Expert Report of Greg Karras
Communities for a Better Environment (CBE)
24 June 2019

Regarding the
Draft Integrated General Reevaluation Report and Environmental Impact Statement, San Francisco Bay to Stockton, California Navigation Study, for the
San Francisco Bay to Stockton, California Navigational Improvement Project

Lead NEPA Agency
Department of the Army
U.S. Army Corps of Engineers
Jacksonville District

I, Greg Karras, declare and say:

I reside in unincorporated Marin County and am employed as a Senior Scientist for Communities for a Better Environment (CBE). My duties for CBE include technical research, analysis, and review of information regarding industrial health and safety investigation, pollution prevention engineering, pollutant releases into the environment, and potential effects of environmental pollutant accumulation and exposure.

Qualifications

My qualifications for this opinion include extensive experience, knowledge, and expertise gained from more than 35 years of industrial and environmental health and safety investigation in the energy manufacturing sector, including petroleum refining, and in particular, refineries in the State of California.

Among other assignments, I served as an expert for CBE and other non-profit groups in efforts to prevent pollution from oil refineries, to assess environmental health and safety impacts at

refineries, to investigate alternatives to fossil fuel energy, and to improve environmental monitoring of dioxins and mercury. I served as an expert for CBE and the City and County of San Francisco and local groups in efforts to replace electric power plant technology with reliable, least-impact alternatives.

I have served as an expert for CBE and other groups participating in environmental impact reviews of petroleum projects, including, among others, the "Chevron Richmond Refinery Modernization Project," the "Contra Costa Pipeline Project," the "Phillips 66 Propane Recovery Project" and the "Shell Greenhouse Gas Reduction Project" in the County of Contra Costa, the "Valero Crude by Rail Project" in Benicia, the "Phillips 66 Rail Spur Extension and Crude Unloading Project" in Arroyo Grande, and the "Keystone Pipeline Project" Phase I. My work as an expert for CBE and other non-profit groups in a 2007–2008 review of the proposed Chevron Richmond refinery "Hydrogen Renewal Project" was cited by the Appeals Court in support of CBE's subsequent successful advocacy regarding that proposed project (*See CBE v. City of Richmond* 184 Cal_Ap.4th).

During 2014 I served as an expert for the Natural Resources Defense Council in research on the effects of changes in oil feedstock quality on refinery air emission rates, specifically, on estimating toxic and particulate emissions from U.S. refinery cracking and coking of low quality, bitumen-derived "tar sands" oils.

As part of CBE's collaboration with the refinery workers union United Steelworkers (USW), community-based organizations, the Labor Occupational Health Program at UC Berkeley, and environmental groups, I served as an expert on environmental health and safety concerns shared by refinery workers and residents regionally. In this role I served as CBE's representative in the Refinery Action Collaborative of Northern California.

I serve as an expert for CBE and other groups in the development of emission control and reduction rules to be considered for adoption by the Bay Area Air Quality Management District.

I served as one of CBE's experts supporting informal state-level climate and energy planning discussions with California State agencies and the Office of Governor Edmund G. Brown. In this capacity I participated in meetings organized and attended by Governor Brown's senior

advisors on 12 July 2013 in Oakland, California and on 13 April 2015 and 4 December 2016 in Sacramento, California.

I authored a technical paper on the first publicly verified pollution prevention audit of a U.S. oil refinery in 1989. I co-authored the first comprehensive analysis of regional oil refinery selenium discharge trends in 1994. From 1992–1994 I authored a series of technical analyses and reports that supported the successful achievement of cost-effective pollution prevention measures at 110 industrial facilities in Santa Clara County. I authored the first comprehensive, peer-reviewed dioxin pollution prevention inventory for the San Francisco Bay, which was published by the American Chemical Society and Oxford University Press in 2001. I co-authored an alternative energy blueprint, published in 2001, that served as a basis for the Electricity Resource Plan adopted by the City and County of San Francisco in 2002. In 2005 and 2007 I co-authored two technical reports that documented air quality impacts from flaring by San Francisco Bay Area refineries and identified feasible measures to prevent these impacts.

My more recent publications include the first peer reviewed estimate of combustion emissions from refining lower quality oil to be based upon data from U.S. refineries in actual operation, which was published by the American Chemical Society in the journal *Environmental Science & Technology* in 2010. I authored a follow up to this study that focused on California refineries, which was peer reviewed and published by the Union of Concerned Scientists in 2011. I authored and presented invited testimony regarding *inherently safer systems* requirements at the U.S. Chemical Safety Board's 19 April 2013 public hearing on the 2012 Chevron Richmond refinery fire. I authored a January 2015 research report on toxic and aerosol emissions from U.S. refinery cracking and coking of bitumen-derived "tar sands" oils. I co-authored a July 2017 CBE technical report on refinery emissions observed under the State's cap-and-trade program from 2013–2015.

