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Via FedEx

February 28, 2008
In reply refer to SHEA-107050

Regional Water Quality Control Board
Los Angeles Region
320 West 4th Street, Suite 200
Los Angeles, CA 90013

Attention: Information Technology Unit

Reference: Compliance File CI-6027 and NPDES No. CA0001309

Subject: 2007 Annual NPDES Discharge Monitoring Report; The Boeing Company, Santa Susana Field Laboratory, Ventura County, California

Dear Sir/Madam:

The Boeing Company (Boeing) hereby submits this annual discharge monitoring report (DMR) for the Santa Susana Field Laboratory (SSFL) for the period of January 1, 2007 through December 31, 2007. This DMR is provided for all outfalls authorized by NPDES Permit No. CA0001309. This reporting period utilizes two sets of permit requirements. The Los Angeles Regional Water Quality Control Board (Regional Board) revised the permit to implement the Los Angeles River Metals Total Maximum Daily Load (TMDL) and Los Angeles River Nutrients TMDL at the March 3, 2006 Regional Board Hearing, and issued an updated NPDES Permit dated March 17, 2006 with an effective date of April 28, 2006. That permit was appealed and on December 13, 2006, the California State Water Resources Control Board (State Board) remanded the NPDES Permit to the Regional Board for the review of the waste discharge requirements for Boeing SSFL. The Regional Board issued a revised permit on November 9, 2007, with an effective date of December 20, 2007. The following is a tabulated list of the two permits effective during 2007.

| NPDES Permit Revisions | Order Number | Issue Date | Effective Dates |
|---|---|---|---|
| 2006 Amendment with TMDL | R4-2006-0036 | March 17, 2006 | April 28, 2006 to December 19, 2007 |
| 2007 Permit | R4-2007-0055 | November 9, 2007 | December 20, 2007 to December 31, 2007 |

This annual DMR provides information and data, including summary tables of surface water sample analytical results, rainfall summaries, liquid waste shipment summaries, and analytical laboratory QA/QC procedures and certifications. A compact disk with the report tables, figures and attachments is being submitted along with this DMR. This document will also be made available electronically at:

www.boeing.com/aboutus/environment/santa_susana/programs.html.

Additionally, hard copies of this report are available at the following: California State University at Northridge Library; Simi Valley Library; and the Platt Branch, Los Angeles Library.

## REPORT CONTENTS

This annual DMR summarizes analytical data collected from the permitted outfalls during 2007. Data for this report have been summarized in tabular form. Therefore, in addition to the report text, this DMR includes the following:

- SSFL facility map showing the outfall locations (Figure 1)
- Summary of Annual Rainfall (Table 1)
- Summary of Liquid Waste Disposal (Table 2)
- Summary of Permit Limit Exceedances (Table 3)
- Outfall-specific Summary Tables and Charts of Analytical Results (Sections 1 through 8)
- Summary of Reasonable Potential Analysis (RPA) (Section 9)
- Storm Water Pollution Prevention Plan Annual Evaluation (Section 10)
- Analytical Laboratory QA/QC Procedures and Certifications (Section 11)

## OVERVIEW OF THE 2007 REPORTING PERIOD AT SSFL

This section presents an overview of the efforts Boeing has made and continues to make to achieve compliance. It provides an overview of best management practices (BMPs) that have been deployed to minimize impacts to surface water and the potential for surface water permit limit exceedances.

As reported in previous DMRs and annual reports submitted by Boeing to the Regional Board, Boeing's investigations suggest that most of the constituents detected in storm water result from naturally occurring soil contributions and atmospheric deposition, or were detected at concentrations consistent with regional background concentrations. In addition, concentrations of certain constituents have almost certainly been influenced by the late September 2005 Topanga Wildfire (Topanga Wildfire) at SSFL. Furthermore, based on SSFL operations and activities, Boeing's opinion is that most of the detections of constituents exceeding permit limits are not the direct result of a known discharge or release from an industrial process or historical contamination at the site. In some cases, former industrial activities at the SSFL may have impacted localized areas of on-site soils and sediments that could have potentially affected storm water quality. However, under regulatory supervision, Boeing has completed numerous mitigation actions to manage surface water impacts potentially resulting from former industrial activities. These actions include extensive soil removal; covering and/or stabilizing areas pending site-wide corrective action implementation; and implementing an extensive system of BMPs. Boeing has implemented and continues to implement and improve BMPs to minimize the transport of soils and/or sediment that may be associated with constituents regulated in the SSFL NPDES permit. Additionally, numerous BMPs are designed to remove dissolved constituents from storm water.

Unlike most industrial facilities regulated through the NPDES Program, the SSFL is a predominantly natural habitat. Greater than ninety percent of the facility is natural and undeveloped, and is covered with natural vegetation (much of which is native), sandstone rock outcrops, and weathered sandstone sediment and soil. Such land use is typically defined as "open space." All discharges from SSFL are storm water with the exception of discharges from the groundwater treatment system. Storm water discharges are not continuous, consistent, or scheduled. Water discharge results from rainfall becoming surface flow, and occurs through natural, unlined drainages. Compounds that naturally occur in rocks and sediment (e.g., metals) are present in the surface water that flows through these drainages. Furthermore, as with all areas around the Los Angeles River Basin, there is a contribution of constituents from atmospheric deposition. The contributions from naturally occurring and atmospheric sources have been addressed in the Flow Science Technical Report "Potential Background Constituent Levels in Storm Water at Boeing's Santa Susana Field Laboratory," February 23, 2006 (Flow Science Background Report). Boeing continues to evaluate this issue, while aggressively striving to achieve our goal of compliance with the permit limits.

Since storm water runoff is sporadic and highly variable in intensity and volume, it is expected that the concentration of these compounds will also vary from sampling event to sampling event. This is discussed in further detail in the following sections.

**Best Management Practices (BMPs)**

In 2007 Boeing improved and upgraded multiple BMPs as listed in the Corrective Action section of this report, in order to address previous exceedances and improve surface water discharge quality. Specific upgrade details are provided by outfall location.

To help to evaluate the effectiveness of BMPs, automated influent and effluent sampling units have been installed above and below BMPs at Outfalls 003, 004, 006, 010, 011, and 018 to collect samples to analyze for suspended sediment concentration during storm events as a means of estimating the constituent removal effectiveness of BMPs. Results are included in the attachment of this report to the Regional Board as required.

The Regional Board adopted the Cease and Desist Order (CDO) No. R4-2007-0056 on November 1, 2007, requiring Boeing to submit a work plan to evaluate, select and implement long term, engineered natural treatment systems (ENTS) in the Outfall 008 and 009 watersheds. Geosyntec Consultants (Geosyntec) have been retained to provide the lead consultation on the ENTS design, which includes management of an Expert Panel comprised of storm water hydrology and BMP design experts (Geosyntec, 2007b). The Expert Panel will address the Regional Board's concerns regarding a design storm for all outfalls at the site and provide technical oversight on the design of the ENTS within the Outfall 008 and 009 watersheds. In 2007, under the direction of Geosyntec, the Expert Panel was selected and a kick-off meeting was held. ENTS construction is scheduled to be complete by October 31, 2008 (Geosyntec, 2007b). This schedule is contingent upon the progress and recommendations of the Expert Panel, permitting issues, DTSC coordination, and various other factors.

In addition to the ENTS design and construction, a remedial action began in 2007 in the drainage of Outfall 009 under the direction of the DTSC and pursuant to Clean-up and Abatement Order (CAO) No. R4-2007-0054, issued by the Regional Board on November 6, 2007, to cleanup and abate wastes observed in this drainage. Soil and debris removal began in the LOX Debris Area on November 14, 2007, and was completed on December 20, 2007. Further debris removal in the Former Shooting Range Area/Northern Drainage Debris Area is scheduled to commence in the spring of 2008. BMPs in the LOX Debris Area (including fiber rolls, straw bales, silt fencing, coco matting, and hydromulch) were deployed during field work to minimize the potential for excessive erosion and impacts to the drainage.

**Wildfires**

Wildfires, the effects of which have been widely documented and which have occurred at the SSFL site, release significant amounts of metals and dioxins, and storm water runoff following forest fire events has been observed to carry significantly higher concentrations and loads of these constituents. Atmospheric deposition rates of metals have been observed to rise several-fold during fires. Atmospheric concentrations of dioxin are also elevated during fires. Fires leave behind ash and destroy vegetation, resulting in significant changes in the hydrologic response of watersheds, including higher runoff volumes, higher flow rates, and higher concentrations of total suspended solids (TSS), which in turn carry regulated constituents (Flow Science Background Report). Post-fire effects can continue to impact the quantity and quality of storm water runoff for several years following a fire.

As previously reported, the Topanga Wildfire began on September 28, 2005, and burned approximately 70% of the SSFL site. On-site activities began immediately following the fire and have continued to date to reduce the impact of the ash and charred material on surface water quality. In 2007, numerous activities continued to take place in order to help restore the natural, engineered and/or institutional controls that aid in minimizing the erosion of surface materials and the migration of sediment in surface water. Hydromulch and/or hydroseed was placed over approximately 20 acres of areas observed to have erodible soils and/or ash. Hydromulch is a semi-liquid organic binder blended with hydromulch paper or wood fiber/pulp that is dispersed onto and adheres to the ground surface and soil surface to protect from further soil erosion, to aid in minimizing sediment transport, and to decrease the potential for mudslides and debris flows. Hydroseed is hydromulch that incorporates a native seed mixture. Hydromulch/hydroseed application occurred upstream and near Outfalls 001, 002, 003, 008, 009, 010, 011 and 018 during 2007.

