CMA ENGINEERS, INC.
CIVIL | ENVIRONMENTAL | STRUCTURAL

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May 3, 2018

Mr. Steve Brewer, Director of Public Works
Public Works Department
Town Offices
4 Epping Street

Dear Mr. Brewer:

The Town of Raymond tasked CMA Engineers with developing preliminary design recommendations to improve the stormwater collection on Lakeview Road. This letter report summarizes the methodology and results for development of the hydrology and hydraulic analysis and the basis for our attached preliminary design.

EXISTING CONDITIONS

Although there are some grass lined swales on Lakeview Road at the top of the hill on Lakeview Road, most of the stormwater is currently collected in paved swales at the edge of the traveled way. The paved swales transport the stormwater along the roadside to the bottom of the hill either over driveways or through the occasional driveway culvert. At the bottom of the hill, there is a single catch basin that captures some of the stormwater and discharges it into Governors Lake via a culvert, but most of the flow continues overland over the beach before entering Governors Lake.

Approximately halfway down the hill, the northern drainage swale travels off the roadside and into an overland swale. The overland swale carries this stormwater, and additional runoff it picks up along the way, in a backyard grass/paved drainage swale to the bottom of the hill where it enters a road cross culvert at Water Street, discharging into a wetland, and then into Governors Lake. The drainage swale is on private property until it crosses under Water Street.

Historically, Governors Lake has had issues with Total Phosphorus (TP), chlorides, and chlorophyll. Currently, the stormwater from Lakeview Road is discharged untreated into Governors Lake. The stormwater from the culvert under Water Street is discharged to an existing wetland, which provides some treatment prior to its discharge into the lake. The Town is interested in evaluating stormwater treatment approaches to provide treatment for total suspended solids and to decrease phosphorus discharges to the lake. Lakeview Road is treated with chloride in the winter to maintain safe road conditions on the steep road. It should be noted that there are no stormwater treatment options that would reduce chloride. Due to its steep slope, reduced road salting is not recommended for Lakeview Road. Reduced road salting might be considered for some of the flatter road sections around the lake, and for relatively flat driveways.

HYDROLOGY

The hydrologic model was created using Autodesk's 'Storm and Sanitary' watershed modelling software,

and the overall watershed was split into three sub-watersheds: the upper watershed flowing into the backyard drainage swale, the backyard drainage swale watershed, and the lower watershed flowing into the beach.

The runoff curve number (CN) used in the model for each of the watersheds represents a weighted average based on the percentage of Soil Groups A, B, C, D, and open water present, as applicable. Soil maps generated by the Natural Resources Conservation Service's (NRCS) Web Soil Survey were used to determine the total area of each soil group.

The Time of Concentration (TOC) for each of the watersheds was calculated based on the summation of times for sheet flow, shallow concentrated flow, and channel flow. The flow lengths for each of the three flow types were measured from a to-scale site plan developed in Autodesk Civil 3D. The topographic information provided from the Town and prepared by Doucet Survey was overlaid on the site plan to determine beginning and ending elevations used to calculate average slopes for each flow type. Based on aerial photography, the ground cover was assumed to be "woods with light underbrush" or "woodland". Cross sectional areas for channels were approximated and then checked to ensure they were not acting as constrictions. For each of the sub-basins, multiple flow paths were checked when determining the controlling TOC. Multiple paths were evaluated to analyze different combinations of lengths, slopes, and flow types.

Below is a brief description of the watersheds and a summary table of the watersheds' properties.

The upper watershed begins at the top of the hill on Lakeview Drive and ends at the point where the runoff travels to the overland swale. This watershed accounts for all the stormwater that flows into the start of the overland drainage swale. The watershed is generally woods and larger house lots, so Woodland and 2 acre lots with Type B and Type C soils were used to determine the average curve number of the watershed.

The backyard drainage swale watershed begins at the end of the upper watershed and terminates at the drainage culvert Water St. This watershed accounts for the additional stormwater flowing into the drainage swale before it enters the culvert. The watershed is generally small house lots, so ¼ acre house lots with Type B and Type C soils were used to determine the average curve number of the watershed.

The lower watershed begins at the end of the upper watershed on the south side of the road and terminates at the Lakeview Road Beach. This watershed accounts for all the stormwater that flows into the beach. The watershed is generally small house lots, so ¼ acre house lots with Type A, Type B, and Type C soils were used to determine the average curve number of the watershed.

Table 1: Watershed Summary

Watershed	Area (ac)	Curve Number	Time of Concentration (min)
Upper Watershed	1.67	67.5	28.8
Overland Drainage Swale Watershed	0.87	79	12.7
Lower Watershed	1.96	76.5	16.5

The amount of precipitation that falls on the site, and its intensity, was determined from various sources. When performing a hydrologic analysis, standard practice in the Northeast is to use the Soil Conservation

Center's (SCS) rainfall distribution curve, and Strafford County is in the Type III zone. To determine the amount of precipitation, Cornell University's Northeast Regional Climate Center (NRCC), which studies and researches climate, and pertinent to this report, has published precipitation amounts for the Northeast based on historical rainfall data that are summarized in Table 2: Rainfall Summary below.

Table 2: Rainfall Summary

Storm Event	Rainfall (inches)
2	3.01
10	3.80
25	5.75
50	6.88

The analysis included the 2-, 10-, 25-, and 50- year storm events. The site was modelled for the 2- through 50-year storm events to determine peak flow rates for the different storm events. Table 3 below summarizes the hydrology results for the three watersheds. Attachment A provides information on the watershed and analysis results for the 10-year storm event.

Table 3: Hydrology Summary

Watershed	Storm Event	Stormwater Runoff (cfs)
Upper Watershed	2	0.6
	10	1.1
	25	2.7
	50	3.7
Overland Drainage Swale Watershed	2	0.9
	10	1.4
	25	2.7
	50	3.5
Lower Watershed	2	2.0
	10	2.7
	25	5.3
	50	7.0

The "first flush", or 1-inch storm event, has the highest concentration of pollutants in stormwater runoff and is used to size stormwater treatment systems in New Hampshire. NHDES has developed, and distributes, a worksheet tool to calculate the Water Quality Volume (WQV) and Water Quality Flow (WQF) to size treatment systems. Entering the watershed data into the worksheet, the WQV and WQF for the entire watershed are 4,345 cubic feet and 0.25 cubic feet per second. See Attachment B for the WQV and WQF calculation results.

RECOMMENDATIONS

Below are preliminary recommendations with budget estimates to improve the stormwater collection system on Lakeview Road and to treat the collected stormwater before it flows into Governors Lake. The preliminary budget estimates are included for reference.

Lakeview Road Stormwater Collection Improvements

We reviewed the existing stormwater collection system on Lakeview Road, and assessed it based on its function and site limitations.

The limitations are a narrow roadway and right-of-way, proximity of homes close to the roadway, and the likelihood of shallow depth to ledge that all limit the ability to install typical structural collection devices outside of the roadway or under the roadway.

Currently, stormwater is generally collected in roadside and paved swales and transported to the bottom of Lakeview Road. The stormwater generated on the northerly side of Lakeview Road travels off the roadway and into a backyard drainage swale. This reduces the stormwater flowing alongside Lakeview Road to the bottom of the hill.

In general, continuing the existing stormwater collection system with minor changes (as noted in the attached preliminary plans and details) as the Town reconstructs Lakeview Road appears to be a reasonable project approach from an engineering and project standpoint. Installing storm drains and catch basins up to the top of the hill would be very costly, and is not merited in this circumstance, in our opinion.

In reconstructing the roadway itself, we recommend reclaiming the existing pavement , fine grading the road to reestablish a typical crown and roadway cross slope, and installation of 3 ½ inches combined of base and wearing course pavements. Additionally, reclaim material is generally too fine to meet the gradation requirements of NHDOT Item 304.3-Crushed Stone, so 1 ½ inch crushed stone is incorporated into the reclaim if needed to meet the specification requirements. Since fine grading will likely create a surplus of material, this material could be collected and reused to improve the road base materials for Water Street and the beach parking area.

Lakeview Road Beach Stormwater Treatment Alternatives

Four options were considered to treat the stormwater prior to its discharge into Governors Lake.

Catch Basin Treatment Only

The catch basin approach carries the lowest cost to the Town, but it will also have minimal effect on improving the quality of the stormwater. At a minimum, we would recommend the installation of Catch Basins #1 - #4 as shown on the preliminary plan to maximize the amount of stormwater collected, so it does not flow over the beach. Also, we would maintain the current discharge point at the bottom of Lakeview Road instead of redirecting the stormwater down Water Street. The installation of deep sump catch basins is generally considered to reduce Total Suspended Solids (TSS) by 25 percent as reported in Mass DEP's Stormwater Handbook, but it will have minimal, if any, impact on improving total phosphorus. The preliminary budget estimate to make these improvements is approximately $71,000.

UNH's Sectional Media Filter

The UNH Stormwater Center recently developed the Sectional Media Filter (SMF) to treat stormwater in urban environments. The City of Dover has installed a few SMF's, and since it is a new technology, stormwater treatment data is not available, but UNH expects preliminary results in the upcoming year.

The SMF filter consists of two chambers: a sediment and floatable collection chamber and a treatment chamber with the two chambers separated by a weir wall and trash rack. The first chamber acts like a deep

sump catch basin and allows sediment to settle out and retain floatables. The second chamber has the media filter and provides treatment to the stormwater. The Stormwater Center reports the media filter is rated to provide treatment to 0.25 cfs of stormwater per filter media section, and based on NHDES's WQF calculator, a single filter section is required. The filter media operates on the same concept as ACF's FocalPoint system (see below), but due to the considerable size difference between the two units, we would not expect the SMF to have comparable treatment efficacy as the FocalPoint. The SMF provides a filter medium with a depth of six inches, and a surface area of 32 square feet, designed to treat the first flush of 0.25 cfs. This is 1/3 the filter medium depth and about 7% of the surface area of the FocalPoint treatment system described below to treat the same flow.