From July 2017 to the present I have been the project manager and lead researcher for a project to investigate and report on technology pathways for health and climate protection, focused on the petroleum fuel chain, and, in particular, the geophysical, technological and social factors which govern the potential impacts and benefits of various potential future pathways.

My curriculum vitae and list of publications are appended hereto as Attachment 1.

Proposed Project EIS

Pursuant to the National Environmental Policy Act ("NEPA") the U.S. Army Corps of Engineers ("Corps") published a Draft Integrated General Reevaluation Report and Environmental Impact Statement ("EIS") for the proposed San Francisco Bay to Stockton Navigational Improvement Project ("project"). The project would physically remove benthic habitat from the northern reach of the San Francisco Bay Delta estuary ("Bay") through a process called dredging.

As currently proposed the project would dredge shipping channels in Pinole Shoal from north of Richmond to Rodeo and in Bulls Head Reach near Martinez, Benicia and Avon from a depth of 35 feet to a depth of 38 feet below mean lower low water ("MLLW") tide. The project also would dredge a rocky area west of Pinole Shoal to 43 feet below MLLW and a sediment trap at Bulls Head Reach to 44 feet below MLLW. The project would remove approximately 1.6 million cubic yards of benthic habitat in and near approximately 13.2 miles of Bay shipping channels between Richmond and Avon. Larger and more heavily laden petroleum tankers could transit the Bay between Richmond and Avon, while those petroleum tankers which now must wait for high tide would no longer need wait those long hours to transit the Bay between Richmond and Avon, as an intended result of the project.

Scope of Review

The project would deepen shipping lanes used by four of the five major petroleum refineries on the Bay to import crude oil and export refined products. Removing these physical barriers to shipping would result in cost-savings to the refiners which the EIS estimates at $11,312,000 per year, and the public rather than the refiners would pay for this at an estimated annual cost of $3,596,000/year. (EIS at D-22, D-24.) These figures from the EIS exclude additional potential benefits to refiners associated with project-induced growth in their petroleum tanker cargoes. Thus, the project could represent a total subsidy to the owners of these four oil refineries and their support infrastructure facilities of at least $14,908,000/year.

The EIS concludes that the project would not result in any change in future volumes of crude and refined products shipped through the Bay, any significant climate impact, or any significant Environmental Justice impact. I have been asked to review the sufficiency of the EIS with respect to these conclusions.

Short Answer

Though less severe than the bottleneck presented by mountainous terrain that largely isolates the West Coast oil industry from that east of the Rocky Mountains, underwater shallows that restrict shipping to four of the five major refineries on the Bay restrict these refineries' import/export capacity. The transport restriction—which the project is intended to and would de-bottleneck significantly—is exacerbated by price differences between California and export markets for the refiners' products and explains much or most of the relatively low capacity utilization of the project-affected refiners. Thus, by de-bottlenecking import/export shipping and subsidizing that benefit to the refiners the project would very likely enable full, or at least increased, use of the refineries' currently unused capacity to boost sales in expanding foreign markets and to import crude oil for that increased production.

Petroleum fuel chain emissions associated with oil refinery production increments that would result from the project have the potential to increase climate, air quality, and Environmental Justice impacts significantly. However, although the Corps could have evaluated the available data documenting these impacts, the EIS does not identify or disclose these impacts. Therefore, the EIS is insufficient as an informational document.

Export-related Petroleum Volumes Shipped

U.S. West Coast petroleum supply and disposition data reported by the U.S. Energy Information Administration ("EIA") are appended hereto as Attachment 2. Table 1 summarizes relevant data from Attachment 2. This table compares these data over ten-year periods ending in 2008 and 2018 in order to more clearly distinguish long-term trends from year-to-year variability which may mask the long-term trends.

Table 1. U.S. West Coast refinery production, domestic demand, and refinery exports to foreign nations of total finished petroleum products: ten-year periods ending in 2008 and 2018

	West Coast Production (billions of barrels)	West Coast Demand (billions of barrels)	Exports from West Coast (billions of barrels)
Ten years ending on 31 Dec 2008	10.683	10.892	0.802
Ten years ending on 31 Dec 2018	10.931	10.456	1.186
Percentage change	+ 2.3 %	– 4.0 %	+ 48 %

barrel: 42 U.S. gallons. Imports & stock changes (not shown) balance supply/demand. Data from Attachment 2.

