Part 2 — Technical Requirements

NRCB Natural Resources Conservation Board

Application under the *Agricultural Operation Practices Act* for a confined feeding operation, manure collection area, and/or manure storage facility(ies)

NRCB USE ONLY	Application number	Legal land description
☐ Approval ☐ Registration ☑ Authorization ☐ Amendment	RA24052	NE 1-41-2 W5M

APPLICATION DISCLOSURE

This information is collected under the authority of the *Agricultural Operation Practices Act* (AOPA), and is subject to the provisions of the *Freedom of Information and Protection of Privacy Act*. This information is public unless the NRCB grants a written request that certain sections remain private.

Any construction prior to obtaining an NRCB permit is an offence and is subject to enforcement action, including prosecution.

I, the applicant, or applicant's agent, have read and understand the statements above, and I acknowledge that the information provided in this application is true to the best of my knowledge.

February 4,2025
Date of signing

[redacted]
Signature

Verhoef Dairy LTD.
Corporate name (if applicable)

Herman Verhoef
Print name

GENERAL INFORMATION REQUIREMENTS

Proposed facilities: list all proposed confined feeding operation facilities and their dimensions. Indicate whether any of the proposed facilities are additions to existing facilities. (attach additional pages if needed)

Proposed facilities	Dimensions (m) (length, width, and depth)
Addition to the dairy barn for dry cows and calfs	27.4mx42.6m
Built a heifer barn	70.1mx18.3m
Solid Manure storage	25mx25m at ground level

Existing facilities: list **ALL** existing confined feeding operation facilities and their dimensions

Existing facilities	Dimensions (m) (length, width, and depth)	NRCB USE ONLY
Dairy barn	42.6mx42.6m	Confirmed
Liquid earthen manure storage	51mx51mx4.5m deep	Confirmed

NRCB USE ONLY

(10) Last updated September 11, 2023

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If a new facility is replacing an old facility, please explain what will happen to the old facility and when. ☐ N/A

Dry cows and heifers will move out of the one half (south side) of the existing dairy barn into the proposed addition of the dairy barn and the proposed heifer barn.
The one half(south side) of the existing dairy barn will be developed for milking cows just like the north side of the barn.

Construction completion date for proposed facilities March 1, 2028

Additional information

Livestock numbers: Complete only if livestock numbers are different from what was identified in the Part 1 application. Note: if livestock numbers increase in your Part 2 application, a new Part 1 application must be submitted which may result in a loss of priority for minimum distance separation (MDS).

Livestock category and type (Available in the Schedule 2 of the Part 2 Matters Regulation)	**Permitted number**	**Proposed increase or decrease in number (if applicable)**	**Total**
From Part 1 application			
Dairy cows (plus dries and replacements)	120	0	120

9 Nov

Part 2 — Technical Requirements

NRCB Natural Resources Conservation Board

Application under the *Agricultural Operation Practices Act* for a confined feeding operation, manure collection area, and/or manure storage facility(ies)

DECLARATION AND ACKNOWLEDGMENT OF APPLICANT CONCERNING *WATER ACT* LICENCE

issued by Alberta Environment and Protected Areas (EPA) for a confined feeding operation (CFO)

Date and sign one of the following four options

OPTION 1: Applying through the NRCB for both the AOPA permit and the *Water Act* licence

I **DO** want my water licence application coupled to my AOPA permit application.

Signed this ____day of _____, 20____. _____

Signature of Applicant or Agent

OPTION 2: Processing the AOPA permit and *Water Act* licence separately

1. I (we) acknowledge that the CFO will need a new water licence from EPA under the *Water Act* for the development or activity proposed in this AOPA application.
2. I (we) request that the NRCB process the AOPA application **independently of** EPA's processing of the CFO's application for a water licence.
3. In making this request, I (we) recognize that, if this AOPA application is granted by the NRCB, the NRCB's decision will not be considered by EPA as improving or enhancing the CFO's eligibility for a water licence under the *Water Act*.
4. I (we) acknowledge that any construction or actions to populate the CFO with livestock pursuant to an AOPA permit in the absence of a *Water Act* licence will **not** be relevant to EPA's consideration of whether to grant the *Water Act* licence application.
5. I (we) acknowledge that any such construction or livestock populating will be at the CFO's sole risk if the *Water Act* licence application is denied or if the operation of the CFO is otherwise deemed to be in violation of the *Water Act*. This risk includes being required to depopulate the CFO and/or to cease further construction, or to remove "works" or "undertakings" (as defined in the *Water Act*).
6. **AS RELEVANT:** I (we) acknowledge that the CFO is located in the South Saskatchewan River Basin and that, pursuant to the *Bow, Oldman and South Saskatchewan River Basin Water Allocation Order* [Alta. Reg. 171/2007], this basin is currently closed to new surface water allocations.
7. **Provide:** Water licence application number(s) _____

Signed this ____ day of _____, 20____. _____

Signature of Applicant or Agent

OPTION 3: Additional water licence not required

1. I (we) declare that the CFO will not need a new licence from EPA under the *Water Act* for the development or activity proposed in this AOPA application.
2. **Provide**: Water license number(s) or water conveyance agreement details 00420902-00-00

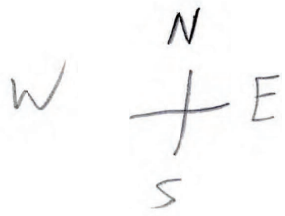
Signed this 4 day of february, 2024. [redacted]

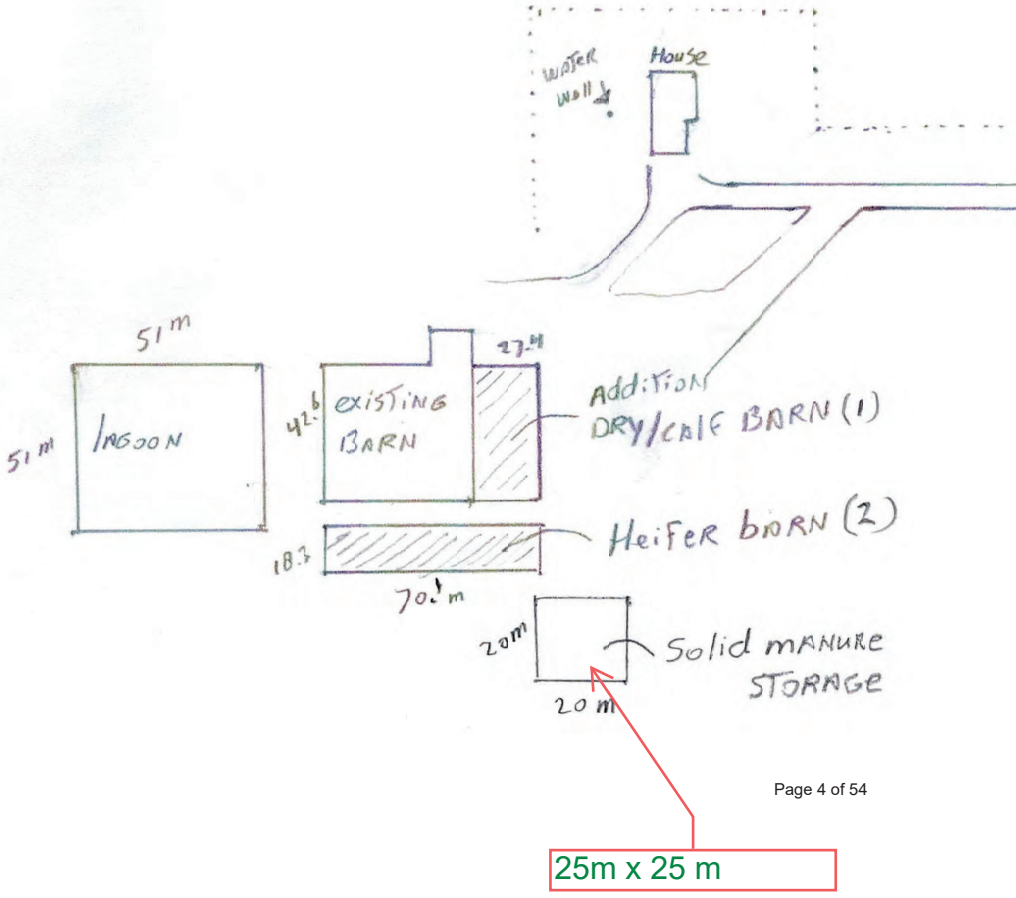
Signature of Applicant or Agent

Last updated September 11, 2023

Verhoef Dairy LTD

NE-1-41-2 W5M





(6)

Part 2 — Technical Requirements

NRCB Natural Resources Conservation Board

Application under the *Agricultural Operation Practices Act* for a confined feeding operation, manure collection area, and/or manure storage facility(ies)

GENERAL ENVIRONMENTAL INFORMATION

(complete this section for the worst case of the existing facility which is the closest to water bodies or water wells and for each of the proposed facilities)

Facility description / name *(as indicated on site plan)*

Existing: Dairy barn **Proposed 1:** Dry/calf barn

Proposed 2: Heifer barn **Proposed 3:** Solid manure storage

Facility and environmental risk information		Facilities				NRCB USE ONLY	
		Existing	Proposed 1	Proposed 2	Proposed 3	Meets requirements	Comments
Flood plain information	What is the elevation of the floor of the lowest manure storage or collection facility above the 1:25 year flood plain or the highest known flood level?	☒ >1 m ☐ ≤ 1 m	☒ >1 m ☐ ≤ 1 m	☒ >1 m ☐ ≤ 1 m	☒ > 1 m ☐ ≤ 1 m	☑ YES ☐ NO ☐ YES with exemption	> 1 m above floodplain
Surface water information	How many springs are within 100 m of the manure storage facility or manure collection area?	0	0	0	0	☑ YES ☐ NO ☐ YES with exemption	None observed during a site visit
	How many water wells are within 100 m of the manure storage facility or manure collection area?	0	0	0	0	☑ YES ☐ NO ☐ YES with exemption	There is one WW on site located >100m from facilities
	What is the shortest distance from the manure collection or storage facility to a surface water body? (e.g., lake, creek, slough, seasonal)	~620m	~620m	~620m	~620m	☑ YES ☐ NO ☐ YES with exemption	Creek located more than 600 m away
Groundwater information	What is the depth to the water table?	>4.5m	>4.5m	>4.5m	>4.5m	☑ YES ☐ NO ☐ YES with exemption	Water table measured at 5.6 m
	What is the depth to the groundwater resource/aquifer you draw water from?	>4.5m	>4.5m	>4.5m	>4.5m	☑ YES ☐ NO ☐ YES with exemption	UGR identified at 15.2 m on WW ID # 466375

