DRAINAGE STUDY

For

9676 Marilla Drive

PDS2014-TM-5584
PDS2013-STP-13-028

Submittal to:
County of San Diego
Planning & Development Services
5510 Overland Ave #310
San Diego, CA 92123

Prepared by:
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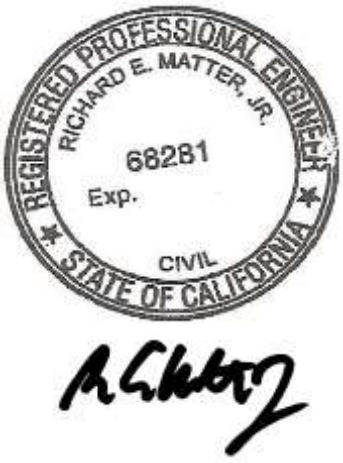

Preparation Date
August 15, 2014

Revision Date
January 5, 2015

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1.0 PROJECT DESCRIPTION:

This report is being prepared for the proposed project located at 9676 Marilla Drive, Lakeside, CA.

The existing site includes previously developed land with flows over mostly natural (dirt) terrain and some pervious surfaces (concrete, asphalt & roofing). The existing right-of-way consists of a 6" AC berm, AC street paving, and natural (dirt) terrain. The proposed project will involve the installation of a new concrete driveway, landscaping, walkways and seven (7) residential detached units. Surrounding land use is predominately multiple family developed residential lots, and a school facility.

The project also proposes to develop the right-of-way to include concrete curb, gutter and a 5' sidewalk adjacent to the site. The lot slopes easterly from the rear of the property to the street at roughly 1%.

2.0 MODELS & METHODS:

This Preliminary Drainage Study incorporates a manual application of the Rational Method as described in the County of San Diego Hydrology Manual.

Rainfall Data: Standard intensity-duration design curve data generated from the County of San Diego Hydrology Manual.

Topographic Data: The Hydrology Maps shown in Appendix B define and contain information used as a basis of generating the project hydrology study.

Runoff Calculations: All runoff formulas, calculations and sizing information is shown in Appendix B.

County of San Diego **Drainage Design Criteria:**
The design criteria, as found in the County of San Diego Hydrology Manual, specifies the design runoff conditions based on the 100 year storm frequency as follows:

> (1) Within floodplain and floodplain fringe areas as defined by the Federal Emergency Management Agency (FEMA). The runoff criteria shall be based upon a 100-year frequency storm:
> (2) For all drainage channels and storm drain systems which will convey drainage from a tributary area equal to and greater than one (1) square mile, the runoff criteria shall be based upon a 100-year frequency storm.
> (3) For tributary areas under one **(1)** square mile:
>
> > (a) The storm drain system shall be designed so that the combination of storm drain system capacity and overflow will be able to carry the 100-year frequency storm without damage to or flooding of adjacent existing buildings or potential building sites.

Rational Method Hydrologic Analysis:
Design Storm – 100-year return interval
Land Use – Residential
Soil Type – Hydrologic soil group D was assured for all areas. Group D soils have very slow infiltration rates when thoroughly wetted. Consisting chiefly of clay soils with a high swelling potential, soils with a high permanent water table, soils with clay pan or clay layer at or near the surface, and shallow soils over nearly impervious materials, Group D soils have a very slow rate of water transmission.
Runoff Coefficient – Runoff coefficients are used/selected in accordance with the County of San Diego Hydrology Manual. When a watershed encompasses solely roofing and/or impervious conditions, a runoff coefficient of 0.95 was selected.
Method of Analysis – The Rational Method is the most widely used hydrologic model for estimating peak runoff rates. Applied to small urban and semi-urban areas with drainage areas less than 0.5 square miles, the Rational Method relates storm rainfall intensity, a runoff coefficient, and drainage area to peak runoff rate. This relationship is expressed by the equation:

$$Q = CIA, \text{ where:}$$

Q = The peak runoff rate in cubic feet per second at the point of analysis.
C = A runoff coefficient representing the area – averaged ratio of runoff to rainfall intensity.
I = The time-averaged rainfall intensity in inches per hour corresponding to the time of concentration.
A = The drainage basin area in acres.

3.0 ANALYSIS & CONCLUSIONS:

The drainage system has been analyzed for capacity and functionality of the proposed system with the improvements of the ultimate condition. The 100-year storm was modeled using Aquaveo Software Hydraulic Toolbox, as required by San Diego County. Calculations for the design were made using methodology presented in the County of San Diego Hydrology Manual.

	C-Value	I_{100}	Area (Ac)	Q_{100}
Existing Condition	0.49	4.62	**0.33**	**0.75 cfs**
Pervious Runoff Area (LID Landscaping)	0.57	4.62	0.06	0.16 cfs
Roof Runoff (to LID Landscaping)	0.95	4.62	0.14	0.62 cfs
Driveway Runoff (LID Porous Paving)	0.95	4.62	0.13	0.26 cfs
Developed Total			**0.33**	**1.04 cfs**

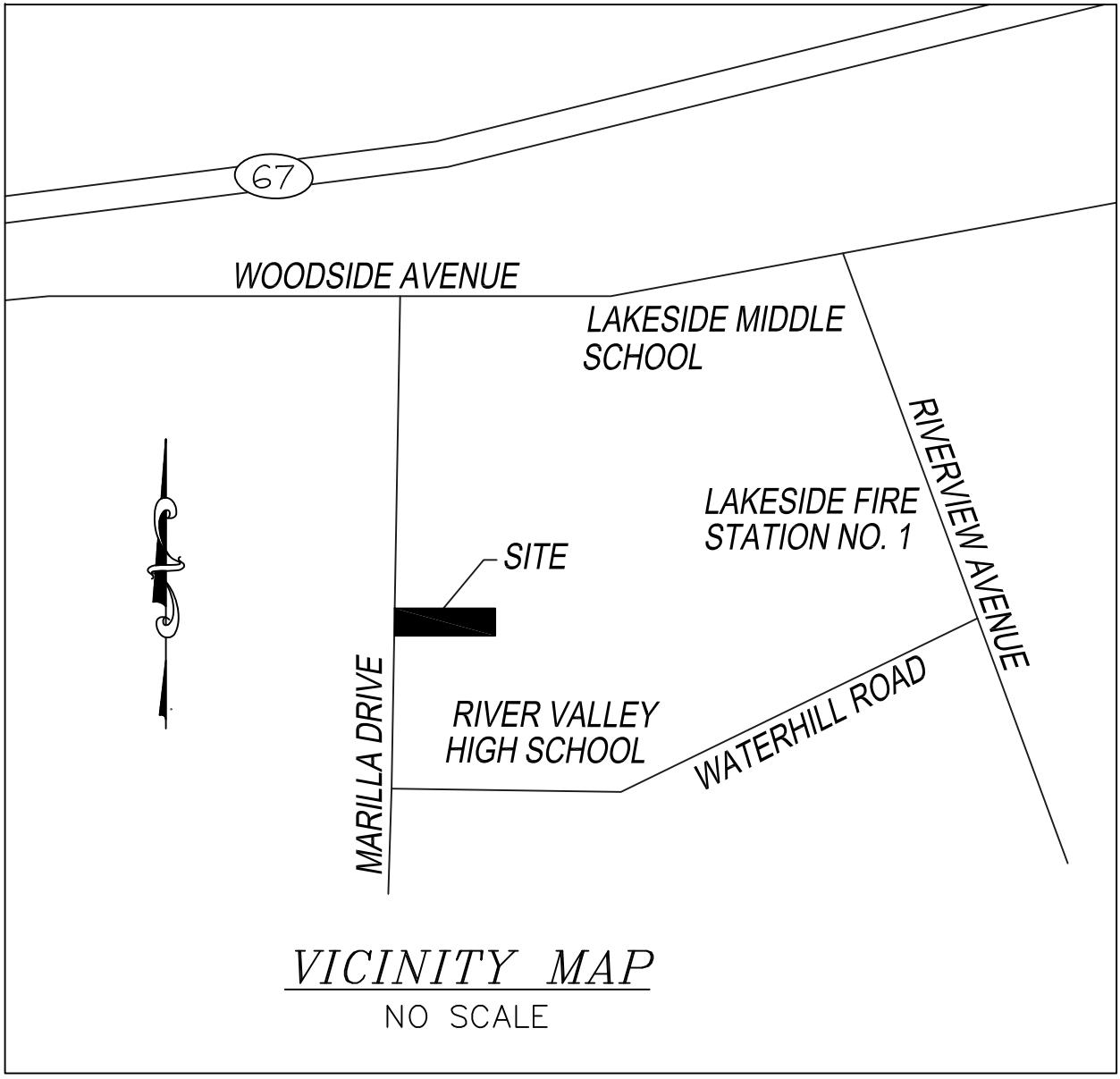
Drainage Management Area (DMA) Name	DMA Area	Post-Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor = Minimum LID Area	**Proposed LID Area (sf)**
LID Landscape	8,712 sf (0.20 ac)	Planter/Landscape	0.1	871 sf	**889 sf**
LID Paving	5,663 sf (0.13 ac)	Porous Paving	0.1	566 sf	**612 sf**

In the existing condition, runoff was conveyed through surface flows to the existing AC street and 6" berm, and ultimately to the existing storm drain network. In the proposed condition, all drainage patterns will ultimately remain the same, and overall site runoff will be reduced.

This project proposes two landscaped infiltration 'basins' similar in design to Appendix C, located at the front and rear of the site, together with porous paving in sections of the proposed driveway. The LID Plan detailing these locations is shown in Appendix D. The increase in runoff by this development shall be mitigated via these infiltration basin areas and porous concrete installation within the proposed driveway. Based on the calculations above, these LID design features will mitigate 99% of the project site runoff during a 100-year storm event.

The required storage volume for this project has been calculated to 0.014 ac-ft (610 cf) during a 100-year storm, based on the detention calculations in Appendix B.

Storage volume proposed on-site has been calculated to 889 cf in the landscaping areas, and 612 cf within the porous paving area.



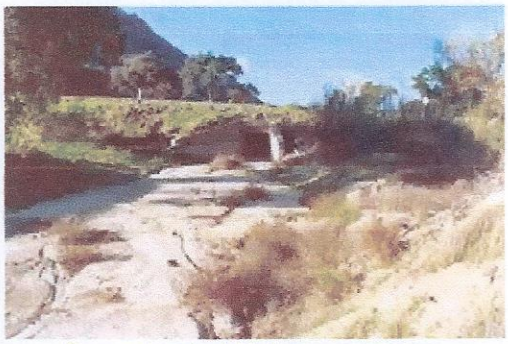
VICINITY MAP

NO SCALE

Appendix B ..... Hydrology Calculations, Tables & Figures

Existing Q100

Vlab **rational.sdsu.edu: Calculation of peak discharge by the rational method** Vlab



Box culvert at highway crossing.

Formula:

$Q_p = C\ I\ A$

In SI Units (metric): L s^{-1}, mm hr^{-1}, and hectares (ha).
In U.S. Customary Units: cfs, in hr^{-1}, and acres (ac).

INPUT DATA:

Select: SI units (metric) / U.S. Customary units

Runoff coefficient C : 0.49

Rainfall intensity I : 4.62 in hr^{-1}

Drainage area A : 0.33 ac

Press button to Calculate or recalculate

OUTPUT:

Peak discharge Q_p : 0.75327920 cfs

Your request was processed at 11:59:31 am on November 20th, 2014 [141120 11:59:31].

Thank you for running rational.sdsu.edu. Please call again.
[090826]

Pervious Q_{100} (proposed)

Vlab **rational.sdsu.edu: Calculation of peak discharge by the rational method** Vlab

Box culvert at highway crossing.

Formula:

$Q_p = C\ I\ A$

In SI Units (metric): L s^{-1}, mm hr^{-1}, and hectares (ha).
In U.S. Customary Units: cfs, in hr^{-1}, and acres (ac).

INPUT DATA:

Select: SI units (metric) / U.S. Customary units

Runoff coefficient C : 0.57

Rainfall intensity I : 4.62 in hr^{-1}

Drainage area A : 0.06 ac

OUTPUT:

Peak discharge Q_p : 0.15932064 cfs

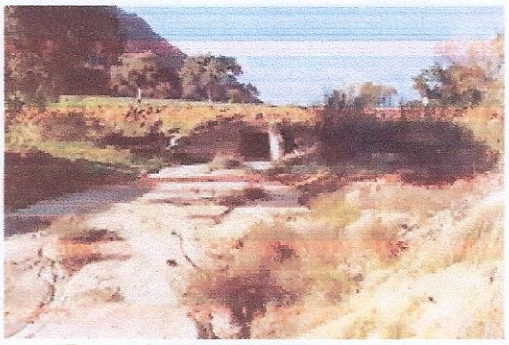
Press button to Calculate or recalculate

Your request was processed at 12:00:04 pm on November 20th, 2014 [141120 12:00:04].

Thank you for running rational.sdsu.edu. Please call again. [090826]

(Proposed) Roof Q100

rational.sdsu.edu: Calculation of peak discharge by the rational method



Box culvert at highway crossing.

Formula:

$$Q_p = C\ I\ A$$

In SI Units (metric): L s^{-1}, mm hr^{-1}, and hectares (ha).
In U.S. Customary Units: cfs, in hr^{-1}, and acres (ac).

INPUT DATA:

Select: SI units (metric) / U.S. Customary units

Runoff coefficient C : 0.95

Rainfall intensity I : 4.62 in hr^{-1}

Drainage area A : 0.14 ac

OUTPUT:

Peak discharge Q_p : 0.61958029 cfs

Press button to Calculate **or recalculate**

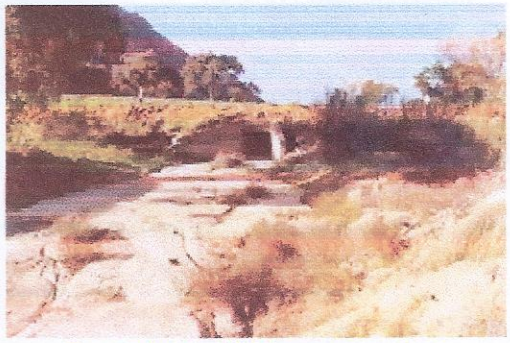
Your request was processed at 12:00:41 pm on November 20th, 2014 [141120 12:00:41].

Thank you for running **rational.sdsu.edu.** Please call again.
[090826]

(Proposed) Driveway Q100

Vlab

rational.sdsu.edu: Calculation of peak discharge by the rational method Vlab



Box culvert at highway crossing.

Formula:

$Q_p = C\ I\ A$

In SI Units (metric): L s^{-1}, mm hr^{-1}, and hectares (ha).
In U.S. Customary Units: cfs, in hr^{-1}, and acres (ac).

INPUT DATA:

Select: SI units (metric) / U.S. Customary units

Runoff coefficient *C* : 0.95

Rainfall intensity *I* : 4.62 in hr^{-1}

Drainage area *A* : 0.13 ac

OUTPUT:

Peak discharge Q_p : 0.57532455 cfs

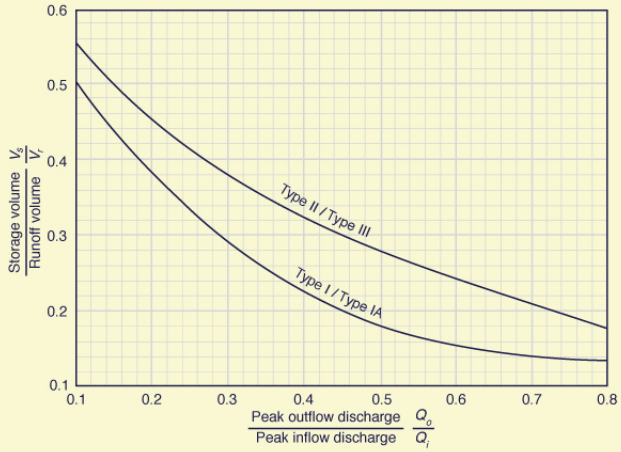
Press button to Calculate **or recalculate**

Your request was processed at 12:00:56 pm on November 20th, 2014 [141120 12:00:56].

Thank you for running **rational.sdsu.edu.** Please call again. [090826]

online_tr55_detention: TR-55 detention basin storage volume calculator

A detention basin in an urban area.



Reference: Natural Resources Conservation Service. (1986). TR-55 Urban Hydrology for Small Watersheds, Chapter 6: Storage Volume for Detention Basins.

INPUT DATA:

[Sample input file]

Watershed (optional):

Units: SI units (metric) / U.S. Customary (SI units) [U.S. units]

Catchment area *A* (ha) [ac]: 0.33 ac

Storm depth *P* (mm) [in]: 2.5 in.

Storm type: Type I / Type IA / Type II / Type III

Pre-development peak flow Q_o (m^3/s) [cfs]: 0.75 cfs

Post-development peak flow Q_i (m^3/s) [cfs]: 1.04 cfs

OUTPUT:

Watershed name (optional):

Selected units: U.S. Customary units

Selected storm type: Type II / Type III

Runoff volume V_r = 0.069 ac-ft

Ratio Q_o / Q_i = 0.721

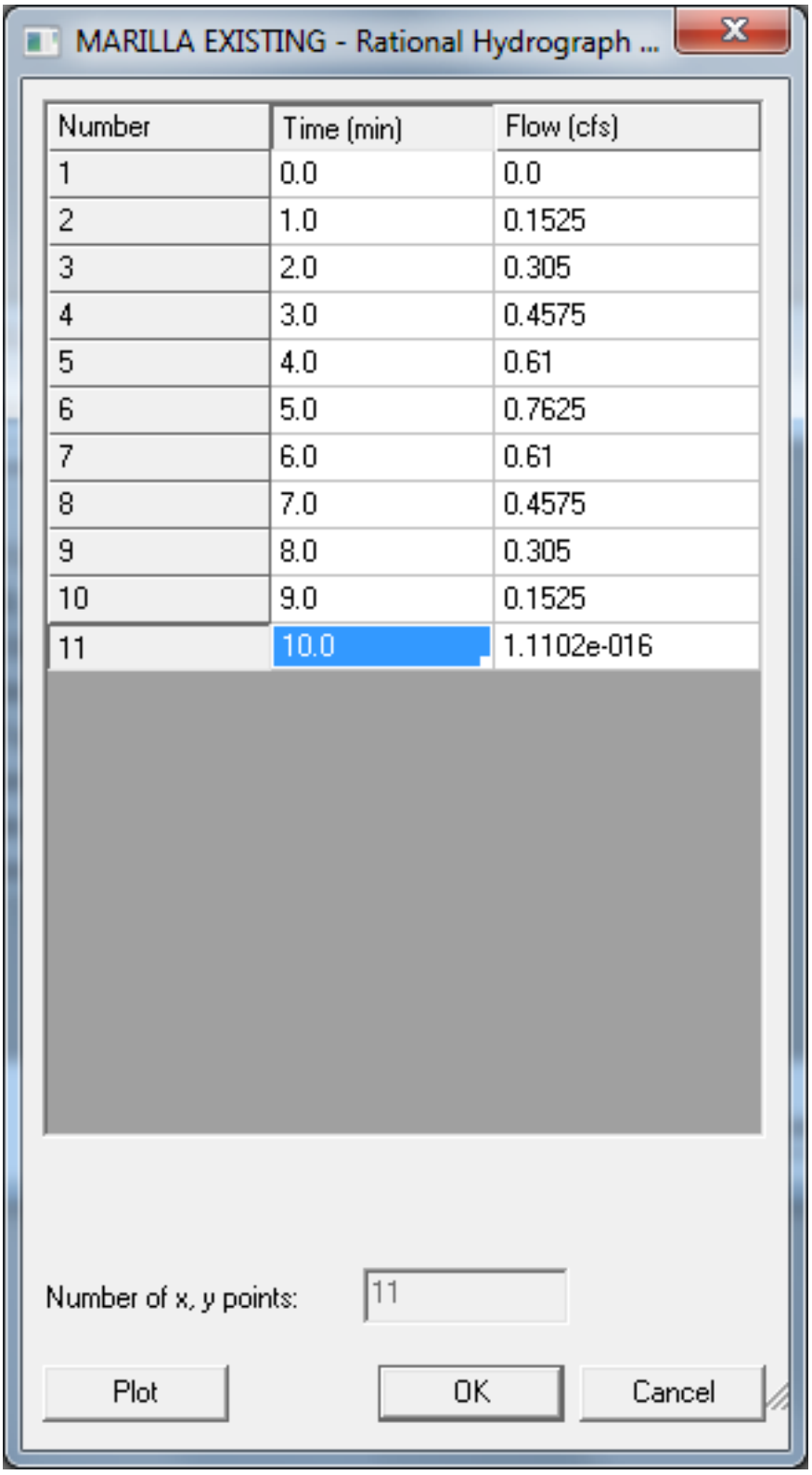
Ratio V_s / V_r = 0.204

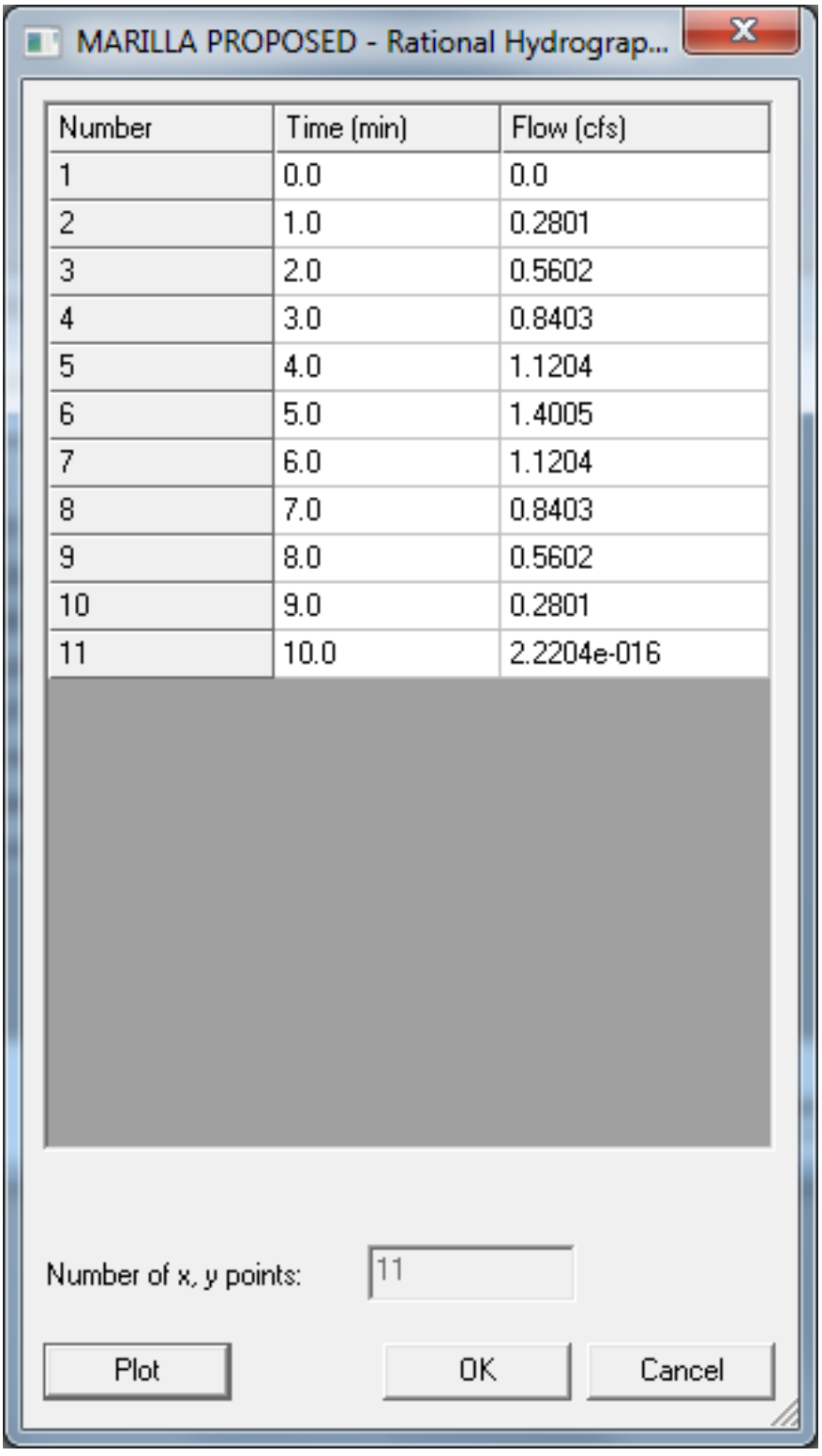
Detention basin storage volume V_s = 0.014 ac-ft

Calculate Reset

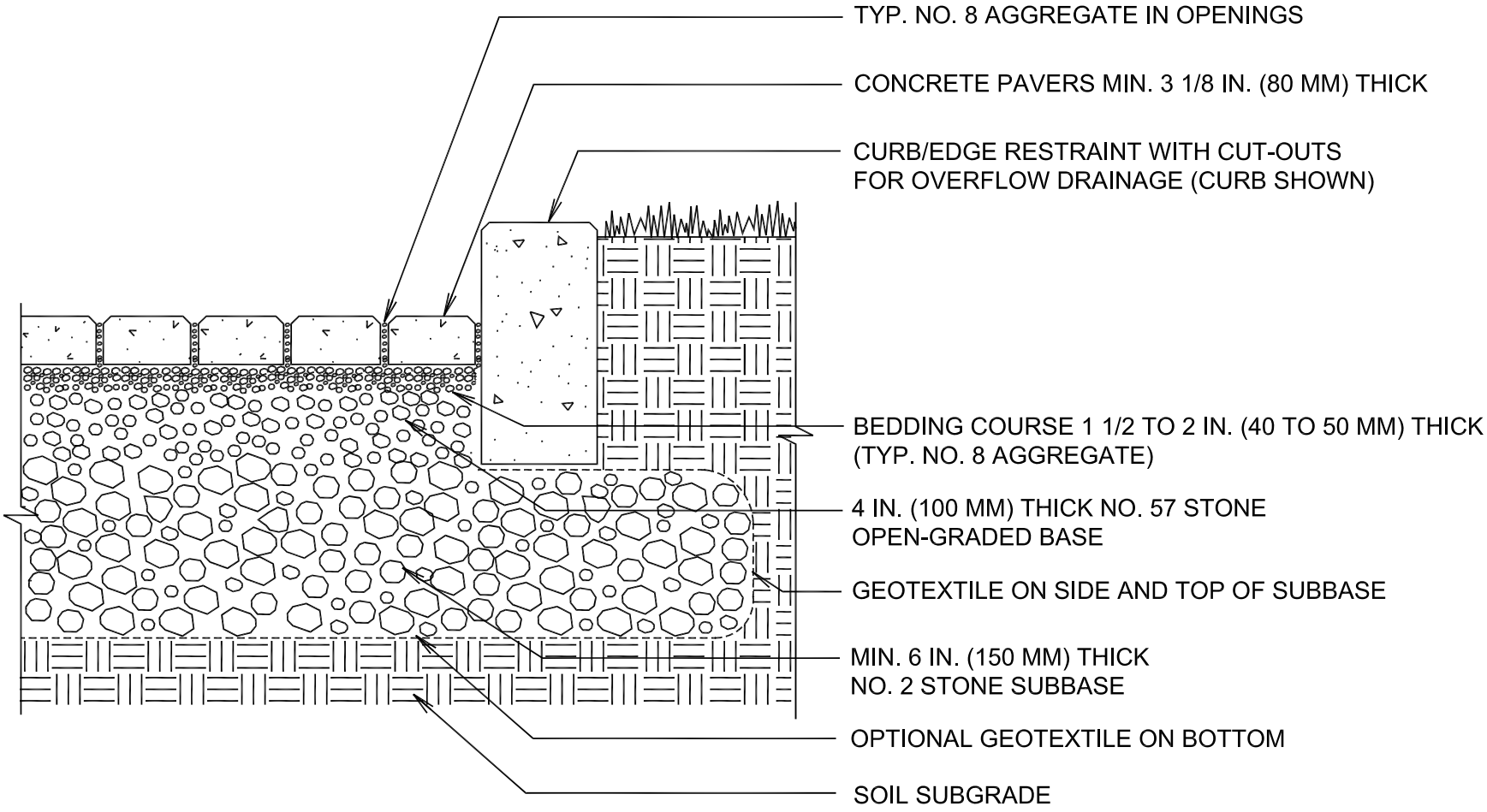
Your request was processed at 01:07:40 pm on December 30th, 2014 [141230 13:07:40].

Thank you for running online_tr55_detention. [140429]


MARILLA EXISTING - Rational Hydrograph ...
Number
Time (min)
Flow (cfs)
1 0.0 0.0
2 1.0 0.1525
3 2.0 0.305
4 3.0 0.4575
5 4.0 0.61
6 5.0 0.7625
7 6.0 0.61
8 7.0 0.4575
9 8.0 0.305
10 9.0 0.1525
11 10.0 1.1102e-016
Number of x, y points:
11
Plot
OK
Cancel


MARILLA PROPOSED - Rational Hydrograp...
Number
Time (min)
Flow (cfs)
1
0.0
0.0
2
1.0
0.2801
3
2.0
0.5602
4
3.0
0.8403
5
4.0
1.1204
6
5.0
1.4005
7
6.0
1.1204
8
7.0
0.8403
9
8.0
0.5602
10
9.0
0.2801
11
10.0
2.2204e-016
Number of x, y points:
11
Plot
OK
Cancel

Appendix C .... LID Details



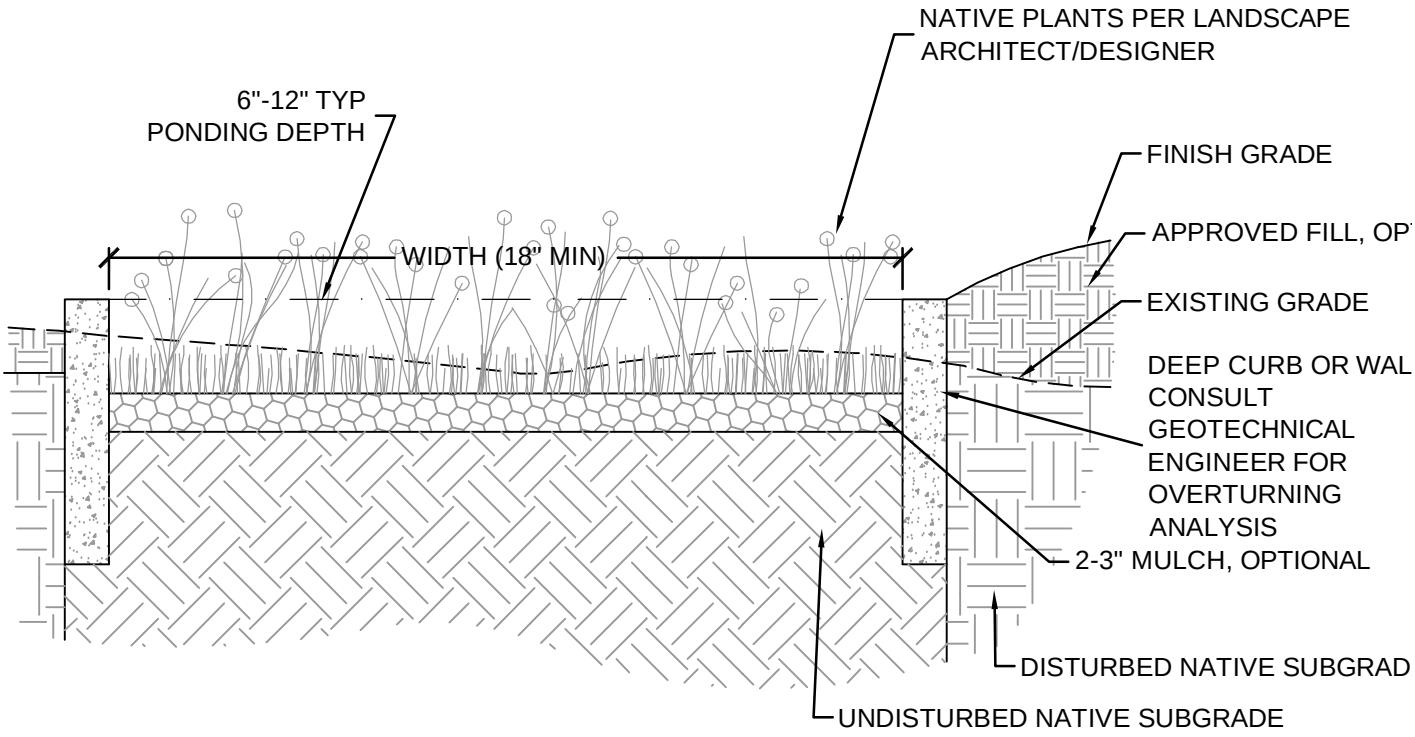
NOTES:

1. 2 3/8 IN. (60 MM) THICK PAVERS MAY BE USED IN PEDESTRIAN APPLICATIONS.
2. NO. 2 STONE SUBBASE THICKNESS VARIES WITH DESIGN.
   CONSULT ICPI PERMEABLE INTERLOCKING CONCRETE PAVEMENT MANUAL.

PERMEABLE PAVEMENT WITH FULL EXFILTRATION TO SOIL SUBGRADE

DRAWING NO. ICPI-68

SCALE NO SCALE



NOTES

DESIGN NOTES:

1. PLANT WITH PLANTS PER LANDSCAPE ARCHITECT DWGS. NATIVE PLANTS ARE PREFERRED, BECAUSE NON-NATIVE AND INVASIVE SPECIES CAN REPRODUCE DOWNSTREAM AND DAMAGE HABITAT. IF NON-NATIVES ARE CHOSEN, BE SURE THAT THEY WILL NOT DAMAGE DOWNSTREAM HABITAT.
2. RUNOFF EXCEEDING THE VOLUME THAT CAN BE INFILTRATED WILL OVERFLOW FROM THE LOWEST POINT. APPROPRIATE CONVEYANCE THAT WILL NOT CAUSE EROSION OR DAMAGE TO DOWNHILL STRUCTURES MUST BE PROVIDED.

CONSTRUCTION NOTES:

2. BUILD AND VEGETATE PLANTER AS EARLY AS POSSIBLE TO ESTABLISH PLANTINGS BEFORE DIRECTING STORMWATER RUNOFF TO IT OR DIVERT STORMWATER AROUND FACILITY. PREFERABLY, THIS PERIOD WOULD LAST A MINIMUM OF 3 MONTHS OR PER LANDSCAPE ARCHITECT/DESIGNER GUIDELINES.
3. INFILTRATION AREAS (THE AREA OF THE PLANTER AS DEFINED BY THE TOP ELEVATION OF THE DEEP CURBS OR WALLS) SHALL BE FENCED OFF FROM THE FIRST DAY OF EARTH MOVING UNTIL PROJECT COMPLETION TO PREVENT COMPACTION OF THE SUBGRADE, DIRT TRACKING ONTO ANY LAYER OF THE FACILITY AND STOCKPILING OF CONSTRUCTION MATERIALS THAT MAY CLOG THE SURFACE.
4. DURING EXCAVATION OF NATIVE SOILS TO THE BOTTOM OF THE FACILITY, RAINFALL MAY CAUSE FINES TO CLOG THE SURFACE OF THE FACILITY. IF THE NATIVE SOIL HAS BEEN EXPOSED TO RAINFALL, HAND RAKE THE SURFACE TO A DEPTH OF 3" TO RESTORE INFILTRATION CAPACITY.
5. CALL THE CIVIL ENGINEER, [ENTER NAME HERE] AT [ENTER PHONE NUMBER HERE] 24 HOURS IN ADVANCE OF CONSTRUCTING THIS FACILITY SO CONSTRUCTION OBSERVATION CAN BE PERFORMED TO IDENTIFY VARIATIONS IN THE FIELD THAT MAY AFFECT DESIGN AND VERIFY PROPER CONSTRUCTION.

Details created by a partnership of:

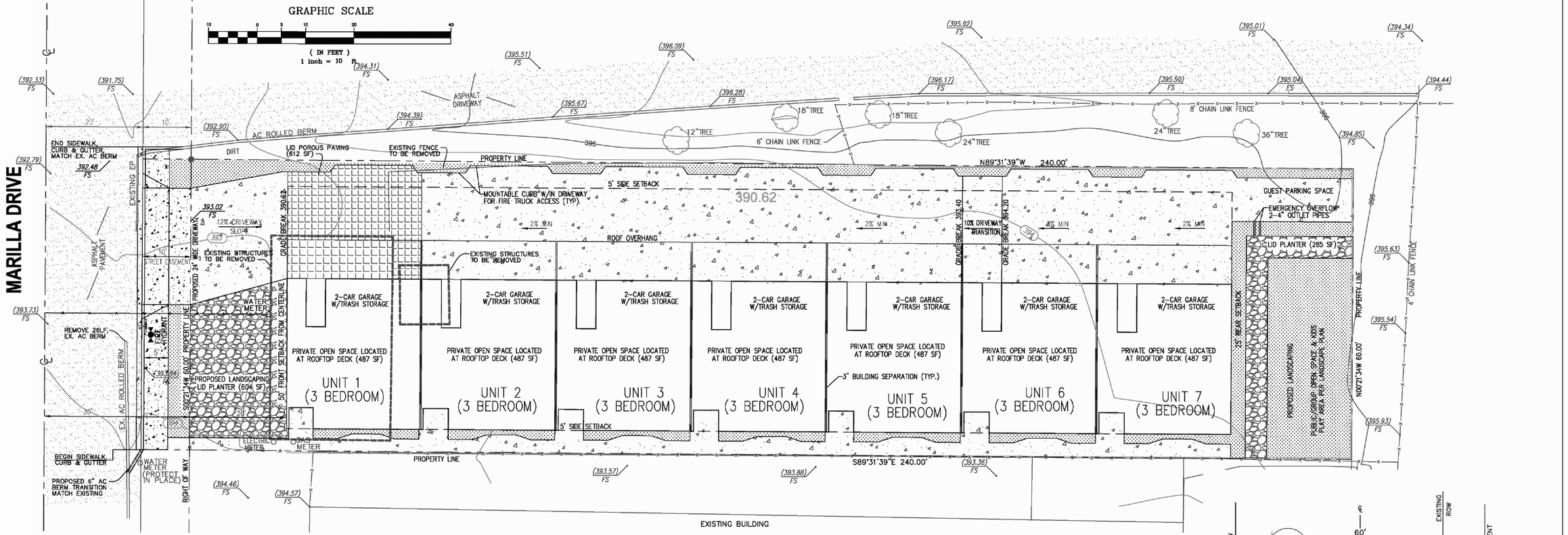
OSU Oregon State University Extension Service | Sea Grant Oregon | greengirl Land Development Solutions

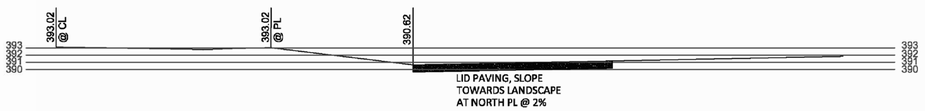
Simple Infiltration Planter

LID 2.06
1 of 1
Scale: NTS

Appendix D .... LID Site Plan

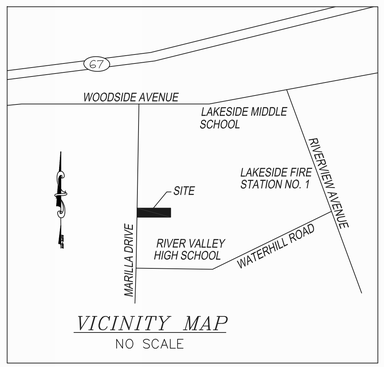
MARILLA LID + PRELIMINARY GRADING PLAN





DRIVEWAY CROSS-SECTION

V SCALE 1:10, H SCALE 1:10



VICINITY MAP

NO SCALE

PRELIMINARY GRADING PLAN NOTE:

THIS PLAN IS PROVIDED TO ALLOW FOR FULL AND ADEQUATE DISCRETIONARY REVIEW OF A PROPOSED DEVELOPMENT PROJECT. THE PROPERTY OWNER ACKNOWLEDGES THAT ACCEPTANCE OR APPROVAL OF THIS PLAN DOES NOT CONSTITUTE AN APPROVAL TO PERFORM ANY GRADING SHOWN HEREON, AND AGREES TO OBTAIN A VALID GRADING PERMIT (IF REQUIRED) BEFORE COMMENCING SUCH ACTIVITY.

SITE IMPERVIOUS AREA:

PRE-CONSTUCTION: 2,478 SF
POST-CONSTRUCTION: 12,265 SF
AVERAGE SITE SLOPE: 1.0%

GRADING QUANTITIES

GRADED AREA	7,497 SF [0.18 AC]	MAX. CUT DEPTH 2.5'	
CUT QUANTITIES	50 CY	MAX CUT SLOPE RATIO (1.5:1 MAX)	
FILL QUANTITIES	0 CY	MAX. FILL DEPTH 0'	
EXPORT	50 CY	MAX FILL SLOPE RATIO (2:1 MAX)	

LEGEND:

PROPERTY LINE/ROW
PROJECT SETBACK LINE
EXISTING CONTOURS (480)
EXISTING SPOT ELEVATIONS (×16.80)
PROPOSED CURB & GUTTER TO
CONCRETE DRIVEWAY
DIRECTION OF FLOW
EXISTING SEWER MAIN (S S S)
EXISTING WATER MAIN (W W W)
EXISTING AC BERM

VON REITER GROUP
Civil Engineering Consultants
11110 negley avenue
san diego, ca 92131
www.vonreiter.com
phone (858) 232-4580
fax (619) 568-3770

PROJECT OWNER:

LANDJAEGGER, INC & SUNNY SKIES HOME SOLUTIONS, INC
CHIEF DENNEY, MANAGER
PO BOX 8088
RANCHO SANTA FE, CA 92067
PHONE (619) 517-3907

PROJECT ENGINEER:

VON REITER GROUP
9974 SCRIPPS RANCH BLVD #264
SAN DIEGO, CA 92131
OFFICE: 858-232-4580

PROJECT ADDRESS:

3676 MARILLA DRIVE
LAKESIDE, CA 92040

ASSESSOR'S PARCEL NUMBER:

382-220-05-00

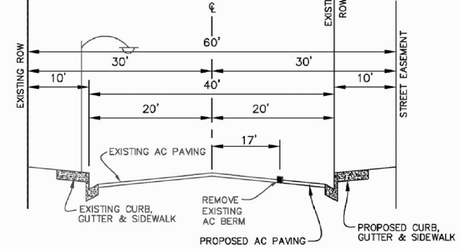
LEGAL DESCRIPTION:

PORTION OF LOT 62, IN THE COUNTY OF SAN DIEGO, STATE OF CALIFORNIA, PER MAP NO. 1683.

BENCHMARK:

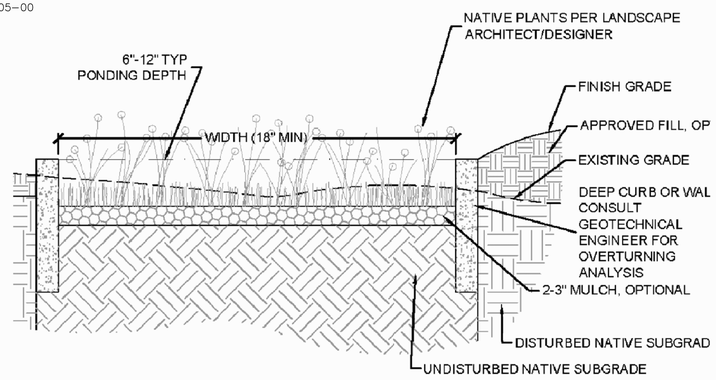
STAND STREET SURVEY MONUMENT M-10 ON CENTERLINE WELLINGTON HILL OFFSET 5' SOUTH CENTERLINE LOS COACHES AT INTERSECTION OF LOS COACHES AND BOWER RD

ELEVATION: 516.65
DATUM: MSL

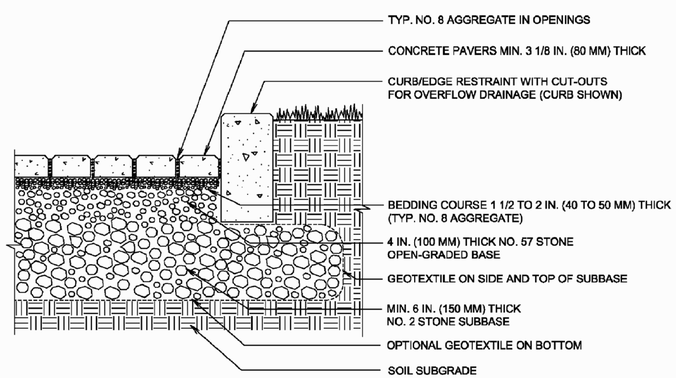


TYPICAL SECTION MARILLA DRIVE

NOT TO SCALE



LID PLANTER DETAIL (NTS)



LID POROUS PAVING (NTS)

DATED: 10/30/2014