

Remediation Mitigation Report – Cootes Paradise and Western Harbour - DRAFT

Cootes Paradise Report
City of Hamilton
Project #WW20101062

Prepared for:

City of Hamilton

3/22/2021



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Prepared for:

City of Hamilton

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1.0 Introduction

1.1 Outline of Order Requirements

This report, **Remediation Mitigation Report – Cootes Paradise and Western Harbour** referred to as the "**Cootes Paradise Report**", has been prepared by Wood Environment & Infrastructure Solutions (Wood) and GM Blue Plan (GMBP) on behalf of the City of Hamilton to address the requirements outlined in the MECP Director's Order: 1- PE3L3 (the "Order", issued December 4, 2020). The content in this report is specific to the remediation and mitigation proposed for Cootes Paradise and the Western Harbour area, to off-set the impacts associated with the Chedoke Creek Spill, as detailed in the Order. The Order has numerous components (ref. Appendix A) which are addressed in the report sections which follow. Notably, Order requirements #1 and 2, have been fulfilled by the City retaining Wood and providing the MECP with confirmation of same on same on January 15, 2021 (ref. Email Girt- Burt). As such, Wood, in association with GMBP, are acting as the City's representative in the capacity of Qualified Person (QP) for the Cootes Paradise Report.

The following outlines the Order requirements (in **bold italics**) and highlights the section in the reporting which follows, where the information has been provided to address the specific needs of MECP.

8. ***By March 22, 2021, submit to the Director for approval, a proposed remediation/mitigation report that is prepared by a Qualified Person(s) for the Cootes Paradise/Western Hamilton Harbor Area to offset the added nutrient loading, principally TP, identified in the Wood reports, the SLR reports and particularly the Hatch reports, and address any other potential on-going impacts (dissolved oxygen, algal blooms) as a result from the sewage spill to this area ("Cootes Paradise Report").***

The current report, "Cootes Paradise Report", has been prepared to address this requirement of the Order; this report is a complement to the earlier report titled "Chedoke Creek Workplan", February 22, 2021, which was prepared to address the first part of the Order, related to the targeted dredging of the Chedoke Creek, specific to Order requirements #3 to 7.

9. ***The report in Item 8 shall, at a minimum:***
 - i. ***Identify and review all potential remediation or mitigation measures, whether direct, indirect, or a combination of measures with consideration for short and long-term measures to address the remediation goal to offset added nutrient loading particularly for TP and any potential on-going impacts (dissolved oxygen, algal blooms) from the sewage spill to the Cootes Paradise/Western Hamilton Harbor Area as identified in the Wood reports, the SLR reports and the Hatch reports;***

Section 2 of this report provides a summary of the outcomes from the "Chedoke Creek Water Quality Improvement Framework", GM Blue Plan and Wood, January 2021 (Draft), ("Framework Study"), which began prior to the issuance of the Order (in September 2020) and was not explicitly written to address the Order requirements. Rather, the Framework Study was commissioned by the City of Hamilton to investigate potential opportunities to improve water quality in the Chedoke Creek, and by extension Cootes Paradise and Hamilton Harbour. That said, the Framework Study has considerable content commonality with the needs expressed in the Order, and as such has been heavily relied upon for relevant information, due to the limited time availability to conduct stand-alone investigations, including stakeholder engagement, which was an important component of the Framework Study.

Section 2 of this report, outlines the options considered through the Framework Study (draft), including an assessment of their potential benefit to the receiving system (Cootes Paradise and Hamilton Harbour) along with a consideration of whether these options would be considered “short” or “long-term” undertakings, given their scope and data needs. Some of the content from the Framework Study has been slightly amended and updated from the January 2021 Draft, based on comments received from stakeholders (reference Appendix C), as well as matters arising specific to the Order. In addition, Section 3 outlines other options considered for off-setting works, beyond those outlined in the Framework Study (draft) and Section 5 provides recommendations for consideration by MECP.

Further, the Chedoke Creek Workplan contains a summary of the loading assessment for nutrients and Total Phosphorus (TP) based on earlier work by Wood, Hatch and SLR (ref. Section 2 from February 22, 2021 report). As noted in that report, it will be necessary to conduct field work in the Lower Chedoke Creek (from the outfall at Hwy 403 to the Princess Point Embayment), to determine the amount and composition of resident sediment. Once determined (through field work planned in 2021 Q2), the understanding of sediment quantity and composition, will guide the City and its partners to better identify the works required as part of the Cootes Paradise Work Plan (ref. Order requirement #10 below).

ii. Undertake consultation with and provide a summary of comments received from the Royal Botanical Gardens, Hamilton Conservation Authority, the Ministry, and any other relevant affected stakeholders for potential remediation and mitigation options as per item i. above;

The City of Hamilton has conducted stakeholder engagement as part of the Framework Study. This engagement involved two presentations; the first was on the issues and problems, and study process, while the second involved a discussion on potential solutions and opportunities to remediate the impacts to Chedoke Creek and its receivers. Furthermore, stakeholders have had a direct opportunity to comment on the draft reporting, released in January 2021.

In addition to the input provided on the Framework Study (ref. Appendix C), the City has, since the issuance of the Order on December 4, 2020, engaged the MECP on the preferred approach to address the Order requirements and associated implementation logistics. Further, the City has also contacted RBG as a central stakeholder and landowner, for insights on area resources, including Species at Risk, and background information on RBG’s planned initiatives for Cootes Paradise. In addition, HCA has been contacted to determine information availability related to the design requirements for the dredging work, as well as data/information needs associated with permitting. Both RBG and HCA were part of the Framework Study, hence have also provided their input to that study which has been considered herein (ref. Section 4).

Lastly, while not considered consultation explicit to the second part of the Order, the City (through Wood) has been reaching out to regulators to determine the permitting needs for the targeted dredging works (details are outlined in the Chedoke Creek Workplan and the current status of the pre-consultation is summarized in Appendix B).

iii. Contain a cost/benefit analysis of all options to assess efficiency and effectiveness of any remediation or mitigation options;

Given the limited time availability since the issuance of the Order, the information provided in this report has relied exclusively on the cost-benefit assessments conducted for the Framework Study (draft), which has been acknowledged to be high-level and not based on detailed analytical assessments. It has been noted in both the Framework Study, as well as this report, that future studies and investigations will be required to fill information gaps on explicit cost-benefits in accordance with

Environmental Assessment (EA) rigour, using the “triple-bottom” line principles of natural, social and economic environments. Section 2 of this report outlines the high-level cost benefit approach and how it has guided the screening of alternatives and the formulation of the recommended actions.

iv. Identify the recommended options for remediation and mitigation;

The Framework Study (draft) identified numerous project opportunities for remediation and mitigation, that were then further reviewed, screened and advanced as part of that study. This report (Cootes Paradise Report) has further assessed these opportunities and others, leading to a set of recommendations for consideration by MECP. These project opportunities were then further subdivided for the purpose of the Order into those works which would be considered as normal or “Planned” by the City, to deal with infrastructure operations and capital upgrades/renewal, and those works which would be considered additive or “Unplanned” (of “Added Value”), with the express purpose of addressing the “off-set” requirements of the Order. Report Section 5 provides the details on the respective recommended options.

v. Identify the proposed offset goal to achieve remediation and/or mitigation with respect to the approximate equivalent loadings from the sewage spill;

The Chedoke Creek Workplan for the targeted dredge contains a summary of the loading assessment for nutrients and TP based on the earlier work by Wood, Hatch and SLR between 2018 and 2020 (ref. Section 2 in Chedoke Creek Workplan). As noted, field work is required in the Lower Chedoke Creek (from the outfall at Hwy 403 to the Princess Point Embayment), to determine the amount and composition of resident sediment related to the spill. Once determined (through field work planned in 2021 Q2), the field work findings will guide the extent and form of targeting dredging work required in the Chedoke Creek and thereby also establish the basis for off-set works in Cootes Paradise to satisfy the requirements of the Order and mitigate the impacts of the spill. Section 5 in this report discusses the approach and the intended process to realize the MECP’s objectives related to the off-set goal.

vi. Propose a methodology for quantification with respect to the offset of the loadings for any remediation and/or mitigation measures to meet the intended goal for overall remediation and/or mitigation to address the added TP loading from the spill; and

The results from the proposed field investigations (2021 Q2) will be used to evaluate the need for additional remediation and/or mitigation efforts to address downstream TP transported from Chedoke Creek to Cootes Paradise and the Western Harbour. Potential restoration and mitigation measures include both a wide range of watershed improvements, such as treatment of non-point pollutant sources, as well as in-water restoration, such as large-scale aeration and wetland restoration. Section 5.1 provides a summary of the available restoration measures and the methodology proposed for establishing the recommended projects to address TP loading downstream of Chedoke Creek, associated with the spill.

vii. Identify and propose timelines to implement the recommended remediation or mitigation measures to offset loadings from TP, impacts to dissolved oxygen from nutrients or other measures that may improve existing or potential impairments with identification of options that can be implemented as soon as possible to start to reduce the on-going or potential impacts.

The Framework Study advanced high-level timelines associated with what it identified as “short” and “long” term undertakings. The Cootes Paradise Report has further assessed the various recommendations, specific to the “unplanned” or “added value” works, and developed associated timelines more explicitly. It is worth noting that two of the key recommendations are associated with new Master Planning Studies for the Lower Chedoke Creek Restoration and the Stormwater Retrofit

Study for the Chedoke Watershed. These studies (estimated to require 12 months each to execute – target completion in 2022) will lead to a set of recommendations for capital works and other related activities. Further, both plans are expected to be comprised of multi-year programs of works which, subject to Council approval and funding, would be able to start design in 2022 and construction in 2023, for the highest priority works. Section 7 in this report provides further details.

- 10. Within six (6) weeks of approval of Item 8 above or such other date approved by the Director in writing, submit to the Director for approval, a proposed workplan for the approved remediation/mitigation measures for Cootes Paradise/Western Hamilton Harbour Area ("Cootes Paradise Workplan"). The workplan shall consider and address, as necessary, Work Ordered in Item 8 and 9 above and any ministry comments upon approval of Item 8, and shall include, but not be limited to, the following:**
- i. A detailed workplan and timeline for carrying out the approved remediation/mitigation options within the Cootes Paradise/Western Hamilton Harbour Area; ;**
 - ii. Calculations referred to in Item 9 iv) and v) or as otherwise approved; and;**
 - iii. Proposed follow-up monitoring required to ensure the recovery and effectiveness of the remediation plan.**

It is understood that once the MECP Director has had an opportunity to review the Cootes Paradise Report, comments will be forthcoming from MECP to potentially update and refine its content, and thereby guide follow-on effort. Once approved by MECP, this updated Cootes Paradise Report will then form the basis for establishing a more detailed work plan associated with the unplanned/"added value" recommendations. This will include information on data requirements, task descriptions and timelines, as well as engagement approaches. The subject report, referred to as the Cootes Paradise Workplan, will be submitted within six (6) weeks of the Director's approval of the Cootes Paradise Report, per the requirements of the Order. Section 6 of the Cootes Paradise Report has outlined a framework for monitoring the benefits and positive impacts associated with the recommended works, which will be further developed as part of the Cootes Paradise Workplan.

