ENGINEERING VENTURES PC

208 Flynn Avenue, Suite 2A, Burlington, VT 05401 · Tel: 802-863-6225 · Fax: 802-863-6306
85 Mechanic Street, Suite B2-2, Lebanon, NH 03766 · Tel: 603-442-9333 · Fax: 603-442-9331
414 Union Street, Schenectady, NY · Tel: 518-630-9614

Stormwater & Erosion Control Narrative
Proposed Subdivision - Laster Property - Preliminary Plat Submittal

The attached plans and narrative below are in support of the preliminary plat subdivision application to the Town of Hinesburg Development Review Board for the above referenced project. Relevant excerpts from Section 6.6 of the Hinesburg Subdivision Regulations are shown in italics followed by responses:

6.6.1 Erosion Control

(1) Erosion control requirements shall apply to land development that requires a zoning permit or DRB approval, within the disturbance guidelines listed below. For such projects all areas exposed during construction shall be protected from erosion in accordance with the Low Risk Site Handbook for Erosion Prevention and Sediment Control published by the Vermont Department of Environmental Conservation (most current version, original edition is circa 2006), as qualified below.

(a) If the total disturbance area is 3,000-10,000 square feet – follow requirements 1,2,4,6,8-12. Requirement #8 requires stabilization of disturbed areas within 7, 14, or 21 days of initial disturbance, followed by stabilization at the end of each work day with certain exceptions. For the purposes of these regulations, the initial time period shall be 14 days.

(b) If the total disturbance area is greater than 10,000 square feet – follow all twelve requirements (see below for information on requirement #7 – i.e., permanent stormwater controls). Requirement #8 requires stabilization of disturbed areas within 7, 14, or 21 days of initial disturbance, followed by stabilization at the end of each work day with certain exceptions. For the purposes of these regulations, the initial time period shall be 14 days.

> Total earth disturbance for the project is estimated as ±1.8-ac or ±78,400-sf.
> The practices outlined in the Vermont DEC Low Risk Site Handbook for Erosion Prevention and Sediment Control are depicted and described on the Erosion Prevention and Sediment Control Plan and Erosion Prevention and Sediment Control Detail Sheets.

(2) Proper erosion control measures shall also be applied to off-site locations that receive soil or fill from the project in question.

> No offsite areas are anticipated to receive fill from the project site.

(3) An erosion control plan (diagram and supporting narrative) shall be submitted with the zoning permit application or DRB application if any of the following apply.

(a) If there is to be any disturbance with slopes of 15% or steeper.

> The project will disturb an estimated 4,650-sf or 0.11-ac of land on slopes 15% or greater.

(b) If there is to be any disturbance within Town designated stream setback and/or buffer areas.

The project largely avoids impact to Town designated stream setbacks. The project proposes disturbance to 720-sf of the stream setback along the Mechanicsville Road right of way. This temporary disturbance includes 200-sf for installation of the gravel wetland treatment area discharge pipe and 524-sf to restore the existing gravel drive to meadow.

(c) If there is to be any disturbance to a channel, ditch or other concentrated stormwater conveyance.

The proposed access drive extending off Mechanicsville Road is positioned roughly at the high point. Only minor earth disturbances are proposed within the portion of the existing roadside ditch which are limited to construction of the new intersection, regrading to direct runoff both north and south as well as the improvements noted above.

(d) If the total area of disturbance is 10,000 square feet or greater.

Total earth disturbance for the project is estimated as ±1.8-ac or ±78,400-sf.

(4) It is the applicant's responsibility to demonstrate that the plan will adequately control erosion, and has, at a minimum, been prepared in accordance with the Low Risk Site Handbook for Erosion Prevention and Sediment Control. Additional measures from the Vermont Standards & Specifications for Erosion Prevention and Sediment Control (most current version, current edition is circa 2006) may be necessary for sites that are not low risk per the categories outlined in the State of Vermont's construction general permit.

An ANR construction general permit will be required for this project with earth disturbance estimated as ±1.8-ac, over the 1-ac threshold for requiring a permit. The project qualifies as Low Risk.

6.6.2 Stormwater Control

A stormwater control plan (diagram and supporting narrative) shall be submitted for any land development that requires a zoning permit or DRB approval, and which creates new impervious surface area of 10,000 square feet or more. The calculation of new impervious surface area may be offset through the removal of existing impervious surface in other areas of the site. Such an offset shall be calculated on a 1:1 area basis – new impervious vs. existing impervious removed. Such an offset shall be contingent on substantially better stormwater infiltration for the area where existing impervious surfaces were removed. This may require the replacement of sub-base material in addition to surface materials. The stormwater control plan shall be prepared by a qualified, licensed engineer, and shall include a certification by the engineer that the plan conforms to the following five provisions:

(1) The latest version of the Vermont Stormwater Management Manual:

- *Water Quality Treatment Standard*
- *Channel Protection Treatment Standard*
- *Groundwater Recharge Treatment Standard*
- *Overbank Flood Protection Treatment Standard*
- *Extreme Flood Protection Treatment Standard*

Credits and waivers indicated in the Vermont Stormwater Management Manual may be used to partly or wholly meet these standards. Evidence of an approved State stormwater permit using the standards

contained in the latest version of the manual will constitute compliance with the VT Stormwater Management standards listed above (e.g., water quality, channel protection, groundwater recharge, overbank flood protection, extreme flood protection). A State stormwater permit approved under an earlier version of the manual shall not constitute compliance with the five standards listed above - i.e., compliance with the latest version of the Vermont Stormwater Management Manual must be demonstrated.

Existing on site impervious is limited to the existing gravel access drive at the southwest corner of the property. This 524-sf or 0.01-ac are is proposed to be eliminated by means of restoring the area to meadow. The development proposes 1.68-ac of new impervious surface which includes the new paved roadway, paved multi-use path, gravel turnaround and individual lot coverage.

- Water Quality Treatment Standard will be met through installation of (2) gravel wetland treatment areas. Adequate storage of the calculated water quality volume is demonstrated in the modeling attachment included at the end of this report.
- Channel Protection Treatment Standard will be met through extended detention within the (2) gravel wetland treatment areas. Detention time has been maximized through containing channel protection volume between the minimum 1" diameter control orifice and the bypass orifice, as demonstrated in the modeling attachment.
- Groundwater Recharge Treatment Standard will be waived as on-site soils within the project area are mapped as Hydrologic Soil Group D.
- Overbank Flood Protection Treatment Standard will be met through extended detention within the (2) gravel wetland treatment areas. Post development peak flow rates are reduced from the pre development condition, as demonstrated in the modeling attachment.
- Extreme Flood Protection Treatment Standard will be waived as impervious surface totals are less than 10-acres.

(2) The plan shall locate soils well suited for infiltration, and address the extent to which such soils will be utilized to infiltrate stormwater.

Project site soils are mapped as Hydrologic Soil Group D, not well suited for infiltration. Furthermore, the presence of Class II Wetland and buffer areas indicates shallow depth to seasonal high water table further restricting the ability for runoff to infiltrate.

(3) Post-development drainage patterns shall mimic (except as noted below) pre-development drainage patterns to the greatest extent possible, especially with regard to where stormwater leaves the site. The post-development drainage pattern shall improve upon (rather than mimic) the pre-development drainage conditions if those conditions already contribute to deleterious stormwater runoff impacts. The stormwater plan shall be designed so that off-site drainage areas will not be overwhelmed during larger storm events (i.e., up to and including a 100-year storm) to a greater extent than in pre-development conditions. The evaluation shall demonstrate that off-site areas will not be subject to increased erosion during a 10-year storm event, and will not otherwise be adversely impacted during a 10-year and a 100-year storm event. The off-site areas to be evaluated shall include:
(a) The area between identifiable stormwater discharge points from the site and the receiving water body (e.g., stream, river, lake) at a point along the water body where the site's drainage area constitutes less than 10% of the water body's drainage area at that location.

