Executive Summary

The City of Richmond has engaged Kerr Wood Leidal Associates Ltd. (KWL) and a team of sub-consultants to prepare a Water and Ecological Resource Management Strategy. This project will support the Garden City Lands Legacy Landscape Plan (the Plan) by developing strategies to protect, restore and enhance important environmental values.

The Garden City Lands (GCL) is a 136.5 acre parcel owned by the City of Richmond. It is located within and at the eastern edge of Richmond's City Centre at 5555 No. 4 Road. The property boundaries are defined by Alderbridge Way along the north property line, No. 4 Road along the east property line, New Westminster Highway along the south property line, and Garden City Road along the west property line.

The Garden City Lands Legacy Landscape Plan is the guiding document for the GCL site development. The work of this project will develop methods to allow the creation and maintenance of the values and facilities that make up the Legacy Landscape Plan.

Site Assessment and Background Review

This part of the report summarizes the knowledge base of pertinent information available at the start of this project. It looks at the background information and literature available and indicates the basic understanding of the site from the perspective of the several disciplines contributing to this project.

Site Reconnaissance

A site visit was conducted on October 27, 2015. Members of the consulting team were accompanied by City staff from the Parks, Planning and Maintenance Departments. During the site reconnaissance, the GCL appeared to be dry without signs of saturation and surface ponding. Surface growth was freshly mowed to approximately 0.2 to 0.3 m in height across the site. Discussions and observation during the site visit covered topics including: site maintenance, site drainage and flooding, the mound, off-site inflow, the remnant bog, and wildlife and park uses.

Hydrogeological Site Assessment

Geotechnical and hydrological investigations conducted over the past several years have provided a wealth of information on the character, extent and thickness of near-surface native materials underlying the GCL and its immediate vicinity. The soils are characterised by a site-wide surficial layer of peat, averaging about 0.6 m in thickness, overlying about 3 m of overbank silt deposits that, in turn, overlie approximately 10 m to 20 m of fine-to-fine to medium-grained sands. These deeper sands are referred to as the Fraser River Sand, and comprise a regional aquifer beneath the GCL and surrounding lands of Richmond and Delta that is hydraulically connected to the Fraser River. The upper part of the peat is fibrous and relatively permeable, and the water table beneath the GCL occurs very close to ground surface within this layer during the wetter parts of the year. In the drier summer months, the water drops into the underlying silts as water infiltrates downward into the deeper sand aquifer. The general groundwater flow direction in the peat appears to have been historically to the southwest.

Water quality within the peat is acidic, with relatively low concentrations of dissolved solids. This contrasts with the near-neutral minerotrophic water of the underlying sand aquifer and shallow groundwater near and beneath roadways where the peat layer has been removed. Locally, water quality in the peat appears to be influenced by mineral soils deposited for internal roadways or for other purposes.

The detailed hydrostratigraphic information gained through the previous investigations provide a good data set for building the physical features of the seepage and water balance model, and setting boundary conditions, flow characteristics and hydraulic properties for model calibration.

Ecological Site Assessment

The GCL property is located on the western edge of the Lulu Island Bog. This raised bog ecosystem once covered much of Lulu Island (and Richmond), but has now been greatly reduced due to agriculture, drainage and other human use and development. Bog ecosystems are unique and have specific challenges and opportunities associated with restoring them. The Garden City Lands bog is in a degraded condition and cannot be considered to be ecologically functional as a true bog, although it does contain regionally rare bog associated species and is potentially a good candidate for restoration. Although there has been considerable research into some aspects of bog ecology and restoration, there are some areas where the knowledge base is limited. One such area pertains to the lagg, which characterizes much of GCL.

Due to the different hydrological requirements of bog and lagg ecosystems (e.g., hydrochemical, pH, nutrient availability, stable versus fluctuating water table), and the relatively small size of the site, there is potential that they may have to be managed separately (i.e., isolated from one another) on GCL lands to support ecological integrity.

Another potential challenge is integrating agricultural activity and bog conservation on the same site. Many agricultural activities require drainage, which in large part has been responsible for the significant loss and degradation of bog and other wetland ecosystems. In addition, water requirements for agriculture are often highest during the summer, when bogs are particularly vulnerable to water drawdown. Water quality requirements for agricultural crops and bog ecosystems are sufficiently different that both their water inputs and outputs will have to be separated from one another.

