EXHIBIT C

Technical Memorandum
Air Quality, Climate Change, and Environmental Justice Issues from Oakland Trade and Global Logistics Center

SEPTEMBER 18, 2015

PREPARED FOR:

EARTHJUSTICE

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EXECUTIVE SUMMARY

Sustainable Systems Research, LLC was asked by EarthJustice to review potential air quality issues associated with the handling and exportation of coal through the proposed Oakland Bulk and Oversized Terminal (OBOT). The OBOT will be a newly constructed bulk export facility located at Berth 7 as part of the Oakland Army Base Redevelopment. A summary of the key findings are as follows,

- The terminal design specification has not been well defined; tonnage of bulk is estimated to be between 9.9 million tons and 10.5 million tons;

- It is unclear how much of the total bulk throughput will be coal, but assuming that 10.5 million tons of coal is shipped each year, as much as **approximately 646 tons per year of fugitive coal dust may be generated by the movement of coal through the port facility;**

- If coal throughput is constrained to the level of investment by Utah partners, as much as **approximately 323 tons per year of fugitive coal dust may be generated by the movement of coal through the port facility;**

- There are no proven topping agents that have demonstrated effectiveness at reducing coal dust over long trips;

- Rail car covers are frequently referred to in the project documents. We were unable to find any evidence of rail cars covers in production, nor evidence of any rail covers that have been field tested for their ability and effectiveness in reducing fugitive coal dust on extended train trips;

- West Oakland is the adjacent neighborhood and is considered a vulnerable community. Vulnerable communities have a higher risk of differential exposure, susceptibility and sensitivity, differential preparedness, and differential ability to recover as a result of cumulative environmental stress;

- Spring dust storms originating in Africa or Asia transport large quantities of dust mixed with industrial soot, polycyclic aromatic hydrocarbons (PAHs), as well as mercury and ozone;

- Atmospheric mercury can travel long distances causing both local and global contamination. In aquatic systems, mercury can be converted to methylmercury, which is a bioaccumulative toxic compound, and finally,

- ***Shipping 10.5 million tons of coal annually through OBOT will contribute approximately 30 million tons of CO_2 each year to climate change***.

INTRODUCTION

Sustainable Systems Research, LLC was asked by EarthJustice to review potential air quality issues associated with the handling and exportation of coal through the proposed Oakland Bulk and Oversized Terminal (OBOT). The OBOT will be a newly constructed bulk export facility located at Berth 7 as part of the Oakland Army Base Redevelopment. The qualifications of the project analysis team are provided in Appendix B.

BACKGROUND

The OBOT has been designated to receive an investment from Utah that would secure access rights to 49% of the terminal capacity most likely for coal.[1] The expected number of trains and actual amount of coal to be transported through the harbor is difficult to ascertain, and as shown below, varies by source,

- Oakland Global Website (OGW): The facility is expected to operate "*24-hours a day to facilitate moving cargo directly between ships and rail, handling up to 12, 50-car trainloads per day*.[2]
- The FAQ list on the Terminal Logistics Solutions website (TLS): "*TLS will be designed to handle an annual throughput of 9,500,000 metric tons of bulk agriculture and mineral commodities and receive up to three unit trains of 114 rail cars per day*.[3]
- The Basis for Design conceptual specifications (BD): "*Design capacity will be 9 million tonnes per annum (Mtpa) (pg1); "The design calls for incoming trains of 104 railcars to be split in and handled on 26 railcars "ladder type" storage tracks (pg. 13).*"[4]

When everything is converted to similar units, the tons of coal projected to be handled at OBOT's design capacity could range from 9.9 to 10.5 million tons per year (Table 1).

Table 1. Coal Shipment Characteristics

	Coal (million-tons/yr)	Unit Trains per day	Cars per Train
OGW	10.5[5]	12	50
TLS	9.5	3	114
BD	9.9[6]		104

[1] Amy O'Donoghue, *Utah invests $53 million in California port for coal, other exports*, Deseret News, April 24, 2015, *available at* http://www.deseretnews.com/article/865627254/Utah-invests-53-million-in-California-port-for-coal-other-exports.html?pg=all; see also, http://www.deseretnews.com/article/865627254/Utah-invests-53-million-in-California-port-for-coal-other-exports.html?pg=all

[2] http://www.oaklandglobal.com/index.php/project/about/project-overview (accessed Sept 14/2015)

[3] http://tlsoakland.com/faq/ (accessed Sept. 14/2015)

[4] http://tlsoakland.com/pdf/4.pdf

[5] 12 trains * 50 cars/train *100 tons/car. Bulk trains cars will vary between 100 to 110 tons per car; coal usually travels in hopper cars which carry between 70 to 110 tons (see, CSX, Railroad Equipment, Hopper Car, http://www.csx.com/index.cfm/customers/equipment/railroad-equipment/ (accessed Sept 5/2015)

[6] Converted to tons

If the shipment of coal from Utah investors is limited to their investment level, 49%, and the total tonnage is 10.5 million tons per year, the amount of coal coming through the terminal would be approximately 5.1 million tons per year, or nearly 14,000 tons per day. Even at this "investment" level activity, as set forth below, the effects of moving this quantity of coal will be quite significant.

