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Low Impact Development Design Strategies

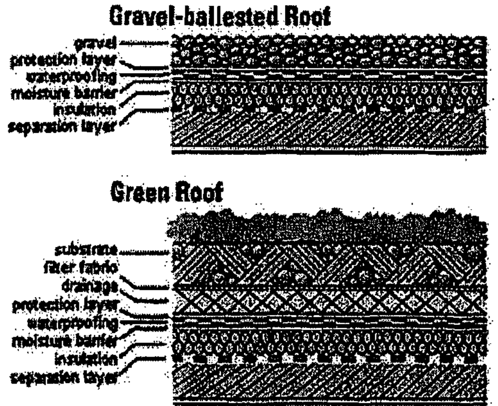
Revised: November 25, 2009

Potomac Village

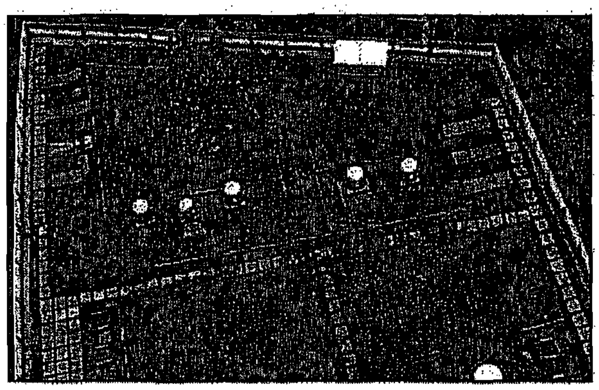
Green Roofs

Green roofs are designed to support plants and mitigate the effects of urbanization on water quality by filtering, absorbing, and detaining rainfall. There are two basic types of green roofs: extensive and intensive. Extensive roofs form a thin vegetated sheath. Their low profile allows them to be added to existing buildings. By contrast, intensive roofs are integral to the roof structure, permitting the use of trees and walkways. A greater depth of media and a greater roof structural capacity may be required to accommodate larger vegetation and surface features.

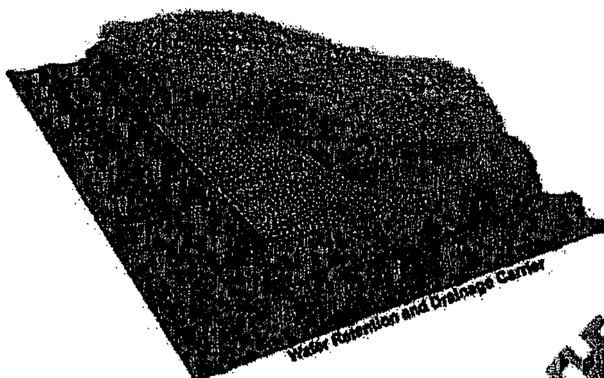
Source: lowimpactdevelopment.org; August 2009



Source: www.epa.gov



Source: www.balancedlivingmag.com



Source: www.treehugger.com

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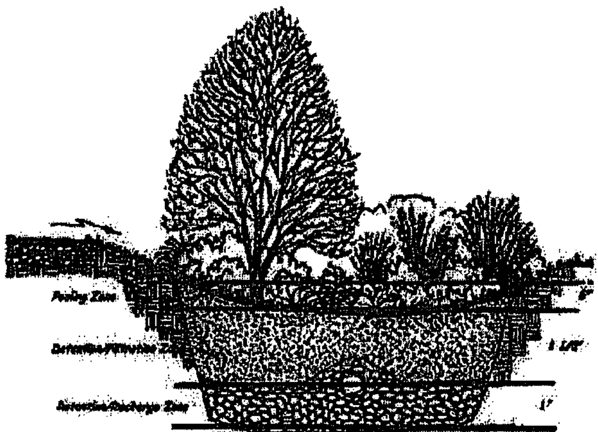
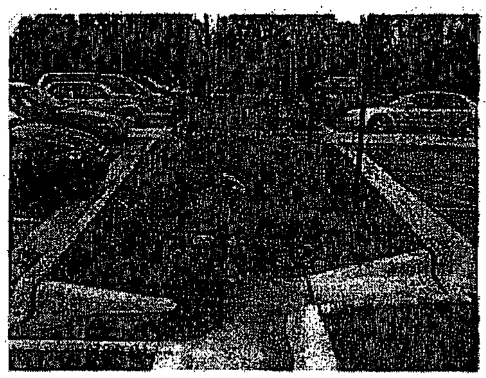
Rain Garden

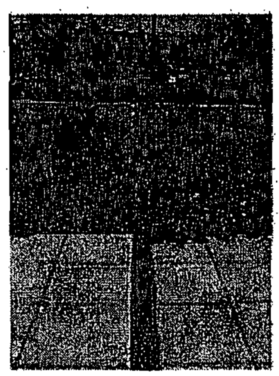
Rain gardens, also known as bioretention cells, are vegetated depressions that store and infiltrate runoff. Rain gardens are designed to encourage vegetative uptake of stormwater to reduce runoff volume and pollutant concentrations. A well design rain garden has an engineered soil which maximizes infiltration and pollutant removal while avoiding stormwater ponding for longer than 24 hours.

Source: lowimpactdevelopment.org; August 2009



Source: www.hawksandowls.com

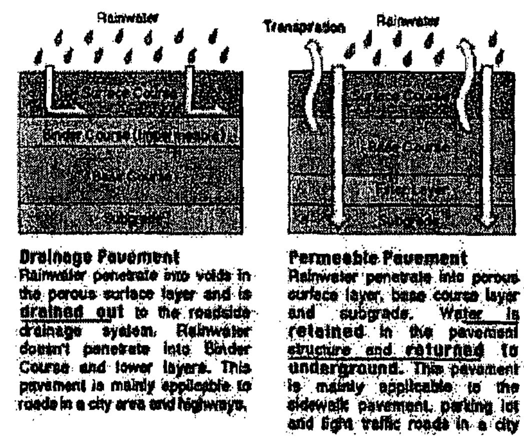




Porous Pavement

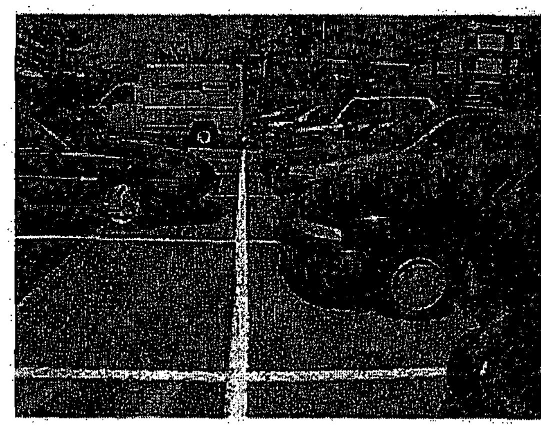
Porous pavement includes pavers, asphalt, and concrete that allow stormwater to pass through voids in the surface and infiltrate into the subbase. The subbase provides storage for stormwater. In unlined systems, infiltration into the underlying soil may also be possible.

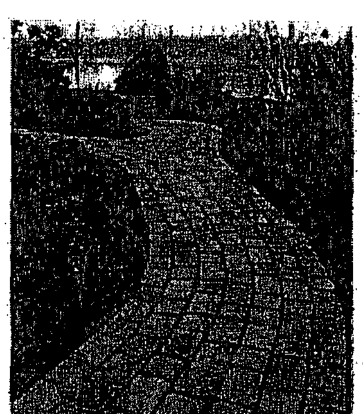
Source: lowimpactdevelopment.org; August 2009



Source: www.nipponroad.co.jp

Source: www.wwcn.ncsu.edu





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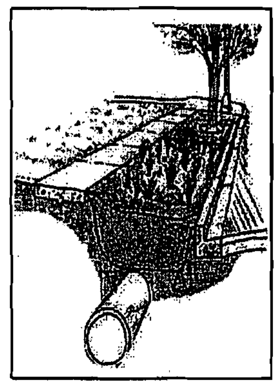
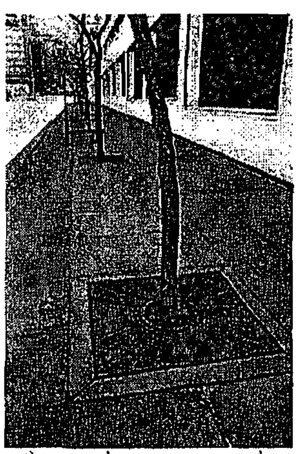
Tree Box Filters

Tree box filters are in-ground containers typically filled with bioretention type soil media containing street trees in urban areas. Runoff is directed to the tree box, where it is filtered by vegetation and soil before entering a catch basin. Tree box filters enhance pollutant removal and are ideal for ultra urban settings and spaces where rain gardens are not practicable.

Source: lowimpactdevelopment.org; August 2009



Source: www.lowimpactdevelopment.org



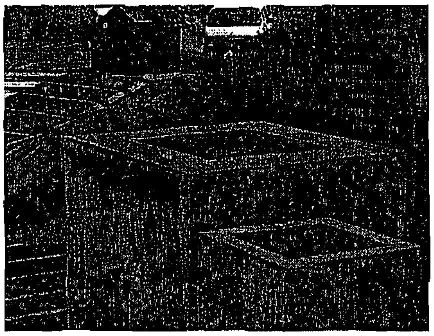
Source: clean-water.uwex.edu

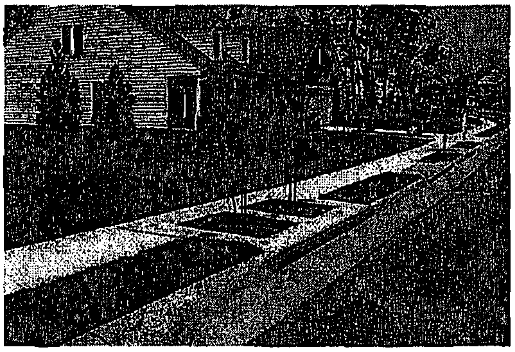
Source: www.coodrownstudios.com

Filterra

Filterra Bioretention Systems capture, cycle and immobilize stormwater pollutants to treat urban runoff. For effective stormwater management, the combination of landscape vegetation and a specially designed filter media allows bacteria, metals, nutrients and total suspended solids (TSS) to be removed naturally. Filterra is well suited for the ultra-urban environment with a high removal efficiency for many stormwater pollutants. Its small footprint allows it to be used in highly developed sites such as landscaped areas, green space, parking lots, and streetscapes.

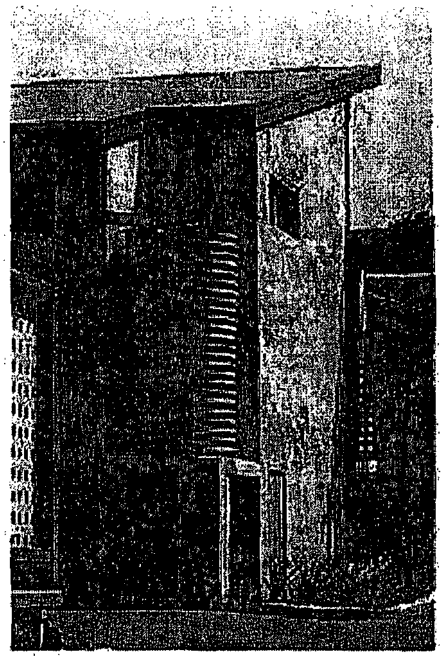
Source: filterra.com; August 2009

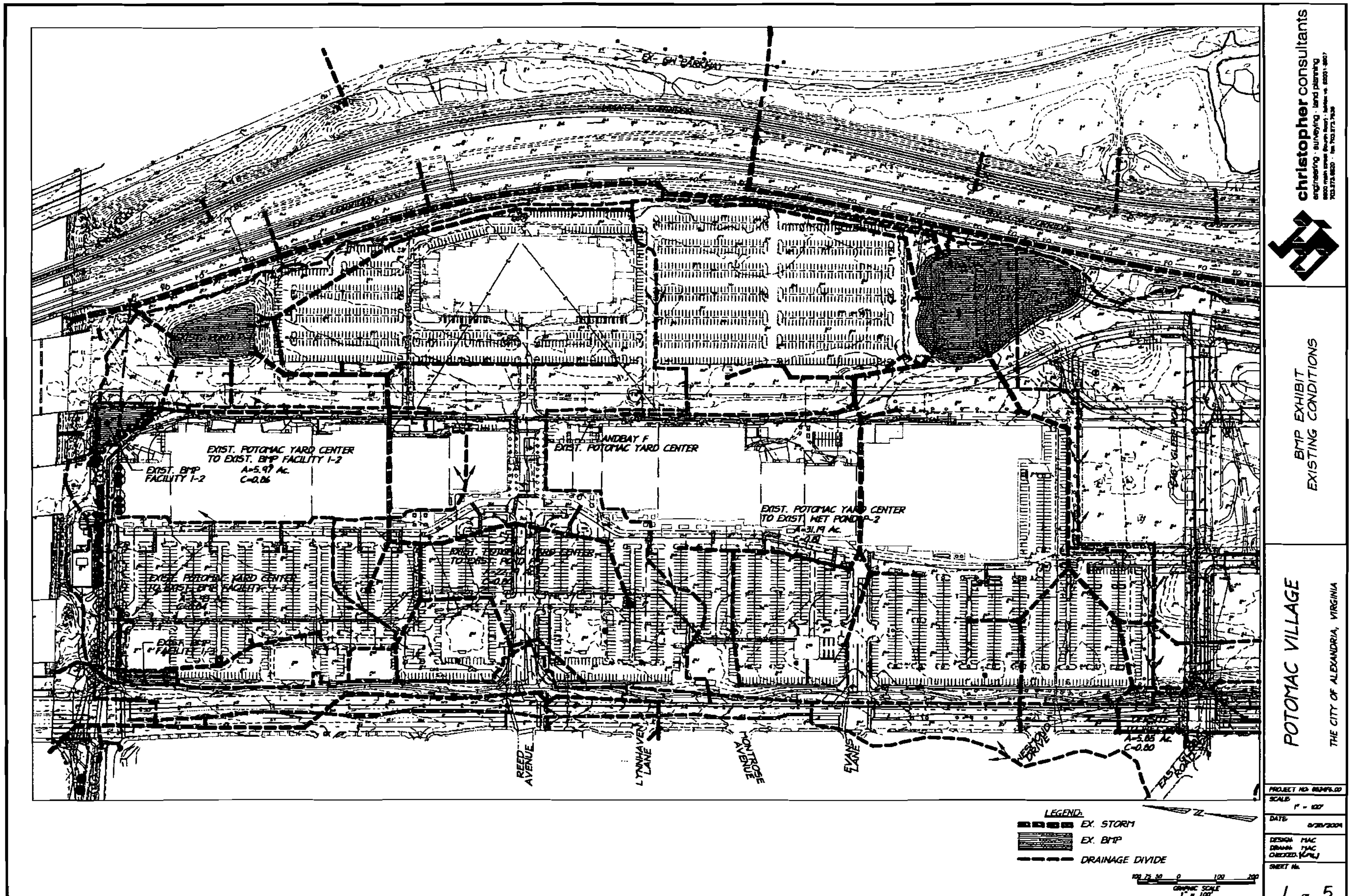




Rainwater Catchment

Rainwater Catchment Facilities can collect and store rainwater, which can be reused for irrigation purposes.

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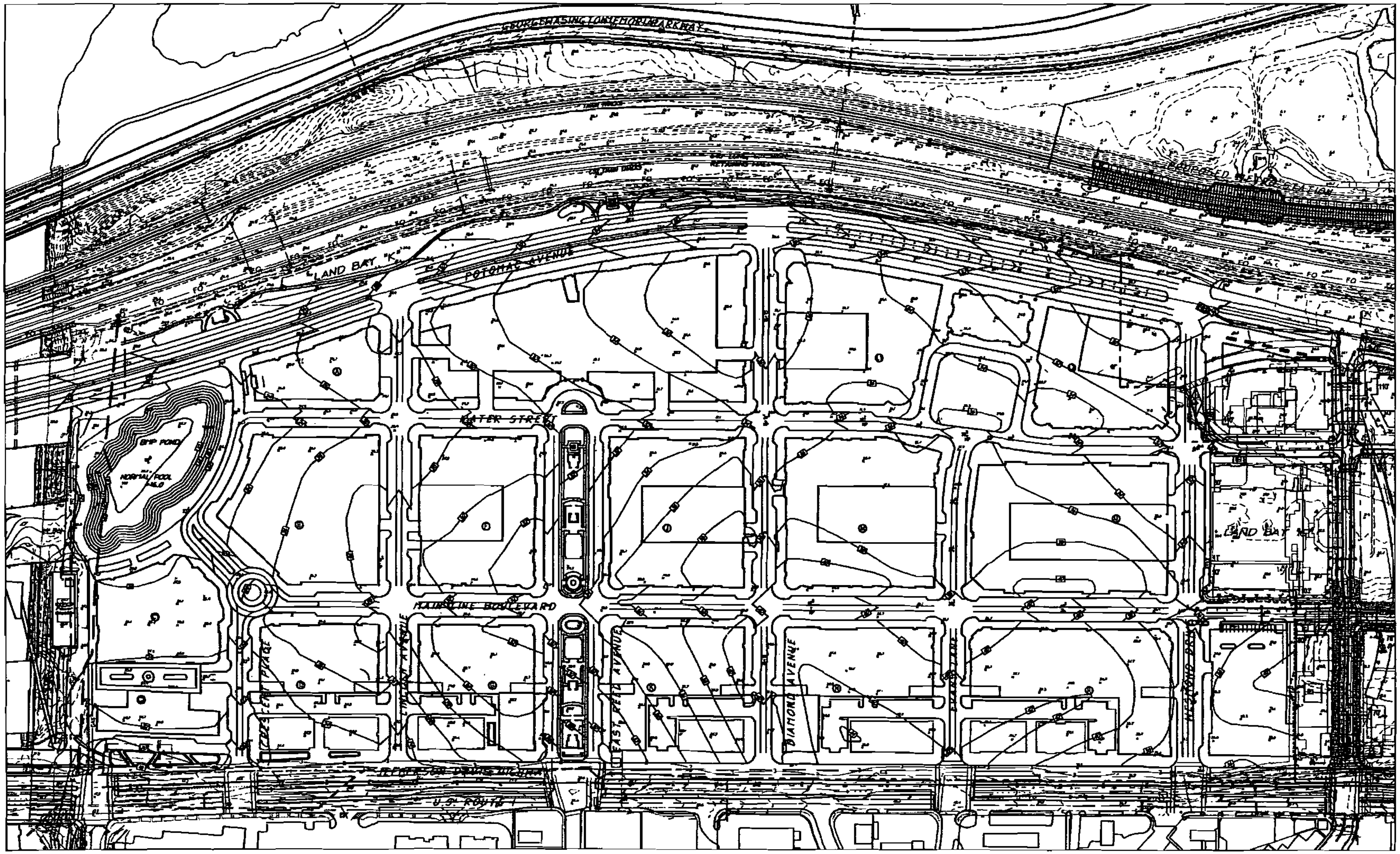
BMP EXHIBIT
EXISTING CONDITIONS
POTOMAC VILLAGE
THE CITY OF ALEXANDRIA, VIRGINIA
SCALE
1" = 100'
SHEET No.
1 of 5
EXIST. POTOMAC YARD CENTER
TO EXIST. BMP FACILITY 1-2
A=5.97 Ac.
C=0.86
EXIST. BMP
FACILITY 1-2
LANDBAY F
EXIST. POTOMAC YARD CENTER
EXIST. POTOMAC YARD CENTER
TO EXIST. WET POND P-2
A=31.19 Ac.
A=5.85 Ac.
C=0.80
REED AVENUE
LYNNHAVEN LANE
MONTROSE AVENUE
EVANS LANE
LEGEND:
EX. STORM
EX. BMP
DRAINAGE DIVIDE
GRAPHIC SCALE
1" = 100'
DESIGN MAC
DRAWN MAC
CHECKED KAJ

C-5844



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BMP EXHIBIT
PROPOSED GRADING
CONCEPT II

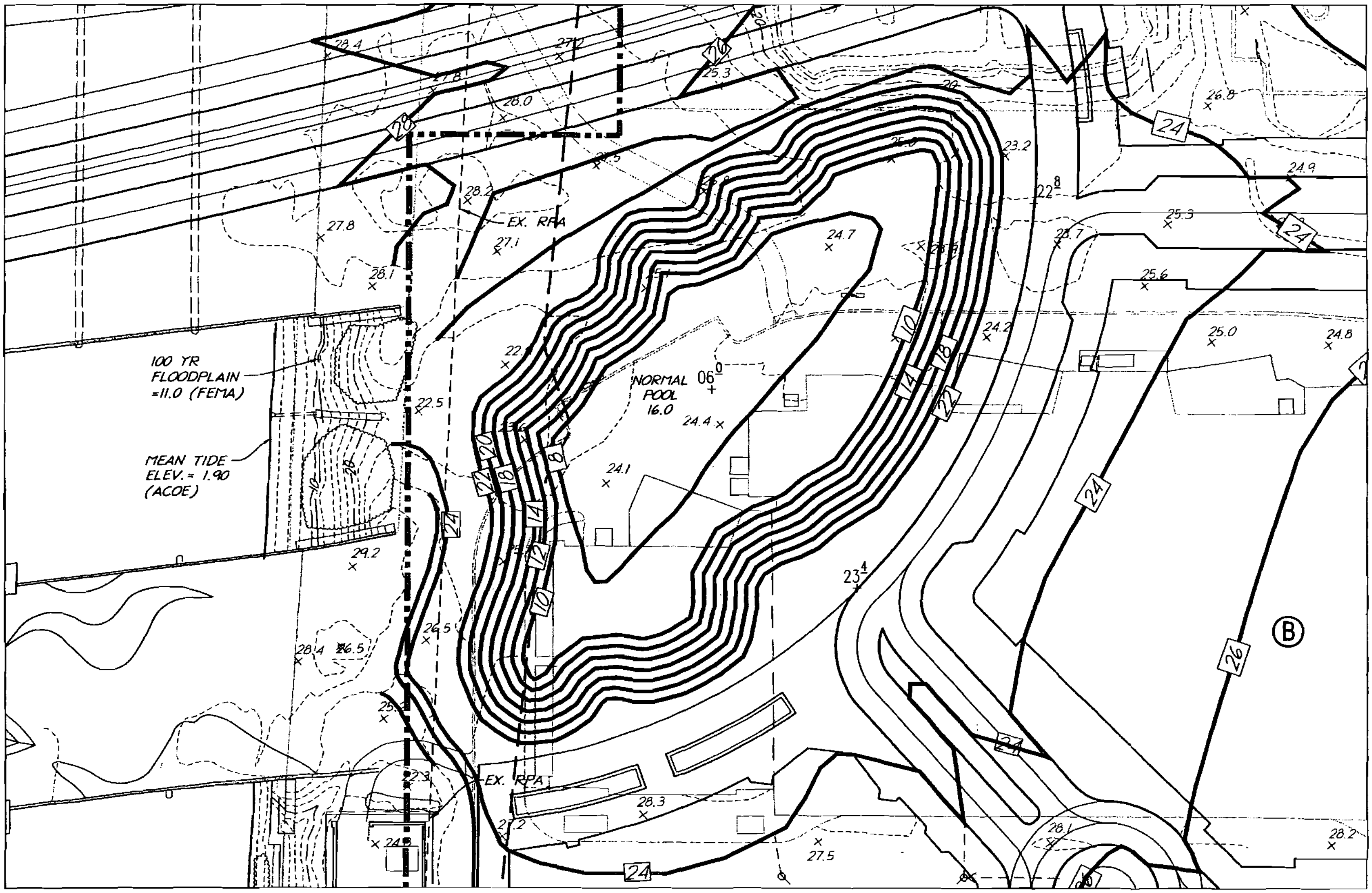
POTOMAC VILLAGE
THE CITY OF ALEXANDRIA, VIRGINIA

PROJECT NO. [illegible]
SCALE: 1" = 100'
DATE: 8/28/2009
DESIGN: MAC, JL, DJ
DRAWN: MAC
CHECKED: [illegible]
SHEET No. 2 of 5
C-5844

LEGEND
- PROPOSED CONTOUR
- PROPOSED SPOT LOCATION
- EXISTING SPOT LOCATION
- PROPERTY LINE

NOTES:
1. EXHIBIT DOES NOT SHOW 500' NATIONAL PARK SERVICE BUILDING RESTRICTION LINE.
2. PROPOSED GRADES ARE BASED ON GRADES TIEING INTO THE EXISTING ROUTE 1 CURBLINE.

100 75 50 0 100 200
GRAPHIC SCALE
1" = 100'



LEGEND

- PROPOSED CONTOUR
- PROPOSED SPOT LOCATION
- EXISTING SPOT LOCATION
- PROPERTY LINE
- 100 YEAR FLOODPLAIN

GRAPHIC SCALE 1" = 25'

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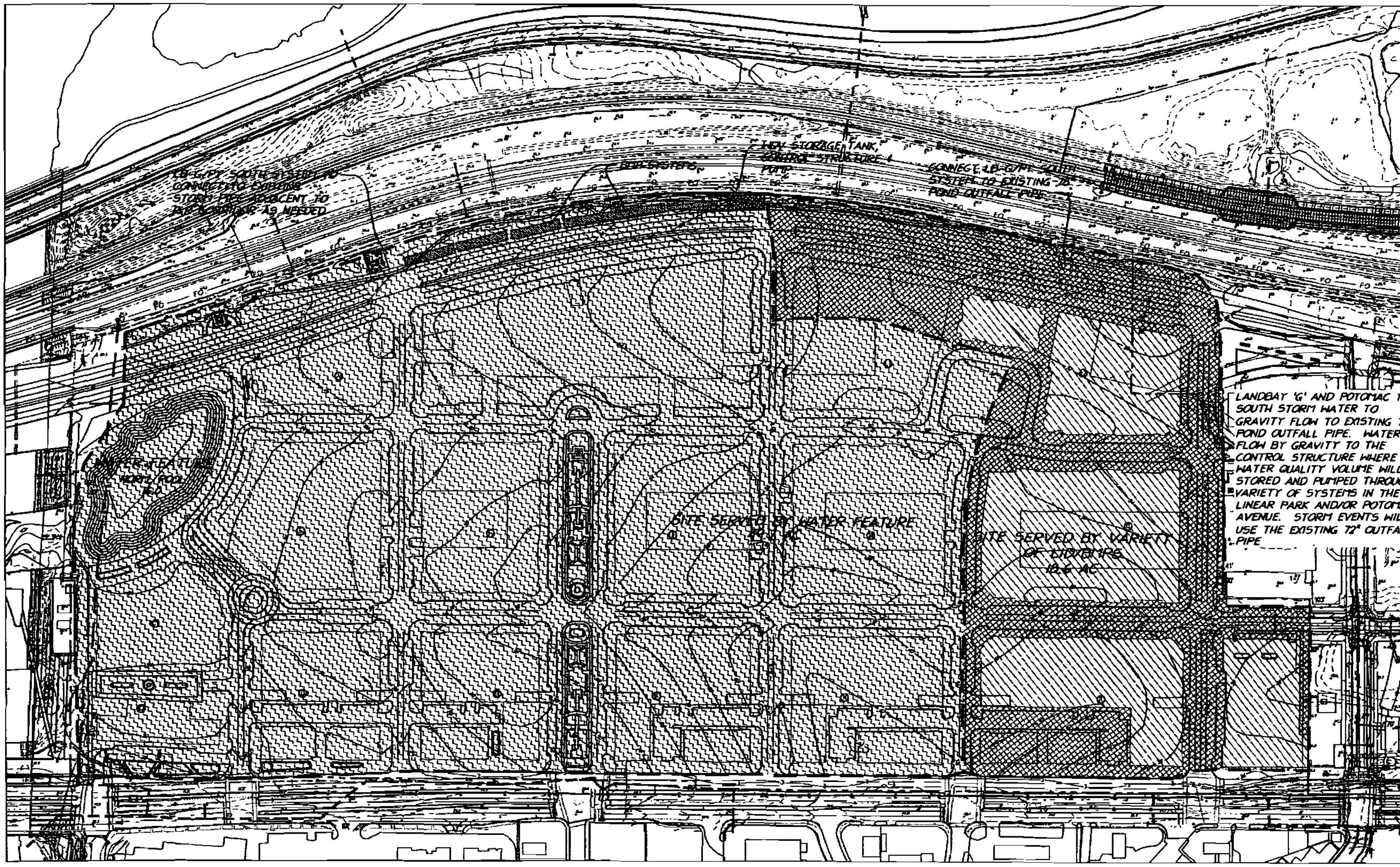
BMP EXHIBIT
PROPOSED GRADING
CONCEPT II
POND DETAIL - LEVEL 1 DESIGN

POTOMAC VILLAGE

THE CITY OF ALEXANDRIA, VIRGINIA

SCALE: 1" = 25'
DATE: 6/28/2009
DESIGN: JL, MAC
DRAWN: MAC
SHEET No. 3 of 5

C-5844



LEGEND

- PROPOSED CONTOUR
- PROPOSED SPOT LOCATION
- PROPERTY LINE
- PROPOSED BMP DIVIDE
- SERVICED BY 60% EFFICIENCY SYSTEM
- SERVICED BY A VARIETY OF SYSTEMS (MIN. 15% EFFICIENCY)
- SERVICED BY WATER FEATURE

100 75 50 0 100 200
GRAPHIC SCALE
1" = 100'

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BMP EXHIBIT
PROPOSED BMP MAP

POTOMAC VILLAGE
THE CITY OF ALEXANDRIA, VIRGINIA

PROJECT NO. 8824F6.00
SCALE: 1" = 100'
DATE: 6/28/2004
DESIGN: JL, MAC
DRAWN: MAC
CHECKED: KMJ
SHEET No.
4 of 5
C-5844

BEST MANAGEMENT PRACTICES (BMP) NARRATIVE

THIS PROJECT, POTOMAC VILLAGE, CONCEPTUALLY PROPOSES TO TREAT THE STORMWATER QUALITY VOLUME FOR THIS SITE FOR COMPLIANCE WITH THE CHESAPEAKE BAY ACT (CBA) AND THE CITY OF ALEXANDRIA REQUIREMENTS THROUGH THE USE OF AN OPEN SPACE AMENITY AT THE NORTH END OF THE SITE ADJACENT TO FOUR MILE RUN THAT INCLUDES A STORM WATER FEATURE. APPROXIMATELY 2/3 OF THE 69.14 ACREA SITE WILL DRAIN TO THIS WATER FEATURE. THE REMAINING 1/3 OF THE SITE WILL BE TREATED WITH A VARIETY OF LOW IMPACT DEVELOPMENT (LIDs) AND INTERGRATED MANAGEMENT PRACTICE (IMPs) FACILITIES. IN ADDITION TO THE BMP DEVICES EMPLOYED FOR THIS PROJECT, 50% OF ALL THE BUILDINGS ON THIS SITE WILL BE DESIGNED WITH GREEN ROOFS. C VALUES USED TO CALCULATE WATER QUALITY VOLUME FROM THE GREEN ROOFS WAS REDUCED TO 0.7 FROM THE CONVENTIONAL 0.9 USED FOR ROOF TOPS.

AS MENTIONED ABOVE, 2/3 OF THE SITE OR 49.7 ACRES WILL DRAIN TO THE WATER FEATURE AT THE NORTH END OF THE SITE. THE TOTAL WET STORAGE VOLUME REQUIRED FOR THE WATER FEATURE IS 299,592 CF AND CAN BE MET IN THE FACILITY AS CURRENTLY PLANNED. OF THE REMAINING 18.6 ACRES, 10.4 ACRES WILL BE TREATED WITH A VARIETY OF LIDs AND IMPs AND 8.2 ACRES WILL BE TREATED WITH SANDFILTERS OR SIMILAR SYSTEMS LOCATED WITHIN THE BUILDING BLOCK. WE HAVE ASSUMED THE LOWEST EFFICIENCY OF 15% THAT IS RECOGNIZED BY THE CITY OF ALEXANDRIA FOR OUR COMPLIANCE CHECK CALCULATIONS FOR LIDs AND IMPs. THE REMAINING 0.84 ACRES FROM THE SITE WILL BE UNTREATED.

IN ADDITION TO THE BMP FACILITIES EMPLOYED FOR THIS SITE, APPROXIMATELY 33 ACRES FROM THE SOUTH WILL NEED TO BE TREATED WITH THIS PROJECT BECAUSE OF THE PROPOSED REMOVAL OF THE EXISTING/PLANNED WET POND EXPANSION (REFERRED TO AS P-2) AT THE SOUTH END OF THE SITE DUE TO THE NEW METRO STATION. AN UNDERGROUND FACILITY IS PROPOSED TO STORE THE WATER QUALITY VOLUME TO ALLOW FOR A PUMP TO ELEVATE THE FLOW TO A MAN-MADE CONVEYANCE SYSTEM. THE SYSTEM WILL PERIODICALLY DRAIN THE STORM WATER INTO A WATER TREATMENT SYSTEM (BIORETENTION, SAND FILTER, OR CARTRIDGE SYSTEM WHERE THE RUNOFF CAN BE TREATED TO MEET THE POLLUTANT REMOVAL REQUIREMENTS).