The GCL must not be considered an isolated ecosystem, but rather a part of the Lulu Island Bog, which includes the DND lands, and the Richmond Nature Park to the east. Any proposed changes to the hydrology in GCL should consider potential effects to the greater whole.

Bog restoration typically follows a long-term outlook, which must be kept in mind for all decisions on ecological management of the site and nearby areas. For example, the Burns Bog Management Plan in Delta has ***a 100 year time horizon***. Future land use changes, adjacent development, and climate change may create conditions that further affect hydrology and bog/lagg ecosystems many years after development of the GCL.

Agricultural Site Assessment

The soils of the Garden City Lands are mixture of organic (peat) and mineral sols. These have previously been classified as Terric Mesisols and Rego Gleysols: saline and peaty phase. The main limitations are soil structure problems (mixture of peat and mineral soils) and high water tables (wetness).

The peat layer is found throughout the site and is underlain by fine-textured (silty) mineral subsoils. The rooting depth (typically 0 to 20 cm for most crops) is likely comprised of organic materials in varying stages of decomposition throughout.

While there is no history of cultivation on the site, similar soils nearby the GCL are used extensively for berry and vegetable production and with proper management will produce an excellent diversity of crops. Special attention will need to be given to soil management if the peat is retained on site.

Any agricultural use will require some amount of land clearing and the incorporation of some plant vegetation. A list of agricultural activities that are highly or moderately suitable for the site includes:

- Garden vegetables such as root vegetables and green vegetables, corn and grains, and squashes;
- Berries including blueberries, raspberries, strawberries and cranberries;
- Field flowers, honey bees and botanical gardens;
- Hoop houses (small and medium);
- Poultry (very small scale) and large scale compost operations;
- Farm retail sales and agri-tourism as well as storing, packing, preparing, or processing foods;
- Passive uses (biodiversity conservation, wildlife viewing, parks, recreation); and
- Education and research including production and development of biological products used in Integrated Pest Management programs.

Surface Water and Drainage Assessment

The GCL site topography is relatively flat with elevation ranging from 1.5 m to 0.6 m Geodetic. The site gently slopes down from the northeast to the southwest with an average slope of 0.08%. This is with the exception of the mound, which is approximately 2.5 m above ground level and located at the northwest corner of the site. The GCL receives direct precipitation on the site and possibly receives off-site stormwater runoff that inflows to the site along Alderbridge Way. During the wet season, excess site runoff is collected by the south perimeter ditch that drains toward the west to the Garden City Road and toward the east to the No. 4 Road storm sewer system. A series of storm system inlets are located along the western edge of the site. However, the inlets were fully blocked by grass and sediment at the time of the field visit.

Historically, surface ponding has been observed at multiple locations. These topographic depression locations, as listed below, are also visible from the orthophoto due to vegetation changes.

- A large pool along the toe of the Mound.
- Multiple locations around the western edge and the southwest corner of the site.
- An area along the entrance from No. 4 Road.

The storm sewer pipes along Garden City Road and No. 4 Road are located along the edge of the road adjacent to the GCL. The storm sewer along Alderbridge Way is located in the middle of the road section, and the storm sewer along Westminster Highway runs along the South side of the road, not next to the GCL. The two pipes adjacent to the edge of the site will be easier to access either for discharge of water from the site or for accessing stormwater volumes to bring onto the site for irrigation.

A MIKE URBAN model of the City's stormwater system was last updated in 2011 to assess the impacts of the 2041 development horizon for the Official Community Plan. The model identified surface flooding nearby the GCL site at all the major nodes located along Alderbridge Way and Garden City Road, attributable to inadequate capacity in the major storm sewer system for the modeled 10-year, 24-hour storm event. The limited capacity in the storm sewer network on Garden City Road may affect the drainage design for development of the site.

This project presents a number of challenges for surface water and drainage considerations, including:

- Drainage will need to be provided to required elevations both for the bog and natural areas and for the agricultural and community use areas.
- There will be a need to retain water on the site to some minimum levels in order to support the bog and wetland natural areas of the Legacy Landscape Plan.

