Stantec Consulting Ltd.
300-10220 103 Avenue NW
Edmonton AB T5J 0K4

September 29, 2025

Project/File: 123317662

Lily Dam, M.Eng., P.Eng.
The City of Red Deer
Box 5008
Red Deer, AB T4N 3T4

Dear Lily Dam,

Reference: 2025 Geohazard Site Inspections Summary for Various Sites in the City of Red Deer, Rev. 0

Stantec Consulting Ltd. (Stantec) was retained by the City of Red Deer (the City) to conduct geotechnical slope stability inspections at nine sites within Red Deer, Alberta. The sites were visited between May 26 and May 28, 2025. The scope of work consisted of the following:

- Review of existing information provided by the City
- Field inspections at nine sites
- Topographic survey for five sites
- Collecting instrument readings at select sites
- Preparing a site inspection report for each site inspected

Limitations of this summary and the attached inspection reports are provided in the attached Statement of General Conditions in **Appendix A**.

1 Purpose

In 2018, the City identified a number of slope sites for inclusion in their Slope Evaluation Project (Parkland Geo 2019). Through this project, the first geotechnical site inspections took place and a baseline of the slope conditions at each site was developed. A risk level was assigned to each site based on the probability and consequence of slope failure, and recommendations were made for the frequency of future monitoring.

In 2022 and 2023, Stantec conducted geotechnical site inspections to provide follow-up geohazard assessment at 15 of the sites identified for the monitoring program in 2018, and updated the risk rankings per the City of Red Deer Risk Ranking Guidelines. Stantec's current 2025 inspections included nine total sites, six of which had been visited in 2022 or 2023, and three of which had not been formally inspected since 2018. Geohazards at each site were assessed and risk rankings were updated accordingly.

2 Field Inspections

The following sites were inspected:

- Site 1 – Heritage Ranch
- Site 2 – Riverview Park
- Site 3 – Riverlands
- Site 5 – Spruce Drive – Waskasoo Creek
- Site 6D – 44th Avenue Close
- Site 8 – 45th Avenue North of 59th Street
- Site 17 – Gaetz Avenue West Service Road north of 37th Street
- Site 19 – Former Elks Club and 36th Street
- Site 25 – Royal Oaks

The site inspection dates are provided in the Table 1 in Section 3, and on the individual inspection reports attached.

During the site inspections, Stantec collected relevant photographs, measurements, instrument readings at select sites, and observations to assess the level of risk for each site based on the City's risk ranking guideline (attached). Following the site inspections, Stantec mobilized a survey crew to select sites (Sites 3, 6D, 8, 19, and 25) to complete topographical surveys. The completed site inspection reports, containing the current risk ranking, recommendations and potential remediation options, a site plan and a photo log are included in
Appendix C.

2.1 Instrument Monitoring

The instrumentation at the inspected sites consisted of slope inclinometers (SI) and standpipe piezometers. Three SIs were measured: one at Site 1, one at Site 5, and one at Site 17. Two piezometers were measured at Site 1. The standpipe piezometer at Site 17, was found to be broken at ground surface and full of gravel and soil. The SI baseline readings from 2018 were not available; therefore, readings taken by Stantec in Fall 2022 (Stantec 2023) were used as baseline readings for Sites 5 and 17, while readings taken by Stantec in Spring 2024 (Stantec 2024) were used as baseline readings for Site 1.

Slope inclinometers are used for monitoring landslide movements normal to the axis of a casing installed in a borehole by traversing a probe along the grooves of a casing (Stark and Choi 2008). The SI probe contains at least one accelerometer, depending on the type of probe, that measures the inclination of the casing with respect to the vertical. Readings are then taken at marked increments so the shape of the casing can be measured at consistent depths. The first reading of an SI casing is referred to as the baseline or zero reading. Subsequent readings are then compared to the baseline to identify changes in the shape and position of the initially vertical casing (i.e., ongoing slope movement).

There are two methods commonly used to plot slope inclinometer measurements: the incremental displacement plot and the cumulative displacement plot. The incremental displacement plot shows localized inclination (i.e., movement) of the casing for each set of readings at each depth. The cumulative displacement plot begins as a vertical line (i.e., baseline reading) and takes the sum of the observed movement at each depth for each set of reading. As such, the cumulative displacement plot shows the accumulative change in shape of the casing over time (Mitre 2010). The plots include two axes, the vertical axis representing the depth below ground surface and the horizontal axis representing deflection.

SIs measure deflection in two perpendicular directions, commonly labelled as the A and B axis. During installation, the A axis is usually aligned with the direction of the slope, capturing movement in the upslope or downslope direction. For the three sites, the positive deflection in direction A indicates movement downslope and the negative deflection indicates movement upslope. There is no threshold deflection or rate of deflection for which specific actions are required.

Where slope movements occur between the A axis and B axis, a skew angle can be applied clockwise to the A axis to define the direction of the resultant movement, known as the X-axis. The rate of slope movement can also be visualized as a time-displacement plot based on change in displacement between two sets of readings over time for a defined zone of movement, as shown with Site 17.

The SI were monitored using an RST MEMS digital inclinometer probe with 0.5 m increments and handheld PC. Readings were taken based on cable marks in relation to the top of SI casing. The standpipe piezometers were monitored using a Heron Instruments water tape. The SI plots are included in **Appendix C** with the applicable site inspection reports.

3 Risk Ranking

The Risk Rankings selected for each site were based on the City of Red Deer Risk Ranking Guidelines created by Parkland Geo in 2019 for the slope monitoring program which were modified from the Alberta Transportation – Geohazard Risk Monitoring Program. The Risk Ranking rating system is included in **Appendix B**. The Risk Ranking system defines the geohazard risk on a scale of 1 to 200 as the product of the Probability Factor and the Consequence Factor. The Probability Factor represents the likelihood of failure on a scale of 1 to 20 while the Consequence Factor represents the ramifications of failure on a scale of 1 to 10. Separate Risk Ranking scales are applied to earth slides and debris flows, and erosion sites. The Risk Ranking system serves as a tool for assessing whether a specific geohazard site has become worse during subsequent inspections. There is no threshold number for which specific actions are required.

Table 1 presents the current risk rankings for each site and is organized from the highest risk ranking to lowest, and includes the current recommended inspection frequencies. Some sites have been split into different areas, in keeping with the risk rankings assigned in 2022 and 2023.

Table 1 2025 Risk Ranking & Recommended Inspection Frequency of Slope Stability Sites

Site No. (Subsection)	Risk Ranking	Probability Factor	Consequence Factor	Inspection Date	Recommended Inspection Frequency
Site 6D – 44th Avenue Close	90	9	10	May 26, 2025	Annually
Site 2 – Riverview Park Lots 2 to 12	72	9	8	May 27, 2025	Every 2 years
Site 25 – Royal Oaks	64	8	8	May 26, 2025	Every 5 Years
Site 2 – Riverview Park Lots 13 to 22	56	7	8	May 27, 2025	Every 2 years
Site 17 – Gaetz Avenue West Service Road north of 37 Street	40	5	8	May 26, 2025	Every 3 years
Site 1 – Heritage Ranch	32	4	8	May 27, 2025	Every 5 years
Site 19 – Former Elks Club and 36th Street	30	3	10	May 28, 2025	Every 5 years
Site 8 – 45th Avenue North of 59th Street	14	7	2	May 27, 2025	Every 5 years
Site 5 – Spruce Drive - Waskasoo Creek	14	7	2	May 26, 2025	Every 5 years
Site 3 - Riverlands	14	7	2	May 26, 2025	Every 5 years
Site 2 – Warwick Drive	10	5	2	May 27, 2025	Every 2 years

4 General Discussion and Recommendations

Recommendations specific to each of the sites are provided in each of the attached site inspection reports. Generally, residents should monitor drainage in their lots and avoid allowing any water to pond. Residents and/or property owners should inspect downspouts and subdrains regularly to ensure they are operating as intended, and/or leading to ponding or erosion. Downspouts can be lengthened using socks, flexible pipe, or other alternatives to extend the outlet points away from steep slopes and historic or existing slide areas.

At this time, Stantec does not recommend further site investigation at all sites, but does recommend continued monitoring of the sites. Instrument installation recommendations have been made for select sites and are noted on the site inspection reports. It is recommended that the City communicate to the landowner at Site 6D that a geotechnical site investigation be completed, including slope stability analyses, to more accurately determine the risk to the home.

5 Closure

This report was prepared for the exclusive use of the City of Red Deer for specific application to the 2025 Slope Stability Inspections. Use of this report is subject to the Statement of General Conditions included in **Appendix A**. It is the responsibility of the City of Red Deer, who is identified as "the Client" within the Statement of General Conditions, to review the conditions and notify Stantec should any of them not be satisfied.

We trust that this report meets your present requirements. This report was prepared by Sonja Pharand, P.Eng., and reviewed by Eric Leishman, M.Sc., P.Eng., and Leslie Cho, M.Eng., P.Eng. If you have any questions or require additional information, please contact the undersigned.

Respectfully,

Stantec Consulting Ltd.

PROFESSIONAL ENGINEER ALBERTA
SONJA A. PHARAND
ID 286545
2025-09-29

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Attachment: Appendix A – Statement of General Conditions
Appendix B – City of Red Deer Risk Ranking Guidelines
Appendix C – Site Inspection Reports

PERMIT TO PRACTICE
STANTEC CONSULTING LTD.
Signature _____ ID 78675
Date 2025-09-29
PERMIT NUMBER: P 0258
The Association of Professional Engineers and Geoscientists of Alberta

6 References

Mitre Software Corporation (2010). GTILT PLUS Inclinometer Data Presentation For Windows User's Manual Version 3.31.

Parkland Geotechnical Consulting Ltd. (2019). 2018 Slope Evaluation Project: Various Sites in the City of Red Deer. Project No. RD6500. Prepared for the City of Red Deer, April 2019.

Stantec Consulting Ltd. (2023). 2022-2023 Geohazard Site Inspections Summary for Various Sites in the City of Red Deer. Project No. 1101000067. Prepared for the City of Red Deer, October 2023.

Stantec Consulting Ltd. (2024). Instrumentation Readings at Red Deer Geohazards Sites 1, 5, and 17. Project No. 1101000067. Prepared for the City of Red Deer, June 2024.

Stark, Timothy D. and Choi, Hangseok (2008). Slope Inclinometers for Landsides.

Appendix A Statement of General Conditions

Stantec

STATEMENT OF GENERAL CONDITIONS

USE OF THIS REPORT: This professional work product ("hereinafter referred to as the Report") has been prepared for the sole benefit of the Client in accordance with Stantec's contract with the Client. While the Report may be provided by the Client to applicable authorities having jurisdiction and to other third parties in connection with the project, Stantec disclaims any legal duty based upon warranty, reliance, or any other theory to any third party, and will not be liable to such third party for any damages or losses of any kind that may result.

BASIS OF THIS REPORT: This Report relates solely to the site-specific project for which Stantec was retained and the stated purpose for which the Report was prepared. The information, opinions, conclusions and/or recommendations made in this Report are in accordance with Stantec's present understanding of the site-specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time the scope of work was conducted and do not take into account any subsequent changes. If the proposed site-specific project differs or is modified from what is described in this Report or if the site conditions are altered, this Report is no longer valid unless Stantec is requested by the Client to review and revise the Report to reflect the differing or modified project specifics and/or the altered site conditions. This Report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose or site, and any unauthorized use or reliance is at the recipient's own risk.

STANDARD OF CARE: Preparation of this Report, and all associated work, was carried out in accordance with the normally accepted standard of care in the state or province of execution for the specific professional service provided to the Client. No other warranty is made.

PROVIDED INFORMATION: Stantec has assumed all information received from the Client and third parties in the preparation of this Report to be correct. While Stantec has exercised a customary level of judgment or due diligence in the use of such information, Stantec assumes no responsibility for the consequences of any error or omission contained therein.

INTERPRETATION OF SITE CONDITIONS: Soil, rock, or other material descriptions, and statements regarding their condition, made in this Report are based on site conditions encountered by Stantec at the time of the scope of work and at the specific testing and/or sampling locations. Classifications and statements of condition have been made in accordance with normally accepted practices which are judgmental in nature; no specific description should be considered exact, but rather reflective of the anticipated material behaviour. Extrapolation of in-situ conditions can only be made to some limited extent beyond the sampling or test points. The extent depends on variability of the soil, rock and groundwater conditions as influenced by geological processes, construction activity, and site use.

VARYING OR UNEXPECTED CONDITIONS: Should any site or subsurface conditions be encountered that are different from those described in this Report or encountered at the test and/or sample locations, Stantec must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the Report conclusions or recommendations are required. Stantec will not be responsible to any party for damages incurred as a result of failing to notify Stantec that differing site or subsurface conditions are present upon becoming aware of such conditions.

PLANNING, DESIGN, OR CONSTRUCTION: Development or design plans and specifications should be reviewed by Stantec geotechnical engineers, sufficiently ahead of initiating the next project stage (e.g., property acquisition, tender, construction, etc.), to confirm that this Report completely addresses the elaborated project specifics and that the contents of this Report have been properly interpreted. Specialty quality assurance services (e.g., field observations and testing) during construction are a necessary part of the evaluation of subsurface conditions and site work. Site work relating to the recommendations included in this Report should only be carried out in the presence of a qualified geotechnical engineer; Stantec cannot be responsible for site work carried out without being present.

Appendix B City of Red Deer Risk Ranking Guidelines

CITY OF RED DEER RISK RANKING GUIDELINES

Table C1 – Geohazard Risk Level Factors – Earth slides and Debris Flow

Risk Level (RL) = (Probability Factor, PF) x (Consequence Factor, CF)

Probability Factor (ranked on a scale of 1 to 20)	
1	Inactive, very low probability of slide occurrence.
3	Inactive, low probability of re-mobilization
5	Inactive, moderate probability of re-mobilization, uncertainty level moderate, or active but very slow rate of movement or indeterminate movement pattern.
7	Inactive, high probability of remobilisation or additional hazards, uncertainty level high, or active with perceptible movement rate and defined zone(s) of movement.
9	Active with moderate steady, or decreasing, rate of ongoing movement.
11	Active with moderate but increasing rate of movement.
13	Active with high rate of movement, steady or increasing.
15	Active with high rate of movement with additional hazards.
20	Catastrophic slide is occurring.

Consequence Factor (ranked on a scale of 1 to 10)	
1	Shallow slopes including fills and cuts. Slide material from the slide may spill into road ditches or impact natural passive areas of parkland or private property. Minor consequence of failure. Slide does not impact roadways, paved paths, park structures, buried services or other surface infrastructure. There is no safety issue for roadway users, park patrons or residents. A maintenance issue.
2	Moderate natural slopes or moderate fills and cuts including: road embankment side slopes, bridge approaches and head slopes. Shallow fills where private land, water bodies, surface development or structures may be impacted. Small volume slides which result in: • partial loss of top-of-slope roadways and blockage of toe-of-slope roads, affecting use of roadways and safety of motorists, but not requiring closure of the roadway. • minor disturbance to park areas or private property including temporary structures; • minor impacts on municipal services and fixed structures such as bridges or culverts (i.e. structures not subject to occupancy); or • minor restriction of water channels and siltation of water bodies.
4	Major slopes, high fills and deep cuts associated with land development, municipal service right-of-ways, bridges, intersections, culverts and other road structures. Moderate to large volume slides which would directly and unavoidably result in: • partial closure or significant detours for roadways; • relocation of park infrastructure (paved paths, board walks, stairways, etc.); • significant disturbance to active use private property (not including structures); or • restriction of water channels and blockage of culverts.
6	Sites where slides would directly and unavoidably result in: road closures; significant loss of active use park areas; water channel blockage without impacting permanent structures; or reconstruction, relocation, abandonment of municipal services and temporary structures.
8	Sites where slides would directly and unavoidably result in loss of public or private property without impacting permanent structures; or reconstruction, relocation, abandonment of municipal services and temporary structures on those properties.
10	Sites where significant loss of infrastructure facilities or permanent structures impacting public safety will occur in the event of a slide. Sites where rapid mobilization of large scale slide is possible.

Table C2 – Geohazard Risk Level Factors – Erosion Sites including River Banks

Probability Factor (ranked on a scale of 1 to 20)	
1	Inactive, very low probability of erosion, non-erodible soils or bedrock, physical or structural limitations to erosion expansion. Flat slopes, well vegetated.
3	Inactive, rills present, gullies forming. Reasonable vegetative soil cover.
5	Inactive, moderate probability of gully formation, mix of non-erodible and erodible soils, or active but very slow rate of erosion even with intense rain events. Moderately steep slopes.
7	Inactive, moderate probability of erosion or additional hazards, or active with barely perceptible erosion expansion from season to season and well defined erosion prone areas (confined flow). Gullies 2 m wide and 1 m deep.
9	Active erosion at moderate rainfall event levels. Gullies actively eroding road embankment or ditches. Mostly erodible soils present. Steep slopes with poorly established vegetative cover.
11	Active erosion at most rainfall event levels, Erodible soils. with little or no vegetative soil cover. Increasing rate of erosion as evidence by gully enlargement. Gullies 5 m wide and 2 m deep formed.
13	Active with high rate of erosion, steady or increasing. Very steep slopes, no vegetative cover.
15	Active with high rate of erosion with additional hazards.
20	Mass wasting of great volumes of soil is occurring, gullies 10 m wide and 4 m deep formed.

Consequence Factor (ranked on a scale of 1 to 10)	
1	Relatively small area of erosion involved confined to a ditch, minor slope or river bank. Less than 25 m of ditch/bank or 100 sq.m. of slope is affected. The slope condition does not impact roadways, paved paths, park structures, buried services or other surface infrastructure. There is no safety issue for roadway users, park patrons or residents. A maintenance issue.
2	Ongoing erosion and associated instabilities in moderate slopes may result in partial loss of roadway embankments or blockage of toe-of-slope roads, affecting use of roadways and safety of motorists, but not requiring closure of the roadway. Minor disturbance to park areas; private property including temporary structures; municipal services and fixed structures not subject to occupancy (e.g. bridges) is possible. Blockage of culverts and deposition of silt in sensitive low areas is also possible.
4	High banks, fills or cut slopes are being undermined by seasonal flows in gullies or permanent water courses. Related active erosional flows would directly and unavoidably result in: • partial closure or significant detours for roadways; • relocation of park infrastructure (paved paths, board walks, stairways, etc.); • significant disturbance to active use private property (not including structures); or • restriction of water channels, blockage of culverts; • damage to existing erosion and sediment control structures.
6	Continued erosion and related slides would directly and unavoidably result in: road closures; significant loss of active use park areas or water channel blockage without impacting permanent structures; or reconstruction, relocation, abandonment of municipal services and temporary structures. Excluding natural river bank slopes, erosion sites where the eroded material flows directly into fish bearing rivers negatively affecting the water quality, aquatic resources and critical fish habitat on an ongoing basis
8	Sites where continued erosion and channel blockage related slides would directly and unavoidably result in loss of public or private property without impacting permanent structures; or reconstruction, relocation, abandonment of municipal services and temporary structures on those properties.
10	Sites where significant loss of infrastructure facilities or permanent structures impacting public safety will occur in the event of a slide related to ongoing erosion and/or channel blockage.

Modified from Original Source: Alberta Transportation - Geohahazard Risk Monitoring Program TOR - Appendix 7.

September 29, 2025
The City of Red Deer

Reference: 2025 Geohazard Site Inspections Summary for Various Sites in the City of Red Deer

Appendix C Site Inspection Reports

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City of Red Deer
Site Inspection Report

SITE NUMBER AND NAME:	LOCATION:
1 - Heritage Ranch	6300 Cronquist Drive

	DATE	PF(1)	CF(1)	TOTAL
PREVIOUS INSPECTION:	July 13, 2022	4	8	32
CURRENT INSPECTION:	May 27, 2025	4	8	32
INSPECTED BY:	Stantec: Sonja Pharand, Benjamin Lou			
REPORT ATTACHMENTS:	Figure 1 – Site Plan Site Photos SI Plots			
Note: (1) PF and CF are probability factor and consequence factor defined in City of Red Deer Risk Ranking Guidelines				

PRIMARY SITE ISSUE:

Landslide along the Red Deer River south bank due to toe erosion

APPROXIMATE DIMENSIONS:

~30 m high, 300 m long along the river

SITE HISTORY

From "Red Deer Riverbank Slope Review Heritage Ranch to Gaetz Avenue Red Deer, Alberta" report by Parkland Geo dated January 2012:

- The entire high bank area from Heritage Ranch to West Park Estates has been subject to shallow slumping and narrow block slides at the crest.
- Developments in the upland area consisted of the Heritage Ranch buildings, Alberta Sports Hall of Fame building, recreation fields, corrals, restrooms, shelters, both paved and unpaved roads, and pedestrian trails.
- The estimated toe and crest of riverbank regression between 1986 and 2009 are 450 mm and 250 mm, respectively, based on air photo review.
- A rock riprap berm was recommended as a riverbank stabilization measure for the Heritage Ranch site and extending east for about 1 km.

From "2018 Slope Evaluation Project" report by Parkland Geo dated April 2019:

- Local experience in the area suggests that landslides occur intermittently along the crest of the riverbank slope, with an average frequency of one every 15 to 20 years. There was evidence of an old slide approximately 30 m wide and 15 m back into the slope approximately 50 m east from the Heritage Ranch building.
- During the 2018 slope evaluations, the site was noted to include an upland area and a large pond which appeared to be a former gravel pit. The transition between the upland area and the flood plain consisted of a mature escarpment slope (approx. 3H:1V), which transitioned to a steep and high riverbank for the Red Deer River.
- The crest area was noted to be relatively stable and heavily wooded with relatively mature trees. Open grass fields were present in the uplands and flood plain areas. The river valley slope was moderately to heavily wooded. The slope face showed some evidence of small block slides in the upper slope materials.
- Five boreholes were drilled by Parkland Geo on June 13, 2012, to depths of up to 19.0 m below grade. A slope inclinometer (SI) was installed in Borehole 3 beside an existing trail near the crest, north of the Heritage Ranch building. Standpipe piezometers were installed in Boreholes 1 to 5. Groundwater levels were measured in July 2012, and varied from approximately 2.0 m below ground surface (bgs) near the corrals (approx. 35 m southwest from the crest) to approximately 17 m bgs (864 m) at the crest. The normal river surface elevation for the area at the time was approximately 853 m.
- The soil stratigraphy encountered at the site generally consisted of topsoil overlying approximately 3.0 m of sand and silt. A thick layer of coarse sand and gravel was encountered below the sand and silt in some locations, and was underlain by approximately 6 m to 8 m of soft to firm, low to high plastic silt and clay. Stiff to very stiff, low to medium plastic clay till was encountered below the silt and clay. An additional layer of sand

and gravel was encountered below the clay till, underlain by weathered siltstone bedrock at an approximate elevation of 865 m.

