ENGINEERING DEPARTMENT

City of New Haven
200 Orange Street, Rm 503
New Haven, CT 06510
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Toni N. Harp
Mayor

May 14, 2014

Jack Melcher
United States Environmental Protection Agency
New England Region
5 Post Office Square – Suite 100 (OES 04-1)
Boston, MA 02109-3912

and

George Hicks
Connecticut Department of Energy and Environmental Protection
Bureau of Water Protection and Land Reuse
Planning and Standards Division
79 Elm Street
Hartford, CT 06106-5127

Re: Request for Information Pursuant to
Section 308 of the Clean Water Act
EPA Docket No. 14-308-06
Letter dated February 13, 2014

Dear Mr. Melcher and Mr. Hicks:

The City of New Haven is submitting the following pursuant to the above Request for Information:

- Statement of Certification
- City of New Haven, Response to USEPA Request for Information, dated 2/13/14

We have worked closely with the Greater New Haven Water Pollution Control Authority (GNHWPCA) to respond to these questions. The City's responses only refer to the storm drainage system and the related stormwater flooding. Refer to the GNHWPCA response to the EPA letter dated February 13, 2014 for the answers to the questions regarding the sewage.

If you have questions or require additional information, please contact me at 203-946-8099.

Sincerely,

Lawrence R. Smith, P.E.
Assistant City Engineer

attachments (2): Stmt of Certification and Response to USEPA RFI

c: Mayor Toni N. Harp
Michael Carter, CAO
Karyn Gilvarg, City Plan
Sidney Holbrook/Tom Sgroi, GNHWPCA

ATTACHMENT C

Statement of Certification

Complete and Include With Your Response

I declare under penalty of perjury that I am authorized to respond on behalf of the City of New Haven. I certify that the foregoing responses and information submitted were prepared by me, or under my direction or supervision and that I have personal knowledge of all matters set forth in the responses and the accompanying information. I certify that the responses are true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment.

By: _____
(Signature)

Assistant City Engineer
(Title)

May 14, 2014
(Date)

CITY OF NEW HAVEN

RESPONSE TO USEPA
REQUEST FOR INFORMATION
DATED FEBRUARY 13, 2014

MAY 16, 2014

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ATTACHMENT C

Copy of EPA's "Request for Information Pursuant to Section 308 of the Clean Water Act; EPA Docket No. 14-308-06" dated February 13, 2013

Response of the City of New Haven to the USEPA
Request for Information dated February 13, 2014
May 16, 2014

INTRODUCTION

The hydraulic analysis is based on the hydraulic model developed and described in the 'Drainage Study for Route 34 and Union Avenue" July 12, 2012 by Cardinal Engineering Associates, Inc. A copy of this report was provided to USEPA (see Page 1, paragraph 3 of the February 13, 2014 EPA letter to Larry Smith –Assistant City Engineer, New Haven in Attachment C).

The hydraulic models in the Cardinal report for the storm drainage were extended and additional analyses performed to address the following questions.

We have worked closely with the Greater New Haven Water Pollution Control Authority (GHNWPCA) to respond to these questions. The City's responses only refer to the storm drainage system and the related stormwater flooding. Refer to the GNHWPCA response to the EPA letter dated February 13, 2014 for the answers to the questions regarding the sewage.

QUESTION 1. Provide a map of the storm drain system tributary to the two outfalls (i.e., South Outfall and North Outfall) discussed in the Cardinal Drainage Study. Include all active regulators and cross-connections from the combined sewer system.

A plan of the existing storm drainage system analyzed in the Drainage Study for Route 34 and Union Avenue dated July 11, 2012 by Cardinal Engineering Associates is included in Attachment A – Figures 1-1 and 1-2. The plan shows the storm sewer trunklines, major drainage structures, regulators and cross connections in the study area. A SWMM schematic of the storm system included in the hydraulic model is shown in Figure 2.

QUESTION 2. Provide a list of dates since January 1, 2010 on which discharges from the storm drain system have resulted in the release of stormwater mixed with sewage to the ground surface in the area tributary to the two outfalls discussed in the Cardinal Drainage Study. Include information regarding the depth and duration of storm event(s) preceding the discharge and the tidal conditions at the time of the discharge.

Please refer to GHNWPCA's answer to their Question No. 3.

QUESTION 3. Describe the hydraulics of the storm drain system, as it existed on October 9, 2013, from CSO regulator 031 downstream to the outfall to New Haven Harbor. Provide the peak hydraulic grade line at mean high tide, for the 1 -year, 2-year, 10-year, and 100-year storms of the following durations: 15 minutes, 60 minutes, 3 hours and 24 hours. This analysis should account for daily peak flows due to diurnal variations and seasonal peak flows during periods of increased infiltration. Include for reference the ground elevations, sewer manhole rim elevations, pipe invert elevations, pipe cross-section dimensions, pipe materials, pipe slope, the elevation of the overflow weir, and the elevation of the rim of the lowest catch basin inside the UARG.

This is also GHNWPCA Question 5.

The drainage basin contributing to this storm sewer system includes two main areas. The first area is referred to as the "Area North of Route 34 and West of State Street". It extends westerly to approximately Dwight Street and northerly to approximately the Grove Street Cemetery. The area is approximately 400 acres and contains among other things, the City's Central Business District, the New Haven Green, the City Municipal Complex, the Yale University Campus South and a portion of Route 34. The second area is referred to as the "Area South of Route 34 and West of Union Avenue". The area is approximately 180 acres and contains residences, businesses and the Yale Medical Center.

These areas were originally served by a combined storm and sanitary sewer system that discharged directly to New Haven Harbor. In the last century flows were directed to a treatment plant with wet weather overflows. Over the years the City has separated the majority of the areas and installed a separate storm sewer. The old combined sewer presently serves as a sanitary sewer for the area but a large percentage of the roof leaders are still connected to it. The storm sewer system also has limited capacity and frequent flooding occurs in the Route 34/Under Air Rights Garage (UARG), Union Avenue and Temple Street Garage areas.

The storm drainage from the study area is conveyed to New Haven Harbor by a trunkline that generally begins in the Route 34 / State Street / Union Avenue area and outlets just north of Canal Dock Road. This is referred to as the "North Outfall". When this trunkline does not have capacity to convey the storm water it overflows into a second trunkline near the west end of Brewery Street and discharges to the Harbor near Church Street Extension. This is referred to as the "South Outfall". These two trunklines pick up approximately 170 acres of additional drainage downstream of the study area from what is referred to in the Cardinal Drainage Study as the "Area between Union Avenue and Sargent Drive". The capacity of the storm sewer systems is reduced by the tidal action of Long Island Sound at the outfalls.

The hydraulic characteristics of the storm sewer system are shown in Attachment A-Tables 1-1 and 1-2 (Storm Drain Structures and Storm Drain Conduits).

CSO Regulator 031 is located at the corner of South Frontage Road and Davenport Avenue. This regulator was closed on October 10, 2013. The sewer was connected to the storm drain in South Frontage Road. The South Frontage Road storm drain does not connect to the Route 34 storm drain until it reaches the Union Avenue Junction Chamber (over one half of a mile downstream of the Under Air Rights Garage).

The analysis of the existing conditions is based on the assumption that 50% of the roof runoff enters the storm sewer. This will account for the fact that a portion of the roof runoff may be separated and also it has been estimated that the roof drainage system will only have the capacity to convey approximately one-half of the storm water runoff.

The analysis does not take into account diurnal peak flow variations or seasonal peak flows during periods of increased infiltration; these variations are small compared to the peak flows for significant rainfall events that cause flooding in the study area. The analyses were conducted using the Mean High Tide elevation at New Haven Harbor (NGVD 1929 El. 3.5).

The results of the hydraulic analyses are shown in Table 2 of Attachment A and in Attachment B. For a 15-minute duration rainfall, a 10-year event will cause flooding in the UARG (HGL El. 13.7). A 25-year rainfall event or larger will cause flooding at all three studied locations: UARG, Temple Street/Garage manhole and South Frontage Road /Davenport Avenue manhole. Lower storms will not cause flooding at those locations since during a 15-minute rainfall event only parts of the larger drainage areas contribute to the peak flows in the storm drainage system.

During a 60-minute rainfall event, the whole drainage area is contributing to the storm system: a 1-year, 60-minute storm will cause flooding in the UARG (floor El. 11.6) and at the Temple Street Garage entrance (El. 15.4). A 10-year, 60-minute rainfall event will cause stormwater to also overflow the higher located South Frontage Road/Davenport Avenue manhole (top El. 18.2).

The third analysis used 6-hour duration rainfall events, based on the hydrographs computed for the Drainage Study for Route 34 and Union Avenue dated July 11, 2012 by Cardinal Engineering Associates. During these longer-duration, lower-intensity rainfall events flooding occurs at the studied locations for a 2-year, 6-hour storm or larger.

Attachment B shows the results of the hydraulic analyses – peak flows, hydraulic grade lines, duration of flooding at the studied locations for the 1-, 2- and 10-year 15-minute, 60-minute and 6-hour rainfall events.

A 3- and 24-hour analysis was not performed because even lower duration storms result in extensive stormwater flooding at the studied locations.

Please note that the computed hydraulic grade lines represent theoretical elevations only (computed by allowing surcharge at the respective structures). In fact, the water will spill over the road as soon as the hydraulic grade line reaches the top of the structure. However, inside the UARG it is possible to get 2-3ft of flooding, due to the confined space and such depths of flooding have been observed in Route 34.

QUESTION 4. Describe the storm with the minimum return period that would result, as it existed on October 9, 2013, in the presence of sewage outside of the collection system at the Under Air Rights Garage during mean high tide, daily peak sewer flows, and seasonal peak infiltration flows. Include the duration and depth of storm, and identify the precise points in the separate sanitary sewers and combined sewer collection system from which sewage would be released.

This is also GHNWPCA Question 6. Refer to GNHWPCA responses for the sewage aspects of this question. This response is for the storm drainage only.

On October 9, 2013 the combined sewer on Davenport Road was connected through Regulator 031 to the storm drain in South Frontage Road. The South Frontage Road storm drain does not connect to the Route 34 storm drain until it reaches the Union Avenue Junction Chamber (over one half of a mile downstream of the Under Air Rights Garage).

Before October 10, 2013, during Mean High Tide, a 1-year, 60-minute duration rainfall event would have caused storm water to flood the UARG and the low areas of Route 34.

The flooding event would have lasted for approximately 35 minutes with a maximum depth of 2ft in the low area of UARG (HGL El. 13.6, above UARG catch basin top El. 11.6).

QUESTION 5. Describe the storm with the minimum return period that, given current conditions, will result in the presence of sewage outside of the collection system at the Under Air Rights Garage during mean high tide, daily peak sewer flows and seasonal peak infiltration flows. Include the duration and depth of storm, and identify the precise points in the separate sanitary sewers and combined sewer collection system from which sewage will be released.

This is also GHNWPCA Question 7. Refer to GNHWPCA responses for the sewage aspects of this question. This response is for the storm drainage only.

As shown above (response to Question 4), the combined sewer system at Regulator 031 did not connect to the Route 34 storm drain system. Therefore, under current conditions at Mean High Tide, the same 1-year, 60-minute duration rainfall event will cause storm water to flood the UARG and the low areas of Route 34. The flooding event will last for approximately 35 minutes with a maximum depth of 2ft in the low area of UARG (HGL El. 13.6 , UARG catch basin top El. 11.6).

QUESTION 6. Describe the hydraulics of the storm drainage system from CSO regulator 034 downstream to the outfall to New Haven Harbor. Provide the peak hydraulic grade line at mean high tide for the 1-year, 2-year, 10-year and 100-year storms of the following durations: 15 minutes, 60 minutes, 3 hours, and 24 hours. This analysis should account for daily peak flows due to diurnal variations and seasonal peak flows during periods of increased infiltration. Include for reference the ground elevations, sewer manhole rim elevations, pipe invert elevations, pipe cross-section dimensions, pipe materials, pipe slope, the elevation of the overflow weir, and the elevation of the lowest floor in the Temple Street Garage.

This is also GHNWPCA Question 8.

For a description of the hydraulics of the storm drainage system from CSO regulator 034 downstream to the outfall to New Haven Harbor see response to Question No. 3.

CSO Regulator 034 is located at the corner of George and Temple Streets. The sewer is connected to the 48" storm drain in Temple Street. The Temple Street storm drain does not connect to the Route 34 storm drain until it reaches the Union Avenue Junction Chamber (over one half of a mile downstream of the Temple Street Garage and Under Air Rights Garage). Flow metering data from GNHWPCA's CSO Flow Monitoring Program at Regulator 034 shows that the storm drain system overflows into the sewer system during rain events.

Analyses for the 1, 2 and 10-year 15-minute, 60-minute and 6-hour rainfall duration have been performed. The 3-hour and 24-hour hydrographs have been replaced with the 6-hour hydrographs as described in the response to Question 3.

The results of the hydraulic analyses are shown in the Attachment A – Table 2 and in Attachment B.

QUESTION 7. Describe the storm with the minimum return period that, given current conditions, will result in the presence of sewage outside of the collection system at the Temple

Street Garage during mean high tide, daily peak sewer flows, and seasonal peak infiltration flows. Include the duration and depth of storm, and identify the precise points in the separate sanitary sewers and combined sewer collection system from which sewage will be released.

This is also GHNWPCA Question 9. Refer to GNHWPCA responses for the sewage aspects of this question. This response is for the storm drainage only.

During Mean High Tide, a 1-year, 60-minute duration rainfall event would cause storm water to briefly overflow the storm sewer manhole on Temple Street at the entrance of the Temple Street Garage. A 2-year, 60-minute storm would result in flooding at the same location for approximately 30 minutes.

QUESTION 8. Describe the methodology used to perform the hydraulic analysis for Questions 3 through 7. Include information regarding storm hydrographs used.

The existing storm sewer system was modeled using EPA's Stormwater Management Model (SWMM) computer program. This general purpose urban hydrology and conveyance system hydraulics software is a dynamic rainfall-runoff model used for a single event or long-term (continuous) simulation of runoff quantity from primary urban areas that provides a three dimensional analysis of the storm or sanitary (combined) sewer system. The routing portion of SWMM transports this runoff through a system of pipes, channels, storage devices and regulators. SWMM tracks the flow depth and the hydraulic grade line in each pipe during a simulation period comprised of multiple time steps.

The hydraulic analyses were performed using three types of hydrographs (see Figure 3):

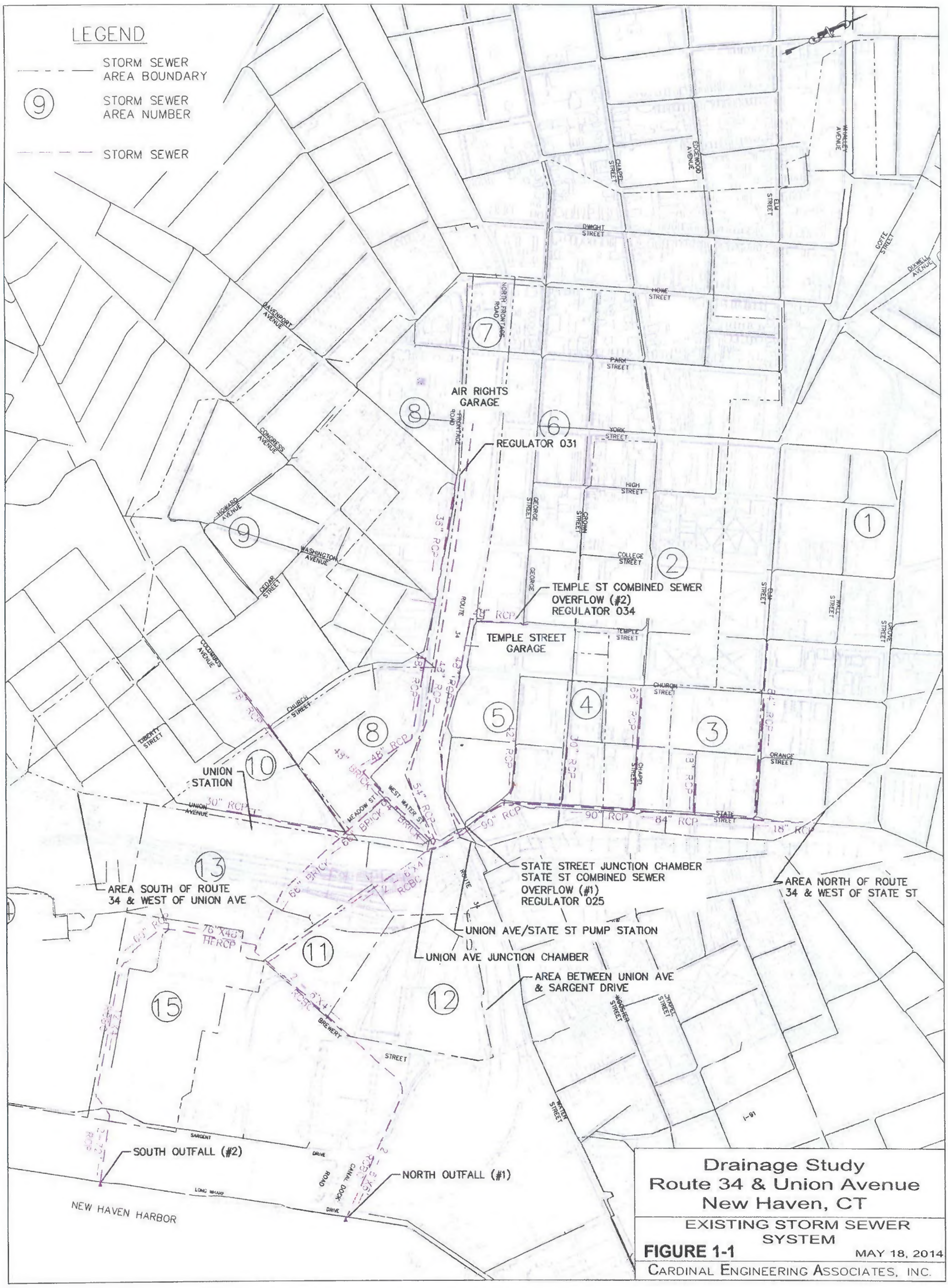
1. **Hydrographs generated by a 15-minute rainfall event. The drainage areas contributing to the flooding in Route 34/UARG and Temple Street/Garage were broken down into smaller areas with a time of concentration of 15 minutes. These areas generate peak flows (using the Rational Method) that were used to develop the triangular hydrographs entered into the SWMM model for the storm sewer trunklines in the study area. The triangular hydrographs have a rising leg duration equal to the time of concentration and a falling leg duration of twice the time of concentration. During a 15-minute rainfall event, only parts of the larger drainage areas contribute to the peak flows in the storm drainage system. Hydrographs for the 15-minute 1-year, 2-year, 10-year and up to 100-year were computed using this procedure. These hydrographs were introduced in the SWMM model at locations (nodes) where the storm sewer trunklines connect to the main 90" RCP at State Street, the 2-6'x4' RCBC at Union Avenue and the 66'' brick at Union Station.**

2. **Hydrographs generated by a 60-minute rainfall event. The hydrographs were designed with rising leg duration equal to the time of concentration, extending the peak flow up to 60 minutes (the rainfall duration), and a falling leg duration of twice the time of concentration. During a 60-minute rainfall event, the whole drainage area contributes to the flows in the storm drain system. Hydrographs for the 60-minute 1-year, 2-year and 10-year storms were computed using this procedure.**

3. **Hydrographs generated by a 6-hour rainfall event. The hydrographs were generated using the NRCS TR-20 24-hour Type III distribution in 0.1hr increments. A 6-hour portion selected symmetrically around the 12-hour point was used to define the unit hydrograph. Rainfall amounts for the 1-, 2- and 10-year events were**

used to compute the 6-hour hydrographs. These hydrographs were introduced in the SWMM model at locations where the storm sewer trunklines connect to the main 90" RCP at State Street, the 2-6'x4' RCBC at Union Avenue and the 66'' brick at Union Station. The results of the hydraulic analyses are shown in Table 2 and Attachment B.

ATTACHMENT A



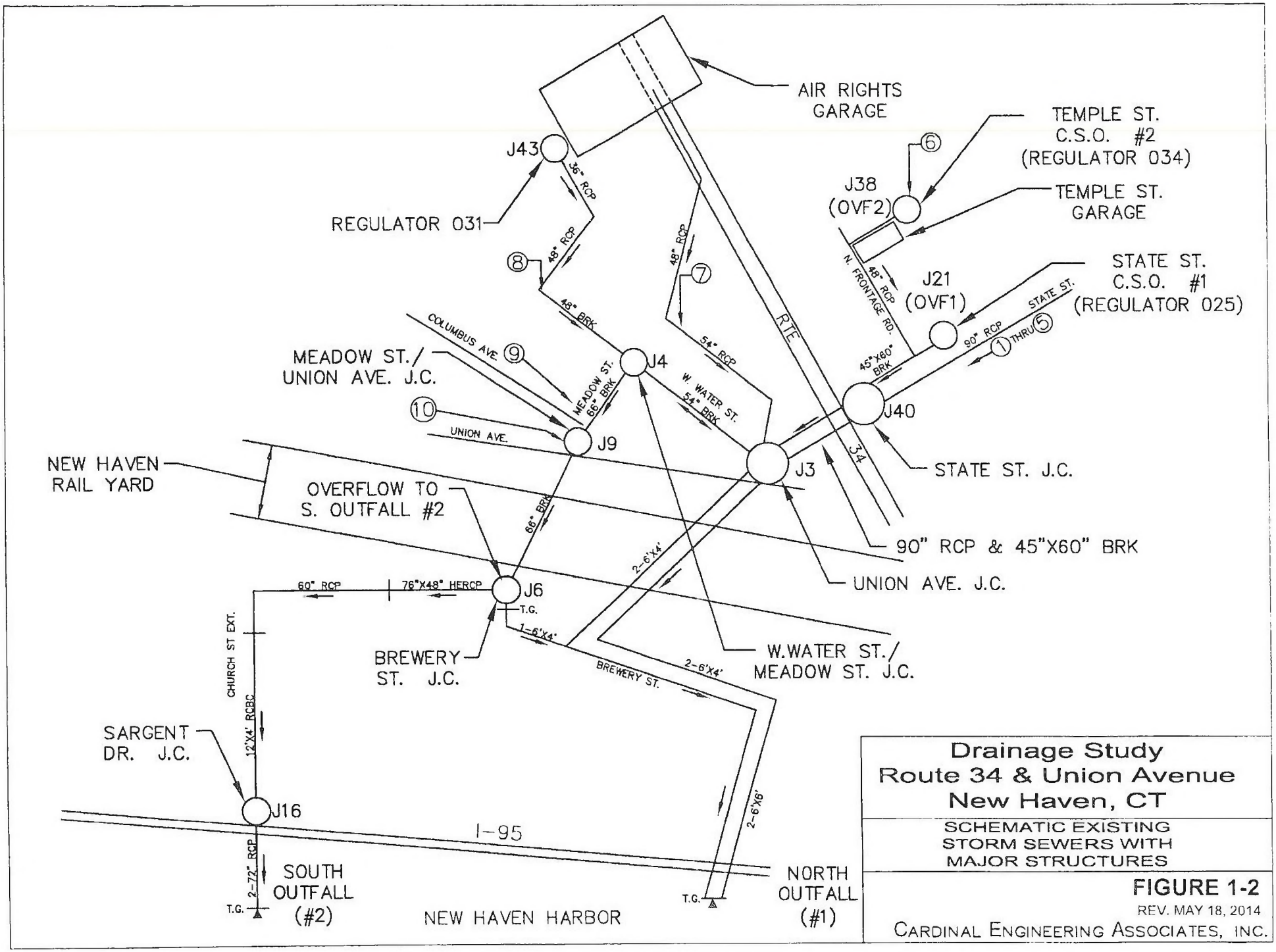
Drainage Study
Route 34 & Union Avenue
New Haven, CT

EXISTING STORM SEWER SYSTEM

FIGURE 1-1

MAY 18, 2014

CARDINAL ENGINEERING ASSOCIATES, INC.



Drainage Study
Route 34 & Union Avenue
New Haven, CT

SCHEMATIC EXISTING STORM SEWERS WITH MAJOR STRUCTURES

FIGURE 1-2

REV. MAY 18, 2014

CARDINAL ENGINEERING ASSOCIATES, INC.

TABLE 1 -1

SWMM MODEL - STORM DRAIN STRUCTURES

NGVD 1929 DATUM MEAN HIGH TIDE EL.+3.5

NODE	INVERT	TOP OF FRAME ELEVATION	STRUCTURE LOCATION / DESCRIPTION
OUT1	-4.80	7.60	NORTH OUTLET TO NEW HAVEN HARBOR
OUT2	0.30	7.50	SOUTH OUTLET TO NEW HAVEN HARBOR
J0	-4.10	8.00	MANHOLE ON 2-6'x6' RCBC SOUTH OF I-95
J1	-2.83	6.90	MANHOLE ON 2-6'x6' RCBC SOUTH OF BREWER STREET
J2	-0.43	8.57	MANHOLE ON 2-6'x6' RCBC SOUTH OF RAILROAD TRACKS
J3	1.00	13.50	UNION AVENUE JUNCTION CHAMBER
J4	1.39	13.09	WEST WATER ST./MEADOW ST. JUNCTION CHAMBER
J5	0.56	10.00	MANHOLE ON 66" STORM PIPE NORTH OF RAILROAD TRACKS
J6	-0.24	8.60	OVERFLOW TO SOUTH OUTFALL #2
J7	2.19	17.90	JUNCTION WITH CROWN STREET STORM TRUNKLINE
J8	2.01	11.05	JUNCTION WITH SOUTH FRONTAGE ROAD STORM PIPE
J9	0.50	10.10	JUNCTION WITH COLUMBUS AVENUE STORM TRUNKLINE
J10	0.98	9.98	MANHOLE ON 72" COLUMBUS AVENUE STORM TRUNKLINE
J11	4.99	16.30	JUNCTION WITH ELM STREET STORM TRUNKLINE
J12	4.10	15.00	JUNCTION WITH CHAPEL STREET STORM TRUNKLINE
J13	3.17	18.00	MANHOLE ON 48" NORTH FRONTAGE ROAD STORM DRAIN
J14	2.36	8.76	MANHOLE ON 60" STORM DRAIN NORTH OF CHURCH ST. EXT.
J15	1.47	8.00	JUNCTION WITH FOOD TERMINAL STORM DRAIN
J16	0.54	9.40	SARGENT DRIVE JUNCTION CHAMBER
J17	2.55	8.00	MANHOLE ON 66" STORM PIPE AT FOOD TERMINAL
J18	-2.51	6.49	JUNCTION WITH POST OFFICE STORM DRAIN
J19	0.53	10.10	UNION AVENUE MANHOLE
J20	2.00	10.20	UNION AVENUE MANHOLE
J21	2.13	24.90	CSO REGULATOR #25; OVERFLOW WEIR ELEV. 4.8
J22	2.75	15.90	ROUTE 34 MANHOLE
J23	3.60	18.00	ROUTE 34 MANHOLE
J24	4.05	19.50	ROUTE 34 MANHOLE
J25	4.78	8.00	ROUTE 34 MANHOLE AT CHURCH STREET
J26	5.20	11.30	ROUTE 34 MANHOLE
J27	4.90	11.50	ROUTE 34 MANHOLE
J28	5.30	11.70	ROUTE 34 MANHOLE AT COLLEGE STREET
J29	5.40	12.30	ROUTE 34 MANHOLE
J30	3.87	16.50	NORTH FRONTAGE ROAD MANHOLE
J31	3.95	21.00	NORTH FRONTAGE ROAD MANHOLE
J32	3.75	12.00	UNION AVENUE MANHOLE
J33	7.18	12.20	UNION AVENUE MANHOLE
J34	8.55	15.00	UNION AVENUE MANHOLE
J35	4.05	24.30	NORTH FRONTAGE ROAD MANHOLE
J36	5.45	18.00	NORTH FRONTAGE ROAD MANHOLE
J37	5.85	15.40	TEMPLE ST/GARAGE MANHOLE (TOP ELEV 15.40)
J38	9.60	21.40	CSO REGULATOR #34; OVERFLOW WEIR ELEV. 12.7
J39	9.80	21.60	JUNCTION WITH GEORGE STREET STORM TRUNKLINE
J40	2.60	18.00	NORTH FRONTAGE ROAD MANHOLE
J41	5.80	11.60	LOWEST CB INSIDE UARG (TOP ELEV. 11.60)
J42	3.70	23.50	SOUTH FRONTAGE ROAD MANHOLE
J43	4.90	18.20	CSO REGULATOR #31; OVERFLOW WEIR ELEV. 6.60
J44	10.93	15.40	CB ON TEMPLE ST/GARAGE (TOP ELEV. 15.40)

TABLE 1 - 2

SWMM MODEL - STORM DRAIN CONDUITS

NGVD 1929 DATUM

MEAN HIGH TIDE EL.+3.5

PIPE	DIAMETER	NODE		INVERTS		SLOPE
		IN	OUT	IN	OUT	
C0	2-6'x6' RCBC	J0	OUT1	-4.10	-4.80	0.0070
C1	2-6'x6' RCBC	J1	J0	-2.83	-4.10	0.0013
C2	2-6'x4' RCBC	J18	J1	-2.51	-2.83	0.0005
C3	2-6'x4' RCBC	J2	J18	-0.43	-2.51	0.0026
C4	2-6'x4' RCBC	J3	J2	1.00	-0.43	0.0010
C5	90" RCP	J7	J3	2.19	1.00	0.0060
C6	90"RCP	J12	J7	4.10	2.19	0.0021
C7	90"RCP	J11	J12	4.99	4.10	0.0010
C8	54"RCP	J21	J3	2.13	1.43	0.0123
C9	54"RCP	J22	J21	2.75	2.13	0.0017
C10	54"RCP	J23	J22	3.60	2.75	0.0022
C11	48"RCP	J24	J23	4.05	3.60	0.0054
C12	48"RCP	J25	J24	4.78	4.05	0.0022
C13	48"RCP	J26	J25	5.20	4.78	0.0009
C14	48"RCP	J27	J26	5.30	5.20	0.0005
C15	48"RCP	J28	J27	5.40	5.30	0.0004
C16	48"RCP	J29	J28	5.50	5.40	0.0008
C17	48"RCP	J13	J40	3.17	2.60	0.0063
C18	54"RCP	J4	J3	1.39	1.00	0.0008
C19	48"RCP	J8	J4	2.01	1.39	0.0034
C20	48"RCP	J6	J2	-0.24	-0.43	0.0013
C21	78"x48" ELL.	J6	J14	3.03	2.36	0.0009
C22	60" RCP	J14	J15	2.36	1.47	0.0025
C23	12'x4' RCBC	J15	J16	1.47	0.54	0.0008
C24	2-72" RCP	J16	OUT2	0.54	0.30	0.0006
C25	66" RCP	J17	J15	2.55	1.47	0.0027
C26	66" RCP	J5	J6	0.56	-0.24	0.0016
C27	66" RCP	J9	J5	0.70	0.56	0.0002
C28	66" RCP	J4	J9	1.39	0.91	0.0013
C29	72" RCP	J10	J9	0.98	0.37	0.0034
C30	54" RCP	J19	J9	0.53	0.50	0.0009
C31	36" RCP	J20	J19	2.03	1.85	0.0072
C32	30" RCP	J32	J20	3.75	2.00	0.0045
C33	18" RCP	J33	J32	7.18	6.66	0.0047
C34	18" RCP	J34	J33	8.55	7.25	0.0041
C35	48"RCP	J30	J13	3.87	3.17	0.0013
C36	48"RCP	J35	J30	4.05	3.87	0.0004
C37	48"RCP	J36	J35	5.45	4.05	0.0038
C38	48"RCP	J37	J36	5.85	5.45	0.0033
C39	48"RCP	J38	J37	9.60	5.85	0.0087
C40	48" RCP	J39	J38	9.80	9.60	0.0200
C41	4'x6" BRICK	J40	J3	2.19	2.02	0.0013
C42	48" RCP	J41	J29	5.80	5.30	0.0005
C43	48" RCP	J42	J8	3.70	3.00	0.0006
C44	36" RCP	J43	J42	4.90	3.70	0.0012
C45	24" RCP	J44	J25	10.93	6.78	0.0058

TABLE 2

NEW HAVEN STORM SEWER - SWMM ANALYSIS
HYDRAULIC GRADE LINE - 15 MIN. DURATION RAINFALL
MEAN HIGH TIDE EL. 3.5 NGVD 1929

STRUCT.	LOCATION	TOP ELEV.	1YR	2YR	10YR	25YR	50YR	100YR
J41	ROUTE 34 - LOWEST C.B. ELEVATION IN UARG	11.6	7.2	8.2	13.7	14.5	14.6	15.2
J43	SOUTH FRONTAGE ROAD M.H. AT DAVENPORT AVENUE	18.2	10.0	12.5	17.6	20.3	24.5	28.2
J37/J44	TEMPLE STREET M.H. AT GARAGE ENTRANCE	15.4	8.2	8.3	14.3	15.4	15.6	20.0

NEW HAVEN STORM SEWER - SWMM ANALYSIS
HYDRAULIC GRADE LINE - 60 MIN. DURATION RAINFALL
MEAN HIGH TIDE EL. 3.5 NGVD 1929

STRUCT.	LOCATION	TOP ELEV.	1YR	2YR	10YR			100YR
J41	ROUTE 34 - LOWEST C.B. ELEVATION IN UARG	11.6	13.6	14.5	15.3			
J43	SOUTH FRONTAGE ROAD M.H. AT DAVENPORT AVENUE	18.2	14.8	16.5	19.5			
J37/J44	TEMPLE STREET M.H. AT GARAGE ENTRANCE	15.4	16.1	17.0	19.6			

NEW HAVEN STORM SEWER - SWMM ANALYSIS
HYDRAULIC GRADE LINE - 6 HR. DURATION RAINFALL
MEAN HIGH TIDE EL. 3.5 NGVD 1929

STRUCT.	LOCATION	TOP ELEV.	1YR	2YR	10YR			100YR
J41	ROUTE 34 - LOWEST C.B. ELEVATION IN UARG	11.6	6.6	13.6	15.6			
J43	SOUTH FRONTAGE ROAD M.H. AT DAVENPORT AVENUE	18.2	9.5	21	27.2			
J37/J44	TEMPLE STREET M.H. AT GARAGE ENTRANCE	15.4	7.6	16.8	21.2			

Bold numbers indicate confined HGL above the critical elevation surface flooding occurs. Actual stormwater surface elevations will be lower in unconfined areas.

TABLE 3

NEW HAVEN STORM SEWER

DRAINAGE AREAS AND FLOWS TO THE EXISTING 2 - 6' x 6' TRUNKLINE (NORTH OUTFALL - #1) AND 2 -72" RCP (SOUTH OUTFALL - #2)

1-YR, 2-YR, 10-YR, 100-YR - 15MIN RAINFALL

AREA (No.)	DESCRIPTION	DRAINAGE AREA (Ac)	ROOF AREA (Ac)	T (min)	EXISTING CONDITIONS* 1-YEAR FLOW (cfs)	2-YEAR FLOW (cfs)	10-YEAR FLOW (cfs)	100-YEAR FLOW (cfs)
	AREA NORTH OF ROUTE 34 AND WEST OF STATE STREET							
1	ELM STREET TRUNKLINE	46	12	15	67	84	101	168
2	CHAPEL STREET TRUNKLINE	44	14.5	15	61	76	91	152
3	COURT STREET STORM SEWER	48.8	21	15	47	56	80	113
4	CROWN STREET STORM SEWER							
5	CHURCH - GEORGE ST STORM SEWER							
6	GEORGE - TEMPLE - N. FRONTAGE TRUNKLINE	21	8.9	15	33.7	42	50.5	84
7	ROUTE 34 TRUNKLINE	16	3	15	28	32	45	75
	AREA SOUTH OF ROUTE 34 AND WEST OF UNION AVENUE							
8.1	PARK STREET	5.8	0.9	15	10.8	13.5	16.2	27
8.2	YORK STREET	10.7	3.2	15	16.6	20.8	24.9	41.5
8.3	CONGRESS AVENUE	18	7.8	15	25.7	32.1	38.6	64.3
8.4	WEST WATER STREET	22.5	4.2	15	25.4	29.4	36.7	73.5
9	COLUMBUS AVENUE 78" TRUNKLINE	58	8	15	84	105	126	210
10	UNION AVENUE STORM SEWER	11.6	1.9	15	12	15	21	35
	AREA BETWEEN UNION AVENUE AND SARGENT DRIVE							
11	24" STORM SEWER TO 2-6'x4' RCBC	9.4	-	15	19	24	32	43
12	POST OFFICE AREA TO 2-6'x4' RCBC	20.5	-	15	37	46	66	102
13	AREA EAST OF UNION AVE TO 60" BRICK TRUNKLINE	38.6	-	15	47	56	81	115
14	AREA TO 43"x 68" PIPE**	85	-	15	106	127	178	254
15	AREA TO 12'x4' RCBC**	18.7	-	15	37	42	60	97

* Existing Conditions assume that 50% of roof area runoff flows into storm sewer

** Areas Tributary to South Outfall

TABLE 4

NEW HAVEN STORM SEWER
DRAINAGE AREAS AND FLOWS TO THE EXISTING 2 - 6' x 6' TRUNKLINE (NDRTH OUTFALL - #1) AND 2 -72" RCP (SOUTH OUTFALL - #2)
1-YR, 2-YR, 10-YR, 100-YR - 60MIN RAINFALL

AREA (No.)	DESCRIPTION	DRAINAGE AREA (Ac)	ROOF AREA (Ac)	T (min)	EXISTING CONDITIONS* 1-YEAR FLOW (cfs)	2-YEAR FLOW (cfs)	10-YEAR FLOW (cfs)	100-YEAR FLOW (cfs)
	AREA NORTH OF ROUTE 34 AND WEST OF STATE STREET							
1	ELM STREET TRUNKLINE	180	46.7	60	176	200	293	440
2	CHAPEL STREET TRUNKLINE	97	32	60	95	109	158	234
3	COURT STREET STORM SEWER	48.8	21	60	47	56	80	113
4	CROWN STREET STORM SEWER							
5	CHURCH - GEORGE ST STORM SEWER							
6	GEORGE - TEMPLE - N. FRONTAGE TRUNKLINE	52.5	22.2	60	49	56	81	
7	ROUTE 34 TRUNKLINE	16	3	60	28	32	47	
	AREA SOUTH OF ROUTE 34 AND WEST OF UNION AVENUE							
8.1	PARK STREET	5.8	0.9	60	10.8	13.5	16.2	27
8.2	YORK STREET	10.7	3.2	60	16.6	20.8	24.9	41.5
8.3	CONGRESS AVENUE	18	7.8	60	25.7	32.1	38.6	64.3
8.4	WEST WATER STREET	22.5	4.2	60	25.4	29.4	36.7	73.5
9	COLUMBUS AVENUE 78" TRUNKLINE	102	29	60	88	104	145	
10	UNION AVENUE STORM SEWER	11.6	1.9	60	12	15	21	35
	AREA BETWEEN UNION AVENUE AND SARGENT DRIVE							
11	24" STORM SEWER TO 2-6'x4' RCBC	9.4	-	60	19	24	32	43
12	POST OFFICE AREA TO 2-6'x4' RCBC	20.5	-	60	37	46	66	102
13	AREA EAST OF UNION AVE TO 60" BRICK TRUNKLINE	38.6	-	60	47	56	81	115
14	AREA TO 43"x 68" PIPE**	85	-	60	106	127	178	254
15	AREA TO 12'x4' RCBC**	18.7	-	60	37	42	60	97

* Existing Conditions assume that 50% of roof area runoff flows into storm sewer
** Areas Tributary to South Outfall

TABLE 5

NEW HAVEN STORM SEWER
DRAINAGE AREAS AND FLOWS TO THE EXISTING 2 - 6' x 6' TRUNKLINE (NORTH OUTFALL - #1) AND 2 -72" RCP (SOUTH OUTFALL - #2)
FLOWS GENERATED BY TYPE III, 6-HOUR DURATION RAINFALL

AREA (No.)	DESCRIPTION	DRAINAGE AREA (Ac)	ROOF AREA (Ac)	T (hr)	EXISTING CONDITIONS* CN_{ave}	1-YEAR FLOW (cfs)	2-YEAR FLOW (cfs)	10-YEAR FLOW (cfs)	100-YEAR FLOW (cfs)
	AREA NORTH OF ROUTE 34 AND WEST OF STATE STREET								
1	ELM STREET TRUNKLINE	180	46.7	6	75	98	208	363	
2	CHAPEL STREET TRUNKLINE	97	32	6	75	58	123	213	
3	COURT STREET STORM SEWER	48.8	21	6	75	38	79	136	
4	CROWN STREET STORM SEWER								
5	CHURCH - GEORGE ST STORM SEWER								
6	GEORGE - TEMPLE - N. FRONTAGE TRUNKLINE	52.5	22.2	6	70	21	50	93	
7	ROUTE 34 TRUNKLINE	16	3	6	90	16	36	62	
	AREA SOUTH OF ROUTE 34 AND WEST OF UNION AVENUE								
8.1	PARK STREET	5.8	0.9	6	75	10	19	31	
8.2	YORK STREET	10.7	3.2	6	75	12	27	47	
8.3	CONGRESS AVENUE	18	7.8	6	75	13	36	64	
8.4	WEST WATER STREET	22.5	4.2	6	75	18	44	83	
9	COLUMBUS AVENUE 78" TRUNKLINE	102	29	6	75	67	140	242	
10	UNION AVENUE STORM SEWER	11.6	1.9	6	75	10	21	36	
	AREA BETWEEN UNION AVENUE AND SARGENT DRIVE								
11	24" STORM SEWER TO 2-6'x4' RCBC	9.4	-	6	75	9	19	32	
12	POST OFFICE AREA TO 2-6'x4' RCBC	20.5	-	6	75	17	37	65	
13	AREA EAST OF UNION AVE TO 60" BRICK TRUNKLINE	38.6	-	6	75	30	63	108	
14	AREA TO 43"x 68" PIPE**	85	-	6	75	65	134	232	
15	AREA TO 12'x4' RCBC**	18.7	-	6	75	16	35	60	

* Existing Conditions assume that 50% of roof area runoff flows into storm sewer
** Areas Tributary to South Outfall

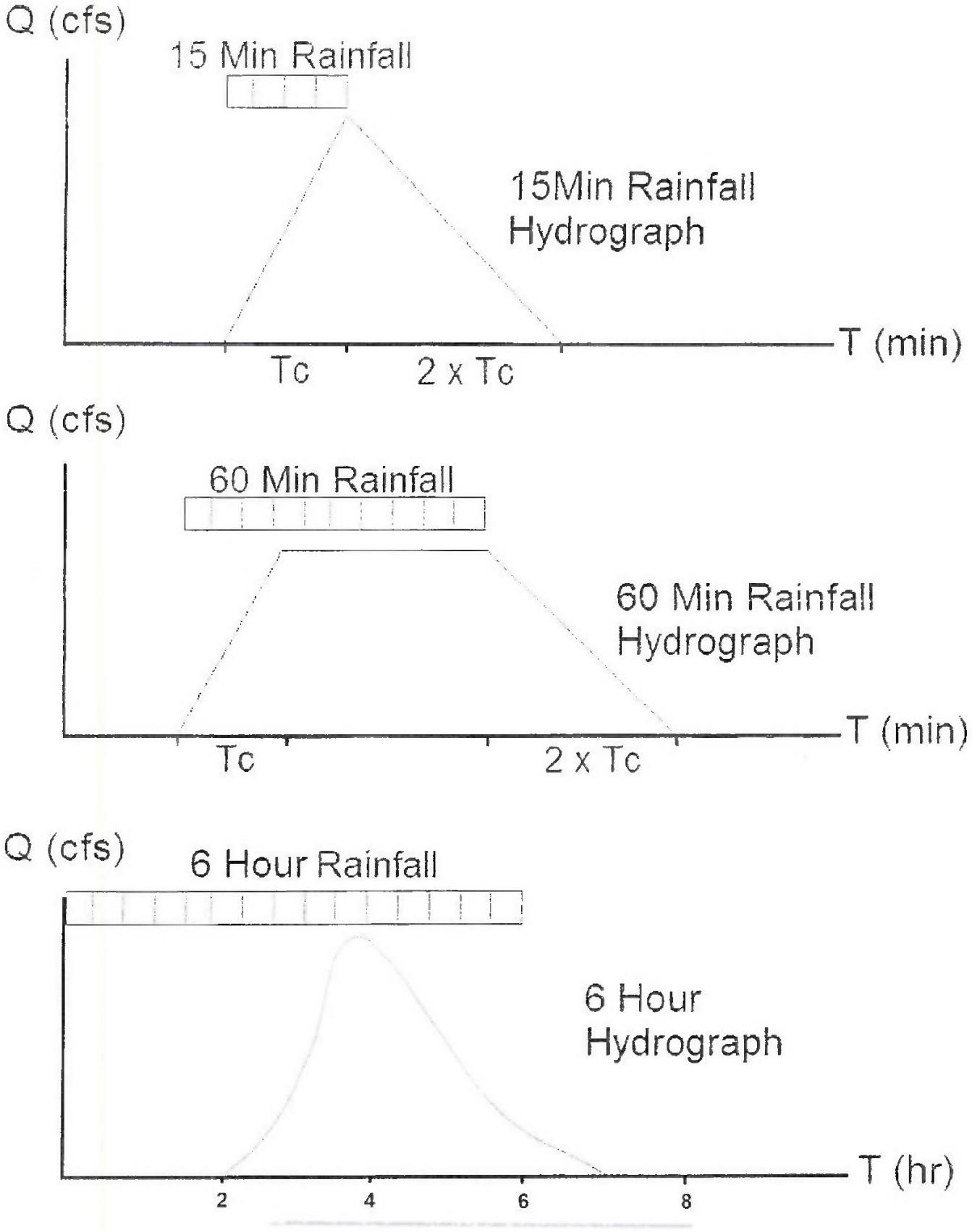

Q (cfs)
15 Min Rainfall
15Min Rainfall
Hydrograph
T (min)
Tc
2 x Tc
Q (cfs)
60 Min Rainfall
60 Min Rainfall
Hydrograph
T (min)
Tc
2 x Tc
Q (cfs)
6 Hour Rainfall
6 Hour
Hydrograph
T (hr)
2
4
6
8

FIGURE 3

ATTACHMENT B

SWMM ANALYSIS – 15MIN RAINFALL

TABLE 2

NEW HAVEN STORM SEWER - SWMM ANALYSIS
HYDRAULIC GRADE LINE - 15 MIN. DURATION RAINFALL
MEAN HIGH TIDE EL. 3.5 NGVD 1929

STRUCT.	LOCATION	TOP ELEV.	1YR	2YR	10YR	25YR	50YR	100YR
J41	ROUTE 34 - LOWEST C.B. ELEVATION IN UARG	11.6	7.2	8.2	13.7	14.5	14.6	15.2
J43	SOUTH FRONTAGE ROAD M.H. AT DAVENPORT AVENUE	18.2	10.0	12.5	17.6	20.3	24.5	28.2
J37/J44	TEMPLE STREET M.H. AT GARAGE ENTRANCE	15.4	8.2	8.3	14.3	15.4	15.6	20.0

NEW HAVEN STORM SEWER - SWMM ANALYSIS
HYDRAULIC GRADE LINE - 60 MIN. DURATION RAINFALL
MEAN HIGH TIDE EL. 3.5 NGVD 1929

STRUCT.	LOCATION	TOP ELEV.	1YR	2YR	10YR			100YR
J41	ROUTE 34 - LOWEST C.B. ELEVATION IN UARG	11.6	13.6	14.5	15.3			
J43	SOUTH FRONTAGE ROAD M.H. AT DAVENPORT AVENUE	18.2	14.8	16.5	19.5			
J37/J44	TEMPLE STREET M.H. AT GARAGE ENTRANCE	15.4	16.1	17.0	19.6			

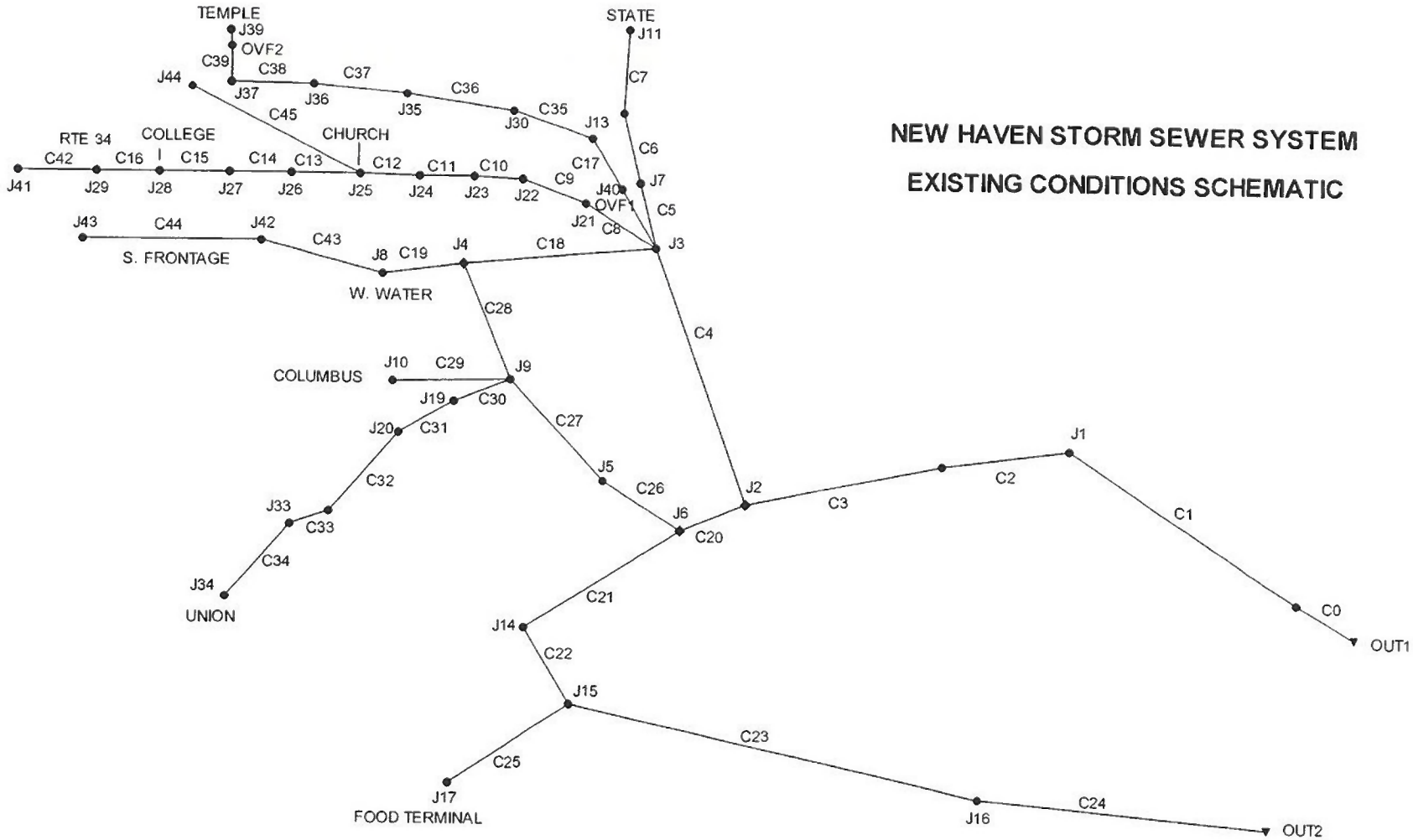
NEW HAVEN STORM SEWER - SWMM ANALYSIS
HYDRAULIC GRADE LINE - 6 HR. DURATION RAINFALL
MEAN HIGH TIDE EL. 3.5 NGVD 1929

STRUCT.	LOCATION	TOP ELEV.	1YR	2YR	10YR			100YR
J41	ROUTE 34 - LOWEST C.B. ELEVATIDN IN UARG	11.6	6.6	13.6	15.6			
J43	SOUTH FRONTAGE ROAD M.H. AT DAVENPORT AVENUE	18.2	9.5	21	27.2			
J37/J44	TEMPLE STREET M.H. AT GARAGE ENTRANCE	15.4	7.6	16.8	21.2			

Bold numbers indicate confined HGL above the critical elevation surface flooding occurs. Actual stormwater surface elevations will be lower in unconfined areas.

