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**STORMWATER DETENTION ANALYSIS  
FOR YARA LAKES ESTATES**

**NEW RESIDENTIAL SUBDIVISION DEVELOPMENT WITH 204 SINGLE-FAMILY RESIDENTIAL LOTS**

**56.712 ACRES OF LAND BEING ALL OF THAT CERTAIN CALLED 41.992 ACRES  
(TRACT 9) AND ALL OF THAT CERTAIN CALLED 14.707 AC. (TRACT 2), RECORDED  
UNDER H.C.C.F. #20120305157 AND LOCATED IN THE JOHNSON HUNTER SURVEY, A-  
35 AND IN THE W.P. HARRIS SURVEY, A-30, HARRIS COUNTY, TEXAS**

PREPARED FOR  
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<b>SECTION / SUB-SECTIONS</b>	<b>TITLE</b>	<b>PAGE NO.</b>
<b>1.</b>	<b>EXECUTIVE SUMMARY</b>	<b>3</b>
<b>2.</b>	<b>INTRODUCTION</b>	
2.1	Project location and area of study	3
2.2	Scope of work	3
2.3	Data source	3
2.4	Survey and Project Datum	4
2.5	FEMA Special Flood Hazard Area	4
<b>3.</b>	<b>ANALYSIS</b>	
3.1	Existing Conditions	4
3.2	Proposed Conditions	4
<b>4.</b>	<b>HYDROLOGY</b>	
4.1	Hydrology Method	4
4.2	Hydraulic Method	5
4.3	Background	5
4.4	Land Use	6
4.5	Hydrograph Routing Data Summary	7-8
4.6	Required Detention Storage	8-11
4.7	On-site Detention Volume provided	12
4.8	XPSWMM Summary results	13-15
4.9	Detention Layout	16
4.10	Storm Outfall Summary	16
<b>5.</b>	<b>ENGINEER'S CONCLUSION</b>	<b>16</b>
<b>6.</b>	<b>TABLES</b>	
TABLE 1	Land Use Categories and Percent Impervious Cover	6
TABLE 2	Site Runoff Variable b	7
<b>7.</b>	<b>LIST OF EXHIBITS</b>	
EXHIBIT 1	Vicinity Map	
EXHIBIT 2	FEMA FIRM Map	
EXHIBIT 3	Existing Conditions Drainage Area Map	
EXHIBIT 4	Proposed Conditions Drainage Area Map	
EXHIBIT 5	Proposed Conditions Detention Pond Layout Map	
EXHIBIT 6	XPSWMM – Existing Conditions Layout	
EXHIBIT 6a	XPSWMM – Existing Conditions 1% Profile	
EXHIBIT 6b	XPSWMM – Existing Conditions 10% Profile	
EXHIBIT 6c	XPSWMM – Existing Conditions Node: P1.1 result	
EXHIBIT 6d	XPSWMM – Existing Conditions Node: MH3 result	
EXHIBIT 6e	XPSWMM – Existing Conditions Node: Pr3b result	
EXHIBIT 7	XPSWMM – Proposed Conditions Layout	
EXHIBIT 7a	XPSWMM – Proposed Conditions 1% Profile	
EXHIBIT 7b	XPSWMM – Proposed Conditions 10% Profile	
EXHIBIT 7c	XPSWMM – Proposed Conditions Node: P1.1 result	
EXHIBIT 7d	XPSWMM – Proposed Conditions Node: MH3 result	
EXHIBIT 7e	XPSWMM – Proposed Conditions Node: Yara Lakes Pond result	
EXHIBIT 7f	XPSWMM – Proposed Conditions Link: Weir	

## **SECTION 1 – EXECUTIVE SUMMARY**

M Lanza Engineering, PLLC undertook the required engineered designs of the infrastructure, Hydrologic and Hydraulic studies, and the preparation of the drainage impact analysis report for the Yara Lakes Estates Subdivision; this proposed development will incorporate new 204 typical Residential lots, 9.761 ac. Detention Basin reserve, 2.7170 ac. park land reserves and 1.9276 ac. landscape/open space reserves.

Under Existing conditions, the site is mostly covered in wooded area (51.04 ac.) and has a storm water channel (5.67 ac.) to convey storm water from adjacent Fairmont Greens North subdivision running along the eastern edge of the property.

The proposed work is the development of Yara Lakes subdivision with single family residential lots with the applicable public infrastructure. These improvements will require the redesign of the existing on-site storm water detention channel; therefore, we are making an amendment to the approved drainage impact analysis for ***Fairmont Greens North*** (refer as FGN in this report) approved by Harris County Flood Control District with Project# 1806270142.

Based on the availability of water and wastewater, and the allowable area to accommodate the required stormwater detention system for the entire land development, the Yara Lakes Estates subdivision development is feasible.

## **SECTION 2 – INTRODUCTION**

### **2.1 PROJECT LOCATION**

The project is located at the northeast intersection of SH 146. and Wharton Weems Blvd., La Porte, Texas 77571 in Harris County. A vicinity map indicating the location of the tract relative to the landmarks is provided as Exhibit-1 in the document.

### **2.2 SCOPE OF WORK**

Yara Lakes Estates subdivision (56.712 ac.) development infrastructure designs, hydrologic and hydraulic study, and drainage impact report to include 204 typical Residential lots.

The scope of work includes:

1. Development of new residential lots to Yara Lakes Estates subdivision.
2. Retrofitting existing storm detention channel to a storm detention pond as per the new proposed development.
3. Preparation of XPSWMM model to analyze the stormwater impact of the proposed development.
4. Hydrologic analysis of the site and its contributing areas, development of drainage areas and calculation of peak discharges for existing and proposed conditions.
5. Determination of the new site ultimate stormwater outfall strategies.

### **2.3 DATA SOURCE**

Following are the documentation used in this analysis:

- Policy Criteria & Procedure Manual, Harris County Flood Control District, July 2019.
- Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) for Harris County, Texas, and Incorporated areas.
- City of La Porte PICM.
- Rainfall Depths and Intensities in NOAA's Atlas 14 rainfall data adopted by HCFCD.
- Storm Water Management Model User's Manual Version 5.1

## 2.4 SURVEY AND PROJECT DATUM

For these calculations we use the current topographic survey by Century Engineering, Inc. dated April 2023. The stormwater design plan sets were referenced to the NAVD 1988 (2001, adjustment) vertical datum as stated on the survey provided by Century Engineering, Inc.

## 2.5 FEMA Special Flood Hazard Area

The property area is covered by effective Flood Insurance Rate Map (FIRM) Panel No. 48201C0945M, revised January 06, 2017. For this study, the property lies partially within shaded Zone-X and Zone "AE", an area considered within the 0.2% and 1% Flood Plain, as shown on Exhibit 2. The flood plain administrator for the development will be the City of La Porte and per the City of La Porte GIS map, the property is not within the Riverine Floodplain therefore floodplain fill mitigation won't be required. All Single Family Residential finished floors will be designed to prevent flood damage and will abide by minimum finished floor requirements for properties in the flood zone.

## SECTION 3 – ANALYSIS

### 3.1 EXISTING CONDITIONS

Under existing conditions, the 56.712 acres is a combination of a storm water detention channel area of 5.67 ac and 51.04 ac. wooded area that was subdivided into tract 3a (30.93 ac.) and 3b (24.35 ac.) where the tract 3a sheet flows into the roadside ditch on Wharton Weems Blvd and Tract 3b drains into the drainage system. The Topography of the area is very flat with low slope (<1%), an average elevation of approximately 12 ft, with highs of 13 ft and lows of 11 ft. According to the FEMA, under panel no. 48201C0945M, the property is located within a 100-Yr and 500-Yr effective floodplain. The storm outfall from adjacent development in the North (Fairmont Greens North) discharges 1%  $Q_{out} = 40.289$  cfs into the private storm water channel located on Yara Lakes project site which is connected via a 24" RCP into the existing detention pond for the Lakes at Fairmont Greens to the south with an ultimate outfall 1%  $Q_{out} = 35.1$  cfs into the A104-00-00 tributary downstream, located in the Clear Creek Watershed.

### 3.2 PROPOSED DEVELOPMENT

As referenced above, the proposed Yara Lakes Estates development consists of developing the 56.712 acres to accommodate 204 <¼ acre single family residential lots. Please refer to Exhibit 5.

## SECTION 4 – HYDROLOGY

### 4.1 HYDROLOGY METHOD

For this analysis, we use the most current available methodology provided by Harris County Flood Control District in their current Policy Criteria and Procedures Manual, criteria for Atlas 14, implementation-July 2019.

The selected method for this analysis is the HCFCD method-2, Small Watershed Hydrograph Method consisting of developing a hydrograph using the site runoff curves, this simplified method is to determine peak discharges for areas from 50 acres up to 640 acres.

The peak flow was determined by using the equation for the site run-off curves:

$$Q_p = b * A^m$$

The total time to peak was calculated using the following equation from the PCPM:

$$T_p = \frac{V}{1.39 * Q_p}$$

## 4.2 HYDRAULIC METHOD

Autodesk XP-SWMM program was used for the impact analysis of the proposed development on the existing conditions of the site and downstream areas. This study builds up on the detention analysis performed for the Fairmont Greens North subdivision and amends the total development and detention area of the overall drainage area of the ponds. This study intends to confirm that there is no adverse negative impact on the surrounding area.

## 4.3 BACKGROUND

This drainage analysis is an amendment to the approved drainage impact analysis for **Fairmont Greens North (FGN) (Project#1806270142)**. The previously approved DIA analyzed the impact of development within 38.32 ac. land out of approx. 95.03 ac. land which includes 3 interconnected detention ponds with storm discharge crossing Wharton Weems Blvd. and into P1.1 (Ex. 3b) which ultimately discharges into tributary A104-00-00. The new amendment analysis is for the remainder 56.7123 acres out of 95.03 ac. tract. **Yara Lakes Estates** will use and improve infrastructure provided for the Fairmont Greens North storm detention while the outfall structure will remain the same as under existing conditions. The new amendment proposes enhancing P3 (exist. Channel, exhibit 5) passing through the subject site to include the additional storm detention volume generated by the proposed Yara Lakes Estates development.

Fairmont Greens North drainage analysis employed 3 interconnected pond systems (i.e., P1, P2, P3) to route the storm runoff safely to the ultimate outfall (tributary A104-00-00). P1 & P2 are located within the existing FGN development while P3 passes through the Yara Lakes Estates property. The originally approved DIA for FGN is based on TP-40 rainfall data. Below is the summary table for FGN development as it was approved in 2019:

**Detention Summary Table**

Fairmont Greens North		
Detention Basin Drainage Area	38.3 acres	
Detention Storage Rate	0.79 acre-feet/acre	
Floodplain Storage Rate	1.0 acre-feet/acre	
Combined Storate Rate	1.02 acre-feet/acre	
Detention Storage Required	21.1 acre-feet	
Floodplain Storage Required	8.9 acre-feet	
Total Storage Required	30.0 acre-feet	
Total Storage Provided	39.2 acre-feet	
	<b>10%</b> <b>(10-yr)</b>	<b>100%</b> <b>(100-yr)</b>
Maximum Allowable Outflow (cfs)	27.0	40.6
Maximum Outflow Provided (cfs)	26.8	35.1

**Table 5: Individual Pond Quantities**

Pond	Berm Area <i>ac</i>	Top of Bank Elev. <i>ft</i>	Pond Depth <i>ft</i>	Wet Pond Elev. <i>ft</i>	Total Pond Volume <i>ac-ft</i>	WSE [10-yr] <i>ft</i>	WSE [100-yr] <i>ft</i>	Freeboard [100-yr] <i>ft</i>
1	3.12	13.5	6	-	10.7	10.44	12.33	1.18
2	4.78	13.5	9.5	7	12.2	9.97	12.21	1.29
3	5.57	13	10.5	-	16.5	8.85	11.49	1.51
Existing	9.25	8.5	9	1.5	35.5	5.21	7.11	1.39

Based on the provided data, it has been determined that FGN possesses 9.2 acre-feet of surplus detention storage within Pond P3. The proposed development must incorporate this existing capacity into its design to accurately calculate the additional on-site detention volume requirements, while maintaining consistent outfall discharge rates

#### 4.4 LAND USE

The land uses impervious cover for both existing and proposed conditions using the most restrictive values in the HCFCF PCMP table 3.5.1 referenced in this report as Table 1. (See Exhibit 3 & 4)

