

Technical Memorandum

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Via Email: Darren.mackenzie@notl.com
To: Darren MacKenzie, C.Tech., rcsi, Town of Niagara-on-the-Lake
From: Sarah Primmer, P.Eng., GEI Consultants
Date: September 18, 2025
Re: Pond Re-design Options Tech Memo
 Vineyard Creek Estates Stormwater Management Pond Review
 Niagara-on-the-Lake, ON
Project No. 2408081

GEI has been retained to review drainage and flooding issues within the Sandalwood Crescent area of Niagara-on-the-Lake, including at the stormwater management pond. In past memos, we have evaluated the capacity and constraints of the current Vineyard Creek Estates stormwater management pond on Sandalwood Crescent, and possibilities to increase storage capacity of the Vineyard Creek Estates stormwater management pond (SWMP). This memo details four stormwater management options that can provide solutions for the noted flooding issues while reducing peak flow rates to the downstream channel. The four options were analyzed on their ability to provide water quantity control to meet allowable release rates and their budgetary costs.

1.0 Catchment Areas

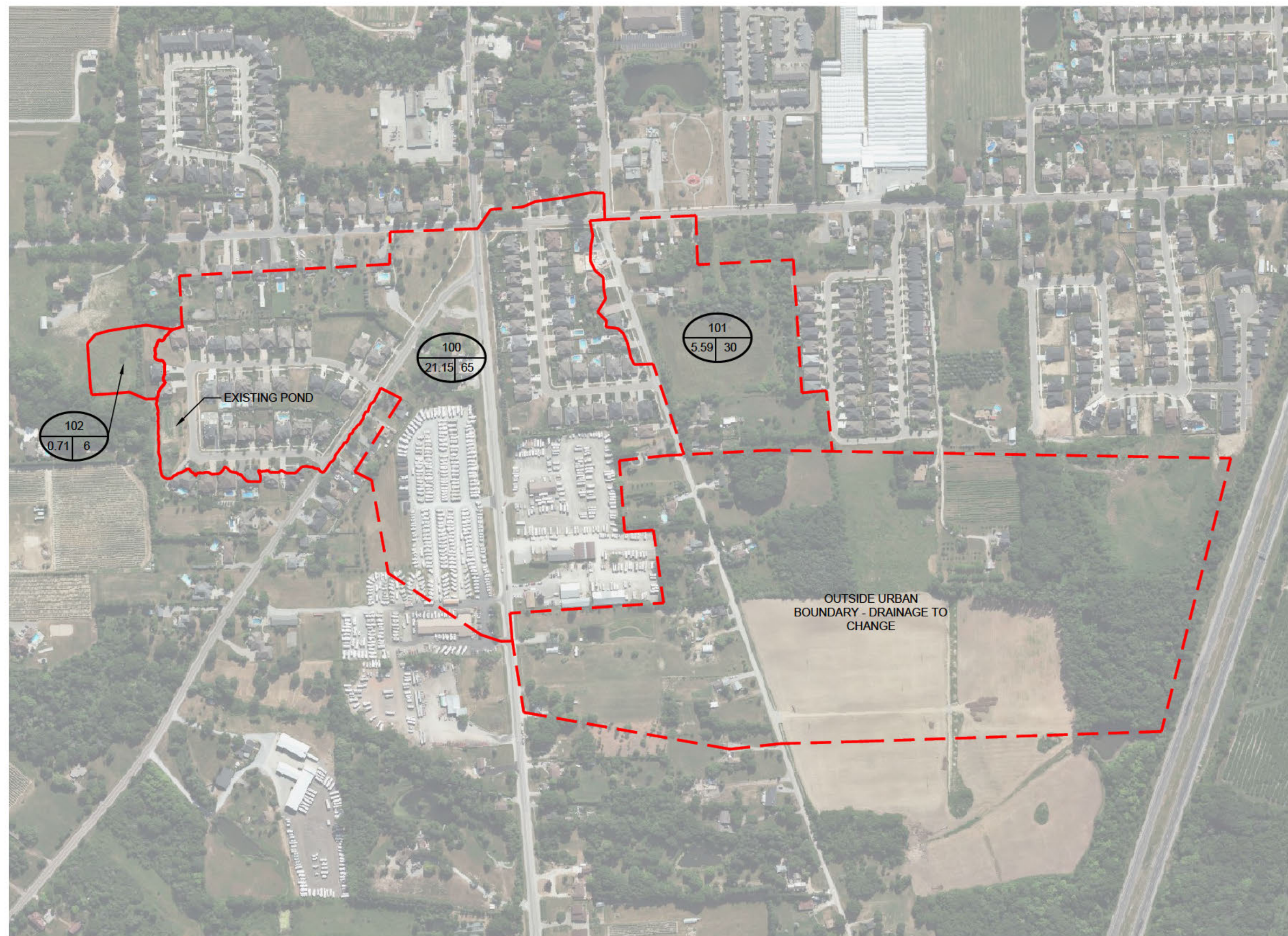
As identified in previous memos, the contributing drainage area to the Vineyard Creek Estates SWMP included an area larger than it was originally designed for. As detailed below, the area included in this analysis assumes that the lands outside of the urban boundary will be redirected and will not ultimately discharge to the existing SWMP. Three (3) catchment areas were modelled for the purpose of hydrological analysis, as shown on Figure 1.

