FINAL REPORT FOR CHEDOKE CREEK WORK PLAN IMPLEMENTATION

CITY OF HAMILTON
71 MAIN STREET WEST, HAMILTON, ONTARIO L8P 4Y5

FINAL REPORT

DATE: JULY 12, 2024

WSP CANADA INC.
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WSP Canada Inc.
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July 12, 2024

Mr. Tim Crowley
Senior Project Manager – Watershed Management
Public Works/Hamiton Water

City of Hamilton
100 King Street West, 9th Floor
Hamilton, ON L8P 1A2

Re: Final Report for Chedoke Creek Work Plan Implementation, City of Hamilton

Dear Sir,

WSP Canada Inc. (WSP) is pleased to submit the attached updated final report for the City of Hamilton for its submission to the Ministry of the Environment, Conservation, and Parks (MECP) in fulfilment of Item #7 in Director's Order # 1-PE3L3. The updated report has addressed those comments received from MECP on May 22, 2024 and confirmed during the meeting with MECP, the City and WSP on June 11, 2024. Should you have any comments or questions, please feel free to contact any of the undersigned.

Sincerely,

Per: Lance Lumbard, MS, MBA, CLP
Assistant Vice President
WSP USA Inc.

Per: Ron Scheckenberger, M.Eng., P.Eng.
President
Scheckenberger & Associates Ltd.

Per: Dale Klodnicki, M.E.Sc., CET, PMP
Senior Principal Ecologist
WSP Canada Inc.

Revision History

FIRST ISSUE

February 2, 2024	Draft release for MECP Review	
Prepared by	Reviewed by	Approved by
Lance Lumbard Dale Klodnicki Michael Godard	Lance Lumbard Ron Scheckenberger	Dale Klodnicki

DRAFT FINAL

July 12, 2024	Draft final for MECP Review (updated based on MECP comments received May 22, 2024)	
Prepared by	Reviewed by	Approved by
Lance Lumbard Dale Klodnicki Michael Godard	Lance Lumbard Ron Scheckenberger	Dale Klodnicki

FINAL

August 14, 2024	Identical to July 12, 2024 version based on MECP e-mail of August 9, 2024 that comments had been satisfactorily addressed	
Prepared by	Reviewed by	Approved by
Lance Lumbard Dale Klodnicki Michael Godard	Lance Lumbard Ron Scheckenberger	Dale Klodnicki

Signatures

Approved[1] by (must be reviewed for technical accuracy prior to approval)

Approved

July 12, 2024

Per: Dale Klodnicki, M.E.Sc., CET, PMP — Date
Senior Principal Ecologist
WSP Canada Inc.

Reviewed

July 12, 2024

Per: Lance Lumbard, MS, MBA, CLP — Date
Assistant Vice President /
Water Quality Management Lead
WSP USA Inc

[1] Approval of this document is an administrative function indicating readiness for release and does not impart legal liability on to the Approver for any technical content contained herein. Technical accuracy and fit-for-purpose of this content is obtained through the review process. The Approver shall ensure the applicable review process has occurred prior to signing the document.

Contributors

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WSP

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1 INTRODUCTION

This report has been prepared to summarize the actions the City of Hamilton has undertaken to comply with the Ontario's Ministry of the Environment, Parks, and Conservation (MECP) Director's Order 1-PE3L3, provided in **Appendix A,** specifically in response to the Main/King Combined Sewer Overflow (CSO) tank discharge into Chedoke Creek and the execution of the Targeted Dredge Project. The report includes a summary of the following key items:

- Directors Order 1-PE3L3;
- Chedoke Creek Work Plan including spill event pollutant loadings and water quality impairments which prompted the order.
- Efforts undertaken by the City and its consultants to understand and remediate the spill event and develop the Chedoke Creek Work Plan.
- Chedoke Creek permitting and design process.
- Contractor selection and bidding.
- Site and construction monitoring.
- Total material and nutrients removed.
- Remaining work to be completed.
- City's Surface Water Quality Program (SWQP)
- Pre/During/Post Water quality comparison (CP11)
- Future water quality monitoring.
- Additional offsetting works.

The draft report was provided to MECP in February, 2024 for review and comments received May 14, 2024. A meeting was held with MECP to review those comments on May 29, 2024, and the report has been updated accordingly to address the comments and input from MECP.

1.1 Summary of Director's Order

Director's Order 1-PE3L3 (Order) issued by the MECP required the City of Hamilton, under item #7, to submit the following items pertaining to the Chedoke Creek Remediation work.

Within one (1) month of the completion of the of the work undertaken pursuant to the approved Chedoke Creek Workplan, submit to the Director, a report prepared by the Qualified Person confirming that the natural environment has been restored to pre-spill conditions and that further impairment to the natural environment will not occur as a result of the spill to the Chedoke Creek as detailed in the attached Provincial Officer's report, and at a minimum contain the following:

i. ***Workplan requirements specified by MECP and the details of the work undertaken to complete the Chedoke Creek Workplan.***
ii. ***Any monitoring results completed before, during and after the work undertaken in accordance with the Chedoke Creek Workplan.***
iii. ***Analysis of the results in Item 7(ii) above for the purposes of the intended monitoring; and***
iv. ***Determination if any requirement for on-going monitoring is required to verify the effectiveness or maintenance of the remedial actions undertaken is necessary.***

1.2 Chedoke Work Plan Overview

The Chedoke Creek Work Plan was prepared by WSP Canada Inc. (WSP; formerly Wood Environment & Infrastructure Solutions Canada Limited), on behalf of the City of Hamilton to address the requirements outlined in the MECP Director's Order: 1-PE3L3 (the "Order", December 4, 2020), specific to the Targeted Dredge Plan for the Lower Chedoke Creek. The Chedoke Creek Work Plan was submitted to the MECP by the City of Hamilton on February 22, 2021, and was approved by the MECP on June 11, 2021. A summary of the Order requirements is provided below.

The Order contained numerous components (**ref. Appendix A**) which were addressed in the Chedoke Creek Work Plan (Work Plan) and are summarized in this section. Notably, Order requirements #1 and 2, were fulfilled once the City retained WSP and provided the MECP with confirmation of same on January 15, 2021. WSP was assigned as the City's representative in the capacity of Qualified Person (QP). WSP was also responsible for the preparation of earlier reporting to address the requirements associated with the initial Order (ref. Provincial Officer's Order, #1-J25YB), including:

- Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report (Wood, January 24, 2019)
- Chedoke Creek – Implementation and Costing Report (Wood, January 24, 2019)

The following excerpts from the Order (in ***bold italics***) and Wood's responses (in non-bold italics) have been provided below, as necessary, to summarize the specific elements of the Work Plan which were included to meet the requirements of the MECP.

3. ***By February 22, 2021, submit to the Director, for approval, a remediation work plan for Chedoke Creek that is developed by the Qualified person to undertake the targeted dredging of Chedoke Creek based on the recommendation identified in section 5.2.5 of the Wood report entitled "MECP Order # 1-J25YB Item 1b – Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report" dated January 24, 2019 ("Chedoke Creek Workplan"). The Chedoke Creek Workplan shall be prepared in accordance with the requirements set out in Items 4 and 5 below.***

*This item specifies the subject work plan prepared by Wood with the City of Hamilton, based on consultation with MECP (**ref. Appendix B**). With specific reference to the recommendations identified in Section 5.2.5 of the Wood report entitled "MECP Order # 1-J25YB Item 1b – Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report" dated January 24, 2019, the following is the relevant excerpt from the subject report:*

> *"Direct Removal*
>
> *Physical removal of the organic sediment within Chedoke Creek will directly address the three primary sources of potential impairment including nutrient contamination, bacteriological contamination, and habitat loss. Dredging can be accomplished either through mechanical means or by use of hydraulic dredge equipment. Hydraulic dredging is recommended in Chedoke Creek over mechanical means for several reasons. Mechanical dredging would not be practicable due to the limited width of the creek, the density of riparian vegetation, and lack of continuous access. Hydraulic dredging provides nearly complete containment of the dredge slurry along the pumping route, which reduces exposure of the sediments to the atmosphere that could cause odour or other problems, if the material were to be handled by an excavator. Additionally, the dredge slurry from a hydraulic dredge can be easily routed to the wastewater system for dewatering and ultimate treatment and disposal, thus avoiding potential issues related to dredged material storage, dewatering, and handling operations, which are generally space intensive and costly. Complete removal of*

this material by hydraulic dredging is recommended as the primary means of remediation. The recommended hydraulic dredge concept plan is further discussed in the following sections."

4. The Chedoke Creek Workplan shall, at a minimum:

ii. Contain a detailed timeline setting out critical milestones and checkpoints with the Ministry for carrying out the Chedoke Creek Workplan;

An overall schedule has been prepared on the basis of current understanding of field work requirements, Species at Risk protocols and Regulator input associated with approvals for permits.

iii. Contain a Species at Risk assessment plan and associated timelines for Chedoke Creek downstream of the spill and including potential impacted areas downstream of Chedoke Creek that may be impacted by targeted dredging;

iv. Undertake consultation with the Species at Risk Branch within the Ministry in respect of any identified items pursuant to 4 iii) and incorporate this feedback and outcome into the workplan for any species at risk;

The Wood Team has consulted with the MECP Species at Risk (SAR) Team to determine the associated species at risk as well as associated protocols and approval requirements and timelines.

v. Provide a description of any anticipated approvals needed to implement the Chedoke Creek Workplan, initial consultation and proposed timelines to obtain such approvals, if required, for the Workplan to be implemented;

vi. The consultation in iv) and v) shall include the Regional Technical Support Section of the Ministry;

Appendix B *details the consultation undertaken by the Wood Team regarding permits and approval requirements associated with the targeted dredge operation. Further the Regional Technical Support Section of the Ministry has been consulted for input.*

vii. Contain a description of the identified areas and the extent (depth, location) of the targeted dredging with a description of how the items outlined in Item 5 below were addressed and a description of any methods for refining identified areas in Item 5 including the impacted areas identified in the Wood reports and SLR reports and timing as needed, in the Chedoke Creek Workplan*;*

As discussed herein, and outlined in various recent consultation with MECP staff, the information on the amount, location and composition of contaminated material is not known at present. It has been proposed to fill this information gap with field data collection including bathymetry and sediment sampling of the Lower Chedoke Creek, Princess Point Embayment and outlet zone of Cootes Paradise. The intent of these field activities is to provide insights in to the "extent (depth and location)" for the targeted dredging. The approach to targeted dredging will be led by a decision-making process which will adapt to field conditions once these are better defined.

viii. Contain a description of the approximate volume of material to be removed;

The Hatch Report (ref. "Quantification of Volume and Contaminant Loadings", Hatch, September 28, 2018), indicated that 2,375 +/- tonnes of total suspended solids (TSS) were discharged during the spill event. Wood's "Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report" included an evaluation of a range of possible in-situ sediment volumes based on the TSS discharged during the spill event. The soft sediment volume of 5,600 m^3 present within Chedoke Creek in 2018 approximates the

estimated volume of wastewater TSS that was discharged during the spill event if it were consolidated to 40% solids. This solids content is considerably higher than typical gravity thickening processes for wastewater sludges which produce a maximum sludge concentration of around 10% solids. Wastewater solids generally undergo thickening processes for only a few days before they are moved to a secondary dewatering process for finishing. Given the extended time wastewater solids may have been resident in Chedoke Creek following the spill, it is reasonable to assume that significant self-compaction beyond normal thickening processes may have occurred. It is also reasonable to assume that a portion of the wastewater solids may have been transported beyond Chedoke Creek and more may have decomposed naturally.

The removal of sediment mass is an important consideration for the proposed remediation efforts within Chedoke Creek and downstream. The current extent of organic sediment volume is likely to have changed since 2018 and will be reassessed as part of this work plan to determine the current volume and nutrient content of organic sediments within the creek and downstream in Cootes Paradise. Based on Wood's findings, additional sediment volume may be identified within Cootes Paradise that could present suitable remediation benefits if removed.

ix. Identify and contain a description of proposed mitigation measures for any short-term impact(s) that may arise from implementing the Chedoke Creek Workplan for Chedoke Creek, its shoreline and connected waterways/natural environment, on any species at risk and other potentially impacted uses. Mitigation measures may include, but are not limited to: exclusion measures for local aquatic uses; limit recreational uses in the area; total suspended solids control as required for carrying out the targeted dredging; and proposed monitoring during any remediation to monitor effectiveness of mitigation measures during dredging identified in iv); and

The overall conditions of Chedoke Creek during Wood's 2018 ecological investigations indicated no significant submerged or emergent vegetation and poor water and sediment quality which reduced the potential for significant presence of pollution tolerant species. The 2018 field effort was intended to provide a preliminary assessment of potential ecological or recreational impacts. Additional effort will be required to assess the presence of Species at Risk or other potential ecological impacts to the Chedoke Creek system and downstream in Cootes Paradise. Utilizing construction best management practices, such as fish exclusion techniques (e.g., deploying silt curtain from shore to extent of dredge area thereby excluding fish from work limits) and fish salvage and relocation protocols to remove fish from with the isolated work areas will be used. Prior to any dredging work being conducted within Chedoke Creek, fish will be removed and excluded from the work area. Additional wildlife exclusion measures and mussel relocation plans will be developed as needed to ensure local biota are avoided, excluded, or removed from the dredging activities, as best possible.

Recreational use of Chedoke Creek is already restricted by the City of Hamilton. Additional restrictions may be necessary particularly during the dredge operation depending on the potential for a revised project footprint to include portions of Cootes Paradise.

While the specific type of dredging technology is still under consideration, hydraulic dredging generally provides the most effective and economic turbidity control measures in a flowing system such as Chedoke Creek. Furthermore, it is anticipated that fine organic sediments will be pumped into the City's wastewater system which will significantly reduce the potential for turbid water returning to Chedoke Creek. Furthermore, once the plan is prepared, a construction monitoring program will be detailed and implemented.

x. Contain a proposed monitoring plan to monitor the recovery of the natural environment and effectiveness of the Chedoke Creek Workplan once dredging is complete

The Wood Team has developed an outline of a proposed monitoring plan which focuses on key indicators related to the natural environment, which would be expected to be tied to the planned improvements associated with the dredging program and the removal of contaminated material. The monitoring program will ultimately also need to reflect any specific conditions associated with the permitting of the works. For example, the anticipated Fisheries Act authorization typically includes post-construction performance monitoring to ensure the site and any enhancement features are functioning as intended and meeting the target success criteria as identified in the authorization. Similarly, the SAR Overall Benefit Permit as per the Endangered Species Act will specify post-enhancement performance monitoring with target success criteria. These post-construction monitoring events can occur within the short-term (e.g., years 1, 2 and 3 post-construction), as well as longer term studies (e.g., years 5 and 10+ post-construction) depending on the species, offset/benefit feature and expected timeframe for use and measures of performance.

5. ***With respect to the area from the Main/King CSO outfall to the mouth of Chedoke Creek, the Chedoke Creek Workplan shall take into consideration the scope of targeted dredging work necessary to restore the natural environment to pre-spill conditions, as to be agreed upon by the Ministry, and to mitigate any impairments or potential impairments from the spill, in relation to the following, but not limited to:***

   i. ***Sediment areas identified as impacted, in consultation with the Ministry, by the sewage spill;***

   ii. ***Sediment areas identified as containing elevated organic material consistent with sewage sludge;***

   iii. ***Sediment areas identified as elevated nutrients (particularly TP, TAN, and TKN);***

   iv. ***Sediment areas identified as had, may have, or continuing to have reduced dissolved oxygen (DO) levels in the water column from historical levels;***

   v. ***Sediment areas identified as having elevated parameters as identified by the ERA carried out by SLR ("Ecological Risk Assessment (ERA), Chedoke Creek, Hamilton, Ontario" dated February 12, 2020) to have moderate or high risk for impacts, or otherwise identified by the reports or in comments by the Ministry; and***

   vi. ***Addressing any ecological flow path requirements and connectivity within the creek in any remedial action plan that may impact low flow path and connectivity***.

   Wood's "Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report" included a preliminary evaluation of items 5.i. through 5.iv. These items and Items 5.v. and 5.vi. are reviewed in detail in Section 2 of this plan. These data will be supplemented with additional field efforts collected by Wood as part of this plan.

The following reports were used in preparing the Work Plan:

- "Quantification of Volume and Contaminant Loadings", Hatch, September 28, 2018
- "Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report" (Wood, January 24, 2019)
- "Chedoke Creek – Implementation and Costing Report" (Wood, January 24, 2019)
- "Peer Review Report - Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report", May 15, 2019, SLR Consulting (Canada) Ltd
- "Ecological Risk Assessment (ERA), Chedoke Creek, Hamilton, Ontario", SLR Consulting (Canada) Ltd., February 12, 2020

- "Cootes Paradise: Environmental Cootes Evaluation Hamilton, Ontario" by SLR Consulting (Canada) Ltd., April 22, 2020
- "Response to Ministry of Environment, Conservation and Parks May 28, 2020, letter entitled Chedoke Creek Spill Response – District Comments" SLR Consulting (Canada) Ltd., June 12, 2020
- Memo entitled "Chedoke Creek Project, Wood Commentary on SLR Peer Review Comments, City of Hamilton" dated May 23,2019 by Wood Environment & Infrastructure Solutions.
- Letter from the City entitled "Response to Director's Order 1-MRRCX" Items 1 & 2 submitted on February 14th, 2020.
- Report entitled "Main-King CSO Tank Overflow Volume Estimates" by HATCH Limited dated April 14th, 2020.
- Letter from the City entitled "Response to Order No.1-MRRCX, Items 3 and 4" submitted on April 30, 2020, with the following attachments:
    - Letter from the City of Hamilton entitled "Director Order Number; Item No. 4, Surface Water Monitoring Program" dated April 30, 2020.
    - Report entitled "Cootes Paradise: Environmental Cootes Evaluation Hamilton, Ontario" by SLR Consulting (Canada) Ltd. dated April 22, 2020.
- "Chedoke Creek Water Quality Improvement Study", GM BluePlan and Wood, (Draft), February 2021

1.2.1 Contaminant Loading Summary

The Order was based on the estimated spill volume and contaminant loadings which were provided by Hatch (2018) as shown in (**Table 1.1**). Total phosphorus (TP) and total Kjeldahl nitrogen (TKN) loading estimates were used to develop targeted restoration strategies including dredging.

