East Hants – Servicing Capacity Study

Technical Memorandum #6 – Stormwater Culverts Assessment

Draft

Prepared for:
The Municipality of East Hants

RVA 226421

May 5, 2023

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RVA 226421

May 5, 2023

Municipality of East Hants
Municipal Office
Lloyd E. Matheson Centre
15 Commerce Court
Elmsdale, NS B2S 3K5

Attention: Derek Normanton, P.Eng.

Dear Mr. Normanton:

Re: Servicing Capacity Study – Draft Technical Memorandum #6 – Stormwater Culverts Assessment

Please find enclosed Draft Technical Memorandum #6 – Stormwater Culverts Assessment. This document is the last of six components to the Servicing Capacity Study. Kindly have this document reviewed and provide comments back to RVA for our consideration within the final document.

Should you have any questions, please don't hesitate to contact the undersigned.

Yours very truly,

R.V. Anderson Associates Limited

Matthew Keeping
Civil Engineering Technologist

Jason Angel, M.Sc., P.Eng., PMP
Senior Project Manger

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Encls.

East Hants Servicing Capacity Study
Stormwater Culverts Assessment

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1.0 Background

The Municipality of East Hants (Municipality) is made up of multiple watersheds which flow into the Shubenacadie River. In order for the flow to reach the river, it must flow through developed areas in Enfield, Elmsdale and Lantz, under Nova Scotia Highway 2 and the CN Railway, before continuing towards the river. Along Highway 2, there are numerous culverts and piped storm water systems which allow flow to pass under the road. During and after heavy rainfall events, the municipality experiences minor flooding on the North side (upstream) of Highway 2.

1.1 Purpose

As development increases and the municipality continues to be one of Nova Scotia's fastest growing communities, the infrastructure under Highway 2 and the CN railway has become a bottleneck as all storm runoff from developments upstream must cross the highway and through provincially owned culverts. Since Highway 2 is a provincial road, the municipality cannot work on or invest in upgrading the stormwater system under Highway 2. As the Municipality continues to grow and forecasts their servicing capacity over the next 25 years, accurate information on the condition and capacity of the storm water system under Highway 2 and the CN Railway is required. This report was developed to provide the Municipality with evidence as to the current condition and capacity. This information can be provided to other stakeholders and owners of the infrastructure to provide recommendations on required maintenance or replacement.

1.2 Methodology

The main area of concern for the stormwater aspect of the study is the culverts crossing under Highway 2. Referring to the Master Drainage Plan written by Dillon in 1998, R.V. Anderson Associates Limited (RVA) identified 32 culverts in the regional service area of Enfield, Elmsdale and Lantz, along Highway 2 to be considered in the study.

Using data provided by the municipality and resources available, RVA completed field inspections and a desktop exercise to assess the condition of the culverts and determine if they have capacity for peak rainfall events. Condition assessments of the culverts are strictly based on flow obstructions, debris and vegetation growth and does not include a structural assessment of the culvert.

1.2.1 Site Investigation

After conversations with the municipality, RVA proposed an outline of field inspections to be performed as part of the stormwater section of the study.

To determine the condition and capacity of the culverts along Highway 2, RVA proposed the following workplan for the analysis of the stormwater culverts:

- Visual inspection of culverts along Highway 2 – Includes taking measurements of culverts to determine maximum capacity.
- Measure water level in culverts.
- Take note of any obstructions in or around the culvert and in the upstream/downstream channels including, sediment, vegetation, and debris.
- Using GPS survey equipment, record inlet and outlet elevations of each culvert to accurately calculate the length and slope.

Once site investigations were complete, all data gathered was assembled and used in the desktop exercise to calculate capacity.

1.2.2 Data Acquisition

Using technology developed in-house for field inspections, RVA employed the following methods to acquire the field data required to complete the condition and capacity assessments.

1.2.2.1 ArcGIS Field Maps

Using the Master Drainage Plan (1998) as a reference, RVA developed mapping of the culverts along Highway 2 from Enfield to Lantz in ArcGIS Pro. Using the mapping to help locate the culverts in the field, RVA also created an inspection form which was attached to each culvert on the map and filled out in the field. Once the inspection was completed inspection reports were automatically generated and uploaded to the cloud.

1.2.2.2 Photos

Using the inspection form mentioned above, RVA took photos of each culvert and attached them directly to the inspection form in the field, supporting the culvert inspections and reducing time required to compile field data into reports. All data recorded in the field automatically populated an inspection report developed by RVA for this application.

1.2.2.3 GPS Survey and Field Measurements

Data collection for completion of the desktop culvert capacity exercise was done using GPS survey to record the inverts and length of each pipe. This survey data along with measurements of the culvert dimensions have been used to verify the capacity of each culvert. Measurements were also taken of the depth of water present in each culvert as well as the depth of sediment and debris.

2.0 Condition Findings

A condition assessment was completed for each of the culverts inspected along Highway 2, Using the same Condition Rating Matrix employed in "*Technical Memorandum #1: Sanitary Sewer Pump Stations Assessment & Condition Summary",* each culvert has been given an overall condition rating based on the matrix in Table 2.1 below. The Mapping developed as part of this exercise shows each culvert colour coded with its corresponding condition rating. The mapping can be found in Appendix "A".

Table 2.1 – Condition Rating Matrix

Condition Rating	Physical Condition	Expected Service Life
1 – Very Good	Excellent working condition. No signs of deterioration.	Like new.
2 - Good	Minor signs of deterioration.	At or beyond mid-stage of life.
3 - Fair	Some elements exhibiting major deficiencies.	Approaching end of life.
4 - Poor	Significant deterioration with localized areas of failure.	Needs to be replaced/repaired in the short term
5 – Very Poor	Asset is beyond repair and, generally, has completely failed.	Needs to be replaced/repaired immediately.
0 - Unknown	Insufficient information exists to estimate asset condition.	

2.1 Type and Size of Culverts

The culverts along Highway 2 vary in type and size. It was observed that some of the culverts identified in the 1998 Master Drainage Plan have been removed and replaced with piped storm sewer systems. It was also observed that many of the culverts are made of multiple sections with varying dimensions, and materials. Many culverts also act as outlets for catch basins and sections of storm sewer. Most of the culverts are Concrete pipe, but some are Concrete Box culverts, and Galvanized Steel culverts. The measurements

recorded in the field are summarized in Table 2.2 below as well as the material and type of culvert.

