Comment on the Draft NEPA Environmental Impact Statement for the Millenium Bulk Terminals — Longview

by Michael Riordan, Ph.D.

This document is my official comment on the NEPA Draft Environmental Impact Statement for the Millennium Bulk Terminals — Longview (MBTL) project, which was released for public comment on September 30, 2016. During the past four years, I have been submitting scoping and other comments on this and other proposed coal-terminal projects in the Pacific Northwest, namely the Gateway Pacific Terminal at Cherry Point, WA, and the Coyote Island project near Boardman, OR. In all of these projects, I have focused on the fugitive coal-dust releases at the terminals, especially into the adjacent waters, and have developed considerable expertise in this area. For an example of this work, please consult my analysis of coal-dust losses into Salish Sea waters near Cherry Point from the planned Gateway Pacific Terminal (GPT).[1] I will restrict my comments to similar aspects of the MBTL NEPA Draft Environmental Impact Statement (hereinafter "DEIS"), particularly those presented in Sections 5.5 Water Quality and 6.7: Coal Dust.

I am particularly concerned about the likely impacts of fugitive coal-dust releases into the adjacent Columbia River, especially on Chinook and other species of salmon that migrate past the piers. Recent research by Brad Hanson and colleagues at the Northwest Fisheries Science Center in Seattle has indicated that Southern Resident Killer Whales ("orcas") migrate in winter to the mouth of the Columbia River to feed upon the salmon there.[2] In summer they return to the Salish Sea waters, including the waters that surround the San Juan Islands where I live. These killer whales are an iconic, totemic species for our islands, drawing thousands of tourists here every year, but they are considered to be "endangered" under the Endangered Species Act, with a population of only 80 surviving individuals remaining. Any adverse impacts, especially cumulative adverse impacts, upon the salmon in the Columbia River will reduce the food available to these orcas in winter and negatively impact this fragile population.

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[1] Michael Riordan, "Estimating Fugitive Coal Dust at the Proposed Gateway Pacific Terminal," Eastsound, WA: Research Now Working Paper No. 16-1, January 26, 2016, available online at *http://www.researchnw.org/wp-content/uploads/2016/01/FugitiveDustAtGPT.pdf.*

[2] M. B. Hanson et al., "Assessng the coastal occurrence of endangered killer whales using autonomous passive acoustic recorders," *J. Acoust. Soc. Am.,* Vol. 134, No. 5 (Novembewr 2013), p. 3486–3495.

In an earlier comment on the SEPA Draft Environmental Impact Statement for this project, attached with the present comment, I concluded that this statement severely underestimated the fugitive coal dust that would be generated by MBTL and escape into the surrounding environment, both on land and into the Columbia River. In that comment I presented a table comparing my own estimates with those given in its Table 5.7-2. Coal Dust Total Suspended Particulates Emissions Rates at Maximum Throughput.[3] A copy of my table is presented below, with updated NEPA DEIS values in the right column:

Operation	**Annual Average TSP Emission Rate, in tons/year**	
Coal pile wind erosion	3.05 – 5.02	(1.08)
Coal pile development and removal	10.8 – 19.1	(2.62)
Ship transfer and conveyors	10.1 – 12.6	(5.25)
From trains during unloading	2.73 – 4.55	(2.10)
Total	**26.7 – 46.3**	**(11.05)**

The figures in the right column reproduce the figures given in NEPA DEIS Table 6.7-2.[4] Except for two changes, this table is identical to the one in my comment on the SEPA DEIS. The differences occur in the fourth line, where 2.10 has replaced 0.91, and in the Total, where 11.05 has replaced 9.86. The discerning reader will note that these changes bring the NEPA DEIS results into better agreement with my own calculations. But there continue to be major differences between my estimates and those results, as the figures for fugitive-dust emissions rates still come in low by factors of 2 to 7, as before, and the total emission rate remains too low by a factor of 2.4 to 4.2. From reading the NEPA DEIS, it is clear that no other changes have been made except for the fugitive coal-dust losses from trains during loading. The rest of the fugitive dust analysis is identical, based on the same report made by URS Corporation, a subcontractor to ICF International, the company responsible for preparing both draft statements.[5]

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[3] Michael Riordan, Comment on the Draft Environmental Impact Statement for the Millennium Bulk Terminals — Longview," June 2016, copy attached with this comment, p. 8.