Additional information (attach supporting information, e.g. borehole logs, records, etc. you consider relevant to your application)

(3) NCW

Part 2 — Technical Requirements

Application under the *Agricultural Operation Practices Act* for a confined feeding operation, manure collection area, and/or manure storage facility(ies)

NRCB USE ONLY

WATER WELL AND SURFACE WATER INFORMATION

Well IDs: __466375 and 436999_____ _____ _____

_____ _____ _____

Surface water related concerns from directly affected parties or referral agencies: ☐ YES ☑ NO

Groundwater related concerns from directly affected parties or referral agencies: ☐ YES ☑ NO

Water wells ☑ N/A

If applicable, exemption for 100 m distance requirements applied: ☐ YES ☐ NO Condition required: ☐ YES ☐ NO

Surface water ☑ N/A

If applicable, exemption for 30 m distance requirements applied: ☐ YES ☐ NO Condition required: ☐ YES ☐ NO

Water Well Exemption Screening Tool ☑ N/A

Water Well ID	Preliminary Screening Score	Secondary Screening Score	Facility

Groundwater or surface water related comments:

Part 2 — Technical Requirements

Application under the *Agricultural Operation Practices Act* for a confined feeding operation, manure collection area, and/or manure storage facility(ies)

NRCB USE ONLY

ENVIRONMENTAL RISK SCREENING INFORMATION

ERST for **proposed** facilities

Facility	Groundwater score	Surface water score	File number
Addition to dairy barn	Low	Low	RA24052
Heifer barn	Low	Low	RA24052
Solid manure storage	Low	Low	RA24052

ERST for **existing** facilities

Facility	Groundwater score	Surface water score	File number
Dairy barn	Low	Low	RA18039
EMS	Low	Low	RA18039

ERST related comments:

Part 2 — Technical Requirements

Application under the *Agricultural Operation Practices Act* for a confined feeding operation, manure collection area, and/or manure storage facility(ies)

NRCB Natural Resources Conservation Board

DISTANCE OF ANY MANURE STORAGE FACILITY (EXISTING OR PROPOSED) TO NEIGHBOURING RESIDENCES

Neighbour name(s)	Legal land description	Distance (m)	NRCB USE ONLY				
			Zoning (LUB) category	MDS category (1-4)	Distance (m)	Waiver attached (if required)	Meets regulations
B. Berze	se-12-41-02	1135	Agriculture	1	1,135		Yes
H&E Steinhilber	nw-31-40-01	1475	Agriculture	1	1,475		Yes
M&J Ruud	sw-01-41-02	960	Agriculture	1	960		Yes
D&A Kikstra	ne-01-41-02	307	Agriculture	1	307		Yes
C&T Szasz	nw-01-41-02	375	Agriculture	1	375		Yes

LAND BASE FOR MANURE AND COMPOST APPLICATION (complete only if an increase in livestock or manure production will occur)

Name of land owner(s)*	Legal land description	Usable area** (ha)	Soil zone ***	NRCB USE ONLY	
				Usable area (ha)	Agreement attached (if required)
				N/A for authorizations	
			Total		

* If you are **not** the registered landowner, you must attach copies of land use agreements signed by all landowners.

** Available manure spreading area (excluding setback areas from residences, common bodies of water, water wells, etc. as identified in Agdex 096-5 Manure Spreading Regulations)

*** Brown, dark brown, black, grey wooded, or irrigated

Additional information (attach any additional information as required)

See the Envirowest engineering report on file dated June 26, 2018

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Part 2 — Technical Requirements

Application under the *Agricultural Operation Practices Act* for a confined feeding operation, manure collection area, and/or manure storage facility(ies)

NRCB USE ONLY

MINIMUM DISTANCE SEPARATION

Methods used to determine distance (if applicable): __Google Earth_____

Margin of error (if applicable): _____

Requirements (m): Category 1:__290_____ Category 2:__386_____ Category 3:___483____ Category 4:__772____

Technology factor: ☐ YES ☑ NO

Expansion factor: ☐ YES ☑ NO

MDS related concerns from directly affected parties or referral agencies: ☐ YES ☑ NO

LAND BASE FOR MANURE AND COMPOST APPLICATION

Land base required: __N/A for authorizations

Land base listed: _____

Area not suitable: _____

Available area _____ Requirement met: ☐ YES ☐ NO

Land spreading agreements required: ☐ YES ☐ NO

Manure management plan: ☐ YES ☐ NO If yes, plan is attached: ☐

PLANS

Submitted and attached construction plans: ☑ YES ☐ NO

Submitted aerial photos: ☑ YES ☐ NO

Submitted photos: ☐ YES ☑ NO

GRANDFATHERING

Already completed: ☐ YES ☐ NO ☑ N/A

If already completed, see _____

Part 2 — Technical Requirements

Application under the *Agricultural Operation Practices Act* for a confined feeding operation, manure collection area, and/or manure storage facility(ies)

NRCB USE ONLY

ALL SIGNATURES IN FILE ☑ YES ☐ NO

DATES OF APPROVAL OFFICER SITE VISITS

March 14, 2025	

CORRESPONDENCE WITH MUNICIPALITIES AND REFERRAL AGENCIES

Date deeming letters sent: ___February 18, 2025_____

Municipality: __Lacombe County_____

☑ letter sent ☑ response received ☑ written/email ☐ verbal ☐ no comments received

Alberta Health Services: ☑ **N/A**

☐ letter sent ☐ response received ☐ written/email ☐ verbal ☐ no comments received

Alberta Environment and Parks: ☐ N/A

☑ letter sent ☑ response received ☑ written/email ☐ verbal ☐ no comments received

Alberta Transportation: ☑ N/A

☐ letter sent ☐ response received ☐ written/email ☐ verbal ☐ no comments received

Alberta Regulatory Services: ☐ N/A

☑ letter sent ☐ response received ☐ written/email ☐ verbal ☑ no comments received

Other: _Gull Lake Deer Creek Gas Coop, Journey Energy, Fort Calgary Resources __ ☐ N/A

☑ letter sent ☐ response received ☐ written/email ☐ verbal ☑ no comments received

Other: _____ ☑ N/A

☐ letter sent ☐ response received ☐ written/email ☐ verbal ☐ no comments received

Part 2 — Technical Requirements

NRCB Natural Resources Conservation Board

Application under the *Agricultural Operation Practices Act* for a confined feeding operation, manure collection area and/or manure storage facility(ies)

SOLID MANURE, COMPOST, & COMPOSTING MATERIALS: Barns, feedlots, & storage facilities - Naturally occurring protective layer

*(complete a copy of this section for **EACH** barn, feedlot, and storage facility for solid manure, composting materials, or compost with a naturally occurring protective layer for the liner)*

Facility description / name *(as indicated on site plan)*

1. Dry/calf barn solid manure pack*
2. Heifer barn solid manure pack
3. Solid MANURE

Manure storage capacity

	Length (m)	Width (m)	Depth below ground level (m)	NRCB USE ONLY Estimated storage capacity (m^3)
inside 1.	27	~~18~~ 42.6	0	Solid manure pad
Inside 2.	70	~~10~~ 18.3	0	Solid manure pad
outside 3.	25	25	0	TOTAL CAPACITY

☐ I plan to use a short-term solid manure storage (STMS) as part of my manure storage and handling plan for this CFO. (The AOPA requirements for STMS are set out in the NRCB Short-Term Solid Manure Storage Requirements Fact Sheet.

Surface water control systems

Describe the run-on and runoff control system

3 — *Any liquid manure in the dry barn will flow in to the existing dairy barn by a manure scraper in to the existing lagoon.
**To prevent run off, we propose to construct a berm with clay. To prevent run on, we will direct the yard water away y from the solid manure storage. See page 8 for run off direction on the Sept 28, 2018 application. No permanent water bodies are present on the home quarter.
See the Enviro West report on file, dated June 26, 2018.

Naturally occurring protective layer details

Thickness of naturally occurring protective layer	0.52 (m)	Provide details (as required) bore hole logs indicate sandy clay loam or clay loam found for a depth of 0.7 to 4.5 meters	
Soil texture	44-48 % sand	18-30 % silt	34-48 % clay
Hydraulic conductivity - naturally occurring protective layer	Depth and type of soil tested 18BH05 0.7-4.5m	Hydraulic conductivity (cm/s) 2.6x10 -7cm/sec	Describe test standard used slug test using AQTEsolv Bouwer-rice method

Additional information *(attach copies of soil test reports)*

NRCB USE ONLY

Requirements met: ☑ YES ☐ NO

Condition required: ☑ YES ☐ NO

Report attached: ☑ YES ☐ NO

(5) New

Last updated February 26, 2021

SOLID MANURE, COMPOST, & COMPOSTING MATERIALS: Barns, feedlots, & storage facilities - Naturally Occurring Protective Layer (cont.)