1.2 Concept of Mitigative Works (offset)

The introduction of excess nutrients from the 2014-2018 discharge of sewage into Chedoke Creek is the primary water quality concern for Cootes Paradise and the Western Harbour, however several other secondary water quality impacts are also ongoing and will require additional mitigation measures. The nutrients introduced during the discharge event have encouraged the growth of suspended algae which can lead to a cascade of additional ecological impairments, including loss of submerged vegetation, generation of additional sedimentation, loss of sediment stability, extreme changes in dissolved oxygen concentration, and loss of habitat. Once the nutrient sources have been controlled and/or better managed, measures such as revegetation and installation of other in-water works (such as floating vegetated mats) can be implemented to mitigate these secondary impairments. These mitigation measures can significantly enhance the ability of an impacted aquatic ecosystem to transition from an algal-dominated stable state to one that is dominated by aquatic macrophytes and supports a sustainable environment.

As outlined in Section 5.1, the offsetting mitigative works being considered for Cootes Paradise and the Western Harbour, largely fall into two forms, those that reduce the nutrients from the inflowing water, and those in-water works that treat the resident nutrients and other contaminants, either in a one-time reduction (such as removal) or continuously through uptake (such as specific plantings). The concept of the mitigative offsetting works considers both of these forms of work in establishing the proposed overall scope to remediate the impacts of the discharge event. As noted earlier, the work plan for the Chedoke

Creek targeted dredging will provide further data on current conditions in the creek, as well as the extent to which the targeted dredge and small-scale local remediation within the Chedoke Creek, will be able to off-set the impacts of the discharge event. Any quantifiable deficit (which is expected) will therefore guide the scope of the plan developed for the remediation of Cootes Paradise and the Western Harbour.

1.3 Chedoke Creek Workplan Context

The Chedoke Creek Workplan (February 22, 2021) was prepared by the City of Hamilton to address the first part of the Order, specific to the Targeted Dredging for the Chedoke Creek. The goal of the Chedoke Creek targeted dredge project is to restore the creek system in response to the discharge event and to provide reasonable complementary offsetting remediation projects within the creek, to account for additional environmental impacts that may not be addressed by dredging alone. Based on dialogue with MECP staff, the emphasis for these smaller scale offsetting works, relates predominantly to the Chedoke Creek system, versus the works outlined in this current report, which are more targeted towards Cootes Paradise and the Western Harbour.

Per the Chedoke Creek Workplan, the City of Hamilton is proposing to incorporate smaller scale offsetting remediation projects to augment and complement the benefits of the targeted dredging project. While not currently fully defined, (as this is part of the work yet to be completed under that plan), several water quality management technologies are available to be used as complements to dredging to improve water quality conditions in the creek by increasing dissolved oxygen and reducing nutrient concentrations. Some of the technologies which were advanced in the Chedoke Creek Workplan, and are going to be assessed over the course of that plan's execution include:

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

As noted above, these works will be spatially focused on the Lower Chedoke Creek, rather than Cootes Paradise and the Western Harbour. It is the current Cootes Paradise Report's objective to address those other offsetting works, which focus on Cootes Paradise and the Western Harbour, including those works which improve the water quality discharging to those systems.

2.0 Overview of Outcomes/Recommendations from Chedoke Creek Water Quality Framework

2.1 Introduction/Overview

The Framework Study summarized and consolidated previous and ongoing analyses conducted in the Chedoke Creek watershed, incorporated staff and stakeholder input, and undertook a broad, high level evaluation of potential improvements. Given the wide range of background information, potential solutions, and staff and stakeholder concerns, the Framework Study consolidated this information and brought forward a series of recommendations, including an implementation plan to address the water quality improvements for the Chedoke Creek system.

By way of background, urban buildout within the Chedoke Creek watershed predates modern standards for contemporary environmental and stormwater management approaches; evidence of this is demonstrated through:

- the enclosure and channelization of Chedoke Creek at several locations,
- combined sewers within the Mid and Lower Chedoke Creek watershed,
- the minimal presence of stormwater management features, and
- the placement of a landfill and other major transportation corridors adjacent to, and bisecting the natural Chedoke Creek channel and Cootes Paradise.

As a result, the Chedoke Creek experiences significant impacts such as sewage contamination, untreated urban stormwater runoff, and landfill leachate contamination. These water quality issues within Chedoke Creek watershed are of additional interest due to the Creek's location and function within the Cootes Paradise and Hamilton Harbour system.

Many recent studies and investigations have characterized the existing condition of Chedoke Creek, the performance of local infrastructure, and in some instances identified potential short and long-term management solutions to address select legacy issues. These studies and investigations have identified that water quality issues within Chedoke Creek, and the downstream receiver, Cootes Paradise, are not the result of any single source but rather are associated with both point and non-point sources throughout the watershed. Notwithstanding there are several information gaps which will need to be filled over time to better inform future remediation and restoration.

The main purpose of the Framework Study was hence to assemble the legacy work that has been completed and further examine this information as a broader system, while reviewing the various solutions that have been previously considered and/or recommended. The approach has involved assessing the watershed conditions, and specifically non-point sources, point sources of contaminants and the Creek, to identify the preferred potential solutions for the Chedoke Creek and its watershed.

2.2 Goals/Objectives

The key objectives of the Framework Study were stated as follows:

- Complete a holistic review of legacy water quality issues within the Chedoke Creek Watershed to identify the potential and likely contaminant sources, and the relative magnitude of their contributions;
- Explore and identify a range of potential *preventative* (to prevent something from occurring), *mitigative* (to make something less severe), and *restorative* (to restore to a past and more natural state) solutions to help address the identified legacy issues;

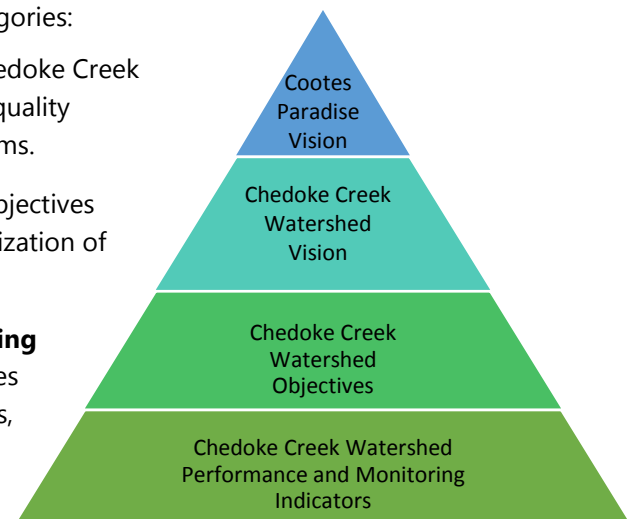
- Identify a preliminary set of management objectives to help guide future infrastructure and policy decisions;
- Engage in Stakeholder Consultation to ensure a comprehensive and common understanding of needs and set the foundation for future consultation and implementation;
- Review a range of potential solutions and provide recommendations for preferred potential solutions; and,
- Develop an Implementation Framework to support the future implementation of management solutions and associated tracking of progress.

The development and adoption of clear, achievable, and measurable objectives are essential to allow for the proper planning, design, implementation, and monitoring of Water Quality Improvements for the Chedoke Creek. These objectives, will guide the City and stakeholders to appropriately define specific needs, prioritize resources, monitor progress, and develop a common consensus related to desired outcomes.

The Framework Study has established the Chedoke Creek Watershed Management objectives based on the City's and stakeholders' Vision for the Chedoke Creek watershed and the broader Cootes Paradise system.

The Framework Study classified the objectives in three main categories:

- **Watershed Vision (Why?):** The Cootes Paradise and Chedoke Creek Watershed Vision represent the "The Goal" of the water quality improvements to the community in broad qualitative terms.
- **Chedoke Creek Watershed Objectives (What?):** The Objectives represent qualitative measures that help and lead to realization of the Watershed Vision.
- **Chedoke Creek Watershed Performance and Monitoring Indicators (How?):** The Indicators represent the measures that can be used to support the evaluation of alternatives, guide the design of infrastructure, and measure improvements over time.



The Framework Study recommended a "preliminary" Chedoke Creek Watershed Vision and Objectives, which ultimately will need to be confirmed and endorsed by the City and the respective stakeholders and public. Further, the Framework Study suggested potential Performance and Monitoring Indicators, which at this stage are qualitative (due to the study's limited technical scope), however moving forward, the City and respective stakeholders will need to establish more quantitative measures for the Performance and Monitoring Indicators.

Cootes Paradise and Hamilton Harbour Vision

The draft long-term vision for Cootes Paradise, based on the "Project Paradise", RBG and Hamilton Harbour Remedial Action Plan (HHRAP) can be described as:

Fully restored and enhanced Cootes Paradise environment

This is a long-term vision that will continue to be dynamic and adjusted over time. The Vision is expected to be refined based on further studies and consultation with the various stakeholders. It should also be noted that based on feedback from stakeholders on the draft Framework Study some amendments are likely for the Vision to better align with stakeholder interests; this will be made part of the final Framework Study reporting.

Chedoke Creek Watershed Vision

Chedoke Creek is one of the main tributaries entering Cootes Paradise, along with Spencer Creek, Ancaster Creek and Borer’s Creek. Notably, Chedoke Creek is one of several sources contributing nutrient loads to Cootes Paradise. Therefore, it is important to recognize that solely addressing/managing the Chedoke Creek water quality issues will not achieve the overall Cootes Paradise Vision. **Figure 1** provides a breakdown by source for an average year for Total Phosphorus nutrient loading to Cootes Paradise (this does not consider the 2014 to 2018 discharge event). Based on stakeholder feedback on the draft Framework Study, Figure 1 may be updated, however it is presented here largely for context, to indicate that the Chedoke Creek is one of many sources of contaminants to Cootes Paradise.