- Drainage may also be challenging due the very low gradients available in this area.
- There is a question whether the site can sustainably supply some or all of the water needs for on-site water uses with storage and re-use of on-site and/or off-site stormwater.

The source of water that enters the site along the South side of Alderbridge Way is currently unknown and the volume of water will be difficult to estimate for storage or conveyance on GCL. Monitoring will be required to quantify the inflow.

Water Resources Management Plan

This Water Resource Management Plan proposes recommended solutions to balance the water needs of the site and support the goals and features of the Legacy Landscape Plan.

Water Management Options for Bog Conservation

Subsurface and Surface Flow Barriers

It is proposed that a primary subsurface and surface flow barrier and perimeter barrier be constructed all the way around the bog area. A plan showing the berm alignment is provided in Figure 10-2. The barrier should be constructed with an impervious or low permeability material that extends from the bottom of the peat layer into the top of the surface berm. The subsurface portion of the barrier is intended to minimize ground water loss form the bog to the proposed agricultural land to the west, drainage ditch to the south, and utility trenches to the north and east. The surface berm is intended to prevent surface water exchange between the bog and the adjacent land uses. The barrier will enhance the bog hydrology and preserve the water quality desired by a healthy bog ecosystem. Construction options for the subsurface barrier are shown in Figure 10-3.

Fen Wetland

An outlet control structure will be installed at the southwest corner of the GCL, where a seasonal wetland exists. The outlet structure will be elevated above existing ground and provide various levels of control for management of the water level. The prolonged duration (winter into the spring) and extended area of ponding is expected to enhance the bog environment during the dry season. The fen wetland also provides nesting, perching, refuge and foraging habitat for wildlife. Examples of the type of outlet structure required to allow control of the water level in the fen wetland are provided in Figure 10-4. The extent of the wetland will be constrained by the primary and perimeter surface flow barrier berms.

The maximum ponding elevation for the fen is recommended to be 1.7 m. The surface berms should have minimum crest elevations of the higher of:

- 0.3 m above the maximum ponding elevation, or
- 0.3 m above existing ground for the perimeter berms, or
- 0.6 m above existing ground for the primary berm.

Bog Water Supply Option

In addition to the bog water conservation approach, including construction of hydraulic barriers and creation of a fen wetland, additional water supply sources were identified and assessed. Only the option of drawing water across No. 4 Road from the DND lands provides a source of water with the correct water chemistry to support and promote the health of the bog plant species. However, this option requires coordination with Federal Government and DND to negotiate access to the site and to conduct groundwater monitoring as soon as possible to further assess if this would be a viable option.

Agricultural Water Management Options

Agricultural Drainage System Design Recommendations

The agricultural drainage system will require the interconnectivity of several design components. The options for each component are found in Section 11 and the design recommendations are summarized in Table .

Table i: Agricultural Drainage System Design Recommendations Summary

Items		Recommendation
Drain Pipe	Spacing	• Drain tile pipe spacing of should be a maximum of 22 m between pipes.
	Depth	• Drain tile pipe should be installed 1.0 to 1.2 m below final grade. • The drainage outlet, i.e. ditch invert, will be lower than 1.0m deep (i.e. lower than the drain pipes).
	Size and Material	• 100 mm diameter is the standard pipe size for the lateral drains; • 150 mm diameter is required for the collector drain pipe; and • High density polyethylene (HDPE) pipes or rigid plastic pipes should be used in peat soils.
	Grading and Length	• For a 100 mm pipe diameter the minimum grade is 0.10% and the maximum grade is 2.00%. A 0.50% to 1.0% grade is recommended; • Lateral pipes should not exceed 600 m before connecting to a collector pipe or ditch outlet; and • A minimum clearance of 300 mm between the bottom of the drain outlet and the ditch bottom is recommended.
	Other Considerations	• Drain tile pipes should ideally be placed at the base of the peat layer and not be cut into the clay-silt layer below. • The base of the peat layer, and invert of the tile drain pipes at the West edge of the site, should be at approximately 0.0 m elevation. • Significant fill material (up to 0.5 m), will be required at the northwest corner and along the western edge of the site. • Cleanouts at the ends of tiles drains and sumps on the collector pipes could be added to provide access for flushing and capacity for sediment removal.
	Alternatives	• If no drain tile pipes are installed then surface ditches should be spaced approximately 60 m apart and be 1.0m to 2m deep.