Exports of West Coast refinery production to foreign countries have increased with refinery production as West Coast demand for finished petroleum products declined. *See* Table 1. West Coast exports increased at a rate of 4.4%/year since 2008, as compared with the 2.4% rate the Corps projected for future Bay Area refinery exports based on nation-wide data (EIS at D-15).

An EIA report on West Coast transportation fuel markets is appended hereto as Attachment 3.

Since the West Coast oil industry is largely isolated from that in the rest of the U.S. by the logistical difficulties and related transport costs associated with major mountain ranges (*see* Attachment 3), differences between nation-wide and regional conditions, and the reliance on national data in the EIS, could explain the lower projected exports increase given in the EIS.

San Francisco Bay Area refineries are net exporters of gasoline and diesel fuels. (Attachment 3.) Indeed, Bay Area refineries are the primary exporters of these fuels to other nations from California. (Id.)

Gasoline and diesel (# 2 distillate) price data reported by the EIA are appended hereto as attachments 4 and 5. These data are summarized in Table 2. Out of state fuel sales are price-discounted significantly compared with California refinery production sold in the state.

Table 2. Average California and other West Coast gasoline and diesel fuel prices, 2012–2018

	California ($/gallon)	Other West Coast ($/gallon)	Price discount from Calif. (% change)
Gasoline—all grades & formulations	$ 3.49	$ 3.13	– 10.3 %
Diesel — No. 2 diesel	$ 3.57	$ 3.33	– 6.7 %

Price data including taxes from attachments 4 and 5.

Additional site-specific data for petroleum supply, disposition and transport reported by the California Energy Commission ("CEC"), are appended hereto as attachments 6 and 7. Data in attachments 3, 6 and 7 show that the percentage of Bay Area refinery fuels production which is dependent upon crude imports far exceeds the percentage of these fuels that are refined here for export to other nations. Export production here relies upon crude imports.

Refinery capacity and capacity utilization data reported by the EIA and federal Clean Water Act authorities are appended hereto as attachments 8–14. Table 3 summarizes these data.

Table 3. Capacity and Utilization of Oil Refining Facilities with San Francisco Bay Marine Terminals
b/d: barrels/day (*b/d capacities shown are barrels/calendar day*)

Company	Chevron	Phillips 66	Shell	Tesoro	Valero	Total for
Location	Richmond	Rodeo	Martinez	Martinez	Benicia	project-affected
Project effect	No	Yes	Yes	Yes	Yes	oil refining
Capacity (b/d)	245,271	96,740	156,400	166,000	145,000	564,140
Utilization (b/d)	244,600	84,020	147,400	143,600	140,100	515,120
Utilization (%)	99.7 %	86.9 %	94.2 %	86.5 %	96.6 %	91.3 %
					Total West Coast refinery capacity utilization (%)	93.5 %
					Project potential increase based on West Coast capacity utilization [a]	+ 2.4 %
					Project potential increase based on SF Bay-specific capacity utilization [b]	+ 9.2 %
					Project-affected percentage of total SF Bay capacity utilization [c]	67.8 %

Capacity data for atmospheric crude distillation in b/cd from Attachment 8 except Rodeo facility capacity from Attachment 10. Utilization data for atmospheric crude distillation is the maximum 12-month average for the most recent 5 years reported, from attachments 9–13, except total West Coast utilization data are from Attachment 14.
[a] From (93.5 – 91.3) ÷ 91.3. [b] From (99.7 – 91.3) ÷ 91.3. [c] From 515,120 ÷ (515,120 + 244,600).

Despite incentives to use otherwise stranded refining capacity which exceeds domestic demand for export production, this option is limited—especially for project-affected refiners—by lower prices in export markets and higher shipping costs compared with those of competitors nearer to the export markets and less bottlenecked by geography. Even in other West Coast states, fuel prices are lower than in California. *See* Table 2. And project-affected refiners import crude to make the fuels they export, thereby in essence paying the costs of the Bay shipping bottleneck twice—first to import the raw material, then to export the refined product. Among other things, refining capacity utilization reflects these factors. Project-affected refiners' maximum sustained capacity utilization is 2.2% lower than that in the West Coast as a whole and 8.4% lower than that of the Bay Area refiner which is *not* affected by the transport bottleneck the project would alleviate. *See* Table 3.[1]

As opportunities to increase their production for domestic use supplied by pipelines, trucks, and smaller, shallower-draft vessels remain bottlenecked by limited domestic demand, project-

[1] These decrements translate to larger potential capacity utilization increments. For example, the same data supporting the –2.2% decrement (91.3% – 93.5% = –2.2%) supports the potential to increase utilization of project-affected refineries' capacity by approximately 2.4%: (93.5 – 91.3) ÷ 91.3 = 2.41.

affected refiners can be expected to use this currently stranded capacity for exports, if and when transport costs of their exports through the Bay are de-bottlenecked by the project. They could sell up to 579 million gallons more gasoline and diesel annually at the same capacity utilization the Richmond refinery has achieved. *See* Table 4. The proposition that oil companies would forgo those sales voluntarily defies belief.

