



May 1, 2023

To: Mr. Gregory Rondeau, Chairman
Town of Franklin Planning Board
355 East Central Street
Franklin, MA 02038

A&M Project #: 2712-02
Re: 25 Forge Parkway
Industrial/Warehouse
Response to
Review Comments

Copy: TMC Holdings & Development 2, LLC

Dear Mr. Rondeau,

Allen & Major (A&M) is in receipt of review comments from the following groups for the above referenced project:

BETA Group, Inc.: Dated April 19, 2023

Town of Franklin Department of Public Works: Dated April 20, 2023

Town of Franklin Department of Planning and Community Development: Dated April 19, 2023

Please find A&M's responses to these comments below. The initial comments are provided along with A&M's responses in **bold**. Comments that have been addressed have been omitted for ease of review.

BETA Group, Inc:

P1. The landscaping plan shows 2 additional trees. As a minimum, BETA recommends that the existing trees that fulfill this requirement be identified on the landscaping plan. BETA will defer this issue to the Board.

A&M Response: The Landscape Plan has been revised to graphically show the existing trees to remain which satisfy this requirement.

SP3. The use of the site is being converted from office to warehouse. BETA recommends that truck turning movements at the entrance for the tractor trailers anticipated be shown and site distances identified to determine whether some trimming of vegetation is needed along Forge Parkway to maintain sight distances, especially to the east.

A&M Response: Forge Parkway is a private road with a posted speed limit of 20 miles per hour (MPH). The stopping sight distance determined by AASHTO for a 20 MPH zone is 115 feet. We've added dimensions to the Layout & Materials Plan which illustrate that a sight distance of 115 feet is available from the site driveway exit. A truck turning figure is provided with this letter which illustrates that a WB-67 is able to maneuver through the site.

SW4. In accordance with the Town of Franklin requirements, the post development peak flow rate and total volume must not exceed pre-development levels. Comment remains. (See comment below)

A&M Response: See response to SW5 below.

SW5. There remains an issue with the exfiltration rate in HYDRO-CAD, the actual exfiltration rate should be

$$\text{Rawls Rate} = 2.41 \text{ Inches/hour}$$

$$\text{Surface area} = 101.58' \times 63.06' = 6,405.3 \text{ sq. ft.}$$

$$\begin{aligned} \text{Rate} &= 6,405.3 [(2.41''/\text{hr})/(12''/\text{ft})] = 1,281.13 \text{ cu. ft./hr} \\ &= 1,281.13 (1 \text{ hr}/3600 \text{ secs}) = 0.36 \text{ cfs.} \end{aligned}$$

In the HYDRO-CAD analysis page 26, the exfiltration rate for the system is 1.10 cfs. Which is 3x the actual rate. Comment remains.

A&M Response: HydroCAD provides three options for calculating pond exfiltration. The method used for the project uses the saturated hydraulic conductivity (Rawls Rate) and calculates the exfiltration rate using Darcy's Law. Darcy's law takes the hydraulic head into consideration when calculating the exfiltration rate. A higher hydraulic head, meaning a higher level of water in the infiltration system, results in a higher exfiltration rate. Since the hydraulic head varies between storm events, the peak exfiltration rate reported by HydroCAD will be different for each storm event. The attached Stage – Discharge worksheets show how the exfiltration rate changes as the water level increases. The "Discarded" column on this worksheet begins with a flow rate of 0.36 cfs, which matches the rate described in the comment above. But as the water level rises, the exfiltration rate rises, until it reaches the maximum value of 1.10 cfs.

SW10. BETA agrees that the modification of the proposed grading will result in a net reduction in the impervious surfaces on site tributary to the system in Forge Parkway, thus the treatment and infiltration requirements for this discharge are not required to meet the standards completely. However, there is the possibility to provide some proprietary treatment either at the final manhole or in the catch basins which will provide some treatment and meet the definition of Maximum Extent Possible.

A&M Response: The Grading & Drainage Plan has been revised to specify that a hood be installed on the outlet pipe of the existing catch basins within the pavement. These hoods will provide treatment of the stormwater prior to discharge to the municipal system.

SW21. Identify proposed inspection port locations on the plan view of the subsurface infiltration system. Comment remains.

A&M Response: An inspection port has been added to the plan view. Inspection and maintenance of the isolator row can be performed via DMH-01.

Department of Public Works:

2. The discharge point from proposed infiltration system outlet has been moved back 4 feet from the property line, however we are still concerned about potential erosion from the discharge during extreme events. Consideration should be given to providing appropriately sized riprap at the outfall for energy dissipation and/or rotating the outfall 90 degrees to the north where there is more room on the subject property if the existing grades are conducive to that alignment.

A&M Response: The headwall was moved an additional 4 feet away from the property line. A spreadsheet is provided with this letter which specifies the sizing requirements for the rip rap apron. The headwall detail on sheet C-503 has been updated to illustrate the rip rap apron dimensions, as specified in the sizing spreadsheet. The rip rap slope detail provided in the plan set specifies a d_{50} stone size of 6" which exceeds that which is specified by the rip rap sizing spreadsheet.