Agricultural Drainage System Design Recommendations Summary (*cont.*)

Items		Recommendations
Drainage Ditch	Alignment	• See Figure 11-1.
	Dimensions	• Minimum bottom width 0.6 m. • 4H:1V side slope for safety reasons, 1.5H:1V side slope if needed and approved by geotechnical engineer.
	Invert	• Ditch invert should be 0.3 m below the tile drain pipe outlets, if possible. • Subject to geotechnical investigation, the ditch invert could be cut into clay layer 0.3 m below peat layer (to allow 0.3 m offset from the drain pipe outlet). • Peat depth is thinner on west side of site, about 0.6 to 1.0 m. • If base of peat layer is approximately elevation 0.0 m. The ditch invert along the West side of the site should be at approximately -0.3 m, which would allow connection to the storm sewer at invert elevation of -0.8m.
	Freeboard	• Maintain a minimum of 0.9 m elevation difference between the base flow water levels in the channel and the field surface elevation. This will provide a good outlet for tile drains.
	Slope	• Channel should have minimum slope at 0.5% to promote drainage if possible, but can be reduced to 0% if necessary.
	Outlet	• Flap gate or other device to prevent back flow from the storm sewer system flowing onto the site.
	Alternative	• Alternative to a drainage ditch, pipe could be used to convey the agriculture runoff to the storm sewer.

Irrigation Requirement and Water Sources

Based on data published by the Ministry of Agriculture through the Metro Vancouver Agricultural Water Demand Model (AWDM) and discussions with Kwantlen Polytechnic University, the estimated irrigation water requirement is 3000 m^3 per hectare per year for the GCL agriculture fields.

Table ii: Irrigation Water Sources Summary

Items	Pros	Cons
Groundwater	• Groundwater withdrawal of 3 L/s from up to two wells does not appear to significantly drawdown the water table in the bog area • On-site source of water.	• Possibility of high iron levels in the groundwater, which require treatment and maintenance of the treatment system • Actual pumping yield unknown at this time, would require test well
Rainwater Harvesting	• Sustainable source • Options include open pond and underground storage tank	• Requires significant area for storage • Seasonal availability if full irrigation volume cannot be stored • Limited to on-site rainwater and runoff only due to urban runoff water quality concerns • Surface storage may require filtration before using in drip irrigation system

Irrigation Water Sources Summary (*cont.*)

Items	Pros	Cons
Fraser River Water	• Abundant volumes	• Issues of salinity and timing for drawing water • High infrastructure costs to transport water to the site, possible pumping
Municipal Water	• Due to flexibility, preferred for the short term	• Expensive • Less sustainable for the long-term

The development of agricultural fields will be a long term process due to phased soil amendment and drainage installations. The irrigation volume is expected to increase over time as field acreage is put into production. The final soil mix will affect crop selection and the ultimate irrigation water needs.

Potable water use is recommended in the short term until the irrigation needs are better defined and other irrigation source options can be implemented.

On-Site Stormwater Management

Stormwater BMPs

The constructed portions of the GCL site (building, parking, buildings, other impervious areas), applicable BMPs were selected based on the hydrologic regime, pre-development conditions, and proposed land use.

Table iii: On-site Stormwater BMPs

Items	Applicable BMPs
Community Hub	• Roof water should be drained to cistern/rain barrels and discharge excess to ground. The water collected can be used for irrigation of nearby plantings.
Path, Plaza and Parking Surfaces	• Pervious paving materials rather than impervious concrete or asphalt can reduce the runoff generated from parking areas. Pervious materials may include pavers, reinforced clean crushed gravel, reinforced turf, or engineered permeable pavements. • Oil and grit separators are suitable for spill control and removal of floatable petroleum-based contaminants as well as coarse grit and sediment from small areas such as parking lots, if the parking areas have impervious paved surfaces.
Road Drainage	• See road drainage servicing plan Figure 12-3

Road Drainage

The GCL site development requires modifications to some of the existing road drainage. A road drainage servicing plan is provided in Figure 12-3.