Additionally, Boeing removed approximately 100 cubic yards of accumulated ash that remained in the Outfall 002 drainage in 2007. Several miles of straw wattles were replaced and several more miles were installed in areas where erosive soils were observed.

**Natural Occurrences of Regulated Constituents Affecting Surface Water Quality**

Boeing's opinion is that most storm water monitoring data collected over the past several years have not indicated any specific on-site industrial or operational source(s) for many of the constituents measured in the runoff. This suggests that many, if not most, of the permit limit exceedances may be due to naturally occurring or regional background concentrations – from naturally occurring constituents in soils, impacts from on-site wildfires and ash deposition from wildfires occurring upwind, or due to regional atmospheric deposition. Attempts to find patterns in the exceedances or magnitudes of constituent concentrations have been generally unsuccessful to date. In most cases exceedances are not repeated with

regularity or consistency and most concentrations of constituents greater than permit limits have not been shown to be related to any potential on-site source area or site activity.

In cases where historical site operations appeared to impact or have the potential to impact surface water, extensive measures were taken, generally by way of removing impacted soils and backfilling with clean material to mitigate such impacts. In some instances, tarping and/or other protective measures were installed to isolate impacted soils from storm water runoff. Following such interim measures, constituents in surface waters were generally within the ranges expected due to natural background conditions.

An outfall by outfall description of the BMPs implemented in 2007 is described in the Corrective Action Section of this document.

## DISCHARGE STATUS

Precipitation during 2007 at SSFL is provided for each month of the year in Table 1. Surface water samples were collected when flow was observed at the designated outfall locations following storm events. From January 1 to December 19, 2007, flow was observed and surface water samples were collected from Outfalls 002, 003, 004, 006, 009, and 010, in accordance with the NPDES Permit No. R4-2006-0036. Between December 20 and December 31, 2007, when NPDES Permit No. R4-2007-0055 was effective, flow was observed and surface water samples were collected from Outfall 014 (Advanced Propulsion Testing Facility [APTF]) and the receiving water location in the Arroyo Simi watershed (Frontier Park). Note that while Permit No. R4-2006-0036 required that *process* water discharges be sampled at Outfalls 012, 013, and 014, the 2007 NPDES Permit No. R4-2007-0055 requires that *storm water* discharges be sampled at these outfalls. All rocket engine testing activities ceased at SSFL in 2006 and will not resume. Hence, the water being sampled at Outfalls 012, 013, and 014 under permit R4-2007-0055 differs significantly from water that had been previously sampled at these outfalls.

All sanitary wastes from the domestic sewage treatment plants (STPs I, II, and III; Outfalls 015, 016, and 017, respectively) were shipped off-site to a permitted treatment and disposal facility. Details of the waste shipments are summarized in Table 2. Because discharges did not occur, samples were not collected from these outfalls. Sanitary waste management practices at the site are such that discharges from Outfalls 015 through 017 are not anticipated to occur in the future; therefore, discharges from Outfalls 015, 016, and 017 are no longer included in or regulated by the Permit that became effective December 20, 2007. Figure 1 illustrates the SSFL facility and the locations of the outfalls.

## SURFACE WATER DISCHARGE ANALYTICAL RESULTS REPORTING

All analyses of surface water discharge samples were conducted at laboratories certified for such analyses by the California Department of Public Health or approved by the Regional Board's Executive Officer and in accordance with current United States Environmental Protection Agency (EPA) guidelines, procedures, or as specified in the monitoring program. As indicated on Page T-3 in the NPDES permit, analytical results were designated "Detected

but not Quantified (DNQ)" (similar to organic analyses being J-flagged by the laboratory or data validator) if the analytical result was greater than or equal to the laboratory's method detection limit (MDL), and less than the State Board's Minimum Level (ML) or laboratory reporting limit (RL). For the purposes of determining compliance with permit limits, data that were designated DNQ or that were J-flagged (estimated values), were reported as such, but were not used to establish compliance because its estimated value was less than the laboratories' RL.

Attachment T-A of the NPDES permit presents the State Board's MLs for use in reporting and determining compliance with NPDES permit limits. The analytical laboratory achieved these MLs for 2007. However, some constituents' daily maximum and/or monthly average discharge limits in the NPDES permit are less than their respective MLs and less than the laboratory RL. In cases where the permit limit is less than the RL and ML, the RL was used to determine compliance. As required in the NPDES permit, Section 11 of this report provides a summary table of constituents listed in the permit, their analytical laboratory methods, MDLs, and RLs, and copies of laboratory quality assurance and quality control procedures. California Department of Public Health Environmental Laboratory Accreditation Program (ELAP) certifications are also included in Section 11, as required in the NPDES permit.

During 2007, specific constituents that had permit limits that were less than the RLs and ML were mercury, bis(2-ethylhexyl)phthalate, cyanide, polychlorinated biphenyls (PCBs), (Aroclor congeners), chlordane, DDD, DDE, DDT, dieldrin, toxaphene, and chlorpyrifos. Of these compounds, cyanide and mercury were detected at concentrations equal to or greater than their RL, both on September 22, 2007. Cyanide (10 micrograms per liter [ug/L]) equaled or exceeded its RL at Outfall 002, and mercury (0.23 ug/L) at Outfall 004.

## SUMMARY OF NON-COMPLIANCE AND CORRECTIVE ACTIONS

Analytical results for all surface water samples are summarized in Table 3 and in the Attachment -- Sections 1 through 8. Consistent with prior annual report submittals and in accordance with the NPDES permit, graphic presentation of the data collected has also been included for specific analytes and parameters that could be effectively graphed. Analytes that had a permit limit were graphed. Analytes that do not have permit limits were not graphed. Graphing consisted of charting an analyte's analytical result(s) with the sample date(s). The graphs are included in each section of the attachment as described below.

The tabular and graphic data for all outfall locations, including the Arroyo Simi receiving water location, where data was collected (i.e., where outfalls flowed) are provided in the attachment as follows:

Attachment:

| | |
|---|---|
| Section 1 Outfall 002 | South Slope below R-2 Pond |
| Section 2 Outfall 003 | RMHF |
| Section 3 Outfall 004 | SRE |
| Section 4 Outfall 006 | FSDF-2 |
| Section 5 Outfall 009 | WS-13 Drainage |

Section 6 Outfall 010 Building 203
Section 7 Outfall 014 APTF
Section 8 Receiving Water Location – Arroyo Simi (Frontier Park)

Included after Table 3 and at the beginning of the sections in the attachment are the Annual Reporting Summary Notes. The Annual Reporting Summary Notes are a compilation of notes, abbreviations, and data validation codes that are found in the analytical data summary tables contained in the attachment.

As indicated in the Attachments, and as summarized in Table 3, a 2007 Summary of Permit Limit Exceedances includes:

- Chloride at Outfalls 006 and 014
- Gross Beta at Outfalls 003 and 006
- Lead at Outfall 009
- Mercury at Outfall 004
- pH at Outfall 003 (pH compliance is based on a range of pH values, therefore, non-compliance could be less than or greater than the permitted range)
- TCDD TEQ at Outfalls 004 and 009
- Total Dissolved Solids (TDS) at Outfall 014

In addition to the above list, the following constituents were detected at concentrations greater than their permit limit at Outfall 002 (located in the buffer zone) on September 22, 2007: arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, manganese, nickel, zinc, ammonia as nitrogen (N), total cyanide, chronic toxicity, gross alpha, gross beta, total combined radium (TCR), and TCDD TEQ.

**Discussion of the Most Prevalent Permit Exceedances**

A discussion regarding TCDD TEQ (dioxin) is included below, considering that it was reported to exceed daily maximum permit limits at three compliance outfall locations, and TCDD TEQ has been a consistent source of exceedances at SSFL in recent years. A short discussion regarding monthly average exceedances is also included.

**TCDD (Dioxin): Discussion of Occurrence and Potential Sources**

Due to the unique process by which TCDD concentrations are determined, a brief discussion of TCDD reporting is included. To enable a single total concentration (commonly called a Toxicity Equivalence (TEQ)) to be calculated from the sum of the 17 dioxin and furan congeners, 2,3,7,8-TCDD 'equivalent' concentrations are calculated for each congener by multiplying that individual congener's concentration by its toxic equivalency factor (TEF). The TEF is based on the toxicity of the congener compared to the toxicity of 2,3,7,8-TCDD. The TEFs published by the World Health Organization (WHO) in 1998 are used. The dioxin summary tables in the attachments show the TEFs for the various congeners. The common term for the sum of the factored concentration is TEQ. When used in this report, the term TCDD refers to the total equivalence of the seventeen 2,3,7,8-substituted dioxin and furan congeners (commonly called the TCDD TEQ).

For the purposes of evaluating compliance with permit limits (as stated in the 2007 NPDES permit on Page 54, Section II, C. 3), TCDD TEQ is based on detected congeners and does not include those congeners reported as ND (not detected) or detected, but not quantified (DNQ). A DNQ is a value less than the laboratory RL, but greater than the laboratory level of detection (LOD). Therefore, when evaluating whether a permit limit exceedance occurred, ND or DNQ data (the resulting estimated values) were considered zero in the calculation.