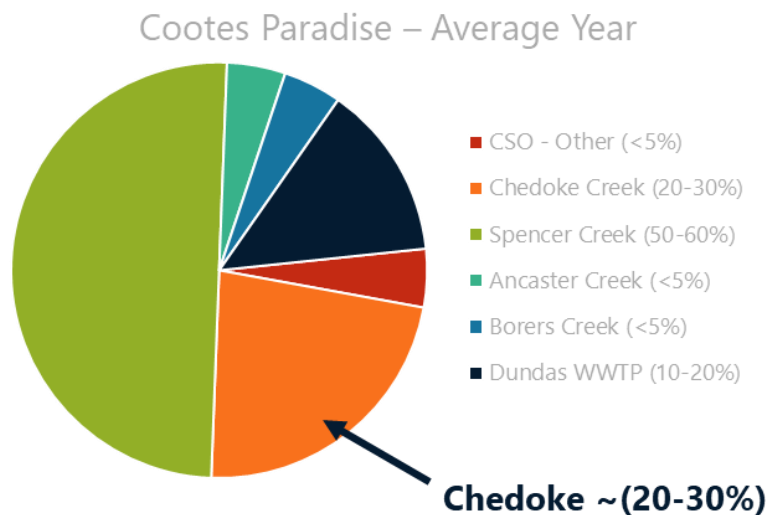


Figure 1. Cootes Paradise Average Year Total Phosphorus Loading

The Chedoke Creek Watershed Vision has been developed to support the Cootes Paradise Vision, as improvements in the Chedoke Creek Watershed will directly and indirectly benefit Cootes Paradise.

The vision for the Chedoke Creek Watershed can be described as:

Improve Chedoke Creek Watershed Water Quality to support:

- *Enhanced wildlife activity and habitat*
- *Safer Recreational Contact*

Chedoke Creek Watershed Management Objectives

Objectives are a qualitative measure intended to support and realize the project vision. These objectives are used as the basis for targets, to assess beneficial impacts, and support prioritization. The objectives need to be achievable and supported by stakeholders and by data, and should have the following characteristics:

- Technically feasible
- Align with City and Stakeholder vision
- Financially feasible
- Implementable timeline
- Complementary to other needs and priorities

The following Chedoke Creek Watershed Objectives have been identified in support of the Chedoke Creek Watershed Vision (the objectives are listed in no particular order of importance):

- Limit sources of high nutrient loads to Chedoke Creek to prevent excess nutrients and limit algae blooms
- Limit sources of contaminants to Chedoke Creek
- Eliminate sanitary sewer cross-connections to the stormwater system (in separated sewer systems)
- Minimize the risk of CSO spills to Chedoke Creek including:
 - Reducing the frequency and volume of overflow events
 - Enhance monitoring and management, to reduce the likelihood of, and reduce the response times to, spill events resulting from infrastructure failures
- Seek opportunities to enhance and naturalize Chedoke Creek

2.3 Options

As part of the Framework Study, a wide range of potential options were considered to address one or more of the identified Management Objectives. These potential options explored a range of *preventative*, *mitigative* and *restorative* solutions, and were then examined at both a local level along the creek, and also within the larger, watershed/City-wide context. The list of potential options was generated based on previously identified solutions, consideration of current industry best practices, and stakeholder engagement and input. The following outlines the potential management options which were considered through the Framework Study. The options were categorized into seven (7) main groups consisting of the following:

- Landfill
- Lower Chedoke Creek
- Wastewater
- Stormwater
- Upper Chedoke Creek
- Engagement
- Monitoring

The foregoing represented specific locations within the watershed or key targeted sources or types of systems, as well as other complementary activities to collect data or feedback. Table 2.1 provides a summary of the various sub-options considered under each group. It should be noted that some of the content in Table 2.1 and the subsequent summaries has been slightly amended from the version of the information provided in the January 2021 draft of the Framework Study, to reflect some of the input received from stakeholders and other needs and/or requirements specifically stemming from the Order requirements.

Table 2.1. Description of Options

	Option Overview	Option Description
Landfill	Direct Clean Water Away from Landfill	<ul style="list-style-type: none"> Prevent local surface water runoff from infiltrating into the landfill and entering leachate collection system (LCS) Realign surface water pathways to allow clean water to directly flow into Chedoke Creek Reduce total volume pumped from LCS to combined sewers due to reduced leachate generation
	Rehabilitate existing Highway 403 Culvert (Landfill)	<ul style="list-style-type: none"> Prevent leachate from contaminating flows from Highway 403 entering the creek via local culvert
	Expand/Fix Leachate Collection System	<ul style="list-style-type: none"> Extend and deepen perforated pipe for leachate collection pipe Prevent leachate from seeping into creek and from contaminating runoff directly entering creek
	Landfill Capping/Barrier	<ul style="list-style-type: none"> Improve landfill capping/barrier to reduce leachate leaking from boundaries Enhance the barrier between the contaminated media and the surface
Lower Chedoke Creek	Constructed Wetland	<ul style="list-style-type: none"> Construct wetland at the outlet of Chedoke Creek where it enters Cootes Paradise (Princess Point) Capture sediments & pollutant loading from Chedoke Creek before entering Cootes Paradise Disperse flows which will enhance natural processes and improve wildlife habitat at outlet of Chedoke Creek
	Aeration System (major/permanent)	<ul style="list-style-type: none"> Install Aeration System in Lower Chedoke Creek System intended to enhance the transfer of dissolved oxygen to Chedoke Creek/Cootes Paradise waters Improves marine habitat along and downstream of the creek
	Stream Naturalization	<ul style="list-style-type: none"> Remove concrete channel and introduce native vegetation for slope stability Reduce stream velocity and sediment buildup downstream Improves marine habitat along and downstream of the creek
	Restore Delta at Mouth of Chedoke Creek	<ul style="list-style-type: none"> Potentially in combination with Constructed Wetland, restore the geometry of the multi-channel delta in the vicinity of Princess Point Improve energy dissipation and sediment transport, while enhancing habitat functions

	Option Overview		Option Description
Lower Chedoke Creek	Physical Capping		<ul style="list-style-type: none"> Apply a cover of clean material on top of contaminated creek bed sediment to mitigate risk of contamination Stabilization of contaminated sediments to prevent resuspension Prevent benthic community from interacting with and processing the contaminated sediments
	Chemical Inactivation		<ul style="list-style-type: none"> Chemically treat nutrient-enriched sediment to reduce internal pollutant loading
	Hydraulic Dredging for Sediment Removal	Complete Removal	<ul style="list-style-type: none"> Remove contaminated sediment via hydraulic dredging Remediate the creek by removing all existing contaminated sediment within creek
		Targeted Removal	<ul style="list-style-type: none"> Targeted removal of contaminated sediment via hydraulic dredging (Part of current MECP Order) Remediate the creek bed by removing targeted sediment with highest potential for negative impacts
Wastewater	Sewer Separation		<ul style="list-style-type: none"> Full sewer separation in Chedoke watershed (i.e., combined systems to a sanitary and storm system) Prevents sanitary waste from overflowing into Chedoke Creek
	Increase Hydraulic Capacity Downstream of Main-King Combined Sewer Overflow (CSO) tank		<ul style="list-style-type: none"> Trunk upgrades from Main-King CSO tank to Woodward Avenue WWTP to accommodate higher storm flows Reduces volume and frequency of combined sewer overflows
	Increase Capacity of Royal CSO tank to Main-King CSO tank (Highway 403 Trunk Sewer Twinning)		<ul style="list-style-type: none"> Reduces volume and frequency of combined sewer overflows Potential elimination of overflows at Aberdeen CSO & reduction in overflows at Royal CSO
	Expand Storage at Main-King CSO tank		<ul style="list-style-type: none"> Increases holding capacity to accommodate combined sewer flows during high flow events Reduces volume and frequency of overflows
	Expand Storage Elsewhere in System		<ul style="list-style-type: none"> Increases capacity to accommodate combined sewer flows during high flow events Reduces volume and frequency of combined sewer overflows Option would be sited upstream of Main-King CSO tank to provide additional system relief

		Option Overview	Option Description
Wastewater	Inspection and Repair	Facilities	<ul style="list-style-type: none"> Prevent combined sewage from potentially infiltrating into creek due to leaks Potential opportunity at Royal CSO Investigation needed to confirm leaks
		Trunk Sewers	<ul style="list-style-type: none"> Prevent combined sewage from potentially infiltrating into creek due to leaks Potential opportunity within trunk sewers running parallel to creek system Investigation needed to confirm leaks
	CSO Monitoring Improvements and Active Management		<ul style="list-style-type: none"> Real Time Control (RTC) Program to optimize the performance of the collection system and CSO tanks Improved inspection and monitoring of CSOs Quantify overflow volume and overflow conditions
	Wet Weather Flow Management (Inflow & Infiltration) in Separated Sewers	Targeted in Chedoke Watershed	<ul style="list-style-type: none"> Identify areas of high Inflow and Infiltration (I&I) in Chedoke Creek watershed Reduce I&I into sanitary sewers thereby reducing sanitary sewer flows Potentially reduce CSO overflows
		Targeted in broader Main-King Catchment	<ul style="list-style-type: none"> Identify areas of high I&I in Main-King catchment Reduce I&I into sanitary sewers thereby reducing sanitary sewer flows Potentially reduce CSO overflows
		Policy/Future Infrastructure Projects	<ul style="list-style-type: none"> More stringent criteria related to new development standards to ensure future construction practices better address I&I issues Reduce I&I into sanitary sewers thereby reducing sanitary sewer flows Potentially reduce CSO overflows
Stormwater	Cross Connection Program		<ul style="list-style-type: none"> Ensure sanitary laterals are not connected to stormwater system in separated sewer system Prioritize within Chedoke Creek catchment, south of Escarpment Fix storm and sanitary cross-connections from homes Reduce sanitary contaminants discharged from stormwater outfalls
	Retrofits throughout the watershed (End-of-Pipe and Source)	City	<ul style="list-style-type: none"> Retrofit existing dry ponds to wet ponds and build treatment at outfalls where opportunities exist in Chedoke watershed Introduce stormwater management practices to areas where there is currently no treatment or management
		MTO	<ul style="list-style-type: none"> Retrofit existing facilities for Highway 403 drainage Introduce stormwater management practices along Highway 403 where there is currently no treatment or management

