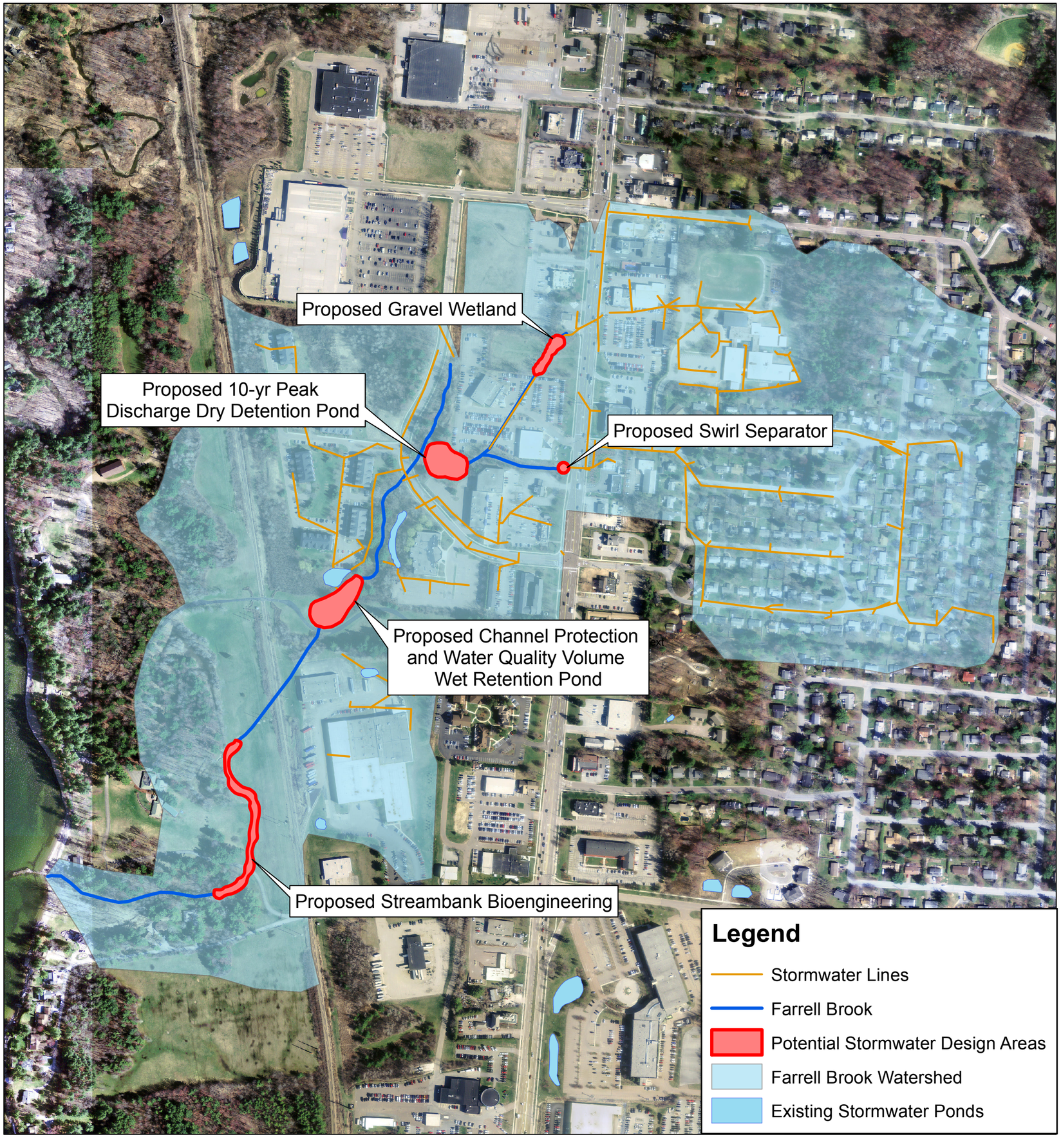
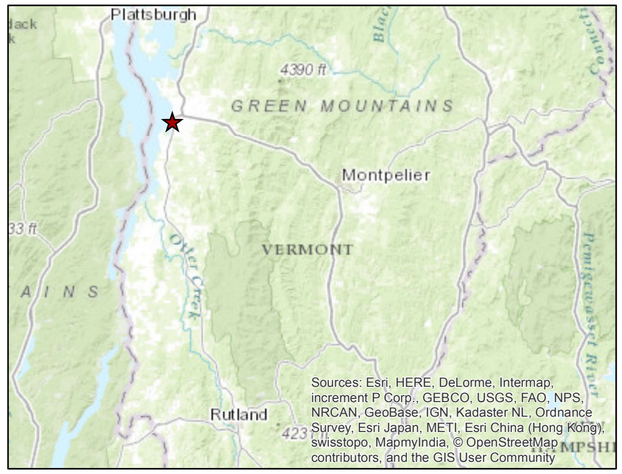
APPENDIX A: Location Maps

The following maps were produced in ArcMap and provide location overview information for the project as a whole and each individual proposed alternative.



Project Overview Map



N

1 inch = 333 feet

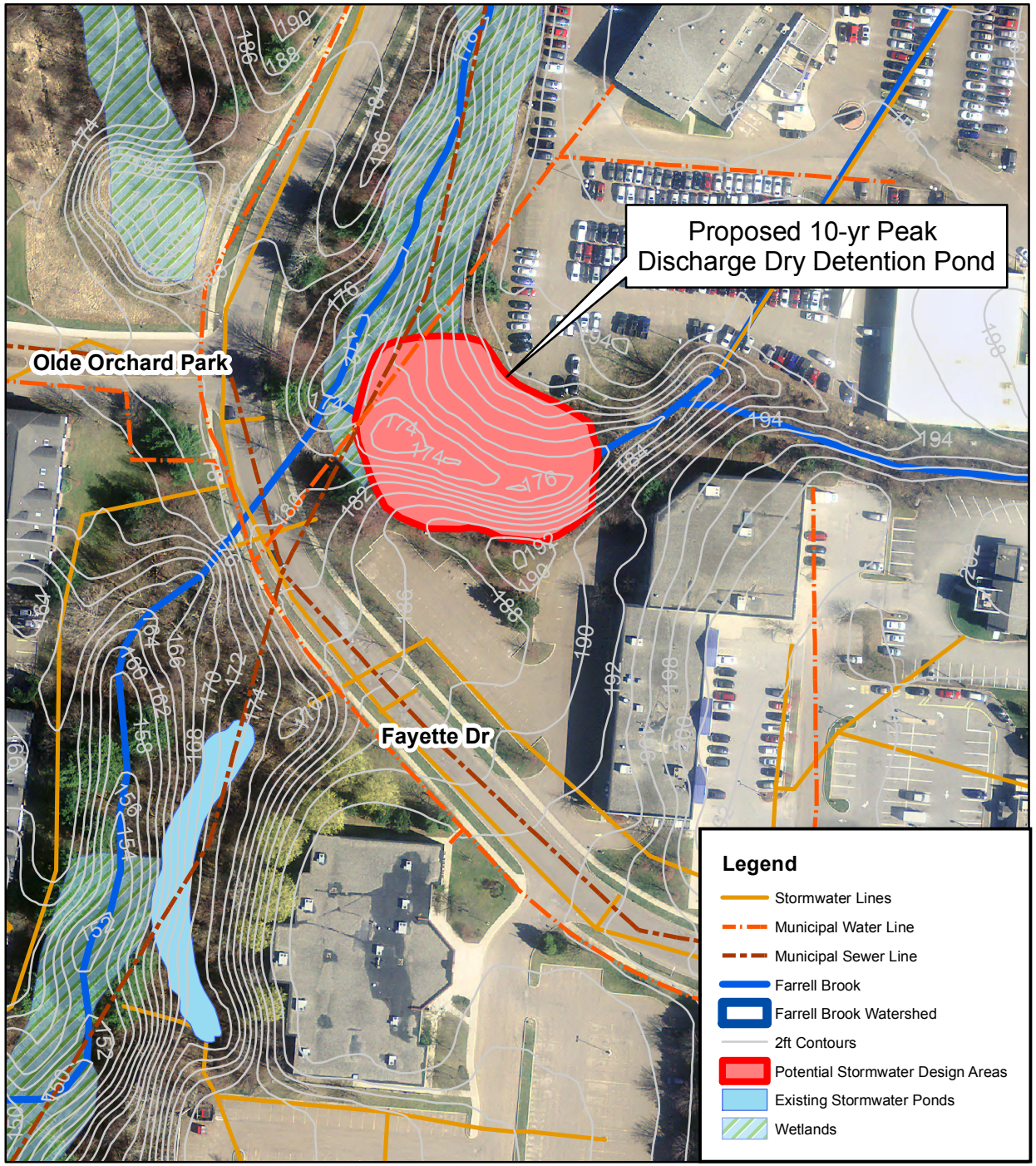
0 250 500 1,000 1,500 2,000 Feet

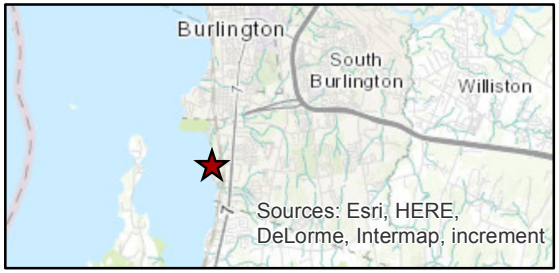
Farrell Brook Watershed

University of Vermont
Senior Design
Spring 2016

Existing pond data provided by the Vermont Agency of Natural Resources (VT ANR).

Detention Pond Location





Farrell Brook Watershed

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Spring 2016

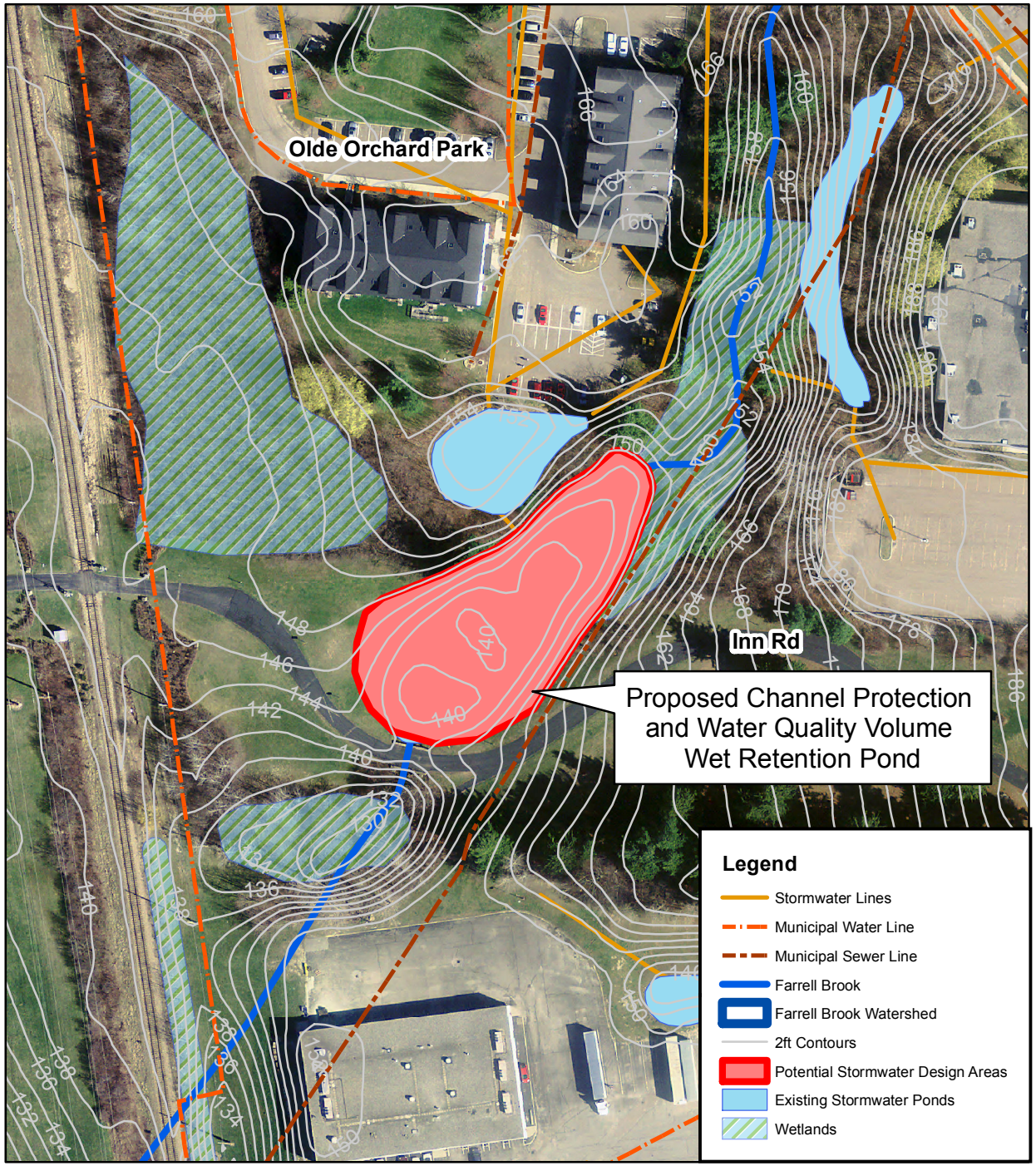
N

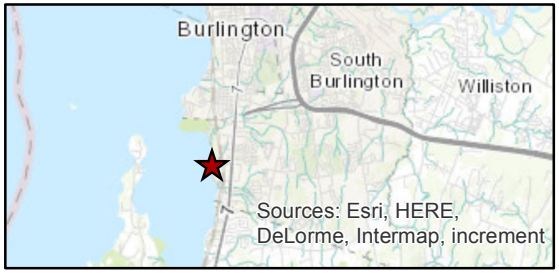
1 inch = 125 feet

0 40 80 160 240 320 Feet

Existing pond, water line, sewer line, and stormwater line data provided by the Vermont Agency of Natural Resources (VT ANR). Further data was download from the Vermont Center for Geographic Information (VCGI) although it may be sourced by outside affiliations. Wetland data by VT ANR. Contour data by VCGI. Imagery provided by VCGI.

Retention Pond Location





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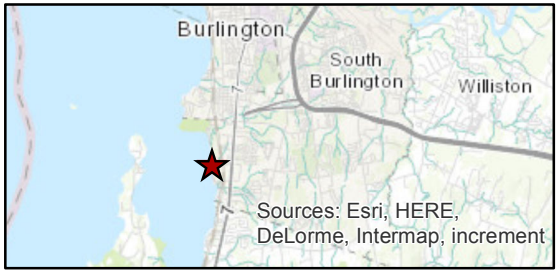
Gravel Wetland Location



Farrell Brook Watershed

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N

1 inch = 125 feet

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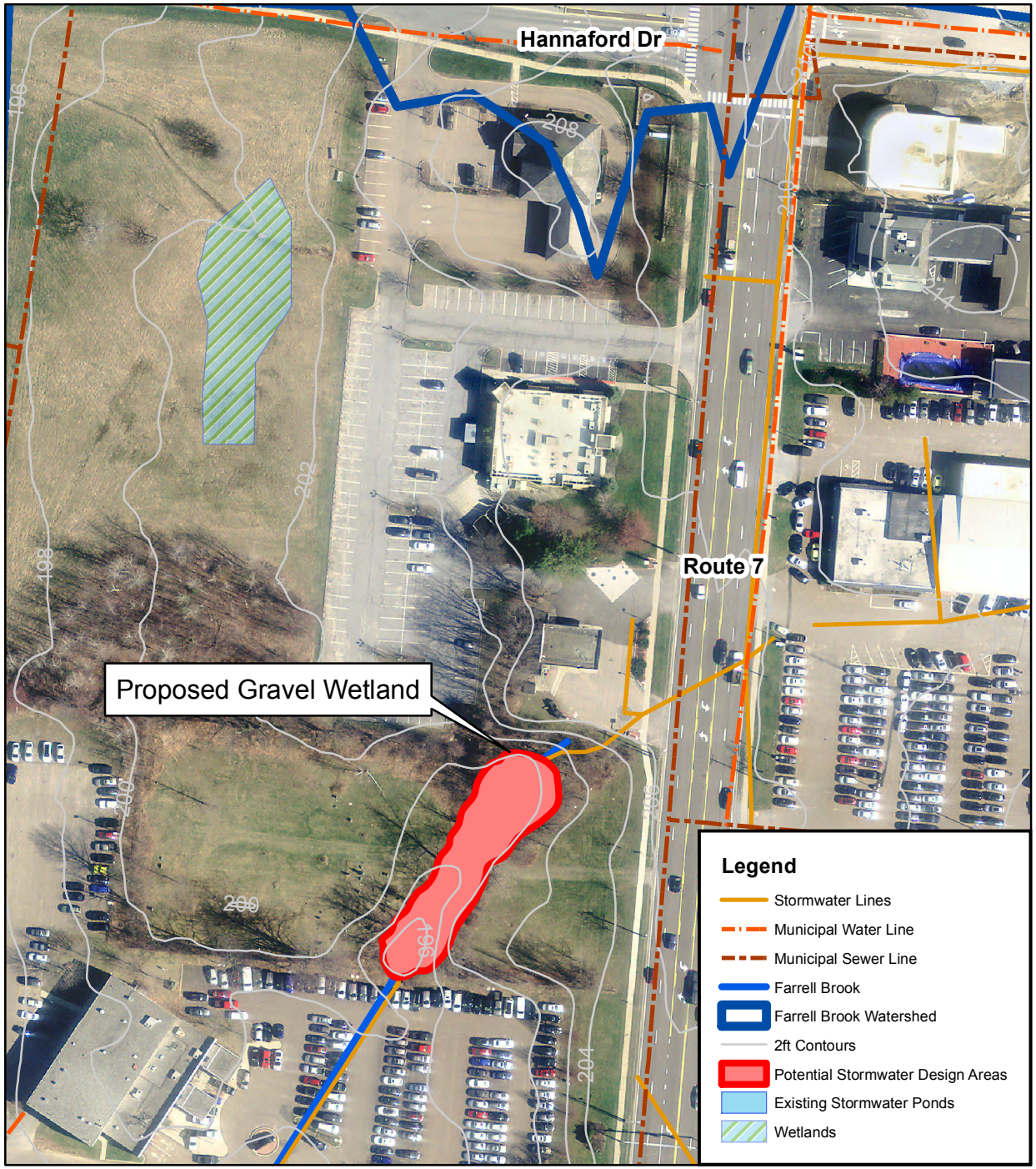
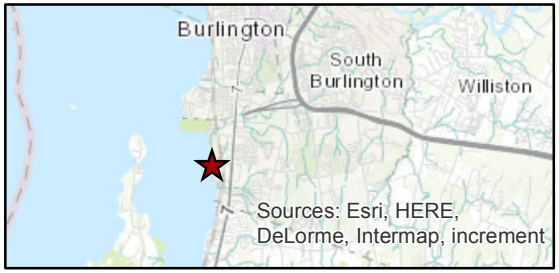
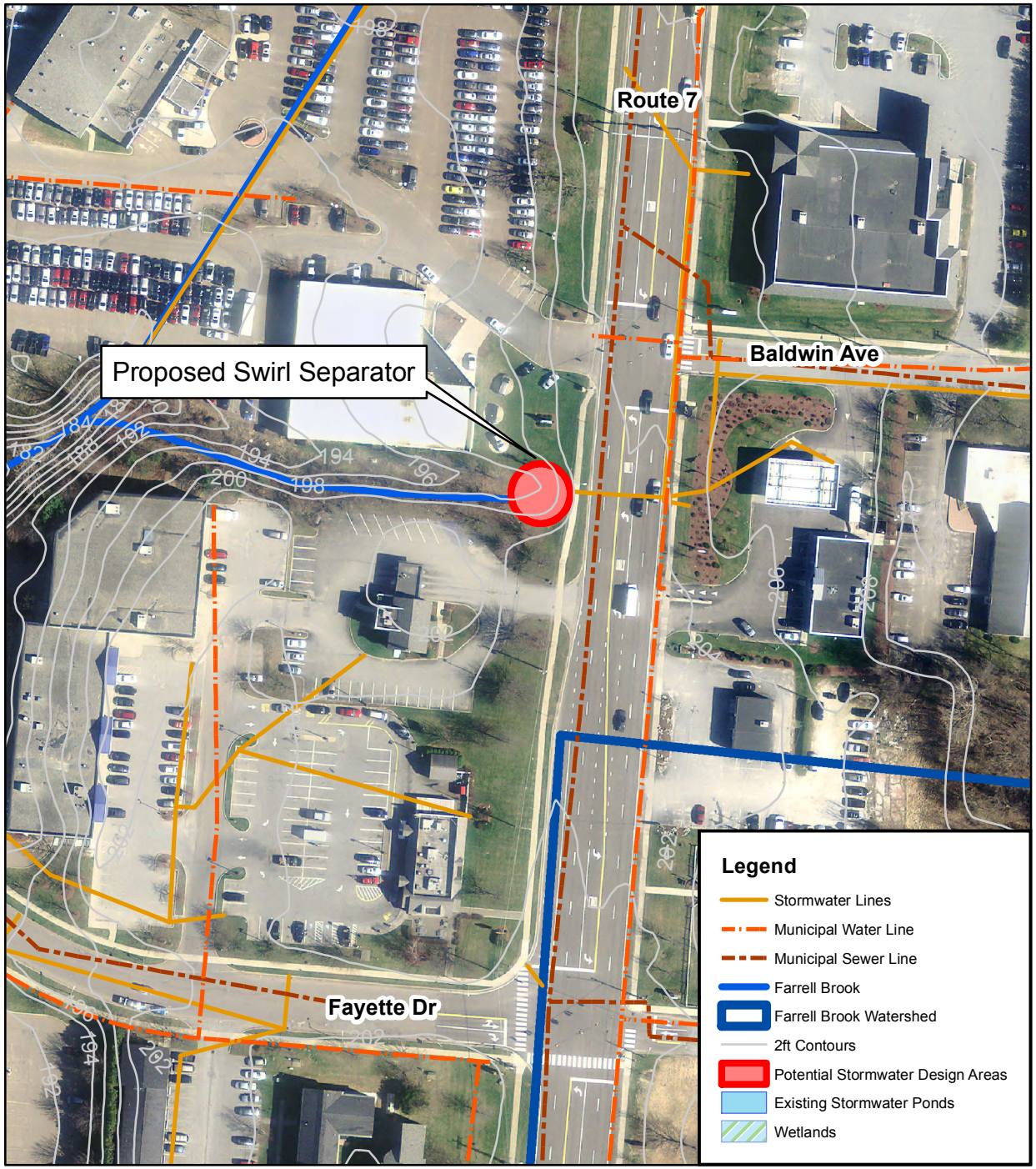


Swirl Separator Location





Farrell Brook Watershed

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Spring 2016

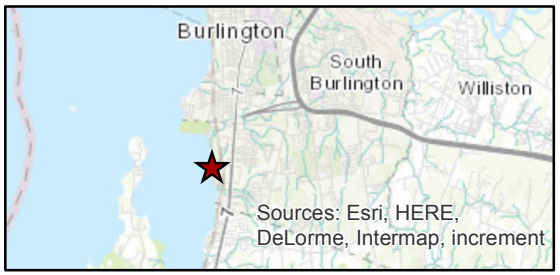
N

1 inch = 125 feet

0 40 80 160 240 320 Feet

Existing pond, water line, sewer line, and stormwater line data provided by the Vermont Agency of Natural Resources (VT ANR). Further data was download from the Vermont Center for Geographic Information (VCGI) although it may be sourced by outside affiliations. Wetland data by VT ANR. Contour data by VCGI. Imagery provided by VCGI.

Streambank Bioengineering Location



Farrell Brook Watershed

University of Vermont
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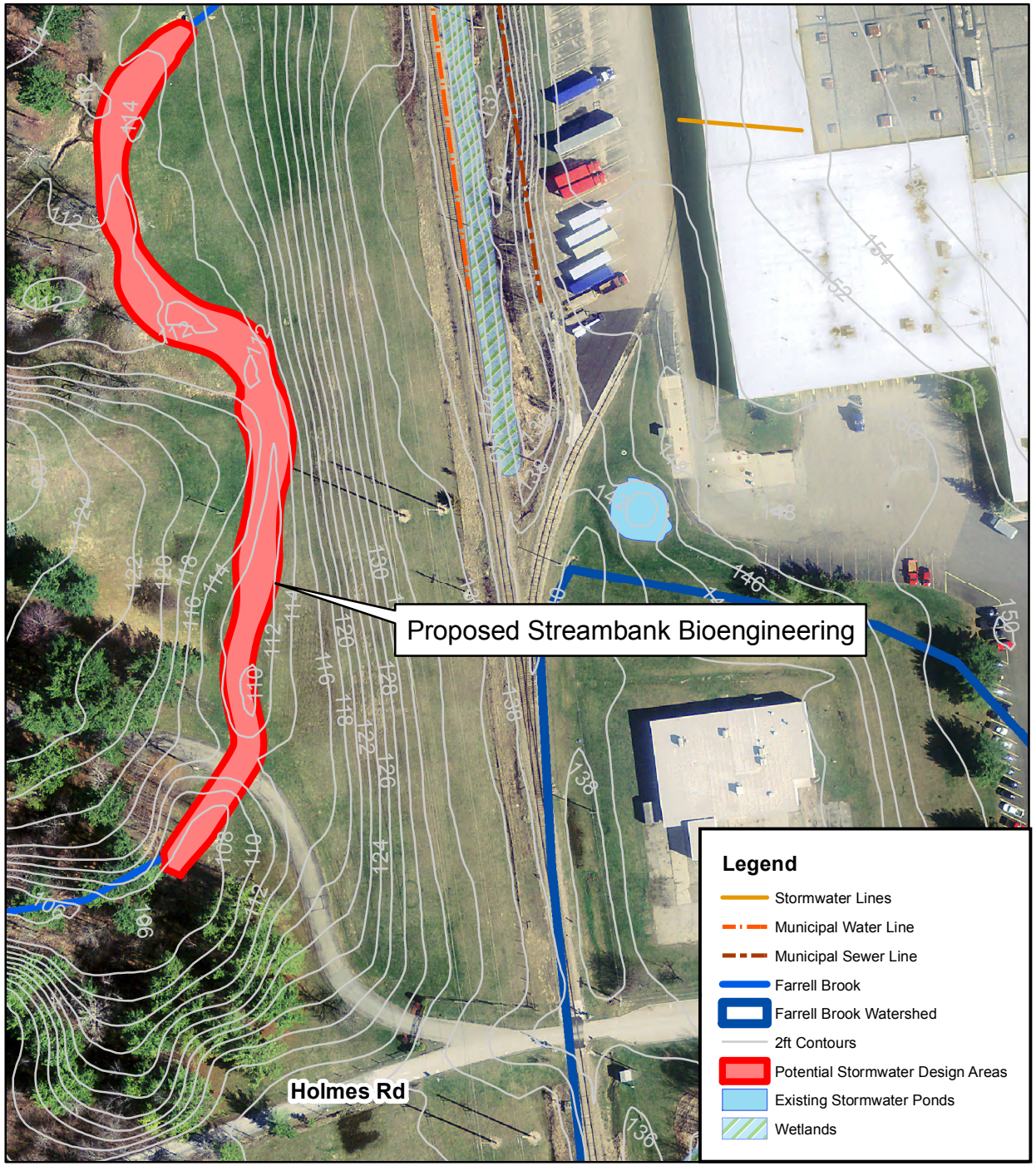

N

1 inch = 125 feet

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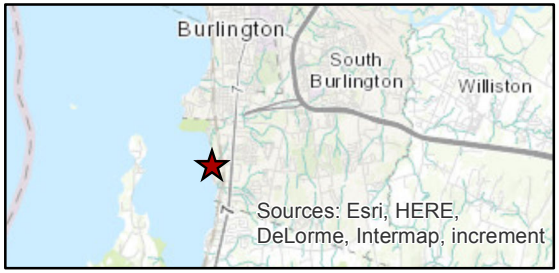
Gravel Wetland Location



Farrell Brook Watershed

University of Vermont
Senior Design
Spring 2016

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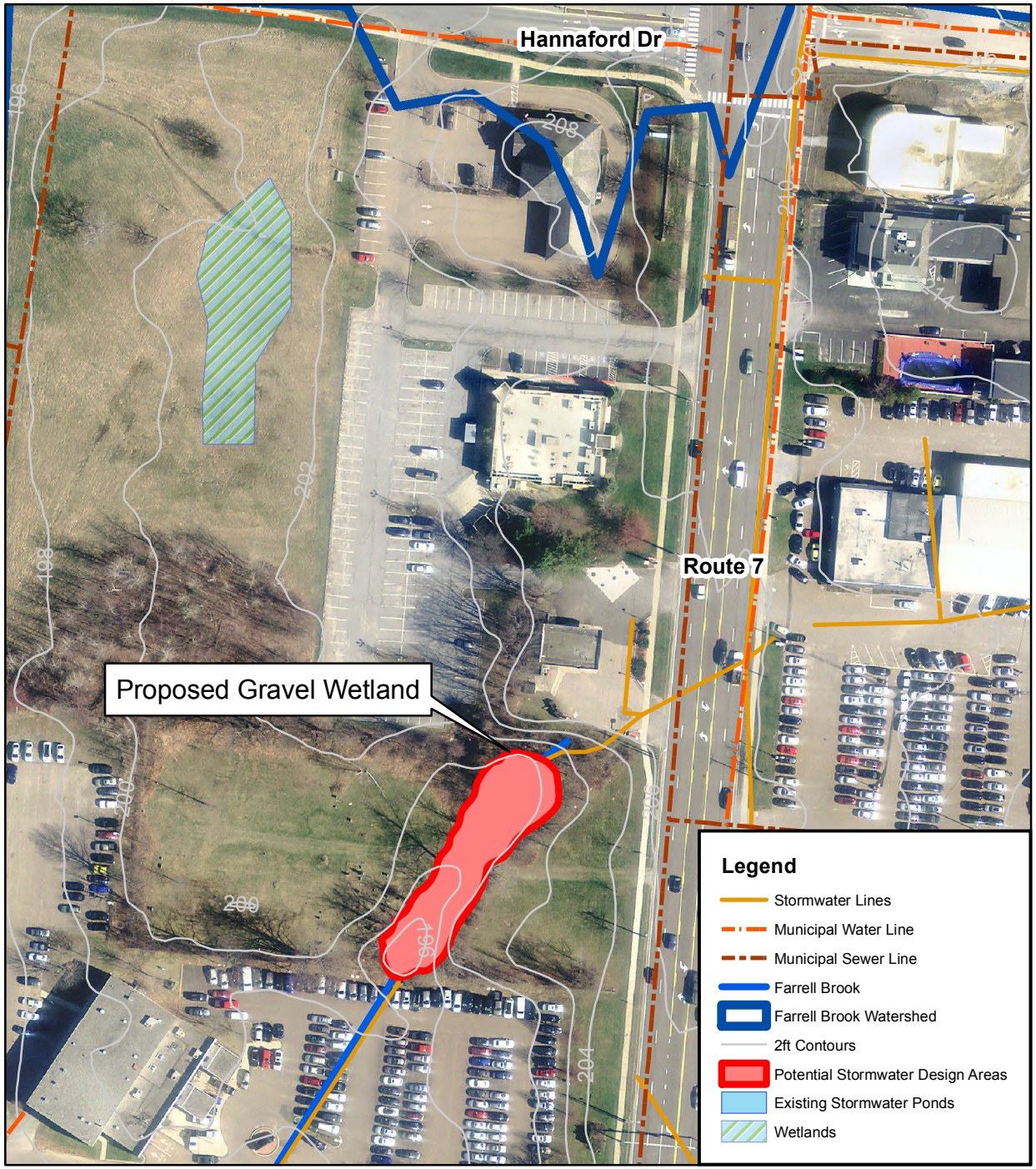


APPENDIX B: Calculations

The following provides a guided explanation of calculations performed to design the detention pond, retention pond and gravel wetland as well as cost estimate calculations. Calculations for the designs generally follow guidelines of the 2002 VT Stormwater Manual Vol. 1 and 2, although some designs are unique in that this project is considered a retrofit.