NRCB USE ONLY

Nine month manure storage volume requirements met ☑ YES ☐ YES With STMS ☐ NO

Depth to water table: _____5.6 m_____ Requirements met: ☑ YES ☐ NO

Depth to Uppermost groundwater resource: _____15.2 m_____ Requirements met: ☑ YES ☐ NO

ERST completed: ☑ see ERST page for details

Surface water control systems

Requirements met: ☑ YES ☐ NO Details/comments:

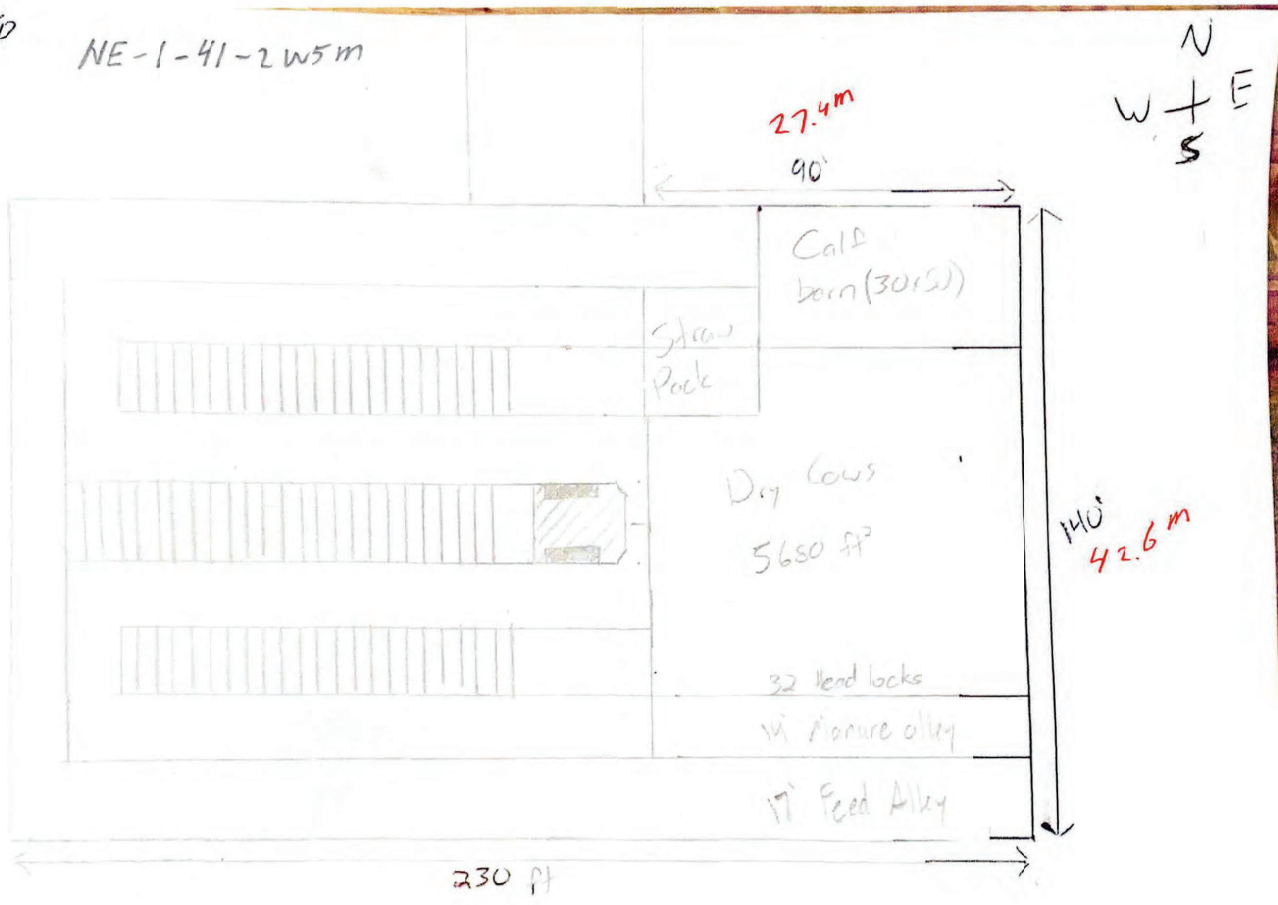
Naturally occurring layer details

A condition will be included in the authorization requiring a post construction site inspection before using the new facilities

Leakage detection system required: ☐ YES ☑ NO If yes, please explain why.

Verhoef Dairy Ltd

NE-1-41-2 W5m



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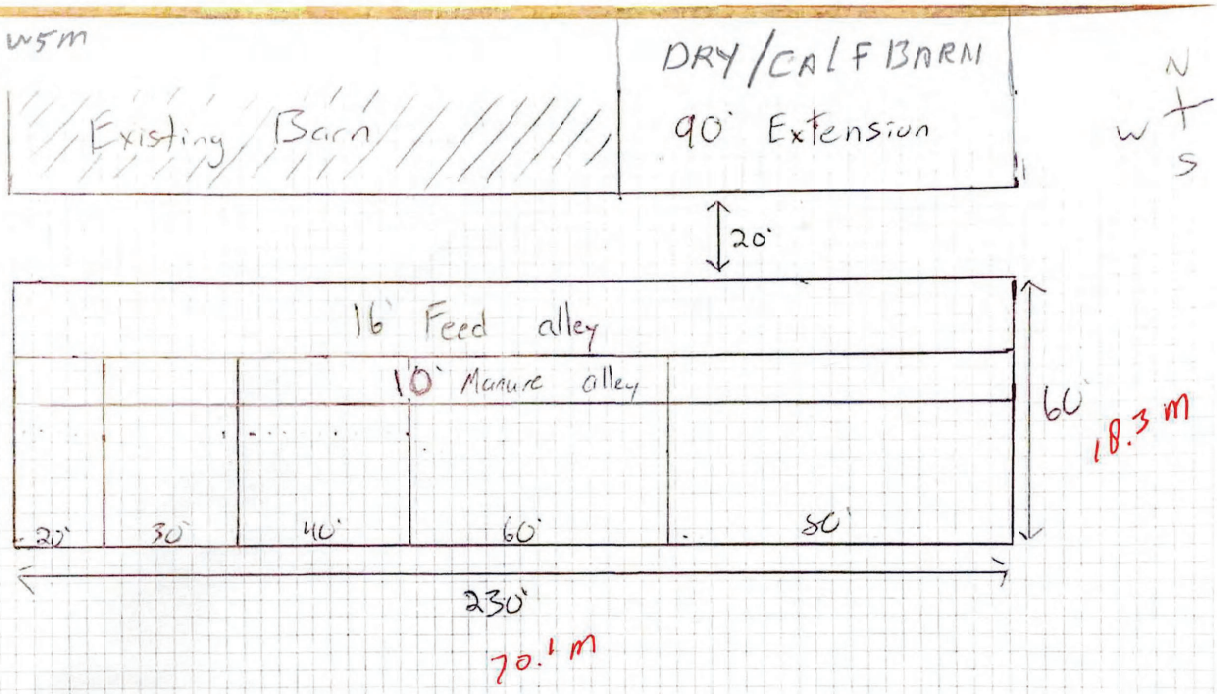
NE-1-41-2-W5M

VERHOEF DAIRY LTD.



Heifer Barn

(8)

Site and Soil Assessment
Liquid EMS Design
NE¼, Sec. 01, Twp.41, Rng. 02 W5M
Lacombe County, Alberta

ENVIROWEST ENGINEERING INC.

Professional Environmental Engineering Services

Envirowest Engineering Inc.
Professional Environmental Engineering Services

Site and Soil Assessment - Amended
Liquid EMS Design
NE¼, Sec. 01, Twp.41, Rng. 02 W5M
Lacombe County, Alberta

Prepared for: Herman Verhoef

Project Number: 1804-42317

Prepared by: Envirowest Engineering Inc.
P.O. Box 4248, Ponoka, Alberta
(403) 783-8229

Report Prepared: June 8, 2018

Private and Confidential

Table of Contents

Appendices

1.0 Introduction and Scope of Work

Envirowest Engineering Inc. (Envirowest) was retained by Mr. Herman Verhoef to conduct a site and soil assessment for the proposed construction of a new EMS (earthen manure storage) facility. The proposed operation will be for 120 head dairy located at NE¼-01-041-02 W5M in Lacombe County, herein after referred to as "the Site".

Representative soil samples were collected at the Site at two potential build locations to allow for the assessment of applicable soil properties. The samples were collected by completing investigative boreholes using a truck mounted rotary auger. Soil samples were collected from selected boreholes and reserved for potential laboratory analysis. A piezometer was located at two borehole locations, one at each potential build location, for the in-situ testing of hydraulic conductivity. The Site assessment occurred on May 8, 2018.

The assessment has been completed in accordance with the standards and regulations associated with the amended Agricultural Operation Practices Act and associated regulations govern all new and modified confined feeding operations (GOA, 2014).

This report will summarize the findings of the soil assessment.

2.0 Site Description

The Site is located approximately 8 kilometers northwest of Bently, Alberta, as indicated on Figure 1. The proposed scope of work is the construction of an earthen manure storage lagoon and barn pad. The EMS and barn pad will likely be located to the southwest of the homestead with secondary location to the northeast of the homestead, as indicated on Figure 2. The build site will be stated in the submitted Part 2 Application.

The topography of the property and immediate area is generally sloping to undulating with slope to the west northwest at the primary build site and northeast at the secondary build site. The closest surface waterbody is a low lying area 620 meters to the northwest of the homestead.

The Site is located in an area where the upper most bedrock is of the Paskapoo Formation. This formation consists of grey to greenish grey, thick bedded calcareous, cherty sandstone; grey and green siltstone and mudstone; minor conglomerate, thin limestone, coal and tuff beds, and is non-marine in nature (Prior, 2013).

The quaternary geology indicates the Site is located in an area of stagnation moraine glacial deposits with till of uneven thickness, local water-sorted material up to 30 m thick, undulating to hummocky topography. Specifically mixed hummocky and moraine plateau topography, flat topped, irregularly shaped hills with a cover of stratified sand, silt and clay interspersed with mounts of till (Shetsen, 1990).

3.0 Standards and Guidelines

The amended Agricultural Operation Practices Act and associated regulations govern all new and modified confined feeding operations (GOA, 2014). The soil assessment for the EMS lagoon was reviewed with respect to the following standards and guidelines:

- A manure storage facility and a manure collection area must have either a protective layer or a liner that meets the requirements of the regulations between the facility or area and the uppermost groundwater resource below the Site.
- The bottom of a liner of a manure storage facility and of a manure collection area must be not less than 1.0 meter (m) above the water table of the Site at the time of construction.
- The bottom of a liner or the base of the protective layer must be not less than 1.0 m above the top of the groundwater resource.
- The protective layer of a manure storage facility and of the manure collection area must provide equal or greater protection than that provided by naturally occurring materials 10 m in depth with an hydraulic conductivity of not more than 1×10^{-6} centimetres per second (cm/sec) for a liquid manure storage facility.
- If the liner of a liquid manure storage facility is made of compacted soil or manufactured materials, it must provide equal or greater protection than that provided by 1.0 m in depth with a hydraulic conductivity of not more than 1×10^{-7} cm/sec.
- The owner or operator of a confined feeding operation must construct manure storage facilities that are sufficient to store all the manure produced by the operation over a period of at least nine consecutive months.
- An open liquid manure storage facility must have a freeboard of not less than 0.5 m when the facility is full.

Other portions of the regulations may also be found to apply to the Site.

4.0 Site Assessment Methodology

Eight investigative boreholes were drilled using a truck mounted rotary auger and completed to depths of between 5.6 m below ground surface (mbgs) and 6.9 mbgs. Five boreholes were completed in the primary build site proposed for the new EMS lagoon and barn pad, three boreholes were completed at the secondary build site. Two boreholes were completed as wells to allow for the in-situ hydraulic conductivity. Borehole drilling and soil sampling were completed on May 8, 2018. The hydraulic conductivity testing was completed on May 29, 2018.

