

# christopher consultants engineering surveying stand planning

# 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 Iosonpachleoelopmentung: August 2809



Source: www.epa.gov

 Function
 Image: Constraint of the second of the second

Source: www.treehugger.com

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christopher consultants organization-surround - land pleasing August 2009

# 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: Instingeetdevelopmontory August 2009



Source: www.bawksandowk.com





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# 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.

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Drainage Pavement Raimesiar penetrate into volds in the percus exclace layer and is <u>strainad</u> out to the readstidadrainage system. Raimwater desart penetrate into Binder Course and lower layers. This paystemet is mainly explanitie to reade in a city area and highways.



Permeable Pavement Asinvisier penetrale into porces curiace layer, beae course layer and subgrads. Water in retained in the pavential structure and raturned to undarground. This pavement is mainly applicable to the sidewalk pavement, paving lot and fight table rooks in a city

Source: www.ininponroad.co.jp



Source: www.wen.nesu.edu







christopher.consultants August 2008

# 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.nwex.edu



Source: www.contrownstadios.com



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# 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











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# Rainwater Catchment



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#### BEST MANAGEMENT PRACTICES (BMP) NARRATIVE

THIS PROJECT, POTOMAC VILLAGE, CONCEPTUALLY PROPOSES TO TREAT THE STORTHAATER 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 249,542 CF AND CAN BE HET IN THE FACILITY AS CURRENTLY PLANNED. OF THE REFLAINING 18.6 ACRES, 10.4 ACRES WILL BE TREATED WITH A VARIETY OF LIDS AND IMPS AND 8.2 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 ISS THAT IS RECOGNIZED BY THE CITY OF ALEXANDRIA FOR OUR COMPLIANCE CHECK CALCULATIONS FOR LIDS AND IMPS. THE REFLAINING 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 DEVELOPTIENT) HAS BEEN USED TO CALCULATE THE POLLUTANT RETIOVAL 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.

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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

christopher consultants, itd. 9900 main street (fourth floor) fairfax, virginia 22031-3907 voice 703.273.6820 fax 703.273.7636 web site www.chr/stopherconsultarits.com Ms. Emily Baker November 25, 2009 Page 2

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 n Warl

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

			Applicant's Estimate	Applicant's Estimate
Potomac Yard	City of Alexandria's	Applicant's Estimate	Low Flow Fixtures-PV	Low Flow Fixtures
	Estimate (MGD)	(MGD)	(MGD)'	All Future (MGD) <sup>2</sup>
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
Oakville Triangle Total West Side Rt. 1	0.1400	0.1400 0.3820	0.1400	0.0910
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 F	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
Evicting Dovelonments				
Existing Developments	0.0231	0.0225	0.0225	0.0226
GW Club	0.024	0.0220	0.0220	0.0220

			-	
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:\*

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

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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



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

October 07, 2009

Joseph Antunovich, AIA ANTUNOVICH ASSOCIATES 224 West Huron Street, 7<sup>th</sup> 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:.

<u>Fixture</u>	<u>Base Design</u>	Proposed Design	<u>Savings</u>
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











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EXHIBIT 6

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#### APPLICANTS ESTIMATE

	Upstream Node	Downstream	Upstream Invert	Downstream invert	Length	Conduit		Diameter	Max. Depth	Free Board	Design Full	Design Full	Max Flow	Max Flow	Max Flow/Design
Name	Name	Node Name	Elevation (ft)	Elevation (ft)	(ft)	Slope (%)	Roughness	(ft)	(ft)	(ft)	Flow (cts)	Flow (MGD)	(ofs)	(MGD)	Flow (%)
30-Inch O	fisite Trunk Sewe	¥	_	-											
Link41	Node1	Node0	-7.28	-7.50	60.3	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%
	Node4	Nodes	-3.83	-4.64	389.0	0.203	0.0105	2.50	3.54	-1.04	22.68	14.76	33.70	21.74	14(7)
	NOCIED	NODE4	-2.24	-3.78	561.1	0.274	0.0105	2.50	4,41	-1.91	29.60	17.16	33,70	21.74	121%
1.014	NODEr	NOCED Maria 7	0.01	-2.37	36/.2	0.3/1	0.0105	2.50	4,71	-2.21	30.94	19,90	33.70	21.74	20020
1.111.20	NateD	NULLE/	1.40	0.05	361.0	0,102	0.0105	2.00	0.00	-3.50	10.24 20.50	10.40	30.70	40.05	1054
	Nodel	Nodo	1.72	177	AG1 0	0.291	0.0105	2.60	6.94	-9-33	28.00	17:95	20.94	10.00	11594
	Nodell	Node10	2.00	9.01	434.6	0.201	0.0105	2.50	650	-0.04	26.46	17.07	30.85	10.00	117%
Link30	Node12	hinda11	5.55	4 49	9264	0.325	0.0105	250	6.52	4.02	28.94	18:57	30.85	19:90	107%
Link29	Node13	Node12	8 62	5.60	315.4	n 292	0.0105	2.50	6.69	-4.19	27.49	1770	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	80.85	19.90	125%
Link27	Node15	Node14	8.56	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	Node15	10.75	10.06	410.9	0.168	0.0105	2.50	7.65	-5.15	20.81	18.49	27.70	17.87	133%
Link24	Node18	Node17	12.12	11.01	424.4	0.282	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	16.07	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	6,82	-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	None23	18 <u>.26</u>	17. <b>70</b>	281.2	0:199	0.0105	2.50	5.88	-8.36	22.66	14.62	23.39	15.03	103%
27-inch 0	nsite Trunk Sewe	f .												· ·	
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%
Link 16	Node28	Node25	19,90	19,33	197.5	0.289	0.0105	2.25	5.94	-3.69	20.60	15.28	23.30	15.03	113%
Link15	Node2/	Node25	21.09	20.10	402.0	0.246	0.0105	2.25	6.20	-3.95	19.03	12,28	23,30	15.03	1225
	Nodeza	NOGEZ/	21,99	21.14	209.5	0.377	0,0105	2,25	6,15	-3.90	23,55	15,19	23.90	15.42	101%
Linki 3	NOGB29	N00920	22.50	22,08	190.0	0.371	0.0105	2.25	5.83	-3.06	23.31	10,00	23.53	10.00	19170
LINK 14, Débend	Notes 20	Note:20	2/ 20	20.01	35.0 906 A	0.394	0.0105	2,20	0.84 E 98	-2.07	21.47	30.40	23,45	15.10	10796
199640	Notesti Notesti	Note: 10	24.90	20.04	679.0	0.320	0,0105	2,23	5.40	-9.10	341.497 391.331	19.09	23.46	15.19	1947 PR 14 696
Linko	Nocie 310	None31	25 45	25.02	199.0	0.929	0.0105	2.20	5.95	-3.00	21.80	14.06	23.04	14.86	106%
Links	Node32	Norie31A	28.25	25.56	297.5	0.903	0.0105	2.25	6.24	-2 991	21.11	13:62	23.05	14.87	109%
Link44	Node33	Noda32	27.23	26.37	360.5	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	4.96	-2.11	25.84	16.74	22.94	14.80	68%-
ONSITE P	UMP STATION			-ț-m-	•										
24-incb O	nsite Trunk Sewe	et.													
Link47	Node2	LS	13.87	13,38	151.9	0.323	0.0105	2.00	2,07	-0.07	15.91	10.26	21.55	13.91	136%
Link46	Node3	Node2	14.44	13.97	124.2	0,978	0.0105	2.00	2,20	-0.20	17.23	11.12	21.55	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%
Link97	Node5	Node4	15,98	15.15	244.4	0.331	0.0105	2.00	2,66	-0.86	16.12	10.40	20.76	19,39	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	18.17	10.43	20.76	13.39	128%
Link3S	Node7A	Node7	17.98	17.50	146.9	0.827	0.0105	2.00	3.68	-1.68	16.01	10,38	20.76	15.39	130%
Link32	Node8	Node7A	16.72	18.08	195.0	0.328	0.0105	2.00	4.00	-2.00	16.05	10.35	20.76	13.39	129%
Linic31	Node9	Node8	19.61	18.62	237.0	0.333	0.0105	2.00	4.40	-2,40	16.17	10.49	20.76	13.39	12676
Link30	Node9A	Node9	20.06	19.71	107.8	0.325	0.0105	2.00	4.53	-2.53	15.98	10.30	20.76	13.39	130%
CIUK53	NOCETU	NOCISIA	20.63	20.16	203.4	0.329	0.0105	200	4,05	-2.66	16.07	10.37	20.76	13.39	12576
LINK28	NODE11	NOCIBIU	21.70	201.95	246.4	0.333	0.0105	2.00	5.27	-3,27	18.16	10.35	20.76	13.39	120%
1.5.1.00	NOGE12	NCC911	CC-34	21.05	210.1	0.325	0.0105	2.00	3,04 ¢.09	-3.01	10.00	10.33	20.70	10.20	14076
	Nodel J	NGC1012	20.40	22.04 03.60	404.2	0.331	1.0105	4.00	0.03	-4.03	10.10	10.35	20.70	13,35	14.0%
Link20	Node15	Modeld	29/91 97-00	60.00 04.66	4001-05 97/0-0	0.330	0.0105	2.00	800		10.00	10.07	10.17	19.88	7696
LANGER Linker	Nodolf	Alorio15	41.00 29.57	27.00	3/3.2	0.048 2.102	0.0105	2.00	4.42		20.00	95.94	6.03	12.00	164
LH1K40	1400810	CIGNAR	20.01	21.30	19.3	<b>N</b> 1 Col	0.0100	باللية	4.46	-6.44	33.20	561,JH	ويتعب	4.06	10.00

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EXHIBIT 6

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#### Low Flow Fod - Potomac Village