- Parkland Geo completed a slope stability analysis in 2012 indicating the following:
  - The factor of safety (FS) of the shallow slope face failure is 1.1.
  - Analysis of a setback distance of 5.5 m and the Heritage Ranch building indicates FS > 1.5.
- It was noted that if the slope was to experience unusually wet conditions or removal of vegetation, a shallow slump has the greatest potential to develop in the slope face.
- A riprap berm over 1 km long was constructed in 2016 to protect the toe / shoreline below the Heritage Ranch building complex.

From "Instrumentation Readings at Red Deer Geohazard Sites 1, 5, and 17" report by Stantec dated June 2024.

- It was noted that one slope inclinometer (SI12-3) and four standpipe piezometers (BH12-1, BH12-2, BH12-4, and BH12-5) were previously installed by others, however only SI12-3, BH12-2, and BH12-4 were found in the field during the 2024 readings. It is inferred that the existing roadway was built over BH12-1 and BH12-5.
- Previous SI readings were not available to Stantec and baseline readings for SI12-3 were taken In May 2024.

ITEM	CONDITIONS EXIST		DESCRIPTION AND LOCATION	NOTICEABLE CHANGE FROM LAST INSPECTION	
	YES	NO		YES	NO
Building Distress		X			X
Slope Movement	X		Old shallow failure about 30 m wide east of the main Heritage Ranch building.		X
Erosion		X			X
Seepage		X			X

OBSERVATIONS AND ASSESSMENT

- No observable change from Stantec's 2022 call-out inspection. No signs of erosion or slope movement were observed. The slope was generally well vegetated (Photos 1, 2 and 3).
- Some asphalt cracking was observed on the pedestrian trail northwest of the Heritage Ranch building (Photo 4). The cracking is likely unrelated to slope movement.
- A section of the toe of the slope is armoured with riprap (Photo 5).
- Slope Inclinometer (SI) SI12-3 was monitored during this inspection. Since baseline readings taken by Stantec in May 2024, no apparent zones of movement have been observed. The observed movement is minimal and likely reflects noise rather than slope movement.
- The standpipe at BH12-2 was found to be dry to 10.3 m below ground surface (bgs). Groundwater was measured at 10.9 m bgs in BH12-4 representing an increase in groundwater level of 4.7 m since May 2024.
- The Probability and Consequence Factors for the site remain unchanged as there is no immediate risk to the adjacent building; however, slope retrogression in the longer-term could be expected due to changes of the watercourse, flooding, or poor surface drainage.

RECOMMENDATIONS

- Monitoring the slope should be considered the minimum requirement for this site. Monitoring may include any of the following:
  - Installation of survey pins and collecting survey (annually) to identify slope movements.
  - Collecting readings from the existing slope inclinometer annually.
  - Reading the groundwater levels in the standpipe piezometers annually.
  - Basic measurements at consistent locations along the slope crest and referenced to permanent features can also be taken to monitor additional slope movements as a "rough check."
- Surface drainage should be monitored and managed to avoid ponding water at the crest and further erosion of the riverbank. Downspouts should be directed away from the crest.
- The recommended site inspection frequency remains at once every 5 years.

Legend

- PHOTO NUMBER AND DIRECTION
- SCARP/TOP OF BANK LOCATION
- TOE OF BANK LOCATION
- APPROXIMATE TOP OF LANDSLIDE (2018)
- [875.00] EXISTING CONTOURS (2016)
- BH# APPROXIMATE BOREHOLE LOCATION & ASSOCIATED YEAR
- BH# BOREHOLE WITH PIEZOMETER
- SI# BOREHOLE WITH SLOPE INCLINOMETER

NOTE: SCARP/TOP OF BANK AND TOE OF BANK LOCATIONS ADAPTED FROM PARKLAND GEO (2019)

AERIAL PHOTO- 2022 CITY OF RED DEER
CADASTRAL - 2021 CITY OF RED DEER

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

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www.stantec.com

Client/Project
City of Red Deer
SITE 1 - HERITAGE RANCH

Figure No.
1

Title
SITE PLAN

SCALE
1:1500
0 15 30 75

2025 Inspection Photos at Site 1 – Heritage Ranch

Photo 1: Old slope failure, well vegetated. Looking downslope (southeast).

Photo 2: Well vegetated riverbank next to trail / stairs, east of the Heritage Ranch building. Looking northeast.

2025 Inspection Photos at Site 1 – Heritage Ranch

Photo 3: Well vegetated riverbank further west from SI12-3, looking east.

Photo 4: Sealed cracks in asphalt pedestrian trail, looking southeast.

2025 Inspection Photos at Site 1 – Heritage Ranch

Photo 5: Toe of riverbank with riprap armouring. Looking southwest.

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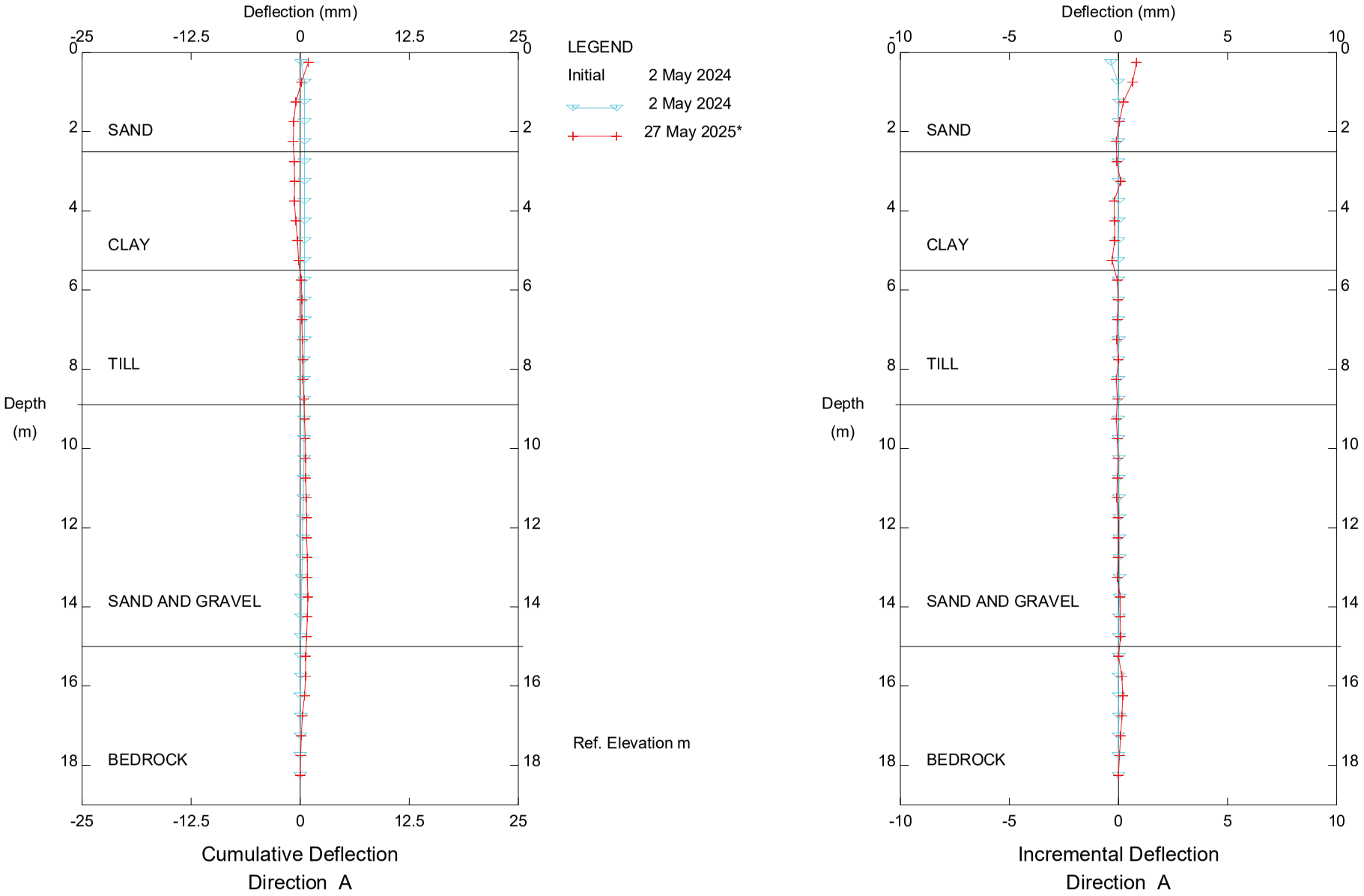

CRD Site 01, Inclinometer SI12-3

Sets marked * include zero shift and/or rotation corrections.

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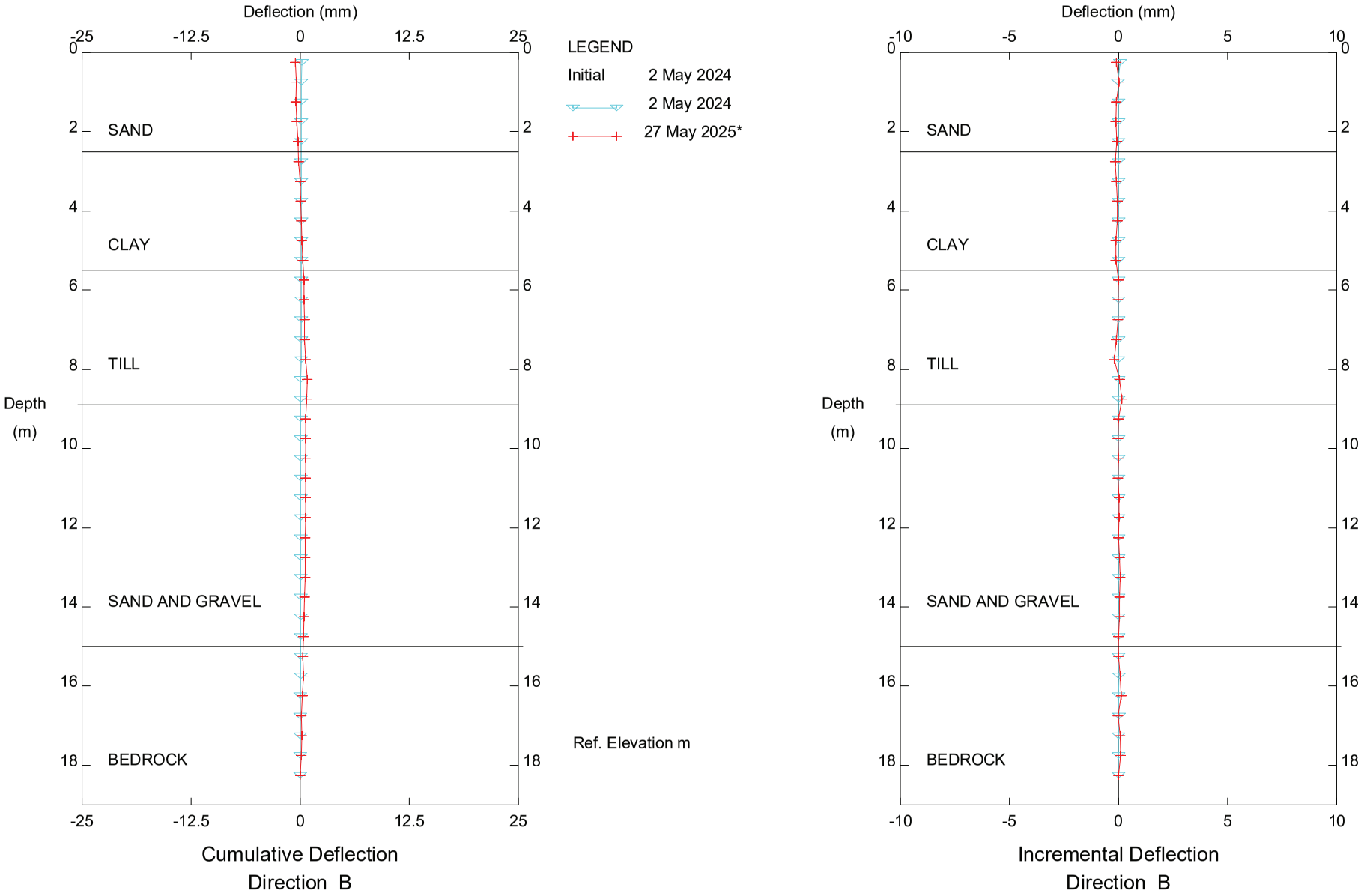
Stantec Consulting Ltd - Edmonton



CRD Site 01, Inclinometer SI12-3

Sets marked * include zero shift and/or rotation corrections.

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Stantec

City of Red Deer
Site Inspection Report

SITE NUMBER AND NAME:	**LOCATION:**
2 – Riverview Park	4 Cronquist Place to 20 Cronquist Close and 55 to 11 Warwick Drive, Red Deer, Alberta

	DATE	**AREA**	**PF(1)**	**CF(1)**	**TOTAL**
PREVIOUS INSPECTION:	November 1, 2022	Lots 4 to 12	9	8	72
		Lots 13 to 22	7	8	56
		Warwick Drive	5	2	10
CURRENT INSPECTION:	May 27, 2025	Lots 4 to 12	9	8	72
		Lots 13 to 22	7	8	56
		Warwick Drive	5	2	10
INSPECTED BY:	Stantec: Sonja Pharand and Benjamin Lou				
REPORT ATTACHMENTS:	Figure 1 – Overall Plan Site Photos				
Note: (1) PF and CF are the Probability Factor and Consequence Factor as defined in the City of Red Deer Risk Ranking Guidelines.					

PRIMARY SITE ISSUE:

Multiple landslides on the south valley slope of the Red Deer River.

APPROXIMATE DIMENSIONS:

Dimensions vary by location. Typical landslide is up to 30 m wide with an undefined toe.

SITE HISTORY

From “Riverview Park Development Setback” report by Parkland Geo dated June 2014:

- The 15 m wide buffer for an old road allowance between the rear of the residential properties and the slope crest had been eroded throughout the years; however, regression did not extend to the residential properties.
- The estimated rates of crest regression behind Lots 2 to 22 were provided, and ranged from 150 mm/year to 650 mm/year.
- Risk maps were provided for the Site, in order to present estimated slope conditions for the area at 50, 75 and 100 years.
- Based on the present (2014) risk map, the homes on Lots 6, 7, and 12 had a factor of safety (FS) less than 1.3. The 50 year risk map, produced using estimated regression rates, indicated that the homes on Lots 4, 8, 9, 10, 11, 14, and 22 would be at risk of having an FS < 1.3 by 2054.

From “2018 Slope Evaluation Project” report by Parkland Geo dated April 2019:

- Riverview Park was subdivided into 24 lots in the mid 1960’s and was fully developed by 2000.
- Two medium sized landslides have occurred in the upper slope at Lot 16 and at the west end of Warwick Drive since the 1960’s.
- The slope face in the west half of Riverview Park (lots 2 to 12) was subject to active face regression due to ongoing toe erosion. This was addressed in 2016 with placement of a riprap toe berm along the shoreline below Heritage Ranch and Riverview Park.
- The general subsurface stratigraphy consists of the following in descending order:
    - 5 m to 10 m of lacustrine sand, silt, and clay
    - 2 m of sand and gravel
    - 10 m to 12 m of clay till. The local till is known to contain boulders and water-bearing sand and gravel.

  - Top of bedrock at elevations ranging from approximately 848 m to 866 m. Shallower bedrock is typically found at the west end of Riverview Park.
- The groundwater table in the upland areas is hydraulically connected to the Red Deer River resulting in a significant drop in the groundwater level below the crest. Groundwater levels about 40 m behind the crest were measured to be about 10 m below grade. The groundwater level in the Westlake subdivision was 3 m to 6 m below grade. Springs are common at varying elevations along the exposed slope face from Lots 2 to 12 at Riverview Park.
- The river elevation is typically at about 852 m.
- The average toe regression between Lots 3 and 12 at Riverview Park was estimated to be about 300 mm/year to 650 mm/year. Parkland Geo estimated an additional crest loss of 2 m to 5 m may occur between Lots 3 to 12 over the next 5 to 10 years (i.e., 2023 to 2028 from time of Parkland Geo's report submission).
- Parkland Geo completed a slope stability analysis after construction of the riprap toe berm in 2016. The analysis indicated the following:
  - In general, the private property line for Lots 7 and 8, general slope face, lower slope, and upper slope at crest, were at risk (Factor of Safety ≤ 1.0).
  - All other structures and property lines were not considered to be at risk (Factor of Safety 1.0 – 1.7).
- Development setbacks indicate the buildings on Lots 6, 7, 12, 13, and Lot 22 are within the setback defined by a Factor of Safety (FS) of 1.3. Lots 4, 14, and 19 are within the setback defined by FS = 1.5. The City purchased Lot 7 and 12 and demolished the houses on the property due to their proximity to the slope crest representing an unacceptable level of risk.

From "2022-2023 Geohazard Site Inspections Summary for Various Sites in the City of Red Deer" report by Stantec dated October 2023:

- The old building at Lot 6 was demolished with a new building constructed further south.
- No buildings were observed on Lot 22.
- The City reported that the homeowner at Lot 6 had complained about high groundwater towards the south end of the property.
- A resident of Warwick Drive provided anecdotal evidence that the east landslide on Warwick Drive is approximately 15 years old and began as a ground crack approximately 5 m below the crest of the slope. The resident indicated that this slide location may be in an area of possible backfill.
- A deck was constructed at the back of Lot 14 and appears to be founded in the slope. A landslide in this zone would have a direct impact on this structure. However, the deck may have been constructed outside of private property and within reserve land.

ITEM	CONDITIONS EXIST		DESCRIPTION AND LOCATION	NOTICEABLE CHANGE FROM LAST INSPECTION	
	YES	NO		YES	NO
Building Distress		X	Previously at-risk buildings have been demolished.		X
Slope Movement	X		Multiple localized landslides observed with some apparent retrogression towards the private properties. Ground cracking observed at the slope crest at Lot 18.	X	
Erosion		X			X
Seepage	X		Saturated ground on reserve land behind Lot 10 and Lot 14.	X	

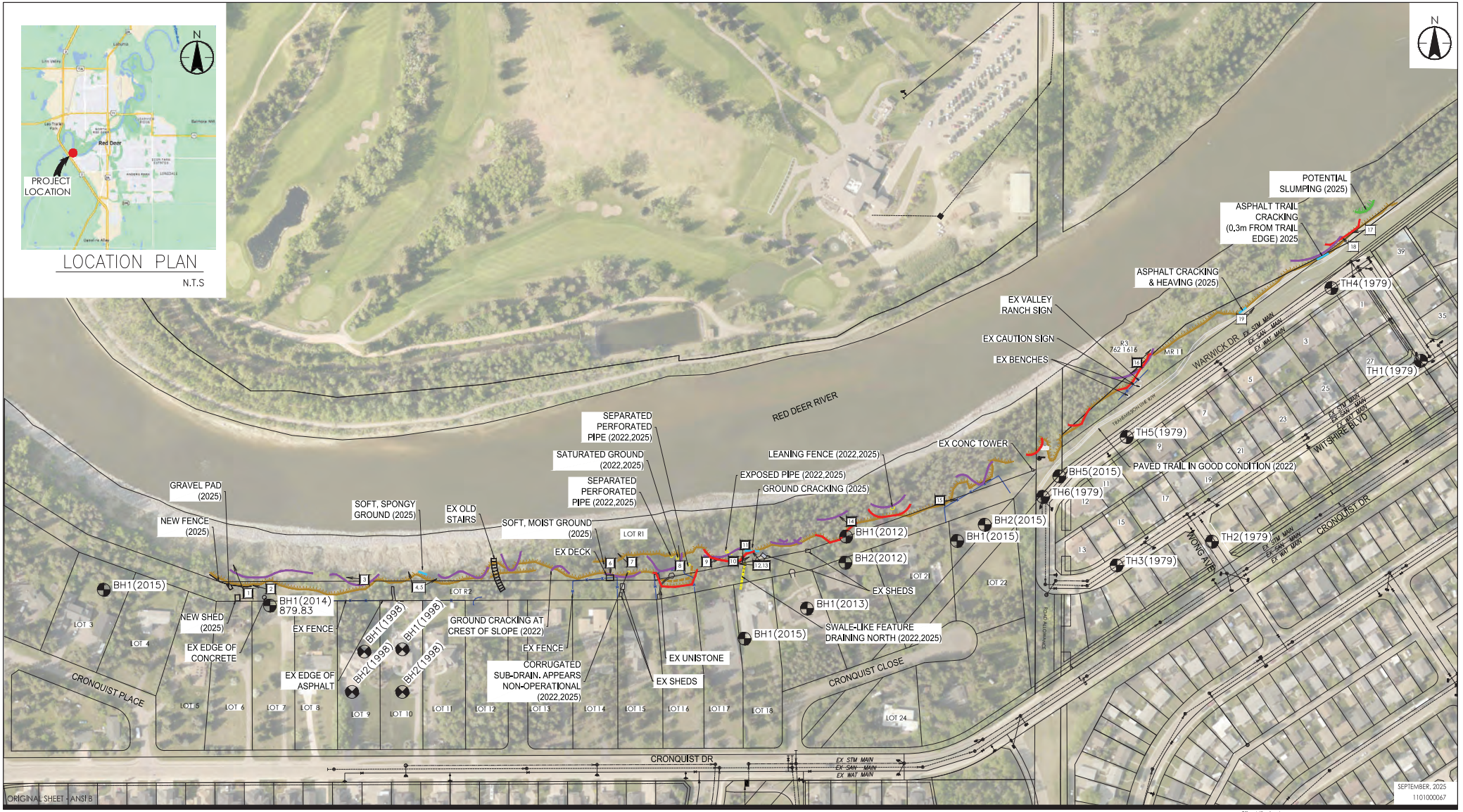
OBSERVATIONS AND ASSESSMENT
• Stantec inspected the site from Lot 4 eastward.