Table 4. Project potential to increase oil refinery gasoline and diesel production for export

	Gasoline (millions of gallons/year)	Diesel (millions of gallons/year)
Production		
Current project-affected baseline	4,485	1,800
Potential increase, likely bound (+ 2.4 %)	108	43
Potential increase, upper bound (+ 9.2 %)	413	166

From capacity utilization of project-affected and other refineries in Table 3 and actual Bay Area yields on crude (gasoline: 56.8%, diesel: 22.8%; CEC data, Atts. 6,7). Potential increments are based on comparisons of project-affected capacity utilization with West Coast (likely bound) and Bay Area-specific (upper bound) data in Table 3.

While it is possible that some unknown factor unique to these refiners, other than this transport bottleneck, might explain their idled capacity and forgone sales, no other explanation is readily apparent, and the EIS does not disclose any such alternative explanation.

Site-specific data support the conclusion that efficient marine shipping capacity provided to refiners by the project would increase petroleum traffic through the Bay associated with refining imported crude and exporting refined products to other nations. For gasoline and diesel exports alone, Bay-specific data, where another refiner has deeper tanker access now, support a project-driven increase in this traffic of 579 million gallons/year, and West Coast data support a project-driven increase of 151 million gallons/year in this traffic. (Table 4.) These increments would be additional to the independent growth in this traffic the EIS projects.

Conclusion: Based on my review of the EIS and publicly available petroleum industry data, including site-specific and West Coast data, it is my professional opinion that the EIS is incorrect in concluding that the project would not result in any change in future volumes of crude and refined products shipped through the Bay.

Potential Climate Impacts

The petroleum fuel chain—extraction, refining, transport, and end-use fuel combustion in transportation and industry—is a sequence of interdependent steps or "links" such that the volume of oil flowing through each link in the chain is limited by the volume flowing through the links upstream and downstream. This interdependence amplifies the transport bottleneck affecting four Bay Area refineries that the project would relieve. At the same time, harmful pollutants emit from each link in the petroleum fuel chain. By relieving the bottleneck to refining for export here, the project could increase emissions from the extraction, refining, transport and end-use combustion of petroleum processed by these four refineries.

Data and analysis developed by the California Air Resources Board (ARB) to estimate the total "well-to-wheel" petroleum fuel chain emissions of carbon dioxide equivalents (CO_2e) from the extraction, refining, transport and combustion of gasoline and diesel refined in California is appended hereto as attachments 15–17.

Attachments 15–17 document petroleum fuel chain emissions associated with refined fuels estimated by the ARB based on grams of CO_2e emitted per unit of lower heating value fuel energy, measured in Megajoules (MJ), and fuel energy densities measured in MJ per gallon. These ARB factors are 100.82 g CO_2e/MJ and 119.53 MJ/gallon for refined gasoline for oxygenate blending upon delivery to blenders ("CARBOB"), yielding a full fuel chain emissions rate for CARBOB gasoline of 12.05 kg/gallon. For California refinery diesel fuel, these ARB factors are 100.45 g CO_2e/MJ and 134.37 MJ/gallon, yielding a full fuel chain emissions rate for diesel of 13.50 kg/gallon. *See* attachments 15–17.

These emission factors, applied to the project-related increases in exported gasoline and diesel volumes shown in Table 4, yield concrete estimates of foreseeable CO_2e emissions that could result from the project.

Table 5 shows the range foreign fuel export increments from Table 4 in gallons and the ARB energy density and emission factors that could be multiplied by this range of fuel volume increments to estimate potential project emissions. At the upper bound of this range, supported by Bay-specific data for refining without the shipping bottleneck the project would address,

CO_2e emissions could increase by 7.22 million tons (metric) per year. At the likely bound, supported by West Coast-specific data, emissions could increase by 1.88 million tons/year.

