8. Monitoring and Adaptive Environmental Management

The SWP Vision is to create a system of greenspaces along the Lake Ontario shoreline which respect and protect the significant natural and cultural features of the Bluffs, enhance the terrestrial and aquatic habitat, and provide a safe and enjoyable waterfront experience. Based on this Vision, a series of Alternative SWP configurations were considered (**Chapter 5**). The Preferred Alternative was selected based on its ability to best achieve SWP Objectives and is detailed in **Chapter 6** and assessed in **Chapter 7**. The monitoring and adaptive environmental management (AEM) process presented in this chapter will ensure that the ecological system modified and enhanced by the SWP is maintained through a set of performance indicators[1] to be developed during Detailed Design.

The monitoring and AEM process presented in this chapter, coupled with the EA amendment mechanism presented in **Chapter 9**, provides a framework from which designers and project managers can use the flexibility built into the EA to maximize SWP benefits and minimize any potential negative effects (see **Chapter 7**) after this EA has been approved. The monitoring and AEM process will be managed by TRCA with input from other SWP Stakeholders, where appropriate.

Section 8.1 describes the monitoring program that informs both the Detailed Design process and the AEM process for the SWP to ensure that the Project Objectives (defined in **Chapter 1**) are achieved. **Section 8.2** describes the AEM process as it relates to the SWP.

8.1 SWP Monitoring Program

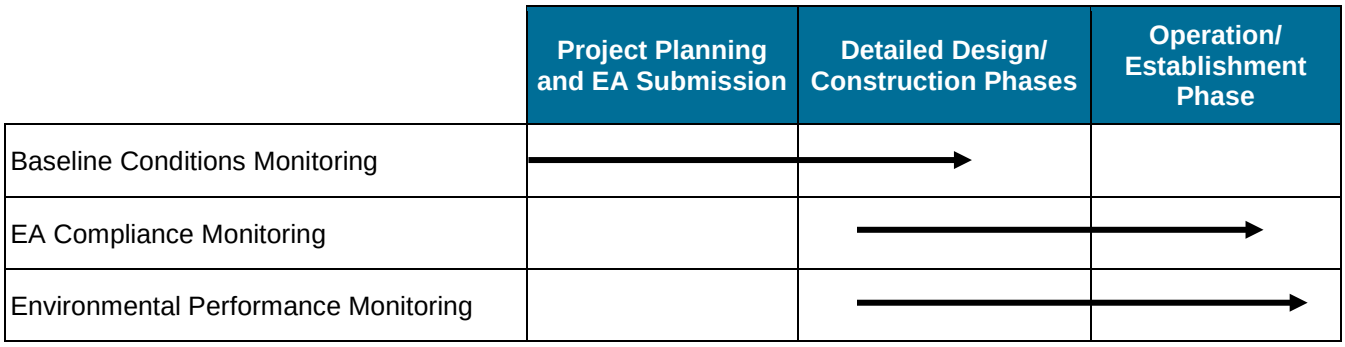
A comprehensive monitoring program is a critical element of the SWP from the pre-design phase through to the operation/establishment phase. The monitoring program serves several functions throughout the life of the SWP:

1. **Baseline conditions monitoring** during the pre-design and design phases will continue to provide data that will inform Detailed Design elements and identify changes to the existing environment that may affect SWP outcomes. Any changes identified through pre-design and design phase monitoring can be incorporated into the Detailed Design and can inform the potential need for EA amendments, if necessary (**Chapter 9** presents an EA amendment process for the SWP);
2. **EA compliance monitoring** will ensure compliance with EA commitments. This monitoring information will be used to inform the AEM process (see **Section 8.2**). The AEM process will begin once the SWP is constructed (up to this point any SWP changes are design-related and will be subject to the amendment process described in **Chapter 9**, if applicable); and,
3. **Environmental performance monitoring** will measure if the SWP functions as intended during the operation/establishment phase.