Table 1.1. Estimated Contaminant Loadings for Period from January 28, 2014 to July 18, 2018 (ref. Hatch 2018)

Flow Component	Spill Volume (GL)	Estimated Total Contaminant Loading (Tonnes)				
		TSS	TP	Ammonia	TKN	cBOD
DWF (2018)	2.9	771	13	63	101	502
WWF (2014-2018)	21.1	1,604	34	96	211	871
TOTAL (2014-2018)	24.0	2,375	47	159	312	1,373

1.2.2 Water Quality Summary

The Work Plan included a summary of water quality in Chedoke Creek and downstream which began to degrade downstream of the Main/King CSO after the initial gate failure on January 28, 2014. *Escherichia coli* (*E. coli)* counts during the January 28, 2014, through December 31, 2017, were about an order of magnitude higher than prior to the beginning of the spill event. Median TP concentration was 2.2 times higher than the pre-spill period. Median ammonia concentrations were similar to pre-spill conditions although the maximum concentrations were higher after the start of the spill event. DO concentration following the first gate failure was similar to the pre-spill condition.

Water quality decreased dramatically after the failure of the second gate on January 1, 2018. TP concentration increased steadily from less than 1 mg/L at the beginning of the second gate failure to over 2.5 mg/L through mid-summer of 2018. Median *E. coli* counts increased by three orders of magnitude following the second gate failure. Median ammonia concentration was approximately an order of magnitude higher (5.89 mg/L) than both the pre-spill period and period between the first and second gate failures.

Water quality at the CP-11 station (**Figure 1.1**) appeared to improve rapidly following correction of the first and second gates on July 18, 2018. TP concentrations at CP-11 decreased to background levels, and similar to pre CSO levels. Median ammonia concentration following gate corrections was 0.28 mg/L or about half of the median concentration during the spill event.

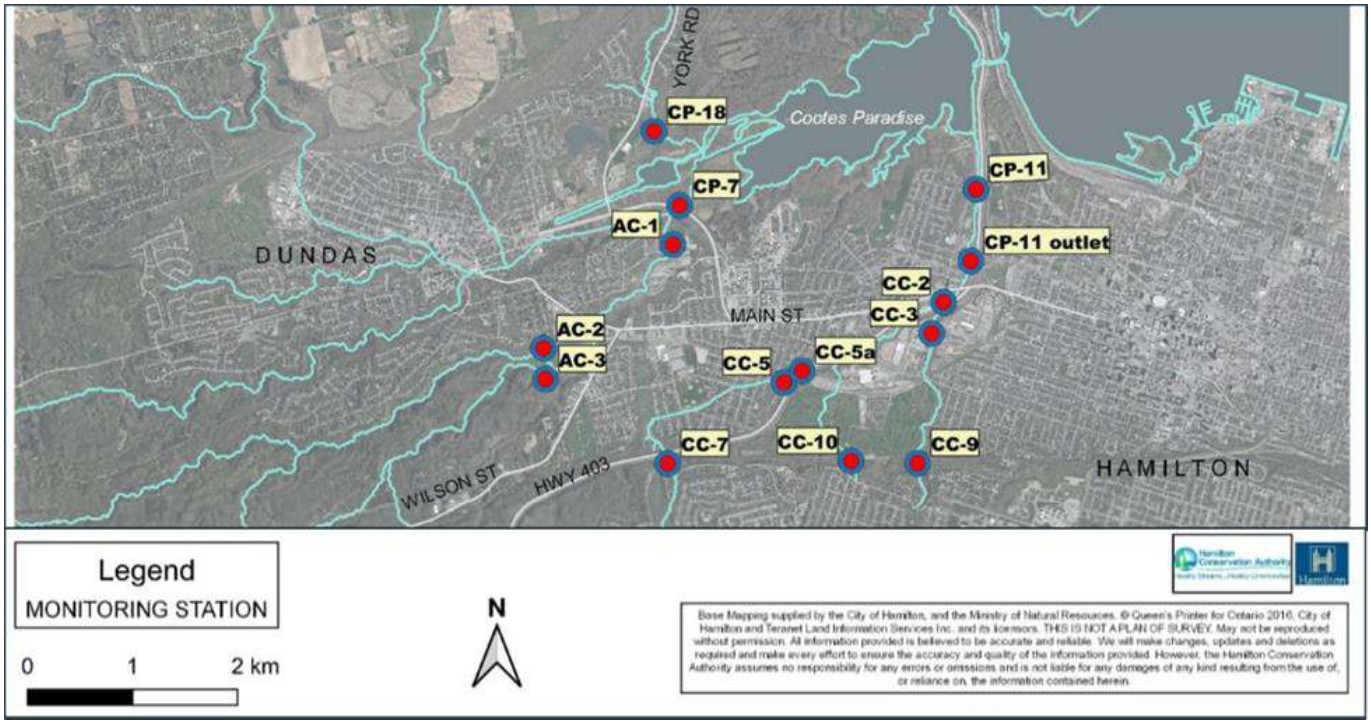

Figure 1.1: Map of Chedoke Creek and Cootes Paradise Monitoring Stations

1.2.3 Stream Conditions

The 2018 stream survey indicated no submerged aquatic vegetation, limited riparian vegetation, and an armored streambank. Some instream habitat (e.g., woody debris) was observed. An algae bloom was observed at Transect C-3/G-5 as shown in **Figure 1.2**. Stream sediments were generally muddy, and the soft sediment thickness layer increased from 0.1 m to about 0.7 m from upstream to downstream. The substrate within the upper half of the creek was sandy and rocky. Soft sediment fractions increased from 13 to 41% from upstream to downstream. Water velocity was highest within the shallow upstream half of the creek and slowed as the water depth became deeper within the downstream half largely due to backwater from Cootes Paradise.

1.2.4 Benthic Invertebrates

Aquatic invertebrates were sampled in 2018 at the locations identified in **Figure 1.2**. Invertebrate abundance and diversity generally decreased from upstream to downstream, reflecting the reduction in habitat quality, as defined by sediment condition. The overall benthic community was dominated by pollutant-tolerant organisms typically found in

poor habitats. The most abundant of these organisms were taxa including chironomids and *Tubificidae* worms. The benthic invertebrate community of Chedoke Creek indicated a pollution-tolerant community which indicates poor environmental conditions typical of urban streams.

1.2.5 Fish Community

Fish data collected by the Royal Botanical Garden (RBG) from 2001 through August 2018 were evaluated, along with fish sampling data collected by WSP, from areas shown in **Figure 1.2** as part of the 2018 *Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation* Report. Data were normalized to catch per unit area. Fish abundance was variable over the period of record, but was, on average, highest at station C1, located about 250 m upstream of the outflow to Cootes Paradise. Fish abundance was also high at station M5, west of the Chedoke Creek discharge to Cootes Paradise. The greatest number of species, on average, was also found at C1.

Figure 1.2: Sediment, Benthic Invertebrate and Fish Sampling Locations

Fish abundance of 6.1 fish/50 m was higher at C1 in 2013 than the 0.1 fish/50 m observed in 2014. A reduction in fish abundance was also observed at station M5 during this same period. Fish abundance increased in 2015 but declined for the next three years relative to the pre-spill abundances. The number of fish species also decreased at C1 after 2014 and similar conditions were found until 2018 when the number of species increased. The number of stress-tolerant fish also appeared to increase from 2014 until 2018 when they declined. Fish sampling results appear to indicate the fish community of Chedoke Creek responded negatively during the spill event and positively following the end of the spill event.

1.2.6 Sediment Conditions Summary

WSP, conducted preliminary sediment core and/or sediment grab sampling within Chedoke Creek at ten (10) locations between September 18th and 19th of 2018 as shown in **Figure 1.2**. Soft sediment thickness across the sample location transects showed greater accumulation of sediments along the west shoreline throughout the creek. Measured sediment thickness ranged from 0.10 to 0.70 m (mean thickness 0.37 m) along the west shoreline compared to 0.04 to 0.59 m (mean thickness 0.26) along the east shoreline and 0.03 to 0.66 m (mean thickness 0.32 m), near the centre of the creek.

In general, the upstream sample locations including C-1, C-2, G-1 and G2 contained less soft sediment (thickness range 0.06 to 0.37 m) compared to the most downstream sample locations C-5/G-6 and C-6/G-7 (thickness range 0.44 to 0.70 m).

1.2.7 Sediment Nutrients

Sediment quality nutrients of interest included ammonia+ammonium, total phosphorus (TP) and total Kjeldahl nitrogen (TKN), all of which were found in the highest concentration within the surface strata (0 to 15 cm) at the C-3/G-5 sample transect, specifically the C-3C sample location (**Figure 1.2**).

The next highest surface strata nutrient concentrations were found at the C-4C sample location, and both locations were positioned near the west shoreline, in areas of soft organic sediment. These sample locations were situated between the Kay Drage Park and Princess Point bridges, showing higher nutrient concentrations were present within this reach and were mostly higher than the surface strata within the Cootes Paradise sample location (C-6/G-7). Nearly all TKN concentrations in surface strata were above the Provincial Sediment Quality Guidelines (PSQG) Lowest Effect Level (LEL) of 550 µg/g, suggesting these sediments contain a level of contamination that can be tolerated by the majority of sediment-dwelling organisms, but not necessarily stress-intolerance taxa as discussed above. Total phosphorus concentrations in all sediment strata samples were greater than the PSQG LEL (600 µg/g) between transects C-4 and C-6/G-7, with the highest concentrations observed at transect C-5/G-6. The phosphorus PSQG Severe Effect Level. (SEL) of 2,000 µg/g was not exceeded by any sample concentration.

Previous sediment quality studies conducted by the RBG in 2006 and 2013 documented nutrient parameters at two locations (CC-1 and CC-2) positioned further northwest from the 2018 C-6/G-7 sample location (**Figure 1.2**). Pre-spill RBG data suggest that TKN enrichment had already occurred downstream in Cootes Paradise. Similarly, TP enrichment was found to have occurred downstream in Cootes Paradise prior to the event. The means and timeframe of TKN and TP enrichment remain unclear.

The mid and lower strata aliquot samples collected from Chedoke Creek showed nutrient concentrations were mostly higher than the surface strata concentrations at sample transects C-5/G-6 and C-6/G-7. These nutrient concentrations within deeper sediment strata suggested legacy nutrient enrichment had occurred where organic sediments were accumulating in the slower-flowing, lower reaches of the creek and within Cootes Paradise.

Nutrient concentrations were high in most samples collected from less than 30 cm in depth. Samples collected from portions of the creek that were sandy (C-1 through C-3) and deep (> 30 cm) had the lowest total Kjeldahl nitrogen and total phosphorus concentrations. Deeper sediment samples (> 30 cm) collected downstream of C-3 were

generally nutrient-enriched which was consistent with the depth of soft sediments in these areas. Presumably, a sandy sediment stratum with lower nutrient concentrations existed downstream of C-3, but further sampling at deeper intervals was needed to identify the vertical elevation of this layer.

1.2.8 Comparison of Preliminary In-Situ Sediment Conditions and Spill Quantities

WSP, estimated a layer of soft organic material approximately 16 m wide with a mean thickness of approximately 0.27 m (+/-) along roughly 1,275 m (+/-) of the creek bed between the Main King CSO and Cootes Paradise. The volume of organic material within Chedoke Creek was initially estimated in 2018 to be approximately 5,600 m^3 (+/-).

Soft sediment collected from Chedoke Creek indicated a moisture content of approximately 40% which suggested that this material was relatively dense and consistent with settling and consolidation of suspended particulate material in the wastewater stream. This material would likely include a portion of the TSS discharged during the spill event which would have subsequently consolidated over the duration of the spill event and thereafter.

WSP estimated that the 2,375 tonnes of TSS discharged during the spill event, per Hatch 2018, would occupy a volume of approximately 5,260 m^3 at 40% solids. This volume was similar to the approximate in-situ soft sediment volume of 5,600 m^3 estimated above.

While removal of solids mass was important, it was equally important to identify the potential TP and TKN mass removal that could be accomplished with a dredging project. As part of the Work Plan, WSP estimated the mass of TKN present within the Chedoke Creek soft sediments was 3 to 4 tonnes compared to 312 tonnes that were discharged during the spill. TP mass within the Chedoke Creek soft sediments was estimated to be 3.3 tonnes while total loading from the event was estimated to be 47 tonnes. The majority of TP and TKN mass load were likely solubilized and transported downstream.

Because the initial mass removal estimates were considerably less than the mass load transported downstream during the spill event, the potential dredge area was expanded to include the Princess Point embayment which is located immediately downstream of Chedoke Creek within Cootes Paradise. This is consistent with the relatively high concentrations of TP observed in the water column in Chedoke Creek and downstream in Cootes Paradise between 2014 and 2018.

1.2.9 Sediment Contaminants

While sediment contaminants including heavy metals and polycyclic aromatic hydrocarbons (PAH) were not the primary focus of the Work Plan, they were a significant consideration from an exposure and dredge material disposal perspective. This was explored in further detail by SLR as part of a 2020 Environmental Risk Assessment (ERA). The ERA indicated a relatively low sediment exposure risk under existing conditions. Exposure of underlying sediment layers with higher concentrations of heavy metals and PAHs was evaluated through subsequent sampling by WSP, and the design of the targeted dredge project was revised to ensure sediments exposed following dredging would not increase the exposure risk of the current sediments.

1.3 Timelines

Date	Event
December 4, 2020	The City receives Director's Order 1-PE3L3 from MECP
February 22, 2021	The City submits the Chedoke Creek Work Plan to MCEP
March 22, 2021	The City submits the Cootes Paradise Report to the MECP
April 2021	A topographic survey is completed via Genius Drone LiDAR system
April-August 2021	Sediment investigations are conducted, and bathymetry data is collected
June 11, 2021	The City receives MECP approval of Chedoke Creek Work Plan and Cootes Paradise Report
April-June 2021	Species At Risk (SAR) investigations take place
July 23, 2021	The City submits the Cootes Paradise Work Plan to the MECP
June-July 2021	Pre-qualifications of contractors take place
August 13, 2021	The City receives MECP approval of Cootes Paradise Work Plan
September 2021	The City installs a small-scale aeration system upstream of Kay Drage Park bridge and 800 square feet of floating treatment wetlands within the Princess Point embayment
September-November 2021	Hydrologic and hydraulic modelling takes place to ensure no flooding impacts during and after targeted dredging construction activities
January-March 2022	100% design and technical specifications for tendering are prepared for permitting and consultation with interested community partners
June 2022	Approval is received from all seven permitting bodies
June 2022	Kay Drage Park and adjoining trail are closed in preparation for targeted dredge activities
May-June 2022	Tendering to the four pre-qualified contractors takes place
June 2022	Lilliput mussels, as identified during the Species at Risk investigations, are searched, collected and relocated within Cootes Paradise
July 8, 2022	Targeted Dredging Construction Tender is awarded to Milestone Environmental Contracting Inc.
August 5, 2022	Lilliput mussel habitat enhancements are completed for the bluegill and sunfish
August 2022	Milestone Environmental Contracting Inc. begin site preparations
August 2022	The City paused preparatory targeted dredge work to continue discussions with the Indigenous community and the MECP
December 2022	The City requests a 12-month extension to the December 31, 2022, Order deadline which is subsequently granted by the MECP
March 2023	MECP amends the Order requiring the City to complete in-water targeted dredging work on or before October 31, 2023
May 2023	The City reaches an agreement with the Indigenous community and the MECP
July 2023	Milestone Environmental Contracting Inc. resumes site preparations and mobilizes the hydraulic dredger
October 13, 2023	The City requests a 1-month extension to the in-water work completion date
October 30, 2023	MECP grants the revised deadline of November 30, 2023, for in-water works
November 17, 2023	In-water targeted dredging activities are completed
December 1, 2023	Transportation of dried sediment to an approved landfill begins
December 30, 2023	Transportation of dried sediment to an approved landfill is completed

The Dredge Material Management Area in the Kay Drage Park was restored over the spring 2024 period.

2 SUMMARY OF WORK UNDERTAKEN

2.1 Data Collection

Data collection for the Chedoke Creek dredging design and permitting occurred in two phases. The first data collection phase, discussed above, was conducted to support the *Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report,* and was also used to prepare the Work Plan for the Chedoke Targeted Dredge project. The second phase involved collection of additional information within the creek and downstream in Cootes Paradise, as specified in the Work Plan, to support the design of the Chedoke Targeted Dredge project. **Figure 2.1** illustrates sediment thickness in the areas sampled in Phase 1 and additional areas that were investigated as part of Phase 2.

