Attachment 1
CR_3268

River Valley Mechanized Access Environmental Impact Assessment

Final Report

Prepared for:

City of Edmonton Sustainable Development, Urban Planning and Environment
Edmonton, Alberta

Prepared by:

Spencer Environmental
Management Services Ltd.
Edmonton, Alberta

Under contract to:

DIALOG
Edmonton, Alberta

Project Number EP 629

January 2016

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Glinis Buffalo
Ecological Planner
Sustainable Development
City of Edmonton
1200 HSBC Bank Place
10250 - 101 Street NW
Edmonton, AB T5J 3P4

21 January 2016
EP-629

Dear Ms. Buffalo,

Re: GB15-42 – River Valley Mechanized Access - FINAL Environmental Impact Assessment and Site Location Study Reports

As requested, enclosed please find two (2) hard copies and one (1) electronic copy (pdf on CD) of each of the final EIA and SLS reports for your files. The final EIA includes an additional concordance table that outlines comments for which the response approach taken in the final EIA reflects a change relative to the proposed response approach outlined in the concordance table submitted in December 2015.

Please contact either of the undersigned if you require additional information.

Sincerely,

Spencer Environmental Management Services Ltd.

Kesia Miyashita

Kesia Miyashita, M.Sc., P.Biol.
Environmental Scientist

per: Andra Bismanis, M.Sc., P.Biol.
Project Manager and Senior Environmental Scientist

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cc: Enrique Peris, Project Manager, Sustainable Development, City of Edmonton
Sean Brown, DIALOG

City of Edmonton Bylaw 7188 Review Comments Summary
GB15-42 - River Valley Mechanized Access Site Location Study and Environmental Impact Assessment –
Addendum to the Environmental Impact Assessment and Site Location Study (December 2015)

22 January 2016

Note: The following concordance table outlines only those comments for which the response approach taken in the final Environmental Impact Assessment reflects a change relative to the proposed response approach outlined in the concordance table submitted in December 2015. Additional comments received from the Urban Ecology Unit and the Energy, Environment and Coordination Unit by way of an email dated 15 January 2016 have also been incorporated. All changes are indicated by bold text.

City of Edmonton Review

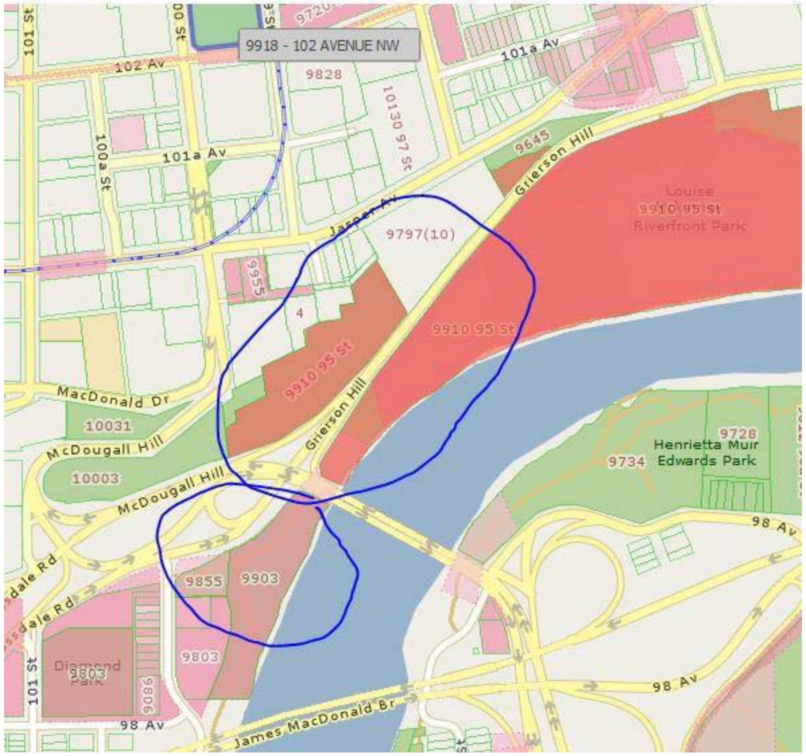
Review Comment	Response Approach	ESR Report Section Reference
SUSTAINABLE DEVELOPMENT (Glinis Buffalo, Ecological Planner, Urban Ecology Unit)		
Environmental Impact Assessment		
5. Design of proposed security fence that runs the length of the funicular is a barrier to wildlife movement. This concern was raised during several meetings between the consultant and Administration. Please provide options for gaps to be left to facilitate wildlife movement.	• This concern was considered very seriously in terms of project design to mitigate impacts to potential medium-sized wildlife movement on McDougall Hill. It is not expected that large-sized animals such as deer use the habitat patch on the steep hill that frequently because there are already barriers to movement created by adjacent busy roadways. The major wildlife corridor in the area is located adjacent to the river, south of McDougall Hill. • Creating some kind of gaps, including using culverts, in the security fencing so that medium-sized animals could pass under the funicular and stairs was	Sections 6.1.6

Review Comment	Response Approach	ESR Report Section Reference
	considered during EIA preparation and project design. The challenge is creating a large enough *functional* gap or tunnel-like feature to accommodate medium-sized animals such as coyotes that does not create a space for people to inhabit. • To provide adequate passage under the funicular and stairs for medium-sized animal passage would require at least a 1.5 m high by 1.5 m wide gap. This is large enough for people to inhabit. If people are living in the gaps, coyotes would not use them anyway. It is also not the intention of the project to provide opportunities for people to live under the infrastructure as there are safety and security concerns. • It was felt the best mitigation measure possible to make the funicular/stairs infrastructure somewhat permeable to wildlife movement given the human safety/infrastructure security/wildlife passage conflict on the slope was to raise the security fence above the ground by 10 cm (Section 6.6 in EIA). This will create a gap for small-sized animals, including hares, to pass under the structure if they wish. In addition the fence mesh will be 5 cm x 15 cm, which should be permeable to small-sized animals. • It is expected that highly urban-adapted coyotes would easily navigate around the	

Review Comment	Response Approach	ESR Report Section Reference
	new infrastructure on the hill if they move through the area, as they successfully do throughout the river valley and ravine system. • **Components of this discussion have been incorporated into Section 6.1.6 of the final EIA.**	
ENGINEERING SERVICES (Paul Lach, Senior Geotechnical Engineer, Transportation Services)		
Based on review of the final geotechnical report, I have some remaining concerns regarding this project. Notably, the conclusions presented concerning slope stability appeared strongly dependent upon the installation of additional instrumentation and the establishment of a comprehensive monitoring program throughout design, construction and operational periods. The geotechnical consultant noted that 'without ongoing monitoring there is an identified increased risk to the planned structures.' The consultant also indicated that the placement and details of exact structures are not currently known and that it is important to consider the stability of the surrounding area and the impacts that construction will have. It was indicated that, as such, ‘it may also be advisable to advance additional test holes in specific locations, once the exact alignment and locations of structures is finalized.'	• **Details from Thurber’s response from December 2015 have been incorporated into Section 6.1.1.1. Thurber’s response (Thurber 2015d) has been added as a reference to the EIA and the full response document has been incorporated into Appendix C.**	**Sections 6.1.1.1**
I am concerned with the open-ended nature of the recommendations in the geotechnical report as it relates to slope stability, the implied potential for insufficient instrumentation and investigation to date, as well as the inference that issues of construction disturbance and construction phase impacts were not yet fully evaluated. I would therefore request further information from the	• **Details from Thurber’s response from December 2015 have been incorporated into Section 6.1.1.1. Thurber’s response (Thurber 2015d) has been added as a reference to the EIA and the full response document has been incorporated into Appendix C.**	**Sections 6.1.1.1**

Review Comment	Response Approach	ESR Report Section Reference
geotechnical consultant providing confirmation of their recommendation that the engineering assessment showed appropriate geotechnical risk levels, in their opinion, to support proceeding with this development. The project proponent should also confirm the ongoing involvement of the geotechnical consultant in the review of all relevant aspects of the detailed engineering design and their full involvement in the construction phase of the project to confirm that work is carried out in strict accordance with their assessment and recommendations.		
The recommendation for additional investigation, instrumentation, and monitoring should be carried out in accordance with the requirements of the geotechnical consultant. Instrumentation monitoring and evaluation prior to and during project construction will provide a valuable tool for evaluation, design, and construction monitoring. Post-construction monitoring should also be conducted but should not be relied upon by the geotechnical consultant as a major factor to mitigate unacceptable levels of geotechnical risk to this project.	• **Details from Thurber's response from December 2015 have been incorporated into Section 6.1.1.1. Thurber's response (Thurber 2015d) has been added as a reference to the EIA and the full response document has been incorporated into Appendix C.**	**Sections 6.1.1.1**
Proper consideration must be given to the unique geotechnical characteristics and inherent risks associated with these lands. Any proposed grading of areas along the slope, vegetation removal, and changes in drainage as may impact slope hydrology, or other proposed construction disturbance must be fully evaluated and approved by the geotechnical consultant.	• **Details from Thurber's response from December 2015 have been incorporated into Section 6.1.1.1. Thurber's response (Thurber 2015d) has been added as a reference to the EIA and the full response document has been incorporated into Appendix C.**	**Sections 6.1.1.1**
I would note that the construction methodology, techniques and equipment adopted will also be important considerations in order to properly manage risk to this project. Construction must be undertaken in a manner to prevent and minimize any	• **Details from Thurber's response from December 2015 have been incorporated into Section 6.1.1.1. Thurber's response (Thurber 2015d) has been added as a**	**Sections 6.1.1.1**

Review Comment	Response Approach	ESR Report Section Reference
potential adverse impacts to the stability of the slopes. Construction activities must be planned and inspected to prevent any adverse changes to the surface or groundwater regimes in the slopes and to minimize disturbance of the slopes.	**reference to the EIA and the full response document has been incorporated into Appendix C.**	
In general, this project will involve a number of engineering challenges and geotechnical risks that must be appropriately minimized and managed through proper engineering design and appropriate construction techniques and practices. It appears that appropriate steps are being undertaken to establish designs with appropriate geotechnical engineering input. Again, this will necessitate the ongoing detailed involvement of the geotechnical consultant in review of the design and throughout the construction phase of the project. Should you have any questions regarding these comments, please call me at (780)496-6358.	• **Details from Thurber's response from December 2015 have been incorporated into Section 6.1.1.1. Thurber's response (Thurber 2015d) has been added as a reference to the EIA and the full response document has been incorporated into Appendix C.**	**Sections 6.1.1.1**
ENERGY, ENVIRONMENT AND COORDINATION UNIT (Barbara Daly)		
In reviewing the history, we find some signed off ESA work in the SW corner (small circle) but an absence of environmental information to the East and Northeast (big circle). Phase I ESA is required for the area indicated by the large circle in the attached snip file.	• **Section 6.1.1.5 of the EIA has been amended to include an additional sub-section to deal with the potential for encountering existing contaminated soils. Additional mitigation measures have been included that commits the City to completing a Phase 1 ESA and complying with all recommendations and mitigation measures stemming from the ESA and/or subsequent investigations.**	**Section 6.1.1.5**

Review Comment	Response Approach	ESR Report Section Reference
		
SUSTAINABLE DEVELOPMENT (Glinis Buffalo, Ecological Planner, Urban Ecology Unit) ***and*** **ENERGY, ENVIRONMENT AND COORDINATION UNIT (Barbara Daly) – from 15 January 2016**		
I have bolded the text from the addendum prepared by Spencer Environmental. Please see our response from the Ecology Unit and Barbara Daly following each bullet.	• **Section 6.1.1.5 of the EIA has been amended to include an additional sub-section to deal with the potential for**	**Section 6.1.1.5**

Review Comment	Response Approach	ESR Report Section Reference
Spencer had indicated: **We previously reviewed the ESA requirements and determined that an ESA is not required for this project based on the following:** o **Bylaw 7188 does not in itself trigger an ESA**. The major goal of the North Saskatchewan River Valley Area Redevelopment Plan (NSRV ARP), Bylaw 7188, is "to ensure the preservation of the natural character and environment of the North Saskatchewan River Valley and its Ravine System". It is our Corporate responsibility to ensure this goal is achieved by completing the environmental review process in order to satisfy the NSRV ARP. As the landowner, the City of Edmonton can request technical studies to be completed at the satisfaction of the reviewing agency. Although Bylaw 7188 does not specifically indicate a Phase I Environmental Site Assessment is required, a Phase I ESA is considered a technical study. Further, a number of the City's governing documents supports the major goal: A. The Way We Grow, Policy 9.5.1 indicates to "Promote the responsible management of contaminated sites to protect public health and the environment" with a specific policy 9.5.1.1 is to "Remediate contaminated sites to a level suitable for the intended use prior to development or redevelopment". B. The Province of Alberta MGA holds the municipality responsible to ensure the site is suitable for its intended purpose. Given the absence of information for the areas	**encountering existing contaminated soils. Additional mitigation measures have been included that commits the City to completing a Phase 1 ESA and complying with all recommendations and mitigation measures stemming from the ESA and/or subsequent investigations.**	

Review Comment	Response Approach	ESR Report Section Reference
indicated, a Phase I ESA and what if any additional work that may lead to, will ensure that all parties can proceed in compliance. C. The Zoning Bylaw for (A) Metropolitan Recreation Zone indicates "The purpose of this Zone is to preserve natural areas and parkland along the river, creeks, ravines and other designated areas for active and passive recreational uses and environment protection in conformance with Plan Edmonton and the North Saskatchewan River Valley Area Redevelopment Plan". Section 540.4 within the Development Regulations for Permitted and Discretionary Uses advises "An environmental review for all developments may be required prior to the issuance of a Development Permit at the discretion of the Development Officer". **o An ESA was not identified by the City as a project requirement during the Bylaw 7188 scoping meeting for the EIA**. A scoping meeting was held August 20, 2015, of which Barbara Daly, Energy, Environment and Coordination Unit, was not present to advise if a Phase I ESA is required at that time, however at the River Valley Mechanized Access - Internal Stakeholder Design Workshop held on September 11, 2015 at the Dialog office, Jacqueline Davis, a member of Barbara Daly's team had advised a Phase I ESA is required. o **To confirm the potential for contaminated sites in the project area we searched Alberta Environment's Environment Site Assessment Repository (ESAR), and**		

Review Comment	**Response Approach**	**ESR Report Section Reference**
found no known contaminated sites. While the provincial website can be useful, is not exhaustive. **o The ESA Guidebook notes that "exclusions shall be granted for … Non-Residential Change of Use that does not add residential or residential related use". That led us to believe that no ESA would be required for the site.** The Guidebook language is intended to suggest flexibility, however, it does not say that exclusions shall ALWAYS be granted.		

City of Edmonton Bylaw 7188 Review Comments Summary
GB15-42 - River Valley Mechanized Access Site Location Study and Environmental Impact Assessment – Draft Reports
23 December 2015

City of Edmonton Review

Review Comment	**Response Approach**	**ESR Report Section Reference**
SUSTAINABLE DEVELOPMENT (Glinis Buffalo, Ecological Planner, Urban Ecology Unit)		
Environmental Impact Assessment		
1. Page 11: Confirm from the options which of the two will pull the cabin: a closed-loop rope system or winch/drum system. Will the footprint change if one system is chosen over the other? Ensure the EIA has assessed all impacts once the system has been confirmed.	• We confirm that the winch/drum system will be used. • There is no difference in footprint between the two systems.	Section 2.3.2.1
2. Submit the monitoring study if avian mortality becomes a significant issue.	• If avian mortality becomes a significant issue, monitoring information will be provided.	Section 2.3.7.4
3. Page 33: Change City Council approved the construction of the East Alignment…" to City Council approved the project to proceed for the East Alignment..." This amendment is to reflect Council's direction "That the Design and Construction phase for the North Bank Mechanized Access project proceed on the basis of the recommended scope of work for the East-alignment outlined in page 5 of the Concept Engineering report, Attachment 1 of the June 16, 2015, Sustainable Development report CR_2429. Please make all edits throughout the document.	• These edits will be reflected in the final EIA document.	Sections 2.2 and 2.3.12.3
4. Discrepancy between text and illustrations pertaining to width of proposed service access road. Text states this item will be 3.5m and the associated drawings identify it as 4.0m. Please make changes to ensure consistency.	• 3.5 m is the correct width of the proposed roadway (see Appendix A). • Clearing for the road will be up to 5.0 m wide, which was accounted for in the	Figure 2.1

Review Comment	Response Approach	ESR Report Section Reference
	vegetation impact analysis. • Figure 2.1 will be revised accordingly in the final EIA.	
5. Design of proposed security fence that runs the length of the funicular is a barrier to wildlife movement. This concern was raised during several meetings between the consultant and Administration. Please provide options for gaps to be left to facilitate wildlife movement.	• This concern was considered very seriously in terms of project design to mitigate impacts to potential medium-sized wildlife movement on McDougall Hill. It is not expected that large-sized animals such as deer use the habitat patch on the steep hill that frequently because there are already barriers to movement created by adjacent busy roadways. The major wildlife corridor in the area is located adjacent to the river, south of McDougall Hill. • Creating some kind of gaps, including using culverts, in the security fencing so that medium-sized animals could pass under the funicular and stairs was considered during EIA preparation and project design. The challenge is creating a large enough *functional* gap or tunnel-like feature to accommodate medium-sized animals such as coyotes that does not create a space for people to inhabit. • To provide adequate passage under the funicular and stairs for medium-sized animal passage would require at least a 1.5 m high by 1.5 m wide gap. This is large enough for people to inhabit. If people are living in the gaps, coyotes would not use	Sections 2.3.2.1, 6.1.6

Review Comment	Response Approach	ESR Report Section Reference
	them anyway. It is also not the intention of the project to provide opportunities for people to live under the infrastructure as there are safety and security concerns. - It was felt the best mitigation measure possible to make the funicular/stairs infrastructure somewhat permeable to wildlife movement given the human safety/infrastructure security/wildlife passage conflict on the slope was to raise the security fence above the ground by 10 cm (Section 6.6 in EIA). This will create a gap for small-sized animals, including hares, to pass under the structure if they wish. In addition the fence mesh will be 5 cm x 15 cm, which should be permeable to small-sized animals. - It is expected that highly urban-adapted coyotes would easily navigate around the new infrastructure on the hill if they move through the area, as they successfully do throughout the river valley and ravine system.	
6. Within Section 2.3.2.2, Graham provides a timeline for different stages/phases of construction. A key item not addressed is their proposed timing for site remediation and landscaping. This item should be included.	- Landscaping and remediation is planned to occur May-September 2017. - This will be added to Section 2.3.2.2. in the final EIA.	Section 2.3.2.2.
7. Proposed drainage infrastructure (i.e. french drains) handling overland flows must be approved for use adjacent to Grierson Hill Road. - Post-comment clarification provided by G. Buffalo on	- Overland flow is generally not captured; only at the funicular base. Drainage Services reviewed an earlier concept where we tied into the City storm system, and	N/A

Review Comment	Response Approach	ESR Report Section Reference
21 December 2015: This should be approved by Drainage Services and Transportation Planning. If they are aware of the plan and are okay with this approach, please include the confirmation indicating this.	commented that it is already at capacity, so overland flows were preferred. • Drainage Services reviewed the EIA and did not express concerns with the concept; do they need more information?	
8. Mitigative measures proposed on page 120 must include how to deal with reduced wildlife movement concerns.	• See response to Comment #5 above. • This comment is unclear as it is our opinion that mitigation measures such as raising the fencing, having relatively large mesh on the fencing, locating the promenade approximately 29 m north of Grierson Hill Road and monitoring wildlife/vehicle collisions are presented on page 120.	
9. As per previous comments submitted through the initial scoping meeting, please identify additional vegetation to be removed associated with the 'viewing platform'. Please identify if mature trees will require removal or pruning to facilitate unobstructed views.	• To confirm, there will be selective pruning of trees under/near the lookout over the river; we have met with Urban Forestry and will continue to coordinate with them. • In general, as stated in the EIA (Sections 2.3.7.4 and 6.2.7.3), “It is expected that the City will need to conduct vegetation pruning in the project area on an ongoing basis for maintenance, horticultural and sight-line reasons.”	Sections 2.3.7.4 and 6.2.7.3
Site Location Study		
1. Page i: Change the “preferred option was approved by City Council on 23 June 2015” to “City Council approved the East Alignment to proceed”.	• These edits will be reflected in the final SLS document.	Executive Summary (introduction, financial, environmental), Section 1.2.2.3
2. Update Plate 1.1 to include the existing wooden stair and trail connector between the stair and promenade.	• We will work with DIALOG to have a more representative plate for the final EIA.	Plate 1.1

Review Comment	**Response Approach**	**ESR Report Section Reference**
3. Elaborate in the “Alternatives Considered” section the rationale/justification for the other five potential site locations in relation to environmental, social, institutional and costs constraints which make a River Valley location essential.	• The following revision is suggested for the alternative section to describe the 2014 study in more detail. The 2014 study is attached in Appendix B. In 2014, the City of Edmonton requested DIALOG to conduct a “high level” review and assessment of the potential for a mechanized access conveyance for five potential alignments in the central part of the North Saskatchewan River Valley, including four on the north side of the river and one on the south side of the river: North Side (Downtown) • 100 Street (“Hotel MacDonald stairs”) • 104 Street • 106 Street(at Alberta Legislature) • 110/109 Street (High Level Bridge) South Side (Strathcona) • 105 Street Each of the proposed alignments in the river valley was assessed using a series of criteria identified by City administration as follows (Dialog 2014): • Connection to active transportation network • Connection to West Rossdale/Generating Station	Section 2.3.12.1

Review Comment	Response Approach	ESR Report Section Reference
	- Connect to River - Connection to Downtown - Connection to Strathcona - Connection to Cloverdale - Year round use potential - Geotechnical Considerations - Structural Considerations - Modal feasibility A construction cost estimate (Class D) was also calculated for each site based on various components and construction area combinations. The details of each site evaluation and construction cost estimate are available in Dialog 2014 in Appendix A of this document. Of the five site locations, Dialog, in consultation with the City, determined that the 106 Street site was no longer required and that an inclined elevator was recommended at three sites (100 Street, 104 Street and 105 Street) and an elevator was recommended at the 100 Street site (Dialog 2014). From those recommendations, City administration selected two preferred locations that formed the basis of the 2015 concept engineering study: 100 Street Access on McDougall Hill on the north side of the river and 105 Street Access within Queen Elizabeth Park on the south side of the river.	
Please address the outstanding comments in an addendum to the original report. Please note once the report is signed off, I will require a final hardcopy and electronic version with	- Comment noted.	N/A

Review Comment	Response Approach	ESR Report Section Reference
addendum(s) attached and this version will act as the "final" document for our records and for City Council submission. Please call me at 780-442-5046 if you or the proponent has any questions.		
COMMUNITY SERVICES, FACILITY AND LANDSCAPE INFRASTRUCTURE (Corey Toews)		
Community Services, Facility and Landscape Infrastructure has coordinated a review of the Environmental Impact Assessment for the above noted project. Community Services, Facility and Landscape Infrastructure remains committed to the mechanized access project but does not support sign off of the Environmental Impact Assessment until an adequate response/answer has been provided for the following:	• N/A	N/A
1. Concrete finishing work for the 100 Street Promontory should ensure the surface provides sufficient traction when wet or when there is snow/ice. Figure A1.10 identifies cast-in-place concrete finished with glass blast and saw cuts. Will this ensure safe use through all seasons? Would not like to replicate the condition at Churchill Square where the concrete is slippery when wet or snow covered. The design should consider a range of program potentials including but not limited to food vendors. Will the suggested materials allow for washing stains away? What are the plans to mitigate potential cracking of the concrete?	• When the surface is textured somewhat (i.e. broom finished or sandblasted), that small bit of surface texture gains you some traction compared to a trowelled or smooth finish. Broom finish may be slightly better, but was not selected for aesthetic reasons. • A large part of slip resistance comes from the amount of foot traffic (which may be an issue at Churchill) and efforts at clearing snow. • The concrete surfaces will be well graded to promote drainage and reduce standing water. • Concrete will be protected from staining and salt intrusion by a penetrating silane treatment. • Cracking will be mitigated by providing adequate reinforcing steel designed to CSA A23.3 code requirements.	N/A

Review Comment	**Response Approach**	**ESR Report Section Reference**
2. Inclusion of bike rails is recommended and should be a requirement of the project. If bike rails are not included and the elevator/funicular is out of operation, or closed depending on operating hours, what alternatives would be provided to cyclists?	• Bike rails will be provided on the stairs. We will provide a rail on the east side of the stairs as a minimum for people taking bikes uphill. We are still looking at the feasibility of a second rail.	Section 2.3.2.1
3. The use of glass should consider realistic maintenance requirements and expectations. The use of glazing and tinting may 'mask' some of the dirt and grime and reduce maintenance requirements. The use of glazing will have the added benefit of reducing bird strikes/mortalities. As a side note, use of glass with decorative glazing has been undertaken in Calgary on recent projects in high profile locations. We recommend following-up with the City of Calgary to discuss and report back on performance, design and maintenance realities of the use of glass in these sorts of projects.	• The project team continues to investigate how a frit or pattern can be used in the glass on the elevator shaft to limit bird strikes. Glass on the railings may also have a frit or pattern to "mask" potential dirt and grime. Some cleaning will be required, and maintenance (buffing out scratches from time to time). We have also reduced the amount of glazing to save costs; only "landing" areas (promontory tip, end of lookout, and other viewpoints) will have glass railings. • We can follow up with the City of Calgary on specific projects if more info can be provided. We (DIALOG and Carlyle + Associates) have been involved in several projects in Calgary and have a good sense of what has been done there. The 7th Ave LRT canopies in Calgary and at Corona Station in Edmonton can get dirty and are not always kept clean. This is more of a concern on non-vertical surfaces.	N/A
4. Please provide additional information on the omega fence. What does this look like? What are the maintenance requirements?	• The OMEGA Fence being proposed is OMEGA II Fence Systems – Omega Architectural. See http://www.omegafence.com/en/download.	N/A

Review Comment	Response Approach	ESR Report Section Reference
	php • It is composed of 4.9 mm diameter steel wire bars, and will be galvanized and polyester powder-coated for minimal maintenance.	
5. It is unclear from the report whether the proposed trail connection between the existing landing (existing staircase) and the new urban staircase will be an informal or formal trail. This trail will need to be formal and maintained and should reflect a high quality design and integration between existing and new infrastructure. An informal trail is not appropriate. It should be noted that several of the site plan drawings identify landscape areas over this pathway and there is no design detail provided to indicate how this trail connects to the urban staircase. Alternatively, is there a design option that retains and refurbishes the existing staircase to complement the proposed infrastructure? This would negate the need for a connecting trail while retaining and enhancing existing pedestrian routes.	• We will consider the trail to be “formal”, as it will be marked and maintained. It will be a secondary route to the main alignment. The addition of this secondary trail was added late in the process and was not reflected on all drawings, but will be a part of the overall design (See new drawing in Appendix A). • The decision to remove the top portion of the stairs and maintain the lower portion was a balance of maintaining the connection to the bus stop and road crossing, and reducing the total area of stairs that require maintenance by City staff.	Section 2.3.2
6. Hours of usage should respect how this route is used. This is a commuter corridor and a critical connection between the downtown and adjacent neighbourhoods (south, west and east). Restricting hours of operation is concerning if amenities such as bike rails are removed. Users would have to carry their bikes or find other routes up or down the hill.	• The restricted hours of usage are envisioned for the mechanized components only, and were the direction of City administration. • Bike rails will be provided for those that want to use the stairs after park hours. The stairs and bike rails are not intended to have limited hours of usage.	Section 2.3.2.1
7. Previous design consideration included an elevator stop at Grierson Hill Road. This had the benefit of linking to an accessible trail that provides direct access to the Low Level	• This linkage remains and is shown in the EIA in Figure 2.1. • The text in Section 2.3.2 will be revised to	Section 2.3.2

Review Comment	Response Approach	ESR Report Section Reference
Bridge. What is the status of this linkage? It is not identified in the EIA report. Please note there are limited accessible connections to south side routes from the riverside shared use path and the Low Level Bridge.	strengthen and clarify this linkage in the final EIA.	
8. The EIA report states that expected system demand is predicted to be 366 users/hour and 183 users/hour/direction during the peak hour service over the lunch hour. Are the majority of lunch hour users using the existing stairs for exercise or for other purposes? The overall design should be based on realistic assumptions and user demands/requirements. Narrowing the 'express' staircase may not be appropriate if the majority of 'peak-time' users are using the stairs for exercise and recreation.	• Concern noted. We designed the stair width to balance cost, footprint on the river valley, express users, and recreational users. • Express stair users will tend to take up a narrow width on the stairs, similar to a swimming pool with a lane for each direction. Providing more width for express users will not likely make a big difference in how many people can use the stairs without adding new "lanes", which we don't see as a possibility given the site constraints. We believe the design provided will accommodate both user groups. • As we are creating a new way of using the stairs, we do not really know how many people will use the seating areas for sitting and enjoying the river valley, or how many people will use the funicular. We are making a best guess based on some assumptions.	N/A
9. During construction pedestrian access along Grierson Hill is to be maintained. This is an important connection and no other re-routes are available.	• The construction manager has been directed to provide pedestrian access either along Grierson Hill Road or along the river valley trail throughout construction. They are coordinating with the LRT construction	N/A

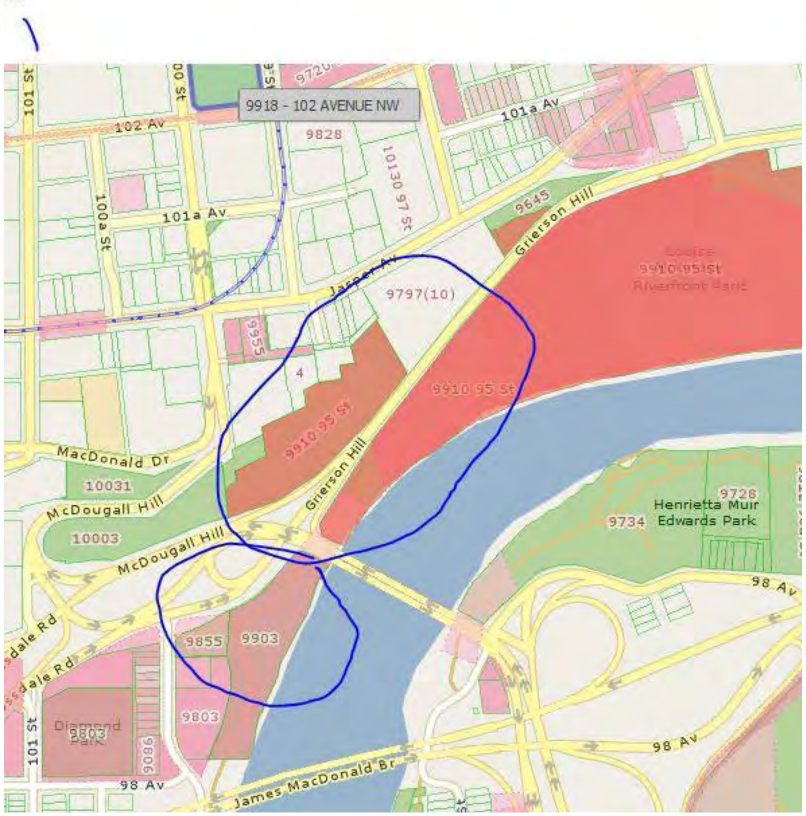
Review Comment	Response Approach	ESR Report Section Reference
	project team as well, since those projects will impact one another.	
10. As the design moves forward additional details on the interface of the riverside trail/elevator is required to ensure that safety concerns are adequately addressed.	• Concern noted; further detail will be provided. A CPTED report was just completed, and will be referenced as we develop details.	N/A
11. Please communicate construction schedules and project timelines as they become available to Natalie Szekely, Festival and Events Liaison with Community and Recreation Facilities (natalie.szekely@edmonton.ca; 780 496-4871).	• The City's project liaison is Henry Maisonneuve. Sam Johnson is the primary contact with the construction manager, but discussions should go through Henry (587-340-4999, samj@graham.ca)	N/A
12. Upon approval of the final plan, a site meeting with Forestry will be required to review construction plans and tree protection during construction conflicts (construction work within 5 metres). This meeting will need to be scheduled a minimum 4 weeks in advance of the construction start date. Please be advised that all costs associated with the removal, replacement or transplanting of trees shall be covered by the Proponent as per the Corporate Tree Management Policy (C456A). Forestry will schedule and carry out all required tree work involved with this project. Please contact Bonnie Fermanuik (780 496- 4960) to arrange this meeting.	• On December 11, 2015, the construction manager's surveyors laid out the construction area. On December 14, 2015, the design team and construction manager met with Melissa Campbell of Urban Forestry to assess the impact on existing trees and get this process started.	N/A
Should you have any questions relating to the above, please contact Corey Toews at 496-8381 or through email at corey.toews@edmonton.ca.	• N/A	N/A
SUSTAINABLE DEVELOPMENT (Liliana Malesevic, Drainage Services)		
Drainage Services Environmental group reviewed draft Site Location Study report and EIA report for above noted project and has no concerns related to this project, aside from protecting existing drainage infrastructure during construction (filter socks around catch basins, clean equipment and	• N/A	N/A

Review Comment	Response Approach	ESR Report Section Reference
vehicles on the road, sediment control measures and erosion protection implemented on time).		
ENGINEERING SERVICES (Paul Lach, Senior Geotechnical Engineer, Transportation Services)		
I reviewed the Environmental Impact Assessment (EIA) and the associated Site Location Study for the proposed Mechanized River Valley Access Project, prepared by Spencer Environmental Management Services Ltd., dated November 2015. I also reviewed the appended Stage 2 Geotechnical Investigation Report prepared by Thurber Engineering Ltd., dated November 12, 2015.	• N/A	N/A
The proposed project alignment is located along the south facing slopes of the North Saskatchewan River valley, east of 100 Street and below the Fairmont Hotel MacDonald. Key project elements include a promontory at top of bank; a mechanized funicular and parallel stairway; a mid-slope promenade and trail connection; a pedestrian bridge across Grierson Hill Road, and; an elevator, stair, and tie-in to the lower trail near the river level.	• N/A	N/A
This project will involve significant inherent geotechnical slope stability risks associated with the location and disturbance along the valley slopes, as well as flood risks for project elements situated at the toe of the slopes near the river level. From the information provided in the EIA, it is understood that the geotechnical risks are to be addressed through the ongoing involvement of the geotechnical consultant throughout the project design and construction phases. From the geotechnical information reviewed, it appeared that relatively comprehensive geotechnical assessment has been performed by Thurber Engineering Ltd. and that critical geotechnical issues have been identified and evaluated. This work has included the review of available	• N/A	N/A

Review Comment	Response Approach	ESR Report Section Reference
geotechnical and geological information for the site and surrounding areas, historical aerial photograph and LiDAR assessment, geotechnical characterization of the project alignment through field investigative programs and laboratory testing, instrumentation installation and monitoring, and geotechnical design with supporting engineering analyses, assessment and engineering judgement.		
Based on review of the final geotechnical report, I have some remaining concerns regarding this project. Notably, the conclusions presented concerning slope stability appeared strongly dependent upon the installation of additional instrumentation and the establishment of a comprehensive monitoring program throughout design, construction and operational periods. The geotechnical consultant noted that 'without ongoing monitoring there is an identified increased risk to the planned structures.' The consultant also indicated that the placement and details of exact structures are not currently known and that it is important to consider the stability of the surrounding area and the impacts that construction will have. It was indicated that, as such, ‘it may also be advisable to advance additional test holes in specific locations, once the exact alignment and locations of structures is finalized.'	• See Appendix C for Thurber’s response.	Sections 5.1.1 and 6.1.1
I am concerned with the open-ended nature of the recommendations in the geotechnical report as it relates to slope stability, the implied potential for insufficient instrumentation and investigation to date, as well as the inference that issues of construction disturbance and construction phase impacts were not yet fully evaluated. I would therefore request further information from the geotechnical consultant providing confirmation of their	• See Appendix C for Thurber’s response.	Sections 5.1.1 and 6.1.1

Review Comment	Response Approach	ESR Report Section Reference
recommendation that the engineering assessment showed appropriate geotechnical risk levels, in their opinion, to support proceeding with this development. The project proponent should also confirm the ongoing involvement of the geotechnical consultant in the review of all relevant aspects of the detailed engineering design and their full involvement in the construction phase of the project to confirm that work is carried out in strict accordance with their assessment and recommendations.		
The recommendation for additional investigation, instrumentation, and monitoring should be carried out in accordance with the requirements of the geotechnical consultant. Instrumentation monitoring and evaluation prior to and during project construction will provide a valuable tool for evaluation, design, and construction monitoring. Post-construction monitoring should also be conducted but should not be relied upon by the geotechnical consultant as a major factor to mitigate unacceptable levels of geotechnical risk to this project.	• See Appendix C for Thurber's response.	Sections 5.1.1 and 6.1.1
Proper consideration must be given to the unique geotechnical characteristics and inherent risks associated with these lands. Any proposed grading of areas along the slope, vegetation removal, and changes in drainage as may impact slope hydrology, or other proposed construction disturbance must be fully evaluated and approved by the geotechnical consultant.	• See Appendix C for Thurber's response.	Sections 5.1.1 and 6.1.1
I would note that the construction methodology, techniques and equipment adopted will also be important considerations in order to properly manage risk to this project. Construction must be undertaken in a manner to prevent and minimize any potential adverse impacts to the stability of the slopes.	• See Appendix C for Thurber's response.	Sections 5.1.1 and 6.1.1

Review Comment	Response Approach	ESR Report Section Reference
Construction activities must be planned and inspected to prevent any adverse changes to the surface or groundwater regimes in the slopes and to minimize disturbance of the slopes.		
In general, this project will involve a number of engineering challenges and geotechnical risks that must be appropriately minimized and managed through proper engineering design and appropriate construction techniques and practices. It appears that appropriate steps are being undertaken to establish designs with appropriate geotechnical engineering input. Again, this will necessitate the ongoing detailed involvement of the geotechnical consultant in review of the design and throughout the construction phase of the project. Should you have any questions regarding these comments, please call me at (780)496-6358.	• N/A	N/A
TRANSPORTATION PLANNING (Audra Jones, Director)		
No concerns or questions.	• N/A	N/A
ENERGY, ENVIRONMENT AND COORDINATION UNIT (Barbara Daly)		
In reviewing the history, we find some signed off ESA work in the SW corner (small circle) but an absence of environmental information to the East and Northeast (big circle). Phase I ESA is required for the area indicated by the large circle in the attached snip file.	• We previously reviewed the ESA requirements and determined that an ESA is not required for this project based on the following: o Bylaw 7188 does not in itself trigger an ESA. o An ESA was not identified by the City as a project requirement during the Bylaw 7188 scoping meeting for the EIA. o To confirm the potential for contaminated sites in the project area we searched Alberta	N/A

Review Comment	Response Approach	ESR Report Section Reference
	Environment's Environment Site Assessment Repository (ESAR), and found no known contaminated sites. o The ESA Guidebook notes that "exclusions shall be granted for … Non-Residential Change of Use that does not add residential or residential related use". That led us to believe that no ESA would be required for the site.	
SUSTAINABLE DEVELOPMENT (Andrew McLellan, Planner, City Wide Planning Section, Current Planning)		
The Site is has a mixture of (AP) Public Parks Zone, (A) Metropolitan Recreation Zone and (AN) River Valley Activity Node Zone and is within the North Saskatchewan River Valley Area Redevelopment Plan. It is within the North Saskatchewan River Valley and Ravine System Protection Overlay and a portion of it is within the Floodplain Protection Overlay.	• N/A	N/A
The proposed River Valley Mechanized Access development is	• N/A	N/A

Review Comment	**Response Approach**	**ESR Report Section Reference**
an Outdoor Participant Recreation Service as it is connected with and functions as a "fitness trail". Outdoor Participation Recreation Services is a Permitted Use within the 'AP' and 'AN' zones and Discretionary in the 'A' Zone.		
A Development Permit is required and was submitted on November 5, 2015 (Development Permit Application # 182041886-001). In the event that any variances are granted, the development decision will be a Class B Discretionary decision and will be subject to the right of appeal by adjacent property owners.	• N/A	N/A
The submitted EIA meets the requirements of the North Saskatchewan River Valley Area Redevelopment Plan. The Central Unit of City Wide Planning Services has no concerns with regards to the content or conclusions of the EIA.	• N/A	N/A

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1.0 INTRODUCTION

1.1 Background

The City of Edmonton proposes to improve overall connectivity and access to the North Saskatchewan River and river valley via mechanized means through the River Valley Mechanized Access (RVMA) project. That project will connect the top-of-bank to the existing river valley trail system through a transportation system that is accessible for all Edmontonians and visitors to Edmonton. The proposed RVMA project offers the potential for connecting major destinations with one another where there is both potential demand and vertical elevation differences that make other transportation modes less suitable (DIALOG 2014). This characteristic of connection is inherent in the relationships between the North Saskatchewan River, the river valley flats and the tableland destinations of downtown Edmonton.

The proposed RVMA project is one of 13 integral initiatives within the greater River Valley Alliance (RVA) Capital Project that were announced in January 2013 (RVA 2013). The RVA's vision is "To create a continuous integrated river valley park system in the Alberta Capital Region, from Devon through Parkland County, Leduc County, Edmonton, Strathcona County and Sturgeon County to Fort Saskatchewan" (RVA 2015). The Capital Project will improve overall public access to the North Saskatchewan River and river valley and add new trails and features to existing infrastructure in what is considered North America's longest metropolitan park system (RVA 2013). Funding for the RVA Capital Project is provided in equal parts from the federal Building Canada Fund ($30 million), the Government of Alberta ($30 million) and the seven RVA municipalities, including City of Edmonton, that benefit from the Capital Project initiatives ($30 million). As part of the Capital Project, the proposed project is fully-funded with a budget of approximately $24 million. The funding rules require that the project must be completed by July 2017.

With respect to the City of Edmonton, specifically, the proposed RVMA project is consistent with the *Ribbon of Green Master Plan* (City of Edmonton 1992) and the major goals of the *North Saskatchewan River Valley Area Redevelopment Plan* (Bylaw 7188) (City of Edmonton 2014). Those goals include: 1) to ensure preservation of the natural character and environment of the North Saskatchewan River Valley and its Ravine System; 2) to establish a public metropolitan recreation area; and 3) to provide the opportunity for recreational, aesthetic and cultural activities in the Plan area for the benefit of Edmontonians and visitors to Edmonton.

The proposed RVMA project will be located on the north river valley slope of the North Saskatchewan River adjacent to and below the Fairmont Hotel Macdonald and extend downslope to the floodplain and lower valley terrace. It will comprise an upper platform, a funicular with adjacent urban and express stairs, a promenade, a pedestrian bridge across Grierson Hill Road, an elevator with accompanying stairs and a cantilevered lookout (Plate 1.1). The funicular will connect the top of the river valley slope to the promenade and pedestrian bridge above Grierson Hill Road. An elevator will connect the pedestrian overpass and cantilevered lookout to existing river valley trails on the lower valley terrace and floodplain between Grierson Hill Road and the North Saskatchewan River. Preliminary design for the proposed RVMA project is currently underway, and those preliminary designs form the basis of this environmental assessment.

Plate 1.1. Proposed River Valley Mechanized Access Project Overview (DIALOG 2015a)

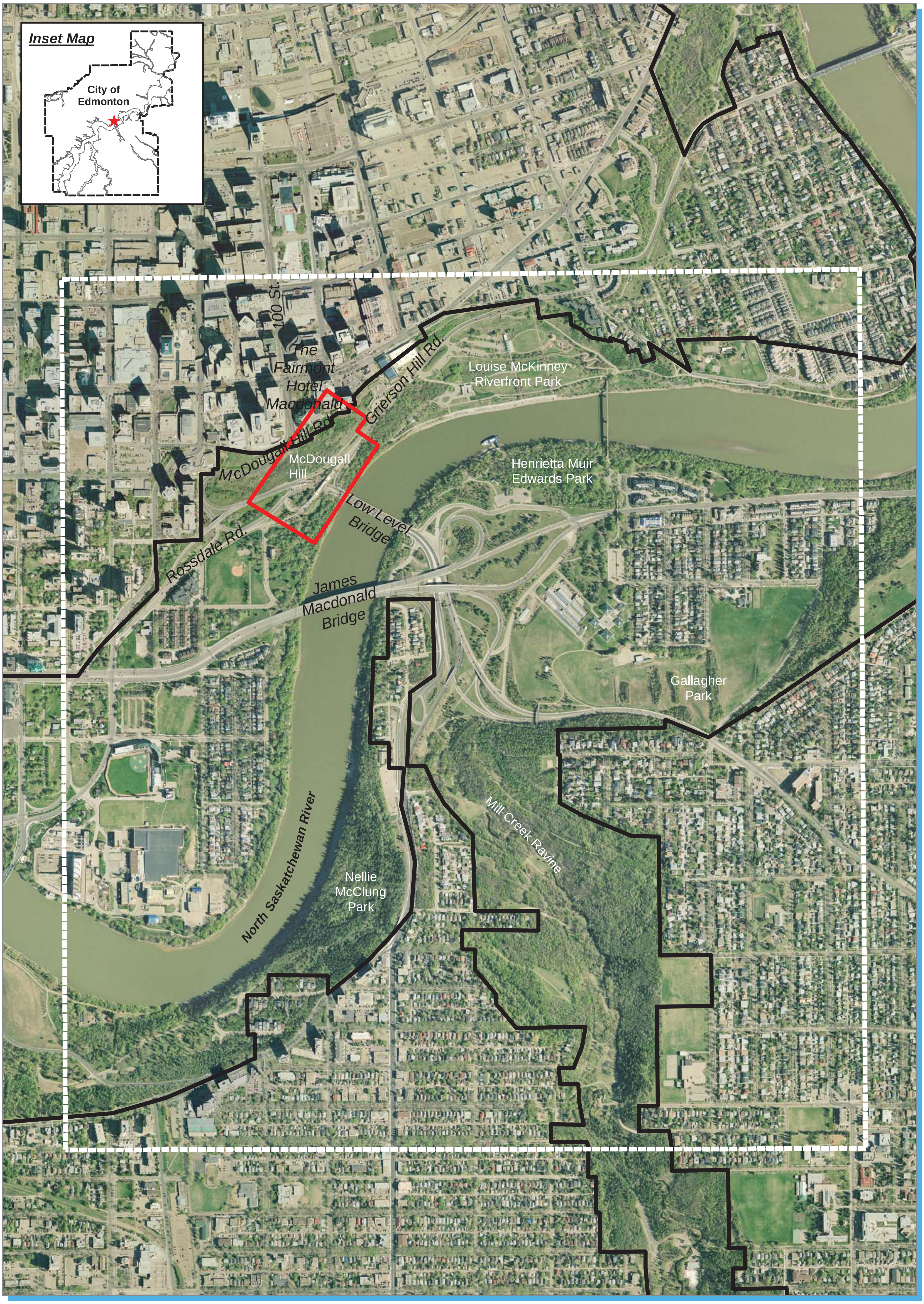
1.2 Environmental Assessment Objectives

Initial review of the proposed RVMA project identified the City of Edmonton as the primary regulator with respect to environmental assessment. The City of Edmonton Sustainable Development Department, which administers the *North Saskatchewan River Valley Area Redevelopment Plan* (Bylaw 7188), indicated that the appropriate level of environmental assessment document to support Bylaw 7188 review would be an Environmental Impact Assessment (EIA). The EIA prepared for this project was based on the following primary objectives:

- Meet the requirements for an environmental review of the project pursuant to Bylaw 7188.
- Assure that all required environmental permits are identified and secured.
- Achieve an environmentally sound design and assure that environmental objectives are met during construction.

1.3 Study Area

In order to focus the impact assessment on the geographic area most likely affected by the proposed RVMA project, a local study area was established, encompassing the entire area with the potential to be physically impacted, either directly or indirectly, by all stages of the project (site preparation, construction, operation and reclamation) (Figure 1.1).



Legend

🟥 Local Study Area
▨ Regional Study Area
⬛ Bylaw 7188 boundary

0 100 200 400 Meters
1:10,000

Figure 1.1. Project Location, Local Study Area and Regional Study Area
River Valley Mechanized Access Project

Aerial Photograph Date: May 2012
Date Map Created: 17 November 2015

SPENCER ENVIRONMENTAL
MANAGEMENT SERVICES LTD.

Study area boundaries were selected with consideration of:

- ecologically relevant boundaries,
- inclusion of potential visual impacts, and
- inclusion of potential reclamation impacts.

1.4 Bylaw 7188 Environmental Review Process

Environmental assessments pursuant to Bylaw 7188 that are prepared for City of Edmonton Sustainable Development are routinely circulated amongst City departments for their comments and feedback. Responses are developed to address any outstanding concerns to the satisfaction of reviewers and Sustainable Development. Once all outstanding concerns are addressed and reviewers are satisfied with the EIA, then Sustainable Development will sign off on the EIA and recommend that it, and an accompanying Site Location Study (SLS; under separate cover), be forwarded to City Council for approval pursuant to the requirements of Bylaw 7188. The approved EIA will also comprise a part of the Development Permit application for the project. No other environmental approvals or permits are required for the proposed project.

1.5 Report Organization

This report contains eight chapters. Chapter 1 (Introduction) provides background information related to the project and describes the report structure. Chapter 2 (Project Description) is the detailed project description, including project justification, the scope of the work, procedures to be used, construction scheduling and a brief summary of the public consultation process. Chapter 3 (Methodology) outlines the impact assessment methodology, while Chapter 4 (Key VEC Issues) summarizes the key Valued Environmental Components (VEC) issues associated with the project, incorporating professional and regulatory concerns.

Chapter 5 (Existing Conditions) and Chapter 6 (Potential Impacts and Mitigation Measures) are organized to describe each potentially affected resource in terms of VECs. Existing conditions for all VECs are described in Chapter 5. Impacts related to project implementation, recommended mitigation measures and any residual impacts after mitigation are described in Chapter 6. Chapter 7 (Summary Assessment) summarizes findings of the EIA, identifies monitoring requirements and follow-up work and summarizes steps taken to resolve issues identified during the assessment. Chapter 8 (References) provides all references and personal communications cited in the report.

Appendices to the report include:

Appendix A: Drainage Approach for River Valley Access Edmonton
Appendix B: Public Consultation Description for the Proposed RVMA Project
Appendix C: Geotechnical Assessment for the Mechanized River Valley Access Project
Appendix D: Vegetation Survey Results (29 June 2015)
Appendix E: Wildlife Species List
Appendix F: Historical Resources

2.0 PROJECT DESCRIPTION

2.1 Declaration

The project proponent is the City of Edmonton. Prime consultant and project manager for the proposed River Valley Mechanized Access (RVMA) project is DIALOG. Spencer Environmental Management Services Ltd. (Spencer Environmental) was retained by DIALOG and is the environmental consultant responsible for preparation of this EIA.

This report represents the findings and conclusions of the environmental consultants, but it also incorporates suggestions and comments from the proponent and the design team. The specific mitigation measures outlined in this document will be followed by the proponent as part of their commitment to environmental best management practices and technologies.

2.2 Project Need/Rationale

The proposed RVMA project is one of 13 integral initiatives within the greater River Valley Alliance (RVA) Capital Project that were announced in January 2013 (RVA 2013). The purpose of those initiatives is to increase access and connectivity within the river valley (City of Edmonton 2015a). As part of the Capital Project, the proposed RVMA project is fully-funded with a budget of approximately $24 million. The funding rules require that the project must be completed by July 2017 otherwise the funding is lost (i.e., it cannot be applied to any other City projects).

City Council approved the RVMA project to proceed for the East Alignment, connecting 100 Street near the Fairmont Hotel Macdonald and the river valley trail system near the Low Level Bridge on 23 June 2015. The proposed project will replace aging existing wooden stairs on McDougall Hill and will improve accessibility of the river valley to people of all ages and abilities through its main components. The proposed urban stair, funicular and pedestrian bridge over Grierson Hill Road offer an exciting opportunity to access and experience Edmonton's Ribbon of Green from the City's downtown. It will promote a variety of recreational uses in the area and enhance a pedestrian and cyclist commuter route between downtown and the south side of the river. Trail tie-ins will better connect users directly to the existing river valley trails on the south side of Grierson Hill Road compared to existing conditions. The City envisions the project as an opportunity for great urban design, embracing the river valley into people's everyday lives. The proposed project offers the potential to be an entrance to the river valley for everyone, regardless of age and ability, and a focal point that will bring people together in the heart of Edmonton.

In addition, the proposed project is consistent with the City of Edmonton's *Ribbon of Green Master Plan*, the goals of the *North Saskatchewan River Valley Area Redevelopment Plan* (Bylaw 7188), *The Way We Grow: Municipal Development Plan* (Bylaw 15100), *The Way We Move: Transportation Master Plan*, *The Way We Live: Edmonton's People Plan* and *The Way We Green: Environmental Strategic Plan*.

2.3 Project Details

2.3.1 Project Setting

The proposed project will be located on the north side of the North Saskatchewan River in central Edmonton. The proposed project area is located immediately adjacent to and south of downtown and comprises a metropolitan park along both sides of the river comprising existing trails, extensive areas of natural and manicured plant communities, urban multi-use parks with associated recreational facilities and urban and transportation infrastructure such as residential areas, arterial roadways and vehicle and light rail transit bridges. Specifically, the proposed project will be located at the top-of-bank adjacent to the Fairmont Hotel Macdonald and extend downslope to the river valley bottom south of Grierson Hill Road and east of the Low Level Bridge (Plate 1.1 and 2.1).

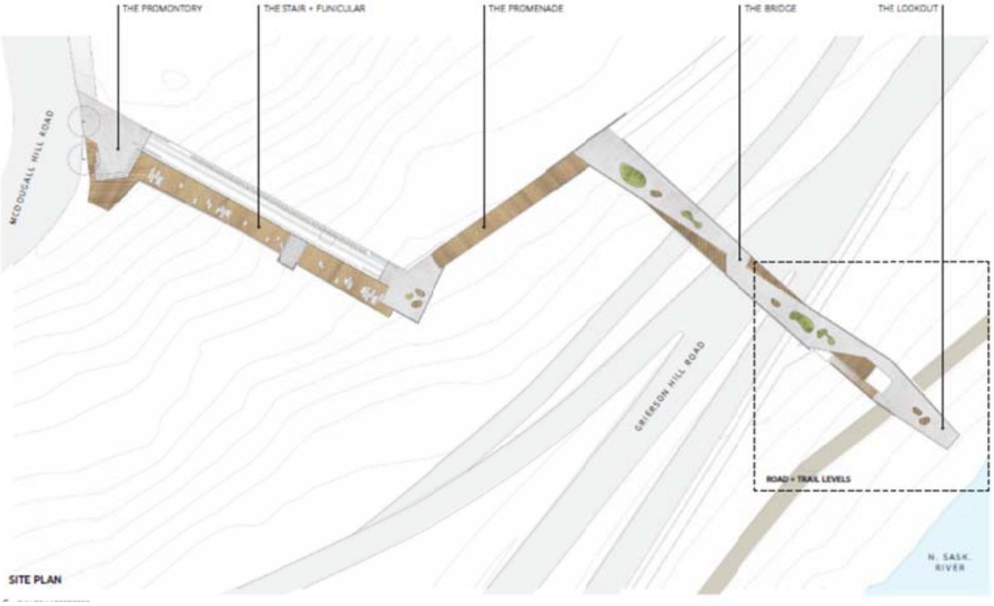


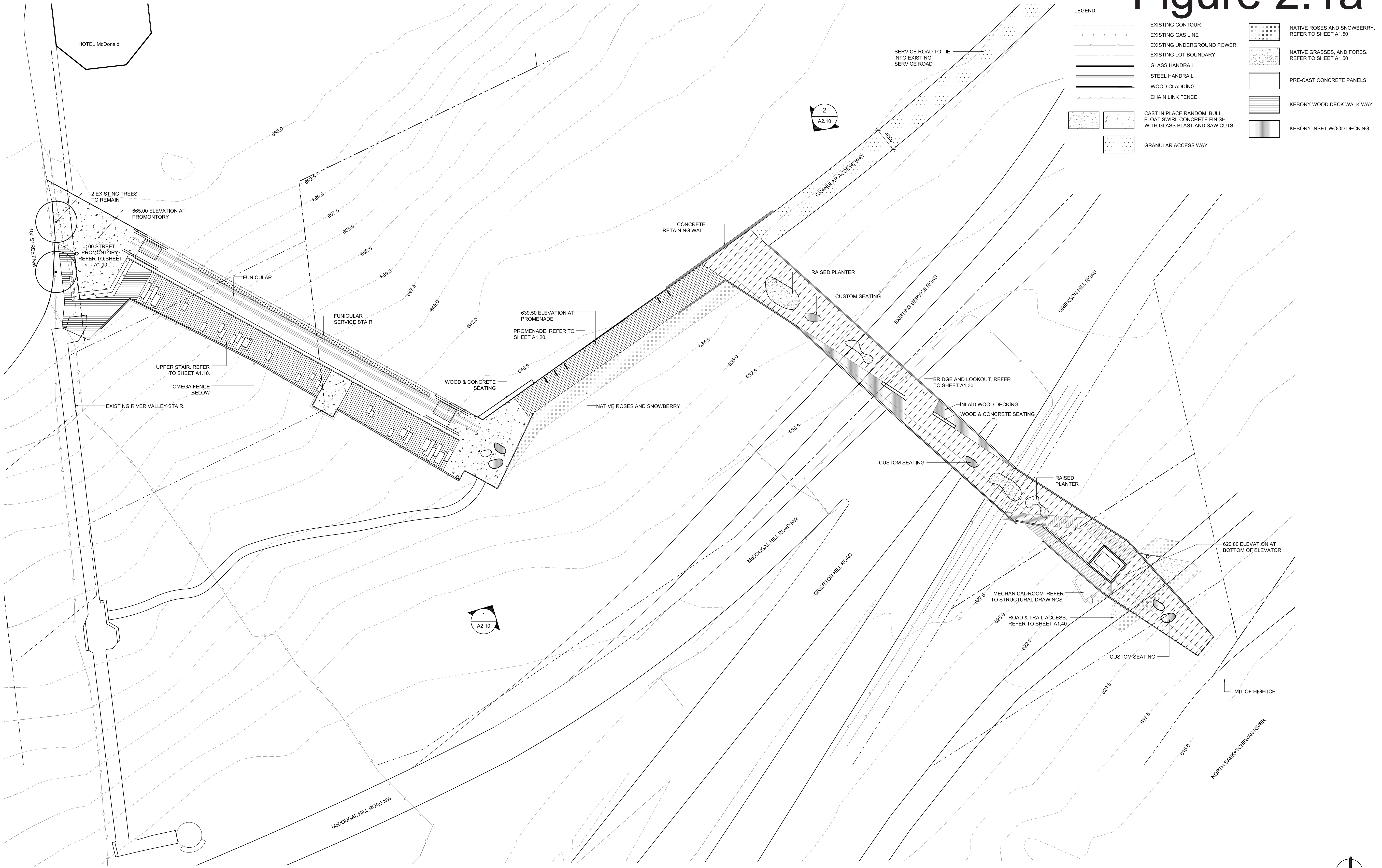
Plate 2.1. River Valley Mechanized Access Site Plan (DIALOG 2015a)

2.3.2 Scope of Work

The key project components of the proposed project include the following elements (Figure 2.1a; Figure 2.1b):

- 100 Street promontory
- Urban stair and express stair
- Funicular
- Promenade and trail connector
- Pedestrian bridge and lookout
- Elevator, stair and SUP tie-in
- Lighting
- Access way (new service road)
- Surface water management

Figure 2.1a



1 SITE DEVELOPMENT PLAN
A1.00 SCALE: 1:300

0 2000 5000 10000 15000

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NOVEMBER 13, 2015
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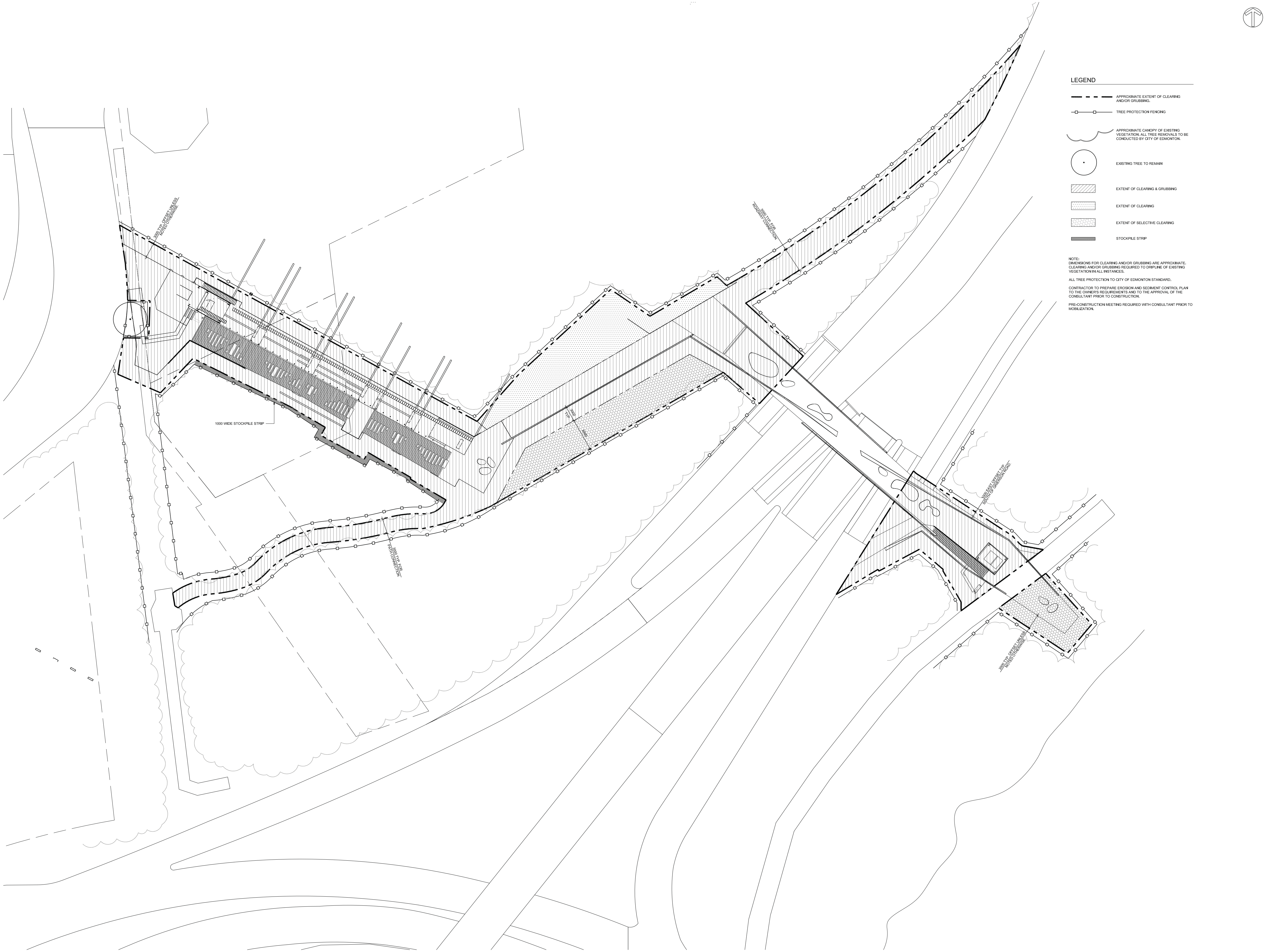
DRAWN BY: MZ, DH, KG, GB

SITE
DEVELOPMENT
PLAN
A1.00



LEGEND

▬ ‒ ‒ ▬	APPROXIMATE EXTENT OF CLEARING AND/OR GRUBBING.
─□─□─	TREE PROTECTION FENCING
⌒⌒	APPROXIMATE CANOPY OF EXISTING VEGETATION. ALL TREE REMOVALS TO BE CONDUCTED BY CITY OF EDMONTON.
⊙	EXISTING TREE TO REMAIN
▨	EXTENT OF CLEARING & GRUBBING
⬚	EXTENT OF CLEARING
▦	EXTENT OF SELECTIVE CLEARING
▬	STOCKPILE STRIP

NOTE:
DIMENSIONS FOR CLEARING AND/OR GRUBBING ARE APPROXIMATE. CLEARING AND/OR GRUBBING REQUIRED TO DRIPLINE OF EXISTING VEGETATION IN ALL INSTANCES.

ALL TREE PROTECTION TO CITY OF EDMONTON STANDARD.

CONTRACTOR TO PREPARE EROSION AND SEDIMENT CONTROL PLAN TO THE OWNER'S REQUIREMENTS AND TO THE APPROVAL OF THE CONSULTANT PRIOR TO CONSTRUCTION.

PRE-CONSTRUCTION MEETING REQUIRED WITH CONSULTANT PRIOR TO MOBILIZATION.

Figure 2.1b

notes

SHEET ISSUED FOR INFORMATION ONLY

NOT FOR CONSTRUCTION

REVISIONS

ISSUE DATA	DATE
ISSUED FOR INTERIM REVIEW	2015-12-18
ISSUED FOR INTERNAL REVIEW	2016-01-19

seal

seal

permit

consultants

DIALOG

consultant project no. 01398E0400

Edmonton FACILITY & LANDSCAPE INFRASTRUCTURE

project

RIVER VALLEY
MECHANIZED ACCESS

drawing title

SITE PREPARATION -
CLEARING &
GRUBBING

scale 1 : 250

drawn by KG
date

checked by JR
date

reviewed by
date

drawing no.
L1.03
sheet no. of

project no. 924398A

- Utility service connection and decommissioning
- Traffic accommodation during construction
- Removal of top portion of existing wooden river valley stair

The following sections will discuss each of these elements in greater detail.

2.3.2.1 RVMA Design

100 Street Promontory

The 100 Street promontory and funicular upper platform will be constructed at the top of the north valley slope adjacent to the west side of the Fairmont Hotel Macdonald (Figures 2.1 and 2.2). All existing lookout elements at this location will be removed and returned to the City of Edmonton to accommodate construction of the promontory. This promontory will be approximately 160 m^2 and serve as a landing for both stair-based and mechanized transportation modes as well as a gathering area and viewpoint for enjoying river valley vistas (Plate 2.2) (DIALOG 2015b). The promontory will be constructed of cast-in-place concrete.

Plate 2.2. Proposed Promontory (DIALOG 2015a)

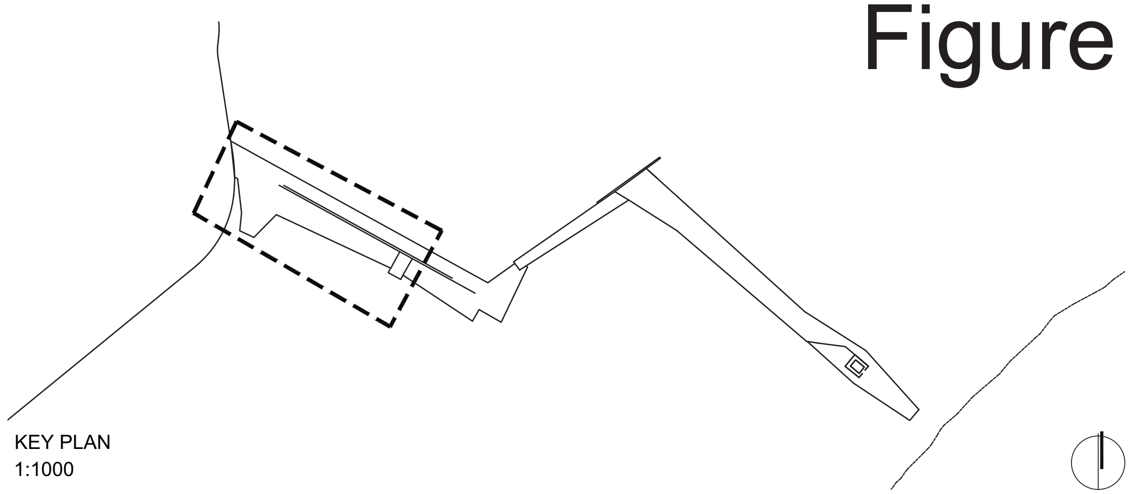
Urban Stair and Express Stair

An urban stair comprising a combination of a stair with landings and a parallel "express" stair with access to a cross-over landing will be constructed immediately adjacent to the funicular (Figures 2.1 and 2.2). The urban stair will be a wood stair system, with integrated glass and wood railings; the express stair will be Kebony wood treads and a glass railing (Plate 2.3). The cross-over landing will be constructed with cast-in-place concrete and finished with a random bull float swirl concrete finish with glass blast and saw cuts. Steel and wooden platforms with glass guardrails will be provided at regular intervals to offer resting places and opportunity to enjoy views of the river valley. A bike rail will be provided on the east side of the stairs for people taking bicycles uphill.

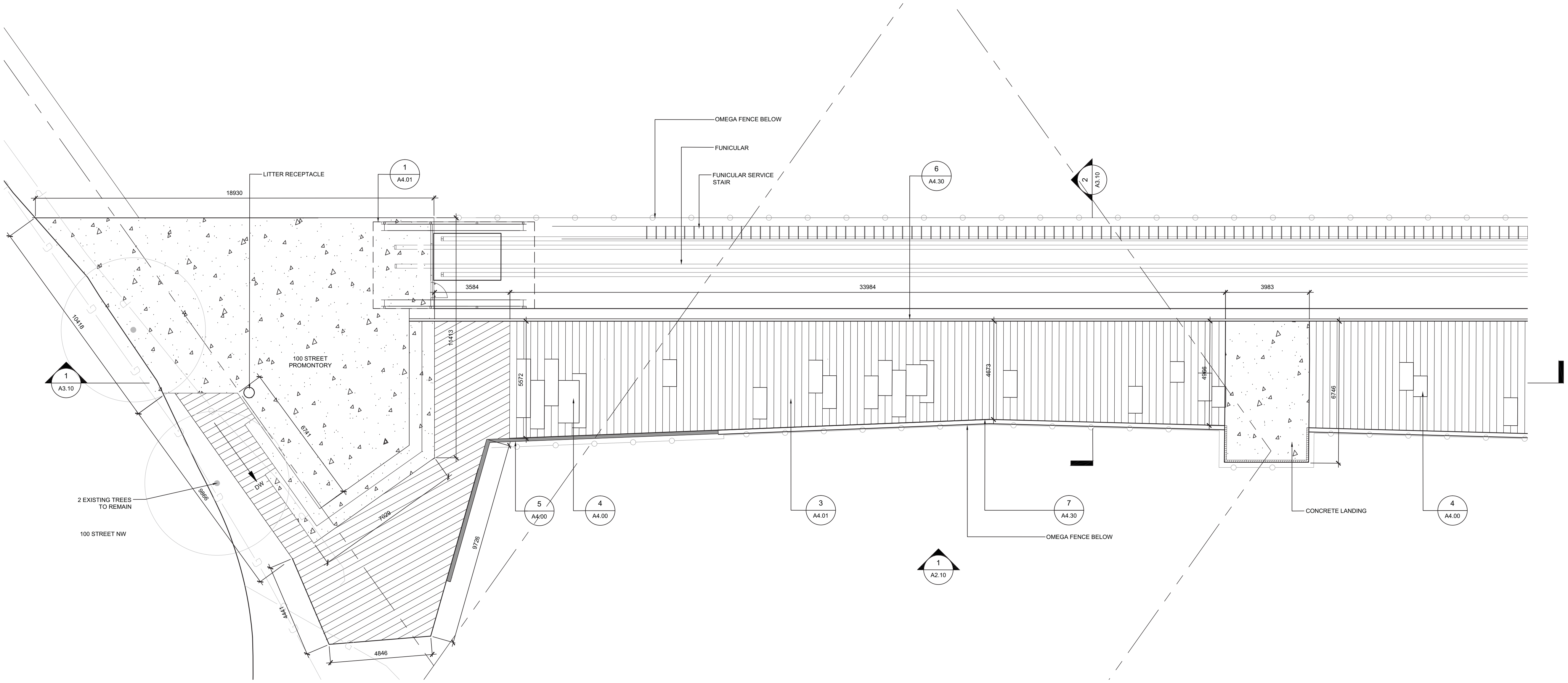
Figure 2.2

LEGEND

- EXISTING GAS LINE
- EXISTING UNDERGROUND POWER
- EXISTING LOT BOUNDARY
- OMEGA FENCE BELOW
- FUNICULAR GLASS WALL AND RAILING
- STEEL HANDRAIL
- WOOD CLADDING
- CAST-IN-PLACE RANDOM BULL FLOAT SWIRL CONCRETE FINISH WITH GLASS BLAST AND SAW CUTS.
- KEBONY WOOD DECKING



KEY PLAN
1:1000



1 A1.10 100 STREET PLAZA AND STAIR UPPER PLAN
SCALE: 1:100

0 1000 2500 5000

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100 ST
PROMONTORY &
STAIR UPPER PLAN

A1.10

Plate 2.3. Urban stair and express stair concept (with funicular track in background) (DIALOG 2015a)

Funicular

In principle, funiculars are cable-propelled systems that pull a car over an inclined track (Plate 2.4). Funiculars (DIALOG 2015b):

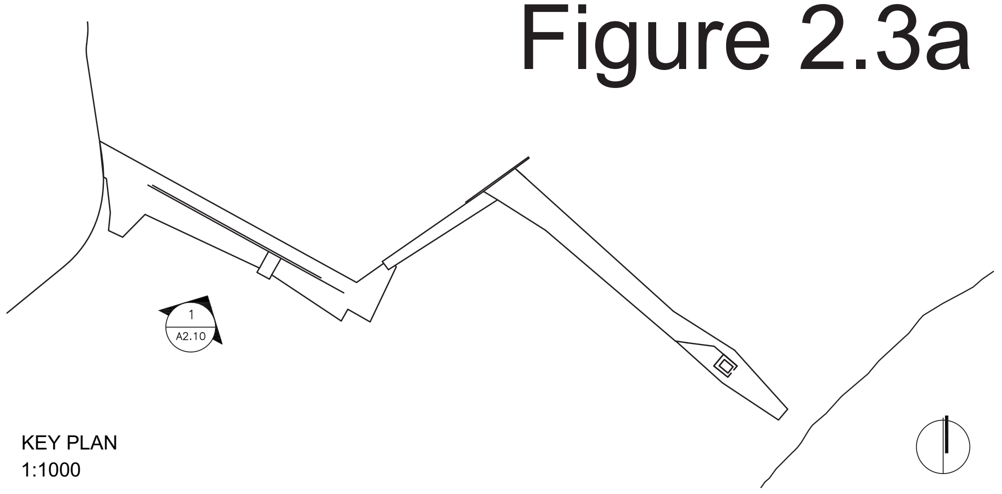
- are safe,
- typically have long service lives,
- are not susceptible to strong winds,
- do not require an operator because they are passenger-controlled,
- are a low-energy option because they are only operated when needed.
- provide a closed compartment that will shelter passengers during operation; and
- are expected to perform better than other mechanized access systems in winter conditions.

Plate 2.4. Sample Funicular/Inclined Elevator System from Greece (DIALOG 2015b)

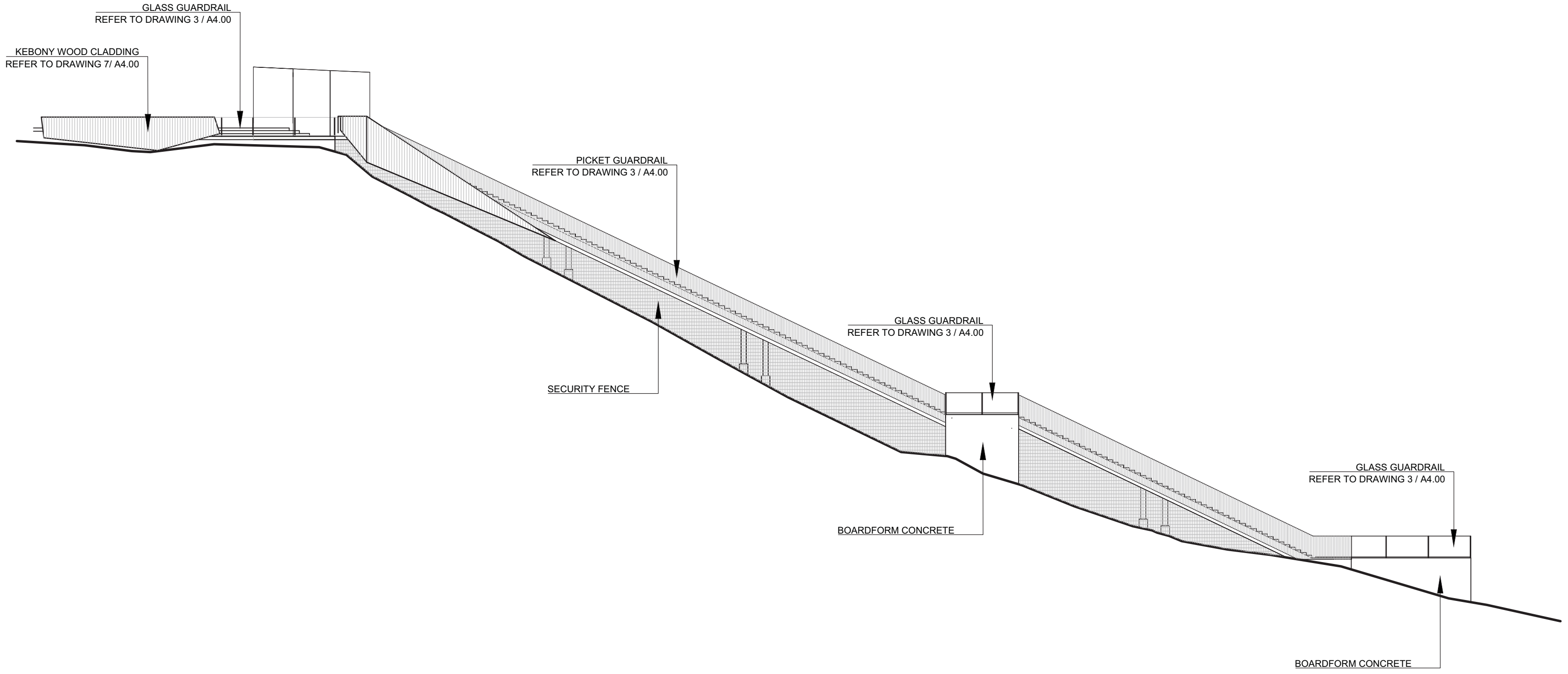
The proposed funicular system for the RVMA project will be located immediately adjacent to the urban stair and will comprise an upper platform accessible from the 100 Street promontory, a lower platform accessible from the promenade and parallel maintenance/emergency stairs (Figures 2.3a and b). Protective glass canopies will be constructed at the top and bottom funicular platforms to protect users from the weather when loading and unloading from the funicular car. The funicular will be passenger-controlled and integrated with the City's existing control system. The funicular system will be approximately 64 m in length and will comprise a one-cabin, cable-propelled system on an elevated and inclined track. The funicular machine, mechanical and electrical rooms will be located under the 100 Street promontory (Figure 2.2). The cabin will be approximately 5.19m^2 (3.0 m x 1.73 m) in size and is expected to provide adequate capacity (e.g., 20 passengers or 10 people + two bikes, etc.) for the proposed system at an operational speed of 2.0 m/s (DIALOG 2015b). Expected system demand (year 2044) is predicted to be 366 users/hour and 183 users/hour/direction during the peak hour service (over the lunch hour) compared to current peak demand of approximately 100 users in each direction during the lunch hour on the existing wooden river valley stairs (DIALOG 2015b). The cabin will have doors at both ends to allow loading and unloading to occur without having to turn bicycles, wheelchairs, strollers, etc. (drive-through approach). It is expected that a one-way trip on the funicular would take approximately 45 seconds to 1 minute, depending on the selected speed of the system (DIALOG 2015b). Funicular hours of operation would coincide with park hours, which are 5:00 a.m. to 11:00 p.m. That could change, however, depending on level of facility use and availability of maintenance staff. The urban and express stairs will be available for use at all hours.

Due to the length of the system (approximately 64 m) (Figure 2.1a), it is expected that a winch/drum system will be required to pull the cabin.

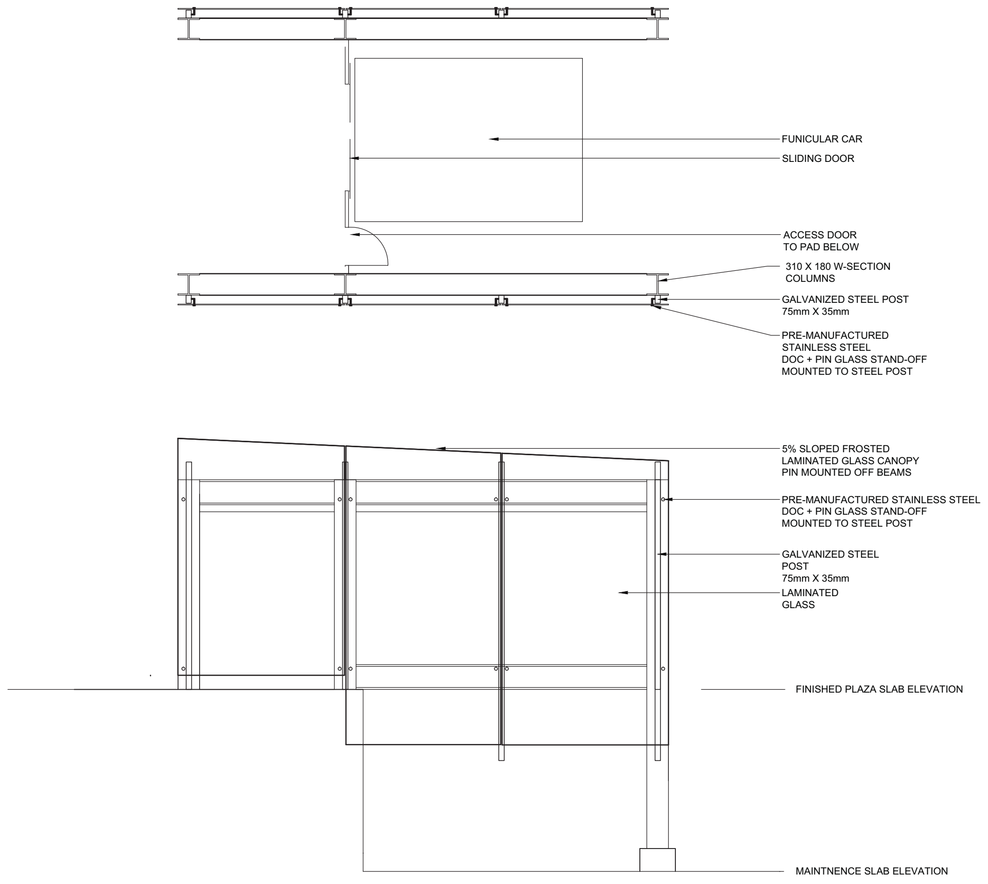
Figure 2.3a



KEY PLAN
1:1000



1 A2.10 ELEVATION 1
SCALE: 1:200
RVA–A2.10–ELEVATION 1&2.DWG



2 A2.10 ELEVATION FUNICULAR
SCALE: 1:50
RVA–A2.10–ELEVATION 1&2.DWG

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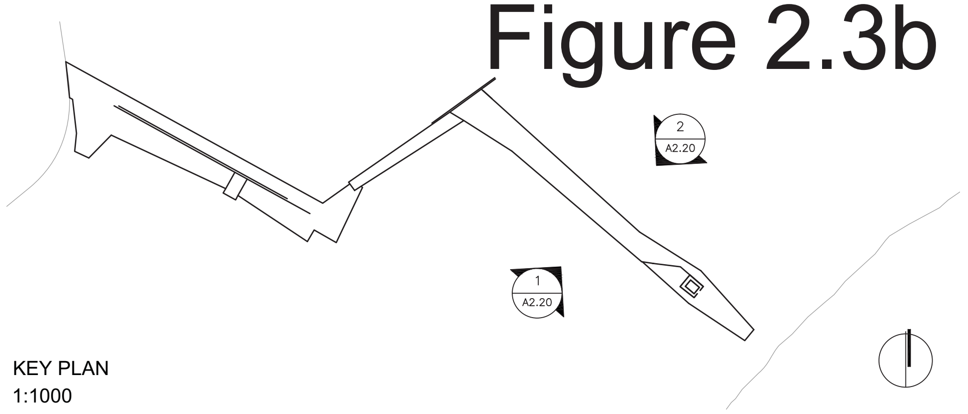
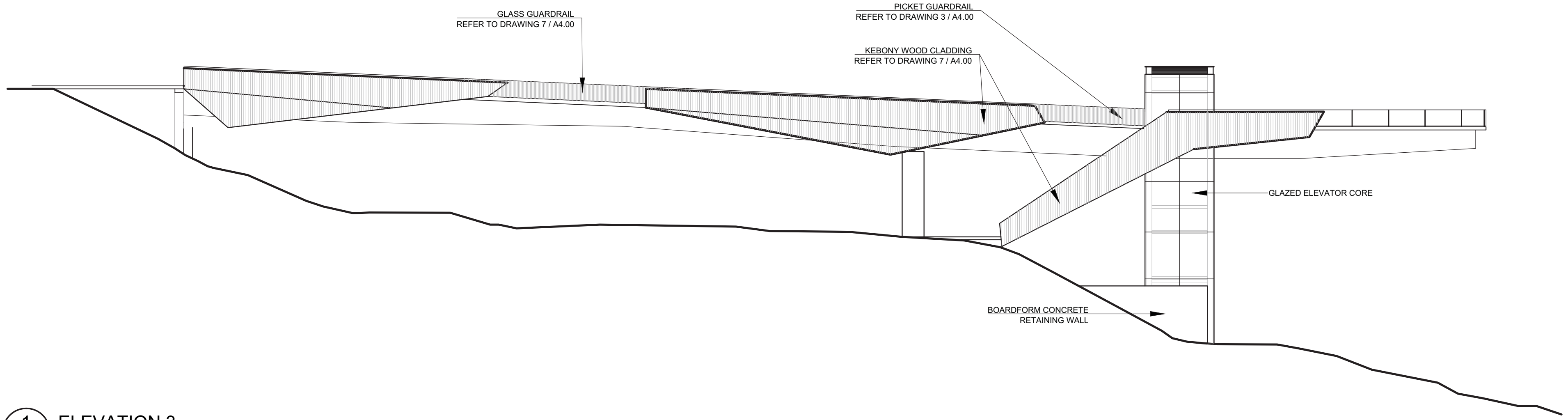
ELEVATIONS
URBAN STAIR/
PROMENADE
A2.10

Figure 2.3b



KEY PLAN
1:1000



1 A2.20 ELEVATION 3
SCALE: 1:200
RVA–A2.20–ELEVATION 3&4.DWG

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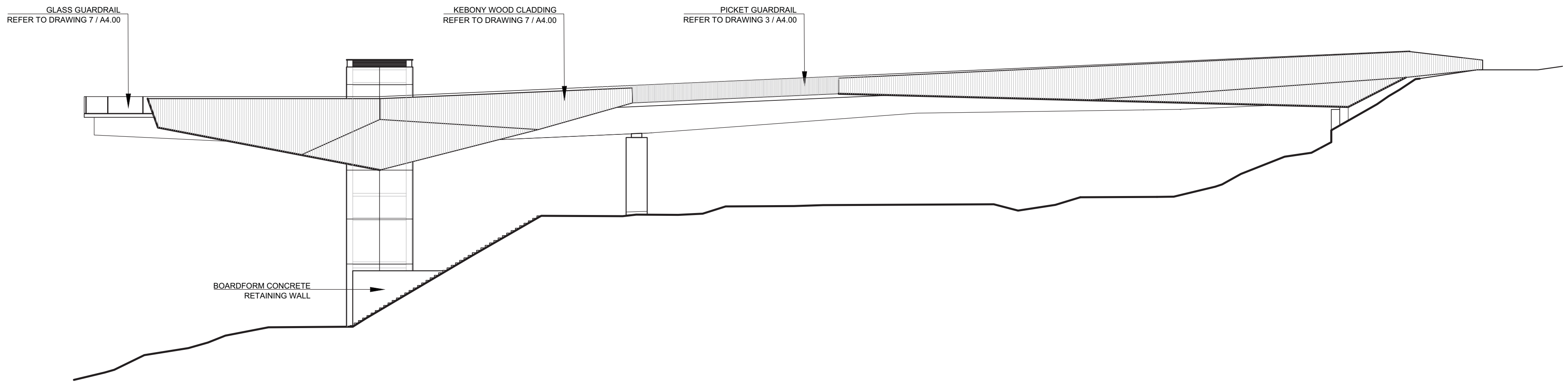
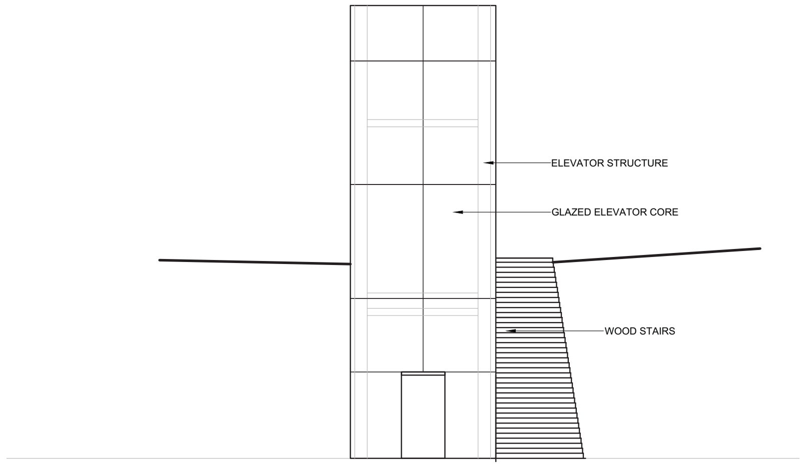


2 A2.20 ELEVATION 4
SCALE: 1:200
RVA–A2.20–ELEVATION 3&4.DWG

0 2000 5000 10000



3 A2.20 TRAIL PLAZA ELEVATION
SCALE: 1:100
RVA–A2.20–ELEVATION 3&4.DWG

0 1000 2500 5000

RIVER VALLEY MECHANIZED ACCESS

DIALOG®

NOVEMBER 13, 2015
01398E0400

ISSUED FOR DEVELOPMENT PERMIT
DRAWN BY: MZ, DH, KG, GB

ELEVATIONS
BRIDGE/LOOKOUT

A2.20

The trackway and an associated maintenance/emergency stair will be 3.8 m wide (DIALOG 2015b). The trackway will be elevated 1.2 m above grade for safety and operation reasons, and will be fenced off to deter tampering. A higher trackway would allow snow to accumulate on the slope below without impeding the funicular car. The trackway will be supported on piers founded on micropiles.

Omega Fence Architectural Fencing will be installed at grade under the outside edge of the maintenance/emergency stairs and the urban stair, on the east and west sides, respectively, to prevent people from climbing on the structure and taking up residence under the structure. The fencing will be 2.4 m high with a 5 cm x 15 cm mesh and a 10 cm gap at the bottom.

Promenade and Trail Connector

A promenade will connect the lower funicular platform and urban stair with the pedestrian bridge (Figure 2.1a) (Plate 2.5). It will be supported by a retaining wall and will be constructed with cast-in-place concrete featuring a random bull float swirl concrete finish with glass blast and saw cuts on the walking surface. A wood bench on a concrete upstand will be located on the north side of the promenade. A 1.5 m wide secondary trail will connect the west side of the promenade below the urban stair and funicular to the existing wooden stair landing to the west. That trail will formalize an existing informal trail that exists across the slope. Providing the trail connection between the existing stairs and the promenade will address concerns raised by internal City stakeholders, allowing a faster pedestrian connection to the Low Level Bridge and the existing bus stops on McDougall and Grierson Hill Roads.

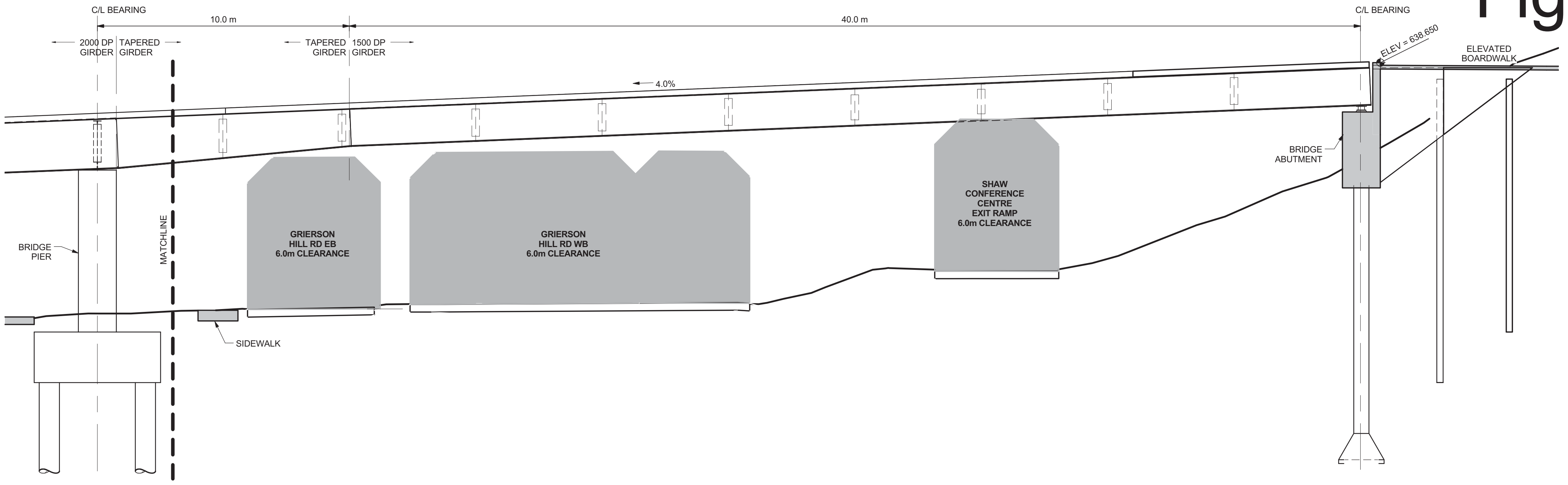
Plate 2.5. Promenade (DIALOG 2015a)

Pedestrian Bridge and Lookout

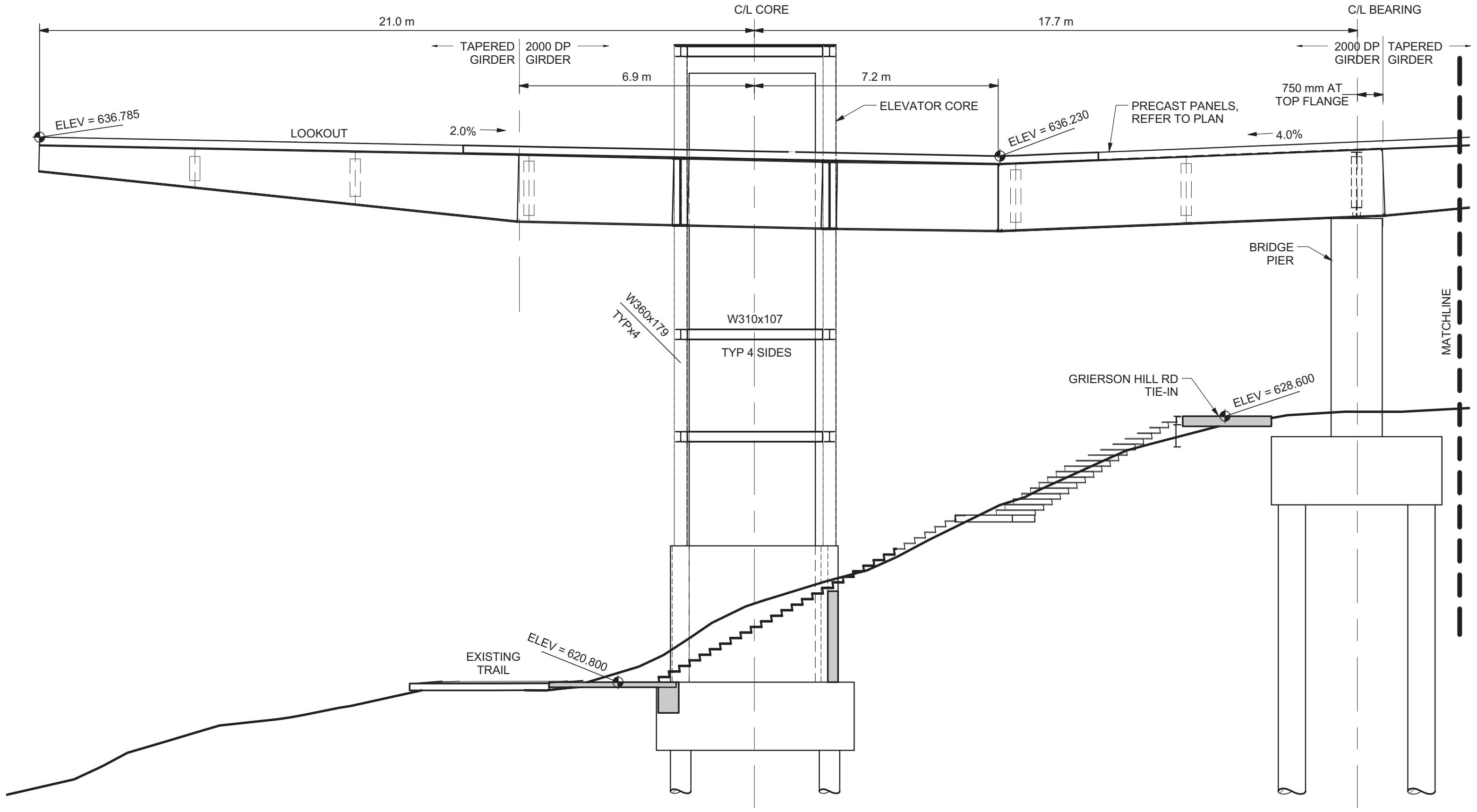
A 68 m long pedestrian bridge will connect the promenade with the elevator/stair (see below) and a 20 m long cantilevered lookout (Figures 2.1 and 2.4) (Plates 2.6 and 2.7). The bridge will be supported by an abutment adjacent to the south end of the promenade, north of the Shaw Conference Centre exit ramp, and a bridge pier located south of the eastbound lane and sidewalk at Grierson Hill Road. The bridge deck will comprise pre-cast concrete panels, steel and wood seating areas and raised and recessed planting areas (Figure 2.1a). Glass guardrails will be located appropriately and Kebony wood cladding is proposed for the outside of the structure (Figure 2.4b).

Plate 2.6. Pedestrian Bridge (DIALOG 2015a)

Figure 2.4



1 S3.01 **ELEVATION - BRIDGE - NORTH**
1 : 100



2 S3.01 **ELEVATION - BRIDGE - SOUTH**
1 : 100

RIVER VALLEY MECHANIZED ACCESS

DIALOG

DP APPLICATION
DRAWN BY: NK

BRIDGE ELEVATION

2015-11-09
01398E0400

S3.01

Plate 2.7. Cantilevered Lookout (DIALOG 2015a)

Elevator, Stair and SUP Tie-in

An elevator, stair and plaza will be constructed at the south end of the project to tie the pedestrian bridge and lookout into the existing river valley SUP system (Figure 2.1a) (Plate 2.8). In addition to the stop at the level of the SUP system, the elevator will also stop at Grierson Hill Road, thereby facilitating access to the Low Level Bridge and nearby residential areas. The elevator will comprise a shaft and machine and maintenance rooms located at the base. A concrete retaining wall and concrete walls for the machine rooms will be constructed at the base of the elevator while the elevator core will be comprised of glazed glass supported on galvanized steel framing. The intent is to use bird-friendly glass to minimize the potential for bird-window collisions. The elevator drive equipment will be located in the 1:100 year floodplain. The intent is to keep the base elevation of the elevator machinery at or above the 1:50 year flood level and the wall-mounted electrical components at or above the 1:100 year flood level. Normally, the life expectancy of this type of equipment is 20 to 25 years, but there is a chance that the equipment will be damaged or destroyed within that service lifetime by a flood. The elevator shaft itself will be structurally designed to withstand water forces associated with a 1:100 year flood event. A hydraulic elevator lift will not be used so that there is no chance of a hydraulic fluid leak during elevator operation. It is expected that the elevator hours of operation would coincide with park hours, which are 5:00 a.m. to 11:00 p.m. That could change, however, depending on level of facility use and availability of maintenance staff. The urban and express stairs will be available for use at all hours, and a bike rail on the east side of the stair will facilitate cyclist use after park hours.

Plate 2.8. Elevator and Trail Connection (DIALOG 2015a)

A Kebony wood walkway will connect the sidewalk on the south side of Grierson Hill Road to concrete stairs leading up to the lookout and pedestrian bridge as well as wood stairs down to a landscaped plaza at the lower elevator access. The existing river valley trail will tie-in to the new elevator, plaza and stair facilities.

Lighting

Site lighting will be designed to illuminate the paths while eliminating spill-over that would illuminate large parts of the river valley (Plate 2.9). It will be designed to provide a safe feeling and limit safety concerns. Pathway lighting will be mounted within handrails or barrier cladding joints.

The lighting design will incorporate controlled, dark-sky friendly exterior lighting, utilizing controls to minimize or eliminate electric lighting when there are no people in the space. Low power LED lighting will be used throughout.

Plate 2.9. Lighting diagram with conceptual drawings (DIALOG 2015a)

Access Way (New Service Road)

An approximately 3.5 m wide new granular service road will be constructed along an existing informal “trail”, on the naturally-occurring flat bench located at the approximate midpoint of the river valley slope and connect to the east end of the promenade (Figure 2.1a). That access was previously trimmed and brushed in spring 2015 in support of project geotechnical investigations. Clearing for the road will be up to 5 m wide (Figure 2.1b). Minimal upgrading work is required to provide level and direct access during construction and for maintenance access during RVMA operation from the upper section of the Shaw Conference Centre access road. The new granular access way will be constructed with a geogrid type system with surface planting on top (e.g., Neoweb Geocell). It is expected that the finished surface will have a topsoil and grass surface.

2.3.2.2 RVMA Construction

The City of Edmonton has decided to deliver this project using a design-bid-build with construction management model. To that end, the City of Edmonton retained Graham Infrastructure LP (Graham) as construction manager for the proposed project.

Graham proposes the following construction activities and staging with the goal of minimizing the overall construction footprint in the river valley (Graham 2015). The following information provides a general outline and will be finalized during detailed design:

March 2016:

- Mobilization to the work site in March 2016 to allow maximum time for construction considering the tight project schedule.
- Grading and vegetation clearing will be conducted by utilizing small-scale tracked construction equipment that is capable of operating safely on the existing slopes in the project area.

April 2016:

- Construction of foundations for the 100 Street promontory (upper platform), lower platform, urban stair and funicular.
- Establish a crane pad for the installation of large structural steel components that form the superstructure of the urban stair, as well as for the installation of structural steel and rails for the funicular.
- Piling for the 100 Street promontory and lower platform will be drilled by larger equipment located on the more accessible and more level working areas with concrete cast-in-place.

May 2016:

- Establish pile caps for the urban stair and funicular foundations.
- Pour concrete for the 100 Street promontory (upper platform)
- Installation of structural steel members for the urban stair and funicular substructure.

- Commence the pier and south abutment pedestrian bridge foundations, with work deferred on the north abutment until removal of the crane from the lower platform to minimize construction footprint.

June 2016:

- Remove crane pad after completion of structural steel and funicular rail installation.
- Construct pedestrian bridge north abutment.
- Continue construction of bridge pier and elevator shaft.
- Commence piling for the promenade.
- Construct urban stair.
- Install funicular drive.

July 2016:

- Complete urban stair construction.
- Construct funicular maintenance/emergency stair.
- Continue funicular control system integration.
- Continue construction of promenade foundation and north bridge abutment.

August 2016:

- Commence pedestrian bridge deck construction.
- Construct lower platform and promenade.

September 2016:

- Complete seasonally-dependent construction activities prior to winter including the promenade, tie-in of the 100 Street promontory to 100 Street and pedestrian bridge deck concrete pour.

October – November 2016:

- Complete pedestrian bridge.
- Install elevator in elevator shaft.
- Work on ancillary work such as installation of lighting, signage, safety railings, details around the lookout and wooden stairs and preliminary deficiency corrections.

December 2016 – February 2017:

- Facility start-up, commissioning, fine-tuning, construction completion and demobilization.

February – July 2017:

- Fine-tuning and operator training.
- Demobilization.

May – September 2017:

- Landscaping and site remediation

<u>July 2017:</u>

- Project completion

2.3.2.3 Surface Water Management/Drainage

Overall, the intent is to provide a sustainable approach to drainage for the proposed RVMA project. A brief description of the proposed drainage design by project component is provided below. Drawings showing the proposed drainage design are available in Appendix A.

Funicular and Promenade

A linear vegetated swale is proposed along the north edge of the promenade (Plate 2.10) (Drawings C1.01, C1.03 and C1.05 in Appendix A) (Hatch Mott MacDonald 2015). Swales are shallow channels designed to store and/or convey runoff and remove pollutants. They may be used as conveyance structures to pass the runoff to the next stage of treatment and can be designed to promote infiltration where solid and groundwater conditions allow. For the proposed RVMA project, surface water flows from the adjacent north slope will flow into this swale feature. The promenade surface will have a 2% slope towards the swale so that surface flows from the promenade will be directed away from the southern edge to the north and collected in the swale.

Plate 2.10. Typical vegetated swale (Hatch Mott MacDonald 2015)

There are three types of swale: standard conveyance swale, dry swale and wet swale (Hatch Mott MacDonald 2015). The most appropriate for this site is a dry swale designed to include a filter bed of prepared soil that overlays an under-drain system. This provides additional treatment and conveyance capacity beneath the base of the swale. They are less effective at treating pollutants than wet swales, but the pollutant load for this pedestrian walkway, as with the stair it is replacing, is going to be very low (Hatch Mott MacDonald 2015).

The swale channel is proposed to be broad and shallow and covered by dense vegetation to reflect the landscaping of the area (Hatch Mott MacDonald 2015). Planting with native grasses, to slow down flows and trap particulate pollutants collected off the surface. As noted above, the swale will contain a buried “French drain” to collect and remove the surface water collected by the swale. The swale and the drain will sit on an impermeable layer to manage the potential for water to migrate through the slope and saturate the ground immediately below the swale. The swale drain will be connected to outfall pipes along its length to allow the collected flow to daylight below the promenade structure and help mitigate the build-up of groundwater behind the promenade’s north supporting wall. Construction of the outfall pipes (Drawing C1.03 in Appendix A) will require cut and cover with a mini-excavator in a 2.0 m wide construction footprint (S. Brown, *pers. comm.*). A toe drain will also be supplied at the promenade north support wall to manage the natural flow of water that does locally occur (Hatch Mott MacDonald 2015).

Bridge and Viewpoint

The pedestrian bridge and lookout will have conventional deck drainage with surface water collected along a curb at the edge of the walking surface (Drawings C1.01, C1.04 and C1.05 in Appendix A) (Hatch Mott MacDonald 2015). Rain gardens (planted areas) will absorb rainfall and not contribute to surface runoff.

Surface water flows will be collected at the top of the elevator stairs and fed to the collection drain at the deck gradient break point on the north side of the elevator (Hatch Mott MacDonald 2015). The flow intercepted at this location will be fed back to the drainage points alongside the pier adjacent to Grierson Hill.

2.3.2.4 Utilities

Several existing and abandoned underground utilities are situated in close proximity to the proposed project area (Drawing 2.1 and Figure C1.02 in Appendix A) (DIALOG 2015b). A storm line, water line and abandoned water line are located near the proposed 100 Street promontory. Telephone, gas and power lines are located along 100 Street, outside the proposed project area. Power lines are located along Grierson Hill Road and McDougall Hill Road at the bottom of the proposed project area. West of the existing wooden stairs, buried communications cables and power cables run downslope along McDougall Hill. No other conflicts were identified in the project area.

2.3.2.5 Removal of Existing Wooden River Valley Stair

The top section of the existing wooden river valley stair to the mid-slope platform located west of the RVMA project will be removed once the new RVMA components are open to the public. The bottom section from the mid-slope platform to Grierson Hill Road will remain and will be connected across the slope to the bottom of the urban stair and funicular by a secondary 1.5 m wide gravel trail. That trail will formalize an existing informal trail that exists across the slope. Providing the trail connection between the existing stairs and the proposed RVMA project will address concerns raised by internal City stakeholders, allowing a faster pedestrian connection to the Low Level Bridge and the existing bus stops on McDougall and Grierson Hill Roads. The disturbed area under the section of existing stair to be removed will be restored with a reclamation mix of native grasses and forbs.

2.3.3 Construction Timing

It is anticipated that the proposed project will be tendered and awarded in early 2016 and that construction will begin in March 2016. Construction is expected to occur over approximately 12 months (see Section 2.3.2.2 for proposed general staging of the project). Project funding requires that the proposed project be totally completed by the end of July 2017.

2.3.4 Construction Protection Measures

Responsibility for construction protection measures will lie with the contractor under the City’s Enviso program and, therefore, cannot be fully specified at this time. The contractor is, however, expected to implement those construction protection measures with environmental implications and their respective mitigation measures covered in this EIA. In addition, it is expected that the appropriate fuel handling procedures, erosion control measures and occupational health and safety requirements will be followed. Posting warning signs near all active construction traffic access points that are freely accessible to the public will alert the public to the temporary construction activities. Fencing will be erected around staging areas.

2.3.5 Resource and Material Requirements

Materials required during RVMA construction will include concrete, wood, structural steel, glass, wood, mechanical and structural components for the funicular and elevator, lights, safety railings. Additional materials will include fencing along the edges of the funicular and urban stair for human safety reasons as well as materials for amenities such as benches, waste receptacles, signage and landscaping materials. Potential hazardous materials on-site will include fuel, lubricants and oils associated with construction equipment; however, the contractor is expected to use equipment that minimizes environmental impact and utilizes environmentally-friendly (e.g., vegetable-based) lubricants and fuels if working in close proximity to the North Saskatchewan River. Hazardous materials will be stored at the staging areas away from the North Saskatchewan River (e.g., at least 100 m away from the river).