List of Calculations:

1) Detention Pond Orifice Sizes
2) Retention Pond
    a. Water Quality Volume
    b. Outlet Structure Design Calculations
    c. Inlet Structure Design Calculations
3) Gravel Wetland
    a. Water Quality Volume
    b. Forebay Design Calculations
    c. Main Wetland Bay Design Calculations
    d. Outlet Structure Design Calculations
    e. Inlet Structure Design Calculations
4) Cost Calculations
    a. Detention and Retention Pond Costs
    b. Gravel Wetland Costs
    c. Swirl Separator Costs

Detention Pond:

Flow through an orifice equation:

$$Q = C \cdot A \cdot \sqrt{2gh}$$
$$C = 0.6$$

Pre-Orchards Upgrade: $Q = 28cfs$

Trial diameter, $D = 18in. \rightarrow H = 7.75\ ft$

$$A = \frac{Q}{C(2gH)^{0.5}} = \frac{28cfs}{0.6\left(2 * 32.2\left(\frac{ft}{s^2}\right) * 7.75ft\right)^{0.5}} = 2.09ft^2$$

$$D = \left(\frac{4A}{\pi}\right)^{\frac{1}{2}} = \left(\frac{4(2.09ft^2)}{\pi}\right)^{\frac{1}{2}} = 1.63ft = 19.6in.$$

Choose 18in. → Q=23.7cfs

Cover Type: 1 Acre, 20% Impervious, $Q = 21.5cfs$

Trial diameter $D = 18in. \rightarrow H = 7.75ft$

$$A = \frac{21.5cfs}{0.6\left(2 * 32.2\left(\frac{ft}{s^2}\right) * 7.75ft\right)^{0.5}} = 1.60ft^2$$

$$D = \left(\frac{4(1.6ft^2)}{\pi}\right)^{\frac{1}{2}} = 1.42ft = 17.1in.$$

Trial Diameter, $D = 15in. \rightarrow H = 7.875ft$

$$A = \frac{21.5cfs}{0.6\left(2 * 32.2\left(\frac{ft}{s^2}\right) * 7.75ft\right)^{05}} = 1.59ft^2$$

$$D = \left(\frac{4(1.59ft^2)}{\pi}\right)^{\frac{1}{2}} = 1.42ft = 17in.$$

Choose 15in. → Q=16.6cfs

Pre-Development Woods/Grass, Good Soil $Q = 7.72cfs$

Trial Diameter, $D = 15in. \rightarrow H = 7.875ft$

$$A = \frac{7.72cfs}{0.6\left(2 * 32.2\left(\frac{ft}{s^2}\right) * 7.875ft\right)^{0.5}} = 0.57ft^2$$

$$D = \left(\frac{4(0.57ft^2)}{\pi}\right)^{\frac{1}{2}} = 0.85ft = 10.2in$$

Trial Diameter, $D = 10in. \rightarrow H = 8.08ft$

$$A = \frac{7.72cfs}{0.6\left(2 * 32.2\left(\frac{ft}{s^2}\right) * 8.08ft\right)^{0.5}} = 0.56ft^2$$

$$D = \left(\frac{4(0.56ft^2)}{\pi}\right)^{\frac{1}{2}} = 0.84ft = 10.1in$$

Choose 10in. → Q=7.46cfs

Retention Pond:

Note: All calculations reference both Vol. 1, and Vol. 2 of the VT 2002 Stormwater Manual

Watershed Area Draining to pond: 108.25 acres*

Impervious Area within Watershed: 41.14 acres*

*Areas determined using ArcMap

Percent Impervious: $\frac{41.14\ acres}{108.25\ acres} * 100 = 38\%\ impervious$

Water Quality Volume (WQ_v) in acre-ft: $WQ_v = \frac{P*R_v*A}{12}$

P=0.9 in (90% Rainfall Event for l in. rain across the state of Vermont)

R_V = the volumetric runoff coefficient equal to: $[0.05 + 0.009 * (I)]$, where *I* is the whole number percent of impervious cover at the site

A = site area in acres

I = % Impervious Surface (decimal)

$$I = 0.38$$

$$WQ_v = \frac{0.9in * [0.05 + 0.009 * 38] * 108.25acre}{12} = 3.183acre - ft$$

Outlet Structure Design:

The goal of the outlet structure is to drain both the channel protection volume, and water quality volume in a specified amount of time. Since Farrell Brook is considered a cold water entity the required retention time is a minimum of 12 hours however longer retention times can lead to more settlement of sediment. For this reason the goal was to get close to a 24 hour retention time, despite the requirement only being 12 hours. It is important to note that the calculations used to design the orifice, and pipe are based off of static water level conditions. In the case that there is more water exiting the pond then coming in the retention times will vary.

Flow Through Pipe Equation:

$$Q = A_p * \sqrt{\frac{2 * g * h}{1 + k_m + k_p * L}}$$

A_p= cross sectional pipe area

h = elevation head

g = gravitational acceleration

n = Manning's coefficient

d = pipe diameter

L = pipe length

k_m = coefficient of minor losses

$k_p = \frac{5087 * n^2}{d^{4/3}}$ pipe friction coefficient

Flow Through Orifice Equation:

$$Q = C \cdot A \cdot \sqrt{2gh}$$

$C =$ .6 for a sharp faced orifice

A_p= cross sectional orifice area

g = gravitational acceleration

h = elevation head

Wqv Drain Pipe:

Outlet of pipe located at 141 ft.

Top of Wqv located at 144.2 ft.

$$142.2\ ft. - 141.0\ ft. = 3.2\ ft.of\ head$$

Designed Wqv = 139000 cubic feet

Permanent Pool Volume = 70150 cubic feet

$$139{,}000\ ft.^3 - 70{,}150\ ft.^3 = 68{,}850\ ft.^3$$

In order for Wqv to drain in 24hrs

$$Q = \frac{68{,}850\ ft.^3}{24\ hr} * \frac{1\ hr}{60\ min} * \frac{1\ min}{60\ s} = .797\ \frac{ft.^3}{s}$$

Guess pipe diameters to match flowrate to $.797\ \frac{ft.^3}{s} \rightarrow$ try 8" Pipe

Calculate cross section area $A = \pi * r^2$

$$A = \pi * 4^2 * \frac{1ft^2}{(12in)^2} = .349\ ft.^2$$

Design assumes the use of corrugated steel with manning coefficient n = .022.

$$Q = .349\ ft.^2 * \sqrt{\frac{2 * 32.2\ ft.^2 * 3.2\ ft.^2}{1 + 1 + \frac{5087 * .022^2}{(\frac{8}{12}\ ft.)^{4/3}} * 20\ ft.}} = .539\ \frac{ft.^3}{s}$$

$\rightarrow$ try 10" pipe

$$A = \pi * 5^2 * \frac{1ft^2}{(12in)^2} = .545\ ft.^2$$

$$Q = .545\ ft.^2 * \sqrt{\frac{2 * 32.2\ ft.^2 * 3.2\ ft.^2}{1 + 1 + \frac{5087 * .022^2}{(\frac{10}{12}\ ft.)^{4/3}} * 20\ ft.}} = .973\ \frac{ft.^3}{s}$$

10" pipe satisfies flowrate back calculate drain time

$$.973\ \frac{ft.^3}{s} * \frac{60\ s}{1\ min} * \frac{60\ m}{1\ hr} = 3500\ \frac{ft.^3}{hr}$$

$$\frac{68850\ ft.^3}{3500 \frac{ft.^3}{hr}} = 19.7\ hrs$$

Cpv Orifice:

Bottom Cpv orifice at 144.2 ft.

Top of Cpv located at 145.6 ft

$$145.6\ ft. - 144.2\ ft. = 1.4\ ft.\ of\ head$$

Designed Cpv = 33,300 cubic feet

In order for Wqv to drain in 24hrs

$$Q = \frac{33{,}330\ ft.^3}{24\ hr} * \frac{1\ hr}{60\ min} * \frac{1\ min}{60\ s} = .385\ \frac{ft.^3}{s}$$

Setting the required flow rate (.385 cfs) equal to the flow through orifice equation allows for the calculation of required orifice area.

$$.385\ \frac{ft.^3}{s} = .6 \cdot A \cdot \sqrt{2 * 32.2 \frac{ft}{s^2} * 1.4\ ft.}$$

Solving for A yields

$$A = \frac{.385\ \frac{ft.^3}{s}}{.6 * \sqrt{2 * 32.2 \frac{ft}{s^2} * 1.4\ ft.}} = .068\ ft.^2$$

Area of circular orifice

$$A = \pi * r^2$$

Solving for r

$$r = \sqrt{.068\ ft.^2/\pi} = .147\ ft.$$

Converting to diameter

$$d = .147\ ft. * 2 * \frac{12\ in.}{1\ ft.} = 3.531\ in$$

→ Choose 4 in. diameter orifice

Calculate area of 4 in. diameter orifice

$$A = \pi * (2\ in.)^2 * \frac{1\ ft.^2}{144\ in.^2} = .067\ ft.^2$$

Recalculate flow rate with 4 in. diameter orifice

$$Q = .6 * .067\ ft.^2 \sqrt{2 * 32.2 \frac{ft}{s^2} * 1.4\ ft.} = .382\ \frac{ft.^3}{s}$$

Calculate time required to drain

$$.382\ \frac{ft.^3}{s} * \frac{60\ s}{1\ min} * \frac{60\ min}{1\ hr} = 1{,}375\ \frac{ft^3}{hr}$$

$$\frac{102{,}150\ ft.^3}{1{,}375\ \frac{ft^3}{hr}} = 24.2\ hrs$$

Inlet Structure:

The inlet structure which doubles as a flow splitter was designed assuming that the detention pond was already in place. The inlet to the flow splitter structure was sized at 48" in case of larger storm events storm however it was not calculated if this sizing was sufficient to handle the flow produced by a storm event producing more water than the detention pond can hold. It is advised that further analysis is performed in regard to this pipe size. The bypass pipe that routes water around the pond when it spills over the weir mechanism is also sized at 48", and the area of open space above the weir wall is slightly larger than the equivalent area provided by the 48" diameter pipe. The height of the weir was chosen such that the top elevation of the weir is the same of the max elevation of water in the pond to prevent over topping. The size of the inlet pipe to the pond was chosen such that it could fit below grade, which allowed for a maximum pipe size of 36" diameter in order to maintain 2 ft. or more of soil above the majority of the pipe length. The 36" pipe allows for a maximum flow rate of 14.5 cfs into the pond, higher flowrates would cause water to back up at the inlet and spill over into the bypass pipe. The calculation of the flowrate for the pipe going into the pond is outlined below.

The inlet to the flow splitter structure is located at 143' and enters the pond at 141' through a 50 ft. 36 in. corrugated steel pipe. The slope of this pipe is 4%, the difference in head between the inlet of the pipe and the outlet into the pond is then 2'. The manning coefficient for corrugated metal was assumed to be 0.022.

Flow Through Pipe Equation:

$$Q = A_p * \sqrt{\frac{2 * g * h}{1 + k_m + k_p * L}}$$

A_p= cross sectional pipe area

h = elevation head

g = gravitational acceleration

n = Manning's coefficient

d = pipe diameter

L = pipe length

k_m = coefficient of minor losses

$k_p = \frac{5087*n^2}{d^{4/3}}$ pipe friction coefficient

Calculate cross section area of 36" diameter pipe $A = \pi * r^2$

$$A = \pi * 18^2 * \frac{1ft^2}{(12in)^2} = 7.069\ ft.^2$$

Calculating the flow rate

$$Q = 7.069\ ft.^2 * \sqrt{\frac{2 * 32.2 \frac{ft}{s^2} * 2\ ft.}{1 + 1 + \frac{5087 *.022^2}{(\frac{36}{12}\ ft.)^{4/3}} * 50\ ft.}} = 14.53\ \frac{ft.^3}{s}$$

Maximum inflow to the retention pond is 14.5 cfs

Gravel Wetlands:

Note: All calculations reference both Vol. 1, and Vol. 2 of the VT 2002 Stormwater Manual

Watershed Area Draining to Wetland: 28.22 acres*

Impervious Area within Watershed: 11.27 acres*

*Areas determined using ArcMap

Percent Impervious: $\frac{11.27\ acres}{28.22\ acres} * 100 = 40\%\ impervious$

Gravel wetlands are designed to hold the water quality volume at a maximum of 3' of water and should drain the water quality volume in 24 hours. The typical permanent pool depth of the main wetland is 3".

Water Quality Volume:

$$WQ_v = \frac{P \cdot R_v \cdot A}{12}$$

WQ_v = water quality volume in acre-ft
P = 90% rainfall event (0.9 in across Vermont)
R_v = volumetric runoff coefficient: $R_v = 0.05 + 0.009 \cdot I$ where I is a whole number percent impervious cover at the site
A = site area (in acres)

$R_v = 0.05 + 0.009 \cdot 40 = 0.410$

$WQ_v = \frac{(0.9\ in)\cdot(0.410)\cdot(28.22\ acres)}{12} = 0.6525\ acre-ft$ = 28,423 ft^3

Due to space constraints it was determined that half the water quality volume may be treated.

Attempt to treat ½ the WQv = 14,211 ft^3

The forebay:
Design to hold 10% of the water quality volume

Pre-treatment bed size = $0.10 \cdot 14{,}211 = 1{,}421.15$ ft^3

At a 3' depth, and considering a factor of safety, the surface area of the forebay must be at least 475 ft^2, designed at 20' in width by 24' in length.

The main wetland bay:
Design to hold 90% of the water quality volume

Main wetland size = $0.90 \cdot 14{,}211 = 12{,}790$ ft^3

At a 3' depth, and considering a factor of safety, the surface area of the main wetland must be at least 4,263 ft^2 and may be designed at 40' in width by 107' in length.

The outlet structure:
½ WQv = 14,211 ft^3

Need to drain 14,211 ft^3 in 24 hours

$$Discharge = 14{,}211\ ft^3 \cdot \frac{1}{24\ hrs} \cdot \frac{1\ hr}{3600\ sec} = 0.1645\ cfs$$

Size outlet orifice for 0.1645 cfs:

Hydraulic head of permanent pool is 3"=0.25'
Assume discharge coefficient (C) = 0.6

$$Q = C \cdot A \cdot \sqrt{2gh}$$

$$A = \frac{Q}{C \cdot \sqrt{2gh}}$$

$$A = \frac{0.1645\ cfs}{0.6 \cdot \sqrt{2 \cdot 32.2\ \frac{ft}{s^2} \cdot 0.25\ ft}} = 0.0683\ ft^2$$

Diameter, $d = 2\sqrt{\frac{A}{\pi}}$ = 0.2949 ft = 3.53 in

➔ **Outlet pipe diameter = 3.50"**

The inlet structure:
The inlet to the flow splitter structure is located at 195' with the top of the structure at 200'. The inflow to the pond enters at 144' through a 15 ft. 18 in. corrugated steel pipe. The difference in head between the inlet of the pipe and the outlet into the pond is 1'. The manning coefficient for corrugated metal was assumed to be 0.022.

Flow through a pipe equation:

$$Q = A_p\sqrt{\frac{2gH}{1+k_m+k_pL}}$$

Q = discharge (cfs)

A_p = pipe cross sectional area (ft^2)

g = acceleration of gravity (ft/s^2)

H = elevation head differential (ft)

k_m = coefficient of minor losses (use 1.0)

k_p = pipe friction coefficient = $\frac{5087(n^2)}{D^{\frac{4}{3}}}$ (Manning's n and pipe diameter, D)

L = pipe length (ft)

$$Q = \pi(\frac{1.5\ ft}{2})^2\sqrt{\frac{2\left(32.2\ \frac{ft}{s^2}\right)(1\ ft)}{1+1+\frac{5087(0.022^2)}{(1.5\ ft)^{\frac{4}{3}}}(15ft)}} = 2.9\ cfs$$

Maximum inflow to the forebay is 2.9 cfs

Cost Calculations:

Ponds

Construction Cost for Ponds:

Using Stantec's cost as an estimate:

$$Cost\ for\ detention\ pond\ per\ cubic\ foot: \frac{\$120{,}000}{81{,}000} = \$1.48/ft^3$$

$$Cost\ for\ retention\ pond: \frac{\$1.48}{ft^3}(172{,}277.58ft^3) = \$255{,}226.05$$

Schueler et Al 2007 Method for cost:

$$Detention\ Pond\ Retrofit: \frac{\$3}{ft^3}(81{,}750ft^3) = \$245{,}250.00$$

$$\rightarrow \$281{,}669.29\ (2016\ dollars)$$

$$Retention\ Pond\ Retrofit: \frac{\$3}{ft^3}(172{,}277.58ft^3) = \$516{,}832.75$$

$$\rightarrow \$593{,}581.70\ (2016\ dollars)$$

Maintenance Costs for Ponds:

All maintenance costs were brought to present worth, $P = A\left[\frac{((1+i)^n - 1)}{(i\,(1+i)^n)}\right]$ and corrected for inflation using the CPI Inflation Calculator. This gave a present worth maintenance cost for the detention pond of $\$501{,}127.12$ and $\$589{,}665.40$ for the retention pond. The interest rate was assumed to be 2.5%.

Gravel Wetlands

EPA 2009 Method for construction costs:

$$\frac{\$8.31}{ft^3}(14{,}211ft^3) = \$118{,}093.41$$

Maintenance Costs							
Sources	**Assumptions**	**Item**	**Unit Price**	**Units**	**Maintenance Schedule (Years)**	**Amount Needed**	**Total Cost**
EPA 2009	when 60% volume is lost	Removing Sediment from Forebay	60	CY	5	13.33CY	799.8
EPA 2009	When 50% volume is lost	Removing Sediment from Main Cells	7600	Event	20		7600
EPA 2009		Clearing Dead Plants	7943.82	Acre	1	0.0128558	102.12
EPA 2009		Removal of Trash	350	Event	1	-	350

Assuming an interest rate of 2.5%, all maintenance costs were brought back to present worth using:

$$P = A\left[\frac{\left((1+i)^n - 1\right)}{\left(i\,(1+i)^n\right)}\right]$$

This gave a present worth maintenance cost of $257,391.32. Adjustments for inflation were made using the CPI Inflation Calculator.

Swirl Separator

The unit costs for the swirl separator were quoted directly from the manufacturers. The manufacturing and maintenance costs were calculated using the below table.

Item	Units	Amount	Cost	Item Amount
Unclassified Excavation	CY	100	$15	$1,500
Earth Borrow	CY	70	$15	$1,050
Unsuitable Soil Excavation	CY	5	$20	$100
Vortechs Model 7000	LS			$25,750
Connection of 10" Conc. Pipe	LS			$500
Connection of 6" PE Pipe	LS			$500
6" PE Pipe	LF	30	$30	$900
12" CPEP	LF	150	$35	$5,250
Catch Basin	Each	2	$2,000	$4,000
Relocating Existing Utilities	LS	N/A		$0
Crushed Stone	CY	4	$25	$100
New Pavement	Ton	12	$75	$900
Stone Fill. Type IV	CY	8	$60	$480
Geotextile Under Stone Fill	SY	15	$6	$90
Top Soil	CY	12	$45	$540
Maintenance and Protection of Traffic	LS			$1,500
Clearing and Grubbing	LS			$200
Erosion and Sediment Control	LS			$1,500
Landscaping	LS			$200
Total				**$45,060**
Say				**$45,000**
****Correction for Inflation**				**$48,000**
40% Contingency***				**$67,200**

*Estimated using the City of South Burlington's Farrell St Stormwater Project (Project was for a smaller model-contingency is high to compensate)

**(2007) Inflation corrected using CPI Inflation Calculator, Vortechs Unit was already in 2016 dollars so was not included in this correction

*** 20% Contingency plus 20% for difference in size between model 5000 and 7000

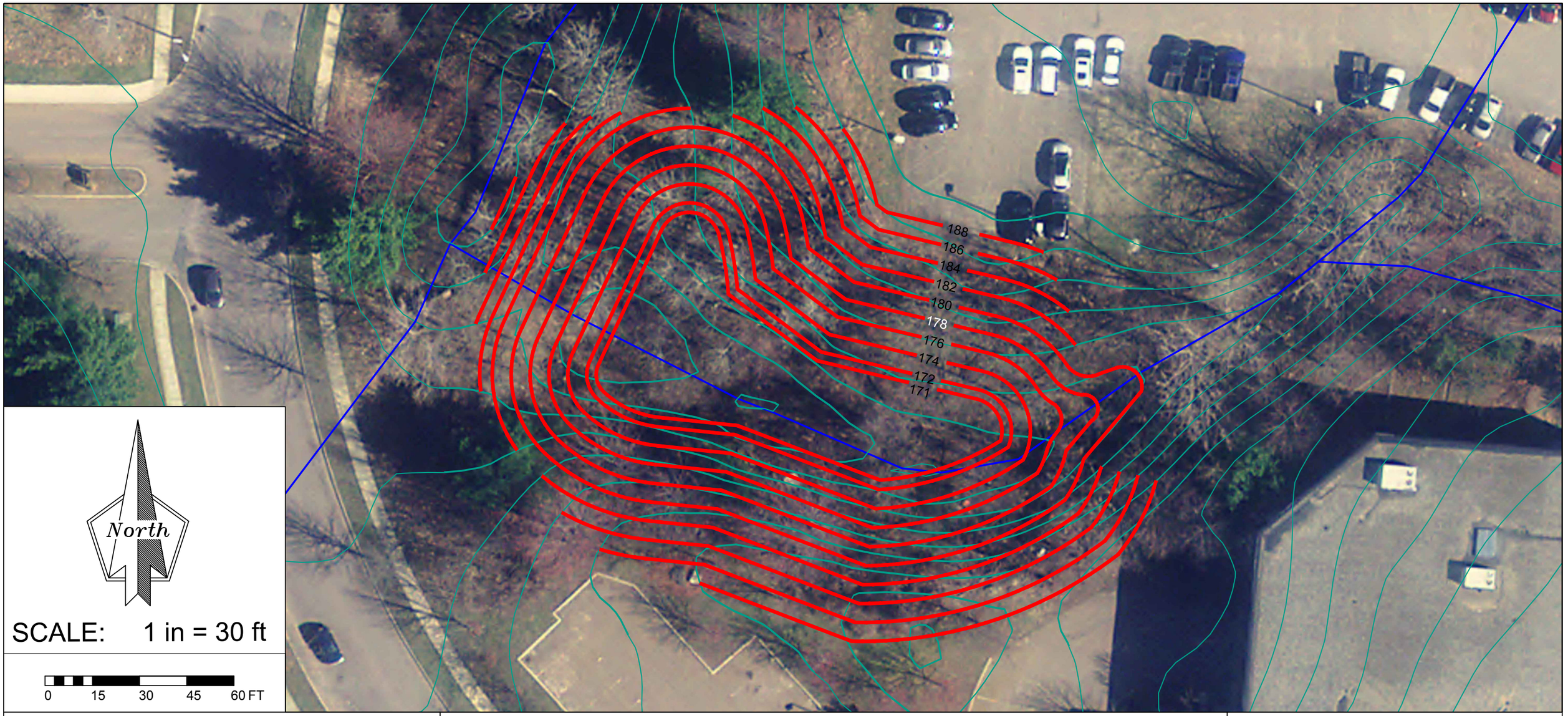
APPENDIX C: AutoCAD Design Sheets

The following provides AutoCAD drawings for the detention pond, retention pond, and gravel wetland designs. Each design is prefaced by an overview image to show general size and shape of each proposed project. These designs should not be considered a 100% design plan set, but provide initial design ideas and details that should be used to gauge the feasibility of the project.

Note:

All location, and elevation information presented in these drawings was sourced from ArcMap layers obtained through resources such as VCGI, City of South Burlington, and Jim Pease of the Vermont Department of Environmental Conservation. Field survey of existing site conditions will be necessary to confirm GIS information and to proceed with any of the following designs.

Additionally all drawings are produced by engineering students, not a professional engineer. All designs need approval of a professional engineer before moving forward.



North

SCALE: 1 in = 30 ft

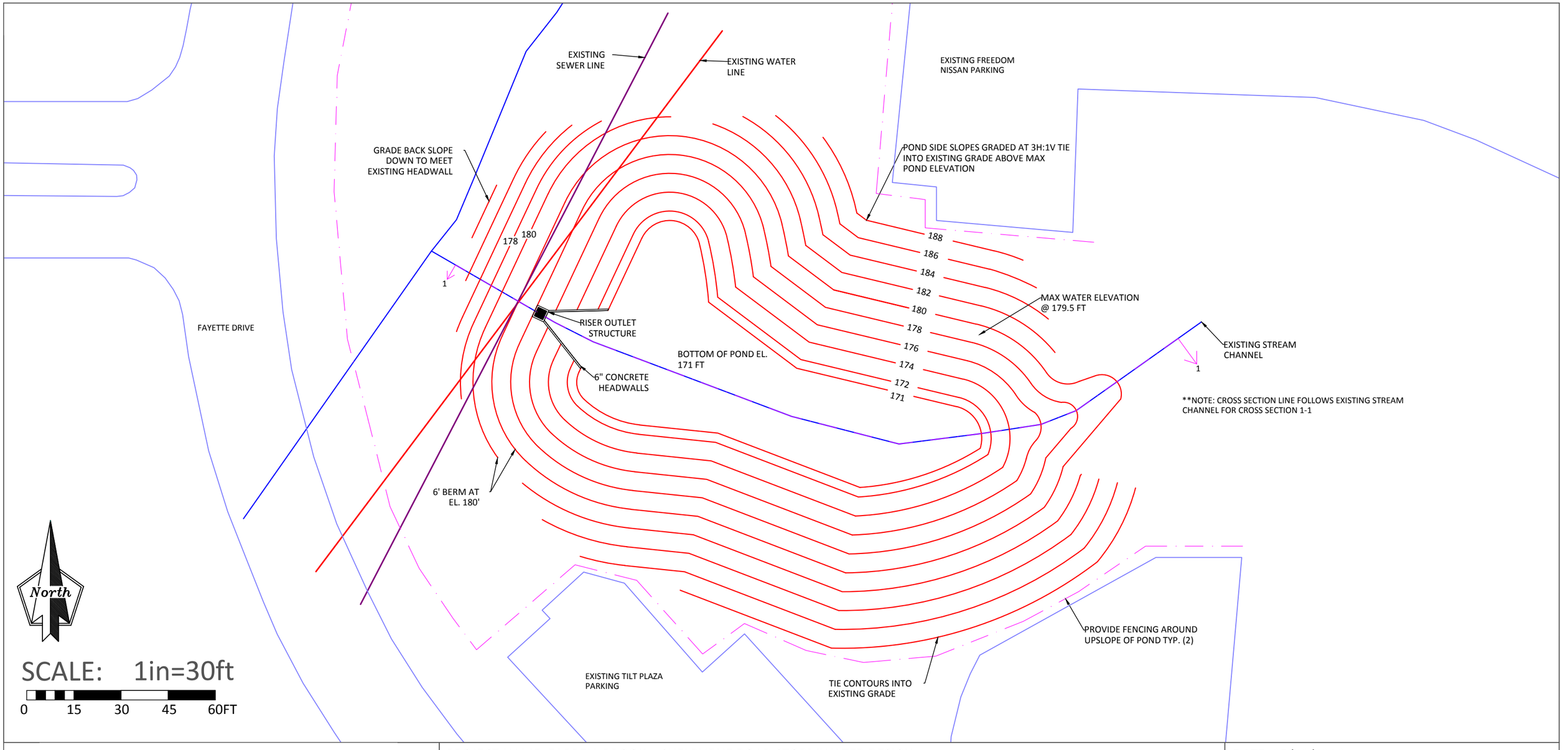
0 15 30 45 60 FT

The UNIVERSITY of VERMONT

PROJECT NAME: FARRELL BROOK - SHELBURNE ROAD STORMWATER DESIGN	DATE: 05/06/2016
CE 175: SENIOR DESIGN, UVM SPRING 2016	DESIGNED BY: JFM
DESIGN DETAIL: CONTOURS AND LOCATION IMAGERY	CHECKED BY: ALD
LOCATION: SOUTH BURLINGTON FAYETTE DR	SHEET 1 OF 27

DETENTION POND

A1

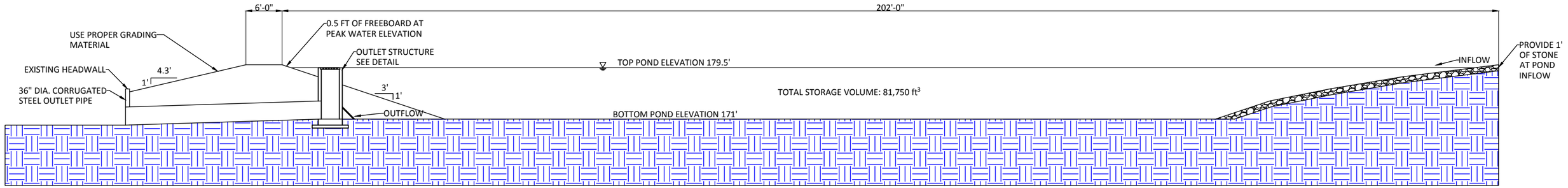


The UNIVERSITY of VERMONT

PROJECT NAME: FARRELL BROOK - SHELBURNE ROAD STORMWATER DESIGN	DATE: 05/06/2016
CE 175: SENIOR DESIGN, UVM SPRING 2016	DESIGNED BY: JFM
DESIGN DETAIL: PLAN VIEW	CHECKED BY: AJS
LOCATION: FAYETTE DRIVE	SHEET 2 OF 27

DETENTION POND

A2

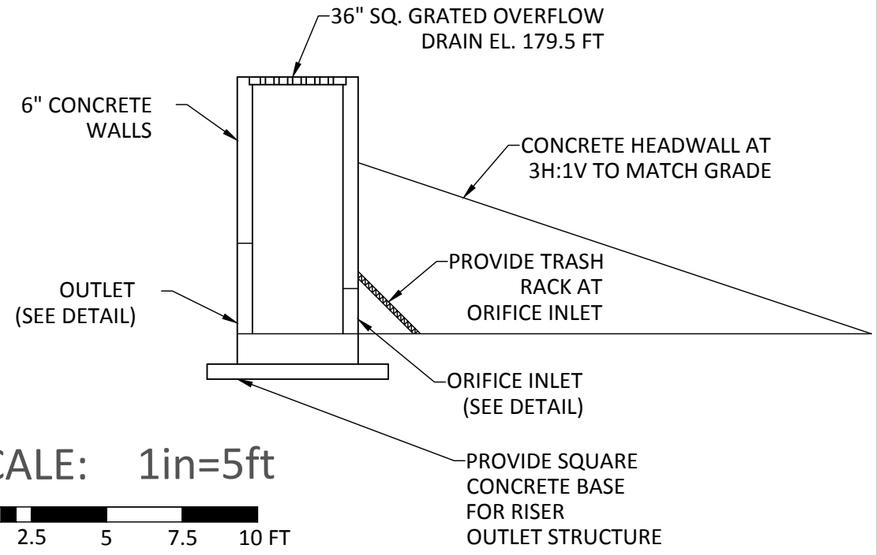


SCALE: 1in=16ft

0 8 16 24 32FT

DETENTION POND CROSS SECTION 1-1

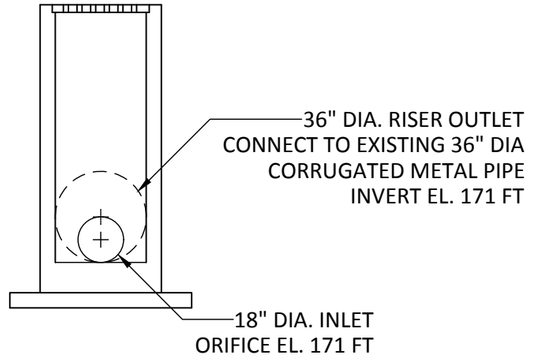
RISER SIDE VIEW



SCALE: 1in=5ft

0 2.5 5 7.5 10 FT

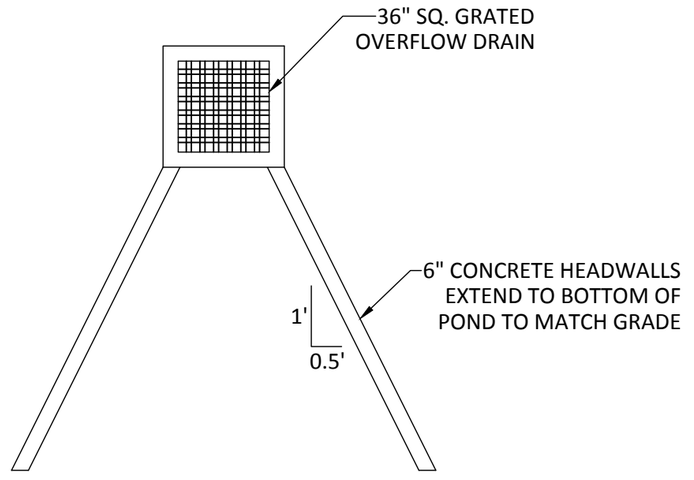
RISER INLET/OUTLET VIEW



SCALE: 1in=5ft

0 2.5 5 7.5 10 FT

RISER TOP VIEW



SCALE: 1in=5ft

0 2.5 5 7.5 10 FT

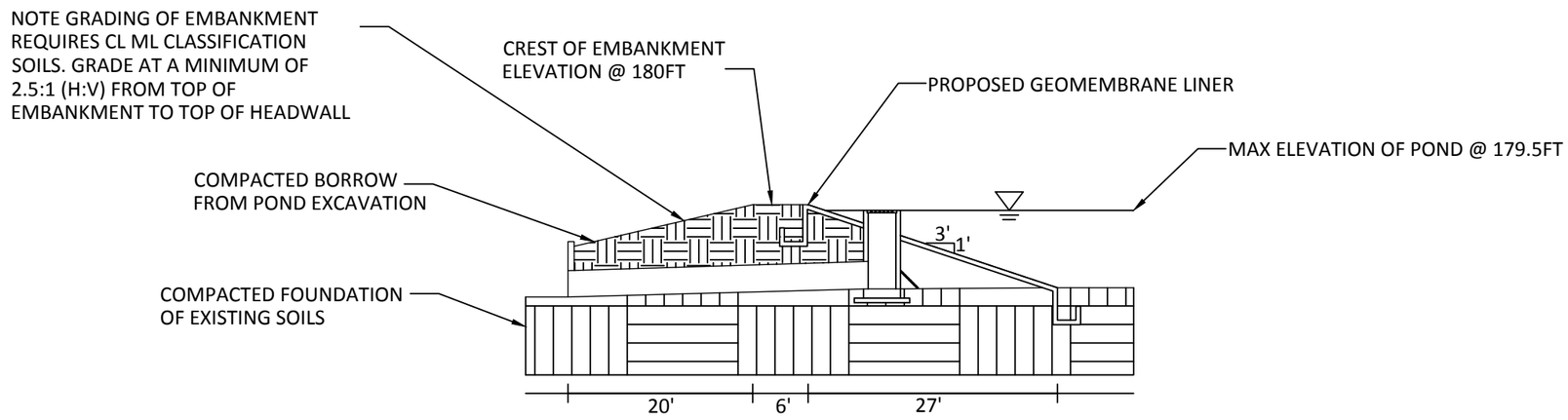
The UNIVERSITY of VERMONT

PROJECT NAME: FARRELL BROOK - SHELBURNE ROAD STORMWATER DESIGN	DATE: 05/06/2016
CE 175: SENIOR DESIGN, UVM SPRING 2016	DESIGNED BY: JFM
DESIGN DETAIL: POND CROSS SECTION AND DETAILS	CHECKED BY: AJS
LOCATION: FAYETTE DRIVE	SHEET 3 OF 27

