Appendix G

Hydrological Studies

ESA

G1 Preliminary Drainage Study

LOS CERRITOS WETLANDS RESTORATION AND OIL CONSOLIDATION PROJECT

CITY OF LONG BEACH

PRELIMINARY DRAINAGE STUDY
For
Pumpkin Patch Site, LCWA Site, and Synergy Visitors Center

Prepared for:

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May 10, 2016

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I. INTRODUCTION

A. PROJECT DESCRIPTION

The project will be implemented on four sites: the Synergy Oil Field Site, the "Pumpkin Patch" Site, the Los Cerritos Wetlands Authority (LCWA) Site, and the 33-acre City Marketplace Marsh (City Property) Site (See Sheet 1). The Synergy Oil Field Site is located at 6433 East 2nd Street between Pacific Coast Highway to the west, the Los Cerritos Channel to the north, Studebaker Road to the east, and 2nd Street to the south. The "Pumpkin Patch" Site is located at 6701 East Pacific Coast Highway at the northeast corner of the intersection with the San Gabriel Channel. The LCWA Site is located at the northeast corner of the intersection of Studebaker Road and Westminster Boulevard. The City Property Site is located between 2nd Street to the north and the San Gabriel River to the south.

The scope of this report will only cover the Visitors Center in the Synergy Oil Field Site, Pumpkin Patch Site, and LCWA Site. The 33-acre City Marketplace Marsh Site and Remaining portion of the Synergy Oil Field Site are not analyzed due to the fact that no drainage impacts are anticipated.

Pumpkin Patch Site: The Pumpkin Patch Site is owned by Beach Oil Minerals Partners. The Pumpkin Patch site is currently vacant, except for one operating oil well. It is currently used for seasonal sales of pumpkins and Christmas trees.

Although the Pumpkin Patch site is approximately 7 acres in size, the oil production operations will be located on 5 acres of the site closest to Pacific Coast Highway. The northeasterly 2-acre portion of the site will be retained as open space and used to provide a 100-foot buffer from the coastal wetland habitat area at the eastern edge of the site.

In order to facilitate the restoration of the approximately southerly 72 acres on the Synergy Oil Field and construction of the public access improvements, the warehouse structures currently on the Synergy Oil Field will be removed and a portion of the oil production activities currently being conducted at the Synergy Oil Field and the City Property Site will be relocated to the 7 acre property. The office uses currently occupying the Bixby building on the Synergy Oil Field site would be relocated to a new approximately 5,200 square feet (sf), two-story office building constructed on the Pumpkin Patch site. Other proposed site development on the Pumpkin Patch Site includes an approximately 9,750 sf of storage/warehouse, parking for 47 cars, drilling of up to fifty (50) new wells (both oil production and water injection wells) and associated production facilities. The height of the office building is 35 feet and the storage/warehouse is 22 feet.

In addition to the 50 wells, two tanks will be constructed on the site: a 3,000 barrel tank for storing "wet oil" that is 30 feet in diameter and 24 feet high; and a 2,000 barrel "skim oil" tank that is 24 feet in diameter and 24 feet high. There is an existing oil well on the Pumpkin Patch site which will be used on a temporary basis as a test well to confirm the feasibility of oil production operations on Pumpkin Patch.

A 22-foot high screen wall will be built on the perimeter of the Pumpkin Patch site. Vehicular access to the site will be from Studebaker Road. The structures will be set back 30 feet from Pacific Coast Highway and perimeter landscaping will be provided along Studebaker, Pacific Coast Highway and the San Gabriel River Channel.

LCWA Site: The Project proposes the drilling and operation of up to seventy (70) wells on a 5-acre parcel owned by LCWA located at Studebaker and Westminster ("LCWA Site") to replace the oil production facilities currently on the Synergy Oil Field and the City Property Site. The LCWA Site is currently undeveloped and is used on a temporary lease basis for equipment storage and staging. Due to the geologic conditions at the Synergy Oil Field (i.e., the Newport-Inglewood Fault traverses the site), the oil field is divided between two operating areas; one on each side of the fault. The oil field operations north of the fault extract oil from a subterranean oil horizon that cannot be accessed from Pumpkin Patch, but can be accessed from the LCWA Site.

The wells will be a combination of oil production well and water injection wells. In addition to the oil production area, the project proposes to construct an elevated pipe rack, a 28,000 barrel sales oil tank (48 feet in height and 70 feet in diameter), and a 5,000 barrel injection water tank (35 feet in height and 32 feet in diameter). The site will also include a 15-20 feet high ground flare, and 3 gas turbines for onsite electrical power generation. A 22-foot high screen wall will be built on the perimeter of the LCWA site. The project proposes to improve the existing driveway off of Studebaker Road to a 30-foot entrance/exit, and to construct a secondary 30-foot access from Westminster Boulevard. Perimeter landscaping will be provided along the Studebaker Road and Westminster Boulevard frontage.

Synergy Site Visitor Center: On the Synergy Oil Field Site, the Project proposes to establish a wetlands mitigation bank and public access trail on the northerly approximately 78 acres of the 154-acre Synergy Oil Field (formerly known as the Bixby Oil Field), to implement a wetlands restoration plan on the southerly approximately 72 acres of the Synergy Oil Field, and to construct public access improvements, including a parking lot on existing disturbed areas and converting an existing building for use as a visitors' center on the remaining approximately 4 acres of the Synergy Oil Field. The mitigation

bank provides for the phased restoration and permanent preservation of restored wetlands. The Project also proposes the removal of thirty-nine (39) oil wells from the southerly 72 acres. The Synergy Oil Field is owned and operated by Beach Oil Minerals Partners.

B. PURPOSE

This drainage report is to provide preliminary drainage analysis to support the EIR process. The sites are analyzed for their undeveloped and developed conditions and results are used to provide preliminary design of the proposed drainage systems.

C. METHODOLOGY

The methodology used to compute storm water runoff was that described in the 2006 County of Los Angeles Department of Public Works Hydrology Manual (ref. 1). The LA county HydroCalc program (ref. 2) was used to calculate the Time of Concentration (Tc) for each subarea. A peak flow rate and runoff volume were also computed for each subarea as part of the result. The Tc calculations and results are located in Appendix.

D. RESULTS

Predeveloped Condition Hydrology Analysis:

Pumpkin Patch Site – The site drains from south to north and toward Studebaker Road. The site is relatively flat (1%) and contain a defined flow path toward Studebaker Road. No offsite run-on entering the site.

LCWA Site – The site drains from east to west and toward an existing asphalt access road. The site is very flat (0.4%) and contain a few low points along the flow path toward the access road. Portion of the onsite flow also sheet flow toward Studebaker Road and Westminster Blvd. No offsite run-on entering the site.

Synergy Site Visitor Center – The site drains from west to east and toward an existing access road. The site is very flat (0.2%) and contain a few low points along the flow path toward the access road. No offsite run-on entering the site.

Developed Condition Hydrology Analysis:

Pumpkin Patch Site – The site drains from south to north and toward Studebaker Road. The site is relatively flat (1%) and contain a defined flow path toward Studebaker Road. No offsite run-on entering the site.

LCWA Site – The site drains from east to west and toward an existing asphalt access road. The site is very flat (0.4%) and contain a few low points along the flow path toward the access road. Portion of the onsite flow also sheet flow toward Studebaker Road and Westminster Blvd. No offsite run-on entering the site.

Synergy Site Visitor Center – The site drains from west to east and toward an existing access road. The site is very flat (0.2%) and contain a few low points along the flow path toward the access road. No offsite run-on entering the site.

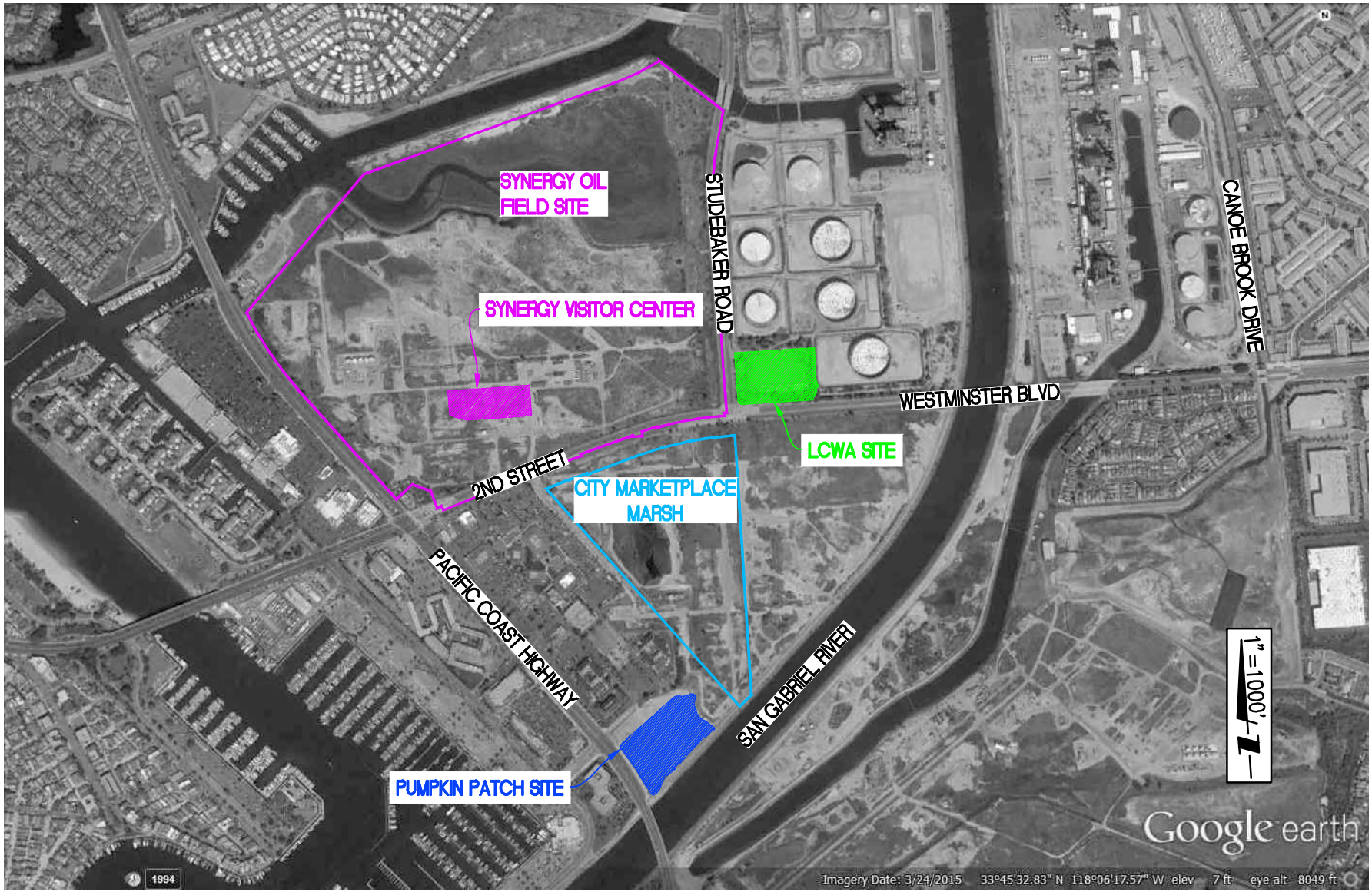
Drainage Area Location	**Pre-Dev Drainage Area (acres)**	**Developed Drainage Area (acres)**	**Pre-Dev Peak Flow (cfs)**	**Developed Peak Flow (cfs)**	**Pre-Dev Storm Volume (ac-ft)**	**Developed Storm Volume (ac-ft)**	**Required Detention (ac-ft)**
Pumpkin Patch	4.82	4.95	1.00	8.27	0.23	1.63	1.40
LCWA	4.06	4.04	0.88	4.78	0.20	1.05	0.85
Synergy Site Visitor Center	2.56	2.56	2.05	3.80	0.45	0.80	0.35

E. CONCLUSION

All storm drain facilities will be designed to provide capacity for a 50-year storm event. Outflow from the sites will follow the predeveloped flow path as they leaving the project. The flow rates will also be controlled to be equal or less than the predeveloped condition with the use of onsite detention.

II. REFERENCES

1. Hydrology Manual, County of Los Angeles Department of Public Works, 2006.
2. HydroCalc, County of Los Angeles Department of Public Works, 2014.



LOCATION MAP

WILSON MIKAMI CORPORATION
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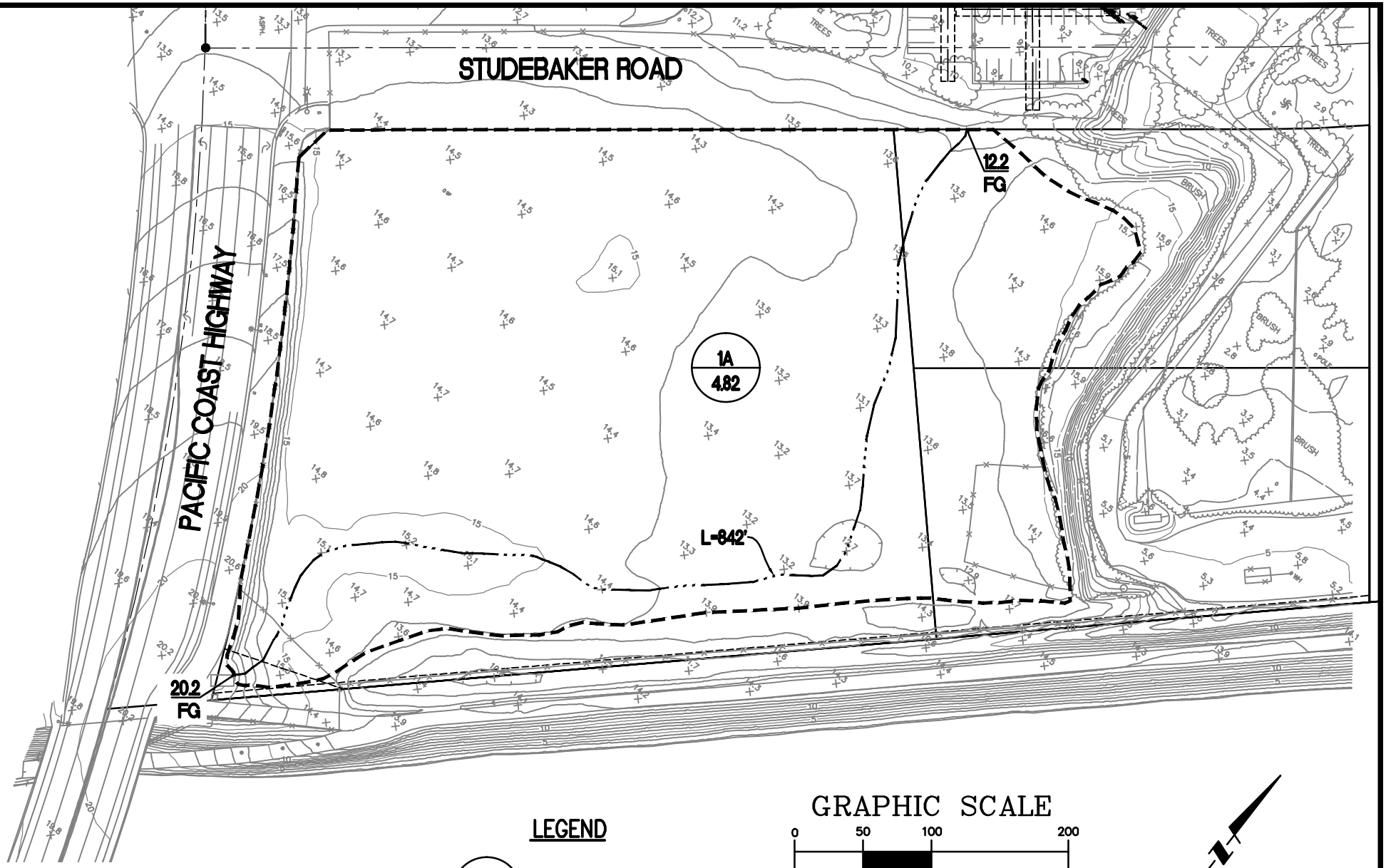
DESIGNED BY:	
DRAFTED BY:	
CHECKED BY:	
DATE:	

PROJECT LOCATION MAP

SHEET 1 OF 7



LEGEND

1A / 1.00 — SUBAREA / AREA (ACRES)

GRAPHIC SCALE

0 50 100 200

(IN FEET)
1 inch = 100 ft.

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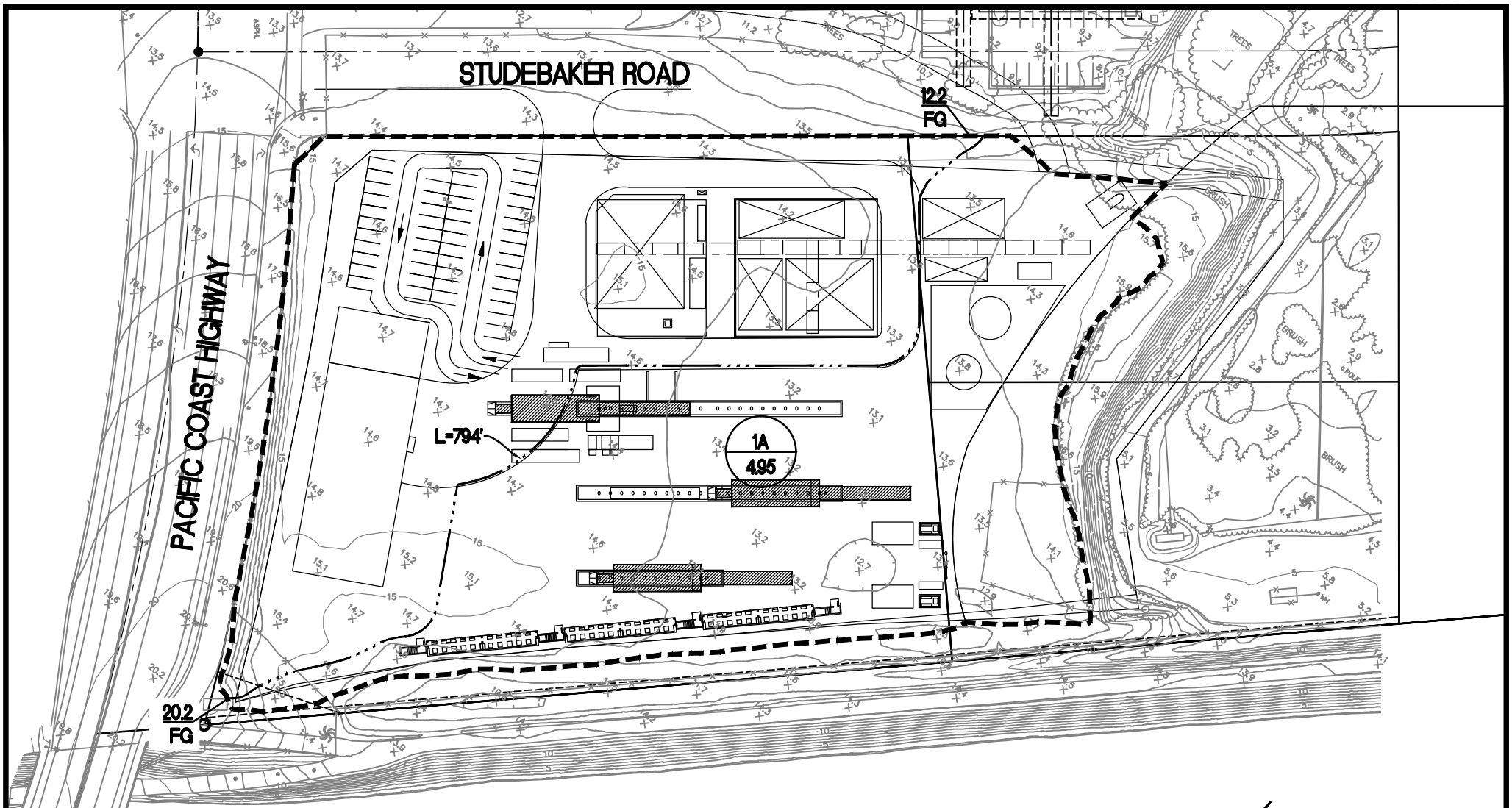
CHECKED BY:	
DATE:	

PUMPKIN PATCH SITE HYDROLOGY EXHIBIT - UNDEVELOPED CONDITION



LEGEND

1A	SUBAREA
1.00	AREA (ACRES)

GRAPHIC SCALE

0 50 100 200

(IN FEET)
1 inch = 100 ft.

