WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

SUITABILITY OF ROCK CRUSHING OPERATIONS FOR AIR QUALITY GENERAL ORDER OF APPROVAL: EVALUATION OF CONTROL TECHNOLOGY, AMBIENT IMPACTS, AND POTENTIAL APPROVAL CRITERIA

FINAL
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In addition to the applicability criteria given above, Ecology recommends that the emission monitoring, recordkeeping and reporting requirements, combined with the approval conditions listed in Section 8, below, be included in the General Order(s) of Approval. **5**

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EXECUTIVE SUMMARY

Ecology's Air Quality Program revised its Notice of Construction rules (contained in Chapter 173-400 Washington Administrative Code) in early 2005 to allow for the establishment of General Orders of Approval. Owners/operators of rock crushers may seek coverage under this general order, but it is not required. Ecology assumes there are certain situations where a source may elect to seek approval to operate from Ecology under the existing New Source Review rules.

Ecology's engineering staff has determined that rock crushing operations meeting the criteria outlined in Table 1, below, are appropriate for issuance of the General Order of Approval. This analysis was based upon the processing of 14,500 tons of material processed in a day. This would equate to a rock crusher with a capacity of 605 tons per hour. In addition, only "virgin" materials were analyzed as opposed to recycled asphalt pavement, concrete, or petroleum contaminated soils.

It became clear that many rock crushers move from "pit to pit" to satisfy the needs of their customers. Therefore, Ecology decided to create General Orders for two categories: stationary rock crushers and portable rock crushers. The majority of the rock crushers in Ecology's jurisdiction are located in rural environments. All of the analyses in this engineering document were based upon siting either the stationary or portable rock crushers in a rural environment because the air dispersion model used is more conservative in a rural environment. Should a rock crusher be proposed in an urban environment and meet the siting criteria listed below, it may become subject to this general order.

Table 1. Rock Crushing Operations Applicability Criteria

Criterion	Limitation
Rock crusher throughput	14,500 tons per day and 1,500,000 tons per year
Control technology	BACT has been determined to be a wet suppression control technology that shall be installed and operated at each emission point (conveyer transfer point, screens, and crushers).
Minimum distance to property line	150 feet (45 meters)
Portable rock crushers	Must not operate in the same location for more than 12 months.
Visible emissions	10% Opacity
Source of electrical power	Stationary rock crushers cannot use portable or stationary diesel engines or diesel generators. There are no restrictions on portable rock crushers.

In addition to the applicability criteria given above, Ecology recommends that the emission monitoring, recordkeeping and reporting requirements, combined with the approval conditions listed in Section 8, below, be included in the General Order(s) of Approval.

1. INTRODUCTION

Purpose

The purpose of this document is to evaluate the emission from rock crushing operations and determine their applicability as a General Order of Approval in Washington state. In addition, a list of minimum requirements, or applicability criteria, will be developed to identify rock crushing operations that would qualify for coverage under the General Order of Approval.

Background

Since 1972, Ecology has required a preconstruction review and permitting program for new sources that will emit pollutants to the air in the State of Washington. This review and permitting process is referred to as "New Source Review" by the state or the relevant local air quality control agency. Based on that review, the relevant agency issues an approval-to-construct and operates the new source. This "Notice of Construction Approval" contains pollutant emission limitations and operating requirements for the new source.

The typical process to obtain a site-specific, individual Notice of Construction air quality permit is described in "How to Apply for a Notice of Construction Air Quality Permit" at http://www.ecy.wa.gov/biblio/ecy070121.html.

Effective February 10, 2005, Ecology revised its regulations to include the General Order of Approval as an alternative to the individual Notice of Construction permit. General Orders of Approval are intended to be a method for owners of commonly permitted, small emission sources to know, prior to committing to purchase and submitting an application to Ecology, what is necessary to comply with Washington's new source review requirement. A significant goal of issuing General Orders of Approval is to simplify the permitting process by reducing the regulatory and administrative burden on the applicant and Ecology. Use of General Orders is intended to reduce the permit processing cost for both the applicant and Ecology.

2. CONSIDERATIONS IN CHOOSING TO EVALUATE ROCK CRUSHING OPERATIONS FOR A GENERAL ORDER OF APPROVAL

Assumptions Used in this Analysis and Recommendations Related to Size and Type of Units

The Ecology Air Quality Program established the following criteria for the General Order of Approval determination. The criteria are:

1. Best Available Control Technology (BACT) and Toxic Air Pollutant-BACT is the same as for a site-specific approval issued during the time the engineering evaluation is developed (in this case 2006).
2. The emissions will not delay the attainment date for any area not in attainment, nor will the emissions cause or contribute to the exceedance of any ambient air quality standard.

3. An emission unit size or type cannot receive a General Order of Approval if the ambient air quality analysis indicates that a Tier 2 review would be required at any potential location.
4. The General Order will assure a covered unit will comply with all applicable new source performance standards, national emissions standards for hazardous air pollutants, national emission standards for hazardous air pollutants for source categories, and emission standards adopted under the Washington State Clean Air Act.
5. The individual emission unit cannot cause a facility to become subject to the Air Operating Permit program or be subject to Prevention of Significant Deterioration (PSD) permitting. However, the facility may be an existing Title V or PSD source.
6. Information content of and analyses described in the technical analysis will be similar to that required in a permit application for this type of emission unit.

Assumptions 1, 2, 4, and 5 reflect the requirements of WAC 173-400-110, 112, 113, and 560 and are requirements for all new source review actions in Washington. Assumption 5 reflects specific requirements for General Orders of Approval found in WAC 173-400-560. Assumption 6 reflects the actuality that this analysis needs to evaluate a number of control options and generic emissions modeling prospectively, rather than a permit application review's retrospective analysis.

Assumption 3 reflects the criteria of the Tier 2 toxic air pollutant review process (WAC 173-460-090). A Tier 2 review is a site-specific analysis of the impacts of toxic air pollutants from a known, existing facility on the surrounding community. A General Order of Approval is developed without a specific site in mind. A General Order of Approval is unable to incorporate the site-specific considerations of the Tier 2 process. In order to reflect this limitation, Ecology is including criteria related to the distance from the described units to property lines and buildings, hills, or other structures that affect ambient air quality concentrations. We are also including criteria to exclude pits that are known to be sources of elevated metals such as arsenic, uranium or other elevated minerals such as asbestos or asbestos-like fibers, principally asbestos, serpentine and olivine. The term "elevated" is not intended to be quantified by numerical testing; rather the term is intended to be used as a qualitative term. Should a source be aware of unique characteristics of a proposed gravel pit, that pit should not seek coverage under this general order and Ecology should not approve coverage for that pit/operation under this general order.

What is a Rock Crusher?

A rock crusher is a machine used to crush (as in taking large rocks as input and producing small rocks and dust as output) any nonmetallic mineral and includes, but is not limited to jaw, gyratory, cone, roll, rod mill, hammer mill, or impactors plus associated screening and materials transfer operations. These sources have been determined to be a routine emission source with minimal impact to ambient the air quality.

The soil which is unearthed by drilling, blasting, excavation, dragline, or suction dredge pumping is loaded into haul trucks, or the crushing equipment, by front-end loaders. The haul trucks dump the soil into bins for crushing, screening, size classification, material handling and storage. The most prominent emissions are in the form of particulate matter. Note: If the

material is wet because it was excavated by dredging, there are usually very few emissions generated.

The soil is processed to separate the large boulders from the smaller rocks by a series of screens. The primary crusher could be a jaw, impact or gyratory type of crusher and produces material in the 3 to 12 inches in diameter range. Undersized material is transferred to a storage pile. The larger material is processed by the secondary crusher (usually a cone or impact crusher) and produces material in the 1 to 4 inches in diameter range. The material is screened again and the larger material is sent to the tertiary crusher, which is usually a cone crusher with output in the 3/16th to 1 inch range.

A typical rock crusher that processes greater than 300,000 tons of rock per year (about 150 tons per hour) and consists of the following components:

- One primary crusher
- One secondary crusher
- One tertiary crusher
- Three screens
- Six conveyers
- 1/8 mile long gravel haul road
- Some form of electricity, such as shore power or an internal combustion diesel engine(s) (direct drive or power generating).

