PRELIMINARY
STORMWATER SITE PLAN FOR

E. DIVISION ELEMENTARY SCHOOL

MOUNT VERNON, WASHINGTON

SEPTEMBER 28, 2016

9/28/16

HARMSEN & ASSOCIATES INC

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PROJECT OVERVIEW

This preliminary Stormwater Site Plan has been prepared for the E. Division Street Elementary School located east of Skagit Highlands Parkway and north of E. Division Street in Mount Vernon, Washington, see Figure 1: Vicinity Map. The project consists of the construction of a new elementary school with accompanying access, bus and car parking and play fields for the Mount Vernon School District. E. Division Street will be widened and a new public roadway constructed to the school site in a parcel known as Tract X. The entire property covers 25.23 acres and is currently forested land. There are several wetlands located on the site that will remain largely undisturbed. Total proposed impervious surface is approximately 6.9 acres. See Figure 3A: Developed School Site Map and Figure 3B: Frontage Improvement Map in Appendix A.

METHODOLOGY

The drainage design for the project has been prepared based on the requirements of the 2012 Department of Ecology Stormwater Management Manual (DOE Manual) as adopted by the City of Mount Vernon. WWHM3 as provided by DOE has been used for determining basin runoff and for sizing of the stormwater facilities.

Based on the flow charts in Figure 2.3 of the DOE Manual and the site parameters, the project is subject to Minimum Requirements 1-10.

The project site parameters are:

- The project will create 5,000 sf of new or replaced impervious area.
- The project will disturb more than 7,000 sf.
- The project does not convert ¾ acre of pasture to lawn.
- The project does not convert 2.5 acres of forest to pasture.

MR 1: PREPARATION OF STORMWATER SITE PLANS

DRAINAGE PLAN DESCRIPTION

The site has been divided into two basins for evaluation of the existing condition runoff. They are the School Site Basin and the Frontage Road Basin.

SCHOOL SITE BASIN

The School Site basin stormwater runoff the site will be collected, treated in bioretention facilities, then conveyed to a detention pond. The runoff from the paving areas will generally sheet flow into one of six bioretention cells, or be conveyed to one by curb or catch basin and pipe. The roof runoff and portions of the paved play areas will flow to one of three bioretention cells. Most of the field runoff and some of the paved play area runoff will be collected and conveyed to the detention pond. To maintain wetland hydrology, it is anticipated that some of the developed area will be collected, conveyed and discharged to the wetland buffer.

FRONTAGE ROAD BASIN

The Frontage Road basin runoff will be collected and conveyed to a detention-wetpond for treatment and detention prior to being discharged to the large onsite wetland system.

WATER QUALITY MEASURES

Following is a list of the proposed construction water quality BMPs. See MR 3: Water Pollution Source Control for more information. The proposed BMPs are as follows:

BMP C101, Preserving Natural Vegetation
BMP C103, High Visibility Fence
BMP C105, Construction Entrance
BMP C106, Wheel Wash
BMP C107, Construction Road/Parking Area Stabilization
BMP C120, Temporary and Permanent Seeding
BMP C121, Mulching
BMP C123, Plastic Covering
BMP C125, Topsoiling/Composting
BMP C130, Surface Roughening
BMP C140, Dust Control
BMP C150, Materials On Hand
BMP C151, Concrete Handling
BMP C152, Sawcutting and Surfacing Pollution Prevention
BMP C153, Material Delivery, Storage and Containment
BMP C154, Concrete Washout Area
BMP C160, Certified Erosion and Sediment Control Lead
BMP C200, Interceptor Dike and Swale
BMP C201, Grass-Lined Channels
BMP C207, Checkdams
BMP C209, Outlet Protection
BMP C220, Storm Inlet Protection

BMP C233, Silt Fence
BMP C241, Temporary Sediment Pond

DETENTION SIZING

Flow control will be provided by two open ponds that will detain runoff to match the existing condition flow durations per the streambank protection standards of the DOE Manual. See Minimum Requirements #6 & 7 for additional information.

CONVEYANCE CALCULATIONS

SCHOOL SITE BASIN

The primary conveyance of runoff will be sheet flow in the parking areas and downspout collectors for the building. Where necessary catch basins and pipe will collect and convey runoff, but these will be kept to a minimum. The bioretention underdrains and overflows will be collected and conveyed in a pipe network to the detention pond.

FRONTAGE ROAD BASIN

A piped conveyance system will be installed along the E. Division Street then to the detention pond. Conveyance calculations for both the school and frontage areas will be included in the final drainage report to be prepared for construction permits.

STORMWATER TREATMENT BMP'S

SCHOOL SITE BASIN

The runoff from the new parking and access drive will flow to bioretention cells for treatment. Bioretention facilities will also be provided for the roof runoff per DOE requirements. See Minimum Requirement #6 for additional information.

FRONTAGE ROAD BASIN

A combination detention-wetpond is proposed to provide for treatment of the runoff from the basin. It will be sized using WWHM3 per DOE requirements. See Minimum Requirement #6 for additional information.

PROTECTION OF WETLANDS

A Critical Areas Study has been done for the site and surrounding properties by Graham-Bunting & Associates. They have delineated several Category II and Category III wetlands on the south and eastern portions of the site. For additional information see Minimum Requirement #8 and the Critical Areas Study under separate cover.

OPERATIONS AND MAINTENANCE

The specific requirements for the ongoing operation and maintenance of the proposed storm water systems will be detailed in the final drainage report to be prepared for construction permits as part of Minimum Requirement #10.

EXISTING CONDITIONS SUMMARY

DESCRIPTION

The site is the E. Division Street Elementary School located east of Skagit Highlands Parkway and north of E. Division Street in Mount Vernon, Washington, see Figure 1: Vicinity Map. Currently the entire 25.23 acre site, 2 parcels, is wooded with trees and brush. As mentioned there are several wetlands on the site. These will for the most part remain undisturbed. The topography of the site slopes from elevation 400 near the southeast corner to 366 at the main wetland and site discharge along the north property line. The building area is located on the upper northeastern portion of the site and is free from wetlands. E. Division Street will be widened and a sidewalk added. The accompanying drainage basin contains 1.25 acres and includes the north half of E. Division Street and the southern half of Tract X. See Figure 2: Existing Site Map in Appendix A.

SOILS DESCRIPTION

Materials Testing & Consulting, Inc has performed soils exploration on the site and has documented the underlying soils in their report titled *Geological Investigation and Engineering Services*. Their report documents the underlying soil as 6-9" of dark brown silt topsoil over oxidized orange-brown sandy silt and silt with gravel to a depth of about 2 feet. Below this is gray-brown dense to very dense silty sand to sandy silt with gravel extending to depths of at least 4 feet. Due to the combination of a high likelihood of seasonal perched groundwater and the relatively impermeable consolidated and cemented glacial till preclude the use of infiltration on the site.

EXISTING BASINS

The site has been divided into two basins for evaluation of the existing condition runoff. They are the School Site Basin and the Frontage Road Basin.

SCHOOL SITE BASIN

The basin consists of the proposed school with associated parking and play areas, and the north half of the new public road in Tract X. The 9.08 acre basin consists of the following land uses:

Forest	9.08 ac

The existing condition flow frequency runoff rates, as calculated by WWHM3 (see Appendix B) are as follows:

2 yr	0.18 cfs
10 yr	0.44 cfs
50 yr	0.75 cfs
100 yr	0.91 cfs

FRONTAGE ROAD BASIN

The basin consists of the southern half of the new public road and the north half of E. Division Street. The 1.25 acre basin consists of the following land uses:

Existing Pavement	0.47 ac

Roadside Grass	0.09 ac
Forest	0.69 ac

The existing condition flow frequency runoff rates, as calculated by WWHM3 (see Appendix B) are as follows:

2 yr	0.14 cfs
10 yr	0.25 cfs
50 yr	0.36 cfs
100 yr	0.41 cfs

UPSTREAM ANALYSIS

SCHOOL SITE BASIN

The building area is on the high portion of the site. The ground descends offsite to the east, and to the south and west towards wetland areas. The property to the north is developed as a residential plat and slopes to the north. With the surrounding properties being lower than the proposed building area, there is no upstream runoff that affects the site.

FRONTAGE ROAD BASIN

The crown along E. Division Street prevents runoff from the south side of the road from flowing into the drainage collection system.

DOWNSTREAM ANALYSIS

Stormwater runoff from the site will be released to the wetland system that flows south to north through the site. As the wetland flows northward it flows under an earthen trail in a 12" culvert. This culvert is known to be overtopped during larger storm events. It is not known if the culvert, that was recently installed as part of the adjacent plat construction, was intended to be overtopped or not. The wetland then bends to the west and flows under the Skagit Highlands Parkway through a concrete bridge. The bridge is about 1100 feet from the site. The wetland system then flows to the northwest to a point about 2900 feet from the site where it joins with College Way Creek and bends northward. The stream channel continues north, then east, eventually connecting to Nookachamps Creek about 2 miles from the site. The drainage course is mostly within wooded corridors through residential developments until it reaches the valley floor near Nookachamps Creek. With implementation of the proposed storm water quality and quantity controls, there should be no significant impact to the downstream drainage system.

MR 2: CONSTRUCTION STORMWATER POLLUTION PREVENTION (SWPP)

Full DOE SWPPP to be prepared under separate cover as part of the construction permit submittal. The primary objective of the SWPPP is to provide best management practices (BMPs) to prevent or minimize adverse stormwater impacts from construction activities on downstream resources and on-site stormwater facilities. Minimization of stormwater flows, prevention of soil erosion, capture of water-borne sediment that has been unavoidably released from exposed soils, and protection of water quality from on-site pollutant sources are all readily achievable when the proper BMPs are planned, installed, and properly maintained. The SWPPP will detail the applicable source control , runoff conveyance and treatment BMPs for the site.

MR 3: WATER POLLUTION SOURCE CONTROL

CONSTRUCTION STORMWATER BMPs

The proposed BMPs will include many of the following:

BMP C101, Preserving Natural Vegetation
BMP C103, High Visibility Fence
BMP C105, Construction Entrance
BMP C106, Wheel Wash
BMP C107, Construction Road/Parking Area Stabilization
BMP C120, Temporary and Permanent Seeding
BMP C121, Mulching
BMP C123, Plastic Covering
BMP C125, Topsoiling/Composting
BMP C130, Surface Roughening
BMP C140, Dust Control
BMP C150, Materials On Hand
BMP C151, Concrete Handling
BMP C152, Sawcutting and Surfacing Pollution Prevention
BMP C153, Material Delivery, Storage and Containment
BMP C154, Concrete Washout Area
BMP C160, Certified Erosion and Sediment Control Lead
BMP C200, Interceptor Dike and Swale
BMP C201, Grass-Lined Channels
BMP C207, Checkdams
BMP C209, Outlet Protection
BMP C220, Storm Inlet Protection
BMP C233, Silt Fence
BMP C241, Temporary Sediment Pond

Additional detail for these BMPs will be included in the Full DOE SWPPP to be prepared with the construction documents.

PERMANENT SOURCE CONTROL BMPs

The following source controls apply:

- Container storage of wastes;
- Vegetation management;
- Cleaning of paved surfaces;
- Storm drainage maintenance;

MR 4: PRESERVATION OF NATURAL DRAINAGE

The site is somewhat rolling with several isolated wetlands. A larger wetland corridor flows south to north through the western half of the school property, ultimately discharging to the north and offsite. The proposed stormwater system will detain runoff at or below the existing forested condition in accordance with the DOE Manual. The release for the runoff from the detention ponds is to the main wetland corridor, thereby maintaining the existing natural drainage.

MR 5: ON-SITE STORMWATER MANAGMENT

Being required to meet Minimum Requirements #1-9 and being a new development site inside a UGA (inside the City limits); the site will need to meet the Low Impact Development Performance Standard or use List #2. Use of List #2 is proposed as follows:

Pavement Areas:

1) Full Dispersion is not practical on this site due to the extent of the proposed development.
2) Permeable Pavement: Given the till nature of the on-site soil, it was deemed infeasible for this site. The City also agreed at the pre-application meeting that permeable pavement would not be feasible. This is also supported by the recommendations in the geotechnical report.
3) Bio-retention: This system will be used for the site. The projected area of the swales at the overflow must total at least 5% of the tributary paved area. The following table lists the basin, tributary paved area, the 5% required area and the bio-retention cell area at 1' water depth. Treatment sizing for the various cells is listed in MR 6.

Bio-Retention Cell #	Area	Required 5% Area	Provided Area
1	28,314 sf	1,416 sf	1,450 sf
2	21,780 sf	1,089 sf	1,100 sf
3	21,780 sf	1,089 sf	1,100 sf
4	56,628 sf	2,831 sf	2,900 sf
5	43,560 sf	2,178 sf	2,200 sf
9	35,610 sf	1,780 sf	1,800 sf

Roof Areas:

1) Full Dispersion is not practical on this site due to the extent of the proposed development;
2) Bio-Retention Cells will be used. The projected area of the swales at the overflow must total at least 5% of the tributary roof area. The following table lists the basin, tributary paved area, the 5% required area and the bio-retention cell area at 1' water depth.

Bio-Retention Cell #	Roof Area	Required 5% Area	Provided Area
6	20,533 sf	1,027 sf	1,728 sf
7	6,755 sf	338 sf	806 sf
8	20,592 sf	1,030 sf	1,728 sf

Lawn and Landscaped Areas:

1) Post Construction Soil Quality and Depth: BMP T5.13 will be implemented on disturbed and landscaped areas.

DRAINAGE BASINS

The project contains a total of 11 drainage basins. Basins 1-10 are sub-basins for the school site itself, See Figure 4: Drainage Basin Map in Appendix A. Basin 11 consists of the frontage improvement widening. Following is a description and land coverages for each drainage basin.

PARKING AREA BASINS

BASIN 1

The basin consists of the eastern portion of the southern parking area and adjacent landscaping and sidewalk. It contains 0.65 acres and is tributary to Bioretention Cell #1. See MR 6 for additional information on the treatment facility sizing. The basin consists of the following land uses:

Pavement & walks	0.53 ac
Landscaping	0.12 ac

BASIN 2

The basin consists of the northwest portion of the southern parking area and the southern portion of the building entry and parking area with adjacent landscaping and sidewalks. It contains 0.50 acres and is tributary to Bioretention Cell #2. See MR 6 for additional information on the treatment facility sizing. The basin consists of the following land uses:

Pavement & walks	0.37 ac
Landscaping	0.13 ac

BASIN 3

The basin consists of the northern portion of the building entry and parking area with adjacent landscaping and sidewalks. It contains 0.50 acres and is tributary to Bioretention Cell #3. See MR 6 for additional information on the treatment facility sizing. The basin consists of the following land uses:

Pavement & walks	0.35 ac
Landscaping	0.15 ac

BASIN 4

The basin consists of the bus loading area, northwest parking area, access to Monarch Blvd and adjacent landscaping and sidewalks. It contains 1.30 acres and is tributary to Bioretention Cell #4. See MR 6 for additional information on the treatment facility sizing. The basin consists of the following land uses:

Pavement & walks	1.10 ac
Landscaping	0.20 ac

BASIN 5

The basin consists of the northern half of the roadway from E. Division Street, the remainder of the southern parking area with adjacent landscaping and sidewalk. It contains 1.00 acres and is tributary to Bioretention Cell #5. See MR 6 for additional information on the treatment facility sizing. The basin consists of the following land uses:

Pavement & walks	0.80
Landscaping	0.20

BUILDING ROOF BASINS

BASIN 6

The basin consists of the southern roof area, southeastern lawn area and adjacent fire loop road. It contains 0.98 acres and is tributary to Bioretention Cell #6. See MR 6 for additional information on the treatment facility sizing. The basin consists of the following land uses:

Roof & pavement	0.63 ac
Landscaping	0.35 ac

BASIN 7

The basin consists of a portion of the central roof, the adjacent courtyard area and fire loop road. It contains 0.57 acres and is tributary to Bioretention Cell #7. See MR 6 for additional information on the treatment facility sizing. The basin consists of the following land uses:

Roof & walks	0.43 ac
Landscaping	0.14 ac

BASIN 8

The basin consists of the northern roof area, northeastern landscaped area and adjacent fire loop road. It contains 0.63 acres and is tributary to Bioretention Cell #8. See MR 6 for additional information on the treatment facility sizing. The basin consists of the following land uses:

Roof & walks	0.55 ac
Landscaping	0.08 ac

BALLFIELD/PLAY AREA BASINS

BASIN 9

The basin consists of the paved play area on the north side of the building. It contains 0.95 acres and is tributary to Bioretention Cell #9. See MR 6 for additional information on the treatment facility sizing. The basin consists of the following land uses:

Pavement	0.95 ac

BASIN 10

The basin consists of the grass ball field area and adjacent walkways. It contains 2.0 acres and is tributary to the detention pond. The basin consists of the following land uses:

Lawn	2.00 ac

FRONTAGE IMPROVEMENT BASIN

BASIN 11

The basin consists of the southern half of the new public road and the north half of E. Division Street. It contains 1.25 acres and is tributary to the Basin 11 Detention-Wetpond. See MR 6 for additional information on the treatment facility sizing. The basin consists of the following land uses:

Pavement	0.95 ac
Grass	0.09 ac
Sidewalk	0.21 ac

MR 6: RUNOFF TREATMENT

With more than 5,000 sf of pollution generating impervious surface the site requires runoff treatment.

Oil Control: The site does not meet the threshold of 100 vehicles per day/1,000 sf of building area.

Phosphorous Control: We have reviewed the 303d listings and there two drainage courses we drain to-through that are near the site. College Way Creek is located about 2900 feet from the site, and Nookachamps Creek is about 2 miles from the site. College Way Creek is listed for dissolved oxygen and water temperature. Nookachamps Creek is not listed downstream of the site. There is no City special requirement for Phosphorous Control. Therefore, we conclude that Phosphorous Control is not required.

