Prepared for:
Shell Oil Products US
Shell Martinez Refinery

Health Risk Assessment for the CO Boilers at the Shell Martinez Refinery, Martinez, California

ENSR Corporation
October, 2006
Document No.: 05975-140-800

ENSR | AECOM

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Reviewed by: Ishrat Chaudhuri

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EXECUTIVE SUMMARY

Facility Description

This document contains the Health Risk Assessment (HRA) for three carbon monoxide boilers (CO boilers) at the Shell Martinez Refinery (SMR) located in Martinez, California (U.S. EPA ID# CAD 009 164 021). The HRA is being conducted as a part of the RCRA Part B Permit renewal process. The emission rates for the CO Boilers are based on data collected in a recent Trial Burn for this facility (ENSR, 2006); specifically, data collected for risk-based testing while the unit is under normal operating conditions. In addition to the CO Boilers, emissions were also evaluated for Tank 12038, fugitives from Tank 12038, fugitives from the CO Boilers and Fly Ash fugitives.

Previous risk assessments have been conducted for this facility and presented to DTSC to support the Part B Permit. The most recent one was conducted in 2000 by Bechtel Corporation (Bechtel, 2000).

The format of this document follows the report outline provided in the Air Toxics Hot Spots Program Risk Assessment Guidelines (OEHHA, 2003).

This HRA also follows the approach outlined in the Protocol for the CO Boiler Health Risk Assessment (ENSR, 2005), which was accepted by California EPA's Department of Toxic Substances Control in a letter dated February 6, 2006.

Facility Contact Information

General facility contact information includes:

Owner:	Shell Oil Products US
Address:	Shell Martinez Refinery PO Box 711 3485 Pacheco Blvd. Martinez, California 94553
U.S. EPA ID No:	CAD 009 164 021
Facility Contact:	Mr. Steven Overman, Senior Staff Engineer
Phone No.:	(925) 313-3281

Process Description

SMR operates an oil refining and manufacturing complex which manufactures LPG, gasoline, intermediate fuels (jet and diesel), industrial fuels, asphalt, petroleum coke, sulfur and catalysts. SMR currently operates three carbon monoxide (CO) boilers and storage tank 12038 that are addressed by the current Hazardous Waste Facility Permit (RCRA Part B Permit) issued by the California Department of Toxic Substances Control (DTSC).

The substances evaluated in this HRA for the CO boilers were identified from the recent Trial Burn results (ENSR, 2006) for Condition 2, which represents the unit under normal operating conditions. Substances detected in at least one of the three runs in Condition 2 of the Trial Burn were selected for evaluation for the CO Boilers. Substances that were not detected in any of the three runs were not evaluated for the CO Boilers,

in accordance with the accepted Protocol (ENSR, 2005). In addition to the CO Boilers, emission rates were also estimated for Tank 12038, fugitives from Tank 12038, fugitives from the CO Boilers and Fly Ash fugitives. Emission rates for these sources were estimated using standard emission factors and recent analytical data, and were also used in the HRA. Tables presenting facility emissions of substances, on an annual and one-hour basis, are included in Tables A-1 and A-2 in Appendix A.

Overview of Dispersion Modeling and Exposure Assessment

The dispersion modeling and exposure assessment were prepared following the Air Toxics Hot Spots Program Risk Assessment Guidelines: The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments (OEHHA, 2003). The modeling was performed using the Hotspots Analysis and Reporting Program (HARP) model, version 1.2a (CARB, 2005). The dispersion model used was ISCST3 (Version 99155), which is integrated into the HARP software.

In the exposure assessment, the selection of receptors and exposure assumptions were based on Tier 1 recommendations provided in OEHHA (2003). The receptors include the Point of Maximum Impact (PMI), the Maximally Exposed Individual Resident (MEIR), the Maximally Exposed Individual Worker (MEIW), and 31 sensitive receptors.

It was assumed that all of the receptors are exposed through inhalation, and soil ingestion and dermal contact. In addition to these pathways, the PMI, MEIR and the maximum sensitive receptors was also assumed to be exposed through produce ingestion, drinking water ingestion, fish ingestion, and mother's milk ingestion (for dioxins).

Dose Response Assessment

Compound-specific dose-response values (also called toxicity values) were identified for chronic (non cancer), cancer and acute health impacts.

Cancer health impacts - The toxicity values used to evaluate potential carcinogenic health effects resulting from long-term inhalation exposure to facility-related substances are called inhalation cancer potency factors. The toxicity values used to evaluate potential carcinogenic health effects resulting from long-term oral exposure to substances are called oral cancer potency factors. Cancer potency factors are expressed as the upper bound probability of developing cancer assuming continuous lifetime exposure to a substance at a dose of one milligram per kilogram of body weight, and are expressed in units of the inverse of milligrams of the compound per kilogram of body weight per day $(mg/kg\text{-}day)^{-1}$.

Chronic (noncancer) health impacts - The toxicity value used to evaluate potential noncarcinogenic health effects resulting from long-term inhalation exposure to substances is called an inhalation Reference Exposure Level (REL) and is expressed in units of ug/m^3. The toxicity value used to evaluate potential noncarcinogenic health effects resulting from long-term oral exposure to substances is called an oral REL in units of mg/kg-day. A chronic REL is a concentration or dose level at or below which no adverse health effects are expected following long-term exposure. Some of the toxic compounds have an impact on one or more target organs (the organ most likely to be affected by the compound). To calculate the total impact on a target organ, the HARP model summed the HI for each compound that affects that organ to determine a total HI.

Acute health impacts - Potential risks due to short-term inhalation exposure (such as respiratory or irritant health effects), in addition to the more commonly evaluated chronic risks to human health discussed above, were evaluated in the HRA. A screening level evaluation of short-term health effects was conducted by comparing predicted maximal short-term air concentrations against acute RELs.

Definition of Health Impacts

Cancer health impacts – Cancer health impacts are estimated as the upper-bound likelihood, over and above the background cancer rate, that a receptor will develop cancer in his or her lifetime as a result of exposure to a compound in environmental media at the site. This likelihood is a function of the lifetime average daily dose of a compound (LADD) multiplied by the Cancer Slope Factor (CSF) for that compound. The cancer risk value is expressed as a probability of somebody getting cancer (e.g., $1x10^{-6}$, or one in one million).

Chronic (non cancer) health impacts - For chronic (non cancer) risk estimates, a Chronic Average Daily Dose (CADD) is calculated that averages a receptor's exposure dose over the exposure duration. The potential risk of adverse non-carcinogenic health effects is estimated for each receptor by comparing the CADD for each compound with the acceptable intake for that compound. The resulting ratio, which is unitless, is known as the Hazard Quotient (HQ) for that compound. For each receptor, the HQs are summed to obtain the Hazard Index (HI). The estimated HI for each receptor is compared to an acceptable HI of 1.

Acute health impacts – Acute health impacts are estimated by comparing the maximum 1-hour air concentrations to acute benchmarks.

Multipathway substances – Multipathway substances are defined as those compounds that are subject to deposition onto soil, plants and water bodies. These compounds need to be evaluated by appropriate oral pathways, as well as the inhalation pathway. These compounds include semi-volatile organic compounds and certain heavy metals, as listed in OEHHA (2003). Multipathway substances evaluated in this analysis include detected dioxins (octachlorodibenzodioxin (OCDD) and octachlorodibenzofuran (OCDF)), polycyclic aromatic hydrocarbons (PAHs) and metals listed in OEHHA (2003a) (arsenic, beryllium, cadmium, chromium, lead, mercury and nickel). These compounds were evaluated for inhalation as well as various oral pathways.

Population level risk estimates – OEHHA (2003) recommends developing population level risk estimates. The population level cancer risk estimates are calculated as estimates of the number of people exposed at specific cancer risk levels. The latest available census results are used to determine the population estimates. This process involves identifying zones of impact. This zone is commonly defined as the area within the isopleth surrounding the facility where receptors have a cancer risk greater than $1x10^{-6}$. OEHHA (2003) also recommends developing a noncancer population estimate of the number of people exposed to acute and chronic noncancer Hazard Indices exceeding 0.5 and 1.0.

Summary of Health Risk Results

Cancer Health Risks

The PMI/MEIW/Sensitive Receptor is located at the New Vistas Christian School (NVCS), 68 Morello Avenue, in Martinez. A residence is located very close to the PMI so it was assumed that the MEIR is also located at this receptor.

Table ES-1 below and Table B-1 in Appendix B present the location and cancer risk for the offsite PMI, MEIR, MEIW, and sensitive receptor. For the PMI, MEIR, and NVCS, cancer risk is calculated on a 70-year, 30-year basis, and on a 9-year basis for both child and adult. Risk for the MEIW is calculated on a 40-year exposure basis. All receptor locations are in Universal Transverse Mercator (UTM) coordinates (NAD27 datum).

Table ES-1 Cancer Risk Summary

	Location, UTM		Cancer Risk (per Million)				
	East (m)	North (m)	70-Yr	30-Yr	9-Yr (Adult)	9-Yr (Child)	40-Yr (Wkr)
PMI	578,889	4,206,946	0.795	0.405	0.121	0.196	N/A
MEIR	578,889	4,206,946	0.795	0.405	0.121	0.196	N/A
MEIW	578,889	4,206,946	N/A	N/A	N/A	N/A	0.163
NVCS	578,889	4,206,946	0.795	0.405	0.121	0.196	N/A

Table B-2 in Appendix B presents the 70-year cancer risk for the above receptor in more detail, indicating the contribution to cancer risk from each substance and from each emission source. Chromium (VI) is the principal substance driving the cancer risk, followed by arsenic.

Non-Cancer Health Risks

The PMI, MEIR, MEIW, and sensitive receptor for chronic non-cancer risk are the same as those for cancer risk. The acute risk PMI is located on a hill to the west-northwest of Alhambra High School (150 E Street). There are buildings nearby that could be a residence or business so it was conservatively assumed that the MEIR and MEIW for acute risk are also at this location. The sensitive receptor for acute non-cancer risk is the Kaiser Permanente Martinez Medical Center (KPMMC) located at 200 Muir Avenue.

Table ES-2 below and Table B-1 in Appendix B present the locations and chronic and acute health hazard index (HHI) for the PMI, the MEIR, MEIW, and NVCS and KPMMC sensitive receptors. All receptor locations are Universal Transverse Mercator (UTM) using the NAD27 datum.

Table ES-2 Non-Cancer Risk Summary

	Chronic Non-Cancer Risk			Acute Non-Cancer Risk		
	Location, UTM			Location, UTM		
	East (m)	North (m)	HHI	East (m)	North (m)	HHI
PMI	578,889	4,206,946	0.014	575,200	4,206,700	0.143
MEIR	578,889	4,206,946	0.014	575,200	4,206,700	0.143
MEIW	578,889	4,206,946	0.009	575,200	4,206,700	0.143
NVCS/KPMMC	578,889	4,206,946	0.014	578,076	4,205,352	0.070

Tables B-3 through B-5 in Appendix B present the chronic and acute non-cancer risk for each of the above receptors in more detail, indicating the contribution to risk from each substance, primary target organs, and from each emission source. Mercury and hydrochloric acid drive the chronic non-cancer health risk. Ammonia and arsenic drive the acute non-cancer health risk.

Figures 1 and 2 are scaled aerial photographs of the facility and immediate surroundings, showing the property boundaries and the receptor grid. Figure 3 shows the locations of the PMI, MEIR, MEIW, and the NVCS and KPMMC sensitive receptors.

