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February 3, 2017

Mr. Bill Gibbons
Iowa Department of Natural Resources
Field Office No. 5
401 SW 7th Street, Suite I
Des Moines, Iowa 50309

Subject: **Subsurface Data, Property Adjacent to the Magellan Des Moines Terminal**
Des Moines, Iowa

Dear Mr. Gibbons:

In coordination with Magellan Pipeline Company, L.P. (Magellan), TRC Environmental Corporation (TRC) hereby submits this letter which transmits some additional data (the "2016 Data") recently developed on a property adjacent to the Des Moines Terminal (located at 2538 SE 43rd Street, owned by Diamond Animal Health, Inc., (the "Diamond Property")), and discusses the findings within the context of the remediation activities that were conducted in the southern portion of the Terminal under Iowa Department of Natural Resources (IDNR) oversight. The 2016 Data were collected in response to a routine geotechnical investigation conducted on the Diamond Property in support of planned building development.

As explained in greater detail in this letter:

1. Remediation and groundwater monitoring were conducted in the southern portion of the Magellan property (the "Southern Remediation Area") for more than 15 years, including monitoring of groundwater quality on the Diamond Property.
2. In 2011 IDNR issued a finding (a "NFA Letter") that no further action in the Southern Remediation Area would be required. This finding was based in part on Tier II model analysis demonstrating that the cleanup goals established for protection of Des Moines River quality would not be exceeded at the Des Moines River Levee.
3. The extent of petroleum-impacted groundwater that was addressed and monitored in the Southern Remediation Area project associated with the Magellan property included the Diamond Property construction area (i.e., the area immediately adjacent to where two monitoring wells were installed for the purpose of delineating petroleum impacts associated with the Southern Remediation Area).

4. The 2016 Data are consistent with the data known/encountered when the Southern Remediation Area site (the "Site") was closed by IDNR. In particular, 2016 Data for locations along the western perimeter of the Diamond Property, located between the Terminal and the Des Moines River, supports the results of the previously submitted Tier II model analysis and provides further demonstration that cleanup goals established for protection of Des Moines River quality will not be exceeded at the Des Moines River Levee.

In summary, the 2016 Data are fully consistent with the regulatory no-further-action determination associated with the Site. In an abundance of caution, Magellan and TRC are reporting this data to supplement and complete the file record.

Background on Magellan-Diamond Relationship

In response to historic petroleum hydrocarbon impacts on the Diamond Property, Williams Pipeline Company (corporate predecessor of Magellan) and Bayer Corporation (the former owner of the Diamond Property) entered into a Settlement Agreement in 1998. By the terms of that agreement, Williams Pipeline Company agreed to pay Bayer Corporation a certain sum of money to resolve claims (including property damage and diminution in value) over the hydrocarbon impacts. Pursuant to the agreement, Diamond Animal Health, Inc. requested that Magellan submit the 2016 Data to the IDNR.

Technical Background

Between 1994 and 2009, extensive remedial operations were performed in the southwest portion of the terminal (termed the Southern Remediation Area), situated adjacent to the Diamond Property. Upon review of the work and data developed for the Site, in a letter dated August 22, 2011, the IDNR issued a finding ("NFA Letter") that no further action in the Southern Remediation Area would be required at that time, all remediation systems could be shut down, and no further monitoring would be required. This finding was based on rationale that included the following:

- Cleanup goals for groundwater at the Des Moines River Levee (termed Levee Groundwater Remediation Goals (LGRGs)) would not be exceeded, and
- Monitoring had demonstrated a stable or downward trend in constituent concentrations.

The attached figure, included with the May 2011 semi-annual groundwater monitoring report (the last round of groundwater monitoring performed prior to the issuance of IDNR's NFA Letter), presents the results of application of the Iowa DNR Tier II Risk Based Corrective Action Model, which showed that constituent concentrations in MW-30 located on the Diamond Property would not cause an exceedance of LGRGs at the Des Moines River Levee (located to the west and south). Additionally, the contaminant levels identified in MW-30 were shown to be decreasing over time as evidenced by the attached graph/figure.

Overview of 2016 Data

The 2016 Data were developed at the Diamond Property in November 2016. The 2016 Data were collected in response to apparent petroleum hydrocarbon impacts observed during an earlier geotechnical engineering study in support of potential new construction. Reports on the geotechnical study and subsequent "Limited Phase II Environmental Site Assessment" ("Phase II ESA") are attached (collectively, the "Reports"). The 2016 Data were comprised of five test borings with collection/analysis of soil and groundwater samples for fuel-related constituents. The layout of the boring relative to monitoring wells MW-29 and MW-30 is illustrated below (well/boring locations are approximate).



Reported constituent concentrations in groundwater from the 2016 Data and most recent monitoring data for MW-29 and MW-30 are presented in the attached table. Constituent concentrations reported in the 2016 Data are similar to concentrations observed in MW-29 and MW-30 during the Southern Remediation Area remediation and post-remediation monitoring periods. The highest constituents concentrations detected in the 2016 Data

were at locations TB-3 and TB-4, located closest to the Terminal and to monitoring wells MW-29 and MW-30. Relative to concentrations in TB-3 and TB-4 and the historic concentrations reported in MW-30, constituent concentrations in TB-1, TB-2, and TB-5 (located further to the west, in the direction of the Des Moines River), were much lower and were also below the LGRG cleanup goals established for the Terminal.

Discussion

As discussed above, the 2016 Data revealed petroleum hydrocarbon impacts to groundwater on the Diamond property that are similar to impacts observed during historic monitoring of the monitoring wells located on the Diamond property. The 2016 Data for groundwater at locations TB-1, TB-2, and TB-5, located along the western edge of the Diamond Property, and lying between the Terminal and the Des Moines River, supports the results of Tier II model analysis performed as part of the remedial work, which showed that cleanup goals established for protection of Des Moines River quality would not be exceeded at the Des Moines River Levee.

Thank you for your consideration of this matter, and please contact me with any questions or comments.

Sincerely,

Keith Piontek

Digitally signed by kpiontek@trcsolutions.com
DN: cn=kpiontek@trcsolutions.com
Date: 2017.02.03 11:58:41 -06'00'

Keith Piontek, P.E.
Principal Engineer

Attachments: 1. Supporting Information.
2. Diamond Property Reports

Cc: Manny Barrett//Magellan
Jim Pray/Brown, Winick, Graves, Gross, Baskerville, & Schoenebaum P.L.C.

ATTACHMENT 1

SUPPORTING INFORMATION

1. **Figure- Area of Interest**
2. **Table – 2016 Data and Monitoring Data for MW-29 and MW-30**
3. **Graphs – Trends in Constituent Concentrations over Time for MW-30**

Modeled maximum extent of Dissolved Phase Ethylbenzene above LGRG (1.30 mg/L)

LEVEE POINT OF COMPLIANCE

LEVEE POINT OF COMPLIANCE

LEVEE POINT OF COMPLIANCE

SWAMP AREA

SWAMP AREA

SWAMP AREA

NORTHEAST PORTION

SOUTHERN PORTION

POINT OF ORIGIN 0,0

DES MOINES RIVER

Area of Interest Enlarged



From: Semi-Annual Monitoring Report (Apex, May 2011), Attachment B

LEGEND

- MONITORING WELL
- SVE/AS WELL LOCATION, FORMER MPE WELL
- STAFF GAUGE
- AS/SVE WELL NEST
- DDC/SVE WELL–TRAIN RACK SYSTEM
- DDC/SVE WELL–MANIFOLD SYSTEM
- AS/SVE WELL–WESTERN SYSTEM
- AS/SVE WELL–CENTRAL SYSTEM
- COMMUNICATION LINE

0 525

SCALE IN FEET

MAGELLAN PIPELINE COMPANY, L.P.
DES MOINES TERMINAL
DES MOINES, IOWA

ETHYLBENZENE

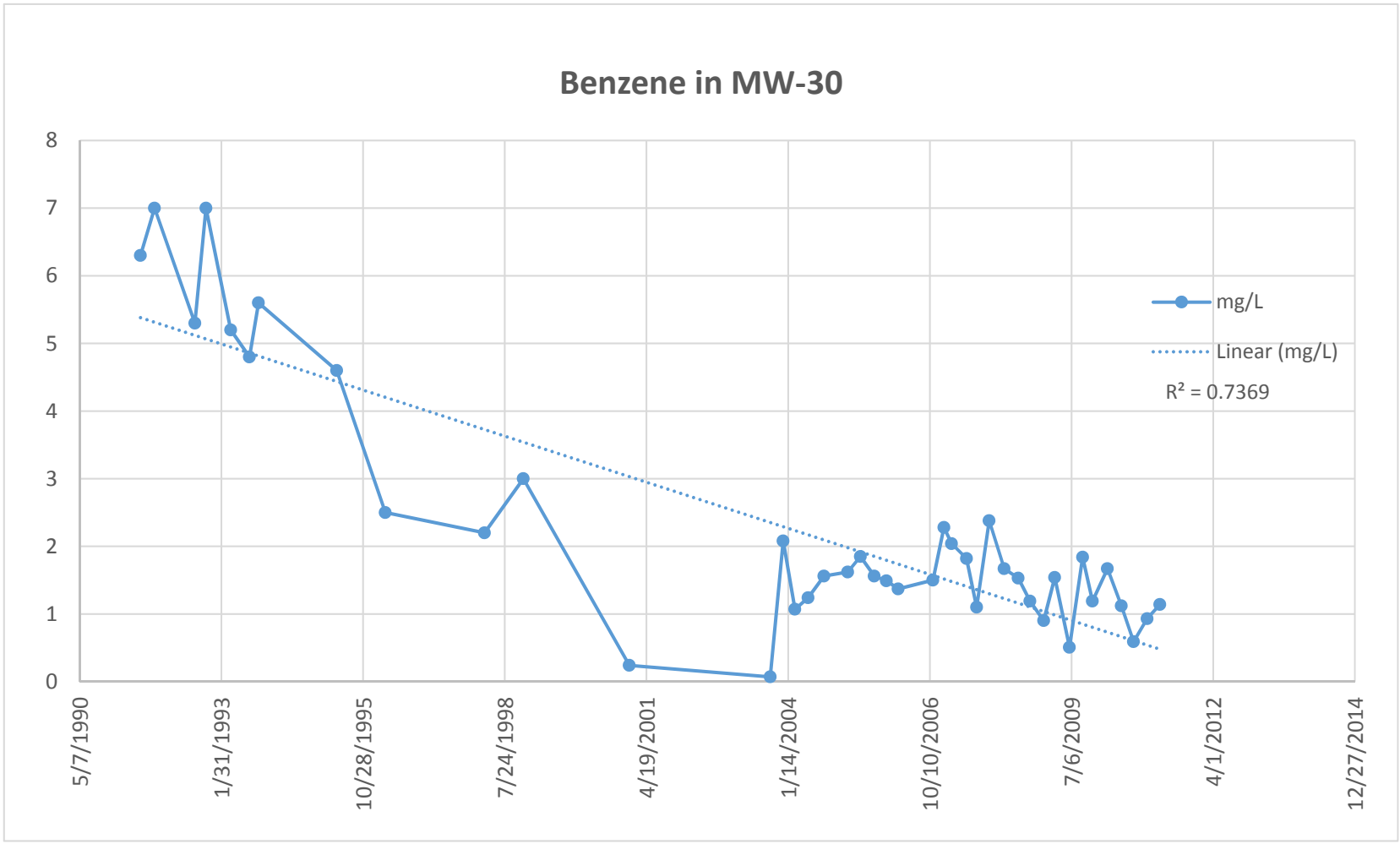
FILE: System Layout Point of Org | DATE: DECEMBER 9, 2008 | FIGURE: 1

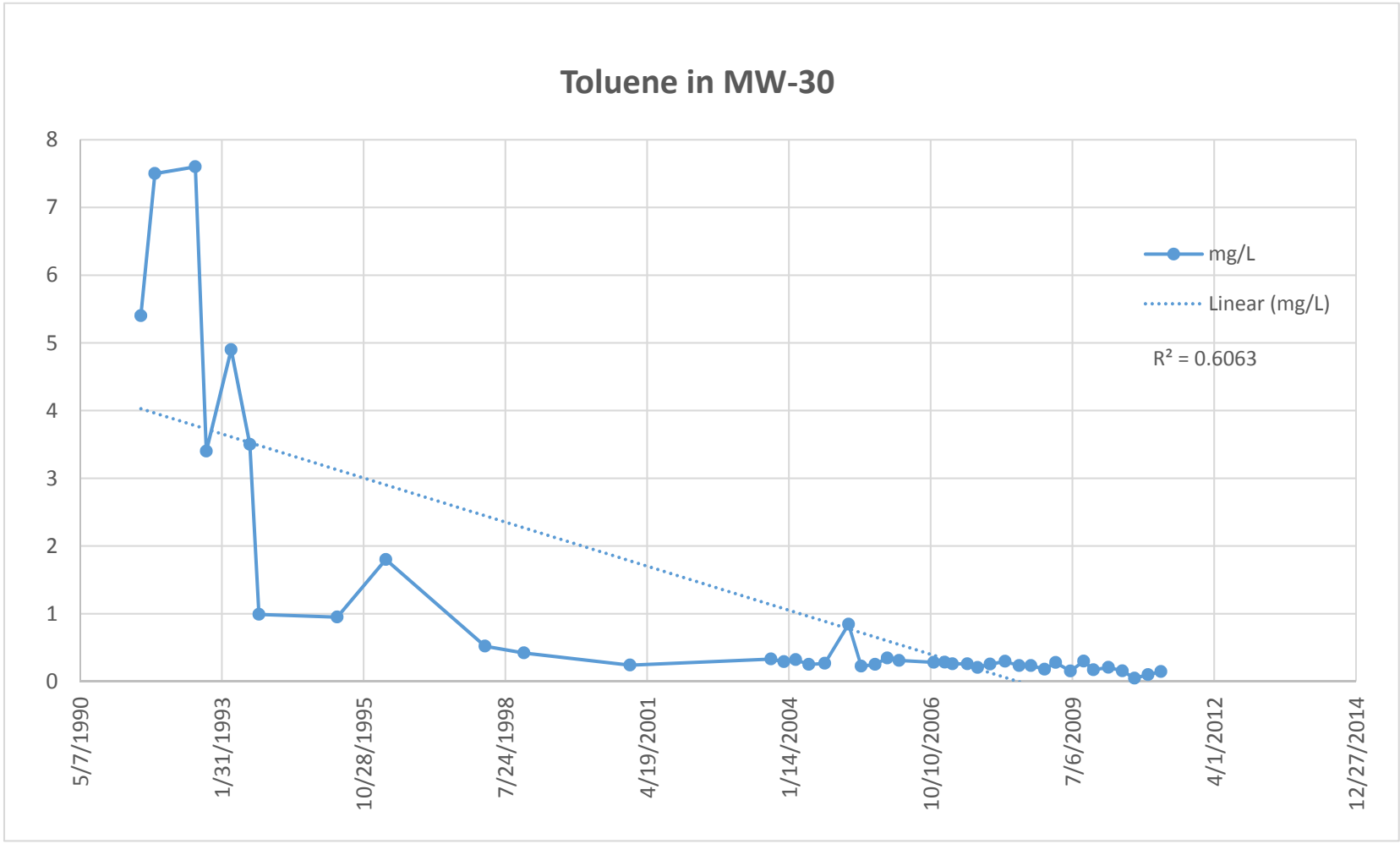
Diamond Property Groundwater Monitoring Data vs. Terminal Cleanup Criteria

