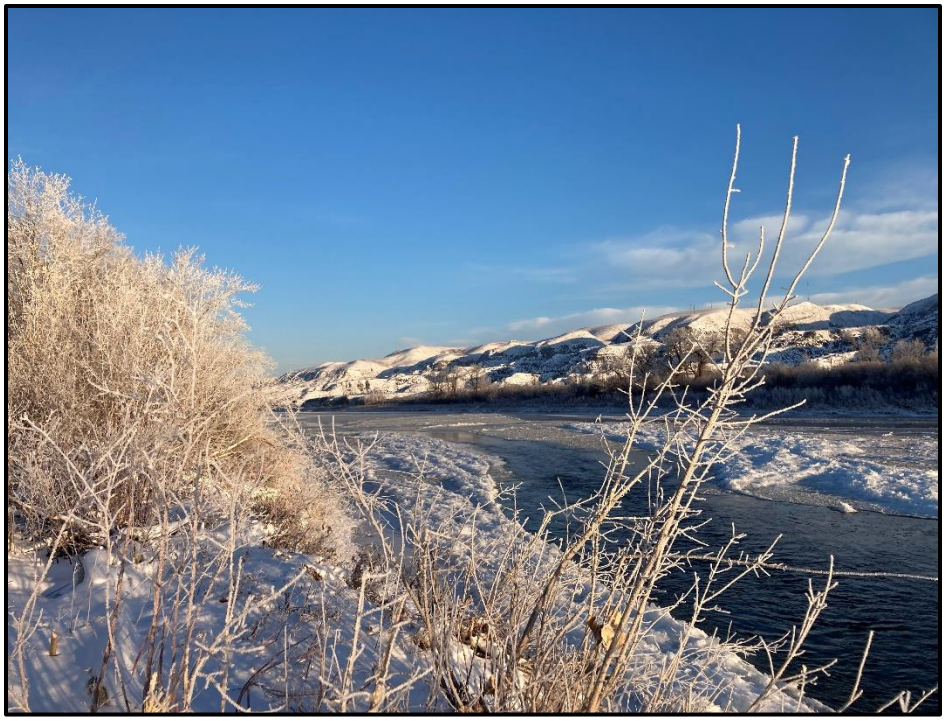
DOWNTOWN DIKE – ENGINEERING DESIGN BASIS

FINAL – Revision 0



Issue Date: March 17, 2023
Project No.: 21.2311.002

SUBMITTED BY:
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TABLE OF CONTENTS

LIST OF TABLES

1. INTRODUCTION AND BACKGROUND

The current Downtown Dike is a 1,150 m long earth filled dike, topped with a paved asphalt trail, and is located in central Drumheller along the right bank of the Red Deer River. The Downtown Dike protects the civic heart of the valley, downtown Drumheller. Critical infrastructure located within downtown Drumheller includes the fire department, city hall, police station, the Badlands Community Facility (BCF), the arena, the Aquaplex, and vital historical, cultural, and tourism facilities. Refer to Drawings C-101 through C-104 of SweetTech's Issued for Approval Drawing Package (dated March 17, 2023) which depict the existing site features and infrastructure surrounding and directly interfacing with the existing dike.

The current Downtown Dike was conceived from a provincial Flood Abatement Work Group (FAWG) and constructed in three (3) phases between 1987 and 1991. The portion of the existing Downtown Dike that runs along Riverside Drive has a concrete jersey barrier positioned on the crest and this jersey barrier extends for approximately 290 m. The height of the existing dike varies from approximately 0.5 m to 2 m above the adjacent ground.

Presently, the Downtown Dike is overtopped by Red Deer River flows of approximately 1,100 m^3/s and was not of sufficient height to provide overtopping protection in the 2005 and 2013 flood events (Town of Drumheller, 2014). Thanks to diligent emergency response by the Town during these events, damage due to overtopping flows during these events was minimized with the placement of emergency temporary fill material.

