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HYDROLOGY STUDY

In the County of Riverside, City of San Jacinto

Parcels 1, 2. 8 and 9

Parcel Map 20795

JOB NUMBER: 17-08

March 6, 2018

WARREN D. TUTTLE

R.C.E. 30171

INTRODUCTION

This project is located in the City of San Jacinto. It involves the development of the four Northerly parcels, Parcels 1, 2, 8 and 9 of Parcel Map 20795, County of Riverside. The location of the project is shown in Attachment 1. The four parcels will be altered slightly by lot line adjustment so that the predominate activity of each parcel will be confined within the boundaries of that parcel as indicated in Attachment 2. The Northwest parcel will be improved as a retail center, the Southwest parcel will contain a retail center along with a fast food restaurant, the Northeast parcel will consist of a service station along with a car wash and the Southeast parcel will be the location of another fast food restaurant. The overall site is bounded on the North by East Main Street, on the East by Ramona Expressway and on the South by Donna Way. To the West is a housing development, Tract 31036, which is separated from the proposed development by a masonry wall.

Currently, all four parcels are unimproved and virtually flat, sloping only slightly downward to the West. The size of the development is 9.46 acres. All storm runoff sheet flows Westerly to a concrete drainage channel which lies just East of the West masonry wall. This drainage swale is the only improvement on the property and flows North to Main Street at a very shallow grade of 0.3%. This concrete channel is the only exit for storm runoff to leave the site following development; therefore, it is essential to reduce the ultimate runoff of the developed reaching this channel to below that of the existing discharge.

The type of soil on the entire site is identified as Type “A”. This type of soil is very pervious resulting in very little discharge reaching the outlet channel. Following development, most of the site will be converted to commercial type activity which is far more impervious resulting in much greater storm runoff. In order to comply with historical runoff standards, this post development runoff must be reduced to that of predevelopment. Because of the nature of the anticipated development, there will be little opportunity to dissipate the storm discharge by surface methods. Instead, the proposed storm runoff control method used in this project will direct all discharge to underground collection chambers until a combination of storm dissipation and soil infiltration reduces the site discharge below historical values.

LIMITATIONS

The purpose of this effort is limited to defining the configuration of the collection system on each Parcel and the size of the underground detention system required to achieve discharge reduction equal to or less than those shown above. The size of the conveyance devices required to maintain a hydraulic gradient below the rim elevation of any catch basin within the system will be addressed in the Hydraulic Study prepared for this project.

SITE SPECIFIC HYDROLOGY DATA

The primary document used to provide the input parameters in this analysis is the Riverside County Hydrology Manual. These parameters include the 100year, 1-hour storm/dissipation rate shown in Plate D-4.1(5 of 6) and the soil group shown in the, Plate C-1.32. These values depict a point precipitation of 1.20 inches and a soil group A to be used in this analysis. Also, to calculate the volume capture requirement of the 85th percentile, the isohyetal Map prepared by the Riverside County Flood Control and Water Conservation District in July 2011, identifies that 85th percentile for San Jacinto to be 0.70 inches. All volume and discharge quantities from these site-specific parameters were determined using Santa Ana Watershed, V_{BMP} and Q_{BMP} Worksheets. Of specific concern is the 85th percentile volume of runoff that must be retained as shown in Table 1, below. Because this value is roughly half that necessary to dissipate the storm to historic levels, this requirement is essentially mute.

TABLE 1 85th PERCENTILE CAPTUE

Parcel 1 – 5663 cf
Parcel 2 – 5200 cf
Parcel 8 – 4221 cf
Parcel 9 – 2557 cf

RUNOFF MANAGEMENT OBJECTIVE

The overriding goal of this construction effort is to insure all storm runoff leaving the site is free of any contaminates created by the proposed activity and is reduced in discharge quantity to a level equal to or below that experienced prior to that of the improvement. Currently, the overall project, Parcels 1, 2, 8 and 9 of PM 2075, is relatively flat with only the most Northeasterly corner rising abruptly to meet the intersection of East Main Street and Ramona Expressway. This small departure from the general terrain topography will not be considered in determining the storm runoff characteristics of the existing site. The predominate characteristics reflect a generally flat terrain, sloping gently to the West at a grade of less than 1%. All runoff within the project area flows to the concrete channel, identified above, and thence to an under sidewalk drain at East Main Street. Although this project defines each Parcel as an individual drainage area, the aggregate discharge of these improved drainage areas must not exceed the existing discharge into this concrete swale.

Each parcel will direct its storm discharge to underground chambers located on the specific parcel generating the runoff. There it will be treated by filtration and reduced in discharge volume to that currently attributed to that parcel. The amount of runoff originating on each parcel in its current configuration is considered the historical runoff produced by each parcel and is summarized in the following Table 2, below.

TABLE 2 HISTORICAL RUNOFF

Parcel 1 – 0.23 cfs
Parcel 2 – 0.23 cfs
Parcel 8 – 0.15 cfs
Parcel 9 – 0.10 cfs

PROCDURAL APPROACH

The site will be designed so that the predominate storm runoff falling on each parcel will captured by catch basins and directed to an underground collection system located on that parcel. This underground system will be comprised of a series of chambers; the first, the isolator chamber, will receive all site runoff. The isolator chamber will rest on nine inches of crushed rock having 40% voids and overlain by a commercial filter fabric. Storm discharge entering this isolator chamber will be completely filtered before it is transferred to adjacent chambers through this crushed rock conduit. The inlet structure to the isolation chamber will be will be constructed to allow periodic maintenance including removal of the floatables and non-floatables retained on the floor of the chamber. Consequently, the chamber will function as large filtration device which will provide all water quality management requirements for that particular parcel, i.e. drainage area (DA). To assist in defining the performance of this underground collection system, a Schematic Diagram that is applicable to all four parcels in shown in Attachment 3. In this diagram, the travel of storm runoff falling on the site is traced from the time it enters a catch basin on the site, through its discharge into the underground chamber where it is treated and reduced in volume, to its eventual discharge into the perimeter concrete channel.

The first diagram in Attachment 3 shows the overall drainage layout typical of any of the four parcels. It shows the initial onsite surface flow collecting at the upstream catch basin, point A, then being transferred though an underground pipe conduit to the catch basin for another collection area in the system, point B, and then to the clean out structure for the isolation chamber of the system, point C. The isolation chamber collects all the untreated raw storm runoff from the site and is equipped with a filter on the floor of the chamber. This filter removes undesirable elements from the discharge before passing through the crush rock pads underlying the isolation chamber and into the downstream collection chambers at point D. These collection chambers are also underlain by this pad of crushed rock and are connected by 12” diameter HDPE manifold which allows them to fill at near the same rate as the isolator chamber. This filling process of the isolation chamber and the connected collection chambers is the primary method of reducing the discharge rate to historical values through normal, defined storm dissipation.