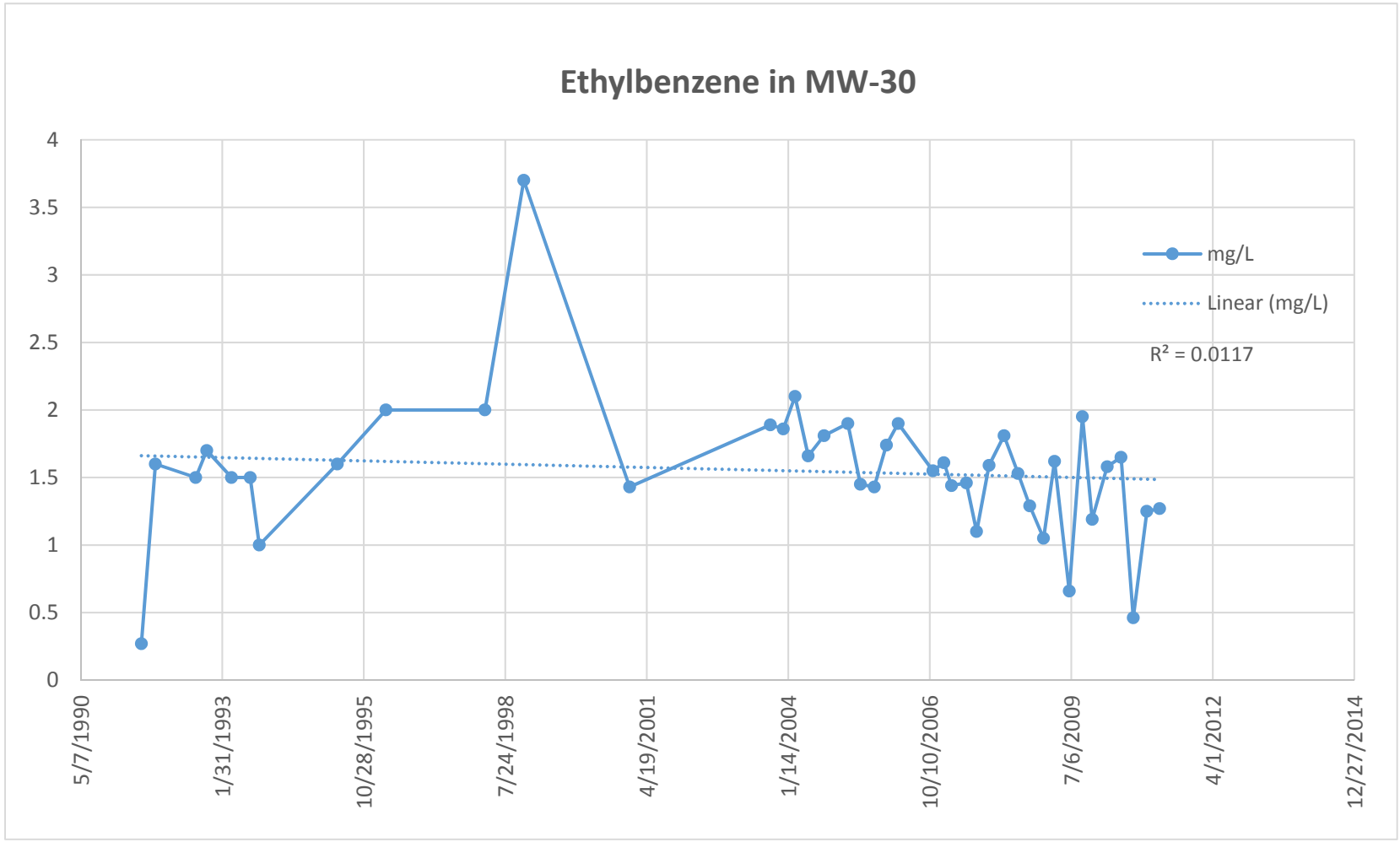
			Benzene (mg/L)	Toluene (mg/L)	Ethylbenzene (mg/L)	Xylene (mg/L)
IDNR-Approved LGRG			**3.88**	**1.9**	**1.3**	**1.65**
Diamond 2016 Phase II Data	DAH-1W	TB-1	0.008	<0.005	0.368	0.036
	DAH-2W	TB-2	0.025	<0.005	0.0198	<.01
	DAH-3W	TB-3	2.05	0.394	8.47	13.8
	DAH-4W	TB-4	0.295	0.103	3.35	0.738
	DAH-5W	TB-5	0.0128	<0.005	0.511	0.427
Magellan Monitoring Data (Previously Submitted to IDNR)	MW-30	11/1/2006	1.5	0.281	1.55	2.73
	MW-30	6/26/2007	1.82	0.259	1.46	2.1
	MW-30	9/6/2007	1.1	0.205	1.1	1.92
	MW-30	12/3/2007	2.38	0.254	1.59	2.39
	MW-30	3/18/2008	1.67	0.296	1.81	3.01
	MW-30	6/25/2008	1.53	0.232	1.53	2.35
	MW-30	9/16/2008	1.19	0.233	1.29	2.01
	MW-30	12/22/2008	0.902	0.179	1.05	1.75
	MW-30	3/10/2009	1.54	0.278	1.62	2.68
	MW-30	6/22/2009	0.507	0.152	0.659	0.887
	MW-30	9/23/2009	1.84	0.299	1.95	1.52
	MW-30	12/1/2009	1.19	0.171	1.19	1.88
	MW-30	3/17/2010	1.67	0.206	1.58	2.31
	MW-30	6/23/2010	1.12	0.155	1.65	2.1
	MW-30	9/17/2010	0.59	0.047	0.462	0.688
	MW-30	12/22/2010	0.931	0.0992	1.25	1.82
	MW-30	3/22/2011	1.14	0.144	1.27	1.78
	MW-29	10/31/2006	0.006	1.04	0.962	3.21
	MW-29	6/26/2007	0.0197	0.591	0.6	2.29
	MW-29	9/6/2007	0.008	0.124	0.175	0.513
	MW-29	12/3/2007	0.019	1.01	0.711	2.76
	MW-29	3/18/2008	0.017	0.348	1.1	1.54
	MW-29	6/25/2008	ND	0.48	0.104	0.414
	MW-29	9/16/2008	0.013	0.523	0.51	1.34
	MW-29	12/22/2008	0.016	0.429	0.723	1.53
	MW-29	3/10/2009	ND	0.037	0.062	0.234
	MW-29	6/22/2009	ND	0.0293	0.0226	0.0738
	MW-29	9/23/2009	0.0147	0.671	1.18	1.98
	MW-29	12/1/2009	0.0036	0.123	0.0235	0.562
	MW-29	3/17/2010	0.0211	0.314	0.582	1.12
	MW-29	6/23/2010	ND	0.0054	0.0087	0.0381
	MW-29	9/17/2010	0.00149	0.00107	0.00374	0.00684
	MW-29	12/22/2010	0.0123	0.0704	0.374	0.567
	MW-29	3/22/2011	0.00507	0.0351	0.0832	0.125

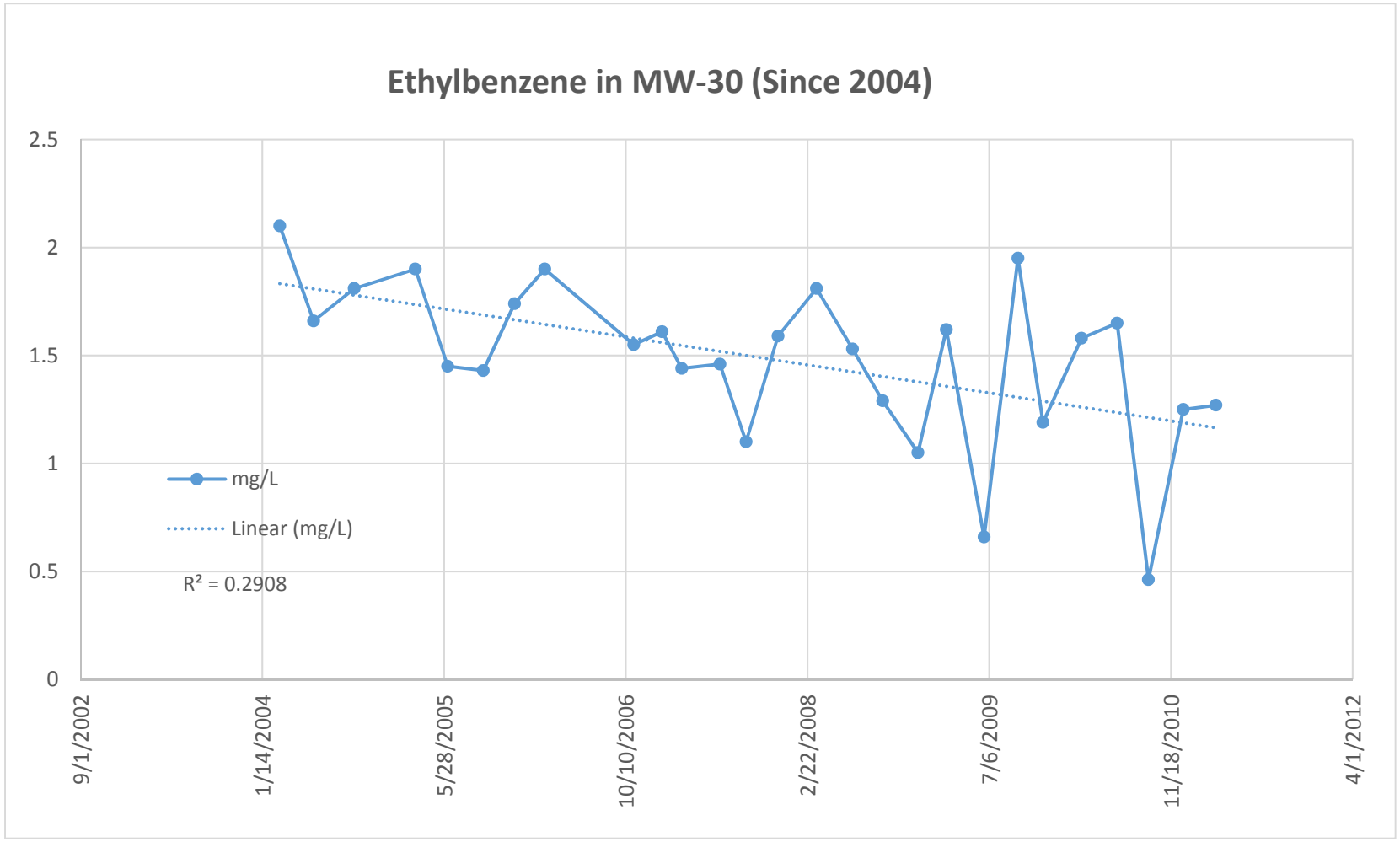
Two year post-remediation monitoring period on which NFA was based.

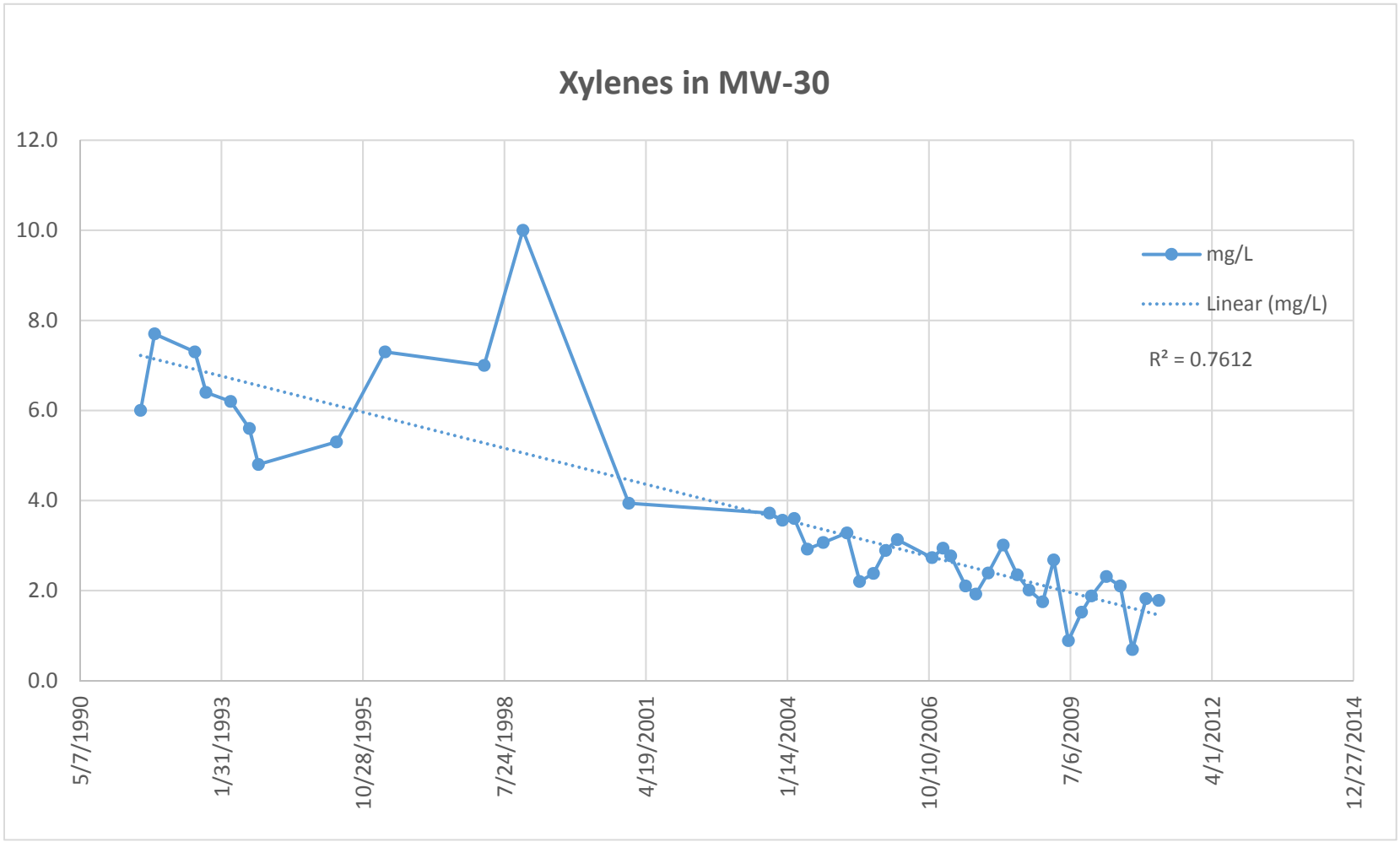
Exceednace of LGRG


Benzene in MW-30
8
7
6
5
4
3
2
1
0
5/7/1990
1/31/1993
10/28/1995
7/24/1998
4/19/2001
1/14/2004
10/10/2006
7/6/2009
4/1/2012
12/27/2014
mg/L
Linear (mg/L)
R² = 0.7369


Toluene in MW-30
8
7
6
5
4
3
2
1
0
5/7/1990
1/31/1993
10/28/1995
7/24/1998
4/19/2001
1/14/2004
10/10/2006
7/6/2009
4/1/2012
12/27/2014
mg/L
Linear (mg/L)
R² = 0.6063


Ethylbenzene in MW-30
4
3.5
3
2.5
2
1.5
1
0.5
0
5/7/1990
1/31/1993
10/28/1995
7/24/1998
4/19/2001
1/14/2004
10/10/2006
7/6/2009
4/1/2012
12/27/2014
mg/L
Linear (mg/L)
R² = 0.0117


Ethylbenzene in MW-30 (Since 2004)
2.5
2
1.5
1
0.5
0
mg/L
Linear (mg/L)
R² = 0.2908
9/1/2002
1/14/2004
5/28/2005
10/10/2006
2/22/2008
7/6/2009
11/18/2010
4/1/2012


Xylenes in MW-30
12.0
10.0
8.0
6.0
4.0
2.0
0.0
5/7/1990
1/31/1993
10/28/1995
7/24/1998
4/19/2001
1/14/2004
10/10/2006
7/6/2009
4/1/2012
12/27/2014
mg/L
Linear (mg/L)
R² = 0.7612

ATTACHMENT 2

REPORTS PROVIDED BY
DIAMOND ANIMAL HEALTH, INC.
2538 SE 43RD STREET
DES MOINES, IOWA 50327

A. Geotechnical Exploration (October 2016)
B. Limited Phase II Environmental Site Assessment (November 2016)

ALLENDER BUTZKE ENGINEERS INC.
GEOTECHNICAL • ENVIRONMENTAL • CONSTRUCTION Q. C.



October 10, 2016 **PN 161409**

GEOTECHNICAL EXPLORATION

DIAMOND ANIMAL HEALTH
RESEARCH AND DEVELOPMENT BUILDING
2538 SE 43RD STREET
DES MOINES, IOWA

PERFORMED FOR

DIAMOND ANIMAL HEALTH
2538 SE 43RD STREET
DES MOINES, IA

3660 109TH STREET • URBANDALE, IOWA 50322 • PHONE 515-252-1885 • FAX 515-252-1888

ALLENDER BUTZKE ENGINEERS INC.

GEOTECHNICAL • ENVIRONMENTAL • CONSTRUCTION Q. C.

October 10, 2016

Diamond Animal Health
2538 SE 43rd Street
Des Moines, IA
Attn: Mr. Rich Kalina

RE: Geotechnical Exploration
Diamond Animal Health
Research and Development Building
2538 SE 43rd Street
Des Moines, Iowa
PN 161409

Dear Mr. Kalina:

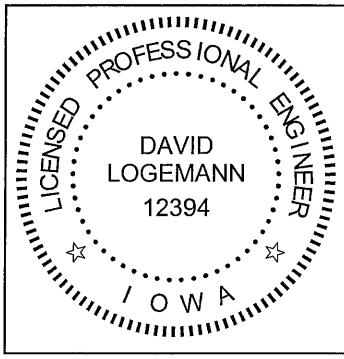
As authorized by you, Allender Butzke Engineers Inc. (ABE) has completed the geotechnical exploration for the above referenced project. The geotechnical exploration was conducted to evaluate physical characteristics of subsurface conditions with respect to design and construction of this project. The enclosed report summarizes the project characteristics as we understand them, presents the findings of the borings and laboratory tests, discusses the observed subsurface conditions, and provides geotechnical engineering recommendations for this project.

We appreciate the opportunity to provide our geotechnical engineering services for this project. If you have any questions or need further assistance, please contact us at your convenience. We are also staffed and equipped to provide construction testing and inspection services on this project as well as environmental site assessments.

Respectfully submitted,
ALLENDER BUTZKE ENGINEERS INC.

Seth Hansen, E.I.
Staff Engineer

David Logemann, P.E.
Principal Engineer



I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

10/10/16

David Logemann, P.E. License Number 12394 Date

My license renewal date is December 31, 2017.

Pages covered by this seal: All Pages.

1 PC and 1 Email Above
1 Email Shive Hattery, Inc.; Attn: Adam S. Conn, P.E.

GEOTECHNICAL EXPLORATION

DIAMOND ANIMAL HEALTH
RESEARCH AND DEVELOPMENT BUILDING
2538 SE 43RD STREET
DES MOINES, IOWA

PN 161409

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GEOTECHNICAL EXPLORATION

DIAMOND ANIMAL HEALTH
RESEARCH AND DEVELOPMENT BUILDING
2538 SE 43RD STREET
DES MOINES, IOWA

PN 161409

October 10, 2016

PROJECT INFORMATION

Diamond Animal Health is planning the construction of a new research and development building at their existing facility located at 2538 SE 43rd Street in Des Moines, Iowa. The new two-story 10,000 square foot building will be pre-engineered slab-on-grade building. Adam Conn, P.E. of Shive Hattery, indicated maximum continuous wall loads and isolated column loads will be on the order of 1 kip per lineal foot and 100 kips, respectively. The finish floor elevation (FFE) of the proposed structure will match the FFE of the existing Building No. 2 at elevation 10.95 feet. The project also includes extending the south parking lot towards the east. Plans indicate the parking lot extension will consist of 7 inches of Portland cement concrete (PCC). Based on existing grades and proposed building FFE, we anticipate minimal cut depths (less than 1 foot) and fill depths of less than 3 feet will be required to achieve final grades.

FIELD EXPLORATION

Two borings were conducted at this site to depths of 20 feet below existing grades on September 23, 2016. Approximate locations of the borings are shown on the enclosed Site Plan and were measured in the field from existing landmarks. The boring surface elevations, indicated on the enclosed Boring Logs, were determined by differential leveling and referenced to the finish floor elevation of the existing building, reported to be at elevation 10.95 feet. Methods of drilling, sampling, standard laboratory testing, and classifying of subsurface materials are discussed in the Boring Log Description/Legend pages of the Appendix.