2.3.6 Waste Disposal

All waste disposal materials will become the property of the contractor. Waste disposal methods will be at the discretion of the contractor. The contractor will, however, be responsible for their disposal at appropriate designated disposal sites remote from the project site and in conformance with environmental regulations. The City of Edmonton requires contractors to develop and maintain a construction material collection and recycling program throughout the duration of the project. As a minimum, 100% of the following materials must be collected and disposed of at an approved recycling facility:

concrete, asphalt and asphalt millings, soil cement, granular material and surplus steel material.

2.3.7 Key Project Activities

2.3.7.1 Site Preparation Phase

Several preparatory activities will precede proposed RVMA project construction activities. Those include:

- Notify adjacent residents and land owners (e.g., Fairmont Hotel Macdonald and other nearby hotels and residences) of the proposed construction schedule.
- Coordinate access for project equipment, establishment of interim safety measures for residents and recreational users, vehicles, etc., and site security.
- Establish construction staging areas.
- Install erosion control measures where required.
- Remove existing vegetation via clearing and grubbing within the disturbance boundaries.
- Remove all existing 100 Street lookout elements (return to City of Edmonton) and existing wood platform and fence.

2.3.7.2 Construction Phase

The main construction activities will include:

- Construction of a 100 Street promontory, funicular and urban stair.
- Construction of a promenade.
- Construction of a pedestrian bridge over Grierson Hill Road.
- Construction of an elevator and stair joining the pedestrian bridge to ground level, with trail tie-ins.
- Remove top portion of existing wooden stair to mid-slope platform

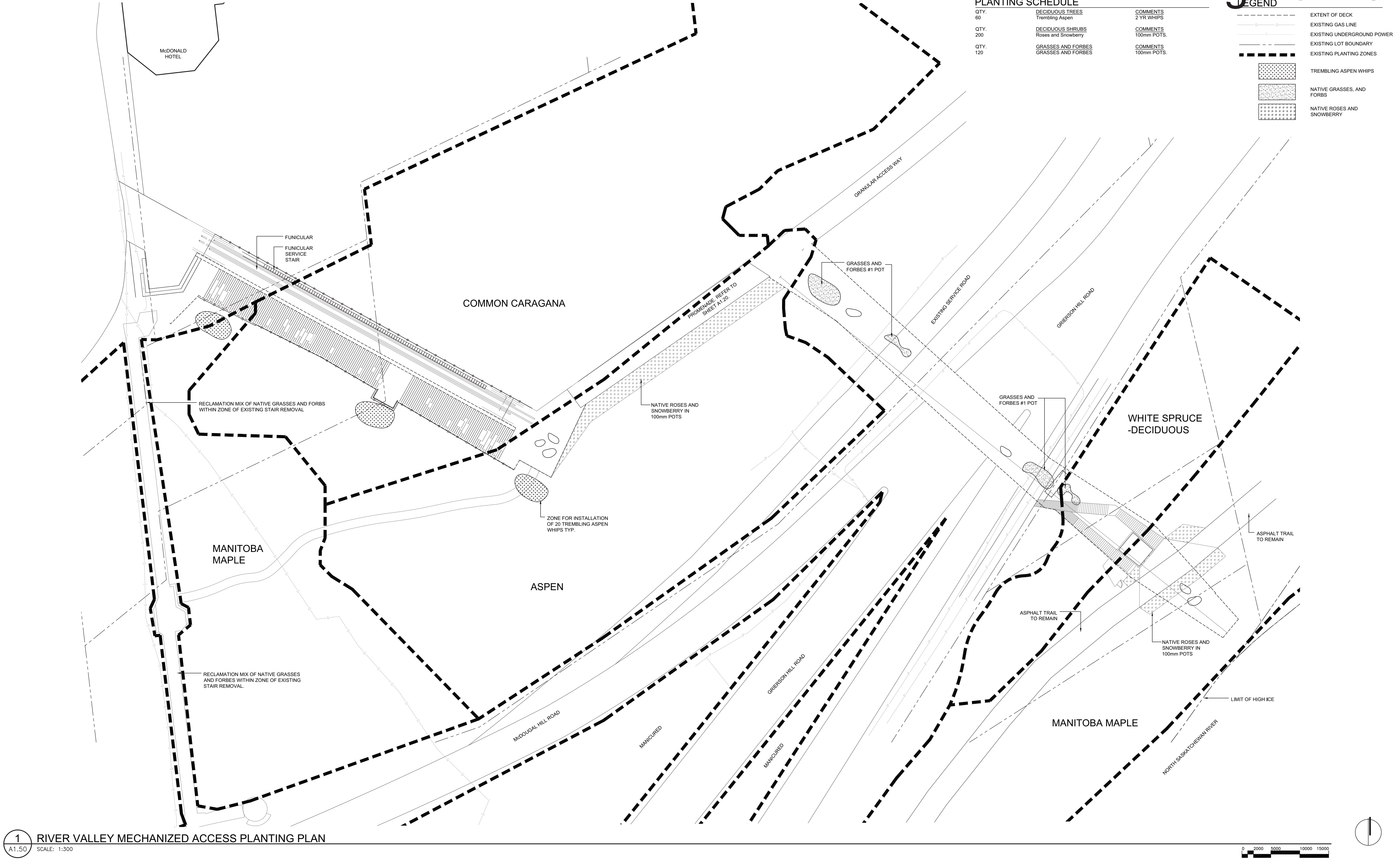
2.3.7.3 Reclamation Phase

Reclamation of disturbed areas as well as formal landscaping associated with the proposed project will be carried out post-construction (Figure 2.5). Existing pruned caragana shrubs are expected to naturally regenerate while disturbed areas will be regraded and topsoiled and planted with a variety of plants including trembling aspen whips, native rose and snowberry shrubs, grasses and forbs and some sod. Rose and snowberry shrubs will be planted under the new urban stair to minimize erosion under the stairs. Once the upper portion of the existing wooden river valley stairs is removed, the disturbed area will be reclaimed with a mix of native grasses and forbs. The removal of any trees subject to the Corporate Tree Management Policy will be compensated for under that policy.

2.3.7.4 Operation and Maintenance Phase

Operation and maintenance of the proposed RVMA is under development between several City departments. To-date, City of Edmonton Building Design and Construction

Figure 2.5



PLANTING SCHEDULE

QTY.	DECIDUOUS TREES	COMMENTS
60	Trembling Aspen	2 YR WHIPS
QTY.	DECIDUOUS SHRUBS	COMMENTS
200	Roses and Snowberry	100mm POTS.
QTY.	GRASSES AND FORBES	COMMENTS
120	GRASSES AND FORBES	100mm POTS.

1
A1.50
RIVER VALLEY MECHANIZED ACCESS PLANTING PLAN
SCALE: 1:300

DIALOG®

RIVER VALLEY MECHANIZED ACCESS

NOVEMBER 13, 2015
01398E0400

ISSUED FOR DEVELOPMENT PERMIT
DRAWN BY: MZ, DH, KG, GB

SITE PLANTING PLAN

A1.50

are working with various departments, including Facility and Maintenance Services and River Valley Operations, to determine how to maintain and operate the funicular and the overall site. General and custodial operations, including snow clearing, will likely be conducted by River Valley Operations. Facility and Maintenance Services will likely take on the mechanical equipment maintenance, through a contracted maintenance entity. The first year of funicular and elevator maintenance will be completed under the construction contract, with options to extend that contract further outside of the project. The City will conduct vegetation pruning in the project area on an ongoing basis for maintenance, horticultural and sight-line reasons.

Bird-Window Collisions

The proposed RVMA project will comprise some glass elements such as glass funicular stations, glass railings in some locations and a two-storey glazed elevator shaft that will be located in a well-treed area near the North Saskatchewan River. While the design intent is to use "bird-friendly" glazed glass that will minimize the potential for avian collisions with these glass elements, the presence of the new glass structure in the river valley may increase the potential for avian collision mortalities. Birds cannot see glass, but instead fly towards the trees and shrubs that they see reflected within the glass (FLAP Canada 2014). This, in turn, can be a source of mortality for migratory birds.

As a best management practice, avian collision mortality resulting from bird strikes against windows should be monitored during operation of the new elevator structure. Monitoring should include numbers and species of birds as well as time of year. It may be that collisions occur at certain times of year only. Significance of the potential impact of avian/window/glass railing collisions is difficult to specifically define at this time without monitoring data of the new structure post-construction. It will depend on the numbers of dead birds observed, the species and seasonality of occurrences. For example, if there are regular bird strikes of migratory bird species in the spring/summer/fall, then that could be considered significant and mitigation measures implemented. It would be considered even more significant if those migratory species were special status species. Special status resident species regularly striking glass project elements throughout the year would also be considered significant. Monitoring year-round once the project is constructed will assist with determining whether avian/window/glass railing collisions are a significant issue at this site.

If avian mortality is considered significant a mitigation strategy such as implementing a harm reduction strategy [e.g., adding uniformly patterned window coverings, markers, etc. (FLAP Canada 2014)] should be considered to reduce bird-window/glass railing collisions and avian mortality.

2.3.8 Project Schedule

It is anticipated that the proposed project will be tendered and awarded in early 2016 and that construction will begin in March 2016. Construction is expected to occur over approximately 12 months (see Section 2.3.2.2 for proposed general staging of the project). Project funding requires that the proposed project be totally completed by the end of July 2017.

2.3.9 Construction Working Hours

Construction will not extend beyond the hours permitted in Part III of the City of Edmonton's Bylaw 14600 (Community Standards Bylaw) (0700-2200 hours Monday to Saturday; 0900-2100 hours Sundays and holidays), unless special permission is granted by the City following standard protocols for exceptions to those Bylaws.

2.3.10 Construction Storage Areas and Access

Proposed laydown/staging locations and site access routes were provided by Graham, the project's construction manager. In general, staging areas and site access areas will be located in areas of prior disturbance as much as possible to minimize adverse environmental impacts. Final laydown areas and site access points will be finalized in consultation between Graham and City of Edmonton internal stakeholders.

2.3.10.1 Potential Laydown/Staging Areas

Graham proposes the following potential laydown/staging locations for construction of the RVMA project (Figure 2.6). The City is in the process of consulting with internal stakeholders to confirm which options are preferred.

A. Primary main laydown area option – potential area for establishment of site offices, washroom facilities, parking areas, waste management facilities, fuel facilities, and other necessary facilities required in support of construction operations.
B. Secondary main laydown area option – to be considered in addition to the Primary area in the event that the Primary option proves to be unsuitable or that additional spaced is required.
C. Tertiary main laydown area option – to be considered in addition to the Secondary area in the event that the Secondary option proves to be unsuitable or that additional space is required.
D. Potential material laydown area for construction of bridge abutment and piers. Directly adjacent to Shaw Conference Centre access road; intermittent traffic impacts would be expected with mitigation through a Traffic Accommodation Strategy.

River Valley Mechanized AccessPotential Laydown / Staging Locations

Figure 2.6

E. Upper platform area – to be utilized for material staging and site deliveries. Potential for temporary lane closures in the vicinity of McDougall Hill Road and 100 Street for delivery and installation of large components.

F. Lower platform and promenade area – to be utilized for temporary resources staging during construction.

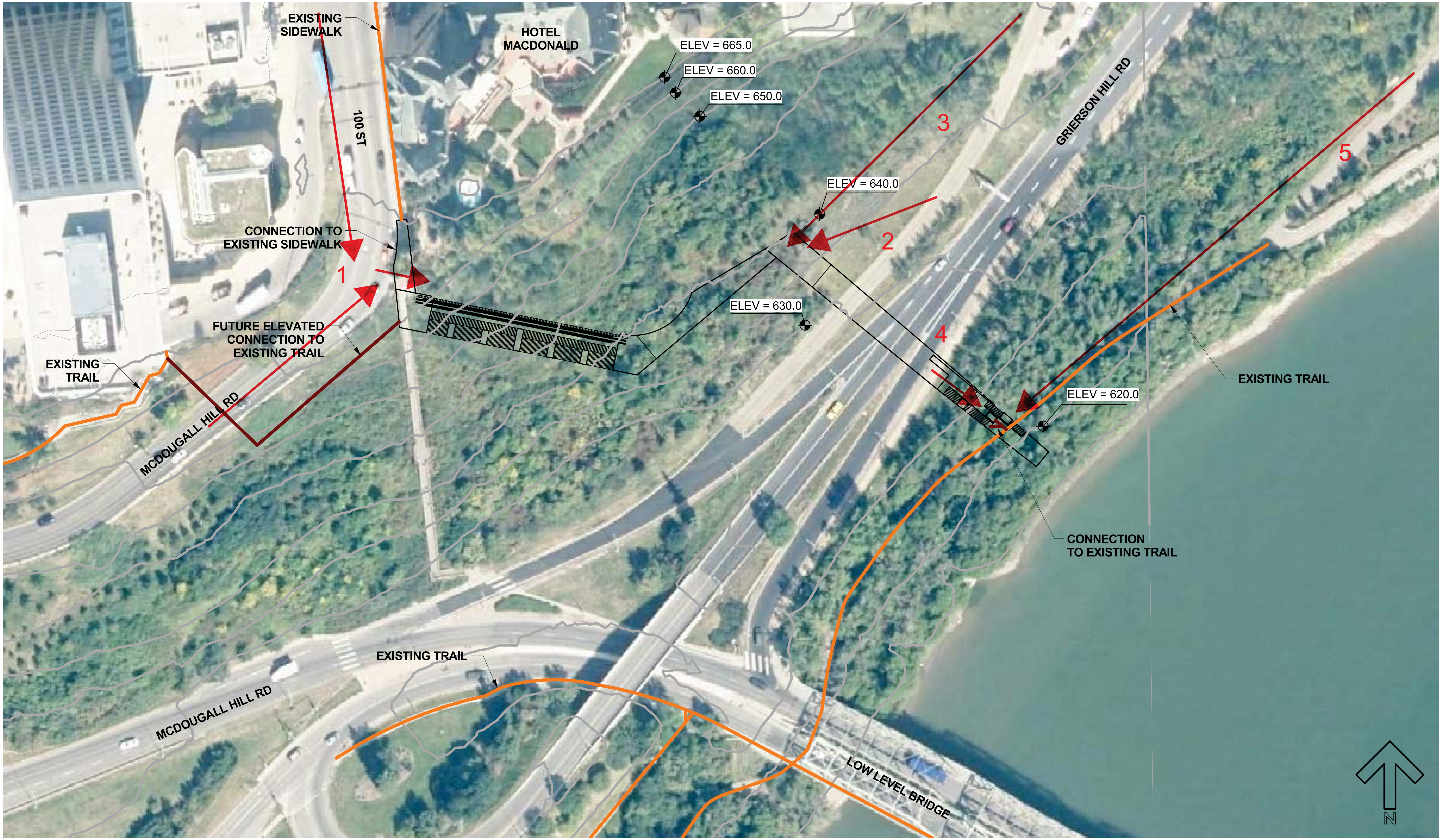
G. Approximately 100 m northwest of the “split” in the river valley trail is a large, wide turnaround area in Louise McKinney Riverfront Park (near the Plaza Building). Utilization of this area for material staging, together with potential site access along the existing trail in the area, can be investigated as an option for constructing the elevator structure with minimal impact to the surrounding environment.

At Community Services’ request, staging areas will be situated so as to maintain safe traffic sightlines during construction and will be fenced and screened to minimize visual impact (M. Hartlaub, *pers. comm.*).

2.3.10.2 Potential Site Access Routes

Graham proposes the following potential primary and secondary site access routes for construction of the RVMA project (Figure 2.7). The City is in the process of consulting with internal stakeholders to confirm which options are preferred.

1. Primary access route: access to the Upper Platform will be required from McDougall Hill Road and/or 100 Street for delivery and installation of large materials – in particular, structural steel, large precast concrete elements, and funicular components. There is potential for intermittent lane closures and/or traffic impacts as this work is carried out.
2. Secondary access route: access to the southern portion of the project will be gained from the Shaw Conference Center access road. One potential alignment for access would be the establishment of a temporary access road sloping up the bank in close proximity to the area that is to be directly impacted by the work.
3. Primary access route: an alternative alignment that should be considered for access to the south portion is the utilization of the existing “trail” (previously trimmed and brushed in spring 2015 in support of project geotechnical investigations) on the naturally-occurring flat bench that runs at the approximate midpoint of the river valley slope. With minimal clearing and upgrading work carried out, level and direct access to the work site from the upper portion of the Shaw Conference Centre access road could be achieved.
4. Secondary access: access to the lower portion of the project could, in some cases, be gained down the slope from the existing sidewalk that runs alongside Grierson Hill Road.
5. Primary access route: alternative access to the lower portion of the project would involve utilizing the existing trail that runs southwest to the project area from Louise McKinney Riverfront Park.



River Valley Mechanized Access
Potential Laydown / Staging Locations

Figure 2.7

2.3.11 Construction Equipment

Construction equipment used in the proposed RVMA project will include typical construction equipment such as a crane, pile driver, small-scale tracked equipment capable of operating safely on the existing river valley slope, skid-steers, excavators and dump trucks.

2.3.12 Alternatives Considered

2.3.12.1 Site Locations and Alignments

DIALOG previously investigated the feasibility of five potential mechanized access alignments in Louise McKinney Riverfront Park in 2009-2010 (Carlyle and Associates et al. 2010). That site was not studied further because of the subsequent development of the Valley Line LRT alignment through Louise McKinney Riverfront Park. The availability of River Valley Alliance Capital Project funding in 2013 for mechanized access in the river valley permitted the City to consider other locations. In 2014, the City of Edmonton requested DIALOG to conduct a "high level" review and assessment of the potential for a mechanized access conveyance for five potential alignments in the central part of the North Saskatchewan River Valley, including four on the north side of the river and one on the south side of the river (DIALOG 2014). The City of Edmonton selected two preferred locations that formed the basis of the previous concept engineering study: 100 Street Access on McDougall Hill on the north side of the river and the 105 Street Access within Queen Elizabeth Park on the south side of the river (DIALOG 2015b). In addition, two separate alignment options, West and East, were proposed for the 100 Street RVMA project area. Both of those options would have connected 100 Street near the Fairmont Hotel Macdonald at the top-of-bank to existing shared use pathways (SUPs) in the river valley and across the Low Level Bridge (Spencer Environmental 2015).

The proposed West option would replace the existing wooden stair on McDougall Hill. Core mechanized access improvements proposed at the proposed west option alignment included (DIALOG 2014):

- Improved plaza at the top-of-bank with lighting, furnishings and plantings.
- Mechanized access with parallel stair (min. 4.2 m width) from top-of-bank to landing 7 m above roadway.
- Pedestrian bridge over Rossdale Road and Grierson Hill to berm at existing overpass.
- Shared-use Path (SUP) extension west to 100 Street along proposed accessible route to connect with North Rossdale and 100 Street.

The proposed East option would begin at the top of the existing wooden stair, but would descend McDougall Hill to the east of the existing stair (Figure 2.1a). Core mechanized access improvements proposed for the East option alignment included (DIALOG 2014):

- Improved plaza at the top-of-bank with lighting, furnishings and plantings.
- Mechanized access with parallel stair (min. 4.2 m width) from top-of-bank to landing 7 m above roadway.

- Pedestrian bridge over Grierson Hill to existing SUP along the North Saskatchewan River.
- SUP between mechanized access landing and Grierson Hill pedestrian bridge.

It was felt that the proposed East and West alignments at 100 Street would provide improved access to the north and south sides of the river, the Low Level Bridge, the proposed Muttart LRT Station and Louise McKinney Riverfront Park.

After consideration of concept engineering, environmental, historic resources, sustainability, constructability (including utilities), cost, operations, schedule and risk management, DIALOG recommended constructing only the East Alignment of the 100 Street Access on McDougall Hill (DIALOG 2015b). That alignment offered the best opportunity to create a vibrant connection for the public between downtown Edmonton and the North Saskatchewan River Valley and would deliver the best long-term benefit for the City of Edmonton with the funding available.

2.3.12.2 Mechanized Access

DIALOG considered several types of mechanized access for the river valley, including the following (DIALOG 2015b):

- Rail-based and at-grade systems:
    - Rack/Cog Railways
    - Funiculars/Inclined Elevators
    - Vertical Elevators
    - Outdoor Escalators

- Aerial Systems:
    - Gondolas/Funitels
    - Chairlifts
    - Tramways/Runifors

DIALOG (2015) found that the large elevation difference and the moderate expected ridership did not validate the use of railways to access the Edmonton river valley. Due to their susceptibility to cold weather and trapping of debris, such as sand in winter, escalators in not fully enclosed buildings do not perform well in Edmonton. Maintenance, especially in the Edmonton outdoor climate, and full accessibility of escalators for such users as cyclists and wheelchairs is challenging and, therefore, escalators were not carried forward as an option. Gondolas/funitels, chairlifts, aerial tramways and funifors require on-site operators, which were not desired by the City. Furthermore, they provide a capacity that is significantly too large for the expected ridership and thus they are not economical. Chairlifts also posed accessibility challenges and patrons would not be adequately protected from the weather. A vertical elevator was not deemed appropriate for the sites from an urban integration point-of-view due to the height of elevator towers that would be required to connect to the top of the valley slope.

Based on these considerations, a funicular was the preferred mechanized system to access the Edmonton river valley at the 100 Street and 105 Street site locations, which was consistent with the site selection study completed in 2014 (DIALOG 2015b).

2.3.12.3 City Council Approval

On 23 June 2015, City Council approved the project to proceed for the East Alignment of the RVMA project connecting 100 Street near the Fairmont Hotel MacDonald and the river valley trail system near the Low Level Bridge comprising the funicular, stairway (urban stair), promenade, pedestrian bridge, elevator and lookout components.

2.4 Environmental Permitting Requirements

2.4.1 Federal Regulatory and Permitting Processes

2.4.1.1 Migratory Birds Convention Act

The proposed project will require some vegetation clearing for construction of the new funicular and urban stair and associated infrastructure. Such vegetation may provide wildlife habitat, specifically nesting habitat for migratory birds. Environment Canada administers the *Migratory Birds Convention Act* (*MBCA*), which prohibits the disturbance of nests of bird species covered under the *Act* (primarily migratory birds). With respect to construction, the *Act* provides guidelines for enforcement only; it is not linked to formal approvals. Violation of the *MBCA* may, however, result in penalties. An amendment to the *Act* further protects disturbance to individual migratory birds and prohibits release of deleterious substances into waters or areas frequented by migratory birds. This EIA provides information that enables the proponent to comply with the *MBCA*, specifically by ensuring that direct mortality to birds and active nests does not occur as a result of the proposed project.

2.4.1.2 Species at Risk Act

Much of the North Saskatchewan River Valley within the proposed project area consists of natural vegetation, typically characterized by forests and shrubby grasslands. Despite ongoing disturbances in the area and on adjacent lands, these communities may provide habitat for some federally-listed wildlife species at risk. The *Species at Risk Act* (*SARA*), administered by Environment Canada, prohibits disturbance to listed species and, in some instances, listed species' habitat. Habitat is defined not only as the area where a species naturally occurs and on which it depends to carry out its life processes, but also areas where that species formerly occurred and has the potential to be reintroduced. The *SARA* emphasizes guidelines for enforcement, and harming a Schedule 1 species is prohibited. Although no approvals or permits are required, violation of the *Act* may result in penalties.

2.4.2 Provincial Regulatory and Permitting Processes

2.4.2.1 Alberta Public Lands Act

The bed and shore of water bodies are owned by the province under the *Public Lands Act*. The proposed RVMA project will not require disturbance of the existing bed and shore of the North Saskatchewan River, as the proposed trails will be located above the top-of-bank and will cross no crown-claimed wetlands. Based on this information, no approvals under the Alberta *Public Lands Act* are anticipated for the proposed project.

2.4.2.2 Alberta Wildlife Act

The Alberta *Wildlife Act* prohibits disturbance to a nest or den of prescribed wildlife species. Although permitting is not required under the *Act*, violations may result in fines. The potential to impact nests or dens is addressed in this EIA so that potential impacts can be addressed through project planning.

2.4.2.3 Historical Resources Act

Any development with potential to disturb historical resources requires clearance by Historical Resources Management Branch (HRMB) of Alberta Culture and Tourism pursuant to the Historical Resources Act. The potential for historical resources to be disturbed was addressed by Altamira Consulting Ltd. (Altamira), who undertook a Historical Resources Overview (HRO) in 2011 and by Turtle Island Cultural Resource Management Inc. (Turtle Island), who more recently prepared a Statement of Justification (SoJ) pertaining to the proposed RVMA project. On the basis of that SoJ, Alberta Culture requires that a Historical Resources Impact Assessment (HRIA) be prepared. To that end, Turtle Island Cultural Resource Management is completing the required HRIA.

2.4.2.4 Alberta Elevating Devices & Amusement Ride Safety Association (AEDARSA)

The proposed funicular/inclined elevator will be an outdoor mechanized access moved by a rope, therefore, CSA Z98 – Passenger Ropeways and Passenger Conveyors is the applicable Canadian standard to design, build, operate and maintain the system. Elevator codes will be considered for the funicular portion of the River Valley Access for guidance on special cabin requirements, such as the doors, the interface between the platforms and the cabin, and emergency devices. Since CSA Z98-14 states that “This Standard may be adopted for use with funicular railways…” the proposed mechanized access will be called a funicular to avoid any confusion.

Stations at the top and bottom of the slope will need to be designed in compliance with the Alberta Building Code 2006 (ABC). Due to the unique application of the proposed mechanized system, variances from CSA Z98 and ABC may be required. Variances with respect to the ropeway system will be worked through in very close collaboration with AEDARSA and will primarily be submitted by the funicular supplier. Some variances from ABC will have to be reviewed and approved by the City of Edmonton building permitting agencies as the project moves forward into detailed design.

2.4.3 Municipal Regulatory and Permitting Processes

2.4.3.1 North Saskatchewan River Valley Area Redevelopment Plan (City of Edmonton Bylaw 7188)

The City of Edmonton's *North Saskatchewan River Valley Area Redevelopment Plan* (Bylaw 7188) requires environmental reviews for projects undertaken in the North Saskatchewan River Valley and tributary ravines. The proposed Mechanized Access project will be established within Bylaw 7188 boundaries; therefore, an environmental assessment is required. This report has been prepared to meet that requirement.

2.4.3.2 The Way We Grow, Municipal Development Plan (Bylaw 15100)

The Way We Grow, Municipal Development Plan (City of Edmonton 2010a) is the City of Edmonton's strategic growth and development plan for the next ten years. It is closely integrated with the Transportation Master Plan in that it identifies future growth and development of the City's infrastructure. This plan provides guidance to the City for developing the City into a more compact, transit oriented and sustainable city. Key objectives that relate to the proposed RVMA project include:

- The City of Edmonton protects, preserves and enhances a system of conserved natural areas within a functioning and interconnected ecological network (Strategic Objective 7.1.1).
- The City protects, preserves and enhances the North Saskatchewan River Valley and Ravine System as Edmonton's greatest natural asset (Strategic Objective 7.3.2).
- The City protects, preserves and improves the North Saskatchewan River Valley and Ravine System as an accessible year-round place for recreation and activity for people of all ages (Strategic Objective 7.3.2).
- The City mitigates the impact of development upon the natural functions and character of the North Saskatchewan River Valley and Ravine System (Strategic Objective 7.3.3).
- The City utilizes parks and open space to complement and enhance biodiversity, linkages, habitat and the overall health of Edmonton's ecological network (Strategic Objective 7.4.1).
- The City expands and enhances Edmonton's inventory of parks and open spaces for the ecological, health, recreation and education benefits they provide (Strategic Objective 7.4.2).

2.4.3.3 The Way We Move, Transportation Master Plan

The Way We Move (City of Edmonton 2009) is the City of Edmonton's Transportation Master Plan, pursuant to the City's overarching strategic plan, *The Way Ahead*. *The Way We Move* sets out goals and objectives to enable the City of Edmonton to address future transportation needs. The plan addresses public transportation as the cornerstone of the Transportation Master Plan and states that "Access for All" is the overriding principle adopted for the development of Edmonton's public transportation network, emphasizing the need for an accessible system for those with mobility challenges, including people with physical, sensory and cognitive disabilities as well as the elderly and people with young children. The plan also incorporates strategies to encourage more active transportation throughout the City. Key objectives that relate to the proposed RVMA project include:

- The City will integrate land use planning and transportation decisions to create an accessible, efficient and compact urban form (Strategic Objective 4.1)
- The City will provide a comprehensive system of transit options for persons with mobility challenges (Strategic Objective 5.3)
- The City will create a walkable environment (Strategic Objective 6.1)
- The City will create a cycle-friendly city (Strategic Objective 6.2)
- The City will create an integrated network of multi-use trail facilities (Strategic Objective 6.3)

2.4.3.4 The Way We Live, Edmonton's People Plan

The Way We Live (City of Edmonton 2010b) is the City of Edmonton's people plan, pursuant to the City's overarching strategic plan, *The Way Ahead*, and intended to advance and support the 10-year goal of improving Edmonton's livability. The plan provides direction on how the municipal government can contribute to the well-being of its citizens by delivering the greatest value of services and infrastructure that are most important to Edmontonians. Key guiding values of the plan include inclusiveness, relationships with the urban Aboriginal population, accessibility, public involvement, and integration with other long-range strategic plans. Key objectives that relate to the proposed RVMA project include:

- The City of Edmonton builds, partners and promotes the use of an integrated, accessible pedestrian and bicycle network (Strategic Objective 1.2.1)
- The City of Edmonton provides, partners and advocates for accessible public transit and active transportation to increase mobility and interaction within the city and across the region (Strategic Objective 1.2.2)
- The City of Edmonton provides and encourages people to explore and enjoy their connection to the natural environment (Strategic Objective 1.2.3)
- The City of Edmonton provides access to its parks, natural areas and green spaces for the enjoyment of Edmontonians (Strategic Objective 2.2.1)
- The City of Edmonton advocates for barrier-free infrastructure (Strategic Objective 3.1.10)
- The City of Edmonton designs and builds its infrastructure using *Crime Prevention through Environmental Design* principles (Strategic Objective 4.1.4)
- The City of Edmonton promotes innovative architecture and design in all areas of the city (Strategic Objective 5.1.4)
- The City of Edmonton designs, builds, provides and protects public access to the top of bank and ravine system (Strategic Objective 5.3.2)

2.4.3.5 The Way We Green, Environmental Strategic Plan

The Way We Green (City of Edmonton 2011) is the City of Edmonton's updated, long-term environmental strategic plan, pursuant to the City's overarching strategic plan, *The Way Ahead*. *The Way We Green* sets out principles, goals, objectives, policies and approaches for the City of Edmonton to preserve and sustain its environment. The two main focuses of the plan are sustainability and resilience, and the plan outlines 12 goals that describe what must ultimately be achieved for the City to be sustainable and resilient with respect to its environment. The goals address healthy ecosystems, emphasizing land, water and air, as well as food and waste concerns faced by the city now and in the future. *The Way We Green* includes a particular emphasis on the natural environment and sustaining healthy ecosystems but also emphasizes increased use of public transit and transit supportive planning. Many key objectives relating to the proposed RVMA project and presented in *The Way We Green* overlap with those of *The Way We Grow* and are presented in Section 2.4.3.2 above.

2.4.3.6 City of Edmonton 1996 Environmental Policy C512

The purpose of this policy is to state the City of Edmonton's commitment to environmental sustainability in accordance with the following guiding principles: 1) quality of life; 2) shared responsibility; 3) decision-making model; 4) protection of the natural environment; 5) intergenerational equality; 6) public awareness and understanding; and 7) citizen consultation and participatory decision-making. Through its planning, decision-making process and leadership, the City will promote the development of an environmentally sustainable community that functions in harmony with the natural environment. In addition, it will exercise environmental stewardship of its operations, products and services, based on its commitment to: (a) prevent pollution; (b) continually improve its environmental performance by setting and reviewing environmental objectives and targets; and (c) meet or exceed applicable environmental legal requirements and other requirements to which it subscribes. Further, the City commits to taking a leadership role in protecting natural heritage and biodiversity within the region. It is expected that construction of the proposed RVMA project will follow the guiding principles of this policy.

2.4.3.7 City of Edmonton Community Standards Bylaw (Bylaw 14600)

Part III of the City of Edmonton's Community Standards Bylaw 14600 establishes construction working periods (0700-3300 hours Monday to Saturday; 0900-2100 hours Sundays and holidays) and acceptable noise levels (not to exceed 65 dBA). Adherence to this bylaw will be required during construction.

2.4.3.8 Development Setback from River Valley/Ravine Crests Policy (C542)

The purpose of the City of Edmonton's Policy C542 is to ensure that urban development is reasonably safe from environmental hazards, such as slope instability, and to protect the river valley and ravine system from urban development that may compromise its long-term stability. The exception to this policy is the downtown and existing river valley communities, where development has already occurred either on the slope or in the floodplain of the River Valley and Ravine System. While the proposed RVMA project may be considered an exception to Policy C542 because of its location adjacent to downtown, the project does satisfy the policy's requirement to ensure the preservation of the River Valley and Ravine System as a significant visual and natural amenity feature, contribute to the ecological functionality of the City's natural areas system, and provide a recreational opportunity for the citizens of Edmonton. In addition, several geotechnical investigations have been conducted in support of the proposed RVMA project and have informed preliminary design and the Bylaw 7188 Environmental Impact Assessment to ensure slope stability is maintained in the area.

2.4.3.9 Corporate Tree Management Policy (C456)

All ornamental trees and natural treed areas on City-owned property are the responsibility of Edmonton Parks Branch (including procurement, maintenance, protection and preservation) pursuant to the City of Edmonton's *Corporate Tree Management Policy* (C456). That policy states that where damage to, or loss of, City trees occurs, equitable compensation for that loss will be recovered from the entity causing the damage or loss and applied to future tree replacement. Compensation amounts are dependent on the type of plant species lost or damaged and are calculated using set formulae or, in some cases, negotiations between City departments.

2.4.3.10 Natural Area Systems Policy (C531)

In June 2007, the City of Edmonton updated its approach to natural area management and adopted Policy C531, which supersedes Policy C467. The City is committed to conserving, protecting and restoring the natural uplands, wetlands, water bodies and riparian areas, as integrated and connected natural systems throughout the City. To that end, the Natural Areas inventory has been updated and includes both tablelands and River Valley Natural Areas. The City is committed to balancing the ecological and environmental considerations of a project with economic and social considerations in its decision making and will demonstrate that it has done so. This goal would require the procurement of appropriately detailed ecological information about any project which has the potential to affect a City Natural Area. While many areas in the North Saskatchewan River Valley and Ravine System comprise native vegetation, the proposed project area comprises disturbed forested and shrubby upland vegetation. In addition, the area is disturbed by a network of roadways on the fringe of the downtown core.

2.4.3.11 City of Edmonton Wildlife Passage Guidelines

In June 2010, the City of Edmonton introduced its *Wildlife Passage Engineering Design Guidelines* (Stantec 2010). The purpose of those guidelines is to provide transportation designers and decision makers with recommendations that incorporate the needs of wildlife into transportation projects. That goal will be met through restoring previously removed habitat connections and ensuring that existing connections remain. The guidelines are also meant to reduce the problem of anthropogenic habitat fragmentation and human-wildlife conflict, including wildlife-vehicle collisions. Although the guidelines represent the ideal designs for wildlife passage structures, the City recognizes that not all transportation projects will be capable of meeting that standard and will consider alternative structures on a project-specific basis. Furthermore, while the proposed RVMA project is not strictly a transportation project, City of Edmonton Sustainable Development requires that these guidelines be considered during project design. Considering the proposed project includes construction of new structures on the relatively undisturbed and steep McDougall Hill, those guidelines will be considered for the proposed project design and construction to reduce any potential impacts to wildlife passage resulting from project activities.

2.4.3.12 Low Impact Development Best Management Practices Design Guide—Edition 1.9 (November 2011)

The "Low Impact Development – Best Management Practices Design Guide" (Design Guide) was developed by the City of Edmonton in November 2011 to provide guidance for the application of low impact development best management practices (LID-BMPs. It provides an overview of LID-BMPs and design guidelines that planners, engineers, developers and designers can use to integrate LID-BMPs into land development, redevelopment or retrofit projects. The Design Guide supports the City's vision of sustainable growth and advances the environmental goals laid out in *The Way We Green*, the City's environmental strategic plan. It is a living document and will be updated based on the results of engineering experience and the results of research studies conducted within the City's local context. While the LID-BMPs are not a design standard, the use of those BMPs is strongly encouraged in the City of Edmonton to achieve sustainable growth and minimize impacts to the environment. As such, the project proponent is incorporating as many LID-BMP's into project design as possible.

2.4.3.13 Enviso Checklist

In 2004, Edmonton City Council approved City Policy C505 (Edmonton's Environmental Management System). This policy stated that the City would establish environmental management systems (known as Enviso in the City of Edmonton) in accordance with the standard ISO 14001. One goal of Enviso is to provide a framework for a strong environmental management system, aimed at legal/regulatory compliance. To that end, an Enviso checklist must be included for all City projects and completed prior to tender.

2.4.3.14 City of Edmonton Sewers Use Bylaw 16200

The release of material, including contaminated runoff, into the ravine system and ultimately into the North Saskatchewan River is regulated by the Sewers Use Bylaw. Part of this Bylaw prohibits the release of hazardous materials and materials that produce a colour value greater than or equal to 50 true colour units. The release of any material other than that permitted in this Bylaw may result in penalties. Compliance will be achieved through spill prevention measures, erosion and sedimentation control measures and adherence to the City of Edmonton's "Contractor's Environmental Responsibilities Package: Construction and Maintenance" (City of Edmonton 2008).

3.0 EIA METHODS

3.1 General Methods

Following are brief descriptions of the main methods and steps employed in the preparation of this EIA.

- We followed the guidelines for information and format for Bylaw 7188 environmental impact assessment, as outlined by the City of Edmonton. We assessed those phases of the project from construction through to operation.
- We reviewed previous environmental assessments in the immediate area of the proposed River Valley Mechanized Access (RVMA) project under consideration in this EIA:
  - *Mechanized River Valley Access—Concept Engineering Design: Environmental Feasibility Assessment* (Spencer Environmental 2015)
  - *River Valley Access: Concept Engineering* (DIALOG 2015c)
  - *North Saskatchewan Central River Valley Mechanized Access* (DIALOG 2014)
  - *McDougall Hill and MacDonald Drive Bridge Assessments: Environmental Screening Report* (Spencer Environmental 2012)
- We queried the Alberta Conservation Information Management System (ACIMS), using a legal land description search, on 27 January 2015 [Alberta Environment and Parks (AEP) 2015a].
- We queried the Fisheries and Wildlife Internet Mapping Tool (FWIMT), using a 1 km radius centered on the proposed alignment, on 27 January 2015 (AEP 2015b).
- We reviewed the project site to ensure all VECs were addressed.
- Potential impacts of the proposed project components were assessed and their significance described. Where feasible, mitigation measures were developed to minimize the severity of impact, and the significance of the residual impact was re-evaluated.
- We identified site-specific concerns by reviewing recent aerial photography and past reports in the vicinity of the proposed project.
- A public consultation open house was held on 8 April 2015 to inform the public about the proposed alignments and to provide an opportunity for questions to be addressed. An online survey was available from 7 April to 26 April to obtain feedback on the proposed project.
- Field surveys were conducted in the project area during spring and summer 2015 to obtain information about plant communities, rare plants, wildlife and historical resources.

3.2 Detailed Methods

The following sections describe in greater detail the approach used in preparing this EIA.

3.2.1 Scoping the Assessment

The assessment scope confirms the assessment process and key regulatory stakeholders and identifies the specific issues to be addressed. The steps involved in scoping the assessment for this project are outlined in the sections below.

3.2.1.1 Level of Assessment

The City of Edmonton Sustainable Development Department determined through discussions with the proponent that an Environmental Impact Assessment was the appropriate level of environmental review for this project.

3.2.1.2 Spatial and Temporal Boundaries

Spatial and temporal boundaries appropriate to the resource are selected to help focus the assessment on an area/timeframe most likely to be affected by the proposed project. In this way, the assessment focused on the area identified in Figure 1.1, although in some instances, this area was expanded or contracted for specific VECs. Where deviations were used, they are mentioned in the description of existing conditions.

3.2.1.3 Issues Identification

EIA issues were identified through the following means and sources:

- Aerial photographs showing the proposed project components were examined for environmental resources and sensitivities.
- City of Edmonton Sustainable Development indicated the appropriate level of environmental assessment, scope of work and issues to be addressed in the EIA.
- Specialist consultants for the subjects of geotechnical engineering, vegetation, wildlife and historical resources identified issues in the project area.
- Our professional judgment based on broad experience with similar projects undertaken in the Edmonton region.

A preliminary list of key resources potentially affected by the proposed RVMA project was developed from *A Guide to Environmental Review Requirements in the North Saskatchewan River Valley and Ravine System* (City of Edmonton 2000). The list also provided a starting point to identify VECs for the EIA. Note that issues identified in this process are *potential* concerns only. The extent to which a concern is real is confirmed through the impact assessment process. In some instances, a perceived concern may not be realized by project activities, but once identified, it must still be analyzed and characterized to satisfy the requirements of the impact assessment process.

3.2.1.4 Selection of Valued Environmental Components

No environmental assessment can be so broad in scope that it investigates potential impacts on all components of the natural social and heritage environments. To be effective, investigations must focus on selected environmental features that are considered most important within the context of the proposed development. Although

EIA practitioners use a variety of terms to describe these features, in this assessment, they are termed Valued Environmental Components (VECs) under Bylaw 7188. Three types of VECs were identified for this assessment:

- **Valued Ecosystem Components:** species or features of the natural environment.
- **Valued Socio-Economic Components:** features of human settlement/development or cultural values.
- **Valued Historic Components:** sites, artifacts, or structures of our natural and human history.

VECs were selected based on five criteria:

- Relative abundance or status,
- Public concern,
- Professional concern,
- Economic importance, or
- Regulatory concern.

Relative abundance or species status refers to resources within the study area that are considered rare, threatened, or endangered at a provincial or national level. It can also include those resources that have a limited distribution or abundance within the local or regional study area.

Resources of public concern include attributes or features that were raised as issues by the public during public consultation. Professional concerns are related to those features of the environment known to be critical for sustaining the ecosystem, or maintaining social or heritage values within the affected site. In the case of the City of Edmonton's river valley and associated ravines, professional concerns might include any resources or features considered an integral component of the river valley as a "Ribbon of Green" or an attribute important for maintaining the current quality of life in the river valley, associated ravines, or the adjoining communities. Resources of economic importance are various and range from aesthetic values important for tourism to sport fisheries.

Lastly, features of regulatory concern apply to resources that have been identified as special concern by provincial or federal regulatory agencies. These could include parkland and associated tree cover and/or rare or migratory species depending on the project type and location. Selected VECs and the jurisdiction used for their selection for this project are listed in Table 3.1.

Table 3.1. Justification for the Selection of VECs

Valued Environmental Components	Relative Abundance/ Status	Public Concern	Professional Concern	Economic Importance	Regulatory Concern	Trigger
Valued Ecosystem Components						
Geotechnical/ Soils -Slope Stability		✓	✓		✓	• Bylaw 7188
Hydrology and Surface Water Quality		✓	✓		✓	• Bylaw 7188
Air Quality		✓	✓		✓	• Bylaw 7188
Vegetation -Native Vegetation -Special Status Species	✓	✓	✓		✓	• Bylaw 7188 • Federal *Species at Risk Act*
Wildlife -Habitat -Special Status Species	✓	✓	✓		✓	• Bylaw 7188 • Federal *Species at Risk Act* • Federal *Migratory Birds Convention Act* • Alberta *Wildlife Act*
Habitat Connectivity		✓	✓		✓	• Bylaw 7188
Valued Socio-Economic Components						
Land Disposition and Zoning		✓	✓		✓	• Bylaw 7188
Residential Land Use		✓	✓		✓	• Bylaw 7188
Recreational Land Use		✓	✓		✓	• Bylaw 7188
Traffic/Parking		✓	✓		✓	• Bylaw 7188
Utilities		✓	✓	✓	✓	• Bylaw 7188
Worker and Public Safety		✓	✓		✓	• Bylaw 7188
Visual Resources		✓	✓		✓	• Bylaw 7188
Valued Historic Components						
Historical Resources		✓	✓		✓	• Alberta *Historical Resources Act* • Bylaw 7188

3.2.2 Description of Existing Conditions

The description of existing conditions provides a current snapshot of the local study area, over which the proposed project can be overlaid to identify areas of potential concern. For the North Saskatchewan River Valley and associated ravines, general environmental conditions are well-documented. A biophysical assessment conducted in 1981 provides a comprehensive overview of the river valley that has been used in several EIAs for projects within the river valley (EPEC Consulting Western Ltd. 1981). Past EIAs have conducted field studies to supplement that information and have reviewed social and heritage conditions specific to their project areas. City departments hold maps, zoning information and other data useful for describing the study area.

That information base was used to develop the general description of existing conditions, which was supplemented with subject-specific field surveys. Specific methods used to describe the existing conditions detailed in Chapter 5 vary slightly with each VEC. Specific methods are described in the respective sections of Chapter 5.

3.2.3 Impact Analysis

Impact analysis is the final step in confirming the likelihood and severity of a potential effect of the project on the environment. In this step, concerns raised by the public, regulators and environmental scientists are evaluated with respect to the existing environmental conditions and characterized so that their significance can be assessed by the regulatory authorities responsible for the environmental assessment process. While some potential impacts might eventually be determined to be negligible, the potential interaction of a VEC with a given project activity must be described and documented in order to resolve the original concern. Impact analysis, therefore, involves a statement of the potential effect, followed by a description of the means by which the VEC may be affected, or remain unaffected, by the project. Lastly, the impact is characterized in terms of standardized descriptors to allow a reviewer to evaluate the significance of project effects. The various stages of impact analysis are outlined in more detail below.

3.2.3.1 Impact Identification

To identify ways that the proposed project could affect VECs, a matrix with project activities along one axis and VECs along the other was developed (Table 6.1). Potential interactions between the elements of each axis were then identified and assessed with regard to the type of change that would occur in the existing environment as a result of the proposed development. Each of these interactions was then described in terms of the project's effect on each VEC.

Visual impact assessment consisted of observing and photographing the site from a variety of nearby and distant viewpoints, including:

- Examining the site from pedestrian and residential vantages, and
- Assessing the visual quality of the existing site environment.

Because potential visual impacts were evaluated in the fall, a subjective determination was made regarding the visual impacts during winter when vegetation is bare of leaves.

3.2.3.2 Impact Description Characteristics

The characteristics used to describe impacts were based on the requirements of Bylaw 7188, the *North Saskatchewan River Valley Area Redevelopment Plan*. Bylaw 7188 recognizes the importance of the North Saskatchewan River Valley and Ravine System as a contiguous open space and recreation system and establishes the Plan Area as an environmental protection area. The plan policy recognizes the Plan Area as containing natural resource areas that will be preserved and enhanced for recreation, scenic and ecological purposes. The essential question regarding the impact of development on any area of the river valley system is whether or not the impact(s) would positively or negatively affect the present quality of the valley as a highly-valued recreational and natural open space.

Based on this guiding piece of legislation, impacts were described and classified as to their magnitude/severity (negligible, minor, or major), direction (positive or adverse), duration (temporary or permanent) and confidence in impact prediction (predictable effect/unknown effect). These criteria were defined as follows:

Magnitude

Negligible Impact: An interaction that is determined to have essentially no effect on the resource. Such impacts are not characterized with respect to direction, duration or confidence.

Minor Impact: An interaction that has a noticeable effect but does not affect local or regional populations, natural or historical resources, or physical features beyond a defined critical threshold (where that exists) or beyond normal limits of natural perturbation. Also, an interaction that does not alter existing or future recreational pursuits at established facilities or well-used areas.

Major Impact: An interaction that affects local or regional populations, natural or historical resources, or physical features beyond a defined critical threshold (where that exists) or beyond the normal limits of natural perturbation, or alters existing or future recreational pursuits at established facilities or well-used areas.

Direction

Positive Impact: An interaction that enhances the quality or abundance of physical features, natural or historical resources, or recreational pursuits or opportunities.

Adverse Impact: An interaction that diminishes the abundance or quality of physical features, natural or historical resources, or recreational pursuits or opportunities.

Duration

Short-term Impact: An interaction resulting in a measureable change that does not persist for longer than one year post-construction.

Long-term Impact: An interaction resulting in a measureable change that persists longer than one year post-construction but at some point dissipates completely.

Permanent Impact: An interaction resulting in measureable change that persists indefinitely.

Confidence

Predictable Impact: Effects are well understood through application in projects of a similar nature.

Uncertain Impact: Effect on VEC is not well understood due to lack of knowledge of the VEC and its response to disturbance, or lack of previous experience with proposed mitigation measures in similar circumstances.

Project interactions presenting a risk to human health and safety were not characterized using the above definitions. They were instead assessed in terms of the degree of perceived risk (i.e., minimal vs. high risk).

3.2.3.3 Initial Impact Assessment and Mitigation Development

All identified project interactions, based on preliminary detailed design, were analyzed and described according to the characteristics defined above. Features of the project activities that would reduce the degree of impact, such as best management practices in erosion and sedimentation control, were reviewed at this stage and used to assign the degree of impact. No additional mitigation measures were applied at this point.

In the next step of the assessment, mitigation measures other than those built into the project description were developed to address the impacts that, if not addressed, would have an undesirable degree of impact on the VEC. All attempts were made to reduce impact severity; however, this was not always feasible or practical. For less severe impacts, mitigation measures were proposed if they were considered cost-effective and/or worked in concert with other proposed measures.

3.2.3.4 Residual Impact Assessment

Any effect remaining after mitigation is termed a residual impact. For the final stage of the assessment, residual impacts were classified according to the impact characteristics described above with one exception—impact rating confidence used for the following descriptors:

Predictable Residual Impact: Efficacy of proposed mitigation measures is well understood through application in similar projects or circumstances.

Uncertain Residual Impact: Efficacy of mitigation measure is not well understood because of lack of previous experience in similar circumstances or lack of knowledge about the VEC.

3.3 Public Consultation

As part of its commitment to public engagement, the City of Edmonton hired Calder Bateman to manage all public communications and engagement for the proposed RVMA project. To that end, the City of Edmonton posted proposed project details to the City of Edmonton website with contact information. A community open house was held on 8 April 2015, with display boards available at City Hall from 7 April to 10 April. An online survey was available from 7 April to 26 April 2015. Details of each specific event are provided below, followed by a summary of feedback (City of Edmonton 2015b; Appendix B). A complete copy of the public engagement program and progress report may be found in Appendix B.

3.3.1 Public Engagement Events

Open House – 8 April 2015

Location: Edmonton City Hall,
Time: 11:00 am to 2:00 pm and 4:00 pm to 8:00 pm
Attendance: 200 people

On 8 April 2015, a public open house was held at Edmonton City Hall. The event was advertised through a public service announcement, online ads, print publications and through the City of Edmonton's social media accounts and website. A road sign was erected near the existing wooden stair to inform commuters and frequent users of the existing stair of the upcoming open house. An in-person meeting was held with representatives of the Fairmont Hotel Macdonald to inform them of the open house. Email invitations were sent to other identified stakeholders. Identified naturalist stakeholders included the Prairie Chapter of the Sierra Club, the Edmonton Naturalization Group, the North Saskatchewan Watershed Alliance, the Federation of Alberta Naturalists, the Edmonton and Area Land Trust, and the Edmonton Nature Club. Other identified stakeholders included the Trails, Paths and Routes Advisory Committee, the Advisory Board for Persons with Disabilities, and the River Valley Coordinating Committee.

Participants at the open house viewed display boards of the recommended east and proposed west alignments on the north side of the river at the 100 Street site and associated project components and amenities. They had opportunities to ask questions and discuss the project with members of the project design team and City of Edmonton staff and provide feedback through comment forms.

Online Survey

An online survey was posted on the City of Edmonton website and was accessible from 7 April to 26 April, 2015. The survey was advertised through a public service announcement, online ads, print publications and through the City of Edmonton's social media accounts and website. Additionally, a road sign was placed near the existing stair at the proposed project site to further promote consultation. A total of 539 responses were received from both the open house and online survey.

3.3.2 Feedback Summary

Open House and Online Survey

Approximately two-thirds of the 539 responses supported the proposed RVMA project. Some respondents identified themselves as wheelchair users, bicyclists, or parents with strollers who felt that the proposed RVMA project would increase their ability to enjoy existing river valley amenities. Other responses indicated that the proposed funicular would act as a potential tourist attraction in the river valley. Responses indicated a strong majority preferred the east alignment based on a better connection to the existing river valley trail system and preferred views and vantage points.

Although most of the feedback was supportive of the proposed RVMA project, concerns were raised about the estimated construction costs, feeling that the grant money could be reallocated to other areas. Potential maintenance and operational costs were also a potential concern. Finally, safety concerns were raised, as the elevator landing at the lower valley terrace will be quite dark, especially during the winter, potentially creating a safety hazard.

3.3.3 Conclusion

Overall, the public supports the proposed RVMA project and are looking forward to the improved accessibility that the proposed project will provide to the river valley for all users, including those with limited mobility. The proposed project is also seen as a unique amenity that will enhance river valley experiences for all users. The east alignment was preferred by the majority of respondents, due to the direct connection with the existing river valley trails and the potential for better vantage points and views, when compared to the west alignment alternative.

3.3.4 Aboriginal Consultation

Aboriginal consultation has not been completed. The City of Edmonton has engaged Turtle Island Cultural Resource Management Inc. to lead Aboriginal consultation for the project (DIALOG 2015b).

4.0 KEY VEC ISSUES

The following are potential key issues identified for this project, based on professional and regulatory knowledge. These issues do not necessarily reflect impacts; however, the EIA seeks to resolve them. The issues are organized by subject area and the statements that appear in bold type represent key issues for that subject area and are represented in the form of questions. These issues form the basis for the impact assessment presented in Chapter 6. Chapter 7 revisits these issues, determines whether they actually represent impacts and summarizes steps taken to resolve them during the assessment.

4.1 Valued Ecosystem Components

4.1.1 Geotechnical/Soils

Terrain within the proposed project area is dominated by the North Saskatchewan River Valley. In particular, the north river valley wall and lower terrace in the project area contain steep slopes. Thus, the potential for slope instability exists. Key issues include:

- **Are geotechnical conditions suitable for construction and operation of all components of the proposed project?**
- **Are there abandoned coal mines in the vicinity of the project area?**

Construction on the steep north river valley slope and lower valley terrace may cause short-term and long-term surface erosion and subsequent sedimentation of the nearby North Saskatchewan River. Such erosion and sedimentation could adversely affect the water quality of the river. Key issues include:

- **Will project construction activities create surface erosion and sedimentation that could adversely affect water quality in the North Saskatchewan River?**

4.1.2 Hydrology/Surface Water Quality/Groundwater

The primary surface water body in the project area is the North Saskatchewan River. The proposed project is situated on the north valley slope and lower valley terrace of the North Saskatchewan River. The lower terminus of the proposed RVMA project will be located within the 1:100 year floodplain of the North Saskatchewan River. In addition, water quality in the North Saskatchewan River is an important local and regional environmental issue. As with most construction activities occurring on or adjacent to the banks of the river, clearing of vegetation and the associated presence of exposed soils could introduce sediment to surface water directly or indirectly via erosion and sediment-laden surface runoff. Key issues include:

- **Will project activities adversely affect water quality in the North Saskatchewan River?**
- **Will stormwater runoff from any project components contribute to north valley slope or lower terrace erosion?**

Hazardous materials (used during construction) could be stored near the North Saskatchewan River. Such materials, if spilled, could leak into the river and adversely affect fish and wildlife. Key issues include:

- **Is there potential for hazardous materials to be spilled during construction activities such that fish and wildlife resources are adversely affected?**

The proposed elevator and elevator shaft and associated stairs will be located within the 1:100 year floodplain and, as a result, could experience occasional flooding. Key issues include:

- **Is there potential for hazardous materials to leak from the elevator component during flooding conditions?**
- **Could flooding undermine the operation of the proposed RVMA project and cause maintenance issues?**

4.1.3 Air Quality

The proposed RVMA project area abuts recreational, commercial and residential areas in Edmonton’s downtown and includes the North Saskatchewan River Valley. Specific air quality issues include:

- **Will construction traffic and construction activities release significant levels of wind-borne dust?**
- **Will dust generation pose a health risk to residents and recreational users?**

4.1.4 Vegetation

Naturally occurring vegetation is present within the North Saskatchewan River valley in the project area. These naturally vegetated areas provide wildlife habitat and have the potential to support rare plant species. Key issues include:

- **Will native or ornamental trees on City lands be removed or damaged during construction? How will a potential loss be mitigated?**
- **Is there potential for the loss or disturbance of any special status native plant species or communities?**

4.1.5 Wildlife

Wildlife habitat, including local and regional habitat corridors, is present in the study area and throughout the North Saskatchewan River Valley and ravine system. Within the local project area, wildlife habitat consists primarily of forested and shrubby upland areas. Key issues include:

- **Will critical habitat be lost?**
- **Will any special status wildlife species be adversely affected by project activities?**

- **Will wildlife movement be blocked or impeded by project construction?**

4.1.6 Habitat Connectivity

The North Saskatchewan River is considered a major wildlife movement corridor, connecting habitats for a variety of wildlife species. In Edmonton's Ecological Network, the lands near the proposed project area are classified as semi-natural linkages (City of Edmonton 2007a). Key issues include:

- **Will existing habitat connectivity be compromised by the proposed project?**

4.1.7 Fish and Aquatic Resources

The proposed RVMA project will be located on the north river valley slope and lower river valley terrace near the North Saskatchewan River. No instream or near-stream works are planned for the proposed project, however, construction activities will occur in an upland vegetated area upslope from the river. Key issues regarding fish and aquatic resources include:

- **Will water quality in the North Saskatchewan River and, in turn, fish habitat, be affected by the proposed project during construction and operation?**

4.2 Valued Socio-Economic Components

4.2.1 Land Disposition and Zoning

The proposed project will take place in the North Saskatchewan River Valley and Ravine System, which is owned by the City of Edmonton. Specifically, the proposed RVMA project components will be located on lands zoned for metropolitan recreation (A), river valley activity node (AN) and public parks (AP). Key issues include:

- **Will land zoning changes be required in order to construct the proposed project?**
- **Will the project cross any other land jurisdictions?**
- **Will any additional land be needed to construct the project?**

4.2.2 Residential Land Use

The proposed RVMA project will be located within the North Saskatchewan River Valley. There are no private residences in the vicinity of the proposed project area; the nearest private residences are located in the Rossdale and Downtown neighbourhoods, outside the west limit of the proposed project area. The key issue for residential land use is:

- **Will project activities adversely affect nearby residents?**

4.2.3 Recreational Land Use

The proposed RVMA project area is situated adjacent to downtown Edmonton and will provide a direct connection to existing river valley recreational amenities. Existing recreational amenities in the vicinity of the proposed project area include existing river valley trails located on the lower river valley terrace, a wooden stair on McDougall Hill and several natural park areas including Rossdale Park and McDougall Park. Louise McKinney Riverfront Park, with a variety of recreational opportunities is located east of the proposed project area. Key issues include:

- **Will the proposed RVMA project meet the objective of increasing outdoor recreation in the river valley?**
- **Will current recreational users be adversely affected by project construction and operation?**
- **Will construction pose safety and health hazards to current recreational users?**

4.2.4 Traffic/Parking

Currently, traffic access to the proposed project area consists of existing City of Edmonton roadways. As the proposed RVMA project is intended to act as an enhanced component of the existing trail system and would, thus, be accessed by non-motorized means, no designated parking is proposed for the project area. Key issues include:

- **Will construction and operation of the proposed RVMA project adversely affect traffic and parking in adjacent areas?**

4.2.5 Utilities

Construction activities in close proximity to existing underground utilities could adversely affect those utilities and pose a public safety risk. The proposed project alignment is situated in close proximity to a storm line, a water line, an abandoned water line and an abandoned gas line near the top of McDougall Hill (DIALOG 2015b). Key issues include:

- **Will any utilities be damaged, resulting in a risk to public safety?**
- **Will any utilities be removed or realigned?**

4.2.6 Worker and Public Safety

Construction of the proposed RVMA project could potentially affect worker and public safety. Project construction will occur within the river valley in close proximity to downtown and existing shared-use paths and river valley stairs. Key issues include:

- **Will construction traffic and construction activities pose a risk to workers, residents, hotel patrons, and recreational users in the project area?**
- **Will hazardous materials during construction pose a risk to worker and public health and safety?**

4.2.7 Visual Resources

Construction activities will affect visual resources from near and distant vantage points within the project study area, including from the river valley and south side of the North Saskatchewan River, over the short- and long-term. Iconic views of the north side of the North Saskatchewan River and downtown Edmonton will be altered by construction and operation of the proposed project. Once the proposed RVMA project is constructed, it will provide opportunities for near and far views of the river valley and beyond. Key issues include:

- **Will construction and operation of the proposed RVMA project adversely affect the visual quality of the North Saskatchewan River Valley?**
- **Will RVMA operation create more accessible river valley views for all Edmontonians and visitors to Edmonton?**

4.3 Valued Historic Components

4.3.1 Historical Resources

With any construction project involving excavation, there is a possibility of disturbing previously unidentified historical, archeological and paleontological resources. Key issues include:

- **Is there potential for previously undiscovered artifacts to be disturbed during construction activities?**

5.0 EXISTING CONDITIONS

5.1 Valued Ecosystem Components

5.1.1 Geotechnical/Soils

5.1.1.1 Methods

The general geology and geomorphology of the North Saskatchewan River Valley were described in the EPEC Consulting Western Ltd. (1981) report on biophysical resources of the river valley.

Thurber Engineering Ltd. (Thurber) undertook preliminary desktop geotechnical assessments for the proposed project area as well as a field investigation (Thurber 2015a). The desktop component included a review of past relevant geotechnical reports, topographic maps and aerial photographs, as well as a coal mine atlas. The field program comprised drilling eight test holes in the project area between January and April 2015 (Thurber 2015b; Appendix C). The test holes were drilled to varying depths between 14.9 m and 22.4 m. Following completion of drilling, standpipe piezometers were installed in three of the test holes, and slope inclinometers and vibrating wire piezometers were installed in the remaining five test holes.

Following collection of soil samples, laboratory tests included visual classification and determination of natural water content. Grain size distribution, Atterberg limits, and direct shear tests were undertaken for selected samples.

5.1.1.2 Description

Surface Conditions

The proposed project area is located on the north side of the North Saskatchewan River, on a relatively steep slope descending from a plateau on which downtown Edmonton is situated to a lower river valley terrace, above the North Saskatchewan River (Thurber 2015b; Appendix C). In this area, bedrock was overlain by alluvium, colluvium, glacial till and glaciolacustrine deposits (Thurber 2015b; Appendix C). Alluvium deposits in this area are typically coarse clayey gravel and silt, with coal, cobbles and occasional boulders; the colluvium in the area consists of weathered surficial and bedrock deposits (Thurber 2015b; Appendix C). Glacial till consisted of mixed clay, silt and sand, with pebbles, boulders and lenses of sand and gravel. The proposed project area is situated at the edge of an area of glaciolacustrine deposits, so this layer, consisting of silt and clay, is expected to be thin (Thurber 2015b; Appendix C).

Subsurface Conditions

Five test holes correspond to the proposed location of the RVMA East Alignment (Thurber 2015b; Appendix C). At the midslope test holes on McDougall Hill, a thin layer of topsoil and a relatively thicker layer of clay overlaid the bedrock. The clay was silty with traces of sand and had a natural moisture content of 22% to 29% (Thurber 2015b; Appendix C). Near Grierson Hill Road, clay till, sand and gravel overlaid the bedrock. The clay till consisted of varying amounts of silt, sand and gravel, with a natural moisture content of 3% to 11% (Thurber 2015b; Appendix C). The sand and gravel layers were interbedded with the clay and were characterized as silty and clayey, with fine-grained sand and gravel. The natural moisture content of the sand was 11% to 21% (Thurber 2015b; Appendix C). At the southern terminus of the propose RVMA alignment, subsurface conditions consist of clay overlaying clay till, similar to the midslope conditions (Thurber 2015b; Appendix C).

Bedrock

Bedrock in the proposed project area belonged to the Edmonton Formation, characterized by interbedded clay shale, sandstone, siltstone and coal (Thurber 2015b; Appendix C). The clay shale was silty and sandy, with coal and sandstone laminations, while the sandstone layers tended to be thinner, with clay shale laminations (Thurber 2015b; Appendix C). Interbedded coal layers, up to 0.8 m thick, were encountered midslope (Thurber 2015b; Appendix C). Within the project area, bedrock occurred between 625 and 645 m above sea level, corresponding to depths of 2.2 m to 7.6 m below the upland elevations, at test holes drilled midslope on McDougall Hill and downslope at Grierson Hill Road, respectively.

Slope Stability

The slope in the proposed project area is considered very steep, ranging from 1H:1V to 2H:1V, with a flat terrace at midslope on McDougall Hill above Grierson Hill Road (Thurber 2015c). Due to extensive urban development in the vicinity of the proposed project area, identifying landslide features was difficult; however, locally-developed small active landslides were identified within the alluvium deposits on the river bank and above Grierson Hill Road in the eastern portion of the proposed project area (Thurber 2015b; Appendix C). Additionally, an area of inactive landslide was detected in the central portion of the project area, with historical aerial photography showing vegetation and slope morphology that are indicative of landslide and slope creep (Thurber 2015b; Appendix C). While Grierson Hill Road is situated along the toe of the landslide, creating conditions for possible movement, there is no evidence of slide reactivation (Thurber 2015b; Appendix C). At the southern edge of the proposed project area, a steep slope extends from Grierson Hill Road to the shared-use path. While this area appears stable, evidence of instability was observed further to the east, where hummocky ground and leaning trees were noted (Thurber 2015c).

Soils

Based on the recent borehole data, topsoils in the project area were typically described as black and highly organic and were generally present to a depth of 20 cm (Thurber 2015b; Appendix C). Topsoils immediately overlaid silty clay with traces of sand and gravel.

Coal Mines

No extensive coal mine workings are present within the proposed project area. Upon review of the province's coal mine atlas, Thurber (2015a) noted an area of coal mine workings between the existing McDougall Hill Road to the north of MacDonald Drive and extending from the Fairmont Hotel Macdonald to the Chateau Lacombe (Thurber 2015a). This mine operated from 1883 to 1897, covering an area of approximately 3 acres and operating at depths greater than 23 m (Thurber 2015a). As all project components will be located on McDougall Hill, the historic coal mine workings are outside the proposed project area (Thurber 2015a).

5.1.2 Hydrology/Surface Water Quality/Groundwater

5.1.2.1 Methods

Surface Water

Surface water flows in the RVMA project area were described based on examination of topographic maps and field observations. Available literature, including biophysical reports prepared by EPEC Consulting Western Ltd. (1981) and relevant environmental assessments prepared by Spencer Environmental, was also reviewed.

North Saskatchewan River Floodplain

The extent of the project area located in the North Saskatchewan River floodplain was assessed through examination of the City of Edmonton Floodplain Protection overlay (City of Edmonton 2015c) and the Alberta Flood Hazard Map (AEP 2015c).

Groundwater

As part of Thurber's geotechnical investigation, relevant borehole data were reviewed (Thurber 2015b; Appendix C). These data included boreholes drilled in support of the proposed project as well as previously-drilled boreholes in the vicinity of the proposed project area. Groundwater depths and elevations were obtained from borehole data.

5.1.2.2 Description

Surface Water

The only surface water body located in the regional study area is the North Saskatchewan River, which is the drinking water source for the City of Edmonton. It is located adjacent to the south edge of the proposed project area. The North Saskatchewan River originates at the Saskatchewan Glacier 500 km upstream of Edmonton and flows through the City for 48 km, from southwest to northeast. Several tributary streams release into the North Saskatchewan River in the City; however, none are located within the local study area.

North Saskatchewan River Floodplain

Most of the proposed RVMA project area is not included in the City of Edmonton's 1:100 year floodplain overlay, as the proposed project covers an area from the top of the north valley slope downslope to a river terrace. The southern terminus of the proposed project area, however, where an elevator and stair will link the RVMA components to the existing river valley trail system, will be situated within the 1:100 year floodplain and could experience occasional flooding.

Groundwater

Based on groundwater monitoring in the boreholes drilled in support of the proposed RVMA project, groundwater is relatively deep, at greater than 9 m below the surface of the ground (Thurber 2015b; Appendix C). Groundwater depths fluctuate in relation to climate and precipitation and water level in the river; thus, readings were taken in March (for boreholes drilled in January and February), April and June 2015 (for all boreholes), following the completion of drilling. In April 2015, groundwater depths at most of the boreholes ranged from 8.9 m to 11.7 m, with groundwater at two boreholes encountered at 15.2 m and 16.6 m. In June 2015, groundwater depths at most boreholes ranged from 9.0 m to 12.0 m, however, groundwater at one borehole was encountered at 15.0 m and another borehole was dry to the bottom of the core at 22.4 m.

Stormwater Management

The proposed project area will be situated in the North Saskatchewan River Valley, at the edge of downtown Edmonton. Adjacent lands at the top-of-bank are highly developed, with runoff from existing buildings and roads directed into existing storm lines. Storm lines run downslope on McDougall Hill, west of the existing stair (DIALOG 2015b). An outfall is situated immediately downstream of the Low Level Bridge, outside the proposed project area. On relatively undeveloped lands on the river valley slope, stormwater currently drains by overland flow downslope towards Grierson Hill Road. Overland flows on the river terraces south of Grierson Hill Road flow towards the adjacent North Saskatchewan River.

5.1.3 Air Quality

Air quality impacts relevant to this project would relate to dust and airborne particulate matter generated primarily by construction. The Alberta Ambient Air Data Management System (AAADMS), more commonly known as the Clean Air Strategic Alliance (CASA) Data Warehouse, is a central repository for ambient air quality data collected in Alberta (CASA 2015). Although data is collected for dust and smoke (coefficient of haze) in general to monitor monthly air quality objectives, site-specific data for construction projects is not measured. No description of existing conditions is, therefore, appropriate for this project.

5.1.4 Vegetation

5.1.4.1 Methods

Literature Review

Vegetation resources in the river valley have been well studied, and there are several resources describing plant communities and sensitive species. Plant communities were previously identified and mapped for the North Saskatchewan River Valley and Ravine System Biophysical Study (Westworth & Associates 1980, *in* EPEC Consulting Western Ltd. 1981). A search of the Alberta Conservation Information Management System (ACIMS) was conducted on 27 January 2015 to determine if any rare plant species had been reported from the study area (AEP 2015a).

Field Investigation

Rare Plant and Plant Community Surveys

A rare plant and plant community survey was undertaken by a professional plant ecologist on 29 June 2015. All plant communities in the project area were surveyed to fully describe the communities and to document rare plant occurrences. Preliminary community delineations that had been mapped prior to field investigations were ground-truthed and boundaries adjusted as necessary.

Each community was surveyed via meandering transects encompassing all proposed project components, access routes and staging areas, as well as lands immediately adjacent to these proposed areas. Communities of native vegetation in the vicinity but not expected to be impacted were coarsely classified based on dominant vegetation; however, a detailed inventory and rare plant survey were not conducted in areas outside of the proposed disturbance limits.

All species were documented and their relative abundances were ranked as dominant, abundant, frequent, occasional, or rare (locally uncommon). This information was used to classify communities, which were classified following the system developed by Westworth & Associates (1980, *in* EPEC Consulting Western Ltd. 1981) for plant communities in the North Saskatchewan River Valley in Edmonton. All wildlife sightings and sign and surface disturbances were recorded. Representative sites were photographed.

All communities were surveyed at an intensity that was deemed sufficient to capture the diversity of habitats within the site and to encounter any rare species present. When S1 or S2 species were observed, their location was marked with a GPS. S3 species are not considered rare provincially, so no mitigation measures are required in the event of their disturbance; however, because the City of Edmonton Parks + Biodiversity Section also treats S3 species as rare within the City of Edmonton, their occurrences were noted but were not recorded on a GPS.

Species that could not be identified in the field were collected and identified with the aid of a dissecting microscope and various botanical manuals. Species scientific and common names follow the most recent data from ACIMS (AEP 2015a). Common names are used throughout the text; however, complete plant community data, including species scientific names, are provided in Appendix D.

Weed Surveys

A noxious weed survey was conducted concurrently with the rare plant and plant community surveys on 29 June 2015, covering all plant communities within the project area. In each community, any noxious or prohibited noxious species observed were recorded and their relative abundance ranked as dominant, abundant, frequent, occasional or rare (locally uncommon).

5.1.4.2 Description

Regional Vegetation

The project study area lies within the Central Parkland Subregion of the Parkland Natural Region, characterized by a mosaic of aspen groves and prairie vegetation (Natural Regions Committee 2006). The mixed landscape is the product of till plains and hummocky uplands, with moisture availability determining the proportion of grass and aspen. Trembling aspen forests dominate the area with balsam poplar stands occurring on poorly drained sites. Both forest types generally have a well-developed and diverse shrub layer, dominated by species such as snowberry, prickly rose, red-osier dogwood and willow (Natural Regions Committee 2006). Much of the native vegetation within this subregion has been cleared for urban and agricultural development, with remnant communities found in ravines or valleys, such as in the local study area.

Local Vegetation

The vegetation study area encompasses parts of two City of Edmonton Natural Areas (056 and 057 RV) (Figure 5.1). Those Natural Areas, however, form part of the Central Area of the *North Saskatchewan River Valley Area Redevelopment Plan* (Bylaw 7188), an area that supports many developed parks and relatively few undisturbed areas. Based on the Westworth & Associates classification system (Westworth & Associates 1980, *in* EPEC Consulting Western Ltd. 1981) for the North Saskatchewan River Valley and Ravine system, the following plant communities were present within the local study area:

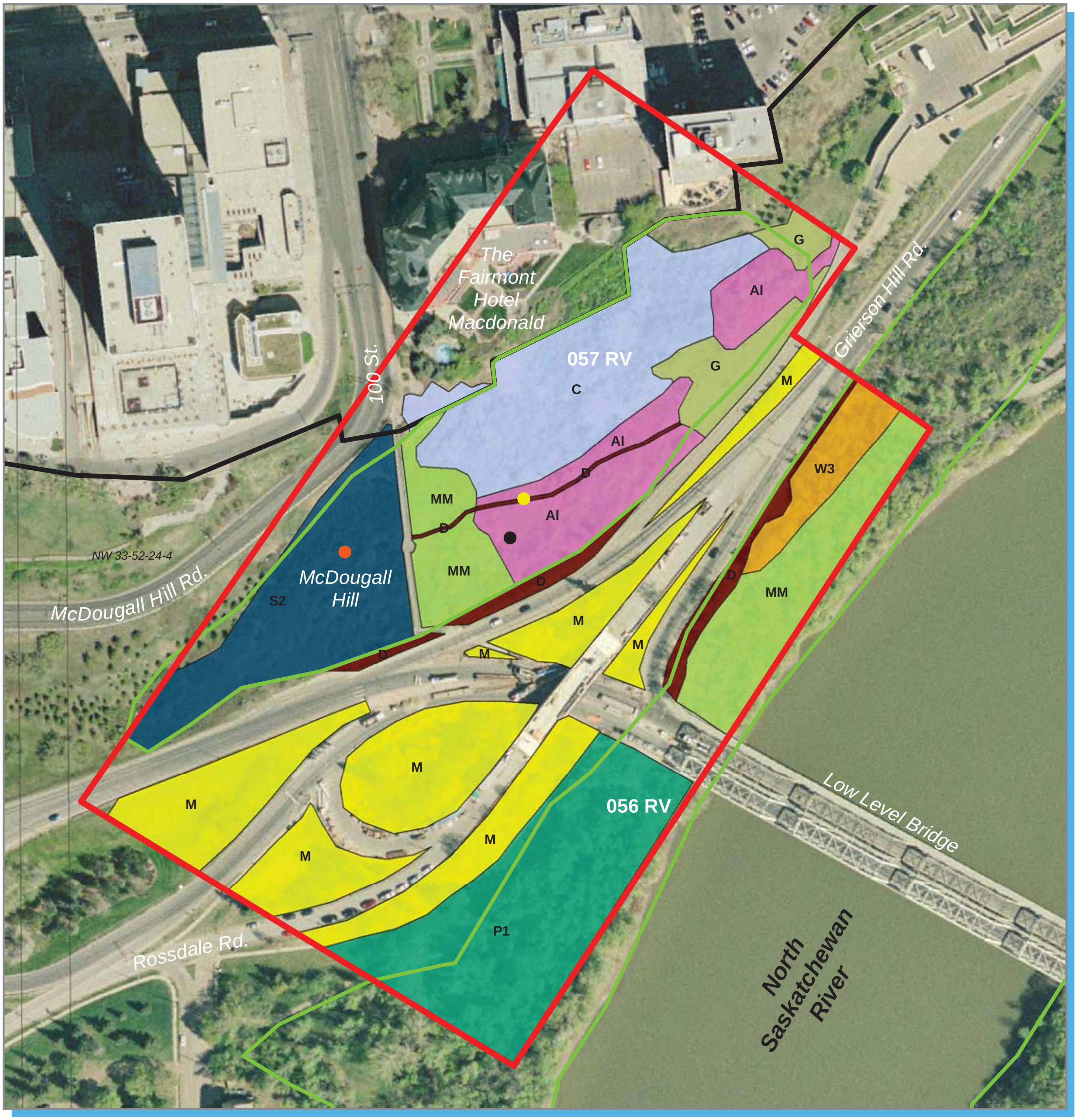
- Manicured (M)
- Grassland (G)
- Aspen (A1)
- Tall Shrubs and Saplings (S2)
- White Spruce-Deciduous (W3)

In addition to these communities, several other communities were observed that were characterized by non-native vegetation and, thus, are not covered by the Westworth & Associates classification system. These communities included:

- Manitoba Maple (MM)
- Caragana (C)
- Weedy-Disturbed (W/D)

Manitoba maple and caragana communities were considered semi-natural plant communities, as they grow without vegetation management efforts although they are dominated by exotic species. As a result, they appeared structurally similar to a natural plant community, dominated by native species.

A summary of these communities is provided in Table 5.1, and a description of each community is provided in the following sections.



Legend

Plant Community

- 🟪 Aspen (Al)
- 🟧 White Spruce-Deciduous (W3)
- 🟩 Manitoba Maple (MM)
- 🟩 Balsam Poplar (P1)
- 🟦 Common Caragana (C)
- 🟦 Tall Shrubs and Saplings (S2)
- 🟩 Grassland (G)
- 🟨 Manicured (M)
- 🟫 Disturbed (D)
- ● Moist Cattail Community

Special Status Species

- ● Round-Leaved Hawthorn
- ● Poison Ivy, approx. location
- 🟥 Local Study Area
- 🟩 City of Edmonton River Valley Natural Areas (2010) (with ID)
- ⬛ Bylaw 7188 boundary

**Vegetation data source: 2015 project-specific fieldwork, and Spencer Environmental (2012b)*

Figure 5.1 Plant Communities and Rare Plant Occurrences

River Valley Mechanized Access Project

N

0 20 40 80 Meters

1:2,300

Aerial Photograph Date: May 2012

Date Map Created: 17 November 2015

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Table 5.1. Summary of Plant Communities and Species Composition for the RVMA Study Area

Plant Community	Area Surveyed (ha)	Number of Species				
		Native	Exotic	Rare	Noxious Weed	Total
Manicured (M)	1.09	4	14	0	2	20
Grassland (G)	0.18	8	13	0	4	25
Aspen (A1)	0.40	23	16	1	3	42
Tall Shrubs and Saplings (S2)	0.55	14	9	1	3	27
White Spruce-Deciduous (W3)	0.14	19	9	0	4	32
Manitoba Maple (MM)	0.57	12	9	0	4	25
Caragana (C)	0.64	3	5	0	2	11
Weedy/Disturbed (W/D)	0.16	2	12	0	1	15

Manicured Areas (M)

Manicured areas were observed at the top of the existing wooden stair, as well as at the bottom of McDougall Hill, and along the roadsides and medians of McDougall Hill Road and Grierson Hill Road (Figure 5.1; Appendix D).

Manicured areas are subject to regular mowing or maintenance; they are characterized by grassy areas and planted beds, as well as areas where the original cover has been maintained but severely thinned (Westworth & Associates 1980, in EPEC Consulting Western Ltd. 1981). In the project area, the vegetation in manicured areas was dominated by Kentucky bluegrass, quackgrass and smooth brome. The planted beds were characterized by silverberry, shrubby cinquefoil, prickly rose, pygmy caragana, and ornamental blackberries (Plate 5.1); however, the planted beds were occasionally overgrown by undesirable exotic species, including scentless chamomile, creeping thistle, common dandelion and white sweet-clover.

Plate 5.1. A manicured area consisting of a planted bed in the median between McDougall Hill Road and Grierson Hill Road near the foot of the existing wooden stair, looking west (29 June 2015)

Overall, 20 species were observed in the manicured areas. Of these, four (20%) were native, while the remaining 16 (80%) were exotic. No special status species were observed, and two noxious weed species (scentless chamomile and creeping thistle) were observed in the manicured areas.

Grassland Communities (G)

A grassland community was documented at the east edge of the project area, north of an access road situated between the Shaw Conference Centre and McDougall Hill Road (Figure 5.1; Appendix D).

Grassland communities are typically comprised of a variety of grass species, with forbs and occasional low-growing shrubs. In the project area, the grassland community was dominated by smooth brome, western wheatgrass, Kentucky bluegrass and quackgrass, with biennial sagewort, wild vetch and common goatsbeard (Plate 5.2). Shrubs were sparse; however, saskatoon, prickly rose, and red-osier dogwood occurred frequently. Occasional planted trees included white spruce, blue spruce, lodgepole pine and jack pine.

Plate 5.2. The grassland community at the east edge of the project area, dominated by smooth brome (29 June 2015)

Overall, 25 species were observed in the grassland community. Of these, eight (32%) were native, while the remaining 17 (68%) were exotic. No special status species were observed in this community. Three noxious weeds were documented: ox-eye daisy, creeping thistle and common burdock.

Aspen Communities (A1)

An aspen community was documented on the lower portion of McDougall Hill, (Figure 5.1; Appendix D).

Aspen communities are generally characterized by a relatively consistent canopy of aspen, with a diverse understorey, consisting of tall and short shrub strata and a variable herb layer (Westworth & Associates 1980, in EPEC Consulting Western Ltd. 1981). In the RVMA project area, aspen, with occasional balsam poplar, Manitoba maple, and common caragana formed the overstorey, while buckbrush, prickly rose, red-osier dogwood and saskatoon formed a dense shrub layer (Plate 5.3). The understorey was characterized by abundant northern bedstraw, wild sarsaparilla, tall lungwort and wild vetch. Smooth brome, red and white baneberry, star-flowered Solomon's-seal and bluebur were also commonly observed.

Plate 5.3. The aspen community, showing a dense shrub layer (29 June 2015)

Overall, 42 species were observed in the aspen community. Of these, 23 (55%) species were native, while the remaining 19 (45%) species were exotic. One special status species (poison ivy – see Special Status Species section below) was observed. Two noxious weeds were documented: common burdock and creeping thistle. Common buckthorn, a prohibited noxious weed was also observed in the aspen community.

Tall Shrub-Sapling Communities (S2)

The western portion of the survey area on McDougall Hill, west of the existing stair, was characterized as a tall shrub-sapling community (Figure 5.1; Appendix D).

Tall shrub-sapling communities tend to occur on a variety of sites throughout the river valley and tend to represent a transitional community between a relatively more open community and a forested area (Westworth & Associates 1980, in EPEC Consulting Western Ltd. 1981). In general, these communities consist of a tall shrub/sapling stratum and a low-shrub stratum below. The herb layer tends to be forb-dominated but variable. In the project area, this community was characterized by an abundance of choke cherry on the lower portions of McDougall Hill and wolfberry, an exotic species, near the top of the hill (Plate 5.4). Red-osier dogwood, prickly rose and buckbrush formed the low-shrub layer. Commonly occurring species in the herb layer include wild sarsaparilla, star-flowered Solomon's-seal, and wild vetch on the moist, lower portions of the slope and smooth brome, biennial sagewort and common goatsbeard on the drier, upper portions of the slope.

Plate 5.4. The tall shrub-sapling community at the top of McDougall Hill, characterized by abundant wolfberry (29 June 2015)

Overall, 27 species were observed in the tall shrub-sapling community. Of these, 14 (52%) were native, while the remaining 12 (44%) species were exotic. No special status species were observed in this community. Two noxious weeds were detected: common burdock and creeping thistle. Common buckthorn, a prohibited noxious weed, also had rare occurrences within this community.

White Spruce-Deciduous Communities (W3)

A white spruce-deciduous community was documented at the proposed RVMA's southern terminus, in the river valley south of Grierson Hill Road (Figure 5.1; Appendix D). This area and the Manitoba maple community immediately to the west were separated from the remainder of the study area on McDougall Hill by two major arterial roadways (McDougall Hill Road, Grierson Hill Road).

White spruce-deciduous communities tend to occur in cool and moist areas within the river valley and ravine system. They are characterized by a canopy of white spruce with balsam poplar and some aspen and birch (Westworth & Associates 1980, in EPEC Consulting Western Ltd. 1981). The shrubs and herbaceous plants in the understorey tend to be highly variable, although tall and short shrub strata and a herbaceous layer tend to be well-defined. In the RVMA project area, the white spruce- deciduous community was characterized by a canopy of white spruce and balsam poplar. Commonly occurring shrubs included prickly rose, red-osier dogwood, saskatoon and buckbrush. The understorey was fairly open and characterized mainly by forbs, including wild sarsaparilla, northern bedstraw, tall lungwort and star-flowered Solomon's-seal (Plate 5.5). Smooth brome and quack grass were commonly occurring grasses in the community.

Plate 5.5. The white spruce-deciduous community with a relatively open understorey (29 June 2015)

Overall, 32 species were observed in the white spruce-deciduous community. Of these, 19 (59%) were native, while the remaining 13 (41%) species were exotic. No special status species were observed within the surveyed area. Two noxious weeds were detected in this community: common burdock and creeping thistle. Common buckthorn, a prohibited noxious weed, also had rare occurrences within this community.

Manitoba Maple Communities (MM)

A Manitoba maple community was documented on McDougall Hill immediately east of the existing wooden stair and forming a relatively narrow community extending from the top of the hill to the bottom, and a second community was situated on the bank of the North Saskatchewan River south of Grierson Hill Road and immediately east of the Low Level Bridge (Figure 5.1).

Manitoba maple communities are not part of the Westworth & Associates classification system; however, Manitoba maple communities are relatively common in Edmonton. In these communities, both the canopy and understorey are dominated by Manitoba maple, an exotic species, and the understorey tends to be poorly developed (Plate 5.6). In the project area, the canopy was dominated by Manitoba maple, with occasional common caragana and balsam poplar (Appendix D). The shrub layer was relatively sparse, with prickly rose, buckbrush, choke cherry and red elderberry. The understorey was open, with abundant smooth brome and common burdock and occasional wild sarsaparilla and wild vetch.

Plate 5.6. The Manitoba maple community, showing a canopy dominated by Manitoba maple and a poorly developed understorey (29 June 2015)

Overall, 25 species were observed in the Manitoba maple communities. Of these, 12 (48%) species were native, while the remaining 13 (52%) species were exotic. No special status species were observed in these communities. Three noxious weeds were documented: common burdock, creeping thistle and creeping bellflower. Common buckthorn, a prohibited noxious weed, was also observed in the Manitoba maple communities.

Caragana Communities (C)

A caragana community was documented along the top of McDougall Hill, east of the existing wooden stair, and extending to the eastern limits of the surveyed area (Figure 5.1).

Caragana communities are not part of the Westworth & Associates classification system. Caragana-dominated communities occur occasionally in Edmonton and are generally characterized as being extremely species-poor, as relatively little can grow beneath the dense cover of common caragana, an exotic species (Plate 5.7). In the project area, the caragana community was characterized by common caragana, with an understorey dominated by smooth brome and common burdock (Appendix D). Occasional other species included biennial sagewort, tall lungwort and star-flowered Solomon's-seal.

Plate 5.7. The caragana community, showing a dense stand of common caragana and a poorly developed understorey (29 June 2015)

Overall, 11 species were observed in the caragana community. Of these, three (27%) were native, seven (64%) were exotic, and one species was identified only to genus and its origins could not be determined. No special status species were observed in this community. Two noxious weed species were documented in the caragana community: common burdock and creeping thistle.

Weedy-Disturbed Communities (W/D)

A weedy-disturbed community was situated at the bottom of McDougall Hill, along the north edge of McDougall Hill Road. (Figure 5.1) The community was relatively narrow and represented the transitional area between maintained roadside and natural communities upslope. As such, this community was characterized by mown grass, some planted vegetation that had been variably maintained, considerable weed cover, and occasional native species (Plate 5.8). Common species included smooth brome, quack grass, alfalfa, and species of sweet-clover. Pygmy caragana and shrubby cinquefoil had been planted along the roadside near the existing stair, forming a dense hedge along the foot of the slope. Creeping thistle occurred occasionally throughout this community. Occasional native species were observed, including prickly rose and Kentucky bluegrass.

Plate 5.8. The disturbed-weedy community at the base of McDougall Hill, looking east (5 October 2015)

Overall, 15 species were observed in the weedy-disturbed community. Of these, two (13%) species were native, while the remaining 13 (87%) species were exotic. No special status species were observed. Despite the abundance of exotic species, creeping thistle was the only noxious weed species documented.

5.1.4.2.1.1.1 Moist Cattail Community

A small cattail community was situated within a disturbed area midslope on McDougall Hill (Figure 5.1; Appendix D). A narrow (approximately 1.5 m wide) informal trail extends to the east from the landing of the existing wooden stair, situated in the transitional area between the Manitoba maple and aspen community downslope and the common caragana community upslope. The majority of the trail is characterized by grasses and exotic forbs, with native shrubs along the edges (Plate 5.9)

Plate 5.9. Informal trail located midslope on McDougall Hill (29 June 2015)

The moist cattail community was characterized by a localized area of relatively moist soils supporting wetland-associated species in addition to typical upland species (Plate 5.10). The origins of this moist patch are uncertain; the moist community could have established at the site of a small groundwater seep, or as a result of surface runoff pooling in the area. The area supported abundant common cattail and frequent northern willowherb. Northern bedstraw, hemp-nettle and creeping thistle were also occasionally observed.

Plate 5.10. The moist cattail community, situated in a clearing (29 June 2015)

Overall, 13 species were observed in the moist cattail community. Of these, six (46%) species were native, while the remaining seven (54%) species were exotic. No special status species were observed in this community, and two noxious weed species, creeping thistle and perennial sow-thistle, were documented in this community.

Special Status Species

In Alberta, rare plants are typically considered to be those that are found in fewer than 20 locations in the province (AEP 2015d). These plants are given conservation rankings of S1 or S2. S1 species are known from five or fewer locations in the province, while S2 species are known from 6-20 locations. The Province typically considers species ranked S3 (21-100 known occurrences) as uncommon, rather than rare, and thus, S3 species are not tracked and mitigation measures for their disturbance are not required. However, the City of Edmonton Parks + Biodiversity Section considers species ranked as S1, S2 and S3 to be rare. To that end, occurrences of S3 species were noted and are listed in the sections below.

A search of ACIMS records for the proposed project area conducted on 27 January 2015 returned records of one special status vascular plant species: smooth sweet cicely (*Osmorhiza longystylis*), which was reported to ACIMS in June 2013. This species is typically found in moist woods. Smooth sweet cicely has recently been downgraded from an S2 species to an S3 species, meaning it has 21-100 confirmed occurrences in the province. It was not detected during the rare plant surveys for the current RVMA project, and the plant communities present in the majority of the study area do not represent suitable conditions for smooth sweet cicely.

A total of two special status species were observed during the current rare plant surveys, both of which were S3 species. These species were poison ivy and round-leaved hawthorn. Poison ivy (*Toxicodendron radicans*) was found in large patch in the aspen community on the lower slopes of McDougall Hill, and round-leaved hawthorn (*Crataegus chrysocarpa*) was found scattered throughout the tall shrub community on McDougall Hill, west of the existing wooden stair. A description of these species, their preferred habitats, and where they were generally observed in the vegetation survey area is provided in the following sections.

Poison Ivy (Toxicodendron radicans)

Poison ivy is a low shrub in the sumac family (Anacardiaceae). It is characterized by long-petioled, glossy leaves made up of three leaflets, with clusters of white flowers located in the leaf axils (Plate 5.11) (Moss 1981). Western poison ivy (*Toxicodendron radicans* var. *rydbergii*) is the variety that occurs in western North America, including the Edmonton area; this variety grows as an erect shrub, as opposed to the climbing vine form of eastern poison ivy (Moss 1981). Poison ivy has a limited distribution in Alberta, where it occurs in the southern Grassland region and reaches its northern limit in the Central Parkland subregion around Edmonton. Poison ivy is found in open woods and river flats. Within the RVMA project area, it formed the dominant understorey vegetation in an area measuring approximately five square meters under a patchy aspen canopy near the transitional area between the Manitoba maple community and the aspen community (Figure 5.1).

Plate 5.11. Poison ivy (*Toxicodendron radicans*), showing the cluster of greenish-white berries in the leaf axils (29 June 2015)

Round-leaved Hawthorn (Crataegus chrysocarpa)

Round-leaved hawthorn is a shrub in the rose family (Rosaceae). It is characterized by broad leaves with doubly-serrate margins and 2-7 cm long thorns on the branches (Plate 5.12) (Moss 1981). Round-leaved hawthorn is typically found in river valleys and open woods and reaches its northern limit in the Central Parkland subregion around Edmonton. Within the project area, it occurred as scattered individuals throughout the tall shrub and sapling community on McDougall Hill, west of the existing wooden stair (Figure 5.1).

Plate 5.12. Typical round-leaved hawthorn (*Crataegus chrysocarpa*), showing doubly-serrated leaf margins and a cluster of red berries (Photo courtesy of L. Kershaw)

5.1.5 Wildlife

5.1.5.1 Methods

Habitat Characterization

Habitat present in the local study area was described from vegetation mapping developed for this environmental assessment (Figure 5.1), observations made during wildlife field investigations, and data from previous environmental assessments (e.g., Spencer Environmental 2012a and 2012b).

In addition to the local study area, a regional wildlife study area was established based on ecological boundaries relevant for those animals with large home range requirements that are likely to occur in the North Saskatchewan River Valley (Figure 1.1). The regional study area accounts for the fact that the local areas may comprise only a small portion of the home range for some species or is likely part of a regional movement corridor. The extent of potential impacts related to the proposed project was also considered in selecting the regional study area. The regional study area is loosely bounded by 104 Street to the west, 87 Avenue to the south, 91 Street to the east, and the northern extent of Louise McKinney Riverfront Park to the northeast (Figure 1.1).

Literature Review

Existing wildlife information was compiled through a review of previous studies conducted within the North Saskatchewan River Valley. The biophysical study by Westworth and Associates (1980, *in* EPEC Consulting Western Ltd. 1981) remains one of the most comprehensive resources for the North Saskatchewan River Valley. Two more recent environmental assessments conducted in the river valley also provided information on wildlife in the local and regional project study areas: the *McDougall Hill and MacDonald Drive Bridge Assessments Environmental Screening Report – Final Report* (Spencer Environmental 2012a); and *Walterdale Bridge Replacement Environmental Assessment Edmonton, Alberta, Final Report* (Spencer Environmental 2012b). In addition, the Fish and Wildlife Internet Mapping Tool (FWIMT) was queried on 27 January 2015 for any rare or special status wildlife species in the local study area (AEP 2015b).

Field Investigations

Breeding bird surveys to characterize breeding bird species richness and abundance in the local study area were conducted on one morning during the breeding bird season (18 June 2015). A total of three, 80 m wide fixed-width transect surveys were conducted; the locations of those transects were selected to maximize the surveyed extent and habitat types available within the local study area without any overlap of the areas surveyed among transects (Figure 5.2). The approximate lengths and areas of the three transects are summarized below in Table 5.2. The transect survey areas had rounded ends resulting from 40-m buffers on transect start and end points and so the calculated transect areas in Table 5.2 reflect that additional area.

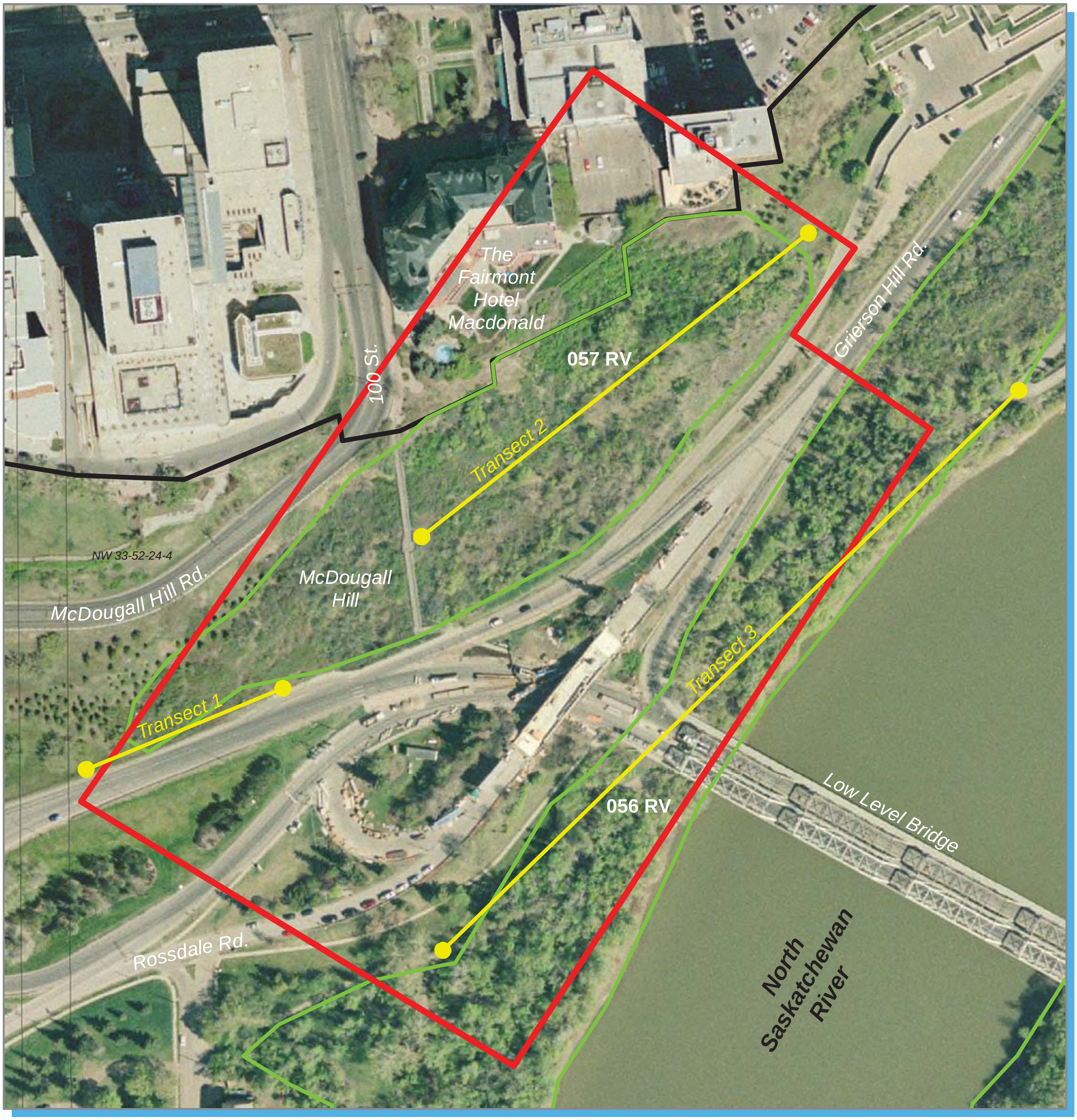
Table 5.2. Summary of Breeding Bird Survey Fixed-Width Transects Surveyed on 18 June 2015

Transect Id	Transect Length (m)	Transect Area (ha)
1	89	1.2
2	212	2.2
3	363	3.4
Total	**664**	**6.8**

During surveys, transects were walked slowly at a rate of 15 to 20 m per minute and all birds detected within a distance of 40 m on either side of the transect were recorded (i.e., an 80 m width). Surveys began at one half hour before sunrise and ended no later than six hours after sunrise.

5.1.5.2 Description

Based on current provincial distributions, local records and field investigations, 116 wildlife species (amphibians, reptiles, birds and mammals) *have the potential to occur* in the local study area (Appendix E). Occurrence refers to species residing year round, during the breeding season only, during the winter and, more briefly, migrating annually or dispersing through the area. Most of the 200 wildlife species that have been observed



Legend

- Breeding Bird Survey Transect
- 🟥 Local Study Area
- 🟩 City of Edmonton River Valley Natural Areas (2010) (with ID)
- ⬛ Bylaw 7188 boundary

Figure 5.2 Breeding Bird Survey Transects

River Valley Mechanized Access Project

0 20 40 80 Meters

1:2,300

Aerial Photograph Date: May 2012

Date Map Created: 17 November 2015

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within the Edmonton area have been observed in the North Saskatchewan River Valley in Edmonton (Westworth and Associates 1980, *in* EPEC Consulting Western Ltd. 1981).

Wildlife habitat within the local study area is fragmented by two major arterial roadways (McDougall Hill Road and Grierson Hill Road), a paved shared-use pathway and the Low Level Bridge. Habitat north of the arterial roadways is located on the steeply sloped north valley slope, which is densely vegetated with tall shrubs, trees and some grassland areas (Figure 5.1). Habitat in the roadway medians and south of the roadways is comprised of manicured areas and forested habitat. Considering the local study area's central-Edmonton location, high level of disturbance, habitat fragmentation and human use, the most common wildlife species potentially occurring within the local study area are those tolerant of human activity. In particular, those disturbance-tolerant species are most likely to include small-sized mammals (e.g., deer mouse) and commonly occurring bird species (e.g., yellow warbler and clay-colored sparrow) that prefer deciduous woodland or shrubby habitats. The manicured areas in the study area are expected to be used primarily for foraging by species that are highly habituated to human disturbance (e.g., black-billed magpie). Large-, medium-, and small-sized wildlife species that are less tolerant of disturbance may be present on an irregular basis, particularly during migration (e.g., Canada warbler) or while undergoing dispersal movements (e.g., cougar).

Regional Habitat

Considering the central urban location of the proposed project, the habitat in the regional study area includes a matrix of developed areas with relatively large proportions of natural, semi-natural, and open manicured areas of vegetation. The majority of large areas of vegetated habitat, however, are located south of the North Saskatchewan River across from the local study area (Figure 5.3). There is a complex of connected parks and natural areas, including Nellie McClung Park, Henrietta Louse Edwards Park, the Muttart Conservatory grounds, Gallagher Park, and Mill Creek Ravine, the latter of which extents for several kilometers to the south. There are less natural and semi-natural areas of suitable wildlife habitat on the north side of the river on the fringes of highly developed Louise McKinney Riverfront Park located immediately northeast of the local study area. Several manicured open areas are found within the Rossdale neighbourhood to the south, but most of the regional study area north of the river is heavily developed. The northwest corner of the regional study area approaches Edmonton's downtown core, which is densely developed.

Wildlife Species Composition

Wildlife species observed or with the potential to occur in the local study area are discussed in the sections below, grouped by their broader taxonomic classifications (amphibians, reptiles, avifauna, and mammals). In the discussion, those species that would travel through the site (e.g., large mammals, overhead birds, etc.) were differentiated from those that might occupy habitat within the proposed project area. These species would be sufficiently tolerant of the surrounding land uses to remain in the area to breed or establish a territory.

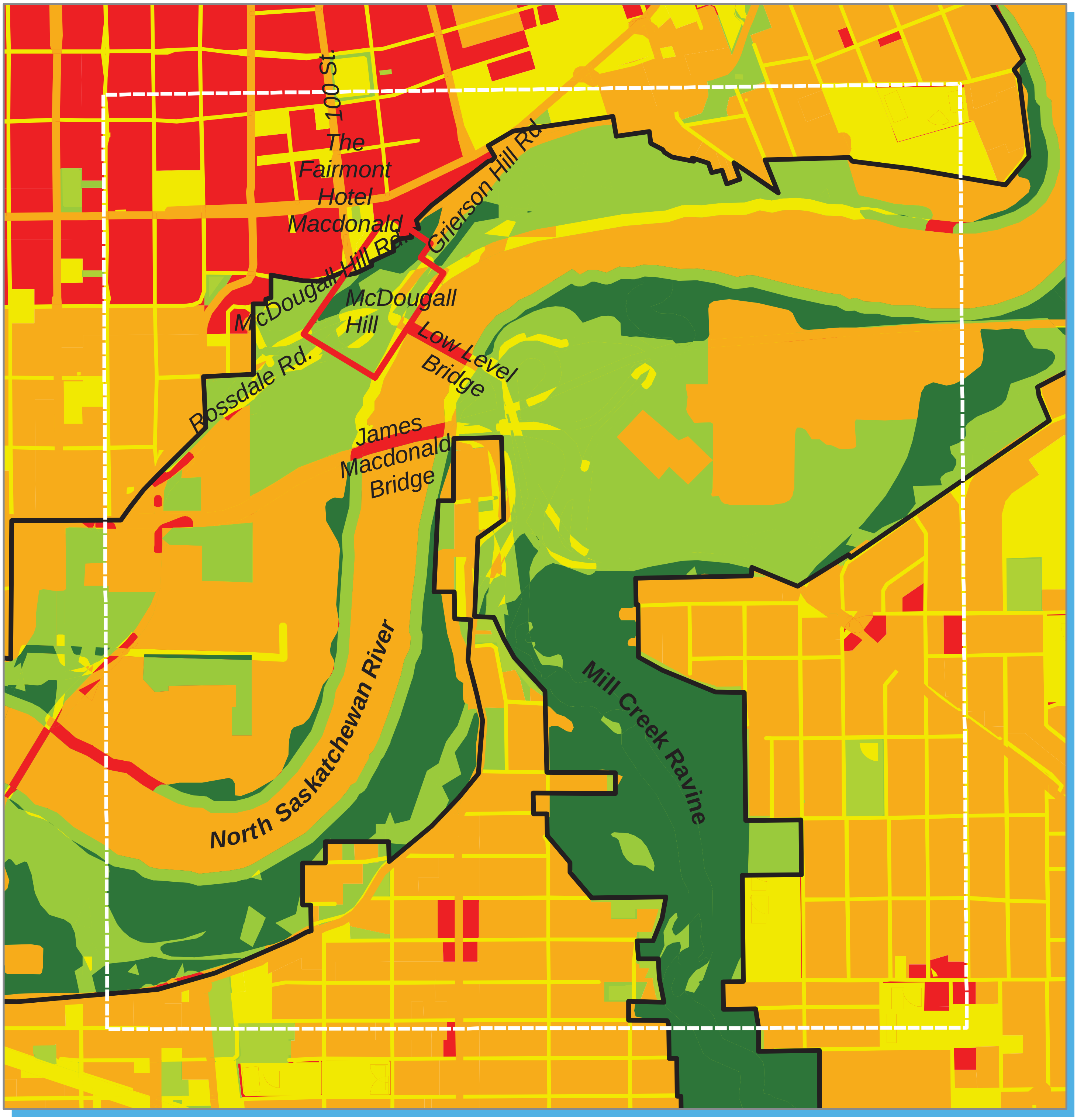

Figure 5.3 Wildlife Landscape Connectivity

River Valley Mechanized Access Project

Date Map Created: 17 November 2015

**Source: Spencer Environmental (2006)*

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Amphibians and Reptiles

Limited amphibian breeding habitat is available in the North Saskatchewan River floodplain in the local study area. The riparian woods adjacent to the river may provide suitable habitat for terrestrial post-breeding stages of some amphibian species (e.g., wood and boreal chorus frogs)(Appendix E), however, there is low potential for them to occur in the local study area as there are no suitable nearby wetland habitats present.

The steep slopes along the North Saskatchewan River Valley in the local study area are not suitable for most reptile species, however, the more level upland areas associated with river valley terraces and the river floodplain may provide habitat suitable for common garter snake (formerly called red-sided garter snake), provincially-ranked as *Sensitive* (Appendix E). Common garter snake is a resident species in the aspen parkland with broad habitat preferences, and is often found near water (Russell and Bauer 2000). All terrestrial reptiles in Alberta, including snakes, congregate in winter dens or hibernacula. Hibernacula may be naturally occurring pits or crevices in rocky outcrops, burrow, co-opted from small to medium-sized mammals, or excavated by the snakes themselves (Russell and Bauer 2000). No known hibernacula are located in the RVMA local study area.

Avifauna

Birds typically represent the largest component of vertebrate species richness in a given habitat. Based on habitat preferences, habitat conditions, and provincial distributions, 83 bird species have the potential to occur within the local study area (Appendix E). Of these potential 83 species, 13 were detected during breeding bird surveys on 18 June 2015. Supporting data from previous studies and biophysical databases confirm that an additional 5 species have been observed in or near the local study areas (Appendix E). Although the majority (68) of these bird species are known to breed in the Edmonton area, most of them are most likely to use the local study area as migrating or foraging habitat, as there is limited suitable breeding habitat in the local study area for species that are not well-adapted to human disturbance and/or that require larger expanses of native vegetation. An additional 11 species are likely to occur in the local study area only during spring and fall migration (e.g., bay-breasted warbler). Of the 83 potentially occurring bird species, 4 species breed north of Edmonton and are likely only to be present in the local study area during the winter months (e.g., common redpoll). Of the 68 potentially-breeding bird species, 17 are resident species that may be found in Edmonton year-round (e.g., common raven, blue jay).