Alderbridge Way and No.4 Road

- Both roads are curbed with catch basins to drain road runoff. The catch basins will remain unchanged.
- Existing storm inspection chambers may remain and be adapted to drain excess runoff from trail areas once the bog area is isolated.

Westminster Highway

- Westbound side of road drains to ditch on GCL site. The ditch remains and should stay on the south side of the perimeter hydraulic flow barrier.

Garden City Road

- Most of the drainage along Garden City Road is intercepted by inlets in the boulevard between the Northbound and Southbound lanes. Road drainage to inlets in the centre median should be maintained.
- Areas of Northbound Garden City Road with turn lanes at road junctions are crowned to drain to the GCL site. New catch basins are required to intercept runoff at these locations.
- The existing storm inspection chambers located along Garden City Road will no longer be needed when the perimeter trail and the agricultural drainage channels are built. These inlets should be closed or disconnected, or adapted to be future catchbasins where needed.

New Storm Drainage Connections

A minimum of two new connections to the storm sewer system are required for the development of the elements of the LLP.

One new storm sewer connection is required to drain the outlet from the bog conservation area. A new storm sewer pipe will be needed to connect the bog outlet structure to the storm sewer pipe on Garden City Road. The 10-year design flow for this connection is 0.8 m^3/s, based on the 10-year, 24-hour event peak runoff for this area according to the City's MIKE Urban drainage model.

The second new storm sewer connection is required to drain the runoff from the farm areas of the GCL site to the storm sewer. This will involve connecting the drainage ditches from the GCL site to either the storm pipe under Garden City Road or to the storm box pipe under Lansdowne Road. It is recommended that the GCL site drainage ditch be connected to the Lansdowne Road storm box pipe, invert -0.853 m. The drainage invert for the ditch on the Western edge of the GCL site is expected to be -0.3 m. The 10-year design flow for this connection is 1.0 m^3/s, based on the 10-year, 24-hour event peak runoff for this area based on the City's MIKE Urban drainage model.

Other Design Considerations

Climate Change

Climate change predictions to the GCL site were made using the regional analysis tool developed by the Pacific Climate Impacts Consortium (PCIC). The model uses 1961-1990 climate data as the baseline condition. The percentage maximum, minimum and mean precipitation departures for the Metro Vancouver region were estimated on an annual and a seasonal basis. The data describing project future climate conditions is provided in Table 12-2. In general, the future modelling conditions for 2020, 2050, and 2080 show a consistent pattern of increased annual total precipitation, and changed seasonal rainfall distribution. Increased winter precipitation suggests increased winter flooding and warmer drier summers suggests increased potential evaporation and transpiration and need for more irrigation water.

Flood Construction Level and Building Elevation

The GCL site has a Flood Construction Level (FCL) of 2.9 m (GSC) however, as the proposed community buildings and facilities are within the ALR, farm buildings other than dwelling units are exempt from the FCL requirement.

If buildings will not be built above the FCL, it is recommended that all the structures are flood-proofed to minimize the damage of short-term flooding which must be expected to occur. In addition, all buildings are recommended to be constructed above the 10-year HGL to avoid the nuisance of frequent flooding. The 10-year HGL along the Western edge of the site on Garden City Road varies from approximately 0.8 m on the Northwest corner to 0.9 m on the Southwest corner. It is recommended that buildings be constructed with a minimum floor elevation of at least 0.3 m above the 10-year HGL, or above 1.2 m elevation.

Survey Elevation and Datum System

The majority of the GCL site is very flat with an average slope of 0.08% from the northeast to the southwest. Low drainage gradient on site and in the downstream stormwater drainage system makes design of infrastructure connections and flooding elevations more sensitive to the accuracy of elevation.

Some elevation data used in this work were not able to be verified to be geodetic. Therefore, it is recommended that all critical elevations be surveyed for design and construction purposes.

Ecological Management Plan

The 2014 Garden City Landscape Legacy Plan envisions restoration of a raised bog/lagg (fen) complex that drains to the southwest corner of the site. Currently the site is indicative of a semi-modified bog with a plant community that has been influenced by its urban setting. Concurrent with the Legacy Plan, a primary goal is to restore this ecosystem back to as natural a state as possible within the limitations of its location.