Department of Planning and Community Development:

1. Applicant is providing cape cod berm. *Planning Board requested reinforced concrete or granite along the north end of the site.*

A&M Response: The plan has been revised to indicate that the curb along the north end of the site shall be either vertical granite or precast concrete.

3. Fire has requested an access road north of the building addition. *Plans should show the fire lane along the North side of the site.*

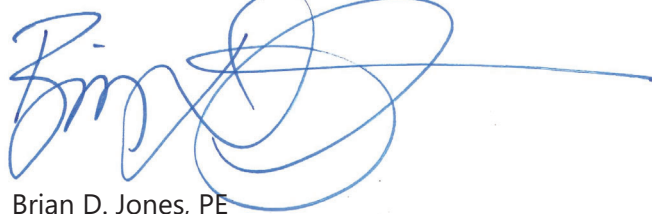
A&M Response: The pavement area along the north side of the building has been revised to include striping to prevent parking within the fire truck access road.

4. Mark the drive isle through the contractors yard.

A&M Response: The drive aisles have been marked through the contractor yard as requested. See Sheet C-102, Layout & Materials Plan.

Very Truly Yours,

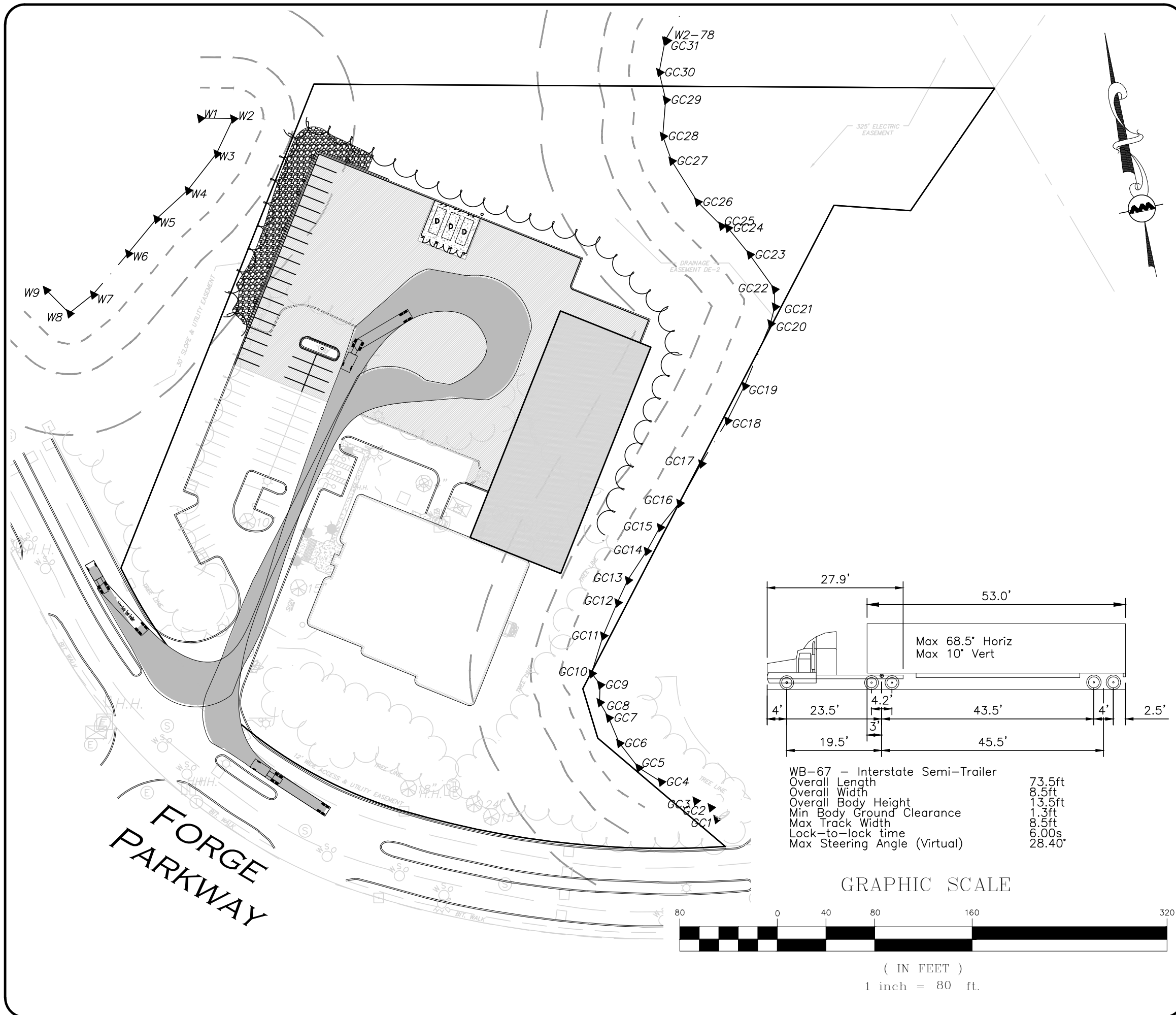
ALLEN & MAJOR ASSOCIATES, INC

A handwritten signature in blue ink, appearing to read "Brian D. Jones", with a long horizontal flourish extending to the right.