This present scope of work involves designing improvements and upgrades to the Downtown Dike to reduce flooding and protect Drumheller based on the updated 1:100 regulated design flow provided by Northwest Hydraulics Consultants (NHC). This will include extending the Downtown Dike downstream, by about 200 m where currently no dike exists, and upgrading the Downtown Dike to a design flow flood level of 1,850 m^3/s plus an additional 0.5 m freeboard. In addition, the design of the Downtown Dike upgrades have accounted for temporary installation of additional adaptive emergency response measures to raise the flood protection which could include earth fill or alternative flood barriers such as AquaDams.

2. DOWNTOWN DIKE DESIGN CRITERIA

When SweetTech originally started working on this project in February 2021, the agreed upon dike geometry design criteria was a 6 m dike top width and 0.75 m freeboard above the 1850 m^3/s design flood elevation. On August 15, 2022, due to economic and public feedback considerations, the DRFMO informed SweetTech that the dike is to be designed to a minimum dike crest width of 4 m, instead of the previously specified 6 m width, and that the freeboard is to be reduced from 0.75 m to 0.5 m (above the regulated 1:100 year flood level). Table 1 summarizes the dike design criteria utilized throughout the design of the Downtown Dike.

Table 1: Downtown Dike Design Criteria Summary

Design Parameter	Design Criteria	Source	Rationale
Red Deer River Design Flow	1850 m^3/s	NHC/DRFMO	• 1:100 year regulated peak instantaneous discharge.
Minimum Dike Freeboard	0.5 m	DRFMO	• Industry standard practice to account for risks and uncertainties. • Typically Ranges between 0.5 m to 1.0 m. • Per DRFMO directive from August 15, 2022.
Minimum Dike Top Width	4 m	DRFMO	• Allows for emergency adaptive fill placement. • Per DRFMO directive from August 15, 2022
Maximum Dike Side Slopes	Riverside: 2H:1V Landside: 2H:1V (plus retaining wall)	Council/ DRFMO	• Based on selected option from November 7, 2022, Council meeting. • Side slopes vary along the dike
Maximum Retaining Wall Exposed Height	2.17 m	Council/ DRFMO/ SweetTech	• Based on selected option from November 7, 2022, Council meeting. • Maximum wall height revised after Council meeting based on SweetTech's retaining wall design modelling. • The retaining walls at the Aquaplex and Riverview Terrace will be maximum 1.4 m in exposed height. • The retaining wall along Riverside Drive will have a maximum exposed wall height of 2.17 m.
Retaining Wall Product (Including facing texture/ colour)	Brown Ledgestone Redi Rock Positive Connection Blocks	Council/ DRFMO/Public Engagement	• Based on selected option from November 7, 2022, Council meeting. • Facing texture/colour selected based on Public Engagement on November 17, 2022.
Retaining Wall Geogrid Product	Miragrid 10XT Miragrid 20XT	SweetTech	• Per SweetTech's retaining wall design modelling. • Miragrid 10XT is required for the Aquaplex and Riverview Terrace Retaining Walls • Miragrid 20XT is required for the Riverside Drive Retaining Wall

Design Parameter	Design Criteria	Source	Rationale
Dike Core Fill Material	Zone 1A Impervious Fill (Min. 25° Internal Friction Angle, Max. $1x10^{-6}$m/s Permeability, non-dispersive, clay content ≥20%, low to medium plastic)	DRFMO/ ParklandGEO	• Per ParklandGEO's March 31, 2022 letter titled RE: Berm Material Borrow Summary
Retaining Wall Reinforced Fill Material	Reworked Clay Till (Min. 28° Internal Friction Angle, Max. $1x10^{-6}$m/s Permeability, non-dispersive, clay content ≥18%, low to medium plastic)	SweetTech	• Based on SweetTech's Retaining Wall Design Analysis and Specifications
Dike Crest Grading (Dike Core)	Min. 4% Crown Min. 4% Crossfall (Retaining Walls)	SweetTech	• Allows for adequate drainage of dike core. • Crossfall required to direct runoff away from retaining wall towards the river.
Dike Crest Grading (Dike Pathway)	Min. 2% Crown Min. 2% Crossfall (Retaining Walls)	SweetTech	• Allows for adequate drainage of dike pathway. • Crossfall required to direct runoff away from retaining wall towards the river.
Dike Pathway Width	3 m	IBI/SweetTech	• City of Calgary Typical Regional Paved Pathway
Dike Access Pathway Width	Min 1.5 m	IBI/SweetTech	• Varies depending on access location / tie in location / anticipated usage
Dike Access Pathway Grades	Max. 8.3%	Alberta Building Code	• Accessibility Standards • Exception: Access to informal river side trail near Schumacher's corner (14.5%)
Dike Horizontal Curvature Minimum Radius	20 m	DRFMO	• Allows for emergency adaptive fill placement with standard tandem dump trucks (with no pup trailer)

