Talburt, Tammy (UTC)

From:	Wright, Al (UTC)
Sent:	Tuesday, January 18, 2011 10:32 AM
To:	Talburt, Tammy (UTC)
Cc:	Michelle, Kayce (UTC)
Subject:	FW: Comments--Repar--Whistling Ridge--ice and snow
Attachments:	Comments_wind energy_cold weather issues_15Jan2011.doc; Cold_Weather_White_Paper.pdf

For the Record. -- Al

Al Wright, Managing Director
Energy Facility Site Evaluation Council
Utilities & Transportation Commission
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From: repar [mailto:[redacted]@saw.net]
Sent: Saturday, January 15, 2011 10:57 PM
To: Wright, Al (UTC)
Subject: Comments--Repar--Whistling Ridge--ice and snow

Dear Mr. Wright,
I am sending you this e-mail, among others, tonight because I have received the following message from all my attempts to e-mail my comments to efsec@utc.wa.gov:

This is an automatically generated Delivery Status Notification.

Delivery to the following recipients failed.

EFSEC@utc.wa.gov

Apparently, the message comes from postmaster@wa.gov. Perhaps the mailbox is full and cannot receive input. So, I guess you are it! Thank you.

Mary J. Repar
[redacted]E. Loop Rd.[redacted]
Stevenson, WA 98648
Tel: 509.427[redacted]
E-mail: [redacted]@saw.net
"Life is not measured by the number of breaths we take but by the moments that take our breath away."

[redacted] Mary J. Repar
[redacted] E. Loop Rd., [redacted]
Stevenson, WA 98648
Tel: 509.427.[redacted]

15 January 2011

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BPA
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503. 230. 4145
www.bpa.gov/comment

Re: Comments on Whistling Ridge Wind Farm and the effects of cold weather, low temperatures, and icing on wind turbines, and safety issues

Dear EFSEC,

I thought I was done but I forgot about the issue of cold temperature effects on wind turbines. I had come across a paper, Wind Energy: Cold Weather Issues, by Antoine Lacroix and Dr. James F. Manwell, from the University of Massachusetts at Amherst Renewable Energy Research Laboratory, June 2000, and felt that the issue of cold weather effects on wind turbines and the inherent safety issues had not been adequately addressed in the DEIS.

In section 3 of the paper, the authors address Cold Weather Issues and state the following:

"There are three general issues important to the operation of wind turbines in cold weather. These issues could be classified under three categories:

- **the impact of low temperatures on the physical properties of materials**
- **the ice accretion on structures and surfaces**
- **the presence of snow in the vicinity of a wind turbine**

Cold weather operation of wind turbines **require that these issues be examined in the design or at least in the phase preceding the installation of the turbines** in their working environment. **Not doing so would mean prolonged period of inactivity required for safety purposes or because turbines inability to perform satisfactorily.**" [my emphasis]

During the DEIS hearings, I do not recall the proponent addressing the issues of changes in physical properties of the materials used in the construction and infrastructure of the wind turbines. Nor do I recall any discussion of ice accretion and its effects and whether snow would have any impacts on turbine operation, efficiency, and safety. Safety of humans and wildlife should be considered and I do not believe that the safety issue was adequately addressed in the DEIS at all. That should now be rectified, before any siting decision is made.

The paper goes on to discuss the effects of low temperatures. You all can read the paper for yourselves, but I will highlight some of the issues raised:

"**Low temperatures affect the different materials used in the fabrication of wind turbines, usually adversely**. Structural elements such as steel and composite material all see their mechanical properties changed by low temperatures. Steel becomes more brittle; its energy absorbing capacity and deformation prior to failure are both reduced.

Composite materials...will be subjected to a **residual stress**. If this stress is sufficient, it can result in **microcracking** ... These microcracks **reduce both the stiffness and the impermeability of the material,** which can contribute to the **deterioration process** (Dutta and Hui, 1997).

Low temperatures can also **damage the electrical equipment such as generators, yaw drive motors and transformers**. When power is applied to these machines after they have been standing in the cold for a long period, the windings can suffer from a thermal shock and become damaged.

Gearboxes, hydraulic couplers and dampers suffer from long exposure to cold weather. As the temperature goes down, the viscosity of the lubricants and hydraulic fluids increases up to a point where **at -40_{o} F, a chunk of heavy gear oil could be used to pound nails** (Diemand,6 1990). **Damage to gears** will occur in the very first seconds of operation where oil is very thick and cannot freely circulate. In addition, due to an increase in internal friction, **the power transmission capacity of the gearbox is reduced** when the oil viscosity has not reached an acceptable level.

Seals, cushions and other rubber parts loose flexibility at low temperatures. This may not necessarily result in part failure but **can cause a general decline in performance**. A typical rubber part can see its stiffness augmented by a factor of 8 at a temperature of -40_{o}F (Brugada, 1989). **Brittleness also increases which changes impact resistance and makes the part prone to cracking** (Brugada, 1989).

Icing represents the most important threat to the integrity of wind turbines in cold weather... Wind turbines must therefore be able to sustain at least limited icing without incurring damage preventing normal operation... **The icing likely to form on wind turbine blades is of two kinds: glaze and rime. Glaze ice is the result of liquid precipitation striking surfaces at temperatures below the freezing point. Glaze is**

rather transparent, hard and attaches well to surfaces. It is the type of icing encountered during ice storms... A study covering a period of fifty years of glaze precipitation in the United States conducted by Tattelman and Gringorten supports this claim. They have established the probability of an ice storm of thickness greater or equal than 0.63 cm for the Pennsylvania, New York and New England regions during one year to be 0.88, i.e. almost once per year.

Rime ice occurs when surfaces below the freezing point are exposed to clouds or fog composed of super-cooled water droplets. Its white and opaque appearance is caused by the presence of air bubbles trapped inside. **Rime ice is of primary importance in high elevation locations such as hills or mountaintops.** Figure 1 and 2 show how severely can a wind turbine be affected by rime ice." [my emphasis]

We are located in the Cascades and we get snow and ice. We have had two ice storms and a snow storm in the last several weeks. The higher up one goes in elevation, the more snow falls because it is colder. The Whistling Ridge wind farm is proposed at higher elevations and the proposed turbines would be stressed by ice and snow, combined with high winds. This should be addressed in the DEIS. What impacts would ice, snow, and high winds have on the composition and operation of the proposed wind turbine farm? How dangerous to the maintenance people and others in the vicinity would ice thrown from turbines be?

The paper gives some idea of the dangers from ice:

"Ice collects on both the rotating and non-rotating surfaces. **The most adverse effect of icing occurs on the rotor itself.** Its consequences on the rotor are the following:

- Interfere with the deployment of speed limiting devices such as tip flaps or movable blade tip
- **Increase the static load on the rotor**
- Change the dynamic balance of the rotor, thereby **accelerating fatigue**
- **Reduce the energy capture** by altering the aerodynamic profile of the rotor
- **Ice fragments can be propelled and represent a safety hazard for population and property in the vicinity of wind turbines.** Larger chunk can also strike the rotor and damage it.

Ice also accumulates on fixed structures such as nacelles, towers and ladder, making periodic maintenance more difficult by preventing easy access to turbine components. **It can interfere with the normal functioning of pitch control and orientation mechanisms.** Finally, the presence of ice on structural elements increases both the static loading and the wind loading due to an augmentation in surface area." [my emphasis]

Snow is a big issue, too. The paper states the following:

"Due to its very low specific gravity, snow is easily carried by wind. **It can infiltrate almost any unprotected openings where an airflow can find its way.** Wind turbine nacelles, i.e. **the housings that contain the gearbox and the generator, are not**

necessarily airtight compartments. In fact, they incorporate many openings in order to provide a supply of fresh air for cooling purposes. Hence, **snow can accumulate inside the nacelle and damage the equipment. This could prove very detrimental for the electrical machinery**. On the other hand, snow could also obstruct these openings and prevent normal circulation of air. It is suggested to use deflectors or baffles in order to keep these openings free of obstruction." [my emphasis]

Rime ice is a problem at higher elevations:

"In the Northeastern U.S., the most suitable sites for wind turbines are frequently mountains or **ridgetops. These also are areas where wind turbines are more susceptible to rime ice due to the relative proximity of low-level clouds**. Bailey (1990) suggests that during cold weather at altitude about 2300 ft, rime ice can be expected approximately 10% of the time. This figure jumps to 20% for altitude above 3000 ft." [my emphasis]

There are proposed solutions to the above stated issues but since these issues are not addressed adequately, if at all in the DEIS, we cannot only speculate about the effects of low temperatures, ice, snow, and wind on wind turbines placed at our high elevations. The question is: How would SDS Lumber address these issues if they had been in the DEIS? And, what solutions, if any, would they have offered as mitigation?

