 E Ground Surface Elevation: 485.05

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 7, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
50.0	**0.0 to 132.0 ft.** - Blind drilled. No sample collected.									57.1	Set temporary 8-in. D casing 5 ft into bedrock. Switched to sonic drilling. Continued drilling through casing. 20.9% O_2, 0% LEL, 0 ppm.
55.0										57.1	
60.0										57.1	20.9% O_2, 0% LEL, 0 ppm..
65.0										57.1	
70.0										57.1	
75.0										57.1	
80.0										57.1	20.9% O_2, 0% LEL, 0 ppm.
85.0										57.1	
90.0										57.1	
95.0										56.9	
100.0										56.9	20.9% O_2, 0% LEL, 0 ppm.

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
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LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-211-SS

Rock Log

Local Site Coordinates: 1067061.27 N, 517021.26 E Ground Surface Elevation: 485.05

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 7, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
100.0	**0.0 to 132.0 ft.** - Blind drilled. No sample collected.									56.9	20.9% O_2, 0% LEL, 0 ppm.
105.0											
110.0										56.9	
115.0										56.9	
120.0										56.9	20.9% O_2, 0% LEL, 0 ppm.
125.0										56.7	
130.0										56.7	
132.0											20.9% O_2, 0% LEL, 0 ppm.

Change in scale see sheet 4 of 5

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-211-SS

Rock Log

Local Site Coordinates: 1067061.27 N, 517021.26 E Ground Surface Elevation: 485.05

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 7, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
132.0											
	132.0 to 133.0 ft. - LIMESTONE, yellowish gray (5Y 8/1) to light olive gray (5Y 6/1). With pale yellowish brown (10YR 6/2), dark yellowish brown (10YR 4/2), dark gray (N3), brownish gray (5YR 4/1), olive gray (5Y 4/1) mottling. Microcrystalline; massive to laminated; competent. Requires multiple hammer blows to fracture, but easily scratched with knife. Reactive with with 10% HCl solution.		1 of 2	4.9/5.0	4.9/4.9	0		FR	R4		20.9% O_2, 0% LEL, 0 ppm.
133.0											
	133.0 to 134.0 ft. - LIMESTONE, as above, but pale yellowish brown (10YR 6/2), yellowish gray (5Y 8/1), and light olive gray (5Y 6/1). Slightly weathered at 133.8 ft: surface discoloration on fracture, weaker along bedding planes, can easily be broken by hand in spots (R1 to R2). Surface discoloration of olive gray (5Y 4/1) and dark greenish gray (5GY 4/1) on fracture. Light gray(N7) to yellowish gray (5Y 8/1) filling of cavities near fracture; some mineralization.					1	[133.8] 70°, J or B, I, R	FR to SW	R3		
134.0											
	134.0 to 135.0 ft. - LIMESTONE, as above, but yellowish gray (5Y 8/1) to light olive gray (5Y 6/1). With some blotches of greenish gray (5G 6/1). Little mottling or spotting; more uniform in color than above. Massive.					0		FR	R4		
135.0										56.7	
	135.0 to 136.0 ft. - LIMESTONE, as above, but yellowish gray (5Y 8/1), light olive gray (5Y 6/1), and greenish gray (5G 6/1).					0		FR	R3 to R4		
136.0											
	136.0 to 137.0 ft. - LIMESTONE, as above, but with white (N9) spotting. Massive, with some lamination and very thin bedding from 136.6 - 136.8 ft. Moderately healed irregular bedding joints from 136.6 - 136.7 ft. Very light gray (N8), light olive gray (5Y 6/1), and olive gray (5Y 4/1) near joints.					0		FR	R4		
137.0											20.9% O_2, 0% LEL, 0 ppm.
	137.0 to 138.0 ft. - LIMESTONE, light olive gray (5Y 6/1). With pale yellowish brown (10YR 6/2), dark yelloish brown (10YR 4/2), white (N9), medium gray (N5), medium bluish gray (5B 5/1) mottling and spotting. Microcrystalline; massive; competent. Requires one hammer blow to fracture, but easily scratched with knife. Reactive with with 10% HCl solution. Some lamination at 137.8 ft.		2 of 2	9.1/10.0	9.1/9.1	0		FR	R3		
138.0											
	138.0 to 139.0 ft. - LIMESTONE, as above, but pale yellowish brown (10YR 6/2) and light olive gray (5Y 6/1). With dark yellowish brown (10YR 4/2), white (N9), olive gray (5Y 4/1) mottling. Microcrystalline to fine-grained. Slightly weathered from 138.4 - 138.9 ft: some lamination, weaker along bedding planes, can be broken by hand with difficulty (R2). With olive gray (5Y 4/1) in weathered interval.					0		FR to SW	R3		
139.0											
	139.0 to 140.0 ft. - LIMESTONE, as above, but light olive gray (5Y 6/1). With white (N9), light gray (N7), and olive gray (5Y 4/1) mottling and spots. Microcrystalline to fine-grained; massive to laminated. Possible moderate healing of bedding joints from 139.3 - 139.4 ft.					0		FR	R4		
140.0										56.7	
	140.0 to 141.0 ft. - LIMESTONE, as above, but very light gray (N8), yellowish gray (5Y 8/1), and light olive gray (5Y 6/1). With mottling of olive gray (5Y 4/1) and greenish gray (5G 6/1). Moderately healed irregular bedding joint at 140.3 ft.					0		FR	R4		
141.0											
	141.0 to 142.0 ft. - LIMESTONE, as above, but yellowish gray (5Y 8/1) to light olive gray (5Y 6/1). Little mottling; more uniform in color than above. Microcrystalline; massive.					0		FR	R4		
142.0											

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-211-SS

Rock Log

Local Site Coordinates: 1067061.27 N, 517021.26 E Ground Surface Elevation: 485.05

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 7, 2013

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough

Fe-Iron, CL-Clay, CaCO3-Calcite

FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered

R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
142.0											
143.0	**142.0 to 143.0 ft.** - LIMESTONE, as above, but yellowish gray (5Y 8/1). Fine (< 1 mm) veins, pale green (10G 6/2) and medium bluish gray (5B 5/1).					0		FR	R4		
144.0	**143.0 to 144.0 ft.** - LIMESTONE, as above, but yellowish gray (5Y 8/1). Uniform in color.					0		FR	R4		
145.0	**144.0 to 145.0 ft.** - LIMESTONE, as above.					0		FR	R3		
146.0	**145.0 to 146.0 ft.** - LIMESTONE, as above, but yellowish gray (5Y 8/1) to light olive gray (5Y 6/1). With olive gray (5Y 4/1), pale yellowish brown (10YR 6/2), white (N9), and medium bluish gray (5B 5/1) spots.					0		FR	R3	56.7	
147.0	**146.0 to 147.0 ft.** - LIMESTONE, as above, but with some lamination from 146 - 146.1 ft.					0		FR	R3 to R4	56.7	20.9% O_2, 0% LEL, 0 ppm.
											Boring Depth: 147 ft. bgs.
151.0											
152.0											
153.0											
154.0											
155.0											

Drilling Contractor: Frontz Drilling, Inc.

Driller: Rob Hamilton

Helpers: Rob Underwood, Ben Williams

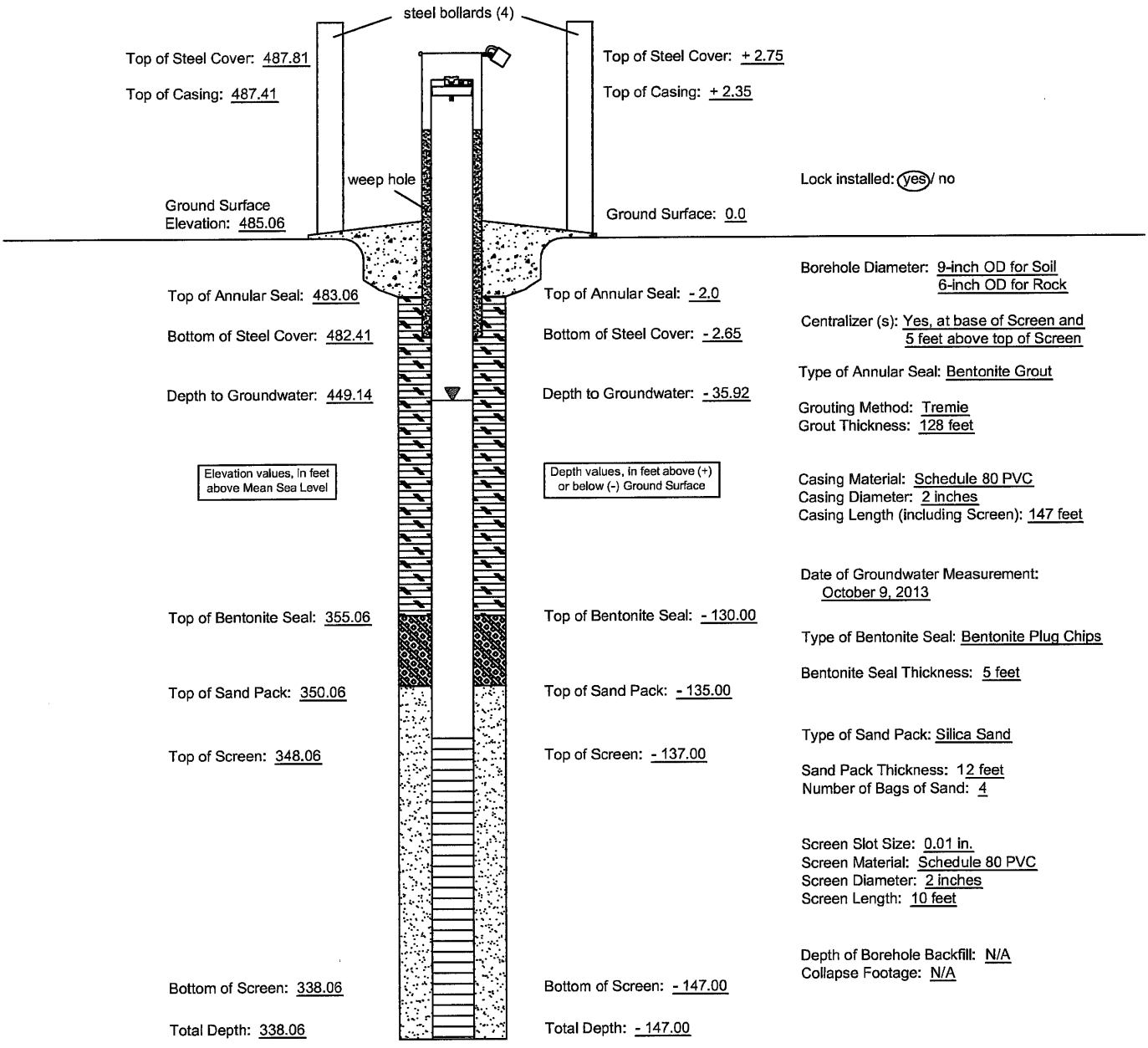
Certifying Geologist: Brian Fingers, Geotechnology, Inc.

Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

Well Coordinates:
N 1067060.785
E 517021.151

Drilling Contractor: Frontz Drilling
Lead Driller: Rob Hamilton
Drilling Dates: October 7-8, 2013



Top of Steel Cover: 487.81
Top of Casing: 487.41
Ground Surface Elevation: 485.06

Top of Steel Cover: + 2.75
Top of Casing: + 2.35
Ground Surface: 0.0

Lock installed: (yes) / no

Top of Annular Seal: 483.06
Bottom of Steel Cover: 482.41
Depth to Groundwater: 449.14

Elevation values, in feet above Mean Sea Level

Top of Annular Seal: - 2.0
Bottom of Steel Cover: - 2.65
Depth to Groundwater: - 35.92

Depth values, in feet above (+) or below (-) Ground Surface

Borehole Diameter: 9-inch OD for Soil
6-inch OD for Rock

Centralizer (s): Yes, at base of Screen and 5 feet above top of Screen

Type of Annular Seal: Bentonite Grout

Grouting Method: Tremie
Grout Thickness: 128 feet

Casing Material: Schedule 80 PVC
Casing Diameter: 2 inches
Casing Length (including Screen): 147 feet

Date of Groundwater Measurement: October 9, 2013

Top of Bentonite Seal: 355.06
Top of Sand Pack: 350.06
Top of Screen: 348.06

Top of Bentonite Seal: - 130.00
Top of Sand Pack: - 135.00
Top of Screen: - 137.00

Type of Bentonite Seal: Bentonite Plug Chips

Bentonite Seal Thickness: 5 feet

Type of Sand Pack: Silica Sand

Sand Pack Thickness: 12 feet
Number of Bags of Sand: 4

Screen Slot Size: 0.01 in.
Screen Material: Schedule 80 PVC
Screen Diameter: 2 inches
Screen Length: 10 feet

Bottom of Screen: 338.06
Total Depth: 338.06

Bottom of Screen: - 147.00
Total Depth: - 147.00

Depth of Borehole Backfill: N/A
Collapse Footage: N/A

(Not to Scale)

4631 North St. Peters Parkway
St. Charles, Missouri 63304
Phone (636) 939-9111
Fax (636) 939-9757
HERST & ASSOCIATES, INC.®

Bridgeton Landfill
Bridgeton, Missouri

PZ-211-SS
As-Built Diagram

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM
MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.			
C.R. NO.		CHECK NO.	
STATE WELL NUMBER		REVENUE NO.	
ENTERED Ph1 Ph2 Ph3		APPROVED BY	ROUTE

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR
NOTE: THIS FORM IS NOT TO BE USED FOR NESTED WELLS

OWNER NAME: Republic Services
CONTACT NAME: Bryan Sehie
VARIANCE GRANTED BY DNR NUMBER:
OWNER ADDRESS: 13570 Saint Charles Rock Rd.
CITY: Bridgeton
STATE: MO
ZIP CODE: 63044
SITE NAME: Bridgeton Sanitary Landfill
WELL NUMBER: PZ-211-55
COUNTY: Saint Louis
SITE ADDRESS: 13570 Saint Charles Rock Rd.
CITY: Bridgeton
STATIC WATER LEVEL: 23.95

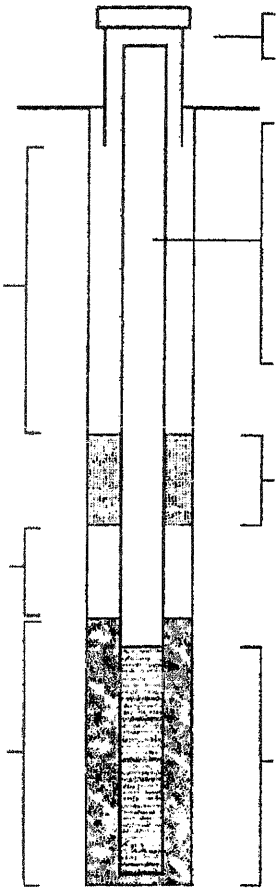
SURFACE COMPLETION
TYPE: ☑ ABOVE GROUND ☐ FLUSH MOUNT
LENGTH AND DIAMETER OF SURFACE COMPLETION: LENGTH 2.5 FT. DIAMETER 5 IN.
DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: DIAMETER 5 IN. LENGTH 2.5 FT.
SURFACE COMPLETION GROUT: ☑ CONCRETE ☐ OTHER

LOCATION OF WELL (D/M/S FORMAT ONLY)
LAT. 38 . 45 . 47.8
LONG. 90 . 26 . 34.6

SMALLEST ___¼ LARGEST ___¼ ___¼
SECTION ___ TOWNSHIP 47 NORTH
RANGE 5 ☑ EAST ☐ WEST

MONITORING FOR: (CHECK ALL THAT APPLY)
☑ RADIONUCLIDES ☐ PETROLEUM PRODUCTS ONLY
☐ EXPLOSIVES ☑ METALS ☑ VOC
☑ SVOCS ☑ PESTICIDES/HERBICIDES

PROPOSED USE OF WELL
☐ GAS MIGRATION WELL ☑ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☐ PIEZOMETERS ☐ INJECTION WELL
☐ DIRECT PUSH



☑ LOCKING CAP
☑ WEEP HOLE
ELEVATION 485.21 FT.

ANNULAR SEAL
LENGTH 128 FT.
☑ SLURRY ☐ CHIPS
☐ PELLETS ☐ GRANULAR
☐ CEMENT/SLURRY
IF CEMENT/BENTONITE MIX:
BAGS OF CEMENT USED ___
% OF BENTONITE USED ___
WATER USED/BAG 360 GAL.

SECONDARY FILTER PACK
LENGTH 0 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK 135 FT.

LENGTH OF PRIMARY FILTER PACK 12 FT.

SURFACE COMPLETION
☑ STEEL ☐ ALUMINUM ☐ PLASTIC

RISER
RISER PIPE DIAMETER 2 IN.
RISER PIPE LENGTH 139 FT.
DIAMETER OF DRILLHOLE 6 IN.
WEIGHT OR SDR# Sch 80

MATERIAL
☐ STEEL ☑ THERMOPLASTIC (PVC)
☐ OTHER

BENTONITE SEAL
LENGTH 5 Foot
☑ CHIPS ☐ PELLETS ☐ GRANULAR
☐ SLURRY
☑ SATURATED ZONE ☐ HYDRATED

SCREEN
SCREEN DIAMETER 2 IN.
SCREEN LENGTH 10 FT.
DIAMETER OF DRILLHOLE 6 IN.
DEPTH TO TOP 137 FT.

SCREEN MATERIAL
☐ STEEL ☑ THERMOPLASTIC (PVC)
☐ OTHER

DEPTH TO	DEPTH FROM	FORMATION DESCRIPTION
0'	45'	Silty Clay
45'	147'	Limestone
TOTAL DEPTH:		147 Foot

FOR CASED WELLS, SUBMIT ADDITIONAL AS BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE & SIZE OF ALL CASING, HOLE DIAMETER & GROUT USED.

SIGNATURE (PRIMARY CONTACTOR)	PERMIT NUMBER	DATE WELL DRILLING WAS COMPELTED
	003839-M	10-8-13

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS. ☐ PUMP INSTALLED

SIGNATURE (WELL DRILLER)	PERMIT NUMBER	SIGNATURE (OF APPRENTICE)	APPRENTICE PERMIT NUMBER
	003456-M		

DISTRIBUTION: WHITE/DIVISION CANARY/CONTACTOR PINK/OWNER
RETURN WHITE COPY WITH APPROPRIATE FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGY AND LAND SURVEY, WELLHEAD PROTECTION SECTION, PO BOX 250, ROLLA, MO 65402 573-368-2165

HERST & ASSOCIATES, INC.®

Hole Number: PZ-211-SD

Rock Log

Local Site Coordinates: 1067056.90 N, 517015.98 E Ground Surface Elevation: 484.82

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 6, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
0.0	**0.0 to 232.0 ft.** - Blind drilled. No sample collected.									Meter: Solinst Model 107 TLC	Blind-drilled from 0 - 232 ft; no samples collected. 0 - 50 ft drilled via air rotary. O_2 (%), methane (%LEL), and VOCs (ppm) monitored at borehole.
5.0										57.9	
10.0										57.6	20.4% O_2, 40% LEL, 18.1 ppm.
15.0										57.6	
20.0										57.6	20.9% O_2, 0% LEL, 0 ppm.
25.0										57.6	
30.0										57.6	
35.0										57.6	
40.0										57.6	
45.0										57.4	Competent bedrock encountered.
50.0										57.4	

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Steve Jett, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-211-SD

Rock Log

Local Site Coordinates: 1067056.90 N, 517015.98 E Ground Surface Elevation: 484.82

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 6, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
50.0	**0.0 to 232.0 ft.** - Blind drilled. No sample collected.									57.4	Set temporary 8-in. D casing 5 ft into bedrock. Continued drilling through casing.
55.0										57.4	
60.0										57.4	
65.0										57.4	
70.0										57.4	
75.0										57.4	
80.0										57.4	20.9% O_2, 0% LEL, 0 ppm.
85.0										57.4	
90.0										57.4	
95.0										57.4	
100.0										57.4	20.9% O_2, 0% LEL, 0 ppm.

