Appendix G:
Hydrology and Water Quality Supporting Information

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G.1 - Stormwater Control Plan

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PRELIMINARY STORMWATER CONTROL PLAN

For

506 BROOKSIDE DRIVE

On-Site and Street Improvements

July 31, 2018

506 Brookside Drive
CenterPoint Properties

725 S. Figueroa Street, Suite 3005
Los Angeles, CA 90248

SWCP Prepared by:
Kier & Wright Civil Engineers & Surveyors
3639 Harbor Blvd. Suite 202
Ventura, CA 93001
Chuck McCallum, PE
805-620-0645

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I. 506 BROOKSIDE DRIVE DATA

Table 1. On-Site and Street Improvement Data

506 Brookside Drive	Industrial Warehouses and Associated Street Improvements
Application Submittal Date	July 31,2018
Project Location	Contra Costa County
Name of Developer	CenterPoint Properties
Project Phase No.	N/A
Project Type and Description	Industrial Warehouses and Associated Street Improvements
Project Watershed	San Pablo Creek
Total Project Site Area (acres)	32.84
Total Area of Land Disturbed (acres)	32.49
Total New Impervious Surface Area	1,126,605 ft^2
Total Replaced Impervious Surface Area	122,124 ft^2
Total Pre-Project Impervious Surface Area	122,124 ft^2
Total Post-Project Impervious Surface Area	1,207,642 ft^2
50% Rule [*]	N/A
Project Density	N/A
Applicable Special Project Categories	N/A
Percent LID	100%
HMP Compliance [†]	N/A

07/31/2018

Pervious and Impervious Area

On-Site:			
Proposed:		LID Bioswale	
Pervious Area:	189,113 S.F.	*Required*	*Proposed*
Impervious Area:	1,166,555 S.F.	47,124 S.F.	73,738 S.F.
Total Area:	1,355,668 S.F.		
Street Imp.:			
Proposed:		LID Bioswale	
Pervious Area:	18,383 S.F.	*Required*	*Proposed*
Impervious Area (Pavement Rehab):	41,087 S.F.		
Impervious Area (Overlay)	00 S.F.	1,709 S.F.	1,991 S.F.
Total Area:	59,470 S.F.		
Total:			
Proposed:		LID Bioswale	
Pervious Area:	207,476 S.F.	*Required*	*Proposed*
Impervious Area (Does not include Street Area Overlay):	1,207,642 S.F.	51,736 S.F.	69,952 S.F.
Total Area:	1,415,138 S.F.		

I. Executive Summary

The Stormwater Control Plans (SWCP) will address the provisions recommended for post construction stormwater control for 506 Brookside Drive in accordance with the C.3 stormwater guidebook from Contra Costa County. The SWCP was based on research and environmental planning for water quality, and will showcase the steps taken to design an effective and environmentally conscious SWCP for post construction stormwater controls.

Modifications to storm drainage will be very minimal during construction. Development will involve clearing and grubbing, use of heavy equipment, demolition of existing buildings, grinding of pavement & concrete, paving, grading and handling of a large variety of building materials. Stormwater runoff volumes may be affected during construction by demolition, grading, foundation construction, structural work, and building finish work.

The project is designed to treat stormwater runoff and will create negligible flow or volume changes to the existing drainage. The design will not exceed the capacity of off-site drainage facilities. Pervious surfaces will be used wherever feasible while replacing existing impervious surfaces to provide stormwater infiltration treatment. Stormwater runoff from the site will eventually drain downstream to the San Pablo Creek. This report will showcase the collective effort taken to design and implement an effective and environmentally conscious SWCP.

Hydro-modification for the entire project will be accommodated. It could be accommodated by the use of detention sufficient to capture the increase in volume during the 24-hour, 10-year design storm and smaller C.3 storm.

No construction shall be permitted anywhere on the Project site unless the applicant demonstrates, to the satisfaction of the Director of Public Works Department, either of the following:

(a) Upon completion of such construction, there will be sufficient detention capacity on the Project site to detain the incremental increase in stormflow volume that occurs during the 24-hour, 10-year design storm, which incremental increase is due to the increase in impervious surface above pre-project levels. Upon completion of such construction, the total square footage of impervious surface area throughout the Project site will remain at or below pre-project levels.

This mitigation measure will assure that hydro-modification is accommodated for the project.

The site will each be improved with new ingress/ egress, public improvements, utility improvements, and new industrial buildings.

I.A. On-Site

The existing site consists of undeveloped area. The site is relatively level and has asphalt driveways and parking. The existing impervious area is roughly 81,037 ft^2. Mean annual precipitation for this area is 21.75 inches according to attached Figure 1 – Contra Costa County Isohyet Map B-166.

The proposed area for 506 Brookside on-site will include improvements on existing in the unincorporated area of Contra Costa County adjacent to North Richmond. Improvements will occur at the south side of Brookside Drive and east of Fred Jackson Way. The total proposed site will include an area of 31.12 acres

I.B. Off-Site Street Improvements

The existing off- site street Brookside Drive include landscaping and street pavement. The site slopes to the west along Brookside Drive with existing impervious area of roughly 41,087 ft^2. The actual portion of existing pavement to be removed and replaced is approximately 41,087 ft^2. The landscape area will remain the same approximately 16,392 ft^2 after construction within the public right-of-way. Mean annual precipitation for this area is 21.75 inches according to attached Figure 1 – Contra Costa County Isohyet Map B-166.

APPENDIX II.A

PRELIMINARY STORMWATER CONTROL PLAN

For

506 BROOKSIDE DRIVE ON-SITE

July 31, 2018

506 Brookside Drive

CenterPoint Properties

725 S. Figueroa Street, Suite 3005
Los Angeles, CA 90248

SWCP Prepared by:
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Attachments

Figure 1 Contra Costa County Isohyet Map B-166
Figure 2 Stormwater Treatment Plan Exhibit

Note: final SWCP will include landscape plans and soils report.

This Stormwater Quality Control Plan was prepared using the template dated February 15, 2012.

I. PROJECT DATA

Table 1. Project Data

Project Name/Number	506 Brookside Drive
Application Submittal Date	July 31,2018
Project Location	Contra Costa County
Name of Developer	CenterPoint Properties
Project Phase No.	N/A
Project Type and Description	Industrial Distribution Warehouse
Project Watershed	San Pablo Creek
Total Project Site Area (acres)	31.47
Total Area of Land Disturbed (acres)	31.12
Total New Impervious Surface Area (sq.ft.)	1,085,518 ft^2
Total Replaced Impervious Surface Area	81,037 ft^2
Total Pre-Project Impervious Surface Area	81,037 ft^2
Total Post- Project Impervious Surface Area	1,166,555 ft^2
50% Rule[*]	Does Not Apply
Project Density	Floor Ratio Ratio = 0.41
Applicable Special Project Categories	n/a
Percent LID and non-LID treatment	100% LID
HMP Compliance [†]	Applicable

II. SETTING

II.A. Project Location and Description

This Stormwater Control Plan (SWCP) will address the provisions recommended for post construction stormwater control for 506 Brookside Drive in accordance with the C.3 stormwater guidebook from Contra Costa County. The SWCP was based on research and environmental planning for water quality, and will showcase the steps taken to design an effective and environmentally conscious SWCP for post construction stormwater controls.

The proposed area for 506 Brookside Drive On-Site will include improvements to the existing site in the unincorporated area of Contra Costa County adjacent to North Richmond. Improvements will occur at the south side of Brookside Drive, east of Fred Jackson Way. The total proposed site will include an area of 31.47acres. The site will include new ingress/egresses, utility improvements and 3 new warehouses with offices. The proposed structures will total approximately 564,940 ft^2 with a Floor Area Ratio of 0.41.

The On-Site project is designed to treat stormwater runoff and will create negligible flow or volume to the existing drainage. The design will not exceed the capacity of off-site drainage facilities. Pervious surfaces will be used wherever feasible. Stormwater runoff from the site will eventually drain downstream to the San Pablo Creek. This report will showcase the collective effort taken to design and implement an effective and environmentally conscious SWCP.

II.B. Existing Site Features and Conditions

The existing site consists of a few residential buildings and undeveloped area. The site is relatively level and has asphalt driveways and parking at the residential buildings. The existing impervious area is roughly 81,037 ft^2. Mean annual precipitation for this area is 21.75 inches according to attached Figure 1 – Contra Costa County Isohyet Map B-166.

II.C. Opportunities and Constraints for Stormwater Control

The primary challenge for stormwater treatment is the existence of impermeable soils (soil clay group D). Discharge of runoff by deep infiltration is not feasible due to the low permeability of the clay soils. Every effort has been made to use indirect filtration methods like Bioretention Facilities for stormwater treatment. Bioretention Facilities are used for treating building roofs, driveways, sidewalks and all proposed hardscape.

III. LOW IMPACT DEVELOPMENT DESIGN STRATEGIES

III.A. Optimization of Site Layout

Every effort has been made to limit the imperviousness of the site. The existing site consists mostly of undeveloped area. The following site layout characteristics help reduce watershed impacts:

- The site design includes designing landscaped-based Bioretention Facilities to collect runoff that would otherwise flow directly to the storm drain system. See section IV for additional descriptions.
- There is an open area in the northwest portion of the site.
- The roof drains of the proposed buildings will discharge into a Bioretention Facilities located within the parcel boundary.

III.B. Use of Permeable Pavements

Conventional concrete and asphalt are used throughout the On-Site project. Permeable pavements will be considered if their use can be deemed beneficial to the On-Site project and watershed. Areas designated for self-treatment will be called out on the SWQP.

III.C. Dispersal of Runoff to Pervious Areas

Runoff from the proposed improvements, wherever possible within good engineering practice, has been directed to pervious areas. To offset runoff to new areas that do not directly drain to pervious areas, existing pavement area runoff is proposed to be collected in Bioretention Facilities. Refer to Figure 2 SWCP for locations and size.

III.D. Feasibility Assessment of Harvesting and Use for Treatment and Flow-Control

III.D.1. Permeability of Site Soils

Though the actual saturated hydraulic permeability (Ksat) is unknown, given the high clay content of the soils and known data in nearby surrounding area, this On-Site project's Ksat is much less than 1.6 inches/hour. Typically high clay content is indicative of very low saturated hydraulic conductivity. Therefore, stormwater treatment systems have been designed accordingly.

III.D.2. Potential Opportunities for Harvesting and Use

As most of the site is being occupied warehouse buildings, the opportunity to collect roof runoff and store that runoff is very limited. Although there is substantial roof area, the ability to gather, store and reuse is not feasible, due to the intricacies of the rooftop design. Besides the proposed warehouse building rooftops there are not much other opportunities for harvesting rainwater. The limited amount of at grade asphalt and sidewalk is split with a good percentage being within the public right of way. The remaining area is so limited that runoff volumes would be too small for any real reuse or benefit.

III.E. Integrated Management Practices

The site proposes to use treatment only Bioretention Facilities to meet the stormwater quality standards for the On-Site project.

IV. DOCUMENTATION OF DRAINAGE DESIGN

IV.A. Descriptions of each Drainage Management Area

IV.A.1. Table 2. Drainage Management Areas

DMA Name	*Surface Type*	*Area (ft^2)*
DMA-1	*Pavement, landscape and driveway apron*	*16,586*
DMA-2	*Pavement ,landscape and driveway apron*	*17,193*
DMA-3	*Roof, pavement, landscape and driveway apron*	*32,749*
DMA-4	*Roof, pavement, landscape and driveway apron*	*57,302*
DMA-5	*Roof, pavement, landscape and driveway apron*	*217,979*
DMA-6	*Roof, pavement landscape and driveway apron*	*172,453*
DMA-7	*Roof, pavement and landscape*	*254,830*
DMA-8	*Roof, pavement, landscape and driveway apron*	*586,576*

IV.A.2. Drainage Management Area Descriptions

A summary of the treated impervious areas and method of treatment:

DMA1, totaling 16,586 ft², will drain, pavement, landscape and driveway apron area to **Bioretention Facility IMP1** and discharges to the proposed new storm drain system.

DMA2, totaling 17,193 ft², will drain pavement, landscape and driveway apron area to **Biotretention Facility IMP2** and discharges to the proposed new storm drain system.