Design Parameter	Design Criteria	Source	Rationale
Minimum Dike Toe Setback from Top of Riverbank*	5 m	SweetTech	• Based on SweetTech's geotechnical modelling and the condition of the existing near vertical riverbank, riprap placement will be required along the riverbank where the dike toe encroaches within 5 m of the top of bank
Post-Construction Traffic Accommodation	Maintain 2-Way Traffic on Riverside Drive	Council/ DRFMO	• Based on selected option from November 7, 2022, Council meeting
Riverside Drive Width (Minimum)	8 m (4 m Lane Width)	Council/ DRFMO	• Based on selected option from November 7, 2022, Council meeting • DRFMO Feedback on SweetTech's 60% Design Package
Minimum Offset Between Retaining Wall and Riverside Drive	0.5 m	Council/ DRFMO	• Based on selected option from November 7, 2022, Council meeting
Riprap	• Min. Top of Riprap Slope of 2H:1V • Min. Underside of Riprap Slope of 1.5H:1V • Min. 1 m thick Class 1 and 2 Riprap Blend	SweetTech	• Required when dike toe is within 5 m of top of bank per SweetTech Geotechnical stability analysis
Dike Surfacing (Side Slopes)	100mm Thick Topsoil and Seed	IBI/SweetTech	• Grass will provide erosion protection to dike core
Design Event for New Stormwater Infrastructure	1:100 year 1 hour	Alberta Environment	• Per Stormwater Management Guidelines for the Province of Alberta (1999) • Ability to adequately convey landside runoff flows when the river water levels are below the outfall elevation
Climate Change Factor for New Stormwater Infrastructure	+18% of Rainfall Intensity	Stantec/Town of Drumheller	• Account projected impacts of climate change in order to install resilient infrastructure. • RCP 8.5 - 2080s projection (%)

Design Parameter	Design Criteria	Source	Rationale
Backflow Prevention	Include Tideflex Valves on All Outfalls	DRFMO	• Reduce landside flooding risks when river water levels are above the outfall elevation • Include emergency pumping plan in the ERP, particularly for the outfalls at D0+755/D0+765

3. DOWNTOWN DIKE DESIGN EVOLUTION

To achieve the desired level of flood protection for the Downtown Dike, specifically along Riverside Drive, numerous options, alternatives, and alignments have been considered by SweetTech, DRFMO, and Town Council over the last two (2) years. For a full history of the evaluated options up to November 2022, refer to SweetTech's Preliminary Design and Options Analysis Report dated November 2, 2022. The following segments of the dike were identified as areas with conflicts requiring evaluation of alternative dike sections and a range of other engineering options. Table 2 outlines the key constraints and the proposed solutions developed throughout the design process to facilitate dike construction in these locations.

Table 2: Downtown Dike Constraints and Proposed Design Solutions

Dike Segment	Dike Station	Constraints	Proposed Design Solution
Rotary Spray Park	D0+000 – D0+080	Utility conflicts and relocation	• Fully Adaptive Dike Zone • As Such, No New Dike Fill is to be Placed Here
Aquaplex	D0+080 – D0+110	Pinch point between the river and the NW corner of the Drumheller Aquaplex	• New Dike Fill Requires a Redi-Rock Retaining Wall (Maximum Exposed Height of 1.4 m). Avoids Impervious Zone 1A Dike Fill Construction into the River
240 Riverside Dr E (Vacant Canalta Lot)	D0+540 – D0+710	Land acquisition required	• Minor Land Acquisition • Slightly Steeper Dike Side Slope (2.5H:1V vs 3H:1V)
Riverview Terrace Condominium	D0+710 – D0+740	Tie into Riverview Terrace/Narrow right of way for dike improvements/Land access agreement required	• New Dike Fill Requires a Redi-Rock Retaining Wall (Maximum Exposed Height of 1.04 m) and Accessible Ramp to the Dike