THE CITY OF ALEXANDRIA'S WORKSHEET A (NEW DEVELOPMENT) HAS BEEN USED TO CALCULATE THE POLLUTANT REMOVAL REQUIREMENT FOR THIS 69.14 ACRE PROJECT. THIS WORKSHEET WAS USED BECAUSE THE EXISTING RETAIL CENTER IS SERVED BY SEVERAL WATER QUALITY FACILITIES AND IS PREDOMENTLY IMPERVIOUS. THE POLLUTANT REMOVAL REQUIRED FOR THIS PROJECT IS 171 LBS/YEAR. AS SHOWN WITH COMPLIANCE WORK SHEET C, 192 LBS/YEAR WILL BE REMOVED WITH THE MEASURES BEING CONSIDERED FOR THIS SITE.

ALEXANDRIA, VIRGINIA
PHOSPHOROUS
LOADING COMPUTATIONS

WORKSHEET A: NEW DEVELOPMENT

1. Compile site-specific data and determine the imperviousness (I site).

POST DEVELOPMENT

A* = 69.14 Acres
I_a structures = 0
parking lot = 0
roadway = 0
other = 0
Total I_a = 50.11 Acres

R_v post = 0.05 + (0.009 x I site) = 0.695 unitless

I site = (Total I_a /A) x 100 = 72% expressed in whole numbers

*A is the total area of the site
** I_a is the total impervious cover on the site

2. Determine need to continue.

I site = 72% (from step 1)
I watershed = 41%

If I site is ≤ 1 [illegible] STOP [illegible]
see p.1-6 of the Alexandria Supplement.

If I site is ≥ 1 [illegible] continue.

3. Select C-values (C pre and post)

C = 0.26 mg/l when I ≤ 20
= 1.08 mg/l when I ≥ 20

When I watershed is > 20%, C pre = [illegible] mg/l

4. Calculate the pre-development load (L pre)

L pre = 3.49 x A [illegible]
= 253.11 pounds per year

5. Calculate the post-development load (L post)

L post = 8.16 x R_v x C x A
= 423.30 pounds per year

6. Calculate the pollutant removal requirement (RR).

RR = L post - L pre
= 170.11 pounds per year.

To determine the overall BMP efficiency required (%RR) when selecting BMP options:

%RR = (RR/L post) x 100
= 40.01%

ALEXANDRIA, VIRGINIA
PHOSPHOROUS
LOADING COMPUTATIONS

WORKSHEET C: COMPLAINCE — POTOMAC VILLAG — 3/1/2009

Select BMP options using screening tools and list them below. Then calculate the load removed for each option. DO NOT LIST BMPs IN SERIES HERE.

Selected Option	Removal* Efficiency x (100%)	x	Fraction of CBPA Drainage Area served (expressed in decimal form)	x	B: L post (lb/yr) A	=	Load Removed (lb/yr)
[illegible]	[illegible]		0.719		423.30		152.8606598
[illegible]	[illegible]		0.150		423.30		9.596081664
[illegible]	[illegible]		0.119		423.30		30.26456525
[illegible]	[illegible]		0.012		423.30		0
Total						=	192.7213068

* For conventional BMPs, see section [illegible] of the Northern Virginia BMP Handbook (NVBMPHB) published by the Northern Virginia Planning District Commission or Chapter 1 of the Alexandria Supplement to the NVBMPHB. For non-conventional BMPs, see section IV, Chapter 1 of the Alexandria Supplement.

Potomac Village – North Pond Volume Computations

[illegible]

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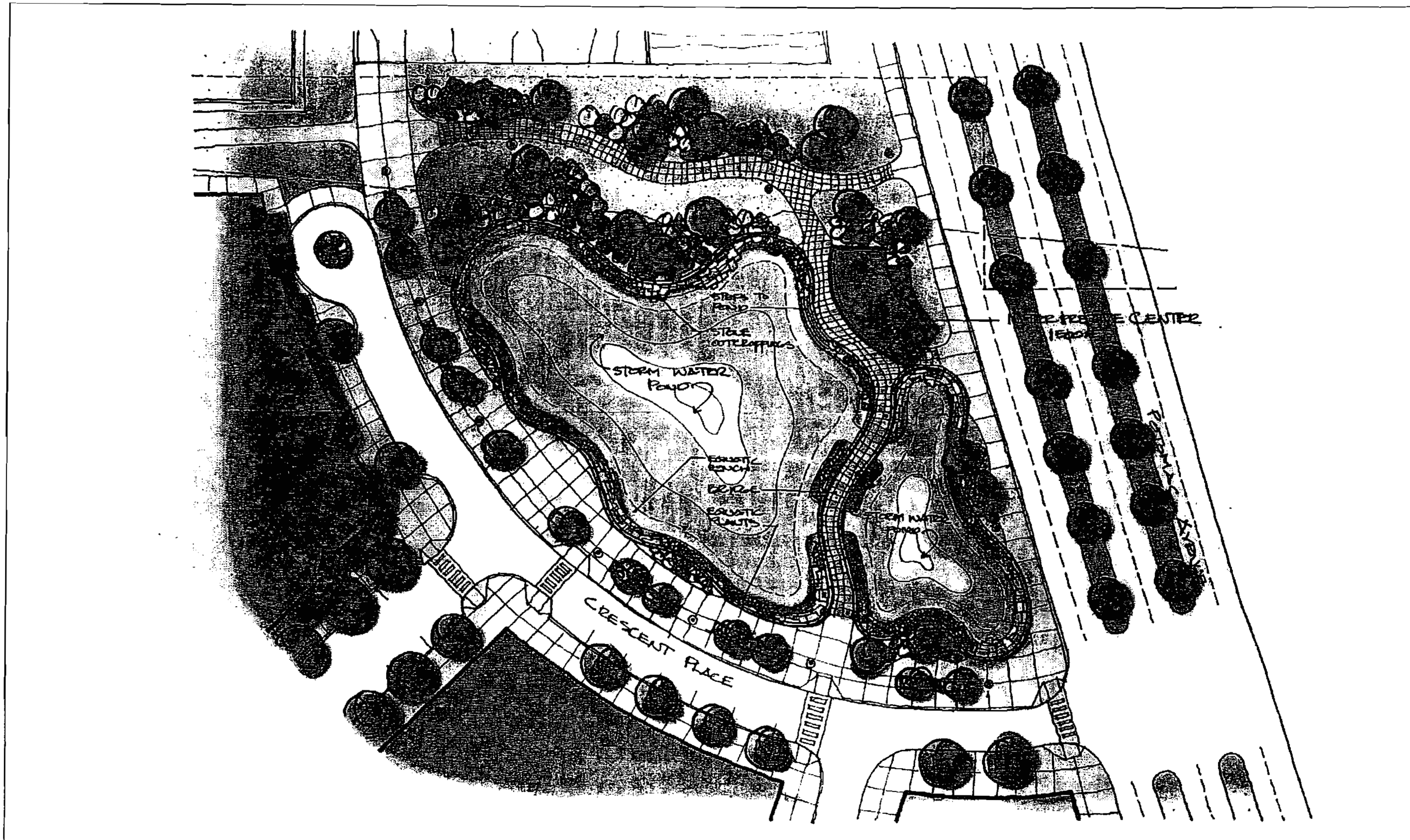
BMP EXHIBIT COMPUTATIONS

POTOMAC VILLAGE
THE CITY OF ALEXANDRIA, VIRGINIA

PROJECT NO. 86346.00
SCALE: N/A
DATE: 8/28/2009
DESIGN: JL
DRAWN: MAC
CHECKED: KMJ
SHEET No. 5 OF 5

C-5844



POTOMAC VILLAGE

Crescent Pond Plan

RREEF Investment Advisor | **McCaffery Interests** Developer | **Antunovich Associates** Architects & Planners

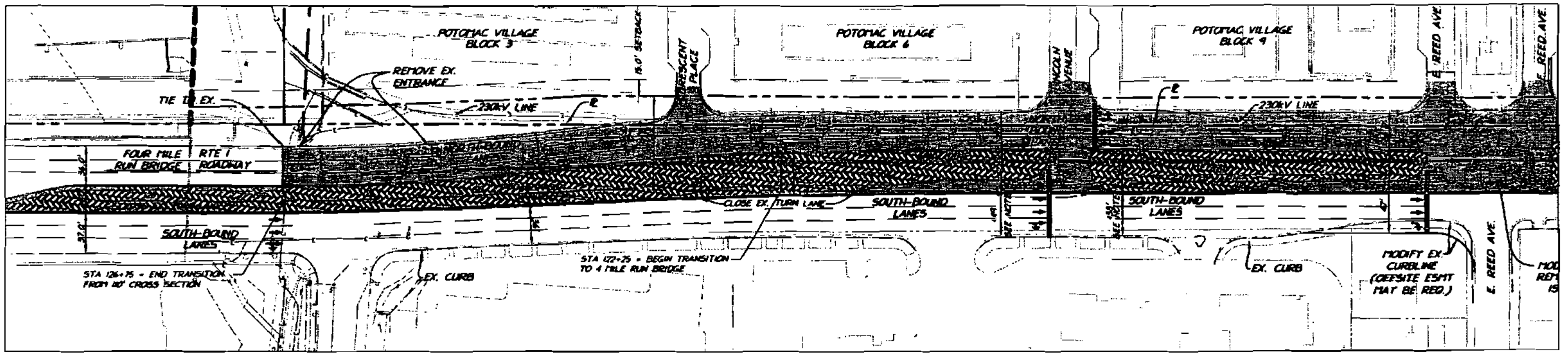
Alexandria, Virginia | **November 25, 2009**

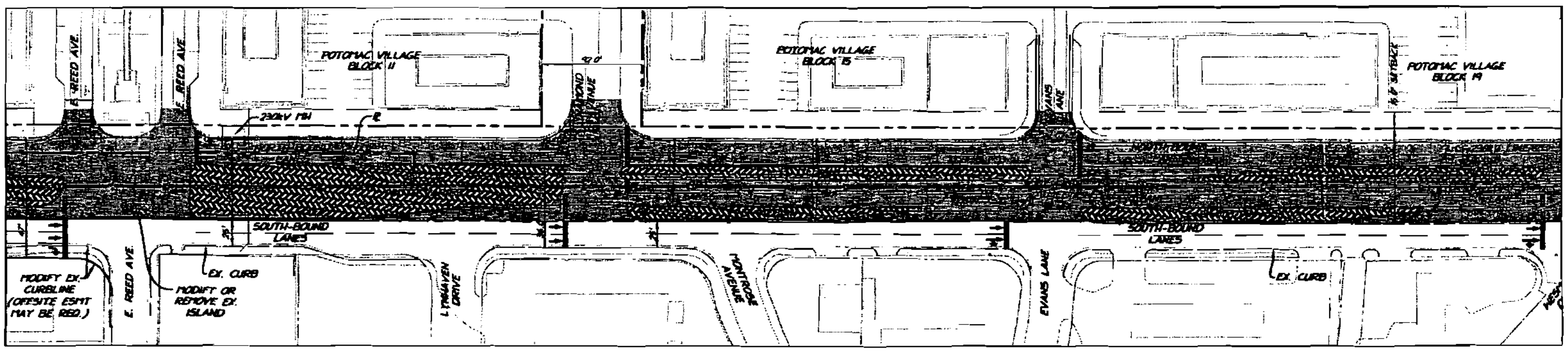
POTOMAC VILLAGE

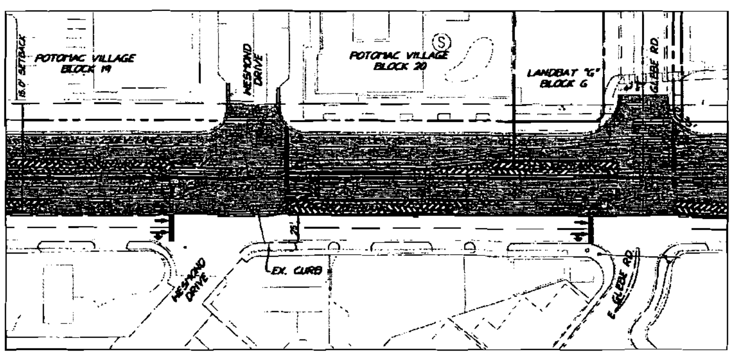
Crescent Pond Section

RREEF Investment Advisor | McCaffery Interests Developer | Antunovich Associates Architects & Planners

Alexandria, Virginia | November 25, 2009







SEE POTOMAC YARD, LANDBAY G FOR CONTINUATION

NOTES:

1. ROUTE 1 SECTIONS PROVIDED BY CITY OF ALEXANDRIA, T&ES, NOVEMBER 17, 2009.
2. ROUTE 1 SECTION DOES NOT MATCH SECTION SHOWN ON APPROVED PRELIMINARY PLAN DSUP 2007-0022 LANDBAY "G".
   - A. LANDBAY G (101' FC TO FC):
     - 2-24' TRAVELWAYS
     - 2-12' MEDIANS
     - 1-29' BRT
   - B. POTOMAC VILLAGE (100' FC TO FC)
     - 2-25' TRAVELWAYS
     - 2-13' MEDIANS
     - 1-24' BRT
3. INTERSECTIONS HAVE NOT BEEN ANALYZED FOR TURNING MOVEMENTS.
4. ROADWAY DIMENSIONS SHOWN ARE FACE OF CURB TO FACE OF CURB
5. PROPOSED WESTERN MEDIAN WILL VARY BETWEEN 12' AND 13' DEPENDING ON EXISTING LOCATION OF WESTERN CURB LINE.
6. R.O.W. SHOWN ON THE EAST SIDE OF RTE 1 WAS TAKEN FROM TAX MAP RECORDS
7. LOCATION OF BUS LANES AND LAYBYS ARE NOT KNOWN AT THIS TIME.
8. ROAD DESIGN IS CONCEPTUAL AND DOES NOT TAKE INTO ACCOUNT GRADING AND UTILITY CONSIDERATIONS UTILITY LOCATIONS AND THE PROXIMITY OF THE 230kV LINE TO THE EASTERN CURB. COORDINATION WITH DOMINION/VIRGINIA POWER WILL BE REQUIRED TO ESTABLISH FINAL DESIGN CRITERIA WITH RELATIONSHIP TO THE 230kV LINE.
9. DIMESIONS MARKED WITH "*" DENOTE AREAS WHERE EXISTING WEST CURB LINE DOES NOT FOLLOW ROUTE 1 CENTERLINE.

LEGEND:

PROPOSED PAVEMENT

PROPOSED MEDIAN

GRAPHIC SCALE 1" = 50'

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9900 main street (fourth floor) · fairfax va. 22031-3907
703.273.6820 fax 703.273.7636

CONCEPTUAL
ROUTE 1
BRT AND MEDAIN EXHIBIT
BRT TO ARLINGTON

POTOMAC VILLAGE
THE CITY OF ALEXANDRIA, VIRGINIA

PROJECT NO. 88246.00
SCALE: 1" = 50'
DATE: NOV. 30, 2009
DESIGN: MAC
DRAWN: MAC
CHECKED:
SHEET No 1 of 1

C-5876

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November 25, 2009

Ms. Emily Baker, P.E.
City Engineer
City of Alexandria
Transportation & Environmental Services
City Hall – Room 4130
301 King Street
Alexandria, Virginia 22314

RE: Potomac Village Sanitary Sewer Conveyance
ccl Project #8824F6.00

Dear Ms. Baker:

In preparation for the redevelopment of the existing Potomac Yard Retail Center to a mixed-use development referred to as Potomac Village, an analysis on the existing and/or future sanitary sewer conveyance systems was performed to establish the ability of these sewers to convey the waste water from the proposed development program for Potomac Village to the Alexandria Sanitation Authority (ASA) Waste Water Treatment Plant (WWTP). As part of this exercise, three different scenarios were analyzed for these systems which consist of a 24" diameter PVC pipe, a 27" diameter PVC pipe and a 30" diameter Centrifugally Cast Fiberglass Pipe (CCFP). The 24" and 27" conveyance systems are located south of the Potomac Village Site on Potomac Yard and the 30" conveyance system is located offsite within dedicated easements or the public right-of-way.

In coordination with your staff, the base line for the analysis included all anticipated sewerage flows from Potomac Village, Potomac Yard, Potomac Greens, existing development parcels, the City's CSO and future development parcels such as Jack Taylor/Hertz, Oakville Triangle, Braddock Fields and the Braddock Metro Neighborhood Plan. In addition, it was determined that the future development sites and Potomac Village be analyzed using low flow plumbing fixtures and the remaining sites be analyzed with standard plumbing fixtures. Low flow fixtures offer a reduction in water usage and are commonly associated with the Leadership in Energy and Environmental Design (LEED) program. Water savings in excess of 35% can be achieved by using low flow fixtures. The analysis utilized a conservative estimate 35% below the City's recommended average design flows for all future development parcels and standard average design flows for the remaining parcels. The analysis also took into account "n" values for the pipe's material of 0.0105 and 0.011, with 0.011 being the worst case.

In closure, the analysis performed using an "n" value (worst case) and low flow fixtures for Potomac Village and all future development parcels shows that the three sanitary conveyance systems mentioned above have the capacity to convey all sewerage flows to the WWTP. The 24" and 27" sanitary conveyance systems experienced no surcharging while the 30" sanitary conveyance system experienced minimum surcharging in six runs of the system with a

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fax 703.273.7636
web site www.christopherconsultants.com

maximum surcharge of 0.55' and minimum surcharge of 0.06' above the crown of the pipe. It is our opinion that this system is adequate to convey the proposed sewerage flows from Potomac Village, from the CSO diversion, all currently planned flows and future flows from the anticipated redevelopment of this area of the City.

Very truly yours,

Kevin M. Washington
Director of Design

Enclosures

cc: Ed Woodbury, McCaffery Interests, Inc.
Morgan Ziegenhein, McCaffery Interests, Inc.
Jonathan Rak, McGuire Woods
Joanna Frizzell, McGuire Woods
Joe Antunovich, Antunovich Associates
William R. Zink, christopher consultants

EXHIBIT 1
SANITARY SEWER FLOW SUMMARY
10-26-09

Potomac Yard	**City of Alexandria's Estimate (MGD)**	**Applicant's Estimate (MGD)**	**Applicant's Estimate Low Flow Fixtures-PV (MGD)[1]**	**Applicant's Estimate Low Flow Fixtures All Future (MGD)[2]**
Landbay F (in process)	2.1310	2.1433	1.3932	1.3932
Landbay G DSUP (nsf)	0.4966	0.4332	0.4332	0.4332
Fire Station DSUP (nsf)	0.0195	0.0263	0.0263	0.0263
Landbay H CDD	0.2356	0.2360	0.2360	0.2360
Partial I/J East DSUP (gsf)	0.2637	0.2659	0.2659	0.2659
I - CDD Balance				
J - CDD Balance				
L - CDD	0.1094	0.1100	0.1100	0.1100
A - Potomac Greens	0.0795			
K - Landbay		0.0400	0.0400	0.0400
Total	**3.3352**	**3.2547**	**2.5046**	**2.5046**
West Side Route 1, COG Round 8 preliminary projections				
Jack Taylor, Hertz	0.2420	0.2420	0.2420	0.1580
Oakville Triangle	0.1400	0.1400	0.1400	0.0910
Total West Side Rt. 1	**0.3820**	**0.3820**	**0.3820**	**0.2490**
Total Potomac Yard Area	**3.7172**	**3.6367**	**2.8866**	**2.7536**
Braddock Fields				
Braddock Fields	**0.3107**	**0.3107**	**0.3107**	**0.2039**
Braddock Metro Neighborhood Plan (MNP)				
Braddock MNP	**1.2029**	**1.2030**	**1.2030**	**0.7819**
Combined Sewer Separation				
CSO District	**0.5500**	**0.5500**	**0.5500**	**0.5500**
Existing Developments				
Clayborne	0.0231	0.0225	0.0225	0.0225
GW Club	0.0024	0.0024	0.0024	0.0024
Prescott	0.0192	0.0192	0.0192	0.0192
Monarch	0.0507	0.0504	0.0504	0.0504
Payne St	0.0627	0.0618	0.0618	0.0618
Fannon (Duke)	0.0174	0.0174	0.0174	0.0174
Total	**0.1755**	**0.1737**	**0.1737**	**0.1737**
Peaked Totals:[3]				
Potomac Yard Area	9.2931	9.0918	7.2165	6.8840
Braddock Fields	0.9321	0.9321	0.9321	0.6117
Braddock Metro Neighborhood Plan	3.6086	3.6090	3.6090	2.3457
Combined Sewer Separation	1.6500	1.6500	1.6500	1.6500
Existing Developments	0.5265	0.5211	0.5211	0.5211
Four Mile Run Pump Station	4.0000	4.0000	4.0000	4.0000
River Road Pump Station	0.5200	0.5200	0.5200	0.5200
Slater's Lane Pump Station	0.7500	0.7500	0.7500	0.7500
Total	21.2802	21.0740	19.1987	17.2825

Notes:
1. Uses Low Flow Fixtures In Potomac Village
2. Uses Low Flow Fixtures for Potomac Village, Jack Taylor/Hertz, Oakville Triangle, Braddock Fields, and Braddock MNP
3. Potomac Yard Area peaked at 2.5, all other contributing areas are peaked at 3.0

EXHIBIT 2

LEHMAN DESIGN CONSULTANTS INCORPORATED

180 West Washington Boulevard
Suite 500
Chicago, Illinois 60602
Voice: (312) 201-9733
Fax: (312) 201-9734
Email: lehmandesigninc.com

October 07, 2009

Joseph Antunovich, AIA
ANTUNOVICH ASSOCIATES
224 West Huron Street, 7th Floor
Chicago, Illinois 60610

RE: **POTOMAC VILLAGE**
Alexandria, Virginia

Dear Joe,

We have reviewed the potential for water savings using low flow plumbing fixtures for the Potomac Village Redevelopment project and offer the following.

As you know, we have collaborated with McCaffery Interests and your office, as well as others, on several "High Performance" or "Green" buildings over the last few years. Many of them have been or will be certified by the United States Green Building Council (USGBC) under their Leadership in Energy and Environmental Design (LEED) program.

One of the items that all these projects had in common was water use savings in excess of **35%** achieved by use of low flow plumbing fixtures and fittings. We have attached information for typical Kohler and Grohe products used for these projects, all of which contributed to these savings as they each meet or exceed the stated goal, including:.

Fixture	Base Design	Proposed Design	Savings
WC	1.6 GPF	1.0 GPF	37.5%
Lav	2.5 GPM	1.5 GPM	40%
Shower	2.5 GPM	1.5 GPM	40%
Kit. Sink	2.5 GPM	1.5 GPM	40%

The projected water savings of 35% mentioned above is a conservative estimate as the actual savings does depend on programmatic issues, including building use, occupancy and size. Furthermore, the fixtures listed are typically residential and commercial fixtures could fare better.

If there are any questions or comments, please contact us.

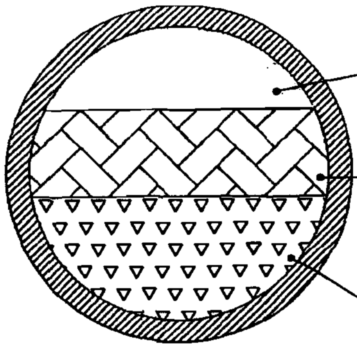
LEHMAN DESIGN CONSULTANTS, Inc.

David A. Lehman

David A. Lehman, President
Michael W. Cusack, PE

COMMONWEALTH OF VIRGINIA
MICHAEL W. CUSACK
Lic. No. 043416
PROFESSIONAL ENGINEER

DESIGN FLOW CAPACITY 30" VCP
12.95 MGD = TOTAL AVAILABLE CAPACITY

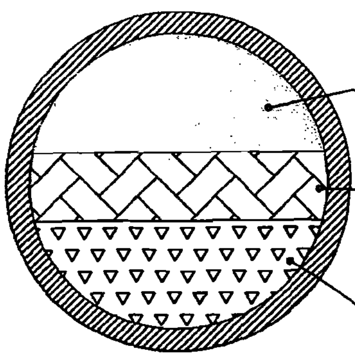


3.53 MGD EXTRA CAPACITY DUE TO PIPE MATERIAL

4.52 MGD FOUR MILE RUN & RIVER ROAD PUMP STATIONS (CITY OF ALEXANDRIA APPROVAL REQUIREMENTS)

4.90 MGD FROM POTOMAC YARD DEVELOPMENT (INCLUDING POTOMAC YARD CENTER)

DESIGN FLOW CAPACITY 30" CCFP
17.68 MGD = TOTAL AVAILABLE CAPACITY



8.26 MGD EXTRA CAPACITY DUE TO PIPE MATERIAL

4.52 MGD FOUR MILE RUN & RIVER ROAD PUMP STATIONS (CITY OF ALEXANDRIA APPROVAL REQUIREMENTS)

4.90 MGD FROM POTOMAC YARD DEVELOPMENT (INCLUDING POTOMAC YARD CENTER)

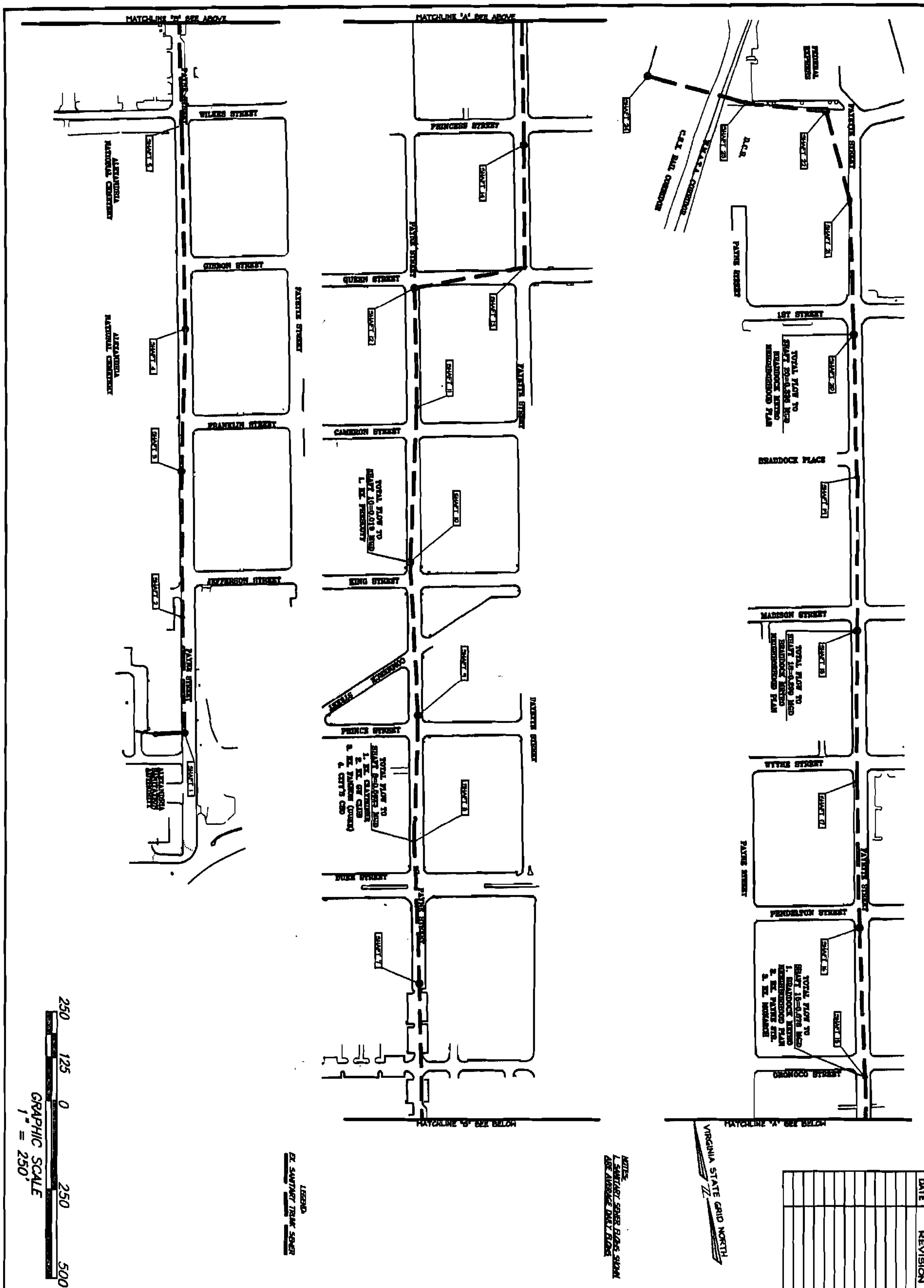
NOTES:

VCP - VITRIFIED CLAY PIPE
CCFP - CENTRIFUGALLY CAST FIBERGLASS PIPE
MGD - MILLIONS OF GALLONS PER DAY

DATE: APRIL, 2003

christopher consultants
engineering · surveying · land planning
christopher consultants, ltd.
9900 main street (fourth floor) · fairfax, va 22031-3907
703.273.6820 · fax 703.273.7636

POTOMAC YARD
OFFSITE
SANITARY TRUNK SEWER
EXHIBIT 3



POTOMAC VILLAGE
SANITARY ALTERNATIVES

THE CITY OF ALEXANDRIA, VIRGINIA

EXISTING 30" OFFSITE
SANITARY TRUNK SEWER
EXHIBIT 4

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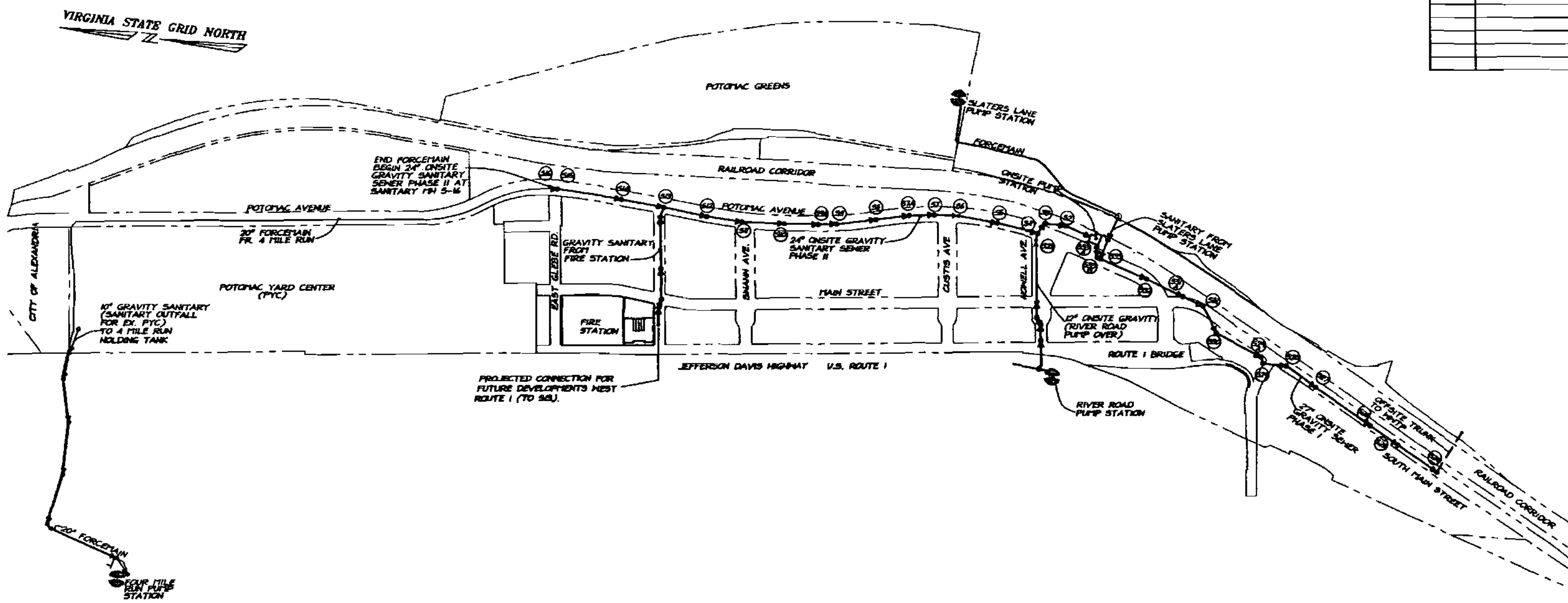
1 of 1