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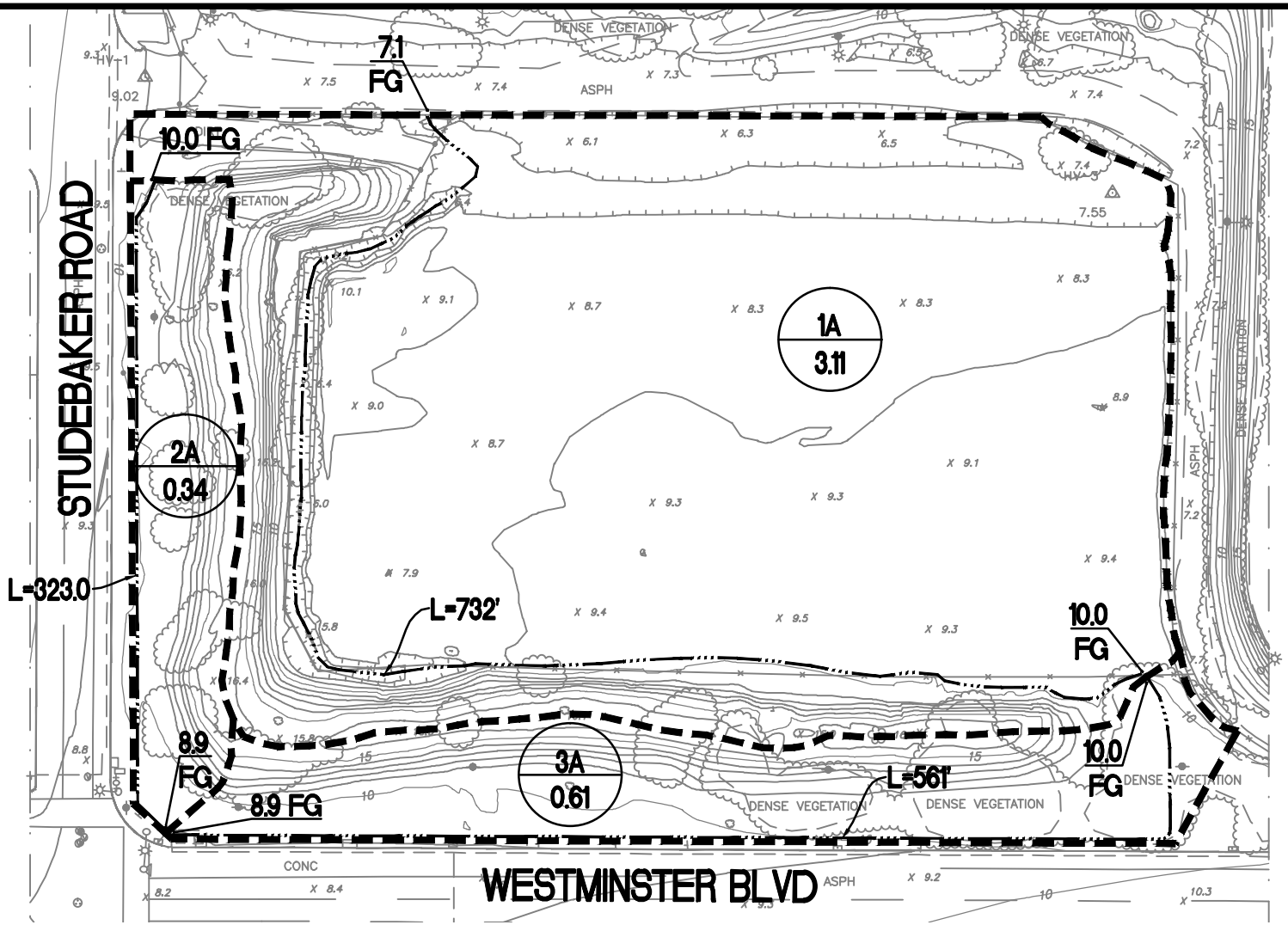
DATE:	

PUMPKIN PATCH SITE HYDROLOGY EXHIBIT - DEVELOPED CONDITION



LEGEND

1A / 1.00 — SUBAREA / AREA (ACRES)

GRAPHIC SCALE

0 40 80 160

(IN FEET)
1 inch = 80 ft.

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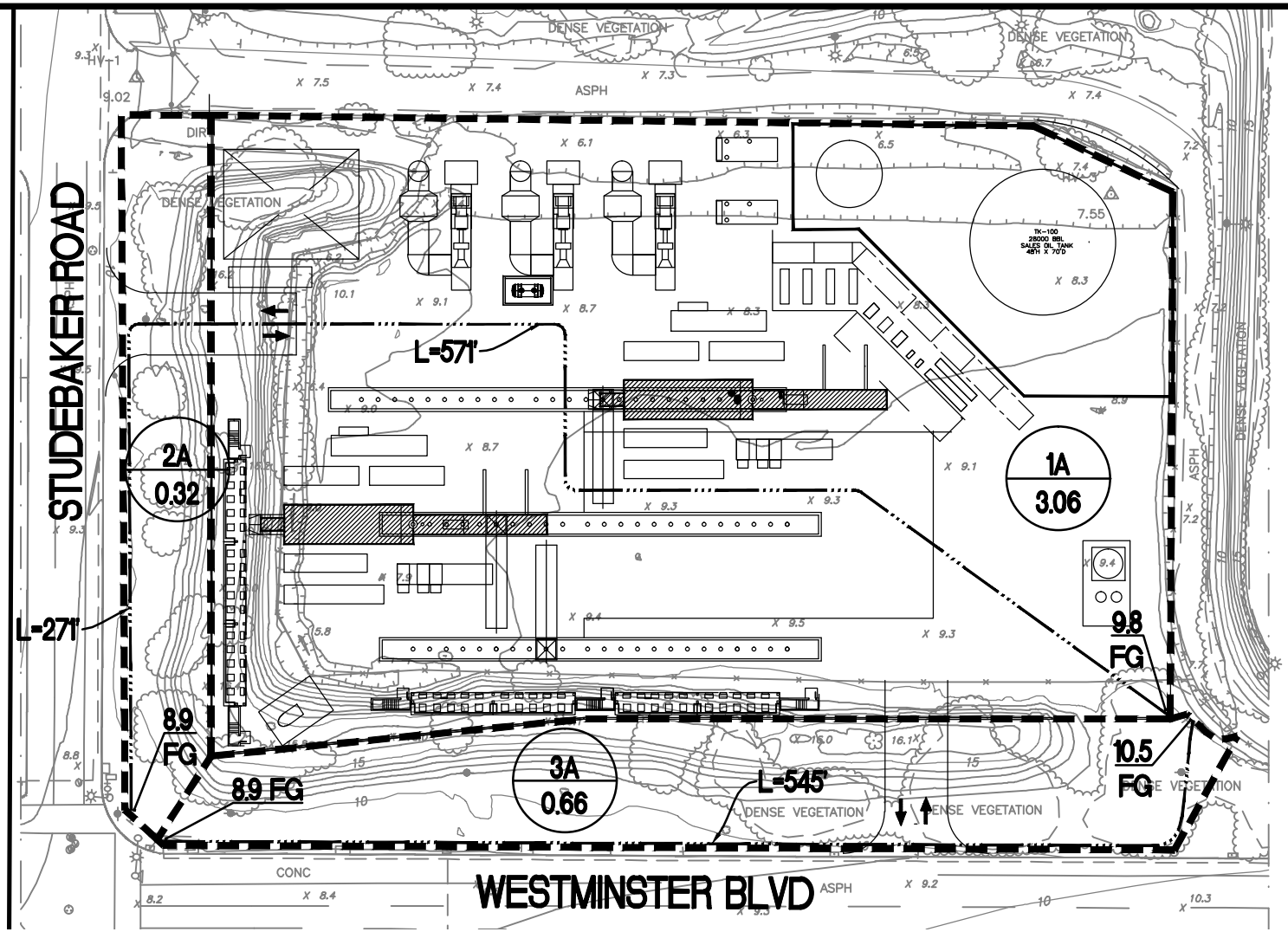
DATE:	

LCWA
HYDROLOGY EXHIBIT -
UNDEVELOPED CONDITION



LEGEND

1A / 1.00 — SUBAREA / AREA (ACRES)

GRAPHIC SCALE

0 40 80 160

(IN FEET)
1 inch = 80 ft.

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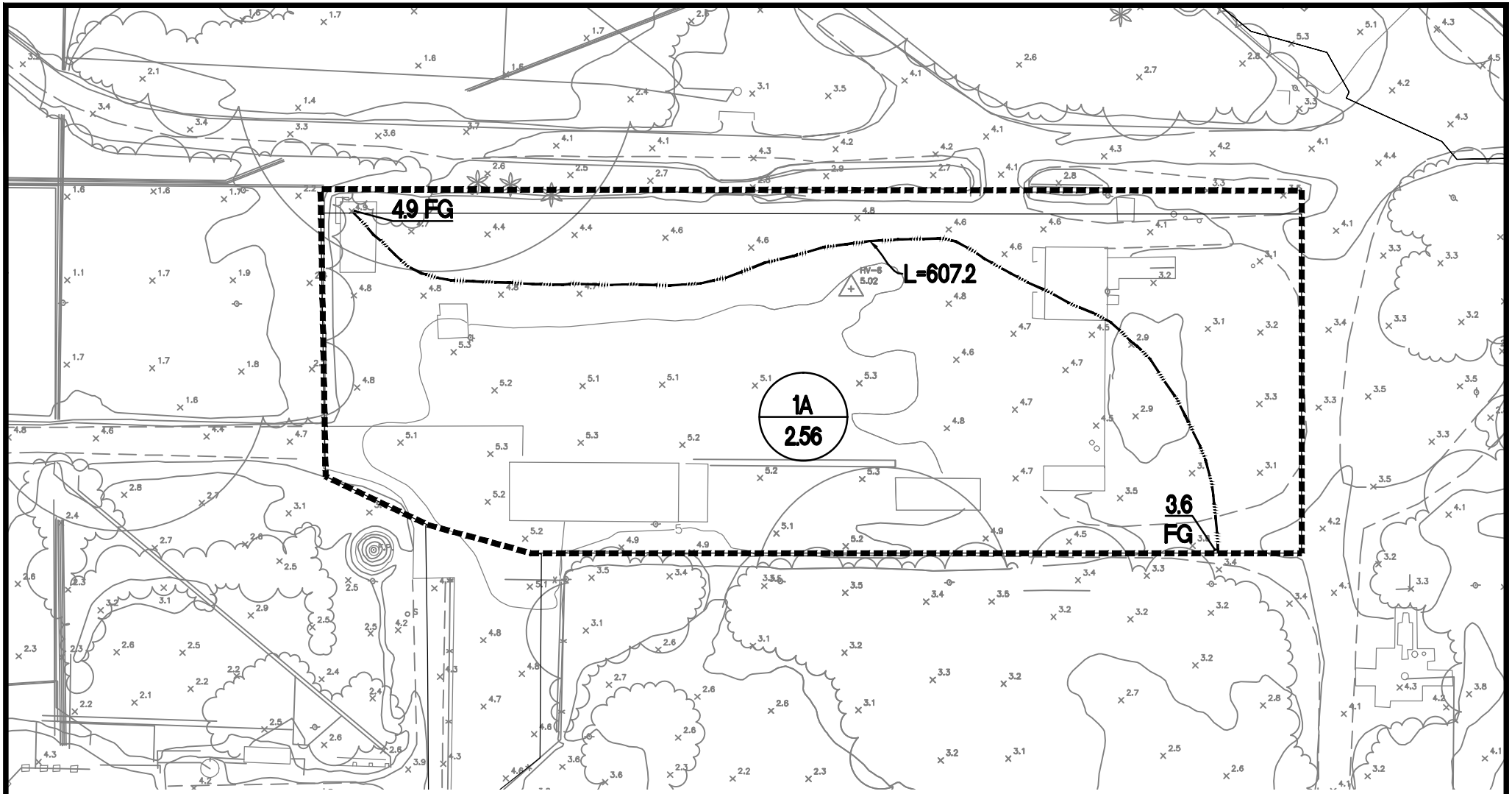
CHECKED BY:	
DATE:	

LCWA HYDROLOGY EXHIBIT - DEVELOPED CONDITION



LEGEND

1A / 1.00 — SUBAREA / AREA (ACRES)

GRAPHIC SCALE

0 40 80 160

(IN FEET)
1 inch = 80 ft.

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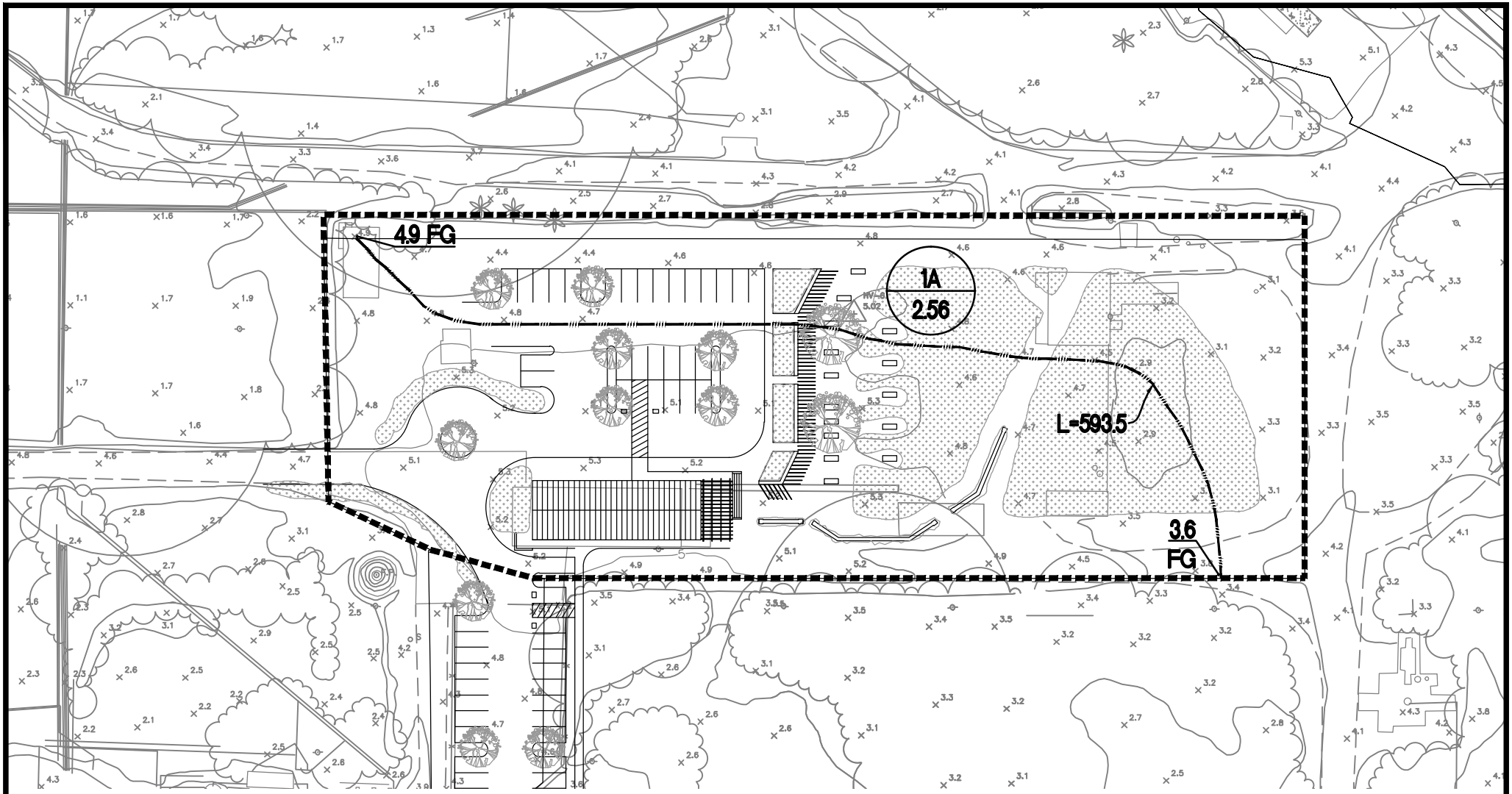
DATE:	

SYNERGY SITE VISITORS CENTER HYDROLOGY EXHIBIT - UNDEVELOPED CONDITION



LEGEND

1A / 1.00 — SUBAREA / AREA (ACRES)

GRAPHIC SCALE

0 40 80 160

(IN FEET)
1 inch = 80 ft.