Table 1 – Land Use Categories and Percent Impervious Cover

Land Use Categories	Land Use Descriptions	% Impervious	% Development
Undeveloped	Unimproved, natural, or agricultural	0	0
Residential – Rural Lot	≥ 5 acre ranch or farm	5	0
Residential – Large Lot (Newer)	> ½ acre new residential neighborhoods , storm sewers or roadside ditches with adequate capacity	25	100
Residential – Large Lot (Older)	> ¼ acre, older neighborhoods with limited capacity roadside ditches	25	50
Residential – Small Lot	≤ ¼ acre	40	100
Schools	Schools with non-paved areas	40	50
Developed Green Areas	Parks or golf courses	15	50
Light Industrial/ Commercial	Office parks, nurseries, airports, warehouses, or manufacturing with non-paved areas	65	100
High Density	Commercial, business, industrial, or apartments	85	100
Isolated Transportation*	Highway or major thoroughfare corridors	80	100
Water	Detention basins, lakes, and channels	100	100

WEIGHTED RUNOFF COEFFICIENT				
<b>EXISTING CONDITIONS</b>				
TOTAL AREA	56.7123			
WOODS	51.042	C (WOODS)	0.2	
CHANNEL	5.670	56.712	C (CHANNEL)	1.0
$C_w = [(51.042 \text{ AC.} * 0.2) + (5.67 \text{ AC.} * 1.0)] / 56.7123 \text{ AC.}$				
EXISTING $C_w$	0.280	% IMPERVIOUS	27.998	
USE <b>0%</b> IMPERVIOUS				
<b>PROPOSED CONDITIONS</b>				
TOTAL AREA	56.7123			
POND	7.7610	C (POND)	1	
LOTS	48.9513	56.712	C (LOTS)	0.4
$C_w = [(7.761 \text{ AC.} * 1.0) + (48.9513 \text{ AC.} * 0.4)] / 56.7123 \text{ AC.}$				
PROPOSED $C_w$	0.482	% IMPERVIOUS	48.21	

#### 4.5 HYDROGRAPH ROUTING DATA SUMMARY

Redevelopment Peak Discharge:

Peak discharges using the equation on HCFCD PCMP 3.3.5.  $Q=bA^m$  for site runoff curves, where A= drainage area (ac.),  $m= 0.786 > 20ac.$  and b= impervious cover variable from Table 2.

Table 2 – Site Runoff Variable b

Impervious Cover	50% Prob.		10% Prob.		1% Prob.		0.2% Prob.	
	≤ 20 acres	> 20 acres	≤ 20 acres	> 20 acres	≤ 20 acres	> 20 acres	≤ 20 acres	> 20 acres
0%	0.7	1.4	1.3	2.4	2.4	4.6	3.6	6.8
10%	0.9	1.8	1.6	3.0	2.9	5.5	4.3	8.1
20%	1.2	2.2	1.9	3.6	3.4	6.5	5.0	9.5
30%	1.4	2.7	2.3	4.4	4.1	7.7	5.8	11.0
40%	1.7	3.3	2.8	5.2	4.7	8.9	6.6	12.6
85%	2.3	4.3	3.5	6.6	5.7	10.9	8.0	15.1

Following is the summary for the linear interpolation used to determine the variable dependent on impervious cover using values in Table 2.:

SITE RUNOFF CURVES						
IMP. COVER	50% PROBABILITY		10% PROBABILITY		1% PROBABILITY	
	≤20 ACRES	≥20 ACRES	≤20 ACRES	≥20 ACRES	≤20 ACRES	≥20 ACRES
%						
0	0.7	1.4	1.3	2.4	2.4	4.6
10	0.9	1.8	1.6	3	2.9	5.5
20	1.2	2.2	1.9	3.6	3.4	6.5
30	1.4	2.7	2.3	4.4	4.1	7.7
40	1.7	3.3	2.8	5.2	4.7	8.9
85	2.3	4.3	3.5	6.6	5.7	10.9
			% IMP.	2-YR	10-YR	100-YR
EXIST. IMPERVIOUS			0.000	1.40	2.40	4.60
PROP. IMPERVIOUS			48.21	3.48	5.46	9.26

RUNOFF CALCULATION			
EXISTING CONDITIONS			
	2-YR	10-YR	100-YR
Q = bA <sup>m</sup>	33.459	57.359	109.938
PROPOSED CONDITIONS			
	2-YR	10-YR	100-YR
Q = bA <sup>m</sup>	83.229	130.383	221.428

## EXCESS OF RUNOFF

EXCESS OF RUNOFF - SMALL WATERSHED HYDROGRAPH METHOD						
WATERSHED		DIRECT RUNOFF (IN.)				
REGION-3		0	40	85	100	%
	100-YR	16	16.7	17.5	18	
	10-YR	6.8	7.7	8.8	9.3	
	2-YR	3.2	4	4.9	5.3	
EXISTING CONDITIONS		PERCENT	100-YR	10-YR	2-YR	
	IMPERVIOUS COVER	0.000	16.0	6.8	3.2	
PROPOSED CONDITIONS			100-YR	10-YR	2-YR	
	IMPERVIOUS COVER	48.21	16.846	7.901	4.16	

## VOLUME OF RUN-OFF CALCULATION

EXISTING CONDITIONS			
	2-YR	10-YR	100-YR
$V = A * I / 12$	15.123	32.137	75.616
PROPOSED CONDITIONS			
	2-YR	10-YR	100-YR
$V = A * I / 12$	19.680	37.339	79.614

## TIME TO PEAK CALCULATION

$T_{pe} = V * 43560 / (1.39 * Q * 3600)$

EXISTING CONDITIONS			
	2-YR	10-YR	100-YR
	3.935	4.877	5.987
PROPOSED CONDITIONS			
	2-YR	10-YR	100-YR
	2.058	2.493	3.130

## 4.6 REQUIRED DETENTION STORAGE

### EXISTING VS. PROPOSED CONDITIONS DETENTION RATE

	2-YR	10-YR	100-YR
AC-FT./AC	0.190	0.337	0.665
AC-FT.	10.793	19.114	37.713
CUF.	470123.24	832586.88	1642786.55

**MALCOMS METHOD HYDROGRAPH**

**YARA LAKES  
FM 146 AT WHARTON WEEMS BLVD., LA PORTE, TX 77571**

**100 YEAR EVENT (24 HOUR)**

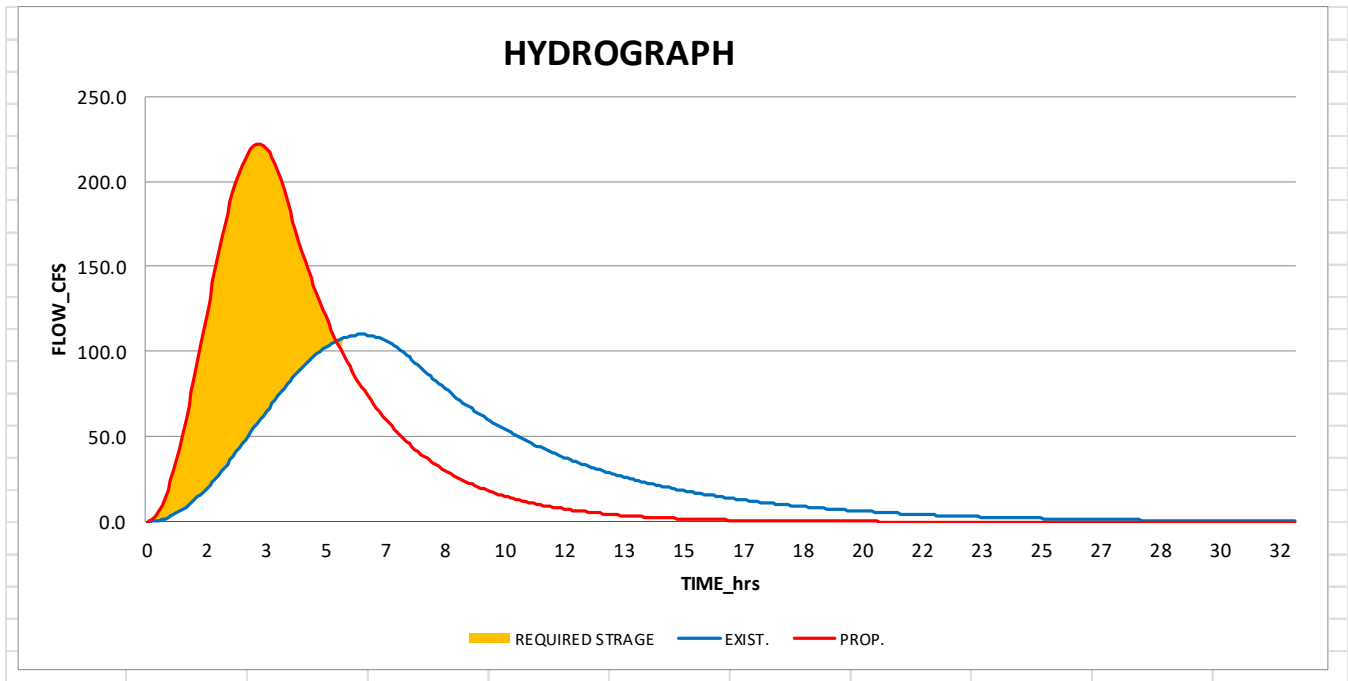
	1% EXIST.	1% PROP.
Drainage Area (Acres)	<b>56.712</b>	<b>56.712</b>
Percent Impervious	<b>0.00</b>	<b>48.21</b>
Excess rainfall volume (in)	16.00	16.85
Peak Flow Rate (cfs)	<b>109.938</b>	<b>221.428</b>
Computed Tp (hrs)	5.99	3.13
Time Increment (hrs)	0.08	

Detention Analysis							
Existing Conditions		Proposed Conditions		Volume (cubic feet)	Volume (acre-feet)	Cum. Vol. (acre-feet)	
TIME (hrs)	Q (cfs)	TIME (hrs)	Q (cfs)				
0	0.0	0.00	0.0				
0.08	0.0	0.08	0.4	44.40	0.00	0.00	
0.16	0.2	0.16	1.4	221.68	0.01	0.01	
0.24	0.4	0.24	3.2	574.96	0.01	0.02	
0.32	0.8	0.32	5.7	1101.70	0.03	0.04	
0.40	1.2	0.40	8.8	1798.13	0.04	0.09	
0.48	1.7	0.48	12.6	2659.23	0.06	0.15	
0.56	2.4	0.56	17.0	3678.80	0.08	0.23	
0.64	3.1	0.64	22.1	4849.51	0.11	0.34	
0.72	3.9	0.72	27.7	6162.89	0.14	0.48	
0.80	4.8	0.80	33.8	7609.48	0.17	0.66	
0.88	5.8	0.88	40.5	9178.78	0.21	0.87	
0.96	6.8	0.96	47.5	10859.43	0.25	1.12	
1.04	8.0	1.04	55.0	12639.21	0.29	1.41	
1.12	9.2	1.12	62.9	14505.15	0.33	1.74	
1.20	10.5	1.20	71.1	16443.60	0.38	2.12	
1.28	11.9	1.28	79.5	18440.34	0.42	2.54	
1.36	13.4	1.36	88.1	20480.69	0.47	3.01	
1.44	15.0	1.44	96.9	22549.55	0.52	3.53	
1.52	16.6	1.52	105.7	24631.56	0.57	4.10	
1.60	18.3	1.60	114.6	26711.17	0.61	4.71	
1.68	20.0	1.68	123.5	28772.74	0.66	5.37	
1.76	21.8	1.76	132.3	30800.67	0.71	6.08	
1.84	23.7	1.84	140.9	32779.51	0.75	6.83	
1.92	25.6	1.92	149.3	34694.00	0.80	7.63	
2.00	27.6	2.00	157.5	36529.26	0.84	8.46	
2.08	29.6	2.08	165.4	38270.83	0.88	9.34	
2.16	31.7	2.16	173.0	39904.79	0.92	10.26	
2.24	33.8	2.24	180.1	41417.85	0.95	11.21	
2.32	35.9	2.32	186.8	42797.43	0.98	12.19	
2.40	38.1	2.40	193.0	44031.78	1.01	13.20	
2.48	40.3	2.48	198.7	45110.03	1.04	14.24	
2.56	42.6	2.56	203.8	46022.26	1.06	15.30	