When all the chambers are full, the treated discharge will have been reduced to a historical discharge rates for that particular parcel, as shown in Table 2, and will enter the discharge conduit. It will be transported to a manhole in the common outlet system for all four parcels, point E. At that point it will join the discharge from the other three parcels which has also been treated and reduced to historical discharge rates. From there, the combined runoff from all four parcels will flow to a discharge structure adjacent to the outflow channel on the West boundary of the site, point F, and eventually into this perimeter channel. The second diagram of Attachment 3 is a profile view of this schematic which further illustrates the collection process.

Storm runoff from all four parcels will be managed in the same manner. The only difference will be the size of the individual systems located on each parcel. The third diagram of Attachment 3 is a schematic of the proposed method of handling the runoff from all the parcels. It details a common outlet pipe whose total discharge quantity is the aggregate of the discharge from the individual parcels. The outlet discharge value of 0.71 cfs is equal to that experience during rain events at predeveloped site.

SURFACE COLLECTION SYSTEM

Attachment 4 shows the overall site, all four parcels, broken down in to proposed tributary area comprised of hardscape and landscape elements, all draining to defined catch basins. The hardscape area is identified by the same nomenclature as the associated catch basin and the contributing landscape areas are identified by the receiving catch basin number followed by L1, L2, etc. The total hardscape and landscape tributary area for each catch basin, along with the anticipated discharge directed to the receiving catch basin, using the V_{BMP} and Q_{BMP} Worksheet, is shown in Attachment 5. The defined discharge value may be reduced somewhat by BMP's employed in the landscape areas; however, it is assumed that these reduction values will be minimal when compared to the overall tributary area discharge. Therefore, any reduction attributed to these actions will be disregarded in determining the volume of the retention chambers needed to reduce the discharge to historical values.

UNDERGROUND SYSTEM DESIGN

All runoff on each of the four parcels will be directed to an underground chamber system which will be designed to reduce the ultimate discharge of the contributing parcel to levels at or below those experienced by the undeveloped site. The discharge quantity entering each chamber system is the aggregate of quantities originating on the associated parcel as summarized in Table 3, below.

TABLE 3 PROPOSED RUNOFF

Parcel 1 – 2.67 cfs
Parcel 2 – 2.46 cfs
Parcel 8 – 1.99 cfs
Parcel 9 – 1.21 cfs

It is quite evident that there is a substantial increase in runoff when the site is developed. The actual discharge rate leaving the chamber is greatly impacted by the length of time required to completely fill it to capacity. Storm runoff dissipation occurs at an anticipated rate. Therefore, the discharge entering the chamber, as identified above, are maximum values which will decrease as the chamber fills to capacity. Once the chamber is full, the actual discharge amount will be decreased considerably. Attachment 6 is a worksheet developed to calculate the expected maximum discharge leaving the chamber when the system is full. It determines the volume of runoff entering the chamber at the storm onset and, depending on the storm duration intensity slope for that particular location, at particular segments of time after the onset of the storm. This worksheet then integrates these periodic fill volumes until the system volume is reached. The storm discharge rate at the time the underground chamber is full, less the constant infiltration rate created through the underlying crushed rock pad, must be equal or less that the historical discharge rate for that Parcel.

Also included in Attachment 6 is the design of the chamber system itself. It shows the number of chambers in each row, the number of rows (including the isolation row) and the separation between the collector rows. This design arrangement the amount leaving is determined through manual iteration until historical discharge values are not exceeded.

ATTACHMENTS

1. Vicinity Map

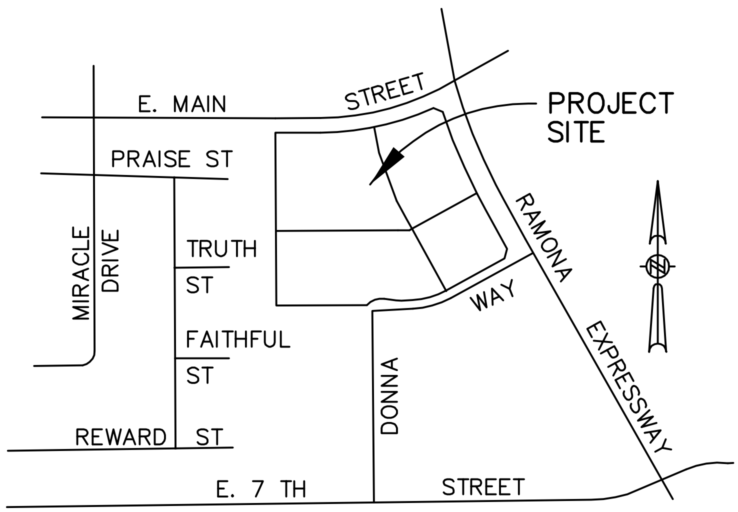
2 Developed Parcels

3. Schematic Diagram of Subsurface Collection Process

4. Site Runoff Tributary Areas

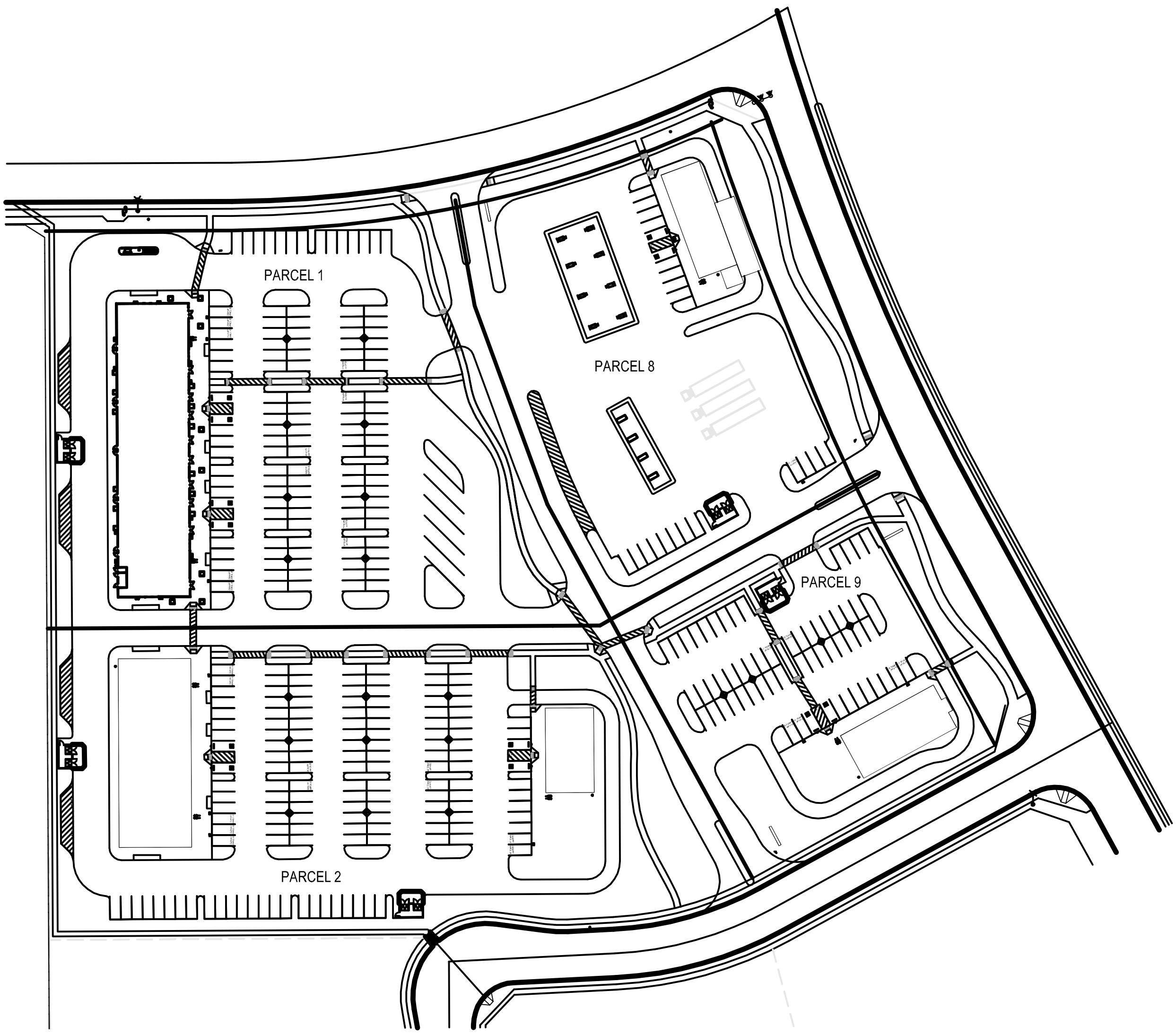
5. Calculator Flow Rate and Volume Output Data