DMA3, totaling 32,749 ft², will drain proposed roof, pavement, landscape and driveway apron area to **Bioretention Facility IMP3** and discharges to the proposed new storm drain system.

DMA4, totaling 57,302 ft², will drain proposed roof, pavement, landscape and driveway apron to **Bioretention Facility IMP4** and discharges to the proposed new storm drain system.

DMA5, totaling 217,979 ft², will drain proposed roof, pavement, landscape and driveway apron to **Bioretention Facility IMP5** and discharges to the proposed new storm drain system.

DMA6, totaling 72,453 ft², will drain proposed roof, pavement, landscape and driveway apron area to **Biotretention Facility IMP6** and discharges to the proposed new storm drain system.

DMA7, totaling 254,830 ft², will drain proposed roof, pavement, and landscape area to **Bioretention Facility IMP7** and discharges to the proposed new storm drain system.

DMA8, totaling 586,576 ft², will drain proposed roof, pavement, landscape and driveway apron to **Bioretention Facility IMP8** and discharges to the proposed new storm drain system.

IV.B. Tabulation and Sizing Calculations

IV.B.1. Information Summary for IMP Design

Table 3. IMP Design Summary

Total On-Site Project Area	1,355,668 ft²
Mean Annual Precipitation	21.75 in
IMPs Designed For:	Treatment and Flow-Control

IV.B.2. Self-Treating Areas

Table 4. Self-Treating Areas

None

IV.B.3. Areas Draining to IMPs

Table 5. IMP Sizing Calculations

IMP Name: IMP1
IMP Type: Flow-Through Planter
Soil Group: IMP1

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing			
DMA1 IMPV	12,185	Concrete or Asphalt	1.00	12,185	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
DMA1 LAND	3,719	Landscape	0.10	372				
			Total	12,557				
				Area	0.040	1.000	502	682

IMP Name: IMP 2
IMP Type: Flow-Through Planter
Soil Group: IMP 2

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing			
DMA2 IMPV	10,702	Concrete or Asphalt	1.00	10,702	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
DMA2 LAND	5,270	Landscape	0.10	527				
			Total	11,229				
				Area	0.040	1.000	449	1,221

IMP Name: IMP3
IMP Type: Flow-Through Planter
Soil Group: IMP3

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing			
DMA3 IMPV	9,959	Concrete or Asphalt	1.00	9,959	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
DMA3 ROOF	15,075	Conventional Roof	1.00	15,075				
DMA3 LAND	4,883	Landscape	0.10	488				
			Total	25,522				
				Area	0.040	1.000	1,021	2,832

IMP Name: IMP4
IMP Type: Flow-Through Planter
Soil Group: IMP4

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing			
DMA4 IMPV	29,909	Concrete or Asphalt	1.00	29,909	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
DMA4 ROOF	21,023	Conventional Roof	1.00	21,023				
DMA4 LAND	3,674	Landscape	0.10	367				
			Total	51,299				
				Area	0.040	1.000	2,052	2,696

Table 5. IMP Sizing Calculations (cont.)

IMP Name: IMP5
IMP Type: Flow-Through Planter
Soil Group: IMP5

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing			
					IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
DMA5 IMPV	107,386	Concrete or Asphalt	1.00	107,386				
DMA5 ROOF	87,545	Conventional Roof	1.00	87,545				
DMA5 LAND	11,869	Landscape	0.10	1,187				
			Total	196,118				
				Area	0.040	1.000	7,845	11,179

IMP Name: IMP6
IMP Type: Flow-Through Planter
Soil Group: IMP6

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing			
					IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
DMA6 IMPV	91,030	Concrete or Asphalt	1.00	91,030				
DMA6 ROOF	50,689	Conventional Roof	1.00	50,689				
DMA6 LAND	20,236	Landscape	0.10	2,024				
			Total	143,743				
				Area	0.040	1.000	5,750	10,498

IMP Name: IMP7
IMP Type: Flow-Through Planter
Soil Group: IMP7

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing			
					IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
DMA7 IMPV	109,354	Concrete or Asphalt	1.00	109,354				
DMA7 ROOF	125,775	Conventional Roof	1.00	125,775				
DMA7 LAND	9,409	Landscape	0.10	941				
			Total	236,070				
				Area	0.040	1.000	9,443	10,292

IMP Name: IMP8
IMP Type: Flow-Through Planter
Soil Group: IMP8

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor	IMP Sizing			
					IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
DMA8 IMPV	242,168	Concrete or Asphalt	1.00	242,168				
DMA8 ROOF	253,755	Conventional Roof	1.00	253,755				
DMA8 LAND	56,315	Landscape	0.10	5,632				
			Total	501,555				
				Area	0.040	1.000	20,062	34,338

V. SOURCE CONTROL MEASURES

V.A. Site activities and potential sources of pollutants

V.B. Source Control Table

Table 6. Sources and Source Control Measures

Potential source of runoff pollutants	*Permanent source control BMPs*	*Operational source control BMPs*
On-Site Storm Drain Inlets	Mark all inlets with the words "No Dumping! Flows to River" or simialr	Maintain and periodically repaint or replace inlet markings and provide stormwater pollution prevention information to new site owners, lessors, or operators. storm drains.
Landscape/Outdoor Pesticide Use	The timing and application methods of the irrigation system at the site have been designed so as to minimize the runoff of excess irrigation water into the stormwater conveyance system.	Maintain landscaping using minimum or no pesticides and provide IPM information to new owners, lessors, and operators.
Plazas, Sidewalks and Parking Garage	Sidewalks and other concrete areas drain to landscape areas where possible.	Sweeping plazas, sidewalks, and parking garage weekly.

V.C. Features, Materials, and Methods of Construction of Source Control BMPs

All storm drain inlets will be marked "No Dumping – Drains to Bay".
All interior floor drains are plumbed to sewer.
The site is designed to minimize runoff and collect drainage in infiltration planters.
All site refuse will be collected in a trash enclosure.
The dock doors will be equipped with door skirts.
Fire sprinkler test water will be filtered through de-chlorination tablets before being discharged to the surface and drained through the bioretention areas.

VI. STORMWATER FACILITY MAINTENANCE

VI.A.1. Commitment to Execute any Necessary Agreements

Agree to provide any necessary easements or rights of entry to Contra Costa County for access and inspection of stormwater BMPs and to make provision of easements or rights of entry a condition of sale.

VI.A.2. Statement Accepting Responsibility for Operation and Maintenance until Responsibility is Transferred

The developers of 506 Brookside Drive agrees to operate and maintain the bioretention facilities until one of the following occurs: (1) Acceptance of maintenance responsibility by Contra Costa County, including the filing of all required easements and establishment of a special district or other permanent funding mechanism or (2) Recordation of Codes, Covenants, and Responsibilities or other agreement that runs with the land and requires future owners to provide and pay for maintenance of stormwater BMPs.

VI.A.3. Stormwater Facilities Operations and Maintenance Plan

The developers of 506 Brookside Drive will submit, with the application for building permits, a draft Stormwater Facilities Operation and Maintenance Plan including detailed maintenance requirements and a maintenance schedule.

VI.B. Summary of Maintenance Requirements for Each Stormwater Facility

Maintenance of BMPs is imperative for adequate stormwater treatment. Maintenance is as follows:

Bioretention Facilities: These areas remove stormwater pollutants through a combination of overland flow through vegetation, surface detention, and filtration through soil. Frequent inspection and maintenance is required until vegetation becomes established. Thereafter, routine maintenance requirements are considered minimal.

Typical routine maintenance consists of the following:

- Inspect soils and plantings. Remove weeds, prune vegetation and replenish mulch as needed. Clear any obstructions and remove accumulation of sediment.
- Inspect side slopes for evidence of instability or erosion and correct as necessary.
- Observe soil at the bottom of the ponding area for uniform percolation throughout. If portions of the area do not drain within 48 hours after the end of a storm, the soil should be tilled and replanted. Remove any debris or accumulation of sediment.
- Examine the vegetation to insure that it is healthy and dense enough to provide filtering and to protect soils from erosion. Confirm that irrigation is adequate and not excessive. Replace dead plants and remove invasive vegetation.

- Abate any potential vectors by filling in holes in the ground and around the ponding area. If mosquito larvae are present and persistent, contact the Contra Costa County Vector Control District for information and advice. Mosquito larvicides should be applied only when necessary and then only by a licensed professional.

VII. CONSTRUCTION PLAN C.3 CHECKLIST

Table 7. Construction Plan C.3 Checklist

Stormwater Control Plan Page #	*BMP Description*	*See Plan Sheet #s*
3-6	Bioretention Facilities to treat stormwater runoff.	C4

VIII. CERTIFICATIONS

The selection, sizing, and preliminary design of stormwater treatment and other control measures in this plan meet the requirements of Regional Water Quality Control Board Order R2-2009-0074 and Order R2-2011-0083.

APPENDIX II.B

PRELIMINARY STORMWATER CONTROL PLAN

For

506 BROOKSIDE DRIVE
STREET IMPROVEMENTS

July 31, 2018

506 Brookside Drive

CenterPoint Properties

725 S. Figueroa Street, Suite 3005
Los Angeles, CA 90248

SWCP Prepared by:
Kier & Wright Civil Engineers & Surveyors
3639 Harbor Blvd. Suite 202
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Attachments

Figure 1 Contra Costa County Isohyet Map B-166
Figure 3 Stormwater Treatment Plan- Streets Exhibit

Note: final SWCP will include landscape plans and soils report.

This Stormwater Quality Control Plan was prepared using the template dated February 15, 2012.

G.2 - Preliminary Drainage Study

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PRELIMINARY
HYDROLOGY AND HYDRAULICS REPORT

For

506 BROOKSIDE DRIVE

July 31th, 2018

CenterPoint Properties

725 S. Figueroa Street, Suite 3005
Los Angeles, CA 90248

Prepared by:

Kier & Wright Civil Engineers & Surveyors

2850 Collier Canyon Road

Livermore, CA 94551

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- Land Use Map – File No. FD 12425

Executive Summary

This document addresses the hydrology associated with the development of the 506 Brookside Drive project located at the intersection of Brookside Drive and Fred Jackson Way, in unincorporated Contra Costa County; and more importantly, the effect this development has on existing downstream storm drain facilities. This document consists of the following:

- This Executive Summary
- A report documenting the analysis of stormflows using the Contra Costa County Rational Method,
- Attachments documenting the analysis of stormflow using the Contra Costa County Small Watershed Hydrograph Method (SWHM) for detention routing, and
- Figures showing Drainage Area 19A

The 506 Brookside project is approximately 31 acres, and upon completion, will contain approximately 555,510 square feet of building warehouse space, approximately 613,947 square feet of associated hardscape, and approximately 202,683 square feet of landscape area (including C.3 bioretention facilities). Roadway improvements will occur along Brookside Drive, and will result in street widening and landscaping features for storm water treatment of the improved street sections.

The proposed project is mapped within Drainage Area 19A per County drainage maps, and drains to both San Pablo Creek and Wild Cat Creek. More specifically, the project is comprised of portions of Subareas Aa, Ac, Ba, Bb, Bc, Be, and Ea. Subareas are named per the storm drain main they are tributary to, with 'A' Subareas draining to Line A which drains south to Wild Cat Creek, 'B' Subareas draining to Line B which drains north to San Pablo Creek, and Subarea Ea directly discharging to Wild Cat Creek.

Per the County Hydrology Map for Drainage Area 19A, expected runoff rates have been identified for each subarea within the tributary based on zoned land use, and these runoff rates have been used for the design of storm drain facilities serving the watershed. In regard to this analysis, these runoff values will be identified as the allowable runoff rates for the project since the existing zoning will not be changed. The allowable runoff rate for the 10-year storm event for the northern portion of the project site draining to Line B, and ultimately to San Pablo Creek, has been shown on the map to be approximately 25.2 cfs. The allowable runoff rate for the 10-year storm event for the southern portion of the project site draining to Line A, and ultimately to Wild Cat Creek, has been determined to be approximately 19.2 cfs.

The Contra Costa County Small Watershed Hydrograph Method (SWHM) has been utilized to calculate the expected 10-year storm event runoff for the proposed project. The rational method hydrology was used as the basis for the input data. Attachments 1 and 3 of this report contain the results of the SWHM calculations. The SWHM shows that the expected 10-year storm event runoff rate for the proposed project will be approximately 40-45 cfs, depending on the grading scheme and routing of the onsite flow.

