STORMWATER MANAGEMENT REPORT

for

SOUTHEAST INLET TOWNHOMES

Blocks 73, 74, 76 & 78
Atlantic City, Atlantic County, New Jersey

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1.0 PROJECT DESCRIPTION

Inlet AC Partners, LLC (Applicant) proposes to develop vacant parcels in the Southeast Inlet section of Atlantic City, Atlantic County, New Jersey with 152 townhouse units pursuant to an approved Redevelopment Plan for the area generally bound by Oriental Avenue, New Hampshire Avenue, the Boardwalk and Metropolitan Avenue.

The various sites include Blocks 73, 74, 76 & 78. Development at the site is subject to review by multiple review agencies including the Casino Reinvestment Development Authority (CRDA), New Jersey Department of Environmental Protection (NJDEP) for a Coastal Area Facilities Review Act (CAFRA) Permit, Atlantic County Planning Board and the Cape Atlantic Conservation District.

The surrounding land uses are as follows:

1. To the north – Across Oriental Avenue, a mix of single-family and multi-family residential.
2. To the east – Across New Hampshire Avenue, vacant land, single and multi-family residential.
3. To the south – Public Boardwalk, and
4. To the west – Across Metropolitan Avenue, Hotel/Casino.

Topographic elevations at the site range from elevation 5 to 10 in the North American Vertical Datum of 1988 (NAVD 88) (Figure 2). Runoff naturally drains towards each of the streets from the middle of each block, and once in the streets it flows along the curb lines towards the north into a storm sewer system in Oriental Avenue. From Oriental Avenue runoff flows through existing storm sewer to Absecon Inlet to the east, which is directly connected to the Atlantic Ocean.

The site is located within Flood Zone AE, elevations 10 and 11 in NAVD88 as indicated on the Preliminary FEMA Flood Insurance Rate Map for City of Atlantic City, Atlantic County, New Jersey number 34001C0456G dated January 30, 2015.

According to the USDA Natural Resources Conservation Service (NRCS) New Jersey Soil Survey web data, the soil types on the project site are (Figure 3):

Psamments (PssA), 0-2% slopes, Hydrologic Soil Group A

2.0 DESIGN CRITERIA

This stormwater management analysis and design is in accordance with the Stormwater Management Rules at N.J.A.C. 7:8, subchapters 5 and 6, the New Jersey Stormwater Best Management Practices Manual, and the New Jersey Soil Erosion and Sediment Control Standards, as applicable.

Furthermore, the following 24 hour rainfall depths for the area of the project site as provided the National Oceanographic and Atmospheric Administration (NOAA), National Weather Service's Atlas 14 Point Precipitation Frequency Estimates have been used as required by NJAC 7:8-5.7(c)1:

Point Precipitation Frequency Estimates per NOAA Rainfall Data					
Design Storm (year)	NOAA Rainfall (in.)	Current Precipitation Adjustment Factor	Current Precipitation (in.)	Projected Precipitation Adjustment Factor	Projected Precipitation (in.)
2	3.34	1.01	3.37	1.22	4.07
10	5.20	1.02	5.30	1.24	6.45
100	8.96	1.03	9.23	1.39	12.45
County Precipitation Frequency Estimates per NOAA Rainfall Data					
Design Storm (year)	NOAA Rainfall (in.)	Current Precipitation Adjustment Factor	Current Precipitation (in.)	Projected Precipitation Adjustment Factor	Projected Precipitation (in.)
2	3.31	1.01	3.34	1.22	4.04
10	5.16	1.02	5.26	1.24	6.40
100	8.90	1.03	9.17	1.39	12.37

The County precipitation estimates will be used throughout this report.

In accordance with the New Jersey Department of Environmental Protection (NJDEP) Stormwater Management Rules at N.J.A.C. 7:8, the development of the project is classified as a "Major Development." A Major Development is defined therein as a development which ultimately disturbs one or more acres of land and/or increases impervious coverage or regulated motor vehicle surface by one-quarter of an acre or more. This project includes disturbance to greater than one acre of land and increases impervious coverage by more than one-quarter acre. The three technical requirements of the Stormwater Management Rules at N.J.A.C 7:8 that generally need to be addressed are groundwater recharge, runoff quantity and runoff quality.