SUBSURFACE CONDITIONS

Site Geology

The site is located within the reclaimed flood plain of the Des Moines River. The natural topography within the flood plain exhibits little relief and is relatively level. Fill materials encountered at the surface have been placed for development or reclamation of the flood plain area. The natural soil profile encountered below the fill materials consists primarily of cohesive alluvial soils comprised of silts and clays grading to extensive deposits of sand and gravel associated with depositional events of the waterways. The overburden alluvial deposits in this area are underlain by the Des Moines series of the Pennsylvanian bedrock system consisting of undifferentiated layers of shale, siltstone, sandstone, limestone, and coal.

Soil Profile

Detailed descriptions of soils encountered by this exploration are provided on the Boring Logs enclosed in the Appendix. The Profile of Borings (Plate A-1) presented in the Appendix depicts the relative deposit elevations in the borings. Following is a discussion of the subsurface materials encountered in the borings. Unless otherwise indicated, the depths of soil stratum and groundwater levels are referenced from below existing grade at the individual boring locations at the time of drilling.

Existing fill consisting of dark brown lean to fat clay (CL-CH) and brown lean clay (CL) was encountered at the ground surface in both borings. In general, the fill appeared to be moist and exhibited stiff consistencies. However, in Boring No. 1 a variable mixture of sand, gravel, and clay was observed between depths of 1 and 3 feet. This 2 foot thick layer also contained trace amounts of rubble materials such as concrete, brick, and asphalt. The existing fill extended to respective depths of 3.5 and 2.3 feet in Boring Nos. 1 and 2.

Very dark brown to dark brown fat clay (CH) cohesive alluvium with trace amounts of sand and organics underlaid the existing fill in both borings. The stiff to very stiff cohesive alluvium extended to respective depths of 11 and 8.5 feet in Boring Nos. 1 and 2. A slight hydrocarbon odor was noted in the cohesive alluvium after a depth of 5.5 feet in Boring No. 1. In Boring No. 2 a layer of sandy fat clay (CH) was observed near the transition zone between the cohesive alluvium and granular alluvium.

Granular alluvium consisting of medium dense clayey fine to medium sand (SC) and fine to medium sand (SP) was encountered underlying the cohesive alluvium. Trace amounts of gravel and zones of coarser sands were encountered in the deeper portions of the borings. A strong hydrocarbon odor was encountered in both borings within the saturated sands.

Groundwater Level Observations

The borings were monitored during and shortly after drilling operations to detect moisture seepage and groundwater accumulation. During drilling operations, saturated sands were encountered below respective depths of 11 and 8.5 feet in Boring Nos. 1 and 2. At the completion of drilling operations, groundwater accumulation was observed near the transition zone between the cohesive alluvium and underlying saturated sands near respective depths of 11 and 8.5 feet in Boring Nos. 1 and 2. The results of our water level observations are noted on the Boring Logs enclosed in the Appendix.

It should be recognized that these short-term water levels are not necessarily a true indication of the groundwater table. Long-term observations would be necessary to accurately define the groundwater variations at this site. Groundwater levels in this area would be a subdued reflection of the adjacent Des Moines River levels. Fluctuation of groundwater levels can occur due to seasonal variations in the amount of rainfall, surface drainage, subsurface drainage, site topography, irrigation practices, ground cover (pavement or vegetation), and the Des Moines River levels.

ANALYSES AND RECOMMENDATIONS

Existing Fill Considerations

Existing fill soils were encountered at the ground surface extending to depths between 2.3 and 3.5 feet below existing grades in both borings. Boring information indicates that fill sections were generally moist but varied in material type and consistency. Other undocumented fill exhibiting less desirable support characteristics could be present in other unexplored areas. Without documented background of the fill placement, there would be risk associated with constructing settlement sensitive structures on existing fill. By constructing footings and floor slabs to bear in

existing fill to avoid the costs of soil remediation, the owner would be accepting the risk of unpredictable settlement and possible future repair costs associated with constructing over unsuitable fill.

To provide reliable support for structures, we recommend the existing fill be completely over-excavated beneath the proposed building and be replaced with engineered compacted fill. Over-excavation and replacement of existing fill beneath the building could be conducted during initial site grading. As described in the *Expansive Soil Considerations* section of this report, the lean to fat clay (CL-CH) portions of the existing fill should not be placed within 2 feet of floor slabs.

Variable existing fill would also pose a risk to new pavements; however, the owner may wish to assume the risk of pavement settlement and cracking by constructing over the existing fill soils since pavements are more easily repaired. As a minimum, if the owner elects to build on the existing fill, extensive geotechnical probing, testing, and observations should be conducted by an ABE geotechnical engineer during over-excavation/construction to further note suitability and support capability of the existing soils beneath the proposed pavement. If any deficient zones are encountered within the fill, we recommend that an over-excavation and backfill procedure be implemented. It should be recognized that test probing is intended to reduce the frequency of inadvertently constructing over deficient soils, but because of the methods and practical extent (3 feet deep) of hand probing, not all deficient zones may be detected and corrected, especially in the lower portions of fill, which would still leave the owner accepting the risk of less desirable building and structure performance.

Expansive Soil Considerations

The lean to fat clay (CL-CH) existing fill soils encountered in Boring No. 1 and the underlying fat clay (CH) cohesive alluvium encountered underlying the existing fill in both borings are moderately to highly plastic and are considered expansive. The expansive soils can cause movement and distress to lightly loaded floor slabs and foundations. The most severe problems occur where higher clay content soils (CH) are in a natural state of low moisture or are highly compacted at moisture contents near or below optimum moisture content on a relatively incompressible base. Subsequent moisture content increases below floor slabs, footings, and pavements after construction then cause the expansive soils to swell appreciably. If the moisture content does not fluctuate much, then the soil swelling and heave will be minor.

An Atterberg Limits test, conducted on the fat clay (CH) alluvium near the anticipated foundation level, resulted in a Liquid Limit (LL) of 52 and a Plasticity Index (PI) of 33. Based on the results of the Atterberg Limits test and a FFE of 10.95 feet, we anticipate the expansive soils will impact construction of floor slabs and lightly loaded footings with sustained bearing pressures of less than 1,000 pounds per square foot (psf).

To reduce the potential for movements associated with the expansive soils, we recommend floor slabs be supported on a minimum of 2 feet of low plasticity cohesive soils or cohesionless soils. Similarly, soils below lightly loaded foundations with sustained bearing pressures of less than 1,000 psf should be over-excavated and backfilled with a minimum of 2 feet of low plasticity cohesive or cohesionless soils. Alternatively, footings could be designed for 1,000 psf or more sustained loads to resist swelling pressures or lightly loaded footings could be extended to a depth of 6 feet to bear below the zone of seasonal moisture change to provide a higher soil surcharge load.

While over-excavating expansive materials generally reduces future movements to acceptable levels, this method does not necessarily eliminate movements. For this reason, it is advisable to design the slab-on-grade floors slabs to "float" free of edge-restraint at walls and columns, and to provide vertical space for movement of any non-load bearing walls setting on the slab.

Typical movements due to moderately expansive (CL-CH) soils are similar to movements that pavements commonly experience from frost heave. Considering that proposed pavements will be subject to frost heave movements, the risk of movement due to moderately expansive soils may be acceptable to the owner. If the owner chooses to accept the risk of possible future movements, we recommend pavements be supported on 12 inches or more of prepared compacted subgrade further discussed in the *Pavement Subgrade Preparation* section of this report. Subgrade condition and moisture content should be maintained until the slabs or pavements are placed. If the soil is allowed to dry prior to slab or pavement placement, the risk of future slab movement would then increase. If the owner prefers to take a more proactive approach to reduce pavement movement due to expansive soils, pavements could bear on 1 foot or more of low plasticity cohesive ($LL \leq 45$; $PI \leq 23$), chemically stabilized on-site plastic soils, or cohesionless soils, such as drained crushed rock similar to Iowa DOT 4123 Modified Subbase.

Newly planted vegetation (trees and shrubs) close to the proposed building will remove moisture from the nearby soils. Foundations and floor slabs can potentially settle due to shrinkage of soils beneath the footings and floor slabs as the soils dry, especially during drought periods when

mature trees withdraw moisture from nearby soils. As a rule of thumb, trees and shrubs should be kept a minimum horizontal distance away from the building equal to the ultimate height of the vegetation. Likewise, excessive irrigation next to the building can contribute to soil swelling and should be avoided.

Site Grading

Cut-and-fill construction will be performed at this site to achieve the desired final grades. Prior to the placing of concrete floors or pavements on this site, or before any fill is placed, the organic and loose materials in addition to all vegetation must be stripped. We expect that a minimum stripping depth of 6 inches will be required. The stripping depths may vary due to localized variations in vegetation cover and subgrade stability. The strippings could be used for landscaping purposes in non-critical areas where support for foundations, floor slabs, and pavements is not required. The subgrade should then be proof-rolled to delineate zones of soft soils present near the surface which may require additional removal or compaction.

We recommend that low plasticity ($LL \leq 45$, $PI \leq 23$) cohesive or cohesionless soils, free of rubble and organics, be used as compacted fill. Inorganic existing soil such as the lean clay (CL) portions of the existing fill would be suitable soil types for general fill applications. The moderately expansive portions of the existing fill (CL-CH) and fat clay (CH) alluvium should not be placed within 2 feet of floor slabs and lightly loaded footings but could be placed in deeper fill areas.

Table A lists recommended minimum compaction requirements for cohesive and cohesionless fill materials in specific applications. For cohesive soils, moisture contents within a range of -1 to +4 percent of the material's optimum moisture content are necessary to achieve the desired fill qualities.

The on-site soils can be excavated utilizing conventional excavation equipment. Granular soils can generally be suitably compacted with vibratory compaction equipment whereas cohesive soils are more suitable for compaction with sheepsfoot or pneumatic type compactors. Care should be exercised in properly backfilling and compacting all trenches, especially utility trenches under or adjacent to the pavement. Loosely compacted or sand backfilled trenches can collect surface water and inadvertently direct it to the pavement subgrade and cause softening of the soil as well as increasing frost heave potential.

TABLE A
RECOMMENDED DEGREE OF COMPACTION GUIDELINES

Construction Application	Standard Proctor (ASTM D698) Cohesive Soil	Standard Proctor (ASTM D698) Cohesionless Soil	*Relative Density (D4253 & D4254) Cohesionless Soil
Class 1	95%	98%	70%
Class 2	90%	93%	45%
Class 3	85%	88%	20%

Class 1 - Subgrade for building foundations, slabs-on-grade, pavements and other critical backfill areas.
Class 2 - Backfill adjacent to structures not supporting other structures - Minor subsidence possible.
Class 3 - Backfill in non-critical areas - Moderate subsidence possible.

*Use Relative Density technique (ASTM D4253 & D4254) where Standard Proctor technique (ASTM D698) does not result in a definable maximum dry density and optimum moisture content.

Excavation Stability and Dewatering

Shallow excavations at this site will encounter predominately cohesive soils with no wet sand seams or layers, while deeper excavations (below 8 feet) will likely encounter saturated sands (SC, SP). If excavations encounter only cohesive soils with no wet sand seams or layers, it is expected that the water seepage can be controlled by permitting it to drain into temporary construction sumps and be pumped outside the perimeter of the excavations. More extensive dewatering such as sand points and wells may be required for excavations which extend down into water bearing sand layers. We recommend that prior to excavating in saturated sand, water levels be maintained 2 feet or more below the bottom of excavations in saturated sand to prevent upward seepage forces which could reduce subgrade support.

The extent of bracing or sloping of open cut excavations will be dependent upon depth of cut, groundwater conditions, soils encountered, length of time the excavation will be open, area available for excavation and local governing regulations. Predominately cohesive soils may appear to stand

nearly vertical in shallow excavations for short periods of time. However, soil creep, surcharge loads, precipitation, subsurface moisture seepage, construction activity vibrations and other factors may cause these soils to cave within an unpredictable period of time. Excavations encountering sand may tend to cave rapidly, especially if water is flowing through the sand. Unstable granular excavation walls may also cause surrounding cohesive soils to become unstable. Temporary shoring, flattening of the excavation slopes or use of trench boxes may be required to maintain a safe condition. It is to be noted that provisions for sloping, shoring and bracing of excavations are required of the contractor by OSHA.

Hydrocarbon Contamination Related Construction

Olfactory observations during this geotechnical exploration indicate that this site has some level of hydrocarbon contamination under the proposed building. Based on boring information, hydrocarbon odors were the greatest within the saturated sands below depths of 11 and 8.5 feet in Boring Nos. 1 and 2, respectively. Contaminated soils encountered in excavations would not be suitable for reuse as engineered compacted fill and should be properly disposed of in a sanitary landfill or land farmed in accordance with Iowa Administrative Code 567 Chapter 120.

If it is desired to provide additional precautionary measures to reduce the potential for hydrocarbon vapors in the building, floor slabs could be placed on permeable granular material, such as clean compacted gravel or crushed rock. Perforated pipes can be placed in the granular bedding and provisions made to circulate air through the underfloor section to evacuate vapors from under the floors, similar in concept to common radon reduction systems. The granular bedding should be covered with a heavy duty vapor barrier material.

Foundation Design

Based on a finish floor elevation of 10.95 feet we assume exterior frost-depth footings will bear near an elevation of 7 feet and interior columns will bear approximately 2 feet higher near an elevation of 5 feet. We anticipate interior and exterior footings bearing at these elevations will be supported on newly placed engineered compacted fill (required to replace existing fill, and achieve final grades, and replace moderately expansive soils) overlying stiff to very stiff natural cohesive alluvium. If lightly loaded footings are extended to a depth of 6 feet (see the *Expansive Soil Considerations* section of this report), we assume footings will be supported by stiff to very stiff natural cohesive alluvium near an elevation of 3 feet.

In our opinion, newly placed engineered compacted fill overlying stiff to very stiff natural cohesive alluvium can provide adequate support for the proposed structure. We recommend that continuous and isolated spread foundations bearing on newly placed engineered compacted fill overlying stiff to very stiff natural soils be proportioned for maximum net allowable soil bearing pressures of 2,500 and 3,000 pounds per square foot, respectively. If footings are extended to a depth of 6 feet to bear on stiff to very stiff natural cohesive alluvium, the same bearing pressures could be used for design. We estimate long-term total settlement due to structural loads will be less than 1 inch and differential settlement may be on the order of ½ of the total settlement when foundations bear on newly placed engineered compacted fill and stiff natural soils.

Continuous foundations should be adequately reinforced to limit deflections caused by non-uniform soil support characteristics. All exterior foundations and foundations in unheated areas should be placed a minimum of 3.5 feet below final grade to provide protection against frost penetration. The on-site cohesive soils and newly placed cohesive fill would be suitable for trench foundations. Footing excavations should be kept free of water accumulation to prevent softening of subgrade soils.

Observations and test probing of the foundation subgrade soils should be conducted by an ABE geotechnical engineer to determine that the soils are compatible with the design criteria. If zones of soft or otherwise unsuitable soils are encountered at foundation level, we recommend that footings be extended to bear on firmer soils or an over-excavation and compacted backfill procedure be implemented. Over-excavations should extend 9 inches laterally in each direction beyond the foundation edges for each foot of over-excavation depth.

Floor Slab Support

As discussed in the *Expansive Soil Considerations* section of this report, soils below the floor slab should consist of at least 2 feet of low plasticity (LL $\leq$ 45; PI $\leq$ 23) cohesive or cohesionless soil. This minimum 2 feet low plasticity buffer can include the permeable granular base placed beneath the slab for ventilating hydrocarbon vapors. Floor slabs supported by 2 feet or more of low plasticity engineered compacted fill can be designed for a modulus of subgrade reaction value of 150 pounds per cubic inch. Testing, observations and probing should be conducted during construction to delineate zones of soft soils which may require repair prior to concrete placement.

Pavement Subgrade Preparation

Uniform subgrade support is critical in pavement performance. As discussed in the *Existing Fill Considerations* section of this report, there is risk of settlement and cracking associated with constructing new pavements over existing fill encountered at this site. The risk of pavement settlement and cracking may be acceptable to the owner for economic reasons, as pavements are more easily repaired than footings and floor slabs.

If the owner chooses to accept the risk of future pavement settlement by constructing new pavements over existing fill, we recommend proof-rolling and technical observations be conducted by an ABE geotechnical engineer during subgrade preparation. As a minimum, we recommend that the prepared subgrade depth be at least 1 foot deep after fine grading or trimming and extend 2 feet beyond the edge of the pavements. The recommended 1 foot of compacted subgrade may necessitate undercutting and reworking soils in cut areas. Subgrade preparation to 1 foot depths for some soil types may not be suitable under repeated heavy construction vehicle loads and may require stabilization to greater depths.

Subgrade preparation should be completed shortly before paving operations commence and is to be maintained in suitable condition until paved. Damages caused by construction traffic or deterioration due to adverse weather are to be repaired prior to paving.

Depending upon conditions encountered at the time of construction, it may be necessary to moisture condition existing soils to achieve the recommended moisture content range of -1 to +4 percent of optimum moisture content. Soils compacted closer to optimum moisture content will exhibit greater stability under construction traffic loading. Suitable cohesive soil compacted to a minimum of 95 percent of maximum dry density determined by ASTM D698 would provide a design support capability equivalent to a CBR value of 3 or a modulus of subgrade reaction value of 100 pounds per cubic inch. Subgrade compaction, moisture content and depth should be verified by an ABE representative.

Pavement Thicknesses

Either rigid (Portland cement concrete, PCC) or flexible (hot mix asphalt, HMA) pavement types could be constructed on the prepared cohesive subgrade. The following Table C summarizes alternate pavement thicknesses for typical lightly-loaded, moderately-loaded and heavily-loaded

paved areas. If a minimum 6 inch thick crushed rock base (such as IDOT 4123 Modified Subbase) with subdrains is constructed on the compacted subgrade to support the pavement, the recommended thicknesses of PCC or HMA pavement may be reduced by ½ and 1 inch, respectively. However, we recommend lightly-loaded PCC pavement sections 5 inches thick not be reduced. A more specific pavement evaluation can be provided if traffic volume and loading information is available.