Figure ES-1 Receptors for HARP Modeling

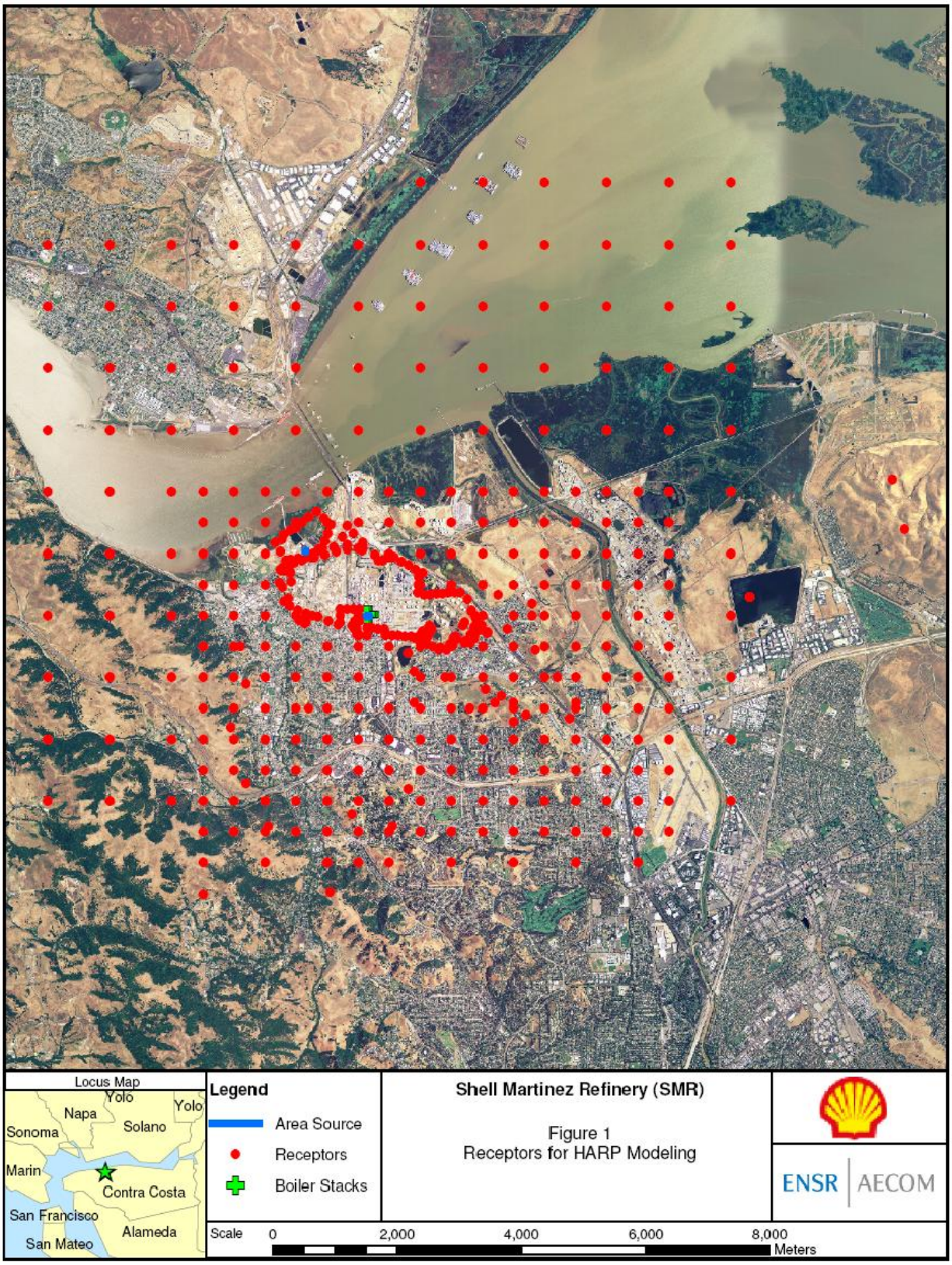

Figure ES-2 Sources for HARP Modeling

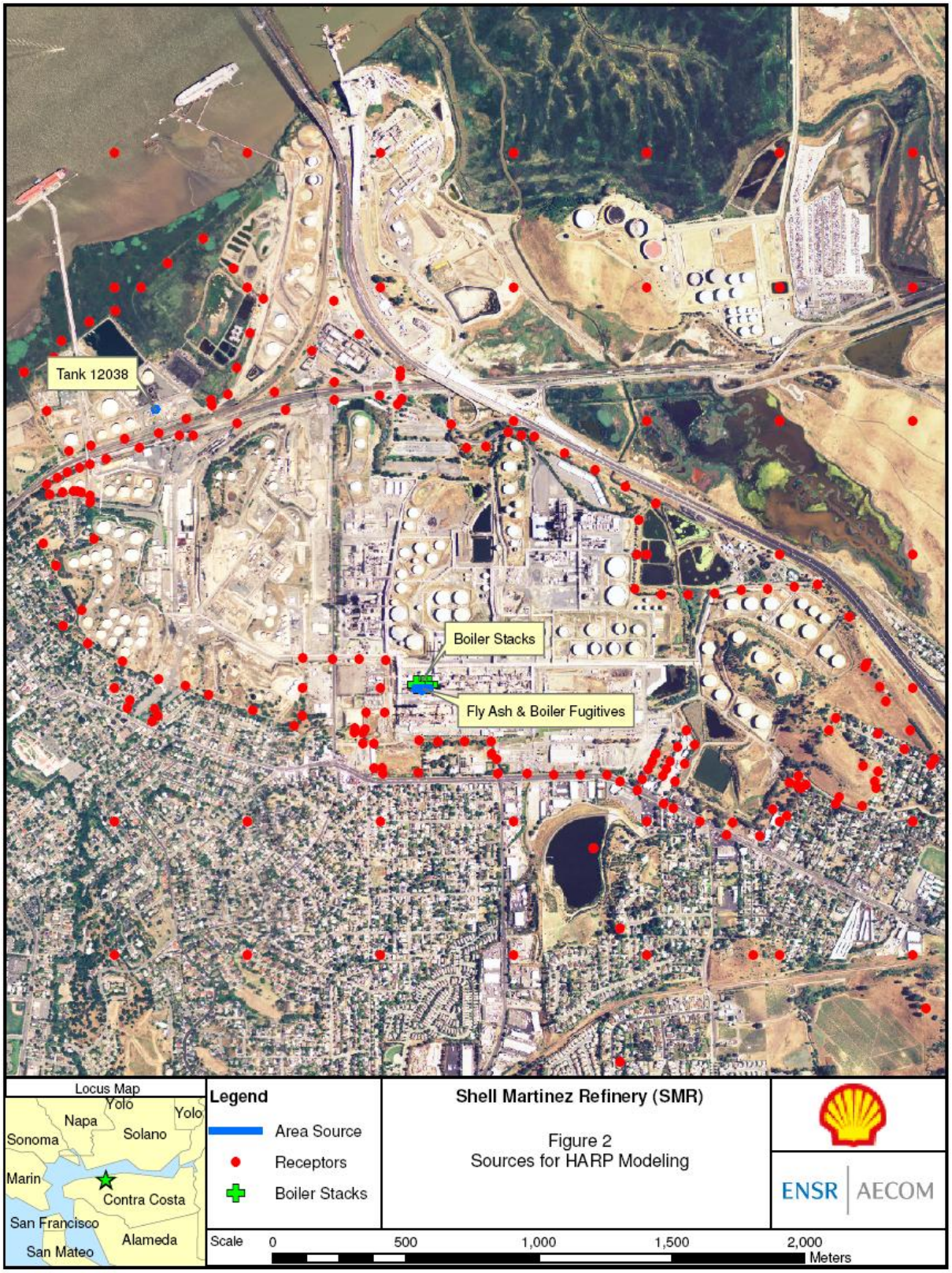

Figure ES-3 Maximum Impact Locations

Population Level Risk Estimates

No population centroids are predicted to have a cancer risk greater than 1 per million therefore population level risks were not estimated. The chronic or acute non-cancer hazard indices are below 1.0 therefore population centroids were not required.

Forms

The required *Health Risk Assessment Summary Form* and the *AB2588 Air Toxics Document Certification & Application Form* are included as part of this Executive Summary.

Conclusions

The modeling results show that none of the receptors have a potential cancer risk greater than 1 in a million, or acute and chronic hazard indices greater than 1. Therefore, no public notification is necessary as a result of this HRA.

Form HRSA

BAY AREA AIR QUALITY MANAGEMENT DISTRICT
939 Ellis Street . . . San Francisco, CA 94109. . . (415) 749-4990 . . . FAX (415) 749-5030 OR 4949
WEBSITE: WWW.BAAQMD.GOV

Health Risk Screening Analysis

IMPORTANT: For any permit application that requires a Health Risk Screening Analysis, fill out one form for each source that emits a Toxic Air Contaminant(s) [or for a group of sources that exhaust through a common stack]. Emissions can be from a discrete point source (with stack) or a source with fugitive emissions (area or volume source). You must provide a plot plan (drawn to scale, if possible) and a local map (aerial photos are recommended), which clearly demonstrate the location of your site, the source(s), property lines, and any surrounding buildings [see attached example]. Label streets, schools, residences, and other businesses. List major dimensions of all buildings surrounding the source in Section C.

Plant Name: Shell Martinez Refinery Plant No.: A0011

Source Description: CO Boiler 1

Source No.: S-1507 (if known) Emission Point No.: P-1507 (if known)

SECTION A *(Point Source)*

1. Does the source exhaust at clearly defined emission point; i.e., a stack or exhaust pipe? ☒ YES OR ☐ NO
   (If YES continue at #2, If NO, skip to Section B)
2. Does the stack (or exhaust pipe) stand alone or is it located on the roof of a building? ☒ alone OR ☐ on roof
   Important: If stack is on a roof, provide building dimensions on line B1 in Section C.
3. What is the height of the stack outlet above ground level? _____ feet OR 49.012 meters?
4. What is the inside diameter of the stack outlet? _____ inches OR _____ feet OR 2.387 meters
5. What is the direction of the exhaust from the stack outlet? ☐ horizontal OR ☒ vertical
6. Is the stack outlet: ☒ open or hinged rain flap OR ☐ rain capped (deflects exhaust downward or horizontally)
7. What is the exhaust flowrate during normal operation? 224,428 cfm (cubic feet/min) OR _____ meters^3/second
8. What is the typical temperature of the exhaust gas? 560 degrees Fahrenheit OR _____ degrees Celsius
   (Skip Section B and Go on to Section C)

SECTION B *(Area/Volume Source)*

This section applies to fugitive emissions that are NOT captured by a collection system nor directly emitted through a stack or other emission point. Volume sources have fugitive emissions generally released within a building or other defined space (e.g., dry cleaner, gasoline station canopy). Area sources are generally flat areas of release (e.g., landfill, quarry).

1. Is the emission source located within a building? ☐ YES (go to #2) OR ☐ NO (go to #3)
2. If YES (source inside building), provide building dimensions on line B1 in Section C
   a. Does the building have a ventilation system that is vented to the outside? ☐ YES OR ☐ NO
   b. If NO (ventilation), are the building's doors & windows kept open during hours of operation? ☐ YES OR ☐ NO
3. If NO (source not inside building), provide a description of the source, dimensions, & indicate location on plot plan.

(Go on to Section C)

SECTION C *(Building Dimensions)*

Provide building dimensions. Use Line B1 only for building with source/stack on the roof or with fugitive emissions inside building. Use Lines B2-B9 for buildings surrounding the source (within 300 feet). Distance and direction are optional if map and/or aerial photo are adequately labeled with locations of buildings. Check one for units: ☐ feet OR ☒ meters

B#	Building name or description	Height	Width	Length	Distance To Source	Direction To Source
B1	N/A				n/a	n/a
B2	63 – Boiler Building	30.5	10	65	5.0	S
B3	64 – Tank	30.5	8.75	8.75	29.5	SE
B4	65 – Tank	25.9	10.25	10.25	46.3	ESE
B5	66 – Tank	45.7	7.75	7.75	60.1	E
B6	67 – Tank	45.7	7.5	7.5	76.8	E
B7	81	24.1	10	28	73.7	SSE

NOTE: Label buildings by B# on plot plan, map and/or aerial photo. Provide comments below for any details that need additional clarification (e.g., list buildings that are co-occupied by your employees and other workers, residents, students, etc).

All buildings are on Shell property

(Go on to Section D)

SECTION D *(Receptor Locations)*

NOTE: Indicate on maps or aerial photos the residential and nonresidential areas surrounding your facility.

1. Indicate the area where the source is located (check one):
   - ☐ zoned for residential use
   - ☐ zoned for mixed residential and commercial/industrial use
   - ☒ zoned for commercial and/or industrial use
   - ☐ zoned for agricultural use
2. Distance from source (stack or building) to nearest facility property line = _____ feet OR 181 meters
3. Distance from source (stack or building) to the property line of the nearest residence = _____ feet OR 390 meters
4. Describe the nearest nonresidential property (check one): ☒ Industrial/Commercial OR ☐ Other _____
5. Distance from source (stack or building) to property line of nearest nonresidential site = _____ feet OR 181 meters
6. Distance from source to property line of nearest school* (or school site) = _____ feet OR ☒ Greater than 1,000 feet

   [Note: Helpful website with California Dept. of Education data: www.greatschools.net]

   Provide the names and addresses of all schools* that have property line(s) within 1,000 feet of the source:

*K-12 and more than twelve children only


576,500
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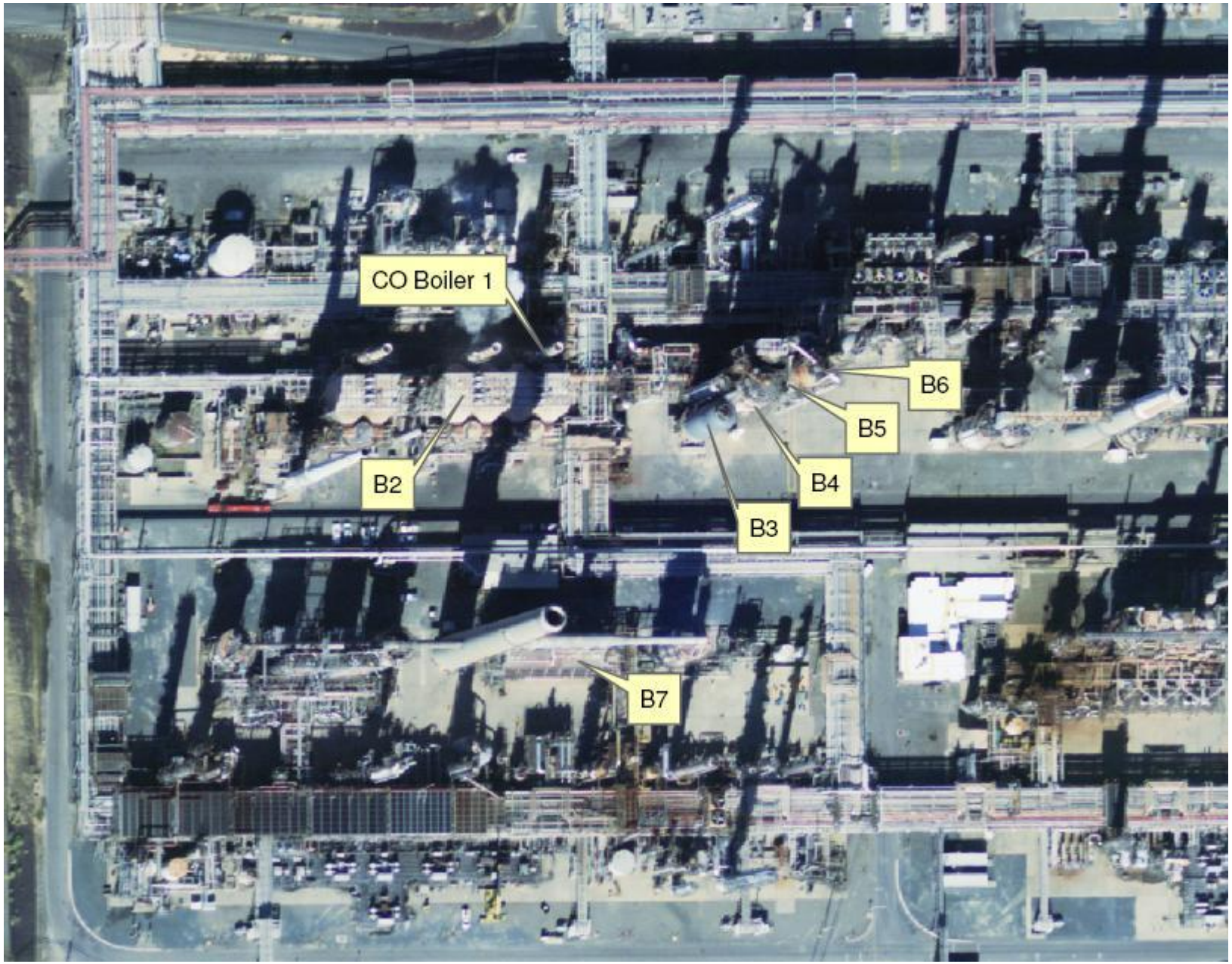
579,500
4,210,000
4,209,500
4,209,000
4,208,500
4,208,000
4,207,500
4,207,000
4,206,500
Tank 12038
& Fugitives
Marina Vista Ave
Sinclair Freeway
CO Boilers
1, 2, & 3
CO Boiler &
Fly Ash Fugitives
Shell Ave
Pacheco Blvd
Locus Map
Yolo
Napa
Yolo
Sonoma
Solano
Marin
Contra Costa
San Francisco
Alameda
San Mateo
Legend
Area Source
Point Source
Property Boundary
UTM Zone 10, NAD 27
Shell Martinez Refinery (SMR)
Source Locations
and Facility Boundary
ENSR | AECOM
Scale 0 250 500 1,000 1,500 2,000
Meters