A soil sample was collected from the proposed area for EMS lagoon construction areas and barn pad area within the primary build site and reserved for potential laboratory analysis. The samples were collected from 1.2 mbgs at borehole 18BH02, 3.0 mbgs at borehole 18BH05, and 5.0 mbgs at borehole 18BH08. Further to the results from the in-situ testing, three soil samples were submitted for analysis for particle size distribution only.

The soil from the Site was assessed based on the requirements specified in the Agricultural Operation Practices Act (GOA, 2014) and associated regulations. One of the critical aspects of meeting these requirements is the assessment of native soil properties to facilitate manure storage facility construction. It is recommended that the earthen manure storage lagoon be constructed in such a way and of appropriate material with an hydraulic conductivity of 1×10^{-6} cm/sec. It is also important to construct such storage facilities in an area where the water table is at least 1 m below the bottom of the facility and in an area not prone to flooding.

The analytical methodologies are referenced with the laboratory reports presented in Appendix C.

5.0 Site Assessment Results

The results of the laboratory analysis are presented in Table 1 below; soil sample locations are presented on Figure 2.

Table 1: Soil Properties Results

Parameter	18BH02	18BH05	18BH08
Sample Depth (m)	1.5	3.0	5.0
Particle Size (% sand)	48	34	44
Particle Size (% silt)	18	30	20
Particle Size (% clay)	34	36	36
Texture Class	Sandy Clay Loam	Clay Loam	Clay Loam

The soil tested from the proposed area of construction was identified as a sandy clay loam or clay loam with a clay content of 34 to 48 percent.

Monitoring well 18MW02 and 18MW08 was hydrated with water numerous times prior to completing the hydraulic conductivity. The hydraulic conductivity test was completed on May 29, 2018.

The initial depth to water was measured in each well. A volume of water was then removed from the well and the change in depth measured over time. The depth was measured every minute for ten minutes, then every five minutes to thirty minutes. The results of the test were analyzed as a slug test using AQTESOLV Bouwer-Rice method for unconfined wells.

The results of the assessment were an in-situ hydraulic conductivity of 2.6×10^{-7} cm/sec in monitoring well 18MW02 (primary location) and 1.5×10^{-8} cm/sec in monitoring well 18MW08 (secondary location).

There was no saturated water table encountered at the time of drilling. Cemented sandstone was encountered at the first build site at 6.8 mbgs, and 5.6 mbgs at the secondary build site.

Sand was encountered in borehole 18BH03, this is considered an anomaly and construction should remain south of this location.

6.0 Design and Construction Considerations

Based on the information obtained it was determined that the native clay, found from approximately 0.7 to 4.4 meters below grade in borehole 18BH02, would have an hydraulic conductivity of 2.6 x 10^{-7} cm/sec. The native clay at the secondary building site found from approximately 2.5 to 5.6 meters below grade in borehole 18BH08, would have an hydraulic conductivity of 1.5 x 10^{-8} cm/sec. It has been determined that there is a natural barrier for both proposed building sites.

Minimum Required Liner Depth at Primary Building Site:

$$\frac{10 \text{ m}}{1 \times 10^{-6} \text{ cm/sec}} = \frac{\mathbf{X} \text{ m}}{2.6 \times 10^{-7} \text{ cm/sec}}$$

$$\mathbf{X} = 2.6 \text{ m}$$

Minimum Required Liner Depth at Secondary Building Site:

$$\frac{10 \text{ m}}{1 \times 10^{-6} \text{ cm/sec}} = \frac{\mathbf{X} \text{ m}}{1.5 \times 10^{-8} \text{ cm/sec}}$$

$$\mathbf{X} = 0.15 \text{ m}$$

Earthen Manure Storage Sizing

The new EMS lagoon is to be constructed in an area west southwest of the homestead, with the barn area to the east of the lagoon. The liquid manure storage facility has been designed for approximately 120 head dairy (lactating plus dries) for a period of approximately twelve months. The following will need to be considered:

- To provide the required capacity the new EMS should be 55 m in length x 55 m in width. The overall depth has been designed as 3.3 m. The overall capacity of the new EMS will be 6,820 cubic metres (1.8 million imperial gallons) which accounts for the required 0.5 m of freeboard. The storage capacity of the new EMS will be 5,389 cubic meters. The sizing is based on an inside end and side wall slope of 3:1 (run/rise).
- The bottom of the liner must be not less than 1.0 m above the top of an aquifer and the shallow groundwater level. The depth to groundwater will be confirmed at the time of construction.
- The overall depth of 3.3 m will be achieved through building the east side of the lagoon 1.5 meters above grade and the west side of the lagoon 2.0 meters above grade to accommodate for elevation.

- The above-grade dykes will prevent runoff from entering the facility. The outside dyke walls should be completed to at slope of 4:1. The crest of the dyke should be sloped slightly outward to direct rainfall away from the storage facility.
- The freeboard depth of 0.5 m and outside dyke walls should be covered with 0.1-0.2 m of topsoil and seeded to prevent soil erosion.

Alternatively, the secondary building site would have the following sizing:

- To provide the required capacity the EMS would be 50 m in length x 50 m in width. The overall depth has been designed as 4.5 m. The overall capacity of the EMS would be 6,268 cubic metres (1.7 million imperial gallons) which accounts for the required 0.5 m of freeboard. The storage capacity of the EMS will be 5,092 cubic meters. The construction would be 4.0 meters below grade with a 0.5-meter berm above grade.

Earthen Manure Storage Construction

The following general construction procedures are recommended, though some modifications may be required based on actual site conditions encountered during construction:

- The topsoil should be stripped from the area for construction. The topsoil can be reused on the freeboard area after construction completion.
- The below-grade depth of the EMS must maintain a minimum of a 1.0 m separation above the indicated water table at the time of construction.
- Construction of the lagoon should be supervised by a professional engineer.

Following completion of the lagoon the operator should:

- Ensure that shrubs, trees, and deep-rooted plants are not allowed to grow on or near the walls of the facility.
- If required, install groundwater monitoring wells to provide a leakage detection system for the facility.

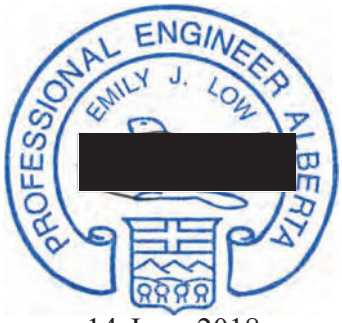
7.0 Closure

Envirowest Engineering Inc. is pleased to submit the report on the site and soil assessment to Herman Verhoef. The information and conclusions contained in this report are for their sole use and such parties as may be normally involved in the approval process for such a facility. No other party is expected to rely upon the information contained within the report without the express written authorization of Envirowest Engineering Inc..

The review has been conducted in accordance with generally accepted environmental engineering practices. No other warranty is expressed or implied.

We trust that this report meets your present needs. Please feel free to contact the undersigned with any questions or should you require additional information.

Respectfully submitted,



14-June-2018

Prepared by:

Emily J. Low, P.Eng.
Envirowest Engineering Inc.

14-June-2018

Reviewed by:

Shawna D. Low, P.Eng
Envirowest Engineering Inc.

Envirowest Engineering Inc.
Association of Professional Engineers and Geoscientists of Alberta
Permit to Practice No. P645

8.0 References

Bouwer, H. (1989). The Bouwer and Rice Slug Test – An Update, Ground Water: Vol. 27, No. 3, 304-3.

GOA (Government of Alberta). (2014, December). Agricultural Operation Practices Act and Regulations. Edmonton, AB: Author

Prior, G.J., Hathway, B., Glombick, P.M., Pana, D.I., Banks, C.J., Hay, D.C., Weiss, J.A. (2013). Bedrock Geology of Alberta (Map 600). Edmonton, AB: Alberta Research Council, Natural Resources Division, Terrain Sciences Department.

Shetsen, I. (1990). Quaternary Geology, Central Alberta. Edmonton, AB: Alberta Research Council, Natural Resources Division, Terrain Sciences Department.

Appendix A

Site Location

ENVIROWEST ENGINEERING INC.
Professional Environmental Engineering Services

Title:

Location of Subject Site
Site and Soil Assessment
NE-01-041-02 W5M
Lacombe County, Alberta

Project No: 1804-42317	**Date:** June 8, 2018
Prepared by: E. Low	**Drawing No:** A1