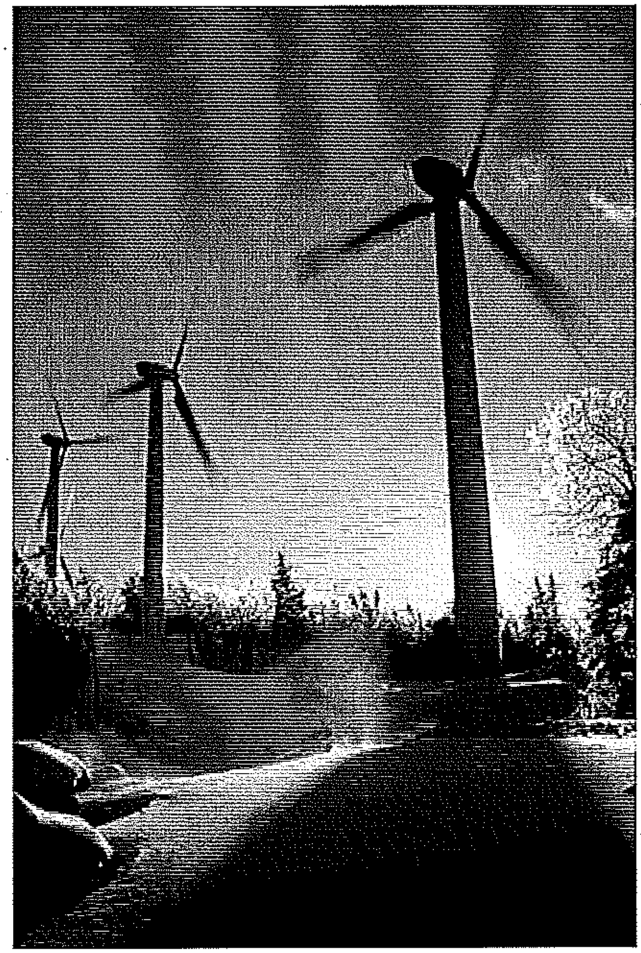
Monitoring activities should have been done for the DEIS, during the winter season so that we could have some data to look at when making any decisions about this proposed wind farm. For example, documenting glaze ice and ice monitoring could have been undertaken by SDS these past few years. The paper suggest that "...the anemometer stations could also be fitted with icing detectors to evaluate the duration of each icing episode and the total number of hours during a season."

Cold weather, low temperatures, icing and safety issues cannot be ignored during the decision-making process for the Whistling Ridge wind farm. **The effects of cold weather, low temperatures, icing on wind turbines, and safety issues are very important issues and should have been addressed in the DEIS, by the proponent.** The safety of maintenance workers and the surrounding community should be of paramount importance. We should also think about the safety of wildlife and how it would be affected by wind turbines hurling globs of heavy ice around indiscriminately. Not a pretty picture.

We do not have enough information about these issues for any one to make an informed decision. We need more information from the proponent about how the wind turbines are going to hold up at higher elevations, on ridgetops, and if they will hold up. Monitoring and fact-finding should be done before any decisions are made. Thank you.

/e-signature/Mary J. Repar
15 January 2011

Wind Energy: Cold Weather Issues



Presented by:
Antoine Lacroix
Dr. James F. Manwell

University of Massachusetts at Amherst
Renewable Energy Research Laboratory
June 2000

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1. Introduction

As the environmental matters become more important and as the world is striving to find cleaner sources of energy, the portion of electricity that is wind generated is likely to increase substantially every year. However, harnessable winds are sometimes located where the climate is inclement for a substantial part of the year. Indeed, areas such as New England and the Mid-West have long been identified for their wind energy potential but partly because of harsh winter conditions, have not seen many wind farms being commissioned.

Until recently, most large-scale wind energy development took place in regions where cold weather was not a major concern, most notably California. More recently, wind energy development has begun to occur in colder regions. Thus, many developers and manufacturers are beginning to gain more cold weather operating experience. Much of that information is not publicly available and in any case, not all of the issues that have been encountered have been completely resolved. The wind farm developer is therefore confronted with a lack of information when planning wind farms in a cold weather environment.

This paper provides an overview of the issues affecting wind turbine operations in cold weather with a special emphasis given on atmospheric conditions prevailing in the Northeast United States. The first section describes previous and more recent wind energy projects in cold weather areas. In the second section, environmental elements most likely to impact on the operation of wind turbines in cold weather are introduced: low temperatures, icing and snow. It also presents various climatic situations and their specific behavior in cold weather. The third section suggests some solutions to problems identified in the previous section. In addition, this paper suggests ideas of further research on the operation of wind turbines in cold climate. It also identifies organizations interested by similar issues whose cooperation would be beneficial.

2. Previous Experience

The first wind turbine to be grid-connected in America was built more than fifty years ago in Vermont. It was located on Grandpa's Knob near Rutland and began feeding the grid for the first time in October 1941 (Putnam, 1948). It is interesting to note that early in the design process, the concern about cold weather, especially icing was very present. Indeed, the selection of Grandpa's Knob was based on the fact that a lower elevation mountain would represent a reduced risk of heavy ice accumulation. The designers wanted to eliminate any possibility of structural failure, which would have resulted in the end of the project. So the choice of Grandpa's Knob was made in spite of superior wind resources available on mountains with higher elevation. The next attempts at grid-connected wind turbines in New England were made during the 1980's in New Hampshire and Vermont at Crotched Mountain and Mt. Equinox respectively. It is fair to say that the difficult winter conditions are partly responsible for their short duration. Note, for example, the accumulation of ice on the turbine shown in figures 1 and 2. During these years, however, some experience was acquired in small wind energy conversion systems. This type of machinery was often installed to provide power for scientific camps, communication relays or meteorological stations in Antarctica and other desolated areas.

More recently, wind turbines have been installed in areas where cold weather conditions exist. In the Midwest, especially in Minnesota and Iowa, glaze ice and snow can be expected (AWEA, 2000). In Vermont, a wind farm has been built in a mountainous domain where rime ice is likely to occur. Europeans have installed wind farms in Scandinavia, the highlands of Germany, Austria and the Alps (Seifert and Tammelin, 1996). Conditions like rime and cold temperatures are likely to be found in these regions. A series of conferences were held in Finland to address these issues and other aspects of wind energy in cold weather such as resource assessment.

3. Cold Weather Issues

There are three general issues important to the operation of wind turbines in cold weather. These issues could be classified under three categories:

- the impact of low temperatures on the physical properties of materials
- the ice accretion on structures and surfaces
- the presence of snow in the vicinity of a wind turbine

Cold weather operation of wind turbines require that these issues be examined in the design or at least in the phase preceding the installation of the turbines in their working environment. Not doing so would mean prolonged period of inactivity required for safety purposes or because turbines inability to perform satisfactorily.

3.1 Low Temperatures

Low temperatures affect the different materials used in the fabrication of wind turbines, usually adversely. Structural elements such as steel and composite material all see their mechanical properties changed by low temperatures. Steel becomes more brittle; its energy absorbing capacity and deformation prior to failure are both reduced. Composite materials, due to unequal shrinkage of their fiber/matrix components, will be subjected to a residual stress. If this stress is sufficient, it can result in microcracking in the material. These microcracks reduce both the stiffness and the impermeability of the material, which can contribute to the deterioration process (Dutta and Hui, 1997).

Low temperatures can also damage the electrical equipment such as generators, yaw drive motors and transformers. When power is applied to these machines after they have been standing in the cold for a long period, the windings can suffer from a thermal shock and become damaged.

Gearboxes, hydraulic couplers and dampers suffer from long exposure to cold weather. As the temperature goes down, the viscosity of the lubricants and hydraulic fluids increases up to a point where at -40° F, a chunk of heavy gear oil could be used to pound nails (Diemand, 1990). Damage to gears will occur in the very first seconds of operation where oil is very thick and cannot freely circulate. In addition, due to an increase in internal friction, the power transmission capacity of the gearbox is reduced when the oil viscosity has not reached an acceptable level.

Seals, cushions and other rubber parts loose flexibility at low temperatures. This may not necessarily result in part failure but can cause a general decline in performance. A typical rubber part can see its stiffness augmented by a factor of 8 at a temperature of -40°F (Brugada, 1989). Brittleness also increases which changes impact resistance and makes the part prone to cracking (Brugada, 1989).

