APPENDIX J
Sanitary Sewer Relocation Analysis

Version 1.0
October 7, 2022 Matrix 24603-531

Anthony Di Giandomenico
CITY OF MISSISSAUGA
300 City Centre Dr.
Mississauga, ON L5B 3C1

Subject: Dixie-Dundas Flood Mitigation Environmental Assessment Project Sanitary Sewer Addendum Report, Regional Municipality of Peel, Dixie Road Infrastructure

Dear Anthony Di Giandomenico:

Further to Matrix Solutions Inc.'s report sent to the Regional Municipality of Peel (the Region) on March 25, 2022, we are pleased to provide additional information in this addendum report addressing sanitary sewers and other Region infrastructure relevant to the flood mitigation environmental assessment (EA) study. Discussion items in this addendum report relate primarily to sanitary sewers but also include consideration of roadway, bridge, and other infrastructure within the Dixie Road portion of the EA study area, including infrastructure located at the Dixie Road and Dundas Street intersection. Items related to the Dundas Street East crossing of Little Etobicoke Creek, located further to the east of Dixie Road, are not the focus of this addendum report.

This addendum report provides additional detail regarding the configuration, constructability, and costs of potential modifications to the Region's Dixie Road infrastructure. This report is intended to guide optimum design alternatives for the EA's preferred alternative flood mitigation solution, which is "Improved Conveyance by Making Room for the Creek." Some review of the EA process to date that led to determining the preferred alternative solution is also included, with a focus on the proposed changes at Dixie Road.

The report promotes a partnership approach for the City of Mississauga (the City) and the Region in considering conceptual designs for Dixie Road items within the EA project study area. Effective collaboration is required to best achieve the City's objectives for flood mitigation within their EA, the Region's objectives for ongoing optimum operation of their infrastructure and roadways, and overall best value for the City and the Region together.

1 ENVIRONMENTAL ASSESSMENT STAGE AND BACKGROUND

The current stage of the Dixie-Dundas flood mitigation project is in Phase 3 of the EA process. This phase defines alternative design concepts for the preferred solution, which has been determined as "Improved Conveyance by Making Room for the Creek."

At the first Public Information Centre (PIC) for the EA project, the following modifications to the Dixie Road crossing of Little Etobicoke Creek were presented for the preferred alternative solution:

- lengthening the bridge span significantly from existing (to 45 m from existing 12 m)
- lowering the Little Etobicoke Creek channel by 0.5 to 1.0 m
- widening the creek channel upstream and downstream of the Dixie Road bridge

PIC No. 1 identified that a longer, but lower, bridge has a cost advantage. A shorter bridge requires a significantly higher road profile. In comparing a 26 m bridge span to the preferred 45 m bridge, an overall cost savings for the longer bridge was estimated at $2.2 million dollars.

Lowering the elevation of the channel, which is required to effectively achieve flood mitigation objectives, will affect the existing large diameter trunk sanitary sewer (size varies from 750 to 975 mm in diameter but is herein referenced as the 900 mm diameter sanitary trunk sewer) that crosses the watercourse immediately upstream of Dixie Road.

Both viable EA alternative solutions (Phase 2 of the EA), and their respective 26 m and 45 m bridge options, required the same lowering of creek invert and, therefore, had the same potential effect on the 900 mm trunk sanitary sewer. The exact amount of creek invert lowering required at Dixie Road (i.e., required for hydraulic reasons for either alternative solution) will need to be adjusted to suit other hydraulic parameters, including channel width, within subsequent portions of the EA (i.e., Phase 3).

Complexities related to future 900 mm trunk sanitary sewer treatments within future designs were not outlined in greater detail in PIC No. 1. Optimum ways to address the 900 mm diameter trunk sewer were left to Phase 3 of the EA, where design alternatives could be further adjusted and confirmed. Considerations surrounding the 900 mm diameter trunk sewer not presented to date are addressed specifically in this current addendum report (see subsequent portions of this addendum report).

At the start of the EA project, an exposed 450 mm diameter sanitary sewer was identified. The location of the exposed crossing is approximately 500 m downstream (i.e., east) of Dixie Road. Matrix's previously referenced technical report dated March 25, 2022, summarized meeting discussions and presented further technical details that focused primarily on available solutions to mitigate the exposed 450 mm diameter sanitary sewer crossing. Various options were presented, including high-level technical details of feasibility and functionality. Some options involve modifications (i.e., additional modifications beyond otherwise required) to the previously referenced 900 mm diameter sanitary trunk sewer crossing the creek at Dixie Road. This latter point is addressed in more detail in this current addendum report to provide clarity.

Subsequent meetings and discussions held with the City, the Region, and consulting team made clear that additional details were still required to ensure optimum decision-making could be made within the EA process. Given the location of the exposed 450 mm diameter crossing, works to mitigate it could potentially be implemented concurrently with EA flood mitigation works. Additionally, the potential advantages of realigning the 450 mm diameter sewer to facilitate and/or improve the function of flood mitigation works needed to be further explored and understood. The potential for design synergies and overall cost savings for mitigating the 450 mm diameter sanitary sewer crossing are considered within the EA project.

2 DIXIE ROAD 900 MM DIAMETER TRUNK SANITARY SEWER

The decision-making process and additional considerations for proposed treatment of the 900 mm diameter trunk sewer within the EA project requires consideration of many items collectively. Each area of focus, and its relationship to other considerations, is outlined subsequently.

2.1 Existing Conditions and Desired Cover

Currently there exists approximately 0.6 m of cover over the trunk sewer from the Little Etobicoke Creek invert at the Dixie Road crossing.

This amount of existing cover is not ideal and does not conform to the Region's standard (which is 1.4 m above pipe obvert). Lowering the trunk sewer for the sole reason of achieving additional/standard cover would not be warranted as a standalone project. Value will be achieved if the sewer were to be lowered for additional reasons (e.g., such as mitigating flooding through the corridor). Accordingly, any lowering of the trunk sewer being considered (for other reasons) should provide the standard amount of cover, per the Region standard, as a goal.

2.2 Dixie Road Profile and Environmental Assessment Preferred Alternative Solution

The preferred EA flood mitigation alternative solution identified that the creek invert of Little Etobicoke Creek through the Dixie Road crossing needs to be lowered by 0.5 to 1.0 m. This amount of lowering facilitates an optimum configuration and effectiveness for channel works and their resulting flood mitigation function. A successful flood mitigation approach is not available without lowering the creek at least 0.5 m. One of the other EA alternative solutions originally investigated (that was not preferred) also required a lowering of the creek by at least 0.5 m to ensure viability. A third EA alternative solution, which did not necessarily require the creek to be lowered, was eliminated from consideration due to costs, which were an order of magnitude higher than the other two alternative solutions.

Additional hydraulic analysis completed more recently indicates that a cost benefit is achieved by lowering the creek invert by even more than 0.5 m, as it reduces the vertical profile increase at the Dixie Road bridge and the roadway transitions up to it. A lowered Dixie Road profile, and its lower costs, was one of the main reasons the EA preferred solution of "Improved Conveyance by Making Room for the Creek" was originally seen to be a good approach. Higher bridge decks associated with other alternative solutions being considered within Phase 2 of the EA indicated roadway costs increasing by as much as $2.2 million dollars (see R.V. Anderson Associates Limited [RVA] memo for additional details [Appendix A]).

In terms of pure hydraulics, an acceptable flood solution can be achieved by lowering the creek by only approximately 0.5 m, but this minimum lowering amount must be combined with other configuration changes to the channel and with a larger bridge structure used than identified in the preferred solution (i.e., larger than 45 m). Additional lowering of the creek up to 1.0 m has been seen to be more advantageous hydraulically according to the most recent work completed for EA Phase 3 hydraulic modelling. As well, it has the potential to bring the proposed Dixie Road roadway profile down even further.

A key issue identified at the Dixie Road crossing of the creek is the existing 900 mm diameter trunk sanitary sewer and its current positioning. A solution could "technically" be achieved by lowering the creek to just

above the outer barrel of this pipe, thereby allowing the creek lowering to proceed without lowering of the trunk sewer. This would require specialized design, with permanent lateral protection in the creek channel both upstream and downstream. Generally, the approach of protecting the trunk sewer, and not lowering it, was abandoned as better options are available. These are outlined subsequently.

2.3 Proposed Lowering Configuration

The extent of the travelled roadway portion of Dixie Road anticipated for profile adjustment within the EA preferred alternative solution, which is "Improved Conveyance by Making Room for the Creek" is approximately 340 m, including new bridge. The original RVA report outlining preliminary details of the roadway improvements (included in Appendix A) puts bridge and roadway costs at $2.2 million dollars less expensive than the next least expensive alternative solution. That non-preferred solution, which has a smaller bridge, would also require over 500 m of roadway reconstruction due to the higher required vertical profile of the bridge. As well, unless a "no-cover" option were deemed to be acceptable for the 900 mm diameter trunk sewer, both of these alternate solutions would also require a lowering of the sanitary sewer for their viability.

As outlined explored in the original sanitary report of March 25, 2022, the Dixie Road trunk sanitary sewer has downstream elevation drops which could allow for a lower sewer to built in the upstream direction. By removing the drop(s), the lower sewer would ensure sufficient cover is achieved at the creek crossing. Figure A1 indicates in plan and profile views the length and positioning of the trunk sewer that would be required to be lowered to accommodate the required lower channel invert. The figure also outlines various other servicing present in the Dixie Road right-of-way (RoW) per City GIS files, which in turn reflect the Region's servicing drawings (EXP 2008, Dixie Road 400 mm watermain concrete pressure pipe). Sewer inverts elevations and lengths are also generally consistent with the original 1964 construction drawings.

Specifically, sewers connecting manholes b through f will have to be lowered to achieve a lowered channel at Little Etobicoke Creek. The significant existing drop occurring at manhole f can be utilized to keep the sewer grades much flatter up to manhole b. It should also be noted that the larger bridge structure at Dixie Road will require the adjustment of manholes b and c away from the new bridge, as indicated in Figure A1.

Table B1 in Appendix B indicates all existing and proposed invert elevations for sewer pipes in the Dixie Road alignment, along with existing and proposed capacities. Lengths of sewer and invert elevations indicated in Figure A1 and in Table B1 will require confirmation through survey prior to completing final design.

In terms of servicing conflicts, Figure A1 indicates a limited potential for them, not including those services that may require temporary support due to open trenching associated with construction. The complexity of addressing anticipated construction techniques will require a greater level of detailed design than completed to date for this EA sanitary addendum report. Potential bridge-related servicing conflicts are also not addressed in this present discussion. In summary, no direct conflicts with a lowered trunk sanitary sewer appear to be anticipated, other than potential trenching conflicts and the required need to provide temporary support to some items.

Recent hydraulic modelling work for the creek and flood plain confirms a proposed creek invert elevation of 119.10 m as providing good overall characteristics and related configuration. A lowered trunk sanitary

sewer using a pipe size of 975 mm diameter, can just achieve an obvert elevation of 117.70 m at the Dixie Road creek crossing, thereby providing a cover of 1.4 m over obvert. This obvert elevation can be achieved using a slope of 0.28%, which provides a full pipe velocity of 1.59 m/s.

In terms of capacity provided by that trunk sewer configuration, it is 1,186 L/s, which is close to the largest existing capacity provided by the existing configuration (1,228 L/s). In order to achieve the larger existing capacity with the new 975 mm diameter sewer, a slope of 0.30% would have to be used, resulting in a depth of cover over obvert at the creek being slightly less at 1.36 m.

See Tables B1 and B2 for detailed calculations of velocity, capacity, and invert elevations for achieving the Region standard cover and achieving preservation of capacity. Both existing and proposed conditions are outlined.

2.4 Costs and Potential Constraints

Preliminary estimated costs for the lowering of the Dixie Road 900 mm diameter sanitary trunk sewer are contained in Table C1. Items included:

- drop structure at manhole b
- creek crossing costs (open cut and restoration)
- new 975 mm diameter sewer from manhole b to manhole f
- maintenance hole structures
- service relocations
- restoration (within Dixie Road reconstruction and for approximately 60 m beyond)
- bypass costs

The preliminary total cost obtained of approximately $4.3 million will require confirmation through additional design process outlining construction techniques and constructability. The cost estimate assumes construction nearby to the existing corridor/trench of the trunk sewer.

Coordination and timing of construction considerations with other Dixie Road bridge and roadway works will be essential to capture the benefits of roadway restoration costs that are already required.

Further discussion of alternate construction approaches (i.e., trenchless) is contained in later portions of this addendum report.

3 DOWNSTREAM 450 MM DIAMETER SEWER CROSSING

An existing exposed 450 mm diameter sewer crossing of Little Etobicoke Creek is located approximately 500 m east of Dixie Road and is described in the previously referenced original document sent by Matrix to the Region dated March 25, 2022. The following sections add additional detail to the available solutions previously described for the crossing.

3.1 Existing Conditions and Overview

The existing sewer currently acts as a weir in the creek. It has no cover and has been determined to be at risk.

3.2 Effect of 450 mm Sewer Realignment on Environmental Assessment Flood Mitigation Works

The most recent creek hydraulic analysis completed for flood mitigation works indicates that the 450 mm diameter exposed sanitary sewer does not necessarily require lowering or realignment by the City in order to complete the EA preferred flood mitigation works. The 450 mm diameter sewer would be left in a less than ideal configuration; however, with no cover in the creek and would require regular monitoring by the Region to ensure its ongoing successful operation. Additionally, leaving the sewer in place will make the design of the watercourse and flood plain more constrained and less able to emulate natural channel-type conditions.

3.3 Mitigation Options Examined

Mitigation options available for the sewer include:

- Realignment of the sewer to Dixie Road and to a lowered Dixie Road 900 mm diameter trunk sewer. The sewer would have to be lowered beyond that required just for obtaining sufficient cover for implementing the preferred flood mitigation alternative solution "Improved Conveyance by Making Room for the Creek."

- Realignment (i.e., lowering) of the exposed sewer's current outlet, which is the existing Jarrow Avenue sewer. Lowering would be required from approximately 80 m north of Dundas Street upstream to the north side of the Little Etobicoke Creek.

- Protecting in place within the proposed EA flood mitigation works. Discussion of potential future mitigation options also included here.

These three options are discussed in subsequent sections of this addendum report.

3.4 Realign to Dixie Road to a Further Lowered Dixie Road Trunk Sanitary

As outlined in the original March 25, 2022 sanitary technical report, the existing creek crossing of the 450 mm diameter sewer can be feasibly realigned from just downstream of Taviton Court to Dixie Road. A new sewer would be constructed within the City-owned valley that is otherwise being used to facilitate the City's flood mitigation requirements. Figure A2 indicates a plan and profile view of this option. Maintenance access structures for the realigned sewer could be located adjacent to or within a proposed City trail that would be constructed as part of the flood mitigation works. Recent creek hydraulic work has determined that this pathway and maintenance access structures could be located above the 1:100-year flood level.

Table B3 indicates technical details for the required extra trunk sewer lowering that would be required on Dixie Road in order to accommodate receiving flows from this newly realigned 450 mm diameter sewer. Additionally, the 975 mm diameter trunk sewer on Dixie Road has been increased in capacity (i.e., higher slope) in order that the additive capacity of the realigned 450 mm diameter sewer is accommodated. Note that capacity calculations only include to manhole g, and further calculations will be required downstream of that manhole in order that required capacity is confirmed. Table B4 indicates calculations for the 450 mm diameter sewer depicted in Figure A2.

Anticipated costs for this mitigation option are listed in Tables C2 and C3 in Appendix C.

Potential servicing conflicts for the portion of 450 mm diameter sewer through the new area of floodplain will be limited to some known storm sewer crossings, but otherwise are not anticipated to be extensive as this area is relatively "green field" and has not been urbanized to date.

3.5 Lowering Jarrow Ave Sewer

A technical alternative exists, which is to lower the existing sanitary sewer that provides existing outlet to the exposed 450 mm diameter sewer (i.e., lowering the existing Jarrow Avenue sewer). As outlined in Figure A3, lowering would be required from approximately 80 m north of Dundas Street upstream to the north side of the Little Etobicoke Creek. Table B5 outlines that technically, the lowering available could provide cover over the sewer of approximately 1.0 m from channel invert to pipe obvert. This amount of achievable cover is 0.4 m less than the the Region recommended standard of 1.4 m.

If the Jarrow Avenue sewer lowering were to be completed now, requiring the restoration of the Jarrow Avenue roadway, costs are estimated in Table C5 of this addendum report. This cost may be hard to justify given the Jarrow Avenue sewer alignment might eventually be determined to be abandoned within future development scenarios associated with the City's Dundas Connects plan.

3.6 Protect in Place - Potential Future Lowering/Realignment

The most recent creek-related hydraulic analysis addressing design alternatives for EA flood mitigation indicates that the 450 mm diameter exposed sanitary sewer does not necessarily require lowering or realignment in order for the flood mitigation solution to be viable. Design of the preferred EA flood mitigation design solution works would, however, be less constrained and likely more able to emulate natural channel-type conditions if the 450 mm diameter sewer were to be moved away (i.e., realigned) or sufficiently lowered. Additionally, without realignment, the 450 mm diameter sewer would be left in a less than ideal configuration with no cover in the creek. It would regular monitoring by the Region to ensure its ongoing successful operation.

Leaving the sewer in place will require its incorporation into a riffle-type structure within the newly constructed creek works associated with the preferred flood mitigation alternative solution. Additionally, the riffle will be strengthened such that pipe may not be moved as part of river processes, likely requiring implementation of buried upstream and downstream armourstone protection or hardened approach otherwise. Costs associated with installing this permanent protection for the pipe are likely in the $100,000 to $200,000 range, given design and installation of works is coincident with other flood mitigation creek works. Other factors (such investigation and potential mitigation of inflows and infiltration) are not included in the estimate but will need to be considered.

