



The Boeing Company  
Santa Susana Field Laboratory  
5800 Woolsey Canyon Road  
Canoga Park, CA 91304-1148

Via FedEx

September 29, 2011  
In reply, refer to SHEA-111480

Ms. Cassandra Owens  
Regional Water Quality Control board  
Los Angeles Region  
320 West 4<sup>th</sup> Street, Suite 200  
Los Angeles, CA 90013

Dear Ms. Owens:

Subject: 2011 Best Management Practices (BMP) Plan Addendum, The Boeing Company, Santa Susana Field Laboratory, Canoga Park, California (Order No. R4-2010-0090; NPDES No. CA0001309, CI No. 6027)

Per the requirements of The Boeing Company's (Boeing) National Pollutant Discharge Elimination System (NPDES) Permit (Order No. R4-2010-0090) adopted by the Regional Water Quality Control Board on June 3, 2010, and following the October 2010 Santa Susana Site 008/009 Best Management Practices (BMP) Plan, Boeing is providing the enclosed 2011 BMP Plan Addendum for the Santa Susana Field Laboratory. This document has been developed with input, and in accordance with, recommendations from the Santa Susana Surface Water Expert Panel and prepared for Boeing and the National Aeronautics and Space Administration (NASA). The attached report will be posted on the Boeing External website at the following address:  
[http://www.boeing.com/aboutus/environment/santa\\_susana/isra.html](http://www.boeing.com/aboutus/environment/santa_susana/isra.html)

If you have any questions or require any further, please contact Debbie Taege at 818-466-8849.

Sincerely,

Thomas D. Gallacher  
Director, Santa Susana Field Laboratory  
Environment, Health and Safety

enclosure

cc: Mr. Peter Raftery, RWQCB  
Mr. Mazhar Ali, RWQCB  
Mr. Buck King, DTSC  
Mr. Allen Elliott, NASA  
Mr. Peter Zorba, NASA  
Dr. Michael Stenstrom, Surface Water Expert Panel  
Mr. Jon Jones, Surface Water Expert Panel  
Dr. Mike Josselyn, Surface Water Expert Panel  
Mr. Randy Dean, CH2M HILL  
Mr. Brandon Steets, Geosyntec  
Ms. Bronwyn Kelly, MWH, e-copy only  
Mr. Alexander Fischl, MWH, e-copy only

*Prepared for*

**The Boeing Company and the National Aeronautics and Space Administration**  
Santa Susana Field Laboratory  
5800 Woolsey Canyon Road  
Canoga Park, CA 91304-1148

# **FINAL 2011 BMP PLAN ADDENDUM**

## **SANTA SUSANA FIELD LABORATORY VENTURA COUNTY, CALIFORNIA**

*Prepared by*

**Geosyntec**   
consultants

engineers | scientists | innovators

6701 Center Drive West, Suite 550  
Los Angeles, CA 90045

*and*

**The Santa Susana Field Laboratory Surface Water Expert Panel**

September 30, 2011

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**Appendix A:** Stormwater BMP Concept Designs for Santa Susana Field Laboratory, Watershed 009, NASA and Boeing Properties

## ABBREVIATIONS AND ACRONYMS

A1LF	Area 1 Landfill
ACOE	Army Corps of Engineers
BMP	Best Management Practice
Boeing	The Boeing Company
CDFG	California Department of Fish and Game
CM	culvert modification
CMP	corrugated metal pipe
COC	constituent of concern
DNQ	data not qualified
DTSC	Department of Toxic Substances Control
ELV	Expendable Launch Vehicle
Expert Panel	Santa Susana Site Surface Water Expert Panel
Geosyntec	Geosyntec Consultants
HDPE	high-density polyethylene
ISRA	Interim Source Removal Action
LOX	liquid oxygen
MWH	MWH Americas, Inc.
NASA	National Aeronautics and Space Administration
NEL	Numeric effluent limit
NPDES	National Pollutant Discharge Elimination System
NRCS	National Resources Conservation Service
RCRA	Resource Conservation and Recovery Act
RFIs	RCRA Facility Investigation
RWQCB	Los Angeles Regional Water Quality Control Board
SAP	sampling and analysis plan
Santa Susana Site	Santa Susana Field Laboratory
SCE	Southern California Edison
TCDD	tetrachlorobenzo-p-dioxin
TEF	toxic equivalency factor
TEQ	toxic equivalency
TSS	total suspended solids
USDA	United States Department of Agriculture

## 1. INTRODUCTION

The document herein describes the conceptual designs for Best Management Practices (BMPs) that were identified based on procedures described in the BMP Plan (MWH et al., 2010a) and an evaluation of potential BMP subarea monitoring data from the 2010/2011 rainy season within the Outfalls 008 and 009 watersheds at the Santa Susana Field Laboratory (Santa Susana Site), Ventura County, California. The BMP Plan was implemented with oversight and participation of the Los Angeles Regional Water Quality Control Board (RWQCB) with the objective of meeting the numeric effluent limits (NELs) for Outfalls 008 and 009 established in the National Pollutant Discharge Elimination System (NPDES) Permit (Order R4-2010-0090) adopted by the RWQCB on June 3, 2010 (RWQCB, 2010). Potential BMP subarea monitoring activities were conducted by MWH Americas, Inc. (MWH) on behalf of The Boeing Company (Boeing) and the National Aeronautics and Space Administration (NASA) according to the 2010/2011 BMP and Interim Source Removal Action (ISRA) Performance Monitoring Sampling and Analysis Plan (SAP) (MWH, 2010). This document was prepared for Boeing and NASA by Geosyntec Consultants (Geosyntec) and the Santa Susana Field Laboratory Surface Water Expert Panel (Expert Panel).

The four related submittals preceding this BMP Plan Addendum are briefly summarized below.

- The October 2010 Santa Susana Site 008/009 BMP Plan (MWH et al., 2010) outlined the Expert Panel's general proposed approach for siting new BMPs in the Outfall 008 and 009 watersheds, including source, erosion, and treatment control BMPs, to improve stormwater quality and minimize future NPDES exceedances at these outfalls. This report also committed to submit a BMP Plan Addendum after the 2010/2011 rainy season that would describe the types and locations of BMPs to be implemented based on the evaluation of available data.
- The December 2010 BMP/ISRA SAP (MWH, 2010), including a BMP monitoring recommendations memorandum prepared by Geosyntec and Expert Panel (Geosyntec and Expert Panel, 2010), outlined the approach for monitoring potential BMP subareas. The purpose of the memorandum was to provide stormwater runoff monitoring recommendations for evaluating where distributed treatment BMPs (both short- and long-term) may be needed in upstream subareas of the Outfall 008 and 009 watersheds, as proposed in the October 2010 Santa Susana Site 008/009 BMP Plan. The memorandum described general guidance for sampling locations, analytes, frequency, and protocol.

- The June 2011 Site Ranking Analysis Approach letter written to the RWQCB (Expert Panel and Geosyntec, 2011a) summarized the Panel’s general approach for ranking and selecting BMP implementation locations in the Outfall 008 and 009 watersheds. The letter described the final, most refined approach to prioritizing potential BMP sites, the factors upon which this approach was based, and the considerations that were taken into account while developing the approach. The BMP site ranking analysis identified several new prioritized sites which were evaluated and summarized in the July ISRA/BMP Annual Report (MWH et al., 2011).
- The July 2011 ISRA/BMP Annual Report (MWH et al., 2011) presented the Expert Panel’s BMP siting analysis and final BMP recommendations, which are further developed herein. The July Annual Report generally found that the water quality in the Outfall 008 watershed was not high priority in terms of its need for treatment; therefore, new BMPs are not required in Outfall 008 and are only recommended for the Outfall 009 watershed. This report included a detailed report prepared by Geosyntec and the Expert Panel (Geosyntec and the Expert Panel, 2011b) that described the monitoring data analyses performed and the results of these statistical evaluations, which form the basis for the Expert Panel’s new BMP recommendations.

The purpose of this BMP Plan Addendum is to present the new erosion and treatment control concepts that are to be implemented in the Outfall 009 watershed at the Santa Susana Site, as well as their corresponding implementation schedules.

## **1.1 Project Background**

In late 2010, a BMP subarea monitoring program (MWH, 2010) was developed and implemented within the Outfall 008 and 009 watersheds at the Santa Susana Site, as stated in the BMP Plan (MWH et al., 2010). The BMP monitoring program was designed to assess the contribution of constituents of concern (COCs) from the source areas of stormwater runoff to identify subareas that were most in need of implementation of new or enhanced stormwater controls or BMPs to improve NPDES permit compliance. This program involved the collection of stormwater samples in proximity to “potential” BMP sites, defined as locations receiving runoff from likely source areas (e.g., ISRA areas, Resource Conservation and Recovery Act [RCRA] Facility Investigation [RFI] areas, or areas where historic industrial activities are known

to have occurred) and other infrastructure (e.g., roads, buildings, parking areas). In addition, runoff from “stormwater background” areas<sup>2</sup>, or locations receiving runoff from unimpacted and undeveloped areas, within the Outfall 008 and 009 watersheds was sampled. During the 2010/2011 rainy season, stormwater runoff inspections and sampling was performed at 3 “potential” BMP sites in the Outfall 008 watershed, 19 “potential” BMP sites in the Outfall 009 watershed, and 5 locations identified to monitor stormwater runoff quality from natural undisturbed or “stormwater background” areas (MWH et al., 2011).