Upon arrival at the OBOT, the coal will be moved to shipping vessels for export. Based on the conceptual design,[7] it appears that hopper cars will be utilized to transport the coal from the trains to ships.[8] The conceptual plans indicate that two commodity dumpers will be used to unload the cars. One commodity dumper has a two car shed, the other has a one car shed with a separate unenclosed shed. To reduce fugitive dust, each coal car will presumably be unloaded in the two car dumping shed and then, according to the conceptual plans, transferred via a hopper to an enclosed conveyor.

Various documents suggests that the staging area for the trains will extend back approximately 2200 feet from the dumper shed, where the track splits. A unit train of 50 cars will use slightly more than one-half of a mile,[9] assuming that a single train is serviced through one dumper shed (rather than taking the time to uncouple and move cars around to use both dumper sheds).

We estimated the fugitive dust emissions for two scenarios: 1) the available bulk potential (12, 50-car trainloads) is used entirely for coal, 2) the amount of coal shipped through the OBOT is limited to the level of the Utah investment (49%, or 6, 50-car trainloads). It is important to note that this analysis may produce conservative estimates in terms of the amount of fugitive coal dust because the basis design (BD), which only recently was made public, indicates that unit trains will be split into 25 car segments for unloading. This would likely produce a larger amount of fugitive coal dust than is estimated in this report.

Scenario 1. Assuming that 12 trains per day arrive with coal (i.e., coal fulfills the entire terminal handling potential), trains will arrive approximately every 2 hours. Conservatively, unloading of the 50-car train can be expected to take between 3 to 4 hours, assuming a bottom dump hopper car is used.[10] During the processing time, cars will be idle on the tracks with exposed coal. At 3 hours unloading time, coal will be exposed approximately 63% of each day; at 4 hours unloading time, coal will be exposed roughly 85% of each day. Under the 4 hour unloading time, this equates to 20 hours of exposed coal each day per train.

Scenario 2. Assuming that 6 trains per day arrive with coal (matching the investment level of 49%), trains should be arriving approximately every 4.8 hours. Unloading of the 50-car train can be expected to take between 3 to 4 hours, assuming a bottom dump hopper car is used.[11] During

[7] See http://tlsoakland.com/pdf/4.pdf
[8] It's also possible that a gondola car could be used; coal moved in this fashion would involve a rotary hopper within the unloading shed.
[9] Assume each hopper car is approximately 60 feet in length and the 50-car train is served by two locomotives, each at 80 feet in length.
[10] If a single car rotary dump is used, the time to unload a 50 car train will be longer, ranging from 4 to 6 hours.
[11] Ibid

the processing time, cars will be idle on the tracks with exposed coal. At 3 hours unloading time, coal will be exposed approximately 63% of each day; at 4 hours unloading time, coal will be exposed roughly 85% of each day. Under the 4 hour unloading time, this equates to 20 hours of exposed coal each day per train.

The dust from exposed coal is susceptible to being blown by wind while waiting to be loaded. Fugitive coal dust can also be generated during unloading, conveyance, and ship loading processes. While the terminal operator has suggested that additional pollution controls may be used for mitigation, there are two considerations that could affect implementation of mitigation strategies. First, there is no requirement to mitigate coal dust, and second, current and projected long-term coal profit margins are sufficiently tight[12] that unless there is a requirement for mitigation, it is unlikely that any will be used. Thus, for the purposes of this report, the main focus in terms of fugitive coal dust is on the staging area and its potential to generate coal dust that affects the surrounding communities.

Fugitive Dust and Diesel Particulate Matter Emissions

The proposed coal export facility will generate significant emissions, both from coal and from locomotive activities. There are four primary factors that influence the quantity of fugitive coal dust from trains:[13] the car and load profile geometry; the physical properties of the coal; the weather and trip characteristics, and the application of dust control measures. Fugitive dust will predominantly occur during the loading, unloading, and transit of the coal. When coal is in transit from Utah, fugitive dust is expected to occur throughout the trip. BNSF has estimated that fugitive dust from coal that is in transit can be in the range of 500 to 2000 lbs *per train car*.[14] Recent research indicates that fugitive dust as well as diesel particulate matter (DPM) emitted as a result of fuel combustion can be significantly higher along rail lines; for $PM_{2.5}$, levels can be as much as double the background concentrations.[15]

Once the coal enters the port facility, both combustion DPM and fugitive dust are concentrated into a smaller area. There will be additional locomotives that will need to be used to assist in train switching. In many cases, the switching trains are usually older line haul trains, and tend to have much higher emissions.[16] Other emissions generating activities include trucks going to and from the terminal, diesel equipment operating onsite and ship emissions.

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[12] Fulton, M. (2014) King Coal disappoints investors: recent financial trends in global coal mining, *Carbon Tracker Initiative*, Energy Transition Advisors: 58 pps.