2.64	44.8	2.64	208.3	46759.60	1.07	16.37
2.72	47.1	2.72	212.2	47314.26	1.09	17.46
2.80	49.4	2.80	215.4	47679.62	1.09	18.55
2.88	51.7	2.88	218.0	47850.23	1.10	19.65
2.96	54.0	2.96	219.8	47821.91	1.10	20.75
3.04	56.3	3.04	221.0	47591.74	1.09	21.84
3.12	58.6	3.12	221.4	47158.07	1.08	22.92
3.20	60.9	3.20	221.2	46520.61	1.07	23.99
3.28	63.2	3.28	220.2	45680.35	1.05	25.04
3.36	65.5	3.36	218.5	44639.62	1.02	26.06
3.44	67.7	3.44	216.1	43402.04	1.00	27.06
3.52	70.0	3.52	213.0	41972.55	0.96	28.02
3.60	72.2	3.60	209.3	40357.32	0.93	28.95
3.68	74.3	3.68	205.0	38563.77	0.89	29.83
3.76	76.5	3.76	200.0	36600.51	0.84	30.67
3.84	78.6	3.84	194.5	34477.27	0.79	31.47
3.92	80.6	3.92	188.6	32238.59	0.74	32.21
4.00	82.7	4.00	182.5	29922.05	0.69	32.89
4.08	84.6	4.08	176.5	27601.72	0.63	33.53
4.16	86.5	4.16	170.7	25353.01	0.58	34.11
4.24	88.4	4.24	165.2	23175.05	0.53	34.64
4.32	90.2	4.32	159.8	21067.00	0.48	35.12
4.40	91.9	4.40	154.5	19028.03	0.44	35.56
4.48	93.6	4.48	149.5	17057.36	0.39	35.95
4.56	95.2	4.56	144.6	15154.21	0.35	36.30
4.64	96.8	4.64	139.9	13317.85	0.31	36.61
4.72	98.2	4.72	135.3	11547.53	0.27	36.87
4.80	99.6	4.80	130.9	9842.55	0.23	37.10
4.88	100.9	4.88	126.6	8202.19	0.19	37.29
4.96	102.1	4.96	122.5	6625.75	0.15	37.44
5.04	103.3	5.04	118.5	5112.54	0.12	37.56
5.12	104.3	5.12	114.6	3661.86	0.08	37.64
5.20	105.3	5.20	110.8	2273.03	0.05	37.69
5.28	106.2	5.28	107.2	945.33	0.02	37.71
5.36	107.0	5.36	103.7	0.00	0.00	37.71
5.44	107.7	5.44	100.3	0.00	0.00	37.71
5.52	108.3	5.52	97.1	0.00	0.00	37.71
5.60	108.8	5.60	93.9	0.00	0.00	37.71
5.68	109.2	5.68	90.8	0.00	0.00	37.71
5.76	109.5	5.76	87.8	0.00	0.00	37.71
5.84	109.8	5.84	85.0	0.00	0.00	37.71
5.92	109.9	5.92	82.2	0.00	0.00	37.71
6.00	109.9	6.00	79.5	0.00	0.00	37.71
6.08	109.9	6.08	76.9	0.00	0.00	37.71
6.16	109.7	6.16	74.4	0.00	0.00	37.71
6.24	109.5	6.24	72.0	0.00	0.00	37.71
6.32	109.1	6.32	69.6	0.00	0.00	37.71
6.40	108.7	6.40	67.3	0.00	0.00	37.71
6.48	108.1	6.48	65.1	0.00	0.00	37.71
6.56	107.5	6.56	63.0	0.00	0.00	37.71

27.04	1.3	27.04	0.0	0.00	0.00	37.71
27.12	1.3	27.12	0.0	0.00	0.00	37.71
27.20	1.3	27.20	0.0	0.00	0.00	37.71
27.28	1.3	27.28	0.0	0.00	0.00	37.71
27.36	1.3	27.36	0.0	0.00	0.00	37.71
27.44	1.2	27.44	0.0	0.00	0.00	37.71
27.52	1.2	27.52	0.0	0.00	0.00	37.71
27.60	1.2	27.60	0.0	0.00	0.00	37.71
27.68	1.2	27.68	0.0	0.00	0.00	37.71
27.76	1.2	27.76	0.0	0.00	0.00	37.71
27.84	1.1	27.84	0.0	0.00	0.00	37.71
27.92	1.1	27.92	0.0	0.00	0.00	37.71
28.00	1.1	28.00	0.0	0.00	0.00	37.71
28.08	1.1	28.08	0.0	0.00	0.00	37.71
28.16	1.1	28.16	0.0	0.00	0.00	37.71
28.24	1.0	28.24	0.0	0.00	0.00	37.71
28.32	1.0	28.32	0.0	0.00	0.00	37.71
28.40	1.0	28.40	0.0	0.00	0.00	37.71
28.48	1.0	28.48	0.0	0.00	0.00	37.71
28.56	1.0	28.56	0.0	0.00	0.00	37.71
28.64	1.0	28.64	0.0	0.00	0.00	37.71
28.72	0.9	28.72	0.0	0.00	0.00	37.71
28.80	0.9	28.80	0.0	0.00	0.00	37.71
28.88	0.9	28.88	0.0	0.00	0.00	37.71
28.96	0.9	28.96	0.0	0.00	0.00	37.71
29.04	0.9	29.04	0.0	0.00	0.00	37.71
29.12	0.9	29.12	0.0	0.00	0.00	37.71
29.20	0.8	29.20	0.0	0.00	0.00	37.71
29.28	0.8	29.28	0.0	0.00	0.00	37.71
29.36	0.8	29.36	0.0	0.00	0.00	37.71
29.44	0.8	29.44	0.0	0.00	0.00	37.71
29.52	0.8	29.52	0.0	0.00	0.00	37.71
29.60	0.8	29.60	0.0	0.00	0.00	37.71
29.68	0.8	29.68	0.0	0.00	0.00	37.71
29.76	0.7	29.76	0.0	0.00	0.00	37.71
29.84	0.7	29.84	0.0	0.00	0.00	37.71
29.92	0.7	29.92	0.0	0.00	0.00	37.71
30.00	0.7	30.00	0.0	0.00	0.00	37.71
30.08	0.7	30.08	0.0	0.00	0.00	37.71
30.16	0.7	30.16	0.0	0.00	0.00	37.71
30.24	0.7	30.24	0.0	0.00	0.00	37.71
30.32	0.7	30.32	0.0	0.00	0.00	37.71
30.40	0.6	30.40	0.0	0.00	0.00	37.71
30.48	0.6	30.48	0.0	0.00	0.00	37.71
30.56	0.6	30.56	0.0	0.00	0.00	37.71
30.64	0.6	30.64	0.0	0.00	0.00	37.71
30.72	0.6	30.72	0.0	0.00	0.00	37.71
30.80	0.6	30.80	0.0	0.00	0.00	37.71

APPLICABLE DETENTION RATE	0.665	AC-FT/AC.
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#### 4.7 ON-SITE DETENTION VOLUME PROVIDED

Existing private storm detention channel (Pr3b) is proposed to be enhanced into a storm detention pond (Yara Pond) sized to detain storm runoff from FGN and Yara Lakes Estates with the same controlled outfall as approved for the FGN development.

```

*-----*
| Variable storage data for node | YARA POND
*-----*

```

Data Point	Elevation ft	Depth ft	Area ft^2	Volume ft^3	Area acres	Volume ac-ft
1	2.5000	0.0000	124321.2419	0.0000	2.8540	0.0000
2	3.5000	1.0000	141015.0892	132579.2274	3.2373	3.0436
3	4.5000	2.0000	159282.2365	282633.7043	3.6566	6.4884
4	5.5000	3.0000	177780.9924	451078.9662	4.0813	10.3553
5	6.5000	4.0000	197536.9770	638649.3554	4.5348	14.6614
6	7.5000	5.0000	217146.5129	845911.7099	4.9850	19.4195
7	8.5000	6.0000	236914.4765	1.07287E+06	5.4388	24.6297
8	9.5000	7.0000	256840.9985	1.31968E+06	5.8963	30.2956
9	10.5000	8.0000	276925.9918	1.58649E+06	6.3573	36.4209
10	11.5000	9.0000	297169.4999	1.87348E+06	6.8221	43.0092
11	12.5000	10.0000	317571.5228	2.18079E+06	7.2904	50.0641
12	13.0000	10.5000	327831.9502	2.34213E+06	7.5260	53.7680
13	13.5000	11.0000	338132.0606	2.50862E+06	7.7624	57.5899

Total on-site required detention volume for FGN: **30.0 ac-ft.**  
 Total on-site provided detention volume for FGN: **39.2 ac-ft.**  
 Total on-site provided detention volume for FGN in P3: **16.5 ac-ft.**  
 Excess detention volume provided by FGN: **9.2 ac-ft.**  
 Total on-site required detention volume for Yara Lakes Estates: **37.713 ac-ft.**

**Effective detention volume provided in Yara Lakes pond: 57.5899 ac-ft. – 16.5 ac-ft. + 9.2 ac-ft. = 50.29 ac-ft.**

#### 4.8 XPSWMM SUMMARY RESULTS

The XP-SWMM (V.2026) software is used for this analysis, the analysis is an amendment to the approved drainage impact analysis (DIA) conducted for Fairmont Greens North subdivision (P#1806270142). The approved copy of the XP-SWMM model that was provided has been modified to keep all the existing elements the same while modifying the rainfall hydrograph for the whole site to Atlas-14 & the Yara Lakes portion where the proposed 10% and 1% hydrograph inflows from Yara Lakes Site into the new reconfigured Yara Lakes Pond (previously Pr3b). The 24" RCP outfall from P3 at elev. 2.5' remains the same.

Under existing conditions, the complete model has been updated to reflect **Atlas-14 flows**. Yara Lakes site drainage area was subdivided into tract 3a (30.93 ac.) and 3b (24.35 ac.) where the tract 3a sheet flows into the roadside ditch on Wharton Weems Blvd. The tract 3b drains into the pond Pr3b ultimately to P1.1 and Out. The ultimate storm discharge occurs at P1.1 and into HCFCD tributary A104-00-00.

Under proposed conditions, the complete model has been updated to reflect **Atlas-14 flows** within the system. The full 56.7123 ac. (Pr3a + Pr3b + partially O1) Yara Lakes Estates site area now drains to Yara Lakes Estates Pond (previously Pr3b) and outfalls through existing 24" RCP between MH3 and P1.1.A weir is set on the Yara Lakes pond at elev. 12.5' to route the excess of storm runoff safely into the roadside ditch. The outfall pipe from FGN development is being increased from 24" to 36" to accommodate the development.

The following data is the summary of the proposed change to the existing design. (Atlas-14)

	Drainage area	Area (ac.)	Impervious Cover	Peak Flow (cfs)		Peak Time (hr.)		Run-off Volume (ac-ft)	
				10-Yr	100-Yr	10-Yr	100-Yr	10-Yr	100-Yr
Existing	FGN – Tract 1	18.9	35.9%	49.04	84.18	2.127	2.708	11.982	26.189
	FGN – Tract 2	19.5	87.6%	68.25	111.15	1.842	2.238	14.441	28.577
	Yara – Tract 3a	30.9	0.00%	35.59	68.213	4.283	5.258	17.510	41.200
	Yara – Tract 3b	24.4	0.00%	29.56	56.656	4.072	4.999	13.827	32.533
	Offsite – 1 (O1)	3.1	6.5%	4.634	8.448	3.371	4.290	1.794	4.163
	Offsite – 2 (O2)	15.7	57.4%	48.21	79.86	1.919	2.426	10.630	22.255
Proposed	FGN – Tract 1	18.9	35.9%	49.04	84.18	2.127	2.708	11.982	26.189
	FGN – Tract 2	19.5	87.6%	68.25	111.15	1.842	2.238	14.441	28.577
	<b>Yara – Tract 3</b>	<b>56.71</b>	<b>48.21%</b>	<b>130.383</b>	<b>221.428</b>	<b>2.493</b>	<b>3.13</b>	<b>37.339</b>	<b>79.614</b>
	<b>Offsite – 1 (O1)</b>	<b>1.4</b>	<b>14.21%</b>	<b>2.448</b>	<b>4.411</b>	<b>2.99</b>	<b>3.79</b>	<b>0.841</b>	<b>1.920</b>
	Offsite – 2 (O2)	15.7	57.4%	48.21	79.86	1.919	2.426	10.630	22.255

#### System Inflow / Outflow:

##### Existing Conditions (Atlas-14)

##### Proposed Conditions (Atlas-14)

*-----*		*-----*	
Initial system volume	= 0.0000 Cu Ft	Initial system volume	= 0.0000 Cu Ft
Total system inflow volume	= 9.76645E+06 Cu Ft	Total system inflow volume	= 9.82432E+06 Cu Ft
Inflow + Initial volume	= 9.76645E+06 Cu Ft	Inflow + Initial volume	= 9.82432E+06 Cu Ft
*-----*		*-----*	
Total system outflow	= 9.75801E+06 Cu Ft	Total system outflow	= 9.70202E+06 Cu Ft
Volume left (Final volume)	= 79940.9798 Cu Ft	Volume left (Final volume)	= 144134.7619 Cu Ft
Evaporation	= 0.0000 Cu Ft	Evaporation	= 0.0000 Cu Ft
Basin Infiltration	= 0.0000 Cu Ft	Basin Infiltration	= 0.0000 Cu Ft
Outflow + Final Volume	= 9.83795E+06 Cu Ft	Outflow + Final Volume	= 9.84616E+06 Cu Ft
*-----*		*-----*	