	Upstream Node	Downstream	Upstream Invert	Downstream Invert	Length	Conduit		Diameter	Max Depth	Free Board	Design Full	Design Full	Max Flow	Max Flow	Max Flow/Design
Nan	e Name	Node Name	Elevation (1)	Elevation (ft)	(ft)	Stope (%)	Roughness	(ft)	(fl)	(ft)	Flow (cfs)	Flow (MGD)	(cfa)	(MGD)	Flow (%)
30-li	ich Offsite Trunk Sewe	х. 													
Link	T 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%
Link	10 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%
Link	39 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%
Link	38 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%
Link	37 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	116%
Link	12 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%
Link	34 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%
Link	33 Node9	Node8	1.72	0.53	351.3	0.339	0.0105	2.50	3.61	-1.11	29.55	10.07	27,74	17.90	94%
Link	2 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%
Link	1 Nodal 1	Node10	4.39	3.21	434.6	0.272	0.0105	2.50	3.36	-0.86	25.45	17.07	27.65	17.84	104%
Link	30 Node12	Node11	5.55	4.49	326.4	0.325	0.0105	2.50	3.26	-0.76	28.94	16.67	27.85	17.84	96%
Link	29 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%
	25 NODE14	NODE13	7.43	6.62	340.8	0.236	0.0105	2.50	3.20	-0.70	24./6	15.97	27.85	17.84	112%
Link	27 (NOOL015)	NOGe14	8.66	7969 8 65	430.1	0.272	0.0105	2.50	3.24	-0.74	25.49	17.09	27.65	17.84	104%
LINK	16 NGGE16	NDGe13	8./1	\$.¥/	416.8	0.178	0.0105	2.50	3.11	-0.01	21.40	13.81	24.50	15.81	114%
	20 NO(1917	Nocie 16	10.75	10.00	410.8	0.168	0.0105	2.50	2.24	-0.44	20,81	18,43	24,06	15.88	110%
Cares.		Nordert Co	10.12	10.47	407.0	0.202	0.0405	2.30	6.00	49,10	20.31	15.70	20.11	10.21/	9/76 (TW
	20 Nodes19	Nedato	10.90	14.97	92/ 10	0.232	0.0105	2.50	1.00	0.02	24.40	10.77	23.00	10.20	0170
1111	zz (NOUEZU Mode21	Notero	1920/	14 94-	2042	0.230	0.0105	250	1.30	A 77	29.00	16.67	23.33	1961	807/0 2014
Link		Noto21	18.99	16 04	362.2	0.200	0.0105	2.60	1 64	0.97	20.11	10.01	21.00	12 14	7996
Link	IQ Node23	Notes	17.51	18.97	221.8	0.243	0.0105	2:50	1 74	676	25.06	16 17	21 27	19.79	85%
i inte	8 Made24	Nivia23	18:26	17.70	261.9	0.199	6.0105	2.50	1.60	0.70	22.66	14 62	20.77	19.40	92%
27.4	ch Onsite Trunk Seve	1				0.100	90 (90		1.00	4-9		1.4.44		l on to	
Link	7 Node25	Node24	18.21	18.28	276.0	0.397	0.0105	2.26	1.78	0.47	22.26	14.56	20.74	13.98	83%
Link	6 Node26	Node25	19.90	19.33	187.5	0.269	0.0105	2.25	1.77	0.48	20.60	13.29	20.70	13.35	100%
Link	5 Node27	Node26	21.09	20.10	402.0	0.246	0.0105	2.25	1.191	0.34	19.03	12.28	20.46	13.20	108%
Link	4 Node28	Node27	21.93	21.14	209.5	0.377	0.0105	2.25	1.88	0.39	23.55	15.19	22:03	14.21	94%
Link	3 Node29	Node28	22.60	22.08	140.0	0.871	0.0105	2.25	1.69	0.56	23.87	15.08	21.33	13.78	91%
Link	12 Node29A	Node29	23.29	22.57	39.5	1,823	0.0105	2.25	1.72	0.53	51.77	39.40	20.76	13.39	40%
Link	1 Node30	Node29A	24,50	23,34	295.0	0.925	0.0105	2.25	1.77	0.48	21.87	14.11	20.72	13.97	95%
Link	0 Node31	Node30	24.89	24,41	173.0	0.277	0.0105	2.26	1.79	0.46	20.20	19.03	20.77	13.40	103%
Linic	Node31A	Node31	25.45	25.02	133.0	0.323	0.0105	2.25	1.69	0.58	21.80	14.08	20.17	19.01	93%
Linid	Node32	Node31A	26.28	25.56	237.5	0.803	0.0105	2.25	1.74	0.61	21.11	13.62	20.18	19.02	96%
Link	14 Node33	Node32	27.23	26.37	300.5	0.286	0.0105	2.25	1.80	0.46	20.51	19.23	19.97	12.88	97%
Link	13 Node34	Node3S	28.74	28.20	116.0	0.458	0.0105	2,25	1.61	0.64	25.94	16.74	19.53	12.60	75%
ONS	TTE PUMP STATION									•					
24-6	ich Onsite Trunk Seve	97 - C		÷	e.,										A 1
Unix	7 Node2	LS	13.87	13.38	151.9	0.323	0.0105	200	1.75	0.25	15.91	10.26	18.36	11.85	115%
Link	15 Node3	Node2	14.44	13.97	124.2	0.978	0.0105	2.00	1.70	0.30	17.23	11.12	18.17	11.72	105%
Link	B 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%
LING	S/ NOGES	F100004	13.95	12.15	299.4	0.391	0.0105	200	1.73	0.2/	16.12	10.40	17,19	11.09	10/%
	12 NOGE5	NOCED	10.82	10.46	220.3	0.880	0.0105	8,00	1.73	0.2/	16.09	10.38	17-35	11,17	108%
Linka	14 NODE/	NOCED	17.40	10.92	144.0	0.333	0.0105	2,00	1.07	0,33	16.17	10.43	17.15	11,06	105%
	S3 NOOB/A	NUCE/	17.50	17.50	140.0	0.327	0.0105	2.00	1.67	0.33	10.01	10.33	17.14	11.06	10/76
م اسلار م اسلار	VZ NOUES	Nodaž	10.72	10.00	10020	0.325	0.0105	2.00	1.69	0.20	16.17	10.49	17.04	10.89	100%
		Noda	90.08	10.04	107.9	0.335	0.0105	2.00	1.65	0.95	15.00	10.90	10.02	10.90	10696
مارون شارون	Norda10	Notes	20.89	20.16	0.101-0	0.323	0.0105	200	1.67	0.49	16.07	10.00	18.00	10.05	100%
	B Model1	Node10	21 75	20.09	248.4	0.993	0.0105	2.00	1.67	0.93	18 18	10.49	14.94	10.00	10.496
	17 Noria12	Nodel 1	22.54	21.85	210.1	0.998	0.0105	2.00	1.68	0.94	16.05	10.40	10.04	10.00	10594
- I - Inter	6 Node13	Node12	29 48	22.64	964.2	0.991	0.0105	200	1.67	0.33	16:10	10.99	16.82	10.85	184%
لى مى مەربا	S Node14	Node13	24.41	23.58	251.8	0.331	0.0105	200	1 57	0.43	16.09	10.37	15.94	0.83	08%
مەرىپ مۇرىز ا	A Node15	Mode14	27.88	24.66	379.2	0.849	0.0105	2.00	1 91	0.69	25.81	16.65	15 65	10.08	AMAL
Link	5 Node16	Note15	28.57	27.98	14.3	4 123	0.0105	2.00	1.05	0.95	39.28	25.94	6.73	4 34	17%



Ħ╉┈┝╉┈┈┝╉╴╶┝╼561.10⋗⋖587.20┝╉┈╴┝╉┈┝╅31.20-434.60-╉╶┝╉╴┝┫╴┝╉╝.10-╉┈╴┝╉24.40-427.00-╉┈┝┻┲┝┫┝┫╺┝┹┝┫┝┲**┼┝┼┝╋┽**┥┝╋╋┪┝╋╋┪┝╋╋┪┝╋

EXHIBIT 6

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#### Low Flow Flot - All Future