Table 5. Potential well-to-wheel CO_2e emissions associated with project fuel exports, in tons/year
Ton: metric ton. **g:** gram **MJ:** Megajoule (energy unit)

	Gasoline	Diesel	Gasoline and diesel
Export volume increment (gallons/year)			
Likely bound (+2.4% production vol.)	108,000,000	43,000,000	151,000,000
Upper bound (+9.2% production vol.)	413,000,000	166,000,000	579,000,000
Fuel energy density (MJ/gallon)	119.53	134.37	—
Emission factor (g CO_2e/MJ)	100.82	100.45	—
Export emissions increment (tons/year)			
Likely bound (+2.4% production vol.)	1,301,510	580,391	1,881,901
Upper bound (+9.2% production vol.)	4,977,069	2,240,579	7,217,648
Federal significance threshold used in the EIS (tons/year):			25,000

Foreign export volume increments from Table 4, based on range of project potential increments from data discussed above and Table 3. Energy densities and emission factors from attachments 15–17. Fuel chain emissions from extraction, refining, transport and end use associated with these exported fuels are shown. Federal significance threshold from EIS at 4-35.

Importantly, regardless of where in the range shown in Table 5 this potential impact of the project is realized, the emissions increment would exceed the federal climate impact significance threshold used in the EIS (25,000 tons/year) by a wide margin. Estimated petroleum fuel chain CO_2e emissions associated with project export increments are 75–289 *times* this significance threshold. This indicates that the project would result in a significant climate impact.

This 1.88–7.22 million ton/year CO_2e increment would be emitted by extracting imported crude and burning exported fuels as well as by refining and transporting petroleum here. (*See* Atts. 16, 17.) Thus, while the project could reduce vessel and tug CO_2e emissions by 132–546 tons/year here, according to the EIS (EIS at 4-36, 4-40, 4-41), it would increase CO_2e emissions outside the state. California climate policy, however, mandates minimizing this type of emission shifting, which it defines as "a reduction in emissions of greenhouse gases within the state that is offset by an increase in emissions of greenhouse gases outside the state." California Health and Safety Code §§ 38505(j), 38562(b)(8). This indicates that the project would conflict with an applicable climate protection plan, policy or regulation.

Conclusion: Based on my review of the EIS and publicly available petroleum industry data, including site-specific and West Coast data, it is my professional opinion that the EIS is incorrect in concluding that the project would not result in any significant increases in greenhouse gas emissions.

Potential Environmental Justice Impacts

Reports from academic research collaborations and from the California Office of Environmental Health Hazard Assessment that provide data and analysis regarding oil refining emissions and Environmental Justice impacts are appended hereto as attachments 18–20.

People of color are disproportionately exposed to particulate matter emissions from refineries in California and in the project area. (Atts. 18, 19.)

According to data presented in Table 2-13 of the EIS, people of color are more concentrated among residents in the project area as compared with residents in the region and state as a whole. However, the EIS concludes that the project would not result in any significant Environmental Justice impact. (EIS at 4-66.). Consequently, the EIS identifies no mitigation for any potential Environmental Justice impact. (EIS at 4-6.)

Emission inventory data for project-affected refineries that were reported by the Bay Area Air Quality Management District (BAAQMD) pursuant to the California Public Records Act are appended hereto as Attachment 21. Attachment 21 includes data for emissions from four project-affected refineries and four adjacent refinery-support facilities[2] of fine particulate matter ($PM_{2.5}$), sulfur dioxide (SO_2), oxides of nitrogen (NO_x) and carbon monoxide (CO).

$PM_{2.5}$, SO_2, NO_x, and CO co-emit with CO_{2e}. Emissions of these pollutants from refineries are strongly correlated with emissions of CO_2e from refineries. *See* Att. 20. Correlations between $PM_{2.5}$ and these other toxic combustion products with CO_2e in refinery emissions (Id.) are unsurprising, since fossil fuel combustion for process energy in refining is known to generate all of these combustion products. Nevertheless, this additional information further supports the

[2] The Phillips 66 Rodeo refinery: BAAQMD Plant A0016; Shell Martinez refinery: BAAQMD Plant A0011; Tesoro Golden Eagle Refinery: BAAQMD Plant B2758; the Valero Benicia refinery: BAAQMD Plant B2626; the Phillips 66 refinery coke calciner: BAAQMD Plant A0022; the Martinez Cogen facility: BAAQMD Plant A1820; the Air Liquide hydrogen plant: BAAQMD Plant B7419; and the Air Products hydrogen plant: BAAQMD Plant B0295.

project potential to increase harmful refinery air pollution via the same debottlenecking of refining capacity which would increase CO_2e emissions.

Project-related capacity utilization increments shown in Table 3 are applied to total current project-affected refining and support facility emissions of $PM_{2.5}$, SO_2, NO_x, and CO in Table 6.