The Expert Panel’s approach for identifying specific BMP subareas for new stormwater controls was to rank potential BMP subarea monitoring sites based on the results of comparisons between the following measured values and thresholds: (a) stormwater concentrations and NPDES permit limits, and (b) stormwater particulate strengths (i.e., constituent particulate mass per mass of total suspended solids (TSS), which normalizes the particulate-bound constituent concentration by the concentration of TSS in the sample to allow for an evaluation of the constituent “strength” of suspended particles) and particulate strengths measured at onsite stormwater background locations (Expert Panel and Geosyntec, 2011a). A statistical methodology was developed to rank the potential BMP monitoring sites based on these comparison results while accounting for the number of useable data available at each site as well as the number of data observations that fell above the thresholds (i.e., reflecting statistical confidence in how frequently each site will exceed the comparison thresholds). This methodology relied on weighting factors that were calculated for each NPDES COC category (specifically metals [including Cd, Cu, Hg, and Pb], dioxins [including 2,3,7,8-tetrachlorobenzo-p-dioxin {TCDD} and TCDD toxic equivalency factor {TEQ}], and TSS) for each site. In the end, the constituent-specific weighting factors were summed to produce a multi-constituent score (ranging from 0.0 [lowest relative exceedance of thresholds] to 1.0 [highest relative exceedance of thresholds]) to allow for relative ranking amongst the potential BMP sites, with the sites with the highest relative rankings recommended to be further evaluated for new stormwater controls based on site-specific considerations and best professional judgment.

In addition to the new proposed controls described in this document, several short-term BMP activities have either already been completed or are (as of September 2011)

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<sup>2</sup> The site specific stormwater background dataset is for the assessment of stormwater only and is not considered part of the ongoing soil background sampling activities begin conducted under Department of Toxic Substances Control (DTSC) oversight.

currently being constructed in Outfall 008 and 009 watersheds to improve surface water quality, as outlined in the July 2011 Annual Report. Some of these activities include a sediment basin and culvert inlet filter at the B-1 area, a sediment basin and biofilter at the lower parking lot soil stockpile area, asphalt removal and site restoration, and ISRA soil excavations, all of which are further detailed in the July 2011 Annual Report (MWH et al., 2011). In total, stormwater runoff from approximately 14 acres of the Outfall 009 watershed was or will be addressed by these stormwater management activities (not including the BMPs proposed herein).

## **1.2 Summary of Expert Panel's BMP Recommendations**

Based on the potential BMP subarea monitoring site analysis results (Expert Panel and Geosyntec, 2011b), eight out of the 19 Outfall 009 sites were identified as top-ranked potential BMP locations. These eight top-ranked sites were then selected for further evaluation based on site-specific considerations and best professional judgment, which accounted for future ISRA and infrastructure demolition plans, existing BMPs, and new BMP implementation constraints and feasibility. As a result of these assessments, the Expert Panel has selected four sites for new BMP implementation as a first priority. The recommended BMPs are located on both Boeing and NASA property. The remaining sites will be monitored during the 2011/2012 rainy season, after which the need for stormwater controls will be re-evaluated.

The existing Santa Susana Site BMP sizing criterion developed by the Expert Panel is for the capture of runoff from the 1-year, 24-hour storm event, or alternatively 90% long-term runoff volume capture (these are roughly equivalent). This criterion was used for the sizing of new treatment controls for the BMP Plan, and is being evaluated by the Expert Panel on a site-by-site basis as individual projects are developed. Upon further project development, site-specific considerations include, for example: constructability constraints (including available space); stormwater monitoring results; anticipated BMP functional lifetime; timeframe for infrastructural demolition and final remediation; anticipated nature of remediation in potential BMP location; capital and operation and maintenance costs; and other information.

## **2. BMP RECOMMENDATIONS**

BMPs were chosen for implementation at four of the top eight highest ranked subareas, with multi-constituent scores ranging from 0.28 to 0.66 (see July 2011 ISRA/BMP Annual Report [MWH et al., 2011] for explanation). Besides their multi-constituent scores, the selected sites were included among the top-ranked sites that were first and second for each of the COC categories (metals, dioxins, and TSS), had detections of the

2,3,7,8-TCDD dioxin congener (at low, data not qualified [DNQ]-estimated quantities), which is typically associated with anthropogenic sources, and had the highest observed dioxin concentrations (noting that the scores do not explicitly account for concentration *magnitudes*, but rather account for *frequency* of exceeding the concentration-based background and permit limit thresholds). These selected sites rank among the highest for metals, dioxins, TSS, and 95<sup>th</sup> percentile background limit and NPDES permit limit exceedances. Based on the aforementioned ranking results, the utilization of best professional judgment (including consideration of information on planned ISRA and demolition measures), and in line with the BMP Plan's goal of siting BMPs based upon monitoring results, new activities and BMPs will be implemented at four locations on either NASA or Boeing property, as described below. Concept designs for the new activities and BMPs are included in Appendix A.

## **2.1 Helipad**

### **2.1.1 Drainage Area Description**

The Helipad site (EVBMP0002, located at the drainage spillway) produces sheet flow from the approximately 4.1 acre helipad area (90% impervious and all directly connected) and is located on property owned by the US Government and administered by NASA. The site includes no areas of exposed surface soil contamination, such as those identified by the ISRA program. The underlying soils are dominantly type B soils (moderate infiltration rates) (United States Department of Agriculture National Resources Conservation Service [USDA NRCS], 2007) combined with, presumably, substantial amounts of exposed bedrock. This area represents a significant source of runoff to Outfall 009 during frequent small rain events given its large directly connected impervious area and direct connection to the Northern Drainage via a slope drain. The monitoring site was ranked first based on the multi-constituent score of 0.66, sixth for metals, and first for dioxins, and exceeded both the 95th percentile background limits and the permit limits. Sheetflow runoff from this paved area currently drains east to an existing concrete spillway, into a 24" corrugated metal pipe (CMP) culvert, and down a steep slope drain into the Northern Drainage approximately 300 feet upstream of the Outfall 009 NPDES monitoring location.

### **2.1.2 BMP Description**

The proposed stormwater control for the helipad is to remove the asphalt and base material (approximately 3.8 acres), which would both reduce runoff quantity and improve runoff quality (i.e., reduce COC concentrations) (Appendix A, Drawing 3). This is to be combined with ripping the underlying surface, fine-contouring the newly

exposed surface to create specific shallow (approximately 4 to 6 inch deep) depressional areas (to break up the flow length and promote infiltration and evapotranspiration) and rigorously applying erosion control and revegetation measures, including wattles and hydroseed mulch, as well as removing newly exposed surficial soils that are above ISRA criteria for the Outfall 009 NPDES COCs. The curbs along the northern, southern, and eastern portion of the helipad will be retained to help direct stormwater runoff; it is not anticipated that any new curb construction will be needed to convey flows. The areas where pavement is being removed will be graded to drain toward the existing concrete spillway, the entrance to which will be lined with a sand bag berm to detain some amount of sediment within the asphalt removal area prior to discharge.

## **2.2 Expendable Launch Vehicle (ELV) Area**

### **2.2.1 Drainage Area Description**

This site (A2SW0001, located upgradient of completed ISRA area A2LF-3 adjacent to the paved road) is located on property owned by the US Government and administered by NASA and contributes sheet flow from an approximately 12 acre area, including Expendable Launch Vehicle (ELV) ISRA areas, a parking lot, a rooftop, a NASA soil stockpile area, and paved roadway surfaces. Approximately 6.2 acres of the site is currently impervious and most of it is directly connected. The dominating soil underlying the site is type B (moderate infiltration rates) (USDA-NRCS, 2007), along with exposed bedrock. This monitoring site was ranked fourth overall with a multi-constituent score of 0.45 and was ranked fifth for metals, second for dioxins (tied with lower parking lot storm drain and soil stockpile, and included the “J-flagged” detection of 2,3,7,8-TCDD), second for TSS, and exceeded both the 95th percentile background limits and the permit limits. This site had the highest observed TCDD TEQ concentrations of those included in this BMP subarea ranking analysis. Culvert modification 1 (CM-1), located shortly downstream of this site, is an existing culvert modification that treats runoff from a 41 acre undisturbed subwatershed, as well as some runoff from this subarea due to an existing broken asphalt channel below the ELV hillside that diverts runoff toward the road and then toward CM-1 instead of toward an existing culvert inlet where BMP subarea monitoring location EVBMP0001 is located (which now represents runoff from helipad road only). ISRA removal activities are planned for the ELV area after 2011.