Dike Segment	Dike Station	Constraints	Proposed Design Solution
Riverside Drive	D0+800 – D1+080	Narrow right of way for dike improvements due to Riverside Drive/Overhead utilities	• Narrowing of Riverside Drive to a Consistent 8 m Width (Including removal and replacement of the curb and gutter on river side of Riverside Drive) • Recentering and regrading of Riverside Drive crown • Removal and replacement of the stormwater infrastructure at 3rd Ave and Riverside Drive • New Dike Fill Requires a Redi-Rock Retaining Wall (Maximum Exposed Height of 2.17 m). Avoids significant dike construction into the River. • Overhead Utilities Relocated
Schumacher's Corner	D1+080 – D1+217	Ex. Schumacher Lift Station and Pr. Expansions Area for the Lift Station	• Dike Alignment Set to Not Encroach on the Existing Lift Station Area • Dike Alignment Shifted/Extended to the East to Provide Additional Area for Future Lift Station Expansion

The section of the Downtown Dike along Riverside Drive is particularly challenging given the spatial constraints of the Red Deer River, the location of Riverside Drive, and the fact that the new dike in this area requires the largest increase in elevation (approx. 3 m in height), to achieve the design requirements of 1850 m^3/s (the regulated 1:100 year flow) plus 0.5 m freeboard.

Along Riverside Drive, significant public consultation and engagement has occurred over the previous year which led to a full day public engagement and consultation session that occurred on September 20, 2022. Based on the feedback from this communication session, it was decided to

consider three (3) options for the optimized dike section (i.e. 4 m top width and 0.5 m freeboard) along Riverside Drive. These three (3) options are summarized below:

Option 1: Removal of Riverside Drive and Replacement with the Typical Dike Section

This option involved removing Riverside Drive and constructing the optimized typical dike section within the road alignment. This option would have allowed for the amount of riprap along the riverbank to potentially be reduced and a retaining wall would not have been required. The total cost of this option was estimated to be the lowest of the three (3) presented. Significant public engagement indicated that this option was strongly not preferred.

Option 2: Fully Maintaining Riverside Drive with Full Height Retaining Wall

This option allowed for the existing road conditions along Riverside Drive to be maintained, but required the dike toe to be positioned as close as possible to the top of the existing riverbank and would require a 2.75 m high Redi-Rock mechanically stabilized earth retaining wall be installed along Riverside Drive. As the dike toe would be installed along the crest of the riverbank, riprap would be required along this section of the downtown dike. The total cost of this option was estimated to be the most expensive of three presented (estimated to be about $1.2 M more than Option 1), primarily due to the 280 m long, ~3 m tall retaining wall.

Option 3: Reduced Width Riverside Drive with Reduced Height Retaining Wall

This option involved reducing the width of Riverside Drive from the existing approx. 11 m to approx. 8 m wide, while maintaining two (2) lanes of traffic. In addition to reducing the width of Riverside Drive, the installation of a 1.1 m to 1.6 m high Redi-Rock mechanically stabilized earth retaining wall would be required along Riverside Drive. Due to the tight spatial constraints along Riverside Drive, riprap bank armouring is required along the dike toe on the river side, although SweetTech will continue design efforts to optimize its extents throughout detailed design. The total cost of this option was estimated to be approximately $350,000 to $500,000 more expensive than Option 1.

Selected Option

These options were presented to Council on November 7, 2022. At the conclusion of this meeting, Council and DRFMO made the decision to have SweetTech proceed with the detailed design of Option 3: Reduced Width Riverside Drive with Reduced Height Retaining Wall. Note that through the subsequent detailed design process, it was determined that a maximum exposed wall height of 2.17 m is required along Riverside Drive, although much of the retaining wall has an exposed wall height of approximately 1.6 m – 1.8 m. This height increase, as compared to the originally presented option on November 7, 2022, is required based on recent detailed survey data and the revised requirement from the DRFMO to maintain a minimum width of 8 m roadway along the entire section of affected Riverside Drive.