Name         Name <th< th=""><th></th><th>Upstream Node</th><th>Downstream</th><th>Upstream invest</th><th>Downstream Invert</th><th>Length</th><th>Conduit</th><th></th><th>Diameter</th><th>Max Depth</th><th>Free Board</th><th>i Design Full</th><th>Design Full</th><th>Max Flow</th><th>Max Flow</th><th>Max Flow/Design</th></th<>		Upstream Node	Downstream	Upstream invest	Downstream Invert	Length	Conduit		Diameter	Max Depth	Free Board	i Design Full	Design Full	Max Flow	Max Flow	Max Flow/Design
Skride Direkt Fund Kaper         17.5         1	Name	Name	Node Name	Elevation (II)	Elevation (ft)	(11)	Slope (%)	Roughness	(11)	(ft)	(ft)	Row (cts)	Flow (MGD)	(cfs)	(MGD)	Flow (%)
Links         Machel         Accel         Accel         Table         Machel         Concerned	30-Inch O	fisite Trunk Sewe	7													
Linka         Nacci:         Nacci: </td <td>Link41</td> <td>Node1</td> <td>Node0</td> <td>-7.28</td> <td>-7.50</td> <td>80.3</td> <td>0.274</td> <td>0.0105</td> <td>2.50</td> <td>1.90</td> <td>0.60</td> <td>26.58</td> <td>17.15</td> <td>27.64</td> <td>17.96</td> <td>105%</td>	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	17.96	105%
LHN2         Mod2         4.14         5.89         46.27         C.231         C.116         2.50         2.50         1.53         Z.744         7.788         102%           LHN2         Mode         C.31         C.31         C.31         C.31         C.35         C.31         C.35         C.34         Z.744         T.788         T.788 <t< td=""><td>Link40</td><td>Node2</td><td>Nodet</td><td>-6.38</td><td>-7.14</td><td>326.6</td><td>0.233</td><td>0,0105</td><td>2.50</td><td>214</td><td>0.37</td><td>24.50</td><td>15.81</td><td>27.84</td><td>17.95</td><td>114%</td></t<>	Link40	Node2	Nodet	-6.38	-7.14	326.6	0.233	0,0105	2.50	214	0.37	24.50	15.81	27.84	17.95	114%
Linko         Nodel         Adds         3.83         -4.84         38.06         0.233         0.016         2.26         2.11         0.178         7.24         17.88         17.84         17.74         17.84         17.74         17.84         17.74         17.84         17.74         17.84         17.74         17.84         17.74         17.84         17.74         17.84         17.74         17.84         17.74         17.84         17.74         17.84         17.74         17.84         17.74         17.84         17.74         17.84         17.74         17.84         17.74         17.84         17.84         17.74         17.84         17.74         17.84         17.84         17.84         17.74         17.84         17.84         17.84         17.84         17.84         17.84         17.84         17.84         17.84 <th17.84< th=""> <th17.84< th=""> <th17.84< <="" td=""><td>Link39</td><td>Node3</td><td>Node2</td><td>-4.74</td><td>-5.89</td><td>408.7</td><td>0.291</td><td>0.0105</td><td>2.50</td><td>2,05</td><td>0.45</td><td>26.94</td><td>17.36</td><td>27.84</td><td>17.96</td><td>103%</td></th17.84<></th17.84<></th17.84<>	Link39	Node3	Node2	-4.74	-5.89	408.7	0.291	0.0105	2.50	2,05	0.45	26.94	17.36	27.84	17.96	103%
Link3         Node:         4.3.7         Serie         Dirac         2.00         2.7.8         2.7.4         17.8         17.9	Lini:38	Node4	Node3	-3.83	-4.64	399.0	0.203	6.0105	2.50	2.31	0.19	22.88	14.76	27.84	17.96	122%
Link2         Mode5         Notes <sup>2</sup> Notes <sup>2</sup> O.S.1         -2.17         SP2 2         O.S.1         D.A.5         2.0.6         A.10         15.4         16.8         27.4         17.8         07%           Link3         Mode7         Link3         Link	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%
Lab2         Mode         Mode         Lab2         Mode         Mode         Z/As         17/8         17/8         17/8           Lab2         Mode         Mode         1.77         0.57         513         0.53         0.516         2.50         2.58         4.18         10.27         2.50         1.5 <td>Link42</td> <td>Node7</td> <td>Node5</td> <td>0.01</td> <td>-2.17</td> <td>587.2</td> <td>0.371</td> <td>0.0105</td> <td>2.50</td> <td>2.15</td> <td>0.35</td> <td>30.94</td> <td>18.96</td> <td>27.84</td> <td>17.96</td> <td>90%</td>	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%
Lakda Model Model 17.2 0.33 031 0.76 2.50 2.62 0.17 2.525 10.07 2.50 10.9 8%. Lakda Model 2.16 1.77 12.12 0.73 14.12 0.26 2.14 0.35 2.50 11.30 2.52 01.13 15.0 2.50 14.6 9%. Lakda Model 2.06 1.56 4.40 05.0 2.50 11.8 0.69 25.4 11.77 2.51 10.2 9%. Lakda Model 2.55 1.55 5.50 5.60 315.4 0.22 0.0105 2.50 11.8 0.52 2.47 11.77 2.51 10.2 1%. Lakda Model 1.051 7.43 0.62 300 0.23 0.0105 2.50 11.8 0.52 2.47 11.77 2.51 10.2 177. Lakda Model 1.051 7.43 0.62 300 0.23 0.0105 2.50 11.8 0.52 2.47 11.57 2.51 10.2 177. Lakda Model 1.051 7.43 0.62 300 0.23 0.0105 2.50 11.8 0.52 2.47 11.57 2.51 10.2 177. Lakda Model 1.051 7.43 0.62 300 0.23 0.0105 2.50 1.94 0.52 2.47 11.57 2.51 10.2 177. Lakda Model 1.051 17.7 12.12 1.0 11 444 0.12 0.010 2.50 1.94 0.65 2.46 17.0 13.2 2.52 1.41 107. Lakda Model 1.0601 1.0.51 1.47 47 47.0 0.22 0.0105 2.50 1.94 0.65 2.46 17.0 13.2 2.52 1.43 107. Lakda Model 1.0.601 1.0.5 1.47 47 47.0 0.22 0.0105 2.50 1.94 0.65 2.44 10.7 2.24 14.47 07. Lakda Model 1.0.65 1.0.7 12.12 1.0 11 444 0.010 2.20 2.10 2.40 0.20 1.94 0.65 2.44 10.7 2.24 14.47 07. Lakda Model 1.0.65 1.0.7 12.12 1.0 11 444 0.010 2.20 1.00 4.20 1.97 0.65 2.44 10.7 2.24 14.47 07. Lakda Model 1.0.65 1.0.7 12.12 1.0 11 444 0.010 2.20 0.010 2.50 1.94 0.66 2.46 10.07 2.24 14.47 07. Lakda Model 1.0.65 1.0.7 12.2 1.0 12 1.0 2.20 0.010 2.50 1.94 0.06 10.0 10.0 10.0 7.22 1.0 14.7 0.7 1.0 14.7 0.02 1.0 10.0 10.0 10.0 10.0 10.0 10.0	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%
Land2 Noos10 Noos20 Noo	Link33	Node9	NodeB	1.72	0.53	351.8	0.339	0.0105	2.50	2.62	-0.12	29.56	19.07	25.09	16.19	65%
Luck         Model 1         Model 1         State 1         44.6         0.272         0.0105         25.0         1.82         0.59         28.4         1.707         28.16         16.19         87.4           Luckids         Model 1         5.55         4.40         5324         0.0105         2.50         1.80         0.52         2.476         15.577         2.16         10.23         87.4           Luckids         Model 4         4.66         7.43         6.62         3.40         0.226         0.106         2.50         1.84         0.55         2.4.64         17.67         2.5.8         1.84         1.84         2.2.8         1.84         1.84         2.2.8         1.84         1.84         2.2.8         1.84         1.84         2.2.8         1.84         2.2.8         1.84         1.84         1.84         2.8.9         1.84         2.2.8         1.84         1.84         2.8.9         1.8.4         2.8.9         1.8.6         2.8.9         1.8.6         2.8.9         1.8.6         2.8.9         1.8.6         2.8.9         1.8.6         2.8.9         1.8.6         2.8.9         1.8.6         2.8.9         1.8.6         2.8.9         1.8.6         2.8.9         1.8.6         2.8	Link32	Node10	Node9	2.98	1.77	491.2	0.281	0.0105	2.60	2.14	0.38	26.90	17.35	25.20	16.26	94%
Lundar Moori 2 Model 2 Nodel 1 5.5 4.49 324 0.328 0.0106 2.50 1.80 0.69 24.4 16.57 24.18 16.23 87%. Lundar Moori 1 Model 2 5.5 5.6 0.4 316.0 0.328 0.0106 2.50 1.80 0.56 2.40 17.09 2.58 16.13 120 0.5%. Lundar Moori 5 Model 4 6.68 7.49 40.1 0.272 0.0105 2.50 1.80 0.56 2.48 17.09 2.58 16.13 126%. Lundar Moori 5 Model 6 0.71 10.75 10.06 41.0.9 0.168 0.0106 2.50 1.80 0.56 2.55 16.7 32.44 16.77 2.24.5 11.11 10.7%. Lundar Moori 5 Model 1 10.75 10.06 41.0.9 0.168 0.0106 2.50 1.80 0.46 2.57 16.77 2.44.5 11.77%. Lundar Moori 5 Model 1 10.75 10.06 41.0.9 0.168 0.0106 2.50 1.87 0.68 24.49 16.77 2.44.7 14.14 00%. Lundar Moori 8 Model 1 10.75 10.06 41.0.9 0.188 0.0106 2.50 1.87 0.68 24.49 16.77 2.44.7 14.14 00%. Lundar Moori 8 Model 1 10.75 10.06 41.0.9 0.188 0.0106 2.50 1.87 0.68 24.49 16.77 2.44.7 14.14 00%. Lundar Moori 8 Model 1 10.75 10.06 41.0.9 0.188 0.0106 2.50 1.87 0.68 24.49 16.77 2.44.8 14.50 0.00%. Lundar Moori 8 Model 1 10.75 10.08 15.94 20.0 0.0106 2.50 1.87 0.68 24.49 16.77 2.44.8 14.50 0.00%. Lundar Moori 8 Model 1 10.7 11.0.14 0.44 0.028 0.0106 2.50 1.78 0.68 24.49 16.77 2.44.8 14.50 0.00%. Lundar Moori 8 Model 1 10.59 11.0.29 12.0.0 0.016 2.50 1.78 0.78 2.50 16.10 19.43 2.60 13.90 7.74. Lundar Moori 8 Model 1 10.0 11.000 11.000 2010 0.016 2.50 1.78 0.78 2.50 16.10 19.43 2.60 13.90 7.74. Lundar Moori 8 Model 1 10.0 11.000 11.000 2010 0.016 2.50 1.78 0.78 2.50 16.10 12.0 0.13.90 7.74. Lundar Moori 8 Model 1 10.0 11.000 11.000 0.020 0.016 2.50 1.78 0.78 2.50 16.10 12.0 0.13.90 7.74. Lundar Moori 8 0.000 11.000 0.000 0.000 0.000 0.25 1.00 0.000 11.000 0.000 11.000 0.000 11.000 0.0000 0.0000 0.000 0.0000 0.0000 0.000 0.0000 0.	Unk31	Node11	Node 10	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%
Lukasi Noosini Modeli 2 6.52 5.60 316.4 0.232 0.0105 2.50 1.86 0.54 2.7.43 17.70 2.817 16.24 16.25 105.4 105	Link30	Node12	Node11	5.55	4,49	326.4	0.325	0.0105	2.50	1.82	0.69	28.94	16.67	25.15	16.23	87%
Land 22, Nooki 14, Noohi 1, 7,42, 4,62, 340,2,0,228, 0,010,5,2,50,1,84,0,35,2,24,6,15,7,2,5,15,16,2,2,14,0,15,2,14,14,15,14,14,14,14,14,14,14,14,14,14,14,14,14,	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	82%
Late: Nedelis Nedelis Nedelis Nedelis 2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.	Link2B	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%
Linka: Noofit No	Link27	NOC615	NODE14	8.66	7.49	450.1	0.272	0.0105	2.50	1.94	0.56	26.49	17.09	25.26	16.31	80%
Link2: No.0617 Nome10 11.75 10.06 A10.8 Latter 200 200 200 200 200 200 200 200 10.77 10.78 20.07 10.07 20.45 11.77 10.77	10026	NOCI816	NO0915	8.71	6.97	416.8	0.178	0.0105	2.50	2.02	0.48	21.40	13.81	22.85	14,81	10/%
Linkie Nobelis Modelli (1212) (121) 4244 (222) (120) (220) (20) (20) (20) (20) (20) (20)	0025	Node17	Node16	10,75	10.06	410.9	0,168	8,0105	2.50	2.05	0.46	20.81	13.48	23.02	14,85	111%
Lance: Nodels Nodels 1.247 420 022 0010 200 124 147 007 2243 147 007 124 147 007 144 144 147 007 007 144 007 144 144 147 007 000 000 000 000 000 000 000 000 0	Link24	Node18	NODE17	12.12	11.01	424.4	0.262	0.0105	2.50	1.86	0.64	25.97	16.75	28.47	16:74	50%
Linkis Node21 Node21 16.26 17.0 16.7 17.0 2014 2010 2.20 1.27 0.005 24.8 16.0 22.4 16.0 2.4 17.0 16.0 22.4 17.0 16.0 2014 17.0 17.4 17.0 17.4 17.0 17.4 17.0 17.4 17.0 17.4 17.4 17.4 17.4 17.4 17.4 17.4 17.4	LENK23	N00619	NOODIS	13.45	12.47	427.0	0.232	0,0106	2.50	1.8/	0.63	24.45	10.77	22.52	14.53	SEA
Linko Nooko		NOC620	NOCEE19	14.07	13.73	394.3	0.238	0.0105	2.50	1.59	0.00	24.80	16.00	22.93	14.4/	SV16
Lunic Notez		NDOB21	NOCEZU	10.60	15.04	3/6.3	0,268	0.0105	2.50	1.7	0.79	20,31	10.87	20.04	13.01	
Linkis Nobel Nobel 14.2 10.2 10.2 10.2 10.2 10.2 200 11.6 2.2 11.7 10.4 1.6 200 16.17 20.6 13.2 974. 274ba Onate Trank Searce Linkis Nobel 15.16 10.2 10.2 10.2 10.2 10.0 2010 2.2 10.0 10.0	Linkzu	NODEXZ	NODEZT	18,83	15.99	208.2	0.351	0.0105	2.50	1.62	0.68	30.11	19,43	24.66	18.55	147
Links         Models         Models </td <td>LINKIN</td> <td>NOCEZS</td> <td>NOOB22</td> <td>17.51</td> <td>10,87</td> <td>22(2)</td> <td>0.243</td> <td>0.0105</td> <td>2,50</td> <td>1.73</td> <td>0.78</td> <td>20.00</td> <td>10.17</td> <td>21.00</td> <td>10.09</td> <td>047A</td>	LINKIN	NOCEZS	NOOB22	17.51	10,87	22(2)	0.243	0.0105	2,50	1.73	0.78	20.00	10.17	21.00	10.09	047A
Link T         Notable T         N	10KIG	NOO24	MORTHEN .	10,20	17.70	261.2	0,189	<u>n n</u> na	200	1.79	.92.71	24.00	14.02	20.00	13-20	Q176.
Luki 1, Notezi Notezi 12,1 102,2 10,0 2,20 0,000 2,20 1,7 0,000 2,20 1,7 0,000 12,20 2,000 13,20 20,00 13,20 1025, 12,1 14,1 14,1 14,1 14,1 14,1 14,1 14,		New COM	E.	10.91	10.00	070 0	0.007	0.0105	0.05	4 77	A 49	00.00	14.02	00.50	19.00	-channel -
Linkis         Notacias         <	Lapri/	Maria 26	Node25	19.00	10.00	107 8	0.307	0.0105	2.00	1.72	0.40	20.60	19:30	20.00	19.20	100%
Linki H.         Notadz         Natural H.         Ziniti H.         Natural H.         Ziniti H.         Natural H.         Ziniti H.         Natural H.         Ziniti H. <thzinit h.<="" th=""> <thzini h.<="" th=""> <thzini< td=""><td>Links to</td><td>Made 27</td><td>Nodo26</td><td>21.00</td><td>30.10</td><td>402.0</td><td>0.203</td><td>0.0105</td><td>2.00</td><td>4.00</td><td>0.26</td><td>10.02</td><td>10.50</td><td>20.00</td><td>19.00</td><td>1000</td></thzini<></thzini></thzinit>	Links to	Made 27	Nodo26	21.00	30.10	402.0	0.203	0.0105	2.00	4.00	0.26	10.02	10.50	20.00	19.00	1000