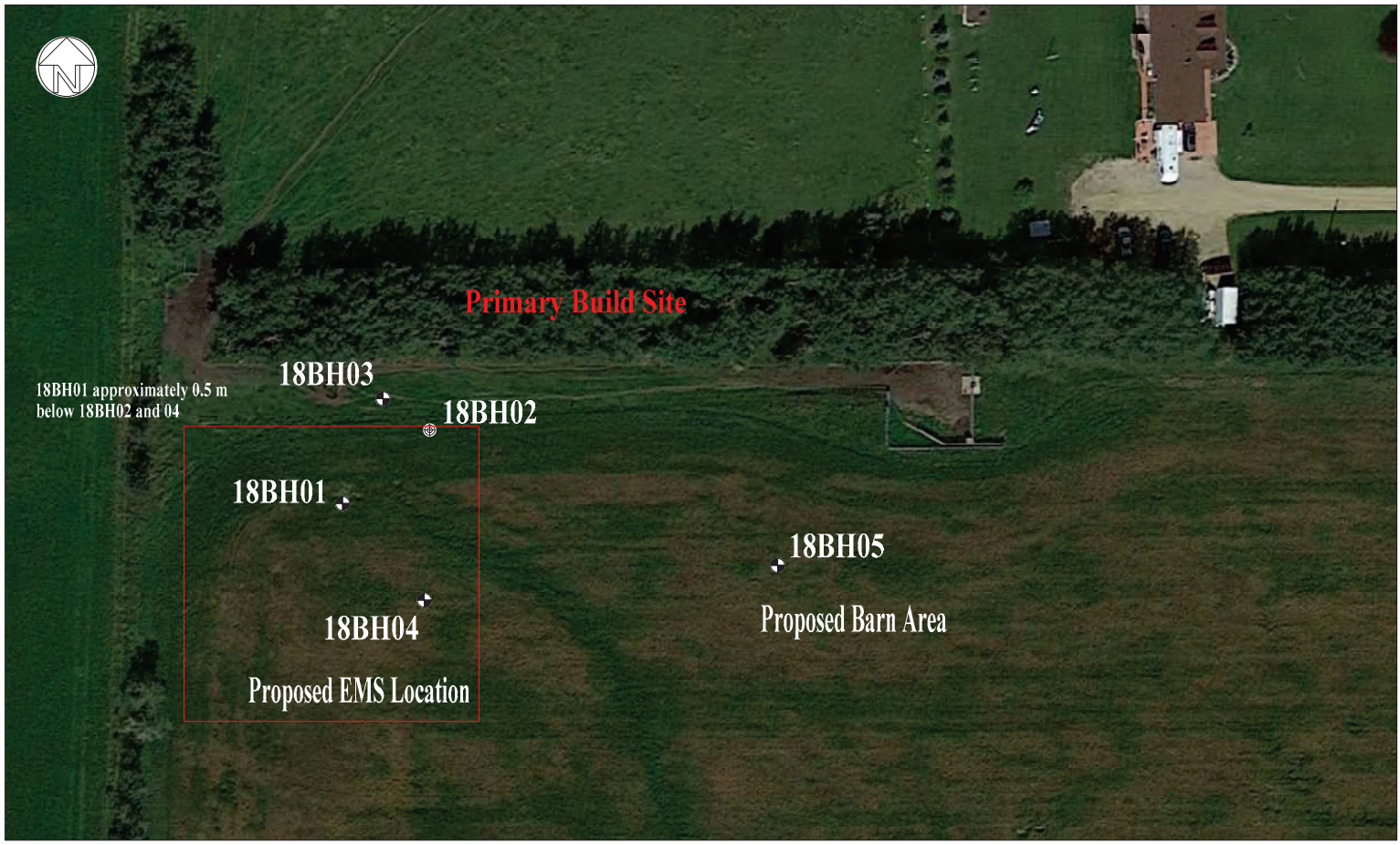
Appendix B

Borehole Locations and Borehole Logs

ENVIROWEST ENGINEERING INC.
Professional Environmental Engineering Services

Title:
Building Site Locations
Site and Soil Assessment
NE-01-041-02 W5M
Lacombe County, Alberta

Project No:	Date:	Figure:
1804-42317	June 8, 2018	B1
Scale:	**Prepared By:**	
1:3,000	E. Low	



ENVIROWEST ENGINEERING INC.
Professional Environmental Engineering Services

Title:
Primary Build Site
Site and Soil Assessment
NE-01-041-02 W5M
Lacombe County, Alberta

Project No:	Date:	Figure:
1804-42317	June 8, 2018	B2
Scale: 1:900	Prepared By: E. Low	

ENVIROWEST ENGINEERING INC.

LOG OF BORING 18BH01

Site and Soil Assessment
NE-01-041-02 W5M
Herman Verhoef

Lacombe County, Alberta
Project No. : 1804-42713

Driller: : Ever Green Drilling
Drilling Method: : Truck Mounted Auger
Drill Date : May 8, 2018
Logged By: : Emily Low, P.Eng

Well:
Elev.:

Depth in Meters	Gastech Reading (ppm) 0 20 40 60 80 100	OVA Reading	GRAPHIC	DESCRIPTION	Water Level
0.0				TOPSOIL	
0.3				SANDY CLAY, moist, soft, dark brown, low plasticity	
0.5					
0.8				SANDY CLAY, some silt, firm, light brown, medium plasticity, trace oxidation	
1.0					
1.3					
1.5					
1.8					
2.0					
2.3				stiff	
2.5					
2.8					
3.0					
3.3					
3.5					
3.8					
4.0					
4.3					
4.5					
4.8					
5.0					
5.3					
5.5				SAND, loose, yellow brown, damp	
5.8					
6.0					
6.3					
6.5					
6.8				CEMENTED SANDSTONE	
7.0					

06-08-2018 G:\42317 Verhoef\18BH01.bor

ENVIROWEST ENGINEERING INC.

LOG OF BORING 18BH02

Site and Soil Assessment
NE-01-041-02 W5M
Herman Verhoef

Lacombe County, Alberta
Project No. : 1804-42713

Driller: : Ever Green Drilling
Drilling Method: : Truck Mounted Auger
Drill Date : May 8, 2018
Logged By: : Emily Low, P.Eng

Depth in Meters	Gastech Reading (ppm) 0 20 40 60 80 100	OVA Reading	GRAPHIC	DESCRIPTION	Well: 18MW02 Elev.:	Water Level
0.0				TOPSOIL		
0.3				SANDY CLAY, some silt, firm, light brown, medium plasticity, trace oxidation		
0.5						
0.8						
1.0						
1.3					Bentonite	
1.5					Solid	
1.8						
2.0						
2.3				stiff		
2.5						
2.8						
3.0					Sand	
3.3					Screen	
3.5						
3.8					Bentonite	
4.0						
4.3						
4.5				SAND, loose, yellow brown, damp		
4.8						
5.0						
5.3						
5.5						
5.8						
6.0						

06-08-2018 G:\42317 Verhoef\18BH02.bor

ENVIROWEST ENGINEERING INC.

LOG OF BORING 18BH03

Site and Soil Assessment
NE-01-041-02 W5M
Herman Verhoef

Lacombe County, Alberta
Project No. : 1804-42713

Driller: : Ever Green Drilling
Drilling Method: : Truck Mounted Auger
Drill Date : May 8, 2018
Logged By: : Emily Low, P.Eng

Well:
Elev.:

Depth in Meters	Gastech Reading (ppm) 0 20 40 60 80 100	OVA Reading	GRAPHIC	DESCRIPTION	Water Level
0.0				TOPSOIL	
0.3				SANDY CLAY, some silt, firm, light brown, medium plasticity	
0.5					
0.8					
1.0					
1.3					
1.5					
1.8					
2.0					
2.3					
2.5					
2.8					
3.0				SAND, loose, yellow brown, damp	
3.3					
3.5					
3.8					
4.0					
4.3					
4.5					

06-08-2018 G:\42317 Verhoef\18BH03.bor

ENVIROWEST ENGINEERING INC.

LOG OF BORING 18BH04

Site and Soil Assessment
NE-01-041-02 W5M
Herman Verhoef

Lacombe County, Alberta
Project No. : 1804-42713

Driller: : Ever Green Drilling
Drilling Method: : Truck Mounted Auger
Drill Date : May 8, 2018
Logged By: : Emily Low, P.Eng

Well:
Elev.:

Depth in Meters	Gastech Reading (ppm) 0 20 40 60 80 100	OVA Reading	GRAPHIC	DESCRIPTION	Water Level
0.0				TOPSOIL	
0.3				SANDY CLAY, moist, soft, dark brown, low plasticity	
0.5					
0.8				SANDY CLAY, some silt, firm, light brown, medium plasticity, trace oxidation	
1.0					
1.3					
1.5					
1.8					
2.0					
2.3				stiff	
2.5					
2.8					
3.0					
3.3					
3.5					
3.8					
4.0					
4.3					
4.5				SAND, loose, yellow brown, damp	
4.8					
5.0					
5.3					
5.5					
5.8					
6.0					

06-08-2018 G:\42317 Verhoef\18BH04.bor

ENVIROWEST ENGINEERING INC.

LOG OF BORING 18BH05

Site and Soil Assessment
NE-01-041-02 W5M
Herman Verhoef

Lacombe County, Alberta
Project No. : 1804-42713

Driller: : Ever Green Drilling
Drilling Method: : Truck Mounted Auger
Drill Date : May 8, 2018
Logged By: : Emily Low, P.Eng

Well:
Elev.:

Depth in Meters	Gastech Reading (ppm) 0 20 40 60 80 100	OVA Reading	GRAPHIC	DESCRIPTION	Water Level
0.0				TOPSOIL	
0.3				SAND, some clay	
0.5					
0.8				SANDY CLAY, some silt, firm, light brown, medium plasticity	
1.0					
1.3					
1.5					
1.8					
2.0					
2.3					
2.5					
2.8					
3.0					
3.3					
3.5					
3.8					
4.0					
4.3					
4.5					

06-08-2018 G:\42317 Verhoef\18BH05.bor

ENVIROWEST ENGINEERING INC.

LOG OF BORING 18BH06

Site and Soil Assessment
NE-01-041-02 W5M
Herman Verhoef

Lacombe County, Alberta
Project No. : 1804-42713

Driller: : Ever Green Drilling
Drilling Method: : Truck Mounted Auger
Drill Date : May 8, 2018
Logged By: : Emily Low, P.Eng

Depth in Meters	Gastech Reading (ppm) 0 20 40 60 80 100	OVA Reading	GRAPHIC	DESCRIPTION	Well: Elev.:	Water Level
0.0				TOPSOIL		
0.3				SAND, some clay, compact, brown		
0.5						
0.8						
1.0						
1.3						
1.5						
1.8						
2.0						
2.3						
2.5				SANDY CLAY, some silt, stiff, brown, medium plasticity		
2.8						
3.0						
3.3						
3.5						
3.8						
4.0						
4.3						
4.5						
4.8						
5.0						
5.3						
5.5						
5.8						
6.0						

06-08-2018 G:\42317 Verhoef\18BH06.bor

ENVIROWEST ENGINEERING INC.

LOG OF BORING 18BH07

Site and Soil Assessment
NE-01-041-02 W5M
Herman Verhoef

Lacombe County, Alberta
Project No. : 1804-42713

Driller: : Ever Green Drilling
Drilling Method: : Truck Mounted Auger
Drill Date : May 8, 2018
Logged By: : Emily Low, P.Eng

Depth in Meters	Gastech Reading (ppm) 0 20 40 60 80 100	OVA Reading	GRAPHIC	DESCRIPTION	Well: Elev.:	Water Level
0.0				TOPSOIL		
0.3				SANDY CLAY, some silt, stiff, light brown, medium plasticity		
0.5						
0.8						
1.0						
1.3						
1.5						
1.8						
2.0						
2.3						
2.5						
2.8						
3.0						
3.3						
3.5						
3.8						
4.0						
4.3						
4.5						
4.8						
5.0						
5.3						
5.5						
5.8				WEATHERED BEDROCK		

06-08-2018 G:\42317 Verhoef\18BH07.bor

ENVIROWEST ENGINEERING INC.