The potential to eventually lower the 450 mm diameter sewer through the creek crossing at some point in the future could also be considered within the context of potential redevelopment of lands abutting the Jarrow Avenue (per the City's Dundas Connects plan).

3.7 Summary of Available Options and Considerations

Lowering the Dixie Road trunk sanitary sewer (900 mm diameter) is required to achieve sufficient cover at the Little Etobicoke Creek crossing for the preferred EA alternative solution. The cost for this lowering is estimated at approximately $4.3 million.

Options identified in this letter-report to address the existing exposed downstream 450 mm diameter sanitary sewer located approximately 500 m downstream of Dixie Road include the following:

- Realign the exposed 450 mm diameter sewer through the new floodplain works associated with the flood mitigation project. The Dixie Road trunk sanitary would require additional lowering to accept these flows. Total cost for these works is estimated at $2.7 million (over and above the Dixie Road trunk lowering otherwise required). The total cost of all sanitary works is $7.0 million ($4.3 million + $2.7 million).

- Lower the Jarrow Avenue sewer to achieve approximately 1.0 m of cover for 450 mm diameter sewer at watercourse crossing. Cost estimated at $2.7 million for Jarrow Avenue works. The total cost of sanitary works including Dixie Road lowering is $7.0 million ($4.3 million + $2.7 million).

- Protect the 450 mm diameter sewer in place within flood mitigation works. Cost estimated at $0.2 million to allow for erosion protection. The total cost of sanitary works including Dixie Road lowering is $4.5 million ($4.3 million + 0.2 million).

Other considerations associated with these three options are outlined as follows:

- Operational costs and ongoing risk will be higher for the leave-in-place option for the 450 mm diameter sewer.

- Bus Rapid Transit (BRT) project coordination will be required with the option of extra lowering on Dixie Road (if required for accommodating a new 450 mm diameter through the floodplain). BRT coordination would not be required for other two options.

- Lower cost options may exist for the Dixie Road trunk extra lowering option by potentially using trenchless approaches such as micro-tunnelling and jack and bore. Potential cost savings have been identified as approximately $1.0 million if constructability will allow. This cost saving would bring the cost of the new 450 mm diameter sewer realignment through the floodplain to $6 million.

- Trenchless approaches for constructing the less deep trunk sanitary sewer on Dixie Road will also be investigated and may be warranted for various operational reasons. Some cost savings may be obtained through a jack and bore or micro-tunnelling approach for all or some portions of the lowering, but the estimate of $4.3 million for the lowering should be maintained. Potential cost savings for the shorter and less deep trunk sewer will not be as significant.

4 SUMMARY AND ENVIRONMENTAL ASSESSMENT NEXT STEPS

The Dixie-Dundas flood mitigation project EA was obliged to examine potential synergistic design alternatives that address the existing exposed 450 mm diameter sanitary sewer. Given how important the

lowered 900 mm diameter trunk sanitary sewer crossing at Dixie Road is to the flood mitigation design, additional technical analysis was also warranted at that location.

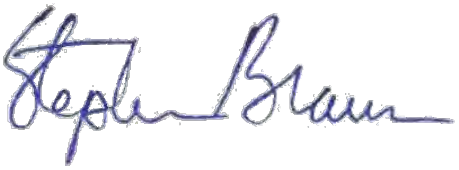
This addendum report is intended to provide the City and the Region with the required level of technical information that will allow a decision to be made regarding proposed approach. We recommend the proposed approach for these sanitary sewers be determined collaboratively between the City and the Region. The EA will then be able to integrate the direction provided.

5 CLOSURE

If you have any other questions or comments, or if an in-person or video conference would be beneficial to clarify any aspects of the enclosed items, please contact the undersigned at 289.323.0975 or by email at sbraun@matrix-solutions.com.

Yours truly,

MATRIX SOLUTIONS INC.



Stephen Braun, P.Eng.
Principal Water Resources Engineer

Reviewed by

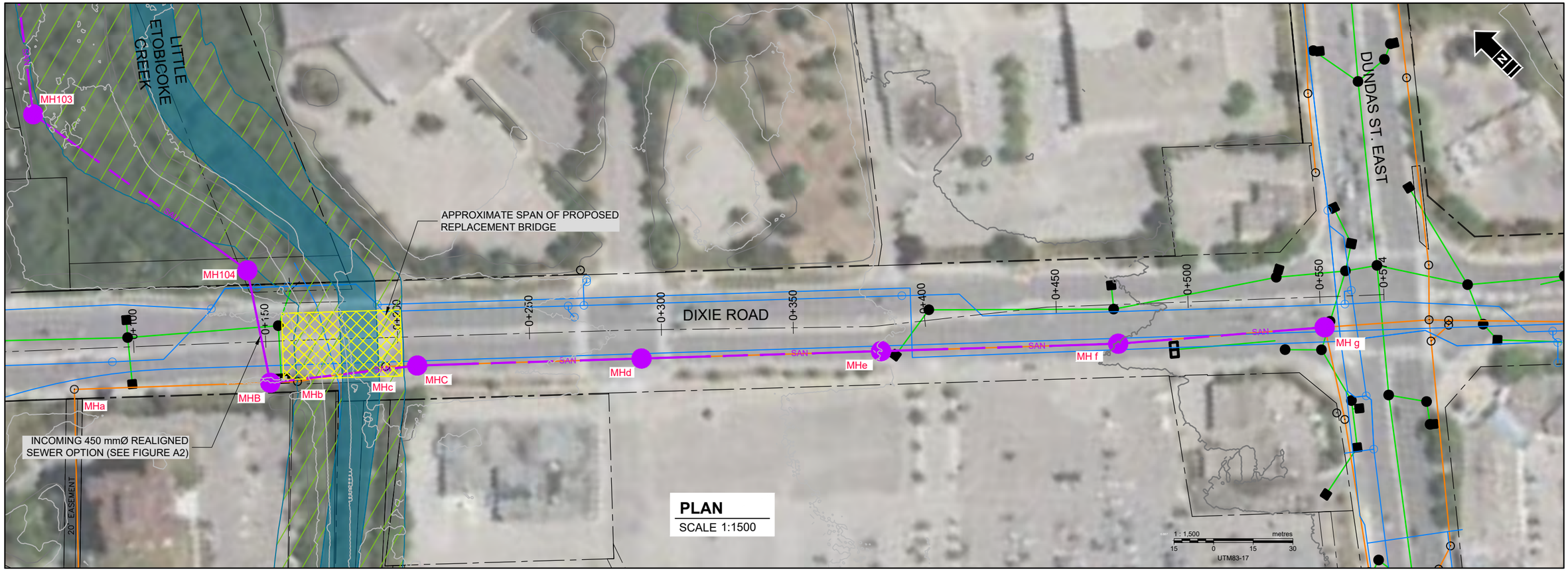
Phil Campbell, B.Eng., P.Eng.
Senior Civil Engineer

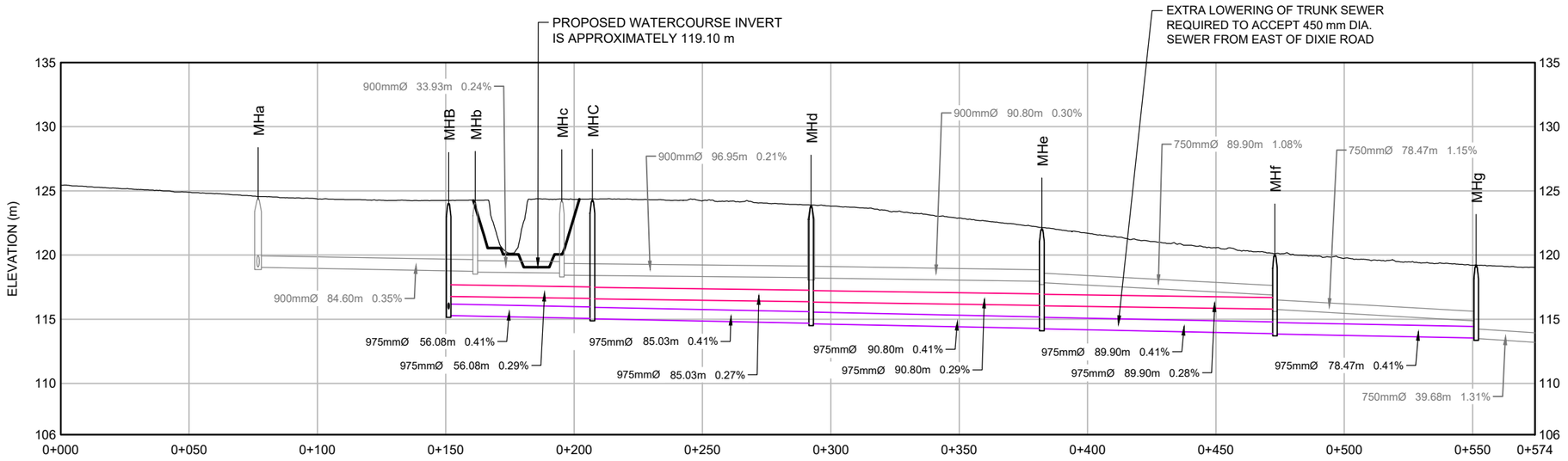
SB/vc
Attachments

VERSION CONTROL

Version	Date	Issue Type	Filename	Description
V0.1	05-Oct-2022	Draft	24603-531 Sanitary Addendum Report 2022-10-05 draft V0.1.docx	Issued to client for review
V1.0	07-Oct-2022	Final	24603-531 Sanitary Addendum Report 2022-10-07 final V1.0.docx	Issued to client

APPENDIX A
Figures





PROFILE
HORIZONTAL SCALE 1:2000
VERTICAL SCALE 1:400

LEGEND
- PROPOSED SANITARY MANHOLES
- PROPOSED SANITARY SEWER
- EXISTING SANITARY MANHOLES
- EXISTING SANITARY SEWER
- EXISTING STORM SEWER
- EXISTING WATERMAIN

REFERENCE:
1. CONCEPTUAL DIXIE ROAD BRIDGE REPLACEMENT BY R.V. ANDERSON ASSOCIATES LIMITED (APPENDIX E).
2. BASE DIGITAL INFORMATION OBTAINED FROM THE CITY OF MISSISSAUGA (SHP AND DGN FORMAT).
3. WORLD IMAGERY DATED MARCH 19 TO NOVEMBER 07 , 2021.

Note: Figure(s) must be used in conjunction with the attached report and is subject to the limitations and conditions stated in the report.

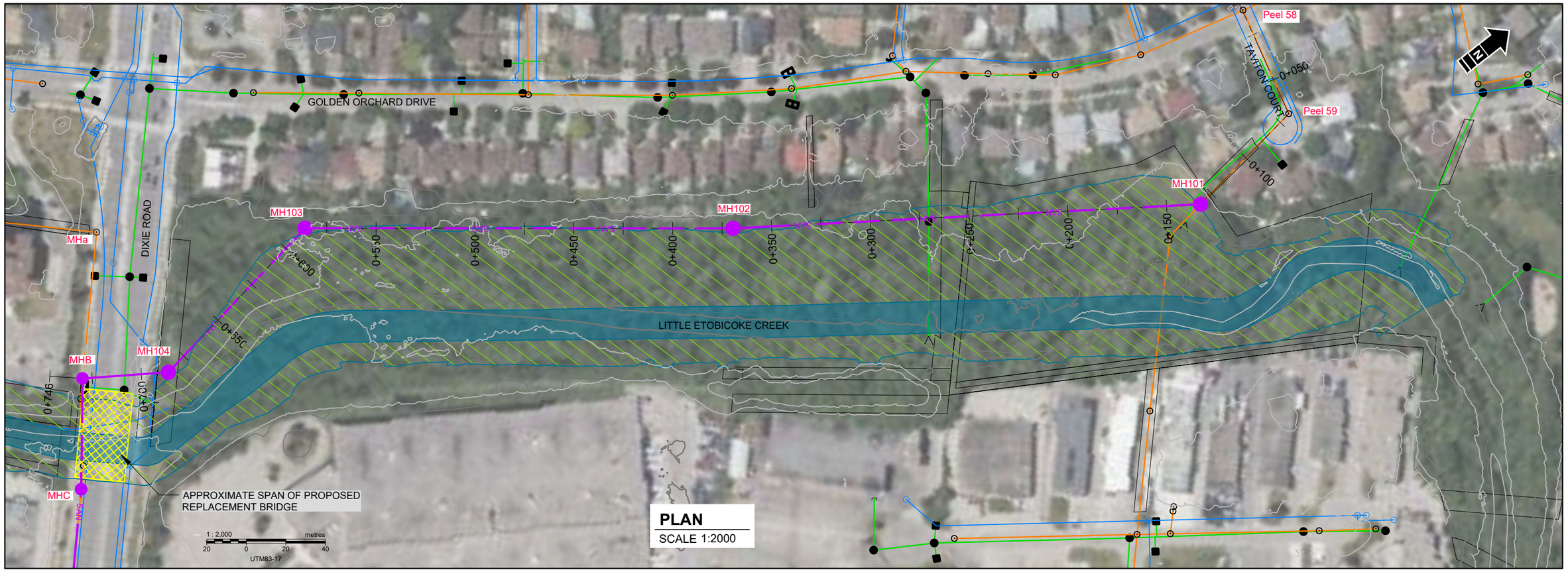
Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

CITY OF MISSISSAUGA
SANITARY ADDENDUM REPORT

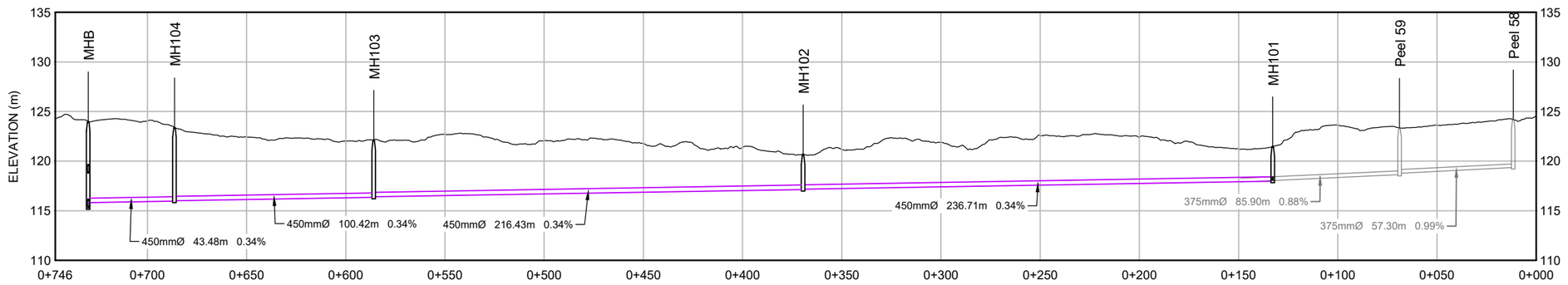
DIXIE ROAD SANITARY SEWER

Date:	Project:	Submitter:	Reviewer:
September 2022	24603-531	M. Samson	S. Braun

Figure A1



PLAN
SCALE 1:2000



PROFILE
HORIZONTAL SCALE 1:2500
VERTICAL SCALE 1:500

LEGEND

- PROPOSED SANITARY MANHOLES
- PROPOSED SANITARY SEWER
- EXISTING SANITARY MANHOLES
- EXISTING SANITARY SEWER
- EXISTING STORM SEWER
- EXISTING WATERMAIN

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Matrix Solutions Inc.
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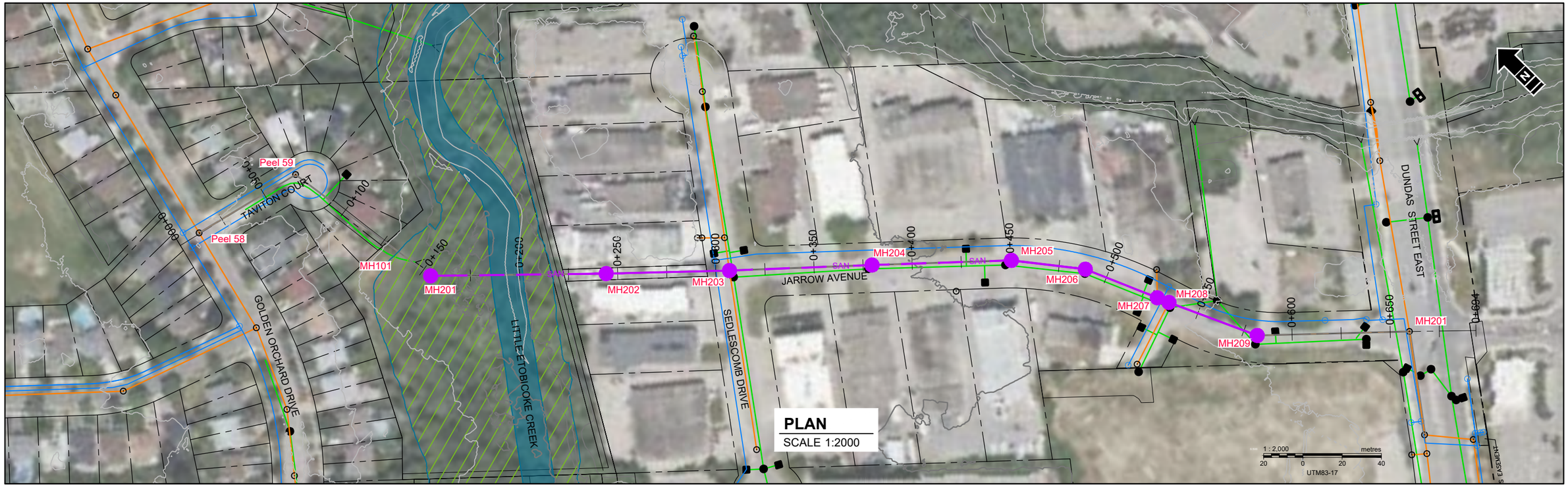
CITY OF MISSISSAUGA
SANITARY ADDENDUM REPORT

