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Mr. Karl Moyers
Santa Cruz County Public Works
2150 N. Congress Drive, Room 117
Nogales, Arizona 85621

Subject: Addendum
Evaluation of Potential Air, Water, and Soil Impacts from Sludge-Related Operations at Rio Rico Sanitary Landfill (RRSL), Santa Cruz County, AZ

Dear Karl:

SCS Engineers (SCS) was retained by Santa Cruz County (SCC), Arizona to provide professional engineering services for Rio Rico Sanitary Landfill (RRSL). This work is an addendum to the previous report, dated March 4, 2015. Work during this phase included performing air, water, and soil sampling; laboratory analysis; and evaluation of the results to assess the potential environmental impacts of sludge-related operations at the RRSL.

## BACKGROUND

SCC began disposal operations at the RRSL in June 1981. On February 6, 2012, the Arizona Department of Environmental Quality (ADEQ) approved a Type III change to the facility, which allowed the disposal of dewatered sewage sludge at the RRSL. On behalf of SCC, SCS conducted various types of environmental sampling on December 15 and 16, 2014, and performed an evaluation of the potential air, water, and soil impacts from these sludge-related operations based on a review of the laboratory data.

On April 22, 2015, SCS completed additional sampling, included testing parameters from on-site air, water, and soil media. SCS's intent is to provide SCC with the data and evaluation needed to make a sound assessment of potential environmental impacts resulting from the site's sludge-related operations.

## SAMPLING METHODOLOGY AND RESULTS

### Task 1 – Sample Basin Water for Barium, Molybdenum, a-Terpineol, Zinc, and Ammonia

#### Sample Collection Methodology

The RRSL stormwater retention basin is approximately 360 feet long and 150 feet wide and is located within the eastern portion of the site, as shown in Figure 1. Because stormwater runoff from the landfill is directed toward and stored in the basin, runoff from areas where sludge-

related operations are performed can potentially carry constituents that may impact the quality of the retention water.

On April 22, 2015, SCS collected two grab samples of water (Basin Water #1A and Basin Water #2A) from the water's edge at the retention basin. Sample locations are shown on Figure 1. Both samples were placed into laboratory-supplied bottles and jars. Each container was labeled with the sample location, date and time of sampling, and name of the sampler.

Filled sample containers were placed into an insulated cooler with ice and chilled to approximately 1-6 degrees Celsius (°C). Samples were shipped via Federal Express (FedEx) to ESC Lab Sciences in Mt. Juliet, Tennessee (Arizona Department of Health Services [ADHS] license number AZ0612) under proper Chain of Custody (COC) procedures, arriving at the laboratory on April 24, 2014.

## Laboratory Analysis of Samples

The two basin water samples were analyzed for total barium, molybdenum, and zinc using U.S. Environmental Protection Agency (EPA) Method 200.7; ammonia using EPA Method 350.1; and a-terpineol using EPA Method 8270C. A copy of the laboratory report from ESC Lab Sciences is provided in Attachment 1.

## Results – Retention Basin Water Samples

The analytical results for the two basin water samples showed that barium, molybdenum, zinc, and ammonia were detected in both samples, as listed in the table below. The results are compared to effluent limitation guidelines from the ADEQ Arizona Pollutant Discharge Elimination System (AZPDES) *Multi-Sector General Permit for Stormwater Discharges Associated with Industrial Activity from Non-Mining Facilities, Subpart L – Sector L – Landfills, Land Application Sites, and Open Dumps.*

**Table 1: Retention Basin Water for RRSL, Santa Cruz County, Arizona**

| Parameter | Basin Water #1A 4/22/2015 | Basin Water #2A 4/22/2015 | MSGP 2010 General Permit Benchmarks[1] |
|---|---|---|---|
| **Barium** | **0.20** | **0.10** | Not Applicable |
| **Molybdenum** | **0.0062** | **0.0078** | Not Applicable |
| **Zinc** | **0.090** | **0.054** | 0.20 mg/L, daily maximum<br>0.11 mg/L, monthly avg. maximum |
| **Ammonia** | **86** | **22** | 10 mg/L, daily maximum,<br>4.9 mg/L, monthly avg. maximum |
| **a-Terpineol** | <0.20 | <0.010 | 0.033 mg/L, daily maximum,<br>0.016 mg/L monthly avg. maximum |

Notes: All results in mg/L = milligrams per liter
1. Based on Effluent Limitations Guidelines, Table 8.L-2, Stormwater Discharges Associated with Industrial Activity – Sector L, MSGP 2010 General Permit, ADEQ