DETENTION POND

A3

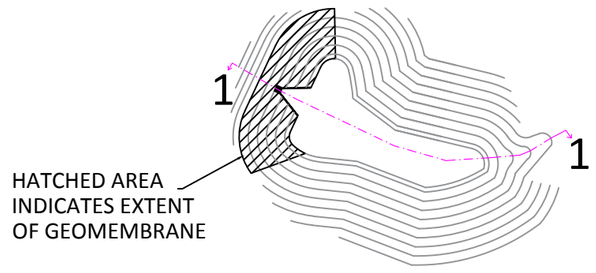
PROPOSED EMBANKMENT CROSS SECTION 1-1



SCALE: 1in=16ft

0 8 16 24 32FT

PLAN VIEW CROSS SECTION 1-1



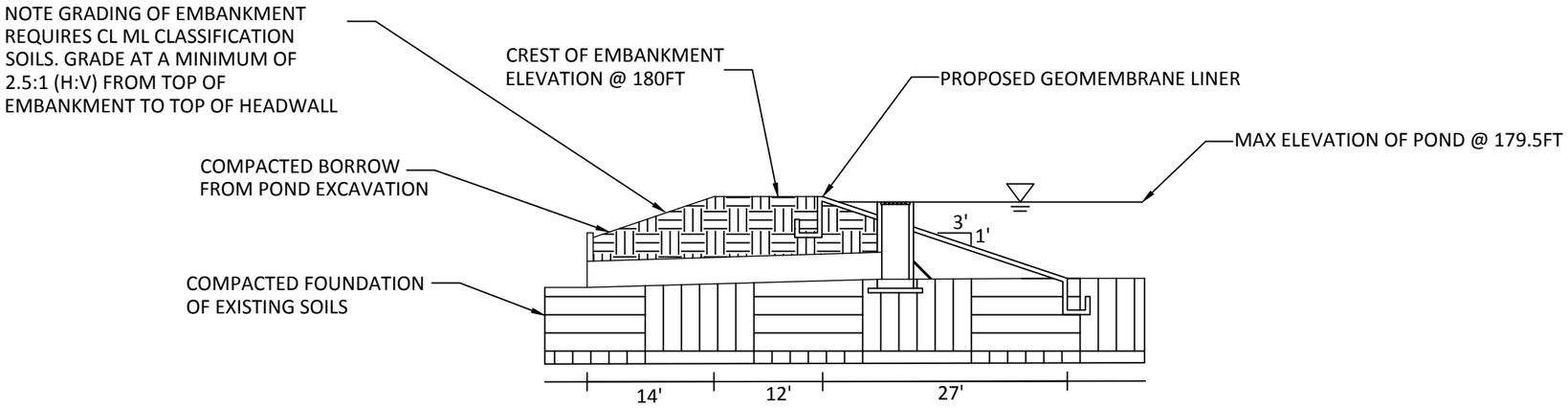
SCALE: 1in=100ft

0 25 50 75 100 FT

The UNIVERSITY of VERMONT

PROJECT NAME: FARRELL BROOK - SHELBURNE ROAD STORMWATER DESIGN	DATE: 05/06/2016
CE 175: SENIOR DESIGN, UVM SPRING 2016	DESIGNED BY: JFM
DESIGN DETAIL: EMBANKMENT CROSS SECTION WITH GEOMEMBRANE LINER	CHECKED BY: AJS
LOCATION: FAYETTE DRIVE	SHEET 4 OF 27
DETENTION POND	A4

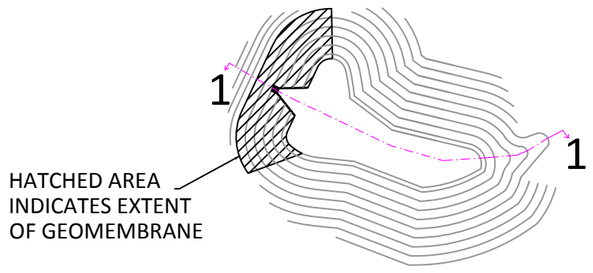
SMALL DAM EMBANKMENT CROSS SECTION 1-1



SCALE: 1in=16ft

0 8 16 24 32FT

PLAN VIEW CROSS SECTION 1-1



North

SCALE: 1in=100ft

0 25 50 75 100 FT

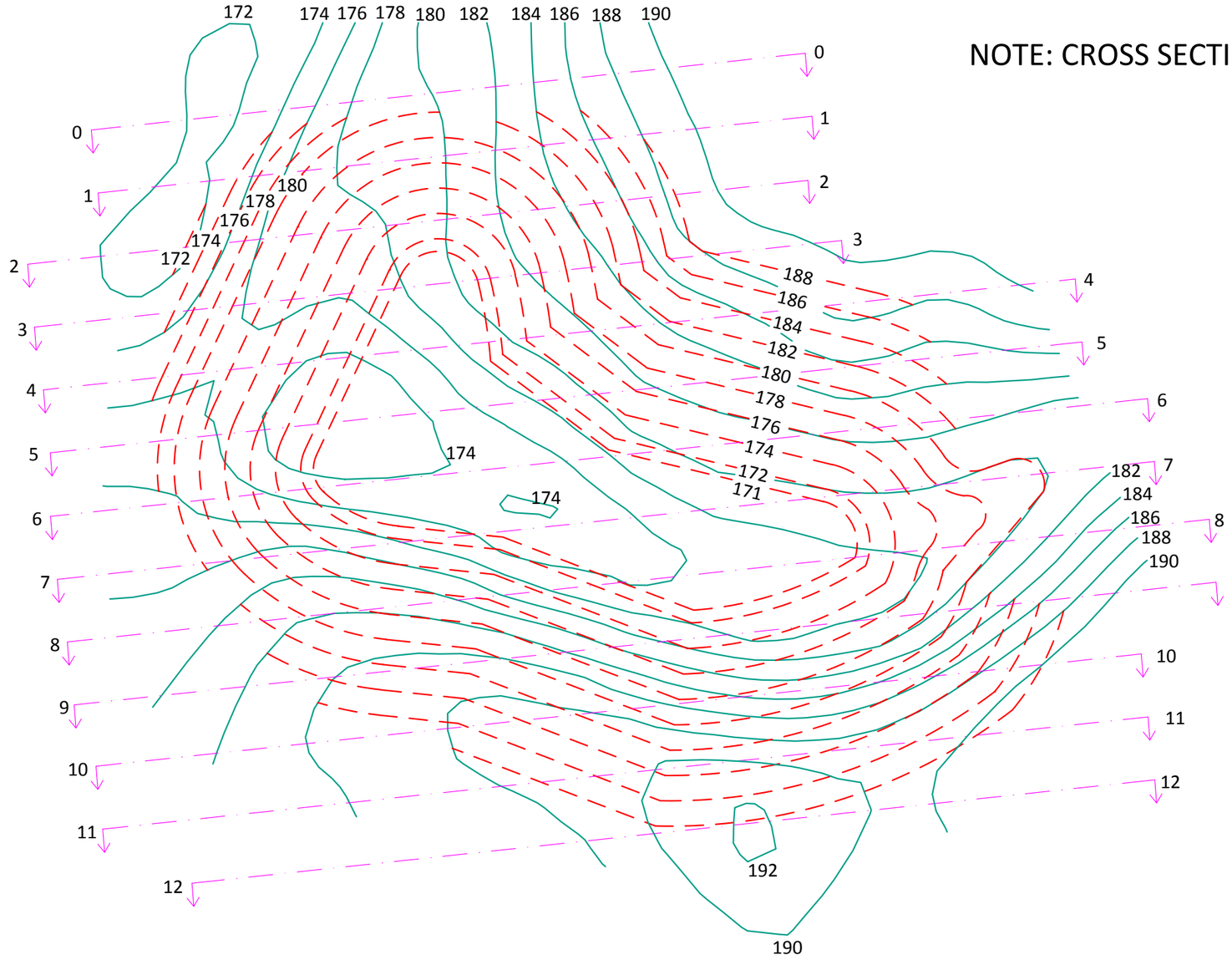
The UNIVERSITY of VERMONT

PROJECT NAME: FARRELL BROOK - SHELBURNE ROAD STORMWATER DESIGN	DATE: 05/06/2016
CE 175: SENIOR DESIGN, UVM SPRING 2016	DESIGNED BY: JFM
DESIGN DETAIL: EMBANKMENT DESIGNED TO SMALL DAM SPECFICIATIONS	CHECKED BY: AJS
LOCATION: FAYETTE DRIVE	SHEET 5 OF 27
DETENTION POND	A5

LEGEND

- EXISTING CONTOUR
- PROPOSED CONTOUR
- SECTION LINE

NOTE: CROSS SECTIONS SPACED AT 15FT



SCALE: 1in=30ft

0 15 30 45 60FT

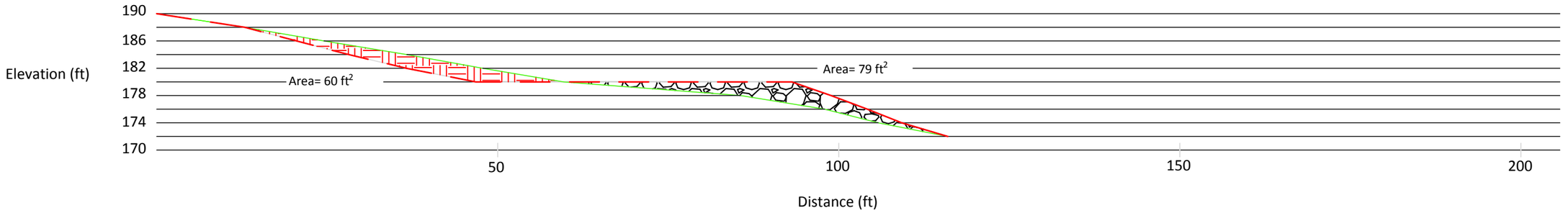
The UNIVERSITY of VERMONT

PROJECT NAME: FARRELL BROOK - SHELBURNE ROAD STORMWATER DESIGN	DATE: 05/06/2016
CE 175: SENIOR DESIGN, UVM SPRING 2016	DESIGNED BY: JFM
DESIGN DETAIL: CUT AND FILL CROSS SECTION LOCATIONS	CHECKED BY: AJS
LOCATION: FAYETTE DRIVE	SHEET 6 OF 27

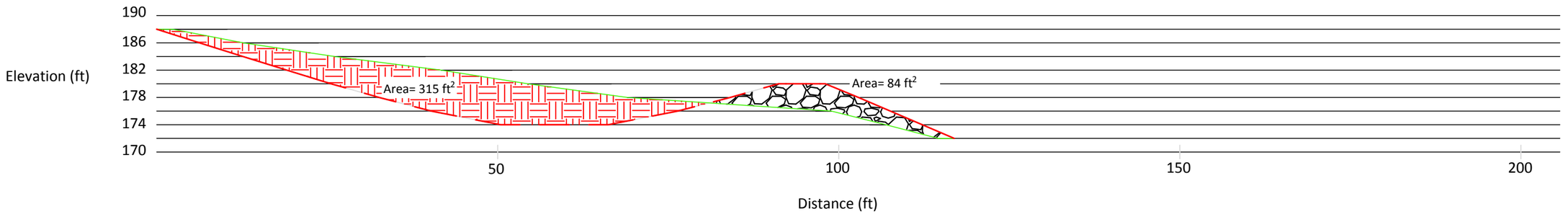
DETENTION POND

A6

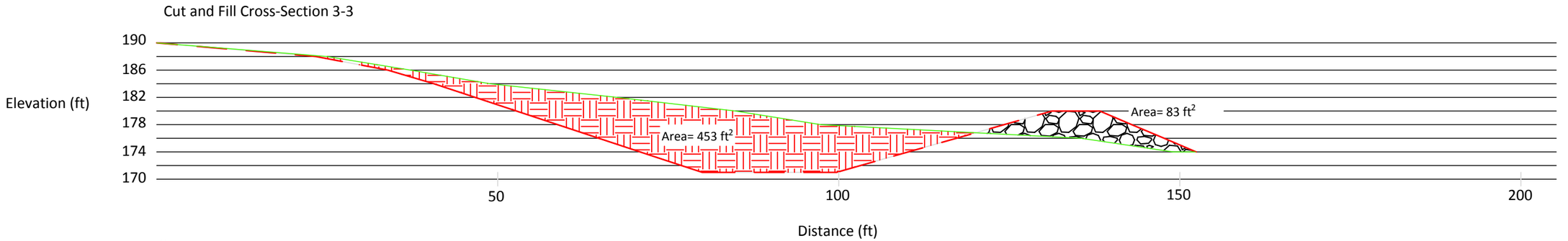
Cut and Fill Cross-Section 1-1



Cut and Fill Cross-Section 2-2



Cut and Fill Cross-Section 3-3



SCALE: 1in=16ft

0 8 16 24 32FT

LEGEND

CUT FILL EXISTING CONTOUR PROPOSED CONTOUR

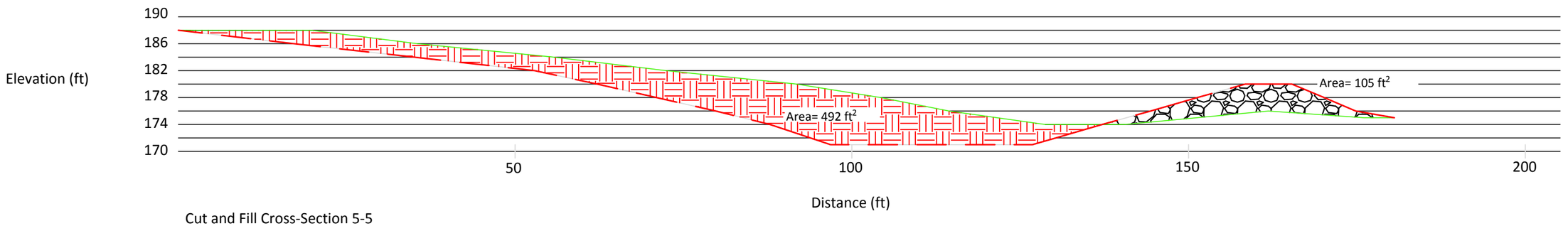
The UNIVERSITY of VERMONT

PROJECT NAME: FARRELL BROOK - SHELBURNE ROAD STORMWATER DESIGN	DATE: 05/06/2016
CE 175: SENIOR DESIGN, UVM SPRING 2016	DESIGNED BY: JFM
DESIGN DETAIL: CUT AND FILL CROSS SECTIONS	CHECKED BY: AJS
LOCATION: FAYETTE DRIVE	SHEET 7 OF 27

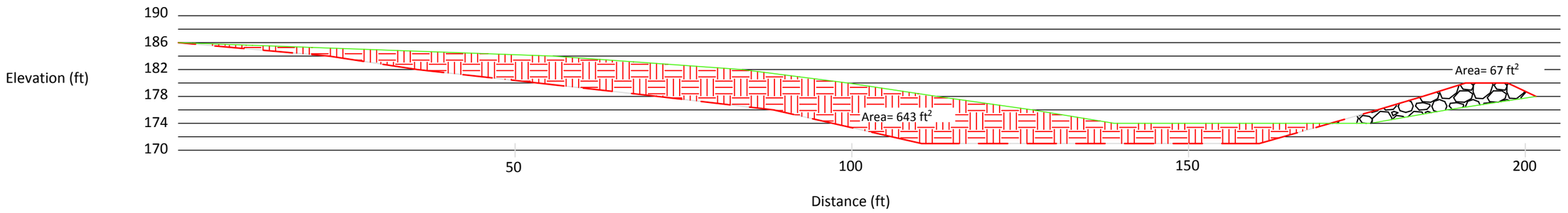
DETENTION POND

A7

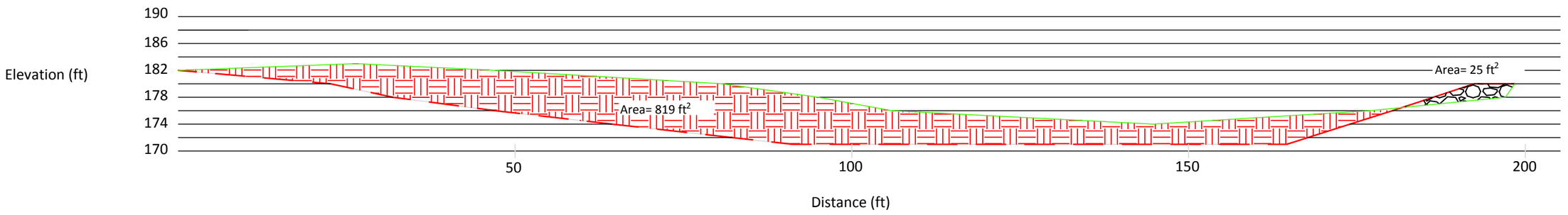
Cut and Fill Cross-Section 4-4



Cut and Fill Cross-Segment 5-5



Cut and Fill Cross-Section 6-6



SCALE: 1in=16ft

0 8 16 24 32FT

LEGEND

CUT FILL EXISTING CONTOUR PROPOSED CONTOUR

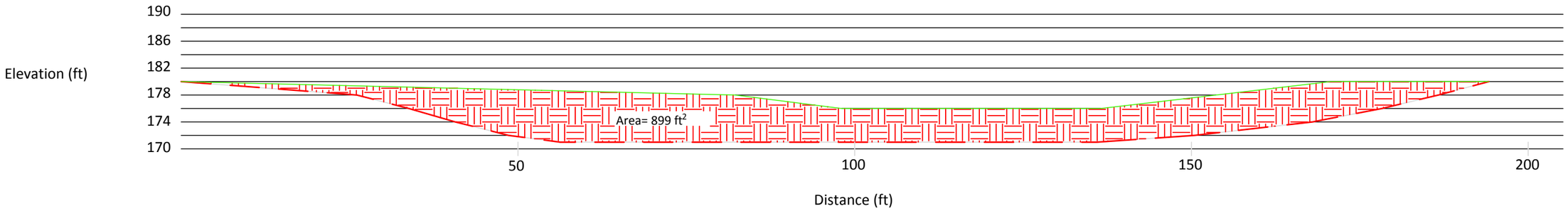
The UNIVERSITY of VERMONT

PROJECT NAME: FARRELL BROOK - SHELBURNE ROAD STORMWATER DESIGN	DATE: 05/06/2016
CE 175: SENIOR DESIGN, UVM SPRING 2016	DESIGNED BY: JFM
DESIGN DETAIL: CUT AND FILL CROSS SECTIONS	CHECKED BY: AJS
LOCATION: FAYETTE DRIVE	SHEET 8 OF 27

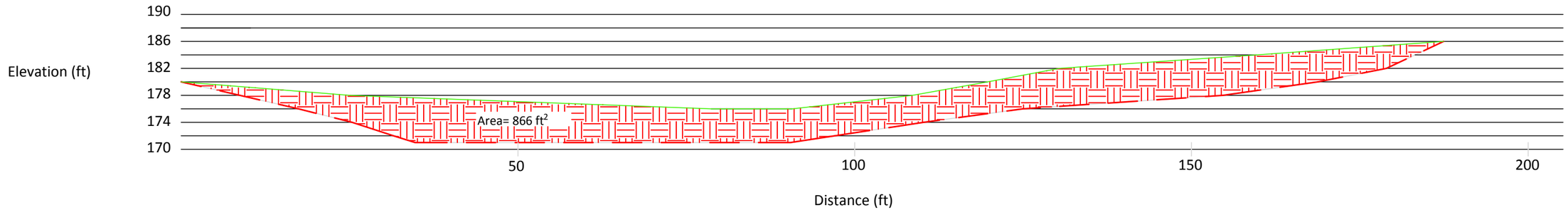
DETENTION POND

A8

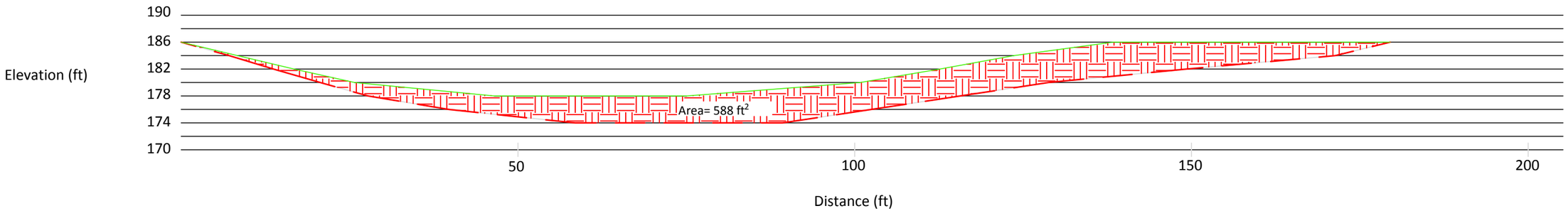
Cut and Fill Cross-Section 7-7



Cut and Fill Cross-Section 8-8



Cut and Fill Cross-Section 9-9



SCALE: 1in=16ft

0 8 16 24 32FT

LEGEND

CUT FILL EXISTING CONTOUR PROPOSED CONTOUR

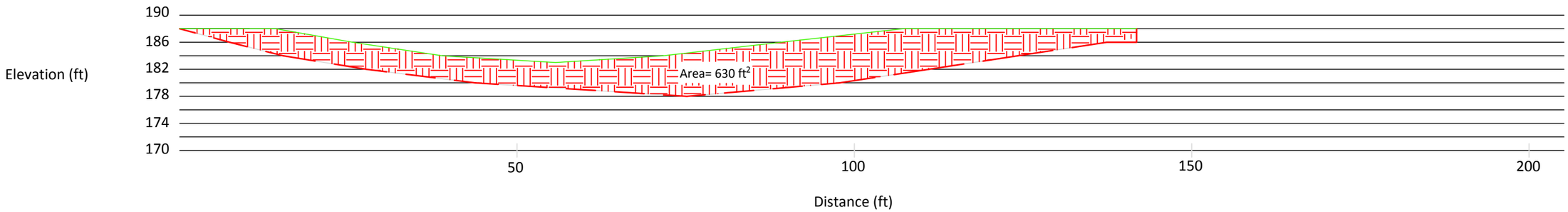
The UNIVERSITY of VERMONT

PROJECT NAME: FARRELL BROOK - SHELBURNE ROAD STORMWATER DESIGN	DATE: 05/06/2016
CE 175: SENIOR DESIGN, UVM SPRING 2016	DESIGNED BY: JFM
DESIGN DETAIL: CUT AND FILL CROSS SECTIONS	CHECKED BY: AJS
LOCATION: FAYETTE DRIVE	SHEET 9 OF 27

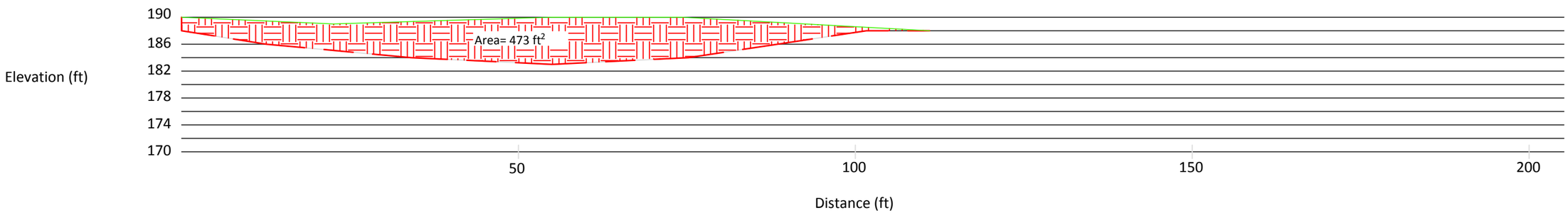
DETENTION POND

A9

Cut and Fill Cross-Section 10-10



Cut and Fill Cross-Section 11-11



LEGEND

CUT FILL EXISTING CONTOUR PROPOSED CONTOUR

SCALE: 1in=16ft

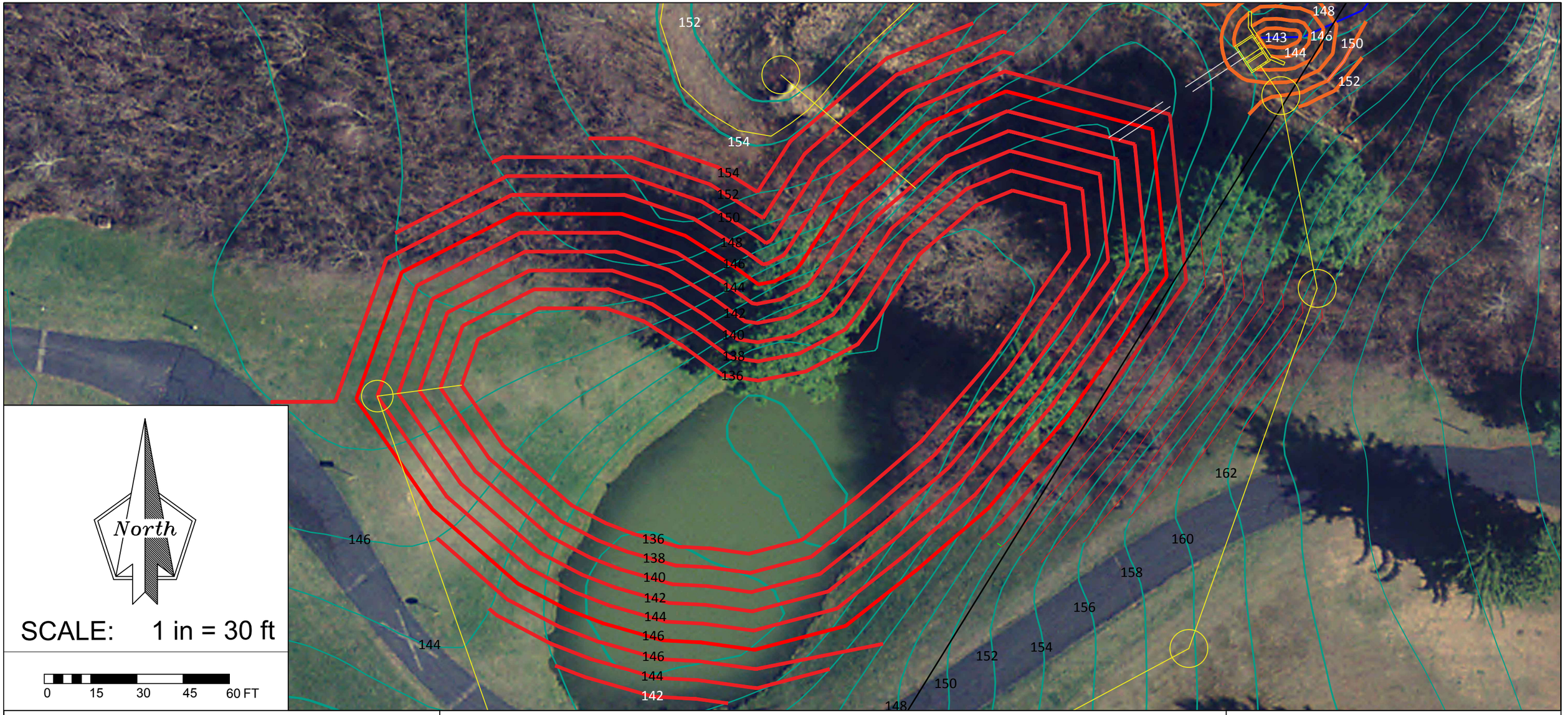
0 8 16 24 32FT

The UNIVERSITY of VERMONT

PROJECT NAME: FARRELL BROOK - SHELBURNE ROAD STORMWATER DESIGN	DATE: 05/06/2016
CE 175: SENIOR DESIGN, UVM SPRING 2016	DESIGNED BY: JFM
DESIGN DETAIL: CUT AND FILL CROSS SECTIONS	CHECKED BY: AJS
LOCATION: FAYETTE DRIVE	SHEET 10 OF 27

DETENTION POND

A10



North

SCALE: 1 in = 30 ft

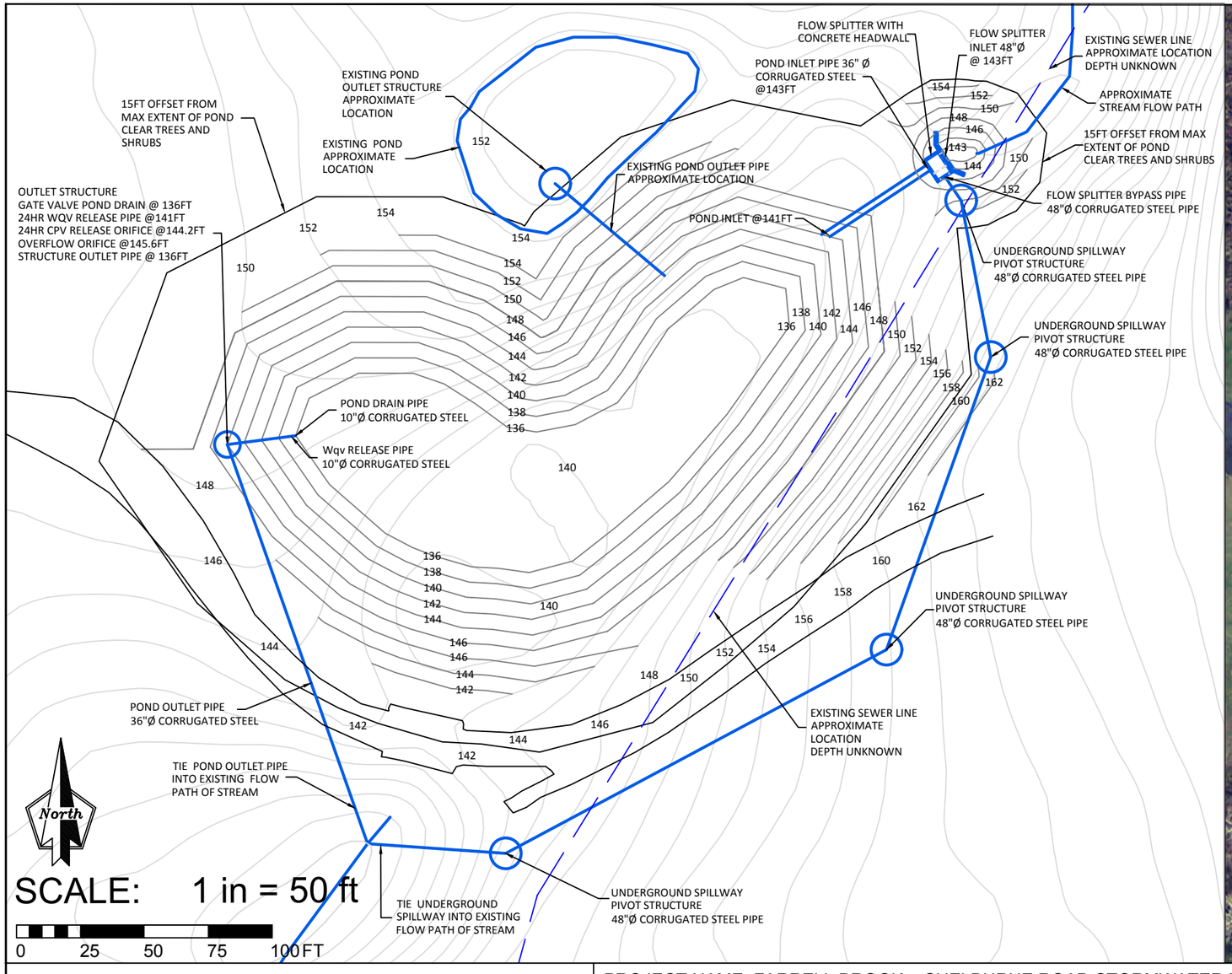
0 15 30 45 60 FT

The UNIVERSITY of VERMONT

PROJECT NAME: FARRELL BROOK - SHELBURNE ROAD STORMWATER DESIGN	DATE: 05/06/16
CE 175: SENIOR DESIGN, UVM SPRING 2016	DESIGNED BY: AJS
DESIGN DETAIL: CONTOURS AND LOCATION IMAGERY	CHECKED BY: ALD
LOCATION: SOUTH BURLINGTON INN RD	SHEET 11 OF 27

RETENTION POND

B1



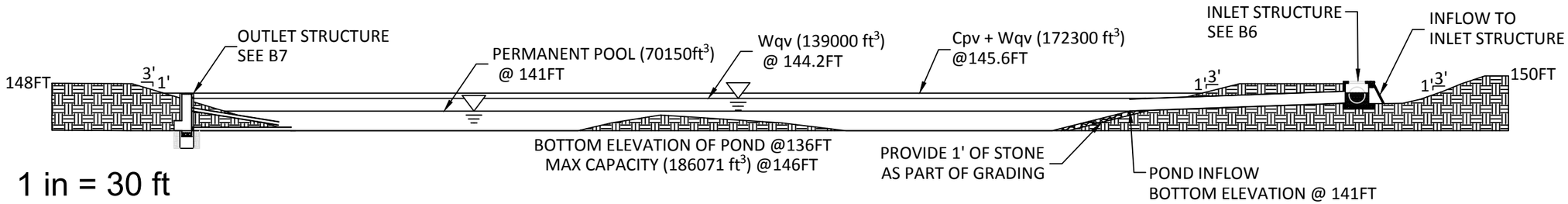
The UNIVERSITY of VERMONT

PROJECT NAME: FARRELL BROOK - SHELBURNE ROAD STORMWATER DESIGN	DATE: 05/06/2016
CE 175: SENIOR DESIGN, UVM SPRING 2016	DESIGNED BY: AJS
DESIGN DETAIL: PLAN VIEW	CHECKED BY: ALD
LOCATION: SOUTH BURLINGTON CITY INN ROAD	SHEET 12 OF 27

RETENTION POND

B2

RETENTION POND CROSS SECTION 1-1

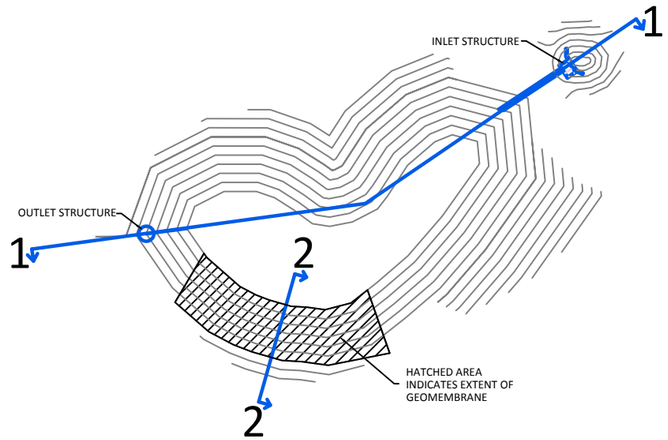


North

SCALE: 1 in = 30 ft

0 15 30 45 60FT

PLAN VIEW OF CROSS SECTION



North

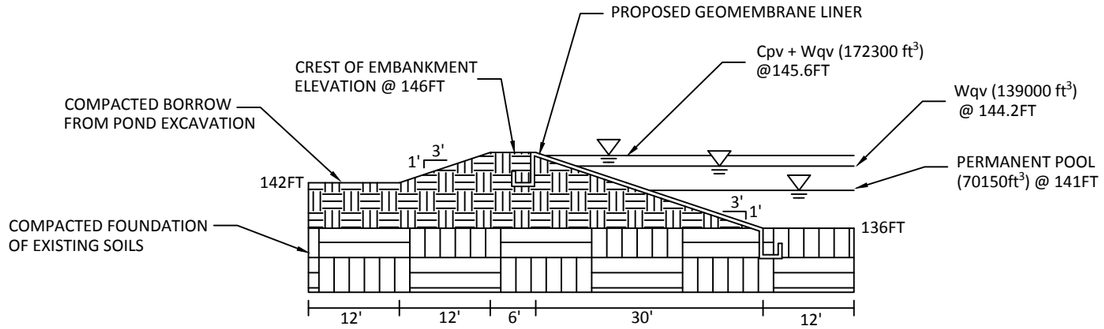
SCALE: 1 in = 100 ft

0 50 100 150 200FT

The UNIVERSITY of VERMONT

PROJECT NAME: FARRELL BROOK - SHELBURNE ROAD STORMWATER DESIGN	DATE: 05/06/2016
CE 175: SENIOR DESIGN, UVM SPRING 2016	DESIGNED BY: AJS
DESIGN DETAIL: RETENTION POND CROSS SECTION	CHECKED BY: ALD
LOCATION: SOUTH BURLINGTON CITY INN ROAD	SHEET 13 OF 27
RETENTION POND	B3