Linki Nodeš2 Nodež Nodež 12260 22.62 140 0.371 0.0105 2.25 1.26 0.67 2.337 10.0 0.13 1.20 0.77 30.40 20.56 13.26 40%. Linki Nodež Nodež 22.26 22.26 22.57 38,5 1,62 0.032 0.0105 2.25 1.78 0.67 2.337 10.0 21.57 14.11 20.56 13.26 40%. Linki Nodež Nodež 24 Nodež 22.20 22.67 38,5 1,62 0.032 0.0105 2.25 1.78 0.67 20.20 13.03 20.55 13.26 102%. Linki Nodež 24 Nodež 24 12.20 23.44 173.0 0.371 0.0105 2.25 1.78 0.47 20.20 13.03 20.55 13.26 102%. Linki Nodež 24 Nodež 14 22.28 25.66 237.5 0.800 0.0105 2.25 1.78 0.47 20.20 13.03 20.55 13.26 102%. Linki Nodeš 14 Nodeš 1 8.45 25.02 133.0 0.322 0.0105 2.25 1.78 0.47 20.20 13.03 20.55 13.26 102%. Linki Nodeš 24 Nodeš 1 8.45 22.28 25.66 237.5 0.800 0.0105 2.25 1.78 0.47 20.20 13.03 20.55 13.28 06%. Linki Nodeš 24 Nodeš 28 Nodeš 1 4.22 28 25.67 28.00 0.0105 2.25 1.78 0.47 20.20 13.03 20.55 13.28 06%. Linki Nodeš 28 Nodeš 28 Nodeš 28.74 23.20 118.0 0.458 0.0105 2.25 1.78 0.47 20.51 13.22 19.47 12.88 06%. Linki Nodeš 28 Nodeš 28.74 23.20 118.0 0.458 0.0105 2.25 1.59 0.866 25.94 16.74 19.52 12.44 74%. Vinki Nodeš Nodeš 14.24 13.97 12.42 0.276 0.0105 2.00 1.74 0.26 15.01 10.26 18.15 11.71 114%. Linki Nodeš Nodeš 15.05 14.44 13.97 124.2 0.376 0.0105 2.00 1.74 0.26 15.01 10.26 18.15 11.71 114%. Linki Nodeš Nodeš 15.05 14.44 13.97 124.2 0.376 0.0105 2.00 1.74 0.26 15.01 10.26 18.15 11.77 11.46 10.04%. Linki Nodeš Nodeš 15.05 14.44 0.331 0.0105 2.00 1.74 0.26 15.01 10.26 18.15 11.71 114%. Linki Nodeš Nodeš 16.02 14.04 18.02 14.08 20.30 0.0105 2.00 1.76 0.23 15.03 10.24 17.73 11.47 111%. Linki Nodeš Nodeš 10.02 17.40 18.22 14.00 0.333 0.0105 2.00 1.74 0.26 15.01 10.28 10.14 17.78 11.47 111%. Linki Nodeš Nodeš 10.02 17.40 18.22 14.00 10.20 1.71 0.29 18.00 10.38 17.01 10.97 100%. Linki Nodeš Nodeš 10.62 10.62 10.65 0.02 1.71 0.29 18.00 10.51 10.55 10.57 10.57 10.57 10.55 10.55 10.55 10.55 10.55 10.55 10.55 10.50 10.5 10.5	Linkid	Node28	Node27	21.02	21.14	1000-8	0.277	0.0105	2 36	1 84	0.30	12,05	16 10	21.01	14.07	0.20
Linki         Nucleiza         Linki         Linki         Nucleiza         Linki         Linki	Linki?	Node20	Node27	21.60 92.60	22.00	140.0	0.277	0.0105	2.25	1:00	0.57	63.00	16/19	21 19	19.02	3-370 G/TeV
Linki Node20         Node20         24.30         23.41         23.62         0.102         2.62         1.71         0.47         0.117         20.01         12.00	Linki 2	Noda294	Norla29	29.20	22.57	90.5	1.923	0.0105	2.26	1.00	0.67	A1 77	92.60	20.56	19.96	Allar.
Linkto Nodešči Nodešči 24.89 24.41 172.0 0.277 0.0105 2.25 1.78 0.47 20.20 13.06 20.57 12.28 12.	linkt 1	Node 20	Norlo20A	24.30	23.94	208.0	0.925	0.0105	2 25	1.79	0.50	21.87	14.51	20.51	13.93	0.44
Links Node31A Node31 25.45 25.02 1130.0 0.223 0.0105 2.25 11.68 0.77 21.80 14.66 149.77 12.88 82% Links Node32 Node31Å 20.28 27.23 26.37 300.5 0.288 0.0106 2.25 1.73 0.57 21.80 14.66 149.77 12.88 82% Links Node33 Node32 27.23 26.37 300.5 0.288 0.0106 2.25 1.73 0.57 21.80 14.66 149.77 12.88 82% Links Node33 Node34 Node33 27.23 26.37 26.20 118.0 0.458 0.0105 2.25 1.59 0.66 25.54 16.74 19.32 17.48 74% Units Node33 Node34 Node33 28.74 28.20 118.0 0.458 0.0105 2.25 1.59 0.66 25.54 16.74 19.32 17.48 74% Links Node34 Node33 15.55 14.54 13.97 124.2 0.378 0.0105 2.00 1.74 0.26 16.91 10.26 18.15 11.71 114% Links Node34 Node3 15.55 14.54 155 0.427 0.0106 2.00 1.74 0.26 16.91 10.26 18.15 11.71 114% Links Node5 Node3 15.55 14.54 155 0.427 0.0105 2.00 1.72 0.28 16.03 10.34 17.78 11.47 114% Links Node5 Node5 16.82 16.06 0.227 0.0105 2.00 1.71 0.29 18.12 10.40 18.26 10.34 10.26% Links Node5 Node5 16.82 16.06 0.297 0.0105 2.00 1.71 0.29 18.10 10.38 10.04 15.96 10.34 10.9% Links Node5 Node5 16.82 16.08 240.0 0.33 0.0106 2.00 1.71 0.29 18.10 10.38 17.01 10.97 106% Links Node7 Node5 16.82 16.08 124.0 0.33 0.0106 2.00 1.71 0.29 18.10 10.33 16.64 10.86 10.34 105% Links Node7 Node5 16.82 16.08 19.57 0.0106 2.00 1.65 0.35 16.17 10.43 16.69 10.38 105% Links Node7 Node5 17.40 16.62 14.44 0.33 0.0106 2.00 1.65 0.35 16.17 10.43 16.69 10.86 105% Links Node7 Node5 19.6.22 18.08 195% Links Node7 Node5 10.6.22 18.08 195% Links Node7 Node5 10.6.2 19.09 19.33 0.0105 2.00 1.68 0.34 16.17 10.43 16.69 10.58 105% Links Node7 Node5 10.6.2 10.08 195% Links Node7 Node5 10.6.2 19.09 19.71 107.8 0.325 0.0105 2.00 1.68 0.34 16.07 10.33 16.64 10.85 105% Links Node7 Node6 17.4 18.72 18.08 195% 10.20 1.68 0.34 16.07 10.33 16.64 10.85 105% Links Node7 Node6 19.74 18.72 18.08 195% 10.20 1.64 0.38 16.07 10.33 16.64 10.85 105% Links Node1 Node9 20.08 19.71 107.8 0.325 0.0105 2.00 1.68 0.34 16.17 10.43 16.69 10.71 103% Links Node1 Node9 20.08 19.71 107.8 0.325 0.0105 2.00 1.64 0.38 16.07 10.33 16.49 10.55 10.55 10.55 Links Node1 Node1 20.38 10.73 102% Links Node	Linkto	Note31	Node30	24.89	26.41	179.0	0.977	0.0105	2.95	1.78	0.00	20.20	19.03	20.55	19.98	10294
Links         NodeS2         NodeS1         21.2         25.64         237.5         0.003         0.0105         2.25         1.73         0.53         21.11         11.82         10.47         12.28         66%           Link44         NodeS2         27.23         29.37         300.5         0.286         0.0105         2.25         1.78         0.47         20.51         13.23         19.73         12.74         6%           Unik44         NodeS2         27.4         28.20         116.0         0.458         0.0105         2.25         1.78         0.47         20.51         13.23         19.73         12.74         6%           OMSTEP FUMP STATION         24-Inch Oxde1         Trank Server          1         14.44         13.97         12.42         0.378         0.0105         2.00         1.68         0.32         17.23         11.12         17.39         11.47         11.45           Link57         Node3         Node3         15.15         24.44         0.331         0.0105         2.00         1.71         0.28         16.03         10.34         17.78         11.47         11145           Link52         Node5         Node5         16.82         16.03	Link9	Node\$1A	Norie 11	25.45	25.02	159.0	0.323	0.0105	2.26	1.68	0.57	21.80	14.06	19.97	12.68	0944
Link44         Mode33         Mode32         27.23         28.37         300.5         0.286         0.0105         2.25         1.73         0.47         20.51         10.23         16.73         12.73         99%           Link43         Node34         Node33         28.74         28.20         118.0         0.438         0.0105         2.25         1.76         0.47         20.51         10.23         16.73         12.73         99%           CINHTE FUNMK Semmer         24-Incbt Onsitte Trunk Semmer         24-Incbt Onsitte Trunk Semmer         11.44         13.97         12.42         0.376         0.0105         2.00         1.74         926         16.91         10.25         11.61         11.71         11.49%           Link47         Node3         15.05         14.54         155.6         0.827         0.0105         2.00         1.74         0.26         16.91         10.24         17.47         11.42         17.42         11.56         10.24         11.56         10.97%         10.96%         10.34         17.78         11.47         11.95%         10.97%         10.96%         10.34         17.77         11.47         11.95%         10.97%         10.97%         10.97%         10.97%         10.97%	Links	Node32	Node31A	26.28	25.56	237.5	0.803	0 0105	2.95	1.75	0.53	2111	19.62	19.97	12.88	0.99
Linklik       Nodeski       Nodeski       28.74       28.20       118.0       0.458       0.0105       2.25       1.50       0.66       25.94       16.74       19.32       12.48       74%         OMSTITE RUMP STATUCM       24-Inch Constite Trunk Gener       Inch       0.323       0.0105       2.00       1.74       0.26       15.91       10.26       18.15       11.71       114%         Link47       Node2       LS       13.87       13.38       15.19       0.323       0.0105       2.00       1.74       0.26       15.91       10.26       18.15       11.71       114%         Link48       Node3       Node4       15.55       14.44       15.92       0.0105       2.00       1.72       0.28       16.03       10.34       17.78       11.47       111%         Link47       Node5       Node5       16.62       16.62       20.30       0.330       0.0105       2.00       1.71       0.29       16.02       10.38       17.01       10.37       10.46         Link37       Node5       Node5       16.42       16.02       16.02       16.02       10.33       16.04       10.38       17.05       10.45       10.35       10.17       1	Link44	Node33	Node32	27.23	26.37	300.5	0.286	0.0105	2.25	1.78	0.47	20.51	18.29	19.73	12.73	AAN.
ONISITE PUBLIC Status         Particle Consists Trunk General         Data         13.38         151.9         0.323         0.0105         2.00         1.74         0.26         15.91         10.26         18.15         11.71         114%           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%           Link47         Node3         Node4         15.05         14.54         155.6         0.827         0.0105         2.00         1.72         0.28         16.03         10.34         17.78         11.47         111%           Link38         Node4         Node5         16.62         16.08         10.94         10.97         10.6%           Link42         Node7         Node7         Node6         17.40         16.92         10.33         0.0105         2.00         1.65         0.35         16.01         10.33         16.94         10.86         10.9%           Link34         Node7         Node7         17.88         17.60         146.9         0.327         0.0105         2.00         1.65         0.35         16.01	Link43	Node34	Node33	28.74	28.20	118.0	0.458	0.0105	2.25	1.59	0.66	25.94	16.74	19.92	12.48	74%
24-Inch Onsitie Trunk Segur         Linkk?         Nocks?         LS         13,87         13,38         151,9         0.323         0.0105         2.00         1.74         0.26         15,91         10.26         16.15         11.71         114%           Linkk?         Nocks2         154.44         13.97         124.2         0.376         0.0105         2.00         1.68         0.32         17.23         11.12         17.52         11.64         10.94           Links7         Nocks3         15.05         14.54         155.8         0.827         0.0105         2.00         1.72         0.28         15.03         10.34         17.78         11.47         111%           Links7         Nocke5         16.064         15.95         15.15         244.4         0.331         0.0105         2.00         1.71         0.29         16.12         10.40         15.96         10.94         10.94           Links7         Nocke5         16.064         17.40         15.92         144.0         0.333         0.0105         2.00         1.65         0.35         16.17         10.43         16.09         10.97           Link33         Nocke7         Nocke6         17.40         15.92	ONGITE P	UMP STATION		2.41.1	11.000		200 - 200 - 200 - 200 - 200 - 200 - 200 - 200 - 200 - 200 - 200 - 200 - 200 - 200 - 200 - 200 - 200 - 200 - 200			11 <b>4</b> -1			(	र <b>ाहर</b>		7.100
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         Node32         Node32         14.44         13.97         124.2         0.376         0.0105         2.00         1.68         0.322         17.23         11.12         17.78         11.47           Link38         Node43         15.05         14.54         155.6         0.262         10.10         2.20         1.71         0.28         16.03         10.34         16.96         10.94         10.97           Link37         Node5         Node5         16.05         14.54         0.531         0.0105         2.00         1.71         0.29         16.10         10.38         16.99         10.97         109%           Link37         Node5         17.40         16.92         144.0         0.333         0.0105         2.00         1.71         0.28         16.09         10.97         109%           Link33         Node7A         Node6         17.40         16.82         144.0         0.333         0.0105         2.00         1.85         0.3	24-Inch Q	nsite Trunk Sevre	r.													
Link46         Node3         Node2         14.44         13.97         124.2         0.378         0.0105         2.00         1.68         0.32         17.23         11.12         17.82         11.66         10.9%           Link38         Node4         Node3         15.05         14.54         155.6         0.827         0.0105         2.00         1.72         0.28         16.03         10.34         17.78         11.47         111%           Link37         Node4         16.95         16.15         244.4         0.331         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         16.01         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         16.01         10.33         16.94         10.86         10.95           Link32         Node7A         18.72         18.08         195.0         0.	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%
Linkss         Node4         Node3         15.05         14.54         155.6         0.227         0.0105         2.00         1.72         0.28         15.03         10.34         17.78         11.47         1115           Link37         Node8         Node5         16.02         15.05         244.4         0.331         0.0105         2.00         1.71         0.29         16.12         10.40         15.86         10.94         10.97           Link37         Node6         Node5         16.02         16.02         200.3         0.300         0.105         2.00         1.71         0.29         16.10         10.38         16.09         10.97         106%           Link34         Node7         Node6         17.40         16.62         144.0         0.333         0.0105         2.00         1.65         0.35         16.17         10.43         16.09         10.96         10.9%           Link33         Node7A         Node7         18.72         18.08         18.05         0.322         0.0105         2.00         1.85         0.34         16.17         10.43         16.99         10.96         10.9%           Link31         Node7A         18.62         20.70         0	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%