[13] Kotchenruther, R (2013) Fugitive dust from coal trains: Factors effecting emissions and estimating PM2.5, EPA Region 10, NW-AIRQUEST 2013: 18 pps. url: http://lar.wsu.edu/nw-airquest/docs/201306_meeting/20130606_Kotchenruther_coal_trains.pdf (accessed Sept 4, 2015).

[14] http://daily.sightline.org/2011/08/10/at-least-the-website-is-clean/

[15] Jaffe, D. (2014) Diesel particulate matter emission factors and air quality implications from in-service rail in Washington State, *Atmospheric Pollution Research*, 5: 344-351.

[16] SR (2007) Toxic Air Contaminant Emissions Inventory and Dispersion Modeling Report for the Delores and ICTF Rail Yards, Long Beach, CA

The likelihood of high levels of fugitive coal dust from the transportation, unloading and storage of coal at the terminal constitutes a major health hazard. Therefore, for the purposes of this report, the main focus of analysis is on fugitive coal dust emissions from trains waiting to be unloaded. Under these conditions, it is reasonable to assume that the coal is mostly dry, and having completed the extended train trip, the degree of control efficiency is approaching zero.

Total Fugitive Coal Dust Emissions

The quantity of emissions can be estimated using U.S. EPA's AP-42 method. However, as will be noted later, this method may underestimate the actual amount of fugitive emissions occurring. Moreover, the current lack of detail regarding the actual process by which the coal will be transported and handled required the use of a number of assumptions that may also result in a less accurate estimate.

Given these caveats, the total emissions from the exposed coal during the train waiting period prior to, or during unloading at the terminal are estimated for Scenario 1 (12 trains per day) to be approximately 646 tons per year and for Scenario 2 (5 trains per day), approximately 323 tons per year.

The calculation details are provided in Appendix A. There are also a few analyses points worth noting. In order to calculate these emissions, the number of disturbances had to be estimated. For the purposes of these calculations, only one disturbance per day was assumed. In fact, the number of disturbances is likely to be much higher, particularly if the 25 car segmenting discussed in the conceptual design basis report (DB) is implemented. It is important to note that every time a train is moved, or jostled, the coal is disturbed. It is also possible that dust will be slightly less if the amount of time used to unload coal is expedited. However, even at 50% less exposure time, under Scenario 1, the total fugitive coal dust emissions will still exceed 315 tons/year.

Viability of Topping Agents and Covers for Reducing Dust

The terminal developer has indicated possibly using coal surfactants (topping agents) and/or covered train cars as methods of mitigating dust emissions. Neither of these methods will provide effective protection from coal dust emissions; surfactants cannot provide protection for the duration of a coal train trip from Utah, and coal covers have never been commercially used or evaluated for their efficacy.

As of 2011, BNSF requires that all shippers moving coal from Wyoming or Montana adhere to BNSF's coal loading rule.[17] However, the BNSF rules do not apply to coal shipped from Utah. The BNSF tariff has two requirements. First, the shipper must groom loaded coal according to a specified rounded top profile, which allows for approximately 26 inches of coal exposure vertically from the top edge of the rail car. The surface width of the exposed area can vary from

[17] BNSF Price List 6041-B, Providing rules and regulations governing unit train and volume all-rail coal service, also accessorial services and charges therefor applying as provide in the price list, Effective October 9, 2011, BNSF Price Management, Fort Worth, Texas: 20 pps.

118 inches to 128 inches. The second requirement is that exposed coal must be treated with one of four topper agents, or demonstrate that whatever is employed for dust suppression can achieve an 85% reduction in coal losses at the time of loading.[18] Topping agents (or surfactants) are used to control the fugitive dust from coal train cars.

Shippers are responsible for paying for dust suppression. There are also no compliance measures in place that would ensure that trains travel the entire length of their trip and meet the 85% dust reduction requirement. Said another way, the only federal rules for surfactant or topping agent use and load profiling only require an application at the mine for coal originating in Montana or Wyoming.[19] Without compliance mechanisms for all trains, regardless of origination, for the application of specific topper agents, it is unlikely that the coal companies would pay for this, particularly as coal's profit margins continue to decline.[20] Therefore, it can reasonably be assumed at this point in time that coal transported and shipped through Oakland from Utah will not be treated with a topping agent and fugitive dust will occur during coal transport and unloading.

However, even if treated with a topping agent, it is likely that the efficiency of any topper agent would be significantly reduced by the time the unit train arrives in Oakland.[21] Topping agents are applied at the mine prior to coal shipping. With the application of a topping agent, an approximately 4 inch crust is created on the exposed surface protruding from the coal car. As cars are jostled and bumped during the train ride, or are exposed to high wind velocities, such as those that occur in high mountain passes, it is likely that the crusting will decay and breakup, leading to exposed coal which can then be windblown.