The above equipment can either be mounted on a skid, be trailerable units with road tires and axels attached, or placed on a trailer. Some form of electric power is needed to operate the crushers, screens, and conveyer belts. The more remote the location, the greater the probability that a diesel generator is collocated at the site. Below is a diagram of a typical rock crusher. (Source AP-42, Section 11.19, August 2004)

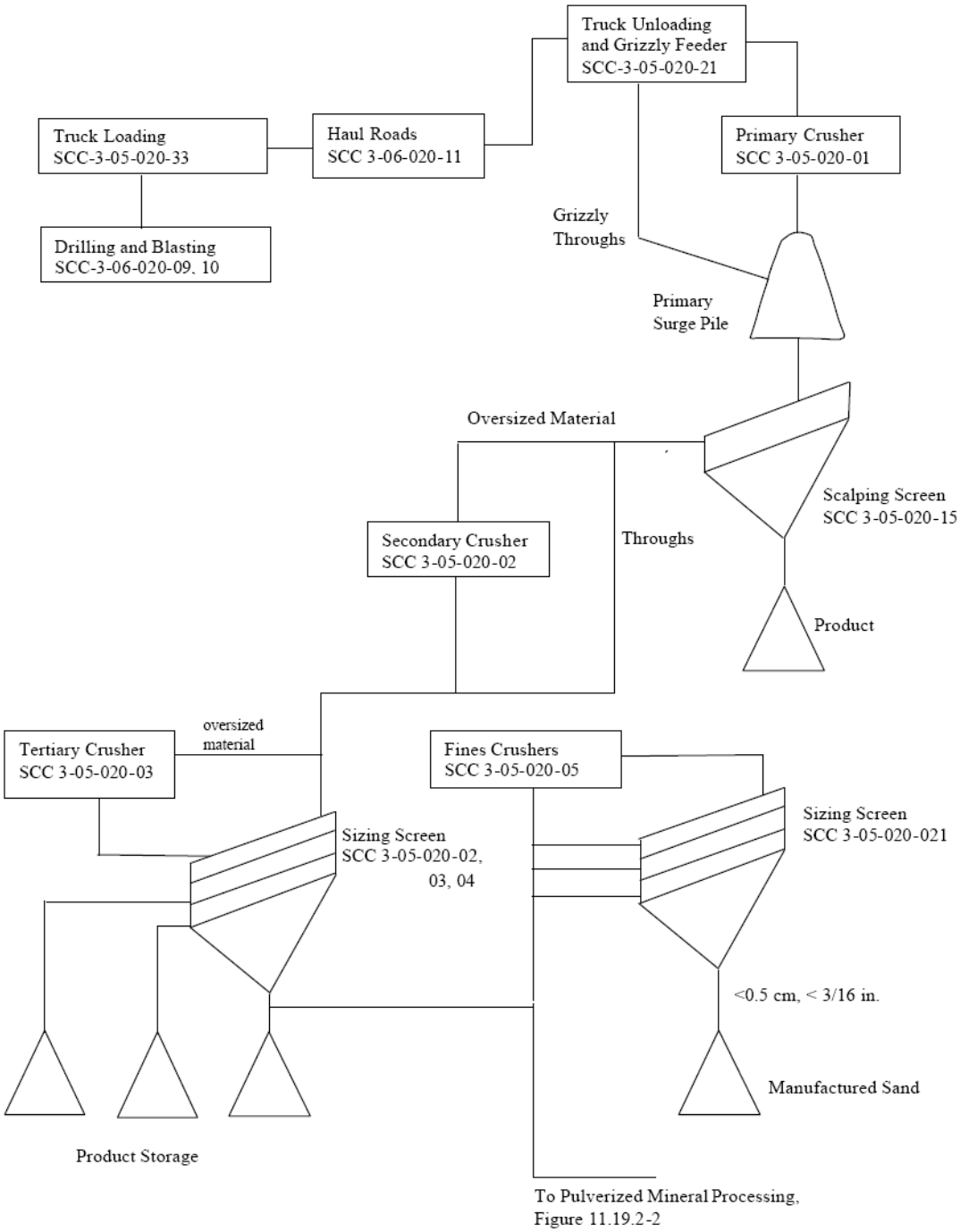

Figure 11.19.2-1. Typical stone processing plant

Diesel IC Engines

A diesel electric generator (otherwise known as a reciprocating internal combustion engine (IC)) operates by compressing a combustible fuel air mixture in a cylinder. The mixture in the cylinder is ignited and the resulting explosion drives the piston down turning a crankshaft. This rotary motion drives an electric generator to produce electricity. Most of the pollutants from an IC engine escape through the unit's exhaust. The primary pollutants are nitrogen oxides (NO_X), carbon monoxides (CO), and particulate matter (PM) and particulate matter smaller than 10 microns in diameter (PM_{10}). In addition, small quantities of sulfur oxides (SO_X), total organic hydrocarbons (TOC), toxic air pollutants (TAP), and smoke are generated.

All rock crushers require some sort of power to operate. Some use electricity from public utility districts (line power), some use direct-drive diesel engines, and many use diesel generators driving electric motors. These diesel engines/generators are classified as non-road engines and their emissions are not accounted for/evaluated in temporary/portable source applications, so their use is not restricted.

Haul Roads

Essentially, a haul road is just a dirt or gravel road that the vehicles travel on when entering and exiting the property. The vehicles traveling over the surface of the road generate emissions. Usually, water is applied to "keep the dust down", but sometimes chemicals (fixidents or crusting agents) are used also.

3. POLLUTANTS OF CONCERN

Rock Crushers

The primary pollutant emitted is particulate matter in the form of PM and PM_{10}, and each emission point has a different emission factor.

Ecology reviewed numerous sources of emission factors for rock crushers. Those sources included the Environmental Protection Agency's (EPA) AP-42, as well as limits used by Ecology regional offices and local air authorities.

Table 2, below, lists emission factors for the emission points with highest emissions from rock crushing operations and compares them to other sources of emissions factors.

Table 2. Emission Factors

Activity	Pollutant	Ecology	**Ecology**	ORCAA	SWCAA	SCAPCA	AP-42 (8/04)	AP-42 (8/04)	AP-42 (7/95)	AP-42 (7/95)	ERO
		uncontrolled	**controlled**				uncontrolled	controlled	uncontrolled	controlled	proposed
		(lb/ton)	**(lb/ton)**	(lb/ton)	(lb/ton)	(lb/ton)	(lb/ton)	(lb/ton)	(lb/ton)	(lb/ton)	(lb/ton)
Screening	PM	0.025	**0.0022**	0.008	0.032	0.00087	0.025	0.0022	NI	NI	0.015
	PM_{10}	0.0087	**0.00074**		0.015		0.0087	0.00074	0.015	0.00084	0.015
Fines	PM	0.3	**0.0036**				0.3	0.0036	0.071	NI	0.071
screening	PM_{10}	0.072	**0.0022**				0.072	0.0022	0.0021	NI	0.071
Product	PM	0.003	**0.00014**	4.8E-05	0.003	0.0011	0.003	0.00014	NI	NI	0.0014
Transfer	PM_{10}	0.0011	**0.000046**		0.0014		0.0011	0.000046	0.0014	0.000048	0.0014
Primary	PM	0.0054	**0.0012**	0.0007			ND	ND	0.0007	NI	0.0024
Crusher	PM_{10}	0.0024	**0.00054**			0.0024	ND	ND	NI	NI	0.0024
Secondary	PM	0.0054	**0.0012**	0.0007	0.005		ND	ND	NI	NI	0.0024
Crusher	PM_{10}	0.0024	**0.00054**		0.0024	0.0024	ND	ND	NI	NI	0.0024
Trtiary	PM	0.0054	**0.0012**				0.0054	0.0012	NI	NI	0.0024
Crusher	PM_{10}	0.0024	**0.00054**			0.0024	0.0024	0.00054	0.0024	0.00059	0.0024
Haul	PM	**7.27 lb/VMT**	**1.5 lb/hr**								
Roads	PM_{10}	**1.85 lb/VMT**	**0.4 lb/lb/hr**		6.2 (lb/VMT)	194 (lb/job)					

Diesel IC Engines

Portable direct drive diesel motors or stationary engines used to generate power or operate the rock crushers have not been evaluated for coverage under this general order. Ecology has not evaluated any pollutants from these engines.

Haul Roads

The primary pollutant emitted is particulate matter in the form of PM and PM_{10}. Ecology reviewed numerous rock crusher permits issued by state and local agencies, EPA's Technology Transfer Network and NPi Emissions Estimation Manual developed by Environment Australia. Ecology chose to use the formula contained in AP-42 Section AP-42 13.2.2-1. That formula is $E=k(s/12)^a(W/3)^b$, where "E" is emissions in pounds of particulate matter per mile traveled; "W" is the vehicle weight; "s" is the silt content of the material, and "k", "a", and "b" are constants.