(b) Should the receiving water body be distant from the site discharge points, the evaluation shall extend as far off site as necessary to reach a point where the site's drainage area constitutes less than 10% of the surrounding drainage area.
(4) Once completed, all such stormwater systems shall be certified as installed per the plan by a qualified, licensed engineer. The plan shall include clear provisions for inspection and long term maintenance by a qualified professional.
(5) Low Impact Development (LID). The use of LID design approaches shall be implemented, taking into consideration the site's soil characteristics, slope, and other relevant factors. To the extent that LID design approaches are not proposed in the stormwater management plan, the applicant shall provide a full justification and demonstrate why the use of LID approaches is not possible. See the Definitions section for an explanation of Low Impact Development.

Project Overview & Basis of Design- The project proposes creation of (8) new residential housing lots. The new roadway, multi-use path and impervious lot coverage will add more than 5,000-sf of new impervious surface, triggering the need for an ANR Operational Stormwater Permit. The project will result in over 1-ac of earth disturbance which will requires coverage under the ANR Construction General Permit.

Site Areas Summary		
Project Area	5.62	acres
Project Earth Disturbace	1.80	acres
New Impervious	1.68	acres

The drainage analysis is based on the estimated 5.62-acres of development area which includes areas proposed to be altered between the predevelopment and post development condition, including the added impervious resulting from the individual residential lot development. Impervious coverage for proposed Lots 1 and 2 has been estimated as 0.09-ac and 0.08-ac respectively, or 11% and 20% impervious. Based on this, Lots 3-8 are assumed to be 35% impervious for the purpose of the stormwater design. The proposed lot coverage calculation is summarized on the Post Development Drainage Area Map.

The erosion prevention and sediment control plan is based on the project earth disturbance, estimated as 1.80-ac. This area generally includes work within the proposed road right of way and associated grading disturbance. This does not include the development of individual lots.

Pre Development (Existing) Condition - The existing site is an undeveloped parcel roughly 102-acres in size. The project area consists mainly of meadow and delineated Class II and Class III wetland and buffer areas constrained to the north by a stream and stream buffer.

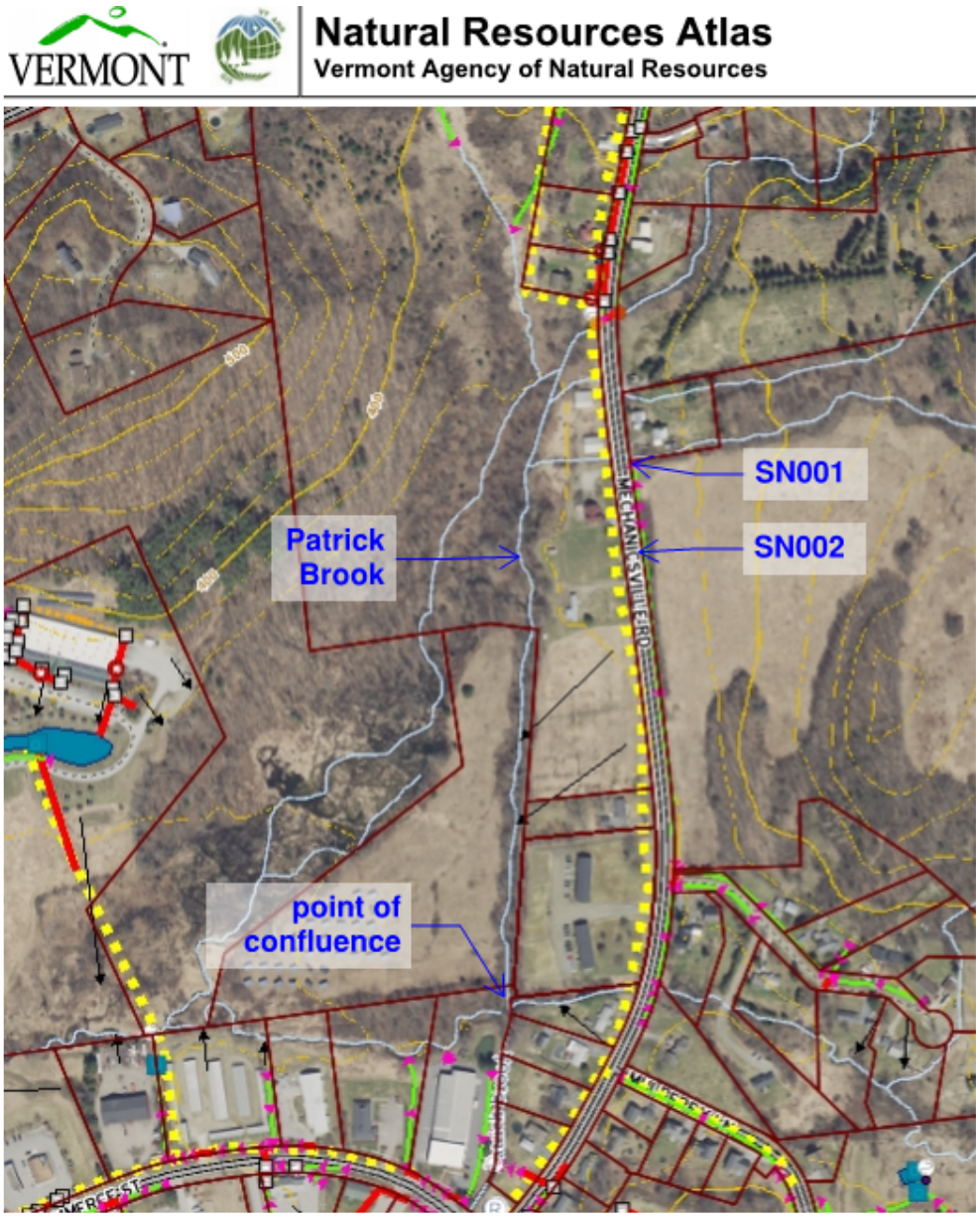
The project site is within the Lake Champlain Watershed and ultimately discharges to the Shelburne Bay Segment. Immediate receiving waters for each discharge point are as noted below, which diverge in Patrick Brook roughly a quarter mile south west of the project site. The site discharge points are identified and described as follows and depicted on the following page:

- SN001 – Unnamed tributary of Patrick Brook
  Roughly 60% of the development area drains to an unnamed tributary of Patrick Brook which runs along the norther edge of the project parcel. The unnamed tributary flows

beneath Mechanicsville Road via an existing culvert located at the northwest corner of the property, continues east approximately 210-ft to discharge to Patrick Brook.

- SN002 – Unnamed wetland tributary to Patrick Brook
  The remaining 40% of the development area drains to a delineated class II wetland area (identified as wetland i) with associated 50-ft buffer. Existing topography indicates the wetland discharges to the roadside swale flowing south along the east edge of Mechanicsville Road for approximately 1,300-ft before crossing beneath the road. Flow continues east about 350-ft to discharge to Patrick Brook.

Soils underlying the development area are mapped primarily as Munson and Raynham silt loams classified as hydrological soil group (HSG) D with surrounding areas mapped as Peru fine sandy loam (HSG C/D) and Scantic silt loam (HSG C/D). Predevelopment slopes average between 12% and 16%.