[4] Millennium Bulk Terminals—Longview, Draft NEPA Environmental Impact Statement, 2016, Table 6.7-2. Coal Dust Total Suspended Particulates Emissions Rates at Maximum Throughput, on p. 6.7-4.

[5] Millennium Coal Export Terminal, Longview, Washington, Environmental Report, Air Quality (URS Corporation, 2015).

Similar underestimates occur for the PM2.5 and PM10 emissions, (which are not presented explicitly in either DEIS), because similar inputs and assumptions were used in making them. As before, the principal reasons for these underestimates include the use of unwarranted, optimistic input parameters in the AP-42 fugitive dust calculations (as are specified by the Environmental Protection Agency), and the application of unjustified and unreasonably high efficiency factors for dust-control measures (such as watering) that are proposed to be used at the terminal. Discerning readers will also note that both the SEPA and NEPA draft statements give emission rates that pretend to be accurate to two decimal places. This is patently absurd — and suggestive of the lack of professionalism that went into making these estimates. Given the large uncertainties in the input parameters (such as the silt and moisture content of the coal), as well as in the efficiency factors applied to account for such mitigation measures as watering coal storage piles, there will be major uncertainties in the resulting emissions rates, which should be recognized by reporting a *range* of values instead of a single value for each contribution and for the total rate. This is what I have done, and it underscores the superiority of my approach. I state this as a Ph.D. physicist (MIT, 1973) familiar with professional standards that require reporting of possible errors and uncertainties in one's calculations and experimental results.

Details of my calculations are included in my attached comment on the SEPA DEIS and will not be repeated herein. For readers' benefit, I also attach Appendices A through K of the URS Corporation's Environmental Report on air quality modeling.[6] For some unexplained reason, this report and these appendices were not available on the MBTL web site and had to be obtained from two of the project co-lead agencies. Upon review of my earlier comment and calculations, a few new and noteworthy observations are in order. Most important is the fact that the URS Corporation *completely ignored* the fugitive-dust releases that will occur due to bulldozing of the coal piles and due to trucks and other vehicles driving along the roads inside the project site, which will of course be covered with coal dust from the storage piles. These are *major omissions* that should be corrected in the final Environmental Impact Statements — for both NEPA and SEPA.

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[6] Millennium Coal Export Terminal, ref. 5. These important documents were curiously not available on the MBTL web site, as if to conceal them. They were finally provided upon my request by the Department of Ecology and Cowlitz County project lco-eaders. Appendices C through G contain the AP-42 (and other) fugitive-dust calculations actually used in the rest of the air-quality and water-quality analyses, which are crucial inputs to the AERMOD computer simulations of fugitive dist dispersal around the terminal site.

To obtain a rough estimate of the bulldozing contributions to the fugitive-dust particulates, I used formulas for bulldozing from Table 11.9-1 in AP-42 Section 11.9 Western Surface Coal Mining and used as input parameters the mean values of the coal silt content S = 8.6 and moisture content M = 10.4.[7] I also assumed that one bulldozer would be working the piles for 8 hours per day, 365 days a year. As the larger, heavier particles would likely fall nearby, completely within the terminal site, I calculated only the PM10 and PM2.5 emissions, not the total suspended particulates TSP. My emissions-rate estimates are:

Net E(PM10) = 5.82 ± 3.20 tons/year (range = 2.62 – 9.02 tons/year)

Net E(PM2.5) = 0.47 ± 0.26 tons/year (range = 0.21 – 0.73 tons/year)

These results have been corrected by a 70 percent efficiency factor (or 1.0 – 0.70 = 0.30) to account for the likelihood that the surfaces (but not the interiors) of the coal piles will usually be wetted during bulldozing operations. Uncertainties were estimated by using the low and high values of S = 6.0 and S = 11.3 in the calculations instead of S = 8.6, and averaging the differences that occur.[8] Note in particular that the annual PM10 emissions from bulldozing operations estimated this way are comparable to the contributions in my table above (on p. 2), which were made for *total* suspended particulates TSP and are thus substantially greater than the corresponding PM10 emissions rates. If added, the bottom line for total suspended particulates would increase to 29.3 – 55.3. Including the fugitive coal dust from vehicles driven through the terminal site (which I did not try to estimate), this exercise demonstrates that two major contributions to the fugitive coal dust from terminal operations have been ignored or overlooked in the URS Corporation analysis — further indicative of the lack of sufficient professionalism in its work.