Enhanced Treatment: Enhanced treatment is required when a commercial site discharges directly to fresh waters or conveyance systems tributary to fresh waters designated for aquatic life use or that have an existing aquatic life use. The site discharges to the onsite wetland. This wetland eventually drains to College Way Creek about 2900 feet from the site, as shown on the County mapping, then to Nookachamps Creek about 2 miles from the site. It is likely that these fresh water bodies contain aquatic life. Bio-retention is the proposed method of runoff treatment and does meet the requirements for Enhanced Treatment.

SCHOOL SITE BASINS 1-8

Runoff from these basins includes areas subject to vehicular use and require treatment. It also includes the building roof basins.

BIORETENTION CELLS

Runoff Treatment has been addressed through the design of several bio-retention cells. Bioretention cells incorporate amended soils and vegetation that use the chemical, biological, and physical properties of plants, microbes, and soils to remove, or retain, pollutants from stormwater runoff. The underlying soils are sandy silt to silty sand precluding infiltration though the native soils. This will require the use of underdrains to collect the treated stormwater.

The *Low Impact Development Technical Guidance Manual for Puget Sound* was referenced to design the specific facilities for this site. The following items are common for all bioretention cells:

Side slopes	3:1
Amended Soil Depth	18"
Amended Soil Infiltration Rate	1.5"/hr
Maximum Surface Storage Depth	12"
Subdrainage	Yes, underdrains will be required.

The amended soils will help support plant and microbial growth and provide additional stormwater storage capacity with a designed voids ratio of 40% as recommended by the design

manuals. To meet treatment requirements, in excess of 91% of the runoff must filter through the amended soils.

TREATMENT FACILITY SUMMARY

There are eight bioretention cells spaced throughout the site. The basin number, facility identification, required bottom area and percent filtered are listed for each facility. See attached WWHM3 screen shots for sizing calculations:

BASIN ID	FACILITY TYPE & ID	BOTTOM AREA (SF) AMENDED SOIL	PERCENT FILTERED
#1	Bioretention Cell #1	1,070 sf	99.6%
#2	Bioretention Cell #2	824 sf	99.7%
#3	Bioretention Cell #3	824 sf	99.7%
#4	Bioretention Cell #4	1,667 sf	98.8%
#5	Bioretention Cell #5	1,692 sf	99.7%
#6	Bioretention Cell #6	1,080 sf	99.1%
#7	Bioretention Cell #7	500 sf	96.7%
#8	Bioretention Cell #8	1,080 sf	99.7%
#9	Bioretention Cell #9	1,800 sf	99.0%

Basin 10 consists of the grass field and not being subject to vehicular traffic, runoff treatment is not required. See Figure 3A: Developed School Site Map in Appendix A.

FRONTAGE IMPROVEMENT BASIN

A combination detention-wetpond is proposed to provide for treatment of the runoff from the basin. The required 'dead' storage as calculated by WWHM3 is 0.0986 ac-ft or 4,295 cf. The pond will be excavated below the live storage elevation to create a permanent wet pool. The 'dead' pool volume will be provided in two cells separated by a berm. The dead storage provided is about 8,400 cf. See Figure 3B: Frontage Improvement Map in Appendix A

MR 7: FLOW CONTROL

There are two ponds proposed for the site to detain runoff in accordance with the DOE Manual. These correspond to the two existing condition basins, one for the school site (Basins #1-10), and one for the road improvement basin (Basin #11).

SCHOOL SITE BASIN FLOW CONTROL FACILITY SUMMARY

An open detention pond will be used to provide stream bank erosion control. The pond will be located to the northwest of the proposed school improvements and discharge to the main onsite wetland. WWHM3 has been used to size the pond and flow controls, see screen shots in Appendix B for more information.

This pond will have the following parameters:

'Live' storage depth = 8.6 feet
Side slopes = 3:1
Bottom Area = 10,000 sf
Storage volume = 139,566 cf

The flow control device will provide detention for flow durations from ½ the 2 year event up to the 50 year event.

The release rates using this flow control are as follows:

Storm Event	Existing Release	Actual Release
2 Year	0.18 cfs	0.10 cfs
10 Year	0.44 cfs	0.28 cfs
50 Year	0.75 cfs	0.62 cfs
100 Year	0.91 cfs	0.84 cfs

For additional pond storage, discharge and level pool information see WWHM output in Appendix B.

FRONTAGE IMPROVEMENTS BASIN FLOW CONTROL FACILITY SUMMARY

A detention-wetpond will be used to provide stream bank erosion control. The pond will be located about 540 feet north of E. Division Street and 70 feet east of the Skagit Highlands Parkway discharge to the onsite wetlands. WWHM3 has been used to size the pond and flow controls, see screen shots in Appendix B for more information.

This pond will have the following parameters:

'Live' storage depth = 1.95 feet
Side slopes = 3:1
Bottom Area = 3,850 sf
Storage volume = 9,365 cf

The flow control device will provide detention for flow durations from ½ the 2 year event up to the 50 year event.

The release rates using this flow control are as follows:

Storm Event	Existing Release	Actual Release
2 Year	0.14 cfs	0.09 cfs
10 Year	0.25 cfs	0.15 cfs
50 Year	0.36 cfs	0.23 cfs
100 Year	0.41 cfs	0.27 cfs

For additional pond storage, discharge and level pool information see WWHM output in Appendix B.

MR 8: WETLANDS PROTECTION

A Critical Areas Study has been done for the site and surrounding properties by Graham-Bunting & Associates. They have delineated several Category II and Category III wetlands on the south and eastern portions of the site. The main wetland system extends from E Division Street, north, passing through the site and continuing offsite to the north. Scattered smaller somewhat isolated wetlands are scattered on the site and surrounding properties. These onsite wetlands will be protected by 75' to 100' protective buffers. Some buffer mitigation is proposed for buffer reductions necessary for construction of the new public roadway and for the school site. For additional information see the Critical Areas Study under separate cover.

An evaluation has been made to determine that the wetland hydrology will not be significantly impacted by the proposed development. The primary concern is that adequate runoff will not reach the wetlands to maintain the current hydrologic levels. To evaluate this, a drainage basin has been selected that includes the area to the northeast of the E Division Street and Skagit Highlands Parkway, north to the Plat of Skagit Highlands and east to, and including, the school site. This area encompasses about 40.4 acres. WWHM2012 was used to perform the calculation as WWHM3 does not include that module. According to the results, see Appendix B, the wetland hydrology is maintained within the 15% tolerance for 9 months. Between mid September through mid December the increase in flow to the wetland exceeds 115% of the current conditions. Further evaluation will be done prior to submittal for construction permits to determine the potential impacts or how the flows can be reduced to better match the current site conditions.

MR 9: BASIN/WATERSHED PLANNING

The City of Mount Vernon does not have any specific drainage basin or watershed requirements for this area beyond implementation of the drainage manual.

MR 10: OPERATION AND MAINTENANCE

The specific requirements for the ongoing operation and maintenance of the proposed storm water systems will be detailed in the final drainage report to be prepared for construction permits as part of Minimum Requirement #10.

