Chapter 6
Coal Dust

6.1 Introduction

This chapter describes the impacts from coal dust on people, property, and ecosystems that could result from construction and operation of each of the build alternatives. The sections that follow describe the study area, the methods used to analyze the impacts, the affected environment, and the impacts of coal dust that could be dispersed by trains carrying coal on the proposed rail line. Section 6.5, *Applicable Regulations*, summarizes the regulations and guidance related to coal dust. Appendix G, *Coal Dust Analysis*, provides further information on the analysis methods. Chapter 4, *Air Quality*, discusses coal dust as a component of particulate emissions. The contribution of the proposed rail line to cumulative impacts related to coal dust is discussed in Chapter 18, *Cumulative Impacts*. Appendix E, *Air Quality, Emissions, and Modeling Data* provides a bibliography of references from the available scientific and industry literature on the emission, dispersion, and deposition of coal dust, as it applies to coal dust from trains.

During the scoping stage leading to the preparation of this Draft EIS, OEA received numerous comments expressing concern that trains on the proposed rail line could emit coal dust and that this coal dust would negatively affect human health, the environment, and safety. OEA has included this chapter in this Draft EIS to consolidate discussion of the potential for coal dust emissions and impacts. To date, the demonstrated harm from coal dust has involved safety and nuisance impacts in limited, specific locations; however, this chapter provides an analysis of potential impacts specific to the proposed rail line. While there are many known human health and ecological impacts associated with coal mining and combustion, this chapter focuses specifically on potential coal dust impacts from the transportation of coal by train (U.S. Geological Survey 2000).

In summary, OEA has concluded that coal dust from trains on the proposed rail line would not harm human health or the environment. OEA predicted the potential concentration of coal dust in the air and found that it would be below the standards set in the National Ambient Air Quality Standards (NAAQS) and the Montana Ambient Air Quality Standards (Montana AAQS) to protect human health.[1] OEA also analyzed the movement of potentially harmful trace elements in coal (such as mercury, lead, and arsenic) in the environment to determine if these chemicals could pose a risk to people or the environment in the project area. OEA found that the concentration of most trace elements in dust, water, soil, and fish would be below the screening levels set by the U.S. Environmental Protection Agency

[1] The National Ambient Air Quality Standards (NAAQS) are set by the U.S. Environmental Protection Agency (USEPA) as authorized by the Clean Air Act, amended in 1990. The Montana Ambient Air Quality Standards (Montana AAQS) are enforced by the Montana Department of Environmental Quality (Chapter 4, Section 4.6, *Applicable Regulations*).

(USEPA). The results indicated, however, that the concentration of barium could exceed the USEPA screening level for surface water. Because OEA relied on conservative assumptions that tend to overstate the concentration of trace elements, OEA believes that the concentration of barium in surface water would actually be lower than the results predict. Also, because barium does not tend to remain dissolved in water, OEA concluded that coal dust from the proposed rail line would not cause the concentration of barium in surface water to exceed the USEPA screening levels. OEA also analyzed the ingredients of the topper agents used to suppress coal dust from rail cars and found that these ingredients are generally not toxic and that the proposed rail line would not emit enough of these chemicals to harm human health or the environment. OEA concludes that the impacts of coal dust would be negligible, but recognizes that there could be minor nuisance impacts.

6.2 Study Area

OEA defined the study area for coal dust impacts from operation of the proposed rail line as the area within 2 miles of the right-of-way. This area includes the rail tracks, the right-of-way, and the adjacent area in which coal dust would most likely be deposited.

6.3 Analysis Methods

6.3.1 Introduction to Coal Dust

Coal dust is a form of particulate matter. Particulate matter is composed of small particles suspended in the air. There are both natural and human sources of particulate matter. Natural sources include dust storms and smoke from wildfires. Human sources include smoke from power plants and factories, vehicle engine exhaust, dust from unpaved roads, tobacco smoke, and coal dust.

Figure 6-1: BNSF Coal Trains
Photo credit: Gerry Putz, www.4rail.net

Coal loaded into train cars is made up of pieces and particles of differing size, including small particles, or dust. The movement of the cars during transit creates vibrations that can break larger pieces of coal into smaller particles, creating more dust. Likewise, during transit, wind and air moving over the train may cause coal dust to blow off the rail cars. After the train passes, the airborne coal dust[2] disperses in the air and settles onto the ground. The distance from the train to where the dust settles on the ground varies depending

[2] Coal dust lost from rail cars is often referred to as *fugitive coal dust*. In the air quality regulatory context, emissions that are not emitted from a stack, vent, or other specific point that controls the discharge are known as fugitive emissions. For example, windblown dust is fugitive particulate matter. For the purposes of this chapter, OEA is referring to fugitive coal dust when using the term *coal dust*.

primarily on the size of the particles, the speed of the train, and meteorological conditions, especially wind speed.

Railroads have transported coal since the invention of the steam locomotive in the early 19th century. Since that time, people living along railroads have been exposed to coal dust of varying particle sizes. Until relatively recently, however, public concern regarding coal dust from rail cars has been limited to nuisance dust at a few locations. It has generally been assumed that the health effects of coal dust from rail cars, if any, would be small (Cope et al. 1986).

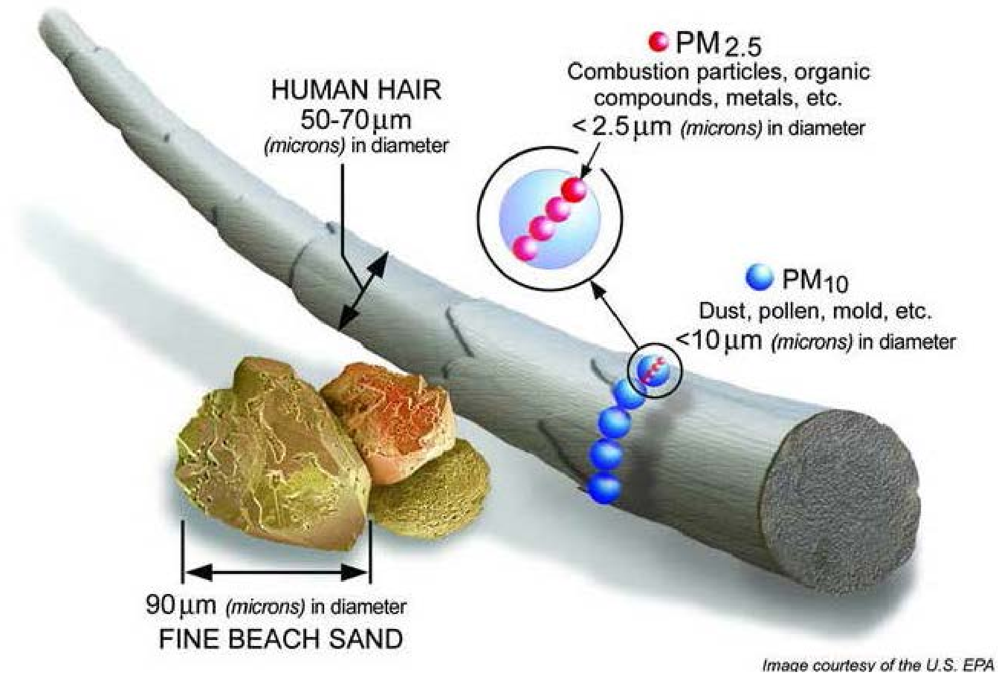
The existing literature on the emission, dispersion, and deposition of coal dust from rail cars is limited, consisting mainly of industry studies and a few peer-reviewed academic studies. Existing studies have relied on several different analysis methods. Some studies used computer simulations to model the emission and dispersion of fugitive coal dust from rail cars. Others conducted experiments using model trains in wind tunnels or by attaching dust collectors to the outside of train cars. Still others used monitoring equipment to measure the concentration of particulate matter (including coal dust) in the air and/or deposition on the ground near rail lines. These studies vary in their conclusions, especially regarding the quantity of coal dust emitted by moving rail cars.