- Groundwater Recharge Standard – N.J.A.C. 7:8-5.4(b)2 states the groundwater recharge requirement of the rules does not apply to projects within the "urban redevelopment area" which is defined in the rules as previously developed parcels in the Metropolitan Planning Area (PA-1). All of Atlantic City is within the urban redevelopment area so this project is exempt from the groundwater recharge requirement.

- Runoff Quality Standard – N.J.A.C. 7:8-5.5 requires the stormwater management measures be designed to reduce the post-developed load of total suspended solids (TSS) in stormwater runoff generated from the water quality design storm by 80 percent of the anticipated load from the developed site, expressed as an annual average. The water quality design storm is 1.25 inches

of rainfall in two hours. Water quality calculations shall take into account the distribution of rain from the water quality design storm. The calculation of the volume of runoff may take into account the implementation of non-structural and structural stormwater management measures.

- Runoff Quantity Control Standard - N.J.A.C. 7:8-5.6(b) requires that in order to control stormwater runoff quantity impacts, the design engineer shall, using the assumptions and factors for stormwater runoff calculations at N.J.A.C. 7:8-5.6, complete one of the following:
  1. Demonstrate through hydrologic and hydraulic analysis that for stormwater leaving the site, post-construction runoff hydrographs for the 2-year, 10-year and 100-year storm events do not exceed, at any point in time, the pre-construction runoff hydrographs for the same storm events; or
  2. Demonstrate through hydrologic and hydraulic analysis that there is no increase, as compared to the pre-construction condition, in the peak runoff rates of stormwater leaving the site for the 2-year, 10-year and 100-year storm events and that the increased volume or change in timing of stormwater runoff will not increase flood damage at or downstream of the site. This analysis shall include the analysis of impacts of existing land uses and projected land uses assuming full development under existing zoning and land use ordinances in the drainage area; or
  3. Design stormwater management measures so that the post-construction peak runoff rates for the 2-year, 10-year and 100-year storm events are 50, 75 and 80 percent, respectively, of the pre-construction peak runoff rates. The percentages apply only to the post-construction stormwater runoff that is attributable to the portion of the site on which the proposed development or project is to be constructed.
  4. In tidal flood hazard areas, stormwater runoff quantity analysis, in accordance with (b)1, 2, and 3 above, is required unless the design engineer demonstrates through hydrologic and hydraulic analysis that the increased volume, change in timing, or increased rate of the stormwater runoff, or any combination of the three will not result in additional flood damage below the point of discharge of the major development. No analysis is required if the stormwater is discharged directly into any ocean, bay, inlet, or the reach of any watercourse between its confluence with an ocean, bay, or inlet and downstream of the first water control structure

3.0 TECHNIQUES OF ANALYSIS

In accordance with the stormwater runoff calculation methodology at N.J.A.C. 7:8-5.7, the quantity (volume and rate) of stormwater runoff is calculated based on the USDA NRCS methodology using the NRCS Runoff Equation and Dimensionless Unit Hydrograph, as described in Technical Release 55 - Urban Hydrology for Small Watersheds (TR-55), dated June 1986. A unit peak discharge factor of 285 is applied to the dimensionless unit hydrograph for runoff estimation on lands that are located within the coastal zones of New Jersey rather than the standard factor of 484. This

is known as the Delmarva unit hydrograph and applies to this site as described in NJDEP Bulletin No. NJ-210-3-1; being in the coastal plain region with slopes less than 5%, low relief and storage areas in depressions. The Delmarva unit hydrograph will predict a lower peak discharge than that of the standard hydrograph, but the volume of stormwater runoff will not be affected by the factor change. The calculations also utilize a National Oceanic and Atmospheric Administration (NOAA) rainfall distribution type C.

National Oceanographic and Atmospheric Administration (NOAA), National Weather Service's Atlas 14 Point Precipitation Frequency Estimates have been used in calculations as required by NJAC 7:8-5.7(c)1. The various Times of Concentration (Tc) were determined for pre and post-developed conditions using the hydraulically longest flow path. The Tc flow path can be found on the Drainage Area Plans located in Appendix I. The pre and post-developed Tc calculations can be found in Appendices B, C, D and E.

Curve numbers (CN) were generated for the drainage areas for pre and post-developed conditions based on the soil group and existing or proposed land use. The CN calculations can be found in Appendices B, C, D and E for the respective routings. Note that impervious areas were calculated as separate subareas to generate hydrographs without weighted CNs as outlined in the BMP manual chapter 5.

