VILLAGE OF CROTON-ON-HUDSON

GEORGIA LANE/WALDWOOD SUBDIVISION
STORM WATER MANAGEMENT BASIN

FINAL
ENGINEERING DESIGN REPORT

Prepared by:

DVIRKA AND BARTILUCCI CONSULTING ENGINEERS
WOODBURY, NEW YORK

AUGUST 2011

VILLAGE OF CROTON-ON-HUDSON
GEORGIA LANE/WALDWOOD SUBDIVISION
STORM WATER MANAGEMENT BASIN
ENGINEERING REPORT

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1.0 INTRODUCTION

1.1 The Study

The Village of Croton-on-Hudson entered into an agreement with Dvirka and Bartilucci Consulting Engineers (D&B) to review the existing Georgia Lane/Waldwood Subdivision Storm Water Management Basin located just south of Georgia Lane and to provide recommendations to maximize storm water retention within the basin and increase its effectiveness as a storm water management facility. As part of this study D&B performed the following tasks:

Task 1 – Field Investigation

As part of this task, D&B performed a field investigation of the storm water management basin and obtained critical measurements, dimensions and geometry of the basin and its associated features, as well as making judgments as to its overall apparent condition.

Task 2 – Evaluate Existing Outlet Structure

D&B performed a detailed hydrologic and hydraulic analysis of the existing basin and its outlet structure(s) based on the information obtained in Task 1, and evaluated and recommended proposed improvements, modifications or reconfigurations of the existing outlet structure in order to maximize storm water retention within the basin in order to reduce peak runoff rates downstream and to handle peak flows through the outlet structure. The hydrology assessment model prepared for the Batten Brook/Mount Airy Road subwatershed (ID No. 18), prepared for the Village in July 2004, was updated based on the information obtained in Task 1, recent improvements made in the watershed, and new 2-foot contours from Westchester County data supplied by the Village.

Task 3 – Engineering Design Report

D&B's evaluations and recommendations prepared for the tasks described above, addressing only this site, are included in this Engineering Design Report. This Engineering Design Report includes:

- A summary the existing conditions of the storm water management basin and its contributing watershed.
- An identification of selected alternative improvements/designs and relative effectiveness of each, together with estimated ranges of cost.
- A description of the recommended improvement/design, rationale and associated cost estimate.
- An identification of applicable environmental permitting requirements associated with the recommended conceptual improvement/design.

1.2 Background

In 2004, D&B prepared a Storm Water Management Plan (the Plan) for the Village of Croton-on-Hudson. The Plan included the comprehensive storm water modeling (hydrology assessment model) of four priority drainage areas identified by the Village and recommendations for alleviating flooding conditions in these areas. Refer to the Village's 2004 Storm Water Management Plan prepared by D&B for the complete study, analysis and recommendations. The Village has undertaken several projects in the four priority drainage areas recommended in The Plan including modifications to the Kaplan's Pond Outlet Structure located in priority drainage basin No. 10-Brook Street and storm drainage improvements along Batten Road which is located in Priority Drainage Basin No. 18-Batten Road/Mount Airy Road.

The Georgia Lane/Waldwood Subdivision Stormwater Management Basin is located in priority drainage area No.18-Mount Airy/Batten Brook Road. The basin is situated just south of Georgia Lane and north of Park Trail. The crest and emergency spillway of the basin have been overtopped numerous times in the past few years and the Village has periodically had to undertake repairs to the basin as a result of the overtopping. In addition, the existing outfall of

the basin becomes clogged with debris requiring constant monitoring by Village personnel and increasing the likelihood the basin will be overtopped during a storm event.

2.0 EXISTING CONDITIONS

The Georgia Lane/Waldwood Subdivision Storm Water Management Basin located just south of Georgia Lane was constructed as the stormwater management facility for the Waldwoods Subdivision. The basin is an embankment basin, with the embankment height varying between 3 to 8 feet. The basin is located on a parcel of property that offers very little opportunity to significantly increase the basin storage capacity. The existing basin has two inlet pipes. One conveys a base flow from streams that have their headwaters in the woods north of Georgia Lane and the other conveys storm water flows from the storm sewer system of Georgia Lane and the subdivision. Because the basin has a constant inflow it has developed a permanent pool of water and wetlands plants have taken root in the basin. These wetlands offer some storm water quality improvements.

The basin has a 15-inch diameter corrugated metal pipe (cmp) as the outfall. The base flows and storm water flows are discharged though the outfall pipe and continue to flow south to a 22-inch by 34-inch elliptical pipe under Park Trail Lane. Flows continue through natural mountain streams and through culverts at road crossings towards Batten Road and ultimately reach the Croton River.