APPENDIX A
MAPS & SCS SOILS DESCRIPTION

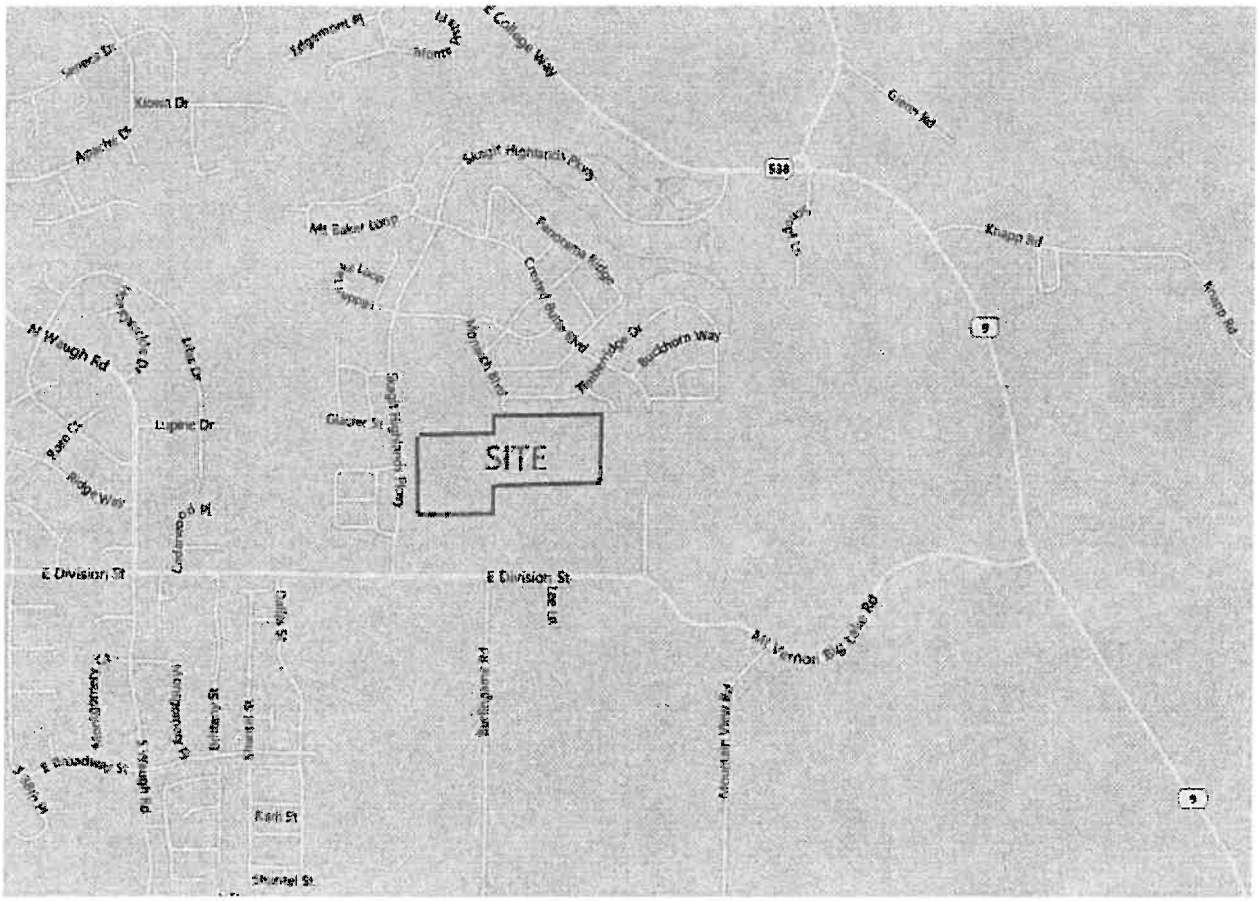


FIGURE 1: VICINITY MAP

FIGURE 2: EXISTING SITE MAP

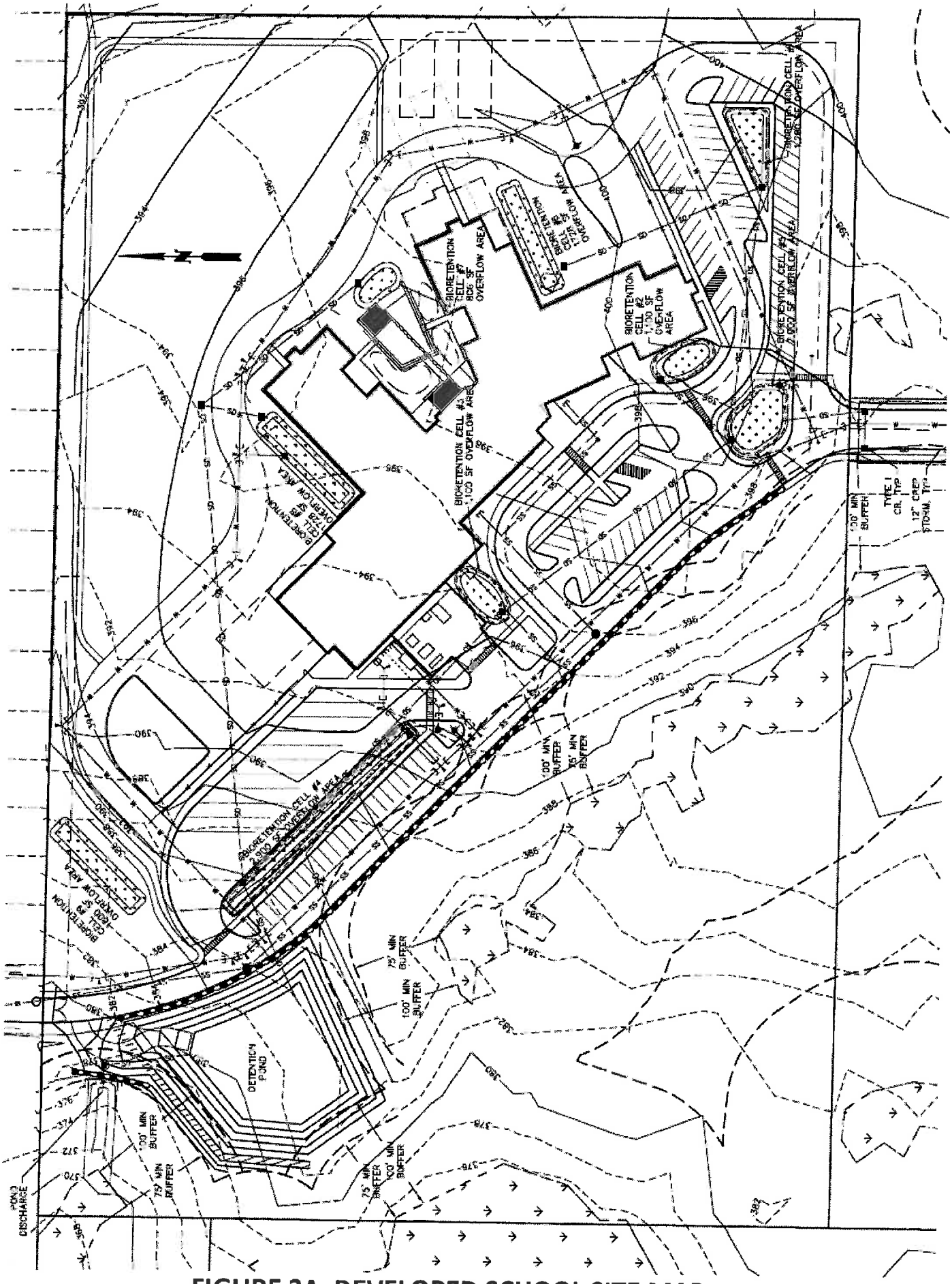


FIGURE 3A: DEVELOPED SCHOOL SITE MAP

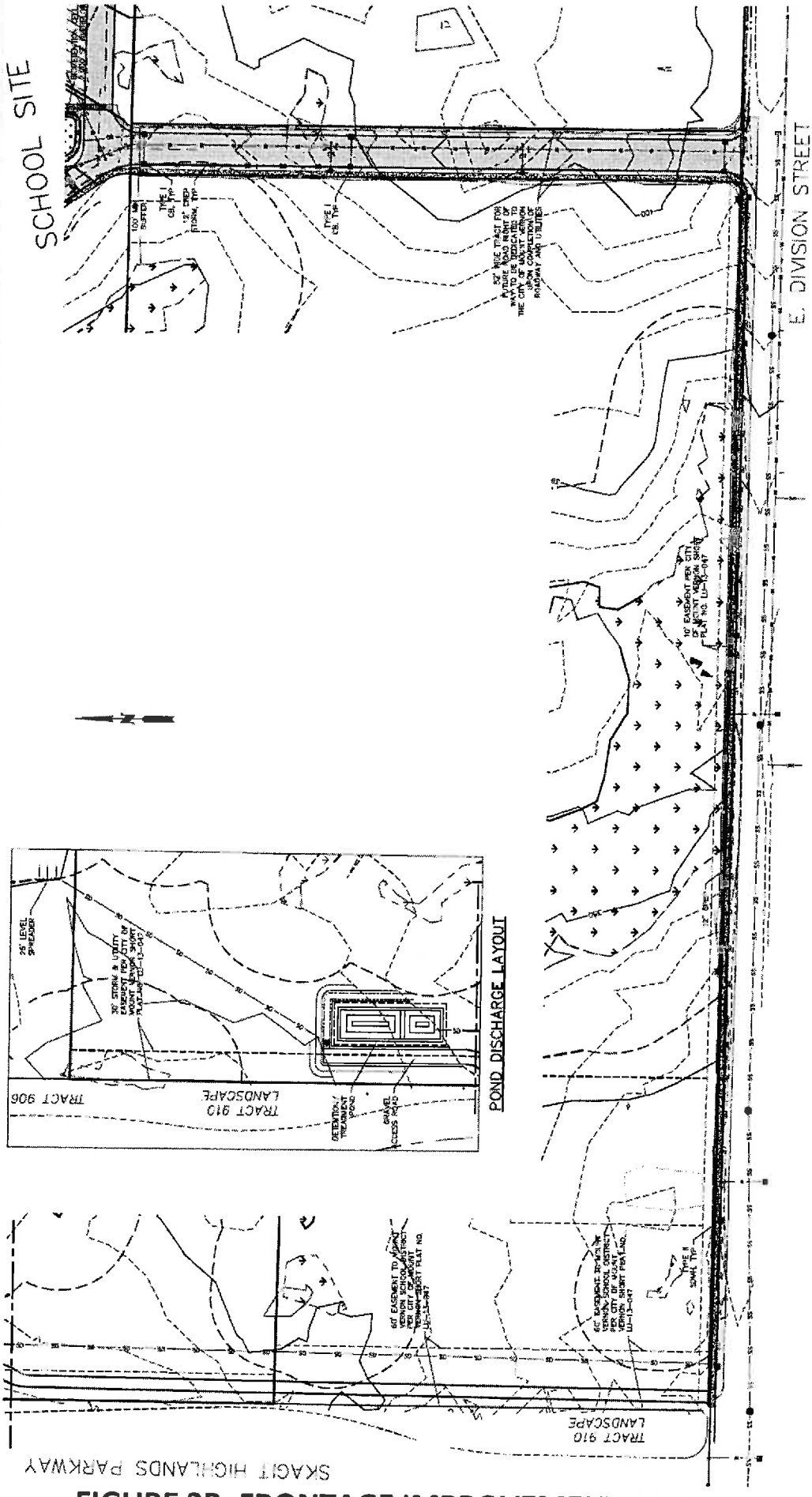


FIGURE 3B: FRONTAGE IMPROVEMENT MAP

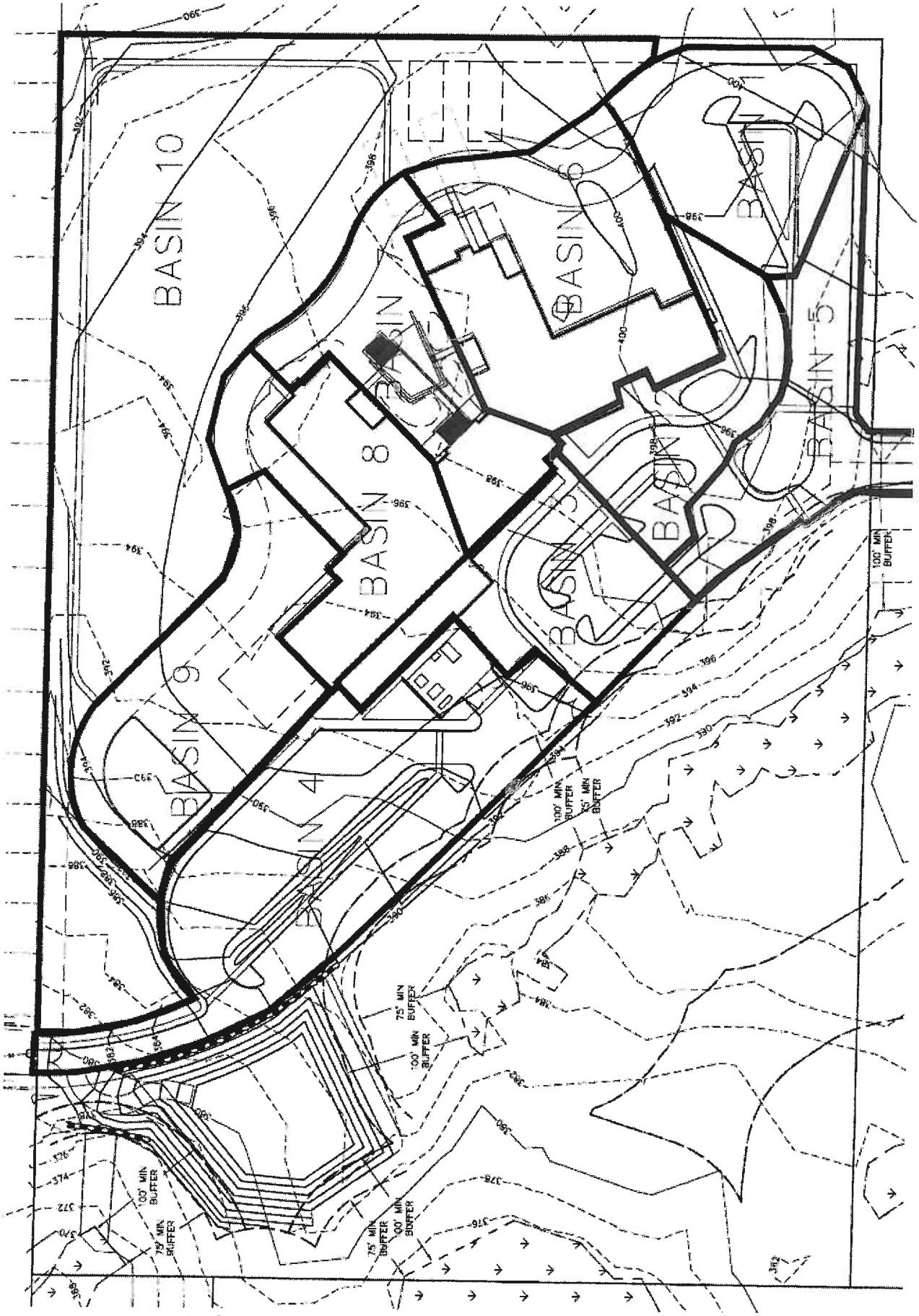


FIGURE 4: SCHOOL SITE DRAINAGE BASIN MAP

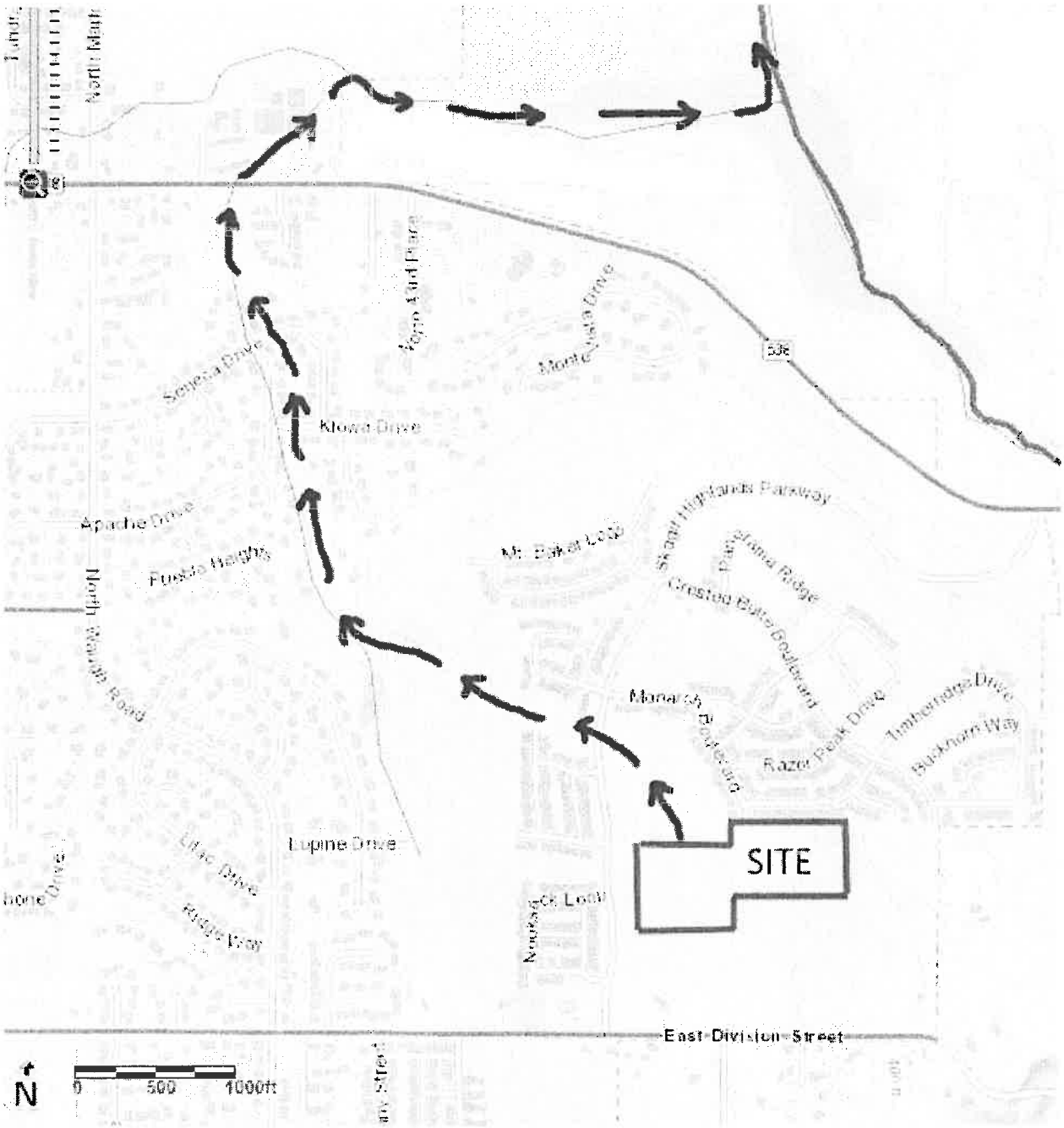
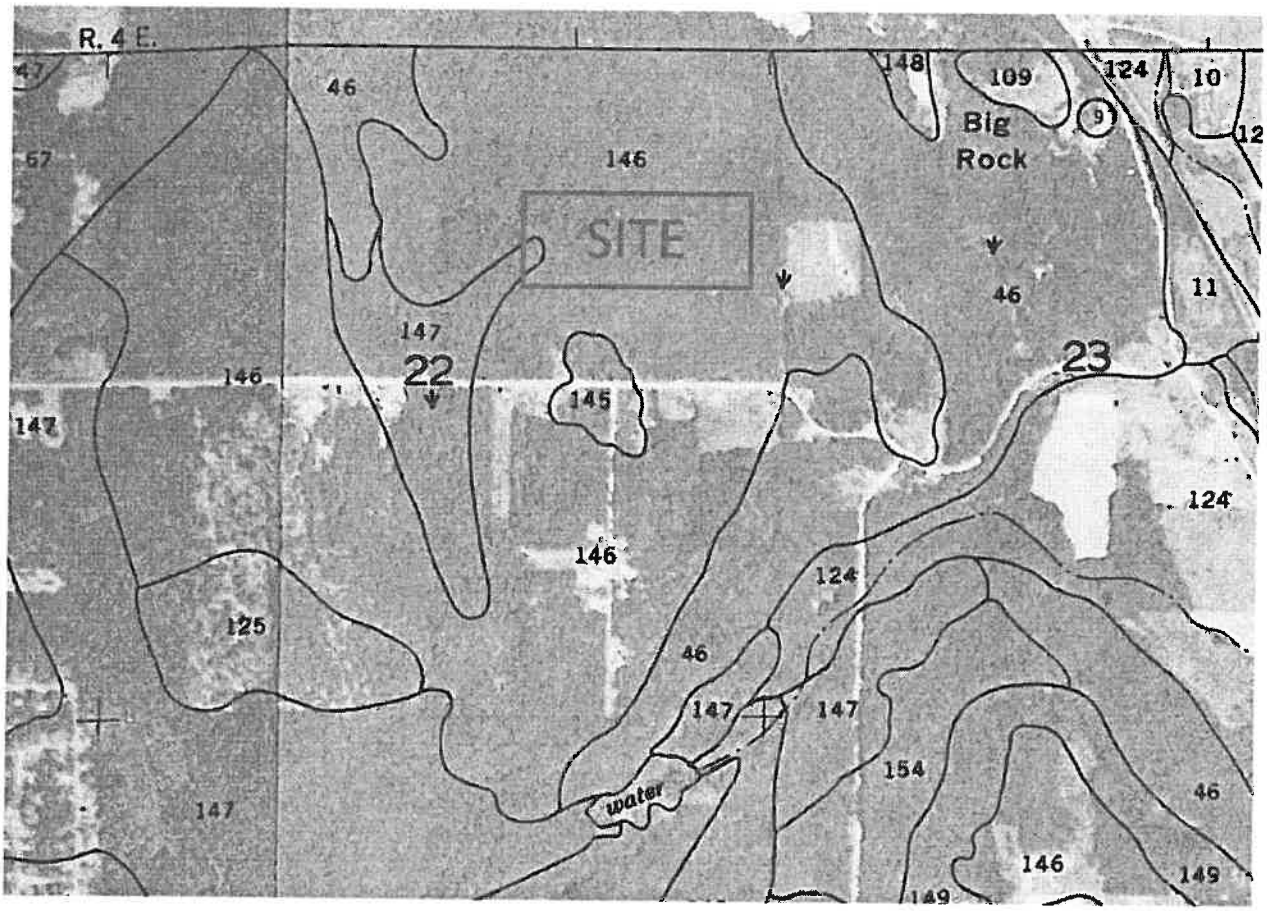


FIGURE 5: DOWNSTREAM ANALYSIS MAP



SCS SOILS MAP

146—Tokul gravelly loam, 0 to 8 percent slopes. This moderately deep, moderately well drained soil is on glacially modified hills. It formed in volcanic ash and loess underlain by glacial till. The native vegetation is mainly mixed conifers and hardwoods. Elevation is 200 to 1,100 feet. The average annual precipitation is about 55 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 150 to 200 days.

Typically, the surface is covered with a mat of needles, leaves, and twigs 1 inch thick. The surface layer is very dark grayish brown gravelly loam 2 inches thick. The subsoil is dark brown and dark yellowish brown gravelly loam 32 inches thick. The substratum is light olive brown gravelly fine sandy loam about 5 inches thick. Olive brown, silica-cemented glacial till that crushes to very gravelly sandy loam is at a depth of about 39 inches. Depth to silica-cemented till ranges from 20 to 40 inches. In some areas the surface layer is loam or silt loam, and in some areas the glacial till is not silica-cemented.

Included in this unit are small areas of Elwell, Heisler, Rinker, and Vanzandt soils on low mountainsides and Barneston soils on terraces.

Permeability of this Tokul soil is moderate above the silica-cemented glacial till and very slow through the till. Available water capacity is low to high. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. Water is perched above the silica-cemented till at a depth of 18 to 36 inches after periods of heavy rainfall in November to May.

Most areas of this unit are used as woodland. A few areas are used as hayland, pastureland, and homesites.

Douglas fir and western hemlock are the main woodland species on this unit. On the basis of a 100-year site curve, the mean site index is 172 for Douglas fir and 166 for western hemlock. On the basis of a 50-year site curve, the mean site index is 130 for Douglas fir and 116 for western hemlock. The highest average growth rate is 183 cubic feet per acre per year for Douglas fir at age 60 and 266 cubic feet per acre per year for western hemlock at age 50. Among the trees of limited extent are western redcedar, red alder, and bigleaf maple. Common forest understory plants are western swordfern, western brackenfern, red huckleberry, salal, trailing blackberry, salmonberry, vine maple, deer fern, ladyfern, Oregongrape, and Pacific trillium.

The main limitation for the harvesting of timber is muddiness caused by seasonal soil wetness. Use of wheeled and tracked equipment when the soil is moist produces ruts, compacts the soil, and damages the roots of trees. Unsurfaced roads and skid trails are soft when wet. Logging roads require suitable surfacing for year-round use. Rock for road construction is not readily available on this unit. The perched water table limits the use of equipment to dry periods.

Seedling establishment and the hazard of windthrow are the main concerns in the production of timber. Reforestation can be accomplished by planting Douglas fir seedlings. If seed trees are present, natural reforestation of cutover areas by red alder occurs readily and by western hemlock it occurs periodically. When openings are made in the canopy, invading brushy plants can prevent the establishment of planted seedlings. Because the rooting depth is restricted by the silica-cemented glacial till layer, trees occasionally are subject to windthrow.

This unit is well suited to hay and pasture. Use of proper stocking rates, pasture rotation, and restricted grazing during wet periods helps to keep the pasture in good condition. In summer supplemental irrigation is required for maximum production. Sprinkler irrigation is the most suitable method of applying water.

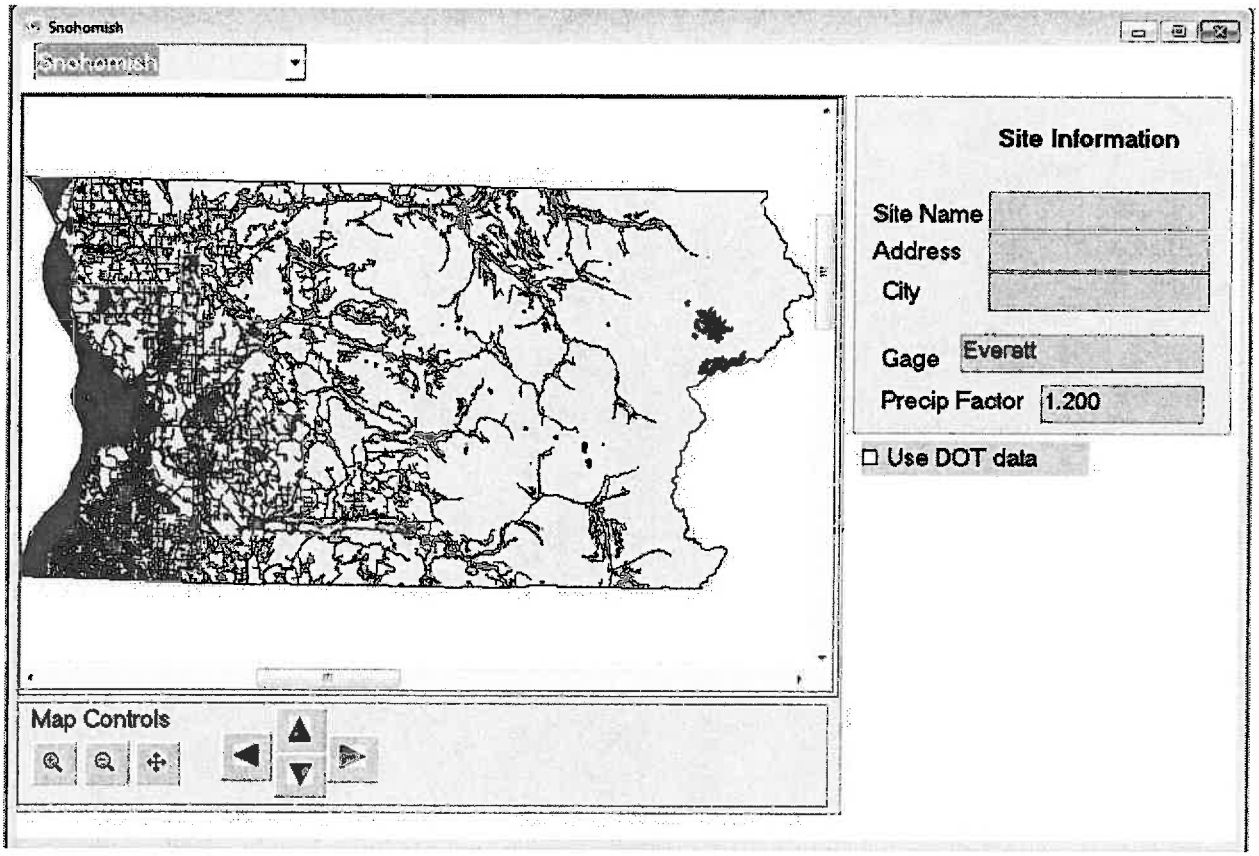
The main limitations of this unit for use as homesites are soil wetness and the very slow permeability of the silica-cemented glacial till. If the unit is used for septic tank absorption fields, use of interceptor drains, additional topsoil placed over the absorption field, and longer than normal absorption lines helps to compensate for these limitations.

