Chevron

John Krogue
Environmental Team
Lead

Salt Lake Refinery
Chevron Products Company
2351 North 1100 West
Salt Lake City, UT 84116
Tel 801 539 7366
Fax 801 539 7130

March 27, 2014

RECEIVED
MAR 3 1 2014
Utah Division of Water Quality

CERTIFIED MAIL
RETURN RECEIPT NO. 7011 2970 0001 8870 1620

Mr. Walt Baker, Director
Utah Division of Water Quality
PO Box 144870
Salt Lake City, Utah 84114-4870

Attn: Jennifer Robinson

Renewal of UPDES Permit UT0000175 – Revised Supplemental RPA Documentation

Dear Mr. Baker:

In a letter dated December 26, 2013, Chevron submitted its weight-of-evidence reasonable potential analysis (RPA) for narrative water quality standards. Based on feedback received from your staff, Chevron has updated and modified its analysis. In addition to minor clarifications and corrections, ammonia was added to the RPA and further pollutant analyses were done for Farmington Bay.

We hope that you may find this useful in developing your policy on the issue in general, as well as moving forward with the permit renewal process.

Sincerely,

John Krogue

Enclosures

750.2.1

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

Executive Summary

When numerical criteria do not apply to a receiving water, the classic approach to "reasonable potential analysis" (comparing maximum expected concentrations to applicable numeric criteria) isn't readily available. In such cases, an agency may use a tiered weight-of-evidence approach to analyzing for "reasonable potential," pursuant to 40 CFR 122.44(d)(1), as part of an NPDES permit renewal. Chevron Products Company ("Chevron") has created an example of such a process and used it to demonstrate a tiered weight-of-evidence reasonable potential analysis for its own discharge, to support the renewal of UPDES Permit No. UT0000175. We used Utah Class 3 acute aquatic life criteria if they existed, or Class 3 human health criteria, or EPA criteria as screening numeric criteria for purposes of this RPA analysis. In the Appendix, the tiered reasonable potential analysis is illustrated in Figure 2.

We were able to demonstrate that we could meet Class 3 or equivalent freshwater acute water quality or human health criteria at the end-of-pipe for 124 of 128 contaminants considered. For Zn, Se, ammonia and CN we assumed dilution credit in the receiving water, the Northwest Oily Drain, assuming a flow of 1.2 MGD from the refinery and 33 MGD from the Salt Lake City Wastewater Reclamation facility upstream; we also checked 16.5 MGD as the background flow in accordance with R317-2-5 which suggests using only 50% of the stream in some cases. There is no reasonable potential for these four constituents after mixing in the receiving water.

Table E1 Summary of Weight-of-Evidence Reasonable Potential Analysis for Chevron Refinery

Compounds	Detected/ Undetected	Believed Present/ Absent	Reasonable Potential Analysis	No. of Cmpds
Volatiles	ND	Believed Absent	No RP if not present	24
Semi-volatiles	ND	Believed Absent	No RP if not present	39
Pesticides	ND	Believed Absent	No RP if not present	17
PCBs	ND	Believed Absent	No RP if not present	8
Volatiles, e.g., BTEX	ND or DNQ	Believed Present Estimate MEC by EPA TSD using MDL or j-flag value to estimate MEC	No RP if MEC < WQC (Class 3 if available; EPA if not)	5
Semi-volatiles, e.g., PAHs, TCDD	ND or DNQ		No RP if MEC < WQC (Class 3 if available; EPA if not)	19
Heavy Metals except Cu, Se, Zn and CN	Detected/ Quantified	Believed Present Estimate MEC by EPA TSD	No RP if MEC < WQC at end-of-pipe (using Class 3 WQC if available; EPA if not)	11

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

Cu	Detected/ Quantified	Believed Present.	No RP if MEC (12.2 μg/L) < WQC (28 μg/L)	1
Zn	Detected/ Quantified	Believed Present.	No RP if MEC after mixing (96 μg/L) <WQC (382 μg/L)	1
Se	Detected/ Quantified	Believed Present.	No RP if MEC after mixing <WQC; No RP if receiving water < Class 3 chronic WQC (4.6 μg/L)	1
CN	Detected/ Quantified	Believed Present.	No RP based on weight of evidence	1
Ammonia as nitrogen	Detected/ Quantified	Believed Present.	No RP if MEC after mixing (8.85 mg/L) <WQC (10.1 mg/L)	1
				128

ND = not detected; DNQ = detected, not quantified; MEC = maximum expected concentration

For selenium and zinc we took dilution credit, using the 80th percentile of more than seven years of quarterly average data from the upstream POTW (2.73 μg/L and 48.3 μg/L) as background concentrations in the receiving water. This is a conservative approach.

We used a similar approach for ammonia. The 80th percentile values of ammonia and pH, based on daily data from the POTW in 2012 (≥150 data points), were 8.53 mg/L and 7.9 pH; the acute screening criterion for ammonia at pH 7.9 is 10.1 mg/L.

For cyanide the water quality criteria are based on "free cyanide" (HCN or CN^-) but most cyanide in wastewater is complexed with metals such as iron and so has very limited bioavailability; Redman and Santore corroborated several other "studies that show that the toxicity in metal-cyanide mixtures is primarily due to free cyanide." [1] However, most wastewater cyanide data are for "total cyanide" (including complexed cyanide that has limited or no bioavailability) because EPA has not approved a method for free cyanide at 40 CFR 136. Chevron gathered additional effluent data using an analytical method that measures "available" cyanide as a surrogate for free cyanide. Using the 80th percentile of the POTW's total cyanide data as background, an approach we consider very conservative, we could not demonstrate that the refinery effluent was below the Class 3 screening criterion after dilution. Therefore our conclusion that there is no reasonable potential for cyanide is based on weight of evidence, including the refinery's consistent ability to pass its whole effluent toxicity limit in 100% effluent.

[1] See Redman, Aaron and Robert Santore, *Bioavailability of Cyanide and Metal-cyanide Mixtures to Aquatic Life*, Environmental Toxicology and Chemistry, 31, No. 8, pp. 1774-1780, August 2012 http://onlinelibrary.wiley.com/doi/10.1002/etc.1906/pdf

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

I. <u>Introduction</u>

Chevron's Salt Lake Refinery discharges treated process wastewater and stormwater to the Northwest Oily Drain, a drainage canal and a Class 3E water of the state. The Northwest Oily Drain flows in turn into Farmington Bay, a Class 5D water of the state. Farmington Bay is also listed as a receiving water for the refinery.

Utah Administrative Code R317-2-6 provides use designations including the following:

6.3 Class 3 -- Protected for use by aquatic wildlife.

> a. Class 3A -- Protected for cold water species of game fish and other cold water aquatic life, including the necessary aquatic organisms in their food chain.
>
> b. Class 3B -- Protected for warm water species of game fish and other warm water aquatic life, including the necessary aquatic organisms in their food chain.
>
> c. Class 3C -- Protected for nongame fish and other aquatic life, including the necessary aquatic organisms in their food chain.
>
> d. Class 3D -- Protected for waterfowl, shore birds and other water-oriented wildlife not included in Classes 3A, 3B, or 3C, including the necessary aquatic organisms in their food chain.
>
> e. Class 3E -- Severely habitat-limited waters. Narrative standards will be applied to protect these waters for aquatic wildlife.

6.5 Class 5 – The Great Salt Lake

> d. Class 5D Farmington Bay
>
> Beneficial Uses -- Protected for infrequent primary and secondary contact recreation, waterfowl, shore birds and other water-oriented wildlife including their necessary food chain.

Note that neither Class 3E nor Class 5D waters have numeric water quality criteria. These narrative criteria require protection of aquatic wildlife or waterfowl, shore birds and other water-oriented wildlife including their necessary food chain. Therefore, in the process illustrated below, Chevron developed an example of a weight-of-evidence reasonable potential analysis using screening criteria or thresholds of concern, and followed in general EPA's approach to reasonable potential analysis.[2]

Sections II and III below describe the general approach that Chevron used. Chevron followed this approach, but did not have to implement every step in demonstrating its weight-of-evidence analysis for the refinery.

II. Developing Screening Numeric Water Quality Criteria or Alternate Thresholds of Concern

Chevron took the following approach in identifying thresholds of concern, in order of preference:

A. Use Utah Class 3 or 5 criteria if any exist. Because the narrative criteria call for protection of aquatic wildlife or waterfowl, shore birds and other water-oriented wildlife including their necessary food chain, and because Class 3A—3D numeric criteria are also designed to protect aquatic wildlife as described by the beneficial uses quoted in Part I above, Chevron believes that the Class 3A – 3D criteria are conservative screening criteria for the narrative criterion.