### **2.2.2 BMP Description**

Activities in this area will include ISRA removal at ELV (including robust erosion and sediment controls), reconstruction of the existing 520-foot asphalt drainage ditch below

ELV with concrete, and installation of a detention basin and new culvert inlet media filter near Helipad Road at the downstream end of the drainage ditch (Appendix A, Drawing 4). An approximately 0.5 acre section of asphalt may also be removed from the upper portion of the drainage area. The detention basin is preliminarily sized to capture 50% of the runoff volume produced over the long-term simulation (1948-2006 period of record) using the existing calibrated SWMM model for the watershed. The current conceptual design is considered to be the largest possible considering the environmental and topographic constraints (steep existing side slopes); a basin sized to 90% capture would be infeasible at this location. The proposed basin's approximate dimensions are 3-foot depth, 85-foot top width, and a 140-foot top length, with 4:1 side slopes for a total capture volume of 23,000 cubic feet. A raised outlet structure, likely two 4-foot diameter riser pipes packed in media, will provide sedimentation and filtration of detained runoff prior to release. Biological, geotechnical, and utility surveys will need to be performed prior to final design, as well as evaluations of constructability (including consideration of shallow adjacent bedrock and excavation volumes). Conceptual plans also include gabion check structures placed intermittently along the concrete channel leading into the detention basin for energy dissipation and velocity control. Continued inspection and maintenance of CM-1 (removal of accumulated sediment) and of the ISRA erosion controls at A2LF-3 will also take place. As shown in Appendix A, Drawing 4, portions of the proposed design are located within a Southern California Edison (SCE) easement. However, pending a utility survey prior to preliminary design, the project is not anticipated to require SCE approval because there are no power poles within 10 feet of the planned basin.

## **2.3 Liquid Oxygen (LOX) Area**

### **2.3.1 Drainage Area Description**

There are two primary drainage areas associated with the liquid oxygen (LOX) site BMPs, totaling approximately 39 acres in combination. The first area drains to a proposed sandbag berm (described below) and consists of the dirt road driveway (gravel covered) and compacted soil graded LOX pad above, both of which sheet flow to the Northern Drainage over the top of its northern bank. The sheetflow runoff from the graded LOX pad runs down the dirt roads and temporarily ponds in the driveway area before spilling over the northern bank of the Northern Drainage, where significant erosion and bank slumping is apparent. The second area, immediately east of LOX, is the outlet of two tributary channels that are deeply incised and located on or near the NASA-Sage Ranch property boundary where they discharge into the Northern Drainage from the north. Both the driveway/LOX pad and tributaries have been targeted by the

Expert Panel for erosion control based on monitoring data and visual observation. The eastern tributary receives concentrated flows from a relatively large subwatershed that includes both NASA and Sage Ranch property. The soil type in this subwatershed consists of type D soils (low infiltration rates and high runoff potential) (USDA- NRCS, 2007). ISRA removal activities are also planned for LOX, around the graded pad area, after 2011.

Monitoring site LXBMP0002 is located on the western LOX dirt access road and was ranked fifth overall with a multi-constituent score of 0.31, seventh for metals, and sixth for dioxins in the BMP Ranking Analysis. As only two samples were collected from this monitoring site during the 2010/2011 rainy season, additional sampling during the 2011/2012 rainy season will provide a greater understanding of stormwater quality for this subarea.

### **2.3.2 BMP Description**

The proposed stormwater controls include placement of approximately 700 linear feet of sandbag berm (roughly 1.5 feet in height) along the top of the northern bank of the Northern Drainage channel to reduce bank erosion and encourage temporary collection of this sheet flow runoff from LOX (Appendix A, Drawing 5). Also, 12-inch high-density polyethylene (HDPE) slope drains will be integrated into this berm to safely convey collected runoff from behind the berm to the bottom of the channel and onto existing bedrock outcrops. The slope drains are conservatively sized to convey the 25-year, 24 hour storm event with a minimum diameter of 12 inches to reduce the risk of blockage. In addition, riprap will be placed as an erosion control measure along areas of concentrated flow from the adjacent tributary. ISRA soil removal is planned to occur around the gravel LOX pad after 2011 and will be implemented without backfill to leave distributed areas for infiltration providing runoff control until final remediation of the LOX RFI area. Another action includes the installation of two geocell crossings that are backfilled with gravel, contoured to the shape of a small channel, and located along the access road east of the LOX area to control erosion at the two tributary crossings. Existing and proposed riprap at these tributary outlets will also be reconstructed with gravel bedding and filtered rock, with channel contouring where shown on the concept design drawing (Appendix A, Drawing 5), for erosion control at these tributary outlets. Finally, flexible growth media, a fibrous matrix that bonds to soil and promotes rapid vegetation establishment upon application, is to be applied to the northern bank of the Northern Drainage at areas with observed bare slopes.

## **2.4 Area 1 Landfill (A1LF) Area**

### **2.4.1 Drainage Area Description**

Monitoring location A1BMP0001 has a drainage area of 1.2 acres and is located in a channel downstream of a portion of the Area 1 Landfill (A1LF), which itself covers 2.4 acres and is located on Boeing property. Low flow runoff from this area is currently treated by CM-9 (noting however that runoff from the southern portion of A1LF [approximately 0.9 acres] drains towards Outfall 011 where there is an active treatment system in place). This monitoring site was ranked seventh overall with a multi-constituent score of 0.28 and was ranked first for metals (tied with lower parking lot storm drain, soil stockpile, and B-1 culvert inlet), ninth for dioxins, and exceeded both the 95th percentile background limits and the permit limits (in this case for TCDD TEQ, which includes congener DNQ results for the purposes of the Expert Panel's ranking analysis)<sup>4</sup>. In August 2011, an adjacent 1.5 acre asphalt parking lot east of the A1LF was removed and stabilized with straw wattles and hydromulch. Hydroseed mulch will be applied prior to the 2011/2012 rainy season; thus reducing runoff to CM-9. The area has predominantly type D soils (low infiltration rates and high runoff potential) (USDA-NRCS, 2007) and significant exposed bedrock.

### **2.4.2 BMP Description**

Conceptual planning at the A1LF indicates that necessary actions include continued inspection and maintenance of CM-9 (removal of accumulated sediment), channel armoring erosion control (i.e., filtered rock bedding) in the drainage channel at the base of the hillside, and potentially rerouting and treating sheet flow runoff from the top of the landfill with a vegetated trapezoidal swale (swale may be geomembrane-lined, pending regulatory review). The swale concept is tentative and currently under consideration by the Expert Panel, and will be re-evaluated based on BMP subarea monitoring results from the 2011/2012 rainy season<sup>5</sup>. If future monitoring data continue to indicate the need for a swale, the concept will then need to be evaluated for permitting feasibility given that the current draft concept crosses the landfill boundary; therefore, it may be subject to Ventura County jurisdiction and review/approval. If it is

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<sup>4</sup> Although actions will be taken to address runoff from this subarea, it should be noted that no NPDES permit limits were exceeded in any of the five grab samples that were collected from this monitoring location during the 2010/2011 rainy season based on NPDES compliance reporting procedures..

<sup>5</sup> The recent asphalt removal and wattles are anticipated to significantly reduce surface runoff and may preclude the need for additional stormwater controls at this location.

found to be permissible and necessary, the swale will run along the top of the slope and will be designed to convey a portion of runoff from the top of the landfill and former parking lot toward Area I Road, into the Outfall 011 watershed. If implemented, the swale will be sized for the 1-year, 24-hour storm event peak flow of 0.1 cubic feet per second. The drainage area contributing to the swale is 3.6 acres, consisting of a 1.2 acre portion of the A1LF, the 1.5 acre asphalt parking lot removal area, 0.8 acres northeast of the parking lot, and a 0.2 acre strip of road. The lower hillside portion of the landfill is currently well vegetated and is occupied by an access road that is covered with erosion controls (hydroseed mulch and straw wattles).

## **2.5 Project Summary**

The four proposed BMPs previously described are designed to address a combined drainage area of approximately 58.9 acres, or 11% of the 536 acre Outfall 009 watershed. Asphalt removal proposed at the new BMP locations totals approximately 5.8 acres (this includes 3.8 acres at the helipad, 0.5 acres at ELV [potentially], and the 1.5 acres of asphalt recently removed at the parking lot adjacent to the A1LF); this is in addition to future onsite asphalt removal associated with building and parking lot demolition restoration activities (e.g., asphalt removal at the lower parking lot). Additional ISRA excavation and restoration activities are planned within the Outfall 009 watershed at 11 areas (16,000 cubic yards *ex situ*) following the completion of Phase III (2011) activities. Potential BMP and performance monitoring will continue as described in the July 2011 Report (MWH et al., 2011) as the site undergoes demolition, remediation, and restoration activities. These continued monitoring activities will help inform the need for and selection of future stormwater controls.