LOG OF BORING 18BH08

Site and Soil Assessment
NE-01-041-02 W5M
Herman Verhoef

Lacombe County, Alberta
Project No. : 1804-42713

Driller: : Ever Green Drilling
Drilling Method: : Truck Mounted Auger
Drill Date : May 8, 2018
Logged By: : Emily Low, P.Eng

Depth in Meters	Gastech Reading (ppm) 0 20 40 60 80 100	OVA Reading	GRAPHIC	DESCRIPTION	Well: 18MW08 Elev.:	Water Level
0.0				TOPSOIL		
0.3				SANDY CLAY, some silt, stiff, light brown, medium plasticity		
0.5						
0.8						
1.0					Bentonite	
1.3					Solid	
1.5						
1.8						
2.0						
2.3						
2.5						
2.8						
3.0				low plasticity		
3.3						
3.5					Sand	
3.8					Screen	
4.0						
4.3						
4.5						
4.8						
5.0						
5.3						
5.5					Bentonite	
5.8						
6.0						

06-08-2018 G:\42317 Verhoef\18BH08.bor

Appendix C

Certificates of Analysis

AGAT Laboratories

6310 ROPER ROAD
EDMONTON, ALBERTA
CANADA T6B 3P9
TEL (780)395-2525
FAX (780)462-2490
http://www.agatlabs.com

CLIENT NAME: **ENVIROWEST**
BOX 4248, 5118-50th STREET
PONOKA, AB T4J1R6
(403) 783-8229

ATTENTION TO: **Shawna Low**

PROJECT: **Verhoef**

AGAT WORK ORDER: **18E345718**

SOIL ANALYSIS REVIEWED BY: **Olga Kulikova, Lab Technician**

DATE REPORTED: **Jun 06, 2018**

PAGES (INCLUDING COVER): **6**

VERSION*: **1**

Should you require any information regarding this analysis please contact your client services representative at (780) 395-2525

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories

6310 ROPER ROAD
EDMONTON, ALBERTA
CANADA T6B 3P9
TEL (780)395-2525
FAX (780)462-2490
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 18E345718

PROJECT: Verhoef

CLIENT NAME: ENVIROWEST

ATTENTION TO: Shawna Low

SAMPLING SITE:

SAMPLED BY:

Particle Size by Hydrometer

DATE RECEIVED: 2018-05-31

DATE REPORTED: 2018-06-05

				SAMPLE DESCRIPTION:	18BH02	18BH05	18BH08
				SAMPLE TYPE:	Soil	Soil	Soil
				DATE SAMPLED:	2018-05-08	2018-05-08	2018-05-08
Parameter	Unit	G / S	RDL		9290307	9290308	9290309
Particle Size Distribution (Sand)	%		2		48	34	44
Particle Size Distribution (Silt)	%		NA		18	30	20
Particle Size Distribution (Clay)	%		NA		34	36	36
Soil Texture					Sandy Clay Loam	Clay Loam	Clay Loam

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9290307-9290309 % Silt is a calculated parameter. The calculated value is determined by subtracting the percent sand and clay values from 100 percent.

Page 37 of 54

Certified By: [redacted]

AGAT Laboratories

6310 ROPER ROAD
EDMONTON, ALBERTA
CANADA T6B 3P9
TEL (780)395-2525
FAX (780)462-2490
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: ENVIROWEST

AGAT WORK ORDER: 18E345718

PROJECT: Verhoef

ATTENTION TO: Shawna Low

SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date:			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Particle Size by Hydrometer															
Particle Size Distribution (Sand)	155	9292430	22	22	0.0%	< 2	119%	80%	120%						
Particle Size Distribution (Silt)	155	9292430	30	30	0.0%		97%	80%	120%						
Particle Size Distribution (Clay)	155	9292430	48	48	0.0%		83%	80%	120%						

Certified By: [redacted]

AGAT Laboratories

6310 ROPER ROAD
EDMONTON, ALBERTA
CANADA T6B 3P9
TEL (780)395-2525
FAX (780)462-2490
http://www.agatlabs.com

Method Summary

CLIENT NAME: ENVIROWEST

AGAT WORK ORDER: 18E345718

PROJECT: Verhoef

ATTENTION TO: Shawna Low

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Particle Size Distribution (Sand)	INOR-171-6010	JONES 2001; SHEPPARD 2007	HYDROMETER
Particle Size Distribution (Silt)	INOR-171-6010	JONES 2001; SHEPPARD 2007	HYDROMETER
Particle Size Distribution (Clay)	SOIL 0520; SOIL 0110; SOIL 0120	JONES 2001; SHEPPARD 2007	HYDROMETER

AGAT Laboratories

2910 12 Street NE
Calgary, Alberta T2E 7P7
P: 403.735.2005 • F: 403.735.2771
webearth.agatlabs.com

Chain of Custody Record

Emergency Support Services Hotline 1-855-AGAT 245 (1-855-242-8245)

Laboratory Use Only
Arrival Temperature: -/-
AGAT Job Number: 18F345718
Date and Time: '18 MAY 31 11:42

Report Information
Company: Enviroest Engineering
Contact: Shauna Low
Address:
Phone: 403-783-8229 Fax:
LSD:
Client Project #: Verhoef

Report Information
1. Name: Emily Low
Email: elow@enviroestengineering.ca
2. Name: Shauna Low
Email: enviroest@telusplanet.net
3. Name:
Email:

Report Format
☐ Single Sample per Page
☒ Multiple Samples per Page

Turnaround Time Required (TAT)
Regular TAT ☒ 5 to 7 business days
Rush TAT ☐ Less than 24 hours ☐ 24 to 48 hours ☐ 48 to 72 hours
Date Required:

RUSH TAT REQUESTS
UPON SELECTING A RUSH TAT, THE CLIENT ACCEPTS THAT A RUSH SURCHARGE WILL BE ADDED TO THE INVOICE. SEE BACK FOR SURCHARGE.

Invoice To
Same Yes / No
Company:
Contact:
Address:
Phone: Fax:
PO/AFE#:

Requirements (Selection may impact detection limits)
☐ CCME: ☐ Agricultural ☐ Industrial ☐ Residential/Park ☐ Commercial ☐ Drinking Water ☐ FWAL
☐ AB Tier 1: ☐ Agricultural ☐ Industrial ☐ Residential/Park ☐ Commercial ☐ Natural Area ☐ AB Surface Water
☐ BC CSR: ☐ AW ☐ IW ☐ LW ☐ DW
☐ Other: ☐ D50 (Drilling) ☐ SPIGEC

LABORATORY USE (LAB ID #)	SAMPLE IDENTIFICATION	SAMPLE MATRIX	DATE/TIME SAMPLED	COMMENTS - SITE SAMPLE INFO. SAMPLE CONTAINMENT	# OF CONTAINERS	Detailed Soil Salinity (Saturated Paste)	CCME BTEX/F1-F4	Soil Metals ☐HWS-B ☐Cr⁶ ☐Hg	Water Metals ☐Dissolved ☐Total ☐Hg ☐Cr⁶	Routine Water Potability	AB Class 2 Landfill	BC Landfill	D50 Detailed Soil Salinity (As Received)	Microtox	BTEXS/VPH/EPH ☐ LEPH/HEPH ☐	XXX Texture (Hydrometer)						HOLD FOR 60 DAYS	PRESERVED (Y/N)	CONTAMINATED/HAZARDOUS (Y/N)
9290307	18BH02	Soil	May 8/18													X							
308	18BH05	↓	↓																				
309	18BH08																						

Samples Relinquished By (Print Name and Sign): Emily Low — Date/Time: May 31/18
[redacted]
Samples Relinquished By (Print Name and Sign): — Date/Time:
Samples Relinquished By (Print Name and Sign): — Date/Time:
Samples Received By (Print Name and Sign): — Date/Time: 31 MAY 18

Pink Copy - Client
Yellow Copy - AGAT
White Copy - AGAT

Page 1 of 1
N°: AB 075428

Document ID: DIC 50 1507 003
Date Revised: December 9th, 2014

AGAT Laboratories

SAMPLE INTEGRITY RECEIPT FORM

RECEIVING BASICS - Shipping

Company/Consultant: ENVIROWEST

Courier: D.O Prepaid Collect

Waybill# -/-

Branch: (EDM) GP FN FM RD VAN LYD FSJ EST Other:____

If multiple sites were submitted at once: Yes (No)

Custody Seal Intact: Yes No (NA)

TAT: <24hr 24-48hr 48-72hr (Reg) Other_____

Cooler Quantity: 0

TIME SENSITIVE ISSUES - Shipping

ALREADY EXCEEDED HOLD TIME? Yes (No)

Inorganic Tests (Please Circle): Mibi , BOD , Nitrate/Nitrite , Turbid ty , Microtox , Ortho PO4 , Tedlar Bag , Residual Chlorine , Chlorophyll* , Chloroamines* Trout, CER, FHM

Earliest Expiry: -/-

Hydrocarbons: Earliest Expiry -/-

SAMPLE INTEGRITY - Shipping

Hazardous Samples: YES (NO) Precaution Taken:_____

Legal Samples: Yes (No)

International Samples: Yes (No)

Tape Sealed: Yes (No)

Coolant Used: Icepack Bagged Ice Free Ice Free Water (None)

Temperature (Bottles/Jars only) N/A if only Soil Bags Received

FROZEN (Please Circle if samples received Frozen) Pail - _____°C

1 (Bottle/Jar)___+___+___=____°C 2(Bottle/Jar)___+___+___=____°C

3 (Bottle/Jar)___+___+___=____°C 4 (Bottle/Jar)___+___+___=____°C

5 (Bottle/Jar)___+___+___=____°C 6 (Bottle/Jar)___+___+___=____°C

7 (Bottle/Jar)___+___+___=____°C 8 (Bottle/Jar)___+___+___=____°C

9 (Bottle/Jar)___+___+___=____°C 10 (Bottle/Jar)___+___+___=____°C

(If more than 10 coolers are received use another sheet of paper and attach)

LOGISTICS USE ONLY

Workorder No: 18E345718

Samples Damaged: Yes (No) If YES why?