4. DETERMINATION OF BEST AVAILABLE CONTROL TECHNOLOGY

State law and rule[1] defines BACT as "an emission limitation based on the maximum degree of reduction for each air pollutant subject to regulation under the Washington Clean Air Act emitted from or which results from any new or modified stationary source, which the permitting

[1] RCW 70.94.030(7) and WAC 173-400-030(12)

authority, on a case-by-case basis, taking into account energy, environmental and economic impacts and other costs, determines is achievable for such source or modification through application of production processes and available methods, systems, and techniques, including fuel cleaning, clean fuels, or treatment or innovative fuel combustion techniques for control of each pollutant."

Ecology typically uses the "top-down" process to determine what BACT is for Notice of Construction reviews. In the 'top-down" analysis process, the applicant lists and ranks all potential pollutant control options from highest level of control (lowest emission rate) to the lowest (highest emission rate). Next, those emission control options that are technically infeasible are removed from the list of available controls. The highest level of control remaining is considered technically feasible to implement on the emission unit. When that level of control is proposed by an applicant, it is accepted as BACT with no further analysis involved. An applicant may choose to demonstrate that the highest level of emissions control is not financially feasible (not cost effective) to implement or has adverse environmental or energy impacts. In this case, the applicant evaluates the economic, environmental and energy impacts of the next most stringent level of control until a level of control is demonstrated to be economically feasible.

In the case of this General Order of Approval's technical analysis document, there is no identified applicant. Thus, Ecology is responsible for providing this BACT technology analysis comparing the economic feasibility of several of the available emission control options available as add-on emission control technologies as part of our process to determine what BACT should be for rock crushing operations.

To simplify the scope of our generic BACT analysis for rock crushers, Ecology focused on answering two questions:

1. What emission limits have been placed on rock crushers for each pollutant of concern in other jurisdictions?
2. What level of emissions control is technologically feasible and available?

To answer the first question, Ecology looked at permits from state and local air pollution control agencies as well as the New Source Performance Standards. It appears that the BACT limits are opacity unless the emission point is routed through a stack, building, or control device like a baghouse.

The answer for the second question is based upon reviewing recently issued permits. The NSPS limit is 15 percent opacity, whereas most permits establish a 10 percent opacity limit.

Control Technologies

A search of EPA's RACT/BACT/LAER Clearinghouse, The California Air Resources Board, the Bay Area Air Quality Management District, and numerous permits resulted in very few technologies available for controlling particulate matter emissions from rock crushers. In fact, there were only four abatement technologies identified. They were fabric filters, wet suppression control technology, cyclones, and water scrubbers. Cost information for these technologies have not been collected or evaluated. We do recognize that three of the four technologies require

capturing the emissions in order to route them through a control device. Capturing could occur in a building or with some sort of negative pressure system. We also recognize that capturing emissions in a building or enclosure would have elevated pollution control costs, and that capturing emissions at a temporary rock crushing operation is typically not necessary. Ecology believes that the majority of rock crushers in Washington state are located in gravel pits in rural areas of the state. If a rock crusher is proposing to locate in an urban environment or one where there is PM/PM_{10} attainment issues, approval to install and operate under this general order may not be appropriate.

BACT for controlling emissions of PM/PM_{10} from stationary and portable rock crushing operations has been selected to be wet suppression control technology, which is essentially water spray nozzles or fog bars that result in emissions of particulate matter that result in visible emissions of 10 percent opacity, or less, when measured by 40 CFR 60 Appendix A, Method 9.

For haul roads, BACT has been selected to be Best Management Practices in accordance with the elements in the Fugitive Dust Control Plan (FDCP). All effort should be taken to limit the amount of visible emissions leaving the site. Emissions of opacity from haul roads should be minimized to reduce the impact of the haul road on the properties adjacent to the site. Ecology is not requiring the source to monitor haul road emissions using EPA Method 9. Rather, we believe that the source can "self-monitor" and follow the requirements outlined in the FDCP. Not following the FDCP may be a justification for enforcement by the appropriate regional office. The attached FDCP includes elements such as watering/oiling gravel roads.

Emissions Calculations

Haul Roads

The AP-42 formula that was used is: $E=k(s/12)^a(W/3)^b$. The table, below, lists the factors used in the equation. All of the factors, except the mean vehicle weight, were derived from AP-42 Section 13.2.2, dated December 2003.

Table 3. Factors Used in the Above Equation

Factor	PM	PM_{10}
k = constant, for industrial roads	4.9	1.5
a = constant for industrial roads	0.7	0.9
s = surface material silt content	4.8	4.8
W = mean vehicle weight (tons)	80,000 loded/40,000 unloaded	80,000 loded/40,000 unloaded
b = constant for industrial roads	0.45	0.45
E = emissions in lb/VMT	**7.27**	**1.85**

As you can see, this formula result in 7.27 pounds of PM per Vehicle Mile Traveled (VMT) and 1.85 pounds of PM_{10} per VMT. In order to calculate the pounds of PM and PM_{10} emitted per year, the following formula was used: Emis=(M/(ws*T))*(# of trips)*(2L)*(E)*(1-C).

Table 4. Assumptions for the Formula Above

Factor	Value
Emis = emissions	Pounds per year
M = material processed	2,000,000 tons per year
ws = weight of soil	2.05 tons per cubic yard
T = volume of truck in cubic yards	10 cubic yards
L = length of haul road	1/8 mile each way
E = emissions in lb/VMT	See table above
C = Control efficiency	85%

Table 5. The Results

	PM	PM_{10}
Pounds per year	13,299	3,384
Tons per year	6.6	1.7
Number of tucks per hour	6	6
Pounds per hour	**1.5**	**0.4**

It was impossible to model the emissions associated with the haul road using the elementary screening model (SCREEN 3). Therefore, Ecology estimated the emissions from a 10 cubic-yard dump truck traveling over a one-eighth of a mile gravel road once every ten minutes for a year. We then calculated the pounds of particulate matter emitted and included that value with the rock crusher emissions and modeled this value as a point source to ensure that the emissions would be below the National Ambient Air Quality Standards. The sources will be required to develop and follow a Fugitive Dust Control Plan (FDCP) to control fugitive dust from haul roads as well as all fugitive dust generated from rock crushing operations. Those FDCP's include active oversight and/or daily action to be taken by the owner/operator of the rock crusher in order to minimize or eliminate fugitive emissions from trucks entering and exiting the rock crushing area. Ecology realizes that in order to load out 14,500 tons of material in a day, a 10 cubic yard dump truck would need to be loaded every two minutes, every day. This is not going to happen. The majority of the material is expected to be stored on site and retrieved as needed. The estimate above is a truck being loaded every 10 minutes. This is still probable over estimating the emissions, but is closer to what could be expected.

IC Diesel Engines

As discussed above, the emissions from diesel IC engines have not been quantified because they are not applicable to portable rock crushers. Stationary rock crushers wishing to use portable diesel generators, portable direct drive diesel motors or stationary engines to generate power or operate the rock crusher are required to seek a Notice of Construction from the appropriate regional office.

Rock Crusher

Ecology estimated the emissions using SCREEN3. SCREEN3 is a single source Gaussian plume model which provides maximum ground-level concentrations for point, area, flare, and volume sources. The model output was based upon 5,300,000 tons of material processed per year. This equates to approximately 14,500 tons of material processed per day, or 605 tons per hour. 5,300,000 tons of material is a pretty big rock crusher. It's unlikely that a rock crusher would actually process this much material in a year.

Table 6. PM and PM_{10} Emissions from the Different Emission Points

Activity	Pollutant	Tons of Material	Emission Factors (lb/ton)	PM lb/hr	PM_{10} lb/hr	PM tons/yr	PM_{10} tons/yr
Product Transfer	PM	5300000	0.00014	0.084703		0.371	
	PM_{10}	5300000	0.000046		0.027831		0.1219
Screening	PM	5300000	0.0022	1.33105		5.83	
	PM_{10}	5300000	0.00074		0.447717		1.961
Primary Crusher	PM	1325000	0.0012	0.181507		0.795	
	PM_{10}	1325000	0.00054		0.081678		0.35775
Screening	PM	1325000	0.0022	0.332763		1.4575	
	PM_{10}	1325000	0.00074		0.111929		0.49025
Product Transfer	PM	1325000	0.00014	0.021176		0.09275	
	PM_{10}	1325000	0.000046		0.006958		0.030475
Secondary Crusher	PM	993750	0.0012	0.13613		0.59625	
	PM_{10}	993750	0.00054		0.061259		0.268313
Screening	PM	993750	0.0022	0.249572		1.093125	
	PM_{10}	993750	0.00074		0.083947		0.367688
Product Transfer	PM	993750	0.00014	0.021176		0.069563	
	PM_{10}	993750	0.000046		0.006958		0.022856
Tertiary Crusher	PM	149062.5	0.0012	0.13613		0.089438	
	PM_{10}	149062.5	0.00054		0.061259		0.040247
Fines screening	PM	149062.5	0.0036	0.249572		0.268313	
	PM_{10}	149062.5	0.0022		0.083947		0.163969
Product Transfer	PM	149062.5	0.00014	0.021176		0.010434	
	PM_{10}	149062.5	0.000046		0.006958		0.003428
			Subtotal	2.44	0.87	10.67	3.83
			Haul roads	1.5	0.4	6.6	1.7
			TOTAL	**3.94**	**1.27**	**17.27**	**5.53**

5. AMBIENT IMPACT ANALYSIS

Compliance with National Ambient Air Quality Standards

All notice of construction applications are required to be evaluated for their ambient air quality impacts. "Ambient air" means the surrounding outside air, the air outside of buildings to which the public has access. In other words, this is the air we all breathe.