4. OVERALL DESIGN SUMMARY

The proposed dike design extends from the Gordon Taylor Bridge to south of the existing Schumacher Corner Lift Station resulting in a 1,217 m long dike, with the first 80 m of the dike, through the Fountain Area, being a fully adaptive dike zone. The dike alignment winds its way behind the existing Aquaplex building, through Centennial Park, and behind the BCF building, for the most part, following the alignment of the existing dike, where possible. To the south of the BCF building, the proposed dike follows the current dike alignment past the vacant Canalta lot towards Riverview Terrace Condominium. After passing Riverview Terrace Condominium building the dike parallels Riverside Drive and terminates south of the existing Schumacher Lift Station. To achieve the required design elevation along Riverside Drive while keeping Riverside Drive open to two (2) way traffic, a Redi-Rock Retaining wall has been designed along Riverside Drive. For the detailed design requirements of the retaining walls along the Downtown Dike alignment, refer to SweetTech's Retaining Wall Design Package.

Subsequent sections of this report provide further detailed information regarding the geotechnical considerations of the design, stormwater conveyance through the dike, hydraulic analysis associated with the Red Deer River, and encountered utility / infrastructure conflicts.

5. GEOTECHNICAL SUMMARY

Refer to SweetTech's Geotechnical Investigation report (dated September 17, 2021) for a detailed discussion of the testing and analysis completed to inform the design of the Downtown Dike. The following section is a summary of the proposed dike fill material parameters and requirements to address the over steepened portions of the riverbank within 5 m of the dike toe.

Based on the findings of our geotechnical assessment, it is SweetTech's opinion that the proposed Downtown Dike design meets the slope stability, seepage, and settlement requirements of this project. The proposed dike fill material parameters analyzed during the stability and seepage analysis consisted of an adequately compacted 25-degree friction angle material with a maximum hydraulic conductivity of $\leq 1 \times 10^{-6}$ m/s. The assessment performed assumed that the dike construction materials consist of a low to medium plasticity, nondispersive clay. Once the proposed fill soil has been selected, laboratory testing is to be performed to confirm the materials friction angle, saturated hydraulic conductivity, plasticity, compacted unit weight, and dispersivity. A risk and stability assessment will need to be re-performed utilizing these provided (actual) material parameters, verifying the resulting safety factors at a critical section along Downtown Dike (if the friction angle or hydraulic conductivity deviate from the aforementioned specified minimum values).

Near the river elevation, lower toe stability safety factors were found while performing our slope stability assessment at D0+687. Typically, the riverbank along the Downtown Dike consists of a near vertical face of silt-based soils with little to no vegetation present on the steep section of the slope that ranges from 0.8 m to 2 m in elevation change. This near vertical section of soil along the toe of the riverbank has been found to be unstable, with a low stability safety factor under drawdown conditions. These safety factors are below the "Minimum Design Factors of Safety for

DRFMO Dikes" specified in Table 4 of the Geotechnical Design Basis Memo for the DRFMO System (DRFMO – Dated April 21, 2021). This is particularly a concern when the Downtown Dike alignment is not adequately set back from the riverbank (i.e., less than 5 m), which is typically due to space constraints for the dike.

It is anticipated that low dike toe stability safety factors will be present for much of the dike alignment and, as such, riprap installation will be required along 510 m (out of 1220 m total) of the newly constructed dike toe. Where the dike is built within 5 m of the crest of the riverbank, it is recommended to grade the steep riverbank at a 2H:1V (localized areas of the bank may be cut as steep as 1.5H:1V) and place a minimum 1 m thick layer of keyed-in riprap along the toe of the riverbank. The top surface of the riprap is to be installed at a grade of min. 2H:1V. This riprap placement at the toe will allow for the safety factor to increase to above 1.1 under drawdown conditions, as per the "Minimum Design Factors of Safety for DRFMO Dikes" found within the Geotechnical Design Basis Memo for the DRFMO System. If riprap is not installed when the dike toe extends within 5 m of the crest of the riverbank, critical failure could extend a significant distance into the dike core, potentially resulting in a non-functional failure that could result in a retrogressive failure of the entire dike section. Where the dike's toe is greater than 5 m from the crest of the riverbank, the potential failures have been deemed to be functional and can be repaired immediately after the flood levels recede. It is critical that as part of the Town's operation and maintenance program for the dikes that any functional failures be addressed immediately after a flood event.