1. ***Performance Indicators*** *will be developed for the SWP through the Detailed Design process to measure the environmental performance (see* ***Section 8.1.3****). Performance Indicators relate to the functional ecological attributes of the naturalized system. Performance Indicators will be developed based on the monitoring of reference wetlands, baseline monitoring and ecological models.*

A standardized data collection protocol will be established for the monitoring program to ensure consistency. The specific data that is collected will depend on the current phase of the SWP so the type of data collected will evolve as the SWP progresses. **Figure 8-1** shows the relationship between the different monitoring phases and the SWP phases.

Figure 8-1: Relationship Between Monitoring Phases and SWP Implementation



8.1.1 Baseline Conditions Monitoring

TRCA and other agencies have been monitoring ecological conditions in Lake Ontario for decades, providing a baseline of existing conditions (see **Chapter 3**) which has informed the planning of the SWP. Continuous baseline conditions monitoring allows the Project Team to identify ecological changes that may occur between EA approval and Project implementation, and the changes that may occur throughout the life of the SWP as external influences exert their pressure on the shoreline protection structures, including the beaches, coastal shorelines and upland areas.

The baseline conditions monitoring will continue, as required, throughout the period between EA approval and Detailed Design to ensure that the most up-to-date and relevant information is used to develop the Detailed Design for the SWP.

8.1.2 EA Compliance Monitoring

EA compliance monitoring is a standard condition of approval for most projects subject to the *EA Act* in Ontario. The purpose of EA compliance monitoring is to ensure compliance with all EA and other commitments made during Project planning and ensure that the SWP is constructed and operates as described within the range of predicted effects.

EA compliance monitoring will take place during the Detailed Design and construction period for the SWP. EA compliance monitoring will ensure adequate environmental protection through the construction period, document compliance with the EA, and monitor the implementation of the approved design using standard BMPs for construction.

The EA compliance monitoring program will be managed by TRCA. A detailed compliance monitoring plan will be developed as part of the overall environmental management plan to guide compliance monitoring during the construction phase.

EA compliance monitoring will address the issues and potential effects such as:

- Ensure compliance with all federal, provincial and municipal permits, licenses and approvals (e.g., noise by-laws, tree removal by-laws, etc.); and,
- Ensure compliance with all commitments made in the EA, including the implementation of mitigative measures as identified in the EA.

Table 8-1 provides a summary of commitments resulting from the SWP EA which will be the basis for compliance monitoring.

EA compliance monitoring will continue until final grading of individual phases is completed. Once final grading is complete, the environmental performance monitoring program (see **Section 8.1.3**) will begin and continue, as required, through the life of the Project.

8.1.3 Environmental Performance Monitoring

The purpose of environmental performance monitoring is to measure desired outcomes related to naturalization and shoreline stability; determine if they have been achieved; trigger adaptive measures where necessary; and inform the refinement of the as-built features.

Environmental performance monitoring will commence at the completion of SWP construction, following final grading and as-built documentation. **Table 8-2** provides examples of environmental performance monitoring that could be conducted for biophysical components of the SWP. The specific details and measures to be included in the environmental performance monitoring program for the SWP will be developed through the Detailed Design and construction phases.

Existing monitoring frameworks provide examples of performance monitoring that could be adapted specifically for the SWP. These existing monitoring frameworks will be augmented with additional performance indicators if required that address ecological and social aspects of SWP Objectives. Monitoring results will be compared against the performance indicators developed during Detailed Design. The comparison of performance indicators against monitoring results is the key driver of the AEM process described in **Section 8.2**. Monitoring results are compared to performance indicators to determine if AEM measures are required to achieve desired outcomes.