The federal government has established National Ambient Air Quality Standards for six common air pollutants. Ecology has adopted these standards with minor changes and also has one additional ambient air quality standard that applies in Washington. All new and modified sources of air pollution in Washington are required to demonstrate that the project will not cause, or contribute to, an exceedence of one or more of these ambient air quality standards.

Ecology used an air quality plume dispersion model to determine whether the ambient impacts from a proposed project will be acceptable. The dispersion model predicts the ambient air concentrations of the various air pollutants caused by the project. The results of the model were compared with the ambient standards to see if the project will cause or contribute to an exceedance of the standard.

Table 6 presents the National Ambient Air Quality Standards (NAAQS) and Washington State Ambient Air Quality Standards (AAQS) for Class II Areas.

National Ambient Air Quality Standards				
Pollutant	Averaging Time	National		Washington State AAQS
		Primary	Secondary	
PM_{10}	Annual	50 $\mu g/m^3$	50 $\mu g/m^3$	50 $\mu g/m^3$
	24-hr.	150 $\mu g/m^3$	150 $\mu g/m^3$	150 $\mu g/m^3$

As discussed in the following section, Ecology performed dispersion modeling using the SCREEN3 model to determine if there would be any difficulties with complying with the above ambient air quality standards. A model unit was used to determine the ambient air quality impacts of a rock crusher. The results of the SCREEN3 model run for 5,300,000 tons of material processed in a year indicate that the emissions do not exceed either the NAAQS or the Washington State AAQS when a background concentration of 60 $\mu g/m^3$ is added. The maximum concentration for a rock crusher occurs at 44 meters from the crusher. Between the crusher and 44 meters, the plume has not looped down far enough to reach nose height (1.7 meters) of an average adult. Staff modeled a flagpole receptor on a hill, adjacent to the rock crusher. The results of that modeling showed that at 45 meters from the rock crusher, the emissions are below the 24-hour NAAQS. This is equal to about nine pickup trucks placed bumper to bumper between the rock crusher and the hill. Ecology believes that this is a reasonable distance; therefore, a siting restriction of 150 feet to the nearest hill will be placed in the general order. $PM_{2.5}$ was not modeled against the NAAQS. Ecology believes that there is very little $PM_{2.5}$ present because $PM_{2.5}$ is a product of combustion.

Table 7. Comparison of the Emissions to the 24-hour PM_{10} NAAQS

Distance from Source	Maximum Modeled Ambient Concentration µg/m^3 (1-hr average)	Maximum Modeled Ambient Concentration µg/m^3 (24-hr. average)	Background Concentration µg/m^3	Total Maximum Modeled Ambient Concentration µg/m^3	NAAQS µg/m^3 (24-hr. average)
44	1388.00	222.80	60	149.12	150
45	1385.00	222.32		148.93	
50	1366.00	219.27		147.71	
55	1349.00	216.54		146.62	
60	1331.00	213.65		145.46	
65	1314.00	210.92		144.37	
70	1298.00	208.35		143.34	

Processing 5,300,000 tons of material each year would result in emissions above the annual average NAAQS. Therefore, a maximum annual restriction of 1,500,000 tons of material processed each year is being placed in the permit in order to stay below the annual NAAQS.

Table 8. Comparison of the Emissions to the Annual PM_{10} NAAQS

Distance from Source	Maximum Modeled Ambient Concentration µg/m^3 (annual average)	Background Concentration µg/m^3	Total Maximum Modeled Ambient Concentration µg/m^3	NAAQS µg/m^3 (annual average)
44	38.30	11.13	49.43	50
45	38.21		49.34	
50	37.69		48.82	
55	37.22		48.35	
60	36.72		47.85	
65	36.25		47.38	
70	35.81		46.94	

As can be seen, emissions of PM_{10} are below the 24-hour and annual average National and State Ambient Air Quality Standards.

6. DISPERSION MODELING

There are a number of dispersion models available for use. All of them use mathematical formulas and meteorological information to predict where the exhaust emissions will travel and the ambient concentrations at specific locations. Models generally come in two forms, screening models and complex models. In most cases, the models use the same formulae. The differences occur in the level of detail of the emission source(s) and meteorological information required by the model. Screening models use a set of default meteorological characteristics and reports which characteristics give the highest pollutant concentration, and the resulting concentration. More complex models require actual weather conditions for the site or the region around the site. Due to their simpler meteorological input characteristics, screening models are typically conservative, in other words, screening models will usually over-predict the ambient

concentrations compared to what would be actually measured (and compared to what would be predicted by a more complex model).

Selection of Model for Use in this Project

Ecology chose to use the SCREEN3 model for predicting ambient concentrations. This is a common screening model that has been recognized by EPA as suitable for this purpose and has been in common use for over the past 15 years. There are other models that the engineering team could choose, but this one is both the simplest to use and the one most often used by small facilities and Ecology in determining ambient air quality impacts from a given facility.

Screening models have one other characteristic that is especially useful to this analysis. The nature of the model is such that if a value of one (1) is used as the input emission rate, that value can be directly scaled to any emission rate. This reduces the number of model iterations required to complete this analysis.

Emission Unit assumptions

Staff chose to estimate the size of a rock crusher and sum all of its emissions into one emission point. The total was then modeled as a 'volume' source which is more appropriate to this type of emission source.

Model Inputs Used

Table 9. Model Inputs Ecology Chose

Description	Model Input
Source type	Volume
Source height (emission release point)	5.0 meters
Lateral dimension of source	20.0 meters
Vertical dimension of source	10.0 meters
Receptor Height	1.7 meters
Urban/Rural Option	Rural
Met	Full meteorology
Flagpole Receptor	10 meters

Applicability Criteria Derived from Potential Ambient Impacts

Our evaluation concluded that there are no unacceptable short-term impacts from processing 14,500 tons of material per day or long-term impacts associated with processing 1,500,000 tons of material each year.

7.0 REGULATORY REQUIREMENTS

There are a number of regulations that apply to the installation and operation of rock crushers proposed for coverage under this General Order of Approval. The following is a listing of those requirements. Some of these requirements result in notification, monitoring, and reporting

requirements. There are also requirements related to periodic payment of fees and reporting of emissions. The Engineering Team recommends that these requirements be included in the text of the General Order of Approval, so the applicant understands what is expected once coverage is granted.

Title 70 RCW, Chapter 70.94, "Washington Clean Air Act"

70.94.152 (3) requires that any order that is adopted under this chapter shall be in accord with this chapter, or the applicable ordinances, resolutions, rules, and regulations adopted under this chapter.

70.94.152 (7) requires that any features, machines, or devices that are the subject of an order shall be maintained and operated in good working order.

70.94.152 (10) requires that any notice of construction approval issued under (3) above shall include a determination that the source will achieve best available control technology (BACT).

State Regulations

WAC 173-400-99 through 104

These sections deal with the source registration program. Section 100 defines which facilities are subject to the registration program and payment of periodic registration fees.

WAC 173-400-105

Subsection (1) relates to submittal of annual emission inventory information.
Subsection (2) relates to the ability of Ecology to request emissions testing.
Subsection (3) relates to site access by agency personnel at reasonable times to ascertain compliance or investigate complaints.

Under WAC 173-400-110

Subsection (5) (d) Exemption threshold table has the following exemption limits requiring new source review for criteria pollutants:

Total suspended particulate (TSP)	= 1.25 tons per year
Particulate matter less than 10 microns (PM_{10})	= 0.75 tons per year
Carbon monoxide (CO)	= 5.00 tons per year
Nitrogen oxides (NOx)	= 2.00 tons per year
Sulfur oxides (SO_2)	= 2.00 tons per year
Volatile Organic Compounds (VOC)	= 2.00 tons per year
Lead (Pb)	= 0.005 tons per year

WAC 173-440-115

Lists the New Source Performance Standards (NSPS) that apply to this general order of approval. Please contact Heather Valdez EPA Region 10 at valdez.heather@epa.gov or (206) 553-6220 for more information.