BNSF has argued that, in their tests, the application of the agent has been shown to 85% effective at reducing fugitive coal dust. While the specific details of the BNSF "Super Trial" testing have never been made publically available, it is clear from the summary report that is available that although BNSF claimed 85% dust suppression at the time of loading, there are significant caveats to both the BNSF testing and the results. First, the experimental treatment (topper) was not randomly assigned to train/cars. This – by itself – would render the results exploratory at best. Further, there is no information provided in the BNSF Super Trial summary report on the range of meteorological conditions or train speeds under which testing occurred. Without these data, it is impossible to characterize the weather or train speed regimes under which the testing was completed, and more importantly, conditions to which results could be applied. Finally, BNSF notes that,

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[18] Docket No. FD 30186, Tongue River Railroad Company, Inc, Information Request No. 3, BNSF Response to Letter from Victoria Rutson, Office of Environmental Analysis, Surface Transportation Board, June 17, 2013.
[19] http://www.bnsf.com/customers/what-can-i-ship/coal/coal-dust.html
[20] Fulton, M. (2014)
[21] See, for example, Kutchenruther EPA Region 10, Fugitive Dust from Coal Trains: Factors Effecting Emissions & Estimating PM2.5, 2013; available at: http://lar.wsu.edu/nw-airquest/docs/201306_meeting/20130606_Kotchenruther_coal_trains.pdf

> "…during the course of the Super Trial, field audits of treated trains showed that there was at times significant variation in the quality and consistency of the physical application of topical treatments at the mines. This was not surprising due to the fact that the application procedures were being done on a test basis with temporary facilities. However, the quality of application of the topical treatment could make a significant difference in the effectiveness of the application in suppressing coal dust emissions. In addition, audits of the load profile show that proper load profiling is not being consistently achieved at the mines. Effective coal dust reduction will require that careful attention be given to controlling the quality of the application process and the load profiling when coal dust suppression measures are implemented (pg 7)."

The limitations pointed out by BNSF preclude use of toppers as a fool proof method for reducing coal dust without additional experimentation that will assist in defining the appropriate application procedures and load profiles, and under what conditions variations are applicable.

In fact, in response to an August 2010 request from Cynthia Brown, Chief, Office of Proceedings, for the Surface Transportation Board, that BNSF provide a list of "academic and industry articles and reports related to coal dust (pg 1)", only three of the 27 papers were peer-reviewed papers. Two of the three peer reviewed papers noted the exploratory nature of their work and called for additional testing on the application and effectiveness of *all* topper agents.

Finally, in recent years there has been some development of hard and soft covers that would theoretically snap onto existing (plain gondola) cars, limiting coal exposure, particularly during transit. In a search for use of these technologies, we were able to find three companies offering possible car covers: CoalCap, ClearRRails, LLC, and Strategic Rail Systems. However, no information was found on the in-use cost, unloading efficiencies, durability, and practicality of the covered systems offered by any of the companies. We were also unable to confirm that any of the cover designs have actually gone into production. In a review of the literature, we could not find any papers or reports that described the technical specifications and provided a report on efficacy. It appears, on the basis of our search, that the covers are not in production, have never been in production, and have never been field tested for their ability and effectiveness for reducing fugitive coal dust on extended train trips.

THE EFFECT OF INCREASED COAL DUST ON HEALTH

Coal dust poses a health threat to communities; exporting coal through Oakland would increase coal dust and exacerbate health problems, especially on already vulnerable populations like West Oakland. Air quality regulations require that particles less than or equal to 10 micrometers in diameter (PM_{10}) and particles up to 2.5 micrometers in size ($PM_{2.5}$) meet national standards. Coarse particles refer to re-suspended dust, soil and crustal material, with mass concentrations greater than a 2.5-µm cut point. Coal dust particles can range in size from 1 to 100 microns, which clearly encompasses size ranges relevant to the PM standards. The quantity of fugitive coal dust, and any effect on current attainment status was not considered in the original EIR, or in the 2012 addendum. This is significant because there are clear health implications for residents in neighborhoods in close proximity to the OBOT.

The effects of particulate matter air pollution on health are well documented.[22] Long-term PM exposure has been implicated in increased incidences of respiratory illnesses,[23] cardiopulmonary mortality,[24] and decreased lung function.[25] Short-term exposure has been associated higher stroke mortality,[26] myocardial infarction,[27] and pollutant-related inflammatory responses.[28] In particular, coal dust increases the likelihood of pneumoconicosis and exacerbates inflammatory responses such as bronchitis and emphysema.

For vulnerable communities, there is a higher risk of differential exposure, susceptibility and sensitivity, differential preparedness, and differential ability to recover as a result of cumulative environmental stress.[29] Children, the elderly, and people with existing health conditions are particularly vulnerable to inhalation of pollution.[30,31] Additionally, low-income households and people of color can be more vulnerable to the effects of pollution exposure for a number of reasons, including greater rates of preexisting health conditions, greater exposure to a number of environmental hazards, greater social vulnerability (including stress), and limited access to health care.[32,33]

West Oakland, the neighborhood which abuts the Port area, is one of the poorest neighborhoods in the county and experiences some of the highest poverty rates in the Bay Area. In 2010, Lisa Jackson, former EPA Administrator, led an environmental justice tour and attended an

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[22] Pope, C. Arden, and Douglas W. Dockery. 2006. "Health Effects of Fine Particulate Air Pollution: Lines That Connect." *Journal of the Air & Waste Management Association* 56 (6): 709–42. doi:10.1080/10473289.2006.10464485.