- A new shed and a flat gravel pad area were observed near the back of Lot 6 (Photo 1). A landslide in this zone would likely have a direct impact on the gravel pad. The shed appears to be inside the setback distance for a slope with a factor of safety of 1.3 based on Parkland Geo's (2014) analysis.
- Landslide features, leaning, curved, and fallen trees were generally observed throughout the south river valley slope at random locations (Photos 2, 3, 9, 12, 14, 15, and 16). Small amounts of undermining were also observed throughout the site behind Lots 11, 15, 18 (Photo 5, 7, 10). The slides seem to vary in age based on vegetation growth. Generally, the site appeared to be in a similar condition as observed in 2022.
- Soft, spongy, vegetated ground was noted at Lot 10 near the crest (Photo 4).
- The fresh ground cracking observed at the crest of the slope in Lot 13 during Stantec's 2022 inspection was not observed during the 2025 inspection, possibly due to vegetation growth. The wooden fence further down the slope behind Lot 13 was observed to be in a similar state as the 2022 inspection, with some of the fence secured in the ground and about half of the fence near horizontal
- Moist, soft ground was also observed at Lot 14 near the existing deck built off the slope, within the reserve land (Photo 6).
- During the site inspection, the homeowner at Lot 14 expressed concerns regarding slope stability due to soft ground conditions and dying trees. The homeowner stated that the spruce trees behind his lot have been dying from an unknown cause. Additionally, one tree fell onto his deck and cracked a support member during a strong windstorm. The homeowner also confirmed that he and his neighbours have been watering their lawns. Stantec directed the homeowner at Lot 14 to contact the City about their concerns.
- Additional landslide features and fallen trees were observed between Lots 13 and 15, similar to the 2022 inspection. The slides appeared to vary in age.
- Multiple pipes and/or subdrains were observed to be leading into the river valley slope between Lots 14 and 16, similar to 2022, presumably for drainage purposes (Photo 8).
- A swale-like feature was observed on the west side of Lot 18 in the backyard. The swale appears to be draining towards the river valley slope (Photo 11) and does not appear changed from the 2022 site inspection.
- Fresh ground cracking was observed near the crest of the slope in Lot 18 (Photo 13).
- An old fence was observed down the slope behind Lot 21, with the posts still in the ground, similar to 2022.
- The crest of the landslide at Lot 22 was observed to be approximately 0.5 m away from the fence, similar to 2022. The fence appears to be leaning slightly and several large trees have fallen.
- The landslides along the slope appear to be inactive or are exhibiting as localized slumping and have not impacted any main structures. As indicated by the Present Risk Map produced by Parkland Geo (2014), not all of the houses on Lots 2 to 22 are outside of the FS = 1.5 setback. In particular, the house on Lot 13 and an out-building on Lot 22 appear to be at the FS = 1.3 setback.
- The paved multi-use pathway between Warwick Drive and the crest of the slope is generally in good condition, similar to 2022.
- Landslides were observed on the west and east sides of Warwick Drive. The west and east slides are approximately across from Lots 8 and 1 on Warwick Drive, respectively. The crest of the eastern slide appears to be approximately 0.5 m from the edge of the multi-use pathway, and the crest of the western slide is approximately 10 m from the pathway, behind a post and cable barrier (Photos 17 and 18). The east slide is well vegetated; however, the scarps of the west slide are not vegetated. Both slides appeared similar as observed in 2022 and are likely inactive or slow moving.
- Small ground cracking and heaving were observed at two locations on the edge of the paved multi-use pathway along Warwick Drive (Photo 19). These cracks and heaves may be due to roots from nearby trees, or normal wear-and-tear.
- A ravine and two old landslides are present at the west end of Warwick Drive across from Lot 11. The areas were well-vegetated with trees that appeared vertical, similar to 2022.
- Based on the June 2023 survey by Stantec Geomatics and the current visual observations, the landslide features observed are not immediately impacting private property but are impacting reserve lands.
- The Probability and Consequence Factors remain the same as 2022.

RECOMMENDATIONS

- Survey pins could be installed to monitor crest retrogression towards reserve land and/or private property.
- Existing subdrain systems should be inspected to ensure water is not leaking into the slope. In addition, existing subdrains could be extended further down the valley slope to reduce potential erosion. Future subdrains should direct water towards the upland areas and away from the river valley slope.
- Regrade ground cracks along the crest (e.g., Lots 13 and 18) to seal and reduce surface water infiltration into the slope. No additional fill should be placed for regrading. Any vegetation removed for regrading the landslide should be reinstated to maintain slope stability.

- The swale-like feature at Lot 18 should be regraded such that channelized surface water flow towards the river valley slope is reduced.
- Watering of back lawns should be avoided since addition of water into the slope could be detrimental to its stability.
- Any future lot development should plan for building development behind the FS = 1.5 setback. Utility services, cisterns, and septic systems should also be planned such that these structures are located as far away from the slope crest as possible.
- The recommended site inspection frequency for Site 2 remains at once every 2 years.



Legend

- SCARP/TOP OF BANK LOCATION (2023)
- TOE OF BANK LOCATION (2023)
- POTENTIAL SLUMPING (2025)
- 2025 OBSERVATIONS
- TOP OF LANDSLIDE (2018)
- APPROXIMATE TOP OF LANDSLIDE (2022)
- NEW FENCE (2025)
- EX FENCE
- BH# APPROXIMATE 2012 BOREHOLE LOCATION
- PHOTO NUMBER AND DIRECTION

AERIAL PHOTO- 2022 CITY OF RED DEER
CADASTRAL - 2021 CITY OF RED DEER
UTILITIES - 2012 DATA FROM CRD

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

Stantec
1100 - 4900 50th Street
Red Deer AB Canada T4N 1X7
www.stantec.com

Client/Project
City of Red Deer
SITE 2 - RIVERVIEW PARK SITE PLAN

Figure No.
1

Title
OVERALL PLAN

SCALE
1:2500

0 25 75 125m

2025 Inspection Photos at Site 2 – Riverview Park

Photo 1: Gravel pad near crest of slope behind Lot 6. Facing northwest.

Photo 2: Slide area behind Lot 7. Facing west.

2025 Inspection Photos at Site 2 – Riverview Park

Photo 3: Slide area behind Lot 9. Facing west.

Photo 4: Soft, spongy ground at crest behind Lot 10, and accumulation of discarded brush on slope. Facing northeast.

2025 Inspection Photos at Site 2 – Riverview Park

Photo 5: Slide behind Lot 11, looking from Lot 10. Facing east.

Photo 6: Soft, moist ground around deck structure on slope at Lot 14. Looking south (upslope).

2025 Inspection Photos at Site 2 – Riverview Park

Photo 7: Historical slide behind Lot 15. Facing northwest.

Photo 8: Two pipes behind between Lots 15 and 16 running towards river slope. Facing north.

2025 Inspection Photos at Site 2 – Riverview Park

Photo 9: Landslide at Lots 17 and 18, taken from Lot 17. Facing east.

Photo 10: Scarp of landslide behind Lot 18. Facing east.

2025 Inspection Photos at Site 2 – Riverview Park

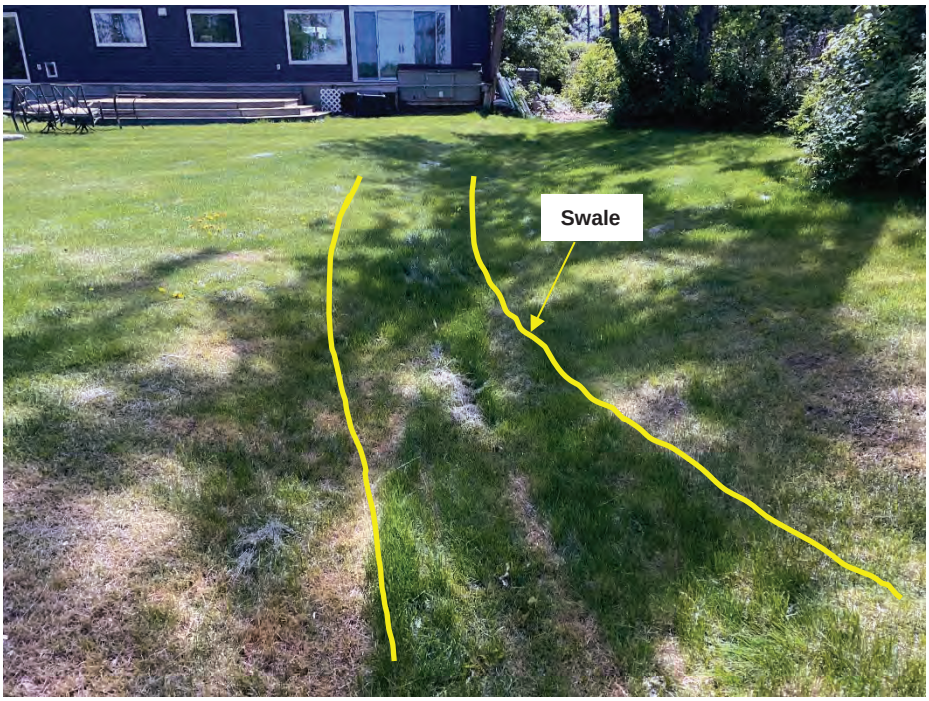


Photo 11: Swale like feature at Lot 18. Appears to be draining north towards river valley slope. Looking south.

Photo 12: Landslide behind Lot 18, from east extent of slide. Facing west.

2025 Inspection Photos at Site 2 – Riverview Park

Photo 13: Ground cracking behind Lot 18, looking northwest.

Photo 14: Landslide behind Lot 20. Facing west.

2025 Inspection Photos at Site 2 – Riverview Park

Photo 15: Slide behind Lot 21, looking downslope (east).

Photo 16: Slide at recreational trail lookout on Warwick Drive, facing northeast.

2025 Inspection Photos at Site 2 – Riverview Park

Photo 17: Slide at east end of Warwick Drive near recreational trail. Facing southwest.

Photo 18: Landslide at east end of Warwick Drive, looking down slope.

2025 Inspection Photos at Site 2 – Riverview Park

Photo 19: Cracking and heaving on edge of asphalt trail at east end of Warwick Drive. Looking east.

SITE NUMBER AND NAME:	**LOCATION:**
3 – Riverlands	East Slope of the Red Deer River from West Park Estates to Taylor Drive Bridge, Red Deer, Alberta

	DATE	**PF(1)**	**CF(1)**	**TOTAL**
PREVIOUS INSPECTION:	October 19, 2018	7	2	14
CURRENT INSPECTION:	May 26, 2025	7	2	14
INSPECTED BY:	Stantec: Sonja Pharand and Benjamin Lou City of Red Deer (the City): Lily Dam			
REPORT ATTACHMENTS:	Figure 1 – Overall Plan Site Photos 2025 Survey Files			
Note: (1) PF and CF are the Probability Factor and Consequence Factor as defined in the City of Red Deer Risk Ranking Guidelines.				

PRIMARY SITE ISSUE:

Multiple landslides on the south valley slope of the Red Deer River.

APPROXIMATE DIMENSIONS:

Dimensions vary by location. Typical landslide is up to 30 m wide with an undefined toe.

SITE HISTORY

From "2018 Slope Evaluation Project" report by Parkland Geo dated April 2019:

- The crest is vegetated with brush and trees with thicker vegetation near Taylor Drive Bridge. The land adjacent to the crest is a 5 m to 15 m wide park reserve strip. Approximately one half of the site is paralleled by 45th Street.
- Two major slope failures were assessed, one smaller failure at the northeast end of the site near Taylor Drive Bridge which occurred in 2014, and one larger failure at the southwest end of the site which occurred at an unknown time. The smaller failure was thought to have been caused by high river levels in 2013.
- The east end of the riverbank had evidence of small block slides and crest slumps which had been overgrown with trees and vegetation. Little evidence of toe scour along the shoreline was noted.
- The general subsurface stratigraphy consists of the following in descending order:
    - Up to 1 m of fill.
    - Up to 5 m of alluvial silt, sand and clay.
    - Up to 4 m of sand and gravel.
    - Top of bedrock at elevations ranging from approximately 847 m to 852 m.
- Groundwater levels in 2016 ranged from 3 m to 5 m below grade indicating high spring river levels.
- The river elevation is generally at about 851.5 m.
- The riverbank is relatively straight and is not subject to major erosion or slope regression. The regression was considered to be negligible.
- Parkland Geo completed a slope stability analysis indicating the following:
    - The short-term and long-term factor of safety (FS) of the slope face is approximately 1.0 to 1.1 indicating a marginally stable slope. Parkland Geo also indicated analyses with FS as low as 0.7 suggesting a failing slope under certain analysis.
    - The FS of the walking trail ranged from 1.1 to 1.3 suggesting marginally stable to stable slopes.
    - Analysis of 45th Street and areas further south indicates a FS >1.5 suggesting stable slopes.

ITEM	CONDITIONS EXIST		DESCRIPTION AND LOCATION	NOTICEABLE CHANGE FROM LAST INSPECTION	
	YES	NO		YES	NO
Building Distress		X			X
Slope Movement	X		Three failures on site. Two at the northeast end near Taylor Drive Bridge and one at the southwest end.	X	
Erosion	X		Some undermining at the southwest historical failure. Erosion channel below east PVC outlet.	X	
Seepage		X			X

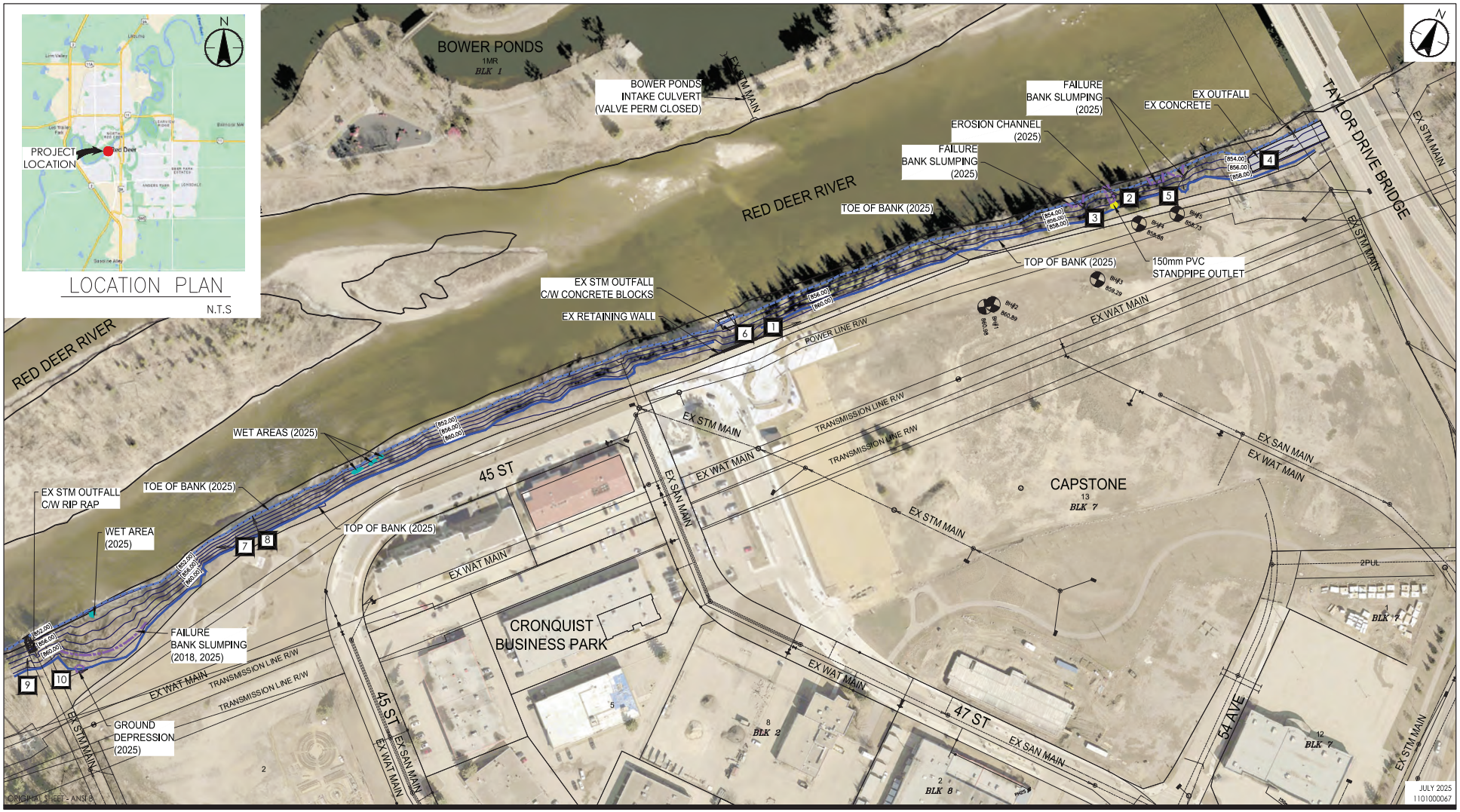
OBSERVATIONS AND ASSESSMENT

- Stantec surveyed the river valley crest with elevation ranging between 858 m to 862 m.
- The asphalt multipurpose trail appears to generally be in good condition with few cracks present (Photo 1).
- The crest and slope were generally well vegetated with brush and trees. The toe of slope was generally lined with riprap.
- A 150 mm diameter PVC pipe outlets onto the slope near the east end of the site. An erosion channel approximately 1 m to 2 m wide is present below the outlet, and trends down to the river (Photo 2).
- The two previous failures appeared to be unchanged from the last inspection in 2018 (Photos 3, 7, 8).
- Concrete armouring was observed on the headslope below Taylor Drive Bridge and approximately 200 m further west across the slope. The armouring ends at about halfway down the slope (Photo 4).
- One additional small failure was observed near the northeast end of site by Taylor Drive Bridge. The failure was localized and ground cracking was observed near the crest (Photo 5).
- Two outfalls were observed at the site, one near the end of 47 Street and the other beyond the bend of 45 Street, near the west end of the site. The one near the end of 47 Street consists of a large diameter pipe and the slope above it is reinforced with geoweb while the outlet area is protected from erosion by articulated concrete blocks (Photo 6). The other outfall at the west end of site outlets from a concrete structure onto riprap armouring the slope before entering the river (Photo 9).
- A depression in the ground approximately 0.1 m deep, 1 m wide, and 3 m long was observed between the crest and the trail on the southwest end of site (Photo 10).
- The survey team picked up features that they marked as “wet areas,” however these were not observed during the geotechnical site inspection.
- A standpipe piezometer (BH#4 on Figure 1) near the 150 mm PVC pipe outlet on the south side of the multipurpose trail was read as it was in close proximity to the site and the casing was found to be unlocked. The standpipe measured dry to 4.5 m below ground surface (approximately 854 m elevation). The installation depth of BH#4 is unknown to Stantec.
- The Probability Factor remains at 7 as the potential for a landslide is high following heavy rainfall or a rise in river levels. The Consequence Factor remains at 2 as a landslide could affect the trail but is not expected to affect 45th Street or private property.

RECOMMENDATIONS

- The landslides along the slope appear to be inactive, or exhibited as localized slumping and have not impacted the trail, road or private property. As such, landslide remediation is likely not required at this time aside from regular (say 5 years) inspections to monitor landslide activity.
- Survey pins could be installed to monitor crest retrogression towards the multipurpose trail.
- Surface drainage should be monitored and managed to avoid ponding water at the crest and further erosion of the riverbank. Future subdrains should direct water towards the upland areas and away from the river valley slope.
- Outfalls and existing drain systems should be inspected on a regular basis to ensure they remain functional and are not leaking water into the slope or onto the slope failure.
- Existing subdrains could be extended further down the slope to reduce erosion. Alternatively, where erosion is present, riprap could be placed on the slope.
- Watering of the grass near the slope should be avoided since addition of water into the slope could be detrimental to its stability, particularly near the existing failures.

- Regrade ground cracks and depressions along the crest to seal and reduce surface water infiltration into the slope. No additional fill should be placed for regrading. Any vegetation removed for regrading the landslide should be reinstated to maintain slope stability.
- If the failures begin to retrogress and the trail becomes at risk, potential remediation options for the slope may include reinforcing the slope with soil nails, constructing a pile wall or armouring/buttressing the riverbank. Alternatively, the trail could be realigned closer to 45th Street to provide a wider buffer from the crest of the river valley.
- Stantec recommends the inspection frequency of once every 5 years or “as needed” if signs of instability appear or if ground cracking and pavement cracking worsen.



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2025.07.15 7:58:01 AM

Stantec

1100 - 4900 50th Street
Red Deer AB Canada T4N 1X7
www.stantec.com

Legend

- 2025 TOP OF BANK
- 2025 TOE OF BANK (APPROX.)
- 2025 SLUMP AREA
- 2025 WET AREA
- [874.00] 2025 CONTOURS
- PHOTO NUMBER AND DIRECTION

AERIAL PHOTO- 2022 CITY OF RED DEER
CADASTRAL - 2021 CITY OF RED DEER
CONTOURS - BASED ON 2016 LIDAR
UTILITIES - 2012 DATA FROM CRD

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

Client/Project
City of Red Deer
SITE 3 RIVERLANDS
SITE PLAN

Figure No.
1

Title
OVERALL PLAN

SCALE
1:2000
0 20 40 100

2025 Inspection Photos at Site 3 – Riverlands

Photo 1: Trail asphalt in good condition. Facing northeast.

Photo 2: Northeast outfall directing into 150 mm PVC pipe. Erosion channel is approximately 1-2 m wide below the outlet. Looking west.

2025 Inspection Photos at Site 3 – Riverlands

Photo 3: Northeast historical failure. Looking north.

Photo 4: Taylor Drive Bridge and concrete slab armouring on headslope. Looking north.

2025 Inspection Photos at Site 3 – Riverlands

Photo 5: Slope failure at northeast end with ground cracking near crest. Facing northeast.

Photo 6: Outfall with the above slope reinforced with geoweb and outlet area protected by articulated concrete blocks at middle of site. Facing north.

2025 Inspection Photos at Site 3 – Riverlands

Photo 7: Historical slump at southwest end. Facing west.