Brian D. Jones, PE
Senior Project Manager

Attachments:

1. Site Development Plans, revised as of May 1, 2023
2. Truck Turning Figure
3. Stage-Discharge HydroCAD worksheets
4. Rip rap apron sizing spreadsheet



REV	DATE	DESCRIPTION
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APPLICANT/OWNER:
TMC HOLDINGS & DEVELOPMENT 2, LLC
 24 WILLIAM WAY
 BELLINGHAM, MA 02019

PROJECT:
25 FORGE PARKWAY
FRANKLIN, MA

PROJECT NO.	2712-02A	DATE:	04-27-23
SCALE:	1" = 80'	DWG. NAME:	C2712-02A
DESIGNED BY:	SM	CHECKED BY:	BDJ

PREPARED BY:



ALLEN & MAJOR ASSOCIATES, INC.
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DRAWING TITLE:	SHEET No.
TRUCK TURNING FIGURE	1

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2712-02A - Proposed HydroCAD

Type III 24-hr 100-year Rainfall=8.78"

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Stage-Discharge for Pond IS-1: IS-1

Elevation (feet)	Discharge (cfs)	Discarded (cfs)	Primary (cfs)	Elevation (feet)	Discharge (cfs)	Discarded (cfs)	Primary (cfs)
284.75	0.00	0.00	0.00	285.28	0.43	0.43	0.00
284.76	0.36	0.36	0.00	285.29	0.43	0.43	0.00
284.77	0.36	0.36	0.00	285.30	0.43	0.43	0.00
284.78	0.36	0.36	0.00	285.31	0.43	0.43	0.00
284.79	0.36	0.36	0.00	285.32	0.43	0.43	0.00
284.80	0.36	0.36	0.00	285.33	0.43	0.43	0.00
284.81	0.37	0.37	0.00	285.34	0.43	0.43	0.00
284.82	0.37	0.37	0.00	285.35	0.44	0.44	0.00
284.83	0.37	0.37	0.00	285.36	0.44	0.44	0.00
284.84	0.37	0.37	0.00	285.37	0.44	0.44	0.00
284.85	0.37	0.37	0.00	285.38	0.44	0.44	0.00
284.86	0.37	0.37	0.00	285.39	0.44	0.44	0.00
284.87	0.37	0.37	0.00	285.40	0.44	0.44	0.00
284.88	0.37	0.37	0.00	285.41	0.44	0.44	0.00
284.89	0.38	0.38	0.00	285.42	0.44	0.44	0.00
284.90	0.38	0.38	0.00	285.43	0.45	0.45	0.00
284.91	0.38	0.38	0.00	285.44	0.45	0.45	0.00
284.92	0.38	0.38	0.00	285.45	0.45	0.45	0.00
284.93	0.38	0.38	0.00	285.46	0.45	0.45	0.00
284.94	0.38	0.38	0.00	285.47	0.45	0.45	0.00
284.95	0.38	0.38	0.00	285.48	0.45	0.45	0.00
284.96	0.38	0.38	0.00	285.49	0.45	0.45	0.00
284.97	0.39	0.39	0.00	285.50	0.45	0.45	0.00
284.98	0.39	0.39	0.00	285.51	0.46	0.46	0.00
284.99	0.39	0.39	0.00	285.52	0.46	0.46	0.00
285.00	0.39	0.39	0.00	285.53	0.46	0.46	0.00
285.01	0.39	0.39	0.00	285.54	0.46	0.46	0.00
285.02	0.39	0.39	0.00	285.55	0.46	0.46	0.00
285.03	0.39	0.39	0.00	285.56	0.46	0.46	0.00
285.04	0.40	0.40	0.00	285.57	0.46	0.46	0.00
285.05	0.40	0.40	0.00	285.58	0.47	0.47	0.00
285.06	0.40	0.40	0.00	285.59	0.47	0.47	0.00
285.07	0.40	0.40	0.00	285.60	0.47	0.47	0.00
285.08	0.40	0.40	0.00	285.61	0.47	0.47	0.00
285.09	0.40	0.40	0.00	285.62	0.47	0.47	0.00
285.10	0.40	0.40	0.00	285.63	0.47	0.47	0.00
285.11	0.40	0.40	0.00	285.64	0.47	0.47	0.00
285.12	0.41	0.41	0.00	285.65	0.47	0.47	0.00
285.13	0.41	0.41	0.00	285.66	0.48	0.48	0.00
285.14	0.41	0.41	0.00	285.67	0.48	0.48	0.00
285.15	0.41	0.41	0.00	285.68	0.48	0.48	0.00
285.16	0.41	0.41	0.00	285.69	0.48	0.48	0.00
285.17	0.41	0.41	0.00	285.70	0.48	0.48	0.00
285.18	0.41	0.41	0.00	285.71	0.48	0.48	0.00
285.19	0.41	0.41	0.00	285.72	0.48	0.48	0.00
285.20	0.42	0.42	0.00	285.73	0.48	0.48	0.00
285.21	0.42	0.42	0.00	285.74	0.49	0.49	0.00
285.22	0.42	0.42	0.00	285.75	0.49	0.49	0.00
285.23	0.42	0.42	0.00	285.76	0.49	0.49	0.00
285.24	0.42	0.42	0.00	285.77	0.49	0.49	0.00
285.25	0.42	0.42	0.00	285.78	0.49	0.49	0.00
285.26	0.42	0.42	0.00	285.79	0.49	0.49	0.00
285.27	0.42	0.42	0.00	285.80	0.49	0.49	0.00