NEW HAVEN STORM SEWER SYSTEM

EXISTING CONDITIONS SCHEMATIC



3-2

TABLE 3

NEW HAVEN STORM SEWER

DRAINAGE AREAS AND FLOWS TO THE EXISTING 2 - 6' x 6' TRUNKLINE (NORTH OUTFALL - #1) AND 2 -72" RCP (SOUTH OUTFALL - #2)

1-YR, 2-YR, 10-YR, 100-YR - 15MIN RAINFALL

AREA (No.)	DESCRIPTION	DRAINAGE AREA (Ac)	ROOF AREA (Ac)	T (min)	EXISTING CONDITIONS* 1-YEAR FLOW (cfs)	2-YEAR FLOW (cfs)	10-YEAR FLOW (cfs)	100-YEAR FLOW (cfs)
	AREA NORTH OF ROUTE 34 AND WEST OF STATE STREET							
1	ELM STREET TRUNKLINE	46	12	15	67	84	101	168
2	CHAPEL STREET TRUNKLINE	44	14.5	15	61	76	91	152
3	COURT STREET STORM SEWER	48.8	21	15	47	56	80	113
4	CROWN STREET STORM SEWER							
5	CHURCH - GEORGE ST STORM SEWER							
6	GEORGE - TEMPLE - N. FRONTAGE TRUNKLINE	21	8.9	15	33.7	42	50.5	84
7	ROUTE 34 TRUNKLINE	16	3	15	28	32	45	75
	AREA SOUTH OF ROUTE 34 AND WEST OF UNION AVENUE							
8.1	PARK STREET	5.8	0.9	15	10.8	13.5	16.2	27
8.2	YORK STREET	10.7	3.2	15	16.6	20.8	24.9	41.5
8.3	CONGRESS AVENUE	18	7.8	15	25.7	32.1	38.6	64.3
8.4	WEST WATER STREET	22.5	4.2	15	25.4	29.4	36.7	73.5
9	COLUMBUS AVENUE 78" TRUNKLINE	58	8	15	84	105	126	210
10	UNION AVENUE STORM SEWER	11.6	1.9	15	12	15	21	35
	AREA BETWEEN UNION AVENUE AND SARGENT DRIVE							
11	24" STORM SEWER TO 2-6'x4' RCBC	9.4	-	15	19	24	32	43
12	POST OFFICE AREA TO 2-6'x4' RCBC	20.5	-	15	37	46	66	102
13	AREA EAST OF UNION AVE TO 60" BRICK TRUNKLINE	38.6	-	15	47	56	81	115
14	AREA TO 43"x 68" PIPE**	85	-	15	106	127	178	254
15	AREA TO 12'x4' RCBC**	18.7	-	15	37	42	60	97

* Existing Conditions assume that 50% of roof area runoff flows into storm sewer

** Areas Tributary to South Outfall

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MERIDEN, CONNECTICUT 06451
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JOB: S. FRONTAGE RD DRAINAGE
SHEET NO. EPA 308 OF 3-4
CALCULATED BY: VZ DATE: 3/25/14
CHECKED BY: DPA DATE: 5/8/14
SCALE:

S. FRONTAGE DRAINAGE SYSTEM

15 MIN DURATION

— D.A TO PARK ST. CB:

50% ROOF RUNOFF INTO STORM SEWER

DA = 5.8AC — IMPERVIOUS 90% C = 0.90

ROOF AREA = 0.9AC — PERVIOUS 10% C = 0.30

50% ROOF = 0.45AC

$C_{AVE} = ((5.8-0.45-0.58)\times 0.90 + 0.58\times 0.30)/(5.8-0.45) =$
$= 0.84$

$T_c = 15$ min — $i_1 = 0.04$ in/min $= 2.4$ in/hr
$i_2 = 0.05$ in/min $= 3.0$ in/hr
$i_{10} = 0.06$ in/min $= 3.6$ in/hr — $i_{100} = 6.0$ (in/hr)

$Q_1 = (5.35)(0.84)(2.4) = \underline{10.8\text{ CFS}}$
$Q_2 = (5.35)(0.84)(3.0) = \underline{13.5\text{ CFS}}$
$Q_{10} = (5.35)(0.84)(3.6) = \underline{16.2\text{ CFS}}$
$Q_{100} = (5.35)(0.84)(6.0) = \underline{27\text{ CFS}}$

— D.A TO YORK ST CB:

D.A = 10.7AC — IMPERVIOUS = 80% (C = 0.90) — PERV = 20% (C = 0.30)

ROOF AREA = 3.2AC → 50% = 1.6AC

$C_{AVE} = ((10.7-1.6-2.1)\times 0.90 + 2.1\times 0.30)/(10.7-1.6) = 0.76$

$T_c = 15$ min — $i_1 = 0.04$ in/min
$i_2 = 0.05$ in/min

$Q_1 = (9.1)(0.76)(2.4) = \underline{16.6\text{ CFS}}$
$Q_2 = (9.1)(0.76)(3.0) = \underline{20.8\text{ CFS}}$
$Q_{10} = (9.1)(0.76)(3.6) = \underline{24.9\text{ CFS}}$
$Q_{100} = (9.1)(0.76)(6.0) = \underline{41.5\text{ CFS}}$

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JOB: 20 FRONTAGE RD DRAINAGE
SHEET NO. _____ OF 3-5
CALCULATED BY: YR DATE: 3/25/14
CHECKED BY: DPA DATE: 5/8/14
SCALE: _____

— D.A TO CONGRESS AVE:

DA = 18AC IMPERVIOUS = 70% (C = 0.90) PERVIOUS = 30% (C = 0.30)

ROOF AREA : 7.8AC → 50% ROOF = 3.9AC

$$C_{AVE} = \left((18 - 3.9 - 5.4) \times 0.90 + 5.4 \times 0.30\right) / (18 - 3.9) = 0.67$$

$T_C = 15\,min$ $i_1 = 0.04\,in/min$
$i_2 = 0.05\,in/min$

$Q_1 = (14.1)(0.76)(2.4) = \underline{25.7\,CFS}$
$Q_2 = (14.1)(0.76)(3.0) = \underline{32.1\,CFS}$
$Q_{10} = (14.1)(0.76)(3.6) = \underline{38.6\,CFS}$
$Q_{100} = (14.1)(0.76)(6.0) = \underline{64.3\,CFS}$

- D.A TO WEST WATER ST OR:

D.A = 22.5AC IMPERVIOUS = 70% (C = 0.90) PERVIOUS = 30% (C = 0.30)

ROOF AREA = 4.2AC 50% ROOF = 2.1AC

$$C_{AVE} = \left((22.5 - 2.1 - 6.75) \times 0.90 + 6.75 \times 0.30\right) / (22.5 - 2.1) = 0.60$$

$T_C = 20\,min$ $i_1 = 2.1\,in/hr$
$i_2 = 2.4\,in/hr$

$Q_1 = (20.4)(0.60)(2.1) = \underline{25.4\,CFS}$

$Q_2 = (20.4)(0.60)(2.4) = \underline{29.4\,CFS}$

$Q_{10} = (20.4)(0.60)(3.0) = \underline{36.7\,CFS}$

$Q_{100} = (20.4)(0.60)(6.0) = \underline{73.5\,CFS}$

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JOB EPA 308
SHEET NO. GEORGE ST FLOWS OF 3-6
CALCULATED BY VZ DATE 3/31/14
CHECKED BY DPA DATE 5/5/14
SCALE

GEORGE ST - TEMPLE ST FLOWS
15 MIN RAINFALL

PART OF GEORGE ST DRAINAGE AREA PEAKS AT 15 MIN RAINFALL:

D.A = 21 AC

PIPE FLOW LENGTH = 1,500 FT

SHALLOW CONC FLOW = 400 FT

OVERLAND FLOW = 100 FT

T_C = 15 min

D.A = 21 AC ; ROOF AREA = 9 AC
50% ROOF RUNOFF INTO STORM SEWER = 4.5 AC

D.A = 21 AC IMPERVIOUS 80% C = 0.90 PERVIOUS 20% C = 0.30

$$C_{AVE} = ((21 - 4.5 - 0.42) \times 0.90 + 0.42 \times 0.30)/(21 - 4.5) = 0.85$$

T_C = 15 min i_1 = 0.04 in/min = 2.4 in/hr
i_2 = 0.05 in/min = 3.0 in/hr
i_{10} = 0.06 in/min = 3.6 in/hr

$Q_1 = (16.5)(0.85)(2.4) = 33.7$ CFS
$Q_2 = (16.5)(0.85)(3.0) = 42$ CFS
$Q_{10} = (16.5)(0.85)(3.6) = 50.5$ CFS
$Q_{100} = (16.5)(0.85)(6.0) = 84$ CFS

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JDB: EPA 302
SHEET NO.: ELM ST FLOWS OF: B-7
CALCULATED BY: VZ DATE: 4/23/14
CHECKED BY: DPA DATE: 5/8/14
SCALE:

ELM ST - STATE ST
TRUNKLINE FLOWS
15 MIN RAINFALL

PART OF ELM ST, D.A PEAKS AT 15 MIN RAINFALL:

DA = 46 AC

PIPE FLOW LENGTH = 2,000 FT
SHALLOW CONC. FLOW = 400 FT
OVERLAND FLOW = 100 FT

Tc = 15 min

D.A = 46 AC ; ROOF AREA = 12 AC
50% ROOF RUNOFF INTO STORM SEWER = 6 AC

D.A = 46 AC IMPERVIOUS 75% PERVIOUS 25%
C = 0.90 C = 0.30

$C_{AVE} = ((46-6-13.8)\times 0.90 + 13.8\times 0.30)/(46-6) = 0.70$

$T_c = 15$ min $i_1 = 0.04$ in/min = 2.4 in/hr
$i_2 = 0.05$ in/min = 3.0 in/hr
$i_3 = 0.06$ in/min = 3.6 in/hr

$Q_1 = (40)(0.70)(2.4) = \underline{67 \text{ CFS}}$

$Q_2 = (40)(0.70)(3.0) = \underline{84 \text{ CFS}}$

$Q_{10} = (40)(0.70)(3.6) = \underline{101 \text{ CFS}}$

$Q_{100} = (40)(0.70)(6.0) = \underline{168 \text{ CFS}}$

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project ELM ST-STATE ST By [illegible] Date 4/23/14

Location DRAINAGE Checked DPA Date 5/8/14

Circle one: (Present) Developed D.A = 46 AC

Circle one: T_c T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID		
1. Surface description (table 3-1)		DAV		
2. Manning's roughness coeff., n (table 3-1) ..		0.015		
3. Flow length, L (total L ≤ 300 ft)	ft	100		
4. Two-yr 24-hr rainfall, P_2	in	3.3		
5. Land slope, s	ft/ft	0.01		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.05	+	= 0.05

Shallow concentrated flow		Segment ID		
7. Surface description (paved or unpaved)		PAVED		
8. Flow length, L	ft	500		
9. Watercourse slope, s	ft/ft	0.01		
10. Average velocity, V (figure 3-1)	ft/s	2.0±		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.07	+	= 0.07

Channel flow		Segment ID		
12. Cross sectional flow area, a	ft^2			
13. Wetted perimeter, p_w	ft			
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft			
15. Channel slope, s	ft/ft			
16. Manning's roughness coeff., n				
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s	4.0±		
18. Flow length, L	ft	2,000		
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.14	+	= 0.14

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 0.26

15 min

B-8

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JOB EPA 308
SHEET NO. CHAPEL ST FLOWS OF B-9
CALCULATED BY VZ DATE 4/23/14
CHECKED BY DPA DATE 5/6/14
SCALE

CHAPEL ST TO STATE ST
TRUNKLINE FLOWS
15MIN RAINFALL

PART OF CHAPEL ST. D.A. PEAKS AT 15MIN RAINFALL

D.A = 44AC
T_c = 15min

D.A = 44AC ROOF AREA = 14.5AC
50% ROOF RUNOFF INTO STORM SEWER = 7.25 AC

D.A = 44AC IMPERVIOUS 75% PERVIOUS = 25%.
C = 0.90 C = 0.30.

$C_{AVE} = ((44 - 7.25 - 13.2) \times 0.90 + 13.2 \times 0.30) / (44 - 7.25) = 0.69$

T_c = 15min

i_1 = 0.04in/min = 2.4in/hr
i_2 = 0.05in/min = 3.0 in/hr
i_{10} = 0.06in/min = 3.6 in/hr
i_{100} = 0.10in/min = 6.0 in/hr

$Q_1 = (36.75)(0.69)(2.4) =$ 61 CFS

$Q_2 = (36.75)(0.69)(3.0) =$ 76 CFS

$Q_{10} = (36.75)(0.69)(3.6) =$ 91 CFS

$Q_{100} = (36.75)(0.69)(6.0) =$ 152 CFS

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project CHANNEL ST - STATE ST By VL Date 4/23/14

Location DRAINAGE Checked DPA Date 5/3/14

Circle one: Present Developed DA: 44 Ac

Circle one: T_c T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID			
1. Surface description (table 3-1)		PAV			
2. Manning's roughness coeff., n (table 3-1) ..		0.016			
3. Flow length, L (total L ≤ 300 ft)	ft	100			
4. Two-yr 24-hr rainfall, P_2	in	3.3			
5. Land slope, s	ft/ft	0.01			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.05	+	=	0.05

Shallow concentrated flow		Segment ID			
7. Surface description (paved or unpaved)		PAVED			
8. Flow length, L	ft	500			
9. Watercourse slope, s	ft/ft	0.01			
10. Average velocity, V (figure 3-1)	ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.07	+	=	0.07

Channel flow		Segment ID			
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft				
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s	40±			
18. Flow length, L	ft	2,000			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.14	+	=	0.14

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 0.26

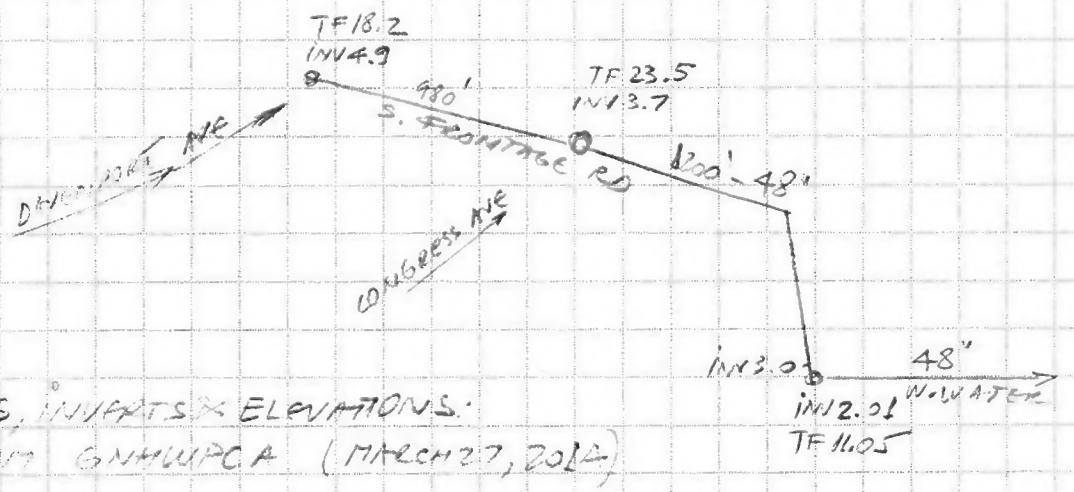
15 min

B-10

CARDINAL
ENGINEERING ASSOC., INC.
3 Colony Street
MERIDEN, CONNECTICUT 06451
(203) 238-1969 FAX (203) 630-2056

JOB CPA 308
SHEET NO. _____ OF B-11
CALCULATED BY VC DATE 4/1/14
CHECKED BY DPA DATE 5/8/14
SCALE _____

EXISTING STORM SEWER
S. FRONTAGE RD TO W. WATER ST.



LENGTHS, INVERTS & ELEVATIONS:
FROM GNHWPCA (MARCH 27, 2014)

Q_1, Q_2 & Q_{10} - 15 MIN COMPUTED USING RATIONAL METHOD FOR AREA BETWEEN WATER ST, RT 34 AND HOWE STREET (GIS MAP).

RT 34 DRAINAGE SYSTEM UPDATES - FROM GHNWPCA

VAL ZORCA

From: Bruce Kirkland [BKirkland@gnhwpca.com]
Sent: Wednesday, April 23, 2014 12:36 PM
To: David Arzt
Cc: Tom Sgroi; LSmith@newhavenct.net; Valentin Zorca; jac3@cardinal-engineering.com; Ricardo Ceballos
Subject: RE: Route 34 New Haven

Dave, here is the information regarding the 24 inch drain from the 48 inch DOT drain in Route 34 to the catch basins at the Temple Street Garage that we discussed at our meeting yesterday.

Updates to your storm drain SWMM model should include:

- Extending the Route 34 drain from the junction chamber at Church Street to the catch basins in front of the Temple Street Garage
  - Add 715 feet of 24 inch RCP at a slope of 0.0058
  - The invert of the 24 inch drain is 24 inches higher than the invert of the 48 inch DOT drain at Church Street (6.78)
  - The catch basins at the end of this drain are in front of the Temple Street Garage (elevation 15.40 feet NGVD29)

Please contact me if you have any questions or require any additional information. Bruce.

From: Bruce Kirkland
Sent: Thursday, March 27, 2014 1:12 PM
To: 'David Arzt'
Cc: Tom Sgroi; LSmith@newhavenct.net; Valentin Zorca; jac3@cardinal-engineering.com; Ricardo Ceballos; 'VAL ZORCA'
Subject: RE: Route 34 New Haven

Dave, I have attached the sewer flow meter data that we discussed. Based on this data and our current CSO Flow Monitoring Program data, there are no overflows to the drain system from REGs 031, 034, or 025 up to and including the 10 year 24 hour storm. Recent flow meter data confirms that the drain system overflows to the sewer system at REGs 034 and 025 (even during a 6 month 24 hour storm). REG 031 was closed in October 2013.

None of our regulators (031, 034 or 025) are connected to the Route 34 drain that serves the Air Rights Garage.

The current pumping capacity of the State/Union pump station is 21 MGD. The future pumping capacity is estimated to be 30 to 35 MGD.

Updates to your storm drain SWMM model should include:

- Extending the Route 34 drain from J29 to the lowest catch basin in the Air Rights Garage
  - Add 920 feet of 48 inch RCP at a slope of 0.0004
  - The catch basin at the end of this drain is the lowest point in the ARG (elevation 11.60 feet) (all elevations are NGVD29)
- Extending the West Water Street drain from J8 to REG 031

B-12

- Add 1200 feet of 48 inch RCP at a slope of 0.0006
- The rim at this junction is 23.5 feet and the invert is 3.70 feet
- Add 980 feet of 36 inch RCP at a slope of 0.0012
- The rim at this junction is 18.2 feet and the invert is 4.90 feet
- The invert of the 24 inch overflow pipe that used to connect to this drain from REG 031 is 6.60 feet
- The rim at REG 031 is 18.2 feet, the invert is 5.75 feet and the 24 inch overflow invert is 6.60 feet

- Do not add sewer overflows from REGs 031, 034 or 025 to the storm drain SWMM model

Please contact me if you have any questions or require any additional information. Bruce.

From: David Arzt [mailto:arzt@cardinal-engineering.com]
Sent: Thursday, March 20, 2014 5:35 PM
To: Ricardo Ceballos; 'VAL ZORCA'
Cc: Bruce Kirkland; Tom Sgroi; LSmith@newhavenct.net; Valentin Zorca; jac3@cardinal-engineering.com
Subject: RE: Route 34 New Haven

Ricardo,

GNHWPCA must have some information regarding OF-031. We do not have any information. Anything you have would be helpful.

Regards,

David P. Arzt, PE
Cardinal Engineering Associates, Inc.
3 Colony Street
Meriden, CT 06451

203-238-1969 (Office)
203-630-2056 (FAX)

CARDINAL
ENGINEERING ASSOCIATES

Serving Connecticut Municipalities for over 50 years.

From: Ricardo Ceballos [mailto:rceballos@gnhwpca.com]
Sent: Thursday, March 20, 2014 12:27 PM
To: VAL ZORCA
Cc: David P. Arzt; Bruce Kirkland; Tom Sgroi
Subject: RE: Route 34 New Haven

Val,
Thank you for the plans. I do not have information on OF-031 (recently closed). Our consultant is almost done with the GIS updates.

B-13

VAL ZORCA

From: Bruce Kirkland [BKirkland@gnhwpca.com]
Sent: Thursday, March 27, 2014 1:12 PM
To: David Arzt
Cc: Tom Sgroi; LSmith@newhavenct.net; Valentin Zorca; jac3@cardinal-engineering.com; Ricardo Ceballos; 'VAL ZORCA'
Subject: RE: Route 34 New Haven
Attachments: Spring 2007 Meter Data.pdf

Dave, I have attached the sewer flow meter data that we discussed. Based on this data and our current CSO Flow Monitoring Program data, there are no overflows to the drain system from REGs 031, 034, or 025 up to and including the 10 year 24 hour storm. Recent flow meter data confirms that the drain system overflows to the sewer system at REGs 034 and 025 (even during a 6 month 24 hour storm). REG 031 was closed in October 2013.

None of our regulators (031, 034 or 025) are connected to the Route 34 drain that serves the Air Rights Garage.

The current pumping capacity of the State/Union pump station is 21 MGD. The future pumping capacity is estimated to be 30 to 35 MGD.

Updates to your storm drain SWMM model should include:

- Extending the Route 34 drain from J29 to the lowest catch basin in the Air Rights Garage
  - Add 920 feet of 48 inch RCP at a slope of 0.0004
  - The catch basin at the end of this drain is the lowest point in the ARG (elevation 11.60 feet) (all elevations are NGVD29)
- Extending the West Water Street drain from J8 to REG 031
  - Add 1200 feet of 48 inch RCP at a slope of 0.0006
  - The rim at this junction is 23.5 feet and the invert is 3.70 feet
  - Add 930 feet of 36 inch RCP at a slope of 0.0012
  - The rim at this junction is 18.2 feet and the invert is 4.90 feet
  - The invert of the 24 inch overflow pipe that used to connect to this drain from REG 031 is 6.60 feet
  - The rim at REG 031 is 18.2 feet, the invert is 5.75 feet and the 24 inch overflow invert is 6.60 feet
- Do not add sewer overflows from REGs 031, 034 or 025 to the storm drain SWMM model

Please contact me if you have any questions or require any additional information. Bruce.

From: David Arzt [mailto:arzt@cardinal-engineering.com]
Sent: Thursday, March 20, 2014 5:35 PM
To: Ricardo Ceballos; 'VAL ZORCA'
Cc: Bruce Kirkland; Tom Sgroi; LSmith@newhavenct.net; Valentin Zorca; jac3@cardinal-engineering.com
Subject: RE: Route 34 New Haven

Ricardo,

8-14

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project _____ By VZ Date 3/31/14

Location GEORGE-TEMPLE ST DRAINAGE Checked DPA Date 5/8/14

Circle one: (Present) Developed

Circle one: T_c T_t through subarea DA = 2.14 ac

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID			
1. Surface description (table 3-1)		PAV			
2. Manning's roughness coeff., n (table 3-1) ..		0.016			
3. Flow length, L (total L ≤ 300 ft)	ft	100			
4. Two-yr 24-hr rainfall, P_2	in	3.3			
5. Land slope, s	ft/ft	0.01			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	0.05	+		= 0.05

Shallow concentrated flow		Segment ID			
7. Surface description (paved or unpaved)		PAVED			
8. Flow length, L	ft	400			
9. Watercourse slope, s	ft/ft	0.01			
10. Average velocity, V (figure 3-1)	ft/s	2.0			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.06	+		= 0.06

Channel flow		Segment ID			
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft				
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s	3.0±			
18. Flow length, L	ft	1500			
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	0.14	+		= 0.14

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 0.25

T_c = 15 min

B-15

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3 Colony Street
MERIDEN, CONNECTICUT 06451
(203) 238-1969 FAX (203) 630-2056

JOB: COLUMBUS AVE
SHEET NO.: DRAINAGE OF: B-16
CALCULATED BY: VZ DATE: 4/23/14
CHECKED BY: DPA DATE: 5/8/14
SCALE:

COLUMBUS AVE TO UNION AVE
TRUNKLINE FLOWS
15 MIN RAINFALL

PART OF COLUMBUS AVE D.A PEAKS AT 15 MIN.

D.A = 52 AC
T_c = 15 MIN

D.A = 52 AC ROOF AREA = 16 AC
50% ROOF RUNOFF INTO STORM SEWER = 8 AC

D.A = 52 AC IMPERVIOUS 75% C = 0.90 PERVIOUS - 30% C = 0.20

$$C_{AVE} = \left((52-8-17.4)\,0.90 + 17.4 \times 0.20\right) / (52-2) = 0.70$$

T_c = 15 min

$Q_1 = (50)(0.70)(2.4) = \underline{84 \text{ CFS}}$

$Q_2 = (50)(0.70)(3.0) = \underline{105 \text{ CFS}}$

$Q_{10} = (50)(0.70)(3.6) = \underline{126 \text{ CFS}}$

$Q_{100} = (50)(0.70)(6.0) = \underline{210 \text{ CFS}}$

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project COLUMBUS AVE By VZ Date 4/23/14

Location DRAINAGE Checked PPA Date 5/8/14

Circle one: Present Developed DA. 58AC

Circle one: T_c T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID			
1. Surface description (table 3-1)		PAV			
2. Manning's roughness coeff., n (table 3-1) ..		0.015			
3. Flow length, L (total L ≤ 300 ft)	ft	100			
4. Two-yr 24-hr rainfall, P_2	in	3.3			
5. Land slope, s	ft/ft	0.005			
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr	0.04	+		= 0.04

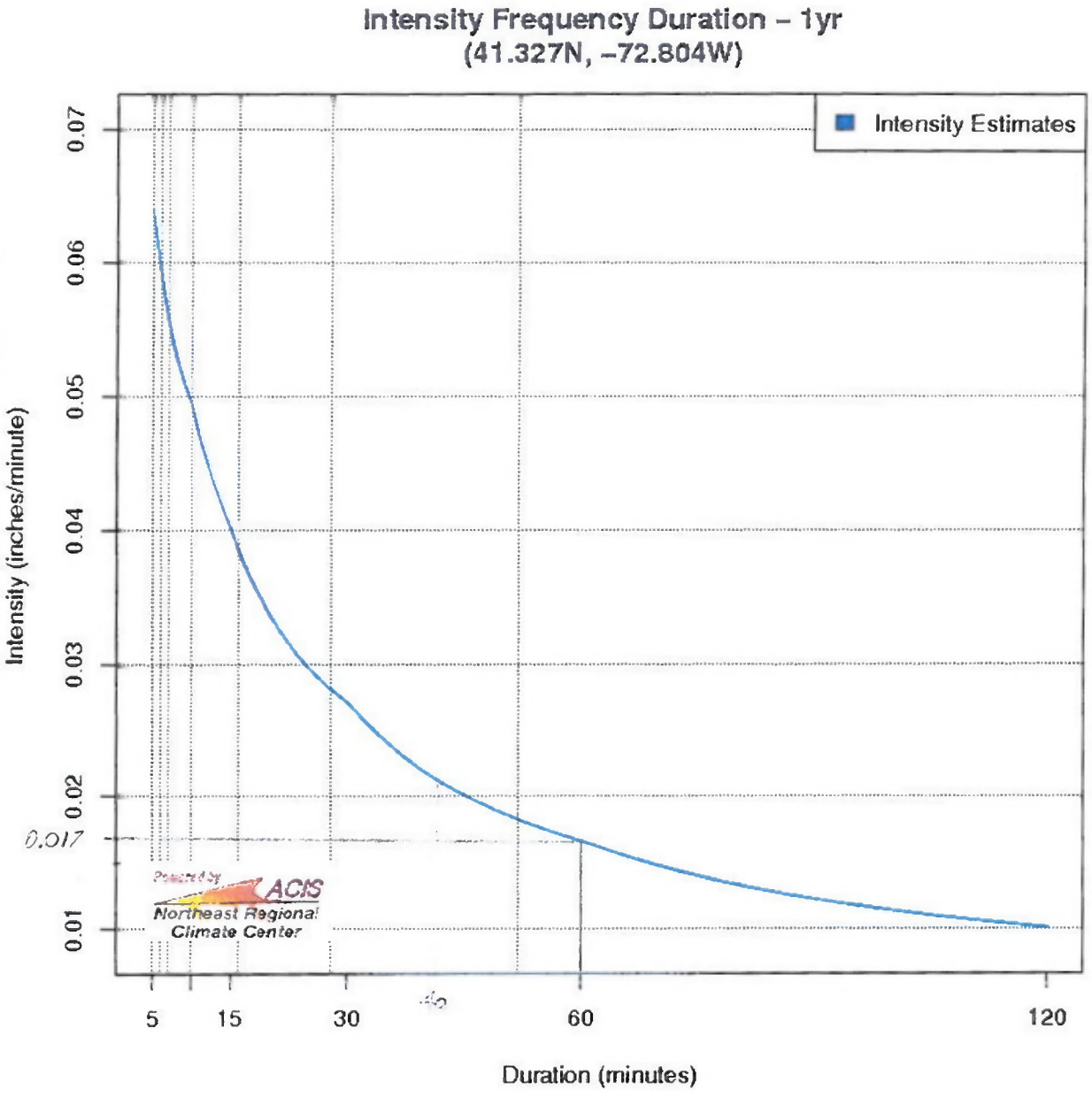
Shallow concentrated flow		Segment ID			
7. Surface description (paved or unpaved)		PAV			
8. Flow length, L	ft	300			
9. Watercourse slope, s	ft/ft	0.005			
10. Average velocity, V (figure 3-1)	ft/s	1.5			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	0.05	+		= 0.05

Channel flow		Segment ID			
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft				
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s	3.0			
18. Flow length, L	ft	700			
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	0.07	+		= 0.07

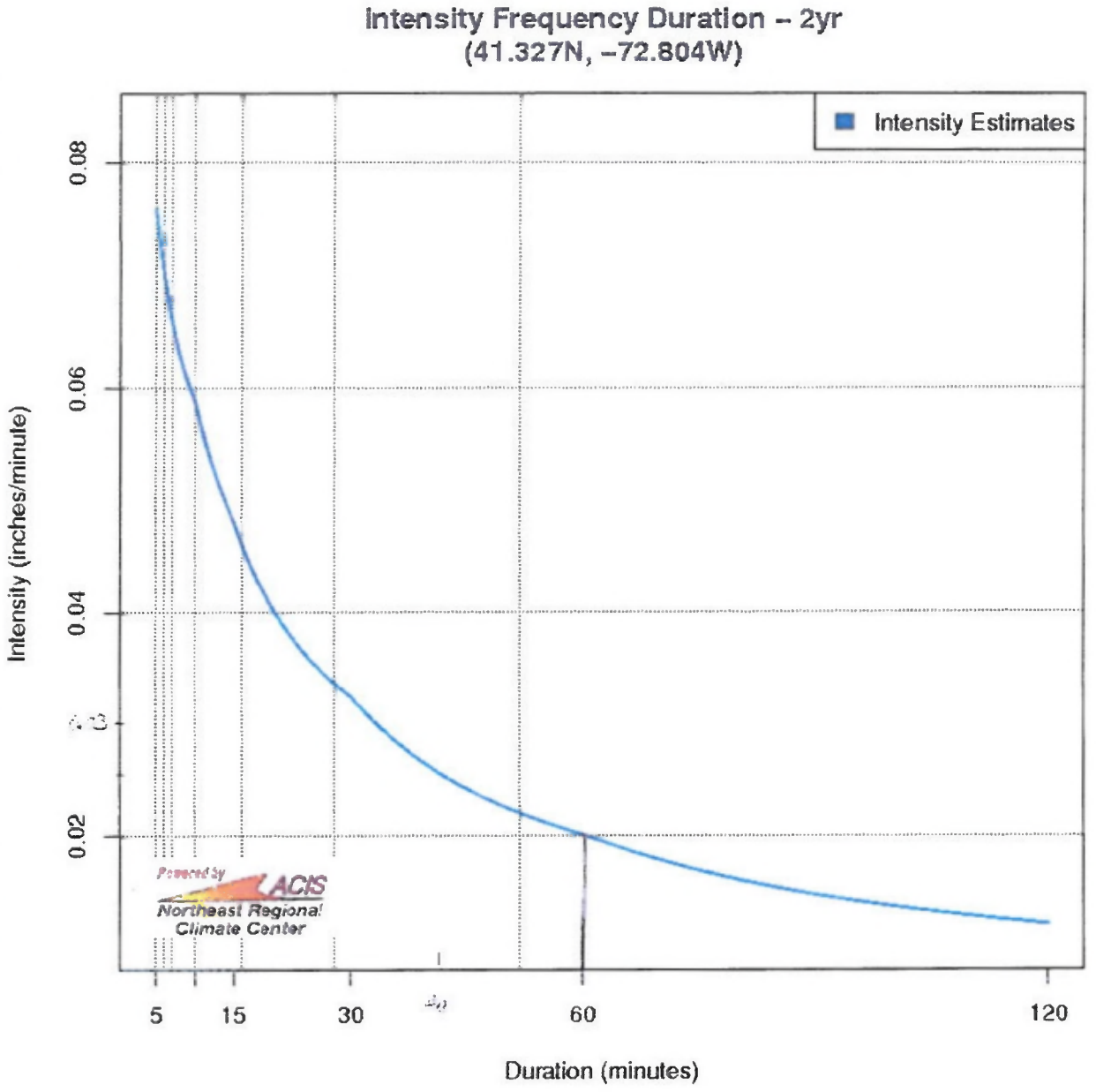
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 0.16

15 min

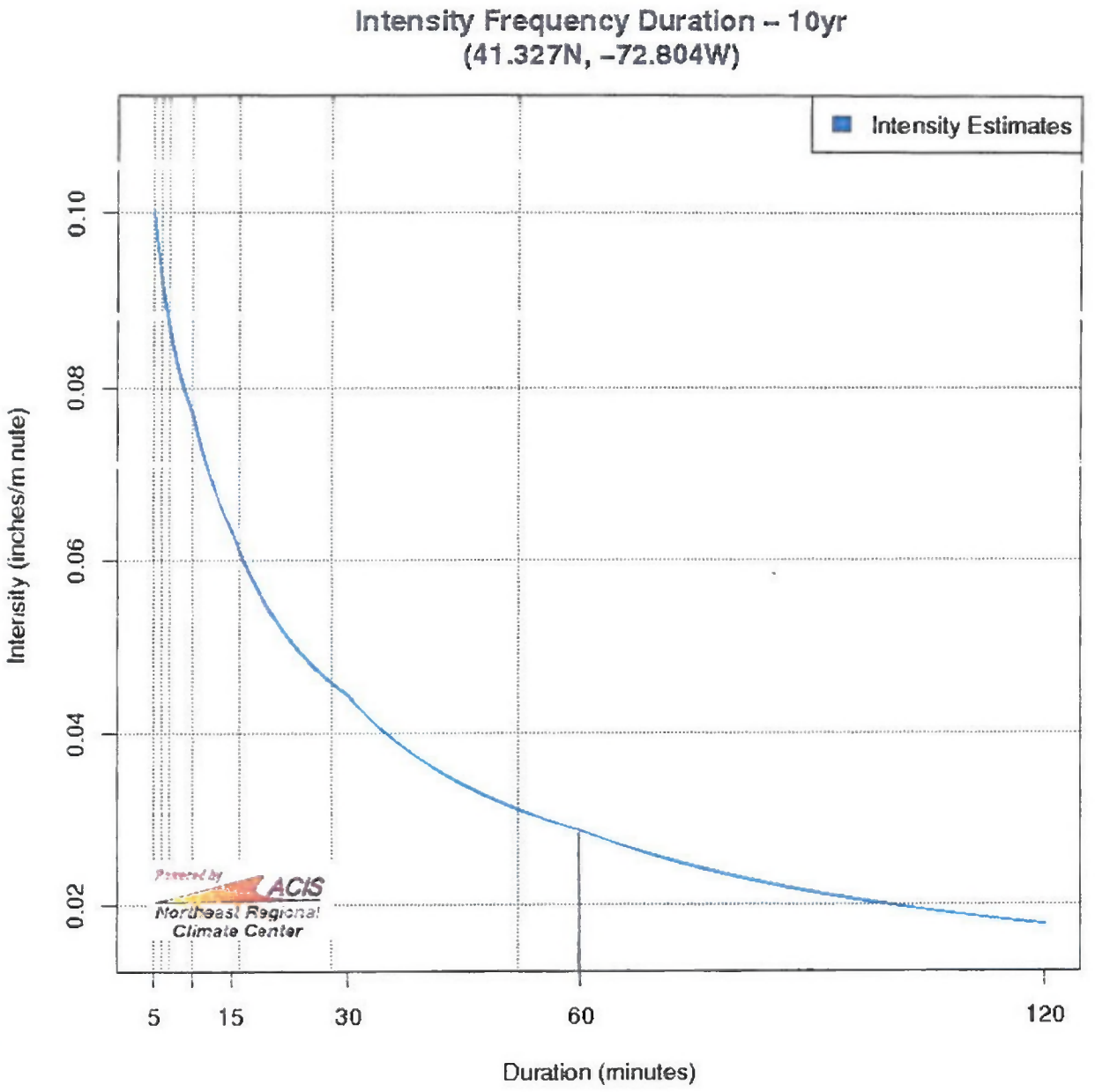
B-17



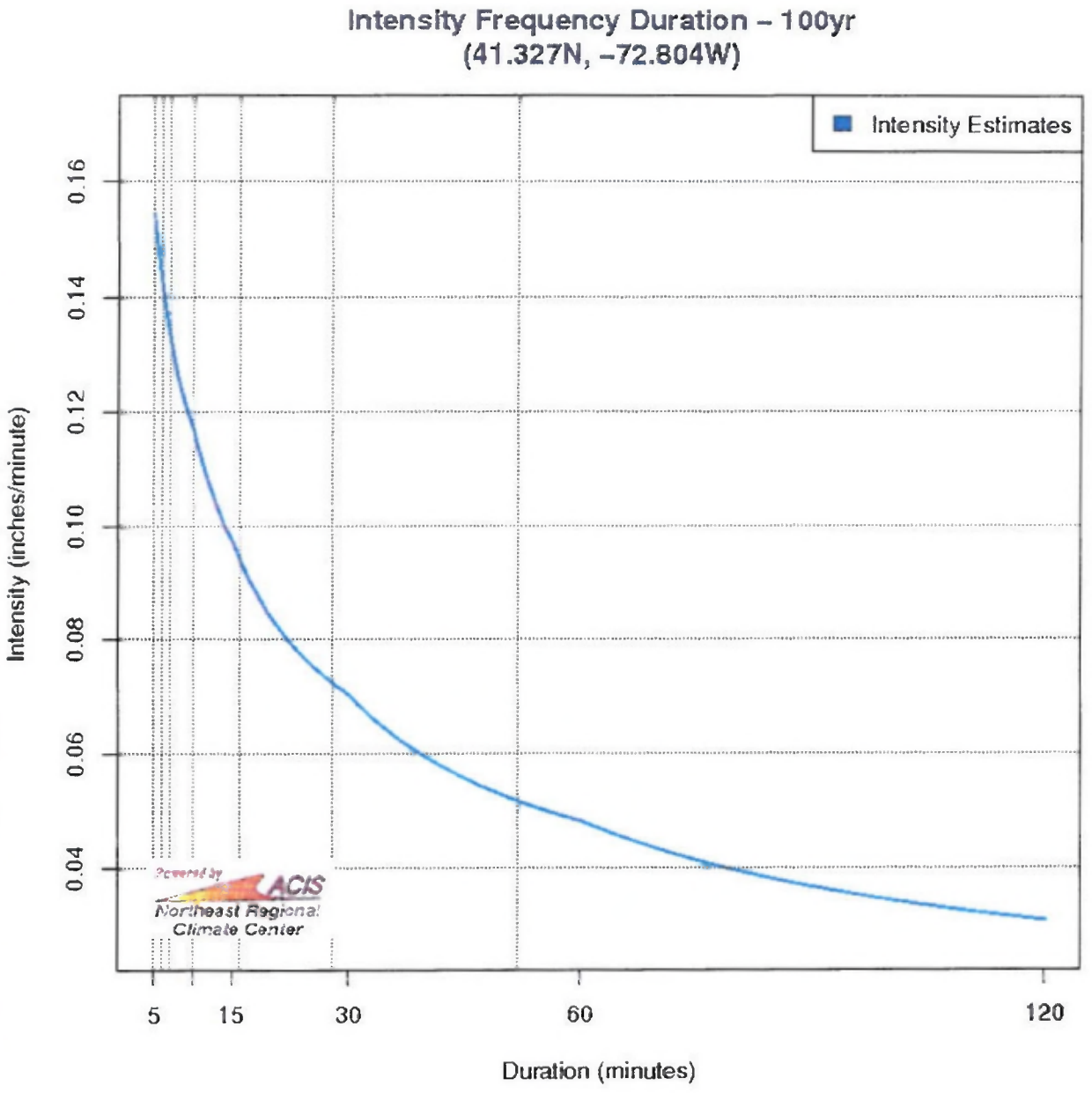
Time	Intensity
5	0.06
6*	0.06
7*	0.06
8*	0.05
9*	0.05
10	0.05
11*	0.05
12*	0.04
13*	0.04
14*	0.04
15	0.04
16*	0.04
17*	0.04
18*	0.04



Time	Intensity
5	0.08
6*	0.07
7*	0.07
8*	0.06
9*	0.06
10	0.06
11*	0.06
12*	0.05
13*	0.05
14*	0.05
15	0.05
16*	0.05
17*	0.04
18*	0.04

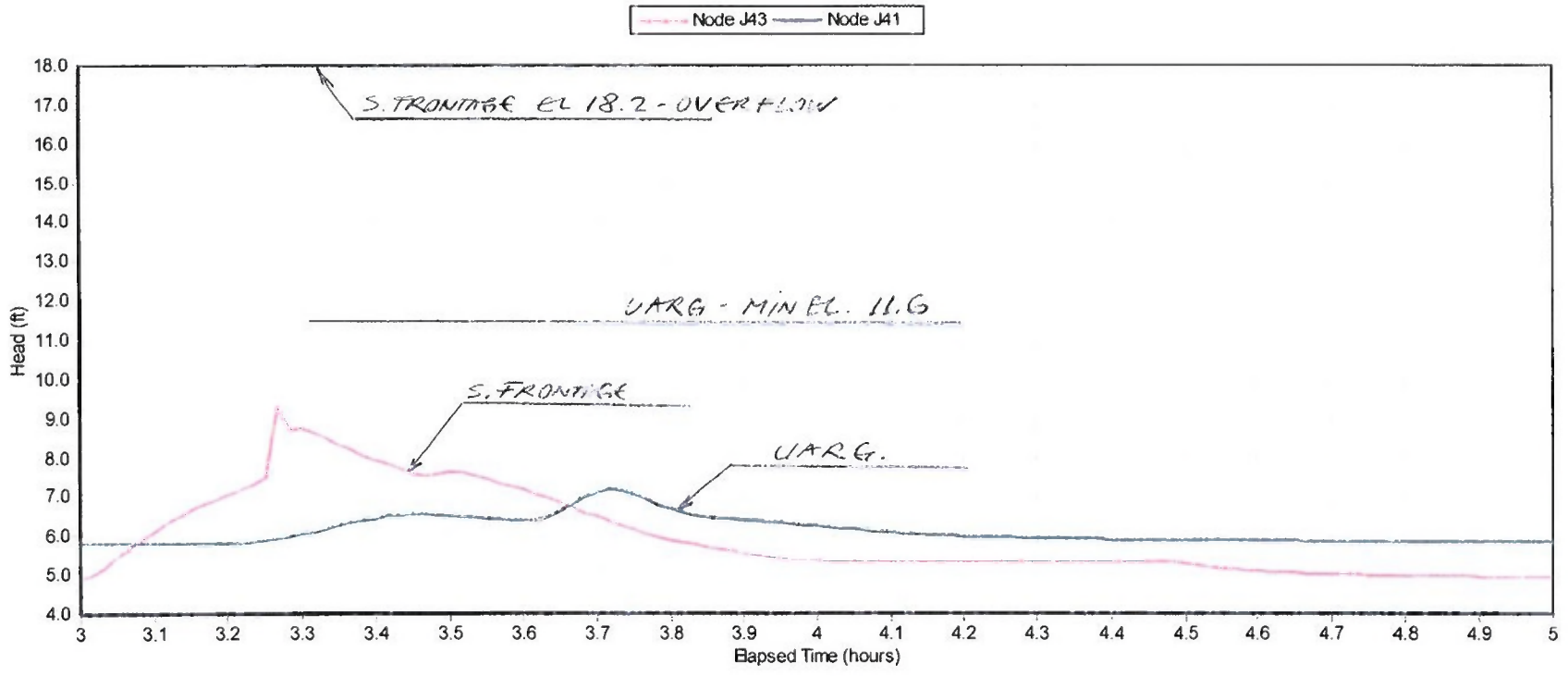


Time	Intensity
5	0.10
6*	0.09
7*	0.09
8*	0.08
9*	0.08
10	0.08
11*	0.07
12*	0.07
13*	0.07
14*	0.07
15	0.06
16*	0.06
17*	0.06
18*	0.06



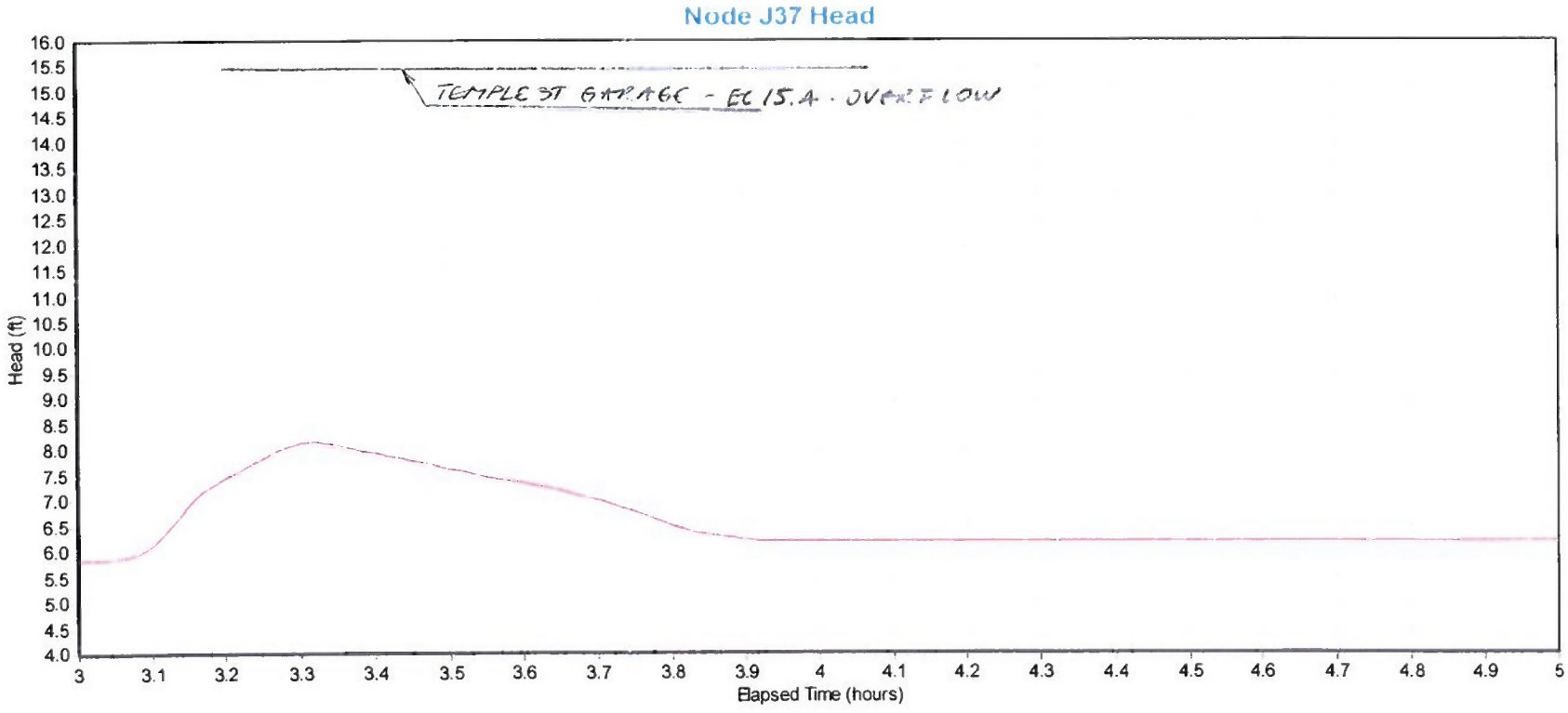
Time	Intensity
5	0.15
6*	0.14
7*	0.13
8*	0.13
9*	0.12
10	0.12
11*	0.11
12*	0.11
13*	0.10
14*	0.10
15	0.10
16*	0.09
17*	0.09
18*	0.09