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CHECKED BY:	
DATE:	

SYNERGY SITE VISITORS CENTER HYDROLOGY EXHIBIT - DEVELOPED CONDITION

III. APPENDICES

RATIONAL METHOD Q50 HYDROLOGY
Undeveloped Condition

Peak Flow Hydrologic Analysis

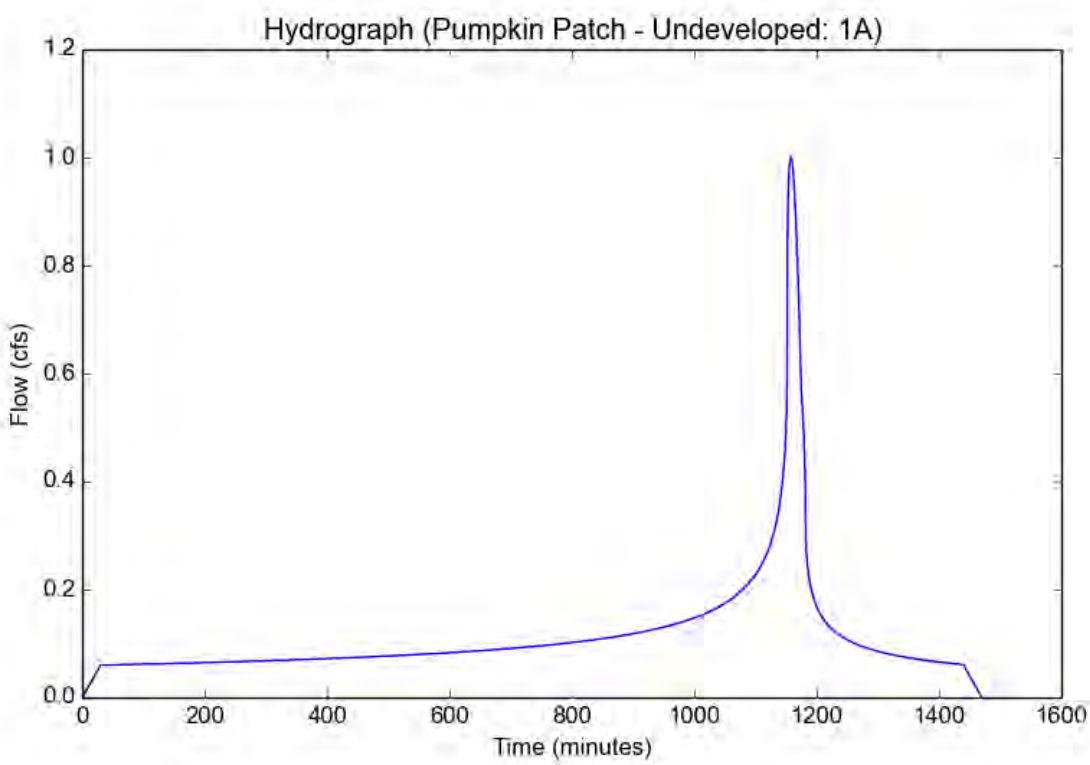
File location: S:/10159.01/drainage/Hydrology/Pumpkin Patch - Undeveloped - 1A.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Pumpkin Patch - Undeveloped
Subarea ID	1A
Area (ac)	4.82
Flow Path Length (ft)	842.0
Flow Path Slope (vft/hft)	0.01
50-yr Rainfall Depth (in)	4.8
Percent Impervious	0.02
Soil Type	15
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	4.8
Peak Intensity (in/hr)	1.2337
Undeveloped Runoff Coefficient (Cu)	0.1534
Developed Runoff Coefficient (Cd)	0.1683
Time of Concentration (min)	30.0
Clear Peak Flow Rate (cfs)	1.0009
Burned Peak Flow Rate (cfs)	1.0009
24-Hr Clear Runoff Volume (ac-ft)	0.2287
24-Hr Clear Runoff Volume (cu-ft)	9962.0038



Peak Flow Hydrologic Analysis

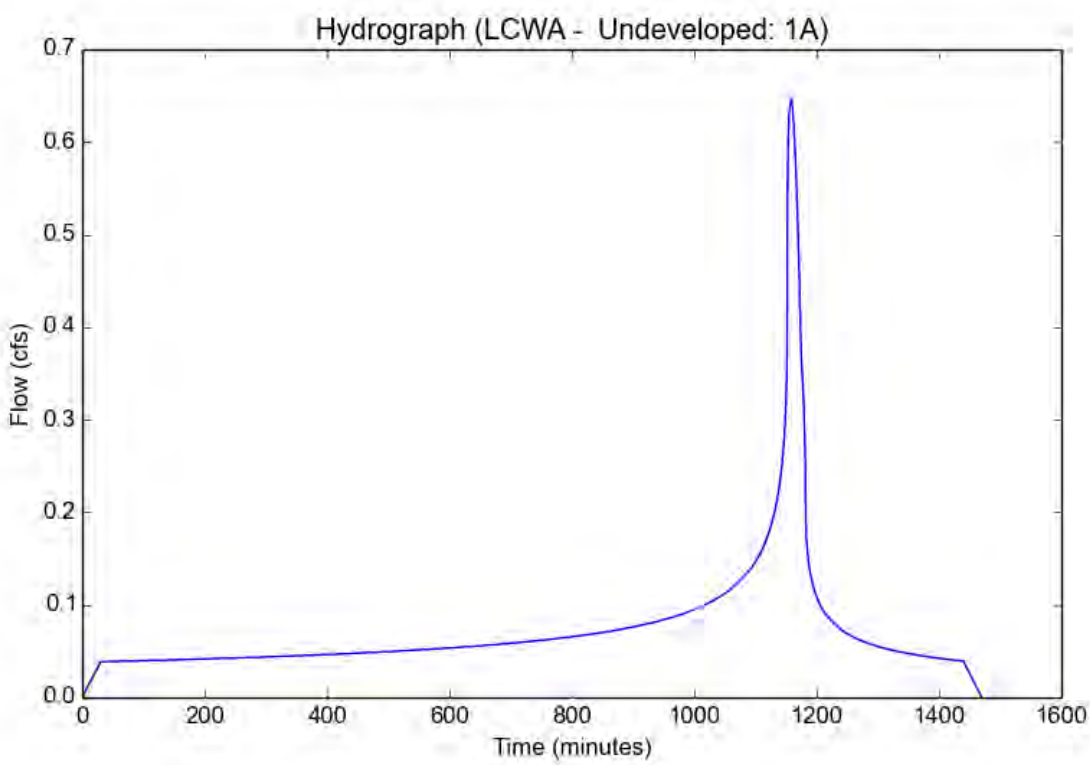
File location: S:/10159.01/drainage/Hydrology/HydroCalc/LCWA - Undeveloped - 1A.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	LCWA - Undeveloped
Subarea ID	1A
Area (ac)	3.11
Flow Path Length (ft)	732.0
Flow Path Slope (vft/hft)	0.004
50-yr Rainfall Depth (in)	4.8
Percent Impervious	0.02
Soil Type	15
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	4.8
Peak Intensity (in/hr)	1.2337
Undeveloped Runoff Coefficient (Cu)	0.1534
Developed Runoff Coefficient (Cd)	0.1683
Time of Concentration (min)	30.0
Clear Peak Flow Rate (cfs)	0.6458
Burned Peak Flow Rate (cfs)	0.6458
24-Hr Clear Runoff Volume (ac-ft)	0.1476
24-Hr Clear Runoff Volume (cu-ft)	6427.7659



Peak Flow Hydrologic Analysis

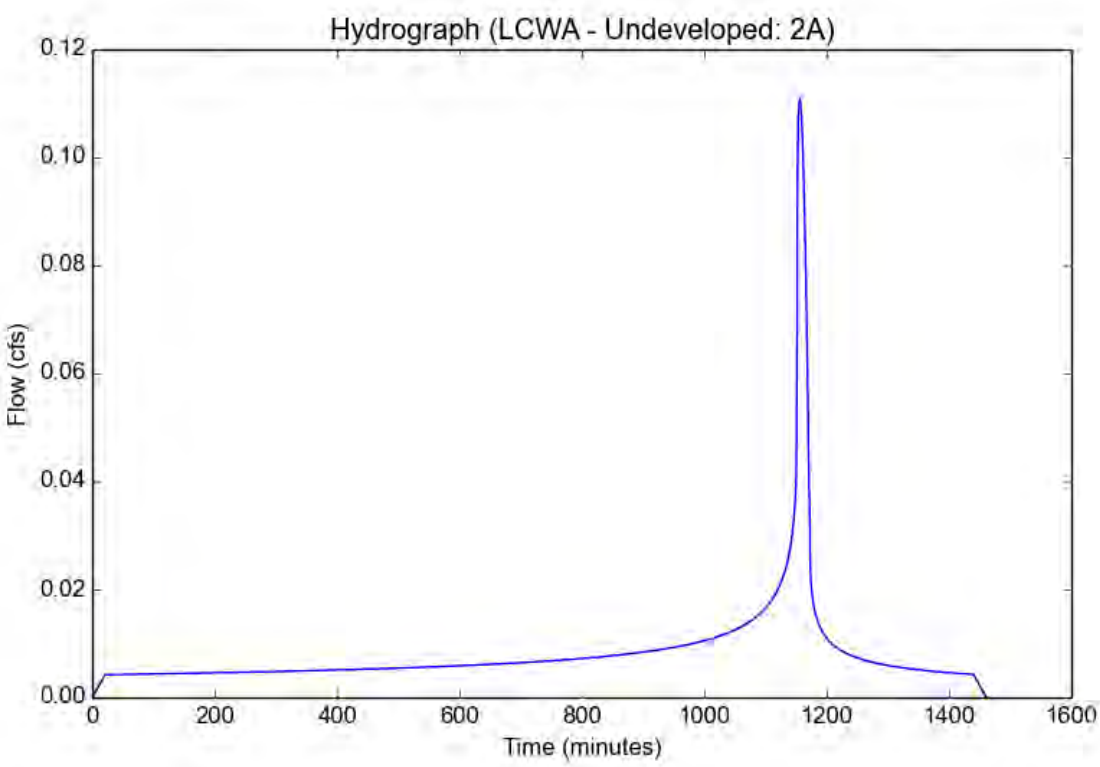
File location: S:/10159.01/drainage/Hydrology/LCWA - Undeveloped - 2A.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	LCWA - Undeveloped
Subarea ID	2A
Area (ac)	0.34
Flow Path Length (ft)	323.0
Flow Path Slope (vft/hft)	0.002
50-yr Rainfall Depth (in)	4.8
Percent Impervious	0.02
Soil Type	15
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	4.8
Peak Intensity (in/hr)	1.4589
Undeveloped Runoff Coefficient (Cu)	0.2096
Developed Runoff Coefficient (Cd)	0.2234
Time of Concentration (min)	21.0
Clear Peak Flow Rate (cfs)	0.1108
Burned Peak Flow Rate (cfs)	0.1108
24-Hr Clear Runoff Volume (ac-ft)	0.0167
24-Hr Clear Runoff Volume (cu-ft)	725.6389



Peak Flow Hydrologic Analysis

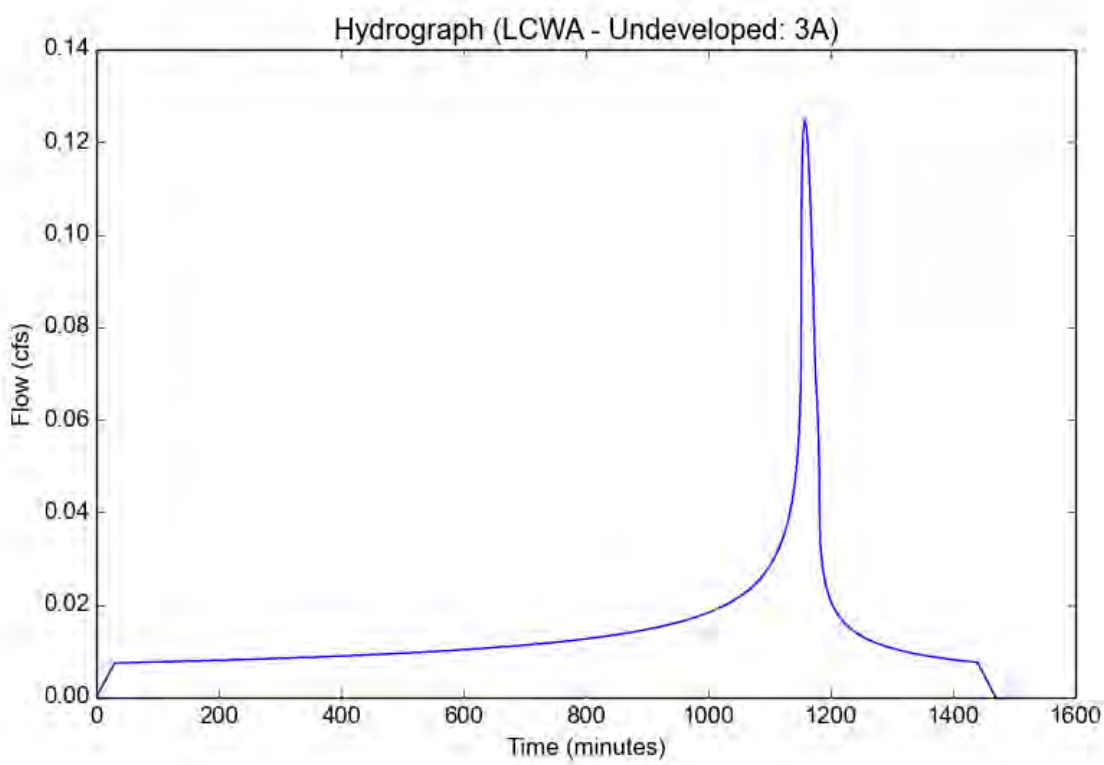
File location: S:/10159.01/drainage/Hydrology/LCWA - Undeveloped - 3A.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	LCWA - Undeveloped
Subarea ID	3A
Area (ac)	0.6
Flow Path Length (ft)	561.0
Flow Path Slope (vft/hft)	0.003
50-yr Rainfall Depth (in)	4.8
Percent Impervious	0.02
Soil Type	15
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	4.8
Peak Intensity (in/hr)	1.2337
Undeveloped Runoff Coefficient (Cu)	0.1534
Developed Runoff Coefficient (Cd)	0.1683
Time of Concentration (min)	30.0
Clear Peak Flow Rate (cfs)	0.1246
Burned Peak Flow Rate (cfs)	0.1246
24-Hr Clear Runoff Volume (ac-ft)	0.0285
24-Hr Clear Runoff Volume (cu-ft)	1240.0835



Peak Flow Hydrologic Analysis

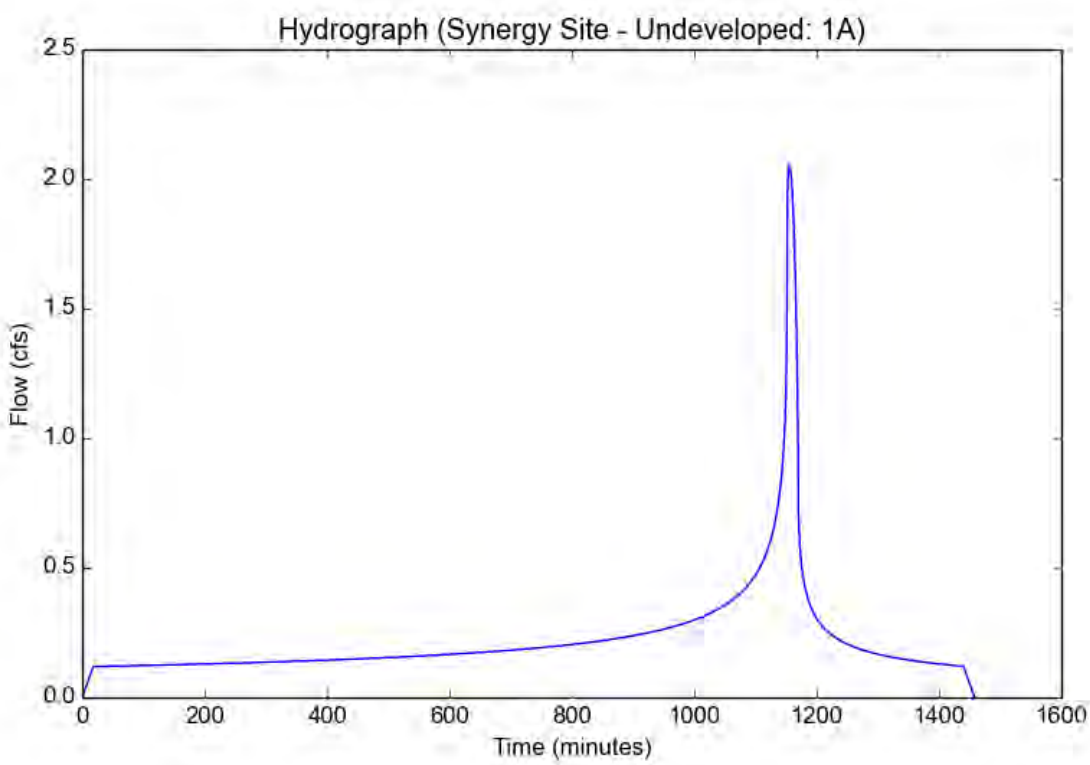
File location: S:/10159.01/drainage/Hydrology/HydroCalc/Synergy Site - Undeveloped - 1A.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Synergy Site - Undeveloped
Subarea ID	1A
Area (ac)	2.56
Flow Path Length (ft)	607.2
Flow Path Slope (vft/hft)	0.002
50-yr Rainfall Depth (in)	4.8
Percent Impervious	0.42
Soil Type	15
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	4.8
Peak Intensity (in/hr)	1.5685
Undeveloped Runoff Coefficient (Cu)	0.2295
Developed Runoff Coefficient (Cd)	0.5111
Time of Concentration (min)	18.0
Clear Peak Flow Rate (cfs)	2.0524
Burned Peak Flow Rate (cfs)	2.0524
24-Hr Clear Runoff Volume (ac-ft)	0.4481
24-Hr Clear Runoff Volume (cu-ft)	19521.2559



RATIONAL METHOD Q50 HYDROLOGY
Developed Condition

Peak Flow Hydrologic Analysis

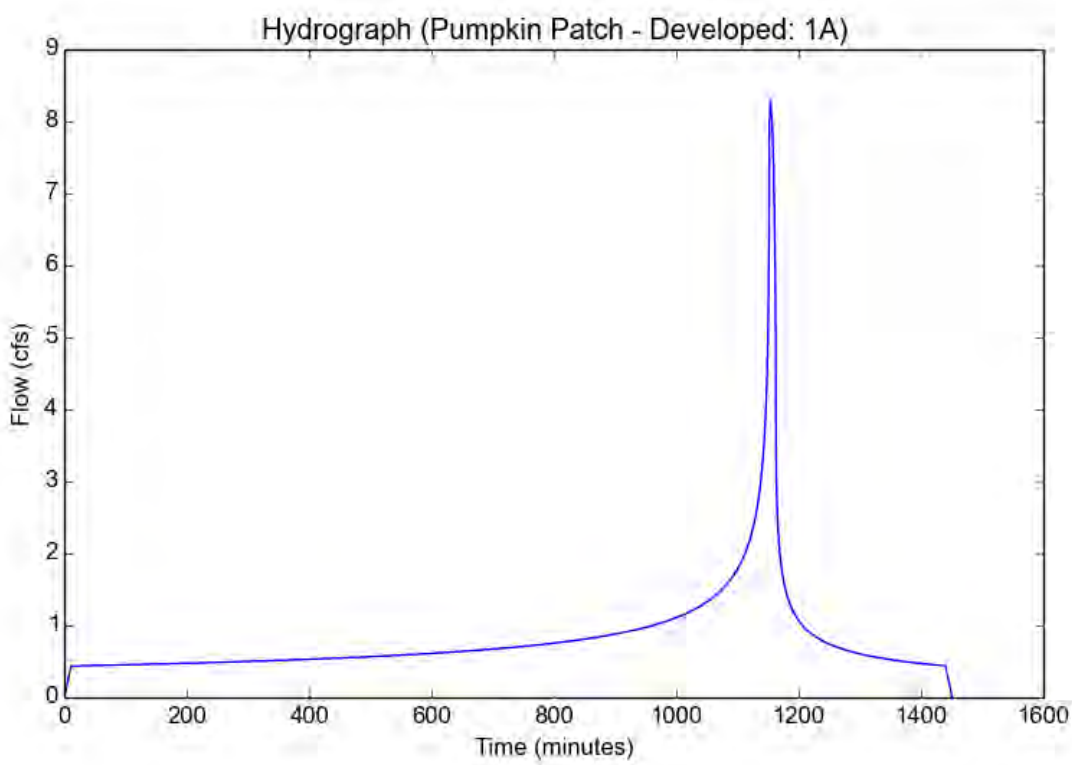
File location: S:/10159.01/drainage/Hydrology/HydroCalc/Pumpkin Patch - Developed - 1A.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Pumpkin Patch - Developed
Subarea ID	1A
Area (ac)	4.95
Flow Path Length (ft)	808.0
Flow Path Slope (vft/hft)	0.01
50-yr Rainfall Depth (in)	4.8
Percent Impervious	0.91
Soil Type	15
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	4.8
Peak Intensity (in/hr)	1.977
Undeveloped Runoff Coefficient (Cu)	0.2871
Developed Runoff Coefficient (Cd)	0.8448
Time of Concentration (min)	11.0
Clear Peak Flow Rate (cfs)	8.2677
Burned Peak Flow Rate (cfs)	8.2677
24-Hr Clear Runoff Volume (ac-ft)	1.628
24-Hr Clear Runoff Volume (cu-ft)	70916.0768