Regular maintenance of the SMF unit would consist of opening the cover over the sediment chamber and using a vacuum truck to remove the collected sediment and floatables, at a frequency to be determined by operating experience. The media filter will need to be replaced periodically, and this would require removal of the top cover, so the entire media filter can be removed with a vacuum truck and replaced with new media. Since the SMF unit is underground, and removal of the top cover is required, it should be located in an off-pavement area that can be accessed by a backhoe and vacuum truck.

Excavation below groundwater level would be required for the installation of this treatment unit. For cost purposes, we have assumed that simple trench dewatering by construction sump pumps would suffice. Borings and assessment of dewatering methods required would need to be completed in final design.

A wetlands permit would be required, at a minimum, for the installation of the outlet pipe from the treatment unit. A minor permit is anticipated.

The preliminary budget estimate, including the sectional media filter and site work, is approximately

$229,000.

ACF's FocalPoint Biofiltration System

Two aboveground solutions were investigated, and ACF Environmental's FocalPoint is the first. The FocalPointis a proprietary system that was developed to treat, and temporarily store, stormwater in a treatment device that functions at grade and below ground. Stormwater treatment starts with deep sump catch basins to provide pretreatment and TSS removal, after which stormwater is discharged into a landscaped containment area that allows the stormwater to flow through the proprietary media filter being treated on its flow through the filter. Below the media filter is a tank system that temporarily stores the stormwater while it infiltrates into the ground. The FocalPoint has an overflow at both levels to help prevent overwhelming the treatment system. The FocalPoint has been approved for use by the NH DES Alteration of Terrain Bureau, and through independent lab testing, ACF reports 91% TSS removal, 66% TP removal, and 48% Nitrogen removal. Since the proposed upgrades include deep sump catch basins providing pretreatment for the FocalPoint system, there should be little sediment entering Governors Lake from the runoff generated by Lakeview Road. Since the discharge from the unit is below grade, and discharges near the Governors Lake water shore, the significant reduction in TSS is an important feature.

As designed, the FocalPoint would only treat stormwater generated by Lakeview Road and the overland swale would continue as it currently does, flowing through the culvert under Water Street and discharging into the wetland adjacent to the beach.

Also, of the options investigated, the FocalPoint is the only BMP that can meet the State's WQV requirements and infiltrate the WQV into the groundwater, but it is our opinion that with the proximity any of the treatment devices to Governors Lake, infiltration of the WQV has minimal benefit.

Dewatering requirements would need to be further investigated for this alternative as well.

Wetlands permitting requirements will consist of impacts to the wetlands because of site grading and installation of the discharge pipe near the shore of Governors Lake. A Minor permit is anticipated.

The FocalPoint carries the highest construction cost of the alternatives investigated. ACF estimates the unit costs approximately $200/sf installed, and ACF has preliminarily estimated the unit will be approximately 450 square feet. The preliminary budget estimate, including the FocalPoint and site work, is approximately

$326,000.

Level Spreader with Grass Filter Strip

The second above ground solution, and our recommended stormwater treatment device, is a level spreader with a grass filter strip. This system includes the deep sump catch basins (providing TSS pretreatment) and an overland swale to collect the stormwater and discharge it into a plunge pool. The plunge pool combines the stormwater from the two sources and acts as a stilling basin to allow more TSS to settle out.

The stormwater spills over the plunge pool and flows to the level spreader which distributes the stormwater over a 35-foot-long weir, reducing the stormwater velocity, and allowing for stormwater treatment in the downstream grass filter strip. Level spreaders with grass filter strips are reported to have approximately 30% TSS removal, 20% TP removal, and 10% Nitrogen removal as reported in Pennsylvania's Stormwater BMP manual. This option also has the benefit of flowing through the existing downstream wetland/riparian buffer after it leaves the grass strip for additional treatment.

The bulk of the construction for this option will occur within an existing wooded wetland, so a wetlands permit will be required. Also, due to the extent of the wetlands disturbance it may qualify as a Major permit and/or wetlands mitigation. If the project requires a Major permit, the Army Corps of Engineers is required to review the permit application, and NH DES Wetland Mitigation Program will need to be consulted if mitigation is a project condition.

Although the level spreader with grass filter strip doesn't provide the same level of treatment as the FocalPoint, it does carry a significantly lower cost. The preliminary budget estimate for the level spreader and site work is approximately $208,000.

A summary of the stormwater treatment alternatives is presented in Table 4 below.

Table 4 Summary of Lakeview Road Stormwater Treatment Alternatives

Alternative	**Estimated Removal Efficiency**		**Estimated Cost**
	TSS	Total P	
Current System	0%	0%	
Catch Basin Treatment	25%	N/A	$71,000
Sectional Media Filter	25%+	UNK	$229,000
Biofiltration System	91%	66%	$326,000
Level Spreader/Grass Filter	30%+	20%+	$208,000

Note that the level spreader/grass filter alternative would provide better treatment than indicated in the above table because the water from the grass filter would flow into an existing wetland for further treatment prior to being discharged to Governor's Lake. There is not a tool available for estimating that additional treatment with reasonable accuracy.

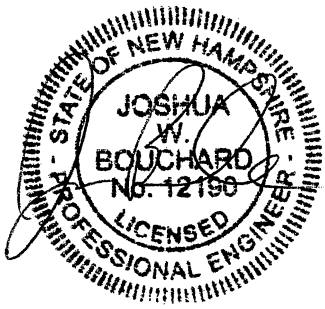
Each of these alternatives would require permitting and final design.

We have appreciated the opportunity to be of service to the Town of Raymond in this capacity. Should you have questions or comments, please don't hesitate to contact us.

Very truly yours,
CMA ENGINEERS, INC.

Joshua W. Bouchard, P.E.
Project Manager

Craig N. Musselman, P.E., BCEE
President



Attachment A

Autodesk® Storm and Sanitary Analysis 2016 - Version 12.0.42 (Build 0)

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Project Description
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File Name ..... 1099-Drainage Analysis-Split.SPF

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Analysis Options
****
Flow Units ..... cfs
Subbasin Hydrograph Method. SCS TR-20
Time of Concentration..... SCS TR-55
Link Routing Method ..... Hydrodynamic
Storage Node Exfiltration.. None
Starting Date MAR-07-2018 00:00:00
Ending Date MAR-08-2018 00:00:00
Report Time Step 00:05:00

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Element Count
****
Number of rain gages 1
Number of subbasins 3
Number of nodes 4
Number of links 4

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Raingage Summary
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Gage ID	Data Source	Data Type	Recording Interval min
Rain Gage-01	10-Yr Storm	CUMULATIVE	6.00

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Subbasin Summary
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Subbasin ID	Total Area acres
LowerRoadway	1.96
OverlandDrainageSwale	0.87
UpperRoadway	1.66

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Node Summary
****

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft²	External Inflow
SpreaderOutlet	JUNCTION	281.25	284.25	0.00	
SwaleInlet	JUNCTION	327.70	330.00	100.00	
GovernorsLake	OUTFALL	274.10	277.10	0.00	
Stor-01	STORAGE	281.50	284.00	0.00	

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Link Summary
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Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
OverlandSwale	SwaleInlet	Stor-01	CHANNEL	553.0	8.3538	0.0130
WaterStCulvert	Stor-01	SpreaderOutlet	CONDUIT	30.0	0.8333	0.0150
LevelSpreader	SpreaderOutlet	GovernorsLake	WEIR			
Roadway	Stor-01	SpreaderOutlet	WEIR			

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Cross Section Summary
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Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs
OverlandSwale	TRAPEZOIDAL	1.50	17.00	1	14.25	0.82	413.74
WaterStCulvert	CIRCULAR	1.50	1.50	1	1.77	0.38	8.31

Runoff Quantity Continuity	Volume acre-ft	Depth inches
Total Precipitation	1.445	3.859
Surface Runoff	0.054	0.144
Continuity Error (%)	-0.002	

Flow Routing Continuity	Volume acre-ft	Volume Mgallons
External Inflow	0.000	0.000
External Outflow	0.532	0.173
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.004	0.001
Continuity Error (%)	0.005	

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Composite Curve Number Computations Report
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Subbasin LowerRoadway

Soil/Surface Description	Area (acres)	Soil Group	CN
1/4 acre lots, 38% impervious	0.29	A	61.00
1/4 acre lots, 38% impervious	0.79	B	75.00
1/4 acre lots, 38% impervious	0.88	C	83.00
Composite Area & Weighted CN	1.96		76.50

Subbasin OverlandDrainageSwale

Soil/Surface Description	Area (acres)	Soil Group	CN
1/4 acre lots, 38% impervious	0.44	C	83.00
1/4 acre lots, 38% impervious	0.44	B	75.00
Composite Area & Weighted CN	0.87		79.00

Subbasin UpperRoadway

Soil/Surface Description	Area (acres)	Soil Group	CN
Woods, Good	0.83	C	70.00
2 acre lots, 12% impervious	0.83	B	65.00
Composite Area & Weighted CN	1.66		67.50

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SCS TR-55 Time of Concentration Computations Report
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Sheet Flow Equation

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where:

Tc = Time of Concentration (hrs)
n = Manning's Roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)