Table 8-1: Summary of Commitments Resulting from the SWP EA

Timing	EA Commitment	EA Report Reference
Detailed Design	Ensure minimum habitat recommendations are either maintained or enhanced as refinements are made through the Detailed Design process.	Section 6.2.2
	Establish site-level details and specific habitat components for terrestrial habitat features.	Section 6.2.2
	Develop aquatic habitat compensation plan and mitigation in consultation with DFO and MNRF.	Section 7.3.1
	Establish site-level details for aquatic habitat features along the newly created shoreline.	Section 6.2.2
	Explore options to mitigate traffic effects during construction on the Guildwood and Brimley Road communities.	Section 7.3.4
	Develop a fill tracking system to account for and audit all fill coming into the site.	Section 6.5
	Establish specific triggers for potential adjustments, refinements or modifications that could occur as part of the adaptive management program.	Section 8.2
	Undertake a Revitalization Plan for Bluffer's Park and East Point Park in co-ordination with the City of Toronto.	Section 7.3.3
	Develop an Operations and Maintenance Plan for the SWP in co-ordination with the City of Toronto.	Section 6.3
	Undertake an updated Traffic Impact Assessment.	Section 7.3
	Continue to engage with the surfing community regarding the Detailed Designs for the West Segment.	Section 7.3.3 and Section 10.9
	Undertake the HEAT model on the final Detailed Designs.	Section 7.3.1
	Assess effects to the cultural meadow on the industrial property east of Grey Abbey Ravine.	Section 7.3.1
	Undertake appropriate archaeological recordings of marine resources S76 and S56, as recommended by the marine archaeologist as part of the mitigation measures.	Section 7.3.4
	Ensure detailed engineering design takes into account extreme weather events.	Section 6.1.7
	On-going consultation with Stakeholders throughout the Detailed Design period.	Section 10.9
	Commitment to discussions with Rohm and Haas Canada LP/Dow Chemical Company to address safety concerns east of Grey Abbey Ravine.	Section 10.9
	On-going consultation with Stakeholders in the East Segment throughout the Detailed Design period, with respect to refinements.	Section 10.9
Construction	Develop tree removal (include plant salvage and relocation) and compensation/restoration plan.	Section 7.3.1
	Monitoring of environmental site controls and mitigation measures during construction.	Section 6.5
	Obtain all relevant municipal, provincial, federal and/or regional occupancy permits.	Section 6.5
	Retain a dedicated community liaison staff as a direct line of contact between the local communities and the Project Team.	Section 7.3.4
	On-going consultation with Stakeholders throughout the construction period.	Section 10.9
Operation/ Establishment	Monitor environmental performance to measure desired outcomes; determine if they have been achieved; and trigger adaptive management where necessary.	Section 8.1.3

Table 8-2: Examples of Environmental Performance Monitoring for Ecological Components of the SWP

Biophysical Component	Environmental Performance Monitoring
Habitat and Species	▪ Identify trends of habitat and species targets through the post-establishment phase ▪ Evaluate habitat and species against intended outcomes and functions
Beach and Shoreline Stability	▪ Evaluate whether beach materials are performing as intended by providing a dynamically stable shoreline ▪ Evaluate whether the hardened nodes are performing as intended by anchoring the dynamic beach system and are remaining stable over a range of coastal conditions
Wave Parameters, Circulation and Sediment Transport and Lake Levels	▪ Document changes in wave parameters, circulation, sediment transport and lake levels over time to inform the need for management adjustments to shorelines

8.2 Adaptive Environmental Management

To ensure that the Preferred Alternative, as presented in **Chapter 6**, functions as desired, an approach to ongoing management is required to continually fine tune SWP components and ensure long-term SWP success. AEM provides a clear process for ongoing management of the SWP to ensure SWP Objectives continue to be achieved through positive feedback mechanisms.

8.2.1 What is Adaptive Environmental Management?

The Canadian Environmental Assessment Agency defines AEM as a systematic process for continually improving environmental management practices by learning about their outcomes and applying that knowledge to improve the outcome. AEM allows for flexibility in project management so modifications and refinements can be incorporated throughout the Project life cycle. AEM is fundamentally a way of incorporating learning through monitoring into a feedback loop that enhances Project outcomes. Undesirable environmental effects are identified early so that management interventions can be implemented promptly to avoid major problems before they occur and to maximize fulfillment of the SWP Objectives.

8.2.2 AEM Strategy for the SWP

The outcome of projects involving extensive habitat restoration and/or enhancement depends on the interaction between the biological components (habitat), the underlying physical components that are created or modified (terrain, soils, hydrology, and coastal processes which can all be modified by changes in climate), and how people use the project area and the surrounding areas.

