120 Iber Road, Unit 203
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www.DSEL.ca

September 14, 2012

Jocelyn Chandler M.Pl. MCIP, RPP
Rideau Valley Conservation Authority
3889 Rideau Valley Drive
Ottawa, ON K2C 3H1

Re: RVCA File No. 11-GOU-SUB
Richmond Village (South) Ltd.
Proposed Van Gaal Channel Re-Alignment

DSEL in collaboration with JFSA, nak design strategies, JTBES, and Kilgour and Associates have prepared a preliminary design in support of a Richmond Village (South) Ltd., proposal to realign and widen the Van Gaal Drain north of Perth Street in order to redefine the floodplain North of Perth Street. The following and attached supporting information was prepared to provide the Rideau Valley Conservation an opportunity provide preliminary feedback on the proposed re-alignment.

The supporting information is presented as a first step toward addressing the existing floodplain north of Perth Street. The following meetings and reports concerning the Van Gaal channel and associated floodplain north of Perth Street have taken place to date:

- January 28, 2010 – Supplemental Staff Report to the RVCA Board of directors, supporting a 2008 proposal to raise the grade of the subject property behind the existing constructed berms. The proposal to fill the area behind the berms was relying on fill generated from the development itself. To import fill specifically to raise the grade would have negative environmental impact (ie numerous trucks to import fill).

- May 19, 2011 – Representatives from Richmond Village (South) Ltd., met with RVCA staff to discuss a proposal to widen and realign and widen the Van Gaal drain north of Perth Street as a vehicle to remove the interim floodplain north of Perth Street.

- July 7, 2011 – DSEL submitted a preliminary design and supporting hydraulic analysis to realign and remove the interim floodplain north of Perth Street for RVCA review and input.

- August 5, 2011 – RVCA provided review comments by e-mail to be addressed and considered in the subsequent submission.

A new channel alignment has been contemplated to address the interim floodplain North of Perth Street and also addresses a number of additional issues. The current proposal is a deviation from the previously submitted channel re-alignment and as such, the consulting team felt it prudent to involve the RVCA prior to completing detailed design.

The following supporting information is attached:

- Site photographs of the existing Van Gaal Drain taken 2012-08-30.
    - At the time of the site visit, the existing drain was dry. Note that a total of 81.9mm of rain fell in the previous 30days leading to August 30, with 8.5mm of rain on August 25 (source: The Weather Network Online). The site photographs show that the existing channel has very few trees providing shade.
- Site photographs of the existing Todd Pond outlet taken 2012-08-30.
    - Nak design strategies was part of the team who created the Todd Pond outlet. This channel is fed by an upstream pond, and therefore has a consistent base flow. These photographs illustrate the desired end product for the proposed Van Gaal Drain outlet.
- nak design strategies Van Gaal Drain Re-Alignment and Channel Enhancement Plans
    - The attached plans illustrate a conceptual planting and meandering low flow channel. These plans were developed in coordination with JFSA, JTBES, and Kilgour and Assoc.
- J.F. Sabourin and Associates Inc – Technical Memo
    - Hydraulic Analysis of realigned drain. The channel hydrology considers the type and placement of the proposed landscaping treatment in predicting water levels along the realigned drain. The analysis shows that the 100-year event is contained within the channel. Some modest modifications to the inlet of the Perth Street culvert are required.
- JTBES – Technical memo
    - JTBES provided advice on the proposed re-aligned channel. Their office prepared additional investigations of the downstream water course and have noted areas of concern. The proposed re-aligned channel will reduce upstream velocities and will benefit the downstream system.
- Kilgour and Associates - Technical Memo
    - Kilgour and Associates were involved in discussions pertaining to the realigned drain and were asked for their feedback and input. Their technical memorandum comments on the proposed design and gives design advise.

The following summarizes additional benefits the re-aligned channel will have on the site as a whole.

1. Addresses and contains the interim floodplain north of Perth Street.

a. Proposed channel realignment and widening meets the goals set forth to contain the 100-year flood elevations without increasing water levels.
b. Eliminates the need to import soils to redefine floodplain per previous agreement. Importing additional soils would prevent continued agricultural practices from taking place. Would unnecessarily add numerous vehicles required to import soils, which would have a negative impact on the existing community. IE noise / traffic.

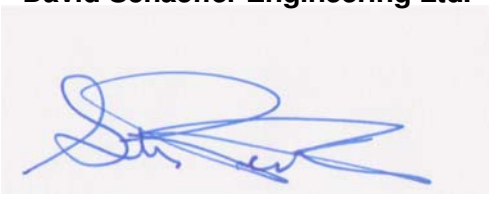
2. Fish Habitat
    a. Channel definition is greater in length and provides opportunity for natural channel design thus improving and adding to the total available habitat.
3. Potential for preservation of woodlot.
    a. Channel definition would potentially minimize the impact on the existing woodlot.
4. No road crossing
    a. Re-aligning channel to the eastern property line eliminates need for the proposed road crossing.
5. Potential for benefit to mitigate existing downstream erosion.
    a. Low flow channel definition may provide opportunities to reduce in stream velocities providing a benefit downstream (JTBES to confirm requirements, JFSA to review impact of greater friction in channel on predicted water levels.)
6. Removes Isolated Stormwater Management Facility
    a. The previous alignment required the introduction of a small stormwater management facility to service a 3.4ha area. The previously conceived facility was not optimal in that it serviced an area less than MOE recommendations (greater than 5ha). Eliminating this facility reduces infrastructure requirements for development. In turn potential reduction in capital expenditures as well as operation and maintenance.

We look forward to discussing the attached proposal and moving forward with detailed engineering plans.