PROPOSED EMBANKMENT CROSS SECTION 2-2

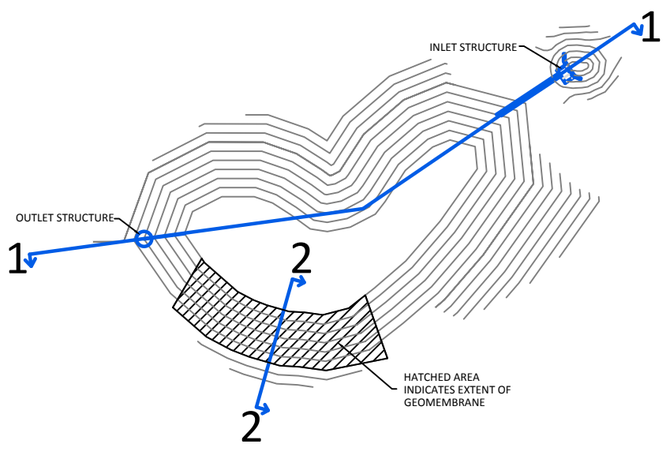


North

SCALE: 1 in = 20 ft

0 10 20 30 40 FT

PLAN VIEW OF CROSS SECTION



North

SCALE: 1 in = 100 ft

0 50 100 150 200FT

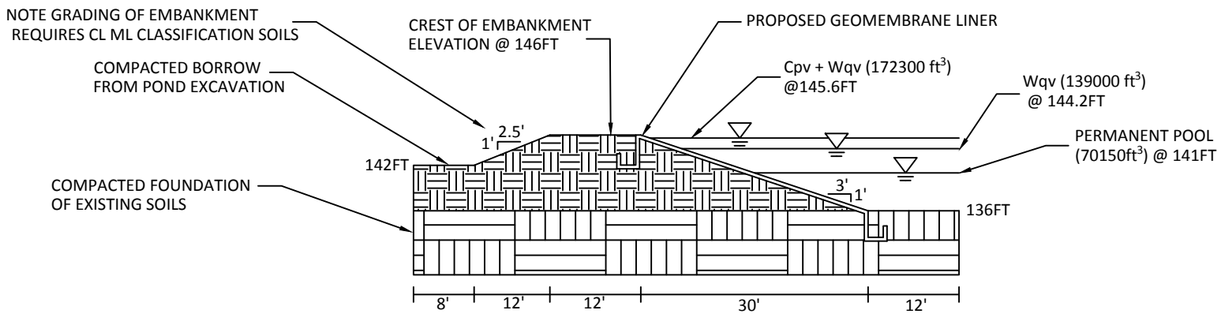
The UNIVERSITY of VERMONT

PROJECT NAME: FARRELL BROOK - SHELBURNE ROAD STORMWATER DESIGN	DATE: 05/06/2016
CE 175: SENIOR DESIGN, UVM SPRING 2016	DESIGNED BY: AJS
DESIGN DETAIL: RETENTION POND EMBANKMENT CROSS SECTION	CHECKED BY: ALD
LOCATION: SOUTH BURLINGTON CITY INN ROAD	SHEET 14 OF 27

RETENTION POND

B4

SMALL DAM EMBANKMENT CROSS SECTION 2-2

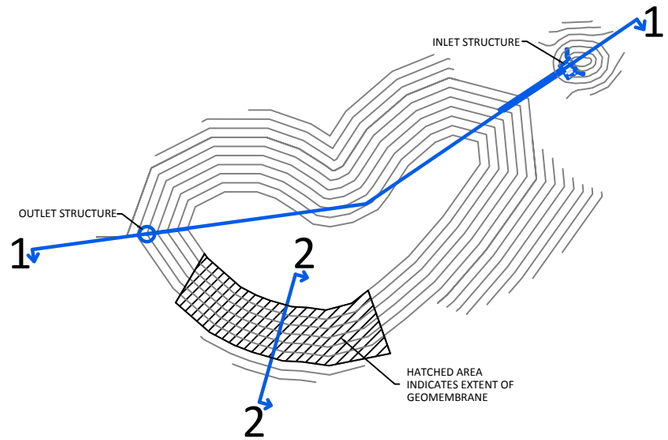


North

SCALE: 1 in = 20 ft

0 10 20 30 40 FT

PLAN VIEW OF CROSS SECTION



North

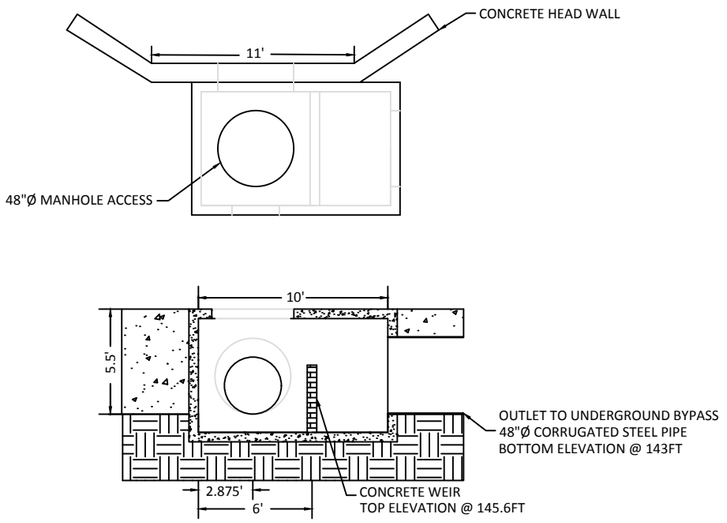
SCALE: 1 in = 100 ft

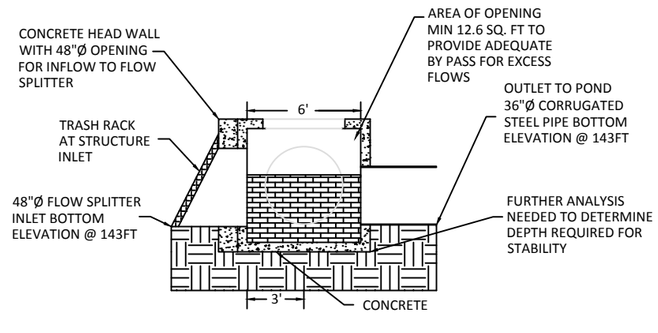
0 50 100 150 200FT

The UNIVERSITY of VERMONT

PROJECT NAME: FARRELL BROOK - SHELBURNE ROAD STORMWATER DESIGN	DATE: 05/06/2016
CE 175: SENIOR DESIGN, UVM SPRING 2016	DESIGNED BY: AJS
DESIGN DETAIL: RETENTION POND SMALL DAM EMBANKMENT CROSS SECTION	CHECKED BY: ALD
LOCATION: SOUTH BURLINGTON CITY INN ROAD	SHEET 15 OF 27
RETENTION POND	B5

INLET STRUCTURE DETAIL

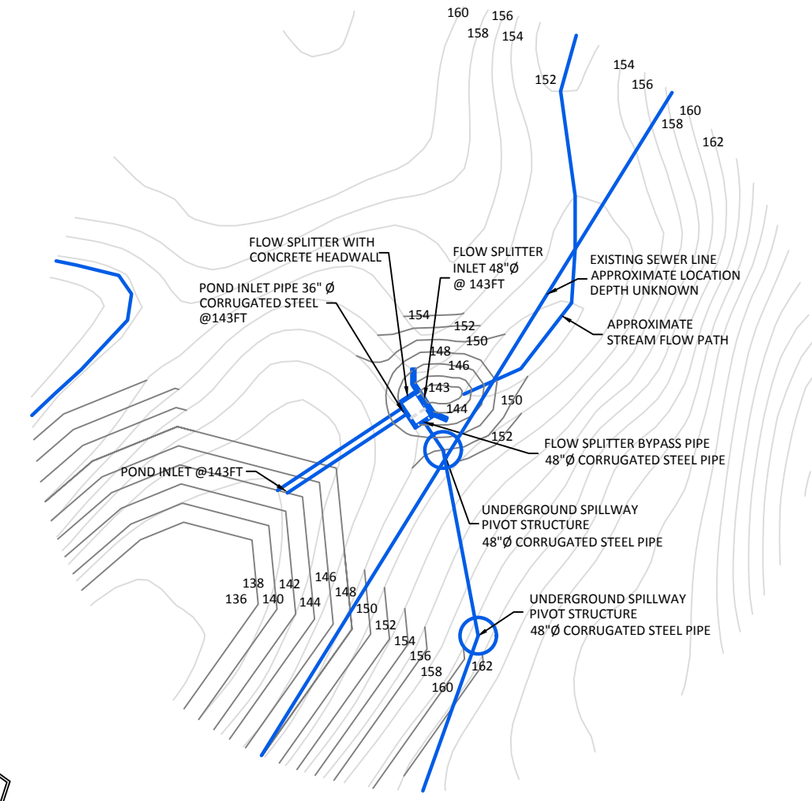




SCALE: 1 in = 8 ft

0 4 8 12 16 FT

INLET STRUCTURE LOCATION



SCALE: 1 in = 50 ft

0 25 50 75 100 FT

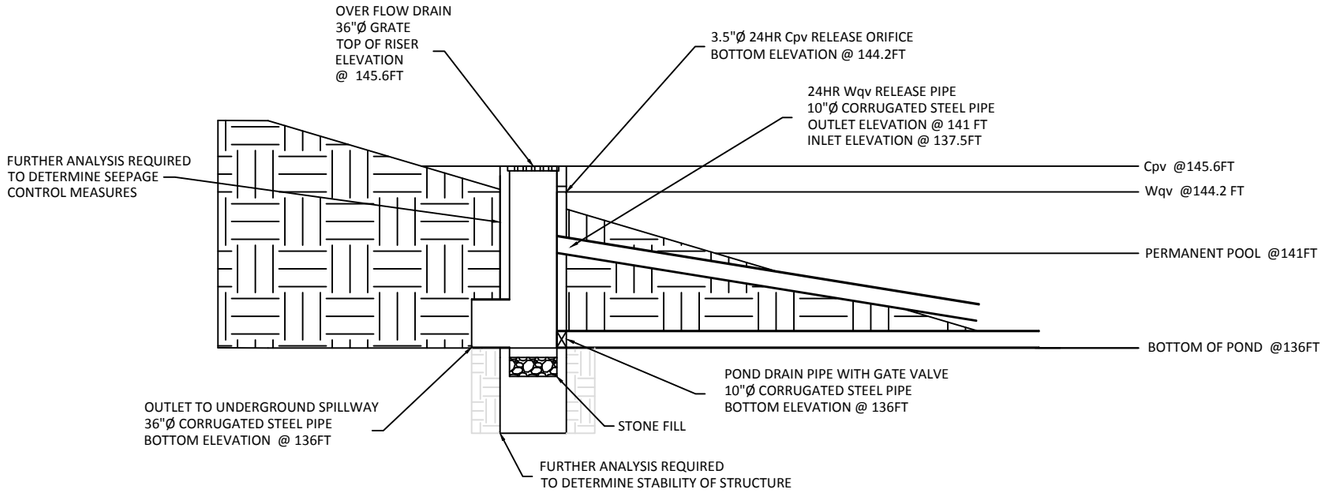
The UNIVERSITY of VERMONT

PROJECT NAME: FARRELL BROOK - SHELBURNE ROAD STORMWATER DESIGN	DATE: 05/06/2016
CE 175: SENIOR DESIGN, UVM SPRING 2016	DESIGNED BY: AJS
DESIGN DETAIL: INLET STRUCTURE	CHECKED BY: ALD
LOCATION: SOUTH BURLINGTON CITY INN ROAD	SHEET 16 OF 27

RETENTION POND

B6

OUTLET STRUCTURE DETAIL

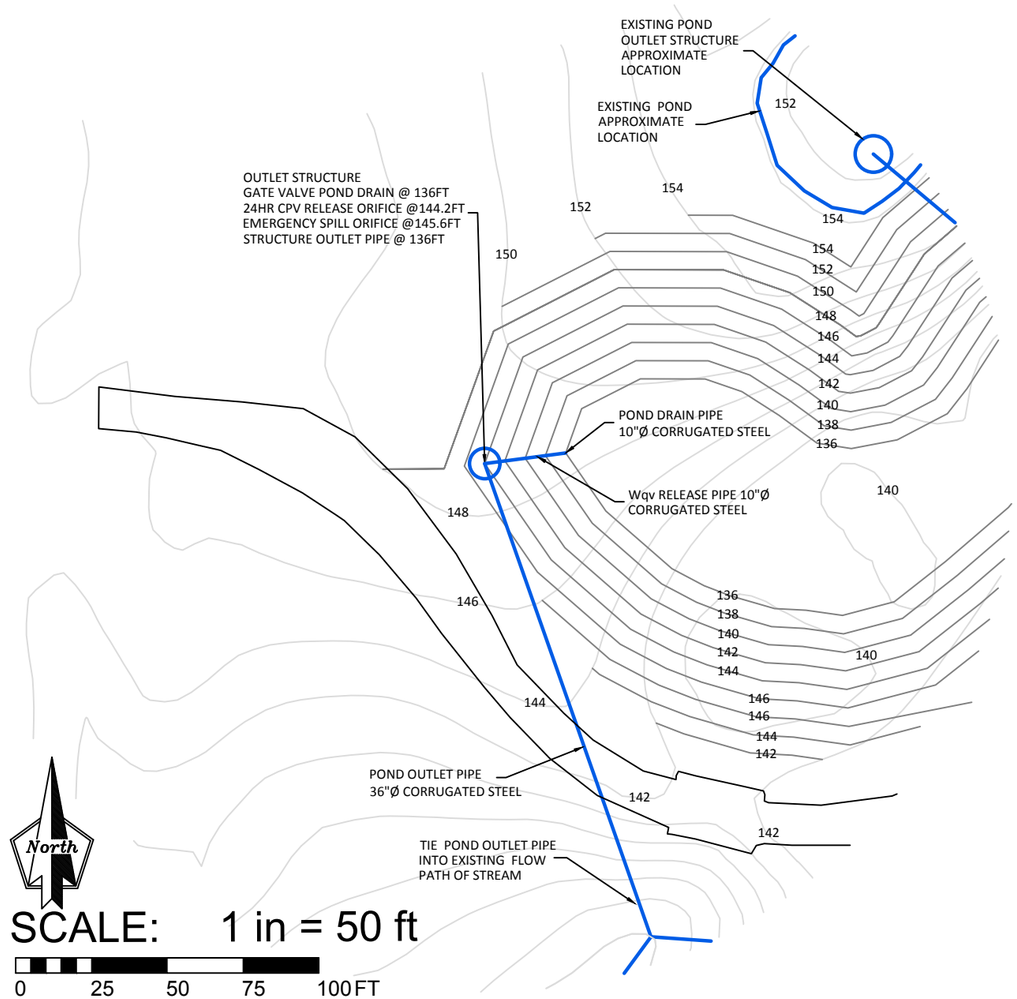


North

SCALE: 1in = 8ft

0 5 10 15 20 FT

OUTLET STRUCTURE LOCATION



North

SCALE: 1 in = 50 ft

0 25 50 75 100 FT

The UNIVERSITY of VERMONT

PROJECT NAME: FARRELL BROOK - SHELBURNE ROAD STORMWATER DESIGN	DATE: 05/06/2016
CE 175: SENIOR DESIGN, UVM SPRING 2016	DESIGNED BY: AJS
DESIGN DETAIL: OUTLET STRUCTURE	CHECKED BY: ALD
LOCATION: SOUTH BURLINGTON CITY INN ROAD	SHEET 17 OF 27

RETENTION POND

B7

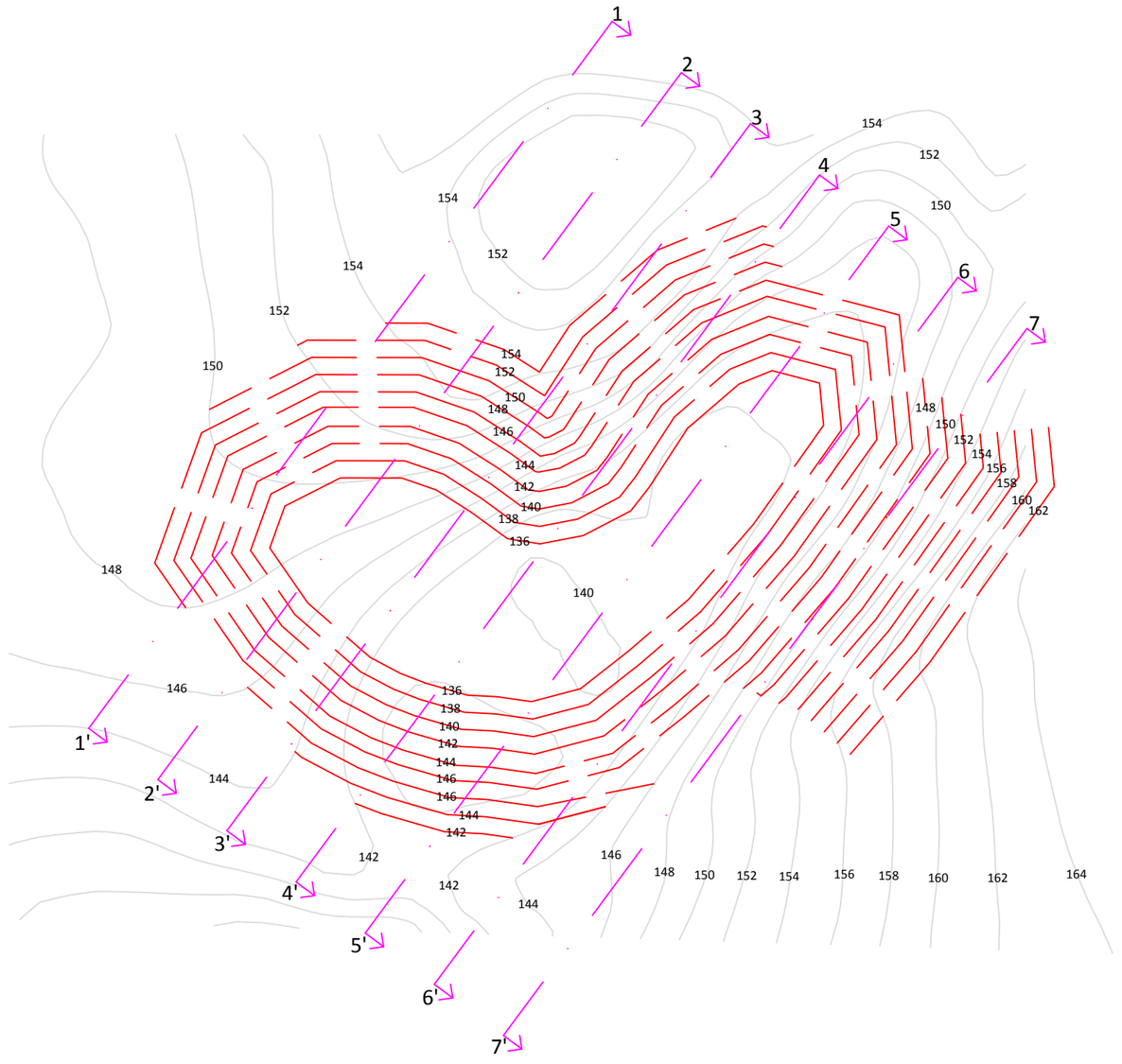
Legend

EXISTING CONTOUR

PROPOSED CONTOUR

SECTION LINE

NOTE: 30FT SPACING BETWEEN SECTION LINES



North

SCALE: 1 in = 50 ft

0 25 50 75 100 FT

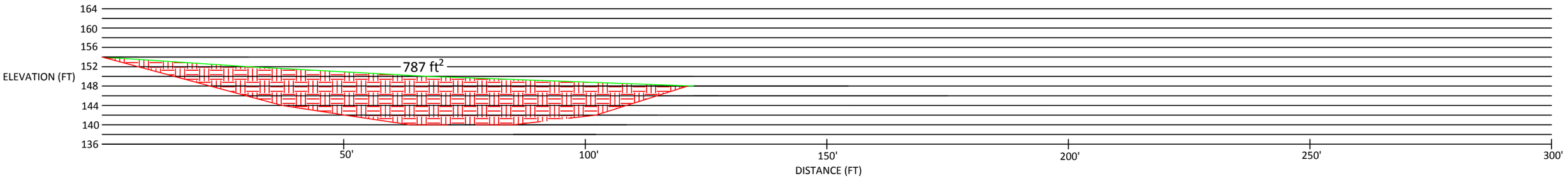
The UNIVERSITY of VERMONT

PROJECT NAME: FARRELL BROOK - SHELBURNE ROAD STORMWATER DESIGN	DATE: 05/06/2016
CE 175: SENIOR DESIGN, UVM SPRING 2016	DESIGNED BY: AJS
DESIGN DETAIL: CUT AND FILL CROSS SECTION LOCATIONS	CHECKED BY: ALD
LOCATION: SOUTH BURLINGTON CITY INN ROAD	SHEET 18 OF 27

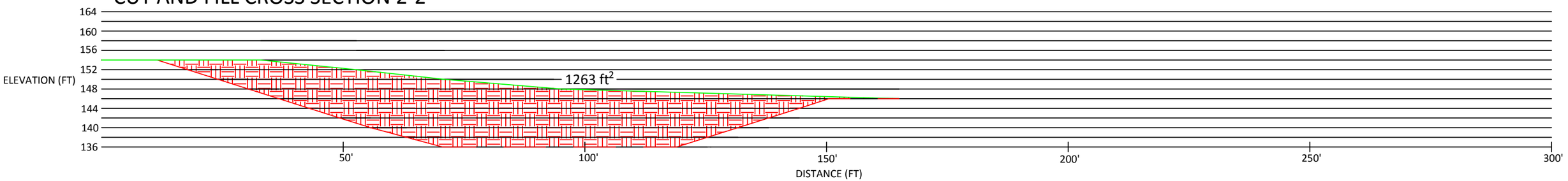
RETENTION POND

B8

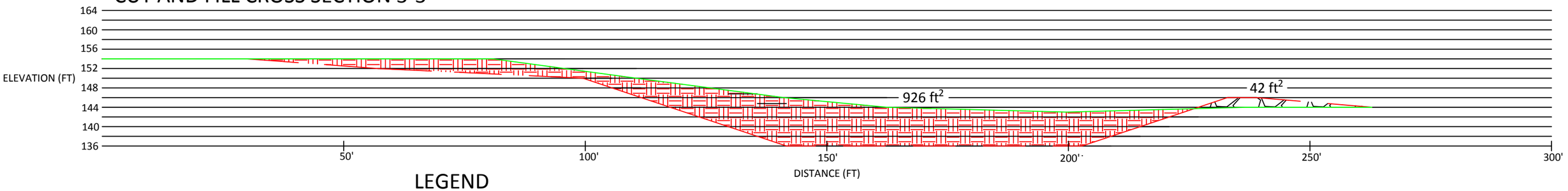
CUT AND FILL CROSS SECTION 1-1'



CUT AND FILL CROSS SECTION 2-2'



CUT AND FILL CROSS SECTION 3-3'



LEGEND

CUT

FILL

EXISTING CONTOUR

PROPOSED CONTOUR

SCALE: 1 in = 20 ft

0 10 20 30 40 FT

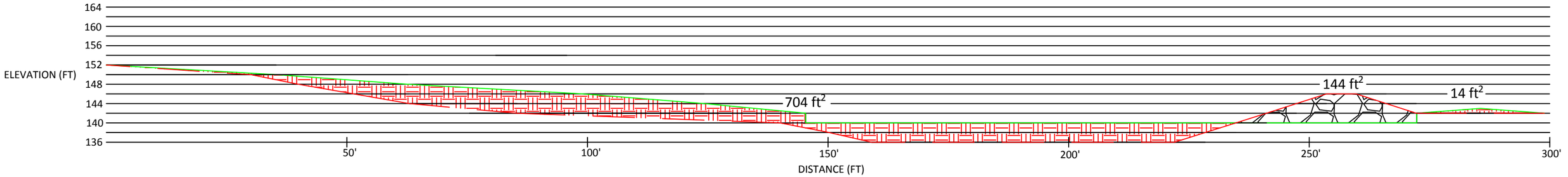
The UNIVERSITY of VERMONT

PROJECT NAME: FARRELL BROOK - SHELBURNE ROAD STORMWATER DESIGN	DATE: 05/06/2016
CE 175: SENIOR DESIGN, UVM SPRING 2016	DESIGNED BY: AJS
DESIGN DETAIL: CUT AND FILL VOLUMES	CHECKED BY: ALD
LOCATION: SOUTH BURLINGTON CITY INN ROAD	SHEET 19 OF 27

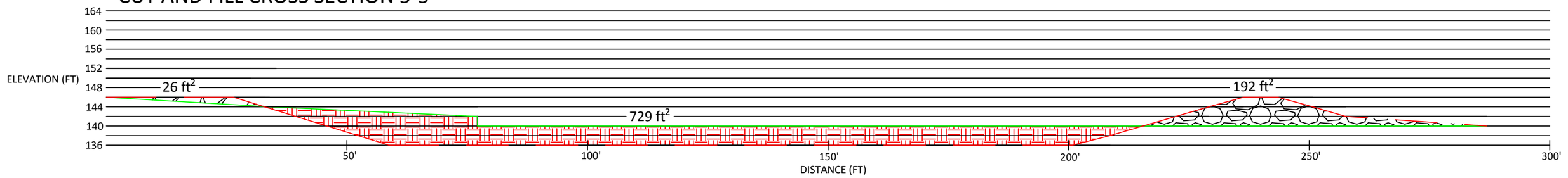
RETENTION POND

B9

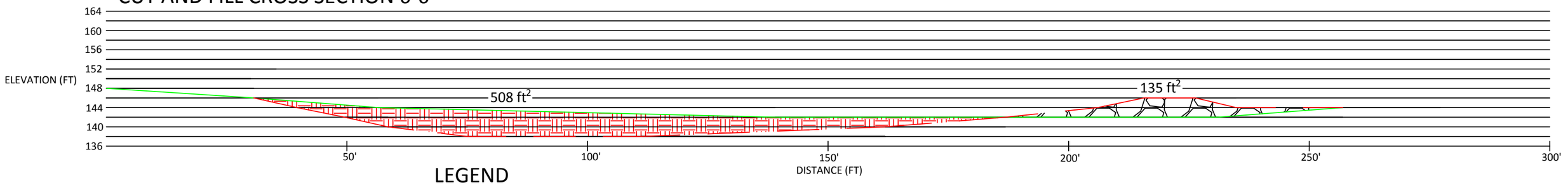
CUT AND FILL CROSS SECTION 4-4'



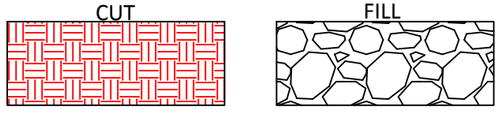
CUT AND FILL CROSS SECTION 5-5'



CUT AND FILL CROSS SECTION 6-6'



LEGEND



SCALE: 1 in = 20 ft

0 10 20 30 40 FT

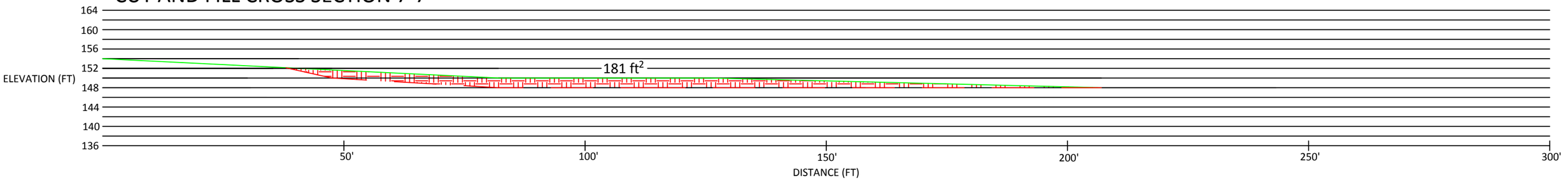
The UNIVERSITY of VERMONT

PROJECT NAME: FARRELL BROOK - SHELBURNE ROAD STORMWATER DESIGN	DATE: 05/06/2016
CE 175: SENIOR DESIGN, UVM SPRING 2016	DESIGNED BY: AJS
DESIGN DETAIL: CUT AND FILL VOLUMES	CHECKED BY: ALD
LOCATION: SOUTH BURLINGTON CITY INN ROAD	SHEET 20 OF 27

RETENTION POND GRADING

B10

CUT AND FILL CROSS SECTION 7-7'



SCALE: 1 in = 20 ft

0 10 20 30 40 FT

LEGEND

CUT

FILL

EXISTING CONTOUR

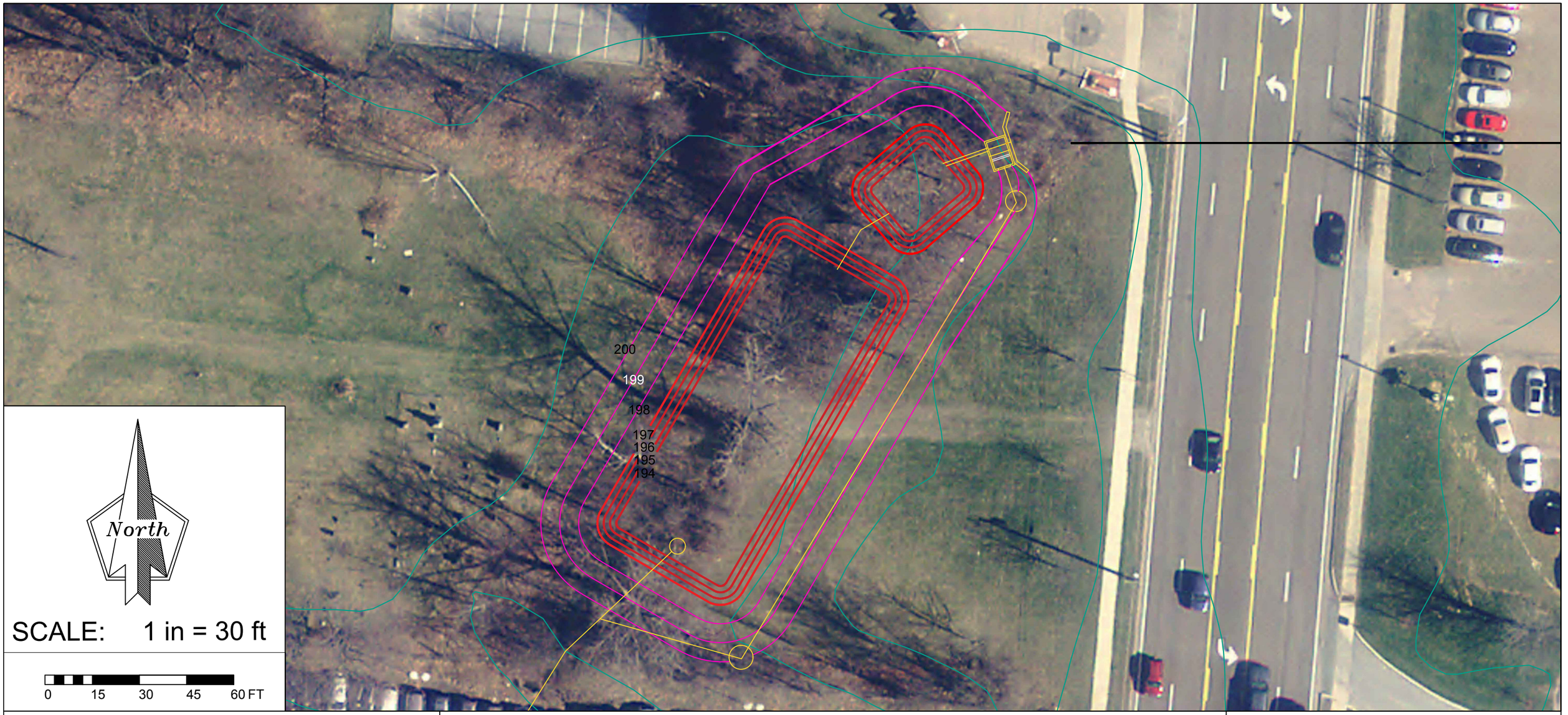
PROPOSED CONTOUR

The UNIVERSITY of VERMONT

PROJECT NAME: FARRELL BROOK - SHELBURNE ROAD STORMWATER DESIGN	DATE: 05/06/2016
CE 175: SENIOR DESIGN, UVM SPRING 2016	DESIGNED BY: AJS
DESIGN DETAIL: CUT AND FILL VOLUMES	CHECKED BY: ALD
LOCATION: SOUTH BURLINGTON CITY INN ROAD	SHEET 21 OF 27