1YR-15MIN
MEAN HIGH TIDE EL 3.5



B-22

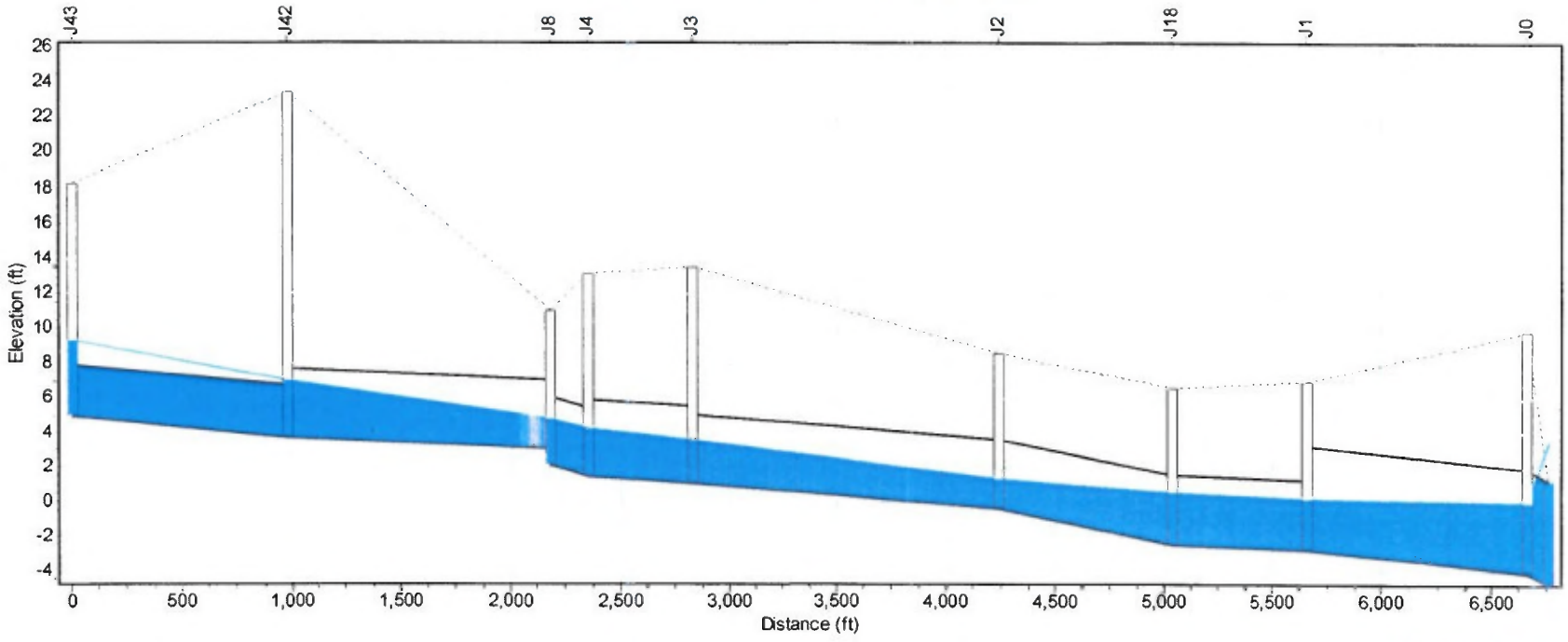
1YR - 15 MIN
MEAN HIGH TIDE EL 3.5



B-23

S. FRONTAGE RD
1YR - 15MIN
MEAN HIGH TIDE 6.5

Water Elevation Profile: Node J43 - Out1

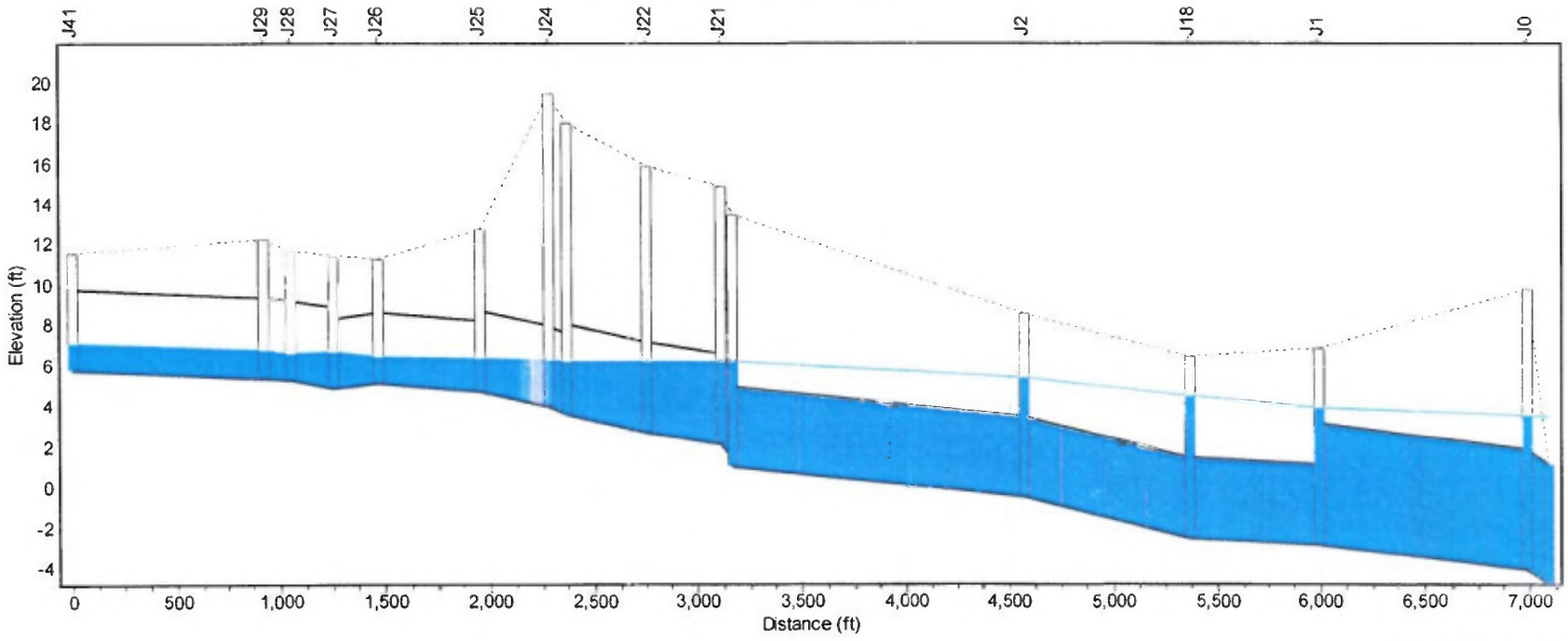


01/23/2012 03:16:00

B-24

UARG
1YR - 15MIN
MEAN HIGH TIDE EL 3.5

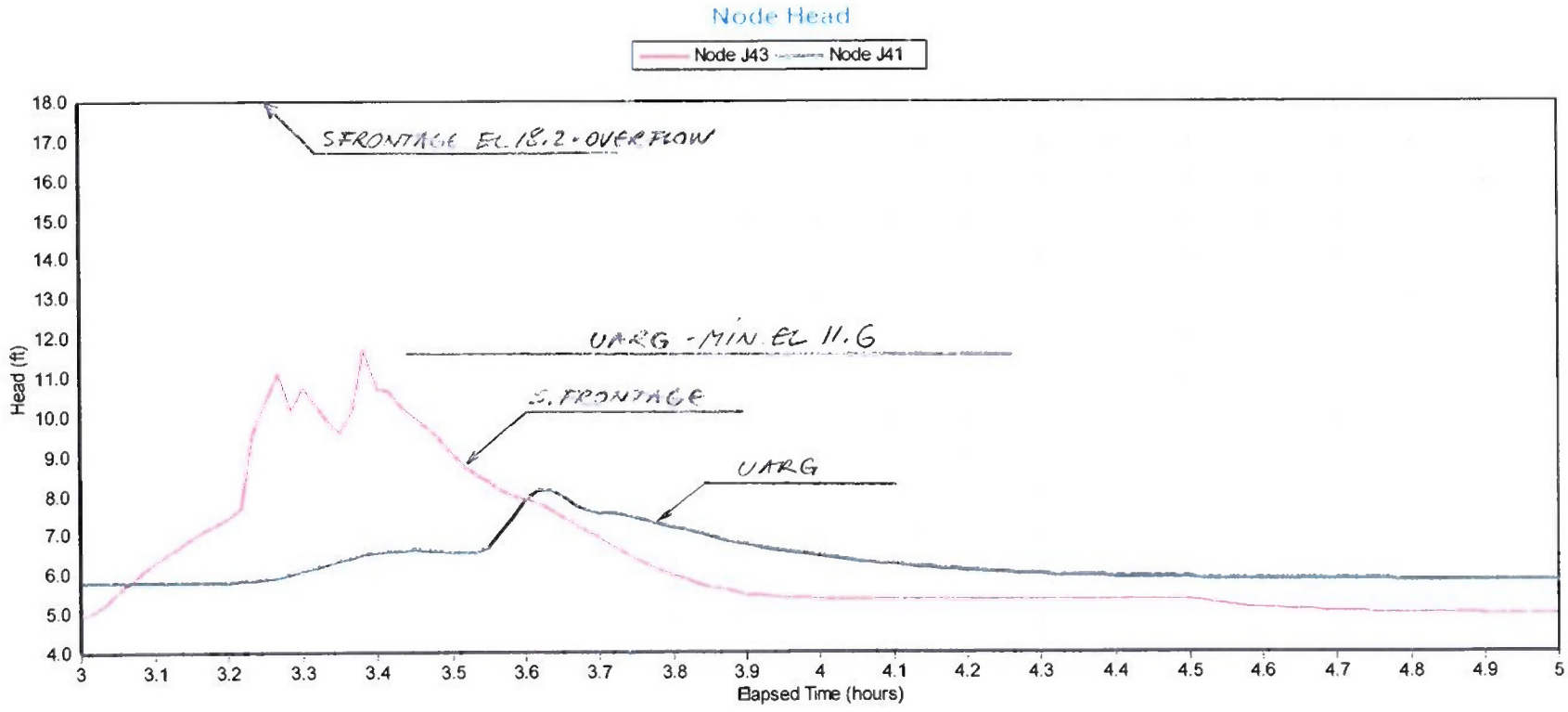
Water Elevation Profile: Node J41 - Out1



01/23/2012 03:43:00

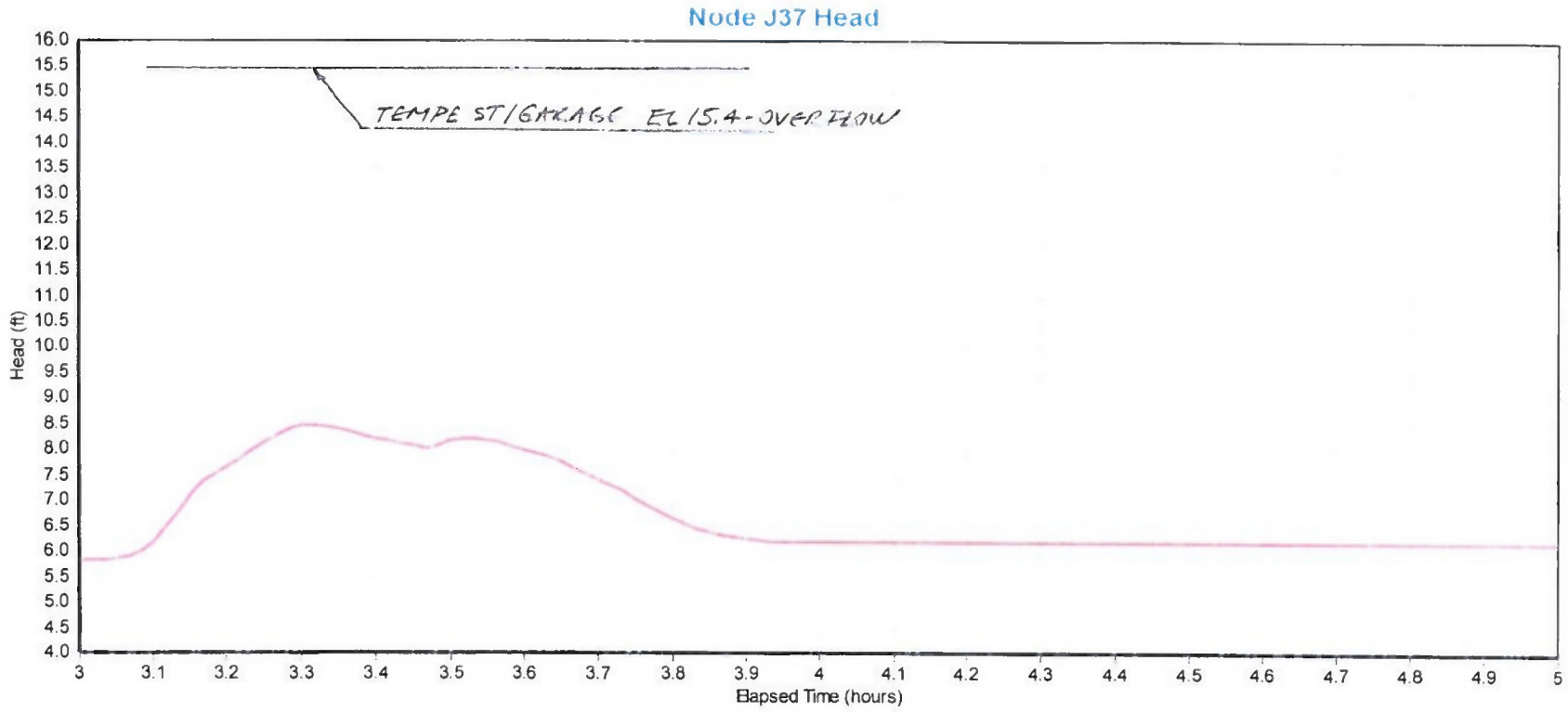
B-25

2YR - 15 MIN
MEAN HIGH TIDE EL. 3.5



2.26

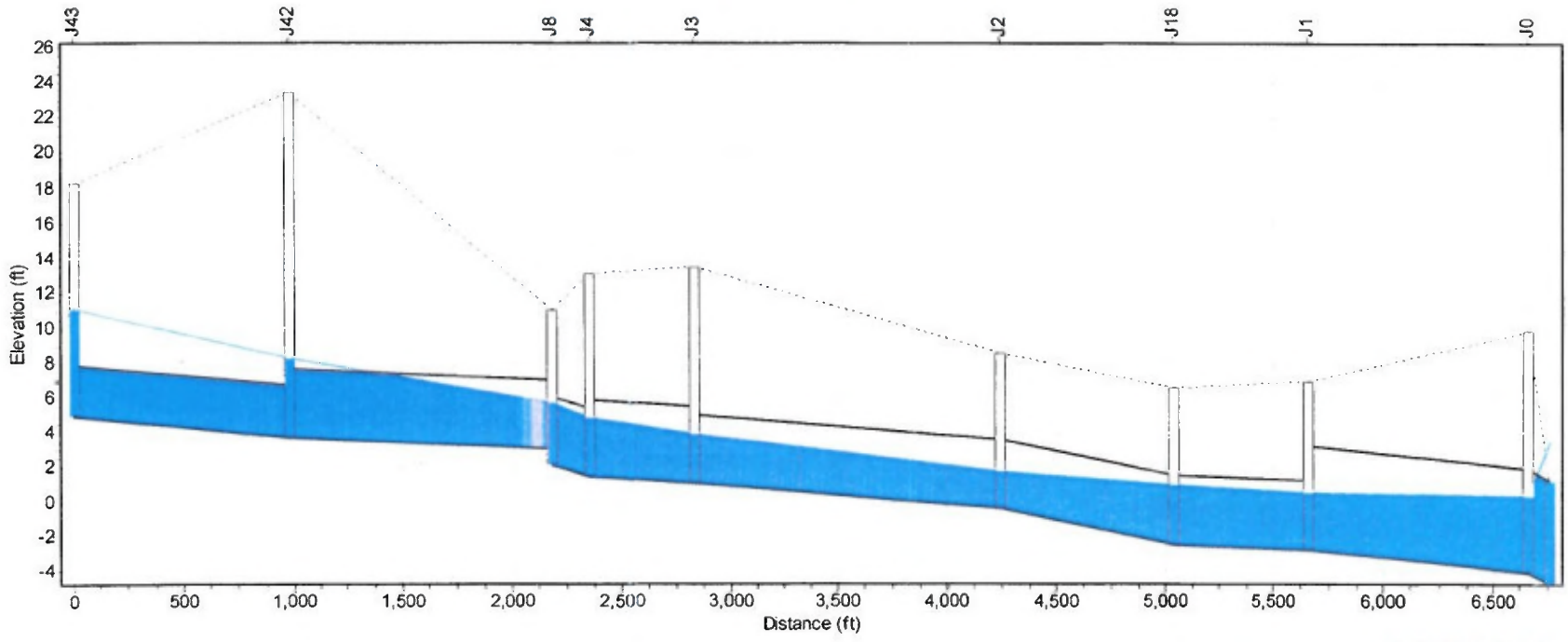
2YR - 15 MIN
MEAN HIGH TIDE EL 3.5



B-27

S. FRONTAGE RD.
2 YR - 15 MIN
MEAN HIGH TIDE EL 2.5

Water Elevation Profile: Node J43 - Out1

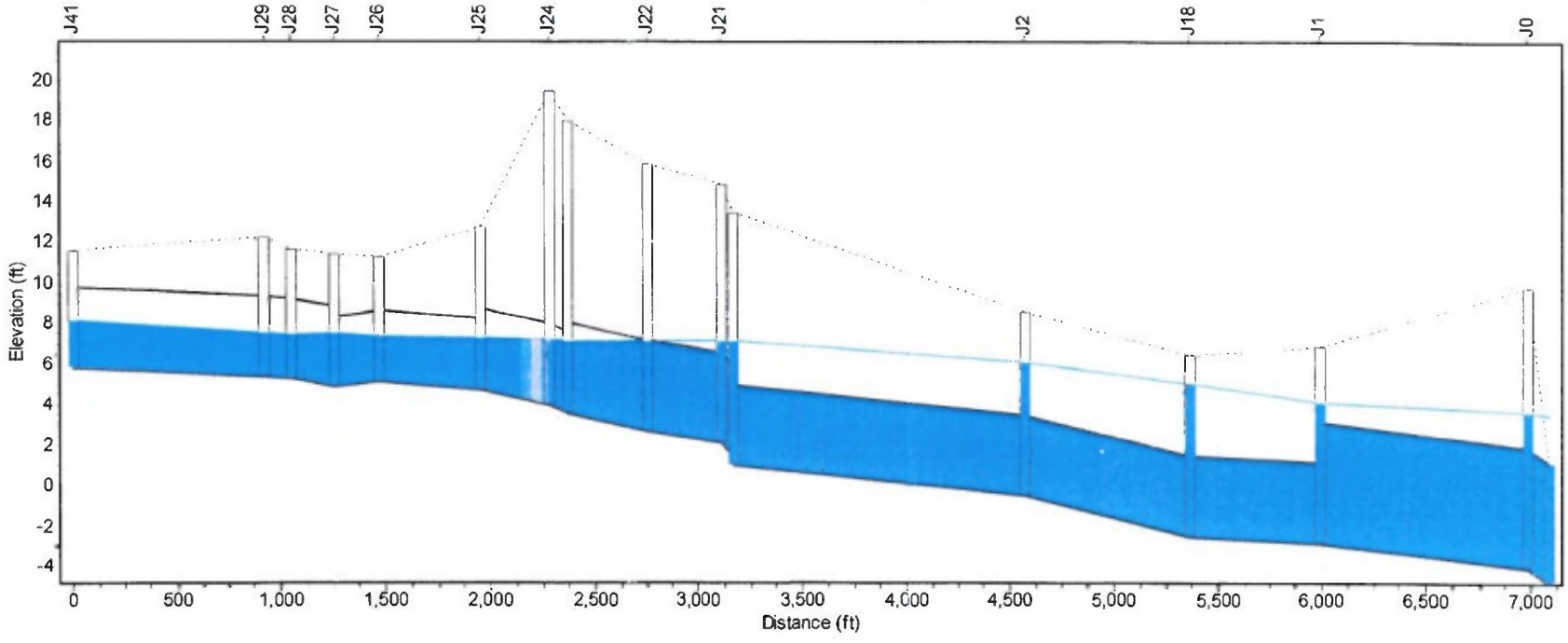


01/23/2012 03:16:00

B-28

UARG.
2YR-15MIN
MEAN HIGH TIDE EL 3.5

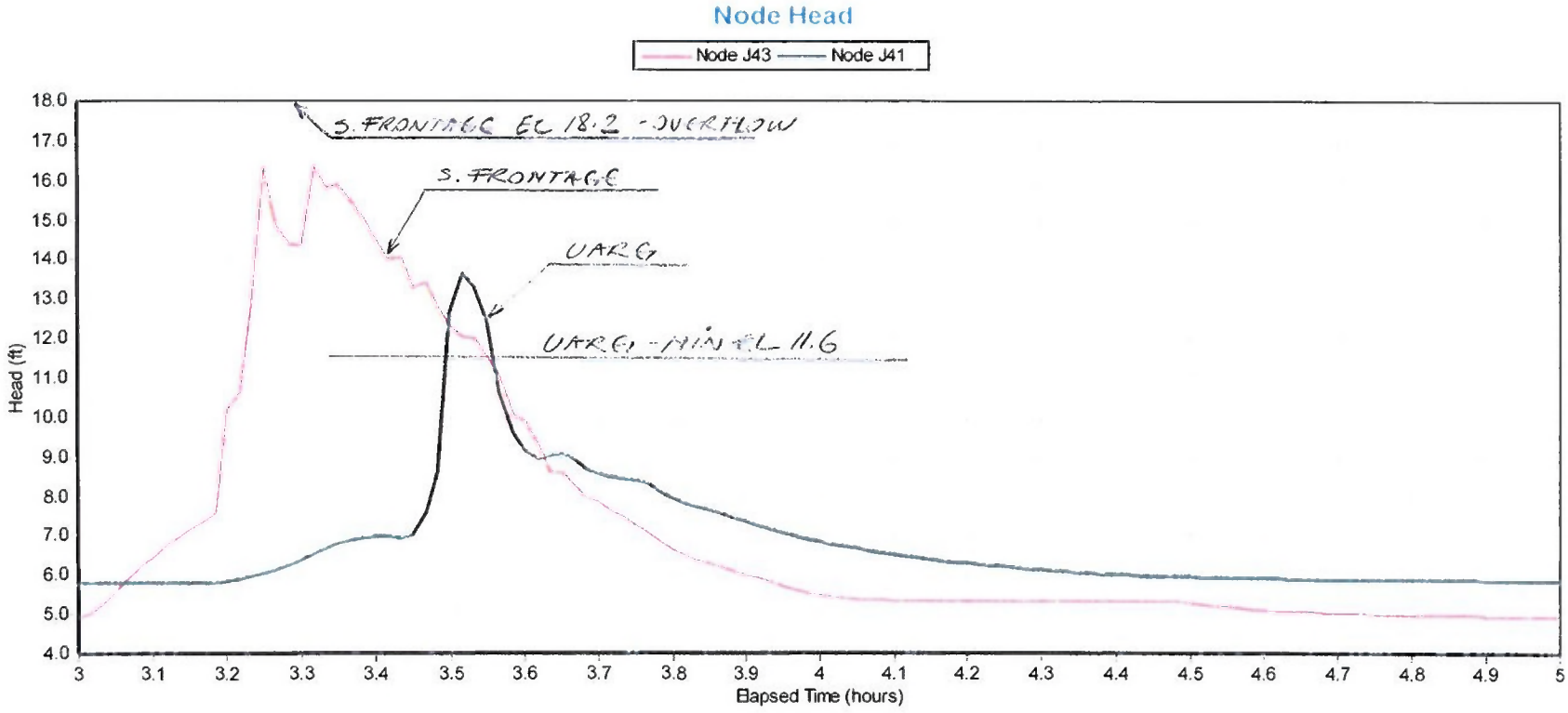
Water Elevation Profile: Node J41 - Out1



01/23/2012 03:37:00

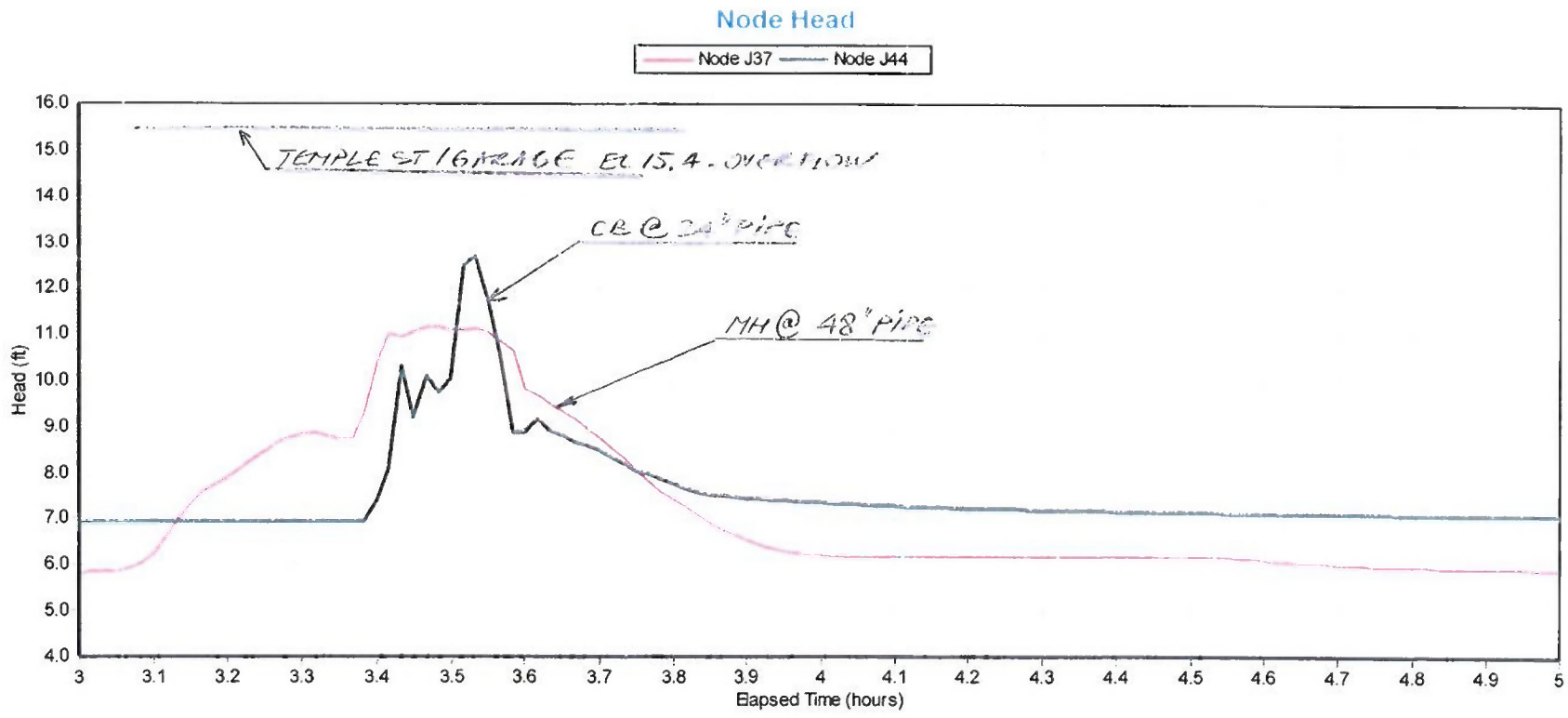
8-29

10YR - 15MIN
MEAN HIGH TIDE EL 3.5



B-30

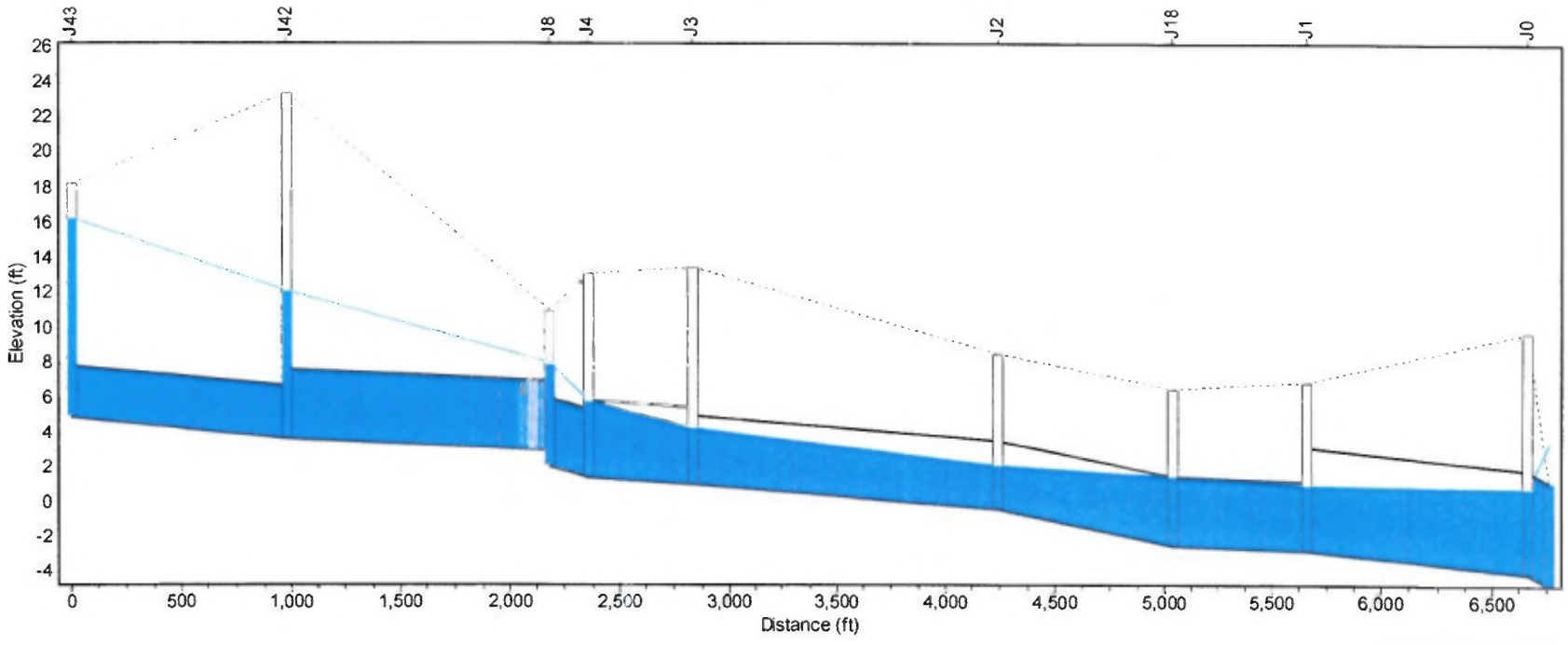
10YR - 15 MIN
MEAN HIGH TIDE EL 2.5



B-31

S. FRONTAGE RD
10YR - 15 MIN
MEAN HIGH TIDE EL 3.5

Water Elevation Profile: Node J43 - Out1

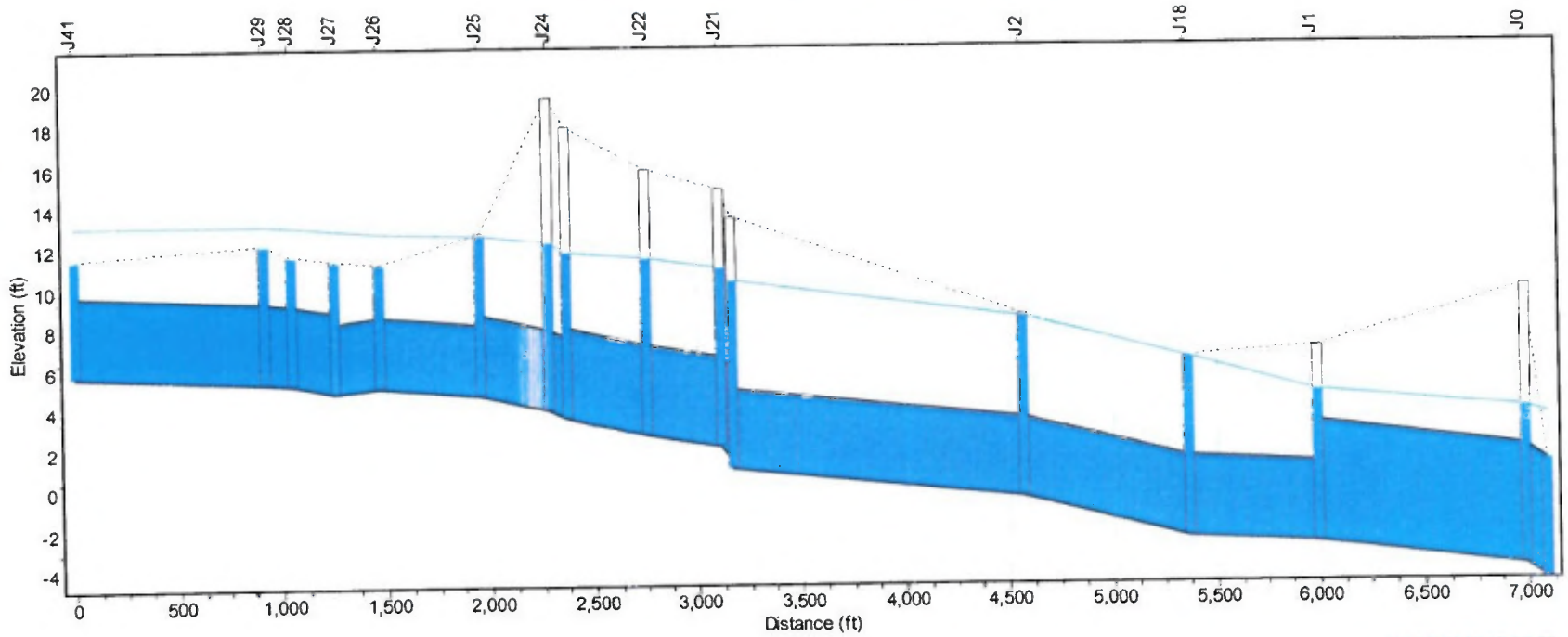


01/23/2017 03:15:00

3-32

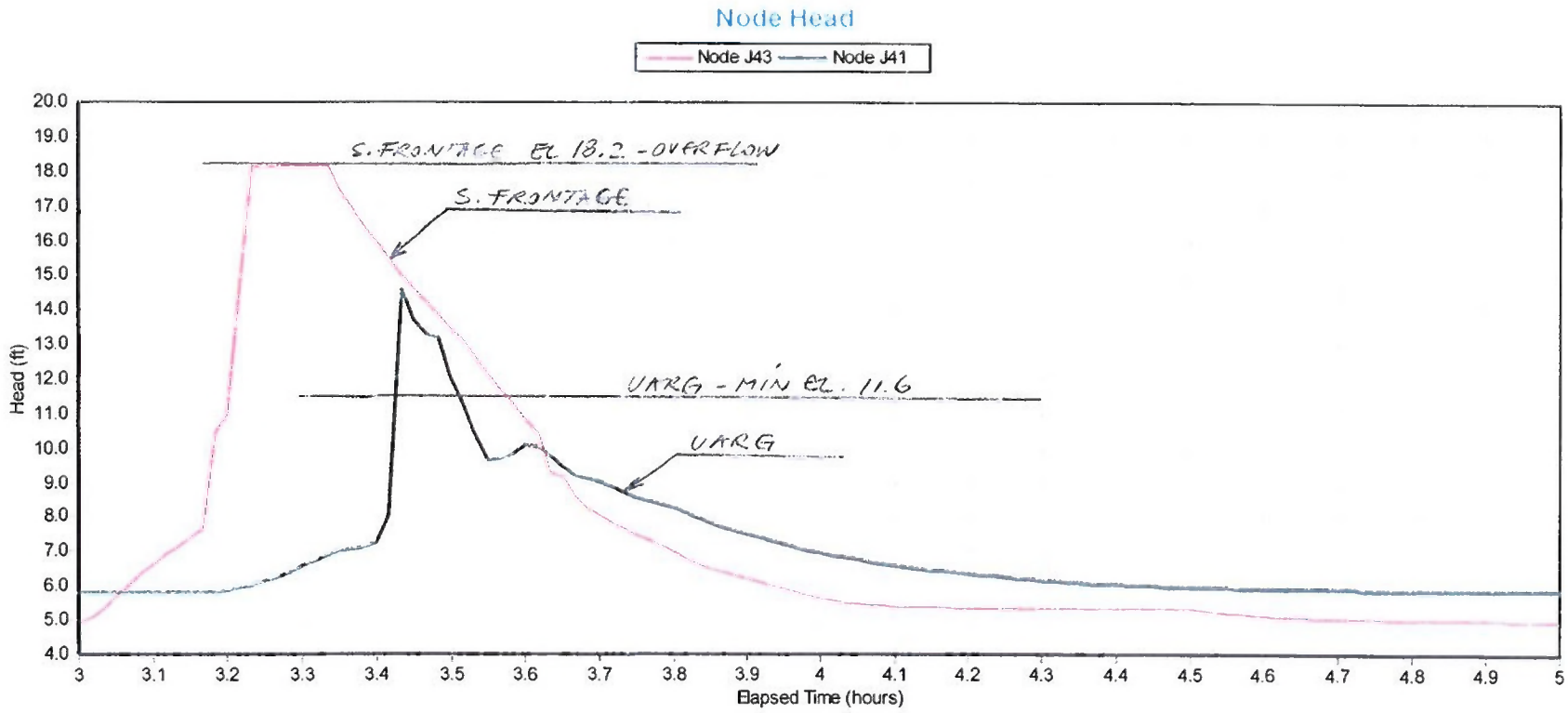
UPRG.
10YR-15MIN
MEAN HIGH TIDE @ 3.5

Water Elevation Profile: Node J41 - Out1



01/23/2012 03:32:00

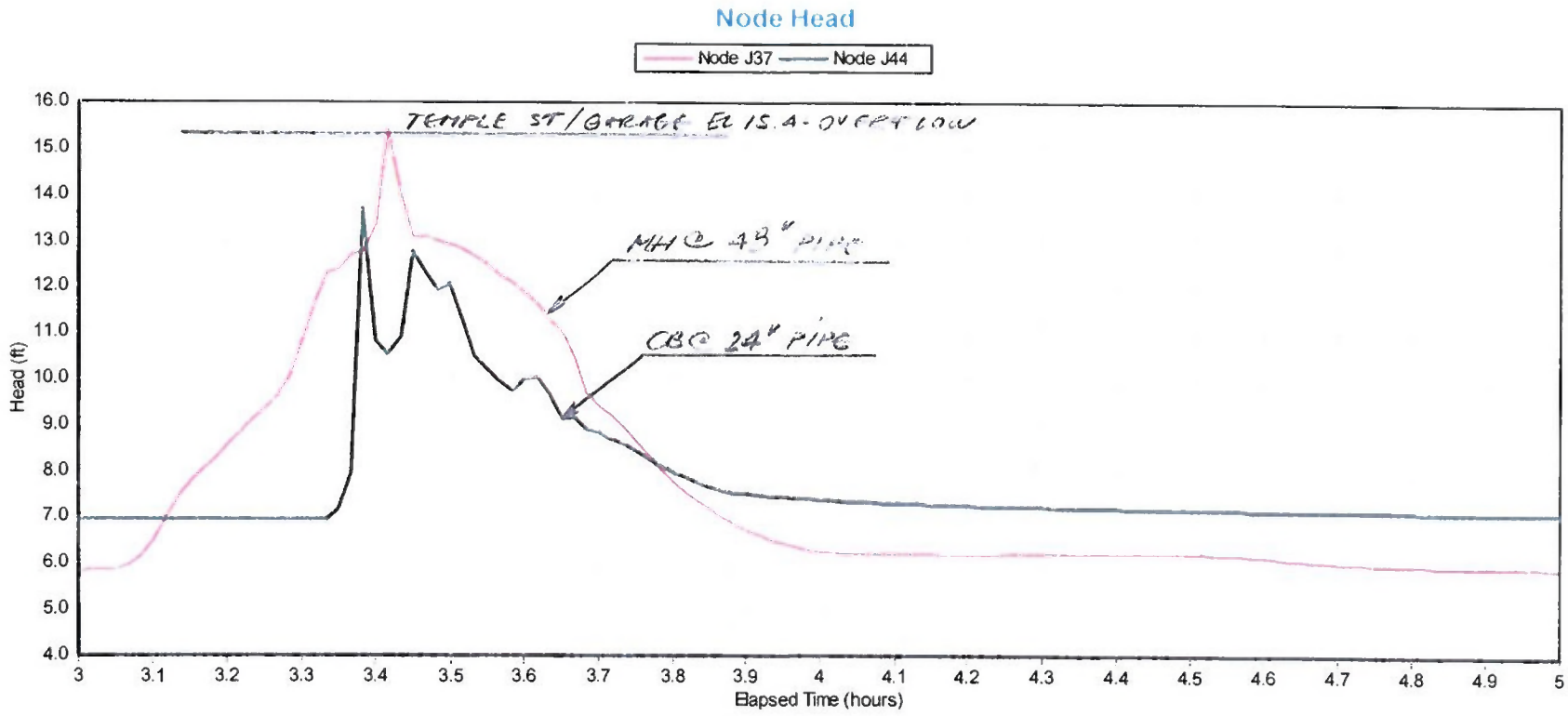
25 YR - 15 MIN
MEAN HIGH TIDE EL 3.5



B-34

25YR - 15MIN

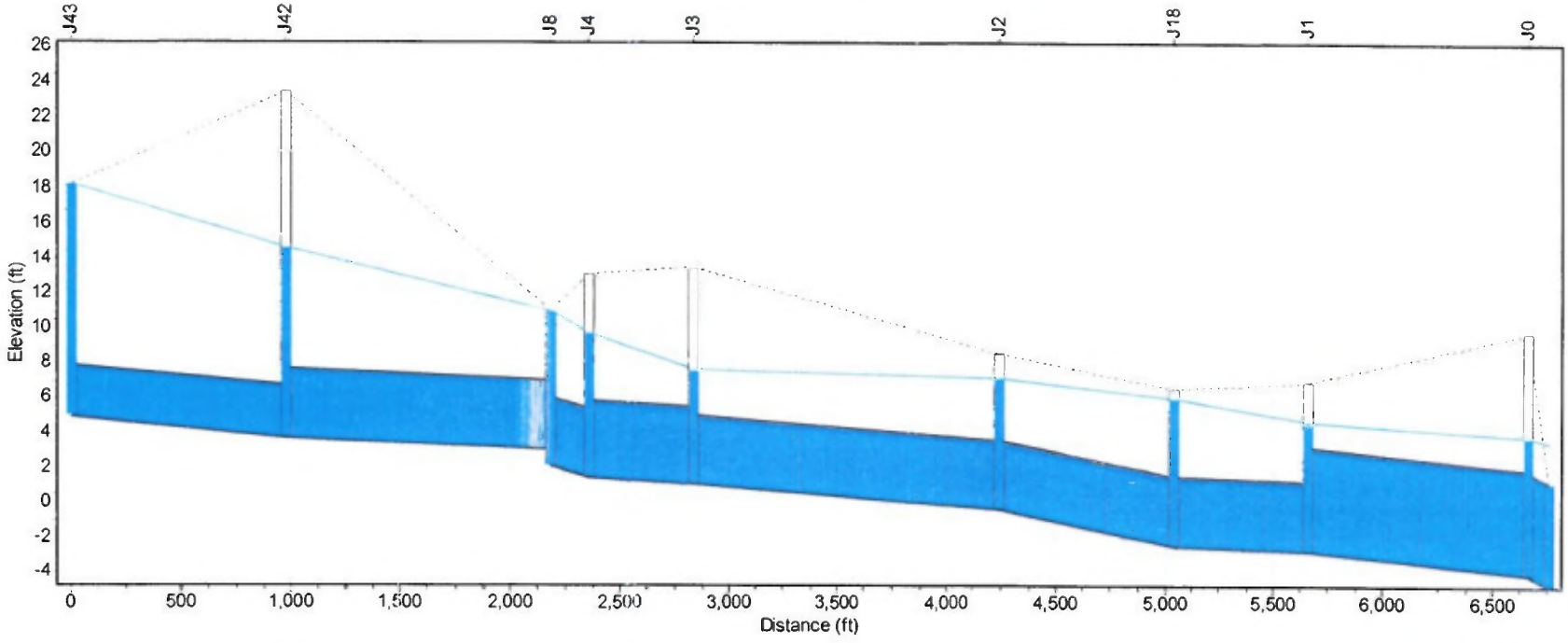
MEAN HIGH TIDE EL 3.5



5-35

S. FRONTAGE RD.
25YR-15MIN
MEAN HIGH TIDE EL. 3.5

Water Elevation Profile: Node J43 - Out1

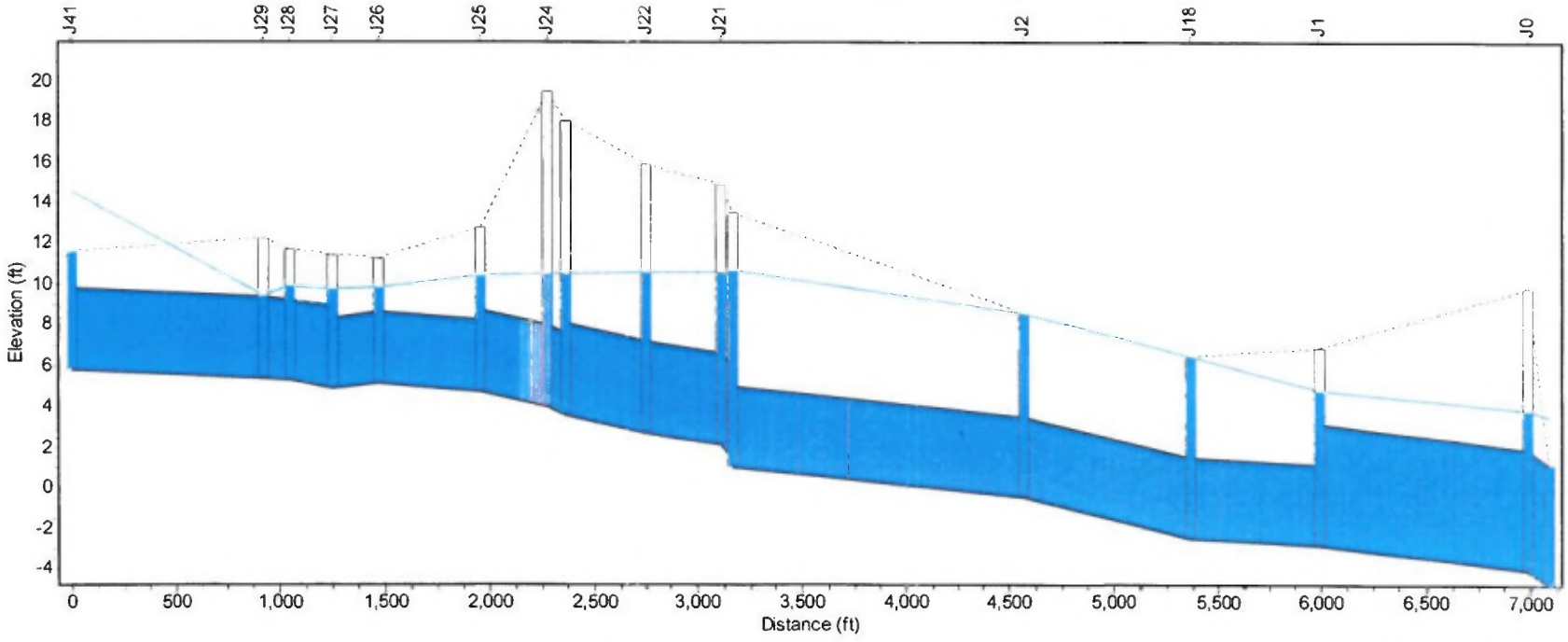


01/23/2012 03:18:00

B-26

UARG
25YR-15MIN
MEAN HIGH TIDE EL 2.5

Water Elevation Profile: Node J41 - Out1



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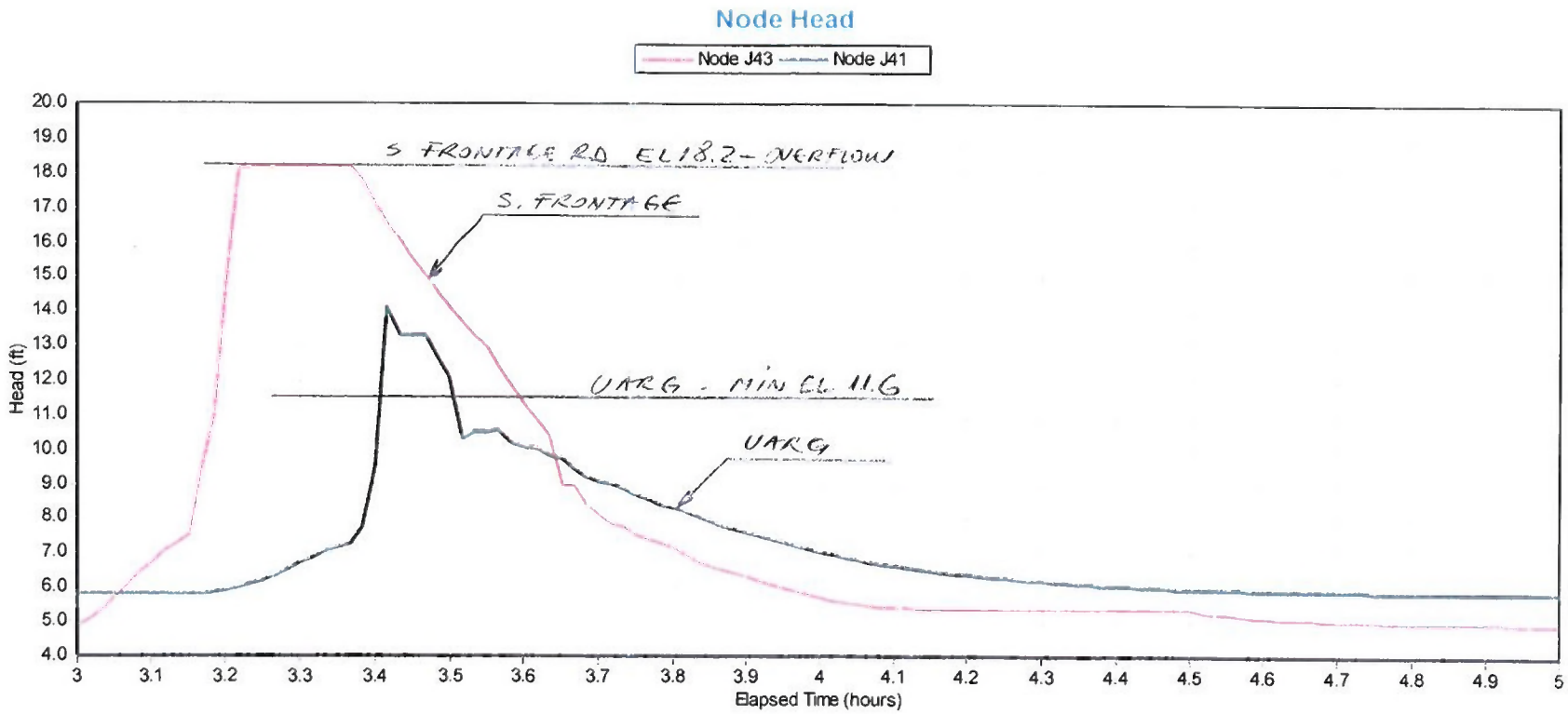
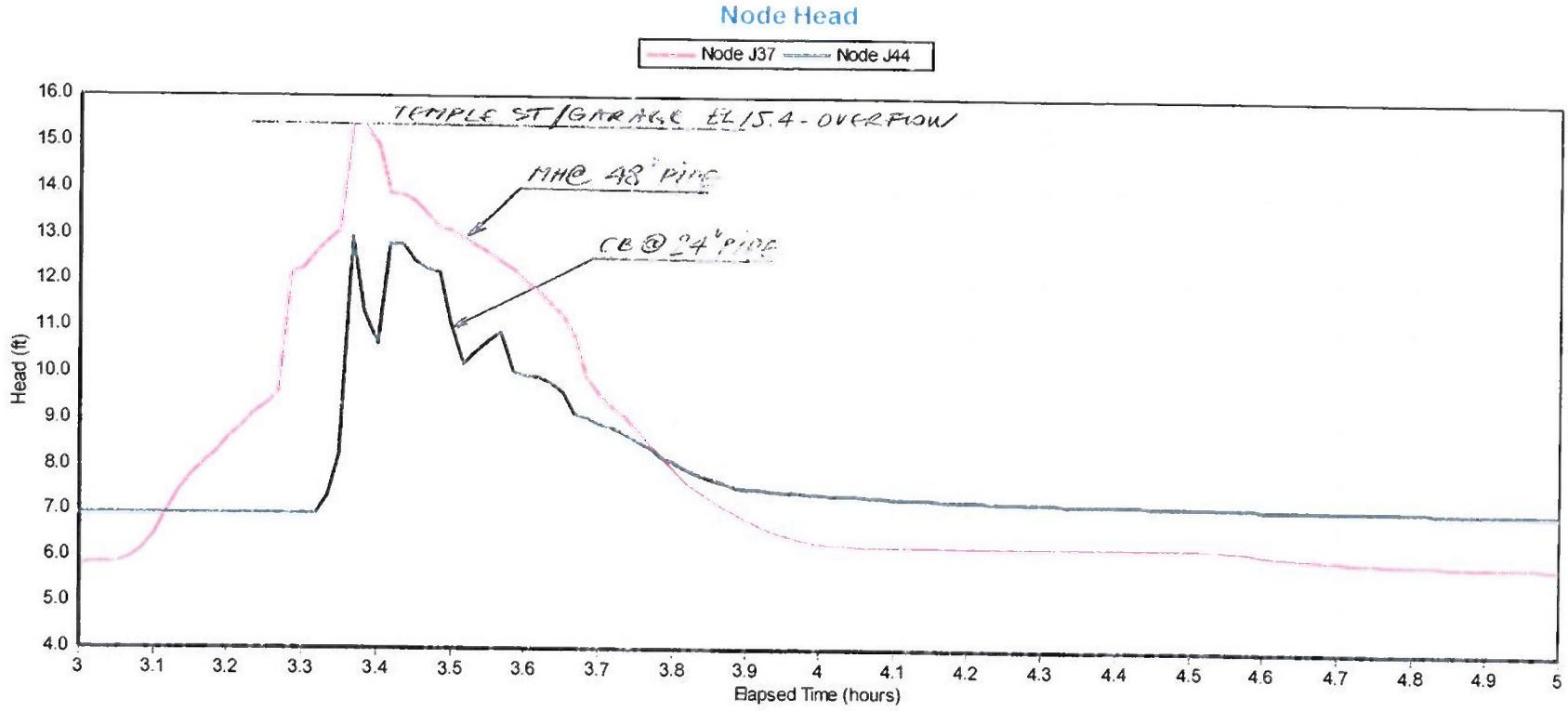
2.37