[23] Dockery, D.W.; Speizer, F.E.; Stram, D.O.; Ware, J.H.; Spengler, J.D.; Ferris, B.G. Effects of Inhalable Particles on Respiratory Health of Children; *Am. Rev. Respir. Dis.* **1989**, *139*, 587-594.

[24] Dockery, D.W.; Pope, C.A., III; Xu, X.; Spengler, J.D.; Ware, J.H.; Fay,M.E.; Ferris, B.G.; Speizer, F.A. An Association between Air Pollution and Mortality in Six U.S. Cities; *N. Engl. J. Med.* **1993**, *329*, 1753-1759.

[25] Pope, C.A., III; Dockery, D.W. Acute Health Effects of PM_{10} Pollution on Symptomatic and Asymptomatic Children; *Am. Rev. Respir. Dis.* **1992**, *145*, 1123-1128.

[26] Kan, H.; Jia, J.; Chen, B. Acute Stroke Mortality and Air Pollution: New Evidence from Shanghai, China; *J. Occup. Health* **2003**, *45*,321-323

[27] Peters, A.; Dockery, D.W.; Muller, J.E.; Mittleman, M.A. Increased Particulate Air Pollution and the Triggering of Myocardial Infarction; *Circulation* **2001**, *103*, 2810-2815.

[28] Liao, D.; Duan, Y.; Whitsel, E.A.; Zheng, Z.-J.; Heiss, G.; Chinchilli, V.M.; Lin, H.-M. Association of Higher Levels of Ambient Criteria Pollutants with Impaired Cardiac Autonomic Control: A Population-Based Study; *Am. J. Epidemiol.* **2004**, *159*, 768-777

[29] EPA, "Framework for Cumulative Risk Assessment," May 2003, EPA/630/P-02/001F; "Concepts, Methods, and Data Sources for Cumulative Health Risk Assessment of Multiple Chemicals, Exposures and Effects: A Resource Document," August 2007, EPA/600/R-06/013F

[30] Rachel Morello-Frosch, Miriam Zuk, Michael Jerrett, Bhavna Shamasunder and Amy D. Kyle. Understanding The Cumulative Impacts Of Inequalities In Environmental Health: Implications For Policy. Health Affairs, 30, no.5 (2011):879-887.

[31] EPA, (2007) "Concepts, Methods, and Data Sources for Cumulative Health Risk Assessment of Multiple Chemicals, Exposures and Effects: A Resource Document," August, EPA/600/R-06/013F.

[32] Morella-Frosh (2011)

[33] EPA (2007)

environmental justice Town Hall in Oakland to raise awareness of the challenges and needs of underserved communities like West Oakland. The neighborhood has a long history of exposure to high levels of pollutants. Compared to other areas in Oakland, residents are exposed to roughly five times higher levels of diesel particulates, and experience more than seven times the per capita diesel exhaust than Alameda County as a whole.[34] Additional fugitive coal dust on top of long-term environmental stress would very likely create cumulative health-related concerns in an already burdened and vulnerable community.

Global Transport of Coal Emissions

There is strong evidence to suggest that much of this coal will be shipped to and consumed within Asia.[35] In addition, scientific evidence now shows that despite being used in Asia, pollutants like fine particulate matter, mercury, and ozone are transported back across the Pacific to the west coast.

China, in particular, is expected to generate the highest demand for coal, followed by Korea, Taiwan, and the developing economies of India and Indonesia. Within the U.S., the use of coal in the future is likely to continue to decline, thus making the Asian markets, in particular China, a likely consumer of the OBOT coal.[36]

Black carbon, which is produced during the combustion process of fossil fuels like coal, is a soot composed of fine particulate matter. A recent Nature review[37] of the state of scientific knowledge with respect to the environmental effects of black carbon revealed a cascading of events that begins with the burning of fossil (diesel and coal) and biomass fuels. The high black carbon emissions from burning then give rise to atmospheric brown clouds that contain, among others, sulphates, nitrates, and fly ash. Rain and snowfall eventually remove the black carbon from the atmosphere and create pollution both locally and globally.

Scientific evidence has shown a pattern of consistent, frequent transport of fine (<2.5 μm) Asian dust over the eastern Pacific and western North America, including California.[38,39] The Asian fine dust concentrations (24-hour average) are between 0.2 and 1 μg/m^3 and only very rarely exceed 5 μg/m^3. Spring dust storms originating in Africa or Asia transport large quantities of dust mixed with industrial soot across the Pacific Ocean. Using aircraft, these dust-soot mixtures