As shown in the above table, zinc, ammonia, and a-terpineol are listed in the Multi-Sector General Permit (MSGP) with respect to effluent limitations. Based on the laboratory results, zinc was below both the monthly average maximum and the daily maximum concentrations in both

samples. Ammonia was above both the monthly average maximum and the daily maximum concentrations in both samples. a-Terpineol was not detected in either sample; however, the dilution factor applied to sample Basin Water #1A caused the laboratory reporting limit to be elevated above the daily maximum and monthly average maximum, causing the results for this sample to be indeterminate. Previous wastewater sample results from laboratory reports provided by SCC did not include analyses for barium, molybdenum, zinc, ammonia, or a-terpineol for comparison (#1500-001-BI-W-AZP WW Composite, sampled 2/14/2012).

Ammonia concentrations can be increased in impoundments and stagnant water due to lack of turbulence and volatilization and greater accumulation of metabolic waste and decomposition products. Increased concentrations can also be due to runoff from landfill and septage.

During the previous investigation, zinc concentrations were above the monthly average maximum and slightly above the daily maximum in one basin water sample. It was concluded that it is possible that sludge (or landfill) operations at the RRSL have impacted the total metal concentrations in the basin water, particularly with respect to zinc. However, zinc is a common pollutant in surface water at landfills without sludge disposal, so its presence may not be a positive indication of sludge impacts.

Based on the above laboratory analytical results and the results discussed in the previous report for the basin water and sediment samples (dated March 4, 2015), it is possible that sludge (or landfill) operations at the RRSL have impacted the concentrations of ammonia and/or total metals (particularly with respect to zinc) in the basin water. However, zinc is a common pollutant in surface water at landfills without sludge disposal and ammonia is common in stagnant water, so their presence may not be a positive indication of sludge impacts.

## Task 2 – Soil Sampling for Barium and Molybdenum

### Soil Sample Collection Methodology

SCS performed soil sampling at approximately the locations used during the previous sampling event. These locations had been selected using the assumption that the potential sludge-derived pollutants would travel via surface and/or subsurface water flow downgradient within the landfill. Therefore, the following three (3) locations were selected for soil sample collection:

1) **Site 6A** – One (1) soil sample upstream of sludge and landfill operations (background)
2) **Site 7A** – One (1) soil sample between areas of sludge operations on landfill (landfill impacts)
3) **Site 8A** – One (1) soil sample downstream of sludge operations on landfill (sludge impacts)

On April 22, 2015, SCS collected samples from native soil at these three (3) locations (Sites 6A, 7A, and 8A). Each sample was collected from the ground surface directly into a laboratory-supplied 8-ounce glass sample jar that was then sealed with a Teflon-lined plastic lid. Each container was labeled with the sample location, date and time of sampling, and name of the sampler. Sample locations are shown on Figure 1.

Filled sample containers were placed into an insulated cooler with ice and chilled to approximately 1-6°C. Samples were shipped the day after sampling via FedEx to ESC Lab Sciences in Mt. Juliet, Tennessee (ADHS license number AZ0612) under proper COC procedures, arriving at the laboratory on April 24, 2015.

### Laboratory Analysis of Samples

The three soil samples were analyzed for barium and molybdenum using EPA Method 6010B. A copy of the laboratory report from ESC Lab Sciences is provided in Attachment 2.

### Results

The analytical results show that barium and molybdenum were detected in the samples, as listed in Table 1 below. The results were compared to Arizona Residential and Non-Residential Soil Remediation Levels (RSRLs and NRSRLs).

**Table 2: Barium and Molybdenum in Soil Samples for RRSL, Santa Cruz County, Arizona**

| Parameter | Site 6A (Background) 4/22/2015 | Site 7A (Landfill Impacts) 4/22/2015 | Site 8A (Sludge Impacts) 4/22/2015 | Arizona Soil Remediation Levels (SRLs) | |
|---|---|---|---|---|---|
| | | | | RSRL | NRSRL |
| **Barium** | **180** | **240** | **130** | 15,000 | 170,000 |
| **Molybdenum** | <0.50 | **0.51** | <0.50 | 390 | 5,100 |

Notes: All results in mg/kg = milligrams per kilogram

Results show that the above metal concentrations in soil from Sites 6A, 7A, or 8A did not exceed the Arizona RSRLs or NRSRLs. Furthermore, there is no appreciable difference between the background and potential impact area concentrations. Based on the analytical results for the three (3) soil samples, evidence does not indicate that sludge operations at the RRSL have impacted the priority pollutant metal concentrations of the site soils.