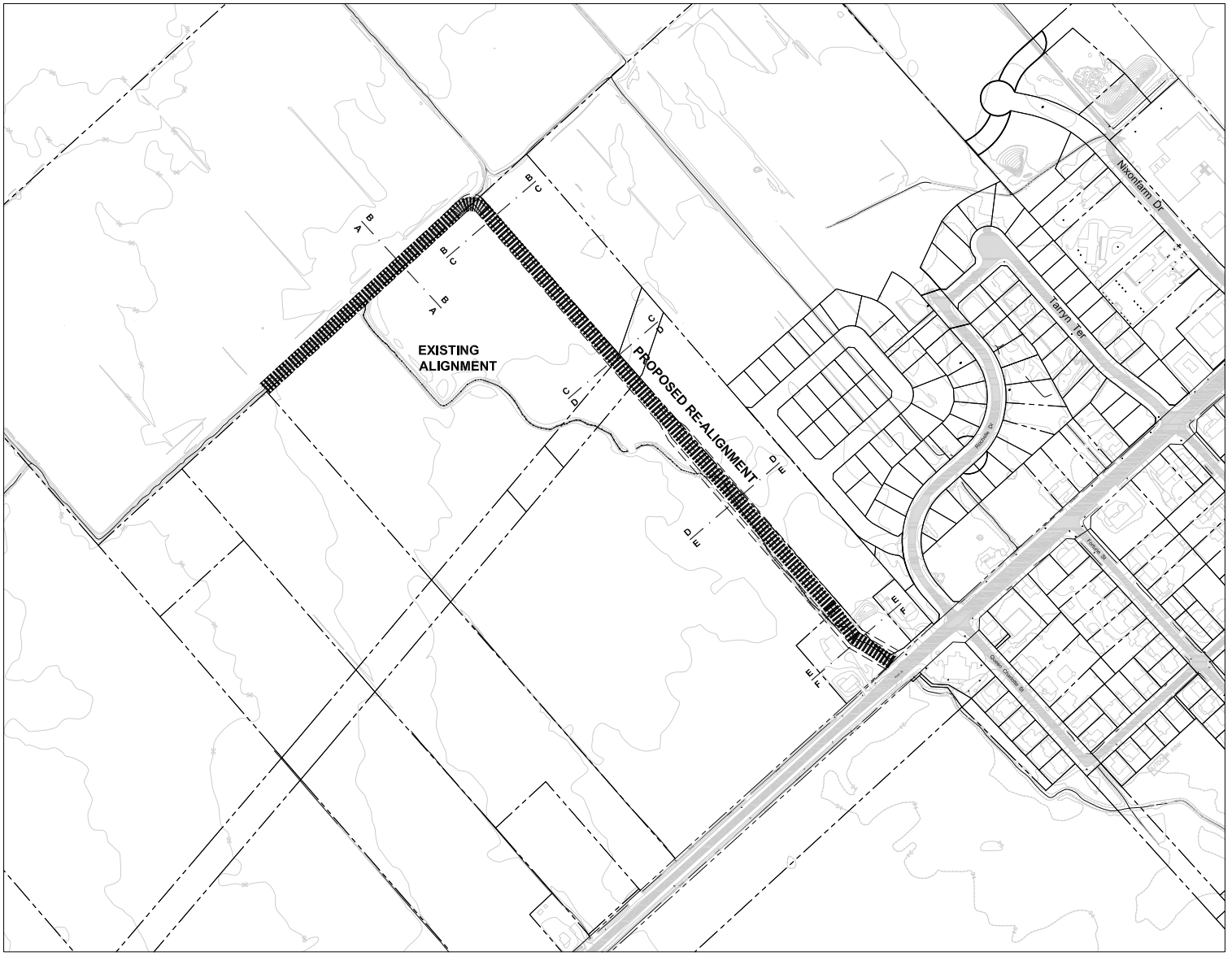
Yours truly,
David Schaeffer Engineering Ltd.

Per: Adam D. Fobert, P.Eng.

Yours truly,
David Schaeffer Engineering Ltd.



Per: Stephen J. Pichette, P.Eng.



