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	RA24047	N1/2 9-32-26 W4M and S1/2 16-32-26 W4M

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.

Jan 21 - 2025
Date of signing

[redacted]
Signature

Hutterian Brethren Church of Valleyview
Corporate name (if applicable)

George Stahl
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)
Dry Cow Hiefer Barn	91.7*13.5

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

Existing facilities	Dimensions (m) (length, width, and depth)	NRCB USE ONLY
Hog Barn #1	97.56X24.4	Confirmed existing facilities
Hog Barn # 2	117.38X25.9	
Dairy Barn	73.17X13.71	

NRCB USE ONLY

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)

Existing facilities continued	**Dimensions (m)** **(length, width, and depth)**	**NRCB USE ONLY**
Calf Barn	30.5x13.71	
Layer Barn	36.58x12.2	
Duck/Goose Barn	30.5x12.2	
Broiler Barn	24.5x9.2	
Existing Concrete Manure Storage	47.8Diameter x 3.1M Deep	

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)

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

Existing Dairy and Calf Barns will be dismantled and destroyed
Existing Layer Barn Will be dismantled and Destroyed

AO Note, this was already proposed and permitted in RA23004

Construction completion date for proposed facilities Dec 2026

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**
No proposed changes to permitted livestock numbers			

Last updated February 26, 2021

DECLARATION AND ACKNOWLEDGMENT OF APPLICANT CONCERNING *WATER ACT* LICENCE

issued by Alberta Environment and Parks (AEP) 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 AEP 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** AEP'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 AEP 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 AEP'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.

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 AEP under the *Water Act* for the development or activity proposed in this AOPA application.

Signed this 1 day of April, 20 23. [redacted]

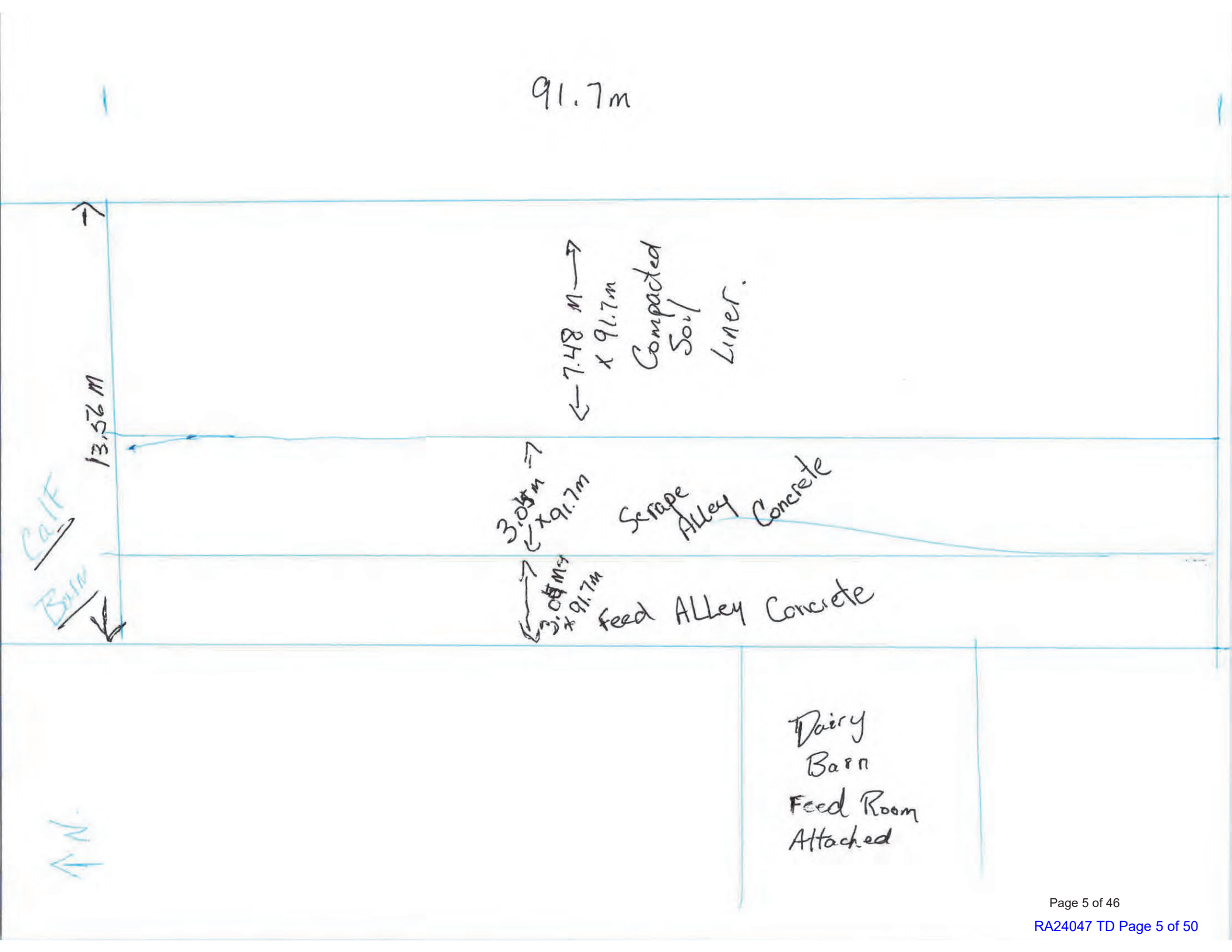
Signature of Applicant or Agent

OPTION 4: Uncertain if *Water Act* licence is needed; acknowledgement of risk (for existing CFOs only)

1. At this time, I (we) do not know whether a new water licence is needed from AEP under the *Water Act* for the development or activity proposed in this AOPA application.
2. If a new *Water Act* licence is needed, I (we) request that the NRCB process the AOPA application **independently of** AEP'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 AEP 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 additional livestock pursuant to an AOPA permit in the absence of a *Water Act* licence will **not** be relevant to AEP's consideration of whether to grant my *Water Act* licence application, if a new water licence is needed.
5. I (we) acknowledge that any such construction or livestock increase 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.

Signed this ____ day of _____, 20____. _____

Signature of Applicant or Agent


91.7m
13.56 m
7.48 m
x 91.7m
Compacted Soil Liner.
3.05m
x 91.7m
Scrape Alley Concrete
3.05m
x 91.7m
Feed Alley Concrete
Calf Barn
Dairy Barn
Feed Room Attached
N

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 and Hog Barn **Proposed 1:** Dry Cow Hiefer

Proposed 2: _____ **Proposed 3:** _____

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	Not in flood plain
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	No springs observed at site
	How many water wells are within 100 m of the manure storage facility or manure collection area?	1	1	0	0	☒ YES ☐ NO ☐ YES with exemption	No water wells within 100 m of proposed dry cow/heifer barn
	What is the shortest distance from the manure collection or storage facility to a surface water body? (e.g., lake, creek, slough, seasonal)	1000m	1000m			☒ YES ☐ NO ☐ YES with exemption	Closest water bodsy is dugout approx 500 m SE
Groundwater information	What is the depth to the water table?		1.9m			☒ YES ☐ NO ☐ YES with exemption	Confirmed
	What is the depth to the groundwater resource/aquifer you draw water from?		60m			☒ YES ☐ NO ☐ YES with exemption	UGR identified WW 169776 at 41.76 m

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

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
The MD of Kneehill	NE 16-32-26-W4	8000	no residence				
Ian Anhorne	NW 15-32-26-W4	1000m	Agriculture	1	1595 m		Yes
Bryan Peter Kasha	SW 15-32-26-W4	700m	no residence				

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

Name of land owner(s)*	Legal land description	Usable area** (ha)	Soil zone ***	NRCB USE ONLY	
				Usable area (ha)	Agreement attached (if required)
Hutterian Brethren of ValleyView	S1/2 of 17-32-26-W4	129.5	Brown		
Hutterian Brethren of ValleyView	08-32-26-W4	259	Brown		
Hutterian Brethren of ValleyView	W1/2 of 09-32-26-W4	120	Brown		
Hutterian Brethren of ValleyView	N1/2 of 5-32-26-W4	129.5	Brown		
Hutterian Brethren of ValleyView	E1/2 of 7-32-26-W4	122	Brown		
			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)

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
Dry cow/heifer barn	Low	Low	RA24047

ERST for **existing** facilities

Facility	Groundwater score	Surface water score	File number
Dairy barn	low	low	RA23004
Calf barn	low	low	RA23004
EMS	low	low	RA23004
Layer barn	low	low	RA23004
Feedlot	low	low	RA10031A
Catch basin	low	low	RA10031A

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 USE ONLY

WATER WELL AND SURFACE WATER INFORMATION

Well IDs: 169776 254520 1471141

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

MINIMUM DISTANCE SEPARATION

Methods used to determine distance (if applicable): Aerial photography

Margin of error (if applicable): +/- 2 m

Requirements (m): Category 1: 882 m Category 2: 1176 m Category 3: 1469 m Category 4: 2351 m

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

N/A for authorizations

Land base required: _____

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 RA10031A

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

November 15, 2024	

CORRESPONDENCE WITH MUNICIPALITIES AND REFERRAL AGENCIES

Date deeming letters sent: February 7, 2025

Municipality: Kneehill 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: Ember Resources, Crossroads Gas ☐ 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

SOLID MANURE, COMPOST, & COMPOSTING MATERIALS: Barns, feedlots, & storage facilities - Concrete liner

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

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

1. Dry Cow Hiefer Barn

2. _____

Manure storage capacity

	Length (m)	Width (m)	Depth below grade to the bottom of the liner (m)	**NRCB USE ONLY** Estimated storage capacity (m^3)
1.	91.7	3.04	0	Adequate storage
2.				
			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

Roofed Barn

Liner protection

Describe how the physical integrity of the liner will be maintained

Concrete Liner-Regular Crack Maintenance

NRCB USE ONLY

Requirements met: ☒ YES ☐ NO

SOLID MANURE, COMPOST, & COMPOSTING MATERIALS: Barns, feedlots, & storage facilities - Concrete liner (cont.)