Using the drainage areas, the TCs and CNs as input data, version 10.20-7a of *HydroCAD,* a hydrologic/hydraulic software program by HydroCad Software Solutions, LLC, was employed to generate runoff volumes and rates.

4.0 LAND COVER CONDITIONS

For the purpose of comparison of pre and post development conditions, the site and surrounding total tributary area is broken into separate drainage areas based on the existing site topography. The tables below summarize the pre-developed and post-developed cover conditions of the various drainage areas. In the pre-developed condition those areas with the designation A are offsite and will not be disturbed and B are located onsite and will receive development. In the pre-developed condition, there is a mix of land cover consisting of impervious (pavement and building), Bare soil and open space..

Refer to Appendix I for the Existing and Proposed Conditions Drainage Area Plans:

Table 4.1: Pre-Developed Cover Conditions

Drainage Area Name	Area (SF)	Impervious Building (SF)	Impervious Pavement (SF)	Bare Soil (SF)	Open Space (SF)
EXDA-78.1 Onsite	9485	1825	1385	5825	450
EXDA-78.2 Offsite	13180	1710	6680	2640	2150
EXDA-78.3 Onsite	8590	0	0	6895	1695
EXDA-78.4 Offsite	19055	0	4565	5625	8865

Drainage Area Name	Area (SF)	Impervious Building (SF)	Impervious Pavement (SF)	Bare Soil (SF)	Open Space (SF)
EXDA-78.5 Offsite	5260	0	5225	35	0
EXDA-78.6 Onsite	4670	0	0	4670	0
EXDA-78.7 Onsite	22745	0	730	19420	2595
EXDA-78.8 Offsite	27945	1365	13830	4150	8600
EXDA-76.1 Onsite	17490	0	530	0	16960
EXDA-76.2 Offsite	39185	4475	15875	9950	8885
EXDA 76.3 Offsite	5265	0	5260	0	5
EXDA 76.4 Onsite	3320	0	0	0	3320
EXDA 76.5 Onsite	29065	0	1090	0	27975
EXDA 76.6 Offsite	46560	1465	18125	19500	7470
EXDA 74.1 Onsite	39725	0	2905	5935	30885
EXDA 74.2 Offsite	51800	4765	17765	15960	13310
EXDA 74.3 Offsite	5815	30	5415	0	370
EXDA 74.4 Onsite	1630	5	25	0	1600
EXDA 74.5 Onsite	19205	0	50	3085	16070
EXDA 74.6 Offsite	16255	0	12810	5	3440
EXDA 74.7 Onsite	3685	0	5	10	3670
EXDA 74.8 Offsite	23950	55	4295	13930	5670
EXDA 73.1 Onsite	35245	0	775	1095	33375
EXDA 73.2 Offsite	22170	0	14620	1585	5965
EXDA 73.3 Offsite	18730	0	2935	15795	0
EXDA 73.4 Offsite	5250	0	5220	0	30
EXDA 73.5 Onsite	2960	0	0	0	2960
EXDA 73.6 Onsite	9170	0	360	3010	5800
EXDA 73.7 Offsite	7070	0	6070	25	975
EXDA 73.8 Onsite	21845	0	110	570	21165
EXDA 73.9 Offsite	52245	0	13770	33735	4740
Total	**588565**	**15695**	**160425**	**173450**	**238995**

In the post-developed condition, the same site drainage patterns and discharge points are maintained, and the land cover in those drainage areas is as follows:

Table 4.2: Post-Developed Cover Conditions

Drainage Area Name	Area (SF)	Impervious Building (SF)	Impervious Pavement (SF)	Bare Soil (SF)	Open Space (SF)
PRDA 78A.1	6385	2710	900	0	2775
PRDA 78A.2	15950	3510	6645	2770	3025
PRDA 78A.3	2635	640	215	0	1780
PRDA 78B.1	8645	4055	1335	0	3255
PRDA 78B.2	19045	0	4565	5620	8860
PRDA 78C.1	5260	0	5260	0	0
PRDA 78D.1	14225	6745	2270	0	5210
PRDA 78D.2	27780	1340	14365	3515	8560
PRDA 78D.3	11015	5400	1810	0	3805
PRDA 76A.1	17595	7415	2525	0	7655
PRDA 76A.2	39075	4475	16380	9950	8270
PRDA 76A.3	4555	2040	670	0	1845
PRDA 76B.1	5270	0	5270	0	0
PRDA 76C.1	46155	1465	18170	19495	7025
PRDA 76C.2	28235	12815	4340	0	11080
PRDA 74A.1	51625	4650	17785	15955	13235
PRDA 74A.2	13145	6070	2035	0	5040
PRDA 74A.3	10525	4730	1590	0	4205
PRDA 74A.4	1710	670	215	0	825