## **3. SCHEDULE**

The following is the anticipated schedule of subsequent action. The schedule is subject to modification based on future information. The need for the A1LF swale will be evaluated throughout the coming rainy season based on local surface runoff observations. For this reason, the schedule below is not applicable to that particular stormwater control. If the swale is deemed necessary, a schedule of subsequent action will be prepared at that time.

- October 2011 – Complete LOX BMPs
- February 2012 – Complete 60% designs for Helipad, ELV
- March 2012 – Complete A1LF BMP (rip rap placement in channel only)

- April 2012 – Complete 90% designs for Helipad and ELV
- May 2012 – Complete 100% designs for Helipad and ELV
- June 2012 – Prepare bid documents, select contractor, and submit permit applications<sup>6</sup>
- July 2012 – October 2012 – Construction of Helipad BMPs (date subject to permits)

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<sup>6</sup> Very few permits are currently anticipated and permits from California Department of Fish and Game (CDFG)/Army Corps of Engineers (ACOE)/RWQCB are not expected.

#### **4. REFERENCES**

Geosyntec Consultants and Santa Susana Field Laboratory Surface Water Expert Panel, 2010. BMP Subarea Sampling Recommendations for 008/009 BMP Work Plan. December 16.

MWH, 2010. 2010-2011 Best Management Practices (BMP) and Interim Source Removal Action (ISRA) Performance Monitoring Sampling and Analysis Plan for the 008/009 Watershed. December 21. [http://www.boeing.com/aboutus/environment/santa\\_susana/water\\_quality/isra\\_101221\\_110693\\_BMPnISRA\\_PerfMntgPlan.pdf](http://www.boeing.com/aboutus/environment/santa_susana/water_quality/isra_101221_110693_BMPnISRA_PerfMntgPlan.pdf)

MWH, Santa Susana Field Laboratory Surface Water Expert Panel, Geosyntec Consultants, Haley & Aldrich, Inc., and CH2M Hill, 2010. Best Management Practices (BMP) Plan, Outfalls 008 and 009 Watersheds, Santa Susana Field Laboratory, Ventura County, California. October 14. [http://www.boeing.com/aboutus/environment/santa\\_susana/water\\_quality/isra\\_10-10-19\\_BMPPlanOF008and009Watersheds.pdf](http://www.boeing.com/aboutus/environment/santa_susana/water_quality/isra_10-10-19_BMPPlanOF008and009Watersheds.pdf)

MWH, Santa Susana Field Laboratory Surface Water Expert Panel, Geosyntec Consultants, and Haley & Aldrich, Inc., 2011. ISRA Performance Monitoring and Potential BMP Subarea Monitoring for Outfalls 008 And 009 Watersheds, 2010-2011 Rainy Season, Santa Susana Field Laboratory, Ventura County, CA. July 29. [http://www.boeing.com/aboutus/environment/santa\\_susana/isra.html](http://www.boeing.com/aboutus/environment/santa_susana/isra.html)

RWQCB, 2010a. Waste Discharge Requirements – The Boeing Company, Santa Susana Field Laboratory, Canoga Park, CA, Order No. R-4-2010-0090, NPDES No. CA0001309. June 16.

Santa Susana Field Laboratory Surface Water Expert Panel and Geosyntec Consultants, 2011a. SSFL Watershed 008 and 009 BMP Site Ranking Analysis Approach. Memorandum to Cassandra Owens, Regional Water Quality Control Board. The Boeing Company, Santa Susana Field Laboratory, Canoga Park, California, Order No. R4-2010-0090, NPDES No. CA0001309, CI No. 6027. June 22.

Santa Susana Field Laboratory Surface Water Expert Panel and Geosyntec Consultants, 2011b. SSFL Watershed 008 and 009 BMP Site Ranking Analysis, July 26.

United States Department of Agriculture Natural Resources Conservation Service (USDA NRCS). 2007. Chapter 7—Hydrologic Soil Groups. Part 630 –Hydrology: National Engineering Handbook, Washington D.C.

# APPENDIX A

# STORMWATER BMP CONCEPT DESIGNS

## FOR

# SANTA SUSANA FIELD LABORATORY

# WATERSHED 009, NASA AND BOEING PROPERTIES

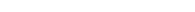
SEPTEMBER 2011

### DRAWING INDEX

DRAWING NO.	TITLE
1	TITLE SHEET
2	LOCUS AND KEY MAP
3	HELIPAD AREA BMPS
4	ELV CULVERT BMPS
5	LOX AREA BMPS
6	AREA 1 LANDFILL BMPS

### LEGEND

#### EXISTING CONDITIONS

	DRAINAGE
	PROPERTY LINE
	DRAIN PIPE
	ISRA BOUNDARY
	RFI BOUNDARY
	SUBCATCHMENT BOUNDARY
	WATERSHED 009 BOUNDARY
	EASEMENT BOUNDARY
	BMP SUBAREA MONITORING LOCATION
	RIPRAP

#### PROPOSED CONDITIONS

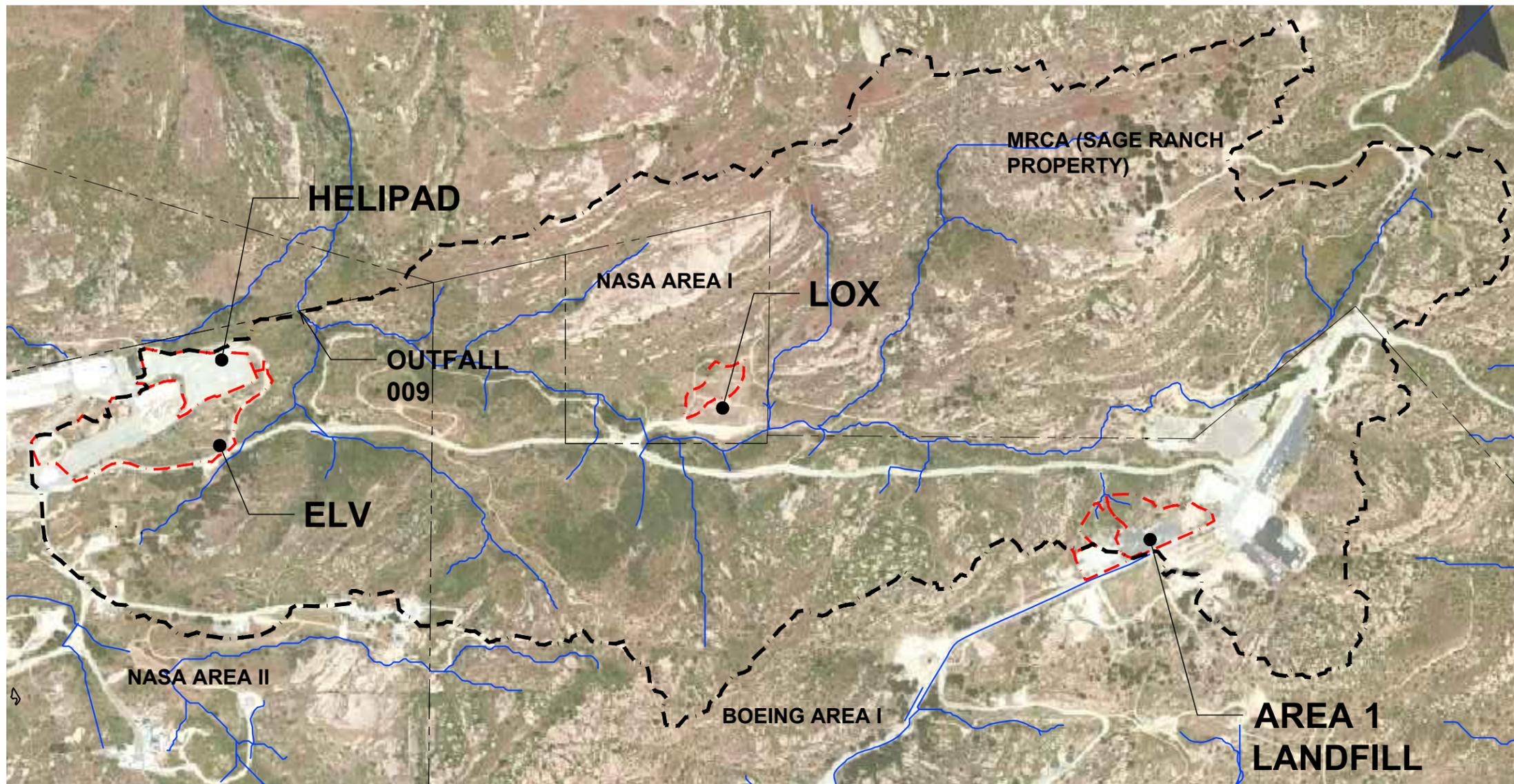
	DRAIN PIPE
	SANDBAG / EARTH BERM
	CHANNEL RECONSTRUCTION
	VEGETATED SWALE
	RIPRAP
	ASPHALT REMOVAL
	FILTER/BASIN WATER SURFACE LEVEL AT OVERFLOW INVERT
	GEOCELL BACKFILLED WITH GRAVEL
	FLOW DIRECTION