The emergency spillway of the storm water management basin consists of a low section on the embankment with small diameter gravel that may be prone to erosion during storm events that top the crest of the emergency spillway

Refer to Figures 2-1 through 2-5 for photographs of the basin.

2.1 Tributary Area

Based on the updated Westchester County Topography provided by the Village, the tributary area to the basin was delineated. Based on the updated topography, the tributary area to the basin has changed slightly from the 2004 study. The tributary area to the basin is approximately 72 acres consisting mostly of lands of wooded area, residential development and a

Emergency Spillway

Wetlands Plants

Dvirka and Bartilucci CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

Croton-on-Hudson

WALDWOOD SUB-DIVISION BASIN PHOTOS

Figure 2-1

36"Ø Inlet

36"Ø Inlet

Dvirka and Bartilucci CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

Croton-on-Hudson

WALDWOOD SUB-DIVISION BASIN PHOTOS

Figure 2-2

Existing 15"Ø Outlet Pipe

Existing 15"Ø Outlet Pipe

Dvirka and Bartilucci CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

Croton-on-Hudson

WALDWOOD SUB-DIVISION BASIN PHOTOS

Figure 2-3

Hole in Embankment

Hole in Embankment

Dvirka and Bartilucci CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

Croton-on-Hudson

WALDWOOD SUB-DIVISION BASIN PHOTOS

Figure 2-4

22" x 34" Elliptical Pipe Under Park Trail

Downstream Side of 15"Ø Outfall Pipe

Dvirka and Bartilucci CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

Croton-on-Hudson

WALDWOOD SUB-DIVISION BASIN AND PARK TRAIL CULVERT PHOTOS

Figure 2-5

Con Edison right-of-way (ROW) located both within the village and the Town of Cortland. The 72-acre tributary area was further divided into four sub-catchment areas, Nos. 13, 14, 15 and 16. Refer to Figure 2-6 for the updated drainage area map for the Batten Brook/Mount Airy Road Drainage area.

The area, runoff curve number and time of concentration for each of the sub-catchment areas tributary to the basin are given below in Table 2-1, Tributary Area Summary.