6. Chamber System Volume Determination Work Sheet

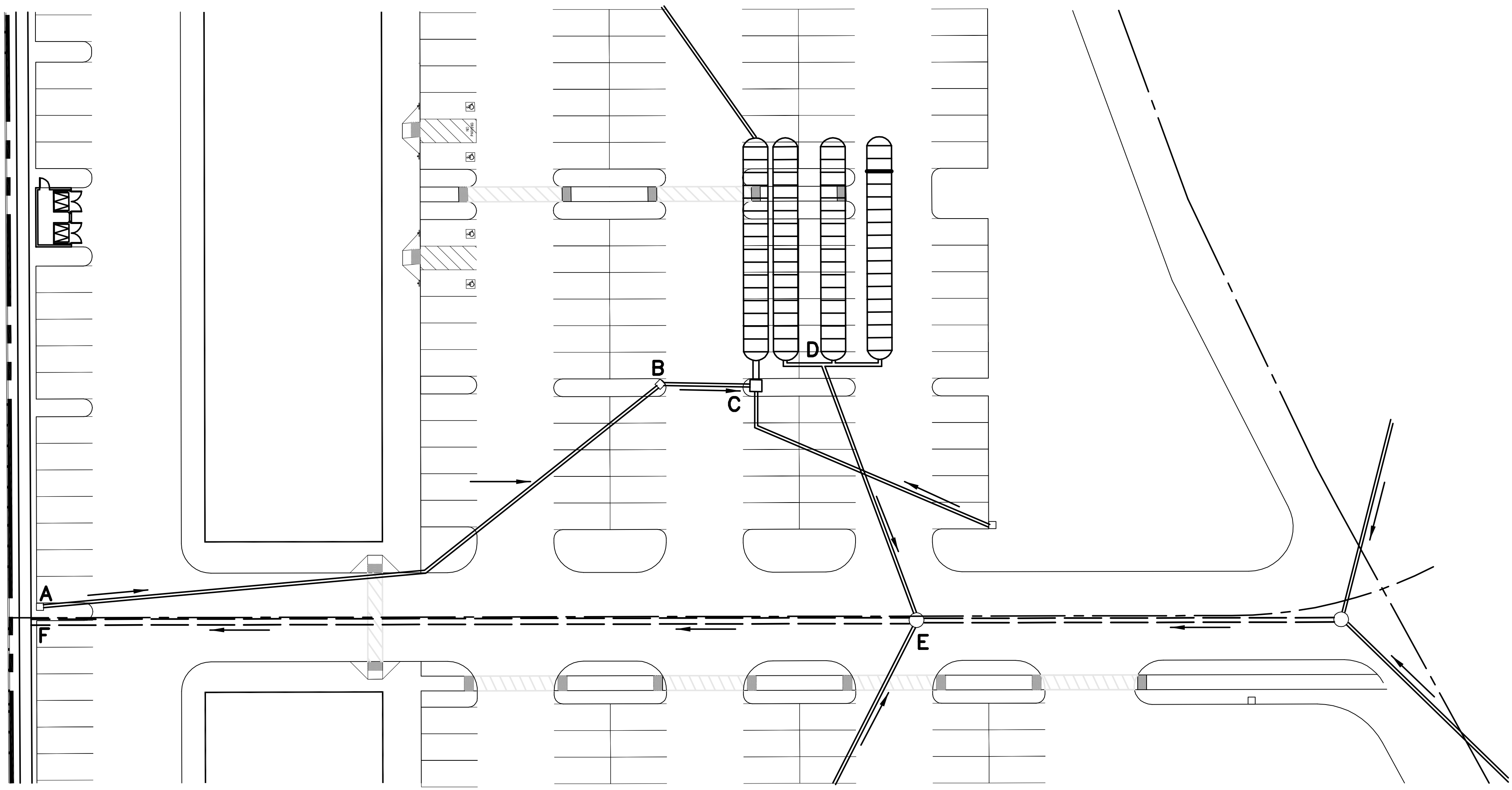


VICINITY MAP
NO SCALE

ATTACHMENT 1

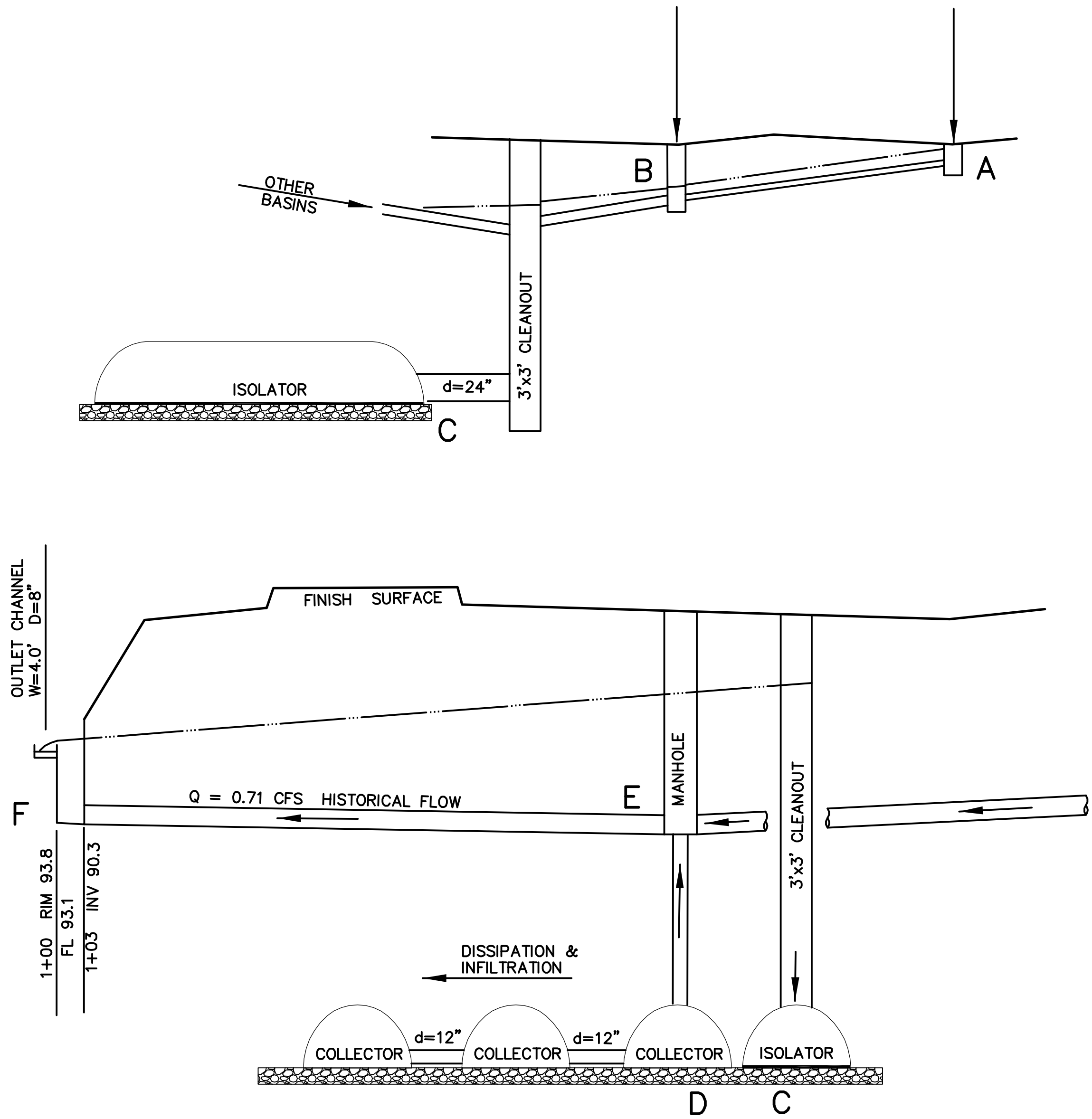


ATTACHMENT 2



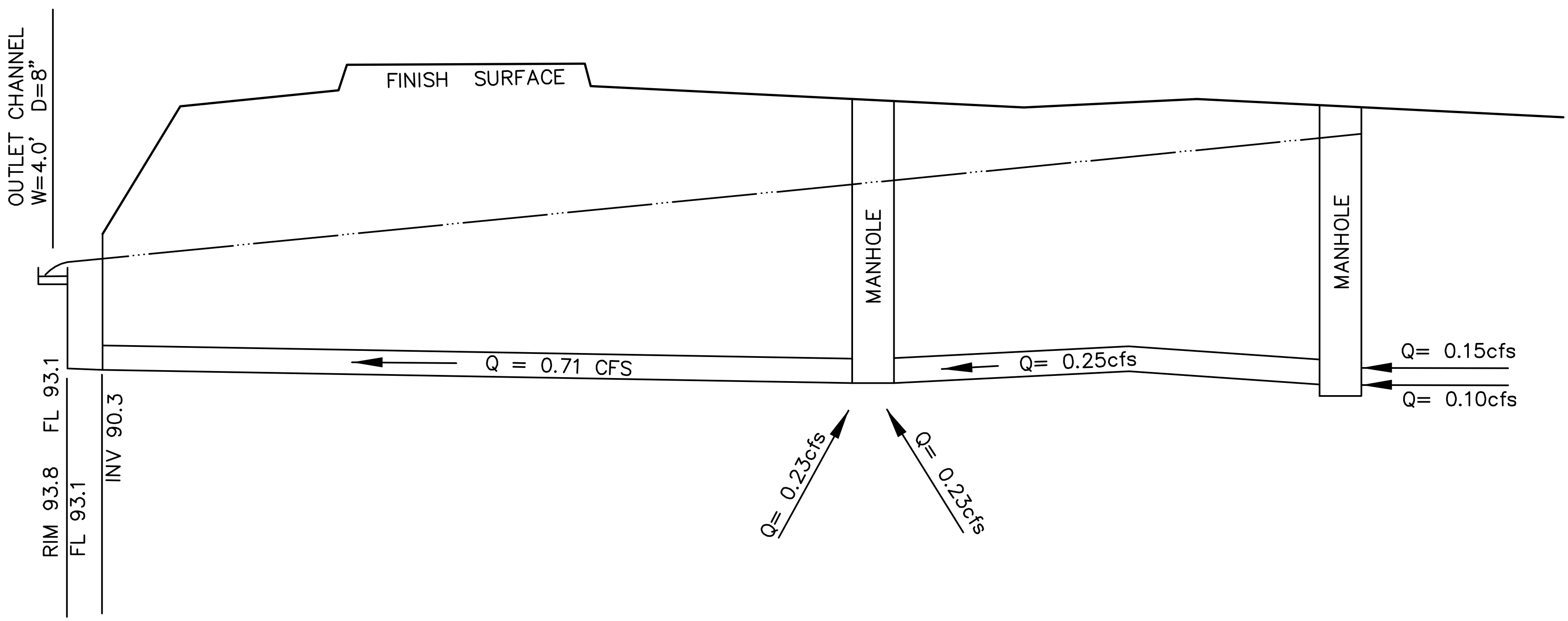
TYPICAL SITE RUNOFF COLLECTION SYSTEM

ATTACHMENT 3
SHEET 1



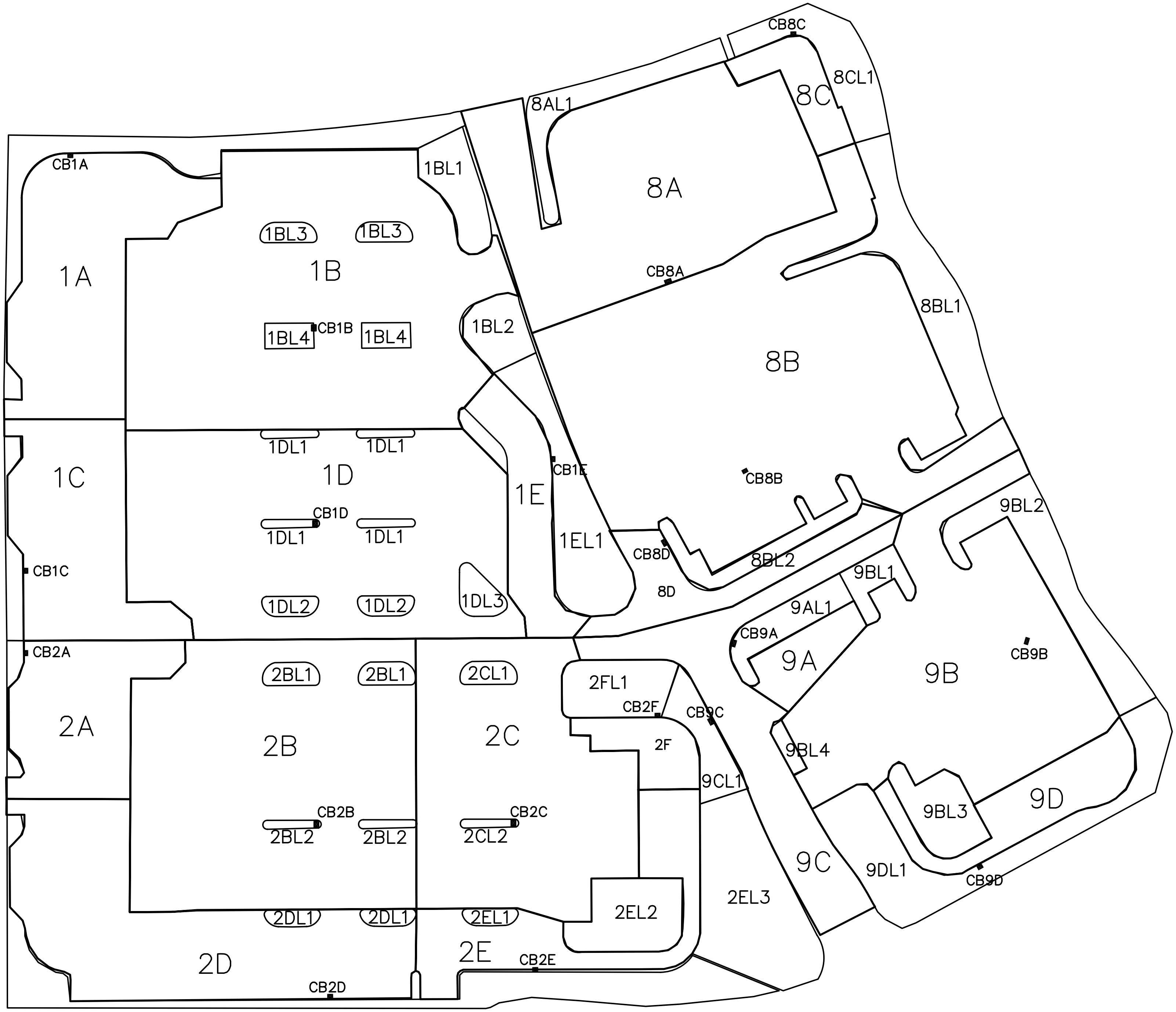
SCHEMATIC PROFILE OF SITE RUNOFF COLLECTION SYSTEM

ATTACHMENT 3
SHEET 2



COMMON SITE OUTLET SYSTEM

ATTACHMENT 3
SHEET 3



SITE RUNOFF TRIBUTARY AREAS

ATTACHMENT 4
SHEET 1

LUISENO VILLAGE DRAINAGE AREAS

Parcel 1

CATCH BASIN	HARDSCAPE sf			LANDSCAPE sf
1A	15428			0
1B	39294	1BL1	2257	6103
		1BL2	1813	
		1BL3	927	
		1BL4	1106	
1C	11917			0
1D	34513	1DL1	847	2707
		1DL2	1076	
		1DL3	784	
1E	5932	1EL1		5251
TOTAL	107084			14061

LUISENO VILLAGE DRAINAGE AREAS

Parcel 2

CATCH BASIN	HARDSCAPE sf			LANDSCAPE sf
2A	9142			0
2B	33652	2BL1	1076	1500
		2BL2	424	
2C	23127	2CL1	538	750
		2CL2	212	
2D	20727	2DL2		1076
2E	8402	2EL1	538	11277
		2EL2	3311	
		2EL3	1106	
2F	2738	2FL1		2739
TOTAL	97789			17341