#### NOTES:

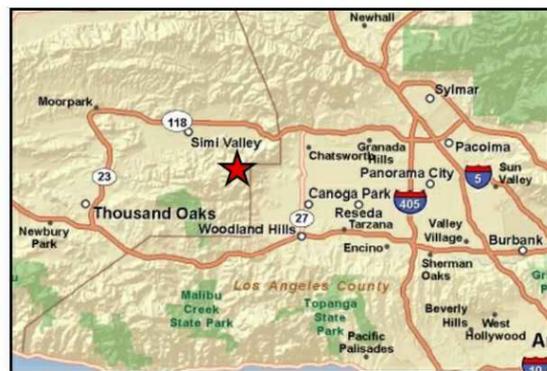
1. AERIAL IMAGERY USED FOR BASE PLANS HEREIN WAS PROVIDED BY SAGE CONSULTANTS, INC. AND WAS FLOWN ON JUNE 2, 2010.
2. CONTOUR DATA SHOWN REPRESENT 1 FT ELEVATION DATA PROVIDED BY SAGE CONSULTANTS, INC.
3. PROPOSED BMP FEATURES AND FOOTPRINTS ARE APPROXIMATE AND INTENDED TO REFLECT INITIAL SIZING BASED ON SURFACE WATER EXPERT PANEL'S SITE-SPECIFIC SIZING CRITERIA.
4. DRAWINGS ARE FOR DESIGN CONCEPT ILLUSTRATION ONLY, ARE PRELIMINARY, SUBJECT TO CHANGE, AND ARE NOT FOR CONSTRUCTION.
5. BIOLOGICAL AND UTILITY SURVEYS REQUIRED AT MOST LOCATIONS. ENGINEERING/CONSTRUCTION FEASIBILITY ASSESSMENT ALSO REQUIRED. COUNTY GRADING AND BUILDING/CONSTRUCTION PERMITS ALSO NEED TO BE CONSIDERED.

TITLE: <b>TITLE SHEET</b>	PREPARED BY:  924 ANACAPA STREET, SUITE 4A SANTA BARBARA, CA 93101 PHONE: 805.897.3800	PREPARED FOR:   SANTA SUSANA FIELD LABORATORY VENTURA COUNTY, CALIFORNIA	PROJECT: <b>STORMWATER BMP CONCEPT DESIGNS                  SSFL WATERSHED 009</b>	DESIGNED BY: JC DRAWN BY: JC	REVIEWED BY: DHB APPROVED BY: BS	DATE: SEPT 2011 PROJ. NO.: SB0363R	DRAWING: <b>1</b>
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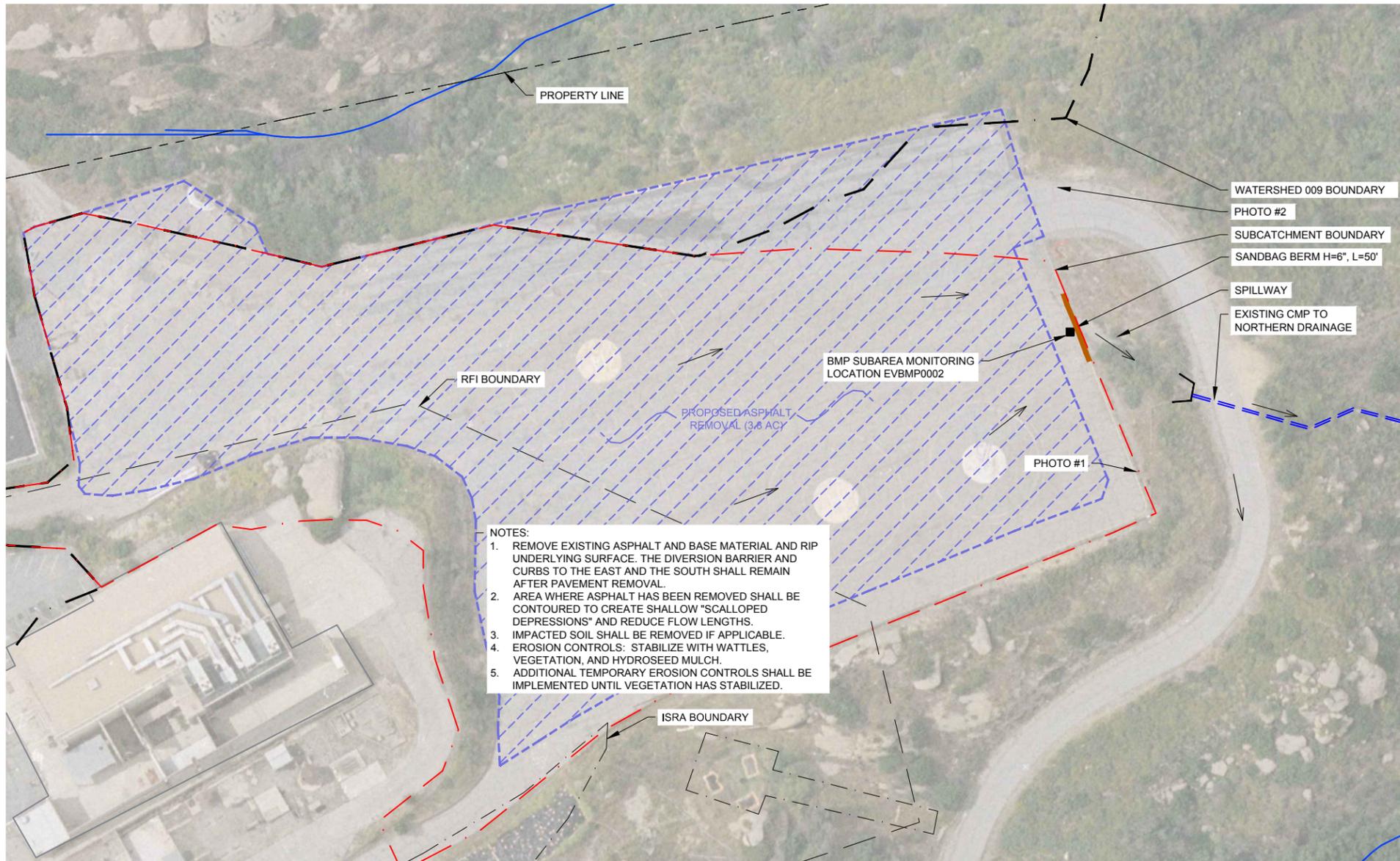
P:\PROJECT FOLDERS\BOEING\SB0363R\BOEING STORMWATER 2011\CADD-GIS FILES\SB0636R--1001 NASA CONCEPT BMP DESIGNS - STANDARD\SHEET 2 - LOCUS PLAN



**LEGEND:**  
 - - - 009 WATERSHED BOUNDARY  
 - - - SUBCATCHMENT BOUNDARY



TITLE: <b>LOCUS AND KEY MAP</b>	PREPARED BY: <b>Geosyntec</b> consultants 924 ANACAPA STREET, SUITE 4A SANTA BARBARA, CA 93101 PHONE: 805.897.3800	PREPARED FOR: <b>BOEING</b>  <b>NASA</b> SANTA SUSANA FIELD LABORATORY VENTURA COUNTY, CALIFORNIA	PROJECT: <b>STORMWATER BMP CONCEPT DESIGNS SSFL WATERSHED 009</b>	DESIGNED BY: JC	REVIEWED BY: DHB	DATE: SEPT 2011	DRAWING: <b>2</b>
				DRAWN BY: JC	APPROVED BY: BS	PROJ. NO.: SB0363R	



- NOTES:
1. REMOVE EXISTING ASPHALT AND BASE MATERIAL AND RIP UNDERLYING SURFACE. THE DIVERSION BARRIER AND CURBS TO THE EAST AND THE SOUTH SHALL REMAIN AFTER PAVEMENT REMOVAL.
  2. AREA WHERE ASPHALT HAS BEEN REMOVED SHALL BE CONTOURED TO CREATE SHALLOW "SCALLOPED DEPRESSIONS" AND REDUCE FLOW LENGTHS.
  3. IMPACTED SOIL SHALL BE REMOVED IF APPLICABLE.
  4. EROSION CONTROLS: STABILIZE WITH WATTLES, VEGETATION, AND HYDROSEED MULCH.
  5. ADDITIONAL TEMPORARY EROSION CONTROLS SHALL BE IMPLEMENTED UNTIL VEGETATION HAS STABILIZED.