Peak Flow Hydrologic Analysis

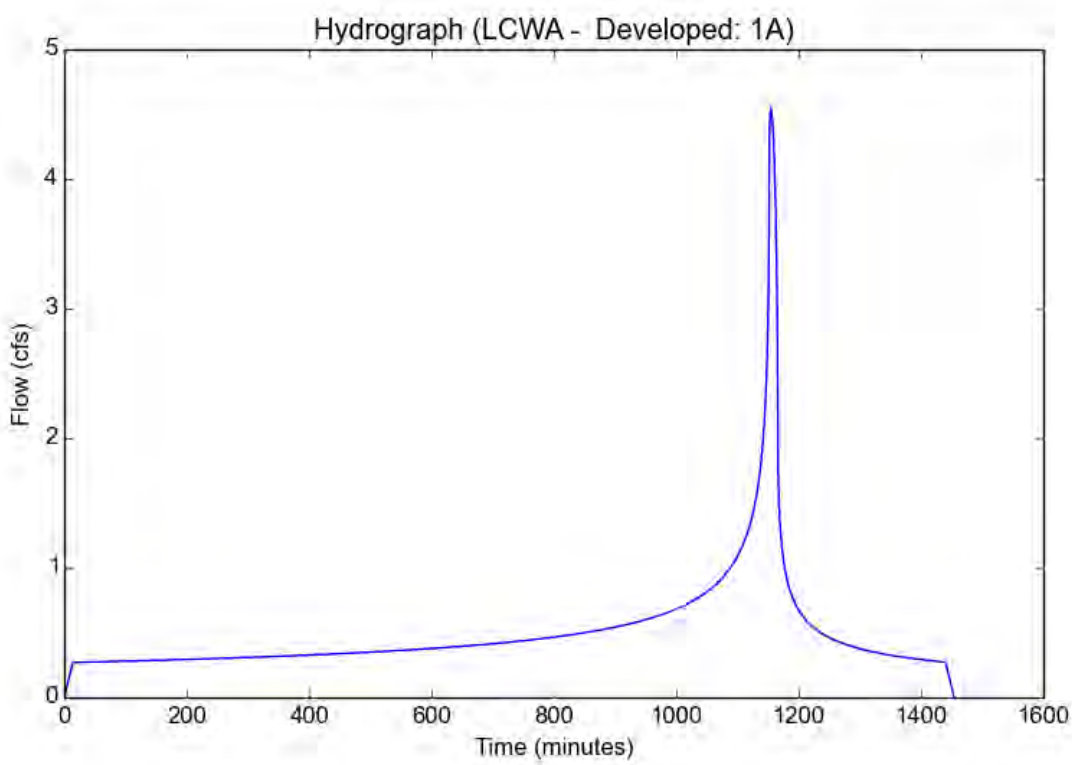
File location: S:/10159.01/drainage/Hydrology/HydroCalc/LCWA - Developed - 1A.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	LCWA - Developed
Subarea ID	1A
Area (ac)	3.06
Flow Path Length (ft)	571.0
Flow Path Slope (vft/hft)	0.001
50-yr Rainfall Depth (in)	4.8
Percent Impervious	0.91
Soil Type	15
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	4.8
Peak Intensity (in/hr)	1.7651
Undeveloped Runoff Coefficient (Cu)	0.2573
Developed Runoff Coefficient (Cd)	0.8422
Time of Concentration (min)	14.0
Clear Peak Flow Rate (cfs)	4.5488
Burned Peak Flow Rate (cfs)	4.5488
24-Hr Clear Runoff Volume (ac-ft)	1.0063
24-Hr Clear Runoff Volume (cu-ft)	43833.0459



Peak Flow Hydrologic Analysis

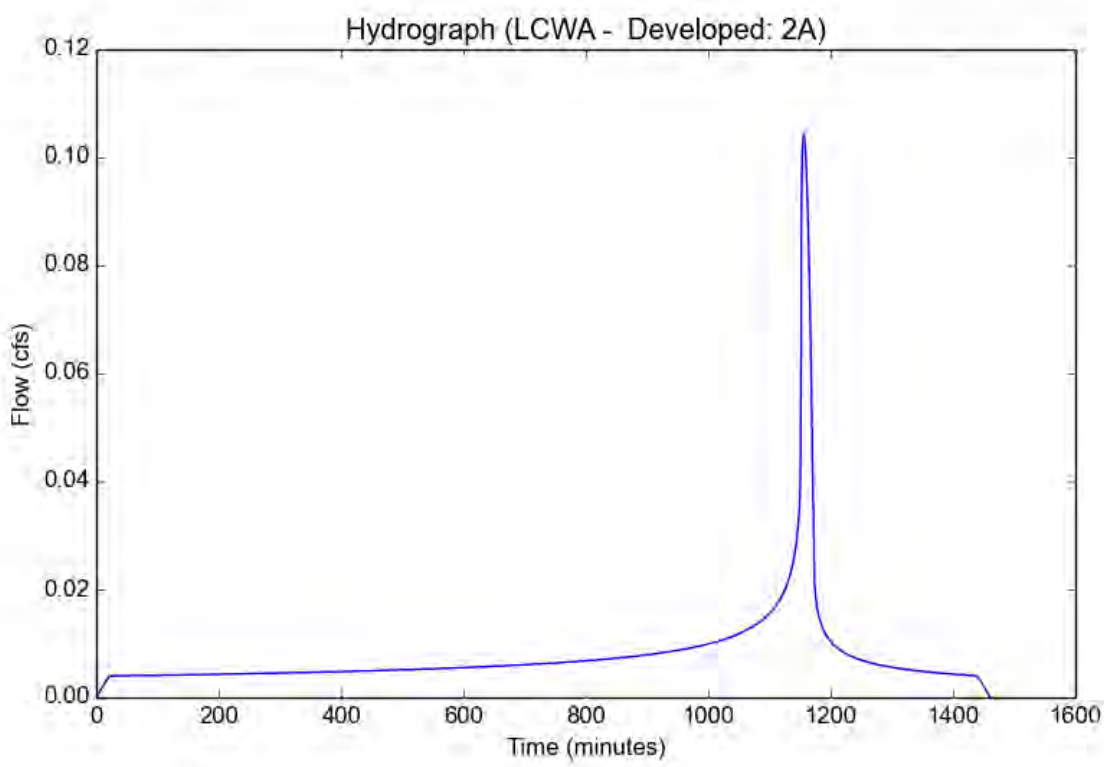
File location: S:/10159.01/drainage/Hydrology/HydroCalc/LCWA - Developed - 2A.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	LCWA - Developed
Subarea ID	2A
Area (ac)	0.32
Flow Path Length (ft)	271.0
Flow Path Slope (vft/hft)	0.001
50-yr Rainfall Depth (in)	4.8
Percent Impervious	0.02
Soil Type	15
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	4.8
Peak Intensity (in/hr)	1.4589
Undeveloped Runoff Coefficient (Cu)	0.2096
Developed Runoff Coefficient (Cd)	0.2234
Time of Concentration (min)	21.0
Clear Peak Flow Rate (cfs)	0.1043
Burned Peak Flow Rate (cfs)	0.1043
24-Hr Clear Runoff Volume (ac-ft)	0.0157
24-Hr Clear Runoff Volume (cu-ft)	682.9543



Peak Flow Hydrologic Analysis

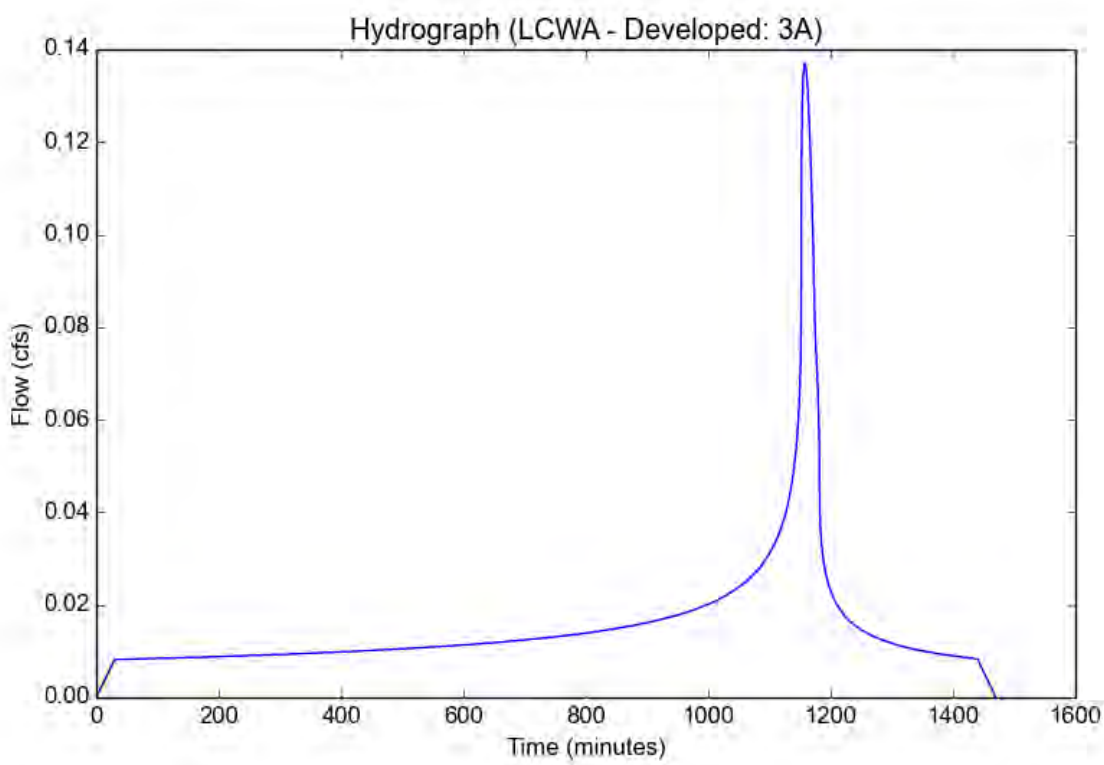
File location: S:/10159.01/drainage/Hydrology/HydroCalc/LCWA - Developed - 3A.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	LCWA - Developed
Subarea ID	3A
Area (ac)	0.66
Flow Path Length (ft)	545.0
Flow Path Slope (vft/hft)	0.003
50-yr Rainfall Depth (in)	4.8
Percent Impervious	0.02
Soil Type	15
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	4.8
Peak Intensity (in/hr)	1.2337
Undeveloped Runoff Coefficient (Cu)	0.1534
Developed Runoff Coefficient (Cd)	0.1683
Time of Concentration (min)	30.0
Clear Peak Flow Rate (cfs)	0.137
Burned Peak Flow Rate (cfs)	0.137
24-Hr Clear Runoff Volume (ac-ft)	0.0313
24-Hr Clear Runoff Volume (cu-ft)	1364.0918



Peak Flow Hydrologic Analysis

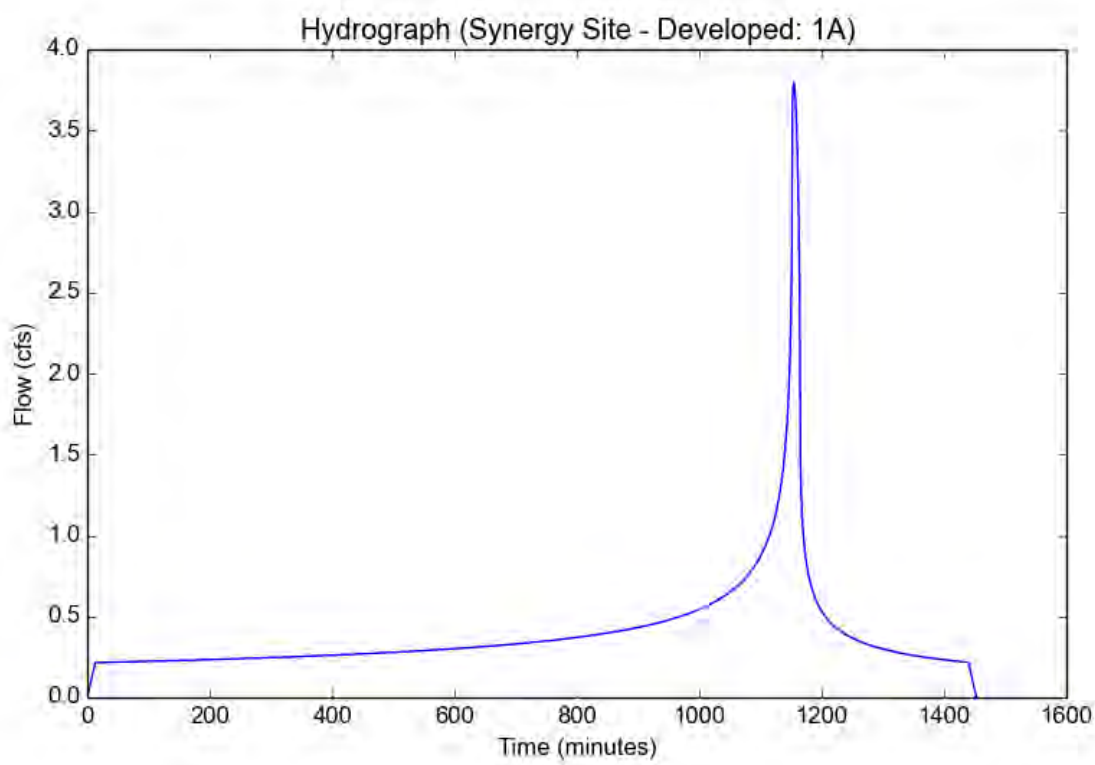
File location: S:/10159.01/drainage/Hydrology/HydroCalc/Synergy Site - Developed - 1A.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Synergy Site - Developed
Subarea ID	1A
Area (ac)	2.56
Flow Path Length (ft)	593.5
Flow Path Slope (vft/hft)	0.002
50-yr Rainfall Depth (in)	4.8
Percent Impervious	0.86
Soil Type	15
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	4.8
Peak Intensity (in/hr)	1.8277
Undeveloped Runoff Coefficient (Cu)	0.2661
Developed Runoff Coefficient (Cd)	0.8113
Time of Concentration (min)	13.0
Clear Peak Flow Rate (cfs)	3.7958
Burned Peak Flow Rate (cfs)	3.7958
24-Hr Clear Runoff Volume (ac-ft)	0.8018
24-Hr Clear Runoff Volume (cu-ft)	34927.4938



G2 Low Impact Development Plan

Low Impact Development Plan
(LID Plan)

Project Name:

Los Cerritos Wetlands Restoration and Oil Consolidation Project

"Pumpkin Patch" Site – 6701 East Pacific Coast Highway, Long Beach, CA 90803

Los Cerritos Wetlands Authority (LCWA) – Northeast corner of the intersection of Studebaker Road and Westminster Boulevard

Synergy Oil Field Site – 6433 East 2nd Street, Long Beach, CA 90803

City Marketplace Marsh – Located between 2nd Street to the north and the San Gabriel River to the south

Prepared for:

Beach Oil Minerals Partners

4901 Birch Street

Newport Beach, California 92660

949-252-9202

Prepared by:

Wilson Mikami Corporation

9 Corporate Park, Suite 100

Irvine, California, 92606

949-679-0090

PE Stamp & Sign Here

May 10, 2016
Revised October 3, 2016
Revised June 6, 2017

Project Owner's Certification

I certify under penalty of law that this document and all attachments were prepared under my jurisdiction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathered the information, to the best of my knowledge and belief, the information submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Owner's Name:			
Owner's Title:			
Company:			
Address:			
Email:			
Telephone No:			
Signature:		Date:	

Preparer (Engineer) Certification

Engineer's Name:	Scott Wilson		
Engineer's Title:	Principal		
Company:	Wilson Mikami Corporation		
Address:	9 Corporate Park, Suite 100, Irvine, CA 92606		
Email:	swilson@wilsonmikami.com		
Telephone No:	949-679-0092		
I hereby certify that this Low Impact Development Plan is in compliance with, and meets the requirements set forth in, Order No. R4-2012-0175, of the Los Angeles Regional Water Quality Control Board.			
Engineer's Signature		Date	
Place Stamp Here			

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1. PROJECT DESCRIPTION

1.1. PROJECT CATEGORY

Category	YES	NO
1. Development [a] of a new project equal to 1 acre or greater of disturbed area and adding more than 10,000 square feet of impervious area [b]	☒	☐
2. Development [a] of a new industrial park with 10,000 square feet or more of surface area [c]	☐	☒
3. Development [a] of a new commercial mall with 10,000 square feet or more surface area [c]	☐	☒
4. Development [a] of a new retail gasoline outlet with 5,000 square feet or more of surface area [c]	☐	☒
5. Development [a] of a new restaurant (SIC 5812) with 5,000 square feet or more of surface area [c]	☐	☒
6. Development [a] of a new parking lot with either 5,000 ft^2 or more of impervious area [b] or with 25 or more parking spaces	☒	☐
7. Development [a] of a new automotive service facility (SIC 5013, 5014, 5511, 5541, 7532-7534 and 7536-7539) with 5,000 square feet or more of surface area [c]	☐	☒
8. Projects located in or directly adjacent to, or discharging directly to a Significant Ecological Area (SEA),[d] where the development will: a. Discharge stormwater runoff that is likely to impact a sensitive biological species or habitat; and b. Create 2,500 square feet or more of impervious area [b]	☐	☒
9. Redevelopment [e] of 5,000 square feet or more in one of the categories listed above **If yes, list redevelopment category here:**	☐	☒
10. Redevelopment [e] of 10,000 square feet or more to a Single Family Home, without a change in landuse.	☐	☒

a Development includes any construction or demolition activity, clearing, grading, grubbing, or excavation or any other activity that results in land disturbance.

b Surfaces that do not allow stormwater runoff to percolate into the ground. Typical impervious surfaces include: concrete, asphalt, roofing materials, etc.

c The surface area is the total footprint of an area. Not to include the cumulative area above or below the ground surface.

d An area in which plant or animal life or their habitats are either rare or especially valuable because of their special nature or role in an ecosystem and would be disturbed or degraded by human activities and developments. Also, an area designated by the City as approved by the Regional Water Quality Control Board.

e Land-disturbing activities that result in the creation, addition, or replacement of a certain amount of impervious surface area on an already developed site. Redevelopment does not include routine maintenance activities that are conducted to maintain the original line and grade, hydraulic capacity, or original purpose of facility, nor does it include modifications to existing single family structures, or emergency construction activities required to immediately protect public health and safety.