A-832

DATE	REVISION
5-8-09	UPDATE DWG. PER MTG. WITH CITY STAFF
10/23/09	UPDATED WITH NEW FLOWS



SANITARY SEWAGE FLOWS TO VARIOUS MANHOLES SHOWN ABOVE

WITH STANDARD WASTEWATER FLOW RATES				WITH MODIFIED WASTEWATER FLOW RATES (35%) FOR POTOMAC VILLAGE		WITH MODIFIED WASTEWATER FLOW RATES (35%) FOR POTOMAC VILLAGE & WEST SIDE OF RTE.1	
FLOWS FROM	TO MANHOLE NUMBER	AVERAGE DAILY FLOW RATE	FLOW RATE (PEAKED/APPROVED)	AVERAGE DAILY FLOW RATE	FLOW RATE (PEAKED/APPROVED)	AVERAGE DAILY FLOW RATE	FLOW RATE (PEAKED/APPROVED)
1. FOUR MILE RUN PUMP STATION	S16	NA	4.0000 MGD	NA	4.0000 MGD	NA	4.0000 MGD
2. POTOMAC VILLAGE REDEVELOPMENT	S16	2.1433 MGD	5.3683 MGD	1.3932 MGD	3.4830 MGD	1.3932 MGD	3.4830 MGD
3. POTOMAC YARD WITH DENSITY TRANSFER LANDBAYS G,H,I & J	S15	0.9351 MGD	2.3378 MGD	0.9351 MGD	2.3378 MGD	0.9351 MGD	2.3378 MGD
4. POTOMAC YARD FIRE STATION	S13	.02630 MGD	0.0657 MGD	.02630 MGD	0.0657 MGD	.02630 MGD	0.0657 MGD
5. RIVER ROAD PUMP STATION	S4	0.1300 MGD	0.5200 MGD	0.1300 MGD	0.5200 MGD	0.1300 MGD	0.5200 MGD
6. SLATER'S LANE PUMP STATION	S33	NA	0.7500 MGD	NA	0.7500 MGD	NA	0.7500 MGD
7. LANDBAYS K & L WITH DENSITY TRANSFER	S27	0.1500 MGD	0.3750 MGD	0.1500 MGD	0.3750 MGD	0.1500 MGD	0.3750 MGD
8. WEST SIDE RTE. 1 (JACK TAYLOR, HERTZ & OAKVILLE TRIANGLE)	S13	0.3820 MGD	0.9550 MGD	0.3820 MGD	0.9550 MGD	0.2490 MGD	0.6225 MGD
9. TOTAL			14.3648 MGD		12.4865 MGD		12.1540 MGD

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EXHIBIT 5

OVERALL SANITARY SEWER LAYOUT

POTOMAC YARD ONSITE/OFFSITE SANITARY SEWER

CITY OF ALEXANDRIA, VIRGINIA

SCALE 1"=260'
DATE 05-01-09
DESIGN NA
DRAWN KMH
CHECKED
SHEET No. 1 of 1

C- 5874

EXHIBIT 6

APPLICANTS ESTIMATE

Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Length (ft)	Conduit Slope (%)	Roughness	Diameter (ft)	Max. Depth (ft)	Free Board (ft)	Design Full Flow (cfs)	Design Full Flow (MGD)	Max Flow (cfs)	Max Flow (MGD)	Max Flow/Design Flow (%)
30-inch Offsite Trunk Sewer															
Link41	Node1	Node0	-7.28	-7.50	80.3	0.274	0.0105	2.50	2.12	0.38	26.58	17.15	33.70	21.74	127%
Link40	Node2	Node1	-6.38	-7.14	326.6	0.233	0.0105	2.50	2.66	-0.16	24.50	15.81	33.70	21.74	138%
Link39	Node3	Node2	-4.74	-5.89	408.7	0.281	0.0105	2.50	2.73	-0.23	26.94	17.38	33.70	21.74	125%
Link38	Node4	Node3	-3.83	-4.64	399.0	0.203	0.0105	2.50	3.54	-1.04	22.88	14.76	33.70	21.74	147%
Link37	Node5	Node4	-2.24	-3.78	561.1	0.274	0.0105	2.50	4.41	-1.91	26.60	17.16	33.70	21.74	127%
Link42	Node7	Node5	0.01	-2.17	587.2	0.371	0.0105	2.50	4.71	-2.21	30.94	19.96	33.70	21.74	109%
Link34	Node8	Node7	0.46	0.05	400.9	0.102	0.0105	2.50	6.00	-3.50	16.24	10.48	33.70	21.74	208%
Link33	Node9	Node8	1.72	0.53	351.3	0.339	0.0105	2.50	6.03	-3.53	29.56	19.07	30.94	19.96	105%
Link32	Node10	Node9	2.98	1.77	431.2	0.281	0.0105	2.50	6.34	-3.84	26.90	17.35	30.94	19.96	115%
Link31	Node11	Node10	4.39	3.21	434.6	0.272	0.0105	2.50	6.50	-4.00	26.46	17.07	30.85	19.90	117%
Link30	Node12	Node11	5.55	4.49	326.4	0.325	0.0105	2.50	6.52	-4.02	28.94	18.67	30.85	19.90	107%
Link29	Node13	Node12	6.52	5.60	315.4	0.292	0.0105	2.50	6.69	-4.19	27.43	17.70	30.85	19.90	112%
Link28	Node14	Node13	7.43	6.62	340.8	0.238	0.0105	2.50	7.02	-4.52	24.76	15.97	30.85	19.90	125%
Link27	Node15	Node14	8.66	7.49	430.1	0.272	0.0105	2.50	7.34	-4.84	26.49	17.09	30.85	19.90	116%
Link26	Node16	Node15	9.71	8.97	416.8	0.178	0.0105	2.50	7.50	-5.00	21.40	13.81	27.70	17.87	129%
Link25	Node17	Node16	10.75	10.06	410.9	0.168	0.0105	2.50	7.65	-5.15	20.81	13.43	27.70	17.87	133%
Link24	Node18	Node17	12.12	11.01	424.4	0.262	0.0105	2.50	7.51	-5.01	25.97	16.75	27.70	17.87	107%
Link23	Node19	Node18	13.46	12.47	427.0	0.232	0.0105	2.50	7.29	-4.79	24.45	15.77	26.31	16.97	108%
Link22	Node20	Node19	14.67	13.73	394.3	0.238	0.0105	2.50	7.12	-4.62	24.80	16.00	26.31	16.97	106%
Link21	Node21	Node20	15.85	14.84	376.3	0.268	0.0105	2.50	6.95	-4.45	26.31	16.97	23.49	15.15	89%
Link20	Node22	Node21	16.83	15.94	253.2	0.351	0.0105	2.50	6.62	-4.12	30.11	19.43	23.99	15.48	80%
Link19	Node23	Node22	17.51	16.97	221.8	0.243	0.0105	2.50	6.11	-3.61	25.06	16.17	23.51	15.17	94%
Link18	Node24	Node23	18.26	17.70	281.2	0.199	0.0105	2.50	5.86	-3.36	22.66	14.62	23.30	15.03	103%
27-inch Onsite Trunk Sewer															
Link17	Node25	Node24	19.21	18.28	276.0	0.337	0.0105	2.25	5.91	-3.66	22.26	14.36	23.30	15.03	105%
Link16	Node26	Node25	19.90	19.33	197.5	0.289	0.0105	2.25	5.94	-3.69	20.60	13.29	23.30	15.03	113%
Link15	Node27	Node26	21.09	20.10	402.0	0.246	0.0105	2.25	6.20	-3.95	19.03	12.28	23.30	15.09	122%
Link14	Node28	Node27	21.93	21.14	209.5	0.377	0.0105	2.25	6.15	-3.90	23.55	15.19	23.90	15.42	101%
Link13	Node29	Node28	22.60	22.08	140.0	0.371	0.0105	2.25	5.93	-3.68	23.37	15.08	23.63	15.25	101%
Link12	Node29A	Node29	23.29	22.57	39.5	1.823	0.0105	2.25	5.92	-3.67	51.77	33.40	23.45	15.13	45%
Link11	Node30	Node29A	24.30	23.34	295.0	0.326	0.0105	2.25	5.35	-3.10	21.87	14.11	23.40	15.10	107%
Link10	Node31	Node30	24.89	24.41	173.0	0.277	0.0105	2.25	5.35	-3.10	20.20	13.03	23.45	15.13	116%
Link9	Node31A	Node31	25.45	25.02	133.0	0.323	0.0105	2.25	5.25	-3.00	21.80	14.06	23.04	14.86	106%
Link8	Node32	Node31A	26.28	25.56	237.5	0.303	0.0105	2.25	5.24	-2.99	21.11	13.62	23.05	14.87	109%
Link44	Node33	Node32	27.23	26.37	300.5	0.286	0.0105	2.25	5.33	-3.08	20.51	13.23	22.98	14.83	112%
Link43	Node34	Node33	28.74	28.20	118.0	0.458	0.0105	2.25	4.36	-2.11	25.94	16.74	22.94	14.80	88%
ONSITE PUMP STATION															
24-inch Onsite Trunk Sewer															
Link47	Node2	LS	13.87	13.38	151.9	0.323	0.0105	2.00	2.07	-0.07	15.91	10.26	21.56	13.91	136%
Link46	Node3	Node2	14.44	13.97	124.2	0.378	0.0105	2.00	2.20	-0.20	17.23	11.12	21.56	13.91	125%
Link38	Node4	Node3	15.05	14.54	155.8	0.327	0.0105	2.00	2.45	-0.45	16.03	10.34	21.56	13.91	134%
Link37	Node5	Node4	15.98	15.15	244.4	0.331	0.0105	2.00	2.86	-0.86	16.12	10.40	20.76	13.39	129%
Link42	Node6	Node5	16.82	16.06	230.3	0.330	0.0105	2.00	3.26	-1.26	16.09	10.38	20.76	13.39	129%
Link34	Node7	Node6	17.40	16.92	144.0	0.333	0.0105	2.00	3.46	-1.46	16.17	10.43	20.76	13.39	128%
Link33	Node7A	Node7	17.98	17.50	146.9	0.327	0.0105	2.00	3.68	-1.68	16.01	10.33	20.76	13.39	130%
Link32	Node8	Node7A	18.72	18.08	195.0	0.328	0.0105	2.00	4.00	-2.00	16.05	10.35	20.76	13.39	129%
Link31	Node9	Node8	19.61	18.82	237.0	0.333	0.0105	2.00	4.40	-2.40	16.17	10.43	20.76	13.39	128%
Link30	Node9A	Node9	20.06	19.71	107.8	0.325	0.0105	2.00	4.53	-2.53	15.96	10.30	20.76	13.39	130%
Link29	Node10	Node9A	20.83	20.16	203.4	0.329	0.0105	2.00	4.86	-2.86	16.07	10.37	20.76	13.39	129%
Link28	Node11	Node10	21.75	20.93	246.4	0.333	0.0105	2.00	5.27	-3.27	16.16	10.43	20.76	13.39	128%
Link27	Node12	Node11	22.54	21.85	210.1	0.328	0.0105	2.00	5.61	-3.61	16.05	10.35	20.76	13.39	129%
Link26	Node13	Node12	23.48	22.64	254.2	0.331	0.0105	2.00	6.03	-4.03	16.10	10.39	20.76	13.39	129%
Link25	Node14	Node13	24.41	23.58	251.8	0.330	0.0105	2.00	6.25	-4.25	16.08	10.37	19.17	12.37	119%
Link24	Node15	Node14	27.88	24.66	379.2	0.849	0.0105	2.00	6.00	-4.00	25.81	16.65	19.63	12.66	76%
Link45	Node16	Node15	28.57	27.98	14.3	4.123	0.0105	2.00	4.42	-2.42	39.28	25.34	6.23	4.02	16%

EXHIBIT 6

Low Flow Fxd - Potomac Village

Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Length (ft)	Conduit Slope (%)	Roughness	Diameter (ft)	Max Depth (ft)	Free Board (ft)	Design Full Flow (cfs)	Design Full Flow (MGD)	Max Flow (cfs)	Max Flow (MGD)	Max Flow/Design Flow (%)
30-Inch Offsite Trunk Sewer															
Link41	Node1	Node0	-7.28	-7.50	80.3	0.274	0.0105	2.50	2.00	0.50	26.58	17.15	30.50	19.68	115%
Link40	Node2	Node1	-6.38	-7.14	326.6	0.233	0.0105	2.50	2.31	0.19	24.50	15.81	30.50	19.68	124%
Link39	Node3	Node2	-4.74	-5.89	408.7	0.281	0.0105	2.50	2.23	0.27	26.94	17.38	30.50	19.68	113%
Link38	Node4	Node3	-3.83	-4.64	399.0	0.203	0.0105	2.50	2.71	-0.21	22.88	14.76	30.50	19.68	133%
Link37	Node5	Node4	-2.24	-3.78	561.1	0.274	0.0105	2.50	2.99	-0.49	26.60	17.16	30.50	19.68	115%
Link42	Node7	Node5	0.01	-2.17	587.2	0.371	0.0105	2.50	2.92	-0.42	30.94	19.96	30.50	19.68	99%
Link34	Node8	Node7	0.46	0.05	400.9	0.102	0.0105	2.50	3.68	-1.18	16.24	10.48	30.50	19.68	188%
Link33	Node9	Node8	1.72	0.53	351.3	0.339	0.0105	2.50	3.61	-1.11	29.56	19.07	27.74	17.90	94%
Link32	Node10	Node9	2.98	1.77	431.2	0.281	0.0105	2.50	3.48	-0.98	26.90	17.35	27.74	17.90	103%
Link31	Node11	Node10	4.39	3.21	434.6	0.272	0.0105	2.50	3.36	-0.86	26.46	17.07	27.65	17.84	104%
Link30	Node12	Node11	5.55	4.49	326.4	0.325	0.0105	2.50	3.26	-0.76	28.94	18.67	27.65	17.84	96%
Link29	Node13	Node12	6.52	5.60	315.4	0.292	0.0105	2.50	3.12	-0.62	27.43	17.70	27.65	17.84	101%
Link28	Node14	Node13	7.43	6.62	340.8	0.238	0.0105	2.50	3.20	-0.70	24.76	15.97	27.65	17.84	112%
Link27	Node15	Node14	8.66	7.49	430.1	0.272	0.0105	2.50	3.24	-0.74	26.49	17.09	27.65	17.84	104%
Link26	Node16	Node15	9.71	8.97	416.8	0.178	0.0105	2.50	3.11	-0.61	21.40	13.81	24.50	15.81	114%
Link25	Node17	Node16	10.75	10.06	410.9	0.168	0.0105	2.50	2.94	-0.44	20.81	13.43	24.58	15.86	118%
Link24	Node18	Node17	12.12	11.01	424.4	0.262	0.0105	2.50	2.68	-0.18	25.97	16.76	25.11	16.20	97%
Link23	Node19	Node18	13.46	12.47	427.0	0.232	0.0105	2.50	2.18	0.32	24.45	15.77	23.60	15.23	97%
Link22	Node20	Node19	14.67	13.73	394.3	0.238	0.0105	2.50	1.90	0.60	24.80	16.00	23.53	15.18	95%
Link21	Node21	Node20	15.85	14.84	376.3	0.268	0.0105	2.50	1.73	0.77	26.31	16.97	21.09	13.61	80%
Link20	Node22	Node21	16.83	15.94	253.2	0.351	0.0105	2.50	1.64	0.87	30.11	19.43	21.91	14.14	73%
Link19	Node23	Node22	17.51	16.97	221.8	0.243	0.0105	2.50	1.74	0.76	25.06	16.17	21.27	13.72	85%
Link18	Node24	Node23	18.26	17.70	281.2	0.199	0.0105	2.50	1.80	0.70	22.66	14.62	20.77	13.40	92%
27-Inch Onsite Trunk Sewer															
Link17	Node25	Node24	19.21	18.28	276.0	0.337	0.0105	2.25	1.78	0.47	22.26	14.36	20.74	13.38	93%
Link16	Node26	Node25	19.80	19.33	187.5	0.289	0.0105	2.25	1.77	0.48	20.60	13.29	20.70	13.35	100%
Link15	Node27	Node26	21.09	20.10	402.0	0.246	0.0105	2.25	1.91	0.34	19.03	12.28	20.46	13.20	108%
Link14	Node28	Node27	21.93	21.14	209.5	0.377	0.0105	2.25	1.86	0.39	23.55	15.19	22.03	14.21	94%
Link13	Node29	Node28	22.60	22.08	140.0	0.371	0.0105	2.25	1.69	0.56	23.37	15.08	21.33	13.76	91%
Link12	Node29A	Node29	23.29	22.57	39.5	1.823	0.0105	2.25	1.72	0.53	51.77	33.40	20.76	13.39	40%
Link11	Node30	Node29A	24.30	23.34	295.0	0.325	0.0105	2.25	1.77	0.48	21.87	14.11	20.72	13.37	95%
Link10	Node31	Node30	24.89	24.41	173.0	0.277	0.0105	2.26	1.79	0.46	20.20	13.03	20.77	13.40	103%
Link9	Node31A	Node31	25.45	25.02	133.0	0.323	0.0105	2.25	1.69	0.56	21.80	14.06	20.17	13.01	93%
Link8	Node32	Node31A	26.28	25.56	237.5	0.303	0.0105	2.25	1.74	0.51	21.11	13.62	20.18	13.02	96%
Link44	Node33	Node32	27.23	26.37	300.5	0.286	0.0105	2.25	1.80	0.46	20.51	13.23	19.97	12.88	97%
Link43	Node34	Node33	28.74	28.20	118.0	0.458	0.0105	2.25	1.61	0.64	25.94	16.74	19.53	12.60	75%
ONSITE PUMP STATION															
24-Inch Onsite Trunk Sewer															
Link47	Node2	LS	13.87	13.38	151.9	0.323	0.0105	2.00	1.75	0.25	15.91	10.26	18.36	11.85	115%
Link46	Node3	Node2	14.44	13.97	124.2	0.378	0.0105	2.00	1.70	0.30	17.23	11.12	18.17	11.72	105%
Link38	Node4	Node3	15.05	14.54	155.8	0.327	0.0105	2.00	1.74	0.26	16.03	10.34	18.02	11.63	112%
Link37	Node5	Node4	15.96	15.15	244.4	0.331	0.0105	2.00	1.73	0.27	16.12	10.40	17.19	11.09	107%
Link42	Node6	Node5	16.82	16.06	230.3	0.330	0.0105	2.00	1.73	0.27	16.09	10.38	17.31	11.17	108%
Link34	Node7	Node6	17.40	16.92	144.0	0.333	0.0105	2.00	1.67	0.33	16.17	10.43	17.15	11.06	106%
Link33	Node7A	Node7	17.98	17.50	146.9	0.327	0.0105	2.00	1.67	0.33	16.01	10.33	17.14	11.06	107%
Link32	Node8	Node7A	18.72	18.08	195.0	0.328	0.0105	2.00	1.69	0.31	16.05	10.35	17.04	10.99	106%
Link31	Node9	Node8	19.61	18.82	237.0	0.333	0.0105	2.00	1.68	0.32	16.17	10.43	16.92	10.92	105%
Link30	Node9A	Node9	20.06	19.71	107.8	0.325	0.0105	2.00	1.65	0.35	15.96	10.30	16.88	10.89	106%
Link29	Node10	Node9A	20.83	20.16	203.4	0.329	0.0105	2.00	1.67	0.33	16.07	10.37	16.99	10.96	106%
Link28	Node11	Node10	21.75	20.93	246.4	0.333	0.0105	2.00	1.67	0.33	16.16	10.43	16.84	10.86	104%
Link27	Node12	Node11	22.54	21.85	210.1	0.328	0.0105	2.00	1.66	0.34	16.05	10.35	16.81	10.85	105%
Link26	Node13	Node12	23.48	22.64	254.2	0.331	0.0105	2.00	1.67	0.33	16.10	10.39	16.82	10.85	104%
Link25	Node14	Node13	24.41	23.58	251.8	0.330	0.0105	2.00	1.57	0.43	16.08	10.37	15.24	9.83	95%
Link24	Node15	Node14	27.88	24.66	379.2	0.849	0.0105	2.00	1.31	0.69	25.81	16.65	15.59	10.06	60%
Link45	Node16	Node15	28.57	27.98	14.3	4.123	0.0105	2.00	1.05	0.95	39.28	25.34	6.73	4.34	17%

EXHIBIT 7

STANDARD FACTORS
30-inch Offsite and 27-Inch Onsite Trunk - Applicant Estimate (n = 0.0105)
Day [0] Time 00:01:00 Step 2

ONSITE 27" GRAVITY SEWER
&
30" OFFSITE TRUNK SEWER

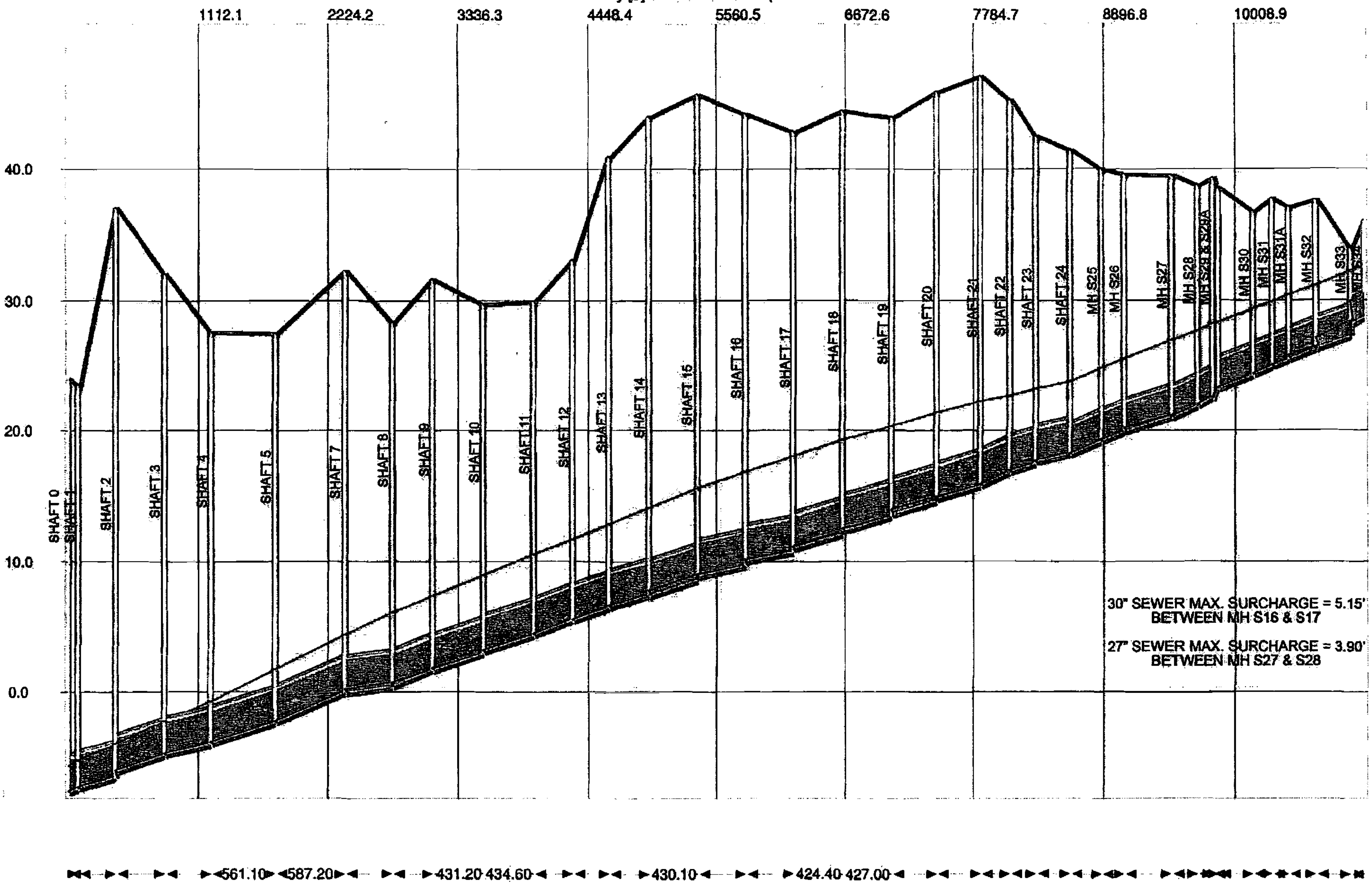


EXHIBIT 6

Low Flow Fix - All Future

Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Length (ft)	Conduit Slope (%)	Roughness	Diameter (ft)	Max Depth (ft)	Free Board (ft)	Design Full Flow (cfs)	Design Full Flow (MGD)	Max Flow (cfs)	Max Flow (MGD)	Max Flow/Design Flow (%)
30-inch Offsite Trunk Sewer															
Link41	Node1	Node0	-7.28	-7.50	80.3	0.274	0.0105	2.50	1.90	0.60	26.58	17.15	27.64	17.86	105%
Link40	Node2	Node1	-6.38	-7.14	326.6	0.233	0.0105	2.50	2.14	0.37	24.50	15.81	27.84	17.96	114%
Link39	Node3	Node2	-4.74	-5.89	408.7	0.281	0.0105	2.50	2.05	0.45	26.94	17.38	27.84	17.98	103%
Link38	Node4	Node3	-3.83	-4.64	399.0	0.203	0.0105	2.50	2.31	0.19	22.88	14.76	27.84	17.98	122%
Link37	Node5	Node4	-2.24	-3.78	561.1	0.274	0.0105	2.50	2.26	0.24	26.60	17.16	27.84	17.96	105%
Link42	Node7	Node5	0.01	-2.17	587.2	0.371	0.0105	2.50	2.15	0.35	30.94	18.96	27.84	17.96	90%
Link34	Node8	Node7	0.46	0.05	400.9	0.102	0.0105	2.50	2.69	-0.19	16.24	10.48	27.84	17.96	171%
Link33	Node9	Node8	1.72	0.53	351.3	0.339	0.0105	2.50	2.62	-0.12	29.56	19.07	25.09	16.19	85%
Link32	Node10	Node9	2.98	1.77	431.2	0.281	0.0105	2.50	2.14	0.38	26.90	17.35	25.20	16.26	94%
Link31	Node11	Node10	4.39	3.21	434.6	0.272	0.0105	2.50	1.92	0.59	26.46	17.07	25.10	16.19	95%
Link30	Node12	Node11	5.55	4.49	326.4	0.326	0.0105	2.50	1.82	0.69	28.94	16.67	25.15	16.23	87%
Link29	Node13	Node12	6.52	5.60	315.4	0.292	0.0105	2.50	1.86	0.64	27.43	17.70	25.17	16.24	92%
Link28	Node14	Node13	7.43	6.62	340.8	0.238	0.0105	2.50	1.98	0.52	24.76	15.97	25.16	16.23	102%
Link27	Node15	Node14	8.66	7.49	430.1	0.272	0.0105	2.50	1.94	0.56	26.49	17.09	25.28	16.31	95%
Link26	Node16	Node15	9.71	8.97	416.8	0.178	0.0105	2.50	2.02	0.48	21.40	13.81	22.95	14.81	107%
Link25	Node17	Node16	10.75	10.06	410.9	0.168	0.0105	2.50	2.05	0.46	20.81	13.43	23.02	14.85	111%
Link24	Node18	Node17	12.12	11.01	424.4	0.262	0.0105	2.50	1.86	0.64	25.97	16.75	23.47	16.14	90%
Link23	Node19	Node18	13.46	12.47	427.0	0.232	0.0105	2.50	1.87	0.63	24.45	15.77	22.52	14.53	92%
Link22	Node20	Node19	14.67	13.73	394.3	0.238	0.0105	2.50	1.84	0.66	24.80	16.00	22.43	14.47	90%
Link21	Node21	Node20	15.85	14.84	376.3	0.268	0.0105	2.50	1.71	0.79	26.31	16.97	20.94	13.51	80%
Link20	Node22	Node21	16.83	15.94	253.2	0.351	0.0105	2.50	1.62	0.88	30.11	19.43	21.68	13.99	72%
Link19	Node23	Node22	17.51	16.97	221.8	0.243	0.0105	2.50	1.73	0.78	25.06	16.17	21.06	13.59	84%
Link18	Node24	Node23	18.26	17.70	281.2	0.199	0.0105	2.50	1.79	0.71	22.66	14.62	20.56	13.26	91%
27-inch Onsite Trunk Sewer															
Link17	Node25	Node24	19.21	18.28	276.0	0.337	0.0105	2.25	1.77	0.48	22.26	14.36	20.56	13.26	92%
Link16	Node26	Node25	19.90	19.33	197.5	0.289	0.0105	2.25	1.76	0.49	20.60	13.29	20.50	13.23	100%
Link15	Node27	Node26	21.09	20.10	402.0	0.246	0.0105	2.25	1.89	0.36	19.03	12.28	20.24	13.06	106%
Link14	Node28	Node27	21.93	21.14	209.5	0.377	0.0105	2.25	1.84	0.41	23.55	15.19	21.81	14.07	93%
Link13	Node29	Node28	22.60	22.08	140.0	0.371	0.0105	2.25	1.68	0.57	23.37	15.08	21.13	13.63	90%
Link12	Node29A	Node29	23.29	22.57	39.5	1.823	0.0105	2.25	1.71	0.54	51.77	33.40	20.56	13.26	40%
Link11	Node30	Node29A	24.30	23.34	295.0	0.325	0.0105	2.25	1.76	0.50	21.87	14.11	20.51	13.23	94%
Link10	Node31	Node30	24.89	24.41	173.0	0.277	0.0105	2.25	1.78	0.47	20.20	13.03	20.55	13.26	102%
Link9	Node31A	Node31	25.45	25.02	133.0	0.323	0.0105	2.25	1.68	0.57	21.80	14.06	19.97	12.88	92%
Link8	Node32	Node31A	26.28	25.56	237.5	0.303	0.0105	2.25	1.73	0.53	21.11	13.62	19.97	12.88	95%
Link44	Node33	Node32	27.23	26.37	300.5	0.286	0.0105	2.25	1.78	0.47	20.51	13.23	19.73	12.73	96%
Link43	Node34	Node33	28.74	28.20	118.0	0.458	0.0105	2.25	1.59	0.66	25.94	16.74	19.32	12.48	74%
ONSITE PUMP STATION															
24-inch Onsite Trunk Sewer															
Link47	Node2	LS	13.87	13.38	151.9	0.323	0.0105	2.00	1.74	0.26	15.91	10.26	18.15	11.71	114%
Link46	Node3	Node2	14.44	13.97	124.2	0.378	0.0105	2.00	1.68	0.32	17.23	11.12	17.92	11.56	104%
Link38	Node4	Node3	15.05	14.54	155.8	0.327	0.0105	2.00	1.72	0.28	16.03	10.34	17.78	11.47	111%
Link37	Node5	Node4	15.96	15.15	244.4	0.331	0.0105	2.00	1.71	0.29	16.12	10.40	16.96	10.94	105%
Link42	Node6	Node5	16.82	16.06	230.3	0.330	0.0105	2.00	1.71	0.29	16.09	10.38	17.01	10.97	106%
Link34	Node7	Node6	17.40	16.92	144.0	0.333	0.0105	2.00	1.65	0.35	16.17	10.43	16.89	10.86	105%
Link33	Node7A	Node7	17.98	17.50	146.9	0.327	0.0105	2.00	1.65	0.35	16.01	10.33	16.84	10.86	105%
Link32	Node8	Node7A	18.72	18.08	195.0	0.328	0.0105	2.00	1.66	0.34	16.05	10.35	16.74	10.80	104%
Link31	Node9	Node8	19.61	18.82	237.0	0.333	0.0105	2.00	1.66	0.34	16.17	10.43	16.60	10.71	103%
Link30	Node9A	Node9	20.06	19.71	107.8	0.325	0.0105	2.00	1.62	0.38	15.96	10.30	16.50	10.65	103%
Link29	Node10	Node9A	20.83	20.16	203.4	0.329	0.0105	2.00	1.64	0.36	16.07	10.37	16.63	10.73	103%
Link28	Node11	Node10	21.75	20.93	246.4	0.333	0.0105	2.00	1.64	0.36	16.16	10.43	16.49	10.64	102%
Link27	Node12	Node11	22.54	21.85	210.1	0.328	0.0105	2.00	1.63	0.37	16.05	10.35	16.40	10.58	102%
Link26	Node13	Node12	23.48	22.64	254.2	0.331	0.0105	2.00	1.64	0.36	16.10	10.39	16.39	10.57	102%
Link25	Node14	Node13	24.41	23.58	251.8	0.330	0.0105	2.00	1.55	0.45	16.08	10.37	15.29	9.86	95%
Link24	Node15	Node14	27.88	24.66	379.2	0.849	0.0105	2.00	1.30	0.70	25.81	16.65	15.59	10.06	60%
Link45	Node16	Node15	28.57	27.98	14.3	4.123	0.0105	2.00	1.05	0.95	39.28	25.34	6.73	4.34	17%

EXHIBIT 7

STANDARD FACTORS
Manhole 16 to LS - Applicants Estimate (n = 0.0105)
Day [0] Time 00:01:00 Step 2