Catchment 100 (21.15ha, 65%) consists of the residential, commercial and industrial land use areas from the existing SWMP south to Warner Road. Runoff generated from this catchment is conveyed via the existing storm sewers, roadside ditches, and culverts, to the existing SWMP.

Catchment 101 (5.59ha, 30%) consists of rural residential land use area south of Warner Road. This catchment includes the future proposed development of Tawny Ridge Phase 2. Runoff generated from this catchment currently flows overland and via roadside ditches and culverts to the intersection of Warner Road and Tanbark Road where it enters the storm sewer system, ultimately discharging into the existing SWMP. When the Tawny Ridge Phase 2 subdivision is developed, peak flows from this development will need to be controlled to the existing conditions level (i.e. 30% impervious).

Catchment 102 (0.71ha, 6%) is the area northeast of the existing SWMP that would discharge into the new proposed dry pond included in Options #3 and #4. This area consists of rearyards and roofs of some

FILE: B:\Working\NIAGARA-ON-THE-LAKE_TOWN OF 2408081 Stormwater Catchment And Pond Review\Work In Progress\Drawings\2408081 - Figure.dwg LAYOUT: SWM FIGURE
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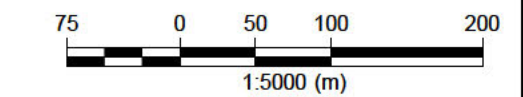


NIAGARA ON
THE LAKE



LEGEND

- DRAINAGE AREA BOUNDARY
- CATCHMENT NUMBER
- % IMPERVIOUS
- CATCHMENT AREA IN HECTARES



CATCHMENT AREAS
FOR VINEYARD CREEK
STORMWATER
MANAGEMENT POND

Figure No. 1



2408081
SEPTEMBER 2025
Scale: 1:5000 | NAD 1983 UTM Zone 17N

houses along Sandalwood Crescent, grassy and wooded area, and the new proposed pond. Runoff generated from this catchment would be controlled by the new pond before ultimately discharging to the existing downstream channel.

As noted in previous memos, a relatively large area outside the urban boundary was also identified as draining to the Vineyard Creeks SWMP. It is understood that the drainage features such as roadside ditches and culverts that are outside the urban boundary will be reconstructed in the future, so that stormwater runoff will ultimately drain away from the pond. The majority of this area, as identified in Figure 1, has not been included in the design of the proposed stormwater management facility options. However, Catchment 100 includes portions of 1224, 1231, and 1239 York Road that are outside the urban boundary. We chose to include these areas, since a portion of these properties are in the urban boundary. The drainage from these properties does not have to be revised since they are considered in this stormwater management analysis.

2.0 Stormwater Management Options

Building on the pond redesign options outlined in Memo 3 (GEI Consultants Canada Ltd., June 2025), the following four (4) options have been analyzed. These options are illustrated on the accompanying drawings.

Option #1. Pond Retrofit - Dry Pond with Retaining Walls.