An AEM strategy is desired for the SWP for a number of reasons including:

1. The need for a flexible strategy to address ecosystem response to changing environmental conditions and human use stressors during and following SWP construction;

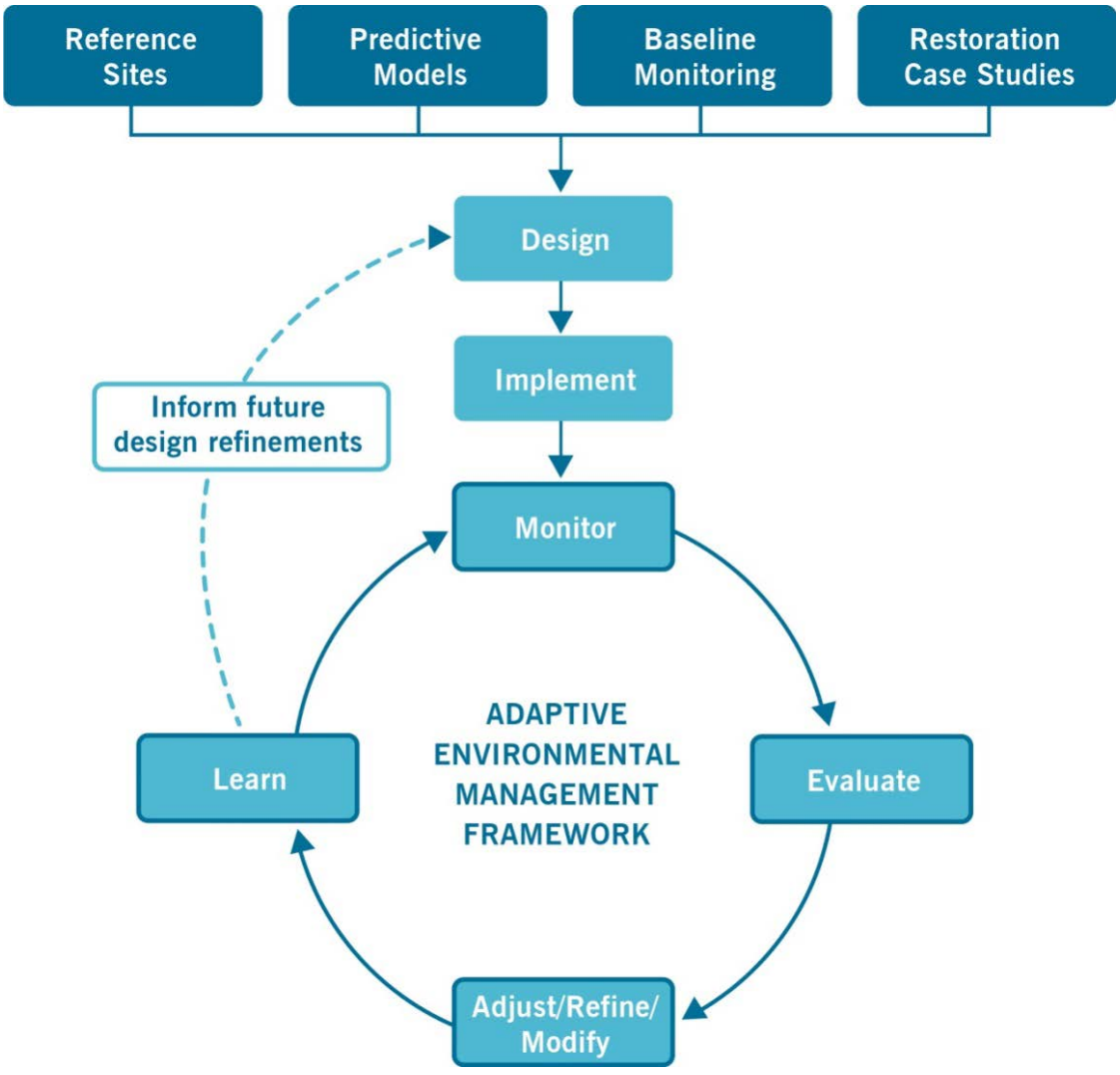
2. The need to create the opportunity to maximize SWP benefits and minimize negative effects throughout the life of the SWP;

3. The need to respond to changes in local weather patterns and long-term climate change that may alter lake water levels and the frequency and duration of inundation of the naturalized features, shoreline features; and/or the severity and frequency of extreme storm events; and,

4. The need to respond to changes or benefits related to future projects and planning initiatives in the SWP Study Area and elsewhere in the Regional Study Area, and to take advantage of enhancements that those projects may provide to this system.