2712-02A - Proposed HydroCAD

Type III 24-hr 100-year Rainfall=8.78"

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Stage-Discharge for Pond IS-1: IS-1 (continued)

Elevation (feet)	Discharge (cfs)	Discarded (cfs)	Primary (cfs)	Elevation (feet)	Discharge (cfs)	Discarded (cfs)	Primary (cfs)
285.81	0.50	0.50	0.00	286.34	0.56	0.56	0.00
285.82	0.50	0.50	0.00	286.35	0.57	0.57	0.00
285.83	0.50	0.50	0.00	286.36	0.57	0.57	0.00
285.84	0.50	0.50	0.00	286.37	0.57	0.57	0.00
285.85	0.50	0.50	0.00	286.38	0.57	0.57	0.00
285.86	0.50	0.50	0.00	286.39	0.57	0.57	0.00
285.87	0.50	0.50	0.00	286.40	0.57	0.57	0.00
285.88	0.50	0.50	0.00	286.41	0.57	0.57	0.00
285.89	0.51	0.51	0.00	286.42	0.57	0.57	0.00
285.90	0.51	0.51	0.00	286.43	0.58	0.58	0.00
285.91	0.51	0.51	0.00	286.44	0.58	0.58	0.00
285.92	0.51	0.51	0.00	286.45	0.58	0.58	0.00
285.93	0.51	0.51	0.00	286.46	0.58	0.58	0.00
285.94	0.51	0.51	0.00	286.47	0.58	0.58	0.00
285.95	0.51	0.51	0.00	286.48	0.58	0.58	0.00
285.96	0.51	0.51	0.00	286.49	0.58	0.58	0.00
285.97	0.52	0.52	0.00	286.50	0.58	0.58	0.00
285.98	0.52	0.52	0.00	286.51	0.59	0.59	0.00
285.99	0.52	0.52	0.00	286.52	0.59	0.59	0.00
286.00	0.52	0.52	0.00	286.53	0.59	0.59	0.00
286.01	0.52	0.52	0.00	286.54	0.59	0.59	0.00
286.02	0.52	0.52	0.00	286.55	0.59	0.59	0.00
286.03	0.52	0.52	0.00	286.56	0.59	0.59	0.00
286.04	0.52	0.52	0.00	286.57	0.59	0.59	0.00
286.05	0.53	0.53	0.00	286.58	0.60	0.60	0.00
286.06	0.53	0.53	0.00	286.59	0.60	0.60	0.00
286.07	0.53	0.53	0.00	286.60	0.60	0.60	0.00
286.08	0.53	0.53	0.00	286.61	0.60	0.60	0.00
286.09	0.53	0.53	0.00	286.62	0.60	0.60	0.00
286.10	0.53	0.53	0.00	286.63	0.60	0.60	0.00
286.11	0.53	0.53	0.00	286.64	0.60	0.60	0.00
286.12	0.54	0.54	0.00	286.65	0.60	0.60	0.00
286.13	0.54	0.54	0.00	286.66	0.61	0.61	0.00
286.14	0.54	0.54	0.00	286.67	0.61	0.61	0.00
286.15	0.54	0.54	0.00	286.68	0.61	0.61	0.00
286.16	0.54	0.54	0.00	286.69	0.61	0.61	0.00
286.17	0.54	0.54	0.00	286.70	0.61	0.61	0.00
286.18	0.54	0.54	0.00	286.71	0.61	0.61	0.00
286.19	0.54	0.54	0.00	286.72	0.61	0.61	0.00
286.20	0.55	0.55	0.00	286.73	0.61	0.61	0.00
286.21	0.55	0.55	0.00	286.74	0.62	0.62	0.00
286.22	0.55	0.55	0.00	286.75	0.62	0.62	0.00
286.23	0.55	0.55	0.00	286.76	0.62	0.62	0.00
286.24	0.55	0.55	0.00	286.77	0.62	0.62	0.00
286.25	0.55	0.55	0.00	286.78	0.62	0.62	0.00
286.26	0.55	0.55	0.00	286.79	0.62	0.62	0.00
286.27	0.55	0.55	0.00	286.80	0.62	0.62	0.00
286.28	0.56	0.56	0.00	286.81	0.63	0.63	0.00
286.29	0.56	0.56	0.00	286.82	0.63	0.63	0.00
286.30	0.56	0.56	0.00	286.83	0.63	0.63	0.00
286.31	0.56	0.56	0.00	286.84	0.63	0.63	0.00
286.32	0.56	0.56	0.00	286.85	0.63	0.63	0.00
286.33	0.56	0.56	0.00	286.86	0.63	0.63	0.00