6.3.2 Coal Dust and Human and Ecological Health

6.3.2.1 Airborne Coal Dust (Particulate Matter)

From a human health perspective, inhalation of coal dust (particulate matter) is the primary exposure pathway of interest. Ingestion of coal dust is a potential, but less significant, exposure pathway. The human exposure analysis for coal dust constituents is included in Appendix G, *Coal Dust Analysis*. The principal characteristic of particulate matter related to human health is particle size. Some particles are visible to the unaided eye as dust or smoke, but the smaller, invisible particles also pose a human health risk. When particulate matter is inhaled, larger particles are filtered in the nose or throat by cilia and mucus, but small particles can pass through into the lungs. The smallest particles can enter the circulatory system, where they harden and inflame the arteries. This increases the risk of heart attack and other cardiovascular problems (Pope et al. 2002, 2004). Most of the smallest particles are produced by combustion, such as the burning of wood or fossil fuels, although some may also be present in dust, such as road dust and coal dust. Figure 6-2 illustrates typical small particle sizes.

Figure 6-2. Particulate Matter Particle Sizes



Source: U.S. Environmental Protection Agency 2013a

Because the health effects of particulate matter depend on particle size, scientists and regulatory agencies typically group small airborne particles into two categories based on particle size. The first category is inhalable particles. It includes particles that are 10 microns and smaller in diameter (PM10). For comparison, a human hair is approximately 70 microns in diameter. The second category is inhalable fine particles. These particles are smaller than 2.5 microns in diameter (PM2.5). These particles are small enough to penetrate into the gas exchange regions of the lungs and are considered to pose the greatest risk to human health. The PM10 category includes PM2.5. Both sizes are regulated as criteria air pollutants (Chapter 4, *Air Quality*). Particles smaller than 10 microns and larger than 2.5 microns are often referred to as *inhalable coarse particles*.[3] Particulate matter is sometimes measured as total suspended particulates (TSP). TSP measures particles of approximately 50 microns and smaller, and includes PM10 and PM2.5.

Coal dust contains large, visible particles and the smaller TSP, PM10, and PM2.5. The larger particles are sometimes referred to as coal particles to distinguish them from TSP, PM10, and PM2.5. The larger particles and TSP may result in nuisance and aesthetic impacts, but OEA found no evidence indicating that they pose a risk to human health when inhaled (Appendix E, *Air Quality, Emissions, and Modeling Data*). On the other hand, PM10 and PM2.5 have been determined to cause adverse human health impacts if the regulatory limits are exceeded (U.S. Environmental Protection Agency 2014c). If any pollutant level exceeds

[3] Terms italicized at first use are defined in Chapter 25, *Glossary*.

regulatory limits, health impacts would depend on the concentration in the air, the duration of the exposure, and the number of times exposure occurs.

Unlike coal dust from rail cars, coal dust in coal mines and its health effects on mineworkers have been widely studied. Long-term, occupational exposure to high concentrations of coal dust in coal mines may cause or worsen respiratory diseases (Centers for Disease Control 2011). Coal miners may experience health problems from particulate matter for several reasons. Miners work in enclosed areas, where coal dust in the air does not disperse easily, and where coal dust concentrations in the air can become very high as compared with concentrations in *ambient* (outdoor) air. Miners are exposed to coal dust repeatedly and over long periods: 8 or more hours per day over many years. If exposure levels are not controlled, miners may be at increased risk for developing pneumoconiosis (black lung disease), asthma, bronchitis, and emphysema. These risks are greater when the coal seam or the surrounding rock contains large amounts of crystalline silica (silicon dioxide), such as quartz. Crystalline silica is known to cause or worsen respiratory diseases, including cancer, when inhaled as dust over long, repeated periods of exposure (U.S. Environmental Protection Agency 1996, Centers for Disease Control 2011).

The health impacts of nonoccupational exposure to coal dust have not been extensively studied. Some studies have found that communities near large coal-handling and processing facilities could have higher rates of respiratory complaints (Temple and Sykes 1992, Brabin et al. 1994). Others have found no difference between these communities and those farther away from coal facilities (Pless-Mulloli et al. 2000, Moffatt, and Pless-Mulloli 2003). In a search of the available scientific literature, OEA did not identify any scientific studies that specifically examined the human health risks associated with coal dust from moving rail cars. Section 6.3.3.4, *Human Health Impacts of Coal Dust Inhalation,* discusses the results of OEA's quantitative analysis of airborne coal dust and human health.

6.3.2.2 Deposited Coal Dust

Coal dust and other forms of particulate matter do not remain in the air indefinitely. Eventually, these particles settle out of the air and deposit on the ground. Human exposure to deposited coal dust can occur by human ingestion of soil, sediment, surface water, groundwater, agricultural products, fish, or other animals that have ingested soil or water tainted by coal dust deposits. The human health impact analysis specifically includes human ingestion of fish because the potential for human exposure to coal dust trace elements would be higher for human ingestion of fish than for human ingestion of terrestrial animals (e.g., game, livestock). Because fish live in water and are constantly exposed to coal dust deposited in water, fish uptake higher rates of coal dust constituents than terrestrial animals ingesting soil or water into which coal dust deposited. Ecological impacts can occur by exposure of plants and animals to coal dust and its constituents in soil, sediment, surface water, and groundwater. Section 6.3.3.5, *Human Health Impacts of Coal Dust Ingestion*, discusses the results of OEA's analysis of potential human health impacts from the ingestion of coal dust in soil and water. Section 6.3.3.6, *Ecological Impacts of Coal Dust* describes OEA's analysis of potential impacts of coal dust on ecological receptors.

Deposited coal dust may also present potential transportation safety issues. In previous proceedings involving the Powder River Basin Joint Line, the Board determined that coal dust is a "particularly harmful contaminant" that can degrade the integrity of railroad *ballast*, which distributes the load from the rail ties (Surface Transportation Board 2011). Coal dust can interfere with the normal drainage of the ballast, causing tracks to be less stable. As a result, fouling of ballast by coal dust may increase the risk of train derailments on the heavily used Powder River Basin Joint Line. The Joint Line in Wyoming and Montana is among the rail lines with the highest volume of coal train traffic (BNSF Railway Company 2012).

Deposited coal dust could also cause nuisance impacts or *amenity impacts* (impacts on features that add value). Airborne coal dust may be deposited on houses, cars, outdoor furniture, and other property. Among the amenity impacts most commonly reported are buildup of particulate matter on surfaces in residences, resulting in the need to clean more frequently, and soiling of laundry dried outdoors (New South Wales Ministry of Health 2007). Section 6.3.3.8, *Nuisance Impacts of Coal Dust* discusses OEA's findings regarding amenity impacts of coal dust.

6.3.3 Coal Dust Emissions, Dispersion, and Impacts

OEA used a variety of analysis methods and models to assess coal dust emissions, dispersion, and potential impacts from inhalation and ingestion. This section describes these methods and presents information from OEA's review of literature on the general impacts of coal dust.

6.3.3.1 Coal Dust Emissions from Rail Cars

Most of the coal dust from rail cars comes directly from the surface of the coal pile in the car (Queensland Rail 2008). Smaller amounts may come from coal that has fallen onto the surfaces of the car or the wheel assemblies during loading. Some coal dust may also leak out around the doors of bottom-dump cars (cars with doors that open on the bottom). The total amount of fugitive coal dust released by a rail car depends on the following factors.

- Coal type and composition
- Coal moisture content
- Size of the top opening of the rail car
- Shape (*profile*) of the coal surface in the car
- Position of the car in the train
- Time and distance traveled
- Train speed

- Ambient wind speed and direction
- Precipitation falling on the cars
- The use of mitigation measures (e.g., *topper agents* or dust suppressants)

A study funded by the U.S. rail industry (Calvin et al. 1993) estimated that a train operating under clear, dry, sunny conditions lost between 0.17 percent (shaped profile) and 0.34 percent (unshaped profile)[4] of the total coal load, with no use of topper agents. These estimates were based on measuring the weight of the cars after loading and again at the end of the trip. The authors did not provide information on the particle sizes associated with this emission of coal dust. OEA notes that weighing cars before and after a trip does not account for the effects of the moisture content of coal. Some types of coal contain large amounts of water, up to more than 60 percent by weight in some lignite coals, and this technique is unreliable for estimating coal dust emissions because coal may dry out and become lighter during transport.

More recently, Ferreira et al. (2003) conducted full-scale measurements of coal dust emitted from trains. They placed dust-collecting instruments onto rail cars carrying coal from a port to a power station in Portugal. Some of the rail cars were equipped with mechanical covers that partially covered the coal load but left some of the coal exposed. Ferreira et al. found that these cars lost less than 0.001 percent of the loaded coal over a 220-mile trip with an average speed between 34 and 37 miles per hour. These are similar to the average speeds anticipated for the proposed rail line.