Throughout the Downtown Dike alignment, the typical dike section has side slopes of 2.5H:1V, however, through Centennial Park side slopes are shallower to allow for maintenance and easier access. In all areas, the dike side slopes are not to be steeper than 2H:1V. If side slopes steeper than 2H:1V are required, SweetTech shall be contacted to conduct additional analysis prior to implementation.

6. STORMWATER CONVEYANCE ANALYSIS SUMMARY

There have been ten (10) existing outfall pipes that have been identified along the length of the existing Downtown Dike. In March 2020 and August 2021, the existing storm pipes beneath the dike and their associated outfalls were camera scoped as part of required maintenance (ensuring proper functionality) and to determine their existing condition and develop design recommendations. The stormwater outfalls need to convey landside runoff to the river, but during high river flows prevent backflow from the river travelling up these outfalls and causing flooding issues on the landside of the dike. Many of the existing outfalls will require a varying degree of repairs, decommissioning, and/or extension with the proposed construction of the Downtown Dike improvements. Proposed outfall improvements and design recommendations are summarized in Table 3 below.

Table 3: Existing Downtown Dike Outfalls Summary

Dike Station	Location Description	Design Recommendations
D0+000	Near Gordon Taylor Bridge	Outside of area of influence of proposed dike improvements – leave as-is

Dike Station	Location Description	Design Recommendations
D0+010	Near Gordon Taylor Bridge	Outside of area of influence of proposed dike improvements – leave as-is
D0+055	Existing Fountain Drainage	To be decommissioned as part pf Spray Park drainage improvements under Town of Drumheller Capital Projects.
D0+105	Existing Spray Park Drainage	Pipe extension required including addition of new headwall and Tideflex valve. Pipe extension length anticipated to be approximately 7.4 m.
D0+240	Outfall E-10	Proposed to repair approximately 5.35m of damage pipe outfall pipe and install a new headwall and Tideflex valve. Proposed to add an upstream manhole to facilitate adequate landside drainage.
D0+500	Outfall E-12	Decommissioning and realignment of some pipe segments including additions of new catch basin(s)/manhole(s). Refer to Drawings C-308 and C-309 for further details.
D0+755	Riverview Terrace Cross Drain	An estimated 2.45 m extension to the cross-drain inlet structure will be required. The existing outfall structure is to be maintained. Installation of a high level outlet pipe is proposed (with Tideflex valve). Refer to Table 4 for information regarding the proposed high level outlet pipe.
D0+965	Outfall E-14	Existing catch basin at the intersection of Riverside Drive and 3rd Ave and outfall structure are to be decommissioned and replaced with a new catch basin tying into the E-15 outfall pipe.
D0+990	Outfall E-15	Replace existing gate valve and headwall with a Tideflex valve and new headwall. Replace pipe segment within dike footprint. Install new catch basin(s) at the intersection of Riverside Drive and 3rd Ave. Includes increasing the diameter of the outfall pipe downstream of the new catch basin(s).
D1+180	Outfall F-1	Approximately 22.1 m extension of the outfall pipe required including addition of new manhole, headwall, and Tideflex check valve.

The following new stormwater infrastructure is proposed to promote proper stormwater conveyance around and through the dike. Table 4 summarizes the proposed new infrastructure and the rationale of their implementation.

Table 4: Downtown Dike New Stormwater Infrastructure Summary

Dike Station	Location Description	Design Recommendations
D0+170	Behind Aquaplex	Installation of two new catch basins and outfall structure (including headwall and Tideflex valve) to facilitate drainage behind the Aquaplex building and west of the existing skate park.