During 2007, TCDD TEQ exceeded permit limits at Outfalls 002, 004, and 009. TCDD has been frequently detected in Department of Toxic Substances Control (DTSC)-approved non-impacted background soil sample locations (MWH, 2005). In some areas, on-site operations have utilized combustion processes. However, the TCDD TEQ values in soils collected from these potentially impacted areas have been found either not to be elevated above background levels, or if elevated, they have been shown to decrease to near background levels within a short distance from the suspected source area.

Also, as documented in the Flow Science Background Report, TCDD TEQ concentrations in storm water runoff from off-site surface water sampling locations in undeveloped areas and in receiving waters during storm conditions are comparable to concentrations in storm water runoff from the SSFL.

**Monthly Average Exceedance Discussion**

Monthly average permit limits are not appropriate for inconsistent, sporadic, and infrequent storm water dominated discharges such as those at SSFL. Based on the data collected from the SSFL, monthly average permit limit exceedances are typically the result of a single exceedance of a daily maximum limit where there are no additional rainfall events or monitoring data during the month.

A monthly average based only on one or two data points is not representative of actual monthly average concentrations or constituent mass traveling to receiving waters over a one-month period. In addition, monthly average permit limits are calculated based on the State of California's Policy for the Implementation of Toxics Standards for Inland Waters, Enclosed Bays, and Estuaries (State Implementation Policy), and the EPA's Technical Support Document for Water Quality-based Toxics Control methodology developed for continuous, end of pipe, Publicly Owned Treatment Works type discharges. This methodology often uses California Toxics Rule chronic criteria as the basis for average monthly permit limits. SSFL storm flows are often shorter in duration than chronic exposure timeframes (i.e., shorter than 4 days (for metals) or 30 days (for ammonia)). Therefore, the average monthly permit compliance criteria and the calculated average monthly concentration may not be representative of appropriate permit criteria or actual monthly site conditions throughout the SSFL.

**Discussion of Permit Limit Exceedances**

The following paragraphs present a summary of permit limit exceedances by outfall. Following these summaries, a discussion of corrective measures is included.

**Storm Water Outfall 001**

Outfall 001 did not discharge during 2007.

**Storm Water Outfall 002**

Exceedance Summary

Outfall 002 had seventeen daily maximum permit limit exceedances, nine monthly average permit limit exceedances, one mass-based daily maximum permit limit exceedance, and one monthly average permit limit exceedance for constituents with permit limits collected at this outfall during the 2007 monitoring period. Only one sample was collected at Outfall 002 during 2007, (on September 22, 2007). All exceedances occurred on that day, as summarized in Table 3.

Exceedance Discussion

*Outfall 002 Mudslide*

Routine inspections are conducted throughout SSFL, including Outfall 002, to inspect the BMPs in place. The September 7, 2007 inspection conducted at Outfall 002 prior to September 22, 2007 showed the newly installed and previously existing sediment control BMPs in place, and no mudslides were observed.

The site experienced heavy rainfall on September 21-22, 2007. Constituent exceedances occurring on September 22, 2007, at Outfall 002 were attributed to a mudslide observed by Boeing personnel the morning of the sample collection date. The mudslide deposited soil directly into the streambed just upstream of Outfall 002. Other mudslides were observed in the vicinity and in other canyons in the undeveloped portion of the site that drains to Outfall 002.

A sample was taken at the outfall on September 22, 2007, despite the fact that the discharge was full of sediment due to the mudslide that had just been observed. The results of the sampling showed, as might be expected given the unusually high and atypical amount of sediment in the sample, anomalously high levels of TSS and elevated levels of 28 regulated constituents.

The mudslides that occurred were unexpected. The slopes in the areas of Outfall 002 had erosion control BMPs such as straw wattles in place. Additionally, hydromulch had been applied to these slopes in late 2005 to early 2006 following the 2005 Topanga Wildfire. Hydromulch typically stabilizes soils immediately following its application and then breaks down and allows vegetation to grow. In the areas of Outfall 002, the hydromulch was in the process of breaking down and new vegetation was taking hold to some extent, as was intended. However, the intensity of rain that occurred on September 22, 2007 was so heavy that the new vegetation did not appear to have sufficiently stabilized the soils to prevent the mudslides that occurred. (Due to the low rainfall during the 2006-2007 storm season, Outfall 002 did not flow until this storm event. The prior sample collected from Outfall 002 was on May 11, 2006). As shown in the Phase 2 Post-Fire Soil Hydrophobicity and Recovery of Infiltration report (Geosyntec, 2007a), soils in the Outfall 002 watershed were found during the Spring 2007 survey to have severe water repellency, indicating severe burn

intensities in these locations and therefore the potential for increased runoff volumes and associated erosion impacts. In summary, high rainfall intensity, the higher soil water repellency in this area due to the Topanga Wildfire, along with the early stages of revegetation that had occurred and the steepness of the natural slopes, all likely contributed to the mudslides.

In a continued effort to address the unstable soils, Boeing immediately began a number of measures to stabilize the slopes in the area following the September 2007 mudslides. Multiple soil stabilization BMPs have been added to those already in place. Since September 22, 2007, Boeing has vacuumed approximately 100 cubic yards of residual sediment and ash in the channel and on surrounding hillsides to reduce, to the extent feasible, further sediment transport down the channel. Boeing has applied additional hydroseed to the hillside to stabilize the soil. Hydroseed is likely to postpone further re-vegetation of the hillside by several months until the hydromulch breaks down, but it will stabilize the fragile soils in the near term.

The sample collected at Outfall 002 following the mudslide showed exceedances of NPDES Permit limits for the following constituents: arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, manganese, nickel, zinc, ammonia as nitrogen (N), total cyanide, chronic toxicity, gross alpha, gross beta, TCR, and TCDD. Details on these exceedances are discussed below. A summary of the NPDES Permit limit exceedances can be found in Table 3.

Outfall 002 is located in the undeveloped portion of the property where no industrial activities have occurred. Note the TSS result for the sample collected was 33,000 mg/L. Prior sampling events ranged from non-detect to 170 mg/L. If the observed soil constituent concentrations in water are converted to concentrations in soil (by assuming the constituents are occurring in the suspended sediment, rather than dissolved phase), the resulting sediment concentrations are below SSFL soil background levels reported (MWH, 2005; Flow Science 2006). Thus, it appears that the unusually high and atypical amount of natural background sediments and ash in the sample from Outfall 002 could, by itself, result in the exceedances of the permit limits at this outfall and should not indicate or suggest impacts of contamination resulting from historical site operations.

*Arsenic, Barium, Beryllium, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Nickel, and Zinc*

The daily maximum and/or monthly average permit limit exceedances for these constituents, which have been frequently detected in Department of Toxic Substance Control (DTSC)-approved background soil samples (MWH, 2005) are indicated in the Summary of Permit Limit Exceedances table in Table 3 of this report.

For most metals, storm water samples are analyzed for both total and dissolved metals. Although the permit specifies that analytical results for total metals are to be compared to permit limits, which are also specified as concentrations of total metals, the dissolved phase of most metals is generally regarded to be the most bioavailable, and information on metals partitioning will be used in the design and refinements of BMPs. It is unlikely that the elevated metals concentrations observed (excluding dissolved concentrations) could cause harm to human or aquatic life. Except for the dissolved concentrations for iron and

manganese, all dissolved metal concentrations (including all those with aquatic toxicity and human health-based permit limits) were less than the total metal permit limits, even when a default CTR-based dissolved/total conversion factor is assumed. The permit limits for iron and manganese are not based on the protection of aquatic life or public health, but rather are based on aesthetic (taste and appearance) effects-based secondary drinking water standards. Furthermore, as the dissolved fraction represents the more bioavailable form for these constituents, toxicity impacts to aquatic receptors would not be expected despite the total metal permit limit exceedances. Table A summarizes these total and dissolved metal results for comparison with the daily maximum permit limits.

Table A. Summary of Metal Permit Limit Exceedances at Outfall 002 on September 22, 2007 (exceeding values shown in **bold**)

| Constituent | Units | Total Concentration | Dissolved Concentration | Daily Max. Permit Limit |
|---|---|---|---|---|
| Arsenic | ug/L | **35** | NA | 10 |
| Barium | mg/L | **2.3** | 0.044 | 1 |
| Beryllium | ug/L | **11** | ND (<0.90) | 4 |
| Cadmium | ug/L | **6.9** | ND (<0.22) | 3.1 |
| Chromium | ug/L | **100** | ND (<2.0) | 16.3 |
| Copper | ug/L | **100** | 7.9 | 14 |
| Iron | mg/L | **97** | **0.62** | 0.3 |
| Lead | ug/L | **310** | 1.9 | 5.2 |
| Manganese | ug/L | **11,000** | **260** | 50 |
| Nickel | ug/L | **110** | 5.3 | 96 |
| Zinc | ug/L | **790** | ND (<6.0) | 119 |

*Ammonia as Nitrogen (N)*

Ammonia as nitrogen (N) was detected at a concentration of 5.9 mg/L in the storm water sample collected from Outfall 002 on September 22, 2007. This concentration was less than the daily maximum permit limit of 10.1 mg/L, but exceeded the monthly average permit limit of 1.96 mg/L (Table 3). Since storm water flow was not consistent or continuous, subsequent samples could not be collected from this outfall. Therefore, only one sample was collected from Outfall 002 in September, and this single sample result was used to evaluate monthly average permit compliance. Wild fires have been shown to increase soil pH, and to cause an increase in nitrate, ammonia, and other plant-nutrient-related compounds (Higgins, et. al., 1989; Earl and Blinn, 2003). Boeing believes that the ammonia as nitrogen (N) concentration observed in this one sample is the result of the September 22 mudslide causing the deposit of native soils and ash into the channel.