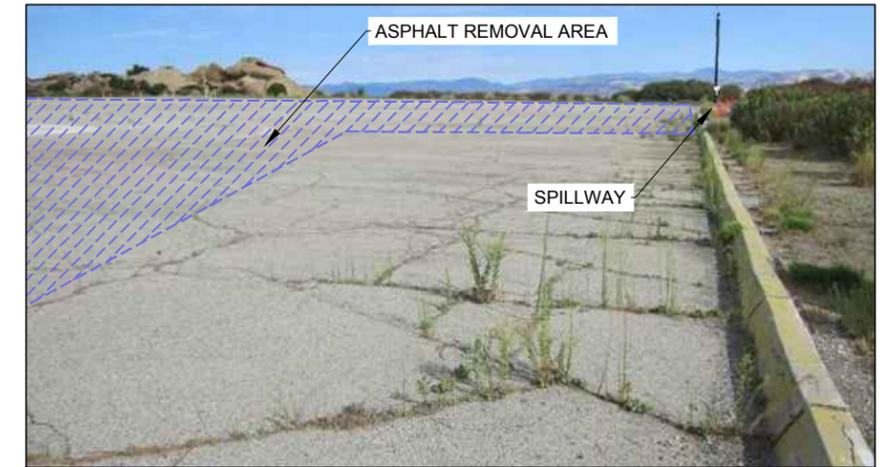


PHOTO #1: LOOKING NORTH ALONG CURB AT EASTERN END OF HELIPAD, SEE MAP.

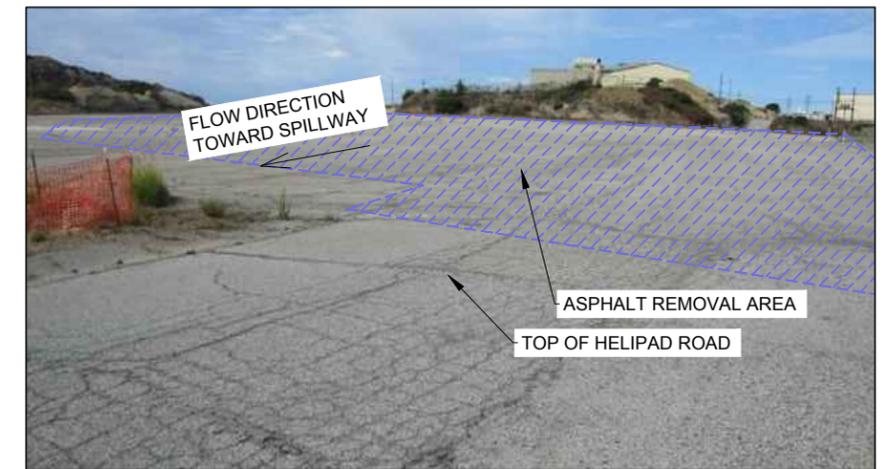
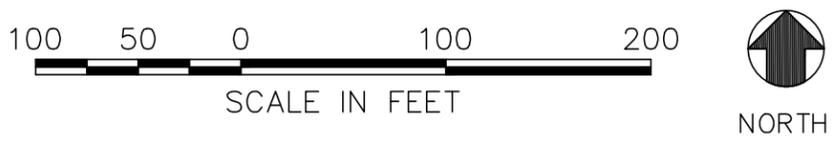


PHOTO #2: LOOKING WEST FROM EASTERN END OF HELIPAD, SEE MAP.

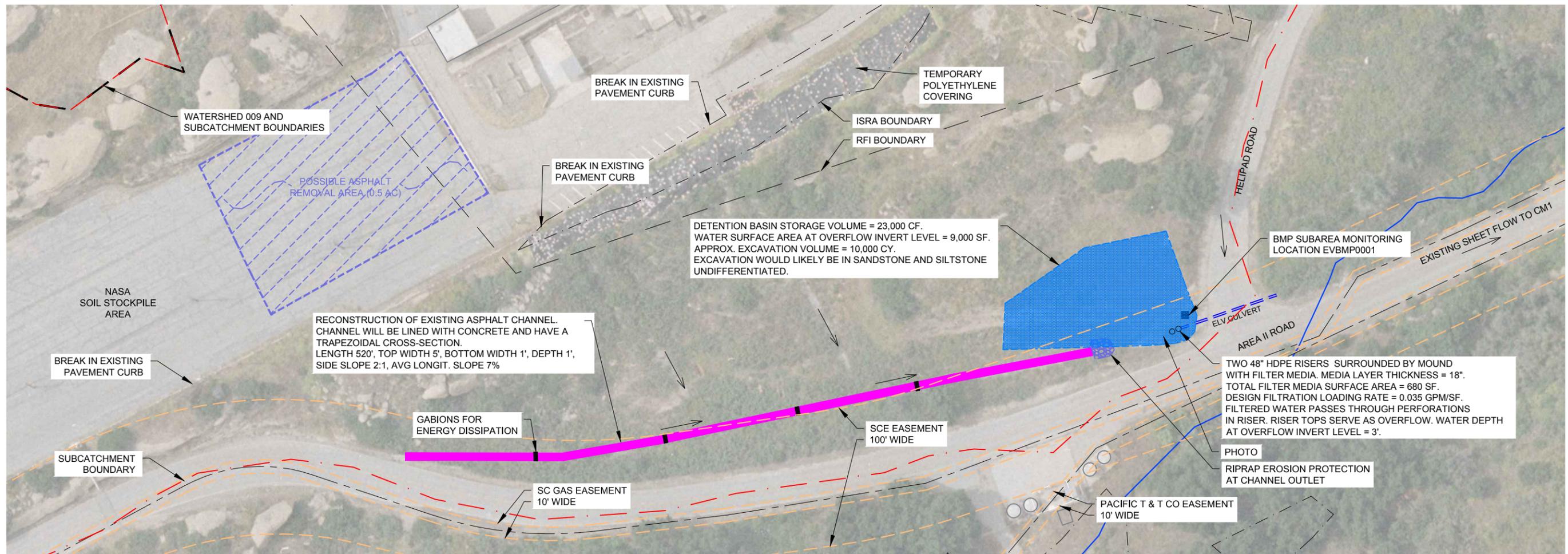


## CONCEPTUAL DESIGN

NOTE: PROPOSED DESIGN FEATURES WERE PRELIMINARILY SIZED AND ARE APPROXIMATE. FINAL BMP DESIGN DETAILS AND SIZES WILL BE CONFIRMED BASED ON ENGINEERING DESIGN ANALYSIS. FINAL DESIGNS WILL BE SUBJECT TO ENGINEERING FEASIBILITY ASSESSMENT, PERMITTING CONSTRAINTS (I.E., REGULATORY AGENCY REQUIREMENTS), AND EXPERT PANEL AND PROPERTY OWNER REVIEW AND APPROVAL.  
 TRIBUTARY AREA TO SPILLWAY IS 4.1 AC AND 90% IMPERVIOUS.  
 ASPHALT REMOVAL MAY REQUIRE COUNTY FIRE DEPARTMENT NOTIFICATION.

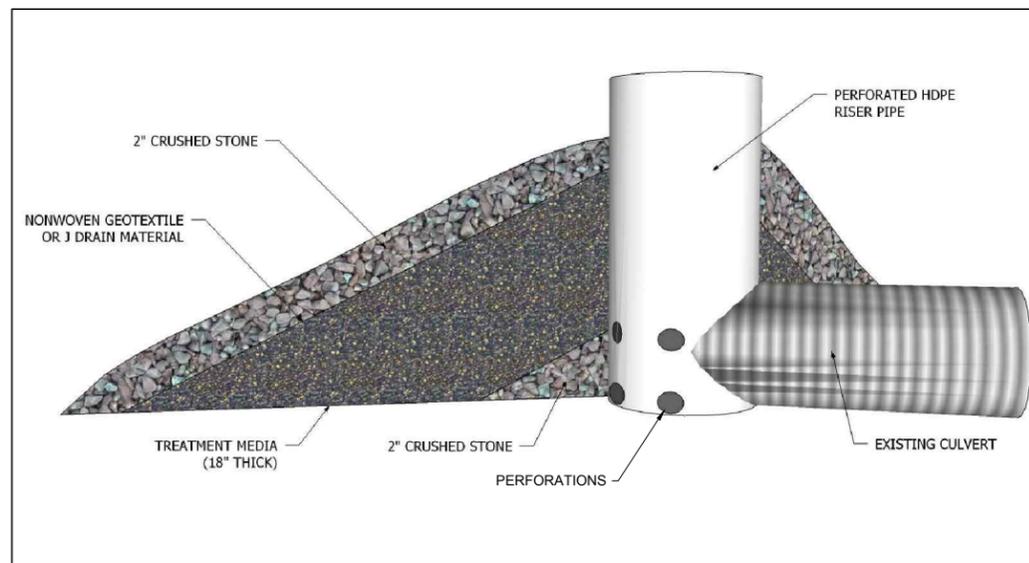
## SITE PHOTOS

TITLE: <b>HELIPAD AREA BMPS</b>	PREPARED BY: <b>Geosyntec</b> consultants 924 ANACAPA STREET, SUITE 4A SANTA BARBARA, CA 93101 PHONE: 805.897.3800	PREPARED FOR: <b>BOEING</b> NASA SANTA SUSANA FIELD LABORATORY VENTURA COUNTY, CALIFORNIA	PROJECT: <b>STORMWATER BMP CONCEPT DESIGNS SSFL WATERSHED 009</b>	DESIGNED BY: JC	REVIEWED BY: DHB	DATE: SEPT 2011	DRAWING: <b>3</b>
				DRAWN BY: JC	APPROVED BY: BS	PROJ. NO.: SB0363R	



