STORM WATER MANAGEMENT REPORT

PATRIOT BLUFF DEVELOPMENT

EPIPHANY DRIVE TOWN OF NEW WINDSOR, NEW YORK

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INTRODUCTION

This Report presents an analysis of the hydrologic and hydraulic conditions found at the site of the proposed Patriot Bluff Development in the Town of New Windsor, Orange County, New York. The subject project is located at the present termination of Epiphany Drive approximately 1,500 feet west of its intersection with Windsor Highway. Patriot Bluff Development proposes to construct 178 attached residential units on a 55.11 acre parcel. The project will be constructed with associated realty improvements including roadways, utilities, and storm water management facilities. The project is contiguous to the Patriot Ridge Development and is owned by RPA Associates LLC/AVR-RPA Development LLC.

This site is situated in the upper region of a watershed that discharges to the Hudson River through a minor tributary. (Refer to following Location Map). To study watershed runoff, a hydrologic model of the project site and the upgradient watershed has been developed using procedures outlined in the NRCS (formerly U.S. Department Of Agriculture) Soil Conservation Service Curve Number Method. This methodology was used in conjunction with Haestad Method's "Pondpack" software to generate peak runoff rates and hydrographs for analysis of pre- and post-development conditions.

HYDROLOGIC ANALYSIS OF PRE-DEVELOPMENT CONDITIONS

PROCEDURE

The watershed model of the project under Pre-development conditions consists of 3 on-site subareas totaling 54.4 acres, and it has identified two critical Study Points for examination. The limits of each subarea have been indicated on the Pre-Development Drainage Plan to provide an accurate analysis of Pre-development runoff rates.

Peak discharges for each subarea were determined by the Soil Conservation Service methodology that considers rainfall events with 24-hour durations. The total rainfall amounts follow a synthetic distribution based on National Weather Service duration frequency data. The subject watershed analysis is based on a Type III Storm representing the spatial distribution of rainfall in the Atlantic Coastal Region. Twenty-four hour rainfall amounts were obtained from the maps provided by the Soil Conservation Service.

FREQUENCY (years)	RAINFALL AMOUNT (inches)
1	3.0
10	5.5
25	6.0
50	7.0
100	8.0

Runoff Curve Numbers and Times of Concentration for each subarea were also determined by procedures outlined by the Soil Conservation Service. The Orange County Soils Maps were used in conjunction with the Pre-Development Drainage Plan, and on-site investigations were performed to determine drainage areas, soil categories, and vegetative cover that were used in the calculation of existing condition Runoff Curve Numbers. The critical runoff path for each subarea was determined through the field investigations with aerial topographic mapping. Times of Concentration were calculated along each critical path to determine peak runoff rates for the 3 on-site subareas.

PRE-DEVELOPMENT DRAINAGE PATTERNS

Study Point A (Lands Of Petro)

Subarea On-I encompasses the northeasterly portion of the project site and is 18.2 acres in size. Its topographic slope varies from relatively flat to moderate, and its vegetative covers are woods and brush. This subarea has a change in grade of 46 feet and its discharge point is to the east into a drainage course on the lands of Petro. Upon entering the drainage course, the storm water flows to the east and crosses Windsor Highway south of Willow Lane.

Study Point B (Continental Manor)

Subarea On-2 represents the majority of the project site and is 30.7 acres in size. This subarea has a change in elevation of 109 feet, and its vegetative covers are also woods and brush. Storm water from this subarea flows to the south where it discharges onto the Continental Manor condominium complex. As with Subarea On-1, the storm water flows to the east and crosses Windsor Highway south of Willow Lane.

Subarea On-3

This subarea is the smallest of the three subareas being 5.5 acres in size. Its vegetative covers are also woods and brush, and its topography varies from relatively flat to very steep. It has a change in elevation of 99 feet and its storm water flows overland to the east onto the southerly portion of the lands of Petro. The storm water continues to the east and crosses Windsor Highway south of Willow Lane.

The Pre-development Drainage Plan indicates an off-site subarea, designated as Subarea Off-Misc. that consists of 0.85 acres which discharges onto Subarea On-1. Because this parcel will generate little storm water discharge, it has been excluded from further study in this Report.