2.2 Assessment

The Phase 2 data collection effort involved over 40 additional transects and division of Chedoke Creek and the Princess Point embayment into five zones as shown in **Figure 2.2**. Analysis of sediment chemistry data obtained in Phase 2 indicated that insufficient water depth and limited amounts of organic sediments were present in Zone 1. Furthermore, sediments in the Princess Point embayment (Zones 4 and 5) contained elevated concentrations of heavy metals at the proposed dredge target depth. Zones 2 and 3 were comparatively easy to access, contained an abundance of soft nutrient-enriched sediments and removal of the sediments to the specified target depths was not anticipated to result in a degradation of sediment surface quality. Therefore, Zones 2 and 3 were recommended for dredging as shown in **Figure 2.3**.

WSP provided updated load reduction estimates for Zones 2 and 3 as shown in **Table 2.1** and updated target dredge elevations to 73.7 m IGLD (International Great Lakes Datum) in Zone 2 (average removal of ~ 0.5 m) and 73.4 m IGLD in Zone 3 (average removal of ~ 0.6 m). An estimated 10,674 m^3 of material, comprised of 29 tonnes of TKN and 23 tonnes of TP, were estimated to be available for removal at the time of the assessment. After reviewing additional sediment chemistry data collected during Phase 2, WSP subsequently recommended a revised dredge target elevation of 73.5 m IGLD in Zone 2 (average removal of ~ 0.5 m) and a dredge target elevation of 73.0 m in Zone 3 (average removal of ~ 0.9 m) and a revised estimated total in-situ removal volume of 11,300 m^3. The revised target dredge depths provided for additional TKN and TP mass removal while maintaining suitable quality of the remaining exposed sediment. Because the revised dredge volume estimate was similar to the previously determined volume estimate, the estimated TKN and TP mass removal was not revised pending the actual dredge volume removal following construction. WSP prepared several technical memoranda detailing the sediment chemistry and rationale for establishing the final dredge limits (**ref. Appendix C**), which were subsequently posted to the City's Chedoke Creek webpage (hamilton.ca/chedokecreek) and included the following:

- Evaluation of Chedoke Creek and Princess Point Sediment Cores and Preliminary Estimate of In-Situ Total Phosphorus and Total Nitrogen Mass, City of Hamilton (July 2021)
- MECP Request for Additional information – Comparison of Existing Sediment Surface and Target Surface Contaminant Concentrations (September 2021)
- Comparison of Sediment Contaminants in Surficial and Deep Layers in Chedoke Creek and Princess Point Sediment Cores and Recommended Dredge Target Modifications (October 2021)

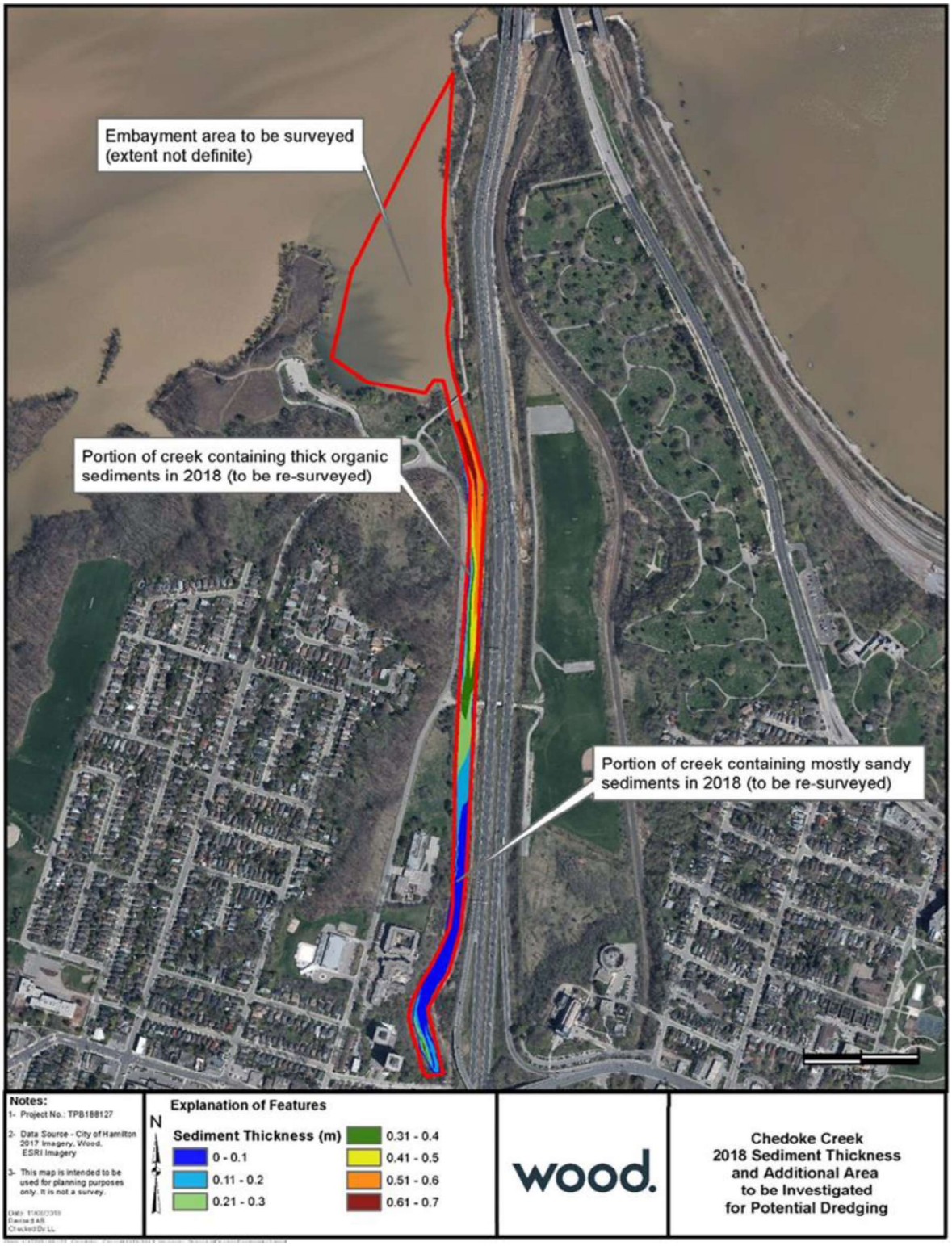

Figure 2.1: Phase 1 Sediment Thickness and Additional Areas Investigated as Part of Phase 2

Figure 2.2: Five Zones Investigated as Part of Phase 2

Figure 2.3: Recommended Dredge Zones 2 and 3.

Table 2.1: Original Zone 2 and 3 Dredge Areas and Associated In-Situ Total Kjeldahl Nitrogen and Total Phosphorus Mass

Project Area	Description	Area (m^2)	Target Dredge Elevation (m IGLD)	Average Targeted Sediment Thickness (m)	Volume (m^3)	Average TKN Conc. (ug/g)	Estimated TKN Mass within Zone (tonnes)	Average TP Conc. (ug/g)	Estimated TP Mass within Zone (tonnes)
Zone 2	CC-C14 to CC-C19	6,946	73.7	0.45	3,347	1,180	7	1,067	6
Zone 3	CC-C19 to CC-C26	9,973	73.4	0.60	7,327	1,641	22	1,251	17
				Total Zones 2 & 3	**10,674**		**29**		**23**

2.3 Design and Bid Specifications

The Chedoke Creek targeted dredge design consisted of two main elements including the dredge template and the dredge material management area (DMMA). The Final Chedoke Creek drawings for tender are provided in Appendix D. **Figure 2.4** provides a plan view (overhead) of the dredge template and a profile view (cross section) of the vertical limits of the targeted dredge project. Target dredge elevations in Zones 2 and 3 were selected to provide maximum pollutant removal while ensuring that the exposed underlying sediment would not result in decreased sediment quality at surface. To avoid potential damage to bridge foundations, areas under both bridges were avoided and the contractor was required to maintain a 10 m offset from either side of each bridge. Slopes were maintained at a minimum of 3:1 along the shore (east and west extents) and 10:1 for areas under the bridges and at the northern and southern dredge limits.

The DMMA was constructed at Kay Drage Park on the east side of Chedoke Creek and HWY 403. Kay Drage Park provided the necessary space for construction of a system of Geotubes® which served to dewater the dredged material. In addition, because Kay Drage Park was constructed over a former landfill, there was suitable truck and heavy equipment access under HWY 403. The DMMA layout is shown in Figure 2.5.

The dredge design required sediment to be pumped from the hydraulic dredge in Chedoke Creek to Kay Drage Park where polymer was injected to facilitate the dewatering process. This process was bench-scale tested by Bishop Water, Inc. as part of WSP's design development process. Once mixed with polymer, the slurry material was pumped into two designed containment cells holding several Geotubes® connected by a common manifold. Water draining from the Geotubes® collected at the low point in the containment cells where it was pumped through an above-ground pipeline to the City of Hamilton's wastewater collection and treatment system through a manhole located south of the park.

Once properly dewatered, the Geotubes® were designed to be cut open to access the dredged material which was then excavated and hauled to an appropriate landfill.

Comprehensive bid specifications were also prepared to accompany the design plans. The bid specifications included an extensive list of submittals that the contractor was required to provide prior to commencement of construction. The list of submittals is provided in Table 2.2.

Table 2.2: Submittal Register

Section No.	Description	Due Per Specs
	Due Prior to Start of Construction	
01300	**Contractor's Daily Progress Report Template**	14 days prior to PCC
02827	**Erosion and Sediment Control Plan**	14 days prior to PCC
01000	**Odour Control Plan**	14 days prior to PCC
17002	**Active Dewatering System Management Plan**	14 days prior to PCC
01300	Timelines for preparation of the sediment dewatering area to receive material	14 days prior to PCC
01300	The expected delivery timeline for geotextile tubes and proposed configuration	14 days prior to PCC
01300	Any proposed flocculants or polymers	14 days prior to PCC
01300	Any deviations from permitted dredging, sediment handling, & dewatering activities	14 days prior to PCC
01300	Discussion of the general operating procedures of the dredging and dredged material placement operations	14 days prior to PCC
01300	Active Dewatering System narrative (means and methods, surveys)	14 days prior to PCC
01300	Supplemental Information	14 days prior to PCC
01300	Testing, submittal of test results (dredged sediments and effluent) per coordination with landfill and wastewater treatment plant respectively	14 days prior to PCC
02827	**Turbidity Monitoring and Control Plan (per permit requirements)**	14 days prior to PCC
01785	**Threatened and Endangered Species Monitoring and Protection Plan**	14 days prior to PCC
17001	**Dredge Plan**	14 days prior to PCC
17001	Contractors dredging, sediment handling, & dewatering activities	14 days prior to PCC
17002	**Dredged Material Removal Plan**	14 days prior to PCC
01300	Means and methods of hauling and disposal of decanted material	14 days prior to PCC
01300	Timeline for the commencement and completion of dredged material removal	14 days prior to PCC
01300	Estimated number of trips per day	14 days prior to PCC
01300	Primary and backup disposal sites (permit condition for landfill disposal - only)	14 days prior to PCC
01300	Written contract with owner of disposal site, acceptance agreement	14 days prior to PCC
01300	Land alterations or permits by regulatory agencies	14 days prior to PCC
01300	Measures to keep streets and waterways free from spilled materials and to repair damages to streets	14 days prior to PCC
01300	**Severe Storm Plan**	14 days prior to PCC
01300	Actions taken before a storm strikes a Project Area	14 days prior to PCC
01300	Weather conditions and water stage threshold for shutdown	14 days prior to PCC
01300	Equipment list, with weather limitations	14 days prior to PCC
01300	Methods of securing equipment during shutdown	14 days prior to PCC
01300	Evacuation plan for personnel	14 days prior to PCC
01300	Operations procedures for securing critical dredge equipment	14 days prior to PCC
01300	Communications protocol (with law enforcement/rescue agencies)	14 days prior to PCC
01561	**Project Environmental Protection Plan**	14 days prior to PCC
01561	Environmental Monitoring Plan	14 days prior to PCC
01561	Dust Management Plan	14 days prior to PCC
01561	List of Emergency Contacts	14 days prior to PCC

Section No.	Description	Due Per Specs
01300	**Health and Safety Plan**	14 days prior to PCC
01550	**Traffic Management Plan**	14 days prior to PCC
01300	**Quality Control Plan**	14 days prior to PCC
01300	Description of QC Organization, identify QC Manager	14 days prior to PCC
01300	Names/authority of QC personnel	14 days prior to PCC
01300	Letter to QC Manager signed by authorized official of firm describing responsibility and delegating authority	14 days prior to PCC
01300	Letters of Direction to all other control reps	14 days prior to PCC
01300	Procedures for scheduling, reviewing, certifying, and managing submittals	14 days prior to PCC
01300	Procedures for testing	14 days prior to PCC
01300	Procedures for tracking deficiencies	14 days prior to PCC
01300	Reporting Procedures	14 days prior to PCC
02101	**Soil Management Plan**	14 days prior to PCC
02480	**Site Restoration Plan**	prior to SOW
02480	**Post Construction Monitoring Plan**	prior to SOW
02480	**Landscaping Plan**	prior to SOW
01300	**Shop Drawings**	prior to SOW
01300	In-water and land-side pipeline layout	prior to SOW
01300	Booster Pump locations and configurations	prior to SOW
01300	Effluent water holding tanks	prior to SOW
01300	Active dewatering equipment	prior to SOW
01300	**Work Plan**	14 days prior to PCC
01300	Layout Drawings	14 days prior to PCC
01300	Projected Schedule (Initial Progress Schedule)	14 days prior to PCC
01300	List of materials and Equipment	14 days prior to PCC
	Due During Construction	
01300	Construction Progress Schedule	Monthly
01300	Monthly Progress Schedule Updates	Monthly
01300	Detailed Monthly Status Reports	Monthly
01300	Daily Progress Reports	Weekly
01025	Signed and sealed hydrographic survey	Prior to SOW
01025	Signed and sealed hydrographic survey	Prior to Final Inspection
01025	Pre-Dredge Condition Assessment	Prior to SOW
01025	Post-Dredge Condition Assessment	Prior to Final Inspection
01025	Progress Hydrographic Survey	Progress Payment Request
01300	Site Inspection and Restoration Report (Dewatering Areas)	Prior to Restoration
01561	Turbidity Monitoring Reports (daily)	Weekly, Unless Exceedance
01050	As-Built Drawings	Prior to Final Inspection