An industry study conducted in Queensland, Australia also found the amount of coal dust emitted by rail trains to be small. This study, prepared on behalf of Queensland Rail Limited (now Aurizon), used a mathematical model (from Witt et al. 1999) to predict the emission of TSP-sized coal dust from trains moving on the Goonyella, Blackwater, and Moura rail systems in Queensland. The model estimated that these rail cars would lose an average of 0.0035 percent of their total load. For cars carrying approximately 90 tons of coal, typical for the cars in the study, this amounted to an average of about 6 pounds of coal dust lost per car, over trips between 100 and 300 miles in length (Queensland Rail 2008).

Witt et al. (1999) developed a computational fluid dynamics model that takes into account the effects of wind direction and velocity. Experimental measurements of dust lift-off from the surface in a wind tunnel at different travel speeds were used by Witt et al. 1999 to characterize the dust emission rate. Based on the experimental data, Witt et al. developed a model for predicting the mass and particle size distribution lifted at different air speeds. The authors evaluated the model and found it to be in good agreement with the wind tunnel observations when only considering air velocity. To limit the number of particle sizes used in the model, the authors collected and aggregated the experimental particle size information

[4] A *shaped profile*, *profiling*, or *shaping* refer to shaping the profile of the loaded coal to minimize fugitive coal dust. This is achieved by grooming the coal pile (which when loaded generally has a trapezoidal shape with sharp edges) to more of a "bread loaf" shape with a rounded top.

to form six size distributions. For each of the six particle size distributions used in the study, the authors fitted a quadratic curve to the experimental air velocity points.

The Queensland Rail (2008) study modified the equations that were developed by Witt et al. (1999) based on the emissions reported by Ferreira et al. (2003), as a function of train speed. The Queensland Rail (2008) equation for TSP-size particles is given below.

$$\text{Emission Factor (loaded coal train)} = 0.0000378(V)^2 - 0.000126(V) + 0.000063$$

where V is the speed of the train (kilometers per hour) and the units for the emission factor are grams of TSP per metric ton of coal per kilometer traveled

The Queensland Rail study also developed similar equations for other particle size distributions. These equations were developed in the absence of any significant moisture. As such, the Queensland Rail study equations provide a conservative estimate because, by wetting the coal, surface precipitation tends to reduce actual emissions. To account for the larger rail cars used in the United States, the emissions-per-car estimates from the Queensland Rail study were increased by OEA based on the relative sizes of the open area at the top of the cars used in Australia versus the cars used in the United States (BNSF Railway Company 2013, Queensland Rail 2008).

The tests on which the above equation is based were performed with shaped coal profiles but did not include adjustments for the use of other dust control techniques such as covers or chemical topper agents. Several studies have found that dust control techniques can significantly reduce coal dust emissions. For example, Ferreira et al. (2003) observed that coal cars equipped with covers emitted much less coal dust than those without covers. Ferreira and Vaz (2004) used scale model trains in a wind tunnel to show that covering coal cars reduced dust emissions by more than 80 percent. The BNSF Railway Company (BNSF) Super Trial studies (2010) reported similar reductions in coal dust emissions using chemical topper agents. BNSF has imposed a tariff (a schedule of shipping rates and requirements) that requires coal shippers in Wyoming and Montana to control coal dust emissions from rail cars. One method allowed by the tariff is to use one of several chemical suppressors (topper agents) that, along with shaping the load profile, have been shown to reduce average coal dust emissions by at least 85 percent. TRRC has stated that, if the proposed rail line is constructed and operated, BNSF plans to require shippers using the proposed rail line to adhere to coal dust mitigation requirements in BNSF Price List 6041-B and Appendices A and B, issued September 19, 2011 (Coburn pers. comm.).

6.3.3.2 Airborne Coal Dust Dispersion

The concentration of coal dust in the air does not remain constant. Like all forms of particulate matter, coal dust disperses over time. Some studies that examine the movement of coal dust in the air use monitoring equipment to estimate the concentration of particulate matter. Others use mathematical models that describe the physical processes to simulate the particulate matter concentration. These models, known as dispersion models, take into account the time-varying sources of emission, as well as meteorological and seasonal conditions. The models require reasonable estimates of emission rates to yield reliable estimates of the dispersion and deposition of particulate matter.

USEPA's AERMOD dispersion model is a well-tested and extensively evaluated dispersion model. OEA used AERMOD in this study to assess both air quality (ambient concentrations of particulate matter) and deposition. (Appendix E, *Air Quality, Emissions, and Modeling Data*, provides information on the application of this model.) Results from the modeling show that the maximum increase in annual PM10 from coal dust emitted by trains on the proposed rail line would occur under the high production scenario[5] with an annual increase of 6.1 micrograms per cubic meter (μg/m^3) at a distance of 50 meters from the rail line. The maximum increase in PM2.5 also would occur under the high production scenario, but would be just 1.2 μg/m^3 at 50 meters from the rail line. Both of these increases would be insufficient to lead to a violation of NAAQS or Montana AAQS for either PM2.5 or PM10.

Monitoring studies can supplement modeling by testing the validity of the modeling results for the limited conditions under which the monitoring data is collected. However, few of the monitoring studies conducted to date for coal dust particulates have provided the information needed to compare the monitored results with dispersion modeling results, because the monitoring studies were conducted for different purposes that do not meet the analysis needs for this project, or because of other study limitations. For example, the monitoring studies report measurements at only one distance from the rail line. They do not account for the background ambient concentration, nor do they report train information (e.g., the number of trains, number of cars per train, and speed of the train) or the use of control measures such as shaping the load profile or using topper agents. All of these factors affect coal dust emissions. In addition, most studies do not analyze the composition of the collected particulate matter and so do not distinguish between coal dust and other particulates.

To date, the most comprehensive monitoring study relevant to coal dust from rail cars is the Pollution Reduction Program 4.2 Particulate Emissions from Coal Trains report prepared by the Australian Rail Track Corporation (ARTC) (2013). ARTC is a government-owned corporation that manages much of the interstate rail network in Australia. The ARTC study measured TSP, PM10, and PM2.5 concentrations as loaded and unloaded coal trains passed the monitors (4 meters from the nearest of four tracks) and compared these measurements with the concentration of particulate matter when no train was present. ARTC found that both loaded and unloaded coal trains were associated with higher measured concentrations of particulate matter. On average, coal trains increased the concentration of PM10 by as much as 7.6 μg/m^3 and the concentration of PM2.5 by as much as 2.1 μg/m^3 as the train passed by the monitor. The ARTC study did not analyze the measured particulate matter to determine the proportion of coal dust. An independent review (Ryan 2014) conducted in response to comments on the ARTC study confirmed the original study results.

[5] The high, medium, and low production scenarios are described in Appendix C, *Coal Production and Markets.* The implications of these scenarios for rail traffic are summarized in Chapter 2, Section 2.3.3, *Rail Traffic.*

The Queensland, Australia Department of Science, Information Technology, Innovation and the Arts (DSITIA) conducted a 1-month study of dust at three sites in the Brisbane suburb of Tennyson. This study was conducted in response to community concern over dust from coal trains (DSITIA 2012). The monitoring site closest to the rail line was 6 meters (20 feet) from the track. The DSITIA study found that the major component of deposited dust was mineral dust (not coal dust), ranging between 40 and 50 percent. Coal accounted for 10 to 20 percent of deposited dust in the samples. Rubber dust, which is generated from tire action of vehicles on roads, accounted for 10 percent. Measurement of airborne dust levels indicated that particulate matter concentrations increased by an average of less than 5 $\mu g/m^3$ when the train was passing by the monitor. The DSITIA study measured airborne dust concentrations as PM20 (particles with a diameter less than 20 microns), so the concentrations of PM10 and PM2.5 would have been lower.

Studies of the particulate matter makeup of the coal have not reported on the frequency or number of passing coal cars. In studies of the composition of particulate matter in the near-rail environment, much of the mass has not been coal dust even though the data were collected near the rail line. Other studies have collected monitoring data very close to the rail line but without using a filter head (a component of the sampler that separates particles by size) so that large particles are allowed to enter the air sampler. For these reasons, isolating the contribution of coal dust to particulate matter emissions is often problematic.