50YR - 15 MIN
MEAN HIGH TIDE EL 3.5



B-33

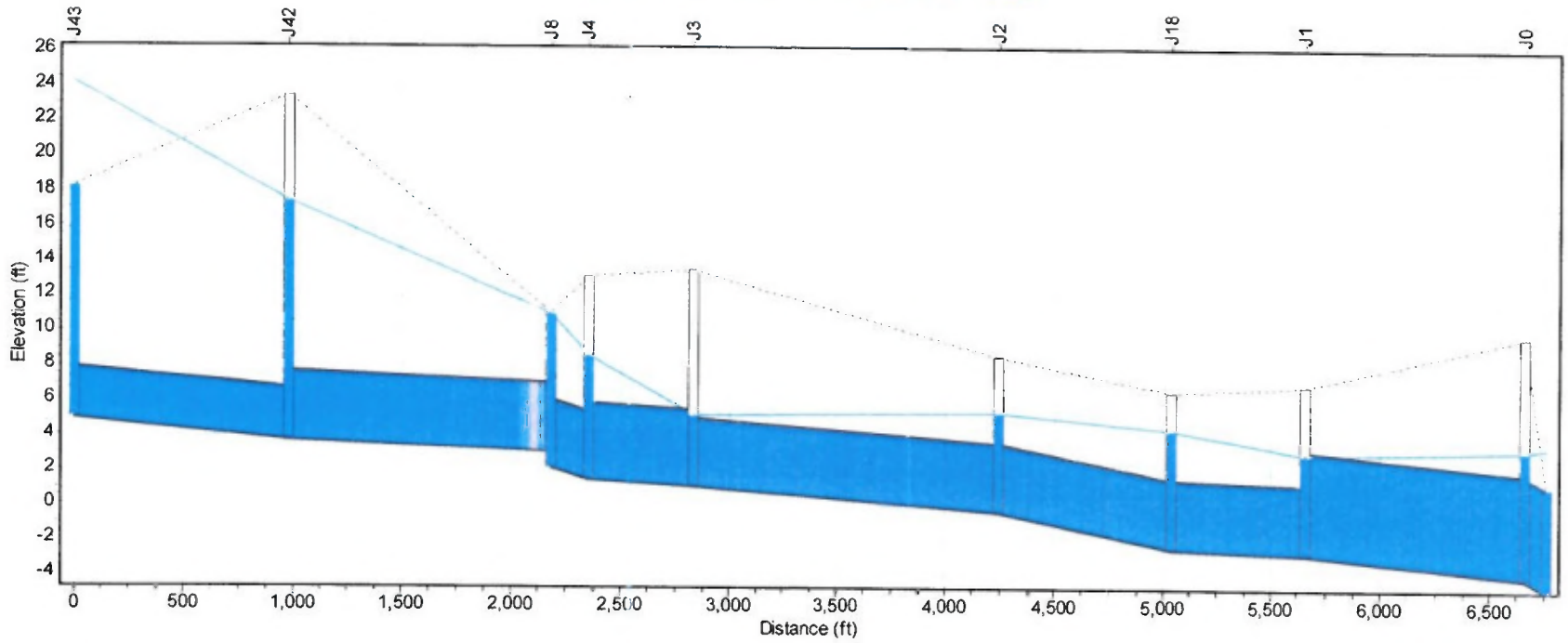
50YR - 15MIN
MEAN HIGH TIDE EL 3.5



A-39

S. FRONTAGE RD.
50YR - 15 MIN
MEAN HIGH TIDE EL 3.5

Water Elevation Profile: Node J43 - Out1

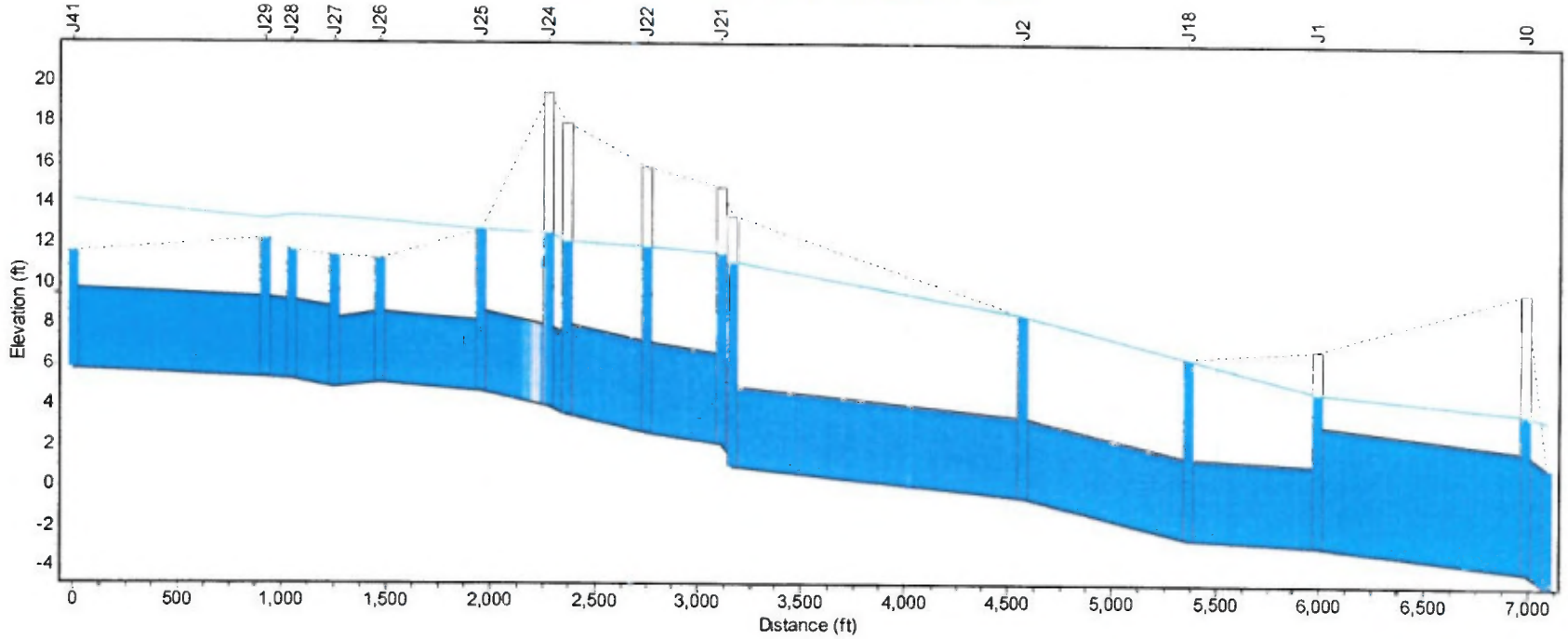


01/23/2012 03:15:00

G-40

UARG
50YR - 15MIN
MEAN HIGH TIDE EL 3.5

Water Elevation Profile: Node J41 - Out1



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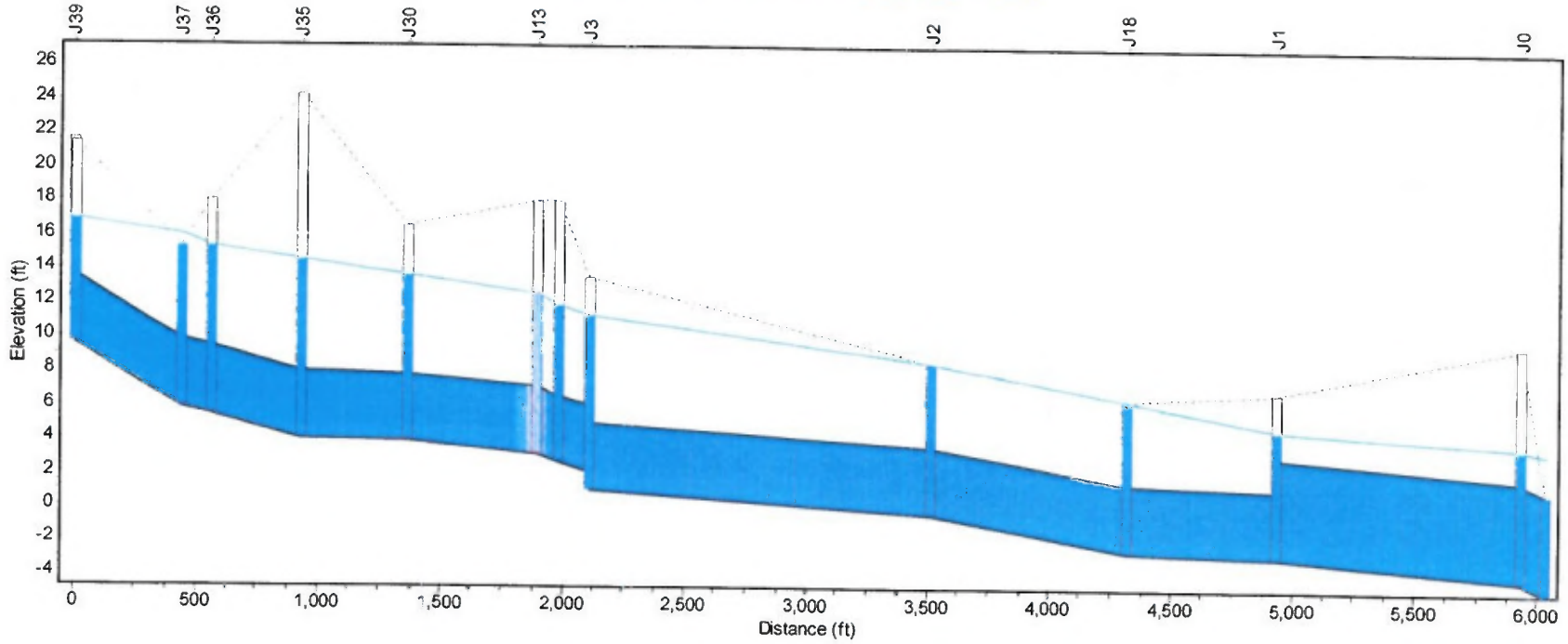
E-41

TEMPLE ST / GARAGE
50YR - 15 MIN
MEAN HIGH TIDE EL 2.5

Water Elevation Profile: Node J39 - Out1



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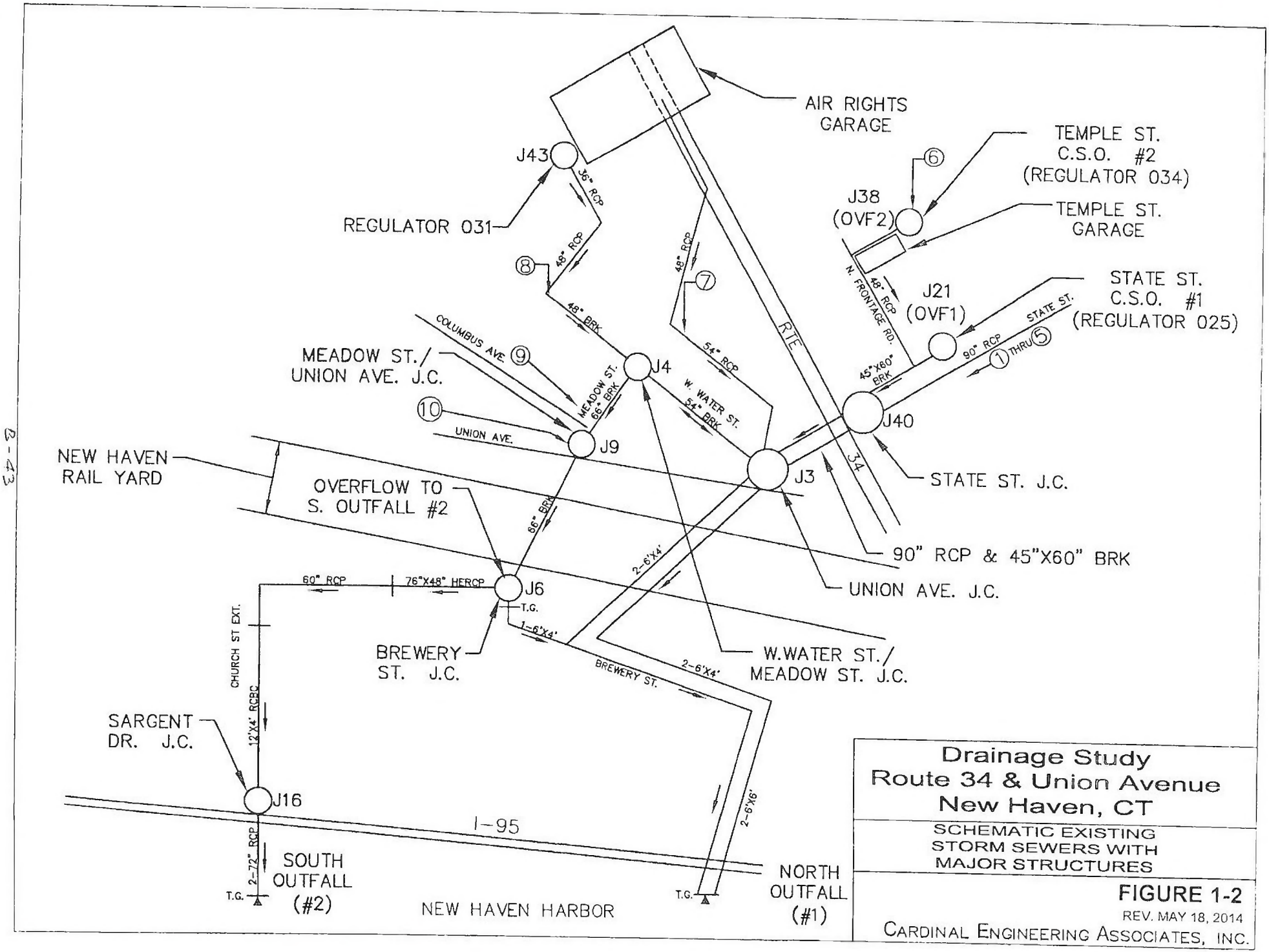
B-42



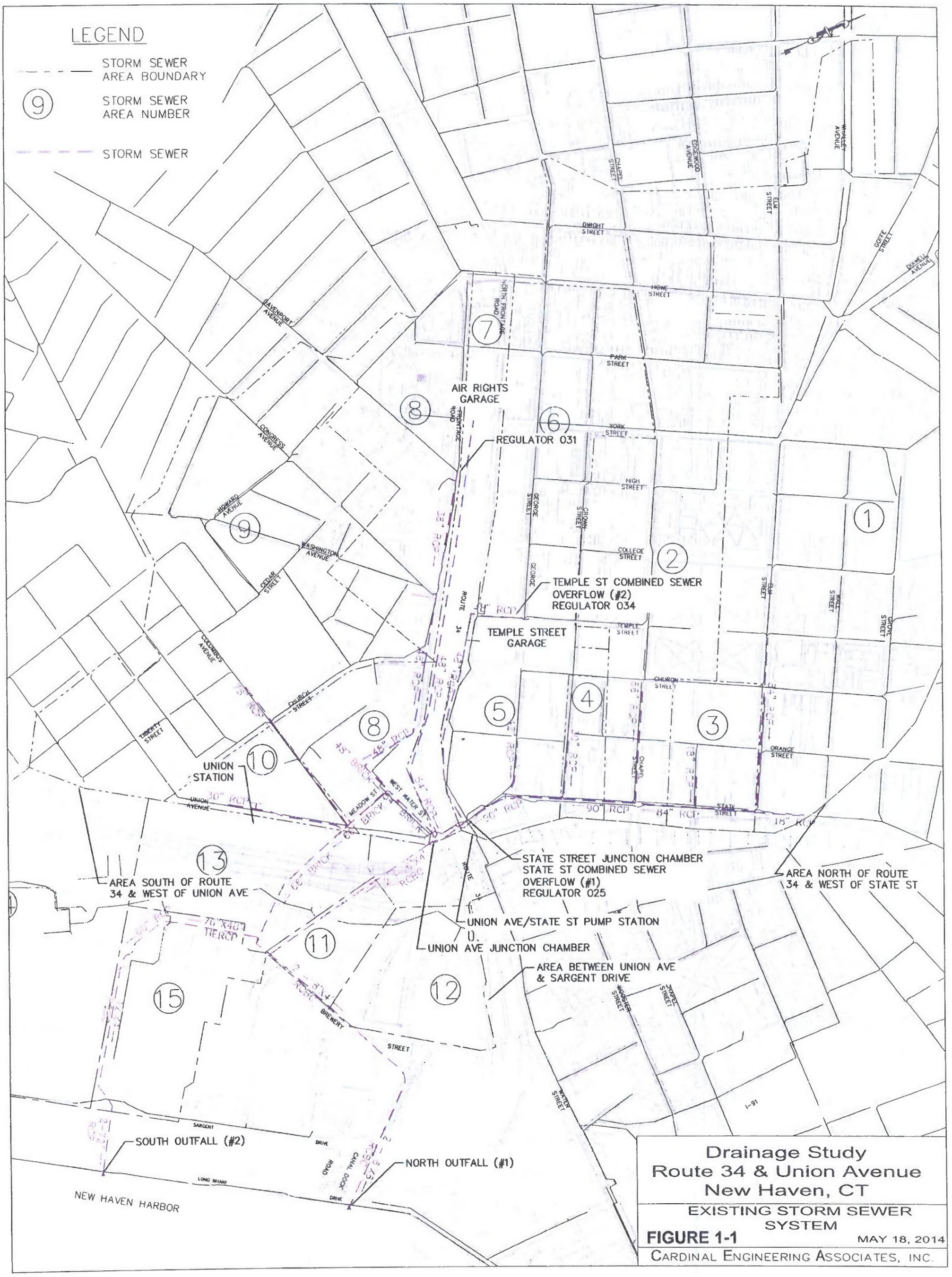
Drainage Study
Route 34 & Union Avenue
New Haven, CT

SCHEMATIC EXISTING STORM SEWERS WITH MAJOR STRUCTURES

FIGURE 1-2

REV. MAY 18, 2014

CARDINAL ENGINEERING ASSOCIATES, INC.


LEGEND
STORM SEWER AREA BOUNDARY
STORM SEWER AREA NUMBER
STORM SEWER
AIR RIGHTS GARAGE
REGULATOR 031
TEMPLE ST COMBINED SEWER OVERFLOW (#2) REGULATOR 034
TEMPLE STREET GARAGE
UNION STATION
AREA SOUTH OF ROUTE 34 & WEST OF UNION AVE
STATE STREET JUNCTION CHAMBER
STATE ST COMBINED SEWER OVERFLOW (#1) REGULATOR 025
AREA NORTH OF ROUTE 34 & WEST OF STATE ST
UNION AVE/STATE ST PUMP STATION
UNION AVE JUNCTION CHAMBER
AREA BETWEEN UNION AVE & SARGENT DRIVE
SOUTH OUTFALL (#2)
NORTH OUTFALL (#1)
NEW HAVEN HARBOR
DAVENPORT AVENUE
CONGRESS AVENUE
HOWARD AVENUE
WASHINGTON AVENUE
CEDAR STREET
COLUMBUS AVENUE
CHURCH STREET
UNION AVENUE
NORTH FRONTAGE ROAD
FRONTAGE ROAD
ROUTE 34
DWIGHT STREET
HOWE STREET
PARK STREET
YORK STREET
HIGH STREET
COLLEGE STREET
TEMPLE STREET
CHURCH STREET
ORANGE STREET
STATE STREET
CHAPEL STREET
GEORGE STREET
CROWN STREET
ELM STREET
EDGEWOOD AVENUE
WHALLEY AVENUE
GOFFE STREET
DIXWELL AVENUE
GROVE STREET
WALL STREET
MEADOW ST
WEST WATER ST
BREWERY STREET
SARGENT DRIVE
CANAL DOCK ROAD
LONG WHARF DRIVE
WATER STREET
WOOSTER STREET
TRUMBULL STREET
I-91
Drainage Study
Route 34 & Union Avenue
New Haven, CT
EXISTING STORM SEWER SYSTEM
FIGURE 1-1
MAY 18, 2014
CARDINAL ENGINEERING ASSOCIATES, INC.

SWMM ANALYSIS – 60MIN RAINFALL

TABLE 4

NEW HAVEN STORM SEWER

DRAINAGE AREAS AND FLOWS TO THE EXISTING 2 - 6' x 6' TRUNKLINE (NORTH OUTFALL - #1) AND 2 -72" RCP (SOUTH OUTFALL - #2)
1-YR, 2-YR, 10-YR, 100-YR - 60MIN RAINFALL

AREA	DESCRIPTION	DRAINAGE AREA	ROOF AREA	T	EXISTING CONDITIONS*			
					1-YEAR FLOW	2-YEAR FLOW	10-YEAR FLOW	100-YEAR FLOW
(No.)		(Ac)	(Ac)	(min)	(cfs)	(cfs)	(cfs)	(cfs)
	AREA NORTH OF ROUTE 34 AND WEST OF STATE STREET							
1	ELM STREET TRUNKLINE	180	46.7	60	176	200	293	440
2	CHAPEL STREET TRUNKLINE	97	32	60	95	109	158	234
3	COURT STREET STORM SEWER	48.8	21	60	47	56	80	113
4	CROWN STREET STORM SEWER							
5	CHURCH - GEORGE ST STORM SEWER							
6	GEORGE - TEMPLE - N. FRONTAGE TRUNKLINE	52.5	22.2	60	49	56	81	
7	ROUTE 34 TRUNKLINE	16	3	60	28	32	47	
	AREA SOUTH OF ROUTE 34 AND WEST OF UNION AVENUE							
8.1	PARK STREET	5.8	0.9	60	10.8	13.5	16.2	27
8.2	YORK STREET	10.7	3.2	60	16.6	20.8	24.9	41.5
8.3	CONGRESS AVENUE	18	7.8	60	25.7	32.1	38.6	64.3
8.4	WEST WATER STREET	22.5	4.2	60	25.4	29.4	36.7	73.5
9	COLUMBUS AVENUE 78" TRUNKLINE	102	29	60	88	104	145	
10	UNION AVENUE STORM SEWER	11.6	1.9	60	12	15	21	35
	AREA BETWEEN UNION AVENUE AND SARGENT DRIVE							
11	24" STORM SEWER TO 2-6'x4' RCBC	9.4	-	60	19	24	32	43
12	POST OFFICE AREA TO 2-6'x4' RCBC	20.5	-	60	37	46	66	102
13	AREA EAST OF UNION AVE TO 60" BRICK TRUNKLINE	38.6	-	60	47	56	81	115
14	AREA TO 43"x 68" PIPE**	85	-	60	106	127	178	254
15	AREA TO 12'x4' RCBC**	18.7	-	60	37	42	60	97

* Existing Conditions assume that 50% of roof area runoff flows into storm sewer
** Areas Tributary to South Outfall

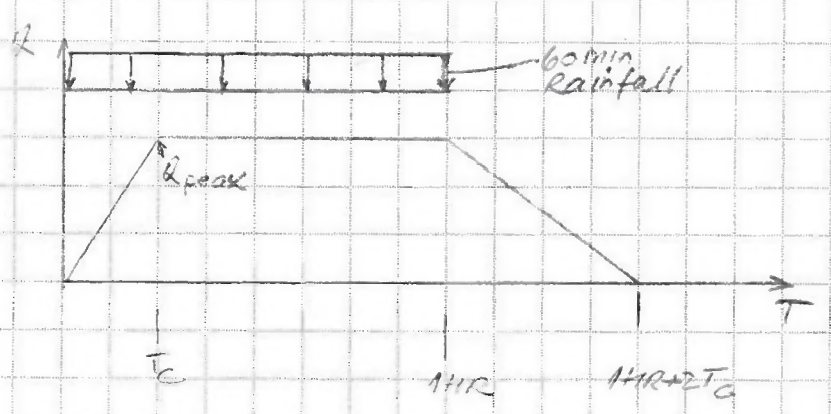
B-45

CARDINAL
ENGINEERING ASSOC., INC.
3 Colony Street
MERIDEN, CONNECTICUT 06451
(203) 238-1969 FAX (203) 630-2056

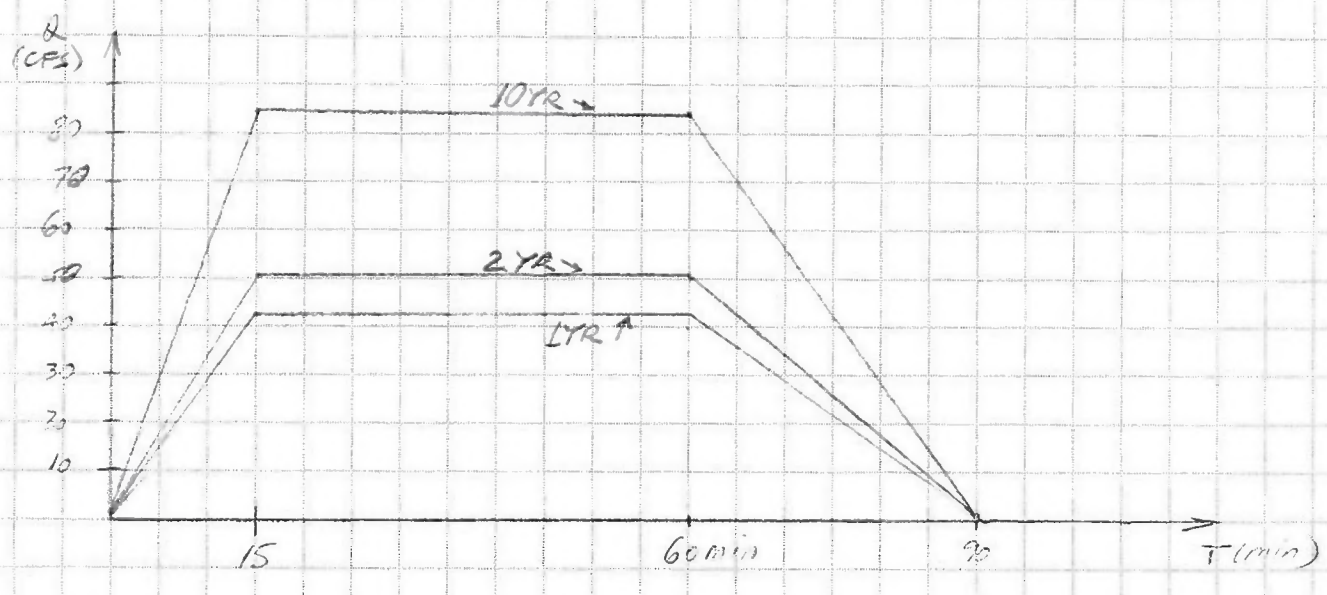
JOB SFRONTAGE RD DRAINAGE EPA 308
SHEET NO. _____ OF B-46
CALCULATED BY VZ DATE 4/3/14
CHECKED BY DPA DATE 5/8/14
SCALE _____

60 MIN DURATION RAINFALL

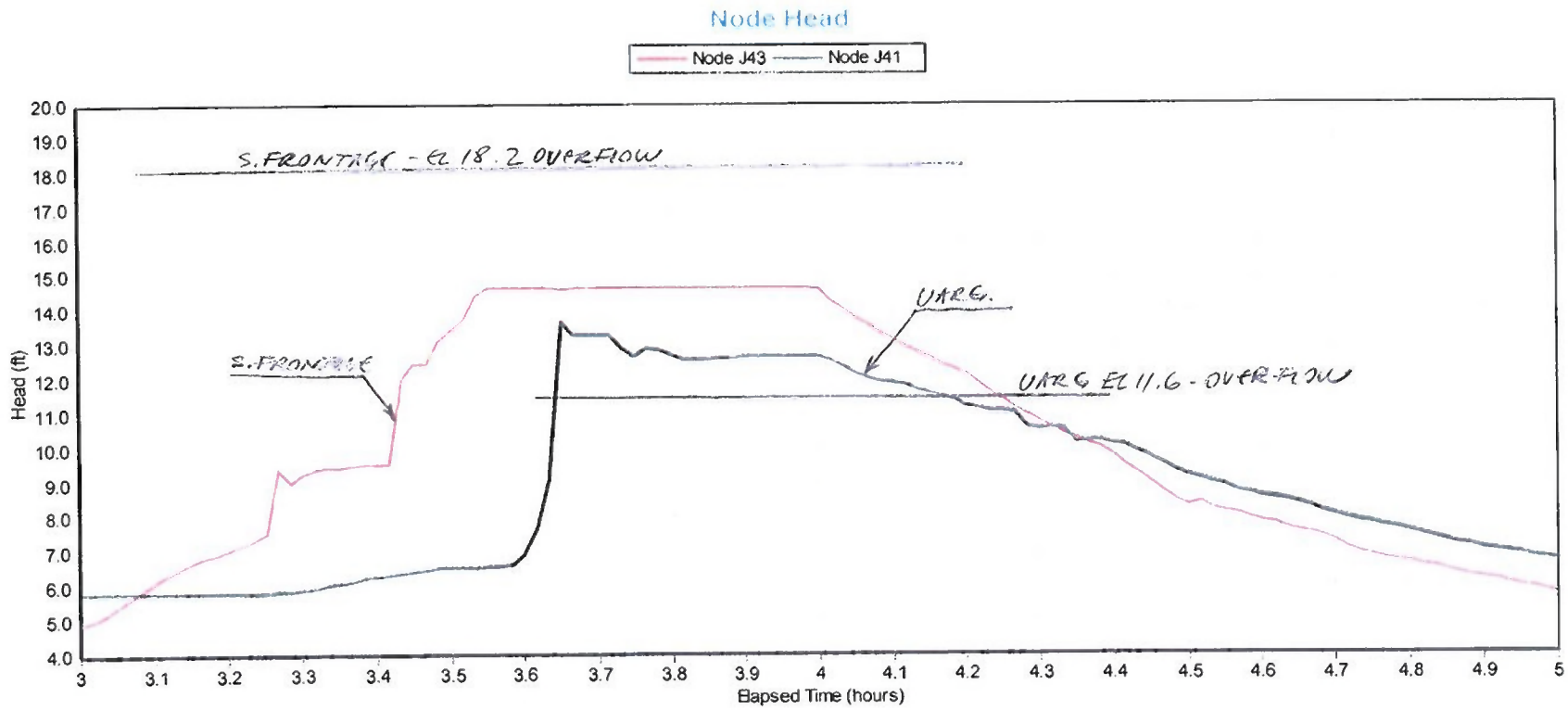
USE RATIONAL METHOD - EXTEND PEAK FLOW FROM T_C TO 60 min :



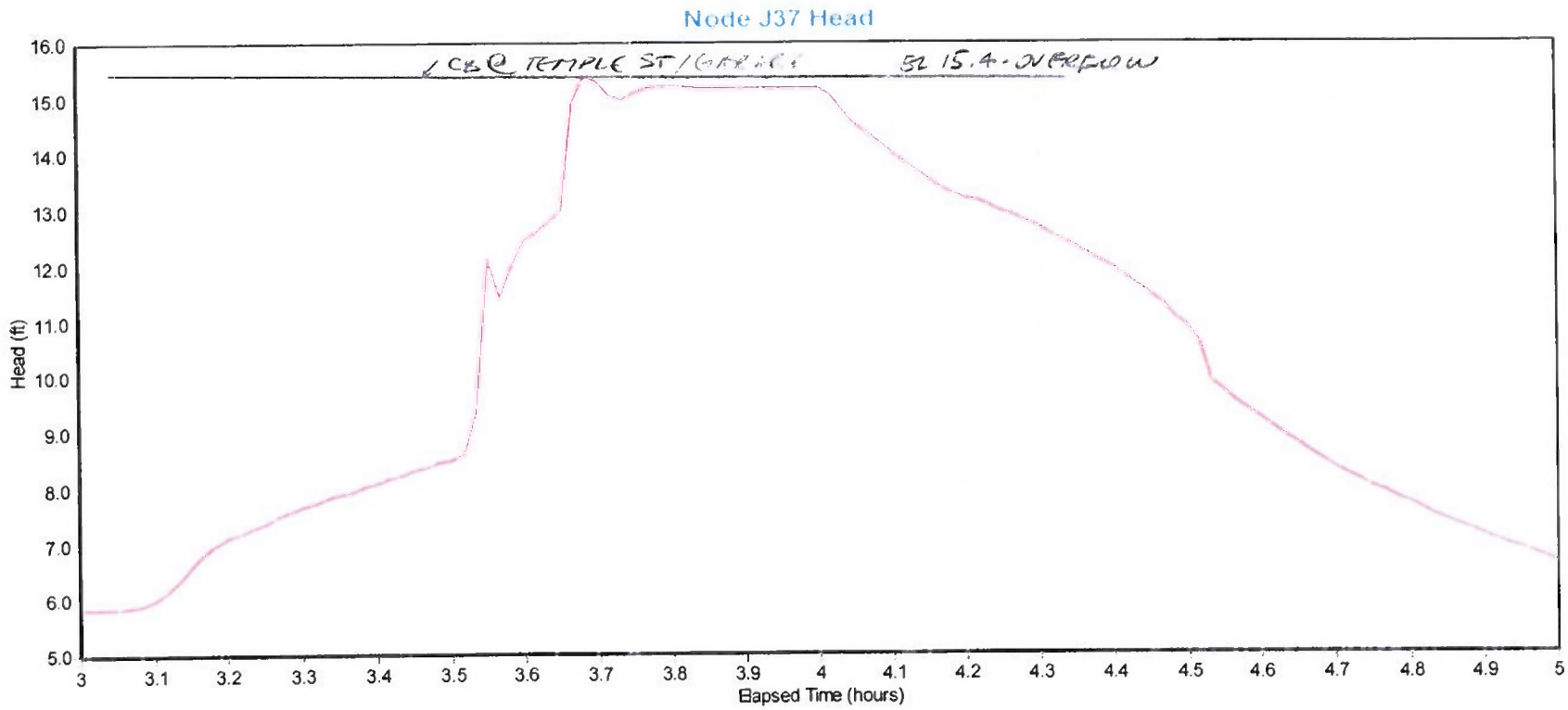
D.A TO TEMPLE ST / GEORGE ST :



1YR - 60 MIN
MEAN HIGH TIDE EL 3.5



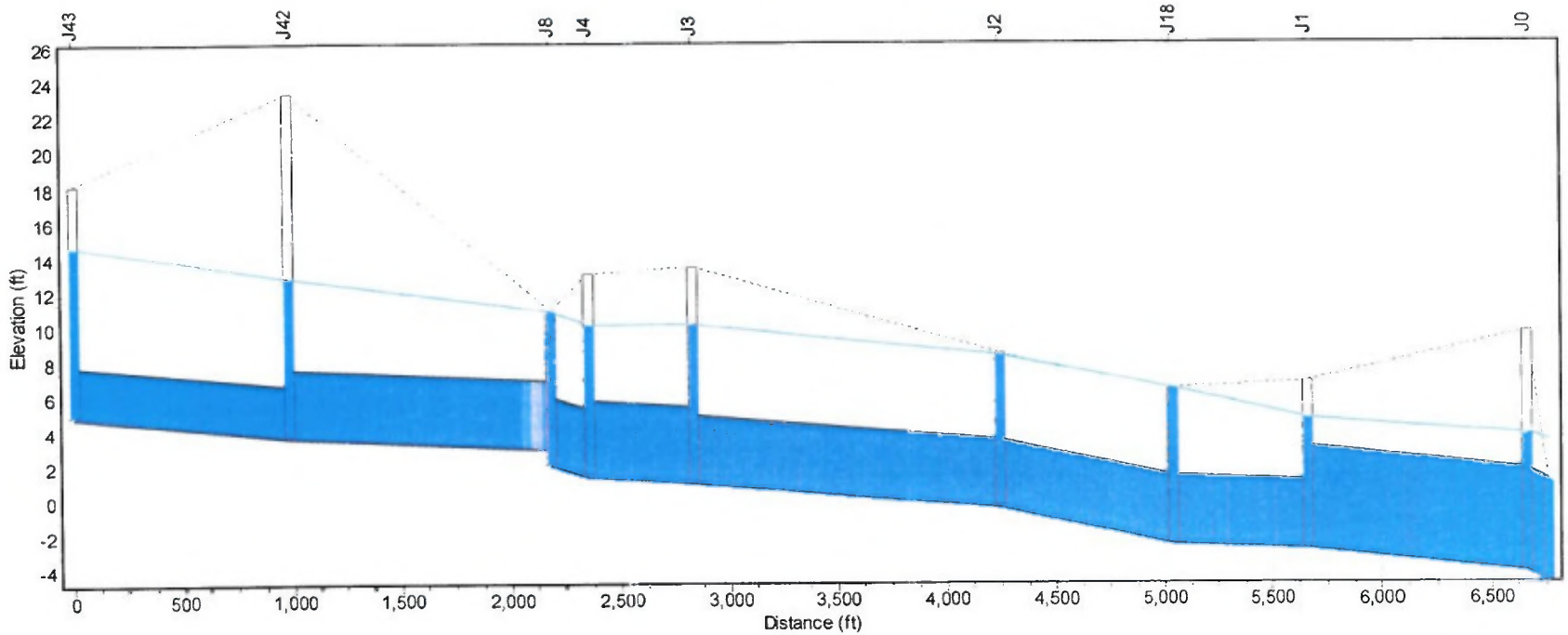
1YR - 60MIN
MEAN HIGH TIDE EL. 3.5



B-43

S. FRONTAGE RD.
1YR - 60 MIN
MEAN HIGH TIDE EL. 3.5

Water Elevation Profile: Node J43 - Out1

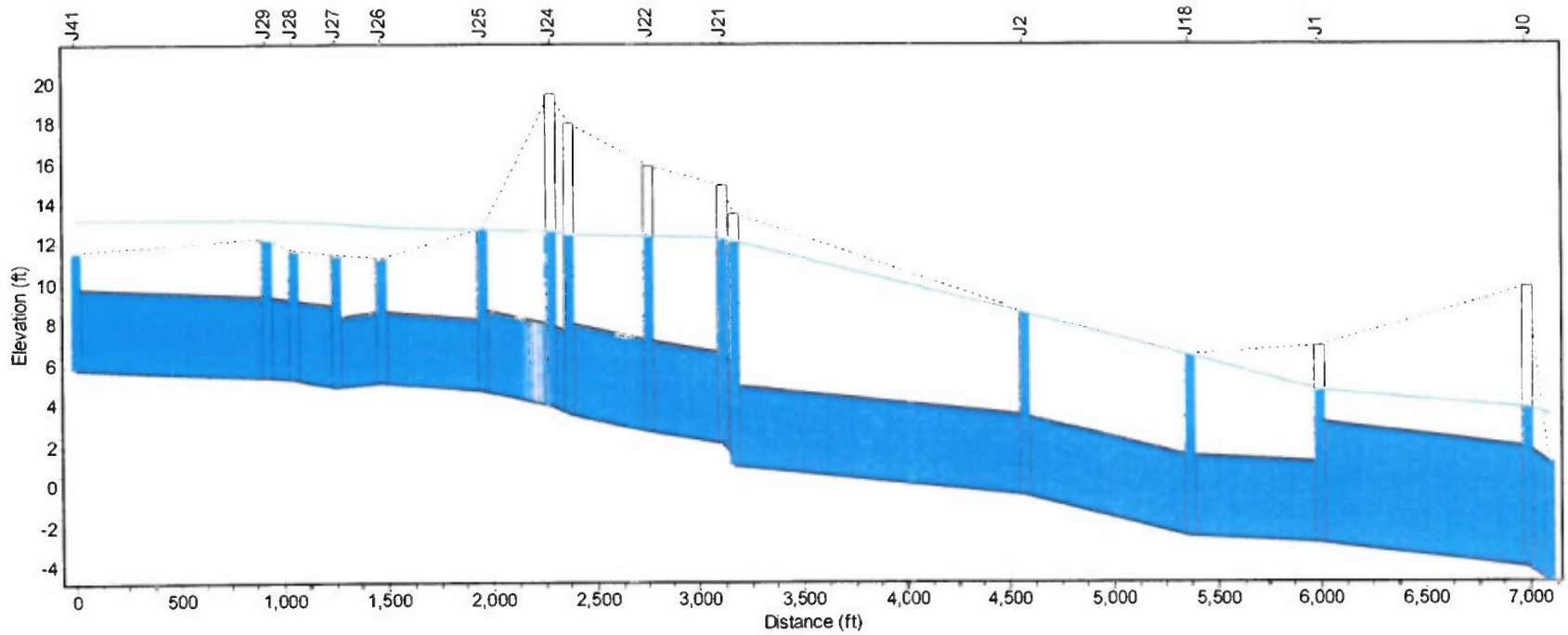


01/23/2012 03:34:00

B-49

ROUTE 34 / UPRG
1YR - 60MIN
MEAN HIGH TIDE EL. 3.5

Water Elevation Profile: Node J41 - Out1

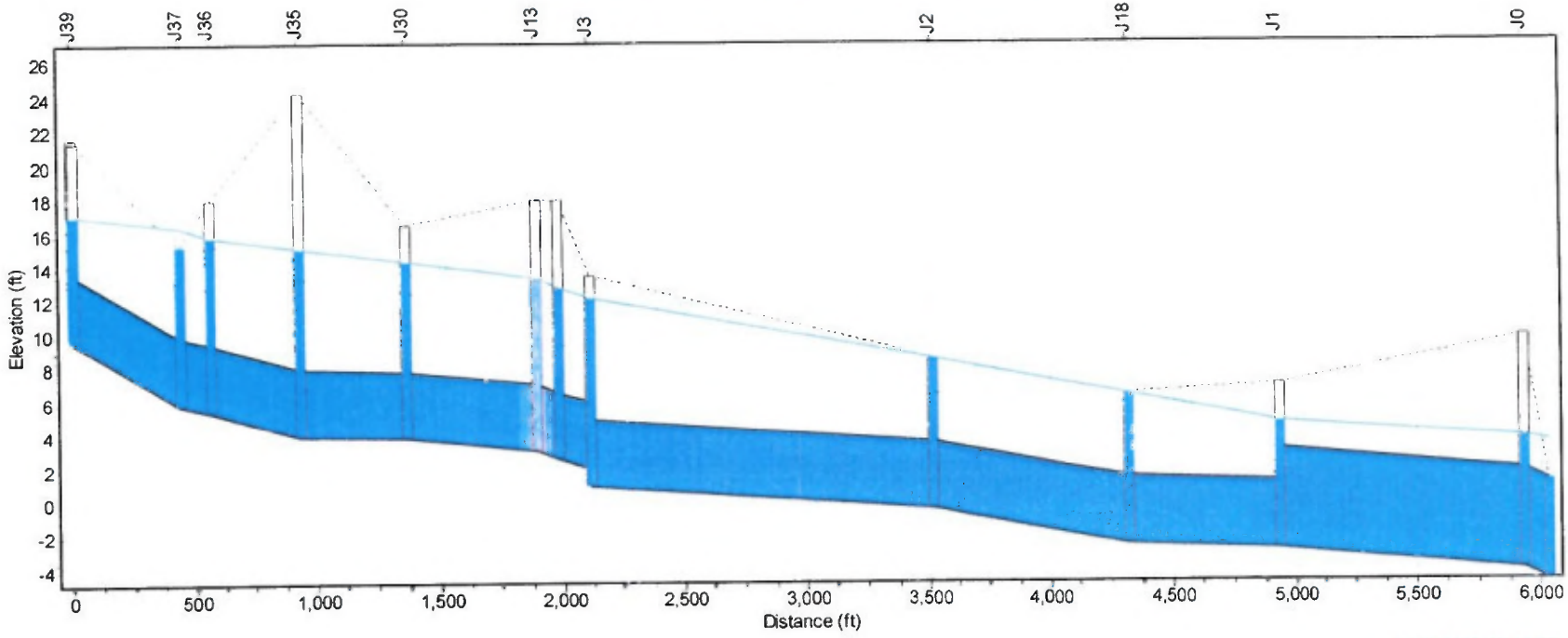


01/23/2012 03:42:00

8-59

TEMPLE ST / GARAGE
1YR - 60 MIN
MEAN HIGH TIDE EL. 3.5

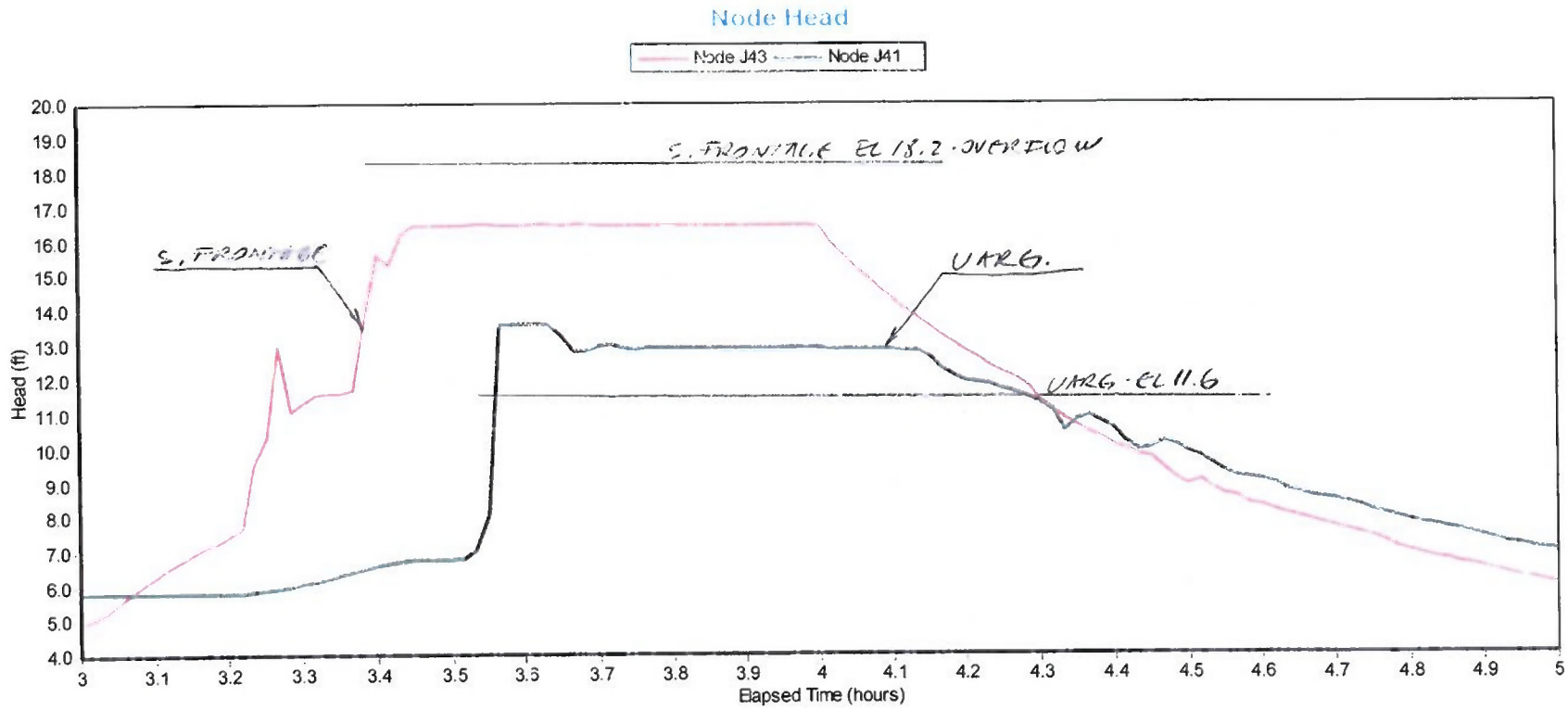
Water Elevation Profile: Node J39 - Out1