CO Boiler 1
B6
B5
B4
B2
B3
B7

Form HRSA

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Plant Name: Shell Martinez Refinery Plant No.: A0011

Source Description: CO Boiler 2

Source No.: S-1509 (if known) Emission Point No.: P-1509 (if known)

SECTION A *(Point Source)*

1. Does the source exhaust at clearly defined emission point; i.e., a stack or exhaust pipe? ☒ YES OR ☐ NO
   (If YES continue at #2, If NO, skip to Section B)
2. Does the stack (or exhaust pipe) stand alone or is it located on the roof of a building? ☒ alone OR ☐ on roof
   Important: If stack is on a roof, provide building dimensions on line B1 in Section C.
3. What is the height of the stack outlet above ground level? _____ feet OR 49.012 meters?
4. What is the inside diameter of the stack outlet? _____ inches OR _____ feet OR 2.387 meters
5. What is the direction of the exhaust from the stack outlet? ☐ horizontal OR ☒ vertical
6. Is the stack outlet: ☒ open or hinged rain flap OR ☐ rain capped (deflects exhaust downward or horizontally)
7. What is the exhaust flowrate during normal operation? 224,428 cfm (cubic feet/min) OR _____ meters^3/second
8. What is the typical temperature of the exhaust gas? 560 degrees Fahrenheit OR _____ degrees Celsius
   (Skip Section B and Go on to Section C)

SECTION B *(Area/Volume Source)*

This section applies to fugitive emissions that are NOT captured by a collection system nor directly emitted through a stack or other emission point. Volume sources have fugitive emissions generally released within a building or other defined space (e.g., dry cleaner, gasoline station canopy). Area sources are generally flat areas of release (e.g., landfill, quarry).

1. Is the emission source located within a building? ☐ YES (go to #2) OR ☐ NO (go to #3)
2. If YES (source inside building), provide building dimensions on line B1 in Section C
   a. Does the building have a ventilation system that is vented to the outside? ☐ YES OR ☐ NO
   b. If NO (ventilation), are the building's doors & windows kept open during hours of operation? ☐ YES OR ☐ NO
3. If NO (source not inside building), provide a description of the source, dimensions, & indicate location on plot plan.

(Go on to Section C)

SECTION C *(Building Dimensions)*

Provide building dimensions. Use Line B1 only for building with source/stack on the roof or with fugitive emissions inside building. Use Lines B2-B9 for buildings surrounding the source (within 300 feet). Distance and direction are optional if map and/or aerial photo are adequately labeled with locations of buildings. Check one for units: ☐ feet OR ☒ meters

B#	Building name or description	Height	Width	Length	Distance To Source	Direction To Source
B1	N/A				n/a	n/a
B2	63 – Boiler Building	30.5	10	65	5.0	S
B3	64 – Tank	30.5	8.75	8.75	44.5	SE
B4	65 – Tank	25.9	10.25	10.25	62.8	ESE
B5	66 – Tank	45.7	7.75	7.75	77.3	E
B6	81	24.1	10	28	77.0	SSE

NOTE: Label buildings by B# on plot plan, map and/or aerial photo. Provide comments below for any details that need additional clarification (e.g., list buildings that are co-occupied by your employees and other workers, residents, students, etc).

All buildings are on Shell property

(Go on to Section D)

SECTION D *(Receptor Locations)*

NOTE: Indicate on maps or aerial photos the residential and nonresidential areas surrounding your facility.

1. Indicate the area where the source is located (check one):
   - ☐ zoned for residential use
   - ☐ zoned for mixed residential and commercial/industrial use
   - ☒ zoned for commercial and/or industrial use
   - ☐ zoned for agricultural use
2. Distance from source (stack or building) to nearest facility property line = _____ feet OR 181 meters
3. Distance from source (stack or building) to the property line of the nearest residence = _____ feet OR 390 meters
4. Describe the nearest nonresidential property (check one): ☒ Industrial/Commercial OR ☐ Other _____
5. Distance from source (stack or building) to property line of nearest nonresidential site = _____ feet OR 165 meters
6. Distance from source to property line of nearest school* (or school site) = _____ feet OR ☒ Greater than 1,000 feet

   [Note: Helpful website with California Dept. of Education data: www.greatschools.net]

   Provide the names and addresses of all schools* that have property line(s) within 1,000 feet of the source:

*K-12 and more than twelve children only


576,500
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579,500
4,210,000
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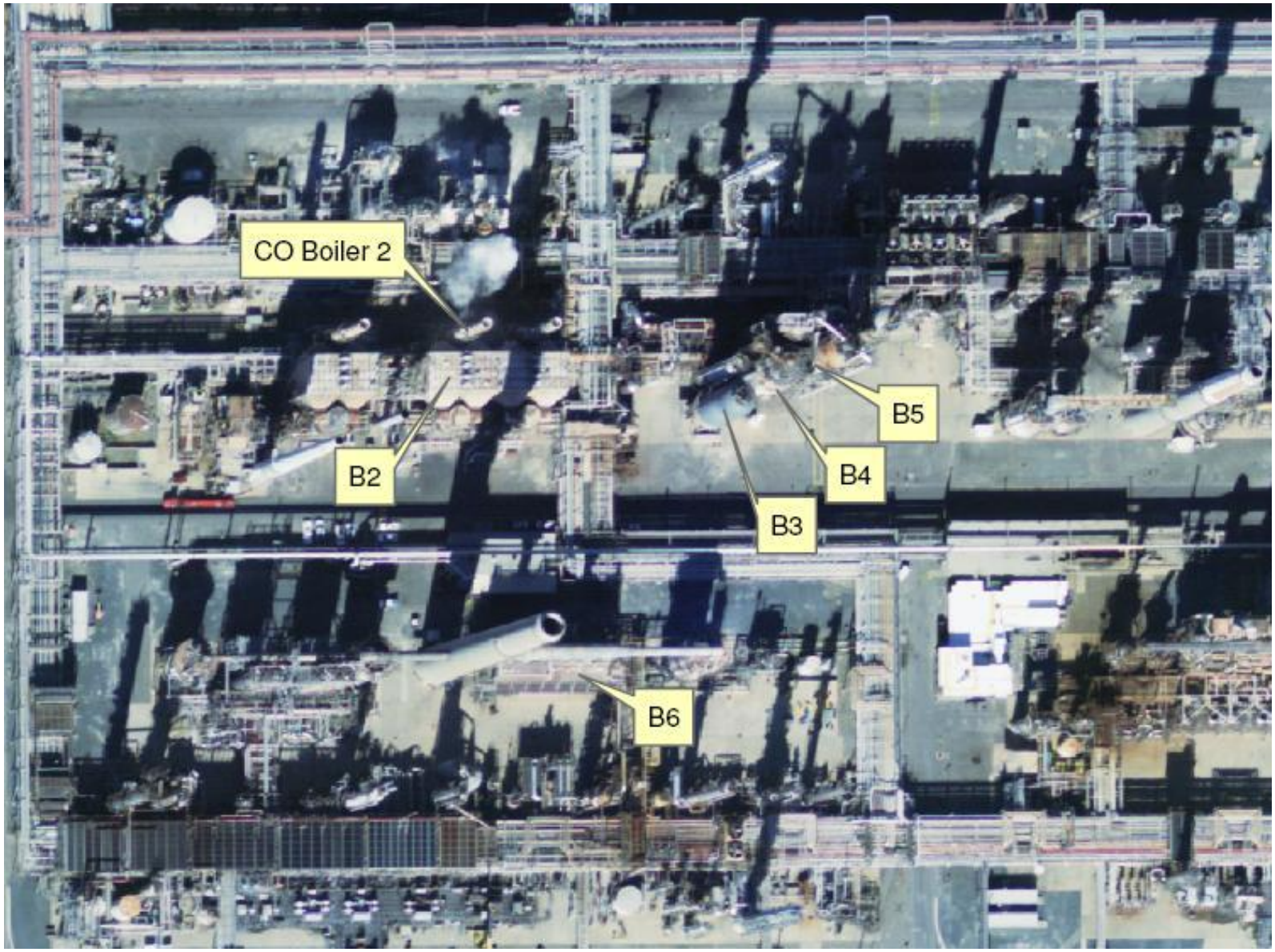
4,207,000
4,206,500
Tank 12038
& Fugitives
Marina Vista Ave
Sinclair Freeway
CO Boilers
1, 2, & 3
CO Boiler &
Fly Ash Fugitives
Shell Ave
Pacheco Blvd
Locus Map
Yolo
Napa
Yolo
Sonoma
Solano
Marin
Contra Costa
San Francisco
Alameda
San Mateo
Legend
Area Source
Point Source
Property Boundary
UTM Zone 10, NAD 27
Shell Martinez Refinery (SMR)
Source Locations
and Facility Boundary
ENSR | AECOM
Scale 0 250 500 1,000 1,500 2,000
Meters


CO Boiler 2
B2
B3
B4
B5
B6

Form HRSA

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Plant Name: Shell Martinez Refinery Plant No.: A0011

Source Description: CO Boiler 3

Source No.: S-1512 (if known) Emission Point No.: P-1512 (if known)

SECTION A *(Point Source)*

1. Does the source exhaust at clearly defined emission point; i.e., a stack or exhaust pipe? ☒ YES OR ☐ NO
   (If YES continue at #2, If NO, skip to Section B)
2. Does the stack (or exhaust pipe) stand alone or is it located on the roof of a building? ☒ alone OR ☐ on roof
   Important: If stack is on a roof, provide building dimensions on line B1 in Section C.
3. What is the height of the stack outlet above ground level? _____ feet OR 49.012 meters?
4. What is the inside diameter of the stack outlet? _____ inches OR _____ feet OR 2.387 meters
5. What is the direction of the exhaust from the stack outlet? ☐ horizontal OR ☒ vertical
6. Is the stack outlet: ☒ open or hinged rain flap OR ☐ rain capped (deflects exhaust downward or horizontally)
7. What is the exhaust flowrate during normal operation? 224,428 cfm (cubic feet/min) OR _____ meters^3/second
8. What is the typical temperature of the exhaust gas? 560 degrees Fahrenheit OR _____ degrees Celsius
   (Skip Section B and Go on to Section C)

SECTION B *(Area/Volume Source)*

This section applies to fugitive emissions that are NOT captured by a collection system nor directly emitted through a stack or other emission point. Volume sources have fugitive emissions generally released within a building or other defined space (e.g., dry cleaner, gasoline station canopy). Area sources are generally flat areas of release (e.g., landfill, quarry).

1. Is the emission source located within a building? ☐ YES (go to #2) OR ☐ NO (go to #3)
2. If YES (source inside building), provide building dimensions on line B1 in Section C
   a. Does the building have a ventilation system that is vented to the outside? ☐ YES OR ☐ NO
   b. If NO (ventilation), are the building's doors & windows kept open during hours of operation? ☐ YES OR ☐ NO
3. If NO (source not inside building), provide a description of the source, dimensions, & indicate location on plot plan.

(Go on to Section C)

SECTION C *(Building Dimensions)*

Provide building dimensions. Use Line B1 only for building with source/stack on the roof or with fugitive emissions inside building. Use Lines B2-B9 for buildings surrounding the source (within 300 feet). Distance and direction are optional if map and/or aerial photo are adequately labeled with locations of buildings. Check one for units: ☐ feet OR ☒ meters

B#	Building name or description	Height	Width	Length	Distance To Source	Direction To Source
B1	N/A				n/a	n/a
B2	63 – Boiler Building	30.5	10	65	5.0	S
B3	64 – Tank	30.5	8.75	8.75	73.2	SE
B4	65 – Tank	25.9	10.25	10.25	91.5	ESE
B5	81	24.1	10	28	90.5	SSE

NOTE: Label buildings by B# on plot plan, map and/or aerial photo. Provide comments below for any details that need additional clarification (e.g., list buildings that are co-occupied by your employees and other workers, residents, students, etc).

All buildings are on Shell property

(Go on to Section D)

SECTION D *(Receptor Locations)*

NOTE: Indicate on maps or aerial photos the residential and nonresidential areas surrounding your facility.