		Option Overview	Option Description
Stormwater	Retrofits for Road Rehabilitation Projects / Low Impact Development (LID) BMP Policy		<ul style="list-style-type: none"> Best Management Practices (BMPs) focussed on water quality treatment to be applied to any road rehabilitation project within the City – targeted to Chedoke Creek watershed Advance City’s stormwater management guidance to include City infrastructure
	City Street Management	Enhanced Street Sweeping	<ul style="list-style-type: none"> Program to implement enhanced street sweeping within Chedoke Creek Watershed and across broader City Clean up debris and contaminants that build up on City roads
		Improve Snow Management within Chedoke Creek Watershed	<ul style="list-style-type: none"> Enhance Snow Management practices to prevent contamination (Chlorides) to Chedoke Creek during melts Review disposal sites for snow that would reduce direct snow melt into urban streams
	Stormwater User Rate/ LID BMP Policy		<ul style="list-style-type: none"> Supports sustainable funding of stormwater management program Incentive program to encourage private property owners to manage stormwater at source on private properties and implement additional BMP’s LID BMPs will help to provide infiltration, reduce runoff volumes and support creek stability
	Enhanced Salt Management	Highway 403	<ul style="list-style-type: none"> Enhance salt management plan for Highway 403
		City Roads	<ul style="list-style-type: none"> Enhance City’s salt management plan for City Roads
	Redevelopment Sites Stormwater Management (SWM) Policy		<ul style="list-style-type: none"> Policies for BMP’s including LID practices for redevelopment sites in City Opportunity for significant stormwater reduction/treatment on redevelopment sites
	Highway 403 Water Quality Improvements		<ul style="list-style-type: none"> Treat highway runoff at collection points along corridor before it enters Chedoke Creek Install stormwater management devices at stormwater outfalls
	Inlet Controls in Combined Sewer Areas		<ul style="list-style-type: none"> Install inlet control devices in combined sewer system Restricts the amount of stormwater that enters enclosed system, reducing the potential of CSO overflows Requires evaluation of major system (overland) capacity

	Option Overview		Option Description
Upper Chedoke Creek	Golf Course	Manage Runoff from the Golf Course	<ul style="list-style-type: none"> • Improve Golf course water management practices including management of fertilizers and pesticide use • Provides treatment prior to runoff entering Chedoke Creek
		Stream Naturalization	<ul style="list-style-type: none"> • Naturalization of channelized portions of creek and introducing native vegetation
		Retrofit and Treatment Online	<ul style="list-style-type: none"> • Provide location for external stormwater treatment on-site at Chedoke Golf Course (Beddoe) • Treatment to capture large portion of Upper Chedoke Creek catchments that currently flow through Golf Course • Opportunity would be part of broader water shed assessment of retrofits
Engagement	Engage Residents, Stakeholders, and City		<ul style="list-style-type: none"> • Educating citizens about water quality issues and benefits of proposed actions • More transparency in water quality monitoring and management • Encourages resident participation in ongoing public initiatives
Monitoring	Program Management and Monitoring		<ul style="list-style-type: none"> • Centralized data sharing portal to house sampling data • Apply consistent protocols to monitor and track benefits • Program will provide data to quantify water quality benefits of proposed actions • Better identify problems and effectiveness of solutions; leads to adaptive management

2.4 Screening

The screening and prioritization of options, as outlined in the Framework Study (draft), generally followed the following approach:

- 1. Screening of Options:** A preliminary screening process for the options was developed and undertaken to determine which options should be *carried forward*, *screened out*, or will *require further investigations/studies*. The overall advantages and disadvantages of the options were reviewed to define which options should be *screened out* versus those that should be *carried forward*.

The screening process considered the following:

- Potential Cost
- Potential Benefit
- Technical or Implementation Challenges
- “No-Regrets” Principles
- Nutrient Loading Impact

The options that were carried forward or required further investigations/studies, were then further refined through the categorization and prioritization process.

- 2. Prioritization and Categorization of Options:** The Framework Study (draft) then prioritized those options carried forward, further refining their advantages and disadvantages. The approach qualitatively evaluated the relative advantages, disadvantages, and potential impacts of each option against the established criteria (ref. **Table 2.2**).

Table 2.2. Prioritization Criteria

	High	Medium	Low
Cost	<\$10 M	\$10-\$50 M	>\$50 M
Timing	Short-Term (<5 Years)	Near-Term (5-10 Years)	Long-Term (>10 Years)
Implementation	Easy	Moderate	Difficult
Visibility	High	Medium	Low

- “High” options generate comparatively beneficial impacts; these are depicted in green
- “Medium” options present a mix of positive and negative elements with some impacts; these are depicted in black
- “Low” options are considered more difficult to implement; these are depicted in red

In addition to the prioritization criteria, the following factors were also considered to aid in the screening and prioritization of options:

1. Functional Effectiveness (Nutrient Loading and Water Quality Improvements)
2. Project Benefit - Type: *Preventative, Mitigative, Restorative*
3. Project Benefit - Spatial Extent: Watershed, Upper Chedoke Creek Watershed, Lower Chedoke Creek Watershed, Cootes Paradise
4. Infrastructure Ownership

Table 2.3 provides a summary of the Screening assessment conducted for the various options as per the Framework Study.

Table 2.3. Options Screening

	Option Overview	Screening	Rationale
Landfill	Direct Clean Water Away from Landfill	Screen Out	<ul style="list-style-type: none"> • Low effectiveness • High cost • Difficult to implement
	Rehabilitate existing Highway 403 Culvert (Landfill)	Carry Forward	<ul style="list-style-type: none"> • Low cost • Highly visible • Relatively straight forward
	Expand/Fix Leachate Collection System	Future Consideration (Data Dependent)	<ul style="list-style-type: none"> • Need to collect more data on effectiveness of recent improvements and reassess before final recommendations
	Landfill Capping/Barrier	Screen Out	<ul style="list-style-type: none"> • Low effectiveness • High cost • Difficult to implement
Lower Chedoke Creek	Constructed Wetland	Future Consideration (Study Dependent)	<ul style="list-style-type: none"> • Highly visible • Restorative solution • Limited operations required
	Aeration System (major/permanent)	Future Consideration (Study Dependent)	<ul style="list-style-type: none"> • Moderately visible • Mitigative solution • Moderate implementation time
	Stream Naturalization	Future Consideration (Lower Chedoke) Screen Out (Mid Chedoke)	<ul style="list-style-type: none"> • Lower Chedoke <ul style="list-style-type: none"> ○ Moderate cost ○ Highly visible ○ Mitigative solution • Mid Chedoke <ul style="list-style-type: none"> ○ Infrastructure constraints ○ Recently re-lined by MTO
	Restore Delta at Mouth of Chedoke Creek	Future Consideration (Study Dependent)	<ul style="list-style-type: none"> • Highly visible • Restorative solution • Limited operations required
	Physical Capping	Screen Out	<ul style="list-style-type: none"> • Low effectiveness • Low visibility
	Chemical Inactivation	Screen Out	<ul style="list-style-type: none"> • Low effectiveness • Low visibility

		Option Overview	Screening	Rationale
Lower Chedoke Creek	Hydraulic Dredging for Sediment Removal	Complete Removal	Screen Out	<ul style="list-style-type: none"> Moderate effectiveness; potentially disruptive Medium visibility High cost
		Targeted Removal	Carry Forward (response to Order)	<ul style="list-style-type: none"> Optimized program to target most severe contaminants Medium visibility Moderate costs
Wastewater	Sewer Separation		Evaluate in Flooding and Drainage MSS	<ul style="list-style-type: none"> Implement recommendations from City's MP study for works within Chedoke Creek
	Increase Hydraulic Capacity Downstream of Main-King Combined Sewer Overflow (CSO) tank		Evaluate in City's Water/ Wastewater/ Stormwater Master Plan	<ul style="list-style-type: none"> City-wide benefits Implement recommendations from City's MP study
	Increase Capacity of Royal CSO tank to Main-King CSO tank (Highway 403 Trunk Sewer Twinning)		In Progress	<ul style="list-style-type: none"> Mitigative solution Design already in process
	Expand Storage at Main-King CSO tank		Screen Out	<ul style="list-style-type: none"> High cost Difficult implementation Main-King CSO tank is maximized at current site
	Expand Storage Elsewhere in System		Evaluate in City's Water/ Wastewater/ Stormwater Master Plan	<ul style="list-style-type: none"> Implement recommendations from City's Master Plan study for within Chedoke Creek
	Inspection and Repair	Facilities	Carry Forward	<ul style="list-style-type: none"> Low cost "No regrets" Ensures facilities are in good operating order
		Trunk Sewers	Carry Forward	<ul style="list-style-type: none"> Low cost "No regrets" Ensures no major I&I in trunk sewers parallel to Chedoke Creek
	CSO Monitoring Improvements and Active Management		In Progress	<ul style="list-style-type: none"> Monitoring and SCADA can better monitor and manage system Currently implemented through other programs

		Option Overview	Screening	Rationale
Wastewater	Wet Weather Flow Management (Inflow & Infiltration) in Separated Sewers	Targeted in Chedoke Watershed	Carry Forward	<ul style="list-style-type: none"> Best management practices provide benefits for local system and offer growth capacity in addition to supporting Chedoke Creek health
		Targeted in broader Main-King Catchment	Carry Forward	<ul style="list-style-type: none"> Best management practices provide benefits for local system and offer growth capacity in addition to supporting Chedoke Creek health
		Policy/Future Infrastructure Projects	Carry Forward	<ul style="list-style-type: none"> Policy will lead to Best management practices which will provide benefits for local system and offer growth capacity in addition to supporting Chedoke Creek health
Stormwater	Cross Connection Program		Ongoing	<ul style="list-style-type: none"> Low cost Quick implementation
	Retrofits throughout the watershed (End-of-Pipe and Source)	City	Future Consideration (Study Dependent)	<ul style="list-style-type: none"> Moderate to high visibility Short to moderate implementation timelines Retroactive treatment
		MTO	Future Consideration (Study Dependent)	<ul style="list-style-type: none"> Low to Moderate visibility Potential for short/moderate implementation MTO led
	Retrofits for Road Rehabilitation Projects / Low Impact Development (LID) BMP Policy		Carry Forward	<ul style="list-style-type: none"> Costs incorporated with other road works Moderate to High visibility Ongoing best management practice
	City Street Management	Enhanced Street Sweeping	Carry Forward	<ul style="list-style-type: none"> Low cost Quick implementation for program
		Improve Snow Management within Chedoke Creek Watershed	Carry Forward	<ul style="list-style-type: none"> Low cost Visible to public Short implementation time "No regrets"
	Stormwater User Rate/LID BMP Policy		Ongoing	<ul style="list-style-type: none"> Self-Funding Helps define link between private practices and improvements to Chedoke Creek