LUISENO VILLAGE DRAINAGE AREAS

Parcel 8

CATCH BASIN	HARDSCAPE sf			LANDSCAPE sf
8A	26752	8AL1		2820
8B	45202	8BL1	6527	8615
		8BL2	2088	
8C	2753	8CL1		3511
8D	4997			
TOTAL	79703			14946

LUISENO VILLAGE DRAINAGE AREAS

Parcel 9

CATCH BASIN	HARDSCAPE sf			LANDSCAPE sf
9A	2633	9AL1		2820
9B	27248	9BL1	1213	8615
		9BL2	4918	
		9BL3	2477	3511
		9BL4	359	
9C	11207	9CL1		1927
9D	5529	9DL1		7409
TOTAL	46617			20350

ATTACHMENT 4
SHEET 2

ATTACHMENT 5

CALCULATOR FLOW RATE AND VOLUME OUTPUT DATA

ATTACHMENT 5

SHEET SET 1

EXISTING FLOW RATE

Santa Ana Watershed - BMP Design Flow Rate, Q_{BMP}

(Rev. 10-2011)

Legend: Required Entries | Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name: Tuttle Engineering
Date:
Designed by:
Case No:
Company Project Number/Name: Luiseno Village

BMP Identification

BMP NAME / ID: Parcel 1 - Existing

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

Design Rainfall Intensity: I = 1.20 in/hr

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type (use pull-down menu)	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Rainfall Intensity (in/hr)*	*Design Flow Rate (cfs)*	*Proposed Flow Rate (cfs)*
1	*132337*	*Natural (A Soil)*	*0.03*	*0.06*	*8276.5*			
	132337		*Total*		8276.5	1.20	*0.23*	

DMAs

Proposed Volume must be greater than the Design Capture Volume

Notes:

Santa Ana Watershed - BMP Design Flow Rate, Q_{BMP}

(Rev. 10-2011)

Legend: Required Entries | Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name: Tuttle Engineering | Date:
Designed by: | Case No:
Company Project Number/Name: Luiseno Village

BMP Identification

BMP NAME / ID: Parcel 2 - Existing

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

Design Rainfall Intensity I = 1.20 in/hr

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMAs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type (use pull-down menu)	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Rainfall Intensity (in/hr)*	*Design Flow Rate (cfs)*	*Proposed Flow Rate (cfs)*
2	*131742*	*Natural (A Soil)*	*0.03*	*0.06*	*8239.3*			
	131742	***Total***			**8239.3**	**1.20**	***0.23***	