This map unit is in capability subclass IIIe.

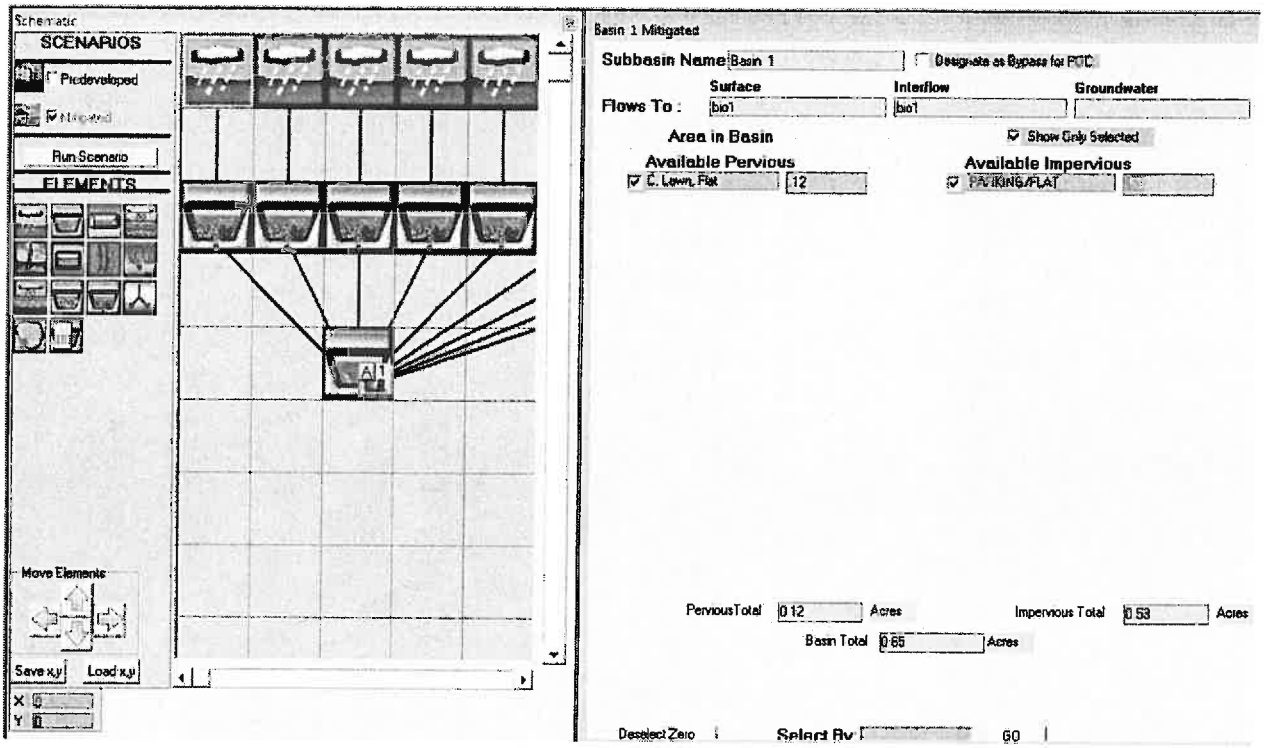
SCS SOILS DESCRIPTION

APPENDIX B
WWHM3 SCREEN SHOTS

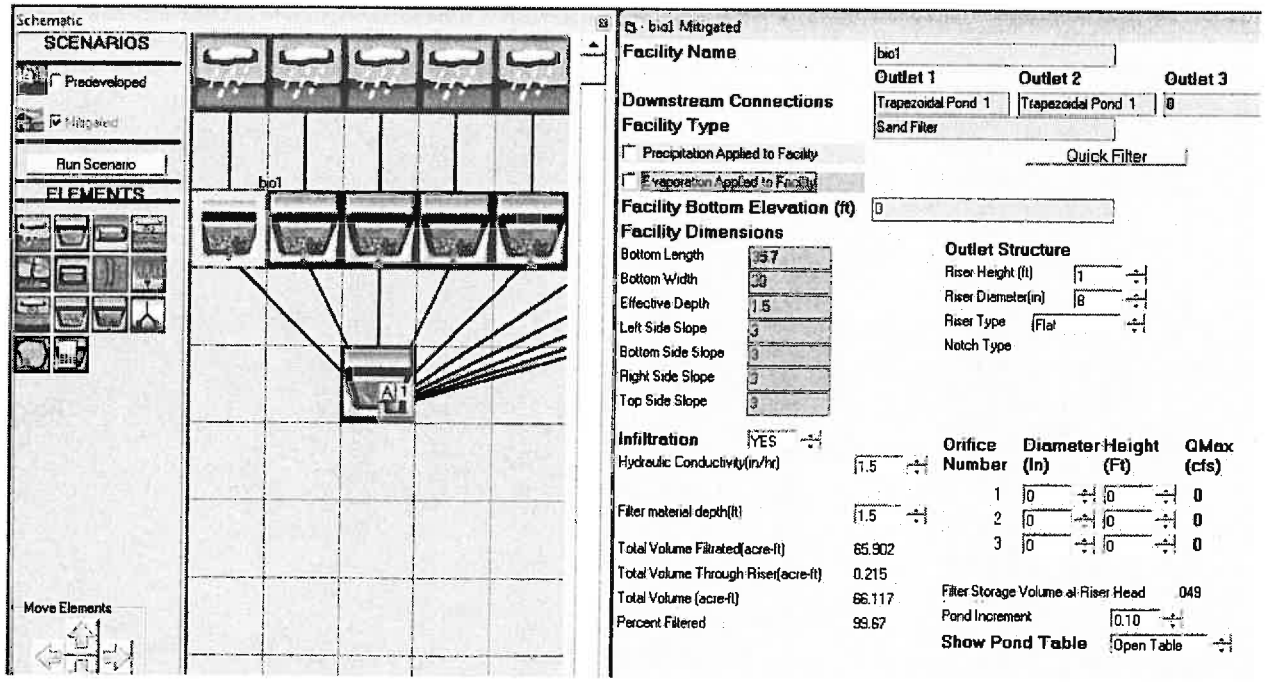
SCHOOL SITE BIORETENTION CELL DESIGN



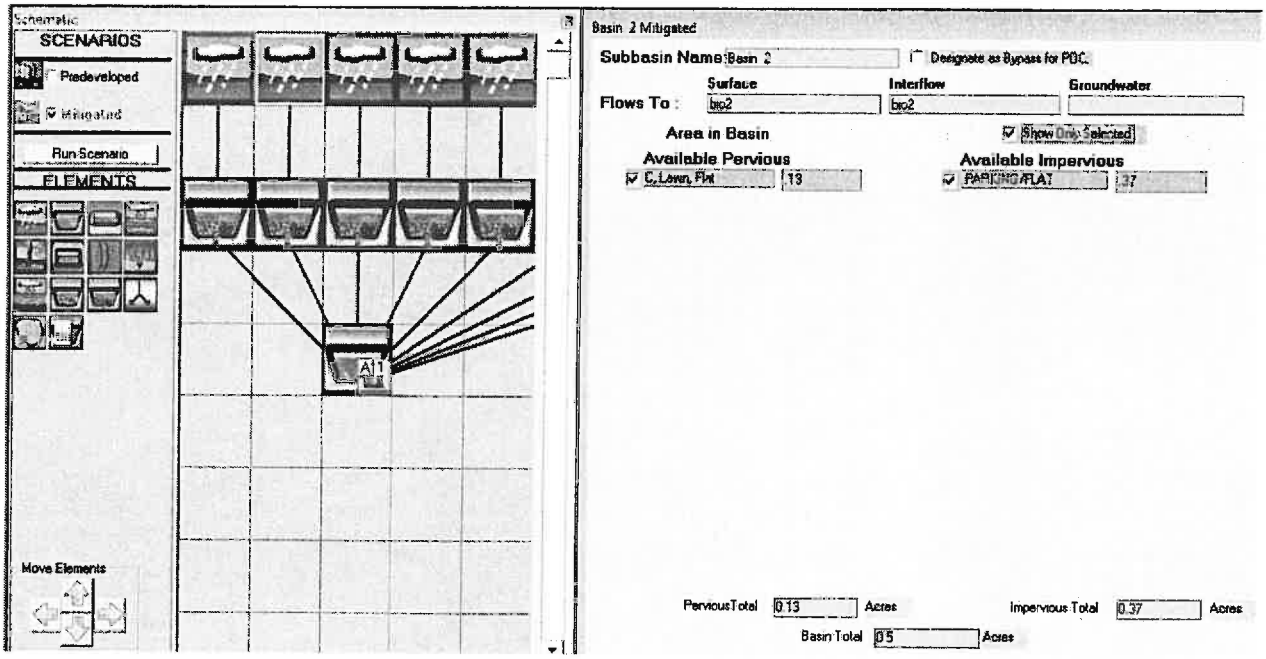
SITE LOCATION



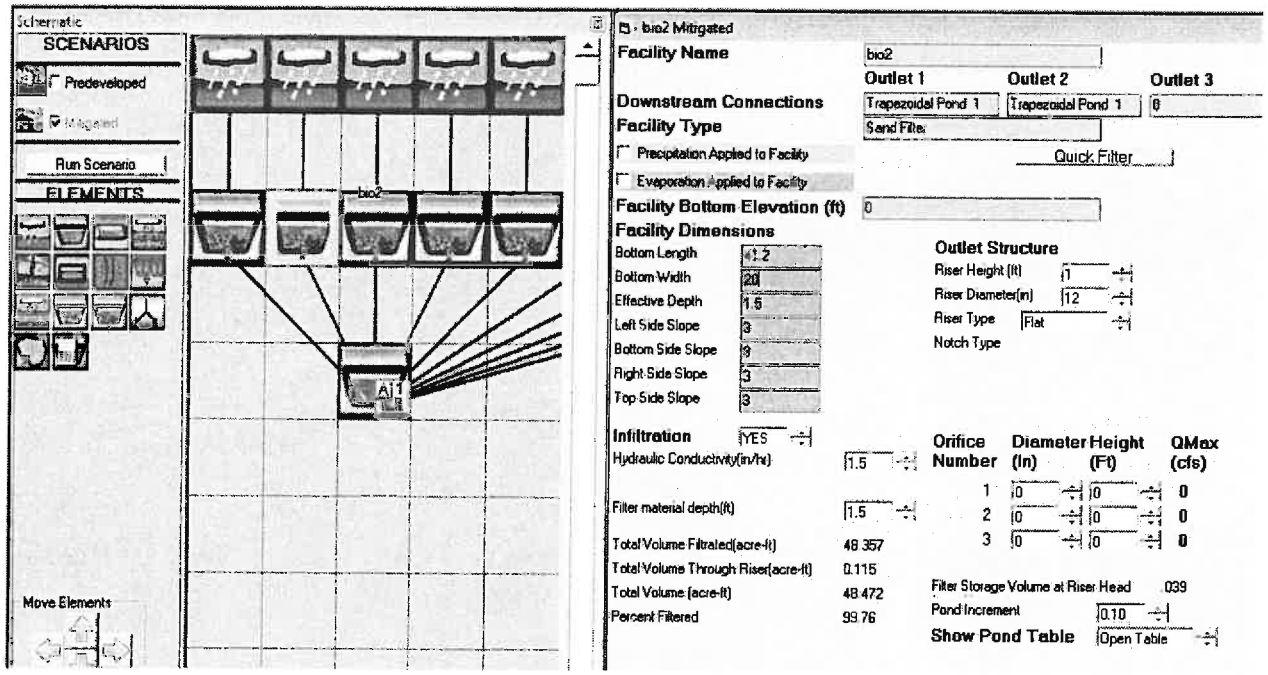
BASIN 1 – BIORETENTION CELL #1



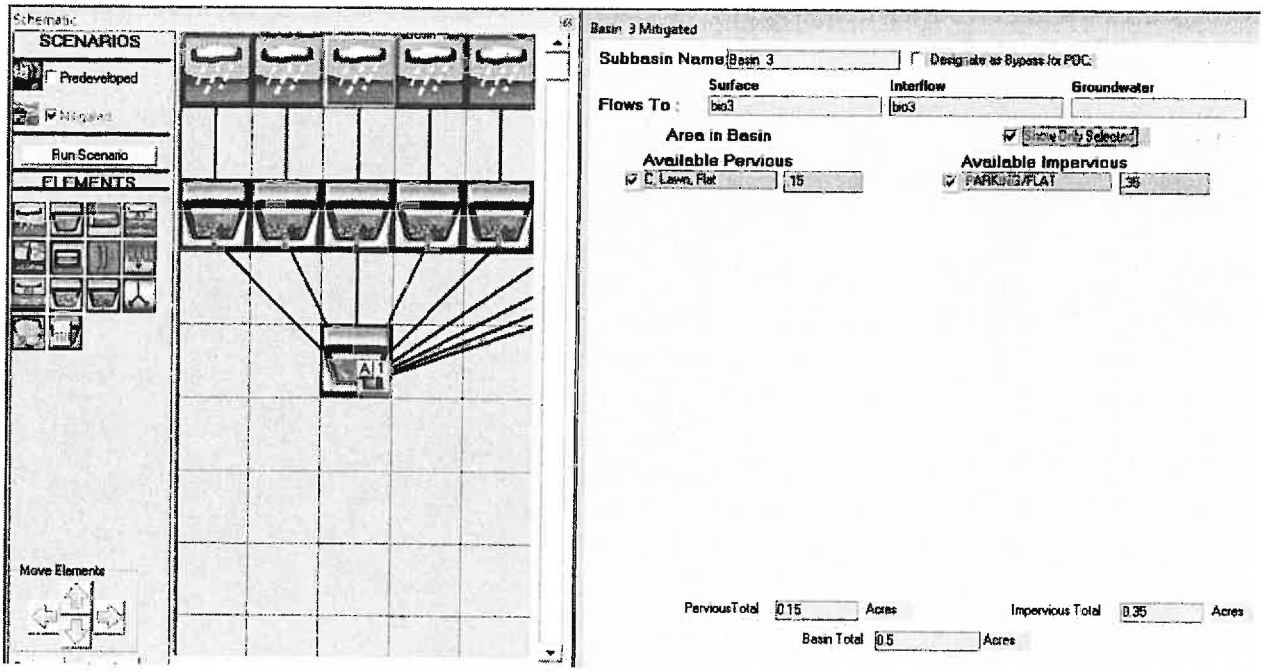
BIORETENTION CELL #1



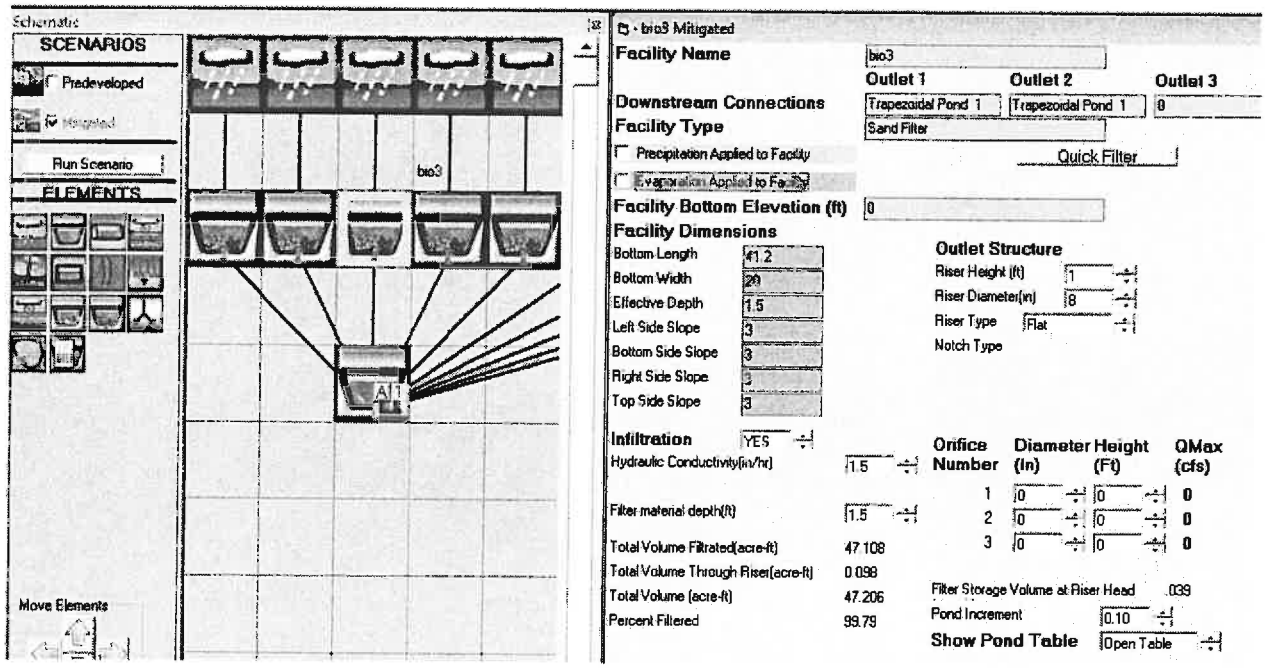
BASIN 2 – BIORETENTION CELL #2



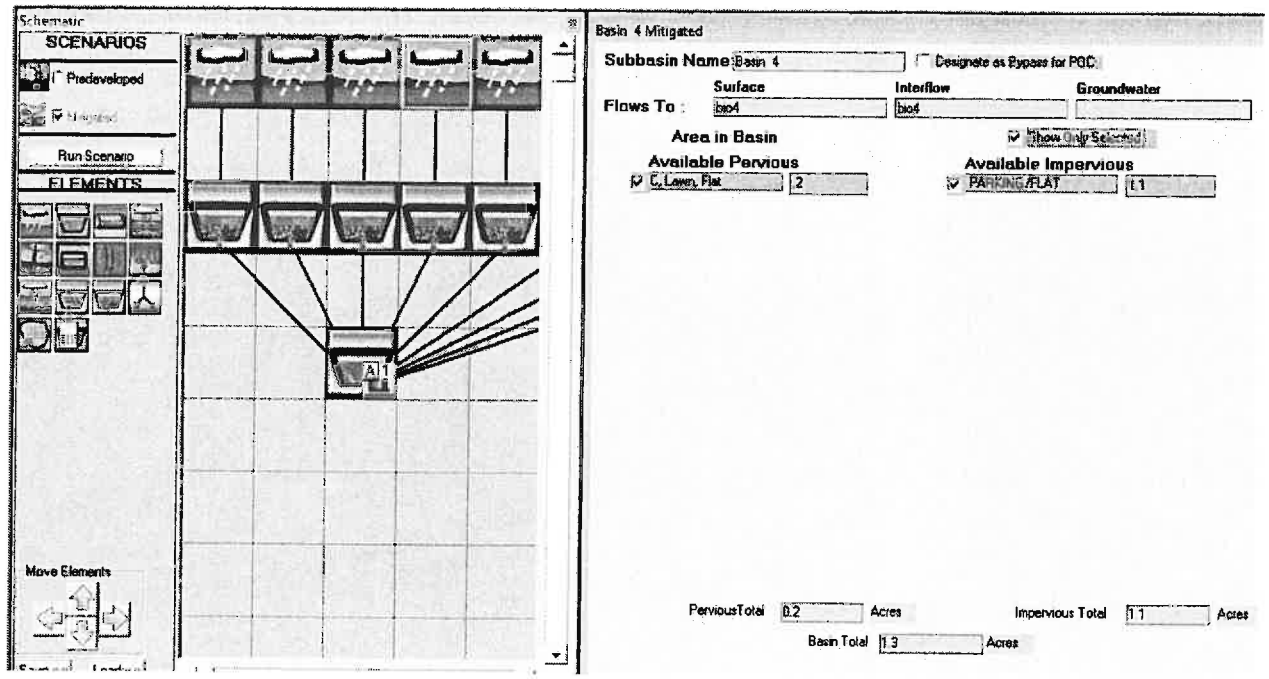
BIORETENTION CELL #2



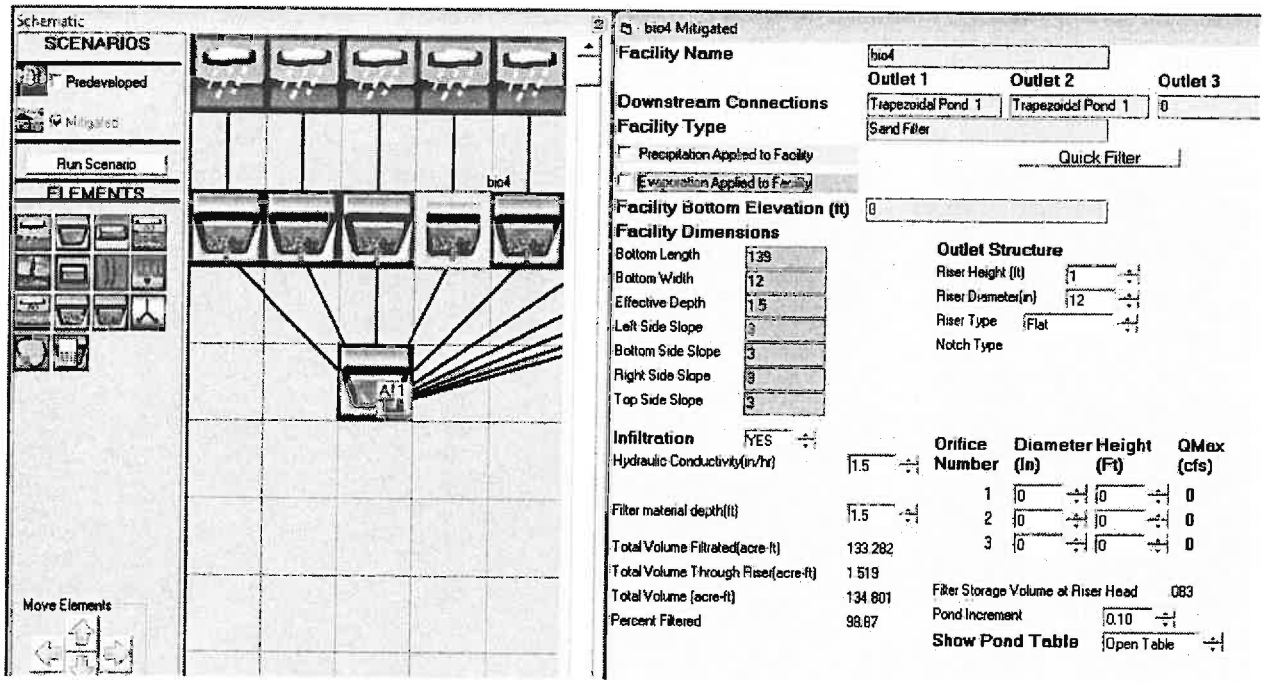
BASIN 3 – BIORETENTION CELL #3



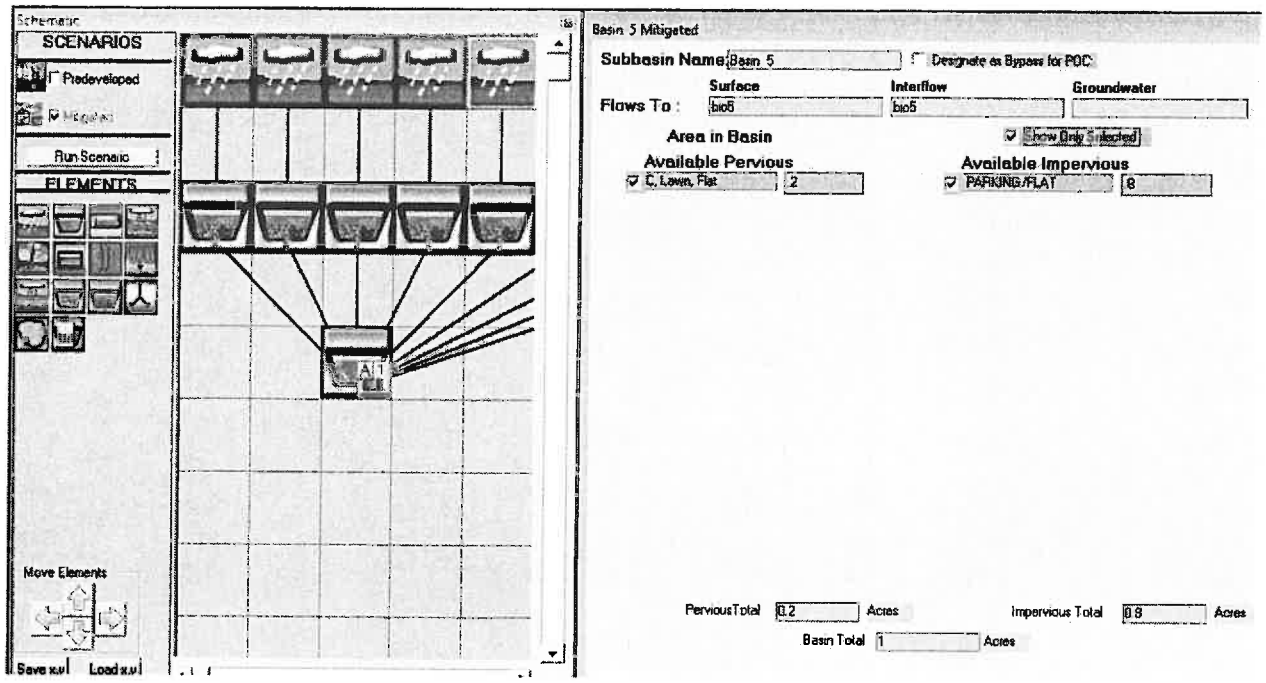
BIORETENTION CELL #3



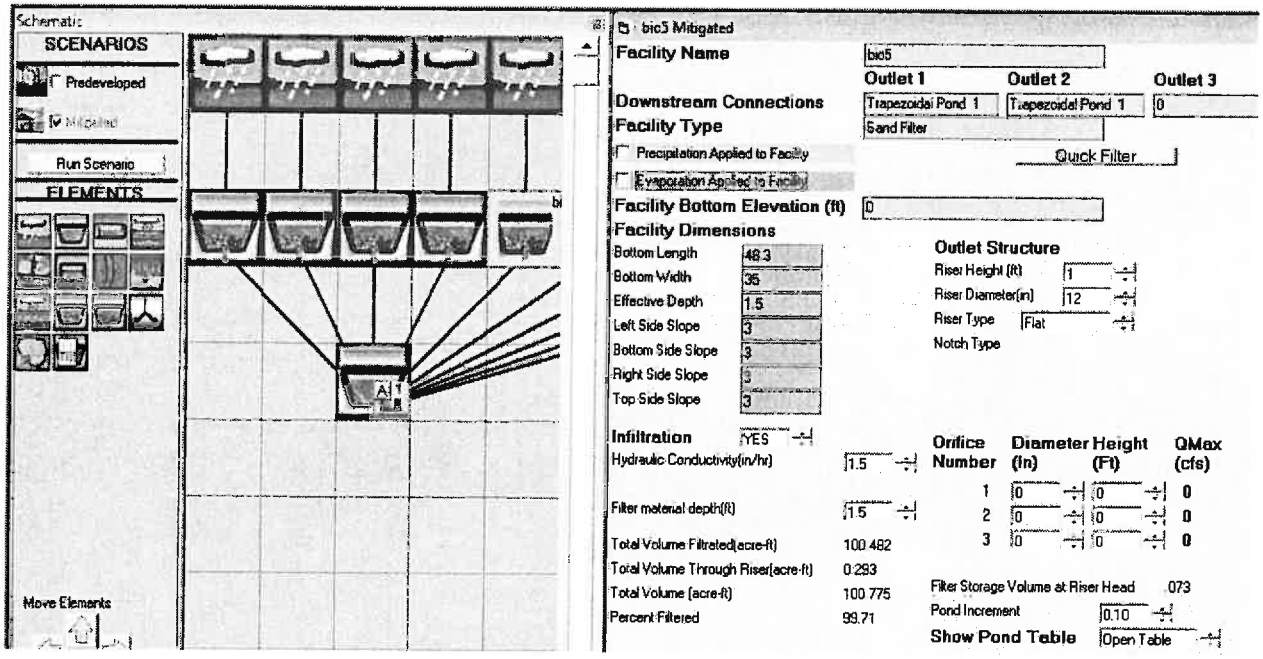
BASIN 4 – BIORETENTION CELL #4



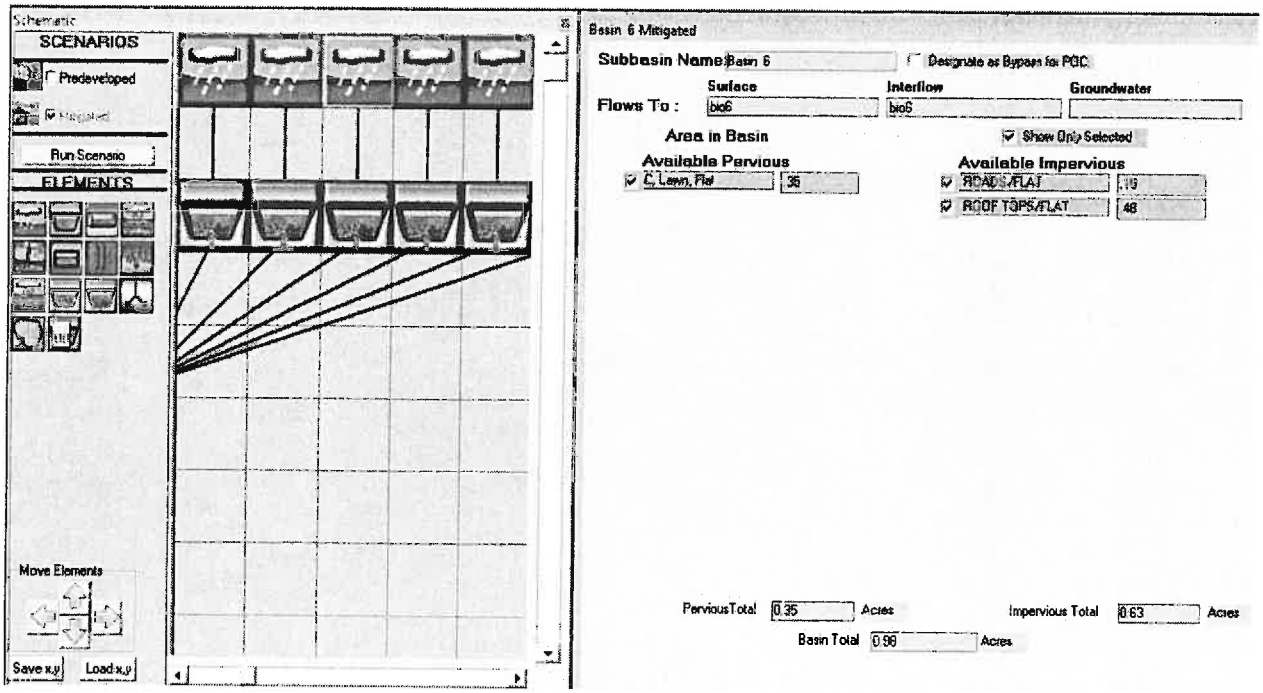
BIORETENTION CELL #4



