Project File: LYF-0381B

Vallis Way Definitive Plan Responses

Vallis Way
Lynnfield, Massachusetts

December 2021

COMMONWEALTH OF MASSACHUSETTS
PETER J
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Refer to File No. **LYF-0381B**

December 1, 2021

Planning Board
55 Summer Street
Lynnfield, MA 01940

RE: Vallis Way / Caggiano

Dear Members,

The following is a response to the September 2, 2021 Linden Engineering report to the Town of Lynnfield Planning Board as it relates to the 109 Lowell Street / Vallis Way Definitive Plan Subdivision filing.

1. Assuming that the remaining land of Vallis is to be included within the subdivision, and further, that the Planning Board has asked that the hydraulics be handled the same as it is with the other lots. Three (3) new lots could be created on the Vallis property, roof infiltration will be utilized up to and including the 100-year storm on all lots, but that typical driveways would be included to discharge to the Vallis Way subdivision drainage system, responses are as follows:

2. Requires no further comment.

3. Requires action of the Planning Board, not the Applicant.

4. Requires no further comment.

5. Requires no further comment.

6. Requires no further comment.

7. The applicant has completed a location of trees on the entire tract, as required by the Planning Board Rules and Regulations, including around the Vallis house, with the exception of the westerly lot line next to the house as it is not anticipated that the house would be removed for the roadway alignment at this time.

8. The location of stormwater management holes 1, 2 and 3 are shown on the latest Existing Conditions plan. There are no readings in the observation wells as they did not extend to groundwater. Subsequently, however, the applicant has hired Lahlaf

Geotechnical Consulting to conduct certain testing which included test hole logs which did go to groundwater in the area of the infiltration basin. Water levels were determined to be at 13.5 and 13 feet in test holes 1 and 2 respectively, and that corresponds to a groundwater elevation of 136.5 and 135.0 within the basin.

9. Requires a response from Town Counsel.

10. Requires a response from the Applicant's counsel.

11. Grate capacity calculations have been provided for the 100-year storm, they, as well as, the piping network are included in the Hydro-Cad model.

12. Additional details have been provided for the chain link fence, and the location of the fence has been adjusted as requested around the new basin geometry.

13. Requires no further comment.

14. Requires a response from the Applicant's counsel.

15. A note has been added that the proposed water main will be routed around the drain, and that it will be laid 6 inches below the drain line. We do not believe any kind of concrete encasement is required.

16. Requires no comment.

17. Requires no comment.

18. Detailed topographic plans have been provided at the entrance and cul-de-sac, as requested, although it has been our experience that these are of little use to the contractor, and that the gutter line profiles provided give the detailed grading necessary to properly grade the intersection and circle.

19. The applicant has located the trees along the property line from Lowell Street to Sta. 2+50, and believes the distance allowed to the toe of slope provides sufficient protection for the trees.

20. Requires no further comment.

21. The note was added to Sheets 2, 3, 4 and 6.

Comments from Town Engineer's June 17, 2021, Initial Review

1. The 109 Lowell Street property is assumed to be part of the subdivision.

2. Requires no further comment.

3. Requires an action of the Planning Board.

4.a Requires input from the Planning Board.

4.b Requires no further comment.

4.c We believe the issue of groundwater below the stormwater management basins has been adequately addressed by the geotechnical information provided.

4.d A cross-section of the basin has been added to the plan.

4.e Requires no further comment.

4.f Requires no further comment.

5. Requires no further comment.

6. The applicant has conducted a flow test and is awaiting any further study requirements of the district.

7. The street lighting has been designed to conform to the interpretation of the street-light design in the comment letter.

Comments relative to the requirements of the Regulations and standard engineering practice, as interpreted by Linden Engineering.

Sheet 1 of 8 Lotting Plan: - Waiver Requests

Section 375-6.4A(13) Requires no additional change or comment.

Section 375-7.1D(1) Requires a decision of the Planning Board.

Plan Comments:

A. Bearings and distances have been shown along the existing 15-foot water easement to Smith Farm Trail.

Sheet 2 of 8 – Existing Conditions Plan: - Waiver Requests

Section 375-6.4.B(1) Requires no further action.

Section 375-6.4.B(4) Requires no further action.

Plan Comments:

B. 375-6.4.B(3) The additional fences on the remaining Vallis property have been shown.
C. 375-6.4.B(7) The significant trees need to be determined by the Planning Board.
D. 375-6.4.B(8) The wetland note has been added to this sheet.

Sheet 3 of 8 – Plan and Profile: - Waiver Requests

NONE

Plan Comments:

E. 375-6.4.C(g) Suggested locations of water services have been shown.

F. Utility crossing Lot 2 has been reviewed.

G. Handicap ramps have been added at Lowell Street.

H. A single boring was done at the top of the hill on Lot 5 to determine the approximate elevation of ledge. At the top of the hill, ledge was encountered at elevation 154. We do not anticipate striking ledge for the road grading or storm drainage as the topography drops sharply and adjoining test holes at DOH 7A and DOH 3B indicated no ledge to elevation 145 and 144, respectively. The house has been dropped from a top foundation of 162.0 to 159.0.

I. The gutter line profile may be flat, but there is adequate drainage away from the gutter at the location of the flat slope. (See detail). We are maintaining the gutter of Lowell Street.

J. The profile of the drain pipe from the end of the cul-de-sac to the sediment forebay has been added. A flared-end section and stone spillway is specified at the end of that pipe.

Sheet 4 of 8 – Topographic Plan: - Waiver Requests

NONE

Plan Comments:

K. 375-6.4.D(5) Requires input from the Planning Board.

L. We do not believe an easement is required for the retaining wall as it will be constructed during a period when both the roadway and adjoining lot is owned by the applicant. We request that we not be required to provide details on the wall's construction at this time as the type of wall has not been determined. It may well be proprietary block retaining wall or masonry. The details can be provided at the time the permit for the wall is applied for.

M. 375-6.4.D(13) The note will be added to this sheet.

N. 375-6.4.D(4) It is believed that the applicant has agreed to plantings along the roadway with the current owner of the property who lives at and owns the land at 109 Lowell Street, as shown. With respect to Lot 5, while it has a very large frontage, it is believed that adequate trees exist along the property line so that additional street trees should not be required.

Sheet 5 of 8 – Street Lighting Plan: - Waiver Requests

NONE

Plan Comments:

O. Street lighting has been re-designed.

P. 375-6.4.E(6) I believe the street lighting control box can go in the easement with the electric transformer.

Sheet 6 of 8 – Erosion Control Plan: - Waiver Requests

NONE

Plan Comments:

Q. Silt sacks have been added to both catch basins on Lowell Street, as well as being required on all the new catch basins on site. They are to remain in place until all surfaces are stabilized.

R. A construction entrance consisting of 12 inches of crushed stone, ¾ to 1½ inches, has been shown on the plan.

S. It is our opinion that the straw wattles are adequate for a project of this size, specifically based on the fact that the soils encountered are not highly erodible. Therefore, erosion controls should be able to be easily handled. We have, however, changed it to 12" bark mulch-filled sock.

T. Reference to the CPPPP in the Stormwater Report has been made for operational details of the erosion control plan.

Sheets 7 & 8 – Detail Sheets: - Waiver Requests

Section 375-6.4.G(1)(h) The requested details regarding a blowup and cross-section have been dealt with in another section of this response.

Section 375-6.4.G(1)(m) No further comment required.

Section 375-6.4.G(1)(u) Requires no further comment.

Plan Comments:

U. No gas is to be brought to the subdivision.

V. Casting number has been changed.

W. The manhole steps have been deleted and poured concrete inverts shown, casting number has been changed.

X. The street light pole base has been changed to the Town standard.

Y. Vertical granite curb has been added to a depth of 6 inches below the stone to the spillway cross-section.

Z. I have been unable to communicate with the Superintendent of the Lynnfield Water District, and provided information as requested to date, see attached.

AA. A typical roof drainage system has been added, similar to the one used at 271 Main Street.

New Comments re: Stormwater Report

BB. There are no comparison tables as there is no existing discharge in the existing condition such that there is nothing to compare to.

CC. Catch basin inlet calculations have been provided, see Hydro-Cad calculations.

DD. The positioning of the Stormceptor STC-900 is to provide the required 45% TSS removal prior to infiltration. It is after the deep-sump catch basins and prior to the infiltration system within the roadway. The STC-900 has the ability to by-pass flow and, as such, can be placed on-line as designed.

EE Calculations substantiating the sizing of the sediment forebay are attached.

FF.1 The floor of the basin has been surfaced with 6 inches of ¾ to 1 inch crushed, washed stone up to the emergency outlet elevation.

FF.2 In situ testing has been conducted and the infiltration rate act as required by the Stormwater Management Regulations.

FF.3 Stormwater calculations have been revised to indicate a 25-year storm immediately followed by a 100-year storm using rainfall data from NOAA Atlas 14, although we understand that standard has not yet been adopted by MADEP, and we have been hearing that it will be changed for a number of years.

FF.4 The Homeowner's Association must restrict additional impervious runoff and conversion of existing woods, as shown on the subdivision plan to the lawn. This needs to be addressed by the attorney.

GG. A note has been added that roof drain design criteria and soil testing must be witnessed by the Town Engineer, and designs are inspected and approved by him.

HH. The CPPPP has been changed to reference a bark mulch-filled sock.

II. The catch basin maintenance in the LTPPP has been changed to state that if the sediment in the sump is more than half the sump depth on inspection, the sump will be cleaned out.

JJ. The LTPPP has been changed to contain the inspection and maintenance frequencies for the STC-900 unit, along with the manufacturer's cleaning procedures.

Miscellaneous New Comments

KK. The undersigned is waiting for the required Title 5 inspections of the sanitary system at 109 Lowell Street to bring to the Board of Health in order to obtain their land-suitability statement.

LL. Needs to be addressed by the applicant's attorney.

Very truly yours,

Peter J. Ogren, P.E., P.L.S.
President
PJO/d/
Enclosures
cc: Paul Caggiano

BMP Performance Tables & Forebay Calculations

Vallis Way

Lynnfield, Massachusetts

SUPPLEMENTAL STORMWATER CALCULATIONS
VALLIS WAY
LYNNFIELD, MASSACHUSETTS

October 26, 2021

PREFACE

The Lynnfield Planning Board in its review of the Vallis Way Subdivision has asked for a number of changes in the approach to the runoff calculations.

First, the September 2, 2021 letter from Linden Engineering requested that computations be made based on the NOAA Atlas 14 rainfall amounts, and that computations be done simulating a 100-year rainfall immediately on top of a 25-year rainfall.

Second, the Planning Board has requested that anticipated development on the Vallis property be included in the hydraulic calculations (Note: the property itself with its existing development has always been included in the calculations). In order to do this it was presumed that one additional lot would be created on an Approval-Not-Required basis (Note: any additional lots would require the removal of the existing Vallis residence), and that no stormwater management would be included as part of that development. That would result in an additional 4,321 square feet of impervious, including house and driveway.

Third, in accordance with the requirements of Section FF.2 of the September 2, 2021 letter, the applicant hired an independent geotechnical testing firm, Lahlaf Geotechnical Consulting, Inc., to conduct permeability testing and grain-size analysis in the area of the proposed infiltration pond. They further excavated to the groundwater level which was determined to be 13.5 feet and 13.0 feet in test holes 1 and 2, respectively. The results of the permeability testing, test hole logs and grain-size analysis are included in the Appendix of this report.

The permeability testing yielded an absolute minimum infiltration rate of 35.2 cm/hr., which equates to 13.85 in/hr. The Stormwater Management Regulations require that that infiltration rate be halfed in order to be used, resulting in a 6.93 in/hr. infiltration rate. This is slightly slower than the 8.27 in/hr. from the Rawls Rate, so that number was used in the original calculations.

In addition, the question was asked as to where ledge might be encountered on Lot 5. On October 22, a single boring was done at the top of the knoll and bedrock was encountered at approximately elevation 154.0, 6 inches above the proposed cellar floor grade on the definitive plan.

CONCLUSION

Based on this analysis, it appears that the above design criteria can be met but it requires increasing the dike and spillway elevation and also increasing the size of the retention pond.

The conclusion of the boring on Lot 5 is that ledge might be encountered in the cellar excavation on the lot although, depending on how regular and extensive the ledge is, the cellar floor elevation might be slightly adjusted to eliminate the need for blasting.

BMP Performance
Vallis Way W/1 Extra Lot (4,321 S.F. House typical Driveway)
Lynnfield, MA

BMP Houses based on 4,321 S.F. house

Storm	Q in (C.F.S.)	Q out Primary (C.F.S.)	Q out Infiltration (C.F.S.)	Water Level above bottom of stone (Ft.)
2 Year	0.31	0	0.06	1.38
10 Year	0.49	0	0.06	2.46
25 Year	0.61	0	0.06	3.28
100 Year	0.78	0	0.06	5.22

Available Depth 5.50'

BMP 2P Infiltration Pond

Storm	Q in (C.F.S.)	Q out Spillway (C.F.S.)	Q out Infiltration (C.F.S.)	Water Level (Ft.)
2 Year	0.36	0	0.36	140.50
10 Year	2.25	0	0.61	141.25
25 Year	4.15	0	0.74	142.14
100 Year	8.53	0	1.23	144.32

BMP 2Pa Inf. Pond if 25 Year Storm Had Just Occured

Storm	Q in (C.F.S.)	Q out Spillway (C.F.S.)	Q out Infiltration (C.F.S.)	Water Level above bottom of stone (Ft.)
2 Year	0.36	0	0.36	142.14
10 Year	2.25	0	0.85	142.53
25 Year	4.15	0	1.03	143.04
100 Year	8.63	0	1.33	144.93

Forebay Sizing Calculation

Required forebay volume must contain 0.1" runoff from all impervious surfaces.

Total impervious surfaces tributary to forebay

= 1.163 Acres = 50,660 s.f.

Required volume = (50,660 s.f.)(0.1")(1 ft/12") = 422CF

Proposed Forebay Volume

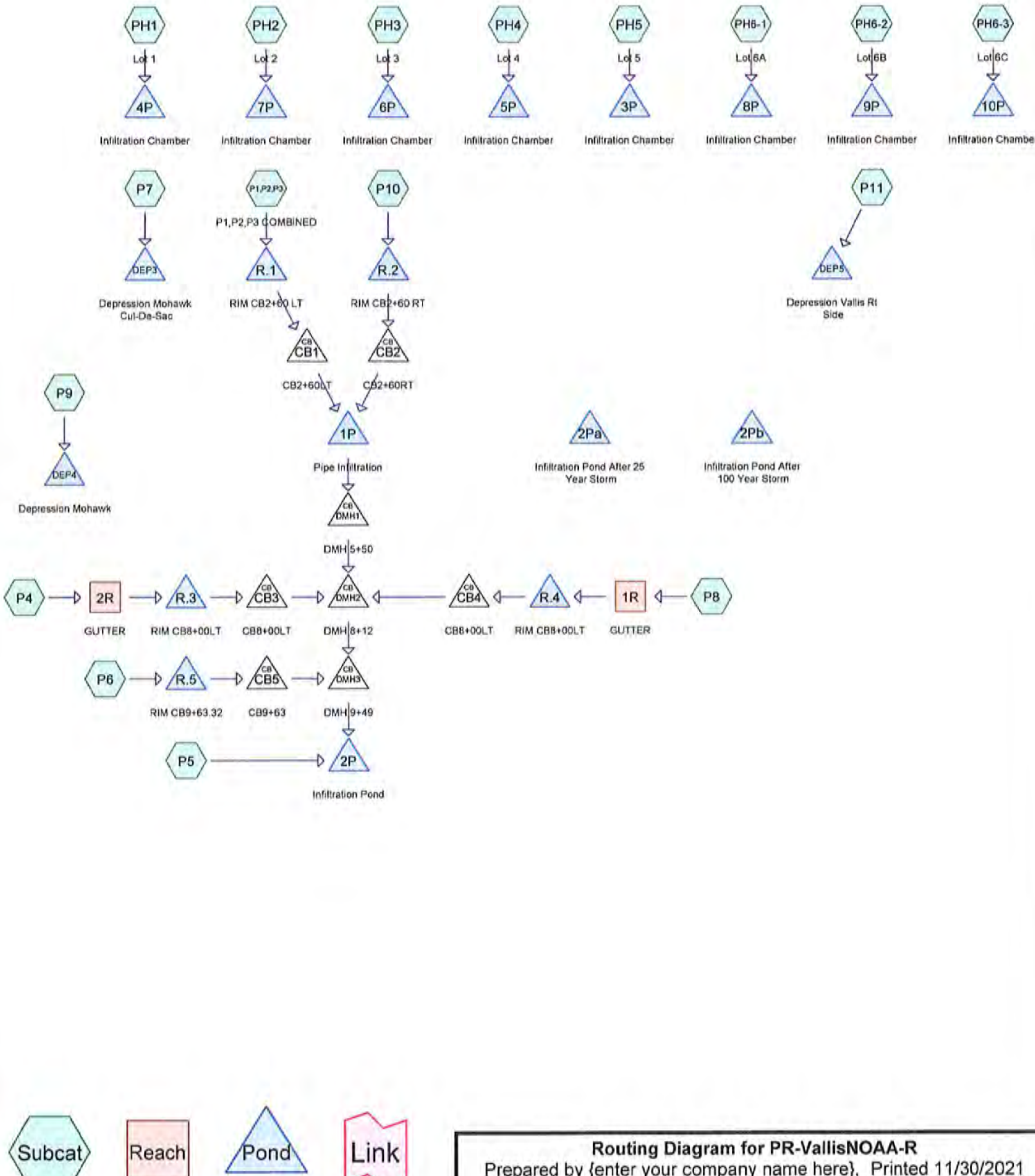
Elev. (ft)	Area (s.f.)	Avg. Area (s.f.)	Inc. (ft)	Vol. (CF)	Cum. Vol. (CF)
140	255				
		378.5	1	378.5	
141	502				378.5
		653	1	653	
142	804				1031.5

Proposed forebay volume = 1031.5CF > Req. forebay vol. 422CF

Proposed Hydro-Cad Report

Vallis Way

Lynnfield, Massachusetts



Routing Diagram for PR-VallisNOAA-R

Prepared by {enter your company name here}, Printed 11/30/2021

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
292,985	39	>75% Grass cover, Good, HSG A (P1,P2,P3, P10, P11, P4, P5, P6, P7, P8, P9)
57,151	98	Paved parking, HSG A (P1,P2,P3, P10, P4, P6, P7, P8)
33,348	98	Roofs, HSG A (PH1, PH2, PH3, PH4, PH5, PH6-1, PH6-2, PH6-3)
198,721	30	Woods, Good, HSG A (P1,P2,P3, P10, P11, P4, P5, P7, P9)
582,204	**45**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
582,204	HSG A	P1,P2,P3, P1,P2,P3, P1,P2,P3, P10, P11, P4, P5, P6, P7, P8, P9, PH1, PH2, PH3, PH4, PH5, PH6-1, PH6-2, PH6-3
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
582,204		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
292,985	0	0	0	0	292,985	>75% Grass cover, Good
57,151	0	0	0	0	57,151	Paved parking
33,348	0	0	0	0	33,348	Roofs
198,721	0	0	0	0	198,721	Woods, Good
582,204	**0**	**0**	**0**	**0**	**582,204**	**TOTAL AREA**

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	1P	145.60	145.60	1.0	0.0000	0.011	0.0	18.0	6.0
2	CB1	146.40	146.20	14.0	0.0143	0.013	0.0	12.0	0.0
3	CB2	146.40	146.20	14.0	0.0143	0.013	0.0	12.0	0.0
4	CB3	144.00	143.37	11.0	0.0573	0.013	0.0	12.0	0.0
5	CB4	144.00	143.37	11.0	0.0573	0.013	0.0	12.0	0.0
6	CB5	142.70	142.51	13.0	0.0146	0.013	0.0	12.0	0.0
7	DMH1	144.40	143.12	256.0	0.0050	0.013	0.0	15.0	0.0
8	DMH2	143.02	142.36	132.0	0.0050	0.013	0.0	15.0	0.0
9	DMH3	142.26	141.59	67.0	0.0100	0.013	0.0	15.0	0.0

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P1,P2,P3: P1,P2,P3 Runoff Area=4.705 ac 3.66% Impervious Runoff Depth=0.00"
Flow Length=300' Tc=14.3 min CN=37 Runoff=0.00 cfs 0 cf

Subcatchment P10: Runoff Area=0.454 ac 42.51% Impervious Runoff Depth=0.53"
Tc=6.0 min CN=62 Runoff=0.20 cfs 872 cf

Subcatchment P11: Runoff Area=0.809 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=275' Tc=9.0 min CN=37 Runoff=0.00 cfs 0 cf

Subcatchment P4: Runoff Area=1.081 ac 15.54% Impervious Runoff Depth=0.09"
Flow Length=455' Tc=16.5 min CN=47 Runoff=0.01 cfs 354 cf

Subcatchment P5: Runoff Area=1.048 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=225' Tc=12.7 min CN=37 Runoff=0.00 cfs 0 cf

Subcatchment P6: Runoff Area=1.134 ac 30.95% Impervious Runoff Depth=0.35"
Flow Length=455' Tc=10.3 min CN=57 Runoff=0.19 cfs 1,429 cf

Subcatchment P7: Runoff Area=1.898 ac 7.85% Impervious Runoff Depth=0.00"
Flow Length=100' Tc=6.0 min CN=37 Runoff=0.00 cfs 0 cf

Subcatchment P8: Runoff Area=0.868 ac 32.14% Impervious Runoff Depth=0.38"
Flow Length=305' Tc=10.5 min CN=58 Runoff=0.17 cfs 1,200 cf

Subcatchment P9: Runoff Area=0.603 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=200' Tc=8.8 min CN=35 Runoff=0.00 cfs 0 cf

Subcatchment PH1: Lot 1 Runoff Area=4,321 sf 100.00% Impervious Runoff Depth=3.08"
Tc=6.0 min CN=98 Runoff=0.31 cfs 1,108 cf

Subcatchment PH2: Lot 2 Runoff Area=3,732 sf 100.00% Impervious Runoff Depth=3.08"
Tc=6.0 min CN=98 Runoff=0.27 cfs 957 cf

Subcatchment PH3: Lot 3 Runoff Area=4,037 sf 100.00% Impervious Runoff Depth=3.08"
Tc=6.0 min CN=98 Runoff=0.29 cfs 1,035 cf

Subcatchment PH4: Lot 4 Runoff Area=4,037 sf 100.00% Impervious Runoff Depth=3.08"
Tc=6.0 min CN=98 Runoff=0.29 cfs 1,035 cf

Subcatchment PH5: Lot 5 Runoff Area=4,321 sf 100.00% Impervious Runoff Depth=3.08"
Tc=6.0 min CN=98 Runoff=0.31 cfs 1,108 cf

Subcatchment PH6-1: Lot 6A Runoff Area=4,300 sf 100.00% Impervious Runoff Depth=3.08"
Tc=6.0 min CN=98 Runoff=0.31 cfs 1,103 cf

Subcatchment PH6-2: Lot 6B Runoff Area=4,300 sf 100.00% Impervious Runoff Depth=3.08"
Tc=6.0 min CN=98 Runoff=0.31 cfs 1,103 cf

Subcatchment PH6-3: Lot 6C Runoff Area=4,300 sf 100.00% Impervious Runoff Depth=3.08"
Tc=6.0 min CN=98 Runoff=0.31 cfs 1,103 cf

Reach 1R: GUTTER Avg. Flow Depth=0.07' Max Vel=1.43 fps Inflow=0.17 cfs 1,200 cf
n=0.013 L=284.0' S=0.0140 '/' Capacity=31.99 cfs Outflow=0.17 cfs 1,200 cf

Reach 2R: GUTTER Avg. Flow Depth=0.03' Max Vel=0.76 fps Inflow=0.01 cfs 354 cf
n=0.013 L=284.0' S=0.0140 '/' Capacity=31.99 cfs Outflow=0.01 cfs 354 cf

Pond 1P: Pipe Infiltration Peak Elev=141.60' Storage=0 cf Inflow=0.20 cfs 872 cf
Discarded=0.20 cfs 872 cf Primary=0.00 cfs 0 cf Outflow=0.20 cfs 872 cf

Pond 2P: Infiltration Pond Peak Elev=140.50' Storage=0 cf Inflow=0.36 cfs 2,983 cf
Outflow=0.36 cfs 2,983 cf

Pond 2Pa: Infiltration Pond After 25 Year Storm Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0 cf

Pond 2Pb: Infiltration Pond After 100 Year Storm Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0 cf

Pond 3P: Infiltration Chamber Peak Elev=1.38' Storage=274 cf Inflow=0.31 cfs 1,108 cf
Outflow=0.06 cfs 1,109 cf

Pond 4P: Infiltration Chamber Peak Elev=1.38' Storage=274 cf Inflow=0.31 cfs 1,108 cf
Outflow=0.06 cfs 1,109 cf

Pond 5P: Infiltration Chamber Peak Elev=1.27' Storage=245 cf Inflow=0.29 cfs 1,035 cf
Outflow=0.06 cfs 1,039 cf

Pond 6P: Infiltration Chamber Peak Elev=1.27' Storage=245 cf Inflow=0.29 cfs 1,035 cf
Outflow=0.06 cfs 1,039 cf

Pond 7P: Infiltration Chamber Peak Elev=1.15' Storage=213 cf Inflow=0.27 cfs 957 cf
Outflow=0.06 cfs 958 cf

Pond 8P: Infiltration Chamber Peak Elev=1.37' Storage=272 cf Inflow=0.31 cfs 1,103 cf
Outflow=0.06 cfs 1,106 cf

Pond 9P: Infiltration Chamber Peak Elev=1.37' Storage=272 cf Inflow=0.31 cfs 1,103 cf
Outflow=0.06 cfs 1,106 cf

Pond 10P: Infiltration Chamber Peak Elev=1.37' Storage=272 cf Inflow=0.31 cfs 1,103 cf
Outflow=0.06 cfs 1,106 cf

Pond CB1: CB2+60LT Peak Elev=146.40' Inflow=0.00 cfs 0 cf
12.0" Round Culvert n=0.013 L=14.0' S=0.0143 '/' Outflow=0.00 cfs 0 cf

Pond CB2: CB2+60RT Peak Elev=146.62' Inflow=0.20 cfs 872 cf
12.0" Round Culvert n=0.013 L=14.0' S=0.0143 '/' Outflow=0.20 cfs 872 cf

Pond CB3: CB8+00LT Peak Elev=144.05' Inflow=0.01 cfs 354 cf
12.0" Round Culvert n=0.013 L=11.0' S=0.0573 '/' Outflow=0.01 cfs 354 cf

Pond CB4: CB8+00LT Peak Elev=144.20' Inflow=0.17 cfs 1,200 cf
12.0" Round Culvert n=0.013 L=11.0' S=0.0573 '/' Outflow=0.17 cfs 1,200 cf

Pond CB5: CB9+63 Peak Elev=142.91' Inflow=0.19 cfs 1,429 cf
12.0" Round Culvert n=0.013 L=13.0' S=0.0146 '/' Outflow=0.19 cfs 1,429 cf

Pond DEP3: Depression Mohawk Cul-De-Sac Peak Elev=149.00' Storage=0 cf Inflow=0.00 cfs 0 cf
Outflow=0.00 cfs 0 cf

Pond DEP4: Depression Mohawk Peak Elev=149.00' Storage=0 cf Inflow=0.00 cfs 0 cf
Outflow=0.00 cfs 0 cf

Pond DEP5: Depression Vallis Rt Side Peak Elev=148.00' Storage=0 cf Inflow=0.00 cfs 0 cf
Outflow=0.00 cfs 0 cf

Pond DMH1: DMH 5+50 Peak Elev=144.40' Inflow=0.00 cfs 0 cf
15.0" Round Culvert n=0.013 L=256.0' S=0.0050 '/' Outflow=0.00 cfs 0 cf

Pond DMH2: DMH 8+12 Peak Elev=143.24' Inflow=0.17 cfs 1,554 cf
15.0" Round Culvert n=0.013 L=132.0' S=0.0050 '/' Outflow=0.17 cfs 1,554 cf

Pond DMH3: DMH 9+49 Peak Elev=142.54' Inflow=0.36 cfs 2,983 cf
15.0" Round Culvert n=0.013 L=67.0' S=0.0100 '/' Outflow=0.36 cfs 2,983 cf

Pond R.1: RIM CB2+60 LT Peak Elev=149.55' Storage=0 cf Inflow=0.00 cfs 0 cf
Outflow=0.00 cfs 0 cf

Pond R.2: RIM CB2+60 RT Peak Elev=149.58' Storage=2 cf Inflow=0.20 cfs 872 cf
Outflow=0.20 cfs 872 cf

Pond R.3: RIM CB8+00LT Peak Elev=148.15' Storage=0 cf Inflow=0.01 cfs 354 cf
Outflow=0.01 cfs 354 cf

Pond R.4: RIM CB8+00LT Peak Elev=148.17' Storage=0 cf Inflow=0.17 cfs 1,200 cf
Outflow=0.17 cfs 1,200 cf

Pond R.5: RIM CB9+63.32 Peak Elev=146.13' Storage=3 cf Inflow=0.19 cfs 1,429 cf
Outflow=0.19 cfs 1,429 cf

Total Runoff Area = 582,204 sf Runoff Volume = 12,406 cf Average Runoff Depth = 0.26"
84.46% Pervious = 491,705 sf 15.54% Impervious = 90,499 sf

Summary for Subcatchment P1,P2,P3: P1,P2,P3 COMBINED

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Pond R.1 : RIM CB2+60 LT

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.31"

Area (ac)	CN	Description
0.172	98	Paved parking, HSG A
2.322	39	>75% Grass cover, Good, HSG A
2.211	30	Woods, Good, HSG A
4.705	37	Weighted Average
4.533		96.34% Pervious Area
0.172		3.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	50	0.0400	0.09		**Sheet Flow, sheet** Woods: Light underbrush n= 0.400 P2= 3.10"
4.8	250	0.0300	0.87		**Shallow Concentrated Flow, shallow** Woodland Kv= 5.0 fps
14.3	300	Total			

Summary for Subcatchment P10:

Runoff = 0.20 cfs @ 12.12 hrs, Volume= 872 cf, Depth= 0.53"
Routed to Pond R.2 : RIM CB2+60 RT

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.31"

Area (ac)	CN	Description
0.193	98	Paved parking, HSG A
0.163	39	>75% Grass cover, Good, HSG A
0.098	30	Woods, Good, HSG A
0.454	62	Weighted Average
0.261		57.49% Pervious Area
0.193		42.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct (calc 4.5 min.)**

Summary for Subcatchment P11:

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Pond DEP5 : Depression Vallis Rt Side

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.31"

Area (ac)	CN	Description
0.596	39	>75% Grass cover, Good, HSG A
0.213	30	Woods, Good, HSG A
0.809	37	Weighted Average
0.809		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	50	0.1800	0.16		**Sheet Flow, Sheet** Woods: Light underbrush n= 0.400 P2= 3.10"
0.2	25	0.1800	2.12		**Shallow Concentrated Flow, Shallow** Woodland Kv= 5.0 fps
1.2	100	0.0400	1.40		**Shallow Concentrated Flow, Shallow grass** Short Grass Pasture Kv= 7.0 fps
2.4	100	0.0100	0.70		**Shallow Concentrated Flow, shallow grass** Short Grass Pasture Kv= 7.0 fps
9.0	275	Total			

Summary for Subcatchment P4:

Runoff = 0.01 cfs @ 14.74 hrs, Volume= 354 cf, Depth= 0.09"
Routed to Reach 2R : GUTTER

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.31"

Area (ac)	CN	Description
0.168	98	Paved parking, HSG A
0.732	39	>75% Grass cover, Good, HSG A
0.181	30	Woods, Good, HSG A
1.081	47	Weighted Average
0.913		84.46% Pervious Area
0.168		15.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	50	0.0400	0.09		**Sheet Flow, sheet** Woods: Light underbrush n= 0.400 P2= 3.10"
5.0	150	0.0100	0.50		**Shallow Concentrated Flow, shallow** Woodland Kv= 5.0 fps
0.8	75	0.0500	1.57		**Shallow Concentrated Flow, shallow grass** Short Grass Pasture Kv= 7.0 fps
1.2	180	0.0150	2.49		**Shallow Concentrated Flow, gutter** Paved Kv= 20.3 fps
16.5	455	Total			

Summary for Subcatchment P5:

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Pond 2P : Infiltration Pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.31"

Area (ac)	CN	Description
0.783	39	>75% Grass cover, Good, HSG A
0.265	30	Woods, Good, HSG A
1.048	37	Weighted Average
1.048		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	50	0.0400	0.09		**Sheet Flow, sheet** Woods: Light underbrush n= 0.400 P2= 3.10"
1.7	50	0.0100	0.50		**Shallow Concentrated Flow, shallow** Woodland Kv= 5.0 fps
1.5	125	0.0400	1.40		**Shallow Concentrated Flow, shallow grass** Short Grass Pasture Kv= 7.0 fps
12.7	225	Total			

Summary for Subcatchment P6:

Runoff = 0.19 cfs @ 12.32 hrs, Volume= 1,429 cf, Depth= 0.35"
Routed to Pond R.5 : RIM CB9+63.32

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.31"

Area (ac)	CN	Description
0.351	98	Paved parking, HSG A
0.783	39	>75% Grass cover, Good, HSG A
1.134	57	Weighted Average
0.783		69.05% Pervious Area
0.351		30.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	50	0.0800	0.25		**Sheet Flow, sheet** Grass: Short n= 0.150 P2= 3.10"
5.0	150	0.0100	0.50		**Shallow Concentrated Flow, shallow** Woodland Kv= 5.0 fps
0.8	75	0.0500	1.57		**Shallow Concentrated Flow, shallow grass** Short Grass Pasture Kv= 7.0 fps
1.2	180	0.0150	2.49		**Shallow Concentrated Flow, gutter** Paved Kv= 20.3 fps
10.3	455	Total			

Summary for Subcatchment P7:

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Pond DEP3 : Depression Mohawk Cul-De-Sac

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.31"

Area (ac)	CN	Description
0.149	98	Paved parking, HSG A
0.413	39	>75% Grass cover, Good, HSG A
1.336	30	Woods, Good, HSG A
1.898	37	Weighted Average
1.749		92.15% Pervious Area
0.149		7.85% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.4	30	0.1000	0.11		**Sheet Flow, sheet** Woods: Light underbrush n= 0.400 P2= 3.10"
0.4	20	0.0100	0.74		**Sheet Flow, sheet** Smooth surfaces n= 0.011 P2= 3.10"
1.2	50	0.0100	0.70		**Shallow Concentrated Flow, shallow grass** Short Grass Pasture Kv= 7.0 fps
6.0	100	Total			

Summary for Subcatchment P8:

Runoff = 0.17 cfs @ 12.27 hrs, Volume= 1,200 cf, Depth= 0.38"
Routed to Reach 1R : GUTTER

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.31"

Area (ac)	CN	Description
0.279	98	Paved parking, HSG A
0.589	39	>75% Grass cover, Good, HSG A
0.868	58	Weighted Average
0.589		67.86% Pervious Area
0.279		32.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0100	0.11		**Sheet Flow, sheet** Grass: Short n= 0.150 P2= 3.10"
1.8	75	0.0100	0.70		**Shallow Concentrated Flow, shallow grass** Short Grass Pasture Kv= 7.0 fps
1.2	180	0.0150	2.49		**Shallow Concentrated Flow, gutter** Paved Kv= 20.3 fps
10.5	305	Total			

Summary for Subcatchment P9:

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Pond DEP4 : Depression Mohawk

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.31"

Area (ac)	CN	Description
0.345	39	>75% Grass cover, Good, HSG A
0.258	30	Woods, Good, HSG A
0.603	35	Weighted Average
0.603		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0100	0.11		**Sheet Flow, sheet** Grass: Short n= 0.150 P2= 3.10"
1.3	150	0.0800	1.98		**Shallow Concentrated Flow, shallow grass** Short Grass Pasture Kv= 7.0 fps
8.8	200	Total			

Summary for Subcatchment PH1: Lot 1

Runoff = 0.31 cfs @ 12.09 hrs, Volume= 1,108 cf, Depth= 3.08"
Routed to Pond 4P : Infiltration Chamber

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.31"

Area (sf)	CN	Description
4,321	98	Roofs, HSG A
4,321		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Summary for Subcatchment PH2: Lot 2

Runoff = 0.27 cfs @ 12.09 hrs, Volume= 957 cf, Depth= 3.08"
Routed to Pond 7P : Infiltration Chamber

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.31"

Area (sf)	CN	Description
3,732	98	Roofs, HSG A
3,732		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Summary for Subcatchment PH3: Lot 3

Runoff = 0.29 cfs @ 12.09 hrs, Volume= 1,035 cf, Depth= 3.08"
Routed to Pond 6P : Infiltration Chamber

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.31"

Area (sf)	CN	Description
4,037	98	Roofs, HSG A
4,037		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Summary for Subcatchment PH4: Lot 4

Runoff = 0.29 cfs @ 12.09 hrs, Volume= 1,035 cf, Depth= 3.08"
Routed to Pond 5P : Infiltration Chamber

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.31"

Area (sf)	CN	Description
4,037	98	Roofs, HSG A
4,037		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Summary for Subcatchment PH5: Lot 5

Runoff = 0.31 cfs @ 12.09 hrs, Volume= 1,108 cf, Depth= 3.08"
Routed to Pond 3P : Infiltration Chamber

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.31"

Area (sf)	CN	Description
4,321	98	Roofs, HSG A
4,321		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Summary for Subcatchment PH6-1: Lot 6A

Runoff = 0.31 cfs @ 12.09 hrs, Volume= 1,103 cf, Depth= 3.08"
Routed to Pond 8P : Infiltration Chamber

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.31"

Area (sf)	CN	Description
4,300	98	Roofs, HSG A
4,300		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Summary for Subcatchment PH6-2: Lot 6B

Runoff = 0.31 cfs @ 12.09 hrs, Volume= 1,103 cf, Depth= 3.08"
Routed to Pond 9P : Infiltration Chamber

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.31"

Area (sf)	CN	Description
4,300	98	Roofs, HSG A
4,300		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Summary for Subcatchment PH6-3: Lot 6C

Runoff = 0.31 cfs @ 12.09 hrs, Volume= 1,103 cf, Depth= 3.08"
Routed to Pond 10P : Infiltration Chamber

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.31"

Area (sf)	CN	Description
4,300	98	Roofs, HSG A
4,300		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Summary for Reach 1R: GUTTER

Inflow Area = 37,810 sf, 32.14% Impervious, Inflow Depth = 0.38" for 2 Year event
Inflow = 0.17 cfs @ 12.27 hrs, Volume= 1,200 cf
Outflow = 0.17 cfs @ 12.33 hrs, Volume= 1,200 cf, Atten= 2%, Lag= 4.1 min
Routed to Pond R.4 : RIM CB8+00LT

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.43 fps, Min. Travel Time= 3.3 min
Avg. Velocity = 0.81 fps, Avg. Travel Time= 5.8 min

Peak Storage= 33 cf @ 12.33 hrs
Average Depth at Peak Storage= 0.07' , Surface Width= 3.37'
Bank-Full Depth= 0.50' Flow Area= 6.0 sf, Capacity= 31.99 cfs

0.00' x 0.50' deep channel, n= 0.013 Asphalt, smooth
Side Slope Z-value= 48.0 0.2 '/' Top Width= 24.10'
Length= 284.0' Slope= 0.0140 '/'
Inlet Invert= 152.30', Outlet Invert= 148.32'

‡

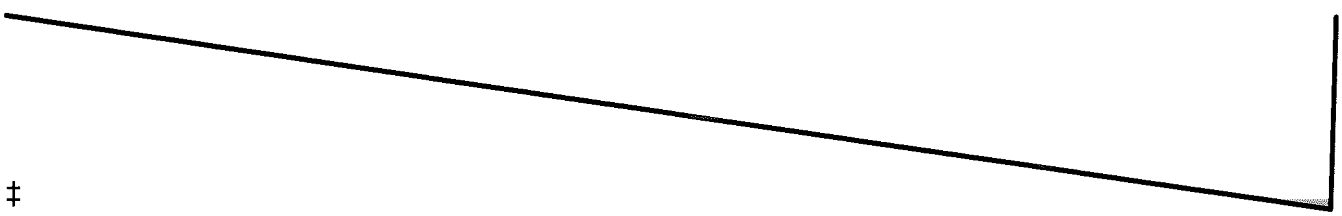
Summary for Reach 2R: GUTTER

Inflow Area = 47,088 sf, 15.54% Impervious, Inflow Depth = 0.09" for 2 Year event
Inflow = 0.01 cfs @ 14.74 hrs, Volume= 354 cf
Outflow = 0.01 cfs @ 14.83 hrs, Volume= 354 cf, Atten= 0%, Lag= 5.3 min
Routed to Pond R.3 : RIM CB8+00LT

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.76 fps, Min. Travel Time= 6.2 min
Avg. Velocity = 0.64 fps, Avg. Travel Time= 7.4 min

Peak Storage= 5 cf @ 14.83 hrs
Average Depth at Peak Storage= 0.03' , Surface Width= 1.28'
Bank-Full Depth= 0.50' Flow Area= 6.0 sf, Capacity= 31.99 cfs

0.00' x 0.50' deep channel, n= 0.013 Asphalt, smooth
Side Slope Z-value= 48.0 0.2 '/' Top Width= 24.10'
Length= 284.0' Slope= 0.0140 '/'
Inlet Invert= 152.30', Outlet Invert= 148.32'



Summary for Pond 1P: Pipe Infiltration

Inflow Area = 224,726 sf, 7.08% Impervious, Inflow Depth = 0.05" for 2 Year event
Inflow = 0.20 cfs @ 12.12 hrs, Volume= 872 cf
Outflow = 0.20 cfs @ 12.12 hrs, Volume= 872 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.20 cfs @ 12.12 hrs, Volume= 872 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Pond DMH1 : DMH 5+50

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 141.60' @ 12.11 hrs Surf.Area= 1,491 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.0 min (905.6 - 905.6)

Volume	Invert	Avail.Storage	Storage Description
#1	141.60'	3,387 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 8,946 cf Overall - 479 cf Embedded = 8,467 cf x 40.0% Voids
#2	145.60'	479 cf	**18.0" Round Pipe Storage** Inside #1 L= 271.0'
		3,866 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
141.60	1,491	0	0
147.60	1,491	8,946	8,946

Device	Routing	Invert	Outlet Devices
#1	Primary	146.10'	**18.0" Round Culvert w/ 6.0" inside fill** L= 1.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 145.60' / 145.60' S= 0.0000 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 1.25 sf
#2	Discarded	141.60'	**6.930 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.24 cfs @ 12.12 hrs HW=141.60' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.24 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=141.60' TW=144.40' (Dynamic Tailwater)
↑—**1=Culvert** (Controls 0.00 cfs)

Summary for Pond 2P: Infiltration Pond

Inflow Area = 404,672 sf, 12.52% Impervious, Inflow Depth = 0.09" for 2 Year event
Inflow = 0.36 cfs @ 12.33 hrs, Volume= 2,983 cf
Outflow = 0.36 cfs @ 12.33 hrs, Volume= 2,983 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.36 cfs @ 12.33 hrs, Volume= 2,983 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 140.50' @ 12.33 hrs Surf.Area= 2,906 sf Storage= 0 cf

Plug-Flow detention time= 0.0 min calculated for 2,980 cf (100% of inflow)
Center-of-Mass det. time= 0.0 min (952.1 - 952.1)

Volume	Invert	Avail.Storage	Storage Description
#1	140.50'	39,382 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
140.50	2,906	0	0
141.00	3,593	1,625	1,625
142.00	4,337	3,965	5,590
143.00	6,379	5,358	10,948
144.00	7,336	6,858	17,805
145.00	8,350	7,843	25,648
146.00	9,420	8,885	34,533
146.50	9,976	4,849	39,382

Device	Routing	Invert	Outlet Devices
#1	Discarded	140.50'	**6.930 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.47 cfs @ 12.33 hrs HW=140.50' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.47 cfs)

Summary for Pond 2Pa: Infiltration Pond After 25 Year Storm

Volume	Invert	Avail.Storage	Storage Description
#1	142.14'	33,089 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
142.14	4,445	0	0
143.00	6,379	4,654	4,654
144.00	7,336	6,858	11,512
145.00	8,350	7,843	19,355
146.00	9,420	8,885	28,240
146.50	9,976	4,849	33,089

Device	Routing	Invert	Outlet Devices
#1	Discarded	142.14'	**6.930 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└─**1=Exfiltration** (Controls 0.00 cfs)

Summary for Pond 2Pb: Infiltration Pond After 100 Year Storm

Volume	Invert	Avail.Storage	Storage Description
#1	144.16'	20,393 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
144.16	7,504	0	0
145.00	8,350	6,659	6,659
146.00	9,420	8,885	15,544
146.50	9,976	4,849	20,393

Device	Routing	Invert	Outlet Devices
#1	Discarded	144.16'	**6.930 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└─**1=Exfiltration** (Controls 0.00 cfs)

Summary for Pond 3P: Infiltration Chamber

Inflow Area = 4,321 sf,100.00% Impervious, Inflow Depth = 3.08" for 2 Year event
Inflow = 0.31 cfs @ 12.09 hrs, Volume= 1,108 cf
Outflow = 0.06 cfs @ 11.80 hrs, Volume= 1,109 cf, Atten= 82%, Lag= 0.0 min
Discarded = 0.06 cfs @ 11.80 hrs, Volume= 1,109 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Peak Elev= 1.38' @ 12.54 hrs Surf.Area= 350 sf Storage= 274 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 25.6 min (781.2 - 755.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	538 cf	**8.42'W x 41.55'L x 5.50'H Field A** 1,923 cf Overall - 580 cf Embedded = 1,344 cf x 40.0% Voids
#2A	0.75'	580 cf	**ADS_StormTech MC-3500 d +Cap** x 5 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap Cap Storage= 14.9 cf x 2 x 1 rows = 29.8 cf
		1,117 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**6.930 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.06 cfs @ 11.80 hrs HW=0.08' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Summary for Pond 4P: Infiltration Chamber

Inflow Area =	4,321 sf,100.00% Impervious,	Inflow Depth = 3.08"	for 2 Year event
Inflow =	0.31 cfs @ 12.09 hrs, Volume=	1,108 cf	
Outflow =	0.06 cfs @ 11.80 hrs, Volume=	1,109 cf, Atten= 82%, Lag= 0.0 min	
Discarded =	0.06 cfs @ 11.80 hrs, Volume=	1,109 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 1.38' @ 12.54 hrs Surf.Area= 350 sf Storage= 274 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 25.6 min (781.2 - 755.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	538 cf	**8.42'W x 41.55'L x 5.50'H Field A** 1,923 cf Overall - 580 cf Embedded = 1,344 cf x 40.0% Voids
#2A	0.75'	580 cf	**ADS_StormTech MC-3500 d +Cap** x 5 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap Cap Storage= 14.9 cf x 2 x 1 rows = 29.8 cf
		1,117 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**6.930 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.06 cfs @ 11.80 hrs HW=0.08' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Summary for Pond 5P: Infiltration Chamber

Inflow Area = 4,037 sf,100.00% Impervious, Inflow Depth = 3.08" for 2 Year event
Inflow = 0.29 cfs @ 12.09 hrs, Volume= 1,035 cf
Outflow = 0.06 cfs @ 11.80 hrs, Volume= 1,039 cf, Atten= 81%, Lag= 0.0 min
Discarded = 0.06 cfs @ 11.80 hrs, Volume= 1,039 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 1.27' @ 12.52 hrs Surf.Area= 350 sf Storage= 245 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 22.4 min (778.1 - 755.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	538 cf	**8.42'W x 41.55'L x 5.50'H Field A** 1,923 cf Overall - 580 cf Embedded = 1,344 cf x 40.0% Voids
#2A	0.75'	580 cf	**ADS_StormTech MC-3500 d +Cap** x 5 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap Cap Storage= 14.9 cf x 2 x 1 rows = 29.8 cf
		1,117 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**6.930 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.06 cfs @ 11.80 hrs HW=0.06' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Summary for Pond 6P: Infiltration Chamber

Inflow Area = 4,037 sf,100.00% Impervious, Inflow Depth = 3.08" for 2 Year event
Inflow = 0.29 cfs @ 12.09 hrs, Volume= 1,035 cf
Outflow = 0.06 cfs @ 11.80 hrs, Volume= 1,039 cf, Atten= 81%, Lag= 0.0 min
Discarded = 0.06 cfs @ 11.80 hrs, Volume= 1,039 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 1.27' @ 12.52 hrs Surf.Area= 350 sf Storage= 245 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 22.4 min (778.1 - 755.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	538 cf	**8.42'W x 41.55'L x 5.50'H Field A** 1,923 cf Overall - 580 cf Embedded = 1,344 cf x 40.0% Voids
#2A	0.75'	580 cf	**ADS_StormTech MC-3500 d +Cap** x 5 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap Cap Storage= 14.9 cf x 2 x 1 rows = 29.8 cf
		1,117 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**6.930 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.06 cfs @ 11.80 hrs HW=0.06' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Summary for Pond 7P: Infiltration Chamber

Inflow Area = 3,732 sf,100.00% Impervious, Inflow Depth = 3.08" for 2 Year event
Inflow = 0.27 cfs @ 12.09 hrs, Volume= 957 cf
Outflow = 0.06 cfs @ 11.85 hrs, Volume= 958 cf, Atten= 79%, Lag= 0.0 min
Discarded = 0.06 cfs @ 11.85 hrs, Volume= 958 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 1.15' @ 12.50 hrs Surf.Area= 350 sf Storage= 213 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 18.6 min (774.3 - 755.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	538 cf	**8.42'W x 41.55'L x 5.50'H Field A** 1,923 cf Overall - 580 cf Embedded = 1,344 cf x 40.0% Voids
#2A	0.75'	580 cf	**ADS_StormTech MC-3500 d +Cap** x 5 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap Cap Storage= 14.9 cf x 2 x 1 rows = 29.8 cf
		1,117 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**6.930 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.06 cfs @ 11.85 hrs HW=0.09' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Summary for Pond 8P: Infiltration Chamber

Inflow Area = 4,300 sf,100.00% Impervious, Inflow Depth = 3.08" for 2 Year event
Inflow = 0.31 cfs @ 12.09 hrs, Volume= 1,103 cf
Outflow = 0.06 cfs @ 11.80 hrs, Volume= 1,106 cf, Atten= 82%, Lag= 0.0 min
Discarded = 0.06 cfs @ 11.80 hrs, Volume= 1,106 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 1.37' @ 12.54 hrs Surf.Area= 350 sf Storage= 272 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 25.5 min (781.2 - 755.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	538 cf	**8.42'W x 41.55'L x 5.50'H Field A** 1,923 cf Overall - 580 cf Embedded = 1,344 cf x 40.0% Voids
#2A	0.75'	580 cf	**ADS_StormTech MC-3500 d +Cap** x 5 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap Cap Storage= 14.9 cf x 2 x 1 rows = 29.8 cf
		1,117 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**6.930 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.06 cfs @ 11.80 hrs HW=0.08' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Summary for Pond 9P: Infiltration Chamber

Inflow Area =	4,300 sf,100.00% Impervious,	Inflow Depth = 3.08"	for 2 Year event
Inflow =	0.31 cfs @ 12.09 hrs, Volume=	1,103 cf	
Outflow =	0.06 cfs @ 11.80 hrs, Volume=	1,106 cf, Atten= 82%, Lag= 0.0 min	
Discarded =	0.06 cfs @ 11.80 hrs, Volume=	1,106 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 1.37' @ 12.54 hrs Surf.Area= 350 sf Storage= 272 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 25.5 min (781.2 - 755.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	538 cf	**8.42'W x 41.55'L x 5.50'H Field A** 1,923 cf Overall - 580 cf Embedded = 1,344 cf x 40.0% Voids
#2A	0.75'	580 cf	**ADS_StormTech MC-3500 d +Cap** x 5 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap Cap Storage= 14.9 cf x 2 x 1 rows = 29.8 cf
		1,117 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**6.930 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.06 cfs @ 11.80 hrs HW=0.08' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Summary for Pond 10P: Infiltration Chamber

Inflow Area =	4,300 sf,100.00% Impervious,	Inflow Depth = 3.08"	for 2 Year event	
Inflow =	0.31 cfs @ 12.09 hrs,	Volume=	1,103 cf	
Outflow =	0.06 cfs @ 11.80 hrs,	Volume=	1,106 cf,	Atten= 82%, Lag= 0.0 min
Discarded =	0.06 cfs @ 11.80 hrs,	Volume=	1,106 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 1.37' @ 12.54 hrs Surf.Area= 350 sf Storage= 272 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 25.5 min (781.2 - 755.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	538 cf	**8.42'W x 41.55'L x 5.50'H Field A** 1,923 cf Overall - 580 cf Embedded = 1,344 cf x 40.0% Voids
#2A	0.75'	580 cf	**ADS_StormTech MC-3500 d +Cap** x 5 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap Cap Storage= 14.9 cf x 2 x 1 rows = 29.8 cf
		1,117 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**6.930 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.06 cfs @ 11.80 hrs HW=0.08' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Summary for Pond CB1: CB2+60LT

Inflow Area =	204,950 sf, 3.66% Impervious,	Inflow Depth = 0.00"	for 2 Year event	
Inflow =	0.00 cfs @ 0.00 hrs,	Volume=	0 cf	
Outflow =	0.00 cfs @ 0.00 hrs,	Volume=	0 cf,	Atten= 0%, Lag= 0.0 min
Primary =	0.00 cfs @ 0.00 hrs,	Volume=	0 cf	

Routed to Pond 1P : Pipe Infiltration

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 146.40' @ 0.00 hrs
Flood Elev= 149.55'

Device	Routing	Invert	Outlet Devices
#1	Primary	146.40'	**12.0" Round Culvert** L= 14.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 146.40' / 146.20' S= 0.0143 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=146.40' TW=141.60' (Dynamic Tailwater)
└─**1=Culvert** (Controls 0.00 cfs)

Summary for Pond CB2: CB2+60RT

Inflow Area = 19,776 sf, 42.51% Impervious, Inflow Depth = 0.53" for 2 Year event
Inflow = 0.20 cfs @ 12.12 hrs, Volume= 872 cf
Outflow = 0.20 cfs @ 12.12 hrs, Volume= 872 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.20 cfs @ 12.12 hrs, Volume= 872 cf
Routed to Pond 1P : Pipe Infiltration

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 146.62' @ 12.12 hrs
Flood Elev= 149.55'

Device	Routing	Invert	Outlet Devices
#1	Primary	146.40'	**12.0" Round Culvert** L= 14.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 146.40' / 146.20' S= 0.0143 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.19 cfs @ 12.12 hrs HW=146.61' TW=141.60' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 0.19 cfs @ 2.32 fps)

Summary for Pond CB3: CB8+00LT

Inflow Area = 47,088 sf, 15.54% Impervious, Inflow Depth = 0.09" for 2 Year event
Inflow = 0.01 cfs @ 14.83 hrs, Volume= 354 cf
Outflow = 0.01 cfs @ 14.83 hrs, Volume= 354 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.01 cfs @ 14.83 hrs, Volume= 354 cf
Routed to Pond DMH2 : DMH 8+12

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 144.05' @ 14.83 hrs
Flood Elev= 148.15'

Device	Routing	Invert	Outlet Devices
#1	Primary	144.00'	**12.0" Round Culvert** L= 11.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 144.00' / 143.37' S= 0.0573 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.01 cfs @ 14.83 hrs HW=144.05' TW=143.14' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 0.01 cfs @ 0.79 fps)

Summary for Pond CB4: CB8+00LT

Inflow Area = 37,810 sf, 32.14% Impervious, Inflow Depth = 0.38" for 2 Year event
Inflow = 0.17 cfs @ 12.34 hrs, Volume= 1,200 cf
Outflow = 0.17 cfs @ 12.34 hrs, Volume= 1,200 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.17 cfs @ 12.34 hrs, Volume= 1,200 cf
Routed to Pond DMH2 : DMH 8+12

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Peak Elev= 144.20' @ 12.33 hrs
Flood Elev= 148.15'

Device	Routing	Invert	Outlet Devices
#1	Primary	144.00'	**12.0" Round Culvert** L= 11.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 144.00' / 143.37' S= 0.0573 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.17 cfs @ 12.34 hrs HW=144.20' TW=143.24' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 0.17 cfs @ 1.52 fps)

Summary for Pond CB5: CB9+63

Inflow Area = 49,397 sf, 30.95% Impervious, Inflow Depth = 0.35" for 2 Year event
Inflow = 0.19 cfs @ 12.32 hrs, Volume= 1,429 cf
Outflow = 0.19 cfs @ 12.32 hrs, Volume= 1,429 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.19 cfs @ 12.32 hrs, Volume= 1,429 cf
Routed to Pond DMH3 : DMH 9+49

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 142.91' @ 12.32 hrs
Flood Elev= 146.10'

Device	Routing	Invert	Outlet Devices
#1	Primary	142.70'	**12.0" Round Culvert** L= 13.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 142.70' / 142.51' S= 0.0146 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.19 cfs @ 12.32 hrs HW=142.91' TW=142.54' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 0.19 cfs @ 2.32 fps)

Summary for Pond DEP3: Depression Mohawk Cul-De-Sac

Inflow Area = 82,677 sf, 7.85% Impervious, Inflow Depth = 0.00" for 2 Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 149.00' @ 0.00 hrs Surf.Area= 7,000 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	149.00'	4,250 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
149.00	7,000	0	0
149.50	10,000	4,250	4,250

Device	Routing	Invert	Outlet Devices
#1	Discarded	149.00'	**6.930 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=149.00' (Free Discharge)
↑—**1=Exfiltration** (Passes 0.00 cfs of 1.12 cfs potential flow)

Summary for Pond DEP4: Depression Mohawk

Inflow Area = 26,267 sf, 0.00% Impervious, Inflow Depth = 0.00" for 2 Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 149.00' @ 0.00 hrs Surf.Area= 2,900 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	149.00'	1,475 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
149.00	2,900	0	0
149.50	3,000	1,475	1,475

Device	Routing	Invert	Outlet Devices
#1	Discarded	149.00'	**6.930 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=149.00' (Free Discharge)
↑—**1=Exfiltration** (Passes 0.00 cfs of 0.47 cfs potential flow)

Summary for Pond DEP5: Depression Vallis Rt Side

Inflow Area = 35,240 sf, 0.00% Impervious, Inflow Depth = 0.00" for 2 Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 148.00' @ 0.00 hrs Surf.Area= 2,800 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	148.00'	4,050 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
148.00	2,800	0	0
149.00	5,300	4,050	4,050

Device	Routing	Invert	Outlet Devices
#1	Discarded	148.00'	**6.930 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=148.00' (Free Discharge)
└─**1=Exfiltration** (Passes 0.00 cfs of 0.45 cfs potential flow)

Summary for Pond DMH1: DMH 5+50

Inflow Area = 224,726 sf, 7.08% Impervious, Inflow Depth = 0.00" for 2 Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Pond DMH2 : DMH 8+12

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 144.40' @ 0.00 hrs
Flood Elev= 151.68'

Device	Routing	Invert	Outlet Devices
#1	Primary	144.40'	**15.0" Round Culvert** L= 256.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 144.40' / 143.12' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=144.40' TW=143.02' (Dynamic Tailwater)
└─**1=Culvert** (Controls 0.00 cfs)

Summary for Pond DMH2: DMH 8+12

Inflow Area = 309,624 sf, 11.42% Impervious, Inflow Depth = 0.06" for 2 Year event
Inflow = 0.17 cfs @ 12.34 hrs, Volume= 1,554 cf
Outflow = 0.17 cfs @ 12.34 hrs, Volume= 1,554 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.17 cfs @ 12.34 hrs, Volume= 1,554 cf
Routed to Pond DMH3 : DMH 9+49

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 143.24' @ 12.34 hrs
Flood Elev= 148.32'

Device	Routing	Invert	Outlet Devices
#1	Primary	143.02'	**15.0" Round Culvert** L= 132.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 143.02' / 142.36' S= 0.0050 '/' Cc= 0.900

n= 0.013, Flow Area= 1.23 sf

Primary OutFlow Max=0.17 cfs @ 12.34 hrs HW=143.24' TW=142.54' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 0.17 cfs @ 1.74 fps)

Summary for Pond DMH3: DMH 9+49

Inflow Area =	359,022 sf,	14.11% Impervious,	Inflow Depth = 0.10"	for 2 Year event	
Inflow =	0.36 cfs @	12.33 hrs,	Volume=	2,983 cf	
Outflow =	0.36 cfs @	12.33 hrs,	Volume=	2,983 cf,	Atten= 0%, Lag= 0.0 min
Primary =	0.36 cfs @	12.33 hrs,	Volume=	2,983 cf	

Routed to Pond 2P : Infiltration Pond

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 142.54' @ 12.33 hrs
Flood Elev= 146.18'

Device	Routing	Invert	Outlet Devices
#1	Primary	142.26'	**15.0" Round Culvert** L= 67.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 142.26' / 141.59' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf

Primary OutFlow Max=0.36 cfs @ 12.33 hrs HW=142.54' TW=140.50' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 0.36 cfs @ 2.67 fps)

Summary for Pond R.1: RIM CB2+60 LT

Inflow Area =	204,950 sf,	3.66% Impervious,	Inflow Depth = 0.00"	for 2 Year event	
Inflow =	0.00 cfs @	0.00 hrs,	Volume=	0 cf	
Outflow =	0.00 cfs @	0.00 hrs,	Volume=	0 cf,	Atten= 0%, Lag= 0.0 min
Primary =	0.00 cfs @	0.00 hrs,	Volume=	0 cf	

Routed to Pond CB1 : CB2+60LT

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 149.55' @ 0.00 hrs Surf.Area= 4 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	149.55'	167 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
149.55	4	0	0
149.89	980	167	167

Device	Routing	Invert	Outlet Devices
#1	Primary	149.55'	**2.0" x 2.0" Horiz. Orifice/Grate X 6.00 columns** X 6 rows C= 0.600 in 24.0" x 24.0" Grate (25% open area)

			Limited to weir flow at low heads
#2	Primary	149.55'	**24.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=149.55' TW=146.40' (Dynamic Tailwater)
↑—**1=Orifice/Grate** (Controls 0.00 cfs)
└—**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond R.2: RIM CB2+60 RT

Inflow Area = 19,776 sf, 42.51% Impervious, Inflow Depth = 0.53" for 2 Year event
Inflow = 0.20 cfs @ 12.12 hrs, Volume= 872 cf
Outflow = 0.20 cfs @ 12.12 hrs, Volume= 872 cf, Atten= 0%, Lag= 0.2 min
Primary = 0.20 cfs @ 12.12 hrs, Volume= 872 cf
Routed to Pond CB2 : CB2+60RT