Table 6. Current and Project-potential Particulate ($PM_{2.5}$), Sulfur Dioxide (SO_2), Nitrogen Oxides (NO_x) and Carbon Monoxide (CO) Emissions from Project-affected Refineries and Support Facilities

Values in short tons per year

	$PM_{2.5}$ (short tons/year)	SO_2 (short tons/year)	NO_x (short tons/year)	CO (short tons/year)
Total current emissions [a]	1,085.0	3,829.0	3,749.0	3,392.0
Likely bound (+2.4% production) [b]	+ 26.1	+ 92.3	+ 90.3	+ 81.7
Upper bound (+9.2% production) [b]	+ 99.8	+ 352.0	+ 345.0	+ 312.0
EIS significance threshold	+100	+100	+100	+100

(a) Mean of 2013–2014 emissions (Att. 21) from the Phillips 66 Rodeo, Shell Martinez, Tesoro Golden Eagle and Valero Benicia refineries, Phillips 66 coke calciner, Martinez Cogen, and Air Liquide and Air Products hydrogen plants. Pre-2013 emission data in Att. 21 were excluded from this estimate due to known $PM_{2.5}$ measurement problems at multiple refinery cracking and cooling units. (b) Project potential production increases by 2.4% based on West Coast capacity utilization and by 9.2% based on Bay Area-specific capacity utilization (Table 3). Significance thresholds from EIS Table 4-3.

Total current emissions from project-affected refining and support facilities shown in Table 6 were taken from the BAAQMD emission inventory. (Att. 21.) To estimate project-related emissions, capacity utilization increments calculated from data in Table 3 were applied to current emissions. For example, the $PM_{2.5}$ increase of +99.8 short tons/year shown in Table 6 would be caused by increasing project-affected capacity utilization 9.2% (based on Bay-specific data) and is calculated from current emissions (1,085 short tons/year) as $1{,}085 \bullet 0.092 = 99.82$.

At the upper bound of the project impact range (+9.2% increase), project emissions would approach or exceed the NEPA significance threshold used by the EIS for each air pollutant shown in Table 6. That significance threshold is 100 short tons/year. (EIS Table 4-3.) At 99.8 short tons per year, $PM_{2.5}$ approaches this threshold, and at 352, 345, and 312 short tons/year, respectively, SO_2, NO_x, and CO emissions would exceed this significance threshold. This indicates that the project could cause significant air quality impacts.

A report on particulate matter, a technical support document for the State Implementation Plan ("SIP") required by the federal Clean Air Act for the San Francisco Bay air basin, and an excerpt from that SIP, each authored by BAAQMD, are appended hereto as attachments 22–24.

Based on extensive research by its staff and many others worldwide, BAAQMD estimated the risk of population level all-cause mortality associated with $PM_{2.5}$—particulate matter with an aerodynamic diameter of 2.5 microns or less—in the Bay Area. (Atts. 22, 23.) $PM_{2.5}$ air pollution accounts for 1,700–3,000 premature deaths in the Bay Area annually, BAAQMD estimates. (Atts. 22, 23.) In the SIP, BAAQMD estimates that reducing Bay Area $PM_{2.5}$ emissions by 3.1 short tons per day would avert 76 premature deaths here each year. (Att. 24.)

BAAQMD's estimate that it could avert 76 deaths per year by cutting $PM_{2.5}$ emissions by 3.1 short tons per day (Id.) represents a population mortality risk of 0.0672 deaths per short ton of $PM_{2.5}$ emitted.[3] This risk factor is based on chronic (30-year) exposures, accounts for Bay Area-specific data and conditions, and is a central estimate, such that actual impacts could be somewhat more, or less, severe. (Att. 23.). Although BAAQMD uses this risk factor in annualized estimates, since it is based on data for chronic (30-year) exposures and the proposed project could operate for that duration, this report applies the risk factor in 30-year estimates.

Mortality risk associated with $PM_{2.5}$ emissions from refining facilities that the project could debottleneck can be estimated by applying the $PM_{2.5}$ risk factor discussed above to the project-driven refining emission increments taken from Table 6.

Table 7 shows this estimate calculation, applying the $PM_{2.5}$ risk factor discussed above to the emission increments in Table 6 over a 30-year period.

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[3] Based on 76 deaths/year ÷ (3.1 short tons/day • 365 days/year) = 0.0672 premature deaths/short ton emitted.