TABLE C
TYPICAL PAVEMENT THICKNESSES

Traffic Volume	Rigid: PCC [1]	Flexible: HMA [2]
Lightly-Loaded [3]	5" [4]	6"
Moderately-Loaded	6"	7"
Heavily-Loaded [5]	7"	8"

1) PCC - Flexural strength of 550 psi
2) Type A HMA - Structural coefficient of 0.44/inch
3) Automobile and 1 to 2 trucks average daily traffic.
4) Thickness reduction due to crushed rock subbase does not apply
5) Entrances, delivery areas, dumpster areas or other areas of heavier truck traffic (25 trucks or less per day).

The above pavement thicknesses are considered to be typical and would require periodic maintenance. This maintenance would consist of sealing cracks/joints and replacement of isolated distressed areas. Thicker pavement sections would reduce maintenance and increase the pavement service life. Likewise, thinner sections would be expected to have a shorter service life that still may satisfy particular project needs but may require more maintenance. Other criteria which influence pavement service life include surface drainage, subsurface drainage, paving material quality, reinforcement, and joint design. Construction procedures involving placement, finishing, curing, jointing and weather protection can significantly impact pavement performance.

Seismic Site Class

The soil profile encountered at this site consists primarily of stiff to very stiff natural clays overlying the primarily medium dense sands. Based on the geologic history of the area and our experience in this area, we expect these soils are underlain by extensive deposits of sand and gravel overlying the Pennsylvanian bedrock system consisting of undifferentiated layers of shale, siltstone,

sandstone, limestone, and coal. Previous borings conducted to the west of this project and US Geological Survey (USGS) Bedrock Topography maps of central Iowa suggest that the bedrock surface in this area is likely near 50 feet below the ground surface.

Based on our knowledge of local geology, soil stratigraphy, and associated soil shear strengths, we interpret that the soil profile at this site would be categorized as Site Class D as described in Table 20.3-1 Site Class Definitions of the 2010 ASCE-7 Standard. Based on 2012/2015 International Building Code Figures 1613.3.1 (1) and (2), Tables 1613.3.3 (1) and (2), and information obtained from the U.S. Geologic Survey, we interpret the structural seismic design site coefficients for mapped spectral response acceleration at short period (F_a) equal to 1.6 and at 1-second (F_v) equal to 2.4.

Frost Heave Considerations

Key elements contributing to frost heave including freezing temperatures, available water, and fine grained frost susceptible soils are generally present at sites in Iowa. As a result, frost heave problems are generally common (and most noticeable) in pavements or sidewalks adjacent to non-frost susceptible elements such as manholes, light poles, and exterior doors or frost protected stoops. Frost heave can cause pavement cracks to develop parallel to and several feet from curbs. This generally occurs where cleared paved areas exposed to freezing temperatures heave more than adjoining paved areas insulated by piled snow. Sometimes it is not readily apparent why frost heave problems occur at one location and not at another seemingly similar location.

While it is appropriate to implement measures to reduce frost heave such as insulation, replacing frost susceptible soils with less frost susceptible soils, void forms, sealing cracks/joints to reduce surface water infiltration, or drainage improvements (surface and subsurface), these measures may simply move the frost heave problem to a different location where preventative measures have not been implemented. Having a smooth transition between heaved and non-heaved areas is desirable, but may be difficult and/or costly to accomplish. We are available to meet with you to discuss options for your consideration to reduce frost heave potential on this project.

GENERAL

The analyses and recommendations in this report are based in part upon the data obtained from the soil borings performed at the indicated locations and from any other information discussed in this report. This report does not reflect any variations which may occur between borings or across the site. The nature and extent of such variations may not become evident until construction. If variations then appear evident, it will be necessary to reevaluate the recommendations of this report.

It is recommended that the geotechnical engineer be provided the opportunity to review the plans and specifications so that comments can be made regarding the interpretation and implementation of our geotechnical recommendations in the design and specifications. It is further recommended that the geotechnical engineer be retained for testing and observation during earthwork and foundation construction phases to help determine that the design requirements are fulfilled.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranty, expressed or implied, is made. In the event that any changes in the nature, design or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report modified or verified in writing by the geotechnical engineer.

The scope of our service was not intended to include any environmental assessment or exploration for the presence of hazardous or toxic materials in the soil, surface water, groundwater or air on, below or adjacent to this site.

APPENDIX

BORING LOG DESCRIPTION/LEGEND

The material types encountered during the drilling operations were recorded on field logs. The profile represented on the Boring Log is based on final classification performed by a geotechnical engineer using the field logs, laboratory observation and testing. The material stratigraphy demarcation lines shown on the Boring Logs indicate changes in soil characteristics, however, actual soil changes or variations may occur as a gradual transition. Soil profile discussion, Log Boring information, water levels and recommendations presented in this report are based upon measured depths below ground levels existing at time of the field exploration, unless otherwise specified.

DRILLING AND SAMPLING

The borings were conducted with either a truck or all-terrain rotary drill rig using the drilling methods indicated on each Boring Log. Soil sampling and/or in-situ testing such as Shelby Tube (ST), split-spoon (SS), drive cone (DC), or core (C) was conducted at depth intervals which were selected in consideration of the characteristics of the proposed construction. Generally undisturbed soil samples are taken at 5 foot depth intervals or change in soil types. Disturbed soil samples from the auger, either jar size or bulk size samples, may be taken at intermediate intervals for the purpose of soil classification or laboratory testing. Borings conducted for soil classification only, will show no designation of sampling although disturbed sampling is performed. Soil samples obtained in the field were identified and sealed for transportation to the laboratory for performance of pertinent physical testing and engineering classification.

Drilling Methods

CFA - Continuous Flight Auger: 4, 6, or 8-inch diameter (ASTM D1452).
RD - Rotary Drilling: Using drilling fluid in cased or uncased boring (ASTM D2113).
HSA - Hollow Stem Auger: 6 or 8-inch diameter, continuous flight auger remains in boring with soil removed from the hollow stem through which undisturbed sampling is conducted.
HA - Hand Auger: 4-inch or less diameter.

Sample Types

ST - Shelby Tube: Thin-walled tube samples of cohesive soils (ASTM D1587).
SS - Split Spoon with 140 lb. manual hammer: Standard penetration test and split-barrel samples (ASTM D1586).
SSA - Split Spoon with 140 lb. automatic hammer: Standard penetration test and split-barrel samples (ASTM D1586).
DC - Drive Cone: Dynamic in-place testing of soil using a 2-inch diameter cone with a 60 degree point driven into the soil for continuous 1-foot intervals in the same manner as Split Spoon, no sample is obtained.
C - Core: Sampling hard soil or bedrock with a diamond core barrel in a rotary drill boring (ASTM D2113).
SPT - Standard Penetration Test: Number of blows required to drive sampler (split spoon or drive cone) into the soil with a 140-pound weight dropping a distance of 30-inches (ASTM D1586), number of blows recorded for each 6-inch interval in an 18-inch (or more) penetration depth, values shown are for each 6-inch interval (if series of number sets are shown) or a total of the last two 6-inch intervals (if only one number is shown) which is commonly referred to as "N" in blows per foot. High resistance is indicated by a high number of blows for a lesser penetration depth listed in inches.
BS - Bulk Sample: Disturbed.
CPT - Cone Penetration Test: Quasi-static in-place testing of soils using a 60 degree cone and friction sleeve which are steadily pushed into the soil and measure skin friction and end bearing (ASTM D3441).

STANDARD LABORATORY TESTING

Representative undisturbed soil samples obtained by the Shelby Tube sampler were tested for moisture content (ASTM D2216), density (dry) and unconfined compressive strength (ASTM D2166) in the laboratory. Results of these tests appear on the respective Boring Logs. Additional soil testing including particle size analysis (ASTM D422) and Atterberg Limits (ASTM D4318) may be conducted, if necessary, to define in more detail pertinent soil characteristics for classification in accordance with the Unified Soil Classification System. Specialized laboratory tests (if conducted) to determine pertinent soil characteristics are discussed in the "Laboratory Testing" section of the report.

WATER LEVEL MEASUREMENT

Water levels indicated on the Boring Logs are the levels measured in the borings at the times indicated. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels is not possible with short term observations.

BORING LOG DESCRIPTION/LEGEND

(page 2 of 3)

DESCRIPTIVE SOIL CLASSIFICATION

Soil description is based on the Unified Classification System as outlined in ASTM Designations D-2487 and D-2488. This classification is primarily based upon visual and apparent physical soil characteristics, comparison with other soil samples, and our experience with the soil. Additional laboratory testing may be conducted, if necessary to define in more detail pertinent soil characteristics. The Unified Soil Classification group symbol shown on the boring logs corresponds with the group names listed below. The description includes soil constituents, moisture conditions, color and any other appropriate descriptive terms.

Group Symbol	Group Name	Group Symbol	Group Name	Group Symbol	Group Name	Group Symbol	Group Name
GW	Well-Graded Gravel	SW	Well-Graded Sand	CL	Lean Clay	CH	Fat Clay
GP	Poorly-Graded Gravel	SP	Poorly-Graded Sand	ML	Silt	MH	Elastic Silt
GM	Silty Gravel	SM	Silty Sand	OL	Organic Clay Organic Silt	OH	Organic Clay Organic Silt
GC	Clayey Gravel	SC	Clayey Sand			PT	Peat

RELATIVE PROPORTIONS			GRAIN SIZE TERMINOLOGY	
Descriptive Term(s) (Of components also present in sample)	Sand and Gravel % of Dry Weight	Fines % of Dry Weight	Major Component of Sample	Size Range
Trace	<15	<5	Cobbles	12 in. to 3 in. (300mm to 75mm)
With	15-30	5-12	Gravel	3 in. to #4 sieve (75mm to 4.75mm)
Modifier	>30	>12	Sand	#4 to #200 sieve (4.75mm to 0.074mm)
			Silt or Clay	Passing #200 sieve (.074 mm)

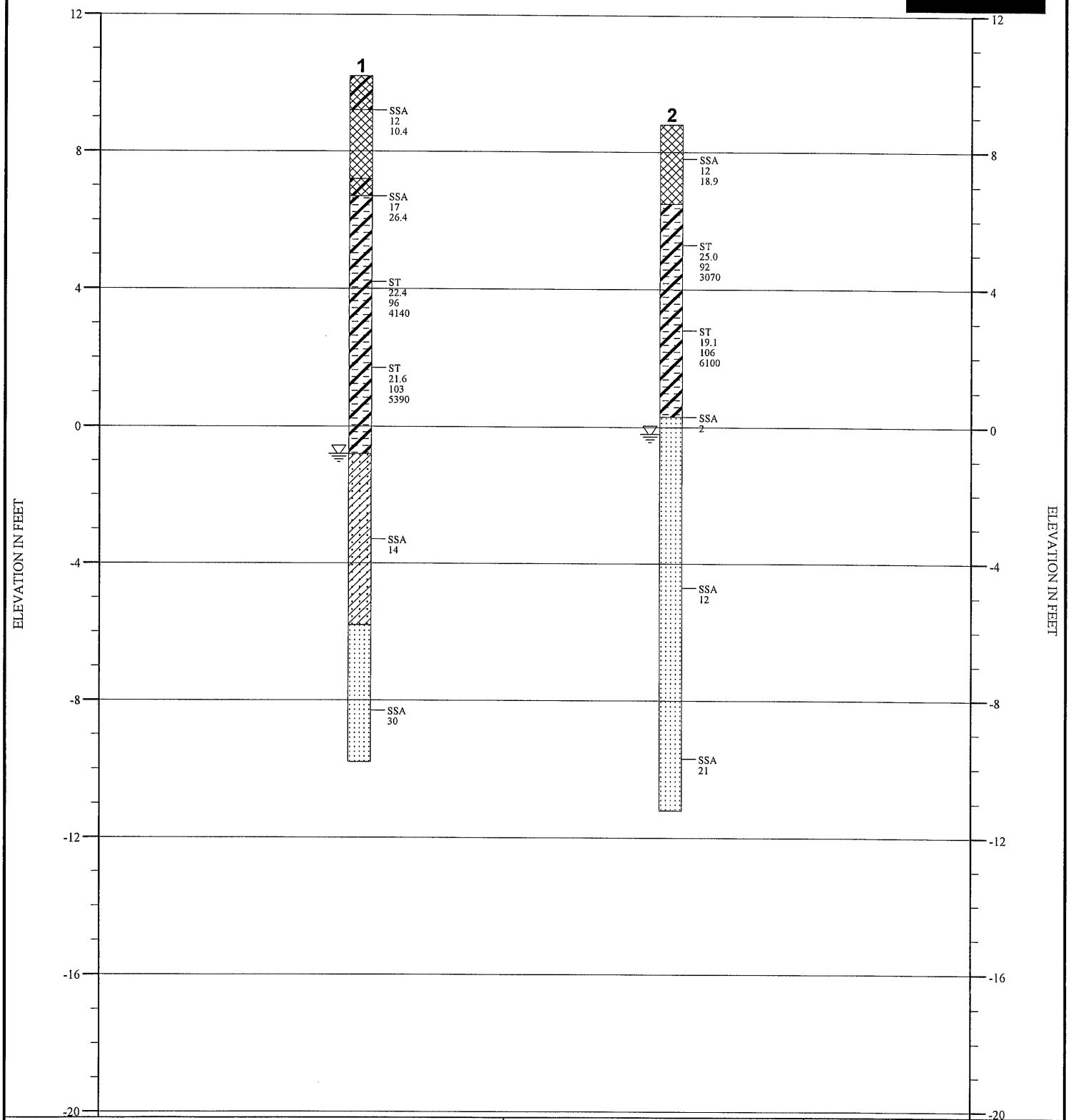
CONSISTENCY OF FINE-GRAINED SOILS			RELATIVE DENSITY OF COARSE-GRAINED SOILS	
Unconfined Compressive Strength, Qu, psf	Consistency	SPT, bpf	SPT, bpf	Relative Density
< 500	Very Soft	0-2	0-4	Very Loose
500-1,000	Soft	2-4	4-10	Loose
1,000-2,000	Medium Stiff	4-8	10-30	Medium Dense
2,000-4,000	Stiff	8-15	30-50	Dense
4,000-8,000	Very Stiff	15-30	50-80	Very Dense
8,000-16,000	Hard	30-100	80+	Extremely Dense
> 16,000	Very Hard	>100		

BORING LOG DESCRIPTION/LEGEND

ABBREVIATIONS

COMMONLY USED ABBREVIATIONS	
ft. or ' - feet	elev. - Elevation
in. or " - inches	% - Percent
psf - pounds per square foot	No. - Number
plf - pound per lineal foot	TB - Test Boring
pcf - pounds per cubic feet	N - blow count (SPT, bpf)
kip - 1000 pounds	USCS - Unified Soil Classification System
ksf - 1000 pounds per square foot	LL - Liquid Limit
klf - 1000 pounds per lineal foot	PL - Plastic Limit
tsf - tons per square foot	PI - Plasticity Index
bpf - blows per foot (SPT, N)	

PROFILE OF BORINGS



Strata symbols

- Lean to Fat Clay Fill
- Fill
- Alluvial Fat Clay
- Clayey Sand
- Poorly Graded Sand
- Lean Clay Fill

Misc. Symbols

- Water table at completion

PROJECT NO.: 161409	DATE: 10/5/2016
PROJECT: Diamond Animal Health R&D Building 2538 SE 43rd Street Des Moines, Iowa	
PLATE: A-1	SCALE: 4 feet/in.

ALLENDER BUTZKE ENGINEERS, INC.

BORING LOG NO. 1

Project No.: 161409

Project: Diamond Animal Health R&D Building
2538 SE 43rd Street
Des Moines, Iowa

Client: Diamond Animal Health
2538 SE 43rd Street
Des Moines, Iowa 50327

Surface Elevation: 10.2'
Datum: FFE of Existing Bldg @ 10.95'

Date Drilled: 9-23-16
Drilling Depth, ft.: 20

Drilling Method: CFA
Page: 1 of 1

Elevation ft.	Depth ft.	Sample No.	Type	SPT bpf	Moisture Content, %	Dry Density pcf	Unconfined Compressive Strength psf	Material Description*	Graphic Log	USCS	Water Level	Depth / Elevation ft.
10	0							Dark brown lean to fat clay, trace sand, organics, and gravel, moist		CL-CH		
8		1	SSA	12	10.4			Brown sand, gravel, and clay mixture, trace brick, concrete, and asphalt, damp from 1' to 3' **FILL**				3.5
6	4	2	SSA	17	26.4			Very dark brown fat clay, trace sand and organics, moist (LL=52, PI=33) Dark brown after 5' Slight hydrocarbon odor after 5.5' **COHESIVE ALLUVIUM**		CH		6.7
4		3	ST		22.4	96	4140					
2	8	4	ST		21.6	103	5390				▽	11
0	12							Brown-gray clayey fine to medium sand, saturated Strong hydrocarbon odor after 11'		SC		-0.8
-2		5	SSA	14				Trace gravel after 14.5' **GRANULAR ALLUVIUM**				
-4	16							Less clay content after 16'		SP		
-6		6	SSA	30								20
-8	20							End of Boring				-9.8
-10												
-12												
-14	24											
-16												

*The stratification lines represent the approximate boundary lines between material types: in-situ, the transition may be gradual.

Water Level Observation
Time: at completion _____ hrs. _____ days
Depth to water: 11 ft. ▽ _____ ft. ▽ _____ ft. ▽

ALLENDER BUTZKE ENGINEERS, INC.
Geotechnical | Environmental | Construction Q.C.