1.2. PROJECT DESCRIPTION

Total Project Area (ft^2): 609,840

Total Project Area (Ac): 14.0

PUMPKIN PATCH SITE - EXISTING CONDITIONS

Condition	Area (ft^2)	Percentage (%)
Pervious Area:	209,993	100
Impervious Area:	0	0

PUMPKIN PATCH SITE - PROPOSED CONDITIONS

Condition	Area (ft^2)	Percentage (%)
Pervious Area:	19,409	9.0%
Impervious Area:	196,244	91.0%

LCWA SITE - EXISTING CONDITIONS

Condition	Area (ft^2)	Percentage (%)
Pervious Area:	176,960	100
Impervious Area:	0	0

LCWA SITE - PROPOSED CONDITIONS

Condition	Area (ft^2)	Percentage (%)
Pervious Area:	54,743	31%
Impervious Area:	121,314	69%

SYNERGY SITE VISITOR CENTER - EXISTING CONDITIONS

Condition	Area (ft^2)	Percentage (%)
Pervious Area:	64,803	58%
Impervious Area:	46,926	42%

SYNERGY SITE VISITOR CENTER- PROPOSED CONDITIONS

Condition	Area (ft^2)	Percentage (%)
Pervious Area:	15,642	14%
Impervious Area:	96,088	86%

SITE CHARACTERISTICS – PUMPKIN PATCH

DRAINAGE PATTERNS/CONNECTIONS	Existing: Existing drainage for the Pumpkin Patch site generally flows in a northerly direction towards Studebaker Road as surface sheet flow. There is one subarea, 1A, which is currently a vacant dirt lot. The area of Subarea 1A is approximately 209,993 SF.
	Proposed: Proposed drainage for the Pumpkin Patch site will flow towards proposed well cellars in the center of the site and will overflow to Studebaker Road. Flow will be conveyed through proposed swales, gutters, and storm drains. Low flow storm water runoff will be treated on-site through the well treatment process. The proposed site will be comprised of 196,244 SF of impervious area, and 19,409 SF of pervious area.
NARRATIVE PROJECT DESCRIPTION:	Currently, the Pumpkin Patch site sits as a vacant lot. Proposed land uses for the site include office space, 9,750 SF of storage/warehouse space, parking for 47 cars, up to 50 new oil production, water injection, and/or water source wells, a water treatment system, and two tanks for oil storage.

SITE CHARACTERISTICS – LCWA SITE

DRAINAGE PATTERNS/CONNECTIONS	Existing: There are three subareas for the LCWA Site. Existing drainage for the first subarea, A1, flows westerly and then northerly along an existing berm. Subarea A1 is currently a vacant dirt lot, and has an area of approximately 135,470 SF. Flow for the second subarea, 2A, flows south along Studebaker Road towards the intersection of Studebaker Road and Westminster Boulevard. Subarea 2A is currently vegetated, and has an area of approximately 14,840 SF. Flow for the third subarea 3A, flows west along Westminster Road towards the intersection of Studebaker Road and Westminster Boulevard. Subarea 3A is currently vegetated, and has an area approximately 26,650 SF.
	Proposed: Proposed drainage for the LCWA site can be considered in one composite area, with 121,314 SF impervious area and 54,743 SF of pervious area. Flow generally goes towards proposed well cellars in the center of the site and overflows to Studebaker Road. Flow will be conveyed through proposed swales, gutters, and storm drains. Low flow storm water runoff will be treated on-site through the well treatment process.

NARRATIVE PROJECT DESCRIPTION:	Currently, the LCWA site is on a temporary lease basis for equipment storage and staging. Proposed land use includes up to 70 new oil production, water injection, and/or water source wells, a28,000 barrel sales oil tank, a 5,000 barrell injection water tanks, a 15-20 foot high ground flare, natural gas powered turbines for onsite electrical power generation, and a water treatment system.

SITE CHARACTERISTICS – SYNERGY SITE AND VISITOR CENTER

DRAINAGE PATTERNS/CONNECTIONS	Existing: For the Visitor Center area, existing drainage generally flows in an easterly direction across the site as surface sheet flow. There is one subarea, 1A, which is currently a partially paved lot with existing buildings. The area of Subarea 1A is approximately 111,729 SF. The existing area for the visitor center site is 46,926 SF impervious area and 64,803 of pervious area. The Visitor Center is part of Synergy Oil Field Site, which consists of 154 acres of wetlands, oil wells, public trails, and an existing building.
	Proposed: For the Visitor Center area, proposed drainage will flow still flow in an easterly direction and will be conveyed to various proposed BMP facilities via surface sheet flow. Proposed conditions result in 96,088 SF of impervious area and 15,642 SF of pervious area. The remaining Synergy site will be a wetlands mitigation and restoration site with 37 oil wells being removed. The existing public trail will remain in place. No additional impervious areas are being added beside the Visitor Center.
NARRATIVE PROJECT DESCRIPTION:	Existing land use includes office space and oil storage. Proposed land use include a conversion of the exiting office space to a visitor's center and a restoration to preservation of wetlands.

OFFSITE RUNON	For all three sites, no offsite runon.
UTILITY AND INFRASTRUCTURE INFORMATION	Pumpkin Patch: Currently, there are not any existing utilities on site. Proposed utilities and infrastructure include oil facilities and wet/dry utilities to service the proposed office building. LCWA Site:

	Currently there are not any existing utilities on site. Proposed utilities and infrastructure include oil facilities and wet/dry utilities to service proposed building and trailers. Synergy Site Visitor Center: There are current oil facilities on site which will be relocated to the Pumpkin Patch site and LCWA Site. There are also wet/dry utilities that will remain on site to service the proposed visitor's center. The public trail system will remain on site.
SIGNIFICANT ECOLOGICAL AREAS (SEAs)	All three sites are not located in or directly adjacent to, or discharging directly to a SEA.

1.3. HYDROMODIFICATION ANALYSIS

DOES THE PROPOSED PROJECT FALL INTO ONE OF THE FOLLOWING CATEGORIES? CHECK YES/NO.	YES	NO
1. *Project is a redevelopment that decreases the effective impervious area compared to the pre-project conditions.*	☐	☒
Describe:		
2. *Project is a redevelopment that increases the infiltration capacity of pervious areas compared to the pre-project conditions.*	☒	☐
Describe: The Pumpkin Patch and LCWA Sites drain to the well process systems. Storm water up to a 25-year storm is reused within the well process system. This process increases infiltration capacity compared to the pre-project condition. The Synergy site drainage plan increases infiltration capacity compared to the pre-project condition through detention and discharges to Second Street.		
3. *Project discharges directly or via a storm drain to a sump, lake, area under tidal influence, into a waterway that has a 100-year peak flow (Q_{100}) of 25,000 cfs or more.*	☐	☒
Describe:		
4. *Project discharges directly or via a storm drain into concrete or otherwise engineered (not natural) channels (e.g., channelized or armored with rip rap, shotcrete, etc.), which, in turn, discharge into receiving water that is not susceptible to hydromodification impacts.*	☐	☒
Describe:		

HYDROMODIFICATION ANALYSIS

This project is exempt from Hydromodification Control Measure.

1.4. PROPERTY OWNERSHIP/MANAGEMENT

	The Pumpkin Patch site is currently owned by Beach Oil Minerals Partners, the LCWA site is currently owned by the Los Cerritos Water Authority, and the Synergy site is currently owned by Beach Oil Minerals Partners.

2. BEST MANAGEMENT PRACTICES (BMPS)

2.1. SITE DESIGN

85TH PERCENTILE, 24-HOUR STORM DEPTH	The LCWA Site and Synergy Site are 0.5 inches, and the Pumpkin Patch is 0.4 inches, based on the Los Angeles County 85th percentile precipitation isohyetal map, so the 0.75 inch storm will be used throughout.
SITE DESIGN	Pumpkin Patch: Flow will be conveyed through proposed swales, gutters, and storm drains and will flow towards well cellars in the middle of the site. 25-year frequency and larger storm flows will overflow from the well cellars to Studebaker Street. LCWA: Flow will be conveyed through proposed swales, gutters, and storm drains and will flow towards well cellars in the middle of the site. 25-year frequency and larger storm flows will overflow from the well cellars to Studebaker Street. Synergy Site Visitor Center: Proposed drainage will flow still flow in an easterly direction and will be conveyed to various proposed bioretention basins via surface sheet flow.

BMP LIST

DMA DESIGNATION	SQUARE FOOTAGE (SF)	ACREAGE (AC)	STORM WATER QUALITY DESIGN VOLUME (SWQDV, CF)	BMP TYPE	MINIMUM BMP SIZE	BMP SIZE PROVIDED	GPS COORDINATES
A	215,653	4.95	11,100	Propriety	7400 cf	7600 cf	33°45’37.23” N 118°06’10.04” W
B1 B2 B3	133,369 13,939 28,750	3.06 0.32 0.66	7,200	Propriety	4800 cf	7400 cf	33°45’37.23” N 118°06’10.04” W
C	111,730	2.56	5450	Bioretention	3633 cf	5500 cf	33°45’13.90” N 118°06’21.39” W

2.2. BMP SELECTION

2.2.1. INFILTRATION BMPS

NAME	INCLUDED
Bioretention without underdrains	☒
Infiltration Trench	☐
Infiltration Basin	☐
Drywell	☐
Proprietary Subsurface Infiltration Gallery	☒
Permeable Pavement (concrete, asphalt, pavers)	☐
Other:	☐
Other:	☐

DESCRIPTION	For the LCWA Site and the Pumpkin Patch Site, propriety treatment control measures will be used to treat the Storm Water Quality Design Volume. Bioretention basins are proposed to be used for the Synergy Site.
CALCULATIONS	See Attachment A for Storm Water Quality Design Volume (SWQDv) calculations.

2.2.2. RAINWATER HARVEST AND USE BMPS

NAME	INCLUDED
Above-ground cisterns and basins	☐
Underground detention	☒
Other: Propriety Treatment Control Measures	☒
Other:	☐
Other:	☐

DESCRIPTION	The LCWA and Pumpkin Patch Site will utilize well cellars and propriety treatment control measures to completely store and treat the Storm Water Quality Design Volume.
CALCULATIONS	N/A

2.2.3. ALTERNATIVE COMPLIANCE BMPS

BIOFILTRATION BMPS
(If Infiltration BMPs and Rainwater Harvest and Use BMPs are Infeasible)

NAME	INCLUDED
Bioretention with underdrains (i.e. planter box, rain garden, etc.)	☐
Constructed Wetland	☐
Vegetated Swale	☐
Vegetated Filter Strip	☐
Tree-Well Filter	☐
Other:	☐
Other:	☐

DESCRIPTION	N/A
CALCULATIONS	N/A

OFFSITE BMPS

(If Infiltration BMPs, Rainwater Harvest and Use BMPs, and Biofiltration BMPs are Infeasible)

NAME	INCLUDED
Offsite Infiltration	☐
Ground Water Replenishment Projects	☐
Offsite Project - Retrofit Existing Development	☐
Regional Storm Water Mitigation Program	☐
Other:	☐
Other:	☐

DESCRIPTION	N/A
CALCULATIONS	N/A

2.2.4. TREATMENT CONTROL BMPS

NAME	INCLUDED
Media Filter	☐
Filter Insert	☐
CDS Unit	☐
Other:	☐
Other:	☐

DESCRIPTION	N/A

2.2.5. HYDROMODIFICATION CONTROL BMPS

NAME	INCLUDED
Infiltration System	☐
Above-ground Cistern	☐
Above-ground Basin	☐
Underground Detention	☐
Other:	☐
Other:	☐

DESCRIPTION	N/A
CALCULATIONS	N/A

2.2.6. NON-STRUCTURAL SOURCE CONTROL BMPS

NAME	CHECK ONE	
	Included	**Not Applicable**
Education for Property Owners, Tenants and Occupants	☒	☐
Activity Restrictions	☒	☐
Common Area Landscape Management	☒	☐
Common Area Litter Control	☒	☐
Housekeeping of Loading Docks	☐	☒
Common Area Catch Basin Inspection	☒	☐
Street Sweeping Private Streets and Parking Lots	☒	☐

2.2.7. STRUCTURAL SOURCE CONTROL BMPS

NAME	CHECK ONE	
	Included	**Not Applicable**
Provide storm drain system stenciling and signage	☒	☐
Design and construct outdoor material storage areas to reduce pollution introduction	☒	☐
Design and construct trash and waste storage areas to reduce pollution introduction	☒	☐
Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	☒	☐
Protect slopes and channels and provide energy dissipation	☒	☐
Loading docks	☐	☒
Maintenance bays	☐	☒
Vehicle wash areas	☒	☐
Outdoor processing areas	☐	☒
Equipment wash areas/racks	☒	☐
Fueling areas	☒	☐
Hillside landscaping	☐	☒

Attachment A

Calculations

Peak Flow Hydrologic Analysis

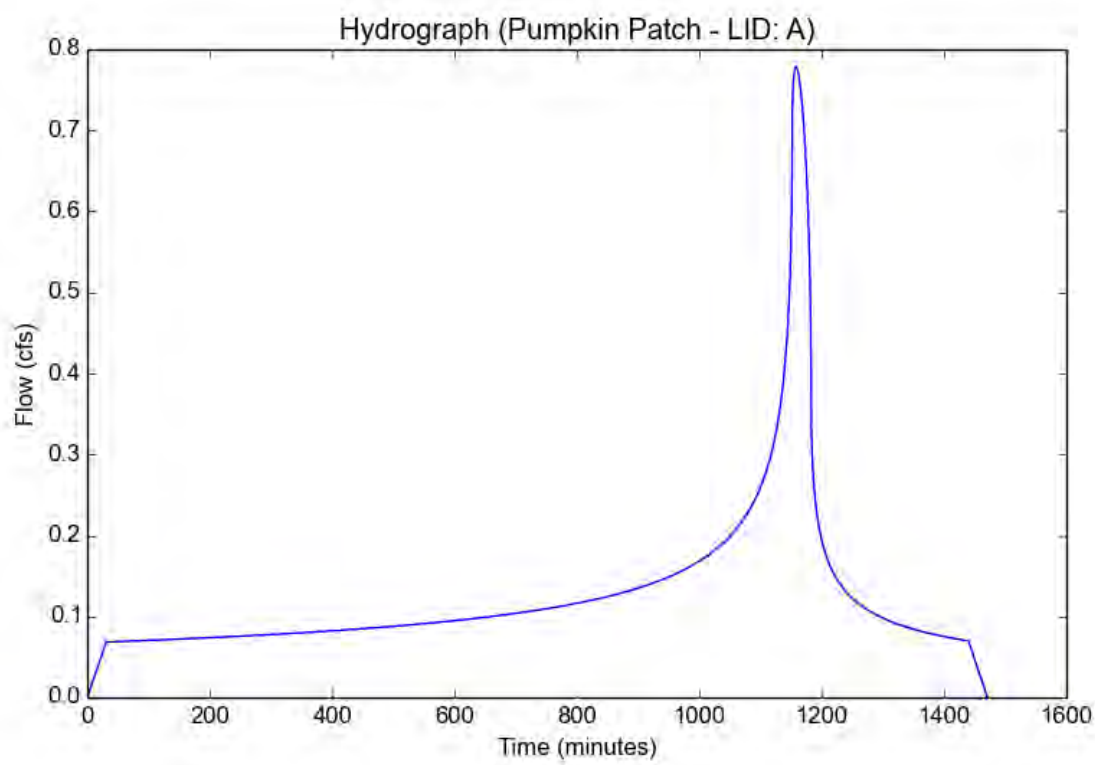
File location: S:/10159.01/drainage/LID/Pumpkin Patch - LID - A.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Pumpkin Patch - LID
Subarea ID	A
Area (ac)	4.95
Flow Path Length (ft)	536.0
Flow Path Slope (vft/hft)	0.011
0.75-inch Rainfall Depth (in)	0.75
Percent Impervious	0.91
Soil Type	15
Design Storm Frequency	0.75 inch storm
Fire Factor	0
LID	True

Output Results

Modeled (0.75 inch storm) Rainfall Depth (in)	0.75
Peak Intensity (in/hr)	0.1898
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.828
Time of Concentration (min)	31.0
Clear Peak Flow Rate (cfs)	0.778
Burned Peak Flow Rate (cfs)	0.778
24-Hr Clear Runoff Volume (ac-ft)	0.254
24-Hr Clear Runoff Volume (cu-ft)	11066.3558



Stormwater Quality Design Volume (SWQDv) – Pumpkin Patch

The following steps are used to calculate the SWCDv for the Pumpkin Patch Site:

Step 1: Calculate the design volume

BMP's should be sized to capture and treat the SWQDv (see Section 6 for SWQDv calculation procedures).

$$SWQD_v = 11{,}100\ ft^3$$

Peak Flow Hydrologic Analysis

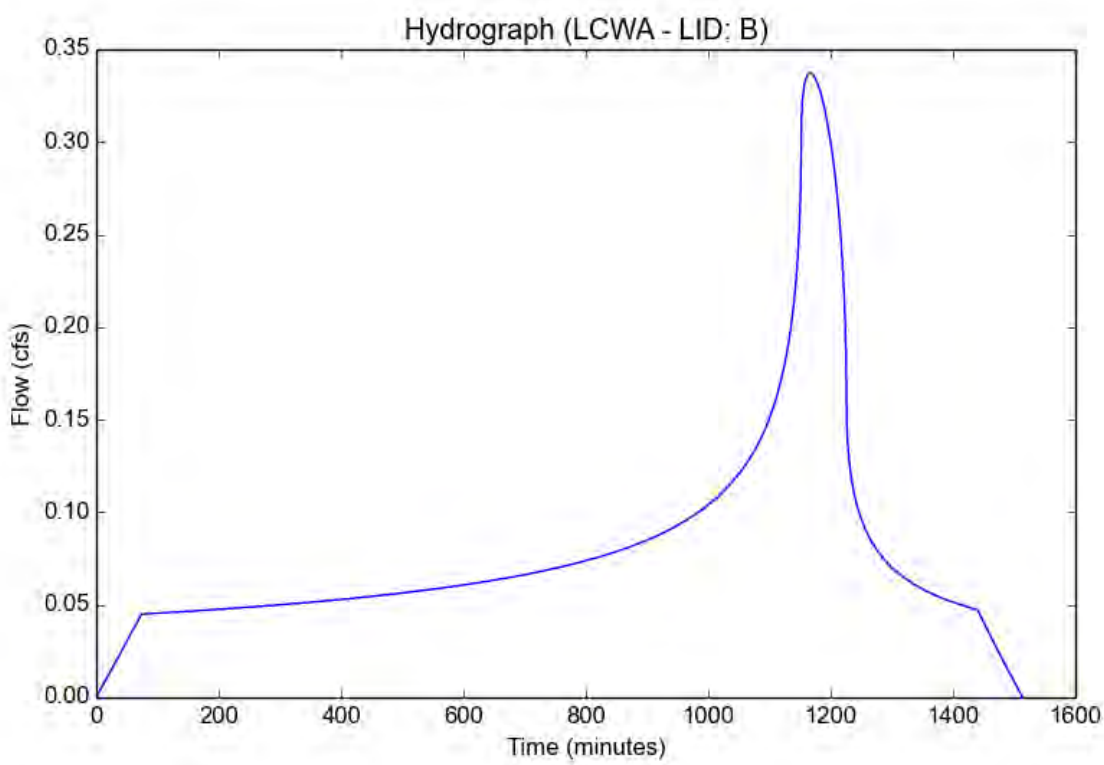
File location: S:/10159.01/drainage/LID/LCWA - LID - B.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	LCWA - LID
Subarea ID	B
Area (ac)	4.04
Flow Path Length (ft)	841.0
Flow Path Slope (vft/hft)	0.001
0.75-inch Rainfall Depth (in)	0.75
Percent Impervious	0.702
Soil Type	15
Design Storm Frequency	0.75 inch storm
Fire Factor	0
LID	True

Output Results

Modeled (0.75 inch storm) Rainfall Depth (in)	0.75
Peak Intensity (in/hr)	0.1261
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.6616
Time of Concentration (min)	74.0
Clear Peak Flow Rate (cfs)	0.3371
Burned Peak Flow Rate (cfs)	0.3371
24-Hr Clear Runoff Volume (ac-ft)	0.1657
24-Hr Clear Runoff Volume (cu-ft)	7217.2518



Stormwater Quality Design Volume (SWQDv) – LCWA Site

The following steps are used to calculate the SWCDv for the LCWA Site:

Step 1: Calculate the design volume

BMP's should be sized to capture and treat the SWQDv (see Section 6 for SWQDv calculation procedures).