Dike Station	Location Description	Design Recommendations
D0+765	Riverview Terrace High Level Outlet	Based on a desktop analysis existing topographic information, approximately 53.6 ha of downtown Drumheller drains to the existing Riverview Terrace Cross Drain. An approximate composite runoff coefficient of 0.69 was developed for this delineated catchment. Based on the 1:100 year 1 hour design storm event (intensity of 42.4 mm/hr), using the rationale method, a peak flow of 4.35 m^3/s was determined. Based on previous climate change reporting by Stantec (Stantec 2020), the rainfall intensity was increase by 18% to account for impacts of climate change resulting in a peak flow of 5.14 m^3/s. Based on HY-8 modelling of the existing cross drain, it was determined to be able to convey 3.55 m^3/s prior the inlet pond spilling onto Riverside Drive. As such, the high level outlet has been sized to convey the remaining 1.59 m^3/s required. The new proposed high level outlet could also be used during high river flows when the low level outlet Tideflex valve is closed. In these events, emergency pumping may be required to convey accumulated water from the landside of the dike through the high level outlet.
D1+140	Schumacher's Corner Cross Drain	Installation of a new cross drain (including headwall and Tideflex valve) north of existing lift station to facilitate of low-lying area between the proposed dike and existing properties.

7. RED DEER RIVER HYDRAULIC ANALYSIS SUMMARY

Refer to Northwest Hydraulic Consultants' (NHC) April 2020 Drumheller River Hazard Study, prepared for Alberta Environment and Parks, for detailed information regarding Red Deer River hydraulic modelling, open water hydrology, channel stability, and flood hazard mapping throughout the entire Drumheller valley.

For a further discussion regarding SweetTech's riverbank stability observations and river engineering assessment, refer to SweetTech's Downtown Dike Preliminary Design & Options Analysis Report (dated November 2, 2022).

8. UTILITIES / INFRASTRUCTURE CONFLICTS SUMMARY

Through the Downtown Dike design process to-date, various utility conflicts were identified with the proposed Downtown Dike construction work. Table 5 summarizes these identified conflicts and the proposed design measures for mitigating the conflicts.

Table 5: Downtown Dike Utility Conflict Mitigation Summary

Dike Stationing	Description	Proposed Design/Mitigation
D0+000 – D0+080	Various ATCO Utilities/Vaults	• Fully Adaptive Dike System
D0+240	Centennial Park Irrigation System	• To be removed / decommissioned • New irrigation designed by others
D0+320 – D0+375	Existing Water Line	• Leave as-is beneath the dike
D0+500	Storm System Infrastructure Behind the BCF	• Refer to Table 3 • Refer to Drawings C-308 and C-309
D0+925 – D1+065	Overhead Power Along Riverside Drive	• Previously relocated by ATCO in Summer 2022
D0+950 – D1+000	Storm Infrastructure at Intersection of Riverside Drive and 3rd Ave	• Refer to Table 3 • Refer to Drawing C-312
D0+930	Abandoned Water Line	• To be removed beneath the dike footprint and capped
D0+990	ASCM No. 639732 (Survey Monument)	• To be addressed by DRFMO / Hunter Wallace Surveys
D1+040 – D1+150	Existing Sanitary Line	• Being managed by the Town of Drumheller Capital Projects • Mitigation projected to be implemented in June 2023
D1+050	Existing Sanitary Manhole	• To maintain the existing manhole • SweetTech's retaining wall alignment was adjusted to shift around the existing manhole
D1+217	Existing Overhead Power	• Conflict not anticipated with dike construction footprint • Contractor to manage safety around line during construction

9. LANDSCAPE ARCHITECTURE SUMMARY

The landscape architecture design scope of work related to the Downtown Dike improvements is currently being handled by IBI Group under the Town of Drumheller Capital Projects.

10. REGULATORY APPROVALS SUMMARY

The DRFMO has initiated discussions with the Province for the Project to ensure an efficient and timely approvals process. The DRMFO and their environmental management team are responsible for coordinating the required regulatory approvals prior to construction. Throughout the design process, SweetTech worked to minimize in-stream works as much as practicable to mitigate and reduce regulatory concerns.

Per SweetTech's design, the anticipated disturbance footprint below the 1:2 year flood level elevation is approximately 2250 m^2 which is required for riprap installation for bank and dike toe stabilization.