BORING LOG NO. 2

Project No.: 161409

Project: **Diamond Animal Health R&D Building**
2538 SE 43rd Street
Des Moines, Iowa

Client: **Diamond Animal Health**
2538 SE 43rd Street
Des Moines, Iowa 50327

Surface Elevation: **8.8**
Datum: **FFE of Existing Bldg @ 10.95'**

Date Drilled: **9-23-16**
Drilling Depth, ft.: **20**

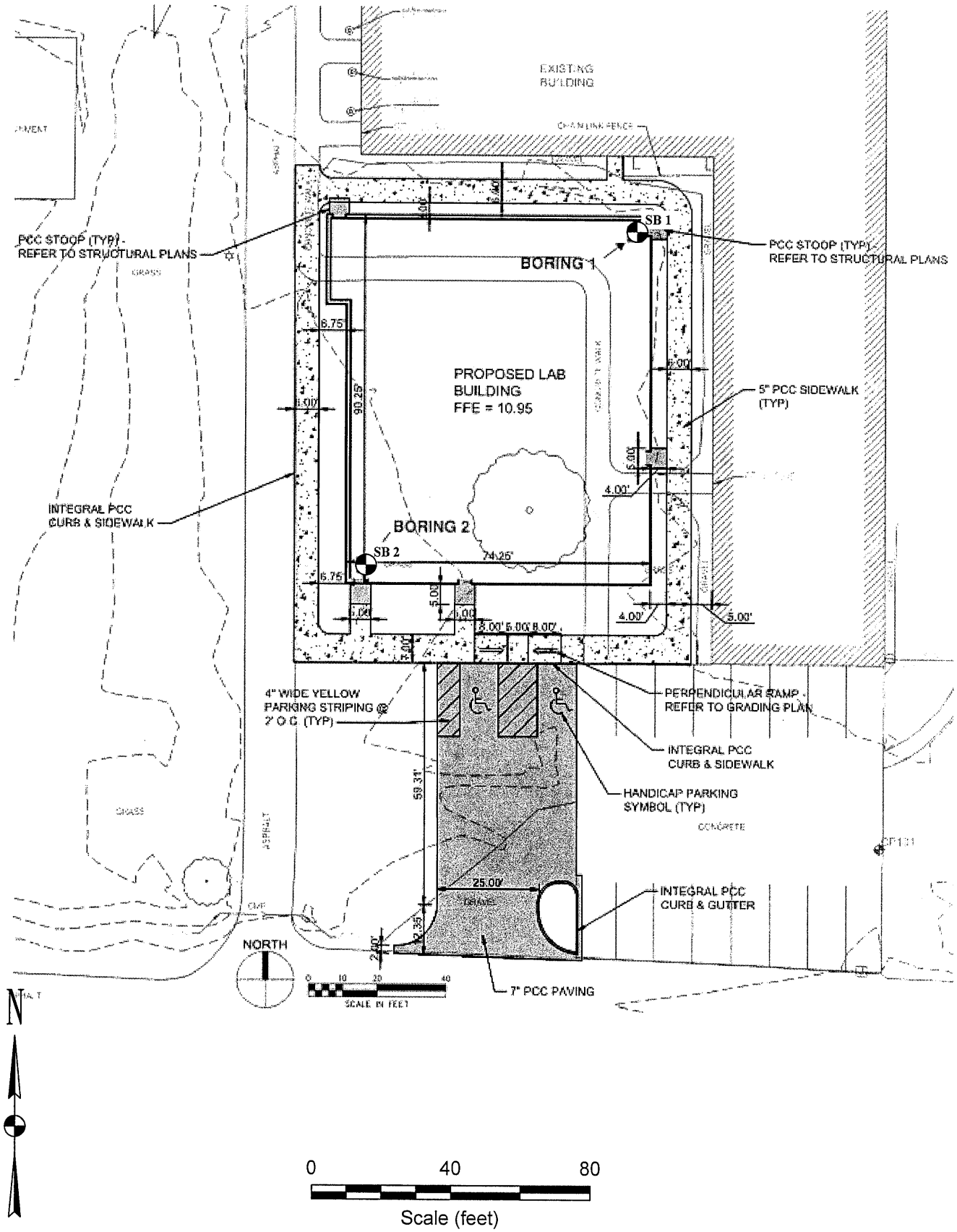
Drilling Method: **CFA**
Page: **1** of **1**

Elevation ft.	Depth ft.	Sample No.	Type	SPT bpf	Moisture Content, %	Dry Density pcf	Unconfined Compressive Strength psf	Material Description*	Graphic Log	USCS	Water Level	Depth / Elevation ft.
8	0							Brown lean clay with sand, trace organics and gravel, moist		CL		
		1	SSA	12	18.9			**FILL**				2.3
6								Very dark brown fat clay, trace organics and sand, moist		CH		6.5
	4	2	ST		25.0	92	3070	Dark brown after 4'				
4								**COHESIVE ALLUVIUM**				
2		3	ST		19.1	106	6100					
	8							Brown-gray sandy fat clay after 7.8'				8.5
0		4	SSA	2				Brown-gray fine to medium sand, trace clay, saturated		SP	▽	0.3
-2								Strong hydrocarbon odor after 8.5'				
	12							Less clay content and trace gravel after 11'				
-4								Medium to coarse sand with gravel from 12' to 15'				
		5	SSA	12				**GRANULAR ALLUVIUM**				
-6								Interbedded clay seams after 15'				
	16											
-8												
-10		6	SSA	21				Medium to coarse sand, trace gravel after 19'				20
	20							End of Boring				-11.2
-12												
-14												
	24											
-16												
-18												

*The stratification lines represent the approximate boundary lines between material types: in-situ, the transition may be gradual.

Water Level Observation
Time: at completion _____ hrs. _____ days
Depth to water: **9** ft. ▽ _____ ft. ▽ _____ ft. ▽

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N

0 40 80

Scale (feet)

SB # **Approximate Sample Location**

Base Plan by Shive-Hattery

ALLENDER BUTZKE ENGINEERS INC. 3660 - 109th Street Urbandale, IA 50322	**Diamond Animal Health R&D Bldg** **2538 SE 43rd Street** **Des Moines, Iowa**	**PN 161409** **Site Plan**

NOTES

ALLENDER BUTZKE ENGINEERS INC.
GEOTECHNICAL • ENVIRONMENTAL • CONSTRUCTION Q. C.

November 21, 2016 **PN 163208**

LIMITED PHASE II ENVIRONMENTAL SITE ASSESSMENT

DIAMOND ANIMAL HEALTH
RESEARCH AND DEVELOPMENT BUILDING
2538 SE 43RD STREET
DES MOINES, IOWA

PERFORMED FOR

DIAMOND ANIMAL HEALTH, INC.
2538 SE 43RD STREET
DES MOINES, IOWA 50327

3660 109TH STREET • URBANDALE, IOWA 50322 • PHONE 515-252-1885 • FAX 515-252-1888

ALLENDER BUTZKE ENGINEERS INC.
GEOTECHNICAL • ENVIRONMENTAL • CONSTRUCTION Q. C.

Diamond Animal Health, Inc.
2538 SE 43rd Street
Des Moines, Iowa 50327

November 21, 2016

Attn: Richard Kalina

RE: Limited Phase II Environmental Site Assessment
Diamond Animal Health
Research and Development Building
2538 SE 43rd Street
Des Moines, Iowa
PN 163208

Dear Mr. Kalina:

The following Limited Phase II Environmental Site Assessment report presents the results of five test borings and laboratory chemical analysis of soil and groundwater samples. The objective of the Phase II ESA was to investigate petroleum hydrocarbon levels in soil and groundwater within the proposed building area.

We appreciate the opportunity to provide our environmental services for this project. If you have any questions concerning this assessment, please contact our office.

Respectfully,
ALLENDER BUTZKE ENGINEERS INC.

Donald D. Edds
Environmental Geologist

2 CC and 1 Email Above

TABLE OF CONTENTS

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1.0 INTRODUCTION

The following report presents the results of a Limited Phase II Environmental Site Assessment performed in accordance with our proposal dated October 7, 2016 and authorized by Richard Kalina with Diamond Animal Health, Inc. on November 2, 2016. The Limited Phase II ESA consisted of five test borings and laboratory chemical analysis of soil and groundwater samples. The objective of the Limited Phase II ESA was to assess soil and groundwater quality on the subject property in response to suspect petroleum hydrocarbon contamination that was encountered in test borings drilled for a geotechnical engineering study.

A Geotechnical Exploration was performed for the property by Allender Butzke Engineers Inc. A report of the Geotechnical Exploration was prepared for Diamond Animal Health, Inc. on October 10, 2016 (PN 161409). Two geotechnical test borings were drilled to a depth of 20 feet at the property on September 23, 2016. Petroleum hydrocarbon odors were encountered in soils from both test borings. The petroleum hydrocarbons were believed to be originating from a petroleum storage facility located east of the property across SE 43rd Street.

It was proposed that the subject property be investigated with five test borings, along with laboratory analysis of soil and groundwater samples. A Site Map showing the test boring locations is enclosed in the appendix. The following report includes information on borehole drilling, soil profile, soil sampling, test well installation, groundwater sampling and laboratory chemical analysis.

2.0 BOREHOLE DRILLING, SOIL PROFILE AND SOIL SAMPLING

2.1 Borehole Drilling

The five test borings were drilled at the site on November 7, 2016 using truck-mounted drilling equipment. The test borings were drilled to depths of 18.5 feet using four-inch diameter continuous flight augers. All drilling and sampling equipment were cleaned with a pressure washer prior to entering the site to prevent off-site contamination. Clean augers and sampling equipment were used for each test boring to prevent cross-contamination. Soils were examined in the field for the presence of discoloration and unusual odors. A photoionization detector (PID) was used to screen soil samples collected from each test boring.

2.2 Soil Profile

Topsoil and/or fill soil were encountered in the upper few feet of the test borings. The topsoil consisted of dark gray lean to fat clay with organics and the fill soils consisted of brown sandy clay with gravel. The topsoil and fill were underlain by brown, dark brown and/or dark gray lean to fat clay (Cohesive Alluvium). Medium to coarse sand (Granular Alluvium) was encountered below a depth of approximately 10 feet in each test boring. Petroleum odors were detected in soils from all test borings. The test borings terminated at a depth of 18.5 feet in Granular Alluvium. Detailed descriptions of the soils encountered during this Limited Phase II Environmental Site Assessment are provided on the Boring Logs enclosed in the appendix.

2.3 Soil Sampling

Strong petroleum odors, soil discoloration, and elevated PID readings were indicated in all test borings. The odors were similar to those of gasoline, rather than diesel fuel. Soil samples were collected from depths of 5 and 17.5 feet below grade in TB-1, from 17.5 feet in TB-2, from 9 and 15 feet in TB-3, from 18 feet in TB-4, and from 2.5 and 17.5 feet in TB-5. The soil samples from depths ranging from 15 to 18 feet were obtained from intervals exhibiting the highest PID reading in each test boring. The shallower soil samples from depths ranging from 2.5 to 9 feet in TB-1, TB-3 and TB-5 were collected to provide additional information on petroleum levels in soil. The soil samples were placed in laboratory-provided glass containers and shipped to the laboratory for chemical analysis.

3.0 TEST WELL INSTALLATION AND GROUNDWATER SAMPLING

3.1 Test Well Installation

Temporary test wells that consisted of an end well point, a lower 10 feet of factory-slotted two-inch diameter PVC screen, and an upper 10 feet of two-inch diameter PVC solid casing were installed in the test borings for groundwater sampling purposes. Water levels were measured in the test wells shortly after they were installed. Water levels measured on November 7, 2016 were 10.76 feet in TB-1, 10.50 feet in TB-2, 11.61 feet in TB-3, 11.43 feet in TB-4, and 10.09 feet in TB-5.

3.2 Groundwater Sampling

Groundwater samples for laboratory chemical analysis were collected from the temporary test wells on November 7, 2016. The samples were collected by lowering disposable plastic bailers into the test wells. Separate bailers were used for each test well to prevent cross-contamination. Petroleum hydrocarbon odors and product sheen was noted in all groundwater samples. As with the soil samples, the petroleum odors in groundwater were similar to those of gasoline, rather than diesel fuel. The groundwater samples were placed in laboratory-provided glass containers, packed in a cooler with ice and shipped along with the soil samples to the laboratory for chemical analysis. Upon completion of groundwater sampling, the temporary test wells were left in place and covered with PVC slip caps.

4.0 LABORATORY CHEMICAL ANALYSIS

Chemical analysis of the soil and groundwater samples was performed by Keystone Laboratories, Inc. All soil and groundwater samples were analyzed for benzene, toluene, ethylbenzene and xylenes by Iowa Method OA-1 and for total extractable hydrocarbons by Iowa Method OA-2. Test results are shown on the analytical report enclosed in the appendix. In addition, petroleum hydrocarbons in soil are shown in Table No. 1 and petroleum hydrocarbons in groundwater are shown in Table No. 2.

5.0 RESULTS

The analytical reports reveal that detectable levels of benzene, toluene, ethylbenzene, and xylenes were present in soil at the site. The benzene concentrations of 0.56 ppm at 15 feet in TB-3, 0.59 ppm at 18 feet in TB-4, and 2.28 ppm at 17.5 feet in TB-5 exceed the Iowa Department of Natural Resources corrective action level of 0.54 ppm. These concentrations are less than the Iowa Land Recycling Program statewide standard of 56 ppm for benzene in soil. Toluene, ethylbenzene, xylenes, and TEH diesel were also detected in one or more of the soil samples. However, their concentrations are less than IDNR corrective action levels and ILRP statewide standards.

Concentrations of benzene, toluene, ethylbenzene, xylenes, and TEH gasoline were detected in the groundwater samples. The benzene concentrations of 8 ppb in TB-1, 25 ppb in TB-2, 2050 ppb in TB-3, 295 ppb in TB-4, and 12.8 ppb in TB-5 exceed the IDNR corrective action level of 5 ppb. The ethylbenzene concentrations of 8470 ppb in TB-3 and 3350 ppb in TB-4 exceed the IDNR corrective action level of 700 ppb. The xylenes concentration of 13800 ppb in TB-3 exceeds the IDNR corrective action level of 10000 ppb. These concentrations also exceed the ILRP statewide standards for groundwater, which are the same as the IDNR corrective action levels. TEH gasoline was detected at concentrations of 5300 ppb in TB-1, 57400 ppb in TB-2, 12000 ppb in TB-3, 61100 ppb in TB-4, and 32000 ppb in TB-5. However, there is no IDNR corrective action level or ILRP statewide standard for TEH gasoline in groundwater.

6.0 CONCLUSIONS

This Limited Phase II ESA has indicated widespread petroleum hydrocarbon contamination in soil and groundwater at the project site. Obvious petroleum odors and elevated PID readings were detected in all five test borings. Laboratory analysis revealed benzene levels in soil from three of the test borings (TB-3, TB-4 and TB-5) exceeding the IDNR corrective action level of 0.54 ppm. Laboratory analysis also revealed benzene levels in groundwater from all test borings, ethylbenzene levels in groundwater from TB-3 and TB-4, and xylenes levels in groundwater from TB-3 exceeding IDNR corrective action levels and ILRP statewide standards.

The highest benzene concentrations in groundwater were found in TB-3 and TB-4 located on the east side of the proposed building area, suggesting a source area located to the east. The petroleum hydrocarbons are believed to be originating from Magellan Des Moines Terminal (fka Williams Des Moines Terminal), a petroleum storage facility located east of the subject property across SE 43rd Street. The results of this Limited Phase II ESA indicate that there is an exposure risk from vapor intrusion into overlying buildings. Vapor intrusion could have an adverse impact on indoor air quality. Future buildings constructed at the project site could be at risk and should be built with properly-designed vapor barriers and/or vapor mitigation systems to reduce vapor intrusion. Furthermore, petroleum-contaminated soil and groundwater encountered in excavations or utility trenches during construction would require special disposal.

Regulations concerning petroleum contamination in soil and groundwater are contained in the Iowa Code and are administered by the Iowa Department of Natural Resources. Therefore, we recommend that the client consult with representatives of the Contaminated Sites Section of the IDNR with regard to the results of this assessment and any additional action that may be required.

7.0 GENERAL

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted environmental assessment practices. Reliance by any other party is prohibited without the written authorization of the client or Allender Butzke Engineers Inc. This investigation is based upon the best information available to us at this time, including visual/olfactory observations, portable vapor detection equipment, and limited laboratory chemical analysis which are assumed to be representative of this site. Evaluation of analytical test results is based on current Iowa Department of Natural Resources and Iowa Land Recycling Program guidelines regarding acceptable concentrations and methods.

Failure to discover hazardous substances or conditions at the time of this report, within the scope of this investigation, does not guarantee unacceptable levels of hazardous materials might not exist at the site. We make no warranty, expressed or implied, for this property nor make certification of the suitability of the future use of the property based on the results of this assessment, except that our services were performed with the level of care and skill ordinarily practiced by members of the profession in this area at this time under similar budget and time restraints.