Post Development Condition – As noted the project will result in 1.68-acres of new impervious surface which will be permitted with the Vermont DEC Agency of Natural Resources. Two gravel wetland treatment areas have been designed in conformance with the Vermont Stormwater Management Manual.

Existing site constraints present challenges for maintaining existing drainage patterns. With the proposed development sloping up from Mechanicsville Road along with the presence of natural wetlands and stream buffers, there is little opportunity for siting stormwater treatment areas at the low point of the development area. What area is available has been used for siting gravel wetland treatment area #1 which will treat runoff from Lots 1 and 2 and the lower portion of the right of way. The capacity of the treatment area has been maximized to prevent disturbance to the nearby Class II Wetland buffer.

Remaining impervious flow to gravel wetland treatment area #2 which is situated nearly half way up the access drive. The treatment area is narrow and extends south from the right of way, running along the existing contours to accommodate grade change across the site. Gravel wetland area #2 has been sized to provide treatment for the remaining developed areas.

Because of the limitations at the west end of the site, the two drainage areas do see some modification between the pre and post development condition. Despite this, treatment and peak flow reductions are met with the two treatment areas. The table below summarizes the changes to the drainage areas and peak flow reduction for the 1-year, 10-year and 100-year storm events.

	SN001 (north discharge)					
	Predevelopment		Post Development		Delta	
Drainage Area	4.38	ac	2.47	ac	-1.91	ac
1-YR Peak	3.06	cfs	1.63	cfs	-1.43	cfs
10-YR Peak	10.11	cfs	7.24	cfs	-2.87	cfs
100-YR Peak	19.88	cfs	14.23	cfs	-5.65	cfs
	SN002 (south discharge)					
	Predevelopment		Post Development		Delta	
Drainage Area	1.46	ac	3.37	ac	1.91	ac
1-YR Peak	1.07	cfs	0.21	cfs	-0.86	cfs
10-YR Peak	3.51	cfs	1.88	cfs	-1.63	cfs
100-YR Peak	6.88	cfs	6.79	cfs	-0.09	cfs

Refer to the hydrologic modeling attachments and drainage area maps for additional information.

EX. HEADWALL
18" CMP INV 364.87
EX. STORM MH
RIM 370.95
EX. 36" CMP
INV OUT 367.31
EX. SEWER MH
RIM 367.46
EX. CATCH BASIN
RIM 370.19
EX. 18" CMP
INV 367.23
CMP35
EX. 18" CMP
INV 366.42
18" CMP
POI#1
CMP34
MBX6.1S
30MPH AHEAD SIGN
POI#2
CMP33
EX. SEWER MH
RIM 369.08
EX. CATCH BASIN
RIM 369.08
MBX6.0SE
CMP32-01
CMP32
ELEC PED
TBM NAIL IN POWER POLE
CMP31
RADAR SIGN
EX. SEWER MH
RIM 363.42
EX. STORM MH
RIM 364.90
EX. CATCH BASIN
RIM 364.28
CMP30
CTC 2 VT2 20
CMP31
POST
30MPH SIGN
EX. CATCH BASIN
RIM 361.52
EX. STORM MH
RIM 363.02
CTC 2 19
35MPH
SIGN
POST
SIGN
CMP28
4-FT POLE W
BURIED TELE.
CABLE
MECHANICSVILLE ROAD
EX. CLASS II WETLAND
WETLAND H
0.25-AC
LOWER SWAMP
50-FT CLASS II WETLAND BUFFER
WETLAND A
PRE DEVELOPMENT DRAINAGE AREA 1
DISCHARGING NORTH TO SN001
4.38-AC
0.01-AC IMPERVIOUS
AND BUFFER
PRE DEVELOPMENT DRAINAGE AREA 2
DISCHARGING SOUTH TO SN002
1.46-AC
50-FT CLASS II WETLAND BUFFER
EX. CLASS II WETLAND
WETLAND I
0.88-AC
MyC
MUNSON & RAYNHAM SILT LOAMS
6-12% SLOPES
VERY ROCKY
HSG C/D
PeC
PERU FINE SANDY LOAM
12-20% SLOPES
HSG C/D
ScA
SCANTIC SILT LOAM
0-2% SLOPES
HSG C/D
EX. CLASS II WETLAND
WETLAND A
1.46-AC
GrC
GROTON GRAVELLY FINE
SANDY LOAM
12-20% SLOPES
HSG A
MyB
MUNSON & RAYNHAM SILT LOAMS
2-6% SLOPES
HSG C/D
EX. CLASS III WETLAND
WETLAND D
0.04-AC
EX. CLASS III WETL
WETLAND C
0.28-AC
EX. CLASS III WETLAND
WETLAND E
0.04-AC
HfD
HARTLAND VERY FINE
SANDY LOAM
12-25% SLOPES
HSG B
EX. CLASS III WETLAND
WETLAND F
0.05-AC
EX. CLASS II WETLAND
WETLAND G

N

PRE-DEVELOPMENT DRAINAGE

- PRE DEVELOPMENT DRAINAGE AREA BOUNDARY
- HYDRAULIC LENGTH
- NRCS SOILS BOUNDARY

GRAPHIC SCALE

50 0 25 50 100 200

1 inch = 50 ft.
for sheet size 24" x 36"

Stamp

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JOE LASTER

1139 Lanier Boulevard
Atlanta, GA 30306
404.822.6990

Sheet Title: PRE DEVELOPMENT DRAINAGE AREA MAP

Project Title: PROPOSED SUBDIVISION
LASTER PROPERTY
TOWN OF HINESBURG, CHITTENDEN COUNTY, VERMONT

EV Project #	20542
Drawn By:	HKW
Checked By:	KW
Scale:	1" = 50'
Date:	04/01/2022

No.	Description	Date

DR-2

PLOTTED: 3/31/2022 2:07 PM

S:\PROJECTS\0-2020\20542 LASTER PROPERTY HINESBURG\DWGS\SHEET FILES\PH1 SUBDIVISION\20542X-DR2-DR3 PRE & POST DRAINAGE AREA MAPS.DWG

EX. HEADWALL
18" CMP INV 364.87
EX. STORM MH
RIM 370.95
EX. 36" CMP
INV OUT 367.31
EX. SEWER MH
RIM 367.46
EX. CATCH BASIN
RIM 370.19
EX. 18" CMP
INV 367.23
MBX6.1.3
PROPOSED
STORMWATER
TREATMENT AREA #1
30MPH AHEAD SIGN
EX. SEWER MH
RIM 369.08
EX. CATCH BASIN
RIM 369.08
MBX6.0.5
TBM NAIL IN POWER POLE
RADAR SIGN
EX. SEWER MH
RIM 363.42
EX. STORM MH
RIM 364.90
EX. CATCH BASIN
RIM 364.28
30MPH SIGN
EX. CATCH BASIN
RIM 361.52
EX. STORM MH
RIM 363.02
GMP28
T-FT POLE W
BURIED TELE.
CABLE
GMP35
EX. 18" CMP
INV 366.42
16" CMP
18" CMP
POI#1
POI#2
GMP32
GMP32-01
GMP32
ELEC PED
GMP31
GMP30
CTC_VT2 20
GMP31
POST
CTC 2.19
35MPH
SIGN
POST/FLAG
SIGN
POST DEVELOPMENT DRAINAGE AREA 1B
DISCHARGING TO SN001
1.5-AC
EX. CLASS III WETLAND
WETLAND H
0.25-AC
WETLAND A
POST DEVELOPMENT DRAINAGE AREA 1
TO GRAVEL WETLAND #1
0.97-AC
POST DEVELOPMENT DRAINAGE AREA 2B
DISCHARGING TO SN002
0.15-AC
EX. CLASS II WETLAND
WETLAND I
0.88-AC
PROPOSED
STORMWATER
TREATMENT AREA #2
MyC
MUNSON & RAYNHAM SILT LOAMS
6-12% SLOPES
VERY ROCKY
HSG C/D
PeC
PERU FINE SANDY LOAM
12-20% SLOPES
HSG C/D
ScA
SCANTIC SILT LOAM
0-2% SLOPES
HSG C/D
GrC
GROTON GRAVELLY FINE
SANDY LOAM
12-20% SLOPES
HSG B
EX. CLASS II WETLAND
WETLAND A
1.46-AC
MyB
MUNSON & RAYNHAM SILT LOAMS
2-6% SLOPES
HSG C/D
EX. CLASS III WETLAND
WETLAND D
0.04-AC
POST DEVELOPMENT DRAINAGE AREA 2
TO GRAVEL WETLAND #2
3.22-AC
EX. CLASS III WETL
WETLAND C
0.28-AC
HtD
HARTLAND VERY FINE
SANDY LOAM
12-25% SLOPES
HSG B
EX. CLASS III WETLAND
WETLAND E
0.04-AC
EX. CLASS III WETLAND
WETLAND F
0.05-AC
EX. CLASS II WETLAND
WETLAND G