No Bubble Wrap Frozen Courier

Other: _____

Account Project Manager: _____ have they been notified of the above issues: Yes No

Whom spoken to: _____ Date/Time: _____

CPM Initial_____

General Comments: _____

* Subcontracted Analysis (See CPM)

Date issued: October 05, 2015

Data Set: \\SHAWNA\Client Data\Client Data\42317 Herman Verhoef\2018 NE-01\18MW02.aqt
Date: 06/08/18
Time: 10:04:46

PROJECT INFORMATION

Company: Envirowest Engineering
Client: Herman Verhoef
Project: 1804-42317
Test Date: May 29, 2018
Test Well: 18MW02

AQUIFER DATA

Saturated Thickness: 1. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: New Well

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.4 m
Static Water Column Height: 2.69 m
Casing Radius: 0.0255 m
Well Radius: 0.075 m
Well Skin Radius: 0.075 m
Screen Length: 1. m
Total Well Penetration Depth: 3.5 m

No. of Observations: 14

Observation Data

Time (min)	Displacement (m)	Time (min)	Displacement (m)
0.	0.4	7.	0.398
1.	0.4	8.	0.398
2.	0.399	9.	0.398
3.	0.399	10.	0.398
4.	0.399	15.	0.398
5.	0.399	20.	0.398
6.	0.399	25.	0.398

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 2.538

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	2.594E-7	cm/sec
y0	0.3993	m

T = K*b = 2.594E-5 cm²/sec

Data Set: \\SHAWNA\Client Data\Client Data\42317 Herman Verhoef\2018 NE-01\18MW08.aqt
Date: 06/08/18
Time: 10:10:45

PROJECT INFORMATION

Company: Envirowest Engineering
Client: Herman Verhoef
Project: 1804-42317
Test Date: May 29, 2018
Test Well: 18MW08

AQUIFER DATA

Saturated Thickness: 3. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: New Well

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.7 m
Static Water Column Height: 3.16 m
Casing Radius: 0.0255 m
Well Radius: 0.075 m
Well Skin Radius: 0.075 m
Screen Length: 3. m
Total Well Penetration Depth: 5. m

No. of Observations: 14

Observation Data

Time (min)	Displacement (m)	Time (min)	Displacement (m)
0.	0.7	7.	0.695
1.	0.695	8.	0.695
2.	0.695	9.	0.695
3.	0.695	10.	0.695
4.	0.695	15.	0.695
5.	0.695	20.	0.696
6.	0.695	25.	0.696

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 3.131

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	1.459E-8	cm/sec
y0	0.6956	m

T = K*b = 4.376E-6 cm²/sec

ENVIROWEST ENGINEERING INC.

P.O. Box 4248
Ponoka, AB.
T4J 1R6
Telephone: 403-783-8229
Facsimile: 403-783-5222

July 5, 2018

Sent via Email: verhoefdairy@cciwireless.ca

Attention: Herman Verhoef

Re: Barn Pad Soil Assessment
Site and Soil Assessment – June 8, 2018
NE-01-041-02 W5M

Dear Herman Verhoef,

As an amendment to the Site and Soil Assessment with prepared date June 8, 2018, the following is an assessment for the barn pad area for which a natural clay protective layer is proposed.

The amended Agricultural Operation Practices Act and associated regulations govern all new and modified confined feeding operations. The soil assessment for the barn pad was reviewed with respect to the following standards and guidelines:

- A manure storage facility and a manure collection area must have either a protective layer or a liner that meets the requirements of the regulations between the facility or area and the uppermost groundwater resource below the Site.
- The bottom of a liner of a manure storage facility and of a manure collection area must be not less than 1.0 meter (m) above the water table of the Site at the time of construction.
- The bottom of a liner or the base of the protective layer must be not less than 1.0 m above the top of the groundwater resource.
- The protective layer of a manure storage facility and of the manure collection area must provide equal or greater protection than that provided by naturally occurring materials 2 m in depth with an hydraulic conductivity of not more than 1 x 10^{-6} centimetres per second (cm/sec) for a solid manure storage facility.

The soil tested from the proposed area of construction was identified as a sandy clay loam or clay loam with a clay content of 34 to 48 percent.

Monitoring well 18MW02 was hydrated with water numerous times prior to completing the hydraulic conductivity. The hydraulic conductivity test was completed on May 29, 2018.

The initial depth to water was measured in each well. A volume of water was then removed from the well and the change in depth measured over time. The depth was measured every minute for ten minutes, then every five minutes to thirty minutes. The results of the test were analyzed as a slug test using AQTESOLV Bouwer-Rice method for unconfined wells.

The results of the assessment were an in-situ hydraulic conductivity of 2.6 x 10^{-7} cm/sec in monitoring well 18MW02. There was no saturated water table encountered at the time of drilling. Cemented sandstone was encountered at 6.8 mbgs.

Based on the information obtained it was determined that the native clay, found from approximately 0.7 to 4.5 meters below grade in borehole 18BH05, the proposed barn pad area, would have an hydraulic conductivity of at least 2.6 x 10^{-7} cm/sec. The protective layer is overlain by sand from below topsoil to the top of the protective layer. It has been determined that there is a natural barrier at the proposed barn pad location.

Minimum Required Liner Depth at Proposed Barn Pad:

$$\frac{2 \text{ m}}{1 \times 10^{-6} \text{ cm/sec}} = \frac{\mathbf{X} \text{ m}}{2.6 \times 10^{-7} \text{ cm/sec}}$$

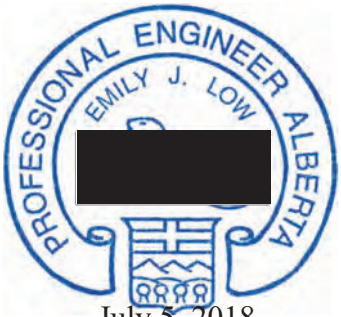
$$\mathbf{X} = 0.52 \text{ m}$$

The information and conclusions contained in this report are for their sole use and such parties as may be normally involved in the approval process for such a facility. No other party is expected to rely upon the information contained within the report without the express written authorization of Envirowest Engineering Inc..

The review has been conducted in accordance with generally accepted environmental engineering practices. No other warranty is expressed or implied.

We trust that this report meets your present needs. Please feel free to contact the undersigned with any questions or should you require additional information.

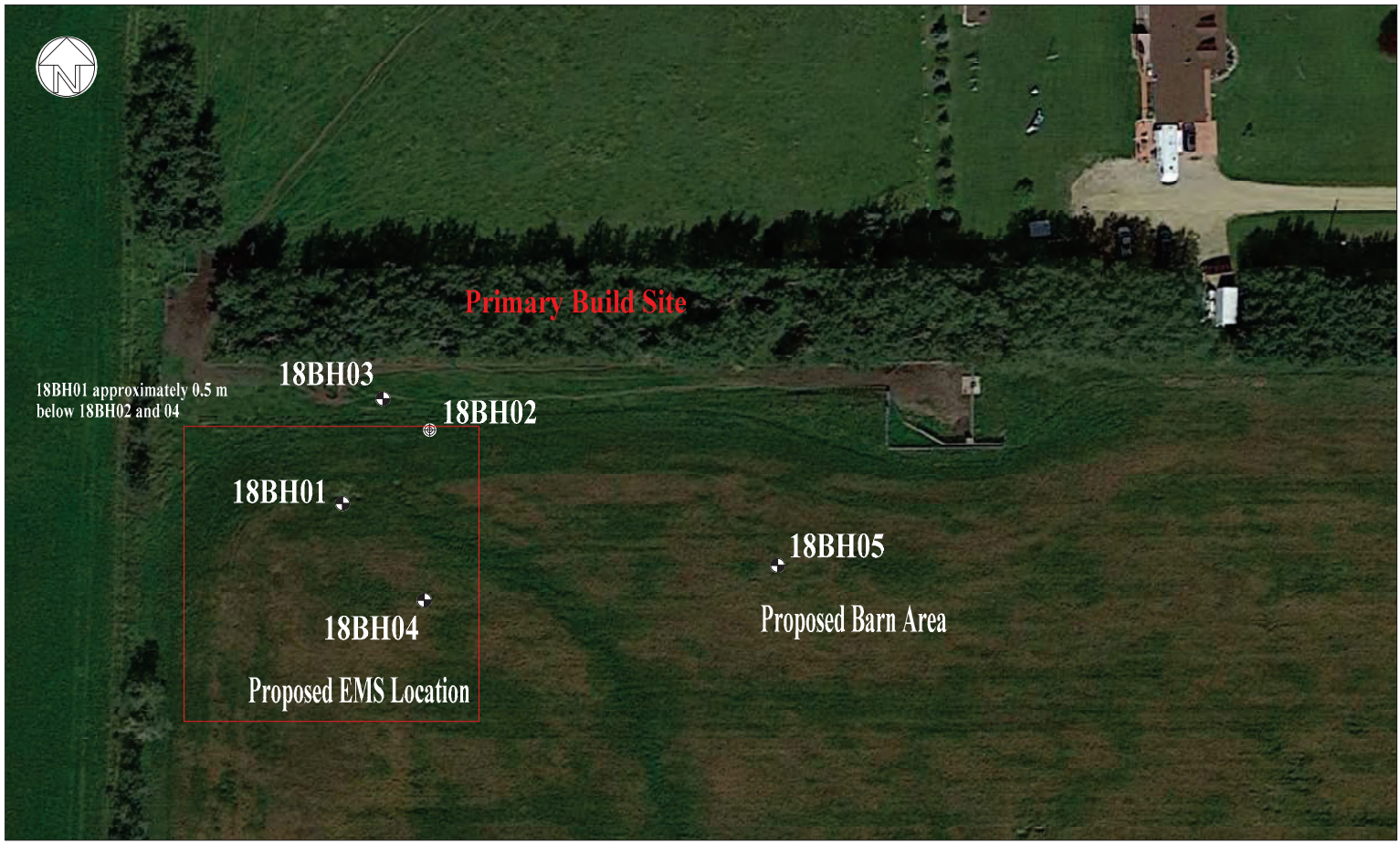
Respectfully submitted,



Emily J. Low, P.Eng
Envirowest Engineering Inc.
July 5, 2018

Envirowest Engineering Inc.
Association of Professional Engineers and Geoscientists of Alberta
Permit to Practice No. P6458 [redacted]

Attachments (3)



ENVIROWEST ENGINEERING INC.
Professional Environmental Engineering Services

Title:
Primary Build Site
Site and Soil Assessment
NE-01-041-02 W5M
Lacombe County, Alberta

Project No:	Date:	Figure:
1804-42317	June 8, 2018	B2
Scale: 1:900	Prepared By: E. Low	

ENVIROWEST ENGINEERING INC.