Breeding Bird Survey Results

Of the 13 species detected during the breeding bird surveys, black-billed magpie, yellow warbler, and American robin were the most abundant species and were detected at all three transects (Table 5.3). Four species, American goldfinch, cedar waxwing, gray catbird and house sparrow (an exotic species) were observed only in the habitats surveyed along Transect 2. Three species, rock pigeon (an exotic species), dark-eyed junco and red-eyed vireo were observed only along Transect 3. Rock pigeons utilize the Low Level Bridge for nesting and roosting. No special status species were observed.

Table 5.3. Birds detected during 80 m fixed-width transect surveys, ordered by total birds detected (18 June 2015)

Species	Transect			Total Birds Detected
	1 (89 m, 1.2 ha)	2 (212 m, 2.2 ha)	3 (663 m, 3.4 ha)	
Black-billed magpie	1	4	9	14
Yellow warbler	3	5	5	13
American robin	1	3	3	7
Rock pigeon			4	4
House finch		2	1	3
American goldfinch		2		2
Cedar waxwing		2		2
Clay-colored sparrow		1	1	2
Gray catbird		2		2
Blue jay		1		1
Dark-eyed junco			1	1
House sparrow		1		1
Red-eyed vireo			1	1
Total Birds Detected	**5**	**23**	**25**	**53**
Species Richness	**3**	**10**	**8**	**13**
Density (birds/ha)	**4.1**	**10.5**	**7.4**	**7.8**

All observed bird species are relatively common and are known to be habitat generalists, utilizing a wide range of habitats. Breeding bird density across all transect areas combined was 7.8 birds/ha. Despite the different transect lengths, species richness for Transects 2 and 3 were similar with 10 and eight species, respectively. Transect 2, however, had a higher species density of 10.5 birds/ha compared to Transect 3 (7.4 birds/ha) and the highest density overall. This is likely because Transect 2 represented the least disturbed habitat (no manicured areas or roads) and a wide variety of treed, shrub and grassland habitat types. In contrast, bird density was lowest for Transect 1 (4.1 birds/ha), likely because it was the most disturbed habitat with the largest proportion of manicured areas and road surface (McDougall Hill Road). Transect 3 fell in the middle with a bird density of 7.4 birds/ha representing some disturbance due to manicured areas, a shared-use path and some roadway area (e.g., Grierson Hill Road, Low Level Bridge) in mature riparian forested habitat.

Mammals

Based on habitat preferences, habitat conditions, and provincial distributions, 30 mammal species have the potential to occur within the local study area (Appendix E). Of these, disturbance-tolerant small-sized mammals are the most likely to occur on a regular basis. For example, even in the downtown portions of Edmonton's river valley, deer mouse, red-squirrel, and snowshoe hare commonly occur in treed areas and white-tailed jack rabbit frequently use manicured open areas. Bat species that are less sensitive to disturbance (e.g., little brown bat) could roost in the balsam poplar woodland habitat in the local study area (Figure 5.1) adjacent to the river and forage over open water of the

North Saskatchewan River. The study area is less suitable for medium- and large-sized mammals due to the extensive road network that bisects it, which act as ecological barriers and reduces the size of potential habitat patches below the minimum home range size for medium- and large- mammals (e.g., 11 ha for porcupine; Stantec Consulting Ltd. 2010). These species may occupy the study area occasionally but are at much higher risk of mortality from vehicle collisions due to the number of roads that would require crossing in order to move around the study area. In addition, the steep slopes of much of the study area preclude it from use as core habitat by medium- to large-sized mammals that prefer travelling on and residing in relatively flat areas. However, highly disturbance-tolerant medium-sized mammals (e.g., coyote) likely use the local study area on a regular basis.

Special Status Species

Based on habitat requirements, habitat availability, and provincial distributions, 21 special status species have the *potential to occur* in the local study area (Appendix E). Of these, three species are addressed further because they have a moderate or high likelihood of occurrence in the local study area and are: ranked in Province’s General Status of Alberta Wild Species 2010 as *At Risk* (peregrine falcon) or *May Be At Risk* (northern bat); listed in Alberta’s *Wildlife Act* as *Threatened* (peregrine falcon); or assessed federally by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and federally listed in Schedule 1 of the *Species At Risk Act* as either *Endangered* (northern bat, little brown bat) or *Special Concern* (peregrine falcon) (Table 5.4).

This section of the report is important for the identification of key biophysical resources as required by the City’s Bylaw 7188 process, but is also important to ensure compliance with the provincial and federal conservation legislation (e.g., Alberta’s *Wildlife Act* and the federal *Species At Risk Act* and *Migratory Birds Convention Act*). When discussing listed species, the likelihood of such species occurring in the area in question and the likely duration of their stay are critical considerations for assessments related to development, as this will influence the possibility that a particular species could be affected by a project. For many of these species, the presence of available habitat does not necessarily indicate that a species will be present. For example, many special status species are listed as such because of limited distribution; therefore not all suitable habitats will be occupied. To account for this, Appendix E includes a qualitative assessment of the likelihood of a special status species occurring in the local study area (noted as low, moderate or high), based on our professional opinion arrived at by considering habitat availability at the site and on adjacent lands and specific potential habitat use by each species (e.g., potentially breeding at the site or passing through the area on migration and stopping to forage). The following section discusses special status species with a high likelihood of occurrence in the local study area; plus all Provincially-ranked *At Risk* and *May Be at Risk* species with a moderate to high likelihood of occurrence and all federally-ranked species, regardless of their provincial status, with at least a moderate likelihood of occurrence (Table 5.4). There is a total of three such species, one bird and two mammals.

Table 5.4. Special Status Species That May Occur in the Local Study Area

Common Name	Scientific Name	Provincial Status[a]	*Wildlife Act* Designation/ New Species Assessed by ESCC [b]	COSEWIC[c] Designation	SARA[d] Designation	Species Recorded in Study Area	Likelihood of Occurrence	Potential Habitat Use
Peregrine Falcon	*Falco peregrinus anatum*	At Risk	Threatened	Special Concern	Schedule 1 (Special Concern)	FWIMT	High	Foraging
Northern Bat	*Myotis septentrionalis*	May Be At Risk	Data Deficient	Endangered	Schedule 1 (Endangered)		Moderate	Breeding, foraging
Little Brown Bat	*Myotis lucifugus*	Secure		Endangered	Schedule 1 (Endangered)		Moderate	Breeding, foraging

[a] According to General Status of AB Wild Species (2010)
[b] Alberta Endangered Species Conservation Committee
[c] Federal ranking by Committee on the Status of Endangered Wildlife in Canada (COSEWIC)
[d] Federal *Species at Risk Act* designation

Fish and Wildlife Internet Mapping Tool (FWIMT)

A search of the Fish and Wildlife Internet Mapping Tool (FWIMT) on 27 January 2015 using a 1 km radius returned records of three special status species: Canadian toad, peregrine falcon, and cougar. Canadian toad and peregrine falcon are discussed in the amphibians and avifauna sections, below. Cougars, which are provincially ranked as *Sensitive,* are occasionally recorded within the North Saskatchewan River Valley while undergoing large scale dispersal movements, but are highly unlikely to remain in the study area for an extended period of time. Special status species that could remain in the study area for extended periods of time are most likely to be breeding birds that can travel easily across the study area by flying and require relatively small areas for breeding territories.

Amphibians

The Canadian toad is provincially listed as *May Be at Risk* and has previously been recorded within 1 km of the study area (AEP 2015b); however, those historical records date back almost 60 years and there is no longer any suitable Canadian toad habitat in the study area (Spencer Environmental 2015).

Avifauna

The peregrine falcon is provincially listed as *At Risk* and listed under Schedule 1 of the *Species At Risk Act* as a species of *Special Concern* because the species is recovering from near extinction due to pesticide use (AEP 2015b). Peregrine falcons prefer rocky cliffs or tall buildings in cities for nesting (White et al. 2002). Several pairs of peregrine falcons are known to have nested on tall structures near the local study area in recent years (AEP 2015b). There is, however, no suitable nesting habitat in the local study area. Peregrine falcons could likely use the air space above the local study area for foraging, therefore, the likelihood of these birds hunting in the local study area is considered high.

Mammals

Two mammal species have recently been assessed by COSEWIC and listed in Schedule 1 of the *Species At Risk Act* as *Endangered*; both species have a moderate likelihood of occurrence within the local study area. Both of these species are bats in the *Myotis* genus (northern bat and little brown bat) and have experienced extreme rates of mortality in the eastern United States due to white-nose syndrome (WNS; COSEWIC 2012a, 2012b). During the breeding season, both species of myotis occupy mid- to late-successional forests, often near water, and roost under the bark of trees or old nest cavities (Pattie and Fisher 1999). Both species are common in the Edmonton area and the treed vegetation in the local study area, particularly between Grierson Hill Road and the North Saskatchewan River may provide habitat for both species.

5.1.6 Habitat Connectivity

Open spaces, such as highly developed agriculture or urban regions and roadways can act as impediments to wildlife movement and dispersal. In such cases, wildlife corridors play a key role in wildlife dispersal because they serve as links between larger habitat areas, accommodating daily, seasonal, or dispersal movements that enable genetic exchange and access to other resources (Paquet et al. 2004). The viability of an area as a wildlife corridor is a function of the continuity in its vegetation structure, its width, the amount and type of surrounding disturbance and the quality of the habitat it connects. Major wildlife corridors provide cover and resources, connecting large areas of habitat at a regional scale. Those corridors are wide and can support a high diversity of species. Minor wildlife corridors provide only limited cover and resources, lack continuity in vegetation structure and cannot support as wide a variety of species. Wide-ranging species such as deer need functional linkages between essential habitats to satisfy all life-stage requirements including food, cover, shelter and reproduction (access to potential mates). Even smaller, but still highly-mobile animals, like songbirds, utilize such corridors to move between areas of suitable habitat. Fragmented landscapes with large open areas and extensively developed lands are barriers or deterrents to many of these species, limiting their ability to move from one habitat patch to the next.

Habitat connectivity for the proposed project was assessed within a single regional study area in order to account for the large areas required for the large home ranges that some medium- and large-sized animals require and to facilitate the discussion of the North Saskatchewan River Valley as a wildlife movement corridor (Figure 5.3). The North Saskatchewan River Valley is identified as a regional biological corridor in Edmonton’s Ecological Network (City of Edmonton 2007a). This notion is generally supported by modelling of habitat resistance to wildlife movement (Spencer Environmental 2006), although modeling also shows that the effectiveness of the river valley as a fully functioning movement corridor throughout the entire City is somewhat limited due to a combination of topography and urban development (Spencer Environmental 2006; Figure 5.3). The river itself is considered a barrier to wildlife movement during most months. This is particularly true for forest songbirds (Tremblay and St. Clair 2009); a species guild that one might expect to cross any open distance, as they do during migration. Thus, the river valley in the regional study area provides corridors on either side of the river, particularly on the south side, but not necessarily across it.

The overall difficulty for wildlife movement in the local study area itself is moderately low (Figure 5.3), but the steep slopes, presence of a complex arterial road network, and the large expanse of open river water adjacent to the local study area present major barriers for movement of wildlife in the local study area on the north side of the river. In fact, the local study area north of Grierson Hill Road may be considered a relatively small habitat patch rather than a corridor. The dense natural and semi-natural vegetation may act as food and cover for small- to medium-sized animals such as mice, weasels, hares and coyotes, however, it is not considered good quality habitat and the numbers of individuals of any of these species is expected to be relatively low. That habitat patch is not ideal for movement because of the steep slopes, its relative isolation due to the high levels of urban development in the area. The existing wooden stair also bisects the habitat patch, which experience high levels of human use, particularly during the lunch period on business days. The existing stairs may be somewhat permeable to small-animal movement, but they do represent an existing barrier on the steep slope. In addition, there is a well-established homeless camp in the local study area, which likely deters animals, even urban-adapted species, from using the habitat in that area.

In contrast, the continuous natural vegetation along the river bank under the existing Low Level and James MacDonald bridges likely provides the most valuable habitat connectivity for regional wildlife movements within the regional study area north of the river, but overall regional study area wildlife use and movement on the north bank near the proposed project area is likely significantly lower than wildlife use and movement on the south side of the river. Specifically, the best habitat connectivity in the regional study area is located south of the river and associated with Mill Creek Ravine and the adjacent parks complex. Wildlife movement in that area south of the river is expected to be much less difficult (Spencer Environmental 2006; Figure 5.3).

5.2 Valued Socio-Economic Components

5.2.1 Land Disposition and Zoning

5.2.1.1 Methods

Current land use was determined through review of land use maps, land ownership maps, City of Edmonton Zoning Bylaw maps (City of Edmonton Zoning Bylaw 12800), air photos and observations collected during field investigations. Further context was provided by assessing proximity of the project area to the North Saskatchewan River Valley Floodplain through review of the City's flood protection overlay (City of Edmonton 2015c).

5.2.1.2 Description

Most of the proposed RVMA project will take place on City-owned lands within the North Saskatchewan River Valley. The exception is the land required for the 100 Street promontory immediately adjacent to the Fairmont Hotel Macdonald. In order to avoid utility conflicts to the west, the City of Edmonton has negotiated a land use agreement with the Fairmont Hotel Macdonald to permit encroachment of the promontory on the southwest edge of hotel lands.

The proposed project area will be situated on the north side of the North Saskatchewan River, within the Central Area of the North Saskatchewan River Valley, as designated in Bylaw 7188 (City of Edmonton 2014). The Central Area is characterized by developed parkland, residential, institutional and transportation infrastructure with limited undisturbed natural vegetation (City of Edmonton 2014).

Current zoning reflects types of recreational uses within the river valley in that area (Figure 5.4). The area near 100 Street and McDougall Hill Road near the top-of-bank is zoned as a public park (AP), while much of McDougall Hill is zoned for metropolitan recreation (A). The purpose of the public park zone is to provide an area for active and passive recreation, while the purpose of the metropolitan recreation area is to preserve natural areas and parkland along the river and to provide opportunities for active and passive recreation uses, in keeping with Bylaw 7188 (City of Edmonton 2010c). The terminus of the proposed pedestrian bridge over Grierson Hill Road will be located in an area zoned as a river valley activity node (AN), a zone that extends from Louise McKinney Riverfront Park. The river valley activity node zone permits limited commercial development within designated areas of parkland to promote active and passive recreation and tourism, while conforming to Bylaw 7188 (City of Edmonton 2010c).

5.2.2 Residential Land Use

5.2.2.1 Methods

Residential land use was described from the City of Edmonton Wards and Standard Neighbourhoods map (City of Edmonton 2007b), as well as from observations during site visits.

5.2.2.2 Description

The proposed RVMA project will be located within the North Saskatchewan River Valley on the south edge of the Downtown neighbourhood. There are no private residences in the immediate vicinity of the proposed project area; the nearest private residences are located approximately 300 m to the west in two apartment buildings (Renaissance Place and Park Square) on McDougall Hill Road and several houses in the Rossdale neighbourhood approximately 700 m south of the proposed project area, south of 97 Avenue.

5.2.3 Recreational Land Use

5.2.3.1 Methods

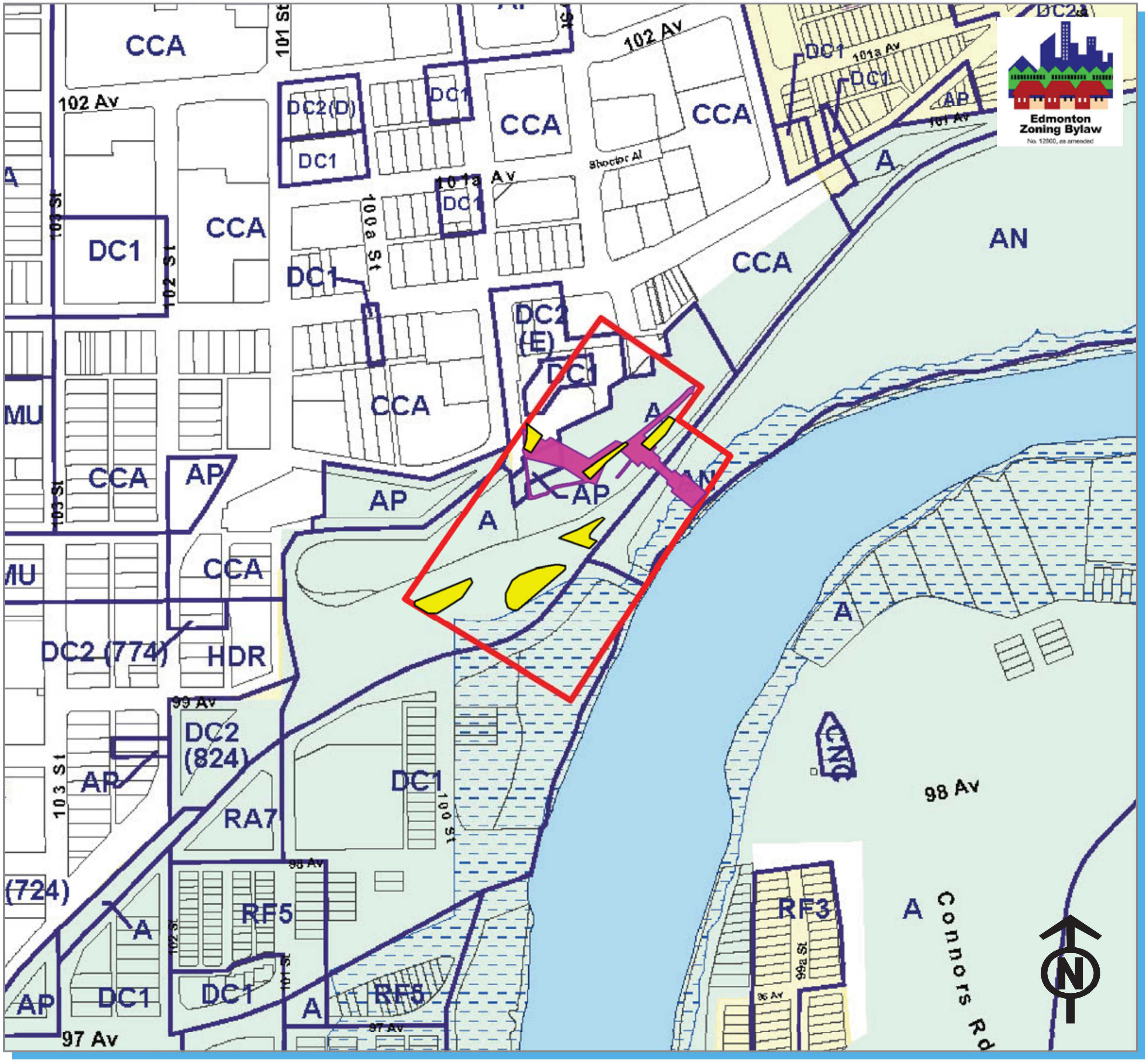
Recreational land use within the local study area was determined by reviewing the City of Edmonton River Valley and Recreation website and by observation during site visits.

5.2.3.2 Description

The proposed RVMA project area is connected to a variety of existing recreational areas in the North Saskatchewan River Valley that support numerous recreational amenities

Figure 5.4
Proposed River Valley Mechanized Access Zoning and Floodplain

River Valley Mechanized Access Project



0 50 100 200 Meters

1:6,000

**Source: Zoning Bylaw, City of Edmonton (Accessed September 2015)*

Legend

- 🟥 Local Study Area
- 🟪 Disturbance Limits
- 🟨 Potential Laydown/Staging Locations

- City Boundary
- RFI Zoning Label
- Zoning Line

Overlays
- North Saskatchewan River Valley & Ravine System Protection Overlay
- Flood Plain Overlay
- Mature Neighbourhood / Medium Scale Residential Infill Overlays
- Medium Density Residential Overlay
- High Rise Residential Overlay
- Major Commercial Corridors Overlay
- Pedestrian Commercial Shopping Street Overlay
- Alberta Avenue Pedestrian Commercial Shopping Street Overlay
- Major and Minor Secondhand Stores Overlay
- Whyte Avenue Commercial Overlay
- Edmonton-Strathcona County Joint Planning Study Area Secondary and Garage Suites Overlay

Date Map Created: 17 November 2015

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(Figure 5.5). Rossdale Parks 1 and 2, McDougall Park and Louise McKinney Riverfront Park are all located in close proximity to the proposed project area, providing green space and recreational amenities. The existing wooden stair on McDougall Hill is well-used by recreationalists as well as pedestrian and cyclist commuters. A recent week-long ridership study found that usage of the stair peaked over the lunch hour, with approximately 100 users in each direction (DIALOG 2015b).

The existing stair connects sidewalks at the top-of-bank to the river valley trail system; however, this access currently includes crossing two busy arterial roads. Paved and granular shared-use paths that make up the river valley trail system are located within the study area and are used for cycling, running, dog walking and cross-country skiing (Spencer Environmental 2012). At the top-of-bank, the Heritage Trail, indicated by red paving stones, extends from the Fairmont Hotel Macdonald in the east to the Alberta Legislature in the west (Alberta Culture and Tourism 2004; Edmonton Downtown Business Association 2015). This trail follows the approximate path from the Hudson’s Bay Company Fort to the village of Edmonton and passes several historical sites along the route (Alberta Tourism and Culture 2004).

5.2.4 Traffic/Parking

5.2.4.1 Methods

Existing traffic, parking and access information were assessed by review of aerial photos and the City of Edmonton Transportation website, as well as by observations made during project field surveys.

5.2.4.2 Description

The proposed RVMA project area will be situated in an area of major arterial roadways connecting downtown Edmonton to the south side of the North Saskatchewan River. Those roads include McDougall Hill Road, 100 Street, Grierson Hill Road and Rossdale Road, all of which are busy commuter arterial roadways.

Due to the proximity to Edmonton’s downtown, public parking is available in several locations in close proximity to the proposed project area. Parking meters are available throughout the downtown area, and four large public parkades (City Hall, Library, Canada Place and Edmonton City Centre West) are situated in the vicinity of the project area, and together, these parkades provide over 2500 parking spaces (City of Edmonton 2015d). The nearest designated parking for river valley park users is in Louise McKinney Park, approximately 0.5 km east of the proposed project area.

The proposed project area is also easily accessed by public transit, with the Central LRT station situated approximately 200 m northwest of the proposed 100 Street promontory/upper terminus of the project area. Numerous bus routes stop on Jasper Avenue, 100 Street and at the top and bottom of McDougall Hill Road.

Figure 5.5
Proposed River Valley Mechanized Access Existing Recreational Uses
River Valley Mechanized Access Project

1:6,000

**Source: City of Edmonton Rivery Valley Trail Map (2011)*

Date Map Created: 17 November 2015

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5.2.5 Utilities

5.2.5.1 Methods

Existing utilities in the project area were assessed from information provided by the preliminary design team, aerial photos, the City of Edmonton Zoning Bylaw maps (City of Edmonton Zoning Bylaw 12800) and observations made during project field surveys.

5.2.5.2 Description

Several existing and abandoned underground utilities are situated in close proximity to the proposed project area. A storm line, water line and abandoned water line are located near the proposed 100 Street promontory. Telephone, gas and power lines are located along 100 Street at the top of the proposed project area. Power lines are located along Grierson Hill Road and McDougall Hill Road at the bottom of the proposed project area. Further west, buried communications cables and power cables run downslope along McDougall Hill.

5.2.6 Worker and Public Safety

5.2.6.1 Identification of Concerns Specific to the Project

This section does not constitute a detailed prescription of the safety measures that should be employed during project construction activities. That was considered beyond the scope of this EIA. The assumption is that the City of Edmonton RVMA project will conform to all applicable municipal, provincial and federal worker and public safety regulations and protocols. This analysis of worker and public safety considered environmental elements that might pose risks to worker and public safety, particularly those linked to identified environmental impacts or local resources. This was done by considering all of the information presented in the preceding chapters of this document to identify physical locations or activities unique to this project that might result in concerns.

5.2.6.2 Description

For the proposed project, worker and public safety concerns are most likely to arise in areas where construction activities would be located near existing public use or infrastructure, or where known safety risks had been identified by the public or regulators. The following elements were identified as having potential to result in worker or public safety concerns:

- Potential for hazards during proposed RVMA construction in areas adjacent to existing recreational use in the river valley.
- Potential for wildfires during construction activities during dry periods in proximity to natural fuel loads.
- Potential for hazards during construction in the vicinity of existing utilities.
- Potential for hazards during proposed pedestrian bridge construction over Grierson Hill Road.
- Potential for hazards during construction on steep river valley slopes.

- Potential for hazards from construction in areas likely to shelter the homeless.

5.2.7 Visual Resources

5.2.7.1 Methods

Visual resources issues identified during this EIA process concerned the temporary visual impact of construction in the North Saskatchewan River Valley and ravine system and in close proximity to adjacent residential and commercial areas, as well as the permanent visual impact of the completed and operational proposed RVMA project. Of these, the permanent features are considered to be of greatest importance. The study area comprised a variety of locations that offered nearby and distant views of the project area. Existing viewscapes were assessed during field investigations, with an emphasis on views from prominent areas, views with particular social significance and other viewscapes identified as stakeholder concerns, including views from residential areas adjacent to or overlooking the project area. Seasonal variations in viewscapes were also considered; while winter/early spring views may not offer the most attractive qualities, consideration of winter views, when deciduous tree foliage is absent, allows assessment of conditions when vegetation screening is least effective.

5.2.7.2 Description

North River Valley Slope and Bank

A prominent public vantage point overlooking the North Saskatchewan River Valley to the south is located at the top-of-bank at 100 Street and McDougall Hill Road. A small plaza is located at the top of the existing wooden stair and aesthetically links the downtown urban environment with the natural environment of the river valley. This lookout point, situated at the top of a steep slope and above the shrubby growth on McDougall Hill, offers predominantly unscreened views of the North Saskatchewan River and river valley and the south river bank in all directions (Plate 5.13).

Plate 5.13. View to the south from the plaza at the top of the existing wooden stair at 100 Street and McDougall Hill (5 October 2015)

Drivers and passengers travelling along many of the roadways in the area, particularly traveling either north or south on McDougall Hill Road, also have partial views of the river valley, especially from the top of McDougall Hill Road. Views are screened in the summer due to dense shrubbery adjacent to the road, while in winter, the views are relatively more open.

Private vantage points, including the Fairmont Hotel Macdonald and nearby apartment buildings, offer similar views from the north side of the river. The Fairmont Hotel Macdonald grounds and south-facing rooms overlooking the North Saskatchewan River Valley offer unrestricted views year-round of the river valley in all directions. While the undeveloped slope below the hotel contributes to viewers' experiences of that natural state of the river valley, the steepness of the slope emphasizes distant views over near views of the slope itself. Two apartment buildings (Renaissance Place and Park Square) are located west of the proposed project area; east-facing units have downstream river valley views encompassing both the north and south banks of the river, including McDougall Hill. Due to their vantage point, the views from those apartment buildings are relatively uninterrupted, although they encompass developed components of the river valley and adjacent lands, including major roadways and Edmonton's downtown.

Terraces at the Shaw Conference Centre provide distant, densely screened views of downtown Edmonton and the upper portions of McDougall Hill; much of McDougall Hill is screened due to the viewing angle, as well as existing vegetation and infrastructure (Plate 5.14). Existing river valley trails connecting the Shaw Conference Centre and Louise McKinney Park and the Low Level Bridge are situated below Grierson Hill Road in dense vegetation. Due to the steepness and dense vegetation of adjacent slopes, recreationalists using the paths have minimal views of the river and upper portions of the slope.

Plate 5.14. View to the west from the Shaw Conference Centre terrace above Grierson Hill Road (5 October 2015)

North Saskatchewan River

Recreationalists on the North Saskatchewan River have uninterrupted 360° views of the river valley. Views include the river, adjacent park sites, forest areas, and the downtown skyline. In addition to recreational boaters, the Edmonton Queen riverboat, which is moored at Rafter's Landing in Henrietta Muir Edwards Park and cruises the river in central Edmonton, offers unrestricted views of the river valley and downtown (Plate 5.15).


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Plate 5.15. View to the west from Rafter's Landing at the Edmonton Queen mooring site (5 October 2015)

South River Bank

The shared-use paths on the south side of the river in Henrietta Muir Edwards Park have minimal views of the river and the north bank, due to dense surrounding vegetation; however, narrower informal trails, situated nearer to the river, provide partially screened views (Plate 5.16). Similarly, informal trails northeast (downstream) of Nellie McClung Park provide partially screened views of the river and the north bank, including downtown Edmonton (Plate 5.17)

Plate 5.16. View to the northwest from an informal trail in Henrietta Muir Edwards Park (5 October 2015)

Plate 5.17. View to the north from a lookout point north of Nellie McClung Park (5 October 2015)

At a greater distance from the proposed project area, vantage points on Cloverdale Road and Strathearn Drive provide unrestricted year-round views of the river valley, encompassing some of the iconic views of downtown Edmonton, including the Muttart Conservatory, the Fairmont Hotel Macdonald and Canada Place (Plate 5.18)

Plate 5.18. View to the north from the top-of-bank at Strathearn Drive (5 October 2015)

5.3 Valued Historic Components

5.3.1 Historical Resources

5.3.1.1 Methods

Altamira Consulting Ltd. (Altamira) previously undertook a Historical Resources Overview (HRO) in 2011 in support of another City of Edmonton project in the project area (Spencer Environmental 2011). More recently, Turtle Island Cultural Resource Management Inc. (Turtle Island) undertook a Historical Resources Statement of Justification (SoJ) in December 2014 in support of the proposed RVMA project (Turtle Island 2014). The SoJ was submitted to Alberta's Ministry of Culture and Community Spirit (now called Ministry of Culture and Tourism), Historical Resource Management Branch (HRMB) for the department's review and comment regarding possible requirements pursuant to the *Historical Resources Act*. HRMB determined in March 2015 that an Historical Resources Impact Assessment (HRIA) was required and issued Schedule A, identifying their requirements for the HRIA (Appendix F).

Specifically, requirements identified in Schedule A included archaeological monitoring in tandem with preliminary design, with targeted deep testing. Schedule A states that the HRIA is to be carried out prior to land surface disturbance during snow-free, unfrozen conditions (Appendix F). In addition, the relationship between the proposed project footprint and a previously identified archaeological site nearby was to be determined.

In conjunction with the geotechnical investigation, Turtle Island subsequently undertook fieldwork in support of an HRIA on 15 April and 13 May 2015, under frost-free, snow-free conditions (Turtle Island 2015). Field inspections consisted of pedestrian traverse, visual examination of target areas, monitoring of geotechnical bores and judgmental shovel tests, as well as review of archival photos to determine the relationship between the proposed development to known cultural resources (Turtle Island 2015). Shovel tests extended to depths between 45 and 70 cm below the surface.

In addition to the HRIA, Schedule A stated that a Paleontological Historical Resources Impact Assessment (pHRIA) was required; the pHRIA, however, was to consist of a monitoring program throughout the construction period. No excavations were to take place until a professional paleontological consultant was on-site to monitor the excavation work.

5.3.1.2 Description

Two geotechnical boreholes were monitored for historical resources, and a total of nine shovel tests were conducted over the project area. None of the boreholes or shovel tests was positive for cultural material (Turtle Island 2015). During their site investigation, Turtle Island (2015) confirmed the location of one previously identified archaeological site along the north bank of the North Saskatchewan River. It was determined that this site is outside the footprint of the proposed RVMA project and would not be impacted by project activities (Turtle Island 2015).

Turtle Island concluded in their HRIA that there are no historic sites in conflict with the proposed RVMA project and, therefore, any concern for further work is not warranted (Turtle Island 2015). The project area is considered to display little or no historical resource value. Turtle Island has submitted their HRIA report to HRMB for their review pursuant to the *Historical Resources Act*.

As construction on the proposed RVMA project has not yet begun, monitoring pursuant to the pHRIA requirements has also not yet been undertaken. Consequently, there is currently no project-specific information on paleontological resources in the proposed project area. Monitoring will be undertaken by a professional paleontological consultant during all excavations during construction, and any paleontological resources encountered will be reported.

6.0 POTENTIAL IMPACTS AND MITIGATION MEASURES

Interactions between specific project activities during the site preparation, construction and operation/maintenance phases of the project and the identified VECs are summarized in Table 6.1. The following sections describe those interactions that have potential to result in an impact.

Ideally, impact analysis begins in the planning stages of a project so that potential impacts that can be mitigated through project design are addressed where possible. Potential impacts were identified based on preliminary design-level information. The successful contractor will utilize the mitigation measures identified in this environmental assessment during construction to minimize environmental impacts.

Impacts to VECs are discussed in terms of the project stages during which they would occur (e.g., construction, operation) because different impacts occur during different project stages.

Table 6.1. VEC/Project Activity Interaction Matrix

			Site Preparation						RVMA Construction					Demolition	Reclamation		Operation	
			Establishment of staging/laydown areas and access routes	Removal of existing lookout elements at 100 Street and existing wood platform and fence	Clear and/or hoard and otherwise protect trees/shrubs in construction areas	Utility, decommission and protection	Establish road, transit and SUP closures and detours	Install temporary erosion & sediment controls	Excavation and foundation construction	Construction of funicular, urban and express stairs and associated elements	Construction of promenade, pedestrian bridge and associated elements	Construction of cantilevered lookout, elevator and wooden stair and associated elements	Utility re-establishment	Wooden stair removal, site recontouring, landscaping	Site regrading, revegetation (landscaping)	Install permanent erosion & sedimentation controls	RVMA infrastructure operation	Maintenance
Valued Environmental Components	Valued Ecosystem Components	Geotechnical/Soils	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Hydrology/Surface Water Quality/ Groundwater	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Air Quality	✓						✓	✓	✓	✓		✓				
		Vegetation	✓		✓				✓	✓	✓	✓		✓	✓			✓
		Wildlife	✓		✓				✓	✓	✓	✓		✓	✓			
		Habitat Connectivity	✓		✓					✓	✓	✓		✓	✓		✓	
		Fish and Aquatic Resources						✓								✓		
	Valued Social Components	Land Disposition and Zoning							✓	✓							✓	
		Residential Land Use					✓										✓	
		Recreational Land Use	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓			✓	✓
		Traffic/Parking	✓				✓				✓	✓					✓	✓
		Utilities	✓			✓			✓	✓	✓	✓	✓					
		Worker and Public Safety	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓			✓	✓
		Visual Resources	✓	✓	✓				✓	✓	✓	✓			✓		✓	✓
	Valued Historical Components	Historic Resources							✓	✓	✓	✓	✓					

6.1 Valued Ecosystem Components

6.1.1 Geotechnical/Soils

Potential impacts related to geotechnical resources and soils include:

- compromised slope stability from proposed project construction and operation,
- soil erosion,
- loss and mixing of topsoil,
- compaction of soils by heavy equipment, and
- accidental spills of hazardous materials near or on unpaved surfaces, resulting in soil contamination.

A detailed analysis of each impact follows below and is summarized in Table 6.2.

6.1.1.1 Slope Stability

Impact

The majority of the project area is located on McDougall Hill, on the north side of the North Saskatchewan River, below 100 Street and extending to below Grierson Hill Road. The entire project will be constructed at or below the top-of-bank of the north valley slope, on the river valley slopes. The slope at this location ranges from 1H:1V to 2H:1V, and despite the steepness, it appears relatively stable over the course of recent monitoring (Thurber 2015b; Appendix C). Previous deep slope movement has been reported in this area in historic (1967) studies; however, recent geotechnical work indicates no significant movement of the slopes over the past four years (Thurber 2015b, c; Appendix C). Thurber recommended a factor of safety of 1.5 to ensure the long-term stability of slopes with structures built on them, while a factor of safety of 1.3 may be considered acceptable with additional monitoring (Thurber 2015b; Appendix C). Thurber (2015) determined that some of the slopes surrounding the proposed project area were characterized by a factor of safety of 1.3 and, thus, recommended a comprehensive slope monitoring program to assess slope stability during construction and operation (Thurber 2015b; Appendix C). Based on this information, the impact to slope stability is rated as adverse, major, short- to long-term and predictable.

Mitigation Measures and Residual Impact

Although the slope is currently considered relatively stable and there is no clear evidence of recent distress or instability, Thurber (2015c) noted that construction on this slope will present several challenges that will require an experienced contractor and, potentially, specialized equipment to ensure the long-term stability of the river valley slope. The proposed project alignment is preferred from a geotechnical perspective, as the upper portions of the stairs and funicular proceed across the slope as they descend, resulting in a less steep structure (Thurber 2015c).

Due to signs of past instability, Thurber recommended that stockpiling of excavated material along the slope should not be allowed, and the addition of fill for grading improvement should be kept to a minimum (Thurber 2015c). Thurber (2015b; Appendix

C) also recommended that a comprehensive slope monitoring program be undertaken for the project area, with a particular focus on areas where the factor of safety is 1.3 or less. Monitoring should continue through design, construction and operation to assess both short- and long-term movements (Thurber 2015a). To that end, DIALOG and Graham have agreed to a slope monitoring program, including the installation of additional slope inclinometers to properly monitor the performance of the slopes in the direct vicinity of the project site. It is planned to install these instruments in early 2016 (Thurber 2015d; Appendix C). Thurber also recommended that quality control inspections by qualified geotechnical personnel during project construction, particularly during foundation installation, be conducted (Thurber 2015b; Appendix C). Accordingly, the contractor plans on having Thurber remain fully engaged throughout the design and construction process to ensure that construction activities will not adversely affect the identified moderately stable slopes (Thurber 2015d; Appendix C). Overall, Thurber is satisfied that the construction methods should not significantly impact the overall slope stability.

Potential slope stability issues at this location have been comprehensively assessed and discussed in consultation with Thurber and have been resolved to the extent possible through project design and construction planning. Careful monitoring during construction and periodic monitoring during operation will be conducted to satisfy concerns regarding the moderately stable slopes. The potential impact rating for the north valley slope remains adverse, major, short- to long-term and predictable.

6.1.1.2 Soil Erosion

Impact

In areas where existing vegetation cover is cleared, exposed soils, particularly fine-textured soils, would likely be vulnerable to water and wind erosion. Fine-textured soil types are more sensitive to wind and water erosion than coarse-textured soil types, particularly if they are located on steep slopes. Soils on permanent slopes (e.g., McDougall Hill) and temporary slopes (e.g., soil stockpiles) are particularly susceptible to erosion as a result of surface runoff. The proposed RVMA project will be situated on relatively steep slopes, where soils have the potential to be eroded from surface water flow downslope toward the North Saskatchewan River. If eroded materials are transported as sediment into the river, soil erosion could have adverse secondary impacts on water quality and aquatic habitat. Impacts of wind and water erosion on soils and soil stability are rated as adverse, minor to major, short-term and predictable.

Mitigation Measures and Residual Impact

Temporary and permanent erosion and sediment control measures, as detailed in the City of Edmonton's *Erosion and Sediment Control Guidelines* (2005) will be implemented during project construction. The contractor will develop and implement a site-specific Erosion and Sediment Control (ESC) Plan; all related monitoring will be undertaken by a Certified Professional in Erosion and Sediment Control (CPESC) or equivalent.

Any stockpiled soils that are susceptible to wind erosion will be stabilized as soon as possible and no later than one week after stockpiling. Following soil replacement and grading, ESCs will involve hydroseeding, erosion netting, silt fences, etc., depending on the slope and location, until vegetative cover becomes re-established. Disturbed areas will be restored to original condition with suitable topsoil and reseeded with an appropriate seed mix and/or planted with appropriate species as soon as possible after construction. Permanent erosion and sedimentation control features will remain. All mitigation measures will be inspected and maintained until vegetation cover is established.

Monitoring both erosion and sedimentation control measures and progress of revegetation will further minimize impacts. Considering these measures, the potential for loss of soils due to wind and water erosion within the project area will be negligible over the short- and long-terms.

6.1.1.3 Loss of Topsoil or Subsoil Mixing

Impact

Topsoil conservation is an important aspect of any work requiring clearing or earthworks. Loss or degradation of topsoil through mixing with subsoils can result in reduced soil fertility and subsequently reclamation capability. The objective of soils management for this project will be to maintain the current capability of soils in the project area, primarily by minimizing disturbance and reclaiming disturbed areas. This will involve minimizing the land area that will be affected by construction, or used for equipment storage and maintenance.

For many soil units in the project area, the transition from topsoil to subsoil layers is evident from colour or textural change; thus salvage depth can be easily determined in the field. In other soil units, the transition is less distinct and there is potential for the topsoil and subsoils to become mixed, thereby affecting the original soil characteristics and soil fertility. In addition, if there are differences in textures between topsoils and subsoils, mixing can cause adverse effects on soil drainage and compactability.

Topsoil and subsoil will be stripped and stockpiled separately for later use in site reclamation. A soil scientist or contractor experienced/trained in identifying soil horizons will be present on-site when stripping topsoil to ensure appropriate salvage depths are determined in areas where the transition to subsoil is unclear and the area involved is large. Such precautions will help reduce the potential for mixing of topsoil and subsoil layers and the impacts of construction on topsoil quantity and quality would be negligible.

Mitigation Measures and Residual Impact

Stripping and stockpiling mineral soils as indicated above will take place under the guidance of a qualified soil scientist or experienced contractor. Using the soils for reclamation efforts within the area after construction completion will ensure the impact remains negligible.

6.1.1.4 Topsoil and Subsoil Compaction

Impact

Compaction could occur on subsoils and fine topsoils where heavy equipment will be operating after grading and placement of soils during reclamation. The potential impact will be a slower rate of plant regeneration, or, more generally, a reduced capability for effective reclamation. Local drainage patterns can also be modified if compaction occurs such that pre-existing terrain contours are changed; changes to drainage patterns could further affect soil erosion, especially on unstable slopes on the north side of the North Saskatchewan River in the project area. The impact of soil compaction is rated as adverse, minor to major, long-term and predictable.

Mitigation Measures and Residual Impact

Disturbed slopes will be graded so that pre-existing contours are restored in the reclaimed site to effectively maintain existing drainage. Subsoils will be ripped and fine topsoils will be disked after they are replaced in reclaimed areas to reduce compaction effects. This will also ensure that drainage is maintained. With these measures, the residual impact will be negligible.

6.1.1.5 Soil Contamination

Accidental Spills of Hazardous Materials

Impact

Fuels or lubricants spilled over soils at staging areas during equipment maintenance or refueling, when stored on-site or in the event of an accident on-site (e.g., leaking hydraulic hose), can cause localized soil contamination. If spills are large, there is potential for the material to spread over a larger area, placing the North Saskatchewan River at risk in some locations and raising the possibility of contamination. Fuels and other hazardous chemicals will be stored a minimum of 100 m from the North Saskatchewan River in a protected location with secondary containment to reduce spill potential. Refueling will also take place a minimum of 100 m from all water bodies. Equipment may be serviced by mobile refueling equipment, provided they adhere to the distance restriction described above. Only minor equipment repairs will be completed in the field; major repairs will take place at a central location, such as a staging area, or off-site. Curbside catch basins will be hoarded appropriately to avoid hazardous material entering the stormwater system. Wherever possible, biodegradable oils and lubricants will be used in equipment. Excess paving and concrete materials will be handled and disposed of appropriately, and concrete vehicles will not be washed on-site. Accidental spills from equipment working on-site will be handled by following provincial BMPs and codes of practice. If standard operating practices are followed, little potential exists for large spills; however, should one occur, the spill will be contained and disposed of following provincial guidelines. Based on the application of these standard BMPs, the potential for hazardous material spills is rated as negligible.

Mitigation Measures and Residual Impact

Spill kits will be carried on equipment or stored at nearby work locations and all personnel will be trained to respond appropriately to a spill. The contractor will develop and implement an Environmental Construction Operations (ECO) Plan, including a spill protection plan, to ensure any spills are quickly and effectively cleaned up, and spills of a certain size will be reported as required by the Alberta *Environmental Protection and Enhancement Act* (*EPEA*). All contaminated soils and used absorbent materials will be disposed of at an approved industrial waste disposal facility. Such measures will reduce the ability for a spill to spread and increase the efficiency of a clean-up. The residual impact remains, as originally assessed, negligible.

Improper Handling of Existing Contaminated Soils

Impact

As with any construction project in close proximity to already developed areas, there is also some potential for existing soil contamination to be encountered during construction activities. No known contaminated sites are located within the project area (AEP 2015e), however, there remains some potential for unknown contaminated sites to be encountered. In such an event, contaminated soils would require proper handling and management measures. Should contaminated soils be encountered and should they be managed improperly, contaminated soils could spread or could otherwise further exacerbate an existing problem. Unmitigated, the improper handling of contaminated soils would be an adverse, minor, short-term and uncertain impact.

Mitigation Measures and Residual Impact

Regarding the potential to encounter existing soil contamination, a Phase 1 Environmental Site Assessment (ESA) will completed to the satisfaction of the City of Edmonton’s Energy, Environment and Coordination Unit (EEC) by the proponent. Once complete, the Phase 1 ESA must be submitted to the EEC for approval. All recommendations and mitigation measures outlined by the Phase 1 ESA, or outlined in any subsequent investigations, must be implemented during construction and operation, as required. Compliance with all recommendations and mitigation measures should result in a residual impact rating of negligible.

Table 6.2. Summary of Impacts and Mitigation for Geotechnical and Soils

Impact Description	Impact Characteristics	Mitigation Measures	Residual Impact Characteristics
Potential for slope instability from project activities	Adverse, major, short- to long-term, predictable	• Manage surface water flows to minimize overland flow downslope • Minimize vegetation clearing on steep riverbank slopes and ensure disturbed areas are revegetated	Adverse, major, short- to long-term, predictable

Impact Description	Impact Characteristics	Mitigation Measures	Residual Impact Characteristics
		• Avoid stockpiling excavated soil on the slope • Engage geotechnical personnel during construction and carefully monitor the stability of the slope	
Soil erosion	Adverse, minor to major, short-term, predictable	• Follow City of Edmonton Erosion and Sediment Control Guidelines • Stockpiled soils will be stabilized as soon as possible and no later than one week after stockpiling • Develop site-specific ESC Plan • Conduct ESC monitoring with CPESC or equivalent • Temporary erosion control measures will remain in place until vegetation is established • Hoard all catch basins as appropriate • Following construction, stabilize exposed soils by planting with approved plantings and seed mixtures • Monitor erosion control and revegetation • Monitor disturbed areas adjacent to the river	Negligible
Topsoil and subsoil mixing	Negligible	• Topsoil and subsoil will be stockpiled separately • Soil scientist or experienced contractor to ensure that appropriate salvage depths are determined • Soil will be used for reclamation within the project area	Negligible
Topsoil and subsoil	Adverse, minor to	• Disturbed areas will be	Negligible

Impact Description	Impact Characteristics	Mitigation Measures	Residual Impact Characteristics
compaction	major, long-term, predictable	graded to pre-existing contours to maintain existing drainage • Subsoils will be ripped and fine topsoils will be disked to reduce compaction • Ensure geotechnical stability and site-specific erosion control are maintained consistent with overall drainage patterns	
Soil contamination – Accidental spill of hazardous materials	Negligible	• Fuel and hazardous materials will be stored 100 m from any water body • Refueling will occur 100 m from any water body • Curbside catch basins will be hoarded appropriately • Biodegradable oils and lubricants will be used in equipment whenever possible • Excess paving and concrete material will be properly handled, disposed of and/or recycled • Concrete vehicles will not be washed on-site • Spill kits will be carried and all personnel will be trained in spill kit use and immediate response. • Ensure an ECO plan, including an emergency spill response, is in place • Collect and dispose of all contaminated soil and used absorbent materials at an approved industrial waste disposal facility	Negligible
Soil contamination – Improper handling of existing	Adverse, minor, short-term, uncertain	• Complete Phase 1 ESA • Implement all recommendations and	Negligible

Impact Description	Impact Characteristics	Mitigation Measures	Residual Impact Characteristics
contaminated soils		mitigation measures of the Phase 1 ESA or subsequent investigations	

6.1.2 Hydrology/Surface Water Quality/Groundwater

Potential impacts to hydrology and surface water include:

- release of sediments to the North Saskatchewan River from construction activities,
- accidental release of hazardous materials (fuel, oil or lubricants) used during construction into the North Saskatchewan River,
- changes to surface drainage patterns/volumes, and
- occasional flooding of some project components due to location in North Saskatchewan River floodplain.

A detailed analysis of each impact follows below and is summarized in Table 6.3.

6.1.2.1 Sediment Release

Impact

Construction of the proposed project will take place on the steep north river valley slope and lower river terrace of the North Saskatchewan River, below the designated top-of-bank and below Grierson Hill Road. As a result, there is a possibility of some sediment generated from construction activities entering the North Saskatchewan River and affecting water quality in the short term. In particular, depending on the location of construction, staging areas and soil stockpiles, it is possible that sediment could be transported to the river from runoff during wet conditions. Where possible, staging areas will not be located in close proximity to the river or near the crest of steep slopes. If construction activities and soil stockpile sites must be located near the North Saskatchewan River and there is potential for sediment transport in those areas, then appropriate short-term erosion and sedimentation control measures will be used. These measures will limit the potential release of eroded sediment into the North Saskatchewan River. Considering these measures, the potential for erosion, sediment release and sedimentation impacts will be negligible.

Mitigation Measures and Residual Impact

Surface water quality characteristics of the North Saskatchewan River will be maintained using erosion and sedimentation controls. The contractor will develop and implement an Environmental Construction Operations Plan (ECO Plan). A site-specific Erosion and Sediment Control (ESC) Plan, pursuant to the City's Enviso program, will be developed and implemented; all related monitoring will be undertaken by a Certified Professional in Erosion and Sediment Control (CPESC) or equivalent. Temporary and permanent erosion control measure, as described in the *Erosion and Sediment Control Guidelines* (City of Edmonton 2005) will be employed during the project.

Stockpiled soils that are susceptible to wind erosion will be stabilized (e.g., tackifier, erosion netting, hydroseeding) as soon as possible and no later than one week after stockpiling. Disturbed areas will be restored to original condition with appropriate topsoil and reseeded or planted with species approved by the City of Edmonton Parks Department, as soon as possible after construction. With these measures in place, the residual impact will remain negligible.

6.1.2.1 Introduction of Deleterious Substances during Construction

Impact

Fuels, oils and lubricants used in construction equipment can degrade aquatic habitat or harm aquatic species if they ever reach the North Saskatchewan River. The federal *Fisheries Act* prohibits the introduction of deleterious substances to fish-bearing waters. Further, a recent amendment of the *Migratory Birds Convention Act* prohibits the release of deleterious substances into waters frequented by migratory birds. Refueling or maintenance of construction equipment will not be permitted within 100 m of the North Saskatchewan River. Equipment operating near the river will have spill kits on hand or nearby in the work area so that accidental release of such material can be quickly and effectively controlled. All personnel will be trained to respond to a spill quickly and effectively. As a result, the potential for accidental release would be minimal. Little potential exists for large spills with these standard operating procedures in place; however, should one occur, it will be contained and disposed of following provincial guidelines. Potential for hazardous materials spills is, therefore, negligible.

Mitigation Measures and Residual Impact

No mitigation measures are required other than following standard operating procedures and provincial hazardous materials spill regulations. Spill kits will be carried on equipment and stored at nearby work locations, and all personnel will be trained to respond appropriately to a spill. The residual impact will remain negligible.

6.1.2.1 Changes to Surface Drainage Patterns/Volumes

Impact

The establishment of proposed RVMA infrastructure in the project area is expected to result in changes to surface drainage patterns as a result of some vegetation removal, slope re-grading and the introduction of new hard-surface infrastructure that will increase impermeable surfaces in the study area. Currently surface water on McDougall Hill naturally infiltrates into the vegetated slope or flows downslope as runoff towards Grierson Hill Road where it enters the City’s storm sewer system. Similarly, surface water flows on the slope south of Grierson Hill Road naturally infiltrates into existing vegetated areas.

During operation, surface drainage patterns will be altered as a result of the construction of project components that will increase impermeable surfaces in the study area. This will result in increased surface runoff, creating the potential to overwhelm existing municipal drainage infrastructure, if not managed adequately, and have the potential to cause erosion and sedimentation on steep slopes in the area. Drainage systems have, therefore, been designed not to overwhelm existing drainage infrastructure, via the use of LID elements such as a vegetated swale (Appendix A). That swale will contain a buried “French drain” to collect and remove the surface water collected by the swale. The swale and the drain will sit on an impermeable layer to manage the potential for water to migrate through the slope and saturate the ground immediately below the swale. The swale drain will be connected to outfall pipes along its length to allow the collected flow to daylight below the promenade structure and help mitigate the build-up of groundwater behind the promenade north supporting wall as well as allow surface water flows to infiltrate into the vegetated slope, thereby slow and minimize runoff into the municipal storm sewer system. A toe drain will also be supplied at the promenade north support wall to manage the natural flow of water that does locally occur.

The pedestrian bridge and lookout will have conventional deck drainage with surface water collected along a curb at the edge of the walking surface. Planted areas will absorb rainfall and not contribute to surface runoff. Surface water flows will be collected at the top of the elevator stairs and fed to the collection drain at the deck gradient break point on the north side of the elevator. The flow intercepted at this location will be fed back to the drainage points alongside the pier adjacent to Grierson Hill.

Despite these measures, new infrastructure with impermeable hard surfaces is being introduced into an otherwise naturally vegetated area. Consequently, surface water flows will become more concentrated in some areas compared to existing conditions and there will be some increased runoff into the City’s storm sewer system, which is already at capacity. Impacts to surface drainage patterns and volumes are, therefore, ranked as adverse, minor, permanent and predictable.

Mitigation Measures and Residual Impacts

During detailed design, the proponent should confirm permanent project drainage requirements with City of Edmonton Drainage Services to minimize an adverse effect on the existing storm sewer system. Residual impacts remain adverse, minor, permanent and predictable.

6.1.2.2 Contamination from Elevator during North Saskatchewan River Flooding

Impact

An elevator, stair and plaza will be constructed at the south end of the project to tie the pedestrian bridge and lookout into the existing river valley trail system. The elevator will comprise a shaft and machine and maintenance rooms located at the base. The elevator drive equipment will be located in the 1:100 year floodplain. The intent is to keep the base elevation at or above the 1:50 year flood level. The life expectancy of this type of equipment is approximately 20 to 25 years, but there is a chance that the equipment will be damaged or destroyed within that service lifetime by a flood. The elevator shaft itself will be structurally designed to withstand water forces associated with a 1:100 year flood event. In addition, there will be no chance of a hydraulic fluid leak into flood waters because a hydraulic elevator lift will not be used for elevator operation. With these measures in place, the impact to river water quality from a hazardous material spill from the elevator drive equipment during flood events is expected to be negligible.

Mitigation Measures and Residual Impact

No further mitigation measures are required and the residual impact remains negligible.

Table 6.3. Summary of Impacts and Mitigation for Hydrology/Surface Water Quality/Groundwater

Impact Description	Impact Characteristics	Mitigation Measures	Residual Impact Characteristics
Sediment release from construction	Negligible	• Implement best environmental construction practices • Contractor will develop and implement an ECO Plan • Contractor will develop and implement an Erosion and Sediment Control (ESC) Plan with all monitoring undertaken by a Certified Professional in Erosion and Sediment Control (CPESC) or equivalent • Stockpiled soils will be stabilized as soon as possible and no later than one week after stockpiling • Temporary erosion control measures will remain in place until vegetation is established • Following construction, stabilize exposed soils by reseeding and planting with approved seed mixes and species	Negligible
Hazardous materials from elevator drive equipment during river flooding	Negligible	• No mitigation measures required	Negligible
Degradation of	Negligible	• Follow standard	Negligible

Impact Description	Impact Characteristics	Mitigation Measures	Residual Impact Characteristics
aquatic habitat from deleterious material spills		construction measures and provincial hazardous spill regulations • Conduct equipment refueling or maintenance activities at least 100 m from the North Saskatchewan River • Ensure hazardous chemicals are stored at least 100 m from any watercourse • Ensure spill kits are accessible • Ensure all personnel are trained in the use of spill kits and immediate response • Ensure spill contingency plan is in place	
Changes to Surface Drainage Patterns/Volumes	Adverse, minor, permanent, predictable	• Confirm requirements for permanent drainage design with Drainage Services during detailed design	Adverse, minor, permanent, predictable

6.1.3 Air Quality

6.1.3.1 Construction Dust and Particulates

Impact

Dust is typically generated during construction activities, but the volume of dust is dependent on the intensity and timing of the dust-generating activity. During wet conditions, exposed soils may be dispersed by construction vehicles along paved roads in the project area (e.g., McDougall Hill Road, Grierson Hill Road), causing mud tracking. In dry conditions, construction vehicle access along graveled or cleared areas in the project area may generate dust. The impact of dust on air quality depends on the proximity of potential receptors as well as the volume of dust generated.

For the proposed project, dust will mainly be generated intermittently through the earthworks phases of the project and by construction vehicle traffic. Nearby visitors to the Fairmont Hotel Macdonald and commuters and recreationalists who will use the existing stair and river valley trail during construction are those most likely to be affected by construction dust. In most cases, dust generation will only be a short-term nuisance; however, there is a slight health risk for people with respiratory sensitivities during infrequent periods of high dust release. Due to the nature of construction activities, impacts are considered likely; however, such an impact would not be significant. The potential impacts of construction dust are considered to be adverse, minor, short-term and predictable.

Mitigation Measures and Residual Impact

Impacts, mitigation measures and residual impacts are summarized in Table 6.4. No further mitigation measures are required other than following standard construction dust monitoring and control measures, such as watering down dusty areas adjacent to residential, commercial or recreational areas, especially during dry, windy days, in order to minimize dust impacts on nearby visitors, residents and recreationalists. All dust monitoring and dust control measures will be outlined in the contractor's Environmental Construction Operations Plan (ECO Plan) for this project. The City of Edmonton's Emissions Management Plan (EMP) will be implemented, and compliance and effectiveness of that plan will be monitored. With these measures in place, the impact of dust on air quality will be reduced to negligible.

Table 6.4. Summary of Impacts and Mitigation for Air Quality

Impact Description	Impact Characteristics	Mitigation Measures	Residual Impact Characteristics
Dust and particulates from nearby construction	Adverse, minor, short-term predictable	• Employ dust suppression measures • Implement City of Edmonton Emissions Management Plan (EMP) and monitor compliance and effectiveness	Negligible

6.1.4 Vegetation

Potential impacts to vegetation include the following:

- Loss or alteration of native plant communities,
- Loss of special status plant species,
- Invasion of weedy species in disturbed areas, and
- Contamination of plants due to accidental spills.

These potential impacts and mitigation measures to reduce their magnitude are described more fully below and are summarized in Table 6.7.

6.1.4.1 Loss or Alteration of Native Plant Communities

Impact

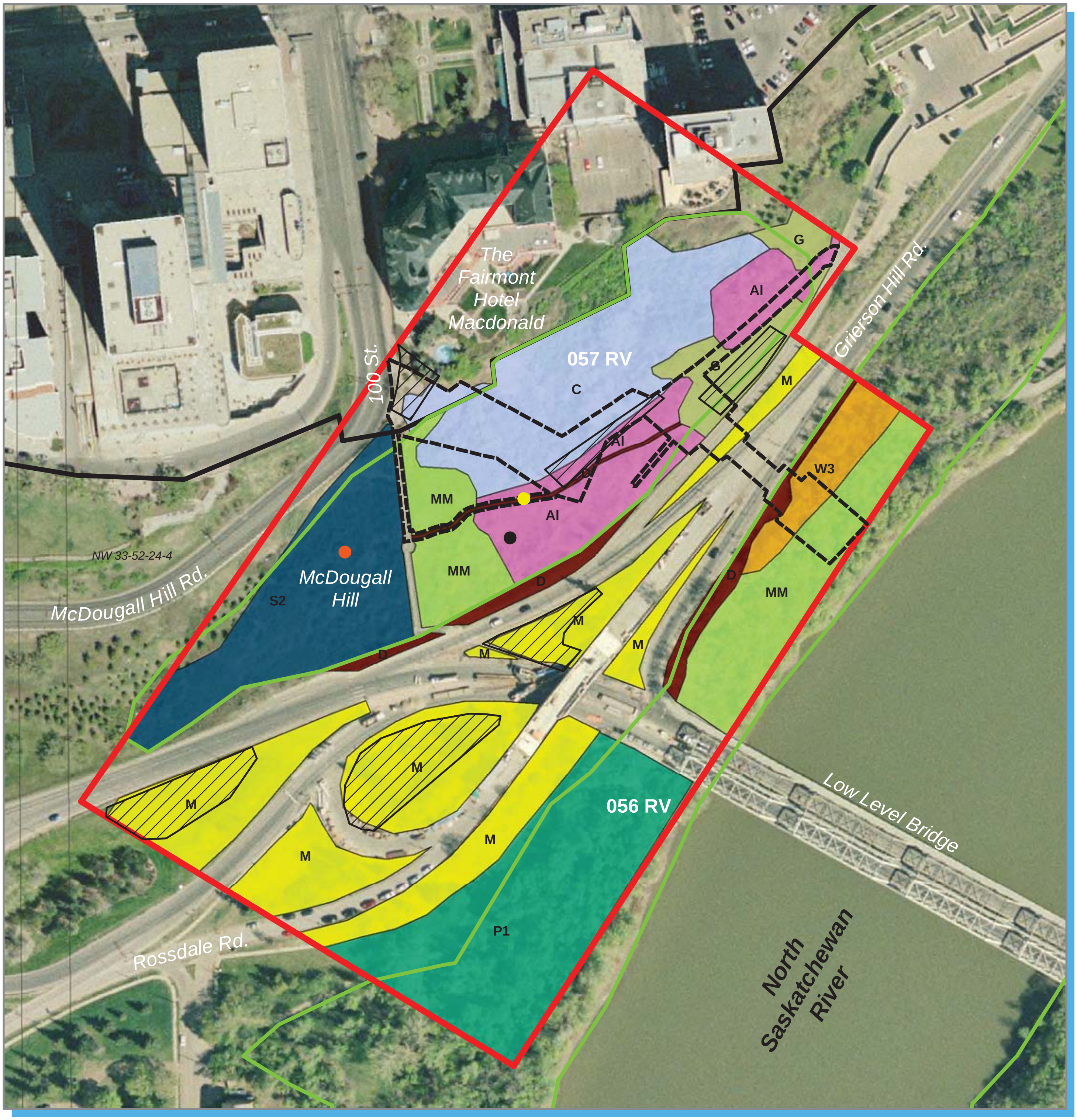
The proposed project footprint will be approximately 0.45 ha (Figure 6.1). An additional 0.34 ha will encompass staging areas and site access. To the extent possible, proposed staging areas have been located in manicured areas or areas of previous disturbance to minimize clearing of native vegetation. Overall, a total of 0.45 ha of native and semi-natural plant communities and 0.33 ha of disturbed and manicured areas will be directly impacted, for a total impact area of 0.79 ha.

Much of the proposed project area is made up of native and semi-natural plant communities, with some manicured areas located on the roadway medians at Grierson Hill Road and McDougall Hill Road. Native plant communities were classified as those consisting mainly of native species. Semi-natural communities were described as communities dominated by exotic species that formed dense and relatively undisturbed communities and supported some native species. These plant communities are situated within City of Edmonton Natural Areas (056 and 057 RV) (Figure 5.1). Those Natural Areas, however, form part of the Central Area of the *North Saskatchewan River Valley: Area Redevelopment Plan* (Bylaw 7188), an area that supports many developed parks and relatively few undisturbed areas. Overall, a total of 0.79 ha of native and semi-natural vegetation will need to be cleared to accommodate proposed project construction (Table 6.5). This area includes both temporary and permanent disturbances along the proposed alignment, with temporary disturbances associated with areas cleared for construction and staging areas only and permanent disturbances associated with areas occupied by permanent infrastructure.

Table 6.5. Impact Areas of Native and Semi-Natural Vegetation for the Proposed RVMA Construction

Plant Community	Description	Impact Area		
		RVMA Components (ha)	Staging Areas (ha)	Total (ha)
Aspen	Native	0.10	0.002	0.11
White Spruce	Native	0.03	0	0.03
Common Caragana	Semi-Natural	0.18	0	0.18
Manitoba Maple	Semi-Natural	0.05	0	0.05
Grassland	Semi-Natural	0.04	0.03	0.08
Disturbed	Exotic	0.02	0	0.02
Manicured	Exotic	0.01	0.30	0.31
TOTAL		0.45	0.34	0.79

The impact to native plant communities is relatively low (0.14 ha), with greater impacts anticipated for the semi-natural (0.31 ha) and manicured areas (0.31 ha). Effects on native plant communities are rated as adverse, minor, long-term to permanent and predictable.



Legend

Plant Community

- 🟪 Aspen (AI)
- 🟧 White Spruce-Deciduous (W3)
- 🟩 Manitoba Maple (MM)
- 🟩 Balsam Poplar (P1)
- 🟦 Common Caragana (C)
- 🟦 Tall Shrubs and Saplings (S2)
- 🟩 Grassland (G)
- 🟨 Manicured (M)
- 🟫 Disturbed (D)
- ● Moist Cattail Community

Special Status Species

- ● Round-Leaved Hawthorn
- ● Poison Ivy, approx. location
- 🟥 Local Study Area
- 🟩 City of Edmonton River Valley Natural Areas (2010) (with ID)
- ☐ Bylaw 7188 boundary
- ▨ Potential Laydown/Staging Location
- ⬚ Disturbance Limits

**Vegetation data source: 2015 project-specific fieldwork, and Spencer Environmental (2012b)*

Figure 6.1
Proposed Vegetation Impact Areas: Construction and Staging
River Valley Mechanized Access Project

N

0 20 40 80 Meters

1:2,300

Aerial Photograph Date: May 2012

Date Map Created: 17 November 2015

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Mitigation Measures and Residual Impact

To further lessen the potential impact on native plant communities during proposed RVMA construction, equipment storage, maintenance and refueling in areas that support native plant communities will be prohibited. Prior to construction, marking the clearing limits with highly visible flagging will help minimize the extent of vegetation loss. In areas where trees and shrubs must be cleared to accommodate construction, woody material will be removed to no less than 300 mm above grade to accommodate subsequent regeneration. Temporarily disturbed areas will be reclaimed using a native seed mix and/or plantings as soon as possible after construction. Native shrubs (e.g., rose and snowberry) and aspen stakes will be planted adjacent to and under the urban stair as well as along the edge of the promenade. The top section of the existing wooden stair will be removed and the area reclaimed with native grasses and forbs. Planted beds will be installed at the 100 Street top-of-bank promontory, along the pedestrian bridge and at the plaza at the downslope terminus of the elevator. In accordance with the City of Edmonton *Corporate Tree Management Policy* (C456), all treed areas on city-owned lands in the proposed project area will be assessed for value by the City of Edmonton Forestry department prior to removal, with required compensation undertaken. Despite these measures, there will still be a loss of native plant communities within the river valley; therefore, the residual impact will remain adverse, minor, long-term to permanent and predictable.

6.1.4.2 Loss of Special Status Plant Species

Impact

Two special status plant species, poison ivy and round-leaved hawthorn, were detected in the project area during field surveys in June 2015 (Table 6.6). Both of those species are ranked as S3 (21-100 occurrences within Alberta). S3 species are not tracked or considered rare by the Province; however, the City of Edmonton Parks + Biodiversity Section does consider S3 species as rare. Specific UTM locations of S3 species were not taken during the rare plant survey, but rather the community type and approximate location were recorded.

Table 6.6. Rare Plant Occurrences and Proposed Impact

Rare Plant Common Name	Rare Plant Scientific Name	Plant Community	Occurs in Proposed Impact Area (yes/no)
Poison ivy	*Toxicodendron radicans*	Aspen (A1)	Unlikely, depending on construction access and staging areas
Round-leaved hawthorn	*Crataegus chrysocarpa*	Tall Shrubs and Saplings (S2)	No

Neither of these species occurred within the proposed footprint of any of the RVMA project components. Round-leaved hawthorn occurred as scattered individuals in the tall shrubs and saplings (S2) community west of the existing stair (Figure 5.1); construction disturbances are not expected to occur beyond the stair, and, thus, round-leaved hawthorn is not expected to be directly impacted. Poison ivy was located in the aspen (A1) community east of the existing stair but southwest of the proposed funicular and urban stair. Thus, construction activities are not expected to directly impact this community, provided that additional clearing is not required downslope to accommodate construction access and staging areas.

Overall, based on the proposed project footprint, impacts on special status plant species within the project area are expected to be negligible, as neither species occurs within the proposed project footprint.

Mitigation Measures and Residual Impact

Both rare plant species are ranked as S3 and mitigation measures are not typically implemented for loss of S3 plant species. Construction access and staging areas will be located to minimize the need for clearing of native plant communities, and as a result, the residual impact from the proposed project will be reduced to negligible.

6.1.4.3 Establishment of Invasive and Weedy Species

Impact

Weed species were documented throughout the project area during field investigations in June 2015. Exotic species and noxious weeds were detected in all plant communities; exotic species were ranked as dominant or abundant in all communities on McDougall Hill except the aspen (A1) community. Weeds were widespread in the project area, with at least one noxious weed species occurring in all community types. Creeping thistle and common burdock were the most widespread noxious weeds. Common buckthorn, a prohibited noxious weed, was observed in five different communities. Although mature weeds will be removed during grubbing, their seeds will remain in stockpiled topsoils to be used in reclamation. Weeds could become established following construction through the movement of seeds and rhizomes deposited on equipment while working in different areas, as well as by recolonization by seeds transported naturally from adjacent weed populations elsewhere in the area. Weed establishment in the immediate project area is undesirable, as weeds may spread to the surrounding native plant communities within the North Saskatchewan River valley. Preventing weed establishment in the first place may be the best and most economical opportunity for weed management. Despite our best efforts, there is a real possibility of the post-construction disturbed areas becoming colonized with weeds due to the prevalence of existing weeds in the area. Unmitigated, the spread of weedy species within reclaimed areas will have an adverse, major, permanent and predictable impact on habitat values and maintenance costs.

Mitigation Measures and Residual Impact

Precautions such as cleaning equipment used in weedy areas before moving into new construction areas will help reduce the potential transfer and spread of weedy species. Using weed control on soil stockpiles left for periods sufficient for the maturation of weeds will prevent additional seed deposition in topsoils. More generally, some weed control may be required until desired vegetation becomes established, but the need for such measures can be assessed through monitoring. Cleared areas will be revegetated with native vegetation as soon as possible. Areas seeded with native seed will not be fertilized. All weed control measures will be outlined in the contractor's Environmental Construction Operations (ECO) Plan. Considering these measures, the residual impact from the proposed RVMA project will be reduced to negligible.

6.1.4.4 Contamination due to Accidental Spills

Impact

Fuel or lubricant spills can occur during refueling or as a result of equipment failure or accidents (e.g., broken hydraulic hose). Should spills occur in areas with natural vegetation, soils or surface waters, these features could be contaminated with hydrocarbons and heavy metals, which, in turn, could result in plant mortality. Most spills would likely be small in nature, but if uncontrolled could spread over large areas. That issue is particularly pertinent in working areas on steep slopes, where uncontrolled spills could spread downslope and potentially into the North Saskatchewan River. Equipment will be refueled and maintained in a central location 100 m away from any water body and preferably on a paved or graveled area. Wherever possible, biodegradable oils and lubricants will be used in equipment that will work in or near water. If fuel is stored on-site, tanks will be secured and have some form of spill protection (e.g., spill pan) available. Spill kits will be carried or readily accessible to equipment working on-site and at the refueling/maintenance areas. Construction personnel will be trained in the use of spill kits. Should a spill occur, personnel will be instructed to immediately contain and attempt to prevent the spread of the spilled material, particularly if near open water. With these measures implemented, the impact of a contaminant spill on vegetation will be negligible.

Mitigation Measures and Residual Impact

No further mitigation is required beyond the standard measures described above. The contractor will develop and implement an Environmental Construction Operations (ECO) Plan, including a spill protection plan, to ensure any spills are quickly and effectively cleaned up and spills of a certain size will be reported as required by the Alberta *Environmental Protection and Enhancement Act* (*EPEA*). The residual impact will be negligible.

Table 6.7. Summary of Impacts and Mitigation for Vegetation

Impact Description	Impact Characteristics	Mitigation Measures	Residual Impact Characteristics
Loss or alteration of native plant communities	Adverse, minor, long-term to permanent, predictable	• Avoid storing, maintaining or refueling equipment in areas of native vegetation • Mark vegetation clearing limits • Reclaim temporarily disturbed areas with a native seed mix • Replace or otherwise compensate for tree loss or damage on City property	Adverse, minor, long-term to permanent, predictable
Loss of special status plant species	Negligible	• No specific mitigation measures for S3 species • Ensure construction access and staging areas are situated to minimize the need for additional vegetation clearing	Negligible
Introduction of weedy or invasive species	Adverse, major, permanent, predictable	• Clean equipment between sites • Use weed control as needed; assess need through monitoring • Use weed control on soil stockpiles if left for sufficient time • Revegetate cleared areas with native seed mix and plantings as soon as possible	Negligible
Loss of vegetation as a result of contamination from fuel and lubricants	Negligible	• Maintain and refuel equipment away from water • Use biodegradable oils/lubricants where possible • Employ spill protection mechanisms if fuel is stored on site • Ensure spill kits are accessible on equipment working on site • Immediately contain spills	Negligible

6.1.5 Wildlife

Potential impacts related to wildlife include the following:

- loss of terrestrial wildlife habitat from clearing activities,
- habitat alienation during construction activities,
- breeding bird mortality due to construction activity during breeding season,

- disruption of wildlife movement during construction, and
- mortality or disturbance to special status wildlife species.

These impacts and recommended mitigation measures to minimize potential impacts are described in the sections below and summarized in Table 6.8.

6.1.5.1 Loss of Terrestrial Habitat

Impact

The proposed RVMA project area will be designed and constructed so that it occupies the smallest footprint possible, thereby minimizing the area of natural and semi-natural vegetation to be cleared. This, in turn, will minimize terrestrial habitat loss. Specifically, approximately 0.14 ha of native habitat (aspen and white spruce plant communities; Figure 6.1) will be impacted, with greater impacts anticipated for the semi-natural (0.31 ha) and manicured (0.31 ha) plant communities. The intent of the project is to avoid mature trees where possible. Common caragana will be pruned to 30 cm in height so that it will naturally regenerate post-construction along with formal landscaping plans including aspen stakes and native planting beds.

Despite the required clearing of natural and semi-natural vegetation, relatively abundant terrestrial habitat will be retained in the local study area and will be suitable for all species likely to be present. Clearing of native and semi-natural vegetation in the proposed RVMA project area will primarily impact avian and small mammal species with preferences for tall shrub and treed habitat preferences. Considering the amount and diversity of habitat that will be retained, the relatively small loss of native habitat is not expected to have detectable impacts on wildlife species diversity (i.e., richness and abundance) or population dynamics in the local study area. The impact of RVMA construction on the loss of native habitat is rated adverse, minor, local, permanent and predictable.

Mitigation Measures and Residual Impact

Prior to construction, marking the project clearing limits with highly visible flagging will minimize the extent of vegetation loss. All damaged or lost trees on City-owned lands will be compensated for in consultation with the City of Edmonton Forestry Department, pursuant to the *Corporate Tree Management Policy*. Also pursuant to this policy, large trees in the construction area will be avoided or hoarded to protect them from damage (e.g., root damage).

Reclamation of disturbed areas as well as formal landscaping associated with the proposed project will be carried out post-construction (Figure 2.5). Existing pruned caragana shrubs are expected to naturally regenerate while disturbed areas will be regraded and topsoiled and planted with a variety of plants including trembling aspen whips, native rose and snowberry shrubs, grasses and forbs and some sod. Rose and snowberry shrubs will be planted under the new urban stair to minimize erosion under the stairs. Once the upper portion of the existing wooden river valley stair is removed, the disturbed area will be reclaimed with a mix of native grasses and forbs. With these measures, loss of vegetation will be mitigated and residual impacts on wildlife habitat will be reduced to negligible.

6.1.5.2 Habitat Alienation

Impact

Activities and noise associated with construction activities can prevent sensitive wildlife species from using adjacent habitat and traveling through wildlife movement corridors. This effect of habitat alienation reduces the amount of usable habitat available to individuals and could impede movement for large and medium-sized animals, albeit temporarily, particularly south of Grierson Hill Road. Most wildlife species using the habitat in the local study area have likely adapted to human disturbance due to the disturbed nature of local parkland, recreational uses, the presence of major arterial roadways and the proximity to downtown Edmonton and nearby residential areas. Any additional disturbance caused by RVMA construction activities is expected to be minimal.

In addition, construction disturbance would be short-term. Work will also generally occur only during daylight hours, allowing animals to pass through the work area in the evening and night, when many animals would typically be most active in the area. Wildlife harassment will be prohibited. Considering all of the above, the impact to wildlife from habitat alienation during construction activities is rated as adverse, minor, temporary but uncertain. Habitat alienation is often rated as uncertain because indirect impacts resulting from alienation are inherently difficult to quantify.

Operation

Activities and noise occurring during RVMA operation have a lower potential than construction to disrupt wildlife species using adjacent habitat and movement corridors. Much of the local study area already experiences high levels of traffic and urban noise. The proposed funicular is expected to generate no more noise than that of a normal conversation. The impact of operation during operation is rated as negligible.

Mitigation Measures and Residual Impact

Construction

All personnel on-site will be instructed not to harass wildlife; residual impacts would remain negligible.

Operation

No mitigation is required; residual impacts will remain negligible.

6.1.5.3 Breeding Bird Mortality due to Clearing during Breeding Season

Impact

Clearing of native and semi-natural vegetation can cause wildlife mortality, particularly during the spring breeding season when the mobility of many species is restricted. At these times, adults remain close to dens and nest sites, and young are not yet able to move long distances. If mortality is high during spring, local populations may suffer short-term declines. This effect is more pronounced in populations already at low levels. Migratory bird nests are protected under the federal *Migratory Birds Convention Act (MBCA)*, which states that nests cannot be disturbed or removed during the breeding season. There are also legal implications for mortality caused by clearing. Both the federal *MBCA* and the Alberta *Wildlife Act* prohibit activities that will lead to the destruction or disturbance of nesting sites of migratory and individual birds. Direct mortality and nest site disturbance resulting from construction activity and clearing would contravene those *Acts*. Should mortality due to clearing occur, it would be an adverse, major, permanent and predictable impact. It is rated as major because it represents contravention of the law.

Mitigation Measures and Residual Impact

Clearing should be scheduled in the fall or winter months to avoid the spring breeding period (20 April to 20 August), minimizing the potential for mortality. Should clearing be planned during the breeding owl season from 01 March to 20 April, then large trees and snags should be examined by a professional biologist for nesting owls. Should clearing be planned during the breeding season for all other birds, all habitat potentially affected by clearing activities will be surveyed by a qualified biologist to determine the presence of breeding birds. Clearing limits should be marked with highly visible flagging to minimize accidental removal of habitat. Based on these measures, the residual impact of the project on breeding bird mortality will be negligible.

6.1.5.4 Disruption of Wildlife Movement during Construction

Impact

The North Saskatchewan River Valley (NSRV) serves as an important regional movement corridor, but is bounded by steep river valley walls and urban development. Available terrestrial habitat has been altered by the creation of parks, trails, road networks and residential and commercial development and can be inaccessible, depending on the location in the river valley. As a result, there are some limitations to the value of the river valley as a corridor for wide-ranging species such as deer, coyote and fox.

The proposed project will include some clearing of native and semi-natural vegetation and manicured areas in a relatively small construction footprint, however, staging and construction areas in the local area may provide a barrier to wildlife movement. This is because the project will be oriented perpendicular to expected wildlife movement in the area, particularly south of Grierson Hill Road along the river. Urban-adapted wildlife will be able to utilize adjacent shrubby and forested river terrace habitat on McDougall Hill and south of Grierson Hill Road to move around the site as they would be accustomed to moving through this existing area of human activity. Animals may, however, avoid the project area during construction and use alternative routes through adjacent contiguous vegetated areas, particularly along the river south of Grierson Hill Road. All personnel will be instructed not to harass wildlife. Based on these considerations, impacts to wildlife movement during construction would be considered adverse, minor, temporary and predictable.

Mitigation Measures and Residual Impact

Construction hours will be limited to the daytime, unless permitted otherwise, to provide opportunities for wildlife to pass through the project area without disturbance. Construction safety fencing should be restricted to the interface between public use areas and active construction areas to limit barriers to wildlife movement. Furthermore, ensuring that wildlife access from the top-of-bank areas to lower slopes of the river banks is not blocked may provide alternative corridors. All personnel will be instructed not to harass wildlife. The residual impact during construction will remain adverse, minor, temporary and predictable.

6.1.5.5 Special Status Species

Impact

A total of three special status species have a high or moderate likelihood of occurrence in the proposed study area: peregrine falcon, northern bat and little brown bat. Following is an account of the project's potential to impact these species.

None of the project components are expected to directly influence the foraging behavior of any peregrine falcons that may hunt or fly over the study area. Construction activity may alienate peregrine avian prey species from the area adjacent to the project area, thereby reducing the probability of falcons foraging in those areas and reducing the potential for direct impact to peregrines. An abundance of foraging opportunities exist elsewhere in the North Saskatchewan River Valley. The potential impact to peregrine falcons is considered negligible.

Some suitable roosting habitat for northern and little brown bats is available in the project study area, particularly in areas where there are large mature balsam poplar trees, such as those adjacent to the North Saskatchewan River south of Grierson Hill Road. These bat species can roost under the bark of mature trees or in old nest cavities during the day and will usually use several different roosts over the course of a spring and summer season. There is potential for the proposed project to directly impact these bat species if vegetation clearing occurs during the spring and summer when bats are present in the Edmonton area. The impact is, therefore, rated as adverse, major, permanent and predictable because they are federally ranked as Endangered.

Mitigation Measures and Residual Impact

Clearing should be scheduled in the fall or winter months to avoid the spring breeding period (20 April to 20 August), minimizing the potential for mortality of breeding birds and roosting bats. Should clearing be planned during the breeding owl season from 01 March to 20 April, then large trees and snags should be checked by a professional biologist for nesting owls. Should clearing of small areas (< 1 ha) be planned during the breeding season for all other birds, all habitat potentially affected by clearing activities will be surveyed by a qualified biologist to determine the presence of breeding birds. Areas larger than 1 ha are not recommended to be surveyed for active nesting because it is impossible to ensure all nests are accounted for and could lead to contravention of the *Migratory Birds Convention Act* and the *Wildlife Act*. Clearing limits should be marked with highly visible flagging or fencing to minimize accidental removal of habitat. With these measures in place, the residual impact to special status species will be negligible.

Table 6.8. Summary of Impacts and Mitigation for Wildlife

Impact Description	Impact Characteristics	Mitigation Measures	Residual Impact Characteristics
Loss of terrestrial habitat	Adverse, minor, local, permanent, predictable.	• Mark clearing limits • Replace lost and damaged trees pursuant to the *Corporate Tree Management Policy* • Reclaim disturbed areas with native species	Negligible
Habitat alienation • Construction • Operation	Adverse, minor, temporary, uncertain Negligible	• Prohibit the harassment of wildlife during construction • Avoid night shifts where possible	Negligible Negligible
Breeding bird mortality from vegetation clearing	Adverse, major, permanent, predictable	• Avoid clearing during breeding season (20 April to 20 August) • If clearing during breeding season, conduct survey with qualified biologist prior to clearing (clearing to include all trees, ground cover and brush piles) • Mark clearing limits	Negligible

Impact Description	Impact Characteristics	Mitigation Measures	Residual Impact Characteristics
Disruption of wildlife movement during construction	Adverse, minor, temporary, predictable	• Avoid night shifts where possible • Instruct personnel to not harass wildlife	Adverse, minor, temporary, predictable
Mortality or disturbance of special status species		• Avoid clearing during breeding season (20 April to 20 August) • If clearing during breeding season, conduct survey with qualified biologist prior to clearing areas <1 ha (clearing to include all trees, ground cover and brush piles)	
Peregrine falcon	Negligible		Negligible
Northern bat Little brown bat	Adverse, major, permanent, predictable		Negligible

6.1.6 Habitat Connectivity

Impact

Moderately high to low levels of wildlife movement resistance are currently present within the fragmented habitat in the study area on the north side of the river (Figure 5.3). Similar levels of wildlife movement resistance are present on the south side of the river across from the local study area, but those habitat areas are larger, are less fragmented and exhibit better functional habitat connectivity compared to the north side of the river. Overall, some landscape connectivity in the study area is present for urban-adapted wildlife, particularly along the North Saskatchewan River bank south of Grierson Hill Road and in some of the areas on the north valley slope; however, it is fragmented by urbanization and human activity.

Some components of the proposed RVMA project will permanently bisect the vegetated steep slope on McDougall Hill, much like the existing wooden stair does. Ultimately, the top section of the existing wooden stair will be removed and the proposed promontory, urban stair, funicular and promenade will be constructed down the slope and to the east, perpendicular to expected wildlife movement in the area. The total width of the urban stair and funicular component will be approximately 9 m and the trackway will be elevated 1.2 m above grade on micropiles for safety and operation reasons. Omega Fence Architectural Fencing will be installed at grade under the outside edge of the maintenance/emergency stairs and the urban stair, on the east and west sides, respectively, to prevent people from climbing on the structure and taking up residence under the structure. The potential impacts of the fencing to wildlife movement was considered seriously during project design and the feasibility of creating gaps in the fencing (including use of culverts) specifically for the purpose of facilitating wildlife movement, was assessed. To provide adequate passage under the funicular and stairs for medium-sized animal passage would require a structure or gap measuring at least a 1.5 m high by 1.5 m wide. A feature of this size would, however, be large enough for people to use or inhabit. This would be in direct conflict with the intention of the project to *not* provide opportunities for people to live under the infrastructure for safety and security concerns. Accordingly, to increase permeability for small- to medium- sized animals (e.g., mice, voles, weasels, hares) to move under the urban stair component, and maintain some habitat connectivity on the slope, the fencing will have a 10 cm gap at the bottom and will have 5 cm x 15 cm mesh. In addition, vegetation such as rose and snowberry bushes will be planted under the urban stair. Medium-sized animals such as coyotes would likely not be able to pass under the fences if they wish to cross the middle of the slope, but, as they are accustomed to doing elsewhere in the urban environment, they would be able to move around the structure by passing under the new pedestrian bridge and along the slope to the south of the promenade structure. The promenade structure will be located approximately 29 m upslope from Grierson Hill Road, which will assist in maintaining habitat connectivity on McDougall Hill and should provide enough space for animals to move through the area without being forced onto McDougall Hill Road. Impacts to habitat connectivity from project components on McDougall Hill are rated as adverse, minor, long-term and predictable.

The elevator, stairs and plaza located on the steep slope between Grierson Hill Road and the existing shared-use path will have a relatively small footprint and is not expected to fragment habitat connectivity along the river for urban-adapted wildlife as it will be permeable to wildlife movement. The cantilevered lookout at the top level of the elevator will be approximately 20 m above the shared-use path and is not expected to adversely impact habitat connectivity. Impacts to habitat connectivity from project components south of Grierson Hill Road are rated as negligible.

Mitigation Measures and Residual Impact

Impacts, mitigation measures and residual impacts are summarized in Table 6.9. Prior to construction, marking the project clearing limits with highly visible flagging will minimize the extent of vegetation loss. All disturbed areas will be reclaimed with native plantings and seed mixes. Post-construction, the City should consider monitoring vehicle-wildlife collisions in the project area to determine if mitigation is required. Based on this information, the residual impact to habitat connectivity on McDougall Hill will remain adverse, minor, long-term and predictable and negligible for the area south of Grierson Hill Road.

Table 6.9. Summary of Impacts and Mitigation for Habitat Connectivity

Impact Description	Impact Characteristics	Mitigation Measures	Residual Impact Characteristics
Loss of habitat connectivity		• Mark project clearing limits with highly visible flagging	
McDougall Hill	Adverse, minor, long-term, predictable		Adverse, minor, long-term, predictable
South of Grierson Hill Road	Negligible		Negligible

6.2 Valued Socio-Economic Components

6.2.1 Land Disposition and Zoning

Impact

The proposed RVMA project will be located on City-owned lands and encroach on adjacent private-property at the Fairmont Hotel Macdonald. The City has successfully negotiated a land use agreement with the hotel so that the 100 Street promontory could be located further to the east in order to avoid conflicts with existing utilities on McDougall Hill. No other changes to land ownership are required.

The proposed project area encompasses lands zoned as AP (Public Parks Zone), A (Metropolitan Recreation Zone) and AN (River Valley Activity Node Zone). No zoning changes are expected for the proposed project.

Impacts to land disposition and zoning are rated as negligible.

Mitigation Measures and Residual Impact

Impacts, mitigation measures and residual impact characteristics are listed in Table 6.10. No mitigation measures are required, and the residual impact will remain negligible.

Table 6.10. Summary of Impacts and Mitigation for Land Disposition and Zoning

Impact Description	Impact Characteristics	Mitigation Measures	Residual Impact Characteristics
Land disposition and zoning changes for project activities to proceed	Negligible	• None required	Negligible

6.2.2 Residential Land Use

We examined the following potential impacts of the proposed project on residential land use:

- Provision of improved connectivity for nearby residents to the river valley and downtown,
- Disturbance to residents from RVMA construction activities, and
- Disturbance to residents from RVMA operation.

These impacts and recommended mitigation measures to minimize potential impacts are described in the sections below and summarized in Table 6.11.

6.2.2.1 Provision of Improved Connectivity to the River Valley and Downtown

Impact

Some residents from close neighbourhoods such as Rossdale or neighbourhoods farther away on the south side of the river such as Cloverdale, Strathearn, Bonnie Doon and Strathcona regularly commute by foot or bicycle to and from downtown Edmonton. Currently, the wooden stair on McDougall Hill is the most direct connection between downtown Edmonton and the river valley for commuters, however, they must navigate across several major arterial roads at the bottom of McDougall Hill and must have full mobility in order to access and use the stair. The proposed project will improve connectivity to and from the river valley by replacing the existing stairs with new infrastructure including stairs, a funicular, promenade, pedestrian bridge and elevator. All users, including those requiring mobility assistance, will be able to move from the top of the north valley slope adjacent the Fairmont Hotel Macdonald down into the river valley and connect to the existing river valley trail system, or vice versa, without having to navigate across busy arterial roadways. Furthermore, the new elevator and stairs at the downslope terminus of the proposed project area will have a stop at sidewalk level along Grierson Hill Road, facilitating access to the Rossdale Neighbourhood and the Low Level Bridge as well as access up to the pedestrian bridge to allow passage over Grierson Hill Road. Thus, the proposed project will provide improved connection and accessibility for nearby residents and neighbourhoods. The impact of the proposed project on connectivity for nearby residents is rated as positive, major, permanent and predictable.

Mitigation Measures and Residual Impact

No mitigation measures are required. Residual impacts will remain positive, major, permanent and predictable.

6.2.2.2 Disturbance to Residents from Construction Activities

Impact

Residential land use in vicinity of the project area is limited, with the nearest residences in the Rossdale and Downtown neighbourhoods, beyond the limits of the study area. Several more distant neighbourhoods are located south of the river and the Low Level Bridge. The existing wooden stair, however, is a well-used pedestrian and cyclist commuter route that may be used by residents of these neighbourhoods. Thus, temporary closures of the existing stair during project construction may adversely affect nearby residents. Furthermore, some residents, especially in the nearby apartment buildings on

McDougall Hill Road, may temporarily experience some disturbance from construction activities; however, those residences are located some distance away from the proposed project area. Those residents may also experience a temporary increase in construction traffic activity. Based on this information, impacts to residential land use from construction are rated as adverse, minor, short-term and predictable.

Mitigation Measures and Residual Impact

Construction working hours will be limited to the hours permitted by the City of Edmonton's Bylaw 14600 (Community Standards Bylaw) (07:00-22:00 hours Monday to Saturday, 09:00-21:00 hours Sundays and holidays). The City of Edmonton has undergone, and continues to undergo, public consultation to best accommodate concerns regarding the construction period. Any trail detours or closure of the existing wooden stair will be clearly stated. Based on this information, residual impacts will be reduced to negligible.

6.2.2.3 Disturbance to Residents from RVMA Operation

Impact

There are no private residences in the immediate vicinity of the proposed project area; the nearest private residences are located approximately 300 m to the west in two apartment buildings (Renaissance Place and Park Square) on McDougall Hill Road and several houses in the Rossdale neighbourhood approximately 700 m south of the proposed project area, south of 97 Avenue. The proposed project area currently supports an existing wooden stair that experiences a high level of usage by recreationalists and non-motorized commuters. Once the proposed RVMA project is constructed, a higher level of use is expected, particularly in evenings and on weekends; however, increased residential traffic is not anticipated, as the majority of the increased usage will be concentrated within the existing river valley park system around the proposed RVMA project. It is expected that the majority of users will be pedestrians and cyclists accessing the site from existing sidewalks or shared-use paths. River valley park users that access the area by vehicle are expected to use existing nearby vehicle parking areas. Based on this information, impacts to residential land use from operation are rated as adverse, minor, permanent and predictable.

Mitigation Measures and Residual Impact

Overall, usage is expected to be comparable to the existing wooden stair on weekdays, with increased usage in the evenings and on weekends. As the proposed RVMA project is considered a connection between downtown and the existing river valley trails, the majority of anticipated users will access the area by foot, transit, or bicycle; consequently, nearby residents are not expected to experience increased residential traffic. Based on these measures, impacts to residential land use from operation are rated as negligible.

Table 6.11. Summary of Impacts and Mitigation for Residential Land Use

Impact Description	Impact Characteristics	Mitigation Measures	Residual Impact Characteristics
Provision of improved connectivity between downtown and the river valley for residents	Positive, major, permanent and predictable	• None required	Positive, major, permanent and predictable
Construction activities resulting in disturbance to residential areas	Averse, minor, short-term and predictable	• Construction working hours limited to the hours permitted by Bylaw 14600 • Signage to indicate trail/stair closures	Negligible
Operation activities resulting in disturbance to residential areas	Adverse, minor, permanent and predictable	• Promote access to the proposed RVMA project area by foot, bicycle or transit	Negligible

6.2.3 Recreational Land Use

Potential impacts of the proposed project on recreational land use include the following:

- Increase in accessibility to the river valley,
- Provision of additional recreational amenities, and
- Disturbance to existing recreationalists during construction.

A summary of the impact analysis is provided in Table 6.12.

6.2.3.1 Improved Accessibility to the River Valley

Impact

The existing wooden stair on McDougall Hill currently experiences a high level of recreational use by pedestrians and cyclists accessing the river valley; however, the existing stair does not provide access to recreational opportunities in the river valley for those with limited mobility. To that end, the proposed RVMA project provides improved access to the river valley for all potential users, including those with limited mobility, such as wheelchair users, the elderly, or parents with small children. The mechanized funicular and elevator components of the proposed project will provide a direct connection from downtown Edmonton to the existing river valley trails for all users, regardless of mobility, while the promenade and pedestrian bridge ensure that users can bypass traffic and avoid numerous curbs and obstacles. Expected system demand (year 2044) is predicted to be 366 users/hour and 183 users/hour/direction during the peak hour service (over the lunch hour) compared to current peak demand of approximately 100 users in each direction during the lunch hour on the existing wooden river valley stairs

(DIALOG 2015b). The impact of the proposed project on accessibility of the river valley is rated as positive, major, permanent and predictable.

Mitigation Measures and Residual Impact

No mitigation measures are required. Residual impacts will remain positive, major, permanent and predictable.

6.2.3.2 Provision of Additional Recreational Amenities

Impact

In addition to providing improved access to existing river valley recreational amenities, the proposed RVMA project has also been designed to support new recreational opportunities. The upper promontory and lower plaza will serve as gathering places and may be the sites of small performances. The urban stair component will provide a leisurely experience while accessing downtown Edmonton and the river valley, through the use of wide landings from which to rest or enjoy the river valley views. The narrower "express" stair will provide fitness opportunities for those interested in using the stair for exercise. The promenade and pedestrian bridge will have seating areas to accommodate those who wish to linger in addition to through-traffic, and a grassy slope above the promenade can be used for picnics. The proposed RVMA project represents one of several important River Valley Alliance initiatives underway to support the RVA's vision of connecting the many parks along the North Saskatchewan River Valley in the Capital Region into one continuous, publicly-accessible park. The proposed RVMA project is also consistent with the City of Edmonton's *Ribbon of Green Master Plan*, the goals of the *North Saskatchewan River Valley Area Redevelopment Plan* (Bylaw 7188), and *The Way We Grow: Municipal Development Plan* (Bylaw 15100). The impact of the proposed project on recreational amenities is rated as positive, major, permanent and predictable.

Mitigation Measures and Residual Impact

No mitigation measures are required. Residual impacts will remain positive, major, permanent and predictable.

6.2.3.3 Disturbance to Existing Recreational Use from Construction Activities

Impact

The proposed RVMA project area is connected to a variety of existing recreational areas in the North Saskatchewan River Valley. Near the proposed upper platform at 100 Street and McDougall Hill Road, a marker for the Heritage Trail directs recreationalists on a walking trail through downtown Edmonton, past numerous historic landmarks. The existing wooden stair on McDougall Hill currently experiences a high level of recreational use by pedestrians and cyclists accessing the river valley as well as other recreationalists using the stairs for fitness. Near the downslope terminus of the proposed project, the shared-use path downslope of Grierson Hill Road connects the proposed project area to Louise McKinney Riverfront Park.

Recreationalists using these amenities may be temporarily inconvenienced by detours during construction. The trail marker for the Heritage Trail will be relocated from its current location to incorporate into the new design at another location nearby. Signage will provide recreationalists in the area with adequate notification of the timing and duration of construction activities. Communications will be maintained with residents who are expected to frequently use these recreational areas. Temporary fencing will be installed to prevent public access into active construction areas. Deliveries of material and equipment as well as construction activities will cause temporary noise disturbances. The potential impacts to recreational use from construction activities are rated as adverse, minor, short-term and predictable.

Mitigation Measures and Residual Impact

Construction noise will be limited to the hours permitted by the City of Edmonton's Bylaw 14600 (Community Standards Bylaw) (07:00-22:00 hours Monday to Saturday; 09:00-21:00 Sundays and holidays). The construction contractor may apply for exemptions to the hours of work if required.

Temporary fencing will be installed around active construction areas when they occur close to existing recreational areas. Signage must be clearly posted indicating a project contact person and prime contractor and shall include project information, duration of construction and a phone number for inquiries. Use of corporate logos should be carefully managed in accordance with Edmonton's Zoning Bylaw 12800. Signage shall be removed within two weeks of construction completion. With these measures in place, residual impacts will be reduced to negligible.

Table 6.12. Summary of Impacts and Mitigation for Recreational Land Use

Impact Description	Impact Characteristics	Mitigation Measures	Residual Impact Characteristics
Improved accessibility to the river valley	Positive, major, permanent and predictable	• None required	Positive, major, permanent and predictable
Provision of additional recreational amenities	Positive, major, permanent and predictable	• None required	Positive, major, permanent and predictable
Disturbance of current recreational use by construction activities	Adverse, minor, short-term, predictable	• Comply with the City's noise Bylaw 14600 (Community Standards Bylaw) • Appropriate signage to inform recreationalists of timing and duration of construction	Negligible

Impact Description	Impact Characteristics	Mitigation Measures	Residual Impact Characteristics
		• Appropriate signage to indicate up-to-date detour information • Temporary fencing where active construction is located near recreational areas	

6.2.4 Traffic and Parking

Potential impacts to traffic and parking include the following:

- Increased construction traffic.
- Increased traffic and parking from RVMA users.

A summary of the impact analysis is provided in Table 6.13

6.2.4.1 Increased Construction Traffic and Parking in the Project Area

Impact

Graham Construction proposes that construction traffic will access the project from 100 Street adjacent to the Fairmont Hotel Macdonald, at the promenade from an existing trail that ties into the Shaw Conference Centre access road at the bottom of McDougall Hill (future service road) and by using the existing shared-use path system south of Grierson Hill Road via Louise McKinney Park (Figure 2.7). Construction traffic, however, is expected to be relatively infrequent and most noticeable during deliveries of equipment and materials. Some temporary road closures will be required during some construction activities such as placing bridge girders over Grierson Hill Road for the pedestrian bridge or when a heavy lift is required for the 100 Street promontory. Main staging areas will be located in manicured roadway medians and adjacent roadsides of Rossdale Road, McDougall Hill Road and Grierson Hill Road. Construction workers will park at staging areas. Without mitigation, impacts resulting from temporary increased construction traffic and parking in the project area are considered adverse, minor to major, short-term and predictable.

Mitigation Measures and Residual Impact

Traffic sightlines will be considered when establishing staging areas so sightlines remain as unobstructed as possible for all roadways in the project area throughout the construction period. The contractor will ensure access is maintained to all nearby commercial establishments (e.g., Fairmont Hotel Macdonald) and that lane closures during peak travel times will be minimized throughout the construction period. With these mitigation measures in place, impacts from temporary increased construction traffic and parking during construction will remain adverse, minor, short-term and predictable.

6.2.4.2 Increased Traffic and Parking in Adjacent Neighbourhoods during RVMA Operation

Impact

The proposed RVMA project will provide a connection from downtown Edmonton to existing river valley trails for recreationalists and non-motorized commuters, with a particular emphasis on those with limited mobility. As such, the proposed project is considered part of the river valley trail network, rather than a destination. Since it is expected the majority of users will access the site from the existing shared-use paths or downtown sidewalks, no designated parking will be provided. The proposed project area is easily accessed by public transit, with Central LRT station located approximately 150 m north of the 100 Street promontory and numerous bus stops along Jasper Avenue, 100 Street and at the top and bottom of McDougall Hill. Public parking is provided throughout downtown Edmonton, with numerous parking meters and four parkades in close proximity to the proposed project area. Some parking for river valley park users is provided in nearby Louise McKinney Riverfront Park to the east and Henrietta Muir Edwards Park on the south side of the river. Although there may be a temporary increase in public use of the new RVMA infrastructure once it is commissioned, it is expected that traffic and parking in the area should not be different than existing conditions and that existing traffic and parking facilities are adequate over the short- and long-terms. Impacts to traffic and parking in the project area, therefore, are considered negligible.

Mitigation Measures and Residual Impact

The City of Edmonton will monitor traffic and parking in adjacent areas to ensure facilities are adequate over time. Residual impacts will remain negligible.

Table 6.13. Summary of Impacts and Mitigation for Traffic and Parking

Impact Description	Impact Characteristics	Mitigation Measures	Residual Impact Characteristics
Increased construction traffic	Adverse, minor to major, short-term and predictable	• Traffic sightlines will be considered when establishing staging areas • Construction schedule will seek to minimize lane closures during construction	Adverse, minor, short-term, predictable
Increased traffic and parking in residential areas from RVMA users	Negligible	• The City of Edmonton will monitor traffic and parking in adjacent areas to ensure facilities are adequate over time.	Negligible

6.2.5 Utilities

6.2.5.1 Damage to Utilities

Potential impacts to existing utilities from construction activities include the following:

- The potential for an interruption in service or a material spill as a result of accidental damage to a utility.

A summary of the impact analysis is provided in Table 6.14.

Impact

Earthworks in the vicinity of buried utilities always create some potential for accidental damage. Damage could result in interruption of services or material spills. Over much of the project area, excavations will be shallow; however, areas of deeper excavations will be required for construction of support piers and piles, the elevator, and the funicular equipment room.

The proposed project alignment was selected to reduce the proximity to buried utilities on the west side of McDougall Hill. All lines will be located and marked prior to initiation of construction activities and workers will practice due diligence with respect to standard safety procedures. In the event that accidental damage occurs, the City will be notified immediately and actions will be taken to implement the City’s response plan. Standard due diligence, with respect to physical line locations, will be practiced prior to excavation commencing. Based on these measures, the impacts on utilities are expected to be negligible.

Mitigation Measures and Residual Impact

No mitigation measures are proposed, and the residual impacts will remain negligible.

Table 6.14. Summary of Impacts and Mitigation for Utilities

Impact Description	Impact Characteristics	Mitigation Measures	Residual Impact Characteristics
Damage to utilities	Negligible	• No additional mitigation measures recommended	Negligible

6.2.6 Worker and Public Safety

Potential impacts to worker and public safety include the following:

- Construction activities posing a hazard to public safety.
- Wildlife caused by construction activities.
- Public hazards caused by damaged utilities.
- Homeless communities taking shelter in local treed areas.

A summary of the impact analysis is provided in Table 6.15.

6.2.6.1 Construction Hazards to Public Safety

Impact

The proximity of the proposed construction area to existing public and recreational infrastructure poses a potential public safety risk. Without proper delineation of work areas during construction, members of the public could access construction zones and experience injury. As part of site preparation, screened fencing will be erected around the staging areas, and warning signs will be posted near all staging areas, all active construction sites and all construction traffic access points that are freely accessible to the public. Traffic sight lines will be maintained on existing roadways in the project area. Should construction activity necessitate, shared-use and informal trail detours will be clearly marked and communicated with user groups. Considering these measures, the impact of project construction on public safety is rated as negligible.

Mitigation Measures and Residual Impact

No additional mitigation measures other than the application of standard operating procedures to ensure public safety are required; impacts are expected to remain negligible.

6.2.6.2 Wildfires Caused by Construction Activities

Impact

In dry conditions, grasses and woody vegetation may present a fuel load for wildfires, and construction activity creates potential to ignite a fire. Construction activities will be confined to a narrow construction footprint that will include several distinct plant communities, which may contain substantial amounts of litter and debris. During dry conditions, particularly in the fall when vegetation is dormant and dry, an accidental fire ignited by sparks from machinery, construction materials or cigarettes could spread quickly. Nearby downtown businesses, residents, commuters and recreationalists would be at risk in the event of a large, fast-spreading fire. City fire crews are nearby and could respond quickly if a fire did begin. In the worst-case scenario, the impact would be adverse, minor to major, short-term and uncertain.

Mitigation Measures and Residual Impact

The following measures will help reduce the potential for construction activities, vehicles or personnel to initiate a wildfire:

- Firefighting equipment will be available near any flammable storage sites, including fuels, lubricants and other petroleum products.
- Smoking throughout the construction site will be prohibited, particularly near fuel storage areas or vegetated areas. A designated smoking area will be established.
- A procedure for on-site fire response will be developed and communicated to all site personnel. That plan will include contact information for local fire and emergency departments.

6.2.6.3 Public Hazards from Damaged Utilities

Impact

Accidental damage to a utility could create a risk to worker and public safety. Standard protocols for this type of work and application of due diligence will minimize the probability of accidental damage to utilities. When working in the vicinity of utility lines, all workers will be briefed on the nature of the utility and protocol in the event of damage, and all worker safety protocols will be followed. Based on this, the impacts will be considered negligible.

Mitigation Measures and Residual Impact

No additional mitigation measures are proposed, and the residual impact will remain negligible.

6.2.6.4 Construction in Areas Likely to Shelter the Homeless

Impact

There are known homeless communities with temporary camps set up on McDougall Hill in the proposed project area. Construction would put these people at risk of personal injury. In the absence of mitigation, the impact would be adverse, minor to major, short-term and predictable.

Mitigation Measures and Residual Impact

Before project construction begins, the City and/or successful contractor should contact appropriate agencies so that measures can be taken to accommodate relocation of affected individuals and provide contact with appropriate relief agencies and/or social workers. While the above measures will reduce the impacts to the homeless population associated with construction somewhat, the impacts will remain adverse, major, short-term and predictable.

Table 6.15. Summary of Impacts and Mitigation for Worker and Public Safety

Impact Description	Impact Characteristics	Mitigation Measures	Residual Impact Characteristics
Construction hazards to public safety	Negligible	• Install fencing around staging areas • Install warning signs around staging areas, active construction and construction traffic access points • Ensure any trail or stair detours are clearly marked	Negligible
Wildfire caused by construction activities	Adverse, minor to major, short-term, uncertain	• Ensure firefighting equipment is available near flammable storage sites • Smoking throughout	Negligible

Impact Description	Impact Characteristics	Mitigation Measures	Residual Impact Characteristics
		construction sites will be prohibited except in designated smoking areas • Develop a procedure for on-site fire response and communicate procedures to all site personnel	
Public hazards from damaged utilities	Negligible	• None required	Negligible
Construction in areas likely to shelter the homeless	Adverse, minor to major, short-term, predictable	• Prior to construction, the Contractor will contact appropriate agencies so that measures can be taken to accommodate the relocation of affected individuals and provide contact with appropriate relief agencies and/or social workers	Adverse, minor to major, short-term, predictable

6.2.7 Visual Resources

Considering the location of the proposed project adjacent to downtown Edmonton, the elevated project components, river valley topography, the excellent topographic vantage points framing the project area, and the proximity and direct sightlines of several residences and major hotels, impacts to existing visual resources may be considerable. Potential to affect existing viewscapes is a consideration both during construction and operation phases, particularly from certain locations/vantage points. Potential impacts to visual resources include the following:

- Construction activities affecting existing views.
- Facility operation activities affecting near and distant existing views.
- Improved accessibility to river valley views.

A summary of the impact analysis is provided in Table 6.16.

6.2.7.1 Construction Activities Affecting Existing Views

Impact

As with all construction projects, and particularly those in visible locations, the aesthetics of the project area will be adversely affected during construction. Construction work will include vegetation clearing within the project footprint, the use of heavy equipment, and establishing staging areas in close proximity to major roadways and shared-use paths. Construction is expected to take approximately one year, and these disturbances are expected to be present throughout the construction period.

Based on available vantage points and estimated sightlines, construction has potential to strongly affect the quality of views from the following locations:

- Lookout point at the top of McDougall Hill Road at 100 Street.
- The Fairmont Hotel Macdonald (the grounds and south-facing rooms).
- Major roadways, including Grierson Hill Road, McDougall Hill Road and Rossdale Road
- Renaissance Place and Park Square apartments (east-facing units).
- Cloverdale Road, Strathearn Drive and Gallagher Park.
- The North Saskatchewan River in central Edmonton.
- Localities within nearby parks (i.e., Henrietta Muir Edwards Park, Louise McKinney Park).
- Terraces at the Shaw Conference Centre.

Screened site fencing will be used at all active construction areas, as a safety measure and to protect against vandalism, as well as provide screening of disturbed areas in the river valley. Following construction, portions of the project area not permanently occupied for RVMA infrastructure will be re-vegetated. Areas of cleared vegetation will be restored or landscaped; and both restoration and landscaping are expected to improve the visual quality of the area, with visual impacts due to construction lessening over time. However, as with any soft landscaping efforts, the visual impact will remain until vegetation matures. Visual impacts of construction are thus expected to persist into the early stages of the operations phase. Construction phase impacts on visual resources in and around the proposed project area are rated as adverse, major, short-term and predictable.