	Option Overview		Screening	Rationale
Stormwater	Enhanced Salt Management	Highway 403	Carry Forward	<ul style="list-style-type: none"> • Low to moderate costs • Short implementation time • "No regrets"
		City Roads	Ongoing	<ul style="list-style-type: none"> • Low to moderate costs • Short implementation time • "No regrets"
	Redevelopment Sites Stormwater Management (SWM) Policy		Carry Forward	<ul style="list-style-type: none"> • Costs incorporated with other works by Others (Developers) • Moderate to High visibility • Ongoing best management practice
	Highway 403 Water Quality Improvements		Carry Forward	<ul style="list-style-type: none"> • Low to moderate costs • Short implementation time
	Inlet Controls in Combined Sewer Areas		Evaluate in City's Flooding and Drainage MSS	<ul style="list-style-type: none"> • Implement recommendations from Flooding and Drainage MSS
Upper Chedoke Creek	Golf Course	Manage Runoff from the Golf Course	Carry Forward	<ul style="list-style-type: none"> • Low cost • Quick implementation • Golf course can remain in operation
		Stream Naturalization	Carry Forward	<ul style="list-style-type: none"> • Highly visible • Golf course can remain in operation
		Retrofit and Treatment Online	Future Consideration (Study Dependent)	<ul style="list-style-type: none"> • Golf course can remain in operation with some potential modifications • Part of broader Retrofit Study
Engagement	Engage Residents, Stakeholders, and City		Carry Forward	<ul style="list-style-type: none"> • Low cost • High visibility for public • Short implementation time
Monitoring	Program Management and Monitoring		Carry Forward	<ul style="list-style-type: none"> • Low cost • Will help improve system understanding and support tracking benefits over time

2.5 Recommendations

The options that were not screened out in Table 2.3, were considered potential solutions that meet the project goals and objectives and were categorized and prioritized based on the methodology described in the foregoing, as well as stakeholder input received through study workshops. The results of the categorization and prioritization process ultimately formed the basis for the “draft” Chedoke Creek Water Quality Improvement Framework.

Solutions Categorization and Prioritization

The solutions were acknowledged to constitute actions under five (5) categories, as follows:

1. **Near-Term Capital Program:** Capital projects with a short timeline or that are already underway with a clear project scope or limited investigation / study required.
2. **Long-Term Capital Program:** Capital projects with a multi-year process and require additional studies or investigations to confirm the scope and benefit. These projects may also be triggered by other City initiatives such as the ongoing “Flooding and Drainage Master Servicing Study”.
3. **Near-Term Operations and Maintenance/Program:** Operations and maintenance projects or programs with a quick start up or that are already underway which provide immediate benefit.
4. **Long-Term Operations and Maintenance/Program:** Operations and maintenance projects or programs that may require procedural/policy changes and/or new funding and staffing. Benefits are likely to be realized over the long-term.
5. **Policy and Public Engagement:** New policies and expanded public engagement to support the study framework with benefits largely realized over the long-term.

The following summarizes the various short-listed options according to these 5 categories.

Near-Term Capital Program

The Near-Term Capital Program consists of projects with a clearly defined scope, do not require extensive study and/or consultation, and that can be implemented immediately to address specific concerns. These projects are anticipated to be implemented within the next 3 years (ref. **Table 2.4**).

Table 2.4. Near-Term Capital Program

Project	Status
Highway 403 Trunk Sewer Twinning	Under Planning and Design
Rehabilitate existing Highway 403 Culvert (Landfill)	Coordination with MTO
Chedoke Creek Targeted Removal	Underway per MECP Order

Long-Term Capital Program

The Long-Term Capital Program consists of projects that require additional studies or investigations to confirm scope and benefits before being implemented. These projects will likely not be fully implemented in the next 3 years; however, studies to support the long-term projects are either underway or are anticipated to commence within the next 2 years or less (ref. **Table 2.5**).

Table 2.5. Long-Term Capital Program

Project	Status
Aeration System	Require assessment through Lower Chedoke Combined EA Study which is Near-term
Constructed Wetland	
Stream Naturalization	
Restore Delta at Mouth of Chedoke Creek	
Other Restoration Opportunities	
Inlet Controls in Combined Sewer Areas	Dependent on Flooding and Drainage Master Servicing Study (on-going)
Sewer Separation	
Retrofits throughout watershed (End-of-Pipe and Source)	Require assessment through Chedoke Watershed Stormwater Retrofit EA Study which is Near-term
Expand Storage Elsewhere in System	Dependent on Water/ Wastewater/ Stormwater Master Plan (on-going)
Increase Capacity Downstream of Main-King CSO tank	
Expand/Fix Leachate Collection System	Dependent on Collection of more performance data before further recommendations
Golf Course – Stream Naturalization	Subject to Study
Highway 403 Water Quality Improvements	MTO Led Initiative

Near-Term Operations and Maintenance/Program

The Near-Term Operations and Maintenance/Program consists of the expansion and/or reprioritization of existing programs. There is the potential to provide immediate benefits, as these programs and investigations can be implemented within the next 2 years or less (ref. **Table 2.6**).

Table 2.6. Near-Term Operations and Maintenance/Program

Project	Status
CSO Monitoring Improvements and Active Management	Underway
Inspection and Repair – Facilities	Underway / Initiate Inspection
Inspection and Repair – Trunk Sewers	
Cross Connection Program	Prioritize in Chedoke Watershed
City Street Management – Enhanced Street Sweeping	Develop and Initiate City Program
City Street Management – Improve snow management within Chedoke Creek Watershed	Enhanced Program
Enhanced Salt Management – City Roads	Enhance Existing Program
Manage Runoff from Chedoke Golf Course	Develop and Initiate City Practices

Long-Term Operations and Maintenance/Program

The Long-Term Operations and Maintenance/Program consists of expanding existing or creating new programs either targeted to the Chedoke Creek watershed or implemented City-wide. There is the potential to provide substantial benefits, but the implementation of these programs will require more time. These programs and investigations may require upfront investigations, policy changes, and new funding and staffing, which is not anticipated to be implemented within the next 2 years (ref. **Table 2.7**).

Table 2.7. Long-Term Operations and Maintenance/Program

Project	Status
Wet Weather Flow in Separated Sewers – Targeted in Chedoke Watershed	Initiate Inflow & Infiltration Monitoring
Wet Weather Flow in Separated Sewers – Targeted in broader Main-King Catchment	
Program Management and Monitoring	Initiate Now and Continue Long Term
Enhanced Salt Management – Highway 403	Enhance Existing Program

Policy and Public Engagement

The Policy and Public Engagement programs involve expanding and creating opportunities for public engagement to monitor progress and better manage the strategy presented in the draft Framework Study. These policies and stakeholder engagement will provide long-term benefits as they strengthen over time (ref. **Table 2.8**).

Table 2.8. Policy and Public Engagement

Project	Status
Engage Residents, Stakeholders, and City	Initiate Now
Redevelopment Sites SWM Policy	Develop Policy Now, Implement through Future Projects
Retrofits for Road Rehabilitation Projects / LID BMP Policy	Develop Policy Now, Implement through Future Projects
Stormwater User Rate/ LID BMP Policy	Currently Underway
Wet Weather Flow in Separated Sewers – Policy / Future Infrastructure Projects	Develop Policy Now, Implement through Future Projects

These categories were further subdivided for the express purpose of addressing the requirements of the Order into those works which would be considered normal or planned by the City to deal with infrastructure operations and capital upgrades and those works which would be considered additive or unplanned (“Added Value”), which can more directly be considered as part of the offsetting works for Cootes Paradise and the West Harbour (ref. Section 5.2).

3.0 Other Potential Measures (Short-term/Focused)

As noted, in the Chedoke Creek Workplan, there are several smaller scale off-set works which are considered as complements to the targeted dredging of the Chedoke Creek, within the Chedoke Creek study area. These include small scale aeration, riparian planting, vegetative mats and beneficial reuse of sediment, and others. Given the focus of the Cootes Paradise Report on the remediation of spill impacts in Cootes Paradise and the Western Harbour, these works (not listed in the Framework Study) could also be considered for Cootes Paradise and the Western Harbour, as natural complements to the Chedoke Creek work. In addition, water quality and aquatic biota sampling have not been conducted within the Princess Point embayment of Cootes Paradise and beyond, to investigate the impacts of the CSO discharge event; hence further field studies in this area will likely be required to support remediation design and options assessment (see below).

Some of the other potential measures, beyond those summarized in the draft Framework Study, which may be considered for remediation of Cootes Paradise and the Western Harbour, include:

- Large Scale Vegetative mats
- Sediment Nutrient Inactivation
- Dredging in Princess Point Embayment and beyond
- Bacteria / Enzymes

The first two in the above list have been described in the Chedoke Creek Workplan. Sediment nutrient inactivation and use of bacteria and/or enzymes to reduce sediment volume are discussed below.

Sediment nutrient inactivation is an additional nutrient inactivation measure which was evaluated previously by Wood in the context of application within Chedoke Creek in 2019. While the use of chemical inactivation products was not considered effective with Chedoke Creek itself, the potential for application of products such as aluminum sulfate or Phoslock® could be more efficacious within an open-water system such as Cootes Paradise, where potential sediment transport is minimal and dredging may not be practicable. One advantage of chemical sediment nutrient inactivation over other remediation measures is that a directly quantifiable mass reduction can be obtained, based on the mass of bioavailable phosphorus determined using a sequential phosphorus fractionation method (ref. Psenner et.al. 1988¹). Potential internal pollutant load reduction from treatment areas outside of the dredge footprint could therefore be estimated using sediment data collected from within the dredge footprint.

Certain species of bacteria are capable of decomposing organic sediments and are commonly used in wastewater treatment to provide a number of beneficial functions including reduction of residual biosolids. Enzymes can be added to the process to expedite the decomposition reactions and further reduce the generation of solids. While these additives can be effective at reducing sediment volume in steady-state bioreactor systems, commonly used in wastewater treatment plants, they are less effective in natural environments where organic sediments are typically highly cellulosic and refractory; nutrient concentrations are several orders of magnitude lower; sediments are not continuously mixed; and conditions are not steady-state. Bacterial supplements could potentially be more effective on sewage-derived sediments compared to sediments originating from algae or plant material. However, even if sewage-derived sediments within Cootes Paradise could be treated effectively, the nutrients would simply be converted from one form to another (e.g., from sediment mass to bacterial mass) and would continue to move downstream through the nutrient spiraling process. For these reasons, bacterial supplements and/or enzyme addition is not recommended.