As described in Chapter 4, *Air Quality*, OEA used equations from Queensland Rail (2008) to calculate coal dust emission factors for fully loaded railcars as a function of air velocity. OEA modeled coal dust concentrations using AERMOD. The modeling indicated that coal dust emissions from rail cars would not cause PM10 or PM2.5 concentrations to exceed the NAAQS or Montana AAQS. OEA also modeled coal dust deposition using AERMOD. OEA combined the deposition modeling results with a fate and transport model to estimate concentrations of coal dust constituents in soil, water, and sediment, and the corresponding concentrations in drinking water and fish. The human exposure analysis for coal dust constituents is included in Appendix G, *Coal Dust Analysis*.

The particulate matter impact assessment for this Draft EIS is based on separate modeling and estimates for each source of particulate matter, including locomotive exhaust, wind erosion of exposed earth surfaces, and coal dust from railcars. Chapter 4, Section 4.5.1.2, *Operation*, provides further detail on the impacts of the proposed rail line with respect to airborne particulate matter including locomotive exhaust particulate matter, wind erosion particulate matter, and coal dust particulate matter. As discussed in Chapter 4, Section 4.5.1.2, *Operation*, the analysis shows that there would be no violations of the NAAQS or Montana AAQS for PM10 or PM2.5 in any analysis year.

6.3.3.3 Airborne Coal Dust Deposition

Coal dust emitted to the atmosphere settles out of the air and deposits on the ground. Coal dust may be deposited directly onto the rail ballast, along the right-of-way, or in adjacent areas. Where the coal dust lands (the distance from and the direction from the rail right-of-way) depends on particle size, wind speed, and other meteorological conditions.

A Queensland, Australia study of the deposition of coal dust along rail lines over a 6-month period found that the maximum deposition of coal dust (TSP size and smaller) occurred at approximately 3 meters (10 feet) from the edge of the track (Queensland Government Safety in Mines Testing and Research Station 2007). At this distance, the coal dust deposition rate was approximately 90 milligrams per square meter per day ($mg/m^2/day$). At 10 meters (33 feet) from the track, deposition dropped to 30 $mg/m^2/day$.

The Tennyson Monitoring Study (DSITIA 2012) reported coal dust deposition rates ranging from 5 $mg/m^2/day$ at 6 meters from the track, 19 $mg/m^2/day$ at 20 meters, and 8 $mg/m^2/day$ at 300 meters. Train activity was reported as 169 loaded coal trains passing by over a 30-day period (an average of 5.6 trains per day, somewhat less than the 7.4 trains per day projected in the low production scenario). However, the measurement method (Standards New Zealand 2003) is based on particles able to pass through a 1-millimeter mesh sieve (1,000 microns, about the size of coarse to very coarse sand). As discussed in Chapter 4, *Air Quality*, it is unclear how much coal dust this method would collect because most of the coal particles are not spherical in shape and might not pass through a 1-millimeter mesh. The study did not report whether the load profile had been shaped or if a topper agent had been applied.

The results of OEA's modeling exercise suggest that the maximum coal dust deposition rate that would occur would be 36$mg/m^2/day$ at a distance of 50 meters from the track. This estimate assumes a high coal production scenario and the use of topper agents (see Appendix E, *Air Quality, Emissions, and Modeling Data*). Chapter 4, Section 4.5.1.2, *Operation*, provides further detail on the deposition analysis and comparison with deposition guidelines.

6.3.3.4 Human Health Impacts of Coal Dust Inhalation

OEA used the methods described in this section to assess the potential for health impacts from inhalation of coal dust that could be emitted by the proposed rail line. Chapter 4, *Air Quality*, provides further detail on the concentrations analysis and comparison with ambient air quality standards.

As discussed in Section 6.3.3.1, *Coal Dust Emissions from Rail Cars*, and 6.3.3.2, *Airborne Coal Dust Dispersion*, OEA could not use existing monitoring studies to infer coal dust concentrations for the proposed rail line because the monitoring studies lack complete details on all of the key elements that determine coal dust emission and dispersion: train activity, meteorology, and coal dust concentrations and size. Therefore, OEA based its analysis of impacts from coal dust on PM10 and PM2.5 concentrations estimated using dispersion modeling. The modeling incorporates all of the important meteorological, emissions, and spatial and temporal dimensions to determine ambient air concentrations of particulate matter and its deposition along the rail line. For the modeling, OEA used coal emissions data from Australian studies conducted by the rail industry and government agencies including Witt et al. (1999) and Queensland Rail (2008). Where appropriate, OEA adjusted these estimates for differences in key parameters such as the size of the coal cars, use of topper agents, shaping the load profile, and train speed. OEA relied on conservative assumptions that tend to overestimate the potential air quality impacts of coal dust emissions from the proposed rail line. Specifically, OEA made the following conservative assumptions.

- OEA modeled coal dust emissions from empty coal trains and from loaded trains.
- OEA's models assumed transport of coal types with the highest reported PM10 and PM2.5 fractions.
- OEA's models assumed that transported coal would be dry and would not be affected by high ambient humidity, rainfall, or snowfall.
- OEA reported the maximum estimated particulate matter concentrations, which may occur within the right-of-way and thus in an area with little or no human exposure.
- OEA selected background particulate matter data from a monitoring site with higher concentrations of background particulate matter than would be expected to occur along the right-of-way.
- OEA selected wind measurement data from a monitoring site in the Tongue River valley. Ground-level winds are highly affected by local conditions and could affect model results. However, it is not feasible to model every location. Because most of the length of most of the build alternatives would be located in the Tongue River valley, the wind data used in the analysis are generally representative. In addition, the prevailing wind directions and the topography of the Tongue River valley provide less pollutant dispersion than would occur with flat topography, and accordingly, the wind data OEA used gives relatively conservative (high) results.

Table 6-1 shows the estimated contribution of coal dust to particulate matter concentrations per train trip for the proposed rail line, as predicted by OEA's model. As described in Appendix E, *Air Quality, Emissions, and Modeling Data*, OEA developed these estimates by modeling the coal dust emissions from the coal trains along with other key inputs, including hourly meteorological data, terrain data, land-use information, coal dust particle size, train speed, type of coal, and application of a topper agent.

Table 6-1. Maximum Per-Train Contribution of Coal Dust to Particulate Matter Concentrations along the Right-of-Way Using Conservative Estimates (μg/m^3 per train round trip)

Train Contribution of Coal Dust to Particulate Matter	PM10	PM2.5
Contribution to 24-hour average	1.85	0.40
Contribution to annual average	0.46	0.09

Notes:
Scenario assumes one unit train of 125 cars, round trip
μg/m^3 = micrograms per cubic meter; PM10 = particulate matter 10 microns or less in diameter; PM2.5 = particulate matter 2.5 microns or less in diameter

The values in Table 6-1 refer to the contribution of a single loaded and unloaded coal train (a complete round trip). In order to assess the impact of coal dust along the right-of-way of the build alternatives, OEA multiplied the estimates in Table 6-1 by the estimated number of trains per day under the production scenarios, as shown in Table 6-2. The low production scenario would require an average of 7.4 trains per day (3.7 loaded and 3.7 unloaded). The medium production scenario assumes that production at the proposed Otter Creek Mine and potentially induced mines would result in average traffic of 11.9 trains per day by 2037. The high production scenarios assume additional mine production would result in average traffic by 2037 of 18.6 trains per day for the northern alternatives and 26.7 trains per day the southern alternatives, respectively.[6]

Table 6-2. Estimated Contribution of Coal Dust to Maximum Particulate Concentration (μg/m³)

Production Scenario **Build Alternative** **Trains Per Day**	**Low** **All** **7.4**	**Medium** **All** **11.9**	**High** **Northern** **18.6**	**High** **Southern** **26.7**
24-Hour Average				
PM10	6.8	11.3	17.2	24.7
PM2.5	1.5	2.4	3.7	5.3
Annual Average				
PM10	1.7	2.8	4.3	6.1
PM2.5	0.3	0.5	0.8	1.2

Notes:
μg/m³ = micrograms per cubic meter; PM10 = particulate matter 10 microns or less in diameter; PM2.5 = particulate matter 2.5 microns or less in diameter

To assess the impacts of coal dust from the proposed rail line, OEA added the predicted contribution of coal trains to the background particulate concentrations in the study area. The Montana Department of Environmental Quality (Montana DEQ) provided data on background concentrations of particulate matter at their Birney-Tongue River monitoring site, the closest monitoring site to the build alternatives. The Birney-Tongue River monitoring site is near several unpaved roads, which can be a significant contributor to particulate matter concentrations in rural areas. Montana DEQ recommended the background concentrations in Table 6-3, which are based on data from the Birney site adjusted by Montana DEQ for the effect of unpaved roads (Walsh pers. comm., Cain pers. comm.).