1. Indicate the area where the source is located (check one):
   - ☐ zoned for residential use
   - ☐ zoned for mixed residential and commercial/industrial use
   - ☒ zoned for commercial and/or industrial use
   - ☐ zoned for agricultural use
2. Distance from source (stack or building) to nearest facility property line = _____ feet OR 134 meters
3. Distance from source (stack or building) to the property line of the nearest residence = _____ feet OR 390 meters
4. Describe the nearest nonresidential property (check one): ☒ Industrial/Commercial OR ☐ Other _____
5. Distance from source (stack or building) to property line of nearest nonresidential site = _____ feet OR 134 meters
6. Distance from source to property line of nearest school* (or school site) = _____ feet OR ☒ Greater than 1,000 feet

   [Note: Helpful website with California Dept. of Education data: www.greatschools.net]

   Provide the names and addresses of all schools* that have property line(s) within 1,000 feet of the source:

*K-12 and more than twelve children only


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Tank 12038
& Fugitives
Marina Vista Ave
Sinclair Freeway
CO Boilers
1, 2, & 3
CO Boiler &
Fly Ash Fugitives
Shell Ave
Pacheco Blvd
Locus Map
Yolo
Napa
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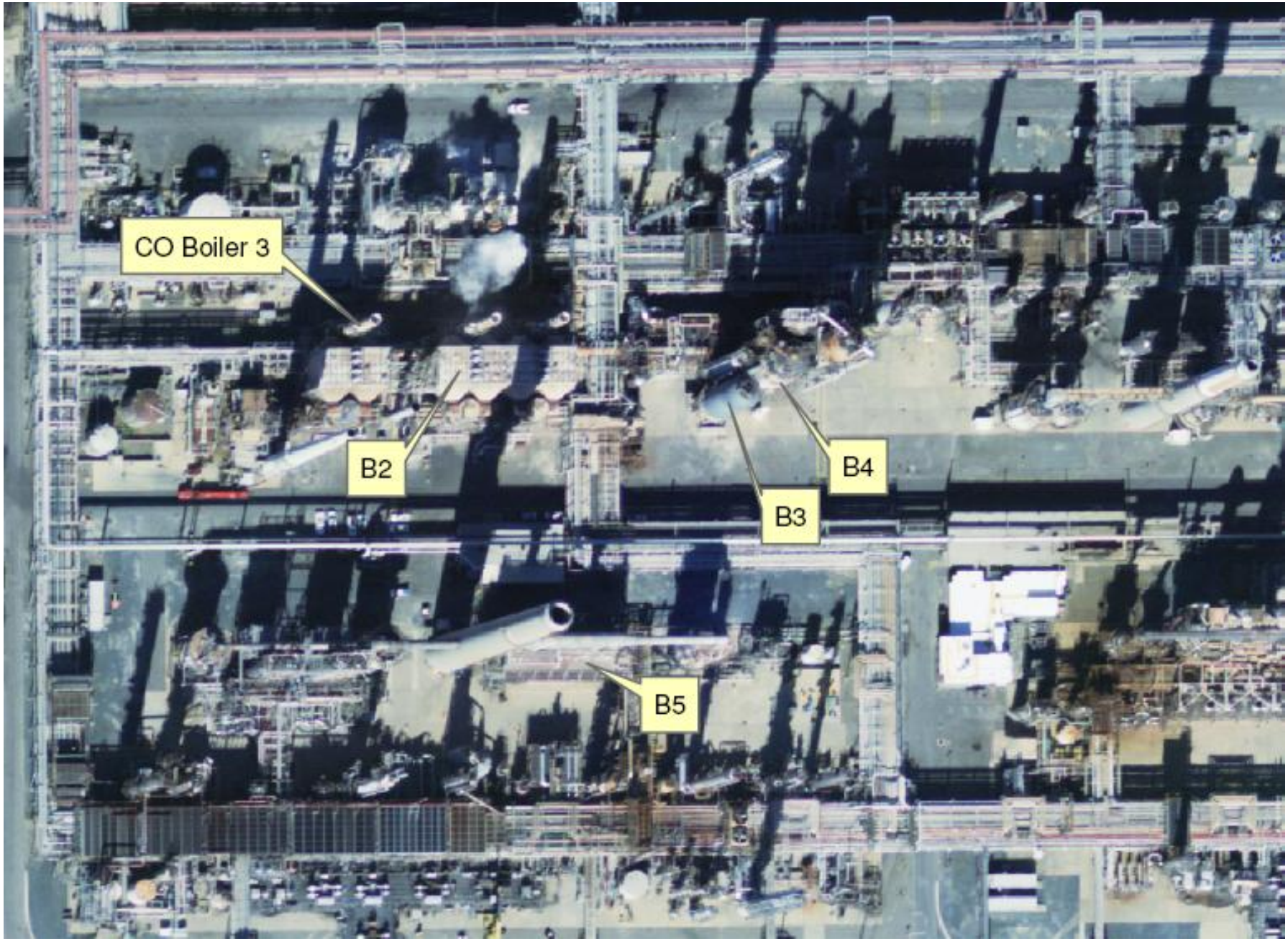
Sonoma
Solano
Marin
Contra Costa
San Francisco
Alameda
San Mateo
Legend
Area Source
Point Source
Property Boundary
UTM Zone 10, NAD 27
Shell Martinez Refinery (SMR)
Source Locations
and Facility Boundary
ENSR | AECOM
Scale 0 250 500 1,000 1,500 2,000
Meters


CO Boiler 3
B2
B3
B4
B5

Form HRSA

BAY AREA AIR QUALITY MANAGEMENT DISTRICT
939 Ellis Street . . . San Francisco, CA 94109. . . (415) 749-4990 . . . FAX (415) 749-5030 OR 4949
WEBSITE: WWW.BAAQMD.GOV

Health Risk Screening Analysis

IMPORTANT: For any permit application that requires a Health Risk Screening Analysis, fill out one form for each source that emits a Toxic Air Contaminant(s) [or for a group of sources that exhaust through a common stack]. Emissions can be from a discrete point source (with stack) or a source with fugitive emissions (area or volume source). You must provide a plot plan (drawn to scale, if possible) and a local map (aerial photos are recommended), which clearly demonstrate the location of your site, the source(s), property lines, and any surrounding buildings [see attached example]. Label streets, schools, residences, and other businesses. List major dimensions of all buildings surrounding the source in Section C.

Plant Name: Shell Martinez Refinery Plant No.: A0011

Source Description: Tank 12038

Source No.: S-1805 (if known) Emission Point No.: P-1805 (if known)

SECTION A *(Point Source)*

1. Does the source exhaust at clearly defined emission point; i.e., a stack or exhaust pipe? ☐ YES OR ☒ NO
   (If YES continue at #2, If NO, skip to Section B)
2. Does the stack (or exhaust pipe) stand alone or is it located on the roof of a building? ☐ alone OR ☐ on roof
   Important: If stack is on a roof, provide building dimensions on line B1 in Section C.
3. What is the height of the stack outlet above ground level? _____ feet OR _____ meters?
4. What is the inside diameter of the stack outlet? _____ inches OR _____ feet OR _____ meters
5. What is the direction of the exhaust from the stack outlet? ☐ horizontal OR ☐ vertical
6. Is the stack outlet: ☐ open or hinged rain flap OR ☐ rain capped (deflects exhaust downward or horizontally)
7. What is the exhaust flowrate during normal operation? _____ cfm (cubic feet/min) OR _____ meters^3/second
8. What is the typical temperature of the exhaust gas? _____ degrees Fahrenheit OR _____ degrees Celsius
   (Skip Section B and Go on to Section C)

SECTION B *(Area/Volume Source)*

This section applies to fugitive emissions that are NOT captured by a collection system nor directly emitted through a stack or other emission point. Volume sources have fugitive emissions generally released within a building or other defined space (e.g., dry cleaner, gasoline station canopy). Area sources are generally flat areas of release (e.g., landfill, quarry).

1. Is the emission source located within a building? ☐ YES (go to #2) OR ☒ NO (go to #3)
2. If YES (source inside building), provide building dimensions on line B1 in Section C
   a. Does the building have a ventilation system that is vented to the outside? ☐ YES OR ☐ NO
   b. If NO (ventilation), are the building's doors & windows kept open during hours of operation? ☐ YES OR ☐ NO
3. If NO (source not inside building), provide a description of the source, dimensions, & indicate location on plot plan.
   Tank 12038

(Go on to Section C)

SECTION C *(Building Dimensions)*

Provide building dimensions. Use Line B1 only for building with source/stack on the roof or with fugitive emissions inside building. Use Lines B2-B9 for buildings surrounding the source (within 300 feet). Distance and direction are optional if map and/or aerial photo are adequately labeled with locations of buildings. Check one for units: ☐ feet OR ☒ meters

B#	Building name or description	Height	Width	Length	Distance To Source	Direction To Source
B1	N/A	N/A	N/A	N/A	N/A	N/A
B2	N/A	N/A	N/A	N/A	N/A	N/A

NOTE: Label buildings by B# on plot plan, map and/or aerial photo. Provide comments below for any details that need additional clarification (e.g., list buildings that are co-occupied by your employees and other workers, residents, students, etc).

All structures within 300 ft are tanks on Shell property

(Go on to Section D)

SECTION D *(Receptor Locations)*

NOTE: Indicate on maps or aerial photos the residential and nonresidential areas surrounding your facility.

1. Indicate the area where the source is located (check one):
   - ☐ zoned for residential use
   - ☐ zoned for mixed residential and commercial/industrial use
   - ☒ zoned for commercial and/or industrial use
   - ☐ zoned for agricultural use
2. Distance from source (stack or building) to nearest facility property line = _____ feet OR 82 meters
3. Distance from source (stack or building) to the property line of the nearest residence = _____ feet OR 450 meters
4. Describe the nearest nonresidential property (check one): ☒ Industrial/Commercial OR ☐ Other _____
5. Distance from source (stack or building) to property line of nearest nonresidential site = _____ feet OR 82 meters
6. Distance from source to property line of nearest school* (or school site) = _____ feet OR ☒ Greater than 1,000 feet

   [Note: Helpful website with California Dept. of Education data: www.greatschools.net]

   Provide the names and addresses of all schools* that have property line(s) within 1,000 feet of the source:

*K-12 and more than twelve children only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Tank 12038
& Fugitives
Marina Vista Ave
Sinclair Freeway
CO Boilers
1, 2, & 3
CO Boiler &
Fly Ash Fugitives
Shell Ave
Pacheco Blvd
Locus Map
Yolo
Napa
Yolo
Sonoma
Solano
Marin
Contra Costa
San Francisco
Alameda
San Mateo
Legend
Area Source
Point Source
Property Boundary
UTM Zone 10, NAD 27
Shell Martinez Refinery (SMR)
Source Locations
and Facility Boundary
ENSR | AECOM
Scale 0 250 500 1,000 1,500 2,000
Meters


Tank 12038
and Fugitives

Form HRSA

BAY AREA AIR QUALITY MANAGEMENT DISTRICT
939 Ellis Street . . . San Francisco, CA 94109. . . (415) 749-4990 . . . FAX (415) 749-5030 OR 4949
WEBSITE: WWW.BAAQMD.GOV

Health Risk Screening Analysis

IMPORTANT: For any permit application that requires a Health Risk Screening Analysis, fill out one form for each source that emits a Toxic Air Contaminant(s) [or for a group of sources that exhaust through a common stack]. Emissions can be from a discrete point source (with stack) or a source with fugitive emissions (area or volume source). You must provide a plot plan (drawn to scale, if possible) and a local map (aerial photos are recommended), which clearly demonstrate the location of your site, the source(s), property lines, and any surrounding buildings [see attached example]. Label streets, schools, residences, and other businesses. List major dimensions of all buildings surrounding the source in Section C.

Plant Name: Shell Martinez Refinery Plant No.: A0011

Source Description: Tank 12038 Fugitives

Source No.: S- N/A (if known) Emission Point No.: P- N/A (if known)

SECTION A *(Point Source)*

1. Does the source exhaust at clearly defined emission point; i.e., a stack or exhaust pipe? ☐ YES OR ☒ NO
   (If YES continue at #2, If NO, skip to Section B)
2. Does the stack (or exhaust pipe) stand alone or is it located on the roof of a building? ☐ alone OR ☐ on roof
   Important: If stack is on a roof, provide building dimensions on line B1 in Section C.
3. What is the height of the stack outlet above ground level? _____ feet OR _____ meters?
4. What is the inside diameter of the stack outlet? _____ inches OR _____ feet OR _____ meters
5. What is the direction of the exhaust from the stack outlet? ☐ horizontal OR ☐ vertical
6. Is the stack outlet: ☐ open or hinged rain flap OR ☐ rain capped (deflects exhaust downward or horizontally)
7. What is the exhaust flowrate during normal operation? _____ cfm (cubic feet/min) OR _____ meters^3/second
8. What is the typical temperature of the exhaust gas? _____ degrees Fahrenheit OR _____ degrees Celsius
   (Skip Section B and Go on to Section C)

SECTION B *(Area/Volume Source)*

This section applies to fugitive emissions that are NOT captured by a collection system nor directly emitted through a stack or other emission point. Volume sources have fugitive emissions generally released within a building or other defined space (e.g., dry cleaner, gasoline station canopy). Area sources are generally flat areas of release (e.g., landfill, quarry).

1. Is the emission source located within a building? ☐ YES (go to #2) OR ☒ NO (go to #3)
2. If YES (source inside building), provide building dimensions on line B1 in Section C
   a. Does the building have a ventilation system that is vented to the outside? ☐ YES OR ☐ NO
   b. If NO (ventilation), are the building's doors & windows kept open during hours of operation? ☐ YES OR ☐ NO
3. If NO (source not inside building), provide a description of the source, dimensions, & indicate location on plot plan.
   Tank 12038 Fugitives from valves, etc

(Go on to Section C)

SECTION C *(Building Dimensions)*

Provide building dimensions. Use Line B1 only for building with source/stack on the roof or with fugitive emissions inside building. Use Lines B2-B9 for buildings surrounding the source (within 300 feet). Distance and direction are optional if map and/or aerial photo are adequately labeled with locations of buildings. Check one for units: ☐ feet OR ☒ meters

B#	Building name or description	Height	Width	Length	Distance To Source	Direction To Source
B1	N/A	N/A	N/A	N/A	N/A	N/A
B2	N/A	N/A	N/A	N/A	N/A	N/A

NOTE: Label buildings by B# on plot plan, map and/or aerial photo. Provide comments below for any details that need additional clarification (e.g., list buildings that are co-occupied by your employees and other workers, residents, students, etc).