Table No. 1
Petroleum Hydrocarbons in Soil

Sample No.	Test Boring and Depth	Benzene	Toluene	Ethylbenzene	Xylenes	TEH Diesel	TEH Waste Oil	TEH Gasoline
DAH-1A	TB-1 @ 5'	<0.20	<0.20	<0.20	<0.40	5	<5	<5
DAH-1B	TB-1 @ 17.5'	0.52	<0.20	0.66	<0.40	84	<5	<5
DAH-2	TB-2 @ 17.5'	<0.20	1.17	0.38	4.87	125	<5	<5
DAH-3A	TB-3 @ 9'	<0.20	<0.20	<0.20	<0.40	<5	<5	<5
DAH-3B	TB-3 @ 15'	**0.56**	0.52	0.21	1.45	42	<5	<5
DAH-4	TB-4 @ 18'	**0.59**	0.27	4.69	1.25	52	<5	<5
DAH-5A	TB-5 @ 2.5'	<0.20	<0.20	<0.20	<0.40	5	<5	<5
DAH-5B	TB-5 @ 17.5'	**2.28**	1.06	3.70	4.74	65	<5	<5
IDNR Action Level		**0.54**	**3.2**	**15**	**52**	**3800**	**NAL**	**NAL**
ILRP Statewide Standard		**56**	**6100**	**7600**	**15000**	**28000**	**9400**	**NAL**

Concentrations are reported in mg/kg or parts per million (ppm)
NAL – No Action Level

Table No. 2
Petroleum Hydrocarbons in Groundwater

Sample No.	Test Boring	Benzene	Toluene	Ethylbenzene	Xylenes	TEH Diesel	TEH Waste Oil	TEH Gasoline
DAH-1W	TB-1	**8**	<5.0	368	36.0	<100	<100	5300
DAH-2W	TB-2	**25**	<5.0	19.8	<10.0	<100	<100	57400
DAH-3W	TB-3	**2050**	394	**8470**	**13800**	<100	<100	12000
DAH-4W	TB-4	**295**	103	**3350**	738	<100	<100	61100
DAH-5W	TB-5	**12.8**	<5.0	511	427	<100	<100	32000
IDNR Action Level		**5**	**1000**	**700**	**10000**	**1200**	**400**	**NAL**
ILRP Statewide Standard		**5**	**1000**	**700**	**10000**	**2200**	**730**	**NAL**

Concentrations are reported in ug/L or parts per billion (ppb)
NAL – No Action Level

APPENDIX



Site Map

Diamond Animal Health R & D Building
2538 SE 43rd Street
Des Moines, Iowa

Denotes Approx. Test Boring Location **SCALE 1 in. = 30 ft.**

BORING LOG NO. TB-1

Project No.: 163208

Project: Diamond Animal Health R & D Building
2538 SE 43rd Street
Des Moines, Iowa

Client: Diamond Animal Health, Inc.
2538 SE 43rd Street
Des Moines, Iowa

Surface Elevation: 788
Datum: USGS NGVD

Date Drilled: 11/7/2016
Drilling Depth: 18.5

Drilling Method 4" CFA
Page 1 of 1

Elevation ft.	Depth ft.	Sample No.	Type	PID (PPM)	Odor	Material Description*	Graphic Log	USCS	Water Level	Well Detail
	0			1078		Brown sandy clay with gravel, moist, with strong petroleum odor FILL				
				1142		Dark brown fat clay, slightly moist, with strong petroleum odor		CH		
		DAH	1A	1211		COHESIVE ALLUVIUM				
780				1114		Brown sandy lean clay, moist, with strong petroleum odor, after 7'		CL		
	10			929					▼	
				865		Gray coarse to medium silty sand, trace gravel, wet, with strong petroleum odor ALLUVIUM		SM		
				968						
				896		Gray brown after 16.5'				
770		DAH	1B	1075						
						End of Boring				
	20									
760										
	30									

*The stratification lines represent the approximate boundary lines between material types: in-situ, the transition may be gradual.

Water Level Observation

Time: at completion 2.5 hrs. _____ days

Depth to water: 10.82 ft. ▽ 10.76 ft. ▼ _____ ft. ▼

ALLENDER BUTZKE ENGINEERS, INC.

Geotechnical - Environmental - Construction Q.C.

BORING LOG NO. TB-2

Project No.: 163208

Project: Diamond Animal Health R & D Building
2538 SE 43rd Street
Des Moines, Iowa

Client: Diamond Animal Health, Inc.
2538 SE 43rd Street
Des Moines, Iowa

Surface Elevation: 788
Datum: USGS NGVD

Date Drilled: 11/7/2016
Drilling Depth: 18.5

Drilling Method 4" CFA
Page 1 of 1

Elevation ft.	Depth ft.	Sample No.	Type	PID (PPM)	Odor	Material Description*	Graphic Log	USCS	Water Level	Well Detail
	0									
				7.9		Dark gray lean to fat clay with organics, moist TOPSOIL		CL-CH		
				10.5		Brown sandy clay with gravel, moist FILL		CH		
						Dark brown fat clay, slightly moist, with petroleum odor				
				30.4						
				15.8		COHESIVE ALLUVIUM				
780				13.1		Dark gray-green sandy lean clay, moist, with petroleum odor, after 7'		CL		
				75.7						
	10			42.6					▼	
				40.6		Gray-green coarse to medium silty sand, trace gravel, wet, with strong petroleum odor		SM		
				201.5						
				212						
				232		ALLUVIUM				
				384						
				253		Very dark gray with gravel after 16'				
770		DAH	2	818						
				318						
						End of Boring				
	20									
760										
	30									

*The stratification lines represent the approximate boundary lines between material types: in-situ, the transition may be gradual.

Water Level Observation

Time: at completion 1.75 hrs. _____ days

Depth to water: 11.07 ft. ▽ 10.50 ft. ▼ _____ ft. ▼

ALLENDER BUTZKE ENGINEERS, INC.

Geotechnical - Environmental - Construction Q.C.

BORING LOG NO. TB-3

Project No.: 163208

Project: Diamond Animal Health R & D Building
2538 SE 43rd Street
Des Moines, Iowa

Client: Diamond Animal Health, Inc.
2538 SE 43rd Street
Des Moines, Iowa

Surface Elevation: 789
Datum: USGS NGVD

Date Drilled: 11/7/2016
Drilling Depth: 18.5

Drilling Method 4" CFA
Page 1 of 1

Elevation ft.	Depth ft.	Sample No.	Type	PID (PPM)	Odor	Material Description*	Graphic Log	USCS	Water Level	Well Detail
790	0					Brown sandy clay with gravel, moist FILL				
				7.1		Dark gray green fat clay, slightly moist		CH		
				9.5		Dark gray after 4'				
				18.0		COHESIVE ALLUVIUM				
				20.0		Dark gray-green sandy lean clay, moist, with strong petroleum odor, after 8'		CL		
780		DAH	3A	560.5						
	10			120.8						
				453		Gray-green coarse to medium silty sand, trace gravel, wet, with strong petroleum odor		SM	▽	
				928.6						
				1056						
				1120		ALLUVIUM				
		DAH	3B	1392						
				914						
				817						
				1048						
770	20					End of Boring				
760	30									

*The stratification lines represent the approximate boundary lines between material types: in-situ, the transition may be gradual.

Water Level Observation

Time: at completion 1 hrs. _____ days

Depth to water: 11.74 ft. ▽ 11.61 ft. ▽ _____ ft. ▽

ALLENDER BUTZKE ENGINEERS, INC.

Geotechnical - Environmental - Construction Q.C.

BORING LOG NO. TB-4

Project No.: 163208

Project: Diamond Animal Health R & D Building
2538 SE 43rd Street
Des Moines, Iowa

Client: Diamond Animal Health, Inc.
2538 SE 43rd Street
Des Moines, Iowa

Surface Elevation: 789
Datum: USGS NGVD

Date Drilled: 11/7/2016
Drilling Depth: 18.5

Drilling Method 4" CFA
Page 1 of 1

Elevation ft.	Depth ft.	Sample No.	Type	PID (PPM)	Odor	Material Description*	Graphic Log	USCS	Water Level	Well Detail
790	0									
				174.2		Dark gray lean to fat clay with organics, moist TOPSOIL		CL-CH		
				152.5		Brown sandy clay with gravel, moist FILL		CH		
						Dark gray fat clay, slightly moist, with petroleum odor				
				158.3		Dark gray-green sandy lean clay, moist, with strong petroleum odor, after 5'		CL		
				280.2		COHESIVE ALLUVIUM				
				764						
780				558						
	10			568		Gray-green coarse to medium silty sand, trace gravel, wet, with strong petroleum odor		SM	▼	
				777						
				517						
				516		Very dark gray at 13'				
				498		ALLUVIUM				
				928		Very dark gray at 15'				
				972						
				987						
		DAH	4	1046						
770						End of Boring				
	20									
760										
	30									

*The stratification lines represent the approximate boundary lines between material types: in-situ, the transition may be gradual.

Water Level Observation

Time: at completion 0.5 hrs. ____ days

Depth to water: 11.50 ft. ▽ 11.43 ft. ▼ ____ ft. ▼

ALLENDER BUTZKE ENGINEERS, INC.

Geotechnical - Environmental - Construction Q.C.

BORING LOG NO. TB-5

Project No.: 163208

Project: Diamond Animal Health R & D Building
2538 SE 43rd Street
Des Moines, Iowa

Client: Diamond Animal Health, Inc.
2538 SE 43rd Street
Des Moines, Iowa

Surface Elevation: 788
Datum: USGS NGVD

Date Drilled: 11/7/2016
Drilling Depth: 18.5

Drilling Method 4" CFA
Page 1 of 1

Elevation ft.	Depth ft.	Sample No.	Type	PID (PPM)	Odor	Material Description*	Graphic Log	USCS	Water Level	Well Detail
	0									
				109.2		Brown sandy clay with gravel, moist FILL				
		DAH	5A	368.2		Dark gray fat clay, slightly moist, with petroleum odor		CH		
				79.1		Dark gray-green sandy lean clay, moist, with petroleum odor, after 5' COHESIVE ALLUVIUM		CL		
780				81.8		Green sand layer at 7'				
				36.6						
				176						
	10			73.5		Gray-green coarse to medium silty sand, trace gravel, wet, with strong petroleum odor		SM	▼	
				106						
				105						
				272						
				385		Very dark gray with gravel from 14'to 15' ALLUVIUM				
				502						
				982.3						
770		DAH	5B	1040						
				508		End of Boring				
	20									
760										
	30									

*The stratification lines represent the approximate boundary lines between material types: in-situ, the transition may be gradual.

Water Level Observation

Time: at completion 0.5 hrs. ____ days

Depth to water: 10.13 ft. ▽ 10.09 ft. ▼ ____ ft. ▼

ALLENDER BUTZKE ENGINEERS, INC.

Geotechnical - Environmental - Construction Q.C.

ANALYTICAL REPORT

November 18, 2016

Work Order: 1K60677

Report To

Don Edds
Allender Butzke Engineers, Inc.
3660 109th Street
Urbandale, IA 50322

Work Order Information

Date Received: 11/08/2016 1:05PM
Collector: Wiseman, Mark
Phone: (515) 252-1885
PO Number: Diamond Animal Health

Project : Site Assessment
Project Number: Diamond Animal Health

Analyte	Result	MRL	Batch	Method	Analyst	Analyzed	Qualifier
1K60677-01 DAH-1A Test Boring 1				Matrix:Soil	Collected:	11/07/16 09:25	
Benzene	<0.20 mg/kg	0.20	1ZK0590	Iowa OA-1	KCS	11/11/16 14:19	
Toluene	<0.20 mg/kg	0.20	1ZK0590	Iowa OA-1	KCS	11/11/16 14:19	
Ethylbenzene	<0.20 mg/kg	0.20	1ZK0590	Iowa OA-1	KCS	11/11/16 14:19	
Xylenes, total	<0.40 mg/kg	0.40	1ZK0590	Iowa OA-1	KCS	11/11/16 14:19	
Surrogate: Chlorobenzene	*104 %*			*59-151*	KCS	11/11/16 14:19	
TEH, as gasoline	<5 mg/kg	5	1ZK0568	Iowa OA-2	BDF	11/16/16 22:29	
TEH, as #2 diesel fuel	**5 mg/kg**	**5**	1ZK0568	Iowa OA-2	BDF	11/16/16 22:29	D-06
TEH, as waste oil	<5 mg/kg	5	1ZK0568	Iowa OA-2	BDF	11/16/16 22:29	
Total Extractable Hydrocarbons	**5 mg/kg**	**5**	1ZK0568	Iowa OA-2	BDF	11/16/16 22:29	
Surrogate: Pentacosane	*59.3 %*			*24-135*	BDF	11/16/16 22:29	
1K60677-02 DAH-2 Test Boring 2				Matrix:Soil	Collected:	11/07/16 10:12	
Benzene	<0.20 mg/kg	0.20	1ZK0590	Iowa OA-1	KCS	11/11/16 21:42	
Toluene	**1.17 mg/kg**	**0.20**	1ZK0590	Iowa OA-1	KCS	11/11/16 21:42	
Ethylbenzene	**0.38 mg/kg**	**0.20**	1ZK0590	Iowa OA-1	KCS	11/11/16 21:42	
Xylenes, total	**4.87 mg/kg**	**0.40**	1ZK0590	Iowa OA-1	KCS	11/11/16 21:42	
Surrogate: Chlorobenzene	*121 %*			*59-151*	KCS	11/11/16 21:42	
TEH, as gasoline	<5 mg/kg	5	1ZK0568	Iowa OA-2	BDF	11/16/16 23:17	
TEH, as #2 diesel fuel	**125 mg/kg**	**5**	1ZK0568	Iowa OA-2	BDF	11/16/16 23:17	D-06
TEH, as waste oil	<5 mg/kg	5	1ZK0568	Iowa OA-2	BDF	11/16/16 23:17	
Total Extractable Hydrocarbons	**125 mg/kg**	**5**	1ZK0568	Iowa OA-2	BDF	11/16/16 23:17	
Surrogate: Pentacosane	*69.0 %*			*24-135*	BDF	11/16/16 23:17	
1K60677-03 DAH-3A Test Boring 3				Matrix:Soil	Collected:	11/07/16 10:27	
Benzene	<0.20 mg/kg	0.20	1ZK0590	Iowa OA-1	KCS	11/11/16 15:03	
Toluene	<0.20 mg/kg	0.20	1ZK0590	Iowa OA-1	KCS	11/11/16 15:03	
Ethylbenzene	<0.20 mg/kg	0.20	1ZK0590	Iowa OA-1	KCS	11/11/16 15:03	
Xylenes, total	<0.40 mg/kg	0.40	1ZK0590	Iowa OA-1	KCS	11/11/16 15:03	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL= Method Reporting Limit.

Allender Butzke Engineers, Inc.
3660 109th Street
Urbandale, IA 50322

November 18, 2016

Work Order: 1K60677

Analyte	Result	MRL	Batch	Method	Analyst	Analyzed	Qualifier
1K60677-03 DAH-3A Test Boring 3				Matrix:Soil		Collected: 11/07/16 10:27	
Surrogate: Chlorobenzene	*104 %*			*59-151*	KCS	11/11/16 15:03	
TEH, as gasoline	<5 mg/kg	5	1ZK0568	Iowa OA-2	BDF	11/17/16 0:05	
TEH, as #2 diesel fuel	<5 mg/kg	5	1ZK0568	Iowa OA-2	BDF	11/17/16 0:05	
TEH, as waste oil	<5 mg/kg	5	1ZK0568	Iowa OA-2	BDF	11/17/16 0:05	
Total Extractable Hydrocarbons	<5 mg/kg	5	1ZK0568	Iowa OA-2	BDF	11/17/16 0:05	
Surrogate: Pentacosane	*69.6 %*			*24-135*	BDF	11/17/16 0:05	
1K60677-04 DAH-4 Test Boring 4				Matrix:Soil		Collected: 11/07/16 11:20	
Benzene	**0.59 mg/kg**	**0.20**	1ZK0590	Iowa OA-1	KCS	11/11/16 20:58	
Toluene	**0.27 mg/kg**	**0.20**	1ZK0590	Iowa OA-1	KCS	11/11/16 20:58	
Ethylbenzene	**4.69 mg/kg**	**0.20**	1ZK0590	Iowa OA-1	KCS	11/11/16 20:58	
Xylenes, total	**1.25 mg/kg**	**0.40**	1ZK0590	Iowa OA-1	KCS	11/11/16 20:58	
Surrogate: Chlorobenzene	*111 %*			*59-151*	KCS	11/11/16 20:58	
TEH, as gasoline	<5 mg/kg	5	1ZK0568	Iowa OA-2	BDF	11/17/16 0:53	
TEH, as #2 diesel fuel	**52 mg/kg**	**5**	1ZK0568	Iowa OA-2	BDF	11/17/16 0:53	D-06
TEH, as waste oil	<5 mg/kg	5	1ZK0568	Iowa OA-2	BDF	11/17/16 0:53	
Total Extractable Hydrocarbons	**52 mg/kg**	**5**	1ZK0568	Iowa OA-2	BDF	11/17/16 0:53	
Surrogate: Pentacosane	*82.9 %*			*24-135*	BDF	11/17/16 0:53	
1K60677-05 DAH-5A Test Boring 5				Matrix:Soil		Collected: 11/07/16 12:32	
Benzene	<0.20 mg/kg	0.20	1ZK0590	Iowa OA-1	KCS	11/11/16 15:48	
Toluene	<0.20 mg/kg	0.20	1ZK0590	Iowa OA-1	KCS	11/11/16 15:48	
Ethylbenzene	<0.20 mg/kg	0.20	1ZK0590	Iowa OA-1	KCS	11/11/16 15:48	
Xylenes, total	<0.40 mg/kg	0.40	1ZK0590	Iowa OA-1	KCS	11/11/16 15:48	
Surrogate: Chlorobenzene	*101 %*			*59-151*	KCS	11/11/16 15:48	
TEH, as gasoline	<5 mg/kg	5	1ZK0568	Iowa OA-2	BDF	11/17/16 1:42	
TEH, as #2 diesel fuel	**5 mg/kg**	**5**	1ZK0568	Iowa OA-2	BDF	11/17/16 1:42	D-06
TEH, as waste oil	<5 mg/kg	5	1ZK0568	Iowa OA-2	BDF	11/17/16 1:42	
Total Extractable Hydrocarbons	**5 mg/kg**	**5**	1ZK0568	Iowa OA-2	BDF	11/17/16 1:42	
Surrogate: Pentacosane	*65.7 %*			*24-135*	BDF	11/17/16 1:42	
1K60677-06 DAH-1W Test Well 1				Matrix:Water		Collected: 11/07/16 12:09	
Benzene	**8.0 ug/L**	**5.0**	1ZK0475	Iowa OA-1	DGB	11/10/16 20:53	
Toluene	<5.0 ug/L	5.0	1ZK0475	Iowa OA-1	DGB	11/10/16 20:53	
Ethylbenzene	**368 ug/L**	**5.0**	1ZK0475	Iowa OA-1	DGB	11/10/16 20:53	
Xylenes, total	**36.0 ug/L**	**10.0**	1ZK0475	Iowa OA-1	DGB	11/10/16 20:53	
Surrogate: Toluene-d8	*104 %*			*89-112*	DGB	11/10/16 20:53	
TEH, as gasoline	**5.3 mg/L**	**0.1**	1ZK0570	Iowa OA-2	BDF	11/17/16 18:55	
TEH, as #2 diesel fuel	<0.1 mg/L	0.1	1ZK0570	Iowa OA-2	BDF	11/17/16 18:55	
TEH, as waste oil	<0.1 mg/L	0.1	1ZK0570	Iowa OA-2	BDF	11/17/16 18:55	
Total Extractable Hydrocarbons	**5.3 mg/L**	**0.1**	1ZK0570	Iowa OA-2	BDF	11/17/16 18:55	