[6] The northern alternatives are the Tongue River Alternatives, Colstrip Alternatives, Tongue River Road Alternatives, and Moon Creek Alternatives. The southern alternatives are the Decker Alternatives.

Table 6-3. Background Particulate Matter Concentration at Birney, Montana Monitoring Site (μg/m³)

Averaging Period	PM10	PM2.5
24-Hour	38	23
Annual	8	6

Notes:
Source: Montana Department of Environmental Quality 2012a, 2012b
$\mu g/m^3$ = micrograms per cubic meter; PM10 = particulate matter 10 microns or less in diameter; PM2.5 = particulate matter 2.5 microns or less in diameter

Table 6-4 shows the estimated coal dust particulate matter concentrations near the right-of-way for the proposed rail line. OEA obtained these estimates by adding the estimated contribution of coal dust to particulate matter concentrations from Table 6-2 to the reported background particulate matter concentrations from Table 6-3 to determine the maximum 24-hour concentration. For the annual average concentration, OEA multiplied the annual average contribution from Table 6-1 by the number of train round trips per day and added the reported background concentration from Table 6-3. For comparison, Table 6-4 also shows the applicable NAAQS for PM10 and PM2.5.

Table 6-4. Estimated Average PM10 and PM2.5 Concentration from Coal Dust from the Proposed Rail Line (μg/m³) Including Background Concentrations

Production Scenario	None (Background Only)	Low	Medium	High	High	NAAQS/ Montana standard[a]
Alternatives	No Action	All	All	Northern	Southern	
Trains/Day	0	7.4	12.2	18.6	26.7	
PM10						
24-Hour	38	44.8	49.3	55.2	62.7	150
Annual	8	9.7	10.8	12.3	14.1	50
PM2.5						
24-Hour	23	24.5	25.4	26.7	28.3	35
Annual	6	6.3	6.5	6.8	7.2	12

Notes:
[a] The annual PM10 NAAQS was revoked on October 17, 2006. However, the Montana Department of Environmental Quality has retained the PM10 standard.
$\mu g/m^3$ = micrograms per cubic meter; NAAQS = National Ambient Air Quality Standard; PM10 = particulate matter 10 microns or less in diameter; PM2.5 = particulate matter 2.5 microns or less in diameter

As Table 6-4 shows, the addition of airborne coal dust to the background levels of particulate matter would not cause particulate matter concentrations in the study area to exceed the NAAQS either alone or in combination with other project-related PM10 or PM2.5 particulate emissions (see also Table 4-5). In addition, these maximum increases in ambient air concentrations for both PM10 and PM2.5 would occur at distances of 40 meters (130 feet) from the track for the 24-hour average and 49 meters (160 feet) from the track for the annual average. These distances would be within the right-of-way of the proposed rail line over most of its length. Coal dust concentrations would be lower at farther distances, where most human exposure could occur.

OEA's conservative estimates suggest that coal dust from the proposed rail line could increase PM10 and PM2.5 concentrations along the right-of-way. The results, however, show that coal dust would not cause particulate matter concentrations in the study area to exceed either the NAAQS or Montana AAQS, which are the established standards for protecting healthy air quality. Chapter 4, Section 4.5.1.2, *Operation*, provides further detail on the modeling and these results.

6.3.3.5 Human Health Impacts of Coal Dust Ingestion

This section describes OEA's analysis of the potential for human health impacts resulting from ingestion of coal dust from operation of the proposed rail line. OEA used an air dispersion and deposition model combined with a fate and transport model to estimate concentrations of coal dust in soil, water, and sediment. Chapter 4, Section 4.3, *Analysis Methods* and Appendix E, *Air Quality, Emissions, and Modeling Data* provide additional details on OEA's air modeling. OEA used mass concentration data from the Montana Bureau of Mines and Geology to characterize the trace element[7] composition of Otter Creek coal (Montana Department of Natural Resources 2006). OEA used these data on the trace element content of coal dust for evaluating potential human health impacts in the absence of an applicable standard for or available research on the human health impacts of coal dust ingestion.

OEA's analysis, described in detail in Appendix G, *Coal Dust Analysis*, consisted of four parts:

- Analysis of coal composition and chemical coal car topper agents.
- Description of the coal dust deposition and fate and transport models.
- Discussion of human health screening levels for coal constituents.
- Evaluation of the potential for human health impacts from coal dust ingestion based on the modeling results.

OEA used conservative assumptions to estimate the concentrations of coal dust and the trace elements that it contains in soil, outdoor dust, fish, surface water, and groundwater. Once the values were estimated, OEA compared these concentrations with health screening levels set by USEPA, other federal agencies, or regional USEPA offices (U.S. Environmental Protection Agency 2002, 2008, 2009, 2013b, 2014a).

OEA also considered potential health and environmental impacts associated with the chemical topper agents applied to coal cars as a dust suppression measure. As discussed in Section 6.3.3.1, *Coal Dust Emissions from Rail Cars*, BNSF has established a tariff that

[7] Elements, such as metals, present at low concentrations relative to the carbon compounds of which coal is primarily comprised.

requires control of coal dust loss from rail cars loaded in Montana and Wyoming. BNSF has determined that an acceptable control method is physically shaping the load profile of the top surface of the coal in the loaded rail car using railcar loading equipment, followed by application of one of several approved topper agents. All of the approved topper products are mixed with water at a concentration of 10 percent and applied at a rate of 15 to 20 gallons per car (BNSF Railway Company 2013). Appendix G, *Coal Dust Analysis* summarizes the available information on the general composition of each product. Most of the constituents in the topper agents have low potential for human health effects from ingestion based on information in the material safety data sheets (BNSF Railway Company 2013) and health impact information (Hazardous Substance Data Bank 2013). Some of the constituents, however, can cause skin and eye irritation with prolonged contact, or irritation of the gastrointestinal tract following ingestion. OEA estimates that topper agent constituents would constitute less than 0.2 percent of the mass of coal dust emitted from rail cars. The deposition rate of topper agent constituents would be no more than approximately 3 mg/m^2/day for any chemical at any site along the rail line. The average deposition rate across the watershed in the project area would be no more than a maximum of approximately 0.25 mg/m^2/day for any chemical. This maximum estimate corresponds to the deposition rates of alkyl alcohol in Nalco Dustbind Plus, which has the highest concentration for any chemical constituent of any listed suppressor agent.

To evaluate human exposure to coal dust constituents, including both trace elements in coal and the chemical constituents of suppressor agents, from soil, outdoor dust, and groundwater ingestion, OEA used the largest estimated deposition rate for particulates 250 microns in diameter and smaller. To evaluate the movement of dust to soil and then to surface water and to fish, OEA used the area-wide average deposition rate of particulates 250 microns in diameter and smaller. This part of the exposure analysis evaluated deposition both directly to surface water and to the surrounding watershed, and assumed that some of the coal dust deposited on the watershed would eventually move into surface water through runoff and erosion. Appendix G, *Coal Dust Analysis*, describes the basis for these decisions and provides the details of the model.

The behavior and *bioavailability*[8] of trace metals from coal dust in soil depends on the association of those metals with various soil components, the forms in which the metals are present in the coal, and local environmental conditions (Fraser Surrey Docks 2013; John and Leventhal 1995; Kabala and Singh 2001; Stepniewska et al. 2010). Given the variability in environmental factors influencing the bioavailability of coal dust constituents, OEA followed USEPA risk assessment guidance, which recommends that, in the absence of data to the contrary, 100 percent of the chemical constituents in coal dust should be assumed bioavailable (U.S. Environmental Protection Agency 2007).

OEA used the following USEPA screening levels and values to evaluate human exposure (U.S. Environmental Protection Agency 2002).

[8] Terms italicized at first use are defined in Chapter 25, *Glossary*.