Mitigation Measures and Residual Impact

During construction, efforts will be made to minimize vegetation clearing, especially of native communities. In addition, clearing will be delayed until just prior to the onset of construction to minimize the duration of the disturbance. Some visual impacts will be mitigated by seeking to maximize visual screening at construction sites close to recreational users and motorists. At the request of City of Edmonton Community Services, screened fencing will be used to further screen staging areas and areas of active construction (M. Hartlaub, *pers. comm.*). In addition, all roadway sightlines will be maintained. Once construction is complete, visual impacts of construction could be eliminated, over time, through careful reclamation and landscaping efforts that integrate with the existing aesthetics of the river valley. With these measures in place, the impacts will be somewhat reduced but will remain adverse, major, short-term and predictable.

6.2.7.2 Facility Operation Activities Affecting Existing Views

Changes to visual resources will be exerted at two scales: landscape (long-distance) and local (short-distance). Viewscape changes from select long-distance views include those from the North Saskatchewan River, Cloverdale Road, Strathearn Drive, Henrietta Muir Edwards Park and Nellie McClung Park. Short-distance views are those from within the proposed study area.

Long-Distance Views

Impact

The proposed project components situated on McDougall Hill, including the funicular, urban stair and express stair are all expected to be visible from distant views, while components situated lower on the slope, such as the promenade and pedestrian bridge are expected to be more screened from a distance. The proposed RVMA project will become a strong architectural element, linking the downtown skyline to the river valley, changing the character of some of Edmonton's most well-known and iconic views. The expanse of natural vegetation on the slope below the Fairmont Hotel Macdonald will be altered by the funicular, urban stair and promenade. Project design will ensure that proposed project components follow the slope profile as much as possible without being substantially elevated to minimize visual impact; however such structures will remain somewhat elevated and visible. Whether the addition of the proposed RVMA project to McDougall Hill results in a positive or negative change is a question of subjective perception; however, project design has endeavored to integrate the proposed project into its natural surroundings while also making it a unique landmark that links downtown Edmonton with the river valley. Overall, changes to long-distance views are considered to be positive or adverse, major, permanent and predictable.

Mitigation Measures and Residual Impact

Architectural design and landscaping that respect and complement the existing river valley aesthetic will reduce the visual impact of the proposed RVMA structures. Hard and soft landscaping elements can serve to soften the transition between structures and their natural parkland surroundings, thus integrating the structures as visual elements within the landscape, rather than visual intrusions imposed upon the landscape. The perceived intrusiveness of structures will likely diminish over time, as ornamental and natural vegetation matures, and as stakeholders become accustomed to the presence of the new structures. While mitigation measures can reduce the degree to which changes to the landscape are viewed as negative, there will be a permanent impact on long-distance views. Residual impacts to long-distance views therefore remain positive or adverse, major, permanent and predictable.

Short-Distance Views

Impact

The proposed RVMA project will comprise a new visual element in what is currently a relatively natural area on McDougall Hill and the North Saskatchewan River Valley flats. The RVMA project will require some clearing of the natural vegetation of McDougall Hill, and once complete, the previous expanse of natural vegetation will be interrupted. Three major groups of stakeholders, including the Fairmont Hotel Macdonald, residents of nearby apartment buildings and recreationalists using the existing wooden stair and existing river valley trails, are situated in close proximity to the proposed project area and will be impacted by changes to short-distance views with the addition of the RVMA project into the landscape.

Project components will be highly visible from all of these areas and vantage points, consequently affecting existing views. The views from the existing trails will be the most screened, due to existing vegetation, while the remaining short-distance views provide unscreened views of the proposed project. Overall, changes to short-distance views are expected to remain positive or adverse, major, permanent and predictable.

Mitigation Measures and Residual Impact

Aesthetic finishes on the proposed RVMA project components will be vital to minimizing the visual impacts of the structures on nearby residents, park users and visitors staying at the Fairmont Hotel Macdonald. Landscaping will strive to integrate the proposed RVMA project into the surrounding natural communities, creating the sense of a connection or gateway into the North Saskatchewan River Valley from downtown. Residual impacts to short-distance views therefore remain positive or adverse, major, permanent and predictable.

6.2.7.3 Improved Accessibility to River Valley Views

Impact

Currently, the vantage point at the top of McDougall Hill Road at 100 Street offers uninterrupted views of the North Saskatchewan River Valley to the east and west. That vantage point, consisting of a small plaza at the top of the wooden stair, is accessible from the sidewalk along the east side of 100 Street to users of varying abilities. The existing stair also offers sweeping views of the river valley from various points along the slope; that stair, however, is inaccessible to those with limited mobility. Additionally, this stair experiences high traffic as a non-motorized commuter route and act as an informal exercise facility, consequently limiting the opportunities for users to stop and enjoy the views because of a lack of frequent landings.

The proposed RVMA project will improve accessibility to the steep valley slope at McDougall Hill. The urban stair will have numerous landings and will encourage users to stop and enjoy the views. The funicular will improve accessibility to views from lower vantage points. Users of all abilities will be able to experience views from mid-slope along the promenade as well as views of the river from tree canopy level from the cantilevered lookout above the lower river valley terrace. The City will need to conduct vegetation pruning in the project area on an ongoing basis for to maintain sight-lines and views in the project area. Overall, impacts resulting from changes to accessibility of views are expected to be positive, major, permanent and predictable.

Mitigation Measures and Residual Impact

No mitigation measures are required. Residual impacts remain positive, major, permanent and predictable.

Table 6.16. Summary of Impacts and Mitigation for Visual Resources

Impact Description	Impact Characteristics	Mitigation Measures	Residual Impact Characteristics
Construction Activities Affecting Existing Views	Adverse, major, short-term and predictable	• Clearly mark vegetation clearing limits to minimize area cleared • Postpone clearing until immediately before construction • Install screened (e.g., mesh) fencing around staging areas	Adverse, major, short-term and predictable
Facility Operation Affecting Long-Distance Views	Positive or adverse, major, permanent and predictable	• Ensure that architectural design complements the existing river valley aesthetic. • Use design and landscaping to soften the transition between structures and the natural parkland surroundings when viewed from a distance, especially as surrounding vegetation matures	Positive or adverse, major, permanent and predictable
Facility Operation Affecting Short-Distance Views	Positive or adverse, major, permanent and predictable	• Use aesthetic finishes on RVMA project components to improve short-distance views and integrate into the river valley setting • Use landscaping to integrate RVMA components into surrounding native river valley vegetation	Positive or adverse, major, permanent and predictable
Facility Operation Improving Accessibility to River Valley Views	Positive, major, permanent and predictable	• None required	Positive, major, permanent and predictable

6.3 Valued Historic Components

6.3.1 Historical Resources

Potential impacts to historical resources include the following:

- Disturbance to historical resources.
- Disturbance to paleontological resources.

Impact analysis for historical resources is summarized in Table 6.17.

6.3.1.1 Disturbance to Historical Resources

Impact

Both shallow and deep excavations will be required to construct the proposed RVMA project. Those activities could potentially disturb existing historical sites; however, the HRIA reported no historical resources within the project area (Turtle Island 2015). Turtle Island (2015) confirmed the location of one previously identified archaeological site, west of the proposed project area. They found that the site, as originally identified, is located outside the footprint of the proposed RVMA project area. As such, that site is not under threat by the proposed project (Turtle Island 2015). Turtle Island concluded in the HRIA that there are no historic sites in conflict with the proposed RVMA project, and, therefore, any concern for further work is not warranted (Turtle Island 2015). Turtle Island has submitted their HRIA report to Alberta Culture's Historic Resources Management Board (HRMB) for their review pursuant to the *Historical Resources Act*. HRMB is currently reviewing the HRIA and a Letter of Clearance pursuant to the *Historical Resources Act* is pending. Impacts to historical resources are expected to be negligible.

Mitigation Measures and Residual Impact

If potential historical resources are discovered during construction, all work will be immediately suspended and the HRMB and the Royal Tyrell Museum will be contacted. Based on this information, impacts to historical resources will remain negligible.

6.3.1.2 Disturbance to Paleontological Resources

Impact

Turtle Island will undertake a monitoring program for paleontological resources during all project excavations throughout the construction period, pursuant to the requirements in the *Historical Resources Act Requirements* (Schedule A). Monitoring will be undertaken by a professional paleontological consultant. Following completion of the monitoring program, a pHRIA will be prepared and submitted to HRMB.

As construction on the proposed RVMA project has not commenced, the monitoring program pursuant to the pHRIA requirements has not yet been initiated. Consequently, there is currently no project-specific information on paleontological. Thus, the impact of the proposed project on paleontological resources is currently unknown.

Mitigation Measures and Residual Impact

No project excavations will to take place until a professional paleontological consultant is on-site to monitor the excavation work. If potential paleontological resources are discovered during construction activities, all work will be immediately suspended and the HRMB and the Royal Tyrell Museum will be contacted. The impacts to paleontological resources remain unknown, based on the present information.

Table 6.17. Summary of Impacts and Mitigation for Historical Resources

Impact Description	Impact Characteristics	Mitigation Measures	Residual Impact Characteristics
Disruption to or destruction of historical resources	Negligible	• If potential historical resources are discovered, suspend work and contact HRMB and Royal Tyrell Museum	Negligible
Disturbance to or destruction of paleontological resources	Unknown	• No excavation work will be undertaken until a professional paleontological consultant is on-site • If potential paleontological resources are discovered, suspend work and contact HRMB and the Royal Tyrell Museum	Unknown

7.0 SUMMARY ASSESSMENT

7.1 Summary of Impacts

With mitigation measures implemented, most impacts to Valued Environmental Components (VECs) identified in this assessment will be reduced to negligible. Some impacts will remain, and residual impacts can be grouped into four categories:

- positive impacts (all ranked as major);
- adverse impacts (both major and minor);
- adverse or positive impacts, depending on aesthetic preferences (all ranked as major); and
- uncharacterized impacts.

7.2 Positive Impacts

Four residual impacts were rated as positive. Positive residual impacts related to improved connectivity between downtown Edmonton and the river valley for residents and recreationalists, the provision of additional recreational amenities, and improved accessibility to river valley views. All positive residual impacts are considered major and permanent (Table 7.1).

Table 7.1. Summary of Positive Residual Impacts Resulting from the Proposed RVMA Project

Impact Description	Impact Characteristics	Current and Proposed Mitigation Measures	Residual Impact Characteristics
Residential Land Use			
Provision of improved connectivity between downtown and the river valley for residents	Positive, major, permanent, and predictable	• None required	Positive, major, permanent, and predictable
Recreational Land Use			
Improved accessibility to the river valley	Positive, major, permanent and predictable	• None required	Positive, major, permanent and predictable
Provision of additional recreational amenities	Positive, major, permanent and predictable	• None required	Positive, major, permanent and predictable
Visual Resources			
RVMA facility operation improving accessibility to river valley views	Positive, major, permanent and predictable	• None required	Positive, major, permanent and predictable

7.3 Adverse Impacts

Eight residual impacts remained adverse after the application of mitigation measures. Adverse residual impacts were related to slope stability, clearing of native plant communities, habitat connectivity, increased construction traffic, construction in areas likely to shelter the homeless and construction impacts on existing river valley views. Residual impacts ranged from minor to major and short- to long-term to permanent (Table 7.2).

Table 7.2. Summary of Adverse Residual Impacts Resulting from the Proposed RVMA Project

Impact Description	Impact Characteristics	Current and Proposed Mitigation Measures	Residual Impact Characteristics
Geotechnical/Soils			
Potential for slope instability from project activities	Adverse, major, short- to long-term, and predictable	• Pending detailed design, conduct additional slope stability analyses where required • Manage surface water flows to minimize overland flow downslope • Minimize vegetation clearing on steep riverbank slopes and ensure disturbed areas are revegetated • Avoid stockpiling excavated soil on the slope	Adverse, major, short- to long-term, and predictable
Hydrology/Surface Water Quality/Groundwater			
Changes to surface drainage patterns/volumes	Adverse, minor, permanent, and predictable	• Confirm requirements for permanent drainage design with Drainage Services during detailed design	Adverse, minor, permanent, and predictable
Vegetation			
Loss or alteration of native plant communities	Adverse, minor, long-term to permanent, and predictable	• Avoid storing, maintaining or refueling equipment in areas of native vegetation • Mark vegetation clearing limits • Reclaim temporarily disturbed areas with a native seed mix • Replace or otherwise compensate for tree loss or damage on City property	Adverse, minor, long-term to permanent, and predictable
Wildlife			
Disruption of wildlife movement	Adverse, minor,	• Avoid night shifts where possible	Adverse, minor, temporary,

Impact Description	Impact Characteristics	Current and Proposed Mitigation Measures	Residual Impact Characteristics
during construction	temporary, predictable	• Instruct personnel to not harass wildlife	predictable
Habitat Connectivity			
Loss of habitat connectivity from new facilities McDougall Hill	Adverse, minor, long-term, predictable	• Mark project clearing limits with highly visible flagging	Adverse, minor, long-term, predictable
Traffic/Parking			
Increased construction traffic	Adverse, minor to major, short-term, and predictable	• Traffic sightlines will be considered when establishing staging areas • Construction schedule will seek to minimize lane closures during construction	Adverse, minor, short-term, predictable
Worker and Public Safety			
Construction in areas likely to shelter the homeless	Adverse, minor to major, short-term and predictable	• Prior to construction, the contractor will contact appropriate agencies so that measures can be taken to accommodate the relocation of affected individuals and provide contact with appropriate relief agencies and/or social workers	Adverse, minor to major, short-term and predictable
Visual Resources			
Construction activities affecting existing views	Adverse, major, short-term and predictable	• Clearly mark vegetation clearing limits to minimize area cleared • Postpone clearing until immediately before construction • Install screened (e.g., mesh) fencing around staging areas	Adverse, major, short-term and predictable

7.4 Positive or Adverse Impacts

Two identified impacts to visual resources could be rated as positive or adverse, depending on personal opinion and values; both relate to the presence of permanent infrastructure following construction of the proposed RVMA project, and both were ranked as major and permanent (Table 7.3).

Table 7.3. Summary of Positive or Adverse Residual Impacts Resulting from the Proposed RVMA Project

Impact Description	Impact Characteristics	Current and Proposed Mitigation Measures	Residual Impact Characteristics
Visual Resources			
RVMA facility operation affecting long-distance views	Positive or adverse, major, permanent and predictable	• Ensure that architectural design complements the existing river valley aesthetic. • Use design and landscaping to soften the transition between structures and the natural parkland surroundings when viewed from a distance, especially as surrounding vegetation matures	Positive or adverse, major, permanent and predictable
RVMA facility operation affecting short-distance views	Positive or adverse, major, permanent and predictable	• Use aesthetic finishes on RVMA project components to improve short-distance views and integrate into the river valley setting • Use landscaping to integrate RVMA components into surrounding native river valley vegetation	Positive or adverse, major, permanent and predictable

7.5 Uncharacterized Impacts

One identified impact was left as uncharacterized. Impacts to paleontological resources remain unknown, as the Paleontological Historical Resource Impact Assessment (pHRIA) has not yet been undertaken. Turtle Island Cultural Resource Management Inc. will undertake a monitoring program for paleontological resources during all project excavations throughout the construction period and subsequently prepare the pHRIA, pursuant to the requirements in the *Historical Resources Act Requirements* (Schedule A). Since construction on the proposed RVMA project has not yet commenced, the monitoring program has not yet been initiated. Consequently, there is currently no project-specific information on paleontological resources in the proposed project area. As a result, potential impacts were uncharacterized at this time.

7.6 Monitoring and Follow-up Requirements

Pursuant to the City of Edmonton's Enviso program, Environmental Construction Operations (ECO) Plan monitoring during the site preparation and construction phases of the project will be required for the proposed RVMA project. As outlined in Chapter 6 of this report, the following additional proponent monitoring requirements have been identified in relation to individual VECs.

Geology/Geomorphology

- Ensure slope stability is maintained in the project area during RVMA construction and operation.

Soils

- An Erosion and Sediment Control (ESC) Plan, pursuant to the City's Enviso program, will be undertaken as part of the project.
    - Monitoring will be undertaken by a Certified Professional in Erosion and Sediment Control (CPESC) or equivalent.

Hydrology/Surface Water Quality/Groundwater

- During construction and operation, monitor erosion and sedimentation controls to minimize potential for sediment release.
- An ESC Plan will be undertaken as part of the project.
    - Monitoring will be undertaken by a CPESC or equivalent.

Air quality

- During construction, monitor apparent dust volumes to ensure dust control measures are adequate.
- During construction, implement Emissions Management Plan (EMP) and monitor compliance and effectiveness.

Vegetation

- Monitor soil stockpiles and reclaimed areas for noxious and prohibited-noxious, weed establishment and determine whether weed-control is required.
- Post-construction, monitor vegetation re-establishment in the project area until well-established.

Wildlife

- As a best management practice post-construction, monitor new glass elements for evidence of avian collision mortality resulting from bird strikes against windows/glass railings. Develop a mitigation strategy (e.g., adding uniformly patterned window coverings, markers, etc.) if required (See Section 2.3.7.4 for additional information).
- Post-construction, monitor vehicle/wildlife collisions in the project area to determine if mitigation is required.

Acoustic Environment

- Monitor noise levels during construction to ensure compliance with City of Edmonton Bylaw 14600 (*Community Standards Bylaw*).

Historic Resources

- Implement a historic resources construction monitoring program for paleontological resources.

7.7 Environmental Protection Planning

To implement certain mitigation measures, the following plans will be developed by the successful contractor:

- The contractor will comply with the City of Edmonton's Enviso program, including the Contractor's Environmental Responsibilities. One such requirement is to develop an Environmental Construction Operations (ECO) Plan.
- Erosion and sediment control plans will be developed. Those plans will consider the methods of construction and will consider short- and long-term erosion and sediment control.
- A construction spill prevention and contingency plan will be prepared.

7.8 Resolution of Key Environmental Issues

Chapter 4 presented a series of issues in the form of questions related to this project. The following section revisits each of those issues and describes the measures identified through this assessment that will mitigate them. Those measures, in combination with the information provided in Chapter 6, present the overall impression about the positive and adverse potential impacts likely to result from the proposed RVMA project and can assist in determining whether it is "environmentally sound". The following is a reiteration and discussion of the issues outlined in Chapter 4, organized by subject area.

7.8.1 Valued Ecosystem Components

7.8.1.1 Geotechnical/Soils

Are geotechnical conditions suitable for construction and operation of all components of the proposed project?

Yes. The proposed RVMA project area is located on the north side of the North Saskatchewan River below downtown. The entire project will be constructed at or below the top-of-bank of the north valley slope, on the river slopes, where the slope ranges from 1H:1V to 2H:1V. Previous deep slope movement has been reported in this area in historic (1967) studies; however, recent geotechnical work indicates no significant slope movement in the past four years. The proposed alignment is preferred from a geotechnical perspective, as the upper portions of the stairs and funicular proceed across the slope as they descend, resulting in a less steep structure. It is expected that potential slope stability issues at this location will be resolved during the ensuing stages of project design.

Thurber recommended a comprehensive slope monitoring program to assess slope stability during construction and operation. Vegetation clearing on the steep riverbank slopes will be kept to a minimum and disturbed areas will be reclaimed and revegetated. Stockpiling of excavated material on the slope will not be allowed, and the addition of fill for grading improvement will be kept to a minimum. Surface water flows will be managed to minimize overland flow downslope.

Are there abandoned coal mines in the vicinity of the project area?

No. There are no extensive coal mine workings present within the proposed project area. Upon review of the province's coal mine atlas, Thurber (2015a) noted an area of coal mine workings between the existing McDougall Hill Road to the north of MacDonald Drive and extending from the Fairmont Hotel Macdonald to the Chateau Lacombe. This mine operated from 1883 to 1897, covering an area of approximately 3 acres and operating at depths greater than 23 m (Thurber 2015a). All project components will be located on McDougall Hill, therefore, the historic coal mine workings are outside the proposed project area.

Will project construction activities create surface erosion and sedimentation that could adversely affect water quality in the North Saskatchewan River?

No. The proposed RVMA project will be situated on relatively steep slopes, where soils have the potential to be eroded from surface water flow downslope toward the North Saskatchewan River. Temporary and permanent erosion and sediment control measures, as detailed in the City of Edmonton's *Erosion and Sediment Control Guidelines* will be implemented during the project. The contractor will develop and implement a site-specific Erosion and Sediment Control (ESC) Plan; all related monitoring will be undertaken by a Certified Professional in Erosion and Sediment Control (CPESC) or equivalent.

Stockpiled soils that are susceptible to wind erosion will be stabilized (e.g., tackifier, erosion netting, hydroseeding) as soon as possible and no later than one week after stockpiling. Disturbed areas will be restored to original condition with appropriate topsoil and reseeded with an appropriate seed mix, approved by the City of Edmonton Parks Department, as soon as possible after construction. Approved shrub plantings may be established to supplement seeding.

7.8.1.2 Hydrology/Surface Water Quality/Groundwater

Will project activities adversely affect water quality in the North Saskatchewan River?

No. Construction of the proposed project will take place on the steep north river valley slope and lower river valley terrace. As a result, there is the possibility of some sediment generated from construction activities entering the North Saskatchewan River. To minimize potential impacts, the contractor will develop and implement an Environmental Construction Operations (ECO) Plan, and a site-specific Erosion and Sediment Control (ESC) Plan, pursuant to the City's Enviso program. All related monitoring will be undertaken by a Certified Professional in Erosion and Sediment Control (CPESC) or equivalent. Temporary and permanent erosion control measures, as described in the City of Edmonton's *Erosion and Sediment Control Guidelines* (City of Edmonton 2005), will be employed during the project.

Stockpiled soils that are susceptible to wind erosion will be stabilized (e.g., tackifier, erosion netting, hydroseeding) as soon as possible and no later than one week after stockpiling. Disturbed areas will be restored to original condition with appropriate topsoil and reseeded and replanted with appropriate native species, approved by the City of Edmonton Parks Department, as soon as possible after construction.

Will stormwater runoff from any project components contribute to north valley slope or lower terrace erosion?

No. Overall, the intent is to provide a sustainable approach to drainage through the use of vegetated swales and associated drain pipes, rain gardens, conventional deck drainage and planted areas so that **s**urface water flows are managed to minimize overland flow downslope and into the City storm water system. The construction footprint will be as small as possible so that vegetation clearing is minimized. All disturbed areas will be reclaimed using appropriate native plantings and seed mixes approved by the City of Edmonton Parks department.

Is there potential for hazardous materials to be spilled during construction activities such that fish and wildlife resources are adversely affected?

No. Standard operating procedures and provincial hazardous materials spill regulations will be followed to minimize potential hazardous material spills. Refueling or maintenance of construction equipment will not be permitted within 100 m of the North Saskatchewan River. Spill kits will be carried on equipment and stored at nearby work locations, and all personnel will be trained to respond appropriately to a spill so that accidental release of hazardous material can be quickly and effectively controlled. As a result, the potential for accidental release will be minimal. Little potential exists for large spills with these standard operating procedures in place; however, should one occur, it will be contained and disposed of following provincial guidelines.

Is there potential for hazardous materials to leak from the elevator component during flooding conditions?

No. While the elevator drive equipment will be located in the 1:100 year floodplain, the elevator shaft will be structurally designed to withstand water forces associated with a 1:100 year flood event. A hydraulic elevator lift will not be used so that there is no chance of a hydraulic fluid leak during elevator operation.

Could flooding undermine the operation of the proposed RVMA project and cause maintenance issues?

Yes. The elevator drive equipment will be located in the 1:100 year floodplain. The intent is to keep the base elevation of the elevator machinery at or above the 1:50 year flood level and the wall-mounted electrical components at or above the 1:100 year flood level. Normally, the life expectancy of this type of equipment is 20 to 25 years, but there is a chance that the equipment will be damaged or destroyed within that service lifetime by a flood. The elevator shaft will be structurally designed to withstand water forces associated with a 1:100 year flood event. Maintenance will be undertaken as required to ensure ongoing operation of all mechanized project components. Facility and Maintenance Services will likely take on the mechanical equipment maintenance, through a contracted maintenance entity. The first year of funicular and elevator maintenance will be completed under the construction contract, with options to extend that contract further outside of the project.

7.8.1.3 Air Quality

Will construction traffic and construction activities release significant levels of wind-borne dust? Will dust generation pose a health risk to residents and recreational users?

No. For the proposed project, dust will mainly be generated intermittently during construction activities and by construction vehicle traffic. Nearby recreationalists are likely to be most affected by construction dust, as there are no residences in the immediate vicinity of the proposed project area. In most cases, dust generation would only be a nuisance; however, there is a slight health risk for people with respiratory sensitivities during infrequent periods of high dust release. Standard construction dust monitoring and control measures such as watering down dusty areas, especially during dry, windy days, will be implemented in order to minimize dust impacts on nearby recreationalists. All dust monitoring and dust control measures will be outlined in the proponent’s Environmental Construction Operations (ECO) Plan for this project.

7.8.1.4 Vegetation

Will native or ornamental trees on City lands be removed or damaged during construction? How will a potential loss be mitigated?

Yes. Proposed RVMA construction will impact 0.45 ha (Figure 6.1) of native and semi-natural plant communities and 0.33 ha of disturbed and manicured areas. Plant communities impacted range from manicured areas with small patches of trees and shrubs in planted beds to aspen forest, Manitoba maple stands, and a large area dominated by common caragana. All vegetated areas on City-owned lands in the project area will be assessed for compensation value prior to removal by the City of Edmonton Forestry department pursuant to the City of Edmonton Corporate Tree Management Policy (C456).

Is there potential for the loss or disturbance of any special status native plant species or communities?

No. Two S3 (21-100 occurrences within Alberta) species were observed within the vegetation study area. S3 species are not tracked and are not considered rare provincially; however, the City of Edmonton does consider S3 species as rare. Neither of these two species is located within the proposed project footprint or proposed staging areas. As a result it is unlikely that either species will be disturbed.

7.8.1.5 Wildlife

Will critical habitat be lost?

No. Removal of small areas of shrubby and treed habitats would lead to some loss of nesting and natal habitat for some birds and other wildlife; however, the areas involved are small and are not unique compared to habitat available in adjacent areas of the river valley.

Will any special status wildlife species be adversely affected by project activities?

Unlikely**.** A total of three special status species have a high or moderate likelihood of occurrence in the proposed project area, and all of these species are urban-adapted and unlikely to be adversely affected by the proposed project. Vegetation clearing should be scheduled in the fall or winter to avoid the spring breeding period (20 April – 20 August), minimizing the potential for mortality of breeding birds and roosting bats. Should clearing be planned during the breeding owl season from 01 March to 20 April, then large trees and snags should be examined by a professional biologist for nesting owls. Should clearing be planned during the breeding season for all other birds, all habitat potentially affected by clearing activities will be surveyed by a qualified biologist to determine the presence of breeding birds.

Will wildlife movement be blocked or impeded by project construction?

Yes. It is likely staging and construction areas in the local area may block or impede wildlife movement because the project will be oriented perpendicular to expected wildlife movement in the area, particularly south of Grierson Hill Road along the river. Urban-adapted wildlife will be able to utilize adjacent shrubby and forested river terrace habitat on McDougall Hill and south of Grierson Hill Road to move around the site as they would be accustomed to moving through this existing area of human activity. Animals may, however, avoid the project area during construction and use alternative routes through adjacent contiguous vegetated areas, particularly along the river south of Grierson Hill Road. Construction hours will be limited to the daytime, unless permitted otherwise, to provide opportunities for wildlife to pass through the project area without disturbance. Construction safety fencing should be restricted to the interface between public use areas and active construction areas to limit barriers to wildlife movement. Furthermore, ensuring that wildlife access from the top-of-bank areas to lower slopes of the river banks is not blocked may provide alternative corridors. All personnel will be instructed not to harass wildlife.

7.8.1.6 Habitat Connectivity

Will existing habitat connectivity be compromised by the proposed project?
Yes, somewhat. Proposed RVMA project components on McDougall Hill will permanently bisect the vegetated steep slope on McDougall Hill, much like the existing wooden stair does. Ultimately, the top section of the existing wooden stair will be removed and the proposed promontory, urban stair, funicular and promenade will be constructed down the slope and to the east, perpendicular to expected wildlife movement in the area. The relatively narrow urban stair and funicular (9 m wide) will be elevated 1.2 m above grade for safety and operation reasons. To maintain some habitat connectivity on the slope and increase permeability of the new urban stair and funicular structures for small- to medium-sized animals (e.g., mice, voles, weasels, hares), adjacent security fencing will have a 10 cm gap at the bottom and will have 5 cm x 15 cm mesh. In addition, vegetation such as rose and snowberry bushes will be planted under the urban stair. Medium-sized animals such as coyotes would likely not be able to pass under the fences if they wish to cross the middle of the slope, but, as they are accustomed to doing elsewhere in the urban environment, they would be able to move around the structure by passing under the new pedestrian bridge and along the slope to the south of the promenade structure. The promenade structure will be located approximately 29 m upslope from Grierson Hill Road, which will assist in maintaining habitat connectivity on McDougall Hill and should provide enough space for animals to move through the area without being forced onto McDougall Hill Road.

The elevator, stairs and plaza located on the steep slope between Grierson Hill Road and the existing shared-use path will have a relatively small footprint and is not expected to fragment habitat connectivity along the river for urban-adapted wildlife as it will be permeable to wildlife movement. The cantilevered lookout at the top level of the elevator will be approximately 20 m above the shared-use path and is not expected to adversely impact habitat connectivity.

7.8.1.7 Fish and Aquatic Resources

Will water quality in the North Saskatchewan River and, in turn, fish habitat, be affected by the proposed project during construction and operation?

No. To minimize potential impacts of erosion and sedimentation, the contractor will develop and implement an Environmental Construction Operations (ECO) Plan, and a site-specific Erosion and Sediment Control (ESC) Plan, pursuant to the City's Enviso program. All related monitoring will be undertaken by a Certified Professional in Erosion and Sediment Control (CPESC) or equivalent. Temporary and permanent erosion control measures, as described in the *Erosion and Sediment Control Guidelines* (City of Edmonton 2005) will be employed during the project. Standard operating procedures and provincial hazardous materials spill regulations will be followed to minimize potential hazardous material spills. Little potential exists for large spills with these standard operating procedures in place; however, should one occur, it will be contained and disposed of following provincial guidelines.

While the elevator drive equipment will be located in the 1:100 year floodplain, the elevator shaft will be structurally designed to withstand water forces associated with a 1:100 year flood event. A hydraulic elevator lift will not be used so that there is no chance of a hydraulic fluid leak during elevator operation.

7.8.2 Valued Socio-Economic Components

7.8.2.1 Land Disposition and Zoning

Will land zoning changes be required in order to construct the proposed project?

No. The proposed project area will be situated on the north side of the North Saskatchewan River, within the Central Area of the North Saskatchewan River Valley, as designated in Bylaw 7188 (City of Edmonton 2014). The Central Area is characterized by developed parkland, residential, institutional and transportation infrastructure with limited undisturbed natural vegetation (City of Edmonton 2014). Current zoning reflects types of recreational uses within the river valley in that area. The area near 100 Street and McDougall Hill Road near the top-of-bank is zoned as a public park (AP), while much of McDougall Hill is zoned for metropolitan recreation (A). It is not anticipated that any changes to the existing zoning will be required to accommodate the proposed RVMA project.

Will the project cross any other land jurisdictions?

No. The proposed RVMA project will be located on City-owned lands or on Fairmont Hotel Macdonald lands subject to a land use agreement with the City. No other land jurisdictions are located in close proximity to the proposed project area.

Will any additional land be needed to construct the project?

Yes. Most of the proposed RVMA project will take place on City-owned lands within the North Saskatchewan River Valley. The exception is the land for the 100 Street promontory immediately adjacent to the Fairmont Hotel Macdonald. In order to avoid utility conflicts to the west, the City of Edmonton has negotiated a land use agreement with the Fairmont Hotel Macdonald to permit encroachment of the promontory on the southwest edge of hotel lands.

7.8.2.2 Residential Land Use

Will project activities adversely affect nearby residents?

No. There are no private residences in the immediate vicinity of the proposed project area. The nearest private residences are located approximately 300 m to the west in two apartment buildings. As a result, construction noise and traffic are unlikely to affect nearby residents. Temporary closures to river valley trails and the existing wooden stair may adversely affect nearby residents during construction, but efforts will be made to minimize the duration of such closures, and detour routes will be clearly marked and communicated with nearby residents and user groups. During operation, a higher level of use is expected, particularly in evenings and on weekends; however, increased residential traffic is not anticipated, as the majority of the increased usage will be concentrated within the existing river valley park system around the proposed RVMA project.

The proposed RVMA project will improve connectivity to and from the river valley by replacing the existing wooden stair with new infrastructure, including stairs, a funicular, promenade, pedestrian bridge and elevator. All users, including those requiring mobility assistance, will be able to move from the top of the north valley slope at 100 Street down into the river valley and connect to the existing SUP system, or vice versa, without having to navigate across busy arterial roadways. The new elevator and stairs at the downslope terminus of the proposed project area will have a stop at sidewalk level along Grierson Hill Road, facilitating access to the Rossdale Neighbourhood and the Low Level Bridge, as well as access up to the pedestrian bridge to allow passage over Grierson Hill Road. Thus, the proposed project will provide improved connection and accessibility for nearby residents, either for recreational uses or as a non-motorized commuter route.

7.8.2.3 Recreational Land Use

Will the proposed RVMA project meet the objective of increasing outdoor recreation in the river valley?

Yes. The proposed RVMA project will provide a direct connection between downtown Edmonton and the North Saskatchewan River Valley for all Edmontonians and visitors to Edmonton, regardless of age or ability. The barrier-free access and integration with the existing shared-use trail network will enable all users to access existing river valley recreational amenities.

Will current recreational users be adversely affected by project construction and operation?

Yes and no. Temporary closures of the existing wooden stair, the sidewalk along Grierson Hill Road and the SUP on the lower valley terrace may temporarily disrupt recreational users in the proposed project area. Efforts will be made during construction to minimize the duration of such closures, and to keep the existing stair open for as much of the construction period as possible. In the event of closures, detours will be clearly marked and communicated with user groups.

During operation, recreational use in the proposed project area will be positively affected, due to improved accessibility to the river valley from downtown Edmonton for all recreationalists as well as the provision of increased recreational opportunities along the urban stair, promenade and lookout, adding a vertical park element to the river valley slope below downtown.

Will construction pose safety and health hazards to current recreational users?

No. As part of site preparation, fencing will be erected around staging areas and active construction sites. Warning signs will be posted near all staging areas, active construction sites and construction access points that are freely accessible to the public. Where necessary, path detours will be clearly marked and communicated with user groups.

7.8.2.4 Traffic/Parking

Will construction and operation of the proposed RVMA project adversely affect traffic and parking in adjacent areas?

Yes and no. In the short term, construction traffic may negatively affect traffic and parking in the vicinity of the project area. Construction traffic is expected to be relatively infrequent; however, temporary road closures will be required during some construction activities, such as placing bridge girders over Grierson Hill Road for the pedestrian bridge. Staging areas will be located in manicured roadway medians and roadsides of Rossdale Road, McDougall Hill Road and Grierson Hill Road. Construction workers will park at staging areas. Traffic sightlines will be considered when establishing staging areas to ensure sightlines remain as unobstructed as possible.

In the longer term, the proposed RVMA project will provide a connection from downtown Edmonton to existing river valley trails for recreationalists and non-motorized commuters, with a particular emphasis on those with limited mobility. As such, the proposed project is considered part of the river valley trail network, rather than a destination, and it is expected that the majority of users will access the site from existing shared-use paths or downtown sidewalks. No designated parking will be provided since the proposed project is not expected to cause significant increases to parking or traffic in the area. The City of Edmonton will monitor parking and traffic in adjacent areas to ensure facilities are adequate over time.

7.8.2.5 Utilities

Will any utilities be damaged, resulting in a risk to public safety?

No. The proposed RVMA alignment was selected from the alternatives to avoid potential impact to utilities in the area. However, standard due diligence, with respect to physical line locations, will be practiced prior to excavation commencing. All lines in the vicinity will be located and parked prior to initiation of construction activity and workers will practice due diligence with respect to standard safety procedures. In the event that accidental damage occurs, the City will be notified immediately and actions taken to implement the City’s response plan.

Will any utilities be removed or realigned?

No. None of the above- or below-ground utilities in the project area are expected to be removed or realigned during construction or operation of the proposed RVMA project.

7.8.2.6 Worker and Public Safety

Will construction traffic and construction activities pose a risk to workers, residents and recreational users in the project area?

No. Warning signs will be posted near all staging areas, active construction areas and construction access points that are freely accessible to the public. Screened fencing will be erected around staging areas and areas of active construction. Traffic sightlines will be considered when establishing staging areas so sightlines remain as unobstructed as possible for all roadways in the project area throughout the construction period. Detours for recreational users and non-motorized commuters using the existing wooden stair will be clearly marked. All construction vehicles will adhere to local speed limits.

Will hazardous materials during construction pose a risk to worker and public health and safety?

No. Standard protocols for this type of work and application of due diligence will minimize the probability of exposure to hazardous materials. When working in the vicinity of utility lines, all workers will be briefed on the nature of the utility and protocol in the event of damage, and all standard worker safety protocols will be followed. The contractor will develop and implement an Environmental Construction Operations (ECO) Plan, including a spill protection plan, to ensure that any spills are quickly and effectively cleaned up, and spills of a certain size will be reported as required by the Alberta *Environmental Protection and Enhancement Act* (*EPEA*).

7.8.2.7 Visual Resources

Will construction and operation of the proposed RVMA project adversely affect the visual quality of the North Saskatchewan River Valley?

Yes and no. In the short term, the aesthetics of the project area will be adversely affected during construction, as construction work will include some vegetation clearing within the project footprint, the use of heavy equipment, and the establishment of staging areas near major roadways and shared-use paths. Efforts will be made to minimize vegetation clearing, and clearing will be delayed until just prior to the onset of construction to minimize the duration of the disturbance. Screened fencing will be used to screen views of active construction and staging areas.

In the longer term, RVMA project components will be visible from near and distant vantage points. The proposed RVMA project will become a strong architectural element, linking the downtown skyline to the river valley, changing the character of some of Edmonton's most well-known and iconic views. Whether the addition of the proposed RVMA project to the slope below downtown results in a positive or negative change is a question of subjective perception; however, architectural design and landscaping that respect and complement the existing river valley aesthetic will reduce the visual impact of the proposed RVMA structures, softening the transition between project components and their natural parkland surroundings.

Will RVMA operation create more accessible river valley views for all Edmontonians and visitors to Edmonton?

Yes. The existing wooden stair on McDougall Hill offers unrestricted views on the North Saskatchewan River Valley in all directions; however, only those with unrestricted mobility can access these views. The proposed project will facilitate access to McDougall Hill and the views of the river valley to all Edmontonians and visitors to Edmonton, and the cantilevered lookout above the lower river valley terrace will provide new views of the river valley. It is expected that the City will conduct some vegetation trimming from time-to-time to maintain visual sight-lines from key vantage points in the project area.

7.8.3 Valued Historic Components

7.8.3.1 Historical Resources

Is there potential for previously undiscovered artifacts to be disturbed during construction activities?

Unlikely. While some excavation will be required for construction, the HRIA reported no historical resources within the proposed project area. Turtle Island confirmed the location of one previously identified archaeological site upstream on the bank of the North Saskatchewan River, outside the proposed project area. Consequently, Turtle Island determined that that site is not under threat by the proposed RVMA project and concluded that there are no historic sites in conflict with the proposed RVMA project and, therefore, future work is not warranted. Turtle Island submitted their HRIA to Alberta Culture and Tourism's Historic Resources Management Board (HRMB) for their review pursuant to the *Historical Resources Act*. HRMB has reviewed the HRIA and a Letter of Clearance pursuant to the *Historical Resources Act* was received on 26 August 2015.

Turtle Island will undertake a monitoring program for paleontological resources during all project excavations throughout the construction period, pursuant to the requirements in the *Historical Resources Act Requirements* (Schedule A). Monitoring will be undertaken by a professional paleontological consultant. Following completion of the monitoring program, a pHRIA will be prepared and submitted to HRMB. As construction on the proposed RVMA project has not commenced, the monitoring program pursuant to the pHRIA requirements has not yet been initiated. Consequently, there is currently no project-specific information on paleontological resources in the proposed project area. However, if potential paleontological resources are discovered during construction activities, all work will be immediately suspended and the HRMB and the Royal Tyrell Museum will be contacted.

7.8.4 Public-Identified Issues

As part of its commitment to public engagement, the City of Edmonton hired Calder Bateman to manage all public communications and engagement. To that end, the City of Edmonton met with stakeholders and held a public open house (City of Edmonton

2015b). Overall, the public supports the proposed RVMA project and many river valley users are looking forward to improved access to the river valley from downtown Edmonton for all Edmontonians and visitors to Edmonton, regardless of age or ability. The input received during the public engagement process has informed project design.

Any questions or concerns that stakeholders had for parts of the project within the Bylaw 788 boundary were addressed in this EIA with suggested mitigation measures, if measures had not already been included in project design.

7.9 Summary Assessment and Conclusions

The City of Edmonton (COE), in partnership with River Valley Alliance (RVA), proposes to improve overall connectivity and access to the North Saskatchewan River and river valley via mechanized means through the River Valley Mechanized Access project. That project will connect the top-of-bank at 100 Street in downtown Edmonton to the existing river alley SUP network through a transportation system that is accessible to all Edmontonians and visitors to Edmonton, regardless of age or ability. The proposed RVMA project comprises a funicular, urban stair and express stair on McDougall Hill, connecting to a promenade and pedestrian bridge across Grierson Hill Road, and an elevator will connect the pedestrian bridge to the existing SUP on the lower valley terrace.

Of the proposed project activities likely to have noticeable effect on the biophysical or socioeconomic environment, two related to slope stability and visual resources were rated as major while several others, including hydrology, vegetation, wildlife, habitat connectivity and traffic were rated as minor. One related to worker and public safety was rated as minor to major. In addition, one related to residential land use, two related to recreational land use and one related to visual resources were rated as positive.

Based on design development, residual major impacted related to slope stability may result from RVMA construction and operation, particularly on McDougall Hill. This concern will likely be mitigated during project detailed design when additional slope stability analyses will be conducted by a geotechnical engineer to minimize the potential for slope instability during RVMA construction and operation.

Minor residual impacts related to hydrology, vegetation, wildlife, habitat connectivity and traffic will results from the proposed project. Surface drainage patterns/volumes will change due to the addition of impermeable hard surface to the project area compared to the existing natural condition. Overall, the intent is to provide a sustainable approach to drainage through the use of vegetated swales and associated drain pipes, rain gardens, conventional deck drainage and planted areas so that surface water flows are managed to minimize overland flow downslope and into the City storm water system.

The proposed project footprint will occupy approximately 0.45 ha, 0.14 ha (31%) of which is native vegetation. All vegetated areas on City-owned lands in the project area will be assessed for compensation value prior to removal by the City of Edmonton Forestry department pursuant to the City of Edmonton Corporate Tree Management

Policy (C456). No special status plant species will be adversely impacted by the proposed project.

It is likely staging and construction areas in the local area may block or impede wildlife movement because the project will be oriented perpendicular to expected wildlife movement in the area, particularly south of Grierson Hill Road along the river. Urban-adapted wildlife will be able to utilize adjacent shrubby and forested river terrace habitat on McDougall Hill and south of Grierson Hill Road to move around the site as they would be accustomed to moving through this existing area of human activity. Animals may, however, avoid the project area during construction and use alternative routes through adjacent contiguous vegetated areas, particularly along the river south of Grierson Hill Road.

Minor residual impacts related to habitat connectivity will result from placement of the new permanent RVMA project components on McDougall Hill. While those components will bisect habitat on the slope, the funicular and urban stair will be raised 1.2 m above grade and the adjacent security fencing will be installed so that there is a 10 cm gap under the fence. This should increase permeability of the infrastructure on the slope to small- to medium-sized animals such as mice, voles, weasels and hares if they wish to cross under the 9 m wide funicular and urban stair structure. Medium-sized animals such as coyotes would likely not be able to pass under the fences if they wish to cross the middle of the slope, but, as they are accustomed to doing elsewhere in the urban environment, they would be able to move around the structure by passing under the new pedestrian bridge and along the slope to the south of the promenade structure. The promenade structure will be located approximately 29 m upslope from Grierson Hill Road, which will assist in maintaining habitat connectivity on McDougall Hill and should provide enough space for animals to move through the area without being forced onto McDougall Hill Road.

In the short term, construction traffic may negatively affect traffic and parking in the vicinity of the project area. Construction traffic is expected to be relatively infrequent; however, temporary road closures will be required during some construction activities, such as placing bridge girders over Grierson Hill Road for the pedestrian bridge. Staging areas will be located in manicured roadway medians and roadsides of Rossdale Road, McDougall Hill Road and Grierson Hill Road. Construction workers will park at staging areas. Traffic sightlines will be considered when establishing staging areas to ensure sightlines remain as unobstructed as possible.

Minor to major residual impacts related to worker and public safety will result from construction of the proposed project. Specifically, there are known homeless communities with temporary camps set up on McDougall Hill in the proposed project area. Construction would put these people at risk of personal injury. To minimize the risk of personal injuries, the City and/or successful contractor will contact appropriate agencies before project construction begins so that measures can be taken to accommodate relocation of affected individuals and provide contact with appropriate relief agencies and/or social workers.

Major residual impacts related to visual resources will result during the construction phase of the proposed project. In the short term, the aesthetics of the project area will be adversely affected during construction, as construction work will include some vegetation clearing within the project footprint, the use of heavy equipment, and the establishment of staging areas near major roadways and shared-use paths. Efforts will be made to minimize vegetation clearing, and clearing will be delayed until just prior to the onset of construction to minimize the duration of the disturbance. Screened fencing will be used to screen views of active construction and staging areas.

Positive, major and permanent residual impacts to residential land use, recreational land use and visual resources will result from construction of the proposed RVMA project. Overall the project will provide improved accessibility and connectivity between downtown Edmonton and the North Saskatchewan River Valley for all nearby residents and recreationalists. In addition, the proposed project will provide additional recreational amenities in the Central Area of the river valley as well as improve overall access to river valley views.

Overall, the positive long-term and permanent impacts of the proposed RVMA project will outweigh the short-term inconveniences of project construction activities. The proposed RVMA project will provide improved access to existing river valley amenities for all potential users, regardless of age and ability. Project components will contribute to a vertical park on McDougall Hill, effectively connecting downtown Edmonton to the river valley, with opportunities for recreationalists to linger, while maintaining a well-used non-motorized commuter route. Barrier free access to the cantilevered lookout will promote unrestricted views of the river valley. At the same time, the proposed project acknowledges the natural value and preserves the integrity of the river valley environment.

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8.2 Personal Communications

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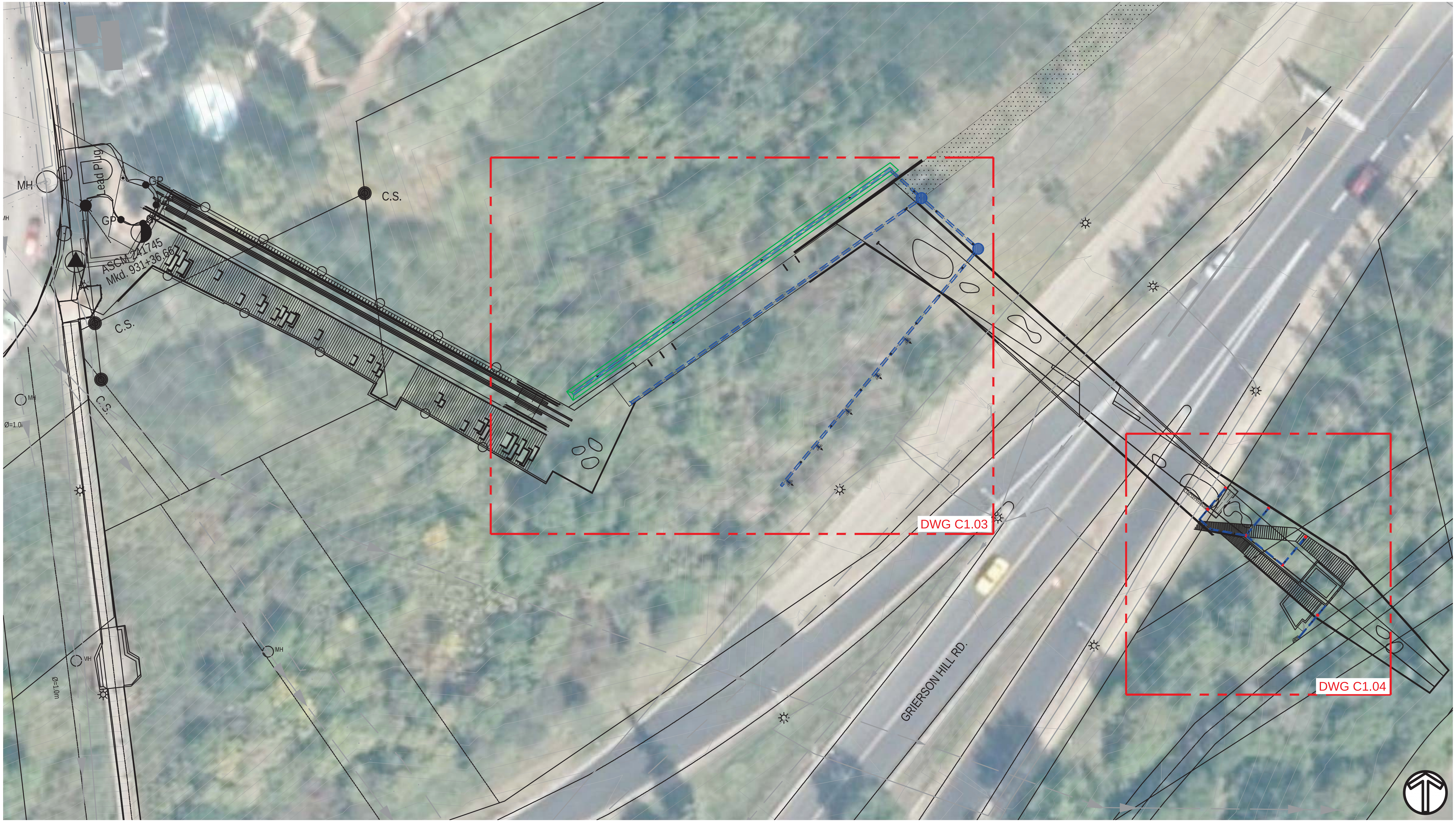
Kershaw, L, M.Sc. Plant Ecologist

Appendix A: Drainage Approach for River Valley Access Edmonton



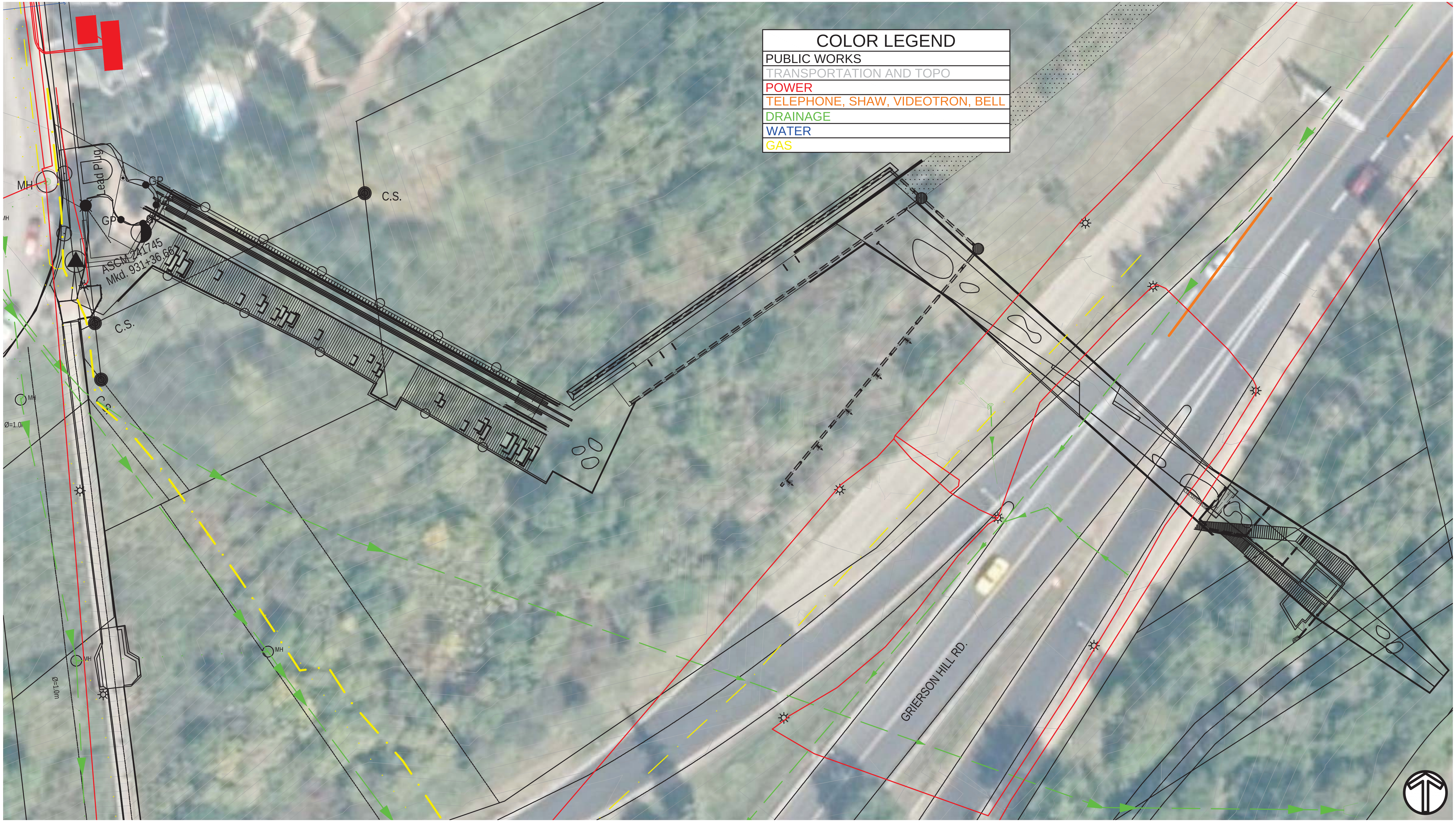
Hatch Mott MacDonald

RIVER VALLEY MECHANIZIED ACCESS

Drawn By: B.T.
Designed By: G.T.
Checked By: G.T.
Date Issued: 09-NOV-2015
Scale: 1:500

CIVIL OVERALL SITE PLAN

C1.01



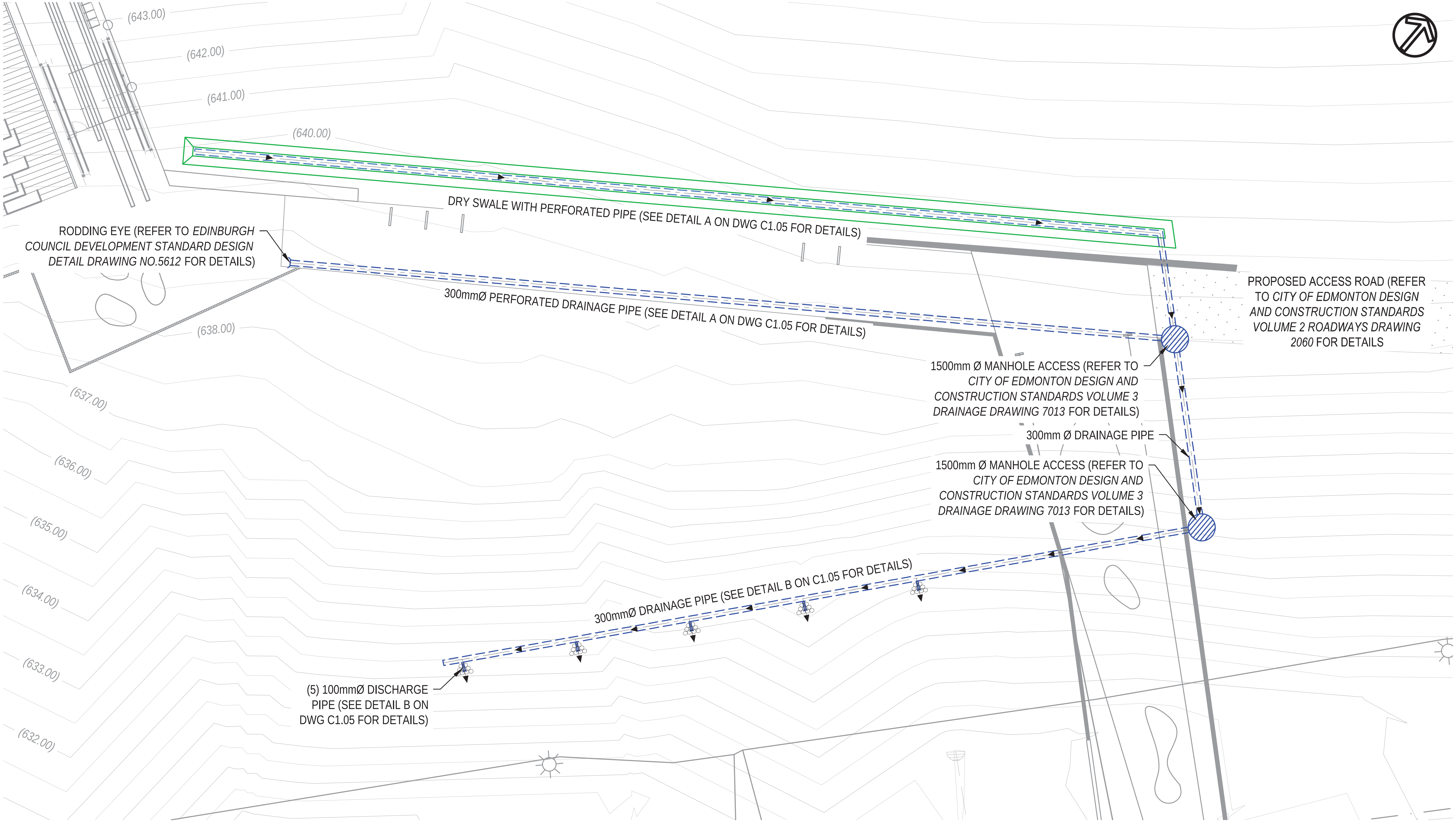
Hatch Mott MacDonald

RIVER VALLEY MECHANIZIED ACCESS

Drawn By: B.T.
Designed By: G.T.
Checked By: G.T.
Date Issued: 09-NOV-2015
Scale: 1:500

CIVIL OVERALL UTILITY PLAN

C1.02



Hatch Mott MacDonald

RIVER VALLEY MECHANIZIED ACCESS

Drawn By: B.T.
Designed By: G.T.
Checked By: G.T.
Date Issued: 09-NOV-2015
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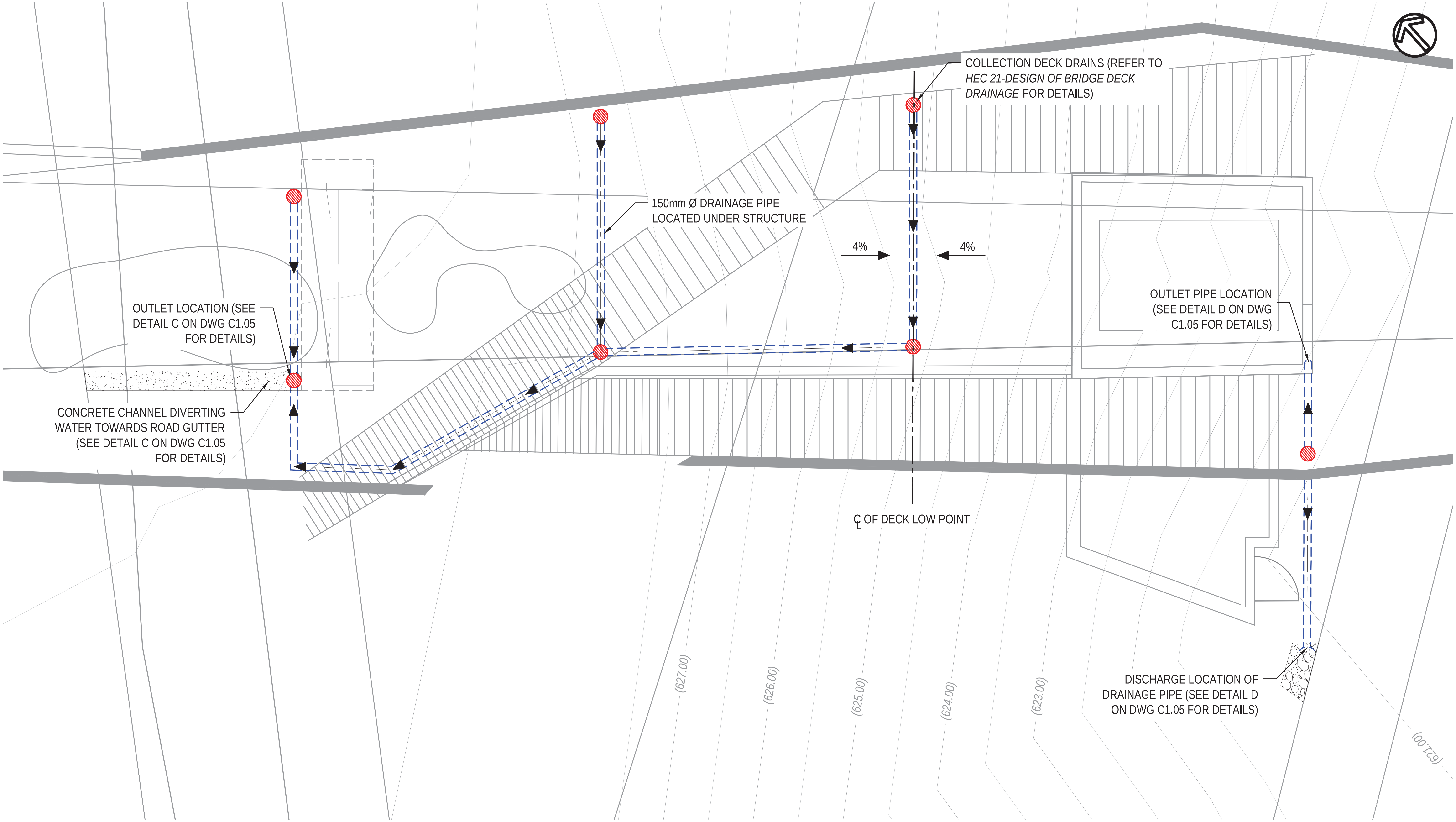
CIVIL OVERALL SITE PLAN
MAIN BOARDWALK
DRAINAGE PLAN

C1.03


COLLECTION DECK DRAINS (REFER TO *HEC 21-DESIGN OF BRIDGE DECK DRAINAGE* FOR DETAILS)

150mm Ø DRAINAGE PIPE LOCATED UNDER STRUCTURE

OUTLET LOCATION (SEE DETAIL C ON DWG C1.05 FOR DETAILS)

CONCRETE CHANNEL DIVERTING WATER TOWARDS ROAD GUTTER (SEE DETAIL C ON DWG C1.05 FOR DETAILS)

OUTLET PIPE LOCATION (SEE DETAIL D ON DWG C1.05 FOR DETAILS)

DISCHARGE LOCATION OF DRAINAGE PIPE (SEE DETAIL D ON DWG C1.05 FOR DETAILS)

℄ OF DECK LOW POINT

Hatch Mott MacDonald

RIVER VALLEY MECHANIZIED ACCESS

Drawn By: B.T.
Designed By: G.T.
Checked By: G.T.
Date Issued: 09-NOV-2015
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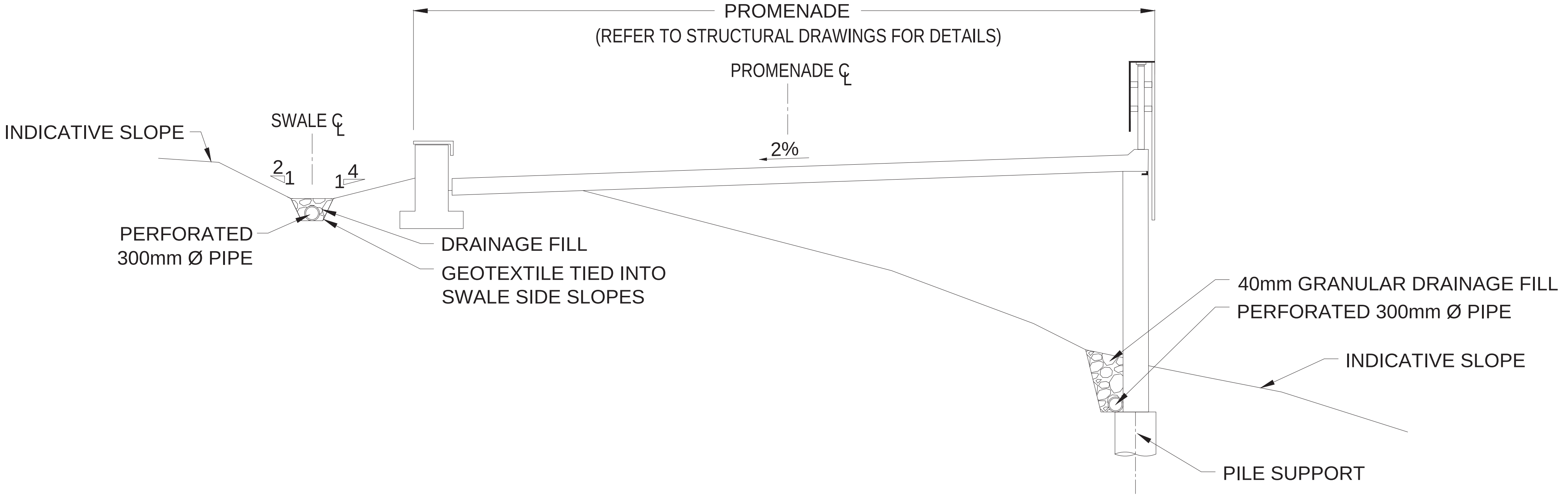
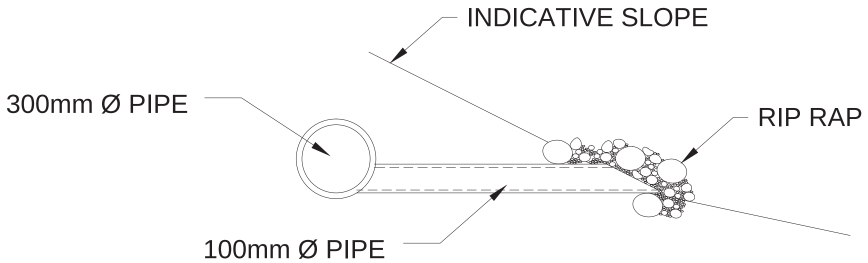
CIVIL OVERALL SITE PLAN
BOARDWALK LOOK OUT
DRAINAGE PLAN

C1.04



A
C1.03
PROMENADE CROSS SECTION
N.T.S



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OUTLET CROSS SECTION
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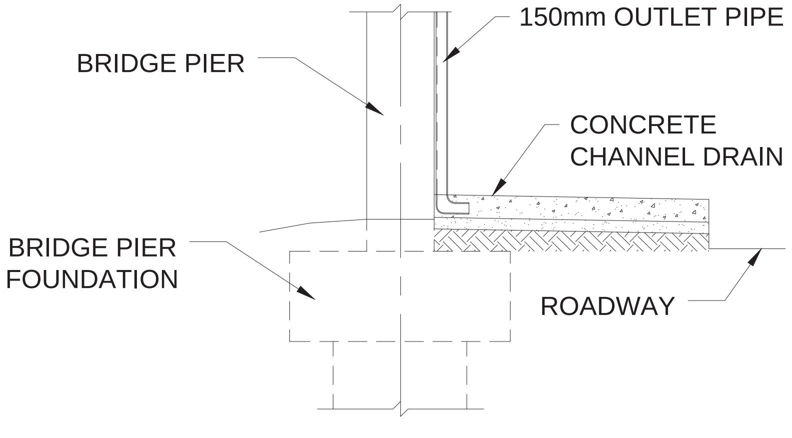

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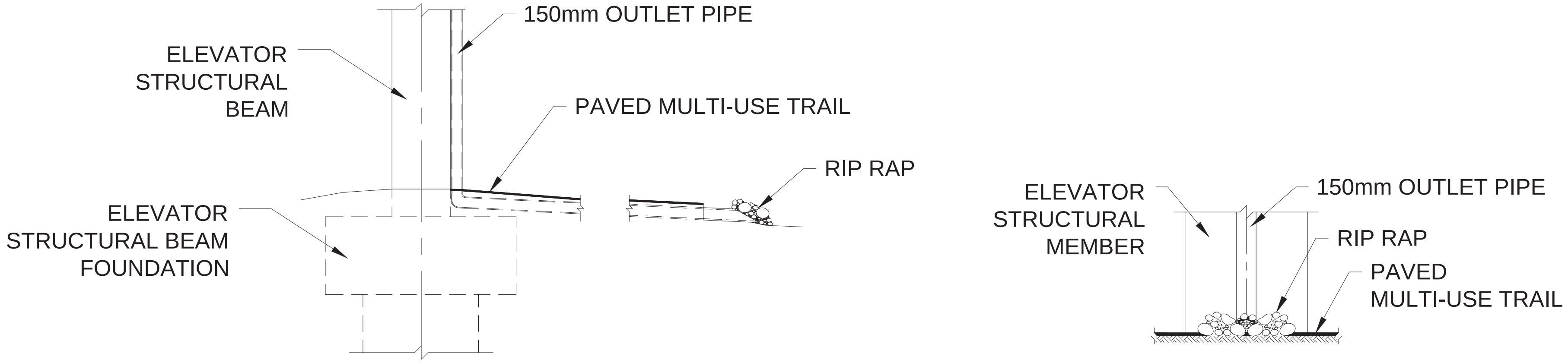
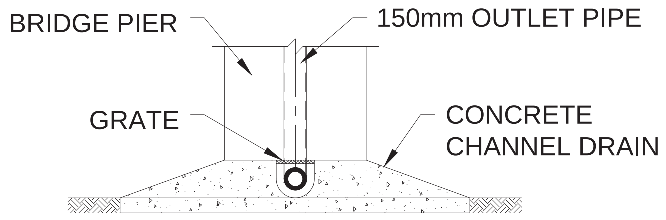


SIDE VIEW

FRONT VIEW

D
C1.04
DRAINAGE OUTLET AT ELEVATOR COLUMN
N.T.S



FRONT VIEW

C
C1.04
DRAINAGE OUTLET AT BRIDGE PIER
N.T.S

Hatch Mott MacDonald

RIVER VALLEY MECHANIZIED ACCESS

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Designed By:	F.B.
Checked By:	G.T.
Date Issued:	09-NOV-2015
Scale:	N.T.S.

CIVIL OVERALL DETAILS

C1.05

Appendix B: Public Consultation Description for the Proposed RVMA Project

Mechanized River Valley Access

Public Engagement Report

April 2015

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Background

The North Saskatchewan River Valley is North America's largest urban park with a total area of more than 7,200 hectares (approximately 18,000 acres). With more than 160 kilometres of maintained pathways and 20 major parks, the River Valley offers citizens unparalleled opportunities to connect to nature, get outside and to go play. The City of Edmonton has partnered with the River Valley Alliance (RVA) on *River Valley Connections*, which is the next significant step in creating a world-class, connected river valley park. Once complete, the project will increase access to and connectivity throughout the river valley.

River Valley Alliance

The River Valley Alliance (RVA) is a non-profit group formed by the seven Alberta Capital Region municipalities bordering the North Saskatchewan River. Their mission is to protect, preserve and enhance the river valley park system from Devon to Fort Saskatchewan.

A 16-member board of directors governs the RVA with representatives from each member municipality. Its three primary goals are:

- To coordinate river valley planning and development within the seven member municipalities.
- Ensure plans respond to and balance the social, recreational, environmental, and economic needs of Capital Region residents.
- Raise funds to bring these plans to reality.

In 2012, the RVA announced $90 million in capital funding for 18 capital region projects to improve public access to, and connectivity within the regional river valley park system. Of the total amount, $72.9 million has been allocated by the RVA for projects within Edmonton.

Funding breakdown

The River Valley Alliance (RVA) provides $48.6 million in funding to the City of Edmonton for River Valley Capital Projects. The RVA funds are sourced from the Government of Canada ($24.3 million) and the Government of Alberta ($24.3 million). The Government of Alberta provided an additional $22.6 million and the City of Edmonton contributed $1.7 million to the projects. [1]

River Valley Connections

In total, $72.9 million in funding has been allocated towards a number of projects, which are grouped into five initiatives. The five initiatives are:

1. **Terwillegar Park Footbridge:** This 262-metre long footbridge link Terwillegar Park in the southwest to River Valley Oleskiw on the north side of the river.

2. **West End Trails:** This initiative will add approximately five kilometres of primary (paved) and secondary (gravel) trails to the river valley main spine trail in Terwillegar Park and River Valley Oleskiw.

3. **East End Trails:** This initiative will develop approximately 16 kilometers of trails in east Edmonton.

4. **Boat Launches and Docks:** Three boat launches and seven docks will be added throughout the river valley for public use.

5. **Mechanized River Valley Access and Touch the Water:** These two initiatives will help increase access to the river valley from the downtown core and will enhance connections to the trail system and the North Saskatchewan River.

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[1] Revised document August 2015- clarified information on funding.

Mechanized River Valley Access

Since 2012, several options have been discussed with City Council to determine how best to implement a mechanized access feature into the river valley.

The City has been studying the feasibility for a mechanized access project that will connect the downtown core to the North Saskatchewan River valley. Based on this study, the City is recommending the construction of a funicular.

Funiculars are cable-propelled systems that haul a car over an inclined track. In addition to the funicular, the project will include an outdoor elevator, an innovative urban staircase and other design features including viewpoints and lookouts. The project will allow people to walk from our vibrant downtown to connect with nature within minutes.

The funicular was selected from among a number of types of mechanized systems that have been built in urban environments to transport people between higher and lower elevations.

Funiculars:

- Safely transport groups of wheelchairs, cyclists, pedestrians and others up and down the river valley bank.
- Have less maintenance and operational requirements than outdoor escalators and gondolas.
- Are not susceptible to strong winds.
- Have a smaller footprint, which allows them to fit in the limited space at the top of the bank.
- Provide full accessibility, unlike chairlifts and escalators.
- Are more economical than other fully accessible systems.

The total budget for the Mechanized River Valley Access project is $24 million.

Stakeholder Consultation

A public open house was held at City Hall on April 8, 2015, between 11:00 a.m. and 2:00 p.m. and between 4:00 p.m. and 8:00 p.m. City of Edmonton staff and project contractors were available to answer questions from members of the public. The open house was attended by approximately 200 people. Display boards and comment forms were available in City Hall from April 7 to April 10, 2015.

An online survey was also conducted to obtain feedback. The survey was available from April 7 to April 26, 2015. Both the open house and the online survey were advertised through a public service announcement, online ads, print publications, and through the City of Edmonton's social media accounts and website. Additionally, a road sign was placed near the existing staircase at the proposed project site to further promote the online survey. Five hundred and thirty nine (539) responses were received from both the open house and online survey.

What We Heard

Participants of the open house and the online survey were asked a single, open-ended question about the project:

"*The Mechanized River Valley Access initiative aims to connect Edmonton's downtown to the existing river valley trail system. The project will include innovative urban design that will facilitate access to the river valley and allow people to travel from our vibrant downtown to connect with nature within minutes*.

The City has been studying the feasibility for a mechanized access project that will connect the downtown to the river. Two alignments have been explored. The City's consultants are recommending the east alignment. What are your thoughts?"

Although the responses received were diverse, several key themes emerged from the completed questionnaires. These were:

Overall support for the initiative

A majority (approximately 2/3) of the 539 responses indicated support for the initiative. Edmontonians are passionate about the river valley and many of those who participated in the survey were pleased to see the City taking initiatives to assist individuals of all abilities to access and enjoy Edmonton’s river valley. Several commenters identified themselves as wheelchair users, bicyclists, or parents with strollers who believe the mechanized access would increase their ability to use and enjoy the amenities within the river valley.

Many commenters also felt the funicular could act as a destination point and potential tourist attraction in the river valley. Several respondents made reference to their positive experiences with funiculars in other cities around the world.

Concern about costs

Although most of the feedback was supportive, a number of comments objected to construction of the project due to the estimated construction costs, even despite the available grant money. These respondents feel that if returned to the funding partners, the money could be reallocated to areas they believe to be of greater importance, such as street maintenance, debt reduction or lowering taxes.

A number of comments from those opposed to the project also raised concerns about the ongoing maintenance and operational costs associated with the funicular. They believe these costs could be quite high, and may ultimately be higher than the initial construction costs. Some believe that users could be charged a nominal fee for using the funicular as a way to recoup these operating costs.

Preference for the east alignment

Of the respondents that expressed a preference between the two proposed alignments, a strong majority is in favour of the east alignment. This preference is based on two main factors:

A preferred destination: Most of the comments in favour of the east alignment cited a preference for this alignment because the urban staircase and outdoor elevator would terminate in the river valley and would allow users immediate access to the trail system.

Preferential viewpoints: Respondents also expressed preference for the views and viewpoints offered by the east alignment rather than those offered by the west alignment.

A small number of individuals indicated a preference for the west alignment. These respondents felt the destination point in the traffic circle would allow for an easier connection to the transit system as well as to the pedestrian river crossing.

It is important to note that many of the commenters that expressed a preference for an alignment did not necessarily support the overall initiative. Many respondents believe the initiative will ultimately be built and thus provided their preference.

Maintain access to the existing staircase during construction

Several comments asked the City to ensure access to the existing staircase during the construction period.

Safety concerns

A number of individuals expressed safety concerns about the alignments. It was noted that the landing area of the east alignment will be quite dark during the winter months, potentially creating a safety hazard. Concerns were also raised about the proximity of the west alignment to a major roadway.

Other responses expressed concern about the possibility for vandalism and the prevalence of drug use in the river valley.

Desire to ensure accessibility

Many commenters were very positive about the impact of the funicular on accessibility to the river valley. However, they noted that currently, neither of the proposed destination points are used or accessed by people with reduced mobility. They asked the City not to ignore the accessibility of the area surrounding the funicular.

A desire to preserve the natural look of the river valley

A small number of commenters expressed concern about the impact of the project on the natural aspects of the river valley. The concerns generally fell into two categories: concerns about the environmental impact of building the mechanized access and concerns about the impact on the natural "look and feel" of the river valley.

Parking concerns

A number of respondents raised concerns about the availability of parking near the site of the proposed funicular. These respondents believe that a lack of parking could lead either to congestion near the funicular or low user numbers due to restricted access to the area.

A desire for commercial development near the Mechanized River Valley Access

A number of individuals asked the City to consider allowing the development of a small-scale, locally-owned and non-chain restaurant or coffee shop. While several of the comments recognized that part of the river valley's charm lies in its undeveloped nature, the proximity to the downtown core and the relatively high level of disturbance in this area of the river valley are factors that would lend well to this type of development in this location.

Conclusion

On the whole, Edmontonians are quite supportive of the Mechanized River Valley Access initiative and many are excited about the prospect of this unique addition to the amenities available in the river valley. They believe that a funicular would help to increase access to the river valley for people of all abilities as well as cyclists, parents with strollers and others who can’t use the existing staircase. They also strongly prefer the proposed east alignment to the proposed west alignment due to its destination along the river valley trail system rather than near the Grierson Hill road interchange.

The input received from this public engagement will help inform and guide the design of the project. The City anticipates that additional public and stakeholder engagement activities will occur at later stages of the project. More information on the status of this project, as well as the other *River Valley Connections* initiatives can be found online at edmonton.ca/rivervalleyprojects.

All inquiries related to the Mechanized River Valley Access initiative can be directed to Rob Marchak Director Strategic Projects, at rob.marchak@edmonton.ca.

Appendix C: Geotechnical Assessment for the Mechanized River Valley Access Project

Contents:

THURBER ENGINEERING LTD.

MECHANIZED RIVER VALLEY ACCESS PROJECT
CITY PROJECT # CP-3592
EDMONTON, ALBERTA
STAGE 2 - GEOTECHNICAL INVESTIGATION

Report

to

Dialog

STEPHEN E. COULTER
11/12/

Stephen Coulter, P.Eng., P.E.
Project Engineer

PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
Signature
Date November 12, 2015
PERMIT NUMBER: P 5186
The Association of Professional Engineers,
Geologists and Geophysicists of Alberta

RENATO V. CLEMENTINO
12 NOV 15

Renato Clementino, Ph.D., P.Eng.
Review Principal

Date: November 12, 2015
File: 19-5861-24

THURBER

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1. INTRODUCTION

This report presents the results of a geotechnical investigation carried out by Thurber Engineering Ltd. (Thurber) for the proposed Mechanized River Valley Access (MRVA) Project located on the north side of the North Saskatchewan River valley directly south of the Hotel Macdonald in Edmonton, Alberta.

Thurber has previously prepared Desktop Geotechnical Assessments for the proposed West and East Alignments of the project, dated January 27, 2015 and April 1, 2015, respectively. These reports presented the results of a review of available geological maps, air photo interpretation, and a preliminary evaluation of geotechnical conditions.

This work was carried out in general accordance with our proposal letter to Mr. Sean Brown, P. Eng. of Dialog dated March 30, 2015.

It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

2. PROPOSED DEVELOPMENT

At present, it is understood that the City of Edmonton (City) is planning to construct the project along one of two alignments, as shown on Drawing No. 19-5861-24-1 in Appendix A, and described below:

- The West Alignment consists of an inclined elevator with adjacent stairs starting immediately south of the Hotel Macdonald to lower McDougall Hill Road with either a pedestrian bridge or extension of the inclined elevator across lower McDougall Hill Road (previously referred to as the Option 1A/1B alignment).
- The East Alignment consists of an inclined elevator with adjacent stairs starting immediately south of the Hotel Macdonald descending to the southeast before switching to a boardwalk structure paralleling Grierson Hill, before crossing it via a bridge structure and terminating at the existing pedestrian path on the north side of the river.

The previously mentioned desktop geotechnical studies, with the various identified route options, provided information for the City of Edmonton to understand the importance of the geotechnical constraints of each option. This previous work was termed as Stage 1 of the geotechnical investigation.

The results of the Stage 1 report allowed further option refinement and as a result, it was decided that the Stage 2 program should consist of a more detailed geotechnical investigation. This Stage 2 program included field investigation, instrumentation installation, laboratory testing, and monitoring, and preparation of this report.

3. METHODOLOGY

3.1 Field Program

The field investigation program consisted of the drilling of eight test holes. Three of the test holes (TH15-1, TH15-3, and TH15-4) were drilled between January 28 and February 2, 2015 as Phase 1 of the field investigation. The remaining five test holes (TH15-2 and TH15-10 through TH15-13) were drilled between April 15 and April 20, 2015 as Phase 2 of the field investigation. The approximate locations of the test holes are presented on Drawing No. 19-5861-24-1 in Appendix A. Survey support for the test hole locations was provided by Opus Stewart Weir Ltd. Of Sherwood Park, Alberta, under contract to Dialog.

The Phase 1 test holes were drilled by Mobile Augers and Research Ltd. (MARL) of Edmonton, Alberta using track mounted drill equipment. The Phase 2 test holes were drilled by a combination of truck and track rig drill equipment by MARL and All Service Drilling Ltd. (ASD) of Nisku, Alberta. All holes were drilled using solid stem augers, with the exception of TH15-2 that was drilled with a combination of solid stem augers in the overburden soil and wet rotary coring in the underlying bedrock. The test holes were drilled to varying depths between 14.9 m and 22.4 m below existing grade.

Prior to commencing the field drilling program, the test holes and site access were laid out during several site reconnaissance visits between January and April 2015. The locations of the test holes were cleared of underground utilities through Alberta One-Call. Work within the river valley was completed following the review and acceptance of an Initial Project Review (IPR) by the City of Edmonton Department of Sustainable Development. A portion of the Phase 2 work was completed following the clearing of trees and brush by the City of Edmonton Department of Urban Forestry.

The advancement of the test holes were supervised by a qualified Thurber field technician. Disturbed samples were taken from rock coring and solid stem auger flights during the test hole drilling. Standard Penetration Tests (SPT) were carried out at selected depths in all test holes. The undrained shear strength (Cpen values) of cohesive soil samples was estimated at select locations using a pocket penetrometer.

Seepage and water levels in the test holes were recorded during and immediately after drilling. Upon completion of the drilling, PVC standpipe piezometers (SP) were installed in three test holes (TH15-4, TH-12, and TH15-3), and slope inclinometer (SI) casing and vibrating wire piezometers (VWP) were installed in the remaining five test hole locations, as shown on the test hole logs, provided in Appendix B.

The SP instrumented holes were backfilled with filter sand and drill cuttings, and were capped with bentonite chips near the ground surface. The SI/VWP instrumented holes were backfilled with cement grout with bentonite chips near the ground surface. Steel stick-up or flush mount protectors, as required, were installed over the instruments. Groundwater levels in SPs and VWPs, along with SI readings were measured immediately after installation, as well as on March 16, April 14, and June 16, 2015.

The results of the geotechnical drilling and field tests, and the details of the piezometer and SI installations and groundwater level readings are summarized on the test hole logs included in Appendix B.

In addition, Thurber has collected VWP and SI readings from two test holes (11BH-01 and 11BH-06) installed in the project vicinity by EBA Engineering Consultants Ltd. (now Tetra Tech EBA Inc.) in 2011 for the future expansion of the adjacent Shaw Conference Centre (SCC). The location of these test holes are presented on Drawing No. 19-5861-24-1 in Appendix A. The logs for these test holes are also presented in Appendix B. Permission to access and monitor these instruments was granted to Thurber by Lisanne Lewis of the SCC. Historical readings and installation details of these instruments were provided to Thurber by Randall McGilvray of EBA Tetra Tech under direction from SCC.

3.2 Laboratory Program

Laboratory testing consisted of visual classification and determination of the natural water content of all soil samples. Atterberg limits and grain size distributions were determined for selected soil samples. Direct shear tests were undertaken for select core and Shelby tube samples. Water-soluble sulphate tests were also carried out on selected samples collected from the test holes to determine the appropriate cement type for the proposed bridge design. The results of laboratory tests are summarized on the test hole logs in Appendix B and individual test results are provided in Appendix C.

4. SITE DESCRIPTION

4.1 Surface Conditions

4.1.1 West Alignment

The West Alignment features an existing wooden staircase that descends from 100 Street at the Hotel Macdonald down the river valley slope to the bottom of Grierson Hill in the vicinity of the Low Level Bridge as shown in Drawing No. 19-5861-24-1 in Appendix A. Overall, the hill is vegetated with brush and low lying trees and appears very steep at a slope of approximately 1H:1V to 2H:1V. At the bottom of the hill the alignment will cross Lower McDougall Hill Road with either a pedestrian bridge or the extension of the inclined elevator to access the existing pedestrian path on the north side of the river.

4.1.2 East Alignment

The East Alignment shares a common starting point with the West Alignment but descends down the same hill in a southeasterly direction as shown in Drawing No. 19-5861-24-1 in Appendix A, where eventually the slope begins to flatten out and a flat terrace area is present in the midslope elevations where the inclined elevator portion of the project is expected to terminate. It is expected that the boardwalk portion of the proposed alignment will follow this midslope ridge before turning towards the river and an elevated pedestrian bridge structure that will cross Grierson Hill Road. At the southern terminus of the alignment, where an elevator and staircase structure is planned there is a slope descending from the Grierson Hill Road level to the asphalt pedestrian path and river bank.

4.2 Bedrock and Surficial Geology

The bedrock and surficial geology is discussed in detail in the Desktop Geotechnical Assessment Reports.

In summary, the project area is located on the North Saskatchewan River Valley slope between a plateau on which Edmonton downtown was built and the North Saskatchewan River bed. In this area, three major surficial geological units are present at the ground surface. The topographically uppermost unit are glaciolacustrine deposits underlain by glacial till. The lowermost unit is the recent alluvium of the North Saskatchewan River. Between those two units is a colluvium unit covering the valley slope.

According to the recent maps published by Alberta Geological Survey, the bedrock topography elevation at the site is between 625 m and 645 m aMSL. The bedrock is from the Edmonton formation consisting of interbedded clay shale, sandstone, siltstone and coal layers.

The study area is at the edge of the extent of an area of glaciolacustrine deposits and at this location these deposits may be very thin or not present at all. The glaciolacustrine deposits are composed of bedded silt and clay with minor sand. The underling till material is composed of mixed clay, silt and sand with pebbles and boulders, and lenses of sand and gravel.

Alluvium is located along both sides of the North Saskatchewan River, and both portions belong to one geological unit. The alluvium is the youngest geological unit in area and the youngest terrace of the North Saskatchewan River. At the project site, the alluvium is composed of coarse clayey gravel with clay layers overlaid by cross bedded silt. The alluvium deposits commonly contain coal, cobles, and occasional boulders.

Colluvium is weathered, gravitationally moved and re-deposited material located on the valley slope. The origin of the colluvium are surficial and bedrock deposits depending on their location within the river valley.

4.3 Landslide Activity

Because of the heavy development of the site, it was difficult to identify specific landslide related features.

For the West Alignment, locally developed small landslides within the alluvium deposits on the bank of the North Saskatchewan River Bank were possible to be identified; however, these are located far enough from the area of interest to be of concern. Additionally an area of creep and probably groundwater seepage is visible in the southeast corner of the site within the alluvial deposits.

For the East Alignment, locally developed small active landslides within the alluvium deposits were also identified on the bank of the North Saskatchewan River Bank as well as along Grierson Hill Road. Additionally, an area of inactive landslide body is visible in the central portion of the study area north of Grierson Hill Road and south of Jasper Avenue. The historic aerial photography from 1920 and 1949 shows vegetation and morphology associated with landslide and slope creep movements. The landscaping and grading completed sometime before 1952 leveled and masked most of the surface morphology that could be caused by slope movement, except the major landslide body form. The toe of the landslide body is cut by the Grierson Hill Road creating conditions for the possible reactivation of movement of the landslide; however, to date there is no evidence of slide reactivation.

4.4 Subsurface Conditions

Subsurface conditions encountered during the drilling program are summarized on the test hole logs in Appendix B. A stratigraphic cross section showing the interpreted soil and bedrock conditions encountered in the test holes are also provided on Drawing Nos. 19-5861-24-2 and 19-5861-24-3 in Appendix A for the West and East Alignments, respectively. It should be noted that the interpreted stratigraphy between test hole locations is provided for illustration purposes only, and the actual stratigraphy may vary somewhat from that noted on the drawing.

Further descriptions of the soil conditions encountered during drilling are provided in the following sections.

4.4.1 West Alignment

Four test holes (TH15-1 through TH15-4) were drilled along the West Alignment inclined elevator and bridge sections. Along this alignment, the subsurface conditions consist of a topsoil layer of up to 0.8 m in thickness overlying overburden soils up to 12.9 m thick, overlying clay shale and sandstone bedrock. The overburden colluvium was found to consist of clay and clay till with interbedded sand layers. Within the traffic loop at the southern terminus of the alignment (TH15-4) clay, gravel, and sand fills were encountered to a depth of 4.6 m. Additionally, weak rafted clay shale bedrock was encountered in TH15-2 from a depth of 6.1 m to 7.6 m and coal was encountered in TH15-4 from a depth of 10.7 m to 12.1 m. The major subsurface units are discussed in the following sections:

4.4.1.1 Clay

Clay was encountered beneath the topsoil in TH15-1 and TH15-3 and beneath fill material in TH15-4, extending to a maximum depth of 9.3 m below ground surface. The clay ranged from low to medium plastic, light grey to light brown, and was sandy and silty.

The natural moisture content of the clay samples ranged from approximately 11 percent to 31 percent. SPT ‘N’ values obtained in the clay ranged from 6 to 16 blows for 300 mm of penetration, indicating a firm to very stiff consistency. One Atterberg limits test conducted on a sample of the clay showed a liquid limit of 28 percent and a plastic limit of 23 percent, indicating low plasticity.

4.4.1.2 Clay Till

Clay till was encountered beneath the clay in TH15-1, TH15-3, and TH15-4, as well as directly beneath the topsoil in TH 15-2, extending to a maximum depth of 12.9 m below ground surface. The clay till raged from low to high plastic, brown to dark grey, and contained varying amounts of silt, sand, and gravel.

The natural moisture content of the clay till samples ranged from approximately 6 percent to 28 percent. SPT ‘N’ values obtained in the clay till ranged from 10 to 60 blows for 300 mm of penetration, indicating a stiff to very hard consistency. Atterberg limits tests conducted on four selected samples of the clay till showed a liquid limit ranging from 38 percent to 53 percent and a plastic limit ranging from 15 percent to 24 percent, indicating a medium to high plasticity.

4.4.1.3 Sand

Native sand layers were encountered interbedded within clay till in TH15-1 and TH15-3 in thicknesses up to 2.3 m. The sand was grey, silty, and contained varying amounts of clay and gravel.

The natural moisture content of the sand samples ranged from approximately 11 percent to 21 percent. SPT ‘N’ values obtained in the sand ranged from 15 to 59 blows for 300 mm of penetration, indicating a compact to very dense state. A grain size analysis test of a selected sand sample showed a gravel content of less than 1 percent, sand content of 46 percent, silt content of 47 percent, and clay content of 7 percent.

4.4.1.4 Bedrock

Clay shale and sandstone bedrock was encountered beneath the varying overburden soils from depths varying from 9.9 m to 12.7 m. Rafted bedrock was encountered in TH15-2 from a depth of 6.1 m to 7.6 m. Clay shale was grey to brown, silty, sandy and featured coal and sandstone laminations. Thinner sandstone layers were grey, fine grained, silty, and featured clay shale laminations.

The natural moisture content of the bedrock samples ranged from approximately 12 percent to 44 percent. SPT ‘N’ values obtained in the clay till ranged from 21 to 85 blows for 300 mm of penetration, indicating a very stiff to very hard consistency in soil mechanics terms. Atterberg limits tests conducted on four selected samples of the clay till showed a liquid limit ranging from 71 percent to 127 percent and a plastic limit of 27 percent, indicating a high plasticity.

4.4.1.5 Fills

In TH15-4, clay fill was encountered beneath the topsoil and extending to a depth of 3.0 m, overlying gravel and sand fill to a depth of 4.5 m.

The natural moisture content of fill samples ranged from 10 percent to 18 percent. SPT ‘N’ values obtained in the fills ranged from 10 to 17 blows for 300 mm of penetration, indicating a stiff to very stiff consistency for clays and a compact state for granular soils. A grain size analysis test of a selected granular fill sample showed a gravel content of 30 percent, a sand content of 50 percent, and a fines (clay and silt combined) content of 20 percent.

4.4.2 East Alignment

For the East Alignment an additional four test holes (TH15-10 through TH15-13) were drilled to explore the subsurface conditions along the boardwalk and pedestrian bridge sections. These four test holes augment TH15-1 and TH15-2, which were also used to develop the stratigraphic cross-section in the inclined elevator section. The following sections discuss the subsurface conditions for the East Alignment for these additional holes, as well as for the EBA test hole 11BH-01 which has been used to understand the subsurface conditions at the southern terminus of the alignment where a bridge abutment/pier/stairway structure is proposed.

For the East Alignment boardwalk the subsurface conditions consist of shallow (less than 2.2 m depth) clay shale and sandstone bedrock with interbedded coal along the midslope ridge (TH15-10 and TH15-11) overlain by topsoil and clay. In the vicinity of Grierson Hill Road (TH15-12 and TH15-13) the subsurface consists of alternating layers of clay till and sand and gravel extending to a maximum depth of 7.7 m overlying clay shale and sand stone bedrock. At the southern terminus of the alignment (11BH-01) the subsurface consists of clay overlying clay till extending to a depth of 7.5 m overlying clay shale and sandstone bedrock. The major subsurface units are discussed in the following sections:

4.4.2.1 Clay

Clay was encountered beneath thin layers of topsoil in TH15-10 and TH15-11 and from the surface in 11BH-01. The depth of the clay in the boardwalk area ranged from 0.6 m to 2.2 m, with decreasing depth to bedrock towards the east. The clay at the 11BH-01 location extended to a depth of 3.0 m below ground surface. The clay ranged from low to high plastic, brown to grey and was silty with traces of sand.

The natural moisture content of the clay samples ranged from approximately 22 percent to 29 percent. SPT 'N' values obtained in the clay ranged from 8 to 10 blows for 300 mm of penetration, indicating a stiff consistency. One Atterberg limits test performed by Thurber and one Atterberg limits performed by EBA showed a liquid limit ranging from 31 percent to 62 percent and a plastic limit of 23 percent, indicating low to high plasticity.

4.4.2.2 Clay Till

Clay till was encountered directly beneath the topsoil in TH15-12 and TH15-13 and beneath the clay in 11BH-01 extending to a depth of 7.6 m. A clay till layer was also encountered at a depth of 9.1 m interbedded within the bedrock in TH15-13. The clay till raged from low to medium plastic, brown to dark brown, and contained varying amounts of silt, sand, and gravel.

The natural moisture content of the clay till samples ranged from approximately 3 percent to 11 percent. SPT 'N' values obtained in the clay till ranged from 9 to 21 blows for 300 mm of penetration, indicating a stiff to very stiff consistency. One Atterberg limits test conducted on a sample of the clay tills showed a liquid limit of 33 percent and a plastic limit of 16 percent, indicating medium plasticity.

4.4.2.3 Sand and Gravel

Sand and gravel layers were encountered interbedded with the clay till in the vicinity of Grierson Hill Road extending to the bedrock layers at a maximum depth of 6.1 m. The sand and gravel ranged from brown to grey, featured fine grained sand and gravel and was silty and clayey.

The natural moisture content of the sand samples ranged from approximately 11 percent to 21 percent. SPT 'N' values obtained in the sand ranged from 12 to 23 blows for 300 mm of penetration, indicating a compact state. A grain size analysis test of a selected sand sample showed a gravel content of less 19 percent, sand content of 53 percent, silt content of 20 percent, and clay content of 8 percent.

4.4.2.4 Bedrock

Clay shale and sandstone bedrock was encountered at a maximum depth of 2.2 m in the boardwalk section (TH15-10 and TH15-11), 6.1 m in the vicinity of Grierson Hill Road (TH15-12 and TH15-13) and 7.6 m on the bank of the river at the south end of the alignment. Coal layers were also encountered in the midslope boardwalk area in thicknesses up to 0.8 m. The clay shale was greenish to bluish grey, silty, sandy, and featured coal and sandstone laminations. Thinner sandstone layers were grey, fine grained, sitly, and featured clay shale laminations.

The natural moisture content of the bedrock samples ranged from approximately 12 percent to 46 percent. SPT 'N' values obtained in the clay till ranged from 6 to greater than 100 blows for 300 mm of penetration, indicating a firm to very hard consistency in soil mechanics terms. Atterberg limits tests conducted on three selected samples of the clay shale showed a liquid limit ranging from 72 percent to 104 percent and a plastic limit ranging from 23 to 26 percent, indicating a high plasticity.

4.5 Groundwater Conditions

Sloughing and groundwater seepage were monitored in the test holes during and immediately after drilling. As mentioned previously, the SPs and VWPs were monitored at drilling completion and again on March 16, April 14, and June 16, 2015. The results are summarized in Table 4.1.

TABLE 4.1
TEST HOLE GROUNDWATER CONDITIONS
SUMMARY OF SLOUGHING/SEEPAGE AND GROUNDWATER LEVELS

TEST HOLE	TEST HOLE DEPTH B.G.S. (m)	SLOUGH LEVEL ON COMPLETION B.G.S. (m)	GROUND WATER AT COMPLETION B.G.S. (m)	PIEZOMETER WATER LEVELS March 16, 2015 B.G.S. (m)	PIEZOMETER WATER LEVELS April 14, 2015 B.G.S. (m)	PIEZOMETER WATER LEVELS June 16, 2015 B.G.S. (m)
TH15-1	18.0	15.8	15.8	15.1	15.2	15.0
TH15-2	22.4	N/A	N/A	N/A	16.6	Dry
TH15-3	14.9	14.0	None	8.6	8.9	9.0
TH15-4	14.9	14.0	8.2	11.6	10.1	10.0
TH15-10	14.9	None	9.5	N/A	11.1	11.0
TH15-11	14.9	14.8	10.5	N/A	10.4	10.5
TH15-12	14.9	14.5	5.3	N/A	11.7	9.1
TH15-13	14.9	None	6.7	N/A	11.1	12.1

Note (1) BGS = Below Ground Surface.

Based on the ground water level readings, it appears that the groundwater table is relatively deep and most likely fluctuates in relation to the adjacent river level.

It should be noted that groundwater levels can vary in response to seasonal climate factors and precipitation, hence, the actual groundwater levels in the standpipes may differ at the time of construction and could vary from those recorded during the course of this investigation.

It is recommended that the groundwater levels be recorded prior to construction to determine seasonal ground water fluctuations.

4.6 Slope Inclinometer Monitoring

As previously discussed, slope inclinometers were installed in five test holes. Additionally, Thurber gained access to existing test holes that contained slope inclinometers that were installed by EBA in 2011. EBA also provided Thurber with the installation details as well as the historical readings for these two test holes.

The slope inclinometers were all measured shortly after installation in either February or April, 2015. Additional monitoring events occurred on March 16 and April 14, 2015 for the Phase 1 instruments, and June 16, 2015 for all instruments, including the Phase 2 and the EBA SIs.

The observed deflection plots for each SI are provided in Appendix D. The results show that the slope along the West Alignment (SI15-1, SI15-2, and SI15-3) has been relatively stable since the instruments were installed with a possible small creep movement in SI15-3 at about 2 m to 4 m depth, which should be confirmed with additional reading.

Along the midslope, where the boardwalk will be situated for the East Alignment (SI15-10 and SI15-11) movement has also been negligible in a period of two months.

The EBA installed instruments provide a longer record of monitoring. SI1 is located at the southern end of the East Alignment and the instrument shows negligible movement in the past 4 years since the last monitoring even in July 2011.

Movement at the SI6 location further to the northeast from the immediate project vicinity, the movements have also been relatively small.

It is important to note that the with the exception of EBA`s SI readings, these are relatively short period monitoring, and therefore, it is recommended to continue to monitor the SIs in a periodic bases (once a month) throughout the project to assess the performance of the slope before, during, and after construction.

4.7 Frost Penetration

The medium to high plastic clay, clay till, and clay fill, encountered in the test holes, are expected to have moderate frost susceptibility.

The expected depth of frost penetration has been estimated for the average soil properties for the in-situ materials encountered in the test holes for both the mean annual Air Freezing Index (AFI) and the 50 year return period Air Freezing Index of 1440ºC and 2350ºC days, respectively. Where the clay is continuous from ground surface, the average annual depth of frost penetration is estimated to be about 1.6 m, and the penetration for a 50-year return period is about 2.5 m.

The estimated depth of frost penetration is for a uniform soil type with no insulation cover. The depth of frost penetration will be reduced if turf or snow cover is present.

5. GEOTECHNICAL ASSESSMENT AND RECOMMENDATIONS

5.1 General

The subsurface conditions at the project site pose a challenge for the design and construction of the foundations of the proposed structure due to the relatively steep slope that must be traversed by the inclined elevator. However, the slope appears to be relatively stable, but precautions must be taken to ensure the long term stability of the river valley slope.

The inclined elevator portions of the project for both the East and West Alignments will be founded on overburden clay and clay till soils, with interbedded sand, extending to depths of up to 15 m overlying competent weathered sandstone and clay shale bedrock.

The pedestrian bridge or elevator extension portion of the West Alignment that will travel over Lower McDougall Hill Road will be founded on clay fill and native clay and clay till extending to depths up to 15 m.

The boardwalk portion of the East Alignment will traverse a midslope ridge with very shallow bedrock, which was encountered less than 2.5 m below the ground surface.

The pedestrian bridge for the East Alignment will progress from the southern end of the boardwalk and an area of very shallow bedrock at higher elevation with piers situated on each side of Grierson Hill Road and terminate at the existing pedestrian path on the north side of the river. The subsurface conditions around the piers along Grierson Hill Road consist of approximately 6 m of overburden clay till with interbedded sand and gravel overlying clay shale and sandstone bedrock. The subsurface conditions around the pier and stairway structure at the south end of the East Alignment consist of approximately 8 m of overburden clay and clay till overlying clay shale and sandstone bedrock.

Given the subsurface conditions and in concert with discussions with Dialog with regard to the anticipated loads and construction challenged, it is recommended that the inclined elevator and boardwalk structures be founded on micropiles embedded into bedrock. Due to the presence of the relatively shallow bedrock, helical piles (screw piles) are not recommended. The bridge abutments and piers that would be constructed for the pedestrian bridges over either Lower McDougall Hill Road (West Alignment) or Grierson Hill Road (East Alignment) may be supported on cast-in-place belled piles founded in a competent bedrock layer. Groundwater and subsurface conditions are both favourable for the installation of these foundation types.

The following sections provide recommendations for these foundation types based upon the encountered and observed subsurface conditions, as well as a review and discussion of the overall stability of the valley slope in the project area.

5.2 Temporary Excavations

Open sloped excavations are considered feasible at the project site for bridge abutment, pier and other areas that required underground excavation for the placement of structural elements. Braced excavations may be considered where space is limited due to sloping ground. Due to the relative depth of groundwater it is not expected that a significant amount of dewatering will be required for temporary excavations. Where sand and gravel layers are expected to be encountered some seepage may be expected and can most likely be handled with sump pump operations.

Temporary excavation slopes of 1H:1V may be utilized for design purposes, depending on the expected soil types and depth of excavation. Depending on the extent of sand layers and/or water bearing zones and local seepage volumes, additional flattening of trench slopes and temporary dewatering may also be required. Should these conditions be encountered, the required safe slope cut back angles and mitigation procedures should be established based on field observations by qualified geotechnical engineers.

Excavated spoil material should be kept back from the top of the excavation by at least the depth of excavation. Personnel should not be allowed in the open trenches during installations, without proper safety precautions being taken.

The above recommendations are for design purposes and should not be considered as clearance for Occupation Health and Safety requirements. In all cases, excavations should be consistent with Alberta Occupational Health and Safety Act, Regulation and Code at all time and the Contractor should be responsible for the stability and safety of the excavation.

Care should be taken to not perform significant excavations in immediate toe areas of sloping areas. The removal of material in these areas may result in a decrease in slope stability. If excavations are planned to be carried out on slopes or at the toe of slopes, they should be analyzed by a qualified geotechnical engineer to ensure the stability of the slope is not compromised , and to establish a proper procedure for excavation on the slopes.

5.3 Inclined Elevator and Boardwalk Foundations

5.3.1 Micropiles

Further to recent discussions with Dialog, it is understood that the inclined elevator portions of both alignments as well as the boardwalk portion of the East Alignment will employ micropiles to support the proposed two structures. The micropiles should be fully embedded into bedrock.

Micropiles consist of drilled, slender piles (less than 300 mm diameter), typically reinforced with a single, high capacity steel bar and backfilled with cement grout. Post-grouting under elevated pressures is often used to allow for higher grout/ground bond values along the grout/ground interface. Due to the small pile diameter, any end-bearing contribution to the load carrying capacity of micropiles should be neglected. Micropiles can withstand large axial loads but should not be subjected to lateral loads.

5.3.2 Design Recommendations

Micropiles should be designed according to the following recommendations:

- Micropiles should be designed as friction piles where loads are transmitted to the ground through the skin friction developed between the pile grout length and the surrounding soils/bedrock. For micropiles embedded into competent bedrock, the ultimate skin friction may be taken as 100 kPa and 36 kPa for the overburden material (ignore the skin friction on the upper 2 m of the micropile). To obtain the factored shaft resistance, the ultimate skin friction value should be multiplied by geotechnical resistance factors of 0.6 and 0.4 for piles subject to compression and tension, respectively. These geotechnical resistance factors are based on the assumption that an adequate static load testing program will be implemented, as discussed in Section 5.3.3.

- Post-grouting under pressure will likely be required in order to attain the above friction capacities. The pressure grouting may be carried out in one or more stages. Selected piles should be load tested to confirm the design capacities.

- Micropiles should be installed at center-to-center spacing of at least 3 micropile diameters or 760 mm, whichever is greater. Closer spaced piles will be subjected to group effect; a group multiplication factor can be provided once the load and configuration of the piles are known.

- Double corrosion protection is recommended for the reinforcement bars used in the proposed micropiles.

5.3.3 Load Testing

Load testing of select micropiles should be performed to verify the adequacy of the contractor's drilling, installation and grouting operations prior to (verification testing) and during (proof testing) construction of production micropiles.

Verification tests should be conducted on sacrificial piles constructed using the same method, equipment and operator that will be used for the production piles. The test piles should be located in close proximity to a test hole to confirm that ground conditions are similar to those at the locations of the production piles, and to allow for the correlation of load test results to soil stratigraphy. As a minimum, two load tests should be performed; one on either bank of the river. Because of site constraints, the piles may be tested in tension only (compression tests require a much more elaborate setup). The testing method should be in accordance with the ASTM D 3689-07 standard. The micropiles should be subjected to a minimum test load equal to 2.0 times the design load. The reinforcing bars may, therefore, have to be of greater size than the production piles to sustain the test loads.

Proof tests should be conducted on 10 percent of the production micropiles at each thrust block. The micropiles may be tested in tension only in accordance with the ASTM D 3689 standard. The test loads should be equal to 1.6 times the design load.

Creep tests should be performed as part of the verification and proof tests at test loads equal to 1.33 times the design load. The loading schedules for both the verification and proof tests (including creep tests), as well as the micropile acceptance criteria should be in accordance with the recommendations of the FHWA (2005).