It is unclear how effective the perimeter hydrological barriers will be at retaining water in the conservation area, which is key to determining if a bog ecosystem can be restored over time. Efforts to restore a functioning bog will take significant resources and are dependent on the effectiveness of the perimeter subsurface hydraulic barriers and surface berms. Adaptive management on site will be important to develop a fuller understanding of the site’s hydrogeology and its influence on plant communities.

Recreation Interface Zone

Areas around the perimeter of GCL have been subject to historical disturbance. This area is proposed to be redeveloped as perimeter berms to support recreational walkways, while at the same time minimizing groundwater and surface flow exchange. Landscaping is proposed as a vegetated buffer between the perimeter road and the conservation areas. These will be linear planted areas that are fragmented by walkways and/or bike lanes. These areas are expected to be raised above the bog and at the level of the adjacent roadways. The ecology is therefore expected to be moderately dry. It is recommended that only native tree and shrub species be planted in these areas.

Remnant Bog Zone

Plant communities found at the eastern edge of the GCL represent the closest plant community to natural bog conditions. This area is currently dominated by invasive species including a high percentage cover of Scotch heather; however, it also supports a number of species that are representative of bog ecosystems. This area has been historically mowed and, as a result, tall shrubs and trees have not established. The long term vision for this area includes establishing a stable shrub dominated plant community with wide-ranging hummocks and mats of sphagnum as well as scattered individual or small groupings of lodgepole pine trees. However, it is unclear based on our current understanding of the hydrological regime what effect the potential management interventions will have on existing vegetation communities or whether the restoration of a stable native bog ecosystem is even possible. The following four vegetation management options are presented with a range of outcomes, arranged in order of increasing cost to implement and manage:

1. No management - allow natural succession
   - Expected outcome: invasive birch/blueberry dominated forest
2. Mowing to maintain a low shrub community
   - Expected outcome: existing low shrub/herb plant community with a high cover of invasive Scotch heather
3. Manage invasive species - manual/mechanical removal
   - Expected outcome: mosaic of shrub species and scattered pine
4. Remove invasive species and plant bog species
   - Expected outcome: mosaic of shrub and herb species with pockets of sphagnum and scattered pine

After sufficient monitoring has provided a better understanding of the hydrological regime and plant communities, one of these strategies or a combination of these may be adopted.

Lagg Zone

The area to be managed as a lagg ecosystem exists to the southwest of the bog area where water naturally drains on site. The lagg is a transition zone that acts as an important buffer between a raised bog (and its acidic, nutrient poor environment) and the surrounding landscape, which is influenced by more nutrient rich water inputs. As such, the lagg typically contains vegetation representative of both bogs and fens, and the hydrological conditions and soil type will influence the pattern of vegetation across the landscape.

Fen Wetland Zone

The marshland, situated in the southwest corner of the site, is the lowest point of GCL. The water table is high in this area and the vegetation is almost entirely dominated by fireweed, Sitka sedge, hardhack and bracken fern. The goal for this area would be to support areas of standing water for most of the year. The area holds standing water through the wetter portions of the year, and has a natural drainage swale running south. Efforts required to enhance this area will be dependent on the effectiveness of the hydrological barriers.

Habitat Enhancement Opportunities

Habitat enhancement can support wildlife by improving the conditions (e.g. vegetation, ground cover, structural diversity) necessary to meet their individual needs. The following enhancement opportunities are expected to increase habitat value for a diversity of wildlife species.

Two stormwater channels are planned to drain the active agricultural area on the western portion of the Garden City Lands site. The final design of these storm water channels is dependent on predicted site stormwater runoff and on geotechnical limitations on the depth of channel excavation as discussed in this strategy. Wetland plant communities that could be planted in these channels to filter and treat agricultural runoff.

Targeted habitat enhancement strategies are recommended to support biodiversity, while mitigating human-wildlife conflicts that may be associated with additional agricultural use, recreational activity and traffic. The habitat features listed below mimic those found in healthy bog and lagg ecosystems and are appropriate regardless of the ecological management option pursued:

- Large woody debris - Large tree trunks that have fallen provide shelter, feeding sites, and movement pathways for wildlife;

- Standing wildlife trees - Dead standing trees or 'planted wildlife trees' are important habitat features for birds, mammals, amphibians and other organisms and provide forage, roosting and nesting sites for a diversity of bird species;
- Raptor perches - Raptors often use perch sites to act as vantage points when hunting prey; and
- Nest boxes/structures - Insect activity is expected to be high for birds and bats and nesting boxes and structures should be installed to support bird and bat species.