¹ Psenner, R., Boström, B., Dinka, M., Petterson, K., Pucsko, R., Sager, M., 1988. Fractionation of phosphorus in suspended matter and sediment. *Archive für Hydrobiologie: Ergebnisse der Limnologie* 30, 98e103.

4.0 Summary of Consultation (to-date/planned)

4.1 General Stakeholders

Internal and external stakeholders were engaged as part of the Framework Study to provide input and help guide the development of the framework. The stakeholder consultation conducted as part of the Framework Study, is considered at this stage to represent the start of an ongoing and collaborative process which will be essential to the successful implementation of the various projects being considered to realize the identified Vision and Management Objectives.

Over the course of the Framework Study, the following external stakeholders were consulted:

- Bay Area Restoration Council (BARC)
- Conservation Halton (CH)
- Environment Hamilton (EH)
- Hamilton Conservation Authority (HCA)
- Hamilton Harbour Remedial Action Plan (HHRAP)
- Individual Indigenous Representatives
- Ontario Ministry of Transportation (MTO)
- Royal Botanical Gardens (RBG) – Cootes Paradise landowner

Further, internal City departments were also consulted throughout the project, to provide input and help guide the development of the framework.

4.2 Focused Consultation related to Order

In terms of the City's work in response to the December 4, 2020 Order, several regulatory agencies and stakeholders have been contacted to initiate early consultation to confirm permitting requirements, review and approval timelines and establish contacts for ongoing consultation throughout the targeted dredge project. A summary of these early engagements is provided in the following, with a record of consultation to-date provided in Appendix B.

4.2.1 Hamilton Conservation Authority

As per the *Conservation Authorities Act* regulation 161/06 under Ontario Regulation 97/04, a Hamilton Conservation Authority (HCA) Work Permit is required for dredging. Early consultation confirmed a 63-day review and approval period for the permit application; however, it is expected to be less than this due to ongoing engagement. The application may include project staging, an erosion and sediment control plan, flood risk assessment, discharge and material management plan, landscape/restoration plan, fisheries assessment, vegetation inventory, landowner permission (e.g., Royal Botanical Gardens), as well as a description of the ecological components including potential Species at Risk (SAR).

4.2.2 Royal Botanical Gardens

The Royal Botanical Gardens (RBG) perform monitoring studies and regulate research projects by others within Cootes Paradise, which includes the outlet of Chedoke Creek and the Princess Point embayment. As such, the proposed targeted dredging project will require an RBG research permit that includes details regarding the purpose and nature of the proposed project and allows the RBG to provide additional guidance regarding sensitive areas, best management practices and SAR observations. Since the RBG has been included in early consultation, and will continue to be included in the planning of this project, issuance of the research permit is anticipated within one month of the formal permit request submission.

4.2.3 Ministry of Transportation

An Encroachment Permit and Building and Land Use Permit are expected to be required as per the *Public Transportation Act* and *Highways Improvement Act*. A meeting with the Ministry of Transportation (MTO) Corridor Management Officers and Drainage Officer confirmed an expected review and approval timeline of one-month. These approvals are commonly processed for construction activities near-to and within the Provincial infrastructure right of ways and the proposed project does not require access from the highway. Should dredging near the piers at the Cootes Paradise Fishway be considered, further engagement with the MTO Structural team may be needed.

4.2.4 Ministry of Natural Resources and Forestry

The Guelph District MNRF has confirmed approval under the *Lakes and Rivers Improvement Act* (LRIA) will not be required for this project since the HCA Work Permit will address the dredging review and approval requirements. As such, no further permitting schedule is required for the LRIA.

4.2.5 Ministry of the Environment, Conservation and Parks

There are a number of potential SAR within the project area, some of which may have direct interactions with a dredging project. As such, early consultation with MECP (currently ongoing) and field survey data, will inform the permitting process under the *Endangered Species Act* (ESA). The ESA presents two primary options for permitting; 1) Section 17(2)(c) Overall Benefit Permit (OBP) process and 2) Section 17(2)(a) Permit regarding risk to human health and safety. Alternatively, proceeding under the Health and Safety Regulation (O.Reg 242/08) would be separate from the Section 17(2)(a) option and would be through the online Health and Safety Projects Registry, that would not require a formal permitting process. The City is evaluating these options concurrently and continues to engage MECP SAR staff to support decision making and to confirm timelines. It is assumed that permitting through the ESA will satisfy requirements of the Federal *Species at Risk Act* (SARA) and a separate SARA approval will not be required. This will be confirmed during consultation with Fisheries and Oceans Canada in the Fisheries Act Authorization project review process. Further, Indigenous engagement is likely required which will be conducted concurrently with other engagement activities.

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

Potential dredging within the Princess Point embayment may require archaeological assessment of the nearshore areas; however, this will be determined once the design and targeted dredge areas are better defined. The Ministry of Heritage, Sport, Tourism, and Culture Industries will be contacted to confirm further assessment requirements; however, this scope of work and review timelines are not anticipated to be a critical path item for the permitting schedule. Depending on the scope of work and feedback from the Ministry, Indigenous engagement is likely to be required, which would be conducted concurrently with other engagement activities.

4.2.7 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 has provided some information via email correspondence; however, further dialogue with TC Inspection Officers is anticipated to provide additional guidance on the potential permitting options. Timelines for the potential review and approval process are not well known; however, a 3 to 4 month period is anticipated. There are mandatory components of the conventional approval process that include a 30-day notice for public comment and a 45-day response and resolution period, followed by a 15-day decision period. These timelines will be discussed with TC to update the anticipated permitting schedule.

4.2.8 Fisheries and Oceans Canada

The Fisheries Protection Program (FPP) evaluates projects via the Request for Project Review (RFR) form submission 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. An RFR was submitted February 23, 2021 and this project was assigned File No. 21-HCAA-00211 on March 10, 2021; however, a formal response to the RFR has not been received. Further engagement with DFO is expected to occur in the near term and will confirm the required permitting path forward. The conventional FA Authorization process is shown below:

- Submit RFR – 45-day review period (maximum, can be as short as 2-weeks)
- Early consultation with DFO for FA Authorization – begin once RFR response received
- Ongoing consultation with DFO to support Draft FA Authorization application
 - Indigenous engagement likely required – to be conducted concurrently with other engagement activities.
- Draft FA Authorization application submitted July 2021 (60-day review period)
- Minister FA Authorization application decision (90-day review/approval period)

The conventional review and approval timeline above indicates approval may be available by February 2022; however, the City plans to engage DFO as soon as possible following receipt of the RFR response to expedite pre-submission review and updates as much as feasible. During this early consultation, the City will also explore an Emergency Authorization option and associated timelines for review and approval, which are site-specific and require dialogue with DFO to confirm.

4.2.9 Impact Assessment Agency of Canada

The MECP has indicated a Provincial Environmental Assessment will not be required. The Impact Assessment Agency of Canada (IAAC) has been contacted to confirm if the proposed project will require a Federal assessment under the *Impact Assessment Act* (IAA). It is understood that the proposed dredging project will not include the construction of a new facility, nor expansion of an existing facility for the treatment, incineration, disposal or recycling of hazardous waste. As such, the City is currently waiting for a response from IAAC to confirm if the IAA will apply. Timelines for review and approval will be determined following further consultation with IAAC, and are unknown at this time due to recent changes to the act and revised data requirements under the IAA.

4.3 Indigenous Nations and Peoples

Indigenous Nations and Peoples engagement is a requirement of formal permitting for the DFO *Fisheries Act* Authorization, MECP SAR Permitting and Archeological Assessments per the Ministry of Heritage, Sport, Tourism, and Culture Industries. The City will fulfill its obligations for these permits accordingly.

4.4 Planned Consultation

The City proposes further consultation as outlined in the draft Framework Study. Further, several of the recommendations include study processes which will also require formal public input. Details on the foregoing are offered in the following:

Framework:

The recommendations outlined in the Framework Study represent a diverse set of policies, projects, and programs which will require multi stakeholder input, feedback, and contributions to be successful. This stakeholder involvement will range from public input to the EA process and public interaction with the various programs and projects, multiple agency approvals, and joint project partnerships such as those with the MTO or RBG, and others.

The Framework Study has recommended that a Chedoke Creek Advisory Committee or equivalent be formed consisting of representatives from the Stakeholders listed in Section 4.1 and others as deemed appropriate, representatives of City Council, and representatives from key City departments.

It is anticipated that the Chedoke Creek Advisory Committee will be chaired by City Staff and will have a "working" mandate of:

- Confirming the Watershed Management Objectives and establishing the Performance and Monitoring Objectives
- Establishing the Monitoring Program requirements
- Reviewing and commenting on proposed Policies and Study Recommendations
- Monitoring the Chedoke Creek Water Quality Strategy progress and reporting to Council on a semi-annual basis
- Leading public outreach efforts

Further, it is anticipated that the Chedoke Creek Advisory Committee or equivalent will serve to streamline public and stakeholder engagement needed to support the implementation of the framework recommendations.

Future Studies:

Two notable recommendations of the draft Framework Study call for Master Planning studies to be conducted as Class Environmental Assessments – Lower Chedoke Master EA Study and Chedoke Watershed Stormwater Retrofit Master EA Study. As part of the execution of these studies explicitly, public stakeholders and others will have a formal opportunity to provide input at strategic points in the respective studies. The input will be able to further guide development of the problem statement, elaborate on the assessment approach and the various alternatives under consideration, leading to the recommended set of preferred solutions.

In addition, several recommendations are based on current or ongoing studies which also have public engagement, hence will be expected to provide further opportunities for the public and others to offer insights, including: Flooding and Drainage Master Servicing Study and the Water/ Wastewater/ Stormwater Master Plan.

5.0 Summary of Recommendations for Spill Off-Set

5.1 Methodology for Quantification

The following approach outlines the nutrient loading and source contribution assessment components of the investigation, highlighting the means to quantify the benefits of the unplanned works currently being considered.