Proposed Volume must be greater than the Design Capture Volume

Notes:

Santa Ana Watershed - BMP Design Flow Rate, Q_{BMP}

(Rev. 10-2011)

Legend: Required Entries / Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name: Tuttle Engineering | Date:
Designed by: | Case No:
Company Project Number/Name: Luiseno Village

BMP Identification

BMP NAME / ID: Parcel 8 - Existing

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

Design Rainfall Intensity: I = 1.20 in/hr

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

	DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type (use pull-down menu)	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Rainfall Intensity (in/hr)*	*Design Flow Rate (cfs)*	*Proposed Flow Rate (cfs)*
DMAs	*8*	*87370*	*Natural (A Soil)*	*0.03*	*0.06*	*5464.2*			
		87370	***Total***			**5464.2**	**1.20**	***0.15***	

Proposed Volume must be greater than the Design Capture Volume

Notes:

Santa Ana Watershed - BMP Design Flow Rate, Q_{BMP}

(Rev. 10-2011)

Legend: Required Entries / Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name: Tuttle Engineering | Date:

Designed by: | Case No:

Company Project Number/Name: Luiseno Village

BMP Identification

BMP NAME / ID: Parcel 8 - Existing

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

Design Rainfall Intensity: I = 1.20 in/hr

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

	DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type (use pull-down menu)	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Rainfall Intensity (in/hr)*	*Design Flow Rate (cfs)*	*Proposed Flow Rate (cfs)*
DMAs	*9*	*60605*	*Natural (A Soil)*	*0.03*	*0.06*	*3790.3*			
		60605	**Total**			**3790.3**	**1.20**	**0.1**	

Proposed Volume must be greater than the Design Capture Volume

Notes:

ATTACHMENT 5

SHEET SET 2

POST DEVELOPMENT VOLUME

Santa Ana Watershed - BMP Design Volume, V_{BMP}

(Rev. 10-2011)

Legend: Required Entries / Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name	Tuttle Engineering	Date	
Designed by		Case No	
Company Project Number/Name	Luiseno Village		

BMP Identification

BMP NAME / ID: Parcel 1 - Post Development

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth, from the Isohyetal Map in Handbook Appendix E

D_{85}= 0.70 inches

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
1L	*14061*	*Ornamental Landscaping*	*0.1*	*0.11*	*1553.1*			
1H	*107084*	*Concrete or Asphalt*	*1*	*0.89*	*95518.9*			
	121145	***Total***			**97072**	**0.70**	**5662.5**	

Proposed Volume must be greater than the Design Capture Volume

Notes:

Santa Ana Watershed - BMP Design Volume, V_{BMP}

(Rev. 10-2011)

Legend: Required Entries / Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name: Tuttle Engineering
Date:
Designed by:
Case No:
Company Project Number/Name: Luiseno Village

BMP Identification

BMP NAME / ID: Parcel 2 - Post Development

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth, from the Isohyetal Map in Handbook Appendix E

D_{85}= 0.70 inches

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
2L	*17341*	*Ornamental Landscaping*	*0.1*	*0.11*	*1915.5*			
2H	*97789*	*Concrete or Asphalt*	*1*	*0.89*	*87227.8*			
	115130	***Total***			**89143.3**	**0.70**	**5200**	

Proposed Volume must be greater than the Design Capture Volume

Notes:

Santa Ana Watershed - BMP Design Volume, V_{BMP}

(Rev. 10-2011)

Legend: Required Entries / Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name: Tuttle Engineering
Date:
Designed by:
Case No:
Company Project Number/Name: Luiseno Village

BMP Identification

BMP NAME / ID: Parcel 8 - Post Development

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth,
from the Isohyetal Map in Handbook Appendix E

D_{85}= 0.70 inches

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
8L	*14946*	*Ornamental Landscaping*	*0.1*	*0.11*	*1650.9*			
8H	*79703*	*Concrete or Asphalt*	*1*	*0.89*	*71095.1*			
	94649	***Total***			**72746**	**0.70**	**4243.5**	

Proposed Volume must be greater than the Design Capture Volume

Notes:

Santa Ana Watershed - BMP Design Volume, V_{BMP}

(Rev. 10-2011)

Legend: Required Entries / Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name: Tuttle Engineering
Date:
Designed by:
Case No:
Company Project Number/Name: Luiseno Village

BMP Identification

BMP NAME / ID: Parcel 9 - Post Development

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth,
from the Isohyetal Map in Handbook Appendix E

D_{85}= 0.70 inches

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
9L	*20350*	*Ornamental Landscaping*	*0.1*	*0.11*	*2247.8*			
9H	*46617*	*Concrete or Asphalt*	*1*	*0.89*	*41582.4*			
	66967	***Total***			**43830.2**	**0.70**	***2556.8***	

Proposed Volume must be greater than the Design Capture Volume

Notes:

ATTACHMENT 5

SHEET SET 2

POST DEVELOPMENT FLOW RATE

Santa Ana Watershed - BMP Design Flow Rate, Q_{BMP}

(Rev. 10-2011)

Legend: Required Entries / Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name: Tuttle Engineering | Date:

Designed by: | Case No:

Company Project Number/Name: Luiseno Village

BMP Identification

BMP NAME / ID: Parcel 1 - Post Development

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

Design Rainfall Intensity: I = 1.20 in/hr

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMAs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type (use pull-down menu)	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Rainfall Intensity (in/hr)*	*Design Flow Rate (cfs)*	*Proposed Flow Rate (cfs)*
1L	*14061*	*Ornamental Landscaping*	*0.1*	*0.11*	*1553.1*			
1H	*107084*	*Concrete or Asphalt*	*1*	*0.892*	*95518.9*			
	121145	***Total***			**97072**	**1.20**	**2.67**	

Proposed Volume must be greater than the Design Capture Volume

Notes:

Santa Ana Watershed - BMP Design Flow Rate, Q_{BMP}

(Rev. 10-2011)

Legend: Required Entries | Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name: Tuttle Engineering
Date:
Designed by:
Case No:
Company Project Number/Name: Luiseno Village

BMP Identification

BMP NAME / ID: Parcel 2 - Post Development

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

Design Rainfall Intensity I = 1.20 in/hr

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type (use pull-down menu)	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Rainfall Intensity (in/hr)*	*Design Flow Rate (cfs)*	*Proposed Flow Rate (cfs)*
2L	*17341*	*Ornamental Landscaping*	*0.1*	*0.11*	*1915.5*			
2H	*97789*	*Concrete or Asphalt*	*1*	*0.892*	*87227.8*			
	115130	***Total***			**89143.3**	**1.20**	***2.456***	

DMAs

Proposed Volume must be greater than the Design Capture Volume

Notes:

Santa Ana Watershed - BMP Design Flow Rate, Q_{BMP}

(Rev. 10-2011)

Legend: Required Entries | Calculated Cells

(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)