Concrete liner details

Concrete thickness 6"	Method of sulphate protection: HS Sulfate resistance
Concrete strength 32mpa	Concrete reinforcement size and spacing 10mm rebar 18" O/C B/W

Concrete requirements can be found in Technical Guideline Agdex 096-93
Guideline minimums:
Solid manure: 25MPa (D)
Solid manure (wet): 30MPa (C)
Method of sulphate protection:
Type 50 or Type 10 with fly ash or equivalent

NRCB USE ONLY

Requirements met: ☒ YES ☐ NO
Condition required: ☐ YES ☒ NO
Report attached: ☐ YES ☒ NO

Additional information *(attach as required)*

NRCB USE ONLY

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

Depth to water table: 1.9 m Requirements met: ☒ YES ☐ NO

Depth to Uppermost groundwater resource: 41.76 m Requirements met: ☒ YES ☐ NO

ERST completed: ☒ see ERST page for details

Surface water control systems

Requirements met: ☒ YES ☐ NO Details/comments:

Concrete liner details

AO Note: The applicant is proposing concrete as an additional liner on top of a compacted clay liner. Since the compacted clay liner meets the liner requiredments, additional details about the concrete are not required

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

SOLID MANURE, COMPOST, & COMPOSTING MATERIALS: Barns, feedlots, & storage facilities - Compacted soil liner

*(complete a copy of this section for **EACH** barn, feedlot, and storage facility for solid manure, composting materials, or compost with a compacted soil liner)*

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

1. Dry Cow Hiefer Barn
2. _____

Manure storage capacity

	Length (m)	Width (m)	Depth below grade to the bottom of the liner (m)	**NRCB USE ONLY** Estimated storage capacity (m^3)
1.	91.7	6.85	0	Adequate storage
2.				
			TOTAL CAPACITY	

AO Note: The applicant has completed a compacted liner underneath the entire barn (91.7 m x 13.5 m). However they have placed an additional concrete liner on part of the barn (3.04 m x 91.7 m)

☐ 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

Roofed Barn/ Shed

Liner protection

Describe how the physical integrity of the liner will be maintained

Compacted liner / refilled and regularly maintained

NRCB USE ONLY

Requirements met: ☒ YES ☐ NO

SOLID MANURE, COMPOST, & COMPOSTING MATERIALS: Barns, feedlots, & storage facilities - Compacted soil liner (cont.)

Compacted soil liner details

Thickness of compacted liner	4m (m)	Provide compacted liner details (as required) Please see Attached Document pages 11-14	
Soil texture	Clayey silt till-clay till % sand	% silt	% clay
Atterberg limits	Plastic limit 13.3-18.2	Liquid limit 22.2-28.8	Plasticity index 4.0-15.5
Hydraulic conductivity	Hydraulic conductivity (cm/s) 1.80-5.53 x10^-8 cm/sec		
	Describe test standard used See soils report		

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

NRCB USE ONLY

Requirements met: ☒ YES ☐ NO
Condition required: ☐ YES ☒ NO
Report attached: ☒ YES ☐ NO

NRCB USE ONLY

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

Depth to water table: 1.9 m — Requirements met: ☒ YES ☐ NO

Depth to uppermost groundwater resource: 41.76 m — Requirements met: ☒ YES ☐ NO

ERST completed: ☒ see ERST page for details

Surface water control systems

Requirements met: ☒ YES ☐ NO Details/comments:

Compacted soil liner details

Hydraulic conductivity after adjustment: See soils report

Liner specification comments (e.g. compaction, moisture content, thickness):

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

Proposed Sewage Lagoon
Valleyview Colony
Near Township Road 322 and Range Road 364
Kneehill County, Alberta

FILE #: Valleyview Colony

April 20, 2023

Table of Contents

April 20, 2023

Valleyview Colony
Kneehill County, Alberta

File #: Valleyview Colony

Attn: George Stahl

Re: Geotechnical Investigation - Valleyview Colony
Proposed Robotic Dairy Barn
Near Township Road 322 and Range Road 364
Kneehill County, Alberta

At your request, we opened 5 boreholes at the proposed lagoon area within Valleyview Colony on March 21 and 22, 2023. The extent out of commission is listed below:

1) Drill five test holes to within the proposed lagoon area.

2) Delineate general soil profile at each test hole location.

3) Install four piezometers and to measure the water tables on March 22 and April 4, 2023.

4) Conduct laboratory soil permeability (hydraulic conductivity) tests and atterberg limit tests and sieve analysis tests to assess the quality of the in-situ clay used as liner and berm material.

5) Comment on use of in-situ soils as clay base liner/berm construction.

6) Provide recommendations for construction of compacted clay liner for the new lagoon.

The purpose of this investigation was to determine the general extent and nature of the subsurface materials encountered along with some basic engineering properties of the subsurface soil. Environmental studies are beyond the scope of this report.

Field Investigation

Five test holes were opened at specified locations. Four holes were opened outside the proposed lagoon area and one hole was drilled within the proposed lagoon area near the center. The approximate locations of the test holes are shown on drawing #1. The test hole opened within the suggested lagoon area was filled with concrete by members of the Valleyview Colony, upon completion of drilling.

The holes were advanced incrementally by augering approximately 1.6 meters into the ground and withdrawing soil on the auger vanes. All samples retained were carefully sealed to prevent moisture loss and subsequently taken to our Soil Mechanics Laboratory for further analysis.

Subsurface Features

A) Subsoil Conditions

The soil profiles, as logged at the borehole locations, are shown on drawing No.'s 2 through 6 inclusive, Appendix A. Results of field and laboratory tests are shown on the borehole logs.

The soil profile in the test hole areas consisted of a layer of topsoil, glacial sand till, sandy silt, silty clay till, and clayey silt till. Description of the following soil types encountered should be read in conjunction with review of the borehole logs.

Topsoil

Topsoil ranging from 80 to 100 millimeters in thickness was encountered in all boreholes at the proposed lagoon area. The topsoil encountered was black, silty, and organic in nature. All topsoil / organic material must be completely removed from the construction area.

Sandy Silt Till

Beneath the topsoil was mostly a native sandy silt till deposit with the exception of hole #5 and #9. In boreholes #5 and #9 areas, a native sand till deposit was noted directly below the organic topsoil. The relatively porous sandy silt thickness ranged from 1.0 to 3.3 meters thick at the test hole locations. Some localized damp sandy interlayers were detected near the bottom of the sandy silt soil at about 3.0 meters in depth at borehole #5 area. Thicker layers of sandy silt could be encountered at varied elevations across the site during site stripping. In borehole #8 location, a sandy silt interlayer was found beneath the clay layer at a depth of approximately 6.3 meters below the existing site grade.

The native glacial sandy silt near the proposed lagoon area was mainly low to non-plastic. Traces of coal specks, sand seams and clay were noted within this natural deposit. The permeable sandy silty till is deemed unacceptable as liner material. It should be removed to depths of at least one meter from the bottom of the new compacted clay liner.

Sand Till

A native sand till deposit with variable thickness was encountered at different elevations across the borehole locations. It appeared that the sand till deposit was porous and unacceptable as liner material. It was found roughly within the top 3.0 to 4.0 meters and above the underlying clay till deposit. Near the bottom of the sand till deposit, some localized damp to wet sand interlayers were found. It is advisable the sand, sandy silt and / or gravel or deleterious material should be removed to depths of at least one meter from the bottom of any new compacted clay liner to prevent erosion of the new pond / lagoon liner.

Silty Clay Till

The glacial silty clay till extended to the bottom of each drilled hole. With the exception of borehole #8, where a layer of porous sandy silt till was found directly beneath the native clay deposit of about 3.4-meter thickness. The lateral extent of this permeable sandy silt till deposit is not known. It is advisable the bottom of the newly compacted clay liner should be constructed to maintain the new lagoon liner at least one meter above the groundwater level.

The onsite native clay till deposit is not suitable as a natural clay liner as it did not meet the minimum hydraulic conductivity requirements ($1x10^{-7}$ cm/s). As well, as the minimum thickness of the natural clay should be at least 10 meters thick to be able to utilize a natural clay liner. The natural clay deposit at borehole #8 location was only about 3.4 meters thick and under bedded by a layer of relatively porous native sandy silt till layer. Also, the top of the native clay found at the drilled hole areas is either above or below the recorded groundwater level. A new lagoon clay liner of at least 1 meter thick has to be constructed starting from at least one meter or more above the highest recorded groundwater level.

During construction of the compacted clay liner, any sandy soil, porous material or unacceptable soil encountered must be over-excavated at least one meter beneath the new clay liner bottom. The over-excavated base must be inspected and approved by our personnel to ensure in terms of depth & width of the over-excavation is acceptable. The over-excavated area must be replaced with approved clay fill and compacted to at least 95% S.P.M.D.D. with moisture added & uniformly mixed to maintain soil moisture at about 2 to 3% over the optimum moisture. It must be noted that temporary dewatering will likely be required in over-excavated areas.

The glacial silty clay till at the borehole locations was mainly firm to stiff in consistency. It was traced with bedrock fragments, coal specks, rusting pebbles. Signs of underground water were detected at various depths within the clay or clayey silt deposits. Additionally, the clay encountered has some low to medium inherent swelling capacity.

Imported clay material with low permeability value and not exceeding k(lab) of 10^{-8} cm/sec can be considered as lagoon clay liner. The borrowed clay material has to be checked for hydraulic conductivity, moisture content and Atterberg limits by our personnel for approval. The onsite clay found at the borehole areas is not suitable as a lagoon clay liner but may be considered as clay liner material for the runoff catch basins and solid manure storage facility or collection area.

B) Groundwater

Underground water and some soil sloughing were detected at the time of site testing on March 21 and 22, 2023. Signs of underground seepage were detected at depths of about 3.0m, 4.0m, 4.1m, 4.7m & 4.0m below the existing site grade at borehole #5, #6, #7, #8, and #9 locations, respectively.