3.2 Icing

Icing represents the most important threat to the integrity of wind turbines in cold weather. Based on the duration of inoperative wind measuring equipment at one surveyed mountain in western Massachusetts, it was determined that icing weather can occur as much as 15% of the time between the months of December and March (Kirchhoff, 1999). Wind turbines must therefore be able to sustain at least limited icing without incurring damage preventing normal operation. Furthermore, it is advisable that power production be maintained in moderate icing for the following reasons:

- To minimize downtime period and benefit from the more favorable winter winds
- To keep the rotor turning and therefore limit the ice growth to leading edge part of the blade that is likely fitted with some ice protection equipment

The icing likely to form on wind turbine blades is of two kinds: glaze and rime. Glaze ice is the result of liquid precipitation striking surfaces at temperatures below the freezing point. Glaze is rather transparent, hard and attaches well to surfaces. It is the type of icing encountered during ice storms. New England and especially Massachusetts is an area of high occurrence for glaze storms as confirmed in Figure 3. A study covering a period of fifty years of glaze precipitation in the United States conducted by Tattelman and Gringorten supports this claim. They have established the probability of an ice storm of thickness greater or equal than 0.63 cm for the Pennsylvania, New York and New England regions during one year to be 0.88, i.e. almost once per year.

Rime ice occurs when surfaces below the freezing point are exposed to clouds or fog composed of supercooled water droplets. Its white and opaque appearance is caused by the presence of air bubbles trapped inside. Rime ice is of primary importance in high elevation locations such as hills or mountaintops. Figure 1 and 2 show how severely can a wind turbine be affected by rime ice.

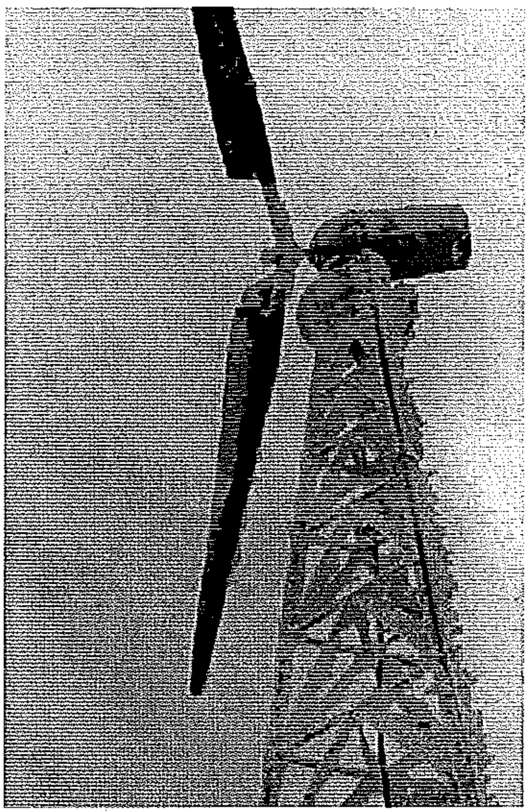

Figure 1. Severe rime ice accretion on a US Windpower 56-100 turbine installed on Mt. Equinox Vt. Note the magnitude and extent of the ice coverage. (University of Illinois at Urbana-Champaign, Dept. of Aeronautical and Astronautical Eng.)

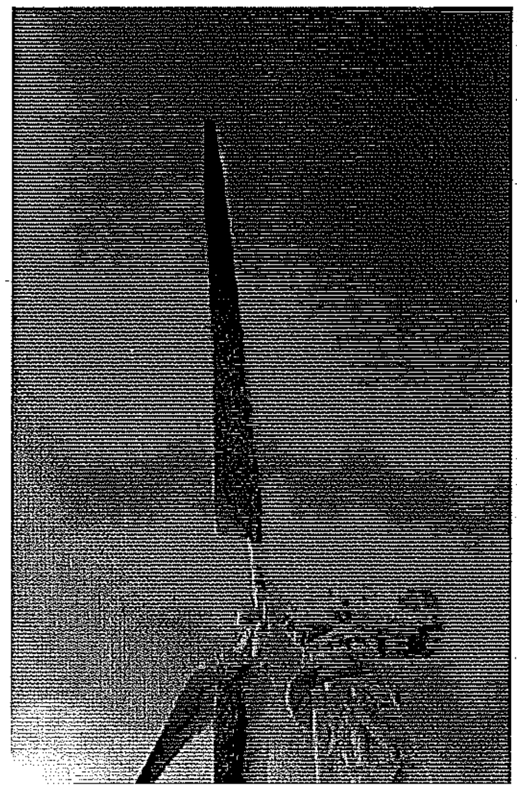

Figure 2. Same as Figure 1 showing a close-up view of the rotor and nacelle. (University of Illinois at Urbana-Champaign, Dept. of Aeronautical and Astronautical Eng)

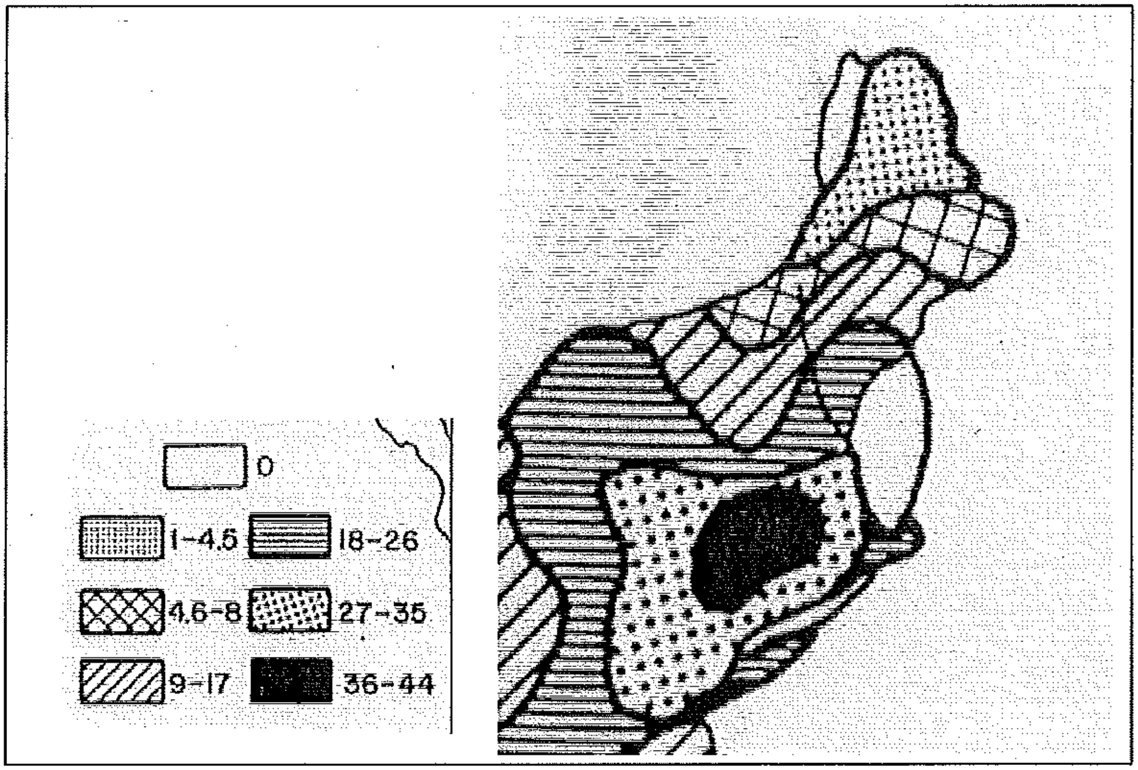

Figure 3. Total number of glaze storms, without regard to ice thickness, observed during the 9-year period of the Association of American Railroads study (undated) (Adapted from Bennett, 1959)

Ice collects on both the rotating and non-rotating surfaces. The most adverse effect of icing occurs on the rotor itself. Its consequences on the rotor are the following:

- Interfere with the deployment of speed limiting devices such as tip flaps or movable blade tip
- Increase the static load on the rotor
- Change the dynamic balance of the rotor, thereby accelerating fatigue
- Reduce the energy capture by altering the aerodynamic profile of the rotor
- Ice fragments can be propelled and represent a safety hazard for population and property in the vicinity of wind turbines. Larger chunk can also strike the rotor and damage it.

Ice also accumulates on fixed structures such as nacelles, towers and ladder, making periodic maintenance more difficult by preventing easy access to turbine components. It can interfere with the normal functioning of pitch control and orientation mechanisms. Finally, the presence of ice on structural elements increases both the static loading and the wind loading due to an augmentation in surface area.