Company Name: Tuttle Engineering

Date:

Designed by:

Case No:

Company Project Number/Name: Luiseno Village

BMP Identification

BMP NAME / ID: Parcel 8 - Post Development

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

Design Rainfall Intensity I = 1.20 in/hr

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMAs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type (use pull-down menu)	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Rainfall Intensity (in/hr)*	*Design Flow Rate (cfs)*	*Proposed Flow Rate (cfs)*
8L	*14946*	*Ornamental Landscaping*	*0.1*	*0.11*	*1650.9*			
8H	*79703*	*Concrete or Asphalt*	*1*	*0.892*	*71095.1*			
	94649	***Total***			**72746**	**1.20**	**2**	

Proposed Volume must be greater than the Design Capture Volume

Notes:

Santa Ana Watershed - BMP Design Flow Rate, Q_{BMP}

(Rev. 10-2011)

Legend: Required Entries / Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name	Tuttle Engineering	Date	
Designed by		Case No	
Company Project Number/Name	Luiseno Village		

BMP Identification

BMP NAME / ID: Parcel 9 - Post Development

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

Design Rainfall Intensity — I = 1.20 in/hr

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMAs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type (use pull-down menu)	Effective Imperviuos Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Rainfall Intensity (in/hr)*	*Design Flow Rate (cfs)*	*Proposed Flow Rate (cfs)*
9L	*20350*	*Ornamental Landscaping*	*0.1*	*0.11*	*2247.8*			
9H	*46617*	*Concrete or Asphalt*	*1*	*0.892*	*41582.4*			
	66967	***Total***			**43830.2**	**1.20**	***1.21***	

Proposed Volume must be greater than the Design Capture Volume

Notes:

WORKSHEET TO DETERMINE STORM DISSIPATION IN BASIN DESIGN 100 YEAR STORM

Parcel 1

This table incorporates the formula Q=CIA to determine the discharge rate "Q" at various intensities. The product of the runoff coefficient "C" and the area "A" is an assumed constant. Therefore, the discharge quantities of "Q" is a direct function of the intensity "I" and their values can be determined at any point and time during storm dissipation. This worksheet evaluates the quantity leaving the site by varying the time of concentration at the basin exit point until the limiting discharge value of the site boundary is reached. The capacity of the basin required to reach this allowable flow can be calculated by integrating the capacities of individual time increments up to the point of time where the maximum allowable discharge value occurs.

Duration Intensity Slope		0.50	(Riverside County Hydrology Manual Platd D-4.1 (5 of 6))
1 Hour 100 Year Intensity	in per hr	1.20	(Riverside County Hydrology Manual Platd D-4.1 (5 of 6))
Peak Discharge at Basin Check Point	cfs	2.67	(Post-development from Site, no basin, per WQMP Worksheet)
Peak Discharge Time	min	9.00	(Time of Concentration; L = 250, H = 1.0, of longest entry run)
		.	
Peak Discharge Intensity	in per hr	3.10	(Intensity at Peak Discharge determined from the storm dissipation formula)
Area Runoff Coefficient Constant (k)		0.86	(Ratio of Peak Discharge at basin check point with Peak Discharge Intensity)

Basin Requirement by Iteration			
Elapsed Time	min	208.00	(Determine by Iteration)
Intensity	in per hr	0.64	(Calculated from Elapsed Time)
Discharge	cfs	0.56	(Product of Area Constant and Intensity)

Elapsed Time	min	5.00	7.00	10.00	25.00	50.00	75.00	100.00	140.00	180.00	208.00
Intensity at Elapsed Time	in per hr	4.16	3.51	2.94	1.86	1.31	1.07	0.93	0.79	0.69	0.64
Discharge at Basin Catch Point	cfs	3.58	3.03	2.53	1.60	1.13	0.92	0.80	0.68	0.60	0.56
Incremental Basin Runoff Volume	cy	9.89	14.69	18.53	68.92	75.97	57.16	47.94	65.69	56.62	35.85

Basin Volume at Design Target Discharge	cy	451	(Determined through iteration by combining incremental volumes up to target discharge)	
Elapsed Time to Design Elev	min	208.00	hrs	3.47
Discharge at Design Volume	cfs	0.56		
Actual Basin Volume	cy	451	(Vary Row 24 until D32= D35)	

CHAMBER SYSTEM VARIABLES AND RESULTS

Number of Units in Row	Number of Rows	Row Separation	Historical Discharge	Req Addn Reduction	Pad Width	Pad Length	Hours to Drain
8	**7**	**4.50**	**0.23**	**-0.02**	**85**	**65**	**9.69**
ea	**ea**	**ft**	**cfs**	**cfs**	**ft**	**ft**	**hrs**

ATTACHMENT 7

PARCEL 1

WORKSHEET TO DETERMINE STORM DISSIPATION IN BASIN DESIGN 100 YEAR STORM

Parcel 2

This table incorporates the formula Q=CIA to determine the discharge rate "Q" at various intensities. The product of the runoff coefficient "C" and the area "A" is an assumed constant. Therefore, the discharge quantities of "Q" is a direct function of the intensity "I" and their values can be determined at any point and time during storm dissipation. This worksheet evaluates the quantity leaving the site by varying the time of concentration at the basin exit point until the limiting discharge value of the site boundary is reached. The capacity of the basin required to reach this allowable flow can be calculated by integrating the capacities of individual time increments up to the point of time where the maximum allowable discharge value occurs.

Duration Intensity Slope		0.50	(Riverside County Hydrology Manual Platd D-4.1 (5 of 6))
1 Hour 100 Year Intensity	in per hr	1.20	(Riverside County Hydrology Manual Platd D-4.1 (5 of 6))
Peak Discharge at Basin Check Point	cfs	2.46	(Post-development from Site, no basin, per WQMP Worksheet)
Peak Discharge Time	min	9.00	(Time of Concentration; L = 250, H = 1.0, of longest entry run)
		.	
Peak Discharge Intensity	in per hr	3.10	(Intensity at Peak Discharge determined from the storm dissipation formula)
Area Runoff Coefficient Constant (k)		0.79	(Ratio of Peak Discharge at basin check point with Peak Discharge Intensity)
Basin Requirement by Iteration			
Elapsed Time	min	193.00	(Determine by Iteration)
Intensity	in per hr	0.67	(Calculated from Elapsed Time)
Discharge	cfs	0.53	(Product of Area Constant and Intensity)

Elapsed Time	min	5.00	7.00	10.00	25.00	50.00	75.00	100.00	140.00	160.00	193.00
Intensity at Elapsed Time	in per hr	4.16	3.51	2.94	1.86	1.31	1.07	0.93	0.79	0.73	0.67
Discharge at Basin Catch Point	cfs	3.30	2.79	2.33	1.48	1.04	0.85	0.74	0.62	0.58	0.53
Incremental Basin Runoff Volume	cy	9.11	13.53	17.08	63.50	69.99	52.66	44.17	60.52	26.83	40.87