End of Executive Summary

ANALYSIS OF STORMFLOWS USING THE CONTRA COSTA COUNTY RATIONAL METHOD

Introduction

This report addresses hydrology issues related to the development of the proposed 506 Brookside Drive project.

The purpose of this report is to identify the potential impacts to off-site drainage facilities from the proposed 506 Brookside project. The project is located in a watershed that is approximately 82 acres, which is far smaller than one square mile. Under County standards, drainage facilities in watersheds of less than one square mile must be hydraulically adequate for a 10-year, 24-hour design storm. This report accordingly addresses drainage during a 10-year design storm. A 10-year, 24-hour design storm has a statistical likelihood of occurring approximately once every ten years for a 24-hour return period.

Project Description

The 506 Brookside Drive project proposes to develop an area located at the corner of Brookside Drive and Fred Jackson Way in the unincorporated (Richmond) area of Contra Costa County. All existing structures and pavement on the privately-owned portions of the site will be removed and replaced with new facilities. The 506 Brookside project will include three new industrial warehouse buildings that make up approximately 555,510 sf in total, and associated hardscape and landscape areas. The project also includes roadway improvements to Brookside Drive. In addition, the project will provide storm water treatment in the form of bio-retention planters.

Section1: Predevelopment Condition

Existing On-site Topography and Drainage Patterns

The 506 Brookside Drive project and offsite improvement areas drain to two separate watersheds. Brookside Drive, the north portion of Fred Jackson Way (north of Pittsburg Avenue), and the northern 17.6 acres of the existing onsite area drain north to the San Pablo Creek Watershed. The southern portion of Fred Jackson Way (south of Pittsburg Avenue) and the southern 13.4 acres of the existing onsite area drain south to the Wild Cat Creek Watershed.

The northern portion of the site runoff (subarea Ba, Bc, Be,) is approximately 34.5-cfs which drains to San Pablo Creek, surface drains from southeast to northwest where it is largely collected by a series of open channel ditches and varying sized pipe culverts which flow west along Brookside Drive and ultimately into an existing 48" storm drain at the corner of Brookside and Fred Jackson Way. This 48" drain crosses Fred Jackson Way and then redirects to the north and crosses Brookside Drive and continues north until it discharges into San Pablo Creek. This system is designated as 'Line B' by the County Drainage Plan for Drainage Area 19A.

The southern portion of the site runoff (subarea Aa, Ac) is approximately 23-cfs which drains to Wild Cat Creek surface flows from east to west where it is collected along Fred Jackson Way and conveyed south into an existing 36" storm drain that drains south along Fred Jackson Way until it discharges into Wild Cat Creek. This system is designated as 'Line A' by the County Drainage Plan for Drainage Area 19A.

Section 2: Rational Method Hydrology

As previously discussed in the Executive Summary of this report, allowable runoff rates for the project site were taken from the County Hydrology Map for Drainage Area 19A. The allowable runoff rate for the northern portion of the site that is conveyed by Line "B", comprised by subareas Ba, Bb and Bc, is approximately 34.5 cfs. The allowable runoff rate for the southern portion of the site that is conveyed by Line "A", comprised of subareas Aa and Ac, is approximately 23 cfs. These values are what the Master Drainage Plan deems allowable from the proposed site draining into County storm drain Lines A and B.

To determine the expected runoff rate from the site for the 10-year storm event, the Contra Costa County Small Watershed Hydrograph Method (SWHM) was used. The mean seasonal rainfall for the site is 21.75", which was taken from the Contra County Isohyet Map (Drawing B-166). Time of concentration for the proposed site varies depending on the grading scheme. Time of concentration for the site ranges from 12 – 20 minutes under the different scenarios analyzed. Using County precipitation duration-frequency-depth curves (Drawing B-159), the associated 10-year storm event precipitation depth for a 15-minute duration storm with MSP of 21.75" is approximately 0.38" for drainage area A, and the associated 10-year storm event precipitation depth for a 15-minute duration for drainage area B is approximately 0.42". Based on the preliminary site use and site plan, a post-developed runoff coefficient of 0.85 was used in accordance with County accepted coefficient for industrial use which ranges between 0.60 – 0.90.

Section 3: Postdevelopment Condition

Effect of Project on Downstream Facilities Based on Contra Costa County Rational Method

As part of the analysis of the effect the proposed development on the existing downstream storm drain facilities, post development runoff was evaluated in order to quantify any increase in runoff from the developed condition.

This analysis was completed in order, to adequately size the onsite storm drain facilities, including the onsite bio-retention planters and to identify the potential impacts to the off-site drainage facilities from the development of the 506 Brookside Drive project. As part of this analysis, we explored and evaluated the capacity of the downstream storm drain facilities designated Line "A" which drains Wild Cat Creek and Line "B" which drains to San Pablo

Creek, within Contra Costa drainage area 19A, and the ability of the existing systems to handle any potential increase in runoff from the proposed development. The hydrologic analysis contained in this report is limited to the on-site area that will be affected by the proposed development, within the property.

The developed portion of the site drainage has been divided into drainage area "A" and drainage area "B". Both drainage areas will be conveyed in a series of roof drains, area drains and/or catch basins and conveyed by storm drain pipes to the bio-retention planters.

Overflow from the on-site bio-retention planters will be conveyed to the off-site storm drain system designated Line "A" which drains Wild Cat Creek and Line "B" which drains to San Pablo Creek.

Addtionally, runoff approximately 8.8 cfs from a portion of existing subarea "Ba", approximately 5.8 ac, drains toward the easterly property line. The offsite drainage area runoff, draining towards the easterly property line will be conveyed through swale/channel and/or catch basins and conveyed by storm drain pipes to the off-site storm drain system, designated Line "B", which unltimately drains to San Pablo Creek.

As part of this development, the existing storm drain facilities designated Line "A" which drains to Wild Cat Creek and Line "B" which drains to San Pablo creek will be constructed in conjunction with this project in accordance with the approved Master Drainage Map.

The proposed improvements to the existing storm drain system and hydrology comparison summary are outlined below:

	Existing Reach		**Proposed Reach**		
Storm Drain Designation	D/S Station	U/S Station±	D/S Station±	U/S Station±	Existing Description
Line A	0+00	6+50	6+50	14+15	36" C.P. w/outlet structure at Wild Cat Creek
Line B	0+00	10+50	10+50	20+60	48" C.P. w/outlet structure at San Pablo Creek

Hydrology Comparison Summary: Existing vs. Proposed Condition

Existing Storm Drain	Existing Drainage Subareas	Allowable Capacity Q (cfs)	Proposed Site Drainage Area	Proposed Q (cfs)	ΔQ (cfs)
Line A	Aa, Ac	23.0	A	19.20	-3.80
Line B	Ba, Bc, Be	34.5	B	25.20	-9.30

Based on the above discussion, calculations, and above described improvements, it is the opinion of this office that development of the subject property as planned will not result in an adverse impact to the subject property, adjacent properties or the existing storm drain system.

Attachment 1: Figures

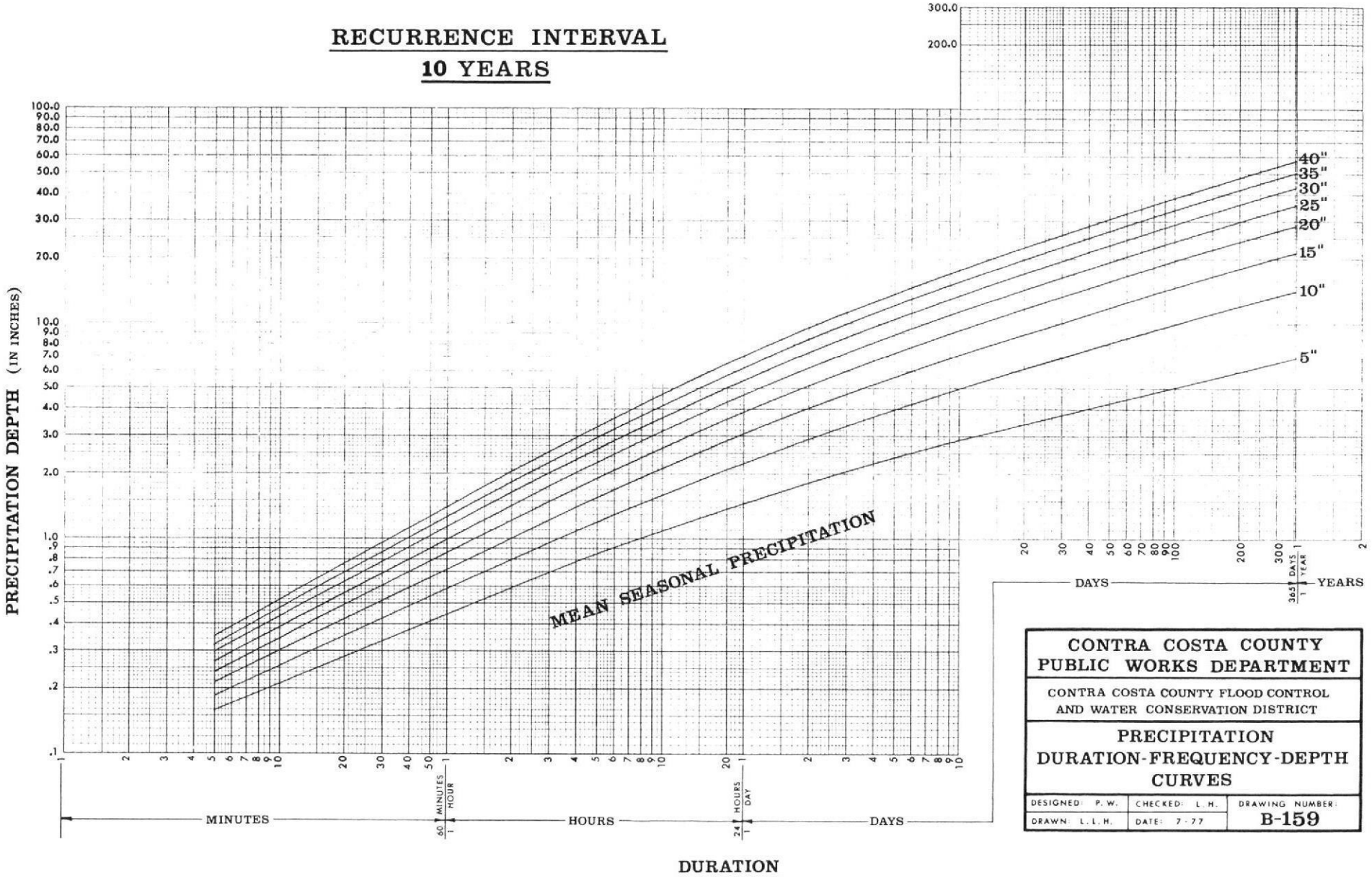
CONTRA COSTA COUNTY
PUBLIC WORKS DEPARTMENT