FLOODPLAIN
SANITARY SEWER REALIGNMENT

Date:	Project:	Submitter:	Reviewer:
September 2022	24603-531	M. Samson	S. Braun

Figure A2



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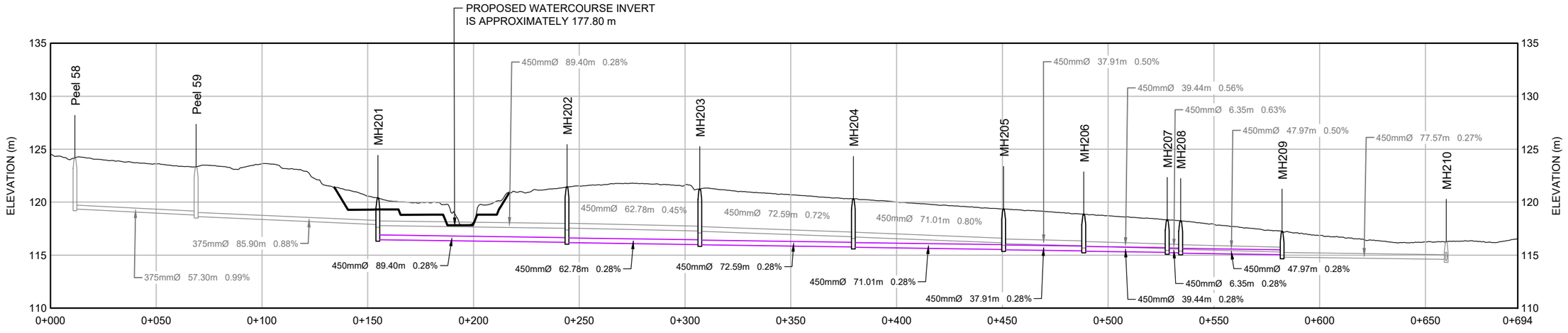

PROFILE
HORIZONTAL SCALE 1:2000
VERTICAL SCALE 1:400

LEGEND

- PROPOSED SANITARY MANHOLES
- PROPOSED SANITARY SEWER
- EXISTING SANITARY MANHOLES
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Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

CITY OF MISSISSAUGA
SANITARY ADDENDUM REPORT

LOWERING OF JARROW AVENUE SANITARY SEWER

Date:	Project:	Submitter:	Reviewer:
September 2022	24603-531	M. Samson	S. Braun

Figure A3

APPENDIX B
Tables

Table B1

Existing and Proposed Dixie Road Trunk Sanitary Sewer (upstream/north of Dundas Street)

Sufficient Lowering to gain standard cover at Little Etobicoke Creek crossing

MH name	Existing		Proposed*		Ex. Distance to d/s MH (m)	Ex Slope %	Ex Pipe Size (mm)	Ex. Vel. (m/s)	Ex Cap. (L/s)	Prop. Distance to d/s MH (m)	Prop Slope %	Prop. Pipe Size (mm)	Prop. Vel. (m/s)	Prop. Cap. (L/s)
	u/s inv	d/s inv	u/s inv	d/s inv										
a	*119.07*	*119.04*	*119.07*	*119.04*	84.6	0.35%	900	1.68	1071	74.2	0.35%	900	1.68	1071
b	*118.74*	*118.67*	118.78	116.78	33.9	0.24%	900	1.39	887	56.1	0.28%	975	1.59	1186
c	*118.59*	*118.44*	116.62	116.59	97.0	0.21%	975	1.38	1027	85.0	0.28%	975	1.59	1186
d	*118.24*	*118.22*	116.36	116.33	90.8	0.30%	975	1.64	1228	90.8	0.28%	975	1.59	1186
e	*117.95*	*117.93*	116.07	116.04	89.9	1.17%	750	2.73	1204	89.9	0.28%	975	1.59	1186
f	*116.88*	*115.76*	115.79	*115.76*	78.5	1.15%	750	2.70	1194	78.5	1.15%	750	2.70	1194
g	*114.86*	*113.50*	*114.86*	*113.50*										

* Lowering required to achieve 1.4 m cover above sewer obvert to **new creek invert level of 119.10 m** (approx.)

NOTE 1: Existing inverts maintained are marked in Italics with shading

NOTE 2: Little Etobicoke Creek crossing occurs at pipe between MH b and MH c, assumed halfway

NOTE 3: All Proposed trunk sanitary sewer assumed to be 975 mm dia. at slope indicated;

NOTE 4: Pipe information and calculations are for pipe downstream of MH. Nominal sizes used.

NOTE 5: All drops through Proposed MHs at 0.03 m (all are straight-though)

NOTE 6: MHs b and c moved to accommodate new creek valley

Slope to drive pipes 0.0028

Pipe Obvert at Creek: 117.68 m

Target: 117.70 m

Table B2

Existing and Proposed Dixie Road Trunk Sanitary Sewer (upstream/north of Dundas Street)

Maximum Lowering and retaining Capacity, cover at Little Etobicoke Creek crossing maximized

MH name	Existing		Proposed*		Ex. Distance to d/s MH (m)	Ex Slope %	Ex Pipe Size (mm)	Ex. Vel. (m/s)	Ex Cap. (L/s)	Prop. Distance to d/s MH (m)	Prop Slope %	Prop. Pipe Size (mm)	Prop. Vel. (m/s)	Prop. Cap. (L/s)
	u/s inv	d/s inv	u/s inv	d/s inv										
a	*119.07*	*119.04*	*119.07*	*119.04*	84.6	0.35%	900	1.68	1071	74.2	0.35%	900	1.68	1071
b	*118.74*	*118.67*	118.78	116.85	33.9	0.24%	900	1.39	887	56.1	0.30%	975	1.64	1228
c	*118.59*	*118.44*	116.68	116.65	97.0	0.21%	975	1.38	1027	85.0	0.30%	975	1.64	1228
d	*118.24*	*118.22*	116.39	116.36	90.8	0.30%	975	1.64	1228	90.8	0.30%	975	1.64	1228
e	*117.95*	*117.93*	116.09	116.06	89.9	1.17%	750	2.73	1204	89.9	0.30%	975	1.64	1228
f	*116.88*	*115.76*	115.79	*115.76*	78.5	1.15%	750	2.70	1194	78.5	1.15%	750	2.82	1246
g	*114.86*	*113.50*	*114.86*	*113.50*										

* Lowering to maximize cover above sewer obvert to **new creek invert level of 119.10 m** (approx.) but retain maximum capacity

NOTE 1: Existing inverts maintained are marked in Italics with shading

NOTE 2: Little Etobicoke Creek crossing occurs at pipe between MH b and MH c, assumed halfway

NOTE 3: All Proposed trunk sanitary sewer assumed to be 975 mm dia. at slope indicated;

NOTE 4: Pipe information and calculations are for pipe downstream of MH in row. Nominal sizes used.

NOTE 5: All drops through Proposed MHs at 0.03 m (all are straight-though)

NOTE 6: MHs b and c moved to accommodate new creek valley

Slope to drive pipes 0.003

Pipe Obvert at Creek: 117.74 m

Target: 117.70 m

Table B3

Existing and Proposed Dixie Road Trunk Sanitary Sewer (upstream/north of Dundas Street)

Sufficient Lowering to allow realigned 450 mm dia. pipe to contribute flow (matching obverts)

MH name	Existing		Proposed*		Distance to	Ex Slope	Ex Pipe Size	Ex. Vel.	Ex Cap.	Prop. Distance	Prop	Prop. Pipe	Prop. Vel.	Prop. Cap.
	u/s inv	d/s inv	u/s inv	d/s inv	d/s MH (m)	%	(mm)	(m/s)	(L/s)	to d/s MH (m)	Slope %	Size (mm)	(m/s)	(L/s)
a	*119.07*	*119.04*	*119.07*	*119.04*	84.6	0.35%	900	1.68	1071	74.2	0.35%	900	1.68	1071
b	*118.74*	*118.67*	118.78	115.29	33.9	0.24%	900	1.39	887	56.1	0.41%	975	1.922	1435
c	*118.59*	*118.44*	115.06	115.03	97.0	0.21%	975	1.38	1027	85.0	0.41%	975	1.922	1435
d	*118.24*	*118.22*	114.68	114.65	90.8	0.30%	975	1.64	1228	90.8	0.41%	975	1.922	1435
e	*117.95*	*117.93*	114.28	114.25	89.9	1.17%	750	2.73	1204	89.9	0.41%	975	1.922	1435
f	*116.88*	*115.76*	113.88	113.85	78.5	1.15%	750	2.7	1194	78.5	0.41%	975	1.922	1435
g	*114.86*	*113.50*	113.53	*113.50*										

* Lowering required to achieve **invert level of new incoming 450 mm sewer from east** (approx.)

NOTE 1: Existing inverts maintained are marked in Italics with shading

NOTE 2: Little Etobicoke Creek crossing occurs at pipe between MH b and MH c, assumed halfway

NOTE 3: All Proposed trunk sanitary sewer assumed to be 975 mm dia. at slope indicated;

NOTE 4: Pipe information and calculations are for pipe downstream of MH. Nominal sizes used.

NOTE 5: All drops through Proposed MHs at 0.03 m

NOTE 6: Additional capacity in trunk provided for full pipe 450 mm dia, assumed at approx 170 L/s, total Flow req'd = 170 L/s + 1248 L/s = 1418 L/s

NOTE 7: 'Target' pipe obvert is required obv elev at trunk sewer to accept 450 mm dia. sewer

NOTE 8: MHs b and c moved to accommodate new creek valley

Slope to drive pipes 0.0041

Pipe Obvert at Creek: **116.15 m**

Target: 116.35 m

Table B4

Proposed 450 mm dia. realigned through floodplain

MH name	Inverts u/s inv	Inverts d/s inv	Distance to d/s MH (m)	Slope %	Pipe Size (mm)	Vel. (m/s)	Cap. (L/s)
Peel 58	-	*119.35*	57.3	0.99%	375	1.58	175
Peel 59	*118.78*	*118.65*	63.9	0.94%	375	1.54	170
101*	*118.05*	**117.97**	236.7	0.34%	450	1.05	166
102	117.17	117.14	216.4	0.34%	450	1.05	166
103	116.40	116.35	100.4	0.34%	450	1.05	166
104	116.01	115.96	43.5	0.34%	450	1.05	166
B	115.82	**115.29**					

* New MH cut into existing line

NOTE 1: Existing inverts maintained are marked in Italics with shading

NOTE 2: Downstream MH B invert obtained from lowered Dixie Rd trunk calculations

NOTE 3: Upstream MH B invert (new 450 mm in) obtained by matching obverts to 975 out

Slope to drive pipes: 0.0034 m/m

Outgoing Invert at MH 101: **117.97** m

Target: 117.97 m

Table B5

Existing and Proposed Jarrow Ave Sanitary Sewer (upstream/north of Dundas Street)

Lowering to gain maximum potential cover at Little Etobicoke Creek crossing

MH name	Existing		Proposed*		Ex. Distance to d/s MH (m)	Ex Slope %	Ex Pipe Size (mm)	Ex. Vel. (m/s)	Ex Cap. (L/s)	Prop. Distance to d/s MH (m)	Prop Slope %	Prop. Pipe Size (mm)	Prop. Vel. (m/s)	Prop. Cap. (L/s)
	u/s inv	d/s inv	u/s inv	d/s inv										
Peel 59	*118.78*	*118.65*	*118.78*	*118.65*	85.9	0.94%	375	1.54	170	85.9	0.94%	375	1.54	170
201	*117.89*	*117.79*	*117.89*	116.46	89.4	0.28%	450	0.95	151	89.4	0.28%	450	0.95	151
202	*117.54*	*117.56*	116.21	116.18	62.8	0.45%	450	1.20	191	62.8	0.28%	450	0.95	151
203	*117.28*	*117.25*	116.01	115.98	72.6	0.72%	450	1.52	242	72.6	0.28%	450	0.95	151
204	*116.73*	*116.72*	115.77	115.74	71.0	0.80%	450	1.60	255	71.0	0.28%	450	0.95	151
205	*116.15*	*116.08*	115.54	115.51	37.9	0.50%	450	1.27	202	37.9	0.28%	450	0.95	151
206	*115.89*	*115.83*	115.41	115.38	39.4	0.56%	450	1.34	213	39.4	0.28%	450	0.95	151
207	*115.61*	*115.60*	115.27	115.24	6.4	0.63%	450	1.42	226	6.4	0.28%	450	0.95	151
208	*115.56*	*115.54*	115.22	115.19	48.0	0.50%	450	1.27	202	48.0	0.28%	450	0.95	151
209	*115.30*	*114.81*	**115.05**	*114.81*	77.6	0.27%	450	0.93	148	77.6	0.27%	450	0.93	148
210	*114.60*	*114.47*	*114.60*	*114.47*										

* Lowering to maximize cover above sewer obvert to creek invert as indicated in calculations below

NOTE 1: Existing inverts maintained are marked in Italics with shading

NOTE 2: Little Etobicoke Creek crossing occurs at pipe between MH 201 and MH 202, assumed halfway

NOTE 3: All Proposed trunk sanitary sewer assumed to be 450 mm dia. at slope indicated;

NOTE 4: Pipe information and calculations are for pipe downstream of MH in row. Nominal sizes used.

NOTE 5: All drops through Proposed MHs at 0.03 m (assumed all are straight-though)

NOTE 6: Invert elev at MH 209 set to achieve invert required IF pipe obverts had been matched at ex. MH 210 (not the case) and existing pipe grade between (0.27%)

Slope to drive pipes 0.0028 m/m

Proposed Pipe Obvert at watercourse: 116.79 m

Ex. Pipe Obvert at watercourse: 118.11 m

Estimated top elev of encasement from hydraulic modelling: **118.53 m** (assumes 0.457 m internal dia. + 0.083 wall thickness + 0.200 encasing thickness)

Invert of watercourse (estimated): 117.80 m

This watercourse invert being immed. downstream of san sewer crossing, to be used ideally in proposed creek design.

Calc. cover over prop. obvert: 1.01 m

APPENDIX C
Cost Estimate Tables

Table C1 - Costs of lowering Dixie Road Trunk Sanitary Sewer

Project Name	Dixie-Dundas Flood Mitigation EA - Sanitary Addendum Report
Project Location	Dixie Road, City of Mississauga, Region of Peel
Project Number	24603
Option ID	C1 - Dixie Road Sanitary Trunk Lowering
Description	Dixie Road (MH f to MH B)
Prepared By	Phil Campbell
Date	05-Oct-22

Input Parameters

Open Cut Creek Crossing Length	56	m	MH B to MH C
Open Cut In Roadway Length	266	m	MH B to MH f
Drop Structure Maintenance Hole	1	ea	MH B
Maintenance Holes	4	ea	MH C, d, e, f

Section 1	MAJOR CONSTRUCTION ITEMS	Estimated Quantity	Unit	Estimated Unit Cost	Total
	975mm diameter sewer	322	m	$ 3,000	$ 966,000
	Extra Over Costs for Channel Crossing Treatment/Install	56	m	$ 2,500	$ 140,000
	Drop Structure MH	1	LS	$ 250,000	$ 250,000
	1800mm dia MHs	4	ea	$ 50,000	$ 200,000
	Existing Sewer Servicing Connections	1	LS	$ 100,000	$ 100,000
	Existing Sewer Removals/Abandonment	322	m	$ 200	$ 64,400
	Maintenance of Flow During Construction	322	m	$ 250	$ 80,500
	Testing, CCTV and Commissioning	322	m	$ 100	$ 32,200
	Trench Restoration within Floodplain Reconstruction Limits	56	m	$ 100	$ 5,600
	Trench Restoration within Road Reconstruction Limits	206	m	$ 500	$ 103,000
	Trench Restoration beyond Floodplain and Road Reconstruction Limits	60	m	$ 2,000	$ 120,000
SUBTOTAL	**MAJOR CONSTRUCTION ITEMS**				**$ 2,061,700**

Section 2	OTHER CONSTRUCTION ITEMS	Estimated Quantity	Factor	Total
	Minor Items	$ 2,061,700	5%	$ 103,100
	Traffic Control	$ 2,061,700	5%	$ 103,100
	Erosion/Sediment Control	$ 2,061,700	3%	$ 61,900
	Dewatering and Water Management	$ 2,061,700	3%	$ 61,900
	Access and Staging	$ 2,061,700	3%	$ 61,900
	General Items	$ 2,061,700	3%	$ 61,900
SUBTOTAL	**OTHER CONSTRUCTION ITEMS**			**$ 453,800**

Section 3	SOFT COSTS	Quantity	Factor	Total
	Engineering Study/Design/Approvals	$ 2,515,500	8%	$ 201,240
	Engineering CA and Inspection	$ 2,515,500	5%	$ 125,775
	Inflation (2022 $ to 2025 $)	$ 2,515,500	12%	$ 301,860
	Contingency	$ 2,515,500	20%	$ 503,100
SUBTOTAL	**SOFT COSTS**			**$ 1,131,975**

Section 4	CONTEXT ADJUSTMENTS FACTORS	Quantity	Factor		Total
N	Greenfield Area				
N	Brownfield Area				
Y	Urban Area	$ 2,515,500	10%		$ 251,600
N	Semi-Urban Area				
N	Rural Area				
Y	Utilities Present	$ 2,515,500	10%		$ 251,600
N	Private Surface Features				
Y	Naturalized Area	$ 2,515,500	2.5%	Partial	$ 62,900
N	Railway Area				
Y	Regional Influence Area	$ 2,515,500	5%		$ 125,800
N	Provincial Influence Area				
N	Cost Sharing Applicable				
SUBTOTAL	**CONTEXT ADJUSTMENTS FACTORS**				**$ 691,900**