Note, for example, that EPA developed numeric criteria for aquatic life by selecting a value that would protect 95% of the species in their data base, and then as a safety factor they divide by two. Utah's Class 3 numeric criteria tend to be the same or lower than EPA criteria. However, Class 3E waters as noted above are "severely habitat-limited" waters. Thus we would not expect to find the range of species that the numeric criteria would seek to protect, including game fish (Class 3A and 3B). Numeric criteria would be overprotective, and presumably that is one reason Utah has not applied them in Class 3E waters.

It follows, then, that if a discharger can show no reasonable potential to exceed the numeric criterion value in the receiving water, there should be no reasonable potential to exceed the narrative standard.

It also follows that even if a discharger cannot show no reasonable potential to exceed the numeric criterion, this does not automatically demonstrate that reasonable potential exists to exceed the narrative standard. This is just the first step in a tiered analysis, and a discharger may demonstrate with other evidence (such as whole effluent toxicity data) that no reasonable potential exists.

---

[2] Based on Chapter 3 of EPA's *Technical Support Document for Water Quality-based Toxics Control*, EPA 505/2-90/001, March 1991. This document is commonly known in water quality circles as the TSD.

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

B. Use aquatic life criteria from the EPA National Toxics Rule Criteria at 40 CFR §131.36, if no aquatic life criteria exist for Utah Class 3 waters. If no aquatic life criteria exist, Chevron then chose to use Utah Class 3 or EPA human health criteria as screening criteria.

Note that since neither 3E nor 5D waters will be appropriate for drinking water, human health criteria for consumption of organisms only were selected for screening purposes. It is debatable whether human health-based criteria are relevant at all, since Class 3E waters are not protected for game fish or for consumption of other aquatic wildlife. In addition, when evaluating performance against human health criteria, a discharge should be evaluated using its geometric mean rather than its maximum expected concentration, because human criteria protect over a long period of exposure (e.g., over a lifetime,[3] although for practical purposes an annual exposure is more useful for evaluation). However, Chevron used the human health criteria for screening against the maximum expected concentration because narrative standards are used to protect Class 3E waters;[4] narrative standards appear at U.A.C. R317-2-7.2 that specifically mention human health effects,[5] albeit that the effects are not specified.

C. Use relevant peer reviewed literature values if neither of the above exists. Relevant means, among things, that they are relevant to the fauna that exist in and around the local receiving water (e.g., fresh water mussels found in streams in New England are not relevant to the Great Salt Lake).

D. Dischargers at their option may submit site specific thresholds they believe are relevant, with supporting scientific information, for consideration by DEQ. E.g., it is well known that some EPA metals criteria can be very low based on very sensitive species that occur east of the Mississippi River but may not be relevant to certain waters in Utah. A site specific criterion

---

[3] See, for example, *Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (2000)*, EPA-822-B-00-004, October 2000, p. 1-11

[4] U.A.C. R317-2-6.3. e. Class 3E -- Severely habitat-limited waters. Narrative standards will be applied to protect these waters for aquatic wildlife.

[5] It shall be unlawful, and a violation of these rules, for any person to discharge or place any waste or other substance in such a way as will be or may become offensive such as unnatural deposits, floating debris, oil, scum or other nuisances such as color, odor or taste; or cause conditions which produce undesirable aquatic life or which produce objectionable tastes in edible aquatic organisms; or result in concentrations or combinations of substances which produce undesirable physiological responses in desirable resident fish, or other desirable aquatic life, or undesirable **human health effects**, as determined by bioassay or other tests performed in accordance with standard procedures; or determined by biological assessments in Subsection R317-2-7.3 [emphasis added].

might be justified in that case, assuming the irrelevant species are removed from the data base and a new 95th percentile of GMAV is developed for the site specific RPA.

E. Weight of Evidence data may be a factor in a finding of no reasonable potential. For example:

1. Whole Effluent Toxicity data may be used in a weight of evidence finding to demonstrate there is no reasonable potential.

2. Process knowledge may be used in a weight of evidence finding to demonstrate there is no reasonable potential. An example would be the priority pollutant list of the pesticides, the manufacture of which is banned. Facilities know whether they use these; if they do not use them, there should be no reasonable potential.

3. Fate models in the receiving water may be weight of evidence. If it is known or can be demonstrated that a contaminant being discharged is somehow transformed so as not to be bioavailable in its toxic form to aquatic life, this would be weight of evidence. Examples might include: precipitation, volatilization, sorption, complexation (for example, binding to other materials as cyanide does to iron and other metal ions), chemical or biochemical oxidation or reduction, and so forth.

III. Reasonable Potential Analysis

As noted, Chevron's approach followed EPA's TSD methodology. In particular, Chevron used EPA's statistical approach to estimate the maximum expected concentration (MEC) at the end-of-pipe, or in the receiving water for a handful of parameters.

A. Compounds Not Present in the effluent. Compounds undetected in the effluent and deemed to be not present do not produce reasonable potential and therefore require no water quality-based limits.

B. Compounds Undetected but Believed Present. If reasonably possible, provide additional weight-of-evidence to demonstrate no reasonable potential. Note: EPA assumes that compounds that are not detected are not present, in general. However, if Chevron believed the compound to be present in the refinery (not necessarily in the effluent), even though undetected in the effluent (benzene, for example), Chevron attempted to estimate an MEC based on the analytical method's method detection limit (MDL).

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

C. Maximum Expected Concentration. If a compound was detected and its concentration could be quantified, or (if below the reporting limit) estimated, the maximum expected concentration (MEC) was estimated statistically following the protocol in EPA's TSD.

D. Dilution.

If the MEC was below the threshold of concern at the end-of-pipe (refinery final effluent), no dilution credit was taken.

Utah water quality standards at R317-2-5 specifically authorize mixing zones. These are zones that allow limited credit for dilution of the effluent in the receiving stream, where appropriate. EPA regulations also support mixing zones[6]. Therefore, establish an estimate of dilution in the receiving water over an appropriate period of time (such as four to seven days, for RPA based on aquatic life chronic criteria and at least one year for human health criteria).

E. Reasonable Potential Analysis for Detected Compounds

Compare the pollutant's MEC (after dilution, if appropriate) with the threshold of concern developed in Part II above. If MEC < threshold, no RP exists and no WQBEL is required. If MEC > threshold, the discharger has not yet demonstrated no reasonable potential, and must rely on additional evidence, as discussed in Part II above.

Sections IV – VI present Chevron's weight-of-evidence reasonable potential analysis for the refinery's effluent.

IV. Effluent Characterization Phase

A. Chevron's NPDES permit renewal application followed general rules for characterizing effluent quality according to the federal regulations at 40 CFR §122.21(g)(7) for existing industrial dischargers, as modified by UDEQ.

1. Quantitative data are required for pollutants known or believed to be present. Quantitative data for pollutants believed to be absent may be volunteered under federal rules but Utah requires data on all priority pollutants. Chevron submitted data on all priority pollutants.

2. If one exists, a method approved at 40 CFR §136 must be used[7]. A method whose method detection limit (MDL) is below the appropriate water quality criterion or threshold of

---

[6] 40 CFR 122.44(d)(1)(ii) and EPA TSD Chapter 3

[7] unless another method is required by 40 CFR Subchapters N or O (not applicable in the case of refineries)

concern (see below) should be selected if one exists; if not, choose the approved method with the lowest MDL. Chevron used 40 CFR 136 methods for priority pollutants exclusively in its renewal application, submitted in June, 2012[8].

B. As part of effluent characterization, Chevron estimated the likely maximum expected concentration (MEC) for pollutants that were detected in the effluent. The approach outlined below follows that suggested by EPA in the Technical Support Document for Water Quality-based Toxics Control[9] (the TSD).

1. When one or more analyses resulted in quantifiable results, use the methods in EPA's TSD Chapter 3 to estimate the MEC. Use factors[10] from EPA's Table 3-2 and assume a coefficient of variation (Cv) = 0.6 if fewer than 10 data points exist; for 10 or more data points, calculate the Cv = mean/standard deviation for the data set. Multiply the factor by the highest concentration in the sample data set.

Example: four analyses show values of 15, 12, 18, and 10 ug/L for zinc. The numerical zinc chronic criterion is 120 ug/L for Class 3 waters in Utah.

The multiplying factor from Table 3-2 for four samples and Cv = 0.6 is 2.6

The highest observed concentration is 18.

The MEC = 2.6 x 18 = 47. It's less than 120 so there is no reasonable potential.

Note: dischargers at their option may choose to collect additional data, which tend to lower the multiplying factor but may also raise the highest observed value. In most cases, where use of the higher (more conservative) multiplying factor still demonstrated no reasonable potential, Chevron did not collect more data.

2. For pollutants that are detected, but not quantified, the discharger should report the reporting level (RL) or level of quantitation (LOQ). Use one-half the RL or LOQ as the maximum observed value. If the discharger at his or her option reports estimated values (j-flagged values) for all cases when the pollutant was detected, use the highest estimated value. Chevron chose to use j-flagged values in this demonstration although it may be appropriate to use one-half the RL or LOQ values as estimates .