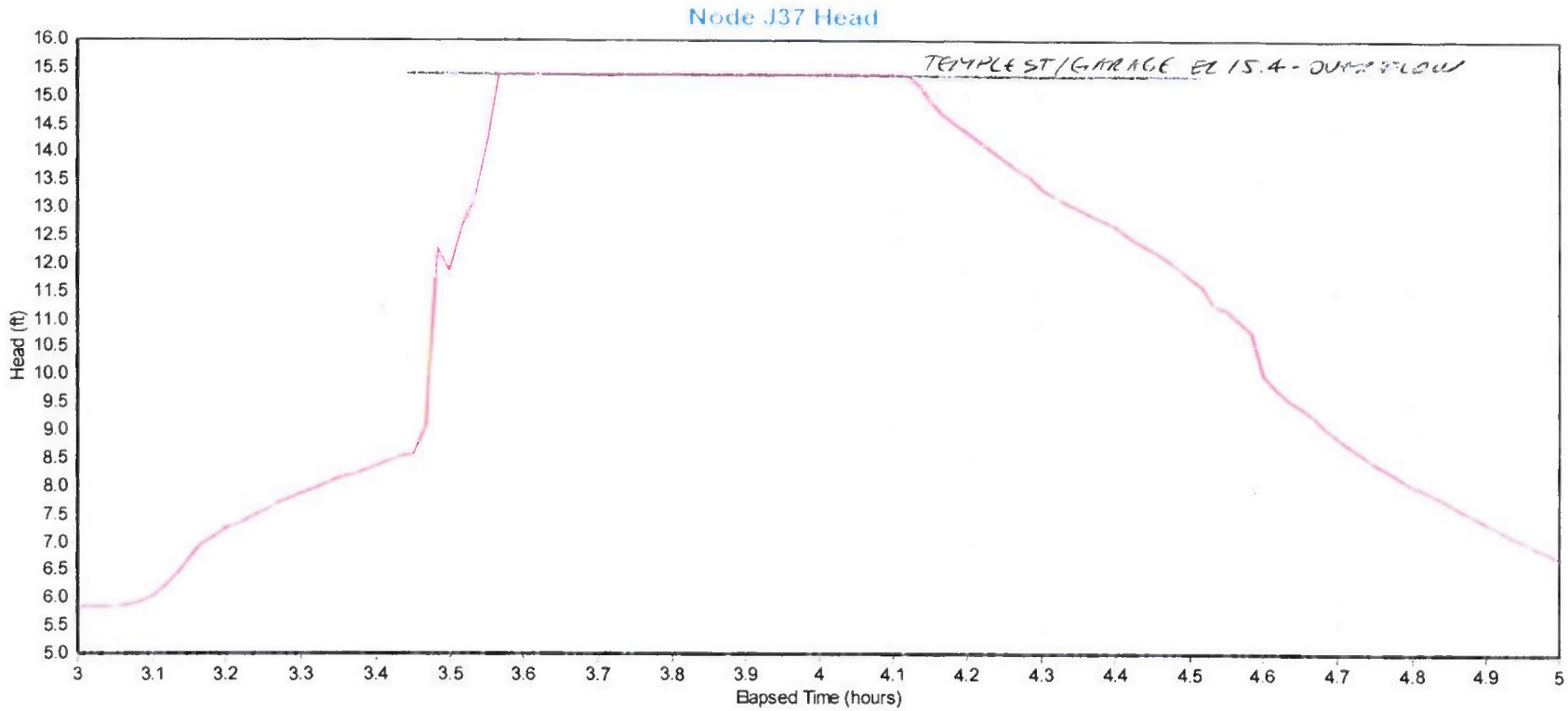
01/23/2012 03:41:00

B-57

2 YR. - 60 MIN
MEAN HIGH TIDE EL 3.5



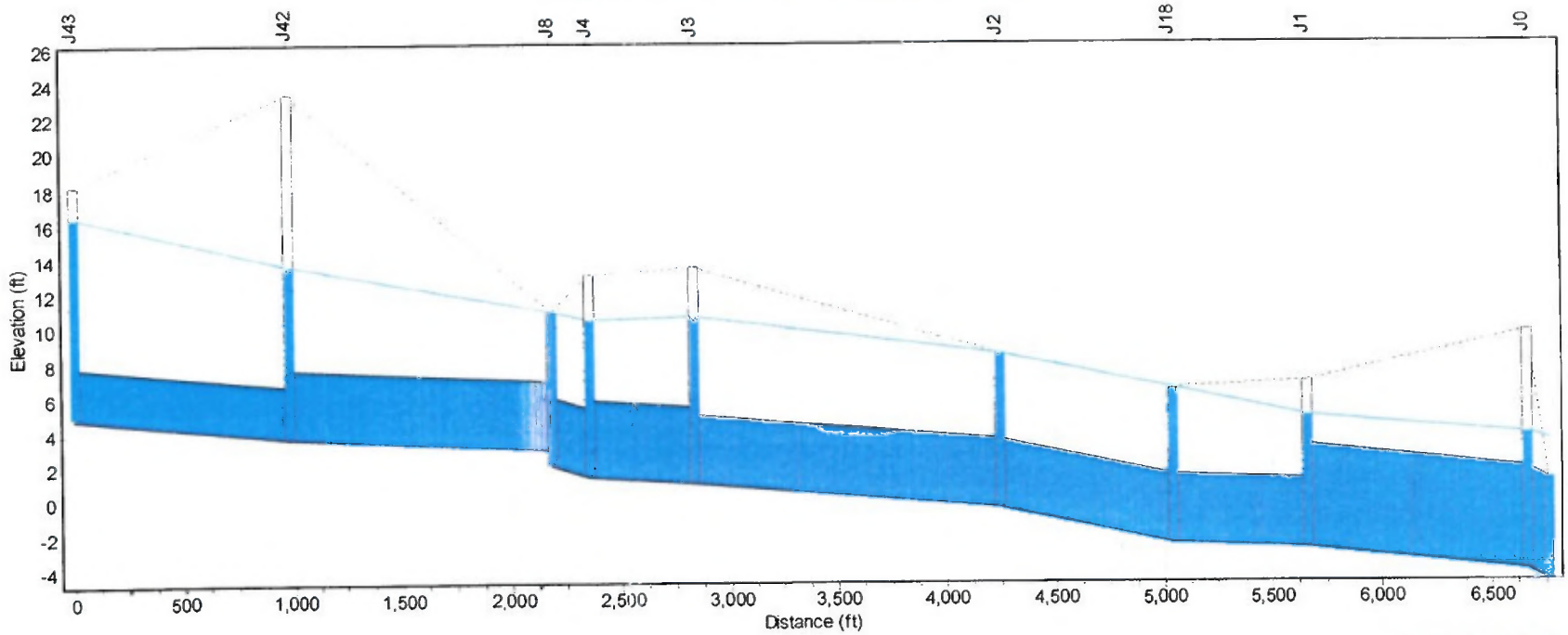
2YR-60MIN
MEAN HIGH TIDE EL. 3.5



B-52

S. FRONTAGE RD.
2YR - 60MIN
MEAN HIGH TIDE EL. 3.5

Water Elevation Profile: Node J43 - Out1

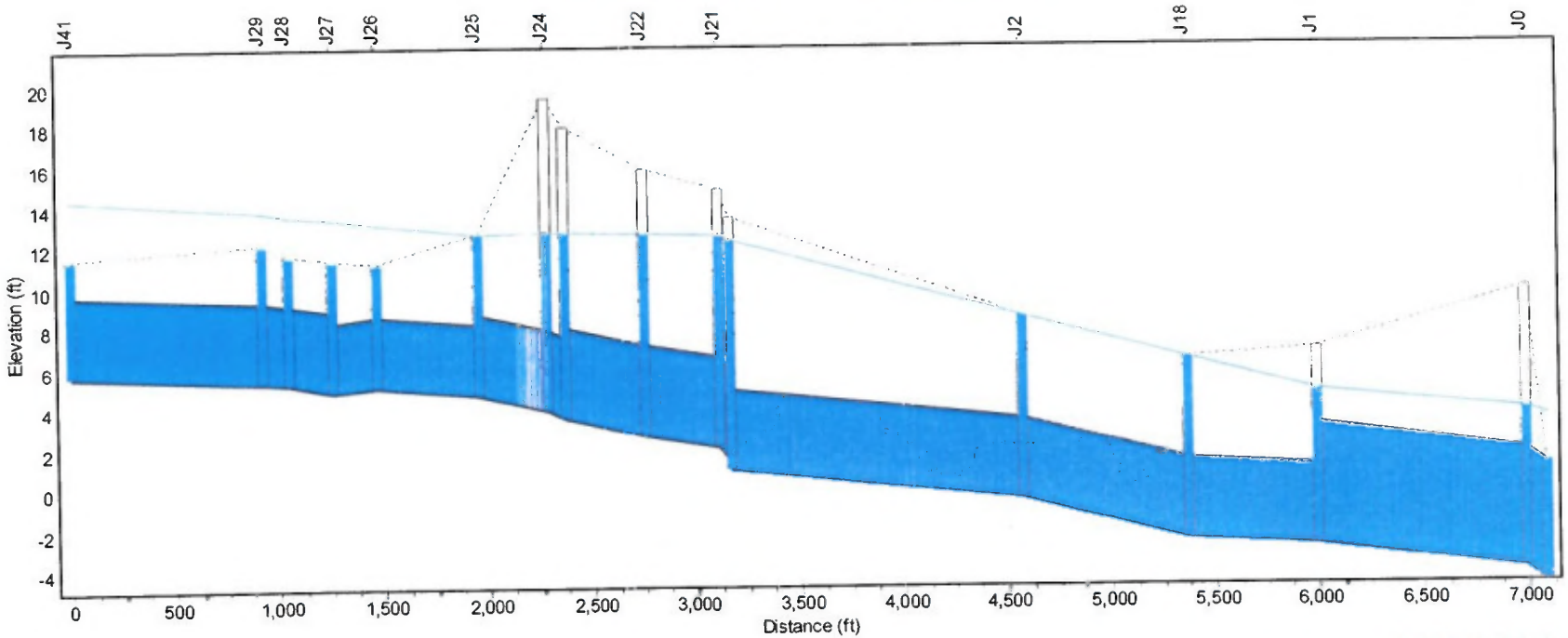


01/23/2012 03:28:00

B-54

ROUTE 34 - YARG
2YR - 60MIN
MEAN HIGH TIDE EL. 3.5

Water Elevation Profile: Node J41 - Out1

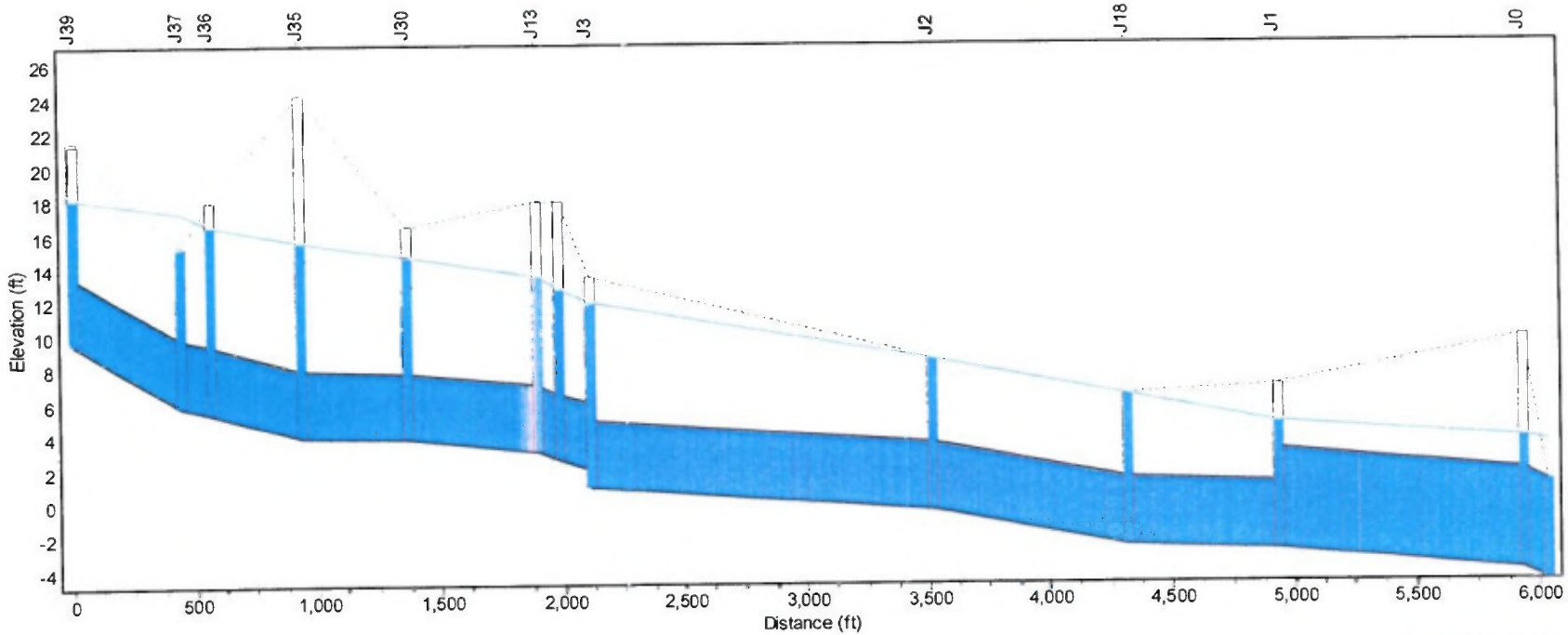


01/23/2012 03:35:00

2-55

TEMPLE ST / GARAGE
2YR - 60 MIN
MEAN HIGH TIDE EL. 2.5

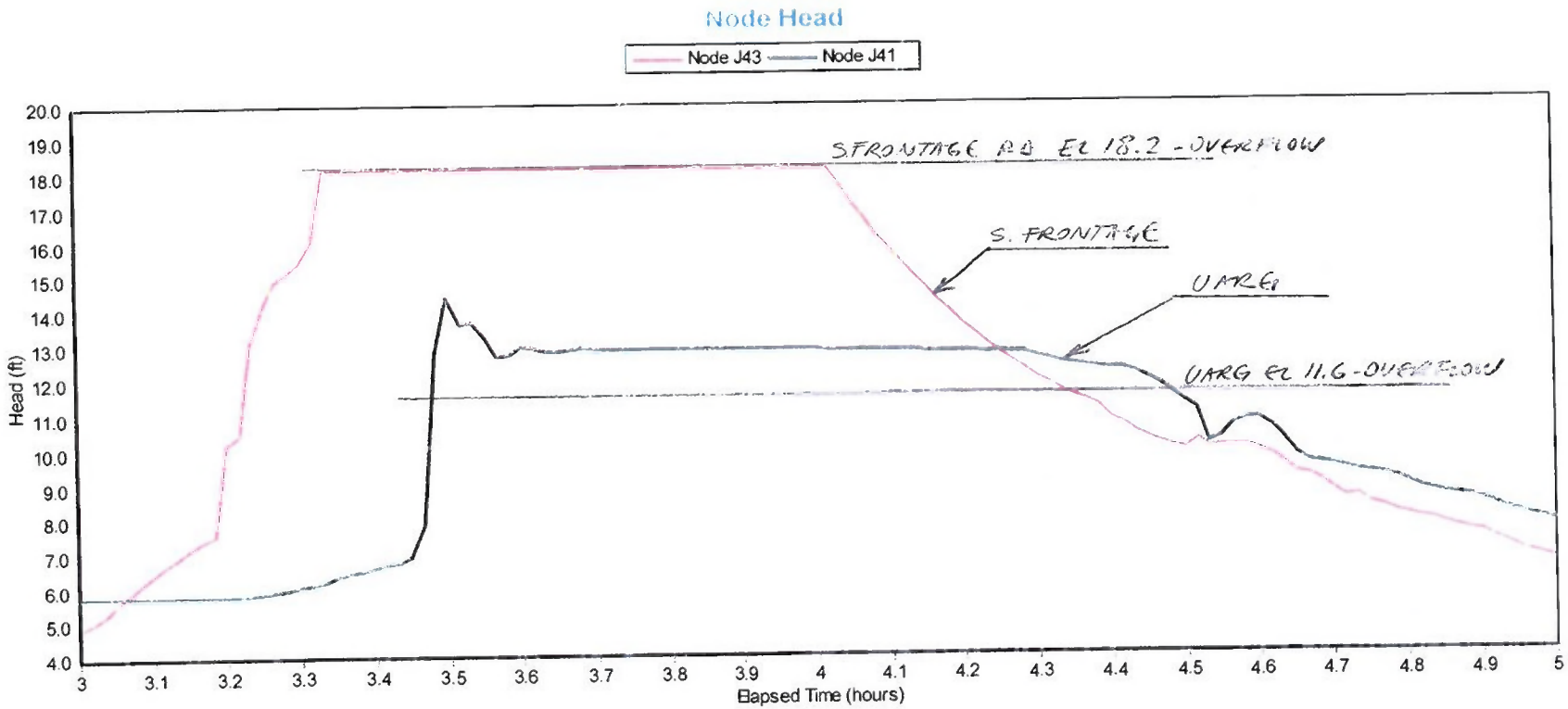
Water Elevation Profile: Node J39 - Out1



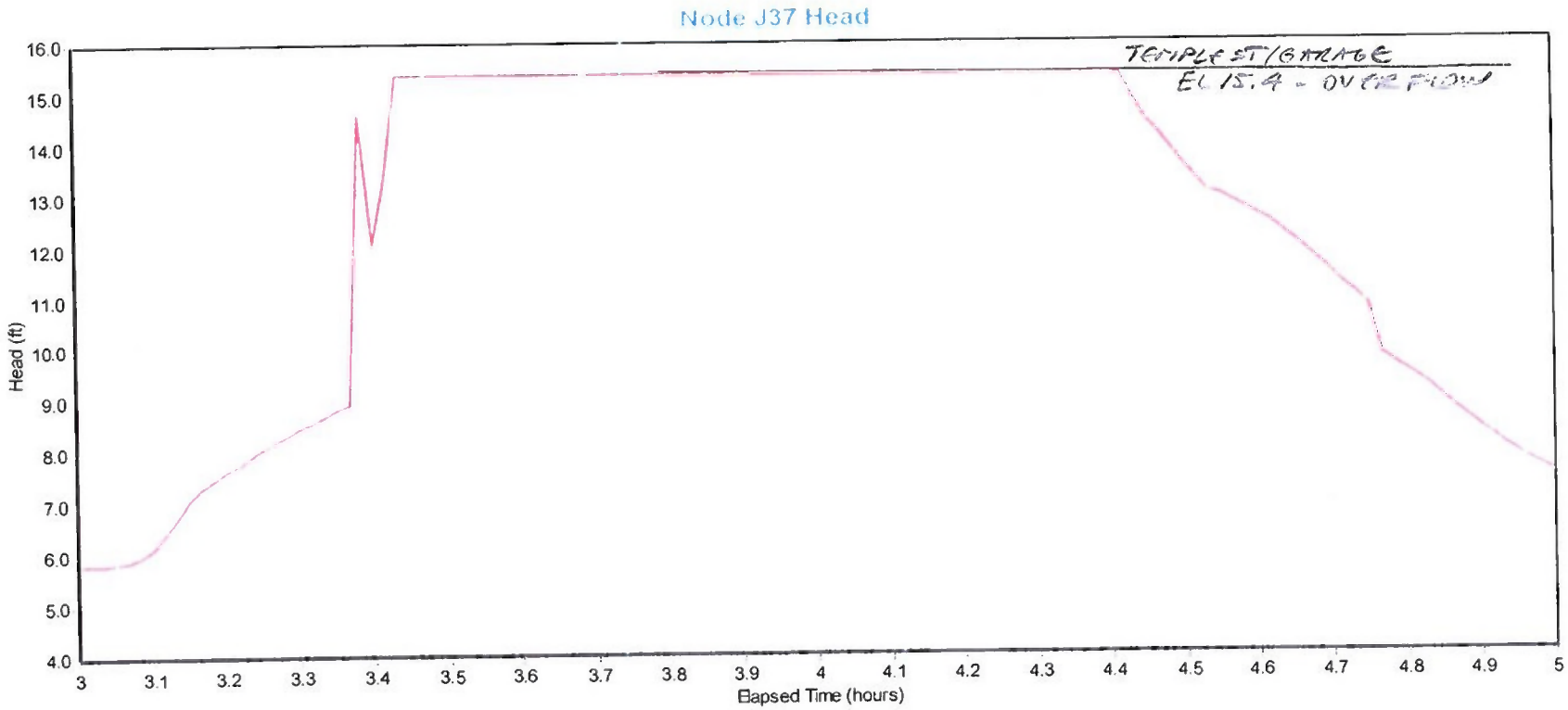
01/23/2012 03:34:00

B-56

10YR - 60 MIN
MEAN HIGH TIDE EL 3.5



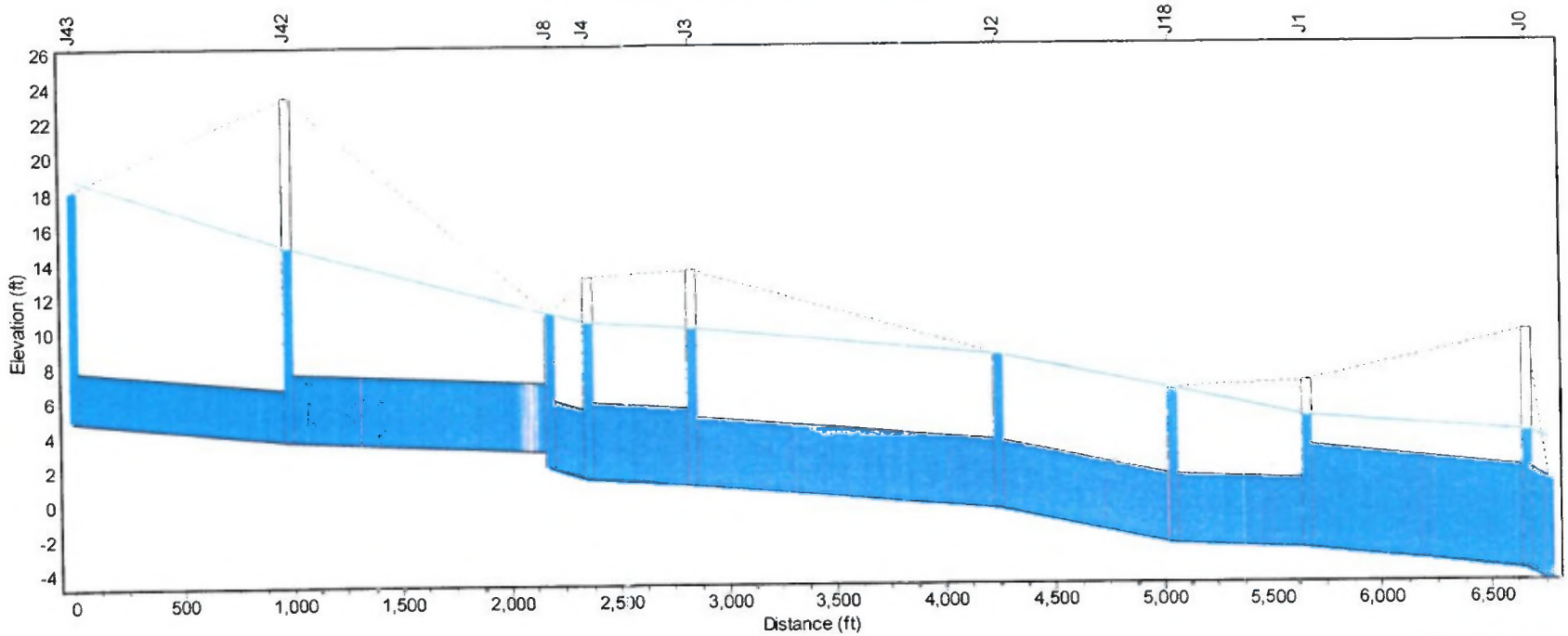
10YR - 60MIN
MEAN HIGH TIDE EL 3.5



2-58

S. FRONTAGE RD.
10YR - 60MIN
MEAN HIGH TIDE EL 2.5

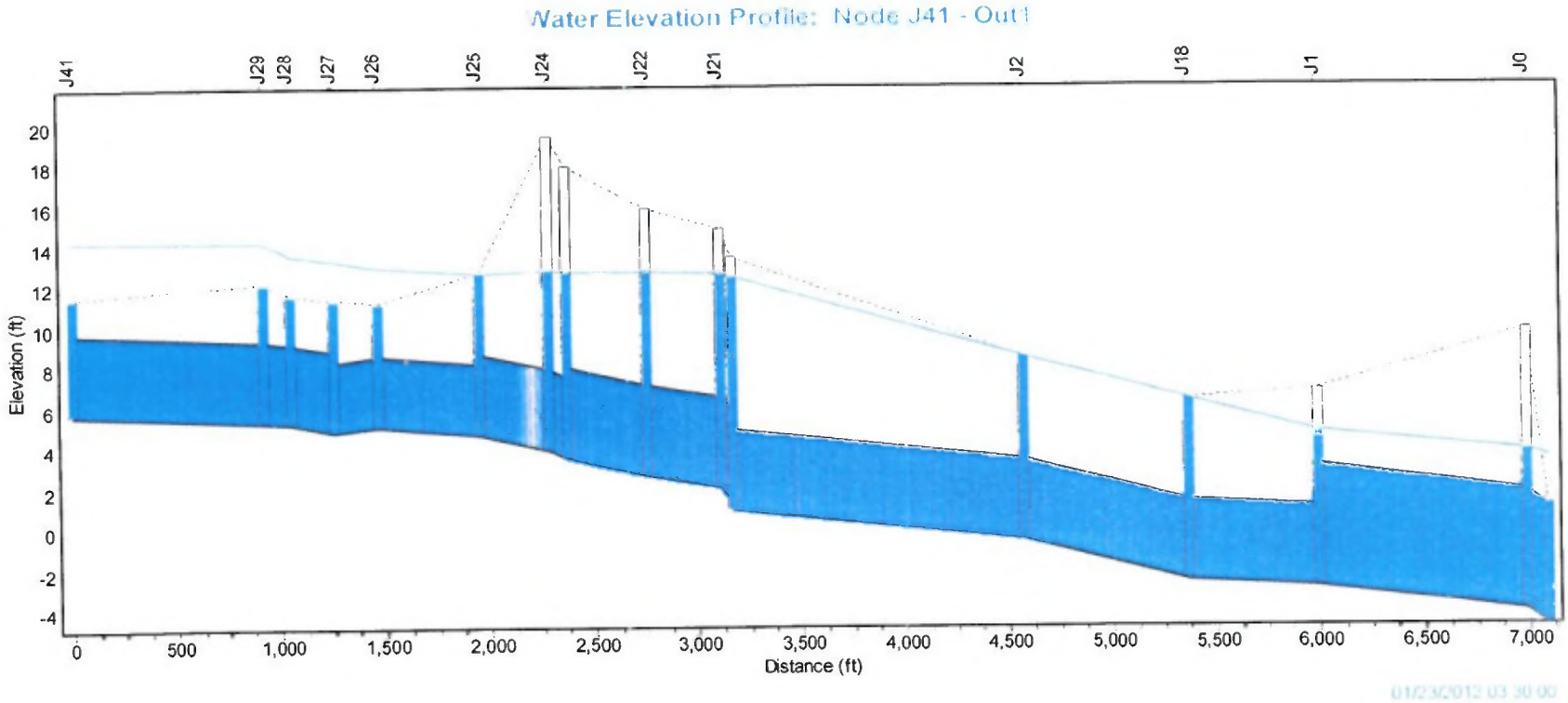
Water Elevation Profile: Node J43 - Out1



01/23/2012 03:22:00

B-59

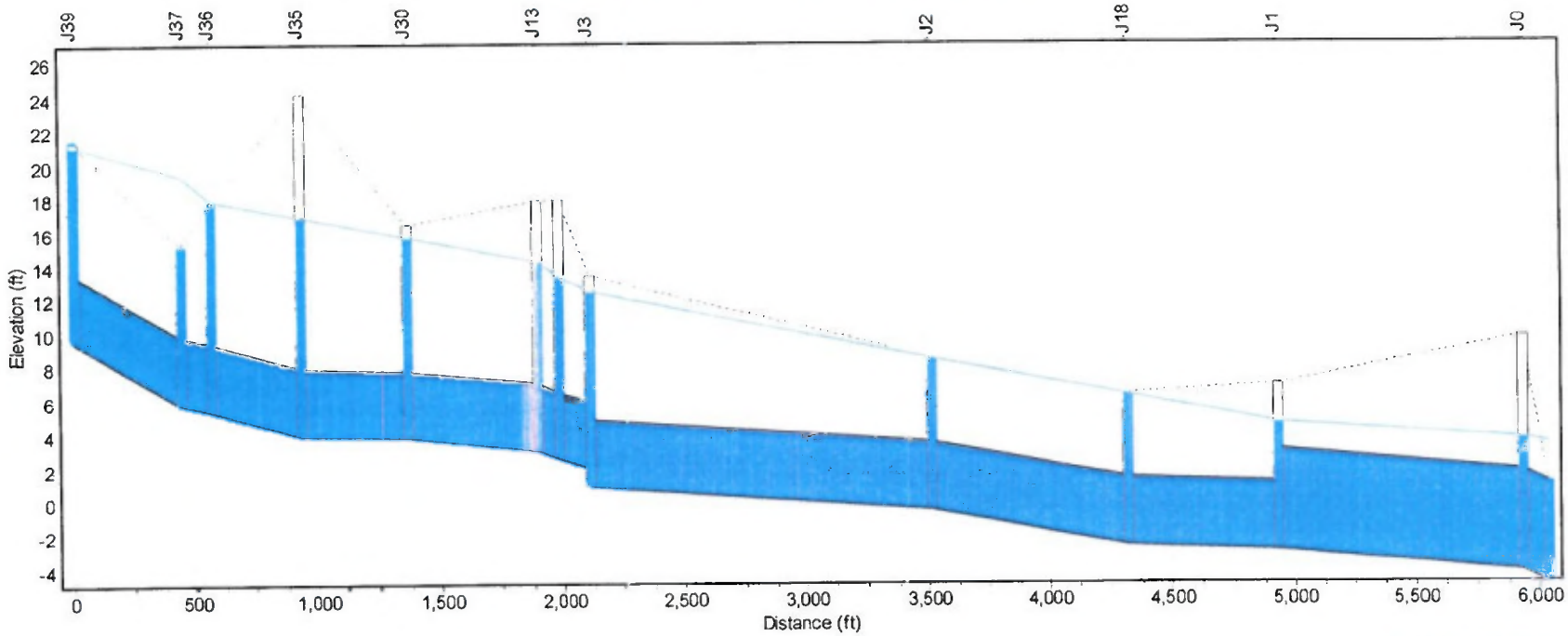
ROUTE 34-UARG
10YR -60MIN
MEAN HIGH TIDE @3.5



8-60

TEMPLE ST / GARAGE
10YR - 60 MIN
MEAN HIGH TIDE EL. 3.5

Water Elevation Profile: Node J39 - Out1



01/23/2012 03:27:00

B-61

SWMM ANALYSIS – 6HR RAINFALL

NEW HAVEN STORM SEWER

DRAINAGE AREAS AND FLOWS TO THE EXISTING 2 - 6' x 6' TRUNKLINE (NORTH OUTFALL - #1) AND 2 -72" RCP (SOUTH OUTFALL - #2)

FLOWS GENERATED BY TYPE III, 6-HOUR DURATION RAINFALL

AREA	DESCRIPTION	DRAINAGE AREA	ROOF AREA	T	EXISTING CONDITIONS*				
					CN_{ave}	1-YEAR FLOW	2-YEAR FLOW	10-YEAR FLOW	100-YEAR FLOW
(No.)		(Ac)	(Ac)	(hr)		(cfs)	(cfs)	(cfs)	(cfs)
	AREA NORTH OF ROUTE 34 AND WEST OF STATE STREET								
1	ELM STREET TRUNKLINE	180	46.7	6	75	98	208	363	
2	CHAPEL STREET TRUNKLINE	97	32	6	75	58	123	213	
3	COURT STREET STORM SEWER	48.8	21	6	75	38	79	136	
4	CROWN STREET STORM SEWER								
5	CHURCH - GEORGE ST STORM SEWER								
6	GEORGE - TEMPLE - N. FRONTAGE TRUNKLINE	52.5	22.2	6	70	21	50	93	
7	ROUTE 34 TRUNKLINE	16	3	6	90	16	36	62	
	AREA SOUTH OF ROUTE 34 AND WEST OF UNION AVENUE								
8.1	PARK STREET	5.8	0.9	6	75	10	19	31	
8.2	YORK STREET	10.7	3.2	6	75	12	27	47	
8.3	CONGRESS AVENUE	18	7.8	6	75	13	36	64	
8.4	WEST WATER STREET	22.5	4.2	6	75	18	44	83	
9	COLUMBUS AVENUE 78" TRUNKLINE	102	29	6	75	67	140	242	
10	UNION AVENUE STORM SEWER	11.6	1.9	6	75	10	21	36	
	AREA BETWEEN UNION AVENUE AND SARGENT DRIVE								
11	24" STORM SEWER TO 2-6'x4' RCBC	9.4	-	6	75	9	19	32	
12	POST OFFICE AREA TO 2-6'x4' RCBC	20.5	-	6	75	17	37	65	
13	AREA EAST OF UNION AVE TO 60" BRICK TRUNKLINE	38.6	-	6	75	30	63	108	
14	AREA TO 43"x 68" PIPE**	85	-	6	75	65	134	232	
15	AREA TO 12'x4' RCBC**	18.7	-	6	75	16	35	60	

* Existing Conditions assume that 50% of roof area runoff flows into storm sewer

** Areas Tributary to South Outfall

	CONGRESS AVE		
	1Yr - 6Hr	2Yr - 6Hr	10Yr - 6Hr
0	0	0	
2.5	0.5	1.8	3.2
3	8	24.5	50
3.2	13	33.5	63.7
3.5	7.4	16.6	29
4	2	4	7
5	0.4	2.6	4.4
6	0	0	0

	WEST WATER ST		
	1Yr - 6Hr	2Yr - 6Hr	10Yr - 6Hr
0	0	0	
2.5	0.5	1.2	3.2
3	9.7	29.4	58
3.2	17.5	44.2	82.7
3.5	6.3	16	29
4	2.1	4.7	11
5	0.4	2.2	4.8
6	0	0	0

	Route 34 up to College St.		
	1Yr - 6Hr	2Yr - 6Hr	10Yr - 6Hr
0	0	0	0
2.5	0.3	1.2	4.2
3	4.3	11	22.4
3.2	8.8	19	32.4
3.5	6.3	11.2	20
4	2.2	3.2	6.2
5	0.4	1.4	2.4
6	0	0	0

	Route 34 up to Church St.		
	1Yr - 6Hr	2Yr - 6Hr	10Yr - 6Hr
0	0	0	0
2.5	0.3	1.9	2.5
3	3.8	9.8	20.2
3.2	7.8	17	29.4
3.5	5.4	10.1	18.7
4	1.5	2.2	4.6
5	0.2	1	1.8
6	0	0	0

	PARK & YORK		
TOTAL	1Yr - 6Hr	2Yr - 6Hr	10Yr - 6Hr
0	0	0	0
2.5	2.9	5.2	3
3	26.3	38.5	50
3.2	31.2	47.2	64
3.5	13	20.4	19
4	3	4.7	7
5	2	3.3	4
6	0	0	0

```
*****************************************************************************
*                                  * TR 20 S/N    :                        *
*                                  * HMVersion    :  3.40                  *
*            TR 20                 * Date         :  5/05/**               *
*                                  * Time         : 10:23:24               *
*   Project Formulation Hydrology  * Input file   : re34ex6.t20            *
*                                  * Output file  : re34ex6.out            *
*                                  *                                       *
*                                  *                                       *
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XXXXXXX XXXXXX   XXXXX   XXXXX
  X    X    X X    X X   XX
  X    X    X      X  X  X X
  X    XXXXXX     X    X X X
  X    X  X    X      X X  X
  X    X   X  X       XX   X
  X    X    X XXXXXXX  XXXXX
```

```
::::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::::
:::                                      :::
::: Full Microcomputer Implementation    :::
:::                by                    :::
:::       Haestad Methods, Inc.          :::
:::                                      :::
::::::::::::::::::::::::::::::::::::::::::::
::::::::::::::::::::::::::::::::::::::::::::
```