RETENTION POND GRADING

B11



North

SCALE: 1 in = 30 ft

0 15 30 45 60 FT

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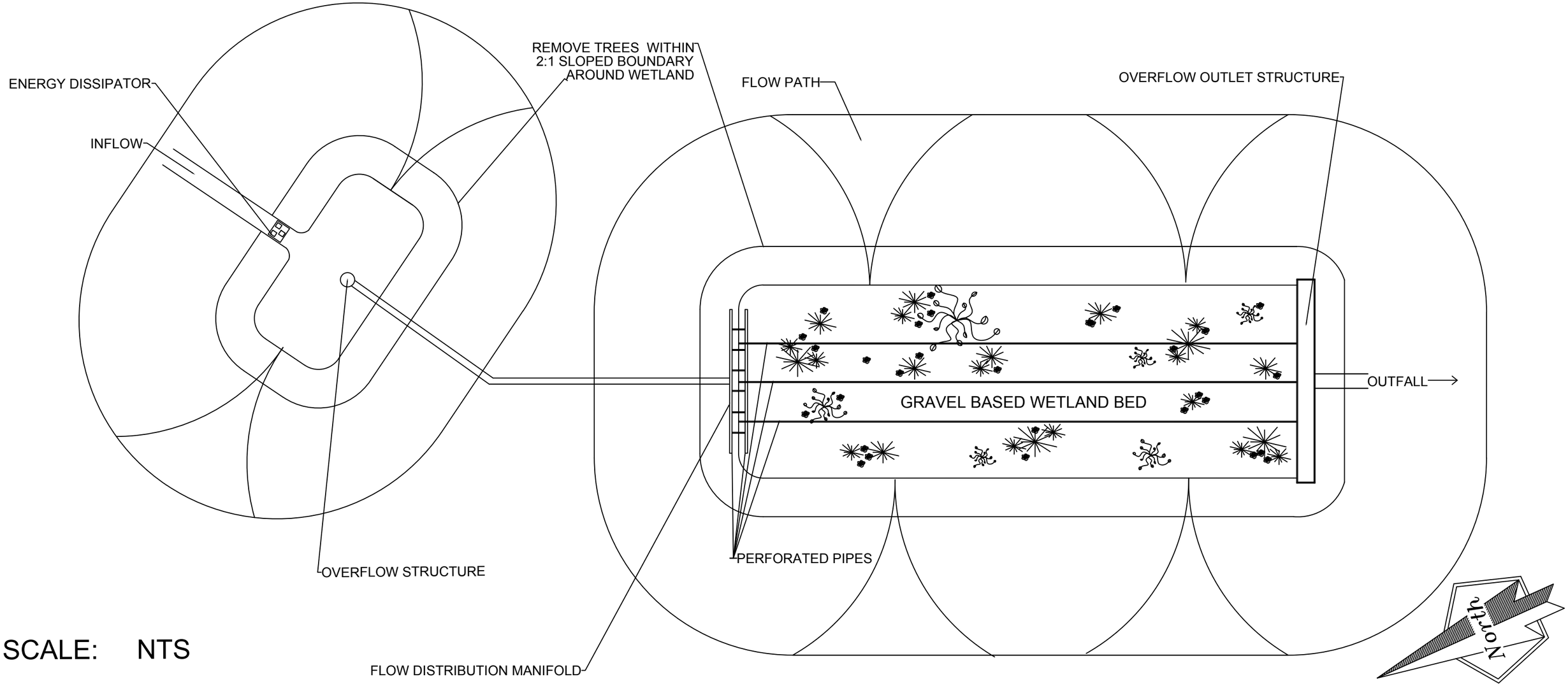
PROJECT NAME: FARRELL BROOK - SHELBURNE ROAD STORMWATER DESIGN	DATE: 05/06/2016
CE 175: SENIOR DESIGN, UVM SPRING 2016	DESIGNED BY: JFM
DESIGN DETAIL: CONTOURS AND LOCATION IMAGERY	CHECKED BY: ALD
LOCATION: SOUTH BURLINGTON CITY CEMETERY	SHEET 22 OF 27

GRAVEL WETLAND

C1



SCALE: NTS

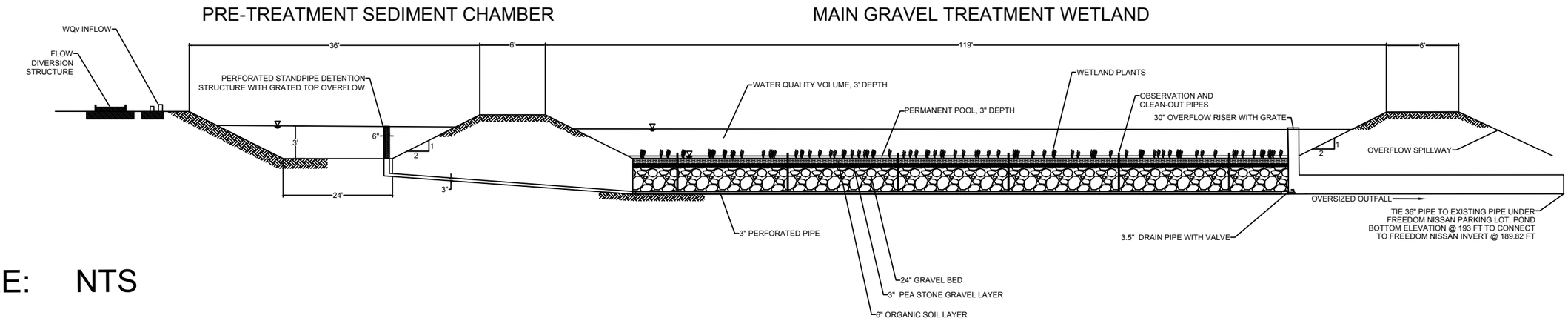
The UNIVERSITY of VERMONT

PROJECT NAME: FARRELL BROOK - SHELBURNE ROAD STORMWATER DESIGN	DATE: 05/06/2016
CE 175: SENIOR DESIGN, UVM SPRING 2016	DESIGNED BY: ALD
DESIGN DETAIL: PLAN VIEW	CHECKED BY: JFM
LOCATION: SOUTH BURLINGTON CITY CEMETARY	SHEET 23 OF 27

GRAVEL WETLAND

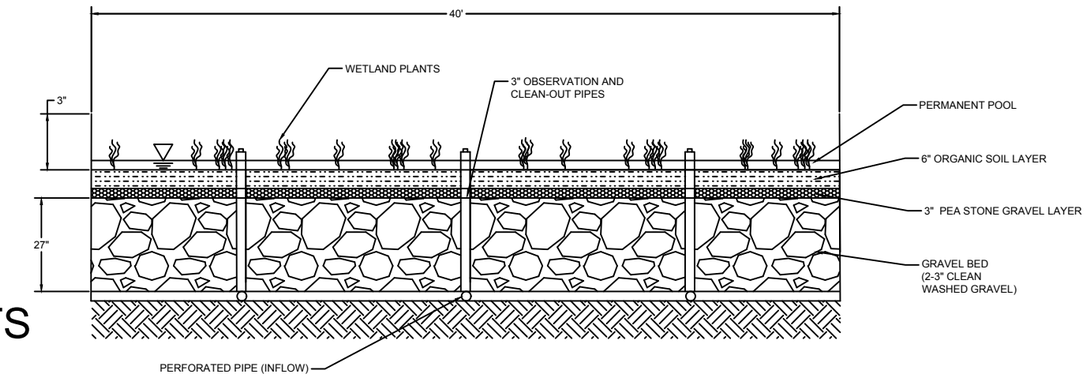
C2

WETLAND CROSS SECTION 1-1



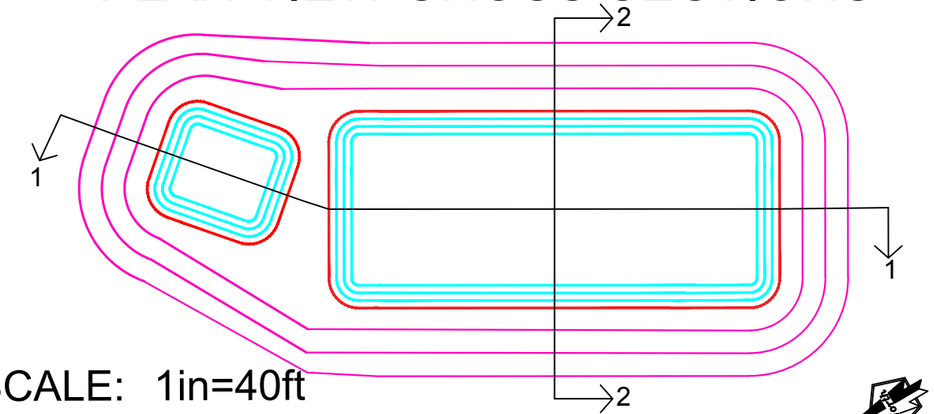
SCALE: NTS

WETLAND CROSS SECTION 2-2



SCALE: NTS

PLAN VIEW CROSS SECTIONS



SCALE: 1in=40ft

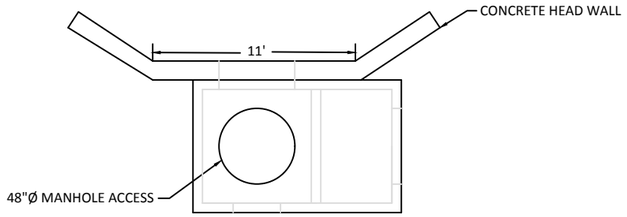
0 10 20 30 40

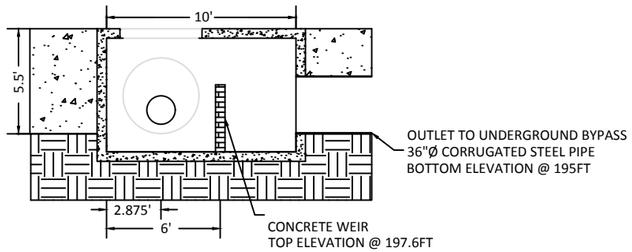
The UNIVERSITY of VERMONT

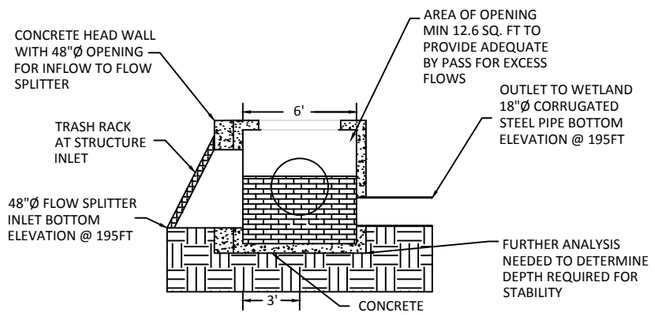
PROJECT NAME: FARRELL BROOK - SHELBURNE ROAD STORMWATER DESIGN	DATE: 05/06/2016
CE 175: SENIOR DESIGN, UVM SPRING 2016	DESIGNED BY: ALD
DESIGN DETAIL: PROFILE CROSS SECTION	CHECKED BY: JFM
LOCATION: SOUTH BURLINGTON CITY CEMETARY	SHEET 24 OF 27

GRAVEL WETLAND

C3

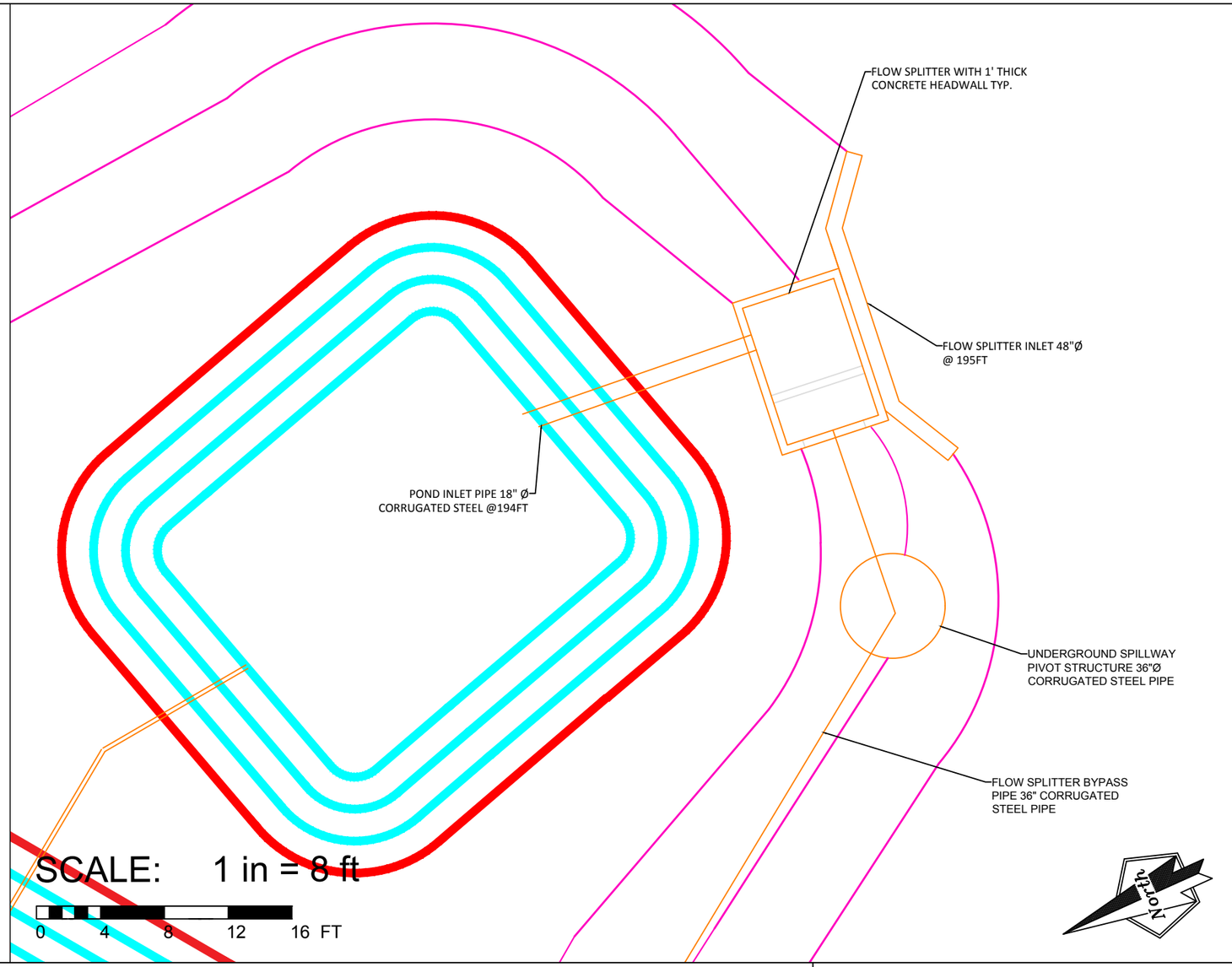






SCALE: 1 in = 8 ft

0 4 8 12 16 FT



SCALE: 1 in = 8 ft

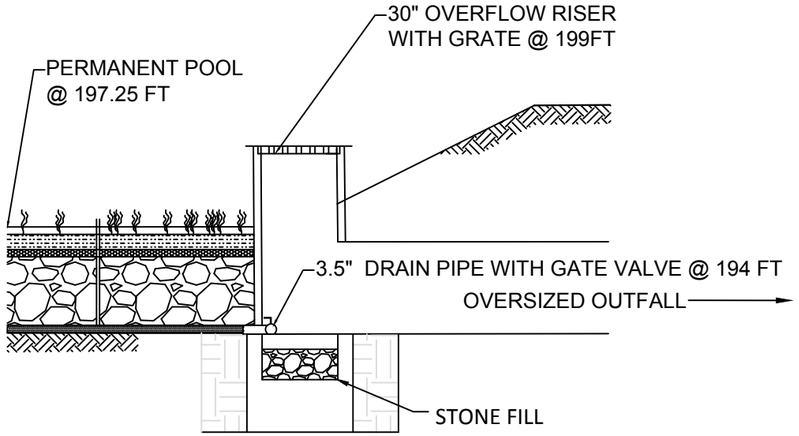
0 4 8 12 16 FT

The UNIVERSITY of VERMONT

PROJECT NAME: FARRELL BROOK - SHELBURNE ROAD STORMWATER DESIGN	DATE: 05/06/2016
CE 175: SENIOR DESIGN, UVM SPRING 2016	DESIGNED BY: ALD
DESIGN DETAIL: INLET STRUCTURE	CHECKED BY: JFM
LOCATION: SOUTH BURLINGTON CITY CEMETARY	SHEET 26 OF 27

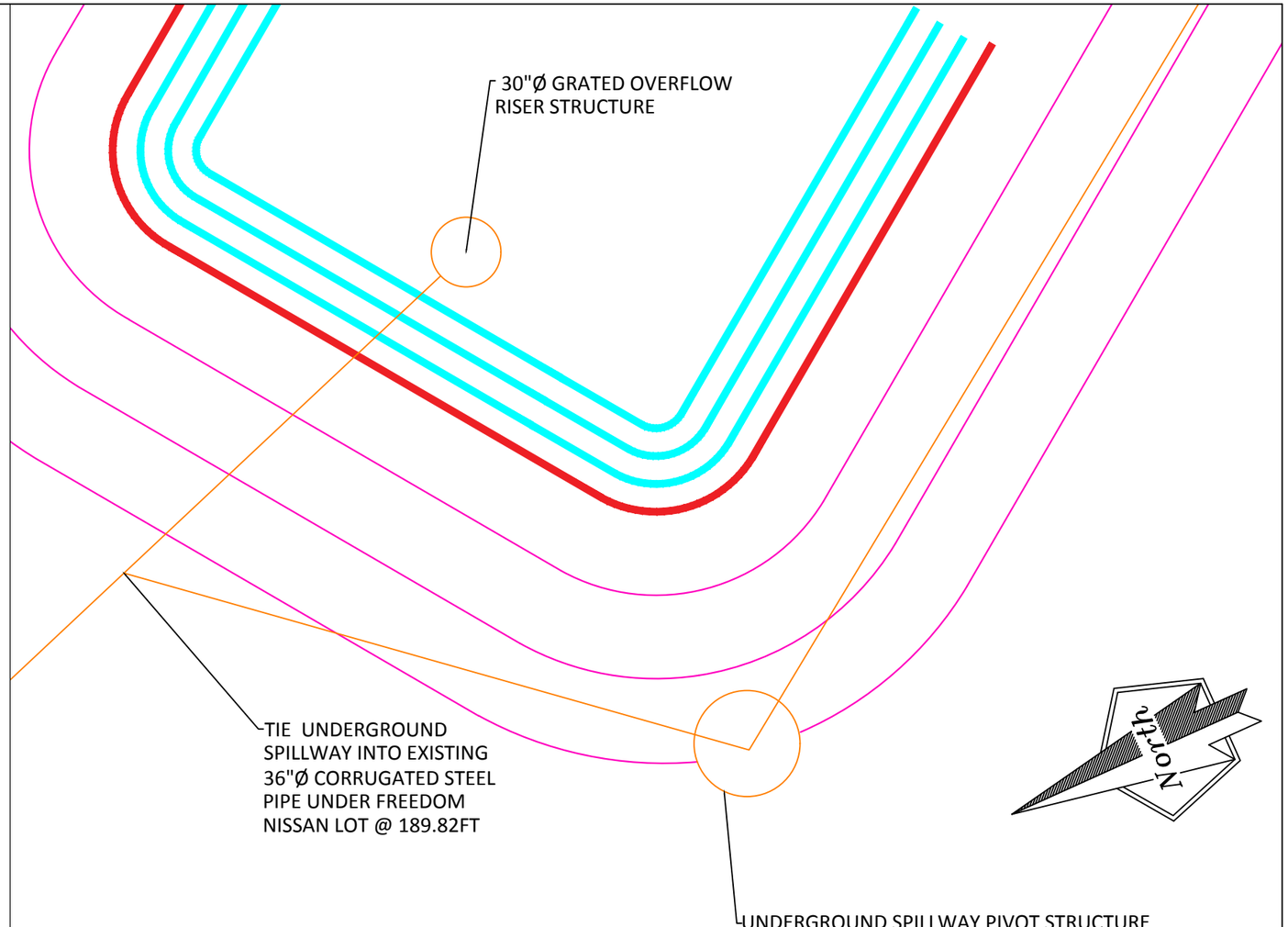
GRAVEL WETLAND

C4



SCALE: 1 in = 5 ft

0 2.5 5 7.5 10 FT



SCALE: 1 in = 10 ft

0 5 10 15 20 FT

The UNIVERSITY of VERMONT

PROJECT NAME: FARRELL BROOK - SHELBURNE ROAD STORMWATER DESIGN	DATE: 05/06/2016
CE 175: SENIOR DESIGN, UVM SPRING 2016	DESIGNED BY: ALD
DESIGN DETAIL: OUTLET STRUCTURE	CHECKED BY: JFM
LOCATION: SOUTH BURLINGTON CITY CEMETARY	SHEET 27 OF 27

GRAVEL WETLAND

C5

APPENDIX D: HydroCAD Analysis

HydroCAD analysis was performed to analyze flow conditions for the design area at pre-development stages. In an ideal situation, flows would be returned to a natural rate seen in the wooded and grass land cover that once existed in this area. The output of the following analyses were used to compare the mitigation efforts of the detention pond, as this was designed to control flows, to the ideal goal.

Figure 1 represents the schematic seen in HydroCAD to represent the "catchment" and "pond". Each analyses consists of a "catchment" with defined land cover, soil type, curve number, and total areas for the watershed. These may be reviewed in Figure 2. The "pond" then represents the location of the detention pond and is the point at which the hydrographs seen in Figure 3 were calculated. The discharge produced in the natural wooded and grass area of 7.2 cfs provides the ultimate goal of mitigation for the 10-yr storm, although this will likely never be reached with today's environment. Figure 4 then provides information on several storm severities.

The second HydroCAD analysis for 1-acre, 20% impervious provides more of a middle ground and more reasonable goal for lowering flows in Farrell Brook.

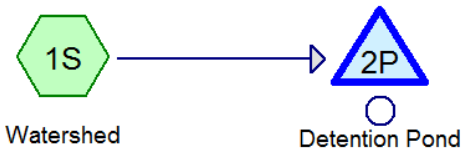


Figure 1. Watershed Routing Diagram

Area (acres)	CN	Description (subcatchment-numbers)
38.937	32	Woods/grass comb., Good, HSG A (1S)
30.700	58	Woods/grass comb., Good, HSG B (1S)
10.881	72	Woods/grass comb., Good, HSG C (1S)
0.126	79	Woods/grass comb., Good, HSG D (1S)
80.644	**47**	**TOTAL AREA**

Figure 2. Input soil parameters and land cover type for watershed node (1S)

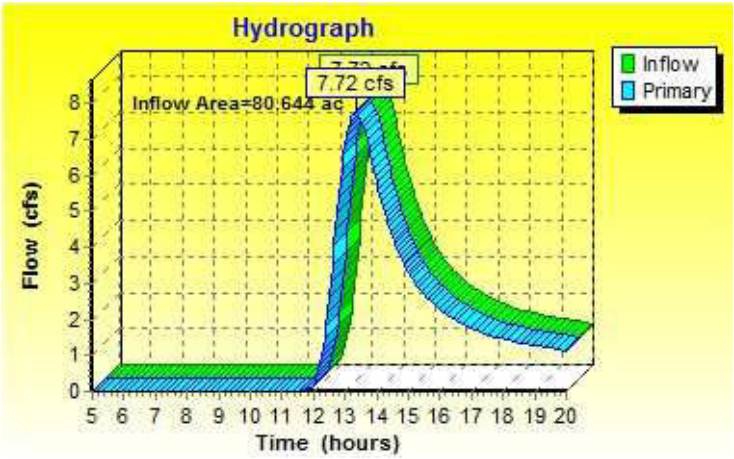


Figure 3. Output hydrograph with peak 10-yr flow at 7.72 cfs

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (cubic-feet)
1-Year	0.99	0.99	**0.00**	**0**
2-Year	1.50	1.50	0.00	0
5-Year	4.79	4.79	0.00	0
10-Year	7.72	7.72	0.00	0
25-Year	11.24	11.24	0.00	0
50-Year	15.24	15.24	0.00	0
100-Year	**17.83**	**17.83**	0.00	0

Figure 4. Modeled flows at various storms levels for Chittenden County, VT

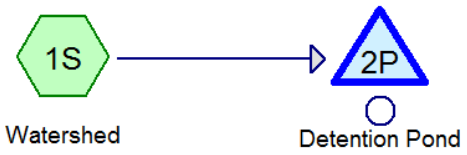


Figure 1. Watershed Routing Diagram

Area (acres)	CN	Description (subcatchment-numbers)
38.937	51	1 acre lots, 20% imp, HSG A (1S)
30.700	68	1 acre lots, 20% imp, HSG B (1S)
10.881	79	1 acre lots, 20% imp, HSG C (1S)
0.126	84	1 acre lots, 20% imp, HSG D (1S)
80.644	**61**	**TOTAL AREA**

Figure 2. Input soil parameters and land cover type for watershed node (1S)

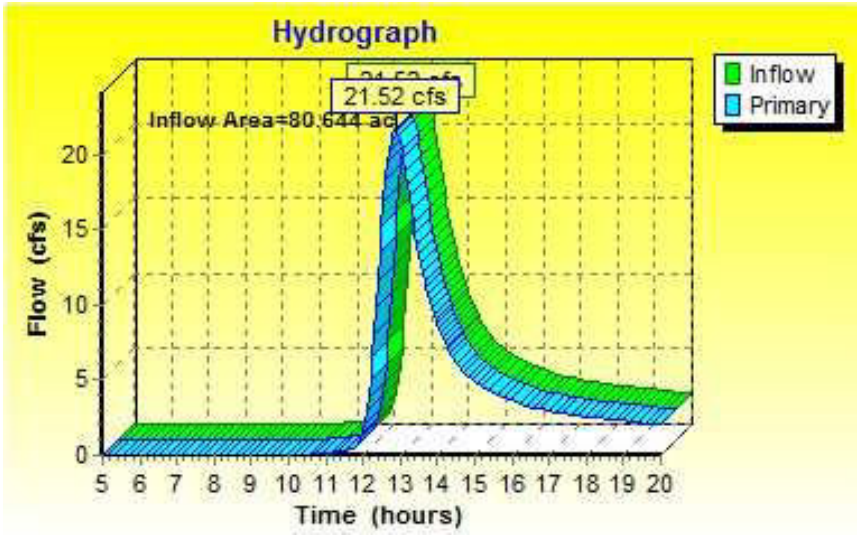


Figure 3. Output hydrograph with peak 10-yr flow at 21.52 cfs

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (cubic-feet)
1-Year	4.41	4.41	**0.00**	**0**
2-Year	5.96	5.96	0.00	0
5-Year	14.26	14.26	0.00	0
10-Year	21.52	21.52	0.00	0
25-Year	30.12	30.12	0.00	0
50-Year	39.85	39.85	0.00	0
100-Year	**46.23**	**46.23**	0.00	0

Figure 4. Modeled flows at various storms levels for Chittenden County, VT

APPENDIX E: Relevant Permits

The following permits would need to be completed for the implementation of any of the proposed designs. Permits have been partially completed to the best of knowledge at this time but are not ready for submittal.

List of Permits

1) Stream Alteration Permit
2) General Wetlands Permit
3) Act 250 Permit

Vermont Wetlands Program
General Permit Qualification Form

Under Sections 9
of the Vermont Wetland Rules

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WATERSHED MANAGEMENT DIVISION
WETLANDS PROGRAM

1. General Permit Eligibility Checklist:
If you cannot verify all of the following, stop and proceed to the Individual Permit Application.

- ■ The activity does not qualify as an Allowed Use under Section 6 of the Vermont Wetland Rules.
- ■ The activity does not need additional conditions to protect functions and values.
- ■ All impacts have been avoided and minimized to the greatest extent possible.
- ■ The wetland complex is not significant for Function 5.5 Exemplary Wetland Natural Community or 5.6 Rare, Threatened and Endangered Species Habitat, or applicant has received a waiver letter from VT Fish and Wildlife. (attach waiver)
- ■ The activity is not located in or adjacent to a vernal pool, fen, or bog.
- ■ The wetland is not at or above 2,500' in elevation (headwaters wetland).
- ■ The project is not located in a Class I wetland or associated buffer zone.
- ■ The activity is not an as-built project that constitutes a violation of the Vermont Wetland Rules.
- ■ The activity is not associated with an activity which received a Wetland Permit.

2. Project Type *(as described in the General Permit)*

Linear Project (linear facilities)

3. Wetland Type Proposed for Impact

Natural Area <Choose Secondary>

4. 50ft Wetland Buffer Proposed for Impact

Natural Area <Choose Secondary>

5. **Activity Threshold** *based on the selections above, select the appropriate threshold. If the activity is greater than the thresholds below, stop and proceed to the Individual Permit Application.* eg: Project type is non-linear, wetland and buffer type is managed and natural, and total impacts are 700 sqft → choose option (d) below.

☐ (a) The total activity impacts proposed are <3,000 square feet of managed wetland or buffer **and** will not exceed 999 square feet of natural wetland or buffer **and** will not exceed 149 square feet of surface water margins.

☐ (b) The activity is associated with a linear project **and** total activity impacts proposed are <5,000 square feet of managed wetland or buffer **and** will not exceed 2,999 square feet of natural wetland or buffer **and** will not exceed 149 square feet of surface water margins.

6. Section 8B Specific Activity Best Management Practices *All permittees covered under the VT Wetland General Permit must implement best management practices (BMP) under section V. of the permit. Here, identify if the proposed activity must implement special BMPs in accordance with Section 8B*

- ☐ 8B(a) Placement, relocation, removal, or upgrade of overhead utility lines
- ☐ 8B(b) Installation of underground facilities including utilities, dry hydrants, foundation drains, and wells
- ☐ 8B(c) Activities in surface water body margins
- ☐ None Apply

The Secretary may require a person applying for an authorization under a general permit to apply for an individual permit. VWR §9.8. Contact your District Ecologist to verify eligibility before submittal.

Vermont Wetlands Program
Permit Application Database Form

Under Sections 8 and 9
of the Vermont Wetland Rules

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WATERSHED MANAGEMENT DIVISION
WETLANDS PROGRAM

Application Submittal Instructions

- If submitting via US post, include a check in the correct fee amount made payable to the "**State of Vermont**," and a CD for applications that contain large files (1 MB or greater).

  Mail to: Vermont Wetlands Program
  Watershed Management Division
  One National Life Drive, Main 2
  Montpelier, VT 05620-3522

- Applications can also be submitted via email to the following address: anr.wsmdwetlands@vermont.gov
  - If submitting via email, please mail a check in the correct fee amount, made payable to the "**State of Vermont**," and a copy of the Vermont Wetlands Program Application Database Form (this page) to the address provided above. ***It is not necessary to mail in a copy of the complete application.***

Applicant Name: L.T., J.M., A.S., A.D., K.B.	**Application Preparer Name:** Laura Tracy
Town where project is located: Burlington	**County:** Chittenden
Span#:	**Vermont Wetlands Project (VWP)# if Known:**
Project Location Description: South of 1095 Shelburne Rd, South Burlington, VT 05403 *911 street address or direction from nearest intersection*	
Brief Project Summary: Detention pond near Freedom Nissan and retention pond on Farrell Property to control stormwater flows.	

Application Type: ☐Individual Permit (multiple wetlands) ☐After the Fact Permit ☐Wetland Determination
☐Individual Permit (single wetland) ☒General Permit Coverage Authorization ☐Permit Amendment: VWP Project #_____

Existing Land Use Type(s): *(Check all that apply)* ☐Residential (single family) ☐Residential (subdivision) ☒Undeveloped
☐Agriculture ☐Transportation ☒Forestry ☐Parks/Rec/Trail ☐Institutional ☒Industrial/Commercial

Proposed Land Use Type(s): *(Check all that apply)* ☐Residential (single family) ☐Residential (subdivision) ☐Undeveloped
☐Agriculture ☐Transportation ☐Forestry ☐Parks/Rec/Trail ☒Institutional ☐Industrial/Commercial

Proposed Impact Type(s): *(Check all that apply)* ☐Buildings ☐Utilities ☐Parking ☐Septic/Well ☒Stormwater
☐Driveway ☐Park/Path ☐Agriculture ☒Pond ☐Lawn ☐Dry Hydrant ☐Beaver Dam Alteration ☐Silviculture
☐Road ☐Aesthetics ☐No Impact ☐Other:_____

Wetland and Buffer Impact Type: *(Check all that apply)* ☐ Dredge ☐Drain ☐Cut Vegetation ☒Stormwater
☐Trench/Fill ☐Other:_____

Wetland Delineation Date(s):

Wetland Improvements		Buffer Zone Improvements		Reason for Improvements
Restoration:	s.f.	Restoration:	s.f.	☐Correction of Violation
Creation:	s.f.	Creation:	s.f.	☐To offset permit impacts
Enhancement:	s.f.	Enhancement:	s.f.	☐Voluntary
Conservation:	s.f.	Conservation:	s.f.	

Wetland Impact Fee Calculations: *Round to the nearest square foot. Fees will auto-calculate.*

Total Wetland Impact (minus linear clear, including ATF)	square feet (s.f.)	Wetland Impact Fee:($0.75/sf)	$ 0.00
Total Wetland Clearing (qualified linear projects only)	square feet (s.f.)	Wetland Clearing Fee:($0.25/sf)	$ 0.00
After The Fact Wetland Impact (to correct a violation)	square feet (s.f.)	After the Fact Wetland Fee: (0.75/sf) *(Required for after the fact permit applications)*	$ 0.00

Total Buffer Zone Impacts and Calculations: *Round to the nearest square foot*

Total Buffer Zone Impact	square feet (s.f.)	Buffer Impact Fee: ($0.25/sf)	$ 0.00

Additional Fees

	Agricultural Crop Conversion *Check here:* ☐ *(Flat fee of $200.00)*	$ 0.00
	Minimum Application Fee: ($50.00) *Required when total impact fee is less than $50.00*	$ 50.00
	Administrative Fee:	$ 240.00
Make Checks Payable to: State of Vermont	**Total Check Amount:**	$ 290.00

Application for Authorization Under the Vermont General Wetland Permit and Determination Petition

Under Sections 8 and 9
of the Vermont Wetland Rules

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WATERSHED MANAGEMENT DIVISION
WETLANDS PROGRAM

Applicant Information: *If the applicant is someone other than the landowner, the landowner information must be included below*			
Applicant Name: Laura Tracy, Jamie Martell, Andrea Dotolo, Andrew Sampsell, and Katrina Benoit			
Address:	City/Town: South Burlington	State Vermont	Zip: 05401
Phone Number:	Email Address:		

Applicant Certification:
By signing this application you are certifying that all of the information contained within is true, accurate, and complete to the best of your knowledge. Original signature is required.