Chapter 173-460 WAC "New Sources of Toxic Air Pollutants"

Does not allow facilities discharging toxics listed under WAC 173-460-150 and WAC 173-460-160 to be exempt from new source review.

WAC 173-460-080, Subsection (2) (e)

Small Quantity Emission Rate (SQER) tables does allow facilities discharging small quantities of chemicals listed under WAC 173-460-150 and WAC 173-460-160 to be exempt from air modeling of the plumes.

Federal Regulations

- 40 CFR 60.4 – Lists the address to send a copy of required Notifications to the Administrator
- 40 CFR 60.7 Notification and Recordkeeping requirements for all NSPS sources. This section defines minimum notifications for NSPS applicable sources.
- 40 CFR 60.8 Performance tests – This section discusses criteria applicable to performance testing of emission units subject to NSPS requirements.
- 40 CFR 60.11 Compliance with standards and maintenance requirements. This section includes direction to the owner to maintain and operate the associated emission control equipment "in a manner consistent with good air pollution control practice for minimizing emissions".

8.0 OTHER RECOMMENDED APPROVAL CONDITIONS

Below are the recommended approval conditions for the two rock crushers (stationary and portable). The majority of the conditions are identical for both stationary and portable rock crushers with the exception of a few. The categories are performance testing, opacity, state and federal requirements, other conditions, recordkeeping and reporting, stationary rock crushers only and portable rock crushers only. Ecology is excluding stationary rock crushers wishing to use on-site diesel engines/generators from coverage under this general order. Emissions from portable non-road engines are exempt from evaluation and therefore allowed under temporary rock crushers. If a source wished to obtain authorization for a stationary rock crushed with diesel electrical generating equipment then they will need to obtain a Notice of Construction permit from the appropriate regional office.

Performance Testing Approval Conditions

Many of the rock crushers proposed for coverage under this General Order of approval are subject to the requirements of the federal NSPS regulations. Please contact Heather Valdez EPA Region 10 at valdez.heather@epa.gov or (206) 553-6220 for more information.

Visible Emissions Approval Condition

Rock crushers will always make some amount of dust. A visible emissions limit of 10 percent opacity is set for each emission point. At no time shall visible emissions leave the property.

- Recommended Approval Condition: Opacity from each product transfer, screening , and crushing point shall not exceed 10 percent opacity when averaged over six (6) minutes. The owner/operator shall take an opacity reading from each emission point at least once per week when the crusher is in operation by a certified Method 9 opacity reader.

Approval Conditions based on Requirements in State and Federal Regulations

The following recommended approval conditions are all derived from the regulatory requirements listed above. Ecology expects that most rock crushers approved under this General Order of Approval will be for applicants that are not highly knowledgeable of the various requirements of state and federal air pollution control regulations. In order to be clear to the applicant/permittee of its obligations, it is reasonable that this General Order of Approval then include the necessary requirements that apply to the rock crusher. The following are the various requirements condensed in to proposed approval conditions. Many of these conditions are copied from existing Notice of Construction approvals and PSD permits.

- Recommended Approval Condition: Unit installation information. The permittee shall submit to Ecology the following information:
    a. The date installation of the rock crusher is complete with anticipated startup date. The anticipated startup date must be no later than 30 days after the installation completion date
    b. Submit actual startup date no later than 15 days after initial startup date.

- Recommended Approval Condition: Operation and Maintenance.
    a. The permittee shall develop and follow an Operations and Maintenance Plan. The plan shall be based upon the recommended operation and equipment maintenance provisions supplied by the manufacturer of the unit.
    b. If the visual inspection for opacity indicates that any opacity can be seen, the permittee is to take immediate steps to bring the equipment back into compliance with the limitation.
- Recommended Approval Condition: Periodic emissions inventory information and other information may be requested by the Ecology. Information requested by Ecology shall be submitted within 30 days of receiving the request unless otherwise specified in the

request. Ecology will supply the necessary forms to use for the periodic emission inventory.

- Recommended Approval Condition: Annual/Periodic Registration or Air Operating Permit fees. The applicant will pay the required registration fees within 30 days of receipt of the invoice from Ecology.
- Recommended Approval Condition: Receipt of this General Order requires the permittee to register the applicable source emission unit(s) with Ecology. Upon request, the permittee shall submit an inventory of emissions from the applicable source emission unit(s) and make payment of all applicable registration fees.
- Recommended Approval Condition: Access to the source for the purpose of determining compliance with the terms of this General Order of Approval by Ecology staff shall be permitted during normal business hours. Failure to allow such access is grounds for an enforcement action under the Washington State Clean Air Act.

Approval Conditions Recommended by Others

- Stockpiles shall be located to minimize exposure to wind. No stockpiles shall be located within 50 feet of the property boundary.
- Recommended Approval Condition: This General order is not valid for soils that are a known source of elevated metals such as arsenic, uranium or other elevated minerals such as asbestos or asbestos like fibers, principally asbestos, serpentine and olivine.

Other Approval Conditions

Ecology has been involved in issuing permits for rock crushers for a number of years. Therefore, we recommend these conditions in order to prevent various future regulatory problems. If the applicant cannot comply with the following conditions, then in order to operate their rock crusher they will need to apply for a Notice of Construction permit from the local Ecology office.

- A wet suppression control technology has been determined to be sufficient to control particulate matter emission from process emission points that include conveyer transfer points, screens, and crushers. A 10 percent opacity limit was set for all visible emissions from each conveyer transfer points, screen, crusher, and fugitive emission source.
- The owner or operator shall develop and follow a fugitive dust control plan. The purpose of the fugitive dust control plan is to develop a methodology for controlling emissions from materials handling, stockpiles, unpaved roads, paved roads, and surface disturbed areas. An example of a fugitive dust control plan will be provided as an attachment to this engineering document.
- Recommended Approval Condition: Rock crushers shall be at least 150 feet from the property boundary.
- The provisions of this General Order of Approval are severable, and if any provision of this authorization, or application of any provisions of this authorization to any circumstance is held invalid, the application of such provision to their circumstances, and the remainder of this authorization, shall not be affected thereby.
- The applicant is required to comply with applicable rules and regulations pertaining to air quality, and conditions of operation imposed upon issuance of this order. Any violation of applicable state and/or federal air quality rules and regulations or of the

terms of this approval shall be subject to the sanctions provided in Chapter 70.94 RCW. Authorization under this Order may be modified, suspended, or revoked in whole or part for cause including, but not limited to, the following:

a. Violation of any terms or conditions of this authorization.

b. Obtaining this authorization by misrepresentation or failure to disclose fully all relevant facts.

Recordkeeping and Reporting

The applicant shall record, compute, and submit the following annual information to Ecology no later than April 15 of each year. All information will be for the calendar year prior to the submittal date:

- Visible emissions observation readings
- Annual production records for the rock crusher
- Dates and location of operation for the rock crusher

Stationary Rock Crushers Only

- No portable or stationary electric gas or diesel generators, no direct drive IC engines. Electricity must come from some off-site source of power (line power).

Portable Rock Crushers Only

A portable rock crusher permit is limited to operating 364 days less than one year at a location. It does not have to remain located in the same site as long as the application identifies all possible locations. Additionally, a portable rock crusher cannot setup and begin operations in a gravel pit that already has a portable rock crusher operating on site. It is assumed that some gravel pits may be seasonal in their use. The 1,500,000 ton per year processing limitation is for each location the portable rock crusher operates.

- No restrictions on power source.
- Application must identify all proposed locations the unit will set up for the duration of the permit.

9. CONCLUSION

Ecology finds that all of the conditions necessary to issue a General Order have been satisfied. Sources wishing to, or that meet the minimum requirements identified in this engineering document, may apply for coverage in either the stationary or portable general orders.

10.0 ABBREVIATIONS AND ACRONYMS

AAQS	Ambient Air Quality Standards
BACT	Best Available Control Technology
CFR	Code of Federal Regulations
CO	Carbon monoxide

ERO	Eastern Regional Office
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
FDCP	Fugitive Dust Control Plan
hr/yr	hours per year
IC	Internal Combustion
NAAQS	National Ambient Air Quality Standards
NSPS	New Source Performance Standard
NOC	Notice of Construction
NO_X	oxides of nitrogen
NSPS	New Source Performance Standard
ORCAA	Olympic Region Clean air Agency
PM	particulate matter
$PM_{2.5}$	particulate matter smaller than 2.5 micrometers in diameter
PM_{10}	particulate matter smaller than 10 micrometers in diameter
PSD	Prevention of Significant Deterioration
RCW	Revised Code of Washington
SCAPCA	Spokane County Air Pollution Control Authority
SO_X	Sulfur oxides
TAP	Toxic air pollutants
TOC	Total organic compounds
TSP	Total Suspended Particulate (same thing as PM)
VMT	Vehicle miles traveled
WAC	Washington Administrative Code
%	percent

APPENDICES

Appendix A
Identification of Indicator Pollutants

Criteria Pollutants

PM

The smaller the particle of particulate matter from rock crushers, the greater the concern. The bigger partials fall out of suspension from the air rather quickly, but the smaller particles can cause a variety of environmental problems. These include respiratory problems in humans and animals due to inhalation and deposition on plants and soil, due to atmospheric fallout. Staff could not find emission factors for $PM_{2.5}$ and we believe that it is unlikely that emissions of $PM_{2.5}$ from rock crushers are significant.