*Total Cyanide*

The total cyanide concentration at Outfall 002 exceeded the daily maximum of 8.5 ug/L at a concentration of 10 ug/L. As this was the first and only flow event at Outfall 002 in 2007, this also resulted in an exceedance of the monthly average permit limit of 4.3 ug/L.

Cyanides can be produced by certain bacteria, fungi, and algae, and are found in a number of foods and plants. The potential for species of cyanide to be produced from wildfires is being studied by Los Alamos National Laboratory and other studies show that cyanides can be

produced by the photo-oxidation of fire retardants (Gallaher and Koch, 2004), some of which may have been used in combating the Topanga Wildfire.

*Chronic Toxicity*

Sampling for toxicity consists of both acute and chronic toxicity for SSFL samples. The acute toxicity test is performed on the fathead minnow (*pimephales promelas)* and the chronic toxicity test is performed on the water flea (*ceriodaphnia dubia)*. The survival results showed 100 percent survival for the acute and chronic toxicity test and No Observable Effect Concentration (NOEC) of 100 percent sample for chronic toxic units (TUc) value of 1.0, which meets compliance with the permit. However, there are two components to the chronic toxicity test: survival and reproduction. Typically, young organisms are more sensitive to chemicals than older organisms. Since reproduction is generally a sensitive endpoint, tests are continued until reproduction begins. The reproduction component of the test showed low reproduction counts when the sample concentration was higher than 6.25 percent (the NOEC). This results in a TUc of 16.0, which exceeds the permit limitation for this test and therefore chronic toxicity exceeded permit limits at Outfall 002 on September 22, 2007.

As previously described, a number of constituents detected in the September 22 sample exceeded their NPDES Permit limits, which most likely caused the chronic toxicity reading of 16.0 TUc. Because prior tests for chronic toxicity at this outfall have never exceeded the permit limit of 1.0 TUc, the most reasonable conclusion is that the elevated TUc value detected was the result of the unusually high amount of native soils present in this sample from the mudslide previously described.

*TCDD TEQ*

The reported concentration of TCDD TEQ in the sample collected on September 22, 2007, from Outfall 002 was $4.26 \times 10^{-5}$ ug/L, which is above the NPDES Permit limit of $2.80 \times 10^{-8}$ ug/L. As this was the first and only flow event at Outfall 002, this also resulted in an exceedance of the monthly average permit limit of $1.4 \times 10^{-8}$ ug/L. Additionally, based on measured flow at Outfall 002, TCDD TEQ also exceeded mass-loading daily maximum NPDES Permit limit of $3.70 \times 10^{-8}$ pounds per day (lbs/day) and monthly average NPDES Permit limit of $1.90 \times 10^{-8}$ lbs/day at resulting concentrations of $8.31 \times 10^{-8}$ lbs/day and $2.82 \times 10^{-8}$ lbs/day, respectively.

Prior TCDD TEQ results at this outfall have ranged from non-detect to $2.32 \times 10^{-6}$ ug/L. Because of the difference between the September 22 event and prior events, it appears that the TCDD TEQ permit limit exceedance was most likely due to the high TSS concentrations caused by the mudslide at Outfall 002. The presence of TCDD in both background soils and fire-related materials is well documented in scientific literature (USEPA, 2000; Gullet and Touati, 2003). These findings are further substantiated by previously completed an on-and off-site study (MWH, 2005) as presented in the Flow Science Background Report (Flow Science, 2006). These reports suggest that the levels of TCDD TEQ measured in surface water samples at the SSFL may result primarily from wildfire combustion processes, regional atmospheric deposition, and other off-site sources.

*Comparison of Permit Exceedances to Background Soil Concentrations*

Under the Resources Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Program at SSFL, DTSC-approved soil samples were collected from "background" areas of the site that represent ambient local background levels unaffected by industrial activities at SSFL (MWH, 2005). The TSS concentration in the sample collected from Outfall 002 was 33,000 mg/L. As shown in Table B below, if measured constituent concentrations in water at Outfall 002 are converted to sediment concentrations by dividing by the TSS concentration (assuming that constituent concentrations are in the suspended sediment, rather than dissolved phase), these calculated values are less than soil background levels, or in the case of TCDD, between background levels for soil and ash. Thus, it appears that most measured concentrations of regulated constituents at Outfall 002 are consistent with high levels of background soil and ash in the sample.

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Table B. Comparison of additional background soil concentrations and TSS

| ANALYTE | Soil Background Comparison Level (MWH, 2005) | Units | Calculated Equivalent Background Water Concentration at 33,000 mg/L TSS | Units | 9/22/07 Result Outfall 002 |
|---|---|---|---|---|---|
| Arsenic | 15 | mg/kg | 495 | ug/L | 35 |
| Barium | 140 | mg/kg | 4.6 | mg/L | 2.3 |
| Beryllium | 1.1 | mg/kg | 36 | ug/L | 11 |
| Cadmium | 1 | mg/kg | 33.0 | ug/L | 6.9 |
| Chromium | 37 | mg/kg | 1,221 | ug/L | 100 |
| Copper | 29 | mg/kg | 957 | ug/L | 100 |
| Iron | 28,000 | mg/kg | 924 | mg/L | 97 |
| Lead | 34 | mg/kg | 1,122 | ug/L | 310 |
| Manganese | 495 | mg/kg | 16,335 | ug/L | 11,000 |
| Nickel | 29 | mg/kg | 957 | ug/L | 110 |
| TCDD TEQ | $5.0x10^{-4}$ ($1.6x10^{-3}$ for ash ) | ug/kg | $1.65x10^{-5}$ 5.28x10-5 (for ash) | ug/L | $4.26x10^{-5}$ |
| Zinc | 110 | mg/kg | 3,630 | ug/L | 790 |

*Radiological Constituents*

NPDES Permit limit exceedances occurred during the Third Quarter of 2007 for gross alpha, gross beta, and total combined radium 226 & 228. Exceedances of these radiological constituent permit limits were detected in annual storm water samples collected from Outfall 002 on September 22, 2007.

The reported concentration of gross alpha in the Outfall 002 September sample was 701±170 pico curies per liter (pCi/L). The NPDES Permit limit for gross alpha is 15 pCi/L. The reported concentration of gross beta in the Outfall 002 September sample was 426±95 pCi/L. The NPDES Permit limit for gross beta is 50 pCi/L.

Annual samples collected on September 22, 2007 from Outfall 002 were analyzed for gross alpha and gross beta, as indicated in the NPDES Permit. Outfall 002 was tested for the remaining radiological constituents as well (total combined radium 226 & 228, strontium-90, and tritium). In accordance with the NPDES Permit, total combined radium was subsequently analyzed from the same sample. Total combined radium results were above the daily maximum permit limit, and therefore contingent analyses for strontium-90 and tritium were conducted as required in the NPDES Permit.

The reported concentration of total combined radium 226 & 228 in the Outfall 002 September sample was 17.01±1.30 pCi/L. The NPDES Permit limit for combined radium 226 & 228 is 5 pCi/L. Strontium-90 and tritium did not exceed the permit limits of 8 pCi/L and 20,000 pCi/L, respectively.

Page T-8, footnote 6 of the NPDES Permit indicates that following an exceedance of an annual constituent, monitoring frequency is increased to once per discharge until the results of four consecutive analyses demonstrate compliance with the effluent limitations. Therefore, Boeing will continue to monitor for gross alpha and gross beta, and radium 226 & 228 at Outfall 002 when flow occurs as required by the NPDES Permit.

Additional analyses not required by the NPDES Permit were conducted[1] on excess sample volume from Outfall 002 with radiological exceedances. Gamma spectroscopy analysis was performed, which can detect the presence of natural and man-made gamma emitting nuclides that may be a source of gross alpha and gross beta in the samples where NPDES Permit limit exceedances were detected.

Strontium-90, tritium and gamma spectroscopy results are reported in the data tables in Section 1. These results include SSFL alpha- and beta-gamma contaminants of concern (cesium-134, cesium-137, cobalt-60, europium-152, europium-154, manganese-54, and uranium).

The gamma spectrometry analysis, however, was not able to determine if these exceedances were from natural or man-made sources as a result of global human activities such as nuclear weapons testing, nuclear research, nuclear power production, and isotope production for medical and industrial purposes known to result in atmospheric deposition of radioisotopes. Both natural and man-made sources of beta-gamma and natural sources of alpha were detected in the sample at Outfall 002, likely due to the highly turbid nature of the sample.

Using the high 33,000 mg/L TSS to translate from pCi/L activity in turbid water to pCi/g activity in soil, the estimated soil concentrations are typical of non-contaminated soil (naturally occurring potassium-40, uranium, and thorium and their decay products plus cesium-137, and strontium-90 from local background soil concentrations from atmospheric deposition. See Table C including footnotes).