*PCC - Pre-Construction Conference

**SOW - Start of Work (Also Commencement of Work)

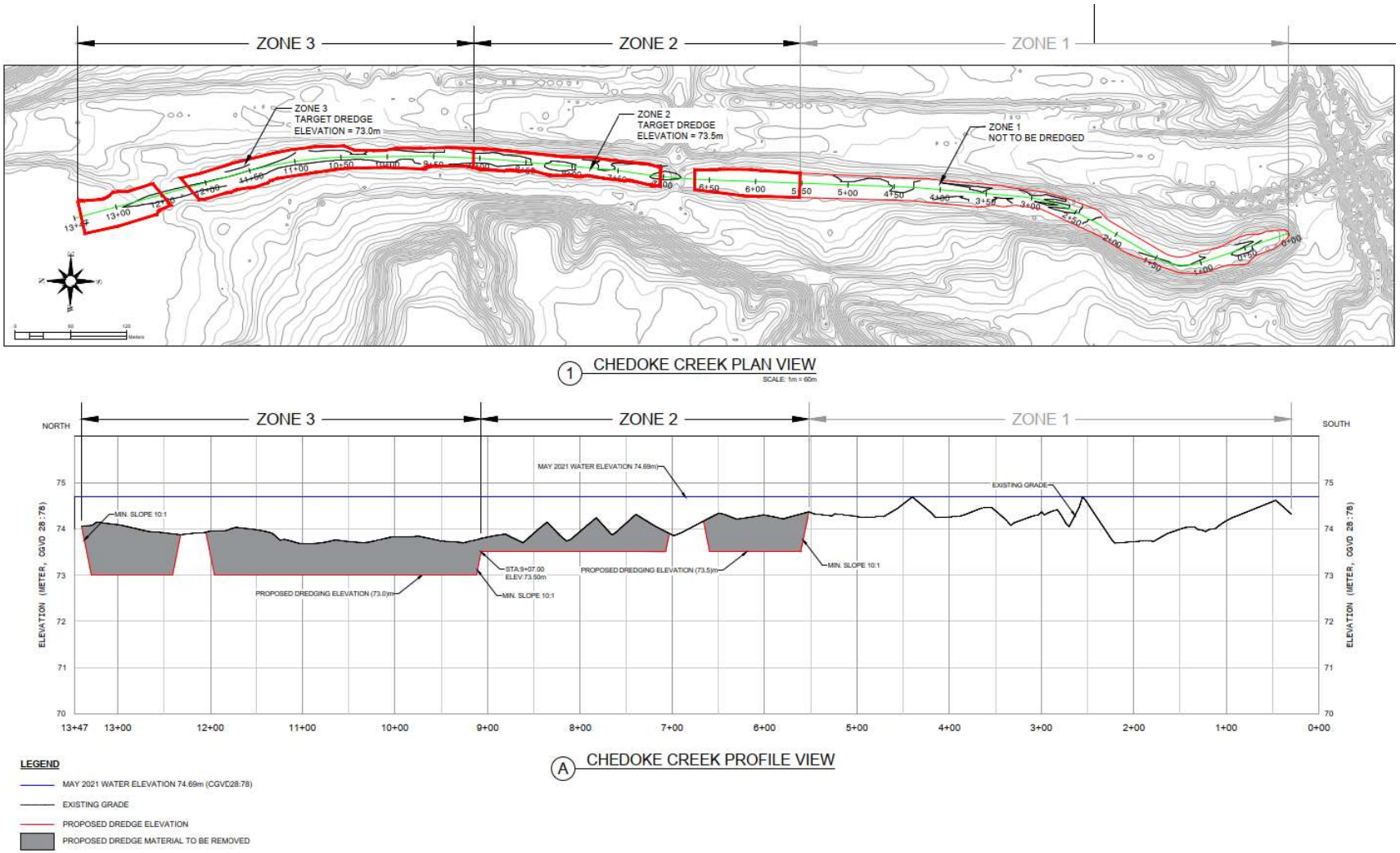

Figure 2.4: Chedoke Creek Plan and Profile View

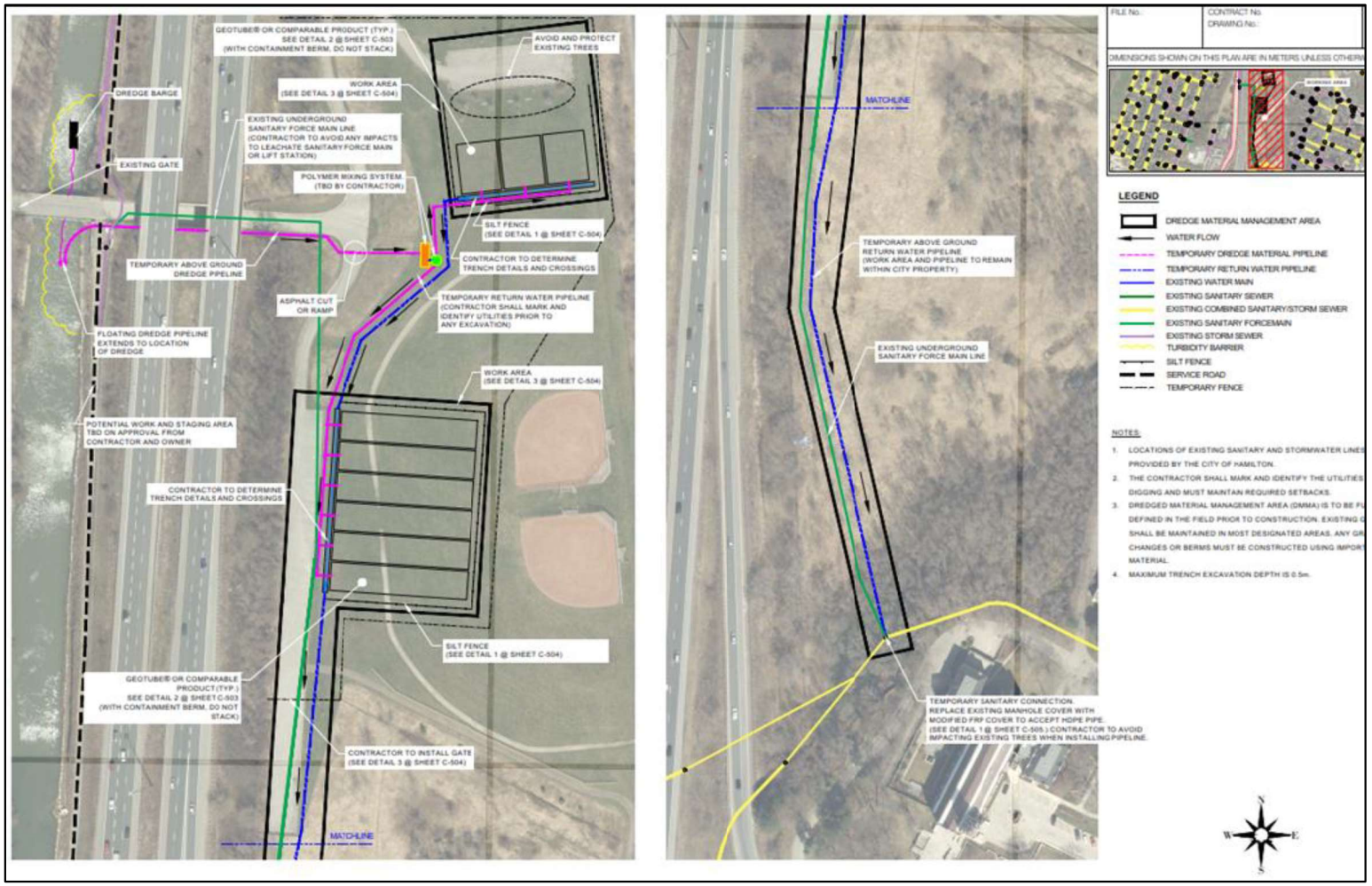

Figure 2.5: Dredge Material Management Area in Kay Drage Park

2.4 Permitting

During the initial stages of the project, consultation was initiated with regulatory agencies and interested community partners to begin early discussions and to confirm permitting requirements, review approval timelines and establish contacts for ongoing consultation throughout the targeted dredge project. A summary of the outcome of these early discussions and permit approvals is provided below. This summary also confirms changes to the original work plan permitting requirements once the agencies were engaged and further details of the proposed works were understood by the regulators. As such, some of the anticipated permitting and approval requirements (e.g., *Fisheries Act* authorization were ultimately not needed).

2.4.1 Hamilton Conservation Authority

As per the *Conservation Authorities Act* regulation 161/06 under Ontario Regulation 97/04, it was determined that a Hamilton Conservation Authority (HCA) Work Permit would be required for the dredging works as they take place within their regulated limits. HCA issued Permit # 2022-06 on February 2, 2022.

2.4.2 Royal Botanical Gardens

The Royal Botanical Gardens (RBG) perform monitoring and regulate research projects by others within Cootes Paradise, which includes the outlet of Chedoke Creek and the Princess Point embayment. As such, RBG identified that the proposed targeted dredging project would require an RBG research permit that includes details regarding the purpose and nature of the proposed project. RBG issued Permit #2021-07 on December 16, 2021.

2.4.3 Ministry of Transportation

The Ministry of Transportation (MTO) confirmed that an Encroachment Permit and Building and Land Use Permit were required as per the *Public Transportation Act and Highways Improvement Act*. Permit # BL-2022-20T-0000036 was issued on February 10, 2022.

2.4.4 Ministry of Natural Resources and Forestry

The Guelph District Ministry of Natural Resources and Forestry (MNRF) confirmed approval under the *Lakes and Rivers Improvement Act* (LRIA) was not required for this project since the HCA Work Permit # 2022-06 addressed the dredging review and approval requirements. As such, no further permitting was required under the LRIA.

2.4.5 Ministry of the Environment, Conservation and Parks

Several Species at Risk (SAR) were identified as being potentially present within the project area, some of which were determined to have direct interactions with the targeted dredging project. As such, early consultation with MECP determined that under the *Endangered Species Act* (ESA) Section 17(2)(c) an Overall Benefit Permit (OBP) would be required. More details of the OBP are discussed in Section 3.1.2.

Additionally, Ontario's Permit to Take Water program ensures water takings in Ontario are managed to the standards of the Great Lakes-St. Lawrence River Basin Sustainable Water Resources Agreement. Companies or organizations who take over 50,000 litres of water/day from a lake, river, stream or groundwater source, must obtain a Permit to

Take Water (PTTW) from the MECP. Permit holders are legally required to record how much water they take each day and must abide by the limits imposed on their permit based on the location and type of water source. MECP issued Permit # P-300-9212648817 on June 15, 2022.

2.4.6 Ministry of Heritage, Sport, Tourism, and Culture Industries

Dredging within the Princess Point embayment had the potential to require archaeological assessment of the nearshore areas; however, it was determined through consultation that the conclusions in the Stage 1 AA, West Hamilton Landfill/Chedoke Creek, Hamilton, Ontario (2006) report that the section of Chedoke Creek north of King Street West had been sufficiently modified through the 20th century and that no further archaeological potential associated with the creek in its current alignment is required.

2.4.7 Transport Canada

The Navigation Protection Program (NPP) within Transport Canada (TC) reviews permit applications under the *Canadian Navigable Waters Act* (CNWA). Early engagement with TC determined that approval under the CNWA would be required. Approval was received on April 11, 2022, under File No.: 2021-405815.

2.4.8 Fisheries and Oceans Canada

The Fisheries Protection Program (FPP) evaluates projects via the Request for Project Review (RFR) form that assesses whether projects are likely to cause death of fish or harmful alteration, disruption, or destruction (HADD) of fish habitat, which would be in contravention of the *Fisheries Act* (FA) and require authorization to proceed.

A RFR was submitted February 23, 2021, and the project was assigned File No. 21-HCAA-00211. DFO issued a Letter of Advice (LOA) for the dredging works; however, it was also determined that due to the potential presence of Lilliput mussel (*Toxolasma cylindrellus*) and its critical habitat a Species at Risk Application (SARA) permit would be required. More details of the SARA permit requirements are discussed in Section 3.1.1.

2.4.9 Impact Assessment Agency of Canada

The MECP indicated that a Provincial Environmental Assessment would not be required. The Impact Assessment Agency of Canada (IAAC) was also contacted, and it confirmed that the targeted dredging project did not require a Federal assessment under the *Impact Assessment Act* (IAA).

2.4.10 Construction Dewatering Sewer Discharge Permit

The City of Hamilton's Construction Dewatering Sewer Discharge Permit is designed for dewatering discharges from construction, land development, renovation, repair, maintenance or demolition activities. A permit is required prior to the start of dewatering and any discharge into the sanitary or combined sewer must comply with the City's Sewer Use Bylaw No. 14-090 Schedule B. Permit # 220701-G was pre-approved on January 24, 2022, and subsequently issued on July 1, 2022.

2.5 Prequalification

Since dredging requires specialized equipment and contracting skills to implement properly, the City determined that a contractor prequalification process was necessary to evaluate interested eligible contractors and provide a streamlined approach to bidding. The City of Hamilton released Request for Pre-qualifications C14-09-21 on May 10, 2021, and received contractor prequalification submittals for the Chedoke Creek Targeted Dredge Project on June 1, 2021. Five contractors provided submittals which were reviewed by the City with four of five contractors selected as pre-qualified.

2.6 Tendering

Designs and technical specifications for tendering were prepared by WSP between January and March 2022. The City released Tender C13-18-22 (Tender for Prequalified Contractors Required for the Targeted Dredging of Chedoke Creek) to the four pre-qualified contractors which was posted April 29, 2022, with a closing date of June 8, 2022. Three addenda were issued during the tender period to answer bidder questions.

A total of three bids were received. A post tender evaluation was performed on the lowest bid to ensure that all conditions addressed the requirements of the Targeted Dredging of Chedoke Creek project. As a result, the tender was awarded on July 8, 2022, to Milestone Environmental Contracting Inc. (Milestone) with a corresponding bid price of $5,919,992.00 (excluding taxes).

2.7 Construction

Kay Drage Park was closed to the public in June 2022 in anticipation of pending site preparation which began with the construction of the southern containment cell (DMMA #1) in early August 2022. Contractor mobilization progressed until August 18, 2022, when the City paused the project after representatives of the Haudenosaunee Development Institute (HDI) arrived on site stating that they were exercising their treaty rights. On October 6, 2022, the City instructed Milestone to implement a standby plan with construction ceasing due to health and safety concerns.

Following further negotiations and executing a settlement agreement with the HDI, WSP and the City issued a Notice to Proceed to Milestone on May 19, 2023. After receiving the notice to resume construction, Milestone continued with the preparation of the containment cells (DMMA #1 & 2), installation of the polymer mixing system, assembly of the dredge pipeline, and mobilized the hydraulic dredge in July 2023. Milestone however continued to make modifications to the construction of the northern containment area (DMMA #2) including re-arranging geotextile containers and pipelines, such that this feature was not completed until October 2023 (it was not required earlier as the capacity of DMMA #1 was sufficient for initial dredged material).

In-water work began on July 17, 2023, with dedicated debris removal between the Desjardins Recreation Trail bridge and the Kay Drage Park bridge. The debris removal was followed by the commencement of targeted dredging approximately 100 meters north of the Desjardins Recreation Trail bridge. Targeted dredging continued to move south in the manner identified in **Figure 2.6**. Interim bathymetric\hydrographic progress surveys were completed as the work progressed with any identified high spots addressed after the completion of the initial targeted dredge template. Further details are provided in Section 3.2.

Unseasonably wet weather and unexpected debris caused some delays and the City was granted an extension by the MECP to complete in-water work by November 30, 2023. Milestone completed in-water work in advance of the revised deadline (November 17, 2023) and began transporting dewatered sediment to designated soil management

receivers\landfills. Further details are provided in Section 3.2. Excavation and transport of dewatered sediment continued until December 30, 2023. All dredged material was removed from the site in advance of the MECP required deadline of December 31, 2023.

After completion of sediment disposal, Milestone continued to work on the removal of temporary berm material used to construct the southern and northern containment cells. This work continued in 2024, with final Kay Drage Park restoration works completed in June 2024.

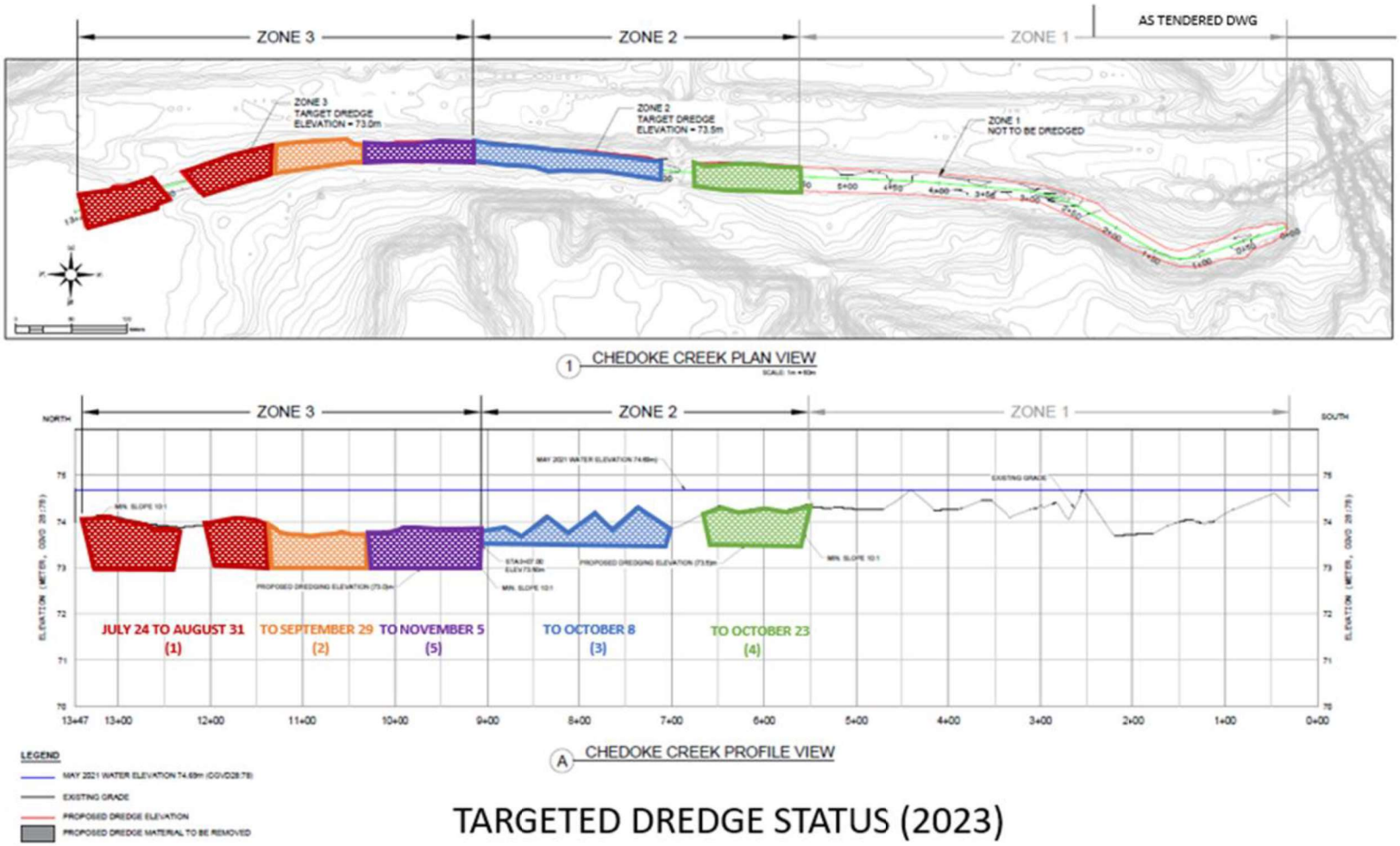

Figure 2.6: Chedoke Creek Plan and Profile View (as dredged)

3 CONSTRUCTION MONITORING RESULTS AND ANALYSIS

3.1 Permitting Requirements

3.1.1 DFO Species at Risk Act Completed Requirements (pre/during dredging)

As identified within Section 2.4, consultation with DFO determined that an application for a *Species at Risk Act* (SARA) permit was required for the mussel relocation component of the project. As part of the SARA permit, the mussel relocation was required to be completed prior to the in-water works to minimize impacts to the federally endangered Lilliput mussel (*Toxolasma parvus*) resulting from the in-water dredging activities which occurred within approximately 2,000 m^2 of mapped critical habitat for Lilliput mussel.