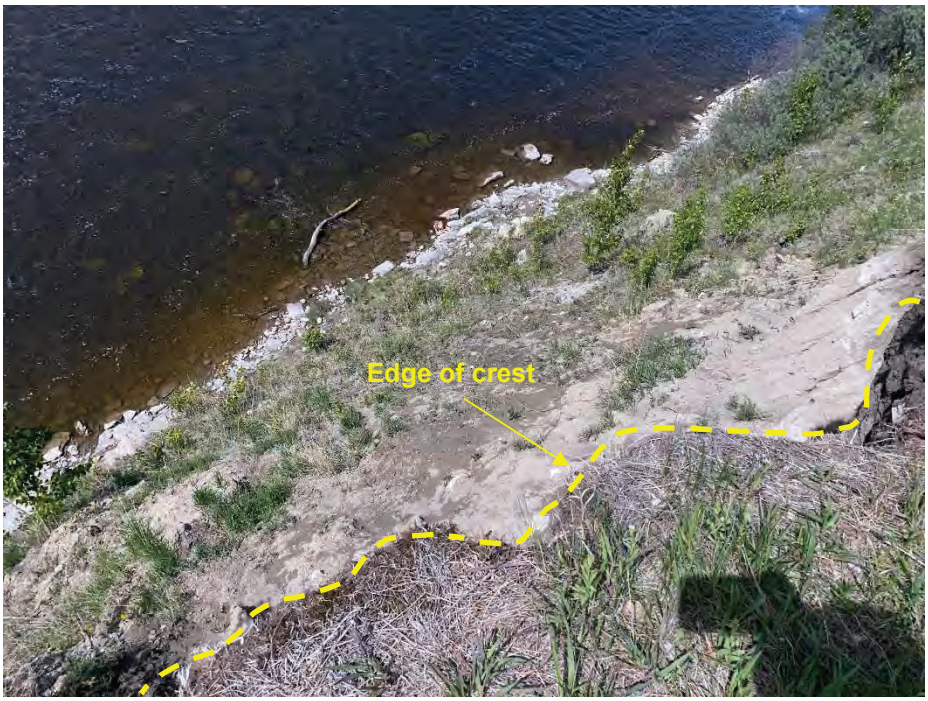


Photo 8: Historical slump at southwest end. Facing down (north).

2025 Inspection Photos at Site 3 – Riverlands

Photo 9: Southwest outfall. Facing north.

Photo 10: Ground depression between crest and trail at southwest end. Facing east.

Stantec

City of Red Deer
Site Inspection Report

SITE NUMBER AND NAME:	**LOCATION:**
5 – Spruce Drive, Waskasoo Creek	Waskasoo Creek, approximately 200 m northwest from the intersection of 37 Street and Spruce Drive, Red Deer, Alberta

	DATE	**PF(1)**	**CF(1)**	**TOTAL**
PREVIOUS INSPECTION:	November 1, 2022	7	2	14
CURRENT INSPECTION:	May 26, 2025	7	2	14
INSPECTED BY:	Stantec: Sonja Pharand and Benjamin Lou			
REPORT ATTACHMENTS:	Site Plan Site Photos Slope Inclinometer Plots			
Note: (1) PF and CF are the Probability Factor and Consequence Factor as defined in the City of Red Deer Risk Ranking Guidelines				

PRIMARY SITE ISSUE:

Regressive landslide caused by erosion on the outer bank of a meander on Waskasoo Creek.

APPROXIMATE DIMENSIONS:

35 m long x 40 m wide

SITE HISTORY

From “2018 Slope Evaluation Project” report by Parkland Geo dated April 2019:

- Before 1950, there was a local access road that ran across the present embankment of Waskasoo creek. In the mid-1950s, the present sloped embankment was constructed by backfilling over much of the old access road.
- Erosional activity at the embankment toe from Waskasoo Creek began sometime between 2000 to 2009 which eventually resulted in high bank regression.
- In 2014, the embankment between Spruce Drive and Waskasoo creek experienced a landslide that blocked and diverted the creek channel up to 15 m north from its pre-slide location.
- The landslide was assessed in 2015 and it was determined that so long as the bank could be stabilized, the risk to Spruce Drive was considered to be minimal and did not warrant major remediation works.
- In 2017, the landslide site was cleared of debris and the creek alignment was repaired. The outside bank of the creek was stabilized and the slope above the toe was graded into the steep upper slope area. The creek bend was stabilized with a gravel toe berm and the area above the scarp was selectively logged to reduce the chance of trees falling. The upper slope area above the landslide was left largely “as-is.”
- A slope stability analysis was conducted on the repaired slope in 2018. In general, the lower slope (old failure bowl), the upper slope face and the pathway were all at risk (Factor of Safety, FS ≤ 1.0). The crest near the sidewalk was estimated to have a FS of 1.2 and the east curb of Spruce Drive had a FS of 1.4.
- The subsurface stratigraphy consists of the following in descending order:
  - Compact sand fill to elevation 866 m.
  - Low to medium plastic interbedded layers of lacustrine silt and clay to elevations 865.0 m to 866.4 m.
  - Firm medium to high plastic lacustrine clay to elevation 863 m.
  - Very stiff medium plastic clay till to elevation 859.7 m.
  - Compact to dense fine sand to about 854 m.
  - Non-cemented sandstone bedrock.
- Groundwater elevations in the embankment above the slide area varied from 865 m to 862.5 m corresponding to about 5 to 10 m below ground surface. Normal creek water level is at about 854 m.

From “Instrumentation Readings at Red Deer Geohazard Sites 1, 5, and 17” report by Stantec dated June 2024.

- Previously documented instruments consisted of one slope inclinometer (BH1-SI).
- An anomalous zone at approximately 11.7 m bgs was noted and likely due to poor installation of the SI casing and not a movement zone. The SI casing was likely installed out of plumb.

- Baseline readings for BH1-SI were taken in November 2022.

ITEM	CONDITIONS EXIST		DESCRIPTION AND LOCATION	NOTICEABLE CHANGE FROM LAST INSPECTION	
	YES	NO		YES	NO
Building Distress		X			X
Slope Movement	X		Landslide at south creek bank. Steep backscarp with sloughing and possible crest regression.	X	
Erosion		X			X
Seepage		X			X

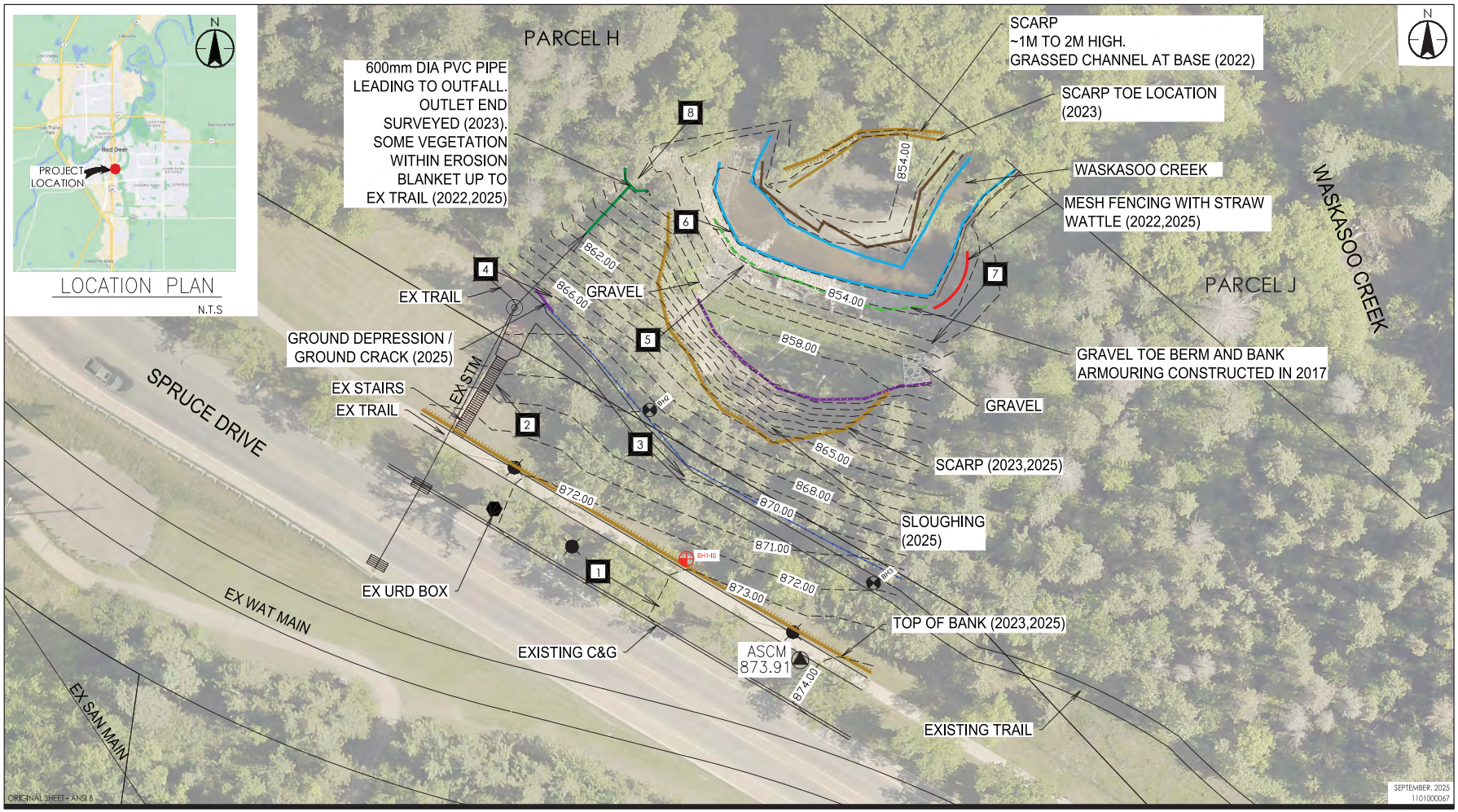
OBSERVATIONS AND ASSESSMENT

- No cracking was observed along Spruce Drive (Photo 1), similar to the last inspection in 2022.
- Minor cracking of the sidewalk at the top of the embankment crest was observed (Photo 2), similar to 2022. The cracks are likely unrelated to landslide activity.
- The unpaved trail at the crest of the slide appeared to be in generally good condition, with no cracking observed (Photo 3).
- A shallow ground crack filled with leaves / debris (Photo 4) was observed along the fence line of the trail, near the trail intersection at the west end of the site. Two large rocks had been placed across the trail at this location, moving trail users further away from the crest of the slope. It is unknown if the rocks and the ground crack are related.
- The site was generally well vegetated with grass, bushes, and trees (Photo 5).
- The creek riverbank was armoured with riprap (Photo 6).
- Straw wattles and mesh fencing were observed along the south creek bank at the east end of the landslide similar to the 2022 inspection.
- The embankment above the gravel toe berm is well-vegetated with tall grasses and shrubs. The backscarp remains exposed similar to the 2022 inspection. Some sloughing is present on the backscarp, possibly due to erosion. The crest has potentially regressed further south due to this erosion (Photo 7).
- The outfall about 10 m to 20 m west of Waskasoo Creek was observed. The structure was replaced in 2021 and appears to be in good condition, similar to 2022. The slope above the outfall is generally well vegetated (Photo 8).
- Slope inclinometer (SI) BH1-SI was monitored during this inspection. Since baseline readings in November 2022, no potential zones of movement have been observed. The observed movement is minimal and likely reflects noise rather than slope movement.
- The Probability Factor remains at 7 as the landslide could be considered as inactive with a high probability of remobilizing. The Consequence Factor remains at 2.

RECOMMENDATIONS

- Monitoring the landslide should be considered the minimum requirement for this site. Monitoring may include any of the following:
  - Installation of survey pins and collecting semi-annual survey (minimum) to identify slope movements. Once slope and/or crest movements have stabilized, survey frequency could be reduced.
  - Collecting readings from the slope inclinometer semi-annually to identify retrogressive slope movements.
  - Basic measurements at consistent locations along the slope crest can also be taken to monitor additional slope movements as a “rough check.”
- The landslide appears to be inactive, or relatively slow moving, and has not impacted any of the City’s infrastructure. However, retrogression of the slide may occur due to land use activity, wet weather, creek erosion at the toe, etc. and may result in loss of the trail, fencing, or outfall. Potential remediation options for the slope may include regrading and armouring the slope or installing a pile wall.
- Seal sidewalk cracks to reduce surface water infiltration.

- Regrade ground depressions along the trail fence to reduce ponding water and surface water infiltration. No additional fill should be placed for regrading. Any vegetation removed for regrading should be reinstated to maintain slope stability.
- Stantec recommends the inspection frequency remain at once every 5 years or “as needed”.



LOCATION PLAN
N.T.S

Legend

- SCARP/TOP OF BANK LOCATION (2023)
- BOTTOM OF BANK (2023)
- WATER EDGE (2023)
- GRAVEL ARMOURING (2023)
- BANK EROSION (2023)
- WOODEN FENCE
- BH# APPROXIMATE 2012 BOREHOLE LOCATION
- SI# BOREHOLE WITH SLOPE INCLINOMETER
- PHOTO NUMBER AND DIRECTION
- OUTFALL

AERIAL PHOTO- 2022 CITY OF RED DEER
CADASTRAL - 2021 CITY OF RED DEER
CONTOURS - BASED ON 2023 SURVEY

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

Stantec
1100 - 4900 50th Street
Red Deer AB Canada T4N 1X7
www.stantec.com

Client/Project
City of Red Deer
SITE 5 - SPRUCE DRIVE-WASKASOO CREEK SITE PLAN

Figure No.
2

Title
OVERALL PLAN

SCALE
1:500
0 5 15 25m

2025 Inspection Photos at Site 5 – Spruce Drive, Waskasoo Creek

Photo 1: Spruce Drive and boulevard between Spruce Drive and sidewalk. Facing southeast.

Photo 2: Sidewalk cracking above the embankment area. Facing east.

2025 Inspection Photos at Site 5 – Spruce Drive, Waskasoo Creek

Photo 3: Trail above landslide area. Facing southeast.

Photo 4: Ground crack near trail fence midway up embankment. Facing east.

2025 Inspection Photos at Site 5 – Spruce Drive, Waskasoo Creek

Photo 5: View of Waskasoo Creek bend from midway up embankment slope. Facing northeast.

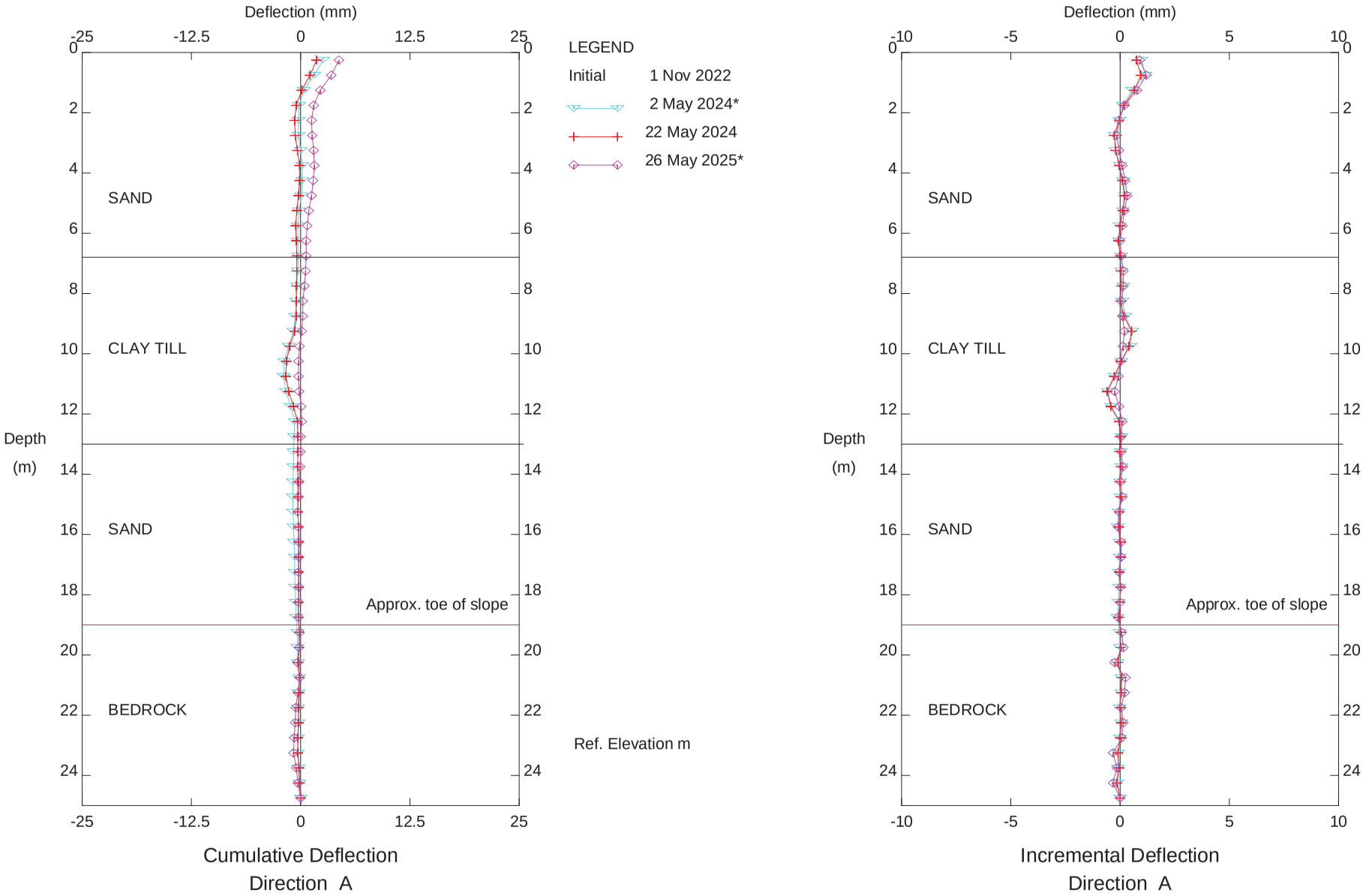
Photo 6: Waskasoo Creek bend with bank armoring. Facing southeast.

2025 Inspection Photos at Site 5 – Spruce Drive, Waskasoo Creek

Photo 7: Landslide area on south bank of Waskasoo Creek, note exposed scarp face. Facing southwest.

Photo 8: Outfall west of creek. Well vegetated above outfall. Facing southwest.

Stantec Consulting Ltd - Edmonton



CRD Site 05, Inclinometer BH1-SI

Sets marked * include zero shift and/or rotation corrections.

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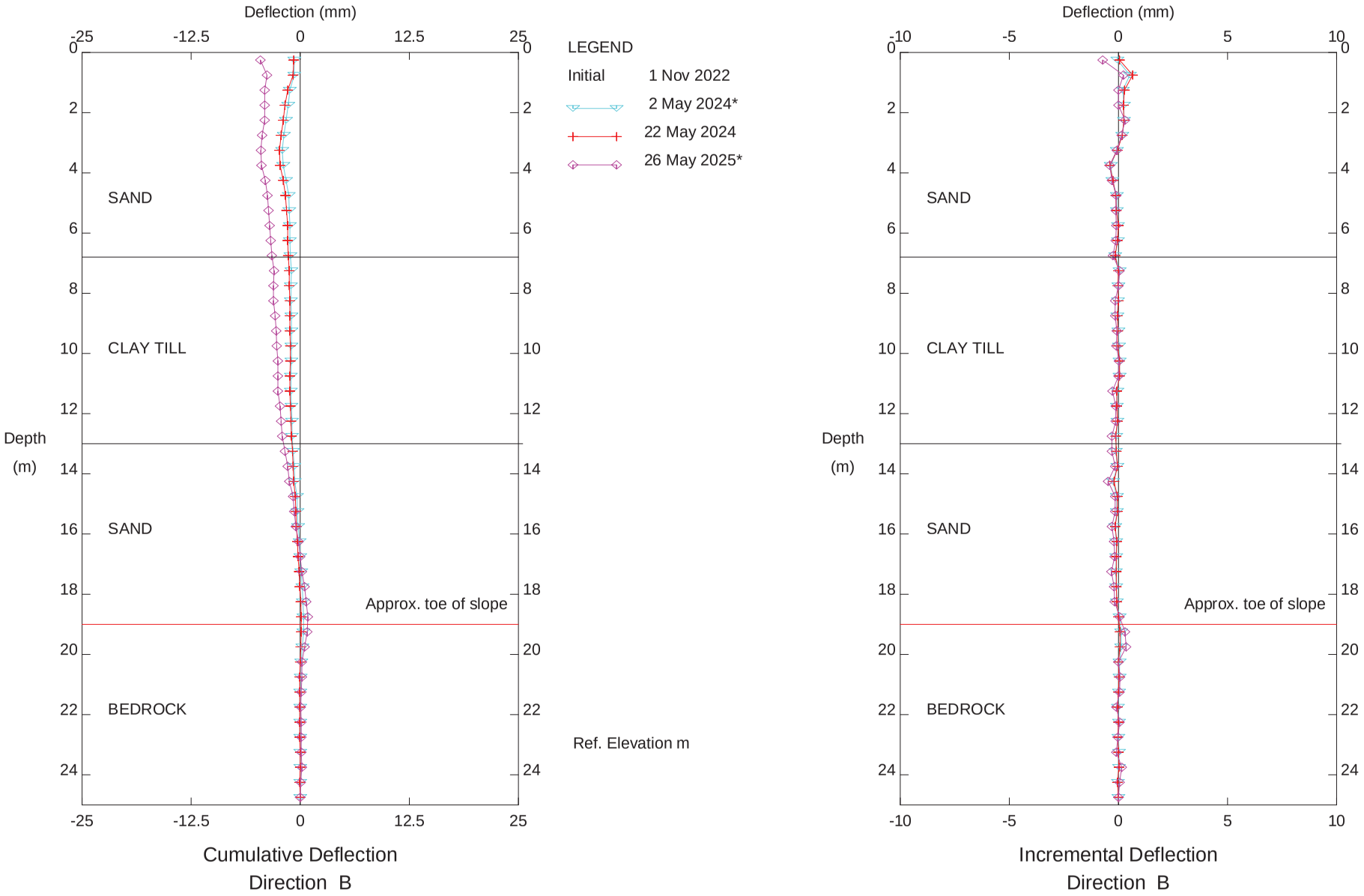
Stantec Consulting Ltd - Edmonton



CRD Site 05, Inclinometer BH1-SI

Sets marked * include zero shift and/or rotation corrections.