Table 2.2 – Culvert Measurements

Asset ID	Type of Culvert	Depth of Water (mm)	Diameter (mm)
45	Concrete/Storm Sewer	600	600
46	Concrete/Storm Sewer	-	600
47	Galvanized Steel	180	600
48	Concrete	-	900
49	Concrete to Concrete Box	600	U/S: 1500 D/S: 600x1300
50	Concrete	-	South: 900 North: 750
52	Concrete	-	U/S: 450 D/S: 750 Steel: 600
53	Concrete	-	900
54	Concrete	-	U/S: 900 D/S: 600x600
55	Concrete to Concrete Box	400	D/S: 100x1400 U/S: 1500
56	Concrete	320	770
57	Steel/Storm Sewer	-	600
59	Galvanized Steel	-	600
60	Concrete Box	-	1250x1280
61	-	-	-
63	Concrete Box	-	D/S: 900x750 U/S: 450
64	Concrete	-	1200
65	Concrete	250	1050
66	Concrete	-	U/S: 600, D/S: 900
67	Concrete	600	U/S: 750 D/S: 1200
68	Concrete Box	-	U/S: 2400x1800 D/S: 1600x1800
69	Concrete	300	750
69A	Concrete	375	750
70	Concrete/Storm Sewer	300	600
71	ConSpan	260	2.3m x 10m
72	Concrete	400	1400
73	Concrete	100	750
74	Concrete	320	750

2.2 Overall Condition Ratings

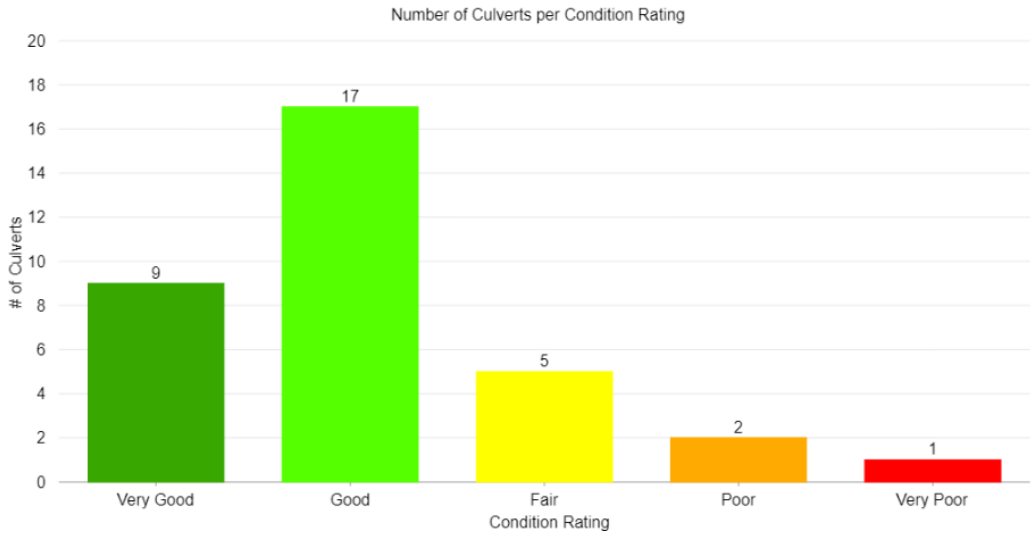
Based on the condition assessment inspections performed in the field, the stormwater culverts along Highway 2 are generally in good condition. All concrete culverts are in good condition however, some of the corrugated steel culverts should be considered for replacement. Appendix B includes all inspection forms with comments and photos to showcase the condition of the culverts and conditions in the upstream and downstream areas. The results of the condition assessment are also summarized in Figure 2.1 below.

Some downstream channels have vegetation growth further downstream that are causing disruptions in flow. The majority of the culverts have varying levels of debris build-up directly around or near the outlet of the pipe which is causing water to pool at the outlet and reducing the capacity of the culvert.

Upstream, most channels were clear of any obstructions. Some were lined with riprap, and some were part of a large tributary where the channel was wide and clear.

As part of the desktop exercise, 27 culverts along the CN railway are to be considered for a capacity study only. While in the field, RVA located and visually inspected three culverts (CN22, CN23 and CN24) along the CN railway which were downstream from Highway 2. The inspection results of these culverts can also be found in Appendix B.

Figure 2.1 – Number of Culverts per Condition Rating



2.3 Mapping

Using ArcGIS and QGIS, RVA has developed mapping showing the watershed boundaries for each watershed upstream of both the Highway 2 culverts and CN Railway culverts. The culverts are color coded based on the condition rating given to them from the Condition Rating Matrix.

Appendix A contains the mapping developed by RVA showing the culverts inspected and watershed boundary. All culverts included in the study along Highway 2 and the CN Railway have been given the same asset identification number as was given in the Master Drainage Plan (1998).

3.0 Hydrology

3.1 Methodology

3.1.1 Catchment Areas

The Catchment areas for each of the identified culverts along Highway 2 have been determined using the most recent available Lidar mapping provided by GeoNova. Contour mapping was developed from the lidar data, this contour mapping was used to delineate the boundary of each catchment area as well as determine the highpoint and slope of each catchment area. Once each catchment area was established, a composite runoff coefficient was determined based on current land use. Each catchment area was compared to those in the 1998 Dillon Master Drainage Plan, in general it was found that the catchment areas determined were similar to those in the Dillon Master Drainage Plan with some expected variations in overall size and location of boundaries. This variation was expected as a result of far greater level of detail available in current lidar mapping than what was available in 1998.

3.1.2 Peak Flow

The peak runoff (Q) from each catchment area was determined using the rational method. The Rational method is a widely used empirical equation for predicting instantaneous peak discharge from small catchment area's typically less than 80 hectares. The peak flow is assumed to occur at a rainfall duration equal to the time of concentration of the catchment area. Time of concentration for each catchment area was determined using the Hathaway equation, the Hathaway equation uses the average slope and a composite roughness coefficient for the catchment area to determine the time of concentration along the principal

watercourse. IDF curves for the present 1 in 100-year and present 1 in 5-year rainfall event were used to determine the expected rainfall intensity for each catchment area. The IDF curves used were for the Halifax International Airport and provided by Environment Canada. Once the rainfall intensity along with the catchment area and composite runoff coefficient was determined for each catchment area the rational method was used to determine the peak runoff (Q). This exercise does not consider upstream effects such as culverts, unknown ditching, storage capacity, etc. these upstream effects could affect the peak instantaneous flows at the outlet of the sub-catchment area. This report does not consider the effects of snow melt, or spring freshets. These events could contribute considerably larger flows over greater lengths of time. The Rational Method does not apply to medium and large catchment areas as runoff concentration is not likely to occur. As such culverts servicing catchment areas greater than 80 hectares have not been included in this tech memo.

3.1.3 Culvert Capacity

Culvert capacity was determined using the peak runoff flows for the 1 in 100-year and 1 in 5-year storm events. Manning's equation was used to determine the capacity of each of the identified culverts. For the purpose of this report only partial pipe flow was considered. For this report culverts have been considered over capacity when they reach full flow conditions. Surcharged conditions were not considered as far greater field investigation would be required to determine the acceptable level of surcharging. Each culvert was treated as a single pipe with uniform cross-sectional area through its full length. For example, if a culvert was 750mm diameter at the inlet but increased in size to 900mm at the outlet, this pipe was considered as 750mm diameter for its full length. It was observed in the field that some culverts had manholes or structures along their length, the losses associated with these manholes/structures were not considered. All culverts were considered to have uniform slope from inlet to outlet, changes in slope through the length of the pipe were not considered. The slopes for the culverts under Highway 2 were obtained through field inspections, all the culverts under the CN railway were assumed to have a uniform slope of 2.0%.