Drainage Area Name	Area (SF)	Impervious Building (SF)	Impervious Pavement (SF)	Bare Soil (SF)	Open Space (SF)
PRDA 74A.5	1710	670	215	0	825
PRDA 74B.1	5815	30	5415	0	370
PRDA 74B.2	4500	1295	430	0	2775
PRDA 74C.1	16505	0	13735	0	2770
PRDA 74C.2	13125	6070	2035	0	5020
PRDA 74C.3	18670	10130	3220	0	5320
PRDA 74D.1	24740	55	4455	13930	6300
PRDA 73A.1	25835	12145	4120	0	9570
PRDA 73A.2	21785	0	14985	1225	5575
PRDA 73A.3	5550	2040	685	0	2825
PRDA 73A.4	2625	640	215	0	1770
PRDA 73B.1	18730	0	2890	15840	0
PRDA 73C.1	5250	0	5250	0	0
PRDA 73D.1	14250	6745	2270	0	5235
PRDA 73D.2	7070	0	6135	0	935
PRDA 73E.1	7130	2710	895	0	3525
PRDA 73E.2	52580	0	14140	33735	4705
PRDA 73E.3	13875	6745	2270	0	4860
TOTAL	**588575**	**118005**	**189705**	**122035**	**158830**

Total Post Developed Impervious Area = 118,005 + 189,705 = 307,710 sf.

Total Pre Developed Impervious Area = 15,695 + 160,425 = 176,120 sf.

Increased Impervious Area = 131,590 sf.

In summary, the total disturbed area is 228,825 sf (total of existing on-site areas) and the increase in impervious surface is 131,590 sf.

5.0 STORMWATER MANAGEMENT FACILITIES

The site is within a tidal flood hazard area. As such, the ground floor of the unit will be a garage with no living space. With this proposed building configuration and due to the urban nature of this site with relatively shallow seasonally high water, the stormwater management (SWM) system will consist of a combination of open infiltration areas in available yard areas, pervious pavement driveways with stone infiltration beds below them, and roof drain dry wells consisting of stone under the building garage slabs. They are interconnected with equalization pipes set at or just above the water quality design storm elevation within the infiltration areas so during the water quality storm they function independently, but during larger storm events they will generally function as one stormwater management feature for each set of units.

The facilities proposed for the project are designed to satisfy the Runoff Quantity Control Standard at N.J.A.C. 7:8-5.4(b)1 and the Runoff Quality Standard at N.J.A.C. 7:8-5.5. They will be maintained by a Homeowners Association to be formed for the community. The basins will be constructed in accordance with current NJDEP standards including adequate separation to the estimated seasonal high water table and the open infiltration features will include a K5 sand bottom for the purpose of

maintaining permeability rates of the subsoil over time allowing ease of replacement for periodic maintenance.

According to Chapter 9.8 of the BMP Manual, the lowest elevation in an infiltration basin must be at least two (2) feet above the seasonal high groundwater table. Soil test pits were advanced at multiple locations on the property, the results for which are included in Appendix H. Depths to the seasonally high groundwater table at each of the test pit locations were measured and at least two feet of separation to the seasonal high water table is provided in the design.