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Stantec

City of Red Deer
Site Inspection Report

SITE NUMBER AND NAME:	LOCATION:
6D – 44th Avenue Close	3910 44 Avenue, Red Deer, Alberta (Lot 2)

	DATE	PF(1)	CF(1)	TOTAL
PREVIOUS INSPECTION:	July 13, 2022	9	10	90
CURRENT INSPECTION:	May 26, 2025	9	10	90
INSPECTED BY:	Stantec: Sonja Pharand and Benjamin Lou City of Red Deer: Lily Dam			
REPORT ATTACHMENTS:	Figure 1 – Site Plan Site Photos Survey File			
Note: (1) PF and CF are the Probability Factor and Consequence Factor as defined in the City of Red Deer Risk Ranking Guidelines				

PRIMARY SITE ISSUE:
Historical landslide

APPROXIMATE DIMENSIONS:
50 m long x 35 m wide

SITE HISTORY

From "2018 Slope Evaluation Project" report by Parkland Geo dated April 2019.

- Both Lots 2 (subject lot) and 40 (neighbouring lot) are located on the crest of an ancient river valley slope.
- The lower portion of the valley slope generally had a moderate grade (~3H:1V) with mature trees and the upper portion of the slope had a steeper grade (up to 1.8H:1V). Uncontrolled fill was placed at the crest of the upper slope in the past, prior to residential development. The fill was relatively thick (up to 6 m) at the neighbouring property (Lot 40) and thinner (~2 m) at the subject site (Lot 2).
- The neighbouring lot (Lot 40) experienced cracking and sliding between 1970 and 1999.
- In early July 1999, the upper fill slope on the west side of Lot 40 started to fail. By mid-July, the crest of the scarp west of the house had dropped approximately 4 to 5 m. Seepage was observed in the failure scarp approximately 1 m below the house basement. In late July, a second slope movement occurred south of the first slide, extending into the side yard of Lot 2. The two slide areas combined and moved down slope, approximately 15 to 25 m from the toe of the original fill.
- In the winter of 1999 to 2000, the slope at Lot 40 was reconstructed using a 2.5 m high, 28 m long timber lagged retaining wall approximately 6 m west of the house on Lot 40. The lagging was restrained by steel H beams set in cast-in-place concrete piles and a whaler beam connected to grouted tie-back anchors a minimum of 13.5 m long. A gravel drain with weeping tile was placed in front of the wall.
- Further slipping was noted in 2001 and 2018, downslope of the retaining wall at Lot 40.
- The general subsurface stratigraphy (from investigations at Lot 40) consists of the following in descending order:
  - 3.0 m to 5.0 m of poor quality fill (moderate levels of organics mixed with clay fill) to an elevation of about 877 m
  - 1.5 m to 3.0 m of colluvial clay with silt, sand, topsoil, and other organic debris
  - 2.0 m to 8.5 m of firm to stiff silt, sand and lacustrine clay
  - Intermittent sand and gravel layers between the lacustrine clay and till
  - Low to medium plastic, stiff to very stiff clay till and sand till. Large boulders and water bearing sand and gravel layers were encountered within the till.
  - Siltstone and clay shale bedrock was encountered below the clay till at the toe of the slope, near an elevation of 853 m

- The groundwater table at the top of the slope at Lot 40 was measured at 6.7 m to 8.5 m below ground surface in 1981. In July 1999 after heavy rains, the groundwater table was measured up to 3.6 m below ground surface. By late summer of 1999, groundwater levels had dropped back to normal, over 5 m below ground surface. In 2018, ParklandGEO measured an existing standpipe which was sheared off at about 3.85 m below ground surface. This may indicate that the slip surface near the crest of the slope is approximately 3.8 m deep.
- ParklandGEO noted that the house on Lot 2 is likely on shallow footings, buried approximately 1.2 m below ground surface.

From "3910 44 Avenue Slope Stability Investigation Summary" report by Stantec dated July 2022.

- According to the landowner at Lot 2, the landside occurred in the backyard during the night of July 10, 2022.
- Cracks and depressions in the backyard were first noticed by the landowner on July 6, 2022. Conditions worsened and eventually lead to the landslide.
- No signs of instability were noted in the front yard and the immediate area around the residence during the emergency call out inspection on July 13, 2022.
- The landslide spans over most of the backyard and encroached into the neighbouring properties near the toe. The backscarp was about 50 m long, slightly encroached the patio base to the north and had an approximately 60 to 70 degree steep face. The soil exposed on the face was predominantly high plastic lacustrine clay overlain by clay fill.
- The landslide was likely triggered by the prolonged heavy rainfalls in summer 2022. Increase in soil weight, reduction in the matric suction in the colluvium and rising groundwater level from rainfall could be attributed to the reduced stability of the slope and likely to have caused the landslide.
- It was observed that the toe of the landslide mass exits at about one third the height of the entire valley slope. Leaning trees were observed near the toe of the landslide, and a toe bulge of about 1.0 to 1.5 m in height was observed in the tree line.
- Several old, curved trees were observed in the landslide mass, suggesting previous slope movement of the valley slope.
- Stantec surveyed the site on July 14, 2022 and established reference points for future comparison.

ITEM	CONDITIONS EXIST		DESCRIPTION AND LOCATION	NOTICEABLE CHANGE FROM LAST INSPECTION	
	YES	NO		YES	NO
Building Distress		X			X
Slope Movement	X		Landslide in backyard of 3910 44 Avenue property. The scarp is approximately 3.5 m to 4.0 m tall with a steep face. Additional slumping has occurred.	X	
Erosion	X		Large erosion channel located at north end of landslide.	X	
Seepage		X			X

OBSERVATIONS AND ASSESSMENT

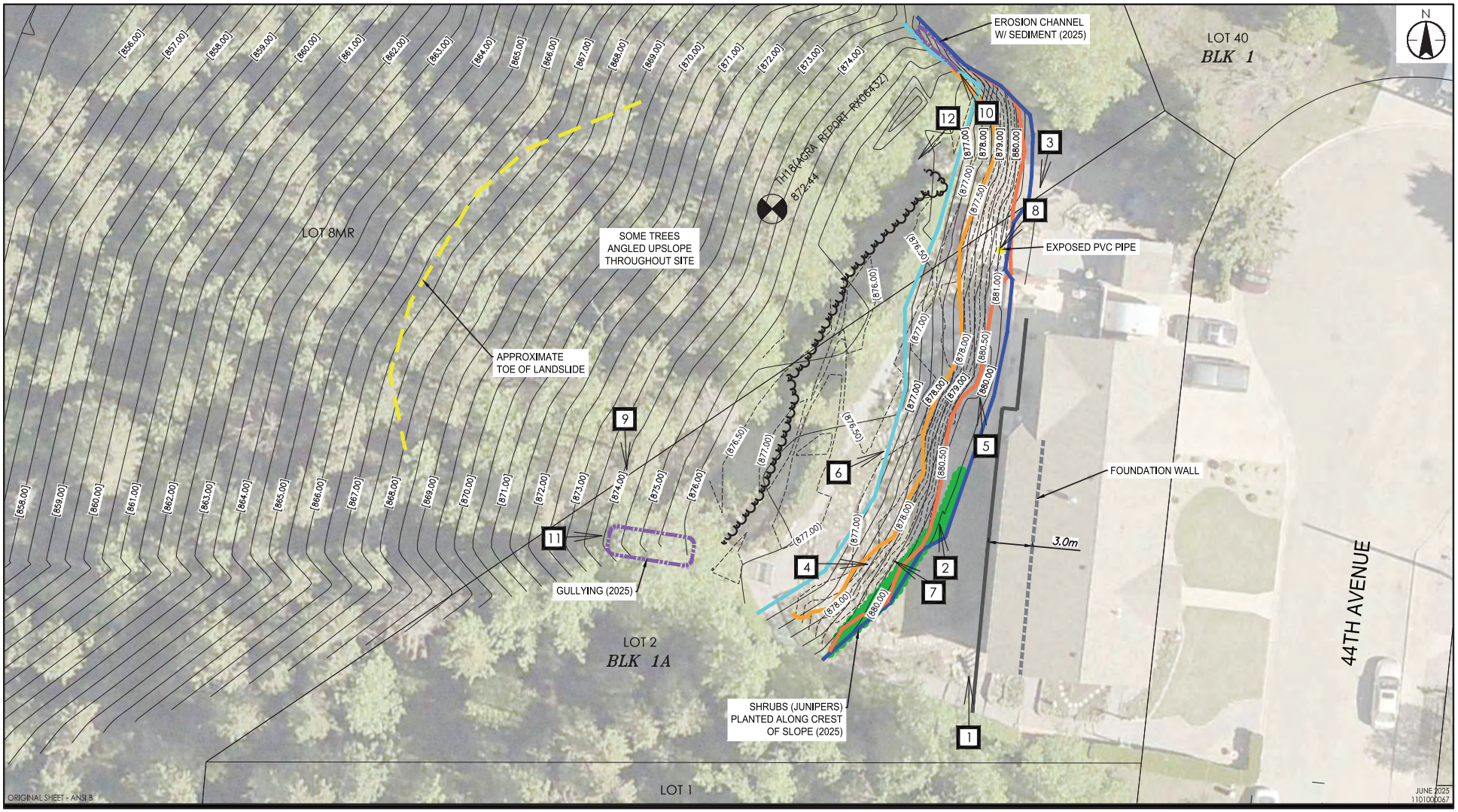
- No signs of instability were observed in the front yard and immediately around the residence, similar to the call-out inspection observations in 2022.
- An about 3 to 8 m wide lawn area between the failed slope and the building appears undisturbed by the slide (Photos 1 and 2). The remaining lawn has been reduced (due to slough) from 2022 as shown in the attached figure. A row of junipers has been planted along the crest of the slope.
- The landslide spans over most of the backyard and encroaches Lot 8MR near the toe. The backscarp was about 50 m long, and generally followed the boundary between the garden and the grassed area with about 3.5 m to 4 m height drop (Photos 2, 4, and 6). These observations appear unchanged from the call-out observations in 2022.

- The backscarp has a moderately steep face (~45 to 60 degrees), different from the 2022 inspection where a steep face of 60 to 70 degrees was observed. The crest has regressed further east, towards the house, likely due to a combination of erosion and slumping activity as the material within the embankment attempts to reach its angle of repose (stable angle). The toe of the scarp has also moved further west, and the decorative rock that was at the toe during the 2022 inspection was not observed (Photo 4).
- The exposed soil was predominately high plastic lacustrine clay overlain by clay fill. The fill appears generally thicker towards the north end. No apparent seepage was observed, and the slope appears lightly vegetated with signs of ongoing erosion (Photos 2 to 6). Given the soil type, the slope may experience further slumping in some areas in order to reach the soil's angle of repose, which may be around 45 degrees or flatter.
- The deck has been lowered and the railing has been removed since the 2022 inspection. The backslope previously encroached on the edge of the patio on the west side of the deck. The backslope has regressed to encroach on the west edge of the deck (Photos 3 and 5).
- The landowner had the scarp and crest blocked with ladders, wood, patio furniture, etc. to deter the deer who are apparently climbing up and down the scarp. Deer tracks were observed on the exposed soil within the scarp.
- The lower portion of the backyard appears to be in use by the landowner (Photo 7).
- A black PVC pipe was observed exiting the backscarp near the crest, on the north side of the house, similar to 2022 (Photo 8).
- Random cracks were observed in the landslide mass, similar to 2022 (Photo 9).
- An erosion channel was observed at the northwest end of the scarp, leading downslope (Photo 10).
- Erosion gullying was observed in an area near the south side of the landslide, further downslope from the existing yard (Photo 11). This gullying may be the result of overland drainage through cracks formed in the slide mass during the slide event. The surrounding slope is moderately vegetated with shrubs and small trees.
- The toe of the landslide mass exits at about one third the height of the entire valley slope.
- The City's recreational trail along Waskasoo Creek is below the toe of the slide.
- Leaning trees were observed within the slide zone (Photo 12), and a toe bulge about 1.0 to 1.5 m in height was observed in the tree line, similar to 2022.
- Further to the site inspection conducted by Stantec and the City on May 26, 2025, Stantec conducted a survey of the site on May 28, 2025. The survey noted the edge of crest had regressed up to 3 m in some locations compared to the previous survey conducted by the City in July 2022. A comparison of the surveyed crest in 2022 and 2025 is shown on the attached figure. It should be noted that the surveyed crest was taken on the east side of the newly planted junipers (south side of crest), therefore some error between the 2022 and 2025 surveyed crest may be present.
- The Probability Factor remains at 9 since the landslide appears to have regressed in some locations since the 2022 inspection. The Consequence Factor remains at 10 due to potential loss of the house and impact to public safety as a result of landslide.

RECOMMENDATIONS

- The City should inform the landowner of the following:
  - Monitor the immediate area around the house and remaining backyard regularly for signs of instability such as cracks, surface depressions, sudden wet spots, etc.
  - Ground pins were installed in the backyard 3 m away from the house. If the above signs develop between the back wall of the house and the pins, the structural integrity of the house could be compromised, and should be considered unsafe for habitation. Activities including walking, climbing, digging, etc. in the backyard near the edge of scarp should be avoided. Additional gardens, lawn ornaments, or furniture should not be placed within 3 m of the crest of the slope.
  - Maintain proper drainage around the building and the backyard. Water should not be allowed to pond at the ground surface, and the lawn/gardens should not be watered to reduce water infiltration into the failing slope mass. The landowner could consider keeping the grass high to help reduce water infiltration into the soil.
  - Existing drain / irrigation systems should be inspected to ensure water is not leaking into the slope or onto the slope failure. Existing subdrains could be extended further down the slope to reduce potential erosion. Future subdrains should direct water away from the slide mass, to the south or east.

- Previous work completed by Parkland Geo focused on the landslide at Lot 40. The City should advise the landowner of Lot 2 that a site specific geotechnical investigation should be completed to provide a detailed assessment of the landslide hazard relative to Lot 2. A new slope stability analysis should be performed as part of the geotechnical assessment to determine the failure zone, the Factor of Safety of the existing slope and a safe setback distance from the landslide.
- Stantec recommends annual site inspections while the house on Lot 2 remains occupied.



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2025.06.23 11:05:54 AM

Stantec

1100 - 4900 50th Street
Red Deer AB Canada T4N 1X7
www.stantec.com

Legend

- PHOTO NUMBER AND DIRECTION
- 2022 EDGE OF CREST
- 2022 TOP OF LANDSLIDE
- 2022 APPROX. TOE OF LANDSLIDE
- EDGE OF BUSHLINE
- 3m MARK OUTSIDE HOUSE FOUNDATION
- 2025 OBSERVATIONS
- 2025 CREST OF LANDSLIDE
- 2025 TOE OF LANDSLIDE
- SHRUBS (2025)
- (874.00) 2022 CONTOURS
- [874.00] 2025 CONTOURS

Client/Project
City of Red Deer
SITE 6D SLOPE INSPECTION
(3910 44 AVENUE)

Figure No.
1

Title
OVERALL PLAN

SCALE
1:250
0 2.5 7.5 12.5m

2025 Inspection Photos at Site 6D – 3910 44 Avenue

Photo 1: Back of house and remaining yard behind scarp, facing north.

Photo 2: Backyard and crest of slide, facing north.

2025 Inspection Photos at Site 6D – 3910 44 Avenue

Photo 3: Side yard and deck at crest of slope, facing south.

Photo 4: Backyard, landslide backscarp showing ~3.5 m drop. Facing northeast.

2025 Inspection Photos at Site 6D – 3910 44 Avenue

Photo 5: Backscarp encroaching the patio, facing north.

Photo 6: Exposed soil at backscarp. Lightly vegetated, at less of an angle. Facing northeast.

2025 Inspection Photos at Site 6D – 3910 44 Avenue

Photo 7: Landslide mass looking downslope (west).

Photo 8: Exposed pipe at crest. Looking down to slide mass from north side of house, facing southwest.

2025 Inspection Photos at Site 6D – 3910 44 Avenue

Photo 9: Open cracks in landslide mass, looking south.

Photo 10: Erosion channel on north end of scarp, heading downslope. Looking northwest.

2025 Inspection Photos at Site 6D – 3910 44 Avenue

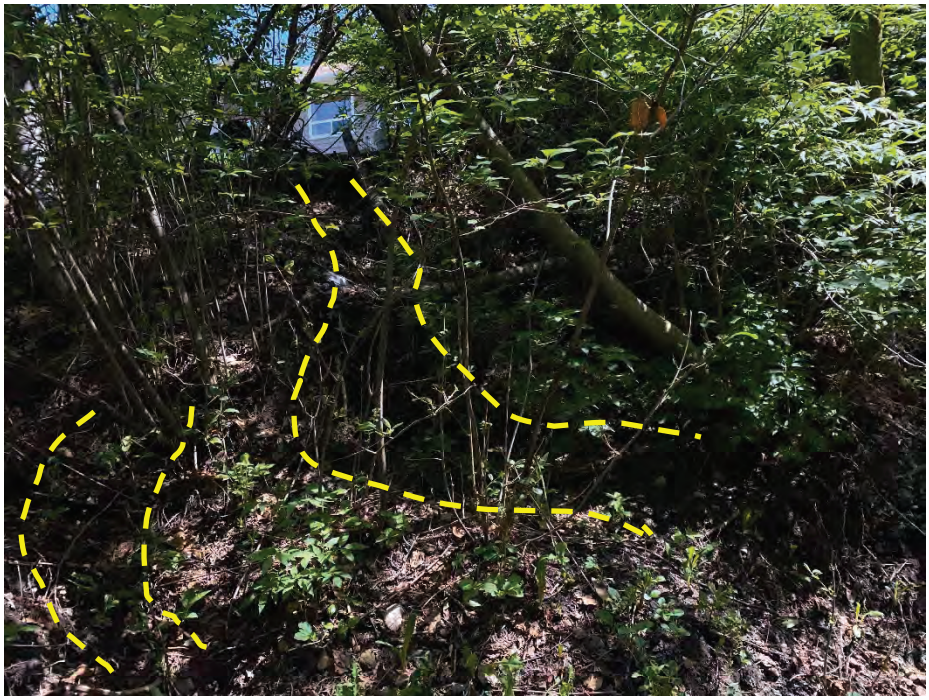


Photo 11: Section of gullying behind slid portion of backyard. Facing east.

Photo 12: Angled trees near the slide mass, facing southwest.

Stantec

City of Red Deer
Site Inspection Report

SITE NUMBER AND NAME:	**LOCATION:**
8 – 45th Avenue North of 59th Street	45th Avenue North of 59th Street, Red Deer, Alberta

	DATE	**PF(1)**	**CF(1)**	**TOTAL**
PREVIOUS INSPECTION:	October 17, 2018	7	2	14
CURRENT INSPECTION:	May 27, 2025	7	2	14
INSPECTED BY:	Stantec: Sonja Pharand and Benjamin Lou City of Red Deer (the City): Lily Dam			
REPORT ATTACHMENTS:	Figure 1 – Overall Plan Site Photos 2025 Survey File			
Note: (1) PF and CF are the Probability Factor and Consequence Factor as defined in the City of Red Deer Risk Ranking Guidelines.				

PRIMARY SITE ISSUE:

Multiple landslides on the east valley slope of the Red Deer River.

APPROXIMATE DIMENSIONS:

Dimensions vary by location. Typical landslide is up to 30 m wide with an undefined toe.

SITE HISTORY

From "2018 Slope Evaluation Project" report by Parkland Geo dated April 2019:

- The strip of natural vegetation at the crest, consisting of brush and trees, separated the road (45th Avenue) from the riverbank. The road was approximately 4 m to 15 m away from the crest. The riverbank was generally well vegetated.
- Three slope failures were present, one bowl shaped slide approximately 50 m north of the Kerry Wood entrance, one approximately 50 m south of the Kerry Wood entrance, which was previously used as a storm outfall, and one at the south end of site near 59th Street with evidence of toe scour. The area adjacent to the 59th Street slide had been repaired with rock rip rap armouring as a result of the 2005 flood.
- The general subsurface stratigraphy consists of the following in descending order:
    - 1 m to 3 m of alluvial silt, sand and clay
    - Up to 3 m of sand and gravel.
    - Top of bedrock at elevations ranging from approximately 847 m to 852 m.
- Groundwater levels are linked to river levels and are typically at an elevation around 849 m. 1:100 year flood levels are about 2.5 m higher.
- In general, the riverbank showed little evidence of toe scour. Some bank scour and damage related to the 2005 flood was observed near the outfall at the south end of the site adjacent to 59th Street. The area has since been armoured and rebuilt as a stepped river access. It was expected that the slope failures were likely to be localized rotational slides in the alluvial soils up to 15 m wide with back scarp 3 m to 8 m back from the crest. The failures would likely be the result of high groundwater levels related to flooding events.
- A slope stability analysis was conducted in 2018 by Parkland Geo. The slope face was generally considered to be marginally stable. Slope stability analysis of45th Avenue with a setback distance of 4 m indicated a factor of safety (FS) of 1.3 suggesting a stable slope. It should be noted that the target FS is typically 1.5 in industry. The closest property line is approximately 20 m away and indicated a stable slope with FS of greater than 2.0.