- Soil screening levels (SSLs) to evaluate human oral exposure to coal dust deposited on soil by way of direct ingestion or ingestion of homegrown produce contaminated via plant uptake, and migration to ground water. SSL values are threshold levels for contaminants that may be ingested directly in soil residues, or for contaminants migrating from soil to groundwater.
- Reference dose (RfD) values to evaluate incidental dust ingestion. RfD values are lifetime, contaminant-specific exposure levels that are likely to be without an appreciable risk of deleterious effects.
- Regional screening and maximum contaminant level (MCL) values to evaluate ingestion of surface water. MCL values are maximum levels of contaminants allowed in drinking water.
- Regional fish screening levels to evaluate ingestion of fish by humans. Fish screening levels are threshold levels. Similar screening levels for other wildlife, such as terrestrial mammals and birds, do not exist. Exposures to fish would be expected to be relatively higher than those for terrestrial wildlife due to the constant exposure of fish to any contaminants present in surface water.

The modeling exercise found that none of the elements that OEA considered would be present in the soil at concentrations greater than the generic SSL for human ingestion of soil. Estimated concentrations in soil ranged from two to five orders of magnitude below the soil ingestion SSLs. For movement through soil to groundwater, none of the estimated trace metal concentrations exceeded the SSL values. Most of these values were two to three orders of magnitude less than the SSL; the value for arsenic was one-half of the SSL. Appendix G, *Coal Dust Analysis* describes these results in detail.

To calculate a conservative estimate of residential exposure to deposited coal dust, OEA created a model of a situation in which a child is exposed to coal dust in a residential outdoor patio-type setting. The model assumed that the child weighs 18.6 kilograms and consumes 200 milligrams per day of soil. In the model, the soil is composed of coal dust mixed with other dust at a depth of 1 millimeter (U.S. Environmental Protection Agency 2011). OEA compared the model results with the USEPA RfD for each of the trace elements for which an RfD has been derived (U.S. Environmental Protection Agency 2014b). OEA found that for all such trace elements, the estimated coal constituent ingestion rates were below the RfD by at least two orders of magnitude. Appendix G, *Coal Dust Analysis* describes these results in detail.

OEA estimated concentrations of coal dust constituents in surface water based on the average deposition from air over the modeled watershed, and subsequent runoff and erosion into the modeled water body. OEA assumed that the surface water in the model would be used untreated for drinking water, although it is likely that drinking water from the Tongue River would be treated by a water utility before being distributed for human consumption. Estimated coal dust constituent values for drinking water in the model were well below available USEPA MCLs and below secondary drinking water standards that were applied where MCLs were not available.

OEA estimated fish concentrations by using estimated concentrations in the water and available bioconcentration factors to model fish uptake. In cases where bioconcentration factors were not available, OEA used a surrogate value of 0.9 based on an approach used by USEPA (U.S. Environmental Protection Agency 1999). All estimated fish concentrations were below identified screening levels. The estimated value for thallium, however, is on the same order of magnitude as the USEPA fish screening benchmark (U.S. Environmental Protection Agency 2013c, 2013d). OEA notes that fish ingest thallium and accumulate the compound in their tissues, yet the correlation between fish accumulation and human thallium intake is uncertain (Agency for Toxic Substances and Disease Registry 1992). The Agency for Toxic Substances and Disease Registry (1992) cites a study in the *Thallium Toxicological Profile* that reports typical concentrations of thallium in food (meat, fish, fat, vegetables) ranging from trace amounts up to 0.05 milligram per kilogram, which is greater than the concentration in fish estimated by the model (0.0107 milligram per kilogram). Therefore, even under OEA's conservative assumptions regarding the deposition and movement of coal dust, the predicted concentration of thallium in fish would be well within the range found in other food sources. Appendix G, *Coal Dust Analysis,* describes the model results for freshwater fish concentrations and compares the results to available guidance levels.

As described above, OEA used conservative assumptions in deposition modeling, fate and transport modeling, constituent bioavailability, and human exposure pathways for constituents in coal to estimate human exposure to coal dust. OEA found that the concentrations of coal dust constituents (including trace element in coal and the chemical constituents of coal topper agents) in soil, dust, water, and fish would be below screening levels for human exposure for all evaluated pathways.

6.3.3.6 Ecological Impacts of Coal Dust

This section describes OEA's analysis of potential ecological impacts of coal dust from operation of the proposed rail line. OEA evaluated the impacts of coal dust on ecological receptors using the same methods as described above for the human health exposure analysis and further described in Appendix G, *Coal Dust Analysis*. OEA used an air dispersion and deposition model combined with a fate and transport model to estimate concentrations of coal dust in soil, water, and sediment. OEA then compared estimated soil, sediment, and water concentrations of trace metals in coal dust with USEPA ecological soil screening levels (Eco-SSLs) to evaluate soil exposure for ecological receptors, including plants, soil invertebrates, avian wildlife, and mammalian wildlife (U.S. Environmental Protection Agency 2005). EPA Eco-SSLs are applicable to plants, soil invertebrates, avian wildlife, and mammalian wildlife. Freshwater screening values by EPA Region 3 and other regions account for ecological impacts from fish exposure (U.S. Environmental Protection Agency 2013d).

OEA also compared estimates of incremental suspended solids resulting from the deposited coal dust with prevailing suspended solids levels and potential targets for the Tongue River (Appendix G, Section G.3.5).

To evaluate the movement of dust to soil and subsequently to sediment and surface water, OEA used the area-wide average deposition rate of particulates 250 microns in diameter and smaller. OEA did not explicitly model particles of aerodynamic diameter 250 microns and larger because particles of this size would deposit very quickly after being blown from a rail car. OEA calculated that particulates larger than 250 microns in diameter deposit most heavily within approximately 5 meters of the center of the track and would not deposit outside of the right-of-way. OEA's model accounts for dust that could be deposited in the watershed and transferred into the water body through runoff and erosion. Appendix G, *Coal Dust Analysis*, describes the basis for these decisions and details about the model.

The behavior and bioavailability of trace metals in soil from coal dust deposition depends on the association of those metals with various soil components, as described in Section 6.3.3.5, *Human Health Impacts of Coal Dust Ingestion*. As for human health impacts, OEA followed USEPA risk assessment guidance to assume that 100 percent of the chemical constituents in coal dust are bioavailable (U.S. Environmental Protection Agency 2007).

OEA used the following screening levels and values to evaluate ecological exposure.

- USEPA Eco-SSLs, where available, to evaluate the potential exposure of plants, soil invertebrates, avian wildlife, and mammalian wildlife to coal dust deposited on soil (U.S. Environmental Protection Agency 2005).
- When USEPA Eco-SSL values were not available, OEA used plant soil screening values from Efroymson et al. (1997). If these values were lower than the USEPA (2005) values, OEA used the values from Efroymson et al. (1997). OEA found that none of the chemical concentrations estimated for soil would result in values greater than the Eco-SSLs for plants, soil invertebrates, avian wildlife, or mammalian wildlife.

For trace elements without Eco-SSLs, the estimated average soil concentrations were more than three orders of magnitude lower than typical background levels in soils (Oak Ridge National Laboratory 2013).

OEA estimated concentrations of coal dust constituents in surface water based on the average deposition from air over a modeled watershed and subsequent runoff and erosion into a modeled water body. Nearly all of the estimated values for water in the model were well below available USEPA freshwater screening benchmarks (U.S. Environmental Protection Agency 2013).

Based on OEA's modeling assumptions, barium is the only coal dust constituent analyzed for which OEA's predicted concentration (10.1 micrograms per liter) would exceed the freshwater screening benchmark of 4.0 micrograms per liter. The conservative model assumption of 100 percent bioavailability (the highest possible value) used in this analysis would likely be unrealistic for barium, as the chemical is not very mobile in most soil systems (Agency for Toxic Substances and Disease Registry 2007). OEA therefore considers the 100 percent bioavailability assumption to represent an overestimate. In addition, barium released to water will readily combine with sulfate ions to form barium sulfate, which precipitates out of solution because of very limited solubility (Agency for Toxic Substances and Disease Registry 2007). Therefore, the 100 percent solubility assumption also contributes to an overestimate of the barium concentration, and OEA concludes that the concentration of barium from coal dust in freshwater would be unlikely to exceed the screening benchmark. OEA also notes that Montana does not have an aquatic life water quality criterion for barium and that barium concentrations in the Tongue River are typically about 50 micrograms per liter, based on monitoring during the period of 2001 to 2005 (U.S. Geological Survey 2007).

OEA used sediment screening benchmarks from the USEPA Region 3 Biological Technical Assistance Group, which provides media-specific ecotoxicological benchmarks that can be used in developing screening-level assessments (U.S. Environmental Protection Agency 2013b). When USEPA developed the sediment benchmarks, it gave preference to benchmarks based on chronic direct exposure and used nonlethal endpoint studies to protect sensitive species. All of the estimated sediment concentrations in OEA's analysis fell below sediment screening benchmarks.