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[34] Pacific Institute (2003) *Reducing Diesel Pollution in West Oakland*, Pacific Institute, San Francisco: 16 pps (last accessed Sept. 10, 2015)
[35] Bornozis, N. (2006) Dry Bulk Shipping: The engine of global trade, A Review of the Dry Bulk Sector, *Sponsored Report in Barrons*, October: 13 ppgs
[36] Thomas M. Power, The Greenhouse Gas Impact of Exporting Coal from the West Coast An Economic Analysis SIGHTLINE DAILY, July, 2011, available at http://www.sightline.org/wp-content/uploads/downloads/2012/02/Coal-Power-White-Paper.pdf
[37] Ramanathan, V., G. Carmichael (2008) Global and regional Climate Changes Due to Black Carbon, *Nature*, Vol. 1: 221-227.
[38] VanCuren, R., T. Cahill (2006) Asian aerosols in North America: Frequency and concentrations of fine dust, *Journal of Geophysical Research*, 111(D20), DOI: 10.1029/2002JD002204
[39] Ewing, S., J. Christenson, S. Brown, R. et al (2010) Pb Isotopes as an Indicator of the Asian Contribution to Partuclate Air Poluution in Urban California, *Environmental Science and Technology*, 44(23): 8911-8916.

have been tracked all the way across the Pacific at elevations as low as the surface to as high as 14km. Under certain conditions, the lifetimes of brown clouds can be extended with the result of increasing the persistence of soot-filled fog.

Other studies have identified significant trans-Pacific atmospheric transport of Asian generated polycyclic aromatic hydrocarbons (PAHs),[40] which result from incomplete combustion of coal, among other fuel sources, as well as mercury[41] and ozone.[42] Mercury, in particular, poses a vexing problem. While Europe and North America were major contributors historically, projections now indicate that fossil fuel emissions generated in Asia will drive growth in global mercury deposition.[43] Atmospheric mercury can travel long distances in the right chemical form,[44] causing both local and global contamination.[45] In aquatic systems, mercury can be converted to methylmercury, which is a bioaccumulative toxic compound in fish and humans.[46] Humans can be exposed to mercury by consuming fish, and mercury poses special risks to women of childbearing age and children.[47] Methylmercury exposure causes impaired neurological development and a host of other issues.[48]

GHG Emissions

The proposed export of coal from the OBOT terminal will generate additional greenhouse gas emissions during combustion that will directly increase the negative effects of climate change. Climate change is responsible for sea level rise and exacerbating the drought, both of which are direct effects to Oakland and California. Every project that results in greenhouse gas emissions contributes to climate change. The magnitude of warming that we experience both currently and in the future is not determined by "emissions in any one year, but by cumulative CO2 emissions" produced over time.[49] Thus, every project must account for its contribution to climate change.

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[40] Lafontaine, S. J. Schrlau, J. Butler et al (2015) Relative influence of trans-Pacific and regional Atmospheric Transport of PAHs in the Pacific Northwest, US.

[41] Jaffe, D.; Prestbo, E.; Swartzendruber, P.; Weiss-Penzias, P.; Kato, S.; Takami, A.; Hatakeyama, S.; Kajii, Y. Export of atmospheric mercury from Asia. Atmos. Environ. 2005, 39 (17), 3029−3038

42 Fischer, E. V.; Jaffe, D. A.; Weatherhead, E. C. Free tropospheric peroxyacetyl nitrate (PAN) and ozone at Mount Bachelor: Causes of variability and timescale for trend detection. Atmos. Chem. Phys. Discuss. 2011, 11 (2), 4105−4139

43 Rafaj, P.; Bertok, I.; Cofala, J.; Schopp, W. Scenarios of global mercury emissions from anthropogenic sources. Atmos. Environ. 2013,79, 472−479

[44] Driscoll, C. T., Mason, R. P., Chan, H. M., Jacob, D. J., and Pirrone, N.: Mercury as a global pollutant: sources, pathways, and effects, Environ. Sci. Technol., 47, 4967–4983, doi: 10.1021/es305071v, 2013

[45] Selin, N. E. Global Biogeochemical Cycling of Mercury: A Review. Annu. Rev. Environ. Resour. 2009,34(1), 43−63.

[46] Mergler, D., Anderson, H. A., Chan, L. H. M., Mahaffey, K. R., Murray, M., Sakamoto, M., and Stern, A. H.: Methylmercury exposure and health effects in humans: a worldwide concern, Ambio, 36, 3–11, doi: 10.1579/0044-7447(2007)36[3:meahei]2.0.co;2, 2007

[47] http://www.fda.gov/food/resourcesforyou/consumers/ucm110591.htm

[48] http://www.who.int/mediacentre/factsheets/fs361/en/

[49] Davis and Socolow (2014) Commitment accounting of CO_2 emissions, *Environmental Research Letters*, 9(8): pg 1 (accessed Sept 10, 2015)

The proposed 10.5 million tons of coal shipped annually through OBOT will contribute approximately 30 million tons of CO_2 each year to climate change.[50] ***This is approximately equivalent to the size of seven average power plants.***