Slotted PVC standpipes were installed in borehole #5, #6, #7 and #8 locations for monitoring the groundwater levels. The approximate borehole elevations and groundwater levels were summarized as follows. The test hole elevations and locations were obtained using a hand-held GPS device. Exact locations and elevations of the boreholes will have to be established by a legal surveyor, if required.

Hole	Longitude	Latitude	Approx. Hole Elevations (meters)	Measured Groundwater Level (m)			
				March 22, 2023		April 4, 2023	
				Elev.	mbg.	Elev.	mbg.
5	51.733427	-113.636281	898.2	894.1	4.1m	894.1	4.1m
6	51.732525	-113.636228	898.4	894.2	4.2m	894.3	4.1m
7	51.733019	-113.635624	898.0	893.8	4.2m	893.8	4.2m
8	51.732940	-113.636802	898.6	894.7	3.9m	894.6	4.0m
9	51.732937	-113.636189	898.3	No Pipe		No Pipe	

mbg = Meters Below Grade

It should be noted that the water conditions were observed in a relatively short term and may not represent stabilized groundwater readings. Hence the actual groundwater condition at the time of construction could vary from those recorded during this investigation.

Summary

A) Legislative Requirements

2008 Reference Guide of the Agricultural Operation Practices Act (AOPA) specifies:

1) Setbacks From Common Bodies of Water

Manure storage facilities or manure collection areas must be constructed at least 30 meters away from a common body of water.

This does not apply if the owner or operator demonstrates to the Natural Resources Conservation Board (NRCB), prior to construction, that either:

- The natural drainage from the facility or area is away from the common body of water, or
- A berm or other secondary protection for the common body of water constructed by the owner or operator protects the common body or water from contamination (Standards and Administration Regulation, Section 7).

2) Natural Protective Layers

There are one or more layers of naturally occurring materials that individually or in aggregate restrict the migration of the contents of the manure storage facility or the manure collection area. The base of the natural protective layer must be 1 meter or more above the top of the groundwater resource.

A natural protective layer for a manure storage facility and a manure collection area must provide equal or greater protection than that provided naturally occurring materials:

- Liquid Manure Storage – The naturally protective layer must be at least 10 meters in depth with a hydraulic conductivity of not more than $1x10^{-6}$ cm/s.
- Runoff Catch Basins – The protective layer must be at least 5 meters in depth with a hydraulic conductivity of not more than $1x10^{-6}$ cm/s.
- Solid Manure Storage Facility or Collection Area – The protective layer must be at least 2 meters in depth with a hydraulic conductivity of not more than $1x10^{-6}$ cm/s.

3) Liners

These are layers constructed out of natural or manufactured material that restricts the migration of the contents of the manure storage facility or manure collection area. Where a liner is used, the bottom of the liner must be 1 meter or more above the water table at the site at the time of construction.

A liner can be constructed out of approved compacted clayey soil, concrete, steel, or other synthetic or manufactured materials but must provide equal or greater protection than that provided by compacted soil.

- Liquid Manure Storage – The compacted liner must be at least 1 meter in depth with a hydraulic conductivity of not more than $1x10^{-7}$ cm/s.
- Runoff Catch Basins – The compacted liner must be at least 1 meter in depth with a hydraulic conductivity of not more than $5x10^{-7}$cm/s.
- Solid Manure Storage Facility or Collection Area – The liner must be at least 0.5 meters in depth with a hydraulic conductivity of not more than $5x10^{-7}$cm/s.

4) Runoff Control Catch Basin

Runoff control catch basins must have these features:

- A storage capacity to accommodate a 1:30 year one-day rainfall.
- A visible marker that clearly indicates the minimum volume possible to accommodate the 1:30 year one-day rainfall occurrence.
- A freeboard of not less than 0.5 meters when the basin is filled to capacity.

5) Short Term Solid Manure Storage

Short-term solid manure storage sites can only be used for an accumulated amount of seven months within a three-year period regardless of the amount of manure stored. In summary, manure can be stored in the field for up to seven consecutive months at one location, and then the site cannot be used for the next two years and five months. Feedlot pens are not considered short-term manure storage sites and must meet the requirements for a manure storage facility.

Short-term solid manure storage sites must be located at least:

- 150 meters from residential or occupied buildings that the producer does not own.
- 100 meters from a spring or water well.
- 1.0 meters above the water table.
- 1.0 meter above the 1 in 25-year maximum flood plain level or 1.0 meter above the highest known flood level if the 1 in 25-year flood plain level is not known.

B) Laboratory Testing

1) Grain Size and Plasticity

Grain size & plasticity tests were conducted on selected soil samples obtained from several test hole locations.

Grain Size

Hole	Elevation (m)	Grain Size Distribution (%)	
		Sand	Silt and Clay
7	2.1	36.5	63.5
8	1.5	70.3	29.7

Plasticity Test

Hole	Elevation (m)	Plasticity (%)			Soil Classification
		Plastic Limit	Liquid Limit	Plasticity Index	
5	4.6	18.2	22.2	4.0	Inorganic Silt
6	4.6	13.3	28.8	15.5	Inorganic Clay (Low Plasticity)

The sieve analysis tests (grain size) indicated the on-site sand and sandy silt soil below the lagoon bottom are porous and unsuitable material for supporting the base of the compacted clay liner and must be removed. The Atterberg limit test results indicated the clay at the borehole locations can be considered as a clay liner material only for runoff catch basins, solid manure storage facility or collection area.

2) Hydraulic Conductivity Tests

Laboratory Hydraulic conductivity tests (K(lab) were conducted on selected clayey soil samples obtained from areas nearby holes #5, #8 and #9 location. The hydraulic conductivity tests were conducted on soil samples within 3 to 5 meters below the existing grade and where the new lagoon base could be. The tests were carried out near natural soil moisture and at adjusted soil moisture for the native clayey soil. The results are summarized as follows:

Hole	Depth (m)	Soil Type	Moisture Content	Coefficient of Hydraulic Conductivity K (lab) (cm/sec)
5	3.1 to 4.7	Clayey Silt Till	14.6%	1.80×10^{-8}
8	3.4 to 4.7	Clay Till	Adjusted 13.3%	4.00×10^{-8}
9	4.1 to 5.3	Clay Till	Adjusted 15.4%	5.53×10^{-8}

K (in-situ) must be one order of magnitude larger than the average K (lab) values obtained. Example: K(in-site) = 10 x K(lab)

In accordance with the requirement of the hydraulic conductivity K (in-situ) values must not be more than 1.0×10^{-7}cm/sec. or K (lab) must not be more than 1.0×10^{-8}cm/sec.

K (lab) conducted on clay samples were in the range of 1.80×10^{-8} cm/sec to 5.53×10^{-8} cm/sec did not meet the requirement of of 1.0×10^{-8} cm/sec or less. We deem approved imported clayey soil is needed for the lagoon clay liner. The imported clay should be tested to ensure it is no more than 1.0×10^{-8} cm/sec for laboratory hydraulic conductivity K(lab) value with adjusted moisture content. The approved, imported clay with suitable moisture must be compacted in 200mm lifts to a minimum of 98% Standard Proctor Maximum Dry Density (S.P.M.D.D.)

C) Runoff Catch Basin, Solid Manure Storage and Collection Area Liner

1) A liner constructed out of natural or manufactured material that restricts the migration of the contents of the manure storage facility or manure collection area. Where a liner is used, the bottom of the liner must be 1 meter or more above the water table at the site at the time of construction.

   A liner can be constructed out of approved compacted clayey soil, concrete, steel, or other synthetic or manufactured materials but must provide equal or greater protection than that provided by compacted soil.

   - Liquid Manure Storage – The compacted liner must be at least 1 meter in depth with a hydraulic conductivity of not more than $1x10^{-7}$ cm/s.

   - Runoff Catch Basins – The compacted liner must be at least 1 meter in depth with a hydraulic conductivity of not more than $5x10^{-7}$cm/s.

   - Solid Manure Storage Facility or Collection Area – The liner must be at least 0.5 meters in depth with a hydraulic conductivity of not more than $5x10^{-7}$cm/s.

2) In the dairy barn area, the recorded groundwater levels are relatively high. They were measured at about 1.6 meters to 2.7 meters at the two borehole locations in the new barn area. The subsurface storage pit floor or slab will be very close to 1 meter (3.3 feet) of the groundwater table. A properly engineered subsurface storage structure using steel or concrete must be used due to the high recorded groundwater table in the barn area.

3) Owners and operators are responsible for the following critical factors for concrete liner construction and maintenance. The points listed below are critical factors for concrete performance:

   - Design and construct each facility using high quality material (including low permeability concrete and proper aggregate) with appropriate reinforcement and placement.

   - Ensure water tightness and proper finishing. Water stops and control joints help prevent leakage.

   - Properly place and cure the concrete and protect it from extremes of cold and hot weather during concrete curing.

   - Ensure the concrete meets the requirements for its intended use (ex: loader traffic).

   - Monitor cracking and repair cracks as soon as they occur.

4) In the design of the concrete liner and concrete slab, the concrete slab foundation supported by the native clay or sand may be designed based on a factored ULS end bearing capacity of 60 kPa. The factored ULS end bearing capacity is calculated by reducing the ultimate end bearing pressure by a geotechnical resistance factor of 0.5.

5) In areas where the bottom of the liner can maintain at least one meter above the water table, a compacted clay liner can be considered in the runoff catch basin, solid manure storage and collection areas.

6) The compacted clay liner or synthetic membrane if used has to achieve the target seepage rates of K (in-situ) 10^{-7}cm/sec or less. As well, the bottom elevation of either liner has to maintain a vertical distance of at least one meter above the water table at the time of construction. Construction of either compacted clay liner or synthetic membrane has to be in compliance of NRCB requirements.

D) Construction of Compacted Clay Liners for New Lagoon

1) All the latest guidelines as specified in the 2008 Agricultural Operation Practices Act should also be adhered to in the design and construction of the compacted liner.

2) The runoff catch basin elevation has to be adjusted to allow the proposed clay liner bottom to maintain at least one meter above the water table at all times.