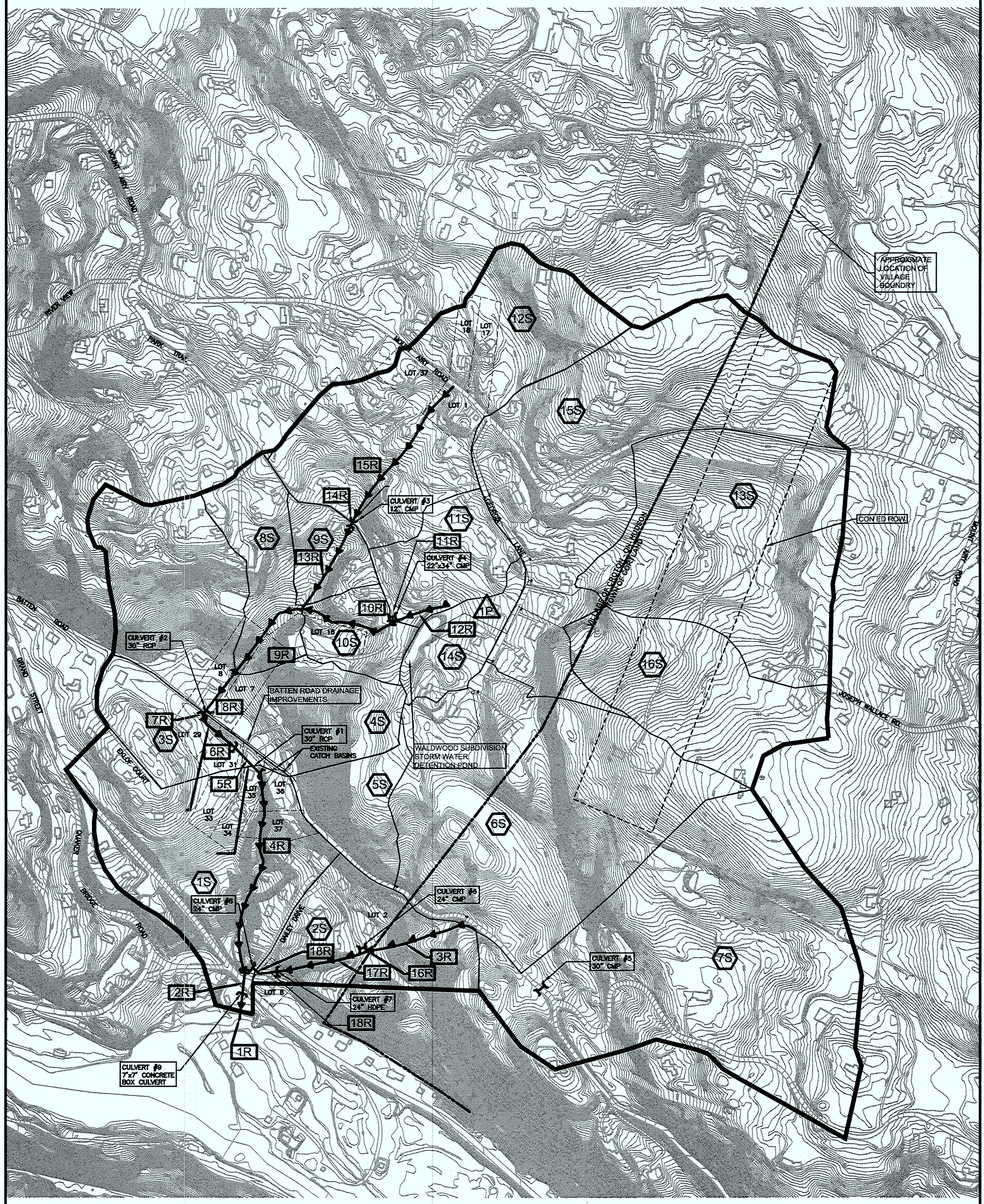
Table 2-1

GEORGIA LANE/ WALDWOOD SUBDIVISION STORM WATER BASIN TRIBUTARY AREA SUMMARY

Sub-catchment ID No.	Area (acres)	Curve Number	Time of Concentration (min.)	Description
13	24.10	59	33.1	Wooded area/headwaters of natural stream/ Con Ed ROW
14	4.15	55	4.3	Waldwood subdivision/storm water management pond
15	30.50	64	31.1	Wooded area/Waldwood subdivision/ Con Ed ROW
16	21.99	59	26.9	Wooded area/headwaters of natural stream/ Con Ed ROW

2.2 Basin Geometry and Capacity

D&B performed a partial topographic survey of the existing basin. Refer to Figure 2-7. Based on the survey performed by D&B the volume of the basin to the crest of the emergency spillway is approximately 30,000 cubic feet. The emergency spillway has a crest elevation of 337.80 feet.



LEGEND

- 7 — SUB–CATCHMENT AREA
- 2R — REACH AND ID No.
- 2P — POND ID No.
- LOT 3 — WESTCHESTER COUNTY TAX MAPS 68.14,68.09, 68.10, 68.13
- WATERSHED BOUNDARY
- SUBCATCHMENT BOUNDARY
- REACH
- VILLAGE/TOWN LINE
- APPROXIMATE TAX MAP. LOT BOUNDRY
- EXISTING STORM DRAIN
- EXISTING CATCH BASIN
- EXISTING MANHOLE

Dvirka and Bartilucci CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

VILLAGE OF CROTON-ON-HUDSON WESTCHESTER COUNTY, NEW YORK
PHASED STORMWATER MANAGEMENT PLAN

BATTEN BROOK ROAD/MOUNT AIRY ROAD SUB-DRAINAGE SYSTEM: (ID No. 18)
UPDATED DRAINAGE AREA MAP

SCALE: 1"=200'

FIGURE 2-6

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EXISTING EMERGENCY SPILLWAY,
ELEVATION APPROXIMATE 337.80

15"ø CMP
OUTLET PIPE

EXISTING
EMBANKMENT

EXISTING
STEAM TUNNEL

NO.	DATE	REVISION	INT.

PROJECT ENGINEER:	DRAWN BY:
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DESIGNED BY:	CHECKED BY:
JRT	KJP

Dvirka and Bartilucci
CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

VILLAGE OF CROTON-ON-HUDSON

WESTCHESTER COUNTY — NEW YORK

WALDWOOD SUBDIVISION RETENTION BASIN

PARTIAL TOPOGRAPHIC SURVEY

PROJECT NO.	DRAWING NO.
2888	FIGURE 2-7
DATE: AUGUST 2011	
SCALE: 1"=10'	

The existing outlet structure for the basin consists of a 15-inch corrugated metal pipe (cmp) with a slope of 3.8%. Based on the current configuration of the outlet structure in relation to the crest of the emergency spillway a maximum head of 4.19 feet can be applied to the pipe, which generates a maximum outflow capacity of approximately 9 cubic feet per second (cfs).