C1	**GRAND TOTAL (excl HST)**	**$ 4,339,375**

Table C2 - Costs of "Extra" Lowering of Dixie Road Trunk Sanitary Sewer to accommodate 450 mm Sanitary Sewer Realignment from East

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

Project Name	Dixie-Dundas Flood Mitigation EA - Sanitary Addendum Report
Project Location	Dixie Road, City of Mississauga, Region of Peel
Project Number	24603
Option ID	C2 - Extra Dixie Road Sanitary Trunk Lowering to Accommodate 450mm Re-alignment from east
Description	Dixie Road (MH g to MH B)
Prepared By	Phil Campbell/S Braun
Date	05-Oct-22

Input Parameters

Open Cut Creek Crossing Length	56	m	MH B to MH C
Open Cut In Roadway Length	345	m	MH B to MH g
Drop Structure Maintenance Hole	1	ea	MHB
Maintenance Holes	5	ea	MH C, d, e, f, g

Section 1	MAJOR CONSTRUCTION ITEMS	Estimated Quantity	Unit	Estimated Unit Cost	Total
	975mm diameter sewer	401	m	$ 3,500	$ 1,403,500
	Extra Over Costs for Channel Crossing Treatment/Install	56	m	$ 2,500	$ 140,000
	Drop Structure MH	1	LS	$ 300,000	$ 300,000
	1800mm dia MHs	5	ea	$ 60,000	$ 300,000
	Existing Sewer Servicing Connections	1	LS	$ 100,000	$ 100,000
	Existing Sewer Removals/Abandonment	401	m	$ 200	$ 80,200
	Maintenance of Flow During Construction	401	m	$ 250	$ 100,250
	Testing, CCTV and Commissioning	401	m	$ 100	$ 40,100
	Trench Restoration within Floodplain Reconstruction Limits	56	m	$ 100	$ 5,600
	Trench Restoration within Road Reconstruction Limits	206	m	$ 500	$ 103,000
	Trench Restoration beyond Floodplain and Road Reconstruction Limits	139	m	$ 2,000	$ 278,000
SUBTOTAL	**MAJOR CONSTRUCTION ITEMS**				**$ 2,850,650**

Section 2	OTHER CONSTRUCTION ITEMS	Estimated Quantity	Factor	Total
	Minor Items	$ 2,850,650	5%	$ 142,600
	Traffic Control	$ 2,850,650	5%	$ 142,600
	Erosion/Sediment Control	$ 2,850,650	3%	$ 85,600
	Dewatering and Water Management	$ 2,850,650	3%	$ 85,600
	Access and Staging	$ 2,850,650	3%	$ 85,600
	General Items	$ 2,850,650	3%	$ 85,600
SUBTOTAL	**OTHER CONSTRUCTION ITEMS**			**$ 627,600**

Section 3	SOFT COSTS	Quantity	Factor	Total
	Engineering Study/Design/Approvals	$ 3,478,250	8%	$ 278,260
	Engineering CA and Inspection	$ 3,478,250	5%	$ 173,913
	Inflation (2022 $ to 2025 $)	$ 3,478,250	12%	$ 417,390
	Contingency	$ 3,478,250	20%	$ 695,650
SUBTOTAL	**SOFT COSTS**			**$ 1,565,213**

Section 4	CONTEXT ADJUSTMENTS FACTORS	Quantity	Factor		Total
N	Greenfield Area				
N	Brownfield Area				
Y	Urban Area	$ 3,478,250	10%		$ 347,900
N	Semi-Urban Area				
N	Rural Area				
Y	Utilities Present	$ 3,478,250	10%		$ 347,900
N	Private Surface Features				
Y	Naturalized Area	$ 3,478,250	2.5%	Partial	$ 87,000
N	Railway Area				
Y	Regional Influence Area	$ 3,478,250	5%		$ 174,000
N	Provincial Influence Area				
N	Cost Sharing Applicable				
SUBTOTAL	**CONTEXT ADJUSTMENTS FACTORS**				**$ 956,800**

C2	**GRAND TOTAL (excl HST)**	**$ 6,000,263**

Table C3 - Costs of 450mm Sanitary Sewer Re-alignment through Little Etobicoke Creek Corridor from Taviton Court to Dixie Road

Matrix Solutions Inc. ENVIRONMENT & ENGINEERING

Project Name	Dixie-Dundas Flood Mitigation EA - Sanitary Addendum Report
Project Location	Dixie Road, City of Mississauga, Region of Peel
Project Number	24603
Option ID	C3 - 450mm Sanitary Sewer Re-alignment through Little Etobicoke Creek Corridor from Taviton Court to Dixie Road
Description	Little Etobicoke Creek Corridor (MHB to MH101) * See table C2 for Dixie Road Sewer lowering required to accommodate 450mm re-alignment*
Prepared By	Phil Campbell/S Braun
Date	05-Oct-22

Input Parameters

Open Cut Creek Crossing Length	0	m	
Open Cut In Floodplain, under prop. Pathway Length	555	m	MH 101 to MH 104
Open Cut In Roadway Length	44	m	MH 104 to MHB
Drop Structure Maintenance Hole	0	ea	
Maintenance Holes	4	ea	MH 104, 103, 102, 101

Section 1	MAJOR CONSTRUCTION ITEMS	Estimated Quantity	Unit	Estimated Unit Cost	Total
	450mm diameter sewer	599	m	$ 600	$ 359,400
	Extra Over Costs for Channel Crossing Treatment/Install	0	m	$ 2,500	$ -
	Drop Structure MH	0	LS	$ 300,000	$ -
	1200mm dia MHs	4	ea	$ 20,000	$ 80,000
	Existing Sewer Servicing Connections	1	LS	$ 40,000	$ 40,000
	Existing Sewer Removals/Abandonment	0	m	$ 200	$ -
	Maintenance of Flow During Construction	0	m	$ 250	$ -
	Testing, CCTV and Commissioning	599	m	$ 100	$ 59,900
	Trench Restoration within Floodplain Reconstruction Limits	555	m	$ 100	$ 55,500
	Trench Restoration within Road Reconstruction Limits	44	m	$ 500	$ 22,000
	Trench Restoration beyond Floodplain and Road Reconstruction Limits	0	m	$ 1,500	$ -
SUBTOTAL	**MAJOR CONSTRUCTION ITEMS**				**$ 616,800**

Section 2	OTHER CONSTRUCTION ITEMS	Estimated Quantity	Factor	Total
	Minor Items	$ 616,800	5%	$ 30,900
	Traffic Control	$ 616,800	2%	$ 12,400
	Erosion/Sediment Control	$ 616,800	2%	$ 12,400
	Dewatering and Water Management	$ 616,800	2%	$ 12,400
	Access and Staging	$ 616,800	2%	$ 12,400
	General Items	$ 616,800	3%	$ 18,600
SUBTOTAL	**OTHER CONSTRUCTION ITEMS**			**$ 99,100**

Section 3	SOFT COSTS	Quantity	Factor	Total
	Engineering Study/Design/Approvals	$ 715,900	8%	$ 57,272
	Engineering CA and Inspection	$ 715,900	5%	$ 35,795
	Inflation (2022 $ to 2025 $)	$ 715,900	12%	$ 85,908
	Contingency	$ 715,900	20%	$ 143,180
SUBTOTAL	**SOFT COSTS**			**$ 322,155**

Section 4	CONTEXT ADJUSTMENTS FACTORS	Quantity	Factor		Total
Y	Greenfield Area	$ 715,900	-10%		-$ 71,600
N	Brownfield Area				
N	Urban Area				
N	Semi-Urban Area				
N	Rural Area				
Y	Utilities Present	$ 715,900	5%	Partial	$ 35,800
N	Private Surface Features				
Y	Naturalized Area	$ 715,900	0%	Co-incident with Channel Work	
N	Railway Area				
N	Regional Influence Area				
N	Provincial Influence Area				
N	Cost Sharing Applicable				
SUBTOTAL	**CONTEXT ADJUSTMENTS FACTORS**				**-$ 35,800**

C3	**GRAND TOTAL (excl HST)**	**$ 1,002,255**
C2	**GRAND TOTAL (excl HST)**	**$ 6,000,263**
C3 + C2	**GRAND TOTAL (excl HST)**	**$ 7,002,518**
C3 + C2 - C1	**Extra Over C1 Cost to accommodate Taviton Ct. 450mm Sanitary Re-Alignment**	**$ 2,663,143**

Table C4 - Costs of 450 mm Sanitary Sewer Lowering from Taviton Ct to Dundas St via Jarrow Ave

Matrix Solutions Inc. ENVIRONMENT & ENGINEERING

Project Name	Dixie-Dundas Flood Mitigation EA - Sanitary Addendum Report
Project Location	Dixie Road, City of Mississauga, Region of Peel
Project Number	24603
Option ID	C4 - 450 mm Sanitary Sewer Lowering from Taviton Ct to Dundas St via Jarrow Ave
Description	Jarrow Avenue (MH 209 to MH 201)
Prepared By	Phil Campbell/S Braun
Date	05-Oct-22

Input Parameters

Open Cut Creek Crossing Length	90	m	MH 201 to MH 202
Open Cut in Easement Length	63	m	MH 202 to MH 203
Open Cut In Roadway Length	276	m	MH 203 to MH 209
Drop Structure Maintenance Hole	1	ea	MH 201
Maintenance Holes	8	ea	MH 202 to MH 209

Section 1	MAJOR CONSTRUCTION ITEMS	Estimated Quantity	Unit	Estimated Unit Cost	Total
	450mm diameter sewer	429	m	$ 600	$ 257,400
	Extra Over Costs for Channel Crossing Treatment/Install	90	m	$ 2,500	$ 225,000
	Extra Over Costs for Easement Treatment/Install	63	m	$ 1,000	$ 63,000
	Drop Structure MH	1	LS	$ 100,000	$ 100,000
	1200mm dia MHs	8	ea	$ 20,000	$ 160,000
	Existing Sewer Servicing Connections	1	LS	$ 100,000	$ 100,000
	Existing Sewer Removals/Abandonment	429	m	$ 200	$ 85,800
	Maintenance of Flow During Construction	429	m	$ 100	$ 42,900
	Testing, CCTV and Commissioning	429	m	$ 100	$ 42,900
	Trench Restoration within Floodplain Reconstruction Limits	90	m	$ 100	$ 9,000
	Trench Restoration within Road Reconstruction Limits	0	m	$ 500	$ -
	Trench Restoration beyond Floodplain and Road Reconstruction Limits	339	m	$ 1,000	$ 339,000
SUBTOTAL	**MAJOR CONSTRUCTION ITEMS**				**$ 1,425,000**

Section 2	OTHER CONSTRUCTION ITEMS	Estimated Quantity	Factor	Total
	Minor Items	$ 1,425,000	5%	$ 71,300
	Traffic Control	$ 1,425,000	3%	$ 42,800
	Erosion/Sediment Control	$ 1,425,000	3%	$ 42,800
	Dewatering and Water Management	$ 1,425,000	3%	$ 42,800
	Access and Staging	$ 1,425,000	3%	$ 42,800
	General Items	$ 1,425,000	3%	$ 42,800
SUBTOTAL	**OTHER CONSTRUCTION ITEMS**			**$ 285,300**

Section 3	SOFT COSTS	Quantity	Factor	Total
	Engineering Study/Design/Approvals	$ 1,710,300	8%	$ 136,824
	Engineering CA and Inspection	$ 1,710,300	5%	$ 85,515
	Inflation (2022 $ to 2025 $)	$ 1,710,300	12%	$ 205,236
	Contingency	$ 1,710,300	20%	$ 342,060
SUBTOTAL	**SOFT COSTS**			**$ 769,635**

Section 4	CONTEXT ADJUSTMENTS FACTORS	Quantity	Factor		Total
N	Greenfield Area				
N	Brownfield Area				
N	Urban Area				
Y	Semi-Urban Area	$ 1,710,300	8%		$ 136,900
N	Rural Area				
Y	Utilities Present	$ 1,710,300	5%	Local Road	$ 85,600
N	Private Surface Features				
Y	Naturalized Area	$ 1,710,300	2.5%	Partial	$ 42,800
N	Railway Area				
N	Regional Influence Area				
N	Provincial Influence Area				
N	Cost Sharing Applicable				
SUBTOTAL	**CONTEXT ADJUSTMENTS FACTORS**				**$ 265,300**

C4	**GRAND TOTAL (excl HST)**	**$ 2,745,235**

APPENDIX D
R.V. Anderson and Associates Limited Report

Dixie-Dundas Flood Mitigation

Dixie Road Bridge Feasibility Report

Prepared for:
Matrix Solutions Inc.

RVA 184319

May 26, 2020

R.V. Anderson Associates Limited
2001 Sheppard Avenue East Suite 300
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Tel 416 497 8600 Fax 855 833 4022
www.rvanderson.com

May 26, 2020 RVA 184319

Matrix Solutions Inc.
6865 Century Ave, Unit 3001
Mississauga, ON L5N 7K2

Attention: Mr. Andrew Doherty, P.Eng.

Dear Mr. Doherty:

Re: Dixie Road Bridge Feasibility Review

R.V. Anderson Associates Limited (RVA) is pleased to submit this Technical Memorandum to **Matrix Solutions Inc. (Matrix)** regarding the above project.

The purpose of this Technical Memorandum is to assess the best replacement structure for the Dixie Road Bridge. This includes evaluating the optimal structure as well as the required road work associated with said structure for each of the proposed channel options provided by Matrix. RVA is well suited to undertake this project since we can leverage our experience in structural and road design. Our team understands the project requirements for design and is confident in that our recommendations provide the best option with the information available.

Please do not hesitate to contact the undersigned if you have any further questions or comments.

Yours very truly,

R.V. ANDERSON ASSOCIATES LIMITED

François Duguay, M.Eng., P.Eng.
Intermediate Structural Engineer

David O'Sullivan, P.Eng., PMP
Senior Associate, Structural Engineer

Dixie-Dundas Flood Mitigation
Dixie Road Bridge Feasibility Report

TABLE OF CONTENTS

LIST OF TABLES

1.0 BACKGROUND INFORMATION

An extreme rainfall event flooded the east side of the City of Mississauga on July 8, 2018. In coordination with Matrix Solutions Incorporated (Matrix) and R.V. Anderson Associates Limited (RVA), the City of Mississauga is carrying out a Feasibility Study to determine options for preventing future flooding upstream of the bridge.

Matrix have prepared three potential alternatives for the approach to flood mitigation:

Option 1: Channel conveyance with minimized footprint.

Option 2: Channel conveyance by making room for the creek.

Option 3: Flood containment with mitigation for upstream impacts.

RVA was tasked with proposing a conceptual replacement structure for Dixie Road Bridge for each of those options. The following sections will present the proposed replacement structure for each of the options. The span configuration for the proposed bridge structure, hydraulic improvements at the structure location, new road profile associated with each bridge option and their impacts, constructability for each option, and structure costs will be presented.

2.0 RECOMMENDED SPAN CONFIGURATION

The following section will present the three (3) proposed bridge span configuration to replace the existing Dixie Road Bridge crossing the Little Etobicoke Creek. Preliminary profiles for all three (3) options can be found in APPENDIX A.

2.1 Option 1 – Minimize footprint

The proposed span configuration for Option 1 is a 26 metres single-span precast prestressed concrete girder bridge. NU1600 girders would be used for the superstructure, bringing the depth of the new superstructure to approximately 2.3 metres. The bottom of the new superstructure would be at an elevation of approximately 123.7 metres. This elevation established by Matrix Solutions would provide a 0.5 metre freeboard for climate change resiliency above the regional flood level of 123.2 metres and would meet current CAN/CSA-S6-14 requirements. This option would raise the current road crown vertical alignment, at the Dixie Road Bridge location, by approximately 1.7 metres.

2.2 Option 2 – Making room for the creek

The proposed span configuration for Option 2 is a 45 metres two-span precast prestressed concrete girder bridge. NU900 girders would be used for the superstructure, bringing the depth of the new superstructure to 1.6 metres. The bottom of the new superstructure would be located at elevation 123.1 metres. This elevation established by Matrix Solutions would provide a 0.4 metre freeboard for climate change resiliency above the regional flood level of 122.7 metres and would meet current CAN/CSA-S6-14 requirements. This option would raise the current alignment, at the Dixie Road Bridge location, by approximately 0.7 metres. This option would require the construction of a pier and foundation in the proposed new larger hydraulic channel.

2.3 Option 3 – Flood containment with mitigation for upstream impacts

The proposed span configuration for Option 3 is a 28 metres single-span precast prestressed concrete girder bridge. NU1600 girders would be used for the superstructure, bringing the depth of the new superstructure to 2.3 metres. The bottom of the new superstructure would be located at elevation 124.5 metres. This elevation established by Matrix Solutions would provide a 0.4 metre freeboard for climate change resiliency above the regional flood level of 124.1 metres and would meet current CAN/CSA-S6-14 requirements. This option would raise the current alignment, at the Dixie Road Bridge location, by approximately 2.6 metres.

3.0 HYDRAULICS

The following section will explain how all three (3) options are improving the hydraulic opening at the Dixie Road Bridge location.

Like previously shown in Section 2, all three (3) options would replace the existing structure with a new structure with a longer span than the current one. Assuming 2:1 slope from the bridge abutment down to the bottom of the new improved channel, all three options would provide a significant increase to the hydraulic opening compared to the existing conditions. Table 3-1 summarizes the water elevation for all three (3) options during a 1-in-100 years storm, for the Regional Flood Level, and the elevation at the bottom the superstructure. These elevations were provided by Matrix Solution Inc. based on the hydraulic modelling of the three (3) conceptual designs.