N

POST-DEVELOPMENT DRAINAGE

- POST DEVELOPMENT DRAINAGE AREA BOUNDARY
- HYDRAULIC LENGTH
- NRCS SOILS BOUNDARY

IMPERVIOUS AREAS SUMMARY

Proposed Lot Coverage

	area	impervious	% impervious
Lot 1	0.84 ac	0.09 ac	11%
Lot 2	0.4 ac	0.08 ac	20%
Lot 3	0.44 ac	0.15 ac	35%
Lot 4	0.47 ac	0.16 ac	35%
Lot 5	0.42 ac	0.15 ac	35%
Lot 6	0.28 ac	0.10 ac	35%
Lot 7	0.42 ac	0.15 ac	35%
Lot 8	0.48 ac	0.17 ac	35%
LOTS		1.05 ac	
pavement	17750 sf	0.41 ac	
sidewalk	4288 sf	0.10 ac	
gravel	4985 sf	0.12 ac	
new impervious		1.68 ac	

GRAPHIC SCALE

50 0 25 50 100 200

1 inch = 50 ft.
for sheet size 24" x 36"

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EV Project #	20542
Drawn By:	HKW
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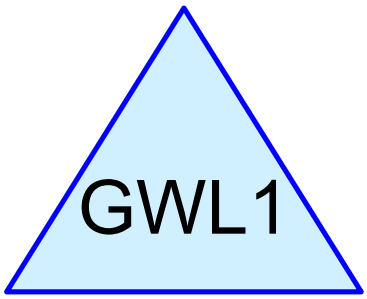
No.	Description	Date

DR-3



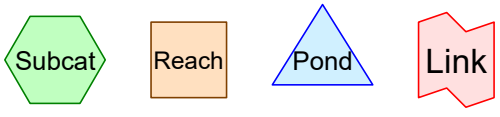
Gravel Wetland #1

Water Quality Volume Calculation - Drainage Area to Gravel Wetland 1

Practice Drainage Area	For Permit Coverage	Not for Permit Coverage	Total to Practice	WQ_v for credit	WQ_v not for credit	Total WQ_v
Total Area (acres)	0.961	0.000	0.961	0.0350	0.0000	0.0350
New Impervious (acres)	0.414	0.000	0.414	1527	CF WQ Storage	

min. 10% pretreatment volume provided in tank: 1,200 gallons or 160-cf

provide min. 1,367-cf of water quality storage for gravel wetland



Summary for Pond GWL1: Gravel Wetland #1

Inflow Area = 0.970 ac, 43.30% Impervious, Inflow Depth = 0.39" for WQ event
Inflow = 0.64 cfs @ 11.94 hrs, Volume= 0.032 af
Outflow = 0.02 cfs @ 13.86 hrs, Volume= 0.026 af, Atten= 97%, Lag= 115.3 min
Primary = 0.02 cfs @ 13.86 hrs, Volume= 0.026 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Starting Elev= 368.00' Surf.Area= 2,036 sf Storage= 1,370 cf
Peak Elev= 369.00' @ 13.86 hrs Surf.Area= 2,370 sf Storage= 2,220 cf (850 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 427.9 min (1,230.1 - 802.3)

Volume	Invert	Avail.Storage	Storage Description
#1	364.50'	1,139 cf	**Gravel Storage (Prismatic)** Listed below (Recalc)
#2	367.50'	4,151 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		5,289 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
364.50	1,265	0.0	0	0
367.50	1,265	30.0	1,139	1,139

storage within gravel section

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
367.50	771	0.0	0	0
367.75	771	20.0	39	39
368.50	771	100.0	578	617
369.00	1,108	100.0	470	1,087
370.00	1,518	100.0	1,313	2,400
371.00	1,984	100.0	1,751	4,151

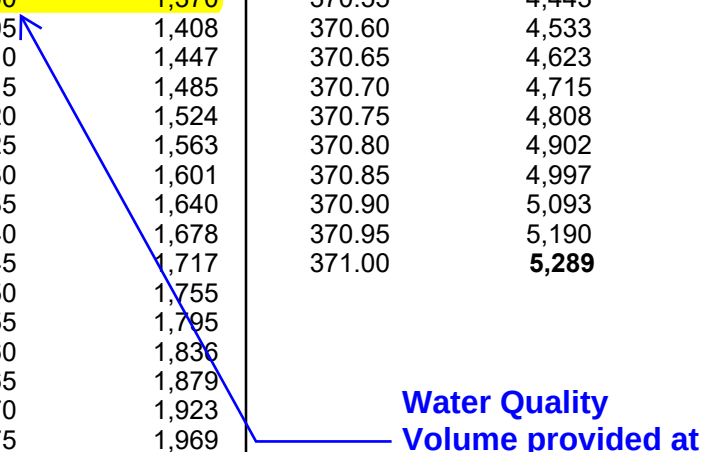
storage above gravel section

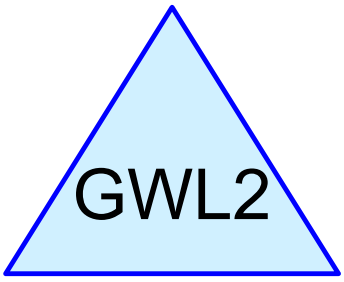
Device	Routing	Invert	Outlet Devices
#1	Primary	367.79'	**12.0" Round Culvert** L= 112.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 367.79' / 367.23' S= 0.0050 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Device 1	368.30'	**1.0" Vert. Control Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	370.33'	**14.9" Horiz. 18" Bypass Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Primary	370.80'	**6.0' long + 1.0 '/' SideZ x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.02 cfs @ 13.86 hrs HW=369.00' (Free Discharge)
- **1=Culvert** (Passes 0.02 cfs of 2.51 cfs potential flow)
  - **2=Control Orifice/Grate** (Orifice Controls 0.02 cfs @ 3.89 fps)
  - **3=18" Bypass Orifice/Grate** (Controls 0.00 cfs)
- **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Stage-Area-Storage for Pond GWL1: Gravel Wetland #1