Drilling Contractor: Frontz Drilling, Inc.
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LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-211-SD

Rock Log

Local Site Coordinates: 1067056.90 N, 517015.98 E Ground Surface Elevation: 484.82

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 6, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
100.0	**0.0 to 232.0 ft.** - Blind drilled. No sample collected.									57.4	20.9% O_2, 0% LEL, 0 ppm.
105.0										57.4	
110.0										57.4	
115.0										57.4	
120.0										57.4	20.9% O_2, 0% LEL, 0 ppm..
125.0										57.4	
130.0										57.4	
135.0										57.4	
140.0										57.4	20.9% O_2, 0% LEL, 0 ppm.
145.0										57.4	
150.0										57.4	

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
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LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-211-SD

Rock Log

Local Site Coordinates: 1067056.90 N, 517015.98 E Ground Surface Elevation: 484.82

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 6, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
150.0	**0.0 to 232.0 ft.** - Blind drilled. No sample collected.									57.4	
155.0										57.1	
160.0										57.1	20.9% O_2, 0% LEL, 0 ppm.
165.0										57.1	
170.0										56.9	
175.0										56.7	
180.0										56.5	20.9% O_2, 0% LEL, 0 ppm.
185.0										56.5	
190.0										56.2	
195.0										56.2	
200.0										56.2	20.9% O_2, 0% LEL, 0 ppm.

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Steve Jett, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-211-SD

Rock Log

Local Site Coordinates: 1067056.90 N, 517015.98 E Ground Surface Elevation: 484.82

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 6, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
200.0	**0.0 to 232.0 ft.** - Blind drilled. No sample collected.									56.2	20.9% O_2, 0% LEL, 0 ppm.
205.0										56.2	
210.0										56.2	
215.0										56.2	
220.0										56.2	20.9% O_2, 0% LEL, 0 ppm.
225.0										56.2	
230.0										56.0	20.9% O_2, 0% LEL, 0 ppm.
232.0											Weathered fracture.

Change in scale see sheet 6 of 7

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Steve Jett, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-211-SD

Rock Log

Local Site Coordinates: 1067056.90 N, 517015.98 E Ground Surface Elevation: 484.82

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Drilling Date(s): October 6, 2013

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
232.0											
	232.0 to 233.0 ft. - LIMESTONE, medium gray (N6). Medium-grained; massive; competent; fresh.		1 of 2	4.8/5.0	3.2/5.0	1	85°, PL	FR	R5		20.9% O_2, 0% LEL, 0 ppm. Weathered fracture.
233.0						0		FR	R5		
234.0						2	90°, PL; 90°, PL	FR	R5		Weathered fracture with very dark gray deposits; slightly weathered fracture with small amounts of dark gray deposits.
235.0						0		FR	R5	55.6	
236.0						0		FR	R5		
237.0											
	240.0 to 241.0 ft. - LIMESTONE, as above.		2 of 2	9.6/10.0	6.8/10.0	5	90°, PL (all 5)	FR	R5		
238.0						4	90°, PL (all 4)	FR	R5		
239.0						3	80°, PL (all 3)	FR	R5		
240.0						2	90°, PL; 90°, PL	FR	R5	55.4	
241.0						1	90°, PL	FR	R5		
242.0											

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Steve Jett, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-211-SD

Rock Log

Local Site Coordinates: 1067056.90 N, 517015.98 E Ground Surface Elevation: 484.82

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 6, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

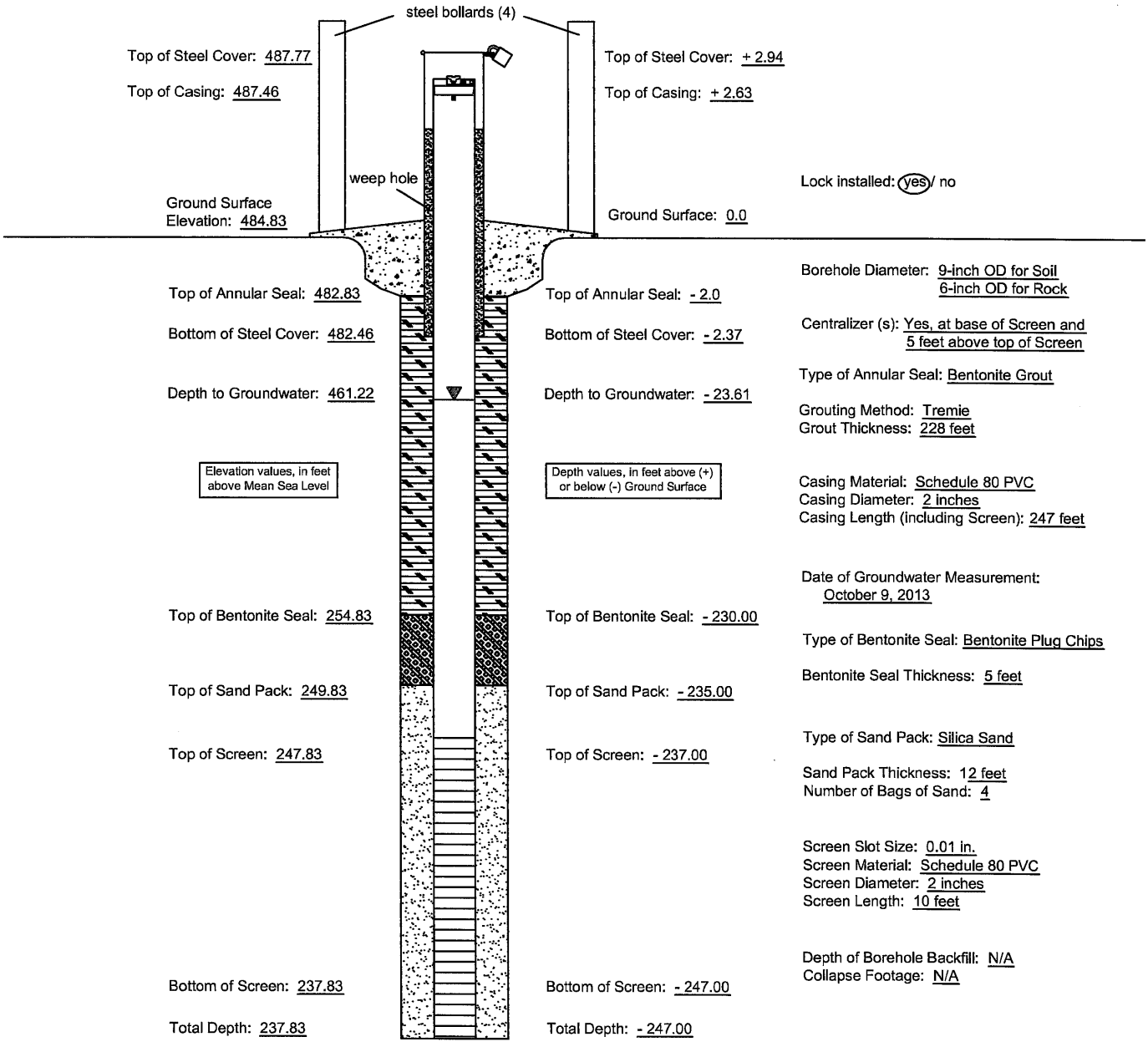
Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
242.0											
						2	90°, PL; 90°, PL	FR	R5		
243.0											
						1	90°, PL	FR	R5		
244.0											
	244.0 to 245.0 ft. - LIMESTONE, medium gray (N6) with light brownish gray (5YR 6/1). Medium-grained; massive; competent; fresh.					0		FR	R5		
245.0										55.6	
	245.0 to 246.0 ft. - LIMESTONE, 245.2 to 246 ft. light brownish gray (5YR 6/1) with mixture of dark gray (N4). Medium to coarse-grained; massive; competent; fresh.					2	90°, PL; 90°, PL	FR	R5		
246.0											
	246.0 to 247.0 ft. - LIMESTONE, dark gray (N4). Coarse-grained; massive; competent; fresh.					3	80°, PL; 90°, PL; 75°, PL	FR	R5		
247.0										55.6	20.9% O_2, 0% LEL, 0 ppm.
											Boring Depth: 247 ft. bgs.
248.0											
249.0											
250.0											
251.0											
252.0											

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Steve Jett, Herst & Associates, Inc.

LIMESTONE

Well Coordinates:
N 1067056.698
E 517016.608

Drilling Contractor: Frontz Drilling
Lead Driller: Rob Hamilton
Drilling Dates: October 6-7, 2013



Top of Steel Cover: 487.77
Top of Casing: 487.46
Ground Surface Elevation: 484.83

Top of Steel Cover: + 2.94
Top of Casing: + 2.63
Ground Surface: 0.0

Lock installed: (yes) / no

Top of Annular Seal: 482.83
Bottom of Steel Cover: 482.46
Depth to Groundwater: 461.22

Top of Annular Seal: - 2.0
Bottom of Steel Cover: - 2.37
Depth to Groundwater: - 23.61

Elevation values, in feet above Mean Sea Level

Depth values, in feet above (+) or below (-) Ground Surface

Borehole Diameter: 9-inch OD for Soil
6-inch OD for Rock

Centralizer (s): Yes, at base of Screen and 5 feet above top of Screen

Type of Annular Seal: Bentonite Grout

Grouting Method: Tremie
Grout Thickness: 228 feet

Casing Material: Schedule 80 PVC
Casing Diameter: 2 inches
Casing Length (including Screen): 247 feet

Date of Groundwater Measurement: October 9, 2013

Top of Bentonite Seal: 254.83
Top of Sand Pack: 249.83
Top of Screen: 247.83

Top of Bentonite Seal: - 230.00
Top of Sand Pack: - 235.00
Top of Screen: - 237.00

Type of Bentonite Seal: Bentonite Plug Chips

Bentonite Seal Thickness: 5 feet

Type of Sand Pack: Silica Sand

Sand Pack Thickness: 12 feet
Number of Bags of Sand: 4

Screen Slot Size: 0.01 in.
Screen Material: Schedule 80 PVC
Screen Diameter: 2 inches
Screen Length: 10 feet