A recent law review article makes a cogent and important argument that GHG emissions that result from international consumption of coal exported from the U.S. must be considered under NEPA, and by extension state environmental laws such as CEQA. Exported coal from OBOT "*is a domestic action triggering domestic damage, with just one link of the proximate cause chain taking place abroad (pg. 245).*" The coal is mined in the U.S., transported to a port in the U.S., consumed overseas, adding additional GHG emissions to the atmosphere, further exacerbating climate change, which in the final link of the proximate cause chain, results in damages to the U.S. Two examples clearly illustrate the damage being done. Within the Bay Area, sea level rise is already occurring as a result of climate change, and projected to be much worse if GHG emissions do not decline.[51] Moreover, there is also now clear scientific evidence that "*anthropogenic warming is estimated to have accounted for 8–27% of the observed [California] drought anomaly in 2012–2014 and 5–18% in 2014 (pg 1).*"[52]

In short, GHG emissions from the proposed shipping of coal through the OBOT will increase the warming caused climate change. Increased warming will lead to both local and global impacts, including sea level rise and droughts that are worse than would occur naturally.

CONCLUSION

The proposed project, which involves transport of upwards of 10.5 million tons of coal from Utah to California to be sold overseas, has a direct and proximate impact on Oakland. The project will create additional health hazards due increased fugitive coal dust emissions. We were unable to find any scientifically validated methods for mitigating the coal dust, which is associated with transport and unloading of the coal at the terminal. The increased potential for significant health effects will be borne primarily by the adjacent neighborhood, West Oakland, which is a vulnerable community. Finally, the GHG emissions generated by the consumption of coal overseas will significantly increase warming caused by climate change. Increased temperatures are responsible for sea level rise and exacerbated drought conditions, the effects of which are observed both locally and globally.

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[50] Derived as: 10,500,500 tons of coal * (2.86 tons CO_2/ton of coal) using conversions found in http://www.eia.gov/coal/production/quarterly/co2_article/co2.html. It should also be noted that Davis and Socolow's (2014) (see note 12) suggest that carbon emissions annually from coal in Utah could be substantially higher. In addition, if the coal is used as coking coal for steel production, emissions may higher.

[51] Slagen, A. M. Carson, C. Katsman (2014) Projecting twenty first century regional sea level changes, *Climate Chane*, 124:317-332.

[52] Williams, P., R. Seager, J. Abatzoglou, B. Cook, J. Smeardon, E. Cook (2015), Contribution of anthropogenic warming to California drought during 2012-2014, *Geophysical Research Letters,* DOI: 10.1002/2015GL064924

Appendix A: Fugitive Dust Calculations for Coal Trains Awaiting Unloading

The emission factor (EF), expressed in g/m^2 per year, is calculated as,

$$EF = k\sum_{i=1}^{N} Pi$$

where k is the particle size multiplier; N is the number of disturbances per year, and P_i is the erosion potential (m/s^2), which is calculated using the observed fastest mile of wind for the *i*th period between disturbances.

The erosion potential, P_i, can be calculated as,

$$P_i = 58(u^* - u_t^*)^2 + 25(u^* - u_t^*) \quad \text{eq. 2}$$

where u^* is the friction velocity (m/s) and u_t is the threshold friction velocity (m/s).

There are some caveats to using the AP-42 method. First, these equations only apply to dry, exposed material. They also assume that there is limited erosion potential, and that the surface of the area on which fugitive emissions may occur is flat. Thus, it is likely that emissions are under-estimated given that new coal will arrive at least 5 times a day.

The friction velocity, u^*, can be estimated by $u^* = 0.053u_{10}^+$, where u_{10}^+ is the fastest mile of wind. The fastest mile wind speed is no longer reported in local weather data; however, it can be calculated using gust basic wind speed.[53] The maximum 5 sec wind gust recorded at the Oakland station at the Western Regional Climate Center (RAWS) was 65 mph.

Calculating $u^* = 0.053(65\ mph) * (\frac{0.4471\frac{m}{s}}{mph})$ = 1.54 m/s. The threshold velocity is taken from Table 13.2.5-2. A factor of 0.54 m/s is used (fine coal dust on concrete pad); this might be relatively conservative since the coal will be in open train cars; most of Utah's coal is bituminous.[54] From eq. 2, the erosion potential, P_i, is equal to 59.49 g/m^2.

Scenario 1.

Setting the number of disturbances to at least once per day, the estimated PM emissions *for single event*, is calculated as,

$$\begin{aligned} PM_{single\ event} &= EF * Area \\ &= \left(1.0\left[\frac{\left(59.49\frac{g}{m^2}\right)\left(0.002205\frac{lb}{g}\right)}{10.764\frac{ft^2}{m^2}}\right]\right) * (No.Trains * Length * Width) \\ &= 4167\ lbs/day \end{aligned}$$

[53] http://publicecodes.cyberregs.com/st/ca/st/b200v07/st_ca_st_b200v07_16_sec009_par006.htm (accessed Sept. 8, 2015).
[54] http://www.ereferencedesk.com/resources/state-symbols/utah/rock.html (accessed Sept. 7, 2015).