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[1] According to Federal Drinking Water Standards (40 CFR Part 141), when gross alpha gross beta activity exceeds 15 pCi/L and 50 pCi/L, respectively; additional analyses are required that test for man-made alpha- and beta-gamma emitters. In the context of drinking water regulations, the purpose of this additional testing it is to ensure that potential doses from these beta/gamma-emitting radionuclides does not exceed four millirem per year. Note this standard assumes exposure through ingestion as drinking water, which is unlikely to occur in storm water runoff. Flow is so intermittent that drinking water standards based on a lifetime of consumption should not apply. Because drinking water limits are used as the basis for NPDES Permit limits, this additional step was followed to further investigate the cause of the gross beta exceedances.

Table C. Comparison of background radiological soil concentrations and TSS

| Outfall 002 Radioisotopes | | | | |
|---|---|---|---|---|
| Total Suspended Solids | 33,000 mg/L<br>33 g/L | | | 22-Sep-07 |
| **Isotope** | **Activity in Water (pCi/L)** | **Equivalent Activity in Soil (pCi/g)** | **Soil Background Range (pCi/g)** | **Source** |
| Gross alpha | 701 +/- 170 | 21 +/- 5.2 | 3 - 30 | 1 |
| Gross beta | 426 +/- 95 | 13 +/- 2.9 | 22 - 35 | 1 |
| Potassium-40 | 268 +/- 38 | 8.1 +/- 1.2 | 19 - 25 | 1 |
| Ra-226 + Ra-228 | 17.01 +/- 1.301 | 0.52 +/- 0.04 | 0.5 - 1.5 | 1 |
| Strontium-90 | 2.79 +/- 0.44 | 0.08 +/- 0.01 | <0.005 - 0.13 | 2 |
| Cesium-137 | 9.06 +/- 2.3 | 0.27 +/- 0.07 | <0.03 - 0.21 | 2 |
| Thorium-232 | 47.8 +/- 11 | 1.45 +/- 0.33 | 0.44 - 1.5 | 1 |

pCi/g pico curies per gram

1. Bell Canyon Sampling. http://www.etec.energy.gov/Health-and-Safety/Bell-Canyon
2. Brandeis Bardin Sampling. http://www.etec.energy.gov/Health-and-Safety/Documents/BrandeisBardin/AddSoilandWaterSamp.pdf

*Gross Alpha*

Uranium analysis using gamma spectroscopy was non-detect, but the detection limits were very high. Total uranium could, therefore, not be subtracted from gross alpha prior to comparison to the 15 pCi/L drinking water limit as required by EPA protocols. However, as indicated in Table C above, a comparison of gross alpha activity in soil is within the range of soil background.

*Gross Beta*

The gross beta limit of 50 pCi/L (15 pCi/L in the 2007 permit) is a screening limit. If the screening limit is exceeded, then potassium-40 should be subtracted and cesium-137, strontium-90 and tritium analyses should be performed and the total effective dose compared to the 4 millirem per year (mrem/y) exposure limit for beta/gamma emitters. Although, the potassium-40 subtracted gross beta value also exceeds the screening limits (426±95 – 268±38 = 158±102 pCi/L), the 4 mrem/y dose limit is met, as shown in Table D below.

Table D. Exposure from Beta/Gamma Emitters Compared to 4 mrem/y

| Isotope | Activity (pCi/L) | EPA MCL (pCi/L) | Ratio | Dose (mrem/y) |
|---|---|---|---|---|
| Cesium-137 | 9.06 | 200 | 0.045 | 0.2 |
| Strontium-90 | 2.79 | 8 | 0.349 | 1.4 |
| Tritium | 15.4 | 20,000 | 0.001 | 0.0 |
| **Total Dose** | | | | **1.6** |

**Storm Water Outfall 003**

Exceedance Summary

Outfall 003 had three exceedances for constituents with permit limits collected at this outfall during the 2007 monitoring period, as summarized in Table 3:

- On January 28, gross beta was detected at concentration of 56.3 ±1.9 pCi/L, where the daily max permit limit is 50 pCi/L.

- On January 28 and February 19, pH was detected at 9.6 and 9.0, respectively, where the daily max permit limit range is 6.5-8.5 pH units.

Exceedance Discussion

*Gross Beta*

Based on additional evaluation of the sample as discussed below, it does not appear that the source of the gross beta detection is man-made.

The exceedance occurred in a sample collected on January 28, 2007 at Outfall 003 as part of a routine sampling event. Annual samples collected on February 19, 2007 were analyzed for gross alpha and gross beta as indicated in the NPDES Permit. Samples collected in February from Outfall 003 were tested for the remaining radiological constituents as well (total combined radium, strontium-90, and tritium). Analyses from this sampling event did not show any NPDES Permit limit exceedances at Outfall 003.

Additional analyses not required by the NPDES Permit were conducted[2] on excess sample volume from the January 28 sample that showed gross beta exceedance. Gamma spectroscopy analysis was performed, which can detect the presence of natural and man-made gamma emitting nuclides that may be a source of gross beta in the samples where NPDES Permit limit exceedance was detected.

No man-made beta/gamma emitting radionuclides were detected above their respective minimum detectable activity (MDAs). Initial gamma spectroscopy results indicated high MDAs, therefore Boeing requested a longer count time to be conducted for these samples for a more accurate MDA at lower concentration levels. These included SSFL beta/gamma contaminants of concern (cesium-134, cesium-137, cobalt-60, europium-152, europium-154, and manganese-54)[3]. In addition the beta emitters, strontium-90 and tritium, were below their MDAs for the January 28th sample for Outfall 003. Therefore no man-made radionuclides from operations at SSFL have been identified that could have caused the high beta values at Outfall 003.

The gamma spectrometry analysis, however, was not able to identify a natural source for the high beta results. Natural sources of beta-gamma emitters include potassium-40 (K-40) and lead-210 (Pb-210). For Outfall 003, both K-40 and PB-210 were below the detection limits, which were 24 pCi/L for K-40 and 160 pCi/L for Pb-210.

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[2] According to Federal Drinking Water Standards (40 CFR Part 141), when gross beta activity exceeds 50pCi/L, additional analyses are required that test for man-made beta-gamma emitters. In the context of drinking water regulations, the purpose of this additional testing is to ensure that potential doses from these beta/gamma-emitting radionuclides do not exceed four millirem per year. Note this standard assumes exposure through ingestion as drinking water, which is unlikely to occur in storm water runoff. Flow is so intermittent that drinking water standards based on a lifetime of consumption should not apply. Because drinking water limits are used as the basis for NPDES permit limits, this additional step was followed to further investigate the cause of the gross beta exceedances.

[3] Sum of the lowest MDAs for these isotopes equals 10.49 pCi/L for Outfall 003 and 18.8 pCi/L for Outfall 006 which is less than the 50 pCi/L gross beta permit limit.

Subsequent gamma spectroscopy analysis of the water used to rinse the new filtration media and water flowing over new roadbed gravel at Outfall 007 has indicated high naturally occurring K-40 (a beta and gamma emitter), which in turn resulted in high beta results for those samples[4]. Consequently, significant circumstantial evidence appears to indicate that the high beta value from Outfall 003 is likely to have been caused by K-40 dissolving out of the new filter media and/or new roadbed gravel.

It is widely reported in scientific literature that in the absence of man-made nuclides, the naturally occurring beta-gamma emitters K-40 and Pb-210 are common and major contributors of gross beta in environmental and drinking water samples (OEHHA, 2003). This is addressed in the Federal and California Drinking Water Standards by allowing the exclusion of detected K-40 concentrations from gross beta concentrations used for compliance purposes.

Monitoring of radiological constituents will continue for samples collected from Outfall 003 to provide a better understanding of the presence of gross beta at these outfalls.

*pH*

The elevated pH values at Outfall 003 in January and February may result from the on-going construction activities at this outfall and the presence of concrete that had been recently installed and had not fully cured. During the First Quarter of 2007, a flume for monitoring surface water flow was installed along a concrete channel upstream of the sample point. Flume installation involved concrete pouring to set the flow measurement device in the existing channel. Uncured concrete can increase the pH of water that comes into contact with it and it typically takes about a month for concrete to fully cure. Elevated pH values are believed to have resulted when runoff contacted the newly-poured concrete.

The pH exceedances occurred during the first two storm events of 2007. A lower pH value of 9.0 was observed during the second sampling event as compared to the pH value of 9.6 observed during the first sampling event. These two exceedances occurred shortly after the installation of the concrete channel and the installation of the flume at Outfall 003 on January 16-17, 2007 and February 5-6, 2007. Once aware of these exceedances, Boeing rinsed the concrete channel on January 25, 2007 and February 20, 2007 to accelerate the curing of the concrete upstream of the sampling location to prevent similar occurrences in the future. All rinse water was captured and shipped off-site for proper disposal. In future instances where new concrete is installed, Boeing will flush the freshly poured concrete and capture the water to alleviate the potential for permit limit exceedances of pH. Boeing will continue to monitor pH data at Outfall 003 and, if necessary, further rinse the concrete to attempt to prevent elevated pH.

[4] Collected storm water from Outfall 007 had gross beta detections of 294 pCi/L and K-40 at 302 pCi/L. Collected rinse water from several outfalls had a gross beta of 162 pCi/L and K-40 at 135 pCi/L. All collected water is currently stored and will be shipped off-site for proper disposal.