Table 7. Project Potential Increase in Premature Mortality Risk from Oil Refinery $PM_{2.5}$ Emissions: Population-level Mortality Risk Associated with $PM_{2.5}$ Inhalation Exposures Over 30 Years

$PM_{2.5}$ emissions (short tons/30 years)		
Current project-affected refining emissions rate [a]	32,550	short tons/30 years
Emission increment [b]		
Likely bound (+2.4% production increase)	783	short tons/30 years
Upper bound (+9.2% production increase)	2,994	short tons/30 years
Risk factor (deaths/short ton $PM_{2.5}$ emitted) [c]	0.0672	deaths/ton emitted
$PM_{2.5}$-associated mortality risk (deaths over 30 years)		
Current project-affected refining emissions total [a]	2,187	deaths/30 years
Impact increment [b]		
Likely bound (+2.4% production increase)	53	deaths/30 years
Upper bound (+9.2% production increase)	201	deaths/30 years

(a) Total current project-affected refining emissions from Table 6 and Att. 21. (b) Project-affected refineries production increases by 2.4% based on West Coast capacity utilization and by 9.2% based on Bay Area-specific capacity utilization from Table 3. (c) Bay Area-specific risk factor from BAAQMD (76 deaths/year averted by 3.1 tons/day $PM_{2.5}$ emission cut) and the calculation: 76 ÷ (3.1 • 365). *See* text, attachments 22–24.

As shown in Table 7, the 30-year population level risk of all-cause mortality associated with increased refinery utilization resulting from the project ranges from 53–201 premature deaths. Moreover, this impact from increased refining capacity utilization would be on top of a 30-year risk of more than 2,000 premature deaths from prolonged oil refining operations—to which the export route de-bottlenecking and subsidy provided by the project also would contribute. People of color are disproportionately represented in the project area (EIS Table 2-13) and would be exposed to this risk disproportionately (Atts. 18, 19).

Adding to the injustice, this severe and disproportionate impact could be caused by excess refinery production for export, to sell other nations fuels that communities here, Californians, and even other U.S. states, would not buy, need or use.

Along with the disproportionate impacts of these project-driven refining emissions, other pollutants from refineries and from other sources could worsen disparately severe health risks in the refinery-impacted populations as a result of the project. The potential for the project to result in larger oil spills in the northern reach of the Bay by encouraging relaxation of tanker load limits and other operational safety measures—which are required now in part because of the physical shipping constraint the project would relieve—seems apparent, and thus foreseeable.

Acute respiratory exposures of nearby residents to volatile components of the spilled oil could recur in greater magnitude. Non-volatile components of the spilled oil may bioaccumulate in the food webs of this estuary, posing increased chronic exposure health risks to people who fish the Bay for food.

It is far from clear that excess and increasing refinery $PM_{2.5}$, SO_2, NO_x, and CO emissions from increased refining operations will turn out to be the only significant and disproportionate impacts on low-income communities of color that could result from the project. This point is important as environmental injustice is often if not always a cumulative burden.

But it is clear that the project is a petroleum import/export transport route debottleneck that would compel affected refiners to ramp production as much as their competitors with deeper transport water, which could exceed NEPA air pollution significance criteria and would cause premature deaths that would occur at disproportionately higher rates in communities of color.

The local refining sector $PM_{2.5}$, SO_2, NO_x, and CO emissions, exposure, and mortality risk presented above, together with the exposure demographics documented and acknowledged in the EIS, support the conclusion that the project would have a reasonable potential to trigger at least one Environmental Justice significance threshold stated in the EIS: There is a clearly foreseeable potential for the project to result in disproportionate impacts on people of color populations which would be "high and adverse." *See* EIS significance criteria at 4-65.

Conclusion: Based on my review of the EIS and publicly available petroleum industry data, including site-specific and West Coast data, it is my professional opinion that the EIS is incorrect in concluding that the project would not result in any significant Environmental Justice impact.

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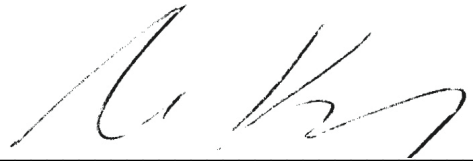
I have given my opinions on these matters based on my knowledge, experience and expertise and the data, information and analysis discussed in this report.

I declare under penalty of perjury that the foregoing is true of my own knowledge, except as to those matters stated on information and belief, and as to those matters, I believe them to be true.

Executed this 24th day of June 2019 at Richmond, California



Greg Karras

Attachments List

1. Curriculum Vitae and Publications List

2. *West Coast (PADD 5) Supply and Disposition;* U.S. Energy Information Administration: Washington, D.C. Excel file.

3. *PADD 5 Transportation Fuels Markets;* U.S. Energy Information Administration: Washington, D.C. **2015.** Report.