CONTRA COSTA COUNTY FLOOD CONTROL
AND WATER CONSERVATION DISTRICT

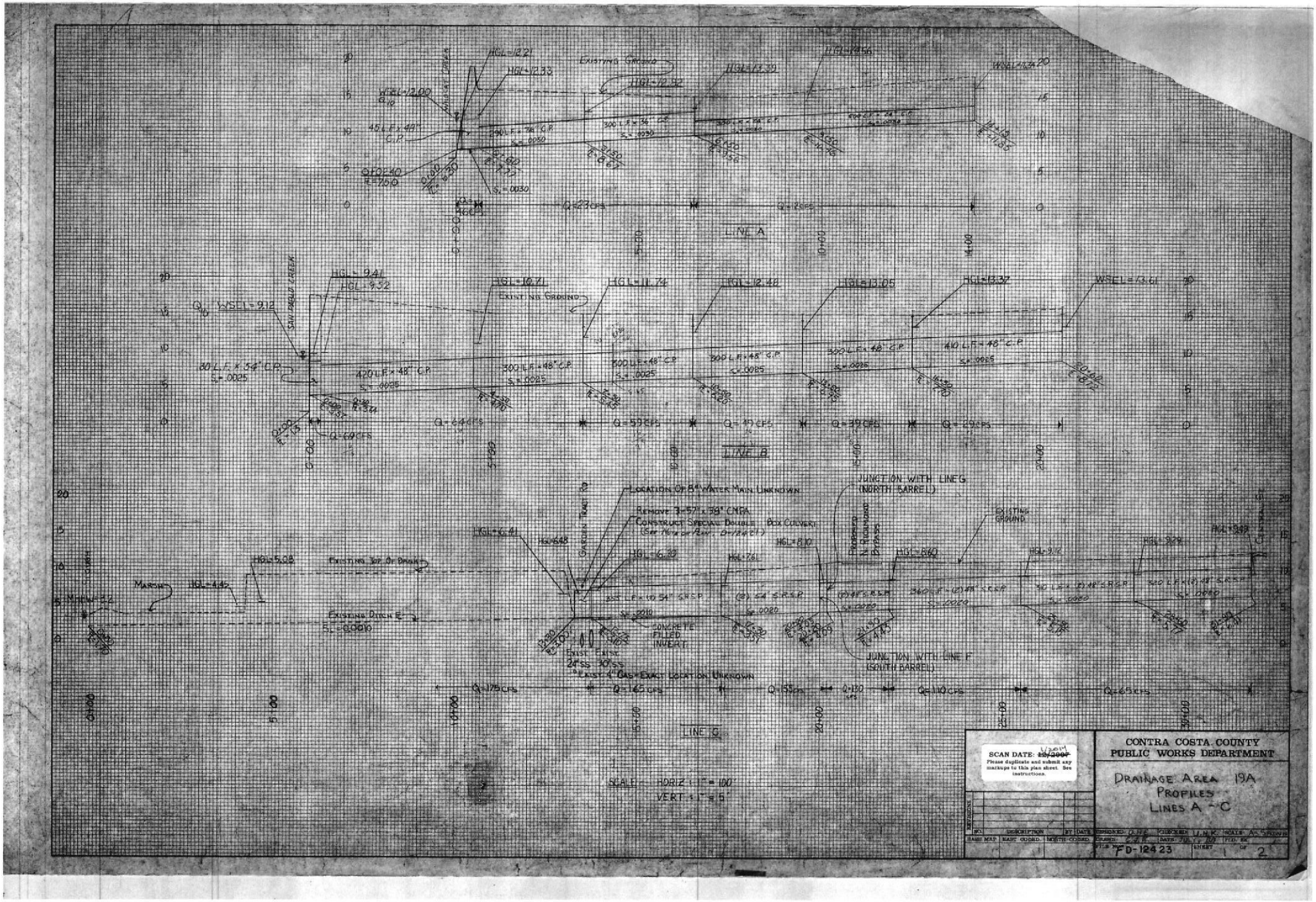
MEAN SEASONAL ISOHYETS
COMPILED FROM PRECIPITATION RECORDS
1879 - 1973

DESIGNED P.W.	CHECKED L.H.	DRAWING NUMBER
DRAWN L.L.H.	DATE 12 77	B-166

RECURRENCE INTERVAL
10 YEARS



CONTRA COSTA COUNTY PUBLIC WORKS DEPARTMENT		
CONTRA COSTA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT		
PRECIPITATION DURATION-FREQUENCY-DEPTH CURVES		
DESIGNED: P. W.	CHECKED: L. H.	DRAWING NUMBER: B-159
DRAWN: L. L. H.	DATE: 7-77	



SCAN DATE: ~~12/30/97~~ 1/20/98

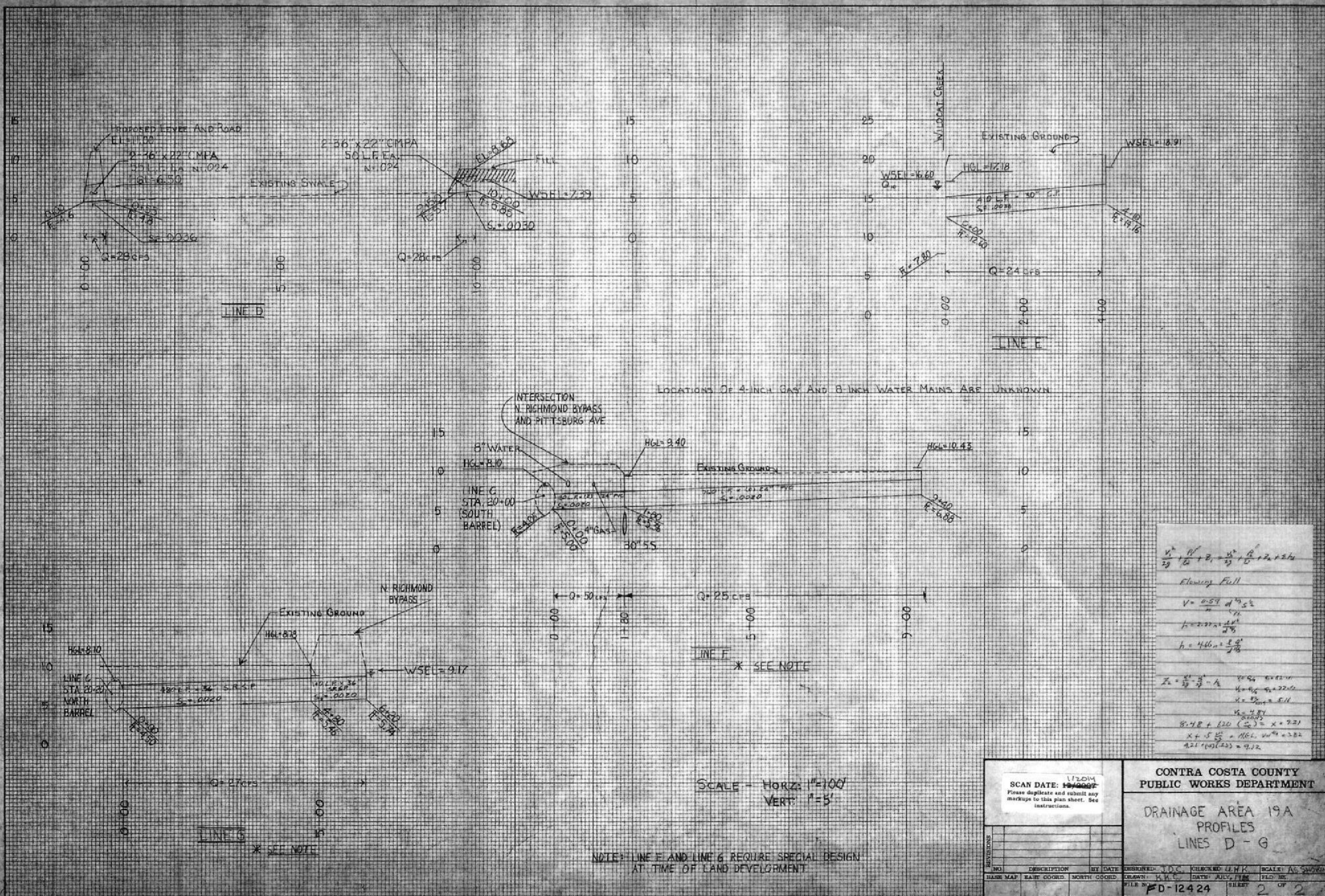
Please duplicate and submit any markups to this plan sheet. See instructions.

CONTRA COSTA COUNTY
PUBLIC WORKS DEPARTMENT

DRAINAGE AREA 19A
PROFILES
LINES A - C

NO.	DESCRIPTION	BY	DATE

DESIGNED: D.H.E. CHECKED: L.H.K. SCALE: AS SHOWN
DRAWN: C.S.R. DATE: JULY '97 FILE NO.
BASE MAP: EAST COORD. NORTH COORD.
FILE FD-12423 SHEET 2 OF


PROPOSED LEVEE AND ROAD
2-36" x 22" CMPA
EXISTING SWALE
2-36" x 22" CMPA
50 L.F. EA.
N=.024
FILL
WSEL=7.39
S=.0030
S=.0036
Q=28 cfs
LINE D
WILDCAT CREEK
EXISTING GROUND
WSEL=18.91
WSEL=16.60
HGL=17.18
Q=24 cfs
LINE E
LOCATIONS OF 4-INCH GAS AND 8-INCH WATER MAINS ARE UNKNOWN
INTERSECTION
N. RICHMOND BYPASS
AND PITTSBURG AVE
8" WATER
HGL=8.10
HGL=9.40
HGL=10.43
EXISTING GROUND
LINE G
STA. 20+00
(SOUTH
BARREL)
S=.0020
4" GAS
30" SS
Q=50 cfs
Q=25 cfs
LINE F
* SEE NOTE
N. RICHMOND
BYPASS
EXISTING GROUND
HGL=8.10
HGL=8.23
WSEL=9.17
LINE G
STA. 20+20
NORTH
BARREL
S=.0020
Q=27 cfs
LINE G
* SEE NOTE
SCALE - HORZ: 1"=100'
VERT: 1"=5'
NOTE: LINE F AND LINE G REQUIRE SPECIAL DESIGN
AT TIME OF LAND DEVELOPMENT
Flowing Full
SCAN DATE: 1/2014
Please duplicate and submit any markups to this plan sheet. See instructions.
CONTRA COSTA COUNTY
PUBLIC WORKS DEPARTMENT
DRAINAGE AREA 19A
PROFILES
LINES D - G
REVISIONS
NO
DESCRIPTION
BY
DATE
BASE MAP
EAST COORD.
NORTH COORD.
DESIGNED: J.D.C.
CHECKED: U.H.K.
SCALE: AS SHOWN
DRAWN: K.K.C.
FLD. BK.
FILE NO. FD-12424
SHEET 2 OF 2