**XPSWMM Junction Depth existing vs proposed conditions:**

Existing Conditions (Atlas-14)

Junction Name	Invert Elevation (ft)	Maximum Elevation (ft)
A2.3	8.6400	9.3550
A2.2	7.2800	9.3544
A2.1	7.0300	9.3535
A1.2	6.3700	9.3390
A1.1	5.3700	9.3378
P1.1	2.1900	9.3246
C3.2	8.4000	9.3621
MHC1	8.1500	9.3621
C3.1	6.2900	9.3583
C1.2	5.5100	9.3411
C1.1	4.7600	9.3364
C2.1	7.0200	9.3460
B2.2	7.7200	9.9559
B2.1	7.1800	9.8247
B1.2	6.2400	9.3483
B1.1	5.5700	9.3464
MHB1	5.4000	9.3458
JCT B1	6.9100	9.7357
P1.2	1.2800	8.9289
P1.3	-0.2300	7.3029
OUT1	-0.5500	1.4500
01	11.1000	19.2512
02	10.8800	19.2004
WWS.1	10.7200	19.2002
WWS.2	10.3800	15.4603
WWS.3	9.8200	15.4583
WWS.4	9.5700	12.2164
Pr1	7.5000	14.2175
2.2	7.0000	13.6906
MH3	2.0000	13.2424
MH2	3.3600	13.5173
WWN.3	9.1500	12.3085
WWN.1	9.1200	12.3049
WWN.2	9.3000	10.4557
OUT3	7.9000	8.7396
3.1	3.0000	13.2429
2.1	7.5000	13.6907
Pr2	7.0000	13.6907
03	9.3000	12.3052
WWN.4	9.1000	12.3095
WWS.5	9.2800	12.2076
04	8.9900	12.2077
WWS.6	8.6600	10.5208
OUT2	7.4650	8.5731
Pr3b	2.7500	13.2427
Pr3a	9.8700	12.3309

Proposed Conditions (Atlas-14)

Junction Name	Invert Elevation (ft)	Maximum Elevation (ft)
A2.3	8.6400	9.1758
A2.2	7.2800	9.1750
A2.1	7.0300	9.1744
A1.2	6.3700	9.1633
A1.1	5.3700	9.1623
P1.1	2.1900	9.1521
C3.2	8.4000	9.1809
MHC1	8.1500	9.1811
C3.1	6.2900	9.1781
C1.2	5.5100	9.1649
C1.1	4.7600	9.1612
C2.1	7.0200	9.1686
B2.2	7.7200	9.9635
B2.1	7.1800	9.8323
B1.2	6.2400	9.1730
B1.1	5.5700	9.1711
MHB1	5.4000	9.1705
JCT B1	6.9100	9.7433
P1.2	1.2800	8.7650
P1.3	-0.2300	7.1744
OUT1	-0.5500	1.4500
01	11.1000	19.1477
02	10.8800	19.0999
WWS.1	10.7200	19.0995
WWS.2	10.3800	15.2522
WWS.3	9.8200	15.2495
WWS.4	9.5700	12.1634
Pr1	7.5000	14.1941
2.2	7.0000	13.6950
MH3	2.0000	12.6329
MH2	3.3600	13.5032
WWN.3	9.1500	12.3171
WWN.1	9.0000	12.3136
WWN.2	8.9000	10.1208
OUT3	7.8500	8.7040
2.1	7.5000	13.6957
Pr2	7.0000	13.6954
03	9.3000	12.3139
WWN.4	9.1000	12.3181
WWS.5	9.2800	12.1582
04	8.9900	12.1586
WWS.6	8.6600	10.5122
OUT2	7.4650	8.5664
YARA POND	2.5000	13.4645

**XPSWMM node comparison table**

NODES	EXIST. CONDITIONS	PROP. CONDITIONS	DETLA (FT.)
	MAX. ELEV. (FT.)	MAX. ELEV. (FT.)	(EXIST. - PROP.)
A1.1	9.3378	9.1623	0.1755
A1.2	9.339	9.1633	0.1757
A2.1	9.3535	9.1744	0.1791
A2.2	9.3544	9.175	0.1794
A2.3	9.355	9.1758	0.1792
B1.1	9.3464	9.1711	0.1753
B1.2	9.3483	9.173	0.1753
B2.1	9.8247	9.8323	-0.0076
B2.2	9.9559	9.9635	-0.0076
MHB1	9.3458	9.1705	0.1753
JCT B1	9.7357	9.7433	-0.0076
C1.1	9.3364	9.1612	0.1752
C1.2	9.3411	9.1649	0.1762
C2.1	9.346	9.1686	0.1774
C3.1	9.3583	9.1781	0.1802
C3.2	9.3621	9.1809	0.1812
MHC1	9.3621	9.1811	0.181
WWS.1	19.2002	19.0995	0.1007
WWS.2	15.4603	15.2522	0.2081
WWS.3	15.4583	15.2495	0.2088
WWS.4	12.2164	12.1634	0.053
WWS.5	12.2076	12.1582	0.0494
WWS.6	10.5208	10.5122	0.0086
WWN.1	12.3049	12.3136	-0.0087
WWN.2	10.4557	10.1208	0.3349
WWN.3	12.3085	12.3171	-0.0086
WWN.4	12.3095	12.3181	-0.0086
Pr1	14.2175	14.1941	0.0234
Pr2	13.6907	13.6954	-0.0047
Pr3a	12.3309	-	-
Pr3b	13.2427	-	-
YARA POND	-	13.4645	-
P1.1	9.3246	9.1521	0.1725
P1.2	8.9289	8.765	0.1639
P1.3	7.3029	7.1744	0.1285
O1	19.2512	19.1477	0.1035
O2	19.2004	19.0999	0.1005
O3	12.3052	12.3139	-0.0087
O4	12.2077	12.1586	0.0491
2.1	13.6907	13.6957	-0.005
2.2	13.6906	13.695	-0.0044
3.1	13.2429	-	-
MH2	13.5173	13.5032	0.0141
MH3	13.2424	12.6329	0.6095
OUT-1	1.45	1.45	0
OUT-2	8.5731	8.5664	0.0067
OUT-3	8.7396	8.704	0.0356

\*\* NEGATIVE DELTA VALUE INDICATES INCREASE IN WSE. AT NODE

\*\* POSITIVE DELTA VALUE INDICATES DECREASE IN WSE. AT NODE

#### 4.9 DETENTION LAYOUT

The existing Pr3b is proposed to be enhanced to detain the excess of runoff generated from the Yara Lakes Estates development. Pr3b outfall configuration remains the same while also keeping the 4:1 side slopes, below is a comparison of the modifications being proposed.

	Pond	HB (ft.)	FL (ft.)	H (ft.)	1% WSE (ft.)	Area (ac.)	Vol. (ac-ft.)
<b>Existing</b>	Pr3b	13.0'	2.5'	10.5'	12.622'	5.57	16.5
<b>Proposed</b>	Yara Lakes Pond	13.5'	2.5'	11.0'	<b>13.4645'</b>	<b>7.762</b>	<b>57.589</b>

#### Detention Pond Design Summary

<b>New Development Area</b>	56.7123 acres		
<b>Total area of Pond</b>	7.762 acres		
<b>Average Natural Ground Elevation</b>	12 – 13 ft.		
<b>Pond Max. Water Surface Elevation</b>	13.50'		
<b>Pond Side Slope</b>	4:1		
<b>Berm Width</b>	15'		
	<b>Total Detention Required (ac-ft.)</b>	<b>Total Provided (ac-ft.)</b>	<b>Rate Provided (ac-ft/ac.)</b>
<b>Detention Vol. (100-Yr)</b>	37.713	57.589	0.997
	<b>10-Yr</b>	<b>100-Yr</b>	
<b>Ultimate Allowable Outfall Rate (cfs)</b>	27.354 cfs	57.573 cfs	
<b>Ultimate Outfall Rate Provided (cfs)</b>	27.347 cfs	53.551 cfs	

#### 4.10 STORM OUTFALL SUMMARY

Based on the XP-SWMM amendment analysis conducted for the proposed Yara Lakes Estates development, following is the ultimate storm outfall result at P1.1 output extracted from the analysis.

Name	Location	Outfall	Outfall Type	Existing Flow (cfs) Atlas-14		Proposed Flow (cfs) Atlas-14	
				10%	1%	10%	1%
Outfall - 1	P1.1	A104-00-00	36" RCP w/ 24" restrictor	27.354	57.573	<b>27.347</b>	<b>53.551</b>

The proposed Yara Lakes Estates development will not have any negative impact on the existing channel while detaining the excess flow generated by Yara Lakes Estates and FGN development.

#### 5.0 ENGINEER'S CONCLUSION

Upon completion of the storm detention & hydraulic amendment analysis via XP-SWMM conducted for the Yara Lakes Estates development result in no negative impact on the working of the existing storm detention & outfall system conveying excess of runoff from Fairmont Greens North, Yara Lakes Estates and Lakes at Fairmont Greens into the tributary A104-00-00 under existing and proposed conditions. With this analysis, M Lanza Engineering, PLLC deems this development will have **no adverse negative impact** on the upstream & downstream drainage conditions.



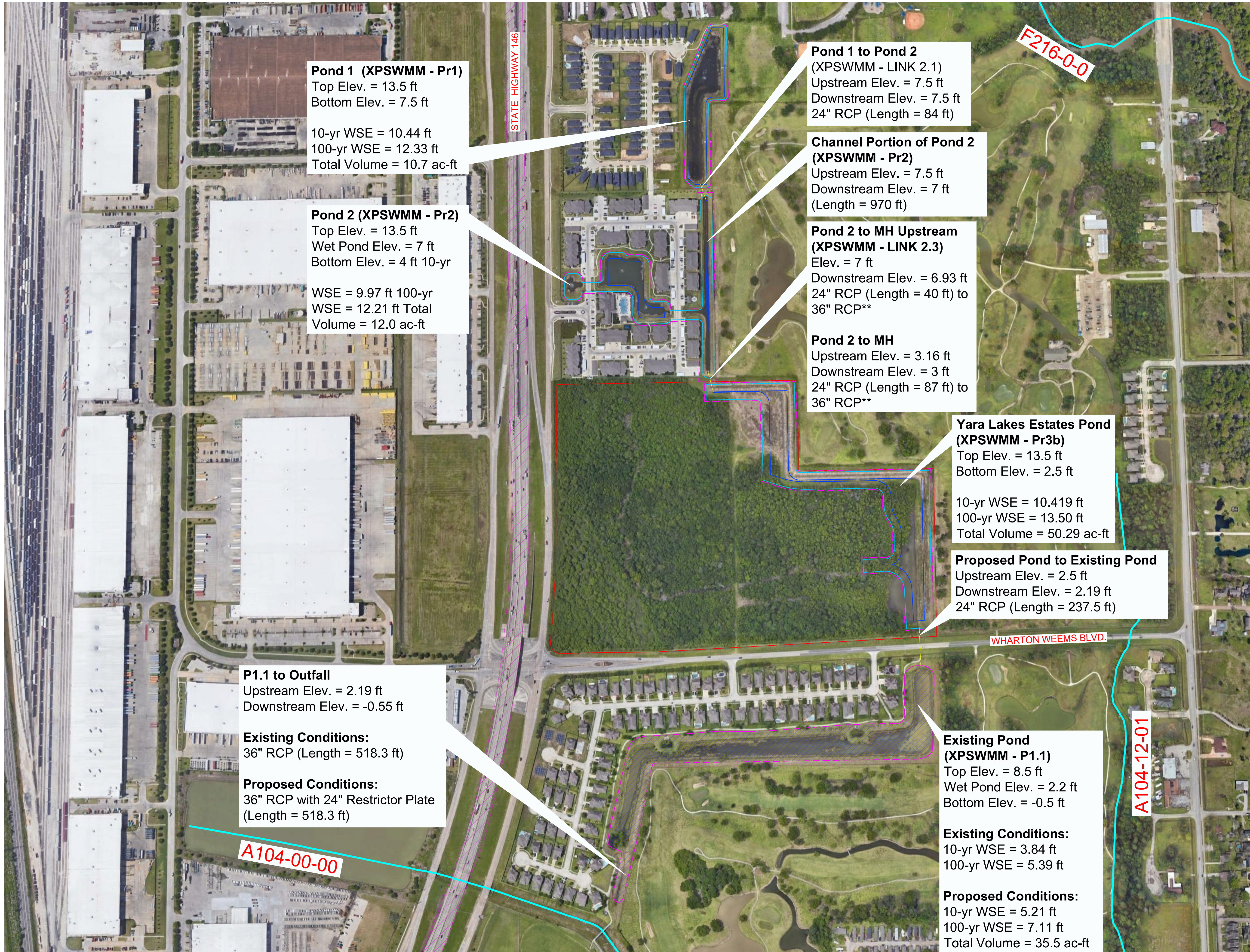
**Mario E. Lanza, P.E.**











**Pond 1 (XPSWMM - Pr1)**  
 Top Elev. = 13.5 ft  
 Bottom Elev. = 7.5 ft  
 10-yr WSE = 10.44 ft  
 100-yr WSE = 12.33 ft  
 Total Volume = 10.7 ac-ft