Depth of Borehole Backfill: N/A
Collapse Footage: N/A

Bottom of Screen: 237.83
Total Depth: 237.83

Bottom of Screen: - 247.00
Total Depth: - 247.00

(Not to Scale)

4631 North St. Peters Parkway
St. Charles, Missouri 63304
Phone (636) 939-9111
Fax (636) 939-9757
HERST & ASSOCIATES, INC.®

Bridgeton Landfill
Bridgeton, Missouri

PZ-211-SD
As-Built Diagram

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM
MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REFERENCE NO.	
C.R. NO.	CHECK NO.
STATE WELL NUMBER	REVENUE NO.
ENTERED Ph1 Ph2 Ph3	APPROVED BY / ROUTE

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR
NOTE: THIS FORM IS NOT TO BE USED FOR NESTED WELLS

OWNER NAME: Republic Services
CONTACT NAME: Bryan Sehie
VARIANCE GRANTED BY DNR NUMBER:
OWNER ADDRESS: 13570 Saint Charles Rock Rd.
CITY: Bridgeton
STATE: MO
ZIP CODE: 63044
SITE NAME: Bridgeton Sanitary Landfill
WELL NUMBER: PZ-211-SD
COUNTY: Saint Louis
SITE ADDRESS: 13570 Saint Charles Rock Rd.
CITY: Bridgeton
STATIC WATER LEVEL: 26.24

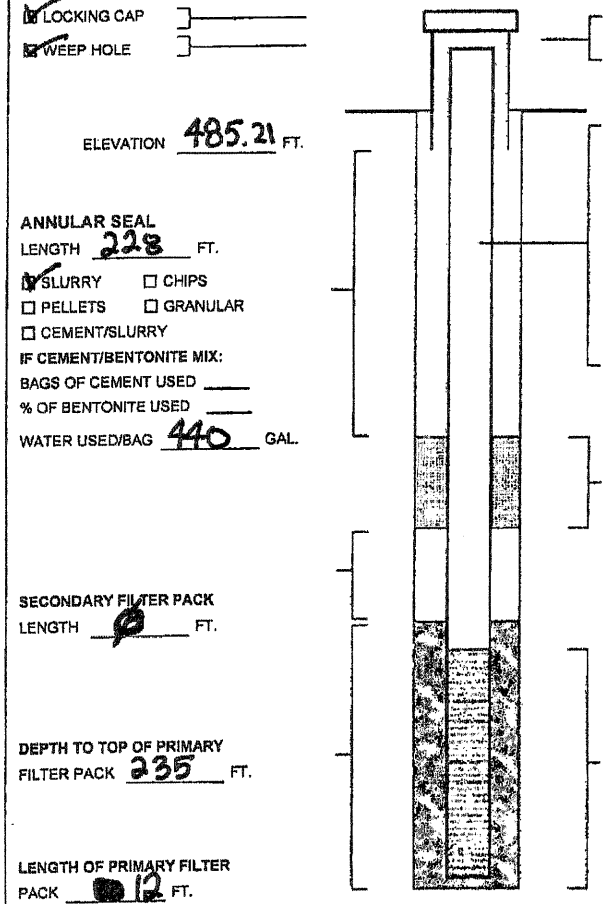
SURFACE COMPLETION
TYPE: ☑ ABOVE GROUND ☐ FLUSH MOUNT
LENGTH AND DIAMETER OF SURFACE COMPLETION: LENGTH 2.5 FT. DIAMETER 5 IN.
DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: DIAMETER 5 IN. LENGTH 2.5 FT.
SURFACE COMPLETION GROUT: ☑ CONCRETE ☐ OTHER

LOCATION OF WELL (D/M/S FORMAT ONLY)
LAT. 38 . 45 . 47.8
LONG. 90 . 26 . 30.6

SMALLEST ¼ LARGEST ¼ ¼
SECTION ____ TOWNSHIP 47 NORTH
RANGE 5 ☑ EAST ☐ WEST

MONITORING FOR: (CHECK ALL THAT APPLY)
☑ RADIONUCLIDES ☐ PETROLEUM PRODUCTS ONLY
☐ EXPLOSIVES ☑ METALS ☑ VOC
☑ SVOCS ☑ PESTICIDES/HERBICIDES

PROPOSED USE OF WELL
☐ GAS MIGRATION WELL ☑ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☐ PIEZOMETERS ☐ INJECTION WELL
☐ DIRECT PUSH



DEPTH TO	DEPTH FROM	FORMATION DESCRIPTION
0'	45'	Silty Clay
45'	247'	Limestone
TOTAL DEPTH:		247 Feet

FOR CASED WELLS, SUBMIT ADDITIONAL AS BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE & SIZE OF ALL CASING, HOLE DIAMETER & GROUT USED.

SIGNATURE (PRIMARY CONTACTOR) | PERMIT NUMBER 003859M | DATE WELL DRILLING WAS COMPELTED 10-7-13

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS. ☐ PUMP INSTALLED

SIGNATURE (WELL DRILLER) | PERMIT NUMBER 003456-M | SIGNATURE (OF APPRENTICE) | APPRENTICE PERMIT NUMBER

MO 780-1415 (07-11)
DISTRIBUTION: WHITE/DIVISION CANARY/CONTACTOR PINK/OWNER
RETURN WHITE COPY WITH APPROPRIATE FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGY AND LAND SURVEY, WELLHEAD PROTECTION SECTION, PO BOX 250, ROLLA, MO 65402 573-368-2165

HERST & ASSOCIATES, INC.®

Hole Number: PZ-212-SS

Rock Log

Local Site Coordinates: 1067490.67 N, 517977.49 E Ground Surface Elevation: 480.15

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 18, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
0.0	**0.0 to 150.0 ft.** - Blind drilled. No sample collected.									Meter: Solinst Model 107 TLC	Blind-drilled enitire boring; no samples collected. Set 10 feet of 12-inch diameter steel temporary casing, then set 35 feet of 8-inch diameter steel temporary casing. Switched from air rotary to sonic and back as needed. O_2 (%), methane (%LEL), and VOCs (ppm) monitored at borehole.
10.0	Cuttings tan/brown silty clay.										20.3% O_2, 0% LEL, 0 ppm. Very wet cuttings at 10 feet below ground surface.
20.0	Cuttings gray/tan sand, silit, clay.										20.3% O_2, 0% LEL, 0 ppm. Wet cuttings 20 - 30 feet.
30.0	Cuttings contain larage limestone/sandstone cobbles and wood fragments										20.3% O_2, 0% LEL, 0 ppm.
35.0											Appear to hit rock at 34 feet.
40.0											20.3% O_2, 0% LEL, 0 ppm.
45.0											
50.0											

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Steve Jett, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-212-SS

Rock Log

Local Site Coordinates: 1067490.67 N, 517977.49 E Ground Surface Elevation: 480.15

Project: Bridgeton Landfill Groundwater Assessment Well Installations

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50.0	**0.0 to 150.0 ft.** - Blind drilled. No sample collected.										
55.0											
60.0											20.9% O_2, 0% LEL, 0 ppm.
65.0											
70.0											
75.0											
80.0	Cuttings change from light gray limestone chips to brown sands and gravels.										
85.0											
90.0	Cuttings indicate back into Limestone.										Difficult to keep hole open since gravel appears to keep intruding the hole.
95.0											
100.0											20.9% O_2, 0% LEL, 0 ppm.

Drilling Contractor: Frontz Drilling, Inc.

Driller: Rob Hamilton

Helper: Rob Underwood

Certifying Geologist: Brian Fingers, Geotechnology, Inc.

Logged By: Steve Jett, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-212-SS

Rock Log

Local Site Coordinates: 1067490.67 N, 517977.49 E Ground Surface Elevation: 480.15

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 18, 2013

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S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
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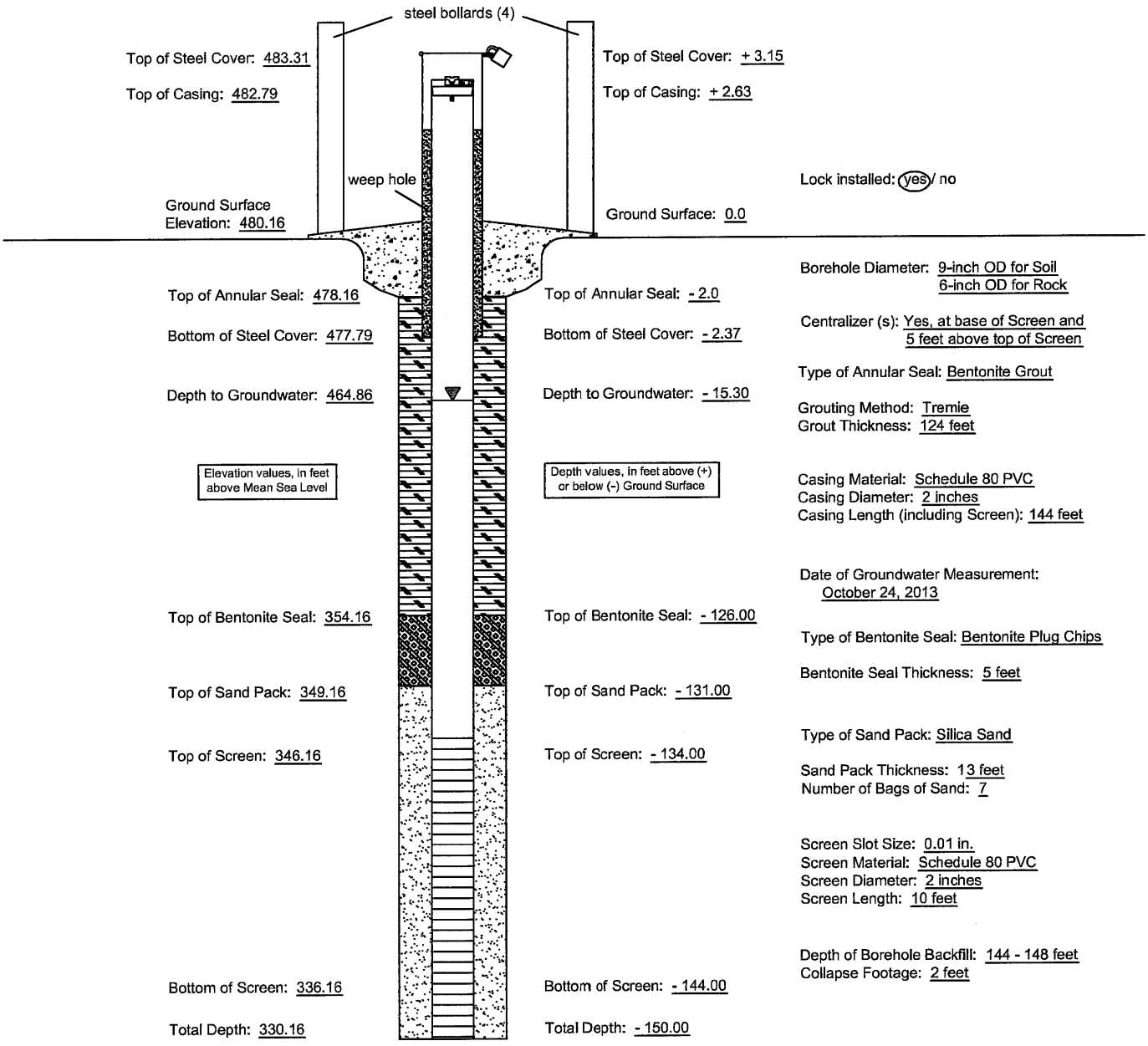
Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
100.0	**0.0 to 150.0 ft.** - Blind drilled. No sample collected.										20.9% O_2, 0% LEL, 0 ppm.
105.0											
110.0											
115.0											Decided to use this borehole for PZ-212-SS and not core, since can't keep hole open to allow coring devices.
120.0											20.9% O_2, 0% LEL, 0 ppm.
125.0											
130.0											
135.0											
140.0											20.9% O_2, 0% LEL, 0 ppm.
145.0											
150.0											