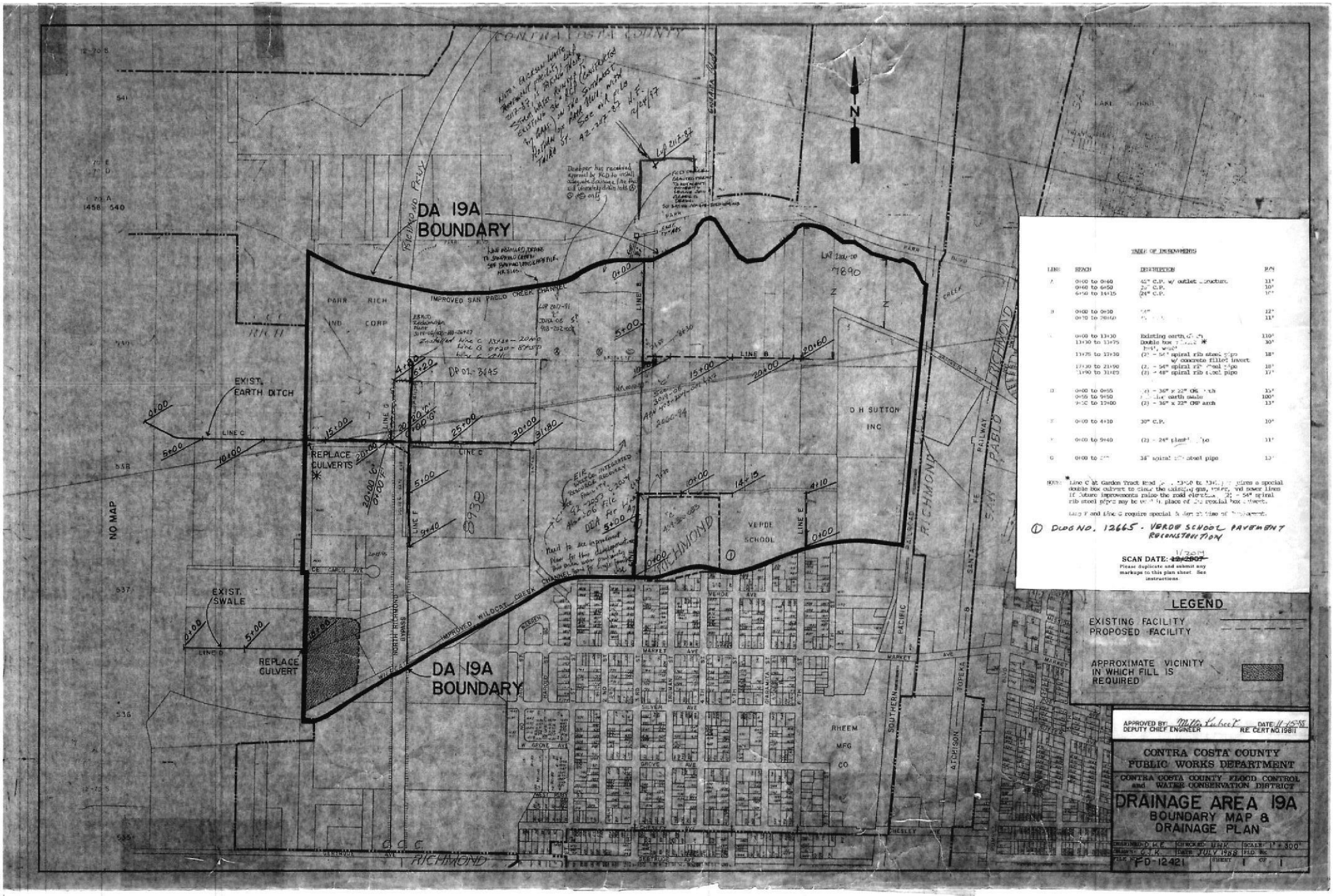


TABLE OF DESIGNATIONS

LINE	REACH	DESCRIPTION	R/S
A	0+00 to 0+60	45" C.P. w/ outlet structure	11'
	0+60 to 6+50	24" C.P.	10'
	6+50 to 14+15	24" C.P.	10'
B	0+00 to 0+30	[illegible]	12'
	0+30 to 20+60	[illegible]	11'
C	0+00 to 13+30	Existing earth channel	110'
	13+30 to 13+75	Double box [illegible] *	30'
	13+75 to 17+30	(2) - 54" spiral rib steel pipe w/ concrete filled invert	18'
	17+30 to 21+90	(2) - 54" spiral rib steel pipe	18'
	21+90 to 31+85	(2) - 48" spiral rib steel pipe	17'
D	0+00 to 0+55	(2) - 36" x 22" CMP arch	15'
	0+55 to 9+50	Earth swale	100'
	9+50 to 12+00	(2) - 36" x 22" CMP arch	13'
E	0+00 to 4+10	30" C.P.	10'
F	0+00 to 9+40	(2) - 24" plastic pipe	11'
G	0+00 to [illegible]	36" spiral rib steel pipe	12'

NOTE: * Line C at Garden Tract Road (approx. 13+50 to 13+75) requires a special double box culvert to clear the existing gas, water, and power lines. If future improvements raise the road elevation, (2) - 54" spiral rib steel pipes may be used in place of the special box culvert.

Line F and Line G require special design at time of improvement.

① DLDG NO. 12665 - VERDE SCHOOL PAVEMENT RECONSTRUCTION

SCAN DATE: ~~12/2007~~ 1/2014

Please duplicate and submit any markups to this plan sheet. See instructions

LEGEND

EXISTING FACILITY

PROPOSED FACILITY

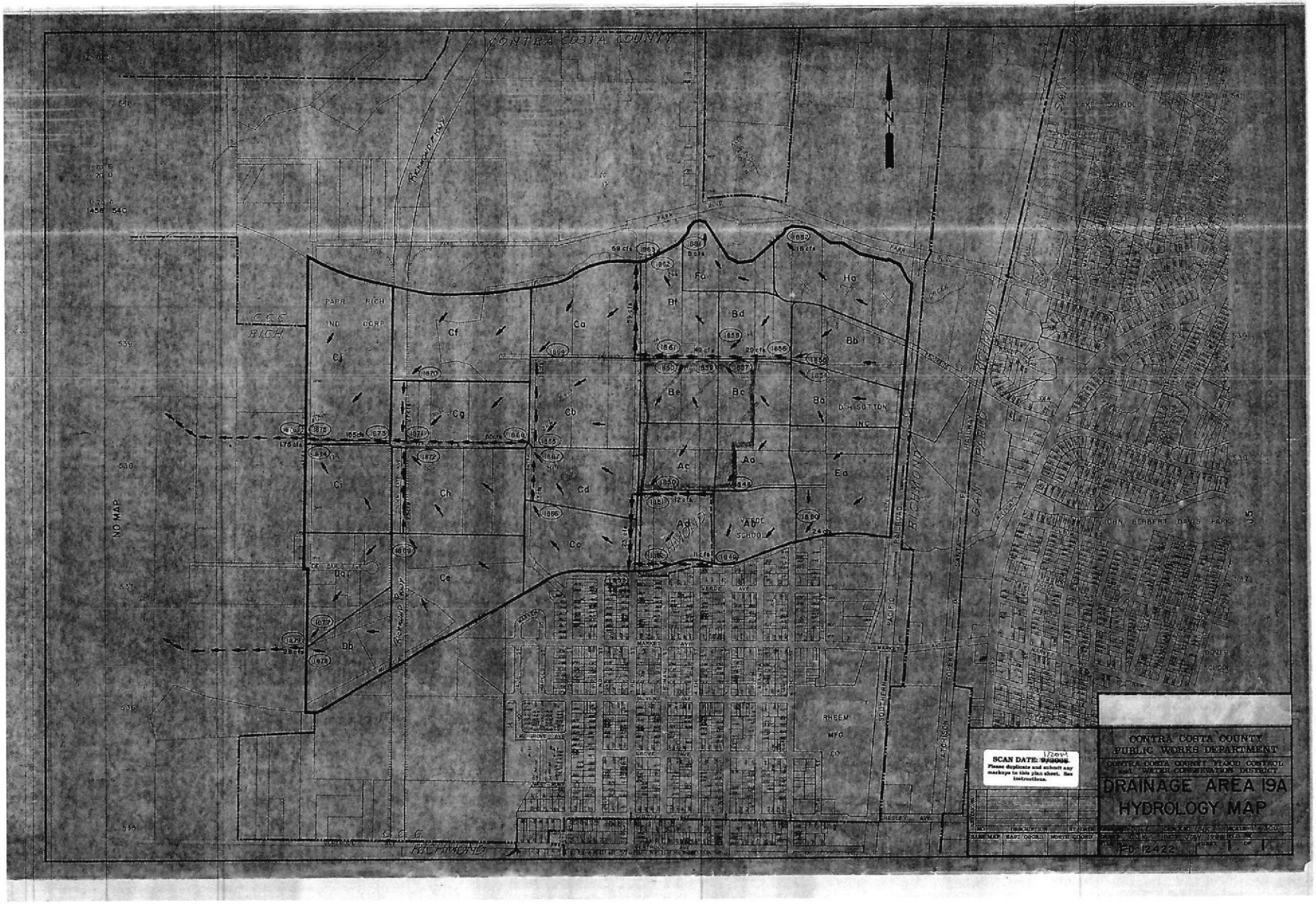
APPROXIMATE VICINITY IN WHICH FILL IS REQUIRED

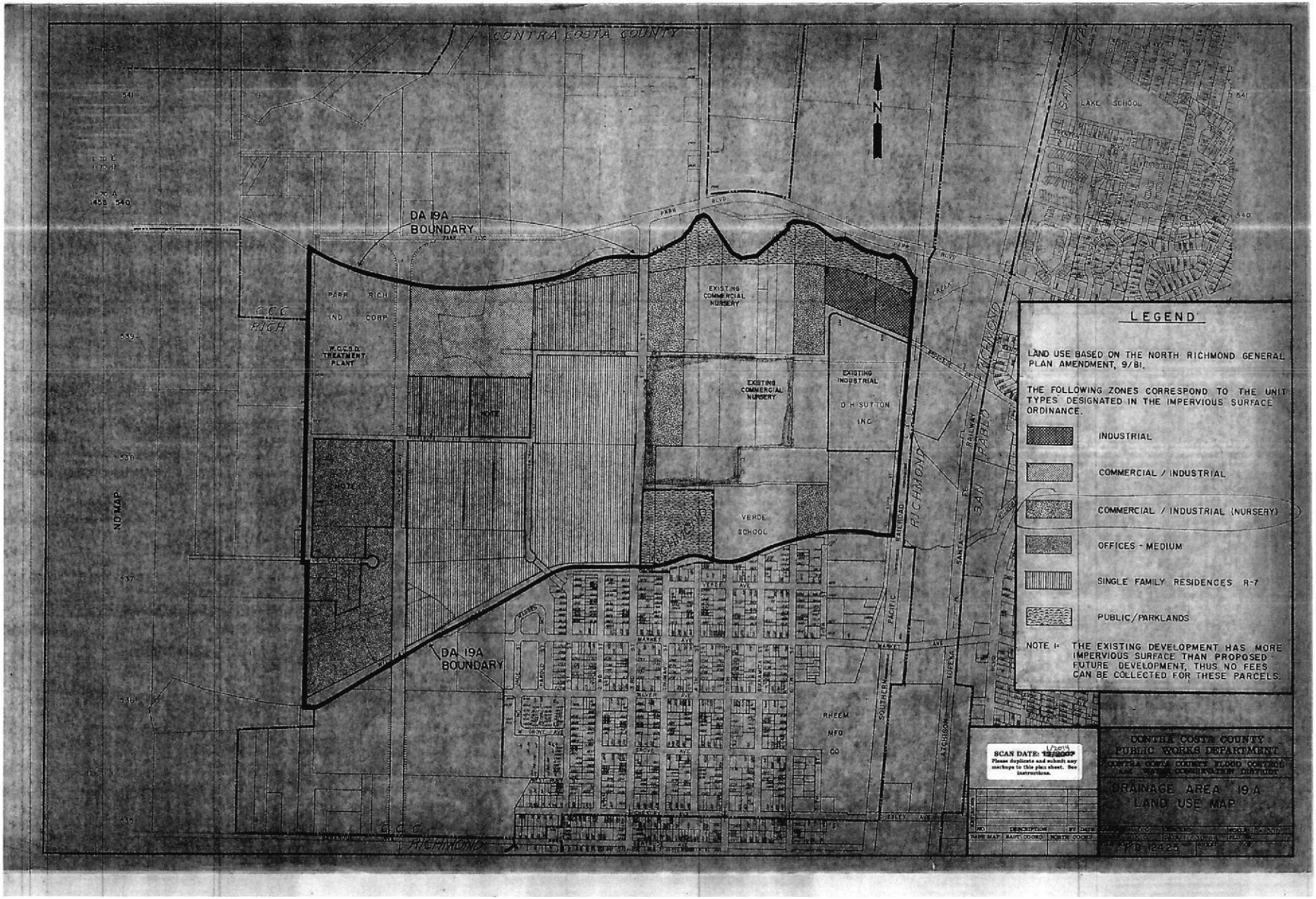
APPROVED BY: Mike Hubert DEPUTY CHIEF ENGINEER DATE: 11-15-88 RE CERT NO. 19811

CONTRA COSTA COUNTY
PUBLIC WORKS DEPARTMENT
CONTRA COSTA COUNTY FLOOD CONTROL and WATER CONSERVATION DISTRICT

DRAINAGE AREA 19A
BOUNDARY MAP & DRAINAGE PLAN

DESIGNED: D.M.K.	CHECKED: D.M.K.	SCALE: 1" = 300'	
DRAWN: C.J.K.	DATE: JULY 1988	FLD. BK.	
FILE NO. FD-12421	SHEET 1 OF 1		


CONTRA COSTA COUNTY
RICHMOND
SAN PABLO
N
PARR RICH IND CORP
C.C.C. RICH
D.H. SUTTON INC
RHEEM MFG CO
JOHN BERRETT DAVIS PARK
NO MAP
SCAN DATE: 1/26/04
Please duplicate and submit any markups to this plan sheet. See instructions.
CONTRA COSTA COUNTY
PUBLIC WORKS DEPARTMENT
CONTRA COSTA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
DRAINAGE AREA 19A
HYDROLOGY MAP
FD 12422