Link37         Nodes         Nodes         15,95         244.4         0.331         0.0105         2.00         1.71         0.29         16,12         10.40         18.86         10.84         10.95           Link42         Node5         Node5         16.62         16,09         230.3         0.330         0.0105         2.00         1.71         0.29         16.09         10.38         17.01         10.97         10.97           Link42         Node5         17.40         16.92         144.0         0.333         0.0105         2.00         1.71         0.29         16.09         10.38         17.01         10.97         10.97           Link33         Node7         17.98         17.60         146.9         0.3327         0.0105         2.00         1.85         0.35         16.01         10.33         16.94         10.96         1976           Link33         Node7A         Node7A         18.72         18.08         195.0         0.328         0.34         16.05         10.25         16.74         10.80         199%           Link30         Node9A         Node6A         19.61         14.82         237.0         0.333         0.0105         2.00         1.62         <	Link\$8	Node4	Node3	15.05	14.54	155.8	0.827	0.0105	2.00	1.72	0.28	16.03	10.34	17.78	11.47	111%
Link32         Node5         16.62         16.09         230.3         0.330         0.0105         2.00         1.71         0.29         16.09         10.38         17.01         10.97         106%           Link34         Node6         17.40         16.62         144.0         0.333         0.0105         2.00         1.65         0.36         16.17         10.48         16.09         10.38         17.01         10.97         106%           Link34         Node7         Node7         17.98         17.60         146.9         0.327         0.0105         2.00         1.65         0.35         16.01         10.33         16.94         10.86         10.97           Link32         Node7A         18.72         18.08         195.0         0.328         0.0105         2.00         1.68         0.34         16.05         10.25         16.74         10.80         10.97           Link31         Node9         Node8         19.61         18.82         237.0         0.323         0.0105         2.00         1.68         0.34         16.17         10.33         16.60         10.71         1037s           Link29         Node9A         Node9A         20.83         20.16 <td< td=""><td>Link37</td><td>Nodes</td><td>Node4</td><td>15.96</td><td>15.15</td><td>244.4</td><td>0.331</td><td>0.0105</td><td>2.00</td><td>1.71</td><td>0.29</td><td>18.12</td><td>10.40</td><td>16.96</td><td>10.94</td><td>105%</td></td<>	Link37	Nodes	Node4	15.96	15.15	244.4	0.331	0.0105	2.00	1.71	0.29	18.12	10.40	16.96	10.94	105%
Link34         Node7         Node6         17.40         18.92         144.0         0.333         0.0105         2.00         1.65         0.36         16.17         10.48         16.09         10.96         109%           Link33         Node7A         Node7A         Node7A         17.98         17.50         146.9         0.327         0.0105         2.00         1.85         0.35         16.01         10.33         16.99         10.96         109%           Link32         Node7A         18.72         18.08         195.0         0.328         0.0105         2.00         1.86         0.34         16.07         10.33         16.94         10.86         109%           Link31         Node9         Node8         19.61         18.82         287.0         0.333         0.0105         2.00         1.86         0.34         16.17         10.43         16.60         10.71         10.37%           Link32         Node9A         Node9         Node40         20.83         20.16         20.3         1.86         0.36         16.07         10.33         16.90         10.71         10.37%           Link28         Node11         Node10         21.75         20.33         0.0105	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%
Link33         Node7         17.98         17.60         146.9         0.327         0.0105         2.00         1.85         0.35         16.01         10.23         16.84         10.85         10.9%           Link32         Node9         Node7A         18.72         18.08         195.0         0.328         0.0105         2.00         1.85         0.34         16.05         10.23         16.84         10.86         10.9%           Link32         Node9         Node9         18.69         16.60         0.325         16.74         10.60         10.3%           Link30         Node9         Node9         20.09         19.71         107.8         0.325         0.0105         2.00         1.66         0.34         16.17         10.43         16.60         10.71         103%           Link29         Node10         Node9         20.09         19.71         107.8         0.325         0.0105         2.00         1.64         0.36         16.07         10.37         16.59         10.65         10.39         16.49         10.64         10.23         16.49         10.64         10.25         10.35         10.37         16.39         10.73         10.37         16.39         10.75	Link34	Node7	Node6	17.40	16.92	144.0	0.333	0.0105	2.00	1.65	0.35	16.17	10.43	16.99	10.96	105%
Link22         Node9         Node7A         18.72         18.08         195.0         0.328         0.0105         2.00         1.88         0.34         18.05         10.25         18.74         10.60         100%           Link31         Node9         Node8         19.61         18.62         237.0         0.333         0.0105         2.00         1.66         0.34         16.17         10.43         16.60         10.71         103%           Link30         Node9         Node9         20.06         19.71         107.8         0.323         0.0105         2.00         1.62         0.36         15.96         10.23         16.60         10.67         10.65	Link33	Node7A	Node7	17.98	17.50	146.9	0.327	0.0106	2.00	1,85	0.35	18.01	10.33	16.84	10.85	105%
Link21         Node9         Node8         19.61         18.82         237.0         0.833         0.0105         2.00         1.66         0.34         16.17         10.43         16.60         10.71         103%           Link20         Node9A         Node9A         Node9A         20.09         19.71         107.8         0.325         0.0105         2.00         1.66         0.34         15.96         10.03         16.60         10.71         103%           Link29         Node9A         Node9A         20.83         20.16         20.3         0.200         1.62         0.36         15.96         10.30         16.63         10.73         103%           Link28         Node11         Node10         21.75         20.39         246.4         0.333         0.0105         2.00         1.64         0.36         16.16         10.43         16.49         10.64         102%           Link27         Node11         Node11         22.54         21.85         21.01         0.3826         0.0105         2.00         1.64         0.36         16.10         10.35         16.40         10.58         10.57         102%           Link25         Node12         23.48         22.64	Link32	Node8	Node7A	18.72	18.08	185.0	0.328	0.0105	2.00	1.68	0.34	16.05	10.25	16.74	10.80	FOC%
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         10.55         103%           Link29         Node10         Node9A         20.83         20.16         203.4         0.229         0.0105         2.00         1.64         0.36         16.07         10.37         16.63         10.73         103%           Link29         Node10         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         10.2%           Link27         Node11         22.54         21.35         210.1         0.328         0.0105         2.00         1.64         0.36         16.16         10.43         16.49         10.58         10.2%           Link26         Node11         22.54         21.35         210.1         0.328         0.0105         2.00         1.63         0.37         16.05         10.35         16.49         10.57         102%           Link25         Node114         Node12         23.48         22.64         254.2	Link31	Node9	Node8	19.61	18.82	297.0	0.833	0.0105	2.00	1.66	0.34	16.17	10.43	16.60	10.71	103%
Link29         Node10         Node9A         20.83         20.16         203.4         0.229         0.0105         2.00         1.64         0.36         16.07         10.37         16.63         10.75         193%           Link28         Node11         Node10         21.75         20.33         0.229         0.0105         2.00         1.64         0.36         16.07         10.37         16.63         10.75         193%           Link28         Node11         Node10         21.75         20.33         0.2105         2.00         1.64         0.36         16.15         10.43         16.49         10.64         102%           Link27         Node11         22.54         21.85         210.1         0.329         0.0105         2.00         1.63         0.37         16.05         10.35         16.39         10.57         102%           Link25         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	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%
Link22         Node11         Node10         21.75         20.93         246.4         0.333         0.0105         2.00         1.84         0.36         16.16         10.43         16.49         10.64         102%           Link22         Node11         Node11         22.54         21.85         21.01         0.326         0.0105         2.00         1.63         0.37         16.05         10.43         16.49         10.54         102%           Link27         Node12         Node11         22.54         21.85         21.01         0.326         0.0105         2.00         1.63         0.37         16.05         10.35         16.40         10.58         102%           Link25         Node12         23.48         22.64         254.2         0.330         0.0105         2.00         1.64         0.36         16.10         10.39         16.39         10.57         12%           Link25         Node14         Node13         24.41         23.58         251.8         0.330         0.0105         2.00         1.50         0.45         16.05         15.29         9.46         9%           Link25         Node15         Node14         27.88         24.66         379.2 <t< td=""><td>Unk29</td><td>Node10</td><td>Node9A</td><td>20.83</td><td>20.16</td><td>203.4</td><td>0.329</td><td>0.0105</td><td>2.00</td><td>1.64</td><td>0.36</td><td>16.07</td><td>10.37</td><td>16.63</td><td>10.73</td><td>103%</td></t<>	Unk29	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%
Link27         Node12         Node11         22.54         21.85         210.1         0.323         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         Node13         24.41         23.58         251.8         0.330         0.0105         2.00         1.55         0.45         16.08         10.37         15.29         8.89         95%           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         8.89         95%           Link24         Node14         27.88         24.69         379.2         0.849         0.0105         2.00         1.50         0.70         25.81         16.65         15.59         10.06         60%           Link45         Node15         28.57         27.38         14.3         1.123         0.	Link28	Node11	Node10	21.75	20.99	246.4	0.333	0.0105	2.00	1.64	0.36	16.15	10.43	16.49	10.64	102%
Link25         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         152.9         9.88         95%           Link25         Node14         Node14         27.88         24.69         379.2         0.849         0.0105         2.00         1.50         0.45         16.08         10.37         15.29         9.88         95%           Link25         Node15         Node14         27.88         24.69         379.2         0.849         0.0105         2.00         1.30         0.70         25.81         16.65         15.59         10.06         60%           Link25         Node16         Node15         28.57         27.38         14.3         1.123         0.0105         2.00         1.05         0.96         39.28         25.34         6.73         4.34         17%	Link27	Node12	Nodel 1	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%
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 9.88 95% Link24 Node15 Node14 27.88 24.69 379.2 0.649 0.0105 2.00 1.30 0.70 25.81 16.65 15.59 10.06 60% Link45 Node15 Node15 28.57 27.98 14.8 4.123 0.0105 2.00 1.05 0.96 39.28 25.34 6.73 4.34 17%	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%
Link24 Node15 Node14 27.88 24.68 379.2 0.848 0.0105 2.00 1.30 0.70 25.81 16.65 15.58 10.06 60% Link45 Node16 Node15 28.57 27.98 14.3 4.123 0.0105 2.00 1.05 0.96 39.28 25.84 6.73 4.84 17%	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	9.60	85%
Linik45 Node16 Node15 28.57 27.98 14.3 4.123 0.0105 2.00 1.05 0.96 39.28 25.34 6.73 4.34 17%	Link24	Node15	Node14	27.88	24.68	379.2	0.849	0.0105	2.00	1.30	0.70	25.81	16.65	15.59	10.06	60%
	Lint45	Node16	Node15	28.57	27.98	14,8	4.123	0.0105	2.00	1,05	0.95	39.28	25.84	6.73	4.84	17%