Figure 8-2 outlines the AEM cycle in relation to the pre-design, construction and operation/ establishment phases of the SWP. The AEM cycle will be applied once the SWP is implemented and will inform future projects through a feedback mechanism from lessons learned. AEM is the ongoing cycle of monitoring, evaluation, adaptation and learning.

Figure 8-2: Relationship Between SWP Design and AEM



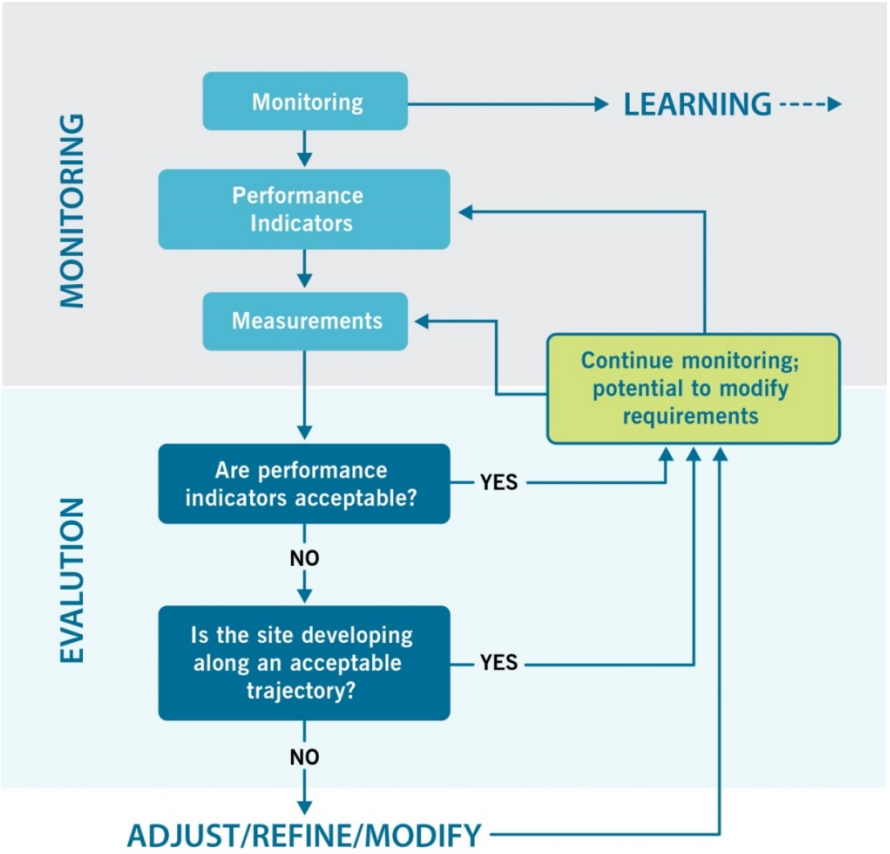
The ability to affect the outcome of the SWP through monitoring and adaptation in response to stochastic events is of paramount importance. The AEM process offers the best process by which to achieve this flexibility. The purpose of AEM and associated monitoring programs is to increase the likelihood of meeting the SWP Vision and Objectives.

8.2.2.1 Monitoring and Evaluation within the SWP AEM Process

Monitoring is a key component of the AEM framework as it establishes conditions pre- and post-construction and allows the determination of which effects are occurring as a result of SWP activities. It identifies environmental changes that are occurring at various spatial scales that may affect SWP outcomes. Monitoring allows for the systematic testing of various systems or actions to assess their ability to achieve a desired function or outcome. The key is to develop an understanding of not only which systems function as intended and which do not, but also which stressors are creating an impact to the system and the reasons for those impacts. The monitoring data that informs the AEM process will be robust and scientifically defensible, providing information that will maximize opportunities to achieve desired outcomes.