**Pond 2 (XPSWMM - Pr2)**  
 Top Elev. = 13.5 ft  
 Wet Pond Elev. = 7 ft  
 Bottom Elev. = 4 ft 10-yr  
 WSE = 9.97 ft 100-yr  
 WSE = 12.21 ft Total  
 Volume = 12.0 ac-ft

**Pond 1 to Pond 2 (XPSWMM - LINK 2.1)**  
 Upstream Elev. = 7.5 ft  
 Downstream Elev. = 7.5 ft  
 24" RCP (Length = 84 ft)

**Channel Portion of Pond 2 (XPSWMM - Pr2)**  
 Upstream Elev. = 7.5 ft  
 Downstream Elev. = 7 ft  
 (Length = 970 ft)

**Pond 2 to MH Upstream (XPSWMM - LINK 2.3)**  
 Elev. = 7 ft  
 Downstream Elev. = 6.93 ft  
 24" RCP (Length = 40 ft) to  
 36" RCP\*\*

**Pond 2 to MH**  
 Upstream Elev. = 3.16 ft  
 Downstream Elev. = 3 ft  
 24" RCP (Length = 87 ft) to  
 36" RCP\*\*

**Yara Lakes Estates Pond (XPSWMM - Pr3b)**  
 Top Elev. = 13.5 ft  
 Bottom Elev. = 2.5 ft  
 10-yr WSE = 10.419 ft  
 100-yr WSE = 13.50 ft  
 Total Volume = 50.29 ac-ft

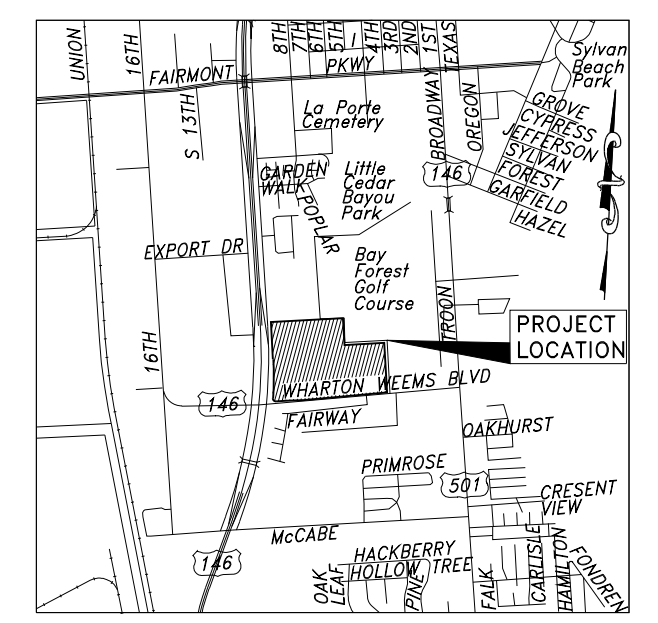
**Proposed Pond to Existing Pond**  
 Upstream Elev. = 2.5 ft  
 Downstream Elev. = 2.19 ft  
 24" RCP (Length = 237.5 ft)

**P1.1 to Outfall**  
 Upstream Elev. = 2.19 ft  
 Downstream Elev. = -0.55 ft  
**Existing Conditions:**  
 36" RCP (Length = 518.3 ft)  
**Proposed Conditions:**  
 36" RCP with 24" Restrictor Plate  
 (Length = 518.3 ft)

**Existing Pond (XPSWMM - P1.1)**  
 Top Elev. = 8.5 ft  
 Wet Pond Elev. = 2.2 ft  
 Bottom Elev. = -0.5 ft

**Existing Conditions:**  
 10-yr WSE = 3.84 ft  
 100-yr WSE = 5.39 ft

**Proposed Conditions:**  
 10-yr WSE = 5.21 ft  
 100-yr WSE = 7.11 ft  
 Total Volume = 35.5 ac-ft



VICINITY MAP  
 CITY OF LA PORTE, HARRIS COUNTY  
 KEY MAP # 580-K

**LEGEND**

- PROJECT AREA
- HCFCD STREAMS
- OUTFALL PIPES
- MAINTENANCE BERM
- TOP OF POND
- BOTTOM OF POND



IN THE CITY OF LA PORTE, TEXAS  
 HARRIS COUNTY

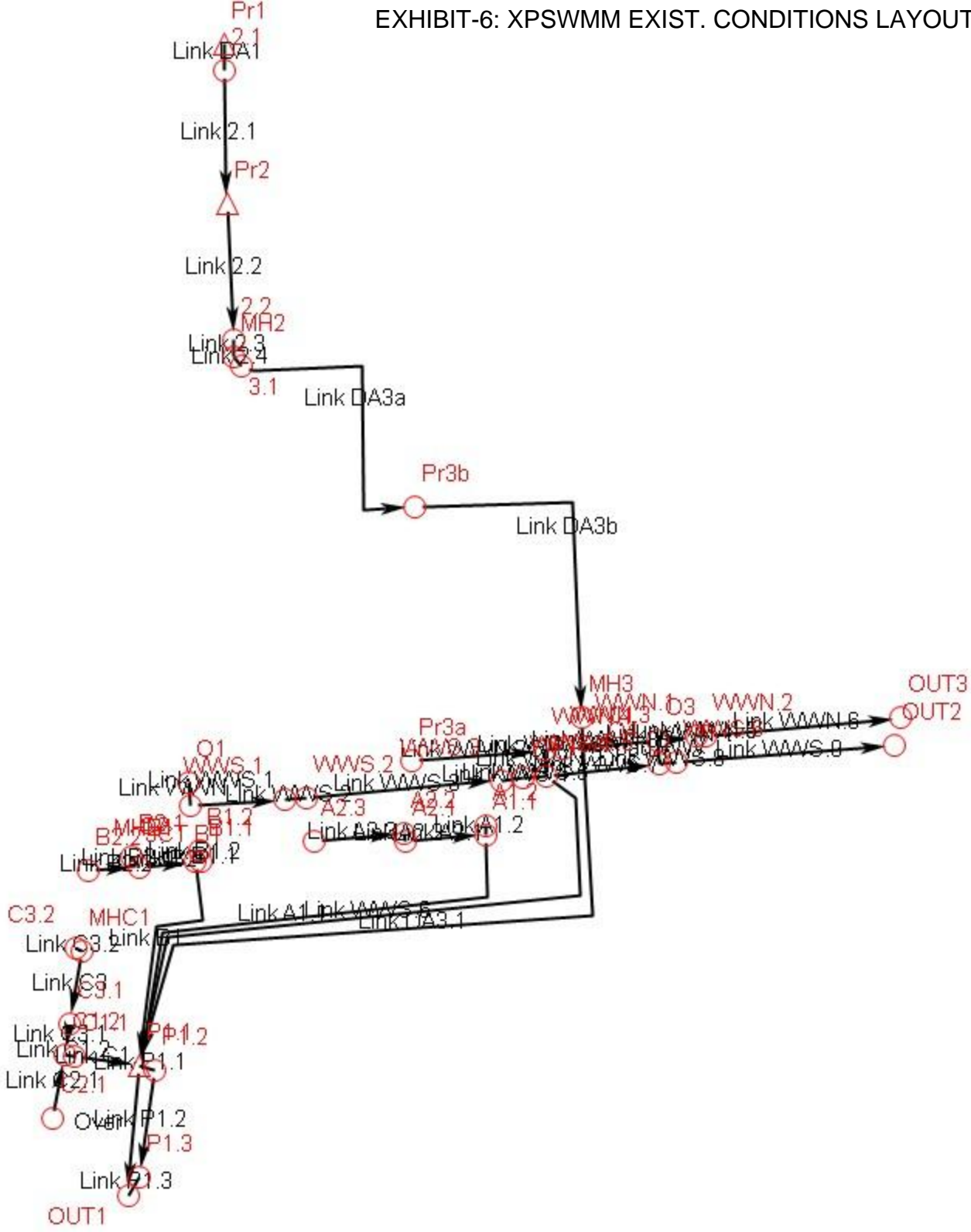
**YARA LAKES ESTATES SUBDIVISION  
 56.7 AC. RESIDENTIAL / COMMERCIAL  
 DEVELOPMENT  
 LA PORTE, TEXAS**

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 CIVIL STRUCTURAL ENGINEERS & PLANNERS  
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DESIGN BY: Mario E. Lanza, P.E.  
 DRAWING BY: Mario E. Lanza, P.E.  
 DATE: October 24, 2025  
 SCALE: NTS.  
 FILE: ML/2023/SOPHA FILE/ GRAND MISSION/EXHIBITS  
 DRAWING: SHEET: 5 / 5

EXHIBIT 5 - PROPOSED DRAINAGE SYSTEM LAYOUT NTS.