The mussel relocation was based on protocols set out in "Protocol for the detection and relocation of freshwater mussel species at risk in Ontario-Great Lakes Area" (Mackie et al. 2008), as well as the "Survey Protocol for Species at Risk Unionid Mussels in Wetlands in Ontario" (OMNRF 2018), with the search area focused within the Prescribed Search Area (PSA) and surrounding work area as outlined in **Figure 3.1**. Due to the proposed dredging activities (dredging downstream to upstream) and unsuitable habitat conditions within the upstream reach, mussels were relocated to areas with known Lilliput mussel populations within Cootes Paradise.

WSP biologists initiated the mussel search and relocation project on June 6, 2022, starting at the downstream extent of the PSA (see **Figure 3.1**) by placing metal fence posts within the substrate and running floating line between them to delineate the search area. Initially (June 6 to 10, 2022), a team of two biologists worked from opposing banks, searching towards the middle by 1 m^2 grids placed upon the substrate. When a line was completely searched, the fence posts were moved upstream 1 m and the search was continued in the same fashion. A total of 20 lines, or approximately 720 of the 4,203 m^2 search area was completed within week one. During the search, one dead/relic Lilliput and two live Paper Pondshell (*Utterbackia imbecillis*) mussels were found with the live mussels relocated to the area identified within **Figure 3.1**.

During the second week of searching, a team of four staff worked as described above; however, two sets of lines were searched simultaneously with the downstream team clearing 2 m^2 on the east and west banks prior to the upstream team initiating their searches to ensure the area was cleared prior to standing within the area. A total of 59 lines, or approximately 2,124 of the 4,203 m^2 search area was searched within the first four days of week two until the water depth became limiting, in that depths did not allow for continued searching by wading. The remaining area (approximately 1,360m^2) was searched by utilizing a similar approach as described above, with two to three staff reaching over the side of an inflatable boat and searching the 1 m^2 grids. During the second week searches, one live Lilliput mussel and three live Paper Pondshell mussels were found with the live mussels relocated to the area identified within **Figure 3.1.** The live Lilliput mussel and one of the Paper Pondshell mussels were tagged (234 and 232 respectively) and placed within the vicinity of a yellow camping peg as part of the required monitoring of SAR mussels following Section 5.3 outlined in the Mackie et al. 2008 protocol, including one (1) month, one (1) year, and two (2 years) after the relocation.

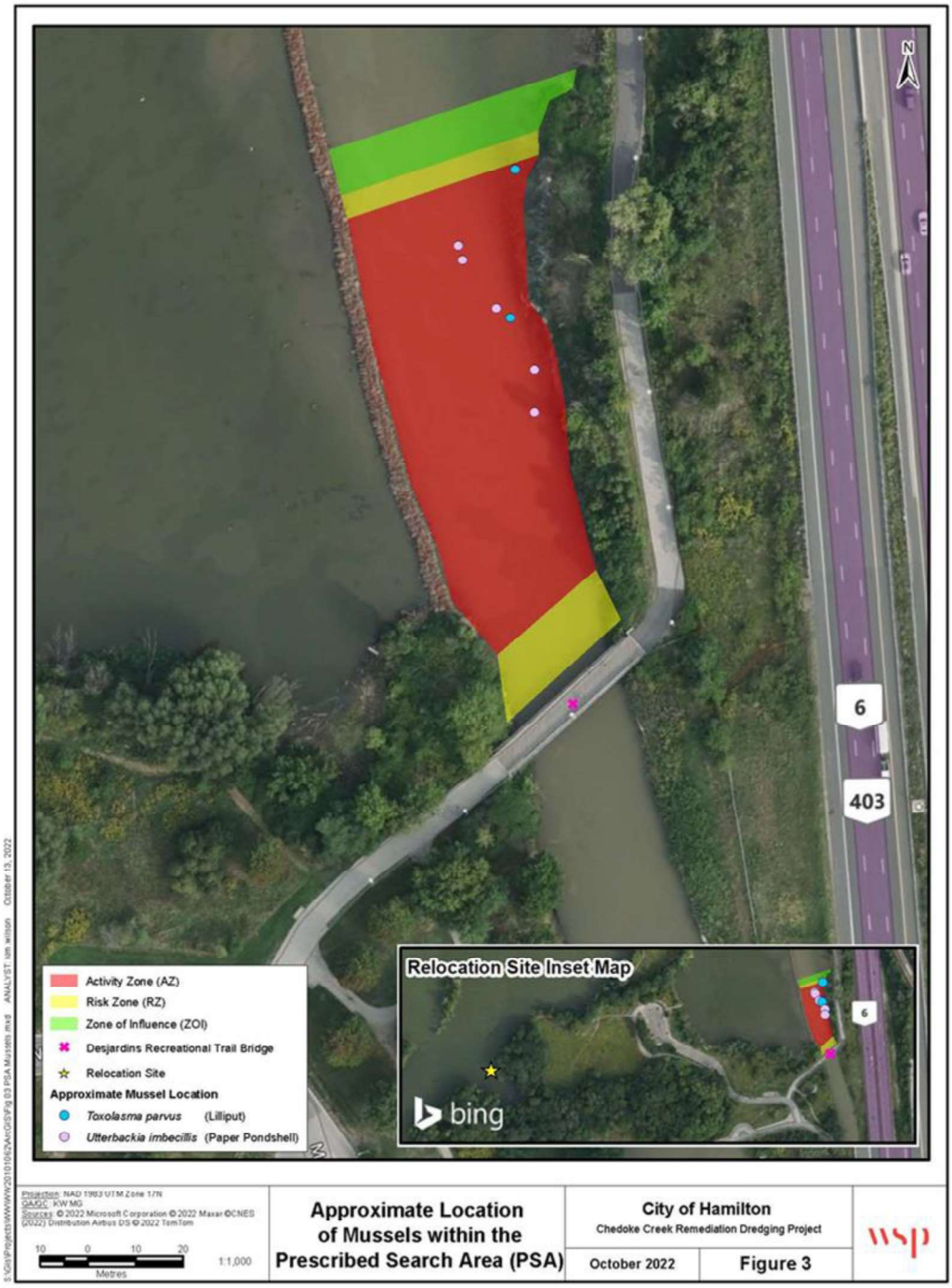

Figure 3.1: Mussel Search and Restoration Map.

As per Condition 3.5 within SARA Permit No.21-HCAA-00211, and as identified above, the one-month monitoring of the relocated SAR Lilliput mussel occurred on 13 July 2022 following methods as per Section 5.3 in the Mackie et al. 2008 protocol. The search centered around the yellow peg, starting at the peg moving outwards for an approximate hour of searching utilizing the “raccooning” technique, and an approximate search area of two metres diameter from the peg. During that search, no live mussels including the tagged Lilliput mussel were found; however, one deceased juvenile Paper Pondshell mussel was located. It should be noted that water levels were approximately 0.8 metres lower from the time of the relocation and the one-month monitoring exercise. As none of the tagged, relocated mussels were found in the area surrounding the peg, a wider search was undertaken and two Paper Pondshell mussels, not related to the relocation efforts were found. The results of the one-month monitoring suggest the relocated mussels may have moved away from the benchmark location, or may have been relocated by predators (e.g., racoons) and could not be found.

These 1-month findings suggested that subsequent 1-year and 2-year post relocation monitoring would no longer be required with this approach confirmed by DFO (ref. Jess Taylor pers. comm. October 25, 2023). As such, future mussel monitoring was not required for the project.

3.1.2 MECP Overall Benefit Permit Completed Requirements (pre/during)

Consultation with the MECP Species at Risk Branch (SARB) was initiated due to several SAR identified as being potentially present within the project area. As part of these early discussions, both an Information Gathering Form (IGF) and Avoidance Alternatives Form (AAF) were submitted to MECP SARB. Upon its review, it was determined that Cootes Paradise and the area within the downstream extent of the remediation area was identified as habitat for Lilliput mussel (*Toxolasma parvum*), a SAR mussel species and that an OBP would be required prior to undertaking the targeted dredging works.

As part of the OBP, WSP on behalf of the City of Hamilton, proposed a series of habitat enhancements within Cootes Paradise. These locations were areas known to have occurrences of Lilliput mussel, and therefore it would create greater opportunities for the glochidia to attach to Bluegill (candidate host sunfish species for the mussel) and promote greater reproduction opportunities for the Lilliput mussel. As part of this Bluegill enhancement program, the OBP plan was to construct 50 habitat enhancement features including brush piles (10), artificial nesting structures (35), and root wads (5) within an area near Cockpit Island and within high density Lilliput mussel habitat between Sassafras Point and Princess Point.

In addition to the habitat enhancements, other conditions within MECP Permit No.WC-C-001-22 included completion of the mussel salvage and providing education and awareness training to all persons engaging in project activities. Details of the mussel salvage are provided above within Section 3.1.1. WSP biologists provided virtual SAR Awareness Training to all staff anticipated to be working on the project in 2022; however, due to project delays in 2022, training was also provided in person in June and July 2023. The topics covered included:

a) the existence and identification of Protected Species and its habitat at the Site, mostly relating to Lilliput mussel but also including other SAR with the potential to move into the Study Area.

b) the requirements of the permit;

c) potential threats posed by Project activities to the Protected Species and its habitat; and

d) mitigation efforts that must be taken to minimize harming the Protected Species.

The installation of the Bluegill enhancements began on August 3, 2022, and was completed on August 6, 2022, focusing on three areas. Site one is west of Cockpit Island, Site two is east of Cockpit Island and Site three is directly west of the Princess Point shoreline within the Westdale Inlet. All three sites had substrates consisting of sand, silt and muck with woody debris, water lily (*Nymphaeaceae sp.)* and limited other aquatic vegetation.

As identified within the OBP Plan, which was submitted as part of the OBP submission to determine the effectiveness of the enhancements and the bluegill fish populations, responses to the enhancement structures were evaluated on May 23, 2023, utilizing shoreline and boat visual searches, mussel viewers and a Lowrance HDS7 fish finder. At the time of the monitoring, water temperatures within the enhancement areas were approximately 17.2°C, with mostly clear skies and an air temperature of 20°C. Secchi disk measurements were taken at each site and recordings were 0.03, 0.03, and 0.02 m respectively from Site 1 to Site 3. All three sites had increased water depths ranging from 1.0 to 1.3 m and the water colour was brown with organic debris within the water column. Due to the total water depth and colour, shoreline nest counts were not possible. A such, visual searches were undertaken from a boat and by wading out to the enhancements and searching the area using mussel viewers. Similar to the shoreline nest counts, the depth and water clarity was limited, and the enhancements were not visible within the viewer. A final approach, using a Lowrance HDS7 fish finder with structure scan (utilizing side imaging to detect structures in real time) was attempted by following transects and floating over the enhancements to identify the locations of the enhancements, and undertake fish counts. Due to the limitations of the side scanner with the water depth, it was not possible to confirm presence of fish within proximity to the enhancements. Shoreline searches of other areas within Cootes Paradise were undertaken to check for nesting Bluegill activity; however, no nests were observed.

A second attempt to undertake the year one monitoring commenced on June 21, 2023. Water temperatures within the relocation areas ranged from 23.2°C to 25.4°C, with mostly clear skies and an air temperature of 25°C. Secchi disk measurements were taken at each site and recordings were 0.19, 0.22, and 0.23 m respectively from Site 1 to Site 3. Subsequent to the unsuccessful attempt to observe fish presence in May 2023, a MarCum LX-9 underwater video camera was utilized by initially floating over the enhancements in a boat to search the area for fish, but due to gusty conditions and limited water clarity that day, it was decided that walking out to each enhancement, and hovering the camera just off the bottom allowed for optimal viewing of the area. At each enhancement, the biologist stood motionless, and the camera was hovered over the enhancement for approximately five minutes with the camera gently rotated during this period to fully observe any fish or wildlife utilizing them. Visual survey results showed that all installed enhancements were intact and within their original locations. It was also noted that the interstitial spaces within the gravel in the nesting boxes was slowly filling with native substrate/sediment; however, no fish or their nests were observed. Shoreline searches of other areas within Cootes Paradise were undertaken to check for nesting Bluegill activity with a single nest observed along the same bank as Site 3; however, within 0.1 m of total water depth.

The results of the 2023 field surveys to assess the effectiveness of the OBP Bluegill enhancements, determined that due to the limitations associated with increased total water depths and limited water clarity following the approach suggested within the OBP Plan, it was not possible to determine whether Bluegill were utilizing the enhancements during their spawning period. WSP provided the MECP SARB with the Year One Annual Monitoring Report on November 24, 2023. Consultation with the MECP SARB included a proposed ranking matrix of six new monitoring options. The top three options, with the highest cumulative score were determined to be the most appropriate in determining if the Bluegill are using the enhancements. These new monitoring options are currently being completed in 2024.

3.1.3 Erosion & Sediment Control Monitoring

Milestone installed approximately 490 meters of silt fence around the DMMA prior to the start of construction. Other products installed by Milestone to control erosion included mudmats with 15-cm diameter stone, silt sacks, and 20-cm silt socks. Specifications for erosion control products are provided in **Appendix E.1**.

Milestone performed daily erosion and sediment control (ESC) inspections of the construction site as part of its normal activities. In addition, WSP provided routine site inspections as documented in **Appendix E.2** to ensure that all ESC controls were operating as intended. Where deficiencies were identified, WSP worked with Milestone to address the issues in a timely manner.

3.1.4 Turbidity Results (during dredging)

Milestone implemented numerous turbidity control measures throughout the duration of the project as required in the plans. Typical upland turbidity control measures (ESC) were installed as discussed in Section 3.1.3. In addition, the dredge was surrounded by a floating turbidity barrier as shown by the yellow clouded line in **Figure 2.5** which effectively isolated the active dredge area from the remainder of the creek. Both ends of the turbidity barrier were secured to the same side of the creek so that it did not interfere with water flow or fish passage.

Turbidity monitoring was conducted by Milestone as required by the contract during the targeted dredging of Chedoke Creek. Weekly reporting began on July 17, 2023, and continued until November 19, 2023 (i.e. until the completion of in water works). Turbidity checks were conducted every half-hour during targeted dredging working hours using a Hoskin Scientific TN400 Handheld Turbidity Monitor at four monitoring locations.

During the 125-day dredging period, only four exceedances were reported. Exceedances are determined by measuring Nephelometric Turbidity Unit (NTU) concentrations outside of operation hours as a background level. Any turbidity concentrations above 10% of the background level are considered in exceedance. All exceedances were due to natural circumstances, like natural water current fluctuations and adverse weather. **Table 3.1** lists the dates of turbidity exceedances and comments by Milestone. On July 17, 2023, wind and current fluctuated throughout the day causing turbidity fluctuations. Similarly natural fluctuations in turbidity caused exceedances on July 19, 2023, and August 11, 2023. Heavy rainfall and wind gusts ensued on July 20, 2023, causing turbidity exceedances. All Milestone turbidity reports can be found in **Appendix F**.

Table 3.1: Turbidity Exceedance Dates and Comments from Milestone during Chedoke Creek Dredging Activity

Dates of Exceedances	Comments
July 17, 2023	Natural Fluctuation.
July 19, 2023	Natural Fluctuation.
July 20, 2023	Natural Fluctuation and adverse weather.
August 11, 2023	Strong north-to-south current.

3.1.5 Permit to Take Water Results (during dredging)

The Targeted Dredging project Permit to Take Water (PTTW) summary is provided in **Table 3.2.** Daily average pump rates were provided by Milestone (**Appendix G**) and were based on flow meter logs from the hydraulic dredger. For the duration of dredge activity (from July 26, 2023, to November 17, 2023), the average pump rate was 3,421 L/min. Minimum and maximum instantaneous pump rates during operation were 1,391 L/min and 5,639 L/min, respectively. Minimum and maximum daily pump rates during operation were 182,000 L/day and 2,263,000 L/day. The total amount of volume pumped during dredge activity (from July 26, 2023, to November 17, 2023) was 136,509,000 liters including 660 hours of dredging over 102 operational days, by Milestone. All amounts and durations fell within the allowable permitted values (ref. Table 3.2).

Table 3.2: Permit to Take Water Project Summary

PRODUCTION DATA	TOTAL	MAX	MED	MIN
Slurry Pumped (m^3/day)	136,509	2,263	1,417	182
Slurry Pumped (litres/day)	136,509,000	2,263,000	1,417,000	182,000
Active Pumping (hrs/day)	660	11	7	1
Active Pumping (litres/min)		5,639	3,449	1,391
Active Pumping Days	102			
PTTW Limit				
Volume Taken per Minute (L)	5,833			
Hours Taken per Day (hrs)	15			
Volume Taken per Day (L)	3,500,000			
Number of Days in a Year (days)	120			

3.1.6 Construction Dewatering Sewer Discharge Permit Results (during dredging)

The Construction Dewatering Sewer Discharge permit included a requirement to provide monthly water quality data. Milestone conducted seven (7) water quality sampling events between August 3, 2023, and December 11, 2023, and delivered samples to ALS Canada Ltd. (ALS) for analysis as shown in **Table 3.3**. Relevant parameters and sanitary discharge limits for each are provided in **Table 3.4**. Sample event five indicated a concentration of 14.2 mg/L gravimetric aggregate organics which exceeded the Sewer-Use Bylaw Schedule B standard of < 5.0 mg/L. Sampling event six was collected on November 30, 2023, for re-analysis of gravimetric aggregate organics only and was found to be < 5.0 mg/L. During the period between obtaining the sample results for samples five and six, the dewatered effluent was held onsite until approval was given to resume discharging. Concentrations in all other samples were within the sewer use bylaw limits. All laboratory reports can be found in **Appendix H.1.**

Daily water volume discharge to the sewer system is provided in **Appendix H.2**. Sewer discharge was monitored from July 26, 2023, through January 3, 2023. The minimum and maximum daily volumes reported by Milestone during days with discharge to the sanitary sewer were 137,466 L/day and 3,340,800 L/day. Daily discharge volumes were recorded from July 26, 2023, through November 17, 2023. Average flow during this time was 1,421,295 L/day. Due to the design of the Dredge Material Management Area (DMMA), discharge to the sewer system took place during and after dredging operations, up to 24 hours in duration each day. Monthly pump operating hours and discharge volume to the sanitary sewer are provided in **Table 3.5**.