It should be emphasized that the objectives of the load testing program are to confirm the adequacy of the contractor's installation methods and to verify that the required design loads can be carried without excessive movement and with an adequate margin of safety for the life of the structure. If the test results indicate lower than specified capacities, modifications to the micropile installation methods and/or length/size of micropiles should be implemented.

5.4 Bridge Foundations

5.4.1 Bored Cast-In-Place Piles

Based on the available test hole information and preliminary information provided to Thurber by Dialog, cast-in-place concrete piles founded into the bedrock are considered feasible for support of the bridge abutments and piers for the pedestrian (or elevator extension) bridges for each of the West (Lower McDougall Hill Road) or East (Grierson Hill Road) alignments. Such piles are capable of sustaining vertical and horizontal loads.

5.4.2 Design for Axial Compressive Loads

Bored cast-in-place piles should be founded into competent bedrock to minimize potential foundation settlement. The top of the competent bedrock varies throughout the project based on location within the project site. Recommendations for cast-in-place piles have been separated into four types based on subsurface conditions and location within the project area:

- East/West Alignment – Upper Platform
- West Alignment – Lower McDougall Hill Road Piers
- East Alignment – North Abutment (Boardwalk/Bridge Transition)
- East Alignment – Grierson Hill Road Piers
- East Alignment – South End Pier

The following recommendations are provided for the design of cast-in-place concrete piles:

- For piles subjected to axial compressive loads, the piles may be designed based on a combination of shaft friction and end bearing resistance as follows:

  $$Q_T = Q_B + Q_S$$

  Where

  Q_T = Ultimate static pile capacity (kN)

  Q_B = Ultimate end bearing resistance (kN)

  Q_S = Ultimate shaft friction resistance (kN)

- The recommended ultimate and factored ULS skin friction (compression and tension) and end bearing values for cast-in-place concrete piles are provided in Table 5.1. The factored ULS values were estimated based on a geotechnical resistance factor of 0.4 for end bearing and compression and 0.3 for tension.

- Shaft resistance along the pile section within 2 m below the finished grade level should be ignored in design to account for the effects of seasonal variations in moisture conditions and disturbances during construction. Similarly, the shaft resistance along the pile section embedded within any new fill should also be ignored due to the potential of fill settlement under self-weight.

TABLE 5.1
RECOMMENDED ULS SKIN FRICTION AND END BEARING VALUES FOR CAST-IN-PLACE PILES

SOIL UNIT	**APPROXIMATE DEPTH* (m)**	**SKIN FRICTION (kPa)**			**END BEARING (kPa)**	
		Ultimate	**Compression Factored (Φ=0.4)**	**Tension Factored (Φ=0.3)**	**Ultimate**	**Factored (Φ=0.4)**
East/West Alignment – Upper Platform						
Topsoil/Clay	0-2	0 **	0	0	N/A	N/A
Clay	2-5	35	14	10	N/A	N/A
Clay Till/Sand	5-13	60	24	18	N/A	N/A
Weathered Bedrock	13-17	70	28	21	N/A	N/A
Bedrock	Below 17	100	40	30	2,000	800
West Alignment – Lower McDougall Hill Road Piers						
Topsoil/Clay Fill	0-2	0 **	0	0	N/A	N/A
Clay/Clay Fill/Sand and Gravel Fill	2-8	25	10	7	N/A	N/A
Clay/Clay Till	8-14	35	14	10	N/A	N/A
Weathered Bedrock	14-16	50	20	15	N/A	N/A
Bedrock	Below 16	100	40	30	2,000	800
East Alignment – North Abutment (Bridge Transition)						
Topsoil/Clay	0-2	0 **	0	0	N/A	N/A
Weathered Bedrock	2-7	50	20	15	N/A	N/A
Bedrock	Below 7	100	40	30	2,000	800

TABLE 5.1 CONTINUED…
RECOMMENDED ULS SKIN FRICTION AND END BEARING VALUES FOR CAST-IN-PLACE PILES

SOIL UNIT	APPROXIMATE DEPTH* (m)	SKIN FRICTION (kPa)			END BEARING (kPa)	
		Ultimate	Compression Factored (Φ=0.4)	Tension Factored (Φ=0.3)	Ultimate	Factored (Φ=0.4)
East Alignment – Grierson Hill Road Piers						
Topsoil/Clay Till	0-2	0 **	0	0	N/A	N/A
Clay Till/Sand/Gravel	2-6	30	12	9	N/A	N/A
Weathered Bedrock	6-10	50	20	15	N/A	N/A
Bedrock	Below 10	100	40	30	2,000	800
East Alignment – South End Pier						
Topsoil/Clay	0-2	0 **	0	0	N/A	N/A
Clay	2-4	25	10	7	N/A	N/A
Clay Till	4-8	40	16	12	N/A	N/A
Weathered Bedrock	8-12	50	20	15	N/A	N/A
Bedrock	Below 12	100	40	30	2,000	800

* Elevations and depths are based upon LIDAR survey in conjunction with survey of test hole locations. Final elevations should be reviewed once alignments are chosen and pile installation depths are known.

** Ignore shaft resistance in the upper 2 m below finished grade level.

- For belled piles, shaft resistance along the sides of the bell and along a distance of one shaft diameter above the bell should be ignored in design to account for the effects of disturbances caused by bell construction and/or settlement on the skin friction along the bottom portion of the pile.

- For straight shaft piles, the center-to-center spacing between piles should not be less than 2.5 times the pile diameter.

- For belled piles, the bell diameter to shaft diameter ratio should not exceed 3:1, and the bell should not be sloped at more than 30 degrees to the vertical. The pile depth should be a minimum of 3 times the bell diameter, or 2 m into competent bedrock, whichever is longer. The minimum edge-to-edge spacing between adjacent piles should be equal to or greater than 0.5 times the bell diameter.

- A minimum pile shaft diameter of 500 mm is recommended to prevent voids from forming during pouring of concrete.

- As a minimum, and not including structural requirements, a nominal percentage of longitudinal reinforcement should be provided over the entire pile length to resist potential uplift forces and tensile stresses.

5.4.3 Lateral Resistance of Pile Foundations

Pile foundations are capable of supporting lateral loads. It is common practice to design the piles for vertical loads, and then check for pile head deflections, bending moments, and shear forces under the design lateral loads. The pile response under lateral loads is governed by the pile type and size, and the characteristics of soil/bedrock within the upper 6 pile diameters (approximately) below the pile head.

For preliminary design, the response of a laterally loaded pile may be assessed using a structural analysis program and the modulus of horizontal subgrade reaction. A more refined analysis of the response of piles and pile groups subjected to lateral loads can be carried out by using the method of p-y curves and specialized software such as L-PILE or GROUP.

5.4.4 Modulus of Horizontal Subgrade Reaction

In this approach, the lateral resistance of soils surrounding the pile shaft may be simulated using the modulus of horizontal subgrade reaction to represent soil stiffness. The recommended values of the modulus of horizontal subgrade reaction for the soil/bedrock units anticipated at the project site are presented in Table 5.2.

TABLE 5.2
RECOMMENDED MODULUS OF HORIZONTAL SUBGRADE REACTION FOR BRIDGE PILES

SOIL UNIT	MODULUS OF HORIZONTAL SUBGRADE REACTION, k_h (MN/m^3)
Clay Till, Clay, Fill	0 to 20/B (1)
Sand and Gravel	6*Z/B (2)
Weathered Bedrock	50/B
Bedrock	120/B

B: Pile diameter; Z: Depth below finished grade level.

(1) The modulus of subgrade reaction increases linearly from zero at the finished ground surface to the maximum design value of 20/B at a depth of 2.5 m below grade.

(2) The modulus of subgrade reaction increases linearly with depth.

For piles installed along the crest of the any slope the values of the modulus of horizontal subgrade reaction provided in Table 5.2 should be reduced to account for the lower resistance of the sloped ground. For a slope with an inclination of 2.5H:1V, a reduction factor of 0.7 should be applied to the modulus of horizontal subgrade reaction of soils within a depth equal to 3 pile diameters below finished grade level at the pile location. The reduction factor should be applied only where the direction of the lateral load is consistent with the downhill direction of the slope.

In the structural analyses, the spring constant, K, for a pile segment of length L can be calculated using the following expression;

$$K = k_h \times B \times L$$

Where:

K = Spring constant (MN/m)

k_h = Modulus of horizontal subgrade reaction (MN/m^3)

B = Pile Diameter (m)

L = Pile segment Length

It should be noted that the modulus of horizontal subgrade reaction is an elastic parameter. Hence, the above modulus values are valid only as long as soil/bedrock behavior remains within the elastic range. The maximum strain level associated with elastic behavior may be taken as a lateral pile deflection at the pile head of about 6 mm or one percent of the pile diameter, whichever is larger. It should also be noted that the values of the modulus of horizontal subgrade reaction presented above apply to individual piles or piles in a group where the center-to-center pile spacing is greater than about 8 times the pile diameter. For closely spaced piles in groups, there will be interaction between piles and the lateral support to each pile will be reduced accordingly. The lateral deflection of a pile in a group will be larger than the deflection of a single pile subjected to the same load. In structural analyses using the modulus of horizontal subgrade reaction, pile group interaction may be modeled by applying group reduction factors to the modulus values. The group reduction factor will depend on the pile spacing, number and layout of piles, the location of the pile within the group, and the direction of loading. These parameters can be provided once more detailed design information is developed.

5.4.5 Pile Construction

In order to attain the design shaft and end bearing resistances provided in Table 5.1, the following measures should be implemented during pile construction:

- Soil and bedrock cuttings recovered during pile installation should be logged by qualified geotechnical inspector. The information should be reviewed by the project geotechnical engineer to confirm that bedrock stratigraphy and conditions are consistent with the design assumptions.

- The side walls of any rock sockets should be cleaned using a wire brush to remove any loose or smeared materials, and should be roughened with a grooving tool.

- All pile excavations should be thoroughly cleaned and visually inspected prior to pouring of the concrete to ensure a satisfactory base has been achieved. No slough or disturbed material should be allowed to remain in the pile holes.

- Concrete should be poured immediately after drilling and inspection of the pile hole are complete in order to reduce the risk of groundwater seepage and sloughing of pile walls;

- Adjacent piles within a center-to-center spacing less than 3 shaft diameters should not be drilled or poured consecutively within the same 24-hour period in order to allow enough time for the concrete in the adjacent pile to set. For concreting of drilled shafts, the guidelines of Clause 7.2.7 of CSA A23.1-04 should be followed.

- Due to the presence of sand and gravel layers and the hydraulic connection between water levels in these units and the river level, the use of temporary steel casings may be required to prevent sloughing and seepage during pile construction.

- Hard layers of siltstone and sandstone were observed within the bedrock. Where encountered during piling, these conditions can slowdown the rate of pile construction. Similarly, boulders and large rocks can be present in river deposits and/or fill soils and can affect the rate of piling.

5.5 Pile Caps

When pile/micropile foundations are used, pile caps are usually required to transfer structure loads onto pile tops. Precautions should be taken to prevent heaving of the pile caps due to frost penetration where the pile cap will lie above the seasonal frost line.

The design of pile caps should be checked to ensure that the dead load applied on the pile cap is sufficient to resist potential frost heave. Alternatively, a crushable, non-degradable void form (such as Beaver Plastics Frost Cushion) may be placed below the pile cap (or grade beam) to accommodate frost heave and reduce frost heave forces on the underside of the pile cap. The ground surface should be sloped away from the pile cap to prevent water from collecting in the void space and freezing.

The pile cap should be designed to resist an upward pressure corresponding to the crushing strength of the void filler and the piles must be able to resist the resulting uplift load. A minimum void thickness of 150 mm is recommended.

5.6 Retaining Walls

Lateral pressures exerted on bridge abutments and retaining walls are generally due to the earth pressure of backfill, residual stresses induced by compaction, pressures due to external surcharge loads at surface, and hydrostatic pressures (if applicable). The magnitude of the lateral pressure depends primarily on the type of backfill and the tolerable movement/rotation of the abutment wall.

Assuming no hydrostatic pressure, the lateral pressure, p_h, acting on the abutment wall is calculated using the equation noted below. Because of the expected relative rigidity of walls to be used in this project, it is recommended that the coefficient of earth pressure at rest (K_o) be used in design. Active earth pressures may be used for walls where the wall is allowed to move away from the backfill to the point of mobilizing the full shear resistance to resist lateral deformation. Passive earth pressures may be used where the wall is allowed to move toward the backfill increasing the pressure on the wall.

$$P_h = K [(\gamma \text{ x } h) + q] \qquad \text{kN/m}^2$$

Where:

P_h = lateral earth pressure at depth h, kN/m^2

K = recommended coefficient of earth pressure (Table 5.3)

γ = bulk unit weight of backfill material, kN/m^3 (Table 5.3)

h = depth below backfill surface, m

q = applicable uniform surcharge loads, kN/m^2

Table 5.3 provides the recommended values of the coefficient of earth pressure and the bulk unit weight for different types of backfill materials as well as for horizontal and sloping backfill (up to 25 degrees, or 2H:1V).

TABLE 5.3
EARTH PRESSURE COEFFICIENTS FOR FOUNDATION WALLS ASSUMING VERTICAL WALL

SOIL DESCRIPTION	**BULK UNIT WEIGHT kN/m^3**	**ASSUMED FRICTION ANGLE**	**K_a ACTIVE**		**K_P PASSIVE**		**K_O AT-REST**	
			Horiz.	**2H:1V**	**Horiz.**	**2H:1V**	**Horiz.**	**2H:1V**
Native Clay Till Backfill compacted to 95 % Standard Proctor	20	25	0.41	0.82	2.5	5.1	0.58	0.90
Pit run gravel compacted to 95 % Standard Proctor	21.5	35	0.27	0.38	3.7	10.0	0.43	0.61

The lateral earth pressure coefficients for gravel fill apply, where the gravel forms a wedge bounded by a 1H:1V slope from the base of the wall to ground surface. The granular backfill should be a well graded, clean, pit run gravel or crushed material, with less than 5 percent passing an 80 micron sieve and a maximum particle size of 75 mm.

All backfill should be placed in 300 mm lifts and compacted to not greater than 95 percent of Standard Proctor Maximum Dry Density. Heavy compaction equipment should not operate immediately adjacent to the permanent walls. Care should be taken not to overstress the walls during backfilling and compaction.

5.7 Valley Slope Stability

5.7.1 General

The earlier results from the installed SI instruments indicate no significant movement of the slopes over the observed time since the start of 2015, suggesting that the slopes are currently stable. This is also evident in the relatively low amount of movement observed in the EBA installed instruments over the past four years.

To further assess the overall condition of the valley slopes in the project area, slope stability analyses were carried out using limit equilibrium methods (Slope/W Software) to determine the stability of the valley slopes in the vicinity of the project. The analyses were carried out on two representative sections of the valley slope: one termed the West Slope which cuts from

100 Street perpendicular down the slope along the steepest continuous section of slope to lower McDougall Hill, situated between the East and West Alignment inclined elevator sections; and the second termed the East Slope which cuts perpendicular to the slope from Hotel Macdonald over Grierson Hill to the southeast and down towards the North Saskatchewan River. The global condition for the overall slope was analyzed in addition to local slopes, including the upper, mid, and lower slopes, where applicable.

Based on the geotechnical desktop and field investigations the subsurface stratigraphy consists of clay overlying clay till overlying weathered bedrock overlying competent bedrock. At the toes of the slopes weaker colluvial clay is present. Sand and gravel layers were also found interbedded within the clay till. The bedrock consists of clay shale with interbedded sandstone layers. Results of the analyses of the slopes are presented in Appendix E and are summarized in Table 5.4. The soil parameter used in the analyses were based on the performed direct shear test results (Appendix C), published data and our experience with similar ground conditions.

TABLE 5.4
CALCULATED FACTORS OF SAFETY FOR REPRESENTATIVE SLOPES

SLOPE CONDITION	**CALCULATED FACTOR OF SAFETY**	
	WEST SLOPE (100 STREET TO LOWER MCDOUGALL HILL)	**EAST SLOPE (HOTEL MACDONALD TO GRIERSON HILL)**
Global	1.5	1.9
Upper	1.7	1.3
Mid	N/A	2.4
Lower	1.3	1.9

For long term stability of slopes with structures built on them, a target factor of safety (FOS) of 1.5 is recommended and a FOS of 1.3 may be acceptable in conjunction with a slope monitoring program to confirm that the construction did not adversely impacted the stability of the slope over time. As indicated on the figures presented in Appendix E as well as in Table 5.4, some of the slopes surrounding this project feature a FOS of 1.3 (West Lower Slope and East Upper Slope).

Given these results and considering the other available information, it is recommended that efforts be focused on a comprehensive slope monitoring program for the slopes surrounding the selected project alignment, especially on the areas where the FOS is 1.3.

Further analysis should be completed once the final alignment has been defined. Placement of fill on the slopes should be avoided; however, if deemed necessary to add some fill, or cuts are planned in or along the valley slopes as part of construction for this project the exact location of these activities should be identified in advance for additional slope stability assessment, as conducted in the following section for an identified cut section.

5.7.2 Boardwalk Cut Section

It is currently understood that the preliminary design for the construction of the boardwalk portion of the project will involve a cut into the upper slope of up to 2 m in height and 5 m in width towards the eastern end of its alignment.

Based upon the weak colluvial clay material present at the near surface at this location, it is recommended that any cut be laid back into the slope at a 4H:1V slope. An additional slope stability analysis was conducted for this proposed cut on the East Slope configuration, as shown in Figure E8 in Appendix E.

The results show that this size of cut at this location does not cause a significant negative impact on the global slope stability, with a marginally decreased FOS of approximately 1.8. The FOS for the midslope, mid, and lower slopes were also analyzed and r unchanged.

However, it should be recognized that the stability of the slope will be especially sensitive to the extents of the cuts in this area. If the cut is expected to advance further back north into the slope, additional analyses should be undertaken. Alternatively, retaining walls can be employed in cut areas to ensure that slope stability is not significantly impacted by cuts along the boardwalk area.

5.8 Cement Type

Eight tests were conducted to determine the water-soluble sulphate ion content of soil samples recovered from the abutment and pier test holes. Results showed the water-soluble sulphate (SO_4) content ranged from of 0.00 percent to 0.06 percent in the soil samples, inicating that there is no potential for sulphate attack on the subsurface concrete. As a result, CSA Type GU (General Use Hydraulic Cement) may be used in the subsurface concrete at this project site.

The recommendations stated above for the subsurface concrete at this site may require further additions and/or modifications due to structural durability, service life or other considerations which are beyond the geotechnical scope.

In addition, if imported material is required to be used at the site and will be in contact with concrete, it is recommended that the fill soil be tested for sulphate content to determine whether the above-stated recommendations remain valid.

5.9 Seismicity

The MRVA site is underlain by a sequence of clay overlying clay till overlying sand (and/or gravel) overlying clay shale and sandstone bedrock at varying depths.

Based on the results of the geotechnical investigation, the MRVA site may be generally classified as Site Class D in accordance with the site classification per Table 4.1.8.4A of the National Building Code (NBCC 2005).

However, since the conditions are varied along the slope and project area, it is recommended that this should be reviewed for localized areas where Site Class C may apply.

5.10 Future Work

Future geotechnical work for this project should be focused on stablishing a monitoring program to allow for the assessment of the performance of the slope. This monitoring should continue through the design, construction, and operation periods of the proposed structures. Based on final alignments and locations of the structures, it will be necessary to install additional slope monitoring instruments where lower slope stability FOS were calculated as shown in this report. This program should be reviewed once final alignments and designs are developed. Without ongoing monitoring there is an identified increased risk to the planned structures.

Additionally, any alteration to valley slopes, including cuts and fills, should be further analyzed to determine their impact on local slopes as well as the overall valley slope. The placement and details of exact structures are not currently known. It is important to consider the stability of the surrounding area and the impacts that construction will have.

It may also be advisable to advance additional test holes in specific locations, once the exact alignment and locations of structures is finalized. Due to the configuration of the surface and subsurface layers, the depth to bedrock has been observed to be variable. It would be important to know the exact depth to bedrock at specific locations in order to provide more robust geotechnical and foundation recommendations at any one particular site within the project area.

6. CONSTRUCTION INSPECTION

The performance of the structures will depend upon the quality of workmanship during construction. This is particularly important in regard to foundation installations where variations in soil conditions could occur. Therefore, it is recommended that inspection be provided by qualified geotechnical personnel during foundation installation to confirm that the piles for the bridge are installed in competent bearing material and that the stratigraphy is similar to those that have been assumed for the design.

7. LIMITATIONS AND USE OF REPORT

There is a possibility that this report may form part of the design and construction documents for information purposes. This report was issued before any final design or construction details have been prepared or issued. Therefore differences may exist between the report recommendations and the final design, in the contract documents, or during construction. In such instances, Thurber Engineering Ltd. should be contacted immediately to address these differences.

Designers and contractors undertaking or bidding the work should examine the factual results of the investigation, satisfy themselves on to the adequacy of the information for design and construction, and make their own interpretation of the data as it may affect their proposed scope of work, cost, schedules, and safety and equipment capabilities.

8. REFERENCES

EBA Engineering Consultants, Ltd. *Geotechnical Assessment – Proposed Shaw Conference Centre Expansion, Edmonton, Alberta.* January 10, 2013.

FHWA – Federal Highway Administration (2005) – Micropile Design and Construction. Publication No. FHWA NHI-05-039.

Thurber Engineering Ltd. *Mechanized River Valley Access, City Project # CP-3592, Stage 1 – Desktop Assessment, Edmonton, Alberta, Revision 1.* January 27, 2015.

Thurber Engineering Ltd. *Mechanized River Valley Access, City Project # CP-3592, Stage 1 – Desktop Assessment, Edmonton, Alberta, Addendum for East Alignment.* April 1, 2015.

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

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5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.

d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

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The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

APPENDIX A

Drawing No. 19-5861-24-1 – Site Plan Showing Test Hole Locations
Drawing No. 19-5861-24-2 – Stratigraphic Cross-Section A-A’ (West Alignment)
Drawing No. 19-5861-24-3 – Stratigraphic Cross-Section B-B’ (East Alignment)

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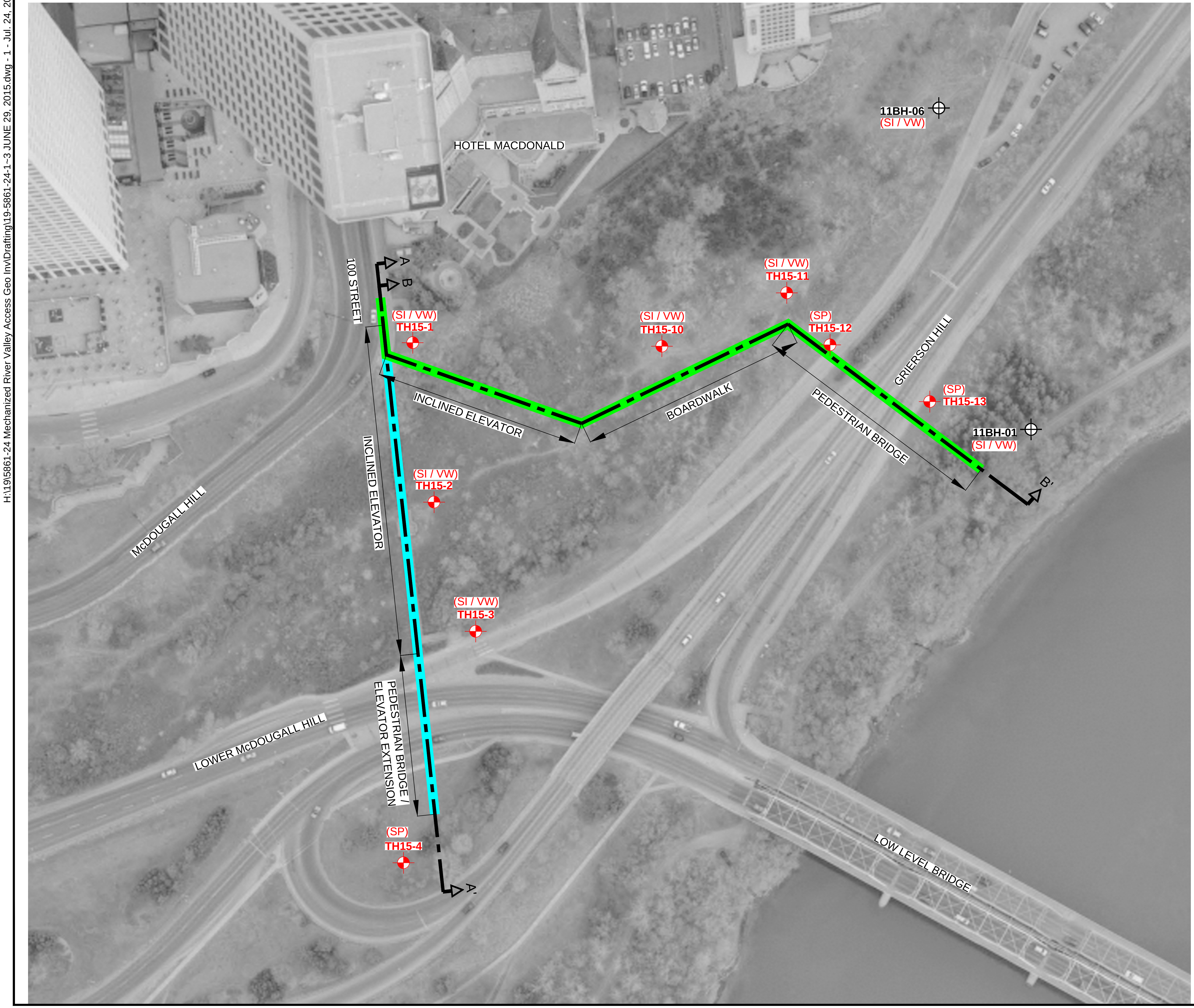

N
W E
S

LEGEND

⌖ TEST HOLE LOCATION (THURBER, 2015)

⌖ TEST HOLE LOCATION (AMEC, 2011)

(SI / VW) SLOPE INCLINOMETER AND VIBRATING WIRE PIEZOMETER

(SP) STANDPIPE PIEZOMETER

🟦 WEST ALIGNMENT

🟩 EAST ALIGNMENT

0 10 20 30 40 50 60 70 m

SCALE 1:1250

DIALOG™

EDMONTON RIVER VALLEY MECHANIZED ACCESS
GEOTECHNICAL INVESTIGATION

SITE PLAN SHOWING APPROXIMATE
TEST HOLE LOCATIONS

DWG No. 19-5861-24-1

DRAWN BY	ML
DESIGNED BY	SEC
APPROVED BY	RVC
SCALE	APPROX. 1:1250
DATE	JULY 2015
FILE No.	19-5861-24

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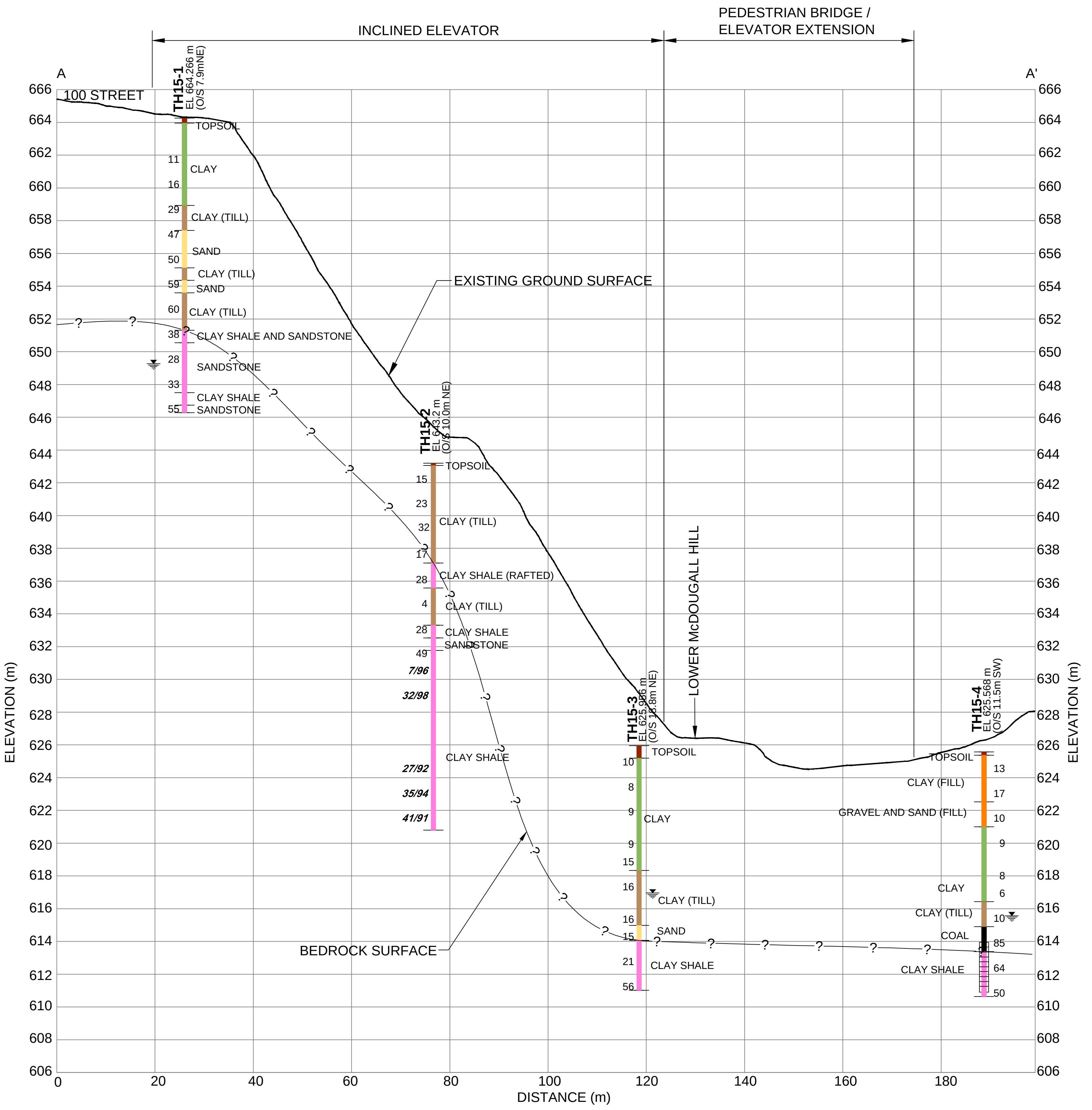

LEGEND

15 ▮	SPT N VALUE
13/38 ▮	RQD / RECOVERY %
▼	WATER LEVEL IN PIEZOMETER
▯	STANDPIPE PIEZOMETER SCREENED INTERVAL

NOTE

DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT THE TEST HOLE LOCATIONS ONLY. THE SOIL STRATIGRAPHY BETWEEN TEST HOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE AND SO MAY VARY FROM THAT SHOWN.

DIALOG™

EDMONTON RIVER VALLEY MECHANIZED ACCESS GEOTECHNICAL INVESTIGATION

STRATIGRAPHIC CROSS - SECTION A - A' (WEST ALIGNMENT)

DWG No. 19-5861-24-2

DRAWN BY	ML
DESIGNED BY	SEC
APPROVED BY	RVC
SCALE	H 1:1000 V 1:300
DATE	JULY 2015
FILE No.	19-5861-24

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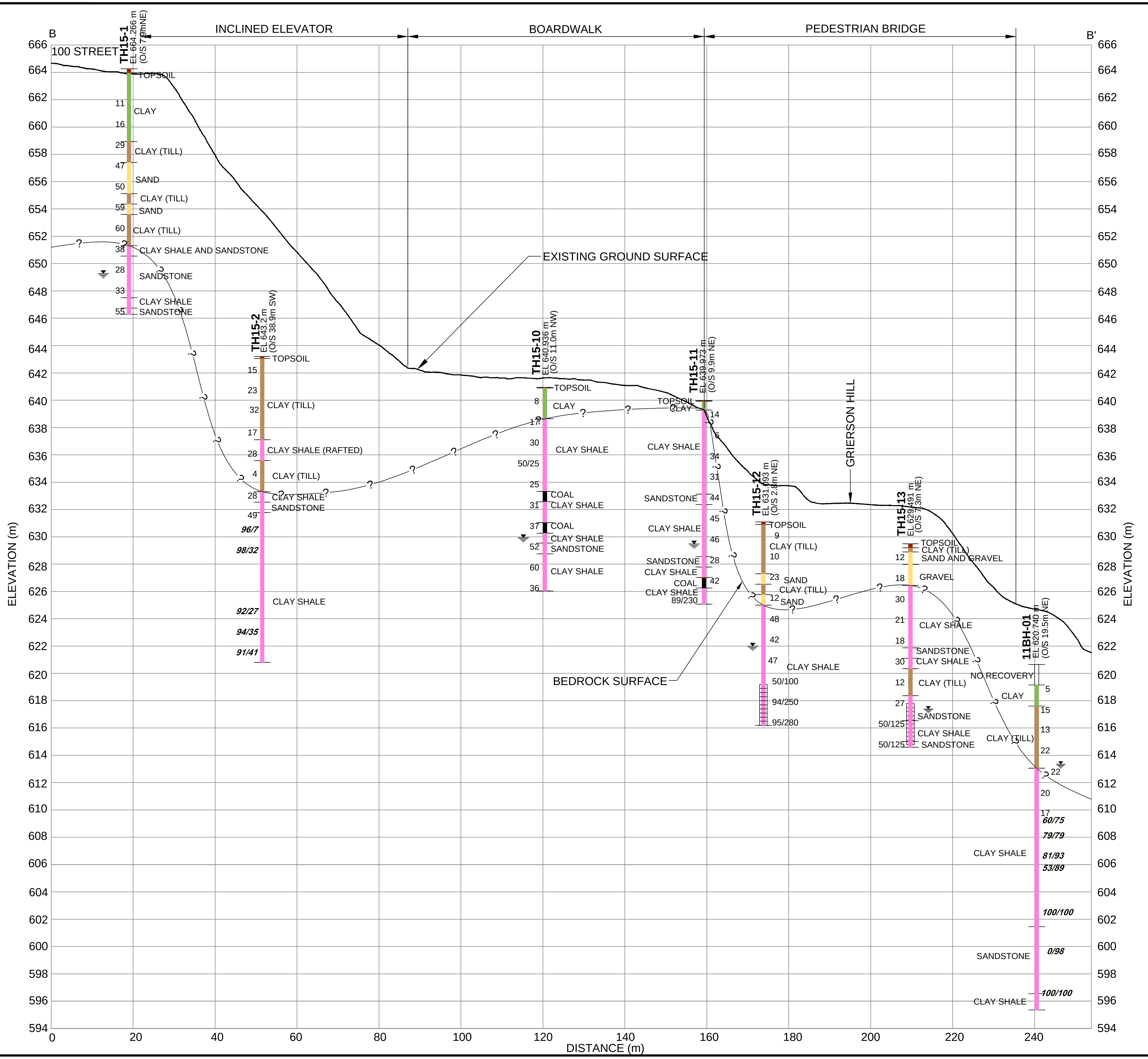

LEGEND

15 SPT N VALUE

13/38 RQD / RECOVERY %

WATER LEVEL IN PIEZOMETER

STANDPIPE PIEZOMETER SCREENED INTERVAL

NOTE

DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT THE TEST HOLE LOCATIONS ONLY. THE SOIL STRATIGRAPHY BETWEEN TEST HOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE AND SO MAY VARY FROM THAT SHOWN.

DIALOG™

EDMONTON RIVER VALLEY MECHANIZED ACCESS GEOTECHNICAL INVESTIGATION

STRATIGRAPHIC CROSS - SECTION B - B' (WEST ALIGNMENT)

DWG No. 19-5861-24-3

DRAWN BY	ML
DESIGNED BY	SEC
APPROVED BY	RVC
SCALE	H 1:1000 V 1:300
DATE	JULY 2015
FILE No.	19-5861-24

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APPENDIX B

Symbols and Terms
Modified Unified Soils Classification System
Current Test Hole Logs
Previous EBA Test Hole Logs

Z:_Edmonton office\Soil_Rock classification\Symbols & Terms-2012.dwg

SYMBOLS AND TERMS USED ON TEST HOLE LOGS

1. VISUAL TEXTURAL CLASSIFICATION OF MINERAL SOILS

CLASSIFICATION	APPARENT PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200 mm	Greater than 200 mm
Cobbles	75 mm to 200 mm	75 mm to 200 mm
Gravel	4.75 mm to 75 mm	5 mm to 75 mm
Sand	0.075 mm to 4.75 mm	Visible particles to 5 mm
Silt	0.002 mm to 0.075 mm	Non-Plastic particles, not visible to the naked eye
Clay	Less than 0.002 mm	Plastic particles, not visible to the naked eye

2. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	APPROXIMATE UNDRAINED SHEAR STRENGTH		APPROXIMATE SPT * 'N' VALUE
Very Soft	Less than 10 kPa		Less than 2
Soft	10 - 25 kPa		2 to 4
Firm	25 - 50 kPa		4 to 8
Stiff	50 - 100 kPa		8 to 15
Very Stiff	100 - 200 kPa	} Modified from National Building Code	15 to 30
Hard	200 - 300 kPa		Greater than 30
Very Hard	Greater than 300 kPa		

* SPT 'N' Value Standard Penetration Test 'N' Value - refers to the number of blows from a 63.5 kg hammer free falling a height of 0.76m to advance a standard 50mm outside diameter split spoon sampler for 0.3m depth into the undrilled portion of the test hole.

3. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	STANDARD PENETRATION TEST (SPT) (Number of Blows per 300 mm)	
Very Loose	0 - 4	
Loose	4 - 10	
Compact	10 - 30	} Modified from National Building Code
Dense	30 - 50	
Very Dense	Over 50	

4. LEGEND FOR TEST HOLE LOGS

SYMBOL FOR SAMPLE TYPE

◩	Shelby Tube	▤	A-Casing
⧄	SPT	▥	Grab
☒	No Recovery	◨	Core

SYMBOLS USED FOR TEST HOLE LOGS

●		MC - Moisture Content (% by weight) of soil sample
▼		Water Level
■	SPT	Standard Penetration Test 'N' Value (Blows/300mm)
▲	CPen	Shear Strength determined by pocket penetrometer
	CVane	Shear Strength determined by pocket vane
	Cu	Undrained Shear Strength determined by unconfined compression test
	SO_4%	Percent (%) of water soluble sulphate ions

THURBER ENGINEERING LTD.

MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS

(MODIFIED BY PFRA, 1985)

MAJOR DIVISION			GROUP SYMBOL	THURBER LOG SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA		
COARSE-GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 75µm)	**GRAVELS** MORE THAN HALF COARSE GRAINS LARGER THAN 4.75 mm	**CLEAN GRAVELS** (LITTLE OR NO FINES)	GW	△▽△	WELL GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	Determine percentages of gravel and sand from grain size curve. Depending on percentages of fines (fraction smaller than 75µm) coarse grained soils are classified as follows: Less than 5% GW, GP, SW, SP More than 12% GM, GC, SM, SC 5% to 12% Borderline cases requiring use of dual symbols	$C_U = \frac{D_{60}}{D_{10}} > 4 ; C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
			GP	▲▼▲	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES		NOT MEETING ALL GRADATION REQUIREMENTS FOR GW	
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	GM	▲▼▲	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES		ATTERBERG LIMITS BELOW "A" LINE I_p LESS THAN 4	Above "A" line with I_p between 4 and 7 are borderline cases requiring use of dual symbols
			GC	▲▼▲	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE I_p MORE THAN 7	
	SANDS MORE THAN HALF COARSE GRAINS SMALLER THAN 4.75 mm	**CLEAN SANDS** (LITTLE OR NO FINES)	SW	⁚	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES		$C_U = \frac{D_{60}}{D_{10}} > 6 ; C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
			SP	oooo	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES		NOT MEETING ALL GRADATION REQUIREMENTS FOR SW	
		SAND WITH FINES (APPRECIABLE AMOUNT OF FINES)	SM	▦	SILTY SANDS, SAND-SILT MIXTURES		ATTERBERG LIMITS BELOW "A" LINE I_p LESS THAN 4	Above "A" line with I_p between 4 and 7 are borderline cases requiring use of dual symbols
			SC	▨	CLAYEY SANDS, SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE I_p MORE THAN 7	
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT SMALLER THAN 75µm)	**SILTS** BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT	$w_L < 50\%$	ML	▥	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (see below)		
		$w_L > 50\%$	MH	▥	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS			
	CLAYS ABOVE "A" LINE NEGLIGIBLE ORGANIC CONTENT	$w_L < 30\%$	CL	▨	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS			
		$30\% < w_L < 50\%$	CI	▨	INORGANIC CLAYS OF MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS			
		$w_L > 50\%$	CH	▨	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS			
	ORGANIC SILTS & CLAYS BELOW "A" LINE	$w_L < 50\%$	OL	▥	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW AND MEDIUM PLASTICITY			
		$w_L > 50\%$	OH	▨	ORGANIC CLAYS OF HIGH PLASTICITY, ORGANIC SILTS			
HIGHLY ORGANIC SOILS			Pt	〰	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOR OR ODOR, AND OFTEN FIBROUS TEXTURE		

SPECIAL SYMBOLS

▩ **BEDROCK** (UNDIFFERENTIATED)

⁚ **SANDSTONE**

▤ **CLAYSTONE** (CLAYSHALE OR MUDSTONE)

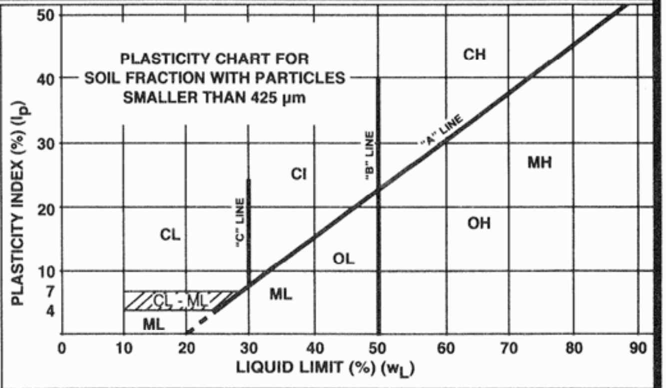
▦ **LIMESTONE**

○ **CONGLOMERATE**

■ **COAL**

▩ **OVERBURDEN** (UNDIFFERENTIATED)

▤ **SILTSTONE**



THURBER ENGINEERING LTD.

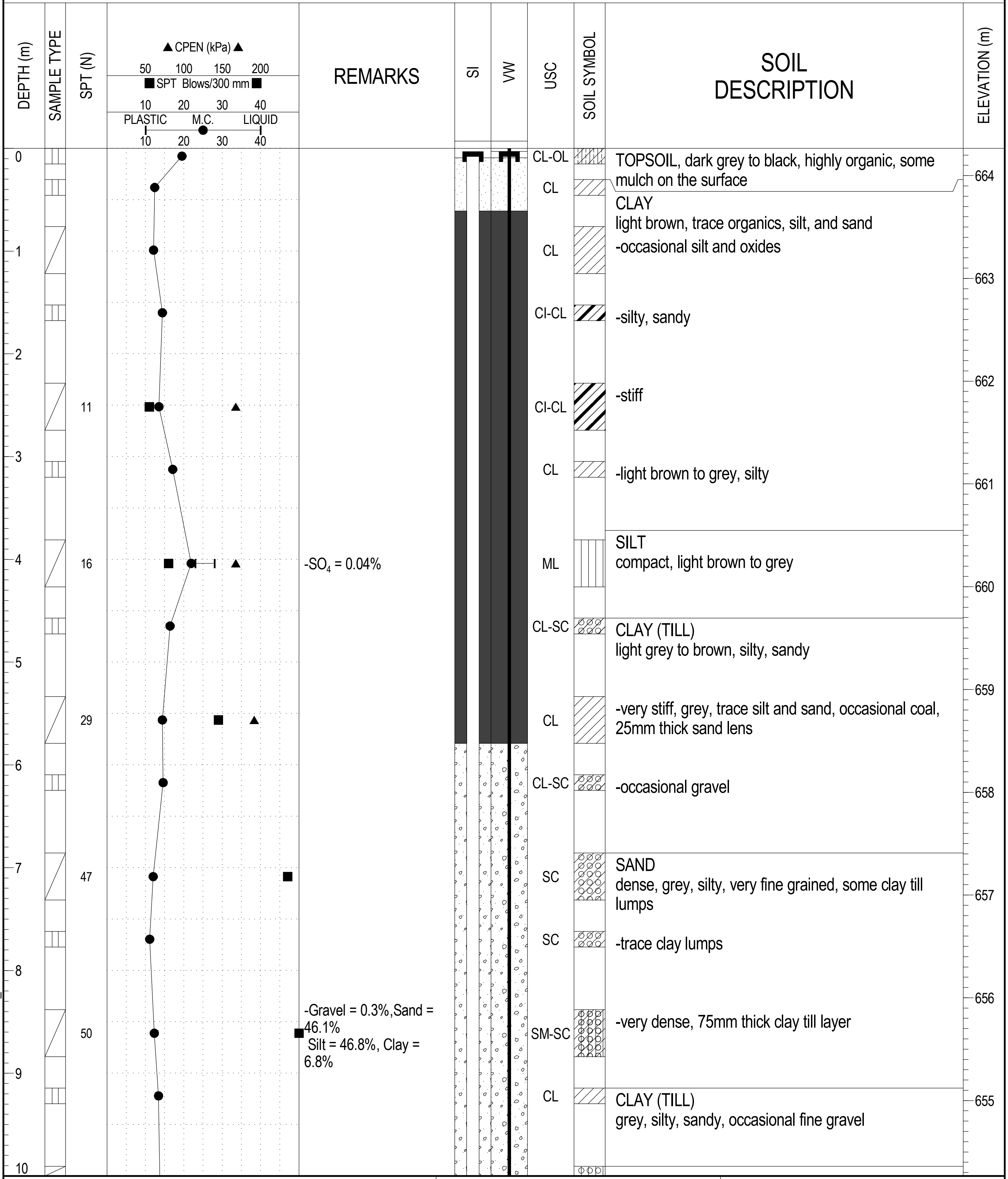
MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS

(MODIFIED BY PFRA, 1985)

CLIENT: DIALOG	PROJECT: MECHANIZED RIVER VALLEY ACCESS GEO INV	BOREHOLE NO: **TH15-1**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: January 29 & 30, 2015	PROJECT NO: 19-5861-24
DRILL/METHOD: Track M4 / Solid Stem Augers	LOCATION: N5934204.889, E33826.966	ELEVATION: 664.27 (m)

SAMPLE TYPE ▥ GRAB SAMPLE ◿ SPT

BACKFILL TYPE ░ SAND ■ BENTONITE ▨ GROUT ▥ SLOUGH



SPT (N)	REMARKS	USC	SOIL DESCRIPTION
		CL-OL	TOPSOIL, dark grey to black, highly organic, some mulch on the surface
		CL	CLAY light brown, trace organics, silt, and sand
		CL	-occasional silt and oxides
		CI-CL	-silty, sandy
11		CI-CL	-stiff
		CL	-light brown to grey, silty
16	-SO_4 = 0.04%	ML	SILT compact, light brown to grey
		CL-SC	CLAY (TILL) light grey to brown, silty, sandy
29		CL	-very stiff, grey, trace silt and sand, occasional coal, 25mm thick sand lens
		CL-SC	-occasional gravel
47		SC	SAND dense, grey, silty, very fine grained, some clay till lumps
		SC	-trace clay lumps
50	-Gravel = 0.3%,Sand = 46.1% Silt = 46.8%, Clay = 6.8%	SM-SC	-very dense, 75mm thick clay till layer
		CL	CLAY (TILL) grey, silty, sandy, occasional fine gravel

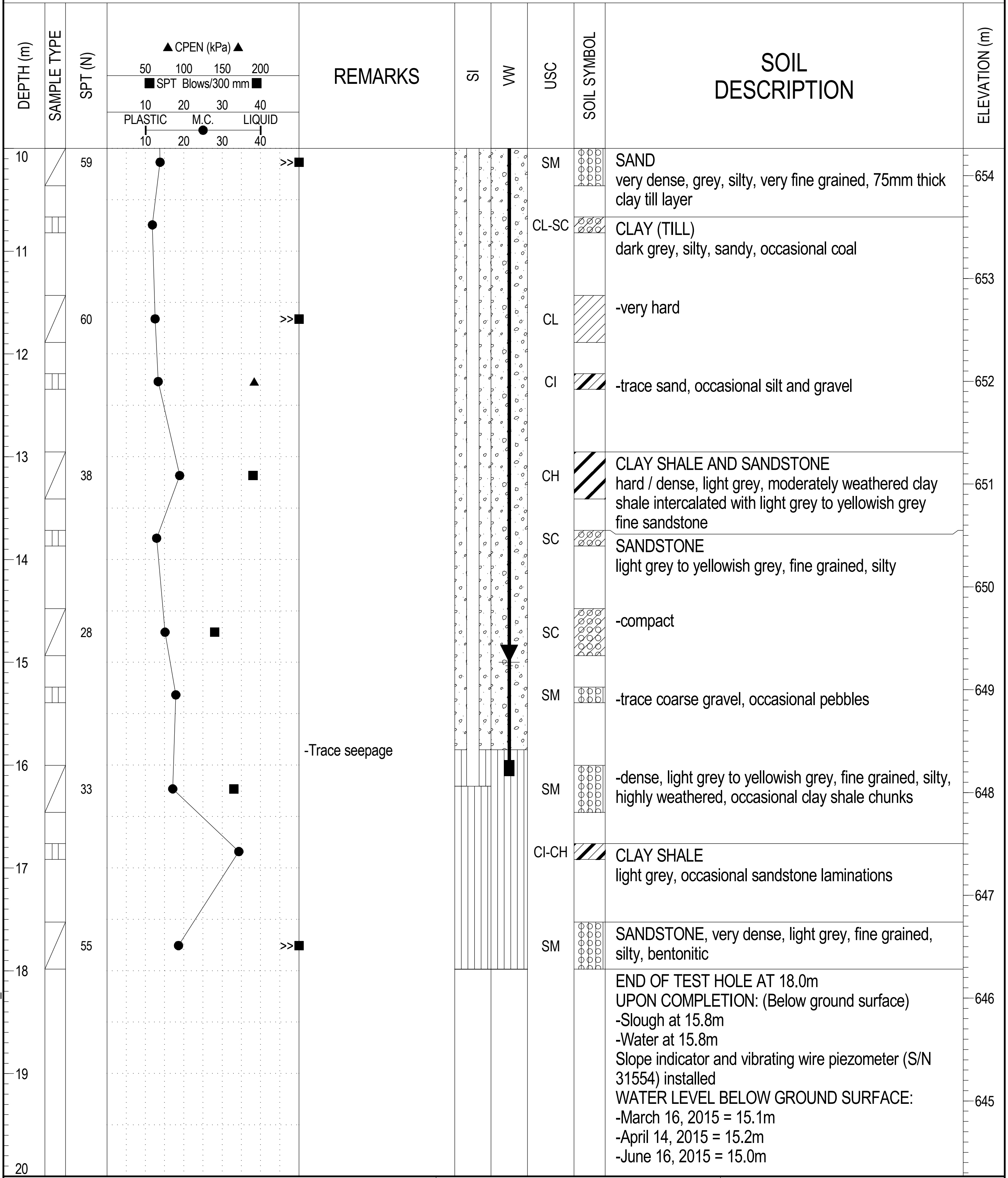
THURBER ENGINEERING LTD.

FIELD LOGGED BY: NKR	COMPLETION DEPTH: 18.0 m
PREPARED BY: SEC	COMPLETION DATE: 1/30/15
REVIEWED BY: RVC	

CLIENT: DIALOG	PROJECT: MECHANIZED RIVER VALLEY ACCESS GEO INV	BOREHOLE NO: **TH15-1**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: January 29 & 30, 2015	PROJECT NO: 19-5861-24
DRILL/METHOD: Track M4 / Solid Stem Augers	LOCATION: N5934204.889, E33826.966	ELEVATION: 664.27 (m)

SAMPLE TYPE ▥ GRAB SAMPLE ◿ SPT

BACKFILL TYPE ⬚ SAND ■ BENTONITE ⬚ GROUT ▥ SLOUGH



-Trace seepage

SOIL DESCRIPTION

SAND
very dense, grey, silty, very fine grained, 75mm thick clay till layer

CLAY (TILL)
dark grey, silty, sandy, occasional coal

-very hard

-trace sand, occasional silt and gravel

CLAY SHALE AND SANDSTONE
hard / dense, light grey, moderately weathered clay shale intercalated with light grey to yellowish grey fine sandstone

SANDSTONE
light grey to yellowish grey, fine grained, silty

-compact

-trace coarse gravel, occasional pebbles

-dense, light grey to yellowish grey, fine grained, silty, highly weathered, occasional clay shale chunks

CLAY SHALE
light grey, occasional sandstone laminations

SANDSTONE, very dense, light grey, fine grained, silty, bentonitic

END OF TEST HOLE AT 18.0m
UPON COMPLETION: (Below ground surface)
-Slough at 15.8m
-Water at 15.8m
Slope indicator and vibrating wire piezometer (S/N 31554) installed
WATER LEVEL BELOW GROUND SURFACE:
-March 16, 2015 = 15.1m
-April 14, 2015 = 15.2m
-June 16, 2015 = 15.0m

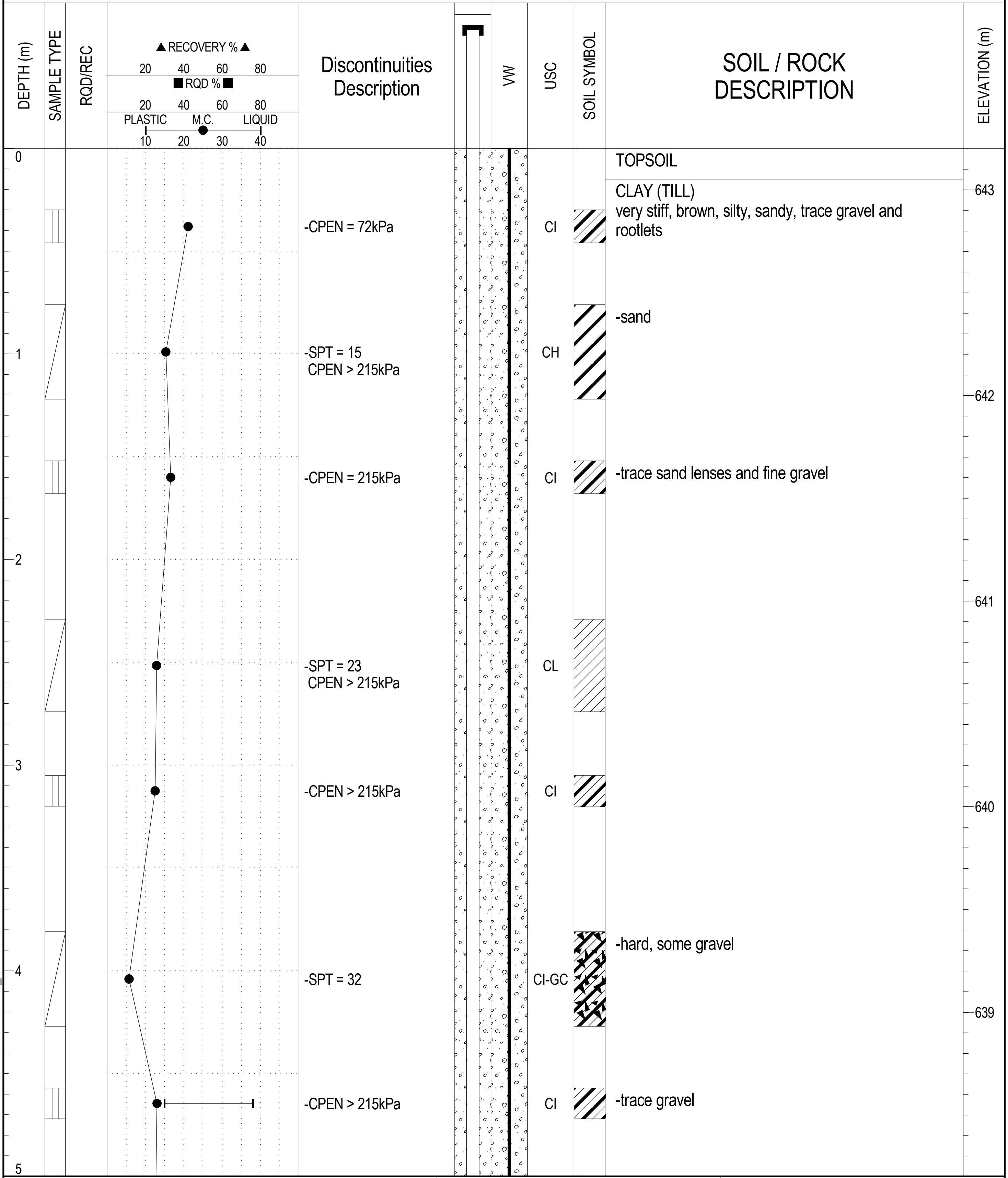
THURBER ENGINEERING LTD.

FIELD LOGGED BY: NKR	COMPLETION DEPTH: 18.0 m
PREPARED BY: SEC	COMPLETION DATE: 1/30/15
REVIEWED BY: RVC	

CLIENT: DIALOG	PROJECT: MECHANIZED RIVER VALLEY ACCESS GEO INV	BOREHOLE NO: **TH15-2**
DRILLING COMPANY: ALL SERVICE DRILLING INC	DATE DRILLED: April 20, 2015	PROJECT NO: 19-5861-24
DRILL/METHOD: Soil Max Jr / Solid Stem Augers - Coring	LOCATION: N5934154.623, E33833.711	ELEVATION: 643.20 (m)

SAMPLE TYPE ▥ GRAB SAMPLE ◿ SPT ☒ NO RECOVERY ▮ CORE

BACKFILL TYPE ⁘ GROUT



Discontinuities Description	USC	SOIL / ROCK DESCRIPTION
		TOPSOIL
		CLAY (TILL) very stiff, brown, silty, sandy, trace gravel and rootlets
-CPEN = 72kPa	CI	
-SPT = 15 CPEN > 215kPa	CH	-sand
-CPEN = 215kPa	CI	-trace sand lenses and fine gravel
-SPT = 23 CPEN > 215kPa	CL	
-CPEN > 215kPa	CI	
-SPT = 32	CI-GC	-hard, some gravel
-CPEN > 215kPa	CI	-trace gravel

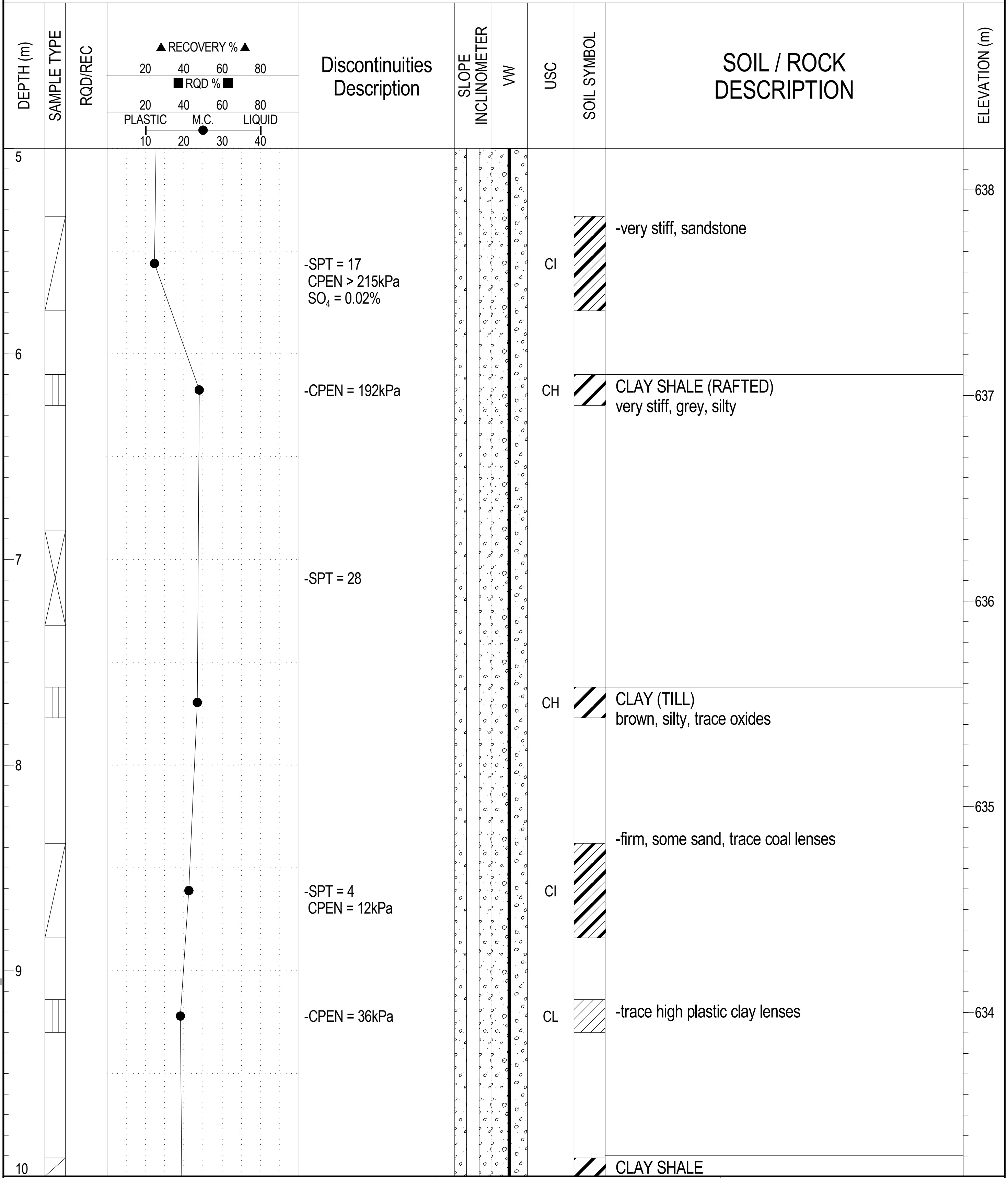
THURBER ENGINEERING LTD.

FIELD LOGGED BY: NNM	COMPLETION DEPTH: 22.4 m
PREPARED BY: SEC	COMPLETION DATE: 4/20/15
REVIEWED BY:	

CLIENT: DIALOG	PROJECT: MECHANIZED RIVER VALLEY ACCESS GEO INV	BOREHOLE NO: **TH15-2**
DRILLING COMPANY: ALL SERVICE DRILLING INC	DATE DRILLED: April 20, 2015	PROJECT NO: 19-5861-24
DRILL/METHOD: Soil Max Jr / Solid Stem Augers - Coring	LOCATION: N5934154.623, E33833.711	ELEVATION: 643.20 (m)

SAMPLE TYPE: ▥ GRAB SAMPLE ◺ SPT ☒ NO RECOVERY ▮ CORE

BACKFILL TYPE: ⁘ GROUT



Discontinuities Description	USC	SOIL / ROCK DESCRIPTION
		-very stiff, sandstone
-SPT = 17 CPEN > 215kPa SO_4 = 0.02%	CI	
-CPEN = 192kPa	CH	CLAY SHALE (RAFTED) very stiff, grey, silty
-SPT = 28		
	CH	CLAY (TILL) brown, silty, trace oxides
		-firm, some sand, trace coal lenses
-SPT = 4 CPEN = 12kPa	CI	
-CPEN = 36kPa	CL	-trace high plastic clay lenses
		CLAY SHALE

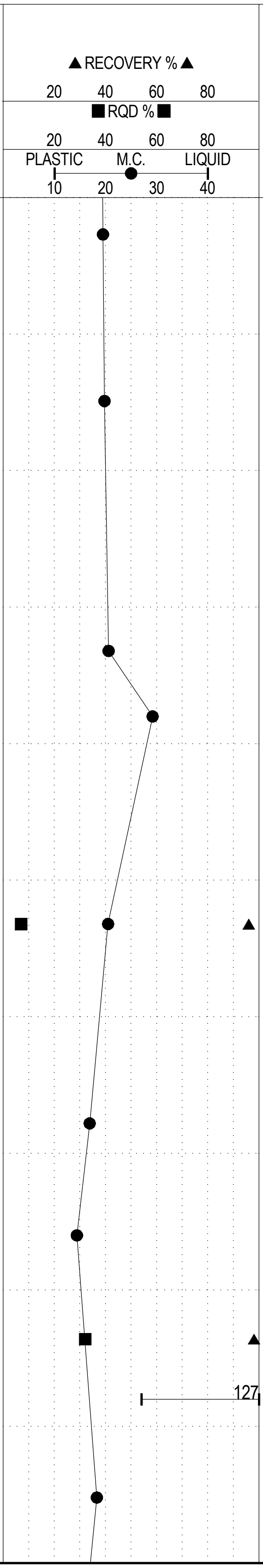
THURBER ENGINEERING LTD.

FIELD LOGGED BY: NNM	COMPLETION DEPTH: 22.4 m
PREPARED BY: SEC	COMPLETION DATE: 4/20/15
REVIEWED BY:	

CLIENT: DIALOG	PROJECT: MECHANIZED RIVER VALLEY ACCESS GEO INV	BOREHOLE NO: **TH15-2**
DRILLING COMPANY: ALL SERVICE DRILLING INC	DATE DRILLED: April 20, 2015	PROJECT NO: 19-5861-24
DRILL/METHOD: Soil Max Jr / Solid Stem Augers - Coring	LOCATION: N5934154.623, E33833.711	ELEVATION: 643.20 (m)

SAMPLE TYPE ▥ GRAB SAMPLE ◸ SPT ☒ NO RECOVERY ▮ CORE

BACKFILL TYPE ⁘ GROUT



DEPTH (m)	RQD/REC	Discontinuities Description	SLOPE INCLINOMETER	VW	USC	SOIL / ROCK DESCRIPTION	ELEVATION (m)
10		-SPT = 28 CPEN > 215kPa			CH	very stiff, dark grey, silty, trace coal	633
					SC	SANDSTONE, grey, fine grained, silty, clayey, some clay shale laminations	
11							632
						CLAY SHALE, hard, dark grey, silty, trace coal lenses	
		-SPT = 49 CPEN = 215kPa			CH		
		-Start coring at 11.9m -Core break at 11.98m				-very stiff to extremely weak, fresh, grey, slightly bentonitic, trace cemented siltstone clasts	
12		-Joint at 12.12m at 60° TCA, curved, rough -Core breaks at 12.23m, 12.37m, and 12.52m				-sandstone laminations from 12.09 - 12.14m	631
	7/96	-Fractured from 12.66 - 12.70m -Core breaks at 12.74m, 12.80m, and 12.84m -Jointed / fractured from 12.88 - 13.21m					
13		-Closed vertical joint from13.21 - 13.39m				-siltstone laminations from 13.26 - 13.39m	630
		-At 13.45m: $\O'_{peak} = 50.9^\circ$ $c'_{peak} = 614.5kPa$ $\O'_{resudual} = 14.3^\circ$ $c'_{resudual} = 128kPa$				-bentonitic, trace cemented siltstone inclusions / laminations	
		-Joint at 13.53m at 70° TCA, undulating, rough -Possible joint at 13.80m at 80° TCA, irregular, rough				Siltstone, very weak to extremely weak, fresh, trace clay shale laminations -slightly cemented, calcareous from 13.75 - 13.84m	
14	32/98	-Jointed / fractured from 13.87 - 13.97m				-very stiff from 13.93 - 13.96m	629
		-Core breaks at 14.06m and 14.16m -Joint at 14.23m at 70° TCA, irregular, rough				-trace siltstone inclusions and sandstone laminations	
15		**-At 14.4m:** $\O'_{peak} = 43^\circ$ $c'_{peak} = 145kPa$					

FIELD LOGGED BY: NNM	COMPLETION DEPTH: 22.4 m
PREPARED BY: SEC	COMPLETION DATE: 4/20/15
REVIEWED BY:	

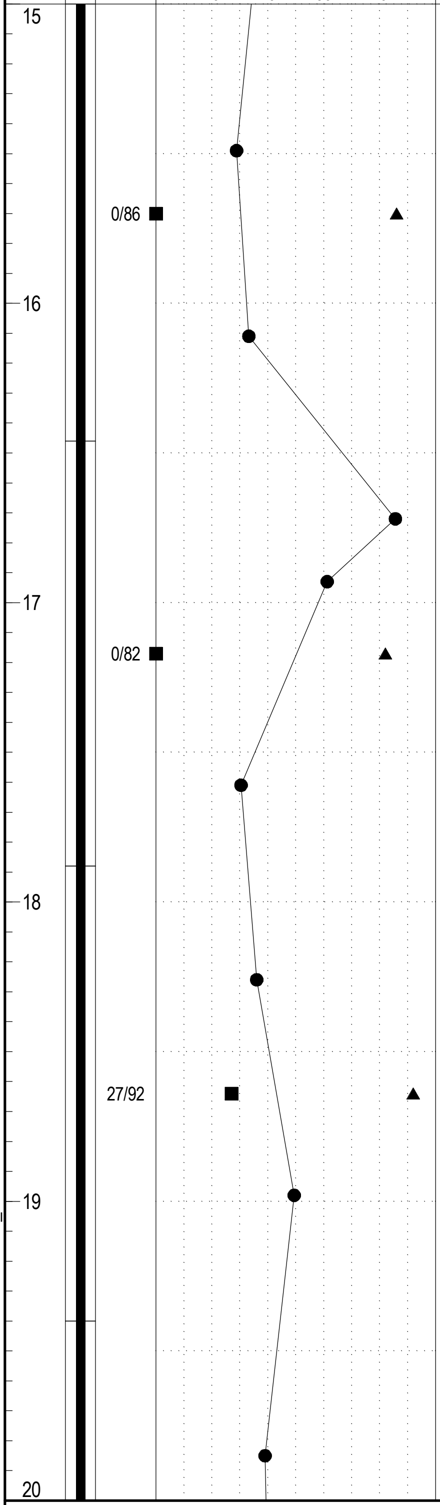
THURBER ENGINEERING LTD.

CLIENT: DIALOG	PROJECT: MECHANIZED RIVER VALLEY ACCESS GEO INV	BOREHOLE NO: **TH15-2**
DRILLING COMPANY: ALL SERVICE DRILLING INC	DATE DRILLED: April 20, 2015	PROJECT NO: 19-5861-24
DRILL/METHOD: Soil Max Jr / Solid Stem Augers - Coring	LOCATION: N5934154.623, E33833.711	ELEVATION: 643.20 (m)

SAMPLE TYPE: ▥ GRAB SAMPLE ◺ SPT ☒ NO RECOVERY ▮ CORE

BACKFILL TYPE: ▨ GROUT

DEPTH (m) | SAMPLE TYPE | RQD/REC | ▲RECOVERY %▲ 20 40 60 80 / ■RQD %■ 20 40 60 80 / PLASTIC M.C. LIQUID 10 20 30 40 | Discontinuities Description | SLOPE INCLINOMETER | VW | USC | SOIL SYMBOL | SOIL / ROCK DESCRIPTION | ELEVATION (m)



Discontinuities Description

Ø'$_{resudual}$ = 13°
c'$_{residual}$ = 0kPa
-Joint at 14.41m at 80° TCA, undulating, smooth
-Core breaks at 14.53m and 14.68m
-Jointed / fractured from 14.75 - 14.92m
-Soft clay rubble from 14.94 - 14.99m
-Core break at 15.05m
-Possible joint at 15.12m at 70° TCA, undulating, rough
-Possible joint at 15.24m at 60° TCA, irregular, rough
-**At 15.32m:**
Ø'$_{peak}$ = 47.9°
c'$_{peak}$ = 885.9kPa
Ø'$_{resudual}$ = 12.7°
c'$_{residual}$ = 180kPa
-Rubble from 15.36 - 15.39m
-Core breaks at 15.45m, 15.49m, 15.58m, and 15.66m
-Joint at 15.79m at 40° TCA, stepped, smooth
-Fractured / rubbled from 15.88 - 15.95m
-Rubble from 16.00 - 16.03m and 16.07 - 16.12m
-Soft rubble from 16.46 - 16.52m
-Joint at 16.54m at 60° TCA, curved, smooth
-Coal part at 16.59m
-Rubble from 16.63 - 16.69m
-Fractured from 16.78 - 17.05m
-Core break at 17.10m
-Fractured from 17.15 - 17.20m
-Joint at 17.26m at 60° TCA, undulating, smooth
-Joints from 17.30 - 17.44m at 10° TCA, closed
-Fractured from 17.44 - 17.54m
-Joint at 17.98m at 80° TCA, planar, smooth
-Joint at 18.06m at 40° TCA, planar, smooth, fractured
-Joint at 18.16m at 60° TCA, irregular, smooth

SOIL / ROCK DESCRIPTION

-hard to extremely weak
-trace small calcareous inclusions

Siltstone, extremely weak, fresh, cemented, trace calcite inclusions

-bentonite laminations from 16.71 - 16.76m, white - green, silty

Coal, extremely weak, fresh
-highly carbonaceous, coal

-slightly carbonaceous, trace coal inclusions

-very weak, trace thin siltstone laminations

-extremely weak to very weak, carbonaceous from 18.90 - 19.03m

ELEVATION (m): 628, 627, 626, 625, 624

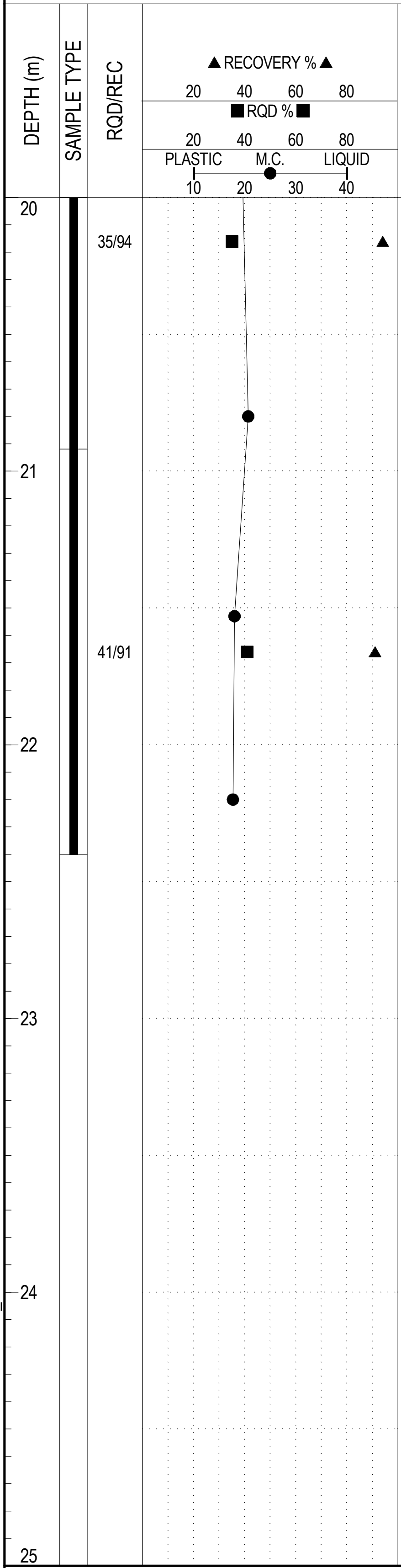
BOREHOLE LOG 19-5861-24-ROCK.GPJ THRBR_AB.GDT 8/19/15- REGULAR LIBRARY-ROCK-NEW LOGO -VW.GLB

THURBER ENGINEERING LTD.	FIELD LOGGED BY: NNM	COMPLETION DEPTH: 22.4 m
	PREPARED BY: SEC	COMPLETION DATE: 4/20/15
	REVIEWED BY:	Page 4 of 5

CLIENT: DIALOG	PROJECT: MECHANIZED RIVER VALLEY ACCESS GEO INV	BOREHOLE NO: **TH15-2**
DRILLING COMPANY: ALL SERVICE DRILLING INC	DATE DRILLED: April 20, 2015	PROJECT NO: 19-5861-24
DRILL/METHOD: Soil Max Jr / Solid Stem Augers - Coring	LOCATION: N5934154.623, E33833.711	ELEVATION: 643.20 (m)

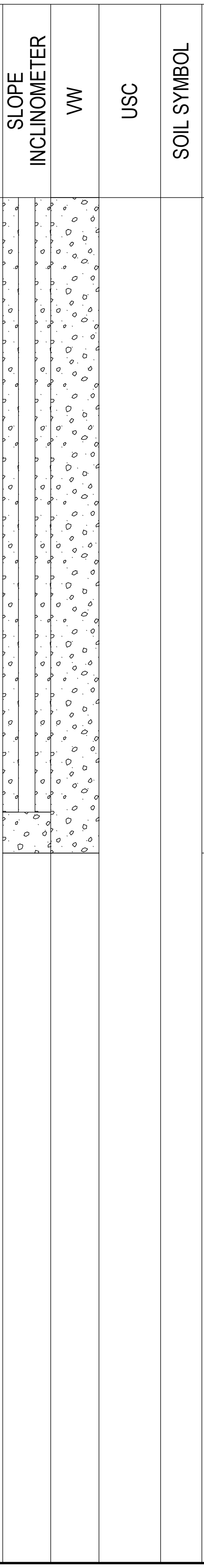
SAMPLE TYPE ▥ GRAB SAMPLE ◿ SPT ☒ NO RECOVERY ▮ CORE

BACKFILL TYPE ▨ GROUT



Discontinuities Description

-Core break at 18.20m
-Joint at 18.28m at 70° TCA, irregular, rough
-Core break at 18.62m
-Joint at 18.68m at 80° TCA, undulating, rough
-Core breaks at 18.75m and 18.80m
-Joint at 18.87m at 70° TCA, irregular, rough, fractured
-Core breaks at 18.98m, 19.00m, and 19.04m
-Fractured from 19.09 - 19.12m
-Core break at 19.50m
-Joint at 19.60m at 80° TCA, curved, smooth
-Joint at 19.68m at 30° TCA with rubble infill
-Core break at 19.73m
-Joint at 19.84m at 50° TCA, irregular, smooth, fractured
-Joints at 19.95 and 20.03m at 60° TCA, closed
-Joint at 20.13m at 60° TCA, curved, smooth
-Joint at 20.26m at 40° TCA, curved, smooth
-Joint at 20.31m at 70° TCA, curved, smooth
-Core break at 20.53m
-Joint at 20.64m at 70° TCA, curved, rough
-Joint at 20.68m at 70° TCA, irregular, rough
-Core break at 21.12m
-Joint at 21.30m at 50° TCA, closed
-Core break at 21.41m
-Joint at 21.57m at 10° TCA, curved, smooth
-Core break at 21.63m
-Joint at 21.68m at 20° TCA, curved, smooth
-Core breaks at 21.73m, 21.77m, and 21.95m
-Joint at 22.08m at 60° TCA
-Core break at 22.20m



SOIL / ROCK DESCRIPTION

END OF TEST HOLE AT 22.4m
UPON COMPLETION:
Slope indicator and vibrating wire piezometer (S/N 32114) installed
WATER LEVEL BELOW GROUND SURFACE:
-April 23, 2015 = 16.6m
-June 16, 2015 = Dry

ELEVATION (m): 623, 622, 621, 620, 619

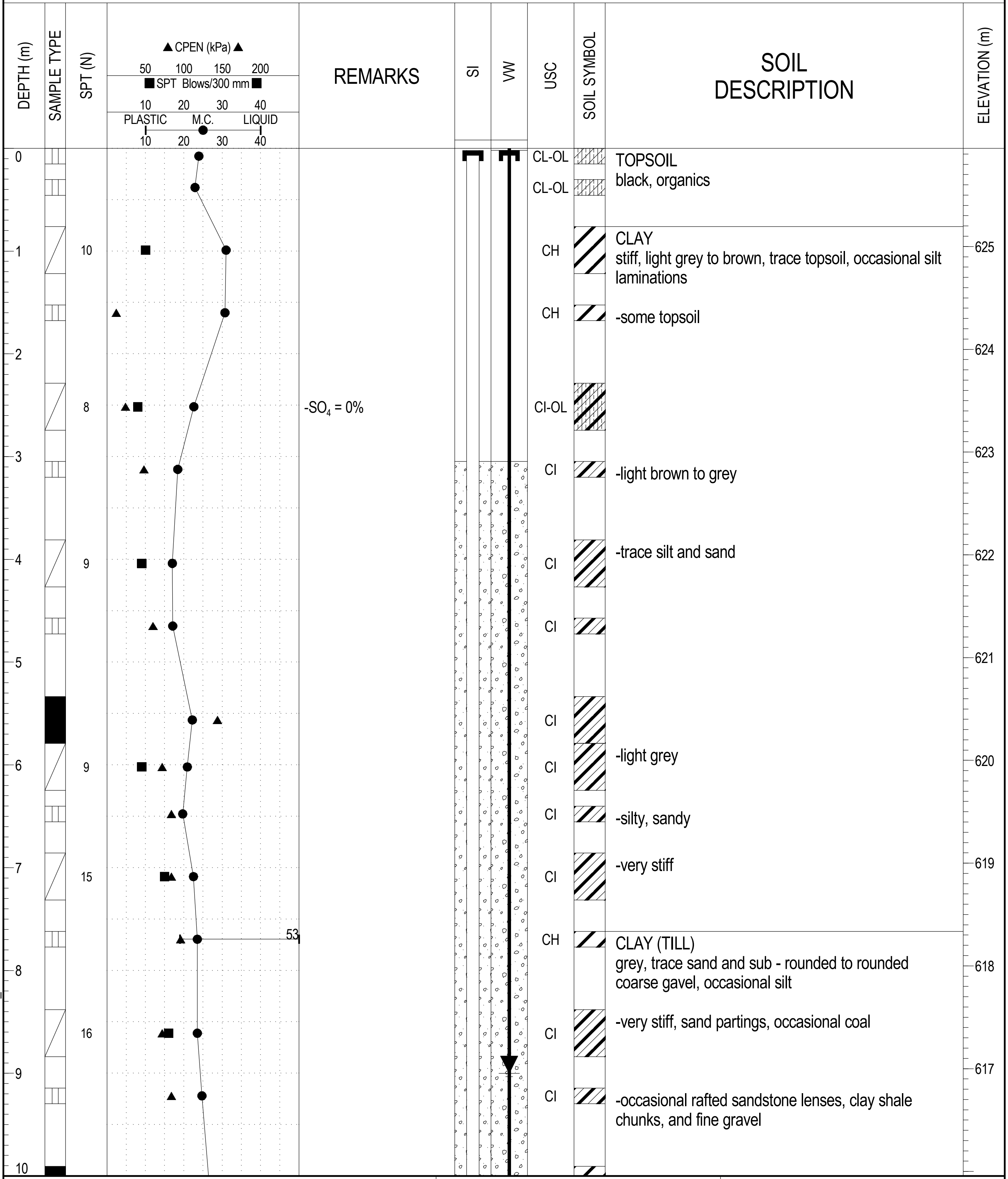
FIELD LOGGED BY: NNM	COMPLETION DEPTH: 22.4 m
PREPARED BY: SEC	COMPLETION DATE: 4/20/15
REVIEWED BY:	

THURBER ENGINEERING LTD.

CLIENT: DIALOG	PROJECT: MECHANIZED RIVER VALLEY ACCESS GEO INV	BOREHOLE NO: **TH15-3**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: January 28, 2015	PROJECT NO: 19-5861-24
DRILL/METHOD: Track M5 unimog / Solid Stem Augers	LOCATION: N5934113.91, E33846.828	ELEVATION: 625.96 (m)

SAMPLE TYPE ▥ GRAB SAMPLE ◺ SPT ■ SHELBY TUBE

BACKFILL TYPE ⁘ GROUT ▥ SLOUGH



TOPSOIL
black, organics

CLAY
stiff, light grey to brown, trace topsoil, occasional silt laminations

-some topsoil

-light brown to grey

-trace silt and sand

-light grey

-silty, sandy

-very stiff

CLAY (TILL)
grey, trace sand and sub - rounded to rounded coarse gavel, occasional silt

-very stiff, sand partings, occasional coal

-occasional rafted sandstone lenses, clay shale chunks, and fine gravel

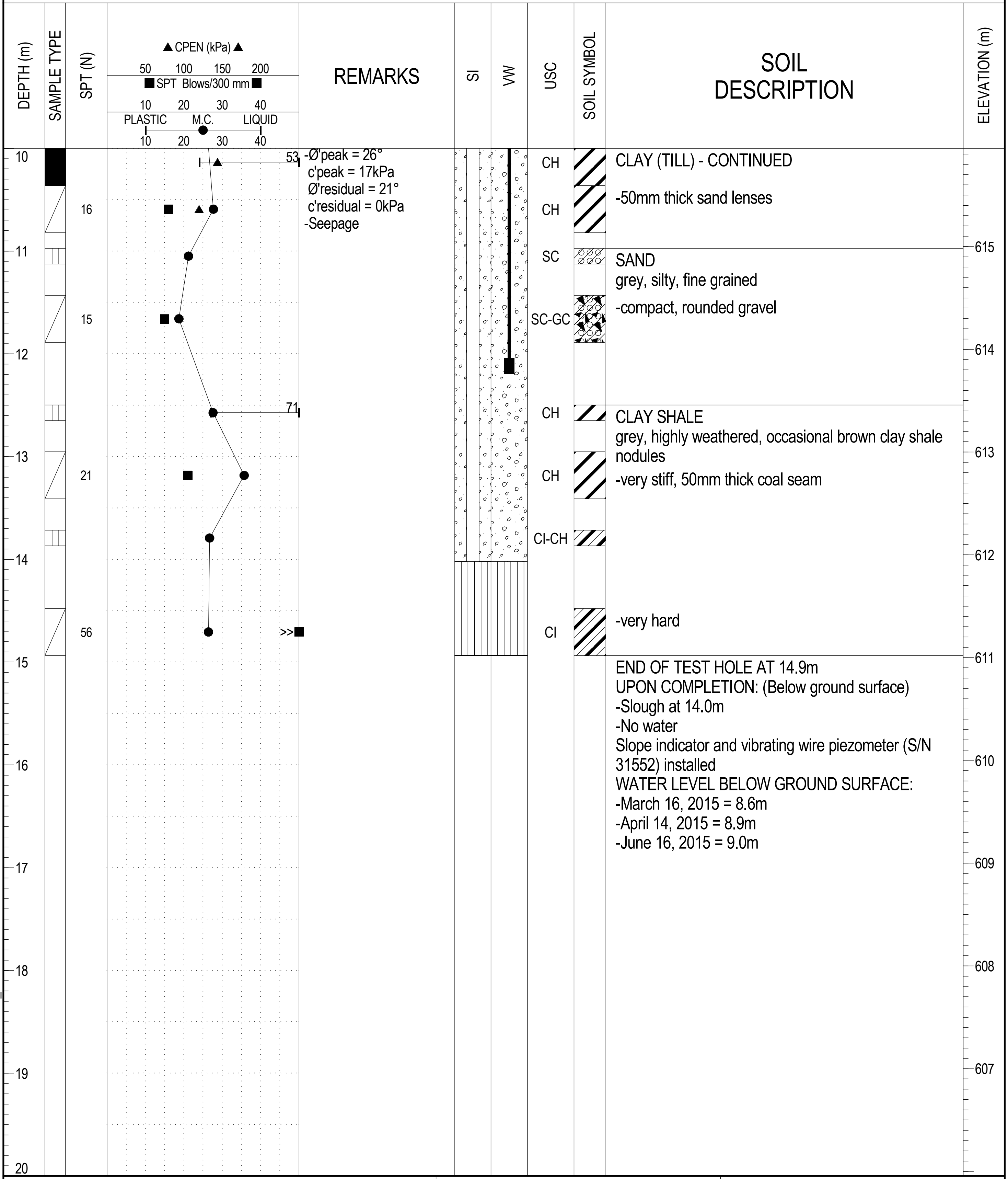
THURBER ENGINEERING LTD.

FIELD LOGGED BY: NKR	COMPLETION DEPTH: 14.9 m
PREPARED BY: SEC	COMPLETION DATE: 1/28/15
REVIEWED BY: RVC	Page 1 of 2

CLIENT: DIALOG	PROJECT: MECHANIZED RIVER VALLEY ACCESS GEO INV	BOREHOLE NO: **TH15-3**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: January 28, 2015	PROJECT NO: 19-5861-24
DRILL/METHOD: Track M5 unimog / Solid Stem Augers	LOCATION: N5934113.91, E33846.828	ELEVATION: 625.96 (m)

SAMPLE TYPE ▥ GRAB SAMPLE ◺ SPT ■ SHELBY TUBE

BACKFILL TYPE ⬚ GROUT ▥ SLOUGH



-Ø'peak = 26°
c'peak = 17kPa
Ø'residual = 21°
c'residual = 0kPa
-Seepage

CLAY (TILL) - CONTINUED

-50mm thick sand lenses

SAND
grey, silty, fine grained

-compact, rounded gravel

CLAY SHALE
grey, highly weathered, occasional brown clay shale nodules

-very stiff, 50mm thick coal seam

-very hard

END OF TEST HOLE AT 14.9m
UPON COMPLETION: (Below ground surface)
-Slough at 14.0m
-No water
Slope indicator and vibrating wire piezometer (S/N 31552) installed
WATER LEVEL BELOW GROUND SURFACE:
-March 16, 2015 = 8.6m
-April 14, 2015 = 8.9m
-June 16, 2015 = 9.0m

THURBER ENGINEERING LTD.	FIELD LOGGED BY: NKR	COMPLETION DEPTH: 14.9 m
	PREPARED BY: SEC	COMPLETION DATE: 1/28/15
	REVIEWED BY: RVC	Page 2 of 2

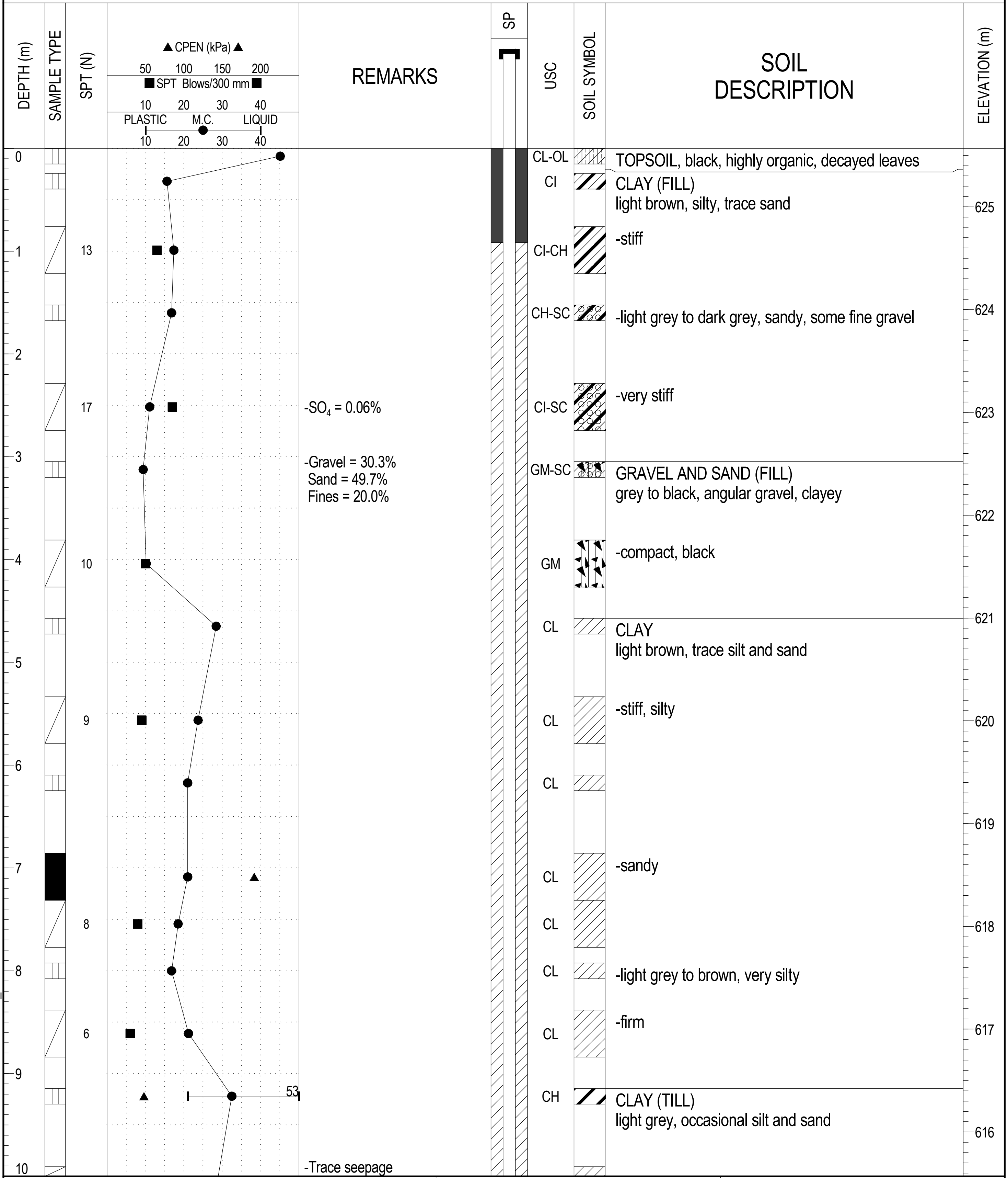
CLIENT: DIALOG | PROJECT: MECHANIZED RIVER VALLEY ACCESS GEO INV | BOREHOLE NO: **TH15-4**

DRILLING COMPANY: Mobile Augers & Research Ltd. | DATE DRILLED: February 2, 2015 | PROJECT NO: 19-5861-24

DRILL/METHOD: Track M5 unimog / Solid Stem Augers | LOCATION: N5934040.923, E33824.086 | ELEVATION: 625.57 (m)

SAMPLE TYPE: ▥ GRAB SAMPLE ▨ SPT ■ SHELBY TUBE

BACKFILL TYPE: ■ BENTONITE ▨ DRILL CUTTINGS ▥ SLOUGH



DEPTH (m)	SPT (N)	REMARKS	USC	SOIL DESCRIPTION
0			CL-OL	TOPSOIL, black, highly organic, decayed leaves
			CI	CLAY (FILL) light brown, silty, trace sand
1	13		CI-CH	-stiff
			CH-SC	-light grey to dark grey, sandy, some fine gravel
	17	-SO_4 = 0.06%	CI-SC	-very stiff
3		-Gravel = 30.3% Sand = 49.7% Fines = 20.0%	GM-SC	GRAVEL AND SAND (FILL) grey to black, angular gravel, clayey
4	10		GM	-compact, black
			CL	CLAY light brown, trace silt and sand
	9		CL	-stiff, silty
6			CL	
7			CL	-sandy
	8		CL	
8			CL	-light grey to brown, very silty
	6		CL	-firm
			CH	CLAY (TILL) light grey, occasional silt and sand
10		-Trace seepage		

THURBER ENGINEERING LTD.

FIELD LOGGED BY: NKR | COMPLETION DEPTH: 14.9 m

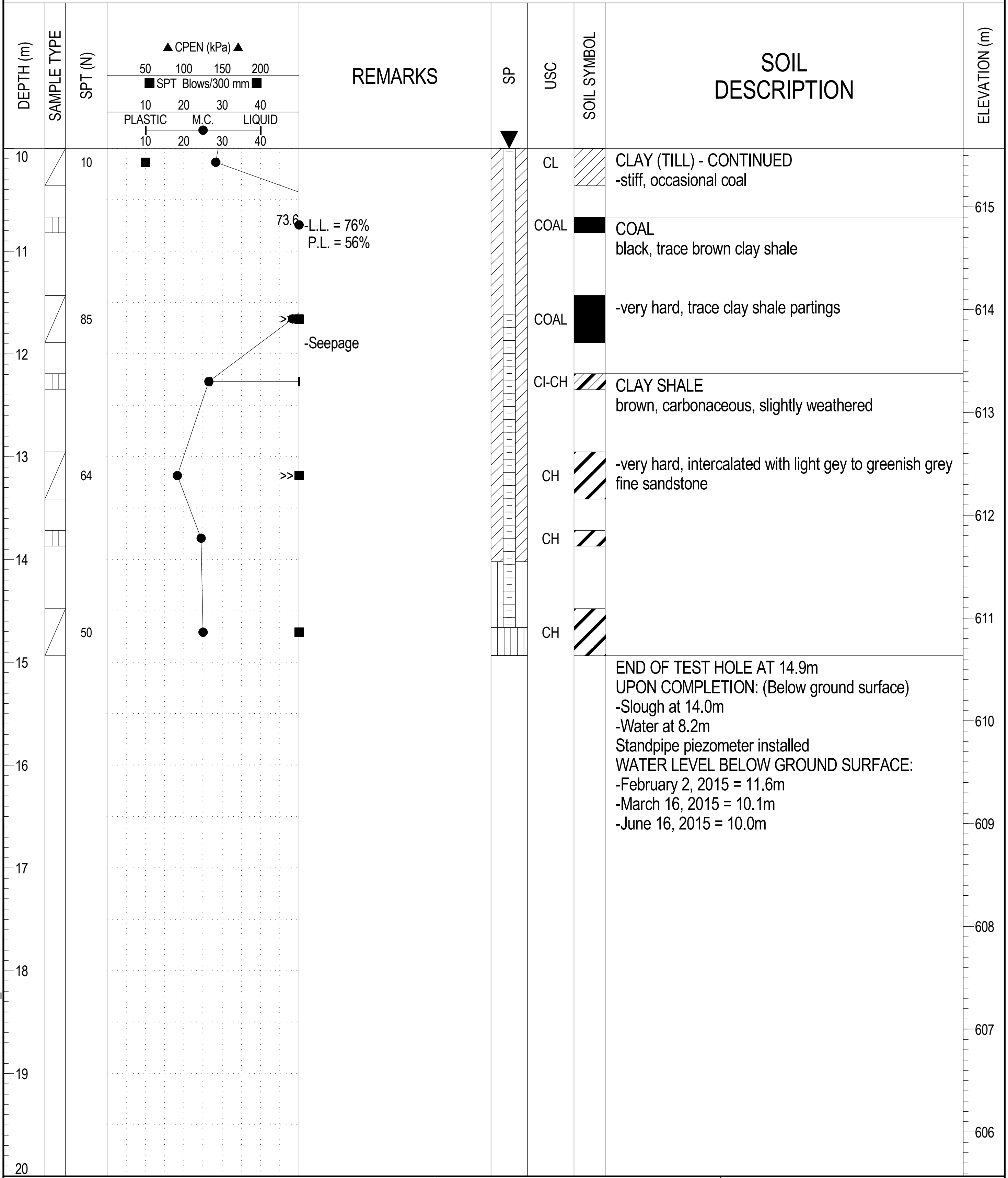
PREPARED BY: SEC | COMPLETION DATE: 2/2/15

REVIEWED BY: RVC

CLIENT: DIALOG	PROJECT: MECHANIZED RIVER VALLEY ACCESS GEO INV	BOREHOLE NO: **TH15-4**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: February 2, 2015	PROJECT NO: 19-5861-24
DRILL/METHOD: Track M5 unimog / Solid Stem Augers	LOCATION: N5934040.923, E33824.086	ELEVATION: 625.57 (m)

SAMPLE TYPE ▥ GRAB SAMPLE ▨ SPT ■ SHELBY TUBE

BACKFILL TYPE ■ BENTONITE ▨ DRILL CUTTINGS ▥ SLOUGH



CLAY (TILL) - CONTINUED
-stiff, occasional coal

COAL
black, trace brown clay shale

-very hard, trace clay shale partings

CLAY SHALE
brown, carbonaceous, slightly weathered

-very hard, intercalated with light gey to greenish grey fine sandstone

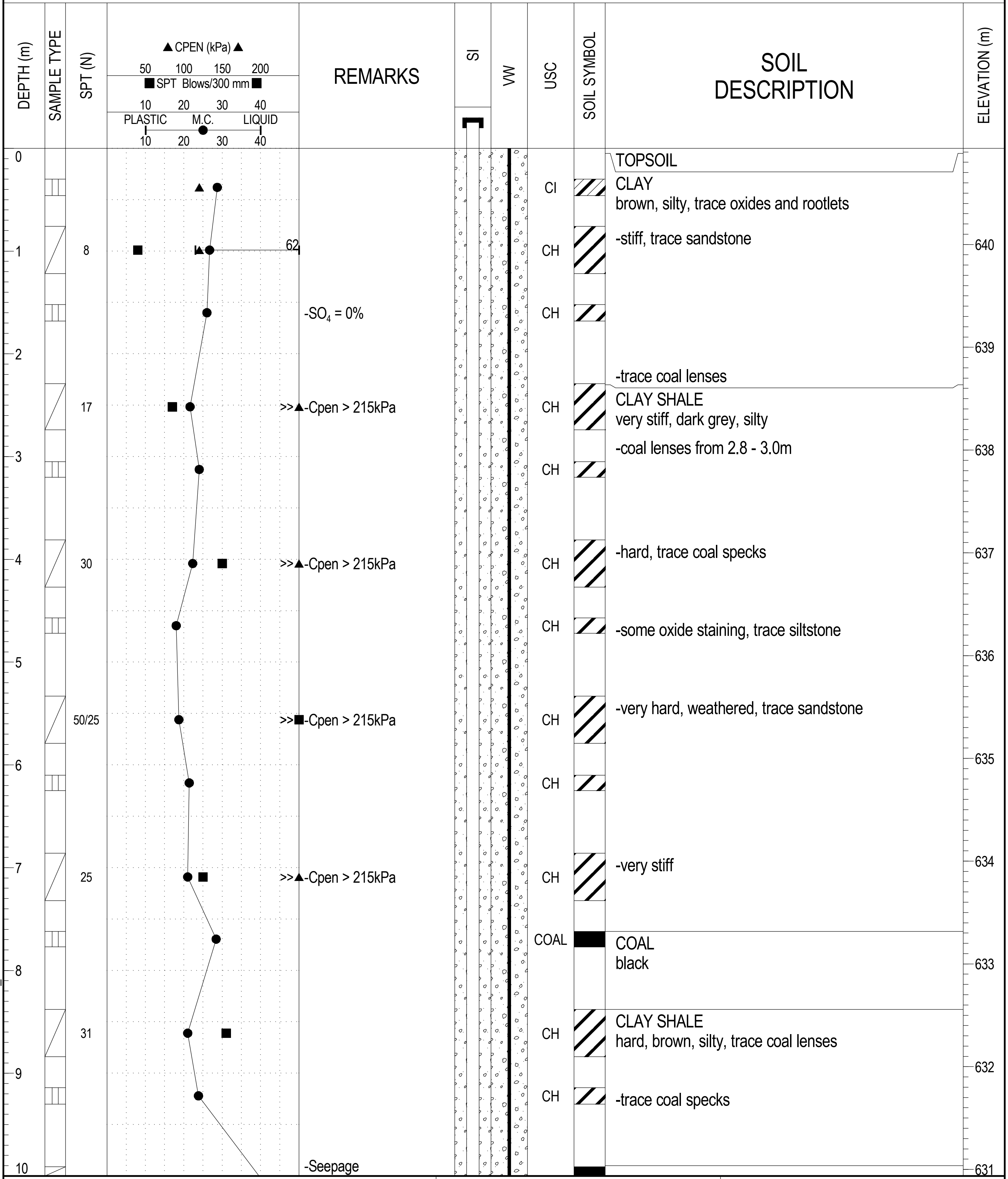
END OF TEST HOLE AT 14.9m
UPON COMPLETION: (Below ground surface)
-Slough at 14.0m
-Water at 8.2m
Standpipe piezometer installed
WATER LEVEL BELOW GROUND SURFACE:
-February 2, 2015 = 11.6m
-March 16, 2015 = 10.1m
-June 16, 2015 = 10.0m

THURBER ENGINEERING LTD.	FIELD LOGGED BY: NKR	COMPLETION DEPTH: 14.9 m
	PREPARED BY: SEC	COMPLETION DATE: 2/2/15
	REVIEWED BY: RVC	Page 2 of 2

CLIENT: DIALOG	PROJECT: MECHANIZED RIVER VALLEY ACCESS GEO INV	BOREHOLE NO: **TH15-10**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: April 16 & 17, 2015	PROJECT NO: 19-5861-24
DRILL/METHOD: M4T / Solid Stem Augers	LOCATION: N5934203.799, E33905.527	ELEVATION: 640.94 (m)

SAMPLE TYPE ▥ GRAB SAMPLE ◺ SPT

BACKFILL TYPE ⁘ GROUT



SPT (N)	REMARKS	USC	SOIL DESCRIPTION
			TOPSOIL
		CI	CLAY brown, silty, trace oxides and rootlets
8		CH	-stiff, trace sandstone
	-SO$_4$ = 0%	CH	
			-trace coal lenses
17	>>▲-Cpen > 215kPa	CH	CLAY SHALE very stiff, dark grey, silty -coal lenses from 2.8 - 3.0m
		CH	
30	>>▲-Cpen > 215kPa	CH	-hard, trace coal specks
		CH	-some oxide staining, trace siltstone
50/25	>>■-Cpen > 215kPa	CH	-very hard, weathered, trace sandstone
		CH	
25	>>▲-Cpen > 215kPa	CH	-very stiff
		COAL	COAL black
31		CH	CLAY SHALE hard, brown, silty, trace coal lenses
		CH	-trace coal specks
	-Seepage		

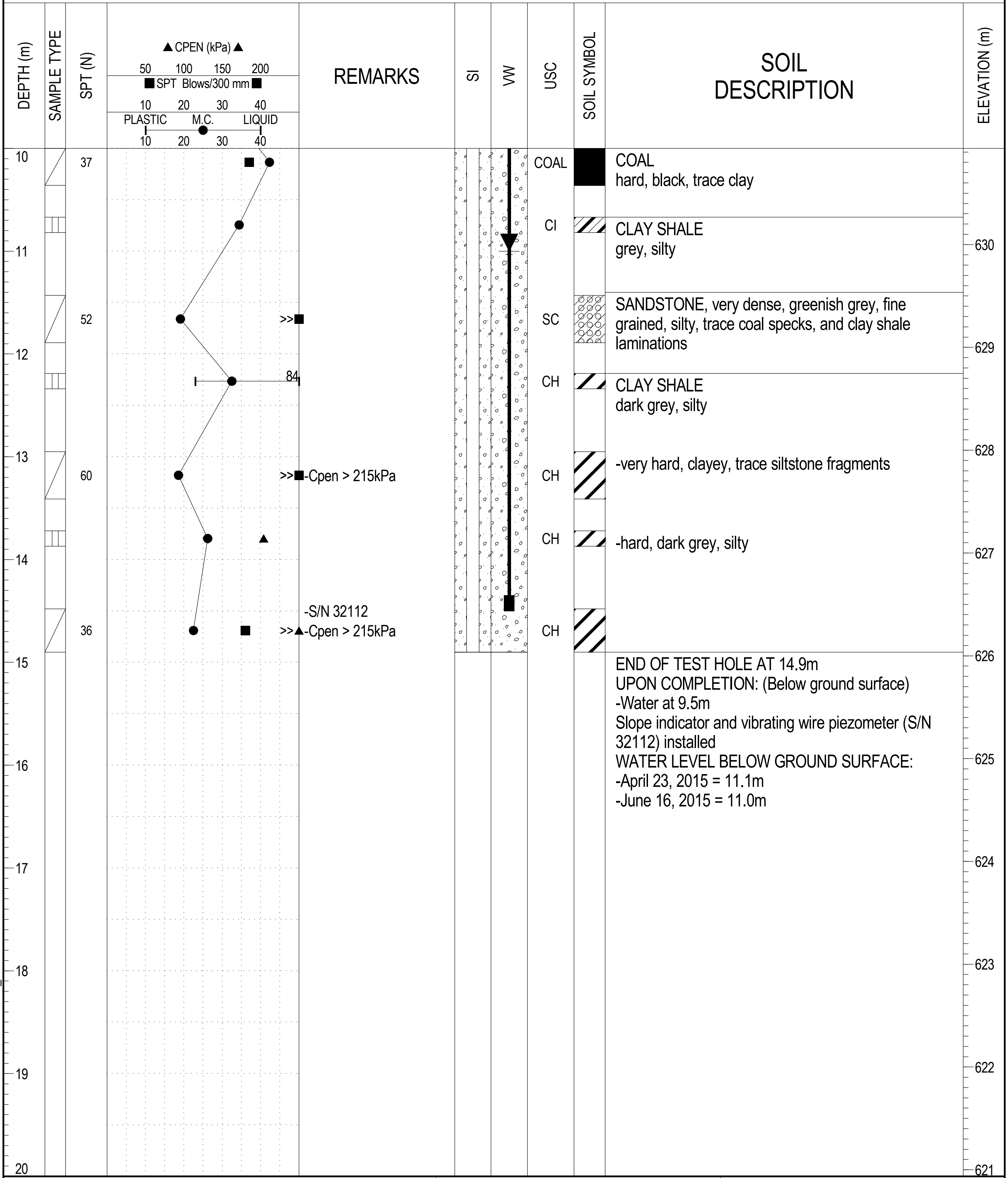
THURBER ENGINEERING LTD.