As described in Appendix G, *Coal Dust Analysis*, OEA estimated deposition of coal dust to the modeled water body by direct deposition and used a simulated landscape to estimate dust in storm water runoff and the associated contributions to suspended solids in the water body. Based on an environmental model of a simulated landscape, OEA estimated the incremental suspended solids in the modeled water body resulting from the deposited coal dust. Using conservative assumptions, such as the highest erosion/runoff rate per unit area of the watershed in the modeling method employed, the model estimated an incremental addition of 0.7 milligrams per liter of suspended solids in the modeled water body.

The Tongue River is listed on the Montana DEQ/USEPA 303(d) list of impaired waters for solids (suspended sediment/bedload) between the Tongue River Reservoir and the Yellowstone River, as discussed in Chapter 9, Section 9.2, *Surface Water*. At this time, however, a suspended solids criterion has not been developed for the river through the total maximum daily load process. A previous study (Montana Department of Environmental Quality 2003) that examined the 303(d) status of the river compared suspended solids concentrations measured for the river to Utah and South Dakota warm water fisheries protection criterion of 90 and 150 milligrams per liter, respectively. The reported data indicate that median suspended solids concentrations generally increase as the river flows from the reservoir to the junction with the Yellowstone River, with a reported median concentration of 46 milligrams per liter downstream of Ashland and 66 milligrams per liter at Miles City. Some reported values did exceed the criteria, but the modeled suspended solids concentration from coal dust deposition is only a small fraction of the suspended solids levels reported for the river.

Because the modeled suspended solids concentration from coal dust deposition is overstated by the conservative modeling assumptions and is nevertheless only a small fraction of the suspended solids levels reported for the Tongue River, which are typically well below the referenced potential criteria, OEA concludes that coal dust deposition would not be likely to cause ecological impacts.

In summary, OEA used conservative assumptions for deposition modeling, fate and transport modeling, determining bioavailability of constituents, and identifying ecological exposure pathways for constituents in coal. OEA's resulting estimates of coal dust constituent concentrations in soil, sediment, and surface water were below screening levels for ecological exposure, with the exception of values for barium in surface water. As discussed in Section 6.3.3.6, *Ecological Impacts of Coal Dust*, OEA's use of several conservative assumptions in the analysis, such as 100 percent bioavailability, overestimate the likely concentration of barium in surface water. Furthermore, when barium is released to water, the compound will precipitate, or come out of solution, as barium sulfate, which has low solubility in water. Therefore, OEA does not expect that concentrations of soluble barium in surface water would exceed benchmark or screening levels.

Similarly, conservative assumptions used to model suspended solids concentrations that could result from coal dust deposition overestimate the likely concentration of coal dust suspended in water, which would be small relative to existing levels of suspended solids in the Tongue River.

6.3.3.7 Safety Impacts of Coal Dust

OEA considered the potential for impacts from coal dust on safety through the fouling of railroad ballast, reduced driver visibility, and effects on road conditions. As described in detail in Section 6.5.3, *Surface Transportation Board Decisions*, the Board has concluded that there is evidence that coal dust can harm the stability of railroad ballast and has approved efforts by railroads to reduce coal dust emissions. OEA did not identify any studies that reported impacts related to coal dust on driver visibility or road conditions. The potential for such impacts at a specific location would be affected by many factors, including train traffic levels, train speed, coal dust emission reduction measures in use, distance from the track, local topographic and meteorological conditions, and vehicle volume. To the extent that road safety impacts could occur with the proposed rail line, higher levels of coal train traffic would result in more frequent impacts than lower traffic levels. Impacts at locations near the tracks would be greater than at locations farther away. Impacts from trains carrying coal with a shaped load profile and to which a topper agent has been applied would be less than impacts from trains carrying untreated coal. Section 6.3.3.8, *Nuisance Impacts of Coal Dust* and Chapter 4, Section 4.5.1.2, *Operation*, provide further detail on impacts from visible coal dust.

6.3.3.8 Nuisance Impacts of Coal Dust

Nuisance impacts such as short-term visible dust or *amenity impacts* are not well studied and thresholds for impacts are not well defined (Queensland Rail 2008). Most of the evidence of visible coal dust emissions comes from anecdotal reports of dust plumes or records of citizen complaints. These reports do not provide data to relate dust events to emissions levels or the efficiency of dust control measures (Calvin et al. 1993; Canadian Council of Ministers of the Environment 2001; New South Wales Ministry of Health 2007). OEA did not identify any studies that reported impacts related to coal dust on driver visibility or road conditions. The potential for nuisance or amenity impacts at a specific location would be affected by many factors, including train traffic levels, train speed, coal dust emission reduction measures in use, distance from the track, and local topographic and meteorological conditions. To the extent that nuisance or amenity impacts could occur with the proposed rail line, higher levels of coal train traffic would result in more frequent impacts than lower traffic levels. Impacts at locations near the tracks would be greater than at locations farther away. Impacts from trains carrying coal with a shaped load profile and to which a topper agent has been applied would be less than impacts from trains carrying untreated coal. Chapter 4, Section 4.5.1.2, *Operation,* provides further detail on potential impacts from visible coal dust.

6.4 Environmental Consequences

Human and ecological health impacts that would be common to all build alternatives could result from construction and operation of any build alternative. These impacts would be affected by the level of train traffic on the proposed rail line.

6.4.1 Impacts Common to All Build Alternatives

Impacts related to coal dust that are common to all build alternatives are described below.

- **Human Health Impacts from the Inhalation of Airborne Coal Dust**

  As described in Section 6.3.3.4, *Human Health Impacts of Coal Dust Inhalation,* OEA determined that, while coal dust from trains on any build alternative could increase PM10 and PM2.5 concentrations along the right-of-way, particulate matter concentrations in the study area would not exceed either the NAAQS or Montana AAQS. Because the NAAQS are the established U.S. standards for healthy air quality, OEA concluded that coal dust emitted by trains on the proposed rail line would not cause air quality in the study area to become unhealthy.

- **Human Health Impacts from Ingestion of Deposited Coal Dust**

  OEA determined that human exposure to coal dust that would be deposited in or near the study area and that could be ingested through soil, dust, groundwater, and fish pathways would be below the screening levels for all pathways (Section 6.3.3.5, *Human Health Impacts of Coal Dust Ingestion*). OEA also determined that, while some of the constituents of topper agents can cause skin and eye irritation, human exposure would be well below the levels that would cause irritation.

- **Ecological Impacts from Deposited Coal Dust**

  As described in Section 6.3.3.6, *Ecological Impacts of Coal Dust*, trains on any build alternative would generate coal dust emissions that would be deposited in or near the study area, where they could cause ecological impacts. OEA determined that exposure to coal dust constituents through soil, dust, groundwater, surface water, and aquatic pathways would be below the screening levels for ecological exposure, with the exception of barium in surface water. As discussed in Section 6.3.3.6, *Ecological Impacts of Coal Dust*, OEA's conservative assumptions in the analysis result in an overestimate the amount of barium that might reach the water, and OEA therefore does not expect that the contribution of coal dust to barium concentrations in surface water would exceed benchmark or screening levels.

  OEA estimated that impacts on suspended solids concentration in the Tongue River from coal dust would be small compared to interim standards/targets and typical suspended solids concentrations in the Tongue River.

- **Nuisance or Amenity Impacts from Deposited Coal Dust**

  As described in Section 6.3.3.8, *Nuisance Impacts of Coal Dust*, and Chapter 4, Section 4.5.1.2, *Operation*, trains on any build alternative would generate coal dust that would be deposited in or near the study area, where the dust could cause nuisance or amenity impacts. These impacts would vary as a function of meteorological conditions, train traffic, proximity to train tracks, and the use of a topper agent or shaping the load profile.

6.4.2 Impacts by Build Alternative

Total coal dust emissions from railcars would vary by build alternative depending primarily on the number of train-miles traveled, and to a much lesser degree on the train speeds. Hence, for any coal production level (which determines the number of trains) the total coal dust emissions would depend on the length of the rail line right-of-way. The emissions per mile of right-of-way per day would be determined by the number of trains per day. The modeled concentrations of coal dust constituents (metals and organic compounds) in soil and water would vary with the deposition of the emissions. As a result, for any coal production level, the degree of impact at any location would be similar across all the build alternatives, but the total area over which that impact would occur would vary with the lengths of the build alternatives.