All structures within 300 ft are tanks on Shell property

(Go on to Section D)

SECTION D *(Receptor Locations)*

NOTE: Indicate on maps or aerial photos the residential and nonresidential areas surrounding your facility.

1. Indicate the area where the source is located (check one):
   - ☐ zoned for residential use
   - ☐ zoned for mixed residential and commercial/industrial use
   - ☒ zoned for commercial and/or industrial use
   - ☐ zoned for agricultural use
2. Distance from source (stack or building) to nearest facility property line = _____ feet OR 82 meters
3. Distance from source (stack or building) to the property line of the nearest residence = _____ feet OR 450 meters
4. Describe the nearest nonresidential property (check one): ☒ Industrial/Commercial OR ☐ Other _____
5. Distance from source (stack or building) to property line of nearest nonresidential site = _____ feet OR 82 meters
6. Distance from source to property line of nearest school* (or school site) = _____ feet OR ☒ Greater than 1,000 feet

   [Note: Helpful website with California Dept. of Education data: www.greatschools.net]

   Provide the names and addresses of all schools* that have property line(s) within 1,000 feet of the source:

*K-12 and more than twelve children only


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Tank 12038
& Fugitives
Marina Vista Ave
Sinclair Freeway
CO Boilers
1, 2, & 3
CO Boiler &
Fly Ash Fugitives
Shell Ave
Pacheco Blvd
Locus Map
Yolo
Napa
Yolo
Sonoma
Solano
Marin
Contra Costa
San Francisco
Alameda
San Mateo
Legend
Area Source
Point Source
Property Boundary
UTM Zone 10, NAD 27
Shell Martinez Refinery (SMR)
Source Locations
and Facility Boundary
ENSR | AECOM
Scale 0 250 500 1,000 1,500 2,000
Meters


Tank 12038
and Fugitives

Form HRSA

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939 Ellis Street . . . San Francisco, CA 94109. . . (415) 749-4990 . . . FAX (415) 749-5030 OR 4949
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Health Risk Screening Analysis

IMPORTANT: For any permit application that requires a Health Risk Screening Analysis, fill out one form for each source that emits a Toxic Air Contaminant(s) [or for a group of sources that exhaust through a common stack]. Emissions can be from a discrete point source (with stack) or a source with fugitive emissions (area or volume source). You must provide a plot plan (drawn to scale, if possible) and a local map (aerial photos are recommended), which clearly demonstrate the location of your site, the source(s), property lines, and any surrounding buildings [see attached example]. Label streets, schools, residences, and other businesses. List major dimensions of all buildings surrounding the source in Section C.

Plant Name: Shell Martinez Refinery Plant No.: A0011

Source Description: CO Boiler Fugitives

Source No.: S- N/A (if known) Emission Point No.: P- N/A (if known)

SECTION A *(Point Source)*

1. Does the source exhaust at clearly defined emission point; i.e., a stack or exhaust pipe? ☐ YES OR ☒ NO
   (If YES continue at #2, If NO, skip to Section B)
2. Does the stack (or exhaust pipe) stand alone or is it located on the roof of a building? ☒ alone OR ☐ on roof
   Important: If stack is on a roof, provide building dimensions on line B1 in Section C.
3. What is the height of the stack outlet above ground level? _____ feet OR _____ meters?
4. What is the inside diameter of the stack outlet? _____ inches OR _____ feet OR _____ meters
5. What is the direction of the exhaust from the stack outlet? ☐ horizontal OR ☐ vertical
6. Is the stack outlet: ☐ open or hinged rain flap OR ☐ rain capped (deflects exhaust downward or horizontally)
7. What is the exhaust flowrate during normal operation? _____ cfm (cubic feet/min) OR _____ meters^3/second
8. What is the typical temperature of the exhaust gas? _____ degrees Fahrenheit OR _____ degrees Celsius
   (Skip Section B and Go on to Section C)

SECTION B *(Area/Volume Source)*

This section applies to fugitive emissions that are NOT captured by a collection system nor directly emitted through a stack or other emission point. Volume sources have fugitive emissions generally released within a building or other defined space (e.g., dry cleaner, gasoline station canopy). Area sources are generally flat areas of release (e.g., landfill, quarry).

1. Is the emission source located within a building? ☐ YES (go to #2) OR ☒ NO (go to #3)
2. If YES (source inside building), provide building dimensions on line B1 in Section C
   a. Does the building have a ventilation system that is vented to the outside? ☐ YES OR ☐ NO
   b. If NO (ventilation), are the building's doors & windows kept open during hours of operation? ☐ YES OR ☐ NO
3. If NO (source not inside building), provide a description of the source, dimensions, & indicate location on plot plan.

(Go on to Section C)

SECTION C *(Building Dimensions)*

Provide building dimensions. Use Line B1 only for building with source/stack on the roof or with fugitive emissions inside building. Use Lines B2-B9 for buildings surrounding the source (within 300 feet). Distance and direction are optional if map and/or aerial photo are adequately labeled with locations of buildings. Check one for units: ☐ feet OR ☒ meters

B#	Building name or description	Height	Width	Length	Distance To Source	Direction To Source
B1	N/A				n/a	n/a
B2	63 – Boiler Building	30.5	10	65	5.0	S
B3	64 – Tank	30.5	8.75	8.75	73.2	SE
B4	65 – Tank	25.9	10.25	10.25	91.5	ESE
B5	81	24.1	10	28	90.5	SSE

NOTE: Label buildings by B# on plot plan, map and/or aerial photo. Provide comments below for any details that need additional clarification (e.g., list buildings that are co-occupied by your employees and other workers, residents, students, etc).

All buildings are on Shell property

(Go on to Section D)

SECTION D *(Receptor Locations)*

NOTE: Indicate on maps or aerial photos the residential and nonresidential areas surrounding your facility.

1. Indicate the area where the source is located (check one):
   - ☐ zoned for residential use
   - ☐ zoned for mixed residential and commercial/industrial use
   - ☒ zoned for commercial and/or industrial use
   - ☐ zoned for agricultural use
2. Distance from source (stack or building) to nearest facility property line = _____ feet OR 130 meters
3. Distance from source (stack or building) to the property line of the nearest residence = _____ feet OR 355 meters
4. Describe the nearest nonresidential property (check one): ☒ Industrial/Commercial OR ☐ Other _____
5. Distance from source (stack or building) to property line of nearest nonresidential site = _____ feet OR 130 meters
6. Distance from source to property line of nearest school* (or school site) = _____ feet OR ☒ Greater than 1,000 feet

   [Note: Helpful website with California Dept. of Education data: www.greatschools.net]

   Provide the names and addresses of all schools* that have property line(s) within 1,000 feet of the source:

*K-12 and more than twelve children only


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Shell Martinez Refinery (SMR)
Source Locations
and Facility Boundary
ENSR | AECOM
Scale 0 250 500 1,000 1,500 2,000
Meters


B2
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B5
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B3
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Fugitives
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Form HRSA

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Health Risk Screening Analysis

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Plant Name: Shell Martinez Refinery Plant No.: A0011

Source Description: Flyash Fugitives

Source No.: S- N/A (if known) Emission Point No.: P- N/A (if known)

SECTION A *(Point Source)*

1. Does the source exhaust at clearly defined emission point; i.e., a stack or exhaust pipe? ☐ YES OR ☒ NO
   (If YES continue at #2, If NO, skip to Section B)
2. Does the stack (or exhaust pipe) stand alone or is it located on the roof of a building? ☐ alone OR ☐ on roof
   Important: If stack is on a roof, provide building dimensions on line B1 in Section C.
3. What is the height of the stack outlet above ground level? _____ feet OR _____ meters?
4. What is the inside diameter of the stack outlet? _____ inches OR _____ feet OR _____ meters
5. What is the direction of the exhaust from the stack outlet? ☐ horizontal OR ☐ vertical
6. Is the stack outlet: ☐ open or hinged rain flap OR ☐ rain capped (deflects exhaust downward or horizontally)
7. What is the exhaust flowrate during normal operation? _____ cfm (cubic feet/min) OR _____ meters^3/second
8. What is the typical temperature of the exhaust gas? _____ degrees Fahrenheit OR _____ degrees Celsius
   (Skip Section B and Go on to Section C)

SECTION B *(Area/Volume Source)*

This section applies to fugitive emissions that are NOT captured by a collection system nor directly emitted through a stack or other emission point. Volume sources have fugitive emissions generally released within a building or other defined space (e.g., dry cleaner, gasoline station canopy). Area sources are generally flat areas of release (e.g., landfill, quarry).

1. Is the emission source located within a building? ☐ YES (go to #2) OR ☒ NO (go to #3)
2. If YES (source inside building), provide building dimensions on line B1 in Section C
   a. Does the building have a ventilation system that is vented to the outside? ☐ YES OR ☐ NO
   b. If NO (ventilation), are the building's doors & windows kept open during hours of operation? ☐ YES OR ☐ NO
3. If NO (source not inside building), provide a description of the source, dimensions, & indicate location on plot plan.

_____

_____

(Go on to Section C)

SECTION C *(Building Dimensions)*

Provide building dimensions. Use Line B1 only for building with source/stack on the roof or with fugitive emissions inside building. Use Lines B2-B9 for buildings surrounding the source (within 300 feet). Distance and direction are optional if map and/or aerial photo are adequately labeled with locations of buildings. Check one for units: ☐ feet OR ☒ meters

B#	Building name or description	Height	Width	Length	Distance To Source	Direction To Source
B1	N/A				n/a	n/a
B2	63 – Boiler Building	30.5	10	65	5.0	S
B3	64 – Tank	30.5	8.75	8.75	73.2	SE
B4	65 – Tank	25.9	10.25	10.25	91.5	ESE
B5	81	24.1	10	28	90.5	SSE

NOTE: Label buildings by B# on plot plan, map and/or aerial photo. Provide comments below for any details that need additional clarification (e.g., list buildings that are co-occupied by your employees and other workers, residents, students, etc).

All buildings are on Shell property

(Go on to Section D)

SECTION D *(Receptor Locations)*

NOTE: Indicate on maps or aerial photos the residential and nonresidential areas surrounding your facility.

1. Indicate the area where the source is located (check one):
   - ☐ zoned for residential use
   - ☐ zoned for mixed residential and commercial/industrial use
   - ☒ zoned for commercial and/or industrial use
   - ☐ zoned for agricultural use
2. Distance from source (stack or building) to nearest facility property line = _____ feet OR 150 meters
3. Distance from source (stack or building) to the property line of the nearest residence = _____ feet OR 375 meters
4. Describe the nearest nonresidential property (check one): ☒ Industrial/Commercial OR ☐ Other _____
5. Distance from source (stack or building) to property line of nearest nonresidential site = _____ feet OR 150 meters
6. Distance from source to property line of nearest school* (or school site) = _____ feet OR ☒ Greater than 1,000 feet

   [Note: Helpful website with California Dept. of Education data: www.greatschools.net]

   Provide the names and addresses of all schools* that have property line(s) within 1,000 feet of the source:

*K-12 and more than twelve children only


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Tank 12038
& Fugitives
Marina Vista Ave
Sinclair Freeway
CO Boilers
1, 2, & 3
CO Boiler &
Fly Ash Fugitives
Shell Ave
Pacheco Blvd
Locus Map
Yolo
Napa
Yolo
Sonoma
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Source Locations
and Facility Boundary
ENSR | AECOM
Scale 0 250 500 1,000 1,500 2,000
Meters


B2
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Fugitives
B7

1.0 Hazard Identification

The Hazard Identification section involves identifying the substances that are evaluated quantitatively in the HRA. The sources of emissions at the facility include the permitted units, which are the three CO Boilers and Tank 12038. Hazardous waste combustion in the CO Boilers results in combustion by-products being emitted from the three stacks. In addition to the stack sources, fugitive sources also release air emissions. The fugitive emission sources include the waste feed storage tank (Tank 12038), process equipment and ash handling.

The substances evaluated in this HRA for the CO boilers were identified from the recent Trial Burn results (ENSR, 2006) for Condition 2, which represents the unit under normal operating conditions. Under Condition 2, testing was performed for polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans (dioxins); polycyclic aromatic hydrocarbons (PAHs); carbonyl compounds (aldehydes); volatile and semivolatile organics; metals; hexavalent chromium; particulate matter; hydrogen chloride, chlorine, ammonia and total hydrocarbons (ENSR, 2006). Substances detected in at least one of the three runs in Condition 2 of the Trial Burn were selected as substances to be evaluated for the CO Boilers. Substances that were not detected in any of the three runs were not evaluated for the CO Boilers, in accordance with the accepted Protocol (ENSR, 2005).

Table 1-1 lists the substances detected in the Trial Burn for the CO Boilers, CAS numbers, whether they were evaluated for cancer, noncancer chronic and/or acute effects, and whether the substances were evaluated for noninhalation exposure pathways.

