Appendix K

Drainage Report

Submitted To:
CITY OF LONG BEACH

DRAINAGE REPORT

FOR LONG BEACH INDUSTRIAL PARK
LONG BEACH, CA

11/5/2018

Job No. 06.198.000

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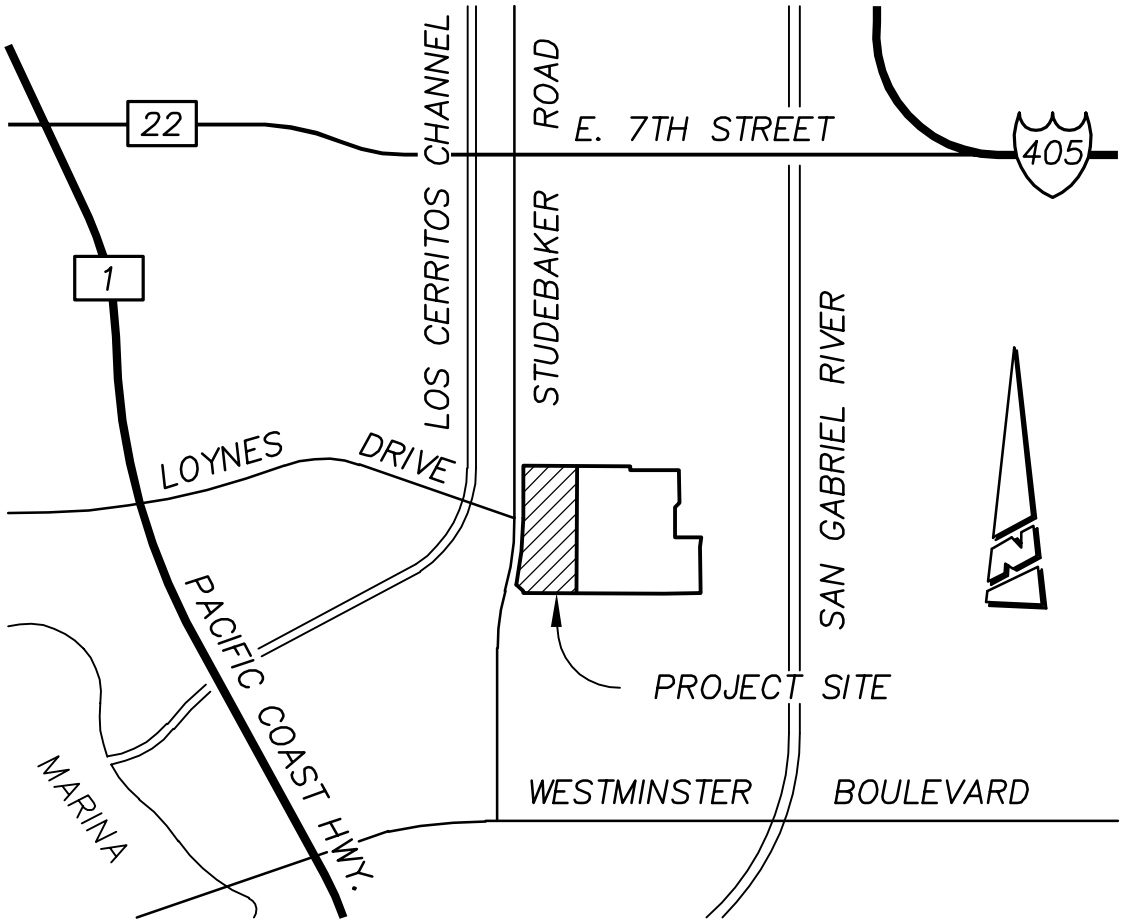

VICINITY MAP
NO SCALE

FIGURE 1

I. INTRODUCTION

A. PURPOSE OF DRAINAGE STUDY

The Long Beach Industrial project is located in the City of Long Beach, Los Angeles County, California. See Vicinity Map – Figure 1. The proposed project will consist of two industrial buildings with loading docks, drive aisles, parking areas and landscape areas. The total project area is approximately 6.6 acres. Existing access to the site is currently provided from Studebaker Road.

The purpose of this report is to compute the existing and developed condition hydrology. This report provides a summary of runoff estimates for the existing and developed conditions, and an overview of impacts to existing drainage facilities.

B. PROJECT DESCRIPTION

The Long Beach Industrial Park will consist of two industrial buildings with loading docks, drive aisles, parking areas and landscape areas. The project boundary encompasses approximately 6.6 acres. The proposed project will consist of two industrial buildings with loading docks, drive aisles, parking areas and landscape areas. The site topography is relatively flat with site elevations ranging from approximately 18.3' to 7.5' above mean sea level. Drainage patterns were determined using a topographic map, aerial imagery and site investigation.

The proposed site improvements will construct drive aisles, parking spaces and two industrial buildings with loading docks. Onsite storm drain facilities will be constructed to convey stormwater flow to an existing storm drain pipe.

1. Project Location

The proposed development area is generally bound by industrial facilities to the north, east and, south and Studebaker Road to the west. See Exhibit A in Appendix C. The site has been vacated. The site was previously used for petroleum facilities and consisted of two large storage tanks and related infrastructure. Most flow patterns begin on the northwest side of the project site and flow towards the southeasterly edge of the site to an existing storm drain pipe.

The entire project area is located within the tributary regional watershed of Nearshore Watershed Group. The Nearshore Watershed Group consists of approximately 14 square miles within the City of Long Beach that ultimately drains into the Pacific Ocean.

2. Existing Land Use

The existing land use is based on aerial topography and on-site visits of watershed areas. The site consisted of petroleum facilities and included of two large storage tanks and related infrastructure. The site was entirely paved, thus, a 100% impervious factor was used in the existing condition hydrology.