ONSITE 24" GRAVITY SEWER
MH S16 TO PUMP STATION

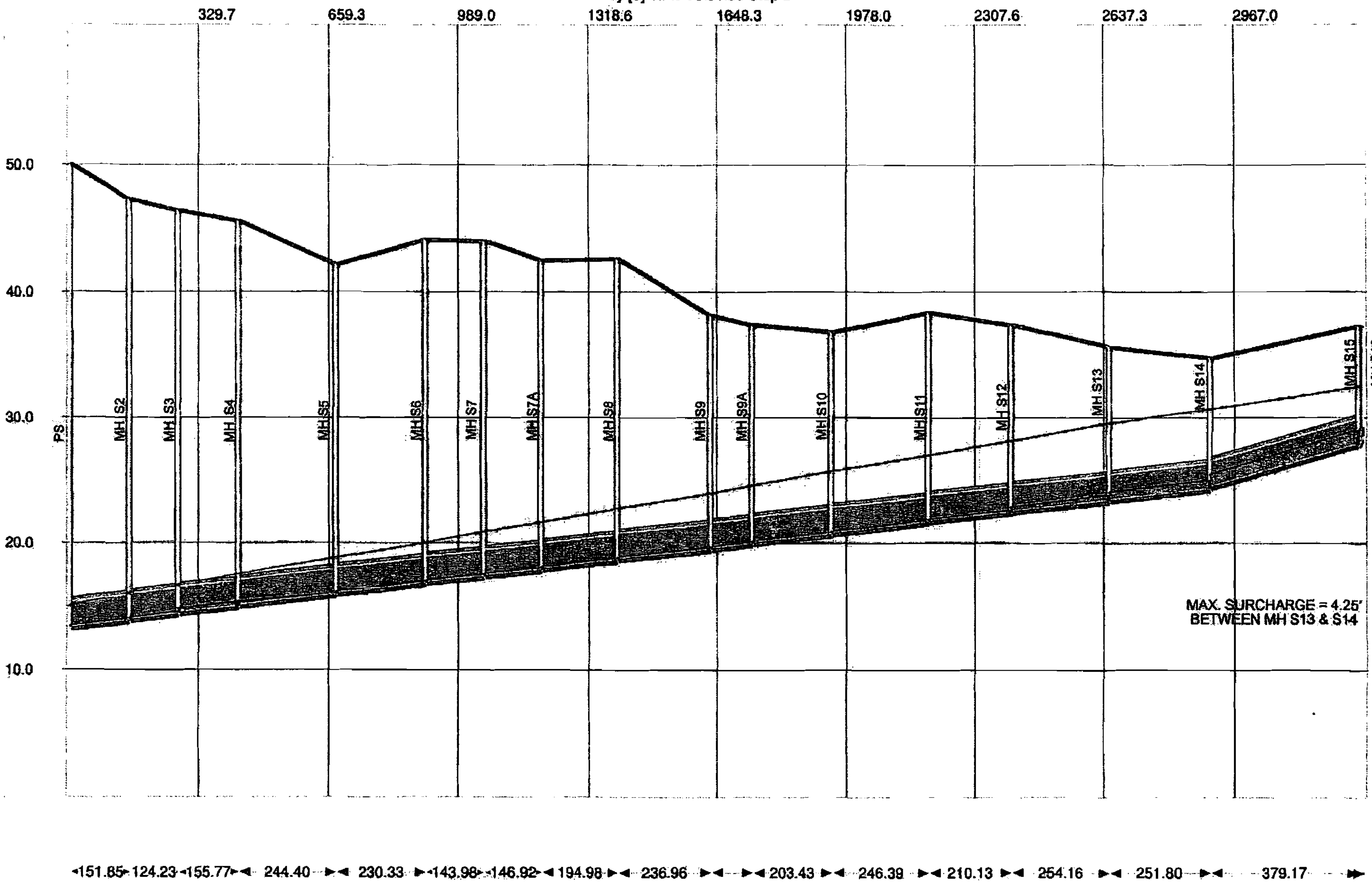


EXHIBIT 7

LOW FLOW FIXTURES - POTOMAC VILLAGE
30-inch Offsite and 27-inch Onsite Trunk - Low Flow - PV (n = 0.0105)
Day [0] Time 00:01:00 Step 2

ONSITE 27" GRAVITY SEWER & 30" OFFSITE TRUNK SEWER

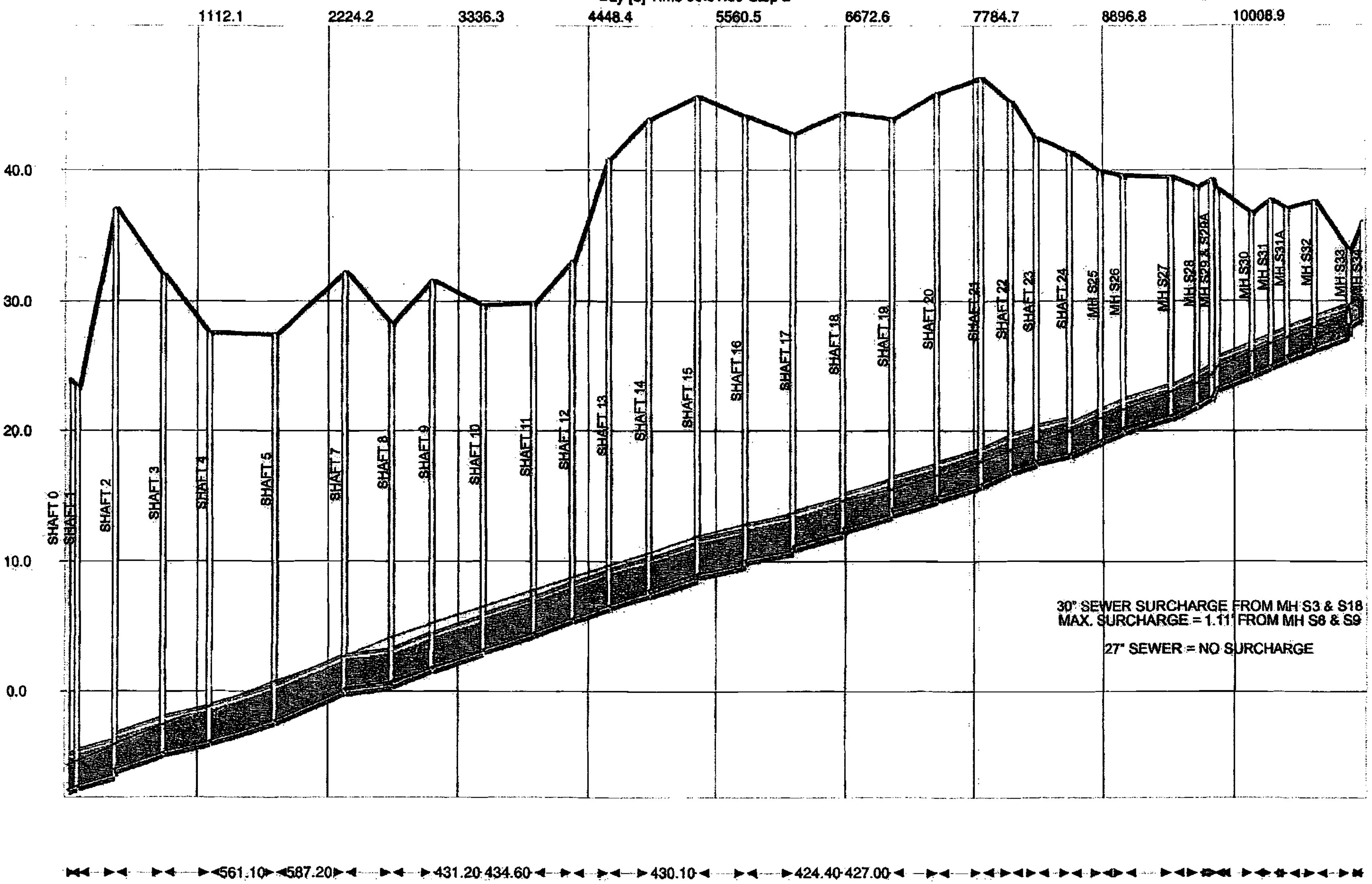


EXHIBIT 7

LOW FLOW FIXTURES - POTOMAC VILLAGE
Manhole 16 to LS - Low Flow - Potomac Village (n = 0.0105)
Day [0] Time 00:01:00 Step 2

ONSITE 24" GRAVITY SEWER
MH S16 TO PUMP STATION

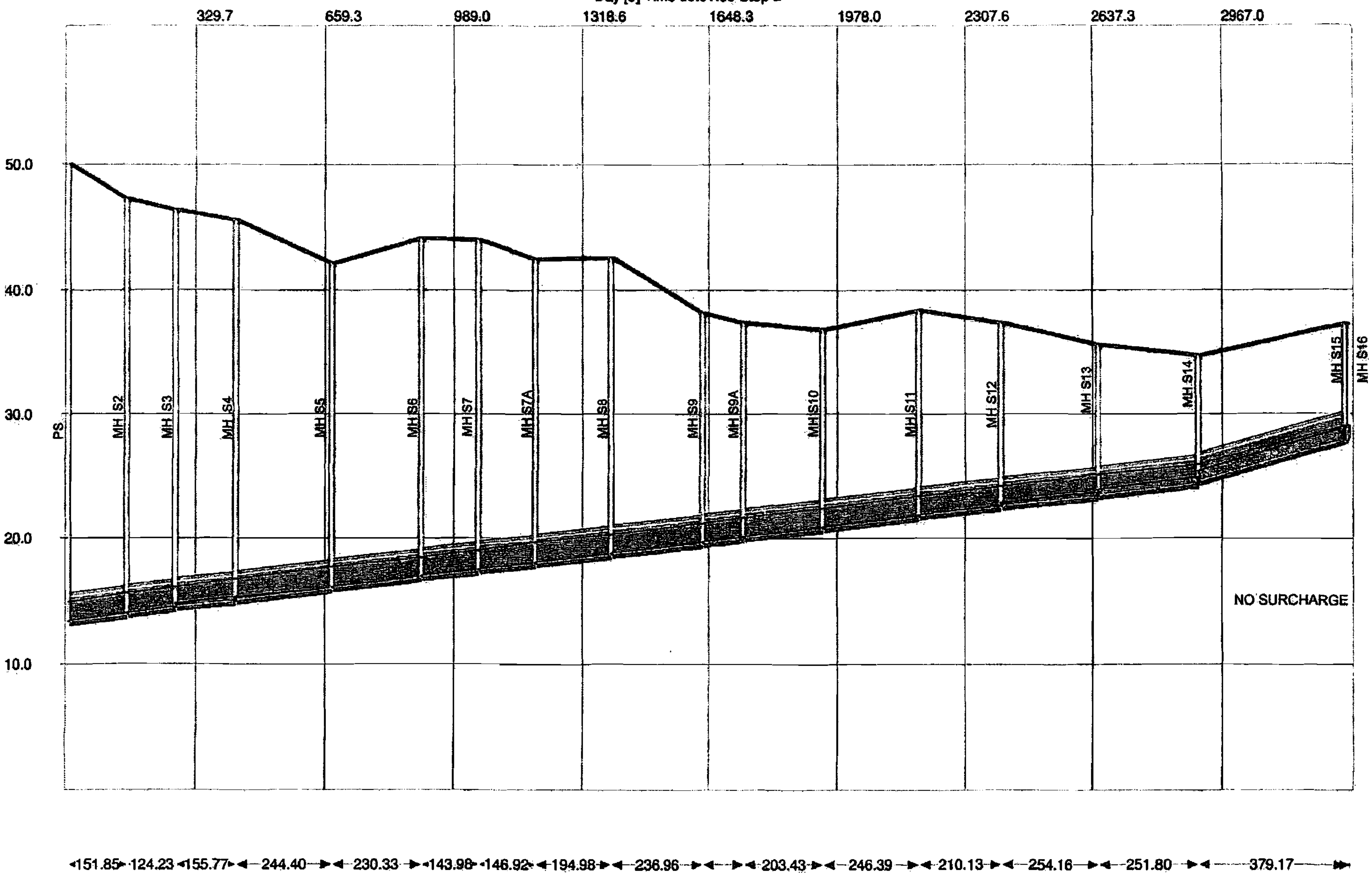


EXHIBIT 7

LOW FLOW FIXTURES - ALL FUTURE DEVELOPMENTS
30-inch Offsite and 27-inch Onsite Trunk - Low Flow - PV (n = 0.0105)
Day [0] Time 00:01:00 Step 2

ONSITE 27" GRAVITY SEWER
&
30" OFFSITE TRUNK SEWER

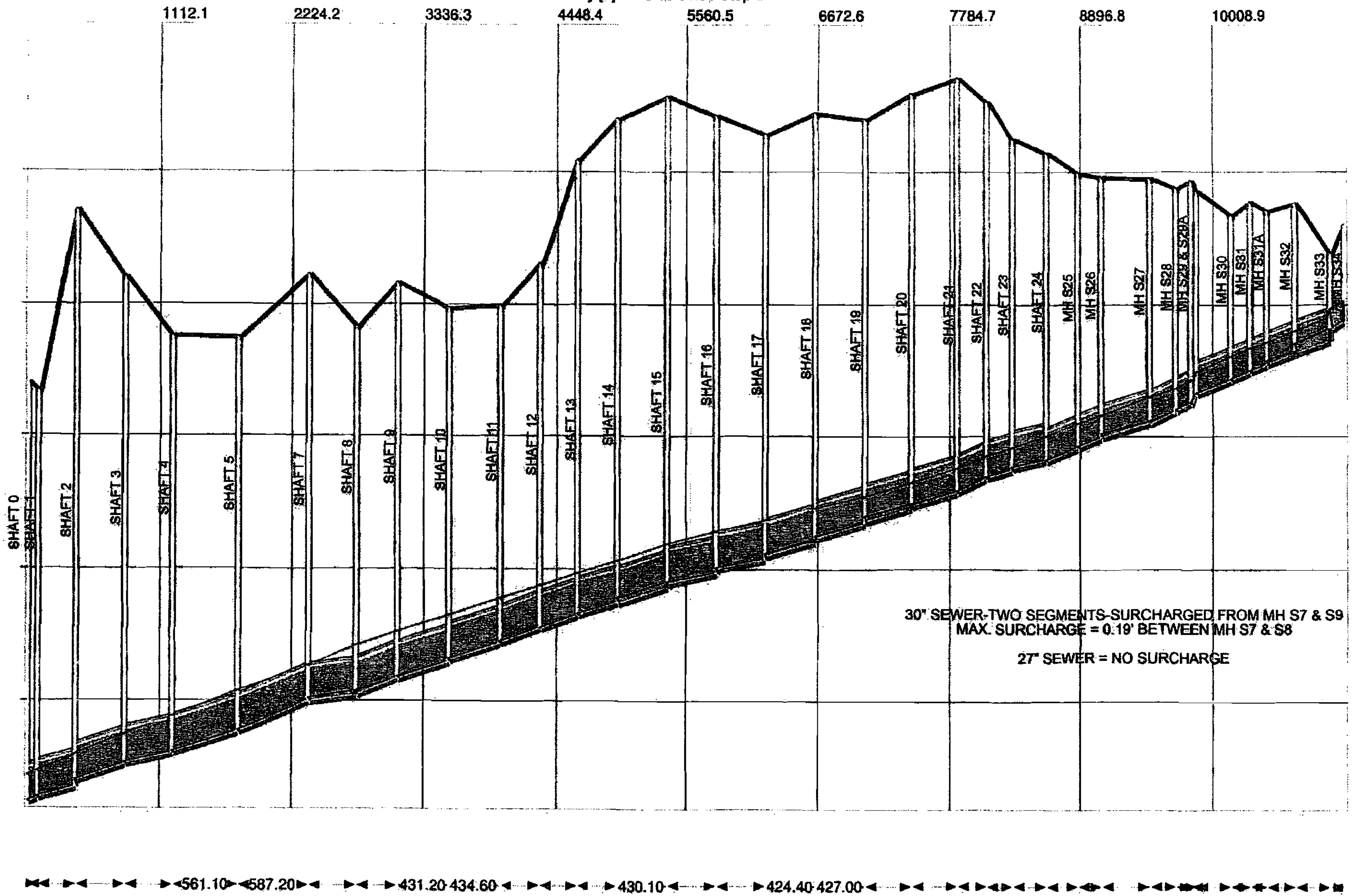


EXHIBIT 7

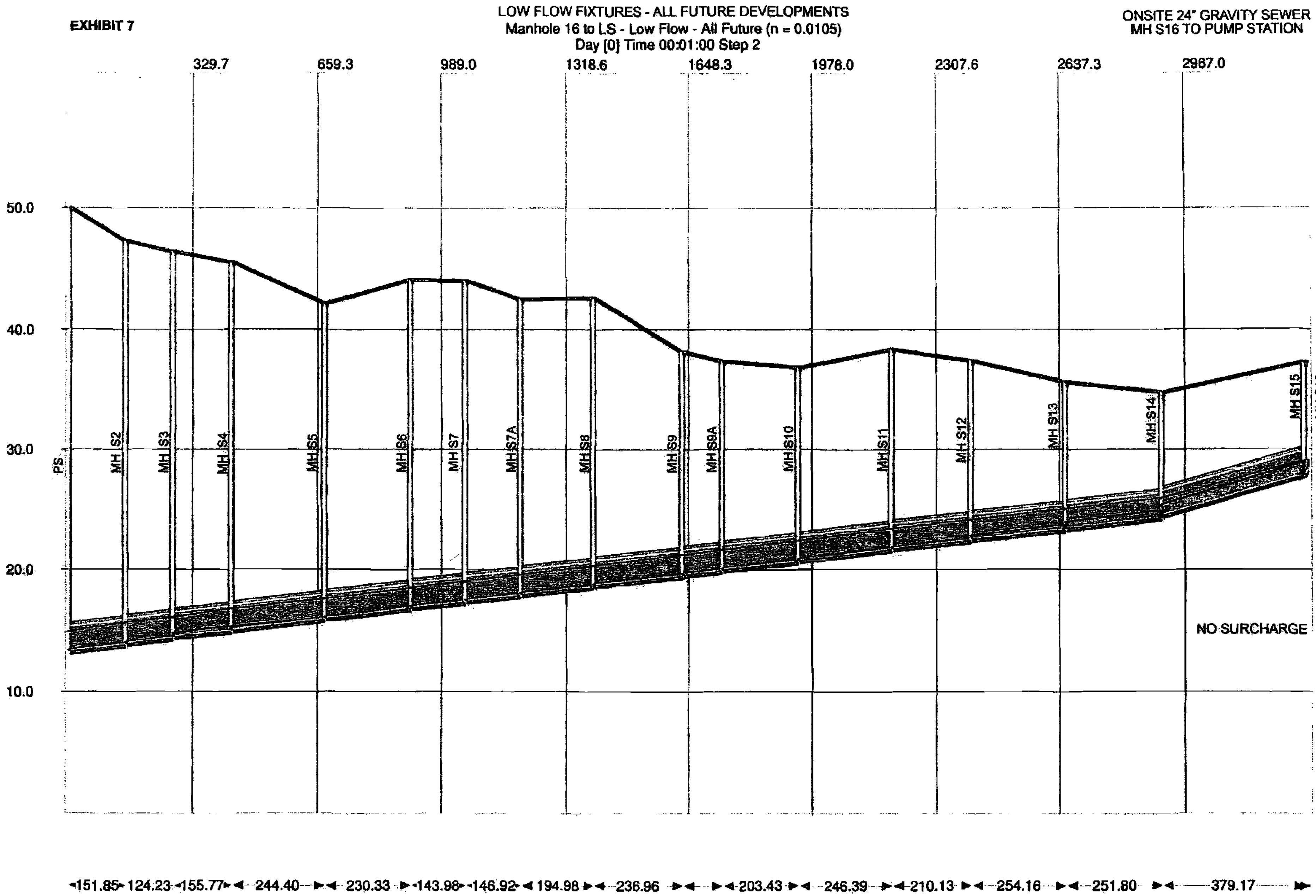

LOW FLOW FIXTURES - ALL FUTURE DEVELOPMENTS
Manhole 16 to LS - Low Flow - All Future (n = 0.0105)
Day [0] Time 00:01:00 Step 2
ONSITE 24" GRAVITY SEWER
MH S16 TO PUMP STATION
329.7
659.3
989.0
1318.6
1648.3
1978.0
2307.6
2637.3
2967.0
50.0
40.0
30.0
20.0
10.0
PS
MH S2
MH S3
MH S4
MH S5
MH S6
MH S7
MH S7A
MH S8
MH S9
MH S9A
MH S10
MH S11
MH S12
MH S13
MH S14
MH S15
MH S16
NO SURCHARGE
151.85
124.23
155.77
244.40
230.33
143.98
146.92
194.98
236.96
203.43
246.39
210.13
254.16
251.80
379.17

EXHIBIT 8

Low Flow Fix - Potomac Village
n = 0.011

Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Length (ft)	Conduit Slope (%)	Roughness	Diameter (ft)	Max Depth (ft)	Free Board (ft)	Design Full Flow (cfs)	Design Full Flow (MGD)	Max Flow (cfs)	Max Flow (MGD)
30-inch Offsite Trunk Sewer														
Link41	Node1	Node0	-7.28	-7.50	80.3	0.274	0.0110	2.50	2.03	0.47	25.37	16.37	30.50	19.68
Link40	Node2	Node1	-6.38	-7.14	326.6	0.233	0.0110	2.50	2.51	-0.01	23.38	15.08	30.50	19.68
Link39	Node3	Node2	-4.74	-5.89	408.7	0.281	0.0110	2.50	2.38	0.12	25.71	16.59	30.50	19.68
Link38	Node4	Node3	-3.83	-4.64	399.0	0.203	0.0110	2.50	2.94	-0.44	21.84	14.09	30.50	19.68
Link37	Node5	Node4	-2.24	-3.78	561.1	0.274	0.0110	2.50	3.54	-1.04	25.40	16.39	30.50	19.68
Link42	Node7	Node5	0.01	-2.17	587.2	0.371	0.0110	2.50	3.60	-1.10	29.54	19.06	30.50	19.68
Link34	Node8	Node7	0.46	0.05	400.9	0.102	0.0110	2.50	4.72	-2.22	16.50	10.00	30.50	19.68
Link33	Node9	Node8	1.72	0.53	351.3	0.339	0.0110	2.50	4.65	-2.15	28.21	18.20	27.74	17.90
Link32	Node10	Node9	2.98	1.77	431.2	0.281	0.0110	2.50	4.74	-2.24	25.68	16.57	27.74	17.90
Link31	Node11	Node10	4.39	3.21	434.6	0.272	0.0110	2.50	4.73	-2.23	25.26	16.30	27.65	17.84
Link30	Node12	Node11	5.55	4.49	326.4	0.325	0.0110	2.50	4.63	-2.13	27.62	17.82	27.65	17.84
Link29	Node13	Node12	6.52	5.60	315.4	0.292	0.0110	2.50	4.66	-2.16	26.18	16.89	27.65	17.84
Link28	Node14	Node13	7.43	6.62	340.8	0.238	0.0110	2.50	4.85	-2.35	23.63	15.25	27.65	17.84
Link27	Node15	Node14	8.66	7.49	430.1	0.272	0.0110	2.50	5.00	-2.50	25.28	16.31	27.65	17.84
Link26	Node16	Node15	9.71	8.97	416.6	0.178	0.0110	2.50	5.01	-2.51	20.43	13.18	24.50	15.81
Link25	Node17	Node16	10.75	10.06	410.9	0.168	0.0110	2.50	5.00	-2.50	19.88	12.81	24.50	15.81
Link24	Node18	Node17	12.12	11.01	424.4	0.262	0.0110	2.50	4.74	-2.24	24.79	16.00	24.50	15.81
Link23	Node19	Node16	13.46	12.47	427.0	0.232	0.0110	2.50	4.36	-1.86	23.34	15.06	23.11	14.91
Link22	Node20	Node19	14.67	13.73	394.3	0.238	0.0110	2.50	4.06	-1.56	23.67	15.27	23.11	14.91
Link21	Node21	Node20	15.85	14.84	378.3	0.268	0.0110	2.50	3.84	-1.34	25.11	16.20	20.35	13.13
Link20	Node22	Node21	16.83	15.94	253.2	0.361	0.0110	2.50	3.38	-0.88	28.74	18.54	20.76	13.39
Link19	Node23	Node22	17.51	16.97	221.8	0.243	0.0110	2.50	2.79	-0.29	23.92	15.43	20.30	13.10
Link18	Node24	Node23	18.26	17.70	281.2	0.199	0.0110	2.50	2.41	0.09	21.63	13.95	20.16	13.01
27-inch Onsite Trunk Sewer														
Link17	Node25	Node24	19.21	18.28	276.0	0.337	0.0110	2.25	2.25	0.00	21.25	13.71	20.13	12.99
Link16	Node26	Node25	19.90	19.33	197.5	0.289	0.0110	2.25	1.96	0.29	19.66	12.68	20.12	12.98
Link15	Node27	Node26	21.09	20.10	402.0	0.248	0.0110	2.25	1.97	0.28	18.16	11.72	20.14	12.99
Link14	Node28	Node27	21.93	21.14	209.5	0.377	0.0110	2.25	1.92	0.33	22.48	14.50	20.92	13.50
Link13	Node29	Node28	22.60	22.08	140.0	0.371	0.0110	2.25	1.68	0.57	22.31	14.39	20.44	13.19
Link12	Node29A	Node29	23.29	22.57	39.5	1.823	0.0110	2.25	1.71	0.54	49.42	31.88	20.19	13.03
Link11	Node30	Node29A	24.30	23.34	295.0	0.325	0.0110	2.25	1.77	0.49	20.88	13.47	20.16	13.01
Link10	Node31	Node30	24.89	24.41	173.0	0.277	0.0110	2.25	1.79	0.46	19.28	12.44	20.04	12.93
Link9	Node31A	Node31	25.45	25.02	133.0	0.323	0.0110	2.25	1.71	0.54	20.81	13.43	19.85	12.81
Link8	Node32	Node31A	26.28	25.56	237.5	0.303	0.0110	2.25	1.77	0.48	20.16	13.00	19.88	12.83
Link44	Node33	Node32	27.23	26.37	300.5	0.286	0.0110	2.25	1.83	0.42	19.58	12.63	19.83	12.79
Link43	Node34	Node33	28.74	28.20	116.0	0.458	0.0110	2.25	1.63	0.62	24.76	15.97	19.51	12.59
ONSITE PUMP STATION														
24-inch Onsite Trunk Sewer														
Link47	Node2	LS	13.87	13.38	151.9	0.323	0.0110	2.00	1.72	0.28	15.19	9.80	17.61	11.36
Link46	Node3	Node2	14.44	13.97	124.2	0.378	0.0110	2.00	1.69	0.31	16.44	10.61	17.61	11.36
Link38	Node4	Node3	15.05	14.54	155.8	0.327	0.0110	2.00	1.75	0.25	15.30	9.87	17.61	11.36
Link37	Node5	Node4	15.96	15.15	244.4	0.331	0.0110	2.00	1.76	0.24	15.39	9.93	16.80	10.84
Link42	Node6	Node5	16.82	16.06	230.3	0.330	0.0110	2.00	1.76	0.24	15.36	9.91	16.80	10.84
Link34	Node7	Node6	17.40	16.92	144.0	0.333	0.0110	2.00	1.73	0.27	15.44	9.96	16.80	10.84
Link33	Node7A	Node7	17.98	17.50	146.9	0.327	0.0110	2.00	1.72	0.28	15.28	9.86	16.80	10.84
Link32	Node8	Node7A	18.72	18.08	195.0	0.328	0.0110	2.00	1.74	0.27	15.32	9.88	16.80	10.84
Link31	Node9	Node8	19.61	18.82	237.0	0.333	0.0110	2.00	1.75	0.25	15.44	9.96	16.80	10.84
Link30	Node9A	Node9	20.06	19.71	107.8	0.325	0.0110	2.00	1.72	0.28	15.23	9.83	16.80	10.84
Link29	Node10	Node9A	20.83	20.16	203.4	0.329	0.0110	2.00	1.73	0.27	15.34	9.90	16.80	10.84
Link28	Node11	Node10	21.75	20.93	246.4	0.333	0.0110	2.00	1.75	0.25	15.42	9.95	16.80	10.84
Link27	Node12	Node11	22.54	21.85	210.1	0.326	0.0110	2.00	1.75	0.25	15.32	9.88	16.80	10.84
Link26	Node13	Node12	23.48	22.64	254.2	0.331	0.0110	2.00	1.76	0.24	15.37	9.92	16.80	10.84
Link25	Node14	Node13	24.41	23.58	251.8	0.330	0.0110	2.00	1.66	0.34	15.35	9.90	15.22	9.82
Link24	Node15	Node14	27.88	24.66	379.2	0.849	0.0110	2.00	1.39	0.61	24.64	15.90	15.62	10.08
Link45	Node16	Node15	28.57	27.98	14.3	4.123	0.0110	2.00	1.08	0.92	37.49	24.19	6.22	4.01

EXHIBIT 9

ONSITE 27" GRAVITY SEWER & 30" OFFSITE TRUNK SEWER

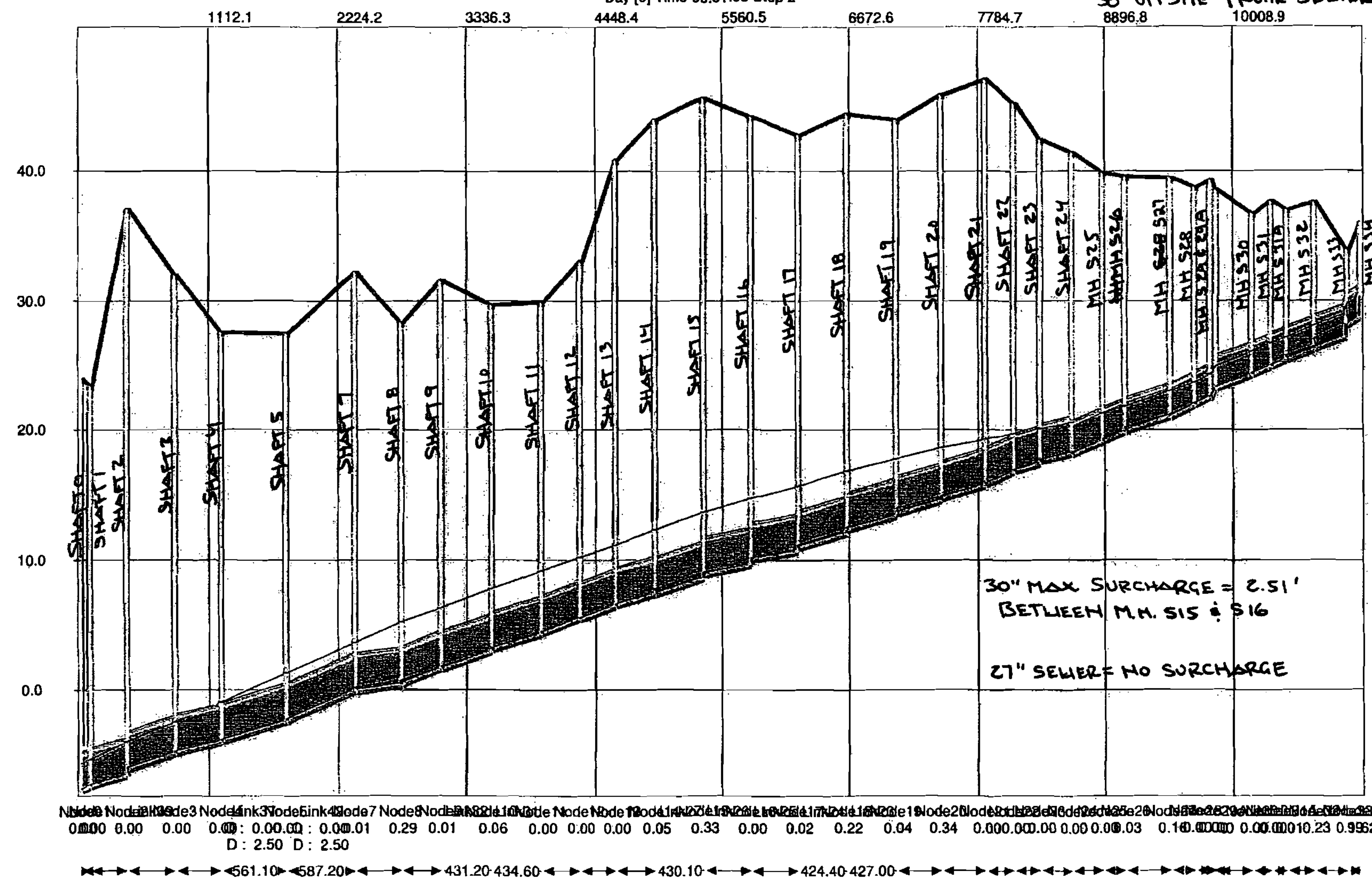


EXHIBIT 9

ONSITE 24" GRAVITY SEWER
MH S16 TO PUMP STATION

Manhole 16 to LS - Low Flow - Potomac Village (n = 0.011)
Day [0] Time 00:01:00 Step 2