2712-02A - Proposed HydroCAD

Type III 24-hr 100-year Rainfall=8.78"

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Stage-Discharge for Pond IS-1: IS-1 (continued)

Elevation (feet)	Discharge (cfs)	Discarded (cfs)	Primary (cfs)	Elevation (feet)	Discharge (cfs)	Discarded (cfs)	Primary (cfs)
286.87	0.63	0.63	0.00	287.40	0.70	0.70	0.00
286.88	0.63	0.63	0.00	287.41	0.70	0.70	0.00
286.89	0.64	0.64	0.00	287.42	0.70	0.70	0.00
286.90	0.64	0.64	0.00	287.43	0.71	0.71	0.00
286.91	0.64	0.64	0.00	287.44	0.71	0.71	0.00
286.92	0.64	0.64	0.00	287.45	0.71	0.71	0.00
286.93	0.64	0.64	0.00	287.46	0.71	0.71	0.00
286.94	0.64	0.64	0.00	287.47	0.71	0.71	0.00
286.95	0.64	0.64	0.00	287.48	0.71	0.71	0.00
286.96	0.64	0.64	0.00	287.49	0.71	0.71	0.00
286.97	0.65	0.65	0.00	287.50	0.71	0.71	0.00
286.98	0.65	0.65	0.00	287.51	0.72	0.72	0.00
286.99	0.65	0.65	0.00	287.52	0.72	0.72	0.00
287.00	0.65	0.65	0.00	287.53	0.72	0.72	0.00
287.01	0.65	0.65	0.00	287.54	0.72	0.72	0.00
287.02	0.65	0.65	0.00	287.55	0.72	0.72	0.00
287.03	0.65	0.65	0.00	287.56	0.72	0.72	0.00
287.04	0.65	0.65	0.00	287.57	0.72	0.72	0.00
287.05	0.66	0.66	0.00	287.58	0.73	0.73	0.00
287.06	0.66	0.66	0.00	287.59	0.73	0.73	0.00
287.07	0.66	0.66	0.00	287.60	0.73	0.73	0.00
287.08	0.66	0.66	0.00	287.61	0.73	0.73	0.00
287.09	0.66	0.66	0.00	287.62	0.73	0.73	0.00
287.10	0.66	0.66	0.00	287.63	0.73	0.73	0.00
287.11	0.66	0.66	0.00	287.64	0.73	0.73	0.00
287.12	0.67	0.67	0.00	287.65	0.73	0.73	0.00
287.13	0.67	0.67	0.00	287.66	0.74	0.74	0.00
287.14	0.67	0.67	0.00	287.67	0.74	0.74	0.00
287.15	0.67	0.67	0.00	287.68	0.74	0.74	0.00
287.16	0.67	0.67	0.00	287.69	0.74	0.74	0.00
287.17	0.67	0.67	0.00	287.70	0.74	0.74	0.00
287.18	0.67	0.67	0.00	287.71	0.74	0.74	0.00
287.19	0.67	0.67	0.00	287.72	0.74	0.74	0.00
287.20	0.68	0.68	0.00	287.73	0.74	0.74	0.00
287.21	0.68	0.68	0.00	287.74	0.75	0.75	0.00
287.22	0.68	0.68	0.00	287.75	0.75	0.75	0.00
287.23	0.68	0.68	0.00	287.76	0.75	0.75	0.00
287.24	0.68	0.68	0.00	287.77	0.75	0.75	0.00
287.25	0.68	0.68	0.00	287.78	0.75	0.75	0.00
287.26	0.68	0.68	0.00	287.79	0.75	0.75	0.00
287.27	0.68	0.68	0.00	287.80	0.75	0.75	0.00
287.28	0.69	0.69	0.00	287.81	0.76	0.76	0.00
287.29	0.69	0.69	0.00	287.82	0.76	0.76	0.00
287.30	0.69	0.69	0.00	287.83	0.76	0.76	0.00
287.31	0.69	0.69	0.00	287.84	0.76	0.76	0.00
287.32	0.69	0.69	0.00	287.85	0.76	0.76	0.00
287.33	0.69	0.69	0.00	287.86	0.76	0.76	0.00
287.34	0.69	0.69	0.00	287.87	0.76	0.76	0.00
287.35	0.70	0.70	0.00	287.88	0.76	0.76	0.00
287.36	0.70	0.70	0.00	287.89	0.77	0.77	0.00
287.37	0.70	0.70	0.00	287.90	0.77	0.77	0.00
287.38	0.70	0.70	0.00	287.91	0.77	0.77	0.00
287.39	0.70	0.70	0.00	287.92	0.77	0.77	0.00

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Stage-Discharge for Pond IS-1: IS-1 (continued)