This involves the elimination of the permanent pool, plus the installation of retaining walls to increase the storage volume by eliminating side slopes.

The proposed pond has a 2m height with a 375mm diameter outlet pipe, 17m wide overflow weir, and a proposed storage volume of 4,800m³.

Option #2. Pond Retrofit and a Stormwater Detention Tank

This involves the changes to the existing pond described in Option #1, with an additional stormwater detention tank adjacent to the pond to increase the storage volume.

The proposed stormwater detention tank has dimensions 50m x 9m x 1m and a storage volume of approximately 380 m³. 300mm diameter storm sewers are proposed between the tank and pond to maximize the combined proposed storage volume. The total storage volume available in this option is 5,180m³.

Option #3. Pond Retrofit, Stormwater Detention Tank, and New Dry Pond

This involves the changes described in Options #1 and #2, and a new dry pond that will provide additional storage volume. This option was sized to control the peak runoff release rates for the 2-year, 5-year, and 100-year design storms to the allowable runoff release rates.

The proposed new dry pond is designed with 4:1 side slope, a storage volume of 5044m³, a 250mm outlet pipe, and a double catchbasin outlet structure. A 1200mm storm sewer is proposed from the bottom of the two ponds so that receiving stormwater runoff can flow to both ponds and maximize usage of the combined proposed storage volume. The total storage volume available in this option is 10,227m³.

Option #4. Existing Pond with New Dry Pond

This involves keeping the Vineyard Creek SWMP essentially "as is" and introducing a new dry pond that will provide additional storage. The new dry pond in this option is larger than Option #3, as it was sized to provide enough storage volume to control peak runoff rates for the 2-year, 5-year, and 100-year design storms to allowable runoff release rates, without making significant changes to the existing pond or adding the storm tank.

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

A summary of the proposed features for the four options is provided below.

Table 1. Summary of Proposed Options for Vineyard Creek Stormwater Management Pond

	Proposed Features			
	Existing Pond to Remain with revised Permanent Pool, Top of Pond, and Outlet Control	Existing Pond to be Retrofit with Retaining Walls (Dry Pond)	Stormwater Detention Tank	New Dry Pond
Option 1		x		
Option 2		x	x	
Option 3		x	x	x
Option 4	x			x

2.1 Water Quality Control

Normal level (70% TSS treatment) water quality control is proposed with all four SWMP options, aligning with the level of control designed for the Vineyard Creek Estates subdivision in the 2005 Stormwater Management Report. This was originally achieved via a permanent pool in the existing pond. However, given that the drainage area to the pond is larger than originally contemplated, and that catchments have a higher impervious level, the existing permanent pool alone is not adequate to provide quality control. In addition, in order to make better use of the space, we are proposing that solutions are dry ponds, which allow for greater storage volume to be used for quality control, rather than used up providing quality control. As such, an oil/girt separator is recommended for all four options. A Stormceptor EFO12 oil/grit separator unit (or equivalent) that can treat up to 39% of total suspended solids from the total drainage area (Catchments 100 and 101) is proposed. [REDACTED]

[REDACTED]

The rest of the needed quality control will be provided by the dry pond(s). Per the Stormwater Management Planning and Design Manual (MECP previously MOE, 2003), for a total area of 26.74ha and imperviousness of 58%, the Basic Level storage requirement is 160 m³/ha which equates to 4,279m³. The dry pond storage volume for all pond options exceeds the requirements for Basic level water quality control (60% TSS treatment). As summarized in Table 2 below, the combination of the two water quality treatment methods can achieve Normal Level TSS treatment (70%) for the contributing areas to the pond.

Table 2. Pond Function - Per Existing Conditions

Water Quality Treatment Method	Proportion of Annual TSS Load to be Treated	%TSS Treatment	Proportion of TSS Load Treated
Oil/Grit Separator (Stormceptor EFO12)	100%	39%	39%
Required Dry Pond Storage Volume for Basic Level Treatment (160 m ³ /ha for 26.74 ha = 4279 m ³)	100% - 39% = 61%	60%	37%
Total TSS Treatment:			76%

3.0 Modelling Analysis

The MIDUSS modelling software was used to simulate the 2-year, 5-year, and 100-year design storm events for the existing pond and four (4) stormwater management options. Horton's equation was used as the infiltration model, with minimum and maximum infiltration rates of 5mm/hr and 125 mmh/hr, corresponding to Hydrological Soil Group C as per the MTO Drainage Management Manual. The 4-hour Chicago rainfall distribution was modelled with IDF parameters from the Vineyard Creek Estates Stormwater Management Report (Kerry T. Howe Engineering Ltd., June 2025) to keep with the intent of the original design, as summarized in Memo 1. Results of the routing analysis are presented below.