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
364.50	0	367.05	968	369.60	2,964
364.55	19	367.10	987	369.65	3,032
364.60	38	367.15	1,006	369.70	3,101
364.65	57	367.20	1,025	369.75	3,171
364.70	76	367.25	1,044	369.80	3,243
364.75	95	367.30	1,063	369.85	3,315
364.80	114	367.35	1,082	369.90	3,388
364.85	133	367.40	1,101	369.95	3,463
364.90	152	367.45	1,120	370.00	3,538
364.95	171	367.50	1,139	370.05	3,615
365.00	190	367.55	1,146	370.10	3,692
365.05	209	367.60	1,154	370.15	3,771
365.10	228	367.65	1,162	370.20	3,851
365.15	247	367.70	1,169	370.25	3,932
365.20	266	367.75	1,177	370.30	4,014
365.25	285	367.80	1,216	370.35	4,098
365.30	304	367.85	1,254	370.40	4,183
365.35	323	367.90	1,293	370.45	4,268
365.40	342	367.95	1,331	370.50	4,355
365.45	361	368.00	1,370	370.55	4,443
365.50	380	368.05	1,408	370.60	4,533
365.55	398	368.10	1,447	370.65	4,623
365.60	417	368.15	1,485	370.70	4,715
365.65	436	368.20	1,524	370.75	4,808
365.70	455	368.25	1,563	370.80	4,902
365.75	474	368.30	1,601	370.85	4,997
365.80	493	368.35	1,640	370.90	5,093
365.85	512	368.40	1,678	370.95	5,190
365.90	531	368.45	1,717	371.00	**5,289**
365.95	550	368.50	1,755		
366.00	569	368.55	1,795		
366.05	588	368.60	1,836		
366.10	607	368.65	1,879		
366.15	626	368.70	1,923		
366.20	645	368.75	1,969		
366.25	664	368.80	2,017		
366.30	683	368.85	2,066		
366.35	702	368.90	2,118		
366.40	721	368.95	2,170		
366.45	740	369.00	2,225		
366.50	759	369.05	2,281		
366.55	778	369.10	2,338		
366.60	797	369.15	2,396		
366.65	816	369.20	2,455		
366.70	835	369.25	2,515		
366.75	854	369.30	2,576		
366.80	873	369.35	2,638		
366.85	892	369.40	2,701		
366.90	911	369.45	2,765		
366.95	930	369.50	2,830		
367.00	949	369.55	2,896		





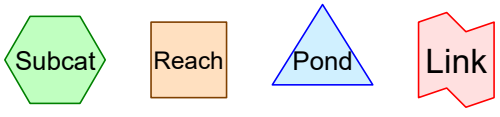
Gravel Wetland #2

Water Quality Volume Calculation - Drainage Area to Gravel Wetland 2

Practice Drainage Area	For Permit Coverage	Not for Permit Coverage	Total to Practice	WQ_v for credit	WQ_v not for credit	Total WQ_v
Total Area (acres)	3.228	0.000	3.228	0.1068	0.0000	0.1068
New Impervious (acres)	1.245	0.000	1.245	4653	CF WQ Storage	

min. 10% pretreatment volume provided in tank: 3,500 gallons or 468-cf

provide min. 4,185-cf of water quality storage for gravel wetland



Summary for Pond GWL2: Gravel Wetland #2

Inflow Area = 3.220 ac, 38.51% Impervious, Inflow Depth = 0.36" for WQ event
Inflow = 1.87 cfs @ 11.95 hrs, Volume= 0.095 af
Outflow = 0.02 cfs @ 24.01 hrs, Volume= 0.077 af, Atten= 99%, Lag= 723.5 min
Primary = 0.02 cfs @ 24.01 hrs, Volume= 0.077 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Starting Elev= 394.50' Surf.Area= 13,169 sf Storage= 6,448 cf
Peak Elev= 395.12' @ 24.01 hrs Surf.Area= 13,280 sf Storage= 9,716 cf (3,268 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 1,453.6 min (2,260.2 - 806.6)

Volume	Invert	Avail.Storage	Storage Description
#1	391.50'	5,921 cf	**Gravel Storage (Prismatic)** Listed below (Recalc)
#2	394.00'	23,293 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		29,214 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
391.50	7,894	0.0	0	0
394.00	7,894	30.0	5,921	5,921

storage within gravel section

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
394.00	5,275	0.0	0	0
394.25	5,275	20.0	264	264
394.50	5,275	20.0	264	528
395.00	5,275	100.0	2,638	3,165
396.00	6,212	100.0	5,744	8,909
397.00	7,188	100.0	6,700	15,609
398.00	8,181	100.0	7,685	23,293

storage above gravel section

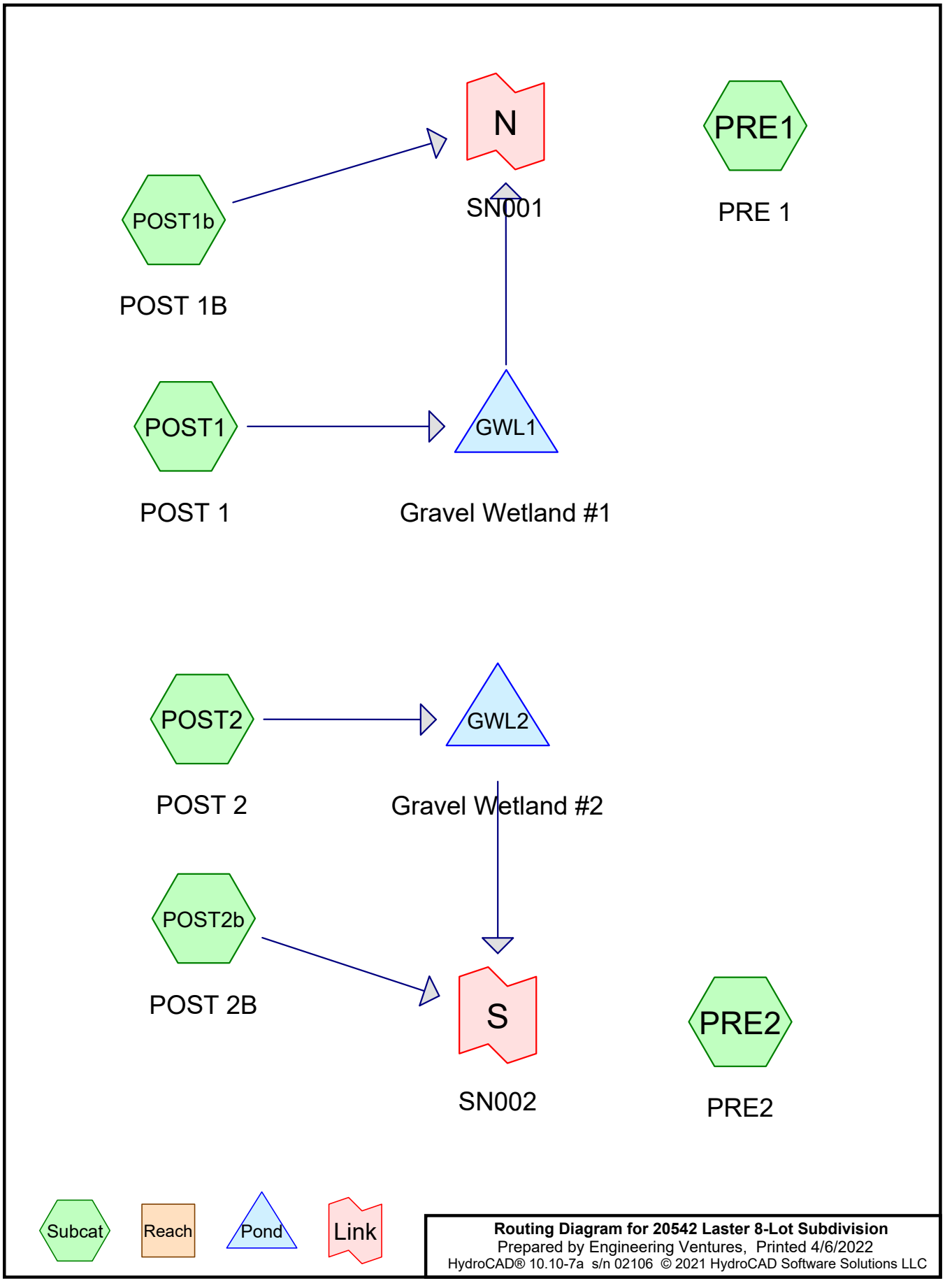
Device	Routing	Invert	Outlet Devices
#1	Primary	394.00'	**24.0" Round Culvert** L= 25.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 394.00' / 392.50' S= 0.0600 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	394.50'	**1.0" Vert. Control Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	396.58'	**14.9" Horiz. 18" Bypass Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	397.75'	**14.9" Horiz. 18" Bypass Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.02 cfs @ 24.01 hrs HW=395.12' (Free Discharge)
└─**1=Culvert** (Passes 0.02 cfs of 5.14 cfs potential flow)
  ├─**2=Control Orifice/Grate** (Orifice Controls 0.02 cfs @ 3.66 fps)
  ├─**3=18" Bypass Orifice/Grate** (Controls 0.00 cfs)
  └─**4=18" Bypass Orifice/Grate** (Controls 0.00 cfs)