R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's Roughness

Subbasin LowerRoadway

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	75.00	0.00	0.00
Slope (%):	7.00	0.00	0.00
2 yr, 24 hr Rainfall (in):	3.00	3.00	3.00
Velocity (ft/sec):	0.12	0.00	0.00
Computed Flow Time (minutes):	10.67	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	323.31	0.00	0.00
Slope (%):	7.00	0.00	0.00
Surface Type:	Paved	Unpaved	Unpaved
Velocity (ft/sec):	5.38	0.00	0.00
Computed Flow Time (minutes):	1.00	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.12	0.00	0.00
Flow Length (ft):	201.06	0.00	0.00
Channel Slope (%):	7.00	0.00	0.00
Cross Section Area (ft²):	0.30	0.00	0.00
Wetted Perimeter (ft):	3.10	0.00	0.00
Velocity (ft/sec):	0.69	0.00	0.00
Computed Flow Time (minutes):	4.84	0.00	0.00

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Total TOC (minutes): 16.52

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Subbasin OverlandDrainageSwale

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.40	0.00	0.00
Flow Length (ft):	75.00	0.00	0.00
Slope (%):	7.50	0.00	0.00
2 yr, 24 hr Rainfall (in):	3.00	3.00	3.00
Velocity (ft/sec):	0.12	0.00	0.00
Computed Flow Time (minutes):	10.38	0.00	0.00

Shallow Concentrated Flow Computations

	Subarea A	Subarea B	Subarea C
Flow Length (ft):	470.00	0.00	0.00
Slope (%):	8.50	0.00	0.00
Surface Type:	Unpaved	Unpaved	Unpaved
Velocity (ft/sec):	4.70	0.00	0.00
Computed Flow Time (minutes):	1.67	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	155.00	0.00	0.00
Channel Slope (%):	0.50	0.00	0.00
Cross Section Area (ft²):	1.23	0.00	0.00
Wetted Perimeter (ft):	3.92	0.00	0.00
Velocity (ft/sec):	3.74	0.00	0.00
Computed Flow Time (minutes):	0.69	0.00	0.00

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Total TOC (minutes): 12.74

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Subbasin UpperRoadway

Sheet Flow Computations

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                                                Subarea A           Subarea B           Subarea
C
          Manning's Roughness:                       0.40                0.00
0.00
          Flow Length (ft):                        150.00                0.00
0.00
          Slope (%):                                 3.00                0.00
0.00
          2 yr, 24 hr Rainfall (in):                 3.00                3.00
3.00
          Velocity (ft/sec):                         0.10                0.00
0.00
          Computed Flow Time (minutes):             26.08                0.00
0.00

  Shallow Concentrated Flow Computations
  -------------------------------------
                                                Subarea A           Subarea B           Subarea
C
          Flow Length (ft):                        204.00                0.00
0.00
          Slope (%):                                 8.80                0.00
0.00
          Surface Type:                           Woodland              Unpaved
Unpaved
          Velocity (ft/sec):                         1.48                0.00
0.00
          Computed Flow Time (minutes):              2.30                0.00
0.00

  Channel Flow Computations
  -------------------------
                                                Subarea A           Subarea B           Subarea
C
          Manning's Roughness:                       0.01                0.00
0.00
          Flow Length (ft):                        510.00                0.00
0.00
          Channel Slope (%):                         8.50                0.00
0.00
          Cross Section Area (ft²):                  1.00                0.00
0.00
          Wetted Perimeter (ft):                     2.00                0.00
0.00
          Velocity (ft/sec):                        21.05                0.00
0.00
          Computed Flow Time (minutes):              0.40                0.00
0.00

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          Total TOC (minutes):                      28.78

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  Subbasin Runoff Summary
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  ------------------------------------------------------------------------
  Subbasin             Total     Total      Peak  Weighted          Time of
  ID                  Precip    Runoff    Runoff     Curve     Concentration
                         in        in       cfs    Number    days  hh:mm:ss
  ------------------------------------------------------------------------
  LowerRoadway          3.80      1.62      2.65    76.500       0  00:16:31
  OverlandDrainageSwale      3.80      1.80      1.42    79.000       0  00:12:44
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UpperRoadway	3.80	1.05	1.09	67.500	0	00:28:46

Node Depth Summary

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days	Time of Max Occurrence hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
SpreaderOutlet	0.02	0.14	281.39	0	12:31	0	0	0:00:00
SwaleInlet	0.01	0.08	327.78	0	12:30	0	0	0:00:00
GovernorsLake	0.00	0.00	274.10	0	00:00	0	0	0:00:00
Stor-01	0.18	1.02	282.52	0	12:30	0	0	0:00:00

Node Flow Summary

Node ID	Element Type	Maximum Lateral Inflow cfs	Peak Inflow cfs	Time of Peak Inflow Occurrence days	Time of Peak Inflow Occurrence hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days	Time of Peak Flooding Occurrence hh:mm
SpreaderOutlet	JUNCTION	0.00	3.58	0	12:31	0.00		
SwaleInlet	JUNCTION	1.08	1.08	0	12:30	0.00		
GovernorsLake	OUTFALL	0.00	3.58	0	12:31	0.00		
Stor-01	STORAGE	3.99	4.61	0	12:20	0.00		

Storage Node Summary

Storage Node ID	Maximum Ponded Volume 1000 ft³	Maximum Ponded Volume (%)	Time of Max Ponded Volume days hh:mm	Average Ponded Volume 1000 ft³	Average Ponded Volume (%)	Maximum Storage Node Outflow cfs	Maximum Exfiltration Rate cfm	Time of Max. Exfiltration Rate hh:mm:ss	Total Exfiltrated Volume 1000 ft³
Stor-01	0.103	41	0 12:30	0.018	7	3.58	0.00	0:00:00	0.000

Outfall Loading Summary

Outfall Node ID	Flow Frequency (%)	Average Flow cfs	Peak Inflow cfs

GovernorsLake	58.94	0.45	3.58
System	58.94	0.45	3.58

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Link Flow Summary
****

Link ID	Element Type	Time of Peak Flow Occurrence	Maximum Velocity Attained	Length Factor	Peak Flow during Analysis	Design Flow Capacity	Ratio of Maximum Flow	Ratio of Maximum Depth	Total Time	Reported Condition
		days hh:mm	ft/sec		cfs	cfs			minutes	
OverlandSwale	CHANNEL	0 12:30	0.41	1.86	1.08	413.74	0.00	0.37	0	Calculated
WaterStCulvert	CONDUIT	0 12:31	5.68	11.65	3.58	8.31	0.43	0.39	0	Calculated
LevelSpreader	WEIR	0 12:31			3.58			0.05		
Roadway	WEIR	0 00:00			0.00			0.00		

****
Highest Flow Instability Indexes
****
All links are stable.

WARNING 107 : Initial water surface elevation defined for Junction SpreaderOutlet is below junction invert elevation.
Assumed initial water surface elevation equal to invert elevation.
WARNING 107 : Initial water surface elevation defined for Junction SwaleInlet is below junction invert elevation.
Assumed initial water surface elevation equal to invert elevation.
WARNING 110 : Initial water surface elevation defined for Storage Node Stor-01 is below storage node invert elevation.
Assumed initial water surface elevation equal to invert elevation.
WARNING 119 : Weir crest invert elevation defined for Weir LevelSpreader is below upstream node invert elevation.
Assumed weir crest invert elevation equal to upstream node invert elevation.
WARNING 117 : Conduit outlet invert elevation defined for Conduit OverlandSwale is below downstream node invert elevation.
Assumed conduit outlet invert elevation equal to downstream node invert elevation.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node SpreaderOutlet.

Analysis began on: Wed May 02 10:09:03 2018
Analysis ended on: Wed May 02 10:09:04 2018
Total elapsed time: 00:00:01

Attachment B

General Calculations - WQV and WQF (optional worksheet)

This worksheet may be useful when designing a BMP that does not fit into one of the specific worksheets already provided (i.e. for a technology which is not a stormwater wetland, infiltration practice, etc.)

Water Quality Volume (WQV)

1.96	ac	A = Area draining to the practice
0.85	ac	A_I = Impervious area draining to the practice
0.43	decimal	I = percent impervious area draining to the practice, in decimal form
0.44	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)
0.86	ac-in	WQV= 1" x Rv x A
3,131	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")

Water Quality Flow (WQF)

1	inches	P = amount of rainfall. For WQF in NH, P = 1".
0.44	inches	Q = water quality depth. Q = WQV/A
93	unitless	CN = unit peak discharge curve number. $CN = 1000/(10+5P+10Q-10*[Q^2 + 1.25*Q*P]^{0.5})$
0.8	inches	S = potential maximum retention. S = (1000/CN) - 10
0.155	inches	Ia = initial abstraction. Ia = 0.2S
29.0	minutes	T_c = Time of Concentration
190.0	$cfs/mi^2/in$	qu is the unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III
0.256	cfs	WQF = q_u x WQV. Conversion: to convert "$cfs/mi^2/in$ * ac-in" to "cfs" multiply by $1mi^2/640ac$

Designer's Notes:

Impervious area assumes 38% impervious area for the 1/4 building lots and a 25' road width of the length of roadway inside the watershed.

CMA ENGINEERS, Inc.