Table 1-1 Substances Evaluated for CO Boilers

Substance	CAS	Cancer	Chronic	Acute	Multipathway
Acetaldehyde	75070	Yes	Yes	No	No
Aluminum	7429905	No	No	No	No
Ammonia	7664417	No	Yes	Yes	No
Anthracene	120127	No	No	No	No
Arsenic	7440382	Yes	Yes	Yes	Yes
Barium	7440393	No	No	No	No
Benzene	71432	Yes	Yes	Yes	No
Cadmium	7440439	Yes	Yes	No	Yes
Carbon disulfide	75150	No	Yes	Yes	No
Carbon tetrachloride	56235	Yes	Yes	Yes	No
Chromium	7440473	No	No	No	No
Chromium VI	18540299	Yes	Yes	No	Yes
Cobalt	7440484	No	No	No	No
Copper	7440508	No	Yes	Yes	No
Di(2-ethylhexyl) phthalate	117817	Yes	Yes	No	Yes
Dibutyl phthalate	84742	No	No	No	No
Dichlorofluoromethane {Freon 12}	75434	No	Yes	No	No
Diethyl phthalate	84662	No	No	No	No
Fluorene	86737	No	No	No	No
Hydrochloric acid	7647010	No	Yes	Yes	No
Lead	7439921	Yes	No	No	Yes
Manganese	7439965	No	Yes	No	No

Table 1-1 Substances Evaluated for CO Boilers (continued)

Substance	CAS	Cancer	Chronic	Acute	Multipathway
Mercury	7439976	No	Yes	Yes	Yes
Methyl bromide {Bromomethane}	74839	No	Yes	Yes	No
Methyl chloride {Chloromethane}	74873	No	No	No	No
Methylene chloride {Dichloromethane}	75092	Yes	Yes	Yes	No
2-Methyl naphthalene	91576	No	No	No	No
Naphthalene	91203	Yes	Yes	No	No
Nickel	7440020	Yes	Yes	Yes	Yes
OCDD	3268879	Yes	Yes	No	Yes
OCDF	39001020	Yes	Yes	No	Yes
Particulate Matter	11101	No	No	No	No
Perchloroethylene {Tetrachloroethene}	127184	Yes	Yes	Yes	No
Phenanthrene	85018	No	No	No	No
Selenium	7782492	No	Yes	No	No
Silver	7440224	No	No	No	No
Toluene	108883	No	Yes	Yes	No
Trichlorofluoromethane {Freon 11}	75694	No	Yes	No	No
Vanadium	7440622	No	No	Yes	No
Xylenes (mixed)	1210	No	Yes	Yes	No
Zinc	7440666	No	Yes	No	No

The selection of substances and emission rates for sources other than the CO Boilers are discussed in Section 2.2. Table 1-2 lists the substances evaluated for Tank 12038, the Tank Fugitives and the CO Boiler Fugitives.

Table 1-2 Substances Evaluated for Waste Feed Storage Tank (Tank 12038), Tank Fugitives and CO Boiler Fugitives

Substance	CAS	Cancer	Chronic	Acute	Multipathway
1,2,4-Trimethylbenzene	95636	No	No	No	No
Benzene	71432	Yes	Yes	Yes	No
Carbon Tetrachloride	56235	Yes	Yes	Yes	No
Carbon Disulfide	75150	No	Yes	Yes	No
Di(2-ethylhexyl) phthalate	117817	Yes	Yes	No	Yes
Dibutyl phthalate	84742	No	No	No	No
Dichlorofluoromethane {Freon 12}	75434	No	Yes	No	No
Diethyl phthalate	84662	No	No	No	No
Ethyl Benzene	100414	No	Yes	No	No
Methyl bromide {Bromomethane}	74839	No	Yes	Yes	No
Methyl chloride {Chloromethane}	74873	No	No	No	No
Methylene chloride {Dichloromethane}	75092	Yes	Yes	Yes	No
Perchloroethylene {Tetrachloroethene}	127184	Yes	Yes	Yes	No

Table 1-2 Substances Evaluated for Waste Feed Storage Tank (Tank 12038), Tank Fugitives and CO Boiler Fugitives (continued)

Substance	CAS	Cancer	Chronic	Acute	Multipathway
Toluene	108883	No	Yes	Yes	No
Trichlorofluoromethane {Freon 11}	75694	No	Yes	No	No
Xylenes	1210	No	Yes	Yes	No

Table 1-3 lists the substances evaluated for the Flyash fugitives.

Table 1-3 Substances evaluated for Flyash fugitives

Substance	CAS	Cancer	Chronic	Acute	Multipathway
Aluminum	7429905	No	No	No	No
Arsenic	7440382	Yes	Yes	Yes	Yes
Barium	7440393	No	No	No	No
Beryllium	7440417	Yes	Yes	No	Yes
Cadmium	7440439	Yes	Yes	No	Yes
Chromium	7440473	No	No	No	No
Chromium VI	18540299	Yes	Yes	No	Yes
Cobalt	7440484	No	No	No	No
Copper	7440508	No	Yes	Yes	No
Lead	7439921	Yes	No	No	Yes
Mercury	7439976	No	Yes	Yes	Yes
Molybdenum trioxide	1313275	No	No	No	No
Nickel	7440020	Yes	Yes	Yes	Yes
Selenium	7782492	No	Yes	No	No
Silver	7440224	No	No	No	No
Vanadium	7440622	No	No	Yes	No
Zinc	7440666	No	Yes	No	No

Emission rates for the selected substances from the various sources are discussed in Section 2.2.

2.0 Exposure Assessment

This section describes information related to the air dispersion modeling and land use for the SMR.

2.1 Information on the Facility and its Surroundings

Name of company:	Shell Oil Products US
Address:	Shell Martinez Refinery PO Box 711 3485 Pacheco Blvd. Martinez, California 94553
Facility Contact:	Mr. Steven Overman, Senior Staff Engineer
Phone No.:	(925) 313-3281

SMR is located in Contra Costa County on the south shore of the Carquinez Strait, near the City of Martinez and north of the City of Concord. The Carquinez Strait feeds water from Suisun Bay to the San Francisco Bay and is a part of the San Francisco Bay-Delta Estuary Watershed, which receives flows from the Sacramento and San Joaquin river delta system and empties into the Pacific Ocean.

The State Water Resources Control Board (SWRCB) has designated beneficial uses of the Carquinez Strait as industrial service supply, a shipping waterway, recreation, commercial fishing, migration of aquatic organisms, spawning and fish reproduction, and an estuarine and wildlife habitat. The SWRCB does not consider the Carquinez Strait a source for the municipal drinking water supply.

The nearest fresh water body to the SMR is the Martinez Reservoir. This reservoir has the capacity for 270 acre-feet of water and is located approximately 0.2 miles south of the nearest SMR property boundary and about 0.5 miles southeast of the CO Boilers. The Martinez Reservoir is fed by the Contra Costa Canal, a 48 mile long water conveyance managed by the Contra Costa Water District (CCWD). Water from the Martinez Reservoir is pumped to the City of Martinez Water Treatment Plant. After treatment the water is supplied to the residents of Martinez as potable water.

Another fresh water reservoir, the Mallard Reservoir, is located approximately two miles east of SMR and just east of the current Tesoro refinery. The Mallard Reservoir provides raw water storage for the adjacent Bollman Water Treatment Plant, which supplies potable water to the central Contra Costa County. Water for the Mallard Reservoir is also supplied via the Contra Costa Canal and managed by the CCWD.

SMR is located in Contra Costa County, the ninth most populous county in California. The 2000 Census data indicated that total population for Contra Costa County was 948,816 persons. The US EPA Environmental Compliance History Online (ECHO) database indicates that the population within a radius of three miles from the approximate center of the SMR is 37,092 persons and the population in a radius of one mile surrounding SMR is 6,191 persons.

2.2 Receptors and Exposure Pathways

A Tier 1 screening risk level risk assessment was conducted in accordance with OEHHA (2003). Risk calculations were conducted using the Hot Spots Analysis and Reporting Program (HARP) software (CARB,

2005). Tier 1 is a standard point-estimate approach using the recommended exposure parameters provided in the guidance. According to the guidance, a minimum of three receptors are evaluated; these are:

1) the Point of Maximum Impact (PMI),

2) the Maximally Exposed Individual Resident (MEIR), and

3) the Maximally Exposed Individual Worker (MEIW).

The PMI is defined as the receptor point with the highest acute, chronic or cancer health impacts outside the facility boundary. The MEIR is defined as the existing off-site residence with the highest acute, chronic or cancer health impacts. The MEIW is defined as the highest acute, chronic, or cancer health impacts at an existing off-site workplace. In addition to these receptors, the New Vistas Christian School (NVCS) and the Kaiser Permanente Martinez Medical Center were evaluated as sensitive receptor locations. For cancer risk estimates, the PMI/MEIW/Sensitive Receptor is located at the NVCS, 68 Morello Avenue, in Martinez. A residence is located very close to the PMI so it was assumed that the MEIR is also at the same location. The PMI, MEIR, MEIW, and sensitive receptor for chronic non-cancer risk are the same as those for cancer risk. The acute risk PMI is located on a hill to the west-northwest of Alhambra High School (150 E Street). There are buildings nearby that could be a residence or business so it was conservatively assumed that the MEIR and MEIW for acute risk are also at this location. The sensitive receptor for acute non-cancer risk is the Kaiser Permanente Martinez Medical Center located at 200 Muir Avenue.

The exposure pathways evaluated depend on the specific substance and specific receptor. OEHHA (2003) guidance states that the inhalation pathway is evaluated for all substances. A small subset of substances is subject to deposition on to the soil, plants, and water bodies. These multipathway substances need to be evaluated by the appropriate noninhalation pathways, as well as by the inhalation pathway. These substances include select SVOCs and metals. Multipathway substances evaluated in this analysis include detected dioxins (OCDD and OCDF), PAHs and metals listed in OEHHA (2003) (arsenic, beryllium, cadmium, chromium, lead, mercury and nickel).

For the MEIR, relevant exposure pathways are:

- Inhalation
- Soil ingestion and dermal contact
- Plant ingestion
- Drinking water ingestion
- Fish ingestion
- Mother's milk ingestion (specifically for dioxins)

Beef, dairy, poultry, and egg ingestion are not viable exposure routes because there are no significant sources of these operations impacted by the CO Boiler emissions (Bechtel, 2000). It is assumed that off-site residents could have backyard gardens, which could receive depositions of SVOCs and metals emitted from the facility. The default equations provided in the HARP model (CARB, 2005) were used to estimate uptake into plants through direct deposition onto the surface and absorption through the root system.

The drinking water ingestion pathway was also evaluated in the previous risk assessment (Bechtel, 2000), which considered the Martinez reservoir for this pathway. This reservoir has the capacity for 270 acre-feet of water and is located approximately 0.2 miles south of the nearest SMR property boundary and about 0.5 miles southeast of the CO Boilers. The Martinez Reservoir is fed by the Contra Costa Canal, a 48 mile long water conveyance managed by the Contra Costa Water District (CCWD). Water from the Martinez Reservoir is pumped to the city of Martinez Water Treatment Plant. After treatment the water is supplied to

the residents of Martinez as potable water. The default equations listed in CARB (2005) were used to estimate deposition onto the Martinez Reservoir.

Similar to the previous risk assessment (Bechtel, 2000), the HRA considered that people living in the area could consume fish from the Carquinez Strait. While it is unlikely that emissions from the CO Boilers could result in fish tissue concentrations significantly higher than existing background levels, this pathway cannot be ruled out and was evaluated in accordance with OEHHA (2003). The Carquinez Strait feeds water from Suisun Bay to the San Francisco Bay and is a part of the San Francisco Bay-Delta Estuary Watershed, which receives flows from the Sacramento and San Joaquin river delta system and empties into the Pacific Ocean. The State Water Resources Control Board (SWRCB) has designated beneficial uses of the Carquinez Strait as industrial service supply, a shipping waterway, recreation, commercial fishing, migration of aquatic organisms, spawning and fish reproduction, and an estuarine and wildlife habitat. CARB (2003) provides default equations to estimate facility deposition onto a surface water body, and compound-specific bioaccumulation factors to estimate compound concentrations in fish tissue resulting from estimated concentrations in surface water.

As a conservative measure, it was assumed that the PMI and sensitive receptor are also exposed through the same pathways as the MEIR. Therefore, the cancer and chronic non-cancer risk estimates for these receptors are the same.

In accordance with OEHHA (2003), relevant exposure pathways for the MEIW are:

- Inhalation
- Soil ingestion and dermal contact

The noninhalation pathways were evaluated only for the multipathway substances, such as SVOCs and metals.

Substance concentrations were calculated in environmental media including air, soil, water, plants and animal products. The HARP software was used to estimate these concentrations, and conduct risk calculations for the selected receptors (CARB, 2005) in a Tier 1 assessment.

2.3 Emission Inventory

2.3.1 Emission Sources

The permitted units at the facility include the three CO Boilers and Tank 12038. A former hazardous waste unit, the Biotreater, no longer receives hazardous waste and DTSC previously agreed to a delay of closure. Similar to the previous HRA (Bechtel, 2000), Biotreater emissions were not included in this HRA. Hazardous waste combustion in the CO Boilers results in combustion by-products being emitted from the three stacks. In addition to the stack sources, ancillary sources also release air emissions. The ancillary emission sources include the waste feed storage tank (Tank 12038), fugitive emissions from process equipment (pumps, valves, flanges, etc.) and ash handling.

2.3.1.1 CO Boilers

SMR operates three CO boilers that are of identical design and operation. The purpose of the CO boilers is to recover energy in the form of steam from several process streams that are generated within the refinery. The boilers are each capable of producing 150,000 pounds per hour (lb/hr) of steam at 650 pounds per square inch, gauge (psig) pressure and 750°F. They are designated as sources S1507, S1509 and S1512 with the Bay Area Air Quality Management District (BAAQMD). Each boiler is a forced draft boiler and is operated continuously. Alcorn Combustion Manufacturing Company built the three boilers on the basis of a single design, without a model number.

The CO Boilers burn three gaseous fuels and one waste feed stream. The gaseous fuels which are normal byproducts of refinery processes are: Catalytic Cracking Unit (CCU) regenerator off gas; Flexigas® from the Flexicoker unit; and refinery fuel gas which contains gaseous hydrocarbon fractions from various refinery processes and is similar to natural gas. In addition, the CO Boilers receive and destroy wastewater treatment sludge that is generated at the SMR. This waste feed stream is a mixture of nonhazardous waste biosolids from the Effluent Treating Plant and dissolved nitrogen flotation (DNF) solids, which are a listed hazardous waste. SMR had been burning the wastewater solids in the CO Boilers prior to establishment of the RCRA hazardous waste program. These units became subject to Part B permitting when the US Environmental Protection Agency designated such wastewater solids as a hazardous waste.