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 149.58' @ 12.12 hrs Surf.Area= 99 sf Storage= 2 cf

Plug-Flow detention time= 0.1 min calculated for 871 cf (100% of inflow)
Center-of-Mass det. time= 0.1 min (905.6 - 905.5)

Volume	Invert	Avail.Storage	Storage Description
#1	149.55'	167 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
149.55	4	0	0
149.89	980	167	167

Device	Routing	Invert	Outlet Devices
#1	Primary	149.55'	**2.0" x 2.0" Horiz. Orifice/Grate X 6.00 columns** X 6 rows C= 0.600 in 24.0" x 24.0" Grate (25% open area) Limited to weir flow at low heads
#2	Primary	149.55'	**24.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.19 cfs @ 12.12 hrs HW=149.58' TW=146.61' (Dynamic Tailwater)
↑—**1=Orifice/Grate** (Weir Controls 0.15 cfs @ 0.59 fps)
└—**2=Orifice/Grate** (Orifice Controls 0.04 cfs @ 0.58 fps)

Summary for Pond R.3: RIM CB8+00LT

Inflow Area = 47,088 sf, 15.54% Impervious, Inflow Depth = 0.09" for 2 Year event
Inflow = 0.01 cfs @ 14.83 hrs, Volume= 354 cf
Outflow = 0.01 cfs @ 14.83 hrs, Volume= 354 cf, Atten= 0%, Lag= 0.3 min
Primary = 0.01 cfs @ 14.83 hrs, Volume= 354 cf
Routed to Pond CB3 : CB8+00LT

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Peak Elev= 148.15' @ 14.83 hrs Surf.Area= 6 sf Storage= 0 cf

Plug-Flow detention time= 0.0 min calculated for 354 cf (100% of inflow)
Center-of-Mass det. time= 0.0 min (1,061.1 - 1,061.1)

Volume	Invert	Avail.Storage	Storage Description
#1	148.15'	58 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
148.15	4	0	0
148.65	226	58	58

Device	Routing	Invert	Outlet Devices
#1	Primary	148.15'	**2.0" x 2.0" Horiz. Orifice/Grate X 12.00 columns** X 6 rows C= 0.600 in 48.0" x 24.0" Grate (25% open area) Limited to weir flow at low heads
#2	Primary	148.15'	**24.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.01 cfs @ 14.83 hrs HW=148.15' TW=144.05' (Dynamic Tailwater)
1=**Orifice/Grate** (Weir Controls 0.01 cfs @ 0.22 fps)
2=**Orifice/Grate** (Orifice Controls 0.00 cfs @ 0.21 fps)

Summary for Pond R.4: RIM CB8+00LT

Inflow Area = 37,810 sf, 32.14% Impervious, Inflow Depth = 0.38" for 2 Year event
Inflow = 0.17 cfs @ 12.33 hrs, Volume= 1,200 cf
Outflow = 0.17 cfs @ 12.34 hrs, Volume= 1,200 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.17 cfs @ 12.34 hrs, Volume= 1,200 cf
Routed to Pond CB4 : CB8+00LT

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 148.17' @ 12.33 hrs Surf.Area= 15 sf Storage= 0 cf

Plug-Flow detention time= 0.0 min calculated for 1,198 cf (100% of inflow)
Center-of-Mass det. time= 0.0 min (936.6 - 936.6)

Volume	Invert	Avail.Storage	Storage Description
#1	148.15'	58 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
148.15	4	0	0
148.65	226	58	58

Device	Routing	Invert	Outlet Devices
#1	Primary	148.15'	**2.0" x 2.0" Horiz. Orifice/Grate X 12.00 columns** X 6 rows C= 0.600 in 48.0" x 24.0" Grate (25% open area) Limited to weir flow at low heads
#2	Primary	148.15'	**24.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600

Limited to weir flow at low heads

Primary OutFlow Max=0.17 cfs @ 12.34 hrs HW=148.17' TW=144.20' (Dynamic Tailwater)
1=Orifice/Grate (Weir Controls 0.14 cfs @ 0.50 fps)
2=Orifice/Grate (Orifice Controls 0.02 cfs @ 0.50 fps)

Summary for Pond R.5: RIM CB9+63.32

Inflow Area = 49,397 sf, 30.95% Impervious, Inflow Depth = 0.35" for 2 Year event
Inflow = 0.19 cfs @ 12.32 hrs, Volume= 1,429 cf
Outflow = 0.19 cfs @ 12.32 hrs, Volume= 1,429 cf, Atten= 0%, Lag= 0.3 min
Primary = 0.19 cfs @ 12.32 hrs, Volume= 1,429 cf
Routed to Pond CB5 : CB9+63

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 146.13' @ 12.32 hrs Surf.Area= 156 sf Storage= 3 cf

Plug-Flow detention time= 0.2 min calculated for 1,428 cf (100% of inflow)
Center-of-Mass det. time= 0.2 min (938.1 - 938.0)

Volume	Invert	Avail.Storage	Storage Description
#1	146.10'	1,901 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
146.10	4	0	0
147.00	4,221	1,901	1,901

Device	Routing	Invert	Outlet Devices
#1	Primary	146.10'	**2.0" x 2.0" Horiz. Orifice/Grate X 6.00 columns** X 6 rows C= 0.600 in 24.0" x 24.0" Grate (25% open area) Limited to weir flow at low heads
#2	Primary	146.10'	**24.0" W x 4.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.19 cfs @ 12.32 hrs HW=146.13' TW=142.91' (Dynamic Tailwater)
1=Orifice/Grate (Weir Controls 0.15 cfs @ 0.59 fps)
2=Orifice/Grate (Orifice Controls 0.04 cfs @ 0.58 fps)

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P1,P2,P3: P1,P2,P3 Runoff Area=4.705 ac 3.66% Impervious Runoff Depth=0.17"
Flow Length=300' Tc=14.3 min CN=37 Runoff=0.11 cfs 2,985 cf

Subcatchment P10: Runoff Area=0.454 ac 42.51% Impervious Runoff Depth=1.58"
Tc=6.0 min CN=62 Runoff=0.77 cfs 2,597 cf

Subcatchment P11: Runoff Area=0.809 ac 0.00% Impervious Runoff Depth=0.17"
Flow Length=275' Tc=9.0 min CN=37 Runoff=0.02 cfs 513 cf

Subcatchment P4: Runoff Area=1.081 ac 15.54% Impervious Runoff Depth=0.62"
Flow Length=455' Tc=16.5 min CN=47 Runoff=0.33 cfs 2,422 cf

Subcatchment P5: Runoff Area=1.048 ac 0.00% Impervious Runoff Depth=0.17"
Flow Length=225' Tc=12.7 min CN=37 Runoff=0.03 cfs 665 cf

Subcatchment P6: Runoff Area=1.134 ac 30.95% Impervious Runoff Depth=1.22"
Flow Length=455' Tc=10.3 min CN=57 Runoff=1.20 cfs 5,037 cf

Subcatchment P7: Runoff Area=1.898 ac 7.85% Impervious Runoff Depth=0.17"
Flow Length=100' Tc=6.0 min CN=37 Runoff=0.05 cfs 1,204 cf

Subcatchment P8: Runoff Area=0.868 ac 32.14% Impervious Runoff Depth=1.29"
Flow Length=305' Tc=10.5 min CN=58 Runoff=0.98 cfs 4,070 cf

Subcatchment P9: Runoff Area=0.603 ac 0.00% Impervious Runoff Depth=0.11"
Flow Length=200' Tc=8.8 min CN=35 Runoff=0.01 cfs 247 cf

Subcatchment PH1: Lot 1 Runoff Area=4,321 sf 100.00% Impervious Runoff Depth=4.98"
Tc=6.0 min CN=98 Runoff=0.49 cfs 1,794 cf

Subcatchment PH2: Lot 2 Runoff Area=3,732 sf 100.00% Impervious Runoff Depth=4.98"
Tc=6.0 min CN=98 Runoff=0.43 cfs 1,550 cf

Subcatchment PH3: Lot 3 Runoff Area=4,037 sf 100.00% Impervious Runoff Depth=4.98"
Tc=6.0 min CN=98 Runoff=0.46 cfs 1,676 cf

Subcatchment PH4: Lot 4 Runoff Area=4,037 sf 100.00% Impervious Runoff Depth=4.98"
Tc=6.0 min CN=98 Runoff=0.46 cfs 1,676 cf

Subcatchment PH5: Lot 5 Runoff Area=4,321 sf 100.00% Impervious Runoff Depth=4.98"
Tc=6.0 min CN=98 Runoff=0.49 cfs 1,794 cf

Subcatchment PH6-1: Lot 6A Runoff Area=4,300 sf 100.00% Impervious Runoff Depth=4.98"
Tc=6.0 min CN=98 Runoff=0.49 cfs 1,786 cf

Subcatchment PH6-2: Lot 6B Runoff Area=4,300 sf 100.00% Impervious Runoff Depth=4.98"
Tc=6.0 min CN=98 Runoff=0.49 cfs 1,786 cf

Subcatchment PH6-3: Lot 6C Runoff Area=4,300 sf 100.00% Impervious Runoff Depth=4.98"
Tc=6.0 min CN=98 Runoff=0.49 cfs 1,786 cf

Reach 1R: GUTTER Avg. Flow Depth=0.13' Max Vel=2.21 fps Inflow=0.98 cfs 4,070 cf
n=0.013 L=284.0' S=0.0140 '/' Capacity=31.99 cfs Outflow=0.95 cfs 4,070 cf

Reach 2R: GUTTER Avg. Flow Depth=0.09' Max Vel=1.68 fps Inflow=0.33 cfs 2,422 cf
n=0.013 L=284.0' S=0.0140 '/' Capacity=31.99 cfs Outflow=0.32 cfs 2,422 cf

Pond 1P: Pipe Infiltration Peak Elev=142.35' Storage=444 cf Inflow=0.77 cfs 5,582 cf
Discarded=0.24 cfs 5,586 cf Primary=0.00 cfs 0 cf Outflow=0.24 cfs 5,586 cf

Pond 2P: Infiltration Pond Peak Elev=141.25' Storage=2,561 cf Inflow=2.25 cfs 12,194 cf
Outflow=0.61 cfs 12,209 cf

Pond 2Pa: Infiltration Pond After 25 Year Storm Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0 cf

Pond 2Pb: Infiltration Pond After 100 Year Storm Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0 cf

Pond 3P: Infiltration Chamber Peak Elev=2.46' Storage=555 cf Inflow=0.49 cfs 1,794 cf
Outflow=0.06 cfs 1,798 cf

Pond 4P: Infiltration Chamber Peak Elev=2.46' Storage=555 cf Inflow=0.49 cfs 1,794 cf
Outflow=0.06 cfs 1,798 cf

Pond 5P: Infiltration Chamber Peak Elev=2.25' Storage=503 cf Inflow=0.46 cfs 1,676 cf
Outflow=0.06 cfs 1,678 cf

Pond 6P: Infiltration Chamber Peak Elev=2.25' Storage=503 cf Inflow=0.46 cfs 1,676 cf
Outflow=0.06 cfs 1,678 cf

Pond 7P: Infiltration Chamber Peak Elev=2.04' Storage=448 cf Inflow=0.43 cfs 1,550 cf
Outflow=0.06 cfs 1,553 cf

Pond 8P: Infiltration Chamber Peak Elev=2.44' Storage=551 cf Inflow=0.49 cfs 1,786 cf
Outflow=0.06 cfs 1,787 cf

Pond 9P: Infiltration Chamber Peak Elev=2.44' Storage=551 cf Inflow=0.49 cfs 1,786 cf
Outflow=0.06 cfs 1,787 cf

Pond 10P: Infiltration Chamber Peak Elev=2.44' Storage=551 cf Inflow=0.49 cfs 1,786 cf
Outflow=0.06 cfs 1,787 cf

Pond CB1: CB2+60LT Peak Elev=146.56' Inflow=0.11 cfs 2,985 cf
12.0" Round Culvert n=0.013 L=14.0' S=0.0143 '/' Outflow=0.11 cfs 2,985 cf

Pond CB2: CB2+60RT Peak Elev=146.87' Inflow=0.77 cfs 2,597 cf
12.0" Round Culvert n=0.013 L=14.0' S=0.0143 '/' Outflow=0.77 cfs 2,597 cf

Pond CB3: CB8+00LT Peak Elev=144.28' Inflow=0.32 cfs 2,422 cf
12.0" Round Culvert n=0.013 L=11.0' S=0.0573 '/' Outflow=0.32 cfs 2,422 cf

Pond CB4: CB8+00LT Peak Elev=144.50' Inflow=0.95 cfs 4,070 cf
12.0" Round Culvert n=0.013 L=11.0' S=0.0573 '/' Outflow=0.95 cfs 4,070 cf

Pond CB5: CB9+63 Peak Elev=143.31' Inflow=1.18 cfs 5,037 cf
12.0" Round Culvert n=0.013 L=13.0' S=0.0146 '/' Outflow=1.18 cfs 5,037 cf

Pond DEP3: Depression Mohawk Cul-De-Sac Peak Elev=149.00' Storage=0 cf Inflow=0.05 cfs 1,204 cf
Outflow=0.05 cfs 1,204 cf

Pond DEP4: Depression Mohawk Peak Elev=149.00' Storage=0 cf Inflow=0.01 cfs 247 cf
Outflow=0.01 cfs 247 cf

Pond DEP5: Depression Vallis Rt Side Peak Elev=148.00' Storage=0 cf Inflow=0.02 cfs 513 cf
Outflow=0.02 cfs 513 cf

Pond DMH1: DMH 5+50 Peak Elev=144.40' Inflow=0.00 cfs 0 cf
15.0" Round Culvert n=0.013 L=256.0' S=0.0050 '/' Outflow=0.00 cfs 0 cf

Pond DMH2: DMH 8+12 Peak Elev=143.64' Inflow=1.10 cfs 6,492 cf
15.0" Round Culvert n=0.013 L=132.0' S=0.0050 '/' Outflow=1.10 cfs 6,492 cf

Pond DMH3: DMH 9+49 Peak Elev=143.02' Inflow=2.25 cfs 11,529 cf
15.0" Round Culvert n=0.013 L=67.0' S=0.0100 '/' Outflow=2.25 cfs 11,529 cf

Pond R.1: RIM CB2+60 LT Peak Elev=149.57' Storage=1 cf Inflow=0.11 cfs 2,985 cf
Outflow=0.11 cfs 2,985 cf

Pond R.2: RIM CB2+60 RT Peak Elev=149.63' Storage=10 cf Inflow=0.77 cfs 2,597 cf
Outflow=0.77 cfs 2,597 cf

Pond R.3: RIM CB8+00LT Peak Elev=148.19' Storage=0 cf Inflow=0.32 cfs 2,422 cf
Outflow=0.32 cfs 2,422 cf

Pond R.4: RIM CB8+00LT Peak Elev=148.23' Storage=2 cf Inflow=0.95 cfs 4,070 cf
Outflow=0.95 cfs 4,070 cf

Pond R.5: RIM CB9+63.32 Peak Elev=146.21' Storage=29 cf Inflow=1.20 cfs 5,037 cf
Outflow=1.18 cfs 5,037 cf

Total Runoff Area = 582,204 sf Runoff Volume = 33,588 cf Average Runoff Depth = 0.69"
84.46% Pervious = 491,705 sf 15.54% Impervious = 90,499 sf

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P1,P2,P3: P1,P2,P3 Runoff Area=4.705 ac 3.66% Impervious Runoff Depth=0.45"
Flow Length=300' Tc=14.3 min CN=37 Runoff=0.73 cfs 7,697 cf

Subcatchment P10: Runoff Area=0.454 ac 42.51% Impervious Runoff Depth=2.38"
Tc=6.0 min CN=62 Runoff=1.21 cfs 3,915 cf

Subcatchment P11: Runoff Area=0.809 ac 0.00% Impervious Runoff Depth=0.45"
Flow Length=275' Tc=9.0 min CN=37 Runoff=0.13 cfs 1,323 cf

Subcatchment P4: Runoff Area=1.081 ac 15.54% Impervious Runoff Depth=1.12"
Flow Length=455' Tc=16.5 min CN=47 Runoff=0.76 cfs 4,389 cf

Subcatchment P5: Runoff Area=1.048 ac 0.00% Impervious Runoff Depth=0.45"
Flow Length=225' Tc=12.7 min CN=37 Runoff=0.17 cfs 1,714 cf

Subcatchment P6: Runoff Area=1.134 ac 30.95% Impervious Runoff Depth=1.93"
Flow Length=455' Tc=10.3 min CN=57 Runoff=2.04 cfs 7,946 cf

Subcatchment P7: Runoff Area=1.898 ac 7.85% Impervious Runoff Depth=0.45"
Flow Length=100' Tc=6.0 min CN=37 Runoff=0.33 cfs 3,105 cf

Subcatchment P8: Runoff Area=0.868 ac 32.14% Impervious Runoff Depth=2.02"
Flow Length=305' Tc=10.5 min CN=58 Runoff=1.64 cfs 6,357 cf

Subcatchment P9: Runoff Area=0.603 ac 0.00% Impervious Runoff Depth=0.34"
Flow Length=200' Tc=8.8 min CN=35 Runoff=0.06 cfs 748 cf

Subcatchment PH1: Lot 1 Runoff Area=4,321 sf 100.00% Impervious Runoff Depth=6.17"
Tc=6.0 min CN=98 Runoff=0.61 cfs 2,222 cf

Subcatchment PH2: Lot 2 Runoff Area=3,732 sf 100.00% Impervious Runoff Depth=6.17"
Tc=6.0 min CN=98 Runoff=0.53 cfs 1,919 cf

Subcatchment PH3: Lot 3 Runoff Area=4,037 sf 100.00% Impervious Runoff Depth=6.17"
Tc=6.0 min CN=98 Runoff=0.57 cfs 2,076 cf

Subcatchment PH4: Lot 4 Runoff Area=4,037 sf 100.00% Impervious Runoff Depth=6.17"
Tc=6.0 min CN=98 Runoff=0.57 cfs 2,076 cf

Subcatchment PH5: Lot 5 Runoff Area=4,321 sf 100.00% Impervious Runoff Depth=6.17"
Tc=6.0 min CN=98 Runoff=0.61 cfs 2,222 cf

Subcatchment PH6-1: Lot 6A Runoff Area=4,300 sf 100.00% Impervious Runoff Depth=6.17"
Tc=6.0 min CN=98 Runoff=0.61 cfs 2,211 cf

Subcatchment PH6-2: Lot 6B Runoff Area=4,300 sf 100.00% Impervious Runoff Depth=6.17"
Tc=6.0 min CN=98 Runoff=0.61 cfs 2,211 cf

Subcatchment PH6-3: Lot 6C Runoff Area=4,300 sf 100.00% Impervious Runoff Depth=6.17"
Tc=6.0 min CN=98 Runoff=0.61 cfs 2,211 cf

Reach 1R: GUTTER Avg. Flow Depth=0.16' Max Vel=2.51 fps Inflow=1.64 cfs 6,357 cf
n=0.013 L=284.0' S=0.0140 '/' Capacity=31.99 cfs Outflow=1.60 cfs 6,357 cf

Reach 2R: GUTTER Avg. Flow Depth=0.12' Max Vel=2.08 fps Inflow=0.76 cfs 4,389 cf
n=0.013 L=284.0' S=0.0140 '/' Capacity=31.99 cfs Outflow=0.76 cfs 4,389 cf

Pond 1P: Pipe Infiltration Peak Elev=146.23' Storage=2,876 cf Inflow=1.22 cfs 11,612 cf
Discarded=0.24 cfs 10,744 cf Primary=0.16 cfs 880 cf Outflow=0.40 cfs 11,624 cf

Pond 2P: Infiltration Pond Peak Elev=142.14' Storage=6,221 cf Inflow=4.15 cfs 21,286 cf
Outflow=0.74 cfs 21,294 cf

Pond 2Pa: Infiltration Pond After 25 Year Storm Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0 cf

Pond 2Pb: Infiltration Pond After 100 Year Storm Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0 cf

Pond 3P: Infiltration Chamber Peak Elev=3.28' Storage=750 cf Inflow=0.61 cfs 2,222 cf
Outflow=0.06 cfs 2,223 cf

Pond 4P: Infiltration Chamber Peak Elev=3.28' Storage=750 cf Inflow=0.61 cfs 2,222 cf
Outflow=0.06 cfs 2,223 cf

Pond 5P: Infiltration Chamber Peak Elev=2.98' Storage=680 cf Inflow=0.57 cfs 2,076 cf
Outflow=0.06 cfs 2,077 cf

Pond 6P: Infiltration Chamber Peak Elev=2.98' Storage=680 cf Inflow=0.57 cfs 2,076 cf
Outflow=0.06 cfs 2,077 cf

Pond 7P: Infiltration Chamber Peak Elev=2.67' Storage=606 cf Inflow=0.53 cfs 1,919 cf
Outflow=0.06 cfs 1,923 cf

Pond 8P: Infiltration Chamber Peak Elev=3.26' Storage=745 cf Inflow=0.61 cfs 2,211 cf
Outflow=0.06 cfs 2,214 cf

Pond 9P: Infiltration Chamber Peak Elev=3.26' Storage=745 cf Inflow=0.61 cfs 2,211 cf
Outflow=0.06 cfs 2,214 cf

Pond 10P: Infiltration Chamber Peak Elev=3.26' Storage=745 cf Inflow=0.61 cfs 2,211 cf
Outflow=0.06 cfs 2,214 cf

Pond CB1: CB2+60LT Peak Elev=146.86' Inflow=0.73 cfs 7,697 cf
12.0" Round Culvert n=0.013 L=14.0' S=0.0143 '/' Outflow=0.73 cfs 7,697 cf

Pond CB2: CB2+60RT Peak Elev=147.02' Inflow=1.21 cfs 3,915 cf
12.0" Round Culvert n=0.013 L=14.0' S=0.0143 '/' Outflow=1.21 cfs 3,915 cf

Pond CB3: CB8+00LT Peak Elev=144.44' Inflow=0.76 cfs 4,389 cf
12.0" Round Culvert n=0.013 L=11.0' S=0.0573 '/' Outflow=0.76 cfs 4,389 cf

Pond CB4: CB8+00LT Peak Elev=144.68' Inflow=1.60 cfs 6,357 cf
12.0" Round Culvert n=0.013 L=11.0' S=0.0573 '/' Outflow=1.60 cfs 6,357 cf

Pond CB5: CB9+63 Peak Elev=143.65' Inflow=2.03 cfs 7,946 cf
12.0" Round Culvert n=0.013 L=13.0' S=0.0146 '/' Outflow=2.03 cfs 7,946 cf

Pond DEP3: Depression Mohawk Cul-De-Sac Peak Elev=149.00' Storage=0 cf Inflow=0.33 cfs 3,105 cf
Outflow=0.33 cfs 3,105 cf

Pond DEP4: Depression Mohawk Peak Elev=149.00' Storage=0 cf Inflow=0.06 cfs 748 cf
Outflow=0.06 cfs 748 cf

Pond DEP5: Depression Vallis Rt Side Peak Elev=148.00' Storage=0 cf Inflow=0.13 cfs 1,323 cf
Outflow=0.13 cfs 1,323 cf

Pond DMH1: DMH 5+50 Peak Elev=144.62' Inflow=0.16 cfs 880 cf
15.0" Round Culvert n=0.013 L=256.0' S=0.0050 '/' Outflow=0.16 cfs 880 cf

Pond DMH2: DMH 8+12 Peak Elev=143.97' Inflow=2.17 cfs 11,626 cf
15.0" Round Culvert n=0.013 L=132.0' S=0.0050 '/' Outflow=2.17 cfs 11,626 cf

Pond DMH3: DMH 9+49 Peak Elev=143.38' Inflow=4.10 cfs 19,572 cf
15.0" Round Culvert n=0.013 L=67.0' S=0.0100 '/' Outflow=4.10 cfs 19,572 cf

Pond R.1: RIM CB2+60 LT Peak Elev=149.63' Storage=9 cf Inflow=0.73 cfs 7,697 cf
Outflow=0.73 cfs 7,697 cf

Pond R.2: RIM CB2+60 RT Peak Elev=149.66' Storage=18 cf Inflow=1.21 cfs 3,915 cf
Outflow=1.21 cfs 3,915 cf

Pond R.3: RIM CB8+00LT Peak Elev=148.21' Storage=1 cf Inflow=0.76 cfs 4,389 cf
Outflow=0.76 cfs 4,389 cf

Pond R.4: RIM CB8+00LT Peak Elev=148.26' Storage=3 cf Inflow=1.60 cfs 6,357 cf
Outflow=1.60 cfs 6,357 cf

Pond R.5: RIM CB9+63.32 Peak Elev=146.26' Storage=59 cf Inflow=2.04 cfs 7,946 cf
Outflow=2.03 cfs 7,946 cf

Total Runoff Area = 582,204 sf Runoff Volume = 54,345 cf Average Runoff Depth = 1.12"
84.46% Pervious = 491,705 sf 15.54% Impervious = 90,499 sf

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P1,P2,P3: P1,P2,P3 Runoff Area=4.705 ac 3.66% Impervious Runoff Depth=1.07"
Flow Length=300' Tc=14.3 min CN=37 Runoff=2.71 cfs 18,260 cf

Subcatchment P10: Runoff Area=0.454 ac 42.51% Impervious Runoff Depth=3.74"
Tc=6.0 min CN=62 Runoff=1.94 cfs 6,169 cf

Subcatchment P11: Runoff Area=0.809 ac 0.00% Impervious Runoff Depth=1.07"
Flow Length=275' Tc=9.0 min CN=37 Runoff=0.52 cfs 3,140 cf

Subcatchment P4: Runoff Area=1.081 ac 15.54% Impervious Runoff Depth=2.07"
Flow Length=455' Tc=16.5 min CN=47 Runoff=1.68 cfs 8,142 cf

Subcatchment P5: Runoff Area=1.048 ac 0.00% Impervious Runoff Depth=1.07"
Flow Length=225' Tc=12.7 min CN=37 Runoff=0.62 cfs 4,067 cf

Subcatchment P6: Runoff Area=1.134 ac 30.95% Impervious Runoff Depth=3.17"
Flow Length=455' Tc=10.3 min CN=57 Runoff=3.52 cfs 13,066 cf

Subcatchment P7: Runoff Area=1.898 ac 7.85% Impervious Runoff Depth=1.07"
Flow Length=100' Tc=6.0 min CN=37 Runoff=1.34 cfs 7,366 cf

Subcatchment P8: Runoff Area=0.868 ac 32.14% Impervious Runoff Depth=3.29"
Flow Length=305' Tc=10.5 min CN=58 Runoff=2.79 cfs 10,357 cf

Subcatchment P9: Runoff Area=0.603 ac 0.00% Impervious Runoff Depth=0.89"
Flow Length=200' Tc=8.8 min CN=35 Runoff=0.27 cfs 1,941 cf

Subcatchment PH1: Lot 1 Runoff Area=4,321 sf 100.00% Impervious Runoff Depth=8.00"
Tc=6.0 min CN=98 Runoff=0.78 cfs 2,881 cf

Subcatchment PH2: Lot 2 Runoff Area=3,732 sf 100.00% Impervious Runoff Depth=8.00"
Tc=6.0 min CN=98 Runoff=0.68 cfs 2,488 cf

Subcatchment PH3: Lot 3 Runoff Area=4,037 sf 100.00% Impervious Runoff Depth=8.00"
Tc=6.0 min CN=98 Runoff=0.73 cfs 2,691 cf

Subcatchment PH4: Lot 4 Runoff Area=4,037 sf 100.00% Impervious Runoff Depth=8.00"
Tc=6.0 min CN=98 Runoff=0.73 cfs 2,691 cf

Subcatchment PH5: Lot 5 Runoff Area=4,321 sf 100.00% Impervious Runoff Depth=8.00"
Tc=6.0 min CN=98 Runoff=0.78 cfs 2,881 cf

Subcatchment PH6-1: Lot 6A Runoff Area=4,300 sf 100.00% Impervious Runoff Depth=8.00"
Tc=6.0 min CN=98 Runoff=0.78 cfs 2,867 cf

Subcatchment PH6-2: Lot 6B Runoff Area=4,300 sf 100.00% Impervious Runoff Depth=8.00"
Tc=6.0 min CN=98 Runoff=0.78 cfs 2,867 cf

Subcatchment PH6-3: Lot 6C Runoff Area=4,300 sf 100.00% Impervious Runoff Depth=8.00"
Tc=6.0 min CN=98 Runoff=0.78 cfs 2,867 cf

Reach 1R: GUTTER Avg. Flow Depth=0.20' Max Vel=2.86 fps Inflow=2.79 cfs 10,357 cf
n=0.013 L=284.0' S=0.0140 '/' Capacity=31.99 cfs Outflow=2.72 cfs 10,357 cf

Reach 2R: GUTTER Avg. Flow Depth=0.16' Max Vel=2.53 fps Inflow=1.68 cfs 8,142 cf
n=0.013 L=284.0' S=0.0140 '/' Capacity=31.99 cfs Outflow=1.66 cfs 8,142 cf

Pond 1P: Pipe Infiltration Peak Elev=147.20' Storage=3,629 cf Inflow=3.65 cfs 24,429 cf
Discarded=0.24 cfs 13,289 cf Primary=3.83 cfs 11,151 cf Outflow=4.07 cfs 24,440 cf

Pond 2P: Infiltration Pond Peak Elev=144.32' Storage=20,200 cf Inflow=8.53 cfs 46,783 cf
Outflow=1.23 cfs 46,802 cf

Pond 2Pa: Infiltration Pond After 25 Year Storm Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0 cf

Pond 2Pb: Infiltration Pond After 100 Year Storm Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0 cf

Pond 3P: Infiltration Chamber Peak Elev=5.22' Storage=1,078 cf Inflow=0.78 cfs 2,881 cf
Outflow=0.06 cfs 2,884 cf

Pond 4P: Infiltration Chamber Peak Elev=5.22' Storage=1,078 cf Inflow=0.78 cfs 2,881 cf
Outflow=0.06 cfs 2,884 cf

Pond 5P: Infiltration Chamber Peak Elev=4.51' Storage=978 cf Inflow=0.73 cfs 2,691 cf
Outflow=0.06 cfs 2,693 cf

Pond 6P: Infiltration Chamber Peak Elev=4.51' Storage=978 cf Inflow=0.73 cfs 2,691 cf
Outflow=0.06 cfs 2,693 cf

Pond 7P: Infiltration Chamber Peak Elev=3.87' Storage=874 cf Inflow=0.68 cfs 2,488 cf
Outflow=0.06 cfs 2,490 cf

Pond 8P: Infiltration Chamber Peak Elev=5.17' Storage=1,071 cf Inflow=0.78 cfs 2,867 cf
Outflow=0.06 cfs 2,870 cf

Pond 9P: Infiltration Chamber Peak Elev=5.17' Storage=1,071 cf Inflow=0.78 cfs 2,867 cf
Outflow=0.06 cfs 2,870 cf

Pond 10P: Infiltration Chamber Peak Elev=5.17' Storage=1,071 cf Inflow=0.78 cfs 2,867 cf
Outflow=0.06 cfs 2,870 cf

Pond CB1: CB2+60LT Peak Elev=147.50' Inflow=2.70 cfs 18,260 cf
12.0" Round Culvert n=0.013 L=14.0' S=0.0143 '/' Outflow=2.70 cfs 18,260 cf