3.3 Snow

Due to its very low specific gravity, snow is easily carried by wind. It can infiltrate almost any unprotected openings where an airflow can find its way. Wind turbine nacelles, i.e. the housings that contain the gearbox and the generator, are not necessarily airtight compartments. In fact, they incorporate many openings in order to provide a supply of fresh air for cooling purposes. Hence, snow can accumulate inside the nacelle and damage the equipment. This could prove very detrimental for the electrical machinery. On the other hand, snow could also obstruct these openings and prevent normal circulation of air. It is suggested to use deflectors or baffles in order to keep these openings free of obstruction.

3.4 Climatic Type

3.4.1 Polar Weather

Locations where wind turbines have supplied energy for many years are the remote sites of Arctic and Antarctica. Small units are used to power radio relay stations, expedition base and navigational aids. The abundant wind supply makes them ideal and very cost-effective sources of energy for these areas. The climatic conditions are more characterized by the extreme low temperatures than by precipitation of any kind. Therefore, the major meteorological concern associated with the polar weather is the severity of the low temperatures that generally degrades the stiffness and toughness properties of materials.

3.4.2 High Elevations

In the Northeastern U.S., the most suitable sites for wind turbines are frequently mountains or ridgetops. These also are areas where wind turbines are more susceptible to rime ice due to the relative proximity of low-level clouds. Bailey (1990) suggests that during cold weather at altitude about 2300 ft, rime ice can be expected approximately 10% of the time. This figure jumps to 20% for altitude above 3000 ft.

3.4.3 Lower Elevations

The type of meteorological hazard most likely to happen at lower elevations is glaze ice. Bailey (1990) suggests that glaze ice events are of short duration and light in intensity but the January of 1998 northeast ice storm proved otherwise. One could only observe the magnitude of the damages inflicted to trees and power lines. It could also suggest that the weather patterns are changing and become more dependent on global meteorological phenomena.

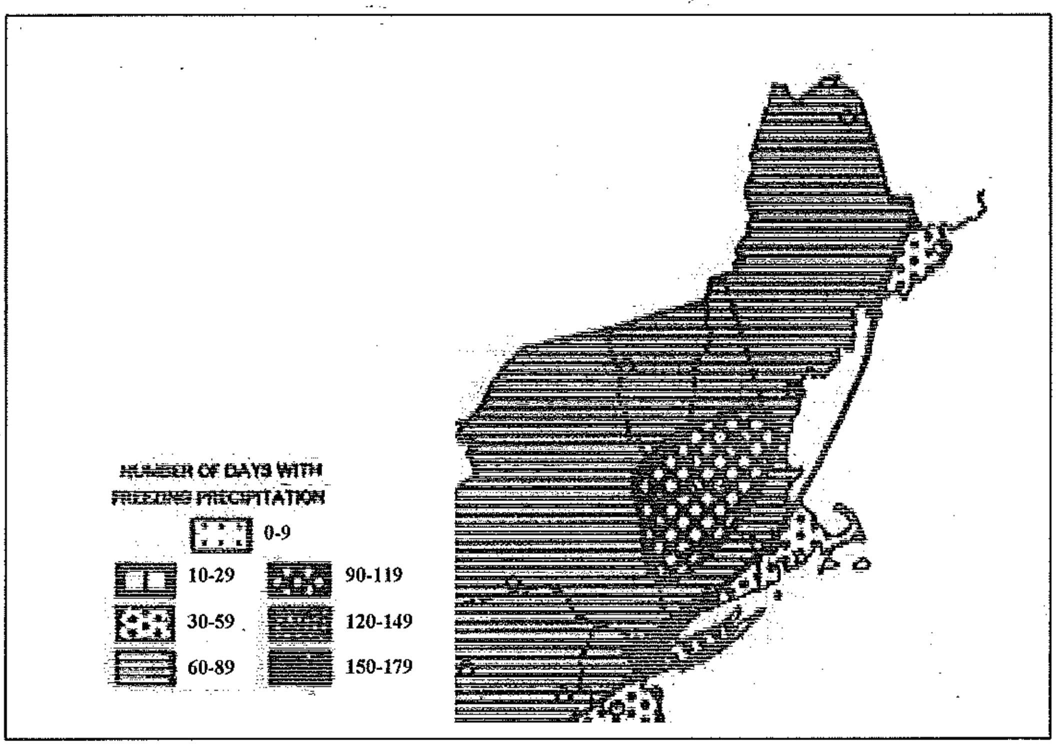

Figure 4. Total number of days with freezing rain or drizzle in the 10-year period from 1939 to 1948. Based on data from 95 Weather Bureau stations (Adapted from Bennett, 1959)

4. Proposed Solutions

Some solutions are already known for cold weather wind turbine operations. In fact, they are the same as any other cold weather engineering applications. This is especially true for materials and other elements whose low temperature behavior is well understood. For instance, the service conditions of a steel tower will determine the type alloy used in its fabrication. This is similar for lubricants; the application it will serve and the outside temperature will dictate the choice of a specific lubricant.

4.1 Low temperatures

Metals have found applications in low temperatures for many years now. For instance, it is well documented that alloys such as nickel and aluminum improve the strength of steel at low temperatures. Aluminum itself is also very suitable for these applications. Composite materials are fairly new and have not found low temperatures widespread applications. Dutta (1989) indicates that technologies that have done well in warmer climate sometimes behaved disastrously in low temperatures. His investigations of composite materials in low temperatures do not suggest a way to prevent unequal shrinkage and residual stress inside the fiber/matrix element. One way to prevent this would be to use fiber and matrix that exhibit similar thermal expansion coefficients.

Preventing thermal shocks on electrical machinery windings could be accomplished by locating heaters inside the nacelle. Prior to turbine activation, these heaters could be operated to provide quick warm up and allow windings to reach an operational temperature.

Heating elements, used as is or with a circulating oil pump, could be added to gearboxes in order to improve the viscosity of the lubricants. A lower viscosity lubricant could be used to facilitate the cold start but this could offer less protection when the normal operating temperature is reached. Another suggestion would be to slowly start the turbine drivetrain and do not apply full torque until a safe lubricant temperature is reached. This could prove to be very impractical considering normal wind turbine start up procedures, however.

Selection of appropriate rubber will insure that seals and other rubber parts retain their elasticity and prevent their brittleness at low temperatures. It is suggested to use special nitride rubber or fluorosilicone materials (Soundunsaari and Mikkonen, 1989).

4.2 Icing

Wind turbine icing has received a lot of attention in the recent years. As wind energy was developing in Scandinavia and in the highlands of Germany, icing was quickly identified as an area of uncertainty. Hence, research has been undertaken to identify and model the type of icing wind turbines would be subjected to. Efforts have also been done in the area of icing prevention technologies. They can be classified in two categories: active and passive.

Passive icing prevention methods rely on the physical properties of the blade surfaces to prevent ice accumulation. An example of passive icing prevention is the application of an anti-adhesive coating on the blade such as teflon. Another approach takes advantage of the heat absorbing capacity of dark colored surfaces and consists in the use of black coated blades. This technique was used on the eleven wind turbines that were erected in Searsburg VT in the summer of 1997.

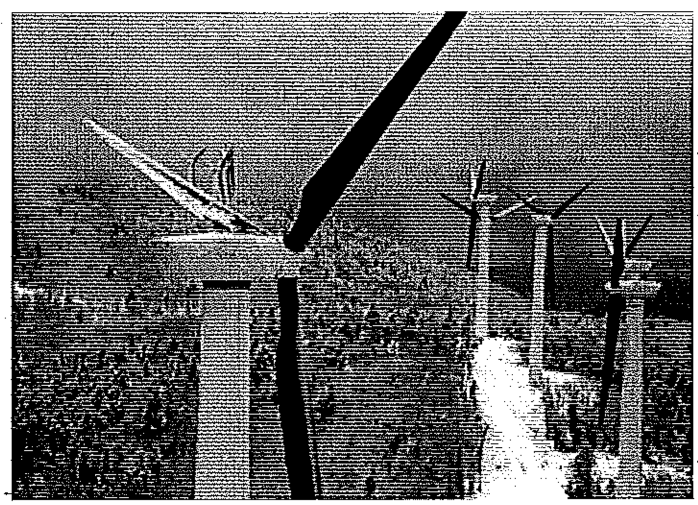

Figure 5. Searsburg turbines use black blades to prevent ice accumulation. Note the layer of ice along the blade leading edge. (National Renewable Energy Laboratory)

Active de-icing methods have also been investigated. They come directly to us from the aeronautical industry. They consist of thermal, chemical and impulse de-icing. In thermal de-icing, electrical elements, similar to the one found on the rear window of a car, can be used to warm and melt the ice accumulation off the blades. Existing research in wind turbine active icing prevention has focused on thermal de-icing. Based on early work in Europe, Jasinski et al. (1998) indicate that thermal anti-icing requires an amount of heater power equal to at least 25% of the turbine maximum rated power. Recent work conducted in Europe indicates that the early estimate in anti-icing power requirement can be revised down. They now claim that the power requirement ranges between 6 to 12% of the output for 1000 to 220 kW turbines respectively.