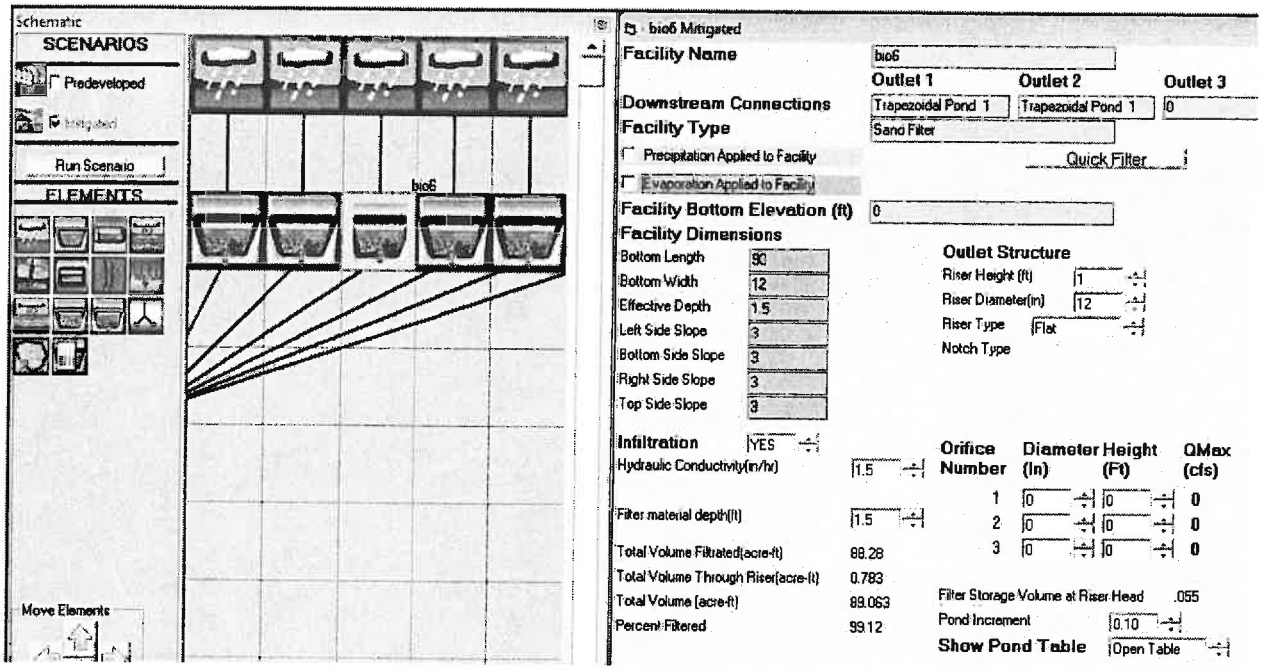
BASIN 5 – BIORETENTION CELL #5



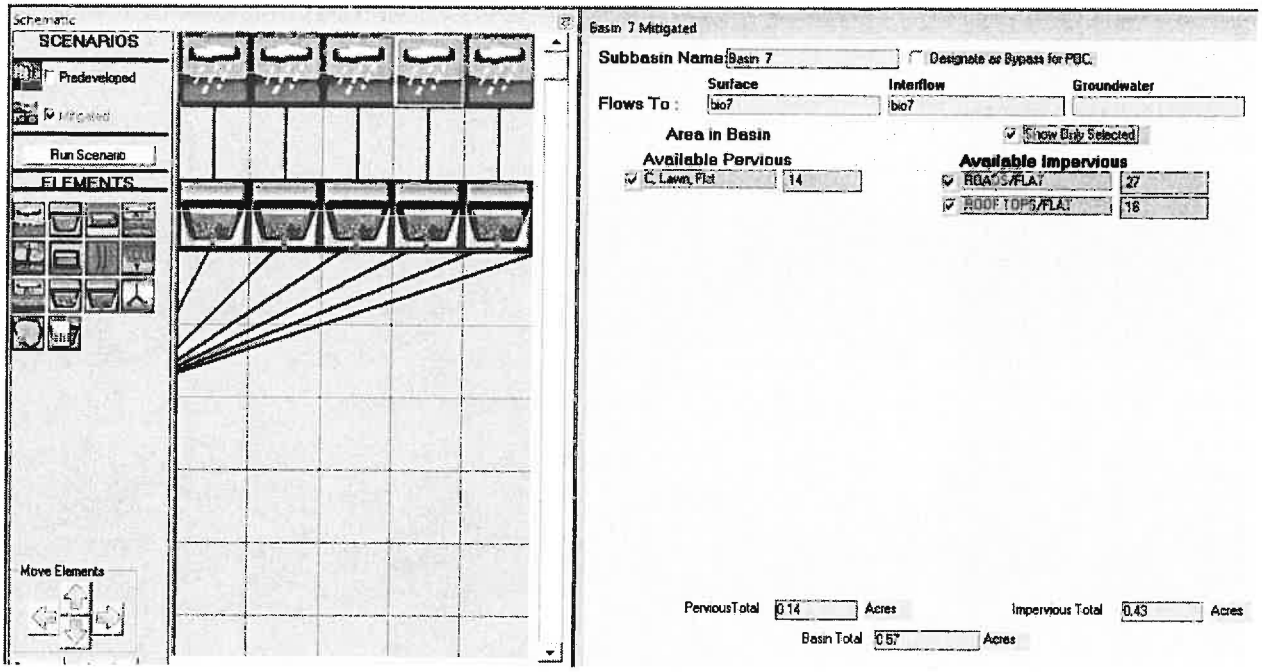
BIORETENTION CELL #5



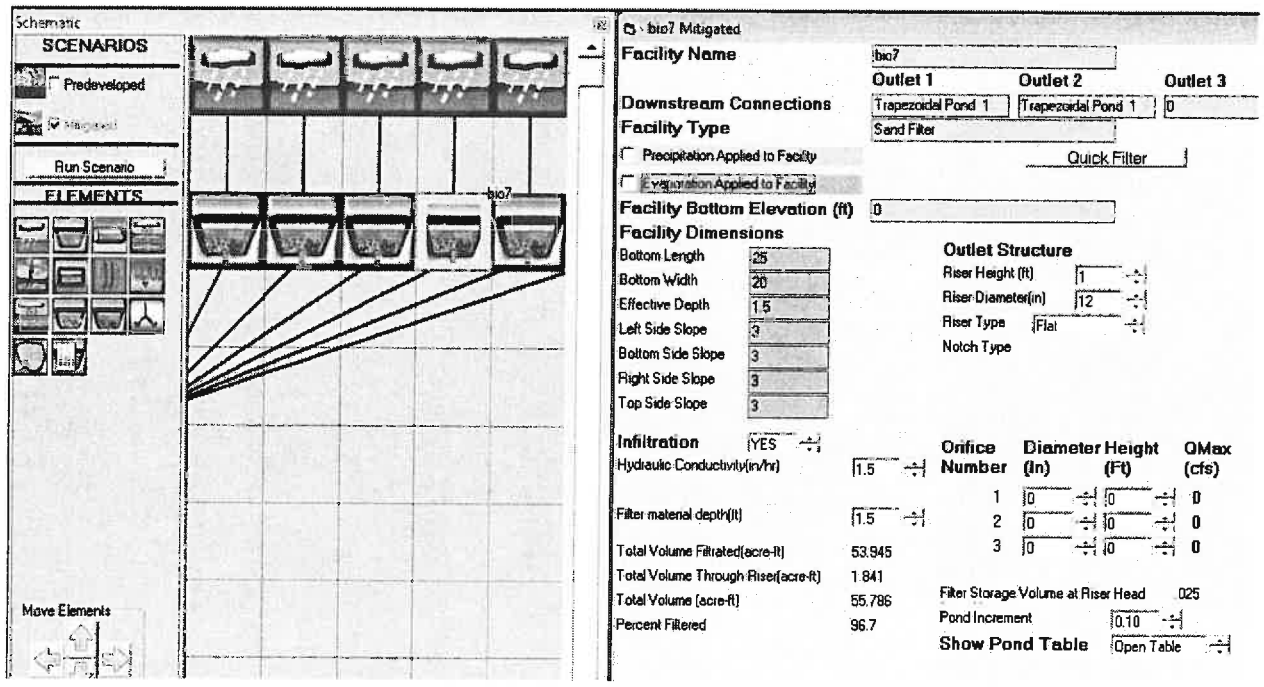
BASIN 6 – ROOF-BIORETENTION CELL #6



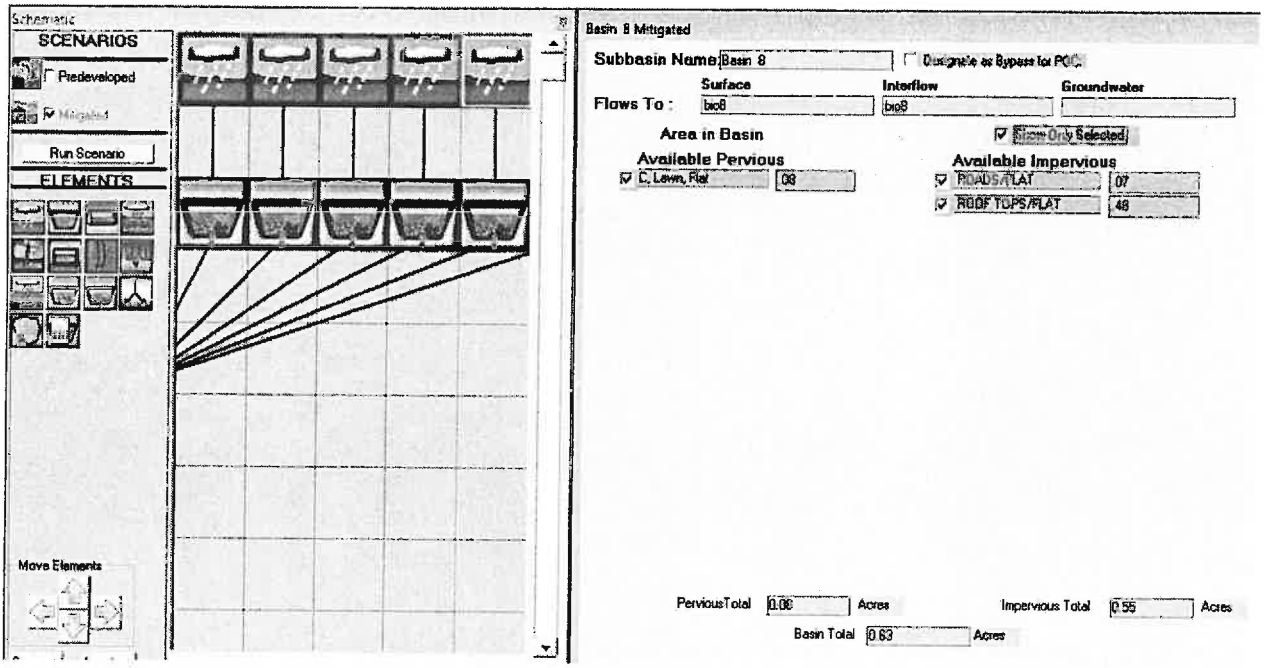
BIORETENTION CELL #6



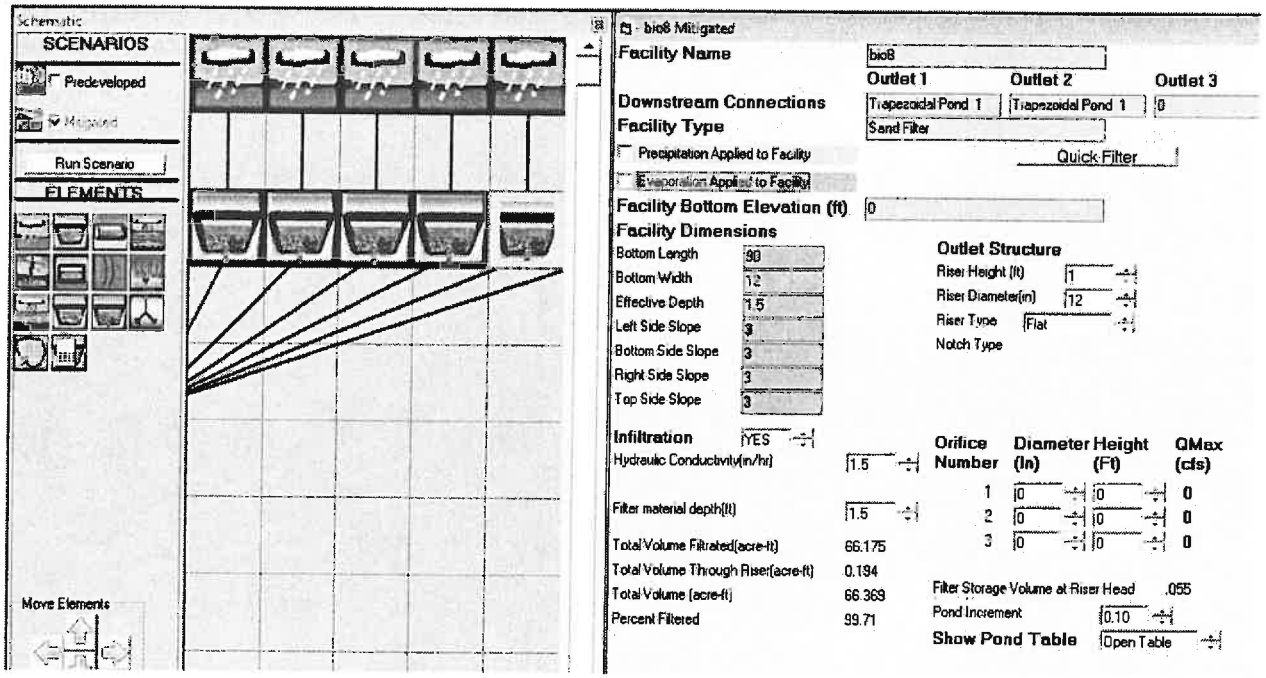
BASIN 7 – ROOF-BIORETENTION CELL #7



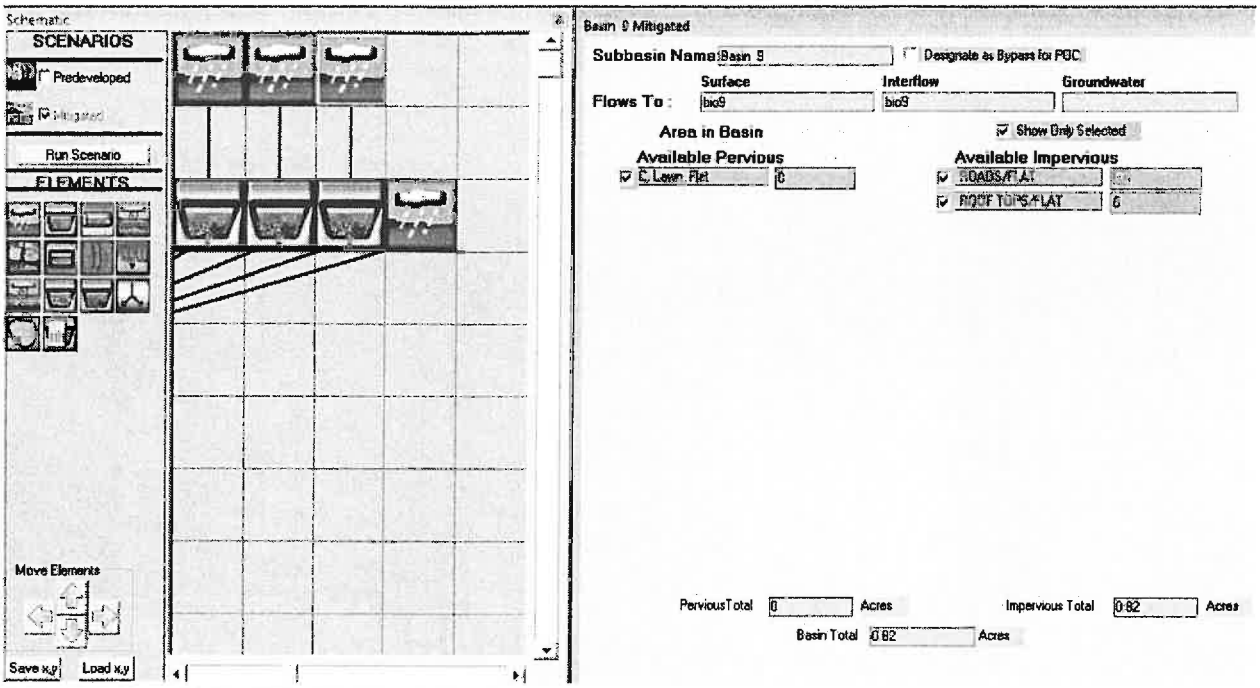
BIORETENTION CELL #7



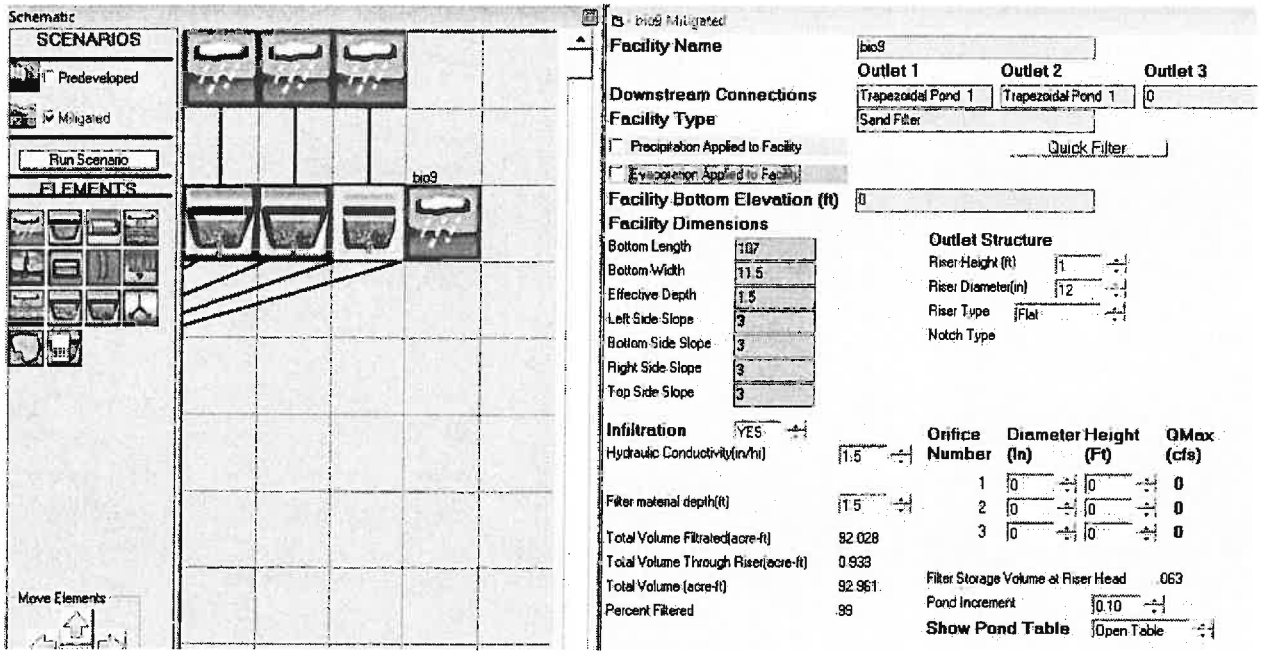
BASIN 8 – ROOF-BIORETENTION CELL #8



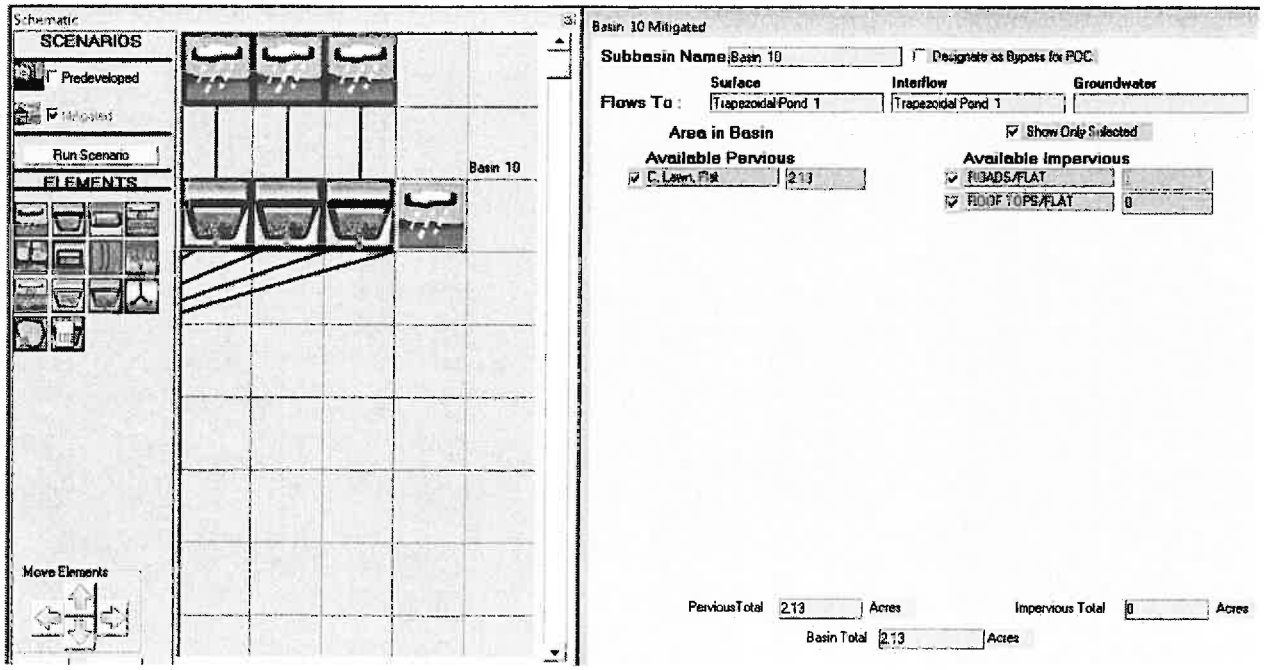
BIORETENTION CELL #8



BASIN 9 – PAVED PLAY AREA

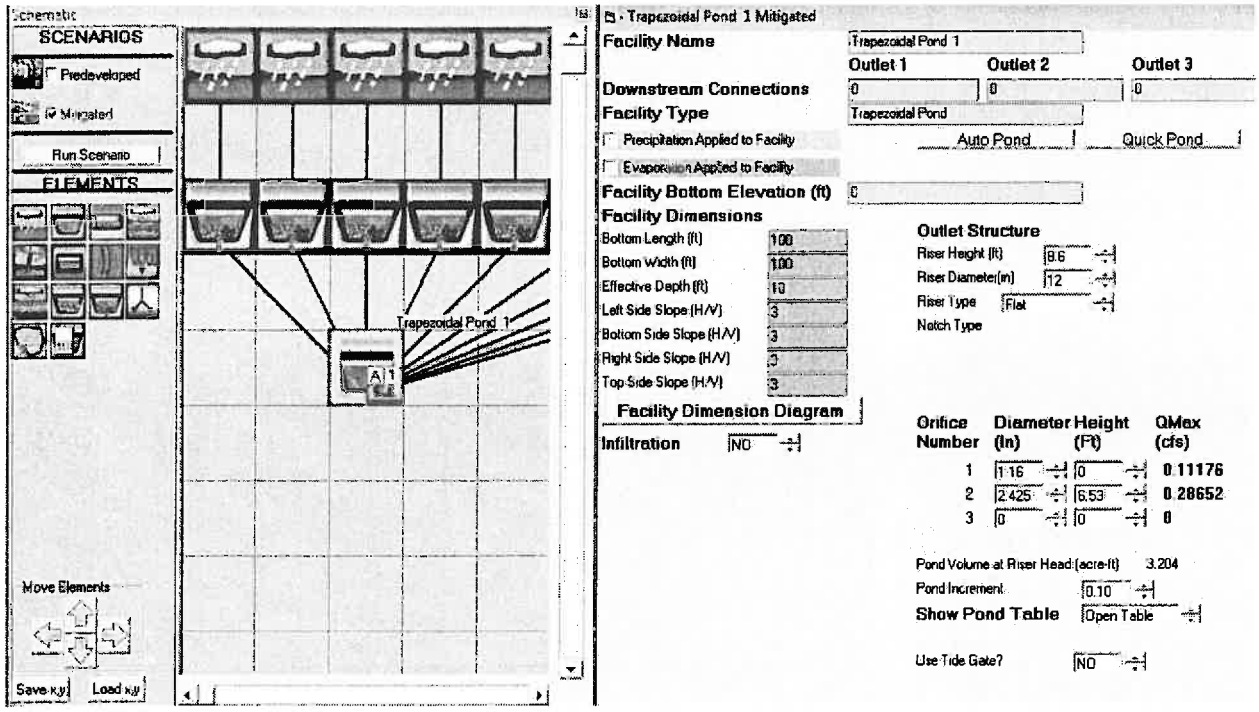


BIORETENTION CELL #9

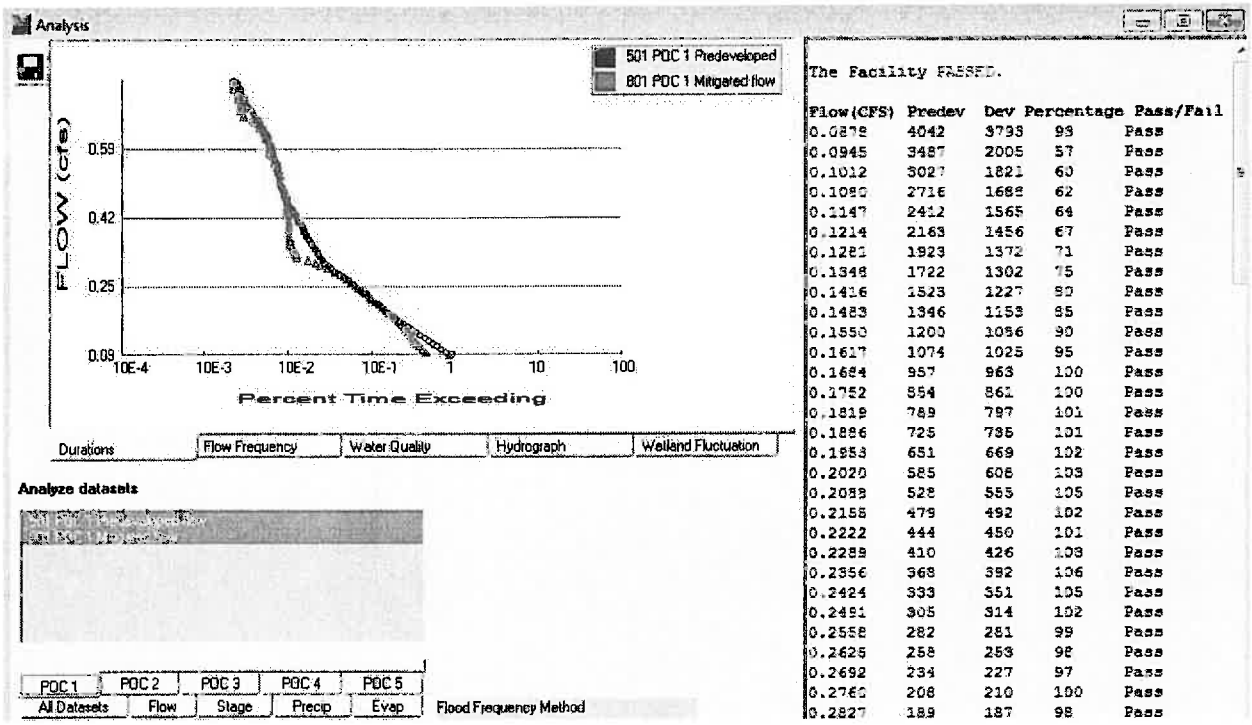


BASIN 10 – PLAY FIELD

SCHOOL SITE BASIN DETENTION POND DESIGN



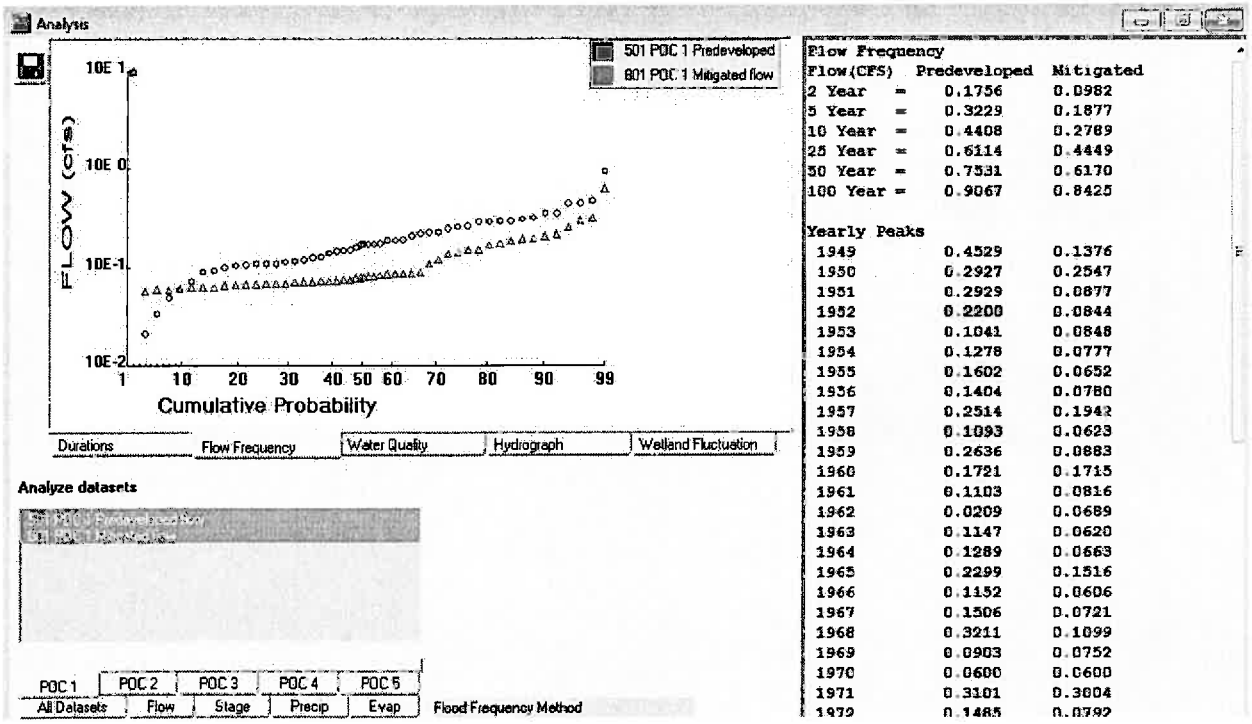
SITE DETENTION POND



The Facility PASSED.