FIELD LOGGED BY: NNM	COMPLETION DEPTH: 14.9 m
PREPARED BY: SEC	COMPLETION DATE: 4/17/15
REVIEWED BY:	

CLIENT: DIALOG	PROJECT: MECHANIZED RIVER VALLEY ACCESS GEO INV	BOREHOLE NO: **TH15-10**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: April 16 & 17, 2015	PROJECT NO: 19-5861-24
DRILL/METHOD: M4T / Solid Stem Augers	LOCATION: N5934203.799, E33905.527	ELEVATION: 640.94 (m)

SAMPLE TYPE ▥ GRAB SAMPLE ◿ SPT

BACKFILL TYPE ⁙ GROUT



-Cpen > 215kPa

-S/N 32112

-Cpen > 215kPa

COAL
hard, black, trace clay

CLAY SHALE
grey, silty

SANDSTONE, very dense, greenish grey, fine grained, silty, trace coal specks, and clay shale laminations

CLAY SHALE
dark grey, silty

-very hard, clayey, trace siltstone fragments

-hard, dark grey, silty

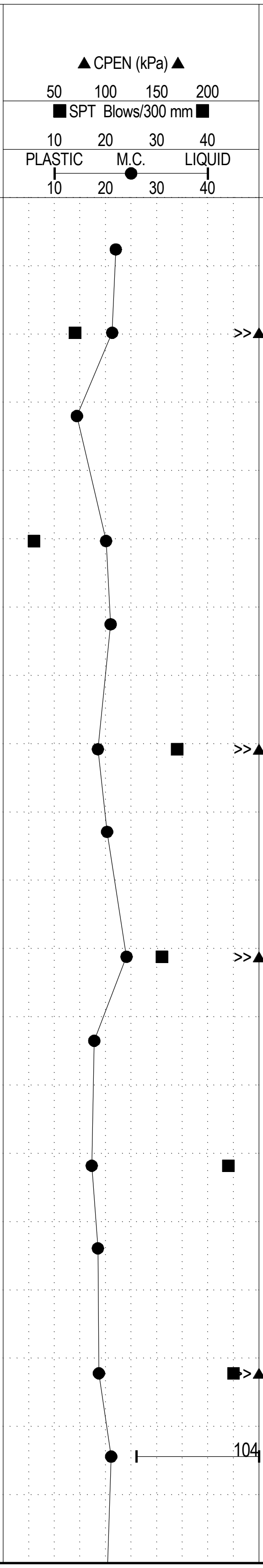
END OF TEST HOLE AT 14.9m
UPON COMPLETION: (Below ground surface)
-Water at 9.5m
Slope indicator and vibrating wire piezometer (S/N 32112) installed
WATER LEVEL BELOW GROUND SURFACE:
-April 23, 2015 = 11.1m
-June 16, 2015 = 11.0m

THURBER ENGINEERING LTD.	FIELD LOGGED BY: NNM	COMPLETION DEPTH: 14.9 m
	PREPARED BY: SEC	COMPLETION DATE: 4/17/15
	REVIEWED BY:	

CLIENT: DIALOG	PROJECT: MECHANIZED RIVER VALLEY ACCESS GEO INV	BOREHOLE NO: **TH15-11**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: April 16 & 17, 2015	PROJECT NO: 19-5861-24
DRILL/METHOD: M4T / Solid Stem Augers	LOCATION: N5934220.643, E33944.901	ELEVATION: 639.97 (m)

SAMPLE TYPE ▥ GRAB SAMPLE ◸ SPT

BACKFILL TYPE ⁘ GROUT ▥ SLOUGH



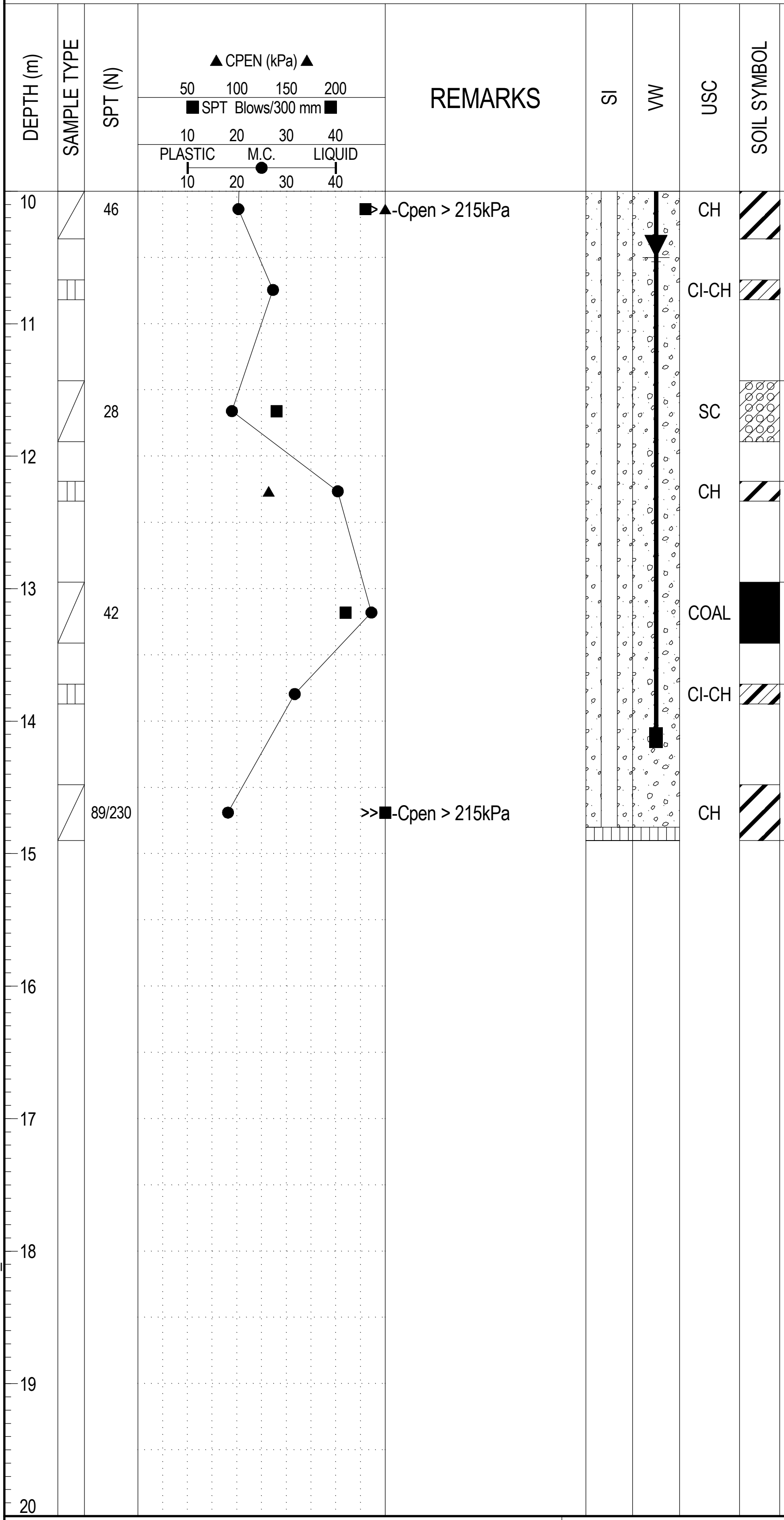
DEPTH (m)	SAMPLE TYPE	SPT (N)	REMARKS	SI	VW	USC	SOIL DESCRIPTION	ELEVATION (m)
0							TOPSOIL	
	GRAB					CH	CLAY grey, silty, trace sand, clay shale nodules, sandstone nodules, and rootlets	
1	SPT	14	>>▲-Cpen > 215kPa			CH	CLAY SHALE stiff, dark grey, silty, trace sandstone and rootlets	639
	GRAB					CH	-brown	
2								638
	SPT	6				CH	-firm, dark grey, trace oxides	
3								637
	GRAB					CH	-grey	
4	SPT	34	>>▲-Cpen > 215kPa			CH	-hard, trace siltstone	636
	GRAB		-SO_4 = 0.06%			CH		
5								635
	SPT	31	>>▲-Cpen > 215kPa			CH	-trace coal lenses	
							-coal lenses from 5.8 - 6.0m	
6								634
	GRAB					CH-MH	-silty	
7	SPT	44				SC	SANDSTONE, dense, grey, fine grained, silty, clayey, trace oxides, coal, and clay shale laminations	633
	GRAB					CH	CLAY SHALE grey, silty	
8								632
	SPT	45	■>▲-Cpen > 215kPa			CH	-hard, trace coal	
9								631
	GRAB					CH		
10	SPT							

THURBER ENGINEERING LTD.	FIELD LOGGED BY: NNM	COMPLETION DEPTH: 14.9 m
	PREPARED BY: SEC	COMPLETION DATE: 4/17/15
	REVIEWED BY:	

CLIENT: DIALOG	PROJECT: MECHANIZED RIVER VALLEY ACCESS GEO INV	BOREHOLE NO: **TH15-11**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: April 16 & 17, 2015	PROJECT NO: 19-5861-24
DRILL/METHOD: M4T / Solid Stem Augers	LOCATION: N5934220.643, E33944.901	ELEVATION: 639.97 (m)

SAMPLE TYPE ▥ GRAB SAMPLE ◺ SPT

BACKFILL TYPE ▨ GROUT ▥ SLOUGH



SPT (N)	REMARKS	USC	SOIL DESCRIPTION
46	■>▲-Cpen > 215kPa	CH	CLAY SHALE - CONTINUED -trace sandstone laminations
		CI-CH	
28		SC	SANDSTONE, compact, grey, fine grained, silty, clayey, some clay shale laminations
		CH	CLAY SHALE bluish light grey, silty, bentonitic
42		COAL	COAL hard, black, trace clay shale
		CI-CH	CLAY SHALE greenish grey, silty
89/230	>>■-Cpen > 215kPa	CH	-very hard, dark grey

END OF TEST HOLE AT 14.9m
UPON COMPLETION: (Below ground surface)
-Slough at 14.8m
-Water at 10.5m
Slope indicator and vibrating wire piezometer (S/N 32113) installed
WATER LEVEL BELOW GROUND SURFACE:
-April 23, 2015 = 10.4m
-June 16, 2015 = 10.5m

ELEVATION (m): 629, 628, 627, 626, 625, 624, 623, 622, 621

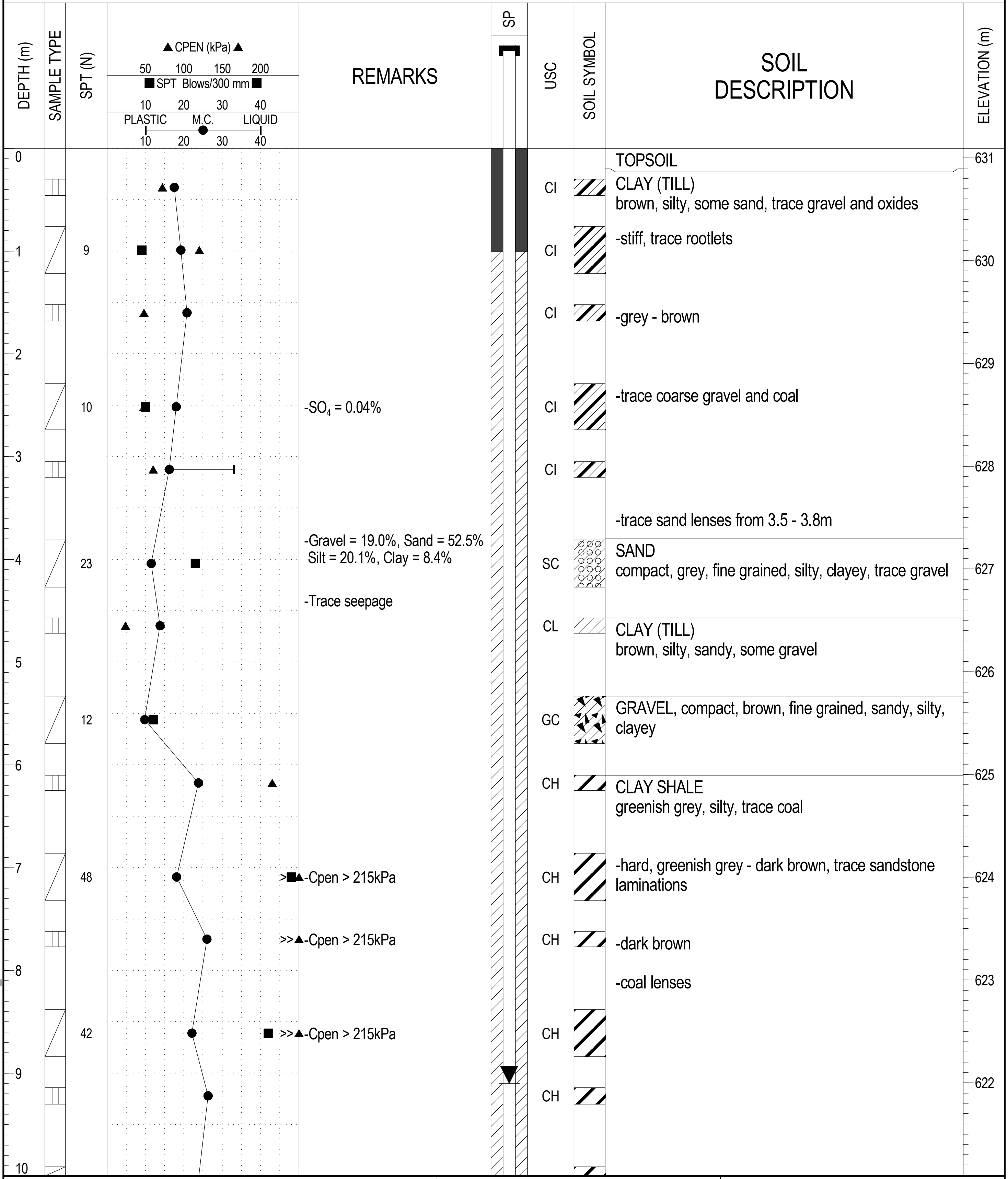
THURBER ENGINEERING LTD.

FIELD LOGGED BY: NNM	COMPLETION DEPTH: 14.9 m
PREPARED BY: SEC	COMPLETION DATE: 4/17/15
REVIEWED BY:	

CLIENT: DIALOG	PROJECT: MECHANIZED RIVER VALLEY ACCESS GEO INV	BOREHOLE NO: **TH15-12**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: April 15, 2015	PROJECT NO: 19-5861-24
DRILL/METHOD: M5 / Solid Stem Augers	LOCATION: N5934204.226, E33958.546	ELEVATION: 631.09 (m)

SAMPLE TYPE ▥ GRAB SAMPLE ▨ SPT

BACKFILL TYPE ■ BENTONITE ▨ DRILL CUTTINGS ▥ SLOUGH



-SO$_4$ = 0.04%

-Gravel = 19.0%, Sand = 52.5%
Silt = 20.1%, Clay = 8.4%

-Trace seepage

-Cpen > 215kPa

-Cpen > 215kPa

-Cpen > 215kPa

TOPSOIL

CLAY (TILL)
brown, silty, some sand, trace gravel and oxides

-stiff, trace rootlets

-grey - brown

-trace coarse gravel and coal

-trace sand lenses from 3.5 - 3.8m

SAND
compact, grey, fine grained, silty, clayey, trace gravel

CLAY (TILL)
brown, silty, sandy, some gravel

GRAVEL, compact, brown, fine grained, sandy, silty, clayey

CLAY SHALE
greenish grey, silty, trace coal

-hard, greenish grey - dark brown, trace sandstone laminations

-dark brown

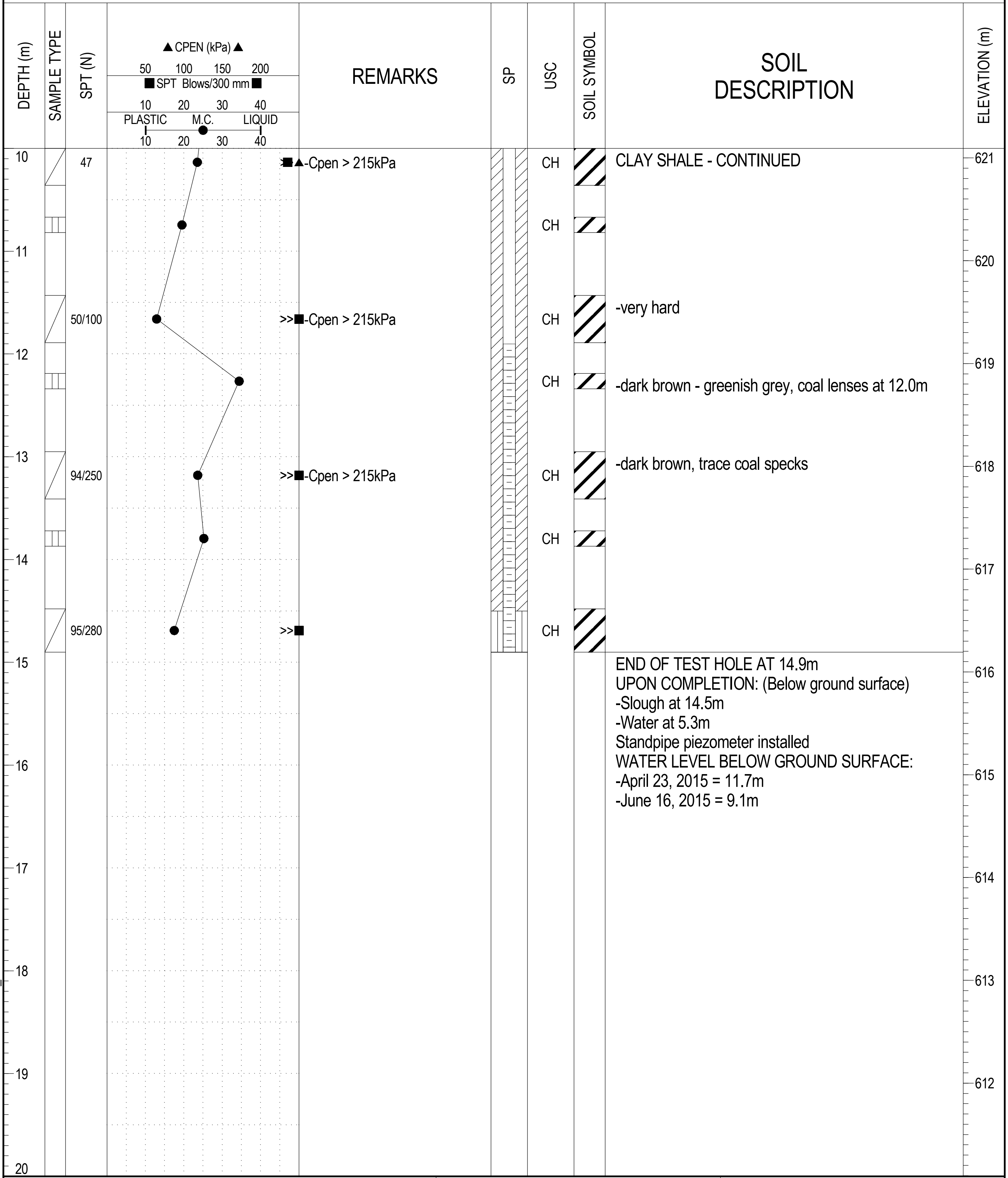
-coal lenses

THURBER ENGINEERING LTD.	FIELD LOGGED BY: NNM	COMPLETION DEPTH: 14.9 m
	PREPARED BY: SEC	COMPLETION DATE: 4/15/15
	REVIEWED BY:	

CLIENT: DIALOG	PROJECT: MECHANIZED RIVER VALLEY ACCESS GEO INV	BOREHOLE NO: **TH15-12**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: April 15, 2015	PROJECT NO: 19-5861-24
DRILL/METHOD: M5 / Solid Stem Augers	LOCATION: N5934204.226, E33958.546	ELEVATION: 631.09 (m)

SAMPLE TYPE ▥ GRAB SAMPLE ▨ SPT

BACKFILL TYPE ■ BENTONITE ▨ DRILL CUTTINGS ▥ SLOUGH



SPT	47	■▲-Cpen > 215kPa	CH	CLAY SHALE - CONTINUED
GRAB SAMPLE			CH	
SPT	50/100	>>■-Cpen > 215kPa	CH	-very hard
GRAB SAMPLE			CH	-dark brown - greenish grey, coal lenses at 12.0m
SPT	94/250	>>■-Cpen > 215kPa	CH	-dark brown, trace coal specks
GRAB SAMPLE			CH	
SPT	95/280	>>■	CH	

END OF TEST HOLE AT 14.9m
UPON COMPLETION: (Below ground surface)
-Slough at 14.5m
-Water at 5.3m
Standpipe piezometer installed
WATER LEVEL BELOW GROUND SURFACE:
-April 23, 2015 = 11.7m
-June 16, 2015 = 9.1m

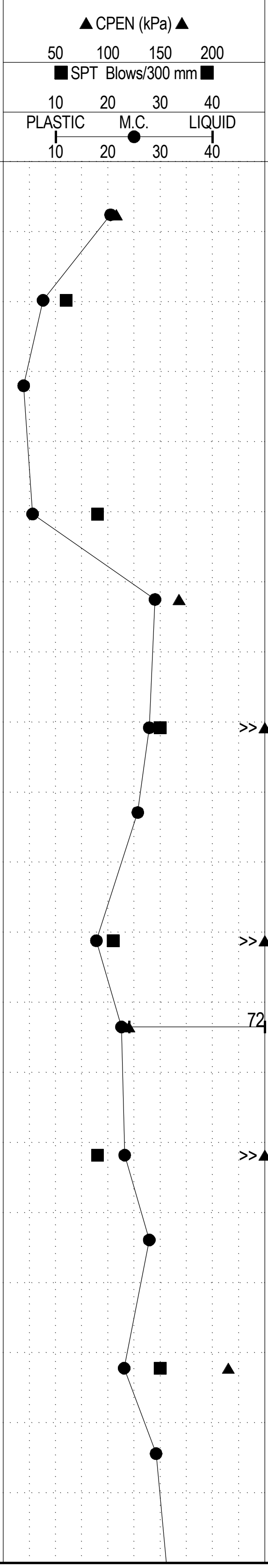
THURBER ENGINEERING LTD.

FIELD LOGGED BY: NNM	COMPLETION DEPTH: 14.9 m
PREPARED BY: SEC	COMPLETION DATE: 4/15/15
REVIEWED BY:	

CLIENT: DIALOG	PROJECT: MECHANIZED RIVER VALLEY ACCESS GEO INV	BOREHOLE NO: **TH15-13**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: April 15, 2015	PROJECT NO: 19-5861-24
DRILL/METHOD: M5 / Solid Stem Augers	LOCATION: N5934186.351, E33989.934	ELEVATION: 629.49 (m)

SAMPLE TYPE ▥ GRAB SAMPLE ◿ SPT

BACKFILL TYPE ■ BENTONITE ▨ DRILL CUTTINGS



DEPTH (m)	SPT (N)	REMARKS	USC	SOIL DESCRIPTION	ELEVATION (m)
0				TOPSOIL	
			CH	CLAY (TILL), brown, silty, some sand, trace fine gravel and rootlets	629
1	12		GC	GRAVEL compact, brown, silty, clayey, sandy	
					628
			GM		
2					
	18		GP-GM		627
3			CI-CH	CLAY SHALE (RAFTED) brown, silty, trace oxides and coal	
					626
4	30	>>▲-Cpen > 215kPa	CI-CH	-hard, dark brown - black, some coal staining	
					625
			CH		
5					
	21	>>▲-Cpen > 215kPa	CH	-very stiff, trace coal staining	624
6			CH	-grey	
					623
7	18	>>▲-Cpen > 215kPa SO_4 = 0.04% -Seepage	CH	-trace siltstone	
					622
			SC	SANDSTONE (RAFTED) bluish grey, fine grained, silty, clayey	
8					
	30		CH	CLAY SHALE (RAFTED) hard, dark grey, silty, trace sandstone laminations	621
9			CI-CL	CLAY (TILL) brown, silty	
					620
10					

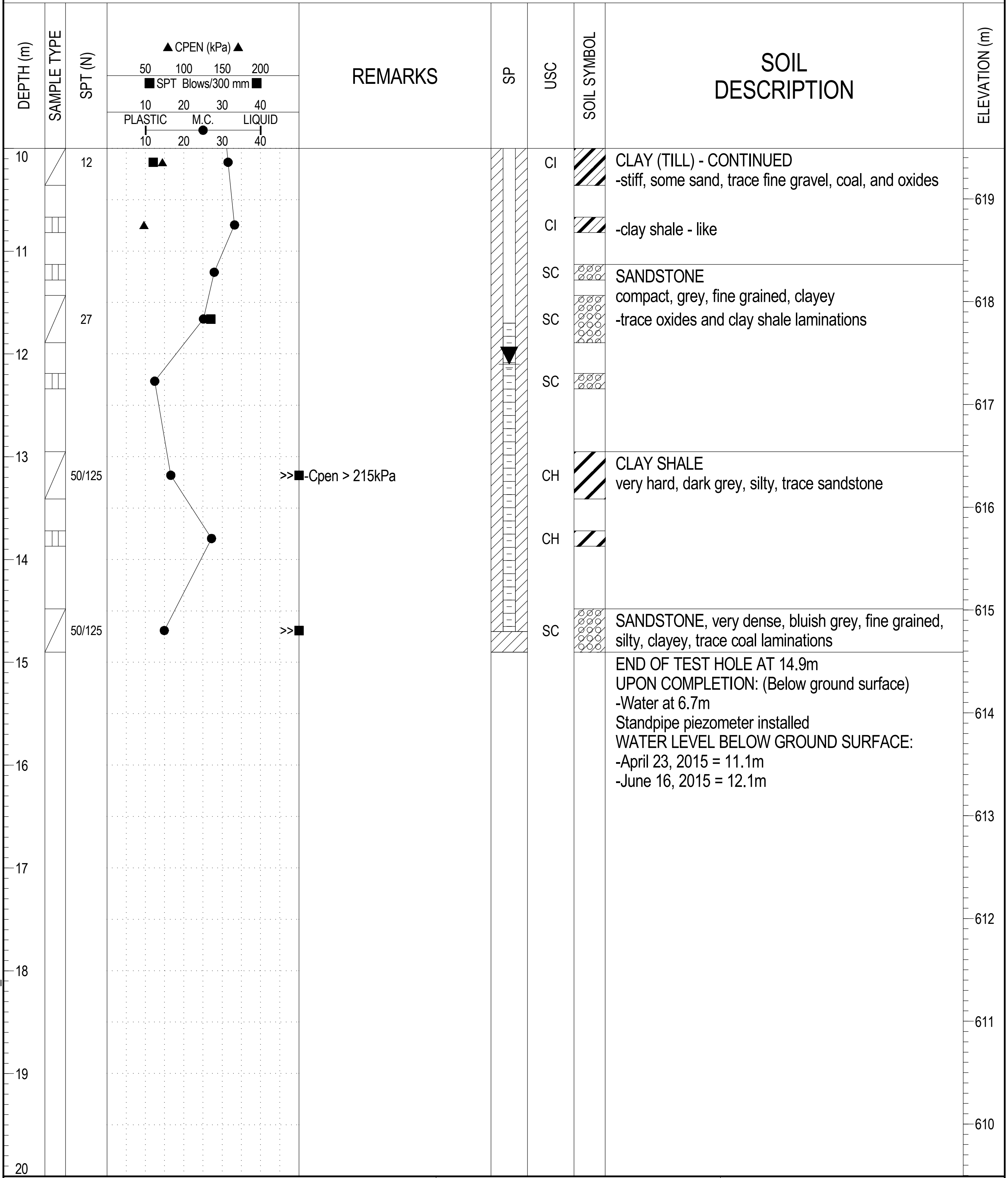
THURBER ENGINEERING LTD.

FIELD LOGGED BY: NNM	COMPLETION DEPTH: 14.9 m
PREPARED BY: SEC	COMPLETION DATE: 4/15/15
REVIEWED BY:	

CLIENT: DIALOG	PROJECT: MECHANIZED RIVER VALLEY ACCESS GEO INV	BOREHOLE NO: **TH15-13**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: April 15, 2015	PROJECT NO: 19-5861-24
DRILL/METHOD: M5 / Solid Stem Augers	LOCATION: N5934186.351, E33989.934	ELEVATION: 629.49 (m)

SAMPLE TYPE ▥ GRAB SAMPLE ▨ SPT

BACKFILL TYPE ■ BENTONITE ▨ DRILL CUTTINGS



SPT (N)	REMARKS	USC	SOIL DESCRIPTION
12		CI	CLAY (TILL) - CONTINUED -stiff, some sand, trace fine gravel, coal, and oxides
		CI	-clay shale - like
		SC	SANDSTONE compact, grey, fine grained, clayey
27		SC	-trace oxides and clay shale laminations
		SC	
50/125	>>■-Cpen > 215kPa	CH	CLAY SHALE very hard, dark grey, silty, trace sandstone
		CH	
50/125	>>■	SC	SANDSTONE, very dense, bluish grey, fine grained, silty, clayey, trace coal laminations

END OF TEST HOLE AT 14.9m
UPON COMPLETION: (Below ground surface)
-Water at 6.7m
Standpipe piezometer installed
WATER LEVEL BELOW GROUND SURFACE:
-April 23, 2015 = 11.1m
-June 16, 2015 = 12.1m

THURBER ENGINEERING LTD.

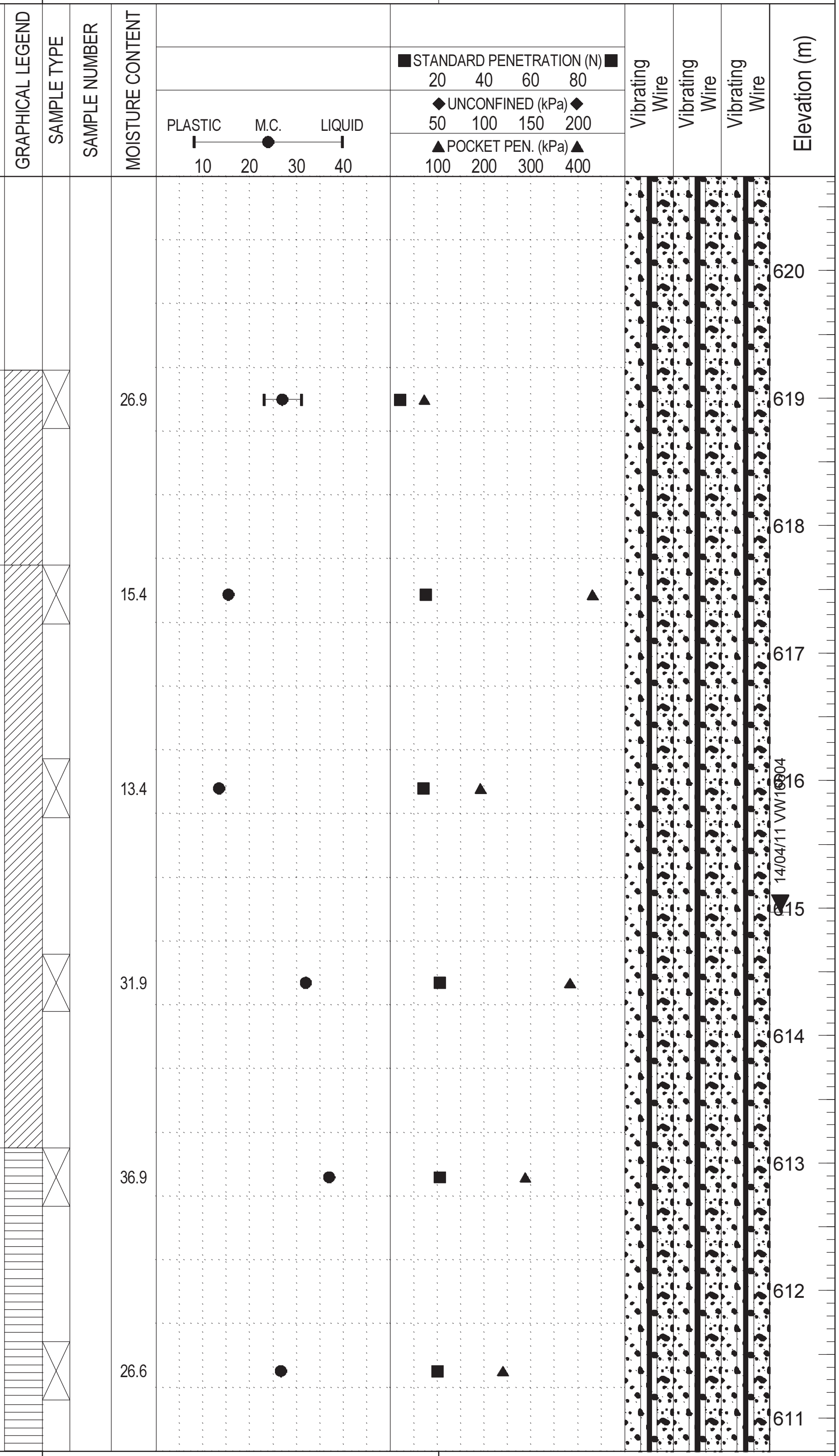
FIELD LOGGED BY: NNM	COMPLETION DEPTH: 14.9 m
PREPARED BY: SEC	COMPLETION DATE: 4/15/15
REVIEWED BY:	Page 2 of 2

CLIENT: Edmonton Economic Development Corporation

BOREHOLE LOG: 11BH-01

PROJECT: SHAW CONFERENCE CENTRE	PROJECT NO: E12101348
NORTHING: 5935159	EASTING: 335217
ELEVATION: 620.74 m	GRID: NAD83

Depth (m)	SOIL DESCRIPTION	MOISTURE CONTENT
0	No recovery	
1		
	CLAY - silty, sandy, moist to wet, firm, non to low plastic, dark brown	26.9
2		
3	CLAY (TILL) - silty, sandy, moist, hard, low plastic, dark brown, coal inclusions	15.4
	- at 3.81 m, gravel lens	
4		
	- at 4.27 m, stiff to very stiff, medium plastic, greyish brown	13.4
5	- at 5.03 m, clay shale pieces	
	14/04/11 VW16604 ▼	
6	- at 6.10 m, very stiff to hard, dark brown, oxide staining, clay shale nodules	31.9
7		
	CLAY SHALE - silty, carbonaceous, moist, very stiff, medium plastic, black	36.9
8	- at 7.77 m, non carbonaceous, greyish brown, clay (till) pockets	
9	- at 9.14 m, high plastic, dark brown to grey, clay gouge - wet, soft	26.6



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CONTRACTOR: GARRITTY & BAKER	COMPLETION DEPTH: 25.3m
RIG TYPE: DRILL: WET ROTARY	STARTED: 2/9/2011
LOGGED BY: DJK	COMPLETED: 2/9/2011
REVIEWED BY: AG	Page 1 of 4

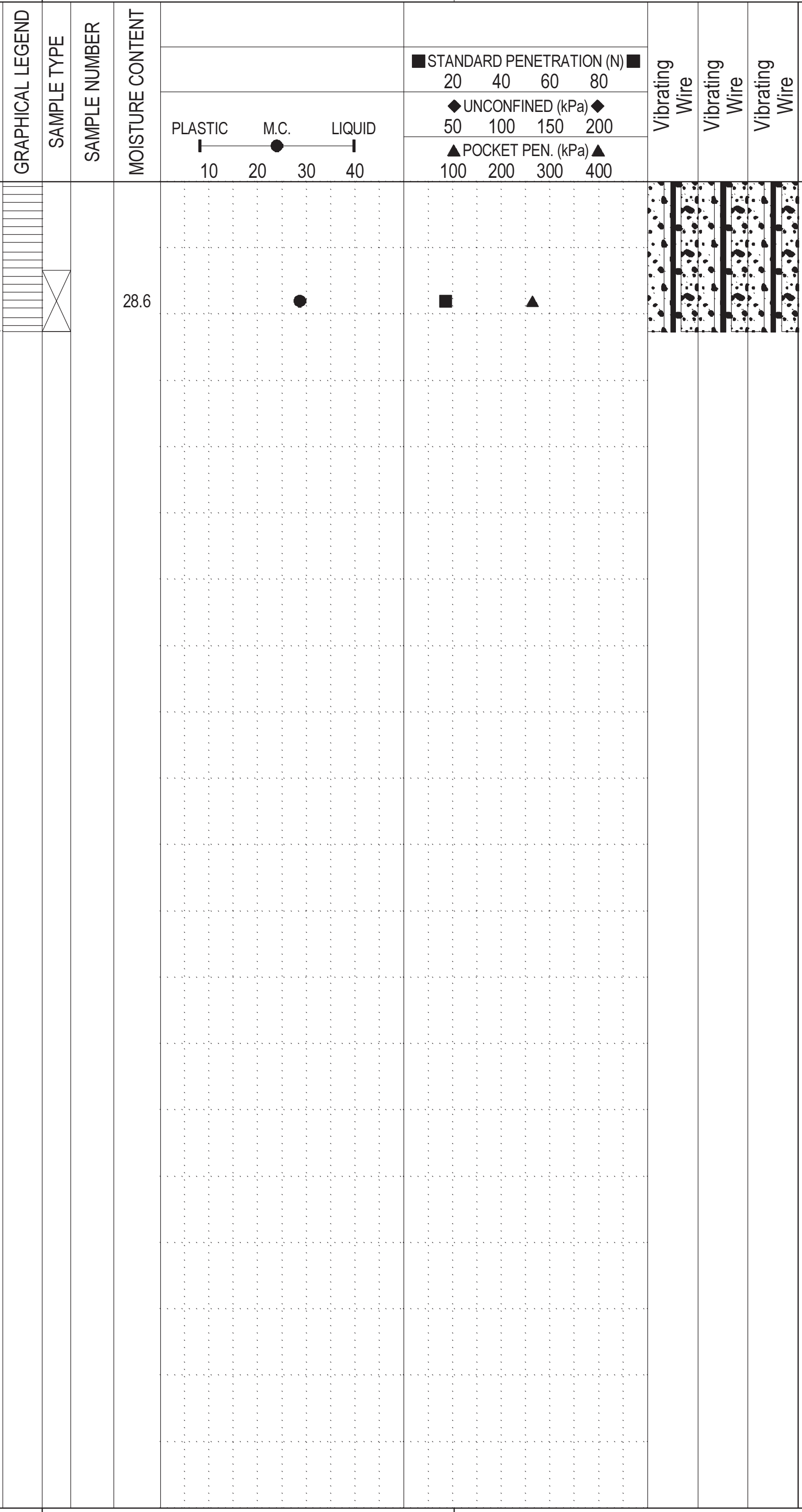
CLIENT:

EDMONTON ECONOMIC DEVELOPMENT CORPORATION

BOREHOLE LOG: 11BH-01

PROJECT: SHAW CONFERENCE CENTRE	PROJECT NO: E12101348
NORTHING: 5935159	EASTING: 335217
ELEVATION: 620.74 m	GRID: NAD83

Depth (m)	SOIL DESCRIPTION	Elevation (m)
	- at 10.36 m, coal lenses	
		610
11	- at 10.82 m, sandstone lens - clayey, silty, moist, light grey	
	- at 10.97 m, clay (till) pockets	
	Continued on rock log.	
		609
12		
		608
13		
		607
14		
		606
15		
		605
16		
		604
17		
		603
18		
		602
19		
		601



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CONTRACTOR: GARRITTY & BAKER	COMPLETION DEPTH: 25.3m
RIG TYPE: DRILL: WET ROTARY	STARTED: 2/9/2011
LOGGED BY: DJK	COMPLETED: 2/9/2011
REVIEWED BY: AG	Page 2 of 4

CLIENT:

EDMONTON
ECONOMIC DEVELOPMENT
CORPORATION

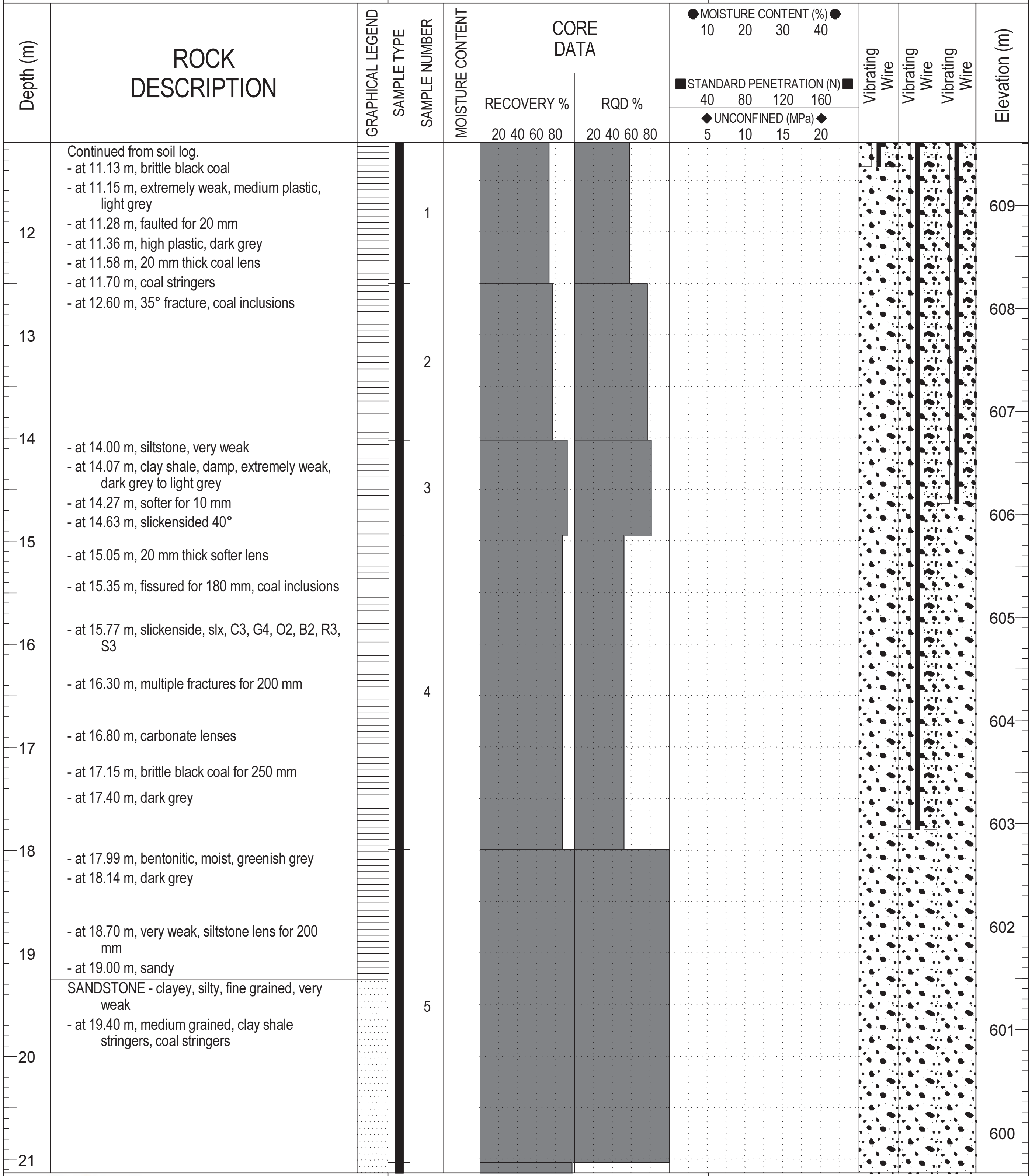
BOREHOLE LOG: 11BH-01

PROJECT: SHAW CONFERENCE CENTRE	PROJECT NO: E12101348
NORTHING: 5935159	EASTING: 335217
ELEVATION: 620.74 m	GRID: NAD83

ROCK DESCRIPTION

Continued from soil log.
- at 11.13 m, brittle black coal
- at 11.15 m, extremely weak, medium plastic, light grey
- at 11.28 m, faulted for 20 mm
- at 11.36 m, high plastic, dark grey
- at 11.58 m, 20 mm thick coal lens
- at 11.70 m, coal stringers
- at 12.60 m, 35° fracture, coal inclusions
- at 14.00 m, siltstone, very weak
- at 14.07 m, clay shale, damp, extremely weak, dark grey to light grey
- at 14.27 m, softer for 10 mm
- at 14.63 m, slickensided 40°
- at 15.05 m, 20 mm thick softer lens
- at 15.35 m, fissured for 180 mm, coal inclusions
- at 15.77 m, slickenside, slx, C3, G4, O2, B2, R3, S3
- at 16.30 m, multiple fractures for 200 mm
- at 16.80 m, carbonate lenses
- at 17.15 m, brittle black coal for 250 mm
- at 17.40 m, dark grey
- at 17.99 m, bentonitic, moist, greenish grey
- at 18.14 m, dark grey
- at 18.70 m, very weak, siltstone lens for 200 mm
- at 19.00 m, sandy

SANDSTONE - clayey, silty, fine grained, very weak
- at 19.40 m, medium grained, clay shale stringers, coal stringers



CONTRACTOR: GARRITTY & BAKER	COMPLETION DEPTH: 25.3m
RIG TYPE: DRILL: WET ROTARY	STARTED: 2/9/2011
LOGGED BY: DJK	COMPLETED: 2/9/2011
REVIEWED BY: AG	Page 3 of 4

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CLIENT:

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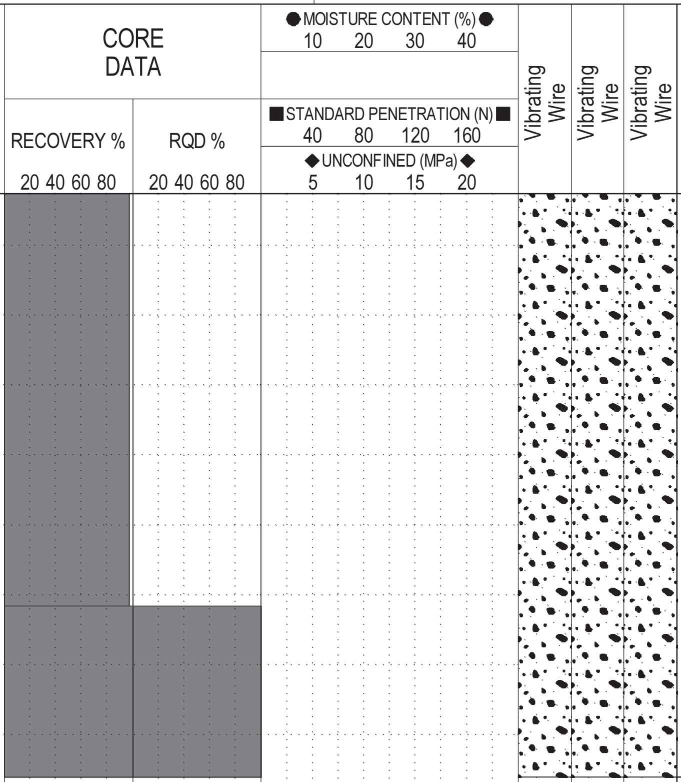
ECONOMIC DEVELOPMENT
CORPORATION

BOREHOLE LOG: 11BH-01

PROJECT: SHAW CONFERENCE CENTRE	PROJECT NO: E12101348
NORTHING: 5935159	EASTING: 335217
ELEVATION: 620.74 m	GRID: NAD83

Depth (m)	ROCK DESCRIPTION	GRAPHICAL LEGEND	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT	Elevation (m)
	- at 21.03 m, moist, light grey					
	- at 21.50 m, coal stringers					
	- at 21.70 m, 40 mm thick clay shale lens					599
22	- at 22.05 m, harder					
				6		598
23						
						597
24	- from 23.88 to 24.08 m, no recovery					
	CLAY SHALE - silty, extremely to very weak, high plastic					
	- at 24.25 m, sandstone lenses					
	- at 24.35 m, 200 mm thick siltstone layer			7		596
25	- at 24.80 m, interbedded sandstone					

END OF BOREHOLE (25.30 metres)
Slope inclinometer installed to 25.00 m
Vibrating wire piezometer (VW#16604) installed at 11.36 metres
Vibrating wire piezometer (VW#16607) installed at 17.90 metres
Vibrating wire piezometer (VW#16608) installed at 14.63 metres
Piezometer elevations:
VW#16604 - 614.13 metres on March 16, 2011
VW#16607 - 613.17 metres on March 16, 2011
VW#16608 - 613.29 metres on March 16, 2011
Note: Grout backfill.



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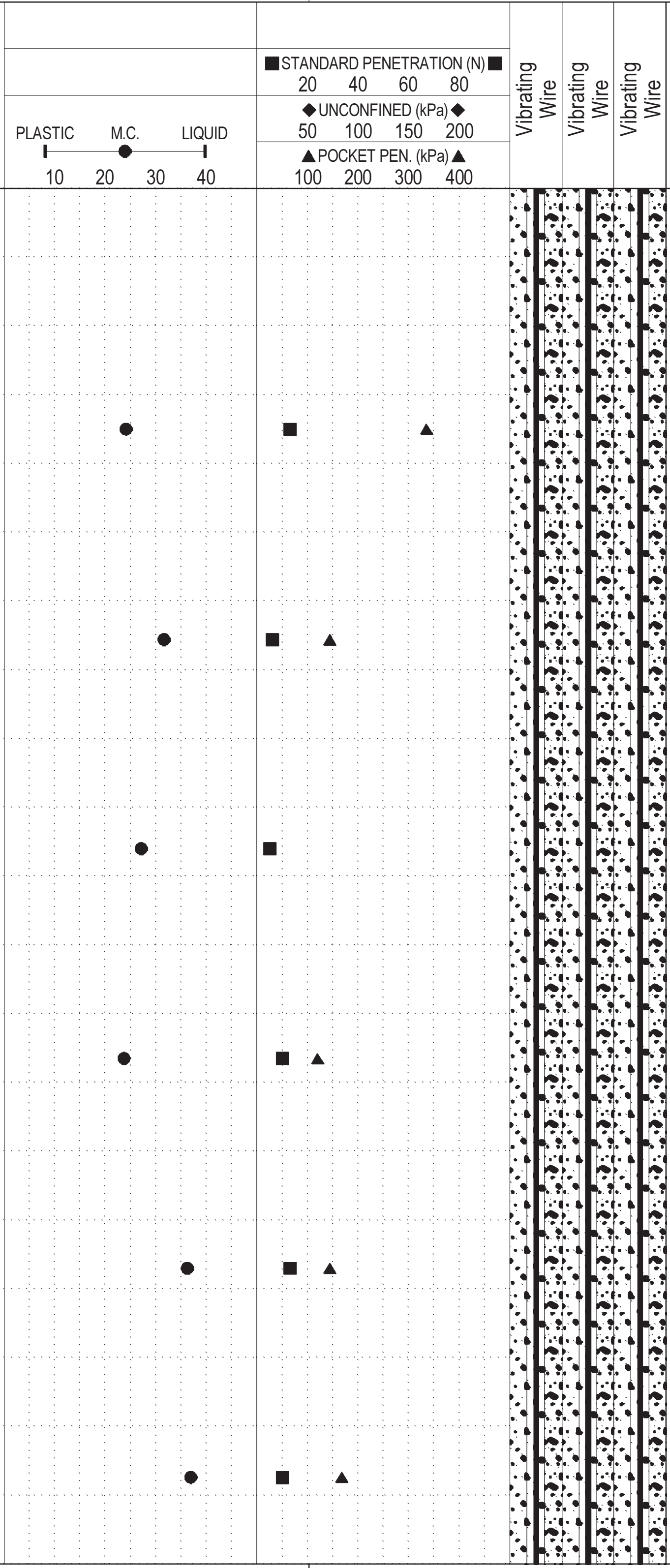
CONTRACTOR: GARRITTY & BAKER	COMPLETION DEPTH: 25.3m
RIG TYPE: DRILL: WET ROTARY	STARTED: 2/9/2011
LOGGED BY: DJK	COMPLETED: 2/9/2011
REVIEWED BY: AG	Page 4 of 4

CLIENT: EDMONTON ECONOMIC DEVELOPMENT CORPORATION

BOREHOLE LOG: 11BH-06

PROJECT: SHAW CONFERENCE CENTRE	PROJECT NO: E12101348
NORTHING: 5935257	EASTING: 335188
ELEVATION: 642.05 m	GRID: NAD83

Depth (m)	SOIL DESCRIPTION	MOISTURE CONTENT	Elevation (m)
	CLAY (FILL) - silty, sandy, organics, medium plastic, dark brown to black, frozen to 1.52 metres		
1			641
	- at 1.52 m, moist, very stiff, dark brown to dark grey	24.1	
2			640
3			639
	- at 3.05 m, moist to wet, stiff, brown, interbedded wet silt laminations	31.6	
4			638
	- at 4.57 m, wet, soft to firm, low plastic	27.1	
5			637
6			636
	SAND (FILL) - silty, organics, medium grained		
	ORGANIC CLAY (FILL) - silty, moist to wet, firm, low plastic, black	23.7	
7			635
	CLAY (FILL) - silty, sandy, moist to wet, stiff, low plastic, very dark brown	36.2	
8	CLAY - silty, moist, stiff, high plastic, light brown		634
9			633
	- at 9.14 m, brown, mottled dark grey	36.9	



CONTRACTOR: GARRITTY & BAKER	COMPLETION DEPTH: 44.65m
RIG TYPE: DRILL: WET ROTARY	STARTED: 3/23/2011
LOGGED BY: DJK	COMPLETED: 3/25/2011
REVIEWED BY: AG	Page 1 of 6

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CLIENT:

BOREHOLE LOG: 11BH-06

PROJECT: SHAW CONFERENCE CENTRE	PROJECT NO: E12101348
NORTHING: 5935257	EASTING: 335188
ELEVATION: 642.05 m	GRID: NAD83

Depth (m)

SOIL DESCRIPTION

- at 10.67 m, brown

CLAY (TILL) - silty, sandy, moist to wet, firm to stiff, low plastic, brown

- at 12.19 m, moist, very stiff, gravel sizes

- at 12.80 m, cobbles or boulder

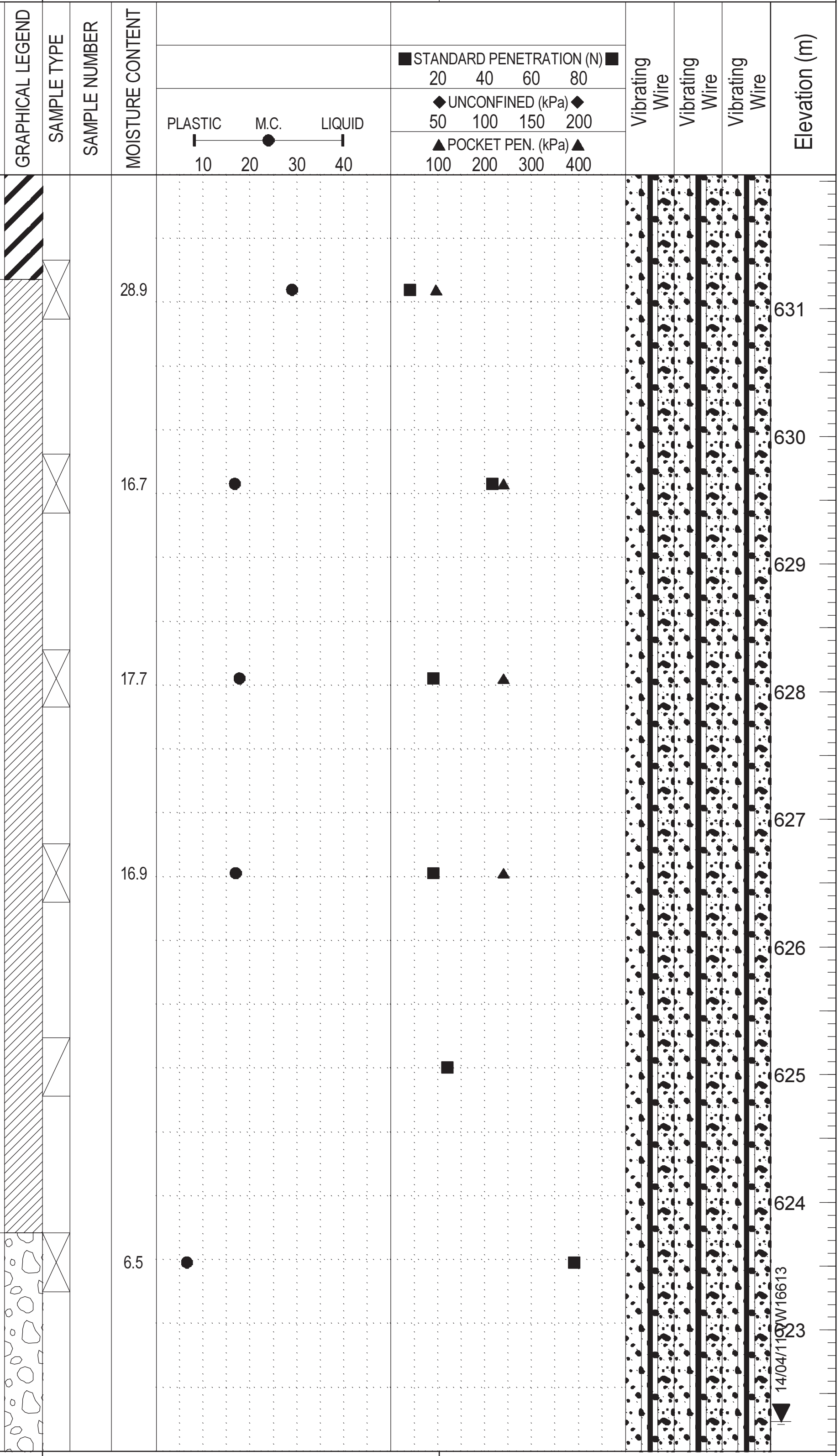
- at 15.24 m, dark grey

- at 17.98 m, gravel

SAND AND GRAVEL - clean, coarse grained, gap graded, very dense

11
12
13
14
15
16
17
18
19

14/04/11 VW16613



CONTRACTOR: GARRITTY & BAKER	COMPLETION DEPTH: 44.65m
RIG TYPE: DRILL: WET ROTARY	STARTED: 3/23/2011
LOGGED BY: DJK	COMPLETED: 3/25/2011
REVIEWED BY: AG	Page 2 of 6

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CLIENT:

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ECONOMIC DEVELOPMENT
CORPORATION

BOREHOLE LOG: 11BH-06

PROJECT: SHAW CONFERENCE CENTRE	PROJECT NO: E12101348
NORTHING: 5935257	EASTING: 335188
ELEVATION: 642.05 m	GRID: NAD83

Depth (m)	SOIL DESCRIPTION	GRAPHICAL LEGEND	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT	PLASTIC M.C. LIQUID 10 20 30 40	■STANDARD PENETRATION (N)■ 20 40 60 80 ◆UNCONFINED (kPa)◆ 50 100 150 200 ▲POCKET PEN. (kPa)▲ 100 200 300 400	Vibrating Wire	Vibrating Wire	Vibrating Wire	Elevation (m)
21											621
	SANDSTONE										
22											620
	CLAY SHALE - silty, damp, extremely weak, high plastic, brown										
23	Continued on rock log.										619
24											618
25											617
26											616
27											615
28											614
29											613

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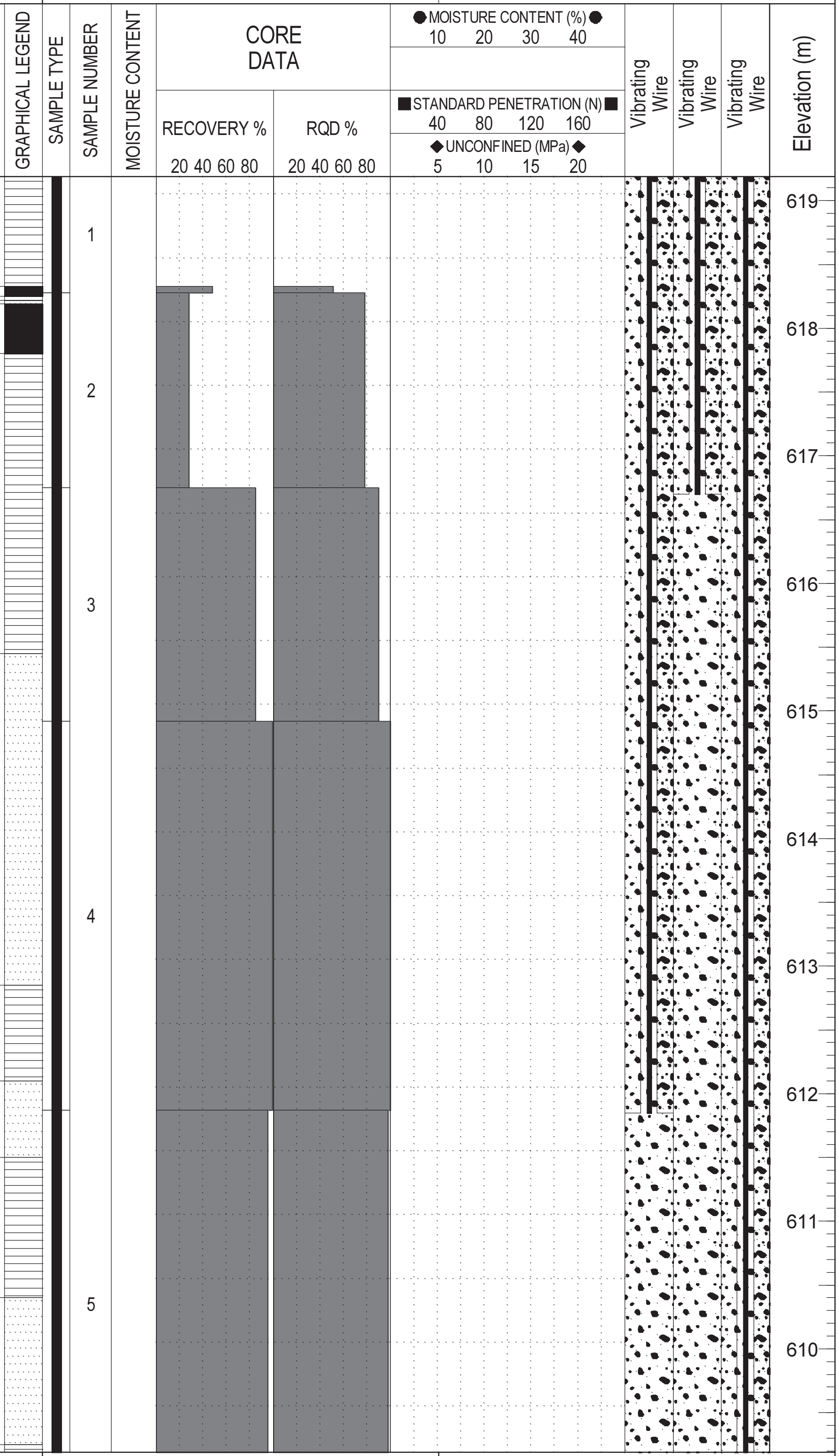
CONTRACTOR: GARRITTY & BAKER	COMPLETION DEPTH: 44.65m
RIG TYPE: DRILL: WET ROTARY	STARTED: 3/23/2011
LOGGED BY: DJK	COMPLETED: 3/25/2011
REVIEWED BY: AG	Page 3 of 6

CLIENT:

BOREHOLE LOG: 11BH-06

PROJECT: SHAW CONFERENCE CENTRE	PROJECT NO: E12101348
NORTHING: 5935257	EASTING: 335188
ELEVATION: 642.05 m	GRID: NAD83

Depth (m)	ROCK DESCRIPTION
23	Continued from soil log. - at 23.10 m, 20 mm thick coal lens - at 23.20 m, harder, grey, R4 - at 23.32 m, coal lens
	COAL - brittle, black
24	CLAY SHALE - R2
	SANDSTONE - R2
	COAL - brittle, black
	CLAY SHALE - silty, damp, high plastic, R5 - at 24.35 m, 20 mm thick bentonitic seam, dark green blue
25	-at 25.30 m, fissured, dark grey
26	- from 25.70 to 25.83 and 26.16 to 26.43 m, interbedded sandstone - silty, clayey, fine grained, uniform, moist, extremely weak, grey brown
27	SANDSTONE - clayey, silty, fine grained, damp to moist, light grey, thin interbedded clay shale lenses - at 26.87 m, fracture at 40-50° from horizontal - at 27.13 m, damp - at 27.30 m, clay shale stringers - at 27.58 m, 150 mm thick clay shale lens - R5
28	
29	- at 28.46 m, moderately strong, 70 mm thick indurated siltstone vein, calcareous, siltier R6 for 100 mm - at 28.75 m, interbedded sandstone lens - fine grained, R5 - at 28.92 m, 90 mm thick siltstone vein
	CLAY SHALE - silty, damp, high plastic, dark grey to grey, R4-R5
30	SANDSTONE - silty, clayey, fine grained, damp, very weak, light grey - at 30.10 m, medium grained, poorly cemented - at 30.40 m, silty - at 30.50 m, 50 mm thick siltstone lens
31	CLAY SHALE - silty, damp, high plastic, R5 - at 30.78 m, slickenside, Slo, C3, G5, B3, R3, S4 - at 31.05 m, 40 mm thick siltstone lens - at 31.10 m, carbonaceous, dark brown to black - at 31.40 m, non carbonaceous, grey to dark grey
32	- from 31.46 to 31.60 m, bentonitic - waxy, high plastic, blue green
	SANDSTONE - silty, clayey, fine to medium grained, damp, light grey, clay shale stringers



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CONTRACTOR: GARRITTY & BAKER	COMPLETION DEPTH: 44.65m
RIG TYPE: DRILL: WET ROTARY	STARTED: 3/23/2011
LOGGED BY: DJK	COMPLETED: 3/25/2011
REVIEWED BY: AG	Page 4 of 6

CLIENT:

EDMONTON
ECONOMIC DEVELOPMENT
CORPORATION

BOREHOLE LOG: 11BH-06

PROJECT: SHAW CONFERENCE CENTRE	PROJECT NO: E12101348
NORTHING: 5935257	EASTING: 335188
ELEVATION: 642.05 m	GRID: NAD83

Depth (m) | ROCK DESCRIPTION | GRAPHICAL LEGEND | SAMPLE TYPE | SAMPLE NUMBER | MOISTURE CONTENT | CORE DATA: RECOVERY % 20 40 60 80; RQD % 20 40 60 80 | ● MOISTURE CONTENT (%) ● 10 20 30 40 | ■ STANDARD PENETRATION (N) ■ 40 80 120 160 | ◆ UNCONFINED (MPa) ◆ 5 10 15 20 | Vibrating Wire | Vibrating Wire | Vibrating Wire | Elevation (m)

33
CLAY SHALE - silty, moist, extremely weak, high plastic
- at 33.00 m, 30 mm thick siltstone pocket
- at 33.22 m, silty, carbonaceous
- at 33.35 m, damp, high plastic, light brown to dark grey

34
- at 33.90 m, <10 mm thick coal lens
- at 34.00 m, R5
- at 34.04 m, fracture at 40° from horizontal
- from 34.20 to 34.40 m, bentonitic - waxy, high plastic, blue green
- at 34.30 m, dark grey to grey

35
SANDSTONE - silty, clayey, fine grained, damp, very weak, light grey
- at 35.00 m, 100 mm thick indurated siltstone, moderately strong
- at 35.10 m, fine to medium grained
- at 35.20 m, interbedded clay shale stringers

36
- at 35.40 m, siltstone vein

CLAY SHALE - silty, extremely weak, high plastic, dark grey to grey
- at 35.90 m, carbonaceous
- at 36.08 m, slickenside, Sld, C2, G4, O3, B3, R1, S1, 60° from horizontal

37
- at 36.14 m, slickenside, Sld, C3, G4, 02, B3, R1, S2, 50° from horizontal, hinges to horizontal

COAL - blocky, black

38
CLAY SHALE - silty, extremely weak, dark brown, coal inclusions
- at 36.50 m, dark grey to grey
- at 36.80 m, softer laminations
- at 37.43 m, moderately strong, dark grey, 30 mm thick siltstone lens

39
- at 37.45 m, fissured, multiple fractures for 800 mm
- at 37.75 m, 30 mm thick siltstone lens, moderately strong
- at 38.25 m, 40 mm thick bentonite - light grey

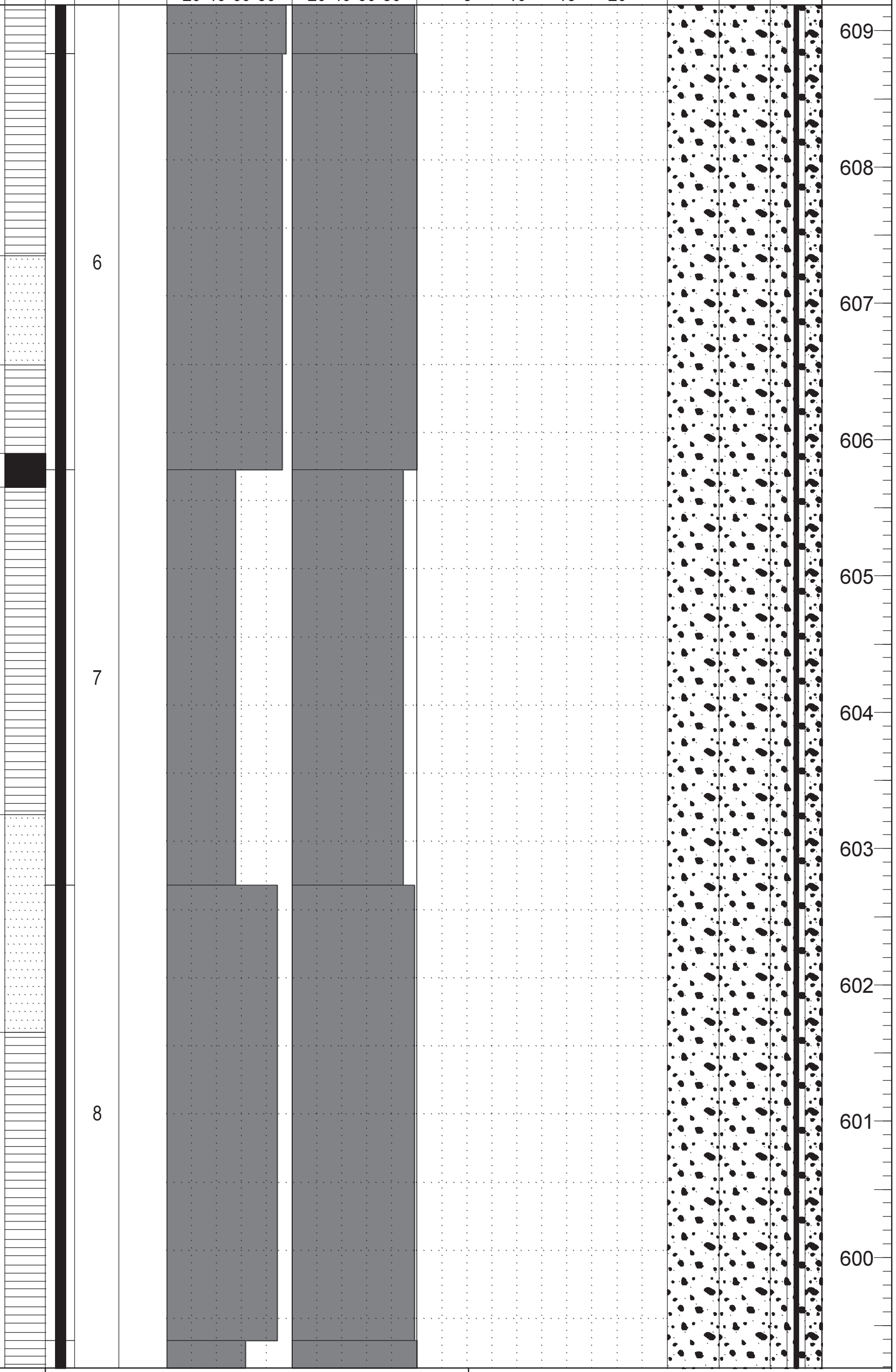
40
- at 38.30 m, very weak, carbonaceous

SANDSTONE - silty, clayey, damp, very weak, light grey
- at 39.30 m, very weak, high plastic, thin coal stringers

CLAY SHALE - silty, moist, extremely weak, high plastic, grey brown

41

42
- at 42.30 m, slickenside, Slo, C3, G1, B3, R4, S4, 10° from horizontal
- at 42.46 m, 10 mm thick siltstone, moderately



CONTRACTOR: GARRITTY & BAKER	COMPLETION DEPTH: 44.65m
RIG TYPE: DRILL: WET ROTARY	STARTED: 3/23/2011
LOGGED BY: DJK	COMPLETED: 3/25/2011
REVIEWED BY: AG	Page 5 of 6

eba
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CLIENT:

EDMONTON
ECONOMIC DEVELOPMENT
CORPORATION

BOREHOLE LOG: 11BH-06

PROJECT: SHAW CONFERENCE CENTRE	PROJECT NO: E12101348
NORTHING: 5935257	EASTING: 335188
ELEVATION: 642.05 m	GRID: NAD83

Depth (m) | ROCK DESCRIPTION | GRAPHICAL LEGEND | SAMPLE TYPE | SAMPLE NUMBER | MOISTURE CONTENT | CORE DATA: RECOVERY % 20 40 60 80, RQD % 20 40 60 80 | ● MOISTURE CONTENT (%) ● 10 20 30 40 | ■ STANDARD PENETRATION (N) ■ 40 80 120 160 | ◆ UNCONFINED (MPa) ◆ 5 10 15 20 | Vibrating Wire | Vibrating Wire | Vibrating Wire | Elevation (m)

43

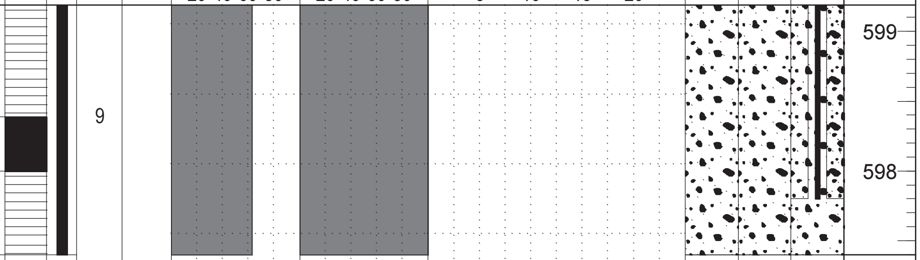
strong
- at 42.54 m, 30 mm thick siltstone, moderately strong
- at 42.95 m, 100 mm thick siltstone
- at 43.30 m, carbonaceous, slickensided 45°
- at 43.47 m, slickenside, Slo, C3, G1 to G2, B3, R1, S2 to S3, 50° from horizontal
- at 43.65 m, 10 mm thick bentonite

44

COAL - black

CLAY SHALE - silty, R4, thin coal veins
- at 44.25 m, 100 mm thick bentonite vein, waxy, green blue to light brown

END OF BOREHOLE (44.65 metres)
Slope indicator installed to 44.42 metres
Vibrating wire #92485 installed at 44.25 metres
Vibrating wire #16603 installed at 30.20 metres
Vibrating wire #16613 installed at 25.35 metres



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CONTRACTOR: GARRITTY & BAKER	COMPLETION DEPTH: 44.65m
RIG TYPE: DRILL: WET ROTARY	STARTED: 3/23/2011
LOGGED BY: DJK	COMPLETED: 3/25/2011
REVIEWED BY: AG	Page 6 of 6

THURBER

APPENDIX C

Laboratory Test Results

THURBER

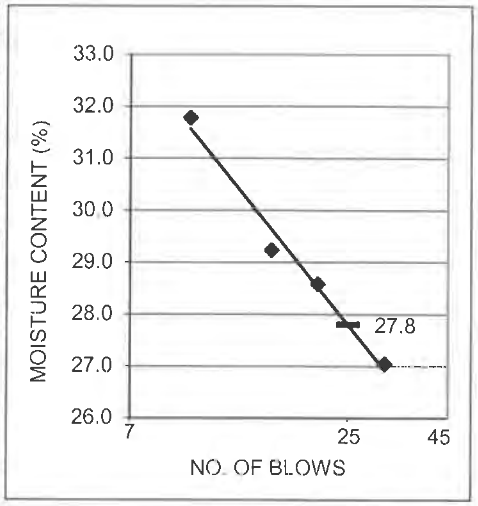
ATTERBERG LIMITS
ASTM D4318

Client: CITY OF EDMONTON
Project: EDMONTON RIVER VALLEY MECHANIZED ACCESS
Project No: 14-31-376
Test Hole: 15-1
Sample No: SPT7
Depth: 12.5 - 14.0' (3.8 m)

Date Tested: 13-Feb-15
Tested By: JAP
Checked By:

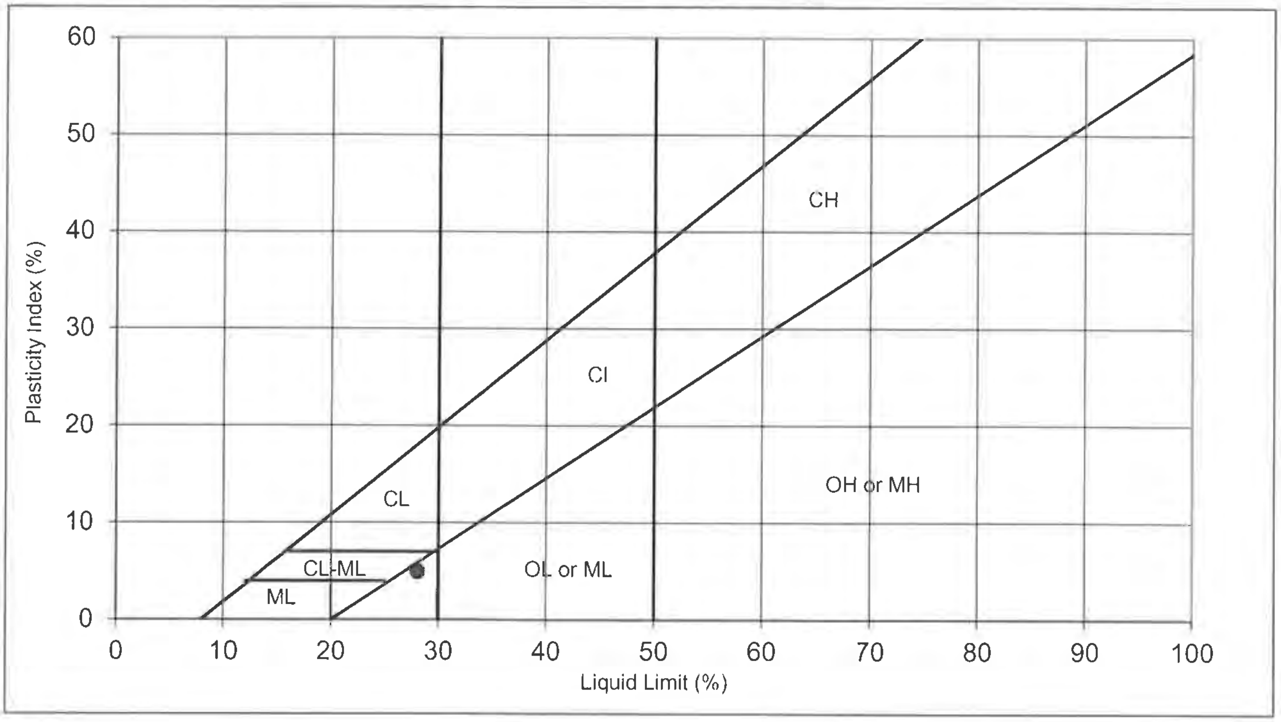
LIQUID LIMIT

Trial No:	1	2	3	4
No of Blows:	31	21	16	10
Container No.	1	2	3	4
Wet Soil + Container	16.21	14.80	16.49	14.97
Dry Soil + Container	12.76	11.51	12.76	11.36
Wt. Of Container	0	0	0	0
Moisture Content	27.0	28.6	29.2	31.8



PLASTIC LIMIT

	1	2		AVERAGE
Container No.	5	6		
Wet Soil + Container	29.28	28.4		
Dry Soil + Container	27.36	26.65		
Wt. Of Container	18.88	18.85		
Moisture Content	22.6	22.4		22.5



REMARKS

Liquid Limit: 28
Plastic Limit: 23
Plasticity Index: 5
USC Classification: ML

TH15-1 SPT7 @ 12.5 - 14.0' (3.8 m)

THURBER

ATTERBERG LIMITS

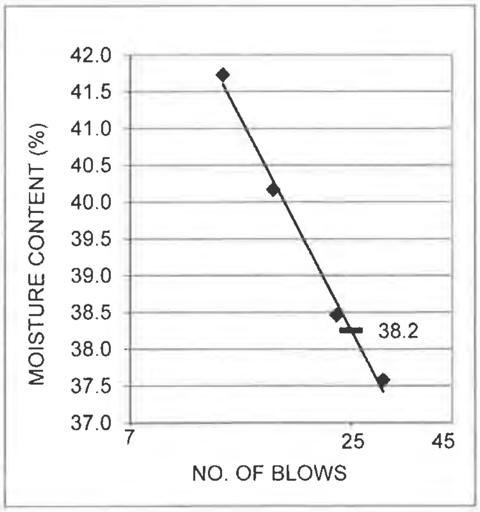
ASTM D4318

Client: DIALOG
Project: MECHANIZED RIVER VALLEY ACCESS GEO INV
Project No: 19-5861-24
Test Hole: TH15 - 2
Sample No: G7
Depth: 4.57 m

Date Tested: 30-Apr-15
Tested By: NM
Checked By:

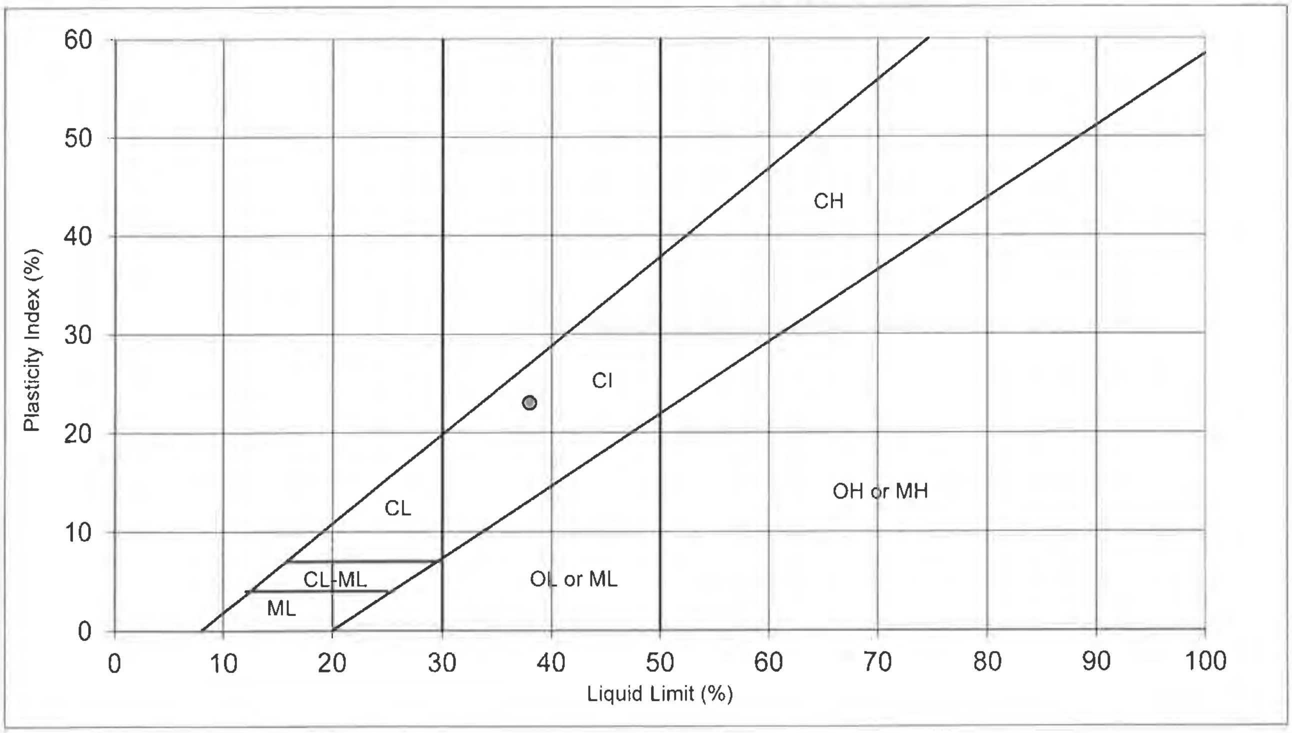
LIQUID LIMIT

Trial No:	1	2	3	4
No of Blows:	30	23	16	12
Container No.	1	2	3	4
Wet Soil + Container	13.84	14.58	13.54	13.96
Dry Soil + Container	10.06	10.53	9.66	9.85
Wt. Of Container	0	0	0	0
Moisture Content	37.6	38.5	40.2	41.7



PLASTIC LIMIT

	1	2	AVERAGE
Container No.	5	6	
Wet Soil + Container	28.15	28.12	
Dry Soil + Container	26.94	26.89	
Wt. Of Container	18.93	18.66	
Moisture Content	15.1	14.9	**15.0**



REMARKS

Liquid Limit: 38
Plastic Limit: 15
Plasticity Index: 23
USC Classification: CI

THURBER

ATTERBERG LIMITS

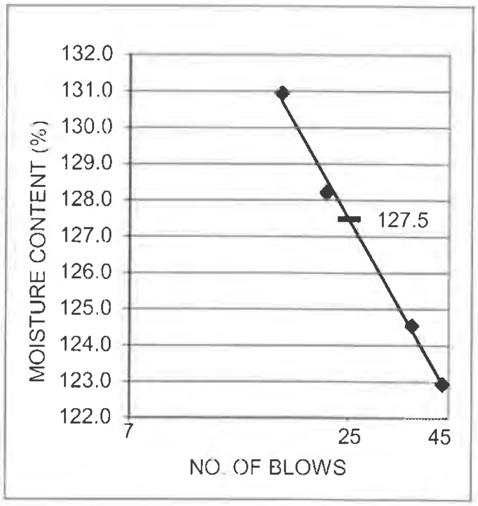
ASTM D4318

Client: DIALOG
Project: MECHANIZED RIVER VALLEY ACCESS GEO INV
Project No: 19-5861-24
Test Hole: TH15 - 2 Depth: 13.45,14.40,15.32 m
Sample No.:

Date Tested: 16-May-15
Tested By: NM
Checked By:

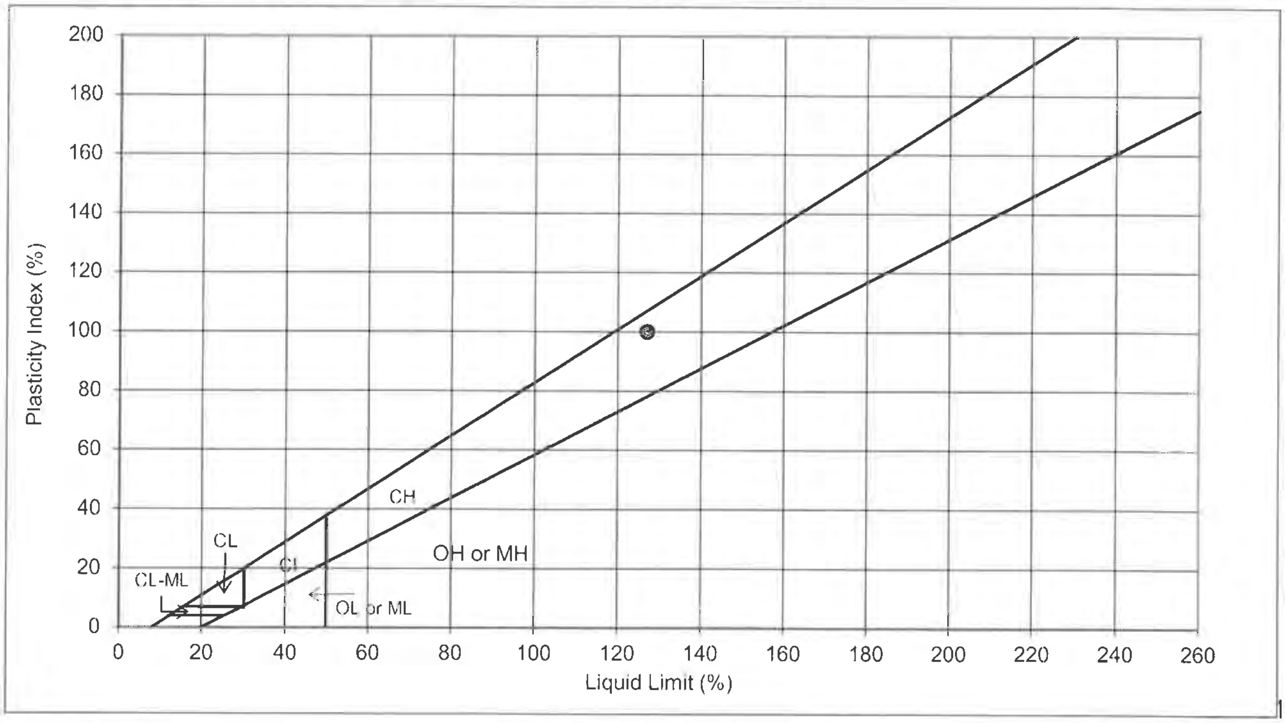
LIQUID LIMIT

Trial No:	1	2	3	4
No of Blows:	43	36	22	17
Container No.	1	2	3	4
Wet Soil + Container	12.44	12.17	12.62	13.51
Dry Soil + Container	5.58	5.42	5.53	5.85
Wt. Of Container	0	0	0	0
Moisture Content	122.9	124.5	128.2	130.9



PLASTIC LIMIT

	1	2	3	AVERAGE
Container No.	5	6		
Wet Soil + Container	27.84	27.96		
Dry Soil + Container	25.93	26.02		
Wt. Of Container	18.78	18.75		
Moisture Content	26.7	26.7		**26.7**



REMARKS : Blenderized Limit

Liquid Limit:	**127**
Plastic Limit:	**27**
Plasticity Index:	**100**
USC Classification:	**CH**

TH15-2 @ 13.45, 14.40, 15.32 m BL

ATTERBERG LIMITS

ASTM D4318

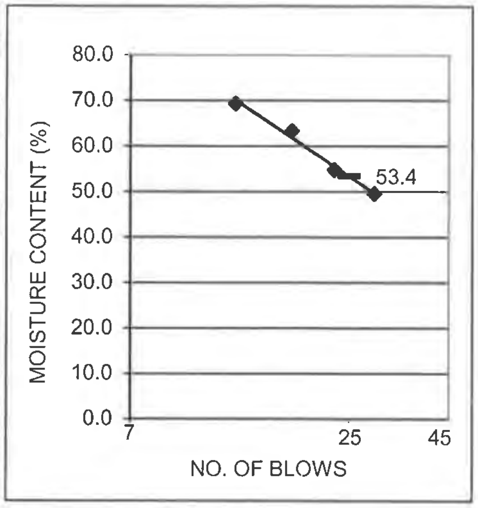
THURBER

Client: CITY OF EDMONTON
Project: EDMONTON RIVER VALLEY MECHANIZED ACCESS GEO INV
Project No: 14-31-376
Test Hole: TH15 - 3
Sample No: GB13
Depth: 25.0 ft. (7.6 m)

Date Tested: 13-Feb-15
Tested By: NM
Checked By:

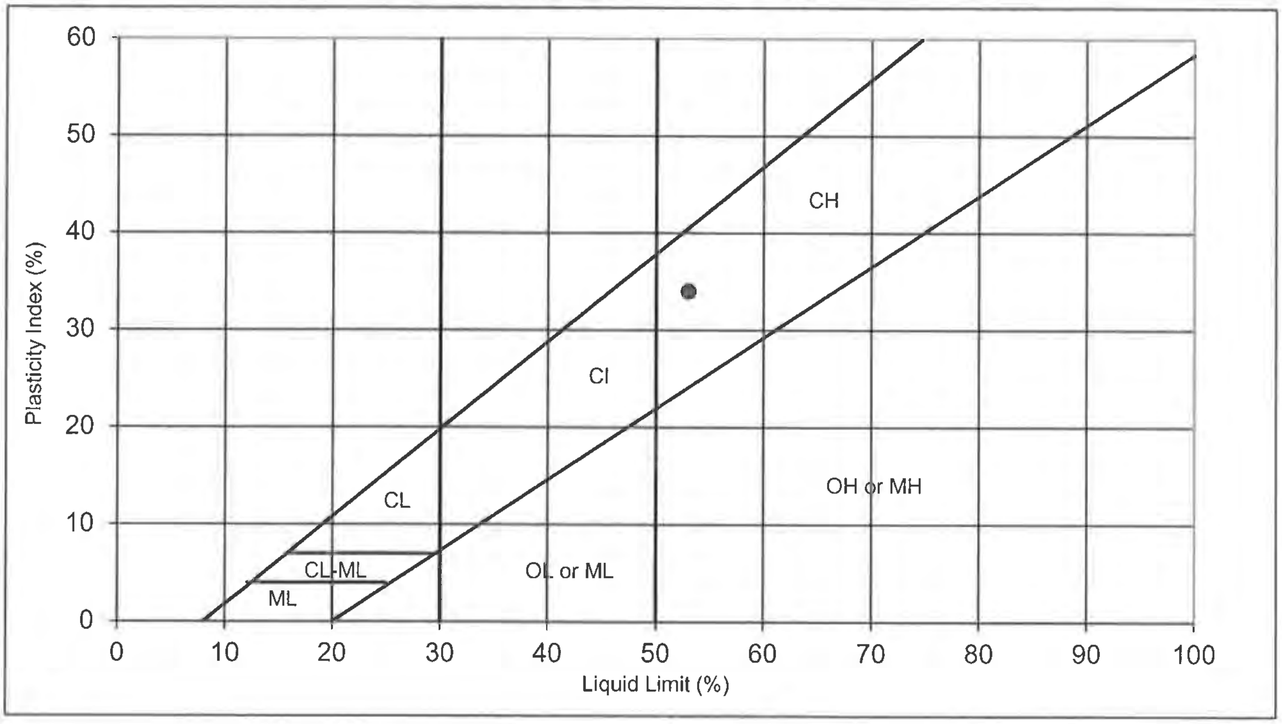
LIQUID LIMIT

Trial No:	1	2	3	4
No of Blows:	29	23	18	13
Container No.	1	2	3	4
Wet Soil + Container	13.62	14.55	14.53	14.56
Dry Soil + Container	9.11	9.40	8.9	8.6
Wt. Of Container	0	0	0	0
Moisture Content	49.5	54.8	63.3	69.3



PLASTIC LIMIT

	1	2		AVERAGE
Container No.	5	6		
Wet Soil + Container	28	28.01		
Dry Soil + Container	26.57	26.56		
Wt. Of Container	18.92	18.74		
Moisture Content	18.7	18.5		**18.6**



REMARKS

Liquid Limit:	**53**
Plastic Limit:	**19**
Plasticity Index:	**34**
USC Classification:	**CH**

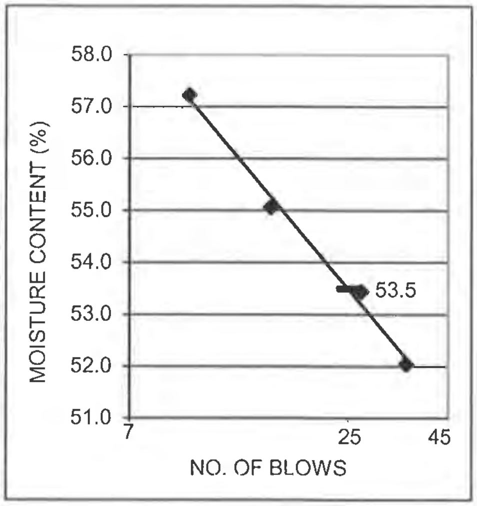
ATTERBERG LIMITS
ASTM D4318

Client: CITY OF EDMONTON
Project: EDMONTON RIVER VALLEY MECHANIZED ACCESS
Project No: 14-31-376
Test Hole: 15-3
Sample No: ST16
Depth: 9.91 - 10.36 m

Date Tested: 13-Feb-15
Tested By: JAP
Checked By:

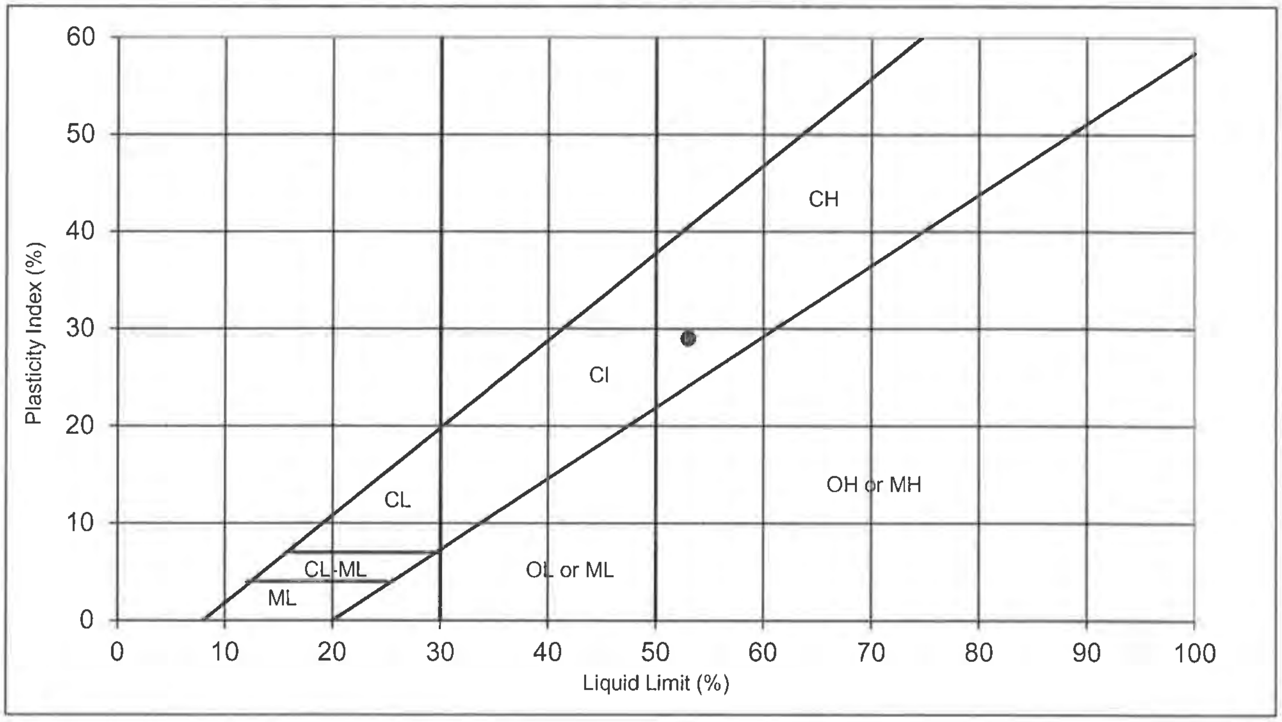
LIQUID LIMIT

Trial No:	1	2	3	4
No of Blows:	35	27	16	10
Container No.	1	2	3	4
Wet Soil + Container	14.58	12.72	13.18	14.7
Dry Soil + Container	9.59	8.29	8.5	9.35
Wt. Of Container	0	0	0	0
Moisture Content	52.0	53.4	55.1	57.2



PLASTIC LIMIT

	1	2		AVERAGE
Container No.	5	6		
Wet Soil + Container	27.71	27.1		
Dry Soil + Container	25.98	25.49		
Wt. Of Container	18.81	18.78		
Moisture Content	24.1	24.0		**24.1**



REMARKS

Liquid Limit:	**53**
Plastic Limit:	**24**
Plasticity Index:	**29**
USC Classification:	**CH**

THURBER

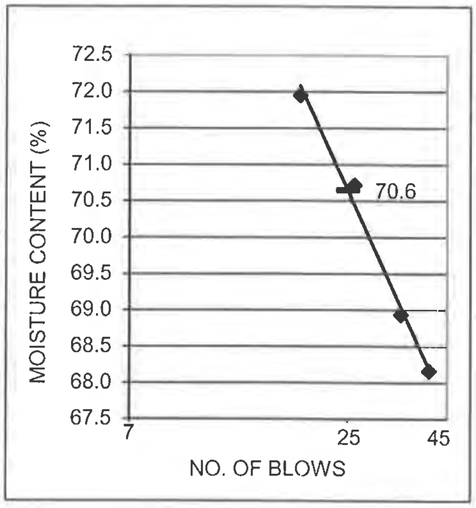
ATTERBERG LIMITS
ASTM D4318

Client: CITY OF EDMONTON
Project: EDMONTON RIVER VALLEY MECHANIZED ACCESS GEO INV
Project No: 14-31-376
Test Hole: TH15 - 3
Sample No: G20
Depth: 41.0 ft. (12.6 m)

Date Tested: 13-Feb-15
Tested By: NM
Checked By:

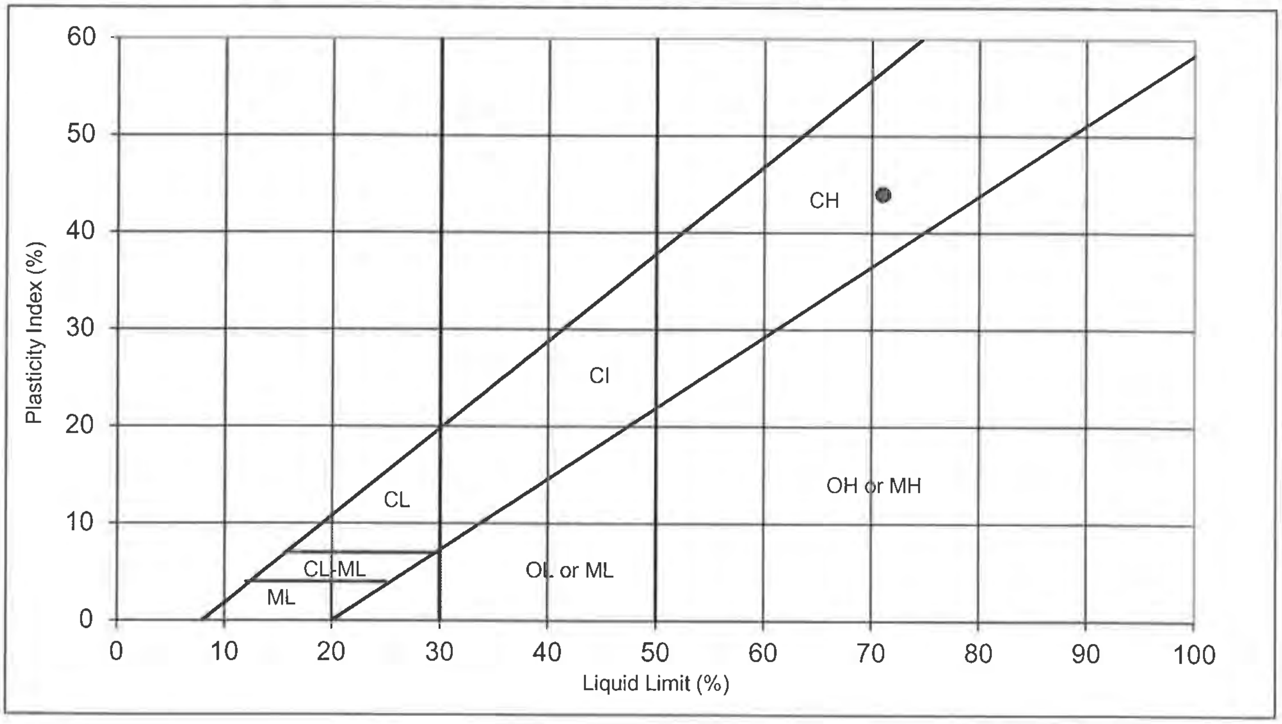
LIQUID LIMIT

Trial No:	1	2	3	4
No of Blows:	40	34	26	19
Container No.	1	2	3	4
Wet Soil + Container	15.79	12.67	13.35	14.22
Dry Soil + Container	9.39	7.50	7.82	8.27
Wt. Of Container	0	0	0	0
Moisture Content	68.2	68.9	70.7	71.9



PLASTIC LIMIT

	1	2		**AVERAGE**
Container No.	5	6		
Wet Soil + Container	27.71	27.99		
Dry Soil + Container	25.82	26.05		
Wt. Of Container	18.72	18.76		
Moisture Content	26.6	26.6		**26.6**



REMARKS

Liquid Limit:	**71**
Plastic Limit:	**27**
Plasticity Index:	**44**
USC Classification:	**CH**

ATTERBERG LIMITS

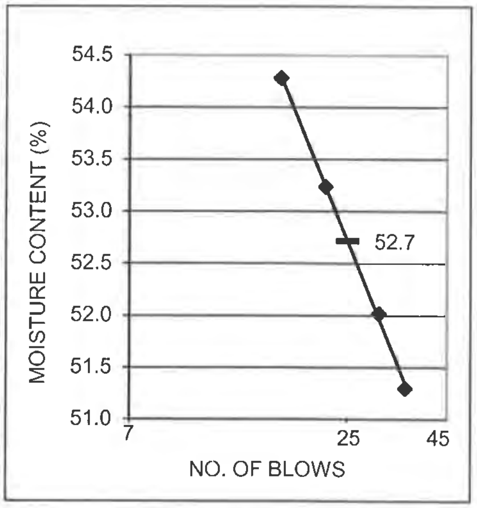
ASTM D4318

Client: CITY OF EDMONTON
Project: EDMONTON RIVER VALLEY MECHANIZED ACCESS GEO INV
Project No: 14-31-376
Test Hole: TH15 - 4
Sample No: GB15
Depth: 30.0 ft. (9.1 m)

Date Tested: 13-Feb-15
Tested By: NM
Checked By:

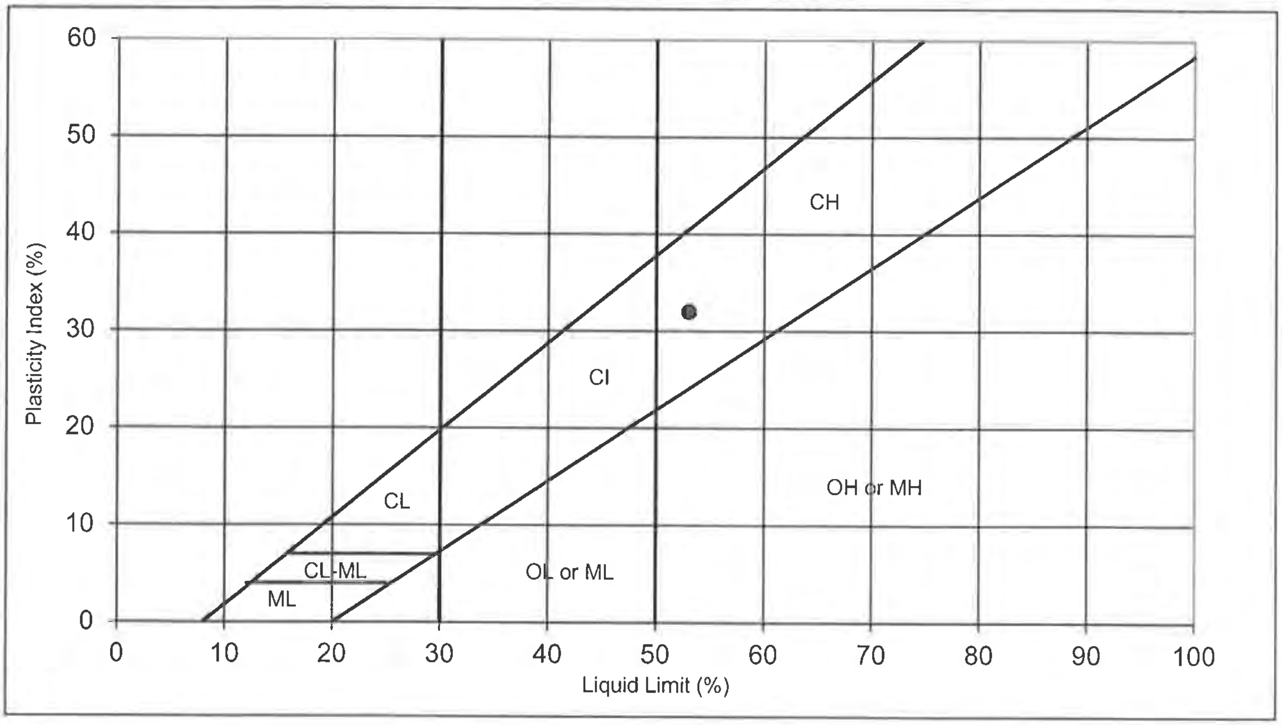
LIQUID LIMIT

Trial No:	1	2	3	4
No of Blows:	35	30	22	17
Container No.	1	2	3	4
Wet Soil + Container	13.42	13.94	13.01	13.87
Dry Soil + Container	8.87	9.17	8.49	8.99
Wt. Of Container	0	0	0	0
Moisture Content	51.3	52.0	53.2	54.3



PLASTIC LIMIT

	1	2		AVERAGE
Container No.	5	6		
Wet Soil + Container	28.05	27.85		
Dry Soil + Container	26.45	26.29		
Wt. Of Container	18.79	18.75		
Moisture Content	20.9	20.7		**20.8**



REMARKS

Liquid Limit:	**53**
Plastic Limit:	**21**
Plasticity Index:	**32**
USC Classification:	**CH**

ATTERBERG LIMITS

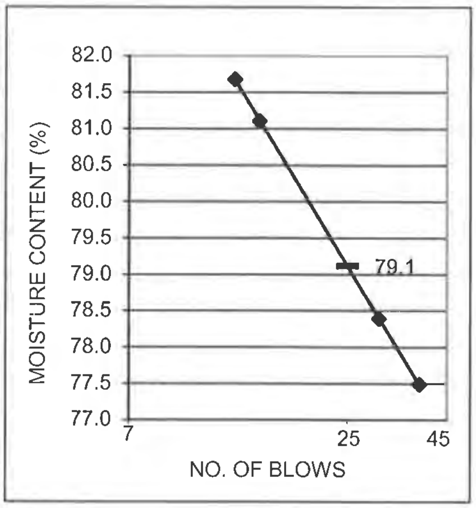
ASTM D4318

Client: CITY OF EDMONTON
Project: EDMONTON RIVER VALLEY MECHANIZED ACCESS
Project No: 14-31-376
Test Hole: 15-4
Sample No: GB17
Depth: 35.0' (10.7 m)

Date Tested: 13-Feb-15
Tested By: JAP
Checked By:

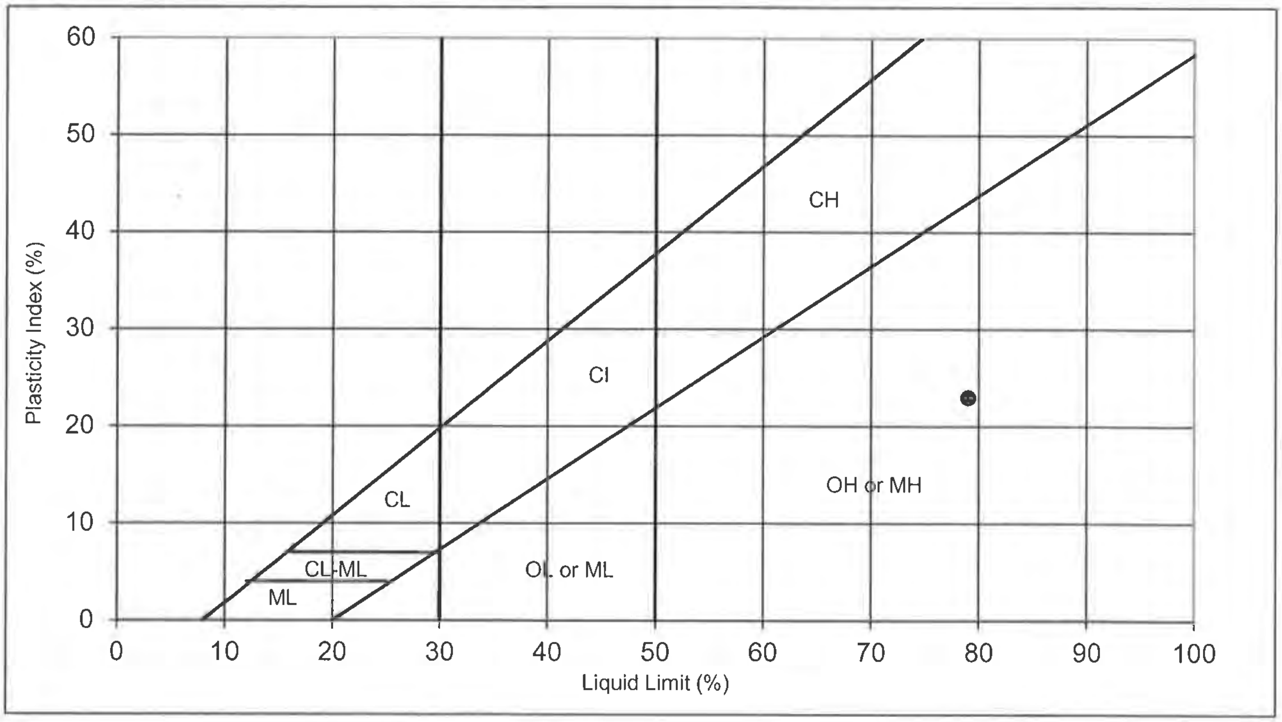
LIQUID LIMIT

Trial No:	1	2	3	4
No of Blows:	38	30	15	13
Container No.	1	2	3	4
Wet Soil + Container	12.14	14.86	13.13	14.77
Dry Soil + Container	6.84	8.33	7.25	8.13
Wt. Of Container	0	0	0	0
Moisture Content	77.5	78.4	81.1	81.7



PLASTIC LIMIT

	1	2		AVERAGE
Container No.	5	6		
Wet Soil + Container	28.14	28.17		
Dry Soil + Container	24.84	24.80		
Wt. Of Container	19.01	18.81		
Moisture Content	56.6	56.3		**56.4**



REMARKS

Liquid Limit:	**79**
Plastic Limit:	**56**
Plasticity Index:	**23**
USC Classification:	**OH**

THURBER

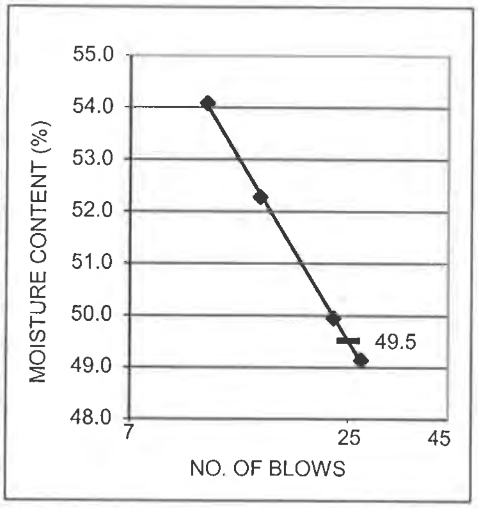
ATTERBERG LIMITS
ASTM D4318

Client: CITY OF EDMONTON
Project: EDMONTON RIVER VALLEY MECHANIZED ACCESS
Project No: 14-31-376
Test Hole: 15-4
Sample No: GB19
Depth: 40.0' (12.2 m)

Date Tested: 13-Feb-15
Tested By: JAP
Checked By:

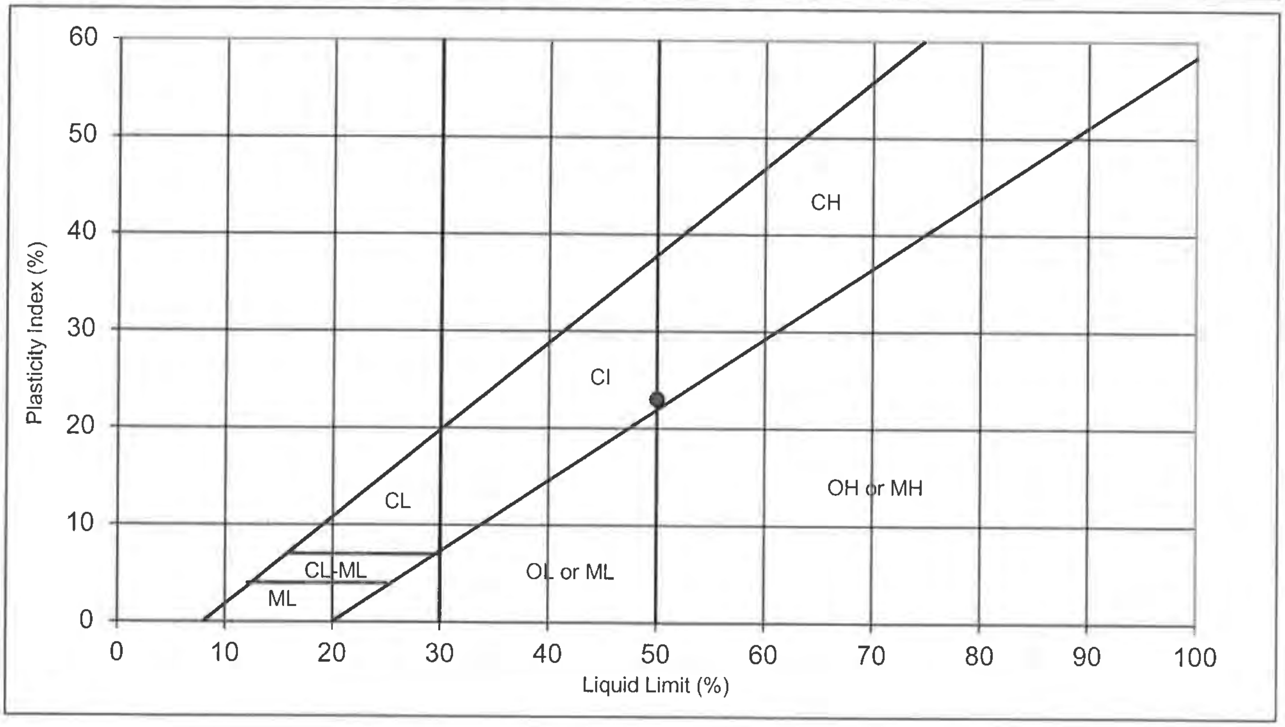
LIQUID LIMIT

Trial No:	1	2	3	4
No of Blows:	27	23	15	11
Container No.	1	2	3	4
Wet Soil + Container	14.51	12.43	12.76	13.99
Dry Soil + Container	9.73	8.29	8.38	9.08
Wt. Of Container	0	0	0	0
Moisture Content	49.1	49.9	52.3	54.1



PLASTIC LIMIT

	1	2		AVERAGE
Container No.	5	6		
Wet Soil + Container	28.52	28.88		
Dry Soil + Container	26.44	26.75		
Wt. Of Container	18.79	18.91		
Moisture Content	27.2	27.2		**27.2**



REMARKS

Liquid Limit:	**50**
Plastic Limit:	**27**
Plasticity Index:	**23**
USC Classification:	**CI-CH**

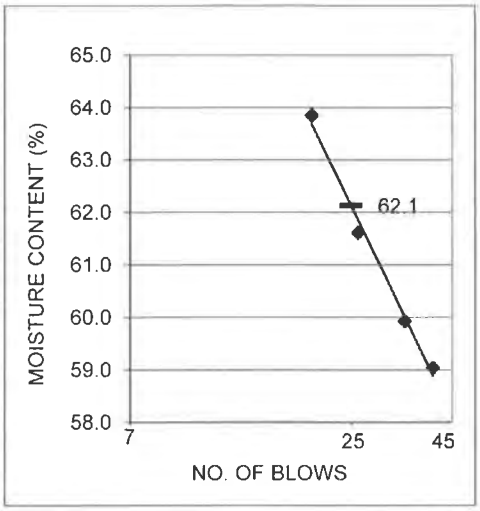
ATTERBERG LIMITS
ASTM D4318

Client: DIALOG
Project: MECHANIZED RIVER VALLEY ACCESS GEO INV
Project No: 19-5861-24
Test Hole: TH15 - 10
Sample No: P2
Depth: 0.76 - 1.22 m

Date Tested: 30-Apr-15
Tested By: NM
Checked By:

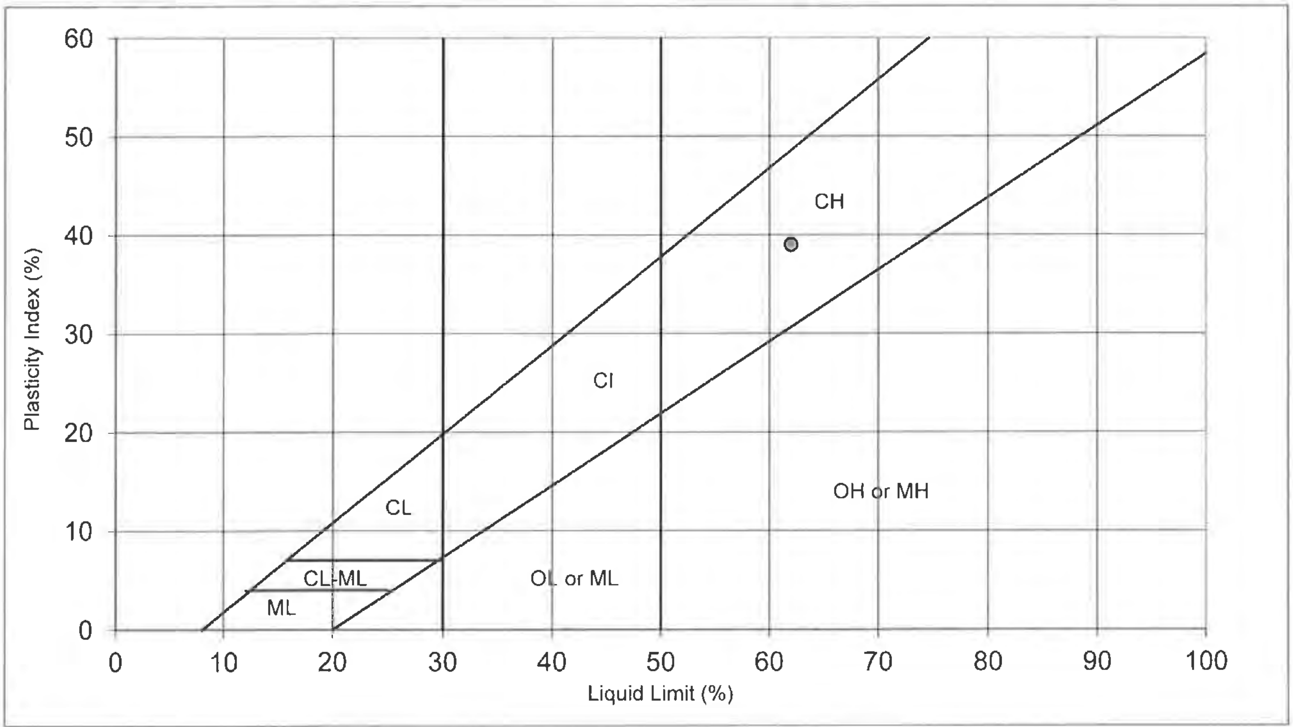
LIQUID LIMIT

Trial No:	1	2	3	4
No of Blows:	40	34	26	20
Container No.	1	2	3	4
Wet Soil + Container	13.28	13.13	13.85	13.37
Dry Soil + Container	8.35	8.21	8.57	8.16
Wt. Of Container	0	0	0	0
Moisture Content	59.0	59.9	61.6	63.8



PLASTIC LIMIT

	1	2	AVERAGE
Container No.	5	6	
Wet Soil + Container	28.05	28.38	
Dry Soil + Container	26.33	26.62	
Wt. Of Container	18.8	18.86	
Moisture Content	22.8	22.7	**22.8**



REMARKS

Liquid Limit:	**62**
Plastic Limit:	**23**
Plasticity Index:	**39**
USC Classification:	**CH**

THURBER

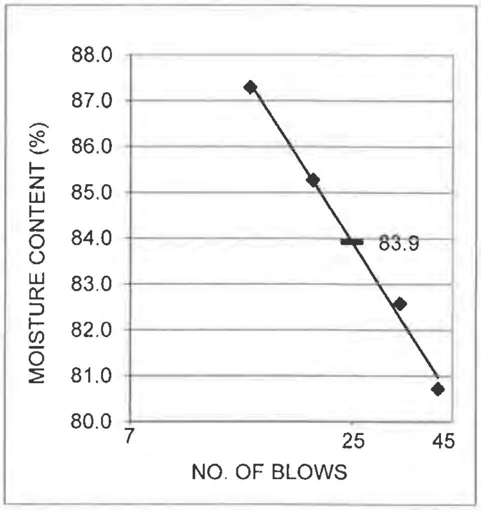
ATTERBERG LIMITS
ASTM D4318

Client: DIALOG
Project: MECHANIZED RIVER VALLEY ACCESS GEO INV
Project No: 19-5861-24
Test Hole: 15-10 Depth: 12.19 m
Sample No.: G17

Date Tested: 30-Apr-15
Tested By: JAP
Checked By:

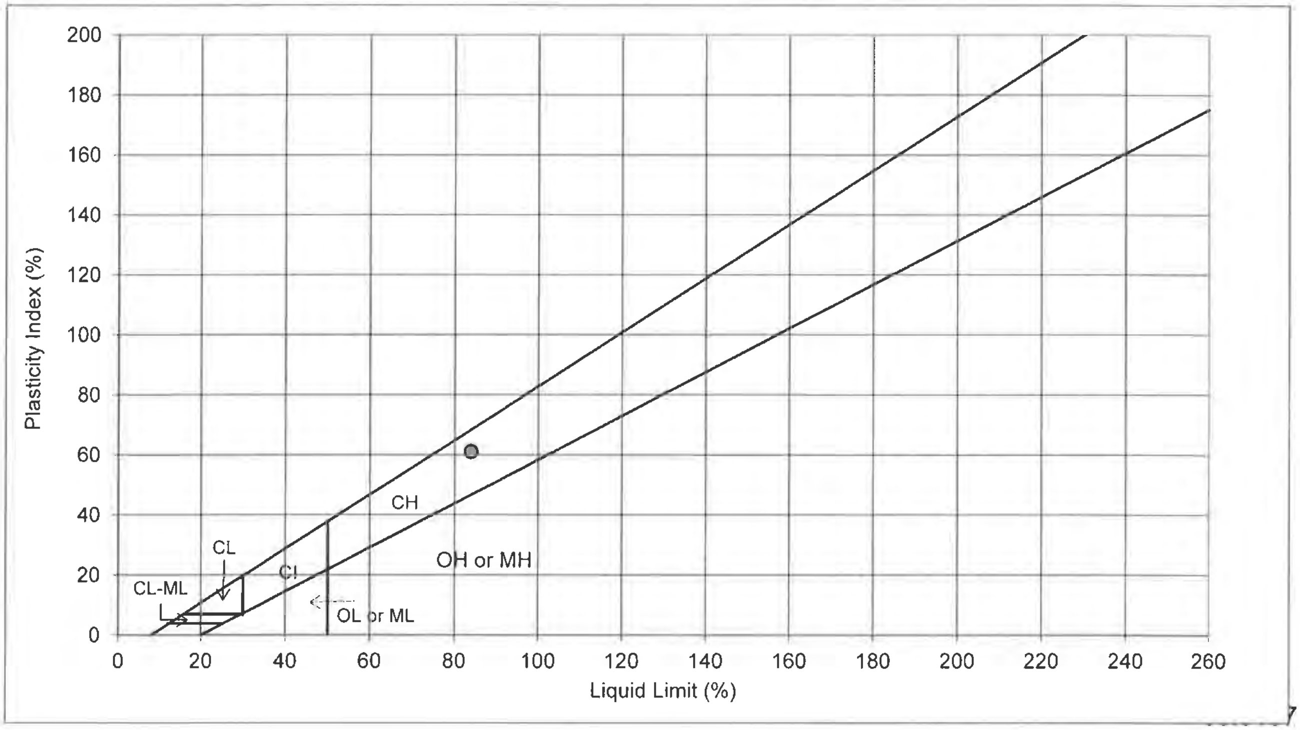
LIQUID LIMIT

Trial No:	1	2	3	4
No of Blows:	41	33	20	14
Container No.	1	2	3	4
Wet Soil + Container	13.59	12.89	12.58	13.56
Dry Soil + Container	7.52	7.06	6.79	7.24
Wt. Of Container	0	0	0	0
Moisture Content	80.7	82.6	85.3	87.3



PLASTIC LIMIT

	1	2	3	AVERAGE
Container No.	5	6		
Wet Soil + Container	28.04	28.84		
Dry Soil + Container	26.29	26.95		
Wt. Of Container	18.76	18.92		
Moisture Content	23.2	23.5		**23.4**



REMARKS :

Liquid Limit:	**84**
Plastic Limit:	**23**
Plasticity Index:	**61**
USC Classification:	**CH**

TH15-10 G17 @ 12.19 m

THURBER

ATTERBERG LIMITS

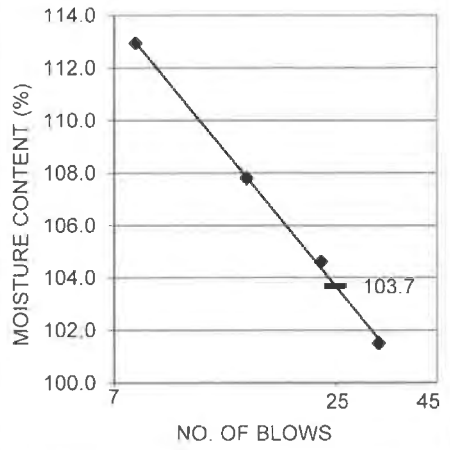
ASTM D4318

Client: DIALOG
Project: MECHANIZED RIVER VALLEY ACCESS GEO INV
Project No: 19-5861-24
Test Hole: 15-11 Depth: 9.14 m
Sample No.: G13

Date Tested: 30-Apr-15
Tested By: JAP
Checked By:

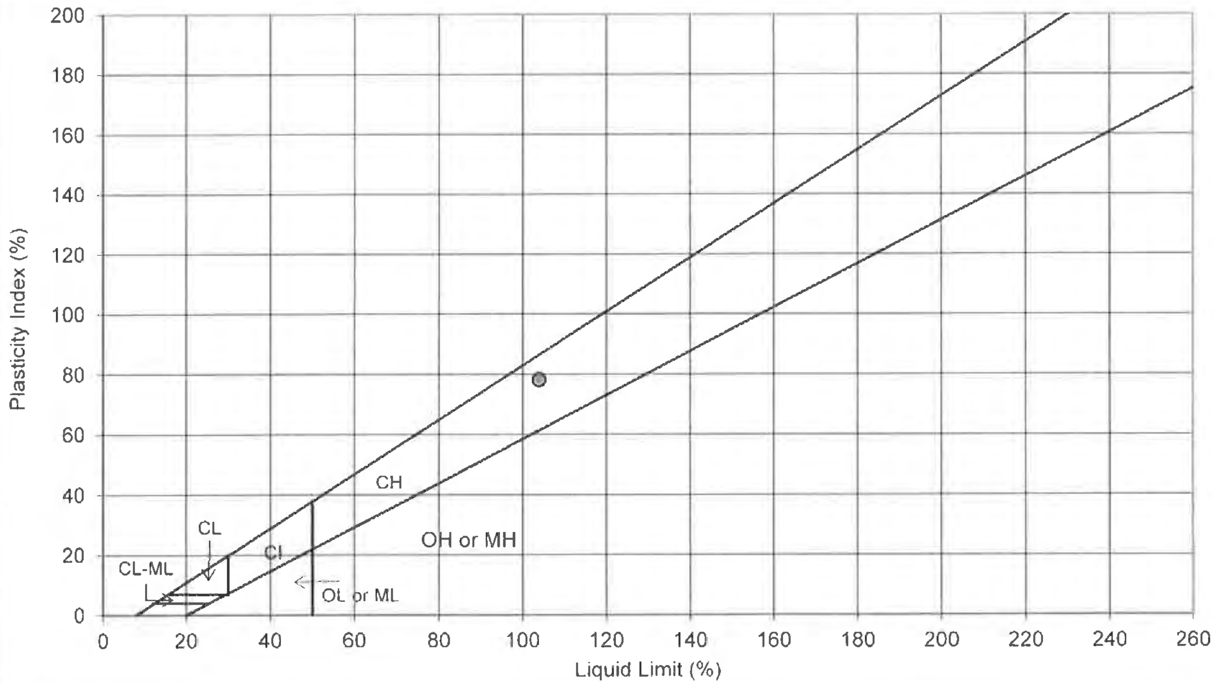
LIQUID LIMIT

Trial No:	1	2	3	4
No of Blows:	32	23	15	8
Container No.	1	2	3	4
Wet Soil + Container	13.52	13.79	14.13	14.16
Dry Soil + Container	6.71	6.74	6.8	6.65
Wt. Of Container	0	0	0	0
Moisture Content	101.5	104.6	107.8	112.9



PLASTIC LIMIT

	1	2	3	AVERAGE
Container No.	5	6		
Wet Soil + Container	28.64	28.75		
Dry Soil + Container	26.61	26.7		
Wt. Of Container	18.9	18.79		
Moisture Content	26.3	25.9		**26.1**



REMARKS :

Liquid Limit:	**104**
Plastic Limit:	**26**
Plasticity Index:	**78**
USC Classification:	**CH**

THURBER

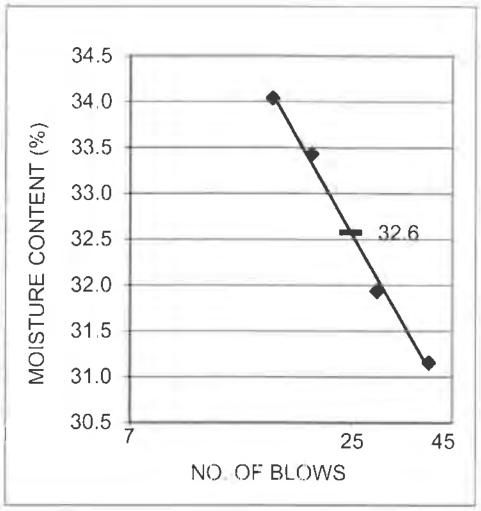
ATTERBERG LIMITS
ASTM D4318

Client: DIALOG
Project: MECHANIZED RIVER VALLEY ACCESS GEO INV
Project No: 19-5861-24
Test Hole: TH15 - 12
Sample No: G5
Depth: 3.05 m

Date Tested: 01-May-15
Tested By: ME
Checked By:

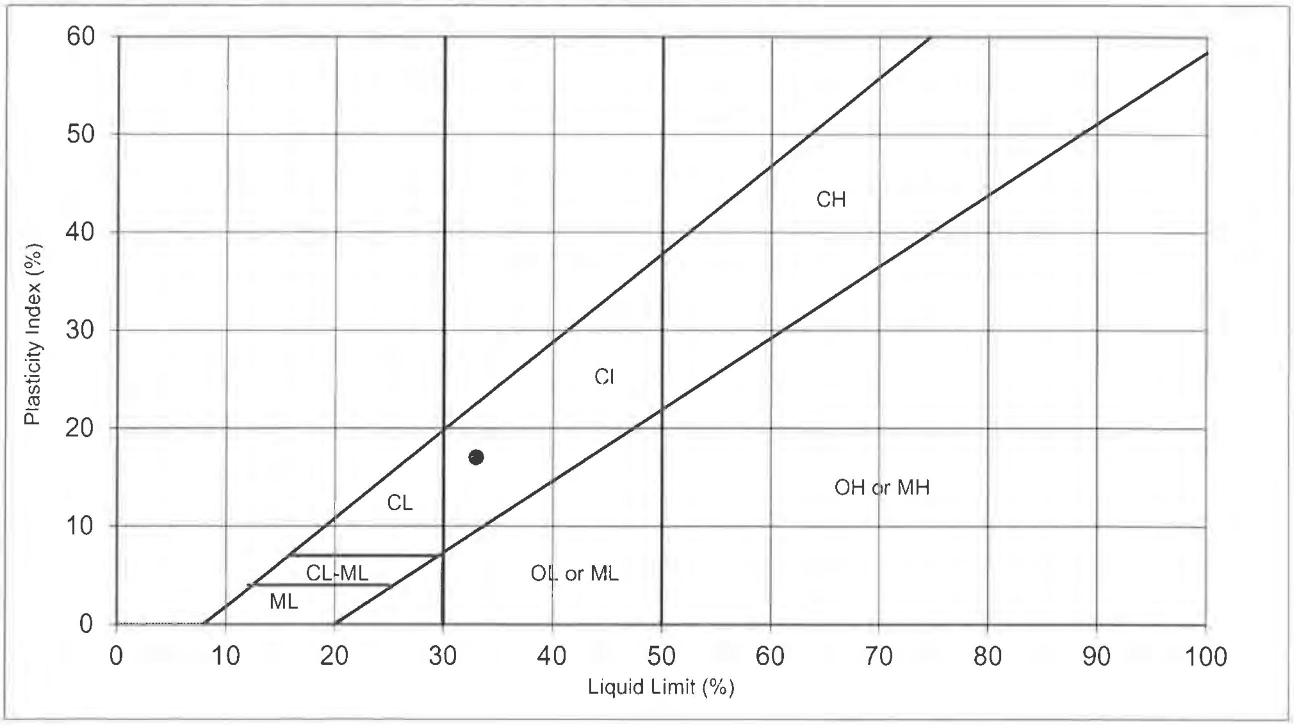
LIQUID LIMIT

Trial No:	1	2	3	4
No of Blows:	39	29	20	16
Container No.	1	2	3	4
Wet Soil + Container	12.25	12.27	13.61	12.64
Dry Soil + Container	9.34	9.30	10.2	9.43
Wt. Of Container	0	0	0	0
Moisture Content	31.2	31.9	33.4	34.0



PLASTIC LIMIT

	1	2		**AVERAGE**
Container No.	5	6		
Wet Soil + Container	27.47	27.12		
Dry Soil + Container	26.25	26.00		
Wt. Of Container	18.68	18.89		
Moisture Content	16.1	15.8		**15.9**



REMARKS

Liquid Limit:	**33**
Plastic Limit:	**16**
Plasticity Index:	**17**
USC Classification:	**CI**

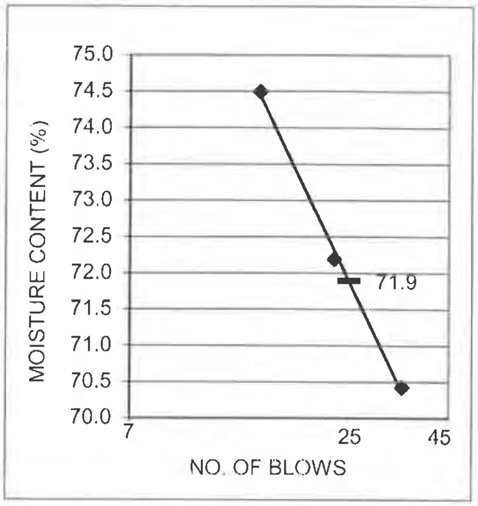
ATTERBERG LIMITS
ASTM D4318

Client: DIALOG
Project: MECHANIZED RIVER VALLEY ACCESS GEO INV
Project No: 19-5861-24
Test Hole: 15-13 Depth: 6.10 m
Sample No.: G9

Date Tested: 01-May-15
Tested By: ME
Checked By:

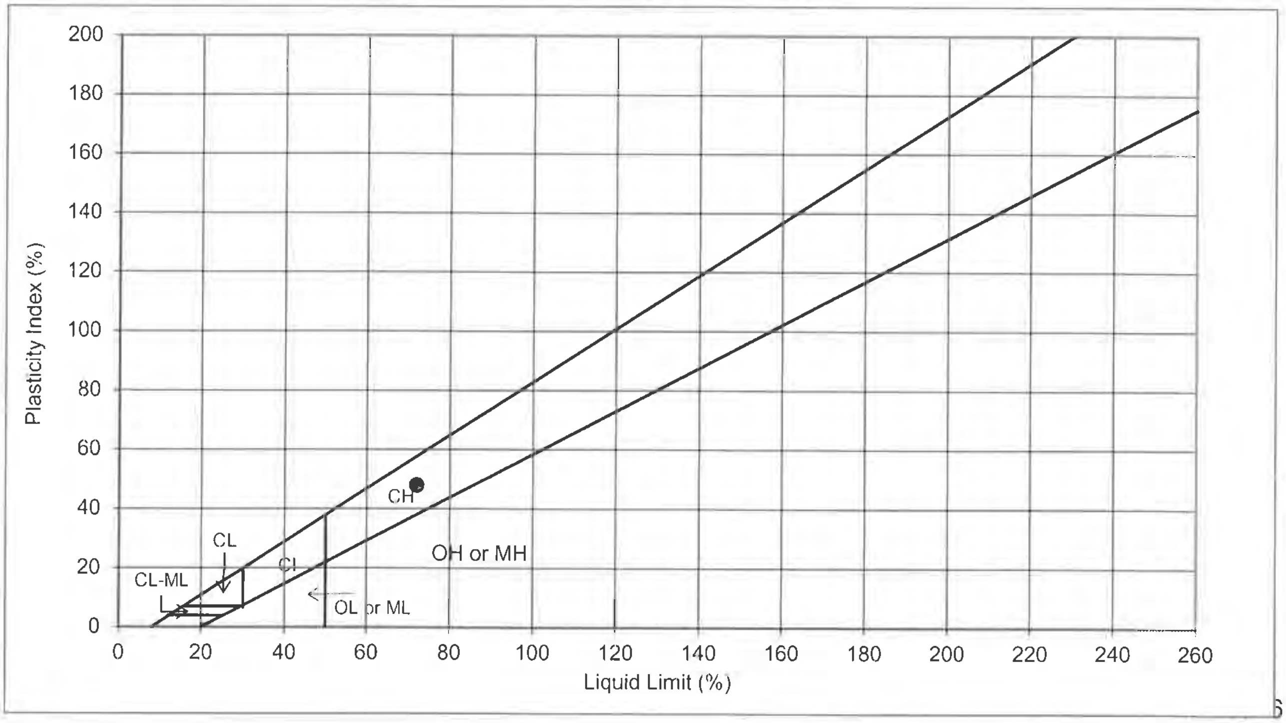
LIQUID LIMIT

Trial No:	1	2	3	4
No of Blows:	34	23	15	
Container No.	1	2	3	
Wet Soil + Container	12.1	11.33	11.15	
Dry Soil + Container	7.1	6.58	6.39	
Wt. Of Container	0	0	0	
Moisture Content	70.4	72.2	74.5	#DIV/0!



PLASTIC LIMIT

	1	2	3	AVERAGE
Container No.	5	6		
Wet Soil + Container	27.04	27.23		
Dry Soil + Container	25.43	25.62		
Wt. Of Container	18.75	18.88		
Moisture Content	24.1	23.9		**24.0**



REMARKS :

Liquid Limit:	**72**
Plastic Limit:	**24**
Plasticity Index:	**48**
USC Classification:	**CH**

TH15-13 G9 @ 6.10 m

THURBER ENGINEERING LTD

4127 Roper Road Edmonton, AB T6B 3S5 T. (780) 438 - 1460 F. (780) 437 - 7125 www.thurber.ca

GRAIN SIZE DISTRIBUTION REPORT

Client: CITY OF EDMONTON

Project: EDMONTON RIVER VALLEY MECHANIZED ACCESS

Project No: 14-31-376

Date Tested: 12-Feb-15

Tested By: JAP

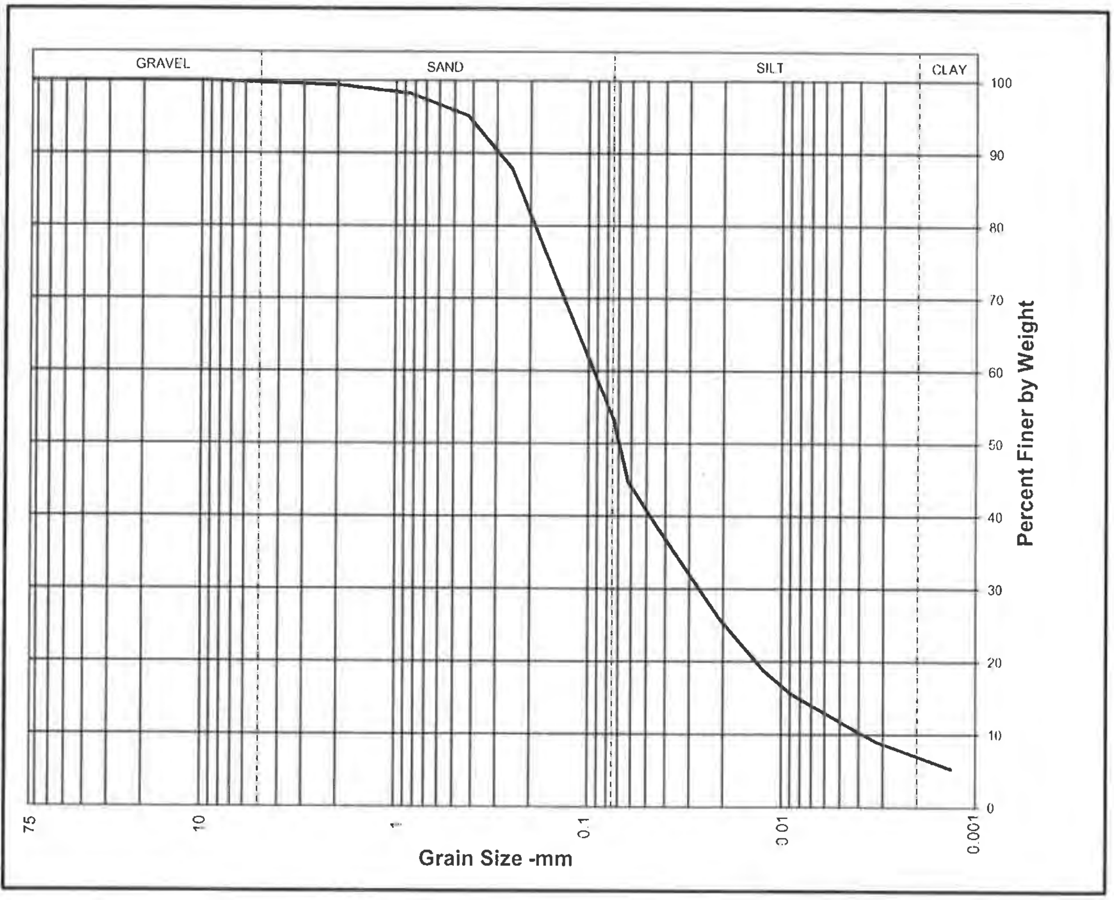
Test Hole: 15-1

Sample Description:

Depth: 27.5-29' (8.3m)

Sample No.: SPT13

Sieve Size -mm	Percent Finer
100.0	100.0
75.0	100.0
62.5	100.0
50.0	100.0
37.5	100.0
25.0	100.0
19.0	100.0
12.5	100.0
9.5	100.0
4.75	99.7
2.00	99.3
0.850	98.2
0.425	95.1
0.250	87.8
0.150	73.2
0.075	53.5
0.062	44.8
0.045	38.9
0.033	33.3
0.021	26.0
0.012	18.9
0.009	15.6
0.006	13.3
0.004	10.7
0.003	9.0
0.002	7.9



Distribution	
Cobbles	0%
Gravel	0.3%
Sand	46.1%
Silt	46.8%
Clay	6.8%

Remarks:

Checked By:

Tested in Accordance with ASTM D422, C136 and C117 unless otherwise indicated

THURBER ENGINEERING LTD.

4127 Roper Road
Edmonton, Alberta T6B 3S5
P: 780.438.1460 F: 780.437.7125

Client: CITY OF EDMONTON

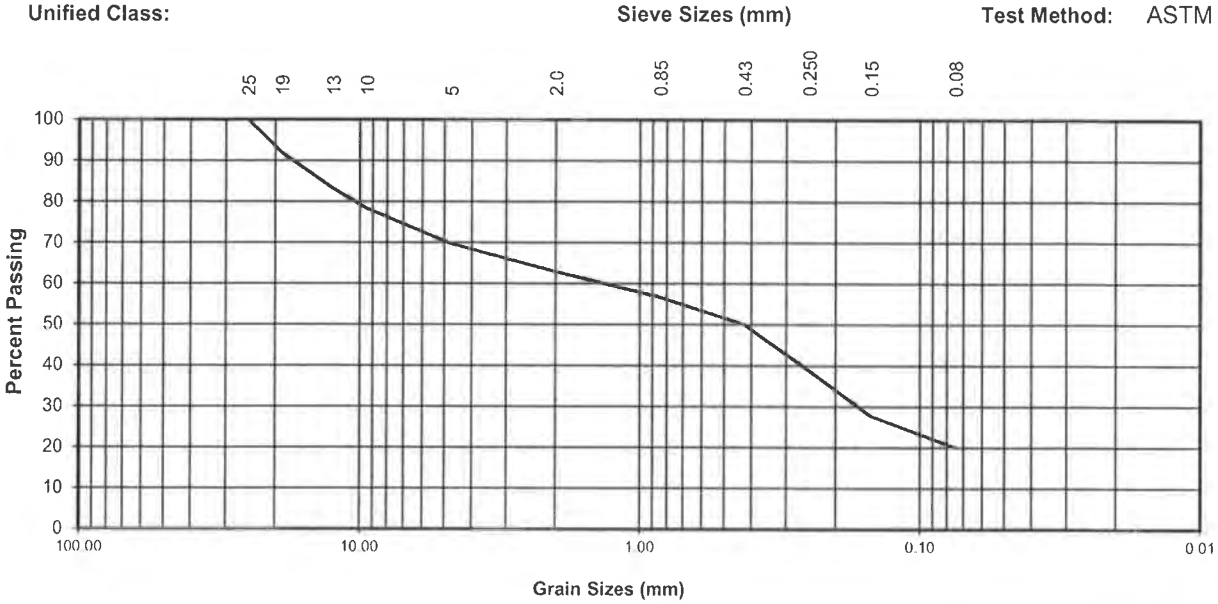
Project: EDMONTON RIVER VALLEY MECHANIZED ACCESS

Project No.: 14-31-376

Date: 12-Feb-15

Sample Source: TH15-4 G6 @ 10.0' (3.0 m)
Material Type:
Specification:
Unified Class:

Date Tested: 12-Feb-15
Sampled by: n/a
Date Sampled: n/a
Test Method: ASTM C 136



Sieve No.	Opening (mm)	Percent Passing	Gradation Limits	
			Max	Min
1	25	100.0		
3/4	19	91.8		
1/2	12.5	83.2		
3/8	9.5	78.4		
#4	4.75	69.7		
#10	2	62.8		
#20	0.85	56.8		
#40	0.425	50.1		
#60	0.25	38.9		
#100	0.15	27.7		
#200	0.075	20.0		

Total Sample Proportions

Gravel:	30.3 %
Sand:	49.7 %
Fines:	20.0 %

Silt and Clay

Silt	-
Clay	-
Total Fines:	

Moisture Content
As Received: 9.4%

Percent Crush: -
Faces Counted:

Computer File : TH15-4 G6
Series No.: n/a

Comments: Trace asphalt chunks

Checked By:

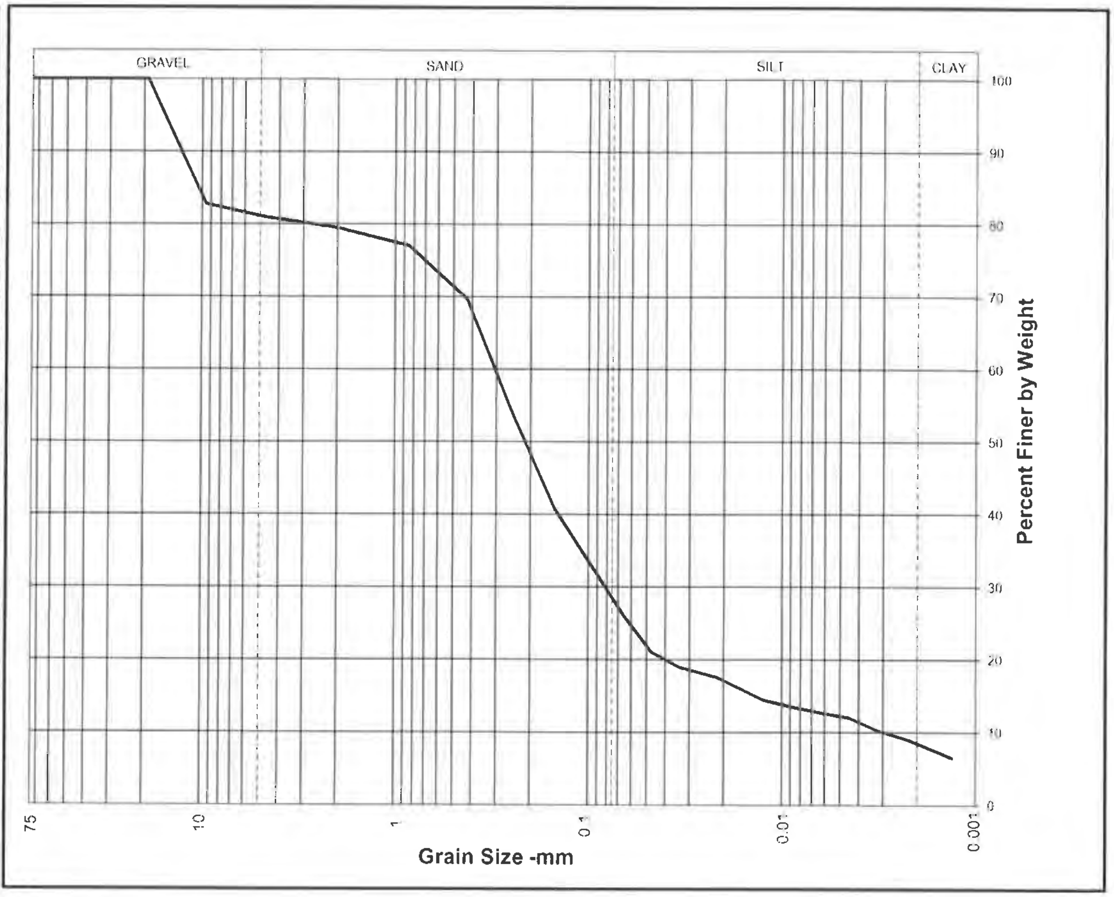
THURBER ENGINEERING LTD.
4127 Roper Road Edmonton, AB T6B 3S5 T. (780) 438 - 1460 F. (780) 437 - 7125 www.thurber.ca

GRAIN SIZE DISTRIBUTION REPORT

Client: DIALOG
Date Tested: 01-May-15
Project: MECHANIZED RIVER VALLEY ACCESS
Project No: 19-5861-24
Tested By: JAP

Test Hole: 15-12
Depth: 3.81 - 4.27 m
Sample Description:
Sample No.: P6

Sieve Size -mm	Percent Finer
100.0	100.0
75.0	100.0
62.5	100.0
50.0	100.0
37.5	100.0
25.0	100.0
19.0	100.0
12.5	89.5
9.5	82.8
4.75	81.0
2.00	79.5
0.850	77.0
0.425	69.6
0.250	54.2
0.150	40.8
0.075	28.5
0.065	26.0
0.047	21.0
0.034	19.0
0.021	17.5
0.013	14.5
0.009	13.5
0.006	12.7
0.004	12.0
0.003	10.2
0.002	9.0



Distribution	
Cobbles	0%
Gravel	19%
Sand	52.5%
Silt	20.1%
Clay	8.4%

Remarks:

Checked By:

Tested in Accordance with ASTM D422, C136 and C117 unless otherwise indicated

Thurber Engineering Ltd.
200, 9636-51 Avenue
Edmonton, Alberta, T6E 6A5
Phone: (780) 438-1425
Fax: (780) 437-7125
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Direct Shear Test Results

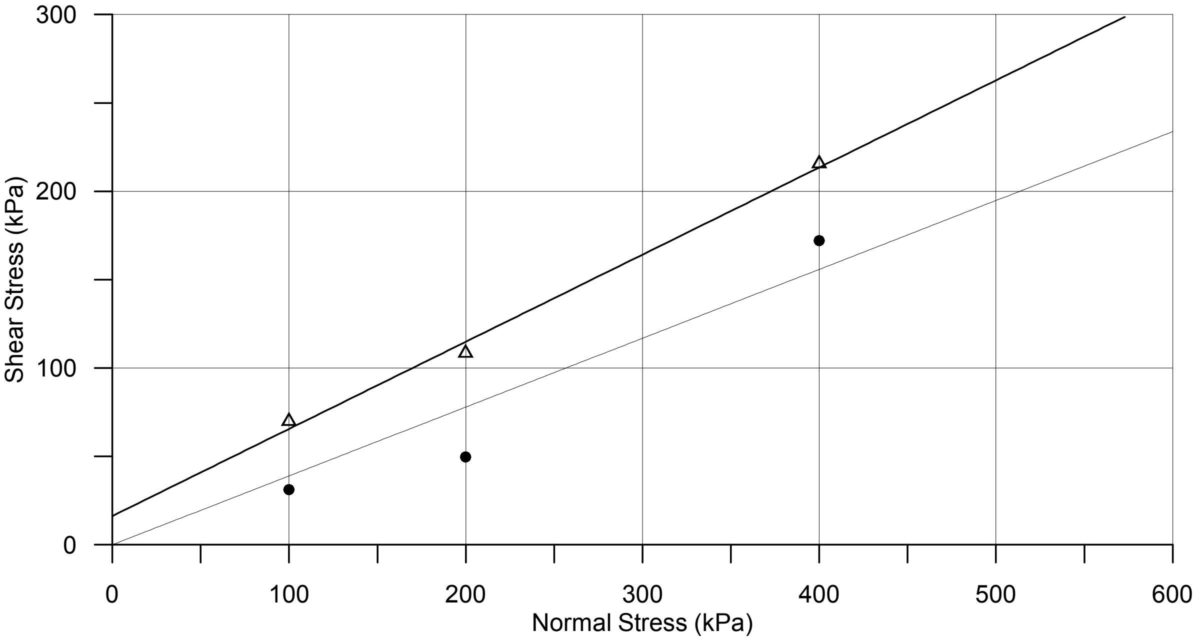
Client: City of Edmonton
Project: River Valley Mechanized Access
Job No.: 14-31-376

Test Hole: TH15-3
Sample: Clay (CH),
silty, brown and grey.
Depth: 9.91 - 10.36 m
Date: Mar 3/15

Peak Strength Parameters:
c' = 17kPa Φ' = 26°
Residual Strength Parameters:
c' = 0 kPa Φ' = 21°

△ Peak Strength
● Residual Strength

Atterberg Limits: LL= 53% PL= 24% PI= 29%



Remarks:

Direct Shear Test Results

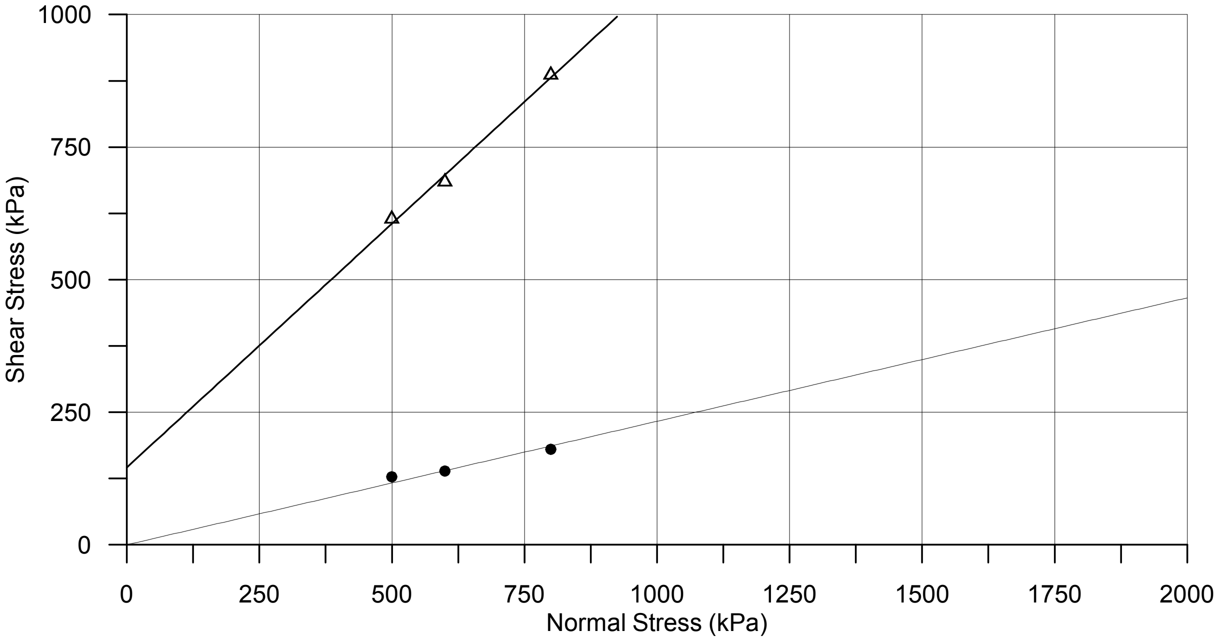
Client: DIALOG
Project: Mechanized River Valley Access
Job No.: 19-5861-24

Test Hole: TH15-2
Sample: Clay Shale (CH),
silty, grey.
Depth: 13.45m, 14.40m, 15.32m
Date: May 12/15

Peak Strength Parameters:
c' = 145 kPa Φ' = 43°
Residual Strength Parameters:
c' = 0 kPa Φ' =13°

△ Peak Strength
● Residual Strength

Atterberg Limits: LL= % PL= % PI= %



Remarks:

THURBER

APPENDIX D

Slope Inclinometer Monitoring Results

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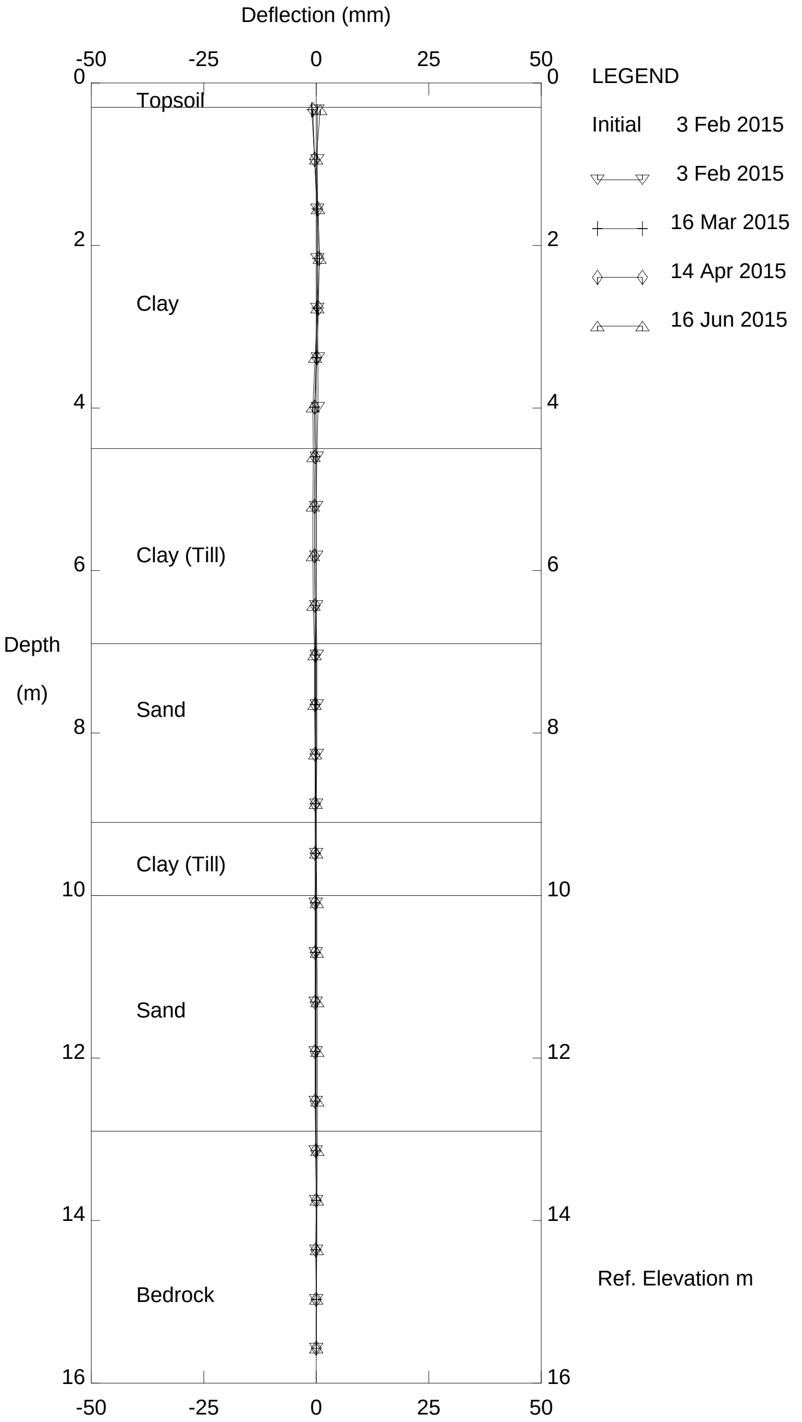
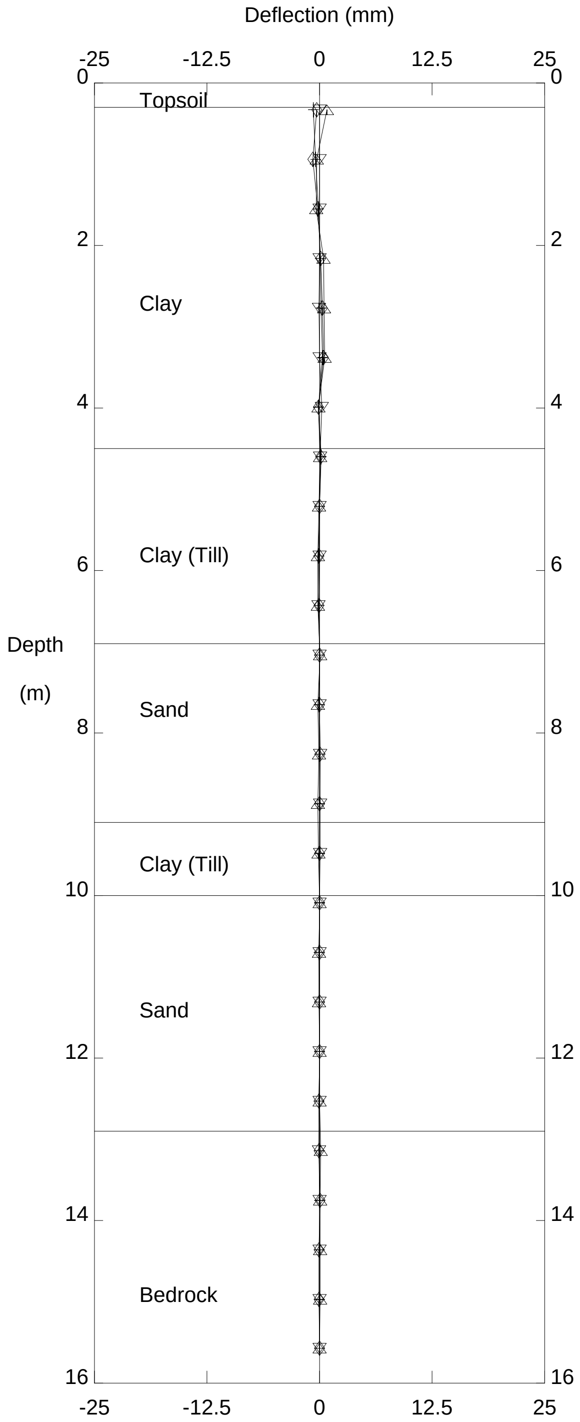


Cumulative Deflection

Direction A



Incremental Deflection

Direction A

Edmonton River Valley Mechanized Access, Inclinometer SI 15-1

City of Edmonton

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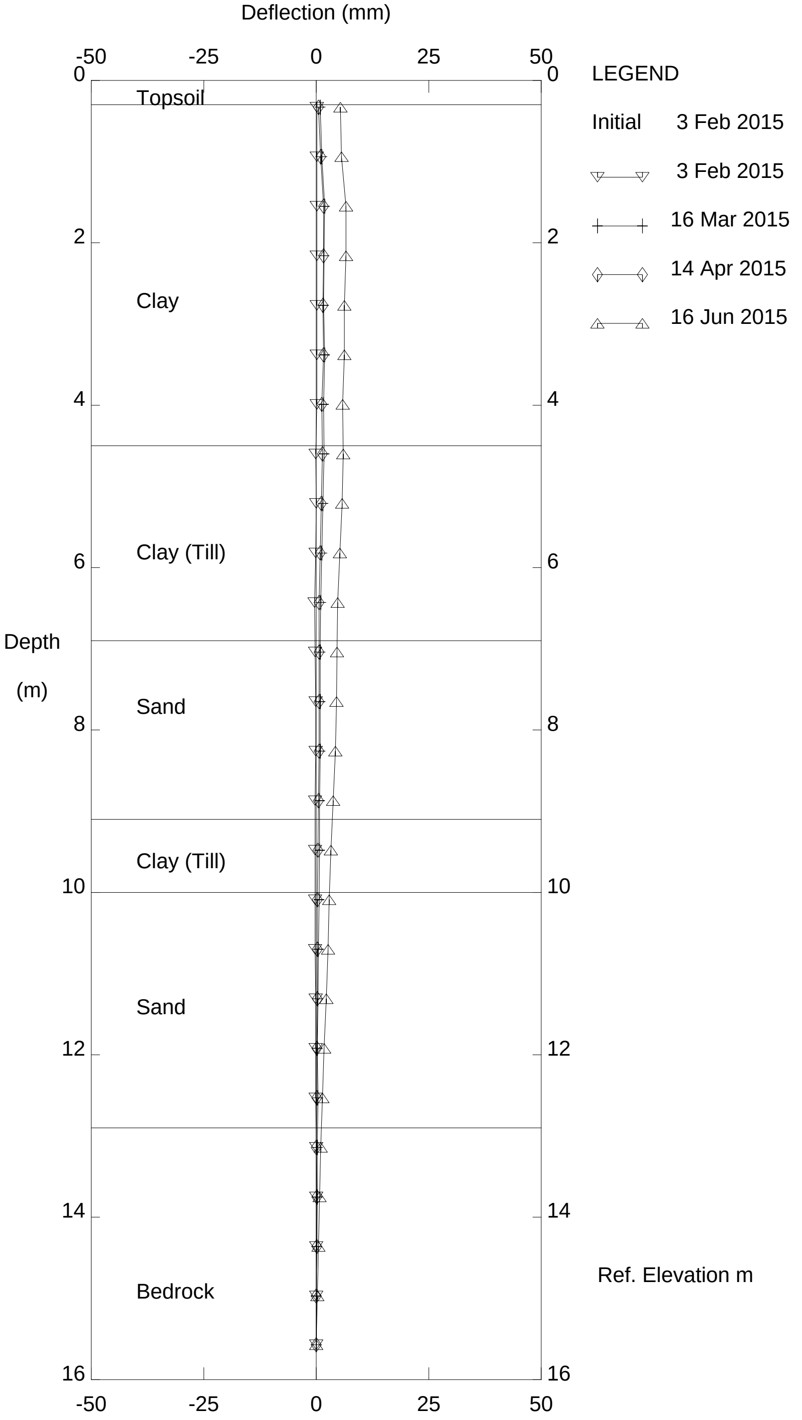
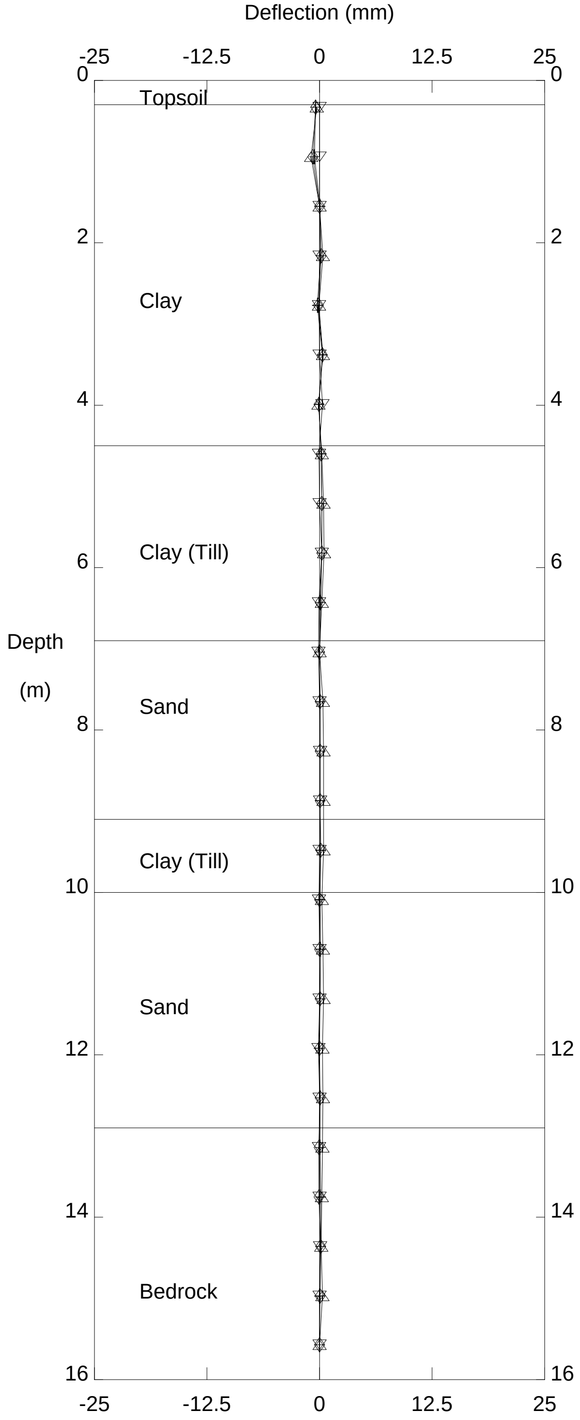
Thurber Engineering Ltd.



Cumulative Deflection

Direction B



Incremental Deflection

Direction B

Edmonton River Valley Mechanized Access, Inclinometer SI 15-1

City of Edmonton

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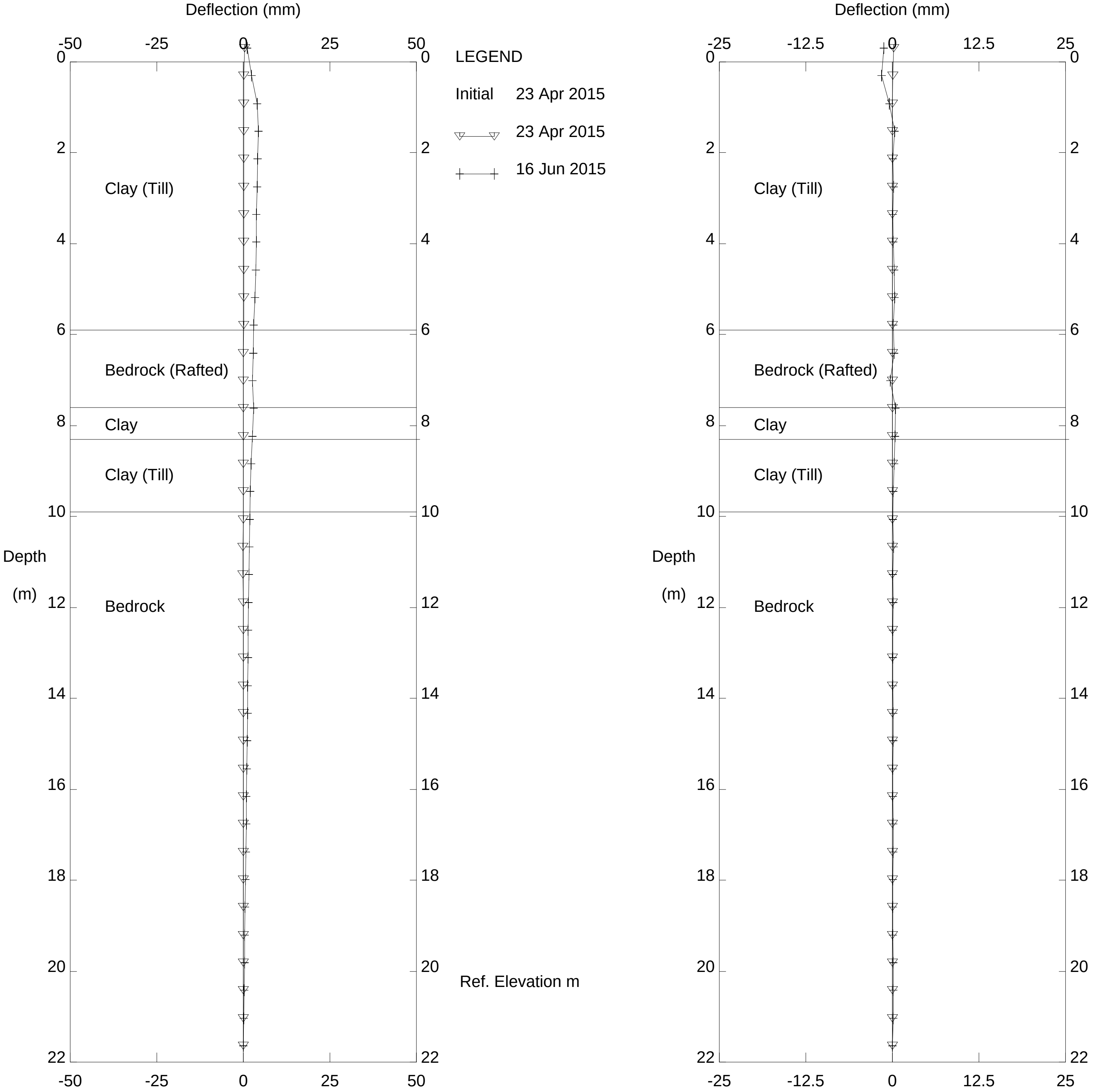
Thurber Engineering Ltd.



Cumulative Deflection

Direction A

Incremental Deflection

Direction A

Edmonton River Valley Mechanized Access, Inclinometer SI15-2

City of Edmonton

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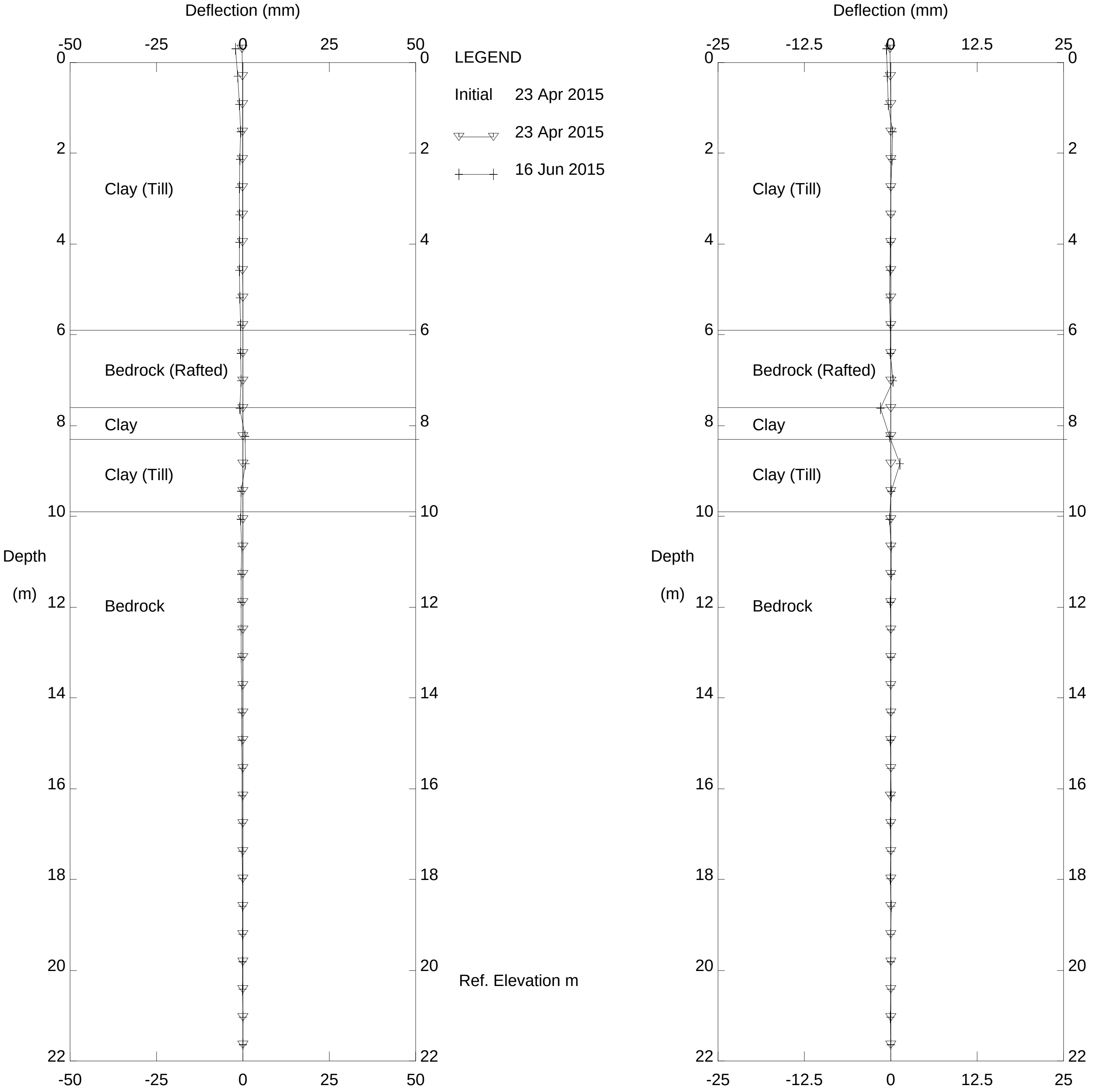
Thurber Engineering Ltd.



Cumulative Deflection

Direction B

Incremental Deflection

Direction B

Edmonton River Valley Mechanized Access, Inclinometer SI15-2

City of Edmonton

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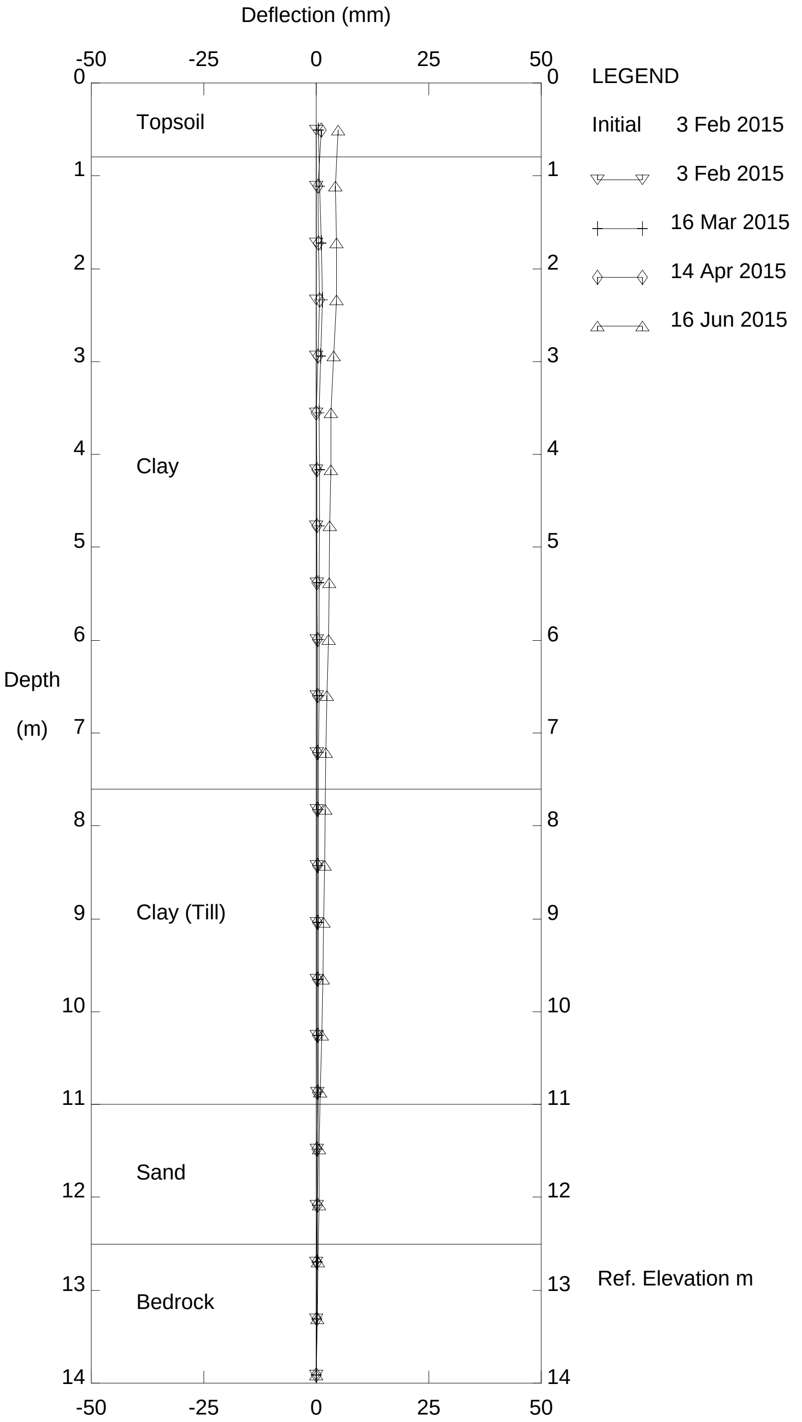
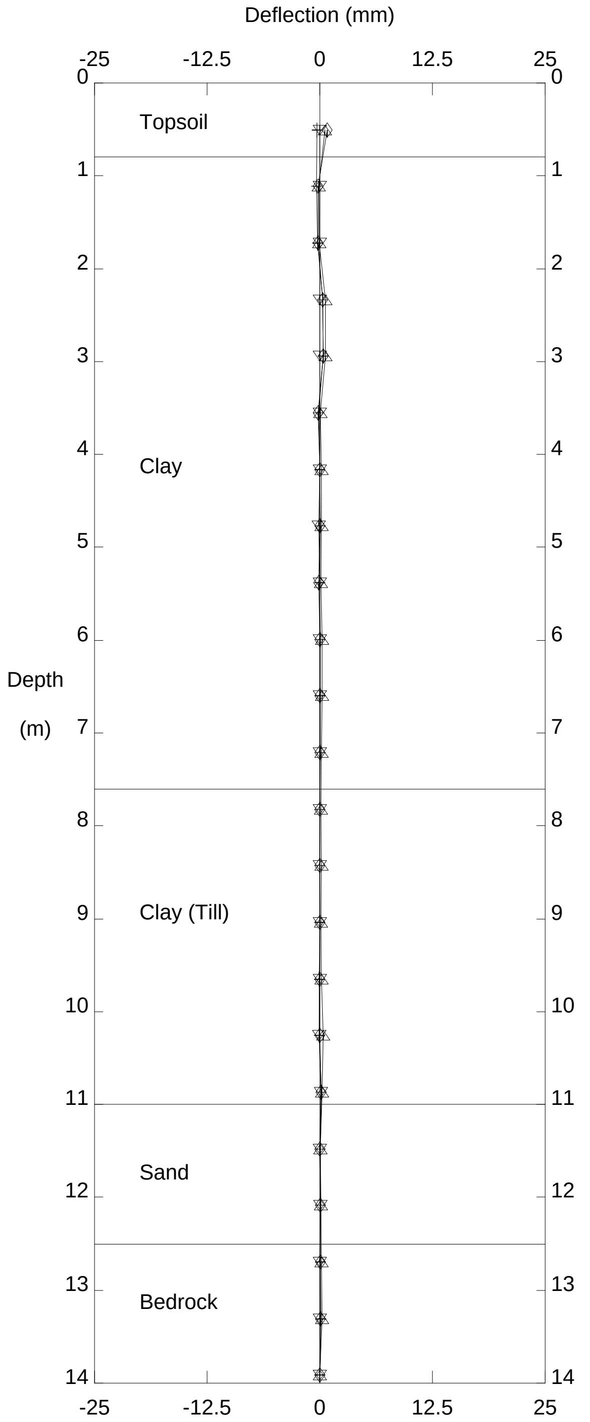
Thurber Engineering Ltd.



Cumulative Deflection

Direction A



Incremental Deflection

Direction A

Edmonton River Valley Mechanized Access, Inclinometer SI 15-3

Dialog

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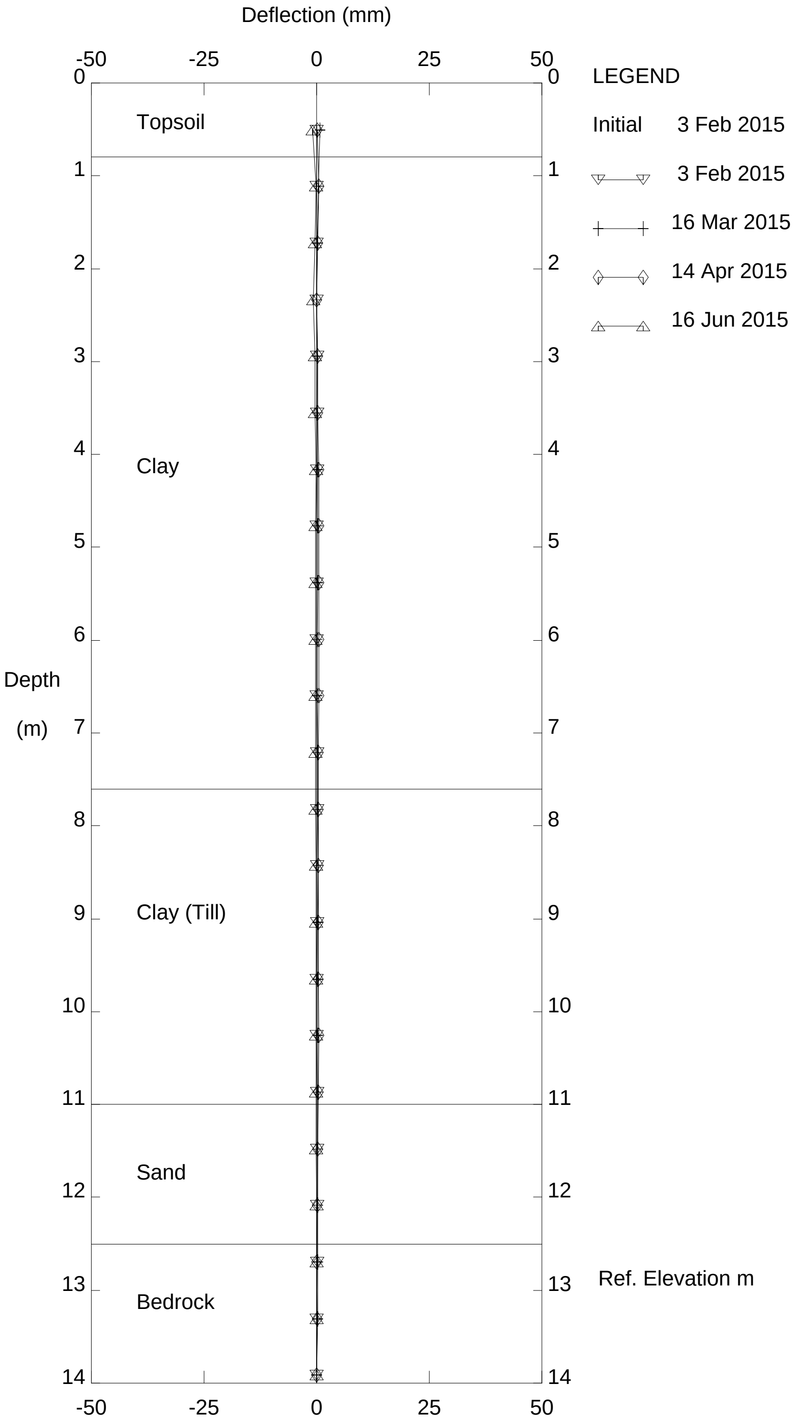
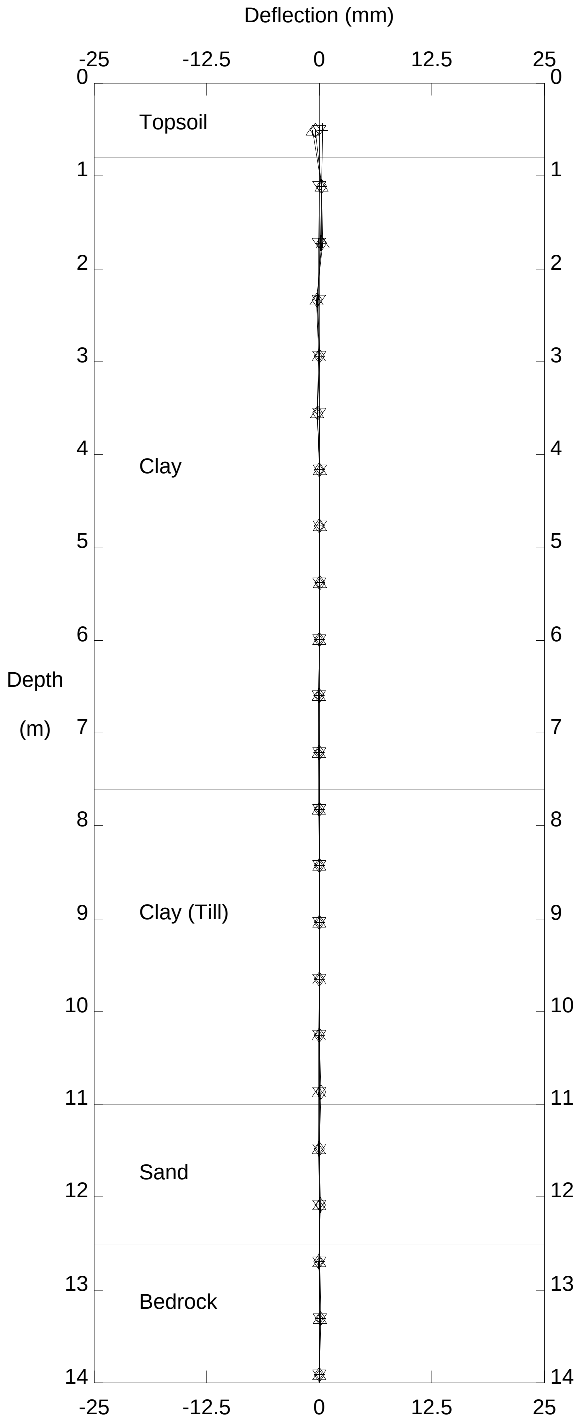
Thurber Engineering Ltd.



Cumulative Deflection

Direction B



Incremental Deflection

Direction B

Edmonton River Valley Mechanized Access, Inclinometer SI 15-3

Dialog

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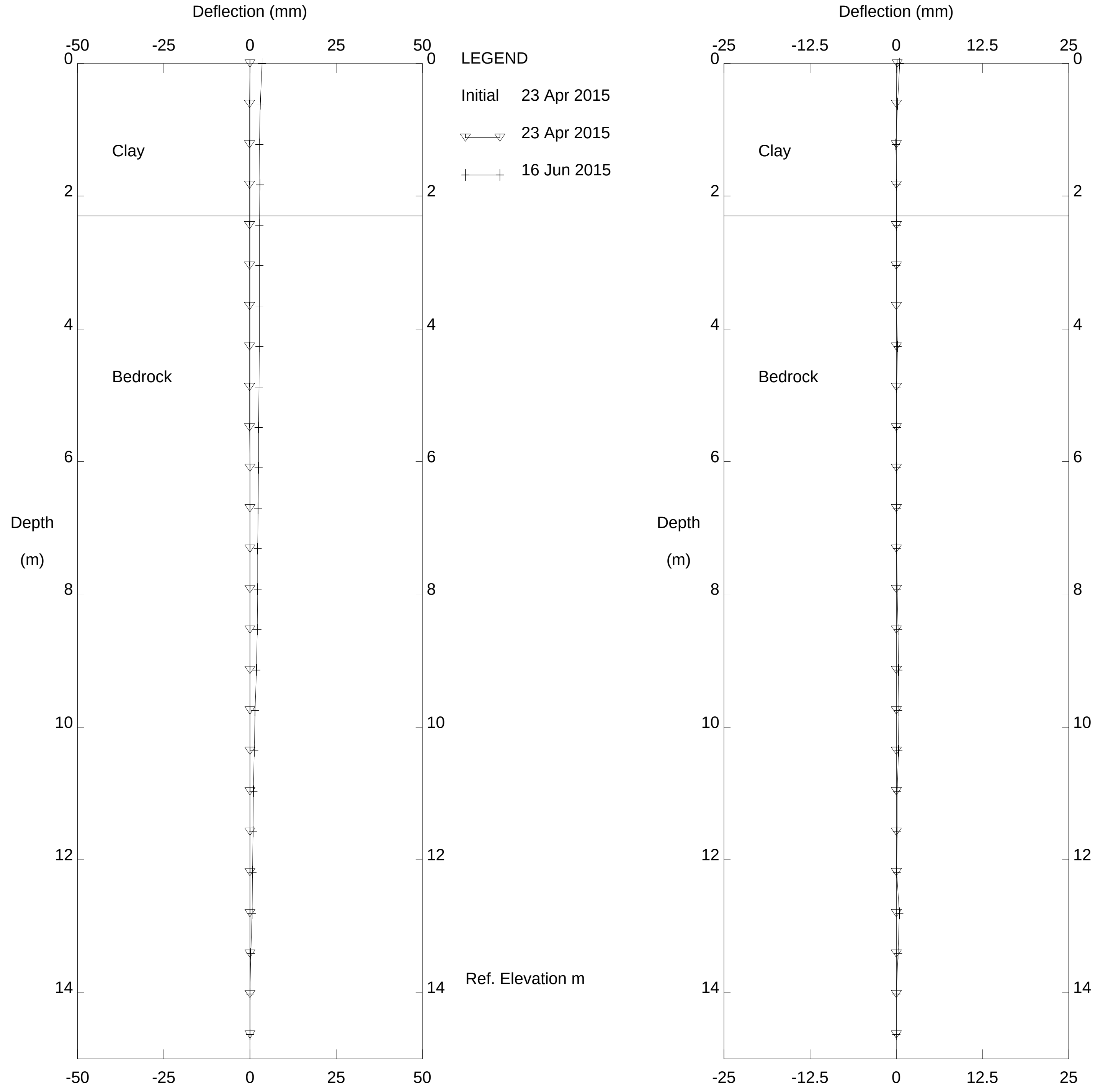
Thurber Engineering Ltd.



Cumulative Deflection

Direction A

Incremental Deflection

Direction A

Edmonton River Valley Mechanized Access, Inclinometer SI15-10

City of Edmonton

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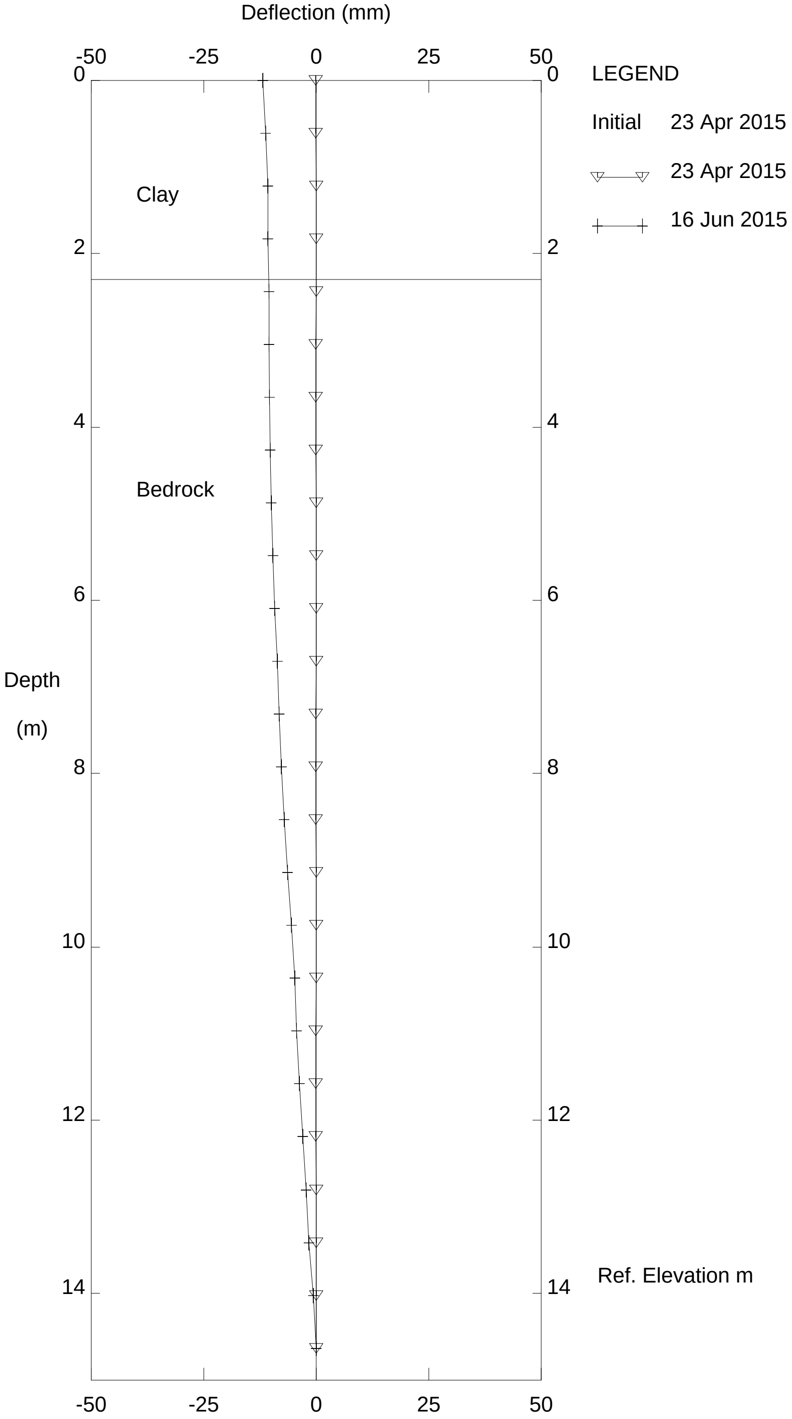
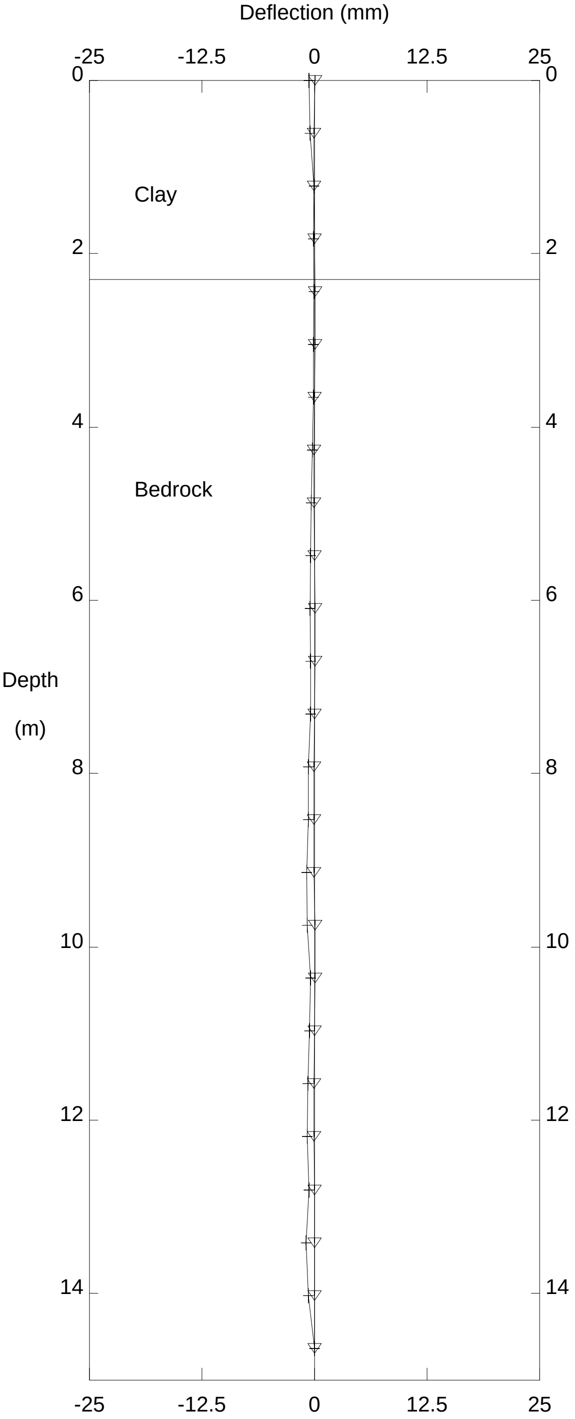
Thurber Engineering Ltd.



Cumulative Deflection

Direction B



Incremental Deflection

Direction B

Edmonton River Valley Mechanized Access, Inclinometer SI15-10

City of Edmonton

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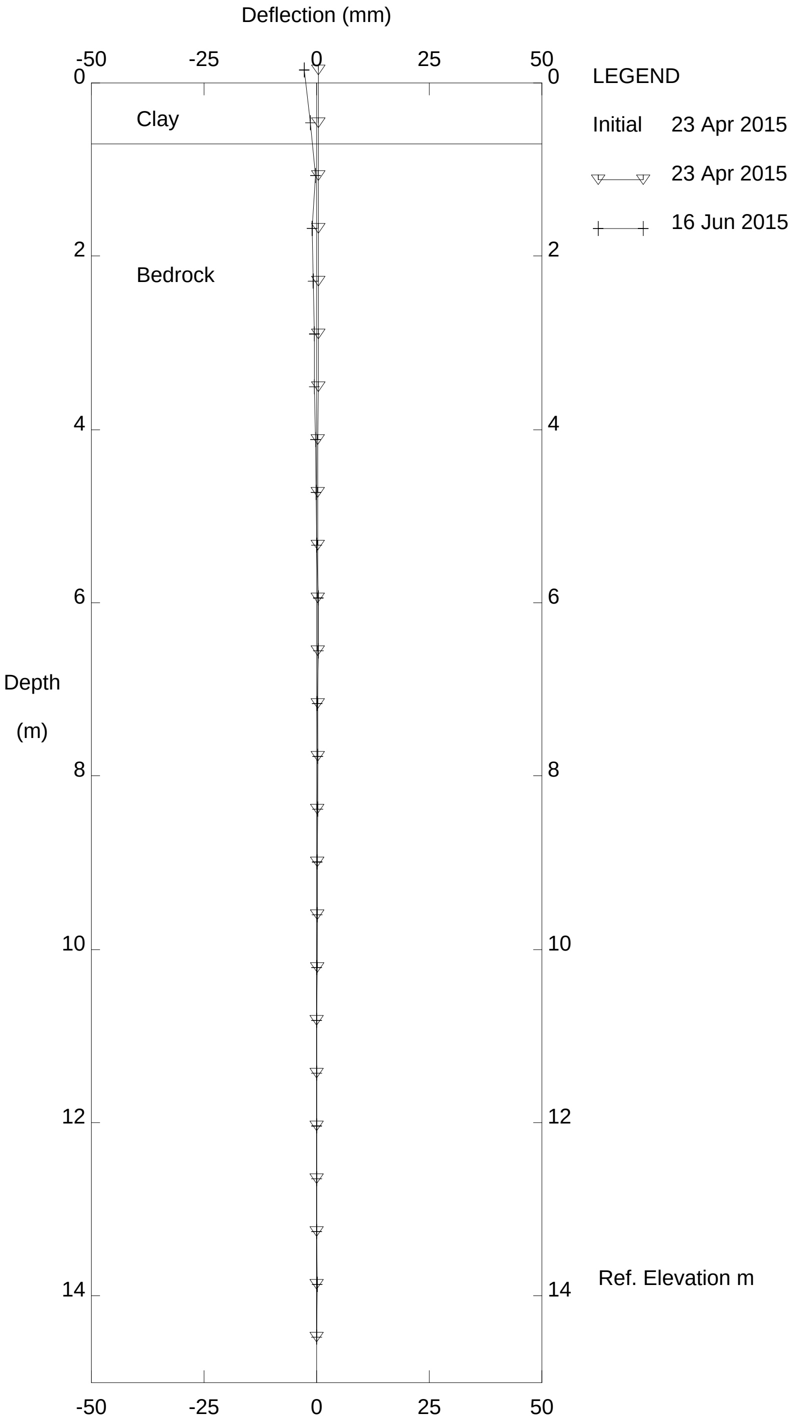
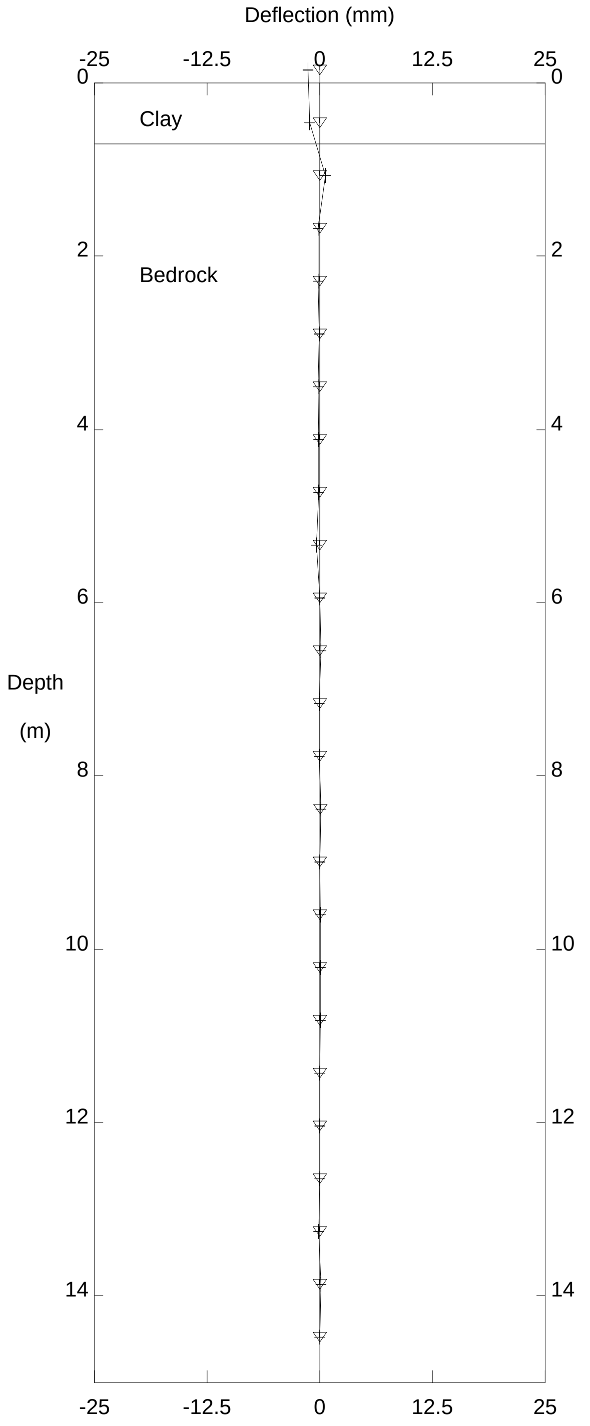
Thurber Engineering Ltd.



Cumulative Deflection

Direction A



Incremental Deflection

Direction A

Edmonton River Valley Mechanized Access, Inclinometer SI15-11

City of Edmonton

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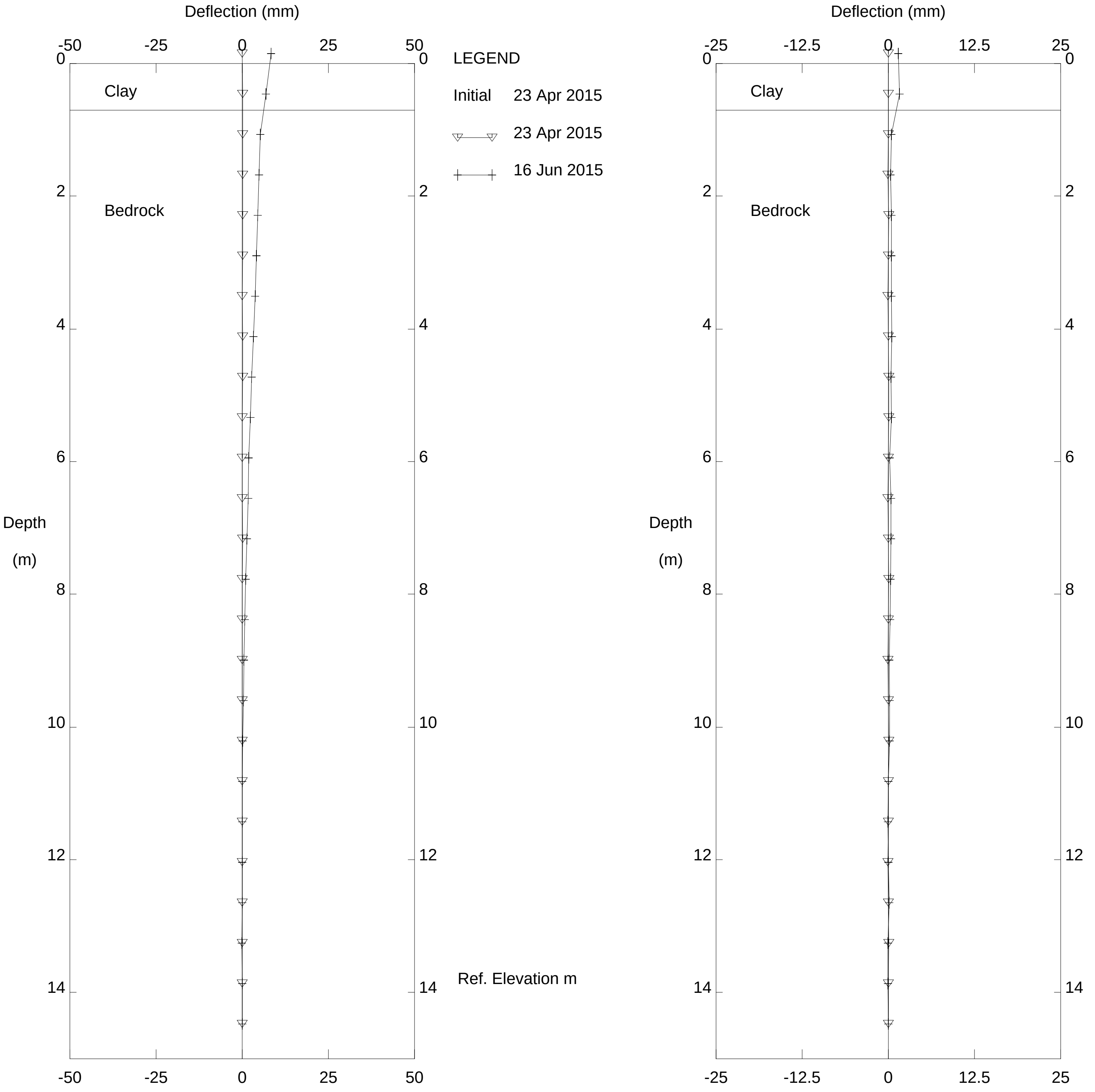
Thurber Engineering Ltd.



Cumulative Deflection

Direction B

Incremental Deflection

Direction B

Edmonton River Valley Mechanized Access, Inclinometer SI15-11

City of Edmonton

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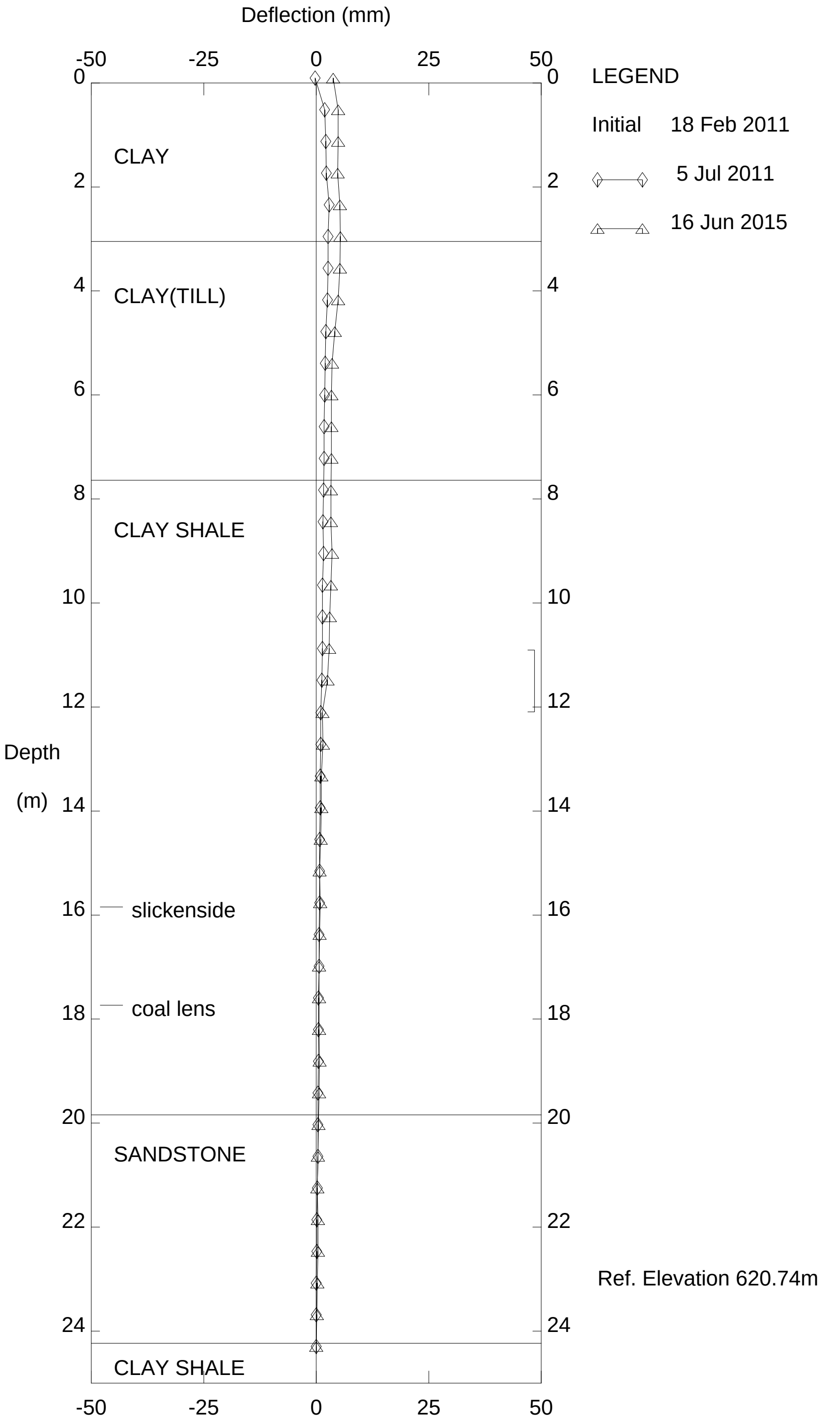
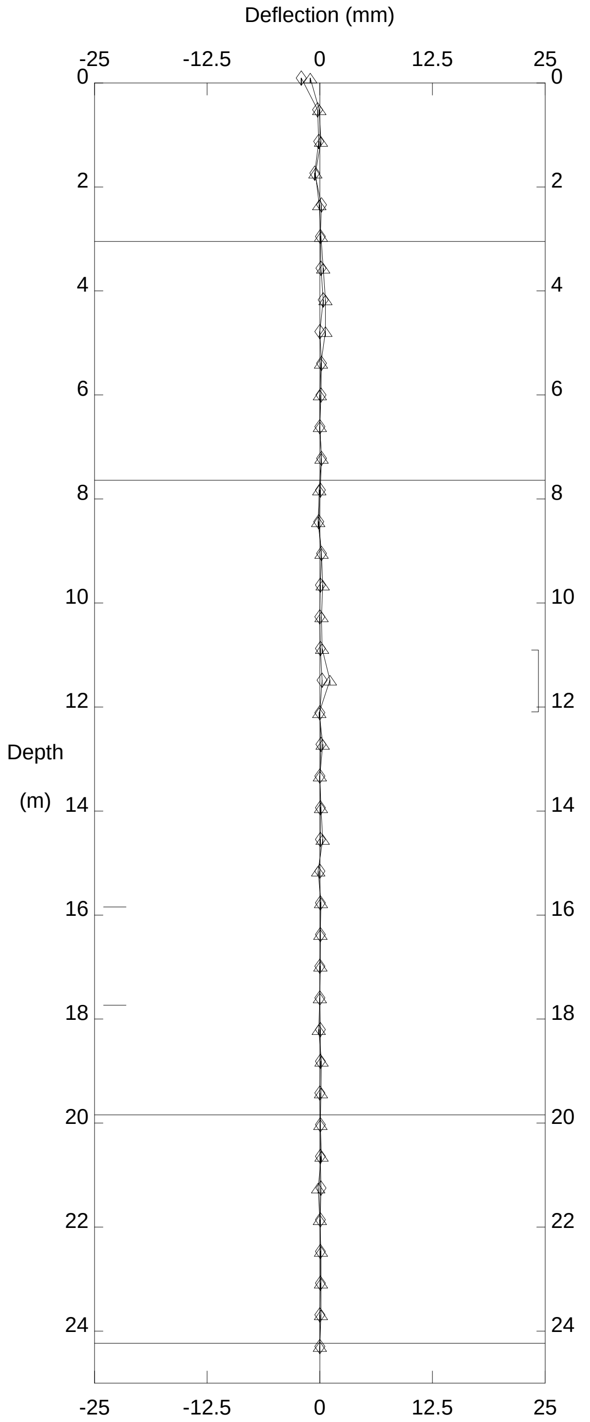
Thurber Engineering Ltd.