Stage-Area-Storage for Pond GWL2: Gravel Wetland #2

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
391.50	0	394.05	5,973	396.60	18,732
391.55	118	394.10	6,026	396.65	19,073
391.60	237	394.15	6,079	396.70	19,417
391.65	355	394.20	6,131	396.75	19,763
391.70	474	394.25	6,184	396.80	20,111
391.75	592	394.30	6,237	396.85	20,462
391.80	710	394.35	6,290	396.90	20,815
391.85	829	394.40	6,342	396.95	21,171
391.90	947	394.45	6,395	397.00	21,529
391.95	1,066	394.50	6,448	397.05	21,890
392.00	1,184	394.55	6,712	397.10	22,253
392.05	1,303	394.60	6,976	397.15	22,618
392.10	1,421	394.65	7,239	397.20	22,986
392.15	1,539	394.70	7,503	397.25	23,357
392.20	1,658	394.75	7,767	397.30	23,730
392.25	1,776	394.80	8,031	397.35	24,106
392.30	1,895	394.85	8,294	397.40	24,484
392.35	2,013	394.90	8,558	397.45	24,864
392.40	2,131	394.95	8,822	397.50	25,247
392.45	2,250	395.00	9,086	397.55	25,633
392.50	2,368	395.05	9,350	397.60	26,021
392.55	2,487	395.10	9,618	397.65	26,411
392.60	2,605	395.15	9,887	397.70	26,804
392.65	2,723	395.20	10,159	397.75	27,199
392.70	2,842	395.25	10,434	397.80	27,597
392.75	2,960	395.30	10,710	397.85	27,998
392.80	3,079	395.35	10,989	397.90	28,400
392.85	3,197	395.40	11,270	397.95	28,806
392.90	3,315	395.45	11,554	398.00	**29,214**
392.95	3,434	395.50	11,840		
393.00	3,552	395.55	12,128		
393.05	3,671	395.60	12,419		
393.10	3,789	395.65	12,712		
393.15	3,908	395.70	13,008		
393.20	4,026	395.75	13,305		
393.25	4,144	395.80	13,605		
393.30	4,263	395.85	13,908		
393.35	4,381	395.90	14,212		
393.40	4,500	395.95	14,520		
393.45	4,618	396.00	14,829		
393.50	4,736	396.05	15,141		
393.55	4,855	396.10	15,455		
393.60	4,973	396.15	15,772		
393.65	5,092	396.20	16,091		
393.70	5,210	396.25	16,413		
393.75	5,328	396.30	16,737		
393.80	5,447	396.35	17,063		
393.85	5,565	396.40	17,392		
393.90	5,684	396.45	17,723		
393.95	5,802	396.50	18,057		
394.00	5,921	396.55	18,393		

Water Quality Volume provided at elev. 393.30



Routing Diagram for 20542 Laster 8-Lot Subdivision
Prepared by Engineering Ventures, Printed 4/6/2022

Summary for Subcatchment PRE1: PRE 1

Runoff = 3.06 cfs @ 12.01 hrs, Volume= 0.167 af, Depth= 0.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 1-year Rainfall=2.01"

Area (ac)	CN	Description
4.370	77	Woods, Good, HSG D
* 0.010	98	Existing Impervious
4.380		Weighted Average
4.370		99.77% Pervious Area
0.010		0.23% Impervious Area

Pre Development
Peak Flow to SN001
3.06-cfs

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	768	0.1200	1.57		**Lag/CN Method, Watershed Lag**

Summary for Subcatchment PRE2: PRE2

Runoff = 1.07 cfs @ 12.00 hrs, Volume= 0.055 af, Depth= 0.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 1-year Rainfall=2.01"

Area (ac)	CN	Description
1.460	77	Woods, Good, HSG D
1.460		100.00% Pervious Area

Pre Development
Peak Flow to SN002
1.07-cfs

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	755	0.1560	1.79		**Lag/CN Method, Watershed Lag**

Summary for Pond GWL1: Gravel Wetland #1

Inflow Area = 0.970 ac, 43.30% Impervious, Inflow Depth = 1.09" for 1-year event
Inflow = 1.89 cfs @ 11.94 hrs, Volume= 0.089 af
Outflow = 0.04 cfs @ 15.77 hrs, Volume= 0.083 af, Atten= 98%, Lag= 230.0 min
Primary = 0.04 cfs @ 15.77 hrs, Volume= 0.083 af
Routed to Link N : SN001

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Starting Elev= 368.00' Surf.Area= 2,036 sf Storage= 1,370 cf
Peak Elev= 370.27' @ 15.77 hrs Surf.Area= 2,909 sf Storage= 3,964 cf (2,594 cf above start)

Plug-Flow detention time= 1,305.7 min calculated for 0.052 af (58% of inflow)
Center-of-Mass det. time= 814.0 min (1,605.5 - 791.5)

Volume	Invert	Avail.Storage	Storage Description
#1	364.50'	1,139 cf	**Gravel Storage (Prismatic)** Listed below (Recalc)
#2	367.50'	4,151 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		5,289 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
364.50	1,265	0.0	0	0
367.50	1,265	30.0	1,139	1,139

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
367.50	771	0.0	0	0
367.75	771	20.0	39	39
368.50	771	100.0	578	617
369.00	1,108	100.0	470	1,087
370.00	1,518	100.0	1,313	2,400
371.00	1,984	100.0	1,751	4,151

Device	Routing	Invert	Outlet Devices
#1	Primary	367.79'	**12.0" Round Culvert** L= 112.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 367.79' / 367.23' S= 0.0050 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Device 1	368.30'	**1.0" Vert. Control Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	370.33'	**14.9" Horiz. 18" Bypass Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Primary	371.00'	**6.0' long + 1.0 '/' SideZ x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.04 cfs @ 15.77 hrs HW=370.27' (Free Discharge)
- **1=Culvert** (Passes 0.04 cfs of 4.20 cfs potential flow)
  - **2=Control Orifice/Grate** (Orifice Controls 0.04 cfs @ 6.69 fps)
  - **3=18" Bypass Orifice/Grate** (Controls 0.00 cfs)
- **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

no outflow from bypass using minimum 1" dia control orifice

Summary for Pond GWL2: Gravel Wetland #2

Inflow Area = 3.220 ac, 38.51% Impervious, Inflow Depth = 1.04" for 1-year event
Inflow = 5.86 cfs @ 11.95 hrs, Volume= 0.278 af
Outflow = 0.04 cfs @ 24.05 hrs, Volume= 0.158 af, Atten= 99%, Lag= 725.9 min
Primary = 0.04 cfs @ 24.05 hrs, Volume= 0.158 af
Routed to Link S : SN002