VAN GAAL DRAIN RE-ALIGNMENT & CHANNEL ENHANCEMENTS

Richmond Village Development Corporation

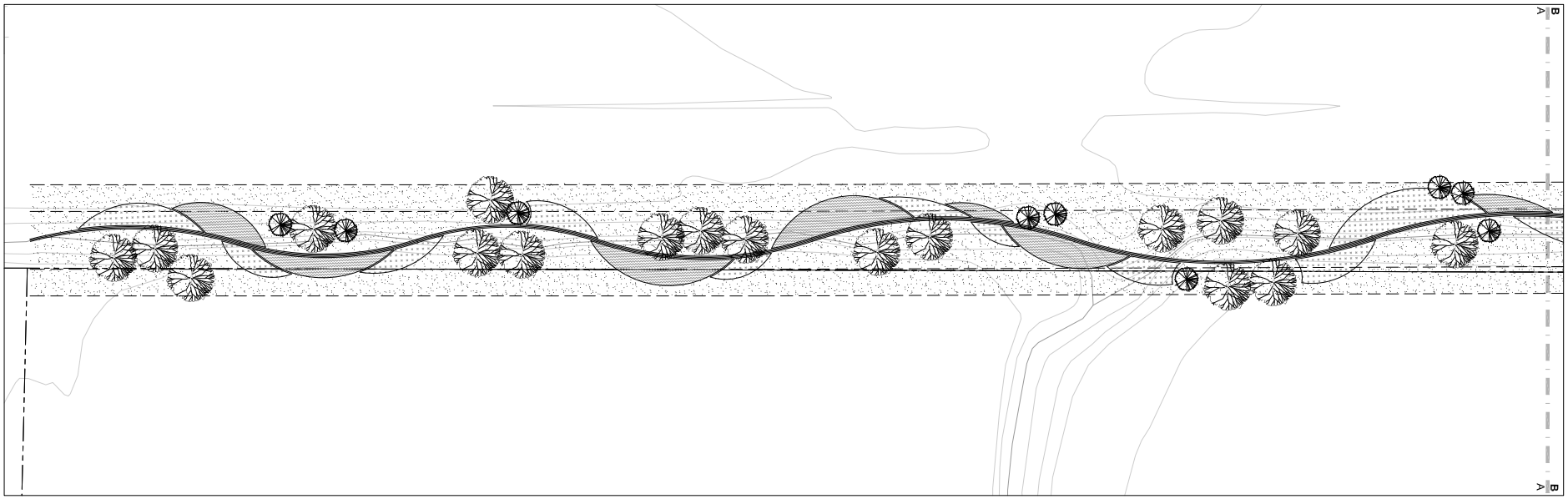
CONTEXT

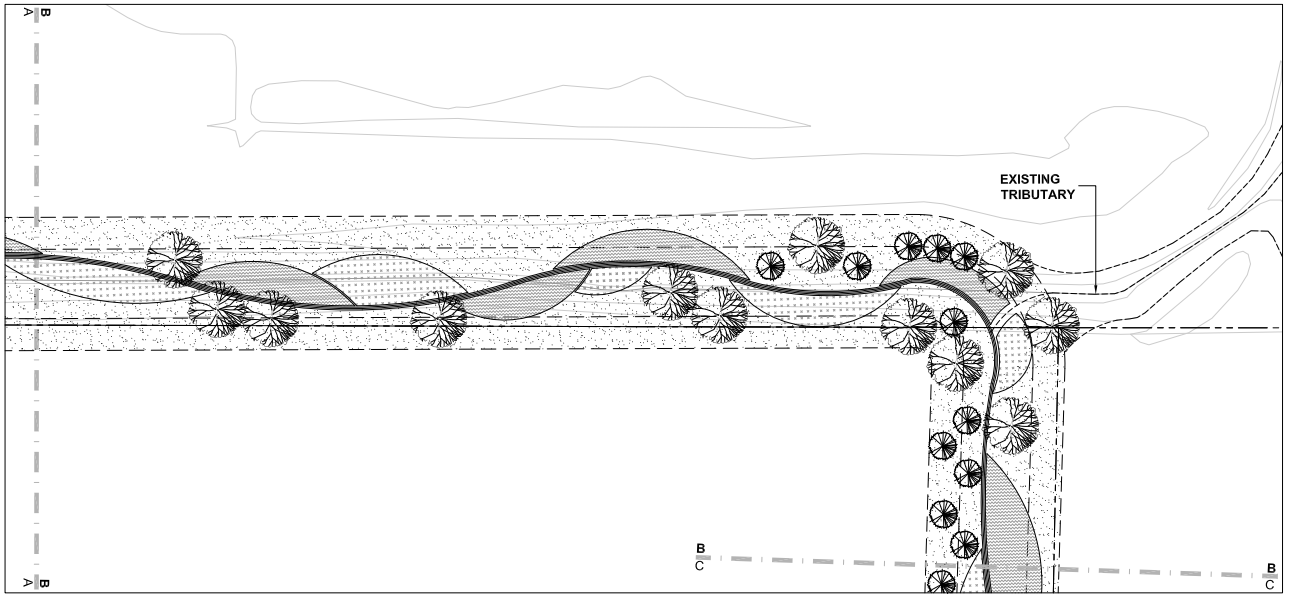
12.08.30

1:2000

Job No. 1-12

nak design strategies
250 Bessemer Street | Studio 100 | Ottawa, Ontario | K1R 6B3
tel: 613.237.2345 | fax: 613.237.8423 | nak@nak-design.com





PROPOSED PLANT LIST

DECIDUOUS TREES
SUGAR MAPLE
RED MAPLE
SILVER MAPLE
BUR OAK
RED OAK
TREMBLING ASPEN
BLACK WILLOW

CONIFEROUS TREES
TAMARACK
WHITE SPRUCE
WHITE PINE
WHITE CEDAR

SHRUBS
PEACH-LEAVED WILLOW
BEBB'S WILLOW
PUSSY WILLOW
STAGHORN SUMAC
COMMON ELDERBERRY
SERVICEBERRY
NANNYBERRY
HIGHBUSH CRANBERRY
RED OSIER DOGWOOD
GRAY DOGWOOD
CHOKECHERRY

WET MEADOW SEED MIX
25% CANADA BLUE JOINT GRASS
25% ROUGH-STALKED MEADOW GRASS
20% HIGHLAND COLONIAL BENTGRASS
15% CREEPING RED FESCUE
5% TALL WHITE ASTER
10% NEW ENGLAND ASTER

DRY-MESIC MEADOW SEED MIX
25% CANADA BLUE GRASS
25% CREEPING RED FESCUE
25% PERENNIAL RYEGRASS
10% RED CLOVER
10% BLACK-EYED SUSAN
5% NEW ENGLAND ASTER

LEGEND

DECIDUOUS TREE
CONIFEROUS TREE
TOP / BOTTOM OF SLOPE
EXISTING TRIBUTARY
SEEDING
SHRUB MIX 'A'
SHRUB MIX 'B'
STABILIZATION PLANTING

PLANTING KEY
XX / # — TREE SPECIES / QUANTITY
X / # — SHRUB SPECIES / QUANTITY

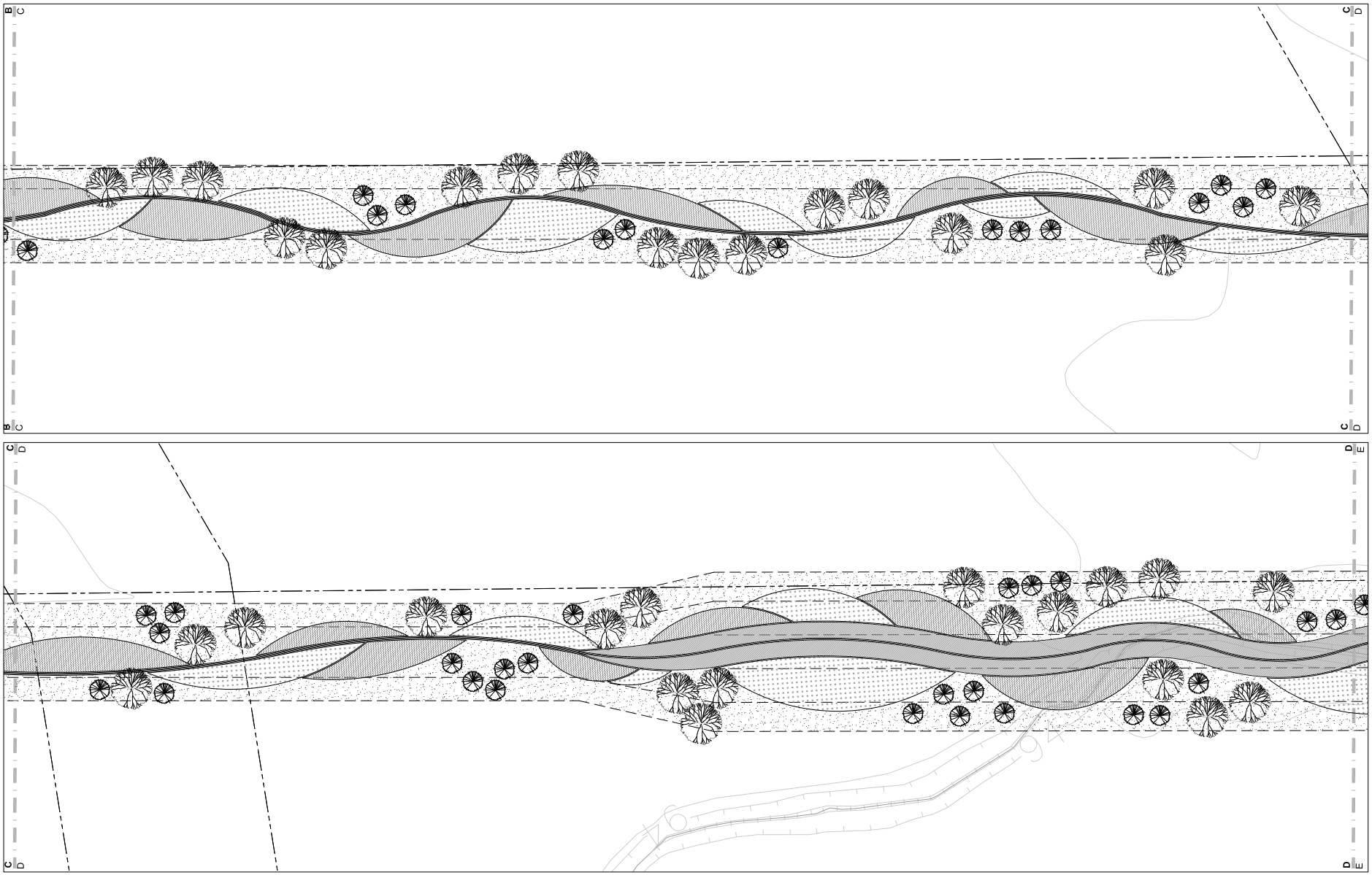
VAN GAAL DRAIN RE-ALIGNMENT & CHANNEL ENHANCEMENTS