Pond CB2: CB2+60RT Peak Elev=147.23' Inflow=1.94 cfs 6,169 cf
12.0" Round Culvert n=0.013 L=14.0' S=0.0143 '/' Outflow=1.94 cfs 6,169 cf

Pond CB3: CB8+00LT Peak Elev=146.61' Inflow=1.66 cfs 8,142 cf
12.0" Round Culvert n=0.013 L=11.0' S=0.0573 '/' Outflow=1.66 cfs 8,142 cf

Pond CB4: CB8+00LT Peak Elev=146.61' Inflow=2.72 cfs 10,357 cf
12.0" Round Culvert n=0.013 L=11.0' S=0.0573 '/' Outflow=2.72 cfs 10,357 cf

Pond CB5: CB9+63 Peak Elev=145.28' Inflow=3.37 cfs 13,066 cf
12.0" Round Culvert n=0.013 L=13.0' S=0.0146 '/' Outflow=3.37 cfs 13,066 cf

Pond DEP3: Depression Mohawk Cul-De-Sac Peak Elev=149.01' Storage=76 cf Inflow=1.34 cfs 7,366 cf
Outflow=1.13 cfs 7,369 cf

Pond DEP4: Depression Mohawk Peak Elev=149.00' Storage=0 cf Inflow=0.27 cfs 1,941 cf
Outflow=0.27 cfs 1,941 cf

Pond DEP5: Depression Vallis Rt Side Peak Elev=148.01' Storage=33 cf Inflow=0.52 cfs 3,140 cf
Outflow=0.45 cfs 3,144 cf

Pond DMH1: DMH 5+50 Peak Elev=147.15' Inflow=3.83 cfs 11,151 cf
15.0" Round Culvert n=0.013 L=256.0' S=0.0050 '/' Outflow=3.83 cfs 11,151 cf

Pond DMH2: DMH 8+12 Peak Elev=146.49' Inflow=5.98 cfs 29,650 cf
15.0" Round Culvert n=0.013 L=132.0' S=0.0050 '/' Outflow=5.98 cfs 29,650 cf

Pond DMH3: DMH 9+49 Peak Elev=144.83' Inflow=7.94 cfs 42,715 cf
15.0" Round Culvert n=0.013 L=67.0' S=0.0100 '/' Outflow=7.94 cfs 42,715 cf

Pond R.1: RIM CB2+60 LT Peak Elev=149.75' Storage=57 cf Inflow=2.71 cfs 18,260 cf
Outflow=2.70 cfs 18,260 cf

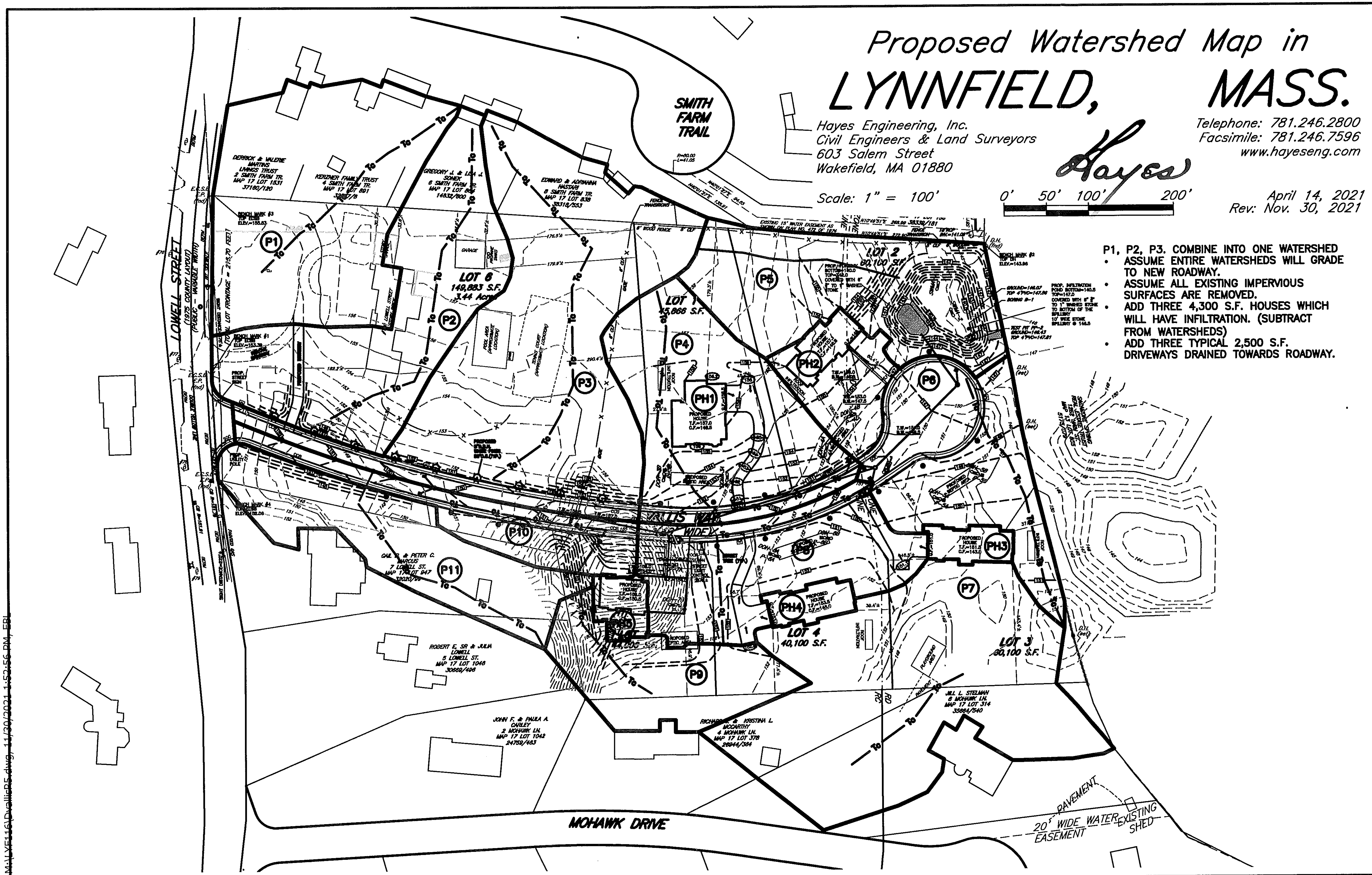
Pond R.2: RIM CB2+60 RT Peak Elev=149.70' Storage=34 cf Inflow=1.94 cfs 6,169 cf
Outflow=1.94 cfs 6,169 cf

Pond R.3: RIM CB8+00LT Peak Elev=148.26' Storage=3 cf Inflow=1.66 cfs 8,142 cf
Outflow=1.66 cfs 8,142 cf

Pond R.4: RIM CB8+00LT Peak Elev=148.30' Storage=6 cf Inflow=2.72 cfs 10,357 cf
Outflow=2.72 cfs 10,357 cf

Pond R.5: RIM CB9+63.32 Peak Elev=146.37' Storage=168 cf Inflow=3.52 cfs 13,066 cf
Outflow=3.37 cfs 13,066 cf

Total Runoff Area = 582,204 sf Runoff Volume = 94,740 cf Average Runoff Depth = 1.95"
84.46% Pervious = 491,705 sf 15.54% Impervious = 90,499 sf



Proposed Watershed Map in
LYNNFIELD, MASS.
Hayes Engineering, Inc.
Civil Engineers & Land Surveyors
603 Salem Street
Wakefield, MA 01880
Telephone: 781.246.2800
Facsimile: 781.246.7596
www.hayeseng.com
Hayes
Scale: 1" = 100'
0' 50' 100' 200'
April 14, 2021
Rev: Nov. 30, 2021
P1, P2, P3. COMBINE INTO ONE WATERSHED
• ASSUME ENTIRE WATERSHEDS WILL GRADE TO NEW ROADWAY.
• ASSUME ALL EXISTING IMPERVIOUS SURFACES ARE REMOVED.
• ADD THREE 4,300 S.F. HOUSES WHICH WILL HAVE INFILTRATION. (SUBTRACT FROM WATERSHEDS)
• ADD THREE TYPICAL 2,500 S.F. DRIVEWAYS DRAINED TOWARDS ROADWAY.
SMITH FARM TRAIL
LOWELL STREET
MOHAWK DRIVE
LOT 6
149,883 S.F.
3.44 Acres
LOT 1
LOT 2
LOT 3
80,100 S.F.
LOT 4
40,100 S.F.
P1
P2
P3
P4
P5
P6
P7
P9
P10
P11
PH1
PH2
PH3
PH4
20' WIDE WATER EASEMENT
PAVEMENT
EXISTING SHED

Construction Period Pollution Prevention Plan

Vallis Way

Lynnfield, Massachusetts

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

SITE DESCRIPTION

Project Name and Location: (Latitude, Longitude, or Address)

Vallis Way
#109 Lowell Street
Lynnfield, MA 01940

Owner Name and Address

Linda C. Vallis
109 Lowell Street
Lynnfield, MA 01940

Applicant Name and Address

Paul Caggiano
26666 Seagul Way, Unit C201
Malibu, CA 90265-4529

Description: (Purpose and Types of Soil Disturbing Activities)

The proposed project is the subdivision of a single lot with an existing single family house to create five lots with single family homes, driveways, roadway, stormwater BMPs, and all appurtenant site work. Soil disturbing activities include installation of erosion and sediment control devices; excavation; drainage system and utility installation; stormwater BMP installation and construction; house construction; road and driveway paving; and landscaping.

Sequence of Major Activities

The order of activities shall be as follows:

1. Install erosion and sediment control devices
2. Clear vegetation from road and lot areas.
3. Excavate and stockpile topsoil
4. Stabilize stockpiles within 14 days of last construction activity in that area
5. Stabilize exposed surfaces where the period of exposure shall be more than two months, but less than twelve months within 14 days of last construction activity in that area
6. Commence grading and excavation activities.
7. Commence roadway and stormwater management area construction (grade to subgrade elevations, install drainage structures; install utilities, install gravel to appropriate elevations, install binder coat of pavement followed by curbing).

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

8. Develop individual lots (grade yard, driveway and foundation areas, install drainage, septic and utility structures, complete driveway and house construction, grade to finish elevations).
9. Install binder coat of pavement followed by curbing
10. Loam and seed all disturbed areas.
11. Install final pavement course and final inspection of all stormwater BMPs.

CONTROLS

Erosion and Sediment Control Stabilization Practices

The Site Contractor / Project Manager ("Manager") is responsible for ensuring that erosion and sedimentation control practices and controls are followed upon commencement of, and during project construction.

A. Protecting and Minimizing Exposed Areas

The project will temporarily leave bare earth open to erosion. Steps shall be taken to minimize this area of exposure by preserving existing vegetation and providing soil stabilization. Equipment and trucks shall be routed only over the existing pavement or areas of proposed work and workers shall minimize foot traffic in vegetated areas adjacent to the work area as much as possible. During site work, utilization of stabilization techniques is necessary for controlling erosion on exposed areas, including grading, seeding and otherwise stabilizing the areas.

B. Sediment And Erosion Control / Soil Stabilization

i) Prior to any construction occurring adjacent to identified resource areas (shown on the plan and/or marked in the field), proper erosion and siltation barriers shall be installed so that throughout and until completion of construction, those areas will be afforded maximum protection. Temporary stockpiles of soil shall be surrounded with an erosion control barrier to prevent sediments from exiting the subject property. All erosion control barriers must be maintained in functioning condition and periodically inspected until areas of bare soil are stabilized to ensure that they are in functioning condition. Any accumulations of sediments present along erosion control barriers shall be removed as soon as possible after deposition in order to ensure the effectiveness of all sedimentation controls.

On sites where grading or other work will occur on moderately steep slopes (3:1 and greater) located immediately upgradient of wetlands, the contractor shall work on one portion of the slope at a time, ensuring the stability of the disturbed soil by immediately loaming and seeding the slope, or otherwise vegetating the slope as desired, and installing erosion control mats (straw or cocoanut fiber designed for the slope steepness). If work is interrupted and the slope is to be left bare or otherwise unstabilized for duration of a day or more, a series of erosion control fences oriented parallel to the slope.

Vegetational Covers

Temporary Vegetational Cover

Any area proposed for removal of vegetation where soil will be exposed for more than 10 days shall be mulched or otherwise treated to prevent erosion. On sediment-producing areas in the buffer zone, where the period of exposure will be more than 30 days, the following procedures should be followed for a cover of annual rye. When bare soils are not completely graded and vegetated by September 30 of any year, winter rye shall be planted as specified in table and mulched with three (3) inches of hay or straw.

a. Install needed surface water control measures.

b. Perform all cultural operations at right angles to the slope.

c. Establish grass or other ground cover species as recommended in the attached excerpt (pgs 144 -146) from Massachusetts Erosion and Sedimentation Guidelines for Urban and Suburban Areas, 2003.

1. Permanent Vegetational Cover

To reduce damages from the potential incidence of sedimentation and runoff to other properties, and to avoid erosion on the site itself, a permanent type cover shall be established in disturbed areas located adjacent to resource areas immediately upon completion of grading. Seeding herbaceous cover is usually the most economical and practical way to stabilize any large area. For this site, all disturbed areas where lawns are desired will be seeded in fall during the period of August 1 to October 1; or in spring by May 15 with a commercial lawn mixture utilizing standard landscape methods and as recommended by the seed manufacturer. Grass sod or landscape plantings may be used instead of seed, if preferred.

In upland/ buffer zone areas, outside of lawn locations, where an erosion control - wildlife seed mixture is desired, prepare soil and use one of grass seed mixes #1 through #6 as recommended in the attached excerpts (pgs 136 -139) from Massachusetts Erosion and Sedimentation Guidelines for Urban and Suburban Areas 2003, to establish a stable, permanent cover.

REFERENCES

Department of Environmental Protection, Bureau of Resource Protection and U.S. Environmental Protection Agency, Massachusetts Erosion and Sedimentation Guidelines for Urban and Suburban Areas: A Guide for Planners, Designers and Municipal Officials.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

Massachusetts Executive Office of Environmental Affairs, Boston, Massachusetts, Reprint: May 2003.

Seeding Dates

Seeding operations should be performed as an early spring seeding (April 1-May 15) with the use of cold treated seed. A late fall early winter dormant seeding (November 1 - December 15) can also be made, however the seeding rate will need to be increased by 50%.

Seeding Methods

Seeding should be performed by one of the following methods:

- Drill seedings (de-awned or de-bearded seed should be used unless the drill is equipped with special features to accept awned seed).
- Broadcast seeding with subsequent rolling, cultipacking or tracking the seeding with small track construction equipment. Tracking should be oriented up and down the slope.
- Hydroseeding with subsequent tracking. If wood fiber mulch is used, it should be applied as a separate operation after seeding and tracking to assure good seed to soil contact.

Mulch

Mulch the seedings with straw applied at the rate of ½ tons per acre. Anchor the mulch with erosion control netting or fabric on sloping areas.

Seed Mixtures for Permanent Cover

Recommended mixtures for permanent seeding are provided on the following pages. Select plant species which are suited to the site conditions and planned use. Soil moisture conditions, often the major limiting site factor, are usually classified as follows:

Dry - Sands and gravels to sandy loams. No effective moisture supply from seepage or a high water table.

Moist - Well drained to moderately well drained sandy loams, loams, and finer; or coarser textured material with moderate influence on root zone from seepage or a high water table.

Wet - All textures with a water table at or very near the soil surface, or with enduring seepage.

When other factors strongly influence site conditions, the plants selected must also be tolerant of these conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

Permanent Seeding Mixtures

Mix	Site	Seed Mixture	Seed, Pounds per: Acre	Seed, Pounds per: 1,000 sf	Remarks
1	Dry	Little Bluestem			* Use Warm Season planting procedure.
		or Broomsedge	10	0.25	* Roadsides
		Tumble Lovegrass*	1	0.10	* Sand and Gravel Stabilization
		Switchgrass	10	0.25	* Clover requires inoculation with nitrogen-fixing bacteria
		Bush Clover*	2	0.10	
		Red Top	1	0.10	* Rates for this mix are for PLS.
2	Dry	Deertongue	15	0.35	* Use Warm Season planting procedures.
		Broomsedge	10	0.25	* Acid sites/Mine spoil
		Bush Clover*	2	0.10	* Clover requires inoculation with nitrogen-fixing bacteria.
		Red Top	1	0.10	
					*Rates for this mix are for PLS.
3	Dry	Big Bluestem	10	0.25	* Use Warm Season planting procedures.
		Indian Grass	10	0.25	* Eastern Prairie appearance
		Switchgrass	10	0.25	* Sand and Gravel pits.
		Little Bluestem	10	0.25	* Golf Course Wild Areas
		Red Top or	1	0.10	* Sanitary Landfill Cover seeding
		Perennial Ryegrass	10	0.25	* Wildlife Areas
					*OK to substitute Poverty Dropseed in place of Red Top/Ryegrass.
					*Rates for this mix are for PLS.
4	Dry	Flat Pea	25	0.60	* Use Cool Season planting procedures
		Red Top or	2	0.10	* Utility Rights-of-Ways (tends to suppress woody growth)
		Perennial Ryegrass	15	0.35	
5	Dry	Little Bluestem	5	0.10	* Use Warm Season planting procedures.
		Switchgrass	10	0.25	* Coastal sites
		Beach Pea*	20	0.45	* Rates for Bluestein and Switchgrass are for PLS.
		Perennial Ryegrass	10	0.25	
6	Dry - Moist	Red Fescue	10	0.25	* Use Cool Season planting procedure.
		Canada Bluegrass	10	0.25	* Provides quick cover but is non-aggressive; will tend to allow indigenous plant colonization.
		Perennial Ryegrass	10	0.25	
		Red Top	1	0.10	* General erosion control on variety of sites, including forest roads, skid trails and landings.
7	Moist-Wet	Switchgrass	10	0.25	* Use Warm Season planting procedure.
		Virginia Wild Rye	5	0.10	* Coastal plain/flood plain
		Big Bluestem	15	0.35	* Rates for Bluestem and Switchgrass are for PLS.
		Red Top	1	0.10	

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

Permanent Seeding Mixtures

Mix	Site	Seed Mixture	Seed, Pounds per: Acre	Seed, Pounds per: 1,000 sf	Remarks
8	Moist Wet	Creeping Bentgrass	5	0.10	* Use Cool Season planting procedures.
		Fringed Bromegrass	5	0.10	* Pond Banks
		Fowl Meadowgrass	5	0.10	* Waterways/ditch banks
		Bluejoint Reedgrass or Rice Cutgrass	2	0.10	
		Perennial Ryegrass	10	0.25	
9	Moist Wet	Red Fescue	5	0.10	*Salt Tolerant
		Creeping Bentgrass	2	0.10	* Fescue and Bentgrass provide low growing appearance, while Switchgrass provides tall cover for wildlife.
		Switchgrass	8	0.20	
		Perennial Ryegrass	10	0.25	
10	Moist Wet	Red Fescue	5	0.10	* Use Cool Season planting procedure.
		Creeping Bentgrass	5	0.10	* Trefoil requires inoculation with nitrogen fixing bacteria.
		Virginia Wild Rye	8	0.20	
		Wood Reed Grass*	1	0.10	* Suitable for forest access roads, skid trails and other partial shade situations.
		Showy Tick Trefoil*	1	0.10	
11	Moist Wet	Creeping Bentgrass	5	0.10	* Use Cool Season planting procedure.
		Bluejoint Reed Grass	1	0.10	* Suitable for waterways, pond or ditch banks.
		Virginia Wild Rye	3	0.10	* Trefoil requires inoculation with nitrogen fixing bacteria.
		Fowl Meadow Grass	10	0.25	
		Showy Tick Trefoil*	1	0.10	
		Red Top	1	0.10	
12	Wet	Blue Joint Reed Grass	1	0.10	* Use Cool Season planting procedure.
		Canada Manna Grass	1	0.10	* OK to seed in saturated soil conditions, but not in standing water.
		Rice Cut Grass	1	0.10	
		Creeping Bent Grass	5	0.10	* Suitable as stabilization seeding for created wetland.
		Fowl Meadow Grass	5	0.10	* All species in this mix are native to Massachusetts.
13	Dry-Moist	American Beachgrass	18"	18' centers	*Vegetative planting with dormant culms, 3-5 culms per planting centers
14	Inter-Tidal	Smooth Cordgrass / Saltmeadow Cordgrass	12-18"	12-18" centers	* Vegetative planting with transplants. centers

Notes:
* Species such as Tumble Lovegrass, Fringed Bromegrass, Wood Reedgrass, Bush Clover and Beach Pea, while known to be commercially available from specific seed suppliers, may not always be available from your particular seed suppliers. The local Natural Resources Conservation Service office may be able to help with a source of supply. In the event a particular species listed in a mix can not be obtained, however, it may be possible to substitute another species.
Seed mixtures by courtesy of Natural Resources Conservation Service, Amherst, MA.

(PLS) Pure Live Seed

Warm Season grass seed is sold and planted on the basis of pure live seed. An adjustment is made to the bulk rate of the seed to compensate for inert material and non-viable seed. Percent of pure live seed is calculated by multiplying the percent purity by the percent germination; (% purity) x (% germination) = percent PLS.
For example, if the seeding rate calls for 10 lbs./acre PLS and the seed lot has a purity of 70% and germination of 75%, the PLS factor is:

(.70 x .75) =.53
10 lbs. divided by .53 = approx. 19 lbs.
Therefore, 19 lbs of seed from the particular lot will need to be applied to obtain 10 lbs. of pure live seed.

Special Note

Tall Fescue, Reed Canary Grass, Crownvetch and Birdsfoot Trefoil are no longer recommended for general erosion control use in Massachusetts due to the invasive characteristics of each. If these species are used, it is recommended that the ecosystem of the site be analyzed for the effects species invasiveness may impose. The mixes listed in the above mixtures include either species native to Massachusetts or non-native species that are not perceived to be invasive, as per the Massachusetts Native Plant Advisory Committee.

Wetlands Seed Mixtures

For newly created wetlands, a wetlands specialist should design plantings to provide the best chance of success. Do not use introduced, invasive plants like reed canarygrass (Phalaris arundinacea) or purple loosestrife (Lythrum salicaria). Using plants such as these will cause many more problems than they will solve.

The following grasses all thrive in wetland situations:

- Fresh Water Cordgrass (*Spartina pectinata*)
- Marsh/Creeping Bentgrass (*Agrostis stolonifera, var. Palustric*)
- Broomsedge (*Andropogon virginicus*)
- Fringed Bromegrass (*Bromus ciliatus*)
- Blue Joint Reed Grass (*Calamagrostis cavedensis*)
- Fowl Meadow Grass (*Glyceria striata*)
- Riverbank Wild Rye (*Elymus riparius*)
- Rice Cutgrass (*Leersia oryzoides*)
- Stout Wood Reed (*Cinna arundinacea*)
- Canada Manna Grass (*Glyceria canadensis*)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A sample wetlands seed mix developed by The New England Environmental Wetland Plant Nursery is shown on the following page.

Wetland Seed Mixture

The New England Environmental Wetland Plant Nursery has developed a seed mixture which is specifically designed to be used in wetland replication projects and stormwater detention basins. It is composed of seeds from a variety of indigenous wetland species. Establishing a native wetland plant understory in these areas provides quick erosion control, wildlife food and cover, and helps to reduce the establishment of undesirable invasive species such as Phragmites and purple loosestrife (*Lythrum salicaria*). The species have been selected to represent varying degrees of drought tolerance, and will establish themselves based upon microtopography and the resulting variation in soil moisture.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

Common Name (*Scientific Name*)	% in Mix	Comments
Lurid Sedge (*Carex lurida*)	30	A low ground cover that tolerates mesic sites in addition to saturated areas; prolific seeder in second growing season.
Fowl Meadow Grass (*Glyceria Canadensis*)	25	Prolific seed producer that is a valuable wildlife food source.
Fringed Sedge (*Carex crinita*)	10	A medium to large sedge that tolerates saturated areas; good seed producer.
Joe-Pye Weed (*Eupatoriadelphus maculatus*)	10	Flowering plant that is valuable for wildlife cover. Grows to 4 feet.
Brook Sedge (*Carex spp., Ovales group*)	10	Tolerates a wide range of hydrologic conditions.
Woolgrass (*Scirpus cyperinus*)	5	Tolerates fluctuating hydrology.
Boneset (*Eupatorium perfoliatum*)	5	Flowering Plant that is valuable for wildlife cover. Grows to 3 feet.
Tussock Sedge (*Carex stricta*)	<5	Grows in elevated hummocks on wet sites, may grow rhizomonously on drier sites.
Blue Vervain (*Verbena hastata*)	<5	A native plant that bears attractive, blue flowers.

The recommended application rate is one pound per 5,000 square feet when used as an understory cover. This rate should be increased to one pound per 2,500 square feet for detention basins and other sites which require a very dense cover. For best results, a late fall application is recommended. This mix is not recommended for standing water.

Maintenance

Inspect seeded areas for failure and make necessary repairs and reseed immediately. Conduct or follow-up survey after one year and replace failed plants where necessary.

If vegetative cover is inadequate to prevent rill erosion, overseed and fertilize in accordance with soil test results.

If a stand has less than 40% cover, reevaluate choice of plant materials and quantities of lime and fertilizer. Re-establish the stand following seedbed preparation and seeding recommendations, omitting lime and fertilizer in the absence of soil test results. If the season prevents resowing, mulch or jute netting is an effective temporary cover.

Seeded areas should be fertilized during the second growing season. Lime and fertilize thereafter at periodic intervals, as needed.

References

North Carolina Department of Environment, Health, and Natural Resources, ***Erosion and Sediment Control Field Manual***, Raleigh, NC, February 1991.

Personal communication, Richard J. DeVergilio, USDA, Natural Resources Conservation Service, Amherst, MA.

U.S. Environmental Protection Agency, ***Storm Water Management For Construction Activities***, EPA-832-R- 92-005, Washington, DC, September, 1992.

Washington State Department of Ecology, ***Stormwater Management Manual for the Puget Sound Basin***, Olympia, WA, February, 1992.

Seeding, Temporary

Planting rapid-growing annual grasses, small grains, or legumes to provide initial, temporary cover for erosion control on disturbed areas.

Purpose

To temporarily stabilize areas that will not be brought to final grade for a period of more than 30 working days.

To stabilize disturbed areas before final grading or in a season not suitable for permanent seeding.

Temporary seeding controls runoff and erosion until permanent vegetation or other erosion control measures can be established.

Root systems hold down the soils so that they are less apt to be carried offsite by storm water runoff or wind.

Temporary seeding also reduces the problems associated with mud and dust from bare soil surfaces during construction.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

Where Practice Applies

On any cleared, unvegetated, or sparsely vegetated soil surface where vegetative cover is needed for less than one year. Applications of this practice include diversions, dams, temporary sediment basins, temporary road banks, and topsoil stockpiles.

Where permanent structures are to be installed or extensive regrading of the area will occur prior to the establishment of permanent vegetation.

Areas which will not be subjected to heavy wear by construction traffic.

Areas sloping up to 10% for 100 feet or less, where temporary seeding is the only practice used.

Advantages

This is a relatively inexpensive form of erosion control but should only be used on sites awaiting permanent planting or grading. Those sites should have permanent measures used.

Vegetation will not only prevent erosion from occurring, but will also trap sediment in runoff from other parts of the site.

Temporary seeding offers fairly rapid protection to exposed areas.

Disadvantages/Problems

Temporary seeding is only viable when there is a sufficient window in time for plants to grow and establish cover. It depends heavily on the season and rainfall rate for success.

If sown on subsoil, growth will be poor unless heavily fertilized and limed. Because overfertilization can cause pollution of stormwater runoff, other practices such as mulching alone may be more appropriate. The potential for over-fertilization is an even worse problem in or near aquatic systems.

Once seeded, areas should not be travelled over.

Irrigation may be needed for successful growth. Regular irrigation is not encouraged because of the expense and the potential for erosion in areas that are not regularly inspected.

Planning Considerations

Temporary seedings provide protective cover for less than one year. Areas must be reseeded annual or planted with perennial vegetation.

Temporary seeding is used to protect earthen sediment control practices and to stabilize denuded areas that will not be brought into final grade for several weeks or months. Temporary seeding can provide a nurse crop for permanent vegetation, provide residue for soil protection and seedbed preparation, and help prevent dust production during construction.

Use low-maintenance native species wherever possible.

Planting should be timed to minimize the need for irrigation.

Sheet erosion, caused by the impact of rain on bare soil, is the source of most fine particles in sediment. To reduce this sediment load in runoff, the soil surface itself should be protected. The most efficient and economical means of controlling sheet and rill erosion is to establish vegetative cover. Annual plants which sprout rapidly and survive for only one growing season are suitable for establishing temporary vegetative cover. Temporary seeding is effective when combined with construction phasing so bare areas of the site are minimized at all times.

Temporary seeding may prevent costly maintenance operations on other erosion control systems. For example, sediment basin clean-outs will be reduced if the drainage area of the basin is seeded where grading and construction are not taking place. Perimeter dikes will be more effective if not choked with sediment.

Proper seedbed preparation and the use of quality seed are important in this practice just as in permanent seeding. Failure to carefully follow sound agronomic recommendations will often result in an inadequate stand of vegetation that provides little or no erosion control.

Soil that has been compacted by heavy traffic or machinery may need to be loosened. Successful growth usually requires that the soil be tilled before the seed is applied. Topsoiling is not necessary for temporary seeding; however, it may improve the chances of establishing temporary vegetation in an area.

Planting Procedures

Time of Planting

Planting should preferably be done between April 1 and June 30, and September 1 through September 30. If planting is done in the months of July and August, irrigation may be required. If planting is done between October 1 and March 31, mulching should be applied immediately after planting. If seeding is done during the summer months, irrigation of some sort will probably be necessary.

Site Preparation

Before seeding, install needed surface runoff control measures such as gradient terraces, interceptor dike/swales, level spreaders, and sediment basins.

Seedbed Preparation

The seedbed should be firm with a fairly fine surface.

Perform all cultural operations across or at right angles to the slope. See **Topsoiling** and **Surface Roughening** for more information on seedbed preparation. A minimum of 2 to 4 inches of tilled topsoil is required.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

Liming and Fertilization

Apply uniformly 2 tons of ground limestone per acre (100 lbs. per 1,000 Sq. Ft.) or according to soil test.

Apply uniformly 10-10-10 analysis fertilizer at the rate of 400 lbs. per acre (14 lbs. per 1,000 Sq. Ft.) or as indicated by soil test. Forty percent of the nitrogen should be in organic form.

Work in lime and fertilizer to a depth of 4 inches using any suitable equipment.

Seedings for Temporary Cover

Species	*Seeding Rates lbs/sq.ft.* 1,000 Sq.Ft.	Acre	*Recommended* Seeding Dates
Annual Ryegrass	1	40	April 1 to June 1 Aug. 15 to Sept. 15
Foxtail Millet	0.7	30	May 1 to June 30
Oats	2	80	April 1 to July 1 August 15 to Sept. 15
Winter Rye	3	120	Aug. 15 to Oct. 15

"Hydro-seeding" applications with appropriate seed-mulch-fertilizer mixtures may also be used.

Seeding

Select adapted species from the accompanying table.

Apply seed uniformly according to the rate indicated in the table by broadcasting, drilling or hydraulic application.

Cover seeds with suitable equipment as follows:

- Rye grass ¼ inch
- Millet ½ to ¾ inch
- Oats 1 to 1-1/2 inches
- Winter rye 1 to 1-1/2 inches.

Mulch

Use an effective mulch, such as clean grain straw; tacked and/or tied down with netting to protect seedbed and encourage plant growth.