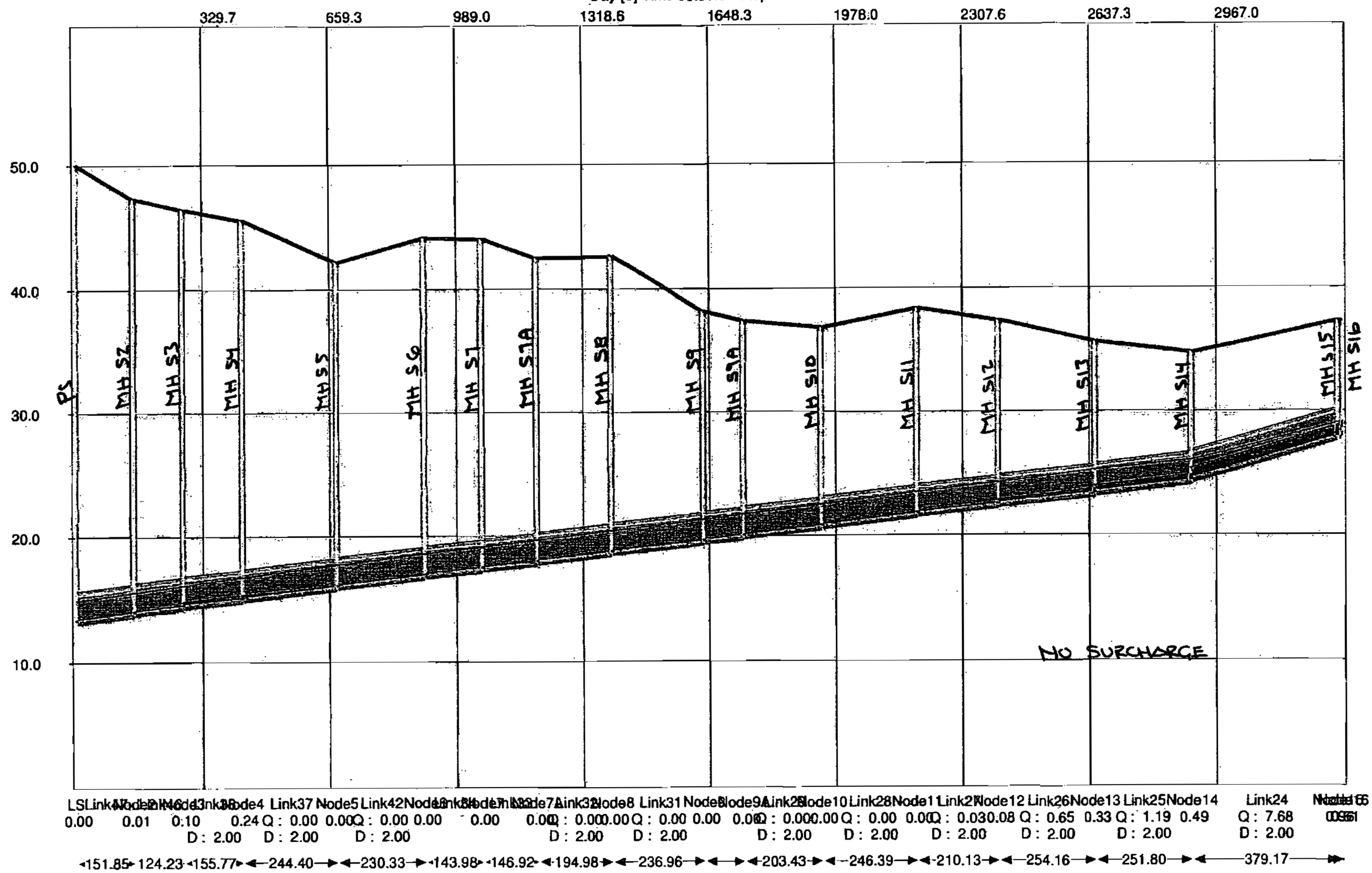


EXHIBIT 9

ONSITE 24" GRAVITY SEWER
MH. S16 TO PUMP STATION

Manhole 16 to LS - Low Flow - All Future (n = 0.011)
Day [0] Time 00:01:00 Step 2

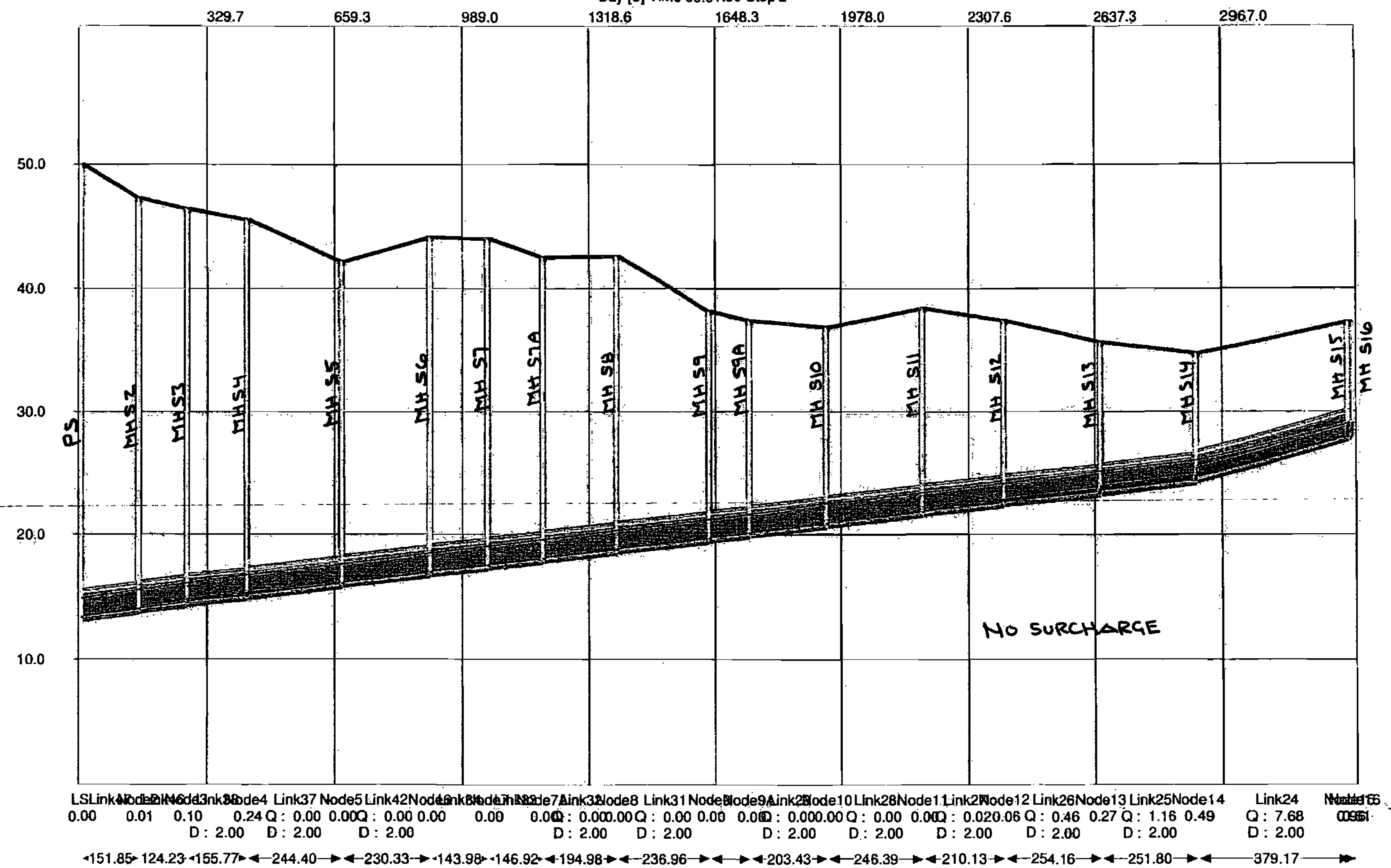


EXHIBIT 9

30-inch Offsite and 27-inch Onsite Trunk Sewer - Low Flow Future (n = 0.011)
Day [0] Time 00:01:00 Step 2

ONSITE 27" GRAVITY SEWER
30" OFFSITE & TRUNK SEWER

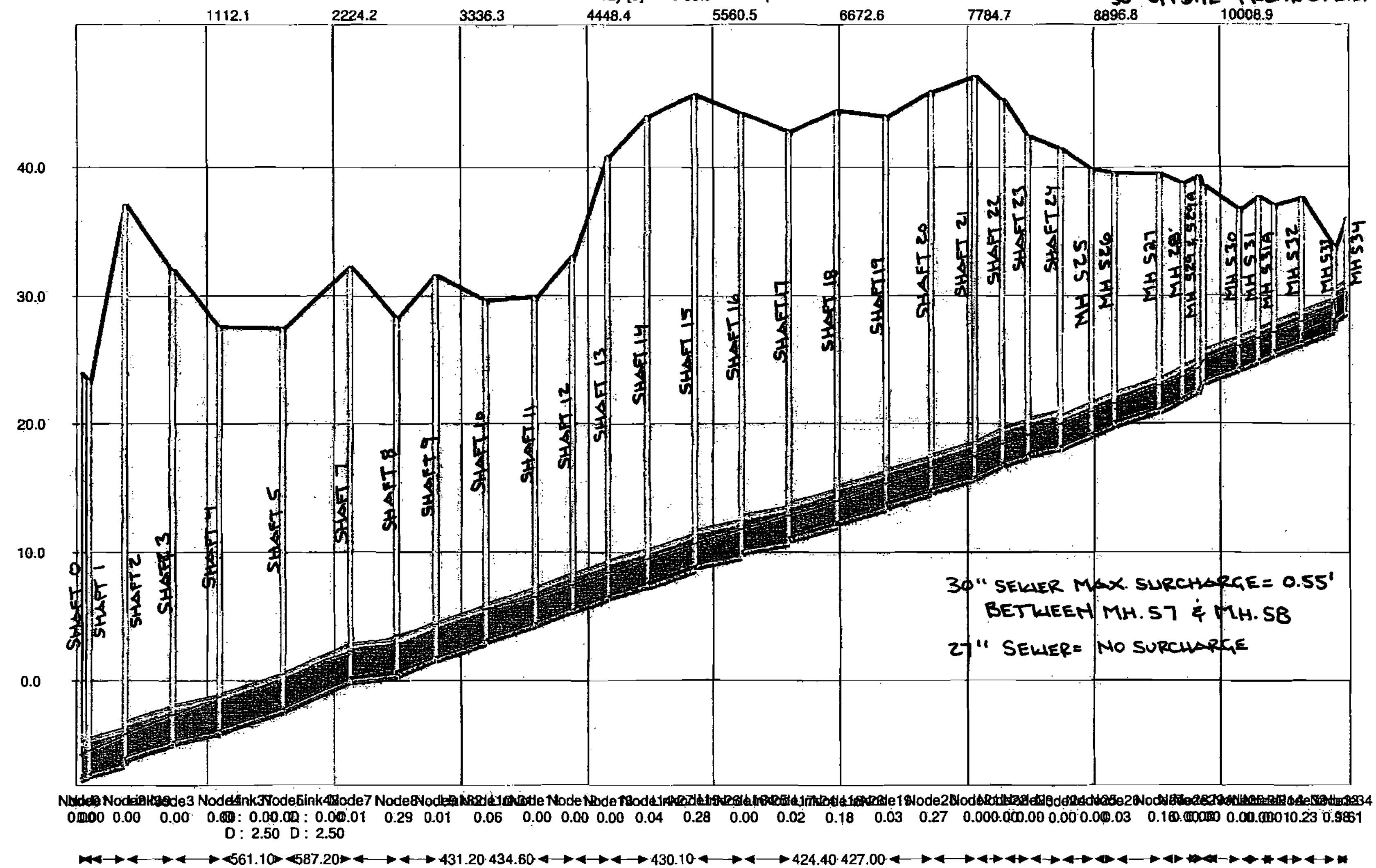
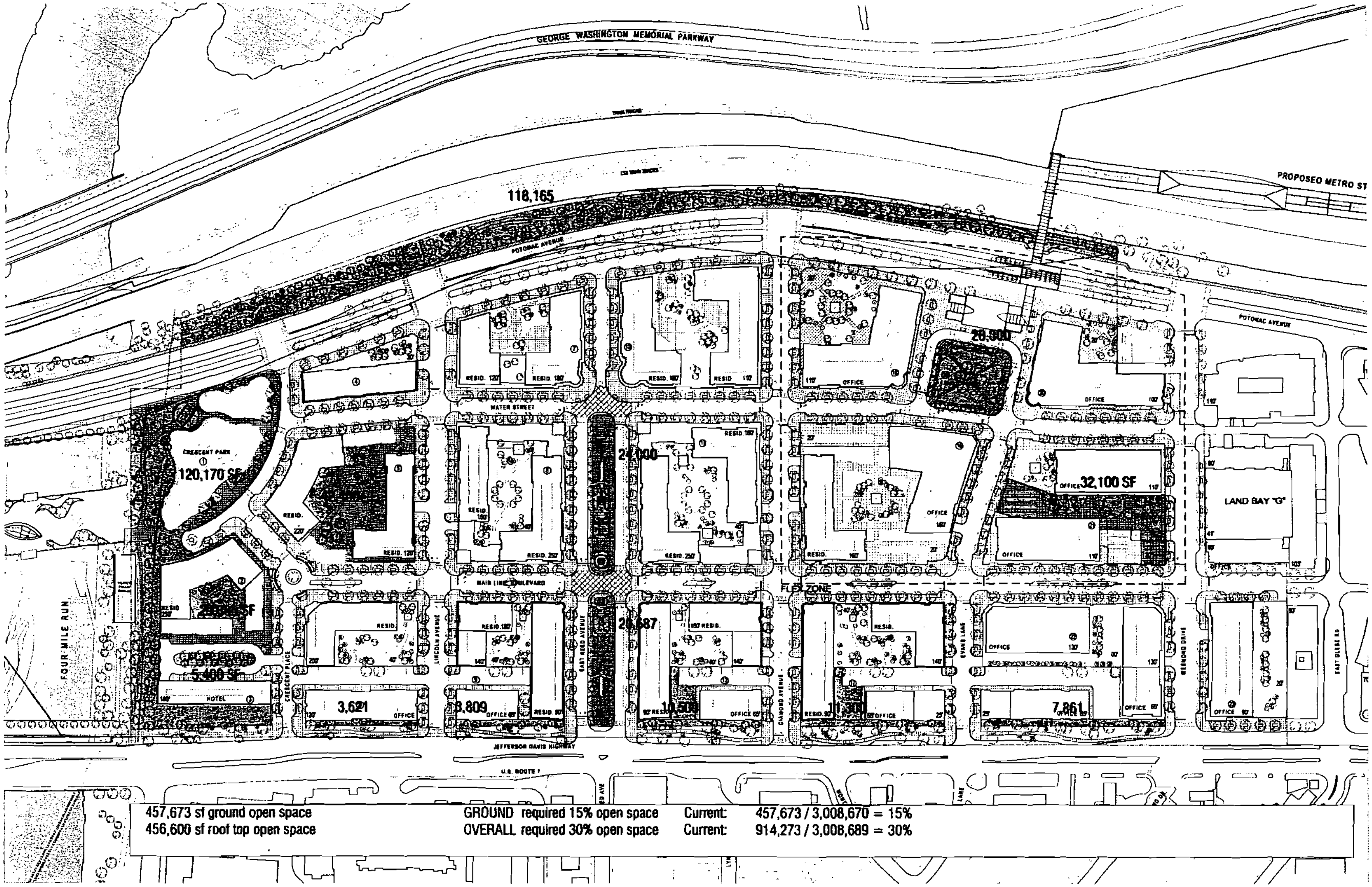


EXHIBIT 8

Low Flow Fixt - All Future
n = 0.011

Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Length (ft)	Conduit Slope (%)	Roughness	Diameter (ft)	Max Depth (ft)	Free Board (ft)	Design Full Flow (cfs)	Design Full Flow (MGD)	Max Flow (cfs)	Max Flow (MGD)
30-inch Offsite Trunk Sewer														
Link41	Node1	Node0	-7.28	-7.50	80.3	0.274	0.0110	2.50	1.93	0.57	25.37	16.37	27.84	17.96
Link40	Node2	Node1	-6.38	-7.14	326.6	0.233	0.0110	2.50	2.21	0.29	23.38	15.08	27.84	17.96
Link39	Node3	Node2	-4.74	-5.89	408.7	0.281	0.0110	2.50	2.13	0.37	25.71	16.59	27.84	17.96
Link38	Node4	Node3	-3.83	-4.64	399.0	0.203	0.0110	2.50	2.56	-0.06	21.84	14.09	27.84	17.96
Link37	Node5	Node4	-2.24	-3.78	561.1	0.274	0.0110	2.50	2.74	-0.24	25.40	18.39	27.84	17.96
Link42	Node7	Node5	0.01	-2.17	587.2	0.371	0.0110	2.50	2.67	-0.17	29.54	19.06	27.84	17.96
Link34	Node8	Node7	0.46	0.05	400.9	0.102	0.0110	2.50	3.05	-0.55	15.50	10.00	27.84	17.96
Link33	Node9	Node8	1.72	0.53	351.3	0.339	0.0110	2.50	2.98	-0.48	28.21	18.20	25.09	16.19
Link32	Node10	Node9	2.98	1.77	431.2	0.281	0.0110	2.50	2.61	-0.11	25.68	16.57	25.09	16.19
Link31	Node11	Node10	4.39	3.21	434.6	0.272	0.0110	2.50	2.30	0.20	25.26	16.30	25.00	16.13
Link30	Node12	Node11	5.55	4.49	326.4	0.325	0.0110	2.50	2.05	0.45	27.62	17.82	25.00	16.13
Link29	Node13	Node12	6.52	5.60	315.4	0.292	0.0110	2.50	1.94	0.57	26.19	16.89	25.00	16.13
Link28	Node14	Node13	7.43	6.62	340.6	0.238	0.0110	2.50	2.05	0.45	23.63	15.25	25.00	16.13
Link27	Node15	Node14	8.66	7.49	430.1	0.272	0.0110	2.50	2.02	0.48	25.28	16.31	25.00	16.13
Link26	Node16	Node15	9.71	8.97	416.8	0.178	0.0110	2.50	2.08	0.42	20.43	13.16	22.77	14.69
Link25	Node17	Node15	10.75	10.06	410.9	0.168	0.0110	2.50	2.11	0.40	19.86	12.81	22.77	14.69
Link24	Node18	Node17	12.12	11.01	424.4	0.262	0.0110	2.50	1.88	0.62	24.79	15.99	22.93	14.79
Link23	Node19	Node18	13.46	12.47	427.0	0.232	0.0110	2.50	1.88	0.62	23.34	15.06	21.94	14.15
Link22	Node20	Node19	14.67	13.73	394.3	0.238	0.0110	2.50	1.86	0.64	23.67	15.27	21.93	14.15
Link21	Node21	Node20	15.85	14.84	376.3	0.268	0.0110	2.50	1.70	0.80	25.11	16.20	20.16	13.01
Link20	Node22	Node21	16.83	15.94	253.2	0.351	0.0110	2.50	1.61	0.89	28.74	18.54	20.60	13.29
Link19	Node23	Node22	17.51	16.97	221.8	0.243	0.0110	2.50	1.70	0.80	23.92	15.43	20.15	13.00
Link18	Node24	Node23	18.26	17.70	281.2	0.199	0.0110	2.50	1.79	0.71	21.63	13.95	19.98	12.89
27-inch Onsite Trunk Sewer														
Link17	Node25	Node24	19.21	18.28	276.0	0.337	0.0110	2.25	1.77	0.48	21.25	13.71	19.93	12.86
Link16	Node26	Node25	19.90	19.33	197.5	0.289	0.0110	2.25	1.77	0.48	19.66	12.68	19.93	12.86
Link15	Node27	Node26	21.09	20.10	402.0	0.246	0.0110	2.25	1.93	0.33	18.16	11.72	19.94	12.86
Link14	Node28	Node27	21.93	21.14	209.5	0.377	0.0110	2.25	1.88	0.38	22.48	14.50	20.69	13.35
Link13	Node29	Node28	22.60	22.08	140.0	0.371	0.0110	2.25	1.67	0.58	22.31	14.39	20.22	13.05
Link12	Node29A	Node29	23.29	22.57	39.5	1.823	0.0110	2.25	1.70	0.55	49.42	31.88	20.00	12.90
Link11	Node30	Node29A	24.30	23.34	295.0	0.326	0.0110	2.25	1.75	0.60	20.88	13.47	19.97	12.88
Link10	Node31	Node30	24.89	24.41	173.0	0.277	0.0110	2.25	1.78	0.47	19.28	12.44	19.88	12.83
Link9	Node31A	Node31	25.45	25.02	133.0	0.323	0.0110	2.25	1.70	0.55	20.81	13.43	19.64	12.67
Link8	Node32	Node31A	26.28	25.56	237.5	0.303	0.0110	2.25	1.76	0.50	20.15	13.00	19.68	12.70
Link44	Node33	Node32	27.23	26.37	300.5	0.286	0.0110	2.25	1.82	0.43	19.58	12.63	19.61	12.65
Link43	Node34	Node33	28.74	28.20	118.0	0.458	0.0110	2.25	1.62	0.64	24.78	15.97	19.30	12.45
ONSITE PUMP STATION														
24-inch Onsite Trunk Sewer														
Link47	Node2	LS	13.87	13.38	151.9	0.323	0.0110	2.00	1.69	0.31	15.19	9.80	17.09	11.03
Link46	Node3	Node2	14.44	13.97	124.2	0.376	0.0110	2.00	1.65	0.35	16.44	10.61	17.09	11.03
Link38	Node4	Node3	15.05	14.54	155.8	0.327	0.0110	2.00	1.70	0.30	15.30	9.87	17.09	11.03
Link37	Node5	Node4	15.96	15.15	244.4	0.331	0.0110	2.00	1.70	0.30	15.39	9.93	16.29	10.51
Link42	Node6	Node5	16.82	16.06	230.3	0.330	0.0110	2.00	1.70	0.31	15.36	9.91	16.29	10.51
Link34	Node7	Node6	17.40	16.92	144.0	0.333	0.0110	2.00	1.67	0.33	15.44	9.96	16.29	10.51
Link33	Node7A	Node7	17.98	17.50	148.9	0.327	0.0110	2.00	1.66	0.34	15.28	9.86	16.29	10.51
Link32	Node8	Node7A	18.72	18.08	195.0	0.328	0.0110	2.00	1.68	0.33	15.32	9.88	16.29	10.51
Link31	Node9	Node8	19.61	18.82	237.0	0.333	0.0110	2.00	1.68	0.32	15.44	9.96	16.29	10.51
Link30	Node9A	Node9	20.06	19.71	107.8	0.325	0.0110	2.00	1.68	0.34	15.23	9.83	16.29	10.51
Link29	Node10	Node9A	20.83	20.16	203.4	0.329	0.0110	2.00	1.67	0.33	15.34	9.90	16.29	10.51
Link28	Node11	Node10	21.75	20.93	246.4	0.333	0.0110	2.00	1.69	0.31	15.42	9.95	16.29	10.51
Link27	Node12	Node11	22.54	21.85	210.1	0.328	0.0110	2.00	1.69	0.31	15.32	9.88	16.29	10.51
Link26	Node13	Node12	23.48	22.64	254.2	0.331	0.0110	2.00	1.70	0.30	15.37	9.92	16.29	10.51
Link25	Node14	Node13	24.41	23.58	251.8	0.330	0.0110	2.00	1.62	0.38	15.35	9.90	15.22	9.82
Link24	Node15	Node14	27.88	24.66	379.2	0.849	0.0110	2.00	1.37	0.63	24.84	15.90	15.62	10.08
Link45	Node16	Node15	28.57	27.98	14.3	4.123	0.0110	2.00	1.08	0.92	37.49	24.19	6.22	4.01



457,673 sf ground open space
456,600 sf roof top open space

GROUND required 15% open space Current: 457,673 / 3,008,670 = 15%
OVERALL required 30% open space Current: 914,273 / 3,008,689 = 30%

POTOMAC VILLAGE ALEXANDRIA, VIRGINIA

Scale: 1" = 80'-0"

Master Plan Scheme IX_C Open Space Diagram

May 14, 2010

Potomac Village

Master Utility
(Storm, Sanitary & Water)
Concept Plan

Supplemental Data/Revised
Executive Summaries

Submitted as part of the
Concept Design Plan for CDD # 19

Prepared by

christopher consultants
engineering · surveying · land planning

ANTUNOVICH ASSOCIATES

Wetland Studies and Solutions, Inc.

BAXTER & WOODMAN
Consulting Engineers

Prepared for

McCAFFERY Interests

January 25, 2010
Revised: February 11, 2010

ccl Project # 8824F6.00

Potomac Village

Storm Water Executive Summary

In preparation for the redevelopment of the existing Potomac Yard Retail Center to a mixed-use development referred to as Potomac Village, christopher consultants, ltd. (ccl), Wetland Studies and Solutions, Inc (WSSI) and Antunovich Associates (AA) have worked with City staff to establish a conceptual storm water master plan. The purpose of the plan is to outline how the redevelopment of the site will not only comply with the City of Alexandria's current Chesapeake Bay Act, but exceed the published performance standards. In order to accomplish this goal the conceptual storm water master plan was developed using the methodologies and calculations proposed in the December 2009 Virginia Department of Conservation and Recreation (DCR) draft storm water regulations. The City staff has asked that the redevelopment of this site exceed these newly published performance standards. This executive summary and backup material will show how the property owner plans to accomplish these lofty goals and to what levels.

The storm water master plan proposes to use several methodologies to treat the storm water quality for the site. Subject to final engineering and planning, all or some of these systems will be implemented to meet the proposed performance specifications described below. The systems can include but may not be limited to the following:

1. Design of an open space amenity at the north end of the site adjacent to Four Mile Run (Crescent Park) that includes a storm water feature. The storm water feature will be a wet pond and will be designed as a Level I or II wet pond in accordance with the draft DCR standards. The facility is proposed to treat approximately 2/3 of the sites storm water runoff.
2. The remainder of the site does not drain to the proposed facility described in 1. Above. Therefore the storm water will be treated with a variety of LID/IMP systems that are both modern and conventional as outlined below and detailed in the backup provided to the City in previous submissions. In general the development will incorporate green roofs, pervious pavements and rooftops, water reuse for irrigation and the occasional bioretention facility should it be needed and site constraints allow.
3. All buildings on this site will be designed with "green roofs". 50% of each building roof will be impervious and the remaining 50% will be pervious. 25% of the pervious area will be green and 25% will be pervious surfaces like pavers or brick (see calculations by WSSI and graphics/narrative provided by AA).
4. Rainwater harvesting systems for irrigation are being considered on a block by block basis. Storm water from the 50% impervious roof tops may be used for irrigation purposes to the extent it is needed.
5. Porous pavement systems with under drains will be used for the on-street public parking spaces subject to site constraints. As well, the porous systems will be used on some rooftops and plazas as feasible.
6. Rain Gardens will be used in the open spaces as needed. It is possible that the "green" areas of the public right of ways will also be used for some form of treatment system.

Implementing the systems described above, Performance Specifications for the project have been established. The Performance Specifications focus on three areas of stormwater: Nutrient Loading; Rain Water Harvesting and Reuse; and Total Runoff Volume Reduction.

1. Nutrient Loading: In accordance with the City of Alexandria's Zoning Ordinance (Article XIII, Section 13-1036-S) the proposed activities on this site are considered "redevelopment". The

existing site generates approximately 1.70 lb/ac/yr of Total Phosphorous (TP) assuming no existing BMPs. With the existing BMPs, the site generates 1.13 lb/ac/yr. The current CBA requires that the site achieve a 10% reduction in TP after it is redeveloped. The proposed DCR storm water regulations require that the site achieve a 20% reduction in Total Phosphorus (TP) from pre-developed conditions. Using the current regulations the site needs to reduce the TP to approximately 1.0 lb/ac/yr. The proposed DCR regulations will require that the TP be reduced from approximately 1.13 lb/ac/yr to approximately 0.90 lb/ac/yr. The owner has agreed to the above site strategies that will produce an overall post-development TP load equal to 0.65 lb/ac/yr which is a **42% reduction** from existing conditions. When development occurs, the loading calculations will be provided on a block-by-block basis. The 2/3 of the site that will be served by the Level II wet pond will maintain a TP less than or equal to 0.60 lb/ac/yr (unless the Level I option is selected) and the remaining portion of the site not served by the wet pond will maintain a TP load less than or equal to 0.80 lb/ac/yr. If the city desires a Level I pond, the overall TP load will increase and the performance standard will increase to something higher than the 0.65 lb/ac/yr currently proposed by the owner.

It is anticipated the construction of this site will occur over many years in order to reach full build out. This will have an impact on the ultimate function of the wet pond. During construction, the wet pond will act as a sediment basin to control erosion and sediment runoff and will not effectively serve as a BMP facility until construction is finished and the site is stabilized. Therefore, those areas served by the wet pond will require a TP loading equal to the loading (0.80lb/ac/yr) required by the areas not served by the wet pond until such time as the wet pond is converted into the permanent BMP facility.

2. Rain Water Harvesting and Reuse: The project will strive to re-use no less than 15% of the total annual runoff volume from the impervious areas of each building for irrigation of street-level and/or green roof landscaping.

3. Total Runoff Volume Reduction: The project will strive to reuse, evapotranspirate, or infiltrate a minimum of 30% of the total volume generated onsite by 1" of rainfall and will be calculated on a block-by-block basis.

We have included the WSSI calculations for a variety of scenarios as requested by the City. You will see that the TP loading could be reduced to approximately 0.53 lb/ac/yr utilizing the systems outlined by the owner above. We have recommended to the owner that we target 0.65 lb/ac/yr as the target goal. This well exceeds current and proposed regulations for a redevelopment site. The reason for this is that site conditions may minimize our ability to implement all of the systems described across the site uniformly. The site constraints include possible perched ground water, high and or variable ground water, environmental constraints and inadequate permeability of existing soils. In addition, the December 2009 DCR standards have established performance standards for the systems proposed. The owner does NOT have control over those standards and they could be modified making it infeasible for this project to realize the additional reductions.

There is an existing wet pond at the southeast corner of the site. This pond was planned to be expanded and upgraded to be an open space amenity in Landbay "K" by the adjoining property owner, Potomac Yard Development. The expansion of the pond was intended to serve Landbay "G", portions of Landbay H and a portion of Potomac Yard Center (now Potomac Village) so that it can meet the current BMP requirements. With the relocation of the planned Metro Station Bridge/entrance and Potomac Avenue, **In order to accommodate the density at the proposed Metro station**, this facility may be eliminated and replaced. To account for the elimination of the pond, this plan proposes a unique solution. The concept is to divert the first ½ inch of runoff from Landbay G into an underground storage vault. Once this vault is full, the larger storm events will be diverted into the existing large diameter storm water conveyance system which drains to Four Mile Run. We will then have designed into the storage tank, a pumping system (with backup generator) to elevate the storm water to the linear park adjacent to the railroad corridor. This water will flow in an underground drainage system, vegetated or hardscaped swale to a series of treatment systems. These systems will be made of a variety of IMP's as outlined in document A but most likely an underground treatment system to meet the same performance standards as existed prior to the elimination of the wet pond and using the current CBA regulations. The possible systems can include a vegetated swale, a cartridge treatment system, tree wells, rain gardens or sand filters within Potomac Avenue or the new Park to treat the water. The timing of Metro construction and the relocation of Potomac Avenue will dictate the timing of construction of this system. Current phasing schemes have Potomac Avenue being constructed in Phase I. At this time, the vault and treatment systems will be designed and installed. Appropriate upstream sediment control features will be needed in order to protect these systems until the site is stabilized.

AA has provided backup which evaluates the size of the open space in Crescent Park. AA provided plans that show the pond in two locations. The first (shown with the previous submissions) has the pond completely outside of the RPA. The second scenario which is new shows an approximate encroachment of 50 feet into the RPA. The first scenario adequately represents what a 10-15 foot encroachment into the RPA might look like. The increase in usable open space adjacent to the residential buildings between the two scenarios is only a few thousand square feet. The City will need to coordinate a response on which scenario should be considered as we move forward with this project but both scenarios work from a technical aspect.

Wetland Studies and Solutions, Inc.