CONTRA COSTA COUNTY
DA 19A BOUNDARY
PARR BLVD
PARR RICH IND CORP
W.C.C.S.D. TREATMENT PLANT
EXISTING COMMERCIAL NURSERY
EXISTING INDUSTRIAL
D H SUTTON INC
EXISTING COMMERCIAL NURSERY
VERDE SCHOOL
CCC
RICHMOND
SAN PABLO
RAILROAD
RAILWAY
SANTA FE
PACIFIC
SOUTHERN
ATCHISON
TOPEKA
MARKET AVE
VERDE AVE
RHEEM MFG CO
LAKE SCHOOL
NO MAP
DA 19A BOUNDARY
CCC
RICHMOND
N
LEGEND
LAND USE BASED ON THE NORTH RICHMOND GENERAL PLAN AMENDMENT, 9/81.
THE FOLLOWING ZONES CORRESPOND TO THE UNIT TYPES DESIGNATED IN THE IMPERVIOUS SURFACE ORDINANCE.
INDUSTRIAL
COMMERCIAL / INDUSTRIAL
COMMERCIAL / INDUSTRIAL (NURSERY)
OFFICES - MEDIUM
SINGLE FAMILY RESIDENCES R-7
PUBLIC/PARKLANDS
NOTE 1- THE EXISTING DEVELOPMENT HAS MORE IMPERVIOUS SURFACE THAN PROPOSED FUTURE DEVELOPMENT, THUS NO FEES CAN BE COLLECTED FOR THESE PARCELS.
SCAN DATE: 1/2014
Please duplicate and submit any markups to this plan sheet. See instructions.
CONTRA COSTA COUNTY
PUBLIC WORKS DEPARTMENT
CONTRA COSTA COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
DRAINAGE AREA 19A
LAND USE MAP
NO. DESCRIPTION BY DATE
NAME MAP BASIS COORD NORTH COORD
PID 12425

Attachment 2: SWHM Analysis

Contra Costa County Small Watershed Hydrograph Method

HYDRO6 Infiltration Method Beta Version 1.1.4 April 4, 2012

Project Name:	Brookside-North - Post Developed
Project Location:	506 Brookside Drive
Project Number:	A17585-1
Flow Location:	North Tributary
Date:	July 31, 2018
Comments:	Proposed Hydrology Map - Area B

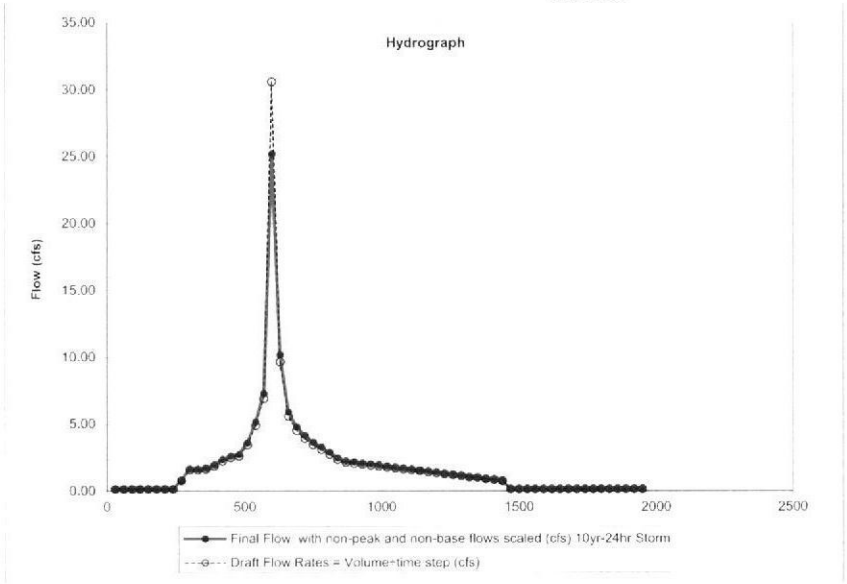
By:	Ben Bourne
Company:	Kier & Wright

Storm Return Period	10-Year	*Pick List*
Storm Duration	24-Hour	*Pick List*
MSP	21.75 in	*(Mean Seasonal Precipitation)*
Watershed Area	17.66 acres	= 769,270 sf = 0.028 sqmi
Composite Rational C Value	0.850	*(From Title & Input Sheet)*
Rational Peak Flow	25.20 cfs	*(From Title & Input Sheet)*
C_f =	1.00	*(Dependant on Storm Return Period)*
C x C_f =	0.85	*(Never > 1.0)*
Storm Depth	4.08 in	*(From built in D-F-D Curves)*
Time Step	30 min	*(Standard time step for Storm Duration)*
Infiltration Rate from C x C_f	0.020 in/hr	= 0.01 inches per inerval *(from built-in curve)*
Initial Loss	0.25 in	*(Standard initial loss)*
Base Flow (5cfs per sq. mi.)	0.14 cfs	= 248.34 cf/time interval

Volume Accounting

Rain Volume	6.00 ac-ft	= 261552 cf
Constant Infiltration Losses	0.71 ac-ft	= 30771 cf
Intial Infiltration Losses	0.37 ac-ft	= 16026 cf
Runoff Volume	4.93 ac-ft	= 214690 cf
Base Flow Volume	0.00456 ac-ft	= 199 cf
Total Storm Runoff Volume	4.93 ac-ft	= 214889 cf

Solve



Volume Adjustment Check				
Target Vol.	230832.7	cf		
Final Vol.	-230832.7	cf		Flow Ratio
Target is zero.	0.00	% Off Target =	0.0%	1.0572

Interval Number	Time at End of Interval (min)	Rainfall Distribution %	Interval Rainfall Depth (in)	Constant Infiltration (in)	Incremental Initial Loss (in)	Incremental Initial Loss Recovery (in)	Initial Loss Balance Amnt. Remaining (in)	Effective Runoff (in)	Interval Runoff Volume (cf)	Total Interval Vol. with Base Flow (cf)	Draft Flow Rates = Volume÷time step (cfs)	Final Flow with non-peak and non-base flows scaled (cfs) 10yr-24hr Storm	Volume Converted from Flow (cf)	
Total Below		**100.00%**	**4.0800**	**0.480**	**0.250**		**n/a**	**3.349**	**214,690**	**230832.7 cf**		**230832.7 cf**		
							Beg=0.25			**Target Volume**		**Final Volume**		
1	30	0.87%	0.0355	0.0100	0.0255	-	0.2245	-	-	248	0.14	0.14	248	
2	60	0.87%	0.0355	0.0100	0.0255	-	0.1990	-	-	248	0.14	0.14	248	
3	90	0.88%	0.0359	0.0100	0.0259	-	0.1731	-	-	248	0.14	0.14	248	
4	120	0.88%	0.0359	0.0100	0.0259	-	0.1472	-	-	248	0.14	0.14	248	
5	150	0.92%	0.0375	0.0100	0.0275	-	0.1197	-	-	248	0.14	0.14	248	
6	180	0.98%	0.0400	0.0100	0.0300	-	0.0897	-	-	248	0.14	0.14	248	
7	210	1.07%	0.0437	0.0100	0.0337	-	0.0560	-	-	248	0.14	0.14	248	
8	240	1.13%	0.0461	0.0100	0.0361	-	0.0199	-	-	248	0.14	0.14	248	
9	270	1.18%	0.0481	0.0100	0.0199	-	-	0.0180	1,154	1,402	0.78	0.82	1,482	
10	300	1.22%	0.0498	0.0100	-	-	-	0.0400	2,564	2,813	1.56	1.65	2,973	
11	330	1.23%	0.0502	0.0100	-	-	-	0.0400	2,564	2,813	1.56	1.65	2,973	
12	360	1.27%	0.0518	0.0100	-	-	-	0.0420	2,692	2,941	1.63	1.73	3,109	
13	390	1.41%	0.0575	0.0100	-	-	-	0.0480	3,077	3,325	1.85	1.95	3,516	
14	420	1.69%	0.0690	0.0100	-	-	-	0.0590	3,782	4,031	2.24	2.37	4,261	
15	450	1.86%	0.0759	0.0100	-	-	-	0.0660	4,231	4,479	2.49	2.63	4,736	
16	480	1.94%	0.0792	0.0100	-	-	-	0.0690	4,423	4,672	2.60	2.74	4,939	
17	510	2.50%	0.1020	0.0100	-	-	-	0.0920	5,898	6,146	3.41	3.61	6,498	
18	540	3.50%	0.1428	0.0100	-	-	-	0.1330	8,526	8,774	4.87	5.15	9,276	
19	570	4.90%	0.1999	0.0100	-	-	-	0.1900	12,180	12,428	6.90	7.30	13,139	
20	600	21.20%	0.8650	0.0100	-	-	-	0.8550	54,810	55,059	**30.59**	**25.20**	45,360	Peak = Rational Method Qp
21	630	6.80%	0.2774	0.0100	-	-	-	0.2670	17,116	17,365	9.65	10.20	18,358	
22	660	4.00%	0.1632	0.0100	-	-	-	0.1530	9,808	10,057	5.59	5.91	10,632	
23	690	3.25%	0.1326	0.0100	-	-	-	0.1230	7,885	8,133	4.52	4.78	8,599	
24	720	2.85%	0.1163	0.0100	-	-	-	0.1060	6,795	7,044	3.91	4.14	7,446	

Interval Number	Time at End of Interval (min)	Rainfall Distribution %	Interval Rainfall Depth (in)	Constant Infiltration (in)	Incremental Initial Loss (in)	Incremental Initial Loss Recovery (in)	Initial Loss Balance Amnt. Remaining (in)	Effective Runoff (in)	Interval Runoff Volume (cf)	Total Interval Vol. with Base Flow (cf)	Draft Flow Rates = Volume÷time step (cfs)	Final Flow with non-peak and non-base flows scaled (cfs) 10yr-24hr Storm	Volume Converted from Flow (cf)
25	750	2.52%	0.1028	0.0100	-	-	-	0.0930	5,962	6,210	3.45	3.65	6,565
26	780	2.28%	0.0930	0.0100	-	-	-	0.0830	5,321	5,569	3.09	3.27	5,888
27	810	2.03%	0.0828	0.0100	-	-	-	0.0730	4,680	4,928	2.74	2.89	5,210
28	840	1.77%	0.0722	0.0100	-	-	-	0.0620	3,975	4,223	2.35	2.48	4,464
29	870	1.62%	0.0661	0.0100	-	-	-	0.0560	3,590	3,838	2.13	2.25	4,058
30	900	1.58%	0.0645	0.0100	-	-	-	0.0540	3,462	3,710	2.06	2.18	3,922
31	930	1.53%	0.0624	0.0100	-	-	-	0.0520	3,334	3,582	1.99	2.10	3,787
32	960	1.47%	0.0600	0.0100	-	-	-	0.0500	3,205	3,454	1.92	2.03	3,651
33	990	1.42%	0.0579	0.0100	-	-	-	0.0480	3,077	3,325	1.85	1.95	3,516
34	1020	1.38%	0.0563	0.0100	-	-	-	0.0460	2,949	3,197	1.78	1.88	3,380
35	1050	1.33%	0.0543	0.0100	-	-	-	0.0440	2,821	3,069	1.70	1.80	3,245
36	1080	1.27%	0.0518	0.0100	-	-	-	0.0420	2,692	2,941	1.63	1.73	3,109
37	1110	1.22%	0.0498	0.0100	-	-	-	0.0400	2,564	2,813	1.56	1.65	2,973
38	1140	1.18%	0.0481	0.0100	-	-	-	0.0380	2,436	2,684	1.49	1.58	2,838
39	1170	1.12%	0.0457	0.0100	-	-	-	0.0360	2,308	2,556	1.42	1.50	2,702
40	1200	1.08%	0.0441	0.0100	-	-	-	0.0340	2,180	2,428	1.35	1.43	2,567
41	1230	1.03%	0.0420	0.0100	-	-	-	0.0320	2,051	2,300	1.28	1.35	2,431
42	1260	0.97%	0.0396	0.0100	-	-	-	0.0300	1,923	2,172	1.21	1.28	2,296
43	1290	0.93%	0.0379	0.0100	-	-	-	0.0280	1,795	2,043	1.14	1.20	2,160
44	1320	0.87%	0.0355	0.0100	-	-	-	0.0250	1,603	1,851	1.03	1.09	1,957
45	1350	0.83%	0.0339	0.0100	-	-	-	0.0240	1,539	1,787	0.99	1.05	1,889
46	1380	0.77%	0.0314	0.0100	-	-	-	0.0210	1,346	1,595	0.89	0.94	1,686
47	1410	0.73%	0.0298	0.0100	-	-	-	0.0200	1,282	1,530	0.85	0.90	1,618
48	1440	0.67%	0.0273	0.0100	-	-	-	0.0170	1,090	1,338	0.74	0.79	1,415
49	1470	0.00%	-	-	-	(0.0100)	0.0100	-	-	248	0.14	0.14	248
50	1500	0.00%	-	-	-	(0.0100)	0.0200	-	-	248	0.14	0.14	248
51	1530	0.00%	-	-	-	(0.0100)	0.0300	-	-	248	0.14	0.14	248
52	1560	0.00%	-	-	-	(0.0100)	0.0400	-	-	248	0.14	0.14	248
53	1590	0.00%	-	-	-	(0.0100)	0.0500	-	-	248	0.14	0.14	248
54	1620	0.00%	-	-	-	(0.0100)	0.0600	-	-	248	0.14	0.14	248
55	1650	0.00%	-	-	-	(0.0100)	0.0700	-	-	248	0.14	0.14	248
56	1680	0.00%	-	-	-	(0.0100)	0.0800	-	-	248	0.14	0.14	248
57	1710	0.00%	-	-	-	(0.0100)	0.0900	-	-	248	0.14	0.14	248
58	1740	0.00%	-	-	-	(0.0100)	0.1000	-	-	248	0.14	0.14	248
59	1770	0.00%	-	-	-	(0.0100)	0.1100	-	-	248	0.14	0.14	248
60	1800	0.00%	-	-	-	(0.0100)	0.1200	-	-	248	0.14	0.14	248
61	1830	0.00%	-	-	-	(0.0100)	0.1300	-	-	248	0.14	0.14	248
62	1860	0.00%	-	-	-	(0.0100)	0.1400	-	-	248	0.14	0.14	248
63	1890	0.00%	-	-	-	(0.0100)	0.1500	-	-	248	0.14	0.14	248
64	1920	0.00%	-	-	-	(0.0100)	0.1600	-	-	248	0.14	0.14	248
65	1950	0.00%	-	-	-	(0.0100)	0.1700	-	-	248	0.14	0.14	248