[8] Chevron used a non-40 CFR 136 method for "available cyanide", in supporting its reasonable potential analysis for cyanide, as described later in this document; those data were not part of the original renewal application.
[9] EPA 505/2-90/001, March 1991
[10] A factor that provides at the 99% confidence level that the maximum observed value in a data set, multiplied by the Table 3-2 factor, exceeds the 95th percentile of the whole population from which the data set was taken.

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

3. When the pollutant is not detected, EPA assigns a value of zero.

V. Analytes that are not degrading receiving water quality.

Analytes are not potentially causing or contributing to a violation of water quality standards if (1) they are not present in the effluent or (2) they are present but below the background concentration of the receiving water.[11] These analytes can be eliminated from further RPA, saving the agency the need to develop screening numeric water quality criteria or thresholds of concern.

A. Not detected, and believed absent based on process knowledge. Chevron found the following were not detected (labeled ND) and are believed to be absent based on process knowledge (this list includes most halogenated compounds and the pesticides, which are not used). Therefore no reasonable potential exists. This group includes nearly all the organic priority pollutants.

[11] If the effluent concentration of a contaminant is below that contaminant's concentration in the receiving water, then the effluent is diluting the receiving water with respect to that contaminant and cannot be contributing to an exceedance of a water quality standard.

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

Table 1 Volatile Compounds (Believed Absent, Undetected)

Volatile Compounds by Method 624 Believed Absent and Undetected	Believed Present	Believed Absent	
2V. Acrylonitrile (107-13-1)		x	ND
4V. Bis(Chloromethyl)Ether (542-88-1)		x	ND
5V. Bromoform (75-25-2)		x	ND
6V. Carbon Tetrachloride (56-23-5)		x	ND
7V. Chlorobenzene (108-90-7)		x	ND
8V. Chlorodibromomethane (124-48-1)		x	ND
9V. Chloroethane (75-00-3)		x	ND
10V. 2-Chloroethylvinyl Ether (110-75-8)		x	ND
12V. Dichlorobromomethane (75-27-4)		x	ND
13V. Dichlorodifluoromethane (75-71-8)		x	ND
14V. 1,1-Dichloroethane (75-34-3)		x	ND
15V. 1,2-Dichloroethane(107-06-2)		x	ND
16V. 1,1-Dichloroethylene (75-35-4)		x	ND
17V. 1,2-Dichloropropane (78-87-5)		x	ND
18V. 1,3-Dichloropropylene (542-75-6)		x	ND
20V. Methyl Bromide (74-83-9)		x	ND
21V. Methyl Chloride (74-87-3)		x	ND
23V. 1,1,2,2-Tetrachloroethane (79-34-5)		x	ND
26V. 1,2-Trans-Dichloroethylene (156-60-5)		x	ND
27V. 1,1,1-Trichloroethane (71-55-6)		x	ND
28V. 1,1,2-Trichloroethane (79-00-5)		x	ND
29V. Trichloroethylene (79-01-6)		x	ND
30V. Trichlorofluoromethane (75-69-4)		x	ND
31V. Vinyl Chloride (75-01-4)		x	ND

Table 2 Acid Semi-volatile Compounds (Believed Absent, Undetected)

Acid Compounds including phenol by Method 625 Believed Absent and Undetected	Believed Present	Believed Absent	
1A. 2-Chlorophenol (95-57-8)		x	ND
2A. 2,4-Dichlorophenol (120-83-2)		x	ND
4A. 4,6-Dinitro-O-Cresol (534-52-1)		x	ND
5A. 2,4-Dinitrophenol (51-28-5)		x	ND
6A. 2-Nitrophenol (88-75-5)		x	ND
7A. 4-Nitrophenol (100-02-7)		x	ND
8A. P-Chloro-M-Chresol (59-50-7)		x	ND
9A. Pentachlorophenol (87-86-5)		x	ND

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

11A. 2,4,6-Trichlorophenol (88-06-2)		x	ND

Table 3 Base Neutral Semi-Volatile Compounds (Believed Absent, Undetected)

Base Neutral Compounds incl. PAHs by Method 625 Believed Absent and Undetected	Believed Present	Believed Absent	
4B. Benzidine (92-87-5)		x	ND
10B. Bis(2-Chloroethoxy)Methane (111-91-1)		x	ND
11B. Bis(2-Chloroethyl)Ether (111-44-4)		x	ND
12B. Bis(2-Chloroisopropyl)Ether (102-60-1)		x	ND
13B. Bis(2-Ethylhexyl)Phthalate (117-81-7)		x	ND
14B. 4-Bromophenyl Phenyl Ether (101-55-3)		x	ND
15B. Butyl Benzyl Phthalate (85-68-7)		x	ND
16B. 2-Chloronaphthalene (91-58-7)		x	ND
17B. 4-Chlorophenyl Phenyl Ether (7005-72-3)		x	ND
20B. 1,2-Dichlorobenzene (95-50-1)		x	ND
21B. 1,3-Dichlorobenzene (541-73-1)		x	ND
22B. 1,4-Dichlorobenzene (106-46-7)		x	ND
23B. 3,3'-Dichlorobenzidine (91-94-1)		x	ND
24B. Diethyl Phthalate (84-66-2)		x	ND
25B. Dimethyl Phthalate (131-11-3)		x	ND
26B. Di-N-Butyl Phthalate (84-74-2)		x	ND
27B. 2,4-Dinitrotoluene (121-14-2)		x	ND
28B. 2,6-Dinitrotoluene (606-20-2)		x	ND
29B. Di-N-Octyl Phthalate (117-84-0)		x	ND
30B. 1,2-Diphenylhydrazine(as Azobenzene) (122-66-7)		x	ND
33B. Hexachlorobenzene (118-74-1)		x	ND
34B. Hexachlorobutadiene (87-68-3)		x	ND
35B. Hexachlorocyclopentadiene (77-47-4)		x	ND
36B. Hexachloroethane (67-72-1)		x	ND
38B. Isophorone (78-59-1)		x	ND
40B. Nitrobenzene (98-95-3)		x	ND
41B. N-Nitrosodimethylamine (62-75-9)		x	ND
42B. N-Nitrosodi-N-Propylamine (621-64-7)		x	ND
43B. N-Nitrosodiphenylamine (86-30-6)		x	ND
46B. 1,2,4-Trichlorobenzene (120-82-1)		x	ND

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

Table 4 Pesticides and PCBs (Believed Absent, Undetected)

Pesticides(and PCBs) by Method 608 Believed Absent and Undetected	Believed Present	Believed Absent	
1P. Aldrin (309-00-2)		x	ND
2P. Alpha-BHC (319-84-6)		x	ND
3P. Beta-BHC (319-85-7)		x	ND
4P. Gamma -BHC (58-89-9)		x	ND
5P. Delta-BHC (319-86-8)		x	ND
6P. Chlordane (57-74-9)		x	ND
7P. 4,4'-DDT (50-29-3)		x	ND
8P. 4,4'-DDE (72-55-9)		x	ND
9P. 4,4'-DDD (72-54-8)		x	ND
10P. Dieldrin (60-57-1)		x	ND
11P. Alpha-Endosulfan (115-29-7)		x	ND
12P. Beta-Endosulfan (115-29-7)		x	ND
13P. Endosulfan Sulfate (1031-07-8)		x	ND
14P. Endrin (72-20-8)		x	ND
15P. Endrin Aldehyde (7421-93-4)		x	ND
16P. Heptachlor (76-44-8)		x	ND
17P. Heptachlor Epoxide (1024-57-3)		x	ND
18P. PCB-1242 (53469-21-9)		x	ND
19P. PCB-1254 (11097-69-1)		x	ND
20P. PCB-1221 (11104-28-2)		x	ND
21P. PCB-1232 (11141-16-5)		x	ND
22P. PCB-1248 (12672-29-6)		x	ND
23P. PCB-1260 (11096-82-5)		x	ND
24P. PCB-1016 (12674-11-2)		x	ND
25P. Toxaphene (8001-35-2)		x	ND

B. Believed present, but not detected, or detected below the reporting limit but not quantified. Whether analytes are "believed present" or "believed absent" is based on knowledge of refinery processes, feedstocks, products, byproducts, waste products, and chemicals used in the refinery. Analytes that are believed present in the refinery are not necessarily present in the effluent. Chevron looked at compounds that were believed present but were still undetected (ND, below), or were detected below the method's reporting limit (Detected, Not Quantified, or DNQ, below).