Elevation (feet)	Discharge (cfs)	Discarded (cfs)	Primary (cfs)	Elevation (feet)	Discharge (cfs)	Discarded (cfs)	Primary (cfs)
287.93	0.77	0.77	0.00	288.46	0.84	0.84	0.00
287.94	0.77	0.77	0.00	288.47	0.84	0.84	0.00
287.95	0.77	0.77	0.00	288.48	0.84	0.84	0.00
287.96	0.77	0.77	0.00	288.49	0.84	0.84	0.00
287.97	0.78	0.78	0.00	288.50	0.84	0.84	0.00
287.98	0.78	0.78	0.00	288.51	0.85	0.85	0.00
287.99	0.78	0.78	0.00	288.52	0.85	0.85	0.00
288.00	0.78	0.78	0.00	288.53	0.85	0.85	0.00
288.01	0.78	0.78	0.00	288.54	0.85	0.85	0.00
288.02	0.78	0.78	0.00	288.55	0.85	0.85	0.00
288.03	0.78	0.78	0.00	288.56	0.85	0.85	0.00
288.04	0.78	0.78	0.00	288.57	0.85	0.85	0.00
288.05	0.79	0.79	0.00	288.58	0.86	0.86	0.00
288.06	0.79	0.79	0.00	288.59	0.86	0.86	0.00
288.07	0.79	0.79	0.00	288.60	0.86	0.86	0.00
288.08	0.79	0.79	0.00	288.61	0.86	0.86	0.00
288.09	0.79	0.79	0.00	288.62	0.86	0.86	0.00
288.10	0.79	0.79	0.00	288.63	0.86	0.86	0.00
288.11	0.79	0.79	0.00	288.64	0.86	0.86	0.00
288.12	0.80	0.80	0.00	288.65	0.86	0.86	0.00
288.13	0.80	0.80	0.00	288.66	0.87	0.87	0.00
288.14	0.80	0.80	0.00	288.67	0.87	0.87	0.00
288.15	0.80	0.80	0.00	288.68	0.87	0.87	0.00
288.16	0.80	0.80	0.00	288.69	0.87	0.87	0.00
288.17	0.80	0.80	0.00	288.70	0.87	0.87	0.00
288.18	0.80	0.80	0.00	288.71	0.87	0.87	0.00
288.19	0.80	0.80	0.00	288.72	0.87	0.87	0.00
288.20	0.81	0.81	0.00	288.73	0.87	0.87	0.00
288.21	0.81	0.81	0.00	288.74	0.88	0.88	0.00
288.22	0.81	0.81	0.00	288.75	0.88	0.88	0.00
288.23	0.81	0.81	0.00	288.76	0.88	0.88	0.00
288.24	0.81	0.81	0.00	288.77	0.88	0.88	0.00
288.25	0.81	0.81	0.00	288.78	0.88	0.88	0.00
288.26	0.81	0.81	0.00	288.79	0.88	0.88	0.00
288.27	0.81	0.81	0.00	288.80	0.88	0.88	0.00
288.28	0.82	0.82	0.00	288.81	0.88	0.88	0.00
288.29	0.82	0.82	0.00	288.82	0.89	0.89	0.00
288.30	0.82	0.82	0.00	288.83	0.89	0.89	0.00
288.31	0.82	0.82	0.00	288.84	0.89	0.89	0.00
288.32	0.82	0.82	0.00	288.85	0.89	0.89	0.00
288.33	0.82	0.82	0.00	288.86	0.89	0.89	0.00
288.34	0.82	0.82	0.00	288.87	0.89	0.89	0.00
288.35	0.83	0.83	0.00	288.88	0.89	0.89	0.00
288.36	0.83	0.83	0.00	288.89	0.90	0.90	0.00
288.37	0.83	0.83	0.00	288.90	0.90	0.90	0.00
288.38	0.83	0.83	0.00	288.91	0.90	0.90	0.00
288.39	0.83	0.83	0.00	288.92	0.90	0.90	0.00
288.40	0.83	0.83	0.00	288.93	0.90	0.90	0.00
288.41	0.83	0.83	0.00	288.94	0.90	0.90	0.00
288.42	0.83	0.83	0.00	288.95	0.90	0.90	0.00
288.43	0.84	0.84	0.00	288.96	0.90	0.90	0.00
288.44	0.84	0.84	0.00	288.97	0.91	0.91	0.00
288.45	0.84	0.84	0.00	288.98	0.91	0.91	0.00

2712-02A - Proposed HydroCAD

Type III 24-hr 100-year Rainfall=8.78"

Prepared by Allen & Major Associates, Inc

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Stage-Discharge for Pond IS-1: IS-1 (continued)