Common Trouble Points

Lime and fertilizer not incorporated to at least 4 inches

May be lost to runoff or remain concentrated near the surface where they may inhibit germination.

Mulch rate inadequate or straw mulch not tacked down

Results in poor germination or failure, and erosion damage. Repair damaged areas, reseed and mulch.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

Annual ryegrass used for temporary seeding
Ryegrass reseeds itself and makes it difficult to establish a good cover of permanent vegetation.
Seed not broadcast evenly or rate too low
Results in patchy growth and erosion.

Maintenance

Inspect within 6 weeks of planting to see if stands are adequate. Check for damage after heavy rains. Stands should be uniform and dense. Fertilize, reseed, and mulch damaged and sparse areas immediately. Tack or tie down mulch as necessary.

Seeds should be supplied with adequate moisture. Furnish water as needed, especially in abnormally hot or dry weather or on adverse sites. Water application rates should be controlled to prevent runoff.

References

Massachusetts Department of Environmental Protection, Office of Watershed Management, Nonpoint Source Program, Massachusetts ***Nonpoint Source Management Manual***, Boston, Massachusetts, June, 1993.

North Carolina Department of Environment, Health, and Natural Resources, ***Erosion and Sediment Control Field Manual***, Raleigh, NC, February 1991.

U.S. Environmental Protection Agency, ***Storm Water Management For Construction Activities***, EPA-832-R- 92-005, Washington, DC, September, 1992.

Washington State Department of Ecology, ***Stormwater Management Manual for the Puget Sound Basin***, Olympia, WA, February, 1992.

Silt Curtain

A temporary sediment barrier installed parallel to the bank of a stream or lake. Used to contain the sediment produced by construction operations on the bank of a stream or lake and allow for its removal.

Where Practice Applies

The silt curtain is used along the banks of streams or lakes where sediment could pollute or degrade the stream or lake.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

Structural Practices

Bark Mulch Wattle – shall be installed as shown on the approved plans to help prevent erosion and sedimentation to the downstream wetland resources on the project.
Catch Basin – shall be fitted with "silt sack"-type devices during construction to prevent the accumulation of sediments in the catch basin sumps. Catch basins are to be cleaned as needed during construction using a truck-mounted vacuum device.
Tracking Pad - shall be installed in the initial stage of construction as shown on the approved plans to reduce deposition of sediments on the existing paved road.

Stormwater Management

The proposed stormwater management plan in the drainage analysis outlines the impacts of stormwater runoff for the project as it related to the downstream areas of comparison. Elements incorporated in the design of the stormwater management plan include the following best management practices (BMPs):

1. Deep Sump Catch basins with Gas Traps
2. Stormceptor STC900
3. Forebay
4. Infiltration basin
5. Infiltration chambers

Utilization of these BMPs as part of the overall watershed management plan will be instrumental in reducing the peak rate of runoff from the site into the wetland.

OTHER CONTROLS

Waste Disposal:

Waste Materials: all waste material shall be collected and stored in secure metal dumpsters rented from a licensed solid waste management company in Massachusetts. The dumpsters shall meet all local and State solid waste management regulations as outlined in 310 CMR 19.00. All trash and construction debris generated on site shall be disposed of in the dumpsters. The dumpsters shall be emptied as often as necessary during construction and transferred to an approved solid waste facility licensed to accept municipal solid waste and/or construction and demolition debris. No construction waste shall be buried on site. All personnel shall be instructed regarding the correct procedure for waste disposal.
Hazardous Waste: All hazardous waste materials shall be disposed of in a manner specified by local or State regulation or by the manufacturer. Site personnel shall be instructed in these practices.
Sanitary Waste: All sanitary waste shall be collected from portable units, as needed, by a septage hauler licensed in Massachusetts, in accordance with the requirements of the local Board of Health.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

Offsite Vehicle Tracking:

Construction entrance and exit shall be via Lowell Street. Accumulated sediments must be removed on a regular basis from the site entrance and adjacent roadway via street sweeping or hand sweeping operations as necessary.

TIMING OF CONTROLS/MEASURES

As indicated in the Sequence of Major Activities, the installation of erosion and sediment control devices and installation of stabilized construction entrances shall be in place prior to major earth excavation activities. Areas where construction activities are exposed more than two months, but less than 12 months shall be stabilized with the temporary stabilization practices referred to above. Once construction activity has been completed in a particular area, that area shall then be stabilized with permanent seed and mulch.

MAINTENANCE/INSPECTION PROCEDURES

Erosion and Sediment Control Inspection and Maintenance Practices

The following items represent the inspection and maintenance practices that shall be used to maintain sediment and erosion control for the project.

1. All control measures shall be inspected at least once every fourteen (14) days and following any storm event of 0.5 inches or greater.
2. All measures shall be maintained in good working order; if a repair is necessary, it shall be initiated within 24 hours of the report.
3. Built up sediment shall be removed from erosion control when it has reached one-third the height of the wattle.
4. Siltation Control shall be inspected for depth of sediment and tears.
5. The catch basin grate shall be inspected for grate elevation relative to current surface condition; condition of silt sacks, and degree to which sediment has accumulated on the grate and in the sump of the catch basin.
6. Temporary and permanent seeding and any plantings shall be inspected for bare spots, washouts, and healthy growth.
7. A maintenance inspection report shall be prepared following each inspection. A copy of the report form to be completed by the inspector is attached with this document.
8. The Site Contractor/ Project Manager ("Manager") shall select three individuals who will be responsible for inspections, maintenance and repair activities. The "Manager" shall be responsible for filling out the inspection and maintenance report.
9. Personnel selected for inspections and maintenance responsibilities shall receive training from the "Manager". They will be trained in all the inspection and

maintenance practices necessary for keeping the erosion and sediment control devices used on site in good working order.

Non-Stormwater Discharges

It is expected that the following non-stormwater discharges will occur from the site during the construction period:

1. Pavement wash waters
2. No non-stormwater discharges shall be directed to unstabilized earth surfaces.

INVENTORY FOR POLLUTION PREVENTION PLAN

The materials or substances listed below are expected to be present on site during construction:

- Bituminous Concrete
- Concrete
- Petroleum Based Products
- Cleaning Solvents
- Adhesives
- Grout
- Masonry Block
- Fertilizers

SPILL PREVENTION

The following are the material management practices that shall be used to reduce the risk of spills or other accidental exposure of materials and substances to stormwater runoff.

Equipment fueling and Storage:

Equipment and associated fuels and lubricants shall be stored in designated locations.

Good Housekeeping:

The following good housekeeping practices must be followed on site during the construction project.

1. A concerted effort shall be made to store only enough product required to complete a particular task
2. All materials stored on site shall be stored in a neat and orderly fashion in their appropriate containers and, if possible, under a roof or other secure enclosure

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

3. Products shall be kept in their original containers with the original manufacture's label
4. Substances shall not be mixed with one another unless recommended by the manufacturer
5. Whenever possible, all of a product shall be used up before disposing of the container
6. Manufacture's recommendations for proper use and disposal shall be followed
7. The site superintendent shall inspect daily to ensure proper use and disposal of materials on site.

Hazardous Products:

Then following practices are intended to reduce the risks associated with hazardous materials.

1. Products shall be kept in original containers unless they are not re-sealable
2. Where feasible, the original labels and material safety data shall be retained, whereas they contain important product information
3. If surplus product must be disposed, follow manufacturer's or local and State recommended methods for proper disposal.

PRODUCT SPECIFIC PRACTICES

The following product specific practices shall be followed on site:

Petroleum Products:

All on site vehicles shall be monitored for leaks and receive regular preventative maintenance to reduce the risk of leakage. Petroleum products shall be stored in tightly sealed containers which are clearly labeled. Any bituminous concrete or asphalt substances used on site shall be applied according to the manufacturer's recommendations.

Fertilizers:

Fertilizers shall be applied in the minimum amounts recommended by the manufacturer. Once applied, fertilizers shall be worked into the soil to limit exposure to stormwater. Storage shall be in a covered shed or trailer. The contents of any partially used bags of fertilizers shall be transferred to a sealable plastic bag or bin to avoid spills.

Paints:

All containers shall be tightly sealed and stored when not required for use. Excess paint shall not be discharged into any catch basin, drain manhole, or any portion of the stormwater management system. Excess paint shall be properly disposed of according to manufacturer's recommendations or State and local regulations.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

Concrete Trucks:

Concrete trucks shall not be allowed to wash out or discharge surplus concrete or drum wash water on site.

SPILL CONTROL PRACTICES

The Site Contractor / Project Manager ("Manager") is responsible for ensuring that materials spill control practices are followed upon commencement of, and during project construction.

In addition to the good housekeeping and material management practices discussed in the previous sections of this plan, the following practices must be followed for spill prevention and cleanup:

1. Manufacturer's recommended methods for cleanup for on-site materials must be readily available at the construction office, and site personnel shall be made aware of the procedures and the location of the information.
2. Materials and equipment necessary for spill cleanup shall be kept in the material storage area on site. Equipment and materials shall include, but not be limited to brooms, dust pans, mops, rags, gloves, goggles, kitty litter, sand sawdust, and plastic and metal trash containers specifically for this purpose.
3. All spills shall be cleaned up immediately after discovery.
4. The spill area shall be kept well ventilated and personnel shall wear appropriate protective clothing to prevent injury from contact with hazardous substance.
5. Spills of toxic or hazardous material shall be reported to the appropriate State and/or local authority in accordance with local and/or State regulations.
6. The spill prevention plan shall be adjusted to include measures to prevent a particular type of spill from reoccurring and how to clean up the spill if there is another occurrence. A description of the spill, what caused it, and the clean up measures shall also be included.
7. The "Manager" shall be the spill preventions and cleanup coordinator. The "Manager" shall designate at least three other site personnel who will be trained in the spill control practices identified above.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

Vallis Way
LYNNFIELD, MASSACHUSETTS

INSPECTION AND MAINTENANCE REPORT FORM

TO BE COMPLETED EVERY 14 DAYS AND WITHIN 24 HOURS OF
A RAINFALL EVENT OF 0.5 INCHES OR GREATER

Date: ___________________

Inspector: ________________________________ Inspector's Title:________________

Days Since Last Rainfall:___________ Amount of Last Rainfall _________

	BMP	BMP Installed? (circle one)		BMP Maintenance Required or Performed? (circle one)		Corrective Action Needed And Notes
1	Catch Basin with Gas Trap	Yes	No	Yes	No	
2	Erosion Control Barrier	Yes	No	Yes	No	
3	Siltsack	Yes	No	Yes	No	
4	Forebay	Yes	No	Yes	No	
5	Infiltration Basin	Yes	No	Yes	No	
6	Subsurface Chambers	Yes	No	Yes	No	
7						

Additional Comments: ____

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Project File: LYF-0381B
Vallis Way
Lynnfield, Massachusetts 01940

OPERATION AND MAINTENANCE PLAN AND LONG-TERM POLLUTION PREVENTION PLAN

#Vallis Way

Lynnfield, Massachusetts
Date: April 15, 2021
Revised November 30, 2021

Hayes Engineering, Inc.

Hayes Engineering, Inc.
603 Salem Street
Wakefield, MA 01880
Tel: (781) 246-2800
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OPERATION AND MAINTENANCE PLAN
VALLIS WAY
LYNNFIELD, MASSACHUSETTS

April 15, 2021
Revised November 30, 2021

GENERAL

The management plan incorporates a combination of three or more of the following chain of structural Best Management Practices to improve the water quality of the stormwater runoff from the proposed roadway.

1. Deep Sump Catch Basin with hood
2. Stormceptor STC900
3. Subsurface Detention Chambers
4. Roadway Sweeping
5. Forebay and Infiltration Basin

These stormwater management facilities have unique characteristics, uses, planning considerations and maintenance requirements. The maintenance requirements, as suggested by the DEP in "Volume 2 Chapter 2: Structural BMP Specifications for the Massachusetts Stormwater Handbook", and the suggested schedules, are summarized in the following sections. It is suggested that the following guidelines be adhered to for a one-year cycle following completion of the project, then adjusted, as necessary, based on the results of the required inspections, unless otherwise stated.

Deep Sump Catch Basin

- Inlets should be cleaned a minimum of four (4) times per year and inspected monthly.
- All sediments and hydrocarbons should be properly handled and disposed, in accordance with local, state and federal guidelines and regulations.
- The sumps of the deep sump catch basins needs to be cleaned out of the depth of the sediment is greater than half the depth of the sump.

Stormwater Management Areas (Subsurface Detention Chambers)

Chamber maintenance is not generally required. However, Subsurface systems are prone to failure due to clogging. Regulating the sediment and petroleum product input to the proposed system is the priority maintenance activity. Sediments and any oil spillage should be trapped and removed before they reach the chambers. Catch basin and proprietary particle separator pre-treatment devices which flow into the infiltration system shall be regularly cleaned according to the maintenance schedules provided herein to prevent fine sediments and debris from entering and clogging the subsurface system. Hayes Engineering, Inc. recommends the following inspection schedule to ensure that the chambers function well into the future.

- The Contractor shall verify that the required crushed stone and geotechnical fabric materials are clean and free of sediments and petroleum residue prior to, during and after the chamber system installation.

- Inspections of the chamber system shall be made by a registered profession engineer after every major storm for the first few months after construction to verify that proper function has been achieved. During these initial inspections, water levels in the chambers should be measured and recorded in a permanent log over several days to check the drainage duration and verify that sediments are not accumulating. If ponded water is present after 24 hours or an accumulation of sediment or debris is noted within the chambers, the Homeowners Association (or designated property manager) and engineer shall determine the cause for this condition and devise an action plan to improve system functionality. Any required maintenance or major repair will be documented in the permanent log book and be completed within seven business days, with a report of such to the Town's Engineer.

- Once the chamber system has been verified to perform as designed, interior chamber conditions shall be inspected at least annually. Post construction inspections (to be conducted through inspection ports) shall consist of documenting interior chamber and bed conditions, measured water depth, and presence of sediment. If inspection indicates that the system is clogged (ponding water present after 24 hours or sediment accumulations present), replacement or major repair actions may be required as determined by a professional engineer. In this case, the Homeowners Association (or designated property manager) and engineer shall determine the cause for this condition and devise an action plan. Any required maintenance or major repair will be documented in the permanent log book and be completed within seven business days, with a report of such to the Town Engineer.

- The inspection and maintenance responsibility for the subsurface system shall belong to the homeowners (or designated property manager).

Stormceptor STC 900 Water Quality Chamber

Regulating the input to the proposed water quality system is the priority maintenance activity. Sediments and any oil spillage should be trapped and removed before they reach the chambers.

- Stormceptor chamber maintenance shall be performed on a regular basis as recommended by the manufacturer (described in the attached excerpt from the Stormceptor Maintenance Brochure obtained from the Stormceptor website (www.stormceptor.com) and as summarized below.

- Sediment removal is recommended annually, but is likely to vary widely based on site conditions and loadings. Typical maintenance cleaning can be done with a vacuum truck. Inspection for each of the Stormceptor units will include a quantification of the sediment load and oil and grease volumes. This is easily made from the surface with a tube dipstick with ball valve inserted through the cleanout pipe or other access port. Depths of sediment indicating maintenance are presented in the following table for the various models. Inspection of the internal structure should be part of the routine inspection plan. The units are designed to accept 15% of their capacity in solids annually based on maximum drainage area loading. Removal of sediment, oils, and grease from the system will depend on rates of accumulation. All sediment and oil waste materials shall be disposed of in accordance with all Federal, State, and Local regulations.

REQUIRED MAINTENANCE *

Model	Sediment Depth (in.)
Stormceptor Model 900	8*

* based on 15% of the interceptor's sediment storage

Infiltration Basin

- In accordance with Volume 2, Chapter 2 of the MassDEP Storm Water Handbook as summarized below:
- Once the basin is in use, inspect it after every major storm (>3.1"/24-hr.) for the first few months to ensure it is stabilized and functioning properly and, if necessary, take corrective action. Note how long water remains standing in the basin after a storm; standing water within the basin 48 to 72 hours after a storm indicates that the infiltration capacity may have been overestimated. If the ponding is due to clogging, immediately address the reasons for the clogging (such as upland sediment erosion, excessive compaction of soils, or low spots). Thereafter, inspect the infiltration basin at least twice per year. Important items to check during the inspection include:
- • Signs of differential settlement,
- • Cracking,
- • Erosion,
- • Leakage in the embankments
- • Tree growth on the embankments
- • Condition of riprap,
- • Sediment accumulation and
- • The health of the turf.
- At least twice a year, mow the buffer area and side slopes. Remove grass clippings and accumulated organic matter to prevent an impervious organic mat from forming. Remove trash and debris at the same time. Use deep tilling to break up clogged surfaces and stabilize immediately. Remove sediment from the basin as necessary but wait until the floor of the basin is thoroughly dry. Use light equipment to remove the top layer so as to not compact the underlying soil. Replace pea gravel as needed. Inspect and clean pretreatment devices associated with basins at least twice a year, and ideally every other month.

Roadway Sweeping

In order to minimize the TSS load to the deep sump catch basins and those BMPs downstream it is planned to sweep the roadway four (4) times per year or more frequently if conditions require. Based upon actual experience and documentation a revised schedule may be submitted to the Town Engineer for approval.

Removal of Siltation Controls

All siltation controls, including, but not limited to Bark Mulch Wattle, shall be removed, with the approval of the Town Engineer, as soon as practical after paving, re-vegetation and total stabilization of the site. Unvegetated areas remaining in the area of the siltation controls shall be loamed and seeded with the appropriate groundcover to ensure re-vegetation as rapidly as possible after the removal of the siltation controls. In the case of all proposed stormwater management facilities, during construction of the proposed stormwater management system the developer shall be the owner and party responsible for maintenance.

Owner and Maintenance Responsibilities

Once the development is complete, the homeowners will assume the responsibility of on-going maintenance, as well as the long-term pollution prevention plan, unless other legally-binding agreements are established with another entity.

INSPECTION AND MAINTENANCE REPORT FORM
VALLIS WAY
LYNNFIELD, MASSACHUSETTS

TO BE COMPLETED FOR REQUIRED INSPECTIONS AND MAINTENANCE
AT THE FREQUENCY SPECIFIED IN THE OPERATION AND MAINTENANCE PLAN

Inspector: ________________ Date: ________________________________

Inspector's Title: ____

Days Since Last Rainfall: _______ Amount of Last Rainfall: _______________

	BMP	BMP Installed at Grade? (circle one)		BMP Maintenance Required or performed? (circle one)		Corrective Action Needed And Notes
1	Catch Basin inlets And gas traps	Yes	No	Yes	No	
2	Forebay	Yes	No	Yes	No	
3	Infiltration Pond	Yes	No	Yes	No	
4	Subsurface Chambers	Yes	No	Yes	No	
5	Erosion Control Barriers	Yes	No	Yes	No	
6	Silt Sacks	Yes	No	Yes	No	
7		Yes	No	Yes	No	

Additional Comments:

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LONG TERM POLLUTION PREVENTION PLAN
VALLIS WAY
LYNNFIELD, MASSACHUSETTS

- Good housekeeping practices: Prevent or reduce pollutant runoff from the project development through the use of street sweeping, erosion control and catch basin cleaning. It should be noted that we are not seeking credit for TSS removal with street sweeping for this project.

- Provisions for storing materials and waste products inside or under cover: All materials stored on site should be stored in a neat and orderly fashion in their appropriate containers and, if possible, under a roof or other secure enclosure. Waste products should be placed in secure receptacles until they are emptied by a licensed solid waste management company in Massachusetts.

- Vehicle washing controls: The project is comprised of single family house lots; therefore, the responsibility lies with the individual homeowners. The homeowners can prevent soap, scum and oily grit from entering the proposed drainage system by washing vehicles on the grass areas instead of the driveway or street.

- Requirements for routine inspections and maintenance of stormwater BMPs: Follow the guidelines outlined above.

- Spill prevention and response plans:

  Prevention: All materials stored on site should be stored in a neat and orderly fashion in their appropriate containers and, if possible, under a roof or other secure enclosure. Products should be kept in their original containers with the original manufacturer's label. Products should not be mixed with one another unless recommended by the manufacturer. If possible, all of the product should be used up before disposing of the container. The Manufacturer's recommendations for proper use and disposal should be followed.

  Response: Manufacturer's recommended methods for cleanup should be followed. Spills should be cleaned up immediately after discovery. The spill area shall be kept well ventilated and personnel shall wear appropriate protective clothing to prevent injury from contact with a hazardous substance. Spills of toxic or hazardous material shall be reported to the appropriate State and/or local authority in accordance with local and/or State regulations.

- Provisions for maintenance of lawns, gardens, and other landscaped areas: The project is comprised of single family house lots, therefore, these activities should be left up the individual homeowners to schedule and perform.

- Requirements for storage and use of fertilizers, herbicides, and pesticides (Should any questions arise about these materials the Order of Conditions for this project should be consulted if applicable):

  Fertilizers: Fertilizers shall be applied in the minimum amounts recommended by the manufacturer. Once applied, fertilizers shall be worked into the soil to limit exposure to stormwater. Storage shall be stored under a roof or other secure enclosure. The contents of any partially used bags of fertilizers shall be transferred to a sealable plastic bag or bin to avoid spills.

  Herbicides and Pesticides: Store herbicides and pesticides in original containers that are closed and labeled, in a secure area out of reach of children and pets. Avoid storing in damp areas where containers may become moist or rusty. Herbicides and Pesticides should not be stored near food. Follow the label instructions strictly about where and how much to apply. Do not put herbicides and pesticides in the trash or down the drain. Use rubber gloves when handling and use an appropriate cartridge mask if using products extensively.

- Pet waste management provisions: The project is comprised of single family house lots, therefore, the responsibility lies with the individual homeowners who own pets to perform the clean up and disposal of their pet waste.

- Provisions for operation and management of septic systems: The project is comprised of single family house lots; therefore, the septic systems are privately owned and the responsibility for these activities lies with the individual homeowners to schedule and perform.

- Provisions for solid waste management: Waste products should be placed in secure receptacles until they are emptied by a licensed solid waste management company in Massachusetts.

- Snow disposal and plowing plans relative to Wetland Resource Areas: Snow disposal should be in accordance with the Bureau of Resource Protection Snow Disposal Guidelines, Guideline No. BRPG01-01 effective December 21, 2015, a copy of which is attached.

- Winter Road Salt and/or Sand Use and Storage restrictions:

  Road Salt: Use and storage should be in accordance with the Bureau of Resource Protection Drinking Water Program Guidelines on Deicing Chemical (Road Salt) Storage, Guideline No. DWSG97-1 effective December 19, 1997, a copy of which is attached.

  Sand: Whenever possible, use of environmentally friendly alternatives, i.e. calcium chloride and sand instead of salt for melting ice should be considered.

- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan: The responsibility lies with the Homeowners Association.

Effective Date: March 8, 2001

Guideline No. BRPG01-01

Applicability: Applies to all federal, state, regional and local agencies, as well as to private businesses.

Supersedes: BRP Snow Disposal Guideline BRPG97-1 issued 12/19/97, and all previous snow disposal guidance

Approved by: Glenn Haas, Assistant Commissioner for Resource Protection

PURPOSE: To provide guidelines to all government agencies and private businesses regarding snow disposal site selection, site preparation and maintenance, and emergency snow disposal options that are acceptable to the Department of Environmental Protection, Bureau of Resource Protection.

APPLICABILITY: These Guidelines are issued by the Bureau of Resource Protection on behalf of all Bureau Programs (including Drinking Water Supply, Wetlands and Waterways, Wastewater Management, and Watershed Planning and Permitting). They apply to public agencies and private businesses disposing of snow in the Commonwealth of Massachusetts.

INTRODUCTION

Finding a place to dispose of collected snow poses a challenge to municipalities and businesses as they clear roads, parking lots, bridges, and sidewalks. While we are all aware of the threats to public safety caused by snow, collected snow that is contaminated with road salt, sand, litter, and automotive pollutants such as oil also threatens public health and the environment.

As snow melts, road salt, sand, litter, and other pollutants are transported into surface water or through the soil where they may eventually reach the groundwater. Road salt and other pollutants can contaminate water supplies and are toxic to aquatic life at certain levels. Sand washed into waterbodies can create sand bars or fill in wetlands and ponds, impacting aquatic life, causing flooding, and affecting our use of these resources.

There are several steps that communities can take to minimize the impacts of snow disposal on public health and the environment. These steps will help communities avoid the costs of a contaminated water supply, degraded waterbodies, and flooding. Everything we do on the land has the potential to impact our water resources. Given the authority of local government over the use of the land, municipal officials and staff have a critically important role to play in protecting our water resources.

The purpose of these guidelines is to help municipalities and businesses select, prepare, and maintain appropriate snow disposal sites before the snow begins to accumulate through the winter.

RECOMMENDED GUIDELINES

These snow disposal guidelines address: (1) site selection; (2) site preparation and maintenance; and (3) emergency snow disposal.

1. SITE SELECTION

The key to selecting effective snow disposal sites is to locate them adjacent to or on pervious surfaces in upland areas away from water resources and wells. At these locations, the snow meltwater can filter in to the soil, leaving behind sand and debris which can be removed in the springtime. The following areas should be avoided:

- Avoid dumping of snow into any waterbody, including rivers, the ocean, reservoirs, ponds, or wetlands. In addition to water quality impacts and flooding, snow disposed of in open water can cause navigational hazards when it freezes into ice blocks.

- Do not dump snow within a Zone II or Interim Wellhead Protection Area (IWPA) of a public water supply well or within 75 feet of a private well, where road salt may contaminate water supplies.

- Avoid dumping snow on MassDEP-designated high and medium-yield aquifers where it may contaminate groundwater (see the next page for information on ordering maps from MassGIS showing the locations of aquifers, Zone II's, and IWPAs in your community).

- Avoid dumping snow in sanitary landfills and gravel pits. Snow meltwater will create more contaminated leachate in landfills posing a greater risk to groundwater, and in gravel pits, there is little opportunity for pollutants to be filtered out of the meltwater because groundwater is close to the land surface.

- Avoid disposing of snow on top of storm drain catch basins or in stormwater drainage swales or ditches. Snow combined with sand and debris may block a storm drainage system, causing localized flooding. A high volume of sand, sediment, and litter released from melting snow also may be quickly transported through the system into surface water.

Site Selection Procedures

1. It is important that the municipal Department of Public Works or Highway Department, Conservation Commission, and Board of Health work together to select appropriate snow disposal sites. The following steps should be taken:

2. Estimate how much snow disposal capacity is needed for the season so that an adequate number of disposal sites can be selected and prepared.

3. Identify sites that could potentially be used for snow disposal such as municipal open space (e.g., parking lots or parks).

4. Sites located in upland locations that are not likely to impact sensitive environmental resources should be selected first.

5. If more storage space is still needed, prioritize the sites with the least environmental impact (using the site selection criteria, and local or MassGIS maps as a guide).

MassGIS Maps of Open Space and Water Resources

If local maps do not show the information you need to select appropriate snow disposal sites, you may order maps from MassGIS (Massachusetts Geographic Information System) which show publicly owned open spaces and approximate locations of sensitive environmental resources (locations should be field-verified where possible). Different coverages or map themes depicting sensitive environmental resources are available from MassGIS on the map you order. At a minimum, you should order the Priority Resources Map. The Priority Resources Map includes aquifers, public water supplies, MassDEP-approved Zone II's, Interim Wellhead Protection Areas, Wetlands, Open Space, Areas of Critical Environmental Concern, NHESP Wetlands Habitats, MassDEP Permitted Solid Waste facilities, Surface Water Protection areas (Zone A's) and base map features. The cost of this map is $25.00. Other coverages or map themes you may consider, depending on the location of your city or town, include Outstanding Resource Waters and MassDEP Eelgrass Resources. These are available at $25.00 each, with each map theme being depicted on a separate map. Maps should be ordered from MassGIS . Maps may also be ordered by fax at 617-626-1249 (order form available from the MassGIS web site) or mail. For further information, contact MassGIS at 617-626-1189.

2. SITE PREPARATION AND MAINTENANCE

In addition to carefully selecting disposal sites before the winter begins, it is important to prepare and maintain these sites to maximize their effectiveness. The following maintenance measures should be undertaken for all snow disposal sites:

- A silt fence or equivalent barrier should be placed securely on the downgradient side of the snow disposal site.

- To filter pollutants out of the meltwater, a 50-foot vegetative buffer strip should be maintained during the growth season between the disposal site and adjacent waterbodies.

- Debris should be cleared from the site prior to using the site for snow disposal.

- Debris should be cleared from the site and properly disposed of at the end of the snow season and no later than May 15.

3. EMERGENCY SNOW DISPOSAL

As mentioned earlier, it is important to estimate the amount of snow disposal capacity you will need so that an adequate number of upland disposal sites can be selected and prepared.

If despite your planning, upland disposal sites have been exhausted, snow may be disposed of near waterbodies. A vegetated buffer of at least 50 feet should still be maintained between the site and the waterbody in these situations. Furthermore, it is essential that the other guidelines for preparing and maintaining snow disposal sites be followed to minimize the threat to adjacent waterbodies.

Under extraordinary conditions, when all land-based snow disposal options are exhausted, disposal of snow that is not obviously contaminated with road salt, sand, and other pollutants may be allowed in certain waterbodies under certain conditions. In these dire situations, notify your Conservation Commission and the appropriate MassDEP Regional Service Center before disposing of snow in a waterbody.

Use the following guidelines in these emergency situations:

- Dispose of snow in open water with adequate flow and mixing to prevent ice dams from forming.

- Do not dispose of snow in saltmarshes, vegetated wetlands, certified vernal pools, shellfish beds, mudflats, drinking water reservoirs and their tributaries, Zone IIs or IWPAs of public water supply wells, Outstanding Resource Waters, or Areas of Critical Environmental Concern.

- Do not dispose of snow where trucks may cause shoreline damage or erosion.

- Consult with the municipal Conservation Commission to ensure that snow disposal in open water complies with local ordinances and bylaws.

FOR MORE INFORMATION

If you need more information, contact one of MassDEP's Regional Service Centers:

Northeast Regional Office, Wilmington, 978-694-3200
Southeast Regional Office, Lakeville, 508-946-2714
Central Regional Office, Worcester, 508-792-7683
Western Regional Office, Springfield, 413-755-2214

or

Call Thomas Maguire of DEP's Bureau of Resource Protection in Boston at 617-292-5602.

Effective Date: December 19, 1997

Guideline No. DWSG97-1

Applicability: Applies to all parties storing road salt or other chemical deicing agents.

Supersedes: Fact Sheet: DEICING CHEMICAL (ROAD SALT) STORAGE (January 1996)

Approved by: Arleen O'Donnell, Asst. Commissioner for Resource Protection

PURPOSE: To summarize salt storage prohibition standards around drinking water supplies and current salt storage practices.

APPLICABILITY: These guidelines are issued on behalf of the Bureau of Resource Protection's Drinking Water Program. They apply to all parties storing road salt or other chemical deicing agents.

I. The Road Salt Problem:
Historically, there have been incidents in Massachusetts where improperly stored road salt has polluted public and private drinking water supplies. Recognizing the problem, state and local governments have taken steps in recent years to remediate impacted water supplies and to protect water supplies from future contamination. As a result of properly designing storage sheds, new incidents are uncommon. These guidelines summarize salt storage prohibition standards around drinking water supplies and current salt storage practices.