3) Over-excavation will be required to allow construction of a 1.0-meter minimum thickness of re-compacted clay liner with approved imported clay. The new compacted clay liner for the lagoon has to be one meter thick at the bottom and 1.2 meters thick on all sides. During the lagoon clay liner construction, proper site grading must be provided for the catch basin and lagoon. Measurement of clay liners are made perpendicular to the underlying surface.

4) Prior to construction of the lagoon clay liner, proper preparation of subgrade soil is required. The subgrade surface below the compacted clay liner should be relatively level (to control liner thickness) and compacted to 95% SPMDD. Soft pockets and presence of sand, silt, gravel layers or other deleterious material must be sub-excavated and replaced with suitable, compacted clay fill.

   As groundwater and soft subgrade soil are anticipated, sensitive and moist subgrade soil can be easily disturbed by excavation equipment and walking traffic. It is beneficial to start the clay liner construction roughly 0.3 meters or more above the groundwater level, referenced to borehole #8 area.

   If sand, silt, gravel, or other unsuitable materials are encountered near the new liner for the lagoon runoff catch basin, storage facility and collection areas, it should be over-excavated. Over-excavation of a minimum of one meter on all sides and replaced with approved clay compacted to 95% SPMDD to prevent piping and erosion of the liner should be completed.

5) The approved imported clay as liner material with not more than k(slab) of 1.0×10^{-8} cm/sec. should be placed in uniform, horizontal lifts of about 200 millimeters maximum loose thickness. Each soil lift must be brought to the specified 2 to 3% over the optimum moisture content before compaction is conducted. Packing should be done with a sheepsfoot packer and continued until the packer points no longer penetrate the soil surface and a minimum compaction 98% S.P.M.D.D. has been achieved.

6) Due to the length of time it takes to undertake lab hydraulic conductivity testing, the field acceptance of clay liners and capping materials is generally given in terms of density, moisture content and soil classification criteria and lab testing of re-molded borrow samples for hydraulic conductivity prior to construction. Using re-molded samples of liner materials for acceptance, it is generally accepted that lab tests on field samples need to provide a hydraulic conductivity value 10 times lower than the Code criteria to account for some variation in the placed liner material. K (design) or K (in-situ) = 10 x average K (lab).

7) The most important form of quality control during construction of compacted clay liners will be observation and direction by our field personnel Frequent in-situ soil density and moisture content tests must be conducted to ensure minimum 2 to 3% over the optimum soil moisture content and 98%SPMDD compaction has been achieved. In-situ soil density and moisture content tests must be conducted. In-situ density and moisture content tests should be conducted on a routine basis for each lift.

8) Lift surfaces that have been allowed to dry out should be scarified prior to placing of the next lift. Lift surfaces that have degraded due to precipitation, etc., should either be removed or allowed to dry to the required moisture content and then be re-compacted.

9) The completed clay liner should be smoothed out with a smooth-barrel compactor to reduce the liner surface area exposed to water absorption and swelling. The liner base must not be allowed to dry out or be exposed to freezing temperatures during and after construction, as hydraulic failure of liner could occur. Ideally, the liner should be flooded as soon as possible after construction and acceptance. A protective cover material should be provided for erosion resistance, and it may consist of sand or gravel.

10) Construction is not recommended during freezing conditions due to the difficulties with moisture conditioning and achieving the desired hydraulic conductivity with the compacted soils. Fill should not be placed frozen, or on frozen ground, unless the effect of thawing soil has been evaluated by a qualified geotechnical engineer.

11) Full-time monitoring by geotechnical personnel to review the base conditions and to check soil compaction should be undertaken during site preparation.

12) Any ground water monitoring wells located outside the lagoon area should be protected for future use, if possible.

E) Berm Construction

1) Foundation preparation consists of stripping all topsoil and any soft, compressible or otherwise unsuitable materials from the berm area.

2) Proof roll the scarified, inorganic subgrade to a minimum of 95% S.P.M.D.D. Sheepsfoot rollers should be used in cohesive soils.

3) In constructing the berms, the acceptable clay fill material approved by our personnel from the surrounding borrowed area should be free of organic debris, cobbles and soft materials. The clay fill with suitable moisture contents should be placed in level, uniform lifts. The maximum loose lift thickness with adjusted moisture should be 200mm depending on the type of compaction equipment. Each lift must be compacted to at least 98% S.P.M.D.D. Compaction tests must be conducted to verify the percentage of compaction achieved.

4) Construction of the berms with suitable height and width will also be required to provide adequate storage and slope. The interior berm slopes should be no steeper than 3 horizontal to 1 vertical. The exterior slopes may range from 4H:1V or flatter if required. The exterior slopes should be covered with 15 to 20 centimeters of seeded topsoil.

5) A freeboard of not less than 0.5 meter is required when the basin is filled to capacity.

F) Trench Backfill

1) Service trenches at the site will likely be excavated and backfilled with the existing on-site clayey material. Backfilling service trenches in thicker lifter is not acceptable and may lead to significant differential settlement. The on-site clayey soil generally needs to be moisture conditioned (i.e. dried or wetted) in order to achieve the specified levels of compaction.

2) Soil used for trench backfill must be free of frozen material, organics, construction waste and any other undesirable debris. It is expected that the existing on-site clayey soils will be used as backfill at the site. The native clayey soil is considered to be suitable for use as trench backfill. To minimize fill settlement, lift thickness should not exceed 200mm and be uniformly compacted to a minimum of 95% SPMDD to within 1.5 m of the finished ground surface. From 1.5 m below ground surface to finished grade a minimum of 98% SPMDD is required.

   For structural applications, trench backfill should be placed in lifts with a thickness not exceeding 200mm and be uniformly compacted to a minimum of 98% SPMDD. The water content of the clay fills should be adjusted to within 2 to 3% above the OMC.

3) Settlement of the compacted backfill in trenches is expected. The magnitude and rate of settlement would be dependent on the backfill soil type, the moisture condition of the backfill at the time of placement, the depth of the service trench, drainage conditions and the initial density achieved during compaction. Density monitoring of backfill placement is recommended to encourage better attention to quality workmanship during placement. Fill materials with variable moisture contents recompacted as trench backfill will not provide ideal structural (road, parking area, slab, berm, etc.) subgrade support.

G) Synthetic Membrane Liner

Flexible synthetic membrane can also be considered as liner material for the lagoon. The objective of the flexible synthetic membrane is to follow the recommendations and meet the seepage control criterion outlined by Alberta Environment and the NRCB. Also, proper procedures have to be undertaken to protect the liner against potential failure mechanisms in cost effective manner.

The design of flexible synthetic membrane liners should include the following considerations:

- Liner bedding requirements.
- Underdrainage and gas venting.
- Need for reinforced materials on side slopes.
- Anchoring methods.
- Seals at structures, e.g., transfer pipe outlets.
- Requirements for earth cover.

Specifications of liner thickness and material properties:

The equivalent seepage rate of the flexible synthetic liner must be very small and well within the required seepage requirements, as outlined by Alberta Environment.

There are many types of synthetic liner materials and often many variations of one type depending on additives, processing procedures, etc. The liner should be made from high quality material, supplied by a reputable, experienced manufacturer. The liner material should be compatible with the contained fluid. It should be strong enough to withstand installation procedures, bedding soil conditions and the service environment without considerable damage or degradation to the liner material or seams.

A qualified consultant or vendor must be used when designing, selecting, specifying and installing geomembrane liners.

It is recommended that synthetic membranes be purchased from suppliers who also supervise installation of their products. They must have considerable experience installing the selected weather-resistant material. The supplier should be prepared to have an experienced foreman or supervisor on site at all times to ensure no puncture or faulty seams develop in the synthetic liner.

Closure

The report reflects the base judgement of Smith Dow & Associates Ltd. considering the information available at the time of preparation which was based on the amount and locations of the test holes drilled and subsequent soil samples that were retrieved. Although caution was taken in gathering the information therein, the results obtained are only advisory for the use of our client. Should conditions encountered during construction appear to be different from those shown by the test holes, this office should be notified immediately in order that we may reassess our recommendations based on the new findings.

Foundation inspections and verification of soil compaction must be performed as recommended in this report. A contingency amount should be included in the construction budget to allow for the possibility of variation in soil conditions which may result in modification of the design and/or changes in construction procedures.

This report has been prepared for the exclusive use of Mr. George Stahl for the specified application to the proposed sewage lagoon development at Valleyview Colony, Kneehill County, Alberta. It has been prepared in accordance with generally accepted soil and foundation engineering practices. This report is for advisory purposes only. No other warranty, expressed or implied, is made.

Any use which a third party makes of this report, or any reliance on or decisions to be made on it, are the responsibility of such third parties. Smith Dow & Associates Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