If we assume that trains are present 85% of the day, that there is at least one disturbance per day, which is extremely conservative given the amount of traffic going through the terminal, and that there is no effective topping left by the time the train has arrived to the port, then the total PM emissions expected from fugitive dust events is calculated as,

$$Total\ PM = PM_{single\ event} * \%Time\ Trains\ are\ Present = 4167 \frac{lbs}{day} * 0.85$$
$$= 646.37\ tons/year$$

Scenario 2, with 6 trains per day, can be calculated similarly. The total estimated annual PM emissions under Scenario 2 are 323.2 tons/year.

Additional caveats to this analysis are noted in the report.

Appendix B: Team Qualifications

For two decades, Professor Deb Niemeier has focused on integrating models for estimating mobile source emissions with transportation modeling. Her primary research interest has been on developing highly accurate, accessible processes and emissions modeling and travel behavior models that can be used in the public sector, including the identification and modeling of environmental health disparities and improved understanding of formal and informal governance processes in urban planning. This combination of basic and translational research has resulted in new ways to identify the spatial properties of mobile source emissions, new methods for developing vehicle emissions inventories, and improved regulatory guidance, including better identification of vulnerable populations. In 2014, she was named a Fellow of the American Association for the Advancement of Science (AAAS) for “distinguished contributions to energy and environmental science study and policy development.” In 2015, she was named a Guggenheim Fellow.

Her accomplishments include serving as the lead author for current federal guidance for PM (particulate matter) hotspot analysis for California, whose standards generally exceed federal standards. This guidance was based on translational work in vehicle emissions modeling and transportation project development conducted as part of the six year state and federally funded program, the UC Davis Air Quality Project (AQP), which resulted more than 50 reports aimed at improving public agency transportation-air quality modeling. Led by Prof. Niemeier, new ways to better estimate mobile source emissions inventories were developed and ushered into public sector practice through the AQP. This work was seminal in developing innovative and rigorous evaluation processes for public agencies charged with assessing the air quality effects of new transportation infrastructure and is used in some form by nearly all state transportation agencies.

More recently, her research group’s efforts in synthesizing research on the return to background concentrations at roadside edge has resulted in a revision of current thinking about minimum acceptable distances from roadway edges for sensitive populations. This work has motivated a number of new studies around the world examining air pollutant concentrations at much greater distances than previously thought necessary. She is currently working with collaborators in sociology and political science broadly examining the intersection of governance processes in regional planning and climate change outcomes, and better connecting urban planning processes with mitigation of environmental disparities. She was also the lead author for the Transportation Chapter of the Southwest Climate Assessment conducted as part of the 2014 National Climate Assessment.

Working with an interdisciplinary research group of graduate students, post-doctoral scholars, and faculty collaborators, she has published 130 journal articles and 9 book chapters. She has been the major advisor for 24 Ph.D. students, a number of whom now serve as university faculty at various institutions, including Cornell University, University of Illinois, University of New Mexico, and Georgia Tech. Her teaching and research has been generously funded by the National Science Foundation, the California Air Resources Board, the Environmental Protection Agency, the Federal Highway Administration, and the California Department of Transportation. As part of a company she formed with 3 former students, she also works with legal advocacy groups and environmental law clinics on social justice issues associated with access to transportation and transportation-air quality.

She is the current and founding Director for the Sustainable Design Lab at UC Davis. She is in her second year of chairing the university budget committee. She currently serves as a member of the

National Academy of Engineering Board on Energy and Environmental Systems. She is on the science advisory board for Capital Public Radio, and wrote their blog on energy and the environment for four years. She chairs the Policy and Environment Cluster of NECTAR, the Network on European Communications and Transport Activities Research. Dr. Niemeier is a member of the Transportation Research Board and has served on several National Research Council committees; her current service includes NCHRP 25-38 (Data Sources for MOVEs) and SHRP 2 C10B (Partnership to Develop an Integrated Travel Demand Model and Fine-Grained, Time-Sensitive Network) Expert Task Group. She is a member of the American Association for the Advancement of Science, recently completing an elected four-year member-at-large term on the AAAS engineering section nominating committee. She is a member of the graduate faculty in the departments of Computer Science; Transportation, Technology, and Policy; Education, and Geography. She currently sits on the Executive Committee of the Graduate Geography Group.

Dr. Niemeier has served as chair of the UC Davis civil engineering department. She also served as the Director of the John Muir Institute and Associate Vice Chancellor in the Office of Research at UC Davis. The John Muir Institute is home to 150 faculty and staff conducting research at the interface of the environment and society. She has received a number of awards including the Aldo Leopold Leadership Award, the Chancellor's Fellow Award, an NSF CAREER award, and UC Davis Outstanding Faculty Mentor and Faculty Advisor awards. She is currently the editor-in-chief of *Sustainable Cities and Society* and also recently completed a six year appointment as the Editor-in-Chief of *Transportation Research, Part A*, the leading international journal focused on transportation policy and practice. She was the first woman in the journal's history to serve in this position. She has served on the Mars Corp. Sustainability Council as well as numerous other sustainability-related boards. She received her B.S. in civil engineering from the University of Texas (1982), and her Ph.D. in civil engineering from the University of Washington (1994).

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