Cumulative Deflection

Direction A



Incremental Deflection

Direction A

E12101348, Inclinometer SI1

Shaw Conference Centre

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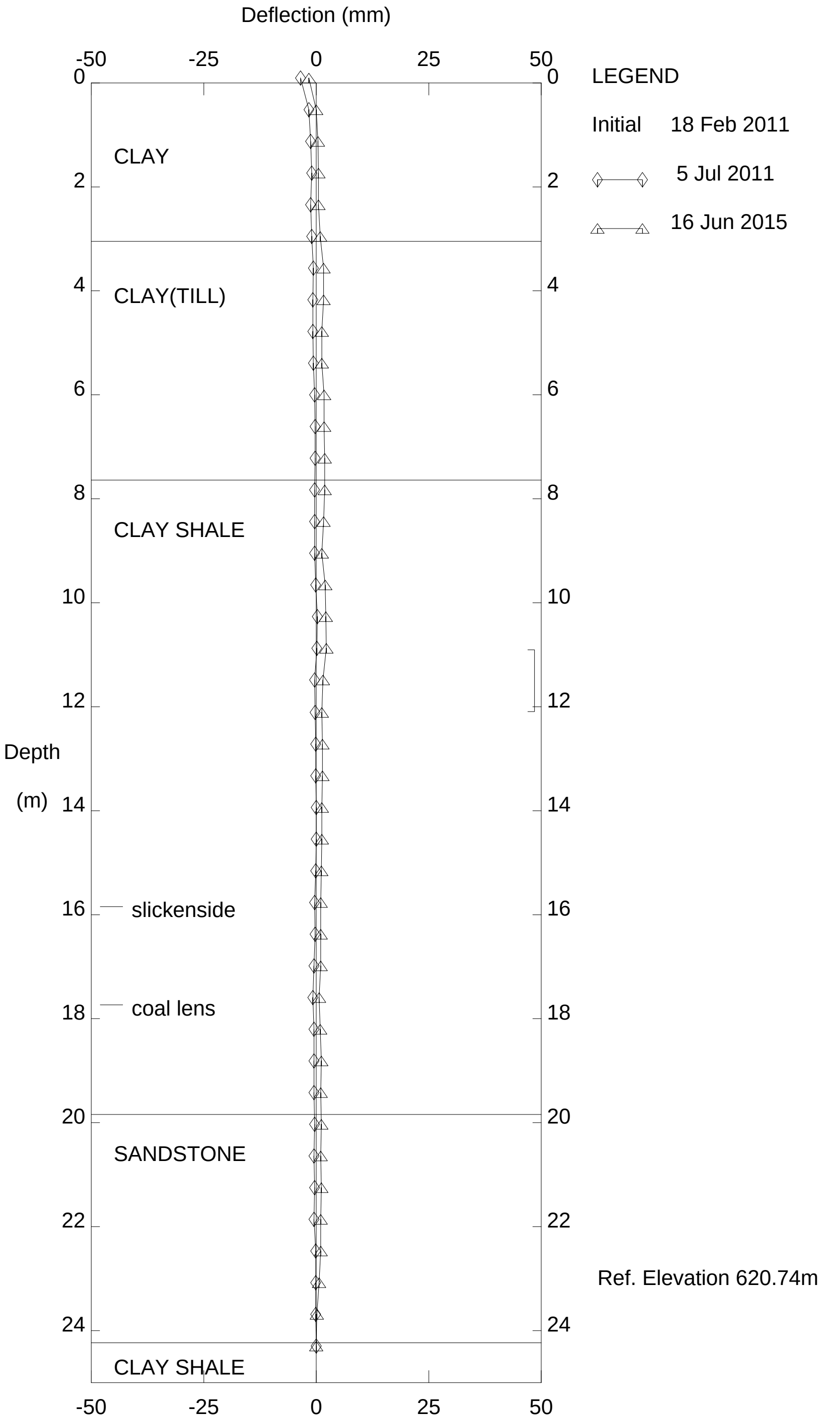
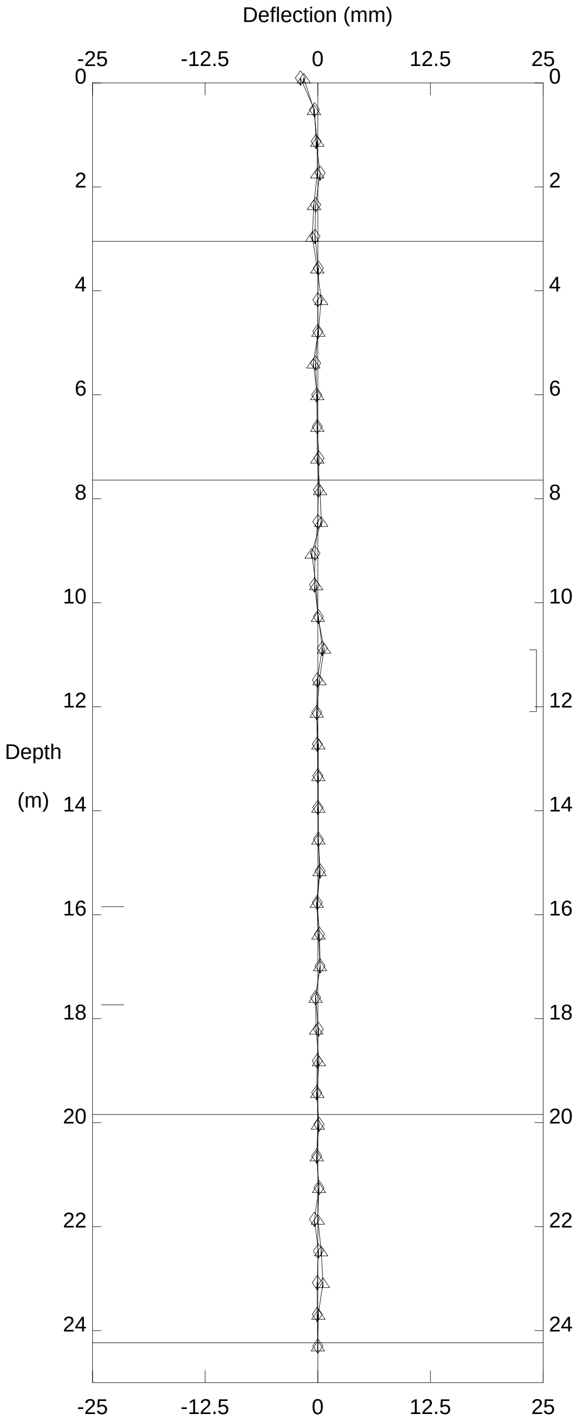
Thurber Engineering Ltd.



Cumulative Deflection

Direction B



Incremental Deflection

Direction B

E12101348, Inclinometer SI1

Shaw Conference Centre

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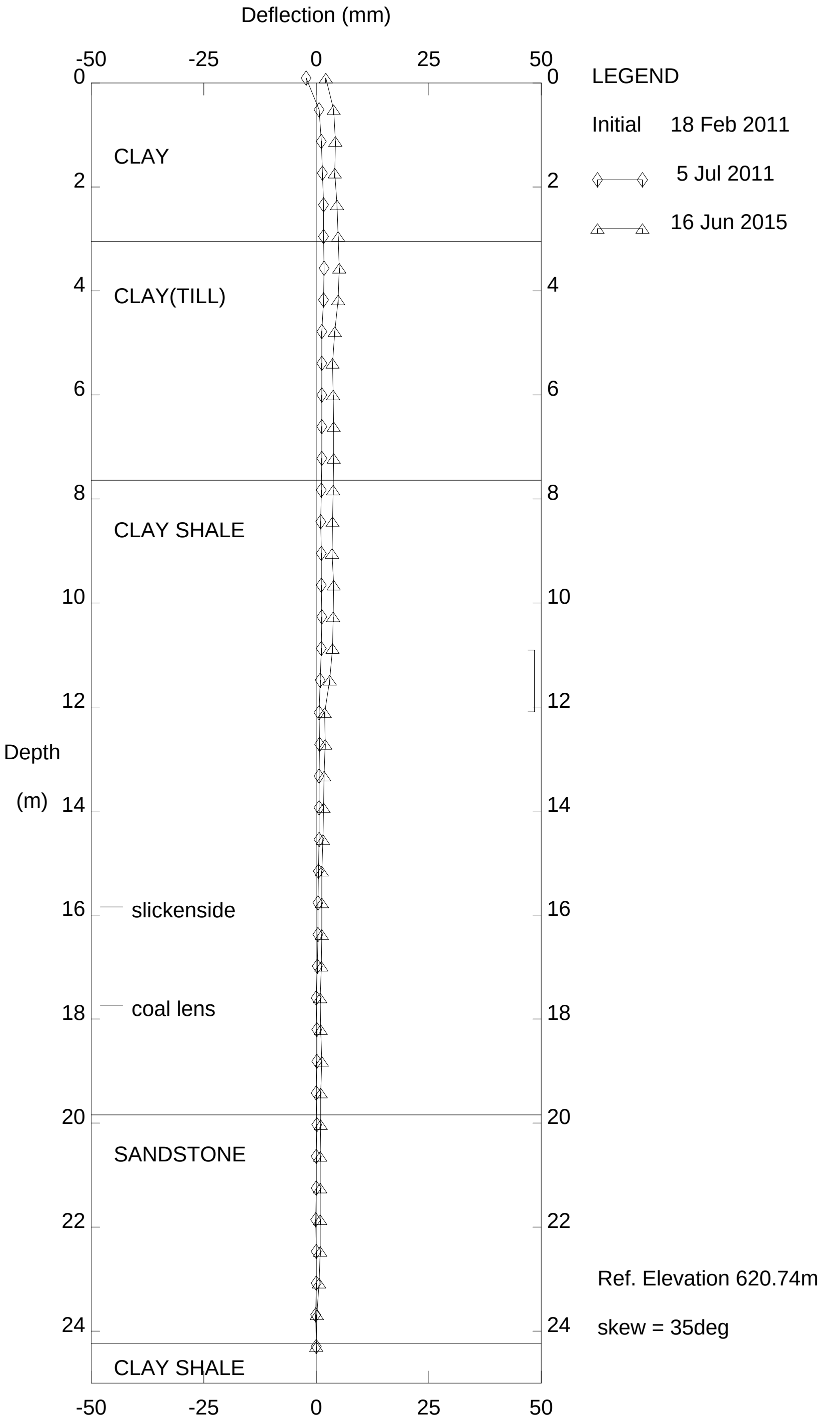
Thurber Engineering Ltd.



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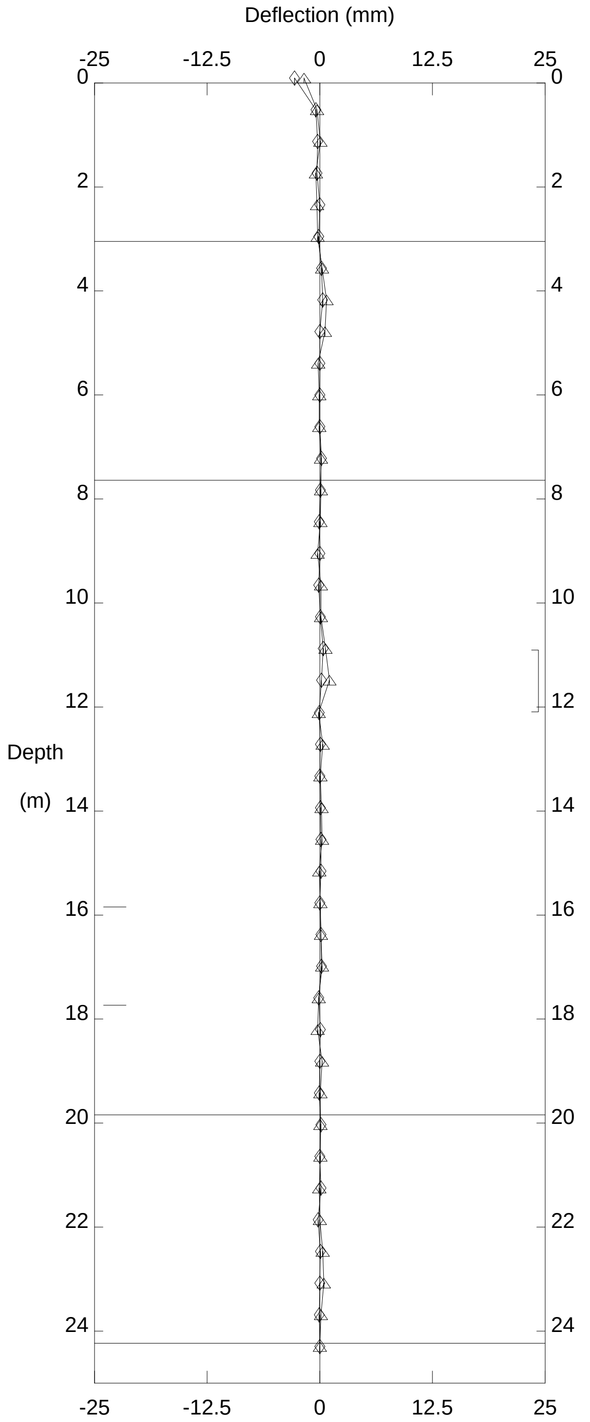
Direction X



Incremental Deflection

Direction X

E12101348, Inclinometer SI1

Shaw Conference Centre

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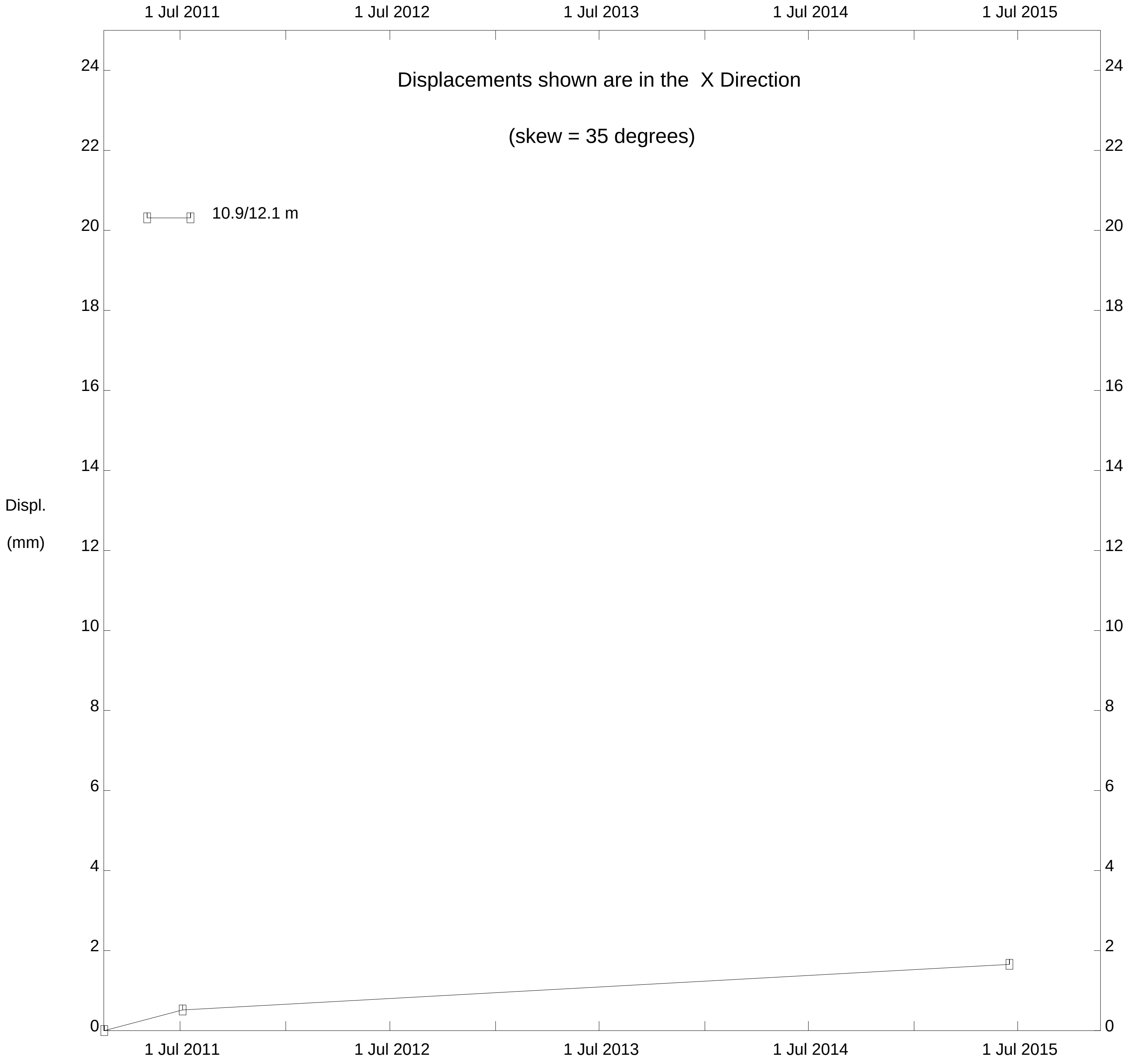
Thurber Engineering Ltd.



E12101348, Inclinometer SI1

Shaw Conference Centre

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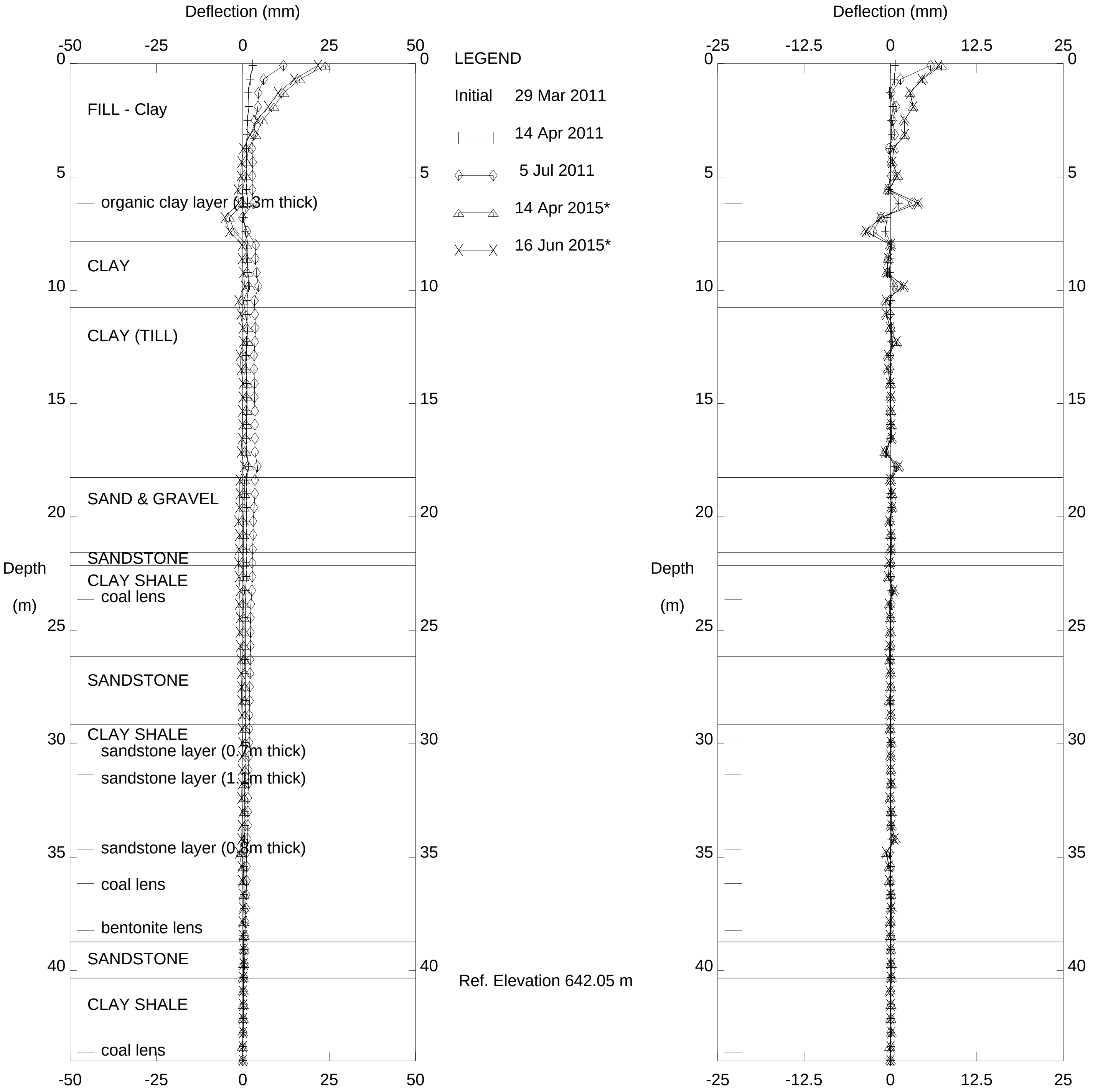

Cumulative Deflection

Direction A

Incremental Deflection

Direction A

E12101348, Inclinometer SI6

Shaw Conference Centre

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

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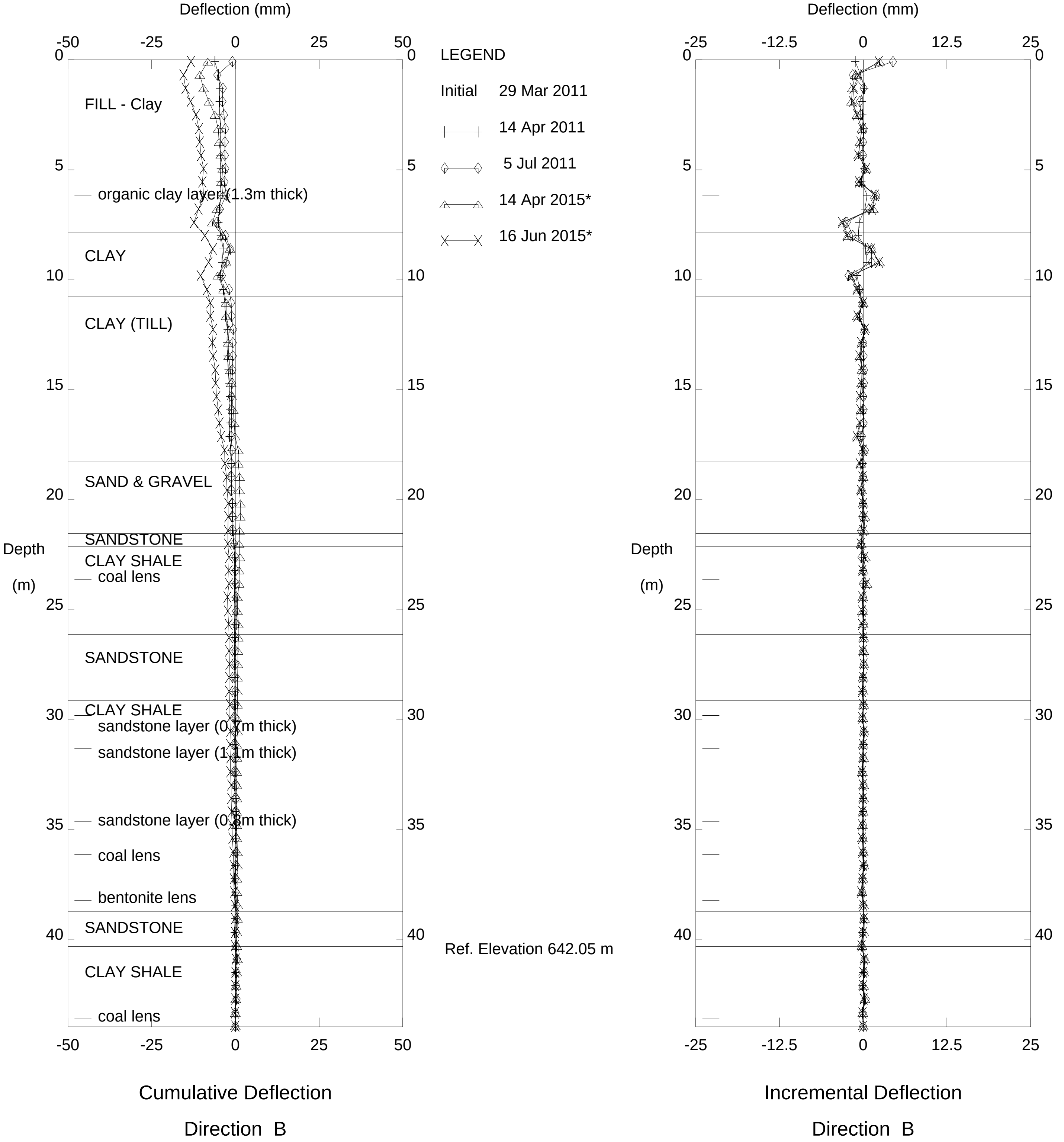
Thurber Engineering Ltd.



E12101348, Inclinometer SI6

Shaw Conference Centre

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

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THURBER

APPENDIX E

Slope Stability Figures

Mechanized River Valley Access
FIGURE E1: West Slope - Global

File Name: 19-5861-24-West Slope - Global.gsz
H:\19\5861-24 Mechanized River Valley Access Geo Inv\Calculations\SlopeW\WestSlope\
Date: 2015-11-12; 10:33:25 AM

Method: Morgenstern-Price

Name: Clay Fill
Unit Weight: 19 kN/m³
Cohesion: 2 kPa
Phi: 22 °

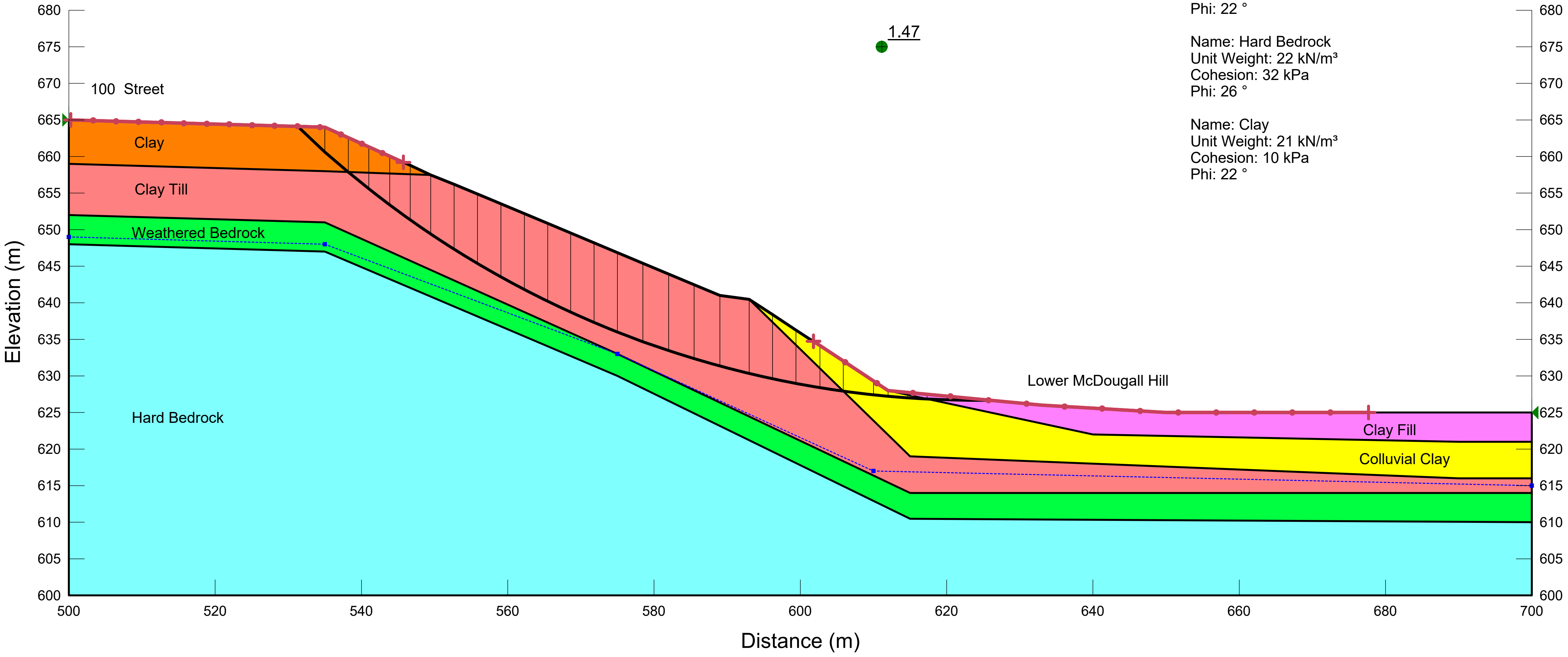
Name: Weathered Bedrock
Unit Weight: 22 kN/m³
Cohesion: 32 kPa
Phi: 24 °

Name: Clay Till
Unit Weight: 20 kN/m³
Cohesion: 12 kPa
Phi: 28 °

Name: Colluvial Clay
Unit Weight: 19 kN/m³
Cohesion: 3 kPa
Phi: 22 °

Name: Hard Bedrock
Unit Weight: 22 kN/m³
Cohesion: 32 kPa
Phi: 26 °

Name: Clay
Unit Weight: 21 kN/m³
Cohesion: 10 kPa
Phi: 22 °



Mechanized River Valley Access
FIGURE E2: West Slope - Upper

File Name: 19-5861-24-West Slope - Upper.gsz
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Cohesion: 2 kPa
Phi: 22 °

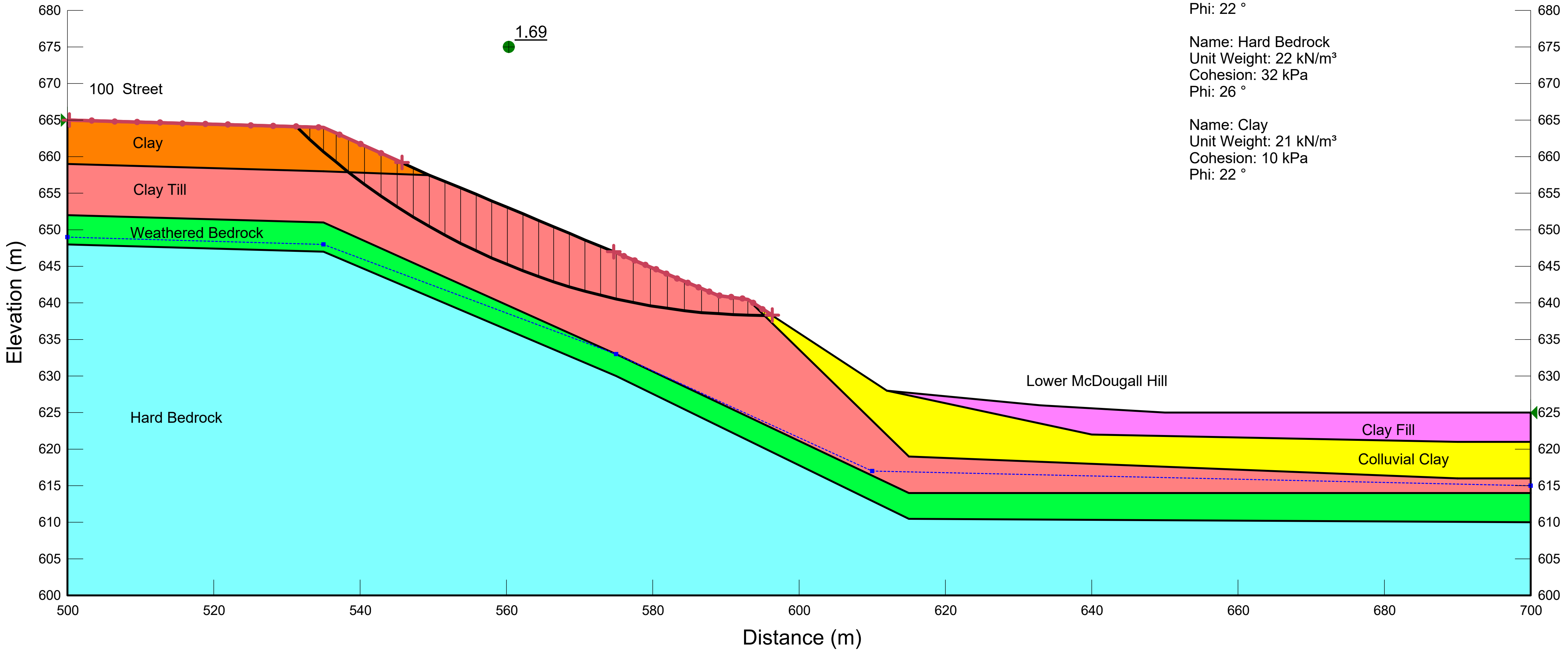
Name: Weathered Bedrock
Unit Weight: 22 kN/m³
Cohesion: 32 kPa
Phi: 24 °

Name: Clay Till
Unit Weight: 20 kN/m³
Cohesion: 12 kPa
Phi: 28 °

Name: Colluvial Clay
Unit Weight: 19 kN/m³
Cohesion: 3 kPa
Phi: 22 °

Name: Hard Bedrock
Unit Weight: 22 kN/m³
Cohesion: 32 kPa
Phi: 26 °

Name: Clay
Unit Weight: 21 kN/m³
Cohesion: 10 kPa
Phi: 22 °



Mechanized River Valley Access
FIGURE E3: West Slope - Lower

File Name: 19-5861-24-West Slope - Lower.gsz
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Date: 2015-11-12; 10:37:25 AM

Method: Morgenstern-Price

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Cohesion: 2 kPa
Phi: 22 °

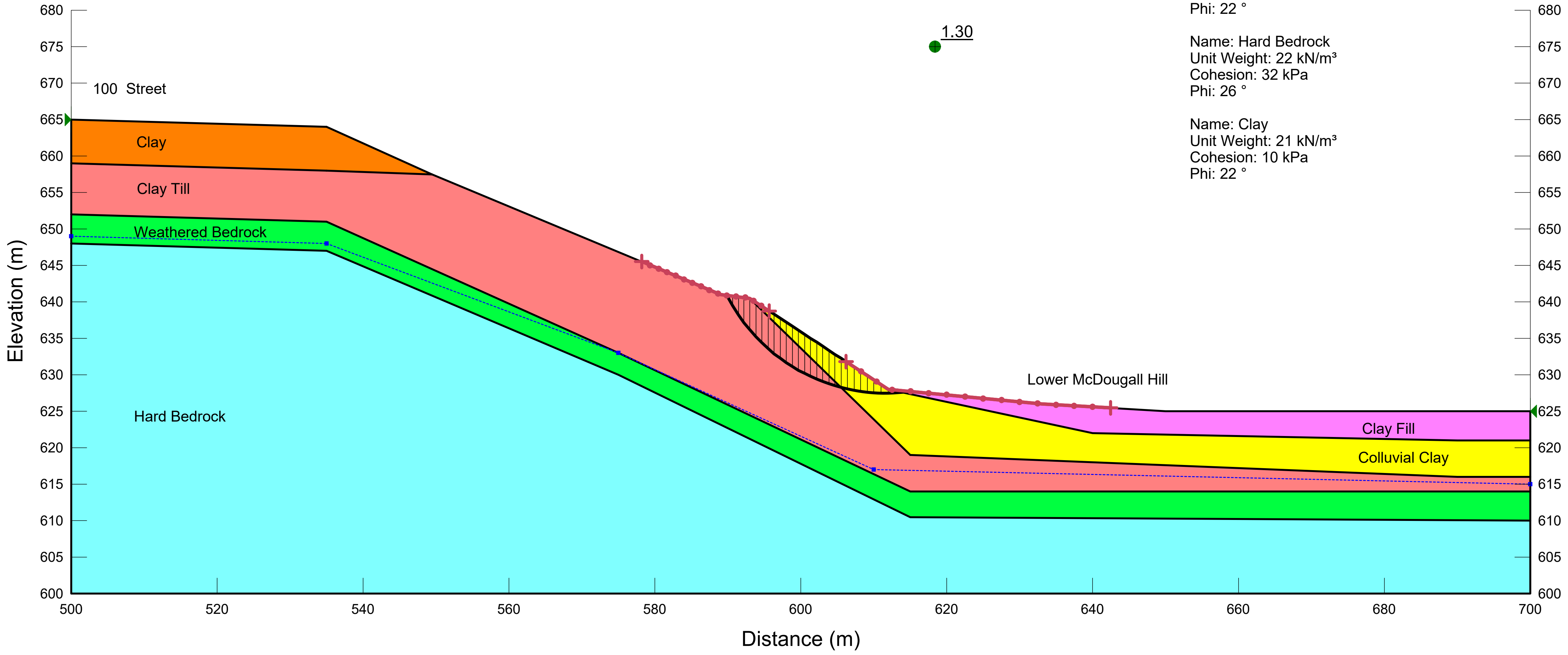
Name: Weathered Bedrock
Unit Weight: 22 kN/m³
Cohesion: 32 kPa
Phi: 24 °

Name: Clay Till
Unit Weight: 20 kN/m³
Cohesion: 12 kPa
Phi: 28 °

Name: Colluvial Clay
Unit Weight: 19 kN/m³
Cohesion: 3 kPa
Phi: 22 °

Name: Hard Bedrock
Unit Weight: 22 kN/m³
Cohesion: 32 kPa
Phi: 26 °

Name: Clay
Unit Weight: 21 kN/m³
Cohesion: 10 kPa
Phi: 22 °



Mechanized River Valley Access
FIGURE E4: East Slope - Global

File Name: 19-5861-24-East Slope - Global.gsz
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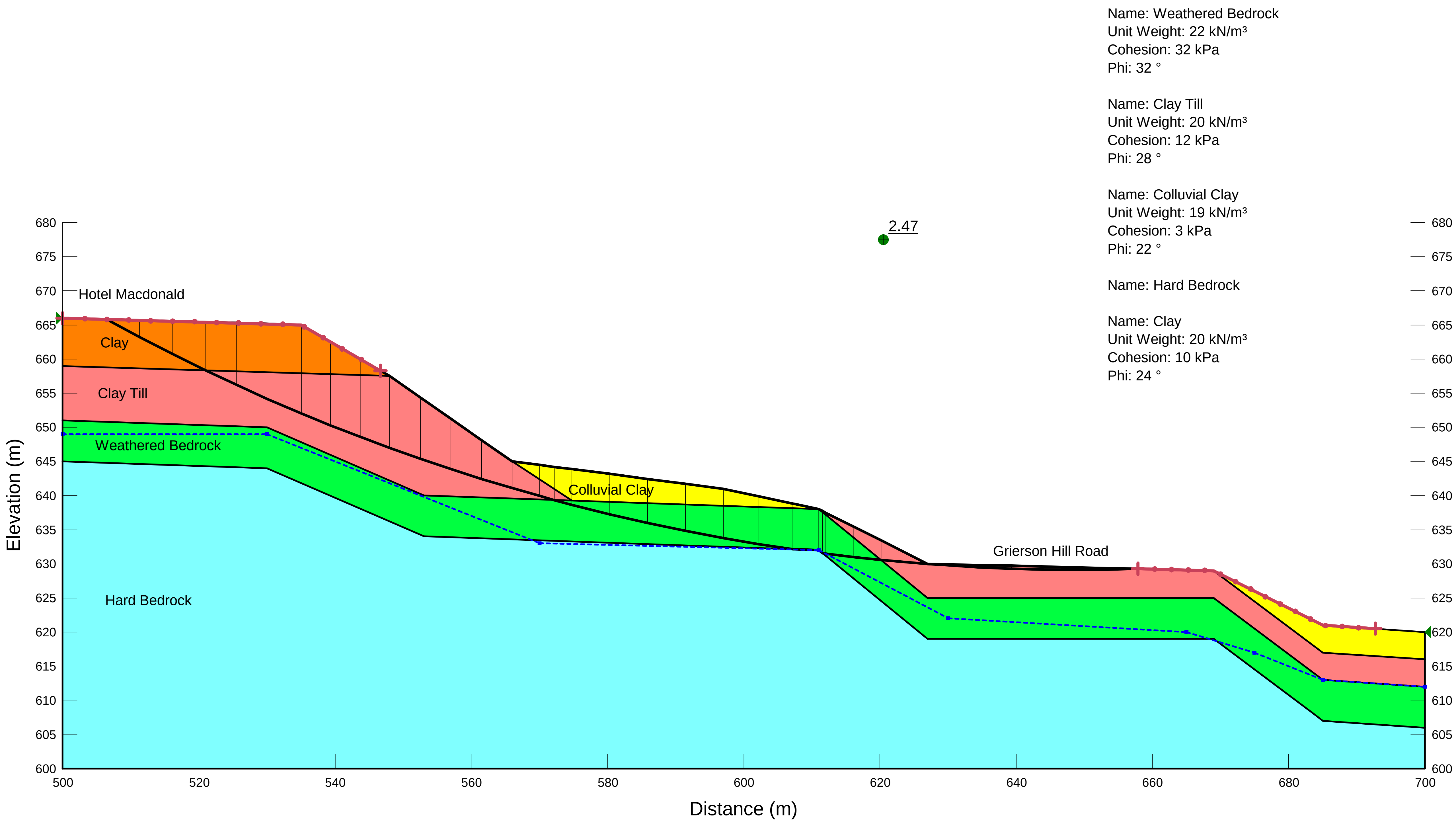
Date: 7/28/2015; 1:19:31 PM

Method: Morgenstern-Price



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Unit Weight: 22 kN/m³
Cohesion: 32 kPa
Phi: 32 °

Name: Clay Till
Unit Weight: 20 kN/m³
Cohesion: 12 kPa
Phi: 28 °

Name: Colluvial Clay
Unit Weight: 19 kN/m³
Cohesion: 3 kPa
Phi: 22 °

Name: Hard Bedrock

Name: Clay
Unit Weight: 20 kN/m³
Cohesion: 10 kPa
Phi: 24 °

Mechanized River Valley Access
FIGURE E5: East Slope - Upper

File Name: 19-5861-24-East Slope - Upper.gsz
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Date: 2015-11-12; 10:45:46 AM

Method: Morgenstern-Price

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Cohesion: 32 kPa
Phi: 24 °

Name: Clay Till
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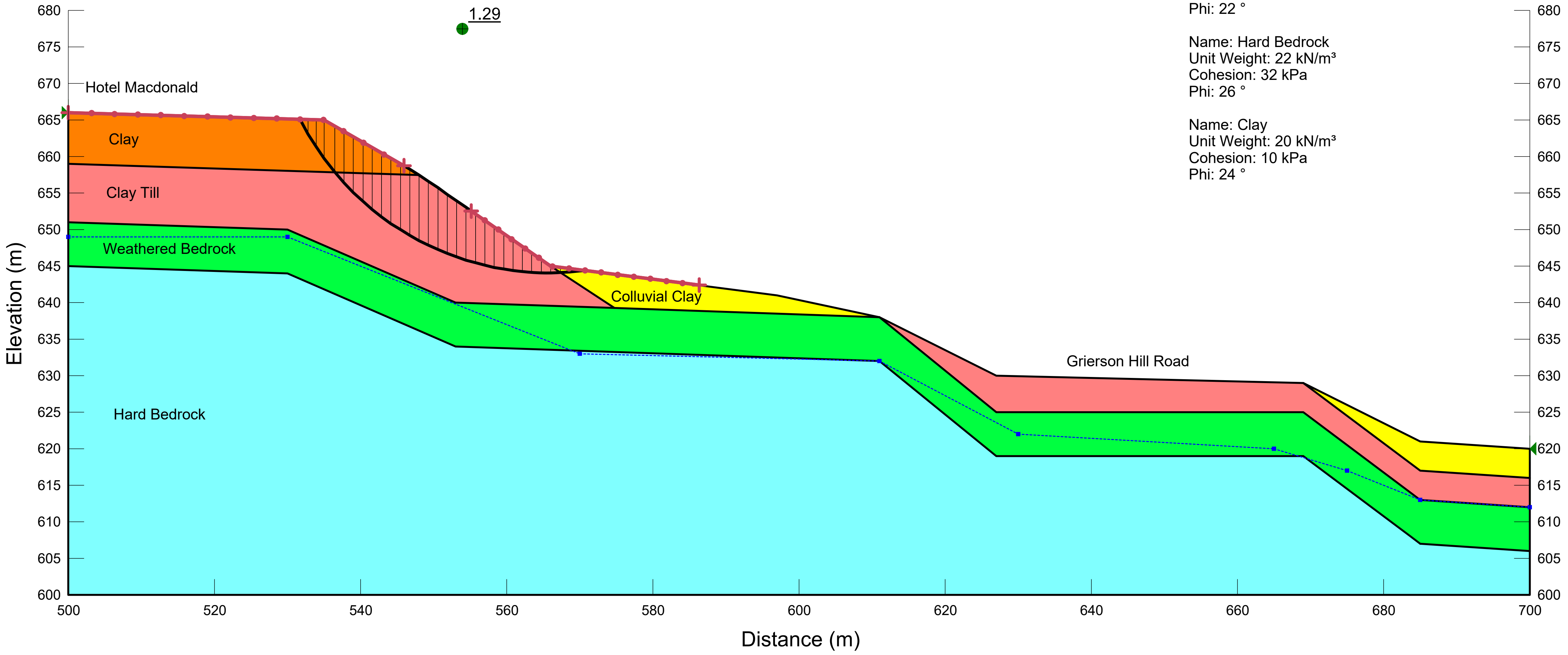
Cohesion: 12 kPa
Phi: 28 °

Name: Colluvial Clay
Unit Weight: 19 kN/m³
Cohesion: 3 kPa
Phi: 22 °

Name: Hard Bedrock
Unit Weight: 22 kN/m³
Cohesion: 32 kPa
Phi: 26 °

Name: Clay
Unit Weight: 20 kN/m³
Cohesion: 10 kPa
Phi: 24 °



Mechanized River Valley Access
FIGURE E6: East Slope - Mid

File Name: 19-5861-24-East Slope - Mid.gsz
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Method: Morgenstern-Price

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Phi: 24 °

Name: Clay Till
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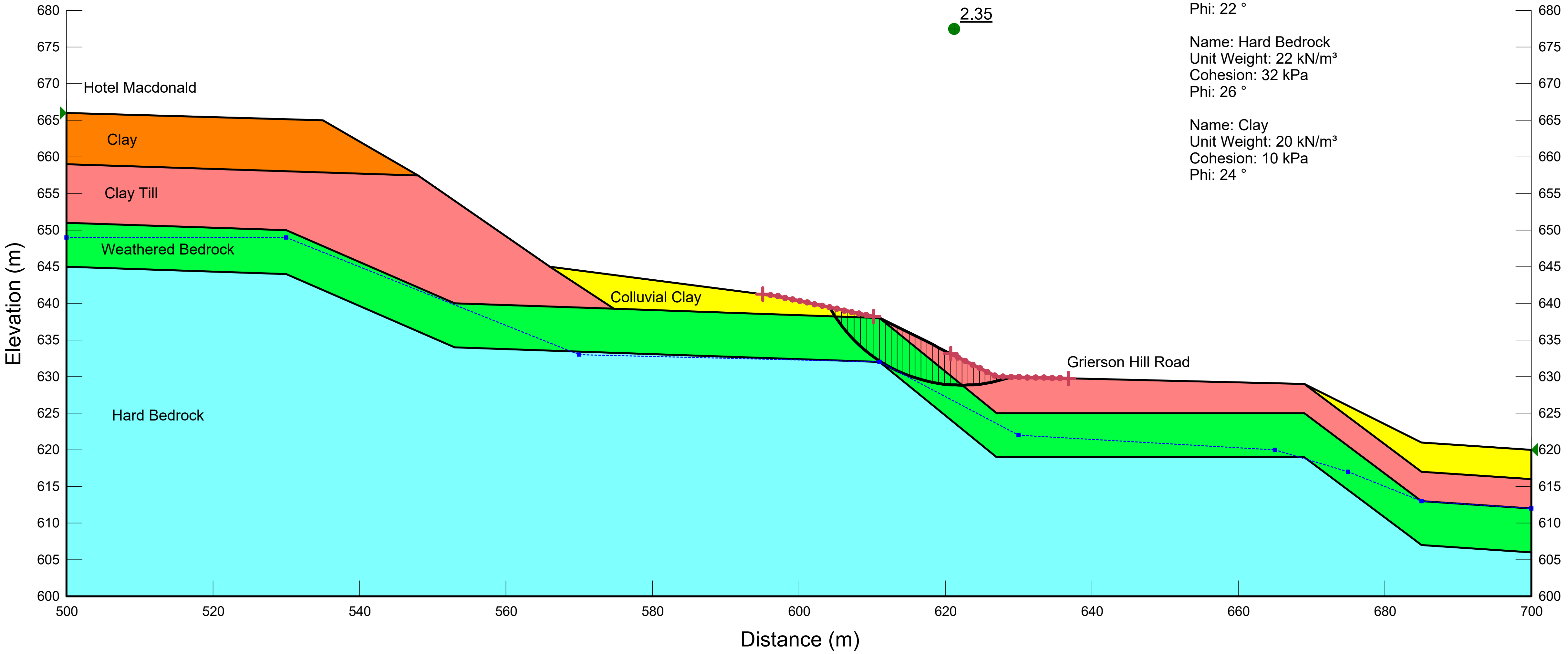
Cohesion: 12 kPa
Phi: 28 °

Name: Colluvial Clay
Unit Weight: 19 kN/m³
Cohesion: 3 kPa
Phi: 22 °

Name: Hard Bedrock
Unit Weight: 22 kN/m³
Cohesion: 32 kPa
Phi: 26 °

Name: Clay
Unit Weight: 20 kN/m³
Cohesion: 10 kPa
Phi: 24 °



Mechanized River Valley Access
FIGURE E7: East Slope - Lower

File Name: 19-5861-24-East Slope - Lower.gsz
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Date: 2015-11-12; 10:42:13 AM

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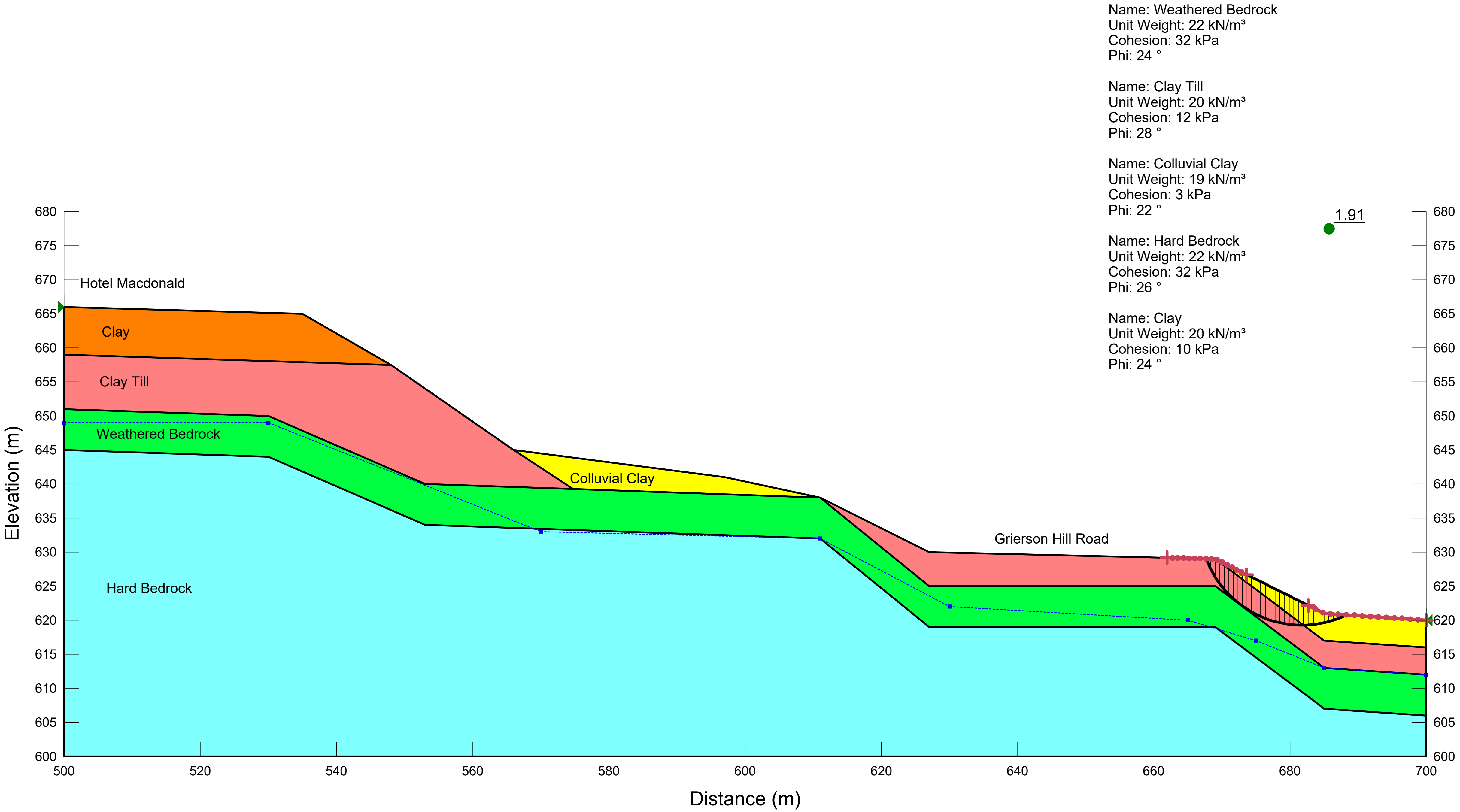
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Cohesion: 32 kPa
Phi: 24 °

Name: Clay Till
Unit Weight: 20 kN/m³
Cohesion: 12 kPa
Phi: 28 °

Name: Colluvial Clay
Unit Weight: 19 kN/m³
Cohesion: 3 kPa
Phi: 22 °

Name: Hard Bedrock
Unit Weight: 22 kN/m³
Cohesion: 32 kPa
Phi: 26 °

Name: Clay
Unit Weight: 20 kN/m³
Cohesion: 10 kPa
Phi: 24 °

Mechanized River Valley Access
FIGURE E8: East Slope With Cut - Global

File Name: 19-5861-24-East Slope Cut - Global.gsz
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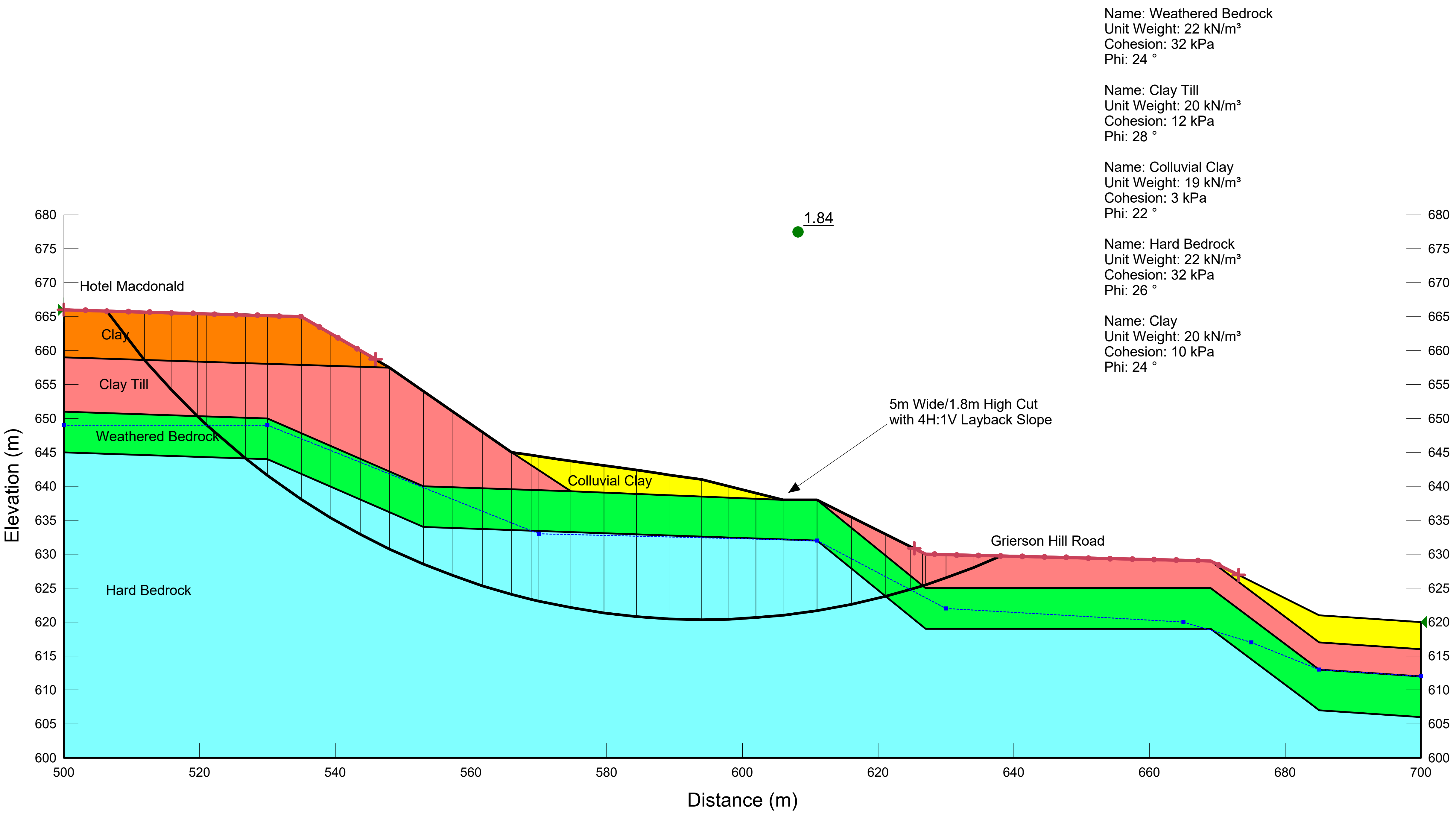

Name: Weathered Bedrock
Unit Weight: 22 kN/m³
Cohesion: 32 kPa
Phi: 24 °

Name: Clay Till
Unit Weight: 20 kN/m³
Cohesion: 12 kPa
Phi: 28 °

Name: Colluvial Clay
Unit Weight: 19 kN/m³
Cohesion: 3 kPa
Phi: 22 °

Name: Hard Bedrock
Unit Weight: 22 kN/m³
Cohesion: 32 kPa
Phi: 26 °

Name: Clay
Unit Weight: 20 kN/m³
Cohesion: 10 kPa
Phi: 24 °

APPENDIX F

Recommended Construction Procedures

RECOMMENDED CONSTRUCTION PROCEDURES

The following construction procedures are considered to represent good practice and are to be read in conjunction with the text of this report.

1. EXCAVATED FOUNDATIONS

1.1 Excavation close to foundation level should be done carefully to avoid disturbance of the soil. It is essential to prevent the soil at foundation level from deterioration due to excessive drying or becoming wet from surface or seepage water. Good drainage both during and after construction is essential.

1.2 Sumps, if required, should be located well away from the foundation area. Softened or overdried soil must be removed and replaced by lean mix concrete or by extending the foundations.

1.3 The foundation must be kept from freezing both during and after construction. Foundation concrete should not be placed on or against frozen soil.

2. BORED CAST-IN-PLACE CONCRETE PILES

2.1 If there is evidence of water bearing and/or sloughing soil, casing should be used to seal off the water or prevent the sloughing of the sides of the hole. The concrete and reinforcing steel should be on hand and placed as soon as the pile hole has been completed and approved.

2.2 Pile bells, if used, should be formed entirely in self-supporting soil and it may be necessary in some cases to extend the pile bell if caving occurs at the location of the bell.

2.3 Water should not be left ponded on the pile base and should be removed, or dried by the use of dry cement when permitted by the engineer.

2.4 Concrete should be placed without segregation and carefully vibrated throughout the full length of the pile to ensure that voids do not exist in the pile shaft. The concrete slump should be between 75 and 125 mm with a minimum compressive strength at 28 days of 21 MPa (3000 psi). Higher compressive strengths may be required for structural or durability reasons, and higher slumps may be necessary for closely spaced reinforcing bars or where concrete is to be tremied under water.

2.5 Steel reinforcing should be tied into the grade beam reinforcing steel. This recommendation is important where the soil below grade beam can swell from a change in moisture content or by frost action before the building is heated.

2.6 Piles closer than 2 1/2 diameters should not be drilled and poured consecutively unless permitted by the engineer and depending upon soil conditions. Where the drilling operation might affect the concrete in the adjacent pile, the drilling should not be carried out until the concrete has at least 24 hours to set, or before the concrete has reached its initial set.

THURBER ENGINEERING LTD.

December 16, 2015 File: 19-5861-24

Dialog
10237 – 104 Street, #100
Edmonton, Alberta
T5J 1B1

Attention: Mr. Sean Brown, P. Eng.

RIVER VALLEY MECHANIZED ACCESS PROJECT
EDMONTON, ALBERTA
RESPONSE TO CITY OF EDMONTON COMMENTS ON 2015 GEOTECHNICAL REPORT

Dear Mr. Brown,

This letter presents clarifications on the final geotechnical report prepared for this project by Thurber Engineering Ltd. (Thurber), dated November 12, 2015.

It is understood that the City of Edmonton (City) provided review comments on this report via a memorandum, dated December 3, 2015 (File No. 508.001). This letter provides responses to these comments and serves to address their noted concerns.

It is a condition of this letter that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

1. CITY OF EDMONTON COMMENTS

Review comments of Thurber's 2015 were provided by Dr. Paul Lach, P.Eng., the General Supervisor of Geotechnical Engineering, Engineering Services, Transportation Services for the City via email on November 23, 2015.

The general sentiment of these comments were that the City had concerns regarding the open-ended nature of the recommendations in the report, in particular how they relate to slope stability. At a minimum the City would request further assurances from the geotechnical engineer (Thurber) concerning their slope stability assessment and confirmation of an ongoing slope stability monitoring program. It was also requested that Thurber continue to work with Dialog in the development of all relevant aspects of the detailed design for this project. Given the context of this project along the river valley slopes, the City requires greater certainty around slope stability and the associated geotechnical risk.

2. GENERAL DISCUSSION OF INITIAL RECOMMENDATIONS

For clarification, the open-ended nature of Thurber's recommendations relating to the slope stability of the river valley slopes in the vicinity of the project area. Thurber's slope stability analysis presented in the report focused on two representative sections that featured the steepest terrain in the project area. These sections were called the East Slope and West Slope in the analyses. For clarification, the location of these sections are illustrated on the attached plan, Drawing No. 19-5861-24-1A, for the East and West Slopes, as Sections C-C' and D-D', respectively. At the time of the preparation of the geotechnical report the final alignment of the proposed structure was not fully defined. However, now the final alignment has been selected and the footprint of the currently proposed structures of the RVMA project is overlain on this provided drawing. The existing ground profiles at mentioned cross sections are also attached for your reference in Drawing No. 19-5861-24-2A.

The slope stability analyses showed that the river valley slopes can be considered to have a satisfactory Factor of Safety (FS) (FS greater than 1.5) based on the collected subsurface data. In addition, the slopes do not appear to be moving and showed no recent visual evidence of instability.

However, portions of the analyzed sections appeared to be moderately stable (FS of approximately 1.3). The two sections of concern are the lower slope of the West Slope (directly south of the funicular section) and the upper slope of the East Slope (directly north of the promenade section. Due to the analyzed moderate stability of these areas, Thurber wished to highlight the sensitivity of these slopes to construction and operational activities and recommended ongoing slope monitoring to ensure the stability of the slopes are not compromised by construction activities.

At the time of the publication of the report, the construction methods and foundation strategy were not completely defined leading to the open-ended nature of the geotechnical recommendations.

3. CLARIFICATION OF PROJECT DETAILS

Following the receipt of the City comments, Thurber (Dr. Renato Clementino, P.Eng. and Mr. Stephen Coulter, P.Eng.) participated in a project meeting with personnel from Dialog (Mr. Sean Brown, P.Eng., Mr. Juan Garay, P.Eng., Mr. Joe Stankevicius, P.Eng., and Ms. Jill Robertson), the owner's engineering consultant; Graham Construction (Mr. Samuel Johnson, P.Eng.), the project contractor; and the City of Edmonton (Mr. Henry Maisonneuve).

This meeting helped clarify the proposed foundation strategy for the elements of the project for the funicular and the promenade portions of the project. It is now understood that the footprint of the project has been finalized. Following review of the footprint for the project and the proposed placement of foundation elements, including possible concrete cast-in-place, micropile, and steel helical piles, Thurber is satisfied that no additional test holes exploring the subsurface stratigraphy will be required. The existing geotechnical test holes should provide adequate information for the design of geotechnical elements of the project as recommended in the report.

During the meeting, construction methodology was also presented and discussed by Dialog and Graham. Discussions of construction sequencing on the slopes for the funicular was clarified and Thurber is now satisfied that the construction methods should not significantly impact the overall slope stability.

Regarding the promenade, Thurber understands the construction of the promenade will require the construction of either a cut-back slope or retaining wall towards its eastern end on the terrace area of the slope. Construction sequencing and details for this retaining wall were also presented and discussed to Thurber's satisfaction that no negative impacts to slope stability will be created by this construction.

It is also planned to have Thurber remain fully engaged with Dialog and Graham throughout the design and construction process to ensure that construction activities will not adversely affect the identified moderately stable slopes.

The stability analyses carried out in our geotechnical report for the so called moderately stable slopes indicate that the critical failure surfaces are relatively shallow at these two relocations, and the proposed structure is located relatively far from these slopes, as shown in the attached cross sections. Thus, even in the event of a slump failure it is unlikely that the slide material will impact the proposed structure.

4. SLOPE MONITORING

To the end of ongoing geotechnical involvement, the final topic covered during this meeting was Thurber's recommendations to provide ongoing slope monitoring to provide further evaluation of slope conditions during construction and operation of the planned structures. In addition to the existing seven slope inclinometers (SIs) already installed, at the site (TH15-1, TH15-2, TH15-3, TH15-10, TH15-11, 11BH-01, and 11BH-06), Thurber proposed to Dialog and Graham the installation of three additional SI instruments to properly monitor the performance of the slopes in the direct vicinity of the project site; specially the two considered moderately stable with a FS=1.3.

The location of these three proposed SI instruments is shown on Drawing No. 19-5861-24-1, attached. TH16-1 is located on the terrace level at the crest of the lower slope along the West Slope section. TH16-2 is located on the terrace level at the toe of the upper slope along the East Slope section, and TH16-3 is located at the crest of the same slope. Periodic monitoring of these additional instruments along with the now existing instruments should provide a complete picture of the performance of the slopes during construction and operation of the proposed structures and satisfy Thurber's concerns regarding the moderately stable slopes. Dialog and Graham have agreed to this strategy and it is planned to install these instruments in early 2016.

It is planned to schedule monitoring event for these instruments once immediately preceding the start of construction and again at key times during the construction schedule (i.e. following crane assembly, foundation excavation, foundation construction, backfill, superstructure loading, etc.). Threshold slope movement tolerance levels will be developed for which in an event of an unlikely construction activity that may trigger a stop order where remedial slope stability measures must be addressed.

It should also be mentioned that the terrace level in the area of the east slope cross-section may also be utilized for the construction of a stability berm, if slope movements are observed in the upper slope north of the promenade. It is expected that there is sufficient relatively level ground in this area to allow for this possible stabilization measure, if required.

Following the completion of construction and commissioning of the project, periodic monitoring of the SI instruments during operation will be undertaken by the City.

5. CLOSURE

We trust this information meets with your needs at this time and addressed the City's outstanding comments and concerns. Please contact the undersigned should questions arise.

Yours very truly,
Thurber Engineering Ltd.
Renato Clementino, Ph.D., P. Eng.
Review Engineer

Stephen Coulter, P. Eng., P.E.
Project Engineer
/ell

Attachments
- Statement of Limitations and Conditions
- Drawing No. 19-5861-24-1A – Site Plan Showing Approximate Test Hole Locations
- Drawing No. 19-5861-34-2A – Representative Cross-Sections

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.

d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

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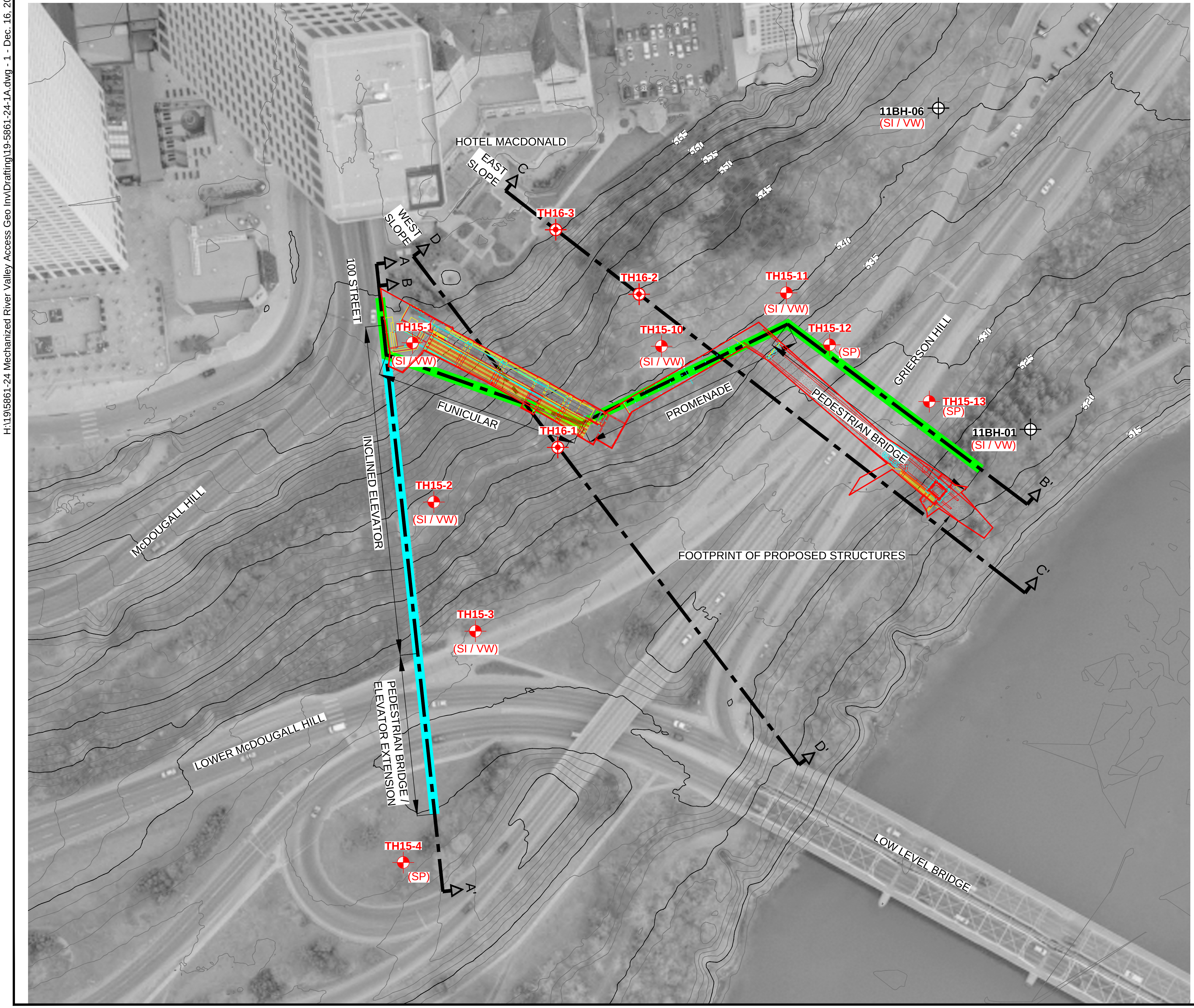

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LEGEND

⊕	TEST HOLE LOCATION (THURBER, 2015)
⊕	TEST HOLE LOCATION (AMEC, 2011)
⊕	PROPOSED SLOPE INCLINOMETER (THURBER, 2016)
(SI / VW)	SLOPE INCLINOMETER AND VIBRATING WIRE PIEZOMETER
(SP)	STANDPIPE PIEZOMETER
🟦	WEST ALIGNMENT
🟩	EAST ALIGNMENT

0 10 20 30 40 50 60 70 m

SCALE 1:1250

DIALOG

EDMONTON RIVER VALLEY MECHANIZED ACCESS GEOTECHNICAL INVESTIGATION

SITE PLAN SHOWING APPROXIMATE TEST HOLE LOCATIONS

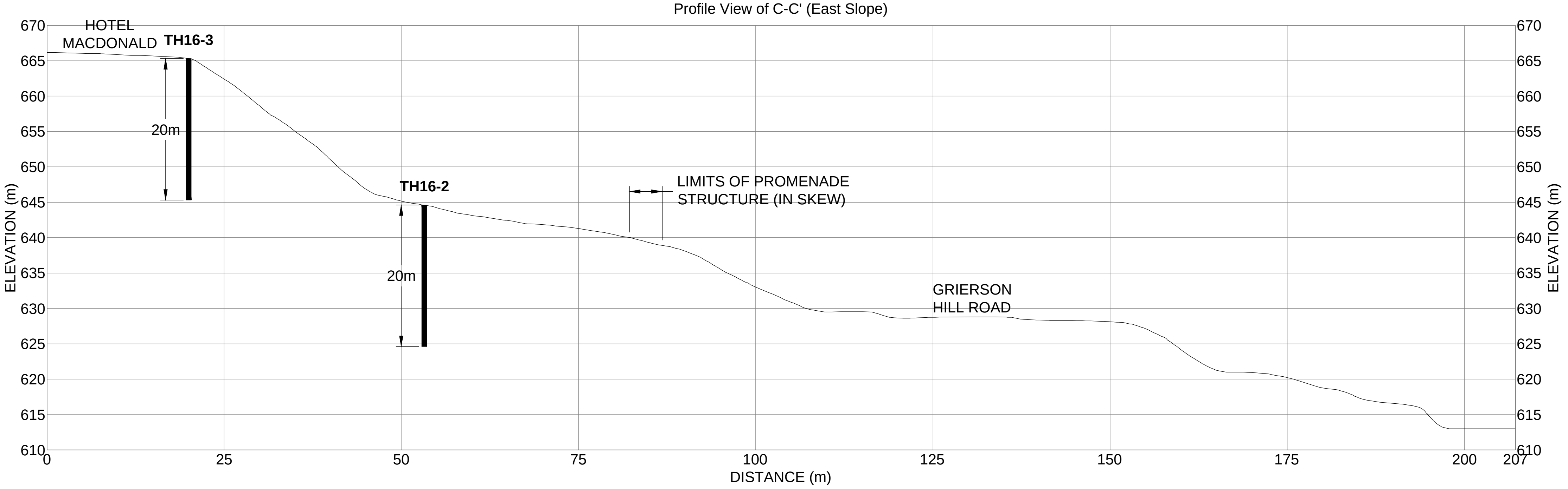
DWG No. 19-5861-24-1A

DRAWN BY	ML
DESIGNED BY	SEC
APPROVED BY	RVC
SCALE	1:1250
DATE	DECEMBER 2015
FILE No.	19-5861-24

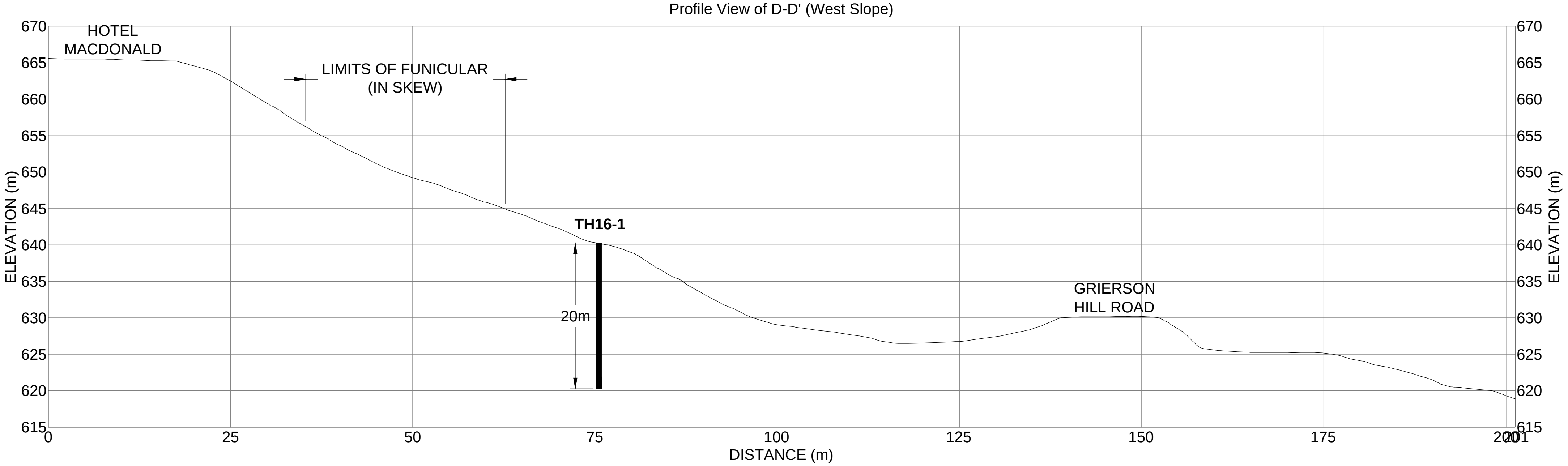
THURBER ENGINEERING LTD.

H:\19\5861-24 Mechanized River Valley Access Geo Inv\Drafting\19-5861-24-2A.dwg - Layout1 - Dec. 16, 2015

Profile View of C-C' (East Slope)



Profile View of D-D' (West Slope)



DIALOG™

EDMONTON RIVER VALLEY MECHANIZED ACCESS
GEOTECHNICAL INVESTIGATION

REPRESENTATIVE CROSS-SECTIONS

DWG No. 19-5861-24-2A

DRAWN BY	KLW
DESIGNED BY	SEC
APPROVED BY	RVC
SCALE	1:750
DATE	DECEMBER 2015
FILE No.	19-5861-24

THURBER ENGINEERING LTD.

Appendix D: Vegetation Survey Results (29 June 2015)

River Valley Mechanized Access Plant Species Inventory by Plant Community (29 June 2015)

Species				**Community**							
Scientific Name	**Common Name**	**ACIMS Rank**	**Origin**	**Aspen (A1)**	**White Spruce-Balsam Poplar (W3)**	**Tall Shrub (S2)**	**Grassland (G)**	**Manitoba Maple (MM)**	**Common Caragana (C)**	**Disturbed Roadside (D)**	**Manicured (M)**
Tree											
Acer negundo	Manitoba maple	SU	Exotic	F	F	O		D		O	F
Fraxinus sp.	ash	SNA	Exotic		O			O			
Picea glauca	white spruce	S5	Native		D		R	R			
Picea pungens	blue spruce	SNA	Exotic				O				F
Pinus banksiana	jack pine	S5	Native			R	O				O
Pinus contorta	lodgepole pine	S5	Native				O				O
Populus balsamifera	balsam poplar	S5	Native	F	A			F			
Populus tremuloides	aspen	S5	Native	D							
Ulmus americana	American elm	SNA	Exotic								R
Shrub											
Amelanchier alnifolia	saskatoon	S5	Native	F	F	A					
Caragana arborescens	common caragana	SNA	Exotic	O		A		F	D	A	F
Caragana pygmaea	pygmy caragana	SNA	Exotic			O				A	F
Cornus stolonifera	red-osier dogwood	S5	Native	A	A	F					
Corylus cornuta	beaked hazelnut	S5	Native	O		O					
Crataegus rotundifolia	Round-leaved hawthorn	S3	Native			R					
Dasiphora fruticosa	shrubby cinquefoil	SNA	Exotic				O			F	A
Elaeagnus commutata	silverberry	S5	Native			F					O
Lycium sp.	wolfberry	SNA	Exotic			D			O	O	
Prunus virginiana	choke cherry	S5	Native	F	O	D		O			
Rhamnus catharticus	common buckthorn	SNA	Prohibited Noxious	R	R	O		R			
Ribes sp.	blackberry	SNA	Exotic								A
Rosa acicularis	prickly rose	S5	Native	D	A	F	F	F		O	F
Salix interior	sandbar willow	S5	Native								
Sambucus racemosa	red elderberry	S4	Native	O	O	F		R			
Symphoricarpos occidentalis	buckbrush	S5	Native	F	A	O		O	R		
Toxicodendron radicans	poison ivy	S3	Native	O							
Forb											
Actaea rubra	red and white baneberry	S5	Native	O	O						
Apocynum androsaemifolium	spreading dogbane	S5	Native	O							
Aralia nudicaulis	wild sarsaparilla	S5	Native	A	A	O		O			
Arctium minus	common burdock	SNA	Noxious	F	O	A	O	A	F		
Artemisia absinthium	absinthe wormwood	SNA	Exotic			O	O		R		
Asparagus officinalis	asparagus	SNA	Exotic	R	R						
Campanula rapunculoides	creeping bellflower	SNA	Noxious		O			O			

Species				Community							
Scientific Name	**Common Name**	**ACIMS Rank**	**Origin**	**Aspen (A1)**	**White Spruce-Balsam Poplar (W3)**	**Tall Shrub (S2)**	**Grassland (G)**	**Manitoba Maple (MM)**	**Common Caragana (C)**	**Disturbed Roadside (D)**	**Manicured (M)**
Chamerion angustifolium	common fireweed	S5	Native	O	R						
Chenopodium album	lamb's-quarters	SNA	Exotic	O							
Chenopodium sp.	goosefoot					R			O		
Cirsium arvense	creeping thistle	SNA	Noxious	O	O	A	F	O	O	F	F
Echinocystis lobata	wild cucumber	SNA	Exotic		R						
Epilobium ciliatum	northern willowherb	S5	Native	R							
Erigeron philadelphicus	Philadelphia fleabane	S5	Native					R			
Erysimum cheiranthoides	wormseed mustard	S5	Native				R				
Galeopsis tetrahit	hemp-nettle	SNA	Exotic	R							
Galium boreale	northern bedstraw	S5	Native	F	F						
Galium trifidum	small bedstraw	S5	Native	R							
Galium triflorum	sweet-scented bedstraw	S5	Native	O	O						
Lactuca serriola	prickly lettuce	SNA	Exotic		R		O	F			
Lappula squarrosa	bluebur	SNA	Exotic	O	R	O	O	A	F		
Leucanthemum vulgare	ox-eye daisy	SNA	Noxious				R				
Lonicera involucrata	bracted honeysuckle	S5	Native	O	F						
Matricaria discoidea	pineappleweed	SNA	Exotic								F
Medicago sativa	alfalfa	SNA	Exotic	R			A			O	
Melilotus alba	white sweet-clover	SNA	Exotic							F	F
Melilotus officinale	yellow sweet-clover	SNA	Exotic	O						A	
Mertensia paniculata	tall lungwort	S5	Native	F	A			O	R		
Petasites frigidus var. *sagittatus*	arrow-leaved coltsfoot	S5	Native	R	O						
Plantago major	common plantain	SNA	Exotic							A	
Senecio vulgaris	common groundsel	SNA	Exotic	O							
Silene latifolia ssp. *alba*	white cockle	SNA	Noxious				O				
Smilacina stellata	star-flowered Solomon's-seal	S5	Native	F	F	O		R	R		
Sonchus arvensis ssp. *uliginosus*	perennial sow-thistle	SNA	Exotic	O							
Sonchus sp.	sow-thistle	SNA	Exotic	O			F	O			
Symphyotrichum ciliolatum	Lindley's aster	S5	Native	F							
Taraxacum officinale	common dandelion	SNA	Exotic	F	O	F	F	F		A	O
Tephroseris palustris	marsh ragwort	S5	Native	R							
Thlaspi arvense	stinkweed	SNA	Exotic	O			O				O
Tragopogon dubius	common goats-beard	SNA	Exotic	O			F				
Trifolium sp.	clover	SNA	Exotic				F				
Tripleurospermum inodorum	scentless chamomile	SNA	Noxious								O
Vicia americana	wild vetch	S5	Native	A	A	F	O	O			
Graminoid											
Bromus inermis	smooth brome	SNA	Exotic	A	A	A	D	A	O	A	F

Species				**Community**							
Scientific Name	**Common Name**	**ACIMS Rank**	**Origin**	**Aspen (A1)**	**White Spruce-Balsam Poplar (W3)**	**Tall Shrub (S2)**	**Grassland (G)**	**Manitoba Maple (MM)**	**Common Caragana (C)**	**Disturbed Roadside (D)**	**Manicured (M)**
Elymus repens	quackgrass	SNA	Exotic	O	O	O	A	F		F	F
Pascopyrum smithii	western wheatgrass	S5	Native				A				
Poa pratensis	Kentucky bluegrass	S5	Native	O	O	O	F	R		F	
Typha latifolia	common cattail	S5	Native	R							
Species Richness				**42**	**29**	**24**	**21**	**22**	**10**	**12**	**17**
Number of Native Species				**27**	**19**	**15**	**8**	**12**	**4**	**2**	**4**
Number of Exotic Species				**19**	**13**	**12**	**17**	**13**	**7**	**13**	**15**
Number of Noxious Weed Species				**3**	**4**	**3**	**4**	**4**	**2**	**1**	**2**

Appendix E: Wildlife Species List

Wildlife Species Potentially Found in the Study Area

Common Name	**Scientific Name**	**Provincial Status (General Status of AB Wild Species 2010)**	**Wildlife Act Designation and New Species Assessed by ESCC**	**COSEWIC Designation**	**SARA Designation**	**Recorded in Study Area**	**Likelihood of Occurrence**	**Potentail Habitat Use**
Canadian Toad	*Anaxyrus hemiophrys*	May Be At Risk	Data Deficient	Not at Risk / HP Candidate (SSC)		FWIMT (historical	Low	Foraging, overwintering
Wood Frog	*Lithobates sylvaticus*	Secure		LP Candidate (SSC)				
Common Garter Snake	*Thamnophis sirtalis*	Sensitive	LP Candidate	LP Candidate (SSC)			Moderate	Breeding, foraging, overwintering
Ruffed Grouse	*Bonasa umbellus*	Secure						
Bald Eagle	*Haliaeetus leucocephalus*	Sensitive		Not at Risk			Moderate	Breeding, foraging
Sharp-shinned Hawk	*Accipiter striatus*	Secure		Not at Risk				
Cooper's Hawk	*Accipiter cooperii*	Secure		Not at Risk				
Swainson's Hawk	*Buteo swainsoni*	Sensitive					Moderate	Breeding, fForaging
Red-tailed Hawk	*Buteo jamaicensis*	Secure		Not at Risk				
Merlin	*Falco columbarius*	Secure		Not at Risk				
Peregrine Falcon	*Falco peregrinus anatum*	At Risk	Threatened	Special Concern	Schedule 1 (Special Concern)	FWIMT	High	Foraging
Rock Pigeon	*Columba livia*	Exotic/Alien				BBS, Spencer 2012b		
Great Horned Owl	*Bubo virginianus*	Secure						
Northern Saw-whet Owl	*Aegolius acadicus*	Secure						
Common Nighthawk	*Chordeiles minor*	Sensitive		Threatened	Schedule 1 (Threatened		Low	Foraging
Ruby-throated Hummingbird	*Archilochus colubris*	Secure						
Belted Kingfisher	*Megaceryle alcyon*	Secure						
Yellow-bellied Sapsucker	*Sphyrapicus varius*	Secure						
Downy Woodpecker	*Picoides pubescens*	Secure						
Hairy Woodpecker	*Picoides villosus*	Secure						
Northern Flicker	*Colaptes auratus*	Secure						
Pileated Woodpecker	*Dryocopus pileatus*	Sensitive					Moderate	Breeding, foraging
Western Wood-pewee	*Contopus sordidulus*	Sensitive					Moderate	Breeding, foraging
Least Flycatcher	*Empidonax minimus*	Sensitive		LP Candidate (SSC)			High	Breeding, foraging
Eastern Phoebe	*Sayornis phoebe*	Sensitive					Moderate	Breeding, foraging
Say's Phoebe	*Sayornis saya*	Secure						
Northern Shrike	*Lanius excubitor*	Secure						
Blue-headed Vireo	*Vireo solitarius*	Secure						
Warbling Vireo	*Vireo gilvus*	Secure						
Philadelphia Vireo	*Vireo philadelphicus*	Secure						

Wildlife Species Potentially Found in the Study Area

Common Name	Scientific Name	Provincial Status (General Status of AB Wild Species 2010)	Wildlife Act Designation and New Species Assessed by ESCC	COSEWIC Designation	SARA Designation	Recorded in Study Area	Likelihood of Occurrence	Potentail Habitat Use
Red-eyed Vireo	*Vireo olivaceus*	Secure				BBS, Spencer 2012b		
Blue Jay	*Cyanocitta cristata*	Secure				BBS		
Black-billed Magpie	*Pica hudsonia*	Secure				BBS, Spencer 2012b		
American Crow	*Corvus brachyrhynchos*	Secure				Spencer 2012b		
Common Raven	*Corvus corax*	Secure						
Tree Swallow	*Tachycineta bicolor*	Secure						
Black-capped Chickadee	*Poecile atricapillus*	Secure				Spencer 2012b		
Red-breasted Nuthatch	*Sitta canadensis*	Secure						
White-breasted Nuthatch	*Sitta carolinensis*	Secure				Spencer 2012b		
House Wren	*Troglodytes aedon*	Secure						
American Robin	*Turdus migratorius*	Secure				BBS, Spencer 2012b		
Gray Catbird	*Dumetella carolinensis*	Secure				BBS, Spencer 2012b		
European Starling	*Sturnus vulgaris*	Exotic/Alien						
Bohemian Waxwing	*Bombycilla garrulus*	Secure						
Cedar Waxwing	*Bombycilla cedrorum*	Secure				BBS		
Tennessee Warbler	*Oreothlypis peregrina*	Secure						
Orange-crowned Warbler	*Oreothlypis celata*	Secure						
Yellow Warbler	*Setophaga petechia*	Secure				BBS, Spencer 2012b		
Chestnut-sided Warbler	*Setophaga pensylvanica*	Secure						
Magnolia Warbler	*Setophaga magnolia*	Secure						
Cape May Warbler	*Setophaga tigrina*	Sensitive	In Process				Low	Migration
Yellow-rumped Warbler	*Setophaga coronata*	Secure						
Black-Throated Green Warbl	*Setophaga virens*	Sensitive	Special Concern				Low	Migration
Blackburnian Warbler	*Setophaga fusca*	Sensitive					Low	Migration
Palm Warbler	*Setophaga palmarum*	Secure						
Bay-breasted Warbler	*Setophaga castanea*	Sensitive	In Process				Low	Migration
Blackpoll Warbler	*Setophaga striata*	Secure						
Black-and-white Warbler	*Mniotilta varia*	Secure						
American Redstart	*Setophaga ruticilla*	Secure						
Ovenbird	*Seiurus aurocapilla*	Secure						
Northern Waterthrush	*Parkesia noveboracensis*	Secure						
Mourning Warbler	*Geothlypis philadelphia*	Secure						
Wilson's Warbler	*Cardellina pusilla*	Secure						
Canada Warbler	*Cardellina canadensis*	Sensitive		Threatened	Schedule 1 (Threatened		Low	Migration
Western Tanager	*Piranga ludoviciana*	Sensitive					Moderate	Breeding, foraging

Wildlife Species Potentially Found in the Study Area

Common Name	Scientific Name	Provincial Status (General Status of AB Wild Species 2010)	Wildlife Act Designation and New Species Assessed by ESCC	COSEWIC Designation	SARA Designation	Recorded in Study Area	Likelihood of Occurrence	Potentail Habitat Use
American Tree Sparrow	*Spizella arborea*	Secure						
Chipping Sparrow	*Spizella passerina*	Secure						
Clay-colored Sparrow	*Spizella pallida*	Secure				BBS, Spencer 2012b		
Savannah Sparrow	*Passerculus sandwichensis*	Secure						
Song Sparrow	*Melospiza melodia*	Secure				Spencer 2012b		
White-throated Sparrow	*Zonotrichia albicollis*	Secure						
White-crowned Sparrow	*Zonotrichia leucophrys*	Secure						
Dark-eyed Junco	*Junco hyemalis*	Secure				BBS		
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Secure						
Brewer's Blackbird	*Euphagus cyanocephalus*	Secure						
Common Grackle	*Quiscalus quiscula*	Secure						
Brown-headed Cowbird	*Molothrus ater*	Secure						
Baltimore Oriole	*Icterus galbula*	Sensitive					Moderate	Breeding, foraging
Purple Finch	*Carpodacus purpureus*	Secure						
House Finch	*Carpodacus mexicanus*	Secure				BBS		
Common Redpoll	*Acanthis flammea*	Secure						
Hoary Redpoll	*Acanthis hornemanni*	Secure						
Pine Siskin	*Spinus pinus*	Secure						
American Goldfinch	*Spinus tristis*	Secure				BBS		
Evening Grosbeak	*Coccothraustes vespertinus*	Secure						
House Sparrow	*Passer domesticus*	Exotic/Alien				BBS		
Masked Shrew	*Sorex cinereus*	Secure						
Pygmy Shrew	*Sorex hoyi*	Secure						
Little Brown Bat	*Myotis lucifugus*	Secure		Endangered	Schedule 1 (Endangere		Moderate	Breeding, foraging
Northern Bat	*Myotis septentrionalis*	May Be At Risk	Data Deficient	Endangered	Schedule 1 (Endangere		Moderate	Breeding, foraging
Silver-haired Bat	*Lasionycteris noctivagans*	Sensitive					Moderate	Breeding, foraging
Big Brown Bat	*Eptesicus fuscus*	Secure						
Hoary Bat	*Lasiurus cinereus*	Sensitive					Moderate	Breeding, foraging
Snowshoe Hare	*Lepus americanus*	Secure						
White-tailed Jack Rabbit	*Lepus townsendii*	Secure						
Least Chipmunk	*Tamias minimus*	Secure						
Red Squirrel	*Tamiasciurus hudsonicus*	Secure						
Northern Flying Squirrel	*Glaucomys sabrinus*	Secure						
American Beaver	*Castor canadensis*	Secure						

Wildlife Species Potentially Found in the Study Area

Common Name	**Scientific Name**	**Provincial Status (General Status of AB Wild Species 2010)**	**Wildlife Act Designation and New Species Assessed by ESCC**	**COSEWIC Designation**	**SARA Designation**	**Recorded in Study Area**	**Likelihood of Occurrence**	**Potentail Habitat Use**
Deer Mouse	*Peromyscus maniculatus*	Secure						
Southern Red-backed Vole	*Clethrionomys gapperi*	Secure						
Meadow Vole	*Microtus pennsylvanicus*	Secure						
House Mouse	*Mus musculus*	Exotic/Alien						
Meadow Jumping Mouse	*Zapus hudsonius*	Secure						
Western Jumping Mouse	*Zapus princeps*	Secure						
Common Porcupine	*Erethizon dorsatum*	Secure						
Coyote	*Canis latrans*	Secure						
Red Fox	*Vulpes vulpes*	Secure						
Ermine	*Mustela erminea*	Secure						
Least Weasel	*Mustela nivalis*	Secure						
Mink	*Neovison vison*	Secure						
Striped Skunk	*Mephitis mephitis*	Secure						
Mountain Lion/Cougar	*Puma concolor*	Secure				FWIMT		
Moose	*Alces alces*	Secure						
Mule Deer	*Odocoileus hemionus*	Secure						
White-tailed Deer	*Odocoileus virginianus*	Secure						

Appendix F: Historical Resources

Historic Resources Application

Activity Administration

Date Received: January 16, 2015 HRA Number: 4725-15-0002-001

Project Category: Recreation and Tourism (4725)

Application Purpose:	☑	Requesting HRA Approval / Requirements
Lands Affected	☑	All New Lands

Project Type:	☑	Trail	ESRI Shapefiles are attached (yes/no)	yes
	☑	Other Recreational Development	Approximate Project Area (ha)	1.34 ha
			Other Reference Number	ACCS file #4715-13-0013

Project Name:	North Saskatchewan River Valley Mechanized Access
Additional Name(s):	

Key Contact:	Mr. Gareth Spicer	Affiliation:	Turtle Island Cultural Resource Management
Address:	5 Creston Crescent NW	City / Province:	Calgary, AB
Postal Code:	T2M 4J9	Phone:	(403) 620-9032
E-mail:	gareth@turtleislandcrm.com	Fax:	(403) 450-9267
		Your File Number:	

Proponent:	City of Edmonton - Sustainable Developement	Contact Name:	Robert Marchak
Address:	6th Floor 10250 101 Street	City / Province:	Edmonton, AB
Postal Code:	T5J 3P4	Phone:	(780) 496-1377
E-mail:	rob.marchak@edmonton.ca	Fax:	() -

Proposed Development Area					Land Ownership			
MER	RGE	TWP	SEC	LSD List	FRH	SA	CU	CT
4	24	52	33	13	☐	☐	☐	☑
4	24	52	29	15	☐	☐	☐	☑
4	24	52	32	2	☐	☐	☐	☑

Historical Resources Impact Assessment:

For archaeological resources:

Has a HRIA been conducted? ☐ Yes ☑ No Permit Number (if applicable):

For palaeontological resource:

Has a HRIA been conducted? ☐ Yes ☑ No Permit Number (if applicable):

Pursuant to Section 37(2) of the *Historical Resources Act*, a Historic Resources Impact Assessment (HRIA) report is required for all or portions of those activities described on this application and its attached plan(s)/sketch(es). The HRIA is to be prepared in accordance with the instructions outlined in the attached Schedule.

David Link

January 29, 2015

Date

Culture and Tourism

OPaC: 006371994

HISTORICAL RESOURCES ACT REQUIREMENTS

CITY OF EDMONTON - SUSTAINABLE DEVELOPMENT NORTH SASKATCHEWAN RIVER VALLEY MECHANIZED ACCESS TRAIL, OTHER RECREATIONAL DEVELOPMENT

HRA REQUIREMENTS PROJECT FILE: 4725-15-0002-001

(Schedule "A")

For the purposes of this Schedule City of Edmonton - Sustainable Development shall be referred to as the "Proponent" and North Saskatchewan River Valley Mechanized Access shall be referred to as the "Project".

1.0 ARCHAEOLOGICAL RESOURCES

The potential for the Project to affect archaeological resources is high.

1.1 Historic Resources Impact Assessment

Pursuant to Section 37(2) of the *Historical Resources Act* a Historic Resources Impact Assessment (HRIA) for archaeological resources and any work resulting from this assessment is to be conducted on behalf of the Proponent by an archaeologist qualified to hold an Archaeological Research Permit within the Province of Alberta. The HRIA is to include a monitoring program as outlined below. In order to conduct the HRIA, the archaeological consultant must submit "An Application for an Archaeological Research Permit - Mitigative Research Project" to the Historic Resources Management Branch, Heritage Division, Alberta Culture and Tourism. Please allow ten working days for the permit to be processed. An approved permit must be issued prior to the initiation of any archaeological field investigations.

1.1.1 Alberta Regulation 254/2002

Archaeological investigations conducted under permit in Alberta are subject to the conditions stated within Alberta Regulation 254/2002, Archaeological and Palaeontological Research Permit Regulation, conditions set forth in the approved permit, and any other conditions that the Minister imposes under Section 30 of the Historical Resources Act.

1.1.2 Contacting the Archaeological Survey

For further information regarding the acquisition of a Permit to Excavate Archaeological Resources and/or archaeological consultants obligations under Alberta Regulation 254/2002, please contact Martina Purdon, Head, Archaeological Information &

Regulatory Approvals at 780-431-2331 (toll-free 310-0000) or martina.purdon@gov.ab.ca

1.1.3 Coverage

Initially, archaeological monitoring is required in tandem with preliminary design and construction work. As high potential floodplain deposits are identified, targeted deep testing is to be undertaken. This may require the removal of overburden in order to reach deeper deposits and is to be synchronized with development activities and opportunities. Once specific design plans are available, more specific studies may be required.

1.1.4 Timing

The HRIA is to be carried out prior to the initiation of any land surface disturbance activities under snow-free, unfrozen ground conditions. For the monitoring portions of the project, no excavations are to occur until an archaeological consultant is present. Should the Project require field studies under winter conditions, directions in the Archaeological Survey, *Survey Notes and Instructions: Information Bulletin Regarding Winter HRIA Work* must be followed.

1.1.5 Deep Testing

A deep testing program is required for intact sediments that will be disturbed by construction activities this is to occur following removal of disturbed overburden.

1.1.6 Assessing Historic Structures:

If historic structures are encountered during the HRIA that will be impacted by the Project, then the directions included in the *Requirements for recording and reporting historic structures within the context of archaeological HRIAs* will apply. The final report, and any interim reports, must address when historic structures are present in or immediately adjacent to the Project impact zone.

1.1.7 Location of HRIA studies

Within the final report and any interim report(s) the location of pedestrian surveys, deep testing program(s), monitoring programs and the location and number of shovel tests must be discussed and clearly illustrated.

1.2 Reporting the results of archaeological resources HRIA

1.2.1 Submission of “Archaeological Site Inventory Data” forms

The Proponent’s archaeological consultant is required to submit “Archaeological Site Inventory Data” forms for each prehistoric and historic archaeological site recorded or re-examined during the conduct of the HRIA. While the discovery of a site must be reported within 30 days following the date of discovery, site data forms are to be submitted within 30 days of the date on which the permit period ends, or at the same time or prior to the submission of any interim report or the final report, whichever comes first.

1.2.2 Submission of HRIA final report

The final report must be submitted within 180 days after the expiration of the permit, or at least six weeks prior to the anticipated conduct of land surface disturbance activities, whichever comes first. Copies of the final report and any interim reports are to be submitted to the Historic Resources Management Branch, Heritage Division, Alberta Culture and Tourism, Old St. Stephen's College, 8820 – 112 Street, Edmonton, Alberta, T6G 2P8.

1.2.3 Submission of interim report(s)

Should the Proponent find it necessary to obtain *Historical Resources Act* approval for portions or all of the lands affected by the Project prior to the submission of the final report, Alberta Culture and Tourism will consider accepting the submission of an interim report, or reports.

2.0 PALAEONTOLOGICAL RESOURCES

The potential for this Project to affect palaeontological resources is high.

2.1 Historic Resources Impact Assessment

Pursuant to Section 37(2) of the *Historical Resources Act* a Historic Resources Impact Assessment (HRIA) for palaeontological resources and any work resulting from this assessment is to be conducted on behalf of the Proponent by a palaeontologist qualified to hold a "Permit to Excavate Palaeontological Resources (Mitigative)" within the Province of Alberta. The HRIA is to consist of a monitoring program. In order to conduct the HRIA, the palaeontological consultant must submit "An Application for Permit to Excavate Palaeontological Resources (Mitigative)" to the Royal Tyrrell Museum of Palaeontology. Please allow ten working days for the permit to be processed. An approved permit must be issued prior to the initiation of any palaeontological field investigations.

2.1.1 Alberta Regulation 254/2002

Palaeontological investigations conducted under permit in Alberta are subject to the conditions stated within Alberta Regulation 254/2002, *Archaeological and Palaeontological Research Permit Regulation*, conditions set forth in the approved permit, and any other conditions that the Minister imposes under Section 30 of the *Historical Resources Act*.

2.1.2 Contacting the Royal Tyrrell Museum of Palaeontology

For further information regarding the acquisition of a "Permit to Excavate Palaeontological Resources", the conduct of the required palaeontological resource HRIA and/or palaeontological consultants obligations under Alberta Regulation 254/2002, please contact Dan Spivak, Head, Resource Management, Royal Tyrrell

Museum of Palaeontology at 403-820-6210 (toll-free 310-0000) or dan.spivak@gov.ab.ca

2.1.3 Coverage

The monitoring program is to include all excavations associated with bridge foundations as well as a palaeontological evaluation of the deep test pits that have been required for the archaeological HRIA. Additional monitoring may be required, based on the results of these studies or for excavations that could impact undisturbed Holocene sediments in tandem with preliminary design and construction work such as:

Hydrovac/Geotechnical: For work requiring excavations below the depth of contemporary/historic overburden, overburden stripping followed by monitoring of intact flood plain deposits.

Multi-use Pathway Modifications: For work requiring excavations below the depth of contemporary/historic overburden, overburden stripping followed by deep testing of intact flood plain deposits.

Shallow Utilities: For work requiring ***new*** excavations below the depth of contemporary/historic overburden, overburden stripping followed by deep testing of intact flood plain deposits.

Landscape and Public Space Modifications: For work requiring excavations below the depth of contemporary/historic overburden, overburden stripping followed by deep testing of intact flood plain deposits.

During construction of the stairways on the valley walls, and during excavation of the pedestrian bridge foundations, there is high probability that early Holocene river terraces and Cretaceous aged Horseshoe Canyon Formation will be impacted. As such, palaeontological monitoring may be necessary during excavation in these locations.

The consultant is to discuss the monitoring program with staff of the Royal Tyrrell Museum of Palaeontology prior to initiation of the project to ensure that all areas of concern have been clearly identified.

Should significant palaeontological resources be encountered during the conduct of the monitoring program the Royal Tyrrell Museum of Palaeontology must be contacted. It may then be necessary for Alberta Culture and Tourism to issue further instructions regarding these resources.

2.1.4 Timing

No excavation activities are to take place on the Project until a professional palaeontological consultant is on-site to monitor the archaeological deep testing activities.

2.2 Reporting the results of the palaeontological resources HRIA

2.2.1 Submission of specimen data sheets

The Proponent's palaeontological consultant is required to submit "Palaeontological Specimen Data Sheets" for each fossil collected during mitigative studies.

2.2.2 Submission of HRIA final report for palaeontological resources

Upon completion of the monitoring program a digital copy of the final report must be submitted to the Historic Resources Management Branch, Heritage Division, Alberta Culture and Tourism using the Online Permitting and Clearance (OPaC) system.

2.2.3 Submission of interim report(s) for palaeontological resources

Should the Proponent require the granting of *Historical Resources Act* approval for any of the segments described in Condition 2.1.3 *Coverage* prior to the 180 days, it may be necessary for the Proponent's palaeontological consultant to submit an interim report, or reports.

3.0 REPORTING THE DISCOVERY OF HISTORIC RESOURCES

During the conduct of historic resources studies a consultant may encounter historic resources that are not the subject of their field of expertise. Under this circumstance, the consultant must follow instructions included in Attachment 1, *Standard Requirements under the Historical Resources Act, Reporting the Discovery of Historic Resources.*

The Proponent must also comply with standard conditions under the *Historical Resources Act*, which are applicable to all land surface disturbance activities in the Province. Standard conditions require applicants to report the discovery of historic resources. These requirements are stated in Attachment 1- *Standard Requirements under the Historical Resources Act, Reporting the Discovery of Historic Resources*.

4.0 FURTHER SALVAGE, PRESERVATIVE OR PROTECTIVE MEASURES

Based upon the results of the HRIA(s), reporting the discovery of archaeological resources, palaeontological resources, historic period sites and/or Aboriginal Traditional Use Site(s) of a type described in Attachment 2, the Proponent may be ordered to undertake further salvage, preservative or protective measures or take any other actions that the Minister responsible for the *Historical Resources Act* considers necessary.

5.0 REQUESTS FOR *HISTORICAL RESOURCES ACT* APPROVAL

Based upon the results of the HRIA studies, Alberta Culture and Tourism may consider granting *Historical Resources Act* approval to all or portions of the Project area. In the final report, and any interim report(s) the Proponent's consultant(s) must clearly identify and illustrate those portions of the Project area for which *Historical Resources Act* approval is requested.

6.0 PRE-EMINENCE OF *HISTORICAL RESOURCES ACT* REQUIREMENTS

Should the contents of conditions included within this Schedule be at variance with any instructions associated with the *Listing of Historic Resources* and/or the permit application, the conditions of the Schedule take precedence. Following instructions as outlined in this Schedule should result in the granting of *Historical Resources Act* approval and/or the issuance of requirements regarding further historic resources studies in a timely manner.

7.0 COMPLIANCE IS MANDATORY

These conditions shall be considered directions of the Minister of Alberta Culture and Tourism under the *Act*. The Proponent and agents acting on behalf of the Proponent are required to become knowledgeable of the conditions. Failure to abide by the conditions will result in *Historical Resources Act* approval not being granted, or delayed.

Alberta Culture

ATTACHMENT 2

ABORIGINAL TRADITIONAL USE SITES

Aboriginal Traditional Use Sites considered by Alberta Culture as historic resources under the *Historical Resources Act* include but may not be limited to the following:

Historic cabin remains;
Historic cabin (unoccupied);
Cultural or historical community camp site;
Ceremonial site/Spiritual site;
Gravesite(s);
Historic settlement/Homestead;
Historic site;
Oral history site;
Ceremonial plant or mineral gathering site;
Trail; and,
Wickiup/Sweat lodge site.

This listing updates the list on pages 5 and 6 of *Tourism, Parks, Recreation and Culture Guidelines for First Nations Consultation on Resource Development and Land Management* (referred to as the Alberta Culture's Consultation Guidelines), Part V of Alberta's *First Nations Consultation Guidelines on Land Management and Resource Development*, dated November, 2007.