II. Salt Pile Restrictions in Water Supply Protection Areas:
Uncovered storage of salt is forbidden by Massachusetts General Law Chapter 85, section 7A in areas that would threaten water supplies. The Drinking Water Regulations, 310 CMR 22.21(2)(b), also restrict deicing chemical storage within wellhead protection areas (Zone I and Zone II) for public water supply wells, as follows: "storage of sodium chloride, chemically treated abrasives or other chemicals used for the removal of ice and snow on roads [are prohibited], unless such storage is within a structure designed to prevent the generation and escape of contaminated runoff or leachate." For drinking water reservoirs, 310 CMR 22.20C prohibits, through local bylaw, uncovered or uncontained storage of road or parking lot de-icing and sanding materials within Zone A at new reservoirs and at those reservoirs increasing their withdrawals under MGL Chapter 21G, the Water Management Act.

For people on a low-sodium diet, 20 mg/L of sodium in drinking water is consistent with the bottled water regulations' meaning of "sodium free." At 20 mg/L, sodium contributes 10% or less to the sodium level in people on a sodium-restricted diet. For more information contact: Catherine Sarafinas at 617-556-1070 or catherine.sarafinas@state.ma.us, or Suzanne Robert at 617-292-5620 or suzanne.robert@state.ma.us.

III. Salt Storage Best Management Practices (BMP):

Components of an "environment-friendly" roadway deicing salt storage facility include:

- the right site = a flat site;
- adequate space for salt piles;
- storage on a pad (impervious/paved area);
- storage under a roof; and
- runoff collection/containment.

For more information, see The Salt Storage Handbook, 6th ed. Virginia: Salt Institute, 2006 (phone 703-549-4648 orhttp://www.saltinstitute.org/publication/safe-and-sustainable-snowfighting/).

IV. Salt Storage Practices of the Massachusetts Highway Department:

The Massachusetts Highway Department (MHD) has 216 permanent salt storage sheds at 109 locations in the state. On leased land and state land under arteries and ramps, where the MHD cannot build sheds, salt piles are stored under impermeable material. This accounts for an additional 15 sites. The MHD also administers a program to assist municipalities with the construction of salt storage sheds. Of 351 communities, 201 municipalities have used state funds for salt storage facilities.

For more information about MHD's salt storage facilities, contact Paul Brown at the Massachusetts Highway Department, 10 Park Plaza, Boston, MA 02116 (phone 617-973-7792).

Preliminary Water Distribution Report

Vallis Way

Lynnfield, Massachusetts

Hayes Engineering, Inc
603 Salem Street
Wakefield, MA 01880
Tel: (781) 246-2800
Fax: (781) 246-7596
Nantucket, MA 02554
Tel: (508) 228-7909

Refer to File No. LYF-0381B

November 30, 2021

John Scenna, PE, Superintendent
Lynnfield Center Water District
86 Phillips St
Lynnfield, MA 01960

RE: Flow Test

Dear Superintendent Scenna,

In accordance with our previous discussions, we conducted a hydrant flow test at the hydrant at the end of Mohawk Lane, taking the residual pressure at the hydrant in front of 130 Lowell Street. Accompanying this letter, please find a copy of the Hydrant Flow Test Report. The Lynnfield Center Water System in this area is very strong and we recorded a flow of 920 gallons a minute with a head loss of only 2 p.s.i. at 130 Lowell Street, very close to the proposed Vallis Way. With the estimated peak flow of the proposed Vallis Way subdivision less than 10 gallons a minute, with a peaking factor or three, I think it can be concluded that the demand will have little or no effect on domestic flow in the area and the fireflow of 3600+/- gallons per minute at 20 p.s.i. will provide ample fire protection for a typical 2 1/2 story single family home.

I would be pleased to discuss this further, if necessary.

Very truly yours,,

Peter Ogren PE, PLS

Peter Ogren PE, PLS

Cc: Emilie Cadamartori

Hydrant Flow Test Report

Test Date 11/30/2021 **Test Time** 0830

Location

Static - Kennedy K81D at 130 Lowell St
Flow - Dresser 500 at end Mohawk Lane

Tested by

Hayes Engineering, Inc.
603 Salem Street
Wakefield, MA 01880
(781) 246.2800

Witnessed by AMC

Notes

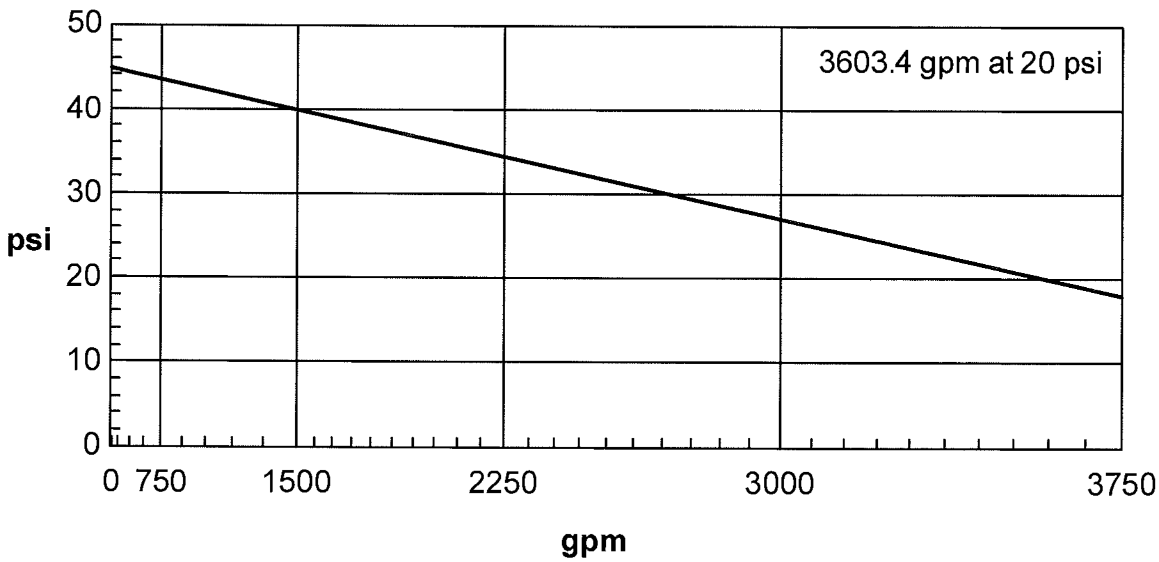
Read Hydrant

45 psi **static pressure**
43 psi **residual pressure**
157 ft **hydrant elevation**

Flow Hydrant(s)

Outlet	Elev	Size	C	Pitot Pressure	Flow
#1	157	2.5	0.80	30	920 gpm

Flow Graph



Created with the free hydrant flow test program from www.igneusinc.com

LGCI
Lahlaf Geotechnical Consulting, Inc.

November 22, 2021

Mr. Paul Caggiano
Paul Caggiano Development LLC
26666 Seagull Way, C201
Malibu, CA 90265
Phone: (603) 305-3719
Email: pcaggdev@hotmail.com

Re: **Geotechnical Report**
Proposed Residential Development
Lynnfield, Massachusetts
LGCI Project No. 2131

Dear Mr. Caggiano:

Lahlaf Geotechnical Consulting, Inc. (LGCI) has completed a geotechnical study for the proposed Residential Development in Lynnfield, Massachusetts. This report contains a summary of our subsurface explorations and foundation design and construction recommendations. We are submitting our report electronically. Please notify us if you wish to obtain a hard copy of the report.

The soil samples and rock core from our explorations are currently stored at LGCI for further analysis, if requested. Unless notified otherwise, we will dispose of the soil samples after three months.

Thank you for choosing LGCI as your geotechnical engineer.

Very truly yours,

Lahlaf Geotechnical Consulting, Inc.

Abdelmadjid M. Lahlaf, Ph.D., P.E.
Principal Engineer

Lahlaf Geotechnical Consulting, Inc.

GEOTECHNICAL REPORT
PROPOSED RESIDENTIAL DEVELOPMENT
LYNNFIELD, MASSACHUSETTS
LGCI Project No. 2131
November 22, 2021

Prepared for:

PAUL CAGGIANO DEVELOPMENT LLC
26666 Seagull Way, C201
Malibu, CA 90265
Phone: (603) 305-3719

GEOTECHNICAL REPORT
PROPOSED RESIDENTIAL DEVELOPMENT
LYNNFIELD, MASSACHUSETTS
LGCI Project No. 2131
November 22, 2021

Prepared for:

PAUL CAGGIANO DEVELOPMENT LLC
26666 Seagull Way, C201
Malibu, CA 90265
Phone: (603) 305-3719

Prepared by:

LAHLAF GEOTECHNICAL CONSULTING, INC.
100 Chelmsford Road, Suite 2
Billerica, Massachusetts 01862
Phone: (978) 330-5912
Fax: (978) 330-5056

Abdelmadjid M. Lahlaf, Ph.D., P.E.
Principal Engineer

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

List of Tables, Figures, and Appendices

1. PROJECT INFORMATION

1.1 Project Authorization

This report presents the results of subsurface explorations and a geotechnical evaluation performed by Lahlaf Geotechnical Consulting, Inc. (LGCI) for the proposed Residential Development in Lynnfield, Massachusetts. We performed our services in general accordance with our proposal No. 21091 dated October 8, 2021. Our services were authorized by Mr. Paul Caggiano of Paul Caggiano Development LLC by signing our proposal on October 8, 2021.

1.2 Purpose and Scope of Services

The purpose of this study was to obtain subsurface information at the site and to provide foundation design and construction recommendations for the proposed Residential Development. LGCI performed the following services:

- Provided a field engineer to coordinate our boring, probe, and test pit locations with Paul Caggiano Development LLC, to mark the boring locations at the site, and to notify Dig Safe Systems Inc. (Dig Safe) and the Town of Lynnfield for utility clearance.

- Performed two (2) double ring infiltrometer tests in two (2) test pits in the material underlying the subsoil in test pits excavated by a subcontractor engaged directly by Mr. Paul Caggiano.

- Engaged a drilling subcontractor for one (1) day to advance one (1) soil boring and one (1) rock probe at the site. Our drilling subcontractor applied for a sidewalk crossing (access) permit from the Town of Lynnfield

- Provided an LGCI geotechnical engineer at the site to coordinate and observe the test pits, soil boring and rock probe, collect soil samples, and prepare field logs.

- Submitted four (4) soil samples for laboratory testing.

- Prepared this geotechnical report containing the results of our subsurface explorations and our recommendations for foundation design and construction.

LGCI did not perform environmental services for this project. LGCI did not perform an assessment to evaluate the presence or absence of hazardous or toxic materials above or below the ground surface at or around the site. Any statement about the color, odor, or the presence of suspicious materials included in our exploration logs or report were made by LGCI for information only and to support our geotechnical services. No environmental recommendations and/or opinions are included in this report.

Our scope does not include reviewing specifications and drawings, or performing field services during construction. LGCI will be pleased to provide these services under a separate agreement. Recommendations for unsupported slopes, stormwater management, erosion control, pavement design, slope stability analyses, site specific liquefaction analysis, and detailed cost or quantity estimates are not included in our scope of work.

1.3 Site Description

Our understanding of the existing site conditions is based on our field observations, our conversations with Paul Caggiano Development LLC, and on the following document:

- Drawing titled: "Existing Conditions Plan, Definitive Plan, Vallis Way, Lynnfield, Mass.," (Existing Conditions Plan) prepared by Hayes Engineering, Inc., dated April 12, 2021, and provided to LGCI by Hayes Engineering, Inc. via e-mail on September 23, 2021.

The site is located at 109 Lowell Street in Wakefield, Massachusetts as shown in Figure 1. The site is bordered by Lowell Street on the southern side, private houses on the eastern and western sides, and the Sagamore Spring Golf Club on the northern side. The site is occupied by a one-story residential dwelling that is to remain on site. The area north of the existing dwelling is heavily wooded.

Based on the Existing Conditions Plan, the grades generally rise gently from about El. 150 feet near the northeastern portion of the site to about El. 158 feet near the western side of the site. There is a hill located on the southern side of the site, the top of the hill is at about El. 172 feet and the grade rapidly drops to about El. 152 feet. The grades in the grass area east of the existing dwelling range between about El. 153 feet near Lowell Street and gradually drop to about El. 148 feet.

1.4 Project Description

Our understanding of the proposed construction is based on our conversations with Paul Caggiano Development LLC, the forementioned Existing Conditions Plan, and on the following document:

- Drawing titled: "Lottling Plan, Definitive Plan, Vallis Way, Lynnfield, Mass.," prepared by Hayes Engineering, Inc., dated April 12, 2021, and provided to LGCI by Hayes Engineering, Inc. via e-mail on September 23, 2021.

We understand that the proposed construction will consist of subdividing the property into five house lots for single family dwellings. These houses will have ground floor elevations of El. 156.5 feet, El. 148.1 feet, El. 151.0 feet, El. 153.0 feet, and El. 153.0 feet in lots 1 to 5, respectively. Lot 1 will require little fill to meet the proposed ground floor and site grading. Lot 2 will require cuts of about 7 feet to reach the proposed ground floor. Lots 3 and 4 will require minor cuts and fill to reach the proposed ground floor. Lot 5 will require removing up to 21 feet of overburden and rock to meet the proposed ground floor. The construction will include the installation of a 40-foot wide right of way called Vallis Way. The proposed construction will include an infiltration pond near the northwest corner of Lot 2. The proposed infiltration pond has a proposed top El. 146.0 feet and a bottom El. 140.0 feet.

1.5 Elevation

We understand that the elevations shown in the Existing Conditions Plan are referenced to the North American Vertical Datum of 1988 (NAVD 88). Elevations are in feet.

2. SITE AND SUBSURFACE CONDITIONS

2.1 Surficial Geology

LGCI reviewed a Surficial Geological Map titled: "Surficial Materials Map of the Reading Quadrangle, Massachusetts," prepared by Stone, B.D., Stone, J.R., and DiGiacomo-Cohen, M.L. Scientific Investigation Map 3402, Quadrangle 124 – Reading, 2018

The Surficial Geological Map indicates that the natural soils in the general vicinity of the site consist of coarse deposits and thin till.

The coarse deposits consist of sand, sand and gravel, and gravel deposits as described below. The sand deposits are comprised mostly of fine to coarse sand. Coarser layers may contain up to 25 percent gravel. Finer layers may contain very fine sand, silt, and clay. The sand and gravel deposits occur as a mixture of gravel and sand within individual layers and as alternating layers of sand and gravel. The sand and gravel layers range between 25 and 50 percent gravel and 50 to 75 percent sand. The gravel deposits are comprised of at least 50 percent gravel, cobbles, and boulders. Sand occurs within gravel beds and as separate layers within the gravel.

The thin till is described as a nonsorted, nonstratified matrix of sand, some silt, and little clay containing scattered pebble, cobble, and boulder clasts. The thin till is generally less than 10 to 15 feet thick.

The Surficial Geological Map of the site is shown in Figure 2.

2.2 LGCI's Boring and Probe

An LGCI representative marked the boring and probe locations in the field, and we notified Dig Safe System, Inc. (Dig Safe) and the Town of Lynnfield for utility clearance prior to drilling.

LGCI engaged Northern Drill Service, Inc. (NDS) of Northborough, Massachusetts to advance one (1) boring (B-1) and one (1) probe (P-1) at the site on October 22, 2021. An LGCI geotechnical engineer observed and logged the boring and probe in the field. The boring and probe were advanced with a Diedrich D-25 ATV track-mounted drill rig using drive and wash technique with a 4-inch casing. Boring B-1 extended to a depth of 20.8 feet beneath the ground surface. Probe P-1 extended to a depth of 10 feet beneath the ground surface.

The drillers performed SPT and obtained split spoon samples with an automatic hammer at two or five-foot intervals in boring B-1 as noted on the boring log in general accordance with ASTM D-1586. The purpose of performing probe P-1 was to probe for possible bedrock, therefore, the drillers did not perform SPT and did not obtain any soil samples in probe P-1. The soil samples are currently stored at LGCI for further analysis, if requested. Unless notified otherwise, we will dispose of the soil samples after three months.

Upon completion, the boreholes were backfilled with the soil cuttings.

Appendix A contains LGCI's boring and probe logs and Figure 3 shows the boring and probe locations. A summary of the boring and probe is shown in Table 1. A summary of the test pits is shown in Table 2. The ground surface elevations shown in the boring and probe logs were interpolated from the Existing Conditions Plan and could be as much as 2 to 3 feet off.

2.3 LGCI's Test Pits

An LGCI representative marked the test pit locations in the field, and we notified Dig Safe and the Town of Lynnfield for utility clearance prior to excavating.

Paul Caggiano Development LLC engaged J. Wyman Excavation of Lynnfield, Massachusetts to excavate two (2) test pits (TP-1 to TP-2) at the site on October 12, 2021. LGCI preformed two (2) double ring infiltrometer test, one (1) in each test pit. The test pits were excavated with a CAT 420E and extended to depths ranging between 13.5 and 14 feet beneath the ground surface.

An LGCI geotechnical engineer observed and logged the test pits in the field.

Upon completion, the test pit excavations were backfilled with the excavated material which was placed in about 18-inch lifts and tamped with the excavator bucket.

Appendix B contains LGCI's test pit logs. A summary of the test pits is shown in Table 2. The ground surface elevations shown in the test pit logs were provided to us by Hayes Engineering, Inc. via e-mail on November 22, 2021.

2.4 Subsurface Conditions

The subsurface description in this report is based on a limited number of explorations and is intended to highlight the major soil strata encountered during our explorations. The subsurface conditions are known only at the actual exploration locations. Variations may occur and should be expected between exploration locations. The exploration logs represent conditions that we observed at the time of our explorations and were edited, as appropriate, based on the results of the laboratory test data and inspection of the soil samples in the laboratory. The strata boundaries shown in our exploration logs are based on our interpretations and the actual transition may be gradual. Graphic soil symbols are for illustration only.

The soil strata encountered in the boring and test pits were as follows, starting at the ground surface:

Forest Mat – A layer of surficial forest mat was encountered at the ground surface in the boring and test pits. The thickness of the forest mat layer ranged between 0.5 and 1 foot.

Subsoil – A layer of subsoil was encountered beneath the surficial forest mat in the test pits and extended to depths ranging between 2.2 and 2.3 feet beneath the ground surface. The subsoil was described as silty sand. The fines content in the subsoil ranged between 20 and 25 percent. The subsoil contained traces of fine subrounded gravel, organic soil, and roots. The excavation effort within the subsoil was described as easy.

Fill – Existing fill was encountered beneath the surficial forest mat in boring B-1 and extended to a depth of 2 feet beneath the ground surface. The fill was described as well graded sand. The fines content in the fill ranged between 5 and 10 percent and the gravel content in the fill ranged up to 45 percent. The fill contained traces of roots.

The SPT N-value in this layer was 13 blows per foot (bpf), indicating medium dense sand.

Sand and Gravel – A layer of sand and gravel was encountered beneath the subsoil in test pit TP-1 and extended to a depth of about 11 feet beneath the ground surface. The samples in this layer were described as well graded gravel with 35 to 40 percent sand, and 15 to 20 percent cobbles and boulders up to 3 feet in diameter. The sand and gravel contained less than 5 percent fines.

Sand – A layer of sand was encountered beneath the sand and gravel in test pit TP-1 and beneath the subsoil and fill in test pit TP-2 and boring B-1, respectively. The sand extended to the termination depth of test pits TP-1 and TP-2, and to the top of bedrock in boring B-1. The samples in this layer were described as well graded sand and silty sand. The sand contained up to 25 percent fines and up to 40 percent gravel.

The SPT N-values in this layer ranged between 24 bpf and refusal, with most values ranging between 24 and 36 bpf, indicating medium dense to dense sand.

Weathered Rock – A layer of weathered rock was encountered beneath the sand layer in boring B-1 and extended to a depth of 16 feet beneath the ground surface. The weathered rock broke into a sand matrix. The sample in this layer was described as silty sand. The fines content in the weathered rock ranged between 20 and 25 percent, and the gravel content ranged up to 35 percent.

The SPT N-value recorded in this layer indicated refusal.

Rock – Rock was encountered within boring B-1 at a depth of 16 feet beneath the ground surface. To confirm and characterize the rock, rock was cored in boring B-1. The rock was described as hard, slightly weathered, slightly to extremely fractured, fine-grained, gray, Diorite. The rock core recovery was about 94.7 percent, and the Rock Quality Designation (RQD) was about 28.1 percent. The coring rate ranged between 2.7 and 5.3 minutes per foot.

2.5 Groundwater

Groundwater was observed in the boring and test pits at depths ranging between 4 and 13.5 feet beneath the ground surface.

The groundwater information reported herein is based on observations made during or shortly after the completion of our explorations and may not represent the actual groundwater level, as additional time may be required for the groundwater levels to stabilize. The groundwater information presented in this report only represents the conditions encountered at the time and locations of our explorations. Seasonal variation should be anticipated.

2.6 Infiltrometer Tests

LGCI provided a geotechnical field engineer to perform two (2) double ring infiltrometer tests in test pits TP-1 and TP-2 (one each).

The excavation was first advanced to the test depth where the test pit bottom was leveled using the excavator bucket. After the infiltrometer rings were driven into the ground, the test was conducted by filling the rings with water. The test pit was advanced deeper after the completion of the test.

The test results are included in Appendix C.

The results include plots of the hydraulic conductivity for flow within the inner and outer rings. The stabilized portion of the plot for the inner ring indicates the permeability value. The results indicate the following approximate permeability, K, values:

TP-1: K = 10 10^{-3} cm/sec.
TP-2: K = 22 10^{-3} cm/sec.

LGCI also performed grain-size analyses on soil samples from the test depths as described below.

2.7 Laboratory Test Data

LGCI submitted four (4) soil samples obtained from the boring and test pits for laboratory testing. The laboratory data sheets are included in Appendix D, and the results are summarized in the table below.

Boring / Test Pit No.	Sample No.	Soil Stratum	Sample Depth (ft.)	Percent Gravel	Percent Sand	Percent Fines
B-1	S1 Bot. 7"	Fill	0 – 2	43.2	49.1	7.7
B-1	S2	Nat. Sand	2 – 4	37.3	52.2	10.5
TP-1	Infil. Test	Nat. Gravel	2.8	62.0	36.4	1.6
TP-2	Infil. Test	Nat. Sand	3.0	26.3	68.9	4.8

3. EVALUATION AND RECOMMENDATIONS

3.1 Foundation Recommendations

3.1.1 General

Based on the results of the boring and test pits, the subsurface conditions at the site are suitable to support the proposed buildings after the subgrade is prepared in accordance with the recommendations in this report. There are a few issues that we would like to highlight for consideration and discussion:

3.1.2 Existing Fill and Subsoil

Existing fill and subsoil were encountered beneath the forest mat. These materials extended to depths ranging between 2 and 2.3 feet beneath the ground surface. These materials are not suitable to support the proposed buildings and should be entirely removed within the proposed building footprints. The removal should extend at least 5 feet beyond the limits of the proposed buildings.

3.1.3 Shallow Foundations

After the existing fill and subsoil are removed, the proposed building may be supported on shallow footings bearing directly on top of the sand and gravel and sand layers.

3.1.4 Rock Removal

Based on the proposed FFEs, rock removal will likely be required on the western side of the site. Depending on the extent of rock removal, blasting may be required. Additional recommendations for rock removal are provided is Section 4.6.1.

3.2 Foundation Recommendations

3.2.1 Footing Design

- For footings bearing on Structural Fill placed directly on top of the natural sand and gravel and sand layers, we recommend a net allowable bearing pressure of 3 kips per square foot (ksf).

- The subgrade of footings should be prepared in accordance with the recommendations in Section 4.1.

- All foundations should be designed in accordance with *The Commonwealth of Massachusetts State Building Code 780 CMR, Ninth Edition* (MSBC 9th Edition).

- Exterior footings and footings in unheated areas should be placed at a minimum depth of 4 feet below the final exterior grade to provide adequate frost cover protection. Interior footings in heated areas may be designed and constructed at a minimum depth of 2 feet below finished floor grades.

- We recommend that wall footings have a minimum width of 2 feet, and that column footings have a minimum width of 3 feet. For foundations with a least lateral dimension smaller than 3 feet, the allowable bearing pressure should be reduced to 1/3 of the recommended allowable bearing pressure times the least dimension in feet.

- Wall footings should be designed and constructed with continuous, longitudinal steel reinforcement for greater bending strength to span across small areas of loose or soft soils that may go undetected during construction.

3.2.2 Settlement

Using the allowable bearing pressure and the minimum footing sizes recommended above, we estimate for foundations constructed in accordance with the recommendations contained in this report that the total post-construction settlement will be less than about 1 inch and that the differential settlement will be 3/4 inch or less over a distance of 25 feet. Total and differential settlements of these magnitudes are usually considered tolerable for the anticipated construction. However, the tolerance of the proposed structure to the predicted total and differential settlements should be assessed by the structural engineer.

3.3 Concrete Slab Considerations

- The proposed floor slabs can be constructed as slabs-on-grade bearing on a minimum of 12 inches of Structural Fill placed directly on top of the natural sand or sand and gravel.

- To reduce the potential for dampness in the proposed floor slabs, the project architect may consider placing a vapor barrier beneath the floor slabs. The vapor barrier should be protected from puncture during construction of the slabs.

- For the design of floor slabs bearing on the materials described above, we recommend using a modulus of subgrade reaction, k_{s1}, of 100 tons per cubic foot (tcf). Please note that the values of k_{s1} are for a 1 x 1 square foot area. These values should be adjusted for larger areas using the following expression:

$$Modulus of Subgrade Reaction (k_s) = k_{s1} * \left(\frac{B+1}{2B} \right)^2$$

where:

k_s = Coefficient of vertical subgrade reaction for loaded area,
k_{s1} = Coefficient of vertical subgrade reaction for 1 x 1 square foot area, and

B = Width of area loaded, in feet.

Please note that cracking of slabs-on-grade can occur as a result of heaving or compression of the underlying soil, but also as a result of concrete curing stresses. To reduce the potential for cracking, the precautions listed below should be closely followed for construction of all slabs-on-grade:

- Construction joints should be provided between the floor slab and the walls and columns in accordance with the American Concrete Institute (ACI) requirements, or other applicable code.
- Backfill in interior and exterior utility trenches should be properly compacted.
- In order for the movement of exterior slabs not to be transmitted to the building foundation or superstructure, exterior slabs such as approach slabs and sidewalks, should be isolated from the building superstructure.

3.4 Under-slab Drainage

Based on the groundwater levels observed in our boring, we believe that an under-slab drainage system will likely be required for the proposed buildings near boring B-1. If the development proceeds with the FFEs listed in Section 1.4, we recommend that the owner install groundwater observation wells to monitor the groundwater levels, especially in the springtime to capture the high groundwater level.

3.5 Seismic Design Criteria

In accordance with Section 1613 of MSBC 9th Edition and based on the boring data, the seismic criteria are as follows:

• Site Class:	D
• Spectral Response Acceleration at short period, S_s (Table 1604.11):	0.237g
• Spectral Response Acceleration at 1 sec., S_1 (Table 1604.11):	0.073g
• Site Coefficient, F_a (Table 1613.3.3(1)):	1.6
• Site Coefficient, F_v (Table 1613.3.3(2)):	2.4
• Adjusted spectral response S_{ms} (Equation 16-37):	0.379g
• Adjusted spectral responses S_{m1} (Equation 16-38):	0.175g

Based on the SPT data from the boring, we believe the site soils are not susceptible to liquefaction.

4. CONSTRUCTION CONSIDERATIONS

4.1 Subgrade Preparation

- Forest mat, existing fill, and other deleterious matter should be entirely removed from within the footprint of the proposed buildings. The removal should extend at least 5 feet beyond the limits of the proposed buildings and paved areas.

- Boulders at the bottom of excavations for footings, slabs, and the subbase of paved areas and sidewalks should be removed; and the resulting excavation should be backfilled with compacted Structural Fill under buildings and with Ordinary Fill under the subbase layer of paved areas and sidewalks.

- The base of the footing excavations should be compacted with a dynamic vibratory compactor weighing at least 200 pounds and imparting a minimum of 4 kips of force to the subgrade, before placing concrete.

- The subgrade in the natural sand or sand and gravel beneath the proposed slabs should be compacted with a dynamic vibratory compactor imparting a minimum of 20 kips of force to the subgrade before placing Structural Fill.

- Where sand that is susceptible to disturbance under foot traffic is encountered at the bottom of footing excavations, the excavation should be extended an additional 6 inches and restored with Structural Fill or crushed stone to serve as working mat.

- Fill placed within the footprint of the proposed buildings should meet the gradation and compaction requirements of Structural Fill shown in Section 4.3.1.

- Fill placed under the subbase of paved areas should meet the gradation and compaction requirements of Ordinary Fill shown in Section 4.3.2.

- Fill placed in the top 12 inches beneath sidewalks, if any, should consist of Structural Fill with less than 5 percent fines.

- An LGCI geotechnical representative should observe the exposed subgrades prior to fill and concrete placement to verify that the exposed bearing materials are suitable for the design soil bearing pressure.

- If soft or loose pockets are encountered in the footing excavations, the soft or loose materials should be removed, and the bottom of the footing should be placed at a lower elevation on firm soil, or the resulting excavation should be backfilled with Structural Fill or crushed stone wrapped in a geotextile filter fabric.

4.2 Subgrade Protection

The onsite sand is frost susceptible. If construction takes place during freezing weather, special measures should be taken to prevent the subgrade from freezing. Such measures should include the use of heat blankets or excavating the final six inches of soil just before pouring concrete. Footings should be backfilled as soon as possible after footing construction. Soil used as backfill should be free of frozen material, as should the ground on which it is placed. Earthwork operations should be suspended during freezing weather.

Materials with high fines content are typically difficult to handle when wet as they are sensitive to moisture content variations. Subgrade support capacities may deteriorate when such soils become wet and/or disturbed. The contractor should keep exposed subgrades properly drained and free of ponded water. Subgrades should be protected from machine and foot traffic to reduce disturbance.

4.3 Fill Materials

Fill placed within the footprint of the proposed buildings should meet the gradation and compaction requirements of Structural Fill. Fill placed outside the building footprint beneath any pavement subbase should meet the gradation and compaction requirements of Ordinary Fill. Structural Fill and Ordinary Fill should consist of inert, hard, durable sand and gravel, free from organic matter, clay, surface coatings, and deleterious materials.

4.3.1 Structural Fill

The Structural Fill should have a plasticity index of less than 6 and should meet the gradation requirements shown below. Structural Fill should be compacted in maximum 9-inch loose lifts to at least 95 percent of the Modified Proctor maximum dry density (ASTM D1557), with moisture contents within ±2 percentage points of optimum moisture content.

Sieve Size	Percent Passing by Weight
3 inches	100
1 ½ inch	80 - 100
½ inch	50 – 100
No. 4	30 – 85
No. 20	15 – 60
No. 60	5 – 35
No. 200*	0 – 10

* 0 – 5 Under sidewalks

4.3.2 Ordinary Fill

Ordinary Fill should have a plasticity index of less than 6 and should meet the gradation requirements shown below. Ordinary Fill should be compacted in maximum 9-inch loose lifts to at least 95 percent of the Modified Proctor maximum dry density (ASTM D1557), with moisture contents within ±2 percentage points of optimum moisture content.

Sieve Size	Percent Passing by Weight
6 inches	100
1 inch	50 - 100
No. 4	20 – 100
No. 20	10 - 70
No. 60	5 – 45
No. 200	0 – 20

4.4 Reuse of Onsite Materials

Based on the results of the grain-size analyses, some of the onsite soils free of organic matter may be used as Structural Fill and/or Ordinary Fill. Soils with high fines content (higher than about 20 percent) are generally very sensitive to moisture content variations and are susceptible to frost. These soils are difficult to compact at moisture contents that are much higher or much lower than the optimum moisture content determined from the laboratory compaction test. Therefore, strict moisture control should be implemented during stockpiling, placement, and compaction of the existing fill.