Basin Volume at Design Target Discharge	cy	398	(Determined through iteration by combining incremental volumes up to target discharge)	
Elapsed Time to Design Elev	min	193.00	hrs	3.22
Discharge at Design Volume	cfs	0.53		
Actual Basin Volume	cy	398	(Vary Row 24 until D32= D35)	

CHAMBER SYSTEM VARIABLES AND RESULTS

Number of Units in Row	Number of Rows	Row Separation	Historical Discharge	Req Addn Reduction	Pad Width	Pad Length	Hours to Drain
7	**7**	**4.50**	**0.23**	**-0.01**	**85**	**58**	**9.59**
ea	**ea**	**ft**	**cfs**	**cfs**	**ft**	**ft**	**hrs**

ATTACHMENT 7
PARCEL 2

WORKSHEET TO DETERMINE STORM DISSIPATION IN BASIN DESIGN 100 YEAR STORM

Parcel 8

This table incorporates the formula Q=CIA to determine the discharge rate "Q" at various intensities. The product of the runoff coefficient "C" and the area "A" is an assumed constant. Therefore, the discharge quantities of "Q" is a direct function of the intensity "I" and their values can be determined at any point and time during storm dissipation. This worksheet evaluates the quantity leaving the site by varying the time of concentration at the basin exit point until the limiting discharge value of the site boundary is reached. The capacity of the basin required to reach this allowable flow can be calculated by integrating the capacities of individual time increments up to the point of time where the maximum allowable discharge value occurs.

Duration Intensity Slope		0.50	(Riverside County Hydrology Manual Platd D-4.1 (5 of 6))
1 Hour 100 Year Intensity	in per hr	1.20	(Riverside County Hydrology Manual Platd D-4.1 (5 of 6))
Peak Discharge at Basin Check Point	cfs	1.99	(Post-development from Site, no basin, per WQMP Worksheet)
Peak Discharge Time	min	9.00	(Time of Concentration; L = 250, H = 1.0, of longest entry run)
		.	
Peak Discharge Intensity	in per hr	3.10	(Intensity at Peak Discharge determined from the storm dissipation formula)
Area Runoff Coefficient Constant (k)		0.64	(Ratio of Peak Discharge at basin check point with Peak Discharge Intensity)
Basin Requirement by Iteration			
Elapsed Time	min	220.00	(Determine by Iteration)
Intensity	in per hr	0.63	(Calculated from Elapsed Time)
Discharge	cfs	0.40	(Product of Area Constant and Intensity)

Elapsed Time	min	5.00	7.00	10.00	25.00	50.00	75.00	100.00	160.00	180.00	220.00
Intensity at Elapsed Time	in per hr	4.16	3.51	2.94	1.86	1.31	1.07	0.93	0.73	0.69	0.63
Discharge at Basin Catch Point	cfs	2.67	2.26	1.89	1.19	0.84	0.69	0.60	0.47	0.44	0.40
Incremental Basin Runoff Volume	cy	7.37	10.95	13.81	51.36	56.62	42.60	35.73	71.26	20.38	37.67

Basin Volume at Design Target Discharge	cy	348	(Determined through iteration by combining incremental volumes up to target discharge)	
Elapsed Time to Design Elev	min	220.00	hrs	3.67
Discharge at Design Volume	cfs	0.40		
Actual Basin Volume	cy	348	(Vary Row 24 until D32= D35)	

CHAMBER SYSTEM VARIABLES AND RESULTS

Number of Units in Row	Number of Rows	Row Separation	Historical Discharge	Req Addn Reduction	Pad Width	Pad Length	Hours to Drain
10	**4**	**4.50**	**0.15**	**-0.01**	**52**	**80**	**9.94**
ea	**ea**	**ft**	**cfs**	**cfs**	**ft**	**ft**	**hrs**

ATTACHMENT 7
PARCEL 8

WORKSHEET TO DETERMINE STORM DISSIPATION IN BASIN DESIGN 100 YEAR STORM

Parcel 9

This table incorporates the formula Q=CIA to determine the discharge rate "Q" at various intensities. The product of the runoff coefficient "C" and the area "A" is an assumed constant. Therefore, the discharge quantities of "Q" is a direct function of the intensity "I" and their values can be determined at any point and time during storm dissipation. This worksheet evaluates the quantity leaving the site by varying the time of concentration at the basin exit point until the limiting discharge value of the site boundary is reached. The capacity of the basin required to reach this allowable flow can be calculated by integrating the capacities of individual time increments up to the point of time where the maximum allowable discharge value occurs.

Duration Intensity Slope		0.50	(Riverside County Hydrology Manual Platd D-4.1 (5 of 6))
1 Hour 100 Year Intensity	in per hr	1.20	(Riverside County Hydrology Manual Platd D-4.1 (5 of 6))
Peak Discharge at Basin Check Point	cfs	1.21	(Post-development from Site, no basin, per WQMP Worksheet)
Peak Discharge Time	min	9.00	(Time of Concentration; L = 250, H = 1.0, of longest entry run)
		.	
Peak Discharge Intensity	in per hr	3.10	(Intensity at Peak Discharge determined from the storm dissipation formula)
Area Runoff Coefficient Constant (k)		0.39	(Ratio of Peak Discharge at basin check point with Peak Discharge Intensity)
Basin Requirement by Iteration			
Elapsed Time	min	229.00	(Determine by Iteration)
Intensity	in per hr	0.61	(Calculated from Elapsed Time)
Discharge	cfs	0.24	(Product of Area Constant and Intensity)

Elapsed Time	min	5.00	7.00	10.00	20.00	50.00	75.00	100.00	150.00	200.00	229.00
Intensity at Elapsed Time	in per hr	4.16	3.51	2.94	2.08	1.31	1.07	0.93	0.76	0.66	0.61
Discharge at Basin Catch Point	cfs	1.62	1.37	1.15	0.81	0.51	0.42	0.36	0.30	0.26	0.24
Incremental Basin Runoff Volume	cy	4.48	6.66	8.40	21.77	44.17	25.90	21.73	36.63	30.73	16.00

Basin Volume at Design Target Discharge	cy	216	(Determined through iteration by combining incremental volumes up to target discharge)	
Elapsed Time to Design Elev	min	229.00	hrs	3.82
Discharge at Design Volume	cfs	0.24		
Actual Basin Volume	cy	216	(Vary Row 24 until D32= D35)	

CHAMBER SYSTEM VARIABLES AND RESULTS

Number of Units in Row	Number of Rows	Row Separation	Historical Discharge	Req Addn Reduction	Pad Width	Pad Length	Hours to Drain
6	**4**	**4.50**	**0.10**	**-0.02**	**85**	**65**	**9.69**
ea	**ea**	**ft**	**cfs**	**cfs**	**ft**	**ft**	**hrs**

ATTACHMENT 7
PARCEL 9