The CO Boilers are well instrumented and air emissions from the CO boilers are tightly controlled. Each boiler is equipped with an automatic waste feed cutoff (AWFCO) system to prevent waste from being injected into the firebox when the boiler is running outside of permitted operating conditions. When a shutoff trip is activated, the waste feed shutoff valve closes quickly (there is approximately a three second delay) to stop the waste flow. Fuel, offgas, and air continue flowing into the firebox, and the boiler continues operating in a normal fashion. When operating conditions in the boiler have returned to within the permit limits, waste feed is again introduced into the firebox by resetting the solenoid that opens the shutoff valve and adjusting the flow controller to the desired flow.

Each of the three CO Boilers utilizes an electrostatic precipitator (ESP) to control particulate matter emissions. NO_X emissions are controlled by regulating CO Boiler operating conditions and by injecting urea downstream of the firebox in the heat recovery section. The urea reduces NO_x emissions by converting them to nitrogen.

The boiler operator inspects the boiler at least daily for fugitive emissions, leaks, spills, and signs of wear or tampering. Any leak or spill is cleaned up, and any emission point or worn equipment is corrected as soon as possible. Incidents and abnormal inspection results are noted in the operating log.

The boiler operator and utilities board operator attend to the boiler operation on a full time basis. They continuously check the operating data and make any necessary adjustments in control set points. Boiler operating data is collected and retained by the process control computer or strip charts.

In the event that an emergency shutdown of the boiler is initiated, the AWFCO system is activated and flow of waste feed is stopped immediately. Fuel and air are also shut off. Regenerator off gas will continue moving through the boiler and exhaust gas control system until the operator diverts the gas to the other two boilers.

The boiler is not equipped with a bypass (dump) stack. However, under extreme circumstances, regenerator off gas may be diverted upstream of the boiler to a bypass stack. Any leak or spill of waste feed and any effects on personnel or surroundings is reported to the appropriate Agencies, as required. Any leak or spill is promptly cleaned up.

2.3.1.2 Tank 12038

Tank 12038 is used to temporarily store the mixture of the hazardous waste DNF solids and the non-hazardous biosolids. Tank 12038 is a carbon steel double-walled tank with overall dimensions of 20 feet diameter and 20 feet high. The primary tank has a capacity of 47,750 gallons and the outer secondary containment tank has a capacity of 51,270 gallons. The tank system consists of a leak detection system, a nitrogen purge system, a vent absorber for odor and emissions control, a level indicator and alarm system, a mixer, flame arrestor, an overflow sump, and associated pumps, pipes, valves, and flanges.

2.3.1.3 Waste Feed Stream

The waste feed stream burned directly in the burners is a mixture of waste DNF solids and biosolids from the SMR Effluent Treatment Plant, which is a biological oxidation process. The DNF solids are a listed RCRA

hazardous waste and have been assigned a Federal RCRA waste code of K048 and a California waste code of CWC 222. The biosolids stream is a non-hazardous waste.

2.3.2 Emission Rates

Long-term average emission rates and maximum short-term emission rates of substances emitted from the CO Boilers, Tank 12038, process equipment, and ash handling are presented in Tables A-1 and A-2 in Appendix A.

2.3.2.1 CO Boiler Stack Emissions

The substances evaluated in this HRA for the CO boilers were identified from the recent Trial Burn results (ENSR, 2006) for Condition 2, which represents the unit under normal operating conditions. Substances detected in at least one of the three runs in Condition 2 of the Trial Burn were selected for evaluation for the CO Boilers. Substances that were not detected in any of the three runs were not evaluated for the CO Boilers, in accordance with the accepted Protocol (ENSR, 2005). The annual average CO Boiler stack emission rates were estimated to be the maximum substance emission rate value from all three runs (Table A-1).

The maximum short-term (1-hour) average emission rates presented in Table A-2 are maximum rates expected during upsets. Emission rates during upsets are assumed to be 10 times greater than emissions measured during Condition 2 of the Trial Burn, which represents normal operating conditions. This approach was used in the previous risk assessment (Bechtel, 2000). The CO Boilers are equipped with an automatic waste feed cut-off system that will automatically shut off the hazardous waste feed to each boiler based on DTSC permit specified criteria. Therefore, it is very unlikely that maximum short-term emissions could be 10 times the normal emissions. However, lacking any other guidance on this issue, the HRA will conduct a conservative assessment with the assumption that maximum short-term emissions are 10 times the normal emissions.

In addition to the target analytes, the Trial Burn results also list Tentatively Identified Compounds (TICs) in each run. These TICs are listed in Table 2-1. For the volatiles, there were no detected TICs or they were listed as 'unknown'. For the semi-volatiles, some TICs were identified (Table 2-1). In some cases, a TIC was identified as a target volatile, such as toluene or ethylbenzene. The VOC analytical results were used to evaluate these compounds. The other TICs listed generally do not have published toxicity values, therefore it is not possible to evaluate them quantitatively in the HRA.

Since the three CO Boiler stacks are nearly identical, their emission characteristics are assumed to be the same.

2.3.2.2 Waste Feed Storage Tank (Tank 12038) Emissions

Emissions from the waste feed storage tank were calculated using USEPA's TANKS model. The concentrations of volatile and semi-volatile substances of the waste in Tank 12038 were taken from analyses of the waste samples collected during Condition 2 of the Trial Burn. The highest reported concentration of each substance was used. For analytes that were not detected above reporting limits in any of the samples but that were present in the CO Boiler stack emissions, the concentration was assumed to be one-half the reporting limit. Analytes that were not detected in the waste and were not present in the stack emissions were assumed not to be present in the waste (Tables A-1 and A-2 in Appendix A).

2.3.2.3 Process Equipment Fugitive Emissions Associated With Tank 12038 and the CO Boiler Feed System

Process equipment includes components such as valves, flanges, pumps, compressors, etc. Process equipment fugitives are grouped into two areas; at Tank 12038 and at the CO Boiler feed system. Total VOC

Table 2-1 Semi-volatile Tentatively Identified Compounds (TICS) Identified in Trial Burn Condition 2

Analyzed	Method	Component	CAS	Result	Run Number	Units
6/21/2006	8270C	Benzene, 1,3-dimethyl-	108383	15	R1-BH	ug
6/21/2006	8270C	Cyclohexasiloxane, dodecamethy	540976	9.2	R1-BH	ug
6/21/2006	8270C	Cyclotetrasiloxane, octamethyl	556672	31	R1-BH	ug
6/21/2006	8270C	Ethylbenzene	100414	14	R1-BH	ug
6/21/2006	8270C	Unknown		7.7	R1-BH	ug
6/21/2006	8270C	Unknown		12	R1-BH	ug
6/23/2006	8270C	Unknown		6.8	R1-COND	ug
6/21/2006	8270C	2-Pentanol, 4-methyl-	108112	55	R2-BH	ug
6/21/2006	8270C	Benzaldehyde, 4-ethyl-	4748781	6.7	R2-BH	ug
6/21/2006	8270C	Butanoic acid, methyl ester	623427	4.2	R2-BH	ug
6/21/2006	8270C	Cyclohexasiloxane, dodecamethy	540976	7.2	R2-BH	ug
6/21/2006	8270C	Cyclopentasiloxane, decamethyl	541026	7.1	R2-BH	ug
6/21/2006	8270C	Cyclotetrasiloxane, octamethyl	556672	15	R2-BH	ug
6/21/2006	8270C	Toluene	108883	1100	R2-BH	ug
6/21/2006	8270C	3-Pentanone	96220	11	R2-FH	ug
6/21/2006	8270C	Toluene	108883	1100	R2-FH	ug
6/21/2006	8270C	1,2-Benzenedicarboxylic acid,	84695	5.1	R3-BH	ug
6/21/2006	8270C	Benzaldehyde, 2-hydroxy-	90028	8.6	R3-BH	ug
6/21/2006	8270C	Benzaldehyde, 4-ethyl-	4748781	11	R3-BH	ug
6/21/2006	8270C	Cyclohexasiloxane, dodecamethy	540976	14	R3-BH	ug
6/21/2006	8270C	Cyclononasiloxane, octadecamet	556718	15	R3-BH	ug
6/21/2006	8270C	Cyclopentasiloxane, decamethyl	541026	9.1	R3-BH	ug
6/21/2006	8270C	Cyclotetrasiloxane, octamethyl	556672	30	R3-BH	ug
6/21/2006	8270C	Cyclotrisiloxane, hexamethyl-	541059	6.9	R3-BH	ug
6/21/2006	8270C	Formamide, n,n-dibutyl-	761659	5.9	R3-BH	ug
6/21/2006	8270C	Isophthalaldehyde	626197	7.6	R3-BH	ug
6/21/2006	8270C	Nonanoic acid	112050	7.5	R3-BH	ug
6/21/2006	8270C	Propylene glycol	57556	5.8	R3-BH	ug
6/21/2006	8270C	Toluene	108883	1100	R3-BH	ug
6/21/2006	8270C	Unknown		9.2	R3-BH	ug
6/21/2006	8270C	Unknown		26	R3-BH	ug
6/21/2006	8270C	Unknown		6.8	R3-BH	ug
6/21/2006	8270C	Unknown		7.3	R3-BH	ug
6/21/2006	8270C	Unknown		6.1	R3-BH	ug
6/21/2006	8270C	Vanillin	121335	9.1	R3-BH	ug
6/23/2006	8270C	Unknown		6.6	R3-COND	ug
6/23/2006	8270C	Unknown		6.6	R3-COND	ug
6/21/2006	8270C	Toluene	108883	550	R3-FH	ug

Notes:
CAS - Chemical Abstracts Service.
BH - back half
COND - condensate
FH - front half
R1, R2 and R3 - Run 1, Run 2 and Run 3.

emission rates from process equipment were calculated by multiplying the number of a specific component by the component-specific VOC emission factor. Bechtel (2000) included a count of the valves, pumps and connectors. The VOC emission factors were derived from Table IV-3a presented in CAPCOA (1995). The emission rate of a specific substance was obtained by multiplying the emission factor by the weight fraction of the specific compound measured in the waste feed. Concentrations of each substance were determined using the same procedure as used for the feed tank emissions. The highest reported concentration of each substance was used, and for analytes that were not detected above reporting limits in any of the samples but were present in the CO Boiler stack emissions, the concentration was assumed to be one-half the reporting

limit. Analytes that were not detected in the waste and were not present in the stack emissions were assumed not to be present in the waste (Tables A-1 and A-2 in Appendix A).

2.3.2.4 Ash Handling Fugitive Emissions

Combustion in the CO Boilers produces flyash. Fugitive flyash emissions can occur as the flyash is collected in the electrostatic precipitators (ESPs), transferred via conveyors to various hoppers, or as the flyash is emptied from the hopper into sling bags (which are then transported off site for disposal). The fugitive flyash emission rate is estimated by multiplying an empirical emission factor (1.07 pound per ton of flyash, as recommended in USEPA (1998)) by the highest flyash generation rate over the past three years (929.1 tons per year in 2005). An emission control efficiency of 99.5% was assumed as recommended in USEPA (1998). The method used to determine the composition of the flyash was similar to that used for organics in the waste feed, based on the analysis of a sample of flyash collected in May, 2006. The emission rates of specific substances in the flyash were estimated by multiplying the fugitive ash emission rate by the weight fraction of a particular toxic measured in the ash. For metal analytes that were not detected above reporting limits but were present in the CO Boiler stack emissions, the concentration was assumed to be one-half the reporting limit. Analytes that were not detected in the flyash and were not present in the stack emissions were assumed not to be present in the flyash (Tables A-1 and A-2 in Appendix A).

2.4 Air Dispersion Modeling

As required by CARB, the HARP model (version 1.2a, Build 23.03.27, August 2005) was used to perform the risk assessment of the trial burn emissions from the SMR facility. The ISCST3 model (version 99155) is integrated in the HARP program. Two sets of meteorological data from the Shell West and Shell East monitoring stations for 2005 were used for modeling, as these are the nearest stations to the facility. The protocol specified that each of these data sets would be run with the Urban and Rural dispersion options. Table 2-2 presents the modeling options used for the dispersion modeling performed by ISCST3 within the HARP model. These are the options specified in the protocol previously submitted to BAAQMD.

Table 2-2 Dispersion Modeling Options for ISCST3

Feature	Option Selected
Regulatory default	No
Rural-urban option	Urban and Rural
Gradual plume rise	No
Stack tip downwash	Yes
Buoyancy induced dispersion	Yes
Calms processing	No
Missing data processing	No
Terrain model	Both
Terrain heights	Elev
Terrain elevation units	Feet
Building downwash	Yes
Lowbound option	No

Determination of property boundaries, source and building locations, and elevations were imported from the previous Bechtel modeling performed in 2000. Sensitive receptor locations (schools, day care centers, hospitals, and nursing homes) were developed via internet search.

Several buildings on-site had the potential to produce wake effects that influence dispersion from the point sources. The EPA Building Profile Input Program (BPIP) inherent to the HARP model (version 95086) was used to generate building downwash parameters for the ISCST3 input file. Locations and building dimensions are included in Table C-1 in Appendix C.

The following HARP modeling options were used for the risk analysis to estimate impacts at the PMI and MEIR.

- Cancer Risk – Derived (Adjusted) Method
- Chronic Hazard Index – Derived (OEHHA) Method
- Acute Hazard Index – Refined Maximum Hourly Acute HHI

For the cancer and chronic hazard index impacts at the MEIW, the HARP modeling option "modeled GLC and default exposure assumptions" was used. The cancer potency factors and reference exposure levels (RELs) used are those listed in the HARP model.

2.4.1 Air Dispersion Modeling Results

Table D-1 in Appendix D presents the modeled ground-level concentrations of each substance for the PMI, MEIR, MEIW, the New Vistas Christian School, and the Kaiser Permanente Martinez Medical Center. The table includes the annual average concentration and the maximum one-hour concentration at each receptor. The table also presents the maximum six-hour concentration, as that is the averaging period for benzene. No substances with four-, or seven-hour averaging periods are emitted from the SMR facility. The modeling files are provided on CD in Appendix E.