37 Brookside Road * Waterbury, Connecticut 06708 * (203) 755-1666

1, 2 & 10 YR - 6 HR HYDROGRAPHS

```
******************80-80 LIST OF INPUT DATA FOR TR-20 HYDROLOGY******************

JOB TR-20                                                    NOPLOTS
TITLE     ROUTE 34-EXISTING CONDITIONS
TITLE     2YR,10YR-6HR STORMS - TYPE IIISTORM
 5 RAINFL 6                    0.2
 8                  0.      0.0091      0.0181      0.0272      0.0366
 8               0.0471     0.0584      0.0712      0.0852      0.1010
 8               0.1191     0.1399      0.1657      0.1970       0.298
 8               0.6001     0.7616      0.8054      0.8366      0.8598
 8               0.8799     0.8974       0.913      0.9271      0.9399
 8               0.9515     0.9621      0.9721      0.9817      0.9911
 8                 1.00
 9 ENDTBL
 6 RUNOFF 1   1      1       0.281         75       0.671 1   1   1       H1
   ENDATA
 7 INCREM 6                    0.1
 7 COMPUT 7   1     1          0.0         2.5         1.6 2   1   1   1-YEAR
   ENDCMP 1
 7 INCREM 6                    0.1
 7 COMPUT 7   1     1          0.0         3.5         1.6 2   1   1   2-YEAR
   ENDCMP 1
 7 INCREM 6                    0.1
 7 COMPUT 7   1     1          0.0         4.7         1.6 2   1   1  10-YEAR
   ENDCMP 1
   ENDJOB 2

*******************************END OF 80-80 LIST*******************************
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TR20 XEQ 5/05/** ROUTE 34-EXISTING CONDITIONS JOB 1 PASS 1
REV 09/01/83 2YR,10YR-6HR STORMS - TYPE IIISTORM PAGE 2

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 1-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 2.50 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.48	97.86	(RUNOFF)

1YR

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .28 SQ.MI.

2.00	DISCHG	.00	.00	.00	.00	.00	.00	.00	.00	.28	2.61
3.00	DISCHG	10.79	28.03	52.87	77.56	94.10	97.75	90.97	79.20	66.78	56.05
4.00	DISCHG	47.64	41.08	35.88	31.91	28.75	26.21	24.13	22.40	20.96	19.72
5.00	DISCHG	18.61	17.60	16.71	15.91	15.22	14.63	14.12	13.70	13.34	13.05
6.00	DISCHG	12.77	12.23	11.16	9.44	7.39	5.42	3.75	2.56	1.78	1.24
7.00	DISCHG	.85	.59	.40	.27	.19	.12	.08	.05	.03	.02
8.00	DISCHG	.01	.00								

RUNOFF VOLUME ABOVE BASEFLOW = .65 WATERSHED INCHES, 117.89 CFS-HRS, 9.74 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP RECORD ID
COMPUTATIONS COMPLETED FOR PASS 1

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 2-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 3.50 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.45	208.18	(RUNOFF)

2YR

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .28 SQ.MI.

2.00	DISCHG	.00	.00	.00	.00	.00	.00	.03	.49	3.03	12.70
3.00	DISCHG	36.89	79.11	132.11	178.89	205.10	204.55	184.74	157.28	130.30	107.68
4.00	DISCHG	90.17	76.69	66.16	58.21	51.94	46.95	42.91	39.60	36.84	34.49

(1)

TR20 XEQ 5/05/** ROUTE 34-EXISTING CONDITIONS JOB 1 PASS 2
REV 09/01/83 2YR,10YR-6HR STORMS - TYPE IIISTORM PAGE 3

5.00	DISCHG	32.39	30.52	28.89	27.46	26.22	25.16	24.25	23.48	22.84	22.31
6.00	DISCHG	21.80	20.87	19.03	16.08	12.59	9.22	6.39	4.35	3.03	2.11
7.00	DISCHG	1.45	1.00	.69	.47	.32	.21	.14	.09	.05	.03
8.00	DISCHG	.01	.00								

RUNOFF VOLUME ABOVE BASEFLOW = 1.30 WATERSHED INCHES, 236.02 CFS-HRS, 19.50 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP RECORD ID
COMPUTATIONS COMPLETED FOR PASS 2

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 10-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 4.70 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

10YR

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.43	362.75	(RUNOFF)

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .28 SQ.MI.

2.00	DISCHG	.00	.00	.00	.03	.19	.70	1.98	5.37	14.19	37.29
3.00	DISCHG	85.64	162.26	251.81	325.19	360.82	351.55	312.05	262.21	214.95	175.95
4.00	DISCHG	146.01	123.11	105.36	92.05	81.63	73.37	66.74	61.33	56.85	53.03
5.00	DISCHG	49.65	46.68	44.09	41.86	39.93	38.28	36.85	35.65	34.65	33.82
6.00	DISCHG	33.02	31.58	28.79	24.32	19.03	13.95	9.66	6.58	4.58	3.19
7.00	DISCHG	2.20	1.51	1.04	.71	.48	.32	.21	.13	.08	.04
8.00	DISCHG	.02	.00								

RUNOFF VOLUME ABOVE BASEFLOW = 2.21 WATERSHED INCHES, 400.44 CFS-HRS, 33.09 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP RECORD ID
COMPUTATIONS COMPLETED FOR PASS 3

EXECUTIVE CONTROL OPERATION ENDJOB RECORD ID

TR20 XEQ 5/05/** ROUTE 34-EXISTING CONDITIONS JOB 1 PASS 1
REV 09/01/93 2YR,10YR-6HR STORMS - TYPE III STORM PAGE 2

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 1-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 2.50 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

1 YR

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.42	58.09	(RUNOFF)

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .15 SQ.MI.

2.00	DISCHG	.00	.00	.00	.00	.00	.00	.00	.00	.13	1.70
3.00	DISCHG	7.63	20.31	37.09	50.98	57.86	55.19	47.88	39.59	32.41	26.99
4.00	DISCHG	22.83	19.64	17.31	15.51	14.09	12.97	12.06	11.27	10.59	10.01
5.00	DISCHG	9.50	9.05	8.65	8.28	7.95	7.67	7.43	7.23	7.06	6.93
6.00	DISCHG	6.75	6.34	5.42	4.16	2.92	1.90	1.25	.82	.53	.34
7.00	DISCHG	.22	.14	.09	.06	.03	.02	.01	.00		

RUNOFF VOLUME ABOVE BASEFLOW = .65 WATERSHED INCHES, 63.46 CFS-HRS, 5.24 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDOP RECORD ID
COMPUTATIONS COMPLETED FOR PASS 1

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 2-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 3.50 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

2 YR

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.40	122.69	(RUNOFF)

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .15 SQ.MI.

2.00	DISCHG	.00	.00	.00	.00	.00	.00	.02	.28	1.92	8.76
3.00	DISCHG	26.18	56.29	90.15	114.37	122.68	112.69	95.21	77.14	62.07	50.89
4.00	DISCHG	42.43	36.02	31.42	27.87	25.11	22.96	21.22	19.73	18.45	17.38
5.00	DISCHG	16.46	15.64	14.92	14.27	13.68	13.17	12.74	12.38	12.08	11.84

(2)

TR20 XEQ 5/05/** ROUTE 34-EXISTING CONDITIONS JOB 1 PASS 2
REV 09/01/83 2YR,10YR-6HR STORMS - TYPE IIISTORM PAGE 3

6.00	DISCHG	11.52	10.80	9.23	7.08	4.97	3.24	2.12	1.39	.90	.59
7.00	DISCHG	.38	.24	.15	.10	.06	.03	.02	.01	.00	

RUNOFF VOLUME ABOVE BASEFLOW = 1.30 WATERSHED INCHES, 127.09 CFS-HRS, 10.50 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP RECORD ID
COMPUTATIONS COMPLETED FOR PASS 2

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 10-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 4.70 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.38	212.91	(RUNOFF)

10YR

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .15 SQ.MI.

2.00	DISCHG	.00	.00	.00	.02	.13	.54	1.48	3.68	9.55	25.54
3.00	DISCHG	59.59	113.05	168.28	204.12	212.15	190.76	158.70	127.04	101.16	82.16
4.00	DISCHG	67.88	57.16	49.50	43.64	39.10	35.59	32.76	30.34	28.30	26.60
5.00	DISCHG	25.15	23.87	22.75	21.72	20.80	20.01	19.34	18.78	18.31	17.93
6.00	DISCHG	17.44	16.34	13.95	10.71	7.52	4.89	3.21	2.10	1.36	.89
7.00	DISCHG	.58	.37	.23	.15	.09	.05	.03	.01	.00	

RUNOFF VOLUME ABOVE BASEFLOW = 2.20 WATERSHED INCHES, 215.69 CFS-HRS, 17.82 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP RECORD ID
COMPUTATIONS COMPLETED FOR PASS 3

EXECUTIVE CONTROL OPERATION ENDJOB RECORD ID

(3, 4, 5)

TR20 XEQ 5/05/** ROUTE 34-EXISTING CONDITIONS JOB 1 PASS 1
REV 09/01/83 2YR,10YR-6HR STORMS - TYPE IIISTORM PAGE 2

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 1-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 2.50 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.26	37.92	(RUNOFF)

1 YR

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .08 SQ.MI.

2.00	DISCHG	.00	.00	.00	.00	.00	.00	.00	.00	.07	2.08
3.00	DISCHG	12.04	27.25	36.43	37.31	30.18	21.67	15.90	12.48	10.21	8.68
4.00	DISCHG	7.65	6.97	6.43	6.02	5.68	5.40	5.13	4.90	4.69	4.49
5.00	DISCHG	4.29	4.11	3.94	3.79	3.67	3.57	3.49	3.43	3.38	3.34
6.00	DISCHG	3.26	2.83	1.81	.90	.42	.20	.09	.04	.02	.01
7.00	DISCHG	.00									

RUNOFF VOLUME ABOVE BASEFLOW = .65 WATERSHED INCHES, 31.85 CFS-HRS, 2.63 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDOP RECORD ID
COMPUTATIONS COMPLETED FOR PASS 1

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 2-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 3.50 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.23	79.22	(RUNOFF)

2 YR

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .08 SQ.MI.

2.00	DISCHG	.00	.00	.00	.00	.00	.00	.01	.42	2.77	11.66
3.00	DISCHG	36.55	65.93	78.57	75.08	58.60	41.10	29.57	22.82	18.43	15.50
4.00	DISCHG	13.55	12.28	11.29	10.54	9.91	9.39	8.91	8.50	8.11	7.75
5.00	DISCHG	7.40	7.08	6.77	6.51	6.28	6.11	5.97	5.85	5.77	5.70

(3, 4, 5)

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TR20 XEQ  5/05/**          ROUTE 34-EXISTING CONDITIONS                                    JOB  1   PASS   2
    REV 09/01/83           2YR,10YR-6HR STORMS - TYPE IIISTORM                                       PAGE   3

  6.00   DISCHG      5.56     4.82     3.08     1.52      .72      .34      .16      .07      .03      .01
  7.00   DISCHG       .00

 RUNOFF VOLUME ABOVE BASEFLOW =  1.30 WATERSHED INCHES,     63.73 CFS-HRS,     5.27 ACRE-FEET;   BASEFLOW =    .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP                                                                  RECORD ID
COMPUTATIONS COMPLETED FOR PASS   2


EXECUTIVE CONTROL OPERATION INCREM                                                                  RECORD ID
MAIN TIME INCREMENT =   .10 HOURS


EXECUTIVE CONTROL OPERATION COMPUT                                                                  RECORD ID  10-YEAR
FROM XSECTION   1                                                   TO XSECTION   1
      STARTING TIME =   .00    RAIN DEPTH =  4.70    RAIN DURATION=  1.00    RAIN TABLE NO.= 6    ANT. MOIST. COND= 2
      ALTERNATE NO.= 1         STORM NO.= 1    MAIN TIME INCREMENT =   .10 HOURS


OPERATION RUNOFF   CROSS SECTION   1

          PEAK TIME(HRS)              PEAK DISCHARGE(CFS)          PEAK ELEVATION(FEET)
             3.21                          136.64                        (RUNOFF)

TIME(HRS)        FIRST HYDROGRAPH POINT =   .00 HOURS     TIME INCREMENT =  .10 HOURS     DRAINAGE AREA =    .08 SQ.MI.
  2.00   DISCHG       .00      .00      .00      .02      .22      .78     1.76     4.36    11.56    30.10
  3.00   DISCHG     74.46   121.32   136.55   125.66    96.09    66.45    47.24    36.07    28.90    24.13
  4.00   DISCHG     21.00    18.96    17.40    16.21    15.22    14.40    13.65    12.99    12.38    11.83
  5.00   DISCHG     11.27    10.77    10.29     9.88     9.54     9.27     9.04     8.87     8.74     8.61
  6.00   DISCHG      8.40     7.28     4.66     2.30     1.09      .51      .24      .11      .05      .02
  7.00   DISCHG       .00

 RUNOFF VOLUME ABOVE BASEFLOW =  2.20 WATERSHED INCHES,    108.10 CFS-HRS,     8.93 ACRE-FEET;   BASEFLOW =    .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP                                                                  RECORD ID
COMPUTATIONS COMPLETED FOR PASS   3


EXECUTIVE CONTROL OPERATION ENDJOB                                                                  RECORD ID
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10 YR

TR20 XEQ 5/05/** ROUTE 34-EXISTING CONDITIONS JOB 1 PASS 1
REV 09/01/83 2YR,10YR-6HR STORMS - TYPE IIISTORM PAGE 2

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 1-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 2.50 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.45	20.34	(RUNOFF)

1YR

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .08 SQ.MI.

2.00	DISCHG	.00	.00	.00	.00	.00	.00	.00	.00	.01	.24
3.00	DISCHG	1.55	5.13	10.91	16.44	19.92	19.89	17.81	15.08	12.59	10.66
4.00	DISCHG	9.16	7.99	7.13	6.45	5.91	5.47	5.12	4.82	4.55	4.31
5.00	DISCHG	4.10	3.92	3.75	3.60	3.46	3.34	3.24	3.16	3.09	3.04
6.00	DISCHG	2.96	2.78	2.38	1.83	1.28	.84	.55	.36	.23	.15
7.00	DISCHG	.10	.06	.04	.03	.02	.01	.00			

RUNOFF VOLUME ABOVE BASEFLOW = .45 WATERSHED INCHES, 23.94 CFS-HRS, 1.98 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP RECORD ID
COMPUTATIONS COMPLETED FOR PASS 1

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 2-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 3.50 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.41	49.42	(RUNOFF)

2YR

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .08 SQ.MI.

2.00	DISCHG	.00	.00	.00	.00	.00	.00	.00	.00	.19	1.86
3.00	DISCHG	7.49	18.77	32.96	44.23	49.34	46.53	40.04	32.91	26.80	22.22
4.00	DISCHG	18.71	16.04	14.10	12.59	11.41	10.48	9.73	9.08	8.52	8.05
5.00	DISCHG	7.63	7.27	6.94	6.64	6.38	6.14	5.95	5.79	5.65	5.55

(5)

TR20 XEQ 5/05/** ROUTE 34-EXISTING CONDITIONS JOB 1 PASS 2
REV 09/01/83 2YR,10YR-6HR STORMS - TYPE IIISTORM PAGE 3

6.00	DISCHG	5.40	5.07	4.33	3.33	2.34	1.52	1.00	.65	.42	.28
7.00	DISCHG	.18	.11	.07	.05	.03	.02	.01	.00		

RUNOFF VOLUME ABOVE BASEFLOW = 1.00 WATERSHED INCHES, 53.06 CFS-HRS, 4.39 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP RECORD ID
COMPUTATIONS COMPLETED FOR PASS 2

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 10-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 4.70 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.39	92.79	(RUNOFF)

10 YR

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .08 SQ.MI.

2.00	DISCHG	.00	.00	.00	.00	.00	.00	.03	.31	1.76	7.27
3.00	DISCHG	20.78	43.69	69.08	86.94	92.75	84.89	71.53	57.84	46.46	38.03
4.00	DISCHG	31.66	26.84	23.38	20.72	18.65	17.04	15.74	14.63	13.67	12.87
5.00	DISCHG	12.19	11.58	11.05	10.56	10.12	9.74	9.42	9.15	8.93	8.75
6.00	DISCHG	8.52	7.99	6.82	5.24	3.68	2.39	1.57	1.03	.66	.43
7.00	DISCHG	.28	.18	.11	.07	.04	.02	.01	.00		

RUNOFF VOLUME ABOVE BASEFLOW = 1.81 WATERSHED INCHES, 95.69 CFS-HRS, 7.91 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP RECORD ID
COMPUTATIONS COMPLETED FOR PASS 3

EXECUTIVE CONTROL OPERATION ENDJOB RECORD ID

TO PARK ST CB:

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TR20 XEQ  4/04/**          ROUTE 34-EXISTING CONDITIONS                                    JOB  1  PASS  1
     REV 09/01/83          2YR,10YR-6HR STORMS - TYPE IIISTORM                                     PAGE  2


EXECUTIVE CONTROL OPERATION INCREM                                                          RECORD ID
MAIN TIME INCREMENT =   .10 HOURS


EXECUTIVE CONTROL OPERATION COMPUT                                                          RECORD ID  1-YEAR
FROM XSECTION   1                                          TO XSECTION   1
      STARTING TIME =   .00   RAIN DEPTH =  2.00   RAIN DURATION=  1.00   RAIN TABLE NO.= 6   ANT. MOIST. COND= 2
      ALTERNATE NO.= 1        STORM NO.= 1   MAIN TIME INCREMENT =   .10 HOURS


OPERATION RUNOFF   CROSS SECTION   1

          PEAK TIME(HRS)          PEAK DISCHARGE(CFS)          PEAK ELEVATION(FEET)
             3.12                       10.12                        (RUNOFF)

TIME(HRS)        FIRST HYDROGRAPH POINT =   .00 HOURS     TIME INCREMENT =  .10 HOURS     DRAINAGE AREA =    .01 SQ.MI.
   1.00   DISCHG      .00      .00      .00      .00      .00      .00      .00      .02      .05      .08
   2.00   DISCHG      .12      .16      .21      .27      .36      .44      .55      .94     1.88     3.86
   3.00   DISCHG     7.95    10.08     8.97     7.19     4.53     2.90     2.08     1.65     1.35     1.18
   4.00   DISCHG     1.06      .99      .91      .86      .81      .77      .73      .69      .66      .63
   5.00   DISCHG      .60      .57      .55      .53      .51      .50      .48      .48      .47      .46
   6.00   DISCHG      .45      .37      .18      .07      .02      .01      .00

  RUNOFF VOLUME ABOVE BASEFLOW =  1.31 WATERSHED INCHES,      7.13 CFS-HRS,      .59 ACRE-FEET;   BASEFLOW =    .00 CFS


EXECUTIVE CONTROL OPERATION ENDCMP                                                          RECORD ID
COMPUTATIONS COMPLETED FOR PASS   1


EXECUTIVE CONTROL OPERATION INCREM                                                          RECORD ID
MAIN TIME INCREMENT =   .10 HOURS


EXECUTIVE CONTROL OPERATION COMPUT                                                          RECORD ID  2-YEAR
FROM XSECTION   1                                          TO XSECTION   1
      STARTING TIME =   .00   RAIN DEPTH =  3.30   RAIN DURATION=  1.00   RAIN TABLE NO.= 6   ANT. MOIST. COND= 2
      ALTERNATE NO.= 1        STORM NO.= 1   MAIN TIME INCREMENT =   .10 HOURS


OPERATION RUNOFF   CROSS SECTION   1

          PEAK TIME(HRS)          PEAK DISCHARGE(CFS)          PEAK ELEVATION(FEET)
             3.11                       19.26                        (RUNOFF)

TIME(HRS)        FIRST HYDROGRAPH POINT =   .00 HOURS     TIME INCREMENT =  .10 HOURS     DRAINAGE AREA =    .01 SQ.MI.
   1.00   DISCHG      .00      .01      .03      .07      .12      .17      .23      .30      .37      .45
   2.00   DISCHG      .54      .64      .75      .89     1.06     1.25     1.48     2.33     4.39     8.27
   3.00   DISCHG    15.88    19.24    16.65    13.08     8.17     5.19     3.70     2.91     2.37     2.07
   4.00   DISCHG     1.86     1.73     1.60     1.51     1.41     1.34     1.27     1.21     1.15     1.10
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1YR -6HR

2YR - 6HR

(7)

RT 34 - TO CHURCH ST
- TO COLLEGE ST.

TR20 XEQ 4/04/** ROUTE 34-EXISTING CONDITIONS JOB 1 PASS 1
REV 09/01/83 2YR,10YR-6HR STORMS - TYPE IIISTORM PAGE 2

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 1-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 2.00 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.21	7.87	(RUNOFF)

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .01 SQ.MI.

2.00	DISCHG	.00	.00	.00	.00	.02	.06	.12	.28	.71	1.80
3.00	DISCHG	4.36	7.03	7.87	7.21	5.50	3.80	2.70	2.06	1.65	1.37
4.00	DISCHG	1.19	1.08	.99	.92	.86	.82	.77	.74	.70	.67
5.00	DISCHG	.64	.61	.58	.56	.54	.53	.51	.50	.50	.49
6.00	DISCHG	.48	.41	.26	.13	.06	.03	.01	.01	.00	

1YR - 6HR

RUNOFF VOLUME ABOVE BASEFLOW = .96 WATERSHED INCHES, 6.22 CFS-HRS, .51 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP RECORD ID
COMPUTATIONS COMPLETED FOR PASS 1

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 2-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 3.30 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.18	17.05	(RUNOFF)

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .01 SQ.MI.

1.00	DISCHG	.00	.00	.00	.00	.00	.00	.00	.00	.02	.07
2.00	DISCHG	.12	.19	.28	.38	.51	.66	.84	1.32	2.57	5.26
3.00	DISCHG	10.89	16.07	17.00	14.98	11.18	7.60	5.32	4.01	3.18	2.63
4.00	DISCHG	2.28	2.05	1.87	1.74	1.63	1.54	1.46	1.39	1.32	1.26
5.00	DISCHG	1.20	1.14	1.09	1.05	1.01	.98	.95	.94	.92	.91

2YR - 6HR

(7)

RT 34

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TR20 XEQ  4/04/**          ROUTE 34-EXISTING CONDITIONS                                    JOB  1   PASS   2
    REV 09/01/83           2YR,10YR-6HR STORMS - TYPE IIISTORM                                      PAGE   3

  6.00   DISCHG        .88      .77      .49      .24      .11      .05      .02      .01      .00

  RUNOFF VOLUME ABOVE BASEFLOW =  2.08 WATERSHED INCHES,     13.44 CFS-HRS,     1.11 ACRE-FEET;   BASEFLOW =    .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP                                                                  RECORD ID
COMPUTATIONS COMPLETED FOR PASS   2


EXECUTIVE CONTROL OPERATION INCREM                                                                  RECORD ID
MAIN TIME INCREMENT =   .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT                                                                  RECORD ID  10-YEAR
FROM XSECTION   1                                                  TO XSECTION   1
       STARTING TIME =   .00    RAIN DEPTH =  5.00    RAIN DURATION=  1.00    RAIN TABLE NO.= 6    ANT. MOIST. COND= 2
       ALTERNATE NO.= 1         STORM NO.= 1    MAIN TIME INCREMENT =   .10 HOURS

OPERATION RUNOFF   CROSS SECTION   1

          PEAK TIME(HRS)              PEAK DISCHARGE(CFS)          PEAK ELEVATION(FEET)
             3.17                          29.65                          (RUNOFF)

TIME(HRS)        FIRST HYDROGRAPH POINT =   .00 HOURS     TIME INCREMENT =  .10 HOURS     DRAINAGE AREA =    .01 SQ.MI.
   1.00   DISCHG        .00      .00      .00      .01      .05      .11      .20      .29      .40      .52
   2.00   DISCHG        .66      .82      .99     1.19     1.45     1.75     2.10     3.05     5.54    10.50
   3.00   DISCHG      20.24    28.60    29.38    25.35    18.69    12.61     8.77     6.56     5.18     4.27
   4.00   DISCHG       3.68     3.30     3.02     2.80     2.62     2.47     2.34     2.22     2.11     2.01
   5.00   DISCHG       1.92     1.83     1.74     1.67     1.61     1.56     1.52     1.49     1.47     1.45
   6.00   DISCHG       1.41     1.22      .78      .38      .18      .09      .04      .02      .01      .00

  RUNOFF VOLUME ABOVE BASEFLOW =  3.66 WATERSHED INCHES,     23.63 CFS-HRS,     1.95 ACRE-FEET;   BASEFLOW =    .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP                                                                  RECORD ID
COMPUTATIONS COMPLETED FOR PASS   3


EXECUTIVE CONTROL OPERATION ENDJOB                                                                  RECORD ID
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10YR-6HR

(81)

TO PARKST CB:

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TR20 XEQ  4/04/**          ROUTE 34-EXISTING CONDITIONS                                    JOB  1   PASS   2
    REV 09/01/83           2YR,10YR-6HR STORMS - TYPE IIISTORM                                      PAGE   3

  5.00   DISCHG      1.04     1.00      .95      .92      .88      .86      .84      .83      .82      .80
  6.00   DISCHG       .78      .65      .32      .12      .04      .02      .01      .00

 RUNOFF VOLUME ABOVE BASEFLOW =  2.54 WATERSHED INCHES,     13.78 CFS-HRS,     1.14 ACRE-FEET;   BASEFLOW =    .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP                                                                  RECORD ID
COMPUTATIONS COMPLETED FOR PASS   2



EXECUTIVE CONTROL OPERATION INCREM                                                                  RECORD ID
MAIN TIME INCREMENT =   .10 HOURS


EXECUTIVE CONTROL OPERATION COMPUT                                                                  RECORD ID  10-YEAR
FROM XSECTION   1                                                    TO XSECTION   1
      STARTING TIME =   .00    RAIN DEPTH =  5.00    RAIN DURATION=  1.00    RAIN TABLE NO.= 6    ANT. MOIST. COND= 2
      ALTERNATE NO.= 1         STORM NO.= 1    MAIN TIME INCREMENT =   .10 HOURS


OPERATION RUNOFF   CROSS SECTION   1

         PEAK TIME(HRS)            PEAK DISCHARGE(CFS)          PEAK ELEVATION(FEET)
            3.10                        31.16                        (RUNOFF)

TIME(HRS)        FIRST HYDROGRAPH POINT =   .00 HOURS     TIME INCREMENT =  .10 HOURS     DRAINAGE AREA =    .01 SQ.MI.
    .00   DISCHG       .00      .00      .00      .00      .00      .00      .00      .00      .01      .05
   1.00   DISCHG       .12      .20      .29      .38      .48      .59      .70      .81      .95     1.08
   2.00   DISCHG      1.25     1.41     1.61     1.83     2.14     2.45     2.83     4.31     7.86    14.22
   3.00   DISCHG     26.31    31.16    26.57    20.69    12.86     8.13     5.78     4.54     3.70     3.22
   4.00   DISCHG      2.90     2.69     2.49     2.34     2.19     2.08     1.97     1.88     1.78     1.70
   5.00   DISCHG      1.62     1.55     1.47     1.42     1.37     1.33     1.30     1.28     1.26     1.24
   6.00   DISCHG      1.21     1.00      .49      .18      .07      .02      .01      .00

 RUNOFF VOLUME ABOVE BASEFLOW =  4.20 WATERSHED INCHES,     22.75 CFS-HRS,     1.88 ACRE-FEET;   BASEFLOW =    .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP                                                                  RECORD ID
COMPUTATIONS COMPLETED FOR PASS   3



EXECUTIVE CONTROL OPERATION ENDJOB                                                                  RECORD ID
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10YR-6HR

7.2

TO YORK ST CS

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TR20 XEQ  4/04/**          ROUTE 34-EXISTING CONDITIONS                                   JOB  1  PASS  1
     REV 09/01/83          2YR,10YR-6HR STORMS - TYPE IIISTORM                                    PAGE  2


EXECUTIVE CONTROL OPERATION INCREM                                                        RECORD ID
MAIN TIME INCREMENT =   .10 HOURS


EXECUTIVE CONTROL OPERATION COMPUT                                                        RECORD ID  1-YEAR
FROM XSECTION   1                                          TO XSECTION   1
      STARTING TIME =   .00    RAIN DEPTH =  2.00    RAIN DURATION=  1.00    RAIN TABLE NO.= 6    ANT. MOIST. COND= 2
      ALTERNATE NO.= 1         STORM NO.= 1    MAIN TIME INCREMENT =   .10 HOURS


OPERATION RUNOFF   CROSS SECTION   1

          PEAK TIME(HRS)            PEAK DISCHARGE(CFS)          PEAK ELEVATION(FEET)
             3.13                        12.47                        (RUNOFF)

TIME(HRS)        FIRST HYDROGRAPH POINT =   .00 HOURS     TIME INCREMENT =  .10 HOURS     DRAINAGE AREA =    .01 SQ.MI.
   2.00   DISCHG      .00      .00      .00      .01      .05      .13      .23      .55     1.40     3.62
   3.00   DISCHG     8.78    12.24    11.56     9.63     6.20     4.03     2.93     2.35     1.93     1.69
   4.00   DISCHG     1.53     1.43     1.33     1.25     1.18     1.12     1.06     1.02      .97      .93
   5.00   DISCHG      .88      .84      .80      .78      .75      .73      .72      .71      .70      .69
   6.00   DISCHG      .67      .56      .27      .10      .04      .01      .00

  RUNOFF VOLUME ABOVE BASEFLOW =   .97 WATERSHED INCHES,      8.85 CFS-HRS,      .73 ACRE-FEET;   BASEFLOW =    .00 CFS


EXECUTIVE CONTROL OPERATION ENDCMP                                                        RECORD ID
COMPUTATIONS COMPLETED FOR PASS   1


EXECUTIVE CONTROL OPERATION INCREM                                                        RECORD ID
MAIN TIME INCREMENT =   .10 HOURS


EXECUTIVE CONTROL OPERATION COMPUT                                                        RECORD ID  2-YEAR
FROM XSECTION   1                                          TO XSECTION   1
      STARTING TIME =   .00    RAIN DEPTH =  3.30    RAIN DURATION=  1.00    RAIN TABLE NO.= 6    ANT. MOIST. COND= 2
      ALTERNATE NO.= 1         STORM NO.= 1    MAIN TIME INCREMENT =   .10 HOURS


OPERATION RUNOFF   CROSS SECTION   1

          PEAK TIME(HRS)            PEAK DISCHARGE(CFS)          PEAK ELEVATION(FEET)
             3.12                        27.19                        (RUNOFF)

TIME(HRS)        FIRST HYDROGRAPH POINT =   .00 HOURS     TIME INCREMENT =  .10 HOURS     DRAINAGE AREA =    .01 SQ.MI.
   1.00   DISCHG      .00      .00      .00      .00      .00      .00      .00      .01      .06      .13
   2.00   DISCHG      .23      .34      .47      .63      .84     1.07     1.36     2.34     4.81    10.07
   3.00   DISCHG    21.11    27.05    24.25    19.53    12.35     7.91     5.69     4.51     3.69     3.23
   4.00   DISCHG     2.91     2.71     2.51     2.36     2.22     2.11     1.99     1.91     1.81     1.73
   5.00   DISCHG     1.64     1.58     1.50     1.45     1.40     1.36     1.33     1.31     1.29     1.27
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1HR - 6HR

2YR - 6HR

(B.2)

TO YORK ST CL

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TR20 XEQ  4/04/**            ROUTE 34-EXISTING CONDITIONS                                   JOB  1   PASS  2
     REV 09/01/83            2YR,10YR-6HR STORMS - TYPE IIISTORM                                     PAGE  3

   6.00    DISCHG      1.24      1.03      .50      .18      .07      .02      .01      .00

  RUNOFF VOLUME ABOVE BASEFLOW =  2.09 WATERSHED INCHES,     19.13 CFS-HRS,     1.58 ACRE-FEET;   BASEFLOW =    .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP                                                            RECORD ID
COMPUTATIONS COMPLETED FOR PASS   2


EXECUTIVE CONTROL OPERATION INCREM                                                            RECORD ID
MAIN TIME INCREMENT =   .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT                                                            RECORD ID  10-YEAR
FROM XSECTION   1                                                    TO XSECTION   1
       STARTING TIME =   .00    RAIN DEPTH =  5.00    RAIN DURATION=  1.00    RAIN TABLE NO.= 6    ANT. MOIST. COND= 2
       ALTERNATE NO.= 1         STORM NO.= 1    MAIN TIME INCREMENT =   .10 HOURS

OPERATION RUNOFF   CROSS SECTION   1

          PEAK TIME(HRS)              PEAK DISCHARGE(CFS)          PEAK ELEVATION(FEET)
             3.11                          47.32                        (RUNOFF)

TIME(HRS)          FIRST HYDROGRAPH POINT =   .00 HOURS     TIME INCREMENT =  .10 HOURS     DRAINAGE AREA =    .01 SQ.MI.
   1.00    DISCHG      .00       .00       .00      .03      .11      .22      .36      .50      .67      .85
   2.00    DISCHG     1.07      1.30      1.57     1.88     2.30     2.75     3.30     5.28    10.15    19.63
   3.00    DISCHG    38.47     47.26     41.24    32.60    20.42    12.99     9.28     7.33     5.97     5.21
   4.00    DISCHG     4.69      4.36      4.04     3.80     3.56     3.38     3.20     3.06     2.90     2.77
   5.00    DISCHG     2.63      2.52      2.40     2.31     2.23     2.18     2.13     2.09     2.06     2.03
   6.00    DISCHG     1.98      1.64       .80      .29      .11      .04      .01      .00

  RUNOFF VOLUME ABOVE BASEFLOW =  3.67 WATERSHED INCHES,     33.62 CFS-HRS,     2.78 ACRE-FEET;   BASEFLOW =    .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP                                                            RECORD ID
COMPUTATIONS COMPLETED FOR PASS   3


EXECUTIVE CONTROL OPERATION ENDJOB                                                            RECORD ID
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10YR-6HR

(2.3)

TO CONGRESS AVE CL.

TR20 XEQ 4/04/** ROUTE 34-EXISTING CONDITIONS JOB 1 PASS 1
REV 09/01/83 2YR,10YR-6HR STORMS - TYPE IIISTORM PAGE 2

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 1-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 2.00 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.16	13.08	(RUNOFF)

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .02 SQ.MI.

2.00	DISCHG	.00	.00	.00	.00	.00	.00	.00	.04	.45	2.45
3.00	DISCHG	8.01	12.74	12.94	11.29	7.43	4.92	3.63	2.94	2.43	2.15
4.00	DISCHG	1.95	1.82	1.70	1.60	1.51	1.44	1.37	1.31	1.25	1.20
5.00	DISCHG	1.14	1.10	1.05	1.01	.98	.96	.94	.92	.91	.90
6.00	DISCHG	.88	.73	.36	.13	.05	.02	.01	.00		

1YR-6HR

RUNOFF VOLUME ABOVE BASEFLOW = .70 WATERSHED INCHES, 9.89 CFS-HRS, .82 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP RECORD ID
COMPUTATIONS COMPLETED FOR PASS 1

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 2-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 3.30 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.13	34.00	(RUNOFF)

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .02 SQ.MI.

2.00	DISCHG	.00	.00	.03	.14	.32	.56	.86	1.81	4.31	10.49
3.00	DISCHG	24.52	33.49	31.26	25.85	16.57	10.74	7.79	6.22	5.11	4.48
4.00	DISCHG	4.05	3.78	3.50	3.30	3.10	2.95	2.80	2.68	2.55	2.44
5.00	DISCHG	2.32	2.22	2.12	2.04	1.98	1.93	1.88	1.86	1.83	1.81
6.00	DISCHG	1.76	1.46	.71	.26	.10	.04	.01	.00		

2YR-6HR

7.3

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TR20 XEQ  4/04/**          ROUTE 34-EXISTING CONDITIONS                                    JOB  1   PASS   2
     REV 09/01/83          2YR,10YR-6HR STORMS - TYPE IIISTORM                                      PAGE   3


  RUNOFF VOLUME ABOVE BASEFLOW =  1.69 WATERSHED INCHES,     24.04 CFS-HRS,     1.99 ACRE-FEET;   BASEFLOW =    .00 CFS


EXECUTIVE CONTROL OPERATION ENDCMP                                                                  RECORD ID
COMPUTATIONS COMPLETED FOR PASS   2



EXECUTIVE CONTROL OPERATION INCREM                                                                  RECORD ID
MAIN TIME INCREMENT =   .10 HOURS


EXECUTIVE CONTROL OPERATION COMPUT                                                                  RECORD ID  10-YEAR
FROM XSECTION   1                                                  TO XSECTION   1
       STARTING TIME =   .00    RAIN DEPTH =  5.00    RAIN DURATION=  1.00    RAIN TABLE NO.= 6    ANT. MOIST. COND= 2
       ALTERNATE NO.= 1         STORM NO.= 1    MAIN TIME INCREMENT =   .10 HOURS


OPERATION RUNOFF   CROSS SECTION   1

          PEAK TIME(HRS)              PEAK DISCHARGE(CFS)          PEAK ELEVATION(FEET)
              3.12                          64.07                          (RUNOFF)

TIME(HRS)        FIRST HYDROGRAPH POINT =   .00 HOURS     TIME INCREMENT =  .10 HOURS     DRAINAGE AREA =    .02 SQ.MI.
   1.00   DISCHG        .00       .00       .00       .00       .00       .00       .00       .03       .15       .33
   2.00   DISCHG        .56       .82      1.14      1.51      2.00      2.55      3.24      5.56     11.38     23.78
   3.00   DISCHG      49.79     63.74     57.11     45.96     29.05     18.62     13.38     10.61      8.68      7.59
   4.00   DISCHG       6.84      6.37      5.90      5.55      5.21      4.95      4.69      4.48      4.26      4.07
   5.00   DISCHG       3.87      3.70      3.53      3.40      3.29      3.21      3.13      3.08      3.04      3.00
   6.00   DISCHG       2.92      2.42      1.18       .43       .16       .06       .02       .01       .00

  RUNOFF VOLUME ABOVE BASEFLOW =  3.17 WATERSHED INCHES,     45.08 CFS-HRS,     3.73 ACRE-FEET;   BASEFLOW =    .00 CFS


EXECUTIVE CONTROL OPERATION ENDCMP                                                                  RECORD ID
COMPUTATIONS COMPLETED FOR PASS   3



EXECUTIVE CONTROL OPERATION ENDJOB                                                                  RECORD ID
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10YR-6HR

(B.4)

TO W. WATER ST CR

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TR20 XEQ  4/04/**          ROUTE 34-EXISTING CONDITIONS                                    JOB  1  PASS  1
     REV 09/01/83          2YR,10YR-6HR STORMS - TYPE III STORM                                    PAGE  2


EXECUTIVE CONTROL OPERATION INCREM                                                          RECORD ID
MAIN TIME INCREMENT =   .10 HOURS


EXECUTIVE CONTROL OPERATION COMPUT                                                          RECORD ID   1-YEAR
FROM XSECTION   1                                          TO XSECTION   1
      STARTING TIME =   .00   RAIN DEPTH =  2.00   RAIN DURATION=  1.00   RAIN TABLE NO.= 6   ANT. MOIST. COND= 2
      ALTERNATE NO.= 1        STORM NO.= 1   MAIN TIME INCREMENT =   .10 HOURS


OPERATION RUNOFF   CROSS SECTION   1

          PEAK TIME(HRS)            PEAK DISCHARGE(CFS)          PEAK ELEVATION(FEET)
             3.23                        17.69                        (RUNOFF)

TIME(HRS)        FIRST HYDROGRAPH POINT =   .00 HOURS     TIME INCREMENT =  .10 HOURS     DRAINAGE AREA =    .03 SQ.MI.
  2.00   DISCHG      .00     .00     .00     .00     .00     .00     .00     .04     .42    2.23
  3.00   DISCHG     7.70   14.39   17.48   16.90   13.28    9.35    6.75    5.23    4.23    3.56
  4.00   DISCHG     3.12    2.83    2.61    2.43    2.29    2.17    2.06    1.97    1.88    1.79
  5.00   DISCHG     1.71    1.64    1.57    1.51    1.46    1.42    1.38    1.36    1.34    1.32
  6.00   DISCHG     1.29    1.12     .72     .35     .17     .08     .04     .02     .01     .00

 RUNOFF VOLUME ABOVE BASEFLOW =   .69 WATERSHED INCHES,     14.33 CFS-HRS,     1.18 ACRE-FEET;   BASEFLOW =    .00 CFS


EXECUTIVE CONTROL OPERATION ENDCMP                                                          RECORD ID
COMPUTATIONS COMPLETED FOR PASS   1


EXECUTIVE CONTROL OPERATION INCREM                                                          RECORD ID
MAIN TIME INCREMENT =   .10 HOURS


EXECUTIVE CONTROL OPERATION COMPUT                                                          RECORD ID   2-YEAR
FROM XSECTION   1                                          TO XSECTION   1
      STARTING TIME =   .00   RAIN DEPTH =  3.30   RAIN DURATION=  1.00   RAIN TABLE NO.= 6   ANT. MOIST. COND= 2
      ALTERNATE NO.= 1        STORM NO.= 1   MAIN TIME INCREMENT =   .10 HOURS


OPERATION RUNOFF   CROSS SECTION   1

          PEAK TIME(HRS)            PEAK DISCHARGE(CFS)          PEAK ELEVATION(FEET)
             3.20                        44.22                        (RUNOFF)

TIME(HRS)        FIRST HYDROGRAPH POINT =   .00 HOURS     TIME INCREMENT =  .10 HOURS     DRAINAGE AREA =    .03 SQ.MI.
  2.00   DISCHG      .00     .00     .02     .13     .33     .62    1.01    1.98    4.59   10.90
  3.00   DISCHG    25.36   40.05   44.22   40.17   30.49   20.98   14.85   11.30    9.02    7.52
  4.00   DISCHG     6.53    5.89    5.40    5.02    4.71    4.46    4.22    4.02    3.83    3.65
  5.00   DISCHG     3.48    3.33    3.18    3.05    2.94    2.86    2.79    2.73    2.69    2.65
  6.00   DISCHG     2.59    2.24    1.43     .71     .34     .16     .07     .03     .01     .01
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1YR-6HR

2YR-6HR

(P.4)

TO WEST WATER ST CB

TR20 XEQ 4/04/** ROUTE 34-EXISTING CONDITIONS JOB 1 PASS 2
REV 09/01/83 2YR,10YR-6HR STORMS - TYPE IIISTORM PAGE 3

7.00 DISCHG .00

RUNOFF VOLUME ABOVE BASEFLOW = 1.69 WATERSHED INCHES, 34.87 CFS-HRS, 2.88 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP RECORD ID
COMPUTATIONS COMPLETED FOR PASS 2

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 10-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 5.00 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.18	82.98	(RUNOFF)

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .03 SQ.MI.

1.00	DISCHG	.00	.00	.00	.00	.00	.00	.00	.03	.13	.34
2.00	DISCHG	.63	.98	1.39	1.88	2.51	3.24	4.15	6.47	12.59	25.71
3.00	DISCHG	53.07	78.27	82.72	72.85	54.34	36.94	25.87	19.49	15.45	12.79
4.00	DISCHG	11.06	9.95	9.10	8.45	7.92	7.48	7.08	6.73	6.40	6.11
5.00	DISCHG	5.81	5.55	5.30	5.08	4.90	4.75	4.63	4.54	4.47	4.40
6.00	DISCHG	4.29	3.71	2.38	1.17	.56	.26	.12	.06	.02	.01
7.00	DISCHG	.00									

10YR - 6HR

RUNOFF VOLUME ABOVE BASEFLOW = 3.17 WATERSHED INCHES, 65.42 CFS-HRS, 5.41 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP RECORD ID
COMPUTATIONS COMPLETED FOR PASS 3

EXECUTIVE CONTROL OPERATION ENDJOB RECORD ID

TR20 XEQ 5/05/** ROUTE 34-EXISTING CONDITIONS JOB 1 PASS 1
REV 09/01/83 2YR,10YR-6HR STORMS - TYPE IIISTORM PAGE 2

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 1-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 2.50 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.37	66.47	(RUNOFF)

1YR

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .16 SQ.MI.

2.00	DISCHG	.00	.00	.00	.00	.00	.00	.00	.00	.04	2.19
3.00	DISCHG	10.61	29.25	50.13	63.47	66.07	57.51	46.74	37.07	29.96	24.88
4.00	DISCHG	21.06	18.36	16.35	14.86	13.65	12.67	11.84	11.17	10.59	10.10
5.00	DISCHG	9.64	9.22	8.82	8.46	8.14	7.87	7.64	7.46	7.31	7.19
6.00	DISCHG	7.08	6.70	5.79	4.28	2.81	1.72	1.03	.64	.38	.23
7.00	DISCHG	.14	.08	.05	.03	.01	.00				

RUNOFF VOLUME ABOVE BASEFLOW = .65 WATERSHED INCHES, 67.11 CFS-HRS, 5.55 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP RECORD ID
COMPUTATIONS COMPLETED FOR PASS 1

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 2-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 3.50 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.34	139.99	(RUNOFF)

2YR

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .16 SQ.MI.

2.00	DISCHG	.00	.00	.00	.00	.00	.00	.00	.43	2.27	11.82
3.00	DISCHG	36.13	77.99	118.24	138.15	136.20	114.83	91.10	70.95	56.32	46.08
4.00	DISCHG	38.48	33.19	29.27	26.39	24.08	22.21	20.67	19.43	18.38	17.49
5.00	DISCHG	16.67	15.91	15.20	14.55	13.98	13.49	13.09	12.76	12.49	12.28

(9)

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TR20 XEQ  5/05/**          ROUTE 34-EXISTING CONDITIONS                                    JOB  1   PASS   2
    REV 09/01/83           2YR,10YR-6HR STORMS - TYPE III STORM                                     PAGE   3

  6.00   DISCHG     12.06    11.42     9.85     7.29     4.78     2.93     1.76     1.09      .65      .40
  7.00   DISCHG       .24      .14      .08      .04      .02      .01      .00

 RUNOFF VOLUME ABOVE BASEFLOW =  1.30 WATERSHED INCHES,    134.30 CFS-HRS,    11.10 ACRE-FEET;   BASEFLOW =    .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP                                                                  RECORD ID
COMPUTATIONS COMPLETED FOR PASS   2



EXECUTIVE CONTROL OPERATION INCREM                                                                  RECORD ID
MAIN TIME INCREMENT =   .10 HOURS


EXECUTIVE CONTROL OPERATION COMPUT                                                                  RECORD ID  10-YEAR
FROM XSECTION   1                                                   TO XSECTION   1
       STARTING TIME =   .00    RAIN DEPTH =  4.70    RAIN DURATION=  1.00    RAIN TABLE NO.= 6    ANT. MOIST. COND= 2
       ALTERNATE NO.= 1         STORM NO.= 1    MAIN TIME INCREMENT =   .10 HOURS


OPERATION RUNOFF   CROSS SECTION   1

          PEAK TIME(HRS)              PEAK DISCHARGE(CFS)          PEAK ELEVATION(FEET)
             3.32                          242.91                          (RUNOFF)

TIME(HRS)        FIRST HYDROGRAPH POINT =   .00 HOURS     TIME INCREMENT =  .10 HOURS     DRAINAGE AREA =    .16 SQ.MI.
  2.00   DISCHG       .00      .00      .00      .03      .18      .77     1.89     5.01    12.02    33.76
  3.00   DISCHG     80.36   152.46   216.29   242.11   231.58   191.72   149.96   115.53    90.71    73.53
  4.00   DISCHG     60.88    52.14    45.68    40.98    37.22    34.20    31.74    29.78    28.12    26.73
  5.00   DISCHG     25.45    24.25    23.15    22.14    21.25    20.49    19.86    19.34    18.93    18.59
  6.00   DISCHG     18.25    17.26    14.88    11.01     7.21     4.42     2.66     1.64      .99      .60
  7.00   DISCHG       .36      .21      .12      .07      .03      .01      .00

 RUNOFF VOLUME ABOVE BASEFLOW =  2.21 WATERSHED INCHES,    227.82 CFS-HRS,    18.83 ACRE-FEET;   BASEFLOW =    .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP                                                                  RECORD ID
COMPUTATIONS COMPLETED FOR PASS   3



EXECUTIVE CONTROL OPERATION ENDJOB                                                                  RECORD ID
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10YR

TR20 XEQ 5/05/** ROUTE 34-EXISTING CONDITIONS JOB 1 PASS 1
REV 09/01/83 2YR,10YR-6HR STORMS - TYPE III STORM PAGE 2

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 1-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 2.50 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

1YR

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.20	9.68	(RUNOFF)

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .02 SQ.MI.

2.00	DISCHG	.00	.00	.00	.00	.00	.00	.00	.00	.01	.86
3.00	DISCHG	4.63	8.77	9.68	8.85	5.96	4.01	3.00	2.46	2.05	1.81
4.00	DISCHG	1.65	1.55	1.45	1.37	1.29	1.24	1.18	1.13	1.08	1.03
5.00	DISCHG	.99	.95	.91	.88	.85	.83	.81	.80	.79	.79
6.00	DISCHG	.77	.64	.31	.11	.04	.02	.01	.00		

RUNOFF VOLUME ABOVE BASEFLOW = .65 WATERSHED INCHES, 7.58 CFS-HRS, .63 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP RECORD ID
COMPUTATIONS COMPLETED FOR PASS 1

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 2-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 3.50 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

2YR

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.15	20.75	(RUNOFF)

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .02 SQ.MI.

2.00	DISCHG	.00	.00	.00	.00	.00	.00	.00	.16	1.01	4.28
3.00	DISCHG	12.91	19.88	19.87	17.16	11.24	7.41	5.45	4.41	3.64	3.21
4.00	DISCHG	2.91	2.72	2.53	2.39	2.25	2.15	2.04	1.95	1.86	1.78
5.00	DISCHG	1.70	1.63	1.56	1.50	1.45	1.42	1.39	1.37	1.36	1.34
6.00	DISCHG	1.31	1.08	.53	.19	.07	.03	.01	.00		

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TR20 XEQ  5/05/**          ROUTE 34-EXISTING CONDITIONS                                    JOB  1   PASS   2
    REV 09/01/83           2YR,10YR-6HR STORMS - TYPE IIISTORM                                      PAGE   3


  RUNOFF VOLUME ABOVE BASEFLOW =  1.30 WATERSHED INCHES,     15.15 CFS-HRS,     1.25 ACRE-FEET;   BASEFLOW =    .00 CFS


EXECUTIVE CONTROL OPERATION ENDCMP                                                                  RECORD ID
COMPUTATIONS COMPLETED FOR PASS   2



EXECUTIVE CONTROL OPERATION INCREM                                                                  RECORD ID
MAIN TIME INCREMENT =   .10 HOURS


EXECUTIVE CONTROL OPERATION COMPUT                                                                  RECORD ID  10-YEAR
FROM XSECTION   1                                                  TO XSECTION   1
       STARTING TIME =   .00    RAIN DEPTH =  4.70    RAIN DURATION=  1.00    RAIN TABLE NO.= 6    ANT. MOIST. COND= 2
       ALTERNATE NO.= 1         STORM NO.= 1    MAIN TIME INCREMENT =   .10 HOURS


OPERATION RUNOFF   CROSS SECTION   1

          PEAK TIME(HRS)              PEAK DISCHARGE(CFS)          PEAK ELEVATION(FEET)
             3.14                          36.10                          (RUNOFF)

TIME(HRS)        FIRST HYDROGRAPH POINT =   .00 HOURS     TIME INCREMENT =  .10 HOURS     DRAINAGE AREA =    .02 SQ.MI.
   2.00   DISCHG        .00       .00       .00       .01       .09       .28       .56      1.44      3.83     10.19
   3.00   DISCHG      25.14     35.36     33.57     28.08     18.10     11.79      8.58      6.88      5.66      4.97
   4.00   DISCHG       4.49      4.19      3.89      3.67      3.45      3.29      3.12      2.98      2.84      2.72
   5.00   DISCHG       2.59      2.48      2.36      2.28      2.21      2.16      2.11      2.08      2.05      2.02
   6.00   DISCHG       1.97      1.63       .80       .29       .11       .04       .01       .00

  RUNOFF VOLUME ABOVE BASEFLOW =  2.21 WATERSHED INCHES,     25.68 CFS-HRS,     2.12 ACRE-FEET;   BASEFLOW =    .00 CFS


EXECUTIVE CONTROL OPERATION ENDCMP                                                                  RECORD ID
COMPUTATIONS COMPLETED FOR PASS   3



EXECUTIVE CONTROL OPERATION ENDJOB                                                                  RECORD ID
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10YR

TR20 XEQ 5/05/** ROUTE 34-EXISTING CONDITIONS JOB 1 PASS 1
REV 09/01/83 2YR,10YR-6HR STORMS - TYPE IIISTORM PAGE 2

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 1-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 2.50 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.13	8.93	(RUNOFF)

1YR

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .01 SQ.MI.

2.00	DISCHG	.00	.00	.00	.00	.00	.00	.00	.00	.03	1.56
3.00	DISCHG	6.33	8.76	8.32	6.40	3.53	2.55	2.05	1.76	1.52	1.40
4.00	DISCHG	1.31	1.23	1.16	1.10	1.04	1.00	.95	.91	.87	.84
5.00	DISCHG	.80	.77	.74	.71	.70	.68	.67	.66	.66	.65
6.00	DISCHG	.62	.34	.08	.02	.00					

RUNOFF VOLUME ABOVE BASEFLOW = .65 WATERSHED INCHES, 6.27 CFS-HRS, .52 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP RECORD ID
COMPUTATIONS COMPLETED FOR PASS 1

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 2-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 3.50 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.10	18.53	(RUNOFF)

2YR

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .01 SQ.MI.

2.00	DISCHG	.00	.00	.00	.00	.00	.00	.00	.30	1.46	6.29
3.00	DISCHG	15.77	18.53	16.24	12.00	6.48	4.60	3.66	3.14	2.70	2.47
4.00	DISCHG	2.30	2.16	2.02	1.92	1.81	1.73	1.65	1.58	1.51	1.44
5.00	DISCHG	1.37	1.32	1.26	1.22	1.19	1.17	1.14	1.13	1.12	1.10
6.00	DISCHG	1.06	.57	.14	.03	.01	.00				

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TR20 XEQ  5/05/**          ROUTE 34-EXISTING CONDITIONS                                    JOB  1   PASS   2
    REV 09/01/83           2YR,10YR-6HR STORMS - TYPE IIISTORM                                      PAGE   3


 RUNOFF VOLUME ABOVE BASEFLOW =  1.30 WATERSHED INCHES,     12.55 CFS-HRS,     1.04 ACRE-FEET;   BASEFLOW =    .00 CFS


EXECUTIVE CONTROL OPERATION ENDCMP                                                                  RECORD ID
COMPUTATIONS COMPLETED FOR PASS   2



EXECUTIVE CONTROL OPERATION INCREM                                                                  RECORD ID
MAIN TIME INCREMENT =   .10 HOURS


EXECUTIVE CONTROL OPERATION COMPUT                                                                  RECORD ID  10-YEAR
FROM XSECTION   1                                                  TO XSECTION   1
      STARTING TIME =   .00    RAIN DEPTH =  4.70    RAIN DURATION=  1.00    RAIN TABLE NO.= 6    ANT. MOIST. COND= 2
      ALTERNATE NO.= 1         STORM NO.= 1    MAIN TIME INCREMENT =   .10 HOURS


OPERATION RUNOFF   CROSS SECTION   1

          PEAK TIME(HRS)              PEAK DISCHARGE(CFS)          PEAK ELEVATION(FEET)
             3.08                          31.89                          (RUNOFF)

TIME(HRS)        FIRST HYDROGRAPH POINT =   .00 HOURS     TIME INCREMENT =  .10 HOURS     DRAINAGE AREA =    .01 SQ.MI.
   2.00   DISCHG        .00       .00       .00       .02       .13       .35       .64      1.96      4.65     13.69
   3.00   DISCHG      29.21     31.79     26.67     19.25     10.27      7.22      5.71      4.87      4.18      3.82
   4.00   DISCHG       3.55      3.32      3.11      2.94      2.78      2.65      2.52      2.41      2.30      2.20
   5.00   DISCHG       2.09      2.00      1.92      1.86      1.80      1.77      1.73      1.71      1.70      1.66
   6.00   DISCHG       1.60       .86       .21       .05       .01       .00

 RUNOFF VOLUME ABOVE BASEFLOW =  2.20 WATERSHED INCHES,     21.30 CFS-HRS,     1.76 ACRE-FEET;   BASEFLOW =    .00 CFS


EXECUTIVE CONTROL OPERATION ENDCMP                                                                  RECORD ID
COMPUTATIONS COMPLETED FOR PASS   3



EXECUTIVE CONTROL OPERATION ENDJOB                                                                  RECORD ID
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10YR

TR20 XEQ 5/05/** ROUTE 34-EXISTING CONDITIONS JOB 1 PASS 1
REV 09/01/83 2YR,10YR-GHR STORMS - TYPE IIISTORM PAGE 2

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 1-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 2.50 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.20	17.21	(RUNOFF)

1YR

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .03 SQ.MI.

2.00	DISCHG	.00	.00	.00	.00	.00	.00	.00	.00	.02	1.52
3.00	DISCHG	8.23	15.60	17.21	15.73	10.59	7.13	5.34	4.37	3.64	3.23
4.00	DISCHG	2.94	2.75	2.57	2.44	2.30	2.20	2.09	2.01	1.91	1.84
5.00	DISCHG	1.75	1.69	1.61	1.56	1.51	1.48	1.45	1.43	1.41	1.40
6.00	DISCHG	1.36	1.13	.55	.20	.08	.03	.01	.00		

RUNOFF VOLUME ABOVE BASEFLOW = .65 WATERSHED INCHES, 13.47 CFS-HRS, 1.11 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDOP RECORD ID
COMPUTATIONS COMPLETED FOR PASS 1

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 2-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 3.50 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.15	36.88	(RUNOFF)

2YR

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .03 SQ.MI.

2.00	DISCHG	.00	.00	.00	.00	.00	.00	.00	.28	1.80	7.61
3.00	DISCHG	22.95	35.34	35.32	30.50	19.98	13.18	9.70	7.83	6.48	5.71
4.00	DISCHG	5.17	4.84	4.50	4.25	4.00	3.82	3.62	3.47	3.31	3.17
5.00	DISCHG	3.02	2.90	2.77	2.67	2.59	2.53	2.47	2.44	2.41	2.38
6.00	DISCHG	2.32	1.92	.94	.35	.13	.05	.02	.00		

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TR20 XEQ  5/05/**          ROUTE 34-EXISTING CONDITIONS                                    JOB  1   PASS   2
    REV 09/01/83           2YR,10YR-6HR STORMS - TYPE IIISTORM                                       PAGE   3


  RUNOFF VOLUME ABOVE BASEFLOW =  1.30 WATERSHED INCHES,     26.93 CFS-HRS,     2.23 ACRE-FEET;   BASEFLOW =    .00 CFS


EXECUTIVE CONTROL OPERATION ENDCMP                                                                  RECORD ID
COMPUTATIONS COMPLETED FOR PASS   2



EXECUTIVE CONTROL OPERATION INCREM                                                                  RECORD ID
MAIN TIME INCREMENT =   .10 HOURS


EXECUTIVE CONTROL OPERATION COMPUT                                                                  RECORD ID  10-YEAR
FROM XSECTION   1                                                  TO XSECTION   1
       STARTING TIME =   .00    RAIN DEPTH =  4.70    RAIN DURATION=  1.00    RAIN TABLE NO.= 6    ANT. MOIST. COND= 2
       ALTERNATE NO.= 1         STORM NO.= 1    MAIN TIME INCREMENT =   .10 HOURS


OPERATION RUNOFF   CROSS SECTION   1

          PEAK TIME(HRS)              PEAK DISCHARGE(CFS)          PEAK ELEVATION(FEET)
             3.14                          64.17                          (RUNOFF)

TIME(HRS)        FIRST HYDROGRAPH POINT =   .00 HOURS     TIME INCREMENT =  .10 HOURS     DRAINAGE AREA =    .03 SQ.MI.
   2.00   DISCHG        .00       .00       .00       .01       .15       .49      1.00      2.57      6.82     18.11
   3.00   DISCHG      44.70     62.86     59.69     49.92     32.18     20.96     15.26     12.23     10.06      8.84
   4.00   DISCHG       7.99      7.45      6.92      6.53      6.14      5.85      5.54      5.30      5.04      4.83
   5.00   DISCHG       4.60      4.41      4.20      4.06      3.92      3.83      3.75      3.69      3.64      3.59
   6.00   DISCHG       3.51      2.90      1.42       .52       .19       .07       .02       .01       .00

  RUNOFF VOLUME ABOVE BASEFLOW =  2.21 WATERSHED INCHES,     45.65 CFS-HRS,     3.77 ACRE-FEET;   BASEFLOW =    .00 CFS


EXECUTIVE CONTROL OPERATION ENDCMP                                                                  RECORD ID
COMPUTATIONS COMPLETED FOR PASS   3



EXECUTIVE CONTROL OPERATION ENDJOB                                                                  RECORD ID
```

10YR

TR20 XEQ 5/05/** ROUTE 34-EXISTING CONDITIONS JOB 1 PASS 1
REV 09/01/83 2YR,10YR-6HR STORMS - TYPE IIISTORM PAGE 2

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 1-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 2.50 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

1YR

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.26	29.93	(RUNOFF)

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .06 SQ.MI.