Civil/Environmental Engineers
35 Bow Street
Portsmouth, NH 03801

PROJECT NAME:	**Lakeview Road**		
PROJECT NO.:	1099		
SHEET NO.:	1	OF	1
CALCULATED BY:	SJE	DATE:	5/2/2018
CHECKED BY:	JWB	DATE:	5/2/2018

Lakeview Road Drainage Improvements
Catch Basin Treatment Option Estimate (Option #1)

Item #	NHDOT#	Item Description	U	Quantity	Cost	Item Cost ($)
General Improvements						
1		Site Preparation	LS	1	$5,000.00	$ 5,000.00
2		4' Catch Basins	EA	2	$3,000.00	$ 6,000.00
3		5' Catch Basins	EA	2	$5,000.00	$ 10,000.00
4	603.6	15" CPP	LF	130	$80.00	$ 10,400.00
5		Crushed Gravel	CY	94	$30.00	$ 2,816.67
6	403.11	Hot Bituminous Pavement-Machine Method	TON	11	$100.00	$ 1,056.25
7	403.12	Hot Bituminous Pavement-Hand Method	TON	5	$150.00	$ 750.00
8		Ledge Removal	CY	30	$150.00	$ 4,500.00
8		Mobilization	LS	1	$10,000.00	$ 10,000.00
					Subtotal	**$ 50,522.92**

Construction Contingency (10%)	$5,100
Engineering Design & Permitting (10%)	$5,100
Construction Administration/Resident Project Representative (20%)	$10,100
Subtotal	**$20,300**
Budget Estimate Total	**$71,000**

CMA ENGINEERS, Inc.

Civil/Environmental Engineers
35 Bow Street
Portsmouth, NH 03801

PROJECT NAME:	**Lakeview Road**			
PROJECT NO.:	1099			
SHEET NO.:	1	OF	1	
CALCULATED BY:	SJE	DATE:	5/2/2018	
CHECKED BY:	JWB	DATE:	5/2/2018	

Lakeview Road Drainage Improvements
UNH Section Media Filter Estimate (Option #2)

Item #	NHDOT#	Item Description	U	Quantity	Cost	Item Cost ($)
Drainage Improvements						
1		Site Preparation	LS	1	$5,000.00	$ 5,000.00
2		Embankment In-Place	CY	100	$10.00	$ 1,000.00
3		4' Catch Basins	EA	2	$3,000.00	$ 6,000.00
4		5' Catch Basins	EA	2	$5,000.00	$ 10,000.00
5	604.324	4' Drainage Manhole	EA	1	$3,000.00	$ 3,000.00
6	604.326	5' Drainage Manhole	EA	1	$4,000.00	$ 4,000.00
7	603.6	15" CPP	LF	326	$80.00	$ 26,080.00
8	209.411	Gravel	CY	235	$30.00	$ 7,063.33
9	403.12	Hot Bituminous Pavement-Hand Method	TON	5	$150.00	$ 750.00
10		Ledge Removal	CY	50	$150.00	$ 7,500.00
11		Mobilization	LS	1	$5,000.00	$ 5,000.00
					Subtotal	**$ 75,393.33**
Roadway Improvements-Water Street						
1		Site Preparation	LS	1	$5,000.00	$ 5,000.00
2		Embankment In-Place	CY	100	$10.00	$ 1,000.00
3		Stabilized Base Shim	CY	70	$20.00	$ 1,400.00
4	403.11	Hot Bituminous Pavement-Machine Method	TON	90	$100.00	$ 9,000.00
5		Mobilization	LS	1	$10,000.00	$ 10,000.00
					Subtotal	**$ 26,400.00**
Parking Lot Improvements						
1		Site Preparation	LS	1	$5,000.00	$ 5,000.00
2		Embankment In-Place	CY	100	$10.00	$ 1,000.00
3	606.158	Guardrail	LF	120	$22.50	$ 2,700.00
4		Loam & Seed	CY	42	$45.00	$ 1,890.00
5		Stabilized Base Shim	CY	36	$20.00	$ 722.96
6	403.11	Hot Bituminous Pavement-Machine Method	TON	38	$100.00	$ 3,830.00
7	403.12	Hot Bituminous Pavement-Hand Method	TON	7	$150.00	$ 984.38
8		Mobilization	LS	1	$10,000.00	$ 10,000.00
					Subtotal	**$ 26,127.34**
UNH-Sectional Media Filter						
1		Site Preparation	LS	1	$2,500.00	$ 2,500.00
2		Embankment In-Place	CY	100	$10.00	$ 1,000.00
3		Focal Point System	U	1	$20,000.00	$ 20,000.00
4	603.6	15" CPP	LF	50	$80.00	$ 4,000.00
5		Landscaping	U	1	$2,000.00	$ 2,000.00
6		Ledge Removal	CY	5	$150.00	$ 750.00
7		Mobilization	LS	1	$5,000.00	$ 5,000.00
					Subtotal	**$ 35,250.00**

Sum	$163,170.67
Construction Contingency (10%)	$16,300
Engineering Design & Permitting (10%)	$16,300
Construction Administration/Resident Project Representative (20%)	$32,600
Subtotal	**$65,200**
Budget Estimate Total	**$229,000**

CMA ENGINEERS, Inc.

Civil/Environmental Engineers
35 Bow Street
Portsmouth, NH 03801

PROJECT NAME:	**Lakeview Road**			
PROJECT NO.:	1099			
SHEET NO.:	1	OF	1	
CALCULATED BY:	SJE	DATE:	5/2/2018	
CHECKED BY:	JWB	DATE:	5/2/2018	

Lakeview Road Drainage Improvements
Focalpoint Treatment System Estimate (Option #3)

Item #	NHDOT#	Item Description	U	Quantity	Cost	Item Cost ($)
Drainage Improvements						
1		Site Preparation	LS	1	$5,000.00	$ 5,000.00
2		Embankment In-Place	CY	100	$10.00	$ 1,000.00
3		4' Catch Basins	EA	2	$3,000.00	$ 6,000.00
4		5' Catch Basins	EA	2	$5,000.00	$ 10,000.00
5	604.324	4' Drainage Manhole	EA	1	$3,000.00	$ 3,000.00
6	604.326	5' Drainage Manhole	EA	1	$4,000.00	$ 4,000.00
7	603.6	15" CPP	LF	326	$80.00	$ 26,080.00
8	209.411	Gravel	CY	235	$30.00	$ 7,063.33
9	403.12	Hot Bituminous Pavement-Hand Method	TON	5	$150.00	$ 750.00
10		Ledge Removal	CY	50	$150.00	$ 7,500.00
11		Mobilization	LS	1	$5,000.00	$ 5,000.00
					Subtotal	**$ 75,393.33**
Roadway Improvements-Water Street						
1		Site Preparation	LS	1	$5,000.00	$ 5,000.00
2		Embankment In-Place	CY	100	$10.00	$ 1,000.00
3		Stabilized Base Shim	CY	70	$20.00	$ 1,400.00
4	403.11	Hot Bituminous Pavement-Machine Method	TON	90	$100.00	$ 9,000.00
5		Mobilization	LS	1	$10,000.00	$ 10,000.00
					Subtotal	**$ 26,400.00**
Parking Lot Improvements						
1		Site Preparation	LS	1	$5,000.00	$ 5,000.00
2		Embankment In-Place	CY	100	$10.00	$ 1,000.00
3	606.158	Guardrail	LF	120	$22.50	$ 2,700.00
4		Loam & Seed	CY	42	$45.00	$ 1,890.00
5		Stabilized Base Shim	CY	36	$20.00	$ 722.96
6	403.11	Hot Bituminous Pavement-Machine Method	TON	38	$100.00	$ 3,830.00
7	403.12	Hot Bituminous Pavement-Hand Method	TON	7	$150.00	$ 984.38
8		Mobilization	LS	1	$10,000.00	$ 10,000.00
					Subtotal	**$ 26,127.34**
Focalpoint Treatment System						
1		Site Preparation	LS	1	$2,500.00	$ 2,500.00
2		Embankment In-Place	CY	100	$10.00	$ 1,000.00
3		Focal Point System	SF	450	$200.00	$ 90,000.00
4		Landscaping	U	1	$2,000.00	$ 2,000.00
5	603.6	15" CPP	LF	50	$80.00	$ 4,000.00
6		Mobilization	LS	1	$5,000.00	$ 5,000.00
					Subtotal	**$ 104,500.00**

Sum	$232,420.67
Construction Contingency (10%)	$23,200
Engineering Design & Permitting (10%)	$23,200
Construction Administration/Resident Project Representative (20%)	$46,500
Subtotal	**$92,900**
Budget Estimate Total	**$326,000**

CMA ENGINEERS, Inc.

Civil/Environmental Engineers
35 Bow Street
Portsmouth, NH 03801

PROJECT NAME:	**Lakeview Road**			
PROJECT NO.:	1099			
SHEET NO.:	1	OF	1	
CALCULATED BY:	SJE	DATE:	5/2/2018	
CHECKED BY:	JWB	DATE:	5/2/2018	