Flow(CFS)	Predev	Dev	Percentage	Pass/Fail
0.0878	4042	3793	93	Pass
0.0945	3487	2005	57	Pass
0.1012	3027	1821	60	Pass
0.1080	2716	1688	62	Pass
0.1147	2412	1565	64	Pass
0.1214	2163	1456	67	Pass
0.1281	1923	1372	71	Pass
0.1348	1722	1302	75	Pass
0.1416	1523	1227	80	Pass
0.1483	1346	1153	85	Pass
0.1550	1200	1056	90	Pass
0.1617	1074	1025	95	Pass
0.1684	957	963	100	Pass
0.1752	854	861	100	Pass
0.1819	789	797	101	Pass
0.1886	725	735	101	Pass
0.1953	651	669	102	Pass
0.2020	585	606	103	Pass
0.2088	528	555	105	Pass
0.2155	479	492	102	Pass
0.2222	444	450	101	Pass
0.2289	410	426	103	Pass
0.2356	368	392	106	Pass
0.2424	333	351	105	Pass
0.2491	305	314	102	Pass
0.2558	282	281	99	Pass
0.2625	258	253	98	Pass
0.2692	234	227	97	Pass
0.2760	208	210	100	Pass
0.2827	189	187	98	Pass

SITE DETENTION POND DURATION ANALYSIS



Flow Frequency