Continued examination of the URS Corporation analysis reveals that its engineers used the lowest possible silt content S = 2.2 percent in their estimates of the fugitive coal dust due to storage pile erosion, as explained at greater length in my prior comment.[9] No

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[7] US Environmental Protection Agency, AP-42 Section 11.9 Western Surface Coal Mining, available at *https://ww3.epa.gov/ttn/chief/ap42/ch11/find/c11s09.pdf*. See Table 11.9-1 on p. 11.9-5 for the bulldozing formulas and Table 11.9-3 on p. 11.9-9 for typical values of parameters S and M to be used in the formulas.

[8] Ibid., Table 11.9-3, which gives the range of measured values of S as extending from 6.0 to 11.3. Other uncertainties would be due to the moisture content assumed, the dust suppression due to wetting, and the duration of bulldozing operations in terms of total hours per day.

[9] This URS Corporation analysis is presented in its Appendix E, attached.

justification is provided for use of this very low number, which yields correspondingly low values of the emissions rates. And there are cogent reasons to believe that the silt content is much higher. This oversight is difficult to explain when measurements of the silt content could easily have been made using samples of Powder River Basin coal from passing trains headed for Canadian ports — another example of URS Corporation's lack of professionalism. If a more credible value of S = 8.6 were used in these calculations, as was done above for the case of bulldozing, the results would have come in a factor of 8.6/2.2 = 3.91 higher, as is reflected in my calculations and in the table on p. 2.

Another serious problem in the URS Corporation analysis, presumably endorsed by ICF International, is the assumption of a 95 percent fugitive-dust reduction efficiency due to spray and fogging systems and to the enclosed conveyor systems. For example, in Section 6.7 Coal Dust, we find the statement:

> A 95% reduction effectiveness was assumed for the enclosed conveyor and spray/fogging systems, which is consistent with a similar facility's draft permit from the Oregon Department of Environmental Quality (2013).[10]

This figure was imported from a previous analysis of the proposed Coyote Island project and has no basis in actual operating experience, as a crucial permit for that project was denied by the Oregon agencies and the project was never built.[11] Moreover, the Coyote Island terminal as proposed had a *completely enclosed* coal-storage-and-transfer system — unlike the MBTL project, which is proposed to employ open coal-storage piles and leave open a portion of its coal-transfer system near the piers, as explicitly stated in the draft NEPA statement:

> All belt conveyors and transfer stations would be fully enclosed, except for the stockpile area and vessel-loading conveyors, which would be open due to their operational requirements.[12]

Therefore the 95 percent figure used in the NEPA DEIS is inadmissible. If one instead uses a more reasonable 90 percent figure in this calculation, the estimated fugitive-dust losses from the ship transfer and conveyors *doubles*, as seen in line 3 of my table on p. 2.

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10 Millennium Bulk Terminals—Longview, Draft NEPA Environmental Impact Statement (ref. 4), p. 6.7-7. A similar unjustified statement about the assumed 95% is made in Section 6.6 Air Quality, p. 6.6-6.

11 I commented on fugitive coal dust from the Coyote Island project and am familiar with its details.

12 Millennium Bulk Terminals—Longview (refs. 4 and 10), p. 6.7-7.

Because the vessel-loading conveyors are to be uncovered, and due to the large coal-dust losses that normally occur during ship loading, these contributions to the total fugitive coal dust from the terminal would act like a *point source*, from which almost all of it would fall immediately into the adjacent waters of the Columbia River. Therefore it should be treated differently from the other emissions contributions. In fact, one should focus upon the total suspended particulates released at this point, rather than PM10 or PM2.5, because essentially *all* the TSP released there will drop into the waters below. As coal loading into ship holds is essentially a bulk-drop operation, one should use equation (1) of AP-42 Section 13.2.4 to calculate the appropriate emissions factor E(TSP):[13]

$$E(TSP) = 0.0032k \times (U/5)^{1.3}/(M/2)^{1.4} \text{ lb/ton},$$

where k = 0.74 for total suspended particulates (TSP);

U = average annual wind speed for the Longview site, or 5.3 mph;

and M = average coal moisture content in percent, or 4.5 as used in the NEPA DEIS.