Legend	This column	This Column
		Ratio Applied
	Max Flow	Max Flow Rate
		Base Flow

Contra Costa County Small Watershed Hydrograph Method

HYDRO6 Infiltration Method Beta Version 1.1.4 April 4, 2012

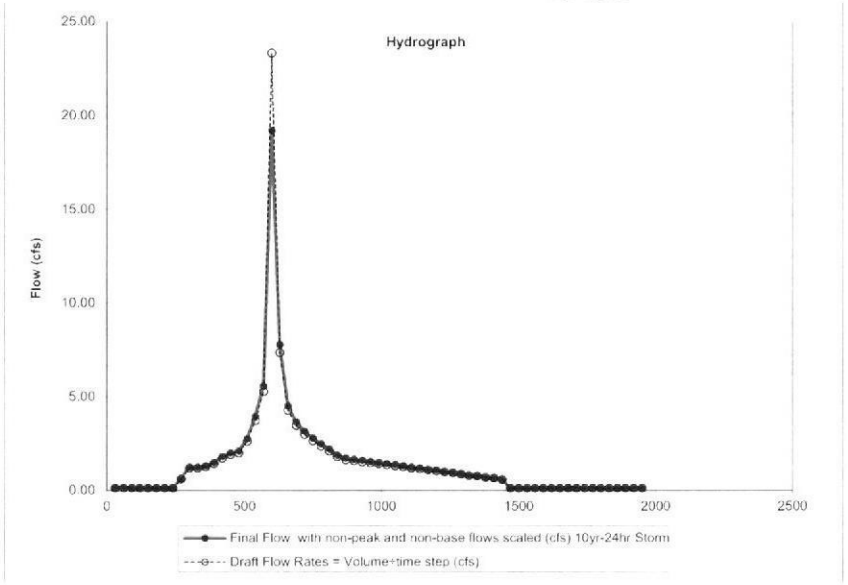
Project Name:	Brookside-South - Post Developed
Project Location:	506 Brookside Drive
Project Number:	A17585-1
Flow Location:	South Tributary
Date:	July 29, 2018
Comments:	Proposed Hydrology Map - Area A

By;	Ben Bourne
Company:	Kier & Wright

Storm Return Period	10-Year	*Pick List*
Storm Duration	24-Hour	*Pick List*
MSP	21.75 in	*(Mean Seasonal Precipitation)*
Watershed Area	13.47 acres	= 586,753 sf = 0.021 sqmi
Composite Rational C Value	0.850	*(From Title & Input Sheet)*
Rational Peak Flow	19.20 cfs	*(From Title & Input Sheet)*
C_f =	1.00	*(Dependant on Storm Return Period)*
C x C_f =	0.85	*(Never > 1.0)*
Storm Depth	4.08 in	*(From built in D-F-D Curves)*
Time Step	30 min	*(Standard time step for Storm Duration)*
Infiltration Rate from C x C_f	0.020 in/hr	= 0.01 inches per inerval *(from built-in curve)*
Initial Loss	0.25 in	*(Standard initial loss)*
Base Flow (5cfs per sq. mi.)	0.11 cfs	= 189.42 cf/time interval

Volume Accounting		
Rain Volume	4.58 ac-ft	= 199496 cf
Constant Infiltration Losses	0.54 ac-ft	= 23470 cf
Intial Infiltration Losses	0.28 ac-ft	= 12224 cf
Runoff Volume	3.76 ac-ft	= 163753 cf
Base Flow Volume	0.00348 ac-ft	= 152 cf
Total Storm Runoff Volume	3.76 ac-ft	= 163905 cf

Solve



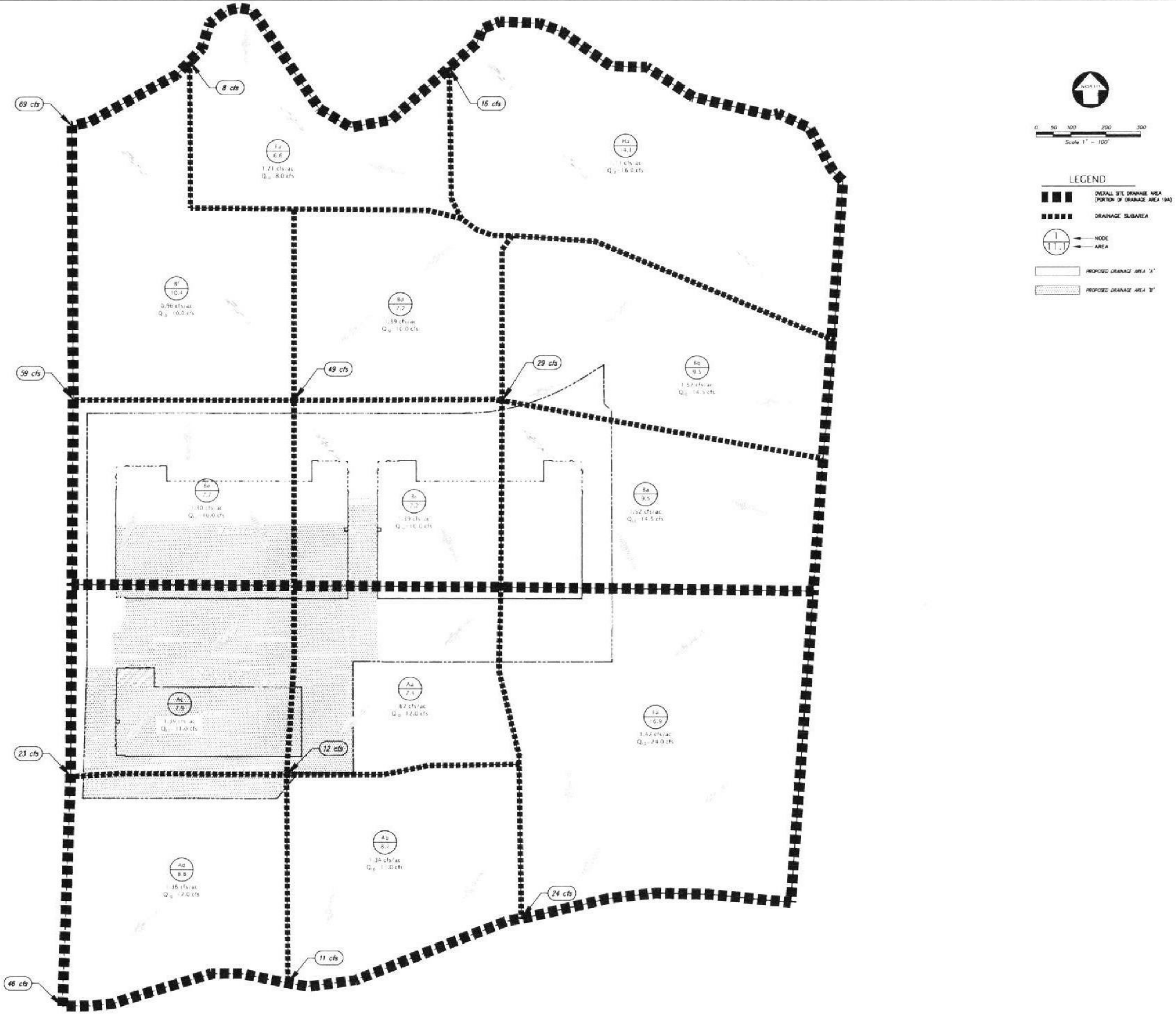
Volume Adjustment Check				Flow Ratio
Target Vol.	176065.5 cf			
Final Vol.	-176065.5 cf			
Target is zero.	0.00	% Off Target =	0.0%	1.0575

Interval Number	Time at End of Interval (min)	Rainfall Distribution %	Interval Rainfall Depth (in)	Constant Infiltration (in)	Incremental Initial Loss (in)	Incremental Initial Loss Recovery (in)	Initial Loss Balance Amnt. Remaining (in)	Effective Runoff (in)	Interval Runoff Volume (cf)	Total Interval Vol. with Base Flow (cf)	Draft Flow Rates = Volume÷time step (cfs)	Final Flow with non-peak and non-base flows scaled (cfs) 10yr-24hr Storm	Volume Converted from Flow (cf)	
Total Below		**100.00%**	**4.0800**	**0.480**	**0.250**		**n/a**	**3.349**	**163,753**	**176065.5 cf**		**176065.5 cf**		
							Beg=0.25			**Target Volume**		**Final Volume**		
1	30	0.87%	0.0355	0.0100	0.0255	-	0.2245	-	-	189	0.11	0.11	189	
2	60	0.87%	0.0355	0.0100	0.0255	-	0.1990	-	-	189	0.11	0.11	189	
3	90	0.88%	0.0359	0.0100	0.0259	-	0.1731	-	-	189	0.11	0.11	189	
4	120	0.88%	0.0359	0.0100	0.0259	-	0.1472	-	-	189	0.11	0.11	189	
5	150	0.92%	0.0375	0.0100	0.0275	-	0.1197	-	-	189	0.11	0.11	189	
6	180	0.98%	0.0400	0.0100	0.0300	-	0.0897	-	-	189	0.11	0.11	189	
7	210	1.07%	0.0437	0.0100	0.0337	-	0.0560	-	-	189	0.11	0.11	189	
8	240	1.13%	0.0461	0.0100	0.0361	-	0.0199	-	-	189	0.11	0.11	189	
9	270	1.18%	0.0481	0.0100	0.0199	-	-	0.0180	880	1,070	0.59	0.63	1,131	
10	300	1.22%	0.0498	0.0100	-	-	-	0.0400	1,956	2,145	1.19	1.26	2,269	
11	330	1.23%	0.0502	0.0100	-	-	-	0.0400	1,956	2,145	1.19	1.26	2,269	
12	360	1.27%	0.0518	0.0100	-	-	-	0.0420	2,054	2,243	1.25	1.32	2,372	
13	390	1.41%	0.0575	0.0100	-	-	-	0.0480	2,347	2,536	1.41	1.49	2,682	
14	420	1.69%	0.0690	0.0100	-	-	-	0.0590	2,885	3,074	1.71	1.81	3,251	
15	450	1.86%	0.0759	0.0100	-	-	-	0.0660	3,227	3,417	1.90	2.01	3,613	
16	480	1.94%	0.0792	0.0100	-	-	-	0.0690	3,374	3,563	1.98	2.09	3,768	
17	510	2.50%	0.1020	0.0100	-	-	-	0.0920	4,498	4,688	2.60	2.75	4,957	
18	540	3.50%	0.1428	0.0100	-	-	-	0.1330	6,503	6,693	3.72	3.93	7,077	
19	570	4.90%	0.1999	0.0100	-	-	-	0.1900	9,290	9,480	5.27	5.57	10,025	
20	600	21.20%	0.8650	0.0100	-	-	-	0.8550	41,806	41,996	**23.33**	**19.20**	34,560	Peak = Rational Method Qp
21	630	6.80%	0.2774	0.0100	-	-	-	0.2670	13,055	13,245	7.36	7.78	14,006	
22	660	4.00%	0.1632	0.0100	-	-	-	0.1530	7,481	7,671	4.26	4.51	8,112	
23	690	3.25%	0.1326	0.0100	-	-	-	0.1230	6,014	6,204	3.45	3.64	6,560	
24	720	2.85%	0.1163	0.0100	-	-	-	0.1060	5,183	5,372	2.98	3.16	5,681	