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

Table 5 Volatiles (Undetected; or Detected, Not Quantified)

Volatile Compounds Analyzed by Method 624 and Believed Present in the Refinery Units: µg/L		MEC=6.2 times MDL or est. value		Utah Human Health WQC	MEC Below Criterion ?	MDL	RL		Estimated Value
1V. Acrolein (107-02-8)	ND	12.40		3 (Note 1)	No	2.00	5.00		
3V. Benzene (71-43-2)	ND	0.51		51	Yes	0.0830	2.00		
11V. Chloroform (67-66-3)	DNQ	0.61		470	Yes	0.0990	2.00		0.210
19V. Ethylbenzene (100-41-4)	ND	0.37		2100	Yes	0.060	2.00		
22V. Methylene Chloride (75-09-2)	DNQ	0.74		590	Yes	0.120	2.00		0.160
24V. Tetrachloroethylene (127-18-4)	ND	0.99		3.3	Yes	0.160	2.00		
25V. Toluene (108-88-3)	DNQ	0.93		15000	Yes	0.150	2.00		0.170

Note 1: acrolein does have an aquatic life criterion; it is 3.0 µg/L for both acute and chronic impacts.

For the above volatile compounds, there are no Class 3 aquatic life criteria except for acrolein. Utah provides human health criteria in Table 2.14.6 of U.A.C. R-317. These compounds, if present at 6.2 times the method detection limit or estimated value as the case may be, would not exceed Utah's human health criteria. Benzene, toluene, ethylbenzene (and xylenes) are known to be highly biodegradable and are typically undetected in refinery effluent downstream of biological treatment. Chloroform, methylene chloride, and tetrachloroethylene are common laboratory solvents and may be used sparingly in the refinery lab or maintenance.

Acrolein is an unsaturated aldehyde, so it may possibly be present in crude or produced in fluid catalytic cracking or coking processes in trace amounts; if so, it would be biochemically oxidized in the effluent treatment system. Acrolein is also an herbicide which may be used in irrigation canals. The refinery does not use acrolein as such.[12]

[12] Acrolein was checked "believed present" on the permit application in the first place because it has been used in the oil and gas industry, although the refinery does not purchase or use any. Because EPA reported [in the Development Document for Effluent Limitations Guidelines and Standards for the Petroleum Refining Point Source Category, EPA 440/1-82/014, October 1982, Table VI-10] over 30 years ago that it was detected in one refinery's influent to treatment (out of 29 refineries studied), we elected to be conservative and check "believed present". Aldehydes are biodegradable and if any were present in the influent it would presumably be biologically treated. EPA did not detect acrolein in any refinery effluent [Development Document, Table VI-7]. We believe it is not present in this refinery's effluent.

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

Table 6 Phenols (Believed Present but Undetected)

Acid Compounds Analyzed by Method 625 and Believed Present in the Refinery Units: µg/L		MEC=6.2 times MDL		Utah Human Health WQC	MEC Below Criterion?	MDL	RL
3A. 2,4-Dimethlyphenol (105-67-9)	ND	5.64		850	Yes	0.910	10.0
10A. Phenol (108-95-2)	ND	3.35		860000	Yes	0.540	10.0

Phenol and 2,4-dimethylphenol may be present in crude oil and are also formed in fluid catalytic crackers and cokers. They are both highly biodegradable at the concentrations encountered in refinery wastewater and are also typically undetected individually after biological treatment. The refinery's current permit includes regulation (in the form of numerical limits) of "phenolic compounds" which is the family of phenol and substituted phenols (including cresols and xylenols), as required by EPA.

Table 7 PAHs (Believed Present but Undetected)

Base Neutral Cmpds incl. PAHs Believed Present and Analyzed by Method 625. Units: µg/L		MEC = 6.2 times MDL		Human Health WQC	MEC Below Criterion?	MDL	RL
1B. Acenaphthene (83-32-9)	ND	4.53		990	Yes	0.730	10.0
2B. Acenaphthylene (208-96-8)	ND	4.09		None	N/A	0.660	10.0
3B. Anthracene (120-12-7)	ND	2.85		40000	Yes	0.460	10.0
5B. Benzo(a)Anthracene (56-55-3)	ND	4.09		0.018	No	0.660	10.0
6B. Benzo(a)Pyrene (50-32-8)	ND	3.22		0.018	No	0.520	10.0
7B. 3,4-Benzofluoranthene (205-99-2)	ND	5.08		0.018	No	0.820	10.0
8B. Benzo(ghi)Perylene (191-24-2)	ND	3.22		0.031	No	0.520	10.0
9B. Benzo(k)Fluoranthene (207-08-9)	ND	5.64		0.018	No	0.910	10.0
18B. Chrysene (218-01-9)	ND	5.77		0.018	No	0.930	10.0
19B. Dibenzo(a,h)Anthracene (53-70-3)	ND	3.29		0.018	No	0.530	10.0
31B. Fluoranthene (206-44-0)	ND	5.89		140	Yes	0.950	10.0
32B. Fluorene (86-73-7)	ND	4.84		5300	Yes	0.780	10.0
37B. Indeno(1,2,3-cd)Pyrene (193-39-5)	ND	4.96		0.018	No	0.800	10.0
39B. Naphthalene(91-20-3)	ND	4.53		None	N/A	0.730	10.0
44B. Phenanthrene (85-01-8)	ND	3.78		None	N/A	0.610	10.0
45B. Pyrene (129-00-0)	ND	4.96		4000	Yes	0.800	10.0

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

In the permit application, Chevron checked "believed present" for the large family of polynuclear aromatic hydrocarbons listed above because they may be present in crude oil or formed in certain refinery processes. However these compounds are very sparingly soluble and in the effluent system they would be associated with soot or other particulate matter which would be removed by the gravity separation, air flotation, or biological treatment steps. They are typically not detected downstream of biological treatment. Additionally, if insoluble they are not considered to be biologically available to aquatic life. The MECs for several are below Utah's human health criteria. Several more, though, have human health criteria of 0.018 μg/L which are lower than we can measure.

PAHs very much prefer to be associated with organic carbon than with water, as demonstrated by the fact that their partitioning coefficients are several orders of magnitude (typical log Koc values[13] in the range of 3—6). If they were present in the refinery's wastewater, they would very much want to be bound to oily particulate matter, and if not removed by solids removal processes upstream of the biological treatment, they would very much want to be bound to biomass which is either fixed on the refinery's rotating biological contactors or removed in the clarifiers downstream. If any PAHs were to pass through the treatment system, they would be bound to particulate matter and would not be bioavailable. They are not detected in the effluent and based on that fact and our knowledge of their characteristics and potential fate in the treatment system, we believe they present no reasonable potential.

TCDD was not detected in the effluent. Its characteristics are much the same as the PAHs; e.g., its partitioning coefficient in water is even greater (log Kow of 6.60 according to EPA[14]). Based on its not being detected and knowledge of its characteristics and fate properties, we believe there is no reasonable potential.

C. Compounds believed present, detected and quantified. These contaminants were principally heavy metals. The following table compares the estimated maximum expected concentration at end of pipe with the Utah Class 3 freshwater acute criteria, assuming a

---

[13] See: http://www.env.gov.bc.ca/wat/wq/Bcguidelines/pahs/pahs-01.htm
based on Neff (1979) and Handbook of Chemistry and Physics (Weast, 1968)

[14] Based on Kow data from U.S. EPA's drinking water technical fact sheet: http://www.google.com/url?sa=t&rct=j&q=tcdd%20and%20drinking%20water&source=web&cd=1&cad=rja&ved=0CDQQFjAA&url=http%3A%2F%2Fwater.epa.gov%2Fdrink%2Fcontaminants%2Fbasicinformation%2Fdioxin-2-3-7-8-tcdd.cfm&ei=aVFbUezhN-2DyAHUjIHIBg&usg=AFQjCNECcL2y81e26RQaS7uwiyw0Tc2mGA

hardness in the Northwest Oily Drain of 100 mg/L. In most cases the refinery effluent is below the criteria , at end of pipe.

Note that the Northwest Oily Drain has a hardness that exceeds 400 mg/L, so with the hardness-based criteria for copper and for zinc, we also compared end-of-pipe concentrations with criteria using values based on 400 mg/L hardness. Copper is below the criterion at end-of-pipe based on this hardness but zinc is not. Zinc will be addressed further, below.

Please note that the criteria themselves are based on the "dissolved" contaminant, whereas the analysis below is based on "total". No correction has been made. This is conservative.

Please note that we included several metals in this analysis that were not detected in the effluent. The proper assumption for contaminants that are not detected is that they are not present. EPA's expectation is that contaminants not are not detected are not present with a certainty of about 95%, with a false negative rate of about 5%. Thus, using the MDL to estimate the maximum expected concentration is a very conservative approach.