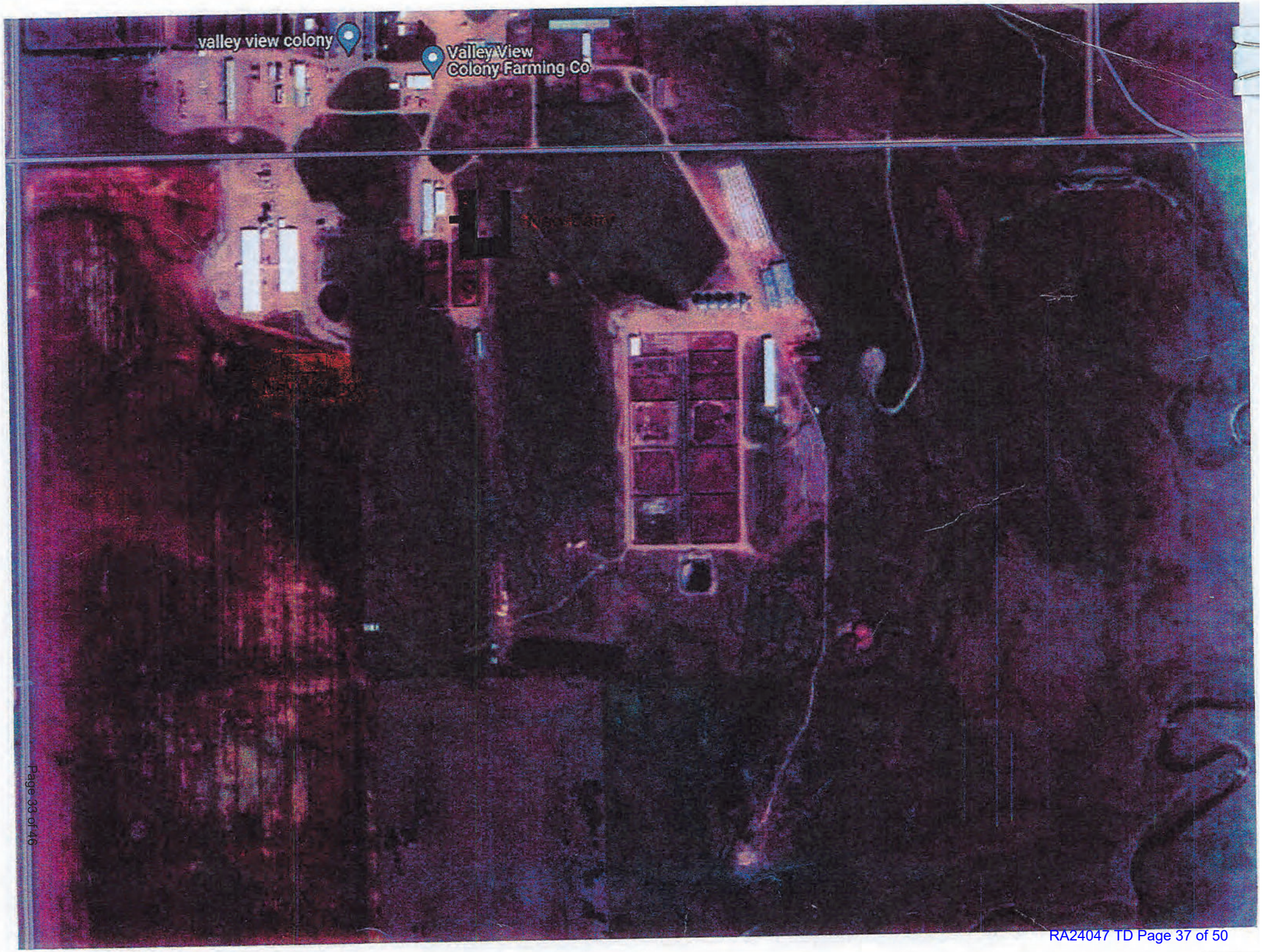
Regards,
Smith Dow and Associates Ltd. (Red Deer)

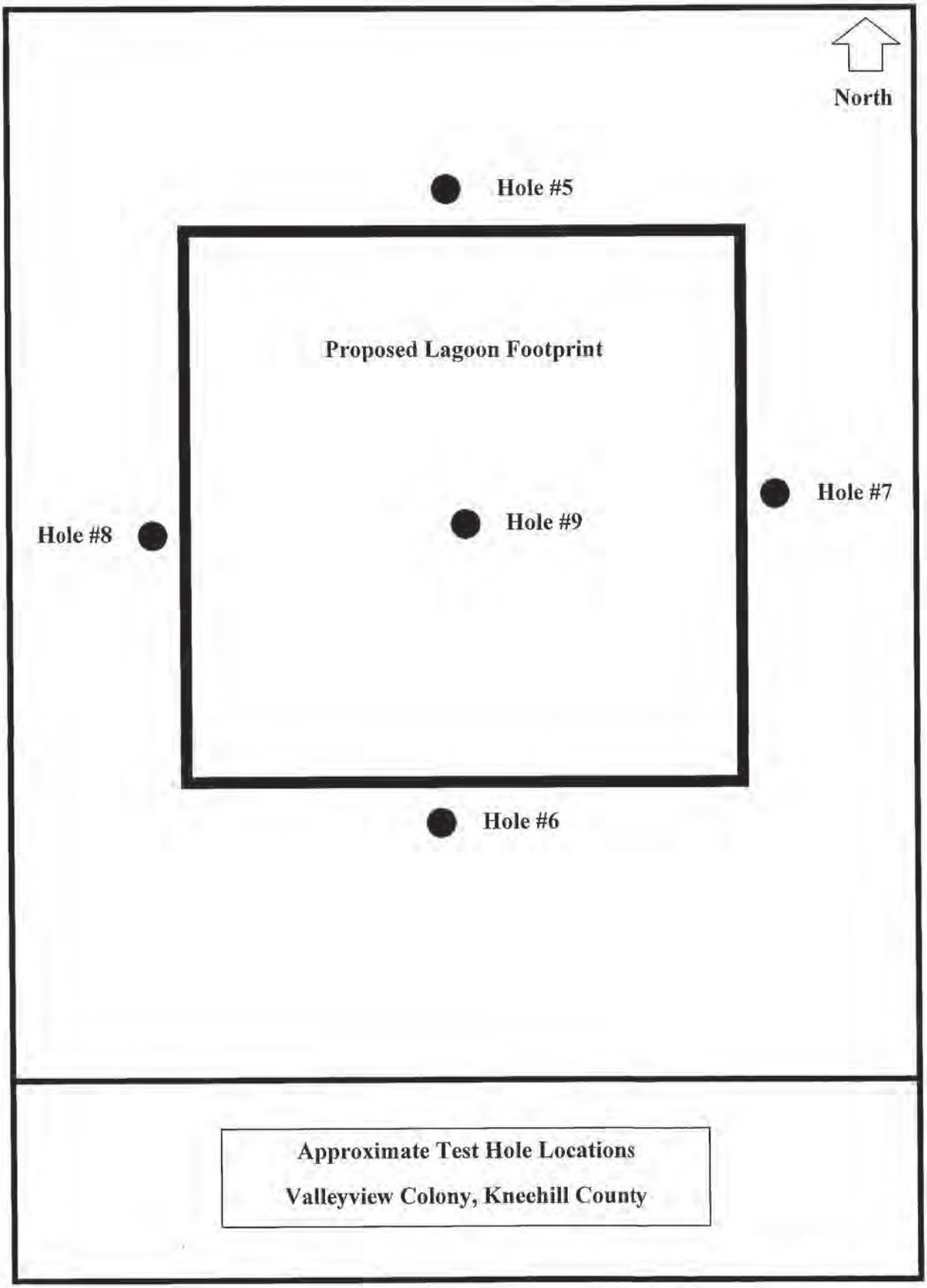
[redacted]

Philip Kwong (P. Eng.)

PROFESSIONAL ENGINEER ALBERTA C.H. PHILIP KWONG

APPENDIX-A


valley view colony
Valley View
Colony Farming Co


North
Hole #5
Proposed Lagoon Footprint
Hole #7
Hole #8
Hole #9
Hole #6
Approximate Test Hole Locations
Valleyview Colony, Kneehill County

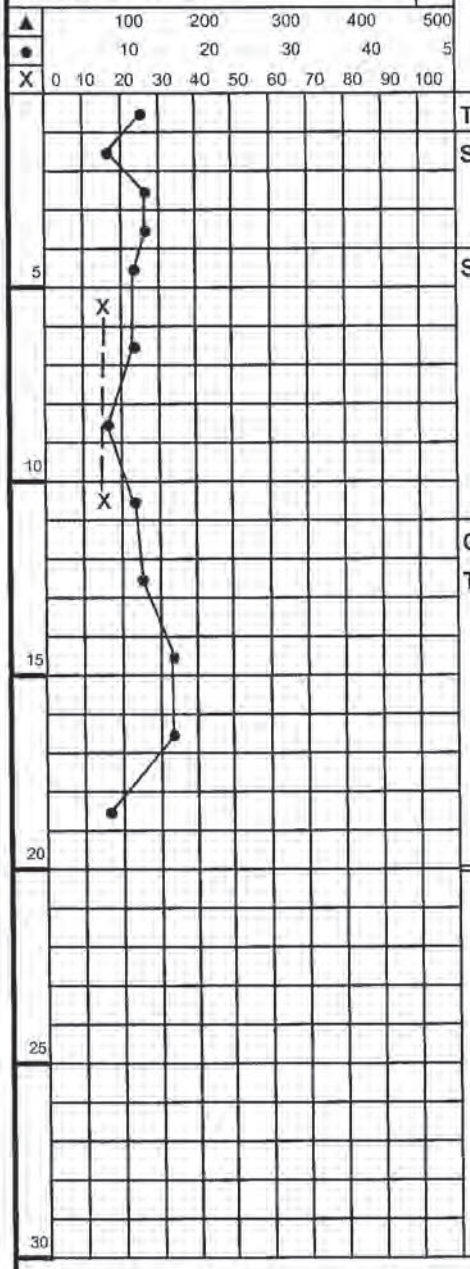
SMITH DOW & ASSOCIATES LTD.
-------Engineering Consultants-------

Project: Lagoon
Valleyview Colony
Knee Hill County, Alberta

DWN	MK	CKD	AK	DATE	March 21, 2023	FILE #		HOLE	5

STRENGTH----------
MOISTURE----------
PENETRATION----------

DATUM - N. Berm - Central Area
APPROX. GROUND ELEV- 898.2m



CLASSIFICATION		SYMBOL	TEST DATA	SAMPLE	Depth feet	Depth meters
Topsoil	straw, organic silt, ~100mm, brown				1	
Sand Till	fine grained, coal traces, frost				2	
	pebbles, non-plastic				3	
	partially free-draining, frost				4	1
Sandy Silt Till	brown				5	
	compact, olive tan, rusting		N= 13	X	6	
	olive				7	2
	clay interbedded				8	
	damp, sand interlayers				9	
	silty, rust specks				10	3
	olive tan		N= 15	X	11	
Clayey Silt Till	low plastic, firm to stiff				12	
	water, silty sand				13	4
	wet				14	
	sandy				15	
	sandy silt				16	5
	water, coal traces, sandy, wet				17	
	pebbles, non-plastic				18	
	silty, low plastic				19	6
	firm to stiff				20	
End of Hole					21	
(Standpipe Installed)					22	7
					23	
					24	
					25	
					26	8
					27	
					28	
					29	
					30	9