3.1.4 CN Culverts

The capacity of the culverts under the CN railway adjacent to Highway 2 have been calculated using the same methods as those detailed in Section 3.1.1 to 3.1.3. The CN culverts were not inspected by RVA staff and therefore no data on these culverts was obtained. All data on these culverts such as size, length, material, etc. have all been obtained from the Master Drainage Plan developed by Porter Dillon Limited for the

municipality in 1998. The results of the CN culvert capacity assessments should not be used in the decision-making process for replacement, upgrades, or rehabilitation of culverts as field measurements and inspections would be required to accurately determine their capacity. The capacity of the culverts have been calculated only to provide guidance on which culverts are of priority for further investigation.

3.2 Results

The results of the stormwater modeling are intended to be a high-level estimate of the current systems capacity and to provide information on the impact of the pipes current condition on its capacity. These results are not intended to be used in the design of replacement culverts as more in-depth stormwater modeling would be required.

3.2.1 Capacity of Highway 2 Culverts

The capacity of the culverts under Highway 2 have been calculated using watershed boundaries and field data developed by RVA. 1 in 5-year storm results can be found in Table 3.1 and 1 in 100-year storm event results can be found in Table 3.2. Field investigations revealed that many culverts were partially or fully blocked with debris and material. These blockages reduce the capacity of the culverts. The percentage of blockage has been summarized in the tables below. Recommendations based on the field investigations and results of the capacity study for the culverts under Highway 2 can be found in Section 4.1.3.

Table 3.1 – Highway 2 Culvert Capacity 1 in 5-year Storm Events

Asset ID	Pipe Dia. (mm)	Pipe Type	Catchment Area (ha)	Peak Flow (Q) (m^3/s)	Capacity Remaining (Clean Conditions)	Percent of Pipe Blocked
45	*					
46	*					
47	600	Steel	11.2	0.53	Insufficient Capacity	75%
48	900	Concrete	73.3	1.86	28%	0%
49	1300x600	Concrete Box	24.5	0.85	66%	30%
50	750	Concrete	27.9	1.01	36%	0%
52	450	Concrete	9.9	0.33	48%	0%
53	900	Concrete	13.6	0.63	69%	0%
54	900	Concrete	12.6	0.78	57%	0%
55	700	Concrete Box	283.1	N/A	N/A	50%
56	450	Concrete	14.8	0.53	81%	40%
57	*					
59	600	Steel	12.9	0.44	55%	60%
60	1250x1280	Concrete Box	109.1	N/A	N/A	10%
61	*					
63	900	Concrete Box	4.7	0.22	95%	0%
64	1200	Concrete	7.6	0.43	92%	0%
65	1050	Concrete	22.6	0.81	69%	0%
66	900	Concrete	19.7	0.70	41%	0%
67	*					
68	1600x1800	Concrete Box	482.1	N/A	N/A	0%
69	750	Concrete	10.8	0.53	71%	40%
69A	750	Concrete	26	1.26	22%	0%
70	*					
71	N/A open bottom structure					
72	1400	Concrete	138	N/A	N/A	0%
73	750	Concrete	32.5	0.75	38%	13%
74	750	Concrete	16.3	0.38	67%	43%

*Capacity not calculated, as these culverts have been converted to piped storm sewer systems.

Table 3.2 – Highway 2 Culvert Capacity 1 in 100-year Storm Events

Asset ID	Pipe Dia. (mm)	Pipe Type	Catchment Area (ha)	Peak Flow (Q) (m^3/s)	Capacity Remaining (Clean Conditions)	Percent of Pipe Blocked
45	*					
46	*					
47	600	Steel	11.2	0.85	Insufficient Capacity	75%
48	900	Concrete	73.3	2.96	Insufficient Capacity	0%
49	1300x600	Concrete Box	24.5	1.36	45%	30%
50	750	Concrete	27.9	1.62	37%	0%
52	450	Concrete	9.9	0.45	17%	0%
53	900	Concrete	13.6	1.01	50%	0%
54	900	Concrete	12.6	1.25	30%	0%
55	1400x1100	Concrete Box	283.1	N/A	N/A	50%
56	450	Concrete	14.8	0.85	70%	40%
57	*					
59	600	Steel	12.9	0.44	55%	60%
60	1250x1280	Concrete Box	109.1	N/A	N/A	10%
61	*					
63	900	Concrete Box	4.7	0.35	93%	0%
64	1200	Concrete	7.6	0.70	87%	0%
65	1050	Concrete	22.6	1.30	50%	0%
66	900	Concrete	19.7	1.13	5%	0%
67	*					
68	1600x1800	Concrete Box	482.1	N/A	N/A	0%
69	750	Concrete	10.8	0.85	54%	40%
69A	750	Concrete	26	2.02	Insufficient Capacity	0%
70	*					
71	N/A open bottom structure					
72	1400	Concrete	138	N/A	N/A	0%
73	750	Concrete	32.5	1.44	Insufficient Capacity	13%
74	750	Concrete	16.3	0.72	47%	43%

*Capacity not calculated, as these culverts have been converted to piped storm sewer systems.

3.2.2 Capacity of CN Railway Culverts

The capacity of the culverts under the CN railway have been calculated using the watershed boundaries developed by RVA. Field investigations were not completed on the CN culverts and therefore, all capacity calculations were completed using culvert information obtained from the 1998 Master Drainage Plan. The capacity of the CN Rail culverts has been calculating using the combined peak flow from the upstream culvert and the peak flow from the sub catchment areas between the CN Railway and Highway 2. 1 in 5-year can be found in Table 3.3 and 1 in 100-year storm event results can be found in Table 3.4 below. The peak flow used in the capacity calculation for the CN culverts does not account for undersized culverts upstream reducing the flow from the northwest of Highway 2.

Table 3.3 – CN Railway Culvert Capacity 1 in 5-year Storm Events

Asset ID	Pipe Dia. (mm)	Pipe Type	Catchment Area (ha)	Contributing Upstream Culverts	Peak Flow (Q) (m^3/s)	Capacity Remaining (Clean Conditions)
CN5	Twin 1200	Concrete	6.3	48	2.79	80%
CN6	N/A Open Bottom Structure					
CN7	1200	-	8.5	49	1.43	75%
CN8	450x900	Wooden Box	1.9	50	1.13	23%
CN9	600x300	Wooden Box	2.7		0.17	70%
CN10	Unknown	Steel Box	6.3	52, 53	1.42	N/A
CN11	1500x1800	Concrete Box	5.7	54, 55	N/A – Catchment area greater than 80ha	
CN12	1200	Steel	0.48	56	0.57	83%
CN13	600 x 750	Steel Box	0.58	57	0.26	76%
CN14	N/A Open Bottom Structure					
CN15	1200	Steel	0.47	59	0.50	91%
CN16	900	Steel	1.15		0.11	93%
CN17	900 x 1500	Steel Box	1.6	60	N/A – Catchment area greater than 80ha	
CN18	300 x 600	Steel Box	31.2	63, 64, 65	2.37	Insufficient Capacity
CN19	750 x 900	Steel Box	28.8	67	3.35	Insufficient Capacity
CN20	1600	Concrete	15	68	N/A – Catchment area greater than 80ha	
CN21	Dillon report shows all flow bypassing to Culvert 20					
CN22	900	Concrete	22	69, 69A	2.83	Insufficient Capacity
CN23	450	Concrete	3.44		0.30	28%
CN24	600	Steel	4.6		0.45	47%
CN25	600	-	57		0.76	12%
CN26	N/A Open Bottom Structure					
CN27	1200	-	20.5	73	1.88	71%
CN28	1200	-	16.4	74	1.04	69%