2.00	DISCHG	.00	.00	.00	.00	.00	.00	.00	.00	.06	1.64
3.00	DISCHG	9.50	21.52	28.76	29.45	23.83	17.11	12.56	9.85	8.06	6.85
4.00	DISCHG	6.04	5.50	5.08	4.76	4.48	4.26	4.05	3.87	3.70	3.54
5.00	DISCHG	3.39	3.25	3.11	2.99	2.89	2.82	2.75	2.71	2.67	2.64
6.00	DISCHG	2.58	2.24	1.43	.71	.34	.16	.07	.03	.01	.01
7.00	DISCHG	.00									

RUNOFF VOLUME ABOVE BASEFLOW = .65 WATERSHED INCHES, 25.14 CFS-HRS, 2.08 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP RECORD ID
COMPUTATIONS COMPLETED FOR PASS 1

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 2-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 3.50 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

2YR

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.23	62.54	(RUNOFF)

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .06 SQ.MI.

2.00	DISCHG	.00	.00	.00	.00	.00	.00	.00	.33	2.18	9.20
3.00	DISCHG	28.85	52.05	62.03	59.27	46.26	32.44	23.35	18.02	14.55	12.23
4.00	DISCHG	10.70	9.69	8.92	8.32	7.83	7.42	7.04	6.71	6.40	6.12
5.00	DISCHG	5.84	5.59	5.34	5.14	4.96	4.82	4.71	4.62	4.56	4.50

TR20 XEQ 5/05/** ROUTE 34-EXISTING CONDITIONS JOB 1 PASS 2
REV 09/01/83 2YR,10YR-6HR STORMS - TYPE IIISTORM PAGE 3

6.00	DISCHG	4.39	3.80	2.43	1.20	.57	.27	.12	.06	.02	.01
7.00	DISCHG	.00									

RUNOFF VOLUME ABOVE BASEFLOW = 1.30 WATERSHED INCHES, 50.31 CFS-HRS, 4.16 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP RECORD ID
COMPUTATIONS COMPLETED FOR PASS 2

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 10-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 4.70 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.21	107.87	(RUNOFF)

10YR

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .06 SQ.MI.

2.00	DISCHG	.00	.00	.00	.02	.17	.61	1.39	3.44	9.13	23.76
3.00	DISCHG	58.78	95.78	107.80	99.21	75.86	52.46	37.30	28.48	22.82	19.05
4.00	DISCHG	16.58	14.97	13.74	12.79	12.01	11.37	10.77	10.25	9.77	9.34
5.00	DISCHG	8.90	8.50	8.13	7.80	7.53	7.31	7.14	7.00	6.90	6.80
6.00	DISCHG	6.63	5.75	3.68	1.81	.86	.40	.19	.09	.04	.01
7.00	DISCHG	.00									

RUNOFF VOLUME ABOVE BASEFLOW = 2.20 WATERSHED INCHES, 85.34 CFS-HRS, 7.05 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP RECORD ID
COMPUTATIONS COMPLETED FOR PASS 3

EXECUTIVE CONTROL OPERATION ENDJOB RECORD ID

TR20 XEQ 5/05/** ROUTE 34-EXISTING CONDITIONS JOB 1 PASS 1
REV 09/01/83 2YR,10YR-6HR STORMS - TYPE IIISTORM PAGE 2

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 1-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 2.50 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.27	64.23	(RUNOFF)

1YR

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .13 SQ.MI.

2.00	DISCHG	.00	.00	.00	.00	.00	.00	.00	.00	.06	3.24
3.00	DISCHG	18.72	43.61	60.66	63.76	53.58	39.48	29.08	22.77	18.50	15.63
4.00	DISCHG	13.69	12.37	11.37	10.60	9.97	9.45	8.99	8.58	8.20	7.86
5.00	DISCHG	7.51	7.19	6.89	6.63	6.40	6.23	6.08	5.97	5.89	5.82
6.00	DISCHG	5.67	4.89	3.20	1.64	.81	.40	.20	.09	.04	.02
7.00	DISCHG	.00									

RUNOFF VOLUME ABOVE BASEFLOW = .65 WATERSHED INCHES, 55.20 CFS-HRS, 4.56 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP RECORD ID
COMPUTATIONS COMPLETED FOR PASS 1

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 2-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 3.50 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.24	134.77	(RUNOFF)

2YR

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .13 SQ.MI.

2.00	DISCHG	.00	.00	.00	.00	.00	.00	.01	.61	3.99	18.11
3.00	DISCHG	57.77	107.17	132.52	129.69	104.80	75.33	54.39	41.87	33.55	28.02
4.00	DISCHG	24.32	21.82	19.97	18.56	17.41	16.46	15.62	14.88	14.20	13.57
5.00	DISCHG	12.95	12.39	11.84	11.37	10.98	10.66	10.40	10.21	10.05	9.91

(14)

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TR20 XEQ  5/05/**          ROUTE 34-EXISTING CONDITIONS                                    JOB  1   PASS   2
    REV 09/01/83           2YR,10YR-6HR STORMS - TYPE IIISTORM                                      PAGE   3

  6.00   DISCHG      9.65     8.32     5.45     2.80     1.38      .68      .33      .16      .07      .03
  7.00   DISCHG       .01      .00

 RUNOFF VOLUME ABOVE BASEFLOW =  1.30 WATERSHED INCHES,    110.46 CFS-HRS,     9.13 ACRE-FEET;   BASEFLOW =    .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP                                                                  RECORD ID
COMPUTATIONS COMPLETED FOR PASS   2



EXECUTIVE CONTROL OPERATION INCREM                                                                  RECORD ID
MAIN TIME INCREMENT =   .10 HOURS


EXECUTIVE CONTROL OPERATION COMPUT                                                                  RECORD ID  10-YEAR
FROM XSECTION   1                                                  TO XSECTION   1
      STARTING TIME =   .00    RAIN DEPTH =  4.70    RAIN DURATION=  1.00    RAIN TABLE NO.= 6    ANT. MOIST. COND= 2
      ALTERNATE NO.= 1         STORM NO.= 1    MAIN TIME INCREMENT =   .10 HOURS


OPERATION RUNOFF   CROSS SECTION   1

          PEAK TIME(HRS)              PEAK DISCHARGE(CFS)          PEAK ELEVATION(FEET)
             3.22                          232.98                        (RUNOFF)

TIME(HRS)        FIRST HYDROGRAPH POINT =   .00 HOURS     TIME INCREMENT =  .10 HOURS     DRAINAGE AREA =    .13 SQ.MI.
  2.00   DISCHG       .00      .00      .00      .04      .34     1.23     2.87     6.94    17.84    47.50
  3.00   DISCHG    118.92   198.87   231.95   218.44   172.60   122.26    87.23    66.43    52.76    43.76
  4.00   DISCHG     37.75    33.74    30.79    28.56    26.74    25.24    23.91    22.76    21.68    20.70
  5.00   DISCHG     19.74    18.86    18.01    17.28    16.67    16.18    15.77    15.46    15.22    14.99
  6.00   DISCHG     14.59    12.57     8.23     4.22     2.09     1.03      .51      .24      .11      .05
  7.00   DISCHG       .01      .00

 RUNOFF VOLUME ABOVE BASEFLOW =  2.20 WATERSHED INCHES,    187.40 CFS-HRS,    15.49 ACRE-FEET;   BASEFLOW =    .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP                                                                  RECORD ID
COMPUTATIONS COMPLETED FOR PASS   3



EXECUTIVE CONTROL OPERATION ENDJOB                                                                  RECORD ID
```

10YR

TR20 XEQ 5/05/** ROUTE 34-EXISTING CONDITIONS JOB 1 PASS 1
REV 09/01/83 2YR,10YR-6HR STORMS - TYPE IIISTORM PAGE 2

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 1-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 2.50 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.20	15.60	(RUNOFF)

1YR

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .03 SQ.MI.

2.00	DISCHG	.00	.00	.00	.00	.00	.00	.00	.00	.02	1.38
3.00	DISCHG	7.46	14.13	15.60	14.26	9.60	6.46	4.84	3.96	3.30	2.92
4.00	DISCHG	2.66	2.50	2.33	2.21	2.08	1.99	1.89	1.82	1.73	1.67
5.00	DISCHG	1.59	1.53	1.46	1.41	1.37	1.34	1.31	1.29	1.28	1.26
6.00	DISCHG	1.24	1.03	.50	.18	.07	.02	.01	.00		

RUNOFF VOLUME ABOVE BASEFLOW = .65 WATERSHED INCHES, 12.20 CFS-HRS, 1.01 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP RECORD ID
COMPUTATIONS COMPLETED FOR PASS 1

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 2-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 3.50 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.15	33.42	(RUNOFF)

2YR

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .03 SQ.MI.

2.00	DISCHG	.00	.00	.00	.00	.00	.00	.00	.26	1.63	6.89
3.00	DISCHG	20.80	32.03	32.01	27.64	18.10	11.94	8.79	7.10	5.87	5.17
4.00	DISCHG	4.69	4.38	4.08	3.85	3.63	3.46	3.28	3.15	3.00	2.87
5.00	DISCHG	2.74	2.63	2.51	2.42	2.34	2.29	2.24	2.21	2.18	2.15
6.00	DISCHG	2.10	1.74	.85	.31	.12	.04	.01	.00		

TR20 XEQ 5/05/** ROUTE 34-EXISTING CONDITIONS JOB 1 PASS 2
REV 09/01/83 2YR,10YR-6HR STORMS - TYPE IIISTORM PAGE 3

RUNOFF VOLUME ABOVE BASEFLOW = 1.30 WATERSHED INCHES, 24.40 CFS-HRS, 2.02 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDOMP RECORD ID
COMPUTATIONS COMPLETED FOR PASS 2

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID 10-YEAR
FROM XSECTION 1 TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 4.70 RAIN DURATION= 1.00 RAIN TABLE NO.= 6 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 1

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
3.14	58.16	(RUNOFF)

10YR

TIME(HRS) FIRST HYDROGRAPH POINT = .00 HOURS TIME INCREMENT = .10 HOURS DRAINAGE AREA = .03 SQ.MI.

2.00	DISCHG	.00	.00	.00	.01	.14	.44	.91	2.33	6.18	16.41
3.00	DISCHG	40.51	56.96	54.09	45.24	29.16	18.99	13.83	11.08	9.12	8.01
4.00	DISCHG	7.24	6.76	6.27	5.92	5.56	5.30	5.02	4.81	4.57	4.38
5.00	DISCHG	4.17	3.99	3.81	3.68	3.56	3.47	3.39	3.34	3.30	3.26
6.00	DISCHG	3.18	2.63	1.28	.47	.18	.06	.02	.01	.00	

RUNOFF VOLUME ABOVE BASEFLOW = 2.21 WATERSHED INCHES, 41.37 CFS-HRS, 3.42 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDOMP RECORD ID
COMPUTATIONS COMPLETED FOR PASS 3

EXECUTIVE CONTROL OPERATION ENDJOB RECORD ID

CARDINAL
ENGINEERING ASSOC., INC.
3 Colony Street
MERIDEN, CONNECTICUT 06451
(203) 238-1969 FAX (203) 630-2056

JOB: EPA 308
SHEET NO. _____ OF 8-99
CALCULATED BY: VR DATE _____
CHECKED BY: DPA DATE: 5/3/14
SCALE _____

- D.A TO WEST WATER ST CB:

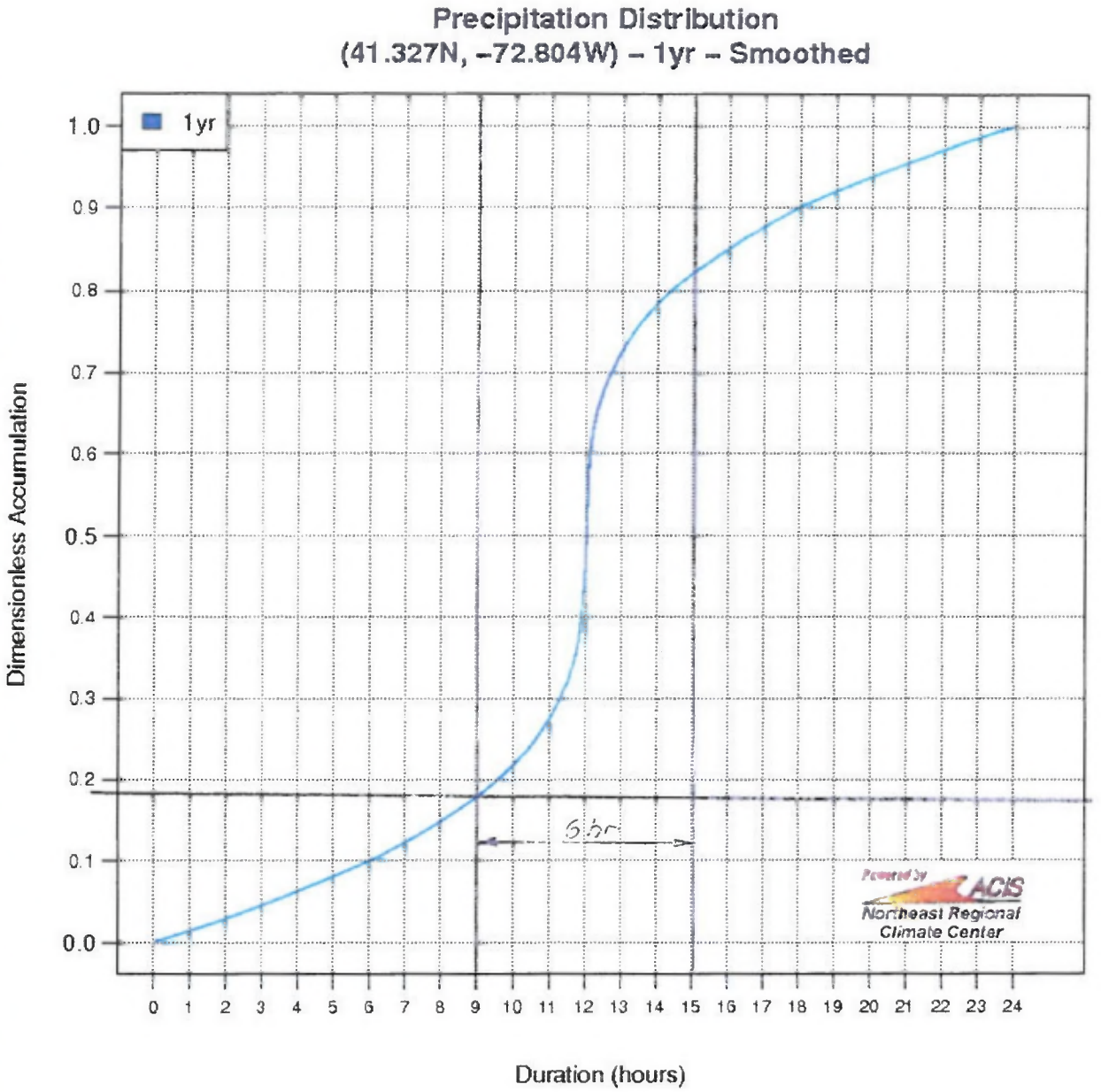
TOTAL D.A = 22.5 AC
- 50% ROOF → DA = 20.4 AC

IMPERV - 70% CN = 98
PERV - 30% CN = 49

CN_{AVE} = 83

T_C = 20 min
USE TR20:

Q_1 = 18 CFS
Q_2 = 44 CFS
Q_{10} = 83 CFS



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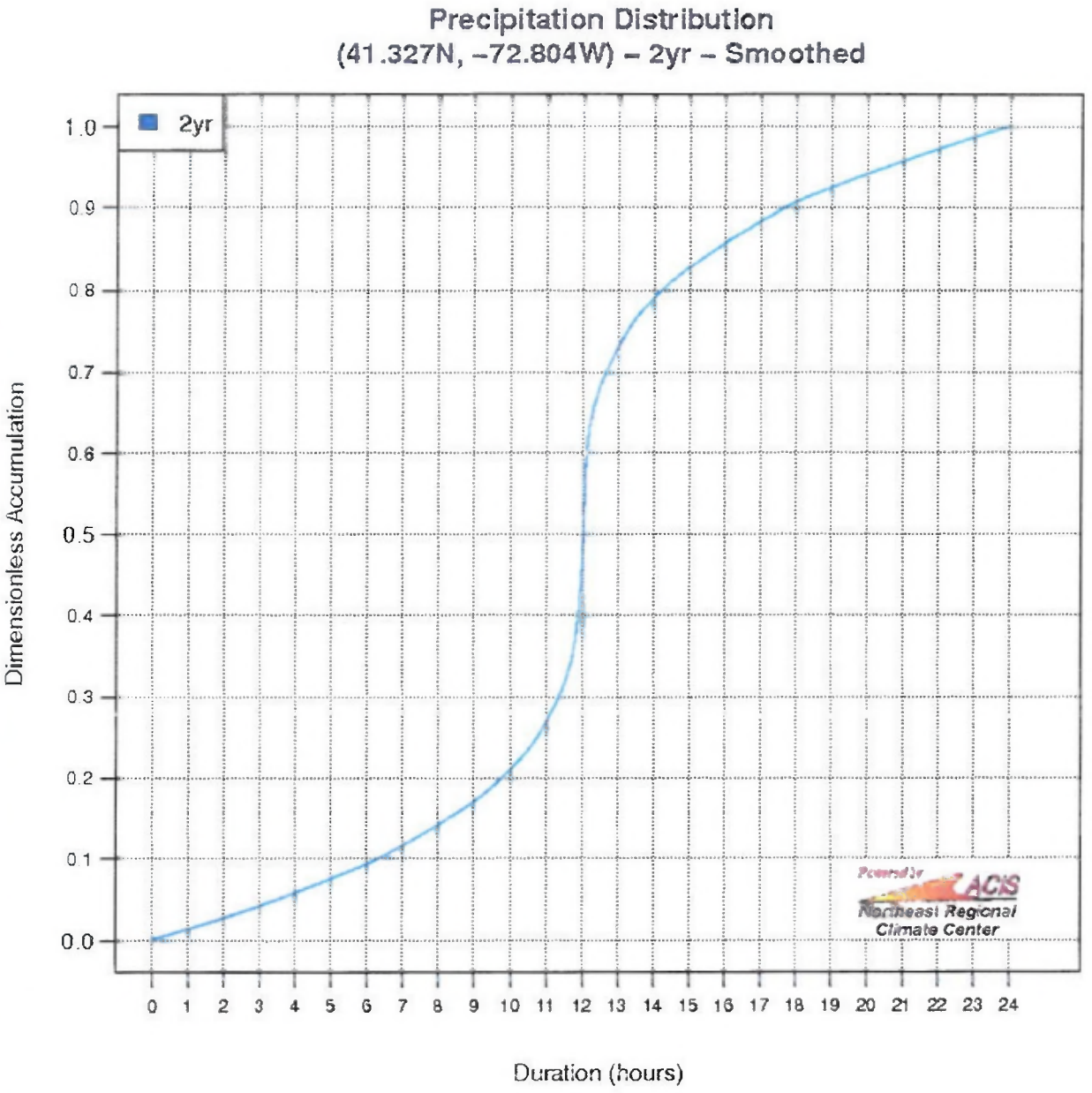
0.1	0.0014
0.2	0.0027
0.3	0.0041
0.4	0.0055
0.5	0.0069
0.6	0.0083
0.7	0.0097
0.8	0.0112
0.9	0.0126
1.0	0.0141
1.1	0.0155
1.2	0.0170
1.3	0.0185



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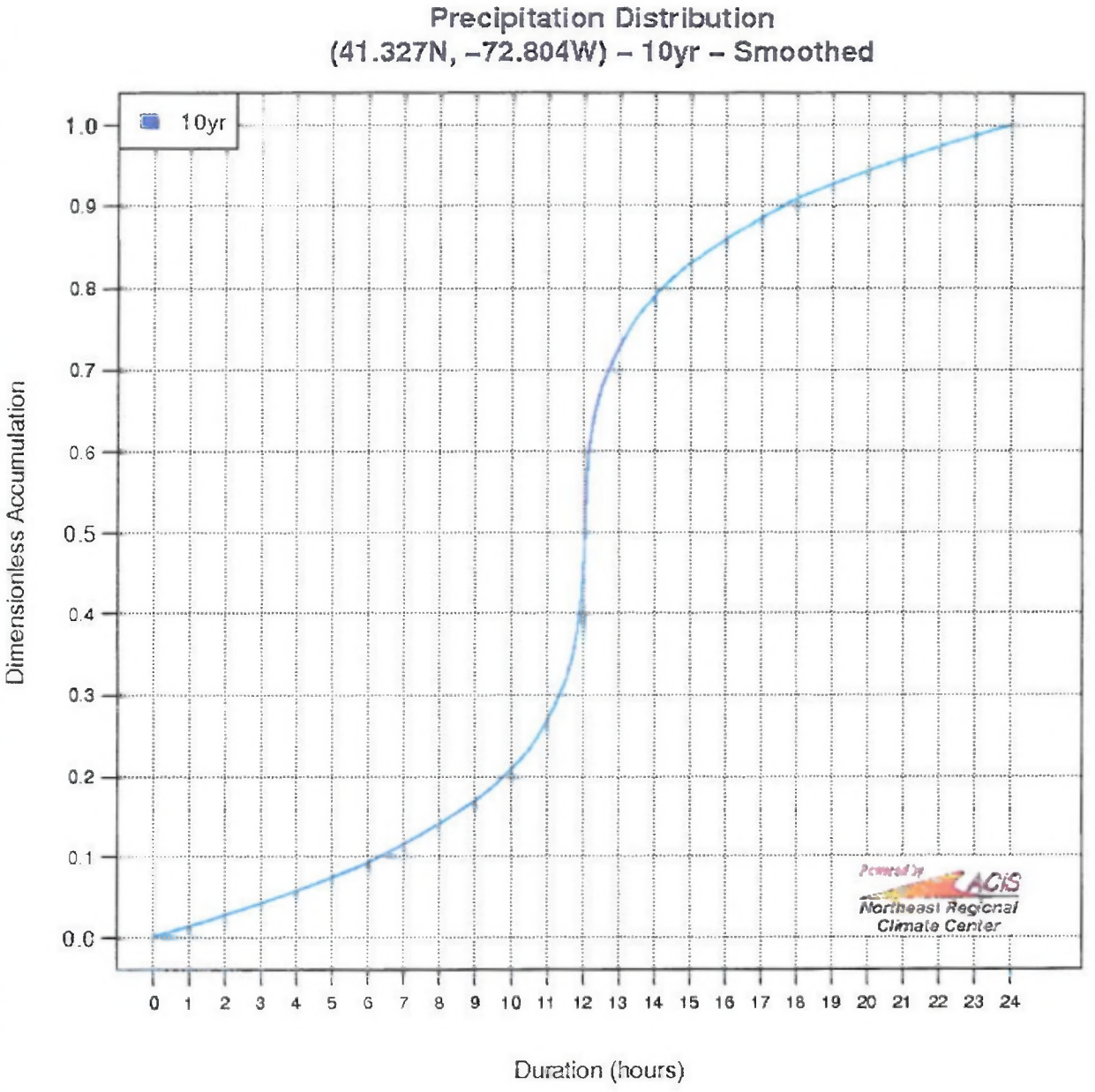
0.2	0.0026
0.3	0.0039
0.4	0.0052
0.5	0.0065
0.6	0.0078
0.7	0.0092
0.8	0.0105
0.9	0.0119
1.0	0.0133
1.1	0.0146
1.2	0.0160
1.3	0.0174



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0.3	0.0038
0.4	0.0051
0.5	0.0064
0.6	0.0077
0.7	0.0091
0.8	0.0104
0.9	0.0117
1.0	0.0131
1.1	0.0144
1.2	0.0158
1.3	0.0172

VAL ZORCA

From: Smith, Ben - NRCS, Tolland, CT [Ben.Smith@ct.usda.gov]
Sent: Monday, May 21, 2012 11:09 AM
To: VAL ZORCA
Subject: RE: Type III 6hr rainfall distribution
Attachments: typeIII_rainfall.txt

Hi Val,

Here is the 24 hr Type III distribution in 0.1 hr increments, taken from the WinTR-20 debug file. We don't have the 6 hour portion already separated as we typically use 24-hr design storms with this type of distribution.

You can select whichever portion you desire as it is built symmetrically around the 12 hour point. Each row is an hour's worth of data.

Import it into Excel and select your range of values.

Subtract the minimum value from all the selected points so the new minimum is 0.0.

Divide by the maximum value to readjust the range from 0.0-1.0.

Finally, recreate your header row with the new "num of points". It should be 61 for 6 hours (10 pts/hr + 1).

If you would prefer to use the new NRCC data I described, I can send you some more information and similar distribution tables.

Good luck,

Ben

From: VAL ZORCA [mailto:zorca@cardinal-engineering.com]
Sent: Monday, May 21, 2012 7:52 AM
To: Smith, Ben - NRCS, Tolland, CT
Subject: RE: Type III 6hr rainfall distribution

Hi Ben

I will use the old TR-20 program to compute hydrographs for the analysis of a large drainage system in New Haven. I want to use a 10-year 6-hour rainfall event to generate hydrographs and introduce them into a SWMM model to see how the different pipes and box culverts behave in time (the system is tidally influenced and flooding occurs frequently).

Val

From: Smith, Ben - NRCS, Tolland, CT [mailto:Ben.Smith@ct.usda.gov]
Sent: Friday, May 18, 2012 3:01 PM
To: VAL ZORCA

typeIII_rainfall

```
====================== Verify Rainfall Distributions Used ======================

Rainfall Distribution Type III  Time increment 0.10000     Num of Points 241
     0.0 0.00100 0.00200 0.00300 0.00400 0.00500 0.00600 0.00700 0.00800 0.00900
 0.01000 0.01100 0.01200 0.01300 0.01400 0.01500 0.01600 0.01700 0.01800 0.01900
 0.02000 0.02101 0.02203 0.02307 0.02412 0.02519 0.02627 0.02737 0.02848 0.02961
 0.03075 0.03191 0.03308 0.03427 0.03547 0.03669 0.03792 0.03917 0.04043 0.04171
 0.04300 0.04431 0.04563 0.04697 0.04832 0.04969 0.05107 0.05247 0.05388 0.05531
 0.05675 0.05821 0.05968 0.06117 0.06267 0.06419 0.06572 0.06727 0.06883 0.07041
 0.07200 0.07363 0.07530 0.07703 0.07880 0.08063 0.08250 0.08443 0.08640 0.08843
 0.09050 0.09263 0.09480 0.09703 0.09930 0.10163 0.10400 0.10643 0.10890 0.11143
 0.11400 0.11666 0.11943 0.12232 0.12532 0.12844 0.13167 0.13502 0.13848 0.14206
 0.14575 0.14956 0.15348 0.15752 0.16167 0.16594 0.17032 0.17482 0.17943 0.18416
 0.18900 0.19402 0.19928 0.20478 0.21052 0.21650 0.22272 0.22918 0.23588 0.24282
 0.25000 0.25776 0.26644 0.27604 0.28656 0.29800 0.31430 0.33940 0.37330 0.41600
 0.50000 0.58400 0.62670 0.66060 0.68570 0.70200 0.71344 0.72396 0.73356 0.74224
 0.75000 0.75718 0.76412 0.77082 0.77728 0.78350 0.78948 0.79522 0.80072 0.80598
 0.81100 0.81584 0.82057 0.82518 0.82968 0.83406 0.83833 0.84248 0.84652 0.85044
 0.85425 0.85794 0.86152 0.86498 0.86833 0.87156 0.87468 0.87768 0.88057 0.88334
 0.88600 0.88858 0.89110 0.89358 0.89600 0.89838 0.90070 0.90298 0.90520 0.90738
 0.90950 0.91158 0.91360 0.91558 0.91750 0.91938 0.92120 0.92298 0.92470 0.92638
 0.92800 0.92959 0.93117 0.93273 0.93428 0.93581 0.93733 0.93883 0.94032 0.94179
 0.94325 0.94469 0.94612 0.94753 0.94893 0.95031 0.95168 0.95303 0.95437 0.95569
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 0.96944 0.97062 0.97179 0.97295 0.97410 0.97523 0.97636 0.97747 0.97858 0.97967
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 1.00000

==================== End Verify Rainfall Distributions Used ====================
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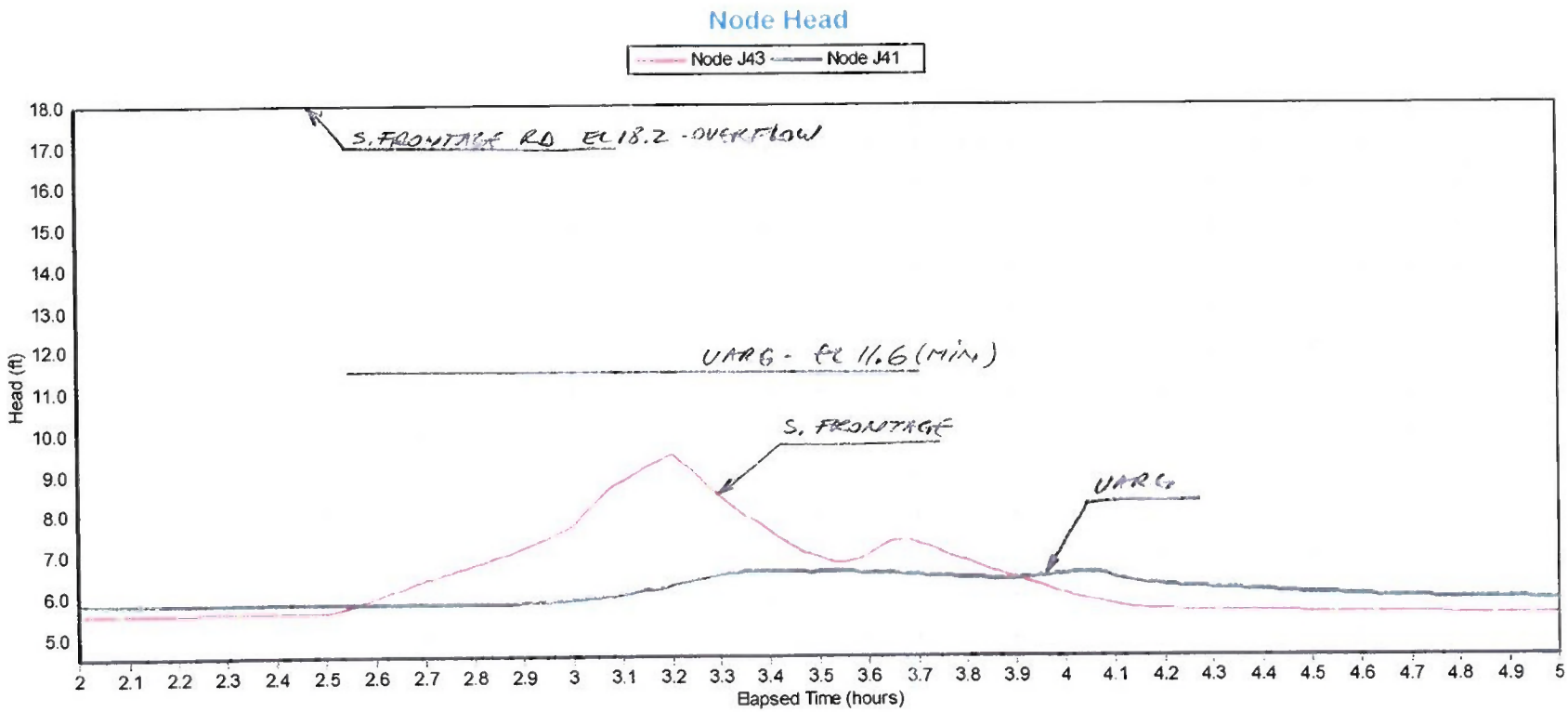
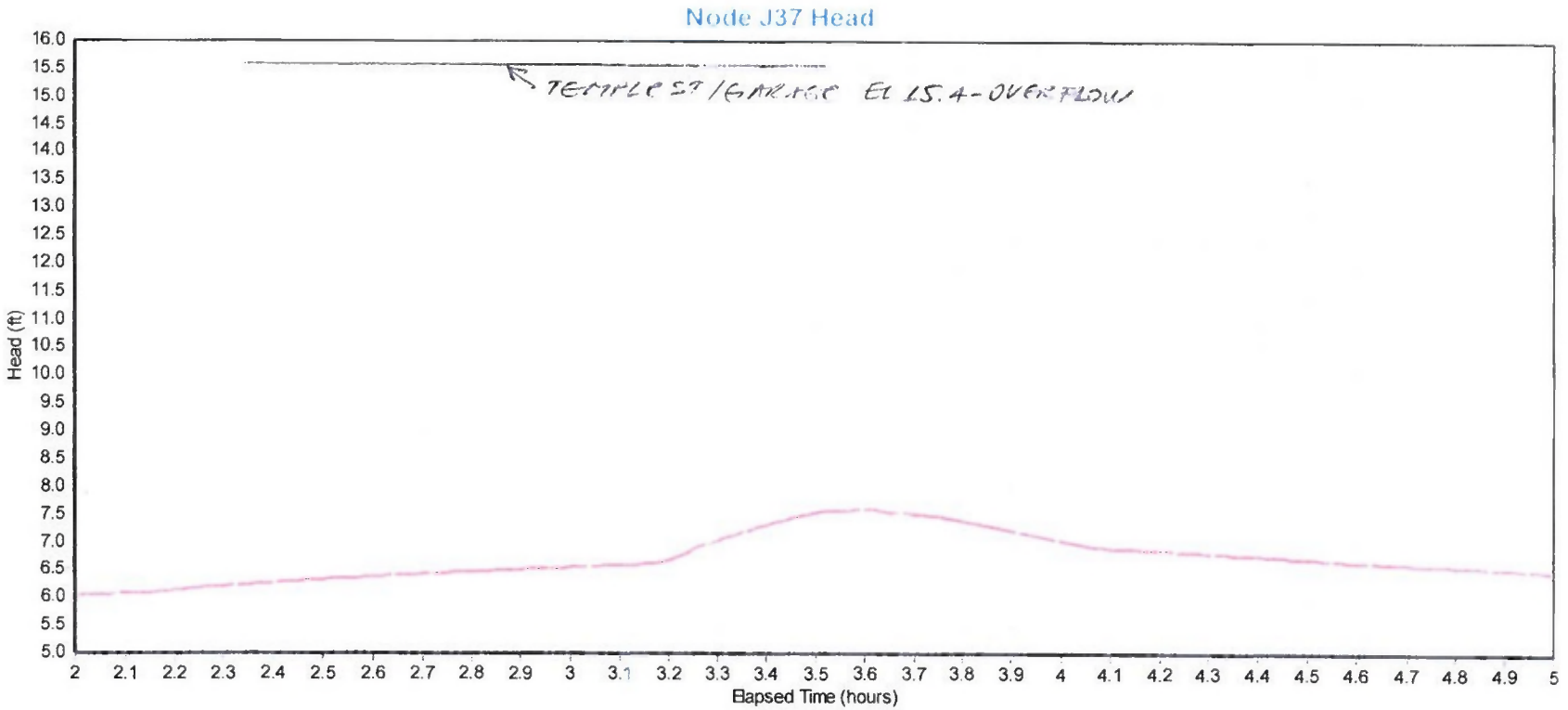
1YR-6HR
MEAN HIGH TIDE EL. 3.5



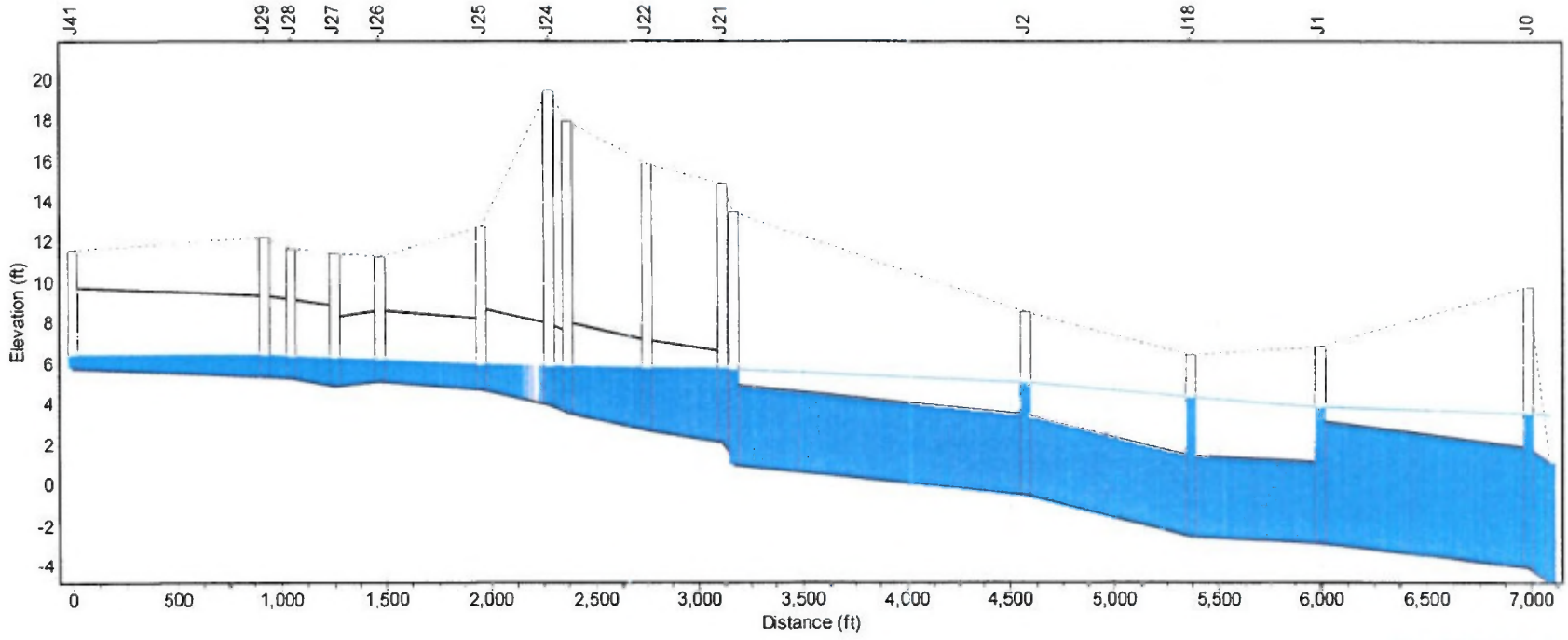
SCI-8

TEMPLE ST / GARAGE
1YR - 6HR
MEAN HIGH TIDE EL. 2.5



ROUTE 34/UAKG
1 YR - 6 HR
MEAN HIGH TIDE EL. 3.5

Water Elevation Profile: Node J41 - Out1

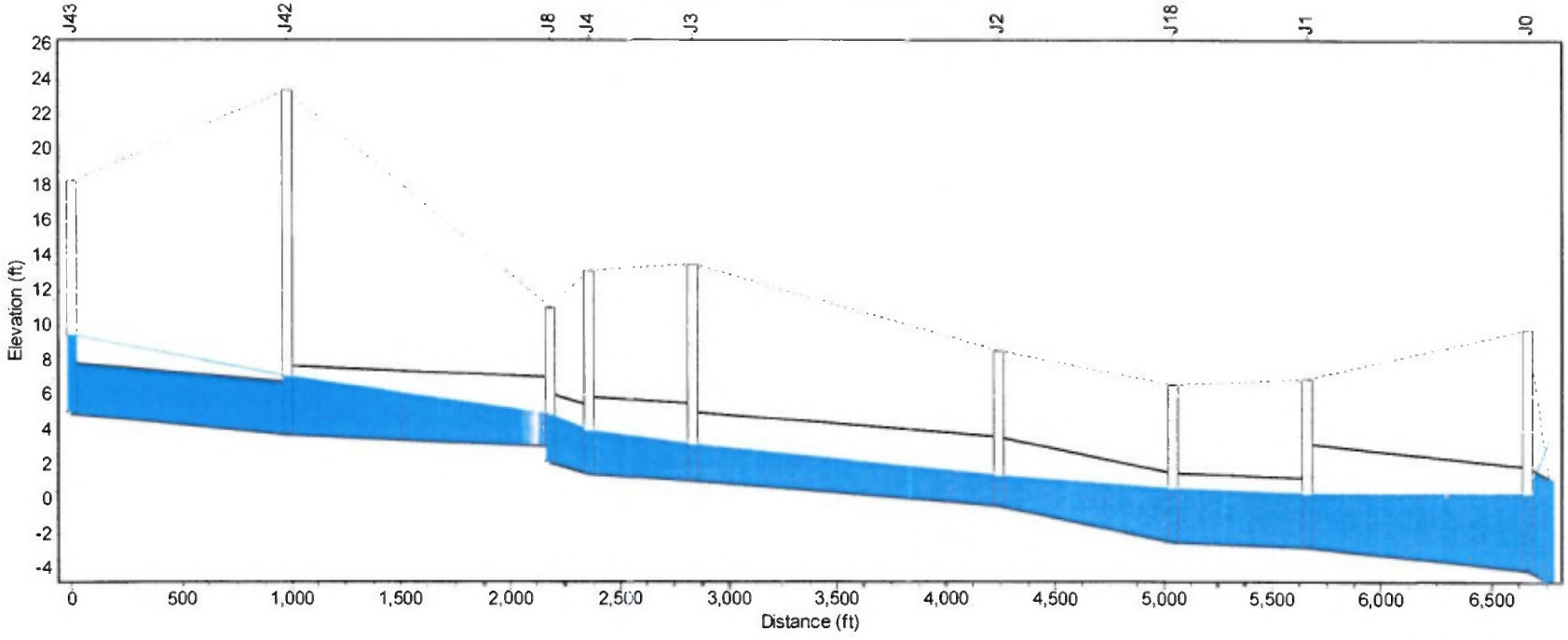


01/23/2012 04:00:00

B-107

S. FRONTAGE RD
1YR - 6HR
MEAN HIGH TIDE EL. 3.5

Water Elevation Profile: Node J43 - Out1

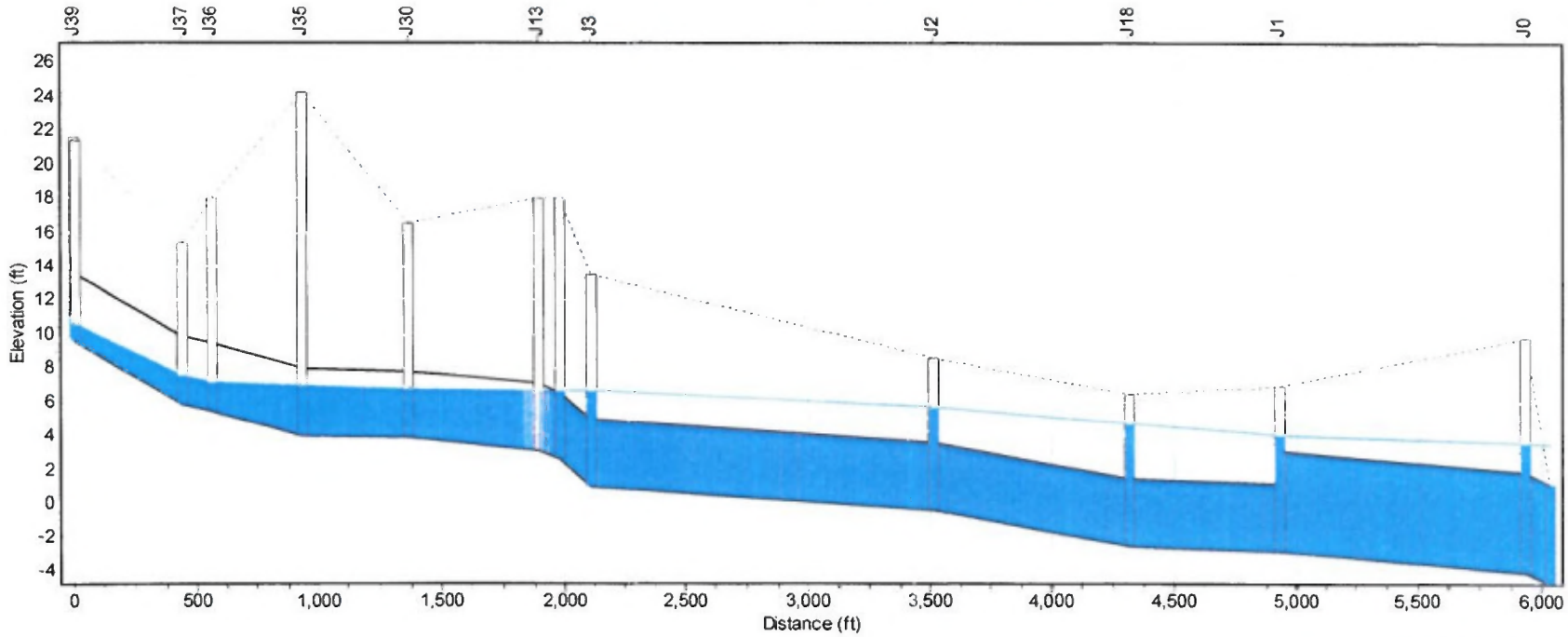


01/23/2012 03:12:00

E-108

TEMPLE ST. / GARAGE
1YR - 6HR
MEAN HIGH TIDE EL. 3.5

Water Elevation Profile: Node J39 - Out1



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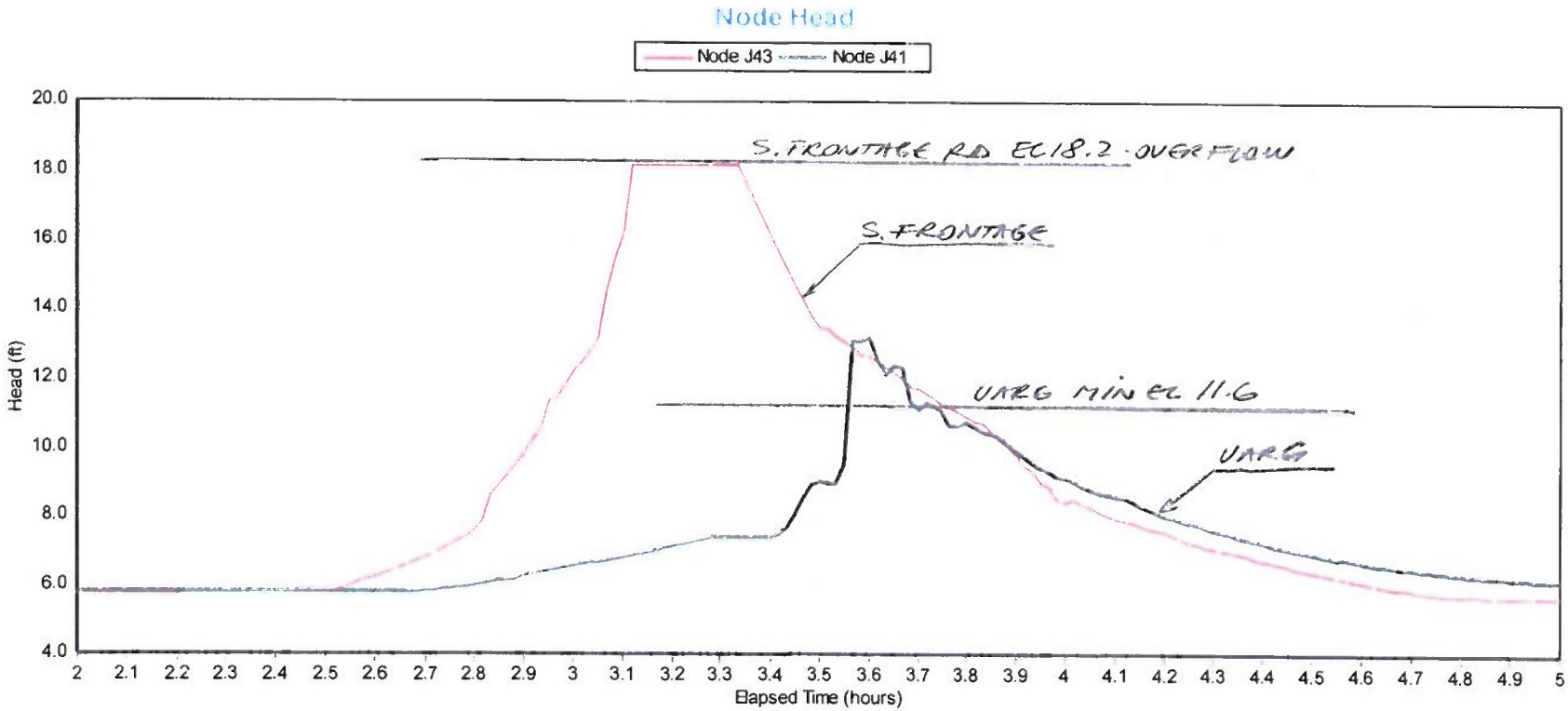
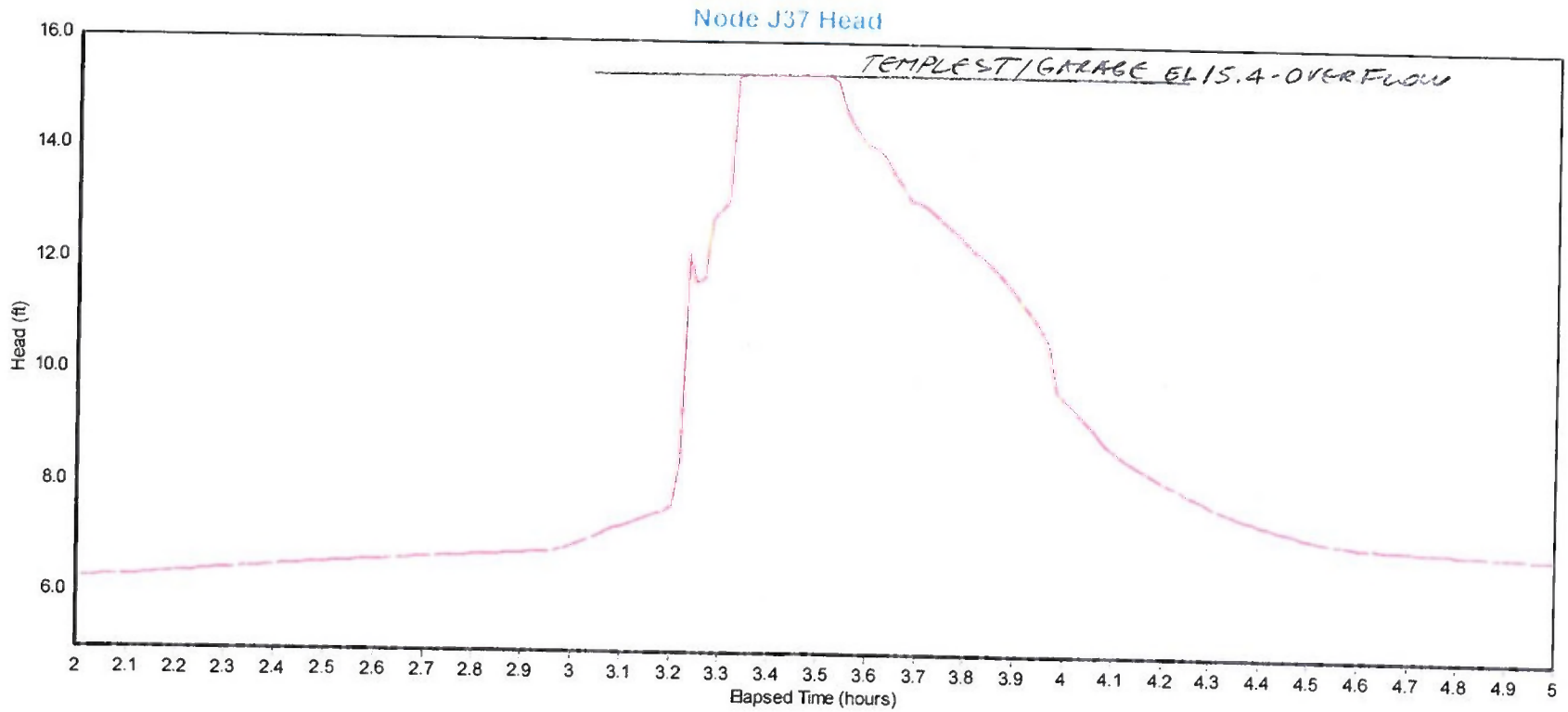
2YR - 6HR
MEAN HIGH TIDE EL 2.5