The benefits from the available remediation and mitigation projects will need to be quantified and selected to meet the requirements of the Order using the methodology premised on the equation below:

$$P_R = P_S - P_D$$

Where:

P_R = Total TP mass reduction required from additional remediation or mitigation in Cootes Paradise or further downstream

P_S = Total TP mass from discharge event (2014 to 2018)

P_D = Total TP mass removal from targeted dredging and small off-set works in Chedoke Creek

The proposed potential projects providing the additional **P_R** TP mass are detailed in Section 5.2. As noted earlier, these projects generally come in two forms, those that address load reductions, either indirectly through in-water projects (Type A) or directly by treatment or removal (Type B), and those that improve water quality by reducing the loading of contaminants to Cootes Paradise and beyond (Type C). Projects that remove TP load to the receiving water can be calculated directly from the associated mass reduction. Other projects that prevent the release of TP can also be assigned a direct load reduction. Therefore, projects such as wetland restoration, aeration and stream naturalization will have indirect TP reduction which can be determined on a case-by-case basis. On this basis **P_R** TP mass will be made up of the following:

- Resident projects in Cootes Paradise (and possibly the Western Harbour) which result in an increase in TP assimilation annually (Type A)
- Projects in Cootes Paradise and the Western Harbour that inactivate or remove TP – one-time removals (Type B)
- Projects which reduce TP loading from runoff based on existing conditions in the watershed from point and non-point sources annually (Type C)

The **P_R** TP mass is a “to be determined estimate”, premised on field work and analysis associated with the targeted dredging. Based on consultation with MECP over the Order period and likely future consultation with stakeholders, notably RBG and HHRAP, it is considered appropriate to introduce a factor which accounts for potential loss of effectiveness over time, and /or a redundancy amount to ensure that the benefits accrued to Cootes Paradise and the Western Harbour remain positive and go beyond a one-to-one off-set amount. The amount of this factor (+50%, +100%) will need to be discussed with MECP through consultation on the current document and can then be reflected in the Cootes Paradise Workplan.

An example **P_R**, calculated using the three types of TP removal, is included in **Table 5.1**. Project load reductions are hypothetical totals for all projects within each TP Removal Type. Additional project types discussed in this report (and others) will be included in the evaluation for the Workplan, premised on feedback from MECP on this methodology.

Table 5.1. Example of Total Phosphorus Removals

Project	TP Removal Type	Performance Unit	TP Removed per Unit	P _R by Project (kg)
Floating Vegetated Mats	A	Tonnes harvested	1 kg*	100
Sediment Nutrient Inactivation	B	kg bioavailable P treated	1 kg	500
Stormwater Treatment	C	kg P load reduction	1 kg	200
			Total	800

*Value from approximate dry weight percentage of TP mass from cattails (*Typha*, spp.) reported by Grossmans', et al., 2014²

5.2 Planned Works

As noted in the introduction (ref. Section 1), planned works (ref. **Table 5.2**) represent those normal operations and maintenance programs and infrastructure renewals, that are either already underway or scheduled/programmed to occur; these include:

Table 5.2. Planned Works per Framework Study

Type	#	Project	Lead/Process
Near-Term Capital	1	Highway 403 Trunk Sewer Twinning	City
	2	Chedoke Creek Targeted Removal (First Part of Order)	
Long-Term Capital	3	Inlet Controls in Combined Sewer Areas	City - via Flooding and Drainage Master Servicing Study
		Sewer Separation	
	4	Expand Storage Elsewhere in System	City - via Water/Wastewater/ Stormwater Master Plan
		Increase Capacity Downstream of Main-King CSO Tank	
Near-Term O&M	5	CSO Monitoring Improvements and Active Management	City
	6	Inspection and Repair – Facilities	
		Inspection and Repair – Trunk Sewers	
	7	Cross Connection Program	
	8	Wet Weather Flow in Separated Sewers –Targeted in Chedoke Watershed and broader Main-King Catchment	City - Initiate Inflow & Infiltration Monitoring
Long-Term O&M	9	Water Quality Program Management and Monitoring	City
Policy and Engagement	10	Stormwater User Rate/ Low Impact Development Best Management Practices Policy	City

² Grossmans, R., Grieger, R., Ackerman, J., Gauthier, S., Swystun, K., Gass, P., Roy D., 2014. Cattail Biomass in a Watershed-Based Bioeconomy: Commercial-scale harvesting and processing for nutrient capture, biocarbon and high-value bioproducts. Published by the International Institute for Sustainable Development.

While the foregoing projects are considered to provide positive benefits to the Chedoke Creek and its receivers, Cootes Paradise and Western Harbour, given that they are either underway or currently being planned, MECP has suggested that it is not considered appropriate to align these with required offsetting works associated with mitigation of the discharge event. Notwithstanding, it remains important to understand that these works contribute to the health of the overall ecosystem and in many cases represent a significant investment by the City of Hamilton.

5.3 Unplanned Works

Unplanned works, or those deemed to potentially provide “added value” and benefits to the ecology and health of Cootes Paradise and the Western Harbour, represent activities that are not currently planned or programmed by the City or other stakeholders (e.g.; MTO) through any current initiative; these new activities include:

Table 5.3. Unplanned Works per Framework Study

Type	#	Project	Lead	
Near-Term Capital	1	Rehabilitate existing Highway 403 Culvert (Landfill)	MTO	
	2	Highway 403 Water Quality Improvements		
	3	Leachate Collection System Monitoring & Data Collection	City - Additional data required before any capital works	
	4	Aeration System (Major)	Based on RBG's 25yr Master Plan	City - via Lower Chedoke Master EA Study
		Constructed Wetland		
Stream Naturalization				
Restore Delta at Mouth of Chedoke Creek Other Remediation and Mitigation Works				
5	Retrofits Throughout Watershed	City via Chedoke Watershed Stormwater Retrofit Master EA Study		
Long-Term Capital	6	Golf Course – Stream Naturalization	City	
	7	Expand/Fix Leachate Collection System (dependant of findings of item 3)		
	8	Lower Chedoke Master EA Capital Works	City – Scope conditional on the outcomes of each EA	
	9	Chedoke Watershed Stormwater Retrofit Master EA Capital Works		
Near-Term O&M	10	Golf Course – Runoff Management	City	
Long-Term O&M	11	Enhanced Salt Management – Highway 403	MTO	
	12	City Street Management – Enhanced Street Sweeping and Snow/Salt Management	City - Develop and Initiate Program	
Policy and Engagement	13	Engage Residents, Stakeholders, and City	City	
	14	Redevelopment Sites - Stormwater Management Policy	City - Develop Policy & Implement through Future Projects	
	15	Retrofits for Road Rehabilitation Projects / Low Impact Development Best Management Practices Policy		
	16	Wet Weather Flow in Separated Sewers – Policy / Future Infrastructure Projects		

The Master Planning Environmental Assessment (EA) studies, specifically the studies supporting unplanned item numbers 4 and 5 above, will involve a detailed environmental, social and economic assessment of opportunities to improve water quality and habitat conditions, in compliance with the *Environmental Assessment Act*. The alternatives identified in the respective EA studies, will be evaluated through fieldwork, analysis (modelling) and agency/stakeholder/Indigenous engagement. This will ultimately lead to a set of preferred projects, including implementation guidance associated with timing, capital budgets, and design requirements.

Beyond those unplanned projects listed in Table 5.3, through the Order and review of various mitigation practices, the following other projects, directly focused on spill mitigation in Cootes Paradise and the Western Harbour, have been identified:

- Large Scale Vegetative mats
- Dredging in Princess Point Embayment and beyond
- Sediment Nutrient Inactivation

To further assist MECP in its review of these unplanned projects, the City has categorized them associated with the form of nutrient offset expected through their implementation based on the methodology described in Section 5.1, including:

- Resident projects in Cootes Paradise (and possibly the Western Harbour) which will result in an increase in TP assimilation annually (Type A)
- Projects in Cootes Paradise and the Western Harbour that inactivate or remove TP – one-time removals (Type B)
- Projects which reduce TP loading from runoff based on existing conditions in the watershed from point and non-point sources annually (Type C)

Using these categories, and building upon the findings from the field work and analysis outlined in the Chedoke Creek Workplan, the scope of offsetting works will be able to be defined, with due consideration of an appropriate redundancy factor. The following provides a summary of categorization of the works under consideration:

Resident Projects (annual removal) – Type A

- Large Scale Vegetative mats
- Outcomes from Lower Chedoke Master EA Study

Resident Projects (one-time removal) – Type B

- Dredging in Princess Point Embayment and beyond
- Sediment Nutrient Inactivation

Watershed Projects (point/non-point annual removals) – Type C

- Rehabilitate existing Highway 403 Culvert (Landfill)
- Highway 403 Water Quality Improvements
- Outcomes from Chedoke Watershed Stormwater Retrofit Master EA Study
- Outcomes from Leachate Collection System Monitoring & Data Collection
- Golf Course – Runoff Management
- Enhanced Salt Management – Highway 403
- City Street Management – Enhanced Street Sweeping and Snow/Salt Management
- Outcomes from application of Redevelopment Sites - Stormwater Management Policy
- Outcomes from application of Retrofits for Road Rehabilitation Projects / Low Impact Development Best Management Practices Policy
- Outcomes from application of Wet Weather Flow in Separated Sewers – Policy / Future Infrastructure Projects

6.0 Monitoring Plan

6.1 Chedoke Creek Watershed Management Objectives

The Order (ref. Item 10 iii), requires that a monitoring plan be developed to collect information on the efficacy of the proposed works to benefit Cootes Paradise and the Western Harbour. The monitoring data will offer insights into the need for any adaptive management to ensure the recovery and effectiveness of the mitigative works are realized to offset the added nutrient loading to Cootes Paradise and the Western Hamilton Harbour Area. Anthropogenic influences to Cootes Paradise are expected to continue, particularly contributions from Chedoke Creek.

The following performance and monitoring indicators from the draft Framework Study, currently submitted for consideration regarding the Chedoke Creek Watershed Management Objectives (CCWMO), have been established in accordance with the preliminary vision, to provide a method to measure progress over time and determine if the management objectives are being achieved. Quantitative targets for the CCWMO have not been established; however, a preliminary qualitative list of potential Performance and Monitoring Indicators that the City and Stakeholders may wish to consider is provided as follows:

- Water Quality concentrations in annual, peak and low flow events
- Number of annual overflow events
- Percent of contributions from CSO
- Percent of urban runoff receiving treatment
- Percent of leachate captured at the Landfill
- Percent of the creek that is naturalized

Following the adoption of the Framework's Vision and Objectives, the City and respective stakeholders will need to identify the Targets, Performance and Monitoring Indicators that will be used to track progress. Additional studies, assessment, and consultation will be needed to establish these Targets, Performance and Monitoring Indicators. This may be in the form of an annual report, where both technical and non-technical elements are highlighted.