Table 5.1: Estimated Seasonally High Water Elevations

Profile Pit #		Basin #	Surface Elevation (ft)	Depth to SHW (ft)	Elevation SHW (ft)	Basin Bottom (ft)	Separation (ft)	Permeability (in/hr)	Depth (in)
73-1	TP-7	B 73A.1	6.9	6.0	0.9	5.75	4.85	36.0	36
73-2	TP-8	WQ 73A.1	7.3	6.0	1.3	5.00	3.74	36.0	36
73-3	TP-9	WQ 73A.1	7.4	6.0	1.4	5.00	3.61	36.0	36
73-5	TP-10	B 73D.1	7.6	5.0	2.6	5.75	3.17	36.0	36
73-6	TP-11	B 73A.1	7.4	6.0	1.4	7.00	5.56	36.0	36
73-7	TP-12	B 73A.3	7.6	7.0	0.6	7.00	6.36	36.0	24
73-8	TP-13	WQ 73D.1	7.5	6.0	1.5	5.00	3.46	36.0	
73-9	TP-14	WQ 73D.1	8.1	7.0	1.1	5.00	3.92	36.0	24
73-10	TP-15	B 73E.3	7.9	7.0	0.9	6.00	5.08	36.0	36
73-11	TP-16	WQ 73E.3	7.5	6.0	1.5	5.00	3.53	36.0	24
73-14	TP-17	WQ 73A.4	7.8			5.00			
	TP-17A	WQ 73A.4	7.6	6.0	1.6	5.00	3.37	36.0	36
74-1	TP-18	WQ 74A.2	6.5	6.0	0.5	5.00	4.48	36.0	30
74-2	TP-19	WQ 74A.3	6.4	5.0	1.4	5.00	3.61	36.0	24
74-3	TP-20	WQ 74A.5	7.4	7.0	0.4	5.00	4.57	36.0	42
74-5	TP-21	WQ 74B.2	8.4	7.0	1.4	5.00	3.59	36.0	48
74-6	TP-22	B 74C.2	7.2	6.0	1.2	6.00	4.81	36.0	24
74-7	TP-23	B 74C.3	7.3	6.0	1.3	6.00	4.74	36.0	24
74-8	TP-24	WQ 74C.3	8.2					36.0	
	TP-24A	WQ 74C.3	8.2	7.0	1.2	5.00	3.77	7.9	24
74-9	TP-25	WQ 74C.2	7.2	5.0	2.2	5.00	2.85	22.8	36
74-10	TP-26	WQ 74C.3	7.6	6.0	1.6	5.00	3.44	36.0	30
74-11	TP-27	WQ 74C.3	7.7	7.0	0.7	5.00	4.27	36.0	24
76-1	TP-28	B 76A.1	6.9	6.0	0.9	6.50	5.58	36.0	36
76-2	TP-29	WQ 76A.1	6.8	6.0	0.8	5.00	4.25	36.0	24
76-3	TP-30	WQ 76A.3	7.6	6.5	1.1	5.00	3.93	36.0	36
76-4	TP-31		9.8	8.0	1.8			36.0	36
76-5	TP-32	WQ 76A.1	6.8	6.0	0.8	5.00	4.17	36.0	24

Profile Pit #		Basin #	Surface Elevation (ft)	Depth to SHW (ft)	Elevation SHW (ft)	Basin Bottom (ft)	Separation (ft)	Permeability (in/hr)	Depth (in)
76-6	TP-33	B 76C.2	6.9	6.0	0.9	5.75	4.82	36.0	24
76-7	TP-34	B 76A.3	7.9	8.0	-0.1	6.25	6.36	36.0	30
76-8	TP-35	WQ 76C.2	7.0	6.0	1.0	5.00	4.04	36.0	24
76-9	TP-36	WQ 76C.2	7.0	7.0	0.0	5.00	5.01	36.0	30
76-10	TP-37		8.7	8.0	0.7		-0.66	8.0	36
78-1	TP-38	WQ 78A.1	7.5	7.0	0.5	5.00		36.0	24
78-2	TP-39	WQ 78B.1	7.6	6.0	1.6	5.00		36.0	24
78-3	TP-40		11.9				0.00	36.0	
	TP-40A		8.0	6.0	2.0			36.0	36
78-4	TP-41	B 78D.1	7.3	6.0	1.3	5.75	4.48	36.0	24
78-5	TP-42	B 78D.1	7.7	7.0	0.7	7.00	6.26	36.0	24
78-6	TP-43	WQ 78D.3	8.3	8.0	0.3	5.00	4.75	36.0	36
78-7	TP-44	WQ 78D.1	7.0	6.0	1.0	5.00		36.0	36
78-8	TP-45	Wq 78D.1	7.1	6.0	1.1	5.00	3.89	36.0	36
78-9	TP-46	WQ 78D.3	7.6	8.0	-0.4	5.00	5.44	36.0	24
78-10	TP-47		8.8	7.0	1.8			36.0	24

Basin cross-section details showing test pit elevations, soil type, depth to seasonal high water, standing water, berm and spillway elevations, and water surface elevations during the 2-year, 10-year, 100-year and emergency conditions (100-year storm with the basin full at the start of the storm) are included on the Details sheets in the overall project plan set.