EXHIBIT-6: XPSWMM EXIST. CONDITIONS LAYOUT



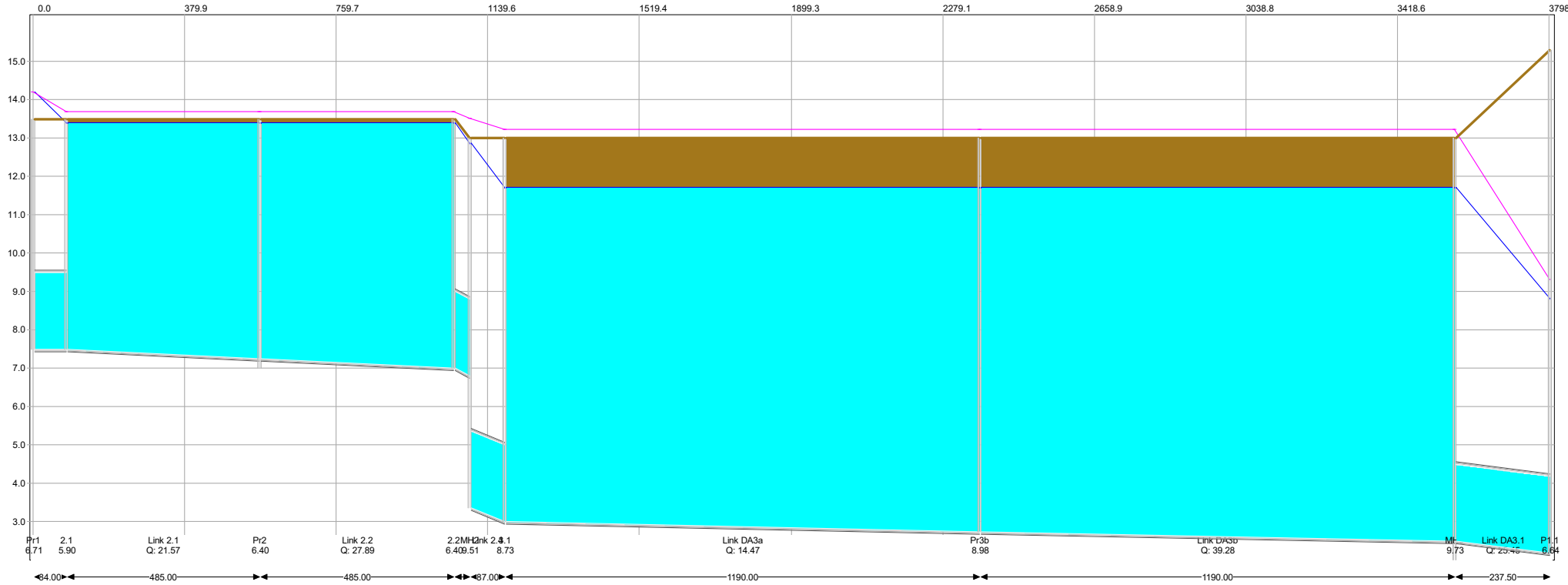


EXHIBIT-6a: XPSWMM EXIST. CONDITIONS 1% PROFILE

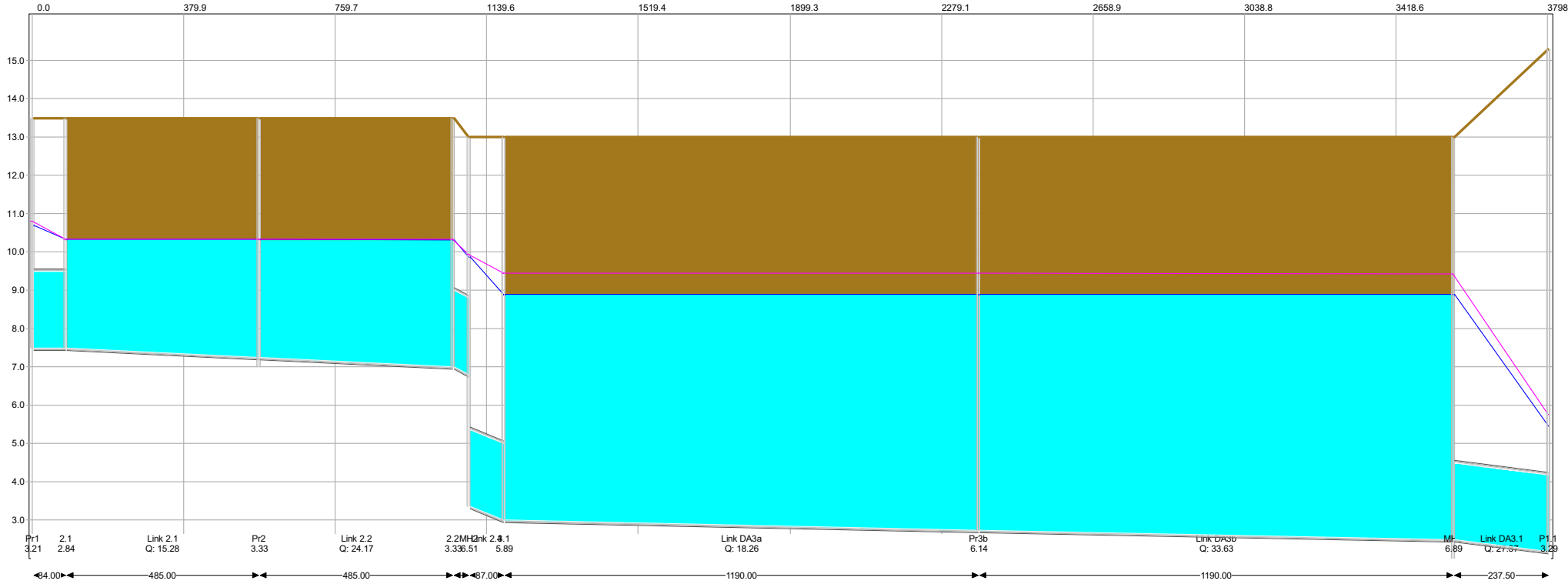
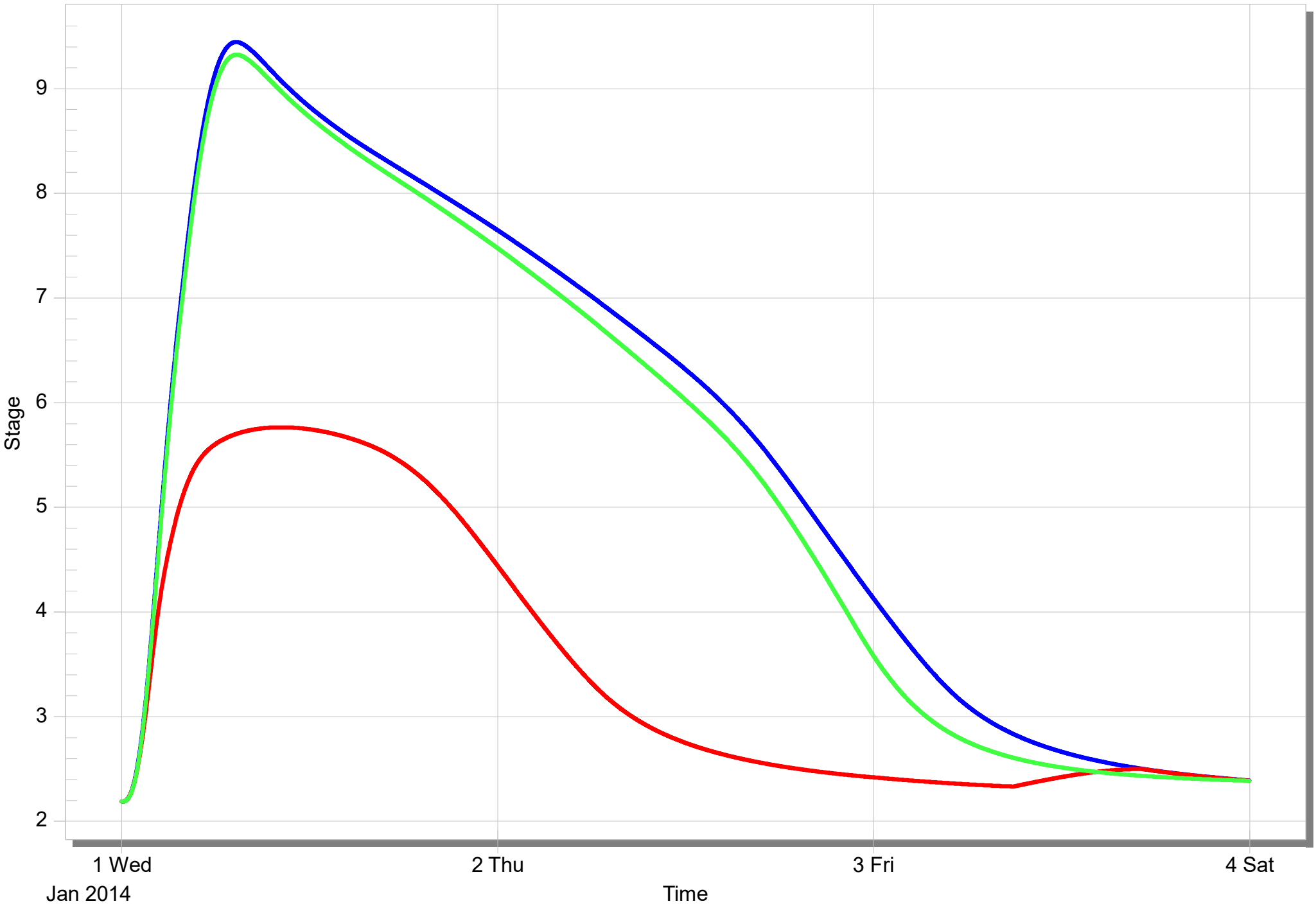


EXHIBIT-6b: XPSWMM EXIST. CONDITIONS 10% PROFILE

Base Scenario[Max 9.446]

10yr[Max 5.765]

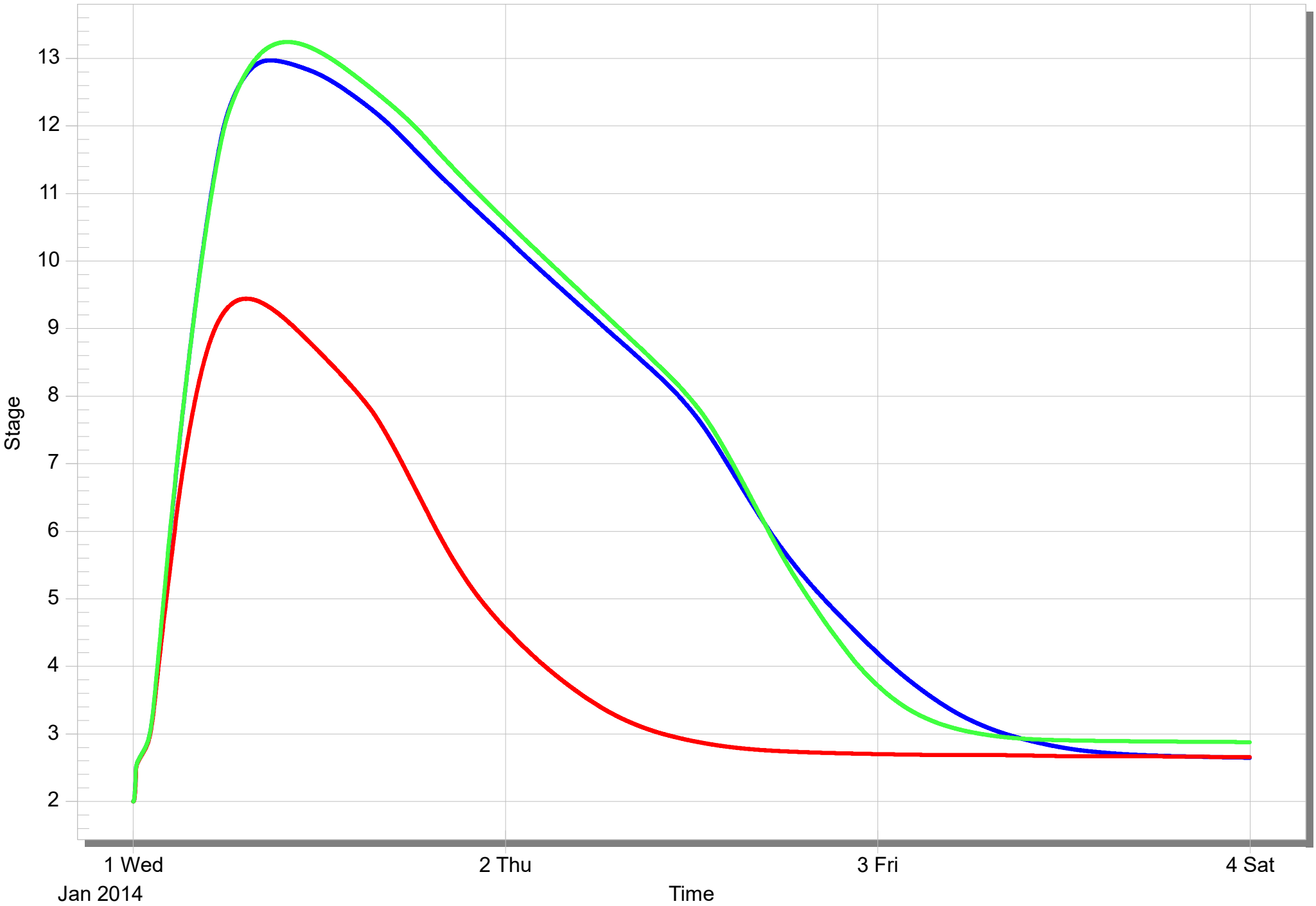
100yr-Free[Max 9.325]



Base Scenario[Max 12.971]

10yr[Max 9.443]

100yr-Free[Max 13.242]



Base Scenario[Max 12.971]

10yr[Max 9.445]

100yr-Free[Max 13.243]