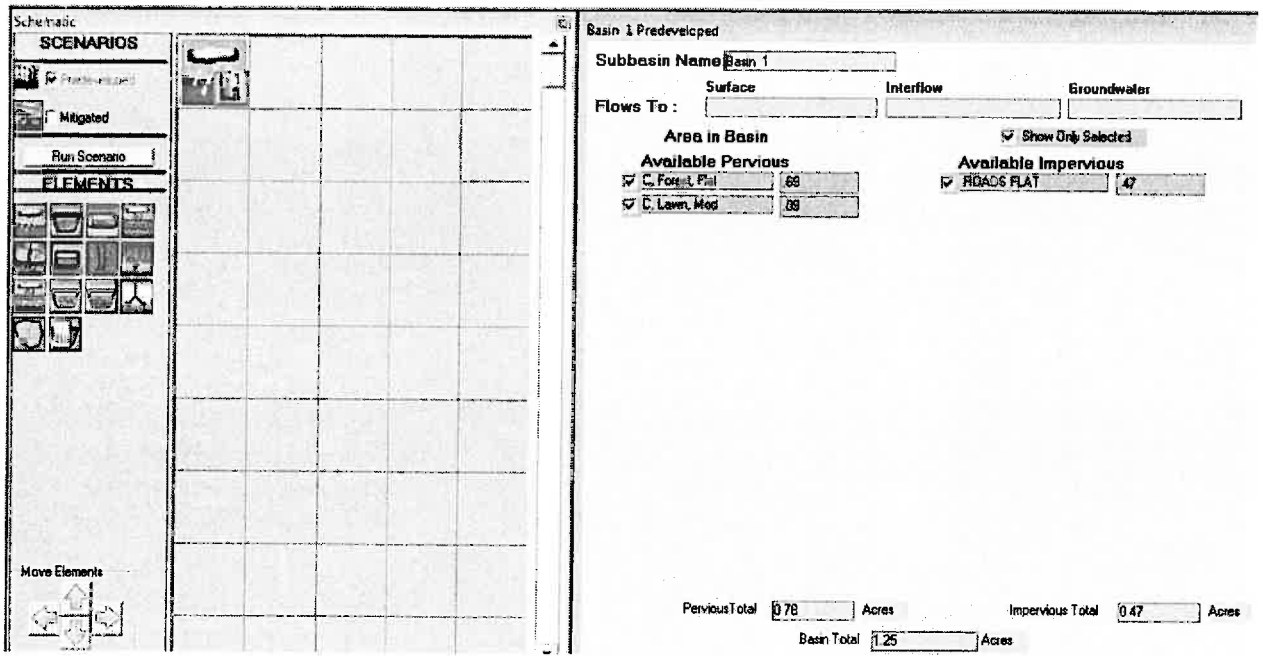
Flow(CFS)	Predeveloped	Mitigated
2 Year =	0.1756	0.0982
5 Year =	0.3229	0.1877
10 Year =	0.4408	0.2789
25 Year =	0.6114	0.4449
50 Year =	0.7531	0.6170
100 Year =	0.9067	0.8425

Yearly Peaks

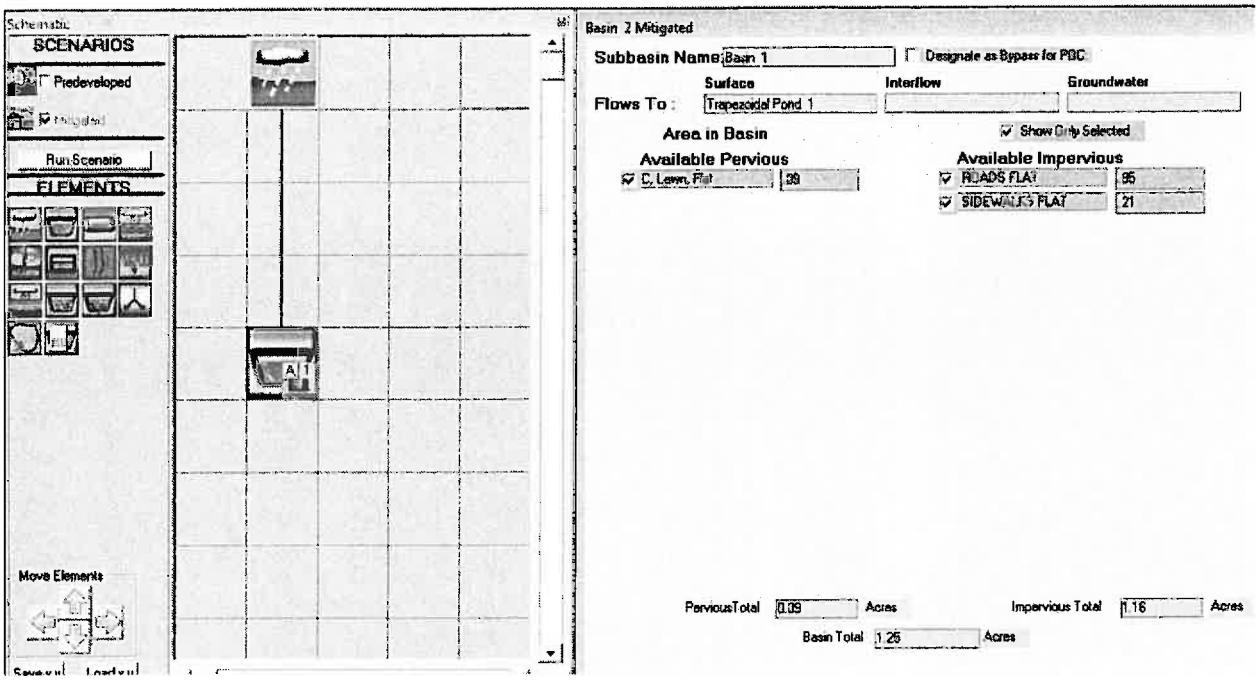
1949	0.4529	0.1376
1950	0.2927	0.2547
1951	0.2929	0.0877
1952	0.2200	0.0844
1953	0.1041	0.0848
1954	0.1278	0.0777
1955	0.1602	0.0652
1956	0.1404	0.0780
1957	0.2514	0.1942
1958	0.1093	0.0623
1959	0.2636	0.0883
1960	0.1721	0.1715
1961	0.1103	0.0816
1962	0.0209	0.0689
1963	0.1147	0.0620
1964	0.1289	0.0663
1965	0.2299	0.1516
1966	0.1152	0.0606
1967	0.1506	0.0721
1968	0.3211	0.1099
1969	0.0903	0.0752
1970	0.0600	0.0600
1971	0.3101	0.3004
1972	0.1485	0.0792

SITE BASIN FLOW FREQUENCY ANALYSIS

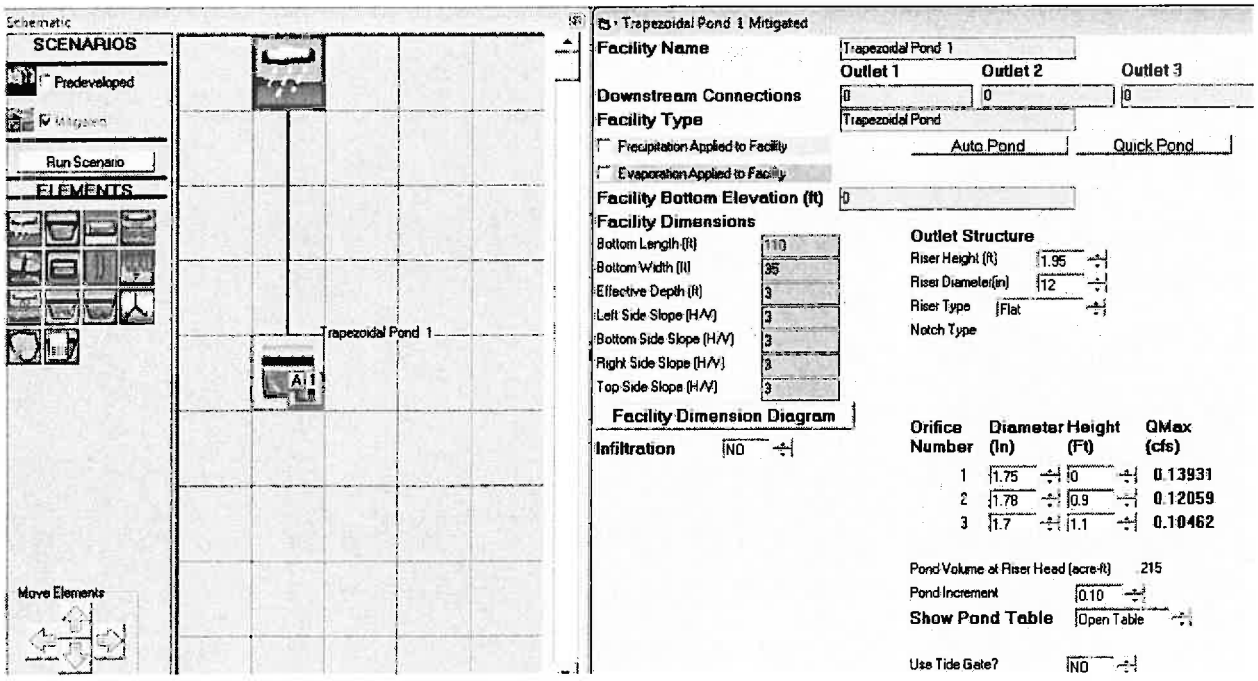
ROAD IMPROVEMENT BASIN DETENTION POND DESIGN