Table 8 Heavy Metals and Cyanide

Heavy Metals Etc. (Testing is required)	Result, µg/L	Estimated MEC = 6.2 x Result	Utah Acute WQC, µg/L (Note 1)	Below Criterion?	MDL	RL	EPA Method
o. Aluminum, Total (7429-00-05)	ND (78)	484	750	Yes	78	100	200.7
1M. Antimony, Total (7440-36-0)	DNQ (0.499)	3.09	640 (Note 2)	Yes for HH	0.274	1.00	200.8
2M. Arsenic, Total (7440-38-2)	38.6	239	340	Yes	0.156	0.600	200.8
4M. Cadmium, Total (7440-43-09)	ND (0.0494)	0.31	2.0	Yes	0.0494	0.18	200.8
5M. Chromium, Total (7440-47-3	ND (0.89)	5.5	570	Yes	0.89	10	200.7
6M. Copper, Total (7440-50-8)	4.68	29	13 (Note 3)	**No**	0.183	0.800	200.8
6M. Copper, Total (7440-50-8)	4.68	29	50 (Note 3)	Yes	0.183	0.800	200.8
7M. Lead, Total (7439-92-1)	1.57	9.7	65	Yes	0.222	0.400	200.8
8M. Mercury, Total (7440-97-6)	DNQ (0.052)	0.32	1.8 (Note 4)	Yes	0.018	0.150	245.1
9M. Nickel, Total (7440-02-0)	7.57	47	468	Yes	0.624	0.800	200.8
10M. Selenium, Total (7782-49-2)	13.5	84	18.4	**No**	0.0726	0.800	200.8
11M. Silver, Total (744022-4)	ND (0.0336)	0.21	1.6	Yes	0.0336	0.40	200.8

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

12M. Thallium, Total (7440-28-0)	0.587	4	6.3 (Note 5)	Yes for HH	0.0788	0.400	200.8
13M. Zinc, Total (7440-66-6)	196	1215	120 (Note 6)	No	1.39	5.00	200.8
13M. Zinc, Total (7440-66-6)	196	1215	379 (Note 6)	**No**	1.39	5.00	200.8
14M. Cyanide, Total (57-12-5)	6.7	42	22	**No** (Note 7)	1.60	5.00	335.4

Notes:

1. Based on a receiving water hardness of 100 mg/L unless otherwise noted.
2. The criterion is Utah's human health criterion based on consumption of organisms only, Table 2.14.6. No aquatic life criteria exist. A human health criterion is not necessarily relevant in these waters, especially because humans will not consume the 3E or 5D waters as drinking water.
3. The copper criterion is 13 µg/L at a receiving water hardness of 100 mg/L; it is 50 at a receiving water hardness of 400 mg/L. The Northwest Oily Drain exceeds 400 mg/L hardness. The effluent would have no reasonable potential at end-of-pipe for hardness above 250 mg/L.
4. EPA freshwater acute criterion [40 CFR §131.36(b)]; Utah has no Class 3 acute criterion for mercury
5. The criterion is EPA's human health criterion based on consumption of organisms, 40 CFR §131.36(b). No aquatic life criteria exist. A human health criterion is not necessarily relevant in these waters. Utah's human health criterion is 0.47 µg/L; this criterion would be met as well after dilution.
6. The zinc criterion is 120 µg/L at a receiving water hardness of 100 mg/L; it is 379 at a receiving water hardness of 400 mg/L. The Northwest Oily Drain exceeds 400 mg/L hardness. The effluent exceeds the criterion at end-of-pipe and we will present further analysis on zinc later in the document.
7. The cyanide criterion is based on free cyanide; the measurement is based on total cyanide. Cyanide is commonly complexed with metals, including iron, copper, nickel, and zinc; these complexes are not "free cyanide" but if present they are part of the total cyanide result. Analytical methods for "free cyanide" are not currently approved at 40 CFR §136 although a method for "available cyanide" exists there. See further discussion below.

D. <u>Cyanide</u>.

In July 2013 the refinery instituted additional effluent sampling for cyanide, and for certain key heavy metals discussed below. Because cyanide complexes with various metal ions including iron, and such complexes may keep it from being bioavailable (or toxic to aquatic life), we performed analyses using Method OIA-1677-09, "Available Cyanide," as well as EPA Method 335.4 for total cyanide. U.S. EPA has approved this method for use[15] and it has been adopted at 40 CFR 136. We believe "available cyanide" more truly represents the toxic fraction (see e.g.,

[15] See http://water.epa.gov/scitech/methods/cwa/metals/cyanide/ and http://water.epa.gov/scitech/methods/cwa/metals/cyanide/upload/2007_08_14_methods_method_cyanide_1677-2004.pdf

Redman and Santore, *Bioavailability of Cyanide and Metal-cyanide Mixtures to Aquatic Life*[16], corroborating this conclusion).

Note in the July 16th data below, Table 9, that the "available" cyanide is only a small fraction of the total cyanide. This demonstrates that total cyanide is a poor measure of the potential impact to aquatic life.

Notably, the available cyanide analytical method has a lower detection limit than EPA's method for total cyanide, 335.4, adopted at 40 CFR 136. Consequently two July samples showed available cyanide when total cyanide was undetected.

Data from the July sampling are presented below.

Table 9 Cyanide Data

Cyanide	Date		Cyanide in Refinery Effluent	
Units: µg/L			Total	Available
Analytical Method			EPA 335.4	OIA-1677-09
NPDES Permit Application	4/2/2012		6.7	
Method Detection Limit	July 2013		5.0	2.0
First Round	7/16/2013		24	8.1
Second Round	7/23/2013		N.D.	4.0
Third Round	7/30/2013		N.D.	4.0

For cyanide we performed a reasonable potential analysis based on the methods in Chapter 3 of EPA's Technical Support Document for Water Quality-based Toxics Control[17] (the TSD). EPA's approach authorizes providing dilution credit, and also requires accounting for the background concentration in the receiving water when dilution credit is taken. To do so, we blended the discharge into the receiving water based on a typical flow from the refinery of 1.2 MGD and from the POTW of 33 MGD. However, we also looked at a background flow of 16.5 MGD as well because UAC R317-2-5 and Utah's Wasteload Analysis Procedures (May 2012) suggest that sometimes only 50% of the stream width can be allocated to a mixing zone. Fifty percent of the

[16] Cited in footnote 1
[17] EPA 505/2-90/001, March 1991

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

POTW flow is 16.5 MGD. In the tables that follow, the term "blended MEC" refers to the result of blending the refinery discharge with the background flow and concentration based on the POTW.

In all three cases where we attempted to model dilution in the Northwest Oily Drain, we used as a background concentration the 80th percentile of the POTW[18] mean performance for the period March 2005 through December 2012. The POTW data are a conservative approximation of background levels because the POTW is the principal upstream source of water in the Northwest Oily Drain. We used the 80th percentile as background because we understand that is what UDEQ would use in establishing a water quality-based effluent limit.

The 80th percentile of the POTW's cyanide performance is 32.2 µg/L as total cyanide. This value exceeds the acute criterion, 22 µg/L, but as we noted, the criterion is based on free cyanide. We do not have "available" cyanide data for the POTW. The POTW, and for that matter the background data in the Northwest Oily Drain, may or may not be exceeding the screening numerical criterion; we can't tell. We can only say that based on using the 80th percentile of total cyanide data as background, we cannot demonstrate no reasonable potential after dilution by calculating the concentration of the blended streams. Accordingly, we looked at additional sources of data.

Table 10 Cyanide RPA

Cyanide in Refinery Effluent	Total	Available	Total	Available
Maximum Observed Effluent, µg/L	24	8.1	24	8.1
No. of Samples	4	3	4	3
TSD Multiplier (Table 3.2, Cv = 0.6)	2.6	3.0	2.6	3.0
Maximum Expected Conc. (MEC), µg/L	62.4	24.3	62.4	24.3
Background, µg/L (POTW 80th%tile as total CN)	32.2	32.2	32.2	32.2
Background Flow, MGD	33	33	16.5	16.5
Acute Screening Criterion, µg/L	22	22	22	22
Blended MEC[19], µg/L	31.9	31.4	31.6	30.6
Exceed Screening Criterion?	Yes	Yes	Yes	Yes

[18] Salt Lake City Water Reclamation Plant, Outfall 003P, Quarterly Data, March 2005 to Dec. 2012
[19] Blended MEC is calculated as (Cb*Fb+MEC*Fr)/(Fb + Fr) where:
Cb = Background concentration, typically the 80th percentile of SLCWRF discharge data (March 2005 – Dec. 2012)
Fb = Background flow, MGD, typically 50% or 100% of SLCWRF flow of 33 MGD
Fr = Refinery Effluent flow, typically 1.2 MGD

Since both the MEC and the POTW's 80th percentile for total cyanide[20] are above the screening criterion, cyanide did not screen out at this point in the evaluation. Therefore Chevron developed additional weight of evidence to show that cyanide does not cause or contribute to an exceedance of the standard.

Cyanide is believed to dissipate fairly rapidly in receiving waters[21]. To demonstrate whether this occurs in the Northwest Oily Drain, Chevron also sampled for total and available cyanide in the Northwest Oily Drain well downstream of both the POTW and the refinery discharge points, at a point before the NWOD enters Farmington Bay.