Using these input values, one obtains E(TSP) = 8.19×10^{-4} lb/ton, which seems like a tiny amount until you consider that 44 million metric tons, or 4.84×10^{7} short tons, of coal are to be loaded annually at maximum throughput. Multiplying by this quantity, one obtains total fugitive-dust development of 19.8 tons/year. Of course, much of this fugitive dust will be contained within the ships' holds, but not the 95 percent optimistically assumed in the NEPA DEIS. Based on the experiences at other coal terminals, this efficiency should range from 50 to 90 percent, depending upon the depth of the coal at any moment. Winds blowing over the open holds will be increased some 20 percent and pull dust up and out due to the well-known Bernoulli effect, which is proportional to the *square* of the wind speed.[14] Using a much more reasonable 70 percent average efficiency factor (multiplying by 0.30), we obtain a total of 5.94 tons of coal dust per year released at the piers during the loading process. The uncertainty in this figure can be estimated by repeating the above calculation using the mean value of M = 6.9 for Western surface coal[15] instead of M = 4.5 in the above equation (which however falls beyond the normal range for which

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[13] US Environmental Protection Agency, AP-42 Section 13.2.4 Aggregate Handling and Storage Piles, *https://www3.epa.gov/ttn/chief/ap42/ch13/final/c13s0204.pdf/*, p. 13.2.4-4.

[14] Michael Riordan, "Estimating Fugitive Coal Dust at the Gateway Pacific Terminal" (ref 1).

[15] AP-42 Section 13.2.4 Aggregate Handling and Storage Piles (ref. 13), Table 13.2.4-1, on p. 13.2.4-2.

this equation is valid) and taking the difference; this yields an uncertainty of 2.67 tons per year. The corresponding range of TSP released at the piers is thus 3.27 to 8.61 tons/year.

Comparing this number with line 3 of my table on p. 2, one can recognize that it represents the dominant fraction of the total fugitive coal dust released from ship loading and conveyors. This number does not include releases from uncovered conveyors at the piers, which presumably extend over the waters of the Columbia River. Releases from those conveyors would necessarily contribute another large quantity of particulates that would fall directly into the river. Combined with the above releases from ship loading, it is not difficult to predict that something like 10 tons of coal per year will enter the river near the piers from these two processes alone. And that amount should be added to the coal dust that would enter river waters from the other, inland operations at the terminal.

Actual experience from other coal terminals has shown that these losses at the piers are the dominant contribution to the coal dust that enters adjacent waters. A close parallel to the MBTL ship-loading process can be found at the Westshore Terminals in Delta, British Columbia, at which the photograph in Fig. 1 was taken. Note especially