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Steve Jett, Herst & Associates, Inc.

LIMESTONE

Well Coordinates:
N 1067490.987
E 517976.455

Drilling Contractor: Frontz Drilling
Lead Driller: Rob Hamilton
Drilling Dates: October 18, 2013



Top of Steel Cover: 483.31
Top of Casing: 482.79
Ground Surface Elevation: 480.16

Top of Steel Cover: + 3.15
Top of Casing: + 2.63
Ground Surface: 0.0

Lock installed: (yes) / no

Top of Annular Seal: 478.16
Bottom of Steel Cover: 477.79
Depth to Groundwater: 464.86

Elevation values, in feet above Mean Sea Level

Top of Annular Seal: - 2.0
Bottom of Steel Cover: - 2.37
Depth to Groundwater: - 15.30

Depth values, in feet above (+) or below (-) Ground Surface

Borehole Diameter: 9-inch OD for Soil
6-inch OD for Rock

Centralizer (s): Yes, at base of Screen and 5 feet above top of Screen

Type of Annular Seal: Bentonite Grout

Grouting Method: Tremie
Grout Thickness: 124 feet

Casing Material: Schedule 80 PVC
Casing Diameter: 2 inches
Casing Length (including Screen): 144 feet

Date of Groundwater Measurement: October 24, 2013

Top of Bentonite Seal: 354.16
Top of Sand Pack: 349.16
Top of Screen: 346.16

Top of Bentonite Seal: - 126.00
Top of Sand Pack: - 131.00
Top of Screen: - 134.00

Type of Bentonite Seal: Bentonite Plug Chips

Bentonite Seal Thickness: 5 feet

Type of Sand Pack: Silica Sand

Sand Pack Thickness: 13 feet
Number of Bags of Sand: 7

Screen Slot Size: 0.01 in.
Screen Material: Schedule 80 PVC
Screen Diameter: 2 inches
Screen Length: 10 feet

Depth of Borehole Backfill: 144 - 148 feet
Collapse Footage: 2 feet

Bottom of Screen: 336.16
Total Depth: 330.16

Bottom of Screen: - 144.00
Total Depth: - 150.00

(Not to Scale)

HERST & ASSOCIATES, INC.®
4631 North St. Peters Parkway
St. Charles, Missouri 63304
Phone (636) 939-9111
Fax (636) 939-9757

Bridgeton Landfill
Bridgeton, Missouri

PZ-212-SS
As-Built Diagram

PZ-212-SS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM
MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REFERENCE NO.	
C.R. NO.	CHECK NO.
STATE WELL NUMBER	REVENUE NO.
ENTERED BY Ph1 Ph2 Ph3	APPROVED BY / ROUTE

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR
NOTE: THIS FORM IS NOT TO BE USED FOR NESTED WELLS

OWNER NAME: Republic Services
CONTACT NAME: Bryan Sehie
VARIANCE GRANTED BY DNR NUMBER:
OWNER ADDRESS: 13570 Saint Charles Rock Rd.
CITY: Bridgeton
STATE: MO
ZIP CODE: 63044
SITE NAME: Bridgeton Sanitary Landfill
WELL NUMBER: PZ-212-SS
COUNTY: Saint Louis
SITE ADDRESS: 13570 Saint Charles Rock Rd.
CITY: Bridgeton
STATIC WATER LEVEL: 19.11

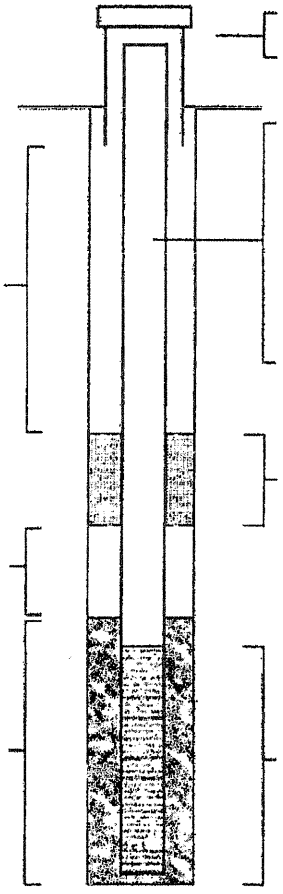
SURFACE COMPLETION
TYPE: ☑ ABOVE GROUND ☐ FLUSH MOUNT
LENGTH AND DIAMETER OF SURFACE COMPLETION: LENGTH 2.5 FT. DIAMETER 5 IN.
DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: DIAMETER 5 IN. LENGTH 2.5 FT.
SURFACE COMPLETION GROUT: ☑ CONCRETE ☐ OTHER

LOCATION OF WELL (D/M/S FORMAT ONLY)
LAT. 38 · 45 · 55.2"
LONG. 90 · 26 · 13 "

SMALLEST ¼ LARGEST ¼ ¼
SECTION 5 TOWNSHIP 47 NORTH
RANGE 5 ☑ EAST ☐ WEST

MONITORING FOR: (CHECK ALL THAT APPLY)
☑ RADIONUCLIDES ☐ PETROLEUM PRODUCTS ONLY
☐ EXPLOSIVES ☑ METALS ☑ VOC
☑ SVOCS ☑ PESTICIDES/HERBICIDES

PROPOSED USE OF WELL
☐ GAS MIGRATION WELL ☑ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☐ PIEZOMETERS ☐ INJECTION WELL
☐ DIRECT PUSH



DEPTH TO	DEPTH FROM	FORMATION DESCRIPTION
0'	34'	Silty clay
34'	80'	Limestone
80'	85'	Sandstone Gravel
85'	144	Limestone
TOTAL DEPTH:		144 FOOT

FOR CASED WELLS, SUBMIT ADDITIONAL AS BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE & SIZE OF ALL CASING, HOLE DIAMETER & GROUT USED.

SIGNATURE (PRIMARY CONTACTOR) | PERMIT NUMBER 003839M | DATE WELL DRILLING WAS COMPELTED 10-18-13

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS. ☐ PUMP INSTALLED

SIGNATURE (WELL DRILLER) | PERMIT NUMBER 003456-M | SIGNATURE (OF APPRENTICE) | APPRENTICE PERMIT NUMBER

MO 780-1415 (07-11)
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HERST & ASSOCIATES, INC.®

Hole Number: PZ-212-SD

Rock Log

Local Site Coordinates: 1067494.79 N, 517980.49 E Ground Surface Elevation: 480.48

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Drilling Date(s): October 19, 2013

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
0.0	**0.0 to 129.0 ft.** - Blind drilled. No sample collected.									Meter: Solinst Model 107 TLC	Blind-drilled from 0 - 129 ft; no samples collected. Switched from air rotary to sonic and back as needed. O_2 (%), methane (%LEL), and VOCs (ppm) monitored at borehole.
5.0										60.2	
10.0										60.2	20.9% O_2, 0% LEL, 0 ppm.
15.0										60.2	
20.0										60.2	20.9% O_2, 0% LEL, 0 ppm.
25.0										60.2	
30.0										60.2	20.9% O_2, 0% LEL, 0 ppm.
35.0										60.2	20.9% O_2, 0% LEL, 0 ppm.
40.0										60.2	
45.0										60.2	
50.0										60.5	20.4% O_2, 0% LEL, 0 ppm.

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt & Steve Jett Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-212-SD

Rock Log

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B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
50.0	**0.0 to 129.0 ft.** - Blind drilled. No sample collected.									60.5	20.4% O_2, 0% LEL, 0 ppm.
55.0										60.5	
60.0										60.5	20.9% O_2, 0% LEL, 0 ppm.
65.0										60.5	
70.0										60.5	20.9% O_2, 0% LEL, 0 ppm.
75.0										60.5	
80.0										60.5	Set temporary 8-in. D casing to 80 ft. Continued drilling through casing. 20.9% O_2, 0% LEL, 0 ppm.
85.0										60.5	
90.0										60.5	
95.0										60.7	
100.0										60.7	20.9% O_2, 0% LEL, 0 ppm.

Drilling Contractor: Frontz Drilling, Inc.
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Rock Log

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F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
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F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
100.0	**0.0 to 129.0 ft.** - Blind drilled. No sample collected.									60.7	20.9% O_2, 0% LEL, 0 ppm.
105.0										60.7	
110.0										60.7	
115.0										60.7	
120.0										60.7	21.2% O_2, 0% LEL, 0 ppm.
125.0										60.7	
129.0											20.9% O_2, 0% LEL, 0 ppm.