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# EXHIBIT A

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Low Flow Fixt - Potomac Village n = 0.011

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Name	Upstream Node Name	Downstream Node Name	Upstream Invert Elevation (ff)	Downstream Invert Elevation (ft)	Length áft)	Conduit Slope (%)	Rouanness	Diameter	Max Depth (ft)	Free Board (ft)	Design Full Flow (cfs)	Design Fuß Flow (MGD)	Atax Flow (cta)	Max Fi (MGD)
Sillanch (	Welte Trunk Series				1.4			1.4						
Link41	Node1	Minin	7.96	.7 80	eri 7	0 274	0.0110	160	2.03	0.47	25 17	16 37	30.50	10 68
1	Node2	Node1	-7,20	.7 14	126.6	0 233	0.0110	250	2.51	-0.01	23 38	15.08	30.50	19.68
1	Kebola	Node7	474	-6 80	409.7	0.281	0.0110	2.60	7 38	0.12	26 71	16.50	30.50	10.60
1 10.35	Noded	Note?	.3.83	4.64	309 0	0.203	0.0110	2.50	294	-0.44	21.84	14.09	30.50	19.60
Link37	Node5	Noted	-3.05	-1 79	661.1	0 274	0.0110	2.60	3.54	-1.04	25.40	16 39	30.50	19 64
1 inkd?	Nodo7	Model	6.04	-9.17	507.7	0.371	0.0110	2.50	3 60	-1:10	29.54	19.06	30.50	19.69
	Nodel	Node2	0.01	0.06	400.0	0 102	0.0110	2.50	477	.2 22	15 50	10.00	30.50	10.68
Lost 37	Noted	Mailat	1 22	0.53	361.3	0,102	0.0510	2.60	465	-3.16	28.21	18 20	27 74	17 00
16633	Mindes10	Model	2.00	1 77	431 2	0.281	8.0110	2.50	474	.2.24	25 68	16.57	27-74	17.00
1 100 21	Node11	Node10	4 39	3.21	434 8	0 272	0.0110	2.50	473	2.23	25.26	16.30	27.65	17.84
Link20	Model 2	Node to	5.65	4:40	126 4	0.225	0.0110	250	461	2 17	97.62	17 82	97.65	17.84
1 101/20	Node13	Note12	6.57	5.40	315.4	0.297	0.0110	2.50	4.96	.5.16	26 18	16.89	27.65	17.84
1	Nuclei 14	Node12	7.43	8.67	1411.0	0 718	0.0110	2.50	4.05		23.63	15.25	27.65	17 84
114477	Abdo15	Nucles 13	6.66	7.40	430.5	0 972	0.0110	2.60	5 00	2.60	25 28	16 31	27.65	17.94
15626	Node16	Node15	9.71	8.97	416 A	0 178	0.0110	250	6.01	251	20 43	13.18	24.50	15.81
Link26	Node17	Noista	10.76	10.06	410.9	0 168	0.0110	250	5 00	2.50	10.88	12 81	24.50	15 A1
1	Note18	Note17	1919	11:01	474 4	0.962	0.0510	250	4 74	.2.24	24.79	16.99	24.50	15 81
1 10423	Mode10	Moders	13.48	12 47	427.0	0232	0.0110	2 50	4.36	4 86	23.34	15.08	23.11	14 P1
Link22	Mode 20	Note10	14.67	19.73	104 1	0.238	0.0110	2.50	4.06	1 56	23.67	15 27	2311	14.91
15-121	Node21	Node20	15.85	14.84	376 3	0 268	0.0110	250	3.84	1 34	25.11	16 20	20.35	.19.19
1.6420	Mode 22	Node24	16.03	15.04	259.2	0 361	0.0110	2.60	1 10	0.88	28 74	18.54	20 78	19.90
Lunkto	Nodo73	Nede 22	17.51	16:07	201.8	0.243	0.0110	7 60	270	-0.29	23.02	15.43	20.30	13.10
	Node24	Nado 99	10.90	17 70	201 7	0.100	0.0110	2.50	2 41	0.09	21 63	13,95	20.16	11.01
120 June 10	nuuucu maiin Tarak Count	NOUBER	10-20	17.70		0.100	here i the	2154		0.00	÷	10000		10.01
1 647	Mode 25	himin74	10.24	18.28	276.0	0 337	0110	9.76	2 25	0.04	21 25	13 71	20.13	12.00
	Node20	Nada 25	10.41	10.20	407 6	0.357	0.0110	1225	1.05	0.20	10.66	12.69	20.12	12.00
Linkit	Node20	Node 20	21.00	2010	407.0	0.248	A 6110	126	1 07	0.26	18 16	11 72	20 14	12 00
Carden 1.4	Node2R	Node20	21.02	21.14	209.5	0 177	B 0110	2.20	1 02	0.23	22 48	14 50	20 02	13.57
11-1-19	hindra 20	Node29	21.00	22.04	140.0	0.171	0.0110	0.95	1 69	0.67	20.24	14 20	20.44	13 10
	Alada 204	Noueza	22.00	22.00	20.5	0.071	0.0110	2.20	1 74	0.54	40.47	21.96	20.10	19:02
Estate 12	NUCCEDA	NUCE20	24.28	22.01	204.0	0.326	0.0140	2.20	1.77	0.40	20,92	93.47	20.10	12.00
1.04	Note30	NUMBER A	24.30	24.45	1710	6 277	0.0110	2.25	1.37	0.46	40.70	13.44	20.04	12.01
Linkiu	(100831 Mi-J-24.8	NUCLEAR	29.08	24.41	433.0	0.173	60110	240	4 74	0.54	20.01	15.41	10.04	12.0
LAUS	. COCODIA	Modest	40.42	20.02	103.0	0.323	0.0110	2.2	1.0	0.49	20.01	13.90	10.00	10.05
LANKO	NOCE-12	NOOBSTA	2020	20.00	201.0	0,000	0.0110	4.20	1.00	0.40	10.50	12.60	10.00	10 7
112149	Node24	No.do 32	20.74	20.3/	110 0	0.250	0.0110	2.25	1.03	0.42	14.30	15.07	10.51	12.73
CHERGE I		1020053-5	20.14	29.24	110.0	0.430	00410	4.40	1.05	U JĢZ	20.00	13,91	19-31	12.35
ORISITE P	URP STATION					•								
24-Inch U	AURINE TRUIDE SIGNA	н 1 С	49.07	19 98	421 0	0 223	0.0440	2.00	4 77	A 78	15 10	0.40	47.81	44.24
CIDE 10	Nodez	La Nu de la	13.07	13.30	194.7	0.323	0.0110	2.00	1.00	0.20	10.18	40.64	47.01	14.30
110640	NUCES	NOCE2	19.99	13.87	165.0	0.370	0.0110	200	1.05	0.05	46.30	0.07	17.01	44.96
Link38	NO284	Nodes	15.05	14,54	103.0	0.327	0.0110	2.00	1.75	0.25	10.30	8.6/	16.00	11.30
Links/	NODED	NOCE4	18,90	15.15	249.4	0,331	0.0110	2.00	1,70	0,24	10,39	1.80	40.00	10.01
	NOCIEC	NOCED	16.82	10.00	430.0	0.330	0.0110	2.00	1.70	0.29	13,30	8.81	10.00	10.04
Link34	Node/	NODBE	17.40	10.92	144.0	0.333	0.0110	2.00	1.73	0.27	10.44	9.80	10.00	10.84
Link33	NOGE/A	NOGE/	17.50	17.20	146.9	0.427	0.0310	2.00	1.74	0.26	13:28	9,00	10,00	10.84
Link32	NOGEB	NOD67A	16.72	10.08	180.0	0.328	0.0110	200	1./4	0.27	13.32	8.60	10.00	10,04
100431	Nodes	Nodes	19.61	18.62	23/10	0.333	0.0110	2.00	1./5	0.25	10.44	8.90	10.80	10.64
Emic30	NodesA	Nodes	20.06	19.71	107.8	0.325	0.0110	2.00	1.72	0.28	19.23	8.03	10.00	10,84
Link29	Node 10	NodeSA	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	9.68	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	10.64
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	27.68	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	27.96	14.3	4.123	D.0110	2.00	1.06	0.92	37.49	24.19	6.22	4.01