In a comprehensive wind turbine icing prevention approach, sensors that could detect the build-up of ice on the rotor could be considered. Such devices already exist for the aeronautical industry. They consist of detection sensors and a control unit. The control unit processes signals received from the sensors and activates the ice removal mechanisms. A similar system could be adapted to work on wind turbines and insure automatic de-icing operations.

5. Recommendations

Wind turbines installed in New England should have demonstrated capabilities to operate and/or survive under cold weather conditions. This includes low temperatures, icing and snow. Studies to monitor the impact of these factors, especially icing, on the operations of wind turbines should be undertaken.

Representative of Massachusetts should participate in international activities regarding the identification and amelioration of cold weather related problems on wind turbine operations. Members of the Massachusetts energy community should establish working relations with groups and organizations already involved in cold weather issues. These include:
CRREL –The U.S. Army Cold Regions Research and Engineering Laboratory; Hanover, N.H.

Wind turbine operators
Green Mountain Power – The Vermont utility operates a 7.5 MW windfarm near Searsburg VT since 1997.

IREQ – Hydro-Québec Research Institute; Varennes, Québec

European nations that are involved in wind energy research:
JOULE III Wind Energy in Cold Climate (WECO) Project, co-funded by the European Commission – The BOREAS Conferences

VTT Energy - The leading institute in research on wind energy in Finland
FMI Energy – The Finnish Meteorological Institute
DEWI – Deutsches Windenergie-Institut

Additional research should be carried out on icing and its effects on wind turbine operations. The following subjects could be of interest:

- The long term effect of icing, especially on blade fatigue

- Is the blade more prone to collect ice when at rest or when running, the answer could be different whether glaze or rime ice is involved
- The ice collection pattern, is it similar to aircraft icing or is it more random in shape?
- What part of the blade is more prone to icing, the root or the tip?
- What is the energy loss associated with icing?

So far, the research in icing seems to have focused on rime ice. This is due maybe because this is a better understood phenomena and also this is the sort of icing occurring where icing on wind turbine is a concern and where research has begun on this subject. Available weather data suggest that this is not necessarily the type of icing most likely to occur in the lower elevations of New England. Therefore, documenting glaze ice on how it forms, its occurrences throughout New England and its impact on the utilities among others, is something that seems valuable to undertake.

An investigative effort could be done in the area of ice monitoring. For instance, the anemometer stations could also be fitted with icing detectors to evaluate the duration of each icing episode and the total number of hours during a season. Although there are different types of ice detectors available, their general operating principle is the same: they sense a change in properties resulting from an accumulation of ice. Some work by detecting the frequency variation in a sonic or vibratory wave while others monitor the capacitance between metal strips. The Rosemount ice detector uses the frequency shift principle (Ryerson, 1988). Researchers from CRREL have used it to study the ice growth on the summit of two New England mountains.

6. Conclusion

The most favorable areas for the production of wind energy are often located where the climatic conditions are severe and unpredictable. In order to improve the performance of wind turbine in this environment, some issues need to be examined carefully.

The issue of low temperatures can be addressed by making sure that the turbine is designed appropriately. The technology is available and has been used for other applications of engineering in cold weather. A problem like icing deserves further investigation. Work in the areas of ice detection, prevention and removal could significantly improve the dependability of wind turbines in cold weather.

Other groups in North America & Europe operate wind turbines in conditions similar to New England. Some have accomplished work in areas that are compatible with our objectives. Cooperation with these organizations is suggested. This would contribute to improve our level of expertise and inform us of the evolution of the technology.

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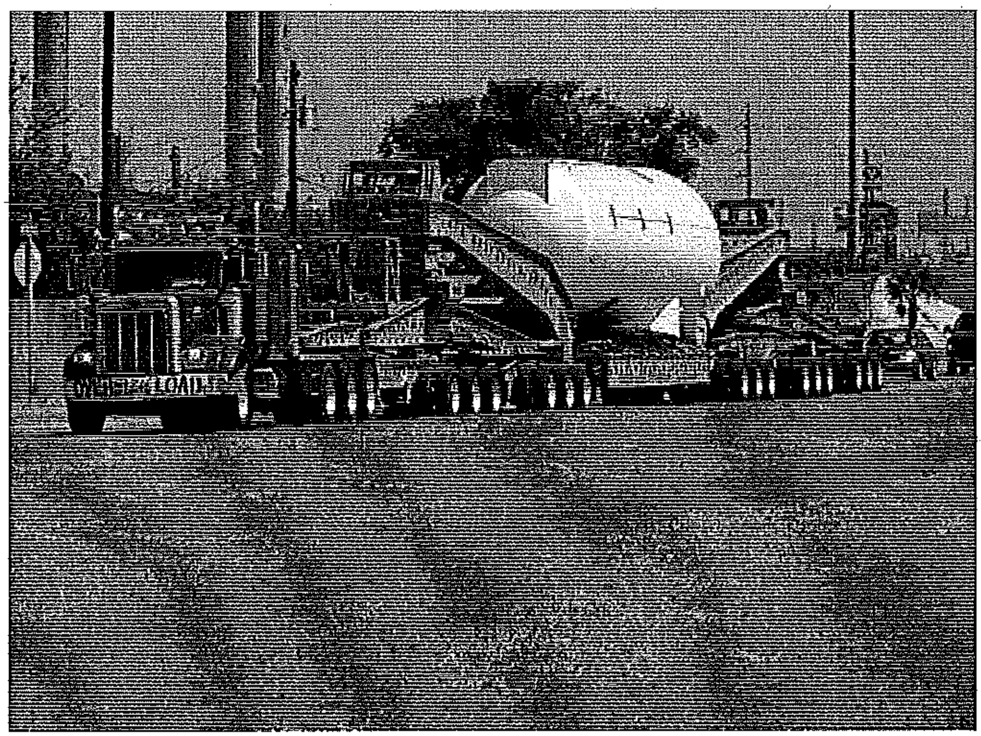
http://www.windpowerengineering.com/news/bigger-turbines-come-with-bigger-transport-headaches/

Bigger turbines come with bigger transport headaches

October 1, 2010 by Kathleen Zipp
Filed under Transportation of Wind Components, Wind Turbine Installation, Wind Watch

1 Comment



Shipping a nacelle is no easy task. Depending on weight most nacelles will require multiple axled trailer configurations to support the inland transport requirements. In the case of this picture, a 19-axle trailer is required to move this 76 ton nacelle. Along with the right truck and trailer configuration, approved routing permits and escorts for each state are also required.

Over the last few years, a 1.5-MW wind turbine has been a prevalent size on U.S. roads and wind farms. It is about the largest and heaviest that transports easily on most U.S. roads. But turbine design is trending to larger units, hence, 2.5 and 3 MW units will soon be more frequently encountered. These will be challenges for transport and construction companies because each state has different rules, and approved routes change as frequently as does the wind. This is potentially bad news for wind farm developers that expect to stay on construction schedules.

Larger equipment presents a transportation challenges because of the weight and size limits imposed by most state departments of transportation (DOTs). **"It seems that logistics can sometimes be left last in the design processes,"** says Alan Redding, director of sales and marketing with transport firm ATS Wind Energy Services, St. Cloud, Minn. "If there is a message for turbine manufacturers, it's that they should start thinking about modular turbines that can be shipped below the upper limits imposed by most state DOTs. Otherwise, they could face a boat-in-the-basement problem, **one in which the size cannot fit through restrictions set by state DOTs**." [my emphasis]

Tower sections provide an example because they are tremendously heavy. Typical lengths run from 60 to 70 ft and more with 15-ft diameters, and weights of 100,000 to 150,000 lb. "This is a huge part. We transport tower loads on special equipment called a Schnable trailer, one with many axles. We need an approved route before getting a permit, and approved routes can change from day to day. That is frustrating for our customers and us because it can be difficult to react to these changes. We are very proactive and try to foresee the potential restrictions or choke points so we can implement alternative routes and measure as soon as possible. We are always working with federal, state, and local governmental agencies to find the best solutions to the route adjustments. These routing adjustments are just a reality and parties involved work constructively to find solutions," adds Redding. A few turbine OEMs are already designing in modules to alleviate shipping problems, he adds, but some modular designs are more efficient than others.