6.0 INFILTRATION, MOUNDING AND GROUNDWATER RECHARGE

Based on the tested permeability rates of the soil on site and the total potential stored depths of runoff in the basins below the lowest outlet, the basins will drain in less than 72 hours. Infiltration calculations are included in Appendix F.

Groundwater mounding associated with the system was evaluated and it was determined that the mounds will not break the surface of the land or potentially impact any adjacent structures. That analysis is included in Appendix F. Note that exfiltration was used pursuant to NJ Best Management Practices (BMP) Manual chapter 5, with the maximum volume of runoff infiltrated during and after the largest rainfall event utilized to create the potential groundwater mound.

As previously noted, In accordance with N.J.A.C. 7:8-5.4(b)2, the groundwater recharge requirement does not apply to this development since the site is located within the Urban Redevelopment Area.

7.0 RUNOFF QUANTITY

The stormwater management basins are designed to decrease the amount of runoff discharging from the site generated by the required storm events. In accordance with N.J.A.C. 7:8-5.4(b), the project must:

1. Demonstrate through hydrologic and hydraulic analysis that for stormwater leaving the site, post-construction runoff hydrographs for the 2-year, 10-year and 100-year storm events do not exceed, at any point in time, the pre-construction runoff hydrographs for the same storm events; or
2. Demonstrate through hydrologic and hydraulic analysis that there is no increase, as compared to the pre-construction condition, in the peak runoff rates of stormwater leaving the site for the 2-year, 10-year and 100-year storm events and that the increased volume or change in timing of stormwater runoff will not increase flood damage at or downstream of the site. This analysis shall include the analysis of impacts of existing land uses and projected land uses assuming full development under existing zoning and land use ordinances in the drainage area; or
3. Design stormwater management measures so that the post-construction peak runoff rates for the 2-year, 10-year and 100-year storm events are 50, 75 and 80 percent, respectively, of the pre-construction peak runoff rates. The percentages apply only to the post-construction stormwater runoff that is attributable to the portion of the site on which the proposed development or project is to be constructed.

For the calculation of existing runoff, the site was modeled as separate subareas based on proposed disturbance limits and land cover. The Existing Drainage Area Plan (Appendix I) defines the subareas and Appendices B and C contain the Pre-Developed Runoff Calculations for current and future precipitation depths. The calculation of the post-development site runoff was performed in the same manner as the pre-developed with the site broken up into different drainage subareas based on the type of land cover and the proposed disturbance limits. The existing drainage patterns are maintained. The Proposed Drainage Area Plan (Appendix I) defines the subareas and Appendices D and E contain the Post-Development Runoff Calculations for current and future precipitation depths. Tables 7.1 and 7.2 below show the reduction of pre and post-developed peak runoff rates and volumes leaving the project site at the separate points of discharge as well as explanation of the runoff rate reduction provided for the proposed disturbed area:

Table 7.1: Runoff Peak Reduction to Point A (Current Rainfall)

Rec Int (yrs)	Rainfall (in)	Pre Developed Peak Rate (cfs)	Pre Developed Peak Rate from Onsite (cfs)	Allowable Post Developed Peak Rate (cfs)	Required %	Post Developed Peak Rate (cfs)	Proposed %
2	3.34	9.53	1.12	8.97	50	8.71	27
10	5.26	18.14	2.61	17.49	75	16.25	28
100	9.17	40.12	8.83	38.35	80	31.43	2

Notes:
1. The Allowable Peak Runoff was calculated as follows:
   $Q_{Allowable} = Q_{Total\ Existing} - (\%\ Improvement\ Required)\ (Q_{Existing\ Disturbed\ Area})$
   $Q_{100\text{-}year} = 40.12\ cfs - (1 - 0.80)\ (8.83\ cfs) = 38.35\ cfs$
2. The Post Developed Peak Runoff percent of existing was calculated as follows:
   $\%\ of\ Existing = 1 - [(Q_{Total\ Existing} - Q_{Total\ Proposed}) / Q_{Existing\ Disturbed\ Area}]$
   $\%\ of\ Existing\ 100\text{-}year = 1 - [(40.12\ cfs - 31.43\ cfs) / 8.83\ cfs] = 2\%$
3. Post Development Peak Runoff of less than 0% shows that more improvement than required is provided.