Change in scale see sheet 4 of 5

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
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LIMESTONE

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Hole Number: PZ-212-SD

Rock Log

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129.0											
	129.0 to 130.0 ft. - LIMESTONE, light olive gray (5Y 6/1). With white (N9), greenish gray (5GY 6/1), and olive gray (5GY 4/1) spotting. Microcrystalline to fine-grained; massive; competent. Requires multiple hammer blows to fracture, but easily scratched with knife. Reactive with with 10% HCl solution.		1 of 4	4.7/5.0	4.7/4.7	0		F	R4		20.9% O_2, 0% LEL, 0 ppm.
130.0										60.7	
	130.0 to 131.0 ft. - LIMESTONE, as above, but with some lamination.					0		F	R3		
131.0											
	131.0 to 132.0 ft. - LIMESTONE, as above, but massive. With addition of very light gray (N8) spotting.					0		F	R4		
132.0											
	132.0 to 133.0 ft. - LIMESTONE, as above, but with addition of grenish gray (5G 6/1) spotting.					0		F	R4 to R5		
133.0											
	133.0 to 134.0 ft. - LIMESTONE, as above, but with faint grayish orange (10YR 7/4) staining at 133.5 ft. Some lamination from 133.5 - 133.7 ft. Possible moderately healed planar bedding joints. Olive gray (5Y 4/1) at healed joints.					0		F	R4 to R5		
134.0											20.9% O_2, 0% LEL, 0 ppm.
	134.0 to 135.0 ft. - LIMESTONE, light olive gray (5Y 6/1). With pale yellowish brown (10YR 6/2), white (N9), medium dark gray (N4), and olive gray (5Y 4/1) spotting. Microcrystalline; massive to laminated; competent. Easily broken by hand, easily scratched with knife. Reactive with 10% HCl solution. Slightly weathered: faint moderate yellowish brown (10YR 5/4) staining; weak along bedding planes, crumbly, can be flaked away with fingernail.		2 of 4	10.0/10.0	10.0/10.0	0		F to SW	R2 to R3		
135.0										60.7	
	135.0 to 136.0 ft. - LIMESTONE, as above, but greater lamination and more significant weathering. Surface discoloration of pale yellowish brown (10YR 6/2) and olive gray (5Y 4/1) on fracture.					1	[135.25] 90°, B, U, VR	SW	R2		
136.0											
	136.0 to 137.0 ft. - LIMESTONE, as above, but with white (N9), very light gray (N8), and olive black (5Y 2/1) spotting.					0		F to SW	R2		
137.0											
	137.0 to 138.0 ft. - LIMESTONE, as above, but with addition of pale yellowish brown (10YR 6/2), dark yellowish brown (10YR 4/2), and greenish gray (5G 6/1) spotting.					0		F	R2 to R3		
138.0	**138.0 to 139.0 ft.** - LIMESTONE, as above, but yellowish gray (5Y 8/1), light olive gray (5Y 6/1), and olive gray (5Y 4/1). With pale yellowish brown (10YR 6/2), grayish green (10G 4/2), white (N9), and greenish gray (5GY 6/1) spotting. Microcrystalline to fine-grained. Slightly weathered: weak along bedding planes, crumbly, can be flaked away with fingernail. However, less lamination than above.					0		F to SW	R2		
139.0											

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt & Steve Jett Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-212-SD

Rock Log

Local Site Coordinates: 1067494.79 N, 517980.49 E Ground Surface Elevation: 480.48

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 19, 2013

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough
Fe-Iron, CL-Clay, CaCO3-Calcite
FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered
R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
139.0											
	139.0 to 140.0 ft. - LIMESTONE, as above, but microcrystalline. Surface discoloration of olive gray (5Y 4/1) on fracture.					1	[139.3] 85°, B P, R	F to SW	R2 to R3		
140.0	**140.0 to 141.0 ft.** - LIMESTONE, as above, but pale yellowish brown (10YR 6/2) and light olive gray (5Y 6/1). With dark yellowish brown (10YR 4/2) and white (N9) spotting.					0		F to SW	R2 to R3		
141.0	**141.0 to 142.0 ft.** - LIMESTONE, as above, but light olive gray (5Y 6/1). With addition of medium gray (N5) and greenish gray (5GY 6/1) mottling. More lamination than above. Very weak along bedding planes, can easily be pulled apart by hand at bedding joints. Surface discoloration of olive gray (5Y 4/1) to dark greenish gray (5GY 4/1) on fracture. Fracture somewhat conchoidal in appearance.					1	[141.7] 85°, B, I, S	F to SW	R2	60.7	
142.0	**142.0 to 143.0 ft.** - LIMESTONE, as above, but with pale yellowish brown (10YR 6/2) and white (N9) spotting; rarely, grayish black (N2) flecks.					0		F to SW	R2		
143.0	**143.0 to 144.0 ft.** - LIMESTONE, as above, but yellowish gray (5Y 8/1) and light olive gray (5Y 6/1). With greenish gray (5GY 6/1) mottling. Faint grayish orange (10YR 7/4) staining from 143.6 - 143.7 ft. Moderately healed planar bedding joint at 143.65 ft. More massive and stronger (R4) after 143.7 ft.					0		F to SW	R2 to R3		
144.0											20.9% O_2, 0% LEL, 0 ppm.

Change in scale see sheet 6 of 7

Boring Depth: 244 ft. bgs.

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt & Steve Jett Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-212-SD

Rock Log

Local Site Coordinates: 1067494.79 N, 517980.49 E Ground Surface Elevation: 480.48

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

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Drilling Date(s): October 19, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
	144.0 to 229.0 ft. - Blind drilled. No sample collected.									Meter: Solinst Model 107 TLC	
144.0											
145.0										60.7	Blind-drilled from 144 - 229 ft; no samples collected; Borehole reamed to 6-inch diameter before setting well. 20.9% O_2, 0% LEL, 0 ppm.
150.0										60.7	
155.0										60.7	
160.0										60.7	
165.0										60.7	
170.0										60.7	
175.0										60.7	
180.0										60.7	
185.0										60.7	
190.0										60.5	20.9% O_2, 0% LEL, 0 ppm.

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
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LIMESTONE

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B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
190.0											
	0.0 to 129.0 ft. - Blind drilled. No sample collected.									60.5	20.9% O_2, 0% LEL, 0 ppm.
195.0										60.5	
200.0										60.5	20.9% O_2, 0% LEL, 0 ppm.
205.0										60.5	
210.0										60.2	
215.0										60.2	
220.0										60.2	20.9% O_2, 0% LEL, 0 ppm.
225.0										60.1	
229.0											20.9% O_2, 0% LEL, 0 ppm.

Change in scale see sheet 8 of 9

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
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LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-212-SD

Rock Log

Local Site Coordinates: 1067494.79 N, 517980.49 E Ground Surface Elevation: 480.48

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Project No.: 120131675

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Drilling Date(s): October 19, 2013

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P-Polished K-Slickensided SM-Smooth R-Rough VR-Very Rough

Fe-Iron CL-Clay CaCO3-Calcite

FR-Fresh SW-Slightly Weathered MW-Moderately Weathered HW- Highly Weathered CW-Completely Weathered

R6- Extremely Strong R5- Very Strong R4- Strong R3- Medium Strong R2- Weak R1-Very Weak R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
229.0											
	229.0 to 230.0 ft. - LIMESTONE, medium gray (N6). Medium-grainied, massive; strong		3 of 4	5.0/5.0	3.4/5.0	1	90°, U	F	R5	60.1	20.9% O_2, 0% LEL, 0 ppm.
230.0											
						3	90°, U; 90°, U; 90°, I	F	R5		
231.0											
						2	90°, I; 90°, I	F	R5		
232.0											
						3	90°, I; 45°, I; 45°, I	F	R5		
233.0											
	233.0 to 234.0 ft. - LIMESTONE, as above, but Crystalline (233-234 ft).					1	90°, PL	F	R5		Extremely fractured, majority are 90 degrees and undulating; 1 vertical fracture at 240.1 feet, which is 0.4 ft long.
234.0											
	234.0 to 235.0 ft. - LIMESTONE, gray (N7). Medium-grained and crystalline; massive; strong (where not fractured); laminated to thinly bedded.		4 of 4	10.0/10.0	1.1/10.0	7	90°, U	F	R5	60.1	
235.0											
						10	90°, U	F	R5		
236.0											
						9	90°, U	F	R5		
237.0											
						10	90°, U	F	R5		
238.0											
						10	90°, U	F	R5		
239.0											

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
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LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-212-SD

Rock Log

Local Site Coordinates: 1067494.79 N, 517980.49 E Ground Surface Elevation: 480.48

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

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Drilling Date(s): October 19, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
239.0											
240.0						7	90°, U	F	R5	59.9	
241.0	**240.0 to 241.0 ft.** - LIMESTONE, tan-gray (5Y 7/2). Aphantitic to fine-grained; massive; strong; dark gray (N5) layers 241.3-241.6 ft and 242.4-243.3 ft).					6	90°, U	F	R5		
242.0						3	90°, U	F	R5		
243.0						7	90°, U	F	R5		
244.0	**244.0 ft.** - LIMESTONE, aphantitic to fine-grained; massive; strong; dark gray (N5) layers 241.3-241.6 ft and 242.4-243.3 ft).					7	90°, U	F	R5	59.9	Temperature readings in open borehole with no water.

