PRELIMINARY
Hydromodification Management Plan

Hawano Subdivision
3100 5566 (TM)
Environmental Log No. 93-19-006OO

April 2012

***Prepared for**:*
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KHA No. 095765000

DECLARATION OF RESPONSIBLE CHARGE

I, hereby declare that I am the Civil Engineer of Work for this project. That I have exercised responsible charge over the design of the project as defined in Section 6703 of the Business and Professions Code, and that the design is consistent with current standards.

I understand that the check of project drawings and specifications by the County of San Diego is confined to a review only and does not relieve me, as Engineer of Work, of my responsibilities for project design.

Tammie Moreno R.C.E. 74417

6-7-12
Date

REGISTERED PROFESSIONAL ENGINEER
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STATE OF CALIFORNIA

Kimley-Horn
and Associates, Inc.

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1.0 Introduction

The proposed project involves the development of 79.6 acres in the East Otay Mesa area of San Diego. The project site is located southeast of the future intersection of Alta Road and Airway Road and immediately north of the U.S./Mexico border. The site involves the mass grading of approximately 23 industrial pads, half width improvements of Alta Road fronting the project and extending Siempre Viva Road and Airway Road approximately 1200' to the west.

In 1990, the State Water Resources Control Board (SWRCB) issued a National Pollutant Discharge Elimination System (NPDES) permit that regulates stormwater discharges. The permit required the use of Best Management Practices (BMPs) to control the discharge of pollutants to waters of the United States. In January 2007, a new Municipal Separate Storm Sewer Systems (MS4) permit, Order R9-2007-0001, was adopted to renew the NPDES permit. The permit directed the copermitees within the County of San Diego to enforce new stormwater discharge requirements by March 2008. Order R9-2009-0007-0001 is based on the federal Clean Water Act (CWA), which prohibits the discharge of any pollutants that impair waterways.

The most significant new requirements include requiring, Low-Impact Development (LID) BMPs, medium/high treatment control BMP effectiveness, and a Hydromodification Management Plan. Low Impact Development (LID) is a required approach to reduce stormwater runoff rates and durations. The technique emphasizes mimicking natural hydrologic conditions through promoting infiltration. The first goal of LID is to reduce the generation of storm water runoff. The second goal is to treat pollutants where they are generated by evenly distributing the management of storm water throughout the site. Selected treatment BMPs must have a medium or high removal efficiency rating or have a treatment train. Any BMPs with low/medium removal efficiency will require an additional BMP placed in series in order to capture pollutants that pass through the first treatment device. The *Hawano Subdivision Storm Water Management Plan* dated December 2011 by Kimley-Horn and Associates further discusses water quality treatment.

This report addresses the Hydromodification Management Plan requirement. Hydromodification refers to changes in the natural flow pattern (surface flow or groundwater) of an area due to development. Land development impacts include increasing impervious surface, decreasing vegetation, soil compaction, and construction of drainage facilities. The effect of these actions on runoff is less infiltration, increased volume, and increased duration. Storms that previously didn't produce runoff under pre-project conditions can produce erosive flows post-project. Ultimately, the receiving water stream bank is eroded with an increase in volume of runoff and the length of time that flows occur.

In order to reduce hydromodification, the County of San Diego adopted the Final Hydromodification Plan into the SUSMP in January 2011 for all Priority Development Projects. This report documents compliance with the Hydromodification Criteria.

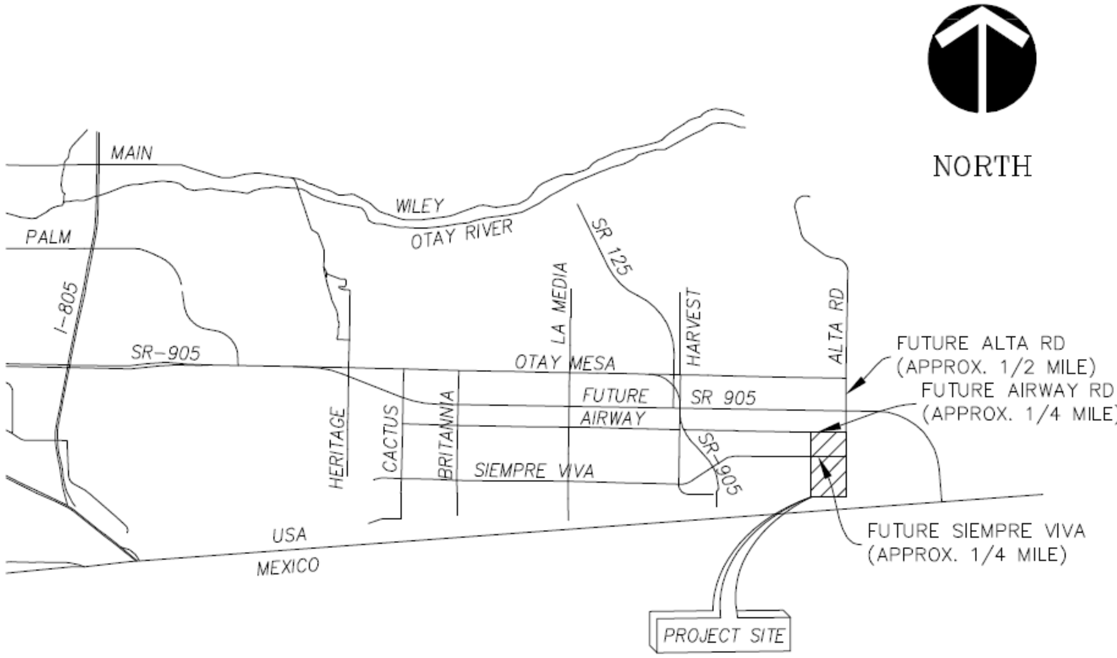

Figure 1: Vicinity Map

2.0 Existing Conditions

The existing site has three main drainage inflow points to the north along Airway Road. The total tributary area contributing runoff flows is 170 acres., approximately 80 acres of this area is within the project boundary and conveyed through natural swales across the site, then passes into Mexico via six 7' wide by 4' high box culverts. A portion of this flow outflows near the eastern boundary of the property along Alta Road, but eventually confluences into the same box culvert at the border. Sheet flow from the western property boundary also accounts for a small portion of the total contributing runoff. Please see **Exhibit A** for the delineation of existing drainage basins and existing drainage flow paths.

The site currently consists of open fields with medium vegetation and was previously used for agricultural purposes. Existing runoff is currently conveyed in a series of existing drainage swales in a natural flow condition across the site and eventually into an existing drainage channel just south of the site. Per the County of San Diego Hydrology Manual, June 2003 the soil classification for the site is Soil Type D. Geotechnical assumptions for hydromodification analysis were based on the criteria used on the adjacent property, Otay Business Park (TM 5505).

3.0 Proposed Conditions

The proposed project will provide several locations to pick up offsite flows from the north. See *Hawano Subdivision CEQA Preliminary Hydrology/Drainage Study* by Kimley-Horn and Associates dated April 2011 for more details**.** These flows will be conveyed in an underground drainage system in Airway Road, Siempre Viva Road, and Alta Road. This underground drainage system has been provided to bypass offsite flows through the proposed site separating proposed onsite flows from the offsite runoff.

Curb inlets and desilt basins will be used to capture onsite flows. A series of underground drainage systems will be provided to route flows to a detention basin located at the southeast corner of the project. The detention basin will be used to detain the developed flows back to existing conditions. The detained flows will be released offsite to the south maintaining the original drainage flow path and avoiding diversion of flows.

One detention basin has been proposed for this project. It has been sized to meet hydromodification criteria and detain the 10, 50, and 100-year storm events. Please refer to **Exhibit B** for the proposed drainage system design.

4.0 Methodology

The Hydromodification Criteria is specified in the San Diego County SUSMP. This criteria requires post-project runoff durations and peak flows to not exceed pre-project durations and peak flows. Specifically, the post-project discharge duration between the low flow threshold to the 10 year flow must not exceed the pre-project durations by more than 10% over more than 10% of the flow duration curve. The low flow threshold which may be 0.1Q2, 0.3Q2, or 0.5Q2 based on channel size, dimension and critical shear. Channels with low susceptibilities for erosion correspond to 0.5Q2, medium susceptibilities correspond to 0.3Q2, and high susceptibilities correspond to the 0.1Q2 threshold. A geomorphologist was retained to perform a downstream channel assessment to determine a low susceptibility rating, see **Appendix A**.

The San Diego Hydrology Model (SDHM) software, downloaded July 2011, was used to analyze the proposed project for compliance with the San Diego County Final Hydromodification Criteria. This software is capable of modeling hydromodification management or flow control facilities to mitigate the effects of increased runoff from proposed land use changes that may have negative impacts downstream.

SDHM is based on actual recorded precipitation data. For this project the nearest precipitation gauge was at the Lower Otay Station with precipitation data 1959-2004. A scaling factor of 1.0 was used for the model.

The program is a continuous simulation program accounting for all storm events which differs from typical methods of using the peak from a single storm event such as 50-yr, 100-yr, etc. SDHM uses the Hydrologic Simulation Program-Fortran (HSPF) software as its computational engine to run rainfall-runoff algorithms. The program HSPF generates hourly runoff time series from the available rain gauge data over number of years is supported by the EPA and USGS. SDHM has taken HSPF and calibrated the parameters for San Diego. Calibration is based on simulated and observed values. Frequency is calculated based on the peak outflow for each year. The peak outflows are ranked and assigned a return period (years) based on the Weibull plotting position:

Return period = N/(m+1)

Where: N= number of years

m= rank

Flow Control Analysis and Sizing

Pre-project and post-project model scenarios for the project site were created. The pre-project model consists of three types of landuse defined as Soil C/D with a flat 0-5% grass surface, Soil C/D with flat 0-5% dirt surface, and Roads, flat (0-5%). The existing site is relative flat, with approximately 72% dirt, 18% natural grass/vegetation, and 10% roads based on aerial photographs.

The post-project model basin consists of impervious roads and industrial use parcels. Although this project proposes street improvements and graded pads, the graded pads are modeled for the ultimate “mixed” industrial use. When the pads are developed, 10% of the site is anticipated to be pervious. The MS4 permit requires all developments to include LID features. The hydromodification management plan models the proposed lots in ultimate condition. Due to mandatory LID measures, the industrial use parcels are modeled utilizing the 10% pervious areas as self-retaining areas. Self-retaining areas can retain and treat a maximum of two times the impervious area, outlined in the San Diego County Standard Urban Stormwater Mitigation Plan (SUSMP) January 2011. Therefore, a total of 30% pervious area is modeled. The 70% impervious area from the parcels was divided between roof area and parking area. (See **Table 1** for Land Use Parameters)

Self-retaining areas may be landscape or pervious surface, See **Figure 2** and **Figure 3** for self-retaining area examples. The future developer of the graded lots must incorporate LID techniques into their project to comply with hydromodification standards. At the time of development, the developer must demonstrate the LID techniques proposed are at a minimum equivalent to this model. Various LID techniques such as permeable pavement, dispersion, green roofs, rainwater harvesting, flow-through planter, bioretention area, or grass swales are available. If LID techniques are not feasible, additional detention for the lot may be required at the time of development.

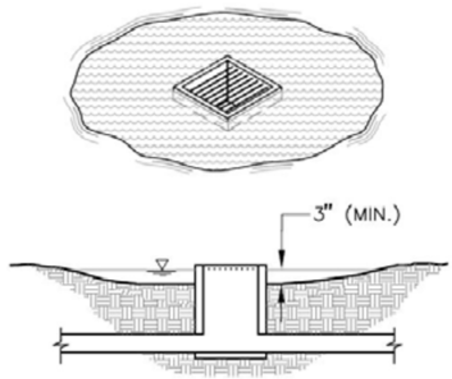

Figure 2: Self-retaining areas. Berm or depress the grade to retain at least and inch of rainfall and set inlets of any area drain at least 3 inches above low point to allow ponding.

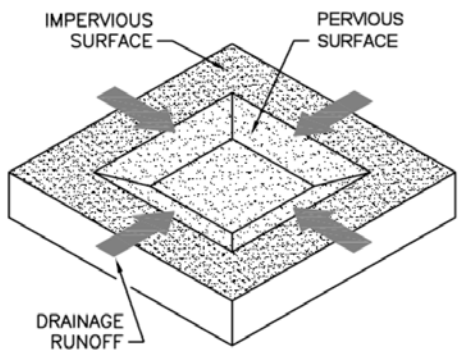

Figure 3: Relationship of impervious to pervious area for self-retaining areas. Ratio: pervious ≤ 0.5 impervious

The water quality runoff from the proposed impervious roads will be directed into grass swales within the right-of-way. Vegetated swales are shallow channels that collect and convey runoff slowly. Runoff is filtered through the vegetation to trap pollutants, promote infiltration, and reduce the flow velocity of the stormwater runoff. Grass swales have not been modeled in SDHM because the grass swales will be designed only to capture the water quality runoff (first flush). The pervious area from the swales accounts for approximately 15% of the dedicated road right-of-way; this was entered into the model as Soil C/D grass (slope 0-5%).

In addition to the LID techniques, ponded storage is required to detain the flows to 20% of the five year design flow. Flow control techniques were sized iteratively through SDHM in order to reach hydromodification compliance. The volume of detention basin size was based on allowable discharge. The precipitation data for the scaled Lower Otay produced the 2-year existing condition flows of 4.09 cfs and the 10-year existing condition flow is 8.32 cfs. San Diego County does not experience large rainfall events; therefore, the returned 2-year frequency runoff is relatively small. Fifty percent of the two year discharge (0.5Q2) generated from the model is 2.05 cfs which is the maximum discharge allowed. See **Table 2** for pre-developed flows.

Table 1: Land Use Parameters (Acres)

Pre-project				Post-project				
				Roads		Industrial Pads		
Pervious D-Grass-Flat	Pervious D-Dirt-Flat	Impervious	Total	Pervious D-Grass-Flat	Impervious	Pervious D-Grass-Flat	Impervious	Total
15.5	62.2	8.6	86.3	2.9	16.15	20.18	47.07	86.3

Table 2: Peak Requirement Pre-developed vs. Mitigated

Flow Frequency	Watershed Basin* Flow (cfs)	
	Pre-developed	Mitigated
2 Year	4.09	1.82
5 Year	5.75	2.15
10 Year	8.32	3.83
25 Year	28.77	5.54

*86.3 Acres

The function AutoPond in SDHM automatically sizes the pond to meet the required flow duration. The watershed requires 15.4 ac-ft of storage to comply with hydromodification requirements (see **Appendix B**). **Figure 4** demonstrates the hydromodification duration requirement is not exceeded provided the following detention basin is incorporated (see **Table 3)**.

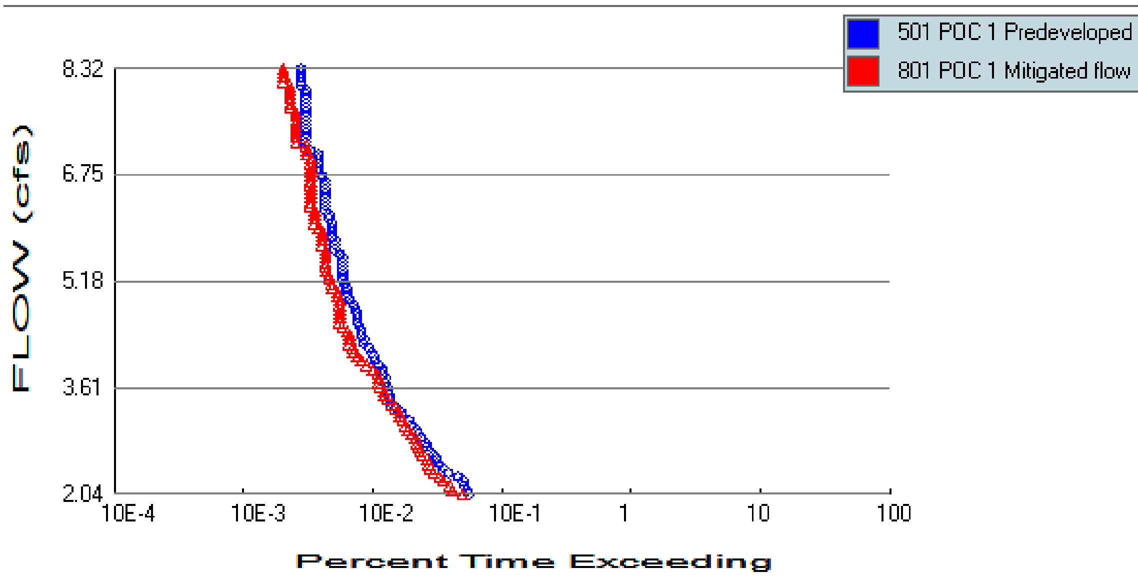

Figure 4: Duration Requirement Pre-developed Flow vs. Mitigated Flow

Table 3: Detention Basin Properties

Detention Basin Properties	Basin
Volume (ac-ft)	15.4
Surface Area (acres)	1.92
Depth (ft)	9
Orifice (inches)	5.6
Drawdown Time (days)	4.9

The detention basin for this project is required to meet the new hydromodification requirements and flow control detention criteria. Flows greater than Q10 is not subject to hydromodification; however, the peak existing discharge from the rational method may not be exceeded. In this case, the hydromodification requirements govern. The 50-year and 100-year hydrographs produced by the rational method presented in the *Hawano Subdivision CEQA Preliminary Hydrology/Drainage Study* dated April 2011 by Kimley-Horn and Associates, pass through the detention basin with more than 1 foot of freeboard. See the *Hydrology/Drainage Study* for additional information regarding discharge rates for the 50 and 100-year rational method storms.

The drawdown time is the time it takes for the basin to empty when completely full. The SDHM program calculates the drawdown time for the detention basin in the result analysis, see **Appendix B**. The drawdown time for the basin is approximately 4.9 days.

5.0 Maintenance

The proposed Hawano Subdivision project will create internal collector roads and mass graded pads for future industrial use tenants. Curb inlets, under sidewalk drains, vegetated swales and desilt basins will be used to capture onsite flows. A series of underground drainage systems will be provided to route flows to a detention basin located at the southeast corner of the project. The detention basin will be used to detain the developed flows back to existing conditions. The detained flows will be released offsite to the south maintaining the original drainage flow path and avoiding diversion of flows. An offline Hydrodynamic Separator will treat flows prior to entering the detention basin as an additional BMP treatment device.

The maintenance of the hydromodification facilities, namely the detention basin, will be the responsibility of Hawano Subdivision (or current owner). The primary funding mechanism for on-going maintenance of the Detention Basin will be at the Developer/Owners Association expense. Additionally, as part of the Maintenance Agreement, the Developer would provide the County with a security which would remain in place for an interim period of five years. The security would equal the estimated costs of two years of maintenance activities.

The operational and maintenance needs of an extended detention basin are as follows:

- Dispersion of alluvial sediment deposition at inlet structures thus limiting the extended localized ponding of water.
- Periodic sediment removal in accordance with the 18” depth threshold or 10% of the storage volume (whichever is less).
- Monitoring of the basin to ensure it is completely and properly drained.

- Vegetation management to prevent marsh vegetation from taking hold, and to limit habitat for disease-carrying fauna.
- Removal of graffiti, grass trimmings, weeds, tree pruning, leaves, litter, and debris.
- Preventative maintenance on monitoring equipment.
- Vegetative stabilization of eroding banks and basal areas.

The detention basins will be inspected and inspection visits will be completely documented:

- Once a month at a minimum.
- After every large storm (after every storm monitored or those storms with more than 0.50 inch of precipitation).
- On a weekly basis during extended periods of wet weather.

Aesthetic Maintenance

The following activities will be included in the aesthetic maintenance program:

- Graffiti Removal. Graffiti will be removed in a timely manner to improve the appearance of a detention basin, and to discourage additional graffiti or other acts of vandalism.
- Grass Trimming. Trimming of grass will be done around fences, the basin, outlet structures, and sampling structures.
- Weed Control. Weeds will be removed through mechanical means.

Functional Maintenance

Functional maintenance has two components:

- Preventive maintenance.
- Corrective maintenance.

Preventive Maintenance

Preventive maintenance will be done on a regular basis. Preventive maintenance activities to be instituted at each detention basin are:

- Mowing. Vegetation in the detention basin will be kept at the average maximum height of 18 inches to prevent the establishment of marsh vegetation, the stagnation of water, and the development of faunal habitats.
- Trash and Debris. During each inspection and maintenance visit to the site, debris and trash removal will be conducted to reduce the potential for inlet and outlet structures and other components from becoming clogged and inoperable during storm events.
- Sediment Management. Alluvial deposits at the inlet structures may create zones of ponded water. Upon these occurrences these deposits will be graded within the detention basin in an effort to maintain the functionality of the BMP. Sediment grading will be accomplished by manually raking the deposits.
- Sediment Removal. Surface sediments will be removed when sediment accumulation is greater than 18-inches, or 10 percent of the basin volume, whichever is less. Vegetation removed with any surface sediment excavation activities will be replaced through reseeding. Disposal of sediments will comply with applicable local, county, state, or federal requirements.
- Mechanical Components. Regularly scheduled maintenance will be performed on valves, fence gates, locks, and access hatches in accordance with the manufacturers'

recommendations. Mechanical components will be operated during each maintenance inspection to assure continued performance.

- Elimination of Mosquito Breeding Habitats. The most effective mosquito control program is one that eliminates potential breeding habitats.

Corrective Maintenance

Corrective maintenance is required on an emergency or non-routine basis to correct problems and to restore the intended operation and safe function of a detention basin. Corrective maintenance activities include:

- Removal of Debris and Sediment. Sediment, debris, and trash, which threaten the ability of a detention basin to store or convey water, will be removed immediately and properly disposed of.
- Structural Repairs. Repairs to any structural component of a detention basin will be made promptly (e.g., within 10 working days). Designers and contractors will conduct repairs where structural damage has occurred.
- Embankment and Slope Repairs. Damage to the embankments and slopes will be repaired quickly (e.g., within 10 working days).
- Erosion Repair. Where a reseeding program has been ineffective, or where other factors have created erosive conditions (i.e., pedestrian traffic, concentrated flow, etc.), corrective steps will be taken to prevent loss of soil and any subsequent danger to the performance of a detention basin. There are a number of corrective actions than can be taken. These include erosion control blankets, riprap, sodding, or reduced flow through the area. Design engineers will be consulted to address erosion problems if the solution is not evident.
- Fence Repair. Timely repair of fences (e.g., within 10 working days) will be done to maintain the security of the site.
- Elimination of Trees and Woody Vegetation. Woody vegetation will be removed from embankments.
- Elimination of Animal Burrows. Animal burrows will be filled and steps taken to remove the animals if burrowing problems continue to occur (filling and compacting). If the problem persists, vector control specialists will be consulted regarding removal steps. This consulting is necessary as the threat of rabies in some areas may necessitate the animals being destroyed rather than relocated.
- General Facility Maintenance. In addition to the above elements of corrective maintenance, general corrective maintenance will address the overall facility and its associated components. If corrective maintenance is being done to one component, other components will be inspected to see if maintenance is needed.

Maintenance of the detention basin will consist of trash and debris, sediment removal. The frequency of inspection should be based on pollutant loading, amount of debris, leaves, sediment etc. and amount of runoff. At a minimum, sediment should be removed from each detention basin at least once a year.

The Hawano Subdivision is responsible for any hazardous waste generated at a detention basin since they are responsible for maintenance. Disposal of sediment, debris, and trash will be contracted out in accordance with local, county, state, and federal waste control programs. Suspected hazardous wastes will be analyzed to determine disposal options. Hazardous materials generated on site will be handled and disposed of according to local, state, and federal regulations. A solid or liquid waste is considered a hazardous waste if it exceeds the criteria listed in the California Code of Federal Regulations, Title 22, Article 11 (State of California, 1985).

6.0 Results

Hydromodification management was required for this project to prevent downstream erosion caused by land development. Ultimate use for the project site consists of arterial roads and "mixed" use industrial parcels. Compliance with the hydromodification criteria was demonstrated using the continuous simulation program SDHM 2011. The post-project scenario was modeled for ultimate use to determine flow control devices. Flow controls required include LID and ponded storage. Runoff from the streets is directed to grass swales for water quality. Industrial use parcels will require LID when fully developed; therefore, the typical 10% pervious area is assumed to be utilizing as self-retaining areas. LID practice alone does not meet hydromodification flow duration requirements; a detention basin is required to reduce runoff peaks and durations. Table 1 previously mentioned provide a summary of these results.

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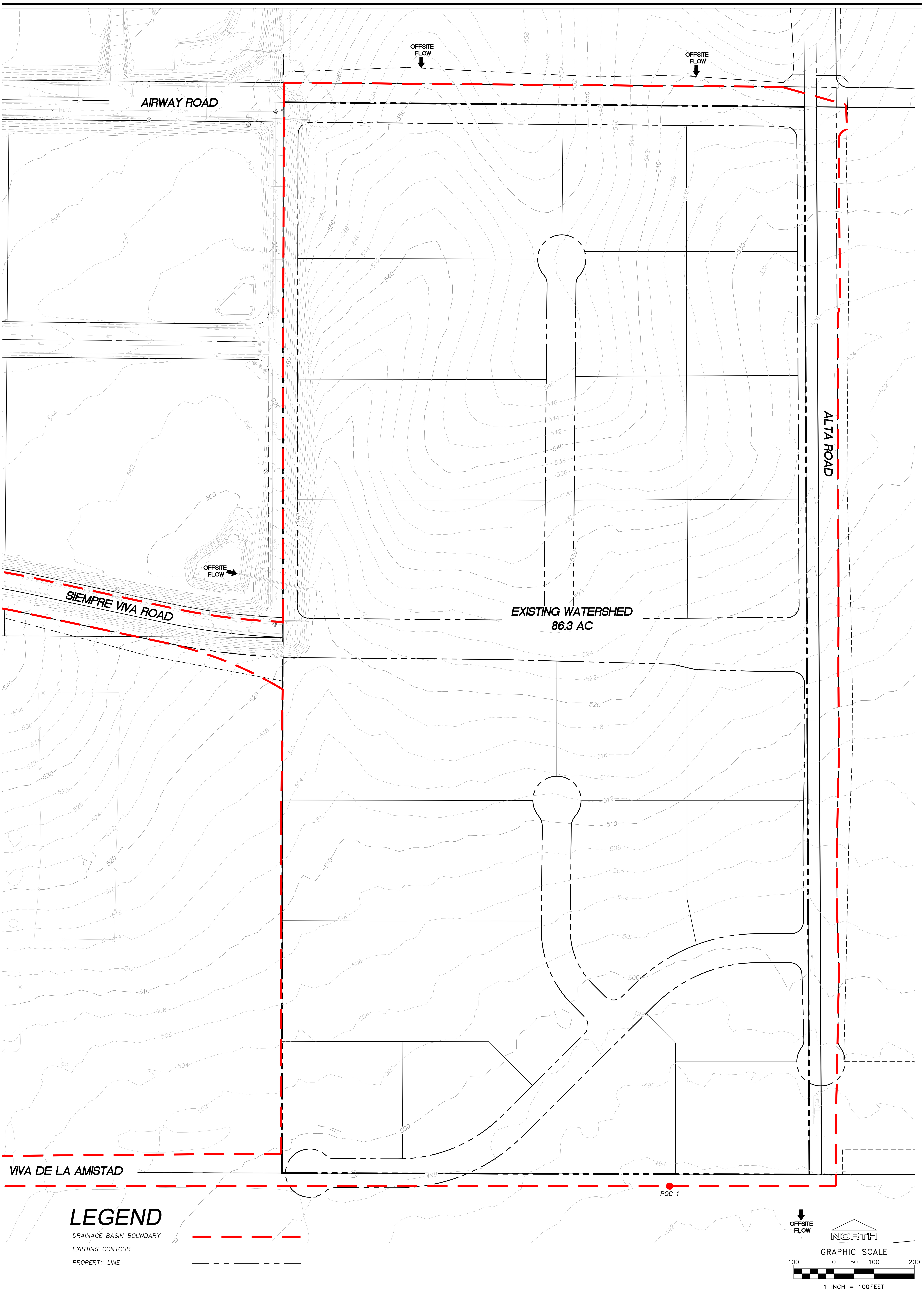
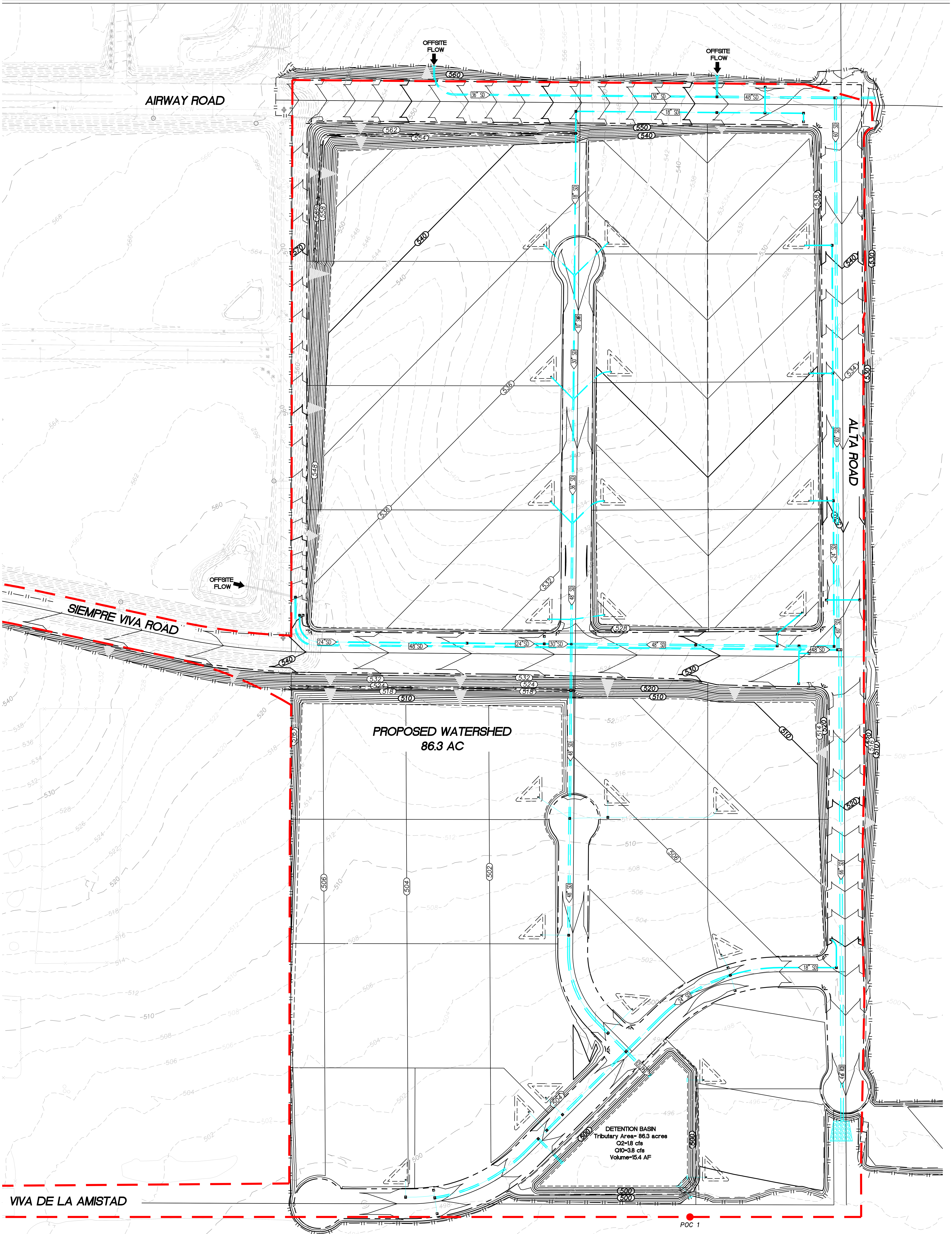


Kimley-Horn and Associates, Inc.

APRIL 2012

HAWANO SUBDIVISION

EXISTING HYDROMODIFICATION EXHIBIT



LEGEND

- DRAINAGE BASIN BOUNDARY
- EXISTING CONTOUR
- PROPERTY LINE
- STORM DRAIN
- GRADING LIMIT

GRAPHIC SCALE

100 0 50 100 200

1 INCH = 100FEET

Kimley-Horn and Associates, Inc.

APRIL 2012

HAWANO SUBDIVISION

PROPOSED HYDROMODIFICATION EXHIBIT

Kimley-Horn and Associates, Inc.

APPENDICES

Kimley-Horn and Associates, Inc.

Appendix A ~ Downstream Channel Analysis

HYDROMODIFICATION SCREENING

FOR THE

HAWANO SUBDIVISION

(TM 5566, Log No. 93-19-006OO)

April 4, 2012

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FOR REVIEW ONLY

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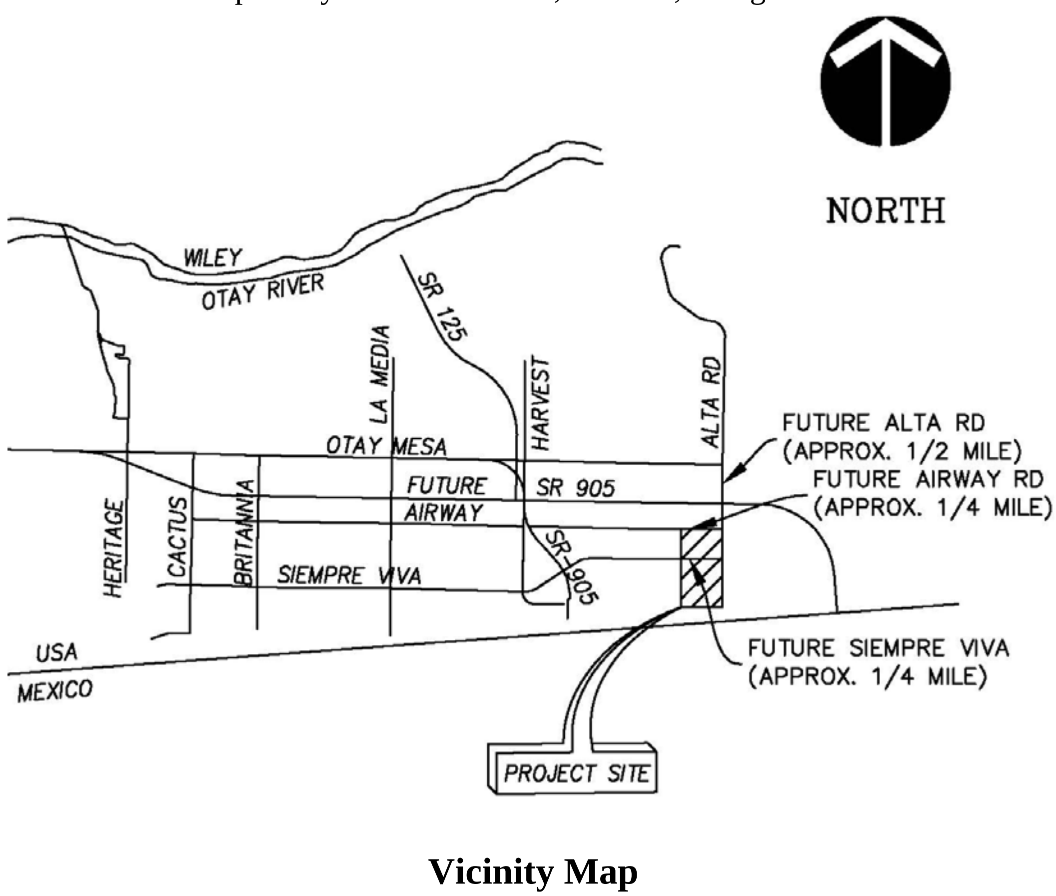
APPENDICES

MAP POCKET

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 BMP Sizing Calculator to establish the appropriate erosion susceptibility threshold of low, medium, or high.



Vicinity Map

This report provides hydromodification screening analyses for the Hawano Subdivision project being designed by Kimley-Horn and Associates, Inc. The project will be an industrial subdivision located immediately southwest of the future intersection of Airway Road and Alta

Road in the Otay Mesa community of the county of San Diego (see the Vicinity Map above as well as the Study Area Exhibit and Site Plan in the map pocket). The site covers approximately 79.6 acres and is gently sloping towards the south. The site is currently undeveloped and primarily supports natural vegetation consisting of grasses and weeds. There is some off-site surface runoff onto the site primarily from the north and west. The proposed project will provide several locations to pick up the off-site flows. The off-site flows will be conveyed through the site by an underground storm drain system that discharges at a single outlet near the southeast corner of the site in the general direction of the pre-project flow path. This storm drain system will be independent of the proposed system serving the on-site flows thus preventing commingling of on- and off-site flows.

The on-site drainage facilities will collect the project runoff and convey it to a proposed detention basin located within the southerly portion of the site. The basin outflow will be released off-site towards the south in the general direction of the pre-project flow path.

Downstream of the project, surface runoff from the site and tributary off-site areas generally flows in a southerly direction across the natural ground surface. The runoff is ultimately collected by six reinforced concrete box culverts just over 200 feet south of the site (see Figures 3 and 4). The box culverts are located within the US border patrol fence and convey runoff a distance of approximately 30 feet through the fence. The runoff then travels from the box culvert outlets south approximately 80 feet over natural ground towards a second parallel fence (see Figure 6), which is generally along the US/Mexico international boundary. Openings in the second fence allow the runoff to pass into Mexico, where it is conveyed by a hardened drainage system.

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 points of compliance, which are at the proposed storm drain outlets from the site.

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.

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. Otherwise English units are used.

Downstream Domain of Analysis

The downstream domain of analysis for the study area has been determined by assessing and comparing the four bullet items above. As discussed previously, the on-site project runoff will be collected by a proposed detention basin, whose outlet works consist of a pipe that discharges towards the south. The off-site runoff tributary to the project will be collected by a separate storm drain system that also outlets to the south (see the Study Area Exhibit). The outlet of each of these storm drains is a point of compliance (POC) and the downstream domain of analysis will be selected below the POCs.

Per the first bullet item, the first permanent grade control below the POCs is at the reinforced concrete box culverts along the northerly border patrol fence (see Figures 3 and 4). The entrance to the box culverts is concrete-lined so the combination of the concrete lining and culverts form the first permanent grade control below both POCs. Runoff downstream of the box culverts will flow over the natural ground surface for a distance of 80 feet before entering a hardened, non-erodible drainage conveyance within Mexico (see Figure 6). A downstream domain of analysis based on a permanent grade control must extend one reach below the grade control. In this case, one reach was taken to be the 80 feet of natural ground surface between the downstream end of the box culverts and the hardened drainage facility in Mexico. The 80 feet is the maximum reach length possible since the Mexican drainage facility further downstream is non-erodible.

The second bullet item is the tidal backwater or lentic (standing or still water such as ponds, pools, marshes, lakes, etc.) waterbody location. 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 of 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 tributary to the permanent grade control covers approximately 483.99 acres (see the Watershed Exhibit in the map pocket). This area includes the project site as well as off-site areas. The additional area between the permanent grade control and the US/Mexico boundary is 10.84 acres. There are no lateral drainages tributary to these two areas, so a 50 percent or equal order (100 percent) tributary will not be reached until some point beyond the international border.

Based on the above information, the downstream domain of analysis for both POCs is based on one reach below the first grade control point, which occurs at the southerly border fence located along the US/Mexico boundary. Of the four bullet criteria, this is the first point reached below the POCs.

Upstream Domain of Analysis

The proposed storm drains at the POCs outlet into the uppermost end of the receiving drainage courses. Since natural drainage courses do not extend upstream of the storm drain outlets, the upstream domain of analysis location will be at the POCs.

Study Reaches within Domain of Analysis

The entire domain of analysis extends from each of the two POCs to the US/Mexico boundary. The total domain of analysis for the westerly POC covers approximately 480 feet and for the easterly POC covers approximately 530 feet. The domain of analysis was subdivided into three study reaches (see the Study Area Exhibit). Reach 1A (upper reach for the westerly POC) is just over 341 feet long and extends from the westerly POC to the upper end of the permanent grade control. Reach 1B (upper reach for the easterly POC) is 389 feet long and extends from the easterly POC to the upper end of the permanent grade control. Reach 3 is 80 feet long and extends from the lower end of the permanent grade control to the US/Mexico boundary. Each reach length is less than the 20 channel width 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, 2-foot contour interval flown topographic mapping was available for the project and the majority of the surrounding study area. Since this is more accurate than NED mapping, it will yield better results. A site investigation was performed that confirmed the accuracy of the mapping.

The watershed areas tributary to Reaches 1A/1B and 2 were determined from the flown topographic mapping and USGS mapping. The flown topographic mapping did not cover a small portion of the upper watershed, so USGS mapping was used for this area. The watershed delineation is included on the Watershed Exhibit in the map pocket and shows that the areas tributary to the downstream ends of Reaches 1A/1B and 2 cover approximately 483.99 acres (0.76 square miles) and 494.83 acres (0.77 square miles), respectively.

The mean annual precipitation was obtained from the rain gage closest to the site. This is the Western Regional Climate Center's Lower Otay Reservoir gage (see Appendix A), which is approximately 3.8 miles from the site. The average annual rainfall measured at this gage for the period of record from 1940 to 1956 is 11.1 inches. Since the period of record does not cover an overly extensive time period, data for the next closest rain gage at Bonita was also reviewed. The Bonita gage is over 10 miles from the site, but has a period of record from 1915 to 1970. The average annual rainfall at Bonita over this period is 11.5 inches. Since this rainfall is similar to the Lower Otay Reservoir gage data, the Lower Otay Reservoir data was determined to appropriately represent the mean annual precipitation for the project.

The valley slope of Reaches 1A/1B were determined from the 2-foot contour interval topographic mapping. 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 length of the flow line. For Reach 2, a smart level was used (see figure in Appendix A) because the topographic mapping did not provide elevation data at the US/Mexico boundary. The valley width is the valley bottom width dictated by breaks in the hillslope. The valley within each study reach exhibits subtle breaks because the topographic relief is very gradual. Consequently, the topographic mapping does not provide a good measure of the valley widths. Because of this, the valley widths were determined through a site investigation. The figures in Appendix A provide a graphical determination of the valley widths from the site investigation. The tributary drainage area, valley slope, and valley width within each reach are summarized in Table 1.

Reach	Tributary Drainage Area, sq. mi.	Valley Slope, m/m	Valley Width, m
1A	0.76	0.0070	17
1B	0.76	0.0121	17
2	0.77	0.0220	17

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.

<u>*Vertical Stability*</u>

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 10. 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 9 show photographs of the bed material within the study reach. 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 found in a labile bed. A pebble count was performed that determined the median (d_{50}) bed material size to be 16 millimeters (mm) in Reach 1A and 1B, and 22.6 mm in Reach 2 (see Appendix B). Figure 6-4 in the County HMP indicates that a d_{50} of 16 mm or greater is within the transitional/intermediate bed category. 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. This requires the most rigorous steps and will generate the appropriate results for the size range.

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 three reaches is within Category B, which represents intermediate bed material of unknown resistance or unknown armoring potential due to a surface veneer such as vegetation. 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 based on the spacing of the grade controls. Category A on Checklist 2 is defined by a grade control spacing of $2/S_v$ meters. The S_v values for Reach 1A, 1B, and 2 from the Form 1 analysis in Appendix A are 0.0070, 0.0121, and 0.220 m/m, respectively. From this, $2/S_v$ for the reaches is 284 meters (932 feet), 166 meters (545 feet), and 91 meters (299 feet), respectively. There are permanent grade controls at the downstream ends of each reach (box culvert and the hardened drainage facilities in Mexico). The total lengths of Reach 1A, 1B, and 2 are 249, 389, and 80 feet, respectively. Since all three reaches are less than their $2/S_v$ value, they are within Category A on Checklist 2.

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 1A, 1B, and 2 are included in Appendix B. The results show a d_{50} of 16 millimeters for Reach 1A and 1B, and 22.6 mm for Reach 2. The screening index values for the three reaches are tabulated in Appendix A. Plotting the d_{50} and screening index values on the Mobility Index Threshold diagram shows that all three reaches have a less than 50 percent probability of incising or braiding, which falls within Category A.

The overall vertical rating is determined from the Checklist 1, Checklist 2, and Mobility Index Threshold results. The scoring is based on the following values:

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

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

$$\text{Vertical Rating} = [(\text{armoring} \times \text{grade control})^{1/2} \times \text{screening index score}]^{1/2}$$
$$= [(6 \times 3)^{1/2} \times 3]^{1/2}$$
$$= 3.6$$

Since the vertical rating is less than 4.5, 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 11) 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 any of the reaches during a field investigation. The drainage courses all have a gently sloping cross-section with very gradual banks that are not subject to erosion (see Figures 1, 2, 3, and 6).

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 ground surface was difficult to penetrate with a probe. In addition, the banks showed no evidence of crumbling and were composed of relatively well-packed particles.

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. Based on the topographic mapping, figures, and site investigation, it is clear that the bank angles are significantly flatter than 30 degrees. Form 6 shows that the probably of mass wasting and bank failure has less than 10 percent risk for a 30 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 the Reaches 1A, 1B, and 2 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).

CONCLUSION

The SCCWRP channel screening tools were used to assess the downstream channel susceptibility for the Hawano Subdivision project. The project runoff will be collected by a proposed on-site storm drain system and detention basin. The tributary off-site runoff will be collected by a separate on-site storm drain system to avoid commingling with on-site runoff. Both drainage systems discharge in a southerly direction towards the US/Mexico boundary. Portions of the receiving drainage courses are naturally lined upstream of Mexico. However, these are gently sloping in the direction of flow, contain very mild banks, and have grade controls. Consequently, there is no evidence of vertical or lateral erosion in the drainage courses. The downstream channel assessment for the drainage courses was performed based on office analyses and field work. The results indicate a low threshold for vertical and lateral susceptibilities for each of the study reaches, which is consistent with the in-site conditions.

The HMP requires that these results be compared with the critical stress calculator results incorporated in the County of San Diego’s BMP Sizing Calculator. The BMP Sizing Calculator critical stress results are included in Appendix B for Reach 1A, 1B, and 2. Based on these values, the critical stress results returned a low threshold. Therefore, the SCCWRP analyses and critical stress calculator demonstrate that the project can be designed assuming a low susceptibility to erosion, i.e., $0.5Q_2$.

Figure 1. Looking Downstream from Westerly POC towards Reach 1A

Figure 2. Looking Downstream from Easterly POC towards Reach 1B

Figure 3. Upstream End of Box Culverts within North Border Patrol Fence (Permanent Grade Control)

Figure 4. Upstream End of Box Culverts and Concrete Lining at North Border Patrol Fence

Figure 5. Downstream End of Box Culverts at Permanent Grade Control

Figure 6. Looking Downstream in Reach 2 towards Southerly Border Fence (US/Mexico Border)

Figure 7. Gravelometer near Upper End of Reach 1A/1B

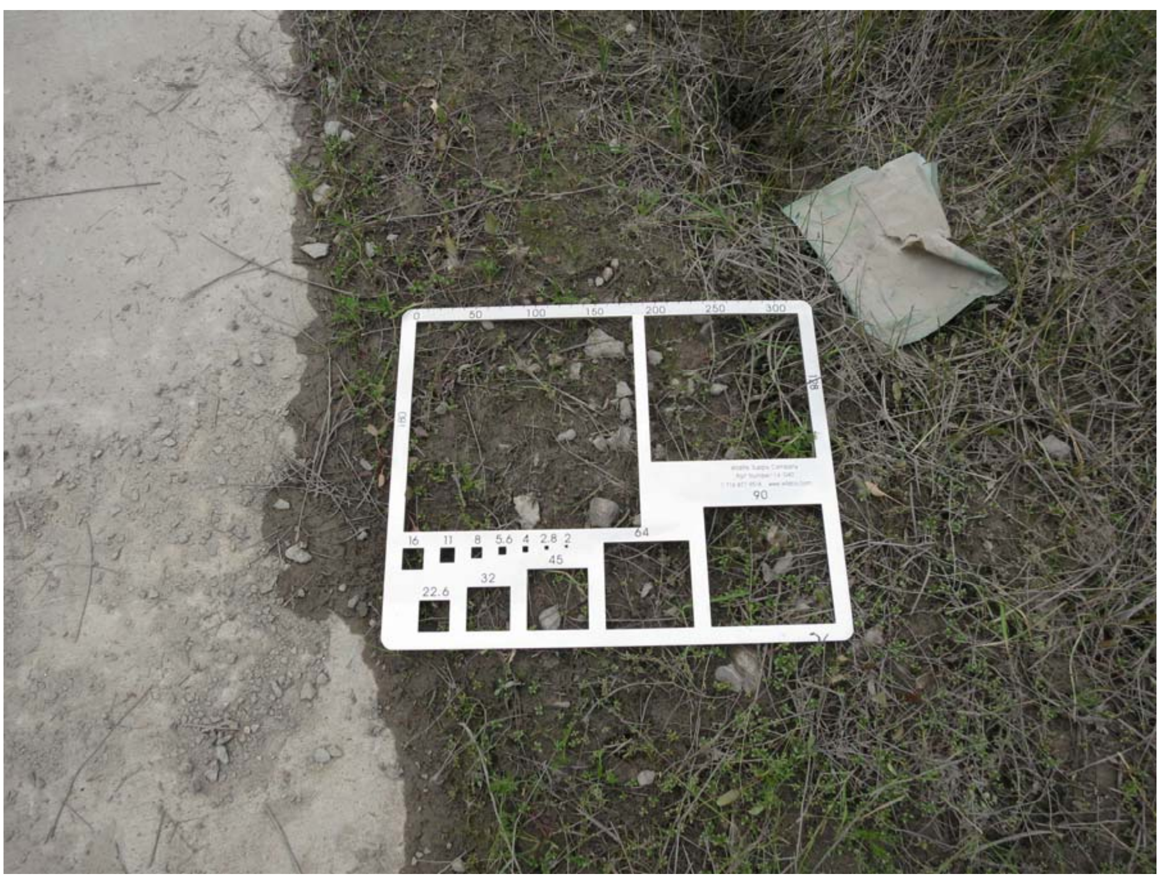


Figure 8. Gravelometer near Lower End of Reach 1A/1B

Figure 9. Gravelometer within Reach 2

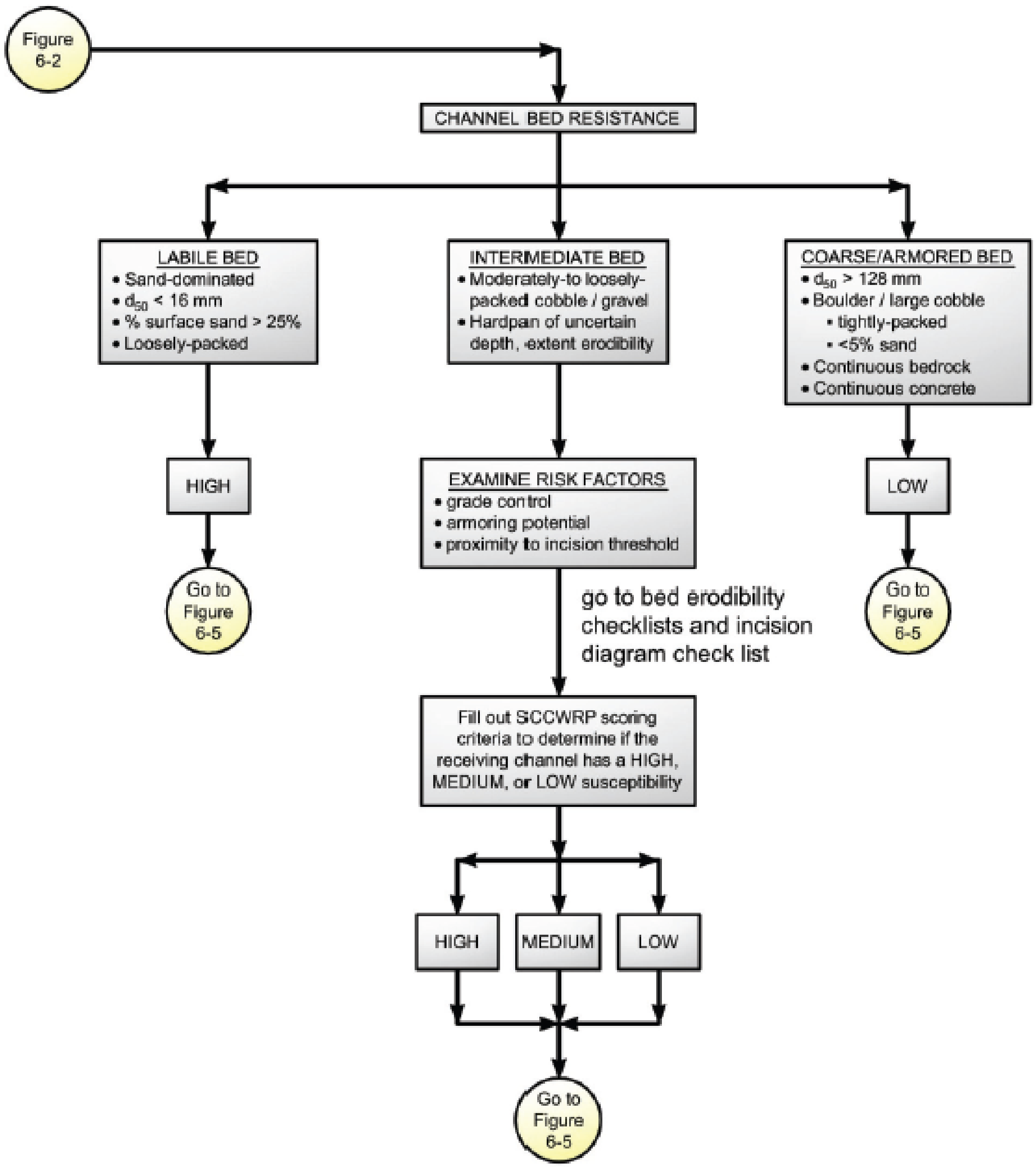


Figure 6-4. SCCWRP Vertical Susceptibility

Figure 10. SCCWRP Vertical Channel Susceptibility Matrix

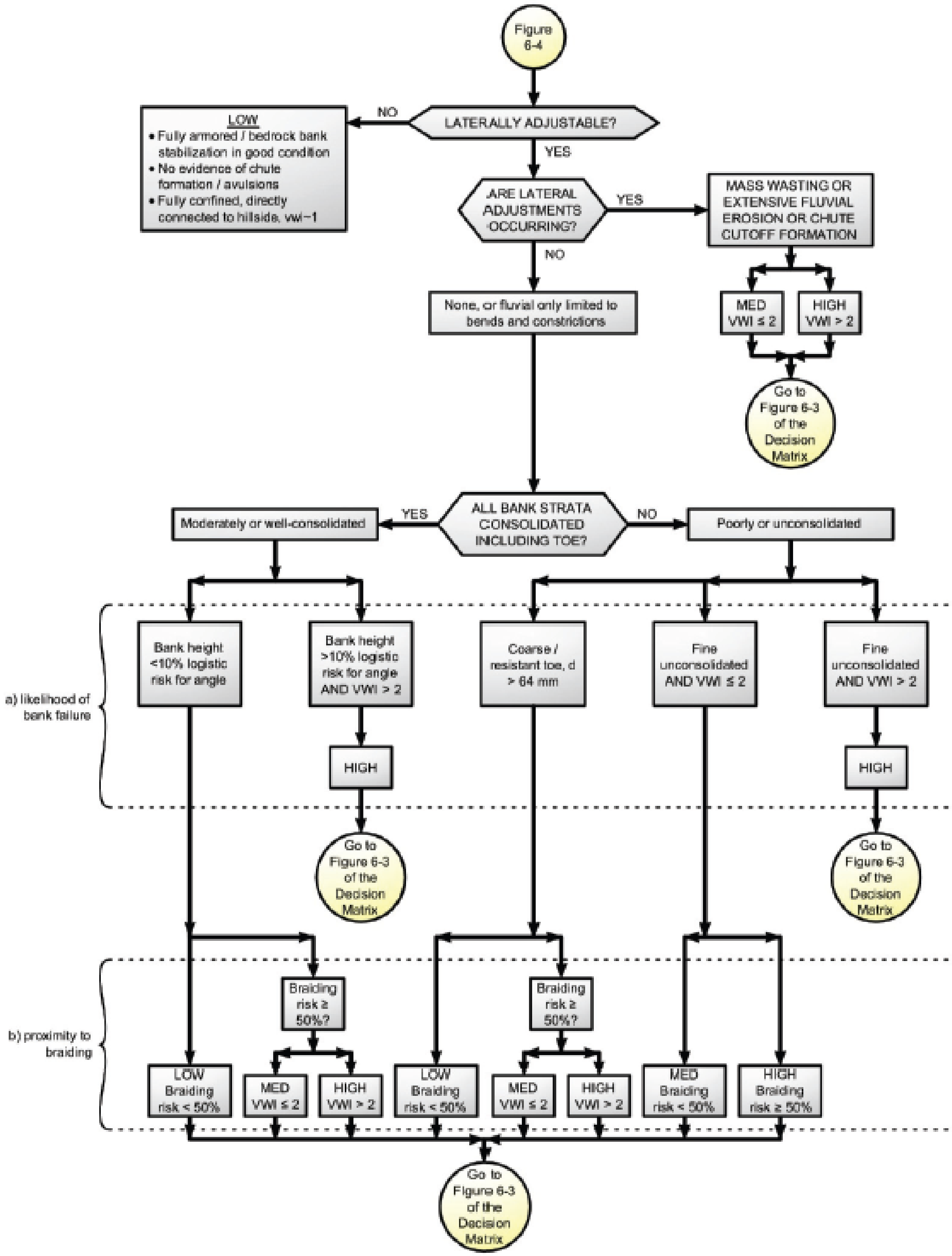


Figure 6-5. Lateral Channel Susceptibility

Figure 11. SCCWRP Lateral Channel Susceptibility Matrix

APPENDIX A

SCCWRP INITIAL DESKTOP ANALYSIS

FORM 1: INITIAL DESKTOP ANALYSIS

Complete all shaded sections.

IF required at multiple locations, circle one of the following site types:

Applicant Site / Upstream Extent / Downstream Extent

Location: Latitude: 32.5567 Longitude: -116.9215

Description (river name, crossing streets, etc.): Hawano Subdivision - southwest of intersection of Airway Road and Alta Road.

GIS Parameters: The International System of Units (SI) is used throughout the assessment as the field standard and for consistency with the broader scientific community. However, as the singular exception, US Customary units are used for contributing drainage area (A) and mean annual precipitation (P) to apply regional flow equations after the USGS. See SCCWRP Technical Report 607 for example measurements and "Screening Tool Data Entry.xls" for automated calculations.

Form 1 Table 1. Initial desktop analysis in GIS.

	Symbol	Variable	Description and Source	Value
Watershed properties (English units)	**A**	Area (mi^2)	Contributing drainage area to screening location via published Hydrologic Unit Codes (HUCs) and/or ≤ 30 m National Elevation Data (NED), USGS seamless server	See attached Form 1 table on next page for calculated values for each reach.
	P	Mean annual precipitation (in)	Area-weighted annual precipitation via USGS delineated polygons using records from 1900 to 1960 (which was more significant in hydrologic models than polygons delineated from shorter record lengths)	
Site properties (SI units)	S_v	Valley slope (m/m)	Valley slope at site via NED, measured over a relatively homogenous valley segment as dictated by hillslope configuration, tributary confluences, etc., over a distance of up to ~500 m or 10% of the main-channel length from site to drainage divide	
	W_v	Valley width (m)	Valley bottom width at site between natural valley walls as dictated by clear breaks in hillslope on NED raster, irrespective of potential armoring from floodplain encroachment, levees, etc. (imprecise measurements have negligible effect on rating in wide valleys where VWI is >> 2, as defined in lateral decision tree)	

Form 1 Tabl e 2. Simplif ied peak flo w, screening index, and valley width index. Values for this table should be calculated in the sequence shown in this table, using values from Form 1 Table 1.

Symbol	Dependent Variable	Equation	Required Units	Value
Q_{10cfs}	10-yr peak flow (ft^3/s)	$Q_{10cfs} = 18.2 * A^{0.87} * P^{0.77}$	A (mi^2) P (in)	See attached Form 1 table on next page for calculated values for each reach.
Q_{10}	10-yr peak flow (m^3/s)	$Q_{10} = 0.0283 * Q_{10cfs}$	Q_{10cfs} (ft^3/s)	
INDEX	10-yr screening index ($m^{1.5}/s^{0.5}$)	$INDEX = S_v * Q_{10}^{0.5}$	Sv (m/m) Q_{10} (m^3/s)	
W_{ref}	Reference width (m)	$W_{ref} = 6.99 * Q_{10}^{0.438}$	Q_{10} (m^3/s)	
VWI	Valley width index (m/m)	$VWI = W_v/W_{ref}$	W_v (m) W_{ref} (m)	

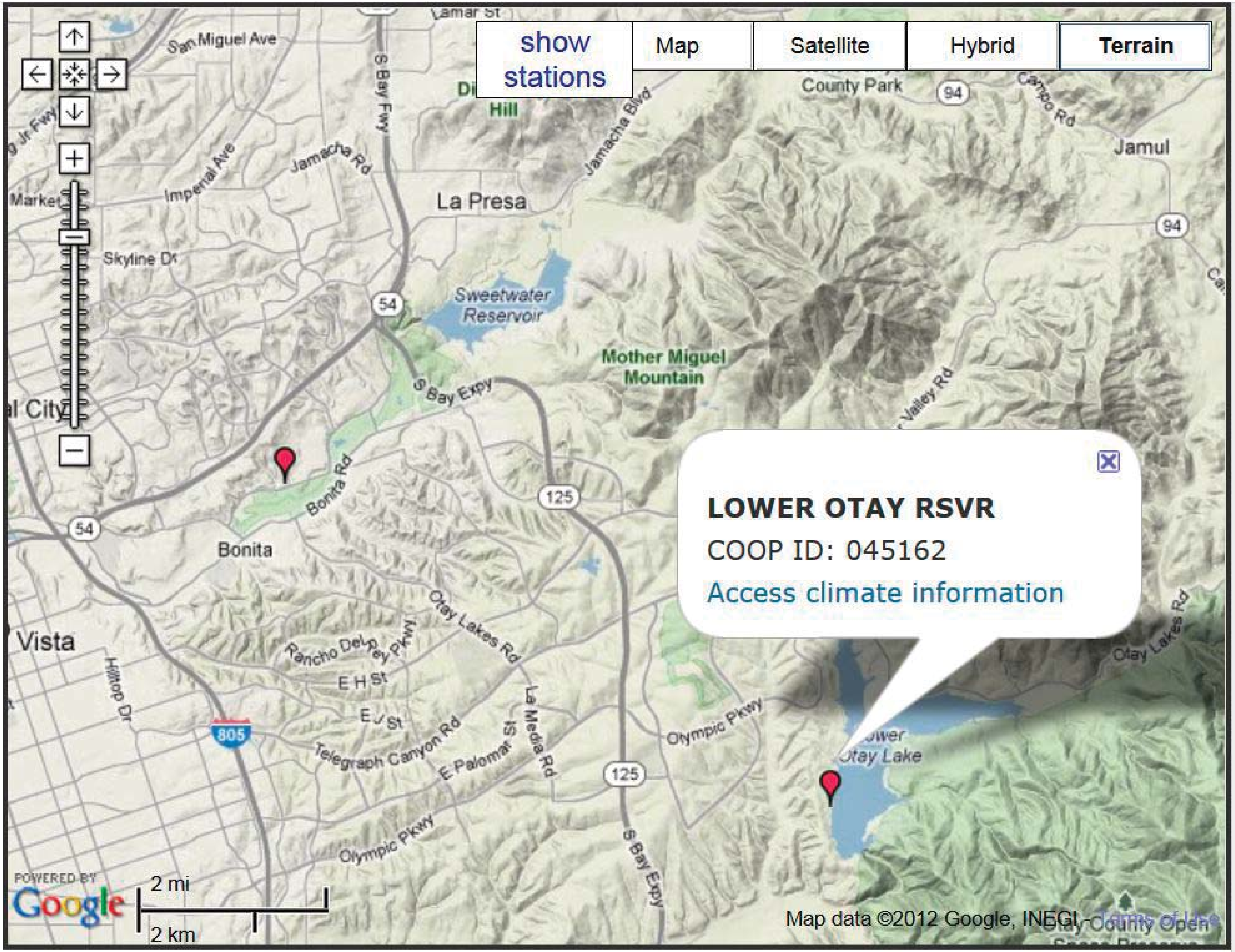
(Sheet 1 of 1)

SCCWRP FORM 1 ANALYSES

Reach	Area A, sq. mi.	Mean Annual Precip. P, inches	Valley Slope Sv, m/m	Valley Width Wv, m	10-Year Flow Q10cfs, cfs	10-Year Flow Q10, cms
1A	0.76	11.07	0.0070	17.0	91	2.6
1B	0.76	11.07	0.0121	17.0	91	2.6
2	0.77	11.07	0.0220	17.0	93	2.6

Reach	10-Year Screening Index INDEX	Reference Width Wref, m	Valley Width Index VWI, m/m
1A	0.011	10.6	1.61
1B	0.019	10.6	1.61
2	0.036	10.7	1.59

Western US COOP Station Map



LOWER OTAY RESERVOIR, CALIFORNIA (045162)

Period of Record Monthly Climate Summary

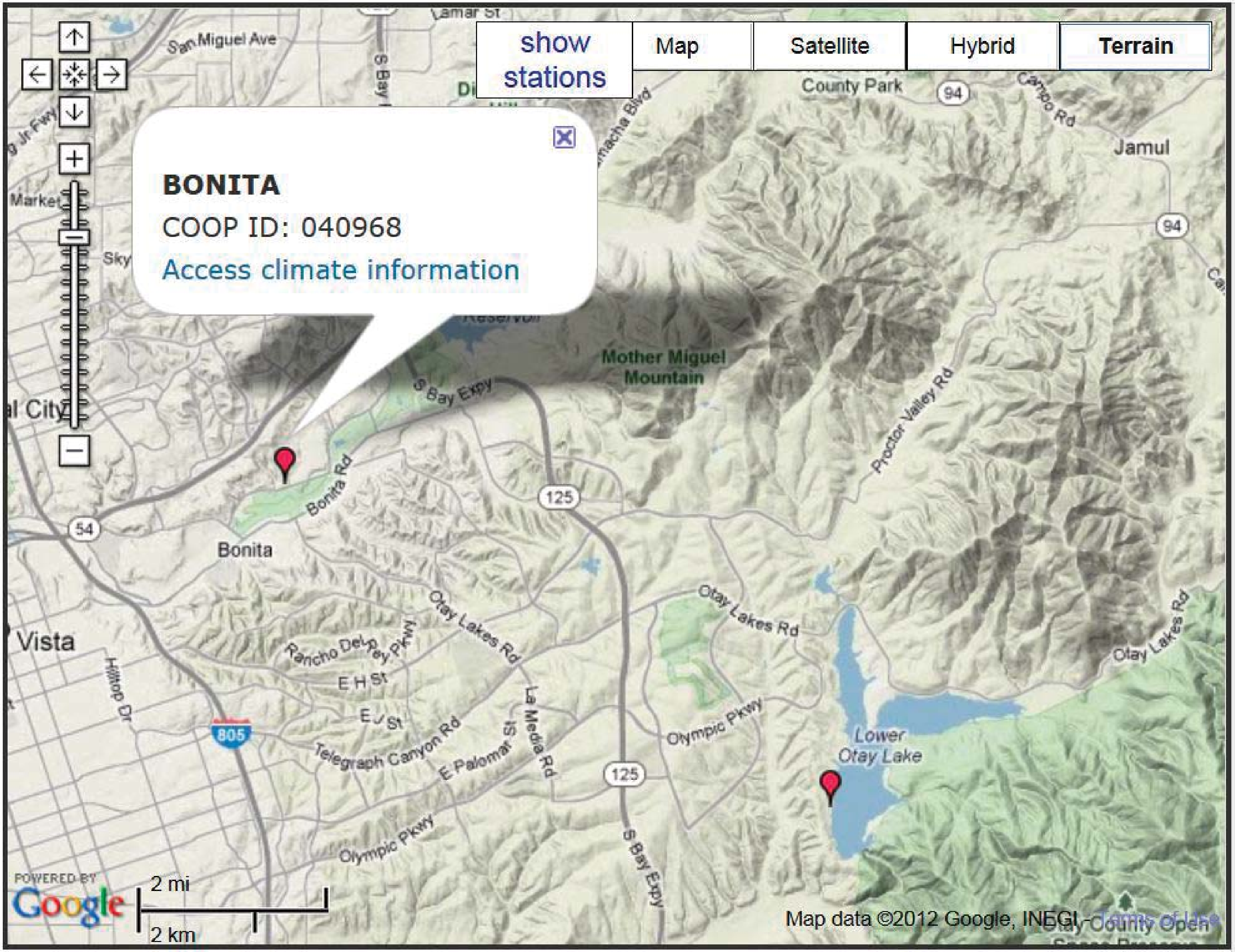
Period of Record : 9/ 1/1940 to 10/31/1956

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)					Insuff	icient	Data						
Average Min. Temperature (F)					Insuff	icient	Data						
Average Total Precipitation (in.)	2.12	1.16	2.28	1.09	0.32	0.03	0.02	0.10	0.03	0.48	0.97	2.46	11.07
Average Total SnowFall (in.)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average Snow Depth (in.)	0	0	0	0	0	0	0	0	0	0	0	0	0

Percent of possible observations for period of record.
Max. Temp.: 0% Min. Temp.: 0% Precipitation: 100% Snowfall: 100% Snow Depth: 100%
Check Station Metadata or Metadata graphics for more detail about data completeness.

Western Regional Climate Center, wrcc@dri.edu

Western US COOP Station Map



BONITA, CALIFORNIA (040968)

Period of Record Monthly Climate Summary

Period of Record : 10/1/1915 to 12/31/1970

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	66.4	67.3	68.6	70.9	72.6	75.0	79.4	80.8	80.6	77.0	73.5	68.4	73.4
Average Min. Temperature (F)	40.0	42.2	44.2	48.2	52.6	55.9	59.6	60.7	57.5	51.6	44.3	40.9	49.8
Average Total Precipitation (in.)	2.14	2.09	1.75	0.97	0.36	0.06	0.01	0.06	0.18	0.55	1.09	2.25	11.51
Average Total SnowFall (in.)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average Snow Depth (in.)	0	0	0	0	0	0	0	0	0	0	1	0	0

Percent of possible observations for period of record.
Max. Temp.: 92.5% Min. Temp.: 92.6% Precipitation: 94% Snowfall: 93.6% Snow Depth: 93.3%
Check Station Metadata or Metadata graphics for more detail about data completeness.

Western Regional Climate Center, wrcc@dri.edu

Smart Level Measurement of Ground Slope in Reach 2

Valley Width in Reach 1A

Valley Width in Reach 1B

Valley Width in Reach 2

APPENDIX B

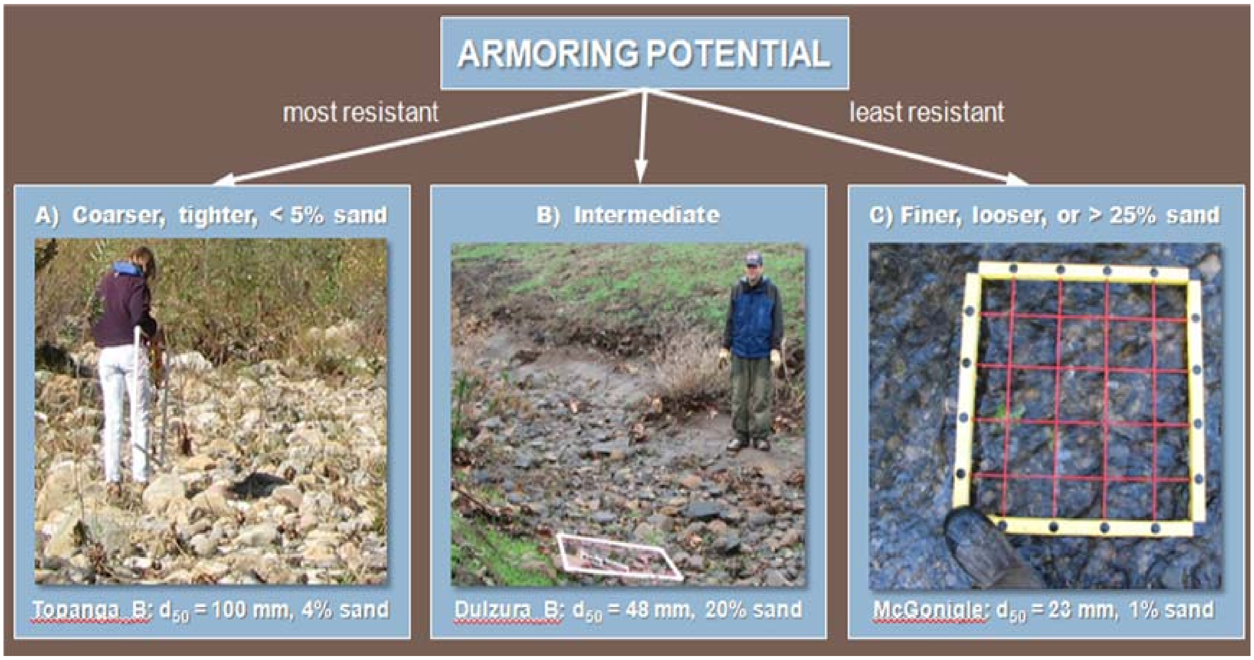
SCCWRP FIELD SCREENING DATA

Form 3 Support Materials

Form 3 Checklists 1 and 2, along with information recording in Form 3 Table 1, are intended to support the decisions pathways illustrated in Form 3 Overall Vertical Rating for Intermediate/Transitional Bed.

Form 3 Checklist 1: Armoring Potential

□	A	A mix of coarse gravels and cobbles that are tightly packed with <5% surface material of diameter <2 mm
X	B	Intermediate to A and C or hardpan of unknown resistance, spatial extent (longitudinal and depth), or unknown armoring potential due to surface veneer covering gravel or coarser layer encountered with probe
□	C	Gravels/cobbles that are loosely packed or >25% surface material of diameter <2 mm



Form 3 Figure 2. Armoring potential photographic supplement for assessing intermediate beds ($16 < d_{50} < 128$ mm) to be used i**n conjunction with Form 3 Checklist 1.**

(Sheet 2 of 4)

REACH 1A, 1B, AND 2 RESULTS

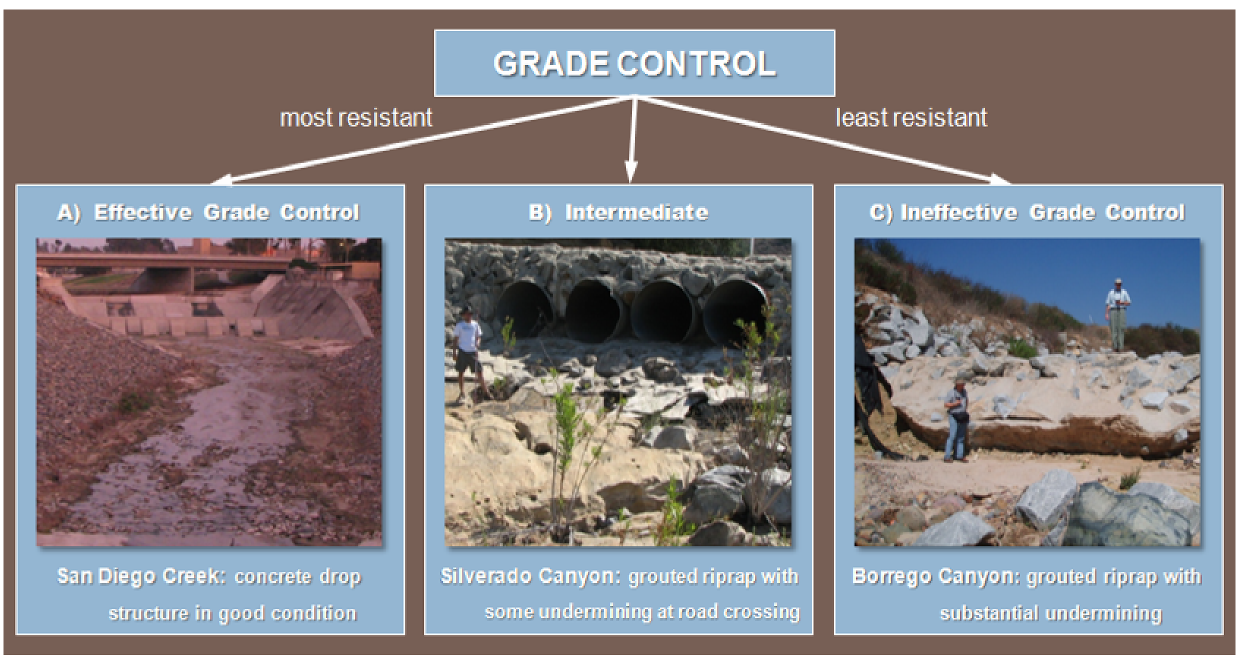
Form 3 Checklist 2: Grade Control

x A Grade control is present with spacing <50 m or $2/S_v$ m

- No evidence of failure/ineffectiveness, e.g., no headcutting (>30 cm), no active mass wasting (analyst cannot say grade control sufficient if mass-wasting checklist indicates presence of bank failure), no exposed bridge pilings, no culverts/structures undermined
- Hard points in serviceable condition at decadal time scale, e.g., no apparent undermining, flanking, failing grout
- If geologic grade control, rock should be resistant igneous and/or metamorphic; For sedimentary/hardpan to be classified as 'grade control', it should be of demonstrable strength as indicated by field testing such as hammer test/borings and/or inspected by appropriate stakeholder

□ B Intermediate to A and C – artificial or geologic grade control present but spaced 2/Sv m to 4/Sv m or potential evidence of failure or hardpan of uncertain resistance

□ C Grade control absent, spaced >100 m or $>4/S_v$ m, or clear evidence of ineffectiveness



Form 3 Figure 3. Grade-control (condition) photographic supplement for assessing intermediate beds ($16 < d_{50} < 128$ mm) to be used in conjunction with Form 3 Checklist 2.

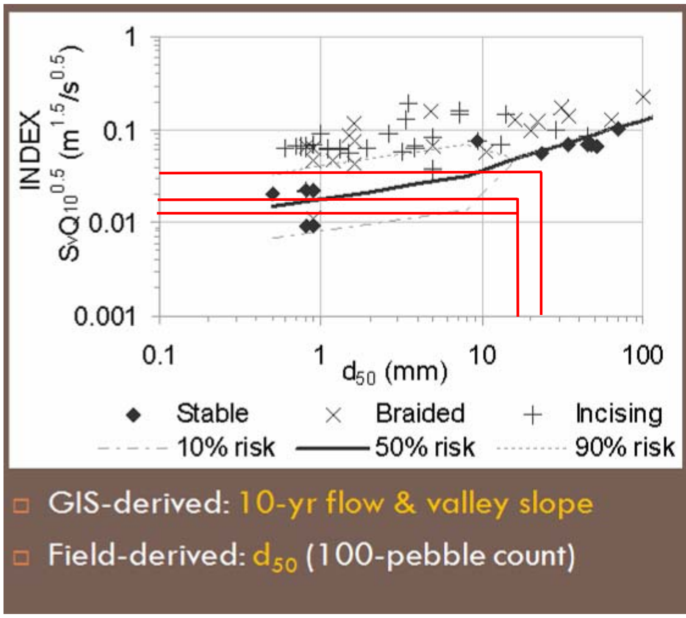
(Sheet 3 of 4)

REACH 1A, 1B, AND 2 RESULTS

Regionally-Calibrated Screening Index Threshold for Incising/Braiding

For transitional bed channels (d_{50} between 16 and 128 mm) or labile beds (channel not incised past critical bank height), use Form 3 Figure 3 to determine Screening Index Score and complete Form 3 Table 1.

See Appendix A for Reach 1A, 1B, and 2 INDEX values (0.0113, 0.0194, 0.0356)



Model Type	d_{50} (mm)	50% Risk $S_vQ_{10}^{0.5}$ ($m^{1.5}/s^{0.5}$)
Logistic Regression $d_{50} \geq 16$ mm	128	0.145
	96	0.125
	80	0.114
	64	0.101
	48	0.087
	32	0.070
	16	0.049
Logistic Reg. $d_{50} < 16$ mm	8	0.031
	4	0.026
	2	0.022
	1	0.018
	0.5	0.015

Form 3 Figure 4. Probability of incising/braiding based on logistic regression of Screening Index and d_{50} to be used in conjunction with Form 3 Table 1.

Form 3 Table 1. Values for Screening Index Threshold (probability of incising/braiding) to be used in conjunction with Form 3 Figure 4 (above) to complete Form 3 Overall Vertical Rating for Intermediate/Transitional Bed (below).. Screening Index Score: A = <50% probability of incision for current Q_{10}, valley slope, and d_{50}; B = Hardpan/d_{50} indeterminate; and C = ≥50% probability of incising/braiding for current Q_{10}, valley slope, and d_{50}.

d_{50} (mm) *From Form 2*	**$S_v*Q_{10}^{0.5}$ ($m^{1.5}/s^{0.5}$)** *From Form 1*	**$S_v*Q_{10}^{0.5}$ ($m^{1.5}/s^{0.5}$)** *50% risk of incising/braiding from table in Form 3 Figure 3 above*	**Screening Index Score (A, B, C)**

Overall Vertical Rating for Intermediate/Transitional Bed

Calculate the overall Vertical Rating for Transitional Bed channels using the formula below. Numeric values for responses to Form 3 Checklists and Table 1 as follows: A = 3, B = 6, C = 9.

$$Vertical\ Rating = \sqrt{\{(\sqrt{armoring * grade\ control}) * screening\ index\ score\}}$$

6 x 3 x 3 = 3.6

Vertical Susceptibility based on Vertical Rating: <4.5 = LOW; 4.5 to 7 = MEDIUM; and >7 = HIGH.

(Sheet 4 of 4)

REACH 1A, 1B, AND 2 RESULTS

PEBBLE COUNT

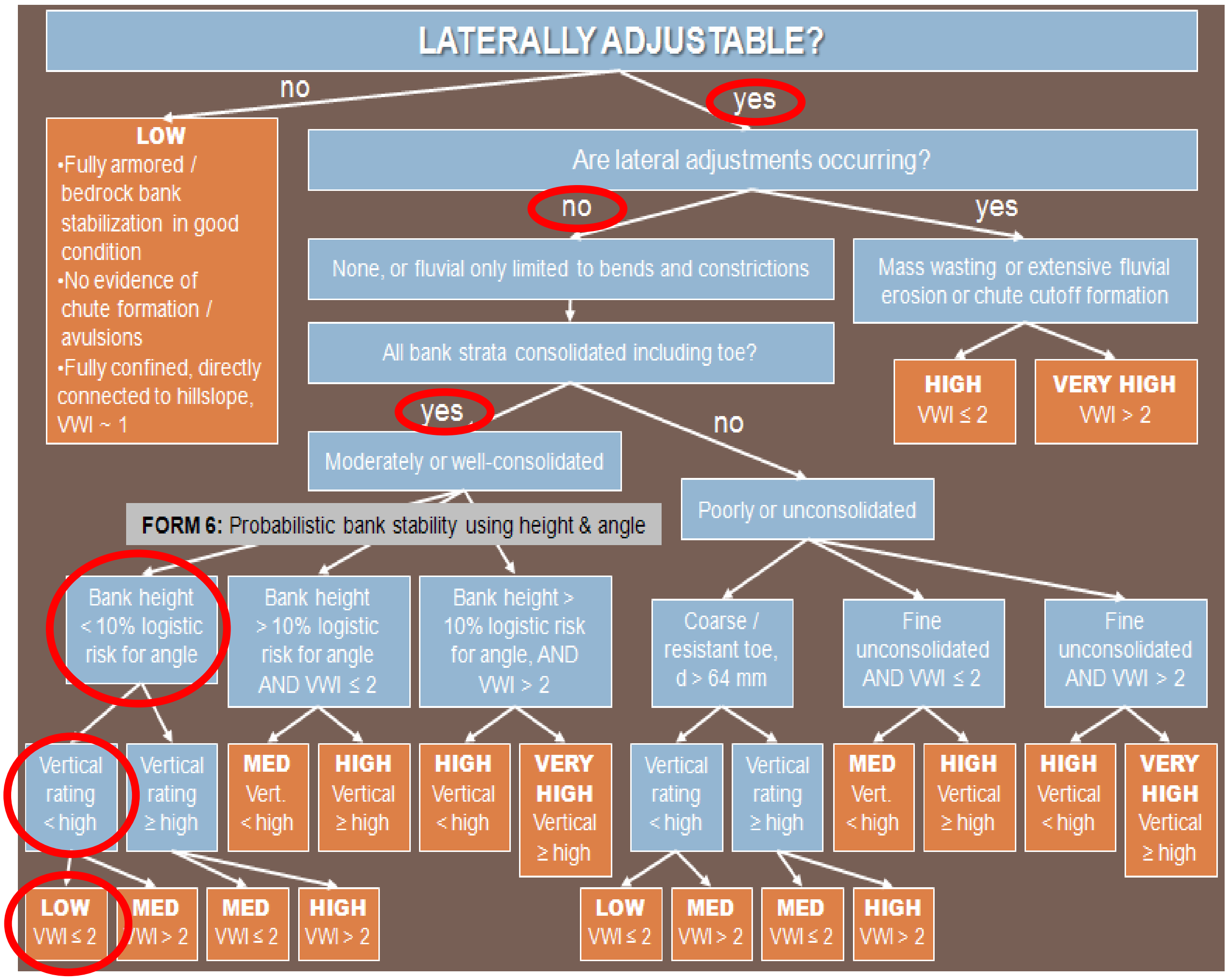
#	Reach 1A Diameter, mm	Reach 1B Diameter, mm	Reach 2 Diameter, mm
1	4	4	4
2	4	4	4
3	4	4	4
4	4	4	4
5	4	4	5.6
6	4	4	5.6
7	4	4	5.6
8	5.6	4	5.6
9	5.6	5.6	5.6
10	5.6	5.6	8
11	5.6	5.6	8
12	5.6	5.6	8
13	5.6	5.6	8
14	5.6	5.6	8
15	5.6	5.6	8
16	5.6	5.6	8
17	5.6	5.6	8
18	5.6	5.6	8
19	5.6	5.6	8
20	5.6	5.6	8
21	8	5.6	11
22	8	8	11
23	8	8	11
24	8	8	11
25	8	8	11
26	8	8	11
27	8	8	11
28	8	8	11
29	8	8	11
30	8	8	11
31	8	8	11
32	8	8	16
33	8	8	16
34	8	11	16
35	8	11	16
36	11	11	16
37	11	11	16
38	11	11	16
39	11	11	16
40	11	11	16
41	11	11	16
42	11	11	16
43	11	11	16
44	11	11	16
45	11	11	16

#	Reach 1A Diameter, mm	Reach 1B Diameter, mm	Reach 2 Diameter, mm	
46	11	11	22.6	
47	11	11	22.6	
48	11	16	22.6	
49	16	16	22.6	
50	16	16	22.6	D50
51	16	16	22.6	
52	16	16	22.6	
53	16	16	22.6	
54	16	16	22.6	
55	16	16	22.6	
56	16	16	22.6	
57	16	16	22.6	
58	16	16	22.6	
59	16	16	22.6	
60	16	16	22.6	
61	16	16	22.6	
62	16	16	22.6	
63	16	16	22.6	
64	16	16	22.6	
65	16	16	22.6	
66	16	16	22.6	
67	16	16	22.6	
68	16	16	22.6	
69	16	16	22.6	
70	16	16	22.6	
71	16	16	22.6	
72	16	16	32	
73	16	16	32	
74	16	22.6	32	
75	16	22.6	32	
76	22.6	22.6	32	
77	22.6	22.6	32	
78	22.6	22.6	32	
79	22.6	22.6	32	
80	22.6	22.6	32	
81	22.6	22.6	32	
82	22.6	22.6	32	
83	22.6	22.6	32	
84	22.6	22.6	45	
85	22.6	22.6	45	
86	22.6	22.6	45	
87	22.6	22.6	45	
88	22.6	22.6	45	
89	22.6	22.6	45	
90	22.6	22.6	45	
91	22.6	22.6	45	
92	22.6	22.6	45	

#	Reach 1A Diameter, mm	Reach 1B Diameter, mm	Reach 2 Diameter, mm
93	22.6	22.6	45
94	22.6	22.6	45
95	22.6	22.6	45
96	22.6	22.6	64
97	22.6	32	64
98	32	32	64
99	32	32	64
100	32	32	64

FORM 4: LATERAL SUSCEPTIBILTY FIELD SHEET

Circle appropriate nodes/pathway for proposed site
OR use sequence of questions provided in Form 5.



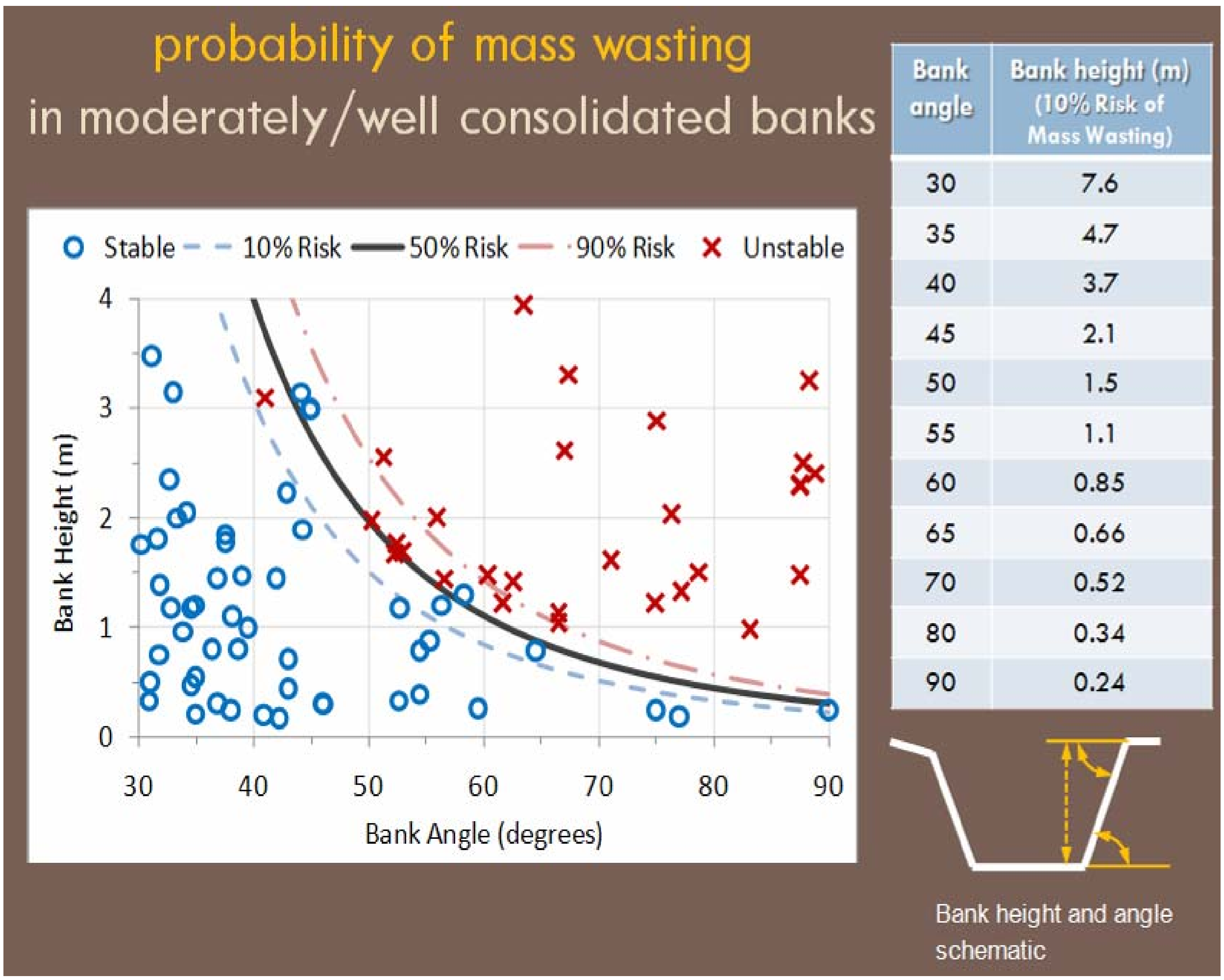
(Sheet 1 of 1)

REACH 1A, 1B, AND 2 RESULTS

FORM 6: PROBABILITY OF MASS WASTING BANK FAILURE

If mass wasting is not currently extensive and the banks are moderately- to well-consolidated, measure bank height and angle at several locations (i.e., at least three locations that capture the range of conditions present in the study reach) to estimate representative values for the reach. Use Form 6 Figure 1 below to determine if risk of bank failure is >10% and complete Form 6 Table 1. Support your results with photographs that include a protractor/rod/tape/person for scale.

	Bank Angle (degrees) *(from Field)*	**Bank Height (m)** *(from Field)*	**Corresponding Bank Height for 10% Risk of Mass Wasting (m)** *(from Form 6 Figure 1 below)*	**Bank Failure Risk** *(<10% Risk)* *(>10% Risk)*
Left Bank	<30	---	---	<10%
Right Bank	<30	---	---	<10%



Bank angle	Bank height (m) (10% Risk of Mass Wasting)
30	7.6
35	4.7
40	3.7
45	2.1
50	1.5
55	1.1
60	0.85
65	0.66
70	0.52
80	0.34
90	0.24

Form 6 Figure 1. Probability Mass Wasting diagram, Bank Angle:Height/% Risk table, and Band Height:Angle schematic.

Result View

CRITICAL STRESS CALCULATOR RESULTS FOR REACH 1A

Define Drainage Basins

Basin: **Unnamed Tributary**

Project: **Hawano Subdivision**

Start | Project | Basin | POC | Export

Manage Your Point of Compliance (POC)

Analyze the receiving water at the 'Point of Compliance' by completing this form. Click Edit and enter the appropriate fields, then click the Update button to calculate the critical flow and low-flow threshold condition. Finally, click Save to commit the changes.

Channel Susceptibility:	LOW
Low Flow Threshold:	0.5Q2

Cancel | Save | Update

Channel Assessed:	Yes	**Vertical Susceptibility:**	Low (Vertical)
Watershed Area (ac):	483.99	**Lateral Susceptibility:**	Low (Lateral)

Material:	Vegetation
Roughness:	0.100
Channel Top Width (ft):	54.0
Channel Bottom Width (ft):	48.0
Channel Height (ft):	0.5
Channel Slope:	0.0070

Large View

uKnow San Diego BMP Sizing Calculator (v3.0)

Home Contacts Legal Logout

Find

Map data provided by OpenStreetMap

Map Details

Result View

CRITICAL STRESS CALCULATOR RESULTS FOR REACH 1B

Define Drainage Basins

Basin: **Unnamed Tributary** Project: **Hawano Subdivision**

Start | Project | Basin | POC | Export

Manage Your Point of Compliance (POC)

Analyze the receiving water at the 'Point of Compliance' by completing this form. Click Edit and enter the appropriate fields, then click the Update button to calculate the critical flow and low-flow threshold condition. Finally, click Save to commit the changes.

Channel Susceptibility: LOW

Low Flow Threshold: 0.5Q2

Cancel Save Update

Channel Assessed: Yes

Watershed Area (ac): 483.99

Vertical Susceptibility: Low (Vertical)

Lateral Susceptibility: Low (Lateral)

Material: Vegetation

Roughness: 0.100

Channel Top Width (ft): 54.0

Channel Bottom Width (ft): 48.0

Channel Height (ft): 0.5

Channel Slope: 0.0121

Large View

uKnow San Diego BMP Sizing Calculator (v3.0)

Home Contacts Legal Logout

Find

Map data provided by OpenStreetMap

Map **Details**

Result View

CRITICAL STRESS CALCULATOR RESULTS FOR REACH 2

Define Drainage Basins

Basin: **Unnamed Tributary**

Project: **Hawano Subdivision**

Start | Project | Basin | POC | Export

Manage Your Point of Compliance (POC)

Analyze the receiving water at the 'Point of Compliance' by completing this form. Click Edit and enter the appropriate fields, then click the Update button to calculate the critical flow and low-flow threshold condition. Finally, click Save to commit the changes.

Cancel Save Update

Channel Susceptibility: LOW

Low Flow Threshold: 0.5Q2

Channel Assessed: Yes

Watershed Area (ac): 494.83

Vertical Susceptibility: Low (Vertical)

Lateral Susceptibility: Low (Lateral)

Material: Vegetation

Roughness: 0.100

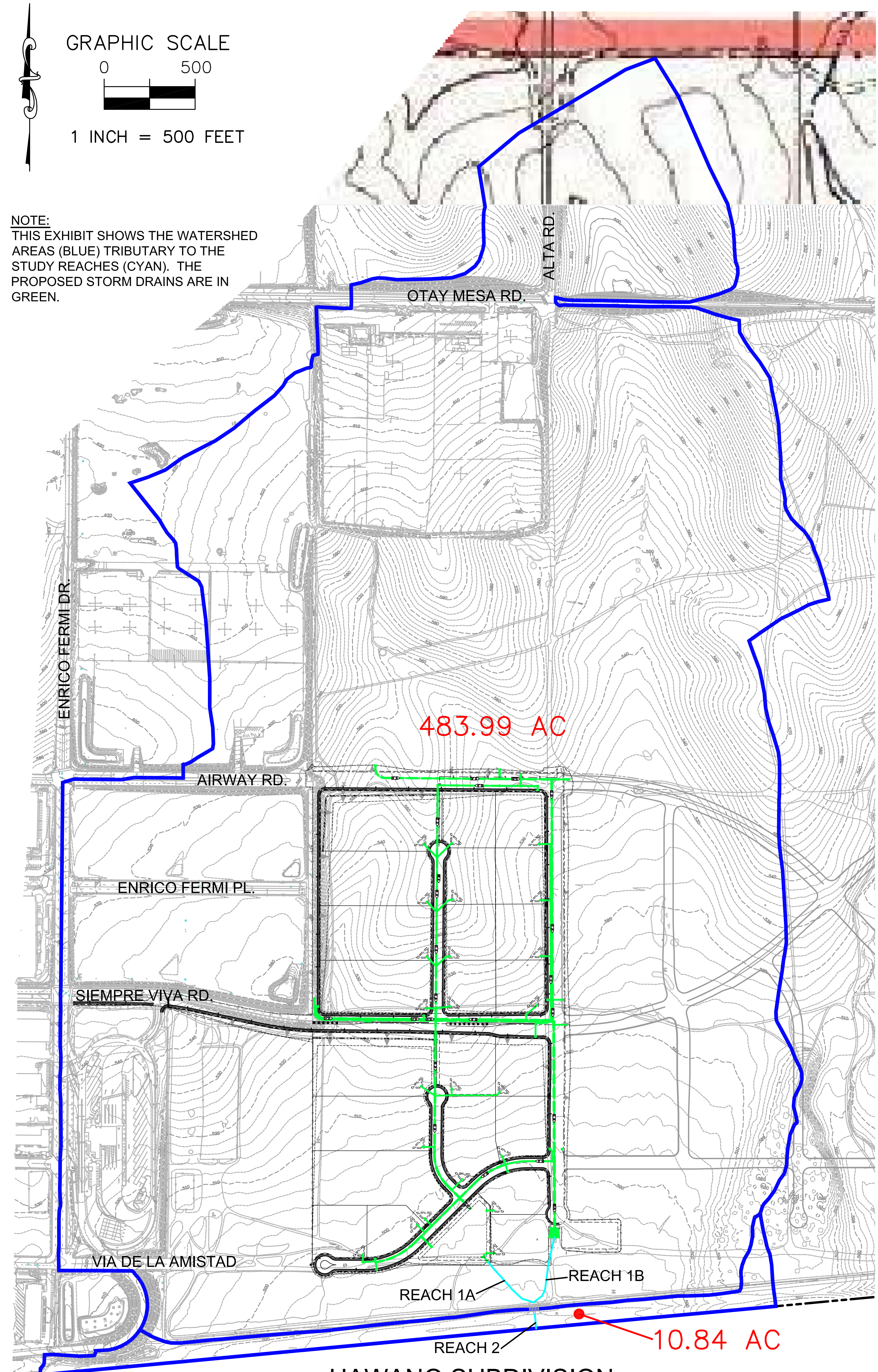
Channel Top Width (ft): 54.0

Channel Bottom Width (ft): 48.0

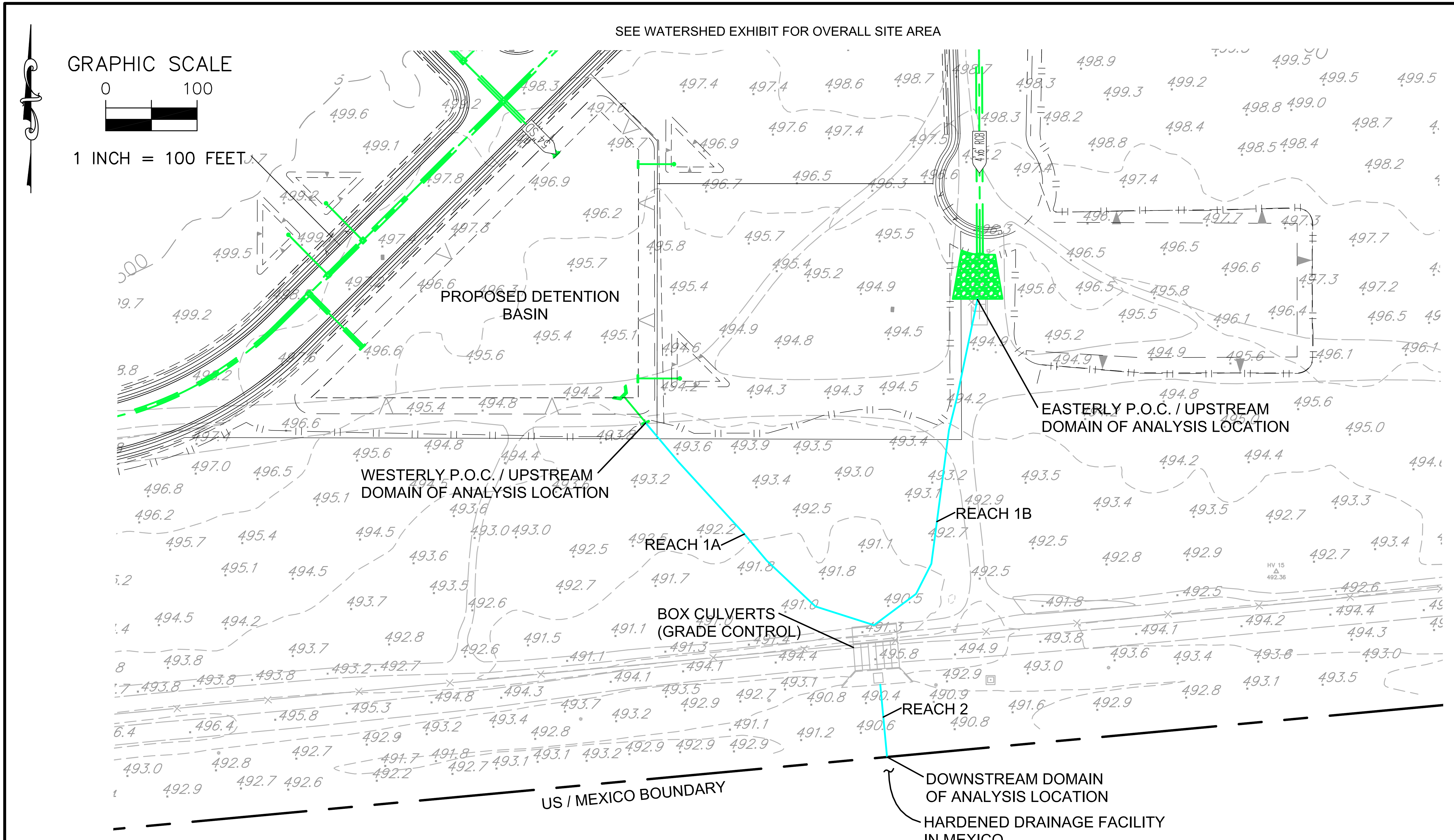
Channel Height (ft): 0.5

Channel Slope: 0.0220

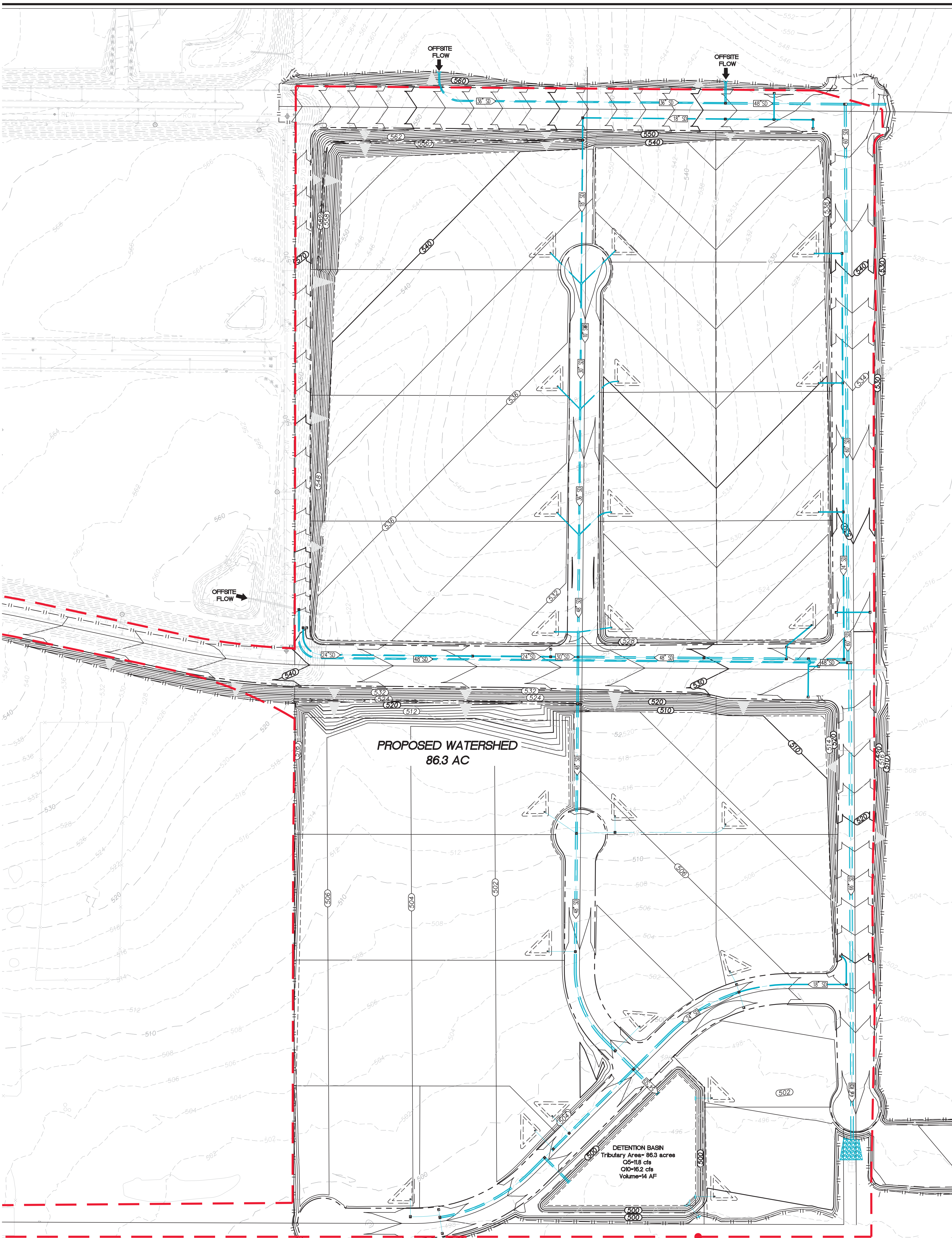
Large View



HAWANO SUBDIVISION
WATERSHED EXHIBIT



HAWANO SUBDIVISION
STUDY AREA EXHIBIT



LEGEND

- DRAINAGE BASIN BOUNDARY
- EXISTING CONTOUR
- PROPERTY LINE
- STORM DRAIN
- GRADING LIMIT

OFFSITE FLOW

NORTH

GRAPHIC SCALE

100 0 50 100 200

1 INCH = 100FEET

Kimley-Horn and Associates, Inc.

SITE PLAN

December 2011

HAWANO SUBDIVISION

PROPOSED HYDROMODIFICATION EXHIBIT

Kimley-Horn
and Associates, Inc.

Appendix B ~ SDHM Output

SDHM2011
PROJECT REPORT

Project Name: Hawano0.5Q2
Site Name :
Site Address:
City :
Report Date : 4/9/2012
Gage :
Data Start : 10/01/1959
Data End : 09/30/2004
(adjusted) **Precip Scale:** 1.00
Version : 2011/06/22

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
D,Grass,FLAT(0-5%)	15.5
D,Dirt, Flat(0-5%)	62.2

Impervious Land Use	Acres
IMPERVIOUS	8.6

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Roads
Bypass: No

GroundWater: No

Pervious Land Use	Acres
D,Grass,FLAT(0-5%)	2.9

Impervious Land Use	Acres
IMPERVIOUS	16.15

Element Flows To:

Surface	Interflow	Groundwater

Trapezoidal Pond 1 Trapezoidal Pond 1

Name : Industrial Pads
Bypass: No

GroundWater: No

Pervious Land Use	Acres
D,Grass,FLAT(0-5%)	**20.18**

Impervious Land Use	Acres
IMPERVIOUS	**47.07**

Element Flows To:

Surface	Interflow	Groundwater
Trapezoidal Pond 1	Trapezoidal Pond 1	

Name : Trapezoidal Pond 1
Bottom Length: 252.90 ft.
Bottom Width: 252.90 ft.
Depth : 9 ft.
Volume at riser head : 13.4819 acre-ft.
Side slope 1: 2 To 1
Side slope 2: 2 To 1
Side slope 3: 2 To 1
Side slope 4: 2 To 1
Discharge Structure
Riser Height: 8 ft.
Riser Diameter: 48 in.
Notch Type : Rectangular
Notch Width : 0.660 ft.
Notch Height: 1.796 ft.
Orifice 1 Diameter: 5.591 in. **Elevation:** 0 ft.

Element Flows To:
Outlet 1 **Outlet 2**

Pond Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
0.0000	1.468	0.000	0.000	0.000
0.1000	1.472	0.147	0.259	0.000
0.2000	1.477	0.294	0.367	0.000
0.3000	1.482	0.442	0.449	0.000
0.4000	1.486	0.591	0.519	0.000
0.5000	1.491	0.740	0.580	0.000
0.6000	1.496	0.889	0.635	0.000

0.7000	1.501	1.039	0.686	0.000
0.8000	1.505	1.189	0.734	0.000
0.9000	1.510	1.340	0.778	0.000
1.0000	1.515	1.491	0.821	0.000
1.1000	1.519	1.643	0.861	0.000
1.2000	1.524	1.795	0.899	0.000
1.3000	1.529	1.948	0.936	0.000
1.4000	1.534	2.101	0.971	0.000
1.5000	1.538	2.255	1.005	0.000
1.6000	1.543	2.409	1.038	0.000
1.7000	1.548	2.563	1.070	0.000
1.8000	1.553	2.718	1.101	0.000
1.9000	1.557	2.874	1.131	0.000
2.0000	1.562	3.030	1.161	0.000
2.1000	1.567	3.187	1.189	0.000
2.2000	1.572	3.344	1.217	0.000
2.3000	1.577	3.501	1.245	0.000
2.4000	1.581	3.659	1.271	0.000
2.5000	1.586	3.817	1.298	0.000
2.6000	1.591	3.976	1.323	0.000
2.7000	1.596	4.136	1.349	0.000
2.8000	1.601	4.296	1.373	0.000
2.9000	1.606	4.456	1.398	0.000
3.0000	1.610	4.617	1.422	0.000
3.1000	1.615	4.778	1.445	0.000
3.2000	1.620	4.940	1.468	0.000
3.3000	1.625	5.102	1.491	0.000
3.4000	1.630	5.265	1.513	0.000
3.5000	1.635	5.428	1.535	0.000
3.6000	1.640	5.592	1.557	0.000
3.7000	1.645	5.756	1.579	0.000
3.8000	1.650	5.921	1.600	0.000
3.9000	1.655	6.086	1.621	0.000
4.0000	1.660	6.252	1.642	0.000
4.1000	1.664	6.418	1.662	0.000
4.2000	1.669	6.585	1.682	0.000
4.3000	1.674	6.752	1.702	0.000
4.4000	1.679	6.920	1.722	0.000
4.5000	1.684	7.088	1.741	0.000
4.6000	1.689	7.257	1.760	0.000
4.7000	1.694	7.426	1.779	0.000
4.8000	1.699	7.596	1.798	0.000
4.9000	1.704	7.766	1.817	0.000
5.0000	1.709	7.937	1.835	0.000
5.1000	1.714	8.108	1.854	0.000
5.2000	1.719	8.280	1.872	0.000
5.3000	1.724	8.452	1.890	0.000
5.4000	1.729	8.625	1.907	0.000
5.5000	1.734	8.798	1.925	0.000
5.6000	1.739	8.972	1.942	0.000
5.7000	1.745	9.146	1.960	0.000
5.8000	1.750	9.321	1.977	0.000
5.9000	1.755	9.496	1.994	0.000
6.0000	1.760	9.672	2.011	0.000
6.1000	1.765	9.848	2.027	0.000
6.2000	1.770	10.02	2.044	0.000
6.3000	1.775	10.20	2.124	0.000

6.4000	1.780	10.38	2.259	0.000
6.5000	1.785	10.55	2.425	0.000
6.6000	1.790	10.73	2.613	0.000
6.7000	1.796	10.91	2.816	0.000
6.8000	1.801	11.09	3.031	0.000
6.9000	1.806	11.27	3.254	0.000
7.0000	1.811	11.45	3.484	0.000
7.1000	1.816	11.63	3.717	0.000
7.2000	1.821	11.82	3.952	0.000
7.3000	1.826	12.00	4.235	0.000
7.4000	1.832	12.18	4.532	0.000
7.5000	1.837	12.37	4.841	0.000
7.6000	1.842	12.55	5.162	0.000
7.7000	1.847	12.73	6.387	0.000
7.8000	1.852	12.92	6.821	0.000
7.9000	1.858	13.10	7.268	0.000
8.0000	1.863	13.29	7.728	0.000
8.1000	1.868	13.48	8.974	0.000
8.2000	1.873	13.66	11.24	0.000
8.3000	1.879	13.85	14.17	0.000
8.4000	1.884	14.04	17.64	0.000
8.5000	1.889	14.23	21.57	0.000
8.6000	1.894	14.42	25.91	0.000
8.7000	1.900	14.61	30.64	0.000
8.8000	1.905	14.80	35.71	0.000
8.9000	1.910	14.99	41.11	0.000
9.0000	1.916	15.18	46.82	0.000
9.1000	1.921	15.37	52.82	0.000

ANALYSIS RESULTS

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	4.089994
5 year	5.745265
10 year	8.319091
25 year	28.770118

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	1.819683
5 year	2.154473
10 year	3.832778
25 year	5.541812

POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs) Predev Mit Percentage Pass/Fail

2.0450	218	188	86	Pass
2.1084	210	172	81	Pass
2.1717	199	162	81	Pass
2.2351	195	154	78	Pass
2.2985	180	145	80	Pass
2.3619	152	137	90	Pass
2.4252	140	129	92	Pass
2.4886	130	118	90	Pass
2.5520	124	112	90	Pass
2.6154	116	109	93	Pass
2.6787	110	99	90	Pass
2.7421	104	95	91	Pass
2.8055	101	92	91	Pass
2.8689	94	87	92	Pass
2.9322	89	76	85	Pass
2.9956	85	73	85	Pass
3.0590	79	71	89	Pass
3.1224	76	66	86	Pass
3.1857	68	61	89	Pass
3.2491	66	56	84	Pass
3.3125	60	56	93	Pass
3.3759	55	55	100	Pass
3.4392	54	48	88	Pass
3.5026	53	44	83	Pass
3.5660	52	42	80	Pass
3.6294	51	41	80	Pass
3.6927	49	39	79	Pass
3.7561	49	36	73	Pass
3.8195	47	32	68	Pass
3.8829	47	31	65	Pass
3.9462	45	29	64	Pass
4.0096	41	28	68	Pass
4.0730	40	26	65	Pass
4.1364	39	26	66	Pass
4.1997	37	24	64	Pass
4.2631	34	21	61	Pass
4.3265	34	19	55	Pass
4.3899	32	19	59	Pass
4.4532	32	18	56	Pass
4.5166	31	17	54	Pass
4.5800	30	17	56	Pass
4.6434	30	17	56	Pass
4.7067	30	17	56	Pass
4.7701	29	16	55	Pass
4.8335	28	14	50	Pass
4.8969	26	13	50	Pass
4.9602	25	13	52	Pass
5.0236	25	12	48	Pass
5.0870	25	11	44	Pass
5.1504	24	11	45	Pass
5.2137	23	11	47	Pass
5.2771	23	10	43	Pass
5.3405	23	10	43	Pass
5.4039	23	10	43	Pass
5.4672	23	10	43	Pass
5.5306	23	10	43	Pass
5.5940	22	9	40	Pass

5.6574	20	9	45	Pass
5.7207	20	9	45	Pass
5.7841	20	8	40	Pass
5.8475	19	8	42	Pass
5.9109	19	8	42	Pass
5.9742	19	8	42	Pass
6.0376	19	7	36	Pass
6.1010	18	7	38	Pass
6.1644	18	7	38	Pass
6.2277	17	7	41	Pass
6.2911	17	7	41	Pass
6.3545	17	7	41	Pass
6.4179	17	7	41	Pass
6.4812	17	6	35	Pass
6.5446	17	6	35	Pass
6.6080	17	6	35	Pass
6.6713	17	6	35	Pass
6.7347	16	5	31	Pass
6.7981	15	5	33	Pass
6.8615	15	5	33	Pass
6.9248	15	5	33	Pass
6.9882	15	5	33	Pass
7.0516	15	5	33	Pass
7.1150	13	5	38	Pass
7.1783	12	4	33	Pass
7.2417	12	4	33	Pass
7.3051	12	4	33	Pass
7.3685	12	4	33	Pass
7.4318	12	4	33	Pass
7.4952	12	4	33	Pass
7.5586	12	4	33	Pass
7.6220	12	4	33	Pass
7.6853	12	4	33	Pass
7.7487	12	4	33	Pass
7.8121	12	4	33	Pass
7.8755	12	4	33	Pass
7.9388	12	4	33	Pass
8.0022	12	4	33	Pass
8.0656	11	4	36	Pass
8.1290	11	4	36	Pass
8.1923	11	4	36	Pass
8.2557	11	4	36	Pass
8.3191	11	4	36	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 **acre-feet**
On-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**
Off-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

Perlnd and Implnd Changes
No changes have been made.

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1959 10 01        END    2004 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File
Name------------------------------>***
<-ID->
***
WDM        26   Hawano0.5Q2.wdm
MESSU      25   PreHawano0.5Q2.MES
           27   PreHawano0.5Q2.L61
           28   PreHawano0.5Q2.L62
           30   POCHawano0.5Q21.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:60
      PERLND      28
      PERLND      31
      IMPLND       1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR
DIG2 FIL2 YRND
    1        Basin  1                   MAX                    1
2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
```

```
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   28      D,Grass,FLAT(0-5%)     1    1    1    1   27    0
   31      D,Dirt, Flat(0-5%)     1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections
*****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS
TRAC ***
   28         0    0    1    0    0    0    0    0    0    0    0
0
   31         0    0    1    0    0    0    0    0    0    0    0
0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags
***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS
TRAC  *********
   28         0    0    4    0    0    0    0    0    0    0    0
0    1    9
   31         0    0    4    0    0    0    0    0    0    0    0
0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT
***
   28         0    1    1    1    0    0    0    0    1    1    0
   31         0    1    1    1    0    0    0    0    1    1    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR
KVARY     AGWRC
   28              0       4.8      0.04       200      0.05
3      0.92
   31              0       4.8     0.045       400      0.05
2      0.95
  END PWAT-PARM2

  PWAT-PARM3
```

```
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR
BASETP    AGWETP
   28             35        30         2         2       0.4
0.05      0.05
   31             35        30         2         2       0.4
0.05      0.05
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4
***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC
LZETP ***
   28           0.08       0.6       0.2       1.5       0.7
0.5
   31              0       0.8       0.2         2       0.7
0
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV
DEC  ***
   28       0.4  0.4  0.4  0.4  0.6  0.6  0.6  0.6  0.6  0.4  0.4
0.4
   31       0.4  0.4  0.4  0.4  0.6  0.6  0.6  0.6  0.6  0.4  0.4
0.4
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV
DEC  ***
   28       0.1  0.1  0.1  0.1 0.06 0.06 0.06 0.06 0.06  0.1  0.1
0.1
   31       0.1  0.1  0.1  0.1 0.06 0.06 0.06 0.06 0.06  0.1  0.1
0.1
  END MON-INTERCEP

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21
***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS
AGWS      GWVS
   28              0         0      0.15         0         4
0.05         0
   31              0         0      0.01         0       0.5
0.3     0.01
  END PWAT-STATE1

END PERLND

IMPLND
```

```
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
    1      IMPERVIOUS             1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections
*****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    6    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    1
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            100     0.035      0.05       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                 <--Area-->     <-Target->   MBLK
***
<Name>   #                 <-factor->     <Name>   #   Tbl#
***
```

```
Basin  1***
PERLND  28                        15.5     COPY   501      12
PERLND  28                        15.5     COPY   501      13
PERLND  31                        62.2     COPY   501      12
PERLND  31                        62.2     COPY   501      13
IMPLND   1                         8.6     COPY   501      15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp>
<-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #
<Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   12.1        DISPLY   1     INPUT
TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp>
<-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #
<Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer
***
    # -  #<------------------><---> User T-series  Engl Metr LKFG
***
                                            in  out
***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections
*****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL
PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL
PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section
```

```
***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each
FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit
possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *
***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS
DB50      ***
  <------><--------><--------><--------><--------><-------->
<-------->      ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section
***
    # -  # ***   VOL     Initial  value  of COLIND     Initial
value  of OUTDGT
          *** ac-ft     for each possible exit        for each
possible exit
  <------><-------->     <---><---><---><---><---> *** <---><--->
<---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp>
<-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #
<Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL
PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL
PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL
PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL
PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member>
Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>
```

```
tem strg strg***
COPY   501 OUTPUT MEAN   1 1     12.1      WDM    501 FLOW
ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>      <-Grp>
<-Member->***
<Name>            <Name> # #<-factor->     <Name>
<Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY          INPUT
MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY          INPUT
MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY          INPUT
MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

```
RUN

GLOBAL
   durations run for poc
  START       1959 10 01        END    2004 09 30
  RUN INTERP OUTPUT LEVEL    3
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File
Name------------------------------->***
<-ID->
***
WDM        26   Hawano0.5Q2.wdm
MESSU      25   DURHAWANO0.5Q2.MES
           30   DURpreHawano0.5Q21.DAT
           31   DURpreHawano0.5Q22.DAT
           32   DURpreHawano0.5Q23.DAT
           33   DURpreHawano0.5Q24.DAT
           34   DURpreHawano0.5Q25.DAT
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:60
      DURANL       1
      DURANL       2
      DURANL       3
      DURANL       4
      DURANL       5
    END INGRP
END OPN SEQUENCE

DURANL
  GEN-DURDATA
    # -  #<----------------Title-----------------> NDUR NLEV PRFG
PUNT ***
    1     DURANL OF FLOW D1                          1   20    1
30
    2     DURANL OF FLOW D2                          1   20    1
31
    3     DURANL OF FLOW D3                          1   20    1
32
    4     DURANL OF FLOW D4                          1   20    1
33
    5     DURANL OF FLOW D5                          1   20    1
34
  END GEN-DURDATA

  DURATIONS
    # -  #   D1  D2 ***
    1    5    1
```

```
  END DURATIONS

  LEVELS
    # -  #***1    2    3    4    5    6    7    8    9   10   11
12   13   14
    1
2.0442.1082.1712.2352.2982.3612.4252.4882.5512.6152.6782.7422.805
2.868
    1     2.9322.9953.0583.1223.1853.249
    2
3.3123.3753.4393.5023.5653.6293.6923.7563.8193.8823.9464.0094.072
4.136
    2     4.1994.2634.3264.3894.4534.516
    3
4.5794.6434.7064.7704.8334.8964.9605.0235.0865.1505.2135.2775.340
5.403
    3     5.4675.5305.5935.6575.7205.784
    4
5.8475.9105.9746.0376.1006.1646.2276.2916.3546.4176.4816.5446.607
6.671
    4     6.7346.7986.8616.9246.9887.051
    5
7.1147.1787.2417.3057.3687.4317.4957.5587.6217.6857.7487.8127.875
7.938
    5     8.0028.0658.1288.1928.2558.319
  END LEVELS
END DURANL
EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp>
<-Member->  ***
<Name>   # <Name>   tem strg<-factor->strg <Name>   #   #
<Name> # #  ***

WDM    501 FLOW     ENGL    1              DURANL   1     INPUT
TIMSER
WDM    501 FLOW     ENGL    1              DURANL   2     INPUT
TIMSER
WDM    501 FLOW     ENGL    1              DURANL   3     INPUT
TIMSER
WDM    501 FLOW     ENGL    1              DURANL   4     INPUT
TIMSER
WDM    501 FLOW     ENGL    1              DURANL   5     INPUT
TIMSER
END EXT SOURCES
END RUN
```

1

Duration analysis operation no. 1

DURANL OF FLOW D1

Start date: 1959/ 9/30 24: 0 End date: 2004/ 9/30 24: 0

Analysis season starts: 12/31 24: 0 Ends: 12/31 24: 0
1

FRACTION OF TIME EACH LEVEL EQUALED OR EXCEEDED WITH DURATION >= THE SPECIFIED DURATIONS
FRACTION IS RELATIVE TO TOTAL TIME SPAN

EVENTS GREATER THAN

LEVELS	DURATIONS 1
2.044	0.5526E-03
2.108	0.5323E-03
2.171	0.5045E-03
2.235	0.4943E-03
2.298	0.4563E-03
2.361	0.3853E-03
2.425	0.3549E-03
2.488	0.3295E-03
2.551	0.3143E-03
2.615	0.2941E-03
2.678	0.2788E-03
2.742	0.2636E-03
2.805	0.2560E-03
2.868	0.2383E-03
2.932	0.2256E-03
2.995	0.2155E-03
3.058	0.2003E-03
3.122	0.1927E-03
3.185	0.1724E-03
3.249	0.1673E-03

EVENTS LESS THAN

LEVELS	DURATIONS 1
2.044	0.9994
2.108	0.9995
2.171	0.9995
2.235	0.9995
2.298	0.9995
2.361	0.9996
2.425	0.9996
2.488	0.9997
2.551	0.9997
2.615	0.9997
2.678	0.9997

2.742	0.9997
2.805	0.9997
2.868	0.9998
2.932	0.9998
2.995	0.9998
3.058	0.9998
3.122	0.9998
3.185	0.9998
3.249	0.9998

UNDEFINED EVENTS (NO WATER)

DURATIONS
1
0.000
1

SUMMARY

TOTAL LENGTH OF DEFINED EVENTS: 394488. INTERVALS

TOTAL LENGTH OF UNDEFINED EVENTS: 0. INTERVALS

TOTAL LENGTH OF ANALYSIS: 16437.00 DAYS

SAMPLE SIZE: 394488

SAMPLE MAXIMUM: 37.35

SAMPLE MINIMUM: 0.000

SAMPLE MEAN: 0.1049E-01

SAMPLE STANDARD DEVIATION: 0.1508

1

Duration analysis operation no. 2

DURANL OF FLOW D2

Start date: 1959/ 9/30 24: 0 End date: 2004/ 9/30 24: 0

Analysis season starts: 12/31 24: 0 Ends: 12/31 24: 0
1

FRACTION OF TIME EACH LEVEL EQUALED OR EXCEEDED WITH DURATION >= THE SPECIFIED DURATIONS
FRACTION IS RELATIVE TO TOTAL TIME SPAN

EVENTS GREATER THAN

LEVELS	DURATIONS 1
3.312	0.1521E-03
3.375	0.1394E-03
3.439	0.1369E-03
3.502	0.1344E-03
3.565	0.1318E-03
3.629	0.1293E-03
3.692	0.1242E-03
3.756	0.1242E-03
3.819	0.1191E-03
3.882	0.1191E-03
3.946	0.1141E-03
4.009	0.1039E-03
4.072	0.1014E-03
4.136	0.9886E-04
4.199	0.9379E-04
4.263	0.8619E-04
4.326	0.8619E-04
4.389	0.8112E-04
4.453	0.8112E-04
4.516	0.7858E-04

EVENTS LESS THAN

LEVELS	DURATIONS 1
3.312	0.9998
3.375	0.9999
3.439	0.9999
3.502	0.9999
3.565	0.9999
3.629	0.9999
3.692	0.9999
3.756	0.9999
3.819	0.9999
3.882	0.9999
3.946	0.9999

4.009	0.9999
4.072	0.9999
4.136	0.9999
4.199	0.9999
4.263	0.9999
4.326	0.9999
4.389	0.9999
4.453	0.9999
4.516	0.9999

UNDEFINED EVENTS (NO WATER)

DURATIONS
1
0.000
1

SUMMARY

TOTAL LENGTH OF DEFINED EVENTS: 394488. INTERVALS

TOTAL LENGTH OF UNDEFINED EVENTS: 0. INTERVALS

TOTAL LENGTH OF ANALYSIS: 16437.00 DAYS

SAMPLE SIZE: 394488

SAMPLE MAXIMUM: 37.35

SAMPLE MINIMUM: 0.000

SAMPLE MEAN: 0.1049E-01

SAMPLE STANDARD DEVIATION: 0.1508

1

Duration analysis operation no. 3

DURANL OF FLOW D3

Start date: 1959/ 9/30 24: 0 End date: 2004/ 9/30 24: 0

Analysis season starts: 12/31 24: 0 Ends: 12/31 24: 0
1

FRACTION OF TIME EACH LEVEL EQUALED OR EXCEEDED WITH DURATION >= THE SPECIFIED DURATIONS
FRACTION IS RELATIVE TO TOTAL TIME SPAN

EVENTS GREATER THAN

LEVELS	DURATIONS 1
4.579	0.7605E-04
4.643	0.7605E-04
4.706	0.7605E-04
4.770	0.7351E-04
4.833	0.7098E-04
4.896	0.6591E-04
4.960	0.6337E-04
5.023	0.6337E-04
5.086	0.6337E-04
5.150	0.6084E-04
5.213	0.5830E-04
5.277	0.5830E-04
5.340	0.5830E-04
5.403	0.5830E-04
5.467	0.5830E-04
5.530	0.5830E-04
5.593	0.5577E-04
5.657	0.5070E-04
5.720	0.5070E-04
5.784	0.5070E-04

EVENTS LESS THAN

LEVELS	DURATIONS 1
4.579	0.9999
4.643	0.9999
4.706	0.9999
4.770	0.9999
4.833	0.9999
4.896	0.9999
4.960	0.9999
5.023	0.9999
5.086	0.9999
5.150	0.9999
5.213	0.9999

5.277	0.9999
5.340	0.9999
5.403	0.9999
5.467	0.9999
5.530	0.9999
5.593	0.9999
5.657	0.9999
5.720	0.9999
5.784	0.9999

UNDEFINED EVENTS (NO WATER)

DURATIONS
1
0.000
1

SUMMARY

TOTAL LENGTH OF DEFINED EVENTS: 394488. INTERVALS

TOTAL LENGTH OF UNDEFINED EVENTS: 0. INTERVALS

TOTAL LENGTH OF ANALYSIS: 16437.00 DAYS

SAMPLE SIZE: 394488

SAMPLE MAXIMUM: 37.35

SAMPLE MINIMUM: 0.000

SAMPLE MEAN: 0.1049E-01

SAMPLE STANDARD DEVIATION: 0.1508

1

Duration analysis operation no. 4

DURANL OF FLOW D4

Start date: 1959/ 9/30 24: 0 End date: 2004/ 9/30 24: 0

Analysis season starts: 12/31 24: 0 Ends: 12/31 24: 0
1

FRACTION OF TIME EACH LEVEL EQUALED OR EXCEEDED WITH DURATION >= THE SPECIFIED DURATIONS
FRACTION IS RELATIVE TO TOTAL TIME SPAN

EVENTS GREATER THAN

LEVELS	DURATIONS 1
5.847	0.4816E-04
5.910	0.4816E-04
5.974	0.4816E-04
6.037	0.4816E-04
6.100	0.4563E-04
6.164	0.4563E-04
6.227	0.4309E-04
6.291	0.4309E-04
6.354	0.4309E-04
6.417	0.4309E-04
6.481	0.4309E-04
6.544	0.4309E-04
6.607	0.4309E-04
6.671	0.4309E-04
6.734	0.4056E-04
6.798	0.3802E-04
6.861	0.3802E-04
6.924	0.3802E-04
6.988	0.3802E-04
7.051	0.3802E-04

EVENTS LESS THAN

LEVELS	DURATIONS 1
5.847	1.000
5.910	1.000
5.974	1.000
6.037	1.000
6.100	1.000
6.164	1.000
6.227	1.000
6.291	1.000
6.354	1.000
6.417	1.000
6.481	1.000

6.544	1.000
6.607	1.000
6.671	1.000
6.734	1.000
6.798	1.000
6.861	1.000
6.924	1.000
6.988	1.000
7.051	1.000

UNDEFINED EVENTS (NO WATER)

DURATIONS
1
0.000
1

SUMMARY

TOTAL LENGTH OF DEFINED EVENTS: 394488. INTERVALS

TOTAL LENGTH OF UNDEFINED EVENTS: 0. INTERVALS

TOTAL LENGTH OF ANALYSIS: 16437.00 DAYS

SAMPLE SIZE: 394488

SAMPLE MAXIMUM: 37.35

SAMPLE MINIMUM: 0.000

SAMPLE MEAN: 0.1049E-01

SAMPLE STANDARD DEVIATION: 0.1508

1

Duration analysis operation no. 5

DURANL OF FLOW D5

Start date: 1959/ 9/30 24: 0 End date: 2004/ 9/30 24: 0

Analysis season starts: 12/31 24: 0 Ends: 12/31 24: 0
1

FRACTION OF TIME EACH LEVEL EQUALED OR EXCEEDED WITH DURATION >= THE SPECIFIED DURATIONS
FRACTION IS RELATIVE TO TOTAL TIME SPAN

EVENTS GREATER THAN

LEVELS	DURATIONS 1
7.114	0.3295E-04
7.178	0.3042E-04
7.241	0.3042E-04
7.305	0.3042E-04
7.368	0.3042E-04
7.431	0.3042E-04
7.495	0.3042E-04
7.558	0.3042E-04
7.621	0.3042E-04
7.685	0.3042E-04
7.748	0.3042E-04
7.812	0.3042E-04
7.875	0.3042E-04
7.938	0.3042E-04
8.002	0.3042E-04
8.065	0.2788E-04
8.128	0.2788E-04
8.192	0.2788E-04
8.255	0.2788E-04
8.319	0.2788E-04

EVENTS LESS THAN

LEVELS	DURATIONS 1
7.114	1.000
7.178	1.000
7.241	1.000
7.305	1.000
7.368	1.000
7.431	1.000
7.495	1.000
7.558	1.000
7.621	1.000
7.685	1.000
7.748	1.000

7.812	1.000
7.875	1.000
7.938	1.000
8.002	1.000
8.065	1.000
8.128	1.000
8.192	1.000
8.255	1.000
8.319	1.000

UNDEFINED EVENTS (NO WATER)

DURATIONS
1
0.000
1

SUMMARY

TOTAL LENGTH OF DEFINED EVENTS: 394488. INTERVALS

TOTAL LENGTH OF UNDEFINED EVENTS: 0. INTERVALS

TOTAL LENGTH OF ANALYSIS: 16437.00 DAYS

SAMPLE SIZE: 394488

SAMPLE MAXIMUM: 37.35

SAMPLE MINIMUM: 0.000

SAMPLE MEAN: 0.1049E-01

SAMPLE STANDARD DEVIATION: 0.1508

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1959 10 01        END    2004 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File
Name------------------------------>***
<-ID->
***
WDM        26   Hawano0.5Q2.wdm
MESSU      25   MitHawano0.5Q2.MES
           27   MitHawano0.5Q2.L61
           28   MitHawano0.5Q2.L62
           30   POCHawano0.5Q21.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:60
      PERLND      28
      IMPLND       1
      RCHRES       1
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR
DIG2 FIL2 YRND
    1        Trapezoidal Pond  1         MAX                     1
2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
```

```
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   28      D,Grass,FLAT(0-5%)     1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections
*****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS
TRAC ***
   28         0    0    1    0    0    0    0    0    0    0    0
0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags
***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS
TRAC  *********
   28         0    0    4    0    0    0    0    0    0    0    0
0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT
***
   28         0    1    1    1    0    0    0    0    1    1    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR
KVARY     AGWRC
   28             0       4.8      0.04       200      0.05
3      0.92
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR
BASETP    AGWETP
   28            35        30         2         2       0.4
0.05      0.05
  END PWAT-PARM3
  PWAT-PARM4
```

```
    <PLS >     PWATER input info: Part 4
***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC
LZETP ***
   28          0.08       0.6       0.2       1.5       0.7
0.5
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV
DEC  ***
   28       0.4  0.4  0.4  0.4  0.6  0.6  0.6  0.6  0.6  0.4  0.4
0.4
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3         ***
    # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV
DEC  ***
   28       0.1  0.1  0.1  0.1 0.06 0.06 0.06 0.06 0.06  0.1  0.1
0.1
  END MON-INTERCEP

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21
***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS
AGWS      GWVS
   28             0         0      0.15         0         4
0.05         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
    1      IMPERVIOUS             1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections
*****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
```

```
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    6    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    1
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            100     0.035      0.05       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                 <--Area-->     <-Target->   MBLK
***
<Name>   #                 <-factor->     <Name>   #   Tbl#
***
Roads***
PERLND  28                        2.9     RCHRES   1      2
PERLND  28                        2.9     RCHRES   1      3
IMPLND   1                      16.15     RCHRES   1      5
Industrial Pads***
PERLND  28                      20.18     RCHRES   1      2
PERLND  28                      20.18     RCHRES   1      3
IMPLND   1                      47.07     RCHRES   1      5

******Routing******
PERLND  28                        2.9     COPY     1     12
IMPLND   1                      16.15     COPY     1     15
PERLND  28                        2.9     COPY     1     13
PERLND  28                      20.18     COPY     1     12
IMPLND   1                      47.07     COPY     1     15
PERLND  28                      20.18     COPY     1     13
RCHRES   1                          1     COPY   501     16
```

```
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp>
<-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #
<Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   12.1        DISPLY   1     INPUT
TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp>
<-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #
<Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer
***
    # -  #<------------------><---> User T-series  Engl Metr LKFG
***
                                                in  out
***
    1     Trapezoidal Pond  1     1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections
*****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL
PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL
PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1
9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section
***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each
FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit
```

```
possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *
***
    1        0  1  0  0    4  0  0  0  0       0  0  0  0  0
2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS
DB50       ***
  <------><--------><--------><--------><--------><-------->
<-------->       ***
    1             1      0.05       0.0       0.0       0.5
0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section
***
    # -  # ***   VOL     Initial  value  of COLIND     Initial
value  of OUTDGT
          *** ac-ft     for each possible exit        for each
possible exit
  <------><-------->     <---><---><---><---><---> *** <---><--->
<---><---><--->
    1        0           4.0  0.0  0.0  0.0  0.0       0.0  0.0
0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   91    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  1.468296  0.000000  0.000000
  0.100000  1.472944  0.147062  0.259620
  0.200000  1.477600  0.294589  0.367158
  0.300000  1.482263  0.442582  0.449675
  0.400000  1.486933  0.591042  0.519240
  0.500000  1.491611  0.739969  0.580528
  0.600000  1.496296  0.889365  0.635936
  0.700000  1.500988  1.039229  0.686890
  0.800000  1.505688  1.189563  0.734316
  0.900000  1.510395  1.340367  0.778860
  1.000000  1.515110  1.491642  0.820990
  1.100000  1.519831  1.643389  0.861062
  1.200000  1.524561  1.795609  0.899350
  1.300000  1.529297  1.948302  0.936073
  1.400000  1.534041  2.101469  0.971409
  1.500000  1.538792  2.255110  1.005504
```

1.600000	1.543551	2.409227	1.038480
1.700000	1.548316	2.563821	1.070440
1.800000	1.553090	2.718891	1.101474
1.900000	1.557870	2.874439	1.131657
2.000000	1.562658	3.030465	1.161056
2.100000	1.567453	3.186971	1.189728
2.200000	1.572256	3.343956	1.217725
2.300000	1.577066	3.501423	1.245093
2.400000	1.581883	3.659370	1.271873
2.500000	1.586708	3.817800	1.298100
2.600000	1.591540	3.976712	1.323807
2.700000	1.596379	4.136108	1.349025
2.800000	1.601226	4.295988	1.373780
2.900000	1.606080	4.456353	1.398096
3.000000	1.610941	4.617204	1.421997
3.100000	1.615810	4.778542	1.445503
3.200000	1.620686	4.940367	1.468632
3.300000	1.625569	5.102680	1.491403
3.400000	1.630460	5.265481	1.513831
3.500000	1.635358	5.428772	1.535932
3.600000	1.640264	5.592553	1.557720
3.700000	1.645176	5.756825	1.579206
3.800000	1.650096	5.921589	1.600405
3.900000	1.655024	6.086845	1.621326
4.000000	1.659959	6.252594	1.641981
4.100000	1.664901	6.418837	1.662379
4.200000	1.669850	6.585574	1.682529
4.300000	1.674807	6.752807	1.702442
4.400000	1.679772	6.920536	1.722124
4.500000	1.684743	7.088762	1.741583
4.600000	1.689722	7.257485	1.760828
4.700000	1.694708	7.426707	1.779865
4.800000	1.699702	7.596427	1.798700
4.900000	1.704703	7.766647	1.817339
5.000000	1.709711	7.937368	1.835790
5.100000	1.714727	8.108590	1.854057
5.200000	1.719750	8.280314	1.872146
5.300000	1.724780	8.452540	1.890062
5.400000	1.729818	8.625270	1.907809
5.500000	1.734863	8.798504	1.925393
5.600000	1.739915	8.972243	1.942818
5.700000	1.744975	9.146488	1.960087
5.800000	1.750042	9.321238	1.977206
5.900000	1.755116	9.496496	1.994178
6.000000	1.760198	9.672262	2.011007
6.100000	1.765287	9.848536	2.027696
6.200000	1.770383	10.02532	2.044249
6.300000	1.775487	10.20261	2.124588
6.400000	1.780598	10.38042	2.259919
6.500000	1.785717	10.55873	2.425782
6.600000	1.790843	10.73756	2.613109
6.700000	1.795976	10.91690	2.816266

```
  6.800000  1.801116  11.09676  3.031178
  6.900000  1.806264  11.27713  3.254651
  7.000000  1.811419  11.45801  3.484054
  7.100000  1.816582  11.63941  3.717143
  7.200000  1.821752  11.82133  3.951955
  7.300000  1.826929  12.00376  4.235048
  7.400000  1.832114  12.18671  4.532475
  7.500000  1.837306  12.37018  4.841865
  7.600000  1.842505  12.55417  5.162743
  7.700000  1.847712  12.73869  6.387742
  7.800000  1.852926  12.92372  6.821413
  7.900000  1.858147  13.10927  7.268330
  8.000000  1.863376  13.29535  7.728096
  8.100000  1.868612  13.48195  8.974461
  8.200000  1.873855  13.66907  11.24127
  8.300000  1.879106  13.85672  14.17236
  8.400000  1.884364  14.04489  17.64062
  8.500000  1.889629  14.23359  21.57259
  8.600000  1.894902  14.42282  25.91871
  8.700000  1.900182  14.61257  30.64261
  8.800000  1.905469  14.80285  35.71608
  8.900000  1.910764  14.99367  41.11645
  9.000000  1.916066  15.18501  46.82496
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp>
<-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #
<Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL
PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL
PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL
PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL
PETINP
WDM      2 PREC     ENGL    1              RCHRES   1     EXTNL
PREC
WDM      1 EVAP     ENGL    1              RCHRES   1     EXTNL
POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member>
Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>
tem strg strg***
RCHRES   1 HYDR   RO     1 1        1      WDM   1000 FLOW
```

```
ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1001 STAG
ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     12.1      WDM    701 FLOW
ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     12.1      WDM    801 FLOW
ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp>
<-Member->***
<Name>            <Name> # #<-factor->     <Name>
<Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW
IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW
IVOL
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW
IVOL
  END MASS-LINK    5

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT
MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT
MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT
MEAN
  END MASS-LINK   15

  MASS-LINK       16
RCHRES     ROFLOW                          COPY           INPUT
MEAN
  END MASS-LINK   16


END MASS-LINK
```

END RUN

```
RUN

GLOBAL
   durations run for poc
  START       1959 10 01        END    2004 09 30
  RUN INTERP OUTPUT LEVEL    3
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File
Name---------------------------------->***
<-ID->
***
WDM        26   Hawano0.5Q2.wdm
MESSU      25   DURHAWANO0.5Q2.MES
           30   DURHawano0.5Q21.DAT
           31   DURHawano0.5Q22.DAT
           32   DURHawano0.5Q23.DAT
           33   DURHawano0.5Q24.DAT
           34   DURHawano0.5Q25.DAT
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:60
      DURANL       1
      DURANL       2
      DURANL       3
      DURANL       4
      DURANL       5
    END INGRP
END OPN SEQUENCE

DURANL
  GEN-DURDATA
    # -  #<----------------Title-----------------> NDUR NLEV PRFG
PUNT ***
    1     DURANL OF FLOW D1                          1   20    1
30
    2     DURANL OF FLOW D2                          1   20    1
31
    3     DURANL OF FLOW D3                          1   20    1
32
    4     DURANL OF FLOW D4                          1   20    1
33
    5     DURANL OF FLOW D5                          1   20    1
34
  END GEN-DURDATA

  DURATIONS
    # -  #   D1  D2 ***
    1    5    1
```

```
  END DURATIONS

  LEVELS
    # -  #***1    2    3    4    5    6    7    8    9   10   11
12   13   14
    1
2.0442.1082.1712.2352.2982.3612.4252.4882.5512.6152.6782.7422.805
2.868
    1     2.9322.9953.0583.1223.1853.249
    2
3.3123.3753.4393.5023.5653.6293.6923.7563.8193.8823.9464.0094.072
4.136
    2     4.1994.2634.3264.3894.4534.516
    3
4.5794.6434.7064.7704.8334.8964.9605.0235.0865.1505.2135.2775.340
5.403
    3     5.4675.5305.5935.6575.7205.784
    4
5.8475.9105.9746.0376.1006.1646.2276.2916.3546.4176.4816.5446.607
6.671
    4     6.7346.7986.8616.9246.9887.051
    5
7.1147.1787.2417.3057.3687.4317.4957.5587.6217.6857.7487.8127.875
7.938
    5     8.0028.0658.1288.1928.2558.319
  END LEVELS
END DURANL
EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp>
<-Member->  ***
<Name>   # <Name>   tem strg<-factor->strg <Name>   #   #
<Name> # #  ***

WDM    801 FLOW     ENGL    1              DURANL   1     INPUT
TIMSER
WDM    801 FLOW     ENGL    1              DURANL   2     INPUT
TIMSER
WDM    801 FLOW     ENGL    1              DURANL   3     INPUT
TIMSER
WDM    801 FLOW     ENGL    1              DURANL   4     INPUT
TIMSER
WDM    801 FLOW     ENGL    1              DURANL   5     INPUT
TIMSER
END EXT SOURCES
END RUN
```

1

Duration analysis operation no. 1

DURANL OF FLOW D1

Start date: 1959/ 9/30 24: 0 End date: 2004/ 9/30 24: 0

Analysis season starts: 12/31 24: 0 Ends: 12/31 24: 0
1

FRACTION OF TIME EACH LEVEL EQUALED OR EXCEEDED WITH DURATION >= THE SPECIFIED DURATIONS
FRACTION IS RELATIVE TO TOTAL TIME SPAN

EVENTS GREATER THAN

LEVELS	DURATIONS 1
2.044	0.4766E-03
2.108	0.4360E-03
2.171	0.4107E-03
2.235	0.3904E-03
2.298	0.3676E-03
2.361	0.3473E-03
2.425	0.3270E-03
2.488	0.2991E-03
2.551	0.2839E-03
2.615	0.2763E-03
2.678	0.2510E-03
2.742	0.2408E-03
2.805	0.2332E-03
2.868	0.2205E-03
2.932	0.1927E-03
2.995	0.1850E-03
3.058	0.1800E-03
3.122	0.1673E-03
3.185	0.1546E-03
3.249	0.1420E-03

EVENTS LESS THAN

LEVELS	DURATIONS 1
2.044	0.9995
2.108	0.9996
2.171	0.9996
2.235	0.9996
2.298	0.9996
2.361	0.9997
2.425	0.9997
2.488	0.9997
2.551	0.9997
2.615	0.9997
2.678	0.9997

2.742	0.9998
2.805	0.9998
2.868	0.9998
2.932	0.9998
2.995	0.9998
3.058	0.9998
3.122	0.9998
3.185	0.9998
3.249	0.9999

UNDEFINED EVENTS (NO WATER)

DURATIONS
1
0.000
1

SUMMARY

TOTAL LENGTH OF DEFINED EVENTS: 394488. INTERVALS

TOTAL LENGTH OF UNDEFINED EVENTS: 0. INTERVALS

TOTAL LENGTH OF ANALYSIS: 16437.00 DAYS

SAMPLE SIZE: 394488

SAMPLE MAXIMUM: 13.82

SAMPLE MINIMUM: 0.000

SAMPLE MEAN: 0.5799E-01

SAMPLE STANDARD DEVIATION: 0.2346

1

Duration analysis operation no. 2

DURANL OF FLOW D2

Start date: 1959/ 9/30 24: 0 End date: 2004/ 9/30 24: 0

Analysis season starts: 12/31 24: 0 Ends: 12/31 24: 0
1

FRACTION OF TIME EACH LEVEL EQUALED OR EXCEEDED WITH DURATION >= THE SPECIFIED DURATIONS
FRACTION IS RELATIVE TO TOTAL TIME SPAN

EVENTS GREATER THAN

	DURATIONS
	1
LEVELS	
3.312	0.1420E-03
3.375	0.1394E-03
3.439	0.1217E-03
3.502	0.1115E-03
3.565	0.1065E-03
3.629	0.1039E-03
3.692	0.9886E-04
3.756	0.9126E-04
3.819	0.8112E-04
3.882	0.7858E-04
3.946	0.7351E-04
4.009	0.7098E-04
4.072	0.6591E-04
4.136	0.6591E-04
4.199	0.6084E-04
4.263	0.5323E-04
4.326	0.4816E-04
4.389	0.4816E-04
4.453	0.4563E-04
4.516	0.4309E-04

EVENTS LESS THAN

	DURATIONS
	1
LEVELS	
3.312	0.9999
3.375	0.9999
3.439	0.9999
3.502	0.9999
3.565	0.9999
3.629	0.9999
3.692	0.9999
3.756	0.9999
3.819	0.9999
3.882	0.9999
3.946	0.9999

4.009	0.9999
4.072	0.9999
4.136	0.9999
4.199	0.9999
4.263	0.9999
4.326	1.000
4.389	1.000
4.453	1.000
4.516	1.000

UNDEFINED EVENTS (NO WATER)

DURATIONS
1
0.000
1

SUMMARY

TOTAL LENGTH OF DEFINED EVENTS: 394488. INTERVALS

TOTAL LENGTH OF UNDEFINED EVENTS: 0. INTERVALS

TOTAL LENGTH OF ANALYSIS: 16437.00 DAYS

SAMPLE SIZE: 394488

SAMPLE MAXIMUM: 13.82

SAMPLE MINIMUM: 0.000

SAMPLE MEAN: 0.5799E-01

SAMPLE STANDARD DEVIATION: 0.2346

1

Duration analysis operation no. 3

DURANL OF FLOW D3

Start date: 1959/ 9/30 24: 0 End date: 2004/ 9/30 24: 0

Analysis season starts: 12/31 24: 0 Ends: 12/31 24: 0

1

FRACTION OF TIME EACH LEVEL EQUALED OR EXCEEDED WITH DURATION >= THE SPECIFIED DURATIONS

FRACTION IS RELATIVE TO TOTAL TIME SPAN

EVENTS GREATER THAN

	DURATIONS
	1
LEVELS	
4.579	0.4309E-04
4.643	0.4309E-04
4.706	0.4309E-04
4.770	0.4056E-04
4.833	0.3549E-04
4.896	0.3295E-04
4.960	0.3295E-04
5.023	0.3042E-04
5.086	0.2788E-04
5.150	0.2788E-04
5.213	0.2788E-04
5.277	0.2535E-04
5.340	0.2535E-04
5.403	0.2535E-04
5.467	0.2535E-04
5.530	0.2535E-04
5.593	0.2281E-04
5.657	0.2281E-04
5.720	0.2281E-04
5.784	0.2028E-04

EVENTS LESS THAN

	DURATIONS
	1
LEVELS	
4.579	1.000
4.643	1.000
4.706	1.000
4.770	1.000
4.833	1.000
4.896	1.000
4.960	1.000
5.023	1.000
5.086	1.000
5.150	1.000
5.213	1.000

5.277	1.000
5.340	1.000
5.403	1.000
5.467	1.000
5.530	1.000
5.593	1.000
5.657	1.000
5.720	1.000
5.784	1.000

UNDEFINED EVENTS (NO WATER)

DURATIONS
1
0.000
1

SUMMARY

TOTAL LENGTH OF DEFINED EVENTS: 394488. INTERVALS

TOTAL LENGTH OF UNDEFINED EVENTS: 0. INTERVALS

TOTAL LENGTH OF ANALYSIS: 16437.00 DAYS

SAMPLE SIZE: 394488

SAMPLE MAXIMUM: 13.82

SAMPLE MINIMUM: 0.000

SAMPLE MEAN: 0.5799E-01

SAMPLE STANDARD DEVIATION: 0.2346

1

Duration analysis operation no. 4

DURANL OF FLOW D4

Start date: 1959/ 9/30 24: 0 End date: 2004/ 9/30 24: 0

Analysis season starts: 12/31 24: 0 Ends: 12/31 24: 0
1

FRACTION OF TIME EACH LEVEL EQUALED OR EXCEEDED WITH DURATION >= THE SPECIFIED DURATIONS
FRACTION IS RELATIVE TO TOTAL TIME SPAN

EVENTS GREATER THAN

LEVELS	DURATIONS 1
5.847	0.2028E-04
5.910	0.2028E-04
5.974	0.2028E-04
6.037	0.1774E-04
6.100	0.1774E-04
6.164	0.1774E-04
6.227	0.1774E-04
6.291	0.1774E-04
6.354	0.1774E-04
6.417	0.1774E-04
6.481	0.1521E-04
6.544	0.1521E-04
6.607	0.1521E-04
6.671	0.1521E-04
6.734	0.1267E-04
6.798	0.1267E-04
6.861	0.1267E-04
6.924	0.1267E-04
6.988	0.1267E-04
7.051	0.1267E-04

EVENTS LESS THAN

LEVELS	DURATIONS 1
5.847	1.000
5.910	1.000
5.974	1.000
6.037	1.000
6.100	1.000
6.164	1.000
6.227	1.000
6.291	1.000
6.354	1.000
6.417	1.000
6.481	1.000

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   6.544      1.000
   6.607      1.000
   6.671      1.000
   6.734      1.000
   6.798      1.000
   6.861      1.000
   6.924      1.000
   6.988      1.000
   7.051      1.000


 UNDEFINED EVENTS (NO WATER)

                      DURATIONS
                     1
              0.000
1

    SUMMARY

    TOTAL LENGTH OF DEFINED EVENTS:      394488. INTERVALS

    TOTAL LENGTH OF UNDEFINED EVENTS:         0. INTERVALS

    TOTAL LENGTH OF ANALYSIS:   16437.00 DAYS

    SAMPLE SIZE:   394488

    SAMPLE MAXIMUM:  13.82

    SAMPLE MINIMUM:  0.000

    SAMPLE MEAN: 0.5799E-01

    SAMPLE STANDARD DEVIATION: 0.2346
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1

Duration analysis operation no. 5

DURANL OF FLOW D5

Start date: 1959/ 9/30 24: 0 End date: 2004/ 9/30 24: 0

Analysis season starts: 12/31 24: 0 Ends: 12/31 24: 0
1

FRACTION OF TIME EACH LEVEL EQUALED OR EXCEEDED WITH DURATION >= THE SPECIFIED DURATIONS
FRACTION IS RELATIVE TO TOTAL TIME SPAN

EVENTS GREATER THAN

LEVELS	DURATIONS 1
7.114	0.1267E-04
7.178	0.1014E-04
7.241	0.1014E-04
7.305	0.1014E-04
7.368	0.1014E-04
7.431	0.1014E-04
7.495	0.1014E-04
7.558	0.1014E-04
7.621	0.1014E-04
7.685	0.1014E-04
7.748	0.1014E-04
7.812	0.1014E-04
7.875	0.1014E-04
7.938	0.1014E-04
8.002	0.1014E-04
8.065	0.1014E-04
8.128	0.1014E-04
8.192	0.1014E-04
8.255	0.1014E-04
8.319	0.1014E-04

EVENTS LESS THAN

LEVELS	DURATIONS 1
7.114	1.000
7.178	1.000
7.241	1.000
7.305	1.000
7.368	1.000
7.431	1.000
7.495	1.000
7.558	1.000
7.621	1.000
7.685	1.000
7.748	1.000

7.812	1.000
7.875	1.000
7.938	1.000
8.002	1.000
8.065	1.000
8.128	1.000
8.192	1.000
8.255	1.000
8.319	1.000

UNDEFINED EVENTS (NO WATER)

DURATIONS
1
0.000
1

SUMMARY

TOTAL LENGTH OF DEFINED EVENTS: 394488. INTERVALS

TOTAL LENGTH OF UNDEFINED EVENTS: 0. INTERVALS

TOTAL LENGTH OF ANALYSIS: 16437.00 DAYS

SAMPLE SIZE: 394488

SAMPLE MAXIMUM: 13.82

SAMPLE MINIMUM: 0.000

SAMPLE MEAN: 0.5799E-01

SAMPLE STANDARD DEVIATION: 0.2346