2.3 Updated Hydrologic Model

Based on the updated Westchester County Topography provided by the Village and survey information of the basin gathered by D&B, the existing hydrologic model for Drainage Area 18–Batten Brook/Mount Airy Road was updated for the 2-, 5-, 10-, and 100-year storm events. Updates to the hydrologic model include:

- Revised tributary areas and Times of Concentration to the Georgia Lane Basin (sub-catchment ID Nos. 13, 14, 15, 16)
- Revised Georgia Lane basin geometry and volume to reflect survey information obtained by D&B
- Updates to reflect the recent improvements made to Batten Road as part of the Batten Road Drainage and Roadway Improvements as recommended in the study.

Based on the changes to the hydrologic model as a result of the updated information flows into the basin as well as flows at other critical areas within the watershed have changed. Table 2-2 below provides a summary of the existing flows at the Georgia Lane/Waldwood Subdivision Basin.

Table 2-2

SUMMARY OF EXISTING FLOWS AT THE GEORGIA LANE/ WALDWOOD SUBDIVISION BASIN

Storm Event	24-Hour Rainfall (inches)	Pond Inflow (cfs)	Pond Outflow (cfs)	Peak WSEL
2-Year	3.50	19.90	8.63	337.61
5-Year	4.50	43.35	40.64[1]	338.29*
10-Year	5.00	57.06	55.72[1]	338.44*
100-Year	7.50	136.72	135.97[1]	339.10*

[1] Includes the 15-inch outlet pipe and emergency spillway.
* Indicates emergency spillway (El. 337.80) is overtopped.

Again, it should be noted that the basin has a crest elevation of approximately 337.80 and, therefore, this is overtopped during the 5-year storm event. This is due to the relationship of basin volume, inflow volume and the capacity of the existing outfall pipe. Table 2-3 provides a summary of flows at other key points in the watershed. These existing flows will be used as the basis for evaluating the impacts of the proposed alternatives. The updated hydrologic model of the existing conditions can be found in Appendix A.

Table 2-3

SUMMARY OF EXISTING FLOWS AT OTHER KEY POINTS IN THE WATERSHED

Storm Event	Flow thru Park Trail* Culvert (cfs)	Flow at Batten Road 30" RCP (cfs)	Flow at Batten Road Lots 33, 34 (cfs)
2-Year	9.32	18.29	12.67
5-Year	43.92	72.33	46.56
10-Year	60.46	101.11	60.13
100-Year	148.78	255.16	239.79

* Note: Capacity of 24" x 36" elliptical culver under Park Trail is approximately 30 CFS.

3.0 EVALUATION OF PROPOSED ALTERNATIVES AND RECOMMENDATIONS

The following proposed alternatives for the basin are aimed at reducing the frequency that the basin is overtopped and mitigating peak storm water runoff rates downstream in the watershed. The impact each proposed alternative has on the frequency of overtopping and downstream impacts has been evaluated in the updated hydrologic model.

The recommended action is one that will reduce the frequency of overtopping and maintain or reduce peak storm water flows downstream in the watershed in a cost effective manner.

3.1 Install Trash Rack/Inlet Protection

Installing a trash rack/inlet protection over the existing 15-inch cmp outfall will reduce the likelihood that the outfall becomes clogged with debris during a storm event. This will reduce the chances that the basin is overtopped during a 2-year storm event as a result of the outfall pipe being clogged. However, based on the model, the basin will still be overtopped for 5-year storm events and greater. The existing inflows, outflows and peak rates from the basin and at other critical areas in the watershed will not change as a result of this improvement. The Village will still need to inspect and clean the trash rack/inlet protection periodically. Because this alternative does not provide any reduction in the frequency that the basin is overtopped or any reduction in peak flows, it is not the recommended action.

3.2 Increase Basin Volume

Increasing the basin volume would provide additional storage capacity thus reducing peak discharge rates and the frequency that the basin is overtopped.

Based on the capacity of the existing outfall pipe and the tributary area, the basin volume would have to be increased by approximately 115,000 cubic feet to prevent frequent overtopping of the basin. The crest of the emergency spillway would also be raised from 337.80 to 339.00.

This is approximately 4 times as large as the existing basin. If a larger basin was constructed, the resultant impacts of flows at the basin and other critical locations in the watershed are summarized in the Tables 3-1 and 3-2 respectively. Refer to Appendix B for the hydrologic model outputs for the enlarged basin.