**Storm Water Outfall 004**

Exceedance Summary

Outfall 004 had three exceedances for constituents with permit limits collected at this outfall during the 2007 monitoring period, as summarized in Table 3:

- On September 22, Mercury was detected at 0.23 ug/L. The daily max permit limit is 0.13 ug/L.

- On September 22 and December 19, TCDD was detected at concentrations of $2.54 \times 10^{-6}$ ug/L and $3.97 \times 10^{-7}$ ug/L, respectively. The daily max permit limit is $2.8 \times 10^{-8}$ ug/L.

Exceedance Discussion

*Mercury*

The dissolved mercury result for the sample collected on September 22, 2007 was DNQ at an estimated value (J) of 0.055 ug/L between the laboratory detection limit and the laboratory reporting limit. This information will be used in the design of BMPs.

Boeing is in the process of replacing the bagged carbon and zeolite currently installed at the outfall with bulk media, such as granular activated carbon and zeolite. The bulk material will allow for more contact time with the filter media. Boeing expects that the increase contact time will decrease the concentration of mercury in future samples.

*TCDD TEQ*

At this time, Boeing is uncertain of the origin of the TCDD in these samples, but it will continue to investigate potential sources of on-site TCDD. The presence of TCDD in both background soils and fire-related materials is well documented in scientific literature (USEPA, 2000; Gullett and Touati, 2003). These findings are further substantiated by previously completed on- and off-site studies (MWH, 2005) as presented in the Flow Science Background Report (Flow Science, 2006) and as reported in the first, second and fourth quarter 2006 DMRs. These reports suggest that the levels of TCDD TEQ measured in surface water samples at the SSFL may result primarily from wildfire combustion processes, regional atmospheric deposition, and other off-site sources.

Additional dioxin removal may be facilitated by increasing the retention time of the water within activated carbon media contained in the BMP installed at Outfall 004. It is unclear exactly what retention time would be necessary to achieve the water-quality based effluent limit of $2.8 \times 10^{-8}$ ug/l for TCDD TEQ. Dioxin congeners are hydrophobic molecules that partition readily into the organic fraction of sediments and solid materials. Activated carbon is believed by EPA to be the best available technology for the removal of dioxins from water (http://www.epa.gov/OGWDW/dwh/t-soc/dioxin.html). However, studies have not been conducted to support the development of technology-based effluent limits for dioxin when activated carbon is used. Boeing is unaware of any studies documenting what retention time, if any, in activated carbon can achieve the SSFL NPDES effluent limit for dioxin. In fact, specific studies of the use of activated carbon do not show effluent concentrations as low as the water quality based effluent limit of $2.8 \times 10^{-8}$ ug/L. One of the few studies identified while researching the literature reported an effluent concentration just below

$8.1x10^{-5}$ ug/l (Torrens, 2000). Nevertheless, Boeing is committed to achieving the water quality based effluent limit, if possible. Specifically, bagged carbon and zeolite at Outfall 004 will be replaced with bulk media, such as granular activated carbon and zeolite. The bulk placement will reduce hydraulic short-circuiting and increase average retention time.

**Storm Water Outfall 005**

Outfall 005 did not discharge during 2007; therefore, no exceedances were measured at this outfall.

**Storm Water Outfall 006**

Exceedance Summary

Outfall 006 had four exceedances of constituents with permit limits collected at this outfall during the 2007 monitoring period, as summarized in Table 3:

- On January 28, December 7, and December 19, chloride was detected at concentrations of 210 mg/L, 170 mg/L, and 210 mg/L, respectively. The daily max permit limit is 150 mg/L.
- On February 19, gross beta was detected at concentrations of 63.8 ± 2.8 pCi/L. The daily max permit limit is 50 pCi/L.

Exceedance Discussion

*Chloride*

Boeing believes the elevated chloride concentration could be attributed to on-going construction activities and wash-off from sand, zeolite, and activated carbon BMP filter media installed at this outfall location.

As part of the BMP evaluation program, Boeing implemented an evaluation test of the BMP material at Outfall 010 to determine its effectiveness in removal of permitted constituents. Water was applied to the area and influent and effluent samples were collected to review the removal of constituents, including chloride. Approximately 6,500 gallons of water was allowed to flow through the drainage and filtration area. Three influent and three effluent samples were collected at one hour intervals during the evaluation. Water used in this evaluation was captured and containerized to prevent discharges from the outfall.

A review of the results of the evaluation indicated chloride concentrations were significantly higher in the effluent samples collected from water flowing through the media filter than in the influent samples. These results indicate the presence of naturally occurring chloride in the sand filter that was installed in the BMP at Outfall 010. Chloride is a naturally occurring compound (Hunter and Davis, 2001). BMP materials installed at the site, including fresh sand, zeolite, and activated carbon, may also contain chloride that may be flushed or rinsed from filter media as shown by the test conducted at Outfall 010.

Due to the consistent use of the same filter media at the BMPs, Boeing believes the results of an evaluation at Outfall 006 would be the same as the results at Outfall 010. Following the permit limit exceedances at Outfall 006, Boeing rinsed the media filter. Rinsing of the media is expected to remove this chloride and other salts and reduce the potential for further exceedances. Rinse water was collected for proper off-site disposal.

Boeing will continue to monitor chloride concentrations at this outfall to try to identify sources. Measures to reduce chloride will be implemented to the furthest extent feasible. Additionally, where new BMP materials are added, Boeing will flush the materials and collect the rinse water to eliminate potential for permit limit exceedances in the future.

*Gross Beta*

Based on additional evaluation of the sample as discussed below, it does not appear that the source of the gross beta detection is man-made.

Annual samples collected on February 19, 2007, from Outfalls 003, 006, 009, and 010 were analyzed for gross alpha and gross beta, as indicated in the NPDES Permit. The sample collected from Outfall 006 showed an exceedance of gross beta. In accordance with the NPDES permit, total combined radium was subsequently analyzed from the same sample. Total combined radium results were below the daily maximum permit limits, therefore no further contingent analyses were required as stated in the NPDES Permit.

A re-analysis was conducted for gross beta to verify the above exceedance. Page T-8, footnote 6 of the NPDES Permit indicates that following an exceedance of an annual constituent, monitoring frequency is increased to once per discharge until the results of four consecutive analyses demonstrate compliance with the effluent limitations. Therefore, following the gross beta exceedance in the sample collected at Outfall 006 on February 19, 2007, the subsequent Outfall 006 sample, collected on February 27, 2007 was analyzed for gross beta. Analysis from the February 27 sampling event for Outfall 006 did not indicate an exceedance. Boeing will continue to monitor for gross beta at Outfall 006 when flow occurs, as required by the NPDES Permit.

Additional analyses not required by the NPDES Permit were conducted[5] on excess sample volume from the sample that showed gross beta exceedance. Gamma spectroscopy analysis was performed, which can detect the presence of natural and man-made gamma emitting nuclides that may be a source of gross beta in the samples where NPDES Permit limit exceedance was detected.

No man-made beta/gamma emitting radionuclides were detected above their respective MDAs. Initial gamma spectroscopy results indicated high MDAs, therefore Boeing requested a longer count time to be conducted for these samples for a more accurate MDA at lower concentration levels. These included SSFL beta/gamma contaminants of concern

[5] According to Federal Drinking Water Standards (40 CFR Part 141), when gross beta activity exceeds 50pCi/L, additional analyses are required that test for man-made beta-gamma emitters. In the context of drinking water regulations, the purpose of this additional testing is to ensure that potential doses from these beta/gamma-emitting radionuclides do not exceed four millirem per year. Note this standard assumes exposure through ingestion as drinking water, which is unlikely to occur in storm water runoff. Flow is so intermittent that drinking water standards based on a lifetime of consumption should not apply. Because drinking water limits are used as the basis for NPDES permit limits, this additional step was followed to further investigate the cause of the gross beta exceedances.

(cesium-134, cesium-137, cobalt-60, europium-152, europium-154, and manganese-54)[6]. Therefore no man-made radionuclides from operations at SSFL have been identified that could have caused the high beta values at Outfall 006.

The gamma spectrometry analysis, however, was not able to identify a natural source for the high beta results. Natural sources of beta-gamma emitters include potassium-40 (K-40) and lead-210 (Pb-210). For Outfall 006, both K-40 and Pb-210 were below the detection limits, which were 52 pCi/L for K-40 and 100 pCi/L for Pb-210.

Subsequent gamma spectroscopy analysis of the water used to rinse the new filtration media and water flowing over new roadbed gravel at Outfall 007 has indicated high naturally occurring K-40 (a beta and gamma emitter), which in turn resulted in high beta results for those samples[7]. Consequently significant circumstantial evidence appears to indicate that the high beta values from Outfall 006 are likely to have been caused by K-40 dissolving out of the new filter media and/or new roadbed gravel. Detailed results of filter media and rinse water, along with a more in-depth discussion on the investigation of elevated gross beta in compliance samples, can be found in the Regional Board submittal "NPDES Radiological Constituents" (Boeing, 2007).

It is widely reported in scientific literature that in the absence of man-made nuclides, the naturally occurring beta-gamma emitters K-40 and Pb-210 are common and major contributors of gross beta in environmental and drinking water samples (OEHHA, 2003). This is addressed in the Federal and California Drinking Water Standards by allowing the exclusion of detected K-40 concentrations from gross beta concentrations used for compliance purposes.