Table 3.4 – CN Railway Culvert Capacity 1 in 100-year Storm Events

Asset ID	Pipe Dia. (mm)	Pipe Type	Catchment Area (ha)	Contributing Upstream Culverts	Peak Flow (Q) (m^3/s)	Capacity Remaining (Clean Conditions)
CN5	1200 (x2)	Concrete	6.3	48	4.47	65%
CN6	N/A Open Bottom Structure					
CN7	1200	Unknown	8.5	49	2.29	60%
CN8	450x900	Wooden Box	1.9	50	1.81	Insufficient Capacity
CN9	600x300	Wooden Box	2.7		0.28	52%
CN10	Unknown	Steel Box	6.3	52, 53	2.29	N/A
CN11	1500x1800	Concrete Box	5.7	54, 55	N/A – Catchment area greater than 80ha	
CN12	1200	Steel	0.48	56	0.91	73%
CN13	600 x 750	Steel Box	0.58	57	0.43	61%
CN14	N/A Open Bottom Structure					
CN15	1200	Steel	0.47	59	0.81	86%
CN16	900	Steel	1.15		0.18	88%
CN17	900x1500	Steel Box	1.6	60	N/A – Catchment area greater than 80ha	
CN18	300x600	Steel Box	31.2	63, 64, 65	3.80	Insufficient Capacity
CN19	750x900	Steel Box	28.8	67	5.37	Insufficient Capacity
CN20	1600	Concrete	15	68	N/A – Catchment area greater than 80ha	
CN21	Dillon report shows all flow bypassing to Culvert 20					
CN22	900	Concrete	22	69, 69A	4.53	Insufficient Capacity
CN23	450	Concrete	3.44		0.49	Insufficient Capacity
CN24	600	Steel	4.6		0.45	15%
CN25	600	-	57		0.76	Insufficient Capacity
CN26	N/A Open Bottom Structure					
CN27	1200	-	20.5	73	1.59	53%
CN28	1200	-	16.4	74	0.94	72%

4.0 Conclusion

This Technical Memorandum has been developed to assist the Municipality of East Hants understand the current conditions and peak capacities of the existing culverts along Highway 2 and the CN Railway, as well as to identify areas of concern where more in-depth studies should be undertaken. Below are conclusions and recommendations for each part of the study.

4.1 Condition Assessment

From the above analysis it is apparent that most culverts along Highway 2 are of adequate size, however, under current conditions the maximum capacity of some culverts is greatly reduced, due to vegetation growth and debris build-up around the drainage channel and inside of the culvert.

Most culverts need maintenance such as having debris removed from inside of pipe, and having vegetation removed from the channel to eliminate disruption in flow. Structural condition assessments were not included in this exercise.

Although the CN culverts are a part of the capacity study only, RVA visually inspected three culverts along the CN railway. Two of these, CN23 and CN24 were in poor condition, with CN22 being full of gravel and the bottom corroded away. RVA has developed recommendations to be considered based on the condition assessments of each culvert along Highway 2, which can be found below.

4.2 Capacity Assessment

The capacity study completed is meant to provide a high-level overview of the current capacity of the culverts under Highway 2 and the CN Railway. It was found that the majority of culverts under Highway 2 and the CN railway have capacity to accommodate the 1 in 5-year storm event if the culverts are cleaned and all blockages removed. It was found that under the 1–100-year storm event some of the culverts under Highway 2 and the CN railway do not have capacity and as a result surcharging of some culverts is likely. Culverts which are over capacity have been identified in Table 4.1.

4.3 Recommendations

As shown below in Table 4.1, RVA has developed recommendations based on the condition assessment and findings of the capacity assessment. This information is put forward for consideration by the municipality and other stakeholders, for future developments and flood

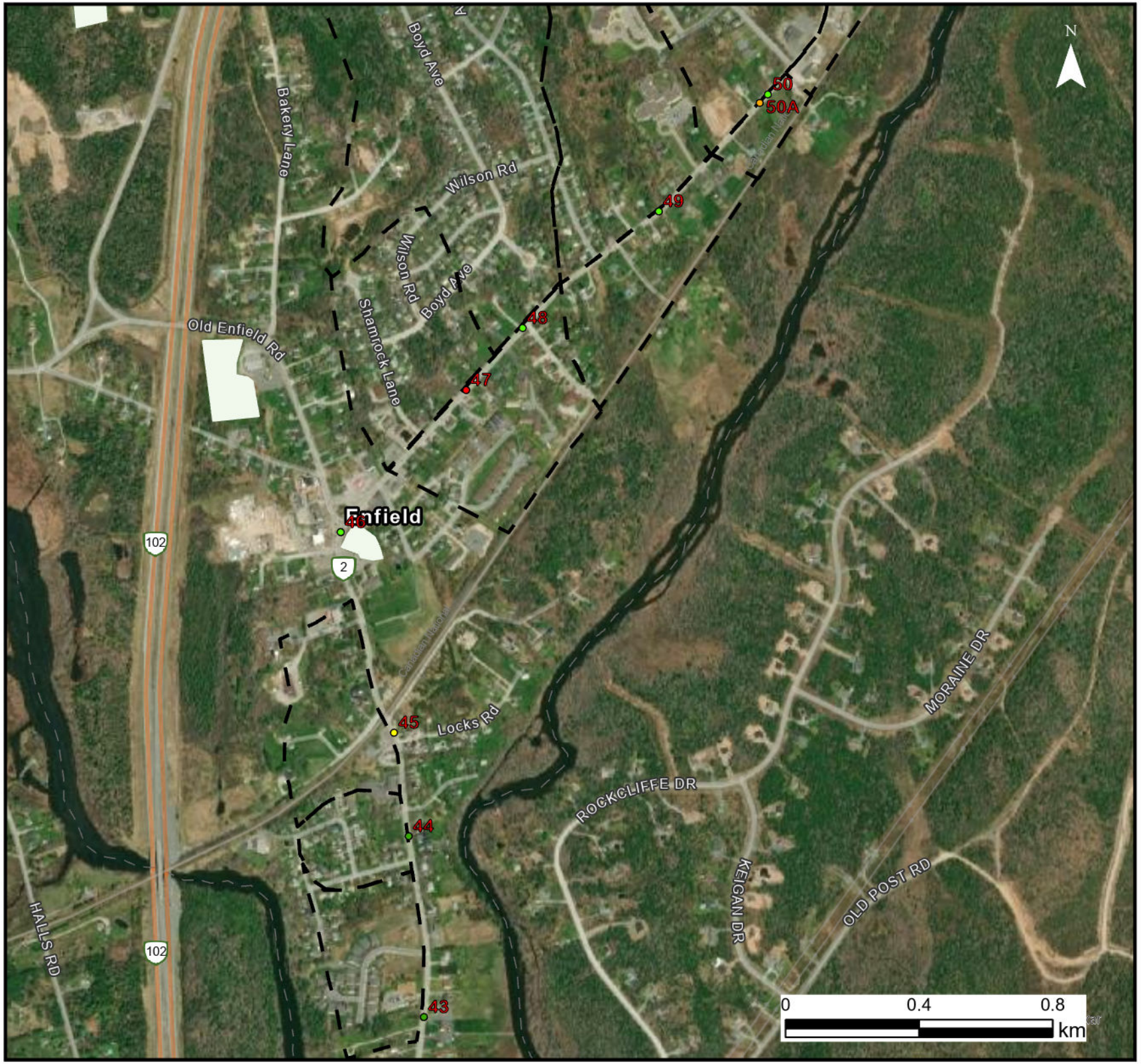
mitigation. Recommendations have not been made for the culverts under the CN railway as further field investigations would be required to accurately determine the required upgrades and maintenance.