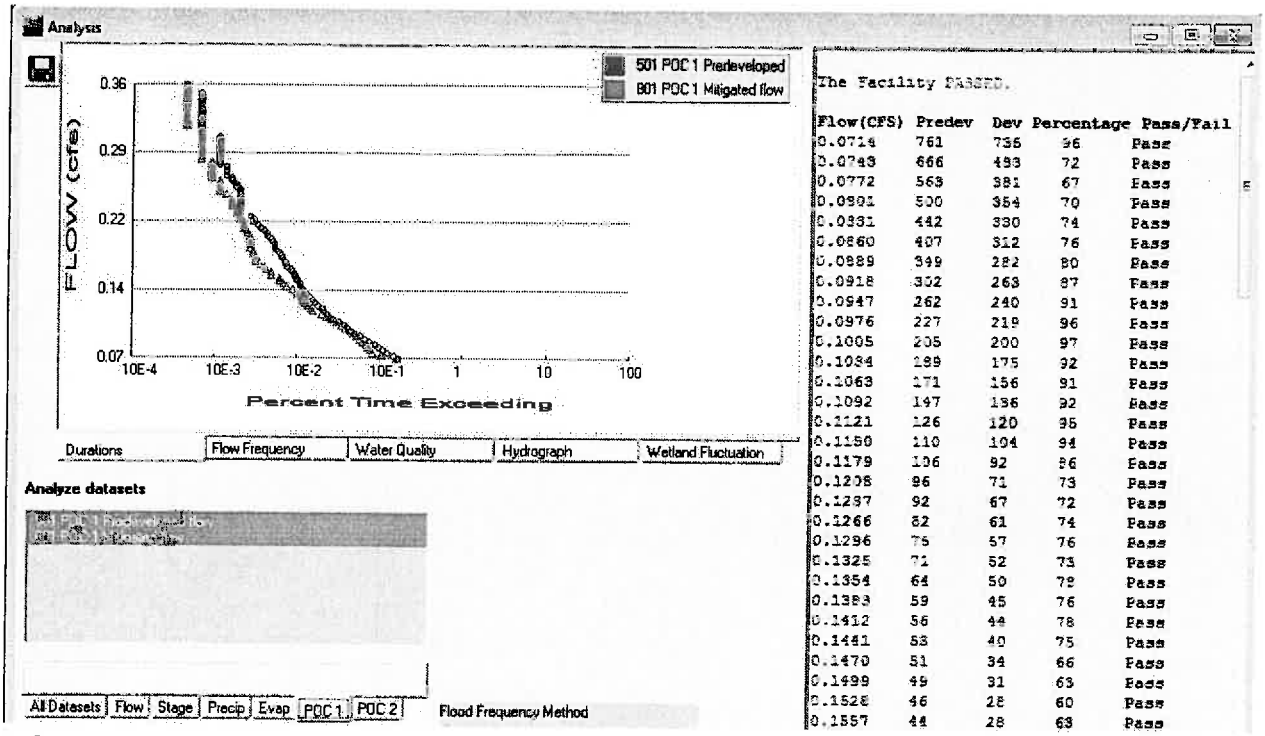
EXISTING ROAD IMPROVEMENT BASIN



DEVELOPED ROAD IMPROVEMENT BASIN



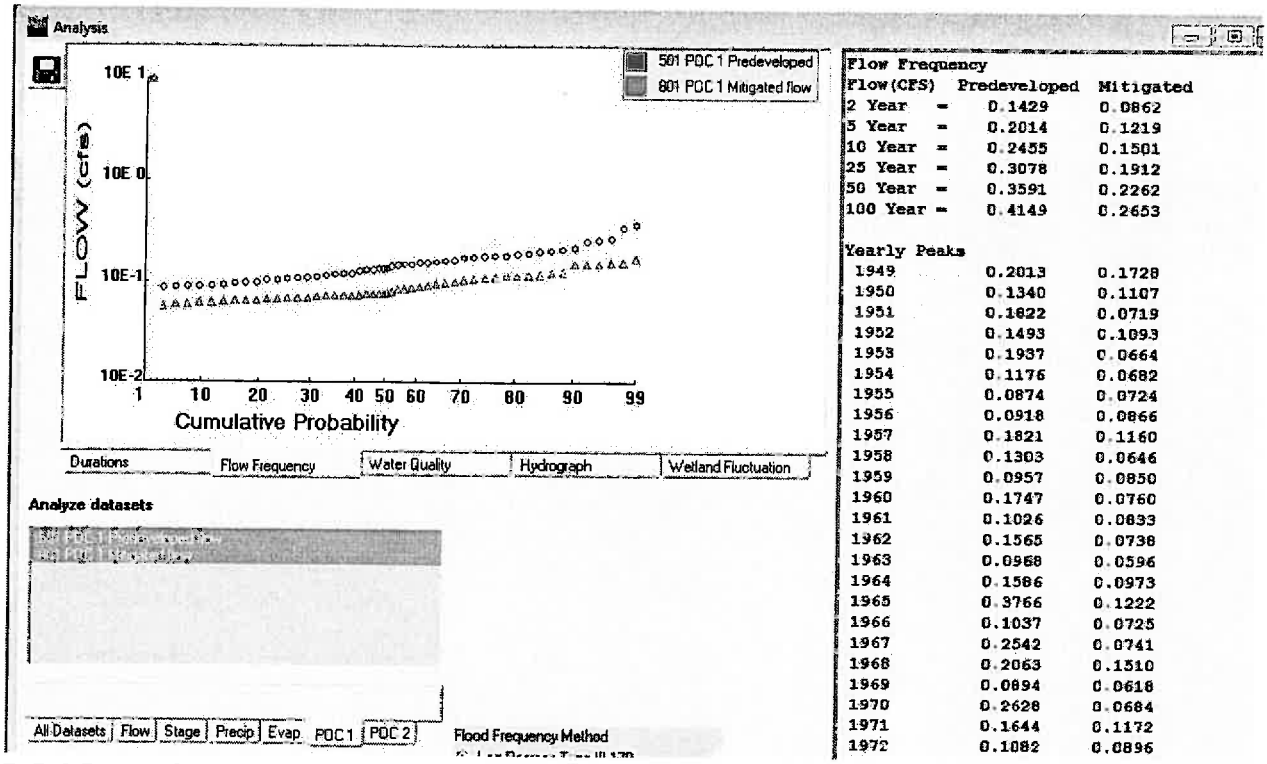
ROAD IMPROVEMENT DETENTION POND



The Facility PASSED.

Flow(CFS)	Predev	Dev	Percentage	Pass/Fail
0.0714	761	735	96	Pass
0.0743	666	493	74	Pass
0.0772	563	381	67	Pass
0.0801	500	354	70	Pass
0.0831	442	330	74	Pass
0.0860	407	312	76	Pass
0.0889	349	282	80	Pass
0.0918	302	263	87	Pass
0.0947	262	240	91	Pass
0.0976	227	219	96	Pass
0.1005	205	200	97	Pass
0.1034	189	175	92	Pass
0.1063	171	156	91	Pass
0.1092	147	136	92	Pass
0.1121	126	120	95	Pass
0.1150	110	104	94	Pass
0.1179	106	92	86	Pass
0.1208	96	71	73	Pass
0.1237	92	67	72	Pass
0.1266	82	61	74	Pass
0.1296	75	57	76	Pass
0.1325	71	52	73	Pass
0.1354	64	50	78	Pass
0.1383	59	45	76	Pass
0.1412	56	44	78	Pass
0.1441	53	40	75	Pass
0.1470	51	34	66	Pass
0.1499	49	31	63	Pass
0.1528	46	28	60	Pass
0.1557	44	28	63	Pass

ROAD IMPROVEMENT DETENTION POND DURATION ANALYSIS



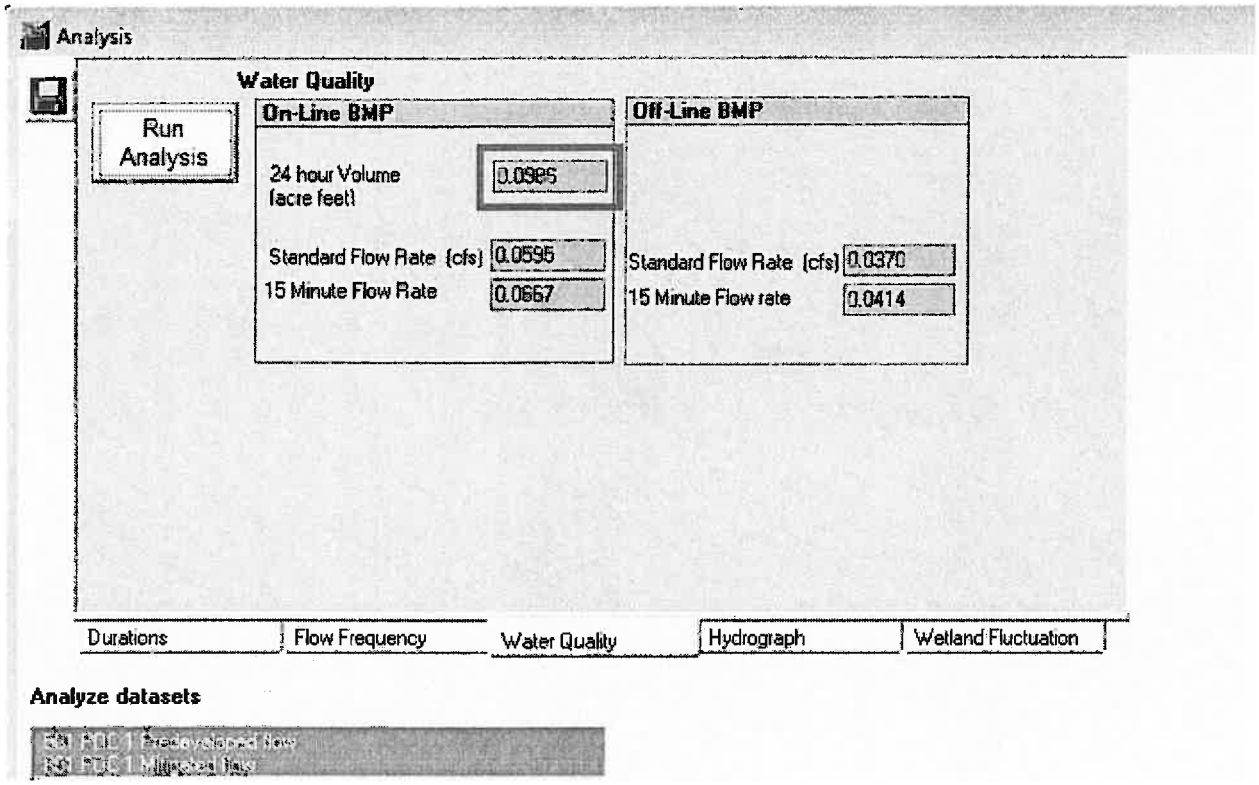
Flow Frequency

Flow(CFS)	Predeveloped	Mitigated
2 Year =	0.1429	0.0862
5 Year =	0.2014	0.1219
10 Year =	0.2455	0.1501
25 Year =	0.3078	0.1912
50 Year =	0.3591	0.2262
100 Year =	0.4149	0.2653

Yearly Peaks

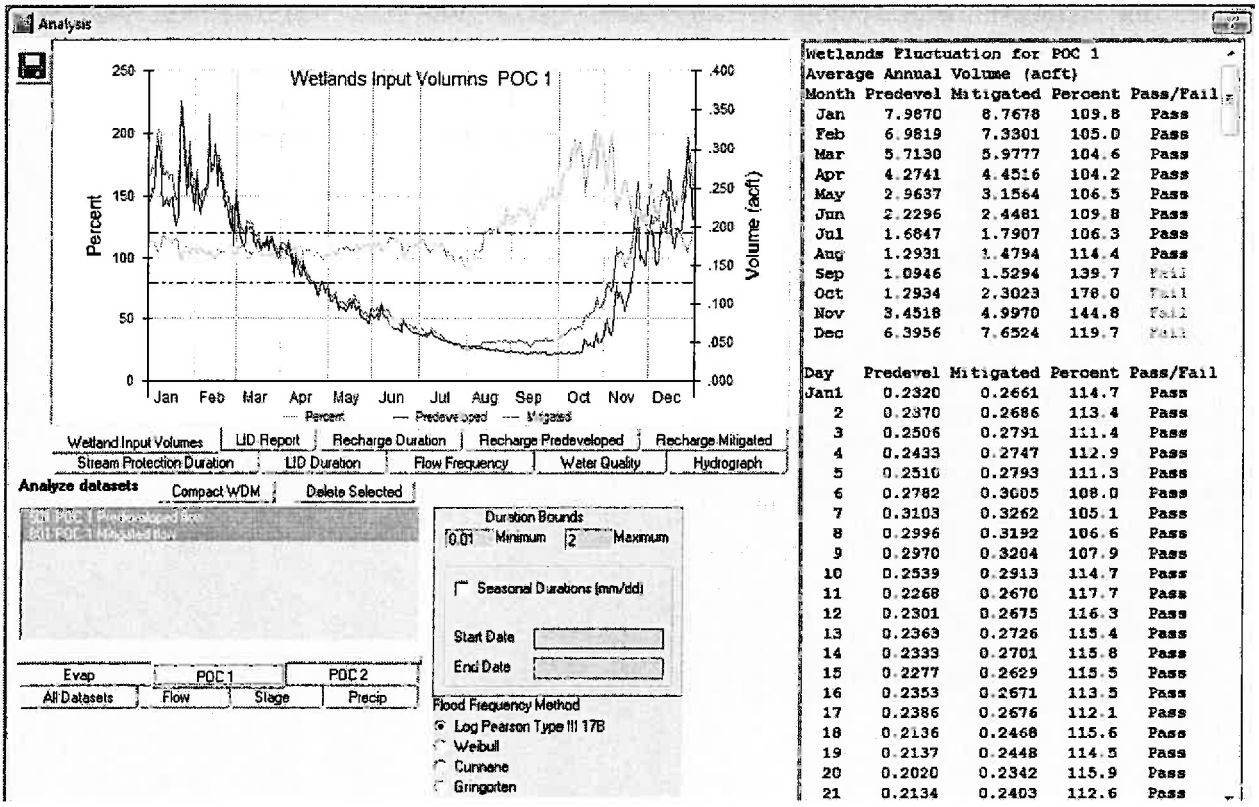
1949	0.2013	0.1728
1950	0.1340	0.1107
1951	0.1822	0.0719
1952	0.1493	0.1093
1953	0.1937	0.0664
1954	0.1176	0.0682
1955	0.0874	0.0724
1956	0.0918	0.0866
1957	0.1821	0.1160
1958	0.1303	0.0646
1959	0.0957	0.0850
1960	0.1747	0.0760
1961	0.1026	0.0833
1962	0.1565	0.0738
1963	0.0968	0.0596
1964	0.1586	0.0973
1965	0.3766	0.1222
1966	0.1037	0.0725
1967	0.2542	0.0741
1968	0.2063	0.1510
1969	0.0894	0.0618
1970	0.2628	0.0684
1971	0.1644	0.1172
1972	0.1082	0.0896

ROAD BASIN FLOW FREQUENCY ANALYSIS



ROAD BASIN WATER QUALITY ANALYSIS

WETLAND HYDROLOGY BASIN ANALYSIS



Wetlands Fluctuation for POC 1
Average Annual Volume (acft)

Month	Predevel	Mitigated	Percent	Pass/Fail
Jan	7.9870	8.7678	109.8	Pass
Feb	6.9819	7.3301	105.0	Pass
Mar	5.7130	5.9777	104.6	Pass
Apr	4.2741	4.4516	104.2	Pass
May	2.9637	3.1564	106.5	Pass
Jun	2.2296	2.4481	109.8	Pass
Jul	1.6847	1.7907	106.3	Pass
Aug	1.2931	1.4794	114.4	Pass
Sep	1.0946	1.5294	139.7	Fail
Oct	1.2934	2.3023	178.0	Fail
Nov	3.4518	4.9970	144.8	Fail
Dec	6.3956	7.6524	119.7	Fail

Day	Predevel	Mitigated	Percent	Pass/Fail
Jan1	0.2320	0.2661	114.7	Pass
2	0.2370	0.2686	113.4	Pass
3	0.2506	0.2791	111.4	Pass
4	0.2433	0.2747	112.9	Pass
5	0.2510	0.2793	111.3	Pass
6	0.2782	0.3005	108.0	Pass
7	0.3103	0.3262	105.1	Pass
8	0.2996	0.3192	106.6	Pass
9	0.2970	0.3204	107.9	Pass
10	0.2539	0.2913	114.7	Pass
11	0.2268	0.2670	117.7	Pass
12	0.2301	0.2675	116.3	Pass
13	0.2363	0.2726	115.4	Pass
14	0.2333	0.2701	115.8	Pass
15	0.2277	0.2629	115.5	Pass
16	0.2353	0.2671	113.5	Pass
17	0.2386	0.2676	112.1	Pass
18	0.2136	0.2468	115.6	Pass
19	0.2137	0.2448	114.5	Pass
20	0.2020	0.2342	115.9	Pass
21	0.2134	0.2403	112.6	Pass

WETLAND HYDROLOGY ANALYSIS