Richmond Village Development Corporation

LAYOUT PLANS

12.09.31
1:200
Job No. 1-12

nak design strategies
250 Bessemer Street | Studio 100 | Ottawa, Ontario | K1R 6B3
tel: 613.237.2345 | fax: 613.237.8423 | nak@nak-design.com



VAN GAAL DRAIN RE-ALIGNMENT & CHANNEL ENHANCEMENTS

Richmond Village Development Corporation

LAYOUT PLANS

12.09.31

1:200

Job No. 1-12

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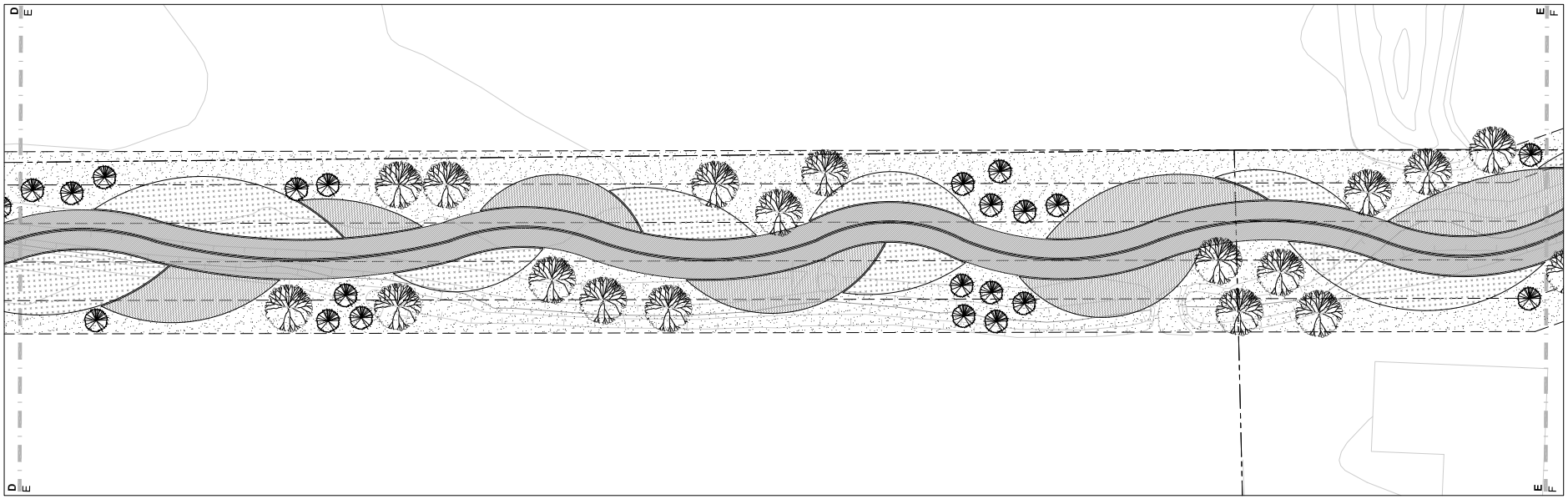

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SILVER MAPLE
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RED OAK
TREMBLING ASPEN
BLACK WILLOW

CONIFEROUS TREES
TAMARACK
WHITE SPRUCE
WHITE PINE
WHITE CEDAR

SHRUBS
PEACH-LEAVED WILLOW
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COMMON ELDERBERRY
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10% BLACK-EYED SUSAN
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DECIDUOUS TREE
CONIFEROUS TREE
TOP / BOTTOM OF SLOPE
SEEDING
SHRUB MIX 'A'
SHRUB MIX 'B'
STABILIZATION PLANTING

PLANTING KEY
XX / # — TREE SPECIES / QUANTITY
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VAN GAAL DRAIN RE-ALIGNMENT & CHANNEL ENHANCEMENTS

Richmond Village Development Corporation

LAYOUT PLANS

12.09.31
1:200
Job No. 1-12

nak design strategies
250 Bessemer Street | Studio 100 | Ottawa, Ontario | K1H 8B3
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J.F. Sabourin and Associates Inc.
WATER RESOURCES AND ENVIRONMENTAL CONSULTANTS

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FAX: (613) 836-0332
WEB: www.jfsa.com

September 6, 2012

David Schaeffer Engineering Limited
120 Iber Road, Unit 203
Ottawa, Ontario K2S 1E9

Attention: **Mr. Adam Forbert, P.Eng.**

Subject: **Richmond Village Development / Proposed Realignment of Van Gaal Drain** *our file:922-11*

As requested by your office, we have evaluated, based on the available information as described below, the preliminary channel dimensions required to contain the 100-year design water levels within the proposed realignment of the Van Gaal Drain. It is understood that approximately 900 m of the existing Van Gaal Drain upstream of Perth Street will be realigned to follow the boundary of the Richmond Village Development Corporation site in the Village of Richmond.

In undertaking this work, the following information was considered:

1) HEC-RAS models of Van Gaal Drain under existing conditions (spring and summer) were obtained from the *Floodplain Mapping Report for the Van Gaal and Arbuckle Municipal Drains in the Village of Richmond* (JFSA, November 2009). The November 2009 *Floodplain Mapping Report* defined the maximum flood levels in the Van Gaal Drain based on three scenarios: (1) the Van Gaal Drain 100-year 24-hour SCS peak flow reaches the Jock River; (2) The Van Gaal 100-year spring snowmelt plus rainfall peak flow reaches the Jock River; and (4) The Jock River 100-year spring snowmelt plus rainfall peak flow reaches the outlet of the Van Gaal Drain.

2) The HEC-RAS models of existing conditions were modified to reflect the proposed channel realignment based on information provided by DSEL. As noted above, it is proposed that approximately 900 m of the existing Van Gaal Drain upstream of Perth Street be realigned to follow the boundary of the Richmond Village Development Corporation site. Note that in order to best define the upstream limit of the channel realignment, existing conditions cross-sections were interpolated in HEC-RAS every 50 m between existing conditions cross-sections 2478 and 2157. The downstream limit of the channel realignment is defined by the Perth Street crossing. Refer to Figure 1 for the proposed channel realignment and cross-section locations.