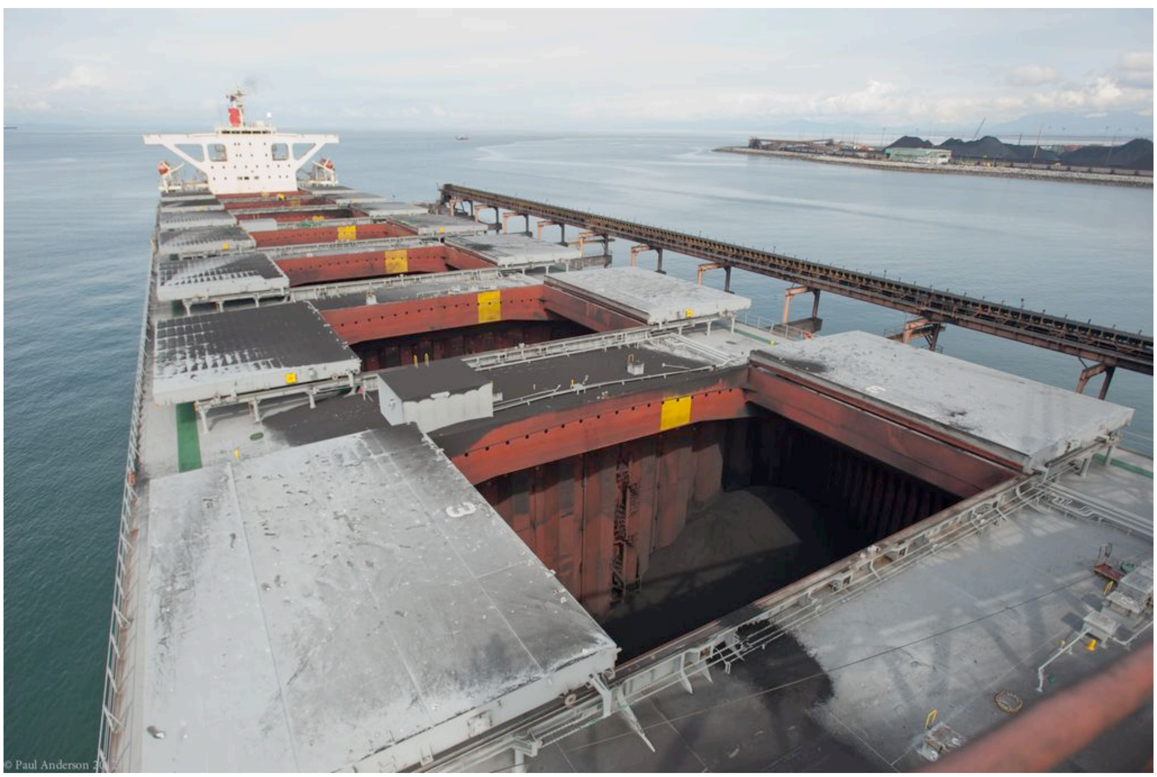

Fig. 1. Coal dust on deck of a bulk carrier being loaded at the Westshore Terminals in Delta, British Columbia (photo credit: Paul K. Anderson).

that the ship holds were filled to less than 50 percent at the time this photo was taken and that there were already large quantities of coal dust on the deck — and presumably that had fallen into the adjacent waters of the Salish Sea. If we assume that 100,000 tons had been loaded by this time, the URS Corporation approach would yield a mere 4 pounds of coal dust released, using the 95 percent efficiency factor. Clearly, this is ridiculously low. This kind of loss can only get worse proportionally as the holds are filled to the brim and the dust kicked up is exposed more directly to the winds passing over the ship. Another important feature to note is the bulk coal dropped onto the deck in the foreground, which often occurs due to operator error as the ship-loading chute passes repeatedly from one hold to the next during loading. The coal that has thus accumulated on the decks of these bulk carriers can then be readily blown into the waters below by ambient winds. Such a process was observed by the person who shot this photograph; it has also been reported and photographed by Lummi fishermen and women working near this coal terminal.[16]

All told, including coal dust losses from ship loading (plus that due to operator error), from uncovered conveyors leading to the piers, and from the remaining terminal operations, one can readily estimate that between 10 and 15 tons of coal annually will fall into the Columbia River near the MBTL piers. An idea of the cumulative impacts of these losses can be obtained from an analysis of the sea floor at Westshore Terminals (Fig. 2).[17]

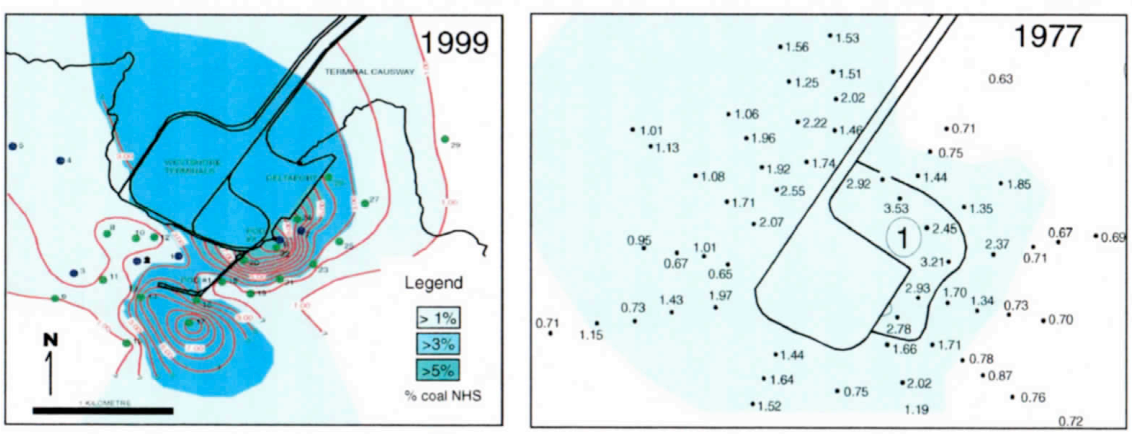

Fig. 2. Coal dust accumulations on the Salish Sea floor adjacent to the Westshore Terminals during a 22-year period from 1977 to 1999 (Johnson and Bustin, ref. 17).