Applicant Signature:_____ Date:_____

Landowner Information: *Landowner must sign the application. If landowner is different from the applicant this section must be filled out*			
☐**Check this box if landowner is the same as the applicant**			
Landowner Name: L&M Park, Farrell Property, Freedom Nissan			
Address:	City/Town South Burlington	State: Vermont	Zip: 05401
Phone Number:	Email Address:		

Landowner Easement: *Attach copies of any easements, agreements, or other documents conveying permission, and agreement with the landowner stating who will be responsible for meeting the terms and conditions of the permit.* ***List the attachment for this information in this section. Describe the nature of the agreement or easement in the space provided below:***

Agreement with landowner will need to be made.

Landowner Certification:
By signing this application you are certifying that all the information contained within is true, accurate, and complete to the best of your knowledge. Original signature is required.

Landowner Signature:_____ Date:_____

Application Preparer Information: *Consultant, engineer, or other representative that is responsible for filling out the application, if other than the applicant or landowner.*			
Application Preparer Name:			
Address:	City/Town	State:	Zip:
Phone Number:	Email Address:		

Application Preparer Certification:
By signing this application you are certifying that all of the information contained within is true, accurate, and complete to the best of your knowledge. Original signature is required.

Application Preparer Signature:_____ Date:_____

Handwritten signatures are also accepted.

1. **Location of wetland and project:** *(Individual Permit Application [IPA] Section 1)*
Location description should include the road the wetland is located on, the compass direction of the wetland in relation to the road, 911 street address if available, and any other distinguishing features.

South of 1095 Shelburne Rd, South Burlington, VT 05403

2. **Program Contact:** *(IPA Section2)*
Indicate here if you have been in contact with the Wetlands Program before the application submittal.

2.1 Date of Interaction with State Wetland Ecologist	2.2. State Wetland Ecologist Name

3. **Wetland Classification:** *(IPA Section 3)*

3.1. The wetland is a class II wetland because: *(IPA Section 3.1)*

The wetland is mapped on the VSWI

3.2. Section 4.6 Presumption *(IPA Section 3.2)*
If the wetland meets the Section 4.6 Presumption, it does so because:

c. The wetland contains dense, persistent, non-woody vegetation and is adjacent to a stream, river, or open body of water.

<Choose One>

<Choose One>

4. **Description of Entire Wetland:** *(IPA Section 4)*
Answer the following questions regarding the entire wetland, which includes all wetland areas connected to the wetland area proposed for impact. Answers may be estimates based on desktop review when wetland extends past the investigation area (parcel boundary). Specific questions about the wetland in the project area will follow.

4.1. Size of Complex in Acres: *(IPA Section 4.1)*
The size of the complex can be obtained from the Wetland Inventory Map for mapped wetlands, or best estimation based on review of aerial photography or site visit. This is not the size of the of the delineated wetland on the subject property unless the entirety of the wetland is represented in the delineation.

4.2. Vegetation Cover Types Present: *(IPA Section 4.2)*
List all wetland types in the entire wetland and their percent cover.
***For example:** 50 acres of softwood forested swamp; or 30% scrub swamp, 70% emergent wetland*

Palustrine,Scrub-Shrub,Broad-Leaved Deciduous

4.3. Pre-project Cumulative Impacts to the Wetland: *(IPA Section 4.7)*
Identify any cumulative ongoing impacts outside of the proposed project that may influence the wetland.
***Examples include but are not limited to:** Wetland encroachments on and off the subject property, land use management in or surrounding the wetland, or development that influences hydrology or water quality. List any past Vermont Wetland Permits or CUD's related to this property.*

Without project treatment increased flows of Farrell Brook may affect adjacent wetlands.

5. **Context of Subject Wetland:** *(IPA Section 5.1)*
Describe where the subject wetland is in the context of the larger wetland or wetland complex described above.
***For example:** Upslope/downslope, narrow eastern "finger", 400 ft. from open water portion.*

West of detention pond and upslope of retention pond.

6. **Subject Wetland Vegetation:** *(IPA Section 5.3)*
List dominant wetland vegetation cover type and associated dominant plant species. For example: emergent marsh with cattails; forested swamp dominated by red maple and yellow birch; shrub swamp dominated by speckled alder and peat moss; wet meadow dominated by reed canary grass.

Palustrine,Scrub-Shrub,Broad-Leaved Deciduous

7. Buffer Zone: *(IPA Section 5.6)*
Describe the buffer zone of the subject wetland

7.1 Buffer Land Use: *(IP Section 5.6.1)*
For example: *Mowed shoulder, forested, old field, paved road, and residential lawns, etc.*
Describe any previous and ongoing disturbance in the buffer zone.

Forested

8. Wetland Function Summary: *(IPA Section 6)*
Check which functions are present in the wetland complex

☒ Flood/Storm Storage	☐ RTE Species
☐ Surface & Groundwater Protection	☐ Education & Research
☐ Fish Habitat	☐ Recreation/Economic
☐ Wildlife Habitat	☐ Open Space/Aesthetics
☐ Exemplary Natural Community	☐ Erosion Control

9. Overall Project Description: *(IPA Section 17)*

9.1. Overall Project Purpose: *(IPA Section 17.1)*
Description of the basic project.
For example: *six-lot residential subdivision; expansion of an existing commercial building, building a single family residence.*

Creation of detention pond to control stormwater flows in Farrell Brook. Expansion of existing pond to create retention pond that will provide treatment for incoming stormwater flows.

10. Project Details: *(IPA Section 18)*
Provide details regarding specific impacts to the wetland and buffer zone.

10.1. Specific Impacts to Wetland and Buffer Zone Dimensions: *(IPA Section 18.1)*
List portions of the project that will specifically impact the wetland or buffer zone and their dimensions.
For example: *driveway crossing with 16' wide fill, installation of buried sewer force main with 5' trench Including fill footprint.*

10.2. Bridges and Culverts: *(IPA Section 18.2)*
Culvert circumference, length, placement and shapes, or bridge details. List any stream alteration permits that are required or obtained where perennial streams or rivers are involved.

Adjustments to culverts are not within wetland boundaries. Stream alteration permits will be included.

11. Wetland and Buffer Zone Impacts: *(IPA Section 19)*

11.1. Wetland Impacts: *(IPA Section 19.1)*
Summarize the square footage of impact in the appropriate category. ***Round to nearest square foot***

Permanent Wetland Fill		s.f.
Temporary Wetland Impact		s.f.
Other Permanent Wetland Impact ***(this number includes clearing of woody vegetation, dredging, and does not include fill)***		s.f.
Total Wetland Impact:	0	s.f.

Describe in detail the proposed impact to wetlands
For example: *Fill for road crossing, temporary impacts for trench and fill related to utility installation.*

11.2. Buffer Zone Impacts: *(IPA Section 19.2)*
Summarize the square footage of impact in the appropriate category.

Temporary Buffer Impact		s.f.
Permanent Buffer Impact		s.f.
Total Buffer Impact:	0	s.f.

Describe in detail the proposed impact to buffer zones
For example: Addition of fill along roadway embankment extending into buffer zone.

11.3. Cumulative Impacts: *(IPA Section 19.3)*
List any potential cumulative or ongoing, direct and indirect impacts on the functions of the wetland.
For example: *Increased noise from parking lot, vegetation management, inputs from stormwater pond outlet, reduction in flood storage volume from the addition of fill from the project.*

Vegetation management, inputs from stormwater pond outlet

12. Mitigation Sequence: *(IPA Section 20)*
Please refer to Section 9.5b of the rules on Mitigation Sequencing for this section.

12.1. Avoidance of Wetland Impacts: *(IPA Section 20.1)*

12.1.1. Can the activity be located on another site owned or controlled by the applicant, or reasonably available to satisfy the basic project purpose? If not, indicate why. Cite any alternative sites and explain why they were not chosen.

12.1.2. Can the proposed activity be practicably located outside the wetland/buffer zone? If not, indicate why. Explain the alternatives you have explored for avoiding the wetland and buffer onsite, And why they are not feasible.

12.2. Avoidance to the Impact to Functions and Values: *(IPA Section 20.2)*

12.2.1. If the proposed activity cannot be practicably located outside the wetland/buffer zone, have all practicable measures been taken to avoid adverse impacts on protected functions?

☐ Yes ☐ No

12.2.2. What design alternatives were examined to avoid impacts to wetland function?
For example: *Use of matting, relocation of footprint, etc.*

12.2.3. What steps have been taken to minimize the size and scope of the project to avoid impacts to wetland functions and values? Include information on project size reduction and relocation.

12.2.4. Explain how the proposed project represents the least impact alternative design. Explain why other alternatives, which you described above, were not chosen.

13. Wetland Determination: *(IP Section 21)*
If the application involves a wetland determination please answer the following.

☐ Wetland is mapped or contiguous to the Vermont Significant Wetland Inventory Map
☐ Wetland is not mapped on or contiguous to the Vermont Significant Wetland Inventory Map

13.1. Reason for Petition: *(IP Section 21.1)*
Please choose one from the dropdown menu.

<Choose One>

13.3. Determination Narrative: *(IP Section 21.2)*
Please provide any narrative to support the petition for a wetland determination here, including previous decisions by the Secretary or Water Board. Determinations are made based on an evaluation of the functions and values present. Here add narrative description on the functions listed in section 8 of this application and described in section 5 of the Vermont Wetland Rules. ***For example:*** *Wetland provides water storage and surface water protection because it is large in size, concave, and naturally vegetated.*

14. Supporting Materials: *(IP Section 22)*

*****ADDITIONAL MATERIALS REQUIRED TO CALL APPLICATION COMPLETE***

14.1. **Location Map: *(IP Section 22.1)*
Provide a location map that is 8 ½" x 11" and separate from any site plans.
The Vermont Natural Resources Atlas is appropriate using USGS topography map base layer, roads, and VSWI wetlands.

Date	Title

14.2. **Site Plan(s): *(IP Section 22.2)*
Please list by date, date of last revision, author, and title. Plans must include wetland delineation and buffer zones, limits of disturbance, erosion controls, building envelopes, and any permanent memorialization.

Title	Author	Date	Last Revision Date

14.3. Other Supporting Documents: *(IP Section 22.5)*
Provide any other documentation that supports the application.
Examples include but are not limited to: *Photographs, easements, agreements, restoration/plan, GIS shapefiles, additional ACOE forms.*

Date	Last Revision	Author	Title

APPLICATION AND REPORTING FORM FOR COVERAGE UNDER THE STREAM ALTERATION PERMIT

(SECTION C.2.2) 10 VSA, SECTIONS 1022 & 7503 And 10 VSA, CHAPTER 41, SUBCHAPTER 2

For Stream Alteration Permitting Use Only

Application Number: _____

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WATERSHED MANAGEMENT DIVISION
RIVERS PROGRAM

It is strongly recommended prior to your submission of this application to have a site visit with the District Engineer in your area. For engineer and district contact information, please visit our website at http://www.watershedmanagement.vermont.gov/rivers.htm

Site visit date _____ Engineer present_____

Please select the application type below:

Individual Permit Application $350.00 Fee	**General Permit Application $200.00 Fee**	**Reporting Activity not requiring an Application $200.00 Fee**

A. Applicant Contact Information:		
1. Name:		
2a. Mailing Address:		
2b. Town/County:	2c. State:	2d. Zip:
3. Phone:	4. Email:	

B. Landowner (If different than applicant):		
1. Name:		
2a. Mailing Address:		
2b.City:	2c. State:	2d. Zip:
3. Phone:	4. Email:	

C. Project Location:	
1. Address:	2. Town:
3. River:	Please follow this link to the ANR Atlas Map
5a Latitude:	5b. Longitude:

D. Contractor:	
1.Name:	2.Phone:
3. Email:	

E. Consultant:	
1.Name:	2.Phone:
3. Email:	

F. Project Description:

G. Please check the Required Attachments : (additional information may be required after initial application review)

- ☐ Location Map
- ☐ Project design drawings including: plan view, cross sections, existing & proposed conditions, bankfull width (channel width at high water)
- ☐ For Individual and General Permits: List of adjoining landowners; names and addresses

H. Applicant Certification for Reporting Activity Only:

I hereby certify that the information on this application is, to the best of my knowledge, true and accurate. I recognize that by signing this application I am giving consent to employees of the State to enter the subject property for the purpose of processing this application and for ensuring compliance with subsequent agency decisions relating to the project.

Applicant Signature: _____ Date: _____

For Stream Alteration General and Individual Permit Applications:
Applicant must file copy of this application with Town Clerk and Adjoiners.

I. Applicant Certification for General and Individual Permits:

I hereby certify that the information on this application is, to the best of my knowledge, true and accurate and that I have provided a copy of this application to the select board and town clerk of the municipality in which this activity is located, the local and regional planning commissions, and to each adjoining landowner as required in the Vermont Stream Alteration Rule. I recognize that by signing this application I am giving consent to employees of the State to enter the subject property for the purpose of processing this application and for ensuring compliance with subsequent agency decisions relating to the project.

Applicant Signature: _____ Date: _____

Print Full Name: _____

If the project is occurring on property other than your own, please include additional signatures below:

Landowner(s) Signature: _____ Date: _____

Print Full Name: _____

Landowner(s) Signature: _____ Date: _____

Print Full Name: _____

A PERMIT MAY BE REQUIRED FROM THE US ARMY CORPS OF ENGINEERS. For information contact:
USA Corps of Engineers, VT Project Office, 8 Carmichael Street Suite 205, Essex Jct VT 05452 802-872-2893

Submit this form and enclose the appropriate application fee listed on the top of page one, payable to:

State of Vermont
Vermont Department of Environmental Conservation
Watershed Management Division
Stream Alteration Permitting
1 National Life Drive, Main 2
Montpelier, VT 05620-3522

Direct all correspondence or questions to Stream Alteration Permitting at: ANR.WSMDRivers@vermont.gov
For additional information visit: www.watershedmanagement.vt.gov

STREAM ALTERATION PERMIT AND REPORTING ACTIVITY INSTRUCTIONS

1) This application is for use by anyone proposing to alter by excavation, movement, or fill of greater than 10 cubic yards in any perennial stream and the activity does not qualify for coverage under the General Permit Section C.2.1. http://www.watershedmanagement.vt.gov/permits/htm/pm_streamalt.htm

2) Provide the applicant name and contact information; may be landowner, municipality, contractor or other.

3) Provide landowner contact information if different from the applicant.

4) Indicate appropriate range of watershed size at the location of the activity. See town-based maps at: http://www.watershedmanagement.vt.gov/rivers/htm/rv_management.htm

5) Provide a brief project description including type of activity, approximate magnitude of project, etc.

6) Describe location by town, address, stream, and latitude/longitude (if known).

7) Provide name, phone number and email for consultant or project designer, if involved, and contractor, if known.

8) Attach location map. Web accessible maps are available at link provided above in #4.

9) Attach a copy of all design drawings, including existing and proposed conditions, plan view, cross sections, and any other pertinent hydraulic, hydrologic, structural, or property boundary information. Plan view typically should extend beyond the construction site so that larger scale stream processes can be identified and considered in the design and regulatory decision. It is preferred but not necessary that design drawings be drawn to scale. In some cases, to-scale drawings may be required.

10) Provide copies of municipal flood hazard area maps wherever any stream crossing structure or other flood plain encroachment is proposed within a mapped flood hazard area.

11) Sign and date the application.

12) Enclose application fee (no cash) payable to “State of Vermont”. The fee is required for activities requiring a written authorization under the Stream Alteration General Permit. This includes: New, replacement, and repair of bridges and culverts as specified in the GP; and lower risk instream activities NOT associated with the next flood or emergency protection of municipal infrastructure and habitable structures (Effective July 1, 2015).

13) Submit a copy of the application to: Department of Environmental Conservation Rivers Program One National Life Drive – Main 2 Montpelier, VT 05620-3522 ANR.WSMDRivers@state.vt.us

14) Submit a copy of application and all required attachments by either ground or electronic mail to the Regional River Management Engineer for the project region (For Regional River Management Engineer contact information see: (http://www.watershedmanagement.vt.gov/rivers/docs/RME_districts_12.14.pdf)

The list items below are only required for General and Individual Permits:

15) Attach a list of adjoining landowners; names and addresses.

16) File a copy of the application and list of adjoining landowners with the selectboard and clerk of the municipality in which the project is located, the local and regional planning commissions, and with each adjoining property owner (For regional planning commissions see: www.vapda.org.).

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APPENDIX F: Existing Stormwater Permits

The following provides all existing stormwater permits in the project area.

List of Existing Permits

1) L&M Park (4835-9010)
2) Farrell Distributing
    a. 3095-9010.R
    b. 3095-INDS
3) Hannaford's Permit (5579-9010)
4) Shelburne Road Act 250 (4C0877)

Permit for L&M Park:

Permit Number 4835-9010
Project ID Number EJ96-0515

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
AUTHORIZATION TO DISCHARGE UNDER
GENERAL PERMIT 3-9010 AMENDED (May 2007)

A determination has been made that the applicant:

Larkin Realty
410 Shelburne Road
South Burlington, VT 05403

meets the criteria necessary for inclusion under General Permit 3-9010 Amended (May 2007). Here after the named applicant shall be referred to as the permittee. Subject to the conditions of General Permit No. 3-9010 Amended (May 2007), the permittee is authorized to discharge stormwater from the L & M Park located on Fayette Drive in South Burlington, Vermont to an unnamed tributary of Lake Champlain as previously described in Individual Permit No. 1-0525:

Manner of Discharge:
S/N 001: Stormwater runoff from the buildings and parking areas of the south and eastern areas of the park, collected via catchbasins, directed to sedimentation basin #1, then conveyed to Lake Champlain via an intermittent drainage way.

S/N 002: Stormwater runoff from the roadway, buildings, and parking areas of the western area of the park, collected via catchbasins, directed to sedimentation basin #2, then conveyed to Lake Champlain via an intermittent drainage way.

S/N 003: Stormwater runoff from the roadway and parking areas, directed via sheet flow to a vegetated swale along the southern property line of the park, then conveyed to Lake Champlain via an intermittent drainage way.

S/N 004: Stormwater runoff from the buildings, roadways, and parking areas of the western portion of the park, directed via overland flow across vegetated terrain to an existing culvert located at the southwest corner of the site, then conveyed to Lake Champlain via an intermittent drainage way.

Compliance with General Permit 3-9010 Amended (May 2007) and this Authorization
The permittee shall comply with this authorization and all the terms and conditions of General Permit 3-9010 Amended (May 2007), including the payment of annual operating fees to the Department. A billing statement for such fees will be sent to the permittee each year. The first year's statement is enclosed. Any permit non-compliance, including a failure to pay the annual operating fee, constitutes a violation of 10 V.S.A. Chapter 47 and may be grounds for an enforcement action or revocation of this authorization to discharge.

Transferability
This authorization to discharge is not transferable to any person except in compliance with Part VI.D. of General Permit 3-9010 Amended (May 2007). A copy of General Permit 3-9010 Amended (May 2007) is available from the Department via the internet at http://www.vtwaterquality.org/stormwater/htm/sw_3-9010.htm

Changes to Permitted Development
In accordance with Part V.G. of General Permit 3-9010 Amended (May 2007), the permittee shall notify the Department of any planned development or facility expansions or changes that may result in new or increased stormwater discharges. The Department shall determine the appropriateness of continued inclusion under General Permit 3-9010 Amended (May 2007) by the modified development or facility.

Annual Inspection and Report
The stormwater collection, treatment and control system authorized herein shall be properly operated and maintained. An inspection shall be conducted between the conclusion of spring snow melt and June 15th of each year. The inspection shall evaluate the operation and maintenance and condition of the stormwater collection, treatment and control system. The permittee shall prepare an annual inspection report on a form available from the Department. The permittee shall submit an inspection report to the Department by July 15th of each year or by July 30th if performed by a utility or municipality pursuant to a duly adopted stormwater management ordinance.

Restatement of Compliance
Every 3 years, the permittee shall submit to the Department a written statement signed by a designer that the stormwater collection, treatment and control system authorized herein is properly operating and maintained. The first re-statement of compliance is due May 10, 2010. Failure to submit a designer's restatement of compliance shall constitute a violation of General Permit 3-9010 Amended (May 2007) and may result in the revocation of this authorization to discharge.

Filing of this Authorization with Local Land Records
In accordance with Part VI.N. of General Permit 3-9010 Amended (May 2007), the permittee shall file a copy of this authorization to discharge in the land records within seven (7) days of its issuance and a copy of the recording shall be provided to the Department within fourteen (14) days of the permittee's receipt of a copy of the recording from the local land records.

Rights to Appeal to the Environmental Court
Pursuant to 10 V.S.A. Chapter 220, any appeal of this decision must be filed with the clerk of the Environmental Court within 30 days of the date of the decision. The appellant must attach to the Notice of Appeal the entry fee of $225.00, payable to the state of Vermont. The Notice of Appeal must specify the parties taking the appeal and the statutory provision under which each party claims party status; must designate the act or decision appealed from; must name the Environmental Court; and must be signed by the appellant or their attorney. In addition, the appeal must give the address or location and description of the property, project or facility with which the appeal is concerned and the name of the applicant or any permit involved in the appeal. The appellant must also

serve a copy of the Notice of Appeal in accordance with Rule 5(b)(4)(B) of the Vermont Rules for Environmental Court Proceedings. For further information, see the Vermont Rules for Environmental Court Proceedings, available on line at www.vermontjudiciary.org. The address for the Environmental Court is 2418 Airport Road, Suite 1, Barre, VT 05641 (Tel. # 802-828-1660).

Effective Date and Expiration Date of this Authorization
This authorization to discharge shall become effective on May 10, 2007 and shall continue until May 10, 2017. The permittee shall reapply for coverage at least sixty (60) days prior to May 10, 2017.

Dated at Waterbury, VT this 10th day of May, 2007.

Jeffrey Wennberg, Commissioner
Department of Environmental Conservation

By _____
Padraic Monks, Interim Section Chief
Stormwater Management Section

Farrell Distributing Permits

Permit Number 3095-9010.R
Project ID Number EJ96-0482

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
AUTHORIZATION TO DISCHARGE UNDER
GENERAL PERMIT 3-9010

A determination has been made that the applicant:

Farrell Distributing Corporation
5 Holmes Road
South Burlington, VT 05403
(Impervious area: 7.72 acres)

meets the criteria necessary for inclusion under General Permit 3-9010. Here after the named applicant shall be referred to as the permittee. Subject to the conditions of General Permit No. 3-9010, the permittee is authorized to discharge stormwater from the Farrell Distributing office, warehouse and distribution facility located at 5 Holmes Road in South Burlington, Vermont to an unnamed tributary of Lake Champlain as previously described and modified in General Permit No. 3095-9010:

Manner of Discharge:

S/N 001: Stormwater runoff from roofs, paved parking and natural terrain of the north half of the facility via catch basins and a grass-lined swale to a detention pond, then discharging to a drainage swale prior to discharge to an unnamed tributary of Lake Champlain.

S/N 002: Stormwater runoff from roofs, paved parking and natural terrain of the south half of the facility via catch basins and overland flow to a sand filtration basin with bypass, the bypassed flows then discharging via a culvert under the railroad tracks to an unnamed tributary of Lake Champlain.

Compliance with General Permit 3-9010 and this Authorization
The permittee shall comply with this authorization and all the terms and conditions of General Permit 3-9010, including the payment of annual operating fees to the Department. A billing statement for such fees will be sent to the permittee each year. The first year's statement is enclosed. Any permit non-compliance, including a failure to pay the annual operating fee, constitutes a violation of 10 V.S.A. Chapter 47 and may be grounds for an enforcement action or revocation of this authorization to discharge.

Transferability
This authorization to discharge is not transferable to any person except in compliance with Part VI.D. of General Permit 3-9010. A copy of General Permit 3-9010 is available

from the Department via the internet at
http://www.vtwaterquality.org/stormwater/htm/sw_3-9010.htm

Changes to Permitted Development
In accordance with Part V.G. of General Permit 3-9010, the permittee shall notify the Department of any planned development or facility expansions or changes that may result in new or increased stormwater discharges. The Department shall determine the appropriateness of continued inclusion under General Permit 3-9010 by the modified development or facility.

Annual Inspection and Report
The stormwater collection, treatment and control system authorized herein shall be properly operated and maintained. An inspection shall be conducted between the conclusion of spring snow melt and June 15th of each year. The inspection shall evaluate the operation and maintenance and condition of the stormwater collection, treatment and control system. The permittee shall prepare an annual inspection report on a form available from the Department. The permittee shall submit an inspection report to the Department by July 15th of each year or by July 30th if performed by a utility or municipality pursuant to a duly adopted stormwater management ordinance.

Restatement of Compliance
Every 3 years, the permittee shall submit to the Department a written statement signed by a designer that the stormwater collection, treatment and control system authorized herein is properly operating and maintained. The first re-statement of compliance is due January 20, 2014. Failure to submit a designer's restatement of compliance shall constitute a violation of General Permit 3-9010 and may result in the revocation of this authorization to discharge.

Filing of this Authorization with Local Land Records
In accordance with Part VI.N. of General Permit 3-9010, the permittee shall file a copy of this authorization to discharge in the land records within fourteen (14) days of its issuance and a copy of the recording shall be provided to the Department within fourteen (14) days of the permittee's receipt of a copy of the recording from the local land records.

Rights to Appeal to the Environmental Court
Pursuant to 10 V.S.A. Chapter 220, any appeal of this decision must be filed with the clerk of the Environmental Court within 30 days of the date of the decision. The appellant must attach to the Notice of Appeal the entry fee of $250.00, payable to the state of Vermont. The Notice of Appeal must specify the parties taking the appeal and the statutory provision under which each party claims party status; must designate the act or decision appealed from; must name the Environmental Court; and must be signed by the appellant or their attorney. In addition, the appeal must give the address or location and description of the property, project or facility with which the appeal is concerned and the name of the applicant or any permit involved in the appeal. The appellant must also serve a copy of the Notice of Appeal in accordance with Rule 5(b)(4)(B) of the Vermont Rules for Environmental Court Proceedings. For further information, see the Vermont

Rules for Environmental Court Proceedings, available on line at www.vermontjudiciary.org. The address for the Environmental Court is 2418 Airport Road, Suite 1, Barre, VT 05641 (Tel. # 802-828-1660).

Effective Date and Expiration Date of this Authorization
This authorization to discharge shall become effective on January 20, 2011 and shall continue until January 20, 2021. The permittee shall reapply for coverage at least sixty (60) days prior to January 20, 2021.

Dated at Waterbury, VT this 20th day of January, 2011.

David K. Mears, Commissioner
Department of Environmental Conservation

By _____
Padraic Monks, Stormwater Program Manager
Stormwater Management Program

Permit No. 3095-INDS
Project ID No. EJ96-0482

STATE OF VERMONT
AGENCY OF NATURAL RESOURCES
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

STORMWATER DISCHARGE PERMIT

STORMWATER RUNOFF TO WATERS OF THE STATE

In compliance with provisions of 10 V.S.A. §1264, the Stormwater Management Rule and in accordance with "Terms and Conditions" hereinafter specified,

Farrell Distributing Corporation
5 Holmes Road
South Burlington, VT 05403

Impervious Area: 1.01 acres

the permittee, is hereby granted permission to discharge stormwater runoff from Farrell Distributing Corp. Site Improvements located at 5 Holmes Road in the City of South Burlington, Vermont to an unnamed tributary of Lake Champlain.

1. Expiration Date: Five years from issuance date of final permit. Note: This permit, unless revoked, modified or suspended, shall be valid until the designated expiration date not withstanding any intervening change in water quality, effluent, or treatment standards, or classification of the receiving waters including groundwater. However, any such changed standard or classification, and any applicable requirement in a total maximum daily load (TMDL) for unnamed tributary of Lake Champlain, shall be applied in determining whether or not to renew this permit, and in determining the conditions of a renewed permit.

   The permittee shall reapply for a renewed discharge permit ninety days prior to the expiration date of this permit.

2. Revocation: 10 V.S.A. §1267 provides as follows:

   The Secretary may, after notice and opportunity for a public hearing, revoke, modify or suspend this permit if it is found that the permittee submitted false or inaccurate information in its application or has violated any requirement, restrictions, or condition of this permit, or if there is any change in any condition that requires either a temporary or permanent reduction or elimination of the permitted discharge. The Secretary shall impose conditions as the Secretary deems necessary for regulating the discharges of a permittee whose permit has been revoked, modified or suspended. Revocation shall be effective upon actual notice thereof to the permittee.

3. Operating Fees: This discharge is subject to operating fees under 3 V.S.A. §2822. The permittee shall submit the operating fees to the Agency in accordance with procedures provided by the Secretary.

4. Recording in Land Records: The permittee shall record a one-page notice of issuance of this discharge permit in the local land records within fourteen (14) days of issuance of this permit on the form provided by the Secretary, per §18-312 of Stormwater Management Rule. A copy

of this form is available on the Stormwater Management Program website. The permittee shall provide a copy of the recording to the Stormwater Management Program within fourteen (14) days of the permittee's receipt of the copy of the recording from the local land records.

5. Transfer of Permit: This permit is not transferable without prior written approval of the Secretary. Provided all applicable fees under 3 V.S.A. §2822 have been paid, a permittee may submit a notice of transfer to the Stormwater Management Program. The notice shall be submitted at least five (5) days prior to the proposed date of transfer. The notice shall state that the prospective permittee has adequate funding to comply with this permit. The permittee shall provide a copy of this permit to the new owner or tenant and inform him of the responsibility to make application for a permit which shall be issued in his name. Any failure to do so shall be considered a violation of this permit.

6. Right of Entry: The permittee shall allow the Secretary, or his or her authorized representatives, at reasonable times, upon presentation of credentials, to enter upon and inspect the permitted premises, and the stormwater collection, treatment and control system; and to sample any discharge to determine compliance with this permit; and to have access to and inspect and copy any records required to be kept pursuant to this permit.

7. Receiving Waters: unnamed tributary of Lake Champlain

8. Manner of Discharge:
S/N 001: Stormwater runoff from expanded parking areas, vehicle parkway compound, and driveway in the south portion of the parcel receives treatment via a bioretention area, two grass channels and a wet pond prior to flowing northwest in an existing conveyance channel and discharging to an unnamed tributary of Lake Champlain.

Stormwater runoff from the expanded building, concrete pads and truck loading ramp in the north portion if the parcel receives treatment via an existing relocated gravel lined basin that outlets south into the unnamed tributary of Lake Champlain.

The *Site Balancing Procedure for the Discharge of Stormwater Runoff from the Expansion or Redevelopment of Impervious Surfaces* was utilized to meet applicable treatment standards for this project.

9. Wastes Permitted: Stormwater runoff from S/N001 of the Farrell Distributing Corp Site Improvements project after treatment from grass channels, bioretention and a wet pond.

10. Volumes Permitted and Frequency of Discharge: Such volumes and frequency as required by the discharge specified in #8 above.

11. Approved Project Design: This project shall be constructed and operated in accordance with the following site plans and details prepared by Civil Engineering Associates, Inc (Sheets: Sheet C1.0A, titled "Partial Proposed Drainage Plan-South," dated March 2015; Sheet C1.1A, titled "Partial Proposed Drainage Plan-North," dated March 2015; Sheet C2.0, titled "Stormwater Details," dated March 2015; Sheet C2.1, titled "Stormwater Details," dated March 2015; Sheet C2.2, titled "Stormwater Details," dated March 2015; Sheet SW1, titled "Proposed Stormwater Treatment Plan," dated March 2015; Sheet SW2, titled "Existing Stormwater Treatment Plan," dated March 2015; and supporting information).

By reference, the above noted plans are made a part of this permit.

12. Inspection and Maintenance Reporting Requirements:

a. The basins, grass channels, and related stormwater collection, treatment and control system shall be maintained in good operating condition at all times and **shall be inspected annually and cleaned as necessary to maintain design specifications. The inspections shall be conducted between the conclusion of spring snow melt and June 15th of each year**.

b. Any sediment removed from the basins, grass channels, and related stormwater collection, treatment and control system shall be disposed of properly in accordance with state and federal statutes and regulations.

c. **By July 15 of each year the permittee shall submit an annual inspection report to the Secretary; or by July 30 of each year if performed by a utility or municipality pursuant to a duly adopted stormwater management ordinance. Annual Inspection Reports shall be submitted to:**

Department of Environmental Conservation
Watershed Management Division
Stormwater Program
1 National Life Drive, Main 2
Montpelier, Vermont 05620-3522

Or by email to anr.wsmdstormwatergeneral@state.vt.us

This report shall include, at a minimum items c.i. through c.vii. below. The permittee(s) may utilize the Annual Inspection Report form available from the Stormwater Program if determined by inspector to be sufficient to fully document inspection and maintenance of the authorized system.

i. Unless previously submitted by the permittee(s) under a previously issued authorization or discharge permit, the first report shall include an inspection and designer's certification that the project was built in compliance with the Approved Project Design per #11 above;

ii. A description of any vegetated areas that require mowing or other maintenance;

iii. A description of any catch basins that require maintenance or sediment removed from sumps;

iv. A description of any illicit discharges to the system (illicit discharges would include dumping of oil, gas, detergent, vehicle wash water, etc.) and corrective action/preventative measures taken if applicable;

v. A description of any re-routing of stormwater to avoid the system;

vi. A description of any erosion noted during inspection (i.e. areas of exposed soil in channels, outlets, or on pond berms);

vii. A description of any cleaning, maintenance operations, or repairs needed to

maintain design specifications, including a schedule for correction of any identified deficiencies;

d. Should any erosion problems occur, the permittee is required to immediately correct any such problems.

e. Any basins, grass channels, or related stormwater devices used during construction for erosion control shall be inspected and cleaned to design specifications immediately after construction has been completed.

13. Personnel and Training Requirements: Such personnel and training as necessary to fulfill the requirements of #12 above.

14. Monitoring and Reporting Requirement: No monitoring required; reporting requirement as specified in #12 above.

15. Other Requirements:
   a. Treated stormwater runoff is the only waste authorized for disposal under the terms and conditions of this permit. The discharge of any hazardous materials or hazardous waste into the stormwater management system is prohibited.

   b. The issuance of this permit does not relieve the permittee from the responsibility to obtain any other local, state or federal permits required by law.