MEMORANDUM

To: Bill Zink (via e-mail: billzink@ccl-eng.com)

From: Jennifer Brophy-Price

Date: February 8, 2010

Re: Potomac Village Stormwater Concepts
Stormwater Calculations and Specifications
WSSI #21812.01

Cc: Mike Rolband, WSSI (via e-mail: mrolband@wetlandstudies.com)
Morgan Ziegenhein, McCaffery Interests
(via e-mail: mziegenhein@mccafferyinterests.com)

Pursuant to our telephone conversation on January 27, 2010, this memo provides further details about WSSI's stormwater calculations for the Potomac Village project, specifically regarding:

- An analysis of the existing site conditions using the Virginia Runoff Reduction Methodology (VRRM) worksheets;
- WSSI's VRRM results for each of the scenarios simulated;
- Green roof specifications; and
- "Pervious" roof specifications.

Existing Site Conditions
WSSI's original estimate of the existing site's TP loading (1.70 lb/ac/yr) was based on site imperviousness (i.e, post-development/pre-BMP) and did not account for existing site BMPs. Per your request, WSSI has modeled the existing development using the VRRM spreadsheets using existing BMP data supplied by christopher consultants, ltd[1]. The existing total phosphorus (TP) loading is 1.13 lb/ac/yr. (See Appendix A.) Therefore, this project's proposed TP loading rate of 0.65 lb/ac/yr is a 42% TP reduction beyond existing conditions.

Article XIII, Section 13-1036(S), of the Zoning Ordinance of the City of Alexandria (the "City"), codified through Ordinance No. 4609, adopted June 23, 2009, defines redevelopment as, "the process of developing land that is or has been previously developed." This definition applies to the Project site; therefore, the proposed DCR stormwater regulations[2] require that the site achieve a 20% reduction in Total Phosphorus (TP) from the previous development (from approximately 1.13 lb/ac/yr to approximately 0.90 lb/ac/yr), vs. a 10% reduction under the current regulations.

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[1] christopher consultants, ltd, the original designer of the Potomac Yard Center project, supplied WSSI with electronic copies of the approved Potomac Yard Center stormwater BMP plans and calculations (Sheets 60-68 of 78) for this analysis.
[2] See discussion in WSSI's memo dated October 27, 2009

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Proposed Site Conditions
WSSI has provided six (6) 24x36" sheets showing our Virginia Runoff Reduction Methodology results for the referenced site, as well as a table detailing the stormwater management steps used for each scenario. (See Appendix B.) Based on the scenarios, which involve the development of a "typical" block (see Appendix B), a TP loading rate of 0.45 lb/ac/yr is only achievable with both enhanced rainwater harvesting[3] and the proposed Level II wet pond. Similarly, a volume reduction greater than 33% requires the use of enhanced rainwater harvesting. See the following scenario results:

- Scenario 1. With rainwater harvesting (from 50% of each roof as proposed) for irrigation only and with a Level I wet pond, the loading rate achieved is 0.77 lb/ac/yr, and the volume reduction is 33%.
- Scenario 2. With rainwater harvesting (from 50% of each roof as proposed) for irrigation only and with the proposed Level II wet pond, the loading rate achieved is 0.53 lb/ac/yr, and the volume reduction is 33%.
- Scenario 3. With enhanced rainwater harvesting (from 50% of each roof as proposed) and with a Level I wet pond, the loading rate is 0.54 lb/ac/yr, and the volume reduction is 52%.
- Scenario 4. With enhanced rainwater harvesting (from 50% of each roof as proposed) and with the proposed Level II wet pond, the loading rate is 0.36 lb/ac/yr, and the volume reduction is 52%.
- Scenario 5. With enhanced rainwater harvesting (from 100% of each roof) and with a Level I wet pond, the loading rate is 0.47 lb/ac/yr, and the volume reduction is 57%.
- Scenario 6. With enhanced rainwater harvesting (from 100% of each roof) and with the proposed Level II wet pond, the loading rate is 0.31 lb/ac/yr, and the volume reduction is 57%.

Please note that all of the modeled TP loadings are less than the proposed DCR requirements for redevelopment. The Potomac Village project commits to a TP loading rate less than or equal to 0.65 lb/ac/yr (rather than the 0.53 lb/ac/yr achieved above) based on the current versions of the VRRM spreadsheets and BMP guidelines[4] to ensure that the rate can be met in the event that some blocks are less conducive to LID features than the "typical" block (i.e., smaller roof-to-road ratio) or other unforeseen circumstances (i.e., insufficient depth to groundwater, which would preclude the use of pervious pavements nearby or heavy in-situ soils which would not allow the site to design Level II permeable pavements[5]).

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[3] i.e., allowing interior uses (such as toilets and laundry) for harvested rainwater.

[4] VRRM Spreadsheets Revision 12/7/09; Vegetated Roof specification Version 2.0 (September 30, 2009); Rainwater Harvesting specification Version 1.6 (September 30, 2009); Cistern Design Spreadsheet Version 1.0; and Permeable Pavement specification Version 1.6 (September 30, 2009).

[5] Level II permeable pavements require an infiltration rate of 0.5 in/hr. In the scenarios herein, WSSI modeled some of the permeable pavements on the site as Level I and some as Level II.

The Potomac Village project also commits to reducing 30% of the site's stormwater volume. This will be achieved through the use of green roofs, permeable pavements, and rainwater harvesting for irrigation.

Irrigation Specifications.
Irrigation for Potomac Village is calculated to receive 20% runoff reduction credit (using the Virginia Rainwater Harvesting Spreadsheet). WSSI assumed a harvested area of 1.15 ac/block (one-half of the "typical" roof) and an irrigated area of 6,000 s.f. per block (which may include green roof or street-level turf). Larger areas of irrigation will result in a higher reuse percentage, as long as the cistern is sized accordingly.

Green Roof Specifications and Benefits
Based on the VRRM, green roofs (Level II) receive 60% runoff reduction credit and 0% nutrient reduction credit. WSSI modeled all of this project's green roofs as Level II green roofs under the assumption that the architect will meet the Virginia BMP Clearinghouse Level II Green Roof specifications[6] and the additional specification that the each green roof be designed with at least a 6" depth of soil media.

To qualify as Level II, each roof must:

- Have a media depth of at least 4";
- Have a 2" stone drainage layer (as opposed to drainage mats);
- Have no more than 10% organic matter in the soil media; and
- Be in conformance to ASTM (2005) International Green Roof Standards[7].

Level II green roofs provide treatment for 1.1" of rainfall. The treatment volume calculation is:

- Tv = (1.1") (Rv) (A) / 12
  Where:
  Rv = the runoff coefficient for a conventional roof (typically 0.95)
  A = roof area

Pervious Roof Specifications
To receive VRRM credit as modeled, non-green, "pervious" rooftops must be covered in pervious pavers (i.e., pavers with either gaps or interconnected voids) underlain by at least 6" of green roof soil media or gravel. Non-green, "pervious" rooftops were modeled as Level I pervious pavements because they will work in a similar manner. Please note that "pervious" rooftops consisting of pavers with void space underneath will not filter the rainwater in the same manner as pavers underlain with soil; any such roofs would need to be modeled in a different manner[8].

[6] Available online at the Virginia Stormwater BMP Clearinghouse: http://www.vwrrc.vt.edu/swc/
[7] Available at http://www.astm.org
[8] Such a rooftop would likely be modeled as Level I extended detention, which receives no runoff reduction credit and 15% TP removal credit under the VRRM guidelines.

Appendix A

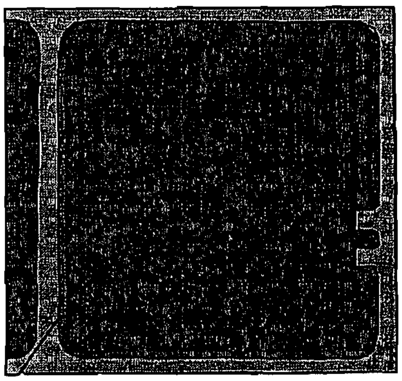
Results of Virginia Runoff Reduction Method (VRRM) Modeling
Existing Site Conditions

Appendix B

Results of Virginia Runoff Reduction Method (VRRM) Modeling
Proposed Site Conditions Scenarios

Parameters of the Virginia Runoff Reduction Method (VRRM) Modeling

WSSI modeled several combinations of BMPs using a "typical block" as a base with the assumption that results can be extrapolated to the Potomac Village site as a whole.



Typical Block
Total area = 4.02 ac.
Total roof area = 2.30 ac.
Harvested roof area = 1.15 ac.
Irrigated area (assumed) = 0.14 ac.

Note: Roof delineations in this graphic are for the sole purpose of illustrating the percentage of rooftops assumed to be harvested in the VRRM model and do not indicate or illustrate the actual layout of any roof.

The results on the following page show the TP load and volume reduction for each of the scenarios. WSSI used combinations of the following BMPs (and design parameters for each) to define the scenarios:

- Rainwater harvesting:
  1. 50% of roof surface, for irrigation only
  2. 50% of roof surface, for irrigation and interior uses (i.e., "enhanced rainwater harvesting")
  3. 100% of roof surface, for irrigation and interior uses
- Wet pond:
  1. Level I
  2. Level II
- Green roof:
  1. 25% of roof surface
  2. 50% of roof surface
- Pervious roof:
  1. 25% of roof surface
  2. 50% of roof surface
- Pervious pavement:
  1. 100% of parking areas

Results of the Virginia Runoff Reduction Method (VRRM) Modeling

The scenarios modeled by WSSI achieved a TP loading between 0.31 and 0.77 lb/ac/yr and a runoff volume reduction between 33% and 57%. In order to achieve a loading of 0.45 lb/ac/yr, both enhanced rainwater harvesting and a Level II wet pond must be employed in the design.

Appendix B: Results of Virginia Runoff Reduction Method (VRRM) Modeling

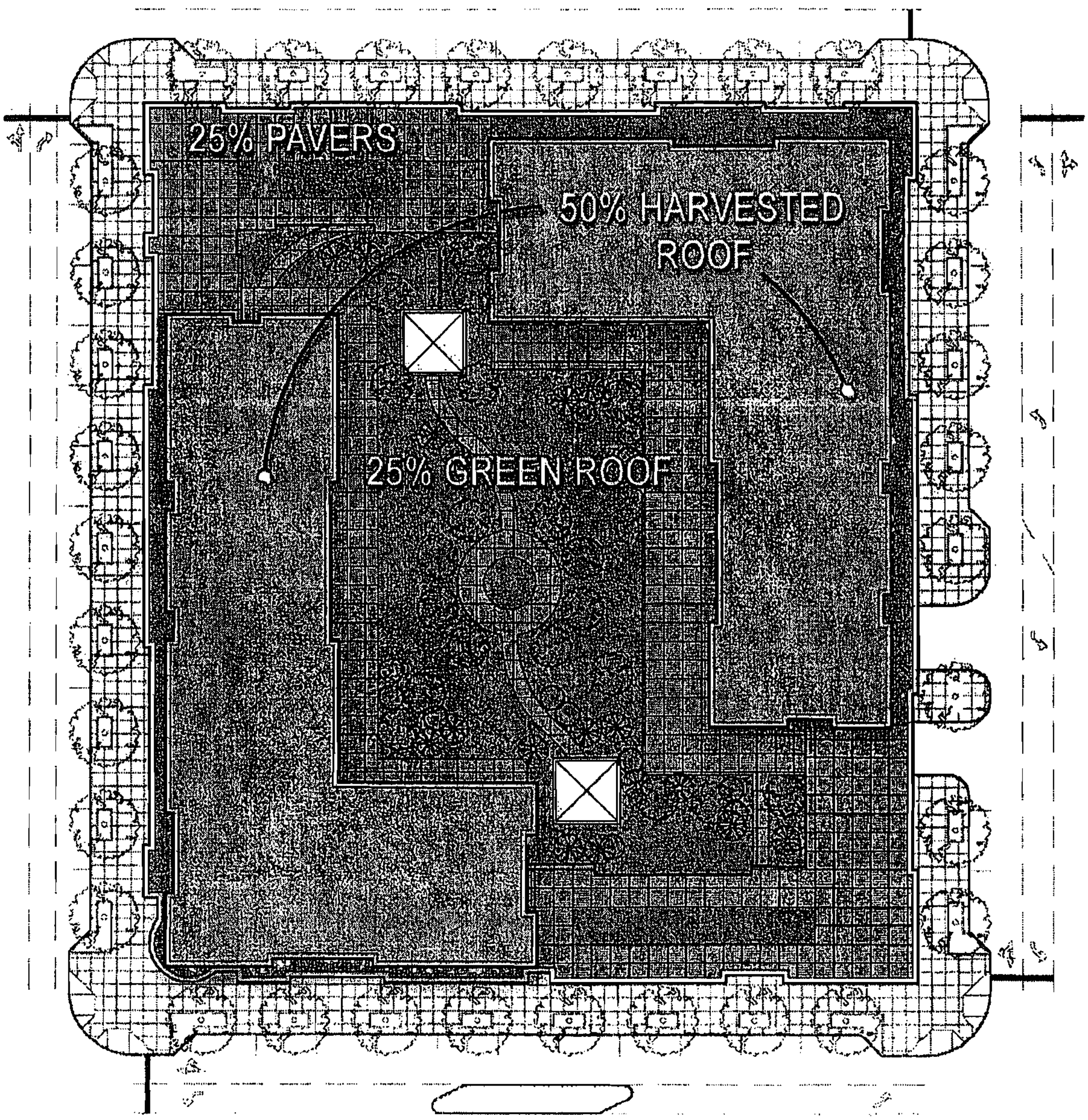
Scenario (Note 1)	Design Parameters					Results (Note 5)	
	Rainwater harvesting (Note 2)	Wet pond	Green roof (Note 3)	"Pervious" roof (Note 4)	Pervious pavement	TP load (lb/ac/yr)	Volume reduction (%)
1	For irrigation only, from 50% of roof surface (note 6), assuming 20% reuse efficiency	Level I	25% of roof surface	25% of roof surface	100% of parking areas	0.77	33%
2	For irrigation only, from 50% of roof surface (note 6), assuming 20% reuse efficiency	Level II	25% of roof surface	25% of roof surface	100% of parking areas	0.53	33%
3	For irrigation and interior uses, from 50% of roof surface (note 6), assuming 80% reuse efficiency	Level I	25% of roof surface	25% of roof surface	100% of parking areas	0.54	52%
4	For irrigation and interior uses, from 50% of roof surface (note 6), assuming 80% reuse efficiency	Level II	25% of roof surface	25% of roof surface	100% of parking areas	0.36	52%
5	For irrigation and interior uses, from 100% of roof surface, assuming 80% reuse efficiency	Level I	25% of roof surface	25% of roof surface	100% of parking areas	0.47	57%
6	For irrigation and interior uses, from 100% of roof surface, assuming 80% reuse efficiency	Level II	25% of roof surface	25% of roof surface	100% of parking areas	0.31	57%

Notes:
1. These scenarios are separate from those presented in WSSI's *November 11, 2009, memo.*
2. Rainwater harvesting reuse efficiency will be determined by the final design of the system (including storage tank size and allowed uses).
3. These calculations assume that green roofs will be designed to Level II standards and will incorporate at least 6" of soil media into the design.
4. "Pervious" roof is rooftop covered in pervious pavers and at least 6" of soil media which is not planted. For these calculations, "pervious" roof has been modeled as pervious pavement.
5. Results were obtained from the Virginia Runoff Reduction Method (VRRM) Worksheet (revision 9/30/2009) using the Design Parameters listed herein for each scenario.
6. "50% of roof surface" indicates the non-pervious, non-green portion of the roof.

The Potomac Village project commits to a loading rate less than or equal to 0.65 lb/ac/yr and a volume reduction of 30%, which can be achieved with a Level II wet pond, rainwater harvesting for irrigation, 25% green roof, 25% pervious roof, and 100% pervious pavements on parking areas and plazas.

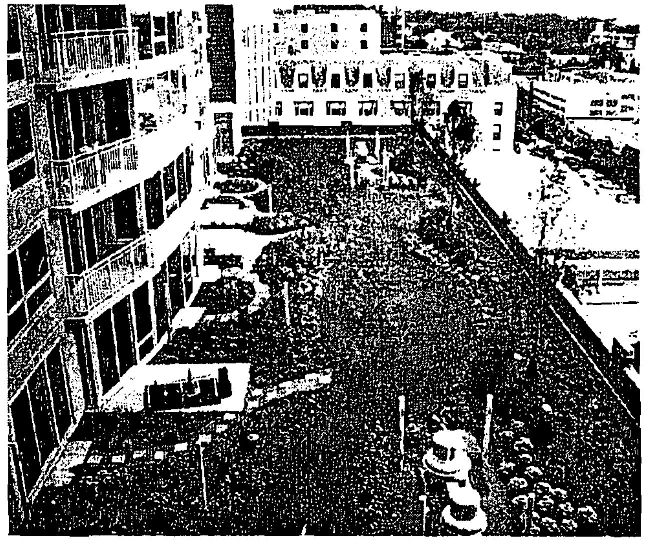
Potomac Village Typical Block Roof Breakdown (BLOCK 10 EXAMPLE)

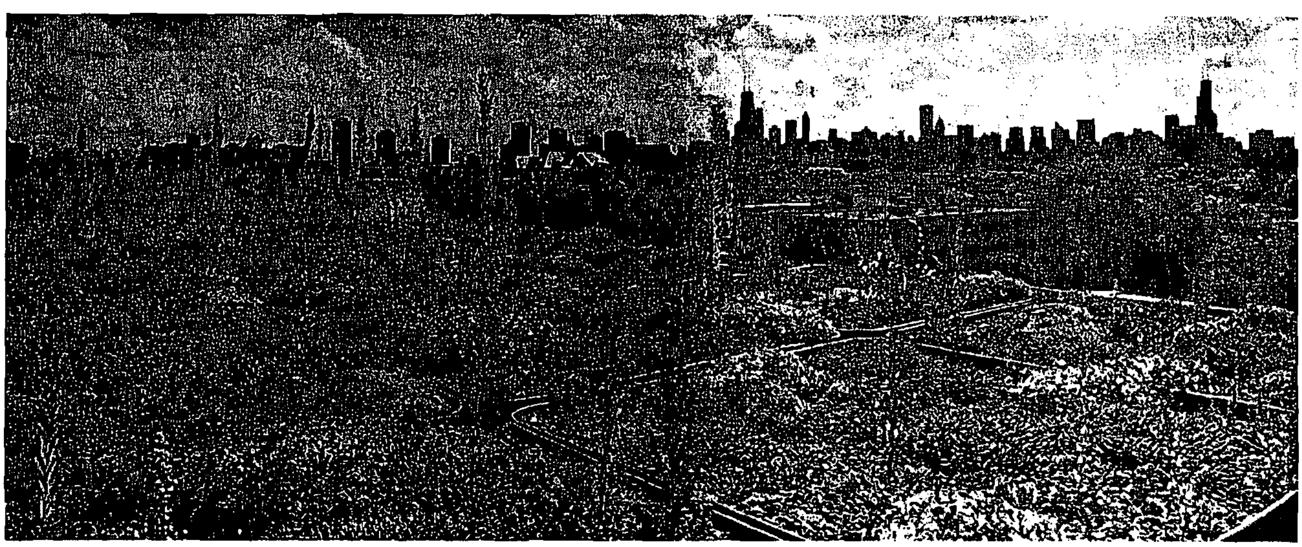
The roof areas of a typical block within Potomac VIllage will be planned consistent with the guidelines outlined in the diagram below (proposed block 10). Approximately 50% of a block's roof area is comprised of an impervious roofing system that will allow, if needed, for water harvesting that can be stored and re-used for the irrigation of site landscaping. Approximately 25% of our roof area is comprised of a "green roof" that is fully vegetated with a minimum of 6" of soil media. Approximately 25% of our roof area is comprised of "permeable pavers" integrated with the "green roof".



Green Roof

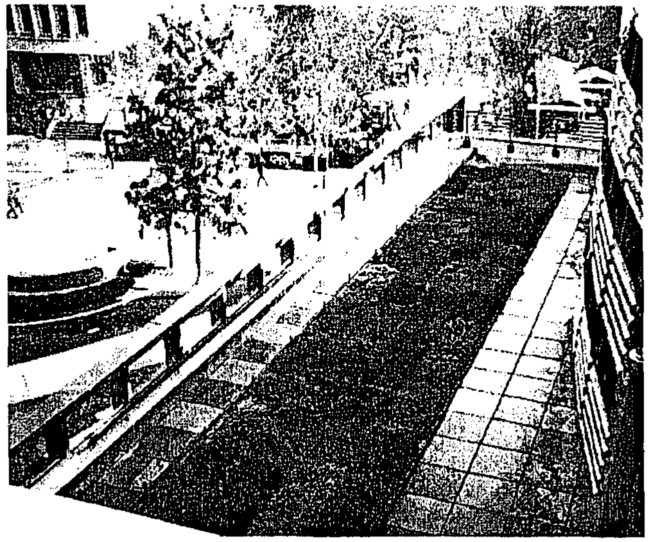
A Green Roof is wholly or partially covered in vegetation, offering the building several benefits. The layer of vegetation provides the building with better insulation, reducing energy costs. It absorbs rainwater, lowering the production of waste water and minimizing the need for complex water drainage systems. The green roof improves air quality by reducing heat reflection, and can provide the building's users with a peaceful retreat. The green roof proposed for Potomac Village is fully vegetated and contains a minimum of 6" of soil.

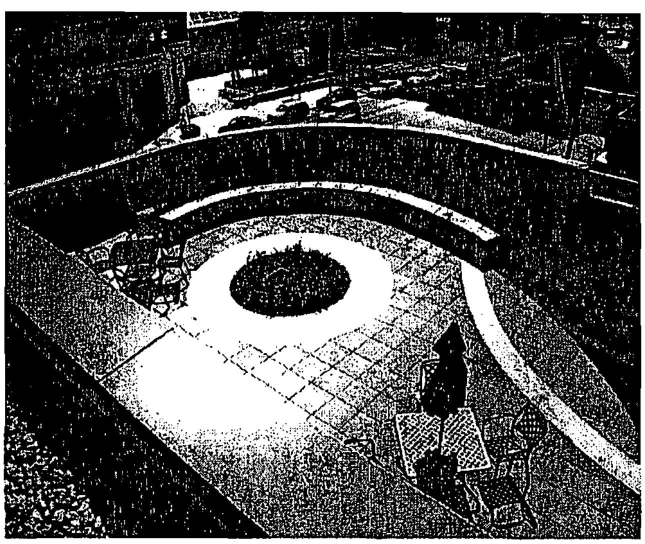




Pervious Pavers

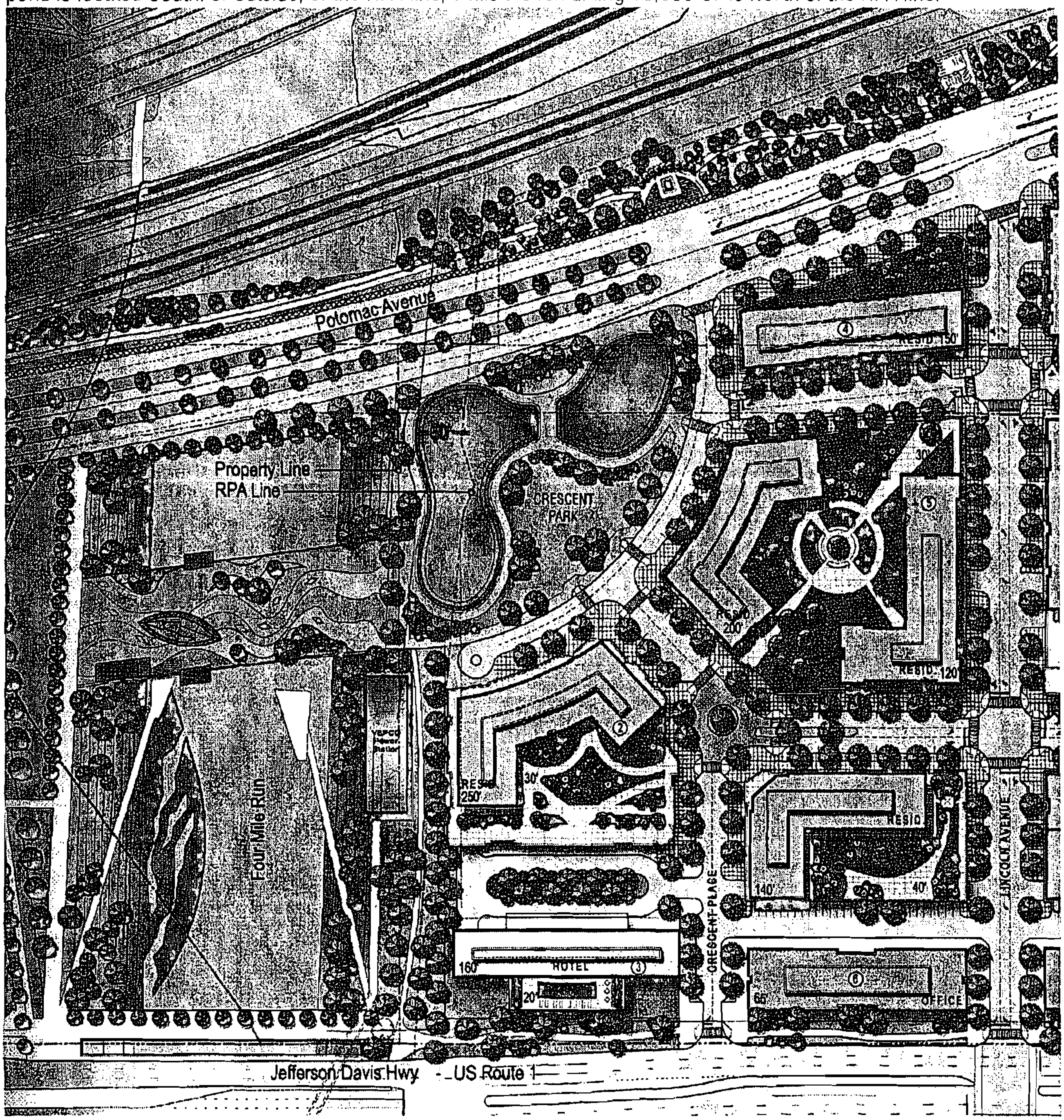
Pervious Pavers create a breathable paved walking surface that allows for the free movement of water. On an elevated deck this paving system is composed of sub-surface layers that filter the water as it drains through first the paver surface, and successive underlying levels of gravel and sand. The remaining water runoff is free of the usual contaminants, and promotes the healthy growth of surrounding areas of green roof. It also helps treat and absorb storm water runoff before it enters the City's natural waterways. Pervious Pavers are easy to maintain and repair, and can, if desired, be made of recycled materials.





Crescent Park-February 1st, 2010

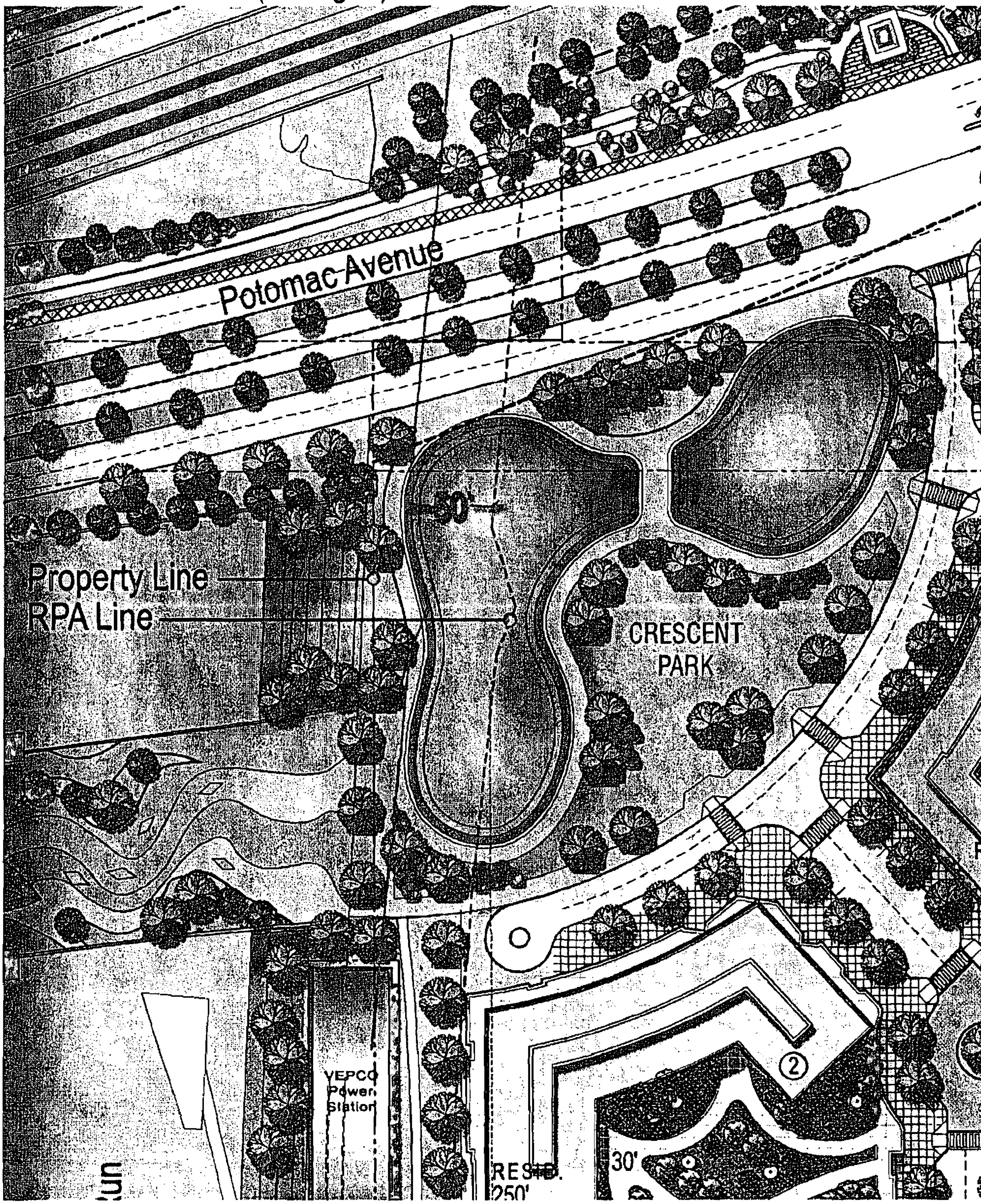
Crescent Park as illustrated, is comprised of a site area of approximately 100,000 SF, of which 76,000 SF is outside the RPA boundary. Shifting the retention pond North, within the RPA line, opens up usable open space closer to the proposed residential district, and away from Potomac Avenue. Of the 100,000 SF park area, the pond occupies 45,000 SF, leaving 55,000 SF for open space. 47,000 SF of open space is located between the RPA line and the southern boundary of Crescent Park. 8,000 SF is located between the RPA line and the northern property line. 29,000 SF of the pond is located South, or outside, of the RPA line, while the remaining 16,000 SF is North of the RPA line.