6.4.3 No-Action Alternative

Under the No-Action Alternative, TRRC would not construct and operate the proposed Tongue River Railroad, and there would be no coal dust impacts from construction or operation of the proposed rail line.

6.4.4 Mitigation and Unavoidable Environmental Consequences

OEA is not recommending that the Board impose mitigation measures to minimize or avoid the impacts of coal dust because coal dust exposure from planned operation of the build alternatives would be within applicable standards and guidelines. OEA anticipates that operation of the proposed rail line would result in airborne coal dust emissions and coal dust deposition. BNSF tariffs require shippers to control coal dust emissions through use of load profiling and application of an approved topping agent or other measures to reduce emissions by at least 85 percent. This emission control is not considered a mitigation measure because BNSF already requires it from coal shippers in Montana and Wyoming. Specifically, TRRC has stated that BNSF plans to require shippers using the proposed rail line to adhere to coal dust mitigation requirements in BNSF Price List 6041-B and Appendices A and B, issued September 19, 2011 (Coburn pers. comm.). OEA concludes that the impacts of coal dust would be negligible but recognizes that there could be minor nuisance impacts.

6.5 Applicable Regulations

Airborne coal dust is regulated in occupational exposure settings (e.g., coal mines). As noted above, nonoccupational (environmental) exposure to coal dust is governed by regulations for non-occupational exposure to particulate matter (PM10 and PM2.5).

6.5.1 Occupational Exposure

Coal miners are protected from exposure to high levels of coal dust by Occupational Safety and Health Administration (OSHA) regulations (29 Code of Federal Regulations [C.F.R.] Part 1910) and Mine Safety and Health Administration (MSHA) regulations (30 C.F.R. Parts 70, 71, 72, 75, and 90). The OSHA standard for occupational exposure to coal dust is an average of 2.4 milligrams per cubic meter of PM10 over 8 hours per day of workplace exposure when coal dust contains less than 5 percent silicon dioxide. The MSHA permissible exposure limit for coal dust containing less than 5 percent silicon dioxide is lower, at 1.5 milligrams per cubic meter.[9] When the dust contains more than 5 percent silicon dioxide, the allowable concentration decreases according to the percentage of silicon

[9] On May 1, 2014, MSHA issued a final rule lowering the standard from 2.0 to 1.5 milligrams per cubic meter (79 Fed. Reg. 24813). For further information, see http://www.msha.gov/endblacklung/.

dioxide present (29 C.F.R. Part 1910.1000 and 30 C.F.R. Part 71.100). This Draft EIS does not address occupational exposure to coal dust in and around mines, but addresses environmental (non-occupational) exposure to particulate matter, including coal dust, along rail lines transporting coal.

6.5.2 Environmental Exposure

All fugitive coal dust, including dust from coal trains, is regulated by the NAAQS for particulate matter (40 C.F.R. Part 50). USEPA sets the NAAQS to protect human health, based on the best and latest scientific information. The NAAQS for PM10 is 150 $\mu g/m^3$ averaged over 24 hours. The NAAQS for PM2.5 is 35 $\mu g/m^3$ averaged over 24 hours or 12 $\mu g/m^3$ averaged over 1 year. These NAAQS are selected to protect human health, including sensitive populations such as children and the elderly, with a margin of safety. Because they regulate environmental exposure of the general population to all sources of particulate matter, the NAAQS are more stringent than the standards regulating occupational exposure of mineworkers to coal dust in coal mines.

Deposited coal dust, in general, may have Clean Water Act implications. In June 2013, the Sierra Club and other environmental organizations filed a lawsuit against BNSF and five coal companies[10] alleging that dust from coal trains has polluted waterways of Washington State (*Sierra Club Inc. et al. v. BNSF Railway Company et al.*, U.S. District Court for the Western District of Washington, Case No. 2:13-cv-00967).

The Sierra Club and its fellow litigants claim that BNSF and the coal shippers did not obtain the necessary permits required to discharge pollution into waterways. The complaint alleges that, under the Clean Water Act, such discharges require National Pollutant Discharge Elimination System permits.

BNSF argues that it is taking precautions to limit coal dust deposition with tariffs that require coal shippers to use coal dust suppression methods (toppers and shaping the load profile). BNSF claims that the environmental groups have not provided sufficient information on specific amounts of coal dust discharged or locations of discharges, and that not all coal dust found in Washington state waters can be traced to BNSF because coal trains and vessels having been traveling through the area for 100 years (Goldberg 2013).

A similar case has been filed in the U.S. District Court for the Eastern District of Washington, where recently a motion to dismiss was denied, allowing the Clean Water Act case to proceed against BNSF (*Sierra Club Inc. et al. v. BNSF Railway Company*, U.S. District Court for the Eastern District of Washington, Case No. 2:13-cv-00272). As of January 2015, both cases are pending.

[10] The five coal companies are Peabody Energy Inc., Global Mining Holding Co. LLC, Ambre Energy North America Inc., Cloud Peak Energy Inc., and FirstEnergy Corp.

6.5.3 Surface Transportation Board Decisions

The Board has issued two decisions related to controlling the emissions of coal dust from rail cars. Both cases involved a coal shipment tariff that BNSF first issued in May 2009. Under the tariff currently in effect, shippers loading coal at Wyoming and Montana mines for shipment subject to the tariff must take measures to reduce in-transit coal dust loss by at least 85 percent, compared with coal cars where no remedial measures have been taken. The 85 percent reduction requirement can be met by shaping the load profile of the coal and applying a chemical topper approved by BNSF. BNSF set maximum allowable emission levels based on a measure called an Integrated Dust Value and installed monitoring instruments along the two affected lines (Orin Line and Black Hills Subdivision) to ensure that coal dust emissions were in the allowed range.

In October 2009, a number of coal shippers collectively filed a petition to the Board challenging the reasonableness of BNSF's initial tariff. In March 2011, the Board issued its first decision regarding the tariff. The Board concluded that BNSF had shown sufficient evidence that coal dust is harmful to railroad ballast and that BNSF can take steps to limit the emission of fugitive coal dust along its lines. However, the Board also found that the BNSF tariff was unreasonable because it did not set clear guidelines for coal shippers. Specifically, shippers would not know if they complied with the tariff when a train was loaded because BNSF did not explain how its Integrated Dust Value standard was calculated.

Following the Board's decision, BNSF revised its tariff using the results of a study of coal dust emissions from rail cars known as the Super Trial. The purpose of the Super Trial was to assess the effectiveness of chemical suppressor agents (toppers or topper agents) in reducing coal dust emissions from rail cars. In the Super Trial, BNSF identified a number of topper agents that significantly reduced the emission of fugitive coal dust.

In July 2011, BNSF issued a revision to its tariff. Under the revised tariff, BNSF would consider coal shipments made using one of the approved topper agents to comply with the dust control provisions of the tariff. The approved topper agents are those that BNSF found could reduce emissions of fugitive coal dust by at least 85 percent when used in combination with shaping the profile of the loaded coal in rail cars. Alternatively, the tariff allows coal shippers to use other methods to reduce dust emissions if the shipper is able to show that its methods reduce emissions of fugitive coal dust by at least 85 percent. The tariff also included a liability provision that required that any methods used to control emissions of fugitive coal dust not adversely impact railroad employees or property.

In its second coal dust decision in July 2012, the Board again acknowledged that BNSF had shown sufficient evidence that fugitive coal dust from rail cars is potentially harmful to railroad ballast and that BNSF can take measures to control the emission of coal dust along its rail lines. Overall, the Board concluded that BNSF's revised tariff was reasonable. However, the Board ruled that the liability provision was unreasonable because the Board found it to be overly broad and ambiguous.

The coal dust cases before the Board were concerned with the effects of coal dust on track stability. In its decisions, the Board concluded that there is sufficient evidence that coal dust can harm the stability of railroad ballast and that BNSF can take measures to control the emission of fugitive coal dust from rail cars. The U.S. Department of Transportation supports the Board's decisions as reasonable and fully consistent with Federal Railroad Administration regulations (Surface Transportation Board 2013). The issues before the Board did not include any potential human health or ecological impacts of fugitive coal dust; therefore, the Board's opinions did not address those issues. The analysis in this chapter and Appendix G, *Coal Dust Analysis*, includes potential human health and ecological impacts and compares them to established criteria issued by environmental regulatory agencies.