4. *California Gasoline and Diesel Retail Prices;* U.S. Energy Information Administration: Washington, D.C. Excel file.

5. *West Coast less California Gasoline and Diesel Retail Prices;* U.S. Energy Information Administration: Washington, D.C. Excel file.

6. *California Refinery Overview and SF Bay Area Crude Oil Slate–1;* Schremp, G. California Energy Commission: Sacramento, CA. 25 April **2016**. Presentation.

7. *California Refinery Overview and SF Bay Area Crude Oil Slate–2;* Schremp, G. California Energy Commission: Sacramento, CA. 19 October **2016**. Presentation.

8. *Refinery capacity data by individual refinery as of January 1, 2018;* U.S. Energy Information Administration: Washington, D.C. Excel file.

9. *Chevron NPDES CA0005134 Attachment F-1;* California Regional Water Quality Control Board, San Francisco Bay Region: Oakland, CA. Clean Water Act production (throughput) data.

10. *Phillips 66 NPDES CA0005053 Attachment F-1;* California Regional Water Quality Control Board, San Francisco Bay Region: Oakland, CA. Clean Water Act production (throughput) data.

11. *Shell NPDES CA0005789 Attachment F-1;* California Regional Water Quality Control Board, San Francisco Bay Region: Oakland, CA. Clean Water Act production (throughput) data.

12. *Tesoro NPDES CA0004961 Attachment F-1;* California Regional Water Quality Control Board, San Francisco Bay Region: Oakland, CA. Clean Water Act production (throughput) data.

13. *Valero NPDES CA0005550 Attachment F-1;* California Regional Water Quality Control Board, San Francisco Bay Region: Oakland, CA. Clean Water Act production (throughput) data.

14. *PAD District 5 Refinery Utilization and Capacity;* U.S. Energy Information Administration: Washington, D.C. Monthly data through March 2019. Excel file.

15. *CCR Sections 95480-95490 LCFS Tables 4 and 7–1;* California Air Resources Board: Sacramento, CA. Low Carbon Fuel Standard; look-up table and fuel densities. Regulation.

16. *Detailed CA-GREET Pathway for California Reformulated Gasoline Blendstock for Oxygenate Blending (CARBOB) from Average Crude Refined in California;* California Air Resources Board: Sacramento, CA. **2014.** Report.

17. *Detailed CA-GREET Pathway for Ultra Low Sulfur Diesel (ULSD) from Average Crude Refined in California;* California Air Resources Board: Sacramento, CA. **2014.** Report.

18. Pastor et al. *Minding the Climate Gap;* **2010.** Authors: Morello-Frosch, R. (U.C. Berkeley); Pastor, M. (U. of Southern Calif,); Sadd, J. L. (Occidental College); Scoggins, J. (U. of Southern Calif.). Report.

19. Brody, J. G., Morello-Frosch, R., Zota, A., Brown, P., Pérez, C., and Rudel, R. A., **2009**. Linking exposure assessment science with policy objectives for environmental justice and breast cancer advocacy: The Northern California Household Exposure Study. *American Journal of Public Health* **99:**(S3). DOI: 10.2105/AJPH.2008.149088.

20. OEHHA, **2017**. *Tracking and Evaluation of Benefits and Impacts of Greenhouse Gas Limits in Disadvantaged Communities: Initial Report;* Office of Environmental Health Hazard Assessment, California Environmental Protection Agency: Sacramento, CA. Report.

21. *BAAQMD Emission Inventory data;* Bay Area Air Quality Management District: San Francisco, CA. Source-specific $PM_{2.5}$, SO_2, NO_x, CO and other data for BAAQMD plants A0016, A0011, B2758, B2626, A0022, A1820, B7419 and B0295. Database updated as of 2 December 2016, reported pursuant to the California Public Records Act. Excel file.

22. BAAQMD, **2012**. *Understanding Particulate Matter: Protecting Public Health in the San Francisco Bay Area;* Bay Area Air Quality Management District: San Francisco, CA. Report.

23. BAAQMD Multi-pollutant Evaluation. Fairely, D., and Burch, D. *Multi-pollutant Evaluation Method Technical Document, 2016 Update;* Bay Area Air Quality Management District: San Francisco, CA. Support documentation for the State Implementation Plan (SIP) for the San Francisco Bay Air Basin. **2016.** Report.

24. SFBAB SIP Excerpt. *Final 2017 Clean Air Plan, Bay Area Air Quality Management District, Adopted April 19, 2017;* Bay Area Air Quality Management District: San Francisco, CA. State Implementation Plan (SIP) for the San Francisco Bay Air Basin. **2017.** Excerpt.