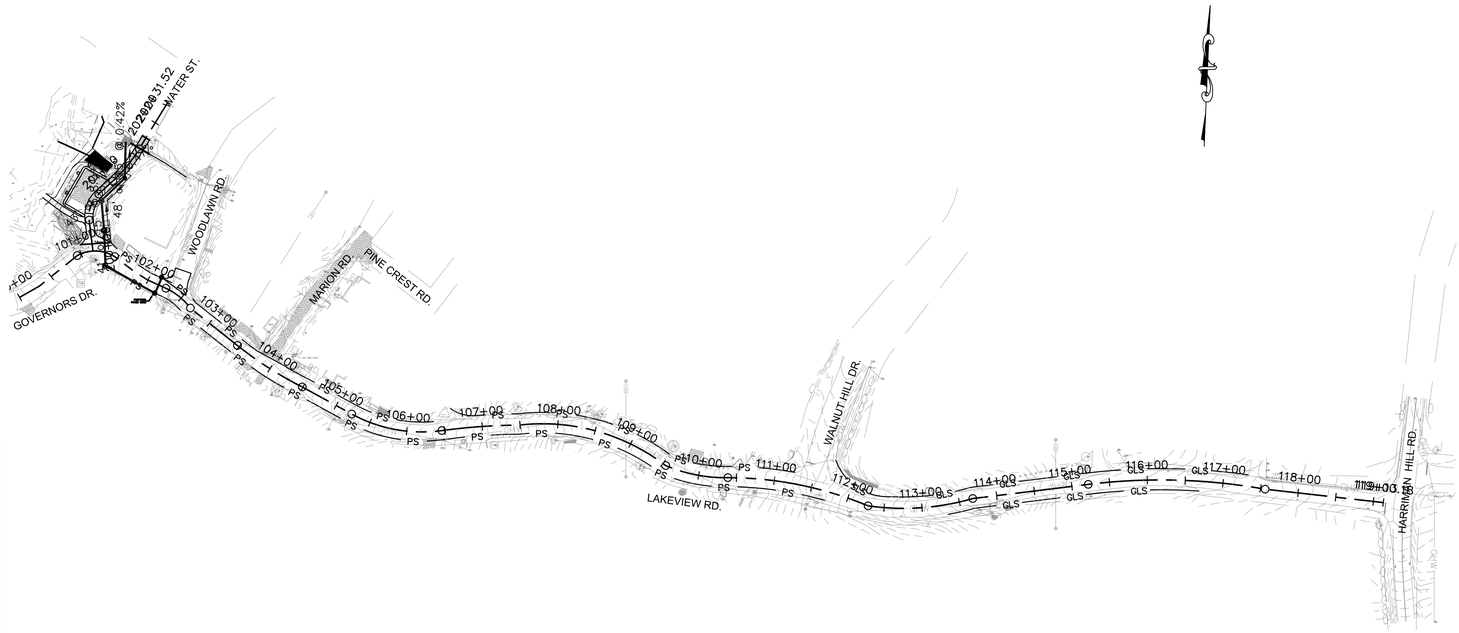
Lakeview Road Drainage Improvements
Level Spreader & Plunge Pool Estimate (Option #4)

Item #	NHDOT#	Item Description	U	Quantity	Cost	Item Cost ($)
Drainage Improvements						
1		Site Preparation	LS	1	$5,000.00	$ 5,000.00
2		Embankment In-Place	CY	100	$10.00	$ 1,000.00
3		4' Catch Basins	EA	2	$3,000.00	$ 6,000.00
4		5' Catch Basins	EA	2	$5,000.00	$ 10,000.00
5	604.324	4' Drainage Manhole	EA	1	$3,000.00	$ 3,000.00
6	604.326	5' Drainage Manhole	EA	1	$4,000.00	$ 4,000.00
7	603.6	15" CPP	LF	326	$80.00	$ 26,080.00
8		Crushed Gravel	CY	235	$30.00	$ 7,063.33
9	403.12	Hot Bituminous Pavement-Hand Method	TON	5	$150.00	$ 750.00
10		Ledge Removal	CY	50	$150.00	$ 7,500.00
11		Mobilization	LS	1	$5,000.00	$ 5,000.00
					Subtotal	**$ 75,393.33**
Roadway Improvements-Water Street						
1		Site Preparation	LS	1	$5,000.00	$ 5,000.00
2		Embankment In-Place	CY	100	$10.00	$ 1,000.00
3		Stabilized Base Shim	CY	70	$20.00	$ 1,400.00
4	403.11	Hot Bituminous Pavement-Machine Method	TON	90	$100.00	$ 9,000.00
5		Mobilization	LS	1	$10,000.00	$ 10,000.00
					Subtotal	**$ 26,400.00**
Parking Lot Improvements						
1		Site Preparation	LS	1	$5,000.00	$ 5,000.00
2		Embankment In-Place	CY	100	$10.00	$ 1,000.00
3	606.158	Guardrail	LF	120	$22.50	$ 2,700.00
		Loam & Seed	CY	42	$45.00	$ 1,890.00
4		Stabilized Base Shim	CY	36	$20.00	$ 722.96
5	403.11	Hot Bituminous Pavement-Machine Method	TON	38	$100.00	$ 3,830.00
6	403.12	Hot Bituminous Pavement-Hand Method	TON	7	$150.00	$ 984.38
7		Mobilization	LS	1	$10,000.00	$ 10,000.00
					Subtotal	**$ 26,127.34**
Level Spreader & Plunge Pool						
1		Site Preparation	LS	1	$2,500.00	$ 2,500.00
2		Embankment In-Place	CY	100	$10.00	$ 1,000.00
3	203.1	Common Excavation	CY	80	$17.00	$ 1,360.00
4		Crushed Stone	CY	4	$30.00	$ 133.33
		Class C Stone	CY	8	$50.00	$ 388.89
		Erosion Control Fabric	SY	222	$5.00	$ 1,111.11
		Loam & Seed	CY	25	$45.00	$ 1,111.11
5	520.01	Concrete Weir	CY	3	$900.00	$ 2,333.33
6		Mobilization	LS	1	$5,000.00	$ 5,000.00
					Subtotal	**$ 14,937.78**

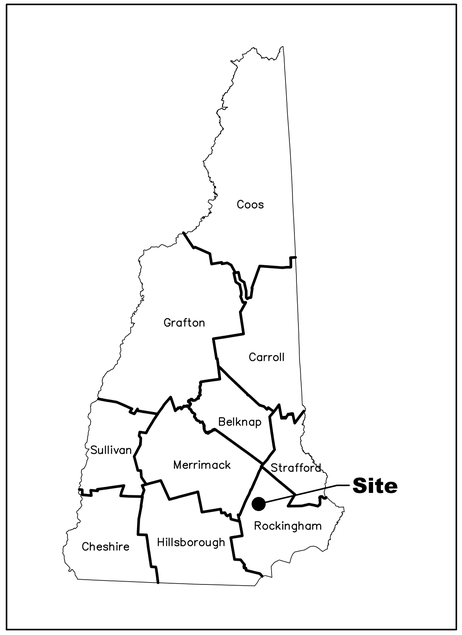
Sum	$142,858.45
Construction Contingency (10%)	$14,300
Engineering Design & Permitting (15%)	$21,400
Construction Administration/Resident Project Representative (20%)	$28,600
Subtotal	**$64,300**
Budget Estimate Total	**$208,000**

Town Of Raymond, New Hampshire
Lakeview Road Drainage Improvements
Preliminary Design
May 2018

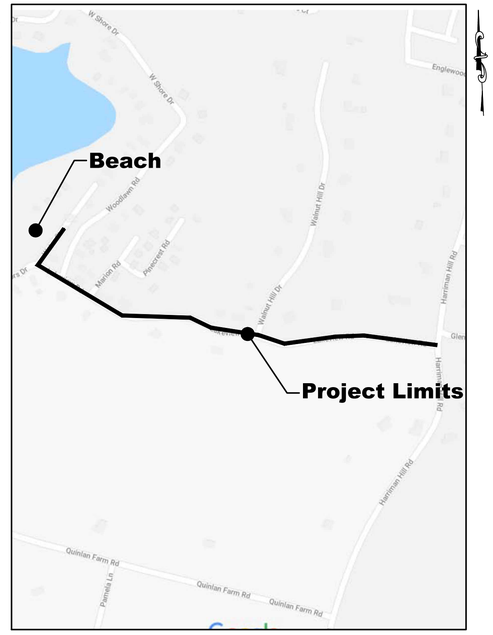
Sheet List Table	
Subset Sheet Number	**Sheet Title**
– –	Cover
EX	
1	Existing Conditions Plan
G	
1	General Plan (1)
2	General Plan (2)
3	General Plan (3)
D	
1	Miscellaneous Details



SITE OVERVIEW
SCALE: 1" = 100'



Locus Plan



Project Location

Prepared For:

Town of Raymond
4 Epping Street
Raymond, NH 03077

Prepared By:

CMA ENGINEERS
CIVIL/ENVIRONMENTAL/STRUCTURAL
Portsmouth, NH 603/431-6196 • Manchester, NH 603/627-0708 • Portland, ME 207/541-4223
cmaengineers.com

Not for Construction

Not for Construction

REFERENCE PLANS

1) PLAN OF TAX MAP 40–3, LOT 178, NO TITLE, DATED 7/24/07, BY DONALD E. DUVAL. NOT RECORDED.

2) "SUBDIVISION SECTION A BRISSE ESTATES, RAYMOND N.H." NOT DATED, NO SURVEYOR INDICATED. R.C.R.D. PLAN 01023–2.

3) "SUBDIVISION SECTION C BRISSE ESTATES, RAYMOND N.H." NOT DATED, NO SURVEYOR INDICATED. R.C.R.D. PLAN 01023–3.

4) "SUBDIVISION SECTION F BRISSE ESTATES, RAYMOND N.H." NOT DATED, NO SURVEYOR INDICATED. R.C.R.D. PLAN 01023–4.

5) "SUBDIVISION SECTIONS A & B BRISSE ESTATES, RAYMOND N.H." NOT DATED, NO SURVEYOR INDICATED. R.C.R.D. PLAN 01023–5.

6) "SUBDIVISION SECTION E BRISSE ESTATES, RAYMOND N.H." NOT DATED, NO SURVEYOR INDICATED. R.C.R.D. PLAN 01480.

7) "DIVIDED LOTS 20–21–22–23 SECTION C BRISSE ESTATES, RAYMOND N.H." FILED OCT 19–1955, NO SURVEYOR INDICATED. R.C.R.D. PLAN 02234.

8) "A PLOT PLAN OF A REVISED SUBDIVISION OF LOTS 13 & 15 BEING PART OF THE SUBDIVISION OF WALNUT HILL PARK SITUATED IN RAYMOND, N.H." DATED AUGUST 8, 1977, BY R.S.L. LAYOUT & DESIGN. R.C.R.D. PLAN C–7218.