16 Private communications, Paul K. Anderson and Ellie Kinley.

17 Ryan Johnson and R. M. Bustin, "Coal dust dispersal around a marine coal terminal (1977-1999), British Columbia: The fate of coal dust in the marine environment," *International Journal of Coal Geology,* Vol. 68 (2006), pp. 56–69; map reproduced in Fig. 2 from p. 66.

In this instance, the quantity of coal loaded annually was substantially less than half the amount that would be loaded at the MBTL piers, about 22 million tons/year or less, and the loading process was similar, with uncovered conveyors extending over the water and loading chutes that extended well down into the ship holds. Note that coal accumulations of 5 percent or greater were measured just southeast, or downwind in the summer, from the two loading piers at Westshore Terminals; closer to the piers, coal particles exceeded 10 percent of the material sampled from the sea floor. Examination of the coal in these areas revealed large-size particles greater than 100 micrometers in diameter, which most likely occurred from spillage due to operator error, as they are too large to have come from wind-driven fugitive-dust processes.[18] This observation demonstrates that estimates limited to wind-driven coal dust, as done in the SEPA and NEPA environmental impact statements for MBTL, will *dramatically underestimate* the amount of coal particles that reach the floor of the Columbia River. Coal losses in loading due to operator error are extremely important and cannot be ignored — as they were in those studies.

Similar large losses in loading have occurred at coal terminals in Seward, Alaska; Prince Rupert, British Columbia; and Duluth, Minnesota. The last one is most instructive because it shipped Powder River Basin coal and was examined in quantitative detail by physicists from the University of Minnesota, comparing simulations and measurements.[19] For a terminal that shipped 3.3 million tons of PRB coal per year, they calculated that 20 tons of fugitive-coal dust annually entered the harbor waters, plus an additional 12 tons from ship-loading processes. That's almost one ton per 100,000 tons loaded, or 9.7 tons of coal lost per million tons loaded. If we apply the same ratio to the Longview terminal, its coal-dust losses into the Columbia River would total nearly *470 tons per year*! While coal-transfer technologies have evolved substantially since 1980, it is unreasonable to expect that they have improved by more than a factor of 10.[20] Therefore, based on such comparative studies, the *minimum losses* to expect at MBTL are 47 tons/year, not 11.05.

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18 Ibid., p. 64. These regions are each about 0.5 square kilometer, or 0.2 square mile, in total area.

19 Michael Sydor and Kirby Stortz, "Sources and Transports of Coal in the Duluth–Superior Harbor," Duluth Environmental Research Laboratory, Office of Research and Development, US Environmental Protection Agency Report No. EPA-600/3-80-07 (January 1980).

20 Westshore Terminals, for example, has been able to reduce its annual fugitive coal-dust losses from 715 to 177 tons/year by such measures as spraying the coal piles and using covered conveyors, which measures will also be used at MBTL, but that still corresponds to almost 6 tons of coal lost per million tons loaded.

This number agrees with the range of total losses in my table (after the fugitive coal dust due to bulldozing is included), but it is a factor of 4.3 higher than the total given in the NEPA DEIS for MBTL. And the coal-dust lost from ship-loading into the waters of the Columbia River could easily be *a factor of 10 higher* than that given in that DEIS, due to operator error and the exposure of these processes.

A glance at Figure 6.7-2. Estimated Maximum Annual Coal Deposition—On Site Alternative on p. 6.7-10 of the NEPA DEIS indicates that some of the greatest fugitive coal-dust losses from MBTL will indeed occur around the piers and into the river waters below. As in the Westshore Terminals example, the most serious losses would occur in limited areas close to the piers totaling about 0.25 square mile or 0.65 square kilometer. But the NEPA DEIS Section 5.5 on Water Quality explicitly states (on p. 5.5-18):

> Coal dust is anticipated to deposit a maximum of 1.45 grams per square meter per year (g/m^2/year) adjacent to the proposed export terminal, including Docks 2 and 3 in the Columbia River. This amount of deposition is well below the nuisance level . . .

Nothing could be further from the truth. From the analyses presented above, it should be abundantly obvious to the reader that the total annual deposition of 1.45 g/m^2/year given in this DEIS is a *gross underestimate* of the coal dust losses in the vicinity of these piers. A better and more accurate estimate would be at least 10 times that much. For example, a loss of 10 tons/year spread evenly over 0.25 square mile or 0.65 square kilometer (equals 6.5×10^5 m^2) yields 14 g/m^2/year and a loss of 15 tons yields 21 g/m^2/year. And these numbers will come in even larger immediately adjacent to the piers!