Table 3.1 – Critical water level for each option

	1-in-100 years Level	Regional Flood Level	Bottom of superstructure
Option 1	122.1 m	123.2 m	123.7 m
Option 2	122.0 m	122.7 m	123.1 m
Option 3	123.1 m	124.1 m	124.5 m

Option 1, with a 26 metres span, would result in an opening of approximately 74.8 m^2. With a 45 metres two-span structure, Option 2 would result in the largest hydraulic opening of all options with an area of 113.4 m^2. This area is divided in two sections, one for the smaller channel at the bottom of the creek which would be 13.4 m^2 for normal water flows, then an additional 100 m^2 capacity during storm events. Finally, the hydraulic opening for Option 3 would be of 83.5 m^2. The larger opening compared to Option 1 is due to the higher elevation of the structure and longer span, creating a larger opening.

It should be noted that all the previously mentioned areas include the freeboard elevation for climate change resiliency.

4.0 IMPACTS

The following section will give a brief description of the anticipated impacts for each of the proposed options.

4.1 Option 1 – Minimize footprint

According to RVA's conceptual design, the length of the construction zone for Option 1 would be in excess of 500 metres long. At this stage of design, the final road alignment has not yet been confirmed. With the new structure being approximately 1.7 metres higher than the existing top of roadway, significant vertical road realignment would be required to match the existing road to the new structure. Some retaining walls would be required at specific locations to realign the road. Substantial temporary road protection shoring, including mechanically stabilized earth walls, is also expected to be required to maintain traffic during removal of existing structure, construction of new structure and realignment of the road during the different stages of construction.

4.2 Option 2 – Make room for the creek

The length of the construction zone for Option 2 is anticipated to be approximately 300 metres long. The small increase in elevation, especially compared to Option 1 and 3,

would require a shorter length of the existing road to be realigned vertically. At this stage, it's anticipated that no retaining walls will be required to realign the roadway and that no significant shoring will be required as well. Excavation to increase the hydraulic opening for the Little Etobicoke Creek will require more effort compared to Option 1 and 3. Minimal road protection shoring is anticipated with this option in order to stage construction while maintaining traffic.

4.3 Option 3 – Flood containment with mitigation for upstream impacts

At this stage, the construction zone for Option 3 is estimated to be in excess of 600 metres long. The final value could be much larger as the new propose structure would be 2.3 metres higher than existing top of roadway. Significant vertical road realignment over a long distance would be required to bring the roadway to the new structure height. Some retaining walls would be required at specific locations to realign the road. Substantial temporary road protection shoring, including mechanically stabilized earth walls, is also expected to be required to maintain traffic during removal of existing structure, construction of new structure and realignment of the road during the different stages of construction.

5.0 CONSTRUCTABILITY

All three (3) options presented would be constructed using a staged approach. This approach is required to maintain a minimum of four lanes of traffic and a left-turning lane throughout the construction of the new structure. Three main stages would be required to construct the new structure while maintaining an acceptable level of traffic on Dixie road. The three proposed stages are as follows:

Stage 1. Traffic will be moved on the western two thirds of the existing bridge. Proper traffic control would be implemented and the eastern third of the existing bridge would be demolished and removed. The first third of the new structure would then be constructed all the while maintaining traffic on the remaining two thirds of the existing structure.

Stage 2. Once Stage 1 is completed, traffic will be diverted onto the first third of the new structure and the western third of the existing structure. The middle section of the existing bridge will be demolished and removed. The middle third of the new structure will be constructed.

Stage 3. Once Stage 2 is completed, traffic will be diverted on the eastern two third of the new structure. The remaining section of the existing structure will be demolished and removed. The final third of the new structure would

then be constructed, and traffic allowed on the full structure once Stage 3 was completed.

Following the opening of the completed new Dixie Road Bridge, channel work as well as site work could be completed while maintaining a safe work site for the workers and the through traffic.

All three (3) options will require the existing channel to be excavated to create a larger hydraulic opening.

The road elevation at the location of the structure will be raised by approximately 1.7 metres for Option 1, and by about 2.6 metres for Option 3. This difference in elevation between the new road alignment and the existing will require some shoring to be in place during the staged construction to stabilize the new higher embankment next to the existing road until the construction is over. Having proper shoring in place while maintaining adequate lane width for the traffic will be an additional challenge for these two options.

Option 2 will require a bridge pier to be constructed in the newly excavated channel to support to the two spans of the structure. This pier and its foundation will require access to construction equipment to bottom. Since the road alignment will only be raised by 0.7m, it is anticipated that minimum or no shoring will be required to retain the new road embankment during construction.

6.0 COST ESTIMATE

Based on the proposed geometry for the three (3) options, a preliminary cost estimate was prepared for each new structure. Table 6-1 presents a high-level cost estimates for all three structures. The cost presented in Table 6-1 includes the new replacement structure as well the anticipated items required for the realign the existing road with the new bridge structure. A preliminary breakdown of the items and cost can be found in Appendix B.

Table 6.1 – Cost estimate for three (3) options.

	Configuration	Cost
Option 1	One span, 26m	$ 7,600,000
Option 2	Two spans, 45m	$ 5,400,000
Option 3	One span, 28m	$ 8,400,000

7.0 SUMMARY AND PREFERRED OPTION

As discussed previously in this report, all three options presented increased the hydraulic opening to various degrees. While Options 1 and 3 involved a smaller bridge structure, it was noted that the impact on the surrounding area would be much larger compared to Option 2. The increase in final elevation for the roadway would require significant vertical road realignment compared to Option 2 and in turn increase the cost of Options 1 and 3. Table 7-1 summarizes the differences between the three (3) proposed options.

Table 7.1 – Comparison of the three (3) options

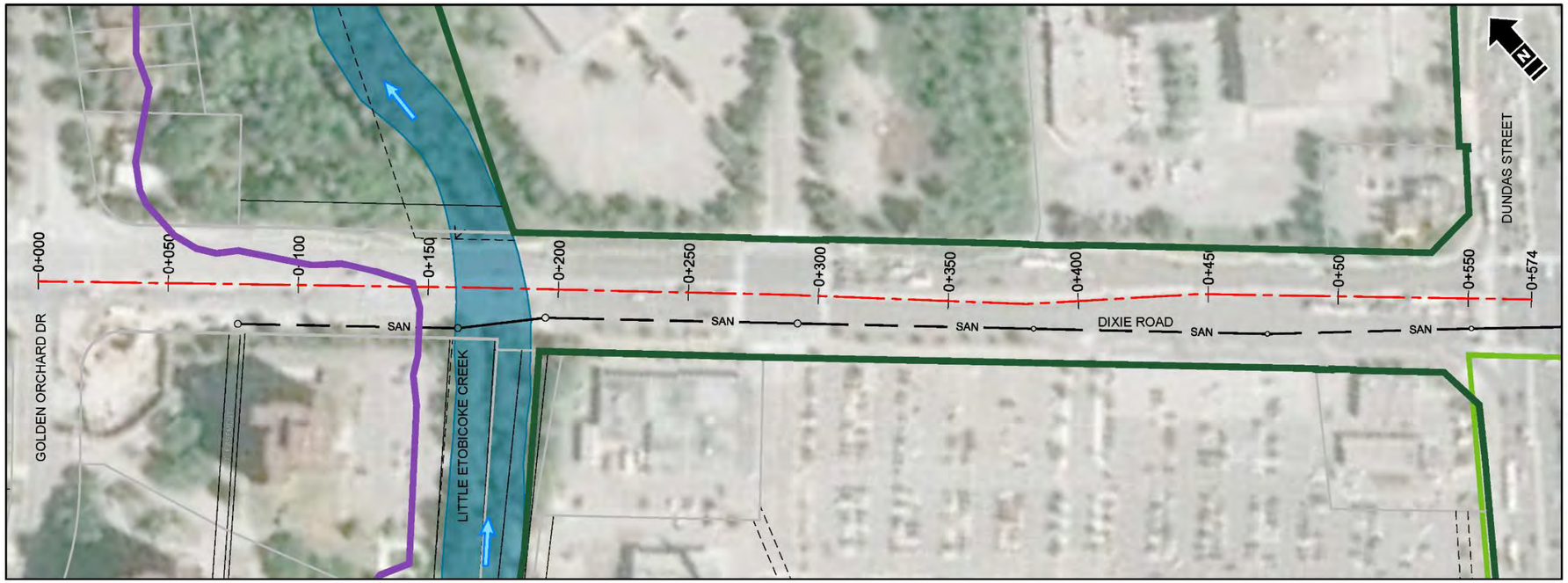
	Option 1	Option 2	Option 3
Span configuration	1 Span – 26 m	2 Spans – 45 m	1 Span – 28 m
Freeboard	0.5 m	0.4 m	0.4 m
Hydraulic opening	74.8 m^2	113.4 m^2	83.5 m^2
Constructability	Standard	Standard	Standard
Impact	Large	Small	Largest
Price	$ 7,600,000	$ 5,400,000	$ 8,200,000

After evaluating all three options, RVA believes that the two-span structure (Option 2) is the best option. When comparing all three proposed option, it becomes clear that Option 2 present the best value. The shallower superstructure will provide the least impact on the vicinity of the project while also providing the largest hydraulic opening as well as the lowest cost.

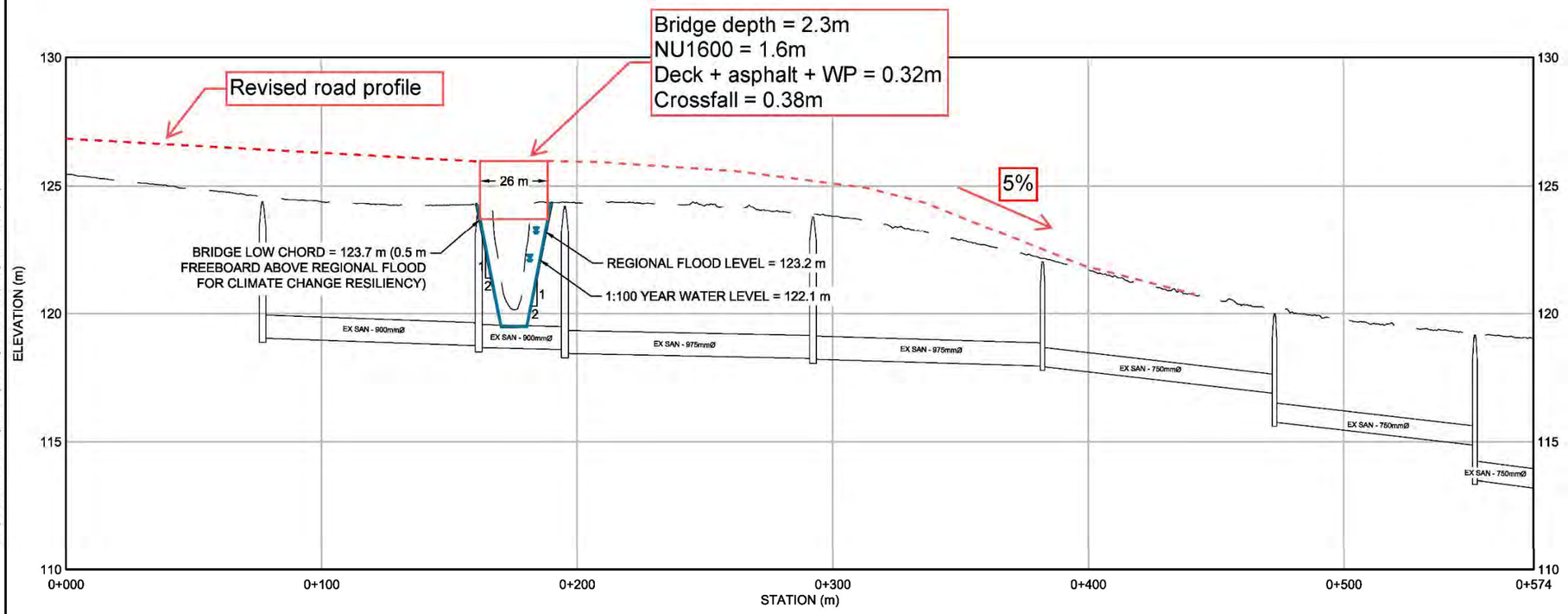
The next step of this project will be to proceed with the Environmental Assessment (EA). Each option will be evaluated, with input from the public and regulatory agencies, to select the preferred option. Once the preferred option has been chosen, the project will move forward with the preliminary design.

Appendix A

ALIGNMENTS



PLAN



DIXIE ROAD PROFILE

LEGEND

- FLOOD PROTECTION LANDFORM
- CREEK CENTRELINE
- CREEK MODIFICATIONS (BANKFULL CHANNEL)
- CREEK MODIFICATIONS (FLOODPLAIN)
- SPECIAL POLICY AREA (SPA)
- LITTLE ETOBICOKE CREEK WATERSHED BOUNDARY
- TRCA REGULATION LIMIT
- EASEMENT
- FLOW DIRECTION
- CROSS-SECTION

1 : 2,000 metres
20 0 20 40
HORIZONTAL SCALE

1 : 200 metres
2 0 2 4
VERTICAL SCALE

NOT FOR CONSTRUCTION

REFERENCE:

1. EXISTING CHANNEL ELEVATIONS BASED ON SURVEY BY MMM (2013). FLOODPLAIN AND DIXIE ROAD ELEVATIONS BASED ON TRCA LIDAR SURVEY (2017).
2. THE 900 mm DIAMETER SANITARY SEWER IS HIGHLIGHTED ON THIS DRAWING AS A KEY INFRASTRUCTURE CONFLICT AT DIXIE ROAD. THE SANITARY SEWER INFORMATION WAS OBTAINED FROM REGION OF PEEL GIS DATA. ADDITIONAL LINEAR INFRASTRUCTURE CROSSING BELOW LEC ARE SHOWN ON THE CONCEPTUAL PROFILE DRAWINGS 1-2, 2-2, 3-2 BASED ON REGION OF PEEL GIS DATA AND DRAWING RECORDS.
3. BASE PLANS WILL BE ADVANCED DURING PRELIMINARY DESIGN TO FURTHER DOCUMENT INFRASTRUCTURE CONFLICTS AND RELOCATION REQUIREMENTS FOR ROADWAYS, PROPERTY LIMITS, SANITARY SEWERS, WATERMAINS, AND UTILITIES.
4. THE REGIONAL WATER LEVEL IS BASED ON MODELLING THE CONCEPTUAL ALTERNATIVE SOLUTION USING THE 1D_2-D MIKE FLOOD MODEL DEVELOPED BY MMM (2015) AND ADVANCED BY MATRIX (2018).
5. THE 1:100 YEAR WATER LEVEL IS ESTIMATED FROM MODELLING THE CONCEPTUAL ALTERNATIVE SOLUTIONS USING THE TRCA HEC-RAS MODEL (2016).

REVISION

No.	DATE	DESCRIPTION	BY	CHK.	DRN.
A	2020-05-12	ISSUED FOR REVIEW	AD	SB	KW

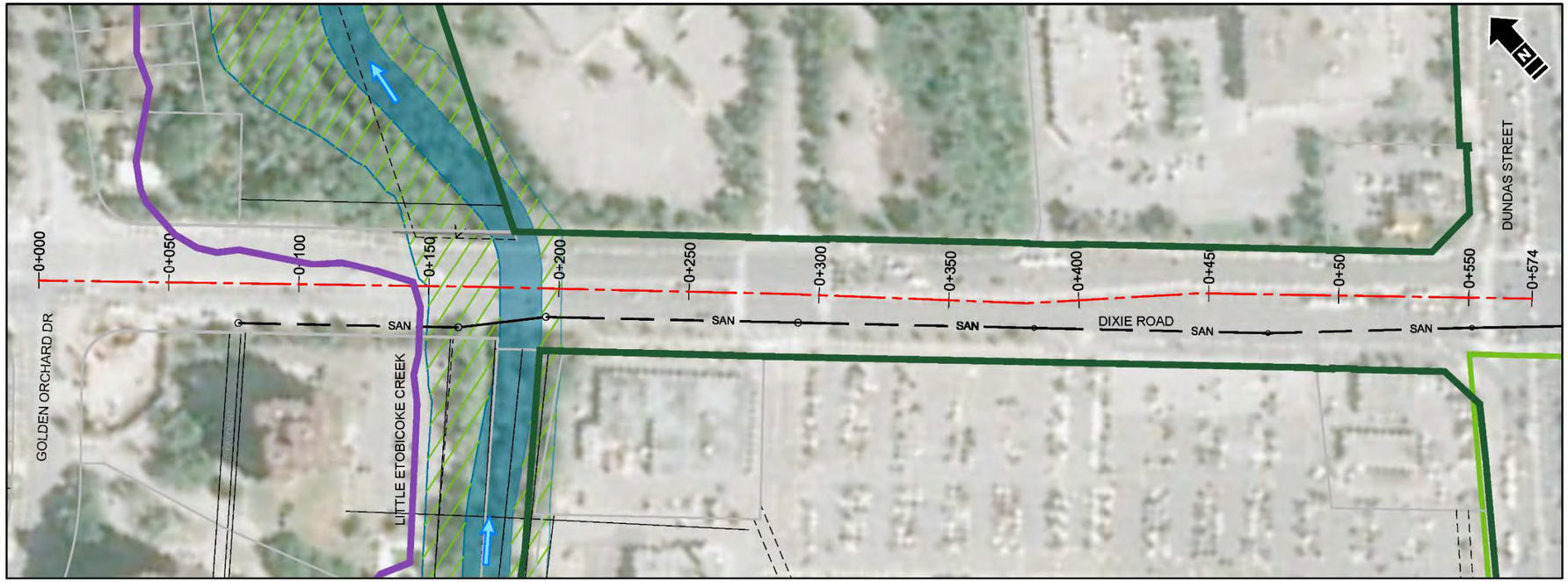
Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