All materials to be used as fill should first be tested for compliance with the applicable gradation specifications. During earthwork operations, the contractor should avoid mixing the reusable soils with fine-grained and/or organic soils.

4.5 Groundwater Control Procedures

Based on the groundwater levels encountered in our explorations, we anticipate that groundwater control procedures will be needed during the excavation for footings. We anticipate that filtered sump pumps installed in pits located at least three feet below the bottom of the excavation may be sufficient to handle surface runoff that may enter the excavation. The contractor should be prepared to use multiple sump pumps as needed.

The contractor should be permitted to employ whatever commonly accepted means and practices are necessary, including well points if necessary, to maintain the groundwater level below the excavation, and to maintain a dry excavation during wet weather. Placement of reinforcing steel or concrete in standing water should not be permitted.

Groundwater levels should be maintained at a minimum of 1-foot below the bottom of excavations during construction.

To reduce the potential for sinkholes developing over sump pump pits after the sump pumps are removed, the crushed stone placed in the sump pump pits should be wrapped in a geotextile fabric. Alternatively, the crushed stone should be entirely removed after the sump pumps are no longer in use and the sump pump pits should be restored with suitable backfill.

4.6 Rock Blasting Consideration

4.6.1 Rock Removal

Based on the currently proposed FFEs, rock cuts will likely be required for footings and utility excavations on the western side of the site.

Minor rock cuts (less than one foot) over short distances may be achieved using hoe-rams or by using other non-blasting techniques. For cuts of more than about 1 foot that extend over large areas, we anticipate that rock blasting will be required.

- Rock should be cut at least 12 inches beneath the bottom of footings, 24 inches beneath the bottom of slabs, and 18 inches beneath the bottom of paved areas.
- Under utility pipes, manholes, and catch basins, rock should be cut a minimum of 12 inches beneath the pipe or structure.
- Laterally, rock should be cut a minimum of 12 inches outside of footings, 3 feet outside of walls, 12 inches outside of utility structures and a minimum of 18 inches on each side of utility pipes.
- To reduce overblasting and the potential for heaved rock, drill holes for blasting should not extend more than 2 feet beneath the minimum depths shown above.
- Rock blasting should be controlled to reduce vibrations and airblast overpressure to below thresholds established in the Earth Moving Specifications.
- To reduce the potential for blasted rock mixing with organic soil, we recommend that the topsoil, roots, tree stumps, and vegetation be removed before blasting. The remainder of the overburden soils and excavatable weathered rock should not be removed before blasting.
- To help obtain information about the top of the rock for rock quantity estimating purposes, we recommend that the Earth Moving Specifications include a requirement for the contractor to perform rock probes at the site in a grid pattern. The results of the probes should include at a minimum the ground surface elevation and the elevation of the top of the rock. The probes should extend at least 5 feet beyond the perceived top of rock to make sure that the perceived top of rock is not a boulder.
- Rock surfaces under footings should be cut as level as possible but not inclined at more than 12H:1V.

- Structural Fill should be separated from the underlying rock using a geotextile fabric in areas where the rock is heavily fractured.

4.6.2 Ground Vibration Monitoring

Rock blasting operations will generate ground vibrations that may result in minor cracks and cosmetic damage to nearby structures. To protect the adjacent structures from potential damage, construction blasting should be carefully controlled and monitored. We recommend monitoring vibrations at the ground surface and at nearby structures before and during the rock blasting operations.

4.6.3 Public Notification

The human perception threshold to vibration is very low, i.e., people are far more sensitive to vibrations than are the structures they occupy. Various studies have indicated that the sound effects are noticeable at peak particle velocity (PPV) values of 0.02 inches per second (ips) and complaints and claims of damage are likely at PPV values of 0.2 to 0.3 ips. These vibration intensities are well below the intensities that would cause structural damage to buildings. For these reasons, we recommend that the owner implement a proactive program of public notification and education of neighbors on the physical characteristics of blasting effects before the start of blasting.

4.6.4 Pre-Construction Condition Survey

We recommend that the Owner perform a pre-construction condition survey of structures located within 250 feet of the nearest blasting operation to document the existing conditions of the structures. The Owner may also consider using crack monitoring gauges to monitor large cracks identified during the pre-construction surveys.

4.7 Temporary Excavations

All excavations to receive human traffic, including utility trenches, basement or footing excavations, or others (i.e. underground storage tanks, etc.), should be constructed in accordance with the OSHA guidelines.

The site soils should generally be considered Type "C" and should have a maximum allowable slope of 1.5 Horizontal to 1 Vertical (1.5H:1V) for excavations less than 20 feet deep. Deeper excavations, if needed, should have shoring designed by a professional engineer.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of the excavation sides and bottom.

5. RECOMMENDATIONS FOR FUTURE WORK

We recommend engaging LGCI to perform the following services:

- Prepare Earth Moving Specifications.
- Review the geotechnical aspect of contractor submittals and requests for information (RFIs).
- Provide a field representative during construction to observe the preparation of the subgrade of footings and floor slabs.

6. REPORT LIMITATIONS

Our analysis and recommendations are based on project information provided to us at the time of this report. If changes to the type, size, and location of the proposed structures or to the site grading are made, the recommendations contained in this report shall not be considered valid unless the changes are reviewed, and the conclusions and recommendations modified in writing by LGCI. LGCI cannot accept responsibility for designs based on our recommendations unless we are engaged to review the final plans and specifications to determine whether any changes in the project affect the validity of our recommendations and whether our recommendations have been properly implemented in the design.

It is not part of our scope to perform a more detailed site history; therefore, we have not explored for or researched the locations of buried utilities or other structures in the area of the proposed construction. Our scope did not include environmental services or services related to moisture, mold, or other biological contaminates in or around the site.

The recommendations in this report are based in part on the data obtained from the subsurface explorations. The nature and extent of variations between explorations may not become evident until construction. If variations from anticipated conditions are encountered, it may be necessary to revise the recommendations in this report. We cannot accept responsibility for designs based on recommendations in this report unless we are engaged to 1) make site visits during construction to check that the subsurface conditions exposed during construction are in general conformance with our design assumptions and 2) ascertain that, in general, the work is being performed in compliance with the contract documents.

Our report has been prepared in accordance with generally accepted engineering practices and in accordance with the terms and conditions set forth in our agreement. No other warranty, expressed or implied, is made. This report has been prepared for the exclusive use of Paul Caggiano Development LLC for the specific application to the proposed residential development in Lynnfield, Massachusetts as conceived at this time.

7. REFERENCES

The Commonwealth of Massachusetts (2017), "The Massachusetts State Building Code, 780 CMR, Ninth Edition."

The Department of Labor, Occupational Safety and Health Administration (1989), "Occupational Safety and Health Standards - Excavations; Final Rule," 20 CFR Part 1926, Subpart P.

USGS – Lynnfield MA topographic map from www.digital-topo-maps.com

Table 1 - Summary of LGCI's Boring and Probe
Proposed Residential Development
Lynnfield, Massachusetts
LGCI Project No. 2131

Boring/Probe No.	Ground Surface Elevation (ft.)[1]	Groundwater[2] Depth / El. (ft.)	Bottom of Forest Mat Depth / El. (ft.)	Bottom of Fill Depth / El. (ft.)	Bottom of Sand Depth / El. (ft.)	Bottom of Weathered Rock / Top of Rock Depth / El. (ft.)	Bottom of Boring Depth / El.(ft.)
B-1	172.0	4.0 / **168.0**	0.5 / **171.5**	2.0 / **170.0**	11.0 / **161.0**	16.0 / **156.0**	20.8 / **151.2**
P-1	171.0	3.0 / **168.0**	- / -	- / -	- / -	- / -	10.0 /[3] **161.0**

1. The ground surface elevation was interpolated from drawing titled: "Existing Conditions Plan, Definitive Plan, Vallis Way, Lynnfield, Mass.," prepared by Hayes Engineering, Inc., dated April 12, 2021, and provided to LGCI by Hayes Engineering, Inc. via e-mail on September 23, 2021. The interpolated ground surface was not based on a surveyed location. Accordingly, the interpolated values could be off by as much as 2 to 3 feet.
2. Groundwater depth based on sample moisture in the boring and on level at end of drilling in the probe.
3. Probe terminated in possible weathered rock.
4. "-" means layer was not encountered.

Table 2 - Summary of LGCI's Test Pits
Proposed Residential Development
Lynnfield, Massachusetts
LGCI Project No. 2131

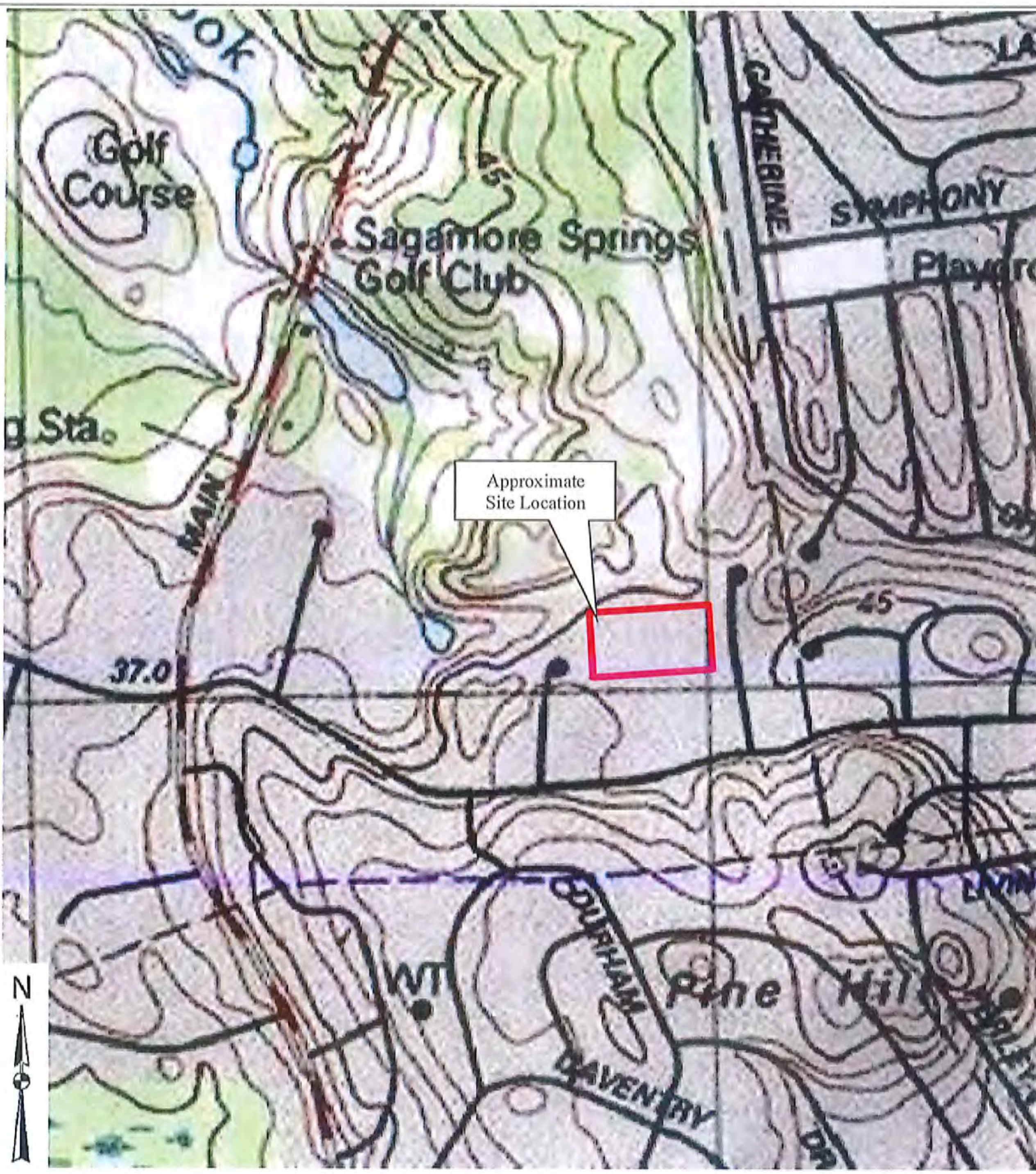
Test Pit No.	Ground Surface Elevation (ft.)[1]	Groundwater[2] Depth / El. (ft.)	Bottom of Forest Mat Depth / El. (ft.)	Bottom of Subsoil Depth / El. (ft.)	Bottom of Sand and Gravel Depth / El. (ft.)	Bottom of Sand Depth / El. (ft.)	Bottom of Test Pit Depth / El. (ft.)
TP-1	146.1	13.5 / **132.6**	1.0 / **145.1**	2.3 / **143.8**	11.0 / 135.1	14.0 [3]/ **132.1**	14.0 [3]/ **132.1**
TP-2	**148.4**	**13.0 / 135.4**	**0.9 / 147.5**	**2.2 / 146.2**	- / -	**13.5 [3]/ 134.9**	**13.5 [3]/ 134.9**

1. The ground surface elevation was provided to LGCI by Hayes Engineering, Inc., the project Civil Engineer, via e-mail on November 22,2021.

2. Groundwater depths based on level at the end of excavation.

3. Test pit terminated in the sand vel layer.

4. "-" means layer was not encountered.

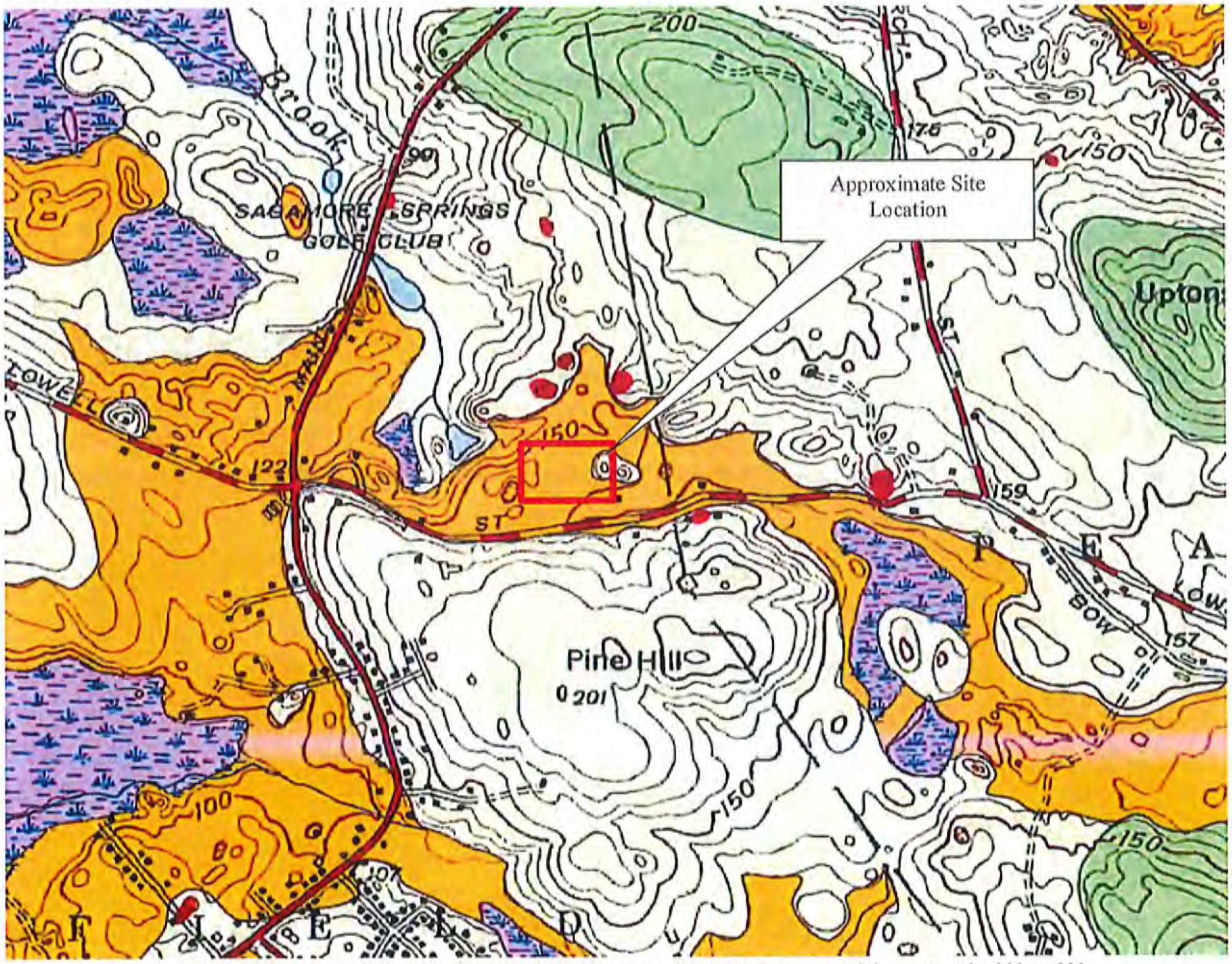


Contour Intervals: 3 meters

0.3 mi

Note: Figure based on USA Topo Maps of Lynnfield, MA obtained from https://viewer.nationalmap.gov/

Client: Paul Caggiano Development LLC	Project: Proposed Residential Development	Figure 1 – Site Location Map	
LGCI Lahlaf Geotechnical Consulting, Inc.	Project Location: Lynnfield, MA	LGCI Project No.: 2131	Date: Nov. 2021



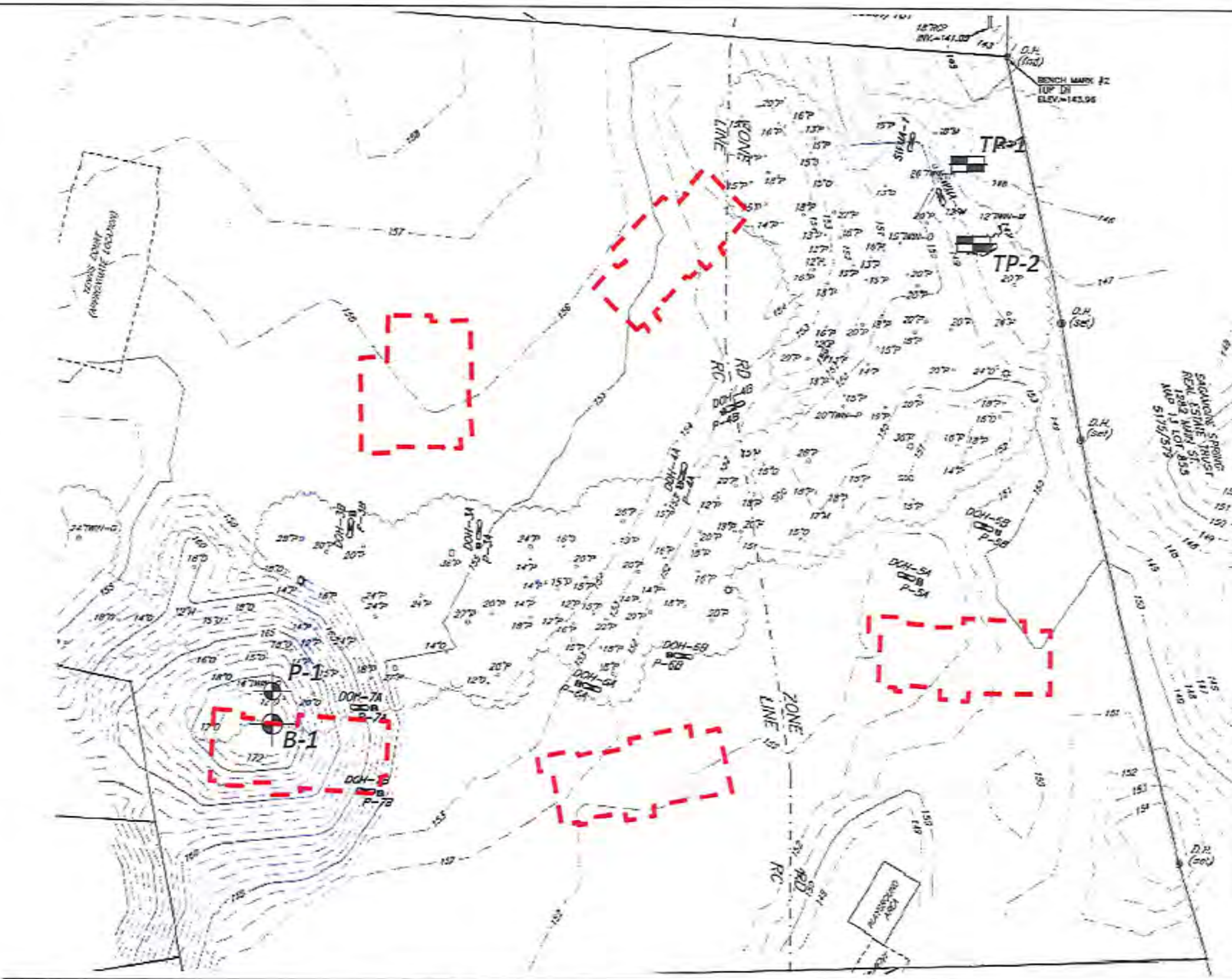
N

Thin till—Nonsorted, nonstratified matrix of sand, some silt, and little clay containing scattered pebble, cobble, and boulder clasts; large surface boulders are common; unit was mapped where till is generally less than 10 to 15 ft thick including areas of shallow bedrock. Predominantly consists of upper till of the last glaciation; loose to moderately compact, generally sandy, commonly stony. Two facies are present in some places: a looser, coarser grained ablation facies, melted out from supraglacial position; and an underlying more compact, finer grained lodgement facies deposited subglacially. In general, both ablation and lodgement facies of upper till derived from fine-grained bedrock are finer grained, more compact, less stony and have fewer surface boulders than upper till derived from coarse-grained crystalline rocks. Across Massachusetts, fine-grained bedrock sources include the red Mesozoic sedimentary rocks of the Connecticut Valley lowland, marble in the western river valleys, and fine-grained schists in upland areas

Coarse deposits consist of *gravel deposits*, *sand and gravel deposits*, and *sand deposits*, not differentiated in this report. *Gravel deposits* are composed of at least 50 percent gravel-size clasts; cobbles and boulders predominate; minor amounts of sand occur within gravel beds, and sand comprises a few separate layers. Gravel layers generally are poorly sorted, and bedding commonly is distorted and faulted due to postdepositional collapse related to melting of ice. *Sand and gravel deposits* occur as mixtures of gravel and sand within individual layers and as layers of sand alternating with layers of gravel. Sand and gravel layers generally range between 25 and 50 percent gravel particles and between 50 and 75 percent sand particles. Layers are well sorted to poorly sorted; bedding may be distorted and faulted due to postdepositional collapse. *Sand deposits* are composed mainly of very coarse to fine sand, commonly in well-sorted layers. Coarser layers may contain up to 25 percent gravel particles, generally granules and pebbles; finer layers may contain some very fine sand, silt, and clay

Figure based on map titled: "Surficial Materials Map of the Reading Quadrangle, Massachusetts," prepared by Stone, B.D., Stone J.R., and DiGiacomo-Cohen, M.L. for U.S. Geological Survey, 2018, Scientific Investigation Map 3402, Quadrangle 124 – Reading.

Client: Paul Caggiano Development LLC	Project: Proposed Residential Development	Figure 2 – Surficial Geologic Map	
LGCI Lahlaf Geotechnical Consulting, Inc.	Project Location: Lynnfield, MA	LGCI Project No.: 2131	Date: Nov. 2021



Legend

Approximate location of test pit advanced by J. Wyman Excavation of Lynnfield, MA on October 12, 2021, and observed by Lahlaf Geotechnical Consulting, Inc. (LGCI).

Approximate location of probe advanced by Northern Drill Service, Inc. of Northborough, MA on October 22, 2021, and observed by LGCI.

Approximate location of boring advanced by Northern Drill Service, Inc. of Northborough, MA on October 22, 2021, and observed by LGCI.

Approximate Limits of Proposed Buildings.

Approximate Scale (ft.)

0 20 40 80 120

Note

Figure based on drawing titled: "Existing Conditions Plan, Definitive Plan, Vallis Way, Lynnfield, Mass.," prepared by Hayes Engineering, Inc., dated April 12, 2021, and provided to LGCI by Hayes Engineering, Inc. via e-mail on September 23, 2021.

Client:	Project:		
Paul Caggiano Development LLC	Proposed Residential Development	Figure 3 – Boring, Probe, and Test Pit Location Plan	
LGCI Lahlaf Geotechnical Consulting, Inc.	Project Location: Lynnfield, MA	LGCI Project No.: 2131	Date: Nov. 2021

APPENDIX A – LGCI's Boring and Probe Logs

LGCI
Lahlaf Geotechnical Consulting, Inc.
100 Chelmsford Rd Suite 2
Billerica, MA 01862
Telephone: 9783305912
Fax: 9783305056

BORING LOG

B-1

CLIENT: Mr. Paul Caggiano
LGCI PROJECT NUMBER: 2131
PROJECT NAME: Proposed Residential Development
PROJECT LOCATION: Lynnfield, MA

DATE STARTED: 10/22/21 **DATE COMPLETED:** 10/22/21
BORING LOCATION: Near top of hill
COORDINATES: NA
SURFACE El.: 172 ft. (see note 1) **TOTAL DEPTH:** 20.8 ft.
WEATHER: 70's / Sunny
GROUNDWATER LEVELS:
∇ **DURING DRILLING:** 4.0 ft. / El. 168.0 ft. Based on sample moisture
▼ **AT END OF DRILLING:** 5.5 ft. / El. 166.5 ft.
▼ **OTHER:** -

DRILLING SUBCONTRACTOR: Northern Drill Service, Inc.
DRILLING FOREMAN: Justin Raymond
DRILLING METHOD: Drive and wash with 4-inch casing
DRILL RIG TYPE/MODEL: Diedrich D-25 Atv
HAMMER TYPE: Automatic
HAMMER WEIGHT: 140 lb. **HAMMER DROP:** 30 in.
SPLIT SPOON DIA.: 1.375 in. I.D., 2 in. O.D.
CORE BARREL SIZE: NX
LOGGED BY: TG **CHECKED BY:** NP

Depth (ft.)	El. (ft.)	Sample Interval (ft.)	Sample Number	Blow Counts (N Value)	Pen./Rec. (in.)	Remark	Strata	Depth El.(ft.)	Material Description
		0					Forest Mat	0.5 / 171.5	S1 - Top 6": Forest Mat
		0-2	S1	3-6-7-6 (13)	24/13		Fill		Bot. 7": Well Graded SAND with Silt and Gravel (SW-SM), fine to coarse, 5-10% fines, 40-45% mostly fine subangular gravel, trace of roots, brown, moist
	170.0	2-4	S2	8-18-18-13 (36)	24/16			2.0 / 170.0	S2 - Well Graded SAND with Silt and Gravel (SW-SM), fine to coarse, 10-15% fines, 35-40% fine to coarse subangular gravel, brown, moist
5		4-6	S3	18-14-10-9 (24)	24/14				S3 - Silty SAND with Gravel (SM), fine to coarse, 20-25% fines, ~25% fine to coarse subangular gravel, light brown, wet
	165.0	6-6.4	S4	100/5"	5/5		Sand		S4 - Similar to S3
10		9-10.5	S5	24-45-63	18/14				S5 - Silty SAND with Gravel (SM), fine to coarse, 20-25% fines, 20-25% fine to coarse subangular gravel, trace of weathered rock, brown, wet
	160.0					1	Boulder	11.0 / 12.0 / 160.0	REMARK 1: Advanced button bit through 1 foot boulder between depths of 11' and 12'.
15		14-14.3	S6	100/4"	4/1	2	Weathered Rock		REMARK 2: Spun 3" casing between depths of 14' to 16'. S6 - Silty SAND with Gravel (SM), fine to coarse, 20-25% fines, 30-35% fine to coarse subangular gravel, brown, wet (weathered rock)
	155.0	16-20.8	C1		57/54		Rock	16.0 / 156.0	C1 - min./ft.: 2.9, 3.1, 2.7, 4.0, 5.3 Rec./Pen.: 54"/57"= 94.74% RQD: 16"/57"=28.07% Hard, slightly weathered, extremely fractured to slightly fractured, fine-grained, gray, DIORITE .
20						3			REMARK 3: Rock core barrel jammed at depth of 20'.
		20.8				4		20.8	REMARK 4: Rock core barrel jammed at depth of 20.7'. Bottom of borehole at 20.8 feet. Borehole backfilled with drill cuttings.
	150.0								
25									

GENERAL NOTES:

1. The ground surface elevation was interpolated from drawing titled: "Existing Conditions Plan, Definitive Plan, Vallis Way, Lynnfield, Mass.," prepared by Hayes Engineering, Inc., dated April 12, 2021, and provided to LGCI by Hayes Engineering, Inc. via e-mail on September 23, 2021. The interpolated ground surface elevation was not based on a surveyed location and could be off as much as 2 to 3 feet.

LGCI Lahlaf Geotechnical Consulting, Inc.
100 Chelmsford Rd Suite 2
Billerica, MA 01862
Telephone: 9783305912
Fax: 9783305056

PROBE LOG

P-1

CLIENT: Mr. Paul Caggiano
PROJECT NAME: Proposed Residential Development
LGCI PROJECT NUMBER: 2131
PROJECT LOCATION: Lynnfield, MA

DATE STARTED: 10/22/21 **DATE COMPLETED:** 10/22/21
BORING LOCATION: Near top of hill
COORDINATES: NA
SURFACE El.: 171 ft. (see note 1) **TOTAL DEPTH:** 10 ft.
WEATHER: 70's / Sunny
GROUNDWATER LEVELS:
∇ DURING DRILLING: -
▼ AT END OF DRILLING: 3.0 ft. / El. 168.0 ft.
▼ OTHER: -

DRILLING SUBCONTRACTOR: Northern Drill Service, Inc.
DRILLING FOREMAN: Justin Raymond
DRILLING METHOD: Drive and wash with 4-inch casing
DRILL RIG TYPE/MODEL: Diedrich D-25 Atv
HAMMER TYPE: NA
HAMMER WEIGHT: NA **HAMMER DROP:** NA
GEOPROBE CASING DIA.:
GEOPROBE LINER DIA.: NA
LOGGED BY: TG **CHECKED BY:** NP

Depth (ft.)	El. (ft.)	Sample Interval (ft.)	Sample Number	Pen./Rec. (in.)	Remark	Strata	Depth El.(ft.)	Material Description
	170.0				1			REMARK 1: Advanced button bit without sampling to probe for rock.
							▼	
5	165.0							
					2			REMARK 2: Encountered possible cobbles or boulder between depths of 7' and 9'.
					3			REMARK 3: Encountered possible weathered rock between depths of 9' and 10'.
10	160.0				4			REMARK 4: Advanced probe to depth of 10'. Terminated probe due to lack of water. Bottom of borehole at 10.0 feet. Borehole backfilled with drill cuttings.
15	155.0							
20	150.0							
25								

GENERAL NOTES:

1. The ground surface elevation was interpolated from drawing titled: "Existing Conditions Plan, Definitive Plan, Vallis Way, Lynnfield, Mass.," prepared by Hayes Engineering, Inc., dated April 12, 2021, and provided to LGCI by Hayes Engineering, Inc. via e-mail on September 23, 2021. The interpolated ground surface elevation was not based on a surveyed location and could be off as much as 2 to 3 feet.