3.0 Dose-Response Assessment

Substance-specific dose-response values (also called toxicity values) were identified for chronic (non cancer), cancer and acute health impacts.

Cancer health impacts - The toxicity value used to evaluate potential carcinogenic health effects resulting from long-term inhalation exposure to a substance is called an inhalation cancer potency factor. The toxicity value used to evaluate potential carcinogenic health effects resulting from long-term oral exposure to a substance is called an oral cancer potency factor. Cancer potency factors are expressed as the upper bound probability of developing cancer assuming continuous lifetime exposure to a substance at a dose of one milligram per kilogram of body weight, and are expressed in units of the inverse of milligrams of the compound per kilogram of body weight per day $(mg/kg\text{-}day)^{-1}$. Oral and inhalation cancer potency factors for the relevant substances evaluated in this risk assessment are provided in HARP (CARB, 2005).

Chronic (noncancer) health impacts - The toxicity value used to evaluate potential noncarcinogenic health effects resulting from long-term inhalation exposure to a substance is called an inhalation Reference Exposure Level (REL) and is expressed in units of ug/m^3. The toxicity value used to evaluate potential noncarcinogenic health effects resulting from long-term oral exposure to a substance is called an oral (REL) in units of mg/kg-day. A chronic REL is a concentration or dose level at or below which no adverse health effects are expected following long-term exposure. Some of the toxic compounds have an impact on one or more target organs (the organ most likely to be affected by the compound). To calculate the total impact on a target organ, the HARP model summed the HI for each compound that affects that organ to determine a total HI. Chronic RELs for substances evaluated in this risk assessment are provided in HARP (CARB, 2005).

Acute health impacts - Potential risks due to short-term inhalation exposure (such as respiratory or irritant health effects), in addition to the more commonly evaluated chronic risks to human health discussed above, were evaluated in the HRA. A screening level evaluation of short-term health effects was conducted by comparing predicted maximal short-term air concentrations against acute RELs. Acute RELs for substances evaluated in this risk assessment are provided in HARP (CARB, 2005).

4.0 Risk Characterization

The risks characterized by this HRA are presented in this Section. Appendix B shows cancer and noncancer risk estimates based on substance and pathway. HARP model output files may be found on the CD included as Appendix E.

4.1 Receptors

A 100-meter grid spacing was used for the property boundary. In addition, grid receptors at 500-meter spacing were used out to a distance of 3,500 meters to the south and 1,000 meters to the north. Grid receptors at 1,000-meter spacing were used out to a distance of 7,000 meters to the north. Additional receptors were placed at the nearest residence and at 31 nearby sensitive receptors, including the nearest school location and the two nearest workplace locations. The cancer risk, chronic hazard index, and acute hazard index are quantified at each of the property boundary, grid, residential and sensitive receptors.

4.2 Cancer Risk

Cancer risks are estimated as the upper-bound likelihood, over and above the background cancer rate, that a receptor will develop cancer in his or her lifetime as a result of exposure to a compound in environmental media at the site. This likelihood is a function of the lifetime average daily dose of a compound (LADD) multiplied by the Cancer Slope Factor (CSF) for that compound. The cancer risk value is expressed as a probability of somebody getting cancer (e.g., $1x10^{-6}$, or one in one million).

Table 4-1 below and Table B-1 in Appendix B present the locations and cancer risk for the offsite point of maximum impact (PMI), the maximum exposed individual resident receptor (MEIR), and the maximum exposed individual worker (MEIW). Cancer risk is also presented for the New Vistas Christian School (NVCS), a nearby sensitive receptor. For the PMI, MEIR, and sensitive receptor, cancer risk is calculated on a 70-year, 30-year basis, and on a 9-year basis for both child and adult. These are essentially the same receptor since they are at the same location and evaluated for the same exposure pathways. Risk for the MEIW is calculated on a 40-year exposure basis. All receptor locations are Universal Transverse Mercator (UTM) (zone 10) using the NAD27 datum.

Table 4-1 Cancer Risk Summary

	Location, UTM		Cancer Risk (per Million)				
	East (m)	North (m)	70-Yr	30-Yr	9-Yr (Adult)	9-Yr (Child)	40-Yr (Wkr)
PMI	578,889	4,206,946	0.795	0.405	0.121	0.196	N/A
MEIR	578,889	4,206,946	0.795	0.405	0.121	0.196	N/A
MEIW	578,889	4,206,946	N/A	N/A	N/A	N/A	0.163
NVCS	578,889	4,206,946	0.795	0.405	0.121	0.196	N/A

The PMI/MEIW/Sensitive Receptor is located at the New Vistas Christian School (NVCS), 68 Morello Avenue, in Martinez. A residence is located very close to the PMI so it was assumed that the MEIR is also located at this receptor.

Table B-2 in Appendix B presents the 70-year cancer risk for the above receptor in more detail, indicating the contribution to cancer risk from each substance and from each emission source. Chromium (VI) is the principal substance driving the cancer risk, followed by arsenic.

4.3 Noncancer Risk

For chronic (non cancer) risk estimates, a Chronic Average Daily Dose (CADD) is calculated that averages a receptor's exposure dose over the exposure duration. The potential risk of adverse non-carcinogenic health effects is estimated for each receptor by comparing the CADD for each compound with the chronic RELs for that compound. The resulting ratio, which is unitless, is known as the Hazard Quotient (HQ) for that compound. For each receptor, the HQs are summed to obtain the Hazard Index (HI). The estimated HI for each receptor is compared to an acceptable HI of 1. Acute risks are estimated by comparing the maximum 1-hour air concentrations to acute RELs.

Table 4-2 below and Table B-1 in Appendix B present the locations and chronic and acute health hazard index (HHI) for the PMI, the MEIR, MEIW, and the NVCS and Kaiser Permanente Martinez Medical Center (KPMMC) sensitive receptors. All receptor locations are Universal Transverse Mercator (UTM) (zone 10) using the NAD27 datum.

Table 4-2 Non-Cancer Risk Summary

	Chronic Non-Cancer Risk			Acute Non-Cancer Risk		
	Location, UTM		HHI	Location, UTM		HHI
	East (m)	North (m)		East (m)	North (m)	
PMI	578,889	4,206,946	0.014	575,200	4,206,700	0.143
MEIR	578,889	4,206,946	0.014	575,200	4,206,700	0.143
MEIW	578,889	4,206,946	0.009	575,200	4,206,700	0.143
NVCS/KPMMC	578,889	4,206,946	0.014	578,076	4,205,352	0.070

Tables B-3 through B-5 in Appendix B present the chronic and acute non-cancer risk for each of the above receptors in more detail, indicating the contribution to risk from each substance, primary target organs, and from each emission source. Mercury and hydrochloric acid drive the chronic non-cancer health risk. Ammonia and arsenic drive the acute non-cancer health risk.

Figures 1 and 2 are scaled aerial photographs of the facility and immediate surroundings, showing the property boundaries and the receptor grid. Figure 3 shows the locations of the PMI, MEIR, MEIW, and the NVCS and KPMMC sensitive receptors.

4.4 Population Exposure

OEHHA (2003) recommends developing population level cancer and noncancer risk estimates based on the latest available census results. However, no population centroids are predicted to have a cancer risk greater than 1 per million. The chronic or acute non-cancer hazard indices are below 1.0. Therefore population level risks were not estimated.

4.5 Discussion of Potential Ecological Impacts

As discussed in Bechtel (2000), an ecological impact analysis was performed as part of the 1989 CO Boiler HRA (Shell, 1989).

4.5.1 Description of environment

As stated in Shell (1989), there is no significant habitat for vegetation or wildlife on the site of the CO Boilers since it is mostly graded, paved, covered with gravel, or developed. Small areas of the Complex are covered with grass, ornamental trees and shrubs. Vegetation and wildlife habitat found in the vicinity of the CO Boilers consist of open water areas, uplands and wetlands.

Open water areas – Open water areas in the site vicinity include the Carquinez Strait and Suisun Bay. The Carquinez Strait and Suisun Bay contain typical aquatic plants and fish species. These open water areas provide valuable habitat for water birds. Open water areas are usually devoid of rooted aquatic plants, and generally contain free-floating algae and phytoplankton (Shell, 1989). Nearby drinking water reservoirs include the Martinez Reservoir and Mallard Reservoir. These reservoirs are used for drinking water.

Wetlands – Wetlands are located to the northwest and north of the site. According to the California Department of Fish and Game's Natural Diversity Data Base, the marsh about 5,000 feet north of the site is delineated as Coastal Brackish Marsh. The marsh located about 5,000 feet northwest of the boilers is considered Northern Coastal Salt Marsh. The marsh located more inland, about 4,000 feet to the northeast, is a freshwater marsh. Northern Coastal Salt Marsh is a highly productive environment consisting of herbaceous and somewhat shrubby, salt-tolerant plant species, which thrive in water (Shell, 1989).

Uplands – The uplands of the inland areas east and northeast of the site (such as Zinc Hill) consist of non-native grasses. Annual grassland cover consists of common introduced weedy forbs and grasses, such as barley, wild oats, foxtail and various thistles. Higher ground along waterways and marshes contains willow trees or shrubs and blackberry.

4.5.2 Potential ecological impacts

It was not possible to conduct a quantitative ecological screening evaluation since HARP does not include an ecological risk component, and does not provide estimated soil or surface water concentrations as output from the model. The Shell (1989) ecological evaluation showed that substance concentrations in various media (air, soil and water) were well below screening level concentrations. The updated emissions data used in this HRA resulted in lower human health risk estimates than were calculated in Bechtel (2000), therefore it is likely that the ecological impacts are also lower than earlier estimates.

4.6 Uncertainty Analysis

The results shown in this report are based on a number of assumptions required to be used by the regulatory agency. Because all facilities are required to make assumptions according to the same guidelines, these results are at best useful as a yardstick for comparing relative risk from one facility to another. Because of the uncertainty in many important assumptions, the results shown are not accurate for predicting actual risk in absolute numbers and should not be used as such. The OEHHA Guidelines caution any users of these results as follows:

"There is a great deal of uncertainty associated with the process of risk assessment. The uncertainty arises from lack of data in many areas necessitating the use of assumptions. The assumptions used in these guidelines are designed to err on the side of health protection in order to avoid underestimation of risk to the public. Sources of uncertainty which may either overestimate or underestimate risk include: 1) extrapolation of toxicity data in animals to humans, 2) uncertainty in the estimation of emissions, 3) uncertainty in the air dispersion models, and 4) uncertainty in the exposure estimates." (OEHHA 2003, page 1-4)

"The quantification of each uncertainty applied in the estimate of cancer potency is itself uncertain. Thus, risk estimates generated by an HRA should not be interpreted as the expected rates of disease in the exposed population but rather as estimates of potential risk, based on current knowledge and a number of assumptions. Additionally, the uncertainty factors integrated within the estimates of noncancer RELs are meant to err on the

side of public health protection in order to avoid underestimation of risk. Risk assessment is best used as a ruler to compare one source to another and to prioritize concerns. Consistent approaches to risk assessment are necessary to fulfill this function." (OEHHA, 2003, page 1-5)

4.7 Conclusions

The following is a summary of the predicted effects from the SMR facility:

- Maximum cancer risk at the receptor with maximum exposure is 0.79 per million for a 24-hour, 70-year exposure. The PMI is located at the New Vistas Christian School (NVCS).
- Maximum cancer risk at the worker receptor with the maximum exposure is 0.16 per million. The MEIW is at the New Vistas Christian School (NVCS).
- Maximum cancer risk at the residential receptor with maximum exposure is 0.79 per million for a 24-hour, 70-year exposure. The MEIR is located near the New Vistas Christian School (NVCS).
- Maximum chronic HI is 0.014. The PMI is located at the New Vistas Christian School (NVCS).
- Maximum chronic HI at the MEIW is 0.009. The MEIW is at the New Vistas Christian School (NVCS).
- Maximum chronic HI at the MEIR is 0.014. The MEIR is located near New Vistas Christian School (NVCS).
- Maximum acute HI is 0.143. The PMI is located on a hill to the west-northwest of Alhambra High School.
- Maximum acute HI at the MEIW is 0.143. The MEIW is located on a hill to the west-northwest of Alhambra High School.
- Maximum acute HI at the MEIR is 0.143. The MEIR is located on a hill to the west-northwest of Alhambra High School.
- Predicted cancer risk and chronic and acute non-cancer risks at all off-site receptors are below acceptable thresholds and do not trigger public notification requirements.

5.0 References

Bechtel. 2000. Martinez Refining Company. CO Boiler Health Risk Assessment. Bechtel Corporation, San Francisco, California. June 2000.

CAPCOA. 1995. Revised 1995 EPA Correlation Equations and Factors for Refineries and Marketing Terminals.

CARB 1997. Emission Inventory Criteria and Guidelines for the Air Toxics "Hot Spots" Program. Appendix A-I. Revised 1997. California Air Resources Board. July 1997.

CARB 2005. HotSpots Analysis and Reporting Program (HARP), Version 1.2a. California Air Resources Board. Updated August, 2005.

ENSR 2005. Protocol for the CO Boiler Health Risk Assessment. Shell Oil Products U.S. Inc., Shell Martinez Refinery. November 2005.

ENSR 2006. Trial Burn Report for CO Boiler No. 2. Prepared for Shell Martinez Refinery, Martinez, California.

MRC. 1998. Martinez Refining Company. AB-2588 Health Risk Assessment. Submitted to the Bay Area Air Quality Management District. Prepared by Bechtel Corporation. October.

OEHHA 2003. Air Toxics Hot Spots Program Risk Assessment Guidelines, The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments, Office of Environmental Health Hazard Assessment. August 2003.

Shell. 1989. Environmental Analysis of the Combustion of Wastewater Treatment Sludge at the Shell Oil Company Martinez Manufacturing Complex (Volumes I and II). Prepared for the Shell Oil Company by Radian Corporation. October 16, 1989.

USEPA. 1998. Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities – Peer Review Draft. EPA530-D-98-001A. USEPA Office of Solid Waste. USEPA Region 6.