Elevation (feet)	Discharge (cfs)	Discarded (cfs)	Primary (cfs)	Elevation (feet)	Discharge (cfs)	Discarded (cfs)	Primary (cfs)
288.99	0.91	0.91	0.00	289.52	0.98	0.98	0.00
289.00	0.91	0.91	0.00	289.53	0.98	0.98	0.00
289.01	0.91	0.91	0.00	289.54	0.98	0.98	0.00
289.02	0.91	0.91	0.00	289.55	0.98	0.98	0.00
289.03	0.91	0.91	0.00	289.56	0.98	0.98	0.00
289.04	0.91	0.91	0.00	289.57	0.98	0.98	0.00
289.05	0.92	0.92	0.00	289.58	0.99	0.99	0.00
289.06	0.92	0.92	0.00	289.59	0.99	0.99	0.00
289.07	0.92	0.92	0.00	289.60	0.99	0.99	0.00
289.08	0.92	0.92	0.00	289.61	1.00	0.99	0.01
289.09	0.92	0.92	0.00	289.62	1.03	0.99	0.04
289.10	0.92	0.92	0.00	289.63	1.06	0.99	0.07
289.11	0.92	0.92	0.00	289.64	1.10	0.99	0.10
289.12	0.93	0.93	0.00	289.65	1.14	0.99	0.15
289.13	0.93	0.93	0.00	289.66	1.19	1.00	0.19
289.14	0.93	0.93	0.00	289.67	1.24	1.00	0.24
289.15	0.93	0.93	0.00	289.68	1.29	1.00	0.29
289.16	0.93	0.93	0.00	289.69	1.35	1.00	0.35
289.17	0.93	0.93	0.00	289.70	1.41	1.00	0.41
289.18	0.93	0.93	0.00	289.71	1.48	1.00	0.47
289.19	0.93	0.93	0.00	289.72	1.54	1.00	0.54
289.20	0.94	0.94	0.00	289.73	1.61	1.00	0.61
289.21	0.94	0.94	0.00	289.74	1.69	1.01	0.68
289.22	0.94	0.94	0.00	289.75	1.76	1.01	0.75
289.23	0.94	0.94	0.00	289.76	1.84	1.01	0.83
289.24	0.94	0.94	0.00	289.77	1.92	1.01	0.91
289.25	0.94	0.94	0.00	289.78	2.00	1.01	0.99
289.26	0.94	0.94	0.00	289.79	2.09	1.01	1.07
289.27	0.94	0.94	0.00	289.80	2.17	1.01	1.16
289.28	0.95	0.95	0.00	289.81	2.26	1.01	1.25
289.29	0.95	0.95	0.00	289.82	2.35	1.02	1.33
289.30	0.95	0.95	0.00	289.83	2.44	1.02	1.43
289.31	0.95	0.95	0.00	289.84	2.54	1.02	1.52
289.32	0.95	0.95	0.00	289.85	2.63	1.02	1.61
289.33	0.95	0.95	0.00	289.86	2.73	1.02	1.71
289.34	0.95	0.95	0.00	289.87	2.83	1.02	1.81
289.35	0.96	0.96	0.00	289.88	2.93	1.02	1.91
289.36	0.96	0.96	0.00	289.89	3.04	1.03	2.01
289.37	0.96	0.96	0.00	289.90	3.14	1.03	2.12
289.38	0.96	0.96	0.00	289.91	3.25	1.03	2.22
289.39	0.96	0.96	0.00	289.92	3.36	1.03	2.33
289.40	0.96	0.96	0.00	289.93	3.37	1.03	2.33
289.41	0.96	0.96	0.00	289.94	3.37	1.03	2.34
289.42	0.96	0.96	0.00	289.95	3.38	1.03	2.34
289.43	0.97	0.97	0.00	289.96	3.38	1.03	2.35
289.44	0.97	0.97	0.00	289.97	3.39	1.04	2.35
289.45	0.97	0.97	0.00	289.98	3.39	1.04	2.35
289.46	0.97	0.97	0.00	289.99	3.40	1.04	2.36
289.47	0.97	0.97	0.00	290.00	3.40	1.04	2.36
289.48	0.97	0.97	0.00	290.01	3.41	1.04	2.36
289.49	0.97	0.97	0.00	290.02	3.41	1.04	2.37
289.50	0.97	0.97	0.00	290.03	3.42	1.04	2.37
289.51	0.98	0.98	0.00	290.04	3.42	1.04	2.38

2712-02A - Proposed HydroCAD

Type III 24-hr 100-year Rainfall=8.78"

Prepared by Allen & Major Associates, Inc

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Stage-Discharge for Pond IS-1: IS-1 (continued)