The achievement of SWP Objectives is assessed by monitoring the system and evaluating the data against pre-defined performance indicators (see **Section 8.1.3** and **Figure 8-3**). If the desired functions or outcomes are not achieved, the SWP features may need to be adapted. The objective is to maximize benefits wherever possible.

Figure 8-3: Monitoring and Evaluation within the AEM Cycle



The evaluation component of AEM will include specific triggers that will determine when management interventions will be required (see examples in **Table 8-3**). Evaluation of monitoring data provides the foundation for learning from the SWP.

8.2.2.2 Adjustments, Refinements and Modifications within the SWP AEM Process

Adaptation (adjust, refine and/or modify) is about taking action to increase the likelihood of achieving SWP Objectives. The purpose of an AEM strategy is to identify undesirable environmental effects early so management interventions can be implemented to avoid major problems before they occur. The environmental performance monitoring described in **Section 8.1.3** will provide clear evidence of SWP outcomes during the operation/establishment phase. Results from monitoring and evaluation will inform the need for adjustments, refinements or modifications to SWP design or operations. **Table 8-3** provides examples of potential AEM triggers and possible adjustments, refinements, or modifications that could be implemented to address any identified problems. The specific triggers for adjustments, refinements or modifications and the specific management options will be determined during Detailed Design and included in an AEM work plan.

Table 8-3: Potential AEM Triggers and Adaptive Measures for SWP Components

Project Component	Potential AEM Triggers	Potential Adjustments, Refinements or Modifications
Aquatic Habitat and Species	▪ Underperformance of desirable species recruitment to the area ▪ Impairment of habitat features (sedimentation, etc.) that significantly affects performance as intended/designed ▪ Impacts to created habitat and/or wildlife by people and/or pets	▪ Adjust/enhance aquatic habitat features and habitats to promote desired species composition ▪ Expand monitoring to identify root causes of low species recruitment ▪ Repair/re-establish habitat features ▪ Adjust public access to habitat areas, by-law changes, enforcement, etc.
Terrestrial/ Wetland Habitat and Species	▪ Undesired species composition ▪ Recreation/human use causing degradation of habitat ▪ In-adequate species diversity and abundance utilizing habitats as per Project design	▪ Conduct vegetation management (herbicide application, manual removal, re-seeding, etc.) ▪ Revegetate or adjust cover management system to control erosion ▪ Reconfigure/manage human use patterns ▪ Adjust/enhance terrestrial habitats as required to attract desired species or abundance
Shoreline Erosion and Bluff Crest Migration	▪ Failure of revetment, headlands or beaches ▪ Excessive loss of beach material ▪ Stable slope is not being achieved as anticipated	▪ Address shoreline erosion and dynamic beach ▪ Remedial action to address slope crest migration

8.2.2.3 Learning within the SWP AEM Process

One of the greatest benefits of the proposed AEM strategy is that it will allow for ongoing learning related to the outcomes of the SWP and future projects. Learning involves systematically documenting the results of monitoring, evaluation and adaptive measures, and providing lessons

learned to a wide audience. TRCA, academia, other agencies and organizations, and the global urban renewal community will benefit from an improved understanding of effective habitat restoration and enhancement techniques established through the planning and AEM strategy for the SWP. Monitoring programs will determine if predictive models provided accurate information to appropriately inform design. Where monitoring reveals any inaccuracies within the predictive models, adjustments can be made for future designs.

Documentation of the monitoring, evaluation and adaptive measures described in this chapter will be used to inform similar projects that are undertaken in the future.

This cycle of monitoring, evaluation, learning and adaptation will be applied to the SWP to respond to uncertainties and external influences related to the SWP and the environment. Examples of external influences are numerous with a prime example being climate. Climate change is expected to influence management of the SWP into the future. Monitoring the conditions over time following completion of the SWP will allow TRCA to respond to change by implementing appropriate AEM measures.

Further complications may arise as a result of the build out period for the SWP that may extend over a number of years. This may trigger a management response to address changes to the environmental, social or economic context of the SWP.