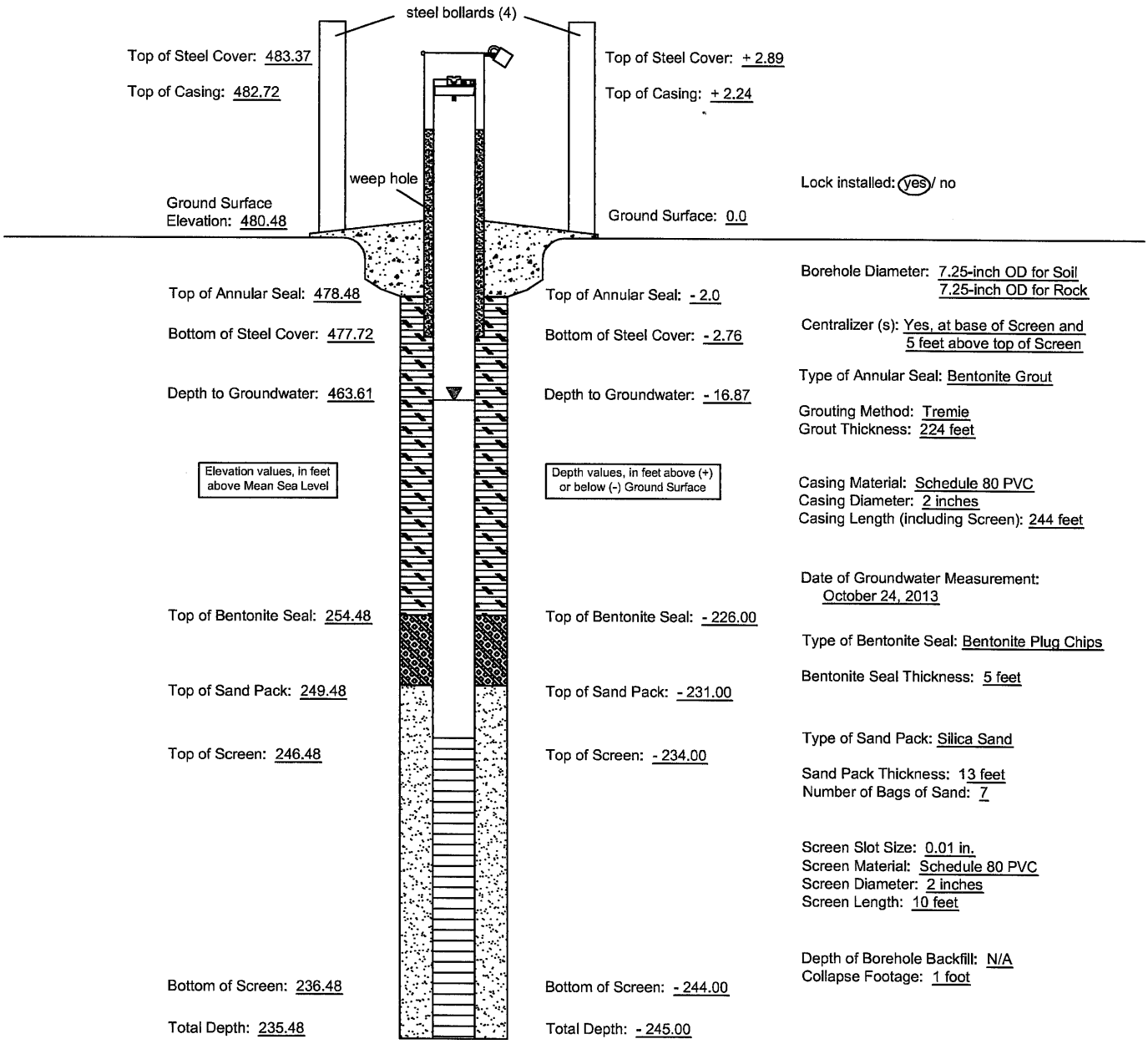
Boring Depth: 244 ft. bgs.

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt & Steve Jett Herst & Associates, Inc.

LIMESTONE

Well Coordinates:
N 1067495.693
E 517980.384

Drilling Contractor: Frontz Drilling
Lead Driller: Rob Hamilton
Drilling Dates: October 19 - 21, 2013



Top of Steel Cover: 483.37
Top of Casing: 482.72
Ground Surface Elevation: 480.48

Top of Steel Cover: + 2.89
Top of Casing: + 2.24
Ground Surface: 0.0

Lock installed: (yes) / no

Top of Annular Seal: 478.48
Bottom of Steel Cover: 477.72
Depth to Groundwater: 463.61

Top of Annular Seal: - 2.0
Bottom of Steel Cover: - 2.76
Depth to Groundwater: - 16.87

Elevation values, in feet above Mean Sea Level

Depth values, in feet above (+) or below (-) Ground Surface

Top of Bentonite Seal: 254.48
Top of Sand Pack: 249.48
Top of Screen: 246.48

Top of Bentonite Seal: - 226.00
Top of Sand Pack: - 231.00
Top of Screen: - 234.00

Bottom of Screen: 236.48
Total Depth: 235.48

Bottom of Screen: - 244.00
Total Depth: - 245.00

(Not to Scale)

Borehole Diameter: 7.25-inch OD for Soil
7.25-inch OD for Rock

Centralizer (s): Yes, at base of Screen and 5 feet above top of Screen

Type of Annular Seal: Bentonite Grout

Grouting Method: Tremie
Grout Thickness: 224 feet

Casing Material: Schedule 80 PVC
Casing Diameter: 2 inches
Casing Length (including Screen): 244 feet

Date of Groundwater Measurement: October 24, 2013

Type of Bentonite Seal: Bentonite Plug Chips

Bentonite Seal Thickness: 5 feet

Type of Sand Pack: Silica Sand

Sand Pack Thickness: 13 feet
Number of Bags of Sand: 7

Screen Slot Size: 0.01 in.
Screen Material: Schedule 80 PVC
Screen Diameter: 2 inches
Screen Length: 10 feet

Depth of Borehole Backfill: N/A
Collapse Footage: 1 foot

4631 North St. Peters Parkway
St. Charles, Missouri 63304
Phone (636) 939-9111
Fax (636) 939-9757
HERST & ASSOCIATES, INC.®

Bridgeton Landfill
Bridgeton, Missouri

PZ-212-SD
As-Built Diagram

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM
MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED	
REFERENCE NO.		
G.R. NO.	CHECK NO.	
STATE WELL NUMBER	REVENUE NO.	
ENTERED Ph1 Ph2 Ph3	APPROVED BY	ROUTE

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR
NOTE: THIS FORM IS NOT TO BE USED FOR NESTED WELLS

OWNER NAME: Republic Services
CONTACT NAME: Bryan Sehie
VARIANCE GRANTED BY DNR NUMBER:
OWNER ADDRESS: 13570 Saint Charles Rock Rd.
CITY: Bridgeton
STATE: MO
ZIP CODE: 63044
SITE NAME: Bridgeton Sanitary Landfill
WELL NUMBER: PZ-212-SD
COUNTY: Saint Louis
SITE ADDRESS: 13570 Saint Charles Rock Rd.
CITY: Bridgeton
STATIC WATER LEVEL: 17.93

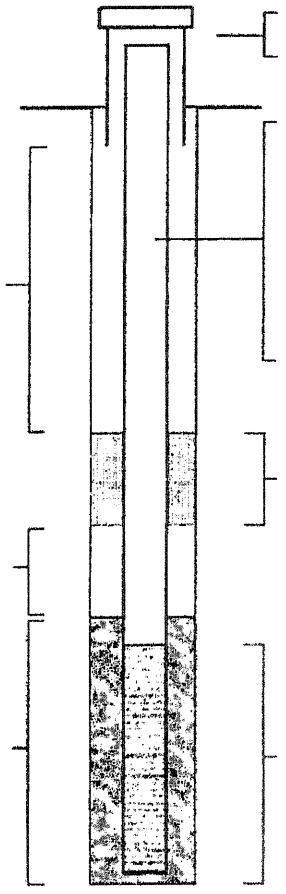
SURFACE COMPLETION
TYPE: ☑ ABOVE GROUND ☐ FLUSH MOUNT
LENGTH AND DIAMETER OF SURFACE COMPLETION: LENGTH 2.5 FT. DIAMETER 5 IN.
DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: DIAMETER 5 IN. LENGTH 2.5 FT.
SURFACE COMPLETION GROUT: ☑ CONCRETE ☐ OTHER

LOCATION OF WELL (D/M/S FORMAT ONLY)
LAT. 38 · 45 · 55.2"
LONG. 90 · 26 · 19.1"

SMALLEST ¼ LARGEST ¼ ¼
SECTION ____ TOWNSHIP 47 NORTH
RANGE 5 ☑ EAST ☐ WEST

MONITORING FOR: (CHECK ALL THAT APPLY)
☑ RADIONUCLIDES ☐ PETROLEUM PRODUCTS ONLY
☐ EXPLOSIVES ☑ METALS ☑ VOC
☑ SVOCS ☑ PESTICIDES/HERBICIDES

PROPOSED USE OF WELL
☐ GAS MIGRATION WELL ☑ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☐ PIEZOMETERS ☐ INJECTION WELL
☐ DIRECT PUSH



☑ LOCKING CAP
☑ WEEP HOLE
ELEVATION 484.18 FT

ANNULAR SEAL
LENGTH 224 FT.
☑ SLURRY ☐ CHIPS
☐ PELLETS ☐ GRANULAR
☐ CEMENT/SLURRY
IF CEMENT/BENTONITE MIX:
BAGS OF CEMENT USED ____
% OF BENTONITE USED ____
WATER USED/BAG 780 GAL.

SECONDARY FILTER PACK
LENGTH 6 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK 231 FT.

LENGTH OF PRIMARY FILTER PACK 13 FT.

SURFACE COMPLETION
☑ STEEL ☐ ALUMINUM ☐ PLASTIC

RISER
RISER PIPE DIAMETER 2 IN.
RISER PIPE LENGTH 236 FT.
DIAMETER OF DRILL HOLE 6 IN.
WEIGHT OR SDR# Sch 80

MATERIAL
☐ STEEL ☑ THERMOPLASTIC (PVC)
☐ OTHER

BENTONITE SEAL
LENGTH 5 Foot
☑ CHIPS ☐ PELLETS ☐ GRANULAR
☐ SLURRY
☑ SATURATED ZONE ☐ HYDRATED

SCREEN
SCREEN DIAMETER 2 IN.
SCREEN LENGTH 10 FT.
DIAMETER OF DRILL HOLE 6 IN.
DEPTH TO TOP 234 FT.