Table 4.1 – Highway 2 Culvert Recommendations

Asset ID	Issues	Recommendations
45	Downstream channel blocked with vegetation	Remove debris and vegetation from downstream channel
47	Insufficient capacity for both 5-year and 100-year storm events	Consider for replacement
48	Vegetation growth in upstream channel. Insufficient capacity for 100-year storm event	Consider for replacement
49	Debris in downstream channel	Remove debris from downstream channel
50	Debris & sediment build-up at outlet	Remove debris and sediment from outlet
52	Debris in downstream channel	Remove debris from downstream channel
54	Outlet obstructed	Remove debris from outlet
55	Debris built up downstream. Insufficient capacity for 100-year runoff event	Remove debris and consider for replacement
56	Debris build-up at outlet	Remove debris from outlet
59	Inlet blocked by haybales. Some debris downstream	Remove haybales and debris
60	Downstream headwall in need of repair	Repair headwall
63	Debris build-up in culvert. Vegetation growth downstream	Remove debris and vegetation
65	Vegetation growth downstream	Remove vegetation growth
66	Debris in upstream channel	Remove debris
69	Debris build-up at both ends of culvert	Remove debris
69A	Insufficient capacity for 100-year runoff event	Consider for replacement
73	Vegetation growth on both ends of pipe. Insufficient capacity for 100-year run-off events	Remove vegetation and consider for replacement
74	Vegetation growth in both downstream and upstream channels	Remove vegetation growth

APPENDIX A

Watershed and Culvert Mapping



Legend

Culverts

- Very Good
- Good
- Fair
- Poor
- Very Poor
- Did Not Inspect
- Catchment Area

EAST HANTS
We live it!

Scale - 1:15,000

Project #: 226421
East Hants Servicing Capacity Study

EAST HANTS STORMWATER CULVERT ASSESSMENT MAPPING

CULVERT 43 TO 50

DRAWN BY: MJK

DATE DRAWN: 2023-04-28

RVA 75 years

Legend

Culverts

- Very Good
- Good
- Fair
- Poor
- Very Poor
- Did Not Inspect
- Catchment Area

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Scale - 1:10,000

Project #: 226421
East Hants Servicing Capacity Study

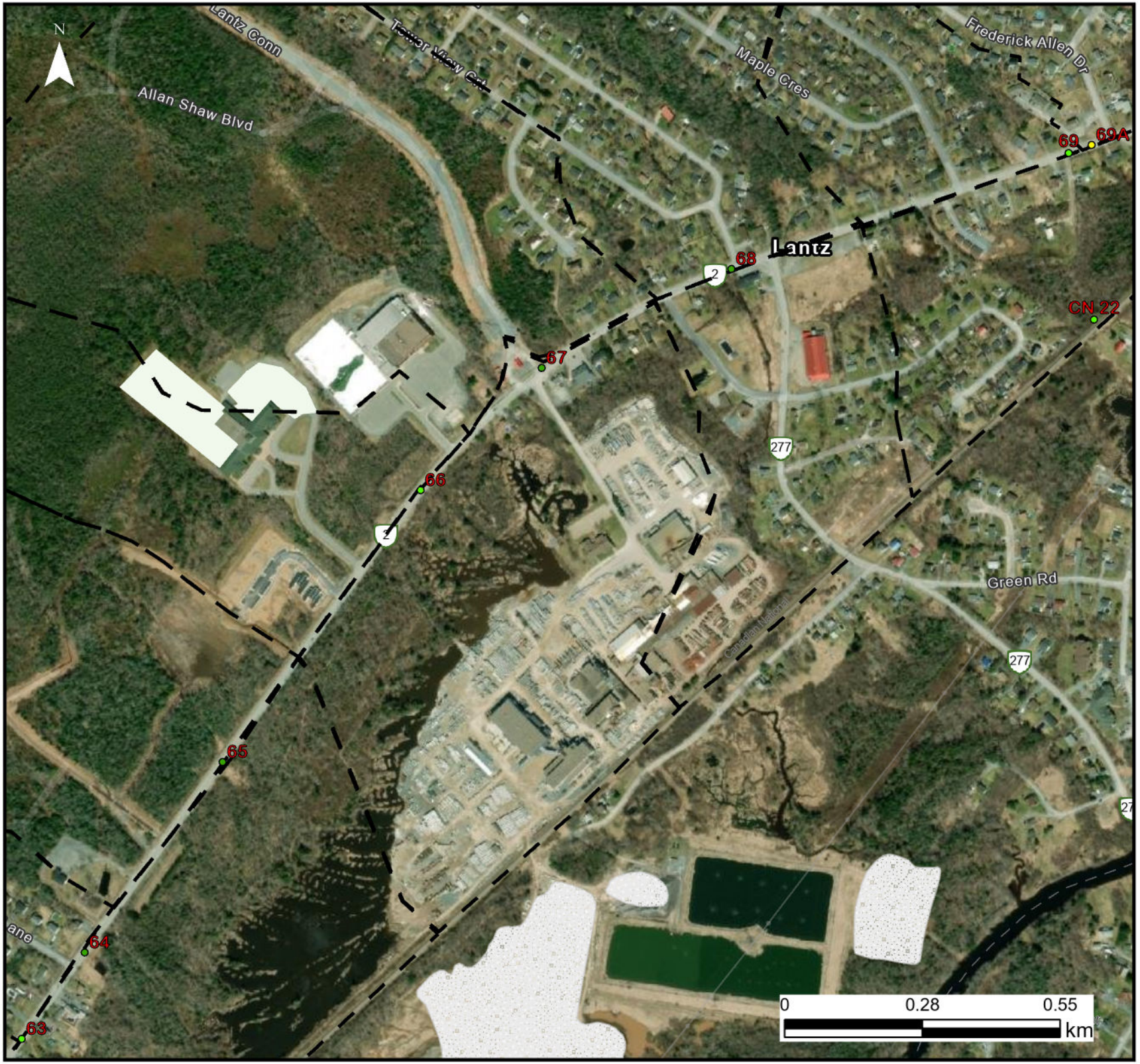
EAST HANTS STORMWATER CULVERT ASSESSMENT MAPPING

CULVERT 52 TO 61

DRAWN BY: MJK

DATE DRAWN: 2023-04-28

RVA 75 years



Legend

Culverts

- Very Good
- Good
- Fair
- Poor
- Very Poor
- Did Not Inspect
- Catchment Area

EAST HANTS
We live it!