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Ħ╉╾┾╶╉╌╌┾╺╉╴╞┝╺╬╘╢╖╏╝┝╺╉╌╞┝┙┪╝╖╝╝╘╝┙╡┹┟╔╝╺┫╌╞┝╡╌╞┝╡╌╞┝╡╌╞┝╡╌╞┝╡╌╞┝╡╌╞┍╡╌╞┍╡╌╞┍╡╌╞┍╡┝┝╝╝┝╝╝╝╝╝╝╝╝╝╝╝

# EXHIBIT 8

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#### Low Flow Flot - All Future n = 0.011

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	Destaura Mada	Downstream	Heatman Inc.	Dammed boomd	1	Circumstantin		•	M					
Name	Name	Node Name	Elevation (it)	Elevention (it)	- CENGRA	Sione (%)	Bountemare	Diameter (Ri)	inax Depth	HTER BOARD	Elan (cfr)	Design Full	Mane Flow	Max Flow
Winch (	White Tourk Some			Citranon fild	69	needen ( val	Roogialess	(49	(19	144	THOM (cts)	100 (0.00)	(cis)	
Link41	Node1	Nade0	-7.28	-7 50	60.3	0.274	0.0110	2.50	1 93.	0.57	25.37	18 37	27 84	17.06
Link40	Node2	Node1	-6.38	-7 14	326.6	0 233	0.0110	2.50	2 21	0.29	23.38	15 75	27.04	17.00
Link39	Node3	Node2	4.74	-5.89	408.7	0.281	0.0110	250	2 13	0.37	25 71	16.59	27 84	17.95
Link38	Node4	Node3	-3.83	-4.64	399.0	0.203	0.0110	2.50	2.58	-0.06	21.84	14.09	27 B4	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	Nodell	Node7	0.46	0.05	400.9	0.102	0.0110	2.50	3.05	-0.55	15.60	10.00	27.84	17.95
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
Linicst	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	17.62	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	16.69	25.00	16.13
Linic28	Node14	Node13	7.43	6.62	340.8	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	250	2.02	D.48	25.28	16,31	25.00	16,13
Linit26	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	D.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
Lint 23	Node19	Node18	13.40	12.47	427.0	0.232	0.0110	2.50	1.88	0.62	23.34	15.06	21.94	14.15
Link22	Node20	Node 19	14,67	13.73	394.3	0.238	,0.0110	2.50	1.88	0.64	23.67	15.27	21.83	14.15
Link21	Node21	Ngde20	15.85	14.84	376.3	0,268	0.01.10	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	Nodeza	18.25	17.70	281,2	D. 199	0.0110	2.50	1.79	0.71	21,63	13,95	19,98	12.89
27-inch C	Insité Trunk Serie	HT								•				
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	18.90	19.33	197.5	0.289	0.0110	2,25	1.77	0.48	18.66	12.68	19,93	12.86
12/18/15	NODE21	NOCIE26	21.09	20.10	402.0	0.246	0.0110	2.25	1.93	0.33	18.16	11.72	19.94	12.68
Link14	NODE28	NDGe27	21.93	21.14	239.5	0.377	0,0110	2.25	1.68	0.38	22.48	14.50	20.69	13.35
C100413	Nodeza	NDOR2B	22.60	22.08	140.0	0.371	0.0110	225	1.87	0.58	22.31	14.39	20.22	13.05
Link12	Node29A	NDGAZU	23.29	22.67	39.5	1.823	0.0110	2.25	1.70	0.55	48,42	31.88	20.00	12.90
Lakin	MODESU	NEOGEZSIA	24,30	23.34	25.0	0.325	0,0110	2.25	1.75	0,60	20.88	13.47	19.97	12.66
	NOCEDI	NO083U	24.89	24.41	1/3.0	0.277	0.0110	2,25	1.78	0.47	19.28	12.44	19.68	12.63
1100	NO0851A	NOUBJ1	20,40	ca ju	133.0	0.323	0.0110	2.25	1.70	0.55	20.61	14.43	19,64	12.87
Links	NOCE32	Notestin	20,25	20,00	237.5	0.303	0.0110	2.25	1.76	0.00	20.15	13.00	18,68	12.70
Link/1	Nuclear Name	Nada12	79.74	20.37	40.0	0.458	0.0110	2.25	1.42	0.43	18.06	12.65	19.61	12,05
OMSTITE		PROPERTY.	20.14	40.20	IND'Ų	0.900	ŵột nu	1.00	1.62	0.04	29.70	10741	19.30	12.45
24. mont	hills Track Som	~												
Link47	Norie2	я. 15	13.87	13 39	151.0	0 123	. 0.0110	ain	1.60	0.34	16 10	o 60	17.00	44.02
i ink46	Node3	Node2	14.44	13.97	124.2	0.378	0.0110	2.00	1.05	0.05	16.44	10.61	17.00	11,03
Link30	Node4	Node3	15.05	14.54	155.8	0.327	0.0110	200	1.00	0.80	15.30	9.67	17.09	11.00
Link37	NodeS	Noded	15.95	15.15	244 4	0 331	0.0110	200	1 70	0.30	15 30	0.03	18 20	10.51
Link42	Node6	Node5	16.82	16.06	290.3	0 330	0.0110	2.00	1 70	0.20	16 36	9.00	10.29	10.01
Link34	Node7	Nodefi	17.40	16.92	144.0	0.333	0.0110	200	1.67	0.33	15 44	0.91	18 29	10.51
Link33	Node7A	Node7	17.98	17.50	148.9	0.327	0.0110	200	1.66	0.34	15 28	9.94	18 29	10.51
Link32	Node8	Node7A	18.72	18.08	195.0	0.328	0.0110	200	1.69	0.33	18.32	9.55	18 20	10.51
Link31	Node9	NodeB	19.61	18.62	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	NodeSA	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	Node 11	22.54	21.85	210.1	0.328	0.0110	2.00	1.69	0.31	15.32	9.88	16 29	10.61
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	0.58	15.35	8.90	15 22	9.82
Link24	Node15	Node14	27.58	24.66	379.2	0.849	0.0110	2.00	1.37	0.63	24 B4	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

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# **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



# ANTUNOVICH ASSOCIATES





**WOODMAN** Consulting Engineers

Prepared for



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.
- 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 <u>42% reduction</u> 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.
- 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, <u>in</u> **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.



# 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<sup>1</sup>. 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<sup>2</sup> 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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<sup>&</sup>lt;sup>1</sup> 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.

<sup>&</sup>lt;sup>2</sup> See discussion in WSSI's memo dated October 27, 2009

Mr. Bill Zink February 8, 2010 WSSI #21812.01 Page 2 of 3

### **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<sup>3</sup> 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<sup>4</sup> 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<sup>5</sup>).

<sup>&</sup>lt;sup>3</sup> i.e., allowing interior uses (such as toilets and laundry) for harvested rainwater.

<sup>&</sup>lt;sup>4</sup> 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).

<sup>&</sup>lt;sup>5</sup> 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.

Mr. Bill Zink February 8, 2010 WSSI #21812.01 Page 3 of 3

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<sup>6</sup> 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<sup>7</sup>.

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<sup>8</sup>.

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<sup>6</sup> Available online at the Virginia Stormwater BMP Clearinghouse: http://www.vwrrc.vt.edu/swc/

<sup>7</sup> Available at http://www.astm.org

<sup>&</sup>lt;sup>8</sup> 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

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

# Appendix B

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

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# 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

	Design Parameters											
Scenario	Rainwater barvesting (Note 2)	Wet	Green mot (Note 3)	"Pervious" roof	Pervicus navement	TPload	Volume					
(Note 1)		pond		(Note 4)		(Ib/ac/yr)	reduction (%)					
1	For irrigation only, from 50% of roof surface (note 6), assuming 20% reuse efficiency	Level	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	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	D.36	52%					
5	For irrigation and interior uses, from 100% of roof surface, assuming 80% reuse efficiency	Level	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	<u>57%</u>					
1												

Notes:

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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).

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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 scanario.

5. "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.

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# Potomac Village Typical Block Roof Breakdown (BLOCK 10 EXAMPLE)

The roof areas of a typical block within Potomac VIIIage 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".



Block 10 Breakdown 1

RREEF Investment Advisor

1

# **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.









# Potomac Village, Alexandria, VA

Green Roofs & Pervious Pavers 2

RREEF Investment Advisor

McCaffery Interests Developer | Antunovich Associates Architects & Planners

February 1st, 2010

# **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.







# Potomac Village, Alexandria, VA

Green Roofs & Pervious Pavers 3

RREEF Investment Advisor

McCatfery Interests Developer | Antunovich Associates Architects & Planners

February 1st, 2010

# 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.



## RREEF Investment Advisor

# Crescent Park (enlarged)



RREEF Investment Advisor McCattery Interests Developer Antunovich Associates Architects & Planners

February 1st, 2018

# 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.



### RREEF Investment Advisor

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February 1st, 2010

Crescent Park

# Crescent Park (enlarged)



# Potomac Village, Alexandria, VA

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

Crescent Park February 1st, 2010

## 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 <u>a conservative estimate</u> 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.



DATE:February 4, 2010TO:Bill ZinkFROM:Derek WoldSUBJECT:Potomac Yard - Sanitary Sewer Evaluation

We have analyzed the capacity of the 24-inch onsite trunk sewer, 27-inch onsite trunk sewer and 30inch 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:

### Surcharging

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.

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## 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**

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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.