3. Proposed Land Use

The Long Beach Industrial Park will consist of two commercial buildings with loading docks, drive aisles, parking areas and landscape areas. The proposed site layout has an impervious cover of 90%. Thus, a 90% impervious cover was used in the developed condition hydrology.

4. *Existing Drainage Facilities*

Flow patterns begin at the northwest side of the project site and flow towards the southeasterly edge of the site and to an existing storm drain pipe. This existing storm drain pipe ultimately drains to the Pacific Ocean.

5. *Proposed Drainage Facilities*

The proposed site improvements will include both the construction of new drainage facilities and the utilization of existing facilities. Drainage patterns will remain relatively unchanged. Stormwater runoff will sheet flow into gutters and be collected by grated inlets which release the flow into a proposed Corrugated Metal Pipe (CMP) Underground Water Quality Basin. Detailed sizing calculations for the (CMP) Underground Water Quality Basin and Modular Wetland Systems Unit are provided in the separately submitted LID Plan for the Long Beach Industrial project. Stormwater runoff greater than the 0.75-inch storm will bypass the modular wetland unit and flow directly to a proposed pump station. The proposed pump station will be designed to handle the 50-year storm. Details and sizing calculations for the pump station will be provided during final engineering.

II. DESIGN CRITERIA

Hydrologic calculations are based on the requirements of the Los Angeles County Flood Control District Hydrology Manual. The Modified Rational method is used to calculate discharges for the project site. The Modified Rational Method is used to evaluate and design on site proposed storm drain systems for the ultimate condition as designated on the hydrology map.

A. RATIONAL METHOD HYDROLOGY CALCULATION

The 50-year mainline flows are computed using the HydroCalc Calculator Modified Rational Method program. The program calculates the runoff at subarea collection points within the watershed, and reports the resulting peak flow in each reach of each drain. The Rational Method calculations are included in Appendix A. The hydrology maps for the existing and proposed conditions are included in the back of this report. (See Appendix C).

The hydrology maps show existing contours and elevations, streets, and proposed storm drain facilities. Watershed boundaries and ridgelines were identified, with watershed areas divided into subareas. Flow paths and proposed drainage systems were laid out, and then drainage areas and flow path lengths were estimated. The portion of the soil map from the Los Angeles County Flood Control District Hydrology Manual was overlaid, and fractions of the soil type and land use were calculated for each sub-area. The soil map indicates that the study area consists of soil no. 3 and the maximum 50-year hour rainfall within the project is 4.8”. See Los Angeles County Public Works Hydrology Maps provided in Appendix B.

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The hydrologic information was entered into the Rational Method computer programs, and peak discharges, times of concentration and hydrographs were calculated at specified nodes, as shown on the hydrology map. The computer files for 50-year calculations are included in Appendix A.

B. BURNED AREAS

Burned calculations are required for undeveloped areas with 15% or less imperviousness. Since the existing improvements include industrial tank facilities exceeding 15% imperviousness, burned flows were not calculated for this project. A fire factor of 0 was used in the rational method calculations.

C. FLOOD ASSESSMENT

The Federal Emergency Management Agent (FEMA) publishes Flood, Insurance Rate Maps (FIRMs) that identify areas where there is flooding potential. The FIRM that applies to the Long Beach Industrial Park project is Los Angeles County Panel 1988 (Map Number 06037C1988F), dated September 26, 2008. The entire project site is within Flood Hazard Zone "X" (Other Areas) – an area determined to be outside the 100-year flood plain. (See Appendix B).

III. PEAK FLOW RATES

A. EXISTING CONDITIONS

For the existing conditions, the study area was divided into one tributary area, Area A1. Drainage areas and patterns were determined using a topographic map, aerial imagery and field visits. Detailed 50-year storm peak runoff calculations are included in Appendix A.

Existing drainage Area A is approximately 6.6 acres. The existing site conditions allow sheet flow from the northwest corner of the site to the southeasterly edge of the site and to an existing storm drain. The existing site conditions for Area A yield a flow of 11.3 cfs. Table 1, shows the flow rate summary for the existing conditions.

TABLE 1: EXISTING CONDITIONS FLOW RATE SUMMARY

50 YEAR STORM EVENT

DRAINAGE AREA	TOTAL STUDY DRAINAGE AREA (acres)	FLOW RATE (cfs)
A1	6.6	11.3

B. PROPOSED CONDITIONS

For the proposed conditions, the study area was divided into one tributary area, Area A1. Drainage areas and patterns were determined using the preliminary grading plan. Proposed drainage Area A1 is 6.6 acres. Detailed 50-year storm peak runoff calculations are included in Appendix A.

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Stormwater runoff will sheet flow into gutters and be collected by grated inlets which release the flow into a Corrugated Metal Pipe (CMP) Underground Water Quality Basin. Detailed sizing calculations for the proposed (CMP) Underground Water Quality Basin and Modular Wetland Systems Unit are provided in the separately submitted LID Plan for the Long Beach Industrial project. Stormwater runoff greater than the 0.75-inch storm will bypass the modular wetland unit and flow directly to a proposed pump station. The proposed pump station will be designed to handle the 50-year storm. Storm drain system sizing will be conducted during final engineering.

The proposed site conditions for the Long Beach Industrial Park yield a flow of 9.8 cfs. Table 2, shows the flow rate summary for the proposed conditions.

TABLE 2: PROPOSED CONDITIONS FLOW RATE SUMMARY

50 YEAR STORM EVENT

DRAINAGE AREA	TOTAL STUDY DRAINAGE AREA (acres)	FLOW RATE (cfs)
A1	6.6	9.8

The proposed conditions yield a total runoff flow of 9.8 cfs. The proposed conditions reduce the runoff generated by the site by 1.5 cfs, (9.8 cfs vs 11.3 cfs).