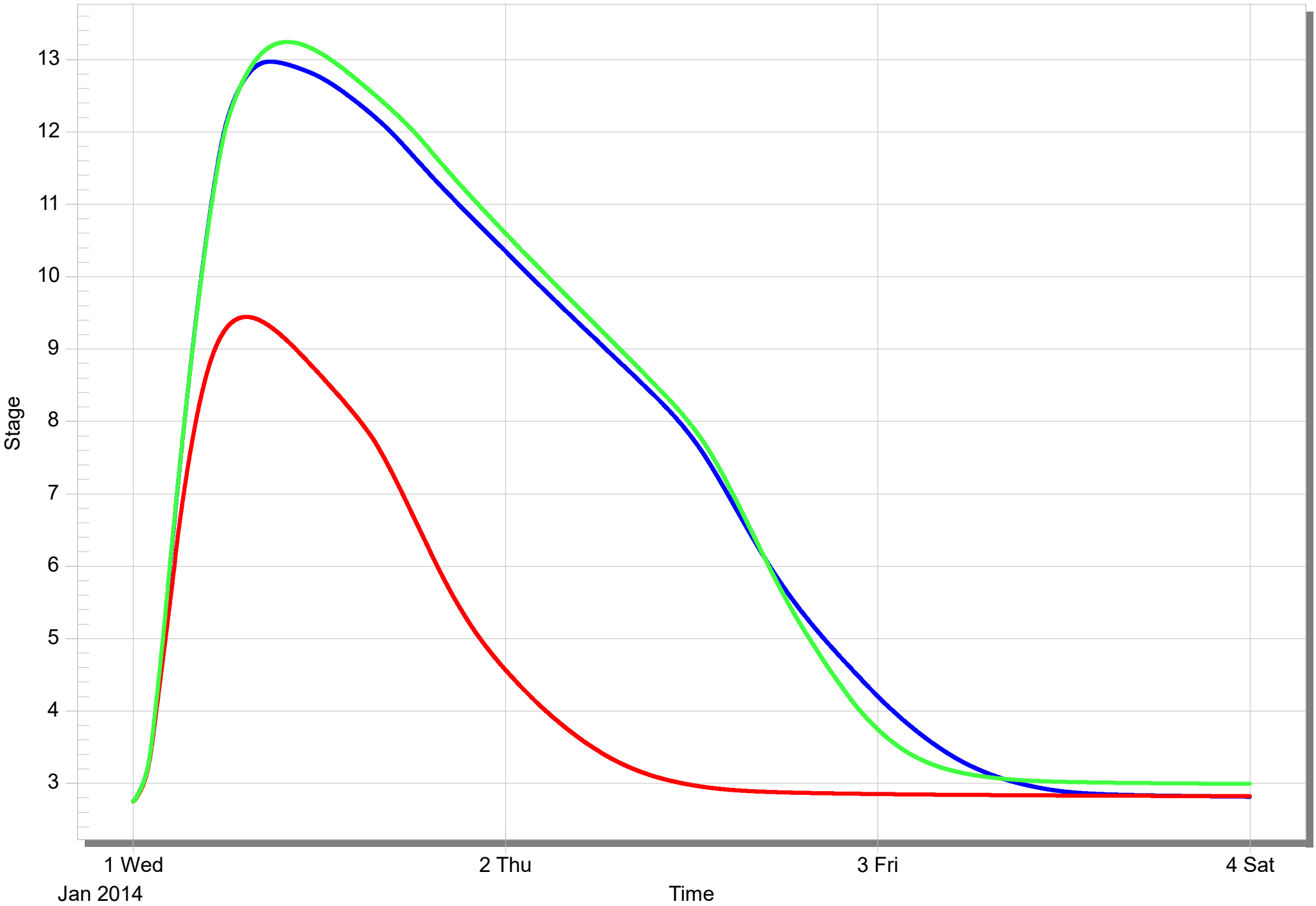
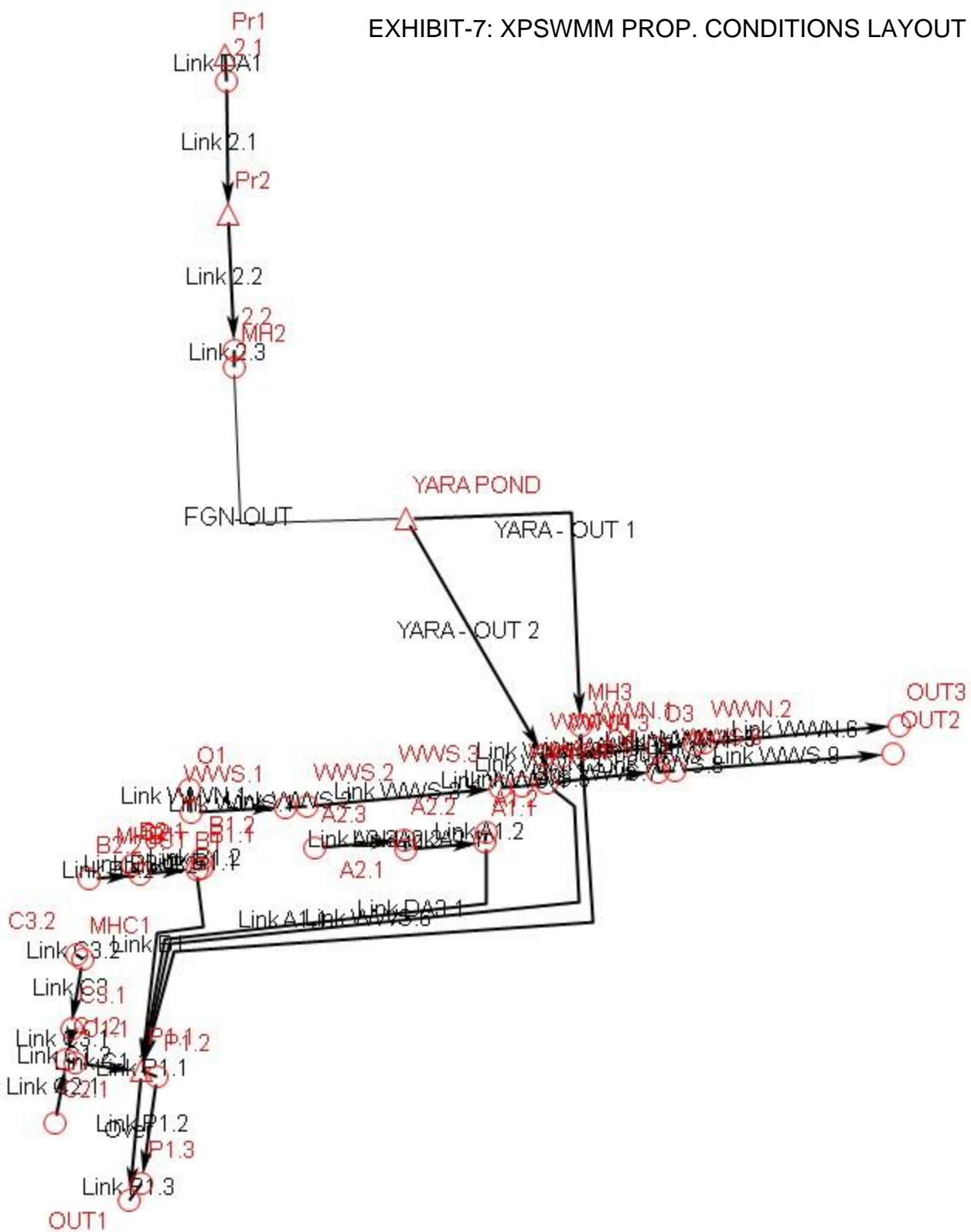
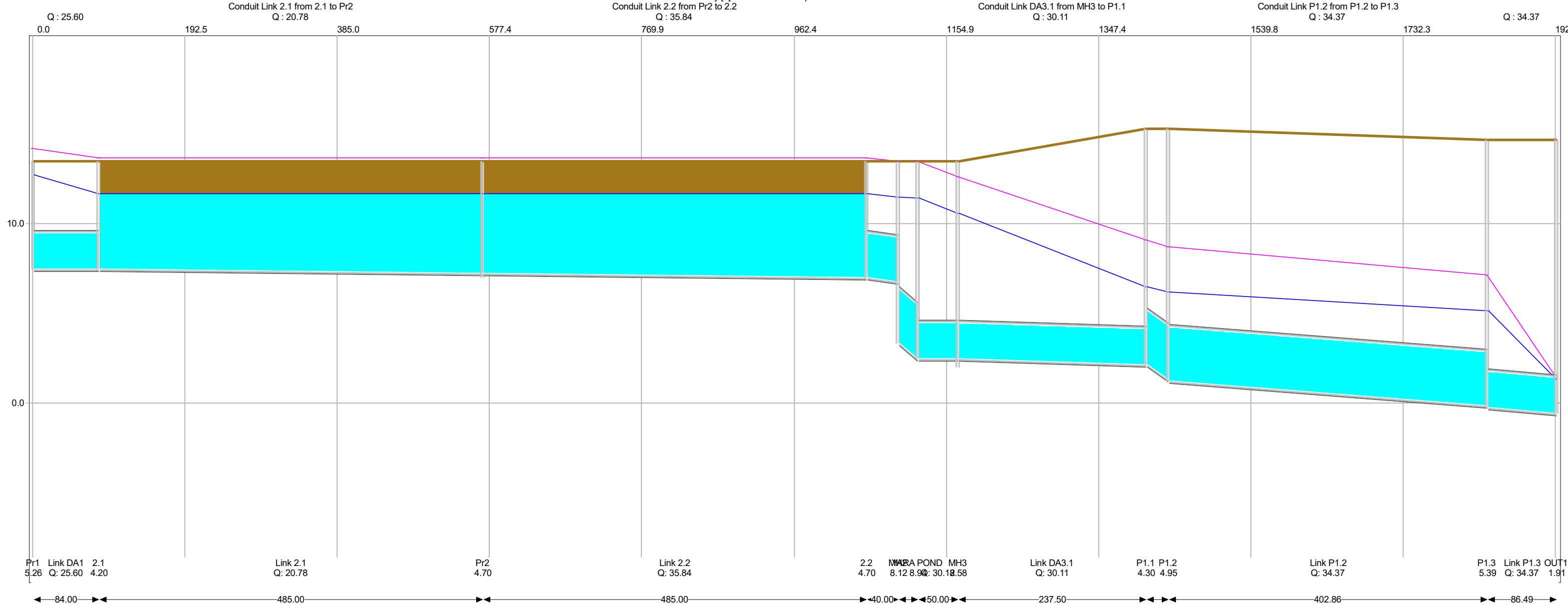


EXHIBIT-7: XPSWMM PROP. CONDITIONS LAYOUT





Q : 25.60      192.5      Conduit Link 2.1 from 2.1 to Pr2      Q : 20.78      385.0      577.4      Conduit Link 2.2 from Pr2 to 2.2      Q : 35.84      769.9      962.4      1154.9      Conduit Link DA3.1 from MH3 to P1.1      Q : 30.11      1347.4      1539.8      Conduit Link P1.2 from P1.2 to P1.3      Q : 34.37      1732.3      1924.8      Q : 34.37

Pr1 Link DA1 2.1      Link 2.1      Pr2      Link 2.2      MARA POND MH3      Link DA3.1      P1.1 P1.2      Link P1.2      P1.3 Link P1.3 OUT1  
 5.26 Q: 25.60 4.20      Q: 20.78      4.70      Q: 35.84      4.70 8.12 8.90 Q: 30.11 1.58      Q: 30.11      4.30 4.95      Q: 34.37      5.39 Q: 34.37 1.91

← 84.00 →      ← 485.00 →      ← 485.00 →      ← 40.00 →      ← 50.00 →      ← 237.50 →      ← 402.86 →      ← 86.49 →