## CONCEPTUAL DESIGN

NOTE: PROPOSED DESIGN FEATURES WERE PRELIMINARILY SIZED AND ARE APPROXIMATE. FINAL BMP DESIGN DETAILS AND SIZES WILL BE CONFIRMED BASED ON ENGINEERING DESIGN ANALYSIS. FINAL DESIGNS WILL BE SUBJECT TO ENGINEERING FEASIBILITY ASSESSMENT, PERMITTING CONSTRAINTS (I.E., REGULATORY AGENCY REQUIREMENTS), AND EXPERT PANEL AND PROPERTY OWNER REVIEW AND APPROVAL. PROPOSED BMPs ARE SIZED BASED ON A TRIBUTARY AREA OF 12 AC THAT IS 52% IMPERVIOUS WITHOUT ASPHALT REMOVAL.



CROSS SECTIONAL ILLUSTRATION OF PROPOSED CULVERT INLET FILTER

## OBLIQUE VIEW



EXISTING ASPHALT CHANNEL LOOKING EAST, APPROX. 20 FT. UPSLOPE FROM CULVERT INLET, SEE MAP.

## SITE PHOTO

TITLE: <b>ELV CULVERT BMPs</b>	PREPARED BY: <b>Geosyntec</b> consultants 924 ANACAPA STREET, SUITE 4A SANTA BARBARA, CA 93101 PHONE: 805.897.3800	PREPARED FOR: <b>BOEING</b> NASA SANTA SUSANA FIELD LABORATORY VENTURA COUNTY, CALIFORNIA	PROJECT: <b>STORMWATER BMP CONCEPT DESIGNS SSFL WATERSHED 009</b>	DESIGNED BY: JC	REVIEWED BY: DHB	DATE: SEPT 2011	DRAWING: <b>4</b>
				DRAWN BY: JC	APPROVED BY: BS	PROJ. NO.: SB0363R	

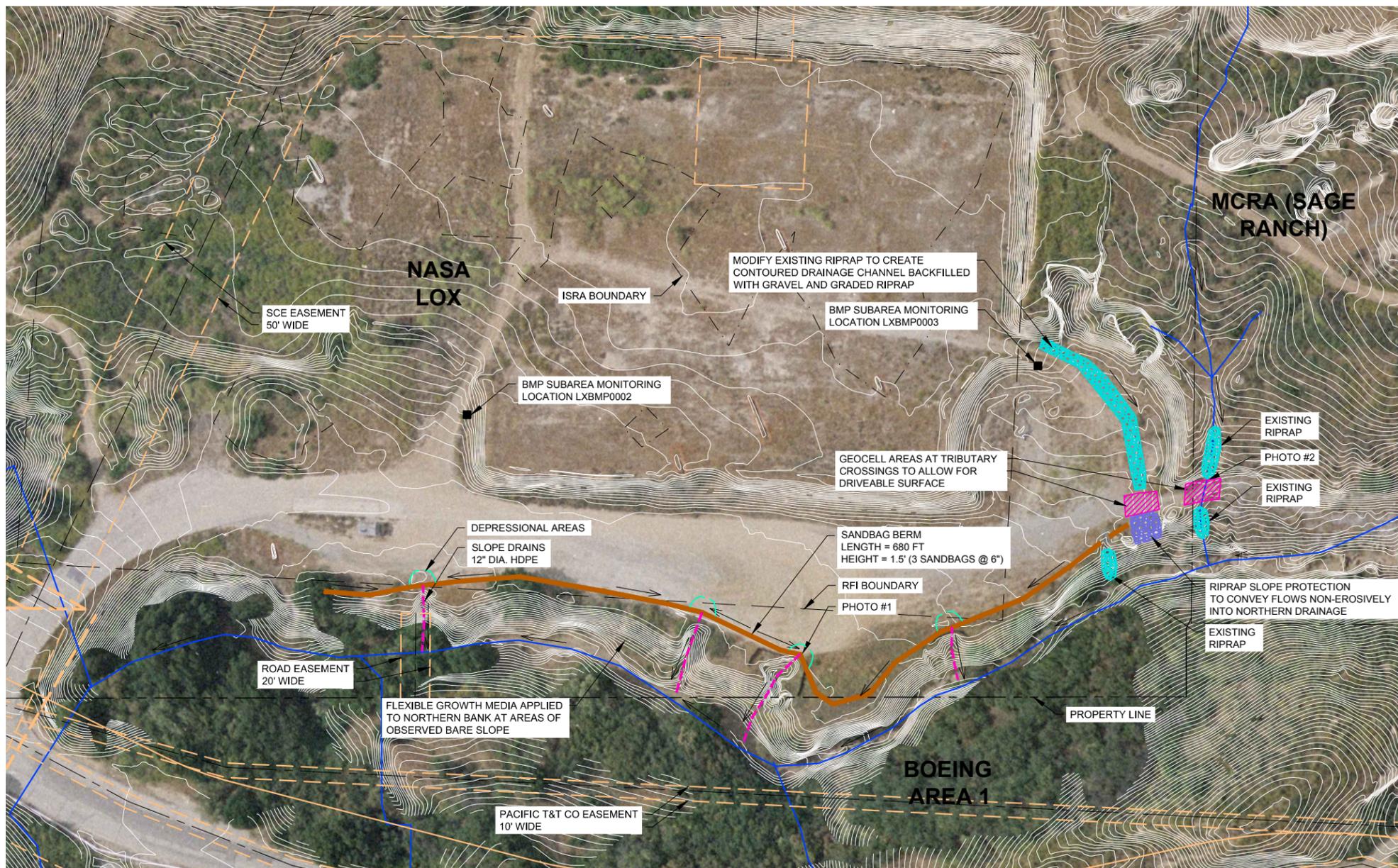


PHOTO #1: LOOKING DOWN EROSION GULLY FROM TOP OF SLOPE. SEE MAP.



PHOTO #2: ACCESS ROAD LOOKING TOWARD SOUTH, SITE OF PROPOSED GEOCELL SHALLOW CROSSING (IN HATCHED AREA ON PHOTO). SEE MAP.