"Many turbine OEMs trying to enter the U.S. market don't understand the DOT and its requirements that we operate under. Thus, a firm building a reliable turbine may be working in a vacuum. Some of these designs, when broken into sections for transport, don't make a lot of logistical sense. I know there are many factors in play. But project schedulers –could expect delays for anything over a 2.3-MW machine that is moved intact, unless the OEM has a special design in which it worked closely with a company like ours to fit it nicely within the confines of a trailer," says Redding.

There are a lot of transport regulation similarities, but there are also a lot of differences from state to state regarding how much weight is allowed per axle or grouping of axles. "It's somewhat fragmented. We've been in this business over 50 years, and it's sometimes difficult for groups trying to understand how we price jobs because what one state has for permitting and structure, another may not. One state may have wind targets to hit so they want to streamline approvals as far as permits and escorts go, while another state may not. The bottom line: regulations are complicated and involved," he adds.

Jobs are simplified with intrastate loads, one that begins and ends in the same state. "Going from east to west Texas is pretty easy. But when traversing multiple states, say from Texas up to Minnesota, the states in between know the project is not theirs, but they get the impact of the heavy equipment, so they can be less accommodating." Redding says he has been working on national transport standards for years through an industry group, Specialized Carriers and Riggers Assn. (scranet.org).

The idea to drive home is that OEMs must bring logistics into their design discussions when they come to the large weights and sizes common in the wind industry. Turbine designers must be involved with how to get equipment from point A to B. There are OEMs that have done this extremely well, and those that have been less successful. The hazard is that those that have done it poorly might be uncompetitive. At the end of the day, OEMs must have lowered their land-cost options. Not allowing for that puts the OEM at a disadvantage. WPE

[redacted]Mary J. Repar
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15 January 2011

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www.bpa.gov/comment

Re: Comments on Whistling Ridge Wind Farm and the proposed Haul Route and the turn radius of semi-trucks carrying huge wind turbine sections on country roads

Dear EFSEC,

When SDS Lumber proposed to use a different route to haul wind turbine sections to its proposed Whistling Ridge Wind Farm so that it would not have to go through the National Scenic Area review process in front of the Gorge Commission, I did some research on their new haul route. The new proposed route goes up to Mill-A and Underwood from Highway 14, on the Cook-Underwood Road.

I don't believe that the semi-trucks carrying the huge wind turbine sections can make the turn radius at the intersection of Hwy. 14 and Cook-Underwood. I think that SDS Lumber should have to do Autocad drawings to show how the trucks are going to successfully maneuver into that turn.. I have gone online and found programs that simulate the turn radii for different types of trucks with numerous axles. I'm sure that SDS Lumber can afford to do the drawings prior to any approval of the project so that it can be determined if the turn can be negotiated or not. If the turn cannot be successfully negotiated, the proponent needs to supply EFSEC with a different haul route or an explanation as to how they plan on hauling the sections for 400 foot turbines up Cook-Underwood Road.

Recently, Skamania county moved a light pole from the west side of the Cook-Underwood intersection to the east side. When I made a public records request to the county road department and to our Public Utility District, neither entity could provide me with a map showing that the pole is actually on county property. The parcel that is on the west side of the intersection belongs to the county. The parcel on the east side of the intersection belongs to the U.S. Government and it is the in-lieu tribal fishing site.

I think, at the very least, that a map should be provided to EFSEC to show if the haul route will only use county land and right-of-way and whether trucks can actually make the turn. **Attachment T-1, Bigger turbines come with bigger transport headaches,** puts it pretty well: 'Larger equipment presents a transportation challenges because of the weight and size limits imposed by most state departments of transportation (DOTs). **"It seems that logistics can sometimes be left last in the design processes,"** says Alan Redding, director of sales and marketing with transport firm ATS Wind Energy Services, St. Cloud, Minn. "If there is a message for turbine manufacturers, it's that they should start thinking about modular turbines that can be shipped below the upper limits imposed by most state DOTs. Otherwise, they could face a boat-in-the-basement problem, **one in which the size cannot fit through restrictions set by state DOTs.**"' [my emphasis]

See Attachment T-2, for an example of a wind farm proposal haul route from New York that gives us some ideas about what can be expected. This particular firm commissioned **a haul route survey** and I think that is what should be done for Whistling Ridge, too. We all need to know, ahead of time and before any siting decision, whether SDS Lumber can actually haul the turbine sections up the proposed route. Attachment T-2 clearly shows that there are certain requirements that must be met before a haul route is chosen:

"WIND TURBINE COMPONENT HAUL ROUTE VIA I-87 AND US11 TO DESTINATIONS IN ALTONA, NY
Summary
Noble Altona Windpark, LLC has purchased sixty eight (68) General Electric 1.5 MW wind turbines for erection and operation in Altona, New York. Delivery of components, principally blades, tower sections, nacelles, and transformers, is expected from the west on U.S. Route 11, from the south on Interstate 87, and from the north on Interstate 87 to U.S. 11. **This document describes the routes and vehicles to be used in this process.** The use of public roads for commercial transport requires permitting from appropriate agencies, in this case NYDOT. **Noble has commissioned a detailed haul route survey in the course of obtaining these permits. [my emphasis]**

The survey will identify obstructions, roadway modifications, utility coordination, private property easements, safety precautions, traffic control, and possibly alternate routes. This document may be modified when alternate routes are identified which lessen the impact of the aforementioned considerations." [my emphasis]

There are also vehicle and road requirements and these are not covered in the DEIS and should be because they will affect our roads and traffic patterns if Whistling Ridge were to be approved:

"Vehicle and Road Requirements
Turbine manufacturer General Electric supplied a document containing dimensions of loaded trucks and their road requirements. In some cases, a truck load is presented in an Eastern and a Western configuration. For deliveries in New York, the Eastern Configuration applies. The largest vehicle used in transporting the equipment to the site is known as the 37 Meter Wind Blade Transport. Figures 3 and 4, from GE Energy, illustrate the physical dimensions of this unit. Figures 5 through 8 display the dimensions of transports bearing the other major components; namely the tower sections and tower nacelle. See also Table I below.

The key requirements are:
• Roads must have grades of 10% maximum.
• **Roads must have no bump or dip greater than 6 inches in height over a 50 foot distance**
• The largest vehicle gross weight is 212,000 pounds, with a maximum 20,000 pounds per axle
• The greatest loaded vehicle vertical clearance height is 15 feet – 0 inches
• **The 37 m blade transport vehicle has a turning radius of 135 feet – 8 inches for the axles, <u>although the vehicle overhang is up to 10 feet beyond this line</u>. Some blade transports having steerable rear axles have shorter turning radii. All other transports have turning radii less than 115 feet. Therefore, corner intersections local to the project sites will be improved to accommodate a turning radius up to 120 feet. Vehicles, i.e. blade transports, requiring a larger turn will be given an assist through the turn with rigging equipment.**
• The greatest total loaded vehicle length is 144 feet
• The greatest vehicle load width is 14 feet – 2 inches" [my emphasis]

There should be a **document containing dimensions of loaded trucks and their road requirements** in the DEIS and there is not. Presumably, by now, SDS Lumber knows what kind of turbines it is proposing for Whistling Ridge and what kind of trucks are used to transport said turbines and other infrastructure. So why isn't this document in the DEIS.

On pages 6 - 11 there are schematics of the radius for turning when transporting the blades and transport schematics for the other wind turbine components. These are essential to the decision-making process and whether a project is doable or not. These types of documents were not in the Whistling Ridge DEIS and I think they should be. Perhaps the proponent is counting on the fact that if the project is approved then the questions about a haul route can be taken up when the project begins and if the proposed haul route, using Hwy. 14 and Cook-Underwood Road, is inadequate then they can go back to the original route through the National Scenic Area because, of course, they now have a EFSEC-approved project and who is going to stop them now?!? What's a mere haul route question?!? Of course, it is always more difficult to undo something once the process has begun.

The haul route and its adequacy should be addressed as soon as possible and they should be addressed with documentation, not just taking somebody's word for it. We all need to see if this haul route is adequate and whether our roads will actually support the deployment of huge semi-trucks filled with tons of wind turbine parts and other infrastructure. The damage to our roads and transportation systems could be incalculable and long-term and we should know ahead of time if we really want to go through with this project, or not, based on the true facts, backed up with pictures and schematics.