Construction of flood mitigation works in the Town of Drumheller requires authorization from several regulatory bodies. In general, the following key approvals/notifications are understood to be required for the construction of the Downtown Dike:

- *Fisheries Act* – Authorization Outstanding
  - Authorization required for all works below the 1:2 year flood elevation (ordinary highwater level).
- *Water Act* – Authorization Outstanding
  - Authorization required for all dike construction activities.
  - Code of Practice required for outfall structure maintenance.
- *Public Lands Act* – Authorization Outstanding
  - Department Licence of Occupations (DLOs) disposition required for bed and shore modifications (i.e., riprap installation)
- *Historical Resources Act* – Approval Received September 10, 2021
  - Amendment/revision required prior to 2023 works.
- *Canadian Navigable Waters Act* – Public Notification Required
- Provincial and Federal First Nations Consultation has been completed or is ongoing in conjunction with the applications for the aforementioned approvals.

11. LAND USE AGREEMENT / ACQUISITION SUMMARY

The proposed upgrades to the Downtown Dike may impact the following properties:

- 240 Riverside Drive East (private lot) – Vacant Canalta Lot
- 280 Riverside Drive East (private lot) – Riverview Terrace Condominium

Scott Land and Lease, on behalf of the DRFMO, is working with the aforementioned property owners to obtain the necessary land use agreements or to acquire the required lands for dike construction and temporary construction laydowns. The majority of the Downtown Dike improvements will take place on municipally and provincially owned land.

12. SUMMARY OF DESIGN REVISIONS SINCE 90% DESIGN REVIEW BY DRFMO

The following is a summary of design revisions to the Downtown Dike design since the DRFMO's review of the 90% design package:

- Addition of riprap bank/dike toe stabilization between STA D0+943 and STA D0+997 where existing outfall E-14 is being removed.
- Required retaining wall geometry, alignment, and grading adjustments for ease of constructability and to avoid utility conflicts.
- Incorporation of DRFMO's review comments from their review of the 90% design package.

13. CONSTRUCTION COST ESTIMATE

A Class A (+/-10%) construction cost estimate will be provided to the DRFMO along with the Issued for Tender submission.

14. SCHEDULE

Through communications with the DRFMO, the Downtown Dike has been slated for construction in Q2 through Q4 of 2023. As such, the schedule for the remaining design, public consultation, and tendering of Downtown Dike works can be extrapolated based on this construction commencement timeline. Table 6 provides a high-level summary of the schedule of Downtown Dike work between now and the start of construction.

Table 6: Approximate Schedule for Downtown Dike Works

Task	Approximate Schedule
Tender Posting	Late-March 2023
Commence Construction Work	Mid-May 2023
Construction Completion	Fall 2023

15. NEXT STEPS

- Finalize and issue the retaining wall design package for review and approval from the DRFMO.
- Finalize design of stormwater infrastructure at 3rd Ave and Riverside Drive upon receipt of survey data for the inverts of the existing catch basins.
- Refining the extent to which the landscape architecture furnishings are to be incorporated with dike construction.
- Engineering review of the proposed irrigation system to installed at Centennial Park.
- Town to provide schedule and proposed work methodology for the existing sanitary line refurbishment near Schumacher's Corner. It is critical that SweetTech has the opportunity to evaluate the impacts of this work on the dike design in this area.

16. CLOSURE

We trust this report provides the required information. Should you have questions or concerns, or require any additional information, please do not hesitate to contact the undersigned at 587-329-6655.

Yours truly,
SweetTech Engineering Consultants
APEGA Permit No: P13638

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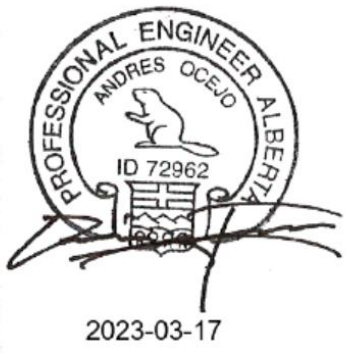

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1963401 ALBERTA LTD.
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PERMIT NUMBER: P013638
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Eric Sweet, M.Eng., P.Eng.
Principal Engineer

17. REFERENCES

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