Potomac Village, Alexandria, VA

N Crescent Park

Crescent Park (enlarged)

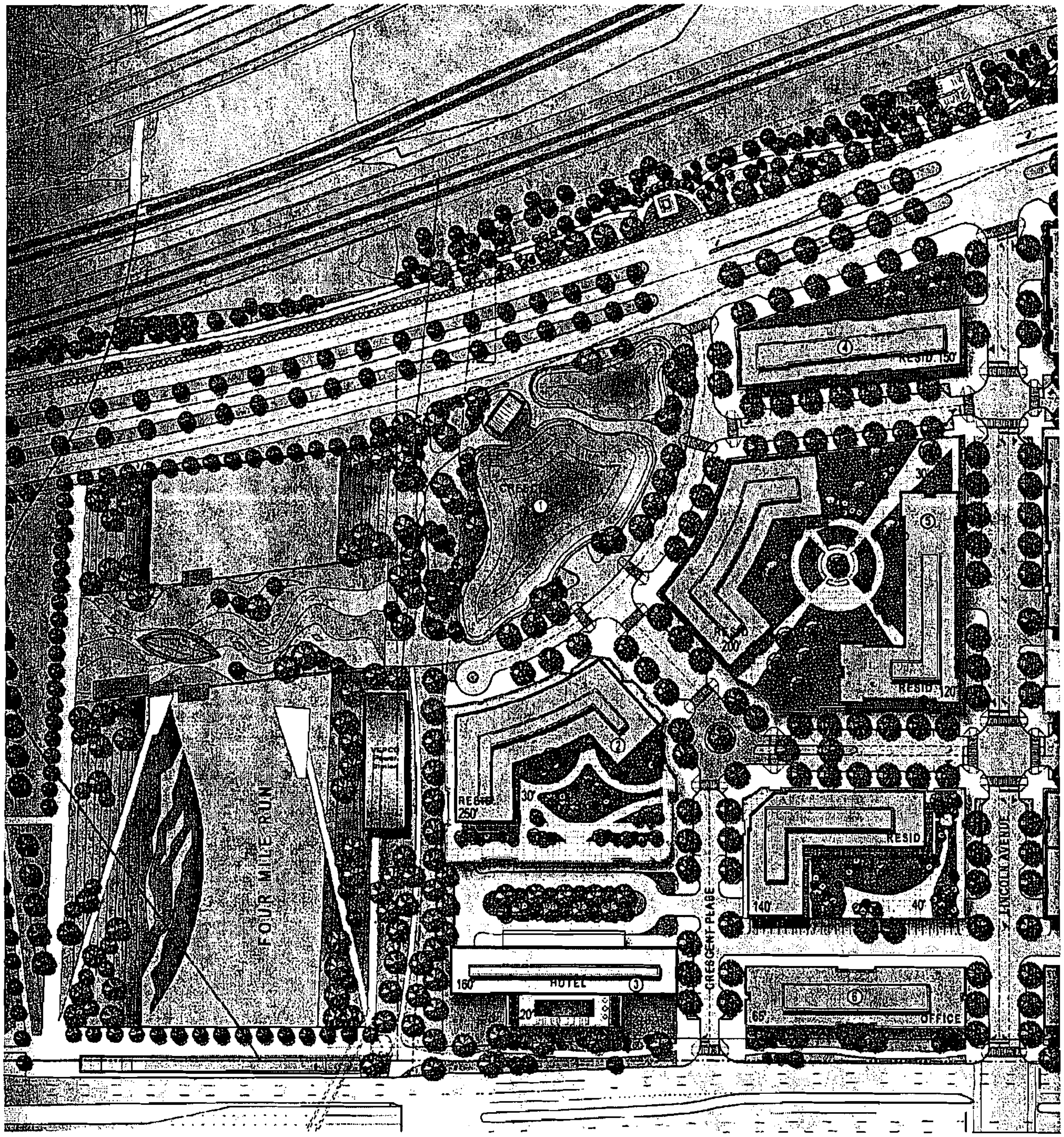


Potomac Village, Alexandria, VA

N Crescent Park

Crescent Park-November 25th, 2009

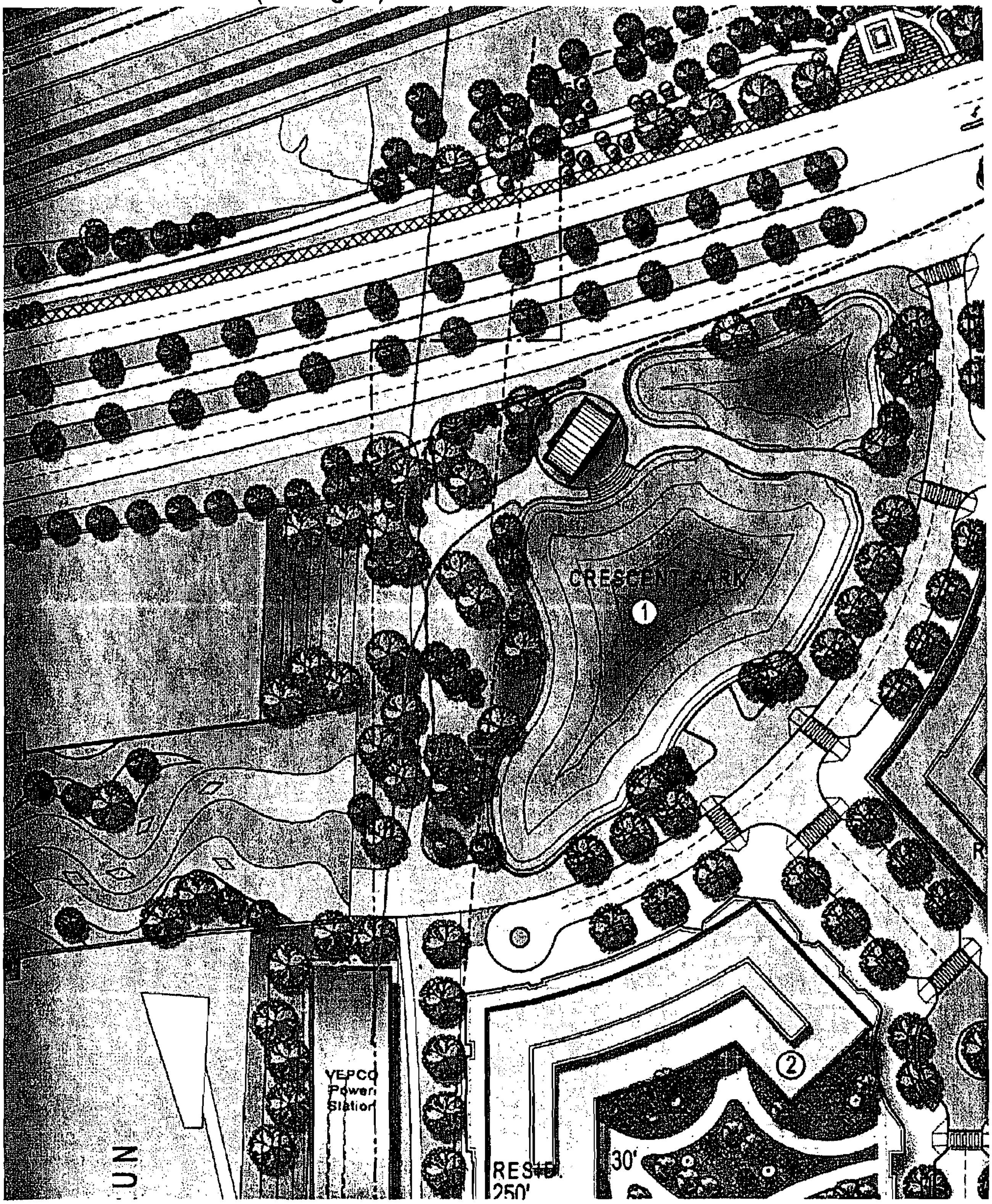
Crescent Park as illustrated, is comprised of a site area of approximately 100,000 SF, of which 76,000 SF is outside the RPA boundary. Of the 100,000 SF park area, the pond occupies 45,000 SF, leaving 55,000 SF for open space. 31,000 SF of open space is located between the RPA line and the southern boundary of Crescent Park. 24,000 SF of open space is located between the RPA line and the northern property line. 45,000 SF of the pond is located South, or outside, the RPA line.



Potomac Village, Alexandria, VA

N Crescent Park

Crescent Park (enlarged)



Potomac Village, Alexandria, VA

N Crescent Park

Potomac Village

Sanitary Sewer Executive Summary

In preparation for the redevelopment of the existing Potomac Yard Retail Center to a mixed-use development referred to as Potomac Village, an analysis of the existing and future sanitary sewer conveyance systems was performed to confirm that these sewers could convey the waste water generated from the proposed development program to the Alexandria Sanitation Authority (ASA) Waste Water Treatment Plant (WWTP). As part of this exercise, several models were created to analyze the existing sanitary system which consists of a 24" diameter PVC pipe, a 27" diameter PVC pipe, an existing pump station and a 30" diameter Centrifugally Cast Fiberglass Pipe (CCFP). The 24" and 27" conveyance systems and pump station are located south of the Potomac Village Site on Potomac Yard and the 30" conveyance system is located offsite within dedicated easements or in the public right-of-way.

In coordination with the City of Alexandria, the base line for the analysis included very conservative models that anticipated flows from Potomac Village, Potomac Yard, Potomac Greens, existing development parcels between the site and the WWTP, separation needs for the City's CSOs, and future development parcels such as Jack Taylor/Hertz, Oakville Triangle which are west of Route 1, Braddock Fields and the Braddock Metro Neighborhood Plan. In addition, it was determined that the future development sites and Potomac Village be analyzed using low flow plumbing fixtures and the remaining sites be analyzed with standard plumbing fixtures. Low flow fixtures offer a reduction in water usage and are commonly associated with the Leadership in Energy and Environmental Design (LEED) program. Water savings in excess of 35% can be achieved by using low flow fixtures in accordance with manufacturer specifications. The analysis utilized a conservative estimate 35% below the City's recommended average design flows for all future development parcels and standard average design flows for the remaining parcels. The analysis also took into account "n" values for the pipe's material ranging from 0.0105 to 0.011 with 0.011 being the worst case. We have agreed to use the 0.011 for all final computations. All modeling has been performed by Baxter and Woodman (BW).

The initial analysis performed use an "n" value of 0.011, assume the City's CSO would connect to the 30" conveyance system at shaft 8 and low flow fixtures for Potomac Village and all future development parcels. This analysis showed that the sanitary conveyance systems mentioned above have the capacity to convey all sewerage flows to the WWTP. The 24" and 27" sanitary conveyance systems experienced no surcharging. The 30" sanitary conveyance system experienced minimum surcharging as previously submitted to the City. The City as dictated that there will be NO surcharging. Subsequently, additional modeling has occurred. In addition, the City is requesting that the CSO flow numbers previously provided to us be increased by over 21%. All work to date has taken into consideration extremely conservative assumptions. For example, in the Braddock Road area, all development has been assumed to be residential (the highest generation of flows). A true mixed use will reduce the flows even more. A conceptual evaluation of the existing pump station indicated that for the increase in flows, modifications to the station's impellers and possible changes to pump elevations will be required. It is our opinion that this system is adequate to convey the proposed sewer from Potomac Village, as well as the other flows being considered.

In addition to the conveyance systems mentioned above, there will be a new pump station, force main and onsite collection system to support the development. There is also an existing 20" force main onsite. Approximately 900' of the force main will need to be relocated based upon current conceptual layouts. It is anticipated that the new pump station, force main and relocation of the existing force main will occur with phase 1 of construction. The onsite collection system will be installed with several phases of construction.

Attached to this Executive Summary is a supplemental memorandum and modeling from BW that includes the 21% + increase in CSO diversion, the final models showing the surcharge and proposed solutions and costs to eliminate the surcharge.

MEMORANDUM

BAXTER & WOODMAN
Consulting Engineers

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Corporate Website: www.baxterwoodman.com
e-mail:info@baxterwoodman.com

DATE: February 4, 2010
TO: Bill Zink
FROM: Derek Wold
SUBJECT: Potomac Yard - Sanitary Sewer Evaluation

We have analyzed the capacity of the 24-inch onsite trunk sewer, 27-inch onsite trunk sewer and 30-inch offsite trunk sewer to evaluate whether there is adequate capacity for the ultimate build-out of the entire tributary area. The results are summarized in our memo dated September 5, 2009 and the Master Utility Concept Plan prepared by Christopher Consultants, dated January 25, 2010. Despite identifying only 0.04 feet of surcharging at one manhole along the 30-inch offsite sewer, at our meeting on January 25, the City stipulated that the criteria for acceptance would be no surcharging in any manholes. In addition, the City expressed concern about the possibility of exceeding the flow rates predicted with the use of low flow fixtures and for future I/I to decrease the reserve capacity.

In order to address these concerns, we recommend consideration of the following:

<u>**Surcharging**</u>

At our meeting on January 25, the City indicated that the CSO flow should be allocated to five different shaft locations. In subsequent correspondence, the City requested that the CSO flow be increased by 120,000 gpd, from 0.55 to 0.67 mgd. This results in surcharging of 0.28 feet at shaft 8, 0.21 feet at shaft 9 and 0.13 feet at shaft 10. Table 1 contains the modeling results for the onsite and offsite sewers. The sanitary sewer profile and hydraulic grade line are shown on Exhibits 1 and 2.

The surcharging can be eliminated by either reducing the flow from the site or increasing the capacity of the downstream trunk sewer as described below. Both alternatives were modeled with low flow fixtures (35 percent flow reduction) and the increased CSO flow (0.67 mgd) input at shafts specified by the City.

Alternative 1: Reduce flow from site

The surcharging in the offsite sewer can be eliminated if the average daily flow is reduced by 0.75 mgd. This corresponds to a 54 percent decrease in flow from Potomac Yard.

Alternative 2: Increase capacity

The second alternative to eliminating surcharging would be to increase the capacity of the offsite trunk sewer. This could be accomplished by several different methods. The first method would be to replace sections of pipe that are under capacity. We have determined that approximately 1,340 lineal feet of 30-inch sewer between shafts 5 and 9 would need to be replaced. Table 2 contains the modeling results for the onsite and offsite sewers. The sanitary sewer profile and hydraulic grade line are shown on Exhibits 3 and 4. The opinion of probable construction cost for this is approximately $2,100,000.

The second alternative to increase the capacity would be to install a parallel relief sewer. We have determined that approximately 400 LF of 24-inch sewer would be required between shafts 7 and 8. Table 3 contains the modeling results for the onsite and offsite sewers. The sanitary sewer profile and hydraulic grade line are shown on Exhibits 5 and 6. The opinion of probable construction cost for this alternative is approximately $500,000. Another alternative to a parallel pipe would be to replace the 30-inch diameter pipe with a 36-inch diameter pipe. However, this would likely be more costly than a smaller diameter relief sewer.

The third alternative is to install a storage tank that connects to shaft 8 and stores the peak flow to prevent surcharging. A storage tank of approximately 75,000 gallons would be needed to eliminate surcharging. The storage tank would also require cleaning and system to return the flow back to the sewer. Due to the cost and maintenance concerns, this option is not recommended.

Thus, we would recommend installing a 24-inch parallel relief sewer between shafts 7 and 8. Potomac Yard should be responsible for the percentage of this cost that is proportional to the flow that is generated by the site, which is equivalent to 20 % or $100,000.

Monitoring

The City has expressed concern about the possibility of the flows generated from the site to exceed the projected flows with low flow fixtures. We recommend a two phased monitoring program to verify that the flows are at or below the projected values.

Pump Station Metering

Flow at the pump station should be metered to record flow from the tributary area. It is unclear from the available drawings whether the pump station has a meter installed. However, it is likely that a pump station of this size would have a meter that could be utilized to record data. If a meter does not exist, we would recommend installing a meter prior to construction at Potomac Yard.

Sewer Flow monitoring

Should the pump station meter indicate the flow from Potomac Yard exceeds the projected flow, we would recommend installing a flow meter in the gravity trunk sewer at the furthest downstream point of Potomac Yard (near manhole S16). This would determine whether the additional flow was generated from Potomac Yard or another offsite area.

If the flow monitoring indicates that the excess flow is from Potomac Yard, then each building should be isolated to determine the source of the increase in flow. The first task of this analysis would be to start with water meter records to compare the actual water usage to the projected usage. If the source of additional flow is not identified, then the next step would be to install a sanitary sewer flow meter at each building to record wastewater flow rates.

Another consideration would be to require that a sanitary sewer flow meter be installed for each building. Incorporating a building sewer meter and low flow fixtures as requirements for buildings sold to other developers would help ensure that the projected peak flow is not exceeded.

Future Infiltration / Inflow

The Potomac Yard project will be required to install a sanitary sewer system that meets the requirements of the City of Alexandria. After the infrastructure is accepted by the City, the responsibility for operating and maintaining the sanitary sewers is the responsibility of the City. This also includes preventing Infiltration and Inflow from entering the sewers and increasing the peak flow. We recommend presenting the following to the City to ensure that the sewers are installed as watertight as possible, using the best available technology for construction, to reduce the potential for future I/I.

1. **Construct sewers using materials specified by the City**. The onsite sanitary sewers should be constructed with pvc pipe, meeting SDR 26, ASTM D3034. The sanitary sewers may also be constructed with pressure rated pipe complying with ASTM D2241 to further reduce the potential for I/I.

2. **Air test sanitary sewer mains.** All sanitary sewer mains shall be air tested for watertightness in accordance with latest ASTM and as required by the City.

3. **Vacuum test manholes.** All sanitary sewer manholes shall be air tested for watertightness in accordance with ASTM C144-93.

4. **Air test services.** Although not required by the City, we would recommend testing the building sanitary services for watertightness to further reduce the potential for I/I and reinforce the commitment to generate the lowest wastewater flow possible from the site.

Move CSO to 17, 15, 12, 11 & 10 and Low Flow Fixtures (35% Reduction)

Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Length (ft)	Conduit Slope (%)	Roughness	Diameter (ft)	Max Depth (ft)	Free Board (ft)	Design Full Flow (cfs)	Design Full Flow (MGD)	Max Flow (cfs)	Max Flow (MGD)
30-Inch Offsite Trunk Sewer														
Link41	Node1	Node0	-7.28	-7.50	80.3	0.274	0.0110	2.50	1.91	0.60	25.37	16.37	27.34	17.64
Link40	Node2	Node1	-6.38	-7.14	326.6	0.233	0.0110	2.50	2.17	0.33	23.38	15.08	27.34	17.64
Link39	Node3	Node2	-4.74	-5.89	408.7	0.281	0.0110	2.50	2.10	0.41	25.71	16.58	27.34	17.64
Link38	Node4	Node3	-3.83	-4.64	399.0	0.203	0.0110	2.50	2.39	0.11	21.84	14.09	27.34	17.64
Link37	Node5	Node4	-2.24	-3.78	561.1	0.274	0.0110	2.50	2.36	0.14	25.40	16.39	27.34	17.64
Link42	Node7	Node5	0.01	-2.17	587.2	0.371	0.0110	2.50	2.29	0.21	29.54	19.06	27.34	17.64
Link34	Node8	Node7	0.46	0.05	400.9	0.102	0.0110	2.50	2.78	-0.28	15.50	10.00	27.34	17.64
Link33	Node9	Node8	1.72	0.53	351.3	0.339	0.0110	2.50	2.71	-0.21	28.21	18.20	27.15	17.51
Link32	Node10	Node9	2.98	1.77	431.2	0.281	0.0110	2.50	2.63	-0.13	25.68	16.57	27.15	17.51
Link31	Node11	Node10	4.39	3.21	434.6	0.272	0.0110	2.50	2.40	0.10	25.26	16.30	26.75	17.26
Link30	Node12	Node11	5.55	4.49	326.4	0.325	0.0110	2.50	2.27	0.23	27.62	17.82	26.44	17.05
Link29	Node13	Node12	6.52	5.60	315.4	0.292	0.0110	2.50	2.05	0.46	26.18	16.89	25.35	16.35
Link28	Node14	Node13	7.43	6.62	340.8	0.238	0.0110	2.50	2.09	0.41	23.63	15.25	25.35	16.35
Link27	Node15	Node14	8.66	7.49	430.1	0.272	0.0110	2.50	2.05	0.45	25.28	16.31	25.35	16.35
Link26	Node16	Node15	9.71	8.97	416.8	0.178	0.0110	2.50	2.07	0.43	20.43	13.18	22.49	14.51
Link25	Node17	Node16	10.75	10.06	410.9	0.168	0.0110	2.50	2.09	0.42	19.86	12.81	22.49	14.51
Link24	Node18	Node17	12.12	11.01	424.4	0.262	0.0110	2.50	1.83	0.67	24.79	15.99	22.04	14.22
Link23	Node19	Node18	13.46	12.47	427.0	0.232	0.0110	2.50	1.83	0.88	23.34	15.06	21.00	13.55
Link22	Node20	Node19	14.67	13.73	394.3	0.238	0.0110	2.50	1.80	0.70	23.67	15.27	20.94	13.51
Link21	Node21	Node20	15.85	14.84	376.3	0.268	0.0110	2.50	1.65	0.85	25.11	16.20	19.21	12.39
Link20	Node22	Node21	16.83	15.94	253.2	0.351	0.0110	2.50	1.56	0.94	28.74	18.54	19.67	12.69
Link19	Node23	Node22	17.51	16.97	221.8	0.243	0.0110	2.50	1.66	0.84	23.92	15.43	19.25	12.42
Link18	Node24	Node23	18.26	17.70	281.2	0.199	0.0110	2.50	1.74	0.77	21.63	13.95	19.04	12.28
27-Inch Onsite Trunk Sewer														
Link17	Node25	Node24	19.21	18.28	276.0	0.337	0.0110	2.25	1.72	0.54	21.25	13.71	19.03	12.28
Link16	Node26	Node25	19.90	19.33	197.5	0.289	0.0110	2.25	1.70	0.55	19.66	12.68	18.95	12.23
Link15	Node27	Node26	21.09	20.10	402.0	0.246	0.0110	2.25	1.85	0.41	18.16	11.72	18.94	12.22
Link14	Node28	Node27	21.93	21.14	209.5	0.377	0.0110	2.25	1.80	0.46	22.48	14.50	19.57	12.62
Link13	Node29	Node28	22.60	22.08	140.0	0.371	0.0110	2.25	1.62	0.64	22.31	14.39	19.32	12.46
Link12	Node29A	Node29	23.29	22.57	39.5	1.823	0.0110	2.25	1.65	0.61	49.42	31.88	19.04	12.28
Link11	Node30	Node29A	24.30	23.34	295.0	0.325	0.0110	2.25	1.89	0.56	20.88	13.47	19.01	12.27
Link10	Node31	Node30	24.89	24.41	173.0	0.277	0.0110	2.25	1.72	0.53	19.28	12.44	18.96	12.23
Link9	Node31A	Node31	25.45	25.02	133.0	0.323	0.0110	2.25	1.63	0.62	20.81	13.43	18.62	12.02
Link8	Node32	Node31A	26.28	25.56	237.5	0.303	0.0110	2.25	1.68	0.57	20.15	13.00	18.62	12.01
Link44	Node33	Node32	27.23	26.37	300.5	0.286	0.0110	2.25	1.74	0.51	19.58	12.63	18.52	11.95
Link43	Node34	Node33	28.74	28.20	118.0	0.458	0.0110	2.25	1.55	0.70	24.76	15.97	18.24	11.77
ONSITE PUMP STATION														
24-Inch Onsite Trunk Sewer														
Link47	Node2	LS	13.87	13.38	151.9	0.323	0.0110	2.00	1.69	0.31	15.19	9.80	17.09	11.03
Link46	Node3	Node2	14.44	13.97	124.2	0.378	0.0110	2.00	1.65	0.35	16.44	10.61	17.09	11.03
Link38	Node4	Node3	15.05	14.54	155.8	0.327	0.0110	2.00	1.70	0.30	15.30	9.87	17.09	11.03
Link37	Node5	Node4	15.96	15.15	244.4	0.331	0.0110	2.00	1.70	0.30	15.39	9.93	16.29	10.51
Link42	Node6	Node5	16.82	16.06	230.3	0.330	0.0110	2.00	1.70	0.31	15.38	9.91	16.29	10.51
Link34	Node7	Node6	17.40	16.92	144.0	0.333	0.0110	2.00	1.67	0.33	15.44	9.96	16.29	10.51
Link33	Node7A	Node7	17.98	17.50	146.9	0.327	0.0110	2.00	1.66	0.34	15.28	9.86	16.29	10.51
Link32	Node8	Node7A	18.72	16.08	195.0	0.328	0.0110	2.00	1.68	0.33	15.32	9.88	16.29	10.51
Link31	Node9	Node8	19.61	18.82	237.0	0.333	0.0110	2.00	1.68	0.32	15.44	9.96	16.29	10.51
Link30	Node9A	Node9	20.06	19.71	107.8	0.325	0.0110	2.00	1.66	0.34	15.23	9.83	16.29	10.51
Link29	Node10	Node9A	20.83	20.16	203.4	0.329	0.0110	2.00	1.67	0.33	15.34	9.90	16.29	10.51
Link28	Node11	Node10	21.75	20.93	246.4	0.333	0.0110	2.00	1.69	0.31	15.42	9.95	16.29	10.51
Link27	Node12	Node11	22.54	21.85	210.1	0.328	0.0110	2.00	1.69	0.31	15.32	9.88	16.29	10.51
Link26	Node13	Node12	23.48	22.64	254.2	0.331	0.0110	2.00	1.70	0.30	15.37	9.92	16.29	10.51
Link25	Node14	Node13	24.41	23.58	251.8	0.330	0.0110	2.00	1.62	0.38	15.35	9.90	15.22	9.82
Link24	Node15	Node14	27.88	24.66	379.2	0.849	0.0110	2.00	1.37	0.63	24.64	15.90	15.62	10.08
Link45	Node16	Node15	28.57	27.98	14.3	4.123	0.0110	2.00	1.08	0.92	37.49	24.19	6.22	4.01

Replace Shaft 5 to 9 and Low Flow Fixtures (35% Reduction)

Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Length (ft)	Conduit Slope (%)	Roughness	Diameter (ft)	Max Depth (ft)	Free Board (ft)	Design Full Flow (cfs)	Design Full Flow (MGD)	Max Flow (cfs)	Max Flow (MGD)
30-inch Offsite Trunk Sewer														
Link41	Node1	Node0	-7.28	-7.50	80.3	0.274	0.0110	2.50	1.91	0.60	25.37	16.37	27.34	17.64
Link40	Node2	Node1	-6.38	-7.14	326.6	0.233	0.0110	2.50	2.17	0.33	23.38	15.08	27.34	17.64
Link39	Node3	Node2	-4.74	-5.89	408.7	0.281	0.0110	2.50	2.10	0.41	25.71	16.59	27.34	17.64
Link38	Node4	Node3	-3.83	-4.64	399.0	0.203	0.0110	2.50	2.39	0.11	21.84	14.09	27.34	17.64
Link37	Node5	Node4	-2.24	-3.78	561.1	0.274	0.0110	2.50	2.36	0.14	25.40	16.39	27.34	17.64
Link42	Node7	Node5	0.01	-2.17	587.2	0.291	0.0110	2.50	2.29	0.21	26.13	16.86	27.34	17.64
Link34	Node8	Node7	0.46	0.05	400.9	0.280	0.0110	2.50	2.23	0.27	26.12	16.85	27.34	17.64
Link33	Node9	Node8	1.72	0.53	351.3	0.290	0.0110	2.50	2.21	0.30	26.12	16.85	27.15	17.51
Link32	Node10	Node9	2.98	1.77	431.2	0.281	0.0110	2.50	2.18	0.32	25.68	16.57	27.15	17.51
Link31	Node11	Node10	4.39	3.21	434.6	0.272	0.0110	2.50	2.12	0.38	25.26	16.30	26.75	17.26
Link30	Node12	Node11	5.55	4.49	326.4	0.325	0.0110	2.50	2.02	0.48	27.62	17.82	26.44	17.05
Link29	Node13	Node12	6.52	5.60	315.4	0.292	0.0110	2.50	1.97	0.53	26.18	16.89	25.35	18.35
Link28	Node14	Node13	7.43	6.62	340.8	0.238	0.0110	2.50	2.08	0.42	23.63	15.25	25.35	18.35
Link27	Node15	Node14	8.66	7.49	430.1	0.272	0.0110	2.50	2.05	0.45	25.28	16.31	25.35	16.35
Link26	Node16	Node15	9.71	8.97	416.8	0.178	0.0110	2.50	2.07	0.43	20.43	13.18	22.49	14.51
Link25	Node17	Node16	10.75	10.06	410.9	0.168	0.0110	2.50	2.09	0.42	19.86	12.81	22.49	14.51
Link24	Node18	Node17	12.12	11.01	424.4	0.262	0.0110	2.50	1.83	0.67	24.79	15.99	22.04	14.22
Link23	Node19	Node18	13.46	12.47	427.0	0.232	0.0110	2.50	1.83	0.68	23.34	15.06	21.00	13.55
Link22	Node20	Node19	14.67	13.73	394.3	0.238	0.0110	2.50	1.80	0.70	23.67	15.27	20.94	13.51
Link21	Node21	Node20	15.85	14.84	376.3	0.268	0.0110	2.50	1.65	0.85	25.11	16.20	19.21	12.39
Link20	Node22	Node21	16.83	15.94	253.2	0.351	0.0110	2.50	1.56	0.94	28.74	18.54	19.67	12.69
Link19	Node23	Node22	17.51	16.97	221.8	0.243	0.0110	2.50	1.66	0.84	23.92	15.43	19.25	12.42
Link18	*Node24*	*Node23*	*18.26*	*17.70*	*281.2*	*0.199*	*0.0110*	*2.50*	*1.74*	*0.77*	*21.63*	*13.65*	*19.04*	*12.28*
27-inch Onsite Trunk Sewer														
Link17	Node25	Node24	19.21	18.28	276.0	0.337	0.0110	2.25	1.72	0.54	21.25	13.71	19.03	12.28
Link16	Node26	Node25	19.90	19.33	197.5	0.289	0.0110	2.25	1.70	0.55	19.66	12.68	18.95	12.23
Link15	Node27	Node26	21.09	20.10	402.0	0.246	0.0110	2.25	1.85	0.41	18.16	11.72	18.94	12.22
Link14	Node28	Node27	21.93	21.14	209.5	0.377	0.0110	2.25	1.80	0.46	22.48	14.50	19.57	12.62
Link13	Node29	Node28	22.60	22.08	140.0	0.371	0.0110	2.25	1.62	0.64	22.31	14.39	19.32	12.46
Link12	Node29A	Node29	23.29	22.57	39.5	1.823	0.0110	2.25	1.65	0.61	49.42	31.88	19.04	12.28
Link11	Node30	Node29A	24.30	23.34	295.0	0.325	0.0110	2.25	1.69	0.56	20.88	13.47	19.01	12.27
Link10	Node31	Node30	24.89	24.41	173.0	0.277	0.0110	2.25	1.72	0.53	19.28	12.44	18.96	12.23
Link9	Node31A	Node31	25.45	25.02	133.0	0.323	0.0110	2.25	1.63	0.62	20.81	13.43	18.62	12.02
Link8	Node32	Node31A	26.28	25.56	237.5	0.303	0.0110	2.25	1.68	0.57	20.15	13.00	18.62	12.01
Link44	Node33	Node32	27.23	28.37	300.5	0.286	0.0110	2.25	1.74	0.51	19.58	12.63	18.52	11.95
Link43	Node34	Node33	28.74	28.20	118.0	0.458	0.0110	2.25	1.55	0.70	24.76	15.97	18.24	11.77
ONSITE PUMP STATION														
24-inch Onsite Trunk Sewer														
Link47	Node2	LS	13.87	13.38	151.9	0.323	0.0110	2.00	1.69	0.31	15.19	9.80	17.09	11.03
Link46	Node3	Node2	14.44	13.97	124.2	0.378	0.0110	2.00	1.65	0.35	16.44	10.61	17.09	11.03
Link38	Node4	Node3	15.05	14.54	155.8	0.327	0.0110	2.00	1.70	0.30	15.30	9.87	17.09	11.03
Link37	Node5	Node4	15.96	15.15	244.4	0.331	0.0110	2.00	1.70	0.30	15.39	9.93	16.29	10.51
Link42	Node6	Node5	16.82	16.08	230.3	0.330	0.0110	2.00	1.70	0.31	15.36	9.91	16.29	10.51
Link34	Node7	Node6	17.40	16.92	144.0	0.333	0.0110	2.00	1.67	0.33	15.44	9.98	16.29	10.51
Link33	Node7A	Node7	17.98	17.50	146.9	0.327	0.0110	2.00	1.66	0.34	15.28	9.86	16.29	10.51
Link32	Node8	Node7A	18.72	16.08	195.0	0.328	0.0110	2.00	1.68	0.33	15.32	9.88	16.29	10.51
Link31	Node9	Node8	19.61	18.82	237.0	0.333	0.0110	2.00	1.88	0.32	15.44	9.96	16.29	10.51
Link30	Node9A	Node9	20.06	19.71	107.8	0.325	0.0110	2.00	1.66	0.34	15.23	9.83	16.29	10.51
Link29	Node10	Node9A	20.83	20.16	203.4	0.329	0.0110	2.00	1.67	0.33	15.34	9.90	16.29	10.51
Link28	Node11	Node10	21.75	20.93	246.4	0.333	0.0110	2.00	1.69	0.31	15.42	9.95	16.29	10.51
Link27	Node12	Node11	22.54	21.85	210.1	0.328	0.0110	2.00	1.69	0.31	15.32	9.88	16.29	10.51
Link26	Node13	Node12	23.48	22.64	254.2	0.331	0.0110	2.00	1.70	0.30	15.37	9.92	16.29	10.51
Link25	Node14	Node13	24.41	23.58	251.8	0.330	0.0110	2.00	1.62	0.38	15.35	9.90	15.22	9.82
Link24	Node15	Node14	27.88	24.66	379.2	0.849	0.0110	2.00	1.37	0.63	24.64	15.90	15.62	10.08
Link45	Node16	Node15	28.57	27.98	14.3	4.123	0.0110	2.00	1.08	0.92	37.49	24.19	6.22	4.01

Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Length (ft)	Conduit Slope (%)	Roughness	Diameter (ft)	Max Depth (ft)	Free Board (ft)	Design Full Flow (cfs)	Design Full Flow (MGD)	Max Flow (cfs)	Max Flow (MGD)
30-inch Offsite Trunk Sewer														
Link41	Node1	Node0	-7.28	-7.50	80.3	0.274	0.0110	2.50	1.91	0.60	25.37	16.37	27.34	17.64
Link40	Node2	Node1	-6.38	-7.14	326.6	0.233	0.0110	2.50	2.17	0.33	23.38	15.08	27.34	17.64
Link39	Node3	Node2	-4.74	-5.89	408.7	0.281	0.0110	2.50	2.10	0.41	25.71	16.59	27.34	17.64
Link38	Node4	Node3	-3.63	-4.64	399.0	0.203	0.0110	2.50	2.39	0.11	21.84	14.09	27.34	17.64
Link37	Node5	Node4	-2.24	-3.78	561.1	0.274	0.0110	2.50	2.36	0.14	25.40	16.39	27.34	17.64
Link42	Node7	Node5	0.01	-2.17	587.2	0.371	0.0110	2.50	2.29	0.21	29.54	19.06	27.34	17.64
Link48	**Bypass**	**Node7**	**0.46**	**0.25**	**200.0**	**0.102**	**0.0110**	**2.00**	**1.81**	**0.20**	**8.56**	**5.52**	**10.28**	**6.63**
Link47	**Node8**	**Bypass**	**0.66**	**0.46**	**200.0**	**0.102**	**0.0110**	**2.00**	**1.86**	**0.14**	**8.56**	**5.52**	**10.30**	**6.64**
Link34	Node8	Node7	0.46	0.05	400.9	0.102	0.0110	2.50	2.06	0.44	15.50	10.00	27.34	17.64
Link33	Node9	Node8	1.72	0.53	351.3	0.339	0.0110	2.50	1.98	0.51	28.21	18.20	27.15	17.51
Link32	Node10	Node9	2.98	1.77	431.2	0.281	0.0110	2.50	2.11	0.39	25.68	16.57	27.15	17.51
Link31	Node11	Node10	4.39	3.21	434.6	0.272	0.0110	2.50	2.11	0.39	25.26	16.30	26.75	17.26
Link30	Node12	Node11	5.55	4.49	326.4	0.325	0.0110	2.50	2.01	0.49	27.62	17.82	26.44	17.05
Link29	Node13	Node12	6.52	5.60	315.4	0.292	0.0110	2.50	1.97	0.53	26.16	16.89	25.35	16.35
Link28	Node14	Node13	7.43	6.62	340.8	0.238	0.0110	2.50	2.08	0.42	23.63	15.25	25.35	16.35
Link27	Node15	Node14	8.66	7.49	430.1	0.272	0.0110	2.50	2.05	0.45	25.28	16.31	25.35	16.35
Link26	Node16	Node15	9.71	8.97	416.8	0.178	0.0110	2.50	2.07	0.43	20.43	13.18	22.49	14.51
Link25	Node17	Node16	10.75	10.06	410.9	0.168	0.0110	2.50	2.09	0.42	19.86	12.81	22.49	14.51
Link24	Node18	Node17	12.12	11.01	424.4	0.262	0.0110	2.50	1.83	0.67	24.79	15.99	22.04	14.22
Link23	Node19	Node18	13.46	12.47	427.0	0.232	0.0110	2.50	1.83	0.68	23.34	15.06	21.00	13.55
Link22	Node20	Node19	14.67	13.73	394.3	0.238	0.0110	2.50	1.80	0.70	23.67	15.27	20.94	13.51
Link21	Node21	Node20	15.85	14.84	376.3	0.268	0.0110	2.50	1.65	0.85	25.11	16.20	19.21	12.39
Link20	Node22	Node21	16.83	15.94	253.2	0.351	0.0110	2.50	1.56	0.94	28.74	18.54	19.67	12.69
Link19	Node23	Node22	17.51	16.97	221.8	0.243	0.0110	2.50	1.66	0.84	23.92	15.43	19.25	12.42
Link18	Node24	Node23	18.26	17.70	281.2	0.199	0.0110	2.50	1.74	0.77	21.63	13.95	19.04	12.28
27-inch Onsite Trunk Sewer														
Link17	Node25	Node24	19.21	18.28	276.0	0.337	0.0110	2.25	1.72	0.54	21.25	13.71	19.03	12.28
Link16	Node26	Node25	19.90	19.33	197.5	0.289	0.0110	2.25	1.70	0.55	19.66	12.66	18.95	12.23
Link15	Node27	Node26	21.09	20.10	402.0	0.246	0.0110	2.25	1.85	0.41	18.16	11.72	18.94	12.22
Link14	Node28	Node27	21.93	21.14	209.5	0.377	0.0110	2.25	1.80	0.46	22.48	14.50	19.57	12.62
Link13	Node29	Node28	22.60	22.08	140.0	0.371	0.0110	2.25	1.62	0.64	22.31	14.39	19.32	12.46
Link12	Node29A	Node29	23.29	22.57	39.5	1.823	0.0110	2.25	1.65	0.61	49.42	31.88	19.04	12.28
Link11	Node30	Node29A	24.30	23.34	295.0	0.325	0.0110	2.25	1.69	0.56	20.86	13.47	19.01	12.27
Link10	Node31	Node30	24.89	24.41	173.0	0.277	0.0110	2.25	1.72	0.53	19.28	12.44	18.98	12.23
Link9	Node31A	Node31	25.45	25.02	133.0	0.323	0.0110	2.25	1.63	0.62	20.61	13.43	18.62	12.02
Link8	Node32	Node31A	26.28	25.56	237.5	0.303	0.0110	2.25	1.68	0.57	20.15	13.00	18.62	12.01
Link44	Node33	Node32	27.23	26.37	300.5	0.286	0.0110	2.25	1.74	0.51	19.58	12.63	18.52	11.95
Link43	Node34	Node33	28.74	28.20	118.0	0.458	0.0110	2.25	1.55	0.70	24.76	15.97	18.24	11.77
ONSITE PUMP STATION														
24-inch Onsite Trunk Sewer														
Link47	Node2	LS	13.87	13.38	151.9	0.323	0.0110	2.00	1.69	0.31	15.19	9.80	17.09	11.03
Link46	Node3	Node2	14.44	13.97	124.2	0.378	0.0110	2.00	1.65	0.35	16.44	10.61	17.09	11.03
Link38	Node4	Node3	15.05	14.54	155.8	0.327	0.0110	2.00	1.70	0.30	15.30	9.87	17.09	11.03
Link37	Node5	Node4	15.96	15.15	244.4	0.331	0.0110	2.00	1.70	0.30	15.39	9.93	16.29	10.51
Link42	Node6	Node5	16.82	16.06	230.3	0.330	0.0110	2.00	1.70	0.31	15.36	9.91	16.29	10.51
Link34	Node7	Node6	17.40	16.92	144.0	0.333	0.0110	2.00	1.67	0.33	15.44	9.96	16.28	10.51
Link33	Node7A	Node7	17.98	17.50	146.9	0.327	0.0110	2.00	1.66	0.34	15.28	9.86	16.29	10.51
Link32	Node8	Node7A	18.72	18.08	195.0	0.328	0.0110	2.00	1.68	0.33	15.32	9.88	16.29	10.51
Link31	Node9	Node8	19.61	18.82	237.0	0.333	0.0110	2.00	1.68	0.32	15.44	9.96	16.29	10.51
Link30	Node9A	Node9	20.06	19.71	107.8	0.325	0.0110	2.00	1.66	0.34	15.23	9.83	16.29	10.51
Link29	Node10	Node9A	20.83	20.16	203.4	0.329	0.0110	2.00	1.67	0.33	15.34	9.90	18.29	10.51
Link28	Node11	Node10	21.75	20.93	246.4	0.333	0.0110	2.00	1.69	0.31	15.42	9.95	16.29	10.51
Link27	Node12	Node11	22.54	21.85	210.1	0.328	0.0110	2.00	1.69	0.31	15.32	9.88	16.29	10.51
Link26	Node13	Node12	23.48	22.64	254.2	0.331	0.0110	2.00	1.70	0.30	15.37	9.92	16.29	10.51
Link25	Node14	Node13	24.41	23.58	251.8	0.330	0.0110	2.00	1.62	0.38	15.35	9.90	15.22	9.82
Link24	Node15	Node14	27.88	24.66	379.2	0.849	0.0110	2.00	1.37	0.63	24.64	15.90	15.62	10.08
Link45	Node16	Node15	28.57	27.98	14.3	4.123	0.0110	2.00	1.08	0.92	37.49	24.19	6.22	4.01

Exhibit 1 - 24-inch Onsite Trunk Sewer
Day [0] Time 00:01:00 Step 2

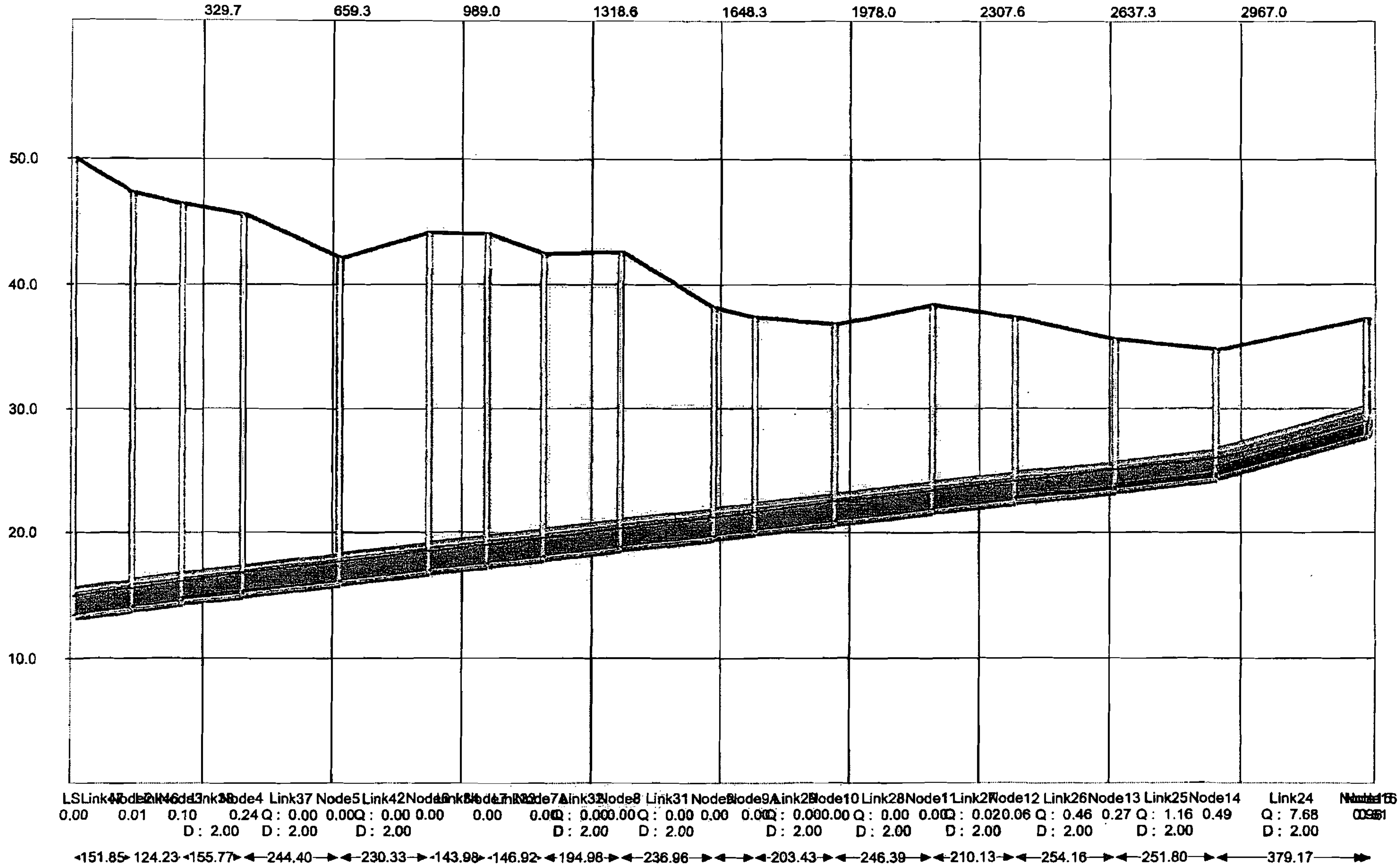
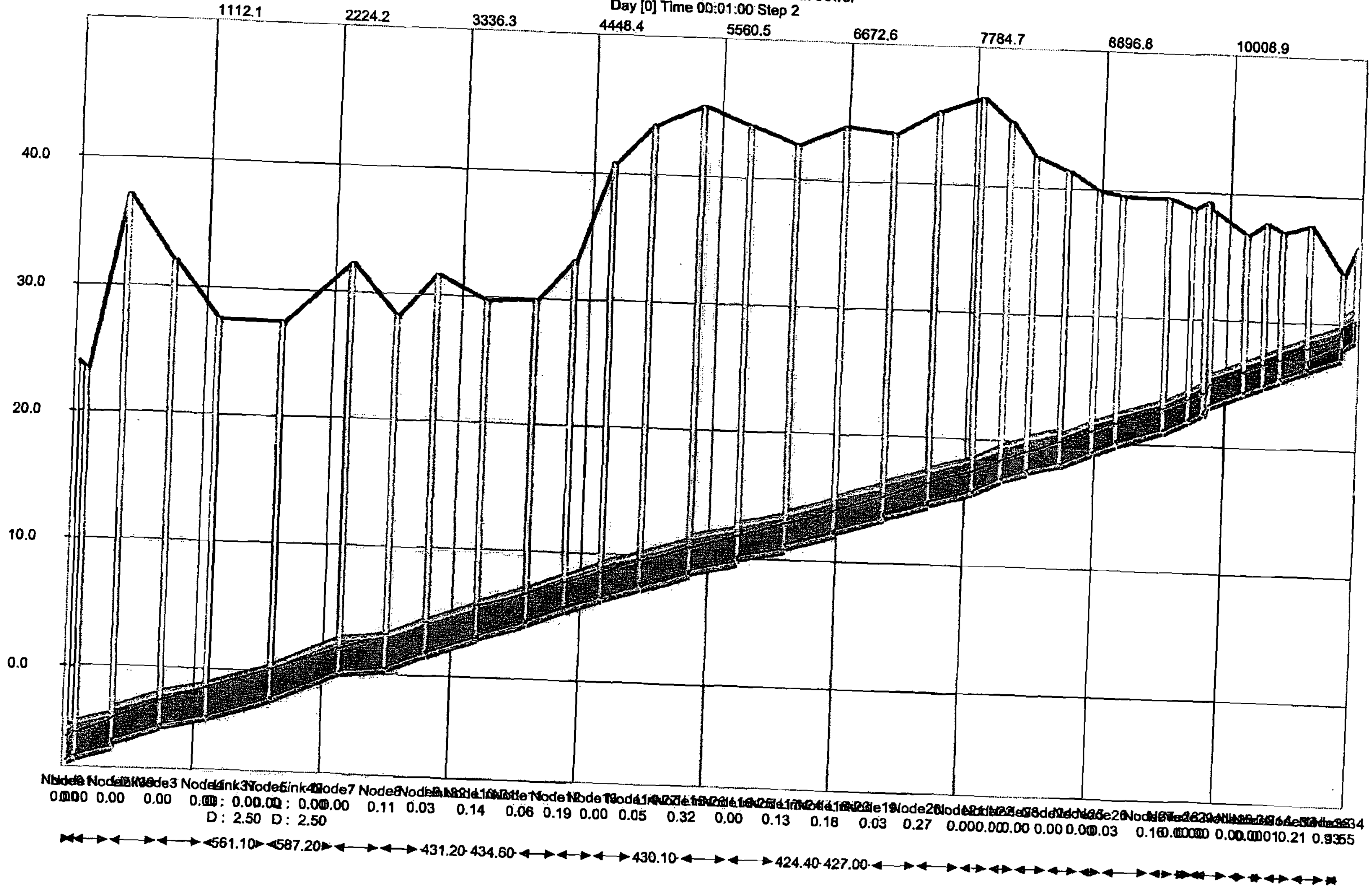


Exhibit 2 - 27-inch and 30-inch Trunk Sewer
Day [0] Time 00:01:00 Step 2



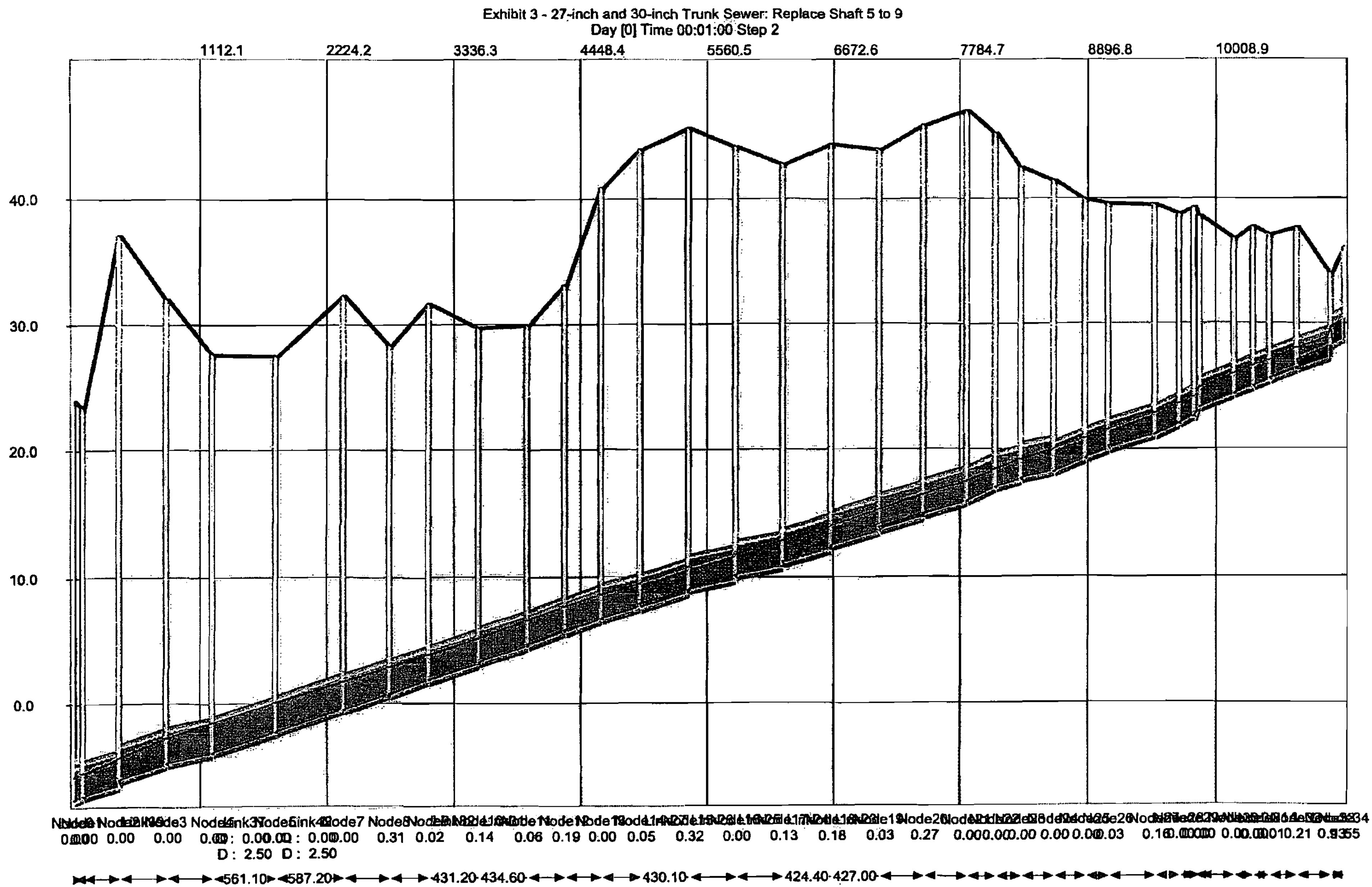


Exhibit 3 - 27-inch and 30-inch Trunk Sewer: Replace Shaft 5 to 9
Day [0] Time 00:01:00 Step 2
1112.1
2224.2
3336.3
4448.4
5560.5
6672.6
7784.7
8896.8
10008.9
40.0
30.0
20.0
10.0
0.0
D : 2.50 D : 2.50
561.10
587.20
431.20 434.60
430.10
424.40 427.00

Exhibit 4 - Blowup of Shaft 4 to 11: Replace Shaft 5 to 9
Day [0] Time 00:01:00 Step 2

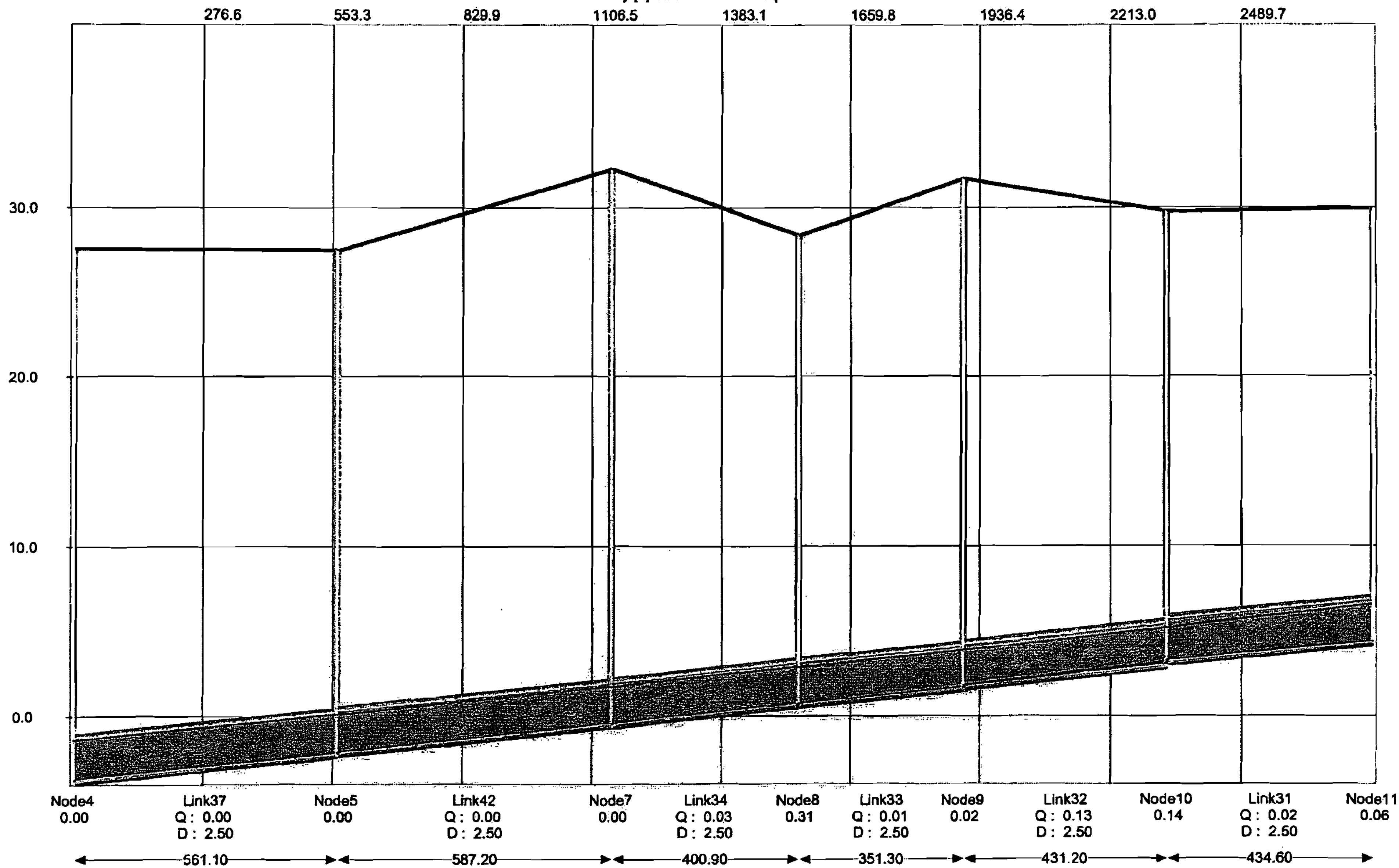
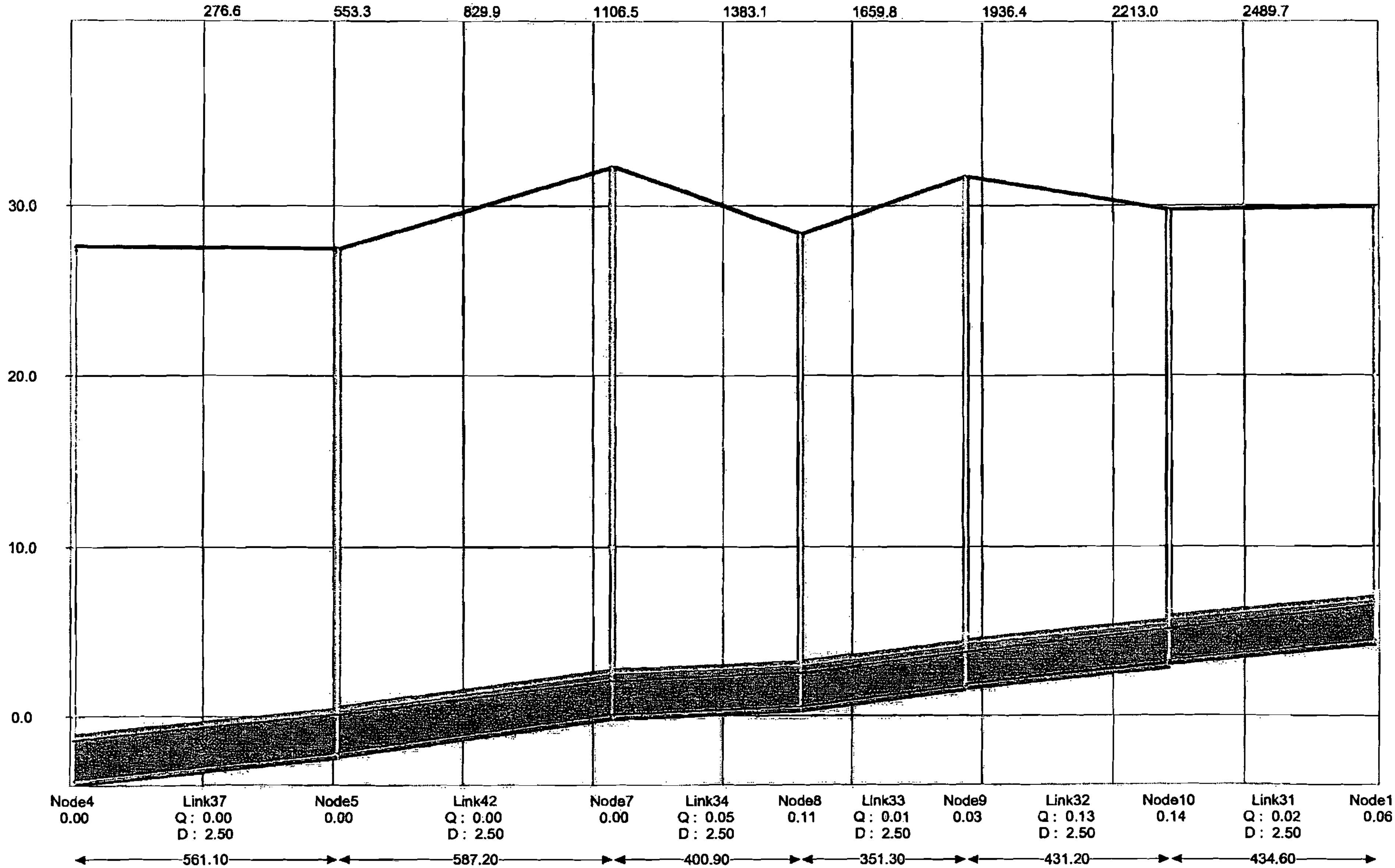


Exhibit 5 - 30-inch Trunk Sewer: Shaft 7 to 8 Relief Sewer
Day [0] Time 00:01:00 Step 2



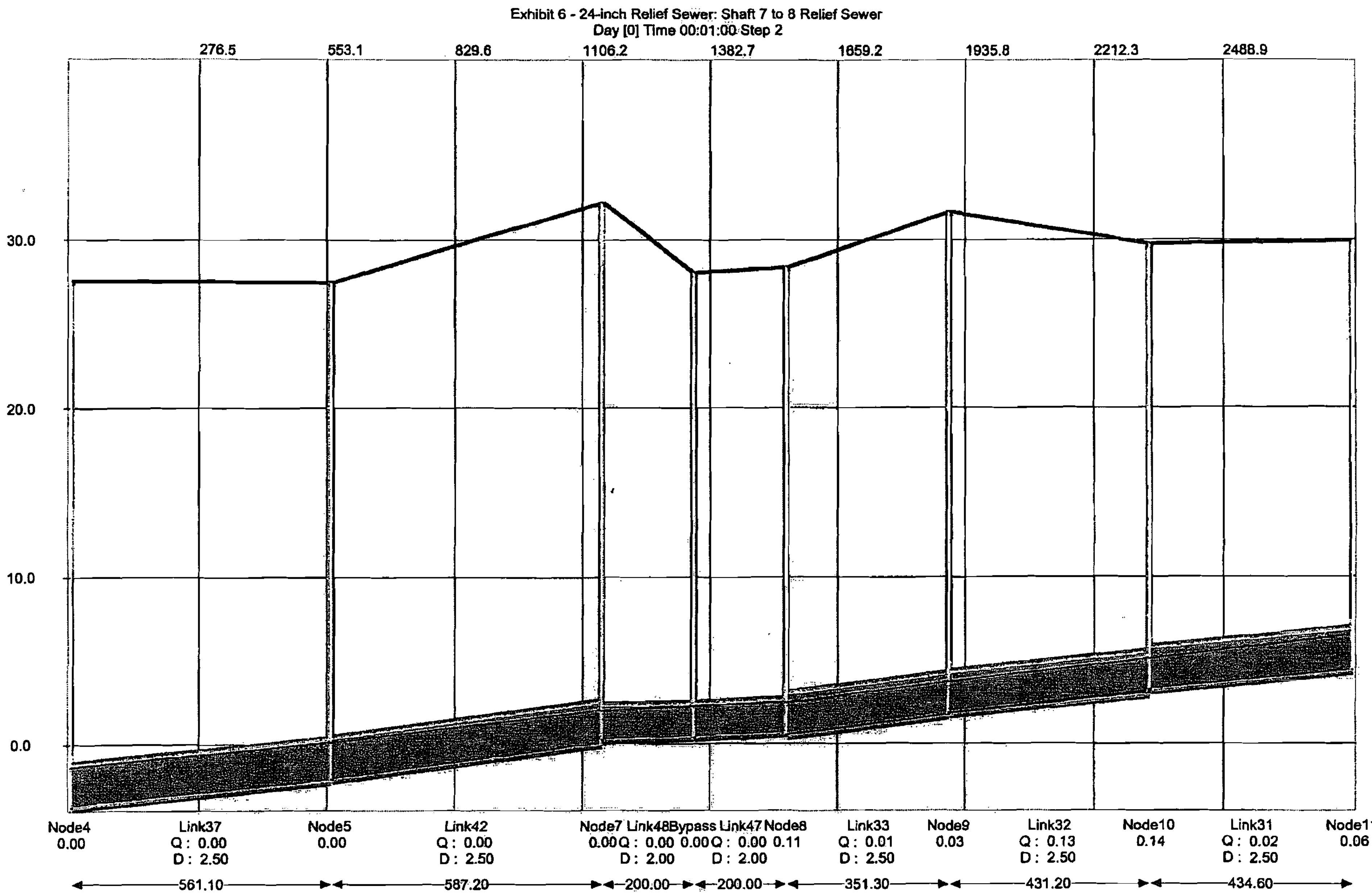


Exhibit 6 - 24-inch Relief Sewer: Shaft 7 to 8 Relief Sewer
Day [0] Time 00:01:00 Step 2
276.5
553.1
829.6
1106.2
1382.7
1659.2
1935.8
2212.3
2488.9
30.0
20.0
10.0
0.0
Node4 0.00
Link37 Q: 0.00 D: 2.50
Node5 0.00
Link42 Q: 0.00 D: 2.50
Node7 0.00
Link48 Q: 0.00 D: 2.00
Bypass 0.00
Link47 Q: 0.00 D: 2.00
Node8 0.11
Link33 Q: 0.01 D: 2.50
Node9 0.03
Link32 Q: 0.13 D: 2.50
Node10 0.14
Link31 Q: 0.02 D: 2.50
Node11 0.06
561.10
587.20
200.00
200.00
351.30
431.20
434.60

Potomac Village

Domestic Water Executive Summary

Virginia American Water Company (VAWC) has provided christopher consultants with a letter stating that the project is within the company's franchised area and that fire and domestic water is available to serve the proposed developed. With further conversations with VAWC, we prepared a conceptual water service layout for the project. The plan shows a looped 12" water service throughout the project and tying into existing infrastructure at the south and north ends of the site. It is anticipated that booster pumps will be in the buildings to meet fire service requirements. It is also anticipated that project will experience a reduction in water demand by implementing Water Harvesting and Reuse for irrigation purposes and only the use of low flow plumbing fixtures.