Table 3.3: Water Quality Sampling Collection Dates

Sampling Event	Date
1	August 3, 2023
2	August 30, 2023
3	October 3, 2023
4	November 2, 2023
5	November 20, 2023
*6	November 30, 2023
7	December 11, 2023

*Event 6 sample analyzed for gravimetric aggregate organics only.

Table 3.4: Sanitary Sewer and Combined Sewer Discharge Limits

Parameter	Limit (µg/L) [a]
cBiochemical Oxygen Demand (cBOD)	300,000
Total Suspended Solids (TSS)	350,000
Total Phosphorus	10,000
Total Kjeldahl Nitrogen (TKN)	100,000
Oil and Grease (animal/vegetable)	150,000
Oil and Grease (mineral/synthetic)	15,000
Phenolic Compounds	1,000
Chlorides	1,500,000
Sulphates	1,500,000
Aluminum (total)	50,000
Iron (total)	50,000
Fluorides	10,000
Antimony (total)	5,000
Bismuth (total)	5,000
Chromium (total)	5,000
Cobalt (total)	5,000
Manganese (total)	5,000
Silver (total)	5,000
Nickel (total)	2,000
Arsenic (total)	1,000
Molybdenum (total)	1,000
Selenium (total)	1,000
Cadmium (total)	700
Mercury (total)	10
Aldrin/Dieldrin	0.2
Benzene	10
Bis(2-ethylhexyl)phthalate	12
Chlordane	100
Chloroform	40
DDT	0.1
1,2-Dichlorobenzene	50
1,4-Dichlorobenzene	80
3,3-Dichlorobenzidine	2
cis-1,2-Dichloroethylene	4,000
trans-1,3-Dichloropropylene	140
Bis(2-ethylhexyl)phthalate	12
Chlordane	100
Chloroform	40
DDT	0.1
1,2-Dichlorobenzene	50
1,4-Dichlorobenzene	80
3,3-Dichlorobenzidine	2
cis-1,2-Dichloroethylene	4,000
trans-1,3-Dichloropropylene	140
Di-n-butyl phthalate	80

Parameter	Limit (µg/L) [a]
Ethylbenzene	160
Hexachlorobenzene	0.1
Hexachlorocyclohexane	100
Methylene Chloride	2,000
Mirex	100
PCBs	1
Pentachlorophenol	5
1,1,2,2-Tetrachloroethane	1,400
Tetrachloroethylene	1,000
Toluene	16
Total Xylenes	1,400
Total PAHs [b]	5
Trichloroethylene	400

[a] Limits from By-Law No. 14-090 For Sewage Disposal Concentrations, Schedule B Table "Limits for Sanitary Sewer and Combined Sewer Discharge."

[b] Total PAHs calculated using the definition of total PAHs in By-Law No. 14-090. According to the By-Law, total PAHs include anthracene, benzo(a)pyrene, benzo(a)anthracene, benzo(e)pyrene, benzo(b)fluoranthene, benzo(j)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, dibenzo(a,i)pyrene, dibenzo(a,j)acridine, 7H dibenzo(c,g)carbazole, fluoranthene, indeno(1,2,3-c,d)pyrene, perylene, phenanthrene, pyrene. Chedoke creek filtrate samples did not include benzo(e)pyrene, dibenzo(a,i)pyrene, dibenzo(a,j)acridine, 7H dibenzo(c,g)carbazole, and perlyene. Benzo(b)fluoranthene and benzo(j)fluoranthene reported as benzo(b/j)fluoranthene in Chedoke Creek filtrate data and value used in total PAH sum. The majority of PAHs in filtrate samples reported as below detection and 1/2 the detection limit used in sum to calculate total PAHs.

Table 3.5: Total Monthly Water Volume Discharge to the Sewer System.

Total Monthly Discharge		
Month	Volume (L)	Operational Days
July	705,479	4
August	31,594,474	25
September	38,051,280	25
October	46,508,760	30
November	31,080,000	17
December	1,008,010	3
January	288,000	1

Hydrographic Surveys and Sediment Volumes

Multiple hydrographic surveys were conducted to support the Chedoke Creek dredging planning, design, and construction process. Notable survey dates were as follows:

1) Initial WSP manual topographic survey to support the Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report (August 2018)
2) WSP manual topographic survey to support the Chedoke Creek dredge design completed April 2021
3) Pre-Dredge survey provided by Milestone (using sonar – ASI Group Ltd Marine) completed July 27-28, 2022.
4) Pre-dredge survey provided by Milestone (using sonar - ASI Group Ltd Marine) (survey completed July 4, 2023, data received July 12, 2023, then updated September 8, 2023) (see **Appendix I.1**)
5) Various progress surveys provided by Milestone (using sonar – ASI Group Ltd Marine)
    a. Interim Survey 1 (August 15, 2023). Progress area 100 m to the north of the Desjardins Recreational Trail Bridge.
    b. Interim Survey 2 (September 15, 2023). Progress area 90 m to the south of the Desjardins Recreational Trail Bridge.
    c. Interim Survey 3 (October 11, 2023). Progress area 230 m to the north of the Kay Drage Park Bridge.
    d. Interim Survey 4 (November 1, 2023). Progress area 130 m to the south of the Kay Drage Park Bridge, and the remaining area between the two bridges.
6) Post-dredge survey provided by Milestone (using sonar - ASI Group Ltd Marine) – November 20, 2023 (see **Appendix I.2**)

The final Chedoke Creek dredge design plans specified that a total of 11,300 m^3 of in-situ sediment was required to be removed, as indicated by the April 2021 survey.

The subsequent pre-dredge survey provided by Milestone (July 12, 2023) indicated that the expected\estimated dredge volume had diminished considerably and only 7,693 m^3 of in-situ sediment remained within the dredge template. This finding was likely the result of continued transport and decomposition of sediments deposited during the spill event between the time of the original survey (April 2021) and the subsequent pre-construction survey (July 2023). There may also have been differences due to the different survey methodologies employed (manual survey vs sonar-based).

An explanation and summary of the differences between the design and the pre-dredge survey in-situ volume estimates is provided in a technical memorandum (dated October 2, 2023), which has been included in **Appendix J** and was provided to the MECP on October 3, 2023.

Based on WSP's analysis of the final post-dredge topographic survey (November 20, 2023) and the original pre-dredge topographic survey (July 12, 2023), a total\final dredge volume of 8,147 m^3 was removed. The total TKN and TP load removal associated with this dredge material is provided in **Table 3.6**. Note that the preceding included 130 m^3 of debris material which was tracked separately.

Released in December of 2019, Excess Soil Regulation O. Reg. 406/19 is designed for the proper management, tracking, and reuse of excess soil. Excess soil is soil that is generated during construction and excavation activities that will no longer be needed at the site. Thus, the excess soil must be transported off the site. As of January 1, 2023, sites must file notices about how they reuse and/or dispose of excess soil in compliance with O. Reg. 406/19.

The removal of sediment from Chedoke Creek was exempt from the Project Area Notice Filing per Schedule 2 Section 3.5 of O. Reg. 406/19, however the City of Hamilton voluntarily reported the required details on the Excess Soil Registry. Initial estimates were provided with the final totals updated within 30 days of the removal of the final material, as required.

Table 3.6: Total Volume Dredged from Zone 2 and 3 and Associated Total Kjeldahl Nitrogen and Total Phosphorus Mass Removal

Project Area	Description	Area (m^2)	Target Dredge Elevation (m IGLD)	Actual Average Sediment Thickness (m)	Volume (m^3)	Average TKN Conc. (ug/g)	Actual TKN Mass Removed by Zone (tonnes)	Average TP Conc. (ug/g)	Actual TP Mass Removed by Zone (tonnes)
Zone 2	CC-C14 to CC-C19	6,946	73.5	0.34	2,333	1,180	4.9	1,067	4.2
Zone 3	CC-C19 to CC-C26	9,973	73.0	0.58	5,814	1,641	17.5	1,251	13.5
				Total Zones 2&3	**8,147**		**22.4**		**17.7**

3.1.7 Sediment Disposal Quantities

The Targeted Dredging of Chedoke Creek project sediment disposal was completed in compliance under Section 8 of Ontario Regulation 406/19 under the Environmental Protection Act. TerraClean Consultants Inc. (TerraClean) and Culp Transport (Culp) carried non-hazardous sediment dredged from Chedoke Creek to three different disposal sites:

- GFL Stoney Creek Landfill (Stoney Creek - Hamilton, Ontario)
    - 8 loads, 275.32 metric tons
- WM Twin Creeks Landfill (Watford, Ontario)
    - 242 loads, 9,536.30 metric tons
- Allied Waste Niagara (Niagara Falls, New York)
    - 31 loads, 851.48 metric tons

A total of 281 truckloads (using end load trailers) were used to dispose the material, for a total of 10,663.10 metric tons of dredged material removed and disposed of off site (debris was accounted for separately as noted).

Hauling records can be found in **Appendix K.1**.

3.1.8 Sediment Quality

Sediment was analyzed using the Toxicity Characteristic Leaching Procedure (TCLP) prior to acceptance by the recipient site. TCLP is a chemical analysis process used to determine whether there are hazardous elements present in a waste. The test involves a simulation of leaching through a landfill and can prove if the waste is dangerous to the environment or not. TCLP Guideline Limits per Ontario MECP General Waste Control Regulation No. 347/90,558/00 is provided in **Table 3.7**. No exceedances were reported. Laboratory reports are provided in **Appendix K.2.**

Table 3.7: TCLP Guideline Limits

Analyte	Unit	ONWCR Sch. 4
Physical Tests		
Air Velocity, Fume Hood	m/sec	-
Burning Rate	mm/sec	-
Ignitability	-	-
Sample Comment	-	-
Temperature of Test Material	C	-
Time to Ignition	Sec	-
TCLP Extractables		
Aroclor, 1016 TCLP	mg/L	-
Aroclor, 221 TCLP	mg/L	-
Aroclor, 1232 TCLP	mg/L	-
Aroclor, 1242 TCLP	mg/L	-
Aroclor, 1248 TCLP	mg/L	-
Aroclor, 1254 TCLP	mg/L	-
Aroclor, 1260 TCLP	mg/L	-
Aroclor, 1262 TCLP	mg/L	-
Aroclor, 1268 TCLP	mg/L	-
Benzo(a)pyrene, TCLP	mg/L	0.001 mg/L
Decachlorobiphenyl, TCLP	%	
Tetrachloro-m-xylene, TCLP	%	
TCLP Extractables Surrogates		
Chrysene-d12, TCLP	%	
Naphthalene-d8, TCLP	%	
Phenanthrene-d10, TCLP	%	
TCLP Metals		
Arsenic, TCLP	mg/L	2.5 mg/L
Barium, TCLP	mg/L	100 mg/L
Boron, TCLP	mg/L	500 mg/L
Cadmium, TCLP	mg/L	0.5 mg/L
Chromium, TCLP	mg/L	5 mg/L
Lead, TCLP	mg/L	5 mg/L
Mercury, TCLP	mg/L	0.1 mg/L
pH, TCLP 1st preliminary	pH Units	-
pH, TCLP 2nd preliminary	pH Units	-
pH, TCLP Extraction Fluid Initial	pH Units	-
pH, TCLP Final	pH Units	-
Selenium, TCLP	mg/L	1 mg/L
Silver, TCLP	mg/L	5 mg/L
Uranium, TCLP	mg/L	10 mg/L

Analyte	Unit	ONWCR Sch. 4
TCLP VOCs		
Benzene, TCLP	mg/L	0.5 mg/L
Carbon Tetrachloride, TCLP	mg/L	0.5 mg/L
Chlorobenzene, TCLP	mg/L	8 mg/L
Chloroform, TCLP	mg/L	10 mg/L
Dichlorobenzene, 1,2-, TCLP	mg/L	20 mg/L
Dichlorobenzene, 1,4-, TCLP	mg/L	0.5 mg/L
Dichloroethane, 1,2-, TCLP	mg/L	0.5 mg/L
Dichloroethylene, 1,1-, TCLP	mg/L	1.4 mg/L
Dichloromethane, TCLP	mg/L	5 mg/L
Methyl Ethyl Ketone [MEK], TCLP	mg/L	200 mg/L
Tetrachloroethylene, TCLP	mg/L	3 mg/L
Trichloroethylene, TCLP	mg/L	5 mg/L
Vinyl Chloride, TCLP	mg/L	0.2 mg/L
Bromofluorobenzene, 4-, TCLP	%	
Difluorobenzene, 1,4-, TCLP	%	
Polychlorinated Biphenyls		
Polychlorinated Biphenyls [PCBs}, total, TCLP	mg/L	0.3 mg/L

ONWCR = Ontario MECP General Waste Control Regulation No. 347/90,558/00
Sch.4 = Schedule 4 Leachate Quality Criteria

4 POST-CONSTRUCTION MONITORING & ACTIONS

4.1 Water Quality

As one of the corrective and preventive actions of the Chedoke Creek spill, the City of Hamilton set out to develop a framework for monitoring surface water quality throughout Hamilton's watersheds. The Surface Water Quality Program (SWQP) is the starting point for the City in gaining a holistic understanding of its receiving waters and the potential impacts from various City assets within the storm and wastewater collection and treatment system.

Various types of overflow structures exist within the City's storm and wastewater infrastructure, both within the combined sewer system, and the separated sewer system. These designed overflow structures have the potential to discharge to the natural environment and include storm relief pumping stations, combined sewer overflow tanks (CSOs), sewer pump stations (SPSs), sewer siphons and flow regulators.

Within the overall service area for the City's storm and wastewater collection and treatment system, five (5) major receiving water bodies exist. These are:

- Hamilton Harbour
- Red Hill Creek
- Grindstone Marsh
- Lake Ontario
- Cootes Paradise Marsh via Spencer & Chedoke Creeks

Headwater tributaries of the Grand River and Niagara Peninsula catchment areas also exist with the boundaries of the City of Hamilton. These headwater tributaries flow south into the Grand River towards Lake Erie, and east outside of City boundary, discharging into Lake Ontario.

Cootes Paradise is an important coastal marsh area in western Lake Ontario and serves as a key sanctuary and habitat for a wide variety of fauna and flora, including rare or threatened species. Owned and managed by the Royal Botanical Gardens (RBG), it spreads over 8.4 km2 including 2.5 km2 of coastal wetland. Since it serves important ecological functions, such as being a significant natural fish nursery and key migratory bird habitat, the Government of Ontario has listed Coates Paradise as a Provincially Significant Class 1 Wetland, and as an Area of Natural and Scientific Interest (ANSI). Cootes Paradise is also a principal environmental protection area, protected under the Royal Botanical Gardens Act 1941. Like the Hamilton Harbour, Cootes Paradise is also designated as an ESA. Its primary tributaries, Chedoke, Westdale, Spencer, Borer's and Ancaster Creeks are also identified as being environmentally significant.

The Dundas WWTP effluent and a number of CSO sites discharge directly into Cootes Paradise or indirectly via its tributary streams. In addition, Cootes Paradise may receive overflows from two (2) Storm Relief Pumping Stations, multiple sewer pump stations (SPSs) with overflow structures, and multiple sewer siphons with overflow structures. The Dundas Equalization Tank may also discharge to Cootes Paradise under emergency conditions, though this is part of the separated sewer system and historically has not overflowed in normal conditions, including no overflows between 2015-2020. In order to improve the Cootes Paradise ecosystem, the City has a goal to control all the CSO discharges to Cootes Paradise to a maximum of one CSO event in an average year, in accordance with the Provincial protocols. The 'average' precipitation year is determined by the City's Pollution Prevention and Control Plan.

Phase I of the Surface Water Quality Program (2022 to 2024) established a monthly surface water monitoring plan, sampling 33 locations throughout the City. Since the program follows an adaptive management process, the 2023 annual review resulted in an amendment to Phase I with the removal of 7 locations and the addition of 17 locations, bringing the total sampling locations for Phase I to 40 locations.

Phase II (2025 to 2026) will focus on assessing the initial sampling plan and making modifications as needed and expanding the coverage of the monitoring plan or the frequency of sampling. From the baseline information captured in Phases I and II, Phase III will focus on infrastructure investment needed to better protect the receiving waters, as well as prioritizing identified areas of interest/on-going water quality anomalies, or hot spots, for regular inspection and enforcement activities, as needed. Currently the 40 surface water locations are sampled monthly, with data on the surface water samples provided through the Open Hamilton Data Portal which is a public-facing resource for up-to-date, easy and transparent data for surface water quality general knowledge, trending, review and research purposes.