C11-8

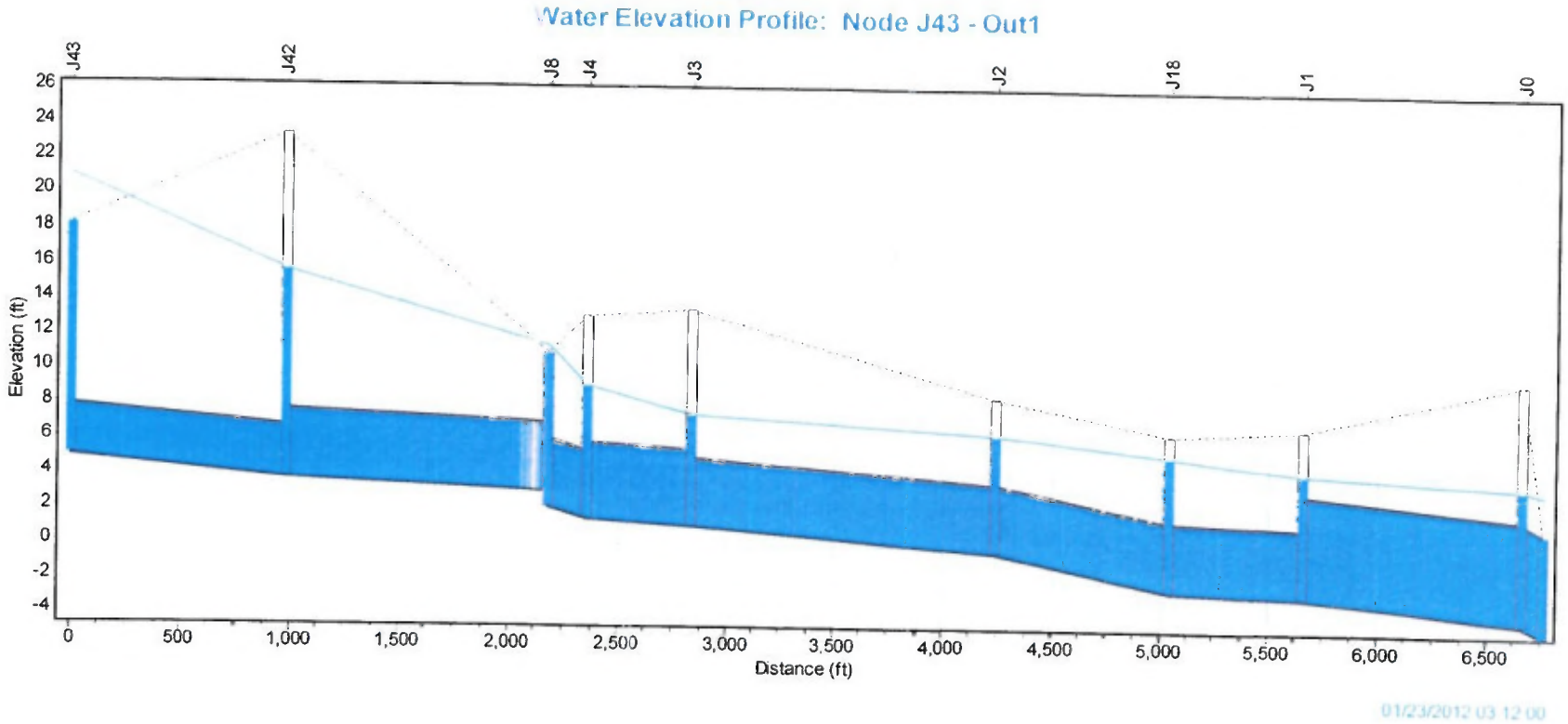
2YR-6HR

MEAN HIGH TIDE EL 3.5



B-111

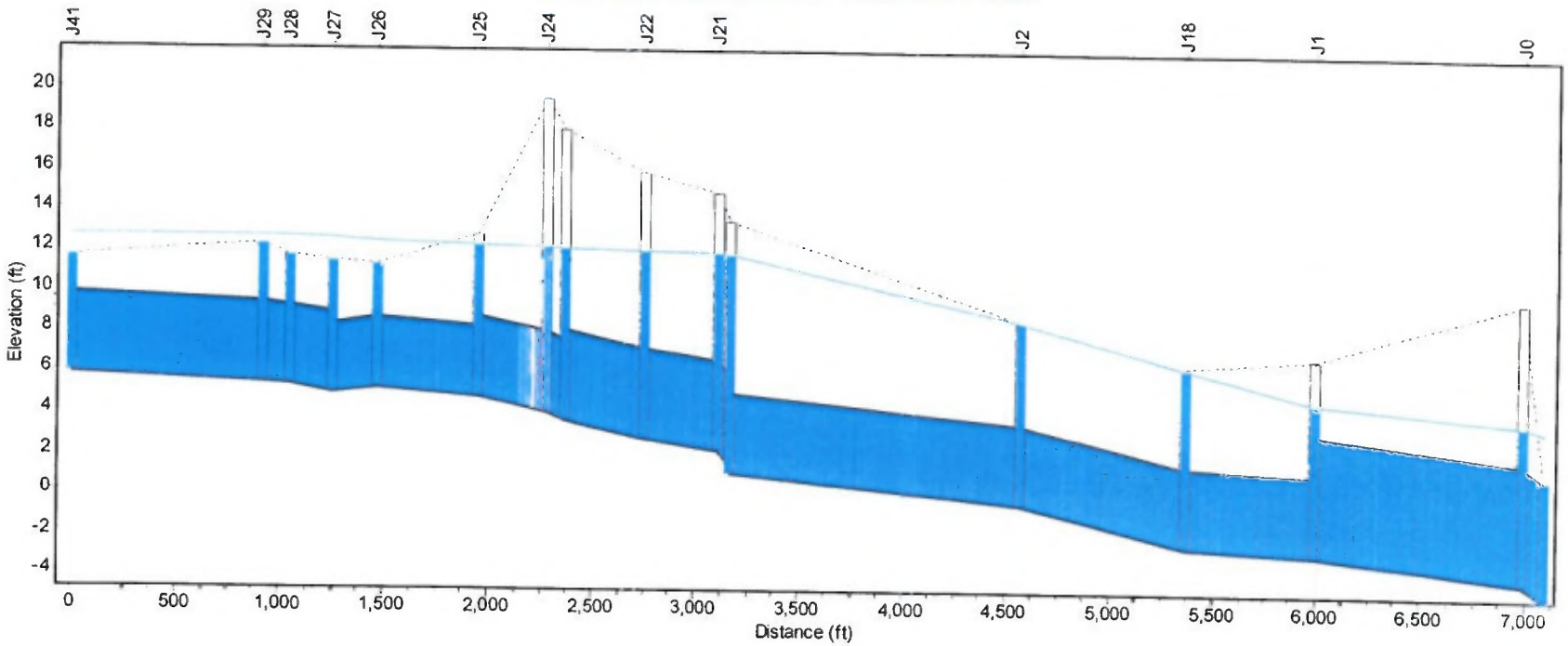
S. FRONTAGE RD
2YR - 6HR
MEAN HIGH TIDE EL 3.5



8-112

ROUTE 34 / UAR 6
2YR - 6HR
MEAN HIGH TIDE EL. 3.5

Water Elevation Profile: Node J41 - Out1



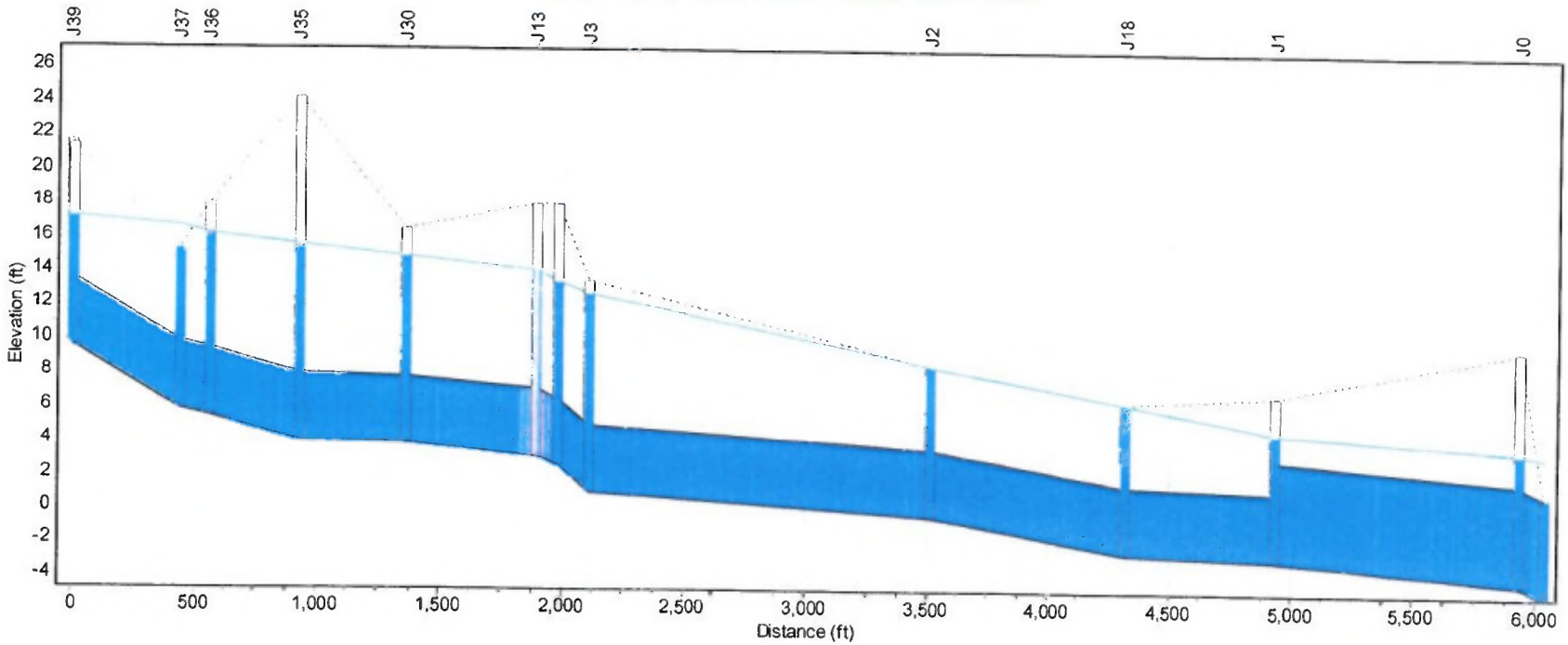
01/23/2012 03:38:00

E-123

SWMM 5

TEMPLE ST. / GARAGE
2YR - 6HR
MEAN HIGH TIDE EL. 3.5

Water Elevation Profile: Node J39 - Out1



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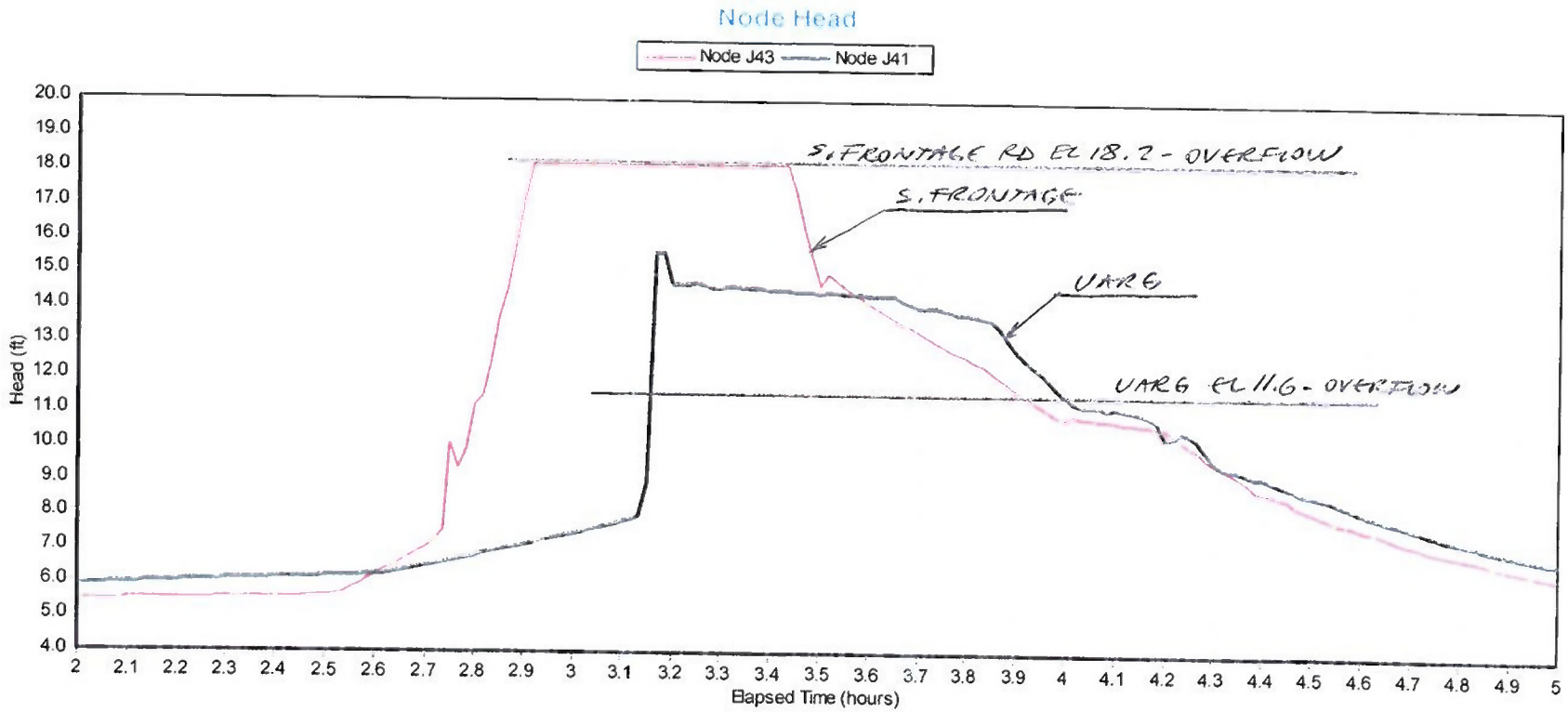
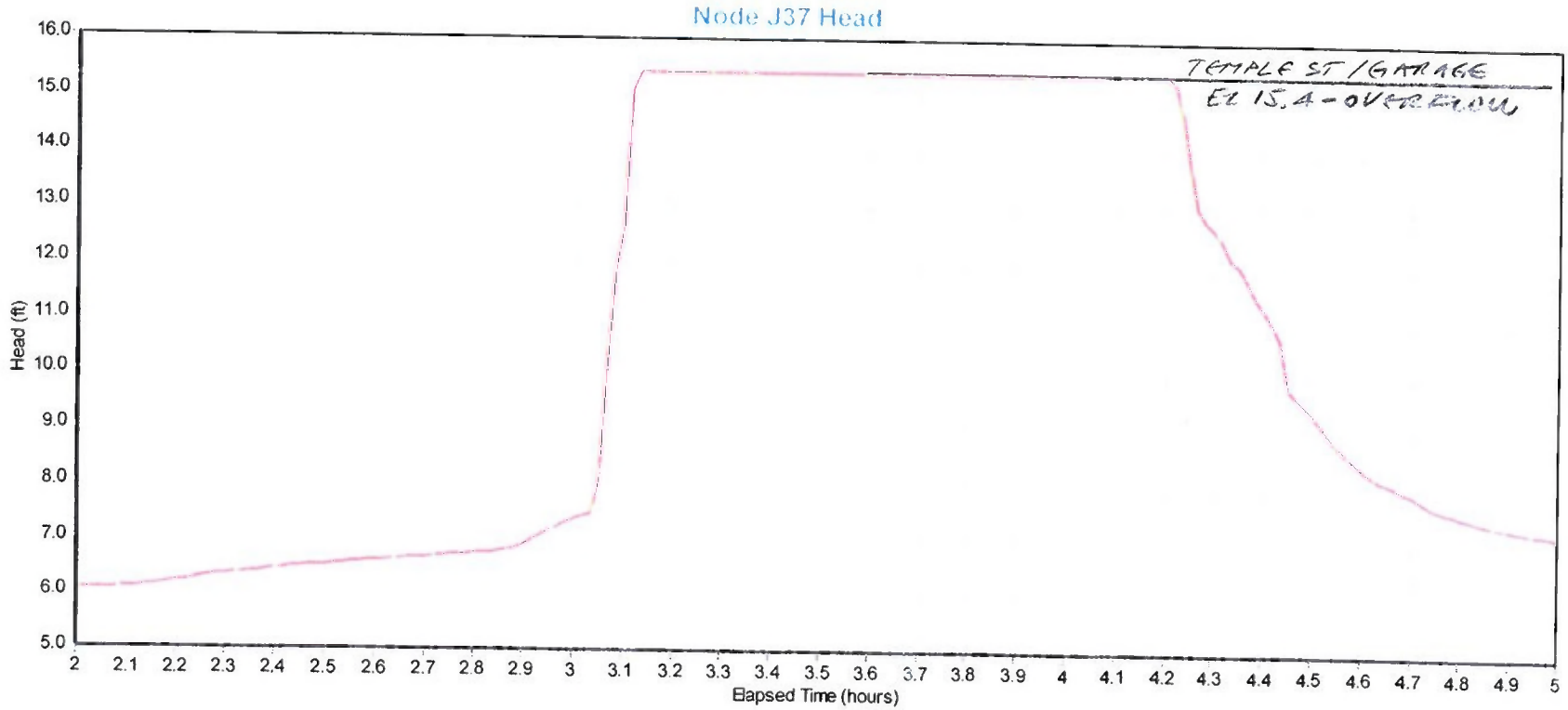
E-114

10YR - 6HR
MEAN HIGH TIDE EL 3.5



B-25

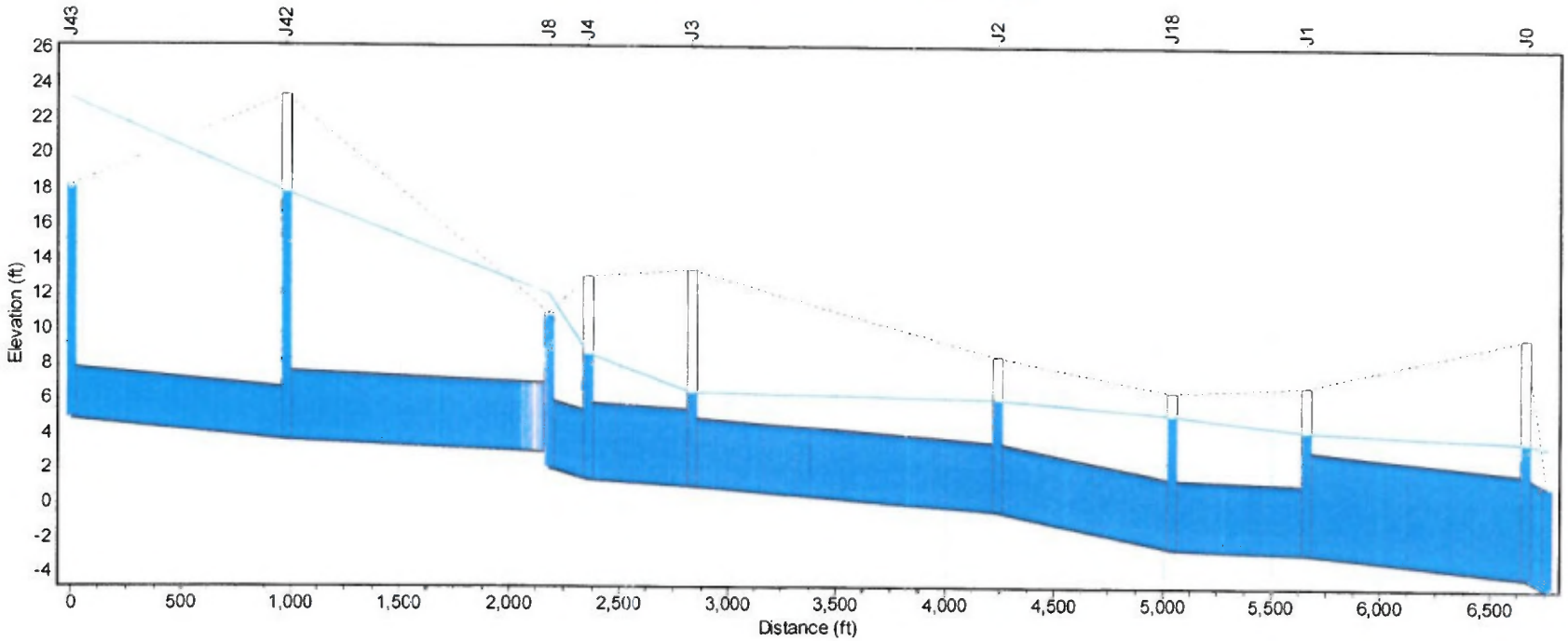
10YR - 6HR
MEAN HIGH TIDE EL. 3.5



B-116

S. FRONTAGE RD.
10YR - 6HR
MEAN HIGH TIDE EL. 2.5

Water Elevation Profile: Node J43 - Out1

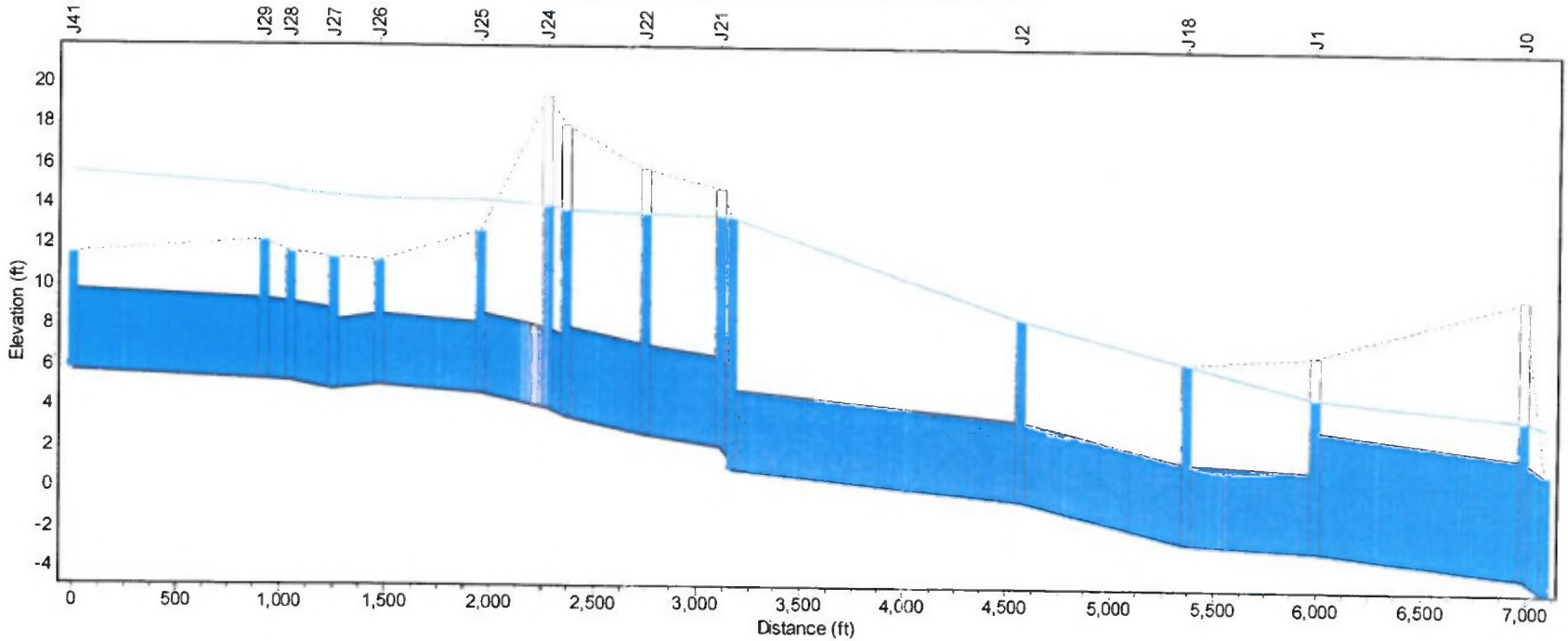


01/23/2012 02:58:00

2-117

ROUTE 34 / UARG
10YR-6HR
MEAN HIGH TIDE EL. 3.5

Water Elevation Profile: Node J41 - Out1



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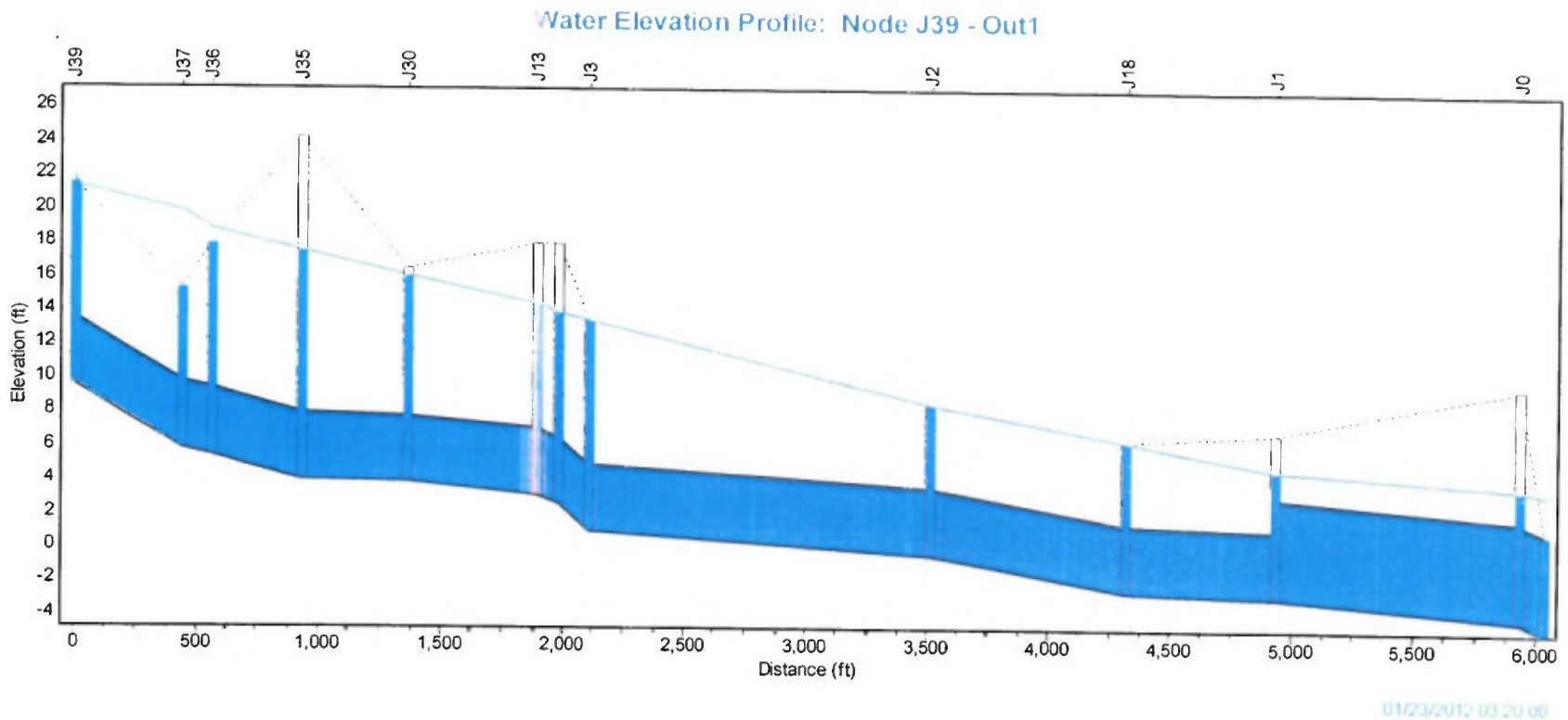
B-118

TEMPLE ST. / GARAGE
10YR - 6HR
MEAN HIGH TIDE EL. 3.5



B-119

ATTACHMENT C

United States Environmental Protection Agency
Region 1 – EPA New England
5 Post Office Square – Suite 100
Boston, MA 02109-3912

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

FEB 18 2014

February 13, 2014

Mr. Larry Smith
Assistant City Engineer
City of New Haven
200 Orange Street, Rm 503
New Haven, CT 06510

Re: Request for Information Pursuant to Section 308 of the Clean Water Act; EPA Docket No. 14-308-06

Dear Mr. Smith:

The EPA has received a complaint from a citizen regarding flooding of the Under Air Rights Garage ("UARG") located at 60 York Street, New Haven, Connecticut. On August 10, 2012, the citizen observed flooding and a sewage smell in the UARG. After contacting the Greater New Haven Water Pollution Control Authority ("GNHWPCA"), the citizen learned of the presence of combined sewer overflow (CSO) regulator 031 at the southeast corner of the UARG.

During the EPA inspection of GNHWPCA's operation and maintenance of its collection system on December 16-18, 2013, GNHWPCA provided EPA inspectors with an email and photos indicating that CSO regulator 031 was closed on October 10, 2013. EPA inspectors visited the CSO regulator on December 17, 2013 to verify that it remained closed. GNHWPCA provided EPA inspectors with a Collection System Map, undated; an Annual Progress Report, dated June 28, 2013; and a CSO Flow Monitoring Plan Status Report, dated December 18, 2013, identifying several additional combined sewer overflow regulators in the vicinity of the UARG.

On December 13, 2013, EPA obtained from the citizen a copy of the Drainage Study for Route 34 and Union Avenue ("Drainage Study") prepared for the City of New Haven by Cardinal Engineering Associates ("Cardinal"), dated July 11, 2012. In the Drainage Study, Cardinal performed hydraulic modeling of the storm drain system and the combined sewer system. The Drainage Study identifies six sections of combined sewer that do not have sufficient capacity to convey a 10-year storm, even with the combined sewer overflows relief points available to the drainage system. The result, according to the Drainage Study, is the potential for discharges of untreated sewage to roadways.

Attached is a request for information asking you to identify the conditions, including precipitation events, which result in the presence of sewage in the UARG and at similar locations. A similar request been sent to the GNHWPCA.

Section 308(a) of the Clean Water Act (the "Act"), U.S.C.§1318(a), authorizes the Environmental Protection Agency ("EPA") to require the owner or operator of a point source to provide information needed to determine whether there has been a violation of the Act.

The City of New Haven is hereby required, pursuant to Section 308(a) of the Act, U.S.C.§ 1318(a), to respond to this Request for Information (the "Request") within **90 calendar days of receipt of this letter**, except where noted otherwise. Please read the instructions in Attachment A carefully before preparing your response and answer each question in Attachment B as clearly and completely as possible.

Your response to this Request must also be accompanied by a certificate that it is signed and dated by the person who is authorized to respond to the Request. A Statement of Certification, Attachment C, is attached to this letter.

Information submitted pursuant to this Request shall be sent by certified mail and shall be addressed as follows:

United States Environmental Protection Agency
New England Region
5 Post Office Square - Suite 100 (OES 04-1)
Boston, MA 02109-3912
Attn: Jack Melcher

and

Connecticut Department of Energy and Environmental Protection
Bureau of Water Protection and Land Reuse
Planning and Standards Division
79 Elm Street
Hartford, CT 06106-5127
Attn: George Hicks

If you have questions regarding this Request, please contact Jack Melcher of my staff at (617) 918-1663 or have your attorney contact Michael Wagner at (617) 918-1735.

Sincerely,

James Chow, Chief
Technical Enforcement Branch

cc: Hon. Toni Harp
George Hicks, Connecticut Department of Energy and Environmental Protection

Attachment A

Information Request

1. Provide a separate narrative response to each and every question and subpart of a question set forth in this Request. Precede each answer with the text and the number of the question and the subpart to which the answer corresponds.

2. If any question cannot be answered in full, answer to the extent possible. If your responses are qualified in any manner, explain.

3. Any documents referenced or relied upon by you to answer any of the questions in the Request must be copied and submitted to EPA with your response. All documents must contain a notation indicating the question and subpart to which they are responding. If the documentation that supports a response to one item duplicates the documentation that supports another item, submit one copy of the documentation and reference the documentation in subsequent responses.

4. If information or documents not known or not available to you as of the date of the submission of the response to this Request for information should later become known, or available to you, you must supplement your response. Moreover, should you find at any time after the submission of your response that any portion of the submitted information is inaccurate or incomplete, you must notify the EPA of this finding as soon as possible and provide a corrected response.

Attachment B

Questions

1. Provide a map of the storm drain system tributary to the two outfalls (*i.e.*, South Outfall and North Outfall) discussed in the Cardinal Drainage Study. Include all active regulators and cross-connections from the combined sewer system.

2. Provide a list of dates since January 1, 2010 on which discharges from the storm drain system have resulted in the release of stormwater mixed with sewage to the ground surface in the area tributary to the two outfalls discussed in the Cardinal Drainage Study. Include information regarding the depth and duration of storm event(s) preceding the discharge and the tidal conditions at the time of the discharge.

3. Describe the hydraulics of the storm drain system, as it existed on October 9, 2013, from CSO regulator 031 downstream to the outfall to New Haven Harbor. Provide the peak hydraulic grade line at mean high tide, for the 1-year, 2-year, 10-year, and 100-year storms of the following durations: 15 minutes, 60 minutes, 3 hours, and 24 hours. This analysis should account for daily peak flows due to diurnal variations and seasonal peak flows during periods of increased infiltration. Include for reference the ground elevations, sewer manhole rim elevations, pipe invert elevations, pipe cross-section dimensions, pipe materials, pipe slope, the elevation of the overflow weir, and the elevation of the rim of the lowest catch basin inside the UARG.

4. Describe the storm with the minimum return period that would result, as it existed on October 9, 2013, in the presence of sewage outside of the collection system at the Under Air Rights Garage during mean high tide, daily peak sewer flows, and seasonal peak infiltration flows. Include the duration and depth of storm, and identify the precise points in the separate sanitary sewers and combined sewer collection system from which sewage would be released.

5. Describe the storm with the minimum return period that, given current conditions, will result in the presence of sewage outside of the collection system at the Under Air Rights Garage during mean high tide, daily peak sewer flows, and seasonal peak infiltration flows. Include the duration and depth of storm, and identify the precise points in the separate sanitary sewers and combined sewer collection system from which sewage will be released.

6. Describe the hydraulics of the storm drainage system from CSO regulator 034 downstream to the outfall to New Haven Harbor. Provide the peak hydraulic grade line at mean high tide, for the 1-year, 2-year, 10-year, and 100-year storms of the following durations: 15 minutes, 60 minutes, 3 hours, and 24 hours. This analysis should account for daily peak flows due to diurnal variations and seasonal peak flows during periods of increased infiltration. Include for reference, the ground elevations, sewer manhole rim elevations, pipe invert

elevations, pipe cross-section dimensions, pipe materials, pipe slope, the elevation of the overflow weir, and the elevation of the lowest floor in the Temple Street Garage.

7. Describe the storm with the minimum return period that, given current conditions, will result in the presence of sewage outside of the collection system at the Temple Street Garage during mean high tide, daily peak sewer flows, and seasonal peak infiltration flows. Include the duration and depth of storm, and identify the precise points in the separate sanitary sewers and combined sewer collection system from which sewage will be released.

8. Describe the methodology used to perform the hydraulic analysis for Questions 3 through 7. Include information regarding storm hydrographs used.

ATTACHMENT C

Statement of Certification

Complete and Include With Your Response

I declare under penalty of perjury that I am authorized to respond on behalf of the City of New Haven. I certify that the foregoing responses and information submitted were prepared by me, or under my direction or supervision and that I have personal knowledge of all matters set forth in the responses and the accompanying information. I certify that the responses are true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment.

By_____
(Signature)

_____
(Title)

_____
(Date)

United States Environmental Protection Agency
Region 1 – EPA New England
5 Post Office Square – Suite 100
Boston, MA 02109-3912

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

RECEIVED
FEB 20 2014

February 13, 2014

Mr. Sidney J. Holbrook
Executive Director
Greater New Haven Water Pollution Control Authority
260 East Street
New Haven, CT 06511

Re: Request for Information Pursuant to Section 308 of the Clean Water Act; EPA Docket No. 14-308-05

Dear Mr. Holbrook:

The EPA has received a complaint from a citizen regarding flooding of the Under Air Rights Garage ("UARG") located at 60 York Street, New Haven, Connecticut. On August 10, 2012, the citizen observed flooding and a sewage smell in the UARG. After contacting the Greater New Haven Water Pollution Control Authority ("GNHWPCA"), the citizen learned of the presence of combined sewer overflow (CSO) regulator 031 at the southeast corner of the UARG.

During the EPA inspection of GNHWPCA's operation and maintenance of its collection system on December 16-18, 2013, GNHWPCA provided EPA inspectors with an email and photos indicating that CSO regulator 031 was closed on October 10, 2013. EPA inspectors visited the CSO regulator on December 17, 2013 to verify that it remained closed. GNHWPCA provided EPA inspectors with a Collection System Map, undated; an Annual Progress Report, dated June 28, 2013; and a CSO Flow Monitoring Plan Status Report, dated December 18, 2013, identifying several additional combined sewer overflow regulators in the vicinity of the UARG.

On December 13, 2013, EPA obtained from the citizen a copy of the Drainage Study for Route 34 and Union Avenue ("Drainage Study") prepared for the City of New Haven by Cardinal Engineering Associates ("Cardinal"), dated July 11, 2012. In the Drainage Study, Cardinal performed hydraulic modeling of the storm drain system and the combined sewer system. The Drainage Study identifies six sections of combined sewer that do not have sufficient capacity to convey a 10-year storm, even with the combined sewer overflow relief points available to the drainage system. The result, according to the Drainage Study, is the potential for discharges of untreated sewage to roadways.

Attached is a request for information asking you to identify the conditions, including precipitation events, which result in the presence of sewage in the UARG and at similar locations. A similar request been sent to the City of New Haven.

Section 308(a) of the Clean Water Act (the "Act"), U.S.C. § 1318(a), authorizes the Environmental Protection Agency ("EPA") to require the owner or operator of a point source to provide information needed to determine whether there has been a violation of the Act.

The GNHWPCA is hereby required, pursuant to Section 308(a) of the Act, U.S.C. § 1318(a), to respond to this Request for Information (the "Request") within **90 calendar days of receipt of this letter**, except where noted otherwise. Please read the instructions in Attachment A carefully before preparing your response and answer each question in Attachment B as clearly and completely as possible.

Your response to this Request must also be accompanied by a certificate that it is signed and dated by the person who is authorized to respond to the Request. A Statement of Certification, Attachment C, is attached to this letter.

Information submitted pursuant to this Request shall be sent by certified mail and shall be addressed as follows:

United States Environmental Protection Agency
New England Region
5 Post Office Square - Suite 100 (OES 04-1)
Boston, MA 02109-3912
Attn: Jack Melcher

and

Connecticut Department of Energy and Environmental Protection
Bureau of Water Protection and Land Reuse
Planning and Standards Division
79 Elm Street
Hartford, CT 06106-5127
Attn: George Hicks

If you have questions regarding this Request, please contact Jack Melcher of my staff at (617) 918-1663 or have your attorney contact Michael Wagner at (617) 918-1735.

Sincerely,

James Chow, Chief
Technical Enforcement Branch

cc: George Hicks, Connecticut Department of Energy and Environmental Protection

Attachment A

Information Request

1. Provide a separate narrative response to each and every question and subpart of a question set forth in this Request. Precede each answer with the text and the number of the question and the subpart to which the answer corresponds.

2. If any question cannot be answered in full, answer to the extent possible. If your responses are qualified in any manner, explain.

3. Any documents referenced or relied upon by you to answer any of the questions in the Request must be copied and submitted to EPA with your response. All documents must contain a notation indicating the question and subpart to which they are responding. If the documentation that supports a response to one item duplicates the documentation that supports another item, submit one copy of the documentation and reference the documentation in subsequent responses.

4. If information or documents not known or not available to you as of the date of the submission of the response to this Request for information should later become known, or available to you, you must supplement your response. Moreover, should you find at any time after the submission of your response that any portion of the submitted information is inaccurate or incomplete, you must notify the EPA of this finding as soon as possible and provide a corrected response.

Attachment B

Questions

1. Provide a map of the combined sewer system tributary to the Union Street Pump Station. Include all regulators and cross-connections, both active and closed, with identifiers sufficient to identify each of the combined sewer overflow relief points listed in the Collection System Map, provided at EPA's December 16-18, 2013 inspection; the Annual Progress Report, dated June 28, 2013; and the CSO Flow Monitoring Plan Status Report, dated December 18, 2013.

2. Describe the current operating condition of the Union Street Pump Station. Include pumping capacity, the number of operational pumps, source of emergency power, and the most recent assessment of pump station condition.

3. Provide a list of dates since January 1, 2010 on which discharges from the combined sewer system or the sanitary sewer system have resulted in the release of sewage to the ground surface in the area tributary to the Union Street Pump Station. Include information regarding the depth and duration of storm event(s) preceding the discharge and the tidal conditions at the time of the discharge.

4. Describe the hydraulics of the combined sewer system tributary to the Union Street Pump Station for all sewers greater than or equal to 30 inches in diameter, and for any other sewer lines tributary to the Union Street Pump Station containing active CSO regulators. Provide the peak hydraulic grade line at mean high tide, for the 1-year, 2-year, 10-year, and 100-year storms of the following durations: 15 minutes, 60 minutes, 3 hours, and 24 hours. This analysis should account for daily peak flows due to diurnal variations and seasonal peak flows during periods of increased infiltration. Include for reference the ground elevations, sewer manhole rim elevations, pipe invert elevations, pipe cross-section dimensions, pipe materials, and pipe slope.

5. Describe the hydraulics of the storm drain system, as it existed on October 9, 2013, from CSO regulator 031 downstream to the outfall to New Haven Harbor. Provide the peak hydraulic grade line at mean high tide, for the 1-year, 2-year, 10-year, and 100-year storms of the following durations: 15 minutes, 60 minutes, 3 hours, and 24 hours. This analysis should account for daily peak flows due to diurnal variations and seasonal peak flows during periods of increased infiltration. Include for reference the ground elevations, sewer manhole rim elevations, pipe invert elevations, pipe cross-section dimensions, pipe materials, pipe slope, the elevation of the overflow weir, and the elevation of the rim of the lowest catch basin inside the UARG.

6. Describe the storm with the minimum return period that would result, as it existed on October 9, 2013, in the presence of sewage outside of the collection system at the Under Air Rights Garage during mean high tide, daily peak sewer flows, and seasonal peak infiltration flows. Include the duration and depth of storm, and

identify the precise points in the separate sanitary sewers and combined sewer collection system from which sewage would be released.

7. Describe the storm with the minimum return period that, given current conditions, will result in the presence of sewage outside of the collection system at the Under Air Rights Garage during mean high tide, daily peak sewer flows, and seasonal peak infiltration flows. Include the duration and depth of storm, and identify the precise points in the separate sanitary sewers and combined sewer collection system from which sewage will be released.

8. Describe the hydraulics of the storm drainage system from CSO regulator 034 downstream to the outfall to New Haven Harbor. Provide the peak hydraulic grade line at mean high tide, for the 1-year, 2-year, 10-year, and 100-year storms of the following durations: 15 minutes, 60 minutes, 3 hours, and 24 hours. This analysis should account for daily peak flows due to diurnal variations and seasonal peak flows during periods of increased infiltration. Include for reference, the ground elevations, sewer manhole rim elevations, pipe invert elevations, pipe cross-section dimensions, pipe materials, pipe slope, the elevation of the overflow weir, and the elevation of the lowest floor in the Temple Street Garage.

9. Describe the storm with the minimum return period that, given current conditions, will result in the presence of sewage outside of the collection system at the Temple Street Garage during mean high tide, daily peak sewer flows, and seasonal peak infiltration flows. Include the duration and depth of storm, and identify the precise points in the separate sanitary sewers and combined sewer collection system from which sewage will be released.

10. Describe the methodology used to perform the hydraulic analysis for Questions 4 through 9. Include information regarding storm hydrographs used.

11. Provide information describing each active CSO regulator in the GNHWPCA collection system. For each CSO regulator, include:

    a. the latitude and longitude of its location;

    b. its current status as active or closed;

    c. the CSO outfall to which it flows;

    d. the time period for which flow metering has been performed;

    e. the number of activations during calendar year 2013; and

    f. the storm with the minimum return period for which a discharge occurred during calendar year 2013.

12. For each CSO outfall and CSO regulator closed since January 1, 1997, identify the date on which the structure was closed, and describe the measures taken to close the structure.

13. By January 31, 2015, provide a System Characterization consistent with Section 2 of EPA's September 1995 *Combined Sewer Overflows Guidance for Long Term Control Plan* ("LTCP Guidance")(EPA 832-b-95-002).

14. By July 31, 2015, provide a Development of Alternatives for CSO Control Update ("Alternatives Update") consistent with Section 3.3 of EPA's LTCP Guidance.

ATTACHMENT C

Statement of Certification

Complete and Include With Your Response

I declare under penalty of perjury that I am authorized to respond on behalf of the Greater New Haven Water Pollution Control Authority. I certify that the foregoing responses and information submitted were prepared by me, or under my direction or supervision and that I have personal knowledge of all matters set forth in the responses and the accompanying information. I certify that the responses are true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment.

By_____
(Signature)

_____
(Title)

_____
(Date)