Table 3-1

SUMMARY OF FLOWS AT ENLARGED BASIN

Storm Event	24-Hour Rainfall (inches)	Pond Inflow (cfs)	Pond Outflow (cfs)		Proposed Peak WSEL
			Exist.	Proposed	
2-Year	3.50	19.90	8.63	6.69	336.24
5-Year	4.50	43.35	40.64	10.12	338.95
10-Year	5.00	57.06	55.72	29.21	339.39*
100-Year	7.50	136.72	135.97	131.49	340.31*

*Indicates emergency spillway overtopped (El. 339.0).

Table 3-2

SUMMARY OF FLOWS AT KEY WATERSHED LOCATIONS WITH ENLARGED BASIN

Storm Event	Flow thru Park Trail Culvert (cfs)		Flow at Batten Road 30" RCP (cfs)		Flow at Batten Road Lots 33, 34 (cfs)	
	Existing	Proposed	Existing	Proposed	Existing	Proposed
2-Year	9.32	7.23	18.29	15.80	12.67	11.10
5-Year	43.92	11.44	72.33	42.11	46.56	29.96
10-Year	60.46	31.35	101.11	55.57	60.13	40.96
100-Year	148.78	143.37	255.16	244.80	239.79	228.35

Although increasing the basin volume would have a substantial reduction in peak storm water flows at downstream locations, given the basins proximity to adjacent properties and lack of any significant area in the existing easement, it does not seem feasible to increase the size of the basin to gain any appreciable storage volume. Given the lack of feasibility, this alternative is not recommended.

3.3 Bypass Existing Base Flows and Modify Existing Spillway

Another proposed alternative would be to route the base stream flows around the basin by installing additional manholes and pipes to bypass the basin and increase the emergency spillway crest to 339.00. This would reduce the tributary area of the basin by approximately 37 acres, reducing flows into the basin. Refer to Figure 3-1 for a conceptual layout of the bypass. Table 3-3 below provides a summary of the resultant flow and impacts to the basin as a result of this alternate. Refer to Appendix C for the hydrologic model output for bypassing existing flows.

Table 3-3

SUMMARY OF FLOWS AT BASIN WITH BYPASS

Storm Event	24-Hour Rainfall (inches)	Pond Outflow (cfs)		Proposed Peak WSEL
		Existing	Proposed	
2-Year	3.50	8.63	6.75	336.28
5-Year	4.50	40.64	9.38	338.23
10-Year	5.00	55.72	14.07	339.14*
100-Year	7.50	135.97	68.69	339.80*