3) Note that the proposed channel realignment will not impact flows in the Van Gaal Drain. As such, flows provided in the existing conditions HEC-RAS models were also used for the proposed conditions models.

4) The proposed channel dimensions were set to contain the 100-year flood levels within the channel for all three spring and summer scenarios, and to set the 100-year proposed conditions water levels at comparable cross-sections (2554, 2478, and 1615 - 1340) equal to or less than the maximum existing conditions flood levels defined in the November 2009 *Floodplain Mapping Report*. Note that 100-year water levels within the majority of the realigned channel are not comparable to existing conditions, given the different locations of the existing and proposed cross-sections.

5) The required low flow channel dimensions for the realigned channel are currently unknown. As such, a 0.3 m deep low flow channel with 0.3 m bottom width, 1H:1V side slopes and 0.9 m top width was assumed for the purposes of this analysis. The top of the low flow channel (beginning of the floodplain) was set to match existing minimum channel elevations at the upstream and downstream limits of the proposed channel

realignment. It should therefore be noted that the bottom of the proposed low flow channel is 0.3 m below the invert of the Perth Street culvert.

6) Two typical cross-sections were sized for the proposed channel realignment; Section A, from the upstream limit of the realignment to cross-section 1682; and Section B, from cross-section 1682 to the downstream limit of the realignment at Perth Street. Refer to Figure 2 for the typical proposed cross-section dimensions. Section A has a floodplain width of 7.5 m and a total depth of 1.7 m based on the existing grade of surrounding lands and the depth required to contain the 100-year design water levels in the channel. Section B has a floodplain width of 15.0 m and a variable depth; the top of the channel is set to match the existing grade of the surrounding land in order to ensure that the adjacent existing Cedarstone Subdivision is unaffected by the proposed channel realignment.

7) The existing conditions HEC-RAS models specify Manning's roughness coefficients of 0.035 for the low flow channel, 0.05 for the banks under spring conditions and 0.08 for the banks under summer conditions. These Manning's roughness coefficients are generally to be maintained in the proposed realigned channel. However, plantings are to be selected in Section B for a 5.0 m wide area of the proposed floodplain (centred around the low flow channel) to set a low Manning's roughness coefficient of 0.04 under both spring and summer conditions.

8) The entrance loss coefficient of Perth Street culvert was changed from 0.5 under existing conditions to 0.2 under proposed conditions, to represent proposed changes to the culvert entrance consisting of a headwall parallel to the embankment (no wingwalls) with three edges rounded to radius of 1/12 barrel dimension. This proposed conditions entrance loss coefficient is in accordance with the *HEC-RAS River Analysis System Hydraulic Reference Manual Version 4.1* (US Army Corps of Engineers, January 2010).

Based on the above information, 100-year design water levels for the proposed realignment of the Van Gaal Drain under the three spring and summer scenarios were determined using HEC-RAS and are presented in Table 1. The proposed conditions 100-year water levels are contained within the proposed channel for all scenarios. Furthermore, as may be seen in Table 1, the proposed conditions water levels at comparable cross-sections are equal to or less than the maximum existing conditions flood levels defined in the November 2009 *Floodplain Mapping Report*.

Yours truly,
J.F. Sabourin and Associates Inc.

Laura Pipkins, P.Eng.

cc: J.F. Sabourin, M.Eng, P.Eng.
Director of Water Resources Projects

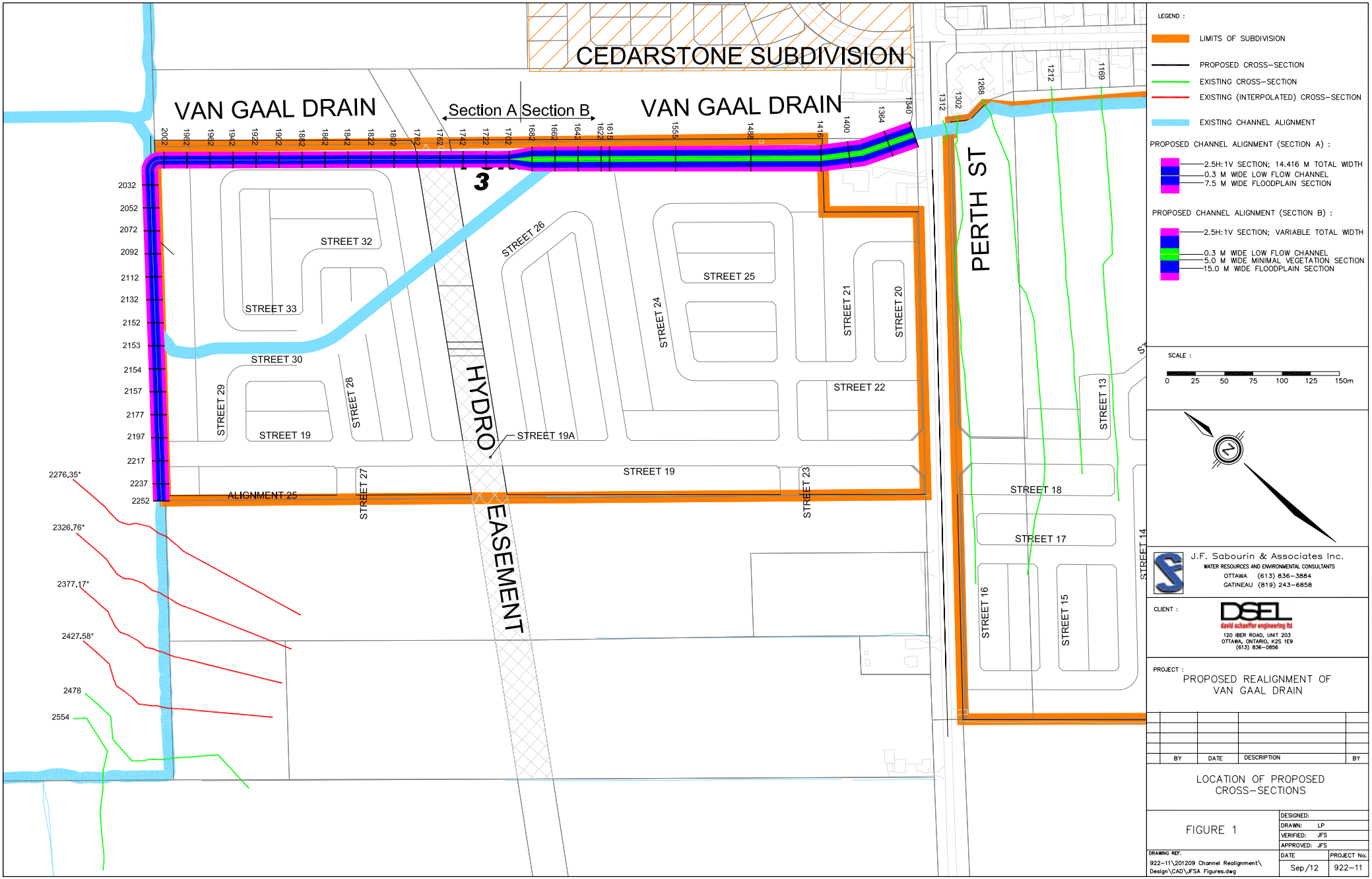
Table 1: Water Levels on Van Gaal Drain Reach 2 to Perth Street Under Proposed Conditions [1]