ITEM	CONDITIONS EXIST		DESCRIPTION AND LOCATION	NOTICEABLE CHANGE FROM LAST INSPECTION	
	YES	NO		YES	NO
Building Distress		X			X
Slope Movement	X		Three previously noted historical failures on site; one approximately 50 m north of the Kerry Wood entrance, one approximately 50 m south of the Kerry Wood entrance, one at the south end of site near 59th Street. One additional slide observed across from the Community Living Society building.	X	
Erosion	X		Undermining of the crest at the southwest historical failure.	X	
Seepage		X			X

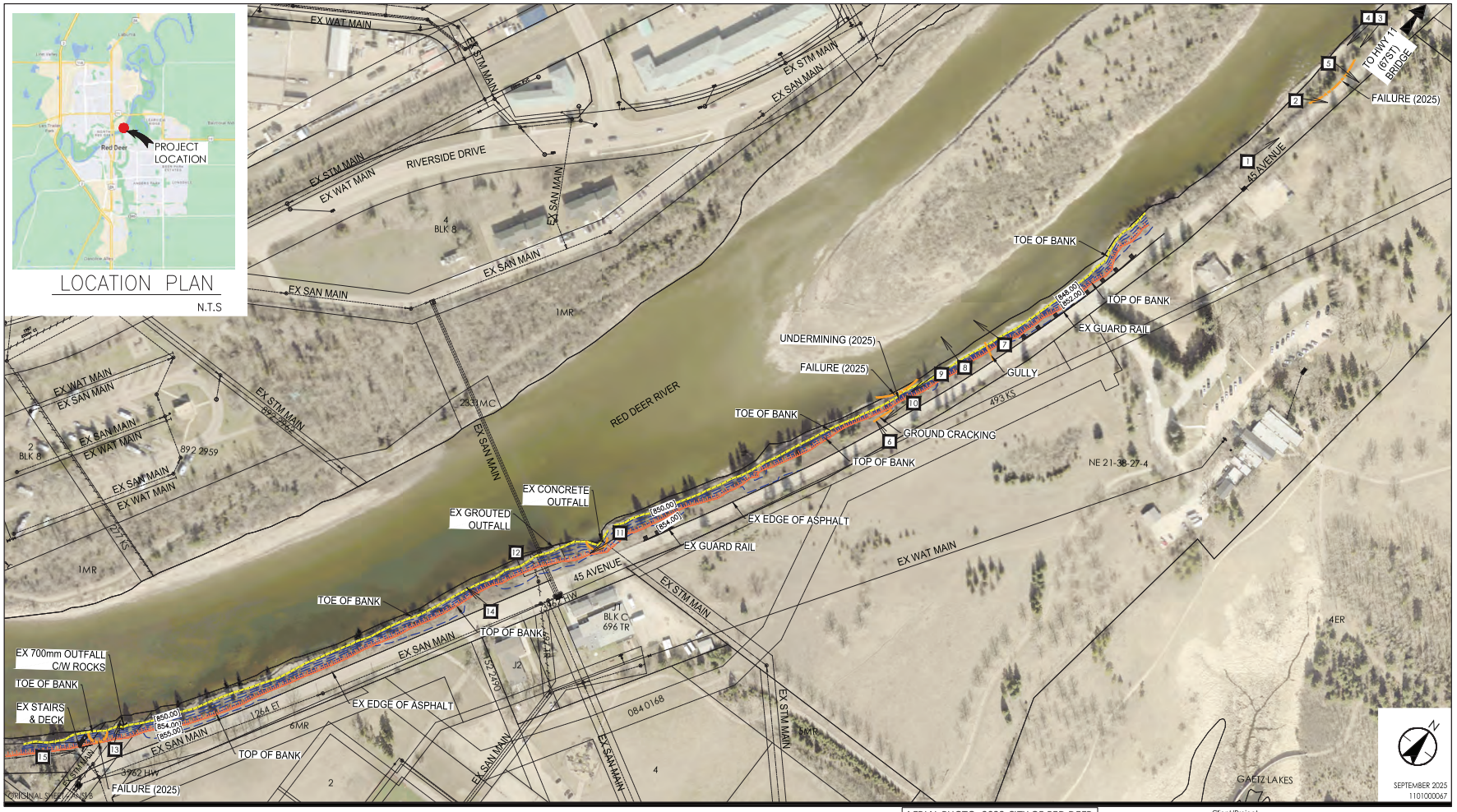
OBSERVATIONS AND ASSESSMENT

- Stantec surveyed the river valley crest with elevation ranging between 852 m to 855 m and the toe of the riverbank ranging between 847 m to 849 m.
- The road (45th Avenue) appeared to be in good condition with few cracks present (Photo 1). The road is narrow with skinny shoulders.
- The riverbank was generally well vegetated with tall grass, brush and trees (Photos 2 and 3).
- Gopher holes (assumed) up to approximately 15 cm in width were observed near the toe of the bank on the north end of site (Photo 4).
- Two historical failures north and south of the Kerry Wood entrance had some areas of exposed, non-vegetated scarp face, while other areas were well vegetated (Photos 5 and 9). Undermining of the crest ranging from 0.3 m to 0.6 m was also observed approximately 5 m away from the road at the failure south of the Kerry Wood entrance.
- Ground cracking approximately 40 mm in width and 0.5 m in length was observed approximately 1.5 m away from the failure crest south of the Kerry Wood entrance (Photo 6).
- An erosion control blanket and riprap were observed on a section of the upper riverbank slope south of the Kerry Wood entrance (Photo 7). The reason for placement is unknown, and no pipe outlets were observed.
- A gully was observed on site south of the Kerry Wood entrance (Photo 8) extending from the crest down toward the lower riverbank and appeared to also be an informal walking trail. The gully is likely from both erosion and foot traffic.
- Scour was observed along the toe of the riverbank, across small sections of the site, up to approximately 1 m high. Cobbles were present near the toe across most of the site (Photos 9 and 10).
- Localized spots where the slope crest was being undermined were observed throughout the site (Photo 10). However, these occurrences were not close to the road.
- Two outfalls were observed that discharged directly into the river; one outfall is located near the middle of the site, across from the Parkland School, and the other is located at the south end of the site (Photos 11 and 12). The outfall across from the school was constructed of concrete, with wing walls and riprap on both sides and some vegetation upslope. The southern outfall consisted of a steel pipe approximately 0.7 m in diameter, with a gabion wall built into the riverbank toe above it. Both outfalls were partially submerged in the river, and no flow was noticeable.
- A grouted outfall was located approximately 45 m southwest of the concrete outfall across from the Parkland School, near the toe of the riverbank (Photo 12). The grouted outfall was part of the City's work to plug an old sanitary pipe to the river. The grout is uncovered and visible; however, this area appears well vegetated with no signs of failure.
- A minor amount of ponding water was observed in front of the Parkland School at the edge of pavement on 45th Avenue.
- A slide not previously noted was observed on the riverbank across from the Community Living Society building. The slide does not appear new, and was well vegetated near the toe, with exposed sandy soil closer to the scarp (Photo 13).
- The southern historical failure near 59th Street had some exposed areas with no vegetation, but appears unchanged (Photo 14).

- The Probability Factor remains at 7 as the potential for a landslide is high after heavy rainfall or rise in groundwater or river levels. The Consequence Factor remains at 2 as a landslide could affect the road with partial closure but is not expected to impact private property or building structures.

RECOMMENDATIONS

- The landslides along the slope appear to be inactive or exhibited as localized slumping that has not impacted the road, structures or private property. However, localized landslides due to wet weather, high river levels, etc. may result in loss of infrastructure. Potential remediation options for the slope may include armouring the toe with riprap, reinforcing the slope with soil nails, re-grading the slope, or constructing a pile wall.
- Regrade ground cracks along the crest to seal and reduce surface water infiltration into the slope. No additional fill should be placed for regrading. Any vegetation removed for regrading the landslide should be reinstated to maintain slope stability.
- Visual inspections and survey along slope crest once every 5 years and reference to permanent features (i.e., survey pins) to monitor additional slope movements.
- Surface drainage should be monitored and managed to avoid ponding water as it can seep into cracks and infiltrate the slope.
- Outfalls and existing drain systems should be inspected to ensure they remain functional and are not leaking water into the slope or onto the slope failure.
- Stantec recommends an inspection frequency of once every 5 years or “as needed” if signs of instability appear such as pavement cracks, toe bulges, or additional slumping.



Legend

- 2025 TOP OF BANK
- 2025 OBSERVATIONS
- 2025 TOE OF BANK
- PHOTO NUMBER AND DIRECTION
- {874.00} 2025 CONTOURS

AERIAL PHOTO- 2022 CITY OF RED DEER
CADASTRAL - 2025 CITY OF RED DEER
CONTOURS - BASED ON 2025 SURVEY
UTILITIES - 2012 DATA FROM CRD

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

Stantec
1100 - 4900 50th Street
Red Deer AB Canada T4N 1X7
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Client/Project
City of Red Deer
SITE 8 - 45 AVENUE NORTH OF 59 STREET
SITE PLAN

Figure No.
1

Title
OVERALL PLAN

SCALE
1:2500
0 25 75 125m

2025 Inspection Photos at Site 8 – 45th Avenue North of 59th Street

Photo 1: 45th Avenue asphalt in good condition. Looking north.

Photo 2: Historical failure north of the Kerry Wood entrance. Facing northeast.

2025 Inspection Photos at Site 8 – 45th Avenue North of 59th Street

Photo 3: Toe of riverbank. Looking south from north end of site.

Photo 4: Gopher holes near north end of riverbank. Looking southwest.

2025 Inspection Photos at Site 8 – 45th Avenue North of 59th Street

Photo 5: Exposed scarp face on historical failure north of the Kerry Wood entrance. Looking east.

Photo 6: Ground crack near historical failure, 1.5 m away from crest. Facing north.

2025 Inspection Photos at Site 8 – 45th Avenue North of 59th Street

Photo 7: Erosion control blanket and riprap on riverbank slope. Facing southwest.

Photo 8: Gully heading downslope taken from top of crest. Facing west.

2025 Inspection Photos at Site 8 – 45th Avenue North of 59th Street

Photo 9: Exposed sandy soil face at failure south of the Kerry Wood entrance. Facing south.

Photo 10: Undermining at edge of crest. Facing southwest.

2025 Inspection Photos at Site 8 – 45th Avenue North of 59th Street

Photo 11: Outfall across from Parkland School. Facing south.

Photo 12: Grouted outfall across from the Parkland School. Facing east.

2025 Inspection Photos at Site 8 – 45th Avenue North of 59th Street

Photo 13: Southern outfall with gabion basket wall. Facing southeast.

Photo 14: Slide observed on riverbank across from the Community Living Society building. Facing northwest.

2025 Inspection Photos at Site 8 – 45th Avenue North of 59th Street

Photo 15: South historical failure area, near 59 Street. Facing northeast.

Stantec

City of Red Deer
Site Inspection Report

SITE NUMBER AND NAME:	**LOCATION:**
17 – Gaetz Avenue West Service Road	Gaetz Avenue West Service Road north of 37th Street and Gaetz Avenue, Red Deer, Alberta

	DATE	**PF(1)**	**CF(1)**	**TOTAL**
PREVIOUS INSPECTION:	November 1, 2022	5	8	40
CURRENT INSPECTION:	May 26, 2025	5	8	40
INSPECTED BY:	Stantec: Sonja Pharand and Benjamin Lou			
REPORT ATTACHMENTS:	Site Plan Site Photos SI Plots			
Note: (1) PF and CF are the Probability Factor and Consequence Factor as defined in the City of Red Deer Risk Ranking Guidelines				

PRIMARY SITE ISSUE:

Possible creep of slope represented by cracking in asphalt and rotation of guard rail.

APPROXIMATE DIMENSIONS:

Approximately 60 m long and 20 m wide.

SITE HISTORY

From "2018 Slope Evaluation Project" report by Parkland Geo dated April 2019:

- The road surface (Gaetz Ave Service Road or 50a Ave) was rebuilt in 2014 with thick asphalt and a geogrid reinforced gravel. The slope is a constructed cut-slope.
- No known records of slope instability at this site but visual evidence (overturning guard rail and tension cracks in pavement) suggested slope movement.
- During the 2018 site assessment, it was noted that the south half of the slope had slow movement. Pavement cracking was observed to include three main cracks running parallel to traffic. The guard rail on the east side of the service road had rotated approximately 20°. The slope face itself did not show any sign of movement.
- Instrumentation was installed shortly after the site assessment. A slope inclinometer was installed at the east side of the road near the guard rail and a standpipe was installed near the crest at the north end of the site.
- A slope stability analysis was conducted as part of the 2018 site assessment. In general, the slope was found to be marginally stable, though susceptible to slow creep during wet weather periods. The risk of a shallow failure on the slope face was considered to be moderate.
- The slope was measured to be between 1.7H:1V and 2.3H:1V.
- The ground surface elevation of BH1 and BH2 was 877.8 m and 877.4 m respectively. The subsurface stratigraphy consists of the following in descending order:
  - Approximately 7 m to 8 m of firm non- to medium plastic glaciolacustrine silt and clay to approximate elevation of 870 m.
  - Up to approximately 6 m of stiff to very stiff low to medium plastic clay till to elevation 865 m.
- Groundwater level in BH2 was about 6 m below ground surface (bgs) in November 2018.

From "Instrumentation Readings at Red Deer Geohazard Sites 1, 5, and 17" report by Stantec dated June 2024.

- Previously documented instruments consisted of one slope inclinometer (BH1(SI1)) and one standpipe piezometer (BH2).
- Previous SI readings were not available to Stantec and baseline readings for BH1(SI1) were taken in November 2022.
- Groundwater level in BH2 was about 6.5 m bgs on May 2, 2024

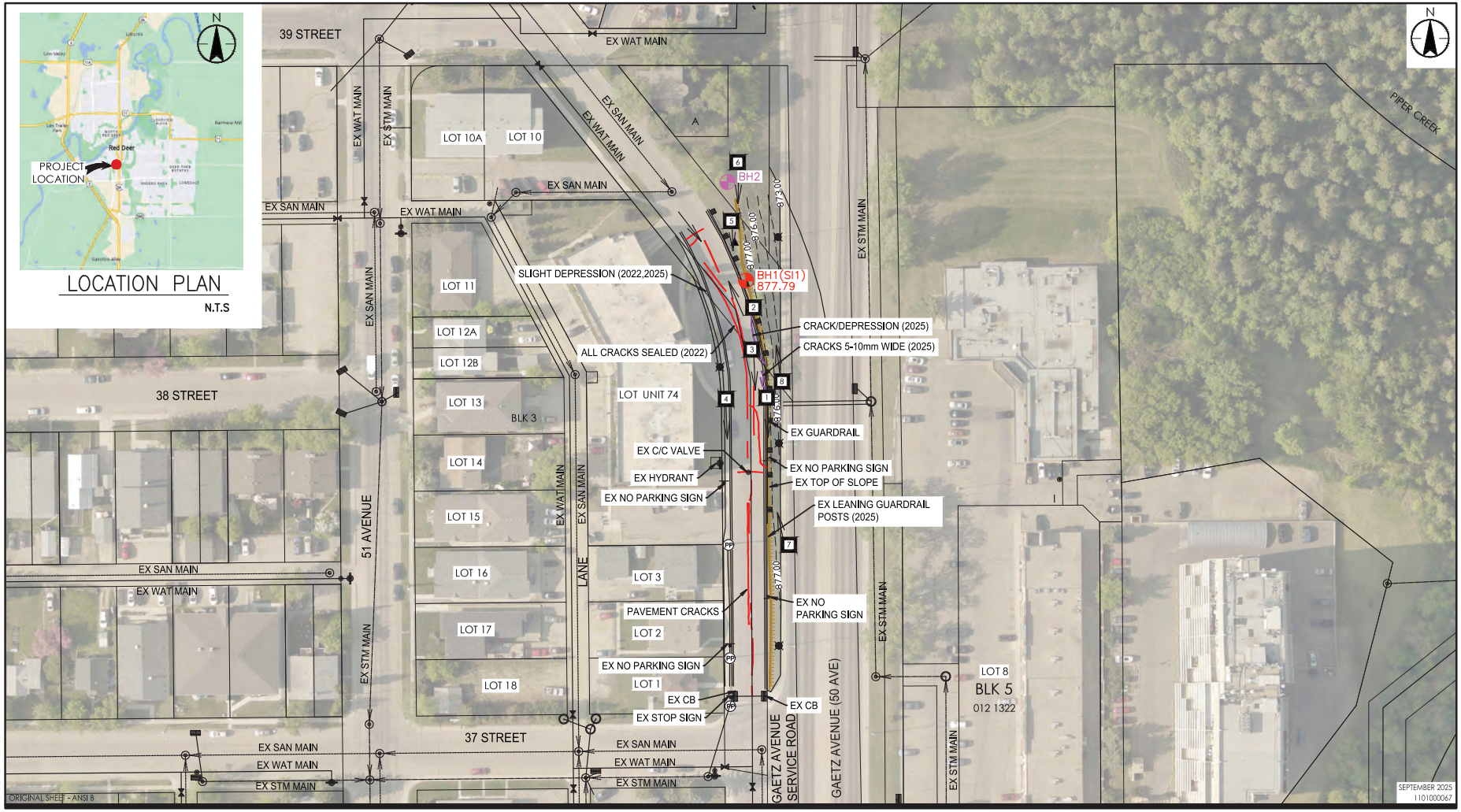
ITEM	CONDITIONS EXIST		DESCRIPTION AND LOCATION	NOTICEABLE CHANGE FROM LAST INSPECTION	
	YES	NO		YES	NO
Building Distress		X			X
Slope Movement	X		Additional pavement cracking has occurred since 2022 inspection.	X	
Erosion		X			X
Seepage		X			X

OBSERVATIONS AND ASSESSMENT

- Numerous sealed cracks were observed in the service road asphalt, concentrated near the centre of the road within the north half of site, and within the north bound lane for the south half, similar to 2022 (Photos 1 and 2).
- Additional cracking and dipping of the pavement was observed near the curb in the north bound lane, mainly concentrated across from the apartment building entrance (Photo 3).
- Sealed cracks were observed in front of the apartment entrance, similar to 2022 (Photo 4).
- No ground cracking was observed on the vegetated areas of the slope or near the crest, similar to 2022 (Photo 5). The slope is well-vegetated.
- The standpipe in BH2 was found to be damaged at the surface and full of debris, and therefore could not be read (Photo 6).
- The service road embankment slope ranged from nearly flat to as steep as 3H:1V at the north survey limit based on Stantec's 2023 survey (Photos 7 and 8).
- Three guardrail posts were observed to be leaning on the south end of the site, between Lots 3 and 74 (Photo 7).
- The slope inclinometer in BH1 (SI1) was read during the inspection. Since baseline readings in May 2024, one potential movement zone has been observed at approximately 2 m depth between the silt and clay layer interface and shows about 8 mm of cumulative movement. Further readings in the future are required to confirm the movement zone and rate of movement. Any cumulative movement is in reference to the May 2024 baseline.
- The Probability Factor remains at 5 since the area appears largely unchanged, with some additional cracking since the 2022 inspection. The Consequence Factor remains at 8 since a slide could result in loss of sidewalk and potentially at least one lane of traffic.

RECOMMENDATIONS

- Monitor the slope inclinometer semi-annually (spring and fall) to identify slope movements.
- The existing standpipe appears to be damaged beyond repair and a new replacement standpipe is recommended. Stantec can provide a quote to drill and install a new standpipe upon request.
- Seal pavement cracks to reduce surface water infiltration into the slope.
- The slope appears to be relatively slow moving and has not impacted any structures or City infrastructure at this time. However, additional creep of the slope or slumping due to land use, wet weather, etc., may result in loss of infrastructure. Potential remediation options for the slope may include slope flattening (reducing the service road to a single lane), removal of the landslide mass and replacement with engineered fill, reinforcing the slope with soil nails, or constructing a retaining wall.
- Stantec recommends the inspection frequency remain unchanged at once every 3 years, or as-needed if pavement cracks become noticeably worse.



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Legend

- SCARP/TOP OF BANK LOCATION (2023)
- 2023 PAVEMENT CRACKS
- 2025 PAVEMENT CRACKS
- EXISTING SIDEWALK
- EXISTING GUARDRAIL
- APPROXIMATE 2018 BOREHOLE LOCATION
- BOREHOLE WITH PIEZOMETER
- BOREHOLE WITH SLOPE INCLINOMETER
- PHOTO NUMBER AND DIRECTION

AERIAL PHOTO- 2022 CITY OF RED DEER
CADASTRAL - 2021 CITY OF RED DEER
CONTOURS - BASED ON 2023 SURVEY

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

Stantec
1100 - 4900 50th Street
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Client/Project
City of Red Deer
SITE 17 - GAETZ AVENUE WEST SERVICE ROAD
SITE PLAN

Figure No.
3

Title
OVERALL PLAN

SCALE
1:1000
0 10 30 50m

2025 Inspection Photos at Site 17 – Gaetz Avenue

Photo 1: Sealed cracks on Gaetz Ave Service Road. Facing south from mid-section.

Photo 2: Sealed cracks on Gaetz Ave Service Road. Facing northwest from mid-section.

2025 Inspection Photos at Site 17 – Gaetz Avenue

Photo 3: Cracks and surface depression on Gaetz Ave Service Road. Facing south.

Photo 4: Sealed cracks by the apartment entrance.

2025 Inspection Photos at Site 17 – Gaetz Avenue

Photo 5: Crest of slope at north end of area. Facing south.

Photo 6: Damaged BH2 standpipe.

2025 Inspection Photos at Site 17 – Gaetz Avenue

Photo 7: Slope at south end of embankment. Facing north.

Photo 8: Slope near mid-section of embankment with leaning guardrail posts. Facing north.

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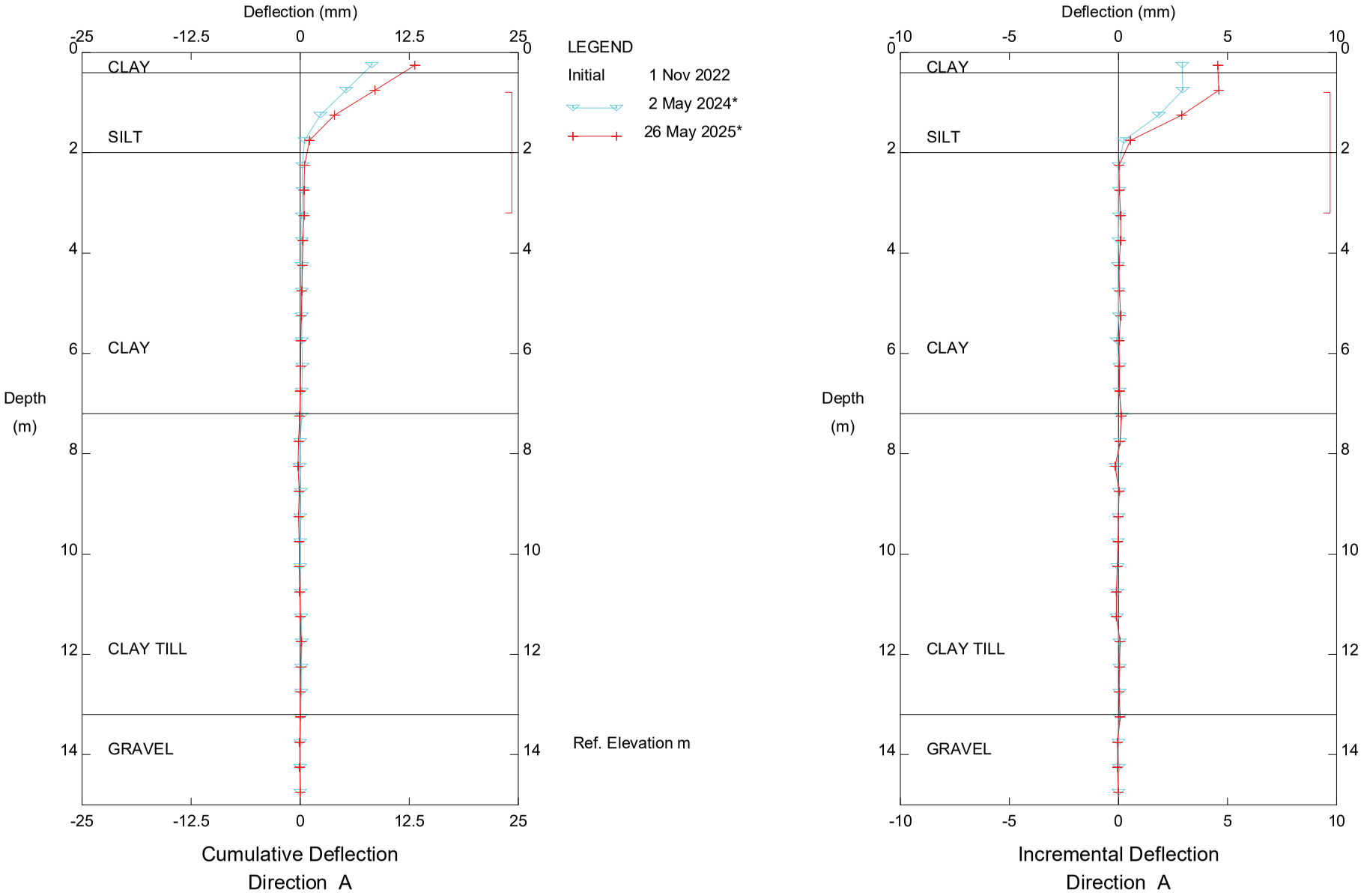

CRD Site 17, Inclinometer BH1 (SI1)

Sets marked * include zero shift and/or rotation corrections.