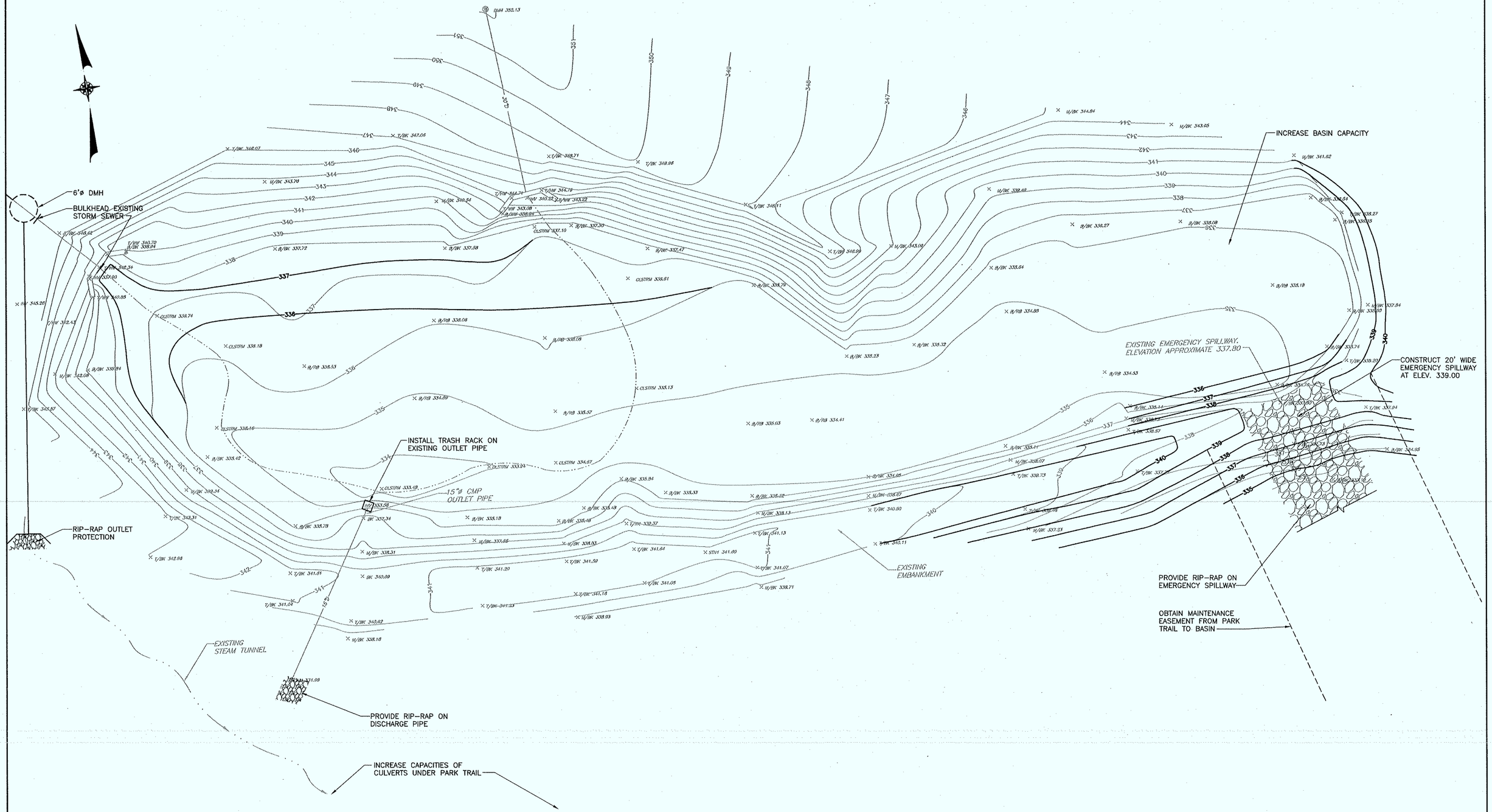
* Indicates emergency spillway is overtopped (El. 339.0).

Table 3-4 summarizes the flows at key watershed locations as a result of diverting the base flows around the basin.

Table 3-4

SUMMARY OF FLOWS AT KEY WATERSHED LOCATIONS WITH BYPASS

Storm Event	Flow thru Park Trail Culvert (cfs)		Flow at Batten Road 30" RCP (cfs)		Flow at Batten Road Lots 33, 34 (cfs)	
	Existing.	Proposed	Existing	Proposed	Existing	Proposed
2-Year	9.32	15.78	18.29	25.19	12.67	17.06
5-Year	43.92	30.94	72.33	62.15	46.56	42.85
10-Year	60.46	39.79	101.11	81.97	60.35	54.18
100-Year	148.78	147.62	255.16	252.83	239.79	236.92



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VILLAGE OF CROTON-ON-HUDSON

WESTCHESTER COUNTY NEW YORK

WALDWOOD SUBDIVISION RETENTION BASIN

BYPASS ROUTING AND BASIN IMPROVEMENTS

PROJECT NO.	DRAWING NO.
2888	FIGURE 3-1
DATE: AUGUST 2011	
SCALE: 1"=10'	

Bypassing flows around the basin will actually increase flows at locations downstream for smaller storm events such as the 2-year storm. This is because the basin in its current configuration provides attenuation of these flows during smaller storm events and releases the stormwater runoff over a period of time. The bypass option would result in an increase in the 2-year flow rate at the Batten Road culvert by approximately 37% and a decrease in the 5-year and 10-year flow rates by about 13%. The 2-year flow rate at lots 33 and 34 on Batten Road increased by approximately 35% and the 5-year and 10-year rates decrease by about 7%.

It is also likely that bypassing the base flows around the basin will cause the wetlands that have developed in the basin to die off. These wetlands provide a storm water quality improvement feature to the basin as these plants take up nutrients, breakdown some heavy metals and trap sediments, as well as provide habitat.

The construction cost estimate for this alternative is approximately $143,150. A detailed cost estimate can be found in Appendix E.