PRE-DEVELOPMENT PEAK RUNOFF RATES

Appendix "A" of this Report contains "Pondpack" worksheets outlining the calculations of Runoff Curve Numbers, Times of Concentration, and Peak Runoff Rates for Pre-Development Conditions. The Pre-Development Plan depicts subarea delineations, and Time Of Concentration paths used in the calculation of these parameters.

Following is a summary table of Peak Runoff Rates for each of the above subareas for storms having return frequencies of 1, 10, 25 and 100 years:

Pre-Development Storm Water Runoff

Subarea	Drainage Area (Acres)	Peak Runoff For Studied Storm Frequencies Waters 1 Yr (Cfs)	10 Yr. (Cfs)	25 Yr. (Cfs)	100 Yr. (Cfs)
Study Point A (On-I)	18.2	7	27	32	51
Study Point B (On-2)	30.7	12	47	55	89
On-3	5.5	2	9	11	17
	54.4				

HYDROLOGIC ANALYSIS OF POST-DEVELOPMENT CONDITIONS

PROCEDURE

Procedures for the determination of Post-development runoff are similar to the procedures described for Pre-development conditions. Alterations to the pre-development watershed model to reflect site development include adjustments to hydrologic subareas, Runoff Curve Numbers and Times of Concentration. The character of the contributing drainage areas will be altered by the construction of the proposed residential units, roads, and appurtenant site improvements. Impervious

areas such as roads, driveways, and roofs infiltrate less rainfall than most natural ground covers and, due to their smooth surfaces, generally accelerate runoff. These factors combine to increase storm water discharge rates subsequent to construction.

Mitigation of storm water runoff impacts will be achieved through the implementation of storm water management practices. The storm water management facility chosen for 3 Post-development subareas is a water quality/storm water detention ponds that will receive on-site runoff, detain, and release it onto downstream properties. The storm water management facilities have been designed to detain their respective Water Quality Volumes and the Hydrograph Volume of a storm having a return frequency of 1 Year. Both the Water Quality Volume and the Hydrograph Volume will be detained and released over 24 hours.

Post-Development Runoff Curve Numbers were generated using appropriate soil categories for grass or impervious surfaces as anticipated with the site development. Composite Runoff Curve Number calculations for each subarea under Post-development conditions are outlined in Appendix "B".

POST-DEVELOPMENT DRAINAGE PATTERNS

To facilitate the analysis of the proposed storm water management facilities, the Post-development watershed model of the project has been divided into six on-site subareas while continuing to examine the two above referenced Study Points. These subareas are presented on the attached Post-Development Drainage Plan and consist of the following:

Study Point A (Lands Of Petro)

Subarea On-1A represents the central portion of developed Patriot Bluff Development site and is 8.95 acres in size. Storm water from this subarea will enter the roadway storm drainage systems where it will be conveyed to Water Quality/Storm Water Detention Pond No. 1 located in the northeastern quadrant of the site. After being detained and treated, the storm water will discharge into the existing drainage course on the lands of Petro and as under Pre-development conditions, it will flow easterly toward Windsor Highway.

Subarea On-1B is 7.73 acres and contains the northerly portion of the undeveloped lands of the Patriot Bluff Development. Storm water from this subarea will flow undetained to the east into the drainage course on the lands of Petro where it will combine with the discharge from Water Quality/Storm Water Detention Pond No. 1. The combined flow will continue east via the drainage course toward Windsor Highway.

Study Point B (Continental Manor)

Subarea On-2A is 14.97 acre in size and encompasses a majority of the Patriot Bluff Development site. Storm water from this subarea will enter the roadway storm drainage systems where it will be conveyed to Water Quality/Storm Water Detention Pond No. 2 located in the southern most portion of the site. After being detained and treated, its storm water will discharge from the Pond onto the Continental Manor site. As under Pre-development conditions the storm water will flow easterly toward Windsor Highway.

Subarea On-2B is 6.53 acres in size and represents the balance of the central portion of the developed site. Storm water from this subarea will enter the roadway storm drainage systems where it will be conveyed to Water Quality/Storm Water Detention Pond No. 3 located in the western portion of the site. After being detained and treated, the storm water will discharge into a large wetlands area located of the project site, and will flow overland to the south onto Continental Manor.

Subarea On-2C is 15.05 acres and represents the balance of the undeveloped land along the westerly boundary of the site. The majority of this subarea is designated wetlands and steep slopes. The storm water generated from this undeveloped area will flow overland undetained to the south onto Continental Manor.