There are no other pollutants of concern from rock crushing operations.

Toxic Air Pollutants

There has been no evaluation of toxic air pollutants performed for this permit. As discussed above, certain gravel pits contain elevated metals such as arsenic, uranium or other elevated minerals such as asbestos, serpentine or olivine. We believe that it is inappropriate to require the applicant to test the soil for metals or to put limits in the permit. Therefore, known sources of elevated metals must seek a regular NOC permit in order to operate.

Appendix B
Background Concentration of PM_{10}

The following was received from Clint Bowman of the Washington State Department of Ecology. Mr. Bowman recommended that 60 µg/m^3 be used as background for emissions of PM_{10} on a 24-hour average.

Background Concentrations in Eastern Washington

The Air Quality Program began monitoring PM_{10} at the Turnbull Slough Wildlife Refuge in 1991. The Turnbull Slough site is well placed to be representative of background concentrations. It is located about 15 miles south-southwest of Spokane, WA, in a region with native grasses and some deciduous trees well-removed from anthropogenic sources of particulate matter.

A brief study in the early 90s calculated a background concentration using TSP (total suspended particulate) data acquired over a 20-year period (1971-1991). The data were subjected to various running median filters to remove the effects of the Mt. St. Helens eruption to effectively compute the median concentration for each day of the year. A comparison with monitors located in Kennewick and Wallula seemed to show that background concentrations could be higher in these more southern locations. However, both of the Kennewick and Wallula sites are influenced by urban and/or industrial emissions and are not adequate for background determination.

The summary statistics for each month are calculated without removing any natural events. The highest observed value occurred in October 1991; the second highest in September 1992. Otherwise, the yearly maximum observed PM_{10} value remained below 61 ug/m^3. Although the TSP derived background value more closely approximated the median, access to better tools allows other statistics to be readily calculated.

Turnbull Slough PM10 (1991-2001)

January

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	N
2.000	4.000	8.000	8.431	11.500	22.000	51

February

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	N
1.000	4.750	9.000	8.854	12.250	19.000	48

March

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	N
1.000	6.000	8.000	9.179	10.250	28.000	56

April

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	N
3.00	6.00	9.00	11.00	11.75	59.00	58

May

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	N
1.00	8.00	13.00	15.98	21.00	50.00	61

June

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	N
1.0	9.0	12.0	12.2	15.0	26.0	56

July

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	N
1.00	9.00	14.00	16.02	20.00	69.00	59

August

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	N
1.00	13.50	22.00	19.97	27.50	46.00	56

September

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	N
1.00	1.40	12.00	14.78	21.00	146.00	37

October

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	N
1.00	7.25	12.00	21.28	21.00	483.00	69

November

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	N
2.00	5.00	8.00	11.19	16.25	35.00	48

December

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	N
2.00	4.00	6.50	7.64	10.00	19.00	52

Prudence suggests that a value between the median and the maximum should be used. Accordingly, the third quartile will be used to define the background PM_{10} concentration for each calendar month. The following plot shows the same data as the table above.

Appendix C
Modeling Results for Rock Crusher without Flagpole Receptors

```
                                        01/30/06
                                        13:40:58
 ***  SCREEN3 MODEL RUN  ***
 *** VERSION DATED 96043 ***

 Rock Crusher no Flagpole Receptors

 SIMPLE TERRAIN INPUTS:
   SOURCE TYPE            =      VOLUME
   EMISSION RATE (G/S)     =     1.00000
   SOURCE HEIGHT (M)       =      5.0000
   INIT. LATERAL DIMEN (M)  =     20.0000
   INIT. VERTICAL DIMEN (M) =     10.0000
   RECEPTOR HEIGHT (M)     =      1.7000
   URBAN/RURAL OPTION      =       RURAL

 THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
 THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.


 BUOY. FLUX =     .000 M**4/S**3;  MOM. FLUX =     .000 M**4/S**2.

 *** FULL METEOROLOGY ***

 **********************************
 *** SCREEN AUTOMATED DISTANCES ***
 **********************************

 *** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

   DIST     CONC           U10M   USTK  MIX HT   PLUME   SIGMA   SIGMA
   (M)   (UG/M**3)   STAB  (M/S)  (M/S)    (M)   HT (M)   Y (M)   Z (M)  DWASH
 -------  ----------  ----  -----  -----  ------  ------  ------  ------  -----
     1.   .0000       0     .0    .0     .0     .00     .00     .00
   100.   1104.       6     1.0    1.0 10000.0    5.00   23.26   11.09    NO
   200.   903.9       6     1.0    1.0 10000.0    5.00   26.46   12.13    NO
   300.   756.1       6     1.0    1.0 10000.0    5.00   29.61   13.13    NO
   400.   653.1       6     1.0    1.0 10000.0    5.00   32.73   13.86    NO
   500.   565.9       6     1.0    1.0 10000.0    5.00   35.82   14.74    NO
   600.   496.4       6     1.0    1.0 10000.0    5.00   38.88   15.58    NO
   700.   440.0       6     1.0    1.0 10000.0    5.00   41.92   16.39    NO
   800.   393.4       6     1.0    1.0 10000.0    5.00   44.93   17.19    NO
   900.   354.3       6     1.0    1.0 10000.0    5.00   47.92   17.96    NO
  1000.   321.3       6     1.0    1.0 10000.0    5.00   50.89   18.71    NO

 MAXIMUM 1-HR CONCENTRATION AT OR BEYOND     1. M:
    44.   1244.       6     1.0    1.0 10000.0    5.00   21.49   10.56    NO

  DWASH=   MEANS NO CALC MADE (CONC = 0.0)
  DWASH=NO MEANS NO BUILDING DOWNWASH USED
  DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
  DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
  DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB
```

```
**********************************
*** SCREEN DISCRETE DISTANCES ***
**********************************

*** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

  DIST     CONC           U10M   USTK  MIX HT   PLUME   SIGMA   SIGMA
   (M)   (UG/M**3)   STAB  (M/S)  (M/S)    (M)   HT (M)   Y (M)   Z (M)  DWASH
-------  ----------  ----  -----  -----  ------  ------  ------  ------  -----
    10.  .0000       0     .0     .0     .0     .00     .00     .00
    40.  .0000       0     .0     .0     .0     .00     .00     .00
    45.  1241.       6    1.0    1.0 10000.0    5.00   21.49   10.56    NO
    50.  1227.       6    1.0    1.0 10000.0    5.00   21.65   10.62    NO
    55.  1212.       6    1.0    1.0 10000.0    5.00   21.81   10.68    NO
    60.  1198.       6    1.0    1.0 10000.0    5.00   21.97   10.75    NO
    65.  1184.       6    1.0    1.0 10000.0    5.00   22.14   10.81    NO
    70.  1170.       6    1.0    1.0 10000.0    5.00   22.30   10.87    NO
    75.  1157.       6    1.0    1.0 10000.0    5.00   22.46   10.93    NO
    80.  1154.       6    1.0    1.0 10000.0    5.00   22.62   10.87    NO
    85.  1141.       6    1.0    1.0 10000.0    5.00   22.78   10.93    NO
    90.  1128.       6    1.0    1.0 10000.0    5.00   22.94   10.98    NO
    95.  1116.       6    1.0    1.0 10000.0    5.00   23.10   11.03    NO
   100.  1104.       6    1.0    1.0 10000.0    5.00   23.26   11.09    NO

 DWASH=   MEANS NO CALC MADE (CONC = 0.0)
 DWASH=NO MEANS NO BUILDING DOWNWASH USED
 DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
 DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
 DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

    ****************************************
    *** SUMMARY OF SCREEN MODEL RESULTS ***
    ****************************************

 CALCULATION        MAX CONC    DIST TO   TERRAIN
  PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
--------------    -----------   -------   -------
SIMPLE TERRAIN      1244.          44.       0.


****************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****************************************************
```

