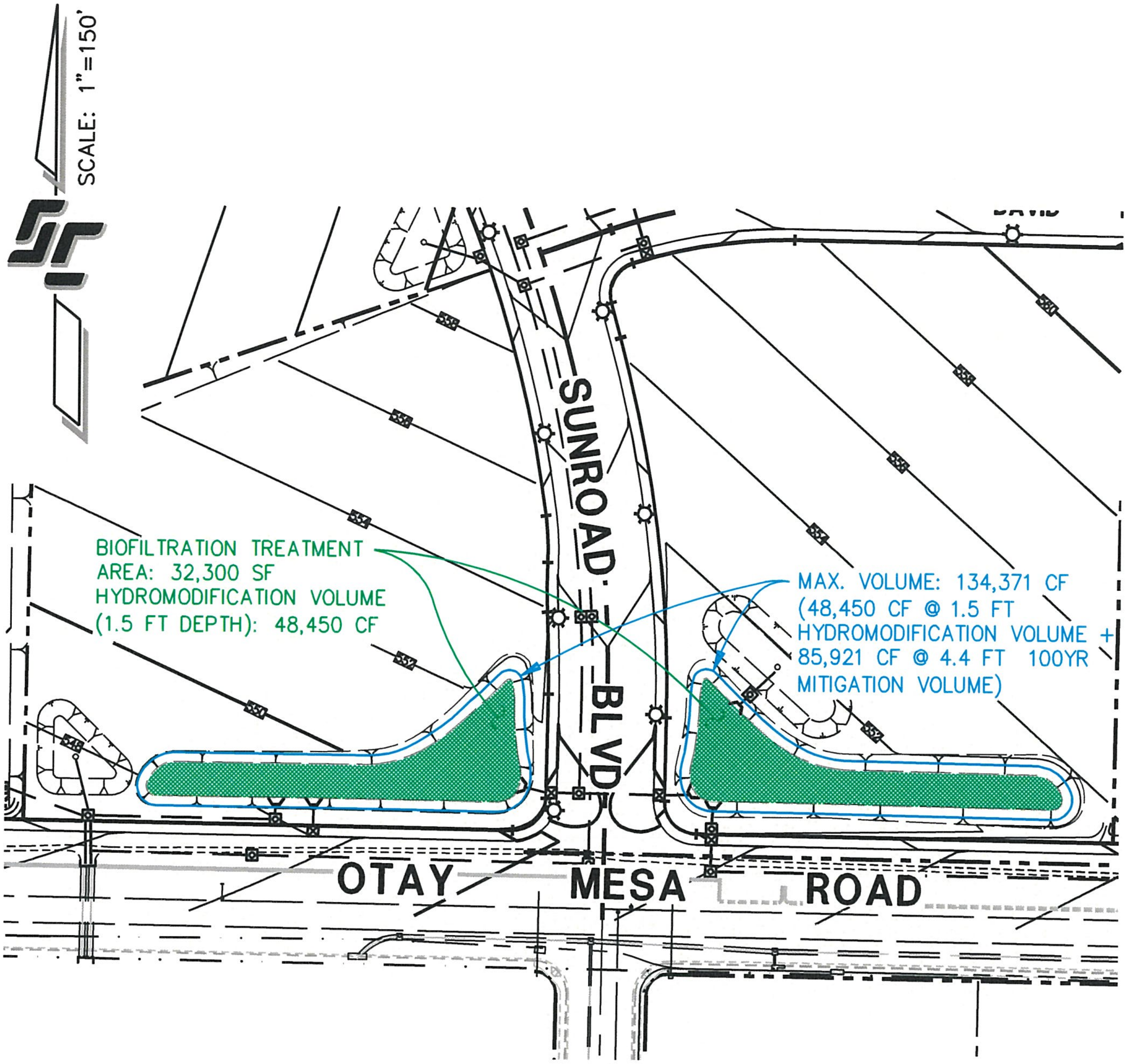
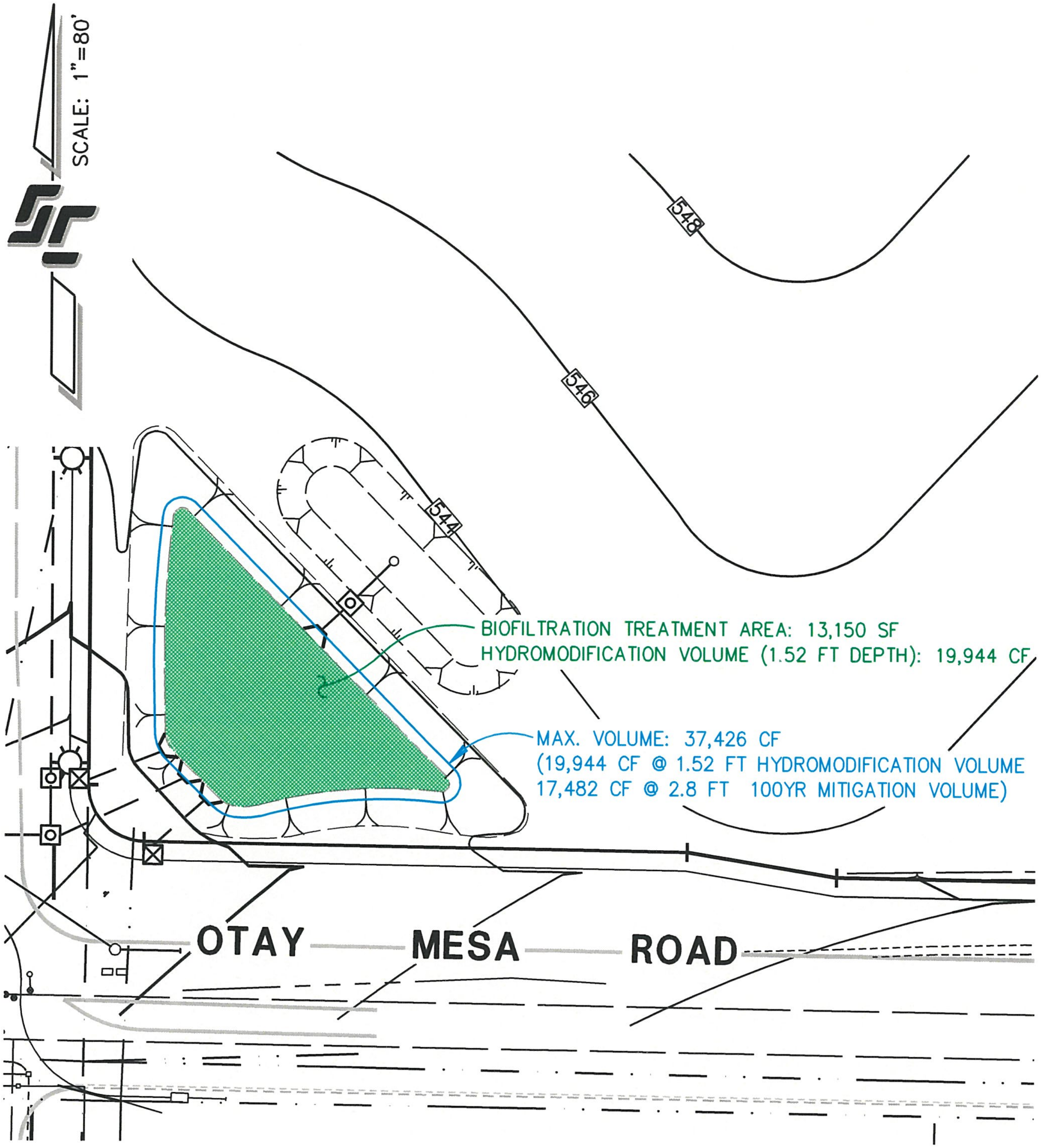


BF-5

DUAL PURPOSE BIOFILTRATION/DETENTION BASIN

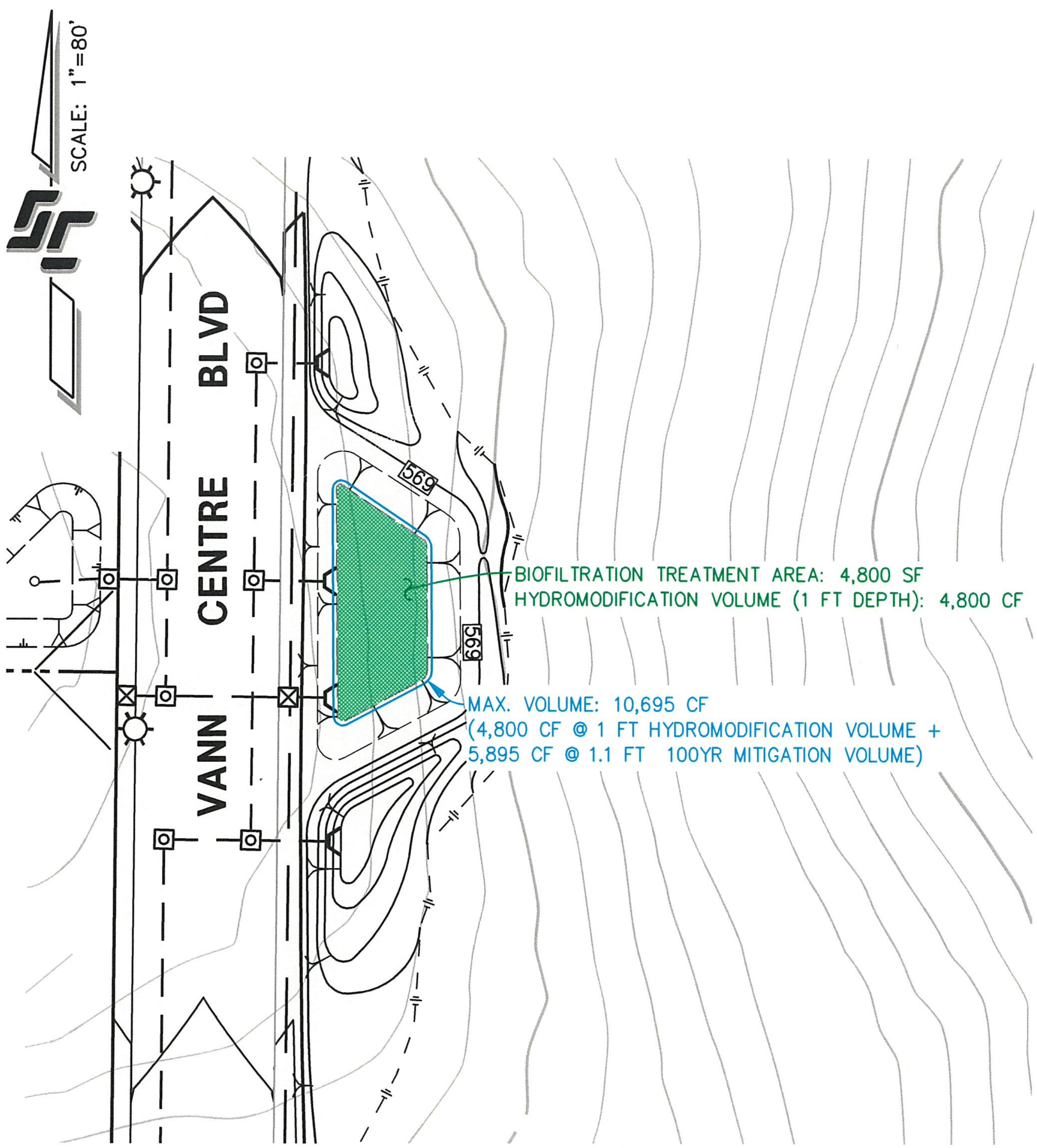
SCALE: 1"=150'



BF-6

DUAL PURPOSE BIOFILTRATION/DETENTION BASIN

SCALE: 1"=80'



BF-7
DUAL PURPOSE BIOFILTRATION/DETENTION BASIN

SCALE: 1"=80'

Attachment 2b

Hydromodification Management Exhibit

Use this checklist to ensure the required information has been included on the Hydromodification Management Exhibit:

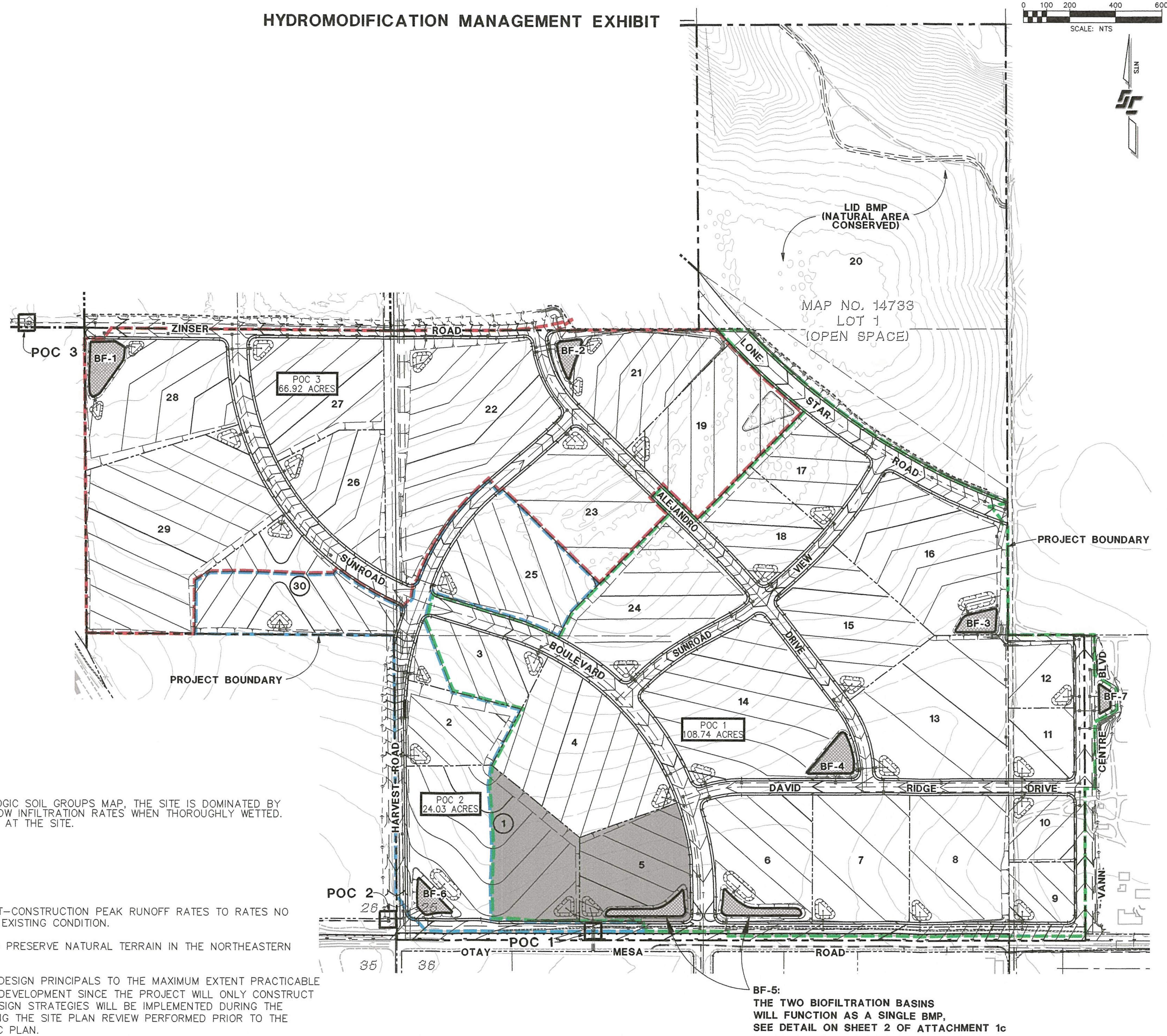
The Hydromodification Management Exhibit must identify:

☒ Underlying hydrologic soil group
☒ Approximate depth to groundwater
☒ Existing natural hydrologic features (watercourses, seeps, springs, wetlands)
☐ Critical coarse sediment yield areas to be protected
☒ Existing topography
☒ Existing and proposed site drainage network and connections to drainage offsite
☒ Proposed grading
☒ Proposed impervious features
☒ Proposed design features and surface treatments used to minimize imperviousness
☒ Point(s) of Compliance (POC) for Hydromodification Management
☒ Existing and proposed drainage boundary and drainage area to each POC (when necessary, create separate exhibits for pre-development and post-project conditions)
☒ Structural BMPs for hydromodification management (identify location, type of BMP, and size/detail)

HYDROMODIFICATION MANAGEMENT EXHIBIT

LEGEND

PROPOSED LOT NUMBER	(1) THRU (30)
SUBDIVISION BOUNDARY	
PROPOSED LOT LINE	
PROPOSED RIGHT-OF-WAY	
EXISTING CONTOUR	630
PROPOSED CONTOUR	630
PROPOSED STORM DRAIN	SD
PROPOSED STORM DRAIN INLET/ CATCH BASIN	
PROPOSED STORM DRAIN CLEANOUT	
PROPOSED STORM DRAIN HEADWALL/ ENERGY DISSIPATOR	
RUNOFF FLOW DIRECTION	
BIOFILTRATION/STORM WATER DETENTION FACILITY (FACILITIES WILL CONTAIN PLANTS TOLERANT OF SATURATED SOIL CONDITIONS)	BF-1
POC BOUNDARY AND LABEL	POC 1 108.74 ACRES
SELF-MITIGATING AREA	



UNDERLYING HYDROLOGIC SOIL GROUP:

PER THE SAN DIEGO COUNTY HYDROLOGY MANUAL, HYDROLOGIC SOIL GROUPS MAP, THE SITE IS DOMINATED BY HYDROLOGIC SOIL GROUP D. GROUP D SOILS HAVE VERY SLOW INFILTRATION RATES WHEN THOROUGHLY WETTED. AS SUCH, INFILTRATION BMPS ARE NOT PROPOSED FOR USE AT THE SITE.

APPROXIMATE DEPTH TO GROUNDWATER:

GREATER THAN 20 FEET

LID TREATMENT BMPS:

1) BIORETENTION/DETENTION WILL BE UTILIZED TO LIMIT POST-CONSTRUCTION PEAK RUNOFF RATES TO RATES NO GREATER THAN THOSE GENERATED BY THE PROJECT IN THE EXISTING CONDITION.

2) THE PROJECT HAS ESTABLISHED AN OPEN SPACE LOT TO PRESERVE NATURAL TERRAIN IN THE NORTHEASTERN CORNER OF THE SITE.

3) THOUGH THE PROPOSED PROJECT WILL EMPLOY LID SITE DESIGN PRINCIPALS TO THE MAXIMUM EXTENT PRACTICABLE (MEP), LID DESIGN OPTIONS ARE LIMITED AT THIS STAGE IN DEVELOPMENT SINCE THE PROJECT WILL ONLY CONSTRUCT STREETS AND ROUGH GRADED PADS. ULTIMATE LID SITE DESIGN STRATEGIES WILL BE IMPLEMENTED DURING THE DEVELOPMENT OF EACH LOT AND WILL BE DETERMINED DURING THE SITE PLAN REVIEW PERFORMED PRIOR TO THE DEVELOPMENT OF EACH LOT, AS MANDATED BY THE SPECIFIC PLAN.

STEVENS-CRESTO ENGINEERING, INC.
CIVIL ENGINEERS • PLANNERS • LAND SURVEYORS
9665 CHESAPEAKE DRIVE, SUITE 200, SAN DIEGO, CA 92123-1352
PHONE: 858.694.5660
FAX: 858.694.5661
www.sceng.com

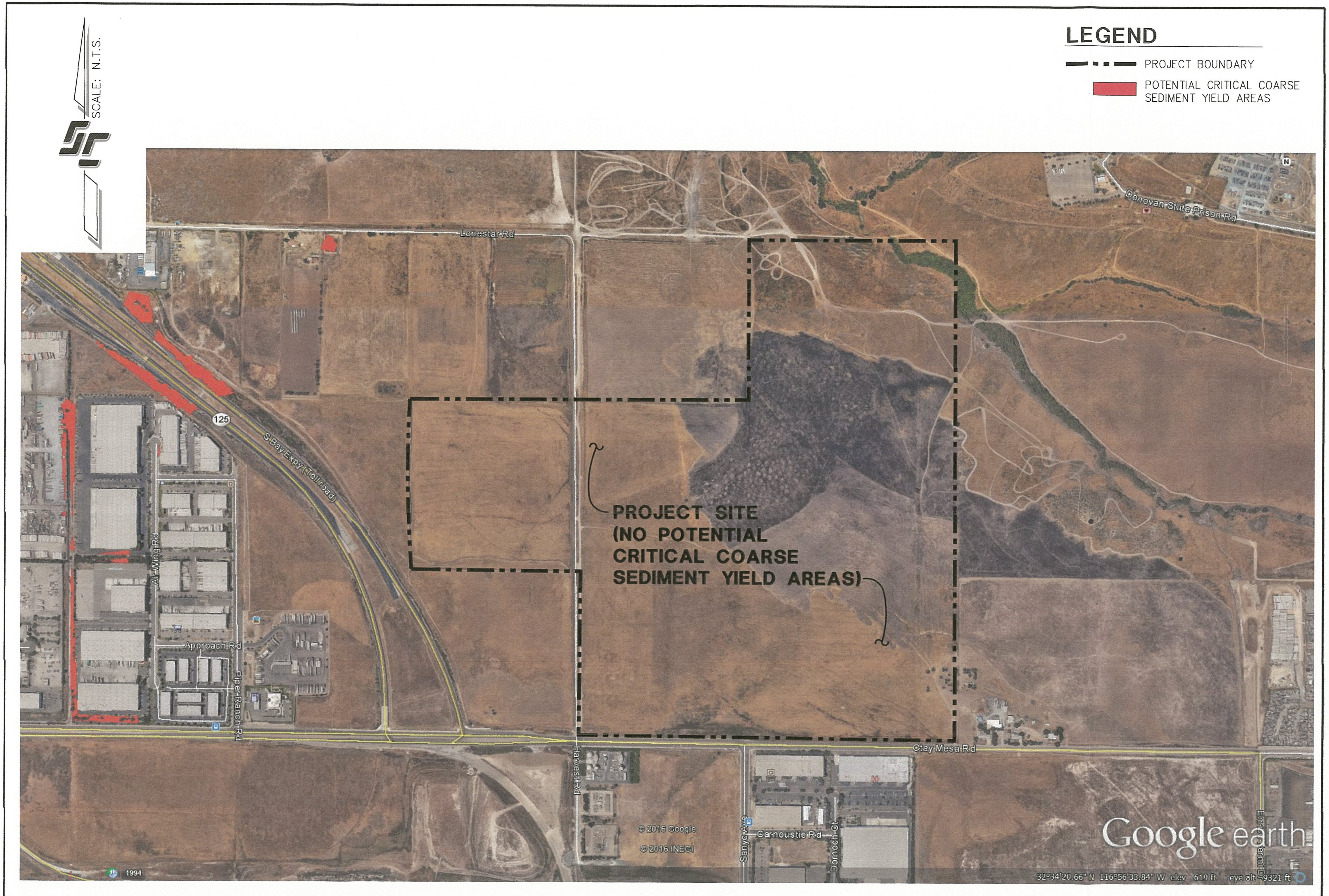
OTAY 250, TRACT 5607
OTAY MESA, CALIFORNIA

ATTACHMENT 2b
HYDROMODIFICATION MANAGEMENT EXHIBIT

DATE: 12/12/2016
SCE NO. 14009.01
SHEET 2b
1 OF 1 SHEET

Attachment 2c

Management of Critical Coarse Sediment Yield Areas



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REVISIONS

OTAY 250, TRACT 5607
OTAY MESA, CALIFORNIA

ATTACHMENT 2c
POTENTIAL CRITICAL COARSE SEDIMENT YIELD AREAS MAP

DATE: 04/04/16
SCE NO. 14009.01
SHEET **2c**

Attachment 2d

Geomorphic Assessment of Receiving Channels

HYDROMODIFICATION SCREENING
FOR
OTAY 250

(Log No. 98-19-013B)

August 15, 2016

Wayne W. Chang, MS, PE 46548

ChangConsultants

Civil Engineering ◦ Hydrology ◦ Hydraulics ◦ Sedimentation

P.O. Box 9496
Rancho Santa Fe, CA 92067
(858) 692-0760

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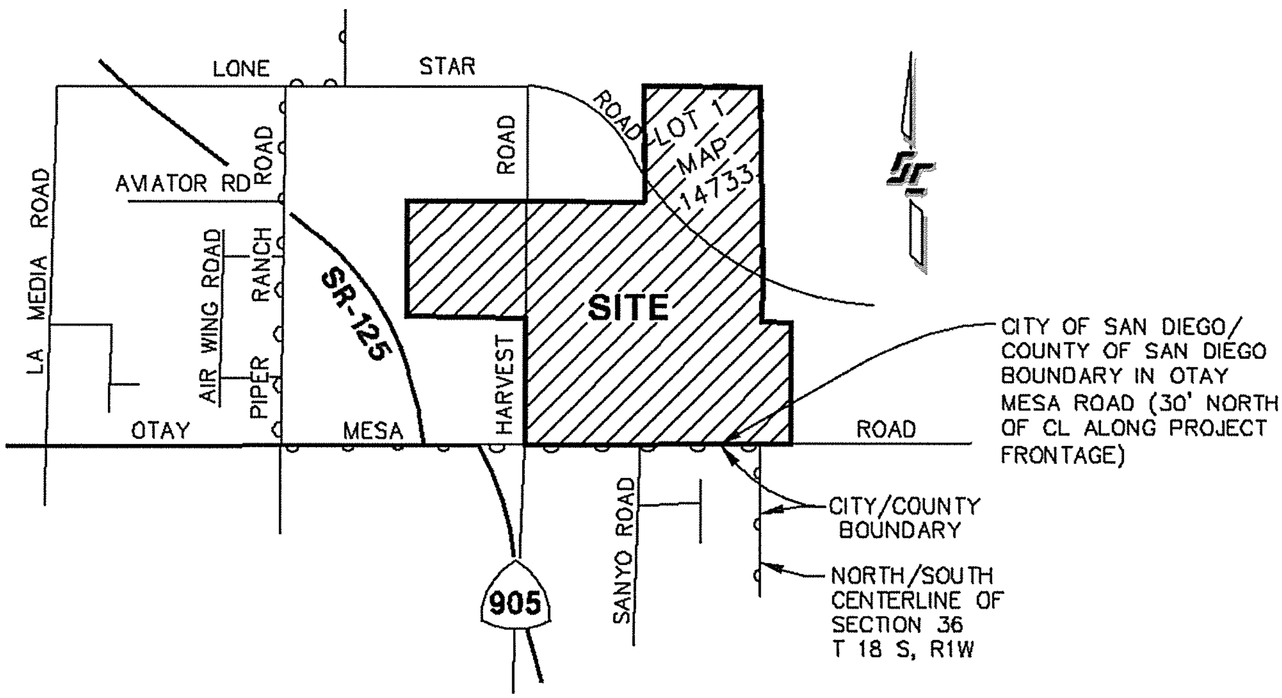
INTRODUCTION

The County of San Diego's March 2011, *Final Hydromodification Management Plan,* and January 8, 2011, *Standard Urban Stormwater Mitigation Plan* (SUSMP) outline low flow thresholds for hydromodification analyses. The thresholds are based on a percentage of the pre-project 2-year flow (Q_2), i.e., $0.1Q_2$ (low flow threshold and high susceptibility to erosion), $0.3Q_2$ (medium flow threshold and medium susceptibility to erosion), or $0.5Q_2$ (high flow threshold and low susceptibility to erosion). A flow threshold of $0.1Q_2$ represents a natural downstream receiving conveyance system with a high susceptibility to bed and/or bank erosion. This is the default value used for hydromodification analyses and will result in the most conservative (largest) on-site facility sizing. A flow threshold of $0.3Q_2$ or $0.5Q_2$ represents downstream receiving conveyance systems with a medium or low susceptibility to erosion, respectively. In order to qualify for a medium or low erosion susceptibility rating, a project must perform a channel screening analysis based on the March 2010, *Hydromodification Screening Tools: Field Manual for Assessing Channel Susceptibility,* developed by the Southern California Coastal Water Research Project (SCCWRP). The SCCWRP results are compared with the critical shear stress calculator results from the County of San Diego's Critical Flow Calculator spreadsheet to establish the appropriate erosion susceptibility threshold of low, medium, or high.



Vicinity Map

This report provides hydromodification screening analyses for Sunroad's Otay 250 project being designed by Stevens-Cresto Engineering, Inc. (Stevens-Cresto). The project is located northeast of the intersection of Otay Mesa Road and State Route 125 (South Bay Expressway) in the county of San Diego (see the Vicinity Map above as well as the Study Area Exhibit in the map pocket). Immediately northeast of the intersection is the proposed California Crossings project. The Otay 250 project surrounds California Crossings on the north and east sides. The Otay 250 site covers approximately 253 acres and is a proposed commercial/light industrial subdivision. The site is gently sloping to the south and southwest. The site is currently undeveloped and primarily supports natural vegetation consisting of grasses, weeds, and small brush. There is some off-site runoff onto the site from the north and east.

Storm runoff from the proposed site and tributary off-site areas generally flows in three separate directions. Runoff from the easterly portion of the site will be conveyed into existing double 60-inch RCPs that cross Otay Mesa Road in a southerly direction. The 60-inch RCPs are approximately 1,720 feet east of the SR 125 on-ramp. The RCPs discharge onto the natural ground surface south of Otay Mesa Road. The flow is then conveyed south over 920 feet south to Caltrans drainage facilities.

Runoff from the southwesterly portion of the site flows in a southwesterly direction. The runoff will be collected by an existing double 6-foot wide by 2-foot high reinforced concrete box culvert on the north side of Otay Mesa Road east of the SR 125 on-ramp. The double box culvert conveys the runoff south across Otay Mesa Road and outlets onto a concrete apron/drop structure and into a stilling basin with concrete banks and a natural bottom. The runoff is conveyed out of the stilling basin in a westerly and then southerly direction by a naturally-lined trapezoidal channel. The trapezoidal channel ultimately flows into Caltrans drainage facilities approximately 850 feet south of Otay Mesa Road.

Runoff from the northerly portion of the site is collected by a proposed storm drain that outlets westerly into a small natural drainage course. The natural drainage course conveys the flow approximately 1,000 feet to an existing Caltrans drainage ditch at the northwest corner of the site. The concrete ditch conveys the flow to a culvert crossing SR 125 approximately 3,500 feet northwest of Otay Mesa Road. The culvert connects to an interconnected system of public storm drain pipes, concrete channels, and concrete culverts that ultimately discharge into a natural channel on the east side of La Media Road approximately 200 feet south of Interstate 905.

The SCCWRP screening tool requires both office and field work to establish the vertical and lateral susceptibility of a downstream receiving channel to erosion. The vertical and lateral assessments are performed independently of each other although the lateral results can be affected by the vertical rating. A screening analysis was performed to assess the low flow threshold for the project's three points of compliance (POC). A POC is the location where the project's runoff enters a natural drainage course. POC 1 is associated with the easterly portion of the site described above, POC 2 is associated with the southwesterly portion of the site, and POC 3 is associated with the northerly portion of the site. POC 2 was assessed by Chang Consultants in the December 9, 2011 report, *Hydromodification Screening for California Crossings* (approved by the County of San Diego).

There is an additional POC within the drainage area tributary to POC 2. The additional POC occurs at the southerly outlet from proposed Lot 30. The additional POC has not been assessed in this report. Therefore, the proposed area draining to the additional POC must be designed for a high susceptibility to erosion, i.e., $0.1Q_2$.

The initial step in performing the SCCWRP screening analysis is to establish the domain of analysis and the study reaches within the domain. This is followed by office and field components of the screening tool along with the associated analyses and results. The following sections cover these procedures in sequence for POC 1 and 3. This is followed by a discussion of the prior results for POC 2 and applicability to the Otay 250 project.

DOMAIN OF ANALYSIS

SCCWRP defines an upstream and downstream domain of analysis, which establish the study limits. The County of San Diego's HMP specifies the downstream domain of analysis based on the SCCWRP criteria. The HMP indicates that the downstream domain is the first point where one of these is reached:

- at least one reach downstream of the first grade control point
- tidal backwater/lentic waterbody
- equal order tributary
- accumulation of 50 percent drainage area for stream systems or 100 percent drainage area for urban conveyance systems (storm drains, hardened channels, etc.)

The upstream limit is defined as:

- proceed upstream for 20 channel top widths or to the first grade control point, whichever comes first. Identify hard points that can check headward migration and evidence of active headcutting.

SCCWRP defines the maximum spatial unit, or reach (a reach is circa 20 channel widths), for assigning a susceptibility rating within the domain of analysis to be 200 meters (656 feet). If the domain of analysis is greater than 200 meters, the study area should be subdivided into smaller reaches of less than 200 meters for analysis. Most of the units in the HMP's SCCWRP analysis are metric. Metric units are used in this report only where given so in the HMP or Caltrans plans. Otherwise English units are used.

Downstream Domain of Analysis
The downstream domain of analysis for POC 1 and POC 3 have been determined by assessing and comparing the four bullet items above. POC 1 is discussed first followed by POC 3. POC 2 was analyzed in prior study, which is discussed later in this report.

As mentioned in the Introduction, storm runoff from the easterly portion of the project will be conveyed to existing double 60-inch RCPs that cross Otay Mesa Road. The RCPs discharge into a natural drainage course on the south side of Otay Mesa Road. The RCP outlets correspond to POC 1. The downstream domain of analysis for the easterly project area is selected below POC 1.

Per the first bullet item, the first permanent grade control below POC 1 was located. The runoff from POC 1 is collected by a Caltrans concrete channel located approximately 1,208 feet downstream of POC 1 (see Figure 6). The concrete channel functions as a grade control because it is a hardened, non-erodible facility that will maintain the upstream drainage course elevations. Since the channel is a Caltrans drainage facility it is considered permanent.

The second bullet item is the tidal backwater or lentic (standing or still water such as ponds, pools, marshes, lakes, etc.) waterbody location. Runoff from POC 1 ultimately flows into Mexico west of La Media Road. A tidal backwater or lentic waterbody does not exist between the project site and Mexico. Therefore, the tidal backwater or lentic waterbody will be further downstream than the downstream domain of analysis established by the permanent grade control criteria.

The final two bullet items are related to the tributary drainage area. The drainage area tributary to POC 1 covers 166.08 acres (see the Study Area Exhibit). The additional area added between POC 1 and the downstream grade control covers 19.42 acres. Therefore, neither an equal order tributary nor a 50 to 100 percent drainage area is accumulated before the grade control.

Based on the above information, the permanent grade control created by Caltrans concrete channel meets the HMP downstream domain of analysis criteria because it is the first point reached from the four bullet items. Per the first bullet item, the downstream domain of analysis should begin one reach below the channel. In this case, the channel connects to a concrete culvert that continues over 3,000 feet west. Consequently, one reach below the grade control will be within the non-erodible culvert, which is not subject to hydromodification impacts. As a result, the downstream domain of analysis location is where the natural drainage course meets the concrete channel.

POC 3 is located at outlet of the proposed storm drain serving the northerly portion of the site (see the Study Area Exhibit).

Per the first bullet item, the first permanent grade control below POC 3 was located. The runoff from POC 3 is collected by a Caltrans concrete drainage ditch located approximately 1,002 feet downstream of POC 3 (see Figure 11) and along the easterly edge of Interstate 905. The concrete drainage ditch functions as a grade control because it is a hardened, non-erodible facility that will maintain the upstream drainage course elevations. Since the ditch is a Caltrans drainage facility it is considered permanent.

In regards to the second bullet item, a tidal backwater or lentic waterbody does not exist between the project site and Mexico. Therefore, the tidal backwater or lentic waterbody will be further downstream than the downstream domain of analysis established by the permanent grade control criteria.

For the third and fourth bullet items, the Study Area Exhibit reveals that there is neither an equal order tributary nor a 50 to 100 percent drainage area is accumulated between POC 3 and the grade control, so these bullet items will not govern over bullet item 1.

Based on the above information, the permanent grade control created by the Caltrans concrete drainage ditch meets the HMP downstream domain of analysis criteria for POC 3 because it is the first point reached from the four bullet items. Per the first bullet item, the downstream domain of analysis should begin one reach below the ditch. In this case, the ditch connects to hardened drainage facilities that continue over 4,000 feet west. Consequently, one reach below the grade control will be within non-erodible facilities, which are not subject to hydromodification impacts. As a result, the downstream domain of analysis location is where the natural drainage course meets Caltrans' concrete drainage ditch.

Upstream Domain of Analysis

The aforementioned RCPs associated with POC 1 and the storm drain outlet associated with POC 3 discharge into the uppermost end of their receiving drainage courses. Since a natural drainage course does not extend upstream of POC 1 or POC 3, the upstream domain of analysis locations will be at POC 1 and POC 3.

Study Reaches within Domain of Analysis

For POC 1, the entire domain of analysis extends along the natural drainage course from the RCP outlets to Caltrans' concrete channel and covers approximately 1,208 feet. The domain of analysis was subdivided into two study reaches with similar characteristics (see the Study Area Exhibit). Reach 1 (upper reach) is 554 feet long and extends below POC 1. Reach 2 (lower reach) is 654 feet long and extends from the downstream end of Reach 1 to the concrete channel. Each reach is within the 656 feet maximum reach length specified by SCCWRP.

For POC 3, the entire domain of analysis extends along the natural drainage course from the northerly area storm drain outlet to Caltrans' concrete ditch and covers approximately 1,002 feet. The domain of analysis was subdivided into two study reaches with similar characteristics (see the Study Area Exhibit). Reach 3 (upper reach) is 366 feet long and extends below POC 3. Reach 4 (lower reach) is 636 feet long and extends from the downstream end of Reach 3 to the concrete ditch. Each reach is within the 656 feet maximum reach length specified by SCCWRP.

INITIAL DESKTOP ANALYSIS

After the domain of analysis is established, SCCWRP requires an "initial desktop analysis" that involves office work. The initial desktop analysis establishes the watershed area, mean annual precipitation, valley slope, and valley width. These terms are defined in Form 1, which is included in Appendix A. SCCWRP recommends the use of National Elevation Data (NED) to determine the watershed area, valley slope, and valley width. The NED data is similar to USGS mapping, so it is not very detailed. For this report, 1-foot contour interval topographic mapping prepared for the project and 2-foot contour interval topographic mapping for the area south of Otay Mesa Road were used for the project and study reaches. A site investigation was performed that confirmed the accuracy of these sources. The mapping does not show Caltrans recent concrete channel (or adjacent freeway work to the south), but the location is available from Google Earth. In addition, Stevens-Cresto provided their most up-to-date engineering drawings for the proposed development.

The required watershed areas were established by Stevens-Cresto's post-project hydrologic analysis as well as the available topographic mapping for the downstream study reaches. Stevens-Cresto delineated a 166.08 acre drainage area tributary to POC 1 from the project and its tributary area. An additional 10.42 acres was delineated below POC 1 tributary to Reach 1, and then another 9.00 acres was delineated tributary to Reach 2. These watershed areas are included on the Study Area Exhibit. Based on the watershed delineations, the drainage areas tributary to the downstream end of Reaches 1 and 2 are 176.50 and 185.50 acres (0.2758 and 0.2898 square miles), respectively.

For POC 3, Stevens-Cresto delineated a 174.61 acre drainage area tributary to the downstream end of Reach 4 as seen on the Study Area Exhibit. This area was used for both Reach 3 and 4. Since the actual area tributary to Reach 3 will be somewhat less, using this area for Reach 3 will yield slightly conservative results (i.e., more potential for erosion).

The mean annual precipitation was obtained from the closest rain gage to the site with extensive historic data. This was the Western Regional Climate Center's Chula Vista gage (see Appendix A). The average rainfall measured at this gage for the period of record from 1918 to 2010 is 9.75 inches.

The valley slope of Reaches 1 and 2 were determined from the 2-foot contour interval topographic mapping, while 1-foot contour interval mapping was available for Reaches 3 and 4. The valley slope is the longitudinal slope of the channel bed along the flow line, so it is determined by dividing the elevation difference within a reach by the flow path. The valley width is the average bottom width of the drainage course between valley slopes. The average valley widths were determined using the topographic mapping to estimate the interface between the bottom and side slopes of the drainage course. The drainage area, valley slope, and valley width within each study reach are summarized in Table 1.

Reach	Tributary Drainage Area, sq. mi.	Valley Slope, m/m	Valley Width, m
1	0.2758	0.0081	13.1
2	0.2898	0.0090	10.4
3	0.2728	0.0126	1.5
4	0.2728	0.0118	1.5

Table 1. Summary of Valley Slope and Valley Width

These values were input to a spreadsheet to calculate the simulated peak flow, screening index, and valley width index outlined in Form 1. The input data and results are tabulated in Appendix A. This completes the initial desktop analysis.

FIELD SCREENING

After the initial desktop analysis is complete, a field assessment must be performed. The field assessment is used to establish a natural channel's vertical and lateral susceptibility to erosion. SCCWRP states that although they are admittedly linked, vertical and lateral susceptibility are assessed separately for several reasons. First, vertical and lateral responses are primarily controlled by different types of resistance, which, when assessed separately, may improve ease of use and lead to increased repeatability compared to an integrated, cross-dimensional assessment. Second, the mechanistic differences between vertical and lateral responses point to different modeling tools and potentially different management strategies. Having separate screening ratings may better direct users and managers to the most appropriate tools for subsequent analyses.

The field screening tool uses combinations of decision trees and checklists. Decision trees are typically used when a question can be answered fairly definitively and/or quantitatively (e.g., d_{50} < 16 mm). Checklists are used where answers are relatively qualitative (e.g., the condition of a grade control). Low, medium, high, and very high ratings are applied separately to the vertical and lateral analyses. When the vertical and lateral analyses return divergent values, the most conservative value shall be selected as the flow threshold for the hydromodification analyses.

Vertical Stability

The purpose of the vertical stability decision tree (Figure 6-4 in the County of San Diego HMP) is to assess the state of the channel bed with a particular focus on the risk of incision (i.e., down cutting). The decision tree is included in Figure 14. The first step is to assess the channel bed resistance. There are three categories defined as follows:

1. Labile Bed – sand-dominated bed, little resistant substrate.

2. Transitional/Intermediate Bed – bed typically characterized by gravel/small cobble, Intermediate level of resistance of the substrate and uncertain potential for armoring.

3. Threshold Bed (Coarse/Armored Bed) – armored with large cobbles or larger bed material or highly-resistant bed substrate (i.e., bedrock).

Figures 7, 8 and 13 show photographs of the bed material within the study reaches. A gravelometer is included in the photographs for reference. Each square on the gravelometer indicates grain size in millimeters (the squares range from 2 mm to 180 mm). Based on the photographs and site investigation, the bed material and resistance is generally within the transitional/intermediate bed category. There was no evidence of a threshold bed condition. However, some bed areas contained smaller grain sizes typically found in a labile bed, while others contains larger gravel-sized particles. A pebble count was performed (see discussion near the end of this section) that determined the median (d_{50}) bed material size to be 8 millimeters (mm) in Reach 1 and 2. A similar size was observed in Reach 3 and 4. Figure 6-4 in the County HMP indicates that a d_{50} less than 16 mm can be within the labile bed category. The figure also identifies that the bed material in a labile bed is "loosely-packed." The Reach 1 through 4 channels do not meet the criteria of containing loosely-packed material. The material was found to be relatively well-compacted during a site investigation. The site investigation revealed no evidence of vertical or lateral erosion.

In addition to the material size and compaction, there are several factors that establish the erodibility of a channel such as the flow rate (i.e., size of the tributary area), grade controls, channel slope, vegetative cover, channel planform, etc. The Introduction of the SCCWRP *Hydromodification Screening Tools: Field Manual* identifies several of these factors. When multiple factors influence erodibility, it is appropriate to perform the more detailed SCCWRP analysis, which is to analyze a channel according to SCCWRP's transitional/intermediate bed procedure. This requires the most rigorous steps and will generate the appropriate results given the range of factors that define erodibility. The transitional/intermediate bed procedure takes into account that bed material may fall within the labile category (the bed material size is used in SCCWRP's Form 3 Figure 4), but other factors may trend towards a less erodible condition. Dr. Eric Stein from SCCWRP, who co-authored the *Hydromodification Screening Tools: Field Manual* in the *Final Hydromodification Management Plan* (HMP), indicated that it would be appropriate to analyze channels with multiple factors that impact erodibility using the transitional/intermediate bed procedure. Consequently, this procedure was used to produce more accurate results.

Transitional/intermediate beds cover a wide susceptibility/potential response range and need to be assessed in greater detail to develop a weight of evidence for the appropriate screening rating. The three primary risk factors used to assess vertical susceptibility for channels with transitional/intermediate bed materials are:

1. Armoring potential – three states (Checklist 1)

2. Grade control – three states (Checklist 2)

3. Proximity to regionally-calibrated incision/braiding threshold (Mobility Index Threshold – Probability Diagram)

These three risk factors are assessed using checklists and a diagram (see Appendix B), and the results of each are combined to provide a final vertical susceptibility rating for the intermediate/transitional bed-material group. Each checklist and diagram contains a Category A, B, or C rating. Category A is the most resistant to vertical changes while Category C is the most susceptible.

Checklist 1 determines armoring potential of the channel bed. The channel bed along each of the four reaches is within Category B, which represents intermediate bed material within unknown armoring potential due to a surface veneer and dense vegetation. Figures 2 through 5 and 12 reveal that all four study reaches contain a relatively uniform cover of grasses, weeds, and bushes. The soil was probed and penetration was relatively difficult through the underlying layer.

Checklist 2 determines grade control characteristics of the channel bed. This is reliant on the spacing of the grade controls. Category A on Checklist 2 is based on a spacing of $2/S_v$ and $4/S_v$. where S_v is the valley slope. S_v is 0.0081, 0.0090, 0.0126, and 0.0118 for Reach 1, 2, 3, and 4, respectively, from the Form 1 analysis in Appendix A. Based on this, the Reach 1 through 4 values for $2/S_v$ are 808, 727, 522, and 556 feet, respectively, and the values for $4/S_v$ are 1,616, 1,455, 1,044, and 1,113 feet, respectively.

The closest grade control downstream of Reach 1 and 2 is the Caltrans concrete channel. The concrete channel is at most 1,208 feet from the upper end of Reach 1 and 654 feet from the upper end of Reach 2. The grade control is further away than the $2/S_v$ values, but closer than the $4/S_v$ values. Therefore, both reaches are within Category B on Checklist 2. A field walk along the study area did not reveal evidence of headcutting or mass wasting (see figures), so the grade control has been effective.

The closest grade control downstream of Reach 3 and 4 is the Caltrans concrete ditch. The concrete ditch is at most 1,002 feet from the upper end of Reach 3 and 636 feet from the upper end of Reach 4. The grade control is further away than the $2/S_v$ values, but closer than the $4/S_v$ values. Therefore, both reaches are within Category B on Checklist 2. A field walk along the study area did not reveal evidence of headcutting or mass wasting (see Figure 12), so the grade control has been effective.

The Mobility Index Threshold is a probability diagram that depicts the risk of incising or braiding based on the potential stream power of the valley relative to the median particle diameter. The threshold is based on regional data from Dr. Howard Chang of Chang Consultants and others. The probability diagram is based on d_{50} as well as the Screening Index determined in the initial desktop analysis (see Appendix A). d_{50} is derived from a pebble count in which a minimum of 100 particles are obtained along transects at the site. SCCRWP states that if fines less than ½-inch thick are at a sample point, it is appropriate to sample the coarser buried substrate. The d_{50} value is the particle size in which 50 percent of the particles are smaller and 50 percent are larger.

The pebble count results for Reach 1 and 2 are included in Appendix B. The results show a d_{50} of 8 millimeters for each area. The screening index for Reach 1 and 2 are tabulated in Appendix A. Plotting the d_{50} and screening index values on the Mobility Index Threshold diagram shows that both Reach 1 and 2 have a less than 50 percent probability of incising or braiding (even less than 10 percent), which falls within Category A. In fact, the screening index values are so small that the pebble count is irrelevant.

The screening index values for Reach 3 and 4 from Form 1 are 0.0123 and 0.0116, respectively. The Screening Index Threshold diagram shows that the probability of incising or braiding is less than 50 percent regardless of d_{50} for an INDEX value of 0.0150 or less. Since the Reach 3 and 4 Screening Index values are less than the smallest 50 percent value (as are Reach 1 and 2), both reaches are within Category A, so a pebble count is not necessary.

The overall vertical rating is determined from the Checklist 1, Checklist 2, and Mobility Index Threshold results. The scoring is uses the following values for each category:

Category A = 3, Category B = 6, Category C = 9

The vertical rating score is based on these values and the equation:

$$\text{Vertical Rating} = [(\text{armoring} \times \text{grade control})^{1/2} \times \text{screening index score}]^{1/2}$$
$$= [(6 \times 6)^{1/2} \times 3]^{1/2}$$
$$= 4.2$$

Since the vertical rating is less than 4.5 (Reach 1, 2, 3, and 4 have the same values), each reach has a low threshold for vertical susceptibility.

Lateral Stability

The purpose of the lateral decision tree (Figure 6-5 from County of San Diego HMP included in Figure 15) is to assess the state of the channel banks with a focus on the risk of widening. Channels can widen from either bank failure or through fluvial processes such as chute cutoffs, avulsions, and braiding. Widening through fluvial avulsions/active braiding is a relatively straightforward observation. If braiding is not already occurring, the next logical step is to assess the condition of the banks. Banks fail through a variety of mechanisms; however, one of the most important distinctions is whether they fail in mass (as many particles) or by fluvial detachment of individual particles. Although much research is dedicated to the combined effects of weakening, fluvial erosion, and mass failure, SCCWRP found it valuable to segregate bank types based on the inference of the dominant failure mechanism (as the management approach may vary based on the dominant failure mechanism). A decision tree (Form 4 in Appendix B) is used in conducting the lateral susceptibility assessment. Definitions and photographic examples are also provided below for terms used in the lateral susceptibility assessment.

The first step in the decision tree is to determine if lateral adjustments are occurring. The adjustments can take the form of extensive mass wasting (greater than 50 percent of the banks are exhibiting planar, slab, or rotational failures and/or scalloping, undermining, and/or tension cracks). The adjustments can also involve extensive fluvial erosion (significant and frequent bank cuts on over 50 percent of the banks). Neither mass wasting nor extensive fluvial erosion was evident within the four reaches during a field investigation. The gently sloping banks are intact in the photographs included in the figures. The relatively uniform vegetative cover on the banks is evidence of the absence of large lateral adjustments.

The next step in the Form 4 decision tree is to assess the consolidation of the bank material. The banks were moderate to well-consolidated. This determination was made because the banks were difficult to penetrate with a probe. In addition, the banks showed limited evidence of crumbling and were composed of well-packed particles (see figures).

Form 6 (see Appendix B) is used to assess the probability of mass wasting. Form 6 identifies a 10, 50, and 90 percent probability based on the bank angle and bank height. The site visit and topographic mapping reveal that the channel banks are gently sloping and much flatter than 2:1 (26.6 degrees). Form 6 shows that the probability of mass wasting and bank failure has less than 10 percent risk for a 26.6 degree bank angle or less regardless of the bank height.

The final two steps in the Form 4 decision tree are based on the braiding risk determined from the vertical rating as well as the Valley Width Index (VWI) calculated in Appendix A. If the vertical rating is high, the braiding risk is considered to be greater than 50 percent. Excessive braiding can lead to lateral bank failure. For Reach 1 through 4 the vertical rating is low, so the braiding risk is less than 50 percent. Furthermore, a VWI greater than 2 represents channels unconfined by bedrock or hillslope and, hence, subject to lateral migration. The VWI calculations in the spreadsheet in Appendix A show that the VWI for each reach is less than 2.

From the above steps, the lateral susceptibility rating is low (red circles are included on the Form 4: Lateral Susceptibility Field Sheet decision tree in Appendix B showing the decision path).

PRIOR CHANNEL ASSESSMENTS

The above Domain of Analysis, Initial Desktop Analysis, and Field Screening sections were prepared for POC 1 and 3. As mentioned in the Introduction, the project contains a southwesterly watershed area that outlets to POC 2. However, the natural channel downstream of POC 2 was previously analyzed in the December 9, 2011 report, *Hydromodification Screening for California Crossings* (approved by the County of San Diego). This report is contained in Attachment 1. The following outlines the applicability of the report to POC 2 associated with Otay 250 followed by a discussion POC 3.

POC 2 Assessment
POC 2 discharges at the same POC location analyzed in the 2011 California Crossings report. The report is contained in Attachment 1. There are two changes that have occurred since the 2011 report was prepared. The first is that the Otay 250 project will reduce the drainage area tributary to the study reaches. Stevens-Cresto's hydrology mapping shows that the drainage area tributary to the POC will be 77.51 acres (see Study Area Exhibit) while the area in the 2011 report's Study Area Exhibit was over 80 acres. The smaller watershed area will result in less potential for erosion; therefore, the Otay 250 project will not adversely affect the 2011 report results. The other change is that Caltrans has extended and realigned a portion of their engineered channel further downstream to connect to their underground storm drain system. This is related to Reach 2 from the 2011 report. However, the fact that Caltrans has extended their channel will not affect the channel assessment results because the channel is engineered, so it is designed to convey flows without hydromodification impacts. Caltrans requires channels adjacent to freeways to be designed for the 100-year flows. Figures 9 and 10 are current photographs of the study reaches, which were assessed in the 2011 report. Reach 1 in Figure 9 is similar to the 2011 report (see Figure 4 in 2011 report for comparison); however, the vegetation is now somewhat more mature, so is more resistant to hydromodification impacts. Reach 2 in Figure 10 shows the engineered channel. Based on this information, the results from the 2011 report for POC 2 are still applicable, i.e., a low susceptibility to erosion ($0.5Q_2$).

POC 3 Assessment
An assessment has been prepared for POC 3 this report. For reference purposes, the next natural watercourse below the POC 3 study area (along east side of La Media Road south of Interstate 905) was assessed in the May 14, 2012 report, *Hydromodification Screening for Sunroad 80 Project* (approved by the City of San Diego). The 2012 report demonstrated that the watercourse had a low susceptibility to erosion.

CONCLUSION

The SCCWRP channel screening tools were used to assess the downstream channel susceptibility for the Otay 250 project. The project runoff will be collected by proposed on-site drainage facilities and outlet to three separate points of compliance. A downstream channel assessment for POC 1 and POC 3 is included in this report and the results indicate a low threshold for vertical and lateral susceptibilities. Downstream channel assessments were previously prepared for POC 2 and the results are still relevant. Those results also indicate low susceptibilities.

The HMP requires that these results be compared with the critical stress calculator results outlined in the County of San Diego HMP. The critical stress results are included in Appendix B for the two POC 1 study reaches and two POC 3 study reaches using the spreadsheet provided by the County. The channel dimensions were estimated from the topographic mapping and site visit. Based on these values, the critical stress results returned a low threshold consistent with the SCCWRP channel screening results. The critical stress analyses for POC 2 are within the prior reports included in Attachment 1, which also returned a low threshold. Therefore, the SCCWRP analyses and critical stress calculator demonstrate that a low overall threshold is applicable to all three points of compliance (i.e., 0.5Q2).

Figure 1. Double 60-inch RCP Outlets at POC 1

Figure 2. Looking Downstream at Reach 1 from Upper End at POC 1