River Station	Scenario			
	1	*2*	*4*	*Max. Allowable* [2]
2554	96.26	96.28	95.86	96.28
2478	96.13	96.14	95.77	96.16
2427.58*	96.04	96.05	95.71	N/A
2377.17*	95.95	95.95	95.63	N/A
2326.76*	95.86	95.88	95.53	N/A
2276.35*	95.80	95.64	95.14	N/A
2252	95.77	95.59	95.04	N/A
2237	95.75	95.57	95.02	N/A
2217	95.72	95.55	94.99	N/A
2197	95.69	95.52	94.95	N/A
2177	95.67	95.49	94.92	N/A
2157	95.64	95.47	94.89	N/A
2154	95.62	95.44	94.85	N/A
2153	95.57	95.39	94.81	N/A
2152	95.52	95.35	94.77	N/A
2132	95.48	95.31	94.73	N/A
2112	95.44	95.26	94.69	N/A
2092	95.39	95.22	94.65	N/A
2072	95.35	95.18	94.61	N/A
2052	95.31	95.14	94.57	N/A
2032	95.26	95.10	94.53	N/A
2002	95.20	95.03	94.48	N/A
1982	95.15	94.99	94.44	N/A
1962	95.11	94.95	94.41	N/A
1942	95.06	94.90	94.38	N/A
1922	95.02	94.86	94.35	N/A
1902	94.97	94.82	94.32	N/A
1882	94.92	94.77	94.29	N/A
1862	94.87	94.73	94.27	N/A
1842	94.83	94.69	94.25	N/A
1822	94.78	94.64	94.23	N/A
1802	94.73	94.60	94.21	N/A
1782	94.67	94.56	94.19	N/A
1762	94.62	94.51	94.18	N/A
1742	94.56	94.47	94.17	N/A
1722	94.50	94.42	94.16	N/A
1702	94.44	94.37	94.15	N/A
1682	94.44	94.38	94.15	N/A
1662	94.42	94.37	94.15	N/A
1642	94.41	94.36	94.15	N/A
1622	94.40	94.35	94.14	N/A
1615	94.39	94.35	94.14	94.61
1555	94.37	94.33	94.14	94.55
1488	94.34	94.31	94.14	94.45
1416	94.32	94.30	94.14	94.41
1400	94.31	94.29	94.14	94.36
1364	94.30	94.29	94.13	94.31
1340	94.17	94.16	94.12	94.21

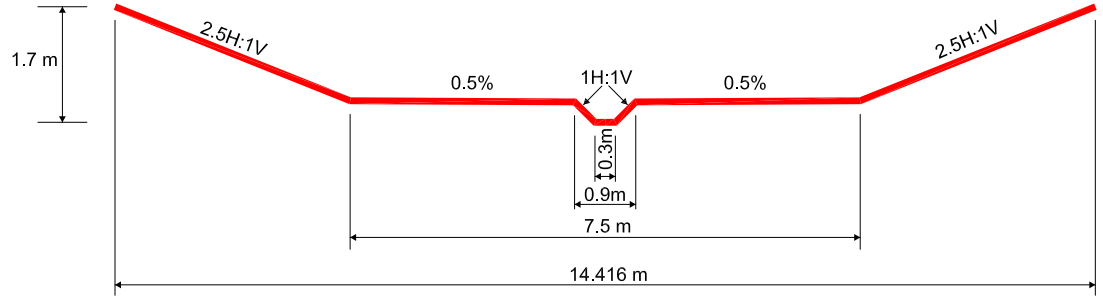
[1] Scenario Descriptions:

1. The Van Gaal Drain 100-year 24-hour SCS peak flow reaches the Jock River.
2. The Van Gaal Drain 100-year spring snowmelt plus rainfall peak flow reaches the Jock River.
4. The Jock River 100-year spring snowmelt plus rainfall peak flow reaches the outlet of the Van Gaal Drain.

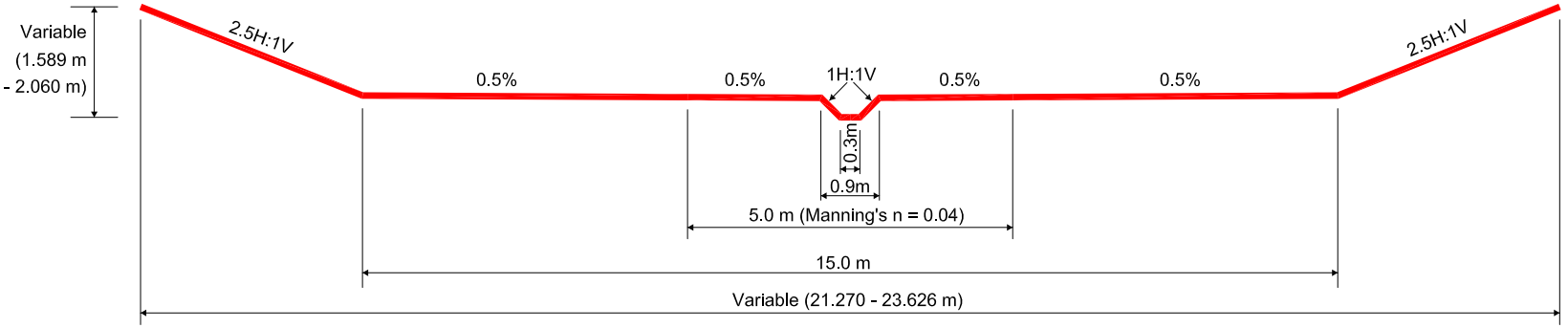
[2] Maximum water level at existing cross-sections as per "*Floodplain Mapping Report for the Van Gaal and Arbuckle Municipal Drains in the Village of Richmond*" (JFSA, November 2009)