Ecological Implementation Framework – Adaptive management, maintenance and monitoring

A primary goal of this strategy is to re-establish a plant community that best represents a bog ecosystem. Towards this end, it is recommended that a vegetation monitoring program be undertaken for the first three years after buffers are installed to better understand groundwater conditions and plant community composition outside of the influence of mowing. The following monitoring schedule supports implementation of the most comprehensive option for managing vegetation in the conservation area - Option 4 – Remove Invasive Species and Plant/Promote Bog Species and Sphagnum, with installation of wildlife habitat features.

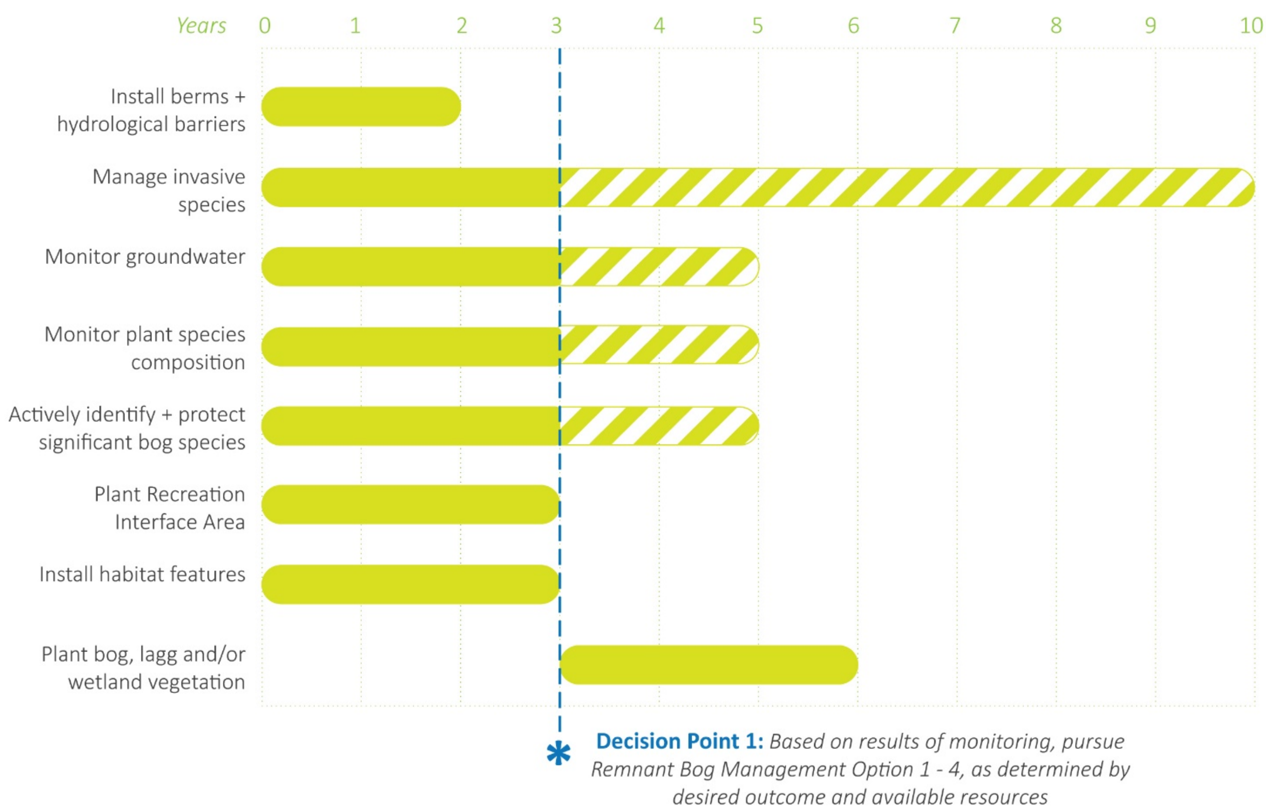

Figure A - 1: Proposed 10-year Treatment Schedule