3.4 Increase Diameter of Existing Culvert, Construct New Outlet Structure and Modify Existing Emergency Spillway

Given the existing relationship between the invert and diameter of the outfall pipe and the crest elevation, the outfall pipe has a capacity of approximately 9 cfs. In order to reduce the occurrence of overtopping the basin the capacity of the existing outfall must be increased in addition to raising the emergency spill crest elevation. In addition to increasing the diameter of the outfall, a tiered outfall structure or riser pipe would be required to provide for maximum attenuation of storm water flows, while safely maintaining the water surface elevation for the 2-, 5- and 10-year event within the basin. The proposed outfall pipe consists of a 30" diameter high density polyethylene pipe (HDPE). The outlet structure could be constructed from a pre-cast concrete catch basin or manhole modified to provide the necessary inlets at the proper elevations. The outlet structure recommended should have a 12-inch low flow orifice to convey the base flows through the basin. This low flow orifice should be equipped with a trash rack to prevent clogging. In addition, the outlet structure will require a 6-foot long weir set at elevation 337.50. This is a conceptual description of an outlet structure, which could be modified during the design

phase to maximize the efficiency of the basin. The impacts as a result of this configuration to the basin and the critical locations downstream are summarized in Table 3-5 and 3-6. The hydrologic model outputs for this alternate can be found in Appendix D.

Table 3-5
SUMMARY OF FLOWS AT BASIN WITH OUTLET STRUCTURE AND 30" PIPE

Storm Event	24-Hour Rainfall (inches)	Pond Inflow (cfs)	Pond Outflow (cfs)		Peak WSEL
			Exist.	Proposed	
2-Year	3.50	19.90	8.63	7.58	337.81
5-Year	4.50	43.35	40.64	34.92	338.87
10-Year	5.00	57.06	55.72	51.72	339.18*
100-Year	7.50	136.72	135.97	134.53	340.06*

* Indicates emergency spillway is overtopped (El. 339.0).

Table 3-6

SUMMARY OF FLOW AT KEY WATERSHED LOCATIONS WITH OUTLET STRUCTURE AND 30" PIPE

Storm Event	Flow thru Park Trail Culvert (cfs)		Flow at Batten Road 30" RCP (cfs)		Flow at Batten Road Lots 33, 34 (cfs)	
	Existing	Proposed	Existing	Proposed	Existing	Proposed
2-Year	9.32	8.14	18.29	16.98	12.67	11.89
5-Year	43.92	37.61	72.33	62.48	46.56	42.11
10-Year	60.46	55.93	101.11	93.00	60.13	57.00
100-Year	148.78	147.01	255.16	252.08	239.79	236.46

This alternative prevents the basin from being crested up to the 10-year storm event. The construction cost estimate for this alternate is $126,350. A detailed cost estimate can be found in Appendix E.

It is because of this option's ability to reduce flows down stream for all storm events, its construction feasibility and cost that this is the recommended action.

In addition, it is recommended that the culvert under Park Trail be improved to convey the 10-year storm event (51.72 cfs).

Refer to Figure 3-2 for recommended improvements.

INCREASE BASIN CAPACITY

EXISTING EMERGENCY SPILLWAY, ELEVATION APPROXIMATE 337.80

CONSTRUCT 20' WIDE EMERGENCY SPILLWAY AT ELEV. 339.00

15"ø CMP OUTLET PIPE

CONSTRUCT NEW OUTLET STRUCTURE AND 30"ø OUTFALL PIPE

EXISTING STEAM TUNNEL

EXISTING EMBANKMENT

PROVIDE RIP-RAP ON EMERGENCY SPILLWAY

OBTAIN MAINTENANCE EASEMENT FROM PARK TRAIL TO BASIN

PROVIDE RIP-RAP ON DISCHARGE PIPE

INCREASE CAPACITIES OF CULVERTS UNDER PARK TRAIL

NO.	DATE	REVISION	INT.

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A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

VILLAGE OF CROTON-ON-HUDSON

WESTCHESTER COUNTY — NEW YORK

WALDWOOD SUBDIVISION RETENTION BASIN

PROPOSED OUTLET STRUCTURE AND BASIN IMPROVEMENTS

PROJECT NO.	DRAWING NO.
2888	FIGURE 3-2
DATE: AUGUST 2011	
SCALE: 1"=10'	

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4.0 OTHER GENERAL RECOMMENDATIONS

In addition to increasing the capacity of the basin outlet pipe and providing a new outlet structure as described in Section 3.4, the following items should also be addressed.