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Allender Butzke Engineers, Inc.
3660 109th Street
Urbandale, IA 50322

November 18, 2016

Work Order: 1K60677

Analyte	Result	MRL	Batch	Method	Analyst	Analyzed	Qualifier
1K60677-06 DAH-1W Test Well 1				Matrix:Water		Collected: 11/07/16 12:09	
Surrogate: Pentacosane	*52.2 %*			*42-137*	BDF	11/17/16 18:55	
1K60677-07 DAH-2W Test Well 2				Matrix:Water		Collected: 11/07/16 13:46	
Benzene	**25.0 ug/L**	**5.0**	1ZK0475	Iowa OA-1	DGB	11/10/16 21:32	
Toluene	<5.0 ug/L	5.0	1ZK0475	Iowa OA-1	DGB	11/10/16 21:32	
Ethylbenzene	**19.8 ug/L**	**5.0**	1ZK0475	Iowa OA-1	DGB	11/10/16 21:32	
Xylenes, total	<10.0 ug/L	10.0	1ZK0475	Iowa OA-1	DGB	11/10/16 21:32	
Surrogate: Toluene-d8	*107 %*			*89-112*	DGB	11/10/16 21:32	
TEH, as gasoline	**OVERRANGE mg/L**	**0.1**	1ZK0570	Iowa OA-2	BDF	11/17/16 19:43	
TEH, as #2 diesel fuel	<0.1 mg/L	0.1	1ZK0570	Iowa OA-2	BDF	11/17/16 19:43	
TEH, as waste oil	<0.1 mg/L	0.1	1ZK0570	Iowa OA-2	BDF	11/17/16 19:43	
Surrogate: Pentacosane	*55.6 %*			*42-137*	BDF	11/17/16 19:43	
1K60677-07RE1 DAH-2W Test Well 2				Matrix:Water		Collected: 11/07/16 13:46	
TEH, as gasoline	**57.4 mg/L**	**1.0**	1ZK0570	Iowa OA-2	BDF	11/18/16 9:21	
Total Extractable Hydrocarbons	**57.4 mg/L**	**1.0**	1ZK0570	Iowa OA-2	BDF	11/18/16 9:21	
Surrogate: Pentacosane	*51.9 %*			*42-137*	BDF	11/18/16 9:21	
1K60677-08 DAH-3W Test Well 3				Matrix:Water		Collected: 11/07/16 13:15	
Benzene	**2050 ug/L**	**50.0**	1ZK0471	Iowa OA-1	DGB	11/10/16 9:07	
Toluene	**394 ug/L**	**50.0**	1ZK0471	Iowa OA-1	DGB	11/10/16 9:07	
Ethylbenzene	**8470 ug/L**	**50.0**	1ZK0471	Iowa OA-1	DGB	11/10/16 9:07	
Xylenes, total	**13800 ug/L**	**100**	1ZK0471	Iowa OA-1	DGB	11/10/16 9:07	
Surrogate: Toluene-d8	*105 %*			*89-112*	DGB	11/10/16 9:07	
TEH, as gasoline	**12.0 mg/L**	**0.1**	1ZK0570	Iowa OA-2	BDF	11/17/16 20:31	
TEH, as #2 diesel fuel	<0.1 mg/L	0.1	1ZK0570	Iowa OA-2	BDF	11/17/16 20:31	
TEH, as waste oil	<0.1 mg/L	0.1	1ZK0570	Iowa OA-2	BDF	11/17/16 20:31	
Total Extractable Hydrocarbons	**12.0 mg/L**	**0.1**	1ZK0570	Iowa OA-2	BDF	11/17/16 20:31	
Surrogate: Pentacosane	*60.0 %*			*42-137*	BDF	11/17/16 20:31	
1K60677-09 DAH-4W Test Well 4				Matrix:Water		Collected: 11/07/16 13:28	
Benzene	**295 ug/L**	**100**	1ZK0471	Iowa OA-1	DGB	11/10/16 10:25	
Toluene	**103 ug/L**	**100**	1ZK0471	Iowa OA-1	DGB	11/10/16 10:25	
Ethylbenzene	**3350 ug/L**	**100**	1ZK0471	Iowa OA-1	DGB	11/10/16 10:25	
Xylenes, total	**738 ug/L**	**200**	1ZK0471	Iowa OA-1	DGB	11/10/16 10:25	
Surrogate: Toluene-d8	*101 %*			*89-112*	DGB	11/10/16 10:25	
TEH, as gasoline	**OVERRANGE mg/L**	**0.1**	1ZK0570	Iowa OA-2	BDF	11/17/16 21:20	
TEH, as #2 diesel fuel	<0.1 mg/L	0.1	1ZK0570	Iowa OA-2	BDF	11/17/16 21:20	
TEH, as waste oil	<0.1 mg/L	0.1	1ZK0570	Iowa OA-2	BDF	11/17/16 21:20	
Surrogate: Pentacosane	*59.9 %*			*42-137*	BDF	11/17/16 21:20	
1K60677-09RE1 DAH-4W Test Well 4				Matrix:Water		Collected: 11/07/16 13:28	

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3660 109th Street
Urbandale, IA 50322

November 18, 2016

Work Order: 1K60677

Analyte	Result	MRL	Batch	Method	Analyst	Analyzed	Qualifier
1K60677-09RE1 DAH-4W Test Well 4				Matrix:Water		Collected: 11/07/16 13:28	
TEH, as gasoline	**61.1 mg/L**	**1.0**	1ZK0570	Iowa OA-2	BDF	11/18/16 10:09	
Total Extractable Hydrocarbons	**61.1 mg/L**	**1.0**	1ZK0570	Iowa OA-2	BDF	11/18/16 10:09	
Surrogate: Pentacosane	*33.8 %*			*42-137*	BDF	11/18/16 10:09	S-06
1K60677-10 DAH-5W Test Well 5				Matrix:Water		Collected: 11/07/16 13:36	
Benzene	**12.8 ug/L**	**5.0**	1ZK0475	Iowa OA-1	DGB	11/10/16 22:10	
Toluene	<5.0 ug/L	5.0	1ZK0475	Iowa OA-1	DGB	11/10/16 22:10	
Ethylbenzene	**511 ug/L**	**5.0**	1ZK0475	Iowa OA-1	DGB	11/10/16 22:10	
Xylenes, total	**427 ug/L**	**10.0**	1ZK0475	Iowa OA-1	DGB	11/10/16 22:10	
Surrogate: Toluene-d8	*106 %*			*89-112*	DGB	11/10/16 22:10	
TEH, as gasoline	**OVERRANGE mg/L**	**0.1**	1ZK0570	Iowa OA-2	BDF	11/17/16 22:08	
TEH, as #2 diesel fuel	<0.1 mg/L	0.1	1ZK0570	Iowa OA-2	BDF	11/17/16 22:08	
TEH, as waste oil	<0.1 mg/L	0.1	1ZK0570	Iowa OA-2	BDF	11/17/16 22:08	
Surrogate: Pentacosane	*69.7 %*			*42-137*	BDF	11/17/16 22:08	
1K60677-10RE1 DAH-5W Test Well 5				Matrix:Water		Collected: 11/07/16 13:36	
TEH, as gasoline	**32.0 mg/L**	**1.0**	1ZK0570	Iowa OA-2	BDF	11/18/16 10:57	
Total Extractable Hydrocarbons	**32.0 mg/L**	**1.0**	1ZK0570	Iowa OA-2	BDF	11/18/16 10:57	
Surrogate: Pentacosane	*55.7 %*			*42-137*	BDF	11/18/16 10:57	
1K60677-11 DAH-1B Test Boring 1				Matrix:Soil		Collected: 11/07/16 09:30	
Benzene	**0.52 mg/kg**	**0.20**	1ZK0590	Iowa OA-1	KCS	11/11/16 20:14	
Toluene	<0.20 mg/kg	0.20	1ZK0590	Iowa OA-1	KCS	11/11/16 20:14	
Ethylbenzene	**0.66 mg/kg**	**0.20**	1ZK0590	Iowa OA-1	KCS	11/11/16 20:14	
Xylenes, total	<0.40 mg/kg	0.40	1ZK0590	Iowa OA-1	KCS	11/11/16 20:14	
Surrogate: Chlorobenzene	*106 %*			*59-151*	KCS	11/11/16 20:14	
TEH, as gasoline	<5 mg/kg	5	1ZK0568	Iowa OA-2	BDF	11/17/16 2:30	
TEH, as #2 diesel fuel	**84 mg/kg**	**5**	1ZK0568	Iowa OA-2	BDF	11/17/16 2:30	D-06
TEH, as waste oil	<5 mg/kg	5	1ZK0568	Iowa OA-2	BDF	11/17/16 2:30	
Total Extractable Hydrocarbons	**84 mg/kg**	**5**	1ZK0568	Iowa OA-2	BDF	11/17/16 2:30	
Surrogate: Pentacosane	*77.1 %*			*24-135*	BDF	11/17/16 2:30	
1K60677-12 DAH-3B Test Boring 3				Matrix:Soil		Collected: 11/07/16 09:30	
Benzene	**0.56 mg/kg**	**0.20**	1ZK0590	Iowa OA-1	KCS	11/11/16 16:32	
Toluene	**0.52 mg/kg**	**0.20**	1ZK0590	Iowa OA-1	KCS	11/11/16 16:32	
Ethylbenzene	**0.21 mg/kg**	**0.20**	1ZK0590	Iowa OA-1	KCS	11/11/16 16:32	
Xylenes, total	**1.45 mg/kg**	**0.40**	1ZK0590	Iowa OA-1	KCS	11/11/16 16:32	
Surrogate: Chlorobenzene	*108 %*			*59-151*	KCS	11/11/16 16:32	
TEH, as gasoline	<5 mg/kg	5	1ZK0568	Iowa OA-2	BDF	11/17/16 3:18	
TEH, as #2 diesel fuel	**42 mg/kg**	**5**	1ZK0568	Iowa OA-2	BDF	11/17/16 3:18	D-06
TEH, as waste oil	<5 mg/kg	5	1ZK0568	Iowa OA-2	BDF	11/17/16 3:18	
Total Extractable Hydrocarbons	**42 mg/kg**	**5**	1ZK0568	Iowa OA-2	BDF	11/17/16 3:18	

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November 18, 2016

Work Order: 1K60677

Analyte	Result	MRL	Batch	Method	Analyst	Analyzed	Qualifier
1K60677-12 DAH-3B Test Boring 3				Matrix:Soil	Collected: 11/07/16 09:30		
Surrogate: Pentacosane	*73.7 %*			*24-135*	BDF	11/17/16 3:18	
1K60677-13 DAH-5B Test Boring 5				Matrix:Soil	Collected: 11/07/16 12:45		
Benzene	**2.28 mg/kg**	**0.20**	1ZK0590	Iowa OA-1	KCS	11/11/16 17:16	
Toluene	**1.06 mg/kg**	**0.20**	1ZK0590	Iowa OA-1	KCS	11/11/16 17:16	
Ethylbenzene	**3.70 mg/kg**	**0.20**	1ZK0590	Iowa OA-1	KCS	11/11/16 17:16	
Xylenes, total	**4.74 mg/kg**	**0.40**	1ZK0590	Iowa OA-1	KCS	11/11/16 17:16	
Surrogate: Chlorobenzene	*113 %*			*59-151*	KCS	11/11/16 17:16	
TEH, as gasoline	<5 mg/kg	5	1ZK0568	Iowa OA-2	BDF	11/17/16 4:06	
TEH, as #2 diesel fuel	**65 mg/kg**	**5**	1ZK0568	Iowa OA-2	BDF	11/17/16 4:06	D-06
TEH, as waste oil	<5 mg/kg	5	1ZK0568	Iowa OA-2	BDF	11/17/16 4:06	
Total Extractable Hydrocarbons	**65 mg/kg**	**5**	1ZK0568	Iowa OA-2	BDF	11/17/16 4:06	
Surrogate: Pentacosane	*72.7 %*			*24-135*	BDF	11/17/16 4:06	

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Allender Butzke Engineers, Inc.
3660 109th Street
Urbandale, IA 50322

Work Order: 1K60677

Determination of Volatile Petroleum Hydrocarbons - Quality Control

Keystone Laboratories, Inc. - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1ZK0471 - EPA 5030B										
Blank (1ZK0471-BLK1)				Prepared: 11/09/16 Analyzed: 11/10/16						
Surrogate: Toluene-d8	*53.1*		*ug/L*	*50.0000*		*106*	*89-112*			
Benzene	ND	1.0	"							
Toluene	ND	1.0	"							
Ethylbenzene	ND	1.0	"							
Xylenes, total	ND	2.0	"							
LCS (1ZK0471-BS1)				Prepared: 11/09/16 Analyzed: 11/10/16						
Surrogate: Toluene-d8	*49.0*		*ug/L*	*50.0000*		*98.0*	*89-112*			
Benzene	51.3	1.0	"	50.0000		103	71-132			
Toluene	50.6	1.0	"	50.0000		101	76-136			
Ethylbenzene	51.6	1.0	"	50.0000		103	66-143			
Xylenes, total	162.0	2.0	"	150.000		108	74-132			
LCS Dup (1ZK0471-BSD1)				Prepared: 11/09/16 Analyzed: 11/10/16						
Surrogate: Toluene-d8	*49.0*		*ug/L*	*50.0000*		*98.0*	*89-112*			
Surrogate: 2,5-Dibromotoluene	*ND*		*"*				*70-130*			
Surrogate: Chlorobenzene	*48.3*		*"*	*50.0000*		*96.5*	*70-130*			
Benzene	51.3	1.0	"	50.0000		103	71-132	0.00	12	
Toluene	50.6	1.0	"	50.0000		101	76-136	0.00	17	
Ethylbenzene	51.6	1.0	"	50.0000		103	66-143	0.00	16	
Xylenes, total	162.0	2.0	"	150.000		108	74-132	0.00	17	
Matrix Spike (1ZK0471-MS1)	**Source: 1K60324-02**			Prepared: 11/09/16 Analyzed: 11/10/16						
Surrogate: Toluene-d8	*253*		*ug/L*	*250.000*		*101*	*89-112*			
Benzene	262.4	5.0	"	250.000	ND	105	74-134			
Toluene	267.2	5.0	"	250.000	ND	107	71-144			
Ethylbenzene	258.0	5.0	"	250.000	ND	103	69-145			
Xylenes, total	804.3	10.0	"	750.000	ND	107	74-132			

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Work Order: 1K60677

Determination of Volatile Petroleum Hydrocarbons - Quality Control

Keystone Laboratories, Inc. - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1ZK0471 - EPA 5030B										
Matrix Spike Dup (1ZK0471-MSD1)	**Source: 1K60324-02**			Prepared: 11/09/16 Analyzed: 11/10/16						
Surrogate: Toluene-d8	*254*		*ug/L*	*250.000*		*102*	*89-112*			
Benzene	259.8	5.0	"	250.000	ND	104	74-134	1.03	10	
Toluene	263.0	5.0	"	250.000	ND	105	71-144	1.58	10	
Ethylbenzene	257.6	5.0	"	250.000	ND	103	69-145	0.155	10	
Xylenes, total	811.2	10.0	"	750.000	ND	108	74-132	0.860	10	
Batch 1ZK0475 - EPA 5030B										
Blank (1ZK0475-BLK1)				Prepared & Analyzed: 11/10/16						
Surrogate: Toluene-d8	*52.7*		*ug/L*	*50.0000*		*105*	*89-112*			
Benzene	ND	1.0	"							
Toluene	ND	1.0	"							
Ethylbenzene	ND	1.0	"							
Xylenes, total	ND	2.0	"							
LCS (1ZK0475-BS1)				Prepared & Analyzed: 11/10/16						
Surrogate: Toluene-d8	*52.0*		*ug/L*	*50.0000*		*104*	*89-112*			
Benzene	59.6	1.0	"	50.0000		119	71-132			
Toluene	60.5	1.0	"	50.0000		121	76-136			
Ethylbenzene	61.0	1.0	"	50.0000		122	66-143			
Xylenes, total	188.3	2.0	"	150.000		126	74-132			
Matrix Spike (1ZK0475-MS1)	**Source: 1K60677-07**			Prepared & Analyzed: 11/10/16						
Surrogate: Toluene-d8	*1000*		*ug/L*	*1000.00*		*100*	*89-112*			
Benzene	1061	20.0	"	1000.00	25.0	104	74-134			
Toluene	1037	20.0	"	1000.00	ND	104	71-144			
Ethylbenzene	1117	20.0	"	1000.00	19.8	110	69-145			
Xylenes, total	3392	40.0	"	3000.00	ND	113	74-132			