Elevation (feet)	Discharge (cfs)	Discarded (cfs)	Primary (cfs)
290.05	3.43	1.05	2.38
290.06	3.43	1.05	2.38
290.07	3.44	1.05	2.39
290.08	3.44	1.05	2.39
290.09	3.45	1.05	2.39
290.10	3.45	1.05	2.40
290.11	3.46	1.05	2.40
290.12	3.46	1.06	2.41
290.13	3.47	1.06	2.41
290.14	3.47	1.06	2.41
290.15	3.48	1.06	2.42
290.16	3.48	1.06	2.42
290.17	3.49	1.06	2.42
290.18	3.49	1.06	2.43
290.19	3.50	1.06	2.43
290.20	3.50	1.07	2.43
290.21	3.51	1.07	2.44
290.22	3.51	1.07	2.44
290.23	3.51	1.07	2.45
290.24	3.52	1.07	2.45
290.25	3.52	1.07	2.45
290.26	3.53	1.07	2.46
290.27	3.53	1.07	2.46
290.28	3.54	1.08	2.46
290.29	3.54	1.08	2.47
290.30	3.55	1.08	2.47
290.31	3.55	1.08	2.47
290.32	3.56	1.08	2.48
290.33	3.56	1.08	2.48
290.34	3.57	1.08	2.48
290.35	3.57	1.09	2.49
290.36	3.58	1.09	2.49
290.37	3.58	1.09	2.50
290.38	3.59	1.09	2.50
290.39	3.59	1.09	2.50
290.40	3.60	1.09	2.51
290.41	3.60	1.09	2.51
290.42	3.61	1.09	2.51
290.43	3.61	1.10	2.52
290.44	3.62	1.10	2.52
290.45	3.62	1.10	2.52
290.46	3.63	1.10	2.53
290.47	3.63	1.10	2.53
290.48	3.64	1.10	2.53
290.49	3.64	1.10	2.54
290.50	3.65	1.10	2.54

Outlet # Headwall-01
 Q100 = **2.53** cfs $T_w = 0.25$ feet
 $D_o = 8$ inches

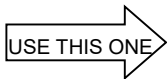
Design Criteria
Apron Dimensions

The dimensions of the apron at the outlet of the pipe shall be determined as follows:

- 1.) The width of the apron at the outlet of the pipe or channel shall be 3 times the diameter of the pipe or width of the channel.

W = 2 feet

- 2.) The length of the apron shall be determined from the following formula when the tailwater depth at the outlet of the pipe or channel is less than one-half the diameter of the pipe or one-half the width of the channel:



$La = 1.8 * Q / Do^{3/2} + 7Do$
La = 13.03 feet

Where:

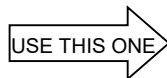
La is the length of the apron
 Q is the discharge from the pipe or channel
 D_o is the diameter of pipe or width of channel

- 3.) When the depth of the tailwater at the outlet of the pipe or channel is equal to or greater than one-half the diameter of the pipe or the width of the channel. Then the following formula applies:

$La = 3.0 * Q_o / Do^{1.5} + 7D_o$
La = 18.61 feet

- 4.) Where there is no well defined channel downstream of the outlet, the width of the downstream end of the apron shall be determined as follows:

- a. For minimum tailwater conditions where the tailwater depth is less than the elevation of the center of the pipe:



$W = 3 * Do + La$
W = 15.03 feet

- b. For maximum tailwater conditions where the tailwater depth is greater than the elevation of the center of the pipe:

$W = 3 * Do + 0.4 * La$
W = 9.44 feet



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Calculated By	SM	Date	04/27/23
Checked By	BDJ	Date	04/27/23

- 5.) Where there is a stable well-defined channel downstream of the apron, the bottom of the apron shall be equal to the width of the channel.
- 6.) The side of the apron in a well-defined channel shall be 2:1 (horizontal to vertical) or flatter. The height of the structural lining along the channel sides shall begin at the elevation equal to the top of conduit and taper down to the channel bottom through the length of the apron.
- 7.) The bottom grade of the apron shall be level (0% grade). No overfall is allowable at the end of the apron.
- 8.) The apron shall be located so that there are no bends in the horizontal alignment of the apron.

Rock Riprap

The following criteria shall be used to determine the dimensions of the rock riprap used for the apron:

- 1.) The median stone diameter shall be determined using the formula:

$$d_{50} = 0.02 * Q^{4/3} / (Tw * D_o)$$

$$d_{50} = \underline{\underline{4.95 \text{ inches}}} \qquad \underline{\underline{\text{USE } 5 \text{ inches}}}$$

d₅₀ minimum 3 inches

Where:

d₅₀ is the median stone diameter in feet

Tw is the tailwater depth above the invert of the pipe channel in feet

Q is the discharge from the pipe or channel in cubic feet per second

D_o is the diameter of the pipe or width of the channel in feet

- 2.) Fifty percent by weight of the riprap mixture shall be smaller than the median size stone designated as d₅₀. The largest stone size in the mixture shall be 1.5 times the d₅₀ size.
- 3.) The quality and gradation of the rock, the thickness of the riprap lining, filter material and the quality of the stone shall meet the requirements in the Rock Riprap BMP. The minimum depth shall be 6 inches or 1.5 times the largest stone size in the mixture whichever is larger (d).

Thickness of the riprap

$$d = 1.5 * (1.5 * d_{50}(\text{largest stone size}))$$

$$d = \underline{\underline{11 \text{ inches}^*}}$$

* must use a minimum of 6"

Rock Rip Rap Gradation

% of weight smaller than the given size	size of stone in inches		
100	7.5	to	10.0
85	6.5	to	9.0
50	5.0	to	7.5
15	1.5	to	2.5

Formulas Used (Reference NHDES Handbook, Pages 7-114, 7-115)