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

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	Unclasers Node	Downstream	Linetreen invert	Competence lawset	Length	Condult		Discoster	Mary Donth	Erne Boer	Deelon Full	Deelan Full	Max Flow	Max Flow
Name	Name	Node Name	Elevation (ft)	Elevation (it)	(ff)	Sione (%)	Roughness	(11)	(fi)	(fft)	Flow (cfs)	Elow (MGD)	(cfs)	(MGD)
30-Jach 0	Halto Trunk Sem	Ar			<u></u>			()		(14			(0.0)	(110)
Unk41	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	0.371	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
Unk32	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	Noda11	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	Noda15	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	15.89	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	21.53	13,95	19.04	12.28
27-Inch O	nsite Trunk Sew	87												
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	Noda26	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	1.65	0.41	18.16	11.72	18.94	12.22
Linak 14	Node28	Node27	21.93	21.14	209.5	0.377	0.0110	2.25	1.60	0.46	22.48	14.50	19.57	12.62
Unk13	Node29	Node28	22.60	22.08	140.0	0.371	0.0110	2.25	1.62	0.64	22.31	14.39	19.32	12.45
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
Link(11	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	0.2//	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
LinkB	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	225	1.55	0.70	24.76	15.97	18.24	11.77
ONSITE P	UMP STATION													
24-inch 0	NULLE FRUNK SEW	er Le	10.07	19.99	151.0	0 222	0.0110	2.00	1 60	0.21	15.10	0.80	17 00	11.02
Link47	NOG82	LS Node0	13.87	13.38	101.9	0.323	0.0110	2.00	1.09	0.31	15./9	9.00	17.09	11.03
Link46	NODES	NOG62	14,44	13.97	124.2	0.378	0.0110	2.00	1.00	0.35	15.20	0.01	17.09	11.03
LUNK38	NDG84	NOCES	13.05	19.09	044.4	0.327	0.0110	2.00	1.70	0.30	15 70	0.07	16.29	10.51
Link37	N0080	NOCEN	10.00	13,13	244.4	0.331	0.0110	2.00	1.70	0.30	15 38	9.55	16.29	10.51
Link42	NOCISO Nociso	Nodes	17.40	16.00	144.0	0.330	0.0110	2.00	1.67	0.31	15.44	9.91	16.29	10.51
Link34	NOCE/	Noceo	17.40	17.52	146.0	0.333	0.0110	2.00	1.07	0.35	15.29	9.90	16.20	10.51
Link33	NODE/A	NODE/	17.50	17.30	190.5	0.327	0.0110	2.00	1.60	0.34	15 32	5.00	16.29	10.51
LINKSE	NUUBD	Nodel	10.72	10.00	227.0	0.323	0.0110	2.00	1.00	0.33	15.44	30.0	16.20	10.51
	NUCES	Node	18-01	10.02	107 0	0.335	0.0110	200	1.00	0.34	16.22	0.82	16.29	10.51
	Noussa	Nodep	20.00	20.10	202.4	0.323	0.0110	2.00	1.00	0.99	15 34	0.00	16 20	10.51
1.100239	Nodo11	Node10	21.03	20.00	246.4	0 333	0.0110	200	1 89	0.31	15.42	9.95	16.29	10.51
Link 07	Node12	Node11	22 54	21.85	210 1	0.329	0.0110	2 00	1.69	0.31	15.32	9 88	16.29	10.51
1 101027	Node12	Mode 12	22.48	22.64	254.2	0.331	0.0110	2.00	1 70	0.30	15 37	9.92	16.29	10.51
	Node14	Node12	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	27.91	24.65	379.2	0.849	0.0110	2.00	1 37	0.63	24 64	15 90	15.62	10.08
	NodelE	Node15	20.00	27.08	14.3	4 123	0.0110	2.00	1 08	0.92	37 49	24 19	6.22	4 01
LU143	1400010	100013	,		1.100		0.0110							

I:RREEF/090791/Model Results/Updates 1-29-10 (4 loc CSO and red Low flow)/Potomac Yard Model Results 2010-1-29.xtsx

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Table 1

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

	Upstream Node	Downstream	Upstream invert	Downstream Invert	Length	Conduit		Diameter	Max Depth	Free Board	Design Full	Design Full	Max Flow	Max Flow
Name	Name	Node Name	Elevation (ft)	Elevation (ft)	(11)	Slope (%)	Roughness	(ft)	(ft)	(ft)	Flow (cfs)	Flow (MGD)	(cfs)	(MGD)
30-inch O	Italia Trunk Sow	ne ne												
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	Noda3	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	0.17	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	Nodes	NOCI67	0.46	0.05	400.9	0.290	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
LIMK32	NO0510	Nodey	2.98	1.77	431.2	0.281	0.0110	2.50	2.18	0.32	25.68	16.57	27.15	17.51
Linkal	NO0811	NODBIU	4.39	3.21	434.6	0.272	0.0110	2.50	2.12	0.38	25.26	16.30	26.75	17.26
Linkao	NOGET2	NDG611	3.35	4.49	326.4	0.325	0.0110	2.50	2.02	0.48	27.52	17.82	26.44	17.05
Link29	NOGE13	N00912	0.52	5.60	315.4	0.292	0.0110	2.50	1.97	0.53	26.18	16.89	25.35	18.35
	NGC1914	NOCO13	7.43	6.62	340.8	0.238	0.0110	2.50	2.08	0.42	23.63	15.25	25.35	18.35
	NODE15	NOCE14	8.66	7.49	430.1	0.272	0.0110	2.50	2.05	0.45	25.28	16.31	25.35	16.35
100126	NO0915	Node15	9.71	8.97	416.8	0.178	0.0110	2.50	2.07	0.43	20.43	13.78	22.49	14,51
Link25	NGC1617	NO0915	10.75	10.06	410.9	0.168	0.0710	2.50	2,09	0.42	19.86	12.81	22,49	14,51
	Node18	NUCE17	12,12	11.01	424,4	0.262	0.0110	2.50	1.83	0.67	24.79	15.99	22.04	14.22
	NUCE 19	NOCE18	14.07	12.47	427.0	0.232	0.0110	2.50	1,83	0.68	23.34	15.06	21.00	13,55
Link22	Nederal Con	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
	Nucleiz I	NODE20	10.85	14.84	3/6.3	0.256	0.0110	2.50	1.65	0.85	25.11	16.20	19.21	12.39
	Node22	NOCE21	17.64	10.07	253-2	0.351	0.0110	2.50	1.56	0.94	28.74	18.54	19.67	12.69
Links	Node24	Nada 22	18.00	17.70	221.0	0.100	0.0110	2.50	1,00	0.84	23.92	15.43	19.25	12.42
110k 10		INOLINE.S	10.20	17.70	201-2	0.159	0.0110	2.30	1,74	4.17	21.03	13.63	19.04	12.28
Link17	Node25	Node24	10 21	18.28	220 0	0.337	0.0110	0.05	1 70	0.54	01 OF	19 71	10.02	10.00
Link16	Node26	Nodo25	19.00	10.23	107.6	0.337	0.0110	2.20	1.72	0.54	10.65	13.71	19.03	12.20
i ink15	Node27	Node26	21 09	26.10	402.0	0.246	0.0110	2.20	1.70	0.41	19.00	12.00	18.30	12.23
ink14	Node28	Node27	21 03	21.14	200.5	0.240	0.0110	2.23	1.00	0.46	72.48	14.50	10.84	12.22
Link13	Node 29	Node28	22 60	22.08	140.0	0.371	0.0110	2.25	1.62	0.40	22.40	14 20	19.37	12.02
Link12	Node29A	Node29	23 29	22 57	39.5	1 823	0.0110	2.25	1.65	0.61	40.42	21.00	19,32	12,49
Link11	Node30	Node29A	24 30	23.34	205.0	0.325	0.0110	2.25	1.60	0.56	73.72	19.47	10.04	10.07
Link10	Node31	Node30	24 89	24.41	173.0	0 277	0.0110	2 25	1.03	0.53	10.28	13.47	19.01	12.27
t ink9	Node31A	Node31	25.45	25.02	133.0	0 323	0.0110	2.25	1.69	0.53	20.81	13.49	10.50	12.23
Links	Node32	Node31A	26.28	25 55	217.5	0.303	0.0110	2 25	1.68	0.57	20.01	13.45	10.02	12.02
link44	Node33	Node32	27.23	28.37	300.5	0.286	0.0110	2.25	1 74	0.51	19 58	12.63	19.02	11.05
1 ink49	Norie34	Node33	28 74	28 20	118.0	0.458	0.0110	2 25	1.55	0.70	24.76	15.97	18 24	11.22
ONSITE P	UMP STATION						••••				24.00	10.01	10.2.4	
24-Inch O	naite Truck Sewe	er.												
Link47	Node2	ัเร	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
Linic38	Node4	Noda3	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	8.96	16.29	10.51
Link30	Node9A	Node9	20.06	19,71	107.8	0.325	0110.0	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	248.4	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

1. RREEF-090791 Model Results/Updates 1-29-10 (4 loc CSO and red Low flow) Potomac Yard Model Results 2010-1-29 disk

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Table 2

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#### Shaft 8 to 7 - 24 inch Bypass and Low Flow Fotures (35% Reduction)

	I Instances Made	Deserved	f for adversion of the second		Langth	Constants		Dismates	Mary Daugh		Dealers Euli	Dealers Full	Mary Floor	Mar Flow
Mama	Name	Node Neme	Elevention (#)	Elevention (#)	Lengen (#)	Slana (#/)	Boughness	(4)	wax Depth	(m)	Elow (cfe)	Design Full Flow (NICD)	(cfa)	(MGD)
THAT IS	Notite Truck Course		Elevation (ity	CRANNIN (10	(iii)	Stops (76)	nooginess	09	119	(14)			(613)	
	Node1	Node0	7.00	7 50	00.0	0.074	0.0110	2 60	1.01	0.60	75 97	16 17	07 24	17 FA
	Note:	Notice 1	-7.20	-7.30	996 E	0.274	0.0110	2.50	2 17	0.00	23.37	15.00	27.34	17.64
	Node2	Node?	-4.74	-5.20	409.7	0.233	0.0110	2.50	2.17	0.35	25.71	16 68	27 34	17.64
Link 29	Noded	Aloda 3	-7.63	.4 64	300.0	0.203	0.0110	2.50	2 30	0.11	21.84	14.09	27 34	17.64
tink 97	Node5	Node4	-3.00	.1 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	Bynass	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	Nodeß	Bypess	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	NodeR	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	Node6	1.72	0.53	351.3	0.339	0.0110	2.50	1.99	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	Node 11	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	Node 19	Node18	13.45	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	14,64	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
Lindk 19	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 Or	nsite Trunk Sewe	r												
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	Noda29	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	18.96	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 P	UMP STATION													
24-Inch Or	naite Trunk Sewe	er												
Link47	Node2	LS	13.87	13.38	151.9	0.323	0.0110	2.00	1.69	0.31	15.18	9.60	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	1/,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	Nocte5	16.82	16.05	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	1.6/	0.33	13,44	9.90	16.28	10.51
Link33	Node7A	Node7	17.98	17.50	146.9	0.327	0.0110	2.00	1.65	0.34	15.20	9.86	10.23	10.51
Link32	Nodel	Node7A	18.72	18.08	195,0	0.328	0.0110	2.00	1.68	0.33	15.44	9.00	16.29	10.51
Link31	Node9	NOCOS	19.01	10.04	237.0	0.333	0.0110	2.00	1.00	0.34	15.22	0.50 0.83	16 20	10.51
Link30	NODESA	MOCION	20,06	19./1	107.8	0.323	0.0110	2.00	1.00	0.34	15.24	2.03	18 20	10.51
Link29	NOCE10	ACCESSA	20.63	20.16	2113.4	0.329	0.0110	2.00	1.07	0.33	15.42	9.9U	16 20	10.51
Link28	Nodel 1	NODE10	21./5	20.55	240.4	0.333	0.0110	2.00	1.08	0.31	15.92	9.93 0.88	16.20	10.51
Link27	NODE12	NOGE11	22,34	C1.03	210.1	0.328	0.0110	2.00	1.00	0.30	15 37	9.92	16 29	10.51
Link26	NODE13	No.0812	20.40	22.04	251.0	0.331	0.0110	2.00	1.62	0.30	15 35	9.90	15 22	9.82
Link25	N00814	NUCLE 13	27,41	23-20	270.0	0.000	0.0110	2.00	1 97	0.50	24 64	15.90	15.62	10.08
1.0024	Node15	Node16	21.00	27.00	14 7	4 123	0.0110	2 00	1.08	0.92	37 49	24 19	6.22	4.01
1.11445	NOCIETO	1400815	28.3/	C1.30	14.3	7.123	0.0110	~.00		V.36	01.40	A-1.10		

1:RREEF/090791/Model Results/Updates 1-29-10 (4 loc CSO and red Low flow)/Potomac Yard Model Results 2010-1-29.xtsx

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Table 3



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Exhibit 3 - 27-inch and 30-inch Trunk Sewer: Replace Shaft 5 to 9

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# **Potomac Village**

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# **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.

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