SCREEN MATERIAL
☐ STEEL ☑ THERMOPLASTIC (PVC)
☐ OTHER

DEPTH TO	DEPTH FROM	FORMATION DESCRIPTION
0'	34'	Silty clay
34'	129'	Limestone
129'	244'	Limestone
TOTAL DEPTH:		244 Foot

FOR CASED WELLS, SUBMIT ADDITIONAL AS BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE & SIZE OF ALL CASING, HOLE DIAMETER & GROUT USED.

SIGNATURE (PRIMARY CONTACTOR) | PERMIT NUMBER 003839 M | DATE WELL DRILLING WAS COMPELTED 10-21-13

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS. ☐ PUMP INSTALLED

SIGNATURE (WELL DRILLER) | PERMIT NUMBER 003456-M | SIGNATURE (OF APPRENTICE) | APPRENTICE PERMIT NUMBER

MO 780-1445 (07-11)
DISTRIBUTION: WHITE/DIVISION CANARY/CONTACTOR PINK/OWNER
RETURN WHITE COPY WITH APPROPRIATE FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGY AND LAND SURVEY, WELLHEAD PROTECTION SECTION, PO BOX 250, ROLLA, MO 65402 573-368-2165

Drilling Log

Project Name: WESTLAKE						Boring No. S-84	
Project No.: 84-075-4-002						Page 1 of 3	
Ground Elevation: 452.9	Location: NE section of Site; Fig I-2					Total Footage: 31.5'	
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
SEE REMARKS	5"	31.5	0	4	0	SEE REMARKS	—
Drilling Co.: WABASH DRILLING CO.				Driller (s): DOAL THORNTON			
Drilling Rig: ACKER MP-5, TRUCK				Type of Penetration Test: STANDARD			
Date: 8-24-84	To: 8-24-84			Field Observer (s): GLEN ERNSTMANN			

Depth	Description	Class.	Blow Count	Recov.	Sample or Box No.	Remarks
1	LIGHT BROWN SAND, SILT AND GRAVEL, DAMP TO DRY (FILL)					5" DIA. SOLID AUGERS 0' TO 30'.
2						
3						
4	GREENISH GRAY TO DARK GRAY SILTY FINE SAND, VERY LOOSE, DAMP (FILL)					
5					5.0	
6			2/2/2	18"/18"	SS-1	
7					6.5	
8						
9						
10						
11						FEW THIN SATURATED SANDY ZONES BELOW 12'.
12	GREENISH GRAY SILTY FINE SAND, ZONES OF DARK GRAY CLAYEY SILT, MOIST TO SATURATED (FILL)					
13		A-22				

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

Boring No. S-84
Page 2 of 3
Project Name WESTLAKE
Project No. 84-075-4-002
Date 8-24-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
15				15.0		
16	GREENISH GRAY SILTY FINE SAND, ZONES OF DARK GRAY CLAYEY SILT, MOIST TO SATURATED (FILL)			24" / 24"	ST-2	Q_p = N.A.
17				17.0		
18						
19						
20						ALL MATERIAL SATURATED BELOW APPROX. 20'.
21						
22						
23	GRAY-BROWN FINE TO MEDIUM SAND, TRACE SILT, MEDIUM DENSE					
24						
25				25.0		
26			9/9/12	18" / 18"	SS-3	
27				26.5		APPROX. 6 FT. OF SLOUGH IN HOLE WHEN SAMPLE SS-4 WAS FIRST ATTEMPTED. CASING WAS DRIVEN TO 30' THEN SLOUGH WASH-BORED OUT W/ TRICONE BIT. NO BENTONITE WAS USED.
28						
29	GRAY MEDIUM TO COARSE SAND, MEDIUM DENSITY, SATURATED					
30		A-23	5/6/9	30.0 12" / 18"	SS-4	

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

Boring No. S-84
Project Name WESTLAKE
Page 3 of 3
Project No. 84-075-4-002
Date 8-24-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
	(SEE ABOVE)			31.5	SS-4	
32	TOTAL DEPTH 31.5'					
33						A 2" dia. PVC piezometer was installed to 30.9'.
34						PVC is flush-jointed, threaded couplings. Bottom 10' is .010" machine slotted screen.
35						Gravel pack 31.5' to 20.0' with a 1.8' thick bentonite pellet seal above.
36						Anulas is grouted from seal to ground surface.
37						T.O.P. is 4.0 above ground surface.
38						
39						
40						
						WATER LEVEL IMMEDIATELY AFTER PIEZOMETER INSTALLATION IS 23.7' BELOW T.O.P. 12:20pm 8-24-84.
						WATER LEVEL IS 23.91' BELOW T.O.P. 7:15am 8-27-84

A-24

APPENDIX B

GROUNDWATER DETECTION MONITORING CONSTITUENTS

Appendix B
Groundwater Detection Monitoring Constiutents
Bridgeton Landfill, LLC - Bridgeton, Missouri

Field Parameters	
Constituent	**Suggested Analytical Method**
Dissolved Oxygen, Field	Field Measurement
Oxidation-Reduction Potential, Field	Field Measurement
pH, Field	Field Measurement
Specific Conductance, Field	Field Measurement
Temperature, Field	Field Measurement
Turbidity, Field	Field Measurement

Inorganic Constituents	
Constituent	**Suggested Analytical Method**
Ammonia as Nitrogen	SM 4500-NH_3 G
Chemical Oxygen Demand (COD)	EPA 410.4
Chloride	SW-946 9056
Fluoride	SW-946 9056
Hardness, Total	SM 2340
Nitrate + Nitrite as Nitrogen	EPA 353.2
Phosphorus, Total	EPA 365.1
Solids, Total Dissolved (TDS)	SM 2540C
Sulfate	SW-946 9056
Total Organic Carbon (TOC)	SM 5310C

Metals	
Constituent	**Suggested Analytical Method**
Antimony, Total	SW-846 6020
Arsenic, Total	SW-846 6020
Barium, Total	SW-846 6010
Beryllium, Total	SW-846 6020
Boron, Total	SW-846 6010
Cadmium, Total	SW-846 6020
Calcium, Total	SW-846 6010
Chromium, Total	SW-846 6020
Cobalt, Total	SW-846 6010
Copper, Total	SW-846 6020
Iron, Total	SW-846 6010
Lead, Total	SW-846 6020
Magnesium, Total	SW-846 6010
Manganese, Total	SW-846 6010
Mercury, Total	SW-846 7470
Nickel, Total	SW-846 6010
Selenium, Total	SW-846 6020
Silver, Total	SW-846 6020
Sodium, Total	SW-846 6010
Thallium, Total	SW-846 6020
Vanadium, Total	SW-846 6020
Zinc, Total	SW-846 6010

Appendix B
Groundwater Detection Monitoring Constiutents
Bridgeton Landfill, LLC - Bridgeton, Missouri

Volatile Organic Compounds	
Constituent	**Suggested Analytical Method**
Acetone	SW-846 8260
Acrylonitrile	SW-846 8260
Benzene	SW-846 8260
Bromochloromethane	SW-846 8260
Bromodichloromethane	SW-846 8260
Bromoform (Tribromomethane)	SW-846 8260
Carbon Disulfide	SW-846 8260
Carbon Tetrachloride	SW-846 8260
Chlorobenzene	SW-846 8260
Chloroethane (Ethyl Chloride)	SW-846 8260
Chloroform (Trichloromethane)	SW-846 8260
Dibromochloromethane (Chlorodibromomethane)	SW-846 8260
1,2-Dibromo-3-chloropropane (DBCP)	SW-846 8260
1,2-Dibromoethane (Ethylene Dibromide; EDB)	SW-846 8260
o-Dichlorobenzene (1,2-Dichlorobenzene)	SW-846 8260
p-Dichlorobenzene (1,4-Dichlorobenzene)	SW-846 8260
trans-1,4-Dichloro-2-butene	SW-846 8260
1,1-Dichloroethane (Ethylidene Chloride)	SW-846 8260
1,2-Dichloroethane (Ethylene Dichloride)	SW-846 8260
1,1-Dichloroethylene (1,1-Dichloroethene; Vinylidene Chloride)	SW-846 8260
cis-1,2-Dichloroethylene (cis-1,2-Dichloroethene)	SW-846 8260
trans-1,2-Dichloroethylene (trans-1,2-Dichloroethene)	SW-846 8260
1,2-Dichloropropane (Propylene Dichloride)	SW-846 8260
cis-1,3-Dichloropropene	SW-846 8260
trans-1,3-Dichloropropene	SW-846 8260
Ethylbenzene	SW-846 8260
2-Hexanone (Methyl Butyl Ketone)	SW-846 8260
Methyl Bromide (Bromomethane)	SW-846 8260
Methyl Chloride (Chloromethane)	SW-846 8260

Appendix B
Groundwater Detection Monitoring Constiutents
Bridgeton Landfill, LLC - Bridgeton, Missouri

Volatile Organic Compounds (Continued)	
Constituent	**Suggested Analytical Method**
Methylene Bromide (Dibromomethane)	SW-846 8260
Methylene Chloride (Dichloromethane)	SW-846 8260
Methyl Ethyl Ketone (MEK; 2-Butanone)	SW-846 8260
Methyl Iodide (Iodomethane)	SW-846 8260
4-Methyl-2-pentanone (Methyl Isobutyl Ketone)	SW-846 8260
Styrene	SW-846 8260
1,1,1,2-Tetrachloroethane	SW-846 8260
1,1,2,2-Tetrachloroethane	SW-846 8260
Tetrachloroethylene (Tetrachloroethene; Perchloroethylene)	SW-846 8260
Toluene	SW-846 8260
1,1,1-Trichloroethane	SW-846 8260
1,1,2-Trichloroethane	SW-846 8260
Trichloroethylene (Trichloroethene)	SW-846 8260
Trichlorofluoromethane (CFC-11)	SW-846 8260
1,2,3-Trichloropropane	SW-846 8260
Vinyl Acetate	SW-846 8260
Vinyl Chloride	SW-846 8260
Xylenes, Total	SW-846 8260

Notes

EPA: Methods of Chemical Analysis of Water and Wastes (March 1983)

SW-846: Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.

SM: Standard Methods for the Examination of Water and Wastewater