6.2 Natural Environment and Effectiveness for Cootes Paradise and Western Harbour

Implementation and effectiveness of the remediation activities specifically for Cootes Paradise and the Western Harbour will be determined by confirming that the remediation measures have been constructed as per the approved plans and are functioning as intended, using the criteria and guidance developed in associated with the MECP, through the response to the Order. In general, the monitoring and evaluation of conditions compared to these criteria will demonstrate overall habitat quality improvement based on improved water quality, reduced sediment contamination concentrations and an improved benthic fauna community. These components will realize improvement at different temporal scales, with the sediment contamination expected to be nearly immediate, concurrent with the dredging and potential chemical inactivation activities. Changes to the sediment quality will support changes to the benthic invertebrate community that will require several years to establish. As such, a series of post-remediation monitoring studies are likely to be required for measurement and confirmation of the remediation activities' effectiveness. The following provides a conceptual monitoring framework for some of the candidate off-set works within the Princess Point embayment of Cootes Paradise, that are ultimately intended to improve water quality flowing downstream to Cootes Paradise and the Western Harbour. A more fulsome and comprehensive monitoring strategy will be provided as part of the workplan for Cootes Paradise and the Western Harbour, once MECP has reviewed this report, and the scope of remediation and mitigation is better defined; the monitoring approach outlined in the following is hence illustrative only at this stage.

6.2.1 Large Scale Vegetative Mats

Floating vegetative mats, also known as floating treatment wetlands (FTWs), have been used to manage and remove excess nutrients and metals from surface waters under a variety of conditions. The plants used for FTWs accumulate and store nutrients within their tissues, which can be mechanically removed from the area thereby improving surface water quality. The amount of uptake and storage of nutrients and metals is dependent on the plant species, and species selection for the Cootes Paradise application can be determined during detailed design. Studies show the shoots accumulate more nutrients and metals than the roots, as such, the target harvest material may be the shoots growing 5 centimeters (cm) above the surface of water. Monitoring implementation and effectiveness of the FTWs can be completed on a thrice annual basis using the periodicity and success criteria as provided in **Table 6.1**.

Table 6.1. Vegetative Mats Monitoring, Success Criteria and Contingency Summary

Monitoring Period	Success Criteria	Action / Contingency
Immediately post-construction (assume Spring installation)	Vegetative mats have been constructed and placed as per the approved design drawings: <ul style="list-style-type: none"> • Appropriate size • Correct plant species • Anchors and placement within specified location and total water depth(s). 	As-constructed survey results provided in a report to document existing conditions and identify non-conformance relative to approved design. Corrective actions to be completed as per discussion with MECP.
Summer post-construction	Inspection of vegetative mats to confirm performance: <ul style="list-style-type: none"> • 80% or greater of planted species are showing new growth and increased biomass • Constructed mats are remaining in-place, anchors are performing as expected and structural maintenance is not required. 	Assessment report to document existing conditions and non-conformance with success criteria including photos of each mat from consistent vantage points taken during the as-constructed surveys. Corrective actions to be completed as per discussion with MECP.
Fall post-construction (end of growing season)	Inspection of vegetative mats and removal of plant tissue for analysis: <ul style="list-style-type: none"> • Constructed mats are remaining in-place, anchors are performing as expected and structural maintenance is not required. • Removal of shoots for laboratory analysis of nutrients and metals to help quantify total removal quantities. 	Assessment report to document existing conditions and non-conformance with success criteria including photos of each mat from consistent vantage points taken during the as-constructed surveys. The report will also document total vegetation mass removed and laboratory analysis results. Corrective actions to be completed as per discussion with MECP.

6.2.2 Dredging in Princess Point Embayment and beyond

Targeted dredging will remove contaminated sediment from the Princess Point embayment and areas potentially beyond (within selected portions of Cootes Paradise). These removals will improve sediment quality and are likely to improve the benthic invertebrate community. Benthic invertebrate community surveys can facilitate assessment of the biological response to dredging, with colonization of the dredged areas to occur during several years post-remediation. The following conceptual monitoring and success criteria may be used to assess implementation and effectiveness of this off-set measure (ref. **Table 6.2.**)

Table 6.2. Targeted Dredging Monitoring, Success Criteria and Contingency Summary

Monitoring Period	Success Criteria	Action / Contingency
Immediately post-construction (sediment removal)	Bathymetric and/or topographic surveys conducted to demonstrate physical remediation was completed appropriately and total removal volume align with the approved design drawings: <ul style="list-style-type: none"> • Correct locations dredged. • Expected total water depth(s) achieved. 	As-constructed survey results provided in a report to document existing conditions and identify non-conformance relative to approved design. Corrective actions to be completed as per discussion with MECP.
Years 1, 3 and 5 post-construction	Inspection of dredge areas: <ul style="list-style-type: none"> • Bathymetric and/or topographic surveys conducted for comparison to as-constructed and previous monitoring event(s) measurements. • Sediment quality sampling of the bioactive layer (top 10 cm) for chemical laboratory analysis confirming contaminants of concern are less than pre-construction values. • Benthic invertebrate community surveys within the targeted dredge areas show increased taxa richness, density and diversity relative to pre-construction values. 	Assessment report to document existing conditions and non-conformance with success criteria. Corrective actions to be completed as per discussion with MECP.

6.2.3 Sediment Nutrient Inactivation








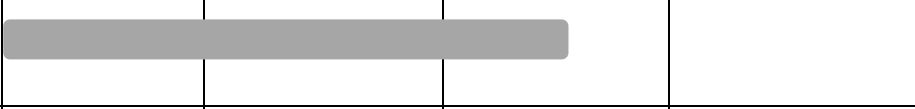
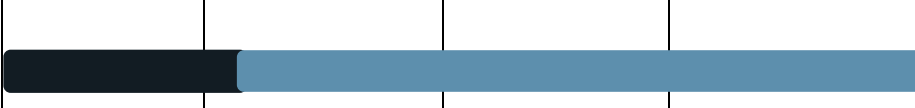

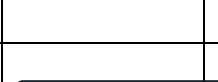
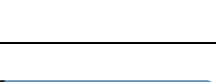







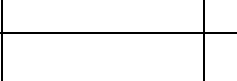
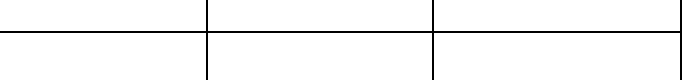
Sediment nutrient inactivation may be used to remove contaminated sediment from within the Princess Point embayment and areas potentially beyond (within Cootes Paradise). The nutrient inactivation would improve sediment quality and is likely to improve the benthic invertebrate community. Benthic invertebrate community surveys can facilitate assessment of the biological response to nutrient inactivation, with colonization of the treatment areas to occur during several years post-remediation. The following conceptual monitoring and success criteria may be used to assess implementation and effectiveness of this offset measure (ref. **Table 6.3.**)

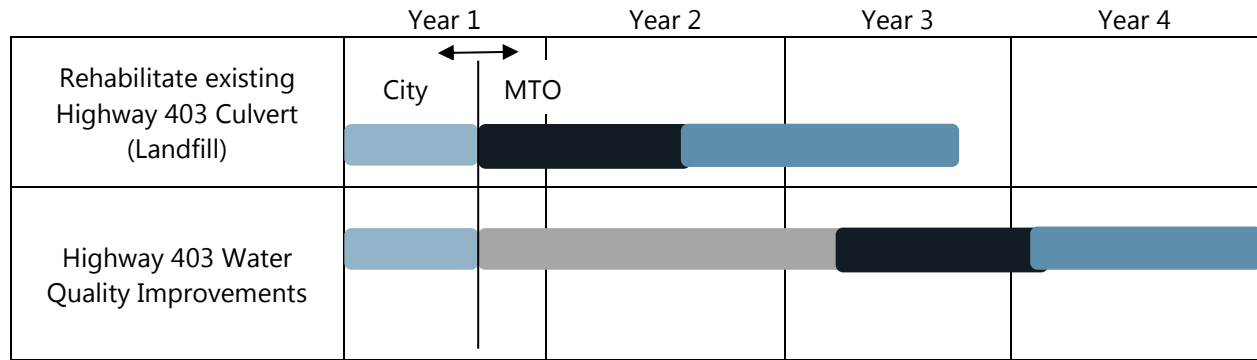
Table 6.3. Sediment Nutrient Inactivation Monitoring, Success Criteria and Contingency Summary

Monitoring Period	Success Criteria	Action / Contingency
Years 1, 3 and 5 post-construction	Inspection of nutrient inactivation treatment areas: <ul style="list-style-type: none"> • Sediment quality sampling of the bioactive layer (top 10 cm) for chemical laboratory analysis confirming nutrient concentrations are less than pre-construction values. • Benthic invertebrate community surveys within the treatment areas show increased taxa richness, density and diversity relative to pre-construction values. 	Assessment report to document existing conditions and non-conformance with success criteria. Corrective actions to be completed as per discussion with MECP.

7.0 Schedule

The estimated timelines to implement the unplanned near-term remediation and mitigation measures, as well as others currently under consideration, is shown in the schedule below. The selected initiatives are those that are considered to have direct applicability toward satisfying the second part of the Order.

	Year 1	Year 2	Year 3	Year 4
Lower Chedoke Master EA Study*				
Chedoke Watershed Stormwater Retrofit Master EA Study**				
Large Scale Vegetative mats ***				
Dredging in Princess Point Embayment and beyond ***				
Sediment Nutrient Inactivation ***				
Golf Course – Runoff Management				
Leachate Collection System Monitoring & Data Collecting				
Redevelopment Sites - Stormwater Management Policy				
Retrofits for Road Rehabilitation Projects / Low Impact Development Best Management Practices Policy				
Wet Weather Flow in Separated Sewers – Policy / Future Infrastructure Projects				



* Implementation of first recommendations – will be a medium-term ~5-year plan

** Implementation of first recommendations – will be a long-term ~20-year plan

*** Dependent on findings and analysis related to Chedoke Creek Workplan



8.0 Next Steps

Following the review of the Cootes Paradise Report by MECP, the City will update the report and use the input and early findings from the Chedoke Creek Workplan, to prepare the Cootes Paradise Workplan, per Order requirement #10. This work plan will be issued to the MECP no later than 6 weeks following the approval of the Cootes Paradise Report by MECP and will contain the following:

- i. A detailed workplan and timeline for carrying out the approved remediation/mitigation options within the Cootes Paradise/Western Hamilton Harbour Area; ;*
- ii. Calculations referred to in Item 9 iv) and v) of the Order (offset calculation) or as otherwise approved; and;*
- iii. Proposed follow-up monitoring required to ensure the recovery and effectiveness of the remediation plan.*

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APPENDIX A: Director's Order #1 - PE3L3



APPENDIX B: Order Consultation Summary

APPENDIX C: Framework Consultation Summary