IV. SUMMARY OF RESULTS

The existing site conditions generate 11.3 cfs (50-year storm) while the proposed site conditions generate 9.8 cfs (50-year storm). The proposed conditions reduce the runoff generated by the site by 1.5 cfs. This indicates there will be no impact to downstream facilities and no detention facilities will be required for this project.

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MODIFIED RATIONAL METHOD CALCULATIONS

EXISTING CONDITIONS

Peak Flow Hydrologic Analysis

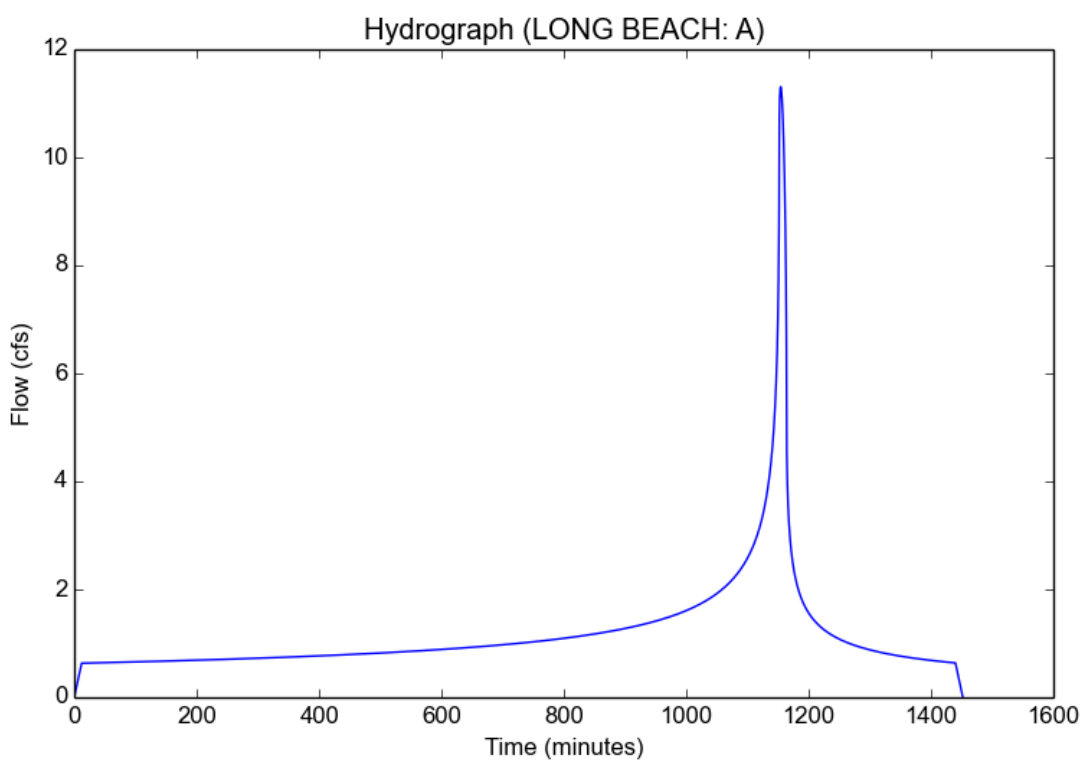
File location: Z:/06.198.000 Long Beach/Hydro/HYDROCALCS/LONG BEACH EXISTING CONDITION.pdf
Version: HydroCalc 1.0.2

Input Parameters

Project Name	LONG BEACH
Subarea ID	A
Area (ac)	6.62
Flow Path Length (ft)	865.0
Flow Path Slope (vft/hft)	0.008
50-yr Rainfall Depth (in)	4.8
Percent Impervious	1.0
Soil Type	3
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	4.8
Peak Intensity (in/hr)	1.8978
Undeveloped Runoff Coefficient (Cu)	0.3063
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	12.0
Clear Peak Flow Rate (cfs)	11.307
Burned Peak Flow Rate (cfs)	11.307
24-Hr Clear Runoff Volume (ac-ft)	2.3635
24-Hr Clear Runoff Volume (cu-ft)	102954.4269



DEVELOPED CONDITIONS

Peak Flow Hydrologic Analysis

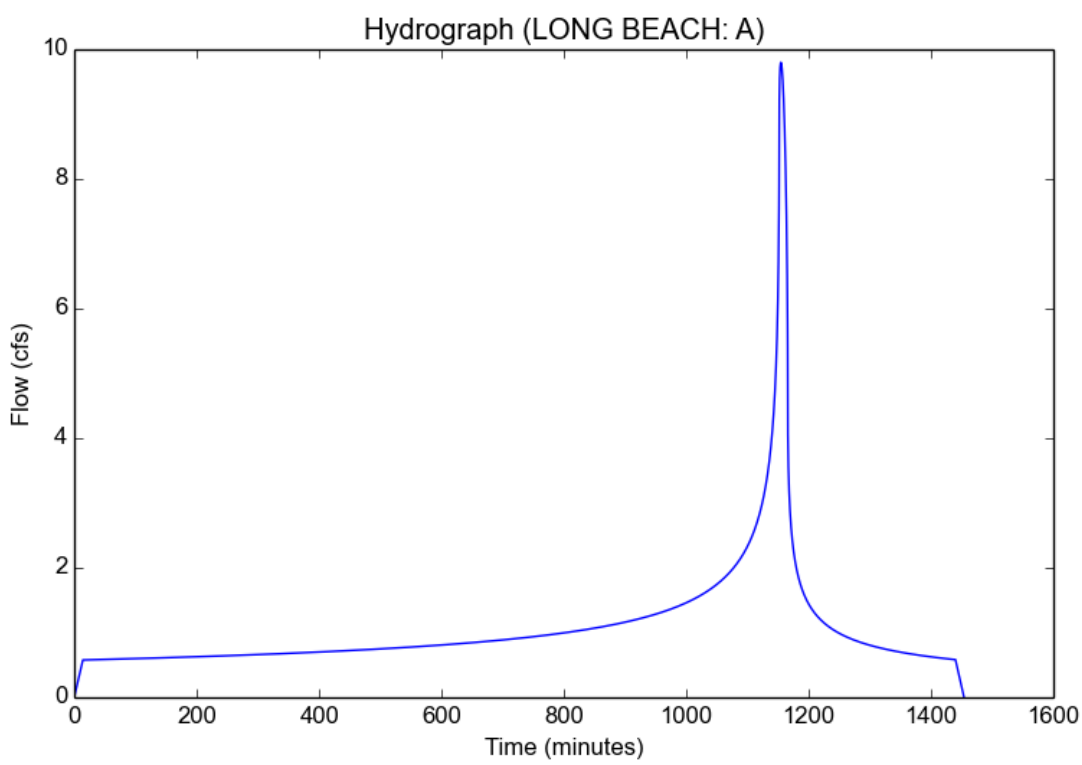
File location: Z:/06.198.000 Long Beach/Hydro/HYDROCALCS/LONG BEACH DEVELOPED CONDITION.pdf
Version: HydroCalc 1.0.2