FILL	CLAY	TILL	Q - Unconfirmed Strength, kN/m2
TOPSOIL	PEAT	COAL	d - Dry Unit Weight, kN/m3
SAND	GRAVEL	WATER	S - Sulphate Concentration, %
SILT	SILTSTONE	LIMITS	N - Penetration Resistance, blows

Tube	/
Penetrometer	X
No Recovery	

TEST HOLE LOG AND LAB DATA

DWG # 2

SMITH DOW & ASSOCIATES LTD.
-------Engineering Consultants-------

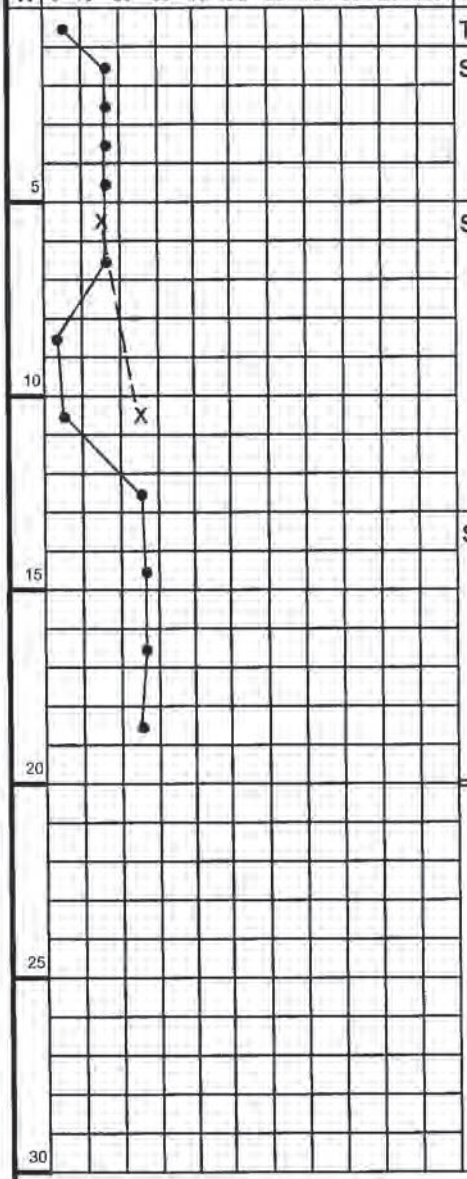
Project: Lagoon
Valleyview Colony
Knee Hill County, Alberta

DWN	MK	CKD	AK	DATE	March 21, 2023	FILE #		HOLE	6

STRENGTH---------- ▲
MOISTURE---------- •
PENETRATION---------- X

▲ 100 200 300 400 500
• 10 20 30 40 5
X 0 10 20 30 40 50 60 70 80 90 100

DATUM - S. Berm - Central Area
APPROX. GROUND ELEV- 898.4m



CLASSIFICATION		SYMBOL	TEST DATA	SAMPLE	Depth (feet)	Depth (meters)
Topsoil	straw, organic silt, ~100mm, frost				1	
Sandy Silt Till	rust brown, olive tan				2	
	sandy, white mineral deposits				3	
	bedrock fragments, frozen				4	1
	clay lenses				5	
Sand Till	dry, compact to medium dense		N= 14	X	6	
	slough, non-plastic, olive tan				7	2
	rusting, tan				8	
					9	
	uniform grain size				10	3
	medium dense to dense		N= 26	X	11	
	non-plastic, damp				12	
	wet, sand lenses				13	4
Silty Clay Till	low plastic, firm to stiff				14	
	stiff				15	
	coal traces				16	5
	silt / sand specks and stringers				17	
	clayey, rust specks				18	
	stiff, stones				19	6
	low plastic, bedrock fragments				20	
End of Hole					21	
(Standpipe Installed)					22	7
					23	
					24	
					25	
					26	8
					27	
					28	
					29	
					30	9

FILL	CLAY	TILL	Q - Unconfirmed Strength, kN/m2
TOPSOIL	PEAT	COAL	d - Dry Unit Weight, kN/m3
SAND	GRAVEL	WATER	S - Sulphate Concentration, %
SILT	SILTSTONE	LIMITS	N - Penetration Resistance, blows

Tube	/
Penetrometer	X
No Recovery	■

TEST HOLE LOG AND LAB DATA

DWG # 3

SMITH DOW & ASSOCIATES LTD.

--------Engineering Consultants--------

Project: Lagoon
Valleyview Colony
Knee Hill County, Alberta

DWN	MK	CKD	AK	DATE	March 21, 2023	FILE #		HOLE	7

STRENGTH---------- ▲
MOISTURE---------- ●
PENETRATION---------- X

▲ 100 200 300 400 500
● 10 20 30 40 5
X 0 10 20 30 40 50 60 70 80 90 100

DATUM - E. Berm - Central Area
APPROX. GROUND ELEV- 898.0m

CLASSIFICATION		SYMBOL	TEST DATA	SAMPLE	Depth (feet)	Depth (meters)
Topsoil	straw / manure, organic silt, ~90mm				1	
Sandy Silt Till	stones, rust brown, silty, frost				2	
	frozen, coal specks				3	
	sandy traces, low to non-plastic				4	1
Sand Till	sand interbedded with silt				5	
	non-plastic, silty		N= 14	X	6	
	low plastic, sandy				7	2
	sand, olive white with coal traces				8	
	uniform grain size				9	
	low plastic silt interlayer				10	3
	firm to stiff		N= 21	X	11	
	coal traces, silty				12	
	wet				13	4
	water, sandy				14	
Clayey Silt Till	silty				15	
	some sand				16	5
	silty w/ light grey sand lenses				17	
	low plastic				18	
	clay, low plastic, stiff				19	6
	dark olive / grey				20	
	End of Hole				21	
	(Standpipe Installed)				22	7
					23	
					24	
					25	
					26	8
					27	
					28	
					29	
					30	9

FILL	CLAY	TILL	Q - Unconfirmed Strength, kN/m2
TOPSOIL	PEAT	COAL	d - Dry Unit Weight, kN/m3
SAND	GRAVEL	WATER	S - Sulphate Concentration, %
SILT	SILTSTONE	LIMITS	N - Penetration Resistance, blows

Tube	/
Penetrometer	X
No Recovery	■

TEST HOLE LOG AND LAB DATA

DWG # 4

SMITH DOW & ASSOCIATES LTD.
-------Engineering Consultants-------

Project: Lagoon
Valleyview Colony
Knee Hill County, Alberta

DWN	MK	CKD	AK	DATE	March 22, 2023	FILE #		HOLE	8

STRENGTH---------- ▲
MOISTURE---------- ●
PENETRATION---------- X

▲ 100 200 300 400 500
● 10 20 30 40 5
X 0 10 20 30 40 50 60 70 80 90 100

DATUM - W. Berm - Central Area
APPROX. GROUND ELEV- 898.6m

CLASSIFICATION		SYMBOL	TEST DATA	SAMPLE	Depth (feet)	Depth (meters)
Topsoil	straw, organic silt, ~80mm, brown				1	
Sandy Silt Till	sandy, olive tan, frost				2	
	clayey, frozen				3	
	low plastic, brown				4	1
Sand Till	non-plastic, coal traces				5	
	clayey silt, rust specks		N= 12	X	6	
	slough, non-plastic, coal traces				7	2
	medium to coarse grained seams				8	
	silty layer				9	
Silty Clay Till	brown, firm to stiff				10	3
	low plastic		N= 16	X	11	
	coal / bedrock fragments				12	
	pebbles				13	4
	silt specks				14	
	sand specks				15	
	water				16	5
	thin sand layer, wet				17	
	silty				18	
	medium to low plastic				19	6
	olive / grey				20	
Sandy Silt Till	white mineral deposits				21	
Till	stones to cobbles sized rock				22	7
	wet, grey, bedrock fragments				23	
	silty lenses w / fissures				24	
	stones, rust specks				25	
	End of Hole				26	8
	(Standpipe Installed)				27	
					28	
					29	
					30	9

FILL	CLAY	TILL	Q - Unconfirmed Strength, kN/m2
TOPSOIL	PEAT	COAL	d - Dry Unit Weight, kN/m3
SAND	GRAVEL	WATER	S - Sulphate Concentration, %
SILT	SILTSTONE	LIMITS	N - Penetration Resistance, blows

Tube	/
Penetrometer	X
No Recovery	■

TEST HOLE LOG AND LAB DATA

DWG # 4

SMITH DOW & ASSOCIATES LTD.
-------Engineering Consultants-------

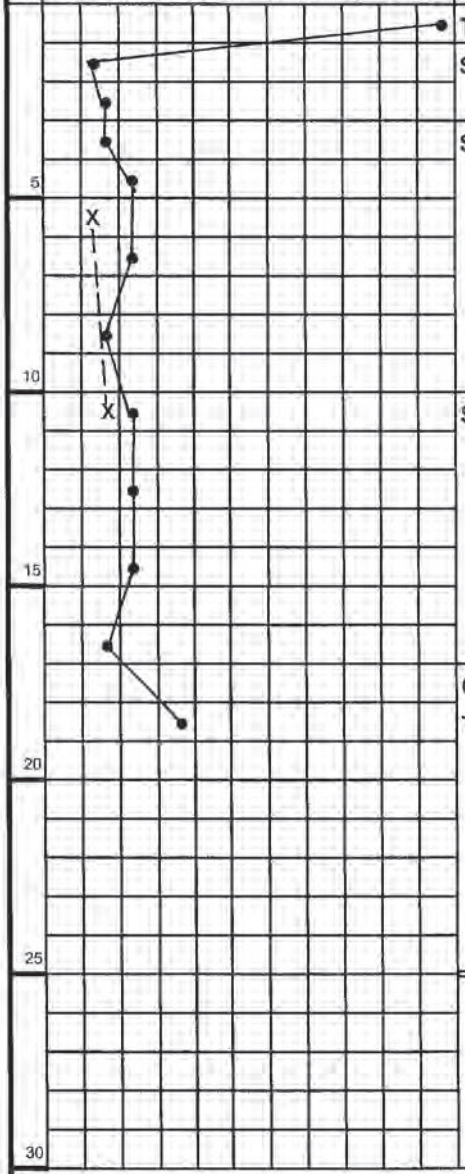
Project: Lagoon
Valleyview Colony
Knee Hill County, Alberta