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

Starting Elev= 394.50' Surf.Area= 13,169 sf Storage= 6,448 cf
Peak Elev= 396.33' @ 24.05 hrs Surf.Area= 14,429 sf Storage= 16,940 cf (10,492 cf above start)

Plug-Flow detention time= 3,831.5 min calculated for 0.010 af (3% of inflow)
Center-of-Mass det. time= 1,590.5 min (2,387.0 - 796.5)

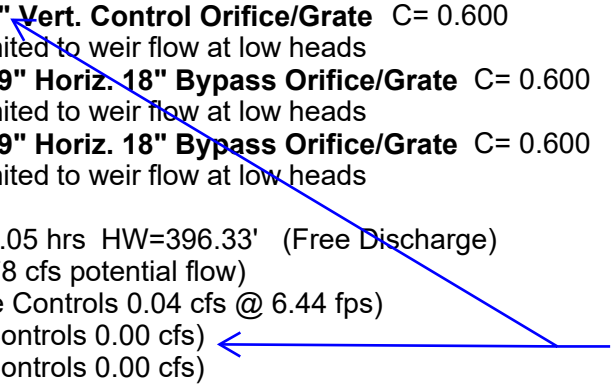
Volume	Invert	Avail.Storage	Storage Description
#1	391.50'	5,921 cf	**Gravel Storage (Prismatic)** Listed below (Recalc)
#2	394.00'	23,293 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		29,214 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
391.50	7,894	0.0	0	0
394.00	7,894	30.0	5,921	5,921

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
394.00	5,275	0.0	0	0
394.25	5,275	20.0	264	264
394.50	5,275	20.0	264	528
395.00	5,275	100.0	2,638	3,165
396.00	6,212	100.0	5,744	8,909
397.00	7,188	100.0	6,700	15,609
398.00	8,181	100.0	7,685	23,293

Device	Routing	Invert	Outlet Devices
#1	Primary	394.00'	**24.0" Round Culvert** L= 25.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 394.00' / 392.50' S= 0.0600 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	394.50'	**1.0" Vert. Control Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	396.58'	**14.9" Horiz. 18" Bypass Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	397.75'	**14.9" Horiz. 18" Bypass Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.04 cfs @ 24.05 hrs HW=396.33' (Free Discharge)
└─**1=Culvert** (Passes 0.04 cfs of 13.78 cfs potential flow)
  ├─**2=Control Orifice/Grate** (Orifice Controls 0.04 cfs @ 6.44 fps)
  ├─**3=18" Bypass Orifice/Grate** (Controls 0.00 cfs)
  └─**4=18" Bypass Orifice/Grate** (Controls 0.00 cfs)



Summary for Link N: SN001

Inflow Area = 2.470 ac, 17.00% Impervious, Inflow Depth = 0.75" for 1-year event
Inflow = 1.63 cfs @ 11.96 hrs, Volume= 0.154 af
Primary = 1.63 cfs @ 11.96 hrs, Volume= 0.154 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

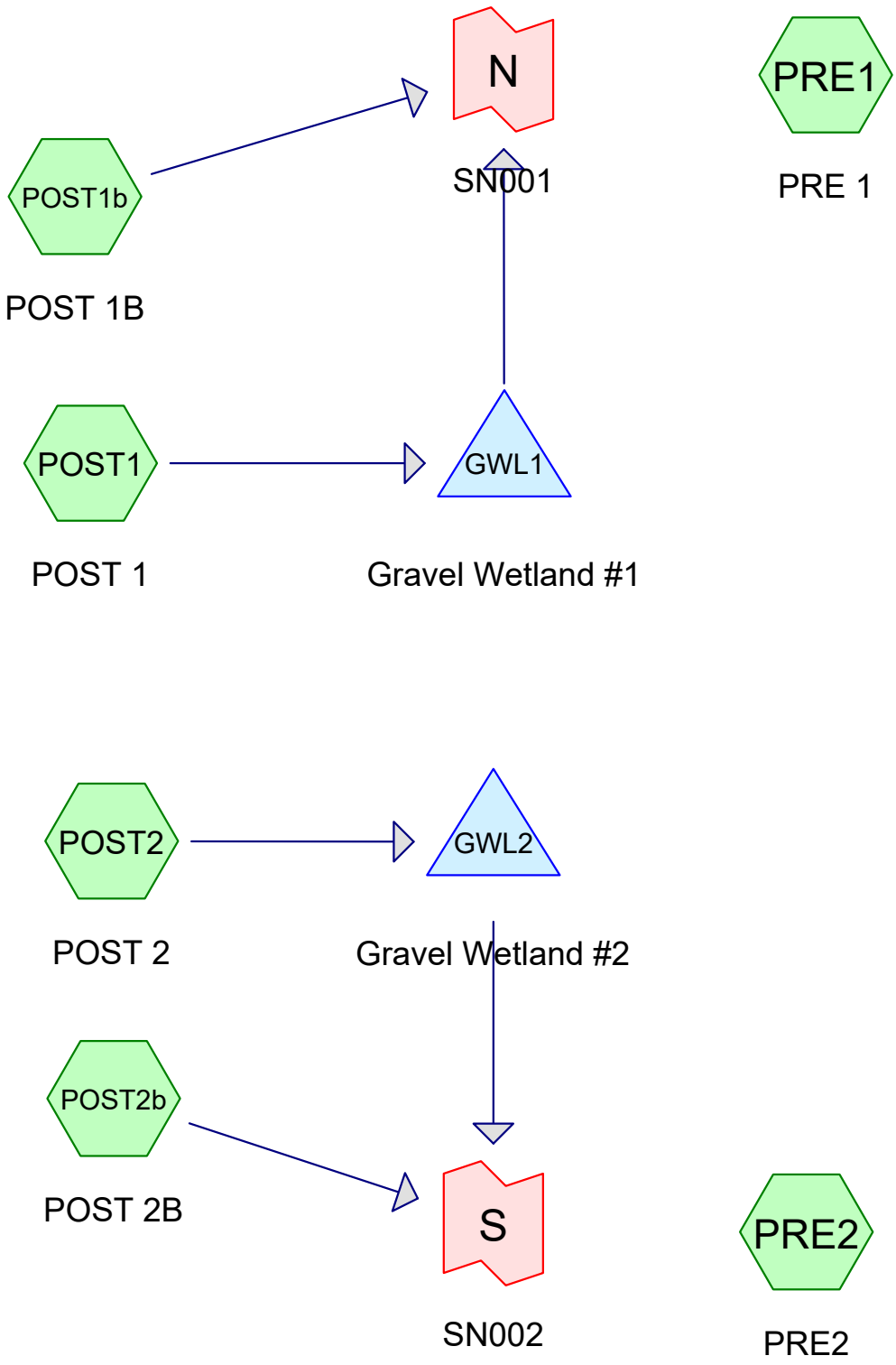
Post Development Peak Flow to SN001 1.63-cfs

Summary for Link S: SN002

Inflow Area = 3.370 ac, 36.80% Impervious, Inflow Depth > 0.59" for 1-year event
Inflow = 0.21 cfs @ 11.91 hrs, Volume= 0.165 af
Primary = 0.21 cfs @ 11.91 hrs, Volume= 0.165 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Post Development Peak Flow to SN002 0.21-cfs