3.1 Allowable Release Rates

As discussed in Memo 3, the target allowable discharge rates to the downstream watercourse are based on the post-development flows that were identified in the Vineyard Creek Estates Stormwater Management Report (dated June 2005). These are as follows:

Table 3. Allowable Release Rates

Storm Event	Flow Rate m ³ /s
2-Year	0.157
5-Year	0.245
100-Year	1.262

3.2 Routing

Analyses in previous Memos 2 and 3 included understanding the storage capacity and function of the existing pond. As the drainage area to the pond was slightly modified to include some area outside the urban boundary, the existing pond function based on the updated drainage area was modelled and is presented in Table 3. The existing pond was modelled based on the revised structures proposed in Memo 3, which allows ponding levels to remain below an elevation of 118.20m.

Table 4. Pond Function - Per Existing Conditions

	Available Capacity			Actual Capacity Used		
	Peak Flow m ³ /s	Storage Volume m ³	Storage Elevation m	Peak Flow m ³ /s	Storage Volume m ³	Storage Elevation m
Bottom of Active Storage	0.000	0	116.40	---	---	---
2-Year	---	---	---	1.008	1,707	117.51
Weir	1.194	2,344	117.81	---	---	---
5-Year	---	---	---	2.338	2,589	117.92
100-Year	---	---	---	6.973	3,216	118.20
Top of Pond	7.698	3,225	118.20	---	---	---

Routing results for the proposed stormwater management strategy in Option #1 are summarized in Table 5.

Table 5. Option 1 – Stage/Storage/Discharge Capacities

	Available Capacity			Actual Capacity Used		
	Peak Flow m ³ /s	Storage Volume m ³	Storage Elevation m	Peak Flow m ³ /s	Storage Volume m ³	Storage Elevation m
Bottom of Pond	0.000	0.0	116.00	---	---	---
2-Year	---	---	---	0.285	2,723	117.13
Weir	0.349	3,840	117.60	---	---	---
5-Year	---	---	---	0.761	3,971	117.66
100-Year	---	---	---	6.311	4,769	117.99
Top of Pond	6.543	4,800	118.00	---	---	---

Routing results for the proposed stormwater management strategy in Option #2 are summarized in Table 6.

Table 6. Option 2 – Stage/Storage/Discharge Capacities

	Available Capacity			Actual Capacity Used		
	Peak Flow m ³ /s	Storage Volume m ³	Storage Elevation m	Peak Flow m ³ /s	Storage Volume m ³	Storage Elevation m
Bottom of Pond	0.000	0	116.00	---	---	---
Bottom of Detention Tank	0.068	480	116.20	---	---	---
2-Year	---	---	---	0.267	2,742	117.01
Top of Detention Tank	0.295	3,263	117.20	---	---	---
Weir	0.349	4,223	117.60	---	---	---
5-Year	---	---	---	0.439	4,251	117.61
100-Year	---	---	---	5.768	5,080	117.96
Top of Pond	6.543	5,183	118.00	---	---	---

Routing results for the proposed stormwater management strategy in Option #3 are summarized in Table 7.

Table 7. Option 3 – Stage/Storage/Discharge Capacities

	Available Capacity			Actual Capacity Used		
	Peak Flow m ³ /s	Storage Volume m ³	Storage Elevation m	Peak Flow m ³ /s	Storage Volume m ³	Storage Elevation m
Bottom of New Dry Pond	0.000	0.0	115.60	---	---	---
Bottom of Pond	0.068	571	116.00	---	---	---
Bottom of Detention Tank	0.090	1,377	116.40	---	---	---
2-Year	---	---	---	0.128	3,630	116.69
Top of Detention Tank	0.158	6,188	117.20	---	---	---
5-Year	---	---	---	0.147	5,184	117.00
T/G (Lip Elev) DICB	0.169	7,154	117.40	---	---	---
100-Year	---	---	---	1.170	8,818	117.73
Top of Pond	2.666	10,227	118.00	---	---	---

Routing results for the proposed stormwater management strategy in Option #4 are summarized in Table 8.