Appendix D
Modeling Results for Rock Crusher with Flagpole Receptors

01/30/06
10:33:59

*** SCREEN3 MODEL RUN ***
*** VERSION DATED 96043 ***

Rock Crusher Flag Pole

SIMPLE TERRAIN INPUTS:
SOURCE TYPE = VOLUME
EMISSION RATE (G/S) = 1.00000
SOURCE HEIGHT (M) = 5.0000
INIT. LATERAL DIMEN (M) = 20.0000
INIT. VERTICAL DIMEN (M) = 10.0000
RECEPTOR HEIGHT (M) = 1.7000
URBAN/RURAL OPTION = RURAL

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

BUOY. FLUX = .000 M**4/S**3; MOM. FLUX = .000 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 5. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
1.	.0000	0	.0	.0	.0	.00	.00	.00	
100.	1220.	6	1.0	1.0	10000.0	.00	23.26	11.09	NO
200.	982.4	6	1.0	1.0	10000.0	.00	26.46	12.13	NO
300.	812.0	6	1.0	1.0	10000.0	.00	29.61	13.13	NO
400.	696.3	6	1.0	1.0	10000.0	.00	32.73	13.86	NO
500.	598.9	6	1.0	1.0	10000.0	.00	35.82	14.74	NO
600.	522.4	6	1.0	1.0	10000.0	.00	38.88	15.58	NO
700.	460.7	6	1.0	1.0	10000.0	.00	41.92	16.39	NO
800.	410.2	6	1.0	1.0	10000.0	.00	44.93	17.19	NO
900.	368.2	6	1.0	1.0	10000.0	.00	47.92	17.96	NO
1000.	332.9	6	1.0	1.0	10000.0	.00	50.89	18.71	NO
1100.	302.8	6	1.0	1.0	10000.0	.00	53.85	19.45	NO
1200.	277.0	6	1.0	1.0	10000.0	.00	56.78	20.17	NO
1300.	254.6	6	1.0	1.0	10000.0	.00	59.70	20.87	NO
1400.	235.1	6	1.0	1.0	10000.0	.00	62.60	21.56	NO
1500.	225.1	6	1.0	1.0	10000.0	.00	65.49	21.53	NO
1600.	209.8	6	1.0	1.0	10000.0	.00	68.36	22.13	NO
1700.	196.3	6	1.0	1.0	10000.0	.00	71.22	22.70	NO
1800.	184.3	6	1.0	1.0	10000.0	.00	74.06	23.26	NO
1900.	173.4	6	1.0	1.0	10000.0	.00	76.90	23.81	NO
2000.	163.6	6	1.0	1.0	10000.0	.00	79.72	24.35	NO

2100.	154.7	6	1.0	1.0	10000.0	.00	82.53	24.88	NO
2200.	146.6	6	1.0	1.0	10000.0	.00	85.33	25.40	NO
2300.	139.1	6	1.0	1.0	10000.0	.00	88.11	25.91	NO
2400.	132.3	6	1.0	1.0	10000.0	.00	90.89	26.41	NO
2500.	126.1	6	1.0	1.0	10000.0	.00	93.66	26.91	NO
2600.	123.1	6	1.0	1.0	10000.0	.00	96.42	26.75	NO
2700.	117.8	6	1.0	1.0	10000.0	.00	99.17	27.20	NO
2800.	112.9	6	1.0	1.0	10000.0	.00	101.91	27.61	NO
2900.	108.4	6	1.0	1.0	10000.0	.00	104.64	28.02	NO
3000.	104.2	6	1.0	1.0	10000.0	.00	107.36	28.42	NO
3500.	86.76	6	1.0	1.0	10000.0	.00	120.85	30.31	NO
4000.	73.85	6	1.0	1.0	10000.0	.00	134.16	32.08	NO
4500.	63.96	6	1.0	1.0	10000.0	.00	147.31	33.74	NO
5000.	56.16	6	1.0	1.0	10000.0	.00	160.32	35.32	NO
5500.	49.88	6	1.0	1.0	10000.0	.00	173.19	36.81	NO
6000.	44.72	6	1.0	1.0	10000.0	.00	185.94	38.24	NO
6500.	40.43	6	1.0	1.0	10000.0	.00	198.57	39.61	NO
7000.	37.12	6	1.0	1.0	10000.0	.00	211.11	40.58	NO
7500.	34.10	6	1.0	1.0	10000.0	.00	223.54	41.72	NO
8000.	31.49	6	1.0	1.0	10000.0	.00	235.89	42.82	NO
8500.	29.21	6	1.0	1.0	10000.0	.00	248.14	43.88	NO
9000.	27.21	6	1.0	1.0	10000.0	.00	260.32	44.90	NO
9500.	25.44	6	1.0	1.0	10000.0	.00	272.42	45.90	NO
10000.	23.87	6	1.0	1.0	10000.0	.00	284.44	46.86	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 1. M:

44.	1388.	6	1.0	1.0	10000.0	.00	21.49	10.56	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 5. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	U10M STAB	USTK (M/S)	MIX HT (M/S)	PLUME (M)	HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
10.	.0000	0	.0	.0	.0	.00	.00	.00	
40.	.0000	0	.0	.0	.0	.00	.00	.00	
45.	1385.	6	1.0	1.0	10000.0	.00	21.49	10.56	NO
50.	1366.	6	1.0	1.0	10000.0	.00	21.65	10.62	NO
55.	1349.	6	1.0	1.0	10000.0	.00	21.81	10.68	NO
60.	1331.	6	1.0	1.0	10000.0	.00	21.97	10.75	NO
65.	1314.	6	1.0	1.0	10000.0	.00	22.14	10.81	NO
70.	1298.	6	1.0	1.0	10000.0	.00	22.30	10.87	NO
75.	1281.	6	1.0	1.0	10000.0	.00	22.46	10.93	NO
80.	1279.	6	1.0	1.0	10000.0	.00	22.62	10.87	NO
85.	1263.	6	1.0	1.0	10000.0	.00	22.78	10.93	NO
90.	1249.	6	1.0	1.0	10000.0	.00	22.94	10.98	NO
95.	1234.	6	1.0	1.0	10000.0	.00	23.10	11.03	NO
100.	1220.	6	1.0	1.0	10000.0	.00	23.26	11.09	NO

```
DWASH=   MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

*********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*    SIMPLE ELEVATED TERRAIN PROCEDURE     *
*********************************************

    TERRAIN       DISTANCE RANGE (M)
     HT (M)      MINIMUM     MAXIMUM
    -------     --------    --------
       5.          1.      10000.
       5.         10.        --
       5.         40.        --
       5.         45.        --
       5.         50.        --
       5.         55.        --
       5.         60.        --
       5.         65.        --
       5.         70.        --
       5.         75.        --
       5.         80.        --
       5.         85.        --
       5.         90.        --
       5.         95.        --
       5.        100.        --

****************************************
   *** SUMMARY OF SCREEN MODEL RESULTS ***
   ****************************************
 CALCULATION        MAX CONC    DIST TO   TERRAIN
  PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
--------------    -----------   -------   -------
SIMPLE TERRAIN      1388.          44.       5.
```

Appendix E
Excel Spreadsheet Calculating PM Emissions at Select Locations

	Rock Crusher		2,000,000 ton/yr	
			PM	
Distance	Unitless	Controlled		
	output	0.493865		
	ug/MEE3	ug/MEE#		
		1-hr. average	24-hr. average	Annual average
44	1244	614.3681	245.7472	61.43681
25	0	0	0	0
50	1227	605.9724	242.3889	60.59724
75	1157	571.4018	228.5607	57.14018
100	1104	545.227	218.0908	54.5227
125	1048	517.5705	207.0282	51.75705
150	996.1	491.9389	196.7756	49.19389
175	948.2	468.2828	187.3131	46.82828
200	903.9	446.4046	178.5618	44.64046
225	862.8	426.1067	170.4427	42.61067
250	824.7	407.2905	162.9162	40.72905
275	789.2	389.7583	155.9033	38.97583
300	756.1	373.4113	149.3645	37.34113
325	725.2	358.1509	143.2604	35.81509
350	696.3	343.8782	137.5513	34.38782
375	669.3	330.5438	132.2175	33.05438
400	653.1	322.5432	129.0173	32.25432
425	629.1	310.6905	124.2762	31.06905
450	606.8	299.6773	119.8709	29.96773
475	585.7	289.2567	115.7027	28.92567
500	565.9	279.4782	111.7913	27.94782