Subarea On-3

This Subarea is located in the southeasterly portion of the Patriot Bluff Development site and is 1.37 acres in size. Storm water from this subarea will be undetained, flow overland onto the lands of Petro, and continue east toward Windsor Highway.

The following is a summary of the site's Post Development peak discharge:

	Drainage Area (Acres)	Peak Runoff For Studied Storm Frequencies 1 Yr (Cfs)	10 Yr. (Cfs)	25 Yr. (Cfs)	100 Yr. (Cfs)
Subarea On-1A	8.95	12	29	33	47
Subarea On-1B	7.73	6	19	22	33
Subarea On-2A	14.97	16	39	44	63
Subarea On-2B	6.53	8	21	24	34

	Drainage Area (Acres)	Peak Runoff For Studied Storm Frequencies 1 Yr (Cfs)	10 Yr. (Cfs)	25 Yr. (Cfs)	100 Yr. (Cfs)
Subarea On-2C	15.05	8	29	33	54
Subarea On-3	1.37	1	3	4	5
	54.60				

ANALYSIS – STUDY POINT A
PROPOSED WATER QUALITY/STORM WATER DETENTION POND NO. 1

The proposed Water Quality/Storm Water Detention Pond (P-1: Micropool Extended Detention) will be situated in the northeast quadrant that is adjacent to Epiphany Drive Extension. This pond, which will be offered for dedication to the Town of New Windsor, will collect storm water from Subarea On-1A where it will be detained and released at a regulated rate through a controlled outlet structure. This outlet structure will consist of a 3-inch diameter orifice, a 3 1/2-inch diameter orifice, and a 4-foot wide rectangular weir.

Water Quality
Water quality measures have been incorporated into the design of this Pond and its design parameters are as follows:

Percent Impervious (I) = 3.68/(8.95)
= .4111 = 41.11%

Runoff Value (Rv) = 0.05 + .009 (I)
= .4201

Water Quality Vol. (WQv) = 1.2 (Rv) (A) / 12
= 1.2 (.4201) (8.95) /12
= 0.3760 Ac-Ft.

Forebay Volume: 10% of the Water Quality Volume

Req'd Forebay Volume = 10% Of WQv
= .10 (.3760 Ac-Ft.)
= 0.0376 Ac-Ft

Provided Forebay Volume = 0.078 Ac-Ft > 0.0376 Ac-Ft

Permanent Pond Volume: 10% of the Water Quality Volume

Req'd Perm. Pond Volume = 10% Of WQv
= .10 (0.3760 Ac-Ft)
= 0.0376 Ac-Ft

Provided Perm Pond Volume = 0.093 Ac-Ft > 0.0376 Ac-Ft

Extended Detention: The remaining 80% of the Water Quality Volume will have extended detention and will be released from the pond over 24 hours via a 3-inch orifice at Inv. Elev. 368.0.

Req'd Extended Det. Vol. = 80% Of WQv
= .80 (0.3760 Ac-Ft)
= 0.3008 Ac-Ft

Req'd Water Surface Elev. To Store Volume = Elev. 368.7 (0.3150 Ac-Ft > 0.3008 Ac.-Ft)

Req'd Average Outflow = (0.315 x 43,560) / (24 x 60 x 60)
= .16 CFS

Actual Average Outflow

Max. Water Surface Elev.	Elev. 368.70
4" Inlet Pipe/3" Orifice Centerline	Elev. 368.13
Max. Head Over 3" Orifice	0.57 Feet
Average Head Over 3" Orifice	0.29 Feet

$Q = ca(2gh)^{0.5}$ where $c = 0.60$

$Q = .60 \times (.785 \times .25^2) (2 \times 32.2 \times .23)^{0.5}$

Q = .13 CFS < .16 CFS Therefore 24 hour extended detention requirement is satisfied

Stream Channel Protection

In order to protect downstream stream channels from erosion resulting from Post-development storm water flows, additional storage volume has been incorporated into the Water Quality/Storm Water Detention Pond. This additional storage detains and releases over 24 hours, the one-year, 24-hour storm event that consists of 3 inches of rainfall over the tributary watershed areas.