CITY OF MISSISSAUGA
DIXIE-DUNDAS FLOOD MITIGATION

OPTION 1
MINIMIZED FOOTPRINT
CONCEPTUAL DIXIE ROAD CROSSING

DATE:	TECHNICAL:	REVIEWER:	DRAWN:
MAY 2020	A.DOHERTY	S.BRAUN	K.WEILER

PROJECT:	REVISION:	DRAWING:
24603-531	A	RVA-1



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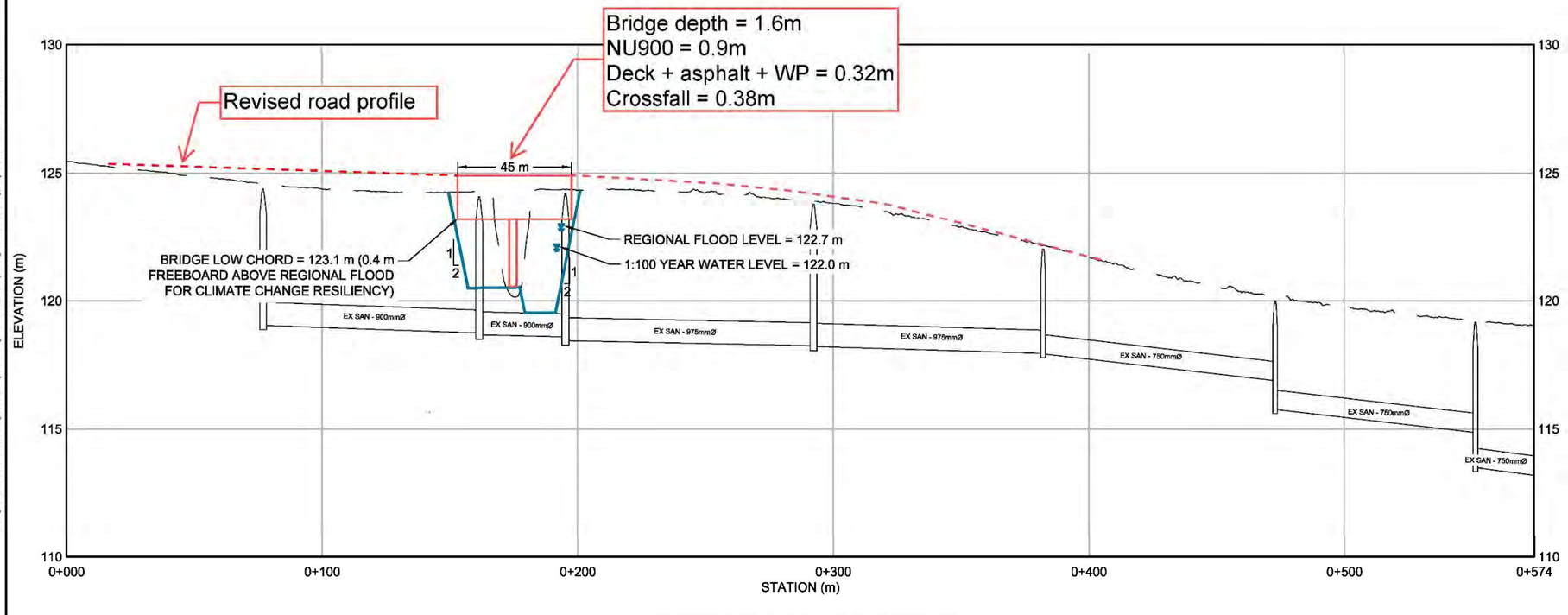

DIXIE ROAD PROFILE

LEGEND

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- CREEK MODIFICATIONS (BANKFULL CHANNEL)
- CREEK MODIFICATIONS (FLOODPLAIN)
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- TRCA REGULATION LIMIT
- EASEMENT
- FLOW DIRECTION
- CROSS-SECTION

1 : 2,000 metres
20 0 20 40
HORIZONTAL SCALE

1 : 200 metres
2 0 2 4
VERTICAL SCALE

NOT FOR CONSTRUCTION

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REVISION

No.	DATE	DESCRIPTION	BY	CHK.	DRN.
A	2020-05-12	ISSUED FOR REVIEW	AD	SB	KW

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

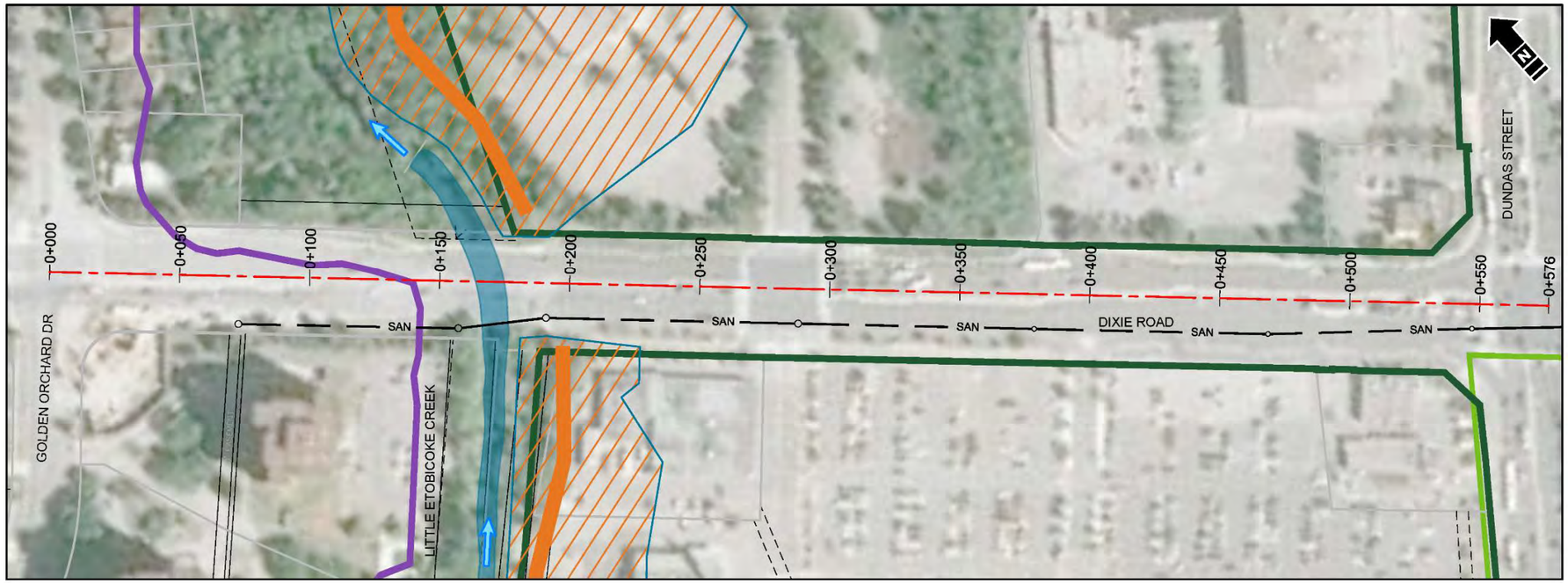
CITY OF MISSISSAUGA
DIXIE-DUNDAS FLOOD MITIGATION

OPTION 2
MAKE ROOM FOR THE CREEK
CONCEPTUAL DIXIE ROAD CROSSING

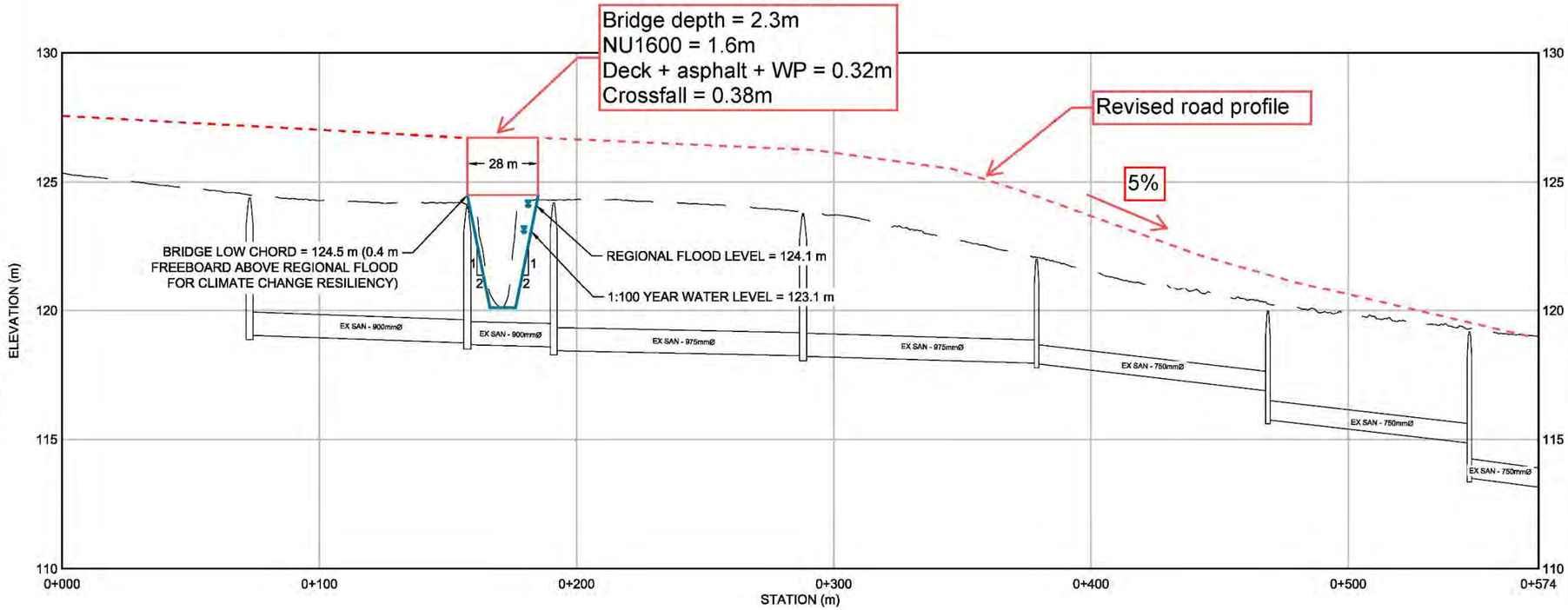
DATE:	TECHNICAL:	REVIEWER:	DRAWN:
MAY 2020	A.DOHERTY	S.BRAUN	K.WEILER

PROJECT:	REVISION:	DRAWING:
24603-531	A	RVA-2

Plot 1:1 = Tabloid (L)



PLAN



DIXIE ROAD PROFILE

LEGEND

- FLOOD PROTECTION LANDFORM
- CREEK CENTRELINE
- CREEK MODIFICATIONS (BANKFULL CHANNEL)
- CREEK MODIFICATIONS (FLOODPLAIN)
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HORIZONTAL SCALE

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REVISION

No.	DATE	DESCRIPTION	BY	CHK.	DRN.
A	2020-05-12	ISSUED FOR REVIEW	AD	SB	KW

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

CITY OF MISSISSAUGA
DIXIE-DUNDAS FLOOD MITIGATION

OPTION 3
FLOOD CONTAINMENT
CONCEPTUAL DIXIE ROAD CROSSING

DATE:	TECHNICAL:	REVIEWER:	DRAWN:
MAY 2020	A.DOHERTY	S.BRAUN	K.WEILER

PROJECT:	REVISION:	DRAWING:
24603-531	A	RVA-3

T:\24603 - Dixie-Dundas\53100 Data\Drafting\C3D\Channel\Production\Figs\Preliminary 10% Design\24603-SP Concept3.dwg - RVA-3 - Tuesday, May 12, 2020 2:58:22 PM - Kim Weiler

Appendix B

COST ESTIMATE

BRIDGE STRUCTURE	UNIT	PRICE	Option 1 QTY	Option 1 TOTAL	Option 2 QTY	Option 2 TOTAL	Option 3 QTY	Option 3 TOTAL
Dewatering & Shoring	LS	$40,000	1	$40,000.00	1	$40,000.00	1	$40,000.00
Demolish Existing Bridge (in three stages)	LS	$500,000	1	$500,000.00	1	$500,000.00	1	$500,000.00
Piles	m	$400	1200	$480,000.00	1200	$480,000.00	1200	$480,000.00
Concrete in Piers	m^3	$1,700	0	$	120	$204,000.00		$
Concrete in Abutment	m^3	$1,700	550	$935,000.00	500	$850,000.00	650	$1,105,000.00
Concrete in Wing Walls	m^3	$1,700	100	$170,000.00	50	$85,000.00	150	$255,000.00
Backfill to Structure	m^3	$90	2500	$225,000.00	500	$45,000.00	3000	$270,000.00
Bearings	ea	$800	34	$27,200.00	51	$40,800.00	34	$27,200.00
Precast Girders	LS	-	1	$442,000.00	1	$573,750.00	1	$476,000.00
Concrete in Deck, Diaphragms and Approach Slabs	m^3	$1,700	450	$765,000.00	750	$1,275,000.00	480	$816,000.00
Sidewalks on Bridge	m^3	$1,700	70	$119,000.00	120	$204,000.00	80	$136,000.00
Bridge Deck Waterproofing	m^2	$50	780	$39,000.00	1350	$67,500.00	820	$41,000.00
Parapet Walls	m^3	$2,500	13	$32,500.00	22	$55,000.00	14	$35,000.00
Railings	m	$500	52	$26,000.00	90	$45,000.00	54	$27,000.00
Paving - HL1	tn	$110	126	$13,860.00	220	$24,200.00	136	$14,960.00
TOTAL FOR BRIDGE STRUCTURE				$3,814,560.00		$4,489,250.00		$4,223,160.00

Roads / Civil	UNIT	PRICE	QTY	TOTAL	QTY	TOTAL	QTY	TOTAL
Temporary Roadway Protection - TL-2	LS	$40,000	1	$500,000.00	1	$100,000.00	1	$600,000.00
Excavation	LS	$100	7500	$750,000.00	750	$75,000.00	8500	$850,000.00
Fill	tn	$15	38000	$570,000.00	3800	$57,000.00	38000	$570,000.00
Granular A and B for Roadway	tn	$20	12960	$259,200.00	6480	$129,600.00	12960	$259,200.00
Asphalt (Top and Base)	tn	$95	3420	$324,900.00	1710	$162,450.00	3420	$324,900.00
Curb, Gutter and Subdrain	m3	$75	800	$60,000.00	400	$30,000.00	800	$60,000.00
MH and CB Structures	ea	$3,000	16	$48,000.00	8	$24,000.00	16	$48,000.00
Top Soil and Sod	m2	$6	3200	$19,200.00	1600	$9,600.00	3200	$19,200.00
Guiderails	m	$150	450	$67,500.00	750	$112,500.00	450	$67,500.00
Biowalls / Retaining Walls	m2	$750	350	$262,500.00	0	$	500	$375,000.00
Traffic Staging / Control	LS	-	1	$150,000.00	1	$75,000.00	1	$200,000.00
Erosion and Sediment Controls	LS	-	1	$50,000.00	1	$25,000.00	1	$50,000.00
Utility Relocations (mainly o/h hydro)	LS	-	1	$700,000.00	1	$150,000.00	1	$700,000.00
Trees / Plantings	LS	-	1	$30,000.00	1	$10,000.00	1	$30,000.00
TOTAL FOR ROADS / CIVIL				$3,791,300.00		$960,150.00		$4,153,800.00

TOTAL AMOUNT	**$7,605,860.00**	**$5,449,400.00**	**$8,376,960.00**

Does NOT include Harmonized Sales Tax (HST)

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

Version 1.0
March 25, 2022 Matrix 24603-531

Syeda Banuri, M.Eng., P.Eng.
Project Manager, Infrastructure Programming and Studies
Transportation, Public Works
REGION MUNICIPALITY OF PEEL
Fourth Floor, Suite B, 10 Peel Centre Dr.
Brampton, ON L6T 4B9

Subject: Dixie-Dundas Flood Mitigation Study and Municipal Class Environmental Assessment
Sanitary Sewer Discussion - Technical Items for Region of Peel Input and Consideration

Dear Syeda Banuri:

A meeting was held December 8, 2021, with representatives of the Region of Peel regarding the above-referenced project (Minutes of Meeting attached to this letter). One of the main action items arising from the meeting was a requirement that additional technical material be made available to the Region to allow further consideration of sanitary sewer items affecting potential alternative flood mitigation solutions being considered in the City's environmental assessment (EA).

The following letter report has been prepared to outline two separate but interrelated sanitary sewer items requiring additional consideration within the EA. These are as follows:

- An exposed 450 mm diameter sewer which crosses the Little Etobicoke Creek approximately 500 m east (i.e., downstream) of the Dixie Road bridge. The pipe is currently acting as a weir in the channel.

- A 900 mm diameter trunk sanitary sewer which crosses the Little Etobicoke Creek at a location just upstream of the Dixie Road bridge. Current cover over the trunk pipe is less than 1.2 m, with different flood mitigation alternative solutions at the bridge requiring consideration of different amounts of pipe lowering to accommodate a potentially lowered creek channel invert.

A new Dixie Road bridge is being proposed within all the potential design alternatives of the preferred flood mitigation solution for the EA. Discussion of the Dixie Road and how its design is integrated into the sanitary sewer items identified above is also contained in this letter-report.

The technical items outlined in this letter-report would also support EA requirements for the integration of potential mitigation designs for the exposed 450 mm diameter sanitary sewer (i.e., Item 1 identified above) into the overall Dixie-Dundas Flood Mitigation project.

We recommend that this letter-report be forwarded to other applicable individuals at the Region of Peel, including those who attended the meeting on December 8, 2021. The Region's review and consideration will allow input toward alternative design solutions being completed in the vicinity of the Dixie Road portion of the City of Mississauga's EA study area.