Thank you all very much for your efforts in this matter. I know that your decision-making process will be long and arduous. Good luck! Please remember the National Scenic Area and all that it stands for.

Sincerely,

e/signature/Mary J. Repar
15 January 2011

Noble
ENVIRONMENTAL POWER

WIND TURBINE COMPONENT HAUL ROUTE VIA I-87 AND US11 TO DESTINATIONS IN ALTONA, NY

Summary

Noble Altona Windpark, LLC has purchased sixty eight (68) General Electric 1.5 MW wind turbines for erection and operation in Altona, New York. Delivery of components, principally blades, tower sections, nacelles, and transformers, is expected from the west on U.S. Route 11, from the south on Interstate 87, and from the north on Interstate 87 to U.S. 11. This document describes the routes and vehicles to be used in this process.

The use of public roads for commercial transport requires permitting from appropriate agencies, in this case NYDOT. Noble has commissioned a detailed haul route survey in the course of obtaining these permits. The survey will identify obstructions, roadway modifications, utility coordination, private property easements, safety precautions, traffic control, and possibly alternate routes. This document may be modified when alternate routes are identified which lessen the impact of the aforementioned considerations.

Route Description

The general area addressed in this study is shown in Figure 1. Component deliveries arriving from the west will be on U.S. Route 11, thence south on NY190. Deliveries from the south will follow I-87 to NY374, west to NY190, thence north to the local and county roads at the project sites. Deliveries from or through Canada will enter New York on I-87, thence south on U.S. 11 to NY190.

Major access to the turbine sites comes from Military Turnpike (NY190), (Figure 2). Turbine site general arrangements are displayed in the Appendix in drawings LP-01 and LP-02. The access roads for 10 turbine sites connect directly to NY190; the remaining 58 sites are accessed via NY190 and local roads.

1. U.S. 11 at NY190: Components from the north or west are expected to come via this intersection. Opposite this corner is the Northern Adirondack Central Schools. Timing for avoidance of school bus arrival and departure may be required for the over dimensional trucks using this corner. U.S. 11 is a three lane road at this point with wide shoulders as well as additional pavement at the entrance to the school.

2. NY190 at Duley Road: This intersection provides access to 19 proposed turbine sites located along Duley Road. In addition, Duley Road via Rand Hill Road accesses the remaining 39 turbine sites. Duley Road is 23 feet wide at this location; NY190 is 34.5 feet wide. The SW corner contains the front lawn of a residence. The NW corner is unoccupied, but includes a utility pole with guy wires, telephone service box, and ~5 foot deep ditch. We recommend obtaining a temporary easement to improve the NW corner for receiving traffic with up to 120 foot turning radius. For vehicles from the north, the NW corner would need rounding to a 52 foot radius of curvature. For vehicles from the south, the end of Duley Road itself would be widened to 54 feet (eliminating the need for rounding the corner). Either treatment will require relocating the service box and utility pole and filling in the shoulder ditch.

3. Duley Road at Rand Hill Road: From Duley Road, vehicles turn left onto Rand Hill Road to approach the 39 turbine sites on Purdy Road. Duley Road is 20.5 feet wide with an 8 foot grassy shoulder. Rand Hill Road is 20 feet wide. The SE corner is unoccupied and contains brush and woodland. We recommend obtaining a temporary easement for the SE corner, which would be rounded to a radius of curvature of approximately 80 feet.

4. Rand Hill Road at Purdy Road: Sites for 39 turbines are accessed from Purdy Road. Purdy Road is an unpaved local road which is no longer maintained. Its condition has degenerated to the point of making travel on it risky without 4 wheel drive and impossible without high vehicle ground clearance. Approximately 2 miles of Purdy Road will require improvement by grading and widening. This will include whatever improvements are necessary to negotiate the corner at Rand Hill Road.