To regulate the pond's outflow, a second 3½-inch orifice has been incorporated into the outlet control structure. This is in addition to the 3-inch orifice that releases the Water

Quality Volume. During the 1 Year 24-hour storm event, storm water will be released through the following:

a 3" orifice	@ El 368.00, and a
3½" orifice	@ El 368.70

The volume of a 1-Year Post-development hydrograph from Subarea On-1A and Subarea On-1B is 1.085 Ac-Ft

Req'd Water Surface Elev. To Store 1 Year Volume = Elev. 370.3 (1.110 Ac-Ft > 1.085 Ac-Ft)

Req'd Average Outflow = (1.085 x 43,560) / (24 x 60 x 60)
= .55 CFS

Actual Average Outflow

	3" Orifice	3½" Orifice
Water Surface Elev.	Elev. 370.30	Elev. 370.30
Orifice Centerline	Elev. 368.13	Elev. 368.85
Max. Head Over Orifice	2.17 Feet	1.45 Feet
Average Head Over Orifice	1.09 Feet	0.73 Feet

$Q = ca(2gh)^{0.5}$ where $c = 0.60$

$Q_{3\text{-inch}} = .60 \times (.785 \times .25^2)(2 \times 32.2 \times 1.09)^{0.5} =$ 0.25 CFS
$Q_{3.5\text{-inch}} = .60 \times (.785 \times .29^2)(2 \times 32.2 \times 0.73)^{0.5} =$ 0.27 CFS
$Q_{total} =$ 0.52 CFS = 0.55 CFS

Therefore 24-hour release requirement is satisfied

Storm Water Detention

The table below summarizes the pond's performance characteristics with respect to detaining peak storm water flows:

Detention Pond Performance

Berm Top Elevation	= Elev. 374.0	
Maximum Storage	= 2.07 Ac-Feet	@ Elev. 372.00
Outlets	= 3" Orifice	@ Elev. 368.00
	= 3½" Orifice	@ Elev. 368.70
	= 4.0 L.F. Weir	@ Elev. 370.30

where $Q_{orifice} = ca(2gh)^{0.5}$ $c = 0.60$
$Q_{weir} = cl(h)^{1.5}$ $c = 3.0$

Storm Frequency	Peak Inflow	Peak Outflow	Maximum Stage
1 YR	12 Cfs	1 Cfs	Elev. 369.5
10 YR	29 Cfs	6 Cfs	Elev. 370.9
25 YR	33 Cfs	9 Cfs	Elev. 371.1
100 YR	47 Cfs	21 Cfs	Elev. 371.8

Upon exiting the Water Quality/Storm Water Detention Pond, the outflow hydrograph combines with the runoff hydrograph from Subarea On-1B. The sum of these hydrographs, presented in Appendix "B", represents the total runoff from the site onto the northerly portion of the lands of Petro under Post-development conditions.

ANALYSIS - STUDY POINT B
PROPOSED WATER QUALITY/STORM WATER DETENTION POND NO. 2

The second Water Quality/Storm Water Detention Pond (P-1: Micropool Extended Detention) will be situated along the southerly border of the project site. This pond, as with Storm Water Detention Pond No. 1, will be offered for dedication to the Town of New Windsor. This pond will collect storm water from Subarea On-2A which encompasses the southern portion of the site. Runoff from this subarea will be held within the pond and released at a regulated rate through a controlled outlet structure consisting of a 4-inch orifice, a second 4-inch diameter orifice, and a 3-foot wide rectangular weir.

Water Quality

Water quality measures have been incorporated into the design of this Pond and its design parameters are as follows:

Percent Impervious (I) = 6.69/(14.97)
= .4469 = 44.69%

Runoff Value (Rv) = 0.05 + .009 (I)
= .4522

Water Quality Vol. (WQv) = 1.2 (Rv) (A) / 12
= 1.2 (.4522) (14.97) /12
= 0.677 Ac-Ft.

Forebay Volume: 10% of the Water Quality Volume

Req'd Forebay Volume = 10% Of WQv
= .10 (.677 Ac-Ft.)
= 0.067 Ac-Ft

Provided Forebay Volume = 0.107 Ac-Ft > 0.067 Ac-Ft

Permanent Pool Volume: 10% of the Water Quality Volume

Req'd Perm. Pool Volume = 10% Of WQv
= .10 (.677 Ac-Ft)
= 0.067 Ac-Ft

Provided Perm. Pool Volume = 0.067 Ac-Ft < 0.110 Ac-Ft

Extended Detention: The remaining 80% of the Water Quality Volume will have extended detention and will be released from the pond over 24 hours via a 4-inch orifice at Inv. Elev. 330.0.