Appendix F

Excel Spreadsheet Calculating PM_{10} Emissions at Select Locations

with a Throughput of 5,300,000 Tons Per Year

	Rock Crusher		5,300,000	
			PM10	
Distance	Unitless	Controlled		
	output	0.160517		
	ug/MEE3	ug/MEE#		
		1-hr. average	24-hr. average	Annual average
44	1244	199.6831	79.873259	19.96831
25	0	0	0	0
50	1227	196.9544	78.781744	19.69544
75	1157	185.7182	74.287268	18.57182
100	1104	177.2108	70.884307	17.72108
125	1048	168.2218	67.288726	16.82218
150	996.1	159.891	63.956393	15.9891
175	948.2	152.2022	60.880888	15.22022
200	903.9	145.0913	58.036527	14.50913
225	862.8	138.4941	55.397627	13.84941
250	824.7	132.3784	52.951348	13.23784
275	789.2	126.68	50.672007	12.668
300	756.1	121.3669	48.546761	12.13669
325	725.2	116.4069	46.562771	11.64069
350	696.3	111.768	44.707195	11.1768
375	669.3	107.434	42.973611	10.7434
400	653.1	104.8337	41.933461	10.48337
425	629.1	100.9812	40.392498	10.09812
450	606.8	97.40172	38.960686	9.740172
475	585.7	94.01481	37.605923	9.401481
500	565.9	90.83657	36.334628	9.083657

Appendix G

Excel Spreadsheet Calculating PM_{10} Emissions at Select Locations with a Throughput of 1,500,000 Tons Per Year

	Rock Crusher		1,500,000	
			PM10	
Distance	Unitless	Controlled		
	output	0.081565		
	ug/MEE3	ug/MEE#		
		1-hr. average	24-hr. average	Annual average
44	1244	101.4669	40.586744	10.14669
25	0	0	0	0
50	1227	100.0803	40.032102	10.00803
75	1157	94.37071	37.748282	9.437071
100	1104	90.04776	36.019104	9.004776
125	1048	85.48012	34.192048	8.548012
150	996.1	81.2469	32.498759	8.12469
175	948.2	77.33993	30.935973	7.733993
200	903.9	73.7266	29.490641	7.37266
225	862.8	70.37428	28.149713	7.037428
250	824.7	67.26666	26.906662	6.726666
275	789.2	64.3711	25.748439	6.43711
300	756.1	61.6713	24.668519	6.16713
325	725.2	59.15094	23.660375	5.915094
350	696.3	56.79371	22.717484	5.679371
375	669.3	54.59145	21.836582	5.459145
400	653.1	53.2701	21.308041	5.32701
425	629.1	51.31254	20.525017	5.131254
450	606.8	49.49364	19.797457	4.949364
475	585.7	47.77262	19.109048	4.777262
500	565.9	46.15763	18.463053	4.615763

Appendix H
Excel Spreadsheet Calculating PM Emissions from Unpaved Roads

			Unpaved Roads			PM		
Source		AP-42 13.2.2-1		by Rich Hibbard			3/1/2006	
		December 2003						
$E=k(s/12)^a(W/3)^b$								
E= emissions in lb/Vehicle Miles Traveled (VMT)								
k= constant, for industrial roads					4.9	PM		
s= surface material silt content					4.8			
a= constant for industrial roads					0.7	PM		
W= mean vehicle weight (tons)			loaded	80000	lbs	unloaded	40000	lbs
b= constant for industrial roads					0.45	PM^{10}		
E (PM^{10})		7.2717	pounds per vehicle mile traveled	Note: this assumes that half of the time the truck is loaded				
Assumptions:								
weight of soil		2.05	tons/cubic yard					
1 Truck		10	cubic yards					
length of haul road		1/4mile	1/8 mile loaded and 1/8 mile un-loaded					
Water control		85%	effective					
Tons of material processed			Pounds of		Tons of		# trucks /hr	lb/hr
			PM per year		PM per year			
4000000			53,208		26.6		22.3	6.1
3000000			39,906		20.0		16.7	4.6
2000000			26,604		13.3		11.1	3.0
1500000			19,953		10.0		8.4	2.3
1000000			13,302		6.7		5.6	1.5

Appendix I
Excel Spreadsheet Calculating PM_{10} Emissions from Unpaved Roads

			Unpaved Roads			PM10		
Source		AP-42 13.2.2-1		by Rich Hibbard			3/1/2006	
		December 2003						
$E=k(s/12)^a(W/3)^b$								
E= emissions in lb/Vehicle Miles Traveled (VMT)								
k= constant, for industrial roads					1.5	PM^{10}		
s= surface material silt content					4.8			
a= constant for industrial roads					0.9	PM^{10}		
W= mean vehicle weight (tons)			loaded	80000	lbs	unloaded	40000	lbs
b= constant for industrial roads					0.45	PM^{10}		
E (PM^{10})		1.8532	pounds per vehicle mile traveled	Note: this assumes that half of the time the truck is loaded				
Assumptions:								
weight of soil		2.05	tons/cubic yard					
1 Truck		10	cubic yards					
length of haul road		1/4mile	1/8 mile loaded and 1/8 mile un-loaded					
Water control		85%	effective					
Tons of material processed			Pounds of		Tons of		# trucks /hr	lb/hr
			PM10 per year		PM10 per year			
4000000			13,561		6.8		22.3	1.5
3000000			10,171		5.1		16.7	1.2
2000000			6,780		3.4		11.1	0.8
1500000			5,085		2.5		8.4	0.6
1000000			3,390		1.7		5.6	0.4

Appendix J
Rock Crusher Fugitive Dust Control Plan Guidelines

The Ecology Air Quality Program (AQP) has developed emission control guidelines to supplement General Order No. 06AQ-E100 and E200. Washington air quality regulations require Best Available Control Technology (BACT) to control air emissions from both **fugitive** and **process** emission points. The guidance provided below will identify emission points and provide a menu of options to control both fugitive and process particulate matter emissions for a rock crusher and associated activities.

I. FUGITIVE EMISSION POINTS

1. Materials handling

    1.1 Front-end loader dumping into aggregate bins
    1.2 Surface mining and loading the primary (jaw) crusher
    1.3 Loading aggregate trucks with conveyor and/or front-end loader
    1.4 Aggregate and/or waste being added to and/or removed from stockpiles

2. Wind erosion from exposed surfaces

3. Access roads and site vehicle access areas

4. Paved roads (carryout, spillage)

II. PROCESS EMISSION POINTS (plant equipment configurations will vary, but all rock crushers will contain the following equipment)

1. Conveyors: Primary emission point for a conveyor is the drop distance for each transfer point

2. Crushers

3. Screens

III. EMISSION CONTROL OPTIONS

1. REQUIRED: Water truck to be on site at all times the crusher is in operation (unless the water truck is obtaining water). The following factors should be considered when applying water to access roads and on-site vehicle access area.

    1.1 Application rate: amount of water applied per unit area (Please note that the peak summer evaporation rate of water in the Tri-Cities can be as high as 14 gallons per day per 100 square foot. The water trucks at a site should have this capability, as a minimum, to keep the road dust down.)
    1.2 Frequency: time between applications
    1.3 Vehicles per hour
    1.4 Weather conditions

2. REQUIRED: Water application systems are required to be installed on the crusher whenever it is in operation. The system shall include a pump, water lines, spray bars or equivalent on the all crusher discharge points and before all fines drop points. The water application rate will be dependant on the operating capacity and type of material per hour passing through each control point, and the ability to keep visible emissions below 10 percent opacity. The following factors should be considered when applying water to process control points:

- 2.1 Application rate: amount of water applied per ton per unit time (gals/ton/time)
- 2.2 When to apply
- 2.3 Weather conditions
- 2.4 Coverage area for each spray bar or nozzle

3. REQUIRED: Speed limitations for site vehicles with procedures to maintain and enforce speed restrictions

4. RECOMMENDED: Location, size, and configuration of stockpiles to reduce wind erosion

5. AS NECESSARY: Dust suppressant

- 5.1 Type and amount of suppressant applied per unit area of roadway (gals/square foot)
- 5.2 Frequency of application (time between applications)
- 5.3 Traffic volumes (vehicles per hour)
- 5.4 Weather conditions

6. AS NECESSARY: Mechanical cleaning (i.e., sweeping paved surfaces)

- 4.1 Cleaning equipment or method
- 4.2 Cleaning frequency

7. AS NECESSARY: Vegetation reclamation

- 7.1 Type of vegetation
- 7.2 When and how planted
- 7.3 Pounds of seed or shrub/tree per acre
- 7.4 Watering system

8. AS NECESSARY: Wind Erosion Response Plan

The fugitive and process emission points and control options described above pertain to a rock crusher and associated activities. The Ecology Air Quality Program requires that visible particulate matter emissions be controlled to less than 10 percent opacity in General Order No. 06AQ-E100 and E200. If you have any questions, please contact Gregory S. Flibbert at (509) 329-3452.