Input Parameters

Project Name	LONG BEACH
Subarea ID	A
Area (ac)	6.62
Flow Path Length (ft)	1100.0
Flow Path Slope (vft/hft)	0.0111
50-yr Rainfall Depth (in)	4.8
Percent Impervious	0.9
Soil Type	3
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)	0.2862
Developed Runoff Coefficient (Cd)	0.8386
Time of Concentration (min)	14.0
Clear Peak Flow Rate (cfs)	9.7995
Burned Peak Flow Rate (cfs)	9.7995
24-Hr Clear Runoff Volume (ac-ft)	2.1569
24-Hr Clear Runoff Volume (cu-ft)	93956.2182



APPENDIX B

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 11. The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum.** For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242,** or visit its website at http://www.ngs.noaa.gov/.

Base map information shown on this FIRM was derived from U.S. Geological Survey Digital Orthophoto Quadrangles produced at a scale of 1:12,000 from photography dated 1994 or later and from National Geospatial Intelligence Agency imagery produced at a scale of 1:4,000 from photography dated 2003 or later.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables *in the Flood Insurance Study report (which contains authoritative hydraulic data)* may reflect stream channel distances that differ from what is shown on this map.

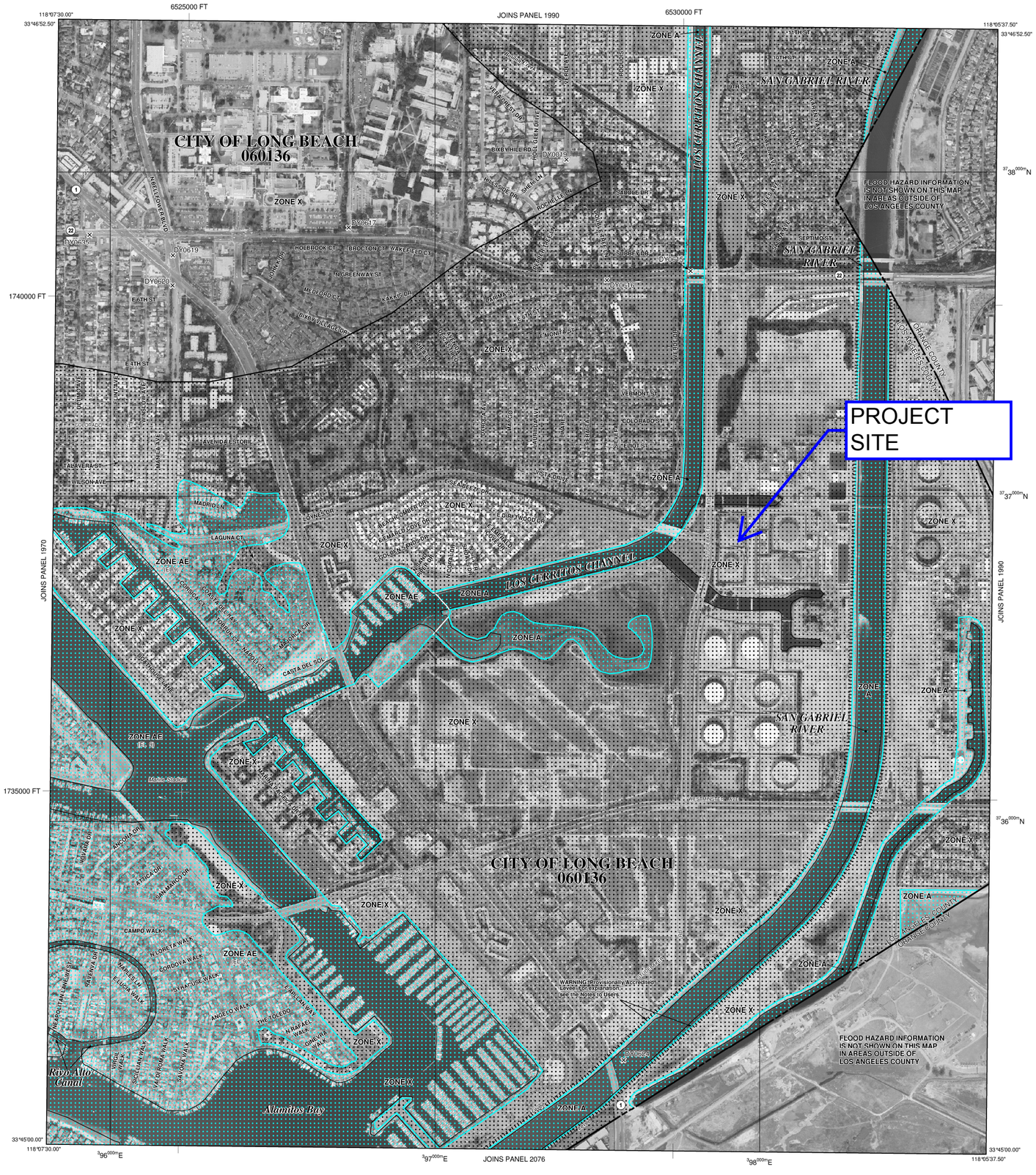
Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, *a Flood Insurance Study report*, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/.