9) "A SURVEY OF A SUBDIVISION TO BE KNOWN AS WALNUT HILL PARK II BEING PART OF LOT 41–TAX MAP 8 OWNED BY WALNUT HILL PARK, INC. SITUATED IN RAYMOND, N.H." DATED NOVEMBER 20, 1978, BY WALTER O'NEIL. R.C.R.D. PLAN 8451.

10) "SUBDIVISION OF LAND FOR GLEN BOSWORTH IN RAYMOND, N.H." DATED JUNE 1973, BY PARKER SURVEY ASSOC, INC. R.C.R.D. PLAN D–4092.

11) "A SURVEY OF A SUBDIVISION TO BE KNOWN AS WALNUT HILL PARK BEING PART OF LOT 41–TAX MAP 8 OWNED BY WALNUT HILL PARK, INC SITUATED IN RAYMOND, N.H." DATED APRIL 28, 1975, BY R.S.L. LAYOUT & DESIGN. R.C.R.D. PLAN D–5282.

12) "A PLAT AND REVISION OF A SUBDIVISION TO BE KNOWN AS WALNUT HILL PARK II OWNED BY WALNUT HILL PARK, INC. AND SITUATED IN RAYMOND, N.H." REVISED DATE AUGUST 6, 1980, BY R.S.L. LAYOUT & DESIGN. R.C.R.D. PLAN D–9709.

NOTES:

1. FIELD SURVEY PERFORMED BY P.J.S. & T.M.M. DURING JANUARY 2018 USING A 5603 TOTAL STATION WITH A TRIMBLE TSC3 DATA COLLECTOR AND A SOKKIA B21 AUTO LEVEL. TRAVERSE ADJUSTMENT BASED ON LEAST SQUARE ANALYSIS.
2. JURISDICTIONAL WETLANDS DELINEATED BY WEST ENVIRONMENTAL, INC DURING JANUARY 2018 IN ACCORDING TO THE CORPS OF ENGINEERS WETLAND DELINEATION MANUAL AND THE REGIONAL SUPPLEMENT TO THE CORPS OF ENGINEERS WETLAND DELINEATION MANUAL: NORTHCENTRAL AND NORTHEAST REGION, VERSION 2.0, JANUARY 2012, US ARMY CORPS OF ENGINEERS.
3. HORIZONTAL DATUM BASED ON NEW HAMPSHIRE STATE PLANE(2800) NAD83(2011) DERIVED FROM REDUNDANT GPS OBSERVATIONS UTILIZING THE KEYNET GPS VRS NETWORK.
4. VERTICAL DATUM IS BASED ON APPROXIMATE NAVD88(GEOID12A) (±.2') DERIVED FROM REDUNDANT GPS OBSERVATIONS UTILIZING THE KEYNET GPS VRS NETWORK.
5. PROPER FIELD PROCEDURES WERE FOLLOWED IN ORDER TO GENERATE CONTOURS AT 1' INTERVALS. ANY MODIFICATION OF THIS INTERVAL WILL DIMINISH THE INTEGRITY OF THE DATA, AND DOUCET SURVEY, INC. WILL NOT BE RESPONSIBLE FOR ANY SUCH ALTERATION PERFORMED BY THE USER.
6. UNDERGROUND UTILITIES SHOWN HEREON ARE BASED ON OBSERVABLE PHYSICAL EVIDENCE AND PAINT MARKS FOUND ON–SITE.
7. THE ACCURACY OF MEASURED UTILITY INVERTS AND PIPE SIZES/TYPES IS SUBJECT TO NUMEROUS FIELD CONDITIONS, INCLUDING; THE ABILITY TO MAKE VISUAL OBSERVATIONS, DIRECT ACCESS TO THE VARIOUS ELEMENTS, MANHOLE CONFIGURATION, ETC.
8. ALL ELECTRIC, GAS, TEL. WATER, SEWER AND DRAIN SERVICES ARE SHOWN IN SCHEMATIC FASHION, THEIR LOCATIONS ARE NOT PRECISE OR NECESSARILY ACCURATE. NO WORK WHATSOEVER SHALL BE UNDERTAKEN ON THIS SITE USING THIS PLAN TO LOCATE THE ABOVE SERVICES. CONSULT WITH THE PROPER AUTHORITIES CONCERNED WITH THE SUBJECT SERVICE LOCATIONS FOR INFORMATION REGARDING SUCH. CALL DIG–SAFE AT 1–888–DIG–SAFE.
9. THIS SURVEY WAS PERFORMED IN WINTER CONDITIONS WITH SNOW COVER ON THE GROUND. A SITE CHECK IS RECOMMENDED IN THE SPRING IN ORDER TO ENSURE THE COMPLETENESS/ACCURACY OF THE INFORMATION SHOWN HEREON.
10. THIS SURVEY IS NOT TO BE CONSTRUED AS A BOUNDARY SURVEY. THE APPROXIMATE RIGHT OF WAY WAS BASED UPON A COMBINATION OF RESEARCH OF RECORD PLANS AND CURRENT DEEDS, IN ADDITION TO FIELD LOCATED MONUMENTS. GIS LINES WERE ALSO USED WHERE THERE WAS NO EVIDENCE AVAILABLE. ABUTTER LINES ARE APPROXIMATE.

CMA ENGINEERS
Civil/Environmental/Structural
Portsmouth, NH • Manchester, NH • Portland, ME
603/431-6196 • 603/627-0708 • 207/541-4223
cmaengineers.com

PRELIMINARY DESIGN

designed by: JWB	drawn by: JWB/SJE	approved by: CNM	scale: 0 20' 40' Scale: 1" = 20'
date: May 2018	project no: 1099	file name: 1099-ECP.dwg	

Town of Raymond, New Hampshire
Department of Public Works
Lakeview Road
Drainage Improvements
Existing Conditions Plan

drawing no. EX-1

sheet: 2 of 6

no.	revision	date	by

GOVERNORS LAKE

107 SIXTH AVENUE
MANCHESTER, NH 03104
R.C.R.D. BOOK 4321, PAGE 193

TAX MAP 40-3, LOT 18
TOWN OF RAYMOND
4 EPPING STREET
RAYMOND, NH 03077
R.C.R.D. BOOK 2505, PAGE 1193

TAX MAP 40-3, LOT 17
TOWN OF RAYMOND
4 EPPING STREET
RAYMOND, NH 03077
R.C.R.D. BOOK 2343, PAGE 1151

TAX MAP 40-3, LOT 16
MICHAEL K. & SUSAN M. SORKIN
3 GOVERNORS DRIVE
RAYMOND, NH 03077
R.C.R.D. BOOK 5795, PAGE 585

TAX MAP 40-3, LOT 25
KENNETH L. JR. MATTEAU
8 WOODLAWN ROAD
RAYMOND, NH 03077
R.C.R.D. BOOK 4957, PAGE 2632

TAX MAP 40-3, LOT 24
MICHAEL W. & DEBRA HAGGSTROM
6 WOODLAWN ROAD
RAYMOND, NH 03077
R.C.R.D. BOOK 5817, PAGE 147

TAX MAP 40-3, LOT 81
JOSEPH A. CALIRI
P.O. BOX 903
RAYMOND, NH 03077
R.C.R.D. BOOK 2794, PAGE 1368

TAX MAP 40-3, LOT 23
ROBERT F. & PATRICIA SCOLEDGE
27 LAKEVIEW ROAD
RAYMOND, NH 03077
R.C.R.D. BOOK 2423, PAGE 867

TAX MAP 40-3, LOT 82
DEBORAH J. CROTEAU
3 WOODLAWN ROAD
RAYMOND, NH 03077
R.C.R.D. BOOK 3732, PAGE 1644

TAX MAP 40-3, LOT 83
THOMAS A. MCKEON
59 SCRABBLE ROAD
BRENTWOOD, NH 03833-6023
R.C.R.D. BOOK 4807, PAGE 580

TAX MAP 40-3, LOT 84
JUDITH MAINS
23 LAKEVIEW ROAD
RAYMOND, NH 03077
R.C.R.D. BOOK 2979, PAGE 2514

TAX MAP 40-3, LOT 85
BROWN FAMILY REVOCABLE TRUST OF
IRENE H. BROWN, TRUSTEE
5 WOOD STREET
SOUTHBOROUGH, MA 01772
R.C.R.D. BOOK 5363, PAGE 258

TAX MAP 40-3, LOT 99
JOSE & ESMERALDA DASILVA
13 BLUEBERRY LANE
HUDSON, NH 03051
R.C.R.D. BOOK 5098, PAGE 1821

TAX MAP 40-3, LOT 100

TAX MAP 40-3, LOT 101
JANICE L. MCCABE &
EDWARD J. CARTON
29 HARRIMAN ROAD
RAYMOND, NH 03077
R.C.R.D. BOOK 2794, PAGE 2350

TAX MAP 40-3, LOT 102
SERGE J. & KATHLEEN EVANGELISTA
20415 MIDWAY BLVD.
PORT CHARLOTTE, FL 33952-4038
R.C.R.D. BOOK 3304, PAGE 885

TAX MAP 40-3, LOT 178
CAPLETTE FAMILY REVOCABLE TRUST
RICHARD M. & NANCY E. CAPLETTE, TRUSTEES
26 LAKEVIEW ROAD
RAYMOND, NH 03077
R.C.R.D. BOOK 5767, PAGE 2284

TAX MAP 40-3, LOT 179
CAPLETTE FAMILY REVOCABLE TRUST
RICHARD M. & NANCY E. CAPLETTE, TRUSTEES
26 LAKEVIEW ROAD
RAYMOND, NH 03077
R.C.R.D. BOOK 5791, PAGE 1497