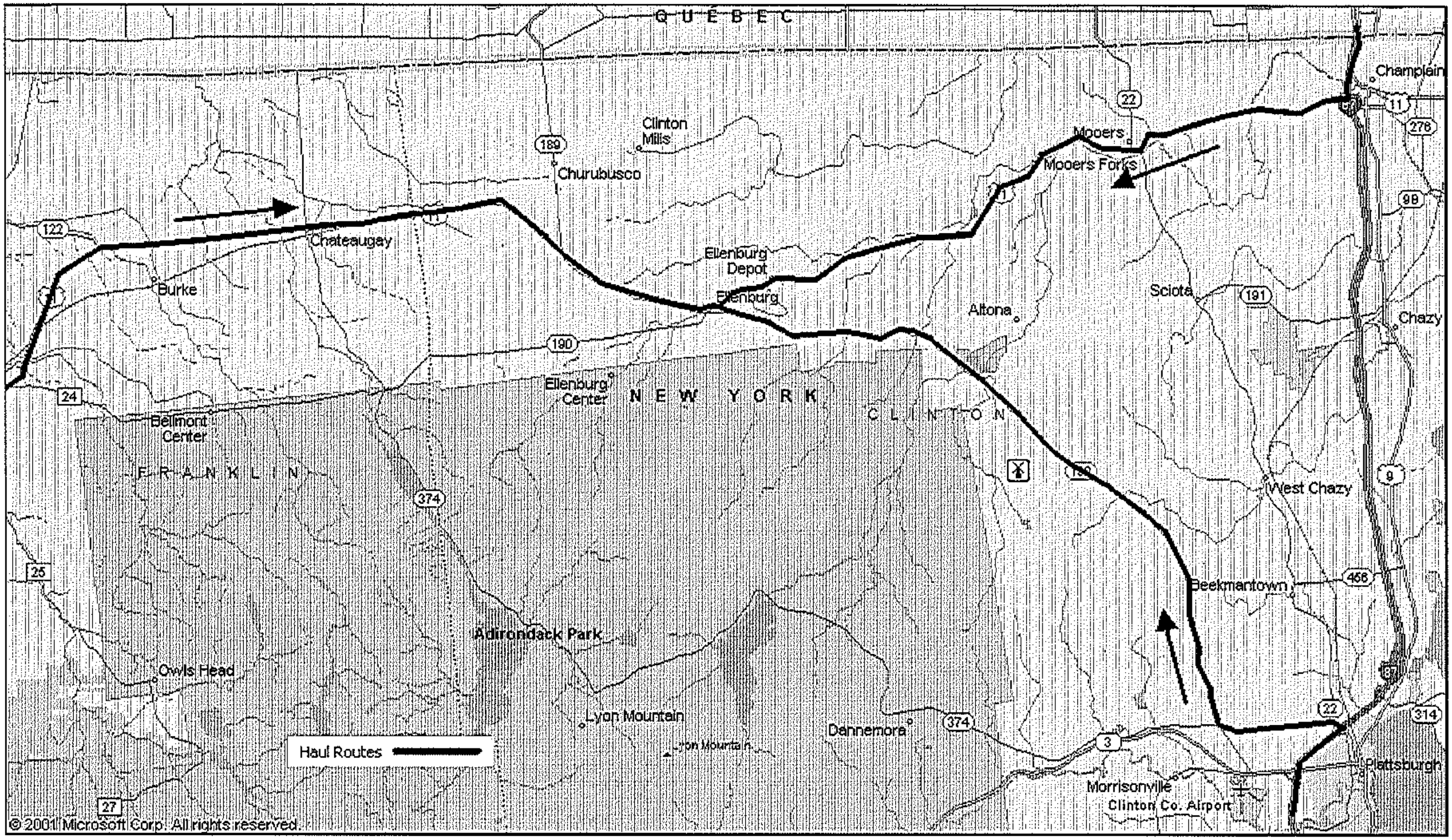

Figure 1
General Location Map

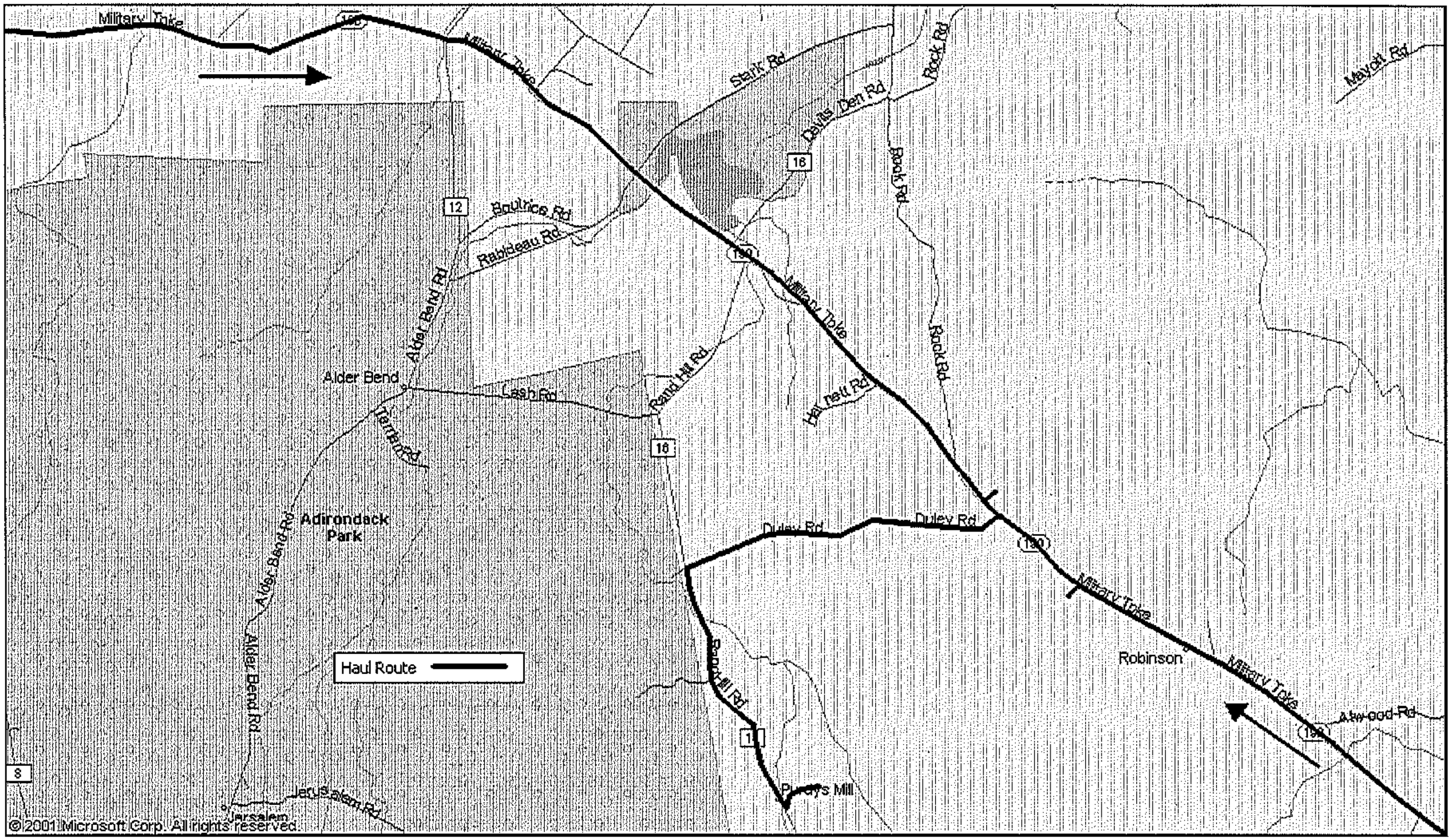

Figure 2
Local Haul Route Map

Vehicle and Road Requirements

Turbine manufacturer General Electric supplied a document containing dimensions of loaded trucks and their road requirements. In some cases, a truck load is presented in an Eastern and a Western configuration. For deliveries in New York, the Eastern Configuration applies.

The largest vehicle used in transporting the equipment to the site is known as the 37 Meter Wind Blade Transport. Figures 3 and 4, from GE Energy, illustrate the physical dimensions of this unit. Figures 5 through 8 display the dimensions of transports bearing the other major components, namely the tower sections and tower nacelle. See also Table I below.

The key requirements are:

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- The greatest total loaded vehicle length is 144 feet
- The greatest vehicle load width is 14 feet – 2 inches

Transport vehicles, drivers, and operations must conform to all applicable federal and State of New York laws. Of special note are requirements for lead and follow vehicles and for vehicle signing.

Table I
Vehicle Weights and Dimensions

Transport Vehicle	Length	Height	Gross Wt.	Turning Radius
Nacelle	112' 10"	14' 8"	197000	111' 2"
Hub Assembly	78' 0"	13' 8"	75000	48' 4"
37 m Blade	143' 11"	13' 6"	<70000	135' 8"
80 m Tower Base	158' 9"	15' 0"	212000	80' 5"
80 m Tower Mid	128' 2"	15' 0"	132000	80' 5"
80 m Tower Top	123' 7"	14' 6"	112000	74' 6"

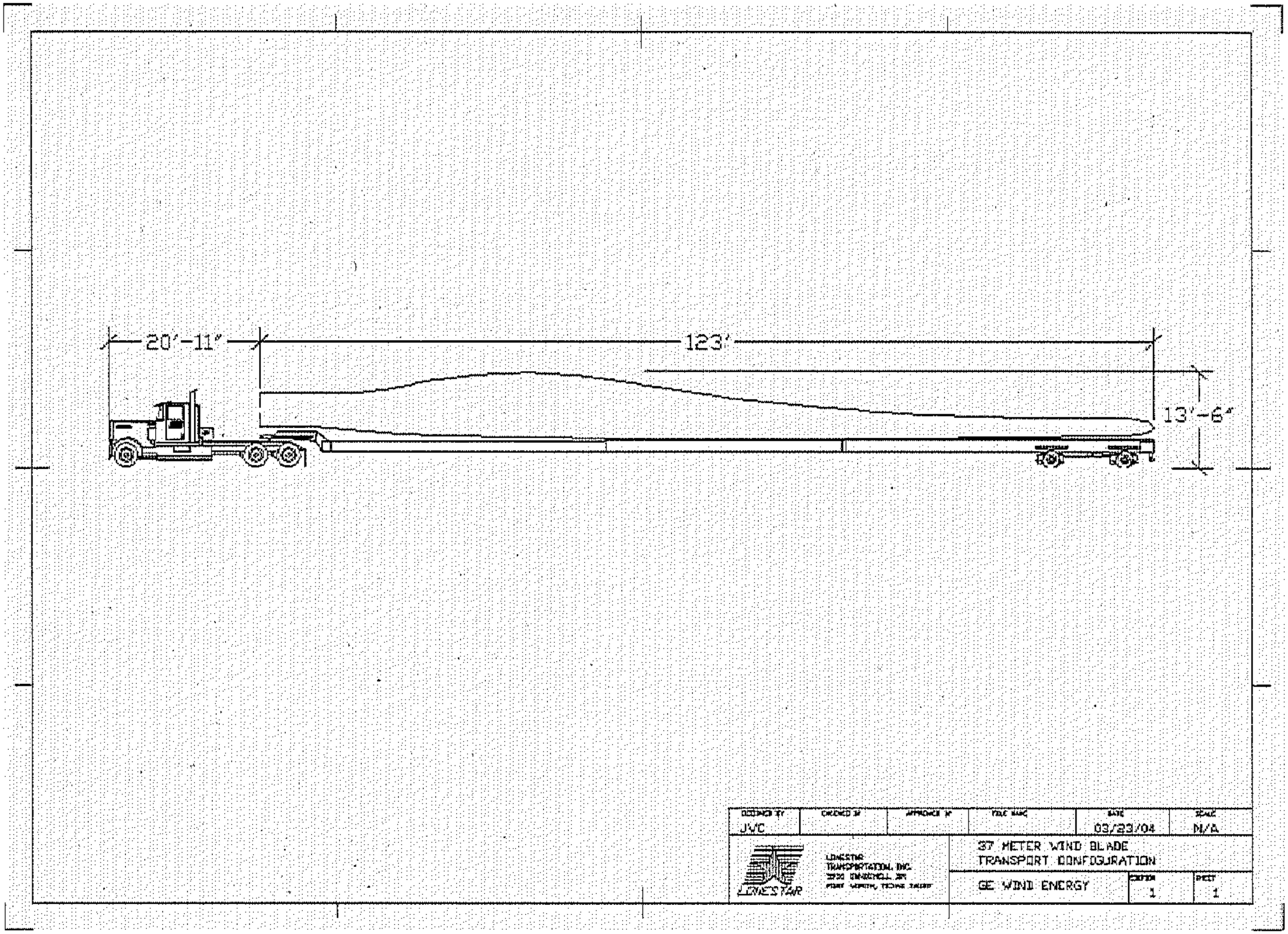


Figure 3
Wind Blade Transport