APPENDIX B – LGCI's Test Pit Logs

LGCI Lahlaf Geotechnical Consulting, Inc.
100 Chelmsford Rd Suite 2
Billerica, MA 01862
Telephone: 9783305912
Fax: 9783305056

TEST PIT LOG

TP-1
PAGE 1 OF 1

CLIENT: Mr. Paul Caggiano
PROJECT NAME: Proposed Residential Development
LGCI PROJECT NUMBER: 2131
PROJECT LOCATION: Lynnfield, MA

DATE STARTED: 10/12/21 **DATE COMPLETED:** 10/12/21
EXCAVATION SUBCONTRACTOR: J. Wyman Excavation
TEST PIT LOCATION: Near the NE corner of the site
EXCAVATION FOREMAN: Mark McCormick
COORDINATES: NA
EXCAVATOR TYPE/MODEL: CAT 420E
SURFACE EL.: 146.07 ft. (see note 1) **TOTAL DEPTH:** 14 ft.
WEATHER: 70's / Sunny
GROUNDWATER LEVELS:
TEST PIT DIMENSIONS: 11' x 5'
▽ **DURING EXCAVATION:** -
LOGGED BY: TG / HO **CHECKED BY:** NP
▼ **AT END OF EXCAVATION:** 13.5 ft. / El. 132.6 ft.

Depth (ft)	El. (ft)	Excavation Effort	Remark	Strata	Depth El.(ft.)	Material Description
0 – 1.0	146.07 – 145.1	E		Forest Mat	1.0 / 145.1	0 ft. - 1 ft.: Forest Mat
1.0 – 2.3	145.1 – 143.8	E		Subsoil	2.3 / 143.8	1 ft. - 2.3 ft.: Silty SAND (SM), fine to medium, 20-25% fines, trace fine rounded to subrounded gravel, trace of organic soil, trace of roots, orange-brown, moist
2.3 – 11.0	143.8 – 135.1	M	1	Sand and Gravel	11.0 / 135.1	2.3 ft. - 11 ft.: Well Graded GRAVEL with Sand (GW), fine to coarse, subangular, 0-5% fines, 35-40% fine to coarse sand, 15-20% cobbles and boulders up to 3' in diameter, light brown, moist REMARK 1: Infiltrometer test performed at depth of 2.8'.
11.0 – 14.0	135.1 – 132.07	E		Sand	14.0	11 ft. - 14 ft.: Silty SAND (SM), fine, 35-40% fines, gray, moist to wet ▼
						Bottom of test pit at 14.0 feet. Test pit backfilled with excavated material and tamped in 18-inch lifts with the excavator bucket.

GENERAL COMMENTS: E = Easy, M - Moderate, D = Difficult, V = Very Difficult

1. The ground surface elevation was provided to LGCI by Hayes Engineering, Inc., the project Civil Engineer, via e-mail on November 22, 2021.

LGCI
Lahlaf Geotechnical Consulting, Inc.
100 Chelmsford Rd Suite 2
Billerica, MA 01862
Telephone: 9783305912
Fax: 9783305056

TEST PIT LOG

TP-2

CLIENT: Mr. Paul Caggiano
PROJECT NAME: Proposed Residential Development
LGCI PROJECT NUMBER: 2131
PROJECT LOCATION: Lynnfield, MA

DATE STARTED: 10/12/21 **DATE COMPLETED:** 10/12/21
TEST PIT LOCATION: Near the NE corner of the site
COORDINATES: NA
SURFACE EL.: 146.43 ft. (see note 1) **TOTAL DEPTH:** 13.5 ft.
GROUNDWATER LEVELS:
∇ **DURING EXCAVATION:** -
▼ **AT END OF EXCAVATION:** 13.0 ft. / El. 133.4 ft.

EXCAVATION SUBCONTRACTOR: J. Wyman Excavation
EXCAVATION FOREMAN: Mark McCormick
EXCAVATOR TYPE/MODEL: CAT 420E
WEATHER: 70's / Sunny
TEST PIT DIMENSIONS: 14' x 7.5'
LOGGED BY: TG / HO **CHECKED BY:** NP

Depth (ft)	El. (ft)	Excavation Effort	Remark	Strata	Depth El.(ft.)	Material Description
		E		Forest Mat		0 ft. - 0.9 ft.: Forest Mat
	145.0	E		Subsoil	0.9 / 145.5	0.9 ft. - 2.2 ft.: Silty SAND (SM), fine, 20-25% fines, trace of organic soil, trace of roots, orange-brown, moist
2.5	142.5	E	1	Sand	2.2 / 144.2	2.2 ft. - 13.5 ft.: Well Graded SAND with Gravel (SW), fine to coarse, 0-5% fines, 25-30% fine to coarse subrounded gravel, 10-15% cobbles and boulders up to 10' in diameter, gray, moist to wet REMARK 1: Infiltrometer test performed at depth of 3'.
5.0	140.0					
7.5	137.5					
10.0	135.0					
12.5					▼	
					13.5	Bottom of test pit at 13.5 feet. Test pit backfilled with excavated material and tamped in 18-inch lifts with the excavator bucket.

GENERAL COMMENTS: E = Easy, M - Moderate, D = Difficult, V = Very Difficult

1. The ground surface elevation was provided to LGCI by Hayes Engineering, Inc., the project Civil Engineer, via e-mail on November 22, 2021.

APPENDIX C - Double Ring Infiltrometer Test Results

Lahlaf Geotechnical Consulting, Inc.

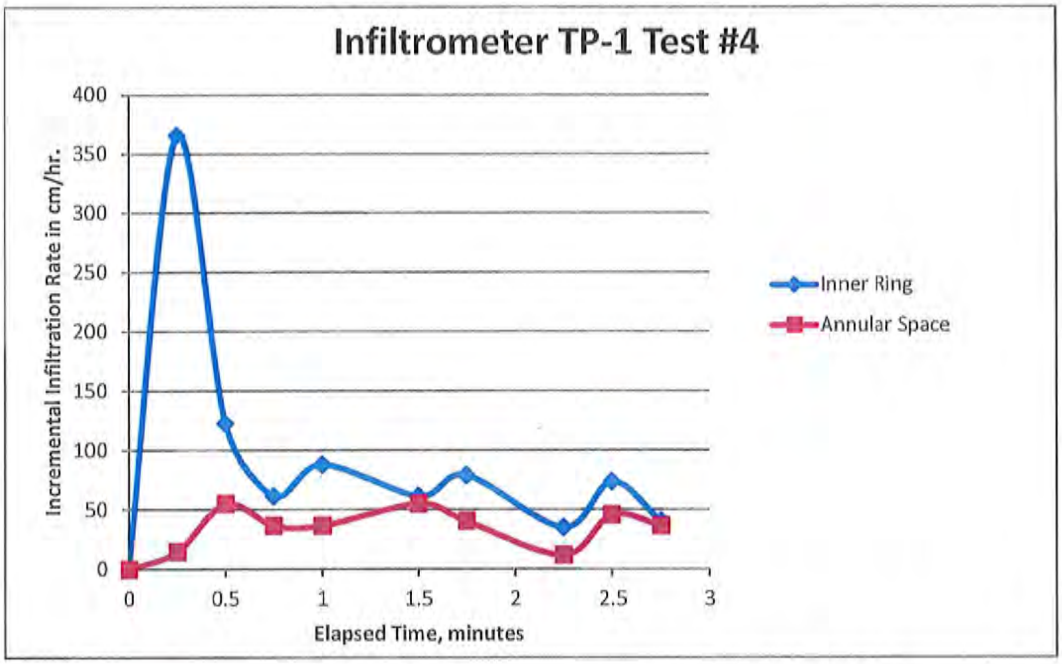
Double Ring Infiltrometer Test

Project:	Name: Proposed Residential Development
	Location: Lynnfield, MA
	LGCI Project Number: 2131
Test Location:	Near the northeast corner of site TP-1 Test #4
Test Procedure:	General accordance with ASTM D 3385
Test Date	10/12/2021
LGCI Representative:	HO / TG
Weather Conditions:	Sunny, 70's
Test Depth:	2.8 feet
Groundwater Depth:	13.5 feet
Soil Stratum:	ASTM (D 2488) Classification: Well Graded GRAVEL with Sand (GW), fine to coarse, subangular, 0-5% fines, 35-40% fine to coarse sand, light brown, moist

	Inner Ring	Annular Space
Area (sq. cm)	730	2189
Depth Driven (in)	3	3
Water Depth (in)	3	3
Mariotte tube (cc/div.)	53.52	167.53

Elapsed Time	Time Increment	Inner Ring			Annular Space		
		Reading	Volume	Infiltration Rate	Reading	Volume	Infiltration Rate
(min)	(min)	(div)	(cc)	(cm/hr.)	(div)	(cc)	(cm/hr.)
0	0	58.3	0	0	58.3	0	0
0.25	0.25	37.5	1113	366.0	57.5	134	14.7
0.5	0.25	30.5	375	123.2	54.5	503	55.1
0.75	0.25	27.0	187	61.6	52.5	335	36.7
1	0.25	22.0	268	88.0	50.5	335	36.7
1.5	0.5	15.0	375	61.6	44.5	1005	55.1
1.75	0.25	10.5	241	79.2	42.3	369	40.4
2.25	0.5	6.5	214	35.2	41.0	218	11.9
2.5	0.25	2.3	225	73.9	38.5	419	45.9
2.75	0.25	0.0	123	40.5	36.5	335	36.7

Notes:



Estimated K = 10×10^{-3} cm/sec at depth of 2.8 feet

LGCI
Lahlaf Geotechnical Consulting, Inc.

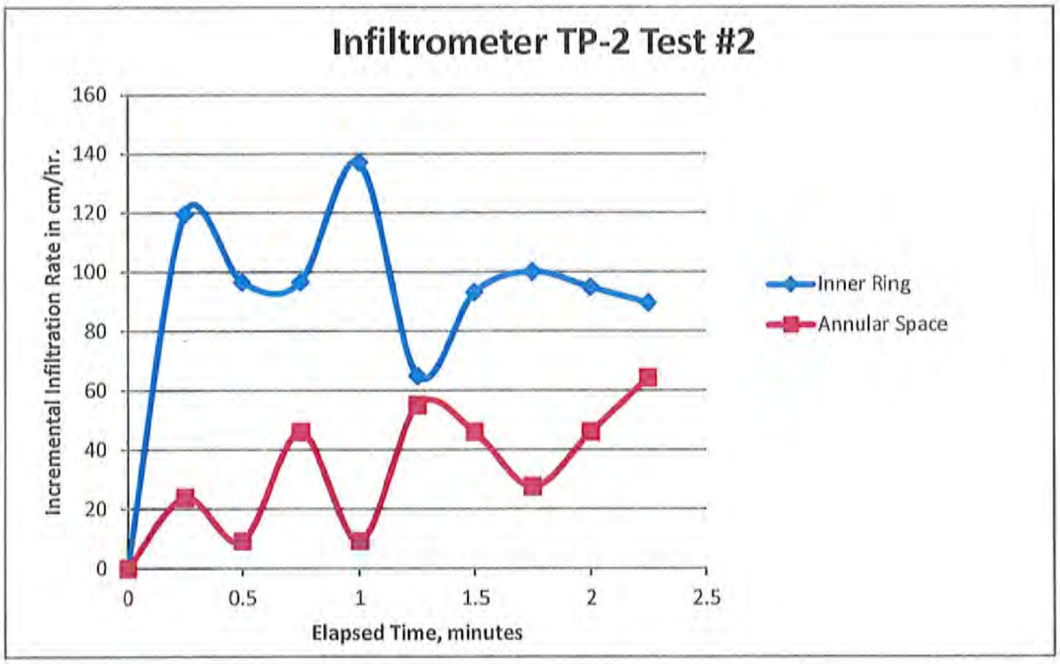
Double Ring Infiltrometer Test

Project:	Name: Proposed Residential Development
	Location: Lynnfield, MA
	LGCI Project Number: 2131
Test Location:	Near the northeast corner of site TP-2 Test #2
Test Procedure:	General accordance with ASTM D 3385
Test Date	10/12/2021
LGCI Representative:	HO / TG
Weather Conditions:	Sunny, 70's
Test Depth:	3.0 feet
Groundwater Depth:	13 feet
Soil Stratum:	ASTM (D 2488) Classification: Well Graded SAND with Gravel (SW), fine to coarse, 0-5% fines, 25-30% fine to coarse, subrounded gravel, gray, moist

	Inner Ring	Annular Space
Area (sq. cm)	730	2189
Depth Driven (in)	3	3
Water Depth (in)	3	3
Mariotte tube (cc/div.)	53.52	167.53

Elapsed Time	Time Increment	Inner Ring			Annular Space		
(min)	(min)	Reading (div)	Volume (cc)	Infiltration Rate (cm/hr.)	Reading (div)	Volume (cc)	Infiltration Rate (cm/hr.)
0	0	58.3	0	0	58.3	0	0
0.25	0.25	51.5	364	119.7	57.0	218	23.9
0.5	0.25	46.0	294	96.8	56.5	84	9.2
0.75	0.25	40.5	294	96.8	54.0	419	45.9
1	0.25	32.7	417	137.2	53.5	84	9.2
1.25	0.25	29.0	198	65.1	50.5	503	55.1
1.5	0.25	23.7	284	93.3	48.0	419	45.9
1.75	0.25	18.0	305	100.3	46.5	251	27.6
2	0.25	12.6	289	95.0	44.0	419	45.9
2.25	0.25	7.5	273	89.7	40.5	586	64.3
2.5	0.25	3.0	241	79.2	39.0	251	27.6
2.75	0.25	0.0	161	52.8	38.0	168	18.4

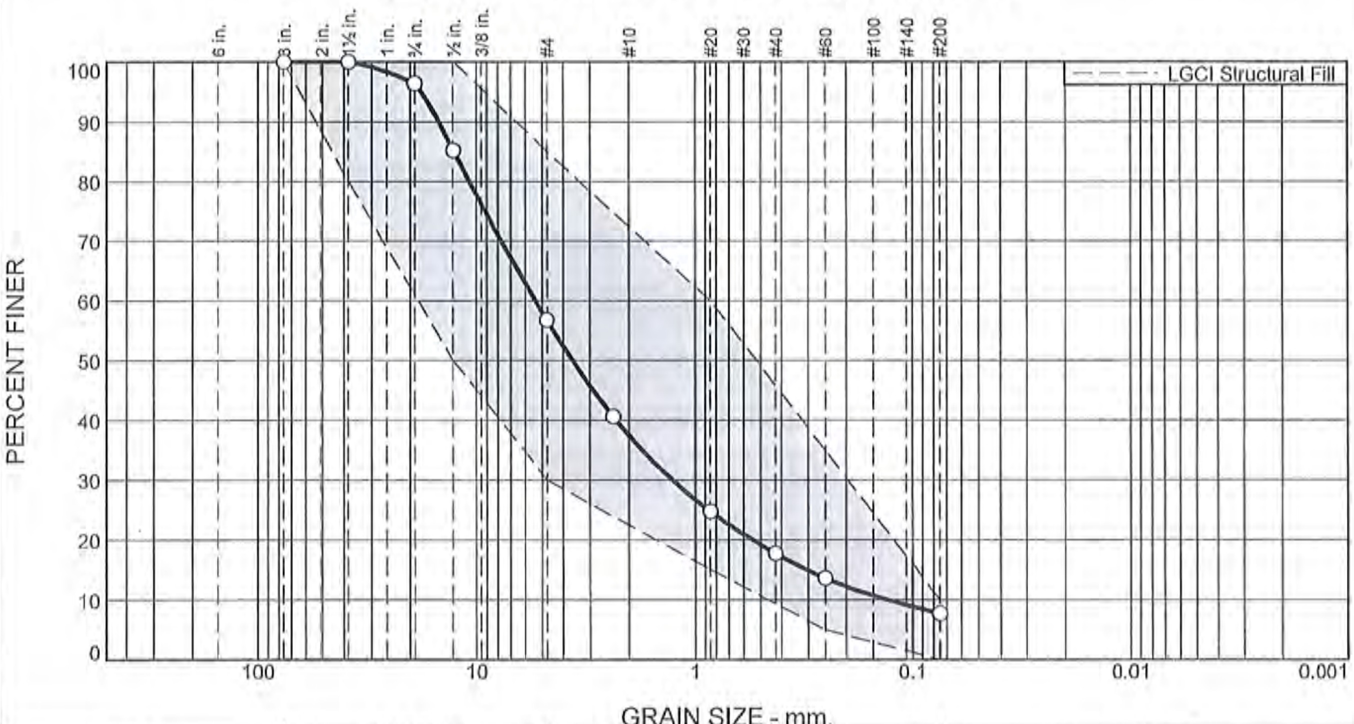
Notes:



Estimated K = 22 x 10^{-3} cm/sec at depth of 3.0 feet

APPENDIX D - Laboratory Test Results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.6	39.6	19.3	19.8	10.0	7.7	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3"	100.0	100.0	
1.5"	100.0	80.0 - 100.0	
0.75"	96.4		
0.5"	85.2	50.0 - 100.0	
#4	56.8	30.0 - 85.0	
#8	40.6		
#20	24.8	15.0 - 60.0	
#40	17.7		
#60	13.6	5.0 - 35.0	
#200	7.7	0.0 - 10.0	

* LGCI Structural Fill

Material Description

ASTM (D 2488) Classification: Well Graded SAND with Silt and Gravel (SW-SM), fine to coarse, 5-10% fines, 40-45% mostly fine subangular gravel, trace of roots, brown

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= 14.8138 D_{85}= 12.6045 D_{60}= 5.3695
D_{50}= 3.6206 D_{30}= 1.2672 D_{15}= 0.3040
D_{10}= 0.1300 C_u= 41.30 C_c= 2.30

Remarks

Fill sample

Date Received: 10/22/21 **Date Tested:** 10/22/21

Tested By: NP

Checked By: TG

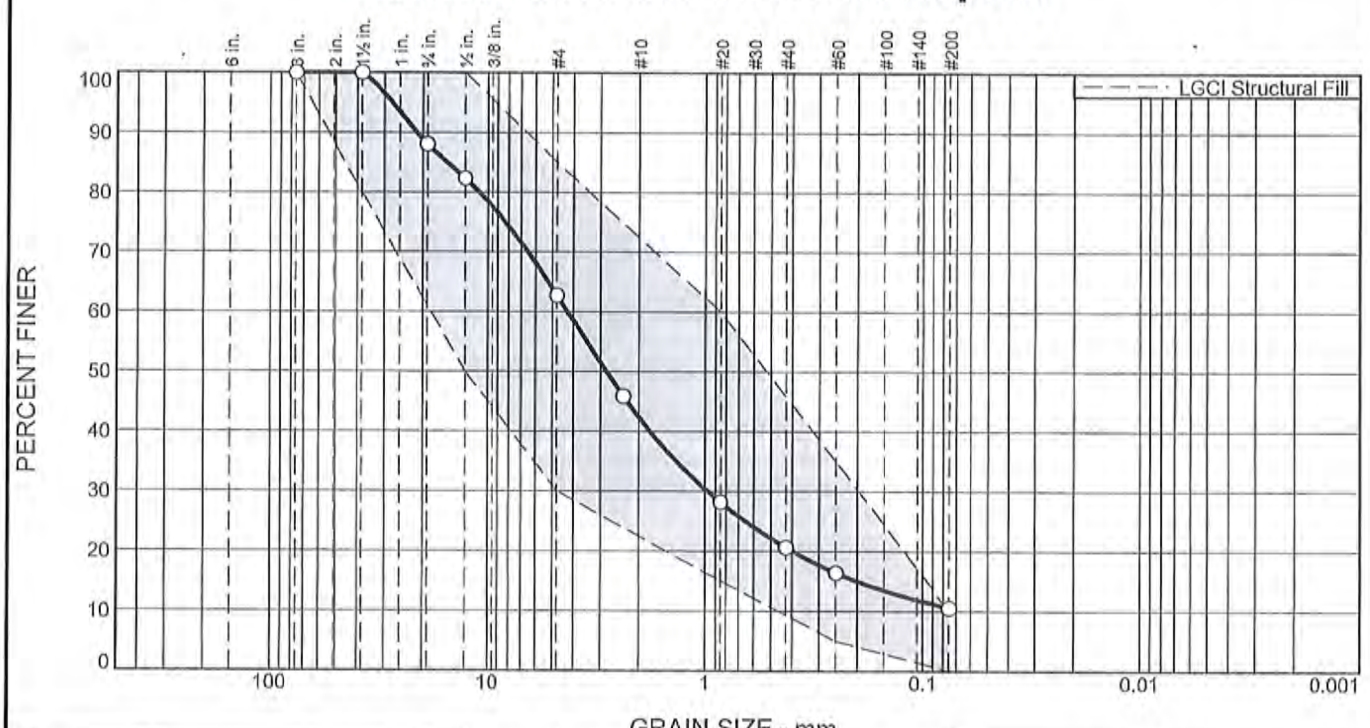
Location: Boring B-1
Sample Number: S1 Bot. 7" **Depth:** 0'-2'

Date Sampled: 10/22/21

LGCI
Lahlaf Geotechnical Consulting, Inc.

Client: Mr. Paul Caggiano
Project: Proposed Residential Development, Lynnfield, MA
Project No: 2131 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.0	25.3	20.3	21.7	10.2	10.5	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3"	100.0	100.0	
1.5"	100.0	80.0 - 100.0	
0.75"	88.0		
0.5"	82.3	50.0 - 100.0	
#4	62.7	30.0 - 85.0	
#8	45.9		
#20	28.2	15.0 - 60.0	
#40	20.7		
#60	16.4	5.0 - 35.0	
#200	10.5	0.0 - 10.0	X

* LGCI Structural Fill

Material Description

ASTM (D 2488) Classification: Well Graded SAND with Silt and Gravel (SW-SM), fine to coarse, 10-15% fines, 35-40% fine to coarse subangular gravel, brown

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= 21.2971 D_{85}= 15.4731 D_{60}= 4.2442
D_{50}= 2.8196 D_{30}= 0.9733 D_{15}= 0.2000
D_{10}= C_u= C_c=

Remarks

Natural sand sample

Date Received: 10/22/21 **Date Tested:** 10/22/21

Tested By: NP

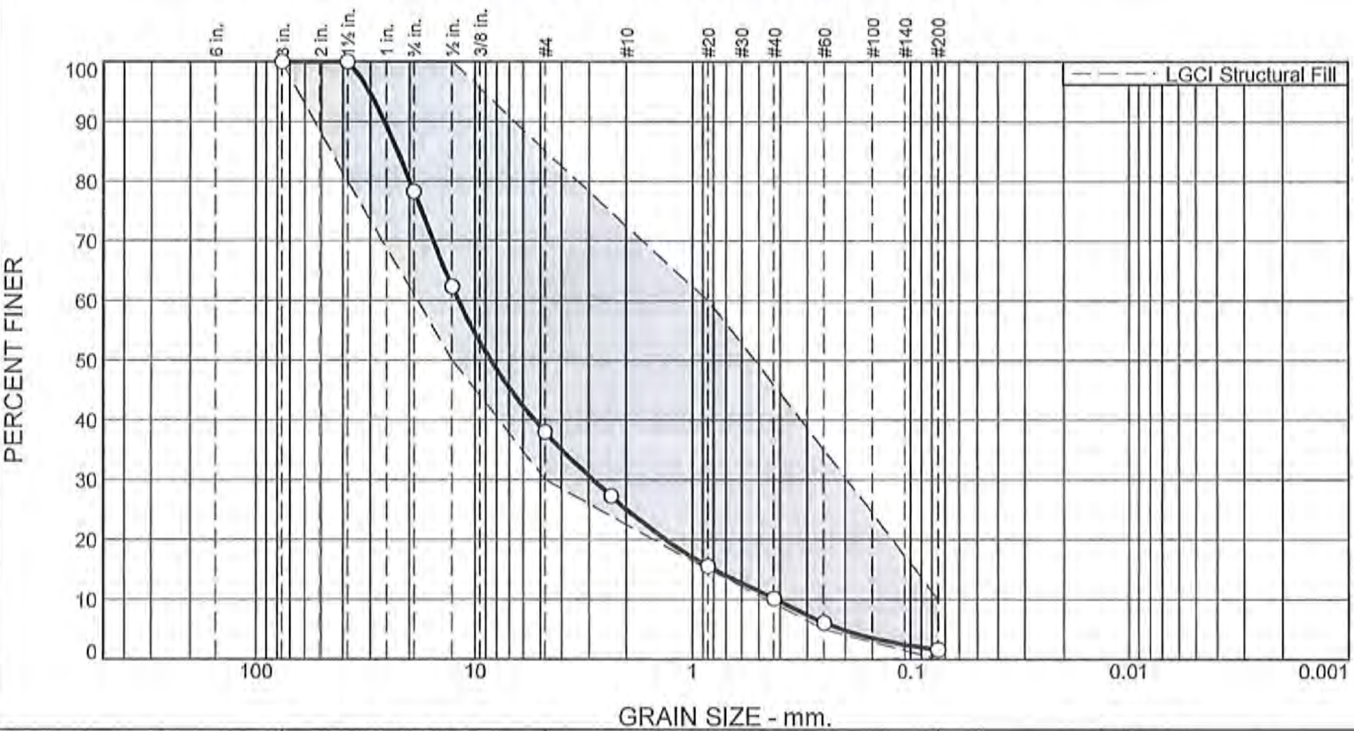
Checked By: TG

Location: Boring B-1
Sample Number: S2 **Depth:** 2'-4' **Date Sampled:** 10/22/21

LGCI
Lahlaf Geotechnical Consulting, Inc.

Client: Mr. Paul Caggiano
Project: Proposed Residential Development, Lynnfield, MA
Project No: 2131 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	21.7	40.3	12.9	14.9	8.6	1.6	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3"	100.0	100.0	
1.5"	100.0	80.0 - 100.0	
0.75"	78.3		
0.5"	62.3	50.0 - 100.0	
#4	38.0	30.0 - 85.0	
#8	27.3		
#20	15.6	15.0 - 60.0	
#40	10.2		
#60	6.1	5.0 - 35.0	
#200	1.6	0.0 - 10.0	

* LGCI Structural Fill

Material Description

ASTM (D 2488) Classification: Well Graded GRAVEL with Sand (GW), fine to coarse, subangular, 0-5% fines, 35-40% fine to coarse sand, light brown

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= GW AASHTO (M 145)=

Coefficients

D_{90}= 25.8915 D_{85}= 22.5685 D_{60}= 11.8843
D_{50}= 8.4641 D_{30}= 2.8653 D_{15}= 0.7956
D_{10}= 0.4156 C_u= 28.60 C_c= 1.66

Remarks

Natural gravel sample

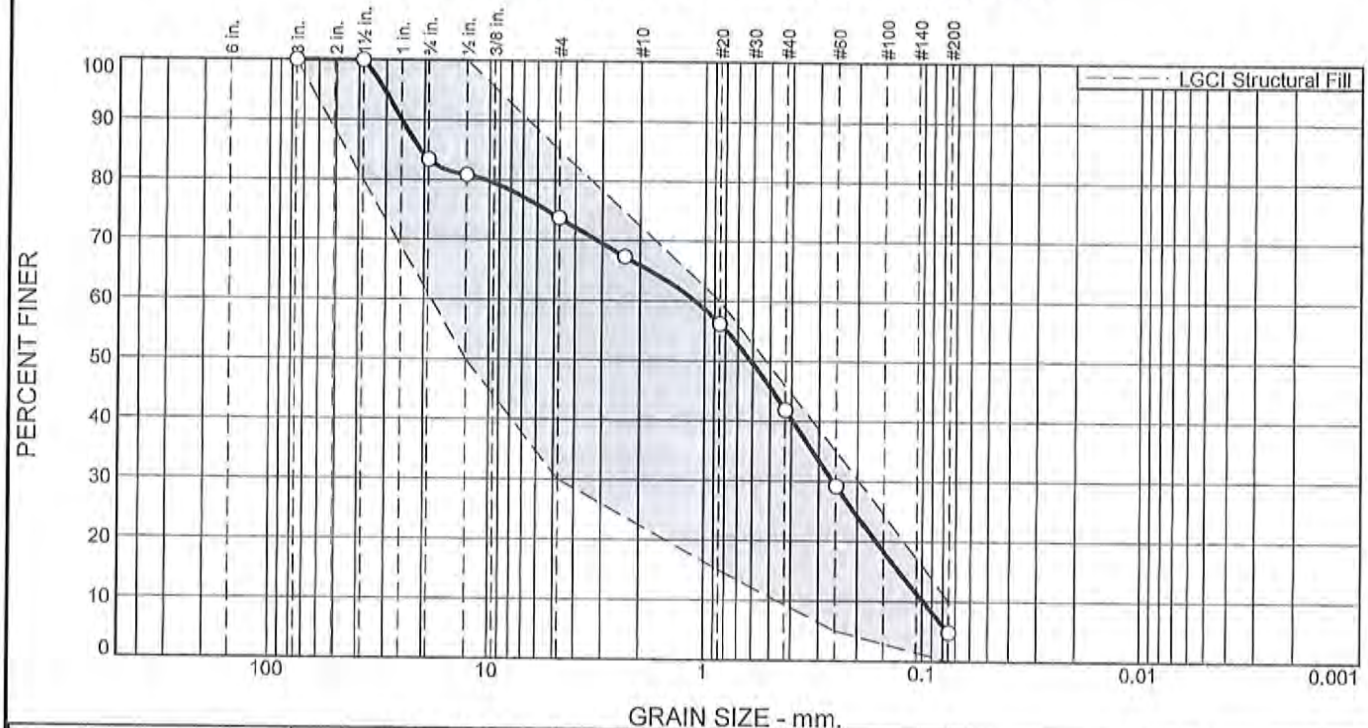
Date Received: 10/12/21 **Date Tested:** 10/12/21
Tested By: NP
Checked By: TG

Location: Test Pit TP-1
Sample Number: Infiltrometer Test 1 **Depth:** 2.8'
Date Sampled: 10/12/21

LGCI
Lahlaf Geotechnical Consulting, Inc.

Client: Mr. Paul Caggiano
Project: Proposed Residential Development, Lynnfield, MA
Project No: 2131 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	16.5	9.8	7.8	24.0	37.1	4.8	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3"	100.0	100.0	
1.5"	100.0	80.0 - 100.0	
0.75"	83.5		
0.5"	80.9	50.0 - 100.0	
#4	73.7	30.0 - 85.0	
#8	67.3		
#20	56.2	15.0 - 60.0	
#40	41.9		
#60	29.2	5.0 - 35.0	
#200	4.8	0.0 - 10.0	

* LGCI Structural Fill

Material Description

ASTM (D 2488) Classification: Well Graded SAND with Gravel (SW), fine to coarse, 0-5% fines, 25-30% fine to coarse subrounded gravel, gray

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= 25.3879 D_{85}= 20.7510 D_{60}= 1.1076
D_{50}= 0.6102 D_{30}= 0.2588 D_{15}= 0.1276
D_{10}= 0.0985 C_u= 11.24 C_c= 0.61

Remarks

Natural sand sample

Date Received: 10/12/21 **Date Tested:** 10/12/21

Tested By: NP

Checked By: TG

Location: Test Pit TP-2
Sample Number: Infiltrometer Test 2 **Depth:** 3.0'
Date Sampled: 10/12/21

LGCI
Lahlaf Geotechnical Consulting, Inc.

Client: Mr. Paul Caggiano
Project: Proposed Residential Development, Lynnfield, MA
Project No: 2131 **Figure**