TAX MAP 40-3, LOT 177
KEVIN LAMONTAGNE
24 LAKEVIEW ROAD
RAYMOND, NH 03077
R.C.R.D. BOOK 5209, PAGE 2307

TAX MAP 34, LOT 48
HARRY C. & SALLY E. RICHARD
62 HARRIMAN HILL ROAD
RAYMOND, NH 03077
R.C.R.D. BOOK 2305, PAGE 1670

TAX MAP 40-3, LOT 176
IAN JEWETT
22 LAKEVIEW ROAD
RAYMOND, NH 03077
R.C.R.D. BOOK 4970, PAGE 665

PROPOSED 35' LONG LEVEL SPREADER
PROPOSED STONE PLUNGE POOL
PROPOSED FOCALPOINT STORMWATER TREATMENT DEVICE
PROPOSED DISCHARGE PIPE FOR FOCALPOINT
PROPOSED GUARDRAIL
PROPOSED PARKING LOT IMPROVEMENTS
PROPOSED PATH
END ROAD IMPROVEMENTS
PROPOSED 15" CPP
PROPOSED STONE-LINED SWALE
PROPOSED PAVED APRON MAINTAIN PAVED SWALE ACROSS INTERSECTION
PROPOSED PAVED BERM
BEGIN ROADWAY IMPROVEMENTS
STATION 101+40, LT START PAVED SWALE
STATION 200+21, LT END PAVED SWALE
DMH1
DMH2
CB1
CB2
CB3
CB4
CB 2812
RIM ELEV.=286.0'
(OUTFALL) 18" RCP INV.=282.5'
CB 2818
RIM ELEV.=286.4'
(OUTFALL) 8" PVC INV.=284.1'
CB 2729
RIM ELEV.=299.8'
(OUTFALL) 12" CMP INV.=297.9'
CBR 2901
RIM ELEV.=294.8'
(OUTFALL) 15" CMP INV.=292.6'
279.5 +
WATER STREET
WOODLAWN ROAD
LAKEVIEW ROAD
GOVERNORS DRIVE
MARION ROAD
PINE CREST ROAD
TBM 5395F
MAG NAIL SET UP "
IN POLE PSNH/32/1/361/11
ELEV.=286.24'

LEGEND

EXISTING

- APPROXIMATE ABUTTERS LOT LINE
- APPROXIMATE EXISTING RIGHT OF WAY
- STONE WALL
- BOX WIRE FENCE
- PICKET FENCE
- ELECTRIC FENCE
- CHAIN LINK FENCE
- GUARDRAIL
- OHW — OVERHEAD WIRE
- D — DRAIN LINE
- MAJOR CONTOUR LINE
- MINOR CONTOUR LINE
- TREE LINE
- SHRUB LINE
- EDGE OF WETLAND
- STREAM
- CONCRETE
- RIP RAP
- LANDSCAPED AREA
- GRAVEL
- UTILITY POLE
- UTILITY POLE & GUY WIRE
- UTILITY POLE W/LIGHT
- SIGN
- BOUND FOUND
- IRON PIPE/ROD FOUND
- FENCE POST
- POST
- W — WELL
- VENT PIPE
- ROOF DRAIN
- ELECTRIC METER
- CATCH BASIN
- WETLAND AREA
- FLAG POLE
- TREE STUMP
- DECIDUOUS TREE
- DECIDUOUS BUSH
- ROCK/BOULDER
- LEDGE OUTCROP

TYP.	TYPICAL
BND. FND.	BOUND FOUND
I.P.F.	IRON PIPE FOUND
CONC.	CONCRETE
GRAN.	GRANITE
HDWL	HEADWALL
EP	EDGE OF PAVEMENT
SWL	SINGLE WHITE LINE
DYL	DOUBLE YELLOW LINE
EM	ELECTRIC METER
S.S.F.	STEEL STAKE FOUND

PROPOSED

- GLS — GRASS LINED SWALE
- PS — PAVED SWALE
- SLS — STONE LINED SWALE
- SILT FENCE
- GUARDRAIL
- SLOPE LINE
- EDGE OF PAVEMENT
- PD — DRAIN
- DIVERSION PIPE
- DRAIN LINE
- CENTERLINE

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no.	revision	date	by

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PRELIMINARY DESIGN

designed by:	drawn by:	approved by:	scale:
JWB	JWB/SJE	CNM	1" = 20'

date:	project no:	file name:
May 2018	1099	1099-Gen Plan.dwg

Town of Raymond, New Hampshire
Department of Public Works

Lakeview Road
Drainage Improvements

General Plan (1)

drawing no.
G-1

sheet: 3 of 6

F:\CADD\PROJECTS\1099-Lakeview Road\Production\1099-Gen Plan.dwg Date Plotted: May 02, 2018 - 12:11pm Plotted By: SEHRMENTRAUT

MARION ROAD
TAX MAP 40-3, LOT 100
TAX MAP 40-3, LOT 101
JANICE L. MCCABE &
EDWARD J. CARTON
29 HARRIMAN ROAD
RAYMOND, NH 03077
R.C.R.D. BOOK 2794, PAGE 2350
TAX MAP 40-3, LOT 102
SERGE J. & KATHLEEN EVANGELISTA
20415 MIDWAY BLVD.
PORT CHARLOTTE, FL 33952-4038
R.C.R.D. BOOK 3304, PAGE 885
TAX MAP 40-3, LOT 105
DAVID R. & SANDRA L. WATERMAN
4 WALNUT HILL DRIVE
RAYMOND, NH 03077
R.C.R.D. BOOK 2871, PAGE 133
TBM 5395D
MAG NAIL SET UP 6"
IN POLE 6/NET&T
ELEV.=347.83'
STATION 106+61, LT
START PAVED SWALE
STATION 106+38, LT
END PAVED SWALE
LAKEVIEW ROAD
104+00
105+00
106+00
107+00
108+00
109+00
REPLACE
TAX MAP 40-3, LOT 175
MONICA L. CYR
P.O. BOX 245
RAYMOND, NH 03077
R.C.R.D. BOOK 5071, PAGE 2428
TBM 5395E
MAG NAIL SET UP 6"
IN POLE PSNH/31/8
ELEV.=323.40'
TAX MAP 34, LOT 48
HARRY C. & SALLY E. RICHARD
62 HARRIMAN HILL ROAD
RAYMOND, NH 03077
R.C.R.D. BOOK 2305, PAGE 1670
TAX MAP 40-3, LOT 174
PAUL H. & PATRICIA A. SHINER
P.O. BOX 796
RAYMOND, NH 03077
R.C.R.D. BOOK 3329, PAGE 538
TAX MAP 40-3, LOT 103
WILLIAM J. & DONNA M. CYR
11 LAKEVIEW ROAD
RAYMOND, NH 03077
R.C.R.D. BOOK 2565, PAGE 967
TAX MAP 40-3, LOT 104
JOSEPH P. & SUSAN M. ROWE
P.O. BOX 795
RAYMOND, NH 03077
R.C.R.D. BOOK 2384, PAGE 773
WALNUT HILL DRIVE
REPLACE
STATION 111+25, LT
END PAVED SWALE
STATION 111+79, LT
START STONE LINED SWALE
TAX MAP 40-3, LOT 118
MARK T. FERA
832 LILAC LANE
DOVER, NH 03820
R.C.R.D. BOOK 4939, PAGE 449
110+00
111+00
112+00
113+00
114+00
115+00
LAKEVIEW ROAD
GRADE TO DRAIN
STATION 111+79, LT
END PAVED SWALE
TBM 5395C
MAG NAIL SET UP 6"
IN POLE 25T/PSNH
ELEV.=371.01'
TBM 5395B
MAG NAIL SET UP 6"
IN POLE 3/NET&T/31/3
ELEV.=387.42'
STATION 113+33, LT
START GRASSED LINED SWALE
TAX MAP 40-3, LOT 173
HARRY C. JR. RICHARD & ROBIN M. NUDD
12 LAKEVIEW ROAD
RAYMOND, NH 03077
R.C.R.D. BOOK 5023, PAGE 1548
R.C.R.D. BOOK 2693, PAGE 2367
TAX MAP 34, LOT 48
HARRY C. & SALLY E. RICHARD
62 HARRIMAN HILL ROAD
RAYMOND, NH 03077
R.C.R.D. BOOK 2305, PAGE 1670
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PRELIMINARY DESIGN

designed by: JWB
drawn by: JWB/SJE
approved by: CNM
date: May 2018
project no: 1099
file name: 1099-Gen Plan.dwg
scale: 1" = 20'

Town of Raymond, New Hampshire
Department of Public Works
Lakeview Road
Drainage Improvements
General Plan (2)

drawing no. G-2
sheet: 4 of 6

F:\CADD\PROJECTS\1099-Lakeview Road\Production\1099-Gen Plan.dwg Date Plotted: May 02, 2018 - 12:12pm Plotted By: SEHRMENTRAUT

TAX MAP 40-3, LOT 117
GARY CORBETT
3 LAKEVIEW ROAD
RAYMOND, NH 03077
R.C.R.D. BOOK 4208, PAGE 490

TAX MAP 40-3, LOT 119
JEFFREY D. & SAMANTHA A. OGLESBY
1 LAKEVIEW ROAD
RAYMOND, NH 03077
R.C.R.D. BOOK 5841, PAGE 1517

TAX MAP 40-3
MICHAEL C. &
P.O. BOX 3
RAYMOND, NH
R.C.R.D. BOOK

HARRIMAN HILL ROAD

GLENN RIDGE

LAKEVIEW ROAD

STATION 117+31, LT
END GRASS LINED SWALE

TBM 5.395A
MAG NAIL SET UP 6"
IN POLE PSNH/3/1/361/1/NET&T
ELEV.=394.65'