**Storm Water Outfall 007**

Outfall 007 did not discharge during 2007.

**Storm Water Outfall 008**

Outfall 008 did not discharge during 2007.

**Storm Water Outfall 009**

Exceedance Summary

Outfall 009 had three permit limit exceedances for constituents with permit limits collected at this outfall during the 2007 monitoring period, as summarized in Table 3:

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[6] Sum of the lowest MDAs for these isotopes equals 10.49 pCi/L for Outfall 003 and 18.8 pCi/L for Outfall 006 which is less than the 50 pCi/L gross beta permit limit.

[7] Collected storm water from Outfall 007 had gross beta detections of 294 pCi/L and K-40 at 302 pCi/L. Collected rinse water from several outfalls had a gross beta of 162 pCi/L and K-40 at 135 pCi/L. All collected water is currently stored and will be shipped off-site for proper disposal.

- On February 19 and September 22, TCDD was detected at $7.64 \times 10^{-7}$ ug/L and $3.13 \times 10^{-6}$ ug/L, respectively; compared to the daily max permit limit of $2.8 \times 10^{-8}$ ug/L.

- On September 22, lead was detected at 8.6 ug/L; compared to the daily max permit limit of 5.2 ug/L.

Exceedance Discussion

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*TCDD TEQ*

Again, Boeing is uncertain where the TCDD in these samples originated, but it will continue to investigate potential sources of on-site TCDD. The presence of TCDD in both background soils and fire-related materials is well documented in scientific literature (USEPA, 2000; Gullett and Touati, 2003). These findings are further substantiated by previously completed on- and off-site studies (MWH, 2005), as presented in the Flow Science Background Report (Flow Science, 2006) and as reported in the first, second and fourth quarter 2006 DMRs. These reports suggest that the levels of TCDD TEQ measured in surface water samples at the SSFL may result primarily from wildfire combustion processes, regional atmospheric deposition, and other off-site sources over which Boeing has no reasonable control.

*Lead*

Samples collected on September 22, 2007 from Outfall 009 show a concentration of lead of 8.6 ug/L, which is above the NPDES Permit limit of 5.2 ug/L. However, the dissolved lead result for this sample was estimated at 0.87 ug/L, J(DNQ), which is below the CTR-based permit limit for lead. Because CTR toxicity criteria are based on the dissolved fraction, this represents the more bioavailable form of the metal, and the toxicity impacts to downstream aquatic receptors would not be expected despite the total metal permit limit exceedance.

*ENTS*

As described above in the 2007 BMP section, progress was made in 2007 towards an ENTS design for the Outfall 008 and 009 watersheds. An Expert Panel was selected and assembled in 2007, and the Panel's progress to date includes review of site background information, multiple meetings and conference calls, a project kickoff meeting with the public in Simi Valley on January 22, and the development of a preliminary site specific design storm recommendation, which is scheduled to be presented by a Panel member at the March 6, 2008 Regional Board hearing. According to the Geosyntec Work Plan (Geosyntec, 2007b), construction of the ENTS is scheduled to be complete by October 31, 2008. This schedule is contingent upon Expert Panel progress and recommendations, permitting issues, DTSC coordination, and various other factors.

Also described above in the 2007 BMP section, the Northern Drainage and LOX Area Debris Removal Project began in 2007 in the drainage area of Outfall 009. Soil and debris removal began in the LOX Debris Area on November 14, 2007 and was completed on December 20, 2007. Further debris removal in the Former Shooting Range Area/Northern Drainage Debris Area is scheduled to commence in the spring 2008. Field inspections were conducted during and after rain events, resulting in no observed storm water discharges from the LOX or Northern Drainage Debris Areas. BMPs, (including fiber rolls, straw bales, silt

fencing, coco matting, and hydromulch), were deployed during field work to minimize the potential for excessive erosion and impacts to the drainage.

**Storm Water Outfall 010**

There were no exceedances at Outfall 010 during 2007.

**Storm Water Outfall 011**

Outfall 011 did not discharge during 2007.

**Storm Water Outfall 012**

On December 20, 2007, NPDES Permit No. R4-2007-0055 became effective and discharges from Outfall 012 were included into the monitoring and reporting program at SSFL. Prior to December 20, 2007, NPDES Permit No. R4-2006-0036 was effective and only discharges occurring during testing operations were monitored and reported at this outfall. All testing operations have ceased at Outfall 012.

Outfall 012 did not discharge while the 2007 Permit was effective (i.e., storm water discharges were regulated) (December 20-31, 2007).

**Storm Water Outfall 013**

As of December 20, 2007, the NPDES Permit No. R4-2007-0055 became effective and discharges from Outfall 013 were included into the monitoring and reporting program at SSFL. Previous to December 20, 2007, NPDES Permit No. R4-2006-0036 was effective and only discharges occurring during testing operations were monitored and reported at this outfall. All testing operations have ceased at Outfall 013.

Outfall 013 did not discharge while the 2007 Permit was effective (i.e., storm water discharges were regulated) (December 20-31, 2007).

**Storm Water Outfall 014**

Benchmark Summary

As of December 20, 2007, NPDES Permit No. R4-2007-0055 became effective and discharges from Outfall 014 were included into the monitoring and reporting program at SSFL. Prior to December 20, 2007, NPDES Permit No. R4-2006-0036 was effective and only discharges occurring during testing operations were monitored and reported at this outfall. All testing operations have ceased at Outfall 014.

Outfall 014 had two elevated concentrations above a benchmark for constituents collected at this outfall during the time storm water discharges were regulated (December 20-31, 2007), as summarized in Table 3.

- On December 21, Chloride was detected at 810 mg/L. The daily max benchmark is 150 mg/L.
- On December 21, Total Dissolved Solids were detected at 2000 mg/L. The daily max benchmark is 950 mg/L.

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Elevated Benchmark Discussion

*Chloride*

Boeing believes the elevated chloride concentration at this outfall location may be attributed to on-going BMP construction activities and wash-off from zeolite filter media, as discussed below.

Chloride is a naturally occurring compound (Hunter and Davis, 2001). BMP materials installed at the site include zeolite and activated carbon that likely contain chloride, resulting in chloride possibly being flushed or rinsed from filter media. Once Boeing became aware of results, Boeing began to rinse the media filter at Outfall 014. Rinsing of the media is expected to remove this chloride and other salts and reduce the risk of further elevated concentrations.

Boeing will initiate additional rinsing of media at Outfall 014 to remove the naturally occurring salts that may cause elevated concentrations. Boeing will continue to monitor chloride concentrations at this outfall to try to identify sources. Measures to reduce chloride will be implemented to the extent possible. Additionally, where new BMP materials are added, Boeing will continue to flush the materials and collect the rinse water for off-site disposal to eliminate potential for any elevated concentrations above a benchmark in the future.

*Total Dissolved Solids*

Total Dissolved Solids (TDS) is naturally occurring and is expected to be present in natural surface water. TDS may also be naturally occurring in BMP materials such as zeolite. Zeolite contains various salts, which are displaced when the zeolite adsorbs metals or other constituents. TDS observed at Outfall 014 could have been generated from the zeolite media employed there to improve water quality. As noted above, the increase in TDS in surface storm water runoff from the BMP correlates with the increase in chloride observed at the same location, as one of the most common constituent of TDS in storm water runoff is chloride. Once Boeing became aware of the results, Boeing began to rinse the media filter at Outfall 014. Rinsing of the media is expected to remove chloride and other salts and reduce the potential of elevated concentrations in the future.

Boeing will initiate further rinsing of the filter media at Outfall 014 to remove the naturally occurring salts that may cause elevated concentrations above a benchmark. Boeing will continue to evaluate all data, improve BMPs, and implement measures to minimize TDS migration to and within surface water.

**Storm Water Outfall 018**

Outfall 018 did not discharge during 2007.

**Treated Groundwater Outfall 019**

NPDES Permit No. R4-2007-0055 became effective on December 20, 2007, and added Outfall 019 to the monitoring and reporting program at SSFL. In 2007, Boeing continued to explore the feasibility of the treatment of certain waste streams and is currently moving forward with a fixed hazardous treatment unit operating under the DTSC Permit-by-Rule. Treated effluent discharges from the Groundwater Extraction Treatment System (GETS) will be released at a separate outfall (Outfall 019) that is co-located with Outfall 011. The GETS is currently under construction and treated groundwater was hauled off-site. Therefore, no discharges were associated with Outfall 019.

## CORRECTIVE ACTIONS

Throughout 2007, Boeing took actions to improve the quality of surface water discharges. These actions included the installation and rinsing of BMP materials at various outfalls and the continued implementation of the site-wide Storm Water Pollution Prevention Plan (SWPPP). SWPPP Activities throughout the SSFL site included site-wide inspections and metal and debris removal, and hydromulch at various areas throughout SSFL. The 2007 SWPPP annual evaluation is included as Section 10 of this report.