Table 7.2: Runoff Peak Reduction to Point A (Projected Rainfall)

Rec Int (yrs)	Rainfall (in)	Pre Developed Peak Rate (cfs)	Pre Developed Peak Rate from Onsite (cfs)	Allowable Post Developed Peak Rate (cfs)	Required %	Post Developed Peak Rate (cfs)	Proposed %
2	4.04	12.64	1.68	11.80	50	11.62	39
10	6.40	23.94	4.00	22.94	75	21.11	29
100	12.40	58.92	16.88	55.54	80	43.97	11

Table 7.3: Stormwater Management Basin Water Surface Elevations

STORMWATER FEATURE	WQ STORM ELEVATION (A)	2 YR STORM ELEVATION (B)	10 YR STORM ELEVATION (C)	100 YR STORM ELEVATION (D)	OUTLET STRUCTURE GRATE/WEIR ELEVATION (E)
WQ 73A.1	5.12	5.19 / 5.25	5.36 / 5.48	5.78 / 6.15	6.10 / 6.80
Basin 73A.1	5.75	5.76 / 5.86	6.16 / 6.39	6.89 / 7.02	7.00
WQ 73A.3	5.04	5.06 / 5.09	5.15 / 5.22	5.40 / 5.65	5.75 / 7.40
Basin 73A.3	7.00	7.00 / 7.01	7.04 / 7.08	7.23 / 7.45	7.50
WQ 73A.4	5.01	5.01 / 5.01	5.02 / 5.02	5.04 / 5.12	5.25 / 7.80
Basin 73A.4	6.50	6.50 / 6.52	6.59 / 6.68	6.92 / 7.20	7.50

STORMWATER FEATURE	WQ STORM ELEVATION (A)	2 YR STORM ELEVATION (B)	10 YR STORM ELEVATION (C)	100 YR STORM ELEVATION (D)	OUTLET STRUCTURE GRATE/WEIR ELEVATION (E)
WQ 73D.1	5.10	5.16 / 5.21	5.31 / 5.41	5.68 / 6.02	6.00 / 7.65
Basin 73D.1	5.75	5.75 / 5.81	5.96 / 6.12	6.50 / 6.91	7.00
WQ 73E.1	5.06	5.09 / 5.13	5.20 / 5.28	5.49 / 5.76	5.75 / 7.74
Basin 73E.1	6.75	6.75 / 6.77	6.85 / 6.94	7.22 / 7.57	7.75
WQ 73E.3	5.10	5.15 / 5.21	5.31 / 5.41	5.68 / 6.02	6.10 / 7.54
Basin 73E.3	6.00	6.02 / 6.20	6.58 / 6.92	7.67 / 7.77	7.75
WQ 74A.2	5.10	5.15 / 5.20	5.30 / 5.40	5.66 / 5.94	5.55 / 6.25
Basin 74A.2	5.75	5.75 / 5.81	5.97 / 6.14	6.55 / 6.97	7.00
WQ 74A.3	5.09	5.12 / 5.17	5.26 / 5.36	5.59 / 5.85	5.45 / 6.6
Basin 74A.3	5.75	5.76 / 5.84	6.03 / 6.21	6.64 / 7.00	7.00
WQ 74A.4	5.01	5.01 / 5.01	5.01 / 5.02	5.03 / 5.13	5.25 / 6.60
WQ 74A.5	5.01	5.01 / 5.01	5.01 / 5.02	5.04 / 5.13	5.25 / 6.92
WQ 74B.2	5.01	5.01 / 5.02	5.06 / 5.10	5.23 / 5.40	5.40 / 6.35
Basin 74B.2	5.75	5.75 / 5.82	6.03 / 6.23	6.68 / 7.00	7.00
WQ 74C.2	5.10	5.15 / 5.20	5.31 / 5.41	5.68 / 6.01	6.00 / 6.95
Basin 74C.2	6.00	6.00 / 6.03	6.13 / 6.26	6.61 / 7.00	7.00
WQ 74C.3	5.12	5.19 / 5.25	5.36 / 5.48	5.78 / 6.14	6.60 / 7.30
Basin 74C.3	6.00	6.00 / 6.08	6.27 / 6.46	6.90 / 7.26	7.25
WQ 76A.1	5.11	5.16 / 5.22	5.33 / 5.43	5.72 / 6.04	5.85 / 6.55
Basin 76A.1	6.25	6.25 / 6.26	6.32 / 6.39	6.66 / 7.01	7.00
WQ 76A.3	5.04	5.06 / 5.09	5.15 / 5.22	5.40 / 5.65	5.70 / 7.25
Basin 76A.3	6.25	6.25 / 6.26	6.32 / 6.39	6.61 / 6.89	7.00
WQ 76C.2	5.04	5.06 / 5.08	5.13 / 5.17	5.30 / 5.46	5.50 / 6.33
Basin 76C.2	5.75	5.75 / 5.79	5.93 / 6.09	6.52 / 7.01	7.00
WQ 78A.1	5.06	5.09 / 5.12	5.20 / 5.27	5.49 / 5.76	5.80 / 7.00
WQ 78A.3	5.01	5.01 / 5.01	5.02 / 5.02	5.04 / 5.13	5.25 / 7.25
Basin 78A.3	6.00	6.02 / 6.15	6.39 / 6.61	7.09 / 7.26	7.25
WQ 78B.1	5.08	5.12 / 5.16	5.25 / 5.34	5.58 / 5.89	5.90 / 7.15
WQ 78D.1	5.10	5.15 / 5.20	5.30 / 5.40	5.67 / 6.00	5.90 / 6.60
Basin 78D.1	5.75	5.75 / 5.80	5.97 / 6.17	6.62 / 7.01	7.00
WQ 78D.3	5.10	5.14 / 5.19	5.29 / 5.39	5.64 / 5.97	6.00 / 7.10
Note 1 - The elevations shown in WQ Storm column are the elevations attained in the subsurface stone storage areas.					