CEDARSTONE SUBDIVISION
VAN GAAL DRAIN
Section A Section B
VAN GAAL DRAIN
PERTH ST
STREET 32
STREET 33
STREET 26
STREET 25
STREET 24
STREET 21
STREET 20
STREET 30
STREET 29
STREET 28
STREET 19
HYDRO EASEMENT
STREET 19A
STREET 22
STREET 19
STREET 27
STREET 23
ALIGNMENT 25
STREET 18
STREET 17
STREET 16
STREET 15
STREET 14
STREET 13
2276.35*
2326.76*
2377.17*
2427.58*
2478
2554
LEGEND :
LIMITS OF SUBDIVISION
PROPOSED CROSS-SECTION
EXISTING CROSS-SECTION
EXISTING (INTERPOLATED) CROSS-SECTION
EXISTING CHANNEL ALIGNMENT
PROPOSED CHANNEL ALIGNMENT (SECTION A) :
2.5H:1V SECTION; 14.416 M TOTAL WIDTH
0.3 M WIDE LOW FLOW CHANNEL
7.5 M WIDE FLOODPLAIN SECTION
PROPOSED CHANNEL ALIGNMENT (SECTION B) :
2.5H:1V SECTION; VARIABLE TOTAL WIDTH
0.3 M WIDE LOW FLOW CHANNEL
5.0 M WIDE MINIMAL VEGETATION SECTION
15.0 M WIDE FLOODPLAIN SECTION
SCALE :
0 25 50 75 100 125 150m
N
J.F. Sabourin & Associates Inc.
WATER RESOURCES AND ENVIRONMENTAL CONSULTANTS
OTTAWA (613) 836-3884
GATINEAU (819) 243-6858
CLIENT :
DSEL
david schaeffer engineering ltd
120 IBER ROAD, UNIT 203
OTTAWA, ONTARIO, K2S 1E9
(613) 836-0856
PROJECT :
PROPOSED REALIGNMENT OF
VAN GAAL DRAIN
BY DATE DESCRIPTION BY
LOCATION OF PROPOSED
CROSS-SECTIONS
FIGURE 1
DESIGNED:
DRAWN: LP
VERIFIED: JFS
APPROVED: JFS
DRAWING REF.
922-11\201209 Channel Realignment\
Design\CAD\JFSA Figures.dwg
DATE Sep/12
PROJECT No. 922-11

SECTION A :



SECTION B :



LEGEND :

PROPOSED CROSS-SECTION

SCALE :

0 50 100 150 200 250 300 350 400cm

J.F. Sabourin & Associates Inc.
WATER RESOURCES AND ENVIRONMENTAL CONSULTANTS
OTTAWA (613) 836-3884
GATINEAU (819) 243-6858

CLIENT :

david schaeffer engineering ltd
120 IBER ROAD, UNIT 203
OTTAWA, ONTARIO, K2S 1E9
(613) 836-0856

PROJECT :

PROPOSED REALIGNMENT OF
VAN GAAL DRAIN

BY	DATE	DESCRIPTION	BY

DIMENSIONS OF PROPOSED
CROSS-SECTIONS

FIGURE 2

DESIGNED:
DRAWN: LP
VERIFIED: JFS
APPROVED: JFS

DRAWING REF.
922-11\201209 Channel Realignment\Design\CAD\JFSA Figures.dwg

DATE: Sep/12

PROJECT No.: 922-11

JTB Environmental Systems Inc.
Fluvial Geomorphology Natural Channel Design Coastal Processes Erosion Control

September 6, 2012

David Schaeffer Engineering Limited
120 Iber Road, Unit 203,
OTTAWA, Ontario K2S 1E9

Attention: Mr. Adam Fobert, P. Eng

Subject: Richmond Village Development: Van Gaal Drain Geomorphology Assessment

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JTBES was contacted by DSEL to complete an erosion threshold analysis for the Van Gaal drain. A previous erosion analysis did not appear to factor in sensitivity to erosion for the reach between Perth Street and Fortune Avenue, and it did not include any information between Fortune Avenue and the Jock River outlet.

Further, an assessment of the potential for realigning the existing drain upstream of Perth Street to accommodate site development has also been requested. The overall benefit of the realignment relative to maintaining the existing condition is discussed.

REALIGNMENT OF THE VAN GAAL DRAIN UPSTREAM OF PERTH STREET

A realignment concept has been provided which shows the drain shifting from its current alignment across the property to a position along the boundary of the property. This realignment will result in an overall straightening of the drain corridor; however the low flow function of the drain will be designed to show a sinuous path.

The result of this shift in position will be an increase in the overall stream length of the drain. Normally there would be concerns with sedimentation as energy budgets are affected by such realignments, particularly in low-gradient sections. However, based on our site visits in 2012 it is possible to create a series of steeper and gentler sections along the realigned drain to maintain sediment transport relationships and overall drain function.

A low flow channel will be incorporated into the design. The purpose of the low flow is to provide for fish habitat; the purpose of the overbank areas will be to provide velocity control which will aid in erosion protection. The overall design will be a positive outcome considering the existing condition of the drain. This is discussed further below.

CAUSES OF EXISTING EROSION ON THE VAN GAAL DRAIN

Erosion on the Drain is caused by a number of factors, some of which are natural and others which are induced as a result of changes in land use/hydrologic behaviour.

Natural erosion delivers sediment to the Drain through a number of possible mechanisms, including sheetwash, frost heave and desiccation fracturing, gravity failures due to oversteepening of the banks, and natural weathering of the clays (caused by repeated wet/dry cycles) which weakens the structural bonds in the clay matrix. Once operated upon by these mechanisms flowing water is easily able to erode and transport this weakened material. Large clumps of bank, once in the active channel, get quickly broken down into constituent clay particles which are cohesionless and very susceptible to erosion by flowing water.

Further, as banks become partly separated by slumps, flow from upstream can get behind the failing

portion of the bank and hydraulic pressure forces the bank to fail more quickly. All of these processes (with the exception of frost heaving due to the time of year of the assessment) were visible along the drain.

Induced changes are the result of human activity upstream in the watershed. In this case, a recent small residential development along Rochelle Drive/Mira Court upstream of Perth Street may have changed the hydrologic properties of overland flow in the area. The increased impervious surface, and apparent lack of stormwater detention, delivers runoff quickly to the Drain during storms, creating a first pulse of fast flow through the Drain during storm events. When additional storm inlets are added to the mix (for instance the drain at Queen Charlotte Street) the cumulative effect of this fast rise in stage and velocity could result in erosion.

Finally, there is the construction of the Drain itself to consider. It is not known whether the Drain cross section was designed using flow analysis at the time of design (though the fact that the 2-year flow is well outside the cross-sectional area of the Drain under current conditions may be telling); if the necessary hydrologic calculations were not used to size the Drain then there is a chance it is undersized. This is currently evident as the Drain appears to be widening in response to flows, though it may be a combination of factors that is causing this to occur and, given the upstream development, may have sent the Drain past a stability threshold and initiated erosion at the scale which is evident today.

Results from the geomorphic analysis indicate the Van Gaal Drain system is a sediment rich as well as energy rich (at times of flowing water) system, which erodes, transports and deposits bed material under rising and falling hydrographs under existing conditions.