The following table lists the Outfall location and respective BMP activities completed during the 2007 calendar year:

| OUTFALL | BMP ACTIVITIES DURING 2007 |
|---|---|
| 001 (South Slope below Perimeter Pond) | Inspected sediment control BMPs. Installed several miles of new fiber rolls. Hydroseed was placed on approximately 2.5 acres of hill slopes to control sediment erosion in December 2007. Calibrated flow meter. (BMP activities at Outfall 011 will also contribute to drainage improvement at Outfall 001.) |
| 002 (South Slope below R-2 Pond) | Inspected and performed maintenance on sediment control BMPs. Installed erosion control measures, including several miles of fiber rolls and numerous hay bales, on hill slopes and within drainage channels. Removed approximately 100 cubic yards of ash from drainages with a supervac. Hydroseed was placed on approximately 5 acres of hill slopes in December 2007. Calibrated flow meter. (BMP activities at Outfall 018 will also contribute to drainage improvement at Outfall 002.) |
| 003 (RMHF) | Completed installation of flume and flow meter. Calibrated flow meter. Hydroseed was placed on approximately 0.5 acre to control sediment erosion. Conducted structural BMP and storm water filter system inspections. Cleaned up debris. |

| OUTFALL | BMP ACTIVITIES DURING 2007 |
|---|---|
| | Rinsed filtration media. Installed 6 foot high dam to retain and filter the 1 - year 24-hour storm of 2.3 inches. The dam has a screened collection and outlet pipe, and is constructed upstream of existing filter bed BMP. The dam will retain the water quality volume and discharge at a flow rate within the filtration capacity of the existing filtration BMP. |
| 004 (SRE) | Completed installation of flume and flow meter. Calibrated flow meter. Conducted structural BMP and storm water filter system inspections. Cleaned up debris. Rinsed filtration media. Completed modification of structural BMP to capture and treat the 1-year 24-hour storm of 2.3 inches. Improvement consists of vertical extension to existing flow barrier upstream of GAC / zeolite bed. The purpose is to retain and filter the 1-year 24-hour storm runoff. |
| 005 (FSDF-1) | Conducted BMP, sedimentation basin and filtration system inspections. Cleaned up debris. Installed portable Baker tanks and treatment system. Added tanks to retain water for testing prior to discharge. |
| 006 (FSDF-2) | Completed installation of flume and flow meter. Conducted structural BMP and storm water filter system inspections. Cleaned up debris. Rinsed filtration media. Upgraded BMP media high density polyethylene (HDPE) walls to correct undermining. |
| 007 (Building 100) | Conducted structural BMP, sedimentation basin and filtration system inspections. Cleaned up debris. Completed modifying designs of structural BMP flow through system. Leveled area and installed additional Baker tanks to store treated water for testing prior to discharge. |
| 008 (Happy Valley) | Sediment control BMPs inspected. Cleaned up debris. Repaired and replaced straw bales, fiber rolls, and silt fence; maintained velocity dissipation device and drainage system. Installed additional silt fencing and fiber rolls to control erosion. Hydroseed was placed on approximately 4 acres in lower portion of drainage within the watershed to control sediment erosion. Upstream maintenance of erosion control measures and debris removal. Calibrated flow meter. Initiated project to develop engineered natural treatment systems. |
| 009 (WS-13 Drainage) | Cleaned up debris; drainage system maintained. Completed installation of flume flow meter. Initiated project to develop engineered natural treatment systems. Installed cat walk for access to flow meter. |
| 010 (Building 203) | Completed installation of flume and flow meter. Calibrated flow meter. Conducted structural BMP and sedimentation/filtration basin inspections. Cleaned up debris. Rinsed filtration media. Installed erosion and sediment controls throughout upland areas. Redesigned access to BMP. |

| OUTFALL | BMP ACTIVITIES DURING 2007 |
|---|---|
| | Hydroseed was placed on approximately 0.5 acre to control sediment erosion. |
| 011 (Perimeter Pond Flume) | Conducted BMP and drainage system inspections. Cleaned up debris. Installed flow meter and calibrated it. Maintained straw bales and fiber rolls. Initiated design of treatment system to pump and treat pond water. Purpose of system is to create pond retention to hold the 1-year 24-hour storm of 2.3 inches. |
| 012 (Alfa Test Stand) | Constructed storm water sampling point. Installed carbon and zeolite bags upstream of sandbag barrier and sampling point. Installed drain pipe out of sandbag barrier, allowing water to flow into sample box located at sampling point. |
| 013 (Bravo Test Stand) | Constructed storm water sampling point. Installed carbon and zeolite bags upstream of sandbag barrier and sampling point. Installed drain pipe out of sandbag barrier, allowing water to flow into sample box placed at sampling point. |
| 014 (APTF Test Stand) | Installed bulk carbon and zeolite in existing pipe culvert. Installed sampling port in existing pipe culvert. Installed sandbag barrier around southern edge of property to redirect storm water running onto the property around the site. |
| 015 (STP I) | No activity. Wastewater currently hauled off-site – no discharges. |
| 016 ( STP II) | No activity. Wastewater currently hauled off-site – no discharges. |
| 017 (STP III) | No activity. Wastewater currently hauled off-site – no discharges. |
| 018 (R-2 Spillway) | Completed installation of structural BMP that consists of a series of eight filter cells in the R-2 Pond concrete overflow channel. Each filter cell is connected in a parallel flow arrangement, with each filter cell filled with GAC and zeolite in bulk form. The top of each filter cell is covered with 4-inches of 2-inch minus crushed rock to prevent erosion of the filter media. Under-drain pipes are installed on the bottom of each filter cell, and covered with a filter sleeve and bedded in 6-inches of a coarse sand to prevent loss of GAC through the under-drain system. Rinsed filtration media. Completed installation of flume and flow meter. Calibrated flow meter. Conducted BMP and drainage system inspections. Cleaned up debris. Began pretreatment system design plans to install at the R-2A pond to remove solids material to maximize the efficiency of the BMP material at Outfall 018. |
| 019 (GETS) | Groundwater Extraction Treatment System (GETS) under construction. Treated groundwater hauled off-site. No discharges. |

## REASONABLE POTENTIAL ANALYSIS (RPA)

Outfall monitoring data was collected in 2007 for Outfalls 002, 003, 004, 006, 009, 010, and 014. Data from this quarter were added to the RPA data set, as per the MWH and Flow Science RPA procedures for the outfall monitoring group, Outfalls 003-010 (excluding Outfall 008) (MWH and Flow Science, 2006). NPDES Permit No. R4-2007-0055 added storm water monitoring at the test stands, therefore, only the fourth quarter data for Outfall 014 was used for RPA determination at Outfalls 012 through 014. The analytical results for this sampling period did not trigger reasonable potential for any constituents not already regulated under the current NPDES permit. Complete RPA tables for the outfall monitoring group are provided in Section 9.


As summarized in the RPA Technical Memo (MWH and Flow Science, 2006), Boeing does not believe the currently used RPA procedures are appropriate for storm water and storm water-dominated discharges from the SSFL.

## CONCLUSIONS

Based on the reported data in 2007 and in previous years, and consistent with published studies referenced in this report, Boeing's belief is that a majority of the constituents that exceeded permit limits result from naturally occurring contributions (e.g., wildfires, native soil discharges into channels), or were detected at concentrations consistent with regional background concentrations and, therefore, were not the direct result of a known discharge or release from an industrial process or historical contamination on the site.

However, former industrial activities at the SSFL may have impacted localized areas of on-site soils and sediments that could have potentially affected surface water quality at some outfalls. Under DTSC supervision, mitigation actions were begun in 2007 and in previous years to manage surface water impacts potentially resulting from former industrial activities. These mitigation actions consisted of implementing an extensive system of BMPs. Boeing has deployed and continues to deploy BMPs to minimize the potential for surface water to contact contaminated on-site soils, sediment, or bedrock, and to minimize transport of soils and/or sediment that may be impacted with constituents regulated in the SSFL NPDES permit.

Boeing will continue to evaluate patterns of compliance and non-compliance, potential source areas, and effectiveness of BMPs to minimize the potential for pollutants, whether naturally occurring or not, to impact surface water at the SSFL.

## FACILITY CONTACT

If there are any questions regarding this report or it enclosures, you may contact Ms. Lori Blair of Boeing at (818) 466-8778.

## CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted.

Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for a knowing violation.

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Executed on the 28th day of February 2007 at the Boeing Company, Santa Susana Field Laboratory.

Sincerely,

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

TDG:bjc

Figure 1 Storm Water Drainage System and Outfall Locations

Table 1 2007 Rainfall Summary
Table 2 2007 Liquid Waste Shipments
Table 3 2007 Summary of Permit Limit Exceedances

Attachments:

| | | |
|---|---|---|
| Section 1 | Outfall 002 | South Slope below R-2 Pond |
| Section 2 | Outfall 003 | RMHF |
| Section 3 | Outfall 004 | SRE |
| Section 4 | Outfall 006 | FSDF-2 |
| Section 5 | Outfall 009 | WS-13 Drainage |
| Section 6 | Outfall 010 | Building 203 |
| Section 7 | Outfall 014 | APTF |
| Section 8 | Receiving Water Location – Arroyo Simi – Frontier Park | |
| Section 9 | Reasonable Potential Analysis (RPA) Summary Tables | |
| Section 10 | Storm Water Pollution Prevention Plan Annual Evaluation | |
| Section 11 | Analytical Laboratory Methods, Method Detection Limits, Reporting Limits, QA/QC Procedures, and ELAP Certifications | |

cc: Jim Pappas, Department of Toxic Substances Control
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Robert Marshall, California State University – Northridge, Library
Dale Redfield, Simi Valley Library
Lynn Light, Platt Branch, Los Angeles Library

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