Scale - 1:10,000

Project #: 226421
East Hants Servicing Capacity Study

EAST HANTS STORMWATER CULVERT ASSESSMENT MAPPING

CULVERT 63 TO 69A

DRAWN BY: MJK

DATE DRAWN: 2023-04-28

RVA 75 years

Legend

Culverts

- Very Good
- Good
- Fair
- Poor
- Very Poor
- Did Not Inspect
- Catchment Area

EAST HANTS
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Scale - 1:15,000

Project #: 226421
East Hants Servicing Capacity Study

EAST HANTS STORMWATER CULVERT ASSESSMENT MAPPING

CULVERT CN24 TO 74

DRAWN BY: MJK

DATE DRAWN: 2023-04-28

RVA 75 years

APPENDIX B

Culvert Inspection Reports

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East Hants Stormwater Assessment Report

Asset ID :	43
Date of Inspection :	March 17, 2023
Culvert Diameter :	
Barrel Type/Material :	
Overall Condition Rating :	Very Good
Comments :	Replaced by storm sewer

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East Hants Stormwater Assessment Report

Asset ID :	44
Date of Inspection :	March 17, 2023
Culvert Diameter :	
Barrel Type/Material :	
Overall Condition Rating :	Very Good
Comments :	Replaced by storm sewer

Photo 1: Catch basin on East side of Highway 2.

Photo 2: Catch basin on East side of shown under embankment at Civic Address 183.

Photo 3: Storm sewer located across the road from catch basin.

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East Hants Stormwater Assessment Report

Asset ID :	45
Date of Inspection :	March 17, 2023
Culvert Diameter :	600mm
Barrel Type/Material :	Concrete
Overall Condition Rating :	Fair
Comments :	Downstream channel filled with vegetation. Water level at obvert. Area behind post office flows to SE swale.

Photo 1: Culvert flowing from Enfield Manor

Photo 2: Catch basin connected to culvert in Post Office Parking Lot

Photo 3: Rear parking lot of Post Office

Photo 4: Downstream channel looking towards pipe

Photo 5: Outlet of pipe underwater

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East Hants Stormwater Assessment Report

Asset ID :	46
Date of Inspection :	March 17, 2023
Culvert Diameter :	600mm
Barrel Type/Material :	Concrete
Overall Condition Rating :	Good
Comments :	Upgraded to storm sewer. 1.7m to bottom of pipe. Pipe flows NW under Home Hardware.

Photo 1: Catch Basin connected to culvert located in Home Hardware Parking Lot

Photo 2: Catch Basin connected to culvert located across the road from Home Hardware

Photo 3: 600mm concrete pipe flowing NW from catch basin across the road from Home Hardware

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East Hants Stormwater Assessment Report

Asset ID :	47
Date of Inspection :	March 17, 2023
Culvert Diameter :	600mm
Barrel Type/Material :	Galvanized Steel
Overall Condition Rating :	Very Poor
Comments :	Downstream channel is full of sediment. Water level 180mm below obvert. Barrel corroded. Rock headwall is falling down. Upstream manhole is in asphalt sidewalk. Catch Basin on lawn draining to culvert.


Photo 1: Cross-section of road above culvert


Photo 2: Outlet of culvert


Photo 3: Ditching around outlet of culvert


Photo 4: Downstream channel


Photo 5: Outlet of culvert with approximately 180mm of water in outlet

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East Hants Stormwater Assessment Report

Asset ID :	48
Date of Inspection :	March 17, 2023
Culvert Diameter :	900mm
Barrel Type/Material :	Concrete
Overall Condition Rating :	Good
Comments :	Barrel is in good condition. Pooling at outlet, no backwater DS. US grass and vegetation growth. Stone head wall recently restored. Landowner states culvert does not have capacity to convey flow. During February rainfall, culvert was 3/4 full at times.

Photo 1: Cross-section of road above culvert

Photo 2: Vegetation growth in upstream channel

Photo 3: Outlet of pipe with restored head-wall

Photo 4: Inlet of culvert

Photo 5: Downstream channel

Photo 6: Catch Basin connected to culvert

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East Hants Stormwater Assessment Report

Asset ID : 49
Date of Inspection : March 17, 2023
Culvert Diameter : 1500mm US, 600 x 1300 DS
Barrel Type/Material :
Overall Condition Rating : Good
Comments : 900mm open above debris. Downstream headwall is leaning, Upstream headwall is in good condition. Shoulder washing away above outlet of culvert. High amount of debris in downstream channel.


Photo 1: Upstream channel


Photo 2: Cross-section of road above culvert


Photo 3: Downstream channel


Photo 4: Outlet of culvert with debris buildup in channel


Photo 5: Storm sewer connected to culvert


Photo 6: 1500mm concrete inlet


Photo 7: Inside of the culvert looking downstream


Photo 8: Inside of catch basin connected to culvert

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East Hants Stormwater Assessment Report

Asset ID :	50
Date of Inspection :	March 17
Culvert Diameter :	900mm S, 750mm N
Barrel Type/Material :	Concrete
Overall Condition Rating :	Good
Comments :	Twin concrete culverts. Debris build up at outlet of both. Storm sewer on west side connected to culverts. 400mm culvert on west side of upstream manhole. No headwall. Upstream storm sewer from White Road subdivision.

Photo 1: Inside of Catch Basin Manhole connected to culvert

Photo 2: 400mm culvert on west side of upstream manhole

Photo 3: Catch basin on west side of culverts

Photo 4: Twin concrete culvert outlets

Photo 5: Downstream channel

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East Hants Stormwater Assessment Report

Asset ID :	52
Date of Inspection :	March 17, 2023
Culvert Diameter :	750mm concrete, 600mm steel, 450mm concrete US
Barrel Type/Material :	
Overall Condition Rating :	Good
Comments :	Minimal high water mark on both culverts. High amount of debris in downstream channel. Gravel inside of upstream end of culvert. Storm sewer on west side connected to culverts.

Photo 1: Downstream channel

Photo 2: Outlet of concrete and steel culverts

Photo 3: Inlet of 450mm concrete culvert

Photo 4: Vegetation growth at outlet of culverts

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East Hants Stormwater Assessment Report

Asset ID :	53
Date of Inspection :	March 17, 2023
Culvert Diameter :	900mm
Barrel Type/Material :	Concrete
Overall Condition Rating :	Very Good
Comments :	Upstream catch basin on top of pipe. Gabion headwall around ponding inlet. Flow passing through. Flow through 600mm culverts Downstream flows under Elmsdale Truck Yard, one heading East and one heading southeast. Storm sewer on west side of highway.