DWN	MK	CKD	AK	DATE	March 22, 2023	FILE #		HOLE	9

STRENGTH---------- ▲
MOISTURE---------- •
PENETRATION---------- X

▲ 100 200 300 400 500
• 10 20 30 40 5
X 0 10 20 30 40 50 60 70 80 90 100

DATUM - Approx. Center of Lagoon
APPROX. GROUND ELEV- 898.3m



CLASSIFICATION		SYMBOL	TEST DATA	SAMPLE	Depth (feet)	Depth (meters)
Topsoil	straw, manure, peat organic, ~90mm				1	
Sand Till	rust brown, silty sand, frost				2	
	clay interlayers, frozen, coal specks				3	
Sandy Silt Till	olive tan, coal traces, stones, frost				4	1
	sand lenses, moist to dry				5	
	non-plastic to low plastic		N= 17	X	6	
	sandy, non-plastic, rust specks				7	2
	medium dense				8	
	low to non-plastic				9	
	coal traces				10	3
Silty Clay Till	olive tan, interbedded silty sand		N= 19	X	11	
	moist to damp, rust specks				12	
	damp, firm to stiff				13	4
	low plastic, varying sizes of stones				14	
	stiff, rust specks				15	
	silt / sand specks				16	5
	stiff, low plastic, coal traces				17	
Clayey Silt Till	water, soft				18	
	wet, sand layer, coal				19	6
	grey, coal and bedrock fragments				20	
	stiff, low plastic				21	
	low to non-plastic				22	7
	water				23	
	sandy				24	
	slough, grey to olive				25	
End of Hole					26	8
(Hole was filled with concrete					27	
slurry using concrete mixed on site)					28	
					29	
					30	9

FILL	CLAY	TILL	Q - Unconfirmed Strength, kN/m2
TOPSOIL	PEAT	COAL	d - Dry Unit Weight, kN/m3
SAND	GRAVEL	WATER	S - Sulphate Concentration, %
SILT	SILTSTONE	LIMITS	N - Penetration Resistance, blows

Tube	/
Penetrometer	X
No Recovery	■

TEST HOLE LOG AND LAB DATA

DWG # 6

Smith Dow & Associates Ltd.

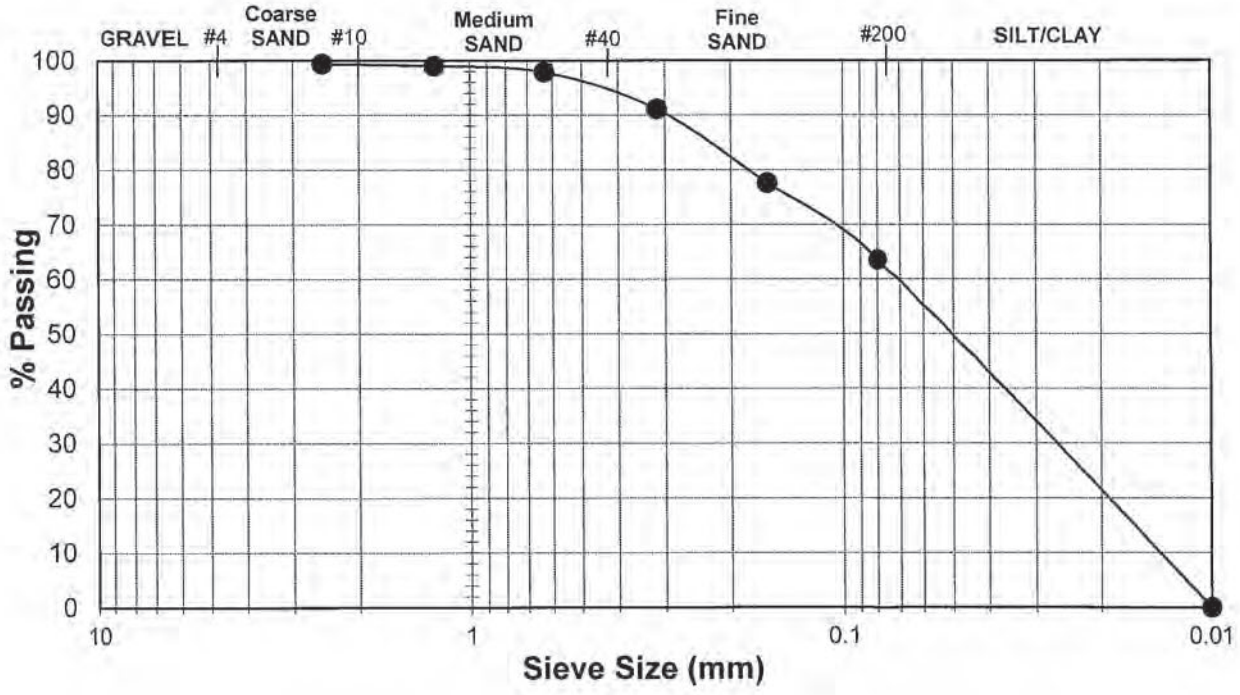
- Foundation and Geotechnical Engineering
- Soil Investigation, Site Assessment
- Testing — Soil, Asphalt, Concrete, Groundwater
- Building Inspections, Indoor Air Testing
- Environment — Audit, Contamination, Radon, Asbestos

4632 - 62 Street, Red Deer, Alta. T4N 6T3
Phone: (403) 343-6888 Fax: (403) 341-4710

Sieve Analysis

Client	Valley View Colony	**Tech**	AH
Date	March 28, 2023	**Sample**	Hole #7 2.1 meters
Project	Valley View Proposed Lagoon	**Fineness Modulus**	N / A
Location	Kneehill County, Alberta		
Remarks	Picked up by our technicians.		

Sieve Size (mm)	% Passing
2.5	99.38
1.25	99.00
0.63	97.85
0.315	91.12
0.16	77.57
0.08	63.52



Smith Dow & Associates Ltd.

- Foundation and Geotechnical Engineering
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- Testing — Soil, Asphalt, Concrete, Groundwater
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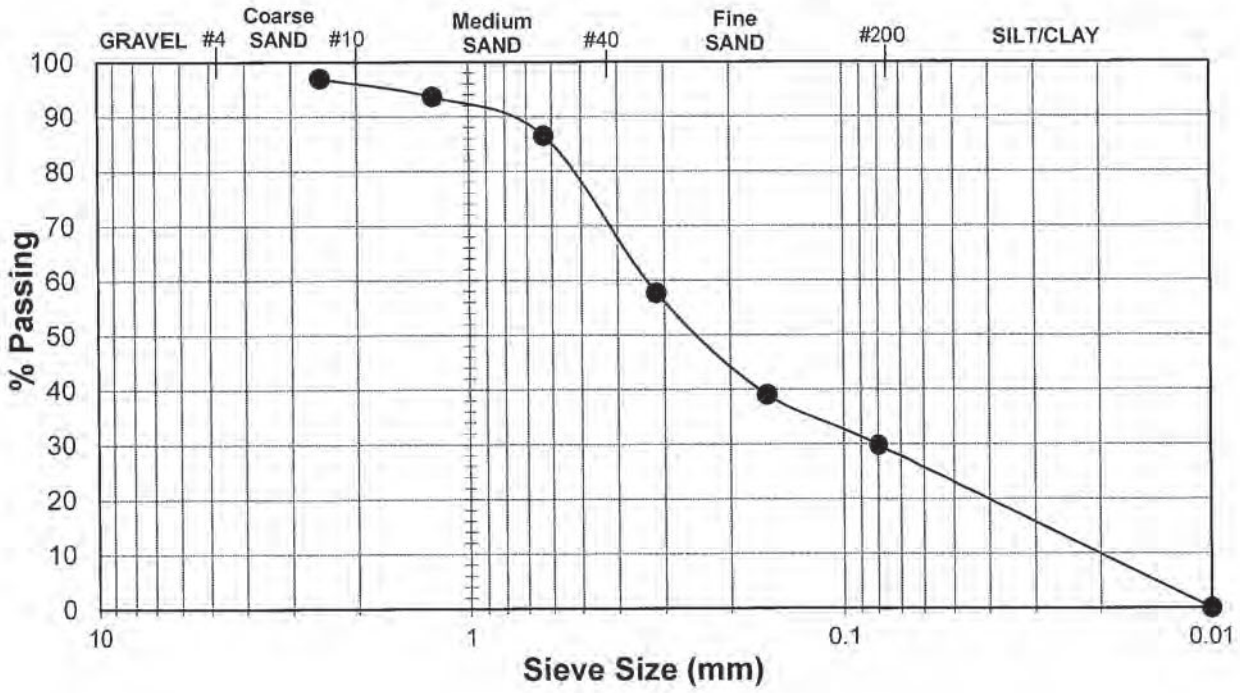
Phone: (403) 343-6888 Fax: (403) 341-4710

Sieve Analysis

Client	Valley View Colony	**Tech**	AH
Date	March 28, 2023	**Sample**	Hole #8 1.5 meters
Project	Valley View Proposed Lagoon	**Fineness Modulus**	N / A
Location	Kneehill County, Alberta		
Remarks	Picked up by our technicians.		