Table 8. Option 4 – Stage/Storage/Discharge Capacities

	Available Capacity			Actual Capacity Used		
	Peak Flow m ³ /s	Storage Volume m ³	Storage Elevation m	Peak Flow m ³ /s	Storage Volume m ³	Storage Elevation m
Bottom of New Dry Pond	0.000	0.0	115.60	---	---	---
Bottom of Pond	0.068	707	116.00	---	---	---
2-Year	---	---	---	0.139	3,581	116.66
5-Year	---	---	---	0.158	5121	117.00
T/G (Lip Elev) DICB	0.169	6,976	117.40	---	---	---
100-Year	---	---	---	1.219	8,487	117.62
Top of Pond	2.666	9,552	118.00	---	---	---

All options can contain the 100-year design storm below the proposed top of pond elevation of 118.00m, which is below the low point elevation of 118.24m at DCB12 on Sandalwood Crescent. However, only options 3 and 4 can control all storm events to the allowable release rates.

3.3 Comparison to Allowable Release Rates

Table 8 compares the post-development release rates for the four options against the allowable release rate.

Table 9. Comparison of Allowable Release Rates to Proposed Options for the Vineyard Creek Estates SWMP.

Storm Event	Allowable (Per Original Design Report)		Existing Pond (Revised Outlet Structures)		Option 1		Option 2		Option 3		Option 4	
	Elevation (m)	Flow (m ³ /s)	Elevation (m)	Flow (m ³ /s)	Elevation (m)	Flow (m ³ /s)	Elevation (m)	Flow (m ³ /s)	Elevation (m)	Flow (m ³ /s)	Elevation (m)	Flow (m ³ /s)
2-Year	117.38	0.157	117.51	1.008	117.13	0.285	117.01	0.267	116.69	0.128	116.66	0.139
5-Year	117.71	0.245	117.92	2.338	117.66	0.761	117.61	0.439	117.00	0.147	117.00	0.158
100-Year	118.22	1.262	118.20	6.973	117.99	6.311	117.96	5.768	117.73	1.170	117.62	1.219

Note: Red shading represents peak flows exceeding allowable release rates, and green shading represents peak flows below allowable release rate.

As shown in Table 6, Options #3 and #4, [REDACTED] can achieve peak flow rates that meet the allowable release rates per the original design. [REDACTED] Options #1 and #2 [REDACTED] do not achieve the allowable release rates. However, both Options #1 and #2 reduce the 2-year and 5-year peak runoff rates compared to the existing pond (with revised outlets) scenario, while maintaining the 100-year design storm flows under the top of pond at an elevation, which will mitigate flooding onto Sandalwood Crescent.

4.0 Budgetary Costs

Costs associated with each option were estimated to provide a high level budget for each option. [REDACTED] IA summary is below.

Table 10. Budgetary Costs

Option	Approx. Construction Costs [REDACTED]
1	\$610,000
2	\$1,000,000
3	\$2,000,000
4	\$1,150,000

Note that these prices are for budgetary purposes only and may change as a result of adjustments to the scope, economic changes, and timing of the works.

5.0 Evaluation

The following table lists the pros and cons of each of the four options.

Table 11. Options Evaluation

Option	Pros	Cons
1	- Cheapest Option - Can be completed quickly, [REDACTED]	- Does not reduce flows to the allowable levels - Will require consultation with NPCA for increased flows - Aesthetic impact as new pond will require fencing along the retaining wall
2	Can be completed quickly, [REDACTED]	- Does not reduce flows to the allowable levels - Will require consultation with NPCA for increased flows - Aesthetic impact as new pond will require fencing along the retaining wall - May be conflicts with utilities for installing the tank
3	Meets the allowable flow rates	- Most expensive [REDACTED] - Aesthetic impact as new pond will require fencing along the retaining wall