Table 11 Total and Available Cyanide in the NWOD Upstream of Farmington Bay

Analyte	Total Cyanide, µg/L		Available Cyanide, µg/L	
Method	EPA 335.4		OIA-1677-090	
	Total	MDL	Available	MDL
Sample Date				
September 23, 2013	ND	5.0	ND	2.0
October 2, 2013	ND	5.0	2.9	2.0
October 9, 2013	ND	5.0	ND	2.0

MDL = method detection limit

These data tell two stories:

1. As we expected, cyanide is short-lived in a receiving water stream. Both the refinery and POTW effluent data suggest typical discharges of 5 – 30 µg/L range as total cyanide but virtually none is detected downstream.

2. The NWOD as it flows toward Farmington Bay is below the Utah Class 3 freshwater chronic criterion of 5.2 µg/L free cyanide. Because this sampling program demonstrates that the NWOD is below the chronic criterion for free cyanide before it enters Farmington Bay, it demonstrates that the POTW and the refinery are not causing or contributing to exceedances in Farmington Bay.

Note as additional weight of evidence, and perhaps the soundest argument for there being no reasonable potential, that the refinery routinely passes its whole effluent toxicity test in 100%

[20] Our estimated "background" concentration since we do not have "available" cyanide data for the POTW
[21] E.g., Section 6.3 of the Toxic Profile for cyanide prepared by the Agency for Toxic Substances and Disease Registry (ATSDR) cites volatilization and sorption as processes that contribute to the loss of cyanide from water. ATSDR cites an EPA study indicating volatilization half-lives of 22—110 hours for concentrations of 25—200 µg/L.

effluent, which supports the conclusion that cyanide is not having a toxic impact. See Section VI following this section.

E. <u>Cations</u>

Based solely on the single sample presented in the permit renewal application, both copper and zinc did not screen out in the refinery effluent at end-of-pipe based on the acute screening criteria (see Table 10 in Part V.C) above. Therefore additional sampling was conducted in July.

Table 12 Copper and Zinc Data

Cations in Refinery Effluent	Date	Copper		Zinc	
Units: µg/L		Total	Dissolved	Total	Dissolved
NPDES Permit Application	4/2/2012	4.68		196	
Method: EPA 200.8 ICP-MS					
Reporting Limit		2.0	2.0	5.0	5.0
First Round	7/16/2013	3.01	2.66	222	185
First Round Duplicate		2.90	2.60	203	191
Average		2.96	2.63	213	188
Second Round	7/23/2013	<2	<2	47.9	26.7
Third Round	7/30/2013	<2	<2	52.1	10.0

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

Table 13 Copper RPA

Copper in Refinery Effluent	Total	Total	Total, In July	Dissolved
Maximum Observed Effluent, µg/L	4.68	4.68	2.96	2.63
No. of Samples	4	4	3	3
TSD Multiplier	2.6	2.6	2.6	3.0
MEC, µg/L	12.2	12.2	8.88	7.89
Assumed Hardness, mg/L	100	400	100	100
Screening Criterion (acute), µg/L	13	N/A	13	13
Screening Criterion (chronic), µg/L	N/A	28	9	9
Exceed Screening Criterion?	No	No	No	No

Copper demonstrates no reasonable potential at end-of-pipe based on the July data. The hardness in the Oily Drain exceeds 400 mg/L, and the chronic criterion at that hardness is 28 µg/L.

Table 14 Zinc RPA

Zinc in Refinery Effluent	Total	Total	Dissolved
Maximum Observed Effluent, µg/L	213	213	188
No. of Samples	4	4	3
TSD Multiplier	2.6	2.6	3.0
MEC, µg/L	554	554	564
Background (POTW 80th percentile[10]), µg/L	48.3	48.3	48.3
POTW Background Flow, MGD	33	16.5	16.5
Assumed Hardness, mg/L	100	100	100
Screening Criterion (chronic), µg/L	120	120	120
Diluted MEC, µg/L	66.0	82.6	83.3
Exceed Screening Criterion?	No	No	No

Zinc did not test out at end-of-pipe but it does after dilution in the Oily Drain, even if the hardness is only 100 mg/L. We looked at a background flow of 16.5 MGD as well because UAC R317-2-5 and Utah's Wasteload Analysis Procedures (May 2012) suggest that sometimes only 50% of the stream width can be allocated to a mixing zone. In either case zinc does not exceed the screening criteria after dilution.

F. Potentially Bioaccumulative Compounds Detected.

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

Mercury tested out (above in Table 8 of Part V.C) at the end-of-pipe based on the permit renewal application alone; however, we took additional mercury data in July because on the permit renewal application, mercury was detected but not quantified and so we used the estimated value of 52 ng/L in Part V.C. The additional sampling used an improved sampling technique and analytical methodology (cold vapor atomic fluorescence). The July data were substantially lower than the estimate from the permit renewal application.

Table 15 Mercury

Mercury in Refinery Effluent	Date		Mercury, ng/L	
Units: ng/L (parts per trillion)			Total	Dissolved
NPDES Permit Application (EPA 245.1)	4/2/2012		DNQ (Estimated as 52)	
Reporting Limit (EPA Method 1631)			0.50	0.50
First Round	7/16/2013		14.7	0.69
First Round Duplicate			14.40	0.65
Average			14.55	0.67
Second Round	7/23/2013		8.57	0.73
Second Round Duplicate			8.01	0.80
Average			8.29	0.77
Third Round	7/30/2013		7.77	0.51
Third Round Duplicate			9.76	0.60
Average			8.77	0.56

As demonstrated below, total mercury was below the acute screening criterion[22] at end-of-pipe and dissolved mercury was below the chronic screening criterion. Criteria are based on dissolved metal. Please note that the EPA freshwater chronic criterion for mercury is 770 ng/L to protect aquatic life[23]; however, the value of 12 ng/L used here (Utah Class 3) for screening is based on protecting against bioaccumulation in the food chain, specifically to protect humans from consuming fish or shellfish containing mercury above the FDA action level of 1 mg/kg[24].

[22] Utah has no acute criterion for mercury; we used the EPA fresh water criterion
[23] See EPA's recommended aquatic life criteria table at http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm

[24] See *Ambient Water Quality Criteria for Mercury – 1984*, EPA 440/84-026, January 1985

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

We screened against acute criteria at end-of-pipe for most constituents but for mercury we chose to screen as well against the chronic criterion to address bioaccumulation and human health.

Table 16 Mercury RPA

Mercury (July 2013 data)	Total	Dissolved
Maximum Observed Effluent, ng/L (parts per trillion)	14.6	0.77
No. of Samples	3	3
TSD Multiplier	3.0	3.0
Maximum Expected Concentration (MEC), ng/L	43.8	2.31
Screening Criterion (acute freshwater, based on EPA), ng/L	1400	N/A
Screening Criterion (chronic), ng/L	N/A	12
Exceed Screening Criterion?	No	No

Selenium.

Selenium tested out based on the data in the permit renewal application, 13.5 µg/L which leads to an MEC of about 84 µg/L. Based on data from June 2006 through Dec. 2012, the discharge from the POTW (Salt Lake City Water Reclamation Facility) had an 80th percentile value of 2.73 µg/L, based on quarterly averages. We selected quarterly averages as representative because the concern for selenium is long-term bioaccumulation, and we did not have data for individual samples. If that value is used for background, the diluted MEC is well below the acute screening criterion in the NW Oily Drain. (Note: for bioaccumulation issues we believe the geometric mean of the background data would be more appropriate; we used the 80th percentile as background in this exercise as a conservative estimate/a conservative screening tool.)

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

Table 17 Selenium RPA Based on Permit Renewal Application

Selenium in Refinery Effluent	Background Flow 33 MGD	Background Flow 16.5 MGD
Effluent, µg/L (Permit Renewal Application)	13.5	13.5
No. of Samples	1	1
TSD Multiplier	6.2	6.2
Maximum Expected Concentration (MEC), µg/L	83.7	83.7
Background (SLCWRF POTW 80^{th} percentile), µg/L	2.73	2.73
Background Flow, MGD	33	16.5
Screening Criterion (acute), µg/L	18.4	18.4
Blended MEC, µg/L	5.57	8.22
Exceed Screening Criterion?	No	No

Chevron collected additional data in July2013.

Table 18 Selenium Data (July 2013)

Selenium in Refinery Effluent	Date		Selenium	
Units: µg/L			Total	Dissolved
NPDES Permit Renewal Application	4/2/2012		13.5	
Reporting Limit by EPA 200.8 ICP-MS			2.0	2.0
First Round	7/16/2013		33.6	31.8
First Round Duplicate			30.8	34.4
Average			32.2	33.1
Second Round	7/23/2013		26.1	25.6
Third Round	7/30/2013		22.3	18.2

This exercise raised the MEC slightly, but not significantly, illustrating that the EPA TSD method provides reasonably consistent results. Below is the RPA using these data:

Table 19 Selenium RPA (Updated with July 2013 Data)

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

Selenium (including July data)	Background Flow 33 MGD	Background Flow 16.5 MGD
Maximum Observed Effluent, µg/L	33.1	33.1
No. of Samples	4	4
TSD Multiplier	2.6	2.6
MEC, µg/L	86.1	86.1
Background (SLCWRF POTW 80th percentile), µg/L	2.73	2.73
Background Flow, MGD	33	16.5
Screening Criterion (acute), µg/L	18.4	18.4
Blended MEC, µg/L	5.66	8.38
Exceed Screening Criterion?	No	No

There was no significant difference in the analysis, compared to that in Table 18.