LOG OF BORING 18BH05

Site and Soil Assessment
NE-01-041-02 W5M
Herman Verhoef

Lacombe County, Alberta
Project No. : 1804-42713

Driller: : Ever Green Drilling
Drilling Method: : Truck Mounted Auger
Drill Date : May 8, 2018
Logged By: : Emily Low, P.Eng

Well:
Elev.:

Depth in Meters	Gastech Reading (ppm) 0 20 40 60 80 100	OVA Reading	GRAPHIC	DESCRIPTION	Water Level
0.0				TOPSOIL	
0.3				SAND, some clay	
0.5					
0.8				SANDY CLAY, some silt, firm, light brown, medium plasticity	
1.0					
1.3					
1.5					
1.8					
2.0					
2.3					
2.5					
2.8					
3.0					
3.3					
3.5					
3.8					
4.0					
4.3					
4.5					

06-08-2018 G:\42317 Verhoef\18BH05.bor

AGAT Laboratories

6310 ROPER ROAD
EDMONTON, ALBERTA
CANADA T6B 3P9
TEL (780)395-2525
FAX (780)462-2490
http://www.agatlabs.com

CLIENT NAME: ENVIROWEST
BOX 4248, 5118-50th STREET
PONOKA, AB T4J1R6
(403) 783-8229

ATTENTION TO: Shawna Low

PROJECT: Verhoef

AGAT WORK ORDER: 18E345718

SOIL ANALYSIS REVIEWED BY: Olga Kulikova, Lab Technician

DATE REPORTED: Jun 06, 2018

PAGES (INCLUDING COVER): 6

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (780) 395-2525

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

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Certificate of Analysis

AGAT WORK ORDER: 18E345718

PROJECT: Verhoef

CLIENT NAME: ENVIROWEST

ATTENTION TO: Shawna Low

SAMPLING SITE:

SAMPLED BY:

Particle Size by Hydrometer

DATE RECEIVED: 2018-05-31

DATE REPORTED: 2018-06-05

		SAMPLE DESCRIPTION:		18BH02	18BH05	18BH08
		SAMPLE TYPE:		Soil	Soil	Soil
		DATE SAMPLED:		2018-05-08	2018-05-08	2018-05-08
Parameter	Unit	G / S	RDL	9290307	9290308	9290309
Particle Size Distribution (Sand)	%		2	48	34	44
Particle Size Distribution (Silt)	%		NA	18	30	20
Particle Size Distribution (Clay)	%		NA	34	36	36
Soil Texture				Sandy Clay Loam	Clay Loam	Clay Loam

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9290307-9290309 % Silt is a calculated parameter. The calculated value is determined by subtracting the percent sand and clay values from 100 percent.

Certified By: [redacted]

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EDMONTON, ALBERTA
CANADA T6B 3P9
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FAX (780)462-2490
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: ENVIROWEST
AGAT WORK ORDER: 18E345718
PROJECT: Verhoef
ATTENTION TO: Shawna Low
SAMPLING SITE:
SAMPLED BY:

Soil Analysis

RPT Date:			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Particle Size by Hydrometer															
Particle Size Distribution (Sand)	155	9292430	22	22	0.0%	< 2	119%	80%	120%						
Particle Size Distribution (Silt)	155	9292430	30	30	0.0%		97%	80%	120%						
Particle Size Distribution (Clay)	155	9292430	48	48	0.0%		83%	80%	120%						

Certified By: [redacted]

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EDMONTON, ALBERTA
CANADA T6B 3P9
TEL (780)395-2525
FAX (780)462-2490
http://www.agatlabs.com

Method Summary

CLIENT NAME: ENVIROWEST

AGAT WORK ORDER: 18E345718

PROJECT: Verhoef

ATTENTION TO: Shawna Low

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Particle Size Distribution (Sand)	INOR-171-6010	JONES 2001; SHEPPARD 2007	HYDROMETER
Particle Size Distribution (Silt)	INOR-171-6010	JONES 2001; SHEPPARD 2007	HYDROMETER
Particle Size Distribution (Clay)	SOIL 0520; SOIL 0110; SOIL 0120	JONES 2001; SHEPPARD 2007	HYDROMETER

AGAT Laboratories

2910 12 Street NE
Calgary, Alberta T2E 7P7
P: 403.735.2005 • F: 403.735.2771
webearth.agatlabs.com

Chain of Custody Record

Emergency Support Services Hotline 1-855-AGAT 245 (1-855-242-8245)

Laboratory Use Only
Arrival Temperature: -/-
AGAT Job Number: 18F345718
Date and Time: '18 MAY 31 11:42

Report Information
Company: Enviroest Engineering
Contact: Shauna Low
Address:
Phone: 403-783-8229 Fax:
LSD:
Client Project #: Verhoef

Report Information
1. Name: Emily Low
Email: elow@enviroestengineering.ca
2. Name: Shauna Low
Email: enviroest@telusplanet.net
3. Name:
Email:

Report Format
☐ Single Sample per Page
☒ Multiple Samples per Page

Turnaround Time Required (TAT)
Regular TAT ☒ 5 to 7 business days
Rush TAT ☐ Less than 24 hours ☐ 24 to 48 hours ☐ 48 to 72 hours
Date Required:

RUSH TAT REQUESTS
UPON SELECTING A RUSH TAT, THE CLIENT ACCEPTS THAT A RUSH SURCHARGE WILL BE ADDED TO THE INVOICE. SEE BACK FOR SURCHARGE.

Invoice To
Same Yes / No
Company:
Contact:
Address:
Phone: Fax:
PO/AFE#:

Requirements (Selection may impact detection limits)
☐ CCME: ☐ Agricultural ☐ Industrial ☐ Residential/Park ☐ Commercial ☐ Drinking Water ☐ FWAL
☐ AB Tier 1: ☐ Agricultural ☐ Industrial ☐ Residential/Park ☐ Commercial ☐ Natural Area ☐ AB Surface Water
☐ BC CSR: ☐ AW ☐ IW ☐ LW ☐ DW
☐ Other: ☐ D50 (Drilling) ☐ SPIGEC

LABORATORY USE (LAB ID #)	SAMPLE IDENTIFICATION	SAMPLE MATRIX	DATE/TIME SAMPLED	COMMENTS - SITE SAMPLE INFO. SAMPLE CONTAINMENT	# OF CONTAINERS	Detailed Soil Salinity (Saturated Paste)	CCME BTEX/F1-F4	Soil Metals ☐HWS-B ☐Cr[6] ☐Hg	Water Metals ☐Dissolved ☐Total ☐Hg ☐Cr[6]	Routine Water Potability	AB Class 2 Landfill	BC Landfill	D50 Detailed Soil Salinity (As Received)	Microtox	BTEXS/VPH/EPH ☐ LEPH/HEPH ☐	XXX Texture (Hydrometer)	HOLD FOR 60 DAYS	PRESERVED (Y/N)	CONTAMINATED/HAZARDOUS (Y/N)
9290307	18BH02	Soil	May 8/18													X			
308	18BH05	↓	↓													X			
309	18BH08	↓	↓													X			

Samples Relinquished By (Print Name and Sign): Emily Low — Date/Time: May 31/18 — Samples Received By (Print Name and Sign): [redacted] — Date/Time: 31 MAY 18

Samples Relinquished By (Print Name and Sign): — Date/Time: — Samples Relinquished By (Print Name and Sign): — Date/Time: — Samples Received By (Print Name and Sign): — Date/Time:

Pink Copy - Client
Yellow Copy - AGAT
White Copy - AGAT

Page 1 of 1

N°: AB 075428

Document ID: DIC 50 1507 003

Date Revised: December 9th, 2014

AGAT Laboratories

SAMPLE INTEGRITY RECEIPT FORM

RECEIVING BASICS - Shipping

Company/Consultant: ENVIROWEST

Courier: D.O Prepaid Collect

Waybill# -/-

Branch: (EDM) GP FN FM RD VAN LYD FSJ EST Other:____

If multiple sites were submitted at once: Yes (No)

Custody Seal Intact: Yes No (NA)

TAT: <24hr 24-48hr 48-72hr (Reg) Other_____

Cooler Quantity: 0

TIME SENSITIVE ISSUES - Shipping

ALREADY EXCEEDED HOLD TIME? Yes (No)

Inorganic Tests (Please Circle): Mibi , BOD , Nitrate/Nitrite , Turbid ty , Microtox , Ortho PO4 , Tedlar Bag , Residual Chlorine , Chlorophyll* , Chloroamines* Trout, CER, FHM

Earliest Expiry: -/-

Hydrocarbons: Earliest Expiry -/-

SAMPLE INTEGRITY - Shipping

Hazardous Samples: YES (NO) Precaution Taken:_____

Legal Samples: Yes (No)

International Samples: Yes (No)

Tape Sealed: Yes (No)

Coolant Used: Icepack Bagged Ice Free Ice Free Water (None)

Temperature (Bottles/Jars only) N/A if only Soil Bags Received

FROZEN (Please Circle if samples received Frozen) Pail - _____°C

1 (Bottle/Jar)___+___+___=____°C 2(Bottle/Jar)___+___+___=____°C

3 (Bottle/Jar)___+___+___=____°C 4 (Bottle/Jar)___+___+___=____°C

5 (Bottle/Jar)___+___+___=____°C 6 (Bottle/Jar)___+___+___=____°C

7 (Bottle/Jar)___+___+___=____°C 8 (Bottle/Jar)___+___+___=____°C

9 (Bottle/Jar)___+___+___=____°C 10 (Bottle/Jar)___+___+___=____°C

(If more than 10 coolers are received use another sheet of paper and attach)

LOGISTICS USE ONLY

Workorder No: 18E345718

Samples Damaged: Yes (No) If YES why?

No Bubble Wrap Frozen Courier

Other: _____

Account Project Manager: _____ have they been notified of the above issues: Yes No

Whom spoken to: _____ Date/Time: _____

CPM Initial_____

General Comments: _____

* Subcontracted Analysis (See CPM)

Date issued: October 05, 2015

Data Set: \\SHAWNA\Client Data\Client Data\42317 Herman Verhoef\2018 NE-01\18MW02.aqt
Date: 06/08/18
Time: 10:04:46

PROJECT INFORMATION

Company: Envirowest Engineering
Client: Herman Verhoef
Project: 1804-42317
Test Date: May 29, 2018
Test Well: 18MW02

AQUIFER DATA

Saturated Thickness: 1. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: New Well

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.4 m
Static Water Column Height: 2.69 m
Casing Radius: 0.0255 m
Well Radius: 0.075 m
Well Skin Radius: 0.075 m
Screen Length: 1. m
Total Well Penetration Depth: 3.5 m

No. of Observations: 14

Observation Data

Time (min)	Displacement (m)	Time (min)	Displacement (m)
0.	0.4	7.	0.398
1.	0.4	8.	0.398
2.	0.399	9.	0.398
3.	0.399	10.	0.398
4.	0.399	15.	0.398
5.	0.399	20.	0.398
6.	0.399	25.	0.398

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 2.538

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	2.594E-7	cm/sec
y0	0.3993	m

T = K*b = 2.594E-5 cm²/sec