Photo 1: Upstream catch basin

Photo 2: Outlet of pipe to to pipe flowing under Truck Yard

Photo 3: Inside of upstream catch basin showing flow into pipe

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East Hants Stormwater Assessment Report

Asset ID :	54
Date of Inspection :	March 17, 2023
Culvert Diameter :	900mm
Barrel Type/Material :	Concrete
Overall Condition Rating :	Good
Comments :	Upstream swale is grass with little obstruction. Gabion basket headwall in good condition. 600 x 600 downstream. Outlet to 450mm southeast. Vertical shoulder on top of culvert.

Photo 1: Outlet of culvert to 450mm pipe to the southeast

Photo 2: Inlet to culvert

Photo 3: Grassy swale flowing into culvert

Photo 4: Inside of culvert looking downstream

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East Hants Stormwater Assessment Report

Asset ID :	55
Date of Inspection :	March 17, 2023
Culvert Diameter :	1100 x 1400
Barrel Type/Material :	Concrete Box
Overall Condition Rating :	Good
Comments :	Vertical face downstream in good condition. Debris buildup in downstream channel. Water depth 400mm in culvert. Upstream pipe 1500 diameter. Prone to back up when river is high. Gabion basket headwall in good condition.

Photo 1: Downstream channel

Photo 2: Upstream flow to culvert

Photo 3: Outlet of culvert

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East Hants Stormwater Assessment Report

Asset ID :	56
Date of Inspection :	March 17, 2023
Culvert Diameter :	770mm
Barrel Type/Material :	Concrete
Overall Condition Rating :	Very Good
Comments :	Brand new culvert. Stone slope along embankment to shoulder. Gravel deposits in downstream channel. 450mm open depth. Upstream channel fairly clean.

Photo 1: Flow out of outlet

Photo 2: Gravel deposits at outlet of culvert

Photo 3: Drainage ditch on side road flowing to culvert

Photo 4: Inlet of culvert

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East Hants Stormwater Assessment Report

Asset ID :	57
Date of Inspection :	March 17, 2023
Culvert Diameter :	600mm
Barrel Type/Material :	Galvanized Steel
Overall Condition Rating :	Good
Comments :	Downstream channel closed in. Shallow drainage area over grown with vegetation. 800mm CN culvert in good condition. Upstream catch basin in good condition. Manhole above sidewalk.

Photo 1: Outlet of culvert

Photo 2: Downstream channel flowing to CN Culvert 13

Photo 3: Catch basin connected to culvert with cracking across road

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East Hants Stormwater Assessment Report

Asset ID :	58
Date of Inspection :	
Culvert Diameter :	
Barrel Type/Material :	
Overall Condition Rating :	
Comments :	Could not find culvert.

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East Hants Stormwater Assessment Report

Asset ID :	59
Date of Inspection :	March 17, 2023
Culvert Diameter :	600mm
Barrel Type/Material :	Galvanized Steel
Overall Condition Rating :	Good
Comments :	500mm drop from pipe to channel. Small debris build up in DS channel but no blockages. Stable stone headwall around US end of pipe. US blocked by bales. A second steel culvert flows into the inspected culvert. No debris buildup in US culvert.


Photo 1: Outlet of culvert


Photo 2: Downstream channel


Photo 4: Bales blocking invert of culvert


Photo 5: Steel culvert flowing into Culvert 59

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East Hants Stormwater Assessment Report

Asset ID :	60
Date of Inspection :	March 17, 2023
Culvert Diameter :	1250 x 1280
Barrel Type/Material :	Concrete Box
Overall Condition Rating :	Good
Comments :	Culvert clean with no blockages. Upstream retaining wall leaning. Downstream headwall corroded. Wetland upstream.


Photo 1: Downstream Channel


Photo 2: Vegetation in upstream channel


Photo 3: Upstream head-wall


Photo 4: Downstream headwall


Photo 5: Outlet of culvert


Photo 6: Inside of culvert looking downstream

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East Hants Stormwater Assessment Report

Asset ID :	61
Date of Inspection :	March 17, 2023
Culvert Diameter :	
Barrel Type/Material :	
Overall Condition Rating :	Fair
Comments :	Small culvert. Outlet between Highway 2 and railway. Pipe completely full of gravel except for top 100mm. Signs of high flow downstream. Local water moving after removing some gravel from pipe and channel.

Photo 1: Flow from culvert after clearing debris

Photo 2: Looking at roadway from outlet of culvert

Photo 3: Outlet of culvert

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East Hants Stormwater Assessment Report

Asset ID :	63
Date of Inspection :	March 17, 2023
Culvert Diameter :	900 x 750
Barrel Type/Material :	Concrete Box
Overall Condition Rating :	Good
Comments :	No flow, sediment on bottom of culvert. Concrete headwall with culvert structure. US pipe 450mm, connected to manhole. Big rocks inside of pipe and around pipe is blocking flow entrance. Grass buildup in channel. Storm sewer on west side with sidewalk.

Photo 1: Outlet of culvert

Photo 2: Inlet of culvert

Photo 3: Downstream channel

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East Hants Stormwater Assessment Report

Asset ID :	64
Date of Inspection :	March 17, 2023
Culvert Diameter :	1200mm
Barrel Type/Material :	Concrete
Overall Condition Rating :	Very Good
Comments :	Very low high water mark. Little flow. Downstream channel clear. Upstream channel clear. Rip-rap embankment on upstream and downstream.

Photo 1: Inside of culvert looking upstream

Photo 2: Outlet of culvert

Photo 3: Inlet of culvery

Photo 4: Downstream channel

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East Hants Stormwater Assessment Report

Asset ID :	65
Date of Inspection :	March 17, 2023
Culvert Diameter :	1050
Barrel Type/Material :	Concrete
Overall Condition Rating :	Very Good
Comments :	Downstream channel is open wetland. Barrel in good condition. Upstream channel is riprap. 250mm of water in downstream end of pipe due to grass. Check dams and ditch rock lining from the south.

Photo 1: Inside of culvert looking upstream

Photo 2: Inlet of culvert with rip-rap channel

Photo 3: Upstream rip-rap channel

Photo 4: Downstream outlet

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East Hants Stormwater Assessment Report

Asset ID :	66
Date of Inspection :	March 17, 2023
Culvert Diameter :	900
Barrel Type/Material :	Concrete
Overall Condition Rating :	Good
Comments :	600mm diameter upstream to MH, changes to 900mm out of MH. Riprap around sides and top of pipe. Downstream channel in good condition, bends to the south after discharge. 250mm drop to channel from culvert. Vegetation and rock blocking entrance.


Photo 1: Outlet area of culvert


Photo 2: Outlet of culvert with rock head-wall


Photo 3: Debris in upstream channel from brush cutting operations


Photo 4: Debris in inlet from brush cutting operations


Photo 5: Downstream channel


Photo 6: Road cross-section above culvert

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East Hants Stormwater Assessment Report

Asset ID :	67
Date of Inspection :	March 17, 2023
Culvert Diameter :	750mmUS, 1200mm DS
Barrel Type/Material :	Concrete
Overall Condition Rating :	Very Good
Comments :	New culvert on North side or road heading southeast. 600mm open depth. Culvert realigned with roundabout along with tributary. Good flow. Downstream end grated. Wide open rip rap channel.