Sieve Size (mm)	% Passing
2.5	96.99
1.25	93.63
0.63	86.51
0.315	57.69
0.16	39.01
0.08	29.75



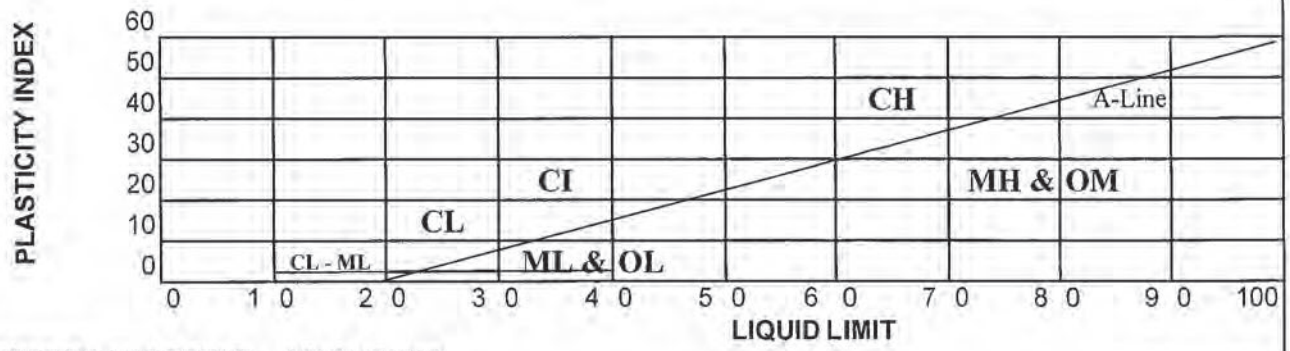
SmithDow

Foundation and Geotechnical Engineering
Soil Investigation and Site Assessment
Slope Stability Reports
Environmental Audits
Material Testing: Soil, Asphalt, and Concrete

Date	March 31, 2023	Project	**Valleyview Proposed Lagoon**
Client	Valleyview Colony	Location	**Kneehill County, Alberta**

Location	Depth (meters)	Liquid Limit	Plastic Limit	Plasticity Index	Flow Index
Hole #5	4.6	22.2	18.2	4.0	6.15

Location	Depth (meters)	Inherent Swelling Capacity	Soil Classification
Hole #5	4.6	Low to Medium	ML
			Inorganic Silt



ATTERBERG LIMIT TEST - ASTM D4318

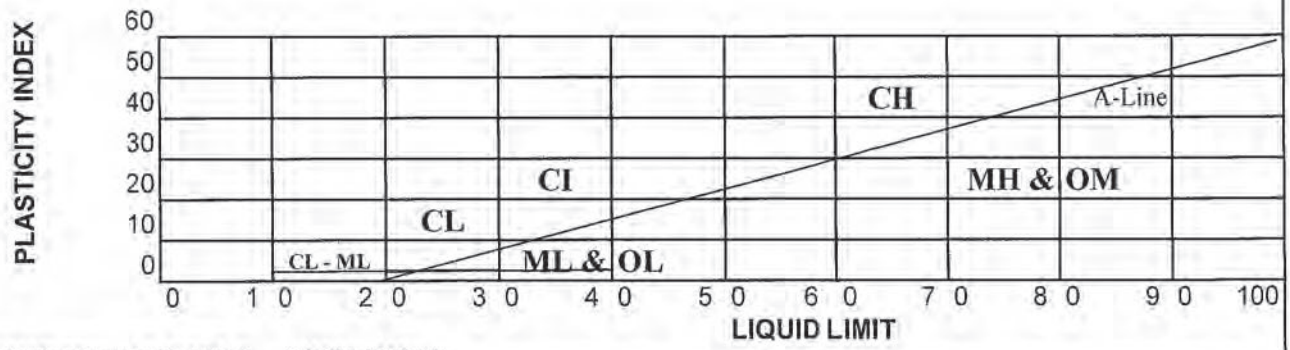
Smith Dow

Foundation and Geotechnical Engineering
Soil Investigation and Site Assessment
Slope Stability Reports
Environmental Audits
Material Testing: Soil, Asphalt, and Concrete

Date	March 29, 2023	Project	Valleyview Proposed Lagoon
Client	Valleyview Colony	Location	Kneehill County, Alberta

Location	Depth (meters)	Liquid Limit	Plastic Limit	Plasticity Index	Flow Index
Hole #6	4.6	28.8	13.3	15.5	5.53

Location	Depth (meters)	Inherent Swelling Capacity	Soil Classification
Hole #6	4.6	Medium	CL Inorganic Clay of Low Plasticity



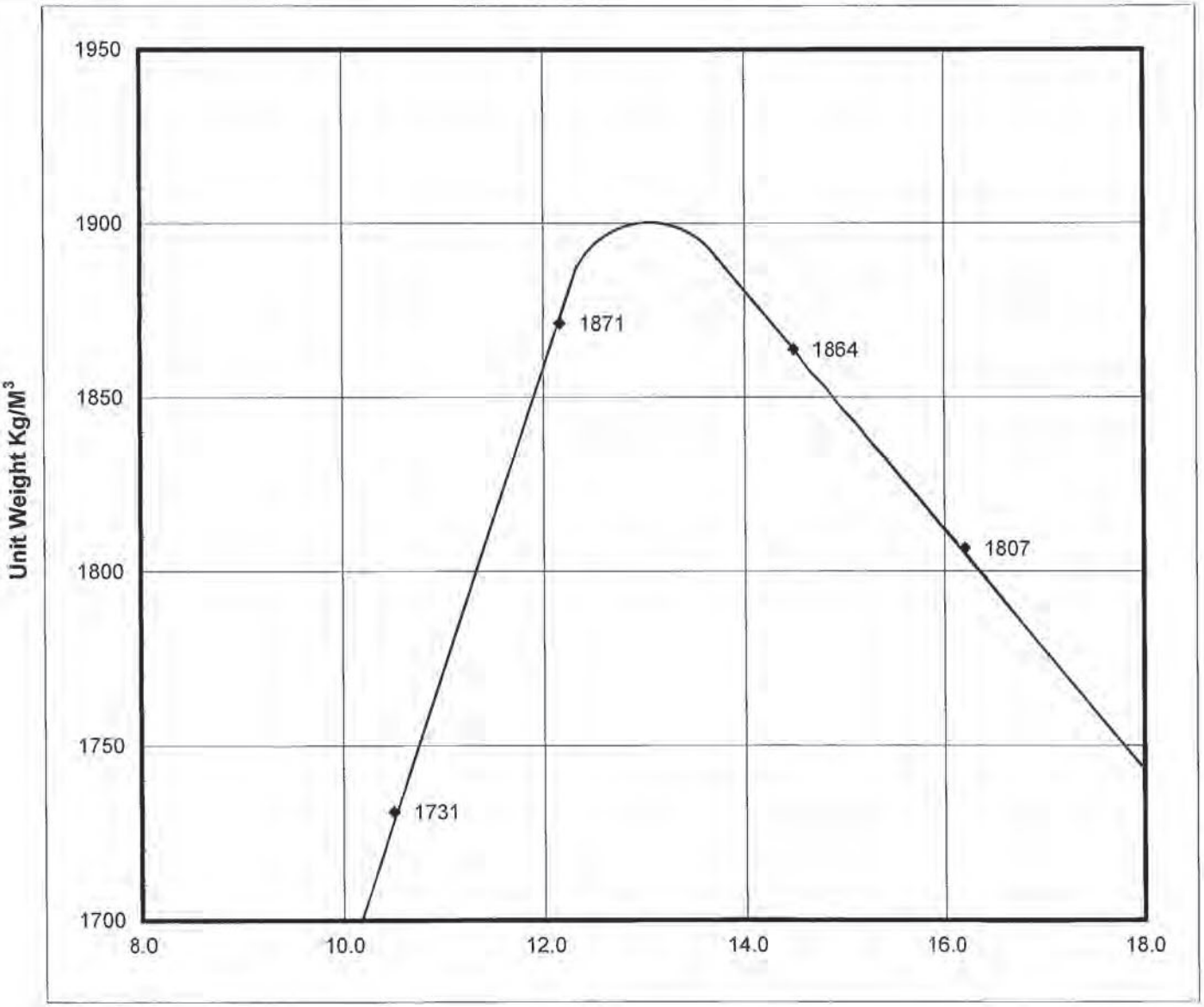
ATTERBERG LIMIT TEST - ASTM D4318

Smith Dow

Foundation and Geotechnical Engineering
Soil Investigation and Site Assessment
Slope Stability Reports
Environmental Audits
Material Testing: Soil, Asphalt, and Concrete

Client	Valleyview Colony	Date Received	21-Mar-23
Project	Valleyview Proposed Lagoon	Technician	AH
Location	Kneehill County, Alberta		

Method of Compaction	Standard Proctor			
Soil Description	Silty Clay			
Remarks	Picked up on Site. Hole #5 3.0 meters to 4.6 meters.			
Trial #	1	2	3	4
Dry Unit Wt	1731	1871	1864	1807
Moisture Content %	10.5	12.2	14.5	16.2
Maximum Unit Wt.	1900 Kg / M^3		Optimum Moisture	13.0 %



SmithDow

Foundation and Geotechnical Engineering
Soil Investigation and Site Assessment
Slope Stability Reports
Environmental Audits
Material Testing: Soil, Asphalt, and Concrete

Client	Valleyview Colony	Date Received	21-Mar-23
Project	Valleyview Proposed Lagoon	Technician	AH
Location	Kneehill County, Alberta		

Method of Compaction	Standard Proctor			
Soil Description	Silty Clay			
Remarks	Picked up on Site. Hole #8 3.4 meters to 4.6 meters.			
Trial #	1	2	3	4
Dry Unit Wt	1757	1885	1850	1799
Moisture Content %	11.0	12.8	14.8	16.6
Maximum Unit Wt.	1890 Kg / M^3		Optimum Moisture	13.1 %

Smith Dow

Foundation and Geotechnical Engineering
Soil Investigation and Site Assessment
Slope Stability Reports
Environmental Audits
Material Testing: Soil, Asphalt, and Concrete

Client	Valleyview Colony	Date Received	21-Mar-23
Project	Valleyview Proposed Lagoon	Technician	AH
Location	Kneehill County, Alberta		

Method of Compaction	Standard Proctor			
Soil Description	Silty Clay			
Remarks	Picked up on Site. Hole #9 4.0 meters to 5.2 meters.			
Trial #	1	2	3	4
Dry Unit Wt	1672	1806	1814	1765
Moisture Content %	9.9	12.0	15.8	17.4
Maximum Unit Wt.	1870 Kg / M^3		Optimum Moisture	13.5 %