16. Compliance with Anti-degradation and Water Quality Standards: The Secretary has determined that the permitted discharges satisfy Vermont's Anti-Degradation Policy described in the Department of Environmental Conservation's Interim Anti-Degradation Implementation Procedure, because the procedure allows a presumption of compliance for discharges that are in compliance with the Vermont Stormwater Management Manual and any additional best management practices that will be used to control the stormwater discharge as described in Section IX.D.1.d of the Department's Interim Anti-Degradation Implementation Procedure. The Secretary has also determined that for such discharges that qualify for the presumption under IX.D.1.d, all existing uses of surface waters, and the level of water quality necessary to protect those existing uses will be maintained and protected. The Secretary has determined that if the permittee is in full compliance with all permit conditions, including approved plans, monitoring, reporting and recordkeeping conditions, and is fully implementing stormwater BMPs required by this permit, the permitted discharges will meet the requirements of the Vermont Stormwater Management Manual and qualify for the presumption described in Section IX.D.1.d of the Department's Interim Anti-Degradation Implementation Procedure and will be presumed to comply with the Vermont Water Quality Standards, including but not limited to §1-03 (Anti-degradation Policy).

17. Renewable Energy Projects – Right to Appeal to Public Service Board:
Any appeal of this decision must be filed with the clerk of the Vermont Public Service Board pursuant to 10 V.S.A. §8506 within 30 days of the date of this decision. The appellant must file with the Clerk an original and six copies of its appeal. The appellant shall provide notice of the filing of an appeal in accordance with 10 V.S.A. §8504(c)(2), and shall also serve a copy of the Notice of Appeal on the Vermont Department of Public Service. For information, see the Rules and General orders of the Public Service Board available on line at

www.psb.vermont.gov. The address for the Public Service Board is 112 State Street Montpelier, Vermont 05620-2701 (Tel. #802-828-2358).

All Other Projects – Right to Appeal to Environmental Court:
Pursuant to 10 V.S.A. Chapter 220, any appeal of this decision must be filed with the clerk of the Environmental Court within 30 days of the date of the decision. The Notice of Appeal must specify the parties taking the appeal and the statutory provision under which each party claims party status; must designate the act or decision appealed from; must name the Environmental Court; and must be signed by the appellant or their attorney. In addition, the appeal must give the address or location and description of the property, project or facility with which the appeal is concerned and the name of the applicant or any permit involved in the appeal. The appellant must also serve a copy of the Notice of Appeal in accordance with Rule 5(b)(4)(B) of the Vermont Rules for Environmental Court Proceedings. For further information, see the Vermont Rules for Environmental Court Proceedings, available online at www.vermontjudiciary.org or call (802) 951-1740. The address for the Environmental Court is 32 Cherry Street, 2nd Floor Suite 303 Burlington, Vermont 05401.

18. Dated this 20th day of May, 2015

David K. Mears, Commissioner
Department of Environmental Conservation

By Padraic Monks
Padraic Monks, Program Manager
Stormwater Management Program

Hannaford's Permit:

Permit Number 5579-9010
Project ID Number EJ96-0470

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
AUTHORIZATION TO DISCHARGE UNDER
GENERAL PERMIT 3-9010 AMENDED (MAY 2007)

A determination has been made that the applicant:

Hannaford Brothers Company
PO Box 1000
Portland, ME 04014

meets the criteria necessary for inclusion under General Permit 3-9010 Amended (May 2007). Here after the named applicant shall be referred to as the permittee. Subject to the conditions of General Permit No. 3-9010 Amended (May 2007), the permittee is authorized to discharge stormwater from the Southland Plaza located on US Route 7 (Shelburn Road) in South Burlington, Vermont to an unnamed tributary of Lake Champlain as previously described in Individual Permit No. 1-1214 and modified as follows:

Manner of Discharge:
S/N 1: Stormwater runoff from the roofs and paved parking and driveways at the southeastern portion of the plaza (Olive Garden building only) directed via overland flow to vegetated terrain and then to a grass-lined swale to an unnamed tributary of Lake Champlain.

This permit covers S/N 001 only of expired permit 1-1214

Compliance with General Permit 3-9010 Amended (May 2007) and this Authorization
The permittee shall comply with this authorization and all the terms and conditions of General Permit 3-9010 Amended (May 2007), including the payment of annual operating fees to the Department. A billing statement for such fees will be sent to the permittee each year. The first year's statement is enclosed. Any permit non-compliance, including a failure to pay the annual operating fee, constitutes a violation of 10 V.S.A. Chapter 47 and may be grounds for an enforcement action or revocation of this authorization to discharge.

Transferability
This authorization to discharge is not transferable to any person except in compliance with Part VI.D. of General Permit 3-9010 Amended (May 2007). A copy of General Permit 3-9010 Amended (May 2007) is available from the Department via the internet at http://www.vtwaterquality.org/stormwater/htm/sw_3-9010.htm

or changes that may result in new or increased stormwater discharges. The Department shall determine the appropriateness of continued inclusion under General Permit 3-9010 Amended (May 2007) by the modified development or facility.

Annual Inspection and Report

The stormwater collection, treatment and control system authorized herein shall be properly operated and maintained. An inspection shall be conducted between the conclusion of spring snow melt and June 15th of each year. The inspection shall evaluate the operation and maintenance and condition of the stormwater collection, treatment and control system. The permittee shall prepare an annual inspection report on a form available from the Department. The permittee shall submit an inspection report to the Department by July 15th of each year or by July 30th if performed by a utility or municipality pursuant to a duly adopted stormwater management ordinance.

Restatement of Compliance

Every 5 years, the permittee shall submit to the Department a written statement signed by a designer that the stormwater collection, treatment and control system authorized herein is properly operating and maintained. The first re-statement of compliance is due January 7, 2013. Failure to submit a designer's restatement of compliance shall constitute a violation of General Permit 3-9010 Amended (May 2007) and may result in the revocation of this authorization to discharge.

Filing of this Authorization with Local Land Records

In accordance with Part VI.N. of General Permit 3-9010 Amended (May 2007), the permittee shall file a copy of this authorization to discharge in the land records within seven (7) days of its issuance and a copy of the recording shall be provided to the Department within fourteen (14) days of the permittee's receipt of a copy of the recording from the local land records.

Rights to Appeal to the Environmental Court

Pursuant to 10 V.S.A. Chapter 220, any appeal of this decision must be filed with the clerk of the Environmental Court within 30 days of the date of the decision. The appellant must attach to the Notice of Appeal the entry fee of $225.00, payable to the state of Vermont. The Notice of Appeal must specify the parties taking the appeal and the statutory provision under which each party claims party status; must designate the act or decision appealed from; must name the Environmental Court; and must be signed by the appellant or their attorney. In addition, the appeal must give the address or location and description of the property, project or facility with which the appeal is concerned and the name of the applicant or any permit involved in the appeal. The appellant must also serve a copy of the Notice of Appeal in accordance with Rule 5(b)(4)(B) of the Vermont Rules for Environmental Court Proceedings. For further information, see the Vermont Rules for Environmental Court Proceedings, available on line at www.vermontjudiciary.org. The address for the Environmental Court is 2418 Airport Road, Suite 1, Barre, VT 05641 (Tel. # 802-828-1660).

Effective Date and Expiration Date of this Authorization
This authorization to discharge shall become effective on January 8, 2008 and shall continue until January 8, 2018. The permittee shall reapply for coverage at least sixty (60) days prior to January 8, 2018.

Dated at Waterbury, VT this 8th day of January, 2008.

Laura Q. Pelosi, Commissioner
Department of Environmental Conservation

By _____
Padraic Monks, Interim Section Chief
Stormwater Management Section

Shelburne Road Act 250:

Project Number	4C0877
Project Name	GERALD MILOT
Number of Lots	
Tract Acres	32.73
Project Acres	32.73
Location	SHELBURNE ROAD
Town	SOUTH BURLINGTON
County	CHITTENDEN
Description	150 RESIDENTIAL UNITS COMMUNITY BLDG. OFFICE BLDG. RETAIL BLDG. MAINTENACE BLDG
Category	unclassified
Project Type	2
Criteria	
Application Type	MAJOR
Applicant	GERALD MILOT / 802-864-7444
Second Applicant	
Contact	STEELE JOHN A. / 802-878-3000
Date Filed	Mar 13, 1991
Date Received	Mar 22, 1991
Date Entered	Mar 28, 1991
Agenda Date	Apr 05, 1991
Permit Agenda Date	Jul 26, 1991
Hearing Date	May 02, 1991
Hearing Time	
Hearing Request Deadline	
Date Decision Issued	Jul 09, 1991
Date Permit Expires	Jul 01, 2021
Status	Not Entered
Withdrawal	
Appeal Date	
Box	EC2141

Days to Receive	9 (Mar 13, 1991 to Mar 22, 1991)
Days to Enter	15 (Mar 13, 1991 to Mar 28, 1991)
Days to Agenda Date	23 (Mar 13, 1991 to Apr 05, 1991)
Days to Permit Agenda Date	135 (Mar 13, 1991 to Jul 26, 1991)
Days to Hearing Date	-50 (May 02, 1991 to Mar 13, 1991)
Days to Issue	118 (Mar 13, 1991 to Jul 09, 1991)

There are no files to display at this time.

APPENDIX G: Cost Tables

The following Tables were used to estimate the maintenance costs for the detention and retention ponds.

Table 1: Unit Costs for Pond and Wetland Maintenance (EPA, 2009)

Maintenance Item	Unit Price ($)	Unit	Mobilization Cost ($)[2]	Maintenance Interva (yrs)[3]
Permanent Pool Issues				
Dam/ Embankment				
unclog internal drains for embankments	10	lf	1,500	R (10)
repair low spots in dam or berm	170	cy	1,500	R (5)
Clogging				
debris removal (preventative)	350	event	0	0.25-1
clear outfall channel of sediment	130	cy	0	5-15
clogged low flow	750	event	800	0.25-1
Pipe Repairs				
Structural - Riser and Barrel				
re-tar CMP barrel	11	sf	800	15-20
install new elbow underground	1,200	ea	800	R
repair CMP barrel joint leak	530	ea	800	R (3-5)
repair leaking concrete principal spillway joint	1,200	ea	0	R (5-10)
replace riser (CMP)	12,000	ea	>2,500	R (25)
replace riser (concrete)	20,000	ea	>2,500	R (50)
replace barrel	1,000	lf	>2,500	R (25-50)
Structural - Pipes				
replace existing underground elbow	1,400	ea	800	R (10)
slip line failing pipes	90	lf	>2,500	R
replace end sections <36"	600	ea	1,500	R
remote control TV video pipes	1	lf	800	5-25
Structural - Other Concrete				
concrete work under ground	600	cy	1,500	R
concrete work above ground	450	cy	1,500	R
grout cracks	50	lf	0	R
parge spalling	25	sf	0	R
repair gutter spalling	230	event	800	R
injection grout concrete leaks	180	lf	800	R
Structural: Metal				
new low flow trash rack	1,700	ea	800	R (5-10)
install high stage trash rack 4'x2'	1,100	ea	1,500	R (20+)
replace CMP anti-vortex device <48"	1,500	ea	1,500	R (10-15)
replace CMP anti-vortex device >48"	4,600	ea	1,500	R (10-15)
remove bolts, lift lugs, form nails	80	ea	800	R

1) These costs were largely derived from data from the Maryland region, based on bid proposal and actual 2005 project data.
2) Cost at four levels: $0 for no mobilization; $800 for minimal mobilization; $1,500 for small project mobilization; >$2,500 for large project mobilization. Note that these are approximations. For items with no mobilization cost, it is assumed that the mobilization cost is incorporated into the overall unit cost, or that the maintenance can be completed during inspection.
3) Bottom number in range represents ideal maintenance interval. Top number represents maximum interval between maintenance activities. R indicates repair items, whose frequency is somewhat unpredictable. The frequencies sometimes reported in parentheses represent an estimate of typical repair frequency.

1. These costs were largely derived from data from the Maryland region, based on bid proposal and actual project data.
2. Cost at four levels: $0 for no mobilization; $800 for minimal mobilization; $1,500 for small project mobilization; >$2,500 for large project mobilization. Note that these are approximations. For items with no mobilization cost, it is assumed that the mobilization cost is incorporated into the overall unit cost, or that the maintenance can be completed during inspection.
3. Bottom number in range represents ideal maintenance interval. Top number represents maximum interval between maintenance activities. R indicates repair items, whose frequency is somewhat unpredictable. The frequencies sometimes reported in parentheses represent an estimate of typical repair frequency.

Vegetation Management				
sod	3.30	sy	800	1-2
seed and top soil bare areas (3 inch depth)	4.40	sy	800	1-2
plant 1.5 inch tree	84	ea	0	R[3]
plant shrub	15	ea	0	R
mowing	300	ac	0	0.5-1
clear outfall and channel of trees	5.50	sy	800	0.5-1
clear embankment of small trees by hand	3.30	sy	800	0.5-1
clear embankment trees with Ambusher or Brushhog	0.90	sy	800	0.5-1
remove live tree (<12 inches)	130	ea	800	R (1-10)
remove live trees larger than 12 inches, <24 inches	250	ea	800	R (10-25)
remove downed timber (up to 40 cy of material)	2,200	event	0	0.25-1
remove dumped vegetative material (up to 40 cy)	2,600	event	0	0.25-1
install wetland plant	6	ea	800	R (3-5)
remove invasive wetland vegetation (machine remove phragmites) (up to 40 cy)	3,000	event	0	R
spray for algae (0.25 ac pond)	600	ea	0	R
spray for cattails (0.25 ac pond)	330	ea	0	R
repair low spots in dry pond bottom	25	sy	1,500	R
remove woody vegetation from dry pond bottom	1,700	event	0	5-10

1. These costs were largely derived from data from the Maryland region, based on bid proposal and actual project data.
2. Cost at four levels: $0 for no mobilization; $800 for minimal mobilization; $1,500 for small project mobilization; >$2,500 for large project mobilization. Note that these are approximations. For items with no mobilization cost, it is assumed that the mobilization cost is incorporated into the overall unit cost, or that the maintenance can be completed during inspection.
3. Bottom number in range represents ideal maintenance interval. Top number represents maximum interval between maintenance activities. R indicates repair items, whose frequency is somewhat unpredictable. The frequencies sometimes reported in parentheses represent an estimate of typical repair frequency.

Dredging and Mucking				
dredge wet ponds (jobs larger than 1000 cy) haul offsite	60	cy	>2,500	5-15
dry pond sediment removal	7,600	event	0	15-25
dewater pond	900	event	0	15-25
muck out undergrounds	390	cy	0	0.5-1
dewater and remove sludge from underground facilities	1	gal	0	0.25-1
typical sediment dump fee (not including trucking)	66	ton	0	NA
truck day for landfill to transport underground dredge materials (minimum, assume 2 to 4 trips in one day)	800	trip-day	0	NA
Access/ Safety				
install warning signs	210	ea	0	R
add manhole steps	100	ea	800	R
new manhole cover	250	ea	0	R
create 12' access road (permanent, cut/fill balances)	40	lf	1,500	R
create 12' access road (permanent, cut/fill non-balance)	65	lf	1,500	R
create 12' access road (temp)	12	lf	1,500	R
install chainlink fence	26	lf	800	R
install ladder (8 foot)	220	each	800	R
install three rail fence	15	lf	800	R
repair asphalt path	26	cy	800	R
supply lock and chain for first one (additional at $30 apiece)	130	ea	0	4-8

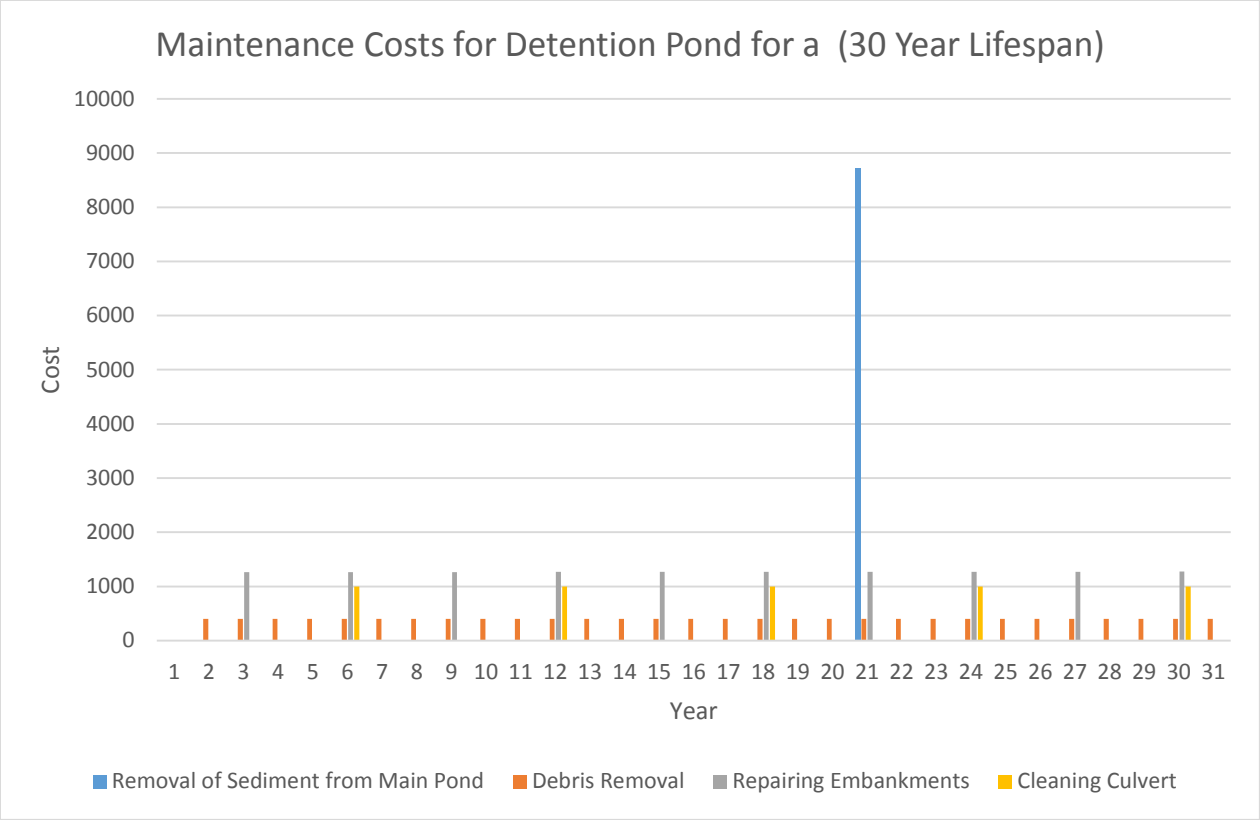
1. These costs were largely derived from data from the Maryland region, based on bid proposal and actual project data.
2. Cost at four levels: $0 for no mobilization; $800 for minimal mobilization; $1,500 for small project mobilization; >$2,500 for large project mobilization. Note that these are approximations. For items with no mobilization cost, it is assumed that the mobilization cost is incorporated into the overall unit cost, or that the maintenance can be completed during inspection.
3. Bottom number in range represents ideal maintenance interval. Top number represents maximum interval between maintenance activities R indicates repair items, whose frequency is somewhat unpredictable. The frequencies sometimes reported in parentheses represent an estimate of typical repair frequency.

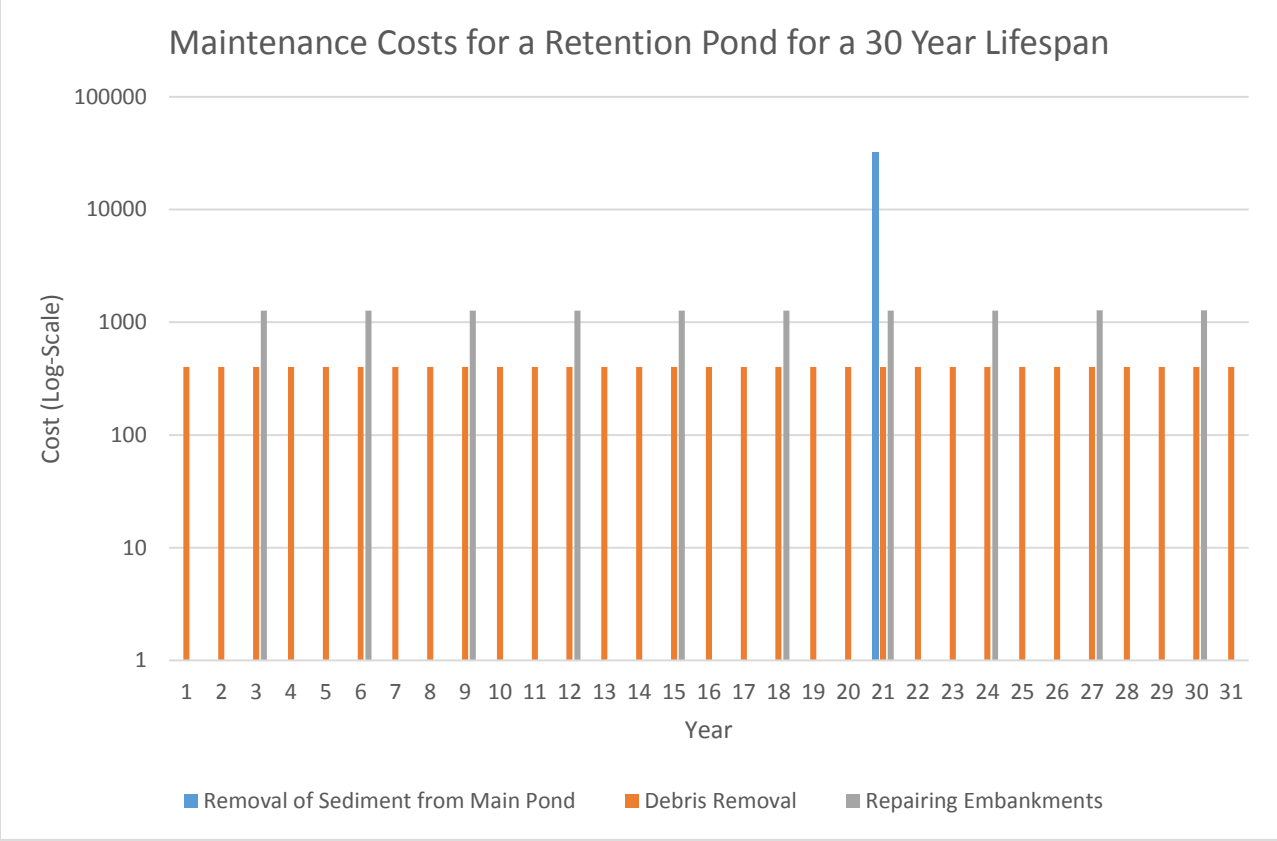
Mechanical Components				
remove old valve	300	ea	800	R (10)
install new valve (<36 inches)	4,600	ea	1,500	R
install new valve (< 24 inches)	3,100	ea	1,500	R
install new valve (<11 inches)	1,300	ea	1,500	R
install new valve (<7 inches)	460	ea	800	R
lubricate valves (same price for first four)	300	ea	0	1-2
Nuisance Issues				
pond/ wetland aeration	560	ea	0	1
treat pond for mosquitoes	1,000	acre	0	R
trap beavers (one week, one location, family of 6)	1,000	event	0	R
fill animal burrows	23	sy	800	R (5-10)
remove graffiti	310	day	800	1-3
Erosion/ Channel Maintenance				
establish new riprap pilot channels (8' wide, 1' deep)	38	lf	1,500	5-15
remove and replace rip rap or pea gravel	160	sy	1,500	15-25
shoreline protection	50	lf	1,500	R
new riprap (general)	80	cy	1,500	R (5-10)
erosion repair	1,100	event	0	R (2-5)
jet clean rip rap (6X 15, 1' silt)	2,500	event	0	15-25

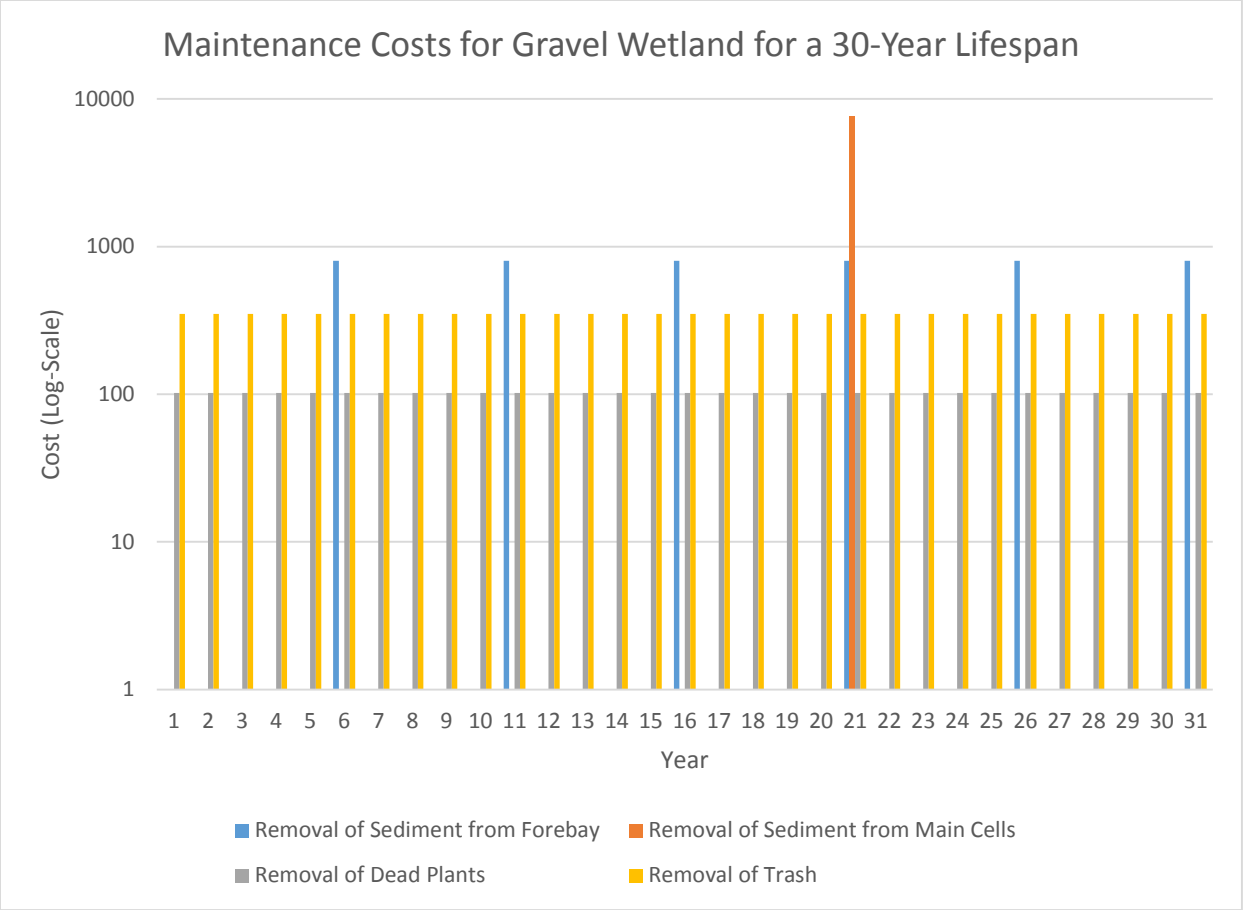
4) These costs were largely derived from data from the Maryland region, based on bid proposal and actual project data.
5) Cost at four levels: $0 for no mobilization; $800 for minimal mobilization; $1,500 for small project mobilization; >$2,500 for large project mobilization. Note that these are approximations. For items with no mobilization cost, it is assumed that the mobilization cost is incorporated into the overall unit cost, or that the maintenance can be completed during inspection.
6) Bottom number in range represents ideal maintenance interval. Top number represents maximum interval between maintenance activities. R indicates repair items, whose frequency is somewhat unpredictable. The frequencies sometimes reported in parentheses represent an estimate of typical repair frequency.

APPENDIX H: Maintenance Cash Flows

The following provides figures that outline the cash flow of maintenance costs for a 30-year lifespan of each proposed project. A 6% interest rate was assumed for all calculations.


Maintenance Costs for Detention Pond for a (30 Year Lifespan)
Cost
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Year
Removal of Sediment from Main Pond
Debris Removal
Repairing Embankments
Cleaning Culvert

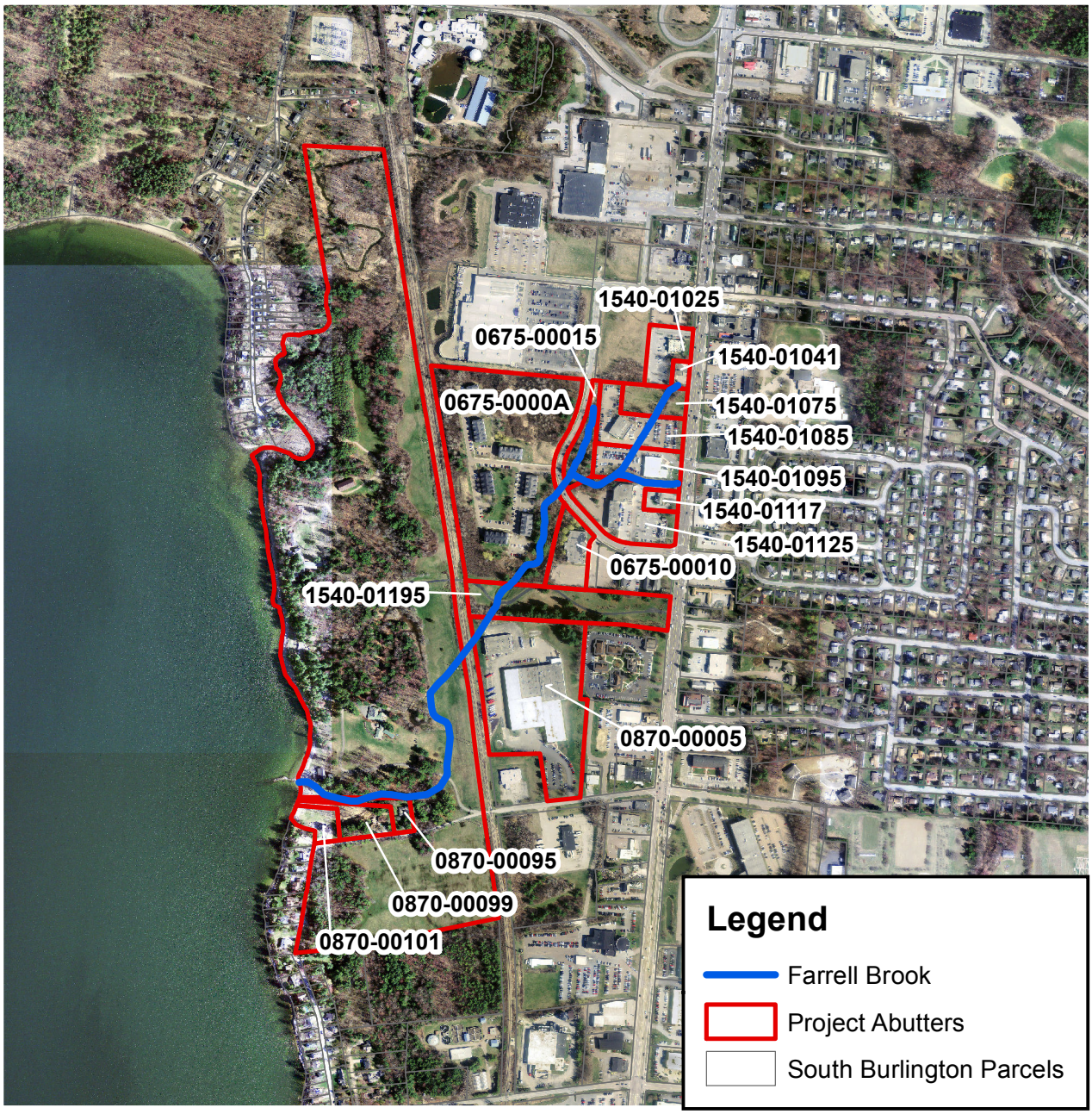

Maintenance Costs for a Retention Pond for a 30 Year Lifespan
Cost (Log-Scale)
100000
10000
1000
100
10
1
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Year
Removal of Sediment from Main Pond
Debris Removal
Repairing Embankments

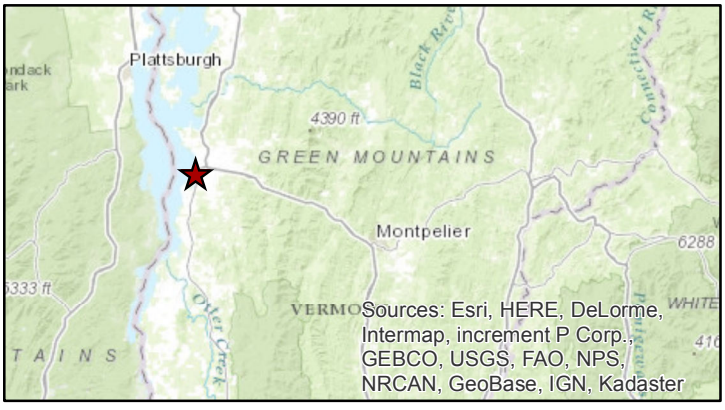

Maintenance Costs for Gravel Wetland for a 30-Year Lifespan
10000
1000
100
10
1
Cost (Log-Scale)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Year
Removal of Sediment from Forebay
Removal of Sediment from Main Cells
Removal of Dead Plants
Removal of Trash

APPENDIX I: Project Abutter Information

The following includes a map of parcels within 100 ft. of Farrell Brook and a table containing parcel information. Theses abutting properties will need to be notified if the project is taken to a further phase.

Project Abutter Information





N

Farrell Brook Stormwater

University of Vermont
Senior Design
Spring 2016

1 inch = 1,000 feet

Feet
0 300 600 1,200 1,800 2,400

Parcel information for abutting properties within 100 ft of Farrell Brook.