WARNING: This levee, dike, or other structure has been provisionally accredited and mapped as providing protection from the 1-percent-annual-chance flood. To maintain accreditation, the levee owner or community is required to submit documentation necessary to comply with 44 CFR Section 65.10 by October 16, 2009. Because of the risk of overtopping or failure of the structure, communities should take proper precautions to protect lives and minimize damages in these areas, such as issuing an evacuation plan and encouraging property owners to purchase flood insurance.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	1% annual chance floodplain boundary
	0.2% annual chance floodplain boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A	Cross section line
23 - - - - - 23	Transect line
97°07'30", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
$^{42}75^{000m}$N	1000-meter Universal Transverse Mercator grid values, zone 11
6000000 FT	5000-foot grid ticks: California State Plane coordinate system, V zone (FIPSZONE 0405), Lambert Conformal Conic
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
September 26, 2008
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1988F

FIRM
FLOOD INSURANCE RATE MAP
LOS ANGELES COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 1988 OF 2350
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LONG BEACH, CITY OF	060136	1988	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06037C1988F

EFFECTIVE DATE
SEPTEMBER 26, 2008

Federal Emergency Management Agency

FIRM MAP

ISOHYET MAP

Public Works LOS ANGELES COUNTY

search our site..

Hydrology Map

A GIS viewer application to view the data for the hydrology manual.

LAYERS

- [x] 50yr Two Tenths (Rainfall)
- [ ] DPA Zones
- [ ] Soils 2004
- [x] Final 85th Percentile, 24-hr Rainfall
- [ ] Final 95th Percentile, 24-hr Rainfall
- [ ] 1-year, 1-hour Rainfall Intensity

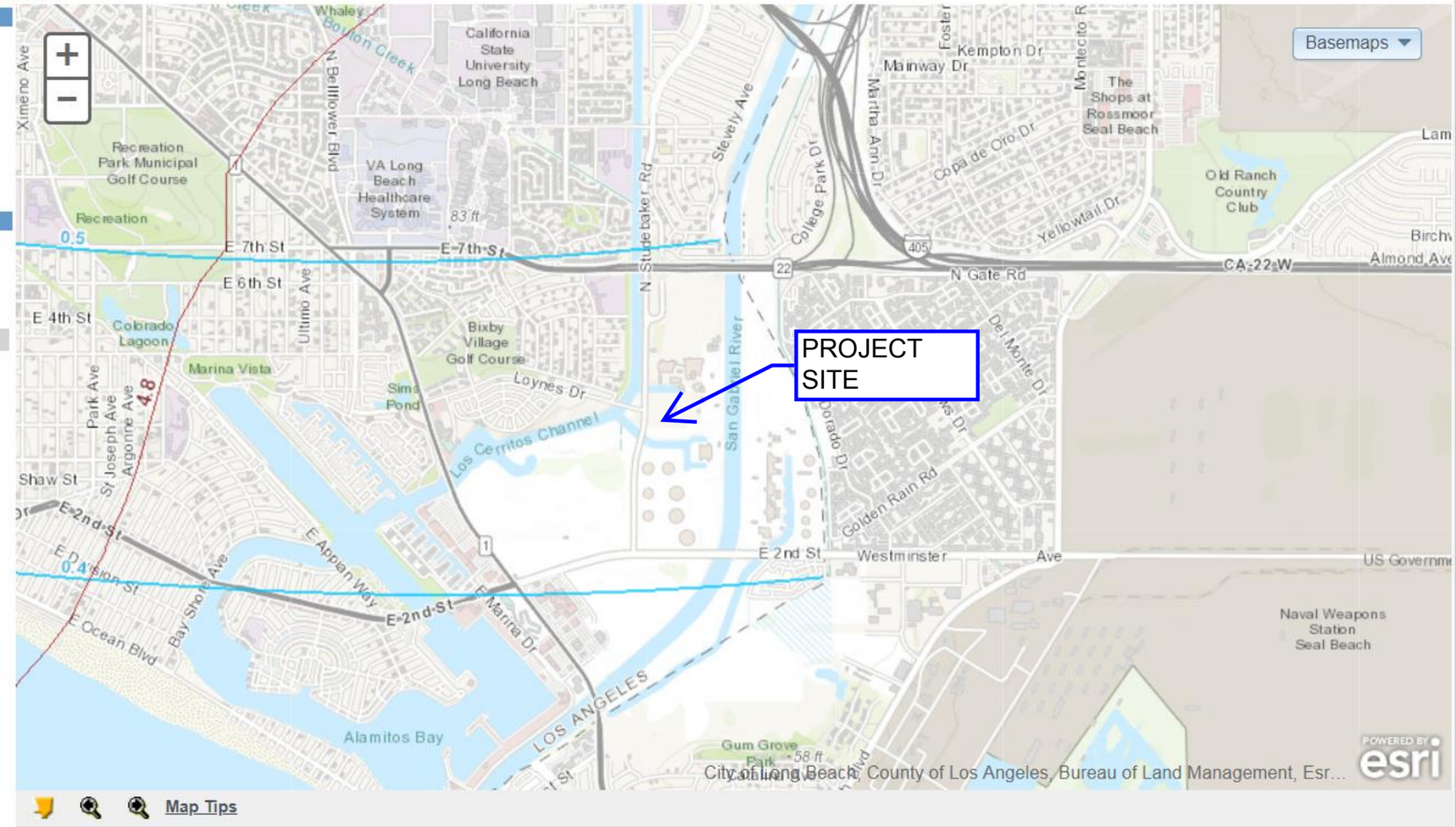
SEARCH

Enter Address, Cross Street, or Parcel No.:
(ex: 900 S. Fremont Ave., Fremont@Valley, 5342005904)