STATION 116+69, LT
END GRASS LINED SWALE

GRADE TO DRAIN

115+00
116+00
117+00
118+00
119+00
119+13.18

-4.47%

SHEET 3
SHEET 2

3" SPLIT RAIL FENCE
5/8" REBAR FLUSH 13" W/CAP

LIMITS OF SNOW/ICE

CONC. BLOCK RET. WALL

STOP
GLEN RIDGE RD

STOP
LAKEVIEW RD

PSNH/13/41/361

ORNAMENTAL SW

TAX MAP 34, L
RONALD J. LAF
DONNA L. BRE
65 HARRIMAN
RAYMOND, NH
R.C.R.D. BOOK

TAX MAP 34, LOT 48
HARRY C. & SALLY E. RICHARD
62 HARRIMAN HILL ROAD
RAYMOND, NH 03077
R.C.R.D. BOOK 2305, PAGE 1670

395B
AIL SET UP 6"
E 3/NET&T/31/3
387.42'

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PRELIMINARY DESIGN

designed by: JWB
drawn by: JWB/SJE
approved by: CNM
scale: 1" = 20'
Scale: 1" = 20'
0 20' 40'

date: May 2018
project no: 1099
file name: 1099-Gen Plan.dwg

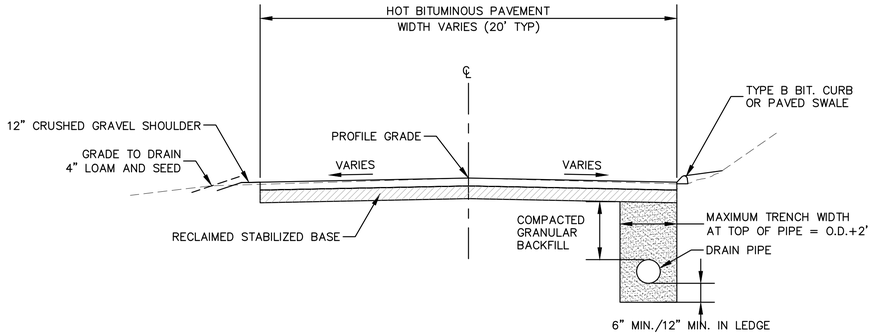
Town of Raymond, New Hampshire
Department of Public Works

Lakeview Road
Drainage Improvements

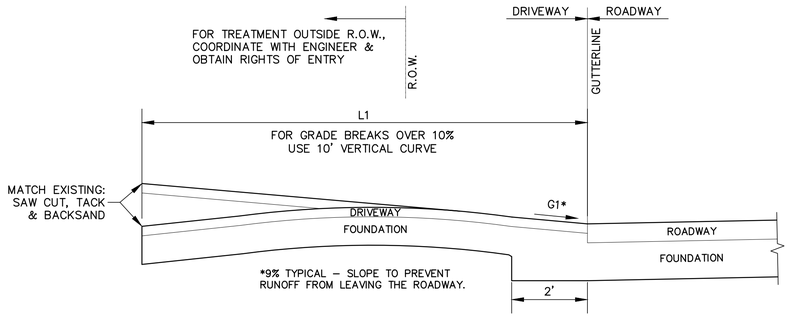
General Plan (3)

drawing no. G-3

sheet: 5 of 6



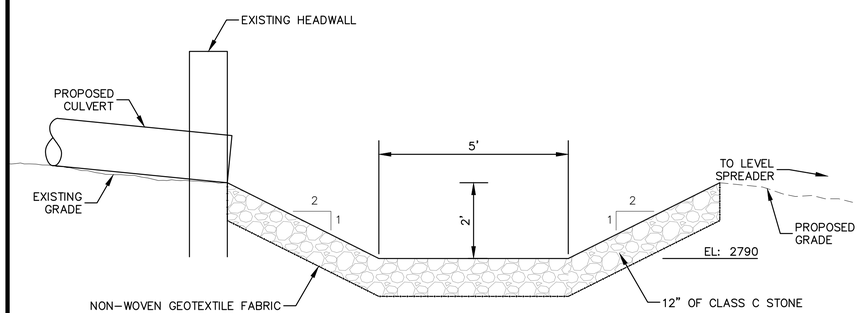
TYPICAL ROAD SECTION
NOT TO SCALE



NOTES:
1. IF THE ALGEBRAIC DIFFERENCE BETWEEN TWO ADJACENT GRADES EXCEEDS 10%, PROVIDE A 10' VERTICAL CURVE TRANSITION.
2. CURBING CAN BE FLARED TO FIT DRIVE RADII IF APPROPRIATE OR ENDED AS DETAILED ABOVE.
3. FOR UNPAVED DRIVES, THE PAVED APRON NORMALLY ENDS AT THE RADIUS TANGENT POINT.

DRIVEWAY DETAIL
NOT TO SCALE

NHDOT
OVER



PLUNGE POOL DETAIL
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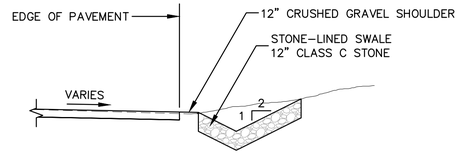
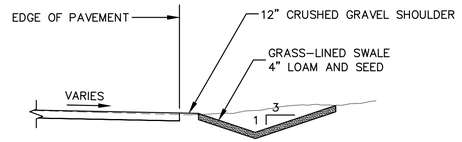


ROADSIDE STONE-LINED SWALE DETAIL
NOT TO SCALE



ROADSIDE GRASS-LINED SWALE DETAIL
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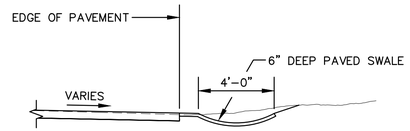
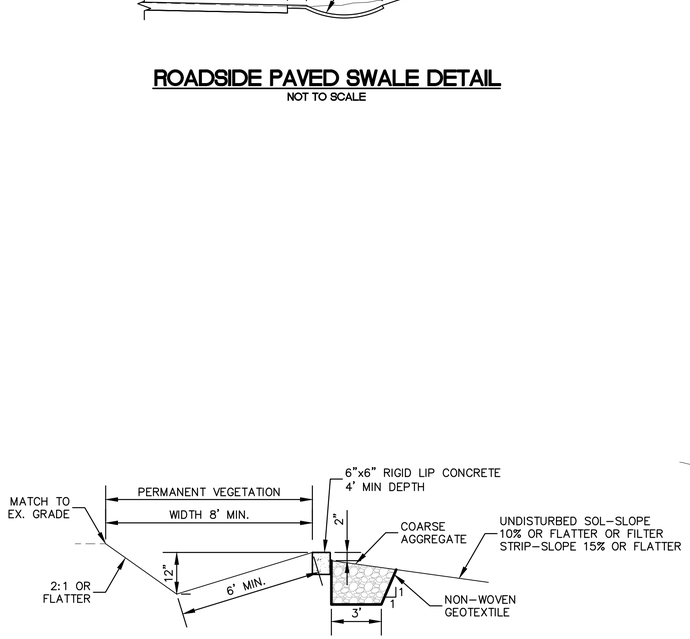
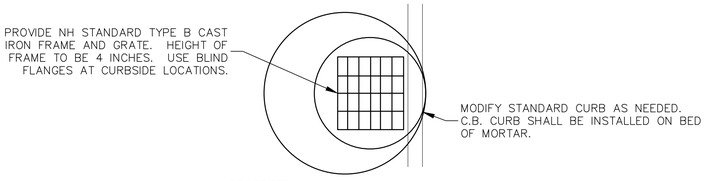


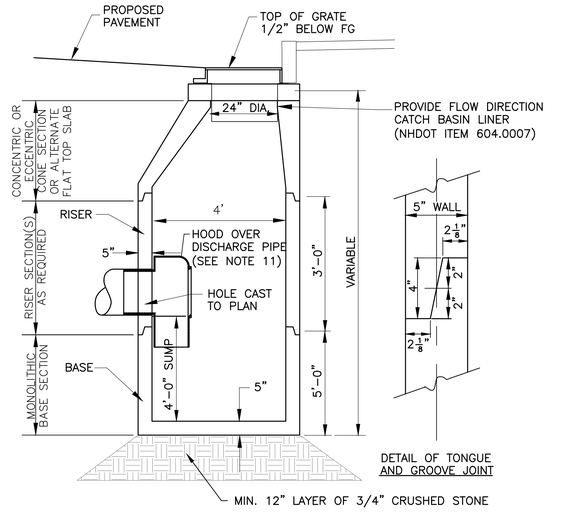
ROADSIDE PAVED SWALE DETAIL
NOT TO SCALE



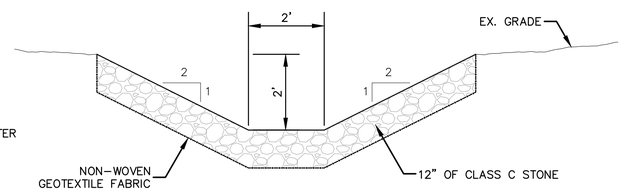
RIGID LIP WITH TIMBER
(DESIGN FLOWS 4 C.F.S. TO 30 C.F.S.)

LEVEL SPREADER DETAIL
NOT TO SCALE





DEEP SUMP CATCH BASIN DETAIL
NOT TO SCALE



STONE-LINED SWALE DETAIL
NOT TO SCALE

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Department of Public Works
Lakeview Road
Drainage Improvements
Miscellaneous Details

drawing no. D-1
sheet: 6 of 6