In addition, the water-quality analysis in that Section 5.5 assumes that the coal dust would go into suspension in the river waters, which just does not happen. From the Westshore experience, the lightest fugitive particles corresponding to PM10 or smaller would float on the surface and form unsightly mats of coal dust.[21] The heavier particles would slowly descend to the floor with the current and coat the river bottom downstream of the terminal.[22] The DEIS authors however did not attempt to simulate these processes, concluding instead that the coal dust falling into the Columbia River “would result in a

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21 This phenomenon was witnessed repeatedly by Ellie Kinley, who provided me photographs of the mats of coal dust that form on Salish Sea waters near Westshore Terminals.

22 This phenomenon was also witnessed in the Duluth study.

change in suspended sediment of less than 1 part per 10 billion" (p. 5.5-18). To obtain such an unjustifiably low figure, they divide their much-too-small number for coal dust deposition by a much-too-large volume of water, corresponding to 1.16 square miles of the Columbia River rather than the 0.25 square miles of shallow waters adjacent to the MBTL piers. Such a simplistic, specious analysis should be rejected by the Army Corps of Engineers.

Although I have not examined it in sufficient detail, the NEPA DEIS Air Quality analysis in Section 6 will necessarily suffer from the same problems of underestimating the fugitive coal-dust contributions. As the low emissions rates calculated in Appendices C through G of the URS Corporation report are used as crucial inputs to the AERMOD simulations of dust dispersal around the MBTL site, they will be propagated through the entire analysis. Errors and omissions in these input values will result in correspondingly low values of PM10 and PM2.5 that result.[23] Therefore the values of PM10 and PM2.5 that appear for coal dust in Tables 6.6-5 and 6.6-6, for example, will be much too low and should be scaled up by a factor of 4 to 5 to account for these discrepancies, to first order. In some cases, such corrections would lead to results that exceed the NAAQS limits — especially for PM10. And one would expect that the worst off-site impacts will still occur along Mt. Solo Road WNW of the MBTL site, where the maximum monthly and annual coal-dust deposition occurs in the present analysis (see Figs. 6.7-1 and 6.7-2) due to the prevailing ESE winter winds.[24] A better and more credible approach would be to repeat the AERMOD computer simulations using corrected values of the input emissions rates from the various terminal activities, along the lines suggested in my prior comment on the SEPA DEIS.

In the final analysis, much more and far better analytical work must be done on the fugitive coal-dust emission and deposition rates before they can be taken seriously as representative of what will occur in actual practice at the Millennium Bulk Terminals, Longview. What currently appears in the NEPA Draft Environmental Impact Statement and in the supporting URS Corporation report are gross underestimates — by factors of 2

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[23] As we used to joke when I was an MIT graduate student doing computer simulations, "Garbage in, garbage out!"

[24] A good comparison with the Westshore example can be found in Fig. 2, where one will note a large blue dust plume extending NW of the terminal, obviously due to the strong SE winds that occur every winter.

to 7 — of the various fugitive-dust emissions rates. These unreasonably low numbers have been propagated through the AERMOD simulations and result in similar gross underestimates of the inhalable PM10 and PM2.5 particulates that will affect areas around the proposed terminal. But achieving that end will require that this work be done by another company, given URS Corporation's highly questionable prior performance. This work would include the use of reasonable input parameters, such as coal silt content, that can be justified by actual measurements of PRB coal, as well as credible dust-control efficiencies based on measured and documented mitigation performances at existing coal terminals. Unprofessional guesswork must not be allowed.

In the vicinity of the terminal piers, it is especially important to evaluate the total suspended particulates that arise and are released to the aquatic environment below, for these are highly likely to find their way directly into the waters of the Columba River. Here one needs not (and should not) use AERMOD to simulate these losses, as escaping particles will fall directly into the river. In the same vein, the losses due to operator error must be included in these estimates, as they will contribute a substantial fraction of the coal entering these waters. In addition, the behavior of these particles after they reach the surface of the water must be adequately treated, as the different sizes of particles behave very differently in water, with the larger, heavier particles slowly sinking and the smaller, lighter ones remaining on the surface, floating downstream. Finally, the adverse impacts of the settling particles on the benthic habitats near and downstream of the pier should be evaluated — especially their annual and cumulative impacts on migrating salmon species. These latter biological and ecological studies will require additional scientific expertise beyond what appears to have been involved in the draft Environmental Impact Statement.

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