PARCEL ID	OWNER	911#	STREET	SPAN	CAT	ACRES	ASS'D $	TAXES
0675-0000A	OLDE ORCHARD REALTY PARTNERSHIP LP	1	OLDE ORCHARD LN	600-188-14700	CA	41.28	$12,926,900	$264,781.65
0675-00010	L & M PARTNERSHIP	10	FAYETTE RD	600-188-13419	C	3	$1,654,400	$33,887.07
0675-00015	CITY OF SOUTH BURLINGTON	15	FAYETTE RD	----------	PUBLIC	1.49	----------	----------
0870-00005	FARRELL DISTRIBUTING CORPORATION	5	HOLMES RD	600-188-12063	C	13.41	$5,469,800	$112,037.91
0870-00095	BOISVERT JANE	95	HOLMES RD	600-188-10627	R1	1	$309,100	$6,417.53
0870-00099	GLASER ADAM	99	HOLMES RD	600-188-10628	R1	1.58	$304,000	$6,311.64
0870-00101	EASTON THOMAS R & KATHLEEN H	101	HOLMES RD	600-188-10629	R1	1.04	$898,400	$18,652.56
1540-01025	BURLINGTON MALL INC	1025	SHELBURNE RD	600-188-10930	C	1.84	$1,497,100	$30,665.10
1540-01041	WESCO INC	1041	SHELBURNE RD	600-188-16489	C	0.38	$258,000	$5,284.59
1540-01075	CITY OF SOUTH BURLINGTON	1075	SHELBURNE RD	----------	PUBLIC	1.64	----------	----------
1540-01085	KAPSHA PROPERTIES LLC	1095	SHELBURNE RD	600-188-13217	C	2.93	$1,641,700	$33,627
1540-01095	KAPSHA PROPERTIES LLC	1089	SHELBURNE RD	600-188-13093	C	2.41	$1,979,500	$40,546.08
1540-01117	CRE JV MIXED FIFTEEN NE BRANCH HOLDINGS	1117	SHELBURNE RD	600-188-11195	C	0.57	$668,100	$13,684.68
1540-01125	LARKIN MILOT PARTNERSHIP	1125	SHELBURNE RD	600-188-13564	C	1.16	$1,023,900	$20,972.52
1540-01195	FARRELL DAVID M TRUSTEE	1195	SHELBURNE RD	600-188-12065	R2	109.9	$4,250,100	$87,054.78

APPENDIX J: Phosphorus Worksheet

The following worksheet is provided by the Agency of Natural Resources Department of Environmental Conservation Watershed Management Division and is available for download here: http://dec.vermont.gov/watershed/stormwater

→Lake Champlain Phosphorus Offset Procedure → Simple Methods Calculation

These calculations are based off the VT annual precipitation at the Burlington International Airport of 36.82 in (NOAA) and an assumed average annual phosphorus concentration for developed lands of 0.44 mg/l. There are two options to enter data for undeveloped sites and sites with existing development. For undeveloped sites, the worksheet takes into account the land cover type with pre-defined options and corresponding loading rates. It then requires a total acreage of area from which it calculates total loading. The second option, developed sites, requires a total acreage and an impervious acreage for the site. It then calculates percent imperious and R_v, which is discussed in the calculations in Appendix B. A total phosphorus loading is then determined.

This worksheet was used to analyze the watershed above each project alternative location and to determine the loading for the entire watershed at its natural state with wooded and grass land cover.

Simple Method Pollutant Loading Calculation Worksheet- Phosphorus

The Simple Method estimates pollutant loading of stormwater runoff for urban and developed areas. This worksheet includes the data and calculations to be used for computation of existing and post-development loads under the Interim Procedure for Offsets for Discharges of Phosphorus to Lake Champlain and Waters that Contribute to the Impairment of Lake Champlain . Fill in the shaded fields bas ed on the project site attributes.

L = 0.226* P * P_j * R_v *A* C Additional informaiton on the Simple Method can be found on the 'Guidance' tab

Where:

L = Annual load (lbs)

P = Yearly rainfall depth (in)

P_j = Fraction of rainfall events producing runoff (use 0.9)

A = Site area (acres)

C = Average annual pollutant concentration (mg/l), see 'Guidance'

0.226 = Unit conversion factor

And:

R_v = 0.05 + 0.009 * I_a

Where:

R_v = Runoff Coefficient

I_a= Whole number percent impervious

Offset Calculations

Project Name:	
P_j	0.9
Project **P***	26.38

*http://www.ncdc.noaa.gov/cdo-web/datatools/normals

Pre-Development Condition

For undeveloped sites use these equations:

Existing Land Use	Loading Rate	Site area (ac)	Load (lbs)
Choose Land Use	0.00		0.00
Choose Land Use	0.00		0.00

OR

For sites with existing development, use the Simple Method :

Simple Method	Land Cover type	Site Area (ac)	Imp. Area (ac)	I_a (%)	R_v	C (mg/L)	Load (lbs)
Existing Conditions	Developed	0	0	0	0.05	0.44	0.00
	Pre-Dev. Total						**0.00**

Post-Development

Land Cover	Site Area (ac)	Imp. Area (ac)	I_a (%)	R_v	C (mg/L)	Load (lbs)
Developed			0	0.05	0.44	0.00
Post-Dev. Total						**0.00**
					Load reduction from treatment (%) (see guidance!)	40
					Post-dev. load after treatment is provided	**0.00**

Load Difference	**Lbs to be offset**	**None**

If the final load difference says "none", no further action is needed. If the number is positive, an offset is required. There are several different options for satisfying offset requirements including the use of additional on-site treatment, the purchase of an existing offset (if available), or the development of an offsite offset project within the same lake segment drainage area.

Last revised 11/24/15

Guidance

Defining Pre-Development Conditions

If the existing condition of the project site can be classified as "developed", meaning comprised of managed turf and impervious surfaces, then the Simple Method shall be used with a C value of 0.44 to determine the pre-development phosphorus load. If the pre-developed conditon is not developed land (e.g., little to no impervious or managed turf), then unit area loading rates extracted from the Champlain TMDL modeling shall be used. Select the land use classification best matching existing conditions, enter the land area for that cover type, and the phosphorus loading rate will auto-populate. The site may seperated among different developed and undeveloped cover types where such a representation would be appropriate, however ensure that the pre-development site area is equal to the post-development site area. These classifications are subject to Agency review.

Simple Method Equation Guidance ($L = 0.226 * P * P_j * R_v * A * C$)

0.226 = Unit conversion factor

L : Simple Method estimate of the annual pollutant load in lbs/year.

P : The yearly rainfall depth in inches. Appropriate values for stations throughout Vermont can be found at the *NOAA, Data Tools: 1981-2001 Normals* website (http://www.ncdc.noaa.gov/cdo-web/datatools/normals). From the website, select the "*Annual/Seasonal Normals* " tab, then select "*Vermont* ", and finally select the station closest to the project site. The Average Annual Precip number can be taken directly from the resulting table and used in Simple Method calculations.

P_j : "*The P_j factor is used to account for the fraction of the annual rainfall that does not produce any measurable runoff. Many of the storms that occur during the year are so minor that all of the rainfall is stored in surface depressions and eventually evaporates. As a consequence, no runoff is produced... Pj should be set at 0.9.* " (Maryland 10% rule Guidance Manual, Appenix C)

areas is the amount of imperviousness of the site. Impervious area is defined as those surfaces in the landscape that cannot infiltrate rainfall consisting of building rooftops, pavement, sidewalks, driveways, etc. In the equation $R_v = 0.05 + 0.009(I)$, "I" represents the percentage of impervious cover expressed as a whole number. A site that is 75% impervious would use I = 75 for the purposes of calculating R_v. " (Maryland 10% rule Guidance Manual, Appendix C)

A : Site area in acres.

C-values for Phosphorus: VT DEC is in agreement with other jurisdications (e.g., State of Maryland, State of Minnesota) that the variability in empirical phosphorus concentrations is too great to meaningully assign different discrete phosphorus C values to different developed land cover types. VT DEC has instead used the Lake Champlain Basin baseline SWAT modeling to solve algabraically for the C factor needed to match current best estimates of developed land phosphorus export. Further docuemation of this approach is available from VT DEC.

C-Values for Sediment: VT DEC will continue to allow designers to use literature supported C values that best describe a project's conditions. The source of any values used must be cited and is subject to Agency review.

Average Annual Phosphorus Concentration for Developed Lands (C) in mg/l

0.44 mg/L for all types of non-transportation developed land.*

* See *Interim Procedure Guidance Document* for basis of this value.

Percent Load Reduction Provided by Treatment Systems

Volume I of the 2002 Vermont Stormwater Management Manual (VSMM) states that the water quality standard is designed to "capture 90 percent of the annual storm events, and to remove 80 percent of the average annual post development total suspended solids load (TSS), and 40 percent of the total phosphorus (TP) load." Thus if the water quality standard is met in accorance with the VSMM, an **80%** sediment load reduction and a **40%** TP load reduction can be assumed. However, if all or a portion of the water quality volume is to be infiltrated using a qualifying practice, a higher TP reduction can be assumed.

Infiltration systems that will qualify for a higher TP removal rate must infiltrate the entire portion of the water quailty volume that is directed to the practice, without the use of an underdrain or overflow. Inlet diversion structures may be used to ensure that only the volume that can be fully infiltrated is directed to the practice. Any surface discharge from the treatment practice up to the 1 year storm condtions will disqualify the practice from getting credit at the higher rate. For the portion of the water quality volume directed to such a practice, a TP removal rate of **90%** may be assumed. For any portions of the site for which all runoff up to and including the 1 year storm is infiltrated using a qualifying practice, a TP removal rate of **98%** may be assumed. When different treatment practices are used to meet stormwater standards, a weighted average may be computed for use

> Site uses a non-infiltration VSMM treatment practice (e.g., wetpond, under-drained bioretention, disconnection). Apply a 40% TP removal rate site wide.

> Site infiltrates the water quality volume via a qualifying practice. Apply a 90% TP removal rate site wide.

> Site infiltrates the 1 year storm runoff volume via a qualifying practice. Apply a 98% TP removal rate site wide.

> Site uses a suite of treatment practices, for example water quality infiltration for a quarter of the site, one year storm infiltration for a quarter of the site, and rate based treatment for the remaining half of the site. Compute a site wide average removal rate (e.g., 0.25*90% + 0.25*98% +

APPENDIX K: Team Project Meeting Minutes

Notes were taken during each team meeting, including those with Jim Pease (VTDEC) and Professor John Lens, are included herein.

Meeting Minutes

1/26/16

- Insufficient pipes
  - any storm over 1 inch, local flooding, basement flooding
- Upgrade all the drainage in the orchard (Option 1)
- Fix certain pipes
- Underground storage, underground detention (Option 2)
- Rain gardens along sides of roads, infiltration gallery, roadside swales (Option 3)
  - unpredictable soils
  - lowest point of drainage is least suitable
  - would not be able to trap enough water
  - High groundwater table (< 2 ft.)
- Downstream pond, west of Shelburne Rd. (Option 4)
  - Fayette Road
  - Detention pond to hand peak discharge
- Enhancement to wooded cemetery, wetland
  - Sedimentation area with forebay
- Stormwater swirl separator
- Underground vault…
- Increase size of downstream pond

2/2/16

- What flows should we use for the downstream (West of Rt. 7) designs?
  - The report say that they would not like to increase flows downstream but this doesn't seem achievable.
  - Should we be designing mitigation practices in the Orchards to slightly decrease flows coming across Rt. 7 and then design structures downstream to deal with these flows?

- What water quality modeling software is Jim familiar with? Does he have suggestions for this?

- Is there someone at Stantec we could set up a meeting with for clarifications on their report?
  - What was their final calculated outflows for each Rt. 7 crossing?
  - The map references "Stormwater Points". Do these refer to storm drains, storm drain manholes, etc.? Nevermind, This information is in the GIS layers we have

- Freedom Nissan has some pavement issues on the south side of their parking lot. It looked like a good amount of runoff was overflowing the parking lot and has knocked over the culvert structure at the base of the parking lot.
  - Can we design anything in this area?
  - We noted one storm drain in this parking lot. Is there information on this area?
  - should we design a new culvert for this parking lot?

- The cemetery area seemed to spark all of our interests. Should we check on permitting in this area before we make a design here or should we just go for it?
    - Could we expand past the forested area towards the front area/road or would this area likely be off limits?

- Could Jim walk us through what all the files were on that disk?
    - I'm seeing designs for Farrell Distributing?
    - What are the wastewater designs?

- Looking at the GIS South Burlington parcel layer I am not seeing any ROWs listed in the orchards. Does Jim know if there is ROW space in this community?

2/10/2016

- Divided Project deliverables for Conditions/ Needs Assessment due Fri. 2/12/2016@2pm
    - Andrew: Section 4
    - Andrea: Section 1
    - Katrina: Section 3
    - Laura: Section 2

- Assigned team roles for overall project
    - Andrea: Contact person
    - Jamie: Project organizer
    - Andrew: Photographer
    - Katrina: Timekeeper
    - Laura: Meeting minute/ note taker

- Start HydroCAD for Farrell Brook area - Andrea

- Go through Stormwater management manual - Katrina

- Contact John for potential help with prioritizing - Jamie

- Go through all files and review Stantec report - Everyone

- Official meeting time: Wednesdays at 5pm
    - Mondays at 5pm
    - Fridays after Senior Design Project class (when needed)

2/17/16

- Plan site visit to collect water samples (Saturday to monitor erosion from rain storm, Sunday to collect samples)
- GPS location where samples are taken.
- Test samples on Monday after senior design
- Reviewed graded report comments and talked about ways to improve sections

- Meet with Holmen to discuss best places along stream to take samples
- Talk to Bomblies about flow meter
- Revise previous sections by next Friday (alternatives due)
- Everyone research stormwater design structures
- Research ways to monitor erosion

2/19/16

- In response to Jim's email we decided to hold off on taking water samples this weekend.
- Meeting with him on Tuesday to go over how to sample, what to sample, and ways to approach the overall problem
- Instead take the weekend to research topics for alternatives submission
    - Erosion control
    - History of area
    - Cost analysis
    - Soil sampling methods

2/22/16

- Discussed pictures and findings from Jamie and Andrews's field visit to the lower part of Farrell Brook.
- Began coming up with questions to ask Jim at Tuesdays meeting (tomorrow).
    - What should we be testing? Soil/ water?
    - How to test?
    - Where to test?
    - Erosion prevention on bends, specifically marked on map?
    - Does he have any prior data that could be of use to us, to compare to data we collect?
- Meeting again tonight at 5pm to discuss further

2/22/16

- Questions prepared for meeting with Jim Pease tomorrow
    - What is the background on water quality for Farrell Brook?
        - Does data already exist for water quality or soil sampling?
        - What are the ways to measure erosion?
        - Should we take our own samples for water quality and try to test the soils for phosphorus, nitrogen, TSS
    - Can we design in the area past the train tracks or is this private property?
    - Where does the stormwater pond on Farrell Distribution land drain to?
    - The land around the outlet culvert on the west side of the train tracks is being eroded by flowing water. What do we think the source of this water is and what is something we could do about the erosion problem? It is our responsibility to redesign/resize culverts in our project area.
    - Soil erosion measures. Large and small scale and in what areas.

- Possible locations include area between Freedom Nissan, bends in the brook west of train tracks, outlet of culvert off of Holmes Rd.
- Is adjusting channel size a possible option.

- Do you know anything about stormwater hot spots and are any of the areas within the project bounds considered stormwater hot spots?

- Possible Design Ideas…
  - Redesign stormwater pond A.
  - Implement erosion prevention measures in areas prone to erosion.
  - Address problem regarding culvert on west side of train tracks.
  - Implement stormwater pond near southwest corner of freedom nissan.
  - Graveyard area

- Main Focus: Water quality in Shelburne Bay
  - -Slowing the flows in Farrell Brook east of railroad tracks
    - -Stormwater ponds to detain flows and allow for sedimentation
      - -Near Farrell Distributing
      - -Fayette Drive
      - -Cemetery
    - -Erosion prevention measures where necessary
    - -Possible infiltration trenches and rain gardens in the orchards
    - -Recommendations for Farrell brook west side of railroad tracks

2/23/16

- Gave Jim typed questions
- Showed initial site pics (upper side of brook)
  - State of Freedom Nissan culvert
    - Jim-limited ability to solve the issue, but pointed out that flow coming of pavement goes right into river ∴ it is connected with water quality in stream
      - Trees holding banks back-avoid removing them
      - Potash and Bartlett are near Farrell-possible similarities
      - Wooded area in the cemetery is fair game at the moment
        - Must be nice looking, avoid graves
        - Could be stopped if archeological issues come up
        - Vegetation is good
        - Currently has dumping occurring-leverage
- Showed lower brook pics
  - Cracked headwall, erosion around culvert
  - Jim-Don't have permission currently to go below railroad tracks
    - Farrell property is getting updated
      - We have plans
    - Really wants treatment options and where to put them
      - What level it can be treated to
    - Pipe systems could be updated if we want
    - If we work below tracks, permission might not be granted

- Does not recommend using stone (hardening) for erosion control
    - Plants/Biological options are much more preferable
    - Fish habitats (ponds)
    - Flows must be under control before developing
    - The ditches are not in stable condition
        - Work with landowner
            - Develop flood plain
            - Improve channel
            - Must control upstream flows first
                - Increased volumes
        - Will have to be fixed eventually due to the erosion problems
- Jim-options
    - Rain gardens in Orchards
    - Pond where Stantec decided
    - Cemetery area
    - Upgrade large pond (expand to left?)
        - Don't want to replace bridge
        - Dredging is possible too
    - Swirl Separator (must be accessible)
    - Need forebay to pond upstream
    - If soil around brook is clay-could be flowing out into Shelburne Bay
    - Rock-lining is possible if it doesn't impede fish being able to swim upstream
- Stormwater Manuals-yellow is required, green is guidance (maintenance, plants)-can be found online
    - Because not a new development the manuals should followed as much as possible
        - For retrofits:
            - BMP Performance curves
- Should be able to find volumes from Stantec report
- Could do recommendations throughout watershed
    - Or design specific aspects
- Natural Channel Design-Right below tracks
    - Steams are always trying to reach a stable meander form
    - Idea is to be able to handle flows without eroding
        - Put in meander form

- Water Quality-Jim
    - Gave us some water quality data and map
        - Potash Brook data
            - Report and Map
        - Hydrocarbon data for one point on Farrell Brook
            - Bartlett Brook is high
        - Relationship between soil erosion and phosphorus
        - Summary of phosphorus monitoring data for Shelburne Bay
        - Report on salt in streams

        - Some areas are limiting salt
        - New water quality parameter
- **Really Stressed-Fix flows first, then work on erosion control…**

3/25/16

- Stantec-Jamie has emailed and we are waiting for a response
- Jamie:
    - Regraded pond-starts at 171 instead of 170
    - Gives slightly more than 81,000 ft3
    - 1ft drop for outlet pipe
    - Should we use a weir?
        - Maybe…
    - Need to do cost estimating and look into permits
    - Utilities: Stantec said not an issue
- Andrew:
    - Graded pond-90,000 ft3
        - Too small, may redo
        - More volume
    - Needs to research inflow and outflow structure
    - Cost estimates are needed
    - Permits
- Katrina
    - Swirl Separators-need one year storm flow
        - Andrea-on google docs
    - Place below Shelburne Road
- Laura
    - Stream Stabilization
        - Jim wants bioengineering
        - Need cost per foot
        - Focus below railroad tracks
        - Multiple options
- Andrea
    - Gravel Wetlands
        - Have sketches
        - Has been designed
    - Needs costs
- Plan:
    - Jamie-Talk to Rizzo about pipes
    - Laura-GIS to get lengths, permitting
    - Katrina-Continue editing report, hazardous waste site
    - Andrew-Work on pond more
    - Andrea-Work with Andrew on diversion/outlet structure
    - Meeting with Jim on Monday at 1pm

4/5/16

- Name of project: make sure it fits the project
- Cemetery option and other options: discuss in report (feasibility, recommendations), Maybe in cemetery?
- Take care of water quality (coarse sediment) above: swirl separator and in cemetery
    - Concept, design not necessary
    - For swirl separator: One year storm flows to size
- Bioengineering stream banks: linear footage, price (paragraph)
    - No detailed analysis
    - Concept
- Farrell Distributing: Look at existing permits and existing treatments
- Make sure we have costs for alternatives
- Channel protection volume at Inn Road is a goal, but not completely necessary if not achievable
    - Channel Protection is a volume so is not detained in upper pond, needs to be taken into account at lower pond
- Inn Road: water quality and as much channel protection as possible
    - Inlet structure and outlet structure
    - Permanent pool volume is a percentage of the WQv
- Upper Pond: Detain flows
    - Look at parcels and right of way
    - Impact to landowners
- Could put swirl separator on other side of Fayette Drive
- Water quality volume can be calculated by simple equation (Stormwater Manual)
- Pretreatment upstream?
- Retrofit so we can make some assumptions as long as they are reasonable
- L&M Park has their own system so we can ignore their runoff
- Do swirl separators need a drop to work?
- Berm is good idea at Inn Road
- Army Corps Permit for wetlands
- Rare and endangered species-check on ANR website
- Mention lack of hazardous waste sites

4/13/16

- Stantec-Jamie has emailed and we are waiting for a response
- Jamie:
    - Regraded pond-starts at 171 instead of 170
    - Gives slightly more than 81,000 ft3
    - 1ft drop for outlet pipe
    - Should we use a weir?
        - Maybe…
    - Need to do cost estimating and look into permits
    - Utilities: Stantec said not an issue
- Andrew:

    - Graded pond-90,000 ft3
        - Too small, may redo
        - More volume
    - Needs to research inflow and outflow structure
    - Cost estimates are needed
    - Permits
- Katrina
    - Swirl Separators-need one year storm flow
        - Andrea-on google docs
    - Place below Shelburne Road
- Laura
    - Stream Stabilization
        - Jim wants bioengineering
        - Need cost per foot
        - Focus below railroad tracks
        - Multiple options
- Andrea
    - Gravel Wetlands
        - Have sketches
        - Has been designed
    - Needs costs
- Plan:
    - Jamie-Talk to Rizzo about pipes
    - Laura-GIS to get lengths, permitting
    - Katrina-Continue editing report, hazardous waste site
    - Andrew-Work on pond more
    - Andrea-Work with Andrew on diversion/outlet structure
    - Meeting with Jim on Monday at 1pm

4/15/16

- Design the detention pond near Freedom Nissan to detain required volume from Stantec Report (Jamie)
    - Graded adequately
    - Email Chris Gendron about the outflow pipe
        - Single pipe
    - Do not need to worry about setbacks, safety benches because of dry pond and it is a retrofit…
    - Cost estimate of excavation and backfill
    - What are relevant standards we need to focus on
- Design the downstream retention pond for the Water Quality Volume WQv (Andrew)
    - If it cannot hold WQv then make it as big as possible and back calculate
    - Also the channel protection volume (from Stantec)
    - Ignore 10-year and 100-year storm volumes because 10-year is detained in upstream pond
    - Design Pre-Treatment (Forebay--Location and size?)

    - Design spillway
    - Design outlet structure
        - Email Chris about calculations and design
    - Cost estimate of excavation or backfill
    - What are relevant standards we need to focus on
- Model Swirl Separators at the two locations (Katrina)
    - Are these in addition to the ponds or separate alternatives??
    - Cost estimate for swirl separators
- Downstream Stabilization (only if we achieve channel protection volume) (Laura)
    - Concept design for stream restoration west side of RR tracks
    - Large stone for toe of channel slope
- Gravel Wetland (Andrea)
- Permit Applications (Andrea)
- Total Cost Estimates
- Report Edits (Katrina)
- If the upstream detention pond controls the flow for a 10-year storm then would it not also control the 1-year channel protection volume CPv??
- Skills Review
    - HydroCAD for restoring to natural (wooded) flows
        - Do calculations for pipe sizes using natural flows
    - Seep model?
- Gravel Wetland
    - Add in information to report
- Swirl Separator
    - 1 in storm (9.1 cfs)
- Bank stabilization/erosion control
    - Linear footage from outlet culvert to woods
- Detention pond
    - Tie into existing culvert?
    - cut/fill calculation
- Retention pond
    - Inlet structure and weir headwall
    - Outlet structure
    - Piping network to connect and put under road
- COSTS
    - Actual construction costs
    - Overall construction estimation costs
    - Labor costs
    - Design cost

- Cost estimates for each project
- Cost estimates for combination options
- Treatment
    - Some sort of treatment justification for each element
    - Treatment combinations

APPENDIX L: Detailed Work Plan

The following work plan was devised at the beginning of the project to estimate the amount of time that would be spent on each aspect.

PROJECT WORK PLAN

Laura Tracy, Andrew Sampsell, Katrina Benoit, Jamie Martell, Andrea Dotolo

CE 175 Senior Design

2/3/2016

Tasks	Engineering	Administration	TOTAL LABOR HOURS BY TASK	*HYPOTHETICAL FEE*
Hypothetical Hourly Billing Rate	*$80*	*$60*		
1) Site Visits and Client Communication	0	15	15	$900
2) Existing Documents Research/Review	25	0	25	$2,000
3) Field Survey and Laboratory Testing	5	0	5	$400
4) Conditions Summary/Needs Assessment	0	5	5	$300
5) Alternatives Evaluation	20	0	20	$1,600
6) Permit Requirements Identification	0	10	10	$600
7) Sustainability, Risk, Uncertainty, Life-Cycle Evaluations	0	20	20	$1,200
8) Alternatives Submission	20	0	20	$1,600
9) 60% Submission	40	10	50	$3,800
10) Final Submission	20	5	25	$1,900
11) Design Night Presentation	20	5	25	$1,900
12) Design Review Panel Presentation	25	0	25	$2,000
13) Address Review Comments/Final Submittal	15	5	20	$1,500
14) Photo story and materials compiled electronically (CD)	0	5	5	$300
15) Project Management	0	50	50	$3,000
16) Contingency Budget	30	0	30	$2,400
TOTALS	220	130	350	$25,400

APPENDIX M: Reported Time

The following table contains the reported hours from each team member, along with total hours for the project.

CE175 Senior Design - Spring 2016 - Billable and Administrative Hours

Project: Shelburne Road Stormwater

Team Members: Katrina Benoit, Andrea Dotolo, Jamie Martell, Andrew Sampsell, Laura Tracy

Week	Jamie Martell		Activity Description	Katrina Benoit		Activity Description	Andrea Dotolo		Activity Description	Laura Tracy		Activity Description	Andrew Sampsell		Activity Description
	Bill	Admin		Bill	Admin		Bill	Admin		Bill	Admin		Bill	Admin	
1/25/2016		1	Meeting with community partner		1	Meeting with community partner		1	Meeting with community partner		0			0	Meeting with community partner
	--	1	Site visit	1		Site visit	1		Site visit	--	1	Site visit	--	1	Site visit
2/1/2016		1	Meeting with community partner		1	Meeting with community partner		1	Review of Stantec report		1	Review of Stantec report		1	Meeting with community partner
	--	1	Review of Stantec report	--	1	Review of Stantec report	--			--			--	1	Review of Stantec report
2/8/2016		2	Project management, reviewing team roles, assigning sections for conditions needs assessment		2	Project management, reviewing team roles, assigning sections for conditions needs assessment		2	Project management, reviewing team roles, assigning sections for conditions needs assessment		2	Project management, reviewing team roles, assigning sections for conditions needs assessment		2	Project management, reviewing team roles, assigning sections for conditions needs assessment
	--			--			--			--			--		
2/17/2016		1.5	Project managemnt and review of report feedback		2	Project management, revision of submitted report		1.5	Project management, revision of submitted report		2	Project management, revision of submitted report		--	
	--			--			--			--			--		
2/19/2016		--			1	Project management		1	Project Managemnet		1	Project management		1	Erosion Control Research
	--			--			--			--			--		
2/21/2016		1.5	Site visit to lower half of Farrell Brook and Shelburne Bay	1		Revision of assigned report section		--			1	Revision of assigned report section		1.5	Site visit to lower half of Farrel Brook and Shelburne Bay
	--			--			--			--			--		
2/22/2016		0.5	Review of site visit and photos with group, discussion of site conditions		1	Review of site visist, project management		1	Review of site visist, project management		1	Review of site visist, project management		0.5	Review of site visit and photos with group, discussion of site conditions
	--	1	Project management with group. Discussion for plan for meeting with Jim Pease	--			--			--	1	Project management with group. Discussion for plan for meeting with Jim Pease	--	1	Project management with group. Discussion for plan for meeting with Jim Pease
2/23/2016		1	Meeting with Jim Pease. Review of questions we had about site visits. Discussion of ideas and locations of how to deal with increased flows and water quality.	--	1	Meeting with Jim Pease. Review of questions we had about site visits. Discussion of ideas and locations of how to deal with increased flows and water quality.		1	Meeting with Jim Pease. Review of questions we had about site visits. Discussion of ideas and locations of how to deal with increased flows and water quality.		--			1	Meeting with Jim Pease. Review of questions we had about site visits. Discussion of ideas and locations of how to deal with increased flows and water quality.
	1.5		Research. Review of Stantec report and review of Swanton Stormwater Feasibility Study	--			--			--			--		
2/24/2016		2	Meeting with group to discuss alternatives designs		2	Meeting with group to discuss alternatives designs		2	Meeting with group to discuss alternatives designs		2	Meeting with group to discuss alternatives designs		2	Meeting with group to discuss alternatives designs
	--			--			--			--			--		
2/25/2016		2	Work on alternatives and editing of report	2		Work on alternatives and editing of sections 1-5 of report	2		Work on alternatives and editing of sections 1-5 of report		--			2	Work on alternatives and editing of sections 1-5 of report
	--			--			--			--			--		
2/26/2016		1	Finalizing and printing alternatives		1	Meeting with group to finalize, print, and bind alternatives submission		1	Meeting with group to finalize, print, and bind alternatives submission		--			1	Meeting with group to finalize, print, and bind alternatives submission
	--			--			--			--			--		
3/2/2016	--	1.5	Meeting with John to discuss projects and alternatives	--	1.5	Meeting with John to discuss projects and alternatives	--	1.5	Meeting with John to discuss projects and alternatives	--			--	1.5	Meeting with John to discuss projects and alternatives
	--			--			--			--			--		
3/14/2016	--	1	Post break check-in with group	--	1	Meeting (Post break check-in)	--	1	Meeting (Post break check-in)	--			--	1	Group Meeting Prior Meeting With Community Partner
	--			--			--			--			--		
3/15/2016	--	1	Meeting with Jim Pease, community partner	--	1	Meeting with community partner	--	1	Meeting with community partner	--	1	Group Meeting	--		
	--			--			--			--			--		
3/16/2016	--	1	Group Meeting	--	1	Meeting	--	1	Meeting	--	1	Group Meeting	--	1	Group Meeting
	--			--			--			--			--		

3/17/2016	--	1.5	Group meeting to discuss 60% submission and doing calcuations	2		Meeting to work on 60% design	2		Meeting to work on 60% design	--			--	3	Group Meeting/Work For 60%
	--			--			--			--			--		
3/18/2016	--			--			--			--			--		
	--			--			--			--			--		
3/19/2016	--			--			--			--			--		
	--			--			--			--			--		
3/20/2016	--	2	Group meeting to work on 60% submission	3		Meeting to work on 60% design	1		Meeting to work on 60% design	--	3	Group Meeting/Work For 60%/ Presentation	--	3	Group Meeting/Work For 60%
	--			--			--			--			--		
3/21/2016	--	1	Meeting with Sean Neely to discuss GIS and AutoCAD and issues with alternatives	--	1	Group Meeting with Sean	--	1	Meeting with Sean for help with AutoCAD and ArcMap	--			--	1	Meet With Sean Neely About AutoCAD, and Other Project Details
	--			--	3	Group Meeting, Work on Report	2	1	Group Meeting, Work on Report	--	3	Group Meeting, Work on Report	--	3	Group Meeting, Work on Report
3/22/2016	--			3		Permit Research	2		ArcMap calculations and work on report	--			--		
	--	4	Group meeting and working on report	--	4	Group Meeting, Work on Report	4		Group Meeting, Work on Report	--	4	Group Meeting, Work on Report	--	4	Group Meeting, Work on Report
3/25/2016	--	1	Meeting with Stantec to discuss report and clarify questions	--	1	Stantec Meeting	--	1	Stantec Meeting	--	1	Stantec Meeting	--	1	Stantec Meeting
	--			--			--			--			--		
3/30/2016	--			--			--	3	GSI Symposium	--			--	0.5	Meeting With John
	--	0.5	Meeting with John	--	0.5	Meeting with John	--	0.5	Meeting with John	--	0.5	Meeting with John	--		
4/4/2016	--	0.5	Weekly, report review, tasks for moving forwards	--	0.5	Weekly Meeting, report review, tasks for moving forward	--	0.5	Weekly Meeting, report review, tasks for moving forward	--	0.5	Weekly Meeting, report review, tasks for moving forward	--	0.5	Weekly Meeting, report review, tasks for moving forward
	--			--			--			--			--		
4/5/2016	--	1.5	Meeting with Jim Pease to discuss project deliverables	--	1.5	Meeting with Jim	--	1.5	Meeting with Jim	--			--		
	--			--			--			--			--		
4/10/2016	--			--			4	1	Gravel Wetland Research and Design	--			--		
	--			--			--			--			--		
4/12/2016	1		Detention pond re-grading and volume calculations	--	1	Meeting with Jim	--			--			--		
4/13/2016	3		Design and Development of detention pond, grading and cross-section	--	2	Group Meeting	--	2	Group Meeting	--	2	Group Meeting	--	2	Group Meeting
	--	1	Team Meeting	--			--			--			--		
4/14/2016	4		Design calculations for detention pond	--			--			--			--	4	Retention Pond Design
	--			--			--			--			--	2	Retention Pond Design
4/17/2016	8		Detention Pond design and site visit	6		Cost Estimates, Report Edits	6		Design Work	--	10	Slope stabilization research, report edits, permit research, site visit	--	7	Retention Pond Design/Details
4/18/2016	10		Detention pond design and development	8		Cost Estimates, Report Edits	12		Design Work and Mapping	--	6	Slope stabilization research, report edits, permit research	--	12	Retention Pond Design/Details
4/19/2016	12		Design developement	10		Cost Estimates, Report Edits	12		Design Work and Mapping	--	6	Report edits	--	12	Retention Pond Design/Details
		1	Meeting with Jim Pease to discuss project deliverables		1	Meeting with Jim Pease to discuss project deliverables		1	Meeting with Jim Pease to discuss project deliverables		1	Meeting with Jim Pease to discuss project deliverables		1	Meeting with Jim Pease to discuss project deliverables
4/20/2016		1	Meeting with John		1	Meeting with John	--	1	Meeting with John	--	1	Meeting with John	--	1	Meeting with John
	12		Design developement	10		Cost Estimates, Report Edits	12		Design Work and Mapping		8	Final adjustments to overall report		12	Retention Pond Design/Details
4/21/2016	8		Report edits and design development for project, formatting of drawings and report	8		Cost Sample Calculations / Final Report Review	10		Final report writing and organization	--	5	Final Report Review	--	10	Retention Pond Design/Details & Complile Work Into Report
Total	59.5	36		54	34		70	29.5		0	65		0	97.5	
	95.5			**88**			**99.5**			**65**			**97.5**		

APPENDIX N: Report Drafts

The following drafts reports were edited by Professor John Lens and can be referenced as needed.