Data collected are reviewed against municipal, provincial and federal regulations and guidelines for general baseline condition purposes. The City is continuing to monitor Chedoke Creek at the stations shown in **Figure 4.1** which are closely monitored for any improvements based on the Targeted Dredging of Chedoke Creek project, and other supportive initiatives in the Chedoke Creek watershed. The City will also continue to study how wastewater and stormwater discharges are influencing the quality of the receiving waters with the Surface Water Quality Program helping to guide refinements to standard operating conditions, and pin-point non-point source contaminates throughout Hamilton's Watersheds.

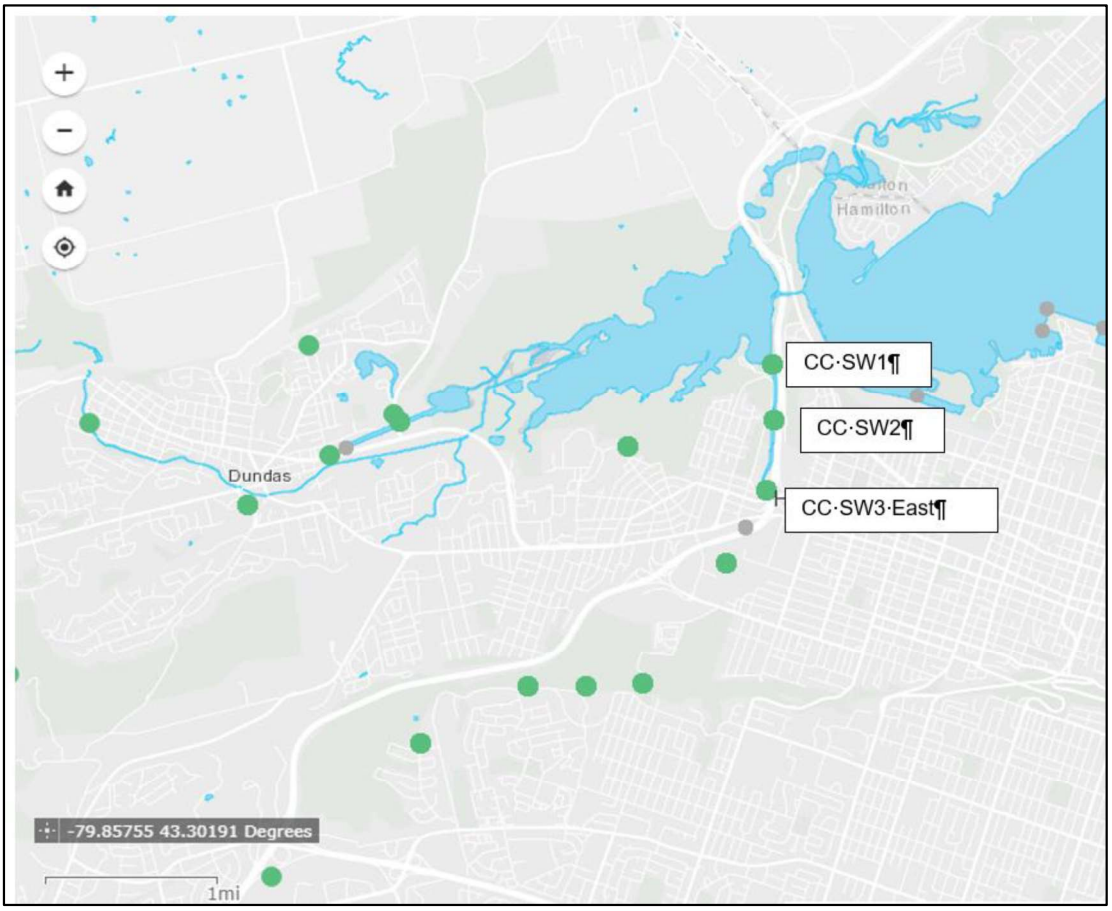

Figure 4.1: Chedoke Creek Monitoring Stations

Water quality data are not the only useful metrics for assessing environmental impacts and establishing restoration success criteria. However, other environmental metrics such as bioassessment criteria are often unavailable for evaluation of "pre-impact" conditions as in the case of Chedoke Creek. Water quality data serves as the best available information to evaluate and compare conditions within Chedoke Creek prior to the spill event, during the spill event, and for the pre-, during and post-restoration periods. It is important to note that Chedoke Creek is an urban drainage conveyance with variable, often poor, water quality conditions that are dependent on rainfall, snowmelt, CSO infrastructure operation and other environmental and infrastructure factors. In addition, water quality data should be considered supplemental to the mass-load reduction provided by removal of poor-quality sediments achieved during the Chedoke Creek Restoration Project as discussed in **Sections 2 and** 3 above.

Station CC-SW2, also referred to as Station CP-11, has the most complete period of record (see **Table 4.1**) of the three stations shown in **Figure 4.1** and is located downstream of the Main/King CSO. Data from the CC-SW2/CP-11 station was previously evaluated through 2018 by WSP as part of MECP Order#1 1-J25YB Item 1b, Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report, WSP, 2019. Available water quality parameters include TP, E. coli, pH, ammonia, DO, and TSS. In addition to the data previously evaluated between 2009 and 2018, **Table 4.2** provides the median values for water quality data collected during the pre-restoration (October 2018 – July 2023), restoration (July 2023 – December 2023), and post-restoration (January 2024 – June 2024) periods. Time-series data for the updated period or record are provided in **Figures 4.2 through 4.7**.

Table 4.1: CC-SW2/SP-11 Period of Record for Water Quality Parameters of Concern

Station	Parameter	Units	Start Date	End Date	Number of Samples
CC-SW2/CP-11	Total Phosphorus	mg/L	5/7/2009	6/13/2024	281
CC-SW2/CP-11	*Escherichia coli*	cfu/100mL	5/7/2009	6/13/2024	280
CC-SW2/CP-11	pH	SU	5/7/2009	3/19/2024	260
CC-SW2/CP-11	Ammonia	mg/L	5/7/2009	5/30/2024	273
CC-SW2/CP-11	Dissolved Oxygen	mg/L	5/7/2009	3/19/2024	239
CC-SW2/CP-11	Total Suspended Solids	mg/L	5/7/2009	6/13/2024	269

Table 4.2: Pre-Event, During Event and Post Event Median Water Quality Data *

Analyte	Pre-event	Gate 1 Open	Gate 2 Failure	Gates Closed	Pre-Restoration	Restoration	Post-Restoration
	(5/7/2009 to 1/28/2014)	*1/28/2014 to 12/31/2017*	*1/1/2018 to 7/18/2018*	*7/19/2018 to October 2018*	*October 2018 to July 2023*	*July 2023 to December 2023*	*January 2024 - June 2024*
TP (mg/L)	0.19	0.386	1.13	0.233	0.280	0.255	0.197
***E. coli* (cfu/100mL)**	510	5900	655000	3300	900	1010	1730
pH (SU)	8.18	7.59	7.09	8.02	7.97	7.73	8.28
Ammonia (mg/L)	0.54	0.51	5.69	0.21	0.29	0.52	0.36
DO (mg/L)	9	9.15	3.51	8.16	10.87	7.60	12.5
TSS (mg/L)	22.3	15.35	24.85	8.4	13.25	17.00	13.2

*Column colors correspond with the color of data points in Figures 4.2 through 4.7

Total phosphorus data shown in **Figure 4.2** suggests TP concentrations at CC-SW2/CP-11 have continued to decrease through the pre-restoration, restoration, and post-restoration phases. The post-restoration TP median concentration of 0.20 mg/L is similar to the pre-event concentration of 0.19 mg/L and is less than 18% of TP median during the Gate 2 failure period.

Median *E. coli* concentrations at CC-SW2/CP-11 shown in **Figure 4.3** suggest that *E. coli* counts returned to pre-event conditions following gate closure and have remained several orders of magnitude below the peak median concentration of 665,000 cfu/100 mL which occurred during the Gate 2 failure period.

Median pH values at CC-SW2/CP-11 shown in **Figure 4.5** indicate that pH returned to pre-spill conditions once the gates were closed. During the Gate 2 failure event, the median pH decreased to 7.1 which was likely a result of high carbon dioxide concentrations associated with wastewater loading. The post-restoration median pH of 8.3 is similar to the pre-spill median pH of 8.2.

Median ammonia concentrations at CC-SW2/CP-11 shown in **Figure 4.5** indicate water quality conditions following gate closure may be better than the pre-spill conditions. The median post-restoration ammonia concentration of 0.36 mg/L is only 67% of the pre-spill median concentration of 0.54 mg/L.

Median DO concentrations at CC-SW2/CP-11 shown in **Figure 4.6** suggest oxygen conditions continued to improve following closure of the gates and were similar to pre-spill conditions during the pre-restoration, restoration and post-restoration periods. Variability in DO concentration during the restoration and post-restoration periods is likely due to water temperature during those periods. Dissolved oxygen data for the post-restoration period was only available from January through March 2024.

Median TSS concentrations at CC-SW2/CP-11 are shown in **Figure 4.7**. Chedoke Creek is an urban drainage conveyance which typically has elevated and variable TSS concentrations depending on a variety of factors including rainfall duration and intensity, snowmelt, and others as discussed above. Median TSS concentrations were similar throughout the period of record and ranged from 9.3 mg/L to 24.9 mg/L. The median TSS concentrations for the pre-restoration (13.3 mg/L), restoration (17.0 mg/L) and post-restoration (13.2 mg/L) periods are all below the pre-event period TSS concentration of 22.3 mg/L.

In summary, water quality conditions at station CC-SW2/CP-11 beginning with gate closure in July, 2018 have improved compared to the period during which gate failures occurred and have generally returned to pre-spill conditions. Limited post-restoration data are available for analysis, however the City will continue to collect and evaluate these data to assess long-term post-restoration benefits resulting from the City's restoration efforts.

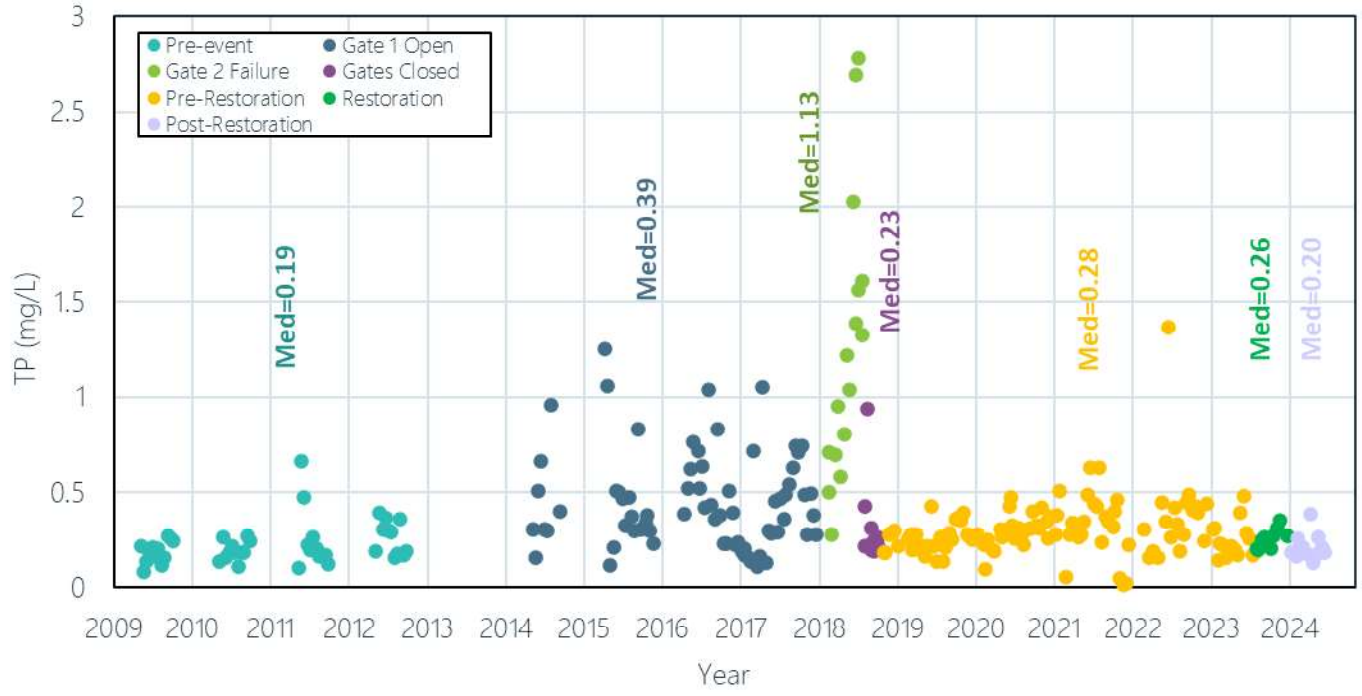

Figure 4.2: Chedoke Creek at CC-SW2/CP-11 TP Concentrations (2009 through 2024)

Figure 4.3: Chedoke Creek at CC-SW2/CP-11 *E. coli* Counts (2009 through 2024)

Figure 4.4: Chedoke Creek at CC-SW2/CP-11 pH (2009 through 2024)

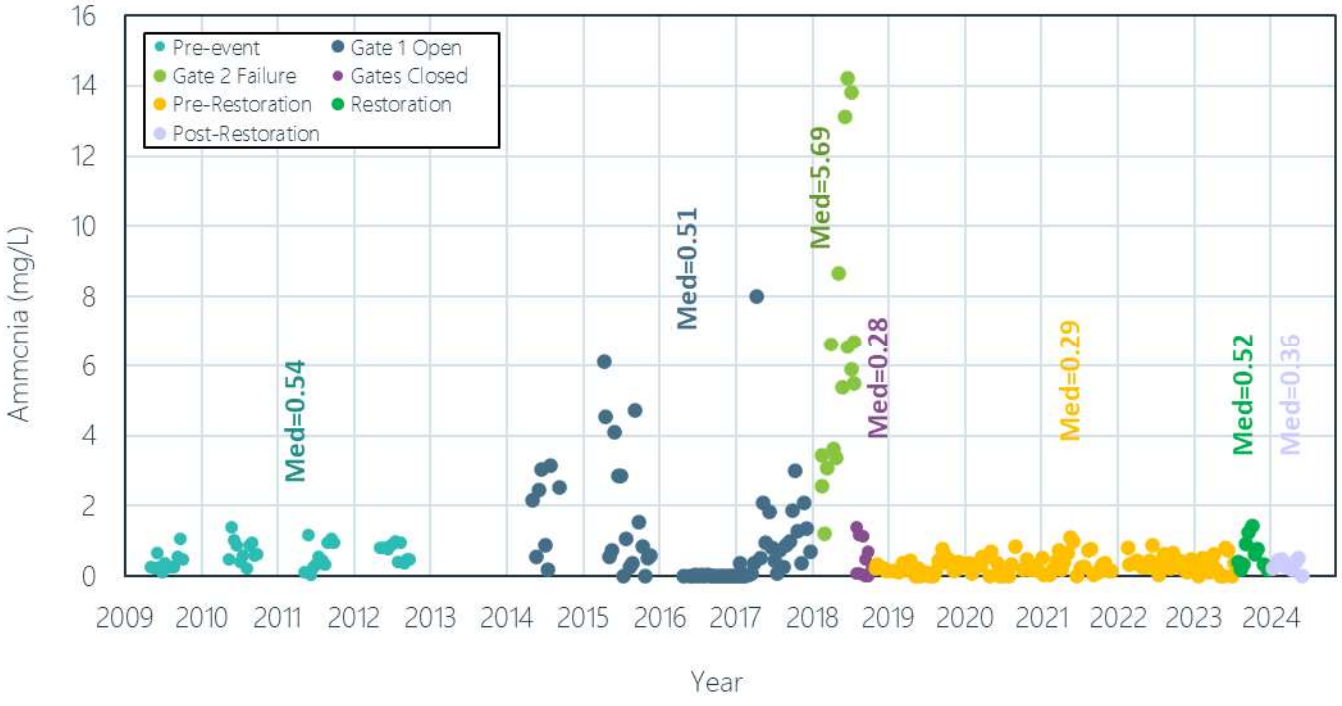

Figure 4.5: Chedoke Creek at CC-SW2/CP-11 Ammonia Concentrations (2009 through 2024)

Figure 4.6: Chedoke Creek at CC-SW2/CP-11 DO Concentrations (2009 through 2024)

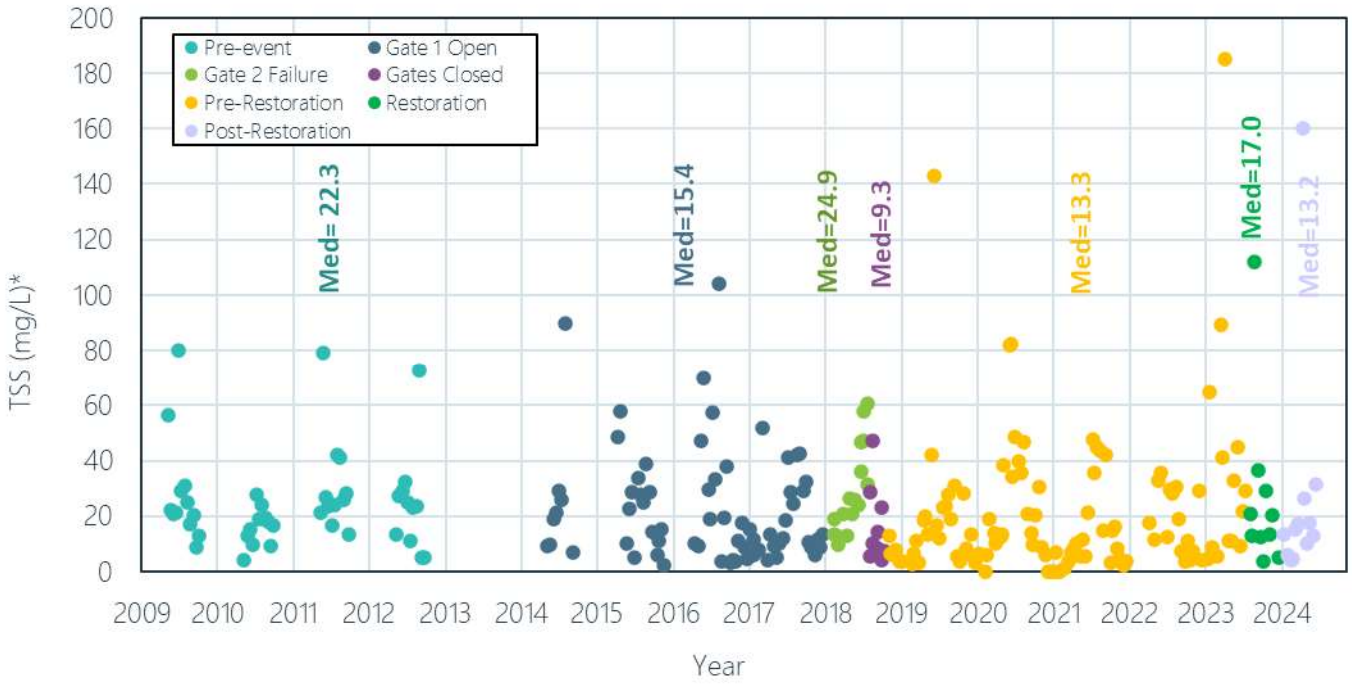

Figure 4.7: Chedoke Creek at CC-SW2/CP-11 TSS Concentrations (2009 through 2024)

*A TSS value of 1,020 mg/L measured on 6/15/2022 is not shown on the graph.