1 INTRODUCTION

The City of Mississauga retained Matrix Solutions Inc. to complete the Dixie-Dundas Flood Mitigation Project. The project is being completed as a Schedule C Municipal Class Environmental Assessment. The City's website and the location of key study documents completed to date are located at the following link: City of Mississauga Project Website - Key Documents

The following project overview is taken from the City's website:

> *The Dixie-Dundas community consists of a variety of residential, commercial, industrial and park and trail land uses and includes designated Special Policy Areas (SPAs) which regulate future development due to flood risks. This area is subject to flooding as a result of spilling from Little Etobicoke Creek near the Dixie Road bridge during high flow conditions including the storm event that occurred on July 8th, 2013.*
>
> *The goal of this study is to find solutions to provide flood protection to residences and businesses as well as to enable future growth in the Dixie-Dundas community as envisioned in the Dundas Connects Master Plan.*

Completion of flood mitigation works through this EA project is anticipated to allow significant reduction of existing flood risk within the City, including the removal of over 1,000 existing structures from potential Regional Storm flooding inundation.

2 RELEVANT SANITARY SEWER INFRASTRUCTURE

Potential flood mitigation works associated with the Dixie-Dundas Class EA would create changes to the Little Etobicoke Creek channel and floodplain. Changes being considered have the potential for impacts to Region of Peel sanitary sewer infrastructure.

The following letter-report has been prepared to outline two distinct but interrelated sanitary sewer items requiring additional consideration within the EA. These two items are:

- an existing exposed 450 mm diameter sewer which crosses the Little Etobicoke Creek approximately 500 m east (i.e., downstream) of the Dixie Road bridge.

- an existing 900 mm diameter trunk sanitary sewer which crosses the Little Etobicoke Creek at a location just upstream of the Dixie Road bridge.

A significant amount of additional sanitary sewer infrastructure exists within the overall Dixie-Dundas Flood Mitigation EA study area; however, only infrastructure related to the above two items is addressed within this letter-report. Additionally, other impacted Region of Peel infrastructure will be addressed through other on-going discussions, including the bridge crossing of Little Etobicoke Creek, other watermains, and sanitary sewer works.

2.1 Location Plan and Sanitary Sewers of Interest

Figure 1 adjacent outlines the current study area of the Dixie-Dundas Flood Mitigation EA Project.

It includes the Expanded Study Area, which is outlined in a recent Project Bulletin prepared for the project in October 2021.

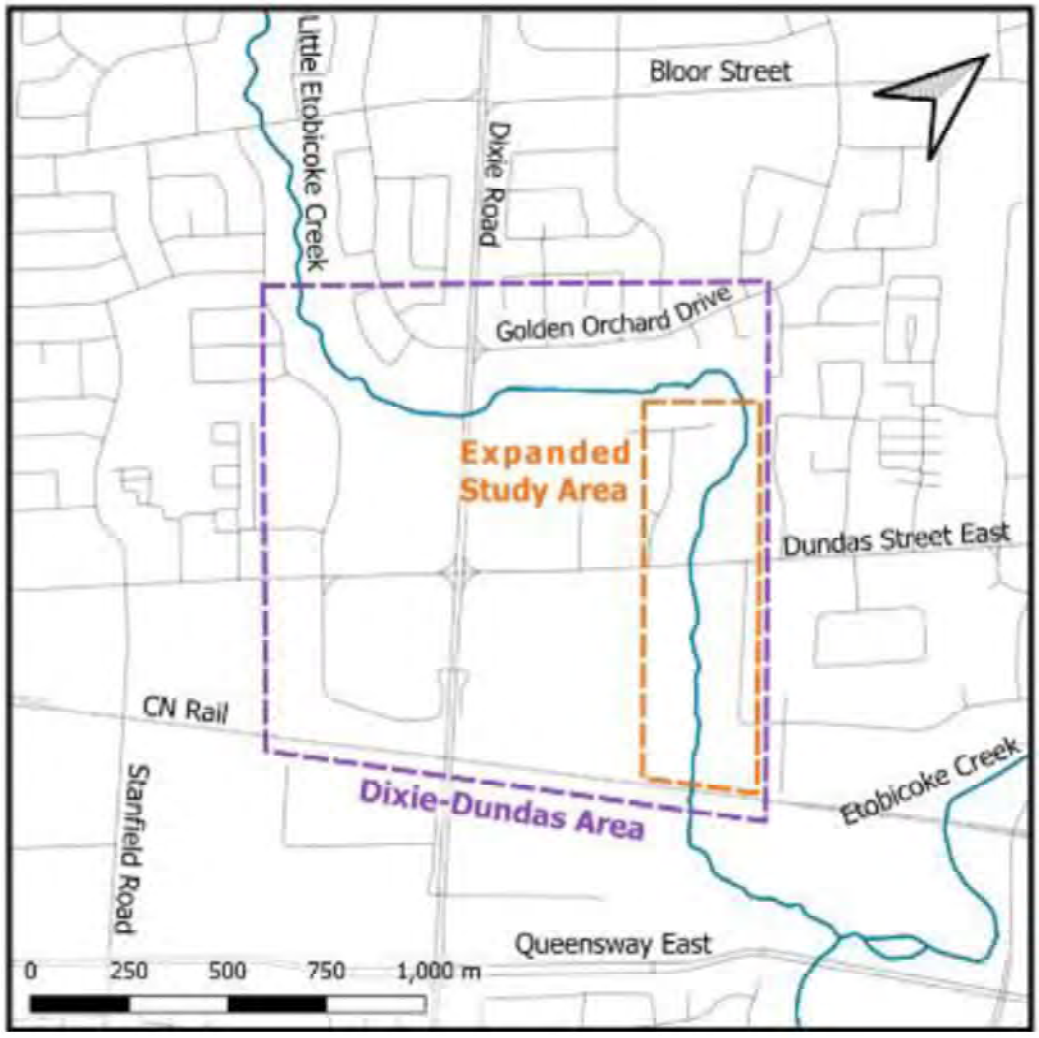

FIGURE 1 Environmental Assessment Study Area Location

Figure 2 below outlines locations of sanitary sewers of interest in the EA study area addressed in this letter-report. Reference points are outlined at key locations of interest.

Sanitary sewers of interest include the network located upstream of the exposed 450 mm diameter crossing of the Little Etobicoke Creek from the Golden Orchard Drive neighbourhood. The current outlet of the network is via Jarrow Drive to Dundas Street.

The existing sanitary trunk along Dixie Road between Little Etobicoke Creek and Dundas Street is also indicated in the figure.

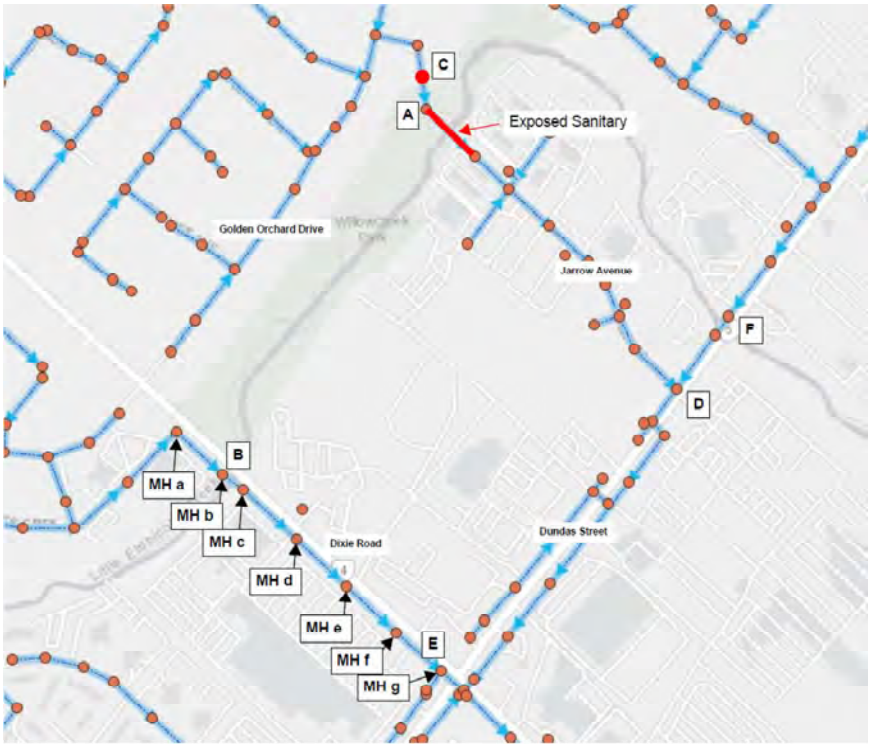

FIGURE 2 Sanitary Sewers of Interest and Reference Points

3 EXPOSED 450 MM DIAMETER SANITARY SEWER

An existing 450 mm diameter sewer crosses the Little Etobicoke Creek approximately 500 m east and downstream of the Dixie Road bridge. The crossing location is marked in red located from Reference Point 'A' in Figure 2. The sewer pipe is exposed to the creek and is currently acting as a weir in the channel. A photograph taken in 2019 is presented in Figure 3.

FIGURE 3 Exposed 450 mm Sewer in Little Etobicoke Creek

The exposed 450 mm diameter sewer is located close to the alternative solutions and works being contemplated to mitigate flooding. The exposed sewer was confirmed (and above photograph taken) while completing supporting field work as part of the overall Dixie-Dundas Flood Mitigation EA project.

When the EA project received expanded scope to increase the study area to downstream of Dundas Street, specific additional scope was outlined to allow investigation of design solutions that would best address the exposed sanitary sewer. Accordingly, potential synergies were explored for completing mitigation designs for the exposed sanitary sewer within the larger EA project.

Various design solutions to address the exposed sanitary sewer are outlined in the following sections. Each design solution's relationship to the overall Flood Mitigation EA project is also outlined.

It should be noted that a new Dixie Road bridge is being proposed within all of the potential design alternatives of the preferred flood mitigation solution for the EA. Discussion of the Dixie Road bridge and how its design is related to various design solutions for the exposed sanitary sewer is also outlined.

3.1 Design Objectives and EA Process

The objectives of this sanitary sewer analysis are to:

- Identify potential design solutions to mitigate the risks associated with the exposed sanitary sewer
- Provide information that will allow the Region of Peel and other relevant stakeholders of the larger Dixie-Dundas Flood Mitigation EA project (including the City of Mississauga) to evaluate potential design solutions based on desired outcome, anticipated feasibility, integration with other proposed works, and limiting environmental impacts
- Work and analysis completed within this memo will assist the Region in satisfying EA requirements related to implementing mitigation works for the exposed sanitary sewer crossing

The approach to identifying potential mitigation strategies for the exposed sewer involved the following steps:

- Review proposed works within the larger Dixie-Dundas Flood Mitigation EA study area to identify potential efficiencies in concurrent construction of mitigating sanitary sewer infrastructure
- Review Region of Peel sanitary standards to gauge feasible rerouting options
- Calculate slope, total drop, and integration with existing infrastructure for each alternate option

The approach for developing the mitigation strategies for the sanitary sewer included the preliminary meeting with the Region to receive their initial feedback regarding the potential alternatives being considered.

3.2 Design Solutions Explored

Based on discussions held at the December 8, 2021, meeting with representatives of the Region of Peel and other Flood Mitigation EA project study team, the following four alternative design solutions were examined to address the exposed sanitary line:

1. Protect the exposed line and leave it in place. It is noted that this alternative might also be implemented as a temporary one, thereby allowing future design alternatives to be completed later.

2. Lower the sewer on Jarrow Avenue (i.e., reconstruct) from upstream of the exposed sewer to the existing connection at Dundas Street and Jarrow Avenue (Figure 2: A - D).

3. Realign the sewer upstream of the exposed section through a realigned Little Etobicoke Creek valley corridor to connect at Dixie Road (Figure 2: A - B). This option requires the lowering of the Dixie Road trunk sanitary sewer.

4. Realign the sewer upstream of the exposed section through a realigned Little Etobicoke Creek valley corridor and continue with new sewer down Dixie Road to Dundas Street (Figure 2: A to E).

5. Realign the sewer east along watercourse valley to Dundas Street (Figure 2: A to F).

3.3 Method of Analysis

The exposed 450 mm diameter pipe originates from a manhole (MH) on the northwest side of Little Etobicoke Creek (see Figure 2, point “A”).

Analysis of proposed options utilized the existing sanitary layout as identified within Region of Peel sanitary main data created on QGIS using open data downloaded from the Region of Peel data portal (https://data.peelregion.ca/). Sanitary Main and Sanitary Node regional data was used.

Regional standards for sanitary sewers as defined by the Region (Peel 2009) were used to determine potential designs. Design discharge by pipe diameter at a given grade was determined from Std. Dwg 2-9-4. Unless otherwise specified, maximum spacing between MHs was assumed as 120 m and minimum drop at a MH was calculated as per Region of Peel standards.

Minimum drop on all MH greater than 300 mm was assumed to be 0.02 m. Where possible, a minimum slope of 0.35% was maintained, but for pipes larger than 300 mm diameter, minimum slope was lowered as shallow as 0.30% if required to match into existing infrastructure.

3.4 Design Solution 1: Protect Existing Line

The first design solution involves protecting and reinforcing the existing line while leaving it in place at its existing crossing of the Little Etobicoke Creek. This option would involve modifying the channel to provide a degree of cover (e.g., a riffle-like structure) and resistance to mechanical scour/impact. This option would not modify the existing obvert or grade of the existing sanitary sewer. It would therefore remain a potential obstruction to flow for the Little Etobicoke Creek over the longer term. Additionally, it would not have adequate cover and would likely remain a long-term maintenance challenge for the Region.

Bank stabilization and localized channel modification, such as placement of upstream and downstream riffle structures, would be required. Design alternatives being contemplated for the overall Flood Mitigation EA are anticipated to be able to accommodate protection of the sanitary sewer crossing, as it is located at the downstream end of proposed works.

Potentially this design solution could provide a temporary solution for the Region, allowing later lowering of the sewer across the creek. For example, Design Solution 2 could then be implemented at a later date. Although the timing of redevelopment of the lands fronting Jarrow Avenue down to Dundas Street is not known, their redevelopment may provide better (i.e., more economical) opportunity for the sewer to lowered.

3.5 Design Solution 2: Reconstruct lowered sewer on Jarrow Avenue to Dundas Street

A potential design solution is available by reconstructing the sanitary sewer downstream of the creek crossing (from A to D on Figure 2). The sewer could be lowered on Jarrow Avenue, and also potentially reconstructed at a shallower slope, all the way down to the existing sewer on Dundas Street. The lower invert elevation available on Dundas Street could potentially provide as much as a 1.39 m lowering through the creek crossing.

The potential for completing this work more economically may arise in association with future redevelopment plans for the lands located northeast of the Dixie Rd and Dundas St intersection. The timing of this future potential redevelopment is not known at this time but is anticipated to be longer term.

The sewer across Little Etobicoke Creek and running down Jarrow Ave. to Dundas Street was assumed to be lowered along its existing alignment and constructed at a new grade of 0.35% (Figure 4; Table 1). Because obverts would have to be matched at Dundas Street from the new sewer into the existing manhole, additional capacity could be provided by a larger pipe if required due to a lowered grade potentially being used up Jarrow Avenue. The larger pipe would be able to achieve the same cover at the creek crossing.

TABLE 1 Design Solution 2: Lower Sewer on Jarrow Ave to Dundas Street

Calculated Potential Upstream Invert Elevation (m)	Ex. Downstream Invert Elevation (at Dundas) (m)	MHs (#)	Total MH Drop (m)	Slope (%)	ΔX (m)	ΔY (m)	Achieved Lowering at Creek Crossing (m)
116.39	114.489	8	0.160	0.35%	499	1.91	1.39

FIGURE 4 Design Solution 2: Lower Sewer between Dundas Street and Jarrow Avenue Scenario

3.6 Design Solution 3: Realignment through flood plain to a lowered Dixie Road Trunk Sanitary Sewer

This potential design solution is made available within the anticipated preferred solution of the Flood Mitigation EA. The sanitary sewer upstream of the existing Little Etobicoke Creek crossing, specifically from just downstream of Taviton Court, could be realigned to Dixie Road (Points A to B on Figure 2). Manholes for the realigned sewer could potentially be located adjacent to a proposed City trail that could be constructed as part of the flood mitigation works.

This solution becomes feasible given that the following design items will be completed in conjunction with the Dixie-Dundas Flood Mitigation EA project:

- The preferred solution at the upstream (Dixie Road) portion of required flood mitigation works includes complete reconfiguration and restoration of the flood plain between Taviton Court and Dixie Road.

- The existing trunk sanitary sewer on Dixie Road does not currently have sufficient cover at its existing crossing of Little Etobicoke Creek. Flood mitigation alternative solutions being examined at the Dixie Road crossing may require additional lowering of the Dixie Road trunk sewer to best suit the economics of the required Dixie Road bridge replacement and associated road reconstruction.

The second bullet point above is discussed in additional detail in Section 4 of this letter report; however, the opportunity to have a sanitary sewer at sufficient elevation at Dixie Road to potentially accommodate this realigned sewer from Taviton Court seems feasible.

A realigned sanitary sewer from Taviton Court would allow construction to occur in a "green field" situation, without traffic considerations for most of its construction. The sewer could be readily integrated into the floodplain design, with manholes for the realigned sewer located on or close to a trail that could be constructed to ensure its effective use as a maintenance access road.

The existing sanitary trunk sewer on Dixie Road is 900 mm diameter at the crossing of Little Etobicoke Creek and varies in size as it flows downstream to Dundas Street. No capacity analysis has been completed on the Dixie Rd trunk sewer or its outlet beyond Dundas Street. At the previously referenced December 8, 2021, meeting, Region of Peel representatives indicated this capacity may be available, although it must be confirmed prior to further consideration of this design solution.

The proposed connection of the realigned 450 mm diameter sewer through the reconfigured and rehabilitated flood plain downstream of Dixie Road is indicated below in Figure 5. Hydraulic capacity considerations for the realigned 450 mm diameter sewer are contained in Table 2, with the assumption that an effective receiving sewer elevation will be provided at Dixie Road via the implementation of flood plain works per the Flood Mitigation EA. Additional discussion of the Dixie Road trunk sewer and its potential lowering associated with the Dixie-Dundas Flood Mitigation Project is contained in Section 4 of this letter report.