Interval Number	Time at End of Interval (min)	Rainfall Distribution %	Interval Rainfall Depth (in)	Constant Infiltration (in)	Incremental Initial Loss (in)	Incremental Initial Loss Recovery (in)	Initial Loss Balance Amnt. Remaining (in)	Effective Runoff (in)	Interval Runoff Volume (cf)	Total Interval Vol. with Base Flow (cf)	Draft Flow Rates = Volume÷time step (cfs)	Final Flow with non-peak and non-base flows scaled (cfs) 10yr-24hr Storm	Volume Converted from Flow (cf)
25	750	2.52%	0.1028	0.0100	-	-	-	0.0930	4,547	4,737	2.63	2.78	5,009
26	780	2.28%	0.0930	0.0100	-	-	-	0.0830	4,058	4,248	2.36	2.50	4,492
27	810	2.03%	0.0828	0.0100	-	-	-	0.0730	3,569	3,759	2.09	2.21	3,975
28	840	1.77%	0.0722	0.0100	-	-	-	0.0620	3,032	3,221	1.79	1.89	3,406
29	870	1.62%	0.0661	0.0100	-	-	-	0.0560	2,738	2,928	1.63	1.72	3,096
30	900	1.58%	0.0645	0.0100	-	-	-	0.0540	2,640	2,830	1.57	1.66	2,993
31	930	1.53%	0.0624	0.0100	-	-	-	0.0520	2,543	2,732	1.52	1.61	2,889
32	960	1.47%	0.0600	0.0100	-	-	-	0.0500	2,445	2,634	1.46	1.55	2,786
33	990	1.42%	0.0579	0.0100	-	-	-	0.0480	2,347	2,536	1.41	1.49	2,682
34	1020	1.38%	0.0563	0.0100	-	-	-	0.0460	2,249	2,439	1.35	1.43	2,579
35	1050	1.33%	0.0543	0.0100	-	-	-	0.0440	2,151	2,341	1.30	1.38	2,475
36	1080	1.27%	0.0518	0.0100	-	-	-	0.0420	2,054	2,243	1.25	1.32	2,372
37	1110	1.22%	0.0498	0.0100	-	-	-	0.0400	1,956	2,145	1.19	1.26	2,269
38	1140	1.18%	0.0481	0.0100	-	-	-	0.0380	1,858	2,047	1.14	1.20	2,165
39	1170	1.12%	0.0457	0.0100	-	-	-	0.0360	1,760	1,950	1.08	1.15	2,062
40	1200	1.08%	0.0441	0.0100	-	-	-	0.0340	1,662	1,852	1.03	1.09	1,958
41	1230	1.03%	0.0420	0.0100	-	-	-	0.0320	1,565	1,754	0.97	1.03	1,855
42	1260	0.97%	0.0396	0.0100	-	-	-	0.0300	1,467	1,656	0.92	0.97	1,752
43	1290	0.93%	0.0379	0.0100	-	-	-	0.0280	1,369	1,559	0.87	0.92	1,648
44	1320	0.87%	0.0355	0.0100	-	-	-	0.0250	1,222	1,412	0.78	0.83	1,493
45	1350	0.83%	0.0339	0.0100	-	-	-	0.0240	1,174	1,363	0.76	0.80	1,441
46	1380	0.77%	0.0314	0.0100	-	-	-	0.0210	1,027	1,216	0.68	0.71	1,286
47	1410	0.73%	0.0298	0.0100	-	-	-	0.0200	978	1,167	0.65	0.69	1,234
48	1440	0.67%	0.0273	0.0100	-	-	-	0.0170	831	1,021	0.57	0.60	1,079
49	1470	0.00%	-	-	-	(0.0100)	0.0100	-	-	189	0.11	0.11	189
50	1500	0.00%	-	-	-	(0.0100)	0.0200	-	-	189	0.11	0.11	189
51	1530	0.00%	-	-	-	(0.0100)	0.0300	-	-	189	0.11	0.11	189
52	1560	0.00%	-	-	-	(0.0100)	0.0400	-	-	189	0.11	0.11	189
53	1590	0.00%	-	-	-	(0.0100)	0.0500	-	-	189	0.11	0.11	189
54	1620	0.00%	-	-	-	(0.0100)	0.0600	-	-	189	0.11	0.11	189
55	1650	0.00%	-	-	-	(0.0100)	0.0700	-	-	189	0.11	0.11	189
56	1680	0.00%	-	-	-	(0.0100)	0.0800	-	-	189	0.11	0.11	189
57	1710	0.00%	-	-	-	(0.0100)	0.0900	-	-	189	0.11	0.11	189
58	1740	0.00%	-	-	-	(0.0100)	0.1000	-	-	189	0.11	0.11	189
59	1770	0.00%	-	-	-	(0.0100)	0.1100	-	-	189	0.11	0.11	189
60	1800	0.00%	-	-	-	(0.0100)	0.1200	-	-	189	0.11	0.11	189
61	1830	0.00%	-	-	-	(0.0100)	0.1300	-	-	189	0.11	0.11	189
62	1860	0.00%	-	-	-	(0.0100)	0.1400	-	-	189	0.11	0.11	189
63	1890	0.00%	-	-	-	(0.0100)	0.1500	-	-	189	0.11	0.11	189
64	1920	0.00%	-	-	-	(0.0100)	0.1600	-	-	189	0.11	0.11	189
65	1950	0.00%	-	-	-	(0.0100)	0.1700	-	-	189	0.11	0.11	189

Legend	This column	This Column
		Ratio Applied
	Max Flow	Max Flow Rate
		Base Flow

Attachment 3: Existing and Proposed Hydrology Maps



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REGISTERED PROFESSIONAL ENGINEER — No. 53447 — CIVIL — STATE OF CALIFORNIA

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TEL (213) 488-8695
FAX (213) 488-8701

Project:

RICHMOND NINOMIYA

BROOKSIDE DRIVE & FRED JACKSON WAY
RICHMOND CA 94801

Consultants:

Civil	KIER & WRIGHT
Structural	
Mechanical	
Plumbing	
Electrical	
Landscape	GREEN DESIGN L.A. INC
Fire Protection	
Soils Engineer	

Title: HYDROLOGY MAP - DRAINAGE AREA 19A

Project Number	A17585-1
Drawn by	B.B.
Date	JULY 2018
Revision	

Sheet

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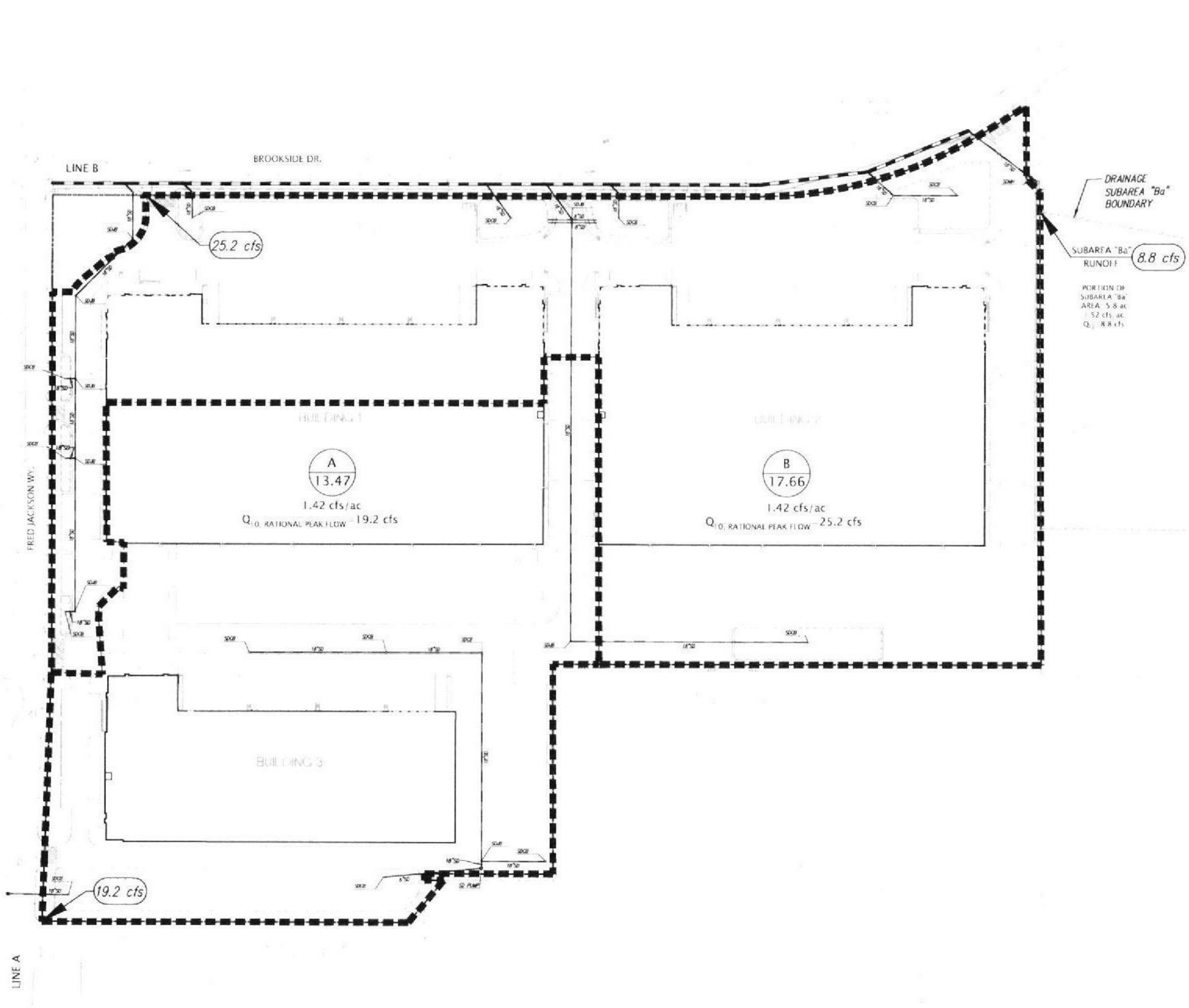

Hydrology Comparison Summary Existing vs. Proposed Condition

Existing Storm Drain	Existing Drainage Subarea	Allowable Capacity (cfs)	Proposed Drainage Area	Proposed (cfs)	Capacity
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Line B	Ba, Bb, Bc	[illegible]	[illegible]	[illegible]	[illegible]

PORTION OF SUBAREA "Ba" AREA: 5.8 ac
1.52 cfs/ac
Q_{10}: 8.8 cfs

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BROOKSIDE DRIVE &
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Consultants:

Civil: KIEF & WRIGHT
Structural
Mechanical
Plumbing
Electrical
Landscape: GREEN DESIGN L.A. INC
Fire Protection
Soils Engineer

Title:

PROPOSED SITE
HYDROLOGY MAP

Project Number: A17585.1
Drawn by: B.B.
Date: JULY 2018
Revision:

Sheet:

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