4.2 MECP Overall Benefit Permit Remaining Requirements

Similar to the year one monitoring and reporting, year two (2024) and year three (2025) effectiveness monitoring, reporting are still required to be completed as part of the OBP. In addition, a final report providing a summary of the information provided in the three annual reports (2022, 2023 and 2024), and a final analysis of the effectiveness of Overall Benefit Activities will be completed following on from the last calendar year of monitoring. As mentioned within Section 3.1.2, consultation with MECP SARB determined the need for a new approach upon their review of the year one (2023) findings and appropriate next steps. Three new monitoring options were proposed for the year two (2024) monitoring and are being conducted. .

4.3 Complementary Monitoring

A number of studies were recommended as part of the previously completed "Chedoke Creek Water Quality Improvement Framework Study" (GM BluePlan Engineering and Wood, April 2021). The City has advanced a number of these studies through the Coote Paradise Work Plan, which remain ongoing. These include:

- Ainslie Wood Neighbourhood Creek Separation Municipal Class Environmental Assessment
- Chedoke Watershed Stormwater Retrofits Master Plan Class Environmental Assessment
- Lower Chedoke Creek Class Environmental Assessment

It is expected that these studies will include a number of recommendations for further monitoring of ecological\environmental features, water quality, and CSO performance, to better assess and evaluate the effectiveness of measures recommended through the preceding studies. These monitoring programs and results will further complement the monitoring work being done under other initiatives for the overall Chedoke Creek watershed. Given that the recommendations from the respective Class EA projects are not yet advanced nor approved, the form and extent of monitoring is not yet defined as it will need to be aligned with the form of capital work (i.e., channel improvements would be monitored differently than say water quality enhancement works). That said, the types of monitoring which are expected as part of the possible works stemming from the respective EAs are anticipated to include chemical and biological water quality indicators, as well as physical monitoring of the stability of the Chedoke Creek (stream morphology) and associated areas (headwaters and receivers).

5 MAIN/KING COMBINED SEWER OVERFLOW TANK CORRECTIVE ACTIONS SUMMARY

Since the discovery of the Chedoke Creek combined sewage discharge in July of 2018, the Public Works Department and Hamilton Water Division has implemented a number of new operational programs and procedural changes to assist in the prevention of future incidents from occurring. However, should further incidents occur, measures are now in place that allow early detection and mitigation. In addition, new protocols ensure appropriate and timely communication to City Council, the community, and the City's partners. Additional programs have also been implemented to enhance the stewardship of the City's watersheds and natural environment.

The following provides a list and brief description of new or revised programs or procedures that have been developed:

Watershed Action Plan

The purpose of the Watershed Action Plan is to reduce the pollution of waterways due to rural and urban runoff, reduce the adverse impact of City infrastructure and operations, increase the retention and infiltration of stormwater into the ground and increase the connectivity of naturalized areas and green infrastructure. The plan also minimizes system capacity risks due to development and climate change and maximizes the adaptability of investments to manage future uncertainties.

Surface Water Quality Program

The Surface Water Quality Program builds a baseline understanding of surface water conditions over time and provides processes to respond to, and investigate, any water quality anomalies that may be due to infrastructure malfunctions or standard operating conditions. The program has developed open communication and transparency with various partners. The City has also launched the Surface Water Quality Program webpage that enables the City to share the surface water quality data with the public.

Wastewater Quality Management Program

The Wastewater Quality Management Program has established new processes or improved existing processes to effectively collect and treat wastewater in a manner that protects the environment and meets legal and regulatory requirements. The program supports the City's commitment to a high-quality wastewater system.

Enhanced City of Hamilton Inspections Program

The Enhanced City of Hamilton Outstation Inspection Team was developed in 2020 and consists of one (1) Maintenance Operator, one (1) Millwright, one (1) Electrician, and one (1) Instrumentation Technician. Four (4) of the full-time equivalent staff approved by Council were used to staff the Enhanced City of Hamilton Outstation Inspection Team, who is tasked with completing thorough inspections and preventative maintenance at the City's water and wastewater treatment plants, pumping stations, reservoirs, water towers, well systems and combined sewer overflow tanks. The team is also responsible for looking at a facility or process area to verify its operational functionality instead of focusing on preventative maintenance of individual components. This includes reviewing the process control narratives, Supervisory Control and Data Acquisition set points, Environmental Compliance Approval requirements, asset information, and the facility/process standard operating procedures.

Monitoring Wastewater Overflows and Bypasses Webpage

Developed in 2020, this webpage includes a live map of overflows and bypasses, the Wastewater Treatment Bypass Log and the Combined Sewer Overflow Log. The live map is updated every 15 minutes providing current information for each outfall location.

Operations and Maintenance Plan

In response to the Chedoke Creek combined sewage spill, in 2019, Hatch Consulting completed a comprehensive review and update of combined sewer overflow operations and maintenance plans. The Operations and Maintenance Plan includes updated standard operating procedures for the combined sewer overflow facilities which are reviewed every three years or sooner if required. The Operations and Maintenance Plan also included an updated process control narrative for the Main/King combined sewer overflow tank. Process control narratives for the remaining facilities were not changed and therefore not included in the Operations and Maintenance Plan, however they are maintained as key operational documents for the facilities.

6 OFFSETTING WORKS ASSESSMENT REVIEW

The Chedoke Creek Work Plan noted that water quality management technologies are often used as complements to dredging to improve water quality conditions by increasing DO and reducing nutrient concentrations.

The Chedoke Creek Work Plan listed some potential technologies including:

1) Floating vegetated mats
2) Small scale Aeration systems
3) Shoreline plantings
4) Beneficial sediment reuse and sediment stabilization

Floating vegetated mats are relatively simple structures designed to promote growth of aquatic vegetation and nutrient absorption. Plantings are placed within net pots held together by a floating platform which can vary in size based on the available space or removal requirements. The platform is anchored to the shoreline or substrate and plants are harvested periodically resulting in direct removal of the nutrients they have assimilated from the water column. Over the course of the targeted dredging project, the City through a separate contract, installed a floating vegetated mat system within Cootes Paradise, which can be seen from the Desjardins Recreational Trail. Expansion of the project to other areas within Cootes Paradise is currently under evaluation through the on-going and complementary initiative associated with the Lower Chedoke Remediation Class Environmental Assessment (EA) Study.

Unconfined aeration systems are often used in lake and water quality management to increase the oxygen transfer rate, improve mixing of stagnant water, and limit the potential for stratification. Aeration systems consist of a compressor, an air distribution system, and a diffuser assembly. The type of compressor depends on the water depth and required air volume. Shallow water aeration systems generally require only a diaphragm compressor which can produce a relatively large air volume at low pressure. Diffuser assemblies are typically placed on the bottom and include an anti-scour plate to limit sediment disturbance. Over the course of the targeted dredging project, the City installed a small-scale aeration system in Chedoke Creek to help increase oxygen levels at the bottom of the creek while decreasing the amount of excess nutrients that contribute to algae blooms and cloudy water. Due to a decrease in temperature, the pumps were turned off in the winter months. The system has since been removed for the targeted dredging activities to take place. An aeration system is also under evaluation through the on-going and complementary initiative associated with the Lower Chedoke Remediation Class Environmental Assessment (EA) Study.

Shoreline plantings are effective at providing habitat, enhancing nutrient uptake, and stabilizing sediments. Plantings are commonly recommended in areas where natural littoral vegetation has been impacted for a variety of reasons and water quality or sediment conditions prevent natural recruitment from occurring. Identification of the appropriate species and a suitable nursery or donor site is important to the success of a planting project. Planting success can be improved by a variety of planting techniques that are specific to the species, substrate, and depth. While not explicitly assessed during the dredging project, riparian plantings are also being reviewed by the City through the on-going and complementary initiative associated with the Lower Chedoke Remediation Class Environmental Assessment (EA) Study. That project is further examining a series of activities to further enhance and restore Chedoke Creek and water quality discharging to Cootes Paradise. Alternatives being reviewed include channel modifications and plantings (delta generation, mixing weirs, shoreline wetlands, floating wetlands) as well as physical measures such as manual oxygenation/aeration, as noted above.

The Chedoke Creek Work Plan indicated that dredged solids may have a beneficial reuse application depending on the type of material identified for removal and its chemical composition. In some cases, sandy material may be utilized to stabilize areas where lake sediments may not have suitable structure to promote growth of emergent vegetation. If enough sandy material is present of sufficient quality, it may be possible to use the material to formalize an earthen

berm to direct discharge from Chedoke Creek away from Princess Point at the location of the current Christmas tree berm at the mouth to Cootes Paradise. As cited above, the City is currently conducting the Lower Chedoke Creek Remediation Class EA, which among other activities is reviewing the potential to re-establish a delta at the mouth of Chedoke Creek in the Princess Point embayment. The outcomes of that on-going study will further identify preferred alternatives for improving overall system health as noted previously.

As outlined in the Cootes Paradise Work Plan (July 2021), the City of Hamilton is addressing the identified deficit in contaminant removal per the targeted dredge by proposing to incorporate additional offsetting remediation within Cootes Paradise and the Western Harbour to further augment and complement the benefits of the targeted dredging project. These activities listed below, among others, were concurrently identified as part of the Chedoke Creek Water Quality Improvement Framework Study (GM BluePlan Engineering and Wood, April 2021) which established a long list of undertakings by the City and other community partners to improve water quality in Cootes Paradise. The activities were carried forward into the Cootes Paradise Work Plan which was subsequently approved by the MECP on August 13, 2021. They complement the targeted dredging work completed under the Chedoke Creek Work Plan, and further address the City's commitment to offsetting works.

Sediment Nutrient Inactivation

A sediment study in Cootes Paradise was finalized in February 2024, with investigative field work in 2023, that included the evaluation of the potential impacts from various sediment treatment alternatives. This will assist the City in evaluating the potential for the implementation of targeted water quality restoration projects within Cootes Paradise. The study involved two proprietary lanthanum-based treatment products which selectively bind and inactivate orthophosphate (a biologically available form of phosphorus) in the water column and limit orthophosphate flux from sediments. Phosphorus is an essential nutrient for algal growth and has been shown to be the limiting nutrient in Cootes Paradise. Results of the study suggest both EutroSORB® G and EutroSORB SI® are effective at reducing TP (the sum of all forms of phosphorus) in the Cootes Paradise water column and both may be an effective means of inactivating sediment TP and providing additional offsetting TP load reduction within Cootes Paradise. The amount of potential offset is directly proportional to the mass of lanthanum applied and the product could be applied to targeted "hot spot" areas.

The City is also conducting other studies and Stormwater Management policy reviews including:

Chedoke Creek Water Quality Retrofit Class EA

The study is focused on the separated sewer portion of the Chedoke Creek watershed. The intent is to assess opportunities to implement stormwater retrofits throughout the watershed (including both end-of-pipe and source controls) to improve the water quality of stormwater discharges. In addition, options for the Chedoke Creek Golf Course (stream naturalization, retrofit and treatment online) are being assessed. The relative benefits, impacts and life cycle costs will be reviewed with the overall goal of developing a prioritized suite of recommended improvements to reduce stormwater contaminant loadings to Chedoke Creek.

Redevelopment Sites – Stormwater Management (SWM) Policy

This project consists of updating the SWM Policy for Redevelopment Sites in the City of Hamilton. The policy will contain prescription of Best Management Practices including Low Impact Development measures for redevelopment sites within the City. In addition, the City has prepared Green Standards and Guidelines (GSG) which prescribe a minimum retention target for water quality and a hierarchal application of stormwater management practices to address the impacts from new development. These are going to City Council in August 2024 for adoption.

The City currently has policies in place across its jurisdiction requiring Stormwater Management for re-development lands. The intent of this policy is to strengthen and potentially improve the rate of water quality treatment with a specific emphasis on contaminants of concern (COC).

The benefits to this action are governed by third parties (development industry) hence predicting the timing and benefits is challenging. An important advantage of this action/policy is that it will come at no/low cost to the public and will represent a direct improvement by providing treatment of runoff for lands currently receiving no treatment. Work continues to progress with internal City staff and the development industry regarding this project.

Retrofits for Road Rehabilitation Projects / Low Impact Development Best Management Practices Policy

The City currently has a practice to examine opportunities to provide SWM (quality/quantity) for rehabilitated/reconstructed roads. The intent of this project (similar to the one above) is to enhance the policy/practice, to strengthen the City's process and practices and to maximize runoff treatment for rehabilitated roads. The emphasis will not only be on new pavement but also existing pavement so that net runoff treatment benefits are realized. The City is in direct control of the outcomes of this action since it will apply to its roadways. The extent of benefits and associated costs of implementation needs to be assessed for each setting as there can be various utility and physical restrictions which can limit the ability to effectively implement focused Best Management Practices. These will need to be assessed on a case-by-case basis. The start of this project is tied to the completion of the previous project, as any future public SWM policy aims to mirror an equivalent private one.

7 SUMMARY/CONCLUSIONS

The City has provided the information above to satisfy the four reporting items detailed in Directors Order 1-PE3L3 outlined below with a summary response provided for each:

i. Workplan requirements specified by MECP and the details of the work undertaken to complete the Chedoke Creek Workplan.

Section 1 provides a summary of the Workplan requirements and how they were satisfied while Sections 2-3 provide a detailed account of the efforts undertaken by the City to develop the Workplan, complete the design and permitting and construct the project.

ii. Any monitoring results completed before, during and after the work undertaken in accordance with the Chedoke Creek Workplan.

Sections 1-2 provide an evaluation of water quality, sediment quality and ecological monitoring efforts that were completed to support both the Workplan and the targeted dredge project permitting requirements. Section 3 provides a summary of the monitoring that took place during project construction by WSP, Milestone and the City. Section 4 provides a summary of water quality conditions before, during, and after restoration compared to water quality conditions during the spill event and prior to the spill event. Water quality conditions within Chedoke Creek have improved compared to the period during the spill event and all indicators evaluated suggest that water quality conditions are at least as good as they were prior to the spill event.

iii. Analysis of the results in Item 7(ii) above for the purposes of the intended monitoring; and

Data were collected in two phases prior to the start of construction and were used to support development of the Workplan as discussed in Section 1.2.2 through 1.2.9, and to complete the final design and permitting effort as discussed in Section 2.

iv. Determination if any requirement for on-going monitoring is required to verify the effectiveness or maintenance of the remedial actions undertaken is necessary.

As discussed in Section 4, the City has committed to ongoing water quality and ecological monitoring to aid in evaluating the effectiveness of the Chedoke Creek dredging project as well as additional actions that the City has already undertaken or is currently planning/evaluating in the watershed.

In conclusion, the information provided in this report demonstrates that “the natural environment has been restored to pre-spill conditions and that further impairment to the natural environment will not occur as a result of the spill to Chedoke Creek”. This conclusion is based on the assessment of the available water quality record pre-, during and post-restoration as well as the understanding related to the commitment by the City of Hamilton to numerous additional measures including on-going monitoring and related actions per the Cootes Paradise Work Plan. Furthermore, the physical condition of the Chedoke Creek in the vicinity of the dredging has also improved in terms of its morphology which should indirectly further improve its habitat and the associated natural environment.

This report and its appendices can be found on the Chedoke Creek Spill & Remediation Activities webpage at www.hamilton.ca/chedokecreek, under Chronology of Events.