Photo 1: Outlet of culvert


Photo 2: Inlet of culvert


Photo 3: Realigned upstream tributary


Photo 4: Downstream channel

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East Hants Stormwater Assessment Report

Asset ID :	68
Date of Inspection :	March 17, 2023
Culvert Diameter :	1600 x 1800 DS, 2400 x 1800 US
Barrel Type/Material :	Concrete Box
Overall Condition Rating :	Very Good
Comments :	Strong flow. Concrete in good condition. Small drop at outlet. US channel and invert in good condition. Small drop in middle at joint.

Photo 1: Inlet to culvert

Photo 2: Outlet of culvert

Photo 3: Downstream channel

Photo 4: Upstream channel

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East Hants Stormwater Assessment Report

Asset ID :	69
Date of Inspection :	March 29, 2023
Culvert Diameter :	750mm
Barrel Type/Material :	Concrete
Overall Condition Rating :	Good
Comments :	Upstream end blocked by downed tree. 300mm of bottom of culvert filled with debris, limited capacity. Good flow in downstream channel along laneway. Road above culvert has cracking. Asphalt walkway on east side.

Photo 1: View of area which flows through culvert

Photo 2: Road cross-section above culvert

Photo 3: Outlet of culvert

Photo 4: Downstream channel

Photo 5: Downstream channel of Culvert 69A

Photo 6: Tree blocking inlet

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East Hants Stormwater Assessment Report

Asset ID :	69A
Date of Inspection :	March 29
Culvert Diameter :	750mm
Barrel Type/Material :	Concrete
Overall Condition Rating :	Fair
Comments :	Local drainage from storm sewer which services daycare and Frederick Allen Drive. Perforated pipe flowing in upstream channel. Downstream channel clear with backwater observed. Pipe half full of water. Pipe collects local water from highway.

Photo 1: Upstream drainage ditch


Photo 2: Inlet to culvert with perforated pipe


Photo 3: Downstream channel looking towards Culvert 69


Photo 4: Road cross-section above culvert


Photo 5: Outlet of culvert

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East Hants Stormwater Assessment Report

Asset ID :	70
Date of Inspection :	March 29, 2023
Culvert Diameter :	600mm
Barrel Type/Material :	Concrete
Overall Condition Rating :	Fair
Comments :	Culvert half full of debris. Serves senior townhouse development upstream. Local ditch inlets in yards on North side. Asphalt walkway on west side with manholes. 200mm PVC pipe at west side of manhole to serve local yard. DS channel grown in with grass.


Photo 1: Cross-section of road above culvert


Photo 2: Shoulder of road above outlet


Photo 3: Seniors complex upstream drainage area


Photo 4: Outlet of culvert full half full of debris


Photo 5: Catch basin in local yard upstream


Photo 6: Downstream channel

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East Hants Stormwater Assessment Report

Asset ID :	71
Date of Inspection :	March 29, 2023
Culvert Diameter :	Conspan 2.30m vertical opening, 10m wide
Barrel Type/Material :	Concrete
Overall Condition Rating :	Very Good
Comments :	Conspan in very good condition, looks new. Wingwalls lined with riprap. Downstream channel drops from invert. Upstream channel drops into culvert (natural bottom). 11 pieces to culvert. High water mark 260mm above footings.

Photo 1: Conspan from downstream side

Photo 2: Conspan from upstream side

Photo 3: Downstream channel

Photo 4: Upstream channel

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East Hants Stormwater Assessment Report

Asset ID :	72
Date of Inspection :	March 29, 2023
Culvert Diameter :	1400mm
Barrel Type/Material :	Concrete
Overall Condition Rating :	Good
Comments :	400mm water level. Downstream channel clean with good flow. 900mm steel culvert beside. Rusty and in poor condition. Downstream of steel culvert clogged with debris. Upstream channel flows well. New gabion head wall.

Photo 1: Road cross-section above culvert (looking Northeast)

Photo 2: Road cross-section above culvert (looking Southwest)

Photo 3: Inlet to culverts with new gabion basket

Photo 4: Outlet of culvert. Notice full flow from concrete culvert however steel culvert has debris buildup

Photo 5: Upstream channel

Photo 6: Downstream channel

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East Hants Stormwater Assessment Report

Asset ID :	73
Date of Inspection :	March 29, 2023
Culvert Diameter :	750mm
Barrel Type/Material :	Concrete
Overall Condition Rating :	Good
Comments :	Stone installed to protect pipe on upstream side. Upstream channel grown over but flowing good with local ditching from woods. Downstream channel has little flow due to grass build up blocking channel. 100mm water depth in pipe.


Photo 1: Outlet of pipe with approximately 100mm of standing water in pipe


Photo 2: Road cross-section above culvert looking Northeast


Photo 3: Road cross-section of culvert looking Southwest


Photo 4: Downstream channel looking Southwest


Photo 5: Upstream channel looking Southwest


Photo 6: Inlet to culvert

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East Hants Stormwater Assessment Report

Asset ID :	74
Date of Inspection :	March 29, 2023
Culvert Diameter :	750mm
Barrel Type/Material :	Concrete
Overall Condition Rating :	Good
Comments :	320mm water level downstream. Upstream and downstream channels are overgrown. Local ditching on each side of culvert. At time of inspection, no development upstream.


Photo 1: Cross-section of road above culvert looking Northeast


Photo 2: Cross-section of road above culvert looking Southwest


Photo 3: Overgrown vegetation in upstream channel


Photo 4: Inlet to culvert


Photo 5: Outlet of culvert


Photo 6: Downstream culvert with vegetation obstructions

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East Hants Stormwater Assessment Report

Asset ID :	CN 22
Date of Inspection :	March 29, 2023
Culvert Diameter :	900mm
Barrel Type/Material :	Concrete
Overall Condition Rating :	Good
Comments :	Good flow through upstream.

Photo 1: Upstream channel

Photo 2: Inlet to culvert

Photo 3: Inside of culvert looking downstream

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East Hants Stormwater Assessment Report

Asset ID :	CN 23
Date of Inspection :	March 29, 2023
Culvert Diameter :	450mm
Barrel Type/Material :	Galvanized Steel
Overall Condition Rating :	Fair
Comments :	Culvert is buried with little flow. 250mm of culvert is filled with gravel.

Photo 1: Outlet of culvert

Photo 2: Downstream drainage area looking at outlet of culvert

Photo 3: Upstream channel with vegetation growth

Photo 4: Inlet to culvert

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East Hants Stormwater Assessment Report

Asset ID :	CN24
Date of Inspection :	March 29, 2023
Culvert Diameter :	600mm
Barrel Type/Material :	Galvanized Steel
Overall Condition Rating :	Poor
Comments :	200mm water level. Culvert collapsed under railway.

Photo 1: Inside of collapsed culvert

Photo 2: Outlet of culvert

Photo 3: Area upstream of culvert along railway

Photo 4: Inlet to culvert