Mobilization of bed materials which have been deposited from upstream will occur under almost all flows and should be encouraged as the system needs to flush out these large deposits of silts and clays. Establishing a threshold discharge based on these surficial deposits is not appropriate as their transport requires very low velocities. Since the 'bedrock' layer is comprised of tight, cohesive clays and is highly resistant to erosion by flowing water, that material is also unsuitable for establishing thresholds. Therefore, given these two points and the fact that the Drain is eroding its banks in multiple locations, the most appropriate erosion threshold for use in this analysis is the bank erosion threshold.

Erosion along banks can be caused by flows that exceed the theoretical critical velocity for entrainment of the cohesive bank material. Assessment of the conditions of the creek show that the banks are comprised of consolidated clay materials, ranging from coarse to fine clay. When these materials are exposed to flowing water, velocities of between 0.225 metres per second (coarse clay) and 0.400 metres per second (fine clay) are required to entrain (erode) these materials (ref. Hjulstrom, 1935).

IMPLICATIONS

Existing Erosion

The analysis clearly shows that there are significant erosion sites on the Van Gaal Drain that have their cause in a number of areas. Addition of stormwater flows from the proposed site, even if controlled to the threshold rate, will not prevent existing erosion from continuing. It must be well understood that existing erosion will continue to occur for the simple reason that once erosion scars develop in banks they become weak points and as such are susceptible to continual erosion unless an intervention is undertaken. For those sites downstream of the stormwater connection point erosion will continue to

occur, the rates of erosion may be lower as there will be some control on velocities which does not occur at present. For those sites upstream of the connection point, the degree and rates of erosion that are currently occurring will continue and that material which is eroded into the Drain will transport to the downstream reach. This continual influx of high sediment loads from upstream will complicate the erodibility of the downstream section.

OVERALL BENEFIT OF THE REALIGNMENT UPSTREAM OF PERTH STREET

Given erosion conditions in the drain downstream of Perth Street, application of the erosion thresholds and re-design of the drain upstream will provide the following benefit:

1. The existing erosive conditions in the drain upstream of Perth Street will be remediated in the design;and
2. Downstream erosion will be mitigated somewhat through the design upstream through the use of erosion thresholds and design principles tasked with controlling erosional velocities

Existing erosion along the Drain will continue once the site has been developed and while the degree of erosion may be somewhat addressed using the thresholds outlined in this study, the fact of the matter is that all erosion will not cease.

This condition assumes the Drain remains in its current configuration. With that condition in place, application of the erosion thresholds will not exacerbate erosion. There is an opportunity to mitigate some of the existing erosion in Reach 3 in a manner which will reduce some stress on reaches 2 and 1, which would be an overall benefit to the Drain system. Considering use of the Drain by aquatic species there is an added benefit to modification of the form and function of the Drain from the homogeneous nature it currently displays to a more diverse state. This can be done using natural channel design principles.

Natural Channel Design Principles

The purpose of natural channel design is to create/modify a system that is not properly functioning to a state where it is more in equilibrium with processes acting upon it. Doing so builds into the system a natural resilience to flow variability which is found in all stable, functioning watercourse systems. With respect to the Drain, and specifically Reach 3 from Perth Street to Fortune Street, it currently is classified as a straight channel with steep, vertical eroding banks that prevent connection to a floodplain during frequent flow events. Low flow events occupy the same channel width as high flow events which means that, as the Drain dries up, water depth is spread over a wide area resulting in shallow water which is not conducive to fish health. In addition, the concentration of flow during multiple events concentrates energy and erosion. This combination of factors acts to further entrench the Drain and create sidewall erosion as it tries to create a stable form over time.

JTBES has modelled a three-stage channel as described above at a coarse level and finds that through natural channel design it is possible to contain stormwater velocities below the threshold value through the site. Doing so lessens pressure on un-restored reaches downstream.

Details of the channel have also incorporated the channel dimensions used by JFSA in their floodplain analysis and findings support the notion that a stable, functioning system can be developed for the realigned sections of the Van Gaal Drain. Upon acceptance in principle by approval agencies JTBES will complete the full design for submission and will provide documentation with respect to function and lessening of downstream impacts.

If I can provide any further details please contact me directly.

Respectfully Submitted,

John T. Beebe, PhD
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2012 September 7 **Our File: 156**

Mr. Adam Fobert
David Schaeffer Engineering Ltd.
120 Iber Road, Unit 203
Ottawa, Ontario, K2S 1E9

Dear Mr. Fobert,

Reference: **Richmond Village Development, Van Gaal Drain Realignment.**

Per your request, we have reviewed the proposed realignment of the Van Gaal Drain for the Richmond Village Development Corporation, as illustrated in Figures 1 and 2 provided by JF Sabourin and Associates, and in the illustrations of the landscaping plans prepared by NAK Design.

Under a prior assignment in support of development in the area, we demonstrated that the feature can contain up to 16 species of fish (Kilgour & Associates and Parish Geomorphic, 2010). Northern Pike (*Esox lucius*) are known to inhabit the feature, while a pike spawning was feature created near Perth Street. Pike are considered a key species for the area, and any works to the channel should consider the spawning requirements of the species.

We also understand that the Van Gaal Drain was dry this year associated with reduced precipitation in June and July. The feature was very dry in 2008 as well. The feature, therefore, is best described as providing intermittent fish habitat. The existing feature has a bankfull width of ~ 5 m, and has no riparian zone providing shade (Kilgour & Associates and Parish Geomorphic, 2010).

The proposed realignment will lengthen the channel, and increase the wetted area during periods of high flow. The realigned feature will also have a low-flow channel that will enhance the fish habitat value for a longer period of time through dry periods. The floor of the realigned channel will is to be planted with a mixture of plants including a mixture of grasses and sedges that are selected to grow under wet and dry conditions.

The realignment of the feature should be enhance ecological functions of the feature and broader area. Northern pike can be anticipated to use the flat shelves, planted with grasses and sedges, for spawning in the spring when the shelves are inundated with water. Riparian canopy will result in greater shade, and reduce heating of the channel. The improved riparian corridor associated with the realigned feature will increase the movements of larger wildlife like deer, from the Jock River corridor through and to the Richmond Wetland to the west of the study area (assuming that other connections are also made). The various plantings within the corridor will increase the diversity of plant life, thus providing a greater diversity of potential habitats for avifauna.

Realignment of the feature presents a minor risk to fishes in the system. Assuming that fish habitat features are provided for in the design, we anticipate that all of the fish species that were demonstrated to be using the Van Gaal Drain will continue to use the drain after the realignment.

Regards,

KILGOUR & ASSOCIATES LTD.

Bruce Kilgour, PhD

Literature Cited

Kilgour & Associates Ltd., and Parish Geomorphic. 2010. Mattamy Richmond Lands, Natural Environment and Impact Assessment Study.