STUDBAKER LONG BEACH | Search

Address Search Results:

STUDBAKER LONG BEACH



Public Works LOS ANGELES COUNTY

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Hydrology Map

A GIS viewer application to view the data for the hydrology manual.

LAYERS

- [ ] 50yr Two Tenths (Rainfall)
- [ ] DPA Zones
- [x] Soils 2004
- [ ] Final 85th Percentile, 24-hr Rainfall
- [ ] Final 95th Percentile, 24-hr Rainfall
- [ ] 1-year, 1-hour Rainfall Intensity

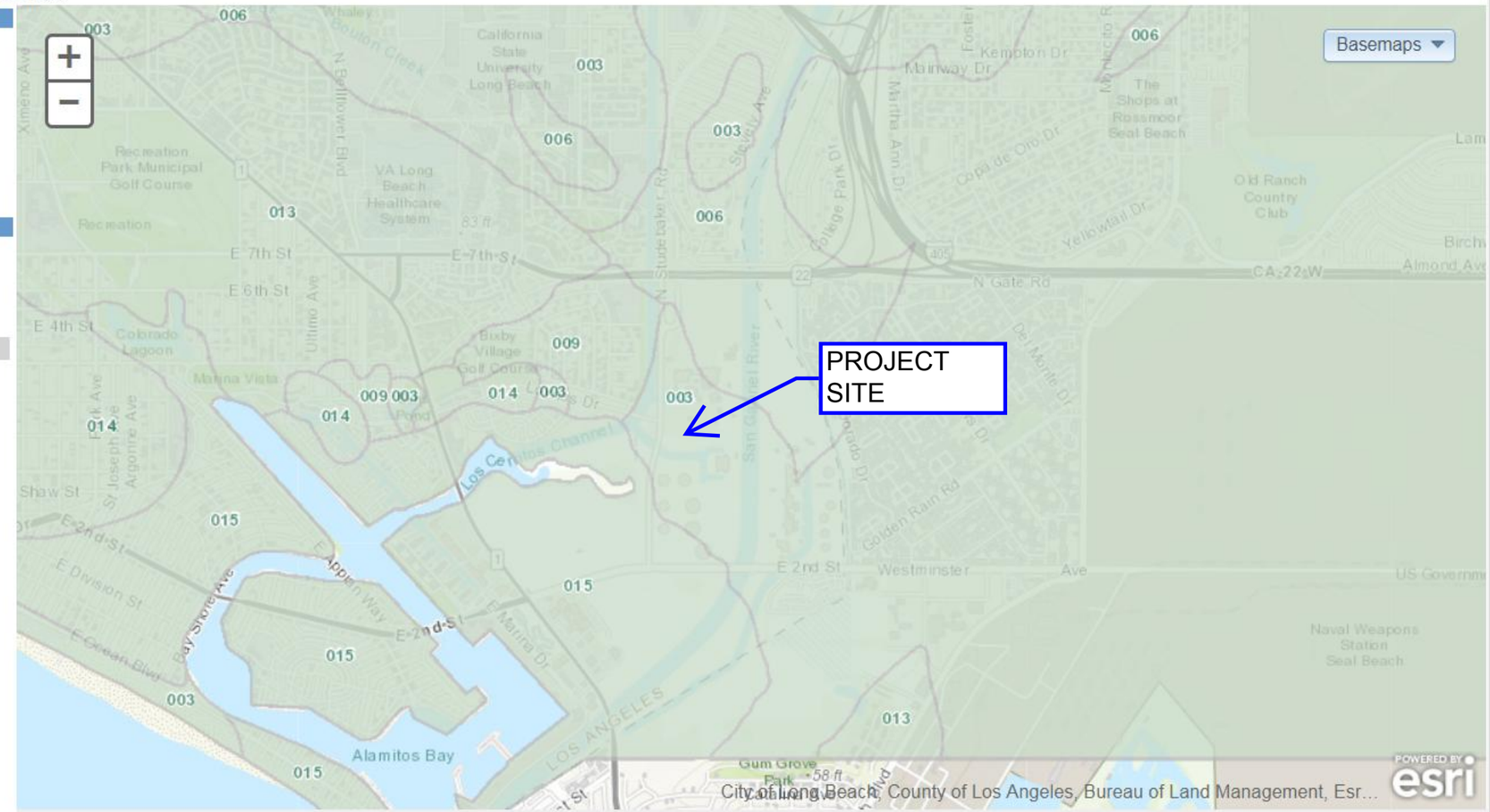
SEARCH

Enter Address, Cross Street, or Parcel No.:
(ex: 900 S. Fremont Ave., Fremont@Valley, 5342005904)

STUDBAKER LONG BEACH | Search

Address Search Results:

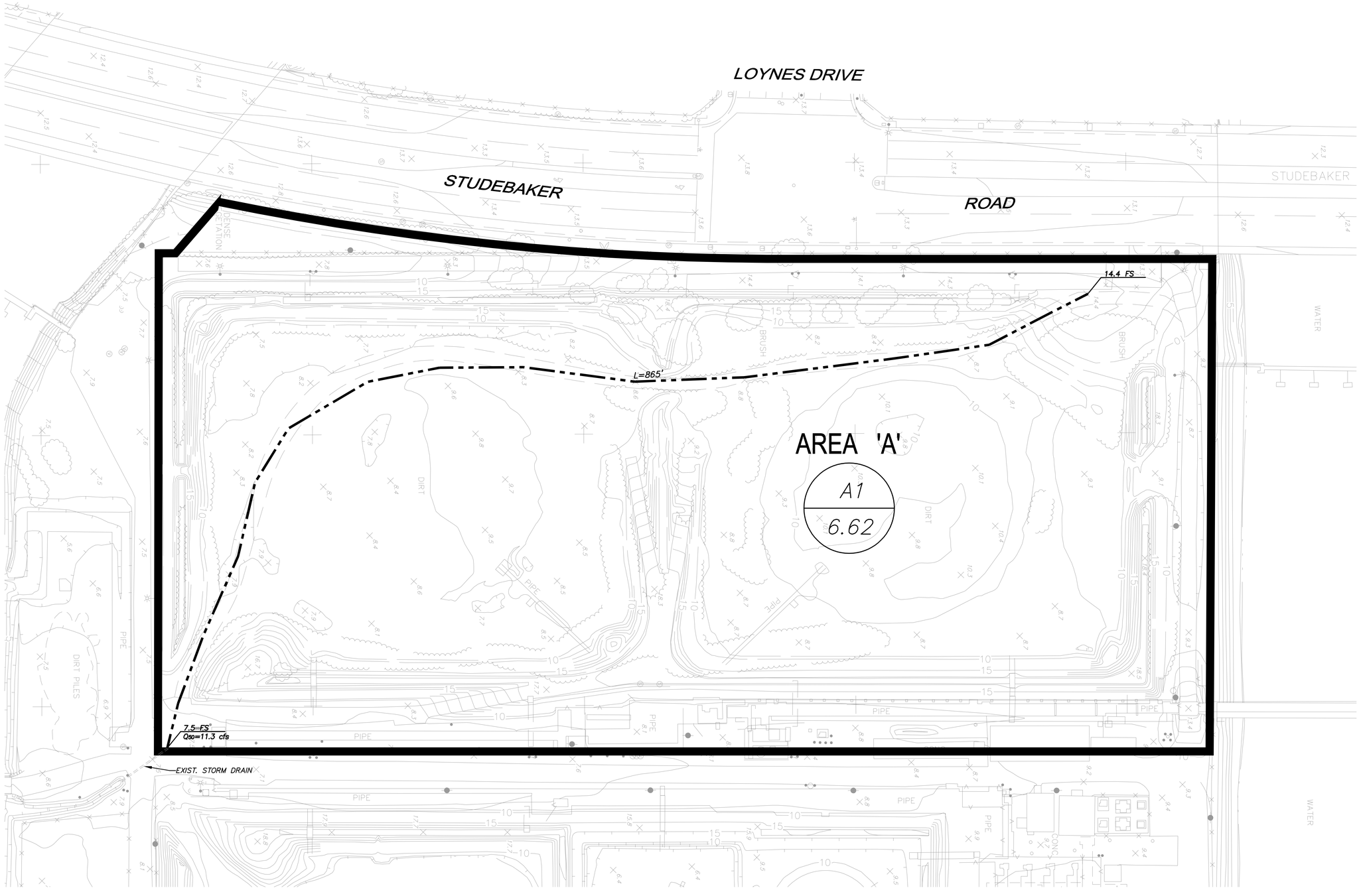
STUDBAKER LONG BEACH



Map Tips

APPENDIX C

EXISTING CONDITIONS EXHIBIT



PERVIOUS DATA
LANDSCAPE AREAS = 0.00 ACRES *
TOTAL AREA = 6.62 ACRES
IMPERVIOUS AREA = 100%

NOTE:
*BASED ON HISTORIC LAND USE.

LEGEND

	MAJOR DRAINAGE AREA BOUNDARY	335.40 INV	INVERT ELEVATION
	SUB-DRAINAGE AREA BOUNDARY	AREA 'A'	DRAINAGE AREA
L=100'	FLOW PATH WITH LENGTH		
A1	DRAINAGE AREA DESIGNATION		
1.00	AREA IN ACRES		
335.4 FS	FINISHED SURFACE ELEVATION		
Q50=1.6 cfs	FLOW RATE OF 50 YEAR STORM (cfs)		
12	NODE NUMBER		

30 0 30 60 90
SCALE: 1"=30'

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PREPARED BY:
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NEWPORT BEACH, CA 92660