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Work Order: 1K60677

Determination of Volatile Petroleum Hydrocarbons - Quality Control

Keystone Laboratories, Inc. - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1ZK0475 - EPA 5030B										
Matrix Spike Dup (1ZK0475-MSD1)	**Source: 1K60677-07**			Prepared & Analyzed: 11/10/16						
Surrogate: Toluene-d8	*1040*		*ug/L*	*1000.00*		*104*	*89-112*			
Benzene	1025	20.0	"	1000.00	25.0	100	74-134	3.41	10	
Toluene	1033	20.0	"	1000.00	ND	103	71-144	0.406	10	
Ethylbenzene	1059	20.0	"	1000.00	19.8	104	69-145	5.28	10	
Xylenes, total	3224	40.0	"	3000.00	ND	107	74-132	5.10	10	
Batch 1ZK0590 - EPA 5030 Soil GC										
Blank (1ZK0590-BLK1)				Prepared & Analyzed: 11/11/16						
Surrogate: Chlorobenzene	*12.9*		*mg/kg*	*12.5500*		*102*	*59-151*			
Benzene	ND	0.20	"							
Toluene	ND	0.20	"							
Ethylbenzene	ND	0.20	"							
Xylenes, total	ND	0.40	"							
LCS (1ZK0590-BS1)				Prepared & Analyzed: 11/11/16						
Surrogate: Chlorobenzene	*12.0*		*mg/kg*	*12.5500*		*95.5*	*59-151*			
Benzene	10.13	0.20	"	10.7800		94.0	59-139			
Toluene	10.27	0.20	"	10.6800		96.2	70-131			
Ethylbenzene	9.88	0.20	"	10.4700		94.4	72-122			
Xylenes, total	19.92	0.40	"	20.4000		97.7	76-119			
Matrix Spike (1ZK0590-MS1)	**Source: 1K60677-01**			Prepared & Analyzed: 11/11/16						
Surrogate: Chlorobenzene	*13.1*		*mg/kg*	*12.5500*		*104*	*59-151*			
Benzene	10.92	0.20	"	10.7800	ND	101	59-146			
Toluene	11.04	0.20	"	10.6800	ND	103	67-139			
Ethylbenzene	10.57	0.20	"	10.4700	ND	101	56-142			
Xylenes, total	21.47	0.40	"	20.4000	0.19	104	63-135			

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November 18, 2016

Work Order: 1K60677

Determination of Volatile Petroleum Hydrocarbons - Quality Control

Keystone Laboratories, Inc. - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1ZK0590 - EPA 5030 Soil GC										
Matrix Spike Dup (1ZK0590-MSD1)	**Source: 1K60677-01**			Prepared & Analyzed: 11/11/16						
Surrogate: Chlorobenzene	*12.6*		*mg/kg*	*12.5000*		*101*	*59-151*			
Benzene	10.82	0.20	"	10.7370	ND	101	59-146	0.888	19	
Toluene	10.97	0.20	"	10.6374	ND	103	67-139	0.588	18	
Ethylbenzene	10.49	0.20	"	10.4283	ND	101	56-142	0.697	22	
Xylenes, total	21.28	0.40	"	20.3187	0.19	104	63-135	0.879	24	

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Allender Butzke Engineers, Inc.
3660 109th Street
Urbandale, IA 50322

November 18, 2016

Work Order: 1K60677

Determination of Extractable Petroleum Hydrocarbons - Quality Control

Keystone Laboratories, Inc. - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1ZK0568 - 3545 OA-2 PFE										
Blank (1ZK0568-BLK1)				Prepared: 11/11/16 Analyzed: 11/16/16						
Surrogate: Pentacosane	*1.20*		*mg/kg*	*2.47600*		*48.4*	*24-135*			
TEH, as gasoline	ND	5	"							
TEH, as #2 diesel fuel	ND	5	"							
TEH, as waste oil	ND	5	"							
Total Extractable Hydrocarbons	ND	5	"							
LCS (1ZK0568-BS1)				Prepared: 11/11/16 Analyzed: 11/17/16						
Surrogate: Pentacosane	*1.16*		*mg/kg*	*2.47600*		*46.7*	*24-135*			
TEH, as #2 diesel fuel	38.4	5	"	101.240		38.0	46-104			QS-01
Matrix Spike (1ZK0568-MS1)	**Source: 1K60677-13**			Prepared: 11/11/16 Analyzed: 11/17/16						
Surrogate: Pentacosane	*1.64*		*mg/kg*	*2.45513*		*66.7*	*24-135*			
TEH, as #2 diesel fuel	110.6	5	"	100.387	65.1	45.3	17-122			
Matrix Spike Dup (1ZK0568-MSD1)	**Source: 1K60677-13**			Prepared: 11/11/16 Analyzed: 11/17/16						
Surrogate: Pentacosane	*1.61*		*mg/kg*	*2.42033*		*66.6*	*24-135*			
TEH, as #2 diesel fuel	124.5	5	"	98.9638	65.1	60.1	17-122	11.8	30	
Reference (1ZK0568-SRM1)				Prepared: 11/11/16 Analyzed: 11/17/16						
Surrogate: Pentacosane	*1.64*		*mg/kg*	*2.47600*		*66.1*	*24-135*			
TEH, as #2 diesel fuel	94.2	5	"	101.240		93.0	75-125			
Batch 1ZK0570 - 3510C OA-2 Sep Fnl										
Blank (1ZK0570-BLK1)				Prepared: 11/11/16 Analyzed: 11/17/16						
Surrogate: Pentacosane	*0.0180*		*mg/L*	*0.0495200*		*36.4*	*42-137*			*S-07*
TEH, as gasoline	ND	0.1	"							
TEH, as #2 diesel fuel	ND	0.1	"							
TEH, as waste oil	ND	0.1	"							
Total Extractable Hydrocarbons	ND	0.1	"							

ND = Non Detect; REC= Recovery; RPD= Relative Percent Difference

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Urbandale, IA 50322

Work Order: 1K60677

Certified Analyses included in this Report

Method/Matrix	Analyte	Certifications
Iowa OA-1 in Soil		
	Benzene	SIA1X
	Toluene	SIA1X
	Ethylbenzene	SIA1X
	Xylenes, total	SIA1X
Iowa OA-1 in Water		
	Benzene	SIA1X
	Toluene	SIA1X
	Ethylbenzene	SIA1X
	Xylenes, total	SIA1X
Iowa OA-2 in Soil		
	Total Extractable Hydrocarbons	SIA1X
Iowa OA-2 in Water		
	Total Extractable Hydrocarbons	SIA1X

Code	Description	Number	Expires
KS-KC	Kansas Department of Health and Environment-KC	E-10110	04/30/2017
KS-NT	Kansas Department of Health and Environment (NELAP)	E-10287	12/31/2016
MO-KC	Missouri Department of Natural Resources	140	04/30/2015
SIA1X	Iowa Department of Natural Resources	95	02/01/2017

Notes and Definitions

D-06	The sample chromatographic pattern does not resemble the fuel standard used for quantitation.
O-11A	OVERRANGE
QS-01	The blank spike recovery and/or blank spike duplicate recovery were outside the established acceptance limits. Batch was accepted based on acceptable MS/MSD/RPD results.
S-06	The recovery of this surrogate is outside control limits due to sample dilution required from high analyte concentration and/or matrix interference's.
S-07	The surrogate recovery for this sample is outside of established control limits.

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November 18, 2016
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Work Order: 1K60677

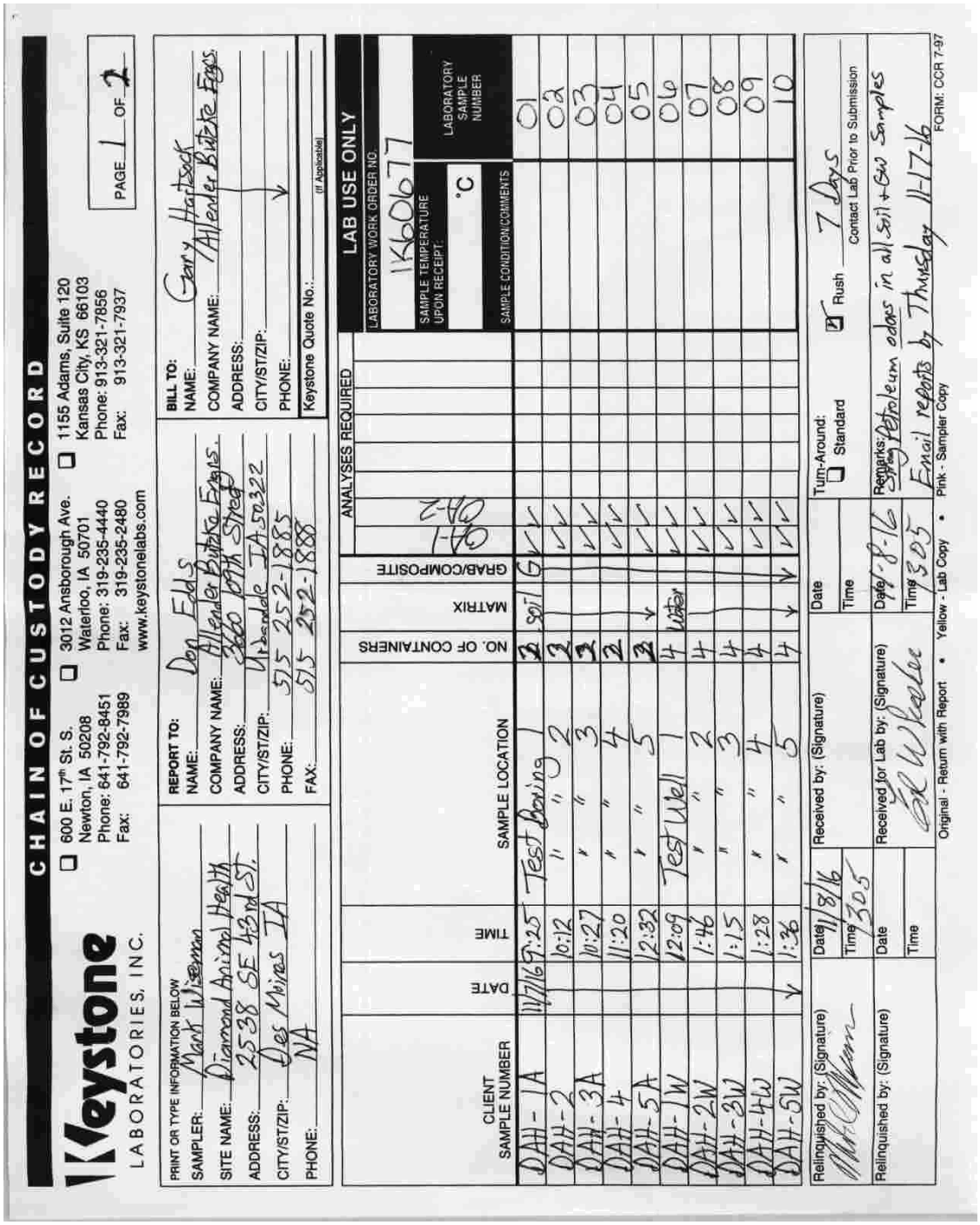
End of Report

Sue Thompson

Keystone Laboratories, Inc.

Sue Thompson
Project Manager II

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CHAIN OF CUSTODY RECORD

Keystone LABORATORIES, INC.

600 E. 17th St. S. Newton, IA 50208 Phone: 641-792-8451 Fax: 641-792-7989

3012 Ansborough Ave. Waterloo, IA 50701 Phone: 319-235-4440 Fax: 319-235-2480

1155 Adams, Suite 120 Kansas City, KS 66103 Phone: 913-321-7856 Fax: 913-321-7937

www.keystonelabs.com

PAGE 1 OF 2

PRINT OR TYPE INFORMATION BELOW
SAMPLER: Mark Wiseman
SITE NAME: Diamond Animal Health
ADDRESS: 2538 SE 43rd ST.
CITY/ST/ZIP: Des Moines IA
PHONE: NA

REPORT TO:
NAME: Don Eds
COMPANY NAME: Allender Butzke Engrs.
ADDRESS: 3660 109th Step
CITY/ST/ZIP: Urbandale IA 50322
PHONE: 515 252-1885
FAX: 515 252-1888

BILL TO:
NAME: Gary Hartsock
COMPANY NAME: Allender Butzke Engs.
ADDRESS:
CITY/ST/ZIP:
PHONE:
Keystone Quote No.: (if Applicable)

LAB USE ONLY
LABORATORY WORK ORDER NO: 1K60677
SAMPLE TEMPERATURE UPON RECEIPT: °C
SAMPLE CONDITION/COMMENTS

ANALYSES REQUIRED: N-NO3, P-PO4

CLIENT SAMPLE NUMBER	DATE	TIME	SAMPLE LOCATION	NO. OF CONTAINERS	MATRIX	GRAB/COMPOSITE	LABORATORY SAMPLE NUMBER
DAH-1A	11/7/16	9:25	Test Boring 1	2	soil	G	01
DAH-2		10:12	" " 2	3			02
DAH-3A		10:27	" " 3	3			03
DAH-4		11:20	" " 4	2			04
DAH-5A		12:32	" " 5	3			05
DAH-1W		12:09	Test Well 1	4	water		06
DAH-2W		1:46	" " 2	4			07
DAH-3W		1:15	" " 3	4			08
DAH-4W		1:28	" " 4	4			09
DAH-5W		1:36	" " 5	4			10

Relinquished by: (Signature) Mark Wiseman — Date 11/8/16 Time 7:05 — Received by: (Signature)

Relinquished by: (Signature) — Date — Time — Received for Lab by: (Signature) EK Wheeler — Date 11-8-16 Time 7:05

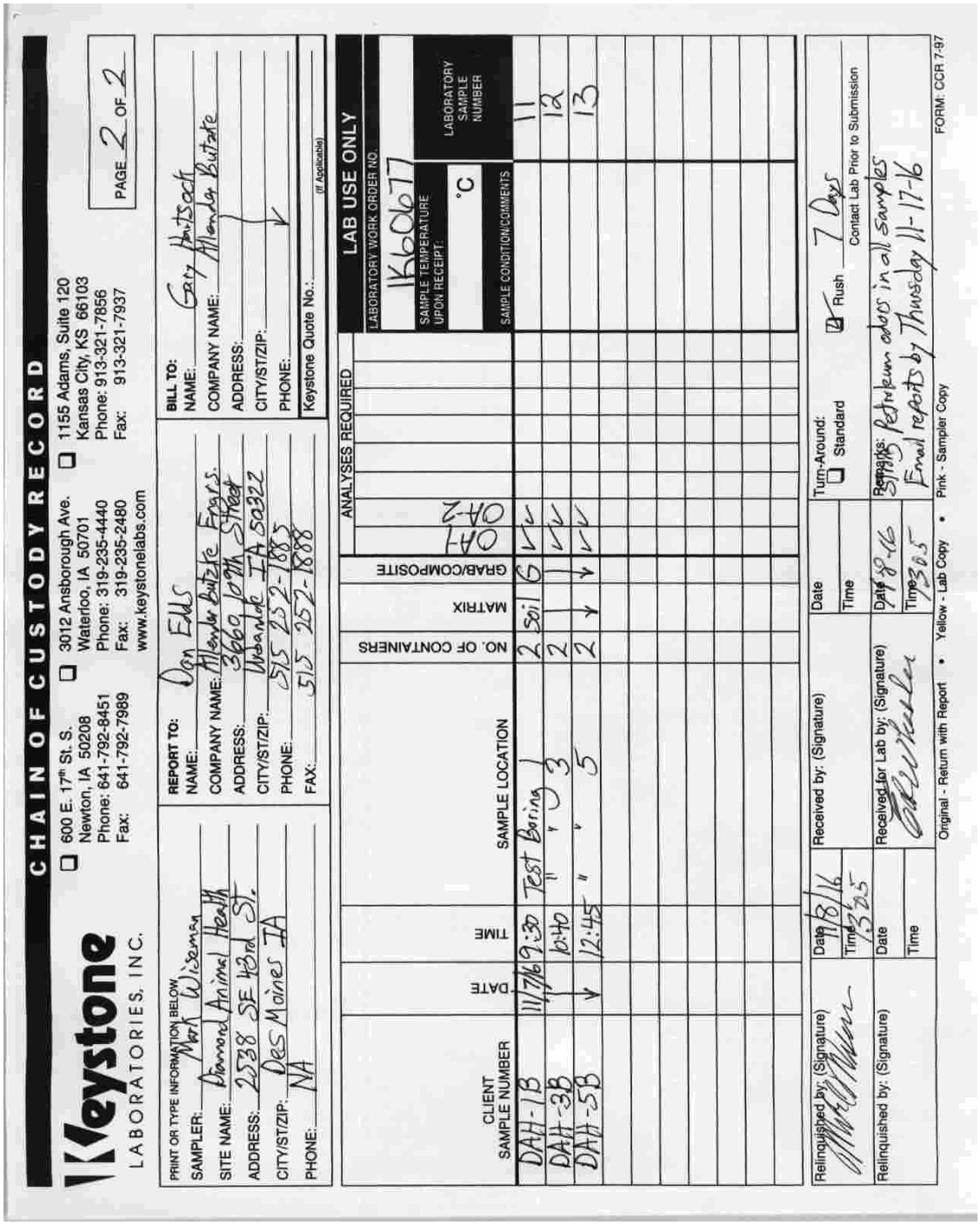
Turn-Around: ☐ Standard ☑ Rush 7 Days — Contact Lab Prior to Submission

Remarks: Sign Petroleum odors in all soil + GW samples
Email reports by Thursday 11-17-16

Original - Return with Report • Yellow - Lab Copy • Pink - Sampler Copy

FORM: CCR 7-97

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PAGE 2 OF 2

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BILL TO: NAME: Gary Hartsock
COMPANY NAME: Allender Butzke
ADDRESS:
CITY/ST/ZIP:
PHONE:
Keystone Quote No.: (if Applicable)

LAB USE ONLY
LABORATORY WORK ORDER NO. 1K60677
SAMPLE TEMPERATURE UPON RECEIPT: °C
SAMPLE CONDITION/COMMENTS

CLIENT SAMPLE NUMBER	DATE	TIME	SAMPLE LOCATION	NO. OF CONTAINERS	MATRIX	GRAB/COMPOSITE	ANALYSES REQUIRED	LABORATORY SAMPLE NUMBER
DAH-1B	11/7/16	9:30	Test Boring 1	2	Soil	G	TPH	11
DAH-3B	"	10:40	" 3	2	"	"	"	12
DAH-5B	"	12:45	" 5	2	"	"	"	13

Relinquished by: (Signature) Mark Wiseman — Date 11/8/16 Time 1325 — Received by: (Signature)
Relinquished by: (Signature) — Date — Time — Received for Lab by: (Signature) — Date 11-8-16 Time 1325

Turn-Around: ☐ Standard ☑ Rush 7 Days — Contact Lab Prior to Submission
Remarks: Petroleum odors in all samples
Email reports by Thursday 11-17-16

Original - Return with Report • Yellow - Lab Copy • Pink - Sampler Copy

FORM: CCR 7-97

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