## Task 3 – Groundwater Sampling for Barium and Molybdenum

### Groundwater Sample Collection Methodology

On March 23, 2015 SCS performed semi-annual groundwater monitoring at the site as documented in our report dated May 8, 2015, which has been submitted to the County under separate cover. As proposed, during the semi-annual groundwater monitoring event groundwater samples were collected from monitoring wells MW-1, MW-3, and MW-4 to be analyzed for barium and molybdenum.

Each well was purged following measurements of depth to water. Measurements of pH, conductivity, and temperature were recorded during purging. Samples were collected after measurements had stabilized. Copies of water sampling logs are included in Attachment 3.

MW-1 and MW-3 were purged using a 2-inch diameter portable submersible pump that was decontaminated before beginning purging and after sampling each of the two wells. A non-phosphate detergent was circulated through the pump and discharge tubing followed by one rinse

with tap water and one rinse with purified water prior to sampling; new unused tubing was used at each well. The pump intake was set approximately midway between the bottom of each well and the measured static water level. The wells were purged at rates of about 3 to 5 gallons per minute (gpm) for approximately 3 well volumes. The pumping rate was then reduced to about 1 gpm during collection of the groundwater sample from the discharge tubing of the well.

MW-4 was purged using a dedicated submersible pump set at approximately 385 feet below ground surface (bgs). The well was purged at a rate of about 5 gpm for more than 3 well volumes. Samples were collected from a bleeder valve on the main discharge line.

Samples to be analyzed for barium and molybdenum were each collected into 1-liter polyethylene bottles preserved with nitric acid. Each container was filled, capped, and labeled with the sample location; date and time of sampling; analytical methods to be used; and preservatives in the sample. Filled sample containers were placed into an insulated cooler with ice. Samples were transported to TestAmerica (Arizona Department of Health Services license number AZ0728), located in Phoenix, Arizona, under chain of custody procedures the day after the samples were collected.

## Laboratory Analysis of Samples

Groundwater samples were analyzed for total barium and molybdenum using EPA Methods 200.7 and 200.8. A copy of selected portions of the laboratory report from TestAmerica is included in Attachment 3; only those pages pertinent to this investigation are included. The complete laboratory report is included in the SCS report *2015 First Half Semi-Annual Groundwater Monitoring Report* (dated May 8, 2015).

## Results

SCS reviewed the laboratory analytical results and compared them to the Arizona Aquifer Water Quality Standards (AWQS). Barium was detected in the samples above laboratory reporting limits. The laboratory results for total barium and molybdenum are summarized in the table below.

**Table 3: Barium and Molybdenum in Groundwater Samples, RRSL, Santa Cruz Co, Arizona**

| Parameter | MW-1 | MW-3 | MW-4 | AWQS |
|---|---|---|---|---|
| **Barium** | **0.10** | **0.0088** | **0.049** | **2.0** |
| **Molybdenum** | <0.0030 | <0.0030 | <0.0030 | NE |

Notes: All results in mg/L = milligrams per liter; NE = None established

Based on the laboratory results for analysis of barium and molybdenum in samples from the three groundwater monitoring wells at the landfill, evidence of impacts to groundwater from the sludge operations was not identified.

### Task 4 – Ambient Air Sampling for *Clostridium difficile*

#### Microbial Sample Methodology and Analysis

In order to assess the potential impacts of the sludge operations on ambient air and airborne microbial species, SCS used a single phase impactor sampler to collect microbial samples at Sites 1A-5A. Microbial samples were collected and tested for *Clostridium difficile* as recommended by RRSL's academic contact at the University of Georgia, Professor David L. Lewis.

The five microbial samples were collected using a single phase impactor sampler supplied by EMSL Laboratories (EMSL). Samples were collected according to the sampling procedures provided by EMSL. Before collecting the samples from Sites 1A-5A, the impactor sampler was wiped clean with a 70 percent isopropyl alcohol wipe and allowed to dry before use. After each sample was collected, the petri dish lid was replaced and masking tape was used to form a seal. The petri dishes were placed in a chilled cooler. On April 23, 2015, the samples were shipped via FedEx overnight to the EMSL laboratory in Cinnaminson, New Jersey, for arrival on April 24, 2015.

#### Results

The analytical report supplied by EMSL for the microbial testing of samples from Sites 1A-5A identified *Clostridium difficile* as Non Detectable for all five (5) samples, indicating no bacterial impacts from sludge operations. The EMSL report is included as Attachment 4.