Routing Diagram for 20542 Laster 8-Lot Subdivision
Prepared by Engineering Ventures, Printed 4/6/2022

Summary for Subcatchment PRE1: PRE 1

Runoff = 10.11 cfs @ 12.00 hrs, Volume= 0.510 af, Depth= 1.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-year Rainfall=3.45"

Area (ac)	CN	Description
4.370	77	Woods, Good, HSG D
* 0.010	98	Existing Impervious
4.380		Weighted Average
4.370		99.77% Pervious Area
0.010		0.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	768	0.1200	1.57		**Lag/CN Method, Watershed Lag**

Pre Development Peak Flow to SN001 10.11-cfs

Summary for Subcatchment PRE2: PRE2

Runoff = 3.51 cfs @ 11.99 hrs, Volume= 0.170 af, Depth= 1.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-year Rainfall=3.45"

Area (ac)	CN	Description
1.460	77	Woods, Good, HSG D
1.460		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	755	0.1560	1.79		**Lag/CN Method, Watershed Lag**

Pre Development Peak Flow to SN002 3.51-cfs

Summary for Link N: SN001

Inflow Area = 2.470 ac, 17.00% Impervious, Inflow Depth = 1.85" for 10-year event
Inflow = 7.24 cfs @ 11.97 hrs, Volume= 0.380 af
Primary = 7.24 cfs @ 11.97 hrs, Volume= 0.380 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

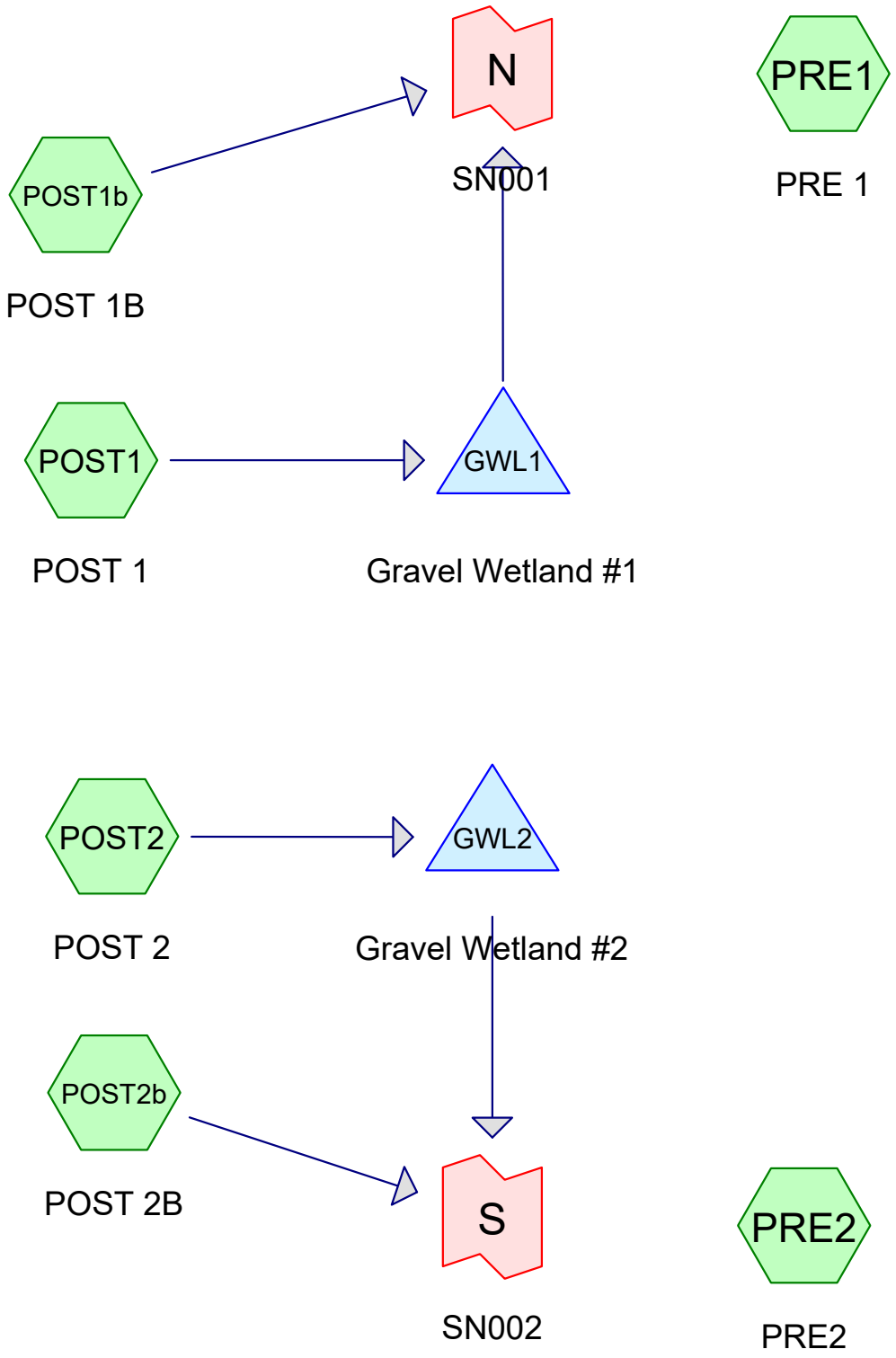
Post Development Peak Flow to SN001 7.24-cfs

Summary for Link S: SN002

Inflow Area = 3.370 ac, 36.80% Impervious, Inflow Depth > 1.66" for 10-year event
Inflow = 1.88 cfs @ 12.11 hrs, Volume= 0.466 af
Primary = 1.88 cfs @ 12.11 hrs, Volume= 0.466 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Post Development Peak Flow to SN002 1.88-cfs



Routing Diagram for 20542 Laster 8-Lot Subdivision
Prepared by Engineering Ventures, Printed 4/6/2022

Summary for Subcatchment PRE1: PRE 1

Runoff = 19.88 cfs @ 12.00 hrs, Volume= 1.005 af, Depth= 2.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-year Rainfall=5.15"

Area (ac)	CN	Description
4.370	77	Woods, Good, HSG D
* 0.010	98	Existing Impervious
4.380		Weighted Average
4.370		99.77% Pervious Area
0.010		0.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	768	0.1200	1.57		**Lag/CN Method, Watershed Lag**

Pre Development Peak Flow to SN001 19.88-cfs

Summary for Subcatchment PRE2: PRE2

Runoff = 6.88 cfs @ 11.98 hrs, Volume= 0.334 af, Depth= 2.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-year Rainfall=5.15"

Area (ac)	CN	Description
1.460	77	Woods, Good, HSG D
1.460		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	755	0.1560	1.79		**Lag/CN Method, Watershed Lag**

Pre Development Peak Flow to SN002 6.88-cfs

Summary for Link N: SN001

Inflow Area = 2.470 ac, 17.00% Impervious, Inflow Depth = 3.32" for 100-year event
Inflow = 16.03 cfs @ 11.96 hrs, Volume= 0.683 af
Primary = 16.03 cfs @ 11.96 hrs, Volume= 0.683 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Post Development Peak Flow to SN001 16.03-cfs

Summary for Link S: SN002

Inflow Area = 3.370 ac, 36.80% Impervious, Inflow Depth > 3.18" for 100-year event
Inflow = 6.79 cfs @ 12.05 hrs, Volume= 0.894 af
Primary = 6.79 cfs @ 12.05 hrs, Volume= 0.894 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Post Development Peak Flow to SN002 6.79-cfs