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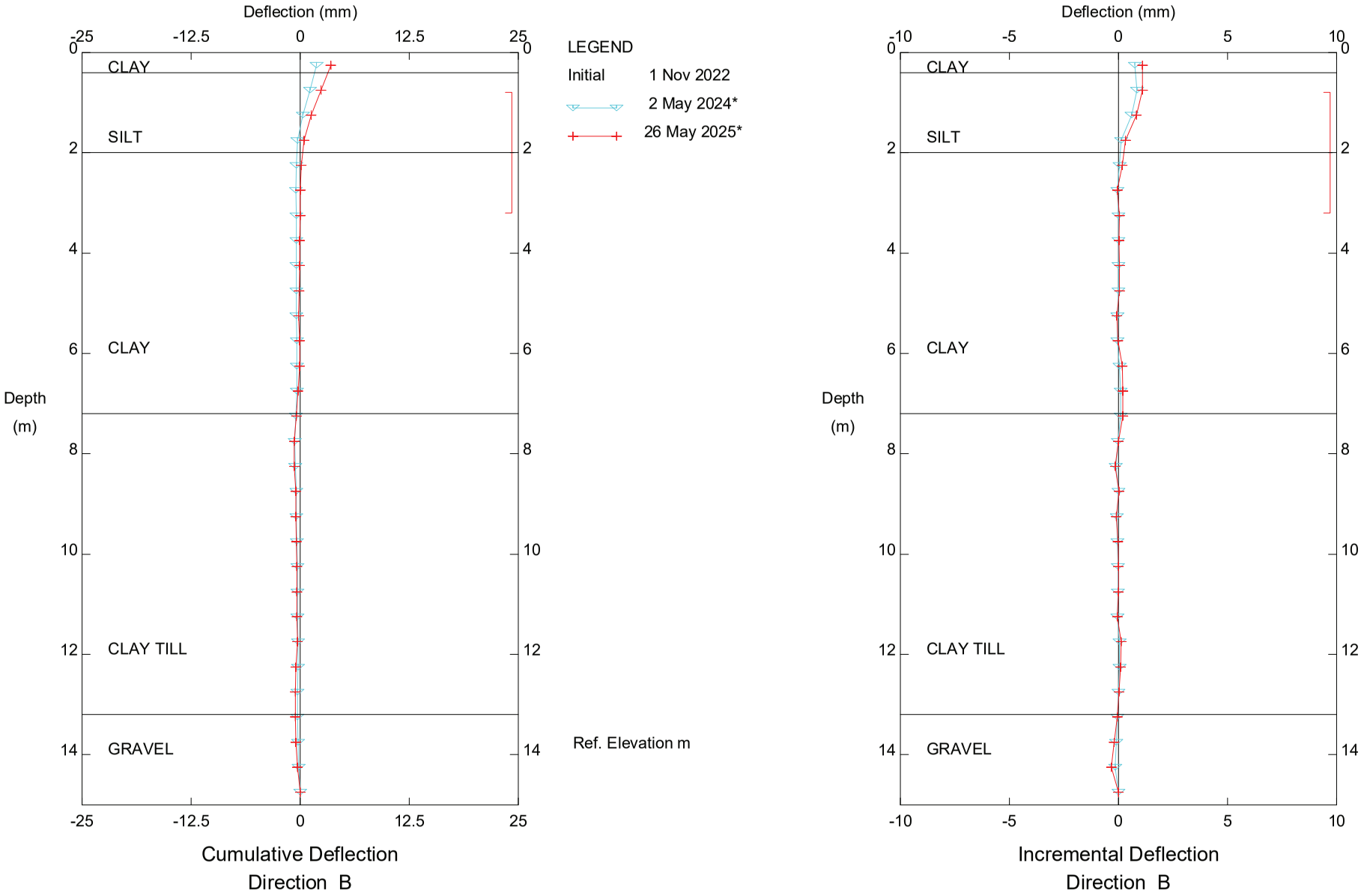
Stantec Consulting Ltd - Edmonton



CRD Site 17, Inclinometer BH1 (SI1)

Sets marked * include zero shift and/or rotation corrections.

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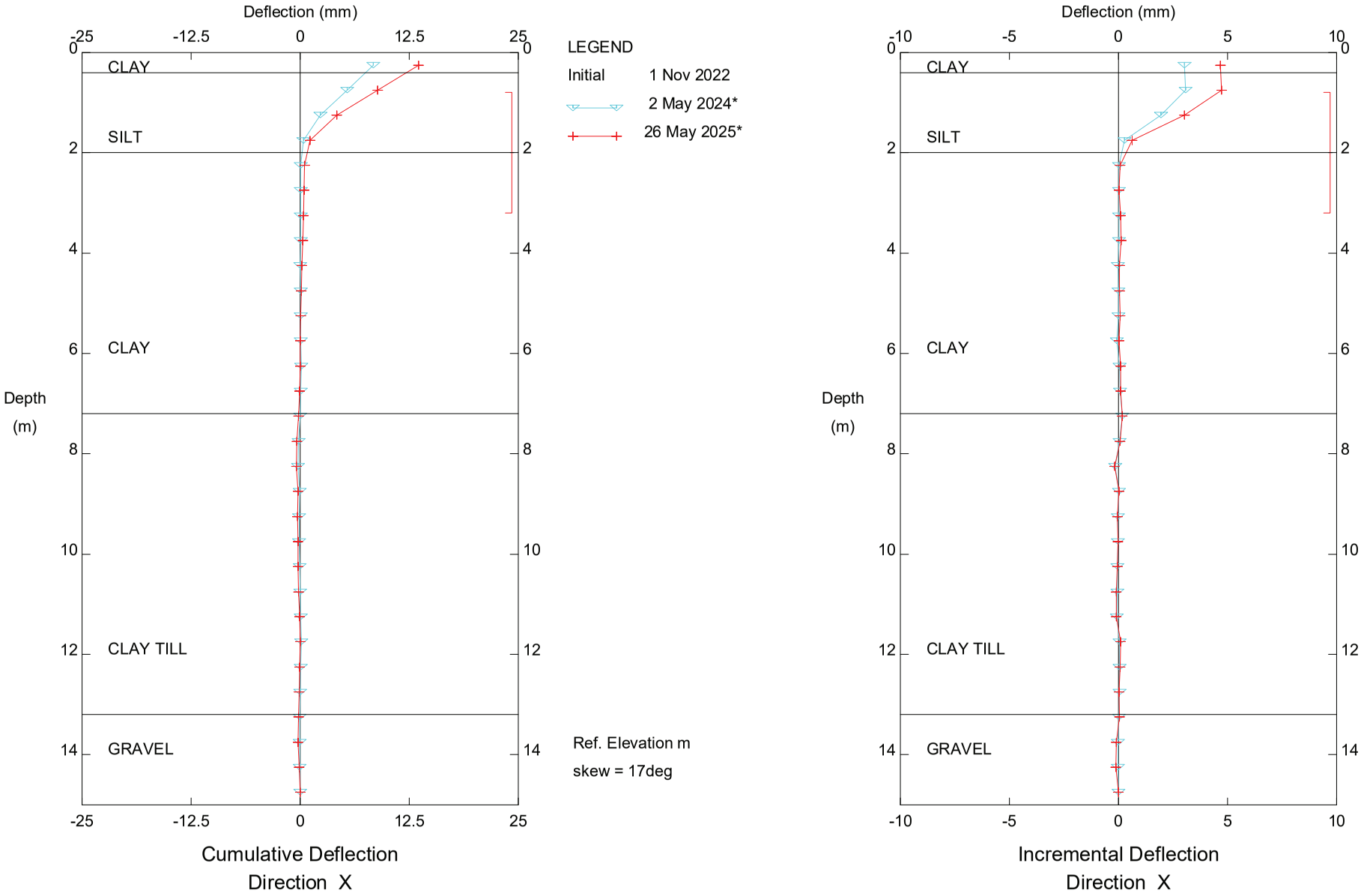
Stantec Consulting Ltd - Edmonton



CRD Site 17, Inclinometer BH1 (SI1)

Sets marked * include zero shift and/or rotation corrections.

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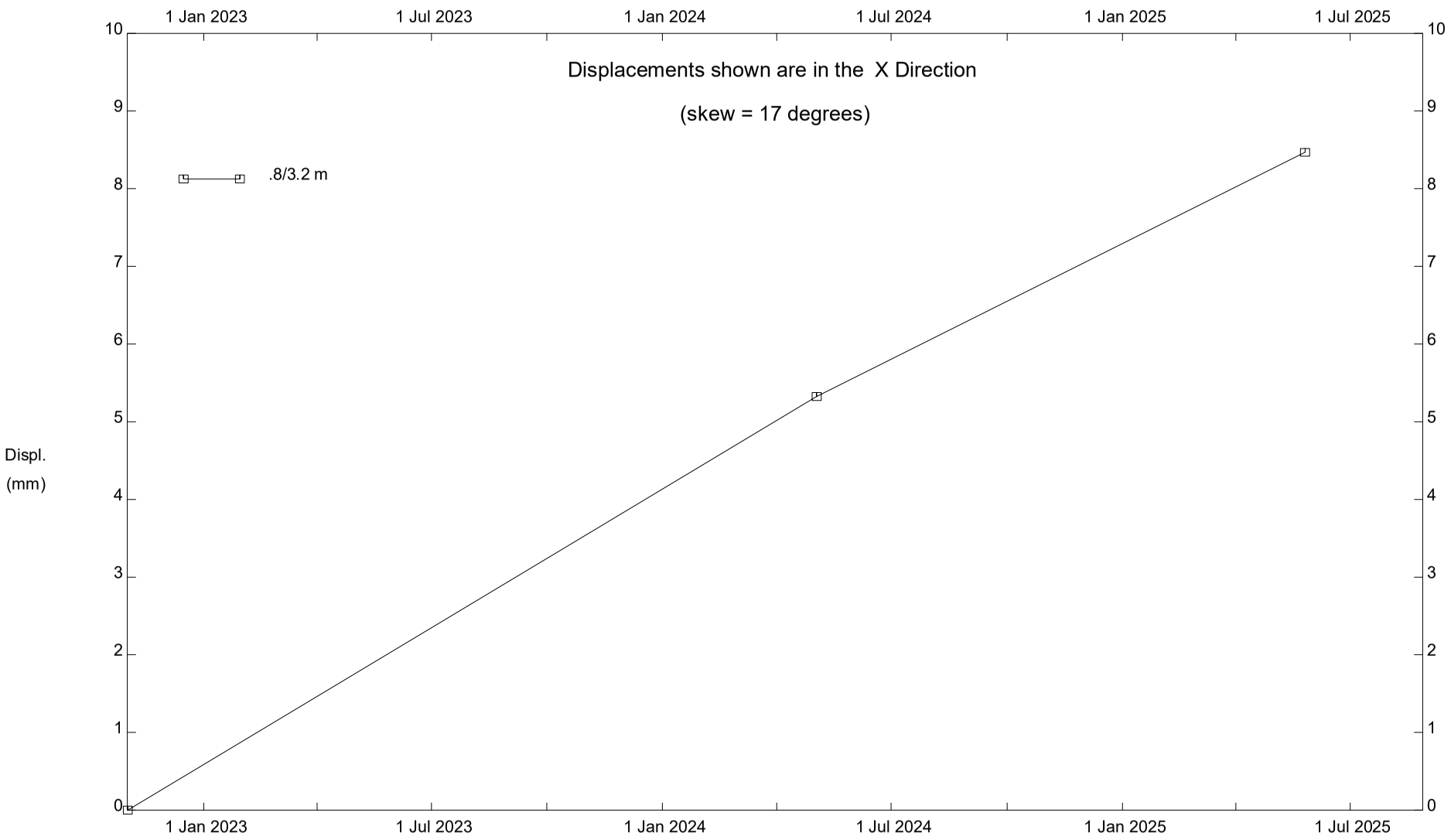
Stantec Consulting Ltd - Edmonton



CRD Site 17, Inclinometer BH1 (SI1)

Stantec

City of Red Deer
Site Inspection Report

SITE NUMBER AND NAME:	**LOCATION:**
19 – Former Elks Club & 36th Street	36th Street, Red Deer, Alberta

	DATE	**PF(1)**	**CF(1)**	**TOTAL**
PREVIOUS INSPECTION:	October 30, 2018	3	10	30
CURRENT INSPECTION:	May 28, 2025	3	10	30
INSPECTED BY:	Stantec: Sonja Pharand and Benjamin Lou City of Red Deer (the City): Lily Dam			
REPORT ATTACHMENTS:	Figure 1 – Overall Plan Site Photos Survey File			
Note: (1) PF and CF are the Probability Factor and Consequence Factor as defined in the City of Red Deer Risk Ranking Guidelines.				

PRIMARY SITE ISSUE:

Historical slide northwest of 36th Street along residential and commercial lots.

APPROXIMATE DIMENSIONS:

Landslide is up to 30 m wide.

SITE HISTORY

From "2018 Slope Evaluation Project" report by Parkland Geo dated April 2019:

- The site comprises a section of the west creek valley slope overlooking Piper Creek and Rotary Park. Developments at the top of the slope include a restaurant (formerly known as the Elks Club), a 15-storey apartment building (Checkmate Court) and two private residences on 49th Avenue and 36th Street.
- The top of the slope elevation is approximately 877 m and the toe of the slope is approximately 860 m. The typical slope inclination ranges from 1.5H:1V to 2.5H:1V. A large gravel toe berm had been placed below the former Elks building, forming a terrace at an approximate elevation of 868 m.
- Anecdotal accounts indicate that in 1960, a major landslide extended from the northeast corner of the former Elks Club building, where it removed a pile support, to approximately within 50 feet of Piper Creek. Furthermore, gravel was placed at the base of the slope by the Elks Club until the landslide stopped moving. The landslide was believed to be caused by a combination of wet weather and grading activity at the crest around the building. The walls and floor in the northeast corner of the current building are structurally supported above a void space which is enclosed by a skirting.
- Additionally, a small block slide was documented at 4806 – 36th Street. Fill was placed over the crest of the river valley slope to increase yard area at this property and the over-steepened fill slid down to the banks of the creek. Toe erosion was not believed to be a contributing factor for this landslide.
- The general subsurface stratigraphy consists of the following in descending order:
    - Topsoil.
    - Up to 7 m of firm, low to medium plastic silt and clay to elevation of approximately 870 m.
    - Very stiff, medium plastic clay till extending below elevation of 860 m.
    - Gravel fill in the toe berm below the former Elks Lodge. Native coarse gravel deposits may also be present within or below the till.
- A slope stability analysis was conducted by Parkland Geo in 2018. The shallow slope face at the former Elks building, the northeast corner of the former Elks building, the slope face at 4806 – 36th Street, were considered to be marginally stable to stable with a Factor of Safety ranging from 1.0 to 1.1. Slope stability analysis at the existing house at 4806 – 36th Street indicated a stable slope with a factor of safety of 1.3.
- The risk for a small shallow "slump-type" failure was estimated to be moderate, and it would take unusually wet conditions to cause a shallow slump. The risk of a larger, deep-seated landslide was considered to be low

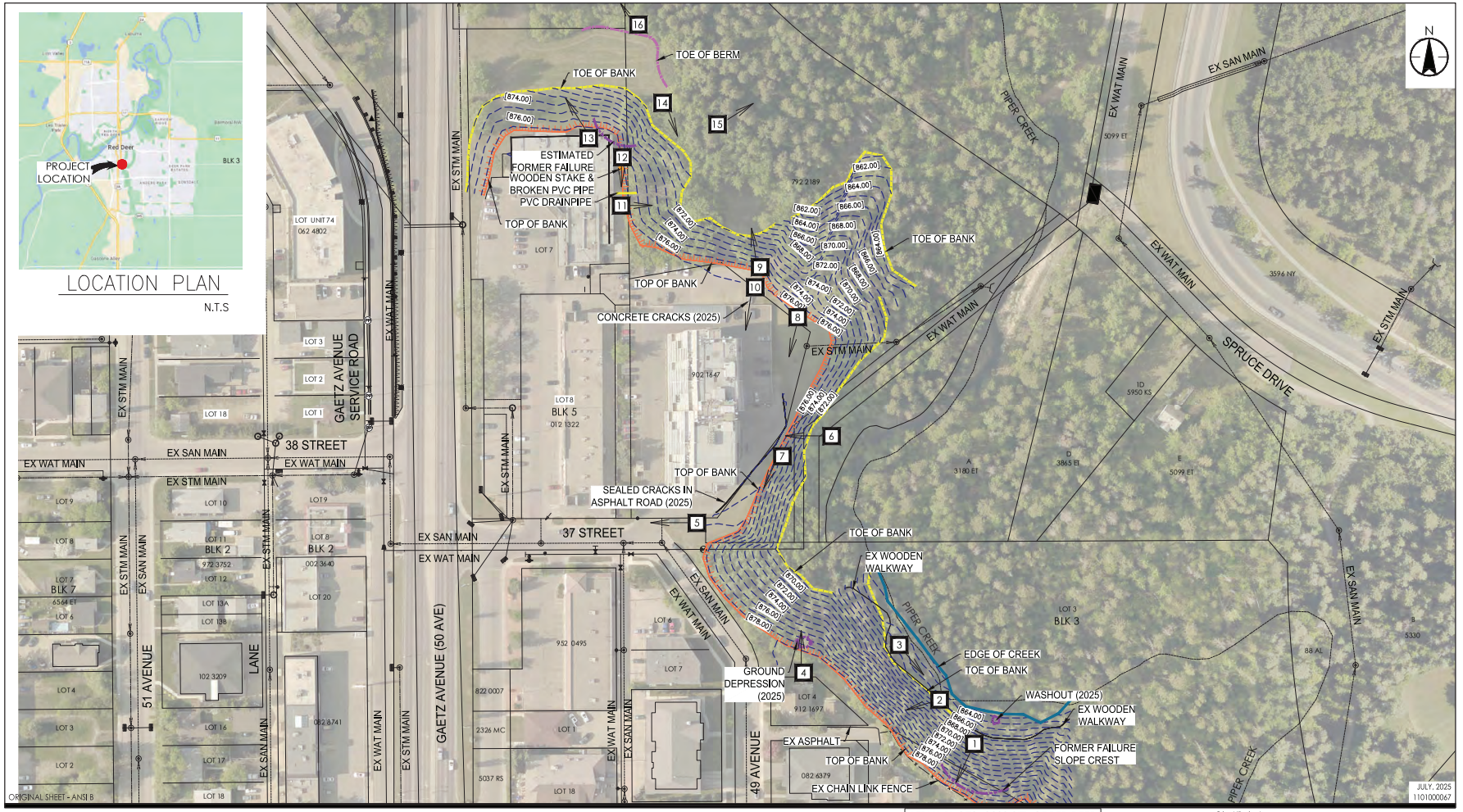
since the valley slope is mature and the stabilization measures appeared to be effective as the landslide had not remobilized in over 50 years.

ITEM	CONDITIONS EXIST		DESCRIPTION AND LOCATION	NOTICEABLE CHANGE FROM LAST INSPECTION	
	YES	NO		YES	NO
Building Distress		X			X
Slope Movement	X		Historical slide northeast of former Elks Club building. Slump behind backyard of 4806-36th Street.		X
Erosion		X			X
Seepage		X			X

OBSERVATIONS AND ASSESSMENT

- The site was generally well vegetated throughout with tall grass, brush, and trees (Photos 1, 2, 6, 8, 9, 16). Very dense vegetation was noted in the area northeast of Lot 4.
- Curved and angled trees, indications of former landslides, were observed on the slope northeast of 4806 – 36th Street (Photos 1 to 3). This slide appears to be localized and inactive with the slope crest located at the fenceline.
- The City's wooden walkway on the south side of Piper Creek and near the toe of the slope was observed to be damaged north of 4806 – 36th Street. The cause of the damage is unknown; however, beams were seen to be split, twisted and partially knocked off the concrete footings. No disturbance to the slope above the walkway was observed, and damage may have occurred from a tree falling. The decking has been removed and the City plans to replace this section of the boardwalk using a screw pile system in 2026. Sections of ground at this location were observed to be wet and muddy (Photo 3). The survey team picked up a feature that they classified as a 'washout' approximately 2 m to 3 m in diameter near the wooden walkway, however it was not observed during the geotechnical site inspection.
- Two ground depressions were observed; a small depression behind Lot 4 (Photo 4), and a shallow depression south of the apartment complex (Photo 5). The ground depression behind Lot 4 was approximately 1 m by 0.5 m and ~50 mm in depth. The shallow depression south of the apartment complex was approximately 5 m long, 0.5 m wide and 20 mm to 40 mm in depth, and is possibly due to a leaking buried pipe or settlement of fill above a buried pipe. Utility mapping information from the City indicates there are no utilities at the observed location, suggesting it could be private services being affected.
- The asphalt road leading to the rear of the apartment building had numerous sealed cracks (Photo 7). Based on the cracking pattern, it is unlikely that it is due to landslide activity.
- Hairline cracks in the concrete wall behind the parking lot at the rear of the apartment complex (Photo 10) were observed but are likely unrelated to slope movement.
- A PVC drainage pipe that appeared to be connected to the east roof drain of the former Elks building was observed to outlet near the top of the slope crest into the grass (Photo 11).
- A hole in the ground, marked with a wooden stake and containing a broken PVC pipe, was noted east of the former Elks building (Photo 12). The pipe has been broken off at ground surface and its origins and purpose are unknown.
- A perforated CSP was observed northeast of the former Elks building, leading downslope towards Piper Creek (Photo 15). The pipe extends to the toe. Water is potentially running out of the perforations and onto the slope during wet weather conditions.
- The landslide northeast of the former Elks Club building appears to be unchanged from the last inspection by Parkland Geo in 2018. The terrace area was vegetated with tall grass and the toe of the slide with brush and trees (Photos 13 & 14). The toe berm also appeared to be in good condition with little cracking.
- The Probability Factor remains at 3 as the landslide appears to be inactive. The Consequence Factor remains at 10 as a landslide could affect private property and public walking trails.