As additional weight of evidence that selenium is not causing or contributing to water quality standards exceedances in Farmington Bay, Chevron obtained analyses for total and dissolved selenium in the Northwest Oily Drain at a point upstream of Farmington Bay but downstream of where the Jordan River may overflow into the NWOD. These data are as follows:

Table 20 Selenium Downstream in the Northwest Oily Drain Before Farmington Bay

Analyte	Selenium, µg/L	
Method	EPA 200.8 or SW6020A	
	Total	Dissolved
Sample Date		
September 23, 2013	1.46	1.50
October 2, 2013	2.3	1.8
October 4, 2013	1.8	1.34

These data all fall well below Utah's freshwater chronic criterion of 4.6 µg/L. Consequently, it appears that dischargers to the NWOD including Chevron are not creating selenium contributions to Farmington Bay that would create reasonable potential.

Ammonia.

Ammonia is not an EPA priority pollutant but it is a pollutant potentially toxic to aquatic life. The refinery has existing limits on ammonia, based on the EPA effluent limitations guidelines. The refinery monitors ammonia in its effluent weekly.

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

Based on the past two years, 105 data points, the refinery's Maximum Expected Concentration (MEC) of ammonia-nitrogen is 13.2 mg/L. Based on daily data from the Salt Lake City Water Reclamation Facility for the year 2012, 150 data points, the 80th percentile of their discharge is 8.53 mg/L NH3-N and the 80th percentile of their pH data, 195 data points, is 7.9. Consistent with the analysis of other constituents, we use these values as surrogates for "background" in the Northwest Oily Drain (NWOD). The Utah Class 3D acute criterion for ammonia at pH 7.9 is 10.1 mg/L. The refinery effluent is below this value 97% of the time at end-of-pipe (2012-2013 data).

Since the refinery exceeds the criterion almost 3% of the time, we evaluated the refinery's impact after dilution in the NWOD. We used half the POTW flow of 33 MGD.

Ammonia in Refinery Effluent	14.25 Dilution
MEC (2012-2013; max. of 105 data points), mg/L	13.2
Background NH3-N (SLCWRF POTW 80th percentile), mg/L	8.5
Background pH (SLCWRF POTW 80th percentile), mg/L	7.9
Dilution Factor (Background 16.5 MGD, Refinery 1.2 MGD)	14.25
Acute Screening Criterion, mg/L, at pH = 7.9	10.1
Diluted MEC, mg/L	9.3
Exceed Acute Screening Criterion?	No

Thus there is no reasonable potential.

Additionally the average refinery effluent is <2 mg/L and the refinery is below 2 mg/L >75% of the time, whereas the average of the "background" data is about 5.5 mg/L. Therefore, on average, the refinery has a net positive impact on water quality with respect to ammonia.

Chevron assessed whether the refinery effluent would cause or contribute to an exceedance of chronic water quality criteria for ammonia at the end of the Northwest Oily Drain (NWOD), as it enters Farmington Bay. The chronic freshwater ammonia criteria for Class 3D waters, using a pH of 7.9 (the POTW's 80th percentile of pH for the year 2012) and a temperature of 20-30 °C (assuming the canal is dominated by the POTW and that water will be in this range at least some of the time) would be 1.0 – 2.0 mg/L as N. However, both the POTW 80th percentile and the refinery's maximum expected concentration exceed these values. Hence, a demonstration cannot be made at this time.

However, the NWOD flows for another 15 miles before it enters Farmington Bay. In the process of reaching the bay, ammonia may either volatilize or be oxidized by nitrifying bacteria. Other water sources enter the NWOD below the refinery. They may provide significant dilution. Consequently, it is not clear that ammonia in the NWOD will exceed chronic criteria upstream of Farmington Bay. We understand the state is proposing that dischargers into this water body participate in a collaborative study to address the fate of ammonia in the NWOD before it reaches Farmington Bay. Chevron looks forward to discussing this approach further with the state.

<u>Farmington Bay</u>

Farmington Bay is also a receiving water listed in the current permit. Like the Northwest Oily Drain it has no numerical water quality criteria. A reasonable potential analysis for Farmington Bay based on using Class 3 freshwater aquatic life or Class 3 human health criteria as screening criteria also demonstrates that the discharge creates no reasonable potential to cause or contribute to a violation of standards in Farmington Bay.

As demonstrated previously, there is no reasonable potential for the compounds that are believed absent and were undetected, presented in Tables 1 –4 above.

The VOCs listed in Table 5 and the phenolic compounds listed in Table 6 were marked "believed present" in the original renewal application. However, they were either not detected at end-of-pipe or they were detected, not quantified. The maximum expected concentrations, estimated using analytical method detection limits or analytical values that were estimated but are below the method reporting limit, were all below the Utah Class 3 human health criteria, except for acrolein. As explained above, acrolein was not detected in the discharge and we in fact believe it is absent in this refinery even though EPA detected it once in their study of other refineries over 30 years ago.

Without repeating the rationale here, we demonstrated that the family of polynuclear aromatic compounds in Table 7 creates no reasonable potential at end-of-pipe based on screening with Utah's Class 3 Human Health criteria, so the same analysis should apply to Farmington Bay.

As noted in the previous section, we attempted to demonstrate meeting the ammonia chronic criteria in the Northwest Oily Drain before Farmington Bay, but due to the limited data currently available have been unable to do so.

That leaves heavy metals in Table 8 (repeated here for convenience). Screening criteria are Utah Class 3 chronic aquatic life criteria except antimony and thallium, where the screening criteria are human health criteria for organism consumption only. For hardness dependent criteria, a hardness of 400 mg/L was assumed.

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

Table 8.1 Metals and Cyanide (Using 4-day Chronic WQC for Screening)

Heavy Metals All units are µg/L	Result (Refinery Effluent)	Estimated MEC	4-day Chronic WQC	Ratio of MEC to Screening Criterion	MDL	RL	EPA Method	Estimated Value from Analysis
o. Aluminum, Total	ND	484	87	5.56	78	100	200.7	
1M. Antimony, Total	DNQ	3.09	Note 1	0.0048	0.274	1.00	200.8	0.499
2M. Arsenic, Total	38.6	239	150	1.60	0.156	0.600	200.8	
4M. Cadmium, Total	ND	0.31	0.64	0.48	0.0494	0.180	200.8	
6M. Copper, Total	4.68	29.0	29.3	0.99	0.183	0.800	200.8	
7M. Lead, Total	1.57	9.7	10.9	0.89	0.222	0.400	200.8	
8M. Mercury, Total	DNQ	0.0438	0.012	3.65	0.018	0.150	245.1	0.052
8M. Mercury, Dissolved	0.000077	0.0023	0.012	0.19		0.00050	1631E	
9M. Nickel, Total	7.57	47	167.0	0.28	0.624	0.800	200.8	
10M. Selenium, Total	13.5	84	4.6	18.20	0.0726	0.800	200.8	
12M. Thallium, Total	0.587	3.64	Note 2	7.74	0.0788	0.400	200.8	
13M. Zinc, Total	196	564	382.4	1.47	1.39	5.00	200.8	
14M. Cyanide, Available		24	5.2	4.67				
14M. Cyanide, Total	6.7	42	5.2	7.99	1.60	5.00	335.4	

Note 1: Antimony has no aquatic life criteria but Utah's human health criterion for organisms only is 640 ug/L.

Note 2: Thallium has no aquatic life criteria but Utah's human health criterion for organisms only is 0.47 ug/L.

Note 3: Mercury, Selenium, Zinc and Cyanide are discussed below

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

Total antimony, cadmium, lead, and nickel; and dissolved mercury: These, highlighted in green, are all below the screening criterion at the end of pipe (ratio of MEC/Criterion <1.0). The criteria are based on dissolved metal.

Aluminum: Aluminum was not detected at end-of-pipe. The Method Detection Limit, 78 µg/L, is below the chronic screening criterion. Therefore, in this sample, there was no reasonable potential. However, the Maximum Expected Concentration based on the MDL would be 484 µg/L, exceeding the screening criterion. Using a dilution credit based on half the 33 MGD flow from the Salt Lake City Water Reclamation Facility, the refinery's effluent would be diluted 14.25:1 leaving a contribution of 34 µg/L, below the chronic criterion of 87.

Furthermore, other states such as New Mexico have recognized that aluminum should have hardness-based criteria. The chronic criterion for aluminum in New Mexico would be >1 mg/L. and would be achieved at end-of-pipe.