EXHIBIT-7a: XPSWMM PROP. CONDITIONS 1% PROFILE

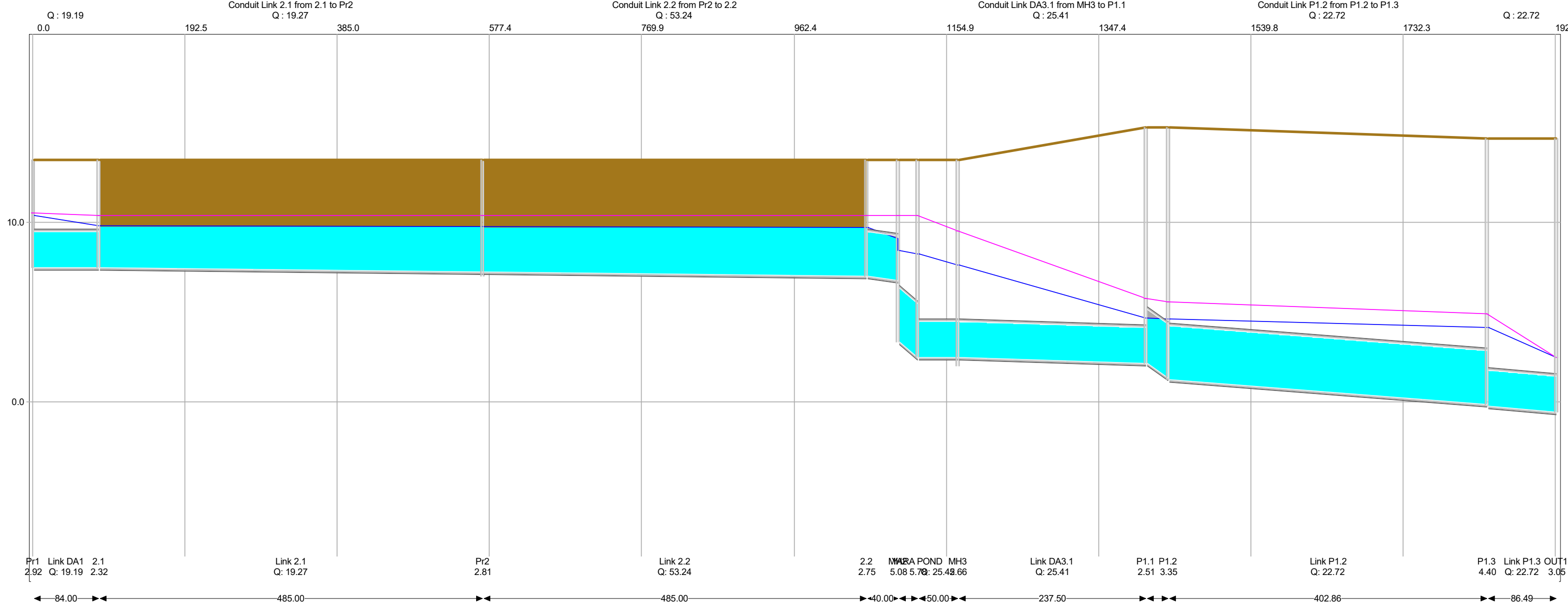


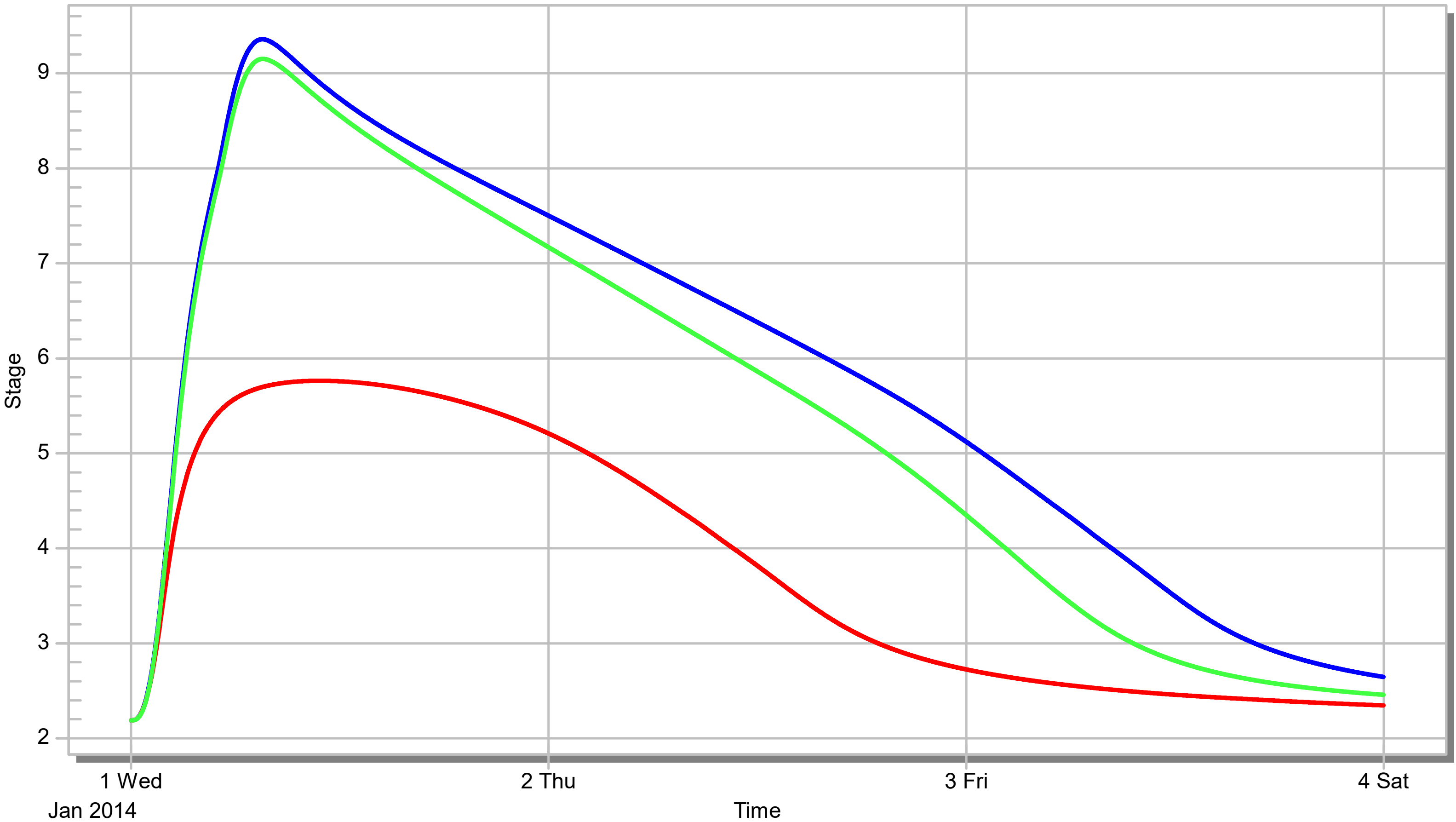
EXHIBIT-7b: XPSWMM PROP. CONDITIONS 10% PROFILE

# Node - P1.1

Base Scenario [Max 9.359]

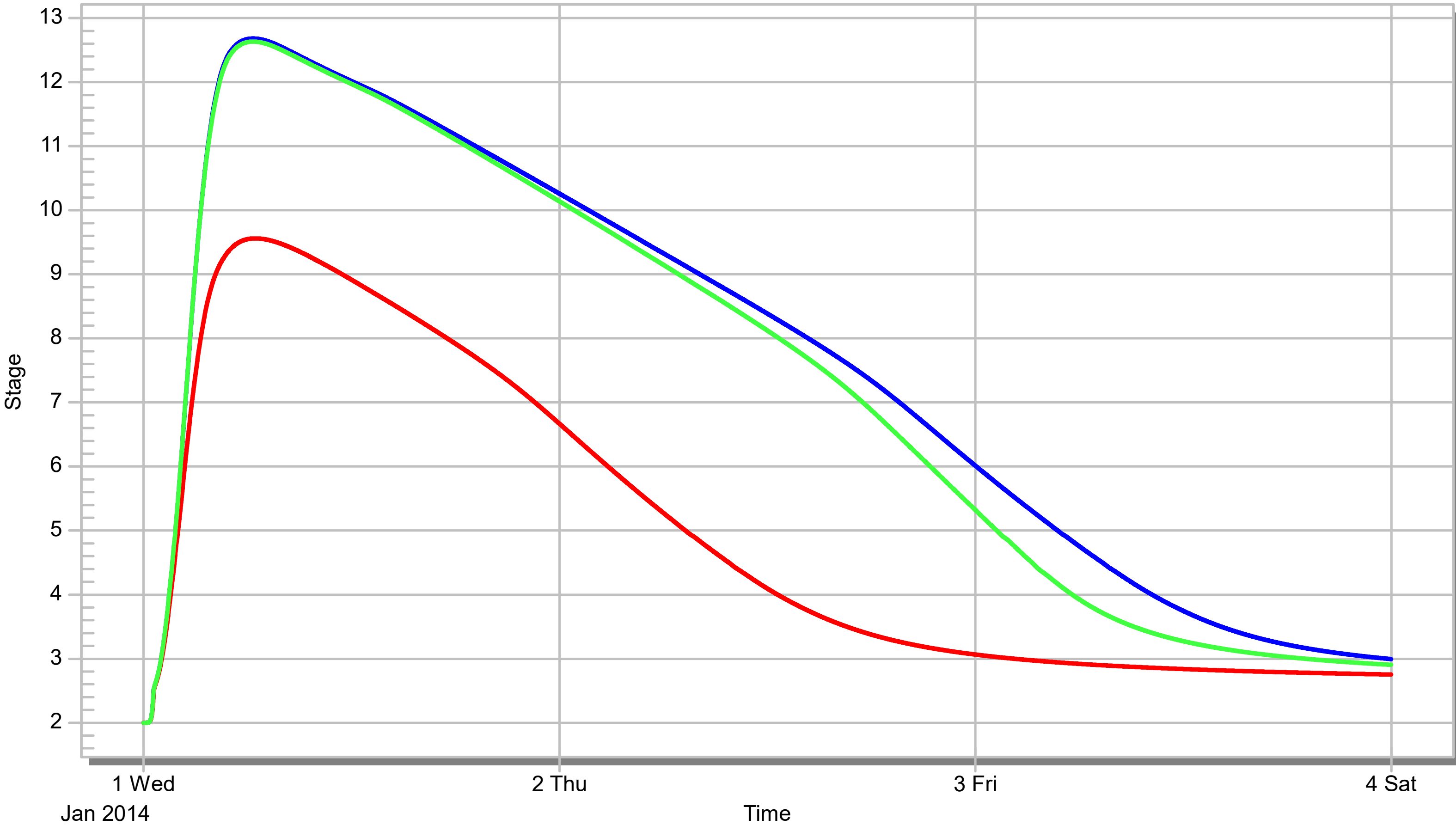
10yr [Max 5.764]

100yr-Free [Max 9.152]



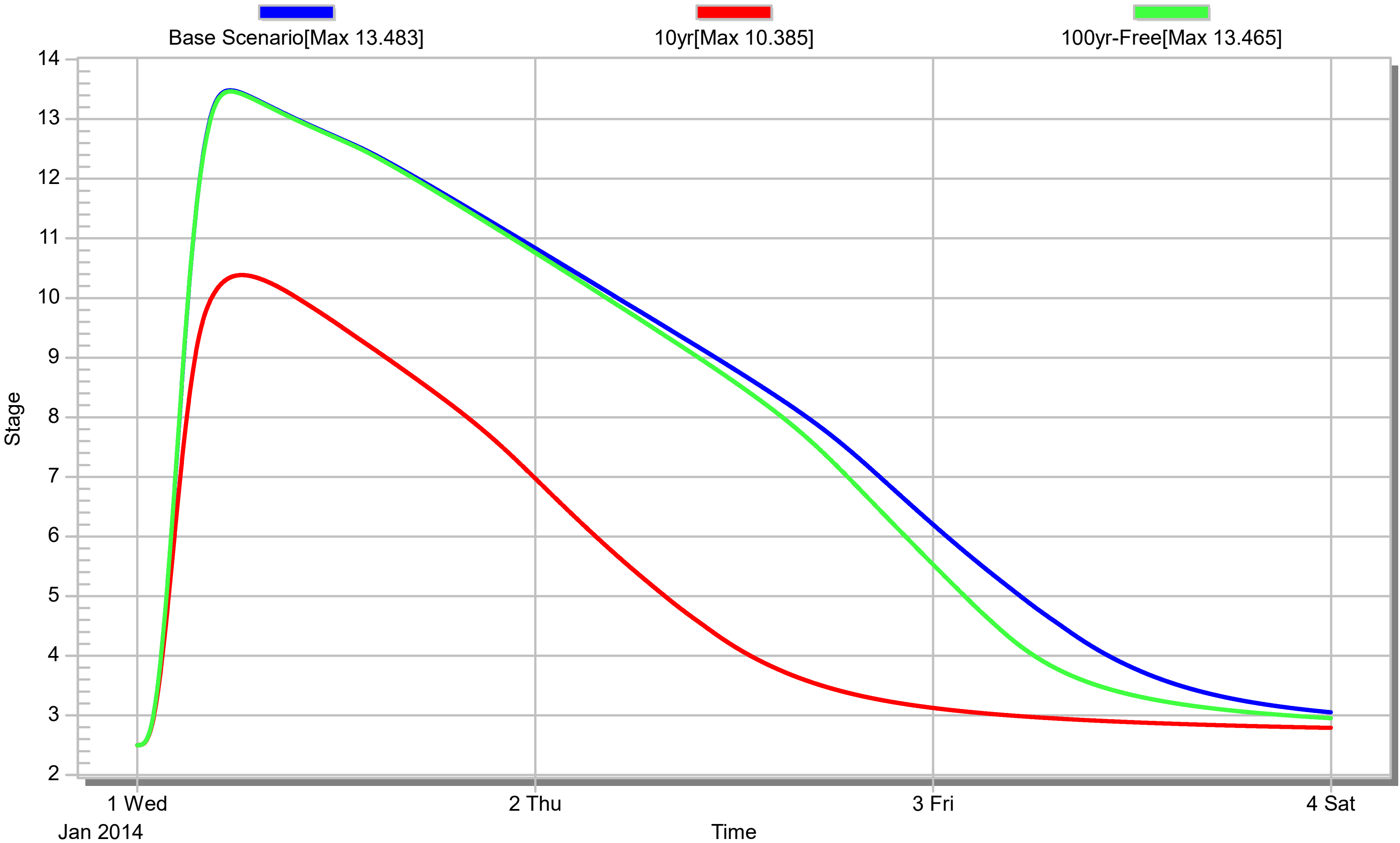
# Node - MH3

Base Scenario [Max 12.681]      10yr [Max 9.561]      100yr-Free [Max 12.633]



# Node - YARA POND

EXHIBIT-7e: XPSWMM PROP. CONDITIONS NODE:  
YARA LAKES POND



Base Scenario [Max 91.560]

10yr [Max 0.000]

100yr-Free [Max 88.465]