## CONCLUSIONS AND RECOMMENDATIONS

### Conclusions

SCS performed air, water, soil sampling, laboratory analysis and subsequent evaluation of the results to assess the potential impacts of sludge-related operations at the RRSL. The conclusions for the performed tasks are summarized below.

- **Task 1 – Basin Water Sampling:** Two grab samples of water were collected from the retention basin and analyzed for total barium, molybdenum, and zinc; ammonia; and a-terpineol. All except a-terpineol were detected in the samples. The results were compared to the AZPDES MSGP effluent limitation guidelines for landfills; only zinc, ammonia, and a-terpineol were identified in the MSGP with respect to effluent limitations. The results for both samples were above the monthly average maximum and daily maximum concentration for ammonia. Based on the laboratory analytical results discussed in the previous report (March 4, 2015), zinc exceeded both the monthly average and daily maximum concentrations. Based on the previous and current results, it is possible that sludge (or landfill) operations at the RRSL have impacted concentrations of ammonia and/or total metals (particularly with respect to zinc) in the basin water.

- **Task 2 – Soil Sampling for Barium and Molybdenum:** Surface samples were collected from native soil at three locations (Sites 6A-8A); one location represented background conditions, one location represented areas with landfill impacts, and one location represented areas with sludge impacts. The samples were analyzed for total barium and molybdenum. Barium was detected in all three samples and molybdenum was detected in one sample, but all were below the Arizona RSRLs and NRSRLs. Based on the analytical results for this and the previous investigation, evidence did not indicate that sludge operations at the RRSL have impacted the total priority pollutant metal, barium, or molybdenum concentrations of the site soils.

- **Task 3 – Groundwater Sampling for Barium and Molybdenum:** Groundwater samples were collected from site monitoring wells MW-1, MW-3, and MW-4 and analyzed for total barium and molybdenum. Barium was detected in the samples above laboratory reporting limits, but all results were below the AWQS. Based on the results of this and the previous investigation, evidence of impacts to groundwater by total priority pollutant metals, barium, or molybdenum from the sludge operations was not identified.

- **Task 4 – Ambient Air Sampling for *Clostridium difficile*:** One sample was collected from each of five locations upwind and downwind of sludge and landfill operations (Sites 1A-5A) and analyzed for the microbe *Clostridium difficile*, which was not detected in the samples. The analytical results of the air samples for this and the previous investigation do not provide evidence that the sludge operations impact the microbe concentrations in ambient air at the RRSL.

## Recommendations

Based on the results of this study, environmental impacts from the sludge operations were not indicated for most media. However, potential sludge or general landfill impacts may have occurred in pond water and sediment, as indicated by detected metals and ammonia. Although SCS does not consider these impacts significant, we have the following recommendations:

- Annual sampling and analysis of pond water and sediment for priority pollutant metals, plus barium and molybdenum, and ammonia, and comparison to previous concentrations to assess contaminant trends.

- In accordance with storm water permits, sampling and analysis for priority pollutant metals, plus barium, molybdenum, and ammonia in storm water samples to evaluate potential impacts to storm water discharges leaving the site.

- Adherence to site operational plans to ensure that sludge material is properly disposed and covered.

## CLOSING

SCS appreciates the opportunity to continue to provide professional engineering services to the County. If you have any questions or need additional information, please contact Pat Sullivan at (916) 361-1297.

Sincerely,

Patrick S. Sullivan, R.E.P.A., C.P.P.
Senior Vice President
**SCS ENGINEERS**

Patricia M. Hartshorne, R.G.
Project Manager
**SCS ENGINEERS**

ph/pss
SCC RRSL Sludge Impact Report 2 Text v0.1.docx

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**List of Tables:**

1. Retention Basin Water for RRSL, Santa Cruz County, Arizona
2. Barium and Molybdenum in Soil Samples for RRSL, Santa Cruz County, Arizona
3. Barium and Molybdenum in Groundwater Samples, RRSL, Santa Cruz Co, Arizona

Enclosures:
1. Figure 1
2. Attachments 1-4

# FIGURE


Source: Google Earth, December 2014

Disclaimer: This figure is based on available data. Actual conditions may differ. All locations and dimensions are approximate.

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Addendum – Air, Water, and Soil Sampling for Sludge Application Impacts
Rio Rico Sanitary Landfill (RRSL)
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Rio Rico, Santa Cruz County, Arizona

Figure 1
Sample Location Map