Arsenic: The chronic screening criterion was not met at end-of-pipe but using the SLCWRF 80^{th} percentile value of 9.30 µg/L as background, the value for arsenic at the boundary of the mixing zone would be 25 µg/L. This is well below the chronic screening criterion.

Thallium: The chronic screening criterion was not met at end-of-pipe. At the boundary of the mixing zone the refinery's contribution would be 0.25 µg/L, below the chronic screening criterion.

Zinc: The screening criterion was not met at end-of-pipe. Using the SLCWRF 80^{th} percentile value of 48.7 µg/L as background, the value for zinc at the boundary of the mixing zone would be 84 µg/L. This is well below the chronic screening criterion.

Mercury: A reasonable potential analysis for mercury in Farmington Bay is presented in Table 28 below, with supporting data in several tables preceding it. There was no RP.

Selenium: A reasonable potential analysis for selenium in Farmington Bay is presented in Table 24 below, with supporting data in several tables preceding it. There was no RP.

Cyanide: The screening criterion was not met at end-of-pipe. As discussed above, the refinery took data in the Northwest Oily Drain (NWOD), reported in Table 11. Those data demonstrate that the NWOD as it flows toward Farmington Bay is below the Utah Class 3 freshwater chronic criterion of 5.2 µg/L free cyanide. Because this sampling program demonstrates that the NWOD is below the chronic criterion for free cyanide before it enters Farmington Bay, it demonstrates that the POTW and the refinery are not causing or contributing to exceedances in Farmington Bay.

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

Based on the above findings, the refinery discharge does not cause or contribute to an exceedance of water quality standards in Farmington Bay, using Utah Class 3 chronic aquatic life or Class 3 human health criteria. Additional data may be required to analyze RP for ammonia.

Mercury and Selenium in Farmington Bay: Although we find no reasonable potential for either mercury or selenium based on our discharge to the Oily Drain, we also conducted a reasonable potential analysis based on the in stream waste concentration in Farmington Bay. Bioaccumulation would be the concern, so we used Class 3 chronic criteria for the assessment. The exercise is essentially a mass balance comparing the load from the refinery to the load from all sources.

Selenium. We used the freshwater chronic criterion for selenium. We have chosen the 90th percentile of selenium concentrations in Farmington Bay, although we understand that DEQ policy would permit using the 80th percentile. We used the 90th percentile load because our source document supplied a 75th percentile and a 90th percentile but not the 80th percentile. We used the more conservative datum. If bioaccumulation is the issue, then assessments based on long-term (e.g., annual) performance are appropriate.

Table 21 Water Sources for Farmington Bay

Water Sources for Farmington Bay	
Source: Eutrophication Paper[1] for UDWQ; Table 5	
	$m^3 \times 10^{\wedge 6}$/yr
Jordan River	307
Davis Country Creeks	30
Wastewater Treatment Plants	354
	691

Note 1: Wurtsbaugh,Wayne A., Amy M. Marcarelli and Greg L Boyer, *Eutrophication and Metal Concentrations in Three Bays of the Great Salt Lake (USA), 2009 Final Report,* July 1, 2012

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

Table 22 Water Column Selenium Concentration in Farmington Bay

Water Column Selenium Concentration in Farmington Bay, µg/L	
Source: Appendix A of USGS Selenium Load Paper[2] (2008)	
Median from LOADEST Summary Statistics	0.60
90%tile from LOADEST Summary Statistics	0.90

Note 2: Naftz, D.L., W. P. Johnson, M.L. Freeman, K. Beisner, X. Diaz and V.A. Cross, *Estimation of Selenium Loads Entering the South Arm of Great Salt Lake, Utah, from May 2006 through March 2008*, USGS, Appendix A

Table 23 Flow Data for Farmington Bay

Flow in Farmington Bay	
Average Refinery Flow, MGD	1.2
Sources to Farmington Bay, m^3 X $10^{\wedge 6}$/yr	691
Sources to Farmington Bay, MGD	500

Table 24 Selenium RPA Based on Farmington Bay and Chronic Criterion

Reasonable Potential Analysis	
Current maximum value, µg/L (from July 2013 data)	33.1
EPA TSD Multiplier for four samples	2.6
Maximum Estimated Concentration (MEC), µg/L	86
Estimated Farmington Bay IWC, µg/L [(0.90*500+86*1.2)/501.2]	1.10
Screening Criterion (Class 3 Chronic Criterion), µg/L	4.6
IWC exceed Screening Criterion?	No

Note: EPA's marine chronic criterion for selenium is 71 µg/L [40 CFR 131.38(b)] Farmington Bay is 1--10% TDS and arguably marine criteria should apply

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

Mercury. A similar analysis was performed for mercury based on Farmington Bay.

Table 25 Water Sources for Farmington Bay

Water Sources for Farmington Bay	
Source: Eutrophication Paper[1] for UDWQ; Table 5	
	m^3 x 10^6/yr
Jordan River	307
Davis Country Creeks	30
Wastewater Treatment Plants	354
	691

Note 1: Wurtsbaugh,Wayne A., Amy M. Marcarelli and Greg L Boyer, *Eutrophication and Metal Concentrations in Three Bays of the Great Salt Lake (USA), 2009 Final Report,* July 1, 2012

Table 26 Estimated Mercury Concentration in Farmington Bay

Water Column Mercury Concentration in Farmington Bay	
Annual Load Discharged[2] to the GSL, kg/yr	2.8
ng/kg	1E+12
L/m^3	1000
Water Column Concentration, ng/L (parts per trillion)	4.1

Note 2: Naftz, David, Christopher Fuller, Jay Cederburg, David Krabbenhoft, and John Whitehead, *Mercury inputs to Great Salt Lake, Utah: Reconnaissance-Phase Results,* Natural Resource and Environmental Issues: Vol. 15 Article 5, 1/1/2009

Table 27 Flow Data for Farmington Bay

Dilution Estimate	
Average Refinery Flow, MGD	1.2
Sources to Farmington Bay, m^3 X 10^6/yr	691
Sources to Farmington Bay, MGD	500

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

Table 28 RPA for Refinery Mercury based on Farmington Bay

Reasonable Potential Analysis	
Current maximum value, ng/L (July data, Table 16)	14.6
EPA TSD Multiplier for three samples	3.0
Maximum Estimated Concentration (MEC), ng/L	43.8
Estimated Farmington Bay IWC [500*4.1+1.2*43.8)/501.2]	4.2
Screening Criterion (Class 3 Chronic Criterion), ng/L	12
IWC exceed Screening Criterion?	No

Thus, the refinery's impact from discharge or mercury or selenium on Farmington Bay does not demonstrate reasonable potential.

Please note that the use of freshwater numeric criteria for Farmington Bay is conservative because Farmington Bay resembles a marine water in terms of its total dissolved solids levels.

Utah has no marine criteria as such, but we can compare Utah's freshwater criteria with EPA's saltwater criteria [40 CFR §131.36(b)]. Utah's freshwater criteria are more conservative.

Table 29 Freshwater and Saltwater Aquatic Life Criteria for Mercury and Selenium

Parameter	Utah Class 3 Freshwater, µg/L			EPA Saltwater, µg/L	
	Acute	Chronic		Acute	Chronic
Mercury		0.012		1.8	0.025
Selenium	18.4	4.6		290	71

VI. Final Weight of Evidence:

Finally, the refinery routinely complies with its whole effluent toxicity limits, i.e., ≤1.0 acute toxicity units at end of pipe. This is strong additional evidence that the narrative standard in the receiving water is being protected.

TABLE I
WEIGHT-OF-EVIDENCE ANALYSIS
FOR NARRATIVE WQ STANDARDS

Table 30 Whole Effluent Toxicity Performance for Refinery Effluent

Acute Toxicity Quarterly Test	Survival (% of Test Species)					
	Control	6.25% Effluent	12.5% Effluent	25% Effluent	50% Effluent	100% Effluent
November 2013[25]	100	95	90	80	30	0
August 2013	100	100	100	100	100	100
May 2013	100	100	100	90	90	85
February 2013	100	95	95	95	95	80
November 2012	90	90	95	90	90	65
August 2012	95	100	100	100	100	95
May 2012	100	100	100	100	100	100
February 2012	95	95	95	100	100	100
November 2011	95	100	90	95	100	100
August 2011	100	100	100	100	100	100
May 2011	100	90	85	95	100	90
February 2011	100	100	100	100	100	20
November 2010	100	100	90	100	100	80
August 2010	95	100	100	95	100	100
May 2010	100	100	100	100	100	100
February 2010	100	100	100	100	100	95
November 2009	100	100	100	100	100	100
August 2009	100	100	100	100	100	100

[25] Although the WET test failed for this quarter, the failure was due to 17.6 mg/L of ammonia in the effluent. Chevron provided this information to UDEQ in a letter to Mr. Walt Baker dated December 3, 2013. The implication of all these data is that priority pollutant toxics are not present in the effluent at toxic levels; ammonia is typically well-controlled.