The alignment of the 450 mm diameter sewer pipe and manholes in the floodplain for this Design Solution 3 would require significant consideration of the trail design such that it could also serve as a maintenance road. The maintenance road's vertical placement above certain flood levels would also have to be effectively achieved. Additionally, the long-term lateral stability of the new creek alignment would have to be assured in order that no risk of erosion would be presented to the new 450 mm diameter sewer alignment. Key considerations of the required lowering of the existing Dixie Road trunk sewer to accommodate the realigned 450 mm diameter sewer are outlined in Section 4 of this letter report.

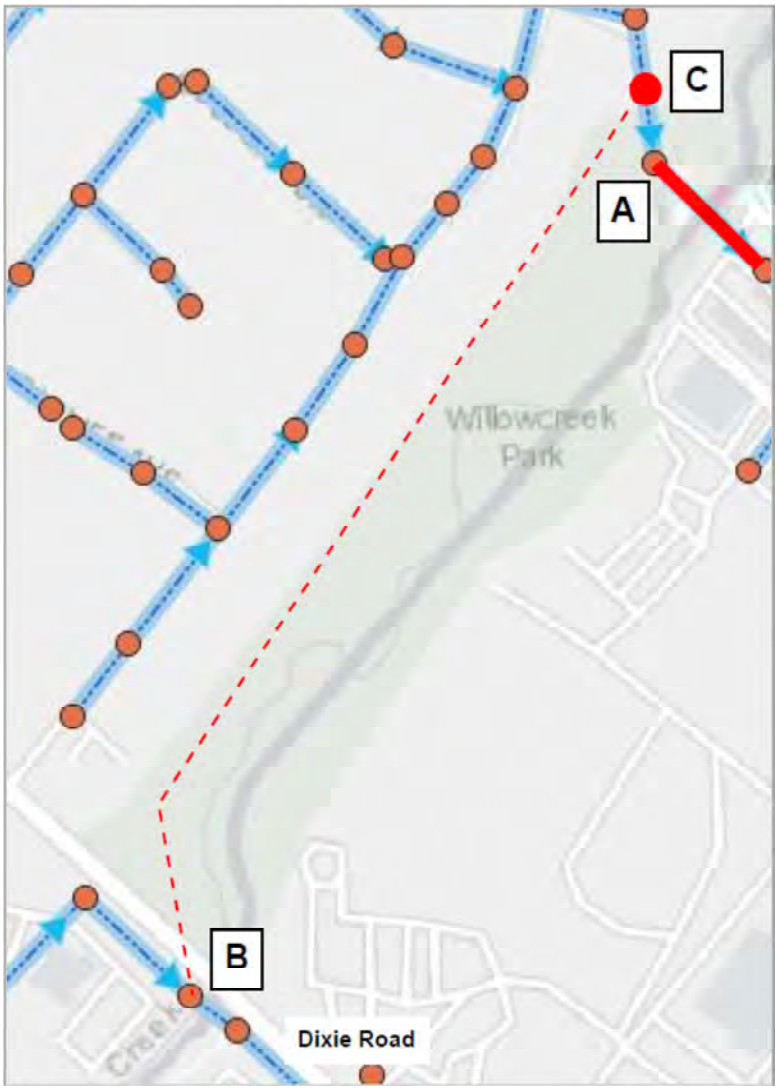

FIGURE 5 Design Solution 3: Realign Sewer to a Lowered Dixie Road Trunk Sanitary

TABLE 2 Design Solution 3: Realign Sewer to a lowered Dixie Road Trunk Sanitary

Upstream		Downstream		Dixie Sanitary (Lowered)		MH (#)	Total MH Drop (m)	Slope (%)	ΔX (m)	ΔY (m)
Invert (m)	Obvert (m)	Invert (m)	Obvert (m)	Invert (m)	Obvert (m)					
117.910	118.360	115.970	116.420	115.373	116.348	7	0.140	0.30%	600	1.940

3.7 Design Solution 4 – Realignment through flood plain and new sewer on Dixie Road Trunk

Option 4 is similar to Option 3, but instead of outletting a realigned 450 mm diameter sewer at Dixie Road, a parallel 450 mm line could be constructed on Dixie Road to outlet at existing MH E on the northwestern side of the Dixie-Dundas intersection. The viability of this option does not depend on a lowered Dixie Road

sanitary trunk, but rather takes advantage of the lower-elevation sanitary near the intersection (Figure 6; Table 5).

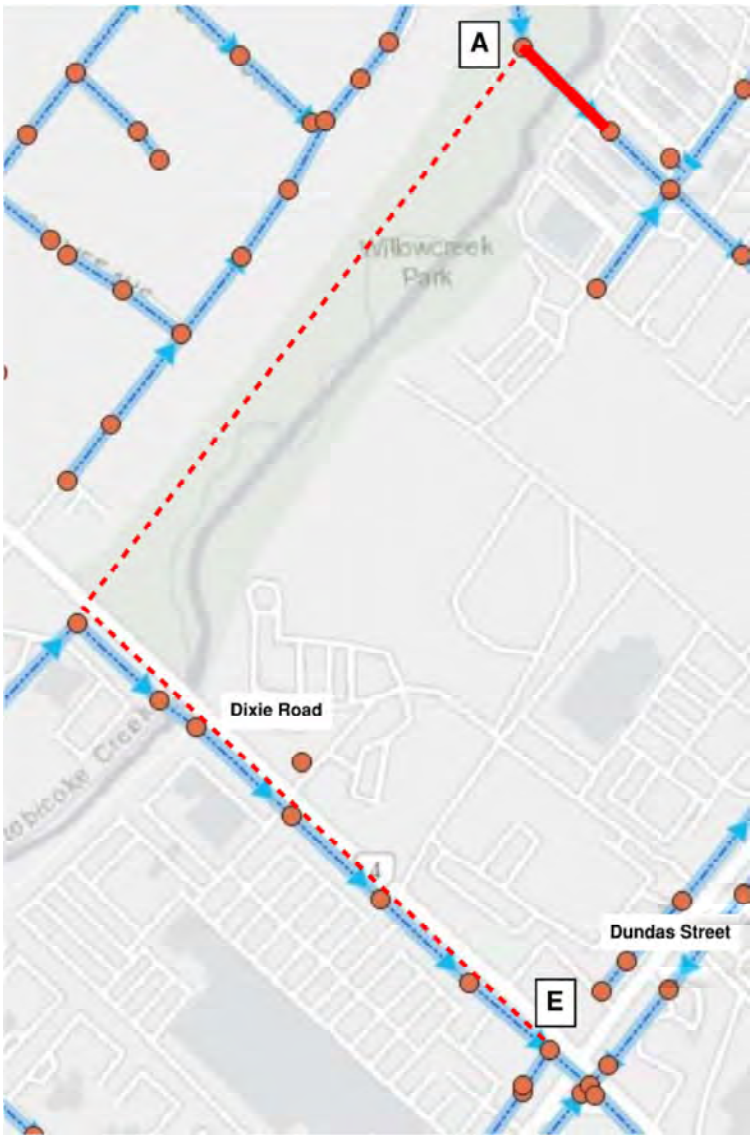

FIGURE 6 Design Solution 4: Realign Through Floodplain to Dixie-Dundas Intersection with New 450 mm sewer

TABLE 3 Design Solution 4: Realign to Dixie-Dundas Intersection with new 450 mm sewer

Upstream		Downstream		Dixie-Dundas Sanitary Outlet (Existing 750 mm)		MH (#)	Total MH Drop (m)	Slope (%)	ΔX (m)	ΔY (m)
Invert (m)	Obvert (m)	Invert (m)	Obvert (m)	Invert (m)	Obvert (m)					
117.787	118.237	114.064	114.514	113.501	114.251	11	0.209	0.35%	1004	3.723

Analysis of this scenario indicates that realignment of the exposed sanitary to integrate with the existing sanitary trunk on the northwest side of the Dixie Road and Dundas Street intersection is technically feasible.

3.8 Design Solution 5: Realign Sewer East Along Watercourse Valley to Dundas Street

Option 5 proposes to realign the sanitary line upstream of the exposed section east along the existing Little Etobicoke Creek valley corridor to Dundas Street (Figure 7; Table 4).

FIGURE 7 Design Solution 5: Realign Sewer East Along Watercourse Valley to Dundas Street

TABLE 4 Design Solution 5: Realign Sewer East Along Watercourse Valley to Dundas Street

Upstream		Downstream		Dundas Sanitary Outlet (Existing 600 mm)		MH (#)	Total MH Drop (m)	Slope (%)	ΔX (m)	ΔY (m)
Invert (m)	Obvert (m)	Invert (m)	Obvert (m)	Invert (m)	Obvert (m)					
117.787	118.237	115.185	115.635	114.958	115.558	9	0.210	0.35%	695	2.602

This design option indicates that realignment of A-F is physically feasible; however, the ecological impacts of disturbing the natural corridor, the majority of which is not otherwise anticipated for rehabilitation within the Flood Mitigation EA works, must be considered.

4 DIXIE ROAD TRUNK SANITARY SEWER LOWERING CONSIDERATIONS

The existing 900 mm diameter trunk sanitary sewer crossing the Little Etobicoke Creek at Dixie Road has been a focus of design solutions and alternative designs of the preferred solution for the Dixie-Dundas Flood Mitigation EA Project. The existing sewer currently has less than the standard desired 1.2 m of cover at the crossing. Depth of cover from outside barrel of trunk sanitary to existing invert of watercourse in this location may be as low as 0.5 m. Accordingly, some type of remediation to ensure better resilience against the effects of long-term erosion has been contemplated to be completed as part of the Flood Mitigation EA project.

The preferred solution to achieve optimum flood mitigation within the Dixie-Dundas EA project (and a solution that will allow the eventual complete removal of the SPAs that stipulate flood policy in this area) is to "Make Room for the Creek." Within that design solution, a new and much longer span for the Dixie Road bridge is required to convey flood flows. The larger bridge and other Region infrastructure that will have to be considered at this creek crossing location, including an existing 400 mm diameter watermain, are not addressed specifically in this letter report; however, these items will require significant consideration within the overall evaluation of potential sanitary sewer mitigation options.

Current design alternatives being investigated within the Flood Mitigation EA project include different options for the elevation of the channel invert through the bridge crossing. Significant cost savings appear to be available if the invert of the creek were to be lowered by up to 1.0 m; however, this would have direct impact on the existing trunk sanitary sewer. Although the sewer would likely best be lowered to some degree to accommodate long-term maintenance through sufficient depth of cover, extra lowering of the trunk sewer could allow significant savings in the works associated with the Dixie Road bridge and associated roadworks.

Given the advantage of this additional trunk sewer lowering, the option of accepting flows from the realigned 450 mm diameter sewer (per Design Solution 3 this letter report) potentially becomes a more cost-effective method to mitigate its current exposure to the creek. The feasibility of further lowering the Dixie Rd trunk sewer to also accommodate this 450 mm diameter requires further consideration.

The sanitary trunk sewer along Dixie Road is indicated in Figure 8, and a summary of vertical realignment elevations are summarized in Table 5.

The Region of Peel will likely want to confirm these design elevations, potentially also through survey. Other design constraints, such as the existing 400 mm diameter watermain, will be required to be considered within the Flood Control EA Project and the alternative design of the Dixie Road bridge and associated roadworks. Additional analysis for sanitary sewer design, depending on the design solution being considered, will likely have to include an analysis of pipe capacities available downstream of Dundas Street. This additional analysis has not been completed as part of this current work.

TABLE 5 Dixie Road Sanitary Trunk Lowering

MH name	Existing		*Proposed - for Creek cover		**Proposed (Des. Solution 3)		Length of Pipe to d/s MH (m)	Slope of Existing Pipe to d/s MH	Size of Existing pipe to d/s MH	Capacity of Existing pipe to d/s MH (L/s)
	u/s inv	d/s inv	u/s inv	d/s inv	u/s inv	d/s inv				
a	*119.07*	*119.04*	*119.07*	*119.04*	*119.07*	*119.04*	82.3	0.367%	900	1097
b	*118.74*	*118.67*	*118.74*	117.24	*118.74*	115.38	35.1	0.242%	900	891
c	*118.59*	*118.45*	117.11	117.06	115.26	115.21	101.0	0.205%	975	1015
d	*118.24*	*118.22*	116.71	116.66	114.86	114.81	89.6	0.302%	975	1232
e	*117.95*	*117.93*	116.35	116.30	114.49	114.44	81.6	1.292%	750	1265
f	*116.88*	*115.76*	116.01	*115.76*	114.16	114.11	76.4	1.181%	750	1210
g	*114.86*	*113.50*	*114.86*	*113.50*	113.84	*113.50*			750	check required for downstream of MH g
* Lowering required to achieve 1.2 m cover at new creek invert level of 119.5 m (approx.)										
** Lowering required to accept 450 mm dia. sewer from east; 450 mm sewer inlets at MH b; matching obverts allows an invert elev of 450 mm dia.:										115.91

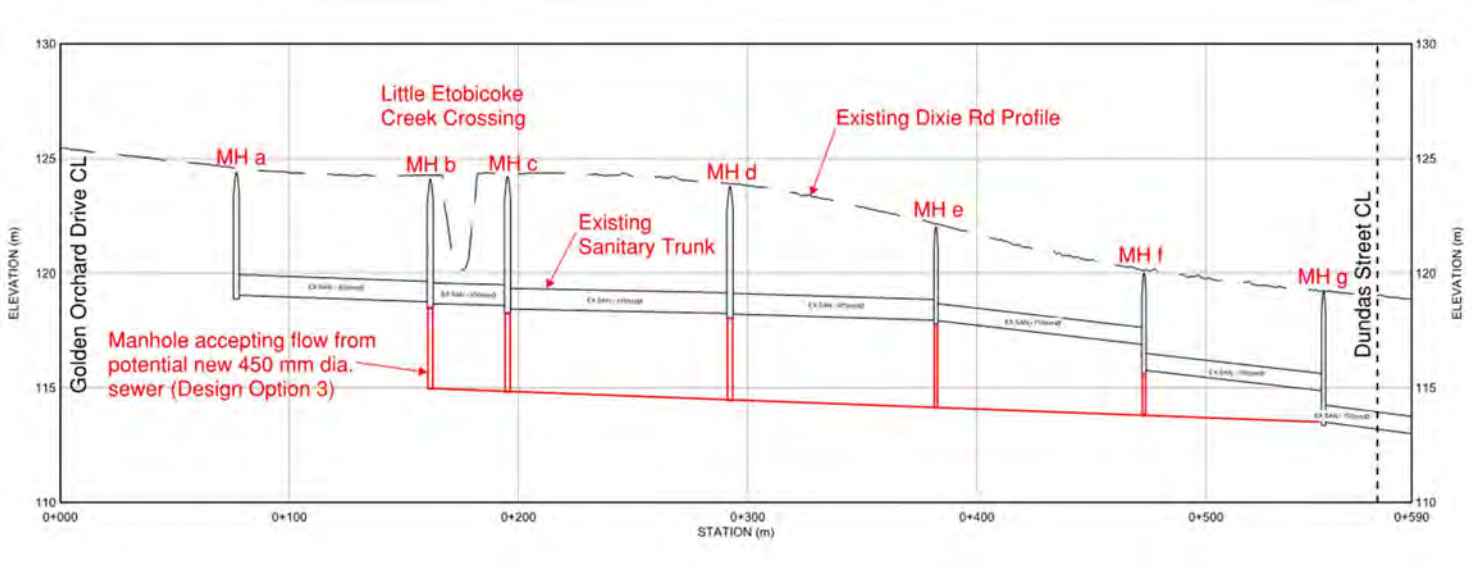

FIGURE 8 Dixie Road Trunk Sanitary Sewer

5 EVALUATION OF DESIGN SOLUTIONS

Each of the mitigation options described in Section 3 can be evaluated in terms of the following aspects:

- Risk reduction to exposed Sanitary Sewer
- Feasibility of Integration with Existing Infrastructure
- Synergy with Other Planned Flood Mitigation EA Works
- Environmental Impact

A formal evaluation process will be undertaken given additional input from the Region of Peel. The Dixie-Dundas Flood Mitigation Project EA likely provides significant additional cost-effective options for the Region in addressing the exposed 450 mm diameter sanitary sewer. Although the existing 900 mm diameter trunk sewer crossing of the creek at Dixie Road is not exposed, its cover is not ideal. Flood mitigation works will also provide opportunity to improve this infrastructure.

6 SUMMARY AND RECOMMENDATIONS

The objectives of this sanitary sewer analysis were to identify potential design solutions that could feasibly mitigate risks associated with the exposed 450 mm diameter sanitary sewer.

It is recommended that the Region of Peel further consider the benefits of pursuing realignment of the exposed 450 mm diameter sewer. Additionally, Matrix Solutions recommends that the design option through the reconfigured flood plain to Dixie Road, per Design Solution 3 outlined in this letter report, should be examined further.

7 CLOSURE

We trust that this letter report suits your present requirements. If you have any questions or comments, please call Steve Braun at 289.323.0975.

Yours truly,

MATRIX SOLUTIONS INC.

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SB/vc
Attachments

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VERSION CONTROL

Version	Date	Issue Type	Filename	Description
V0.1	17-Feb-2022	Draft	24603-531 Sanitary Sewer Analysis LR 2022-02-17 draft V0.1.docx	Issued to client for review
V1.0	25-Mar-2022	Final	24603-531 Sanitary Sewer Analysis LR 2022-03-25 final V1.0.docx	Issued to Region (and client copied)

REFERENCES

Region of Peel (Peel). 2009. Public Works. Design, specifications & procedures manual - Linear infrastructure. Accessed October 1, 2021. https://www.peelregion.ca/public-works/design-standards/pdf/sanitary-sewer-design-criteria.pdf