STORMWATER FEATURE	WQ STORM ELEVATION (A)	2 YR STORM ELEVATION (B)	10 YR STORM ELEVATION (C)	100 YR STORM ELEVATION (D)	OUTLET STRUCTURE GRATE/WEIR ELEVATION (E)
Note 2 - The elevations shown for the 2, 10 & 100 year storms are for the current/projected rainfall depths, respectively.					
Note 3 - The elevations shown in the outlet structure grate/weir column are the elevation of the 2.5" orifice and yard grate, respectively for the subsurface stone storage areas or crest elevation of the 5' wide weir for the surface basins.					

Appendices C and D contain the Post-Development Runoff Calculations.

8.0 RUNOFF QUALITY

In accordance with NJAC 7:8-5.2 and 5.5(a), a land development that creates 0.25 acres or more of new or additional impervious surface must include stormwater management measures that reduce the average annual total suspended solids (TSS) load in the post-construction runoff from the new impervious surface by 80%.

In accordance with Chapters 4 and 9 of the BMP Manual, infiltration structures are given a TSS removal rate of 80%. The calculations for the Water Quality Storm in Appendix E show that the entire volume of runoff generated by the water quality storm in each basin drainage area is retained for infiltration. Since the volume of runoff retained in each of the basins is greater than or equal to the respective runoff generated by the WQ storm, the water quality requirement of the applicable regulations is met.

9.0 GREEN INFRASTRUCTURE AND LOW IMPACT TECHNIQUES

The Green Infrastructure (GI) standards outlined in the BMP Manual for infiltration basins used for water quality treatment limit their total contributory drainage areas to less than 2.5 acres. Each of the water quality basins proposed with this project are sited and designed to limit their drainage areas to less than 2.5 acres. This also distributes groundwater recharge for the more frequent rainfall events throughout the site.

10.0 SOIL EROSION AND SEDIMENT CONTROL

In addition to temporary soil erosion control measures during construction, off-site stability in accordance with Chapter 21 of the NJ Soil Erosion and Sediment Control Standards is also provided with the reductions in flow rates outlined in section 7 above.

11.0 STORMWATER CONVEYANCE

No changes to the existing stormwater conveyance system are proposed. The existing City-owned storm sewer infrastructure will remain in its existing condition

and receive runoff from this site with no change in drainage patterns, and a reduction in runoff flow rates from required design storms as described in this report.

12.0 CONCLUSION

As described above, the entire Stormwater Management System and its components are designed in accordance with applicable state and local municipal regulations and requirements and low impact stormwater management measures are utilized where practical. The retention and infiltration basins are designed to accommodate the required design storms and provide runoff quantity reduction and water quality treatment as outlined in the State Stormwater Rules at N.J.A.C. 7:8 while providing an environmentally responsible and economically feasible system.