Req'd Extended Det. Vol. = 80% Of WQv
= .80 (.677 Ac-Ft)
= .542 Ac-Ft

Req'd Water Surface Elev. To Store Volume = Elev. 330.9 (0.546 Ac-Ft > 0.542 Ac-Ft)

Req'd Average Outflow = (.546 x 43,560) / (24 x 60 x 60)
= .28 CFS

Actual Average Outflow

Max. Water Surface Elev.	Elev 330.90
4" Orifice Centerline	Elev 330.17
4" Orifice	0.73 Feet

Average Head Over 4" Orifice 0.37 Feet

$Q = ca\,(2gh)^{0.5}$ where $c = 0.60$
$Q = .60 \times (.785 \times .33^2)\,(2 \times 32.2 \times .37)^{0.5}$
$Q = .25$ CFS $< .28$ CFS Therefore 24 hour extended detention is satisfied

Stream Channel Protection

In order to protect downstream stream channels from erosion resulting from Post-development storm water flows, additional storage volume has been incorporated into the Water Quality/Storm Water Detention Pond. This additional storage detains and

releases over 24 hours, the one-year, 24-hour storm event that consists of 3 inches of rainfall over the tributary watershed areas.

To regulate the pond's outflow, a second 4-inch orifice has also been incorporated into the outlet control structure. This is in addition to the 4-inch orifice that releases the Water Quality Volume. During the one-year 24-hour storm event, storm water will be released through the following:

a 4" orifice	@ El 330.00, and a
4" orifice	@ El 330.90

The volume of a 1-year Post-development hydrograph from Subarea On-2A and On-2C is 1.661 Ac-Ft.

Req'd Water Surface Elev. To Store Volume = Elev. 332.6 (1.677 Ac-Ft > 1.661 Ac-Ft)

Req'd Average Outflow = (1.677 x 43,560) / (24 x 60 x 60)
= .85 CFS

Actual Average Outflow

	4" Orifice (1st)	4" Orifice (2nd)
Water Surface Elev.	Elev. 332.60	Elev. 332.60
Orifice Centerline	Elev. 330.17	Elev. 331.06
Max. Head Over Inlet Pipe/Orifice	2.43 Feet	1.54 Feet
Average Head Over Pipe/Orifice	1.22 Feet	0.77 Feet

$Q = ca(2gh)^{0.5}$ where $c = 0.60$

$Q_{4\text{-inch}} = .6 \times (.785 \times .33^2) (2 \times 32.2 \times 1.22)^{0.5}$ = 0.46 CFS
$Q_{4\text{-inch}} = .6 \times (.785 \times .33^2) (2 \times 32.2 \times 0.77)^{0.5}$ = 0.36 CFS
Q_{total} = 0.72 CFS < 0.85 CFS

Therefore 24-hour release requirement is satisfied

Storm Water Detention

The table below summarizes the pond's performance characteristics with respect to detaining peak storm water flows:

Detention Pond Performance		
Berm Top Elevation	= Elev. 337.0	
Maximum Storage	= 3.505 Acre-Feet	@ Elev. 335.0

Outlets	= 4" Orifice	@ Elev. 330.0
	= 4" Orifice	@ Elev. 330.9
	= 3' L.F. Weir	@ Elev. 332.6

where $Q_{orifice} = ca\ (2gh)^{0.5}$ c = 0.60
$Q_{weir} = cl\ (h)^{1.5}$ c = 3.0

Storm Frequency	Peak Inflow	Peak Outflow	Maximum Stage
1 YR	16 Cfs	1 Cfs	Elev. 332.0
10 YR	39 Cfs	10 Cfs	Elev. 333.6
25 YR	44 Cfs	13 Cfs	Elev. 333.9
100 YR	63 Cfs	28 Cfs	Elev. 334.9

Upon exiting the Water Quality/Storm Water Detention Pond, the outflow hydrograph combines with the runoff hydrograph from Subarea On-2B and On-2C. The sum of these hydrographs, presented in Appendix "B", represents the total runoff onto Continental Manor.

PROPOSED WATER QUALITY/STORM WATER DETENTION POND NO. 3

The third Water Quality/Storm Water Detention Pond (P-5: Pocket Pond) will be situated in the central portion of the project site. Unlike the other 2 ponds, this pond will be privately owned by a Homeowner's Association. This pond will collect storm water from Subarea On-2B which encompasses the northwest portion of the site. Runoff from this subarea will be held within the pond and released at a regulated rate through a controlled outlet structure consisting of a 2-inch orifice, a second 2-inch diameter orifice, and a 4-foot wide rectangular weir.

Water Quality

Water quality measures have been incorporated into the design of this Pond and its design parameters are as follows:

Percent Impervious (I) = 2.38/(6.53)
= .3644 = 36.44%

Runoff Value (Rv) = 0.05 + .009 (I)
= .3780

Water Quality Vol. (WQv) = 1.2 (Rv) (A) / 12
= 1.2 (.3780) (6.53) /12
= 0.247 Ac-Ft.

Forebay Volume: 10% of the Water Quality Volume

Req'd Forebay Volume = 10% Of WQv
= .10 (.247 Ac-Ft.)
= 0.0247 Ac-Ft

Provided Forebay Volume = 0.0800 Ac-Ft > 0.0247 Ac-Ft

Permanent Pool Volume: 40% of the Water Quality Volume

Req'd Perm. Pool Volume = 40% Of WQv
= .40 (.247 Ac-Ft)
= 0.099 Ac-Ft

Provided Perm. Pool Volume = 0.227 Ac-Ft > 0.099 Ac-Ft

Extended Detention: The remaining 50% of the Water Quality Volume will have extended detention and will be released from the pond over 24 hours via a 2-inch orifice at Inv. Elev. 374.0.

Req'd Extended Det. Vol. = 50% Of WQv
= .50 (.247 Ac-Ft)
= .123 Ac-Ft

Req'd Water Surface Elev. To Store Volume = Elev. 374.7 (0.129 Ac-Ft > 0.123 Ac-Ft)

Req'd Average Outflow = (.123 x 43,560) / (24 x 60 x 60)
= .06 CFS

Actual Average Outflow

Max. Water Surface Elev.	Elev 374.70
2" Orifice Centerline	Elev 374.08
Max. Head Over 2" Orifice	0.62 Feet

Average Head Over 2" Orifice 0.31 Feet

$Q = ca(2gh)^{0.5}$ where $c = 0.60$

$Q = .60 \times (.785 \times .17^2) (2 \times 32.2 \times .31)^{0.5}$

Q = .06 CFS = .06 CFS Therefore 24 hour extended detention is satisfied

Stream Channel Protection

In order to protect downstream stream channels from erosion resulting from Post-development storm water flows, additional storage volume has been incorporated into the Water Quality/Storm Water Detention Pond. This additional storage detains and releases over 24 hours, the 1 Year 24-hour storm event that consists of 3 inches of rainfall over the tributary watershed areas.

To regulate the pond's outflow, a second 2-inch orifice has also been incorporated into the outlet control structure. This is in addition to the 2-inch orifice that releases the Water Quality Volume. During the 1 Year 24-hour storm event, storm water will be released through the following:

a 2" orifice	@ El 374.00, and a
2" orifice	@ El 374.70

The volume of a 1-Year Post-development hydrograph from Subarea On-2B is 0.412 Ac-Ft.

Req'd Water Surface Elev. To Store Volume = Elev. 376.0 (0.422 Ac-Ft > 0.412 Ac-Ft)

Req'd Average Outflow = (0.412 x 43,560) / (24 x 60 x 60)
= .21 CFS

Actual Average Outflow

	2" Orifice (1st)	2" Orifice (2nd)
Water Surface Elev.	Elev. 376.00	Elev. 376.00
Orifice Centerline	Elev. 374.08	Elev. 374.78
Max. Head Over Orifice	1.92 Feet	1.22 Feet
Average Head Over Orifice	0.96 Feet	0.61 Feet

$Q = ca\,(2gh)^{0.5}$ where $c = 0.60$

$Q_{2\text{-inch}} = .6 \times (.785 \times .17^2)\,(2 \times 32.2 \times 0.96)^{0.5} = 0.10$ CFS
$Q_{2\text{-inch}} = .6 \times (.785 \times .17^2)\,(2 \times 32.2 \times 0.61)^{0.5} = 0.08$ CFS
$Q_{total} =$ 0.18 CFS < 0.21 CFS

Therefore 24-hour release requirement is satisfied

Storm Water Detention

The table below summarizes the pond's performance characteristics with respect to detaining peak storm water flows:

Detention Pond Performance	
Berm Top Elevation	= Elev. 380.0

Maximum Storage	= 1.059 Acre-Feet	@ Elev. 378.0
Outlets	= 2" Orifice	@ Elev. 374.0
	= 2" Orifice	@ Elev. 374.7
	= 4.0 L.F. Weir	@ Elev. 376.0

where $Q_{orifice} = ca\,(2gh)^{0.5}$ $c = 0.60$

$Q_{weir} = cl\,(h)^{1.5}$ $c = 3.0$

Storm Frequency	Peak Inflow	Peak Outflow	Maximum Stage
1 YR	8 Cfs	1 Cfs	Elev. 376.1
10 YR	21 Cfs	11 Cfs	Elev. 377.0
25 YR	23 Cfs	13 Cfs	Elev. 377.1
100 YR	34 Cfs	17 Cfs	Elev. 378.0

Upon exiting the Water Quality/Storm Water Detention Pond, the pond discharge flows overland to the south where it combines with the hydrograph from Subarea On-2A and On-2C. The sum of these hydrographs, presented in Appendix "B", represents the total runoff onto the lands of Continental Manor.

SUMMARY

The following table represents the peak runoff rates from composite hydrographs for a range of storm frequencies under Pre- and Post-development conditions.

Pre- And Post-Development Storm Water Runoff

Subarea	Prop./ Exist.	Drainage Area (Acres)	Peak Runoff For Studied Storm Frequencies 1 Yr (Cfs)	10 Yr. (Cfs)	25 Yr. (Cfs)	100 Yr. (Cfs)
Study Point A (On-I)	Exist.	18.2	7	27	31	51
Study Point A (On-IA & On-1B)	Prop.	16.68	6	19	23	47
Study Point B (On-2)	Exist.	30.7	12	47	55	89
Study Point B (On-2A, On-2B & On-2C)	Prop.	36.55	8	38	46	79

	Prop./ Exist.	Drainage Area (Acres)	Peak Runoff For Studied Storm Frequencies 1 Yr (Cfs)	10 Yr. (Cfs)	25 Yr. (Cfs)	100 Yr. (Cfs)
Subarea On-3	Exist.	5.5	2	9	11	17
	Prop.	1.37	1	3	4	5

As demonstrated by the above table and the analyses presented herein, the selected Storm Water Management Facilities can be successfully incorporated into the proposed Patriot Bluff Development to reduce Post-development peak runoff rates to a level equal to or less than those under Pre-development conditions. All three Ponds can also pass peak storm water flows generated by a 100-Year Storm Event.

In summary, the Post-development drainage patterns will remain unchanged from the Pre-development conditions. Runoff from the project sites will continue to contribute flow to the three points of discharge at a rate substantially less than that experienced under existing conditions.

EPIPHANY DRIVE CULVERT

A storm drainage culvert has been incorporated into the design of the proposed Epiphany Drive Extension. This culvert will convey storm water generated by the Heritage Middle School, properties located along Park Hill Drive and Ona Drive, and a portion of Subarea On-1 Culvert. The culvert has been designed to convey flows generated by a storm event having a Return Frequency of 50 Years, and its design parameters are as follows:

Epiphany Drive Extension Culvert

Contributing Areas	
Subarea Off-1	95.7 Acres
Subarea Off-2	35.3 Acres
Portion of Subarea On-1B	6.0 Acres
	137.00 Acres
50 Year Peak Flow	238 CFS
Upstream Invert	370.5 Ft.
Downstream Invert	369.7 Ft.
Length	84 Ft.
Slope	0.95 %

Culvert Size	Dual 7' x 3' Conc. Box
Allow. Headwater Elev.	374.0 Ft.
Computed Headwater Elev.	374.0 Ft. (Outlet Control)

APPENDIX A

PRE-DEVELOPED CONDITIONS

(COPY OF ANALYSIS IS AVAILABLE AT NEW WINDSOR PLANNING BOARD OFFICE)

APPENDIX B

POST-DEVELOPED CONDITIONS

(COPY OF ANALYSIS IS AVAILABLE AT NEW WINDSOR PLANNING BOARD OFFICE)

APPENDIX C

EPIPHANY DRIVE CULVERT

(COPY OF ANALYSIS IS AVAILABLE AT NEW WINDSOR PLANNING BOARD OFFICE)