EXHIBIT A
HYDROLOGY MAP
LONG BEACH INDUSTRIAL PARK
EXISTING CONDITION

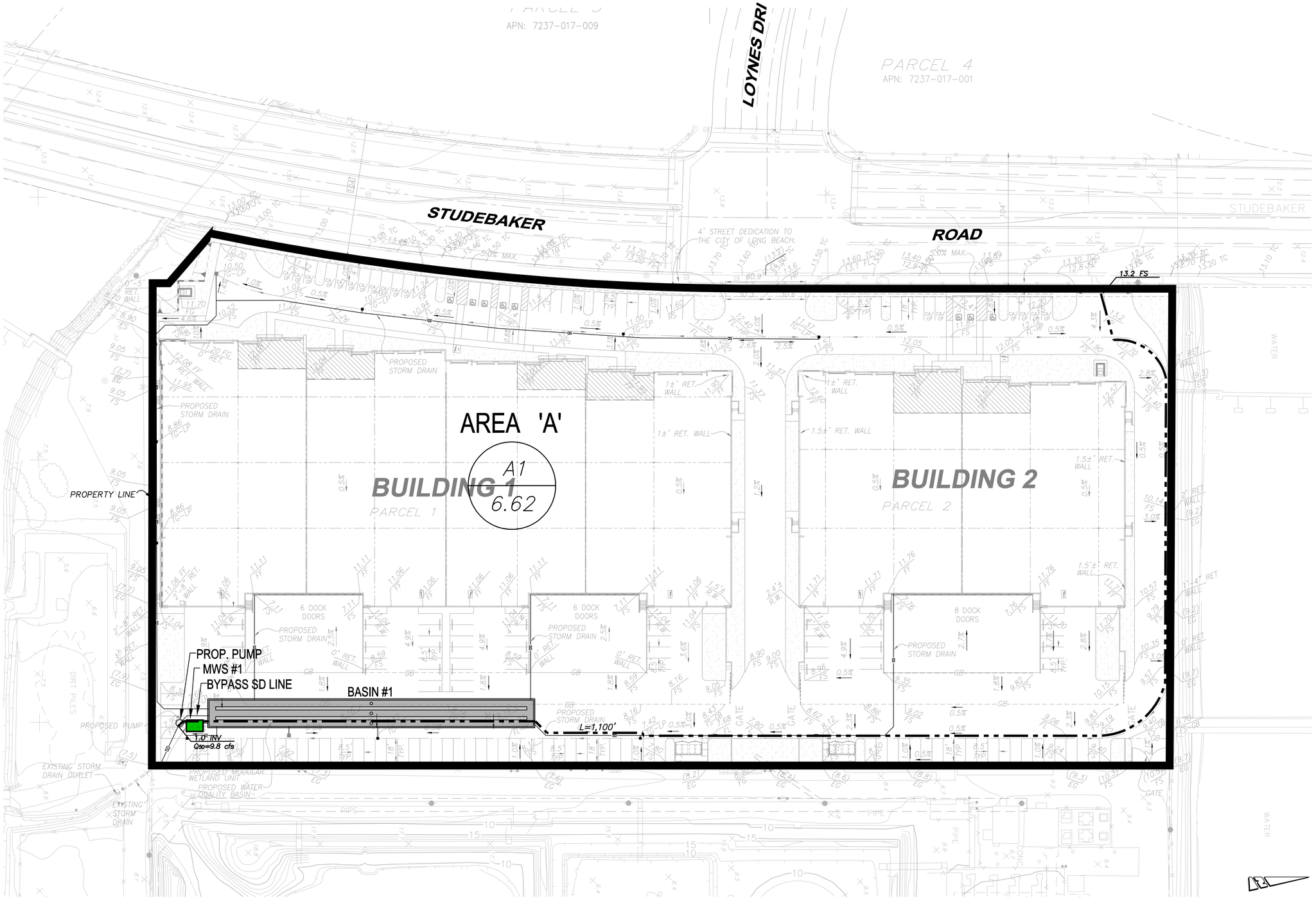
DATE: 11/5/18

SHEET 1 OF 1

Drawing Name: Z:\06.198.000 Long Beach\Hydro\EXHIBITS\EXHIBIT A - EXISTING CONDITIONS.dwg

Plotted: Nov 06, 2018 - 3:53pm by: Sam Aguilar

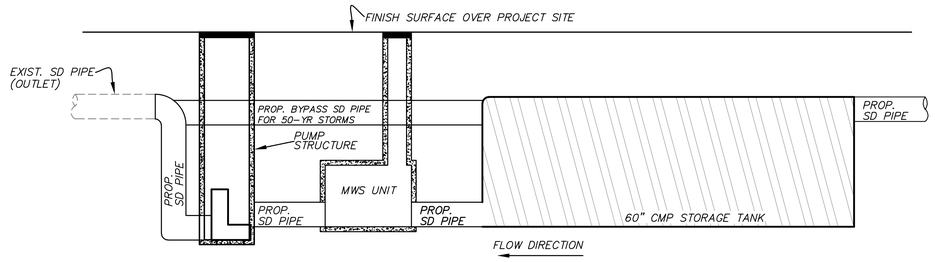
DEVELOPED CONDITIONS EXHIBIT



PERVIOUS DATA
LANDSCAPE AREAS = 0.63 ACRES
TOTAL AREA = 6.62 ACRES
IMPERVIOUS AREA = 90%

LEGEND

	MAJOR DRAINAGE AREA BOUNDARY	335.40 INV	INVERT ELEVATION
	SUB-DRAINAGE AREA BOUNDARY	AREA 'A'	DRAINAGE AREA
L=100'	FLOW PATH WITH LENGTH	MWS #1	MODULAR WETLAND UNIT NUMBER
	STORM DRAIN PIPE	BASIN #1	CMP UNDERGROUND WATER QUALITY BASIN NUMBER
B2	DRAINAGE AREA DESIGNATION		CMP UNDERGROUND WATER QUALITY BASIN
1.21	AREA IN ACRES		MODULAR WETLAND UNIT
335.40 FS	FINISHED SURFACE ELEVATION		



WATER QUALITY SYSTEM / DRAINAGE DETAIL
NTS

30 0 30 60 90
SCALE: 1"=30'

PREPARED FOR:
PROACTIVE ENGINEERING CONSULTANTS
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EXHIBIT B
HYDROLOGY MAP
LONG BEACH INDUSTRIAL PARK
DEVELOPED CONDITION

DATE: 11/5/18

SHEET 1 OF 1

Drawing Name: Z:\06.198.000 Long Beach\Hydro\EXHIBITS\EXHIBIT B - DEVELOPED CONDITIONS.dwg

Plotted: Nov 06, 2018 - 3:50pm by: Sam Aguilar