$$SWQD_v = 7{,}200\ ft^3$$

Peak Flow Hydrologic Analysis

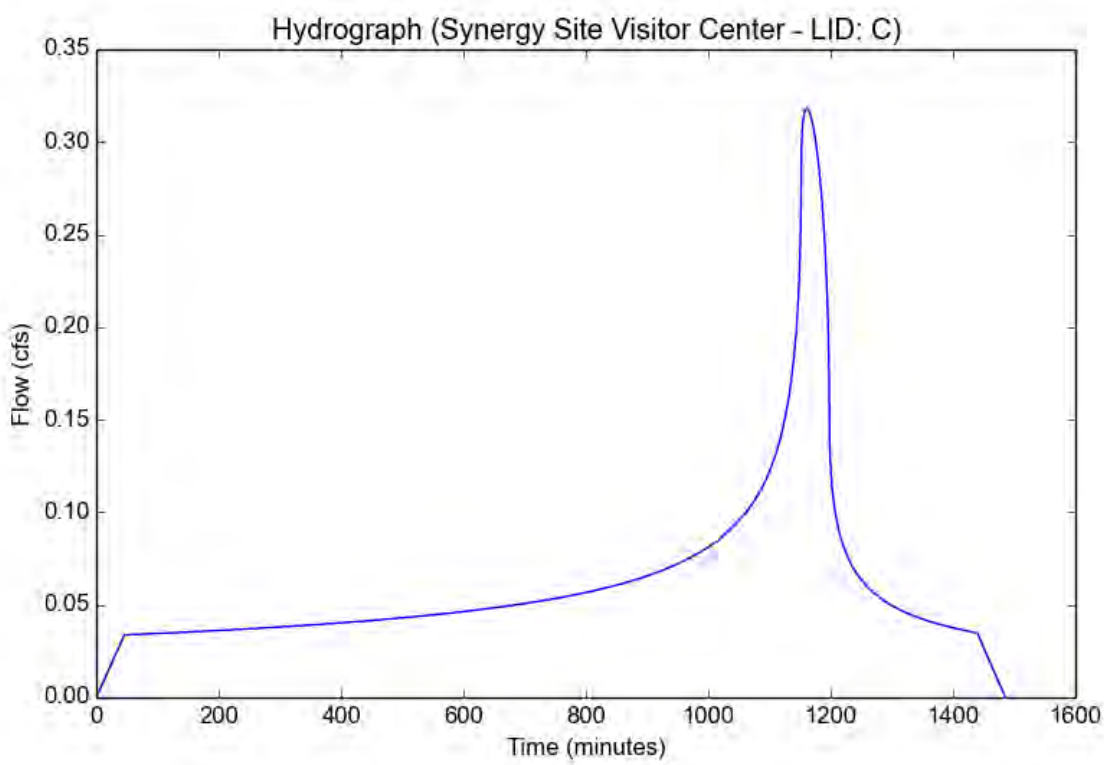
File location: S:/10159.01/drainage/LID/Synergy Site Visitor Center - LID - C.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Synergy Site Visitor Center - LID
Subarea ID	C
Area (ac)	2.56
Flow Path Length (ft)	593.5
Flow Path Slope (vft/hft)	0.002
0.75-inch Rainfall Depth (in)	0.75
Percent Impervious	0.86
Soil Type	15
Design Storm Frequency	0.75 inch storm
Fire Factor	0
LID	True

Output Results

Modeled (0.75 inch storm) Rainfall Depth (in)	0.75
Peak Intensity (in/hr)	0.1577
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.788
Time of Concentration (min)	46.0
Clear Peak Flow Rate (cfs)	0.3181
Burned Peak Flow Rate (cfs)	0.3181
24-Hr Clear Runoff Volume (ac-ft)	0.125
24-Hr Clear Runoff Volume (cu-ft)	5446.8046



Bioretention BASIN DESIGN – Synergy Site

The following steps are used to design a bioretention basin for the Synergy Site:

Step 1: Calculate the design volume

Bioretention areas should be sized to capture and treat the SWQDv (see Section 6 for SWQDv calculation procedures).

$$SWQD_v = 5{,}450\ ft^3$$

Step 2: Calculate the design infiltration rate

Determine the corrected in-situ infiltration rate (f_{design}) of the native soil using the procedures described in the most recent GMED Policy GS 200.1

Use f_{design} = 2.5 in/hr

Step 3: Calculate the bioretention area

Select a surface ponding depth (d) that satisfies the geometric criteria and meets the site constraints. Selecting a deeper ponding depth (up to 1.5 ft) generally yields a smaller footprint, however, it will require greater consideration for public safety, energy dissipation, and plant selection.

Calculate the time for the selected ponding depth to filter through the planting media using the following equation:

$$d_{max} = t_p \text{ x } \frac{\mathrm{f_{design}}}{12}$$

Where:

D_{max} = Ponding depth (max 1.5 ft) [ft];
t_p = Required detention time for surface ponding (max 96 hr) [hr]; and
f_{design} = Design infiltration rate [in/hr].

Use d = 1.5 ft.

$$t_p = \frac{\mathrm{d \text{ x } 12}}{\mathrm{f_{design}}} = \frac{1.5\ x\ 12}{2.5}$$

t_p = 7.2 hr < 96 hr.

Calculate the required infiltrating surface (bottom of the bioretention area) using the following equation:

$$A = \frac{SWQD_v}{d}$$

Where:

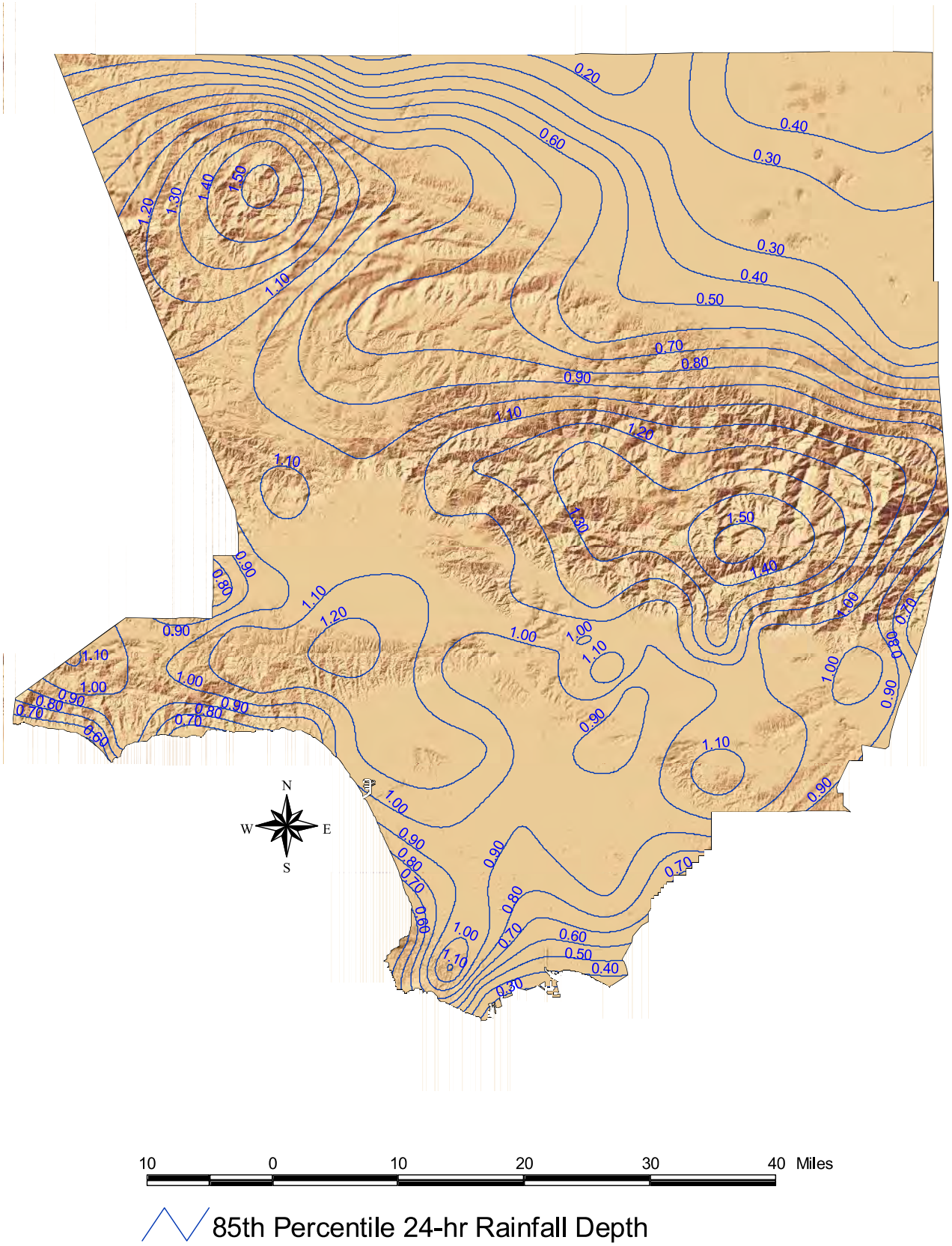
A = Bottom surface area of infiltration area [ft^2];
SWQDv = Storm Water Quyality design volume [ft^3]; and
d = Ponding depth (max 1.5 ft.) [ft].

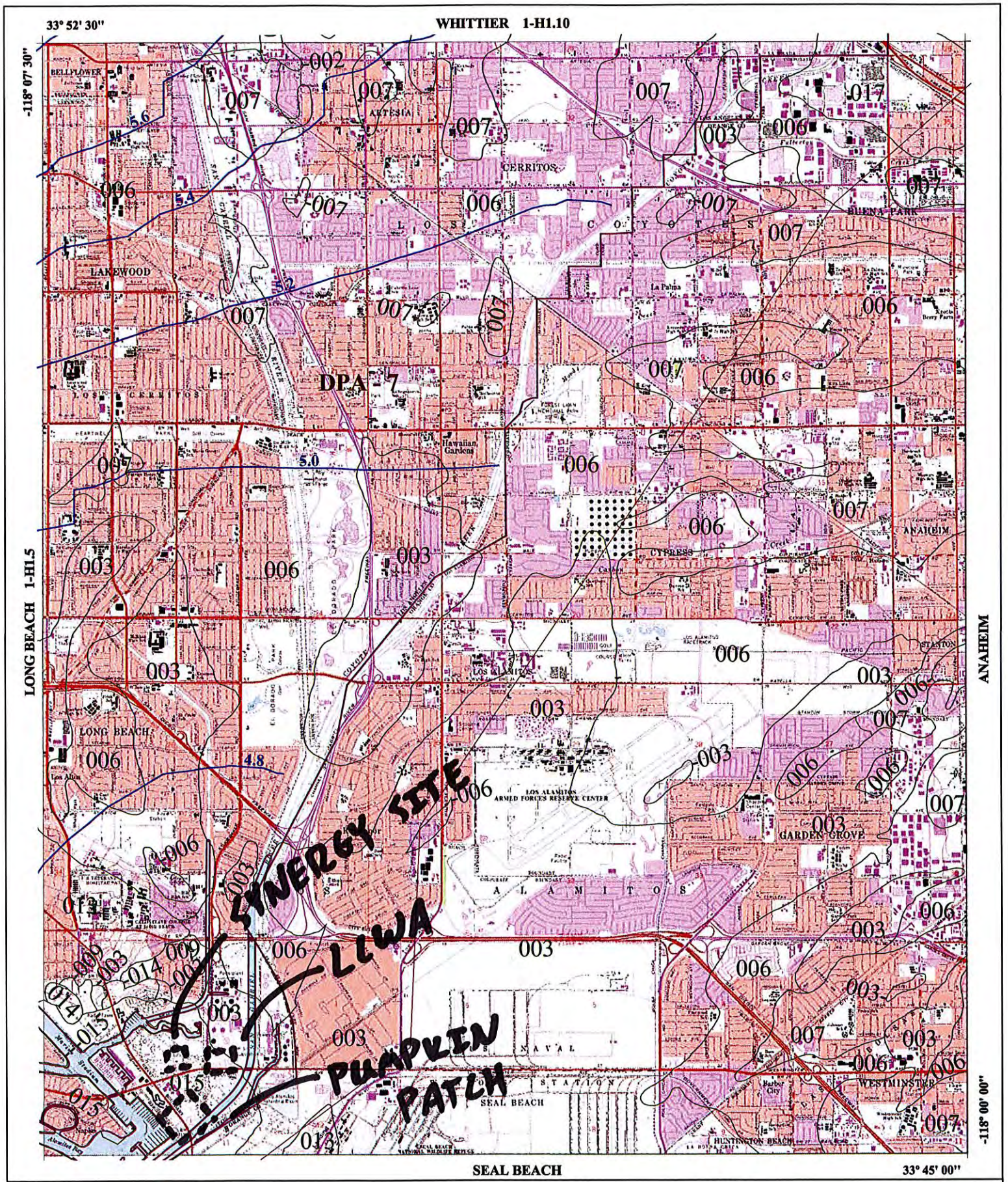
$$A = \frac{5450}{1.5}$$

A = 3633 sq. ft.

The project provided 5500 square feet of surface area.

85th Percentile 24-hr Rainfall Isohyetal Map





016 SOIL CLASSIFICATION AREA

7.2 INCHES OF RAINFALL

DPA - 6 DEBRIS POTENTIAL AREA

1 0 1 2 Miles

25-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.878
10-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.714

LOS ALAMITOS
50-YEAR 24-HOUR ISOHYET

1-H1.6

LOS ANGELES COUNTY PUBLIC WORKS Public Service That Works

RET-1: Bioretention

Description

A bioretention area is a vegetated shallow depression that is designed to receive, retain, and infiltrate stormwater runoff from downspouts, piped inlets, or sheet flow from adjoining paved areas. A shallow ponding zone is provided above the vegetated surface for temporary storage of stormwater runoff. During storm events, stormwater runoff accumulates in the ponding zone and gradually infiltrates and filters through the bioretention soil media before infiltrating the underlying soil.

Stormwater runoff treatment occurs through a variety of natural mechanisms as stormwater runoff filters through the vegetated root zone. A portion of the water held in the root zone of the soil media is returned to the atmosphere through transpiration by the plants. Bioretention areas are typically planted with native, drought-tolerant plant species (i.e., wildflowers, sedges, rushes, ferns, shrubs, small trees) that do not require fertilization and can withstand wet soils for at least 24 hours.

A schematic of a typical bioretention area is presented in Figure E-1.

LID Ordinance Requirements

Bioretention can be used to meet the on-site retention requirement of the LID Ordinance. Bioretention will prevent pollutants in the SWQDv from being discharged off-site.

Advantages

- Provides shade and windbreaks
- Enhances site aesthetics
- Retains stormwater runoff and eliminates pollutant discharge
- May conserve water

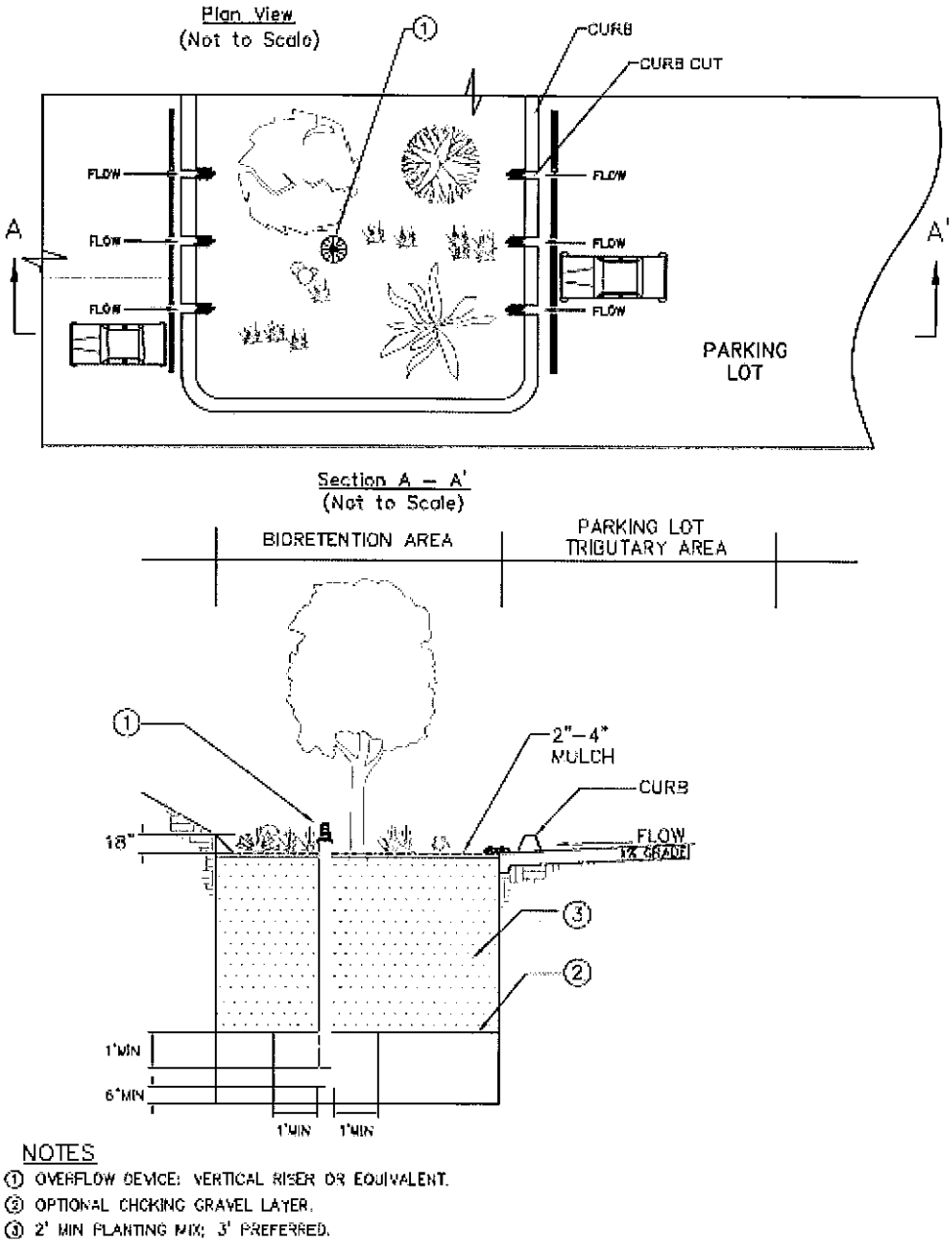


Figure E-1. Bioretention Area Schematic

Disadvantages

- May not be appropriate for industrial sites or locations with contaminated soils or where spills may occur because of the potential threat to groundwater contamination
- Is not suitable for areas with a shallow groundwater table or unstable surface stratum, including steep (greater than 20 percent) or unstable slopes
- May result in standing water, which may allow vector breeding

General Constraints and Implementation Considerations

- Bioretention areas can be applied in various settings, including, but not limited to:
    - Individual lots for rooftop, driveway, and other on-lot impervious surface
    - Shared facilities located in common areas for individual lots
    - Areas within loop roads or cul-de-sacs
    - Landscaped parking lot islands
    - Within right-of-ways along roads
    - Common landscaped areas in apartment complexes or other multi-family housing designs
    - Parks and along open space perimeters
- If tire curbs are provided and parking stalls are shortened, cars may overhang the bioretention area.
- Bioretention areas must be located sufficiently far from structure foundations to avoid damage to structures (as determined by a certified structural or geotechnical engineer).
- Any parking areas bordering the bioretention area must be monolithically poured concrete or deepended curb concrete to provide structural stability to the adjacent parking section.
- The overflow device must drain away from building foundations to the storm drain system or another suitable infiltration area.
- Bioretention areas cannot be located on sites with a slope greater than 20 percent (5:1).
- The project site must be graded to minimize erosion as stormwater runoff enters the bioretention area by creating sheet flow conditions rather than a concentrated stream condition or by providing energy dissipation devices at the inlet.
- The general landscape irrigation system should incorporate the bioretention area, as applicable. Sediment controls (i.e., silt fences) can be used around the bioretention area to prevent high sediment loads from entering the area during construction activities.

- During construction, activities should avoid compaction of native soils below planting media layer or gravel zone.
- Stormwater runoff must be diverted around the bioretention area during the period of vegetation establishment. If diversion is not feasible, the graded and seeded areas must be protected with suitable sediment controls (i.e., silt fences).

Design Specifications

The following sections describe the design specifications for bioretention areas.

Geotechnical

Due to the potential to contaminate groundwater, cause slope instability, impact surrounding structures, and potential for insufficient infiltration capacity, an extensive geotechnical site investigation must be conducted during the site planning process to verify site suitability for bioretention. All geotechnical investigations must be performed according to the most recent Geotechnical and Materials Engineering Division (GMED) Policy GS 200.1. Soil infiltration rates and the groundwater table depth must be evaluated to ensure that conditions are satisfactory for proper operation of a bioretention area. The project applicant must demonstrate through infiltration testing, soil logs, and the written opinion of a licensed civil engineer that sufficiently permeable soils exist on-site to allow the construction of a properly functioning bioretention system.

Bioretention is appropriate for soils with a minimum corrected in-situ infiltration rate of 0.3 in/hr. The geotechnical report must determine if the proposed project site is suitable for a bioretention area and must recommend a design infiltration rate (see "Design Infiltration Rate" under the "Sizing" section). The geotechnical investigation should be such that a good understanding is gained as to how the stormwater runoff will move through the soil (horizontally or vertically) and if there are any geological conditions that could inhibit the movement of water.

Pretreatment

Pretreatment is important for all structural stormwater quality control measures, but it is particularly important for retention facilities. Pretreatment refers to design features that provide settling of large particles before stormwater runoff enters a stormwater quality control measure in order to reduce the long-term maintenance burden. Pretreatment should be provided to reduce the sediment load entering a bioretention area in order to maintain the infiltration rate of the bioretention area. To ensure that bioretention areas are effective, the project applicant must incorporate pretreatment devices that provide sediment reduction (e.g., vegetated swales, vegetated filter strips, sedimentation manholes, and proprietary devices). The use of at least two pretreatment devices is highly recommended for bioretention areas.

Setbacks

Bioretention areas must be sited following the setbacks from the most recent GMED Policy GS 200.1.

Geometry

- Bioretention areas must be sized to capture and retain the SWQDv with an 18-inch maximum ponding depth.
- The planting soil depth must be a minimum of two feet, but three feet is preferred. The planting soil depth should provide a beneficial root zone for the chosen vegetation and adequate storage for the SWQDv.

Sizing

Bioretention areas are sized using a simple sizing method where the SWQDV must be completely infiltrated within 96 hours. Bioretention areas provide stormwater runoff storage above ground.

Step 1: Determine the SWQDv

Bioretention areas must be designed to capture and retain the SWQDv (see Section 6 for SWQDv calculation procedures).

Step 2: Determine the design infiltration rate

Determine the corrected in-situ infiltration rate (f_{design}) of the native soil using the procedures described in the most recent GMED Policy GS 200.1.

Step 3: Calculate the bioretention area

Determine the required size of the bioretention area by assuming the SWQDv will fill the available ponding depth. The maximum depth of stormwater runoff that can be infiltrated within the maximum retention time (96 hrs) is calculated using the following equation:

$$d_{max} = \frac{f_{design}}{12} \times t$$

Where:

d_{max} = Maximum depth of water that can be infiltrated within the required drawdown time [ft];
f_{design} = Design infiltration rate [in/hr]; and
t = Maximum detention time (max 96 hrs) [hr].

Select the ponding depth (d_p) such that:

$$d_{max} \geq d_p$$

Where:

d_{max} = Maximum depth of water that can be infiltrated within the maximum retention time [ft]; and
d_p = Ponding depth (max 1.5 ft) [ft].

Calculate the infiltrating surface area (bottom of the bioretention area) required:

$$A = \frac{SWQDv}{d_p}$$

Where:
A = Surface area of the bottom of the infiltration basin [ft^2];
SWQDv = Stormwater quality design volume [ft^3]; and
d_p = Ponding depth [ft].

Flow Entrance and Energy Dissipation

Maintain a minimum slope of 1 percent for pervious surfaces and 0.5 percent for impervious surfaces to the bioretention area inlet. The following types of flow entrances can be used for bioretention areas:

- Level spreaders (i.e., slotted curbs) can be used to facilitate sheet flow.
- Dispersed low velocity flow across a landscape area. Dispersed flow may not be possible given space limitations or if the bioretention area is controlling roadway or parking lot flows where curbs are mandatory.
- Dispersed flow across pavement or gravel and past wheel stops for parking areas.
- Flow spreading trench around perimeter of bioretention area. May be filled with pea gravel or vegetated with 3:1 side slopes similar to a swale. A vertical-walled open trench may also be used at the discretion of the Los Angeles County Department of Public Works (LACDPW).
- Curb cuts for roadside or parking lot areas, if approved by LACDPW: curb cuts should include rock or other erosion controls in the channel entrance to dissipate energy. Flow entrance should drop two to three inches from curb line and provide an area for settling and periodic removal of sediment and coarse material before flow disperses to the remainder of the bioretention area.
- Piped entrances, such as roof downspouts, should include rock, splash blocks, or other erosion controls at the entrance to dissipate energy and disperse flows.

- Woody plants (i.e., trees, shrubs) can restrict or concentrate flows and can be damaged by erosion around the root ball and must not be placed directly in the entrance flow path.

Drainage

Bioretention areas must completely drain within 96 hours. Soils must be allowed to dry out periodically in order to restore hydraulic capacity to receive stormwater runoff from subsequent storm events, maintain infiltration rates, maintain adequate soil oxygen levels for healthy soil biota and vegetation, and provide proper soil conditions for biodegradation and retention of pollutants.

Hydraulic Restriction Layer

Lateral infiltration pathways may need to be restricted due to the close proximity of roads, foundations, or other infrastructure. A geomembrane liner, or other equivalent waterproofing, may be placed along the vertical walls to reduce lateral flows. The geomembrane liner must have a minimum thickness of 30 mils and meet the requirements of Table E-1. Generally, waterproof barriers must not be placed at the bottom of the bioretention area as it would prevent incidental infiltration which is important to meeting the required on-site retention requirement.

Table E-1. Geomembrane Liner Specifications for Bioretention Areas

Parameter	Test Method	Specifications
Material		Non-woven geomembrane liner
Unit weight		8 oz/yd^3 (minimum)
Filtration rate		0.08 in/sec (minimum)
Puncture strength	ASTM D-751 (Modified)	125 lbs (minimum)
Mullen burst strength	ASTM D-751	400 lb/in^2 (minimum)
Tensile strength	AST D-1682	300 lbs (minimum)
Equiv. opening size	US Standard Sieve	No. 80 (minimum)

Vegetation

Prior to installation, a licensed landscape architect must certify that all plants, unless otherwise specifically permitted, conform to the standards of the current edition of American Standard for Nursery Stock as approved by the American Standards Institute, Inc. All plant grades shall be those established in the current edition of American Standards for Nursery Stock.

- Shade trees must have a single main trunk. Trunks must be free of branches below the following heights:

CALIPER (in)	Height (ft)
1½-2½	5
3	6

- Plants must be tolerant of summer drought, ponding fluctuations, and saturated soil conditions for 96 hours.
- It is recommended that a minimum of three types of tree, shrubs, and/or herbaceous groundcover species be incorporated to protect against facility failure due to disease and insect infestations of a single species.
- Native plant species and/or hardy cultivars that are not invasive and do not require chemical inputs must be used to the maximum extent practicable.

The bioretention area should be vegetated to resemble a terrestrial forest community ecosystem, which is dominated by understory trees, a shrub layer, and herbaceous ground cover. Select vegetation that:

- Will be dense and strong enough to stay upright, even in flowing water;
- Has minimum need for fertilizers;
- Is not prone to pests and is consistent with Integrated Pest Management practices;
- Will withstand being inundated for periods of time; and
- Is consistent with local water conservation ordinance requirements.

Irrigation System

Provide an irrigation system to maintain viability of vegetation, if applicable. The irrigation system must be designed to local code or ordinance specifications.

Restricted Construction Materials

Use of pressure-treated wood or galvanized metal at or around a bioretention area is prohibited.

Overflow Device

An overflow device is required at the 18-inch ponding depth. The following, or equivalent, should be provided:

- A vertical PVC pipe (SDR 26) to act as an overflow riser.
- The overflow riser(s) should be eight inches or greater in diameter, so it can be cleaned without damage to the pipe.
- The inlet to the riser should be at the ponding depth (18 inches for fenced bioretention areas and 6 inches for areas that are not fenced), and be capped

with a spider cap to exclude floating mulch and debris. Spider caps should be screwed in or glued (e.g., not removable). The overflow device should convey stormwater runoff in excess of the SWQDv to an approved discharge location (e.g., another stormwater quality control measure, storm drain system, or receiving water).

Maintenance Requirements

Maintenance and regular inspections are important for proper function of bioretention areas. Bioretention areas require annual plant, soil, and mulch layer maintenance to ensure optimal infiltration, storage, and pollutant removal capabilities. In general, bioretention maintenance requirements are typical landscape care procedures, which include:

- Irrigate plants as needed during prolonged dry periods. In general, plants should be selected to be drought-tolerant and not require irrigation after establishment (two to three years).
- Inspect flow entrances, ponding area, and surface overflow areas periodically, and replace soil, plant material, and/or mulch layer in areas if erosion has occurred. Properly-designed facilities with appropriate flow velocities should not cause erosion except potentially during in extreme events. If erosion occurs, the flow velocities and gradients within the bioretention area and energy dissipation and erosion protection strategies in the pretreatment area and flow entrance should be reassessed. If sediment is deposited in the bioretention area, identify the source of the sediment within the tributary area, stabilize the source, and remove excess surface deposits.
- Prune and remove dead plant material as needed. Replace all dead plants, and if specific plants have a high mortality rate, assess the cause and, if necessary, replace with more appropriate species.
- Remove weeds as needed until plants are established. Weed removal should become less frequent if the appropriate plant species are used and planting density is attained.
- Select the proper soil mix and plants for optimal fertility, plant establishment, and growth to preclude the use of nutrient and pesticide supplements. By design, bioretention facilities are located in areas where phosphorous and nitrogen levels are often elevated such that these should not be limiting nutrients. Addition of nutrients and pesticides may contribute pollutant loads to receiving waters.
- In areas where heavy metals deposition is likely (i.e., tributary areas to industrial, vehicle dealerships/repair, parking lots, roads), replace mulch annually. In areas where metals deposition is less likely (i.e., residential lots), replace or add mulch as needed to maintain a two- to three- inch depth at least once every two years.
- Analyze soil for fertility and pollutant levels if necessary. Bioretention soil media are designed to maintain long-term fertility and pollutant processing capability.
- Eliminate standing water to prevent vector breeding.

- Inspect overflow devices for obstructions or debris, which should be removed immediately. Repair or replace damaged pipes upon discovery.

A summary of potential problems that may need to be addressed by maintenance activities is presented in Table E-2.

The County requires execution of a maintenance agreement to be recorded by the property owner for the on-going maintenance of any privately-maintained stormwater quality control measures. The property owner is responsible for compliance with the maintenance agreement. A sample maintenance agreement is presented in Appendix H.

Table E-2. Bioretention Troubleshooting Summary

Problem	Conditions When Maintenance Is Needed	Maintenance Required
Vegetation	Overgrown vegetation	Mow and prune vegetation as appropriate.
	Presence of invasive, poisonous, nuisance, or noxious vegetation or weeds	Remove this vegetation and plant native species as needed.
Trash and Debris	Trash, plant litter, and dead leaves present	Remove and properly dispose of trash and debris.
Irrigation (if applicable)	Not functioning correctly	Check irrigation system for clogs or broken lines and repair as needed.
Flow Entrance/Overflow Device	Flow entrance/overflow areas clogged with sediment and/or debris	Remove material.
	Overflow device blocked or broken	Clean and/or repair as needed.
Erosion/Sediment Accumulation	Presence of erosion or sediment accumulation	Check flow entrance to ensure proper function. Repair, or replace if necessary, the flow entrance. Repair eroded areas with gravel as needed. Re-grade the bioretention area as needed.
Contaminants and Pollution	Any evidence of oil, gasoline, contaminants, or other pollutants	Remove any evidence of visual contamination from floatables such as oil and grease.
Standing water	Standing water observed more than 96 hours after storm event	Remove and replace plant media (sand, gravel, topsoil, mulch) and vegetation

T-6: Proprietary Treatment Control Measures

Definition

The LID Standards Manual provided information for selecting and designing the more common treatment-based stormwater quality control measures for projects. The treatment-based stormwater quality control measures included in this appendix (T-1 to T-5) are non-proprietary (public domain) designs that have been reviewed and evaluated by LACDPW and determined generally acceptable.

Proprietary devices are commercial products that typically aim at providing stormwater treatment in space-limited applications, often using patented innovative technologies. The most commonly encountered classes of proprietary stormwater quality control measures include hydrodynamic separation, catch basin insert technologies, cartridge filter-type controls, and proprietary biotreatment devices.

Hydrodynamic separation devices (alternatively, swirl concentrators) are devices that remove trash, debris, and coarse sediment from incoming flows using screening, gravity settling, and centrifugal forces generated by forcing the influent into a circular motion. By having the water move in a circular fashion, rather than a straight line, it is possible to obtain significant removal of suspended sediments and attached pollutants with less space as compared to wet vaults and other settling devices. Hydrodynamic devices were originally developed for combined sewer overflows, where they were used primarily to remove coarse inorganic solids. Hydrodynamic separation has been adapted for stormwater treatment by several manufacturers and is currently used to remove trash, debris, and other coarse solids down to sand-sized particles. Several types of hydrodynamic separation devices are also designed to remove floating oils and grease using sorbent media.

Catch basin inserts are manufactured filters or fabric placed in a drop inlet to remove sediment and debris and may include sorbent media to remove floating oils and grease. There are a multitude of inserts of various shapes and configurations, typically falling into one of three groups: socks, boxes, and trays. The sock-type filters are typically constructed of a fabric, usually polypropylene. The fabric may be attached to a frame or the grate of the inlet may hold the sock. Socks are meant for vertical (drop) inlets. Boxes are constructed of plastic or wire mesh. Typically a polypropylene “bag” is placed in the wire mesh box and the bag takes the form of the box. Most box products are one box; that is, settling and filtration through media occur in the same box. Other products consist of one or more trays or mesh grates. The trays may hold different types of media. Filtration media vary by manufacturer. Types include polypropylene, porous polymer, treated cellulose, and activated carbon. Inserts are an easy and inexpensive retrofitting option because drain inlets are already a component of most standard drainage systems. Inserts are usually only suitable for mitigating relatively small tributary areas (less than one acre) because they are limited by treatment capacity and influent flow rate.

Cartridge filter-type controls typically consist of a series of vertical filters contained in a vault or catch basin that provide treatment through filtration and sedimentation. The vault may be divided into multiple chambers where the first chamber acts as a pre-settling basin for removal of coarse sediment while another chamber acts as the filter bay and houses the filter cartridges. The performance and capacity of a cartridge filter installation depends on the properties of the media contained in the cartridges. Cartridge filter manufacturers often provide an array of media types each with varying properties, targeting various pollutants and a range of particle sizes. Commonly used media include media that target solids, such as perlite, and media that target both dissolved and non-dissolved constituents, such as compost leaf media, zeolite, and iron-infused polymers. Manufacturers try to distinguish their products through innovative designs that aim at providing self cleaning and draining, uniformly loaded, and clog resistant cartridges that functional properly over a wide range of hydraulic loadings and pollutant concentrations.

Proprietary biotreatment devices are devices that are manufactured to mimic natural systems such as wetlands by incorporating plants, soil, and microbes engineered to provide treatment at higher flow rates or higher volumes and with smaller footprints than their natural counterparts. Incoming flows are typically filtered through natural media (mulch, compost, soil, plants, microbes, etc) and either infiltrated or collected by an underdrain and delivered to the storm system. Tributary areas for biotreatment devices tend to be limited to 0.5 to 1.0 acres.

The vendors of the various proprietary stormwater quality control measures provide detailed documentation for device selection, sizing, and maintenance requirements. Tributary area sizes are limited to the capacities of the largest available model. The latest manufacturer supplied documentation must be used for sizing and selection of all proprietary devices. Links to the websites of a number of vendors of proprietary devices are provided at www.BMPLA.org. All proprietary devices proposed for use by a project applicant must be approved by LACDPW.

General Design Specifications

Proprietary stormwater quality control measure vendors are constantly updating and expanding their product lines, so refer to the latest design guidance from the vendors. General guidelines on the performance, sizing, and operation and maintenance of proprietary devices are provided through LACDPW Watershed Division.

Expected Performance

For hydrodynamic devices, it has been stated with respect to combined sewer overflows that the practical lower limit of hydrodynamic separation is a particle with a settling velocity of 12 to 16.5 ft/hr (0.10 to 0.14 cm/s). As such, the focus for hydrodynamic separation in combined sewer overflows has been with settleable solids generally 200 μm and larger, given the presence of the lighter organic solids. For inorganic sediment, the above settling velocity range represents a particle diameter of 50 to 100 μm. Thus, hydrodynamic separation devices are effective for removal of course sediment, trash,

and debris and useful for pretreatment in combination with other types of stormwater quality control measures that target smaller particle sizes.

Because there is a wide range of catch basin insert configurations, it is not possible to generalize the expected performance. Inserts should mainly be used for catching coarse sediments and floatable trash, and are effective for pretreatment in combination with other types of stormwater quality control measures. Trash and large objects can greatly reduce the effectiveness of catch basin inserts with respect to sediment and hydrocarbon capture. Frequent maintenance and the use of screens and grates to keep trash out may decrease the likelihood of clogging and prevent obstruction and bypass of incoming flows.

Cartridge filters have been proven to provide efficient removals for both dissolved and non-dissolved pollutants. However, cartridge filters are less adept at handling high flow rates when compared to catch basin inserts and hydrodynamic devices due to the enhanced treatment provided through the filtration mechanism.

Because proprietary biotreatment devices are relatively new compared to the other types of proprietary treatment devices included in the LID Standards Manual, there are fewer third party studies on proprietary biotreatment devices. The available performance information is mostly vendor-supplied. According to the vendors, like their natural counterparts, proprietary biotreatment devices are highly efficient at mitigating dissolved metals, nutrients, and suspended solids.

Sizing

Hydrodynamic devices, catch basin inserts, and cartridge filters are flow-based stormwater quality control measures, but can be sized to capture and treat the mitigation volume of the SWQDv with additional facilities to manage stormwater runoff flow. Proprietary biotreatment devices on the other hand include both volume-based and flow-based stormwater quality control measures. Volume-based proprietary devices should be sized to capture and treat the mitigation volume of the SWQDv if used as a standalone stormwater quality control measure.

Auxiliary components of proprietary devices such as sorbent media, screens, baffles, and sumps are selected based on site-specific conditions such as the expected loading and the desired frequency of maintenance. Sizing of proprietary devices is reduced to a simple process whereby a model can simply be selected from a table or a chart based on a few known quantities (tributary area, location, design flow rate, design volume, etc). Some manufacturers either size the devices for potential clients or offer calculators on their websites that simplify the design process even further and lessens the possibility of using obsolete design information. For the latest sizing guidelines, refer to the manufacturer's website.

Operation and Maintenance

Hydrodynamic Separation Devices

Hydrodynamic separators do not have moving parts and are not maintenance intensive. However, maintenance is important to ensure that the device operates as efficiently as possible. Proper maintenance involves frequent inspections throughout the first year of installation, especially after major storm events. The systems are considered full when the sediment level is within one foot from the top of the unit, at which point it must be cleaned out. Removal of sediment can be performed with a sump vacuum or vactor truck. Some hydrodynamic separator devices may contribute to mosquito breeding if they do not fully drain stormwater runoff between storm events. Refer to manufacturer's guidelines for inspection and maintenance activities.

Catch Basin Inserts

Catch basin inserts can be maintenance-intensive because of their susceptibility for accumulating trash and debris. Regular maintenance activities include the clean-up and removal of accumulated trash and sediment while major maintenance activities include replacing filter media (if used) and or repairing/replacing geomembrane fabrics. Refer to manufacturer's guidelines for inspection and maintenance activities.

Cartridge Filters

For cartridge filters, maintenance activities include periodically removing trash, debris, and sediment from the vault floor, typically twice per year depending on the accumulation rate, using a sump vacuum or vactor truck. The cartridges may need to be replaced when they become saturated, which will occur approximately every other year depending on the pollutant accumulation rate. The manufacturers of these devices typically provide contract operation and maintenance services.

All stormwater vaults that contain standing water can become a breeding area for vectors. Manufacturers have developed systems, such as a perforated pipe installed in the bottom of the vault that is encased in a filter sock to prevent clogging, to completely drain the vault.

Biotreatment Devices

Maintenance of biotreatment devices can be provided by the manufacturer and typically consists of routine inspection and hand removal of accumulated trash and debris. Vactor trucks or mechanical maintenance activities are not needed for biotreatment devices.

Attachment B

Geotechnical Investigation

(TBD)

Attachment C

City Forms

(TBD)

Attachment D

Master Covenant Agreement (MCA)

(TBD)

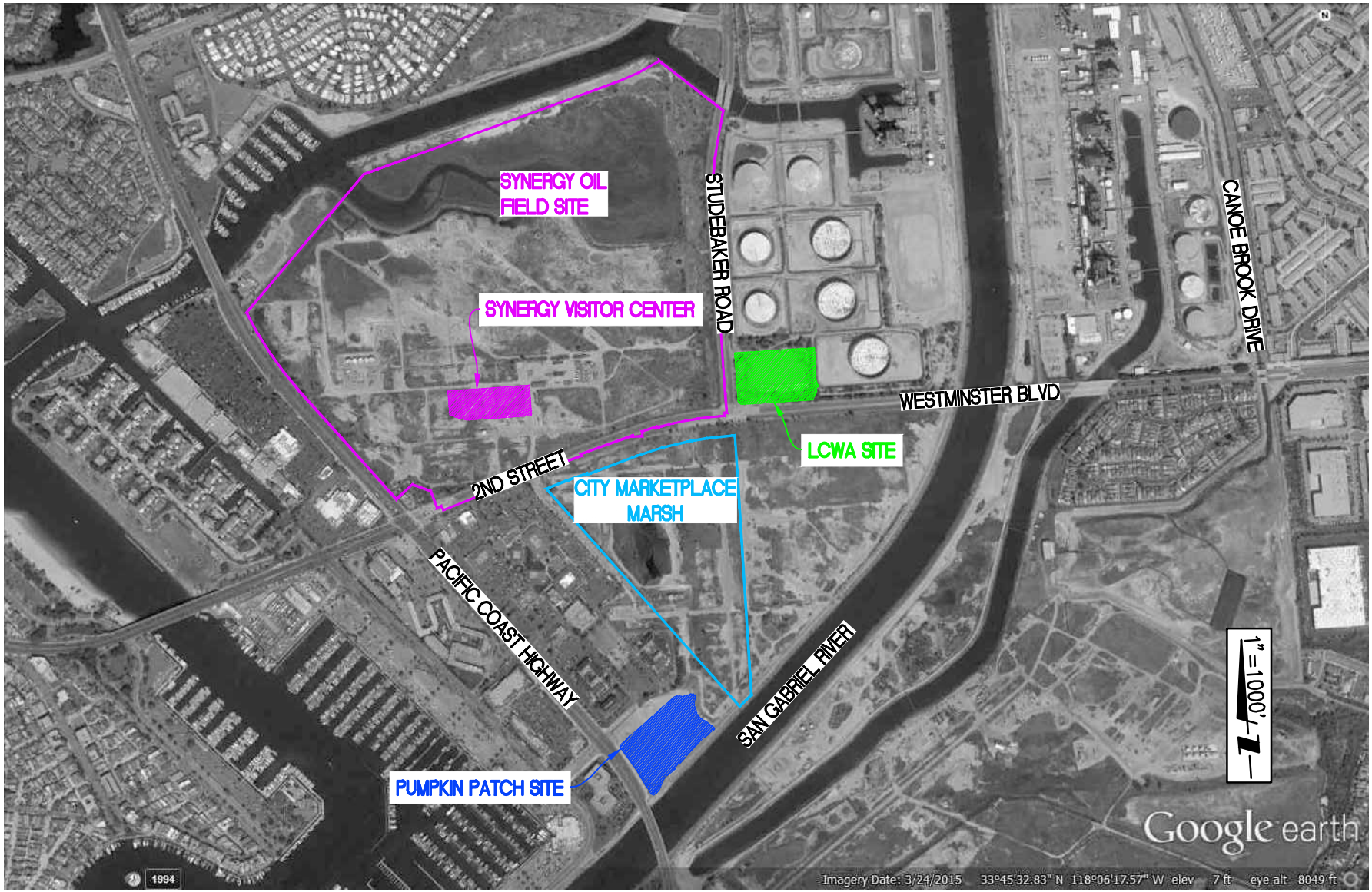
Attachment E

Operations and Maintenance (O&M) Plan

(TBD)

Attachment F

Plans



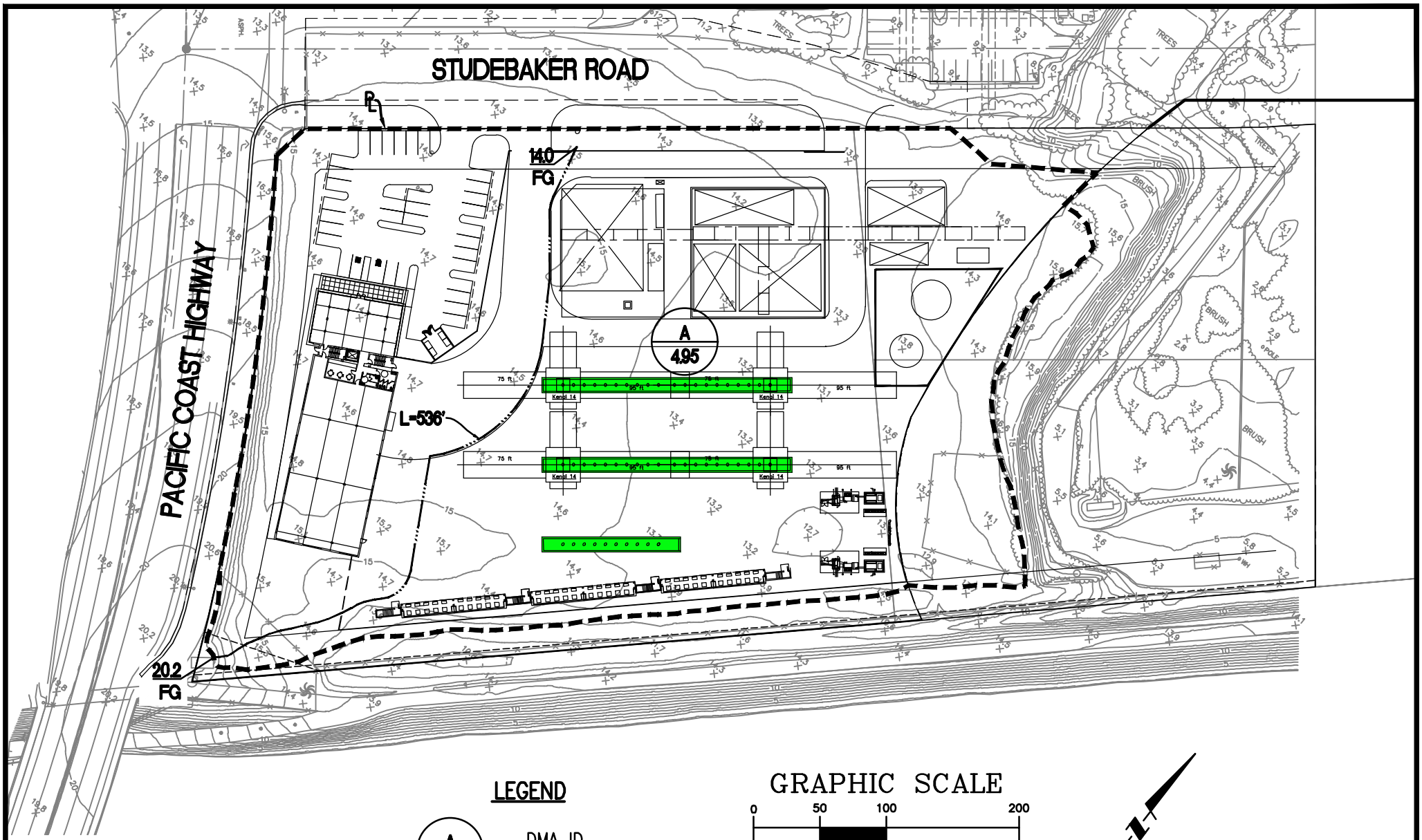
LOCATION MAP

WILSON MIKAMI CORPORATION
9 CORPORATE PARK, SUITE 100, IRVINE, CA 92606
T: 949-679-0090 F: 949-679-0091

DESIGNED BY:	
DRAFTED BY:	
CHECKED BY:	
DATE:	

PROJECT LOCATION MAP

SHEET 1 OF 4



LEGEND

A / 1.00 — DMA ID / AREA (ACRES)

PROPRIETARY TREATMENT CONTROL MEASURES

GRAPHIC SCALE

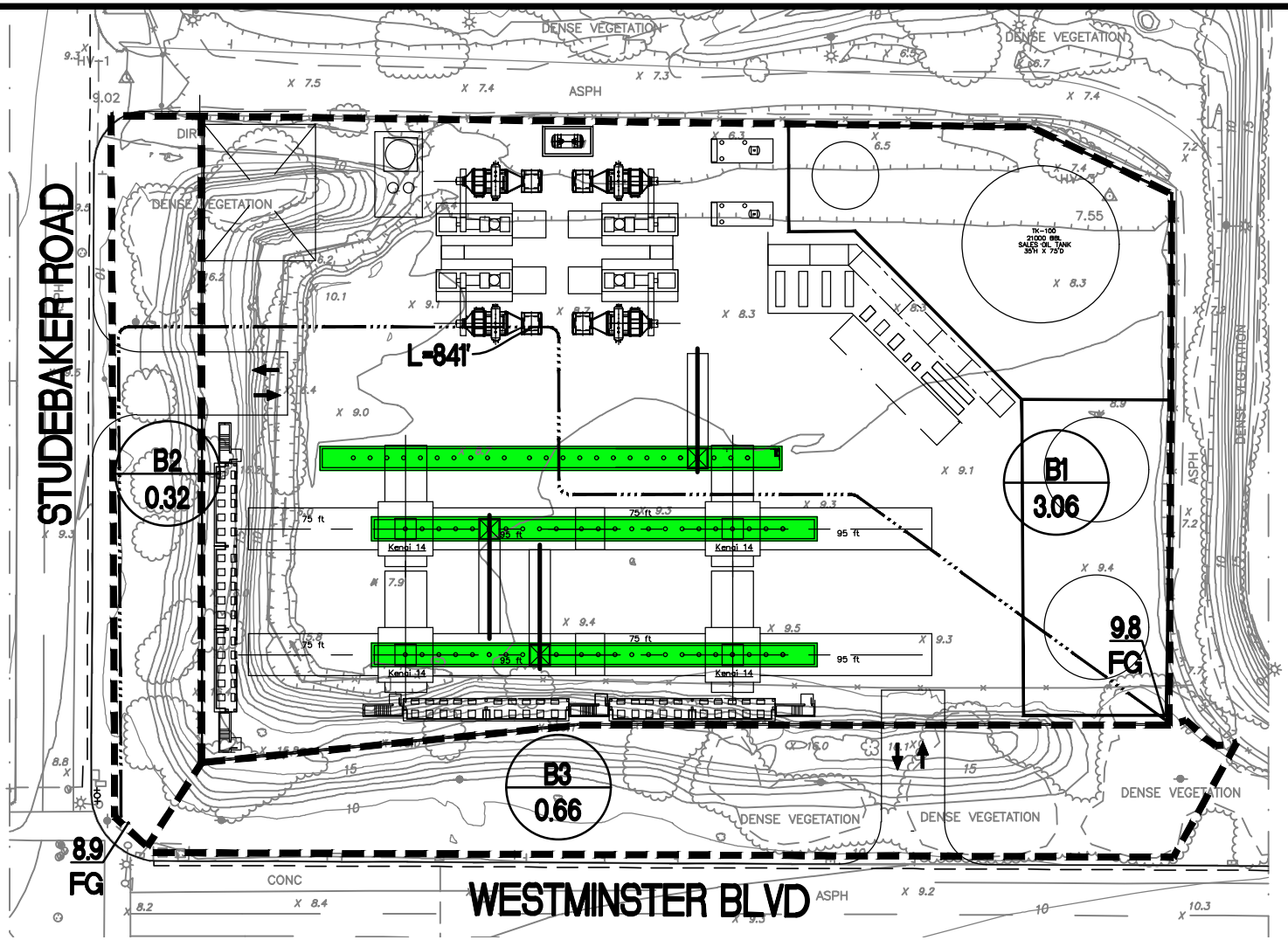
0 50 100 200

(IN FEET)
1 inch = 100 ft.

WILSON MIKAMI CORPORATION
9 CORPORATE PARK, SUITE 100, IRVINE, CA 92606
T: 949-679-0090 F: 949-679-0091

DESIGNED BY:	
DRAFTED BY:	
CHECKED BY:	
DATE:	

PUMPKIN PATCH SITE BMP EXHIBIT



LEGEND

A / 1.00 — DMA ID / AREA (ACRES)

PROPRIETARY TREATMENT CONTROL MEASURES

GRAPHIC SCALE

0 40 80 160

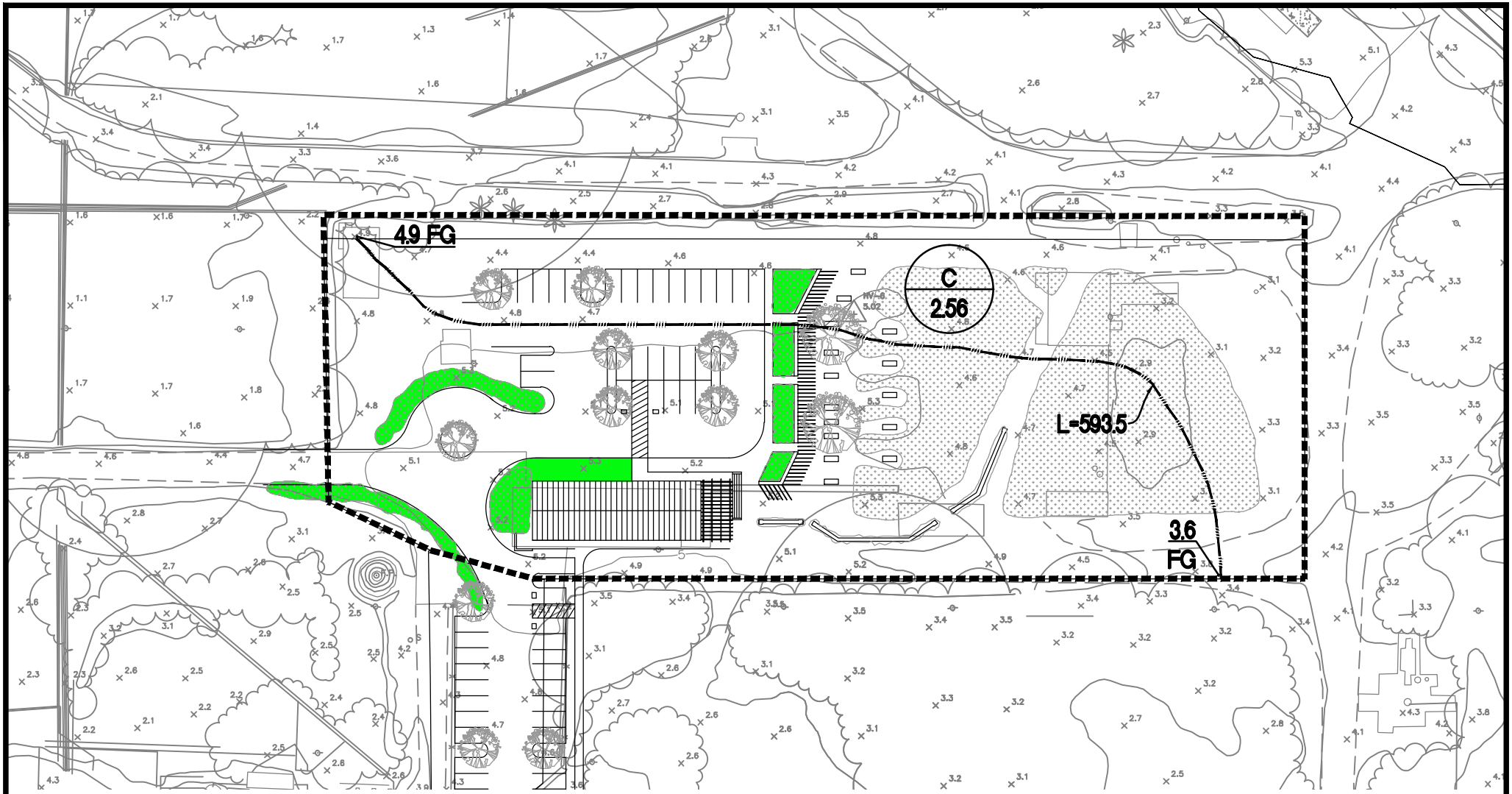
(IN FEET)
1 inch = 80 ft.

WILSON MIKAMI CORPORATION
9 CORPORATE PARK, SUITE 100, IRVINE, CA 92606
T: 949-679-0090 F: 949-679-0091

DESIGNED BY:	
DRAFTED BY:	
CHECKED BY:	
DATE:	

LCWA SITE
BMP EXHIBIT

SHEET 3
OF 4



LEGEND

A / 1.00 — DMA ID / AREA (ACRES)

BIORETENTION BASIN

GRAPHIC SCALE

0 40 80 160

(IN FEET)

1 inch = 80 ft.

N

WILSON MIKAMI CORPORATION

9 CORPORATE PARK, SUITE 100, IRVINE, CA 92606

T: 949-679-0090 F: 949-679-0091

DESIGNED BY:	
DRAFTED BY:	
CHECKED BY:	
DATE:	

SYNERGY SITE VISITORS CENTER BMP EXHIBIT

SHEET 4 OF 4