RECOMMENDATIONS
• The landslides along the slope appear to be inactive and have not impacted structures or private property. However, localized landslides or remobilization of the historical slides due to exceptionally wet weather and/or high groundwater levels may result in loss of infrastructure. • Regrade surface depressions along the crest to seal and reduce surface water infiltration into the slope. No additional fill should be placed for regrading. Any vegetation removed for regrading the landslide should be reinstated to maintain slope stability. • Survey along slope crest once every 5 years and reference to permanent features to monitor additional slope movements. • Surface drainage should be monitored and managed to avoid ponding water as it can seep into cracks and infiltrate the slope. • Existing drainage systems should be inspected to ensure they remain functional and are not leaking water into the slope or onto the slope failure. The PVC drain near the former Elks Club building could be extended downslope below the toe to reduce erosion and risk of slope instability. • Stantec recommends the inspection frequency of once every 5 years or “as-needed” if signs of instability appear.



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Legend

- 2025 TOP OF BANK
- 2025 OBSERVATIONS
- 2025 TOE OF BANK
- 2025 TOE OF BERM
- EDGE OF CREEK
- PHOTO NUMBER AND DIRECTION
- {874.00} 2025 CONTOURS

AERIAL PHOTO- 2022 CITY OF RED DEER
CADASTRAL - 2025 CITY OF RED DEER
CONTOURS - BASED ON 2025 SURVEY
UTILITIES - 2012 DATA FROM CRD

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

Stantec
1100 - 4900 50th Street
Red Deer AB Canada T4N 1X7
www.stantec.com

Client/Project
City of Red Deer
SITE 19 - FORMER ELKS CLUB AND 36 STREET SITE PLAN

Figure No.
1

Title
OVERALL PLAN

SCALE
1:1500

0 15 30 75

Stantec

2025 Inspection Photos at Site 19 – Former Elks Club & 36 Street

Photo 1: Slope area northeast of 4806 36th Street. Looking upslope (south).

Photo 2: Slope area near 4806 36th Street. Facing west.

2025 Inspection Photos at Site 19 – Former Elks Club & 36 Street

Photo 3: Damaged section of wooden walkway north of 4806 36th Street. Looking southeast.

Photo 4: Ground depression northeast of Lot 4. Facing north.

2025 Inspection Photos at Site 19 – Former Elks Club & 36 Street

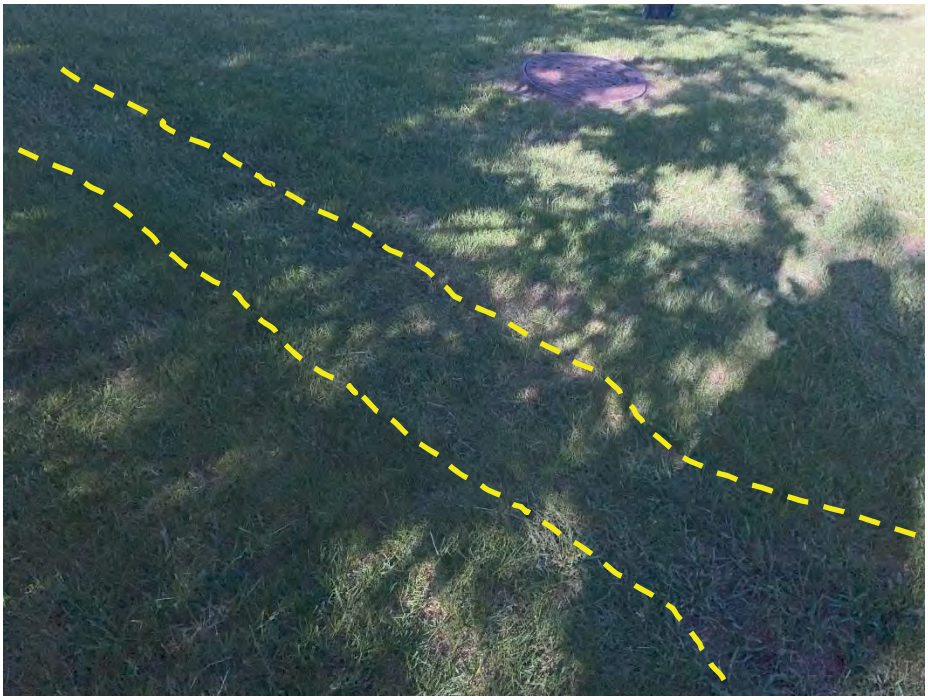


Photo 5: Shallow ground depression south of apartment complex. Facing west.

Photo 6: Slope area east of apartment complex. Looking upslope (west).

Photo 7: Access road east of apartment complex with sealed cracks. Facing southwest.

Photo 8: Area at top of slope, east of apartment complex. Facing southwest.

Photo 9: Well vegetated slope north of apartment complex. Facing north.

Photo 10: Hairline cracks in concrete parking wall of the apartment complex. Facing southwest.

Photo 11: PVC drainage pipe east of former Elks building directing onto slope. Facing east.

Photo 12: Hole with stake and broken PVC standpipe east of former Elks building. Facing south.

Photo 13: Slope north of restaurants. Facing northwest.

Photo 14: Historical failure northeast of former Elks building. Facing west.

Photo 15: Perforated CSP drain northeast of former Elks building directed downslope. Facing northwest.

Photo 16: Piper Creek area northeast of former Elks building. Facing northeast.

Stantec

City of Red Deer
Site Inspection Report

SITE NUMBER AND NAME:	LOCATION:
25 – Royal Oaks	Royal Oaks Apartments, 5211 and 5217 39 Street, Red Deer, Alberta

	DATE	PF(1)	CF(1)	TOTAL
PREVIOUS INSPECTION:	August 18, 2022	8	8	64
CURRENT INSPECTION:	May 26, 2025	8	8	64
INSPECTED BY:	Stantec: Sonja Pharand and Benjamin Lou City of Red Deer (the City): Lily Dam			
REPORT ATTACHMENTS:	Site Plan Site Photos			
Note: (1) PF and CF are the Probability Factor and Consequence Factor as defined in the City of Red Deer Risk Ranking Guidlines				

PRIMARY SITE ISSUE:

Landslide along south side of building.

APPROXIMATE DIMENSIONS:

60 m wide x 30 m long x 10 m high

SITE HISTORY

From "Geotechnical Investigation Proposed 39th Street Apartment Building Red Deer, Alberta" report by AGRA Earth & Environmental dated May 1997:

- A geotechnical investigation and slope stability analysis was conducted by AGRA.
- Fill was reported to have been pushed over the crest of the slope by the property owners in the preceding years to increase the horizontal area at the crest of the original slope. The slope was reported to have failed due to the fill placed on the upper part of the slope. The depth and lateral extent of the failure was not clear based on available information.
- The fill consisted mainly of a mixture of clay, silt, sand, and gravel with inclusions of topsoil, concrete, asphalt, and other deleterious material. Fill appeared to have been placed without any compaction effort.
- Fill thickness ranged from 1 m to 5 m below 1997 grade and was greatest near the crest of the slope.
- A development setback of 15 m was recommended by AGRA between the building and the crest to achieve a Factor of Safety greater than 1.5.
- Other report recommendations included re-grading the slumped fill to no steeper than 3H:1V; avoidance of excessive irrigation of lawns and gardens; not permitting automatic lawn sprinkler systems; and discharging weeping drain systems into the sanitary system.

From "2018 Slope Evaluation Project" report by Parkland Geo dated April 2019:

- Royal Oaks apartment was built in 1997 consisting of two separate buildings after the failure described in AGRA (1997).
- As part of construction, the slope overlooking Waskasoo Creek was regraded and backfilled to level and square off the site to accommodate underground parking. It is unclear whether the fill discussed in AGRA (1997) was removed and replaced. The original crest elevation was about 876 m and the parkade floor was constructed at about 873.5 m. The toe of the slope is at about 867 m.
- Belled piles were used to support the buildings and were founded at about elevation 868 m.
- Backfill was placed to about 876.5 m to provide level patio areas for the first-floor apartment units.
- Tension cracks were observed in the fill during a wet period in 2007 along the south and west sides of the buildings. Minor regrading was completed to close and flatten the tension cracks.
- The general subsurface profile consists of clay fill overlying stiff low to medium plastic glacio-lacustrine deposits to about 868 m underlain by very stiff medium plastic clay till. Groundwater is expected to be within 2 m to 4 m from ground surface in the upland areas and deeper below the crest.
- A slope stability analysis was conducted and indicated the existing south slope was marginally stable. In addition, the slope stability analyses concluded that the building was not at risk (Factor of Safety > 1.5).

From "2022-2023 Geohazard Site Inspections Summary for Various Sites in the City of Red Deer" report by Stantec dated October 2023:

- The building manager informed the City and Stantec that there is a sprinkler system installed in the south lawn.
- The building managers also indicated that one of the units on the southeast corner of the property observed a 50 mm grade drop in their balcony leading away from the building. Some balcony doors were also adjusted in 2022. It was not made clear which balcony doors were adjusted.
- Stantec observed the tension cracks discussed in Parkland Geo (2019) appeared to be in similar locations along the west and south sides of the buildings.
- The landslide may have reactivated or accelerated due to the relatively wet weather experienced in 2022. It is unclear how the backfill was placed during construction of the building. It is possible that the backfill placed on the slope prior to 1997 was not fully removed and the original slump was not repaired, leading to a reactivation of the 1997/2007 landslide.
- The existing slope was 2.5H:1V based on 2016 LiDAR, which was steeper than recommended by AGRA. It is likely that the ground behind the tension crack had deformed due to the loss of buttress from the failed soil mass, a phenomenon of retrogressive failure. The deformed ground may have led to distress of the balconies.

ITEM	CONDITIONS EXIST		DESCRIPTION AND LOCATION	NOTICEABLE CHANGE FROM LAST INSPECTION	
	YES	NO		YES	NO
Building Distress	X		In 2022, the building manager indicated that some balcony doors were adjusted in previous years. In 2022, a board member indicated that there was a grade/drop in their balcony towards the downslope side in previous years. A hole in the ground (approx. 300 mm dia.) has exposed the underside of the far eastern unit's patio slab.	X	
Slope Movement	X		Ground crack observed along hedges on south side of the buildings. Leaning and curved trees along south and west slopes. Toe bulging at base of south slope. A small depression was observed near the toe of the slope, downslope from the southwest corner of the building.	X	
Erosion	X		Minor erosion rills and ground cracking are present on the unvegetated informal path from the northwest side of the building to the City's multi-use pathway.	X	
Seepage		X			X

OBSERVATIONS AND ASSESSMENT

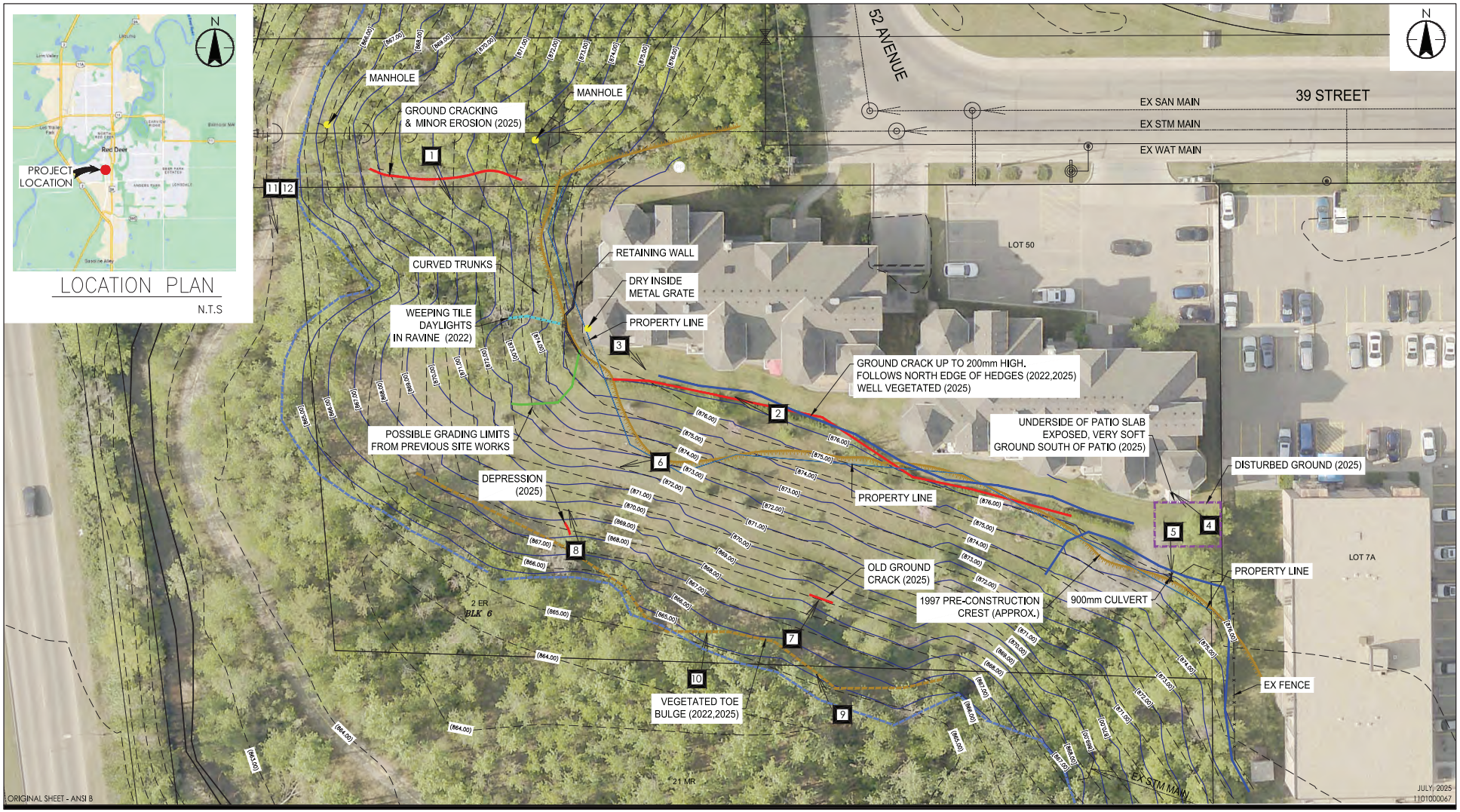
- Cracks in the ground 20 mm to 50 mm wide and minor erosion were observed down the slope along the informal trail from the northwest side of the building to the City's multi-use pathway (Photo 1). The cracks were up to 30 mm deep and did not appear to be due to landslide activity.
- The 150 mm to 200 mm deep ground crack observed in 2022 was present along the crest following the hedges, similar to the previous 2022 inspection (Photos 2 & 3). The ground crack was observed approximately 3.5 m to 4 m away from brick planters adjacent to the buildings. Cracking appeared more prominent near the east building. The crack appeared generally well vegetated, and otherwise unchanged from 2022.
- Soft, dry, cracked soil was present against the south side of the far east unit's patio slab, continuing to the crest of the slope. A hole approximately 300 mm in diameter exists against the patio slab and the underside of the slab was exposed (Photo 4). Ground cracking patterns suggest that the hole may increase in size with time.
- No other signs of distress were observed along the building walls, planters, or patios, similar to 2022.

- A 0.9 m diameter CSP culvert was found, and outlets directly south from the exposed patio slab (Photo 5). The soil above the CSP was soft. Based on the unvegetated state of the soil above and beside the culvert, it appears that the culvert was recently installed . Based on the outlet alignment, the culvert appears to lead to the undermined patio slab. It is unclear to the City or Stantec whether the culvert is connected to the building. The culvert outlets at the crest of the slope with no erosion protection present downslope. A grate was observed on the culvert outlet.
- The ground appears to have been disturbed from the far east patio to the far east fenced corner of the building lot. Minor vegetation was present, and the soil was generally soft, dry, and cracking.
- The south and west slopes were well vegetated with a combination of trees and grasses (Photo 6). Some trees were observed along both slopes that were either angled or curved, similar to 2022.
- A thin ground crack, approximately 2 m to 3 m long, that appeared generally well vegetated, was observed on the south slope (Photo 7).
- A small depression (approximately 75 mm deep) was observed downslope from the southwest corner of the west building, near the toe (Photo 8).
- Toe bulging was observed at the base of the slope similar to 2022 (Photo 9). Leaning trees were observed adjacent to the toe.
- The failure mass appears somewhat less vegetated (e.g., less trees) than surrounding areas, similar to 2022 (Photo 10).
- An outfall is present at the creek to the west of the site, and was recently upgraded. Riprap lines the creek bank around the outfall, and an erosion control blanket was placed upslope (Photo 11).
- The paved pedestrian trail to the west of the site was generally in good condition with both sealed and open cracks present in the asphalt (Photo 12). The cracks did not appear to be related to slope movement.
- During the inspection, the southwest corner of the west building was undergoing siding replacement adjacent to the wooden retaining wall and weeping tile. Due to the construction activity, access was limited and the wooden retaining wall and weeping tile system were not observed.
- Stantec understands that the City has not heard any updates or concerns from the building managers since 2022 regarding the site.
- It should be noted that the contour lidar data from 2016 has some discrepancy in certain locations compared to Stantec's 2025 survey data which may be attributed to accuracy and quality of the earlier LiDAR data.
- The Probability Factor remains at 8 due to the potential of landslide remobilization. The Consequence Factor remains at 8 since the landslide would result in loss of public and private property without impacting permanent structures.

RECOMMENDATIONS

- The City may advise the owner that it would be prudent to implement monitoring of the landslide as a minimum requirement for this site. Monitoring may include any of the following:
  - Installation of survey pins in the ground or survey marks on building perimeters and balconies, and collecting annual survey (minimum) to identify slope movements.
  - Installing slope inclinometers to monitor landslide movement in the spring and the fall.
  - Basic measurements at consistent, marked locations along the slope crest can also be taken to monitor additional slope movements as a "rough check."
- The City should contact the owner and determine the origin and purpose of the 0.9 m diameter culvert that was found during the site inspection. Stantec can provide further recommendations upon reviewing this information, if required. In addition, construction records should be requested to ensure proper compaction and material placement during the installation of the culvert.
- Culvert drainage should be directed away from the slope face to reduce surficial erosion and water infiltration into the slope. Erosion protection such as riprap can be placed at the outlet to improve erosion control.
- The hole against the far east patio slab should be backfilled to reduce surface water infiltration under the building.
- The soft soil around the culvert and far east patio should be properly compacted, graded to reduce ponded water, then vegetated to maintain slope stability.
- Ground cracks and depressions should be regraded to seal and flatten them. No additional fill should be placed for regrading. Any vegetation removed for regrading the landslide should be replanted to maintain slope stability.
- The sprinkler system should be inspected for leaks and repaired immediately if leaks are found. In addition, excessive watering of the lawn is not recommended since addition of water into the slope could be detrimental to its stability.

- The landslide appears to be relatively slow moving and has not impacted the main building structure. However, some balconies may have been affected. Further distress to the balconies may cause tearing/cracking of the building and could lead to major repairs of the overall building structure. As such, landslide remediation is recommended to be implemented to avoid distress of the building structure. Potential remediation options in the future may include structural options such as installing a micro-pile wall or reinforcing the slope with soil nails. These two types of structural reinforcement allow the use of small construction equipment for limited access areas. It may be more cost effective to monitor the building and landslide prior to landslide remediation.
- The recommended inspection frequency is once every 5 years or “as needed”.



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ORIGINAL SHEET - ANSI B

JULY, 2025
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Stantec

1100 - 4900 50th Street
Red Deer AB Canada T4N 1X7
www.stantec.com

Legend

- 2025 TOP OF BANK
- 2025 TOE OF BANK (APPROX.)
- 2025 OBSERVATIONS
- 1997 PRE-CONSTRUCTION CREST (APPROX.)
- 2022 VEGETATED TOE BULGE (APPROX.)
- 2022 GROUND CRACK
- (874.00) 2016 CONTOURS
- [874.00] 2025 CONTOURS
- PHOTO NUMBER AND DIRECTION

AERIAL PHOTO- 2022 CITY OF RED DEER
CADASTRAL - 2021 CITY OF RED DEER
CONTOURS - BASED ON 2016 LIDAR
UTILITIES - 2012 DATA FROM CRD

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

Client/Project
City of Red Deer
SITE 25 - ROYAL OAKS SITE PLAN
(5211 39 STREET)

Figure No.
1

Title
OVERALL PLAN

SCALE
1:500
0 5 15 25m

2025 Inspection Photos at Site 25 – Royal Oaks

Photo 1: Ground cracking and erosion down west slope on informal trail. Looking southeast.

Photo 2: South yard. Looking west.

2025 Inspection Photos at Site 25 – Royal Oaks

Photo 3: South yard. Looking east.

Photo 4: Hole in ground adjacent to far east unit patio slab at east building. Looking northwest.

2025 Inspection Photos at Site 25 – Royal Oaks

Photo 5: Culvert draining onto south slope. Looking south.

Photo 6: South slope face. Looking west.

Photo 7: Old ground crack on south slope. Looking northeast.

Photo 8: Small depression on south slope face, close to the toe. Looking northwest.

2025 Inspection Photos at Site 25 – Royal Oaks

Photo 9: Toe of south slope with angled trees and bulging. Looking west.

Photo 10: Toe bulge at south slope. Looking north.

Photo 11: Creek below west slope. Riprap and brush layering on creek edge. Looking west.

Photo 12: Creek pedestrian trail with some sealed and some open cracks. Looking south.