- The emergency spillway crest should be increased to 339.00 and the entire spillway should be covered or armored with stone rip-rap or other measures sized for the velocities it will be subjected to during the 100-year storm event to prevent erosion.
- Pilot channels should be constructed to convey base flows directly to the outfall pipe to minimize ponding and stagnant water within the basin.
- During construction sediment should be removed from the basin, this will increase basin capacity and provide for additional storage and attenuation of storm water flows greater than those theoretically calculated.
- The existing animal burrows in the embankment should be filled in and compacted, displacing the animals residing in the embankment.
- Obtain maintenance easement or ROW from Park Trail to the storm water basin from the property owner for purposes of periodic maintenance and inspection.

APPENDIX A

UPDATED EXISTING CONDITIONS HYDROLOGIC MODELS

APPENDIX B

HYDROLOGIC MODEL OF ENLARGED BASIN

APPENDIX C

HYDROLOGIC MODEL OF BYPASS

APPENDIX D

HYDROLOGIC MODEL OF REVISED OUTLET STRUCTURE AND SPILLWAY

APPENDIX E

DETAILED COST ESTIMATES OF ALTERNATES

CONSTRUCTION COST ESTIMATE FOR BYPASSING SUBCATCHMENTS 13S AND 16S INTO EXISTING STREAM

VILLAGE OF CROTON-ON-HUDSON
WESTCHESTER COUNTY, NY

Item	Description	Unit	Unit Price	Quantity	Total
1	36" HDPE Storm Drain	LF	$200.00	75	$15,000.00
2	6-foot Diameter Manhole	EA	$6,000.00	1	$6,000.00
3	Excavation	CY	$30.00	110	$3,300.00
4	Select Fill	CY	$30.00	75	$2,250.00
5	Clearing and Grubbing	LS	$4,000.00	1	$4,000.00
6	Rock Excavation	CY	$300.00	11	$3,300.00
7	Trash Rack for Existing Outlet	EA	$500.00	1	$500.00
8	Rip-Rap for Emergency Spillway Reinforcement/36-inch Bypass Pipe	CY	$50.00	120	$6,000.00
9	Soil Erosion and Sediment Control	LS	$5,000.00	1	$5,000.00
10	Topsoil, Seed, and Mulch	LS	$5,000.00	1	$5,000.00
11	Emergency Spillway Grade Improvements	LS	$5,000.00	1	$5,000.00
12	Culvert Improvements at Park Trail	LS	$15,000.00	1	$15,000.00
13	Row Survey, Easement Legal Fees	LS	$10,000.00	1	$10,000.00
14	Concrete Headwall	EA	$5,000.00	1	$5,000.00
15	Connection to Existing Drainage Structure	EA	$800.00	1	$800.00
16	Mobilization and Demobilization (10% of Total Construction)	LS	$10,000.00	1	$10,000.00

Construction Cost Total:	$96,150.00
20% Contingency:	$25,000.00
15% Engineering Allowance:	$22,000.00
TOTAL PROJECT COST:	**$143,150.00**

CONSTRUCTION COST ESTIMATE FOR OUTLET STRUCTURE AND 30-INCH OUTFALL PIPE WITH IMPROVEMENTS TO EMERGENCY SPILLWAY

VILLAGE OF CROTON-ON-HUDSON
WESTCHESTER COUNTY, NY

Item	Description	Unit	Unit Price	Quantity	Total
1	30-inch Diameter HDPE Pipe	LF	$100.00	40	$4,000.00
2	Precast Concrete Outlet Structure with Trash Rack	EA	$15,000.00	1	$15,000.00
3	Excavation	CY	$30.00	110	$3,300.00
4	Select Fill	CY	$30.00	25	$750.00
5	Clearing and Grubbing	LS	$5,000.00	1	$5,000.00
6	Rock Excavation	CY	$300.00	11	$3,300.00
7	Core Cut-Off Trench/Anti-Seep Collar	LS	$5,000.00	1	$5,000.00
8	Rip-Rap for Emergency Spillway Reinforcement/30-inch Discharge Pipe	CY	$50.00	120	$6,000.00
9	Soil Erosion and Sediment Control	LS	$5,000.00	1	$5,000.00
10	Topsoil, Seed and Mulch	LS	$5,000.00	1	$5,000.00
11	Emergency Spillway Grade Improvements	LS	$5,000.00	1	$5,000.00
12	Culvert Improvements at Park Trail	LS	$15,000.00	1	$15,000.00
13	Row Survey, Easement Legal Fees	LS	$10,000.00	1	$10,000.00
14	Mobilization and Demobilization (10% of Total Construction)	LS	$9,000.00	1	$9,000.00

Construction Cost Total:	$91,350.00
20% Contingency:	$18,000.00
15% Engineering Allowance:	$17,000.00
TOTAL PROJECT COST:	**$126,350.00**