## CONCEPTUAL DESIGN NOT FOR CONSTRUCTION



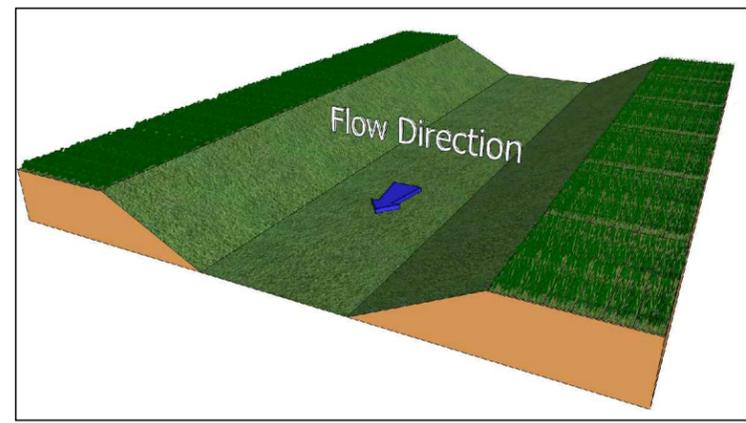
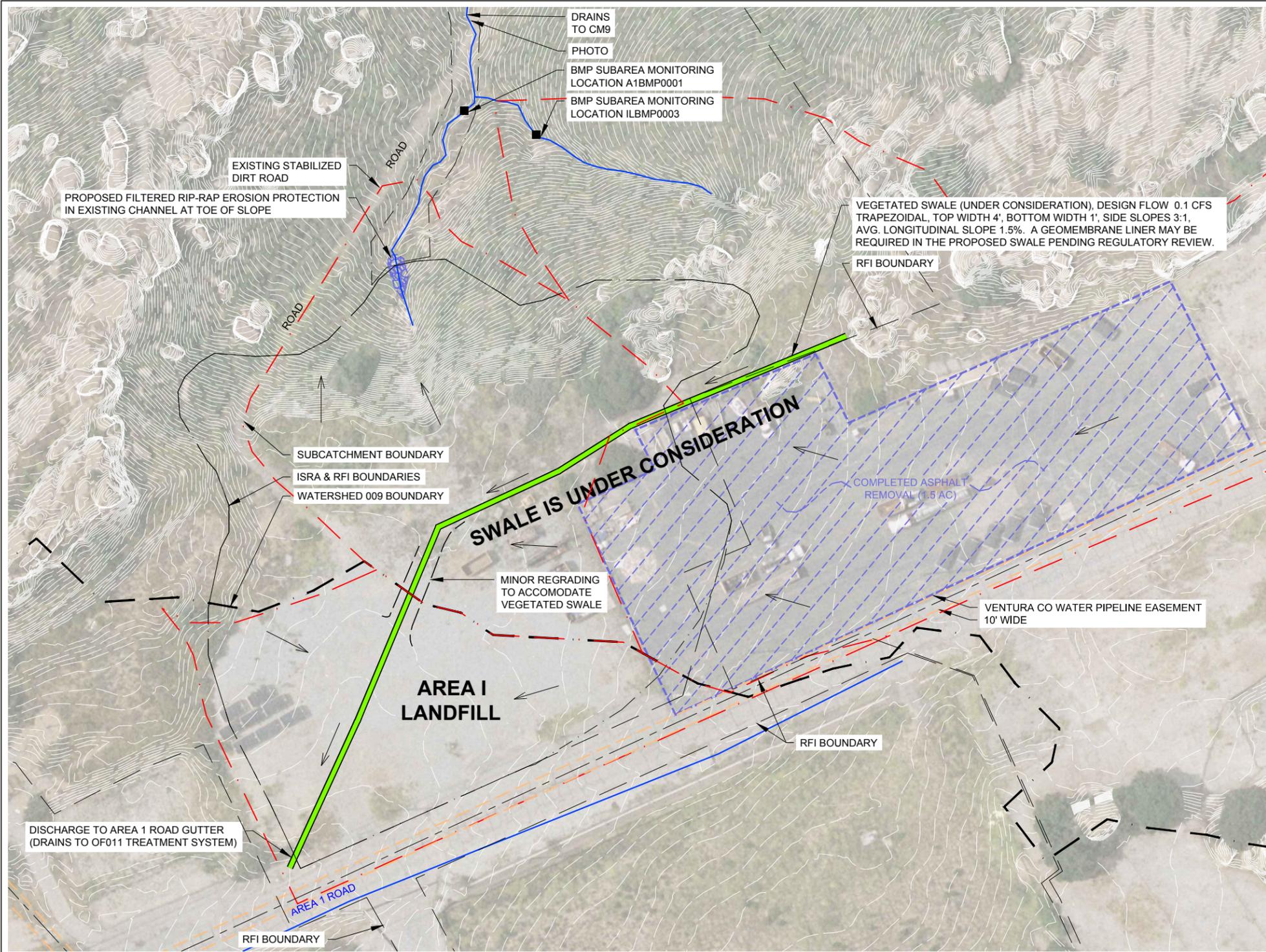
### NOTES:

- PROPOSED DESIGN FEATURES WERE PRELIMINARILY SIZED AND ARE APPROXIMATE. SUBAREA DRAINAGE BOUNDARIES ARE NOT SHOWN AS THEY ARE UNDEFINED FOR THIS AREA. FINAL BMP DESIGN DETAILS AND SIZES WILL BE CONFIRMED BASED ON SITE VISIT AND ENGINEERING DESIGN JUDGMENT AND ANALYSIS. FINAL DESIGNS WILL BE SUBJECT TO ENGINEERING FEASIBILITY ASSESSMENT, PERMITTING CONSTRAINTS (I.E., REGULATORY AGENCY REQUIREMENTS), AND EXPERT PANEL AND PROPERTY OWNER REVIEW AND APPROVAL.
- SLOPE DRAINS SHOULD BE KEYED IN TO THE SAND BAG BERM SO THAT WATER FLOW AROUND THE PIPE IS PREVENTED.
- GRADED DITCH SHOULD BE CONSTRUCTED ON UPSLOPE SIDE OF BERM TO ENSURE PROPER DRAINAGE TOWARDS SLOPE DRAIN INLETS, UNLESS EXISTING GRADE ALREADY ALLOWS FOR THIS.
- EXISTING RIPRAP SHOULD BE REINSTALLED WITH FILTERED ROCK BEDDING, AND PROPOSED RIPRAP SHOULD BE SIMILARLY INSTALLED WITH FILTERED ROCK BEDDING.
- GEOCELL TRIBUTARY CROSSINGS SHOULD BE SHAPED INTO A CHANNEL TO ALLOW FOR CONVEYANCE OF CONCENTRATED FLOWS ACROSS THEM.

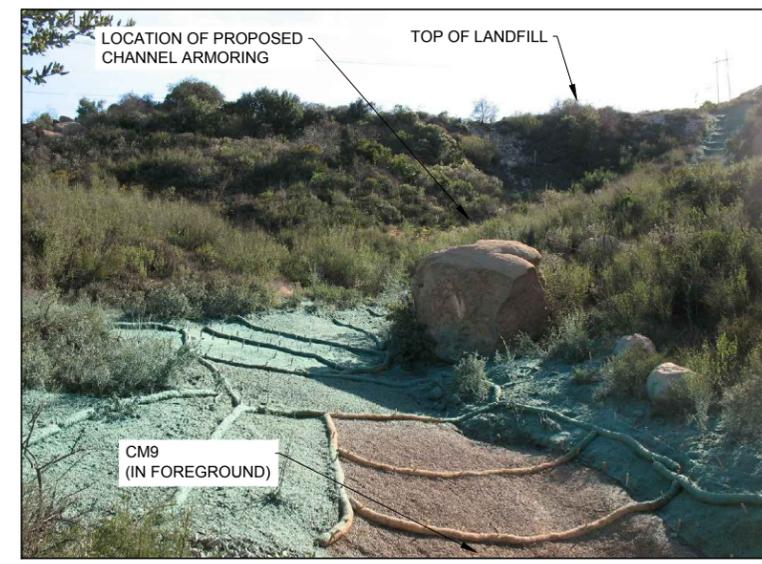
## SITE PHOTOS

TITLE:	<b>LOX AREA BMPS</b>	PREPARED BY:	Geosyntec 924 ANACAPA STREET, SUITE 4A SANTA BARBARA, CA 93101 PHONE: 805.897.3800	PREPARED FOR:	BOEING NASA SANTA SUSANA FIELD LABORATORY VENTURA COUNTY, CALIFORNIA	PROJECT:	<b>STORMWATER BMP CONCEPT DESIGNS SSFL WATERSHED 009</b>	DESIGNED BY:	JC	REVIEWED BY:	DHB	DATE:	SEPT 2011	DRAWING:	<b>5</b>
								DRAWN BY:	JC	APPROVED BY:	BS	PROJ. NO.:	SB0363R		

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CROSS SECTIONAL ILLUSTRATION OF PROPOSED VEGETATED SWALE  
**OBLIQUE VIEW**



FROM CM9 LOOKING SOUTH TOWARD A1LF HILLSIDE, SEE MAP.

**SITE PHOTO**

**CONCEPTUAL DESIGN**

NOTE: PROPOSED DESIGN FEATURES WERE PRELIMINARILY SIZED AND ARE APPROXIMATE. FINAL BMP DESIGN DETAILS AND SIZES WILL BE CONFIRMED BASED ON SWMM MODEL AND ENGINEERING DESIGN ANALYSIS. FINAL DESIGNS WILL BE SUBJECT TO ENGINEERING FEASIBILITY ASSESSMENT, PERMITTING CONSTRAINTS (I.E., REGULATORY AGENCY REQUIREMENTS), AND EXPERT PANEL AND PROPERTY OWNER REVIEW AND APPROVAL.

TITLE: <b>AREA 1 LANDFILL BMPS</b>	PREPARED BY: <b>Geosyntec consultants</b> 924 ANACAPA STREET, SUITE 4A SANTA BARBARA, CA 93101 PHONE: 805.897.3800	PREPARED FOR: <b>BOEING</b> NASA SANTA SUSANA FIELD LABORATORY VENTURA COUNTY, CALIFORNIA	PROJECT: <b>STORMWATER BMP CONCEPT DESIGNS SSFL WATERSHED 009</b>	DESIGNED BY: JC	REVIEWED BY: DHB	DATE: SEPT 2011	DRAWING: <b>6</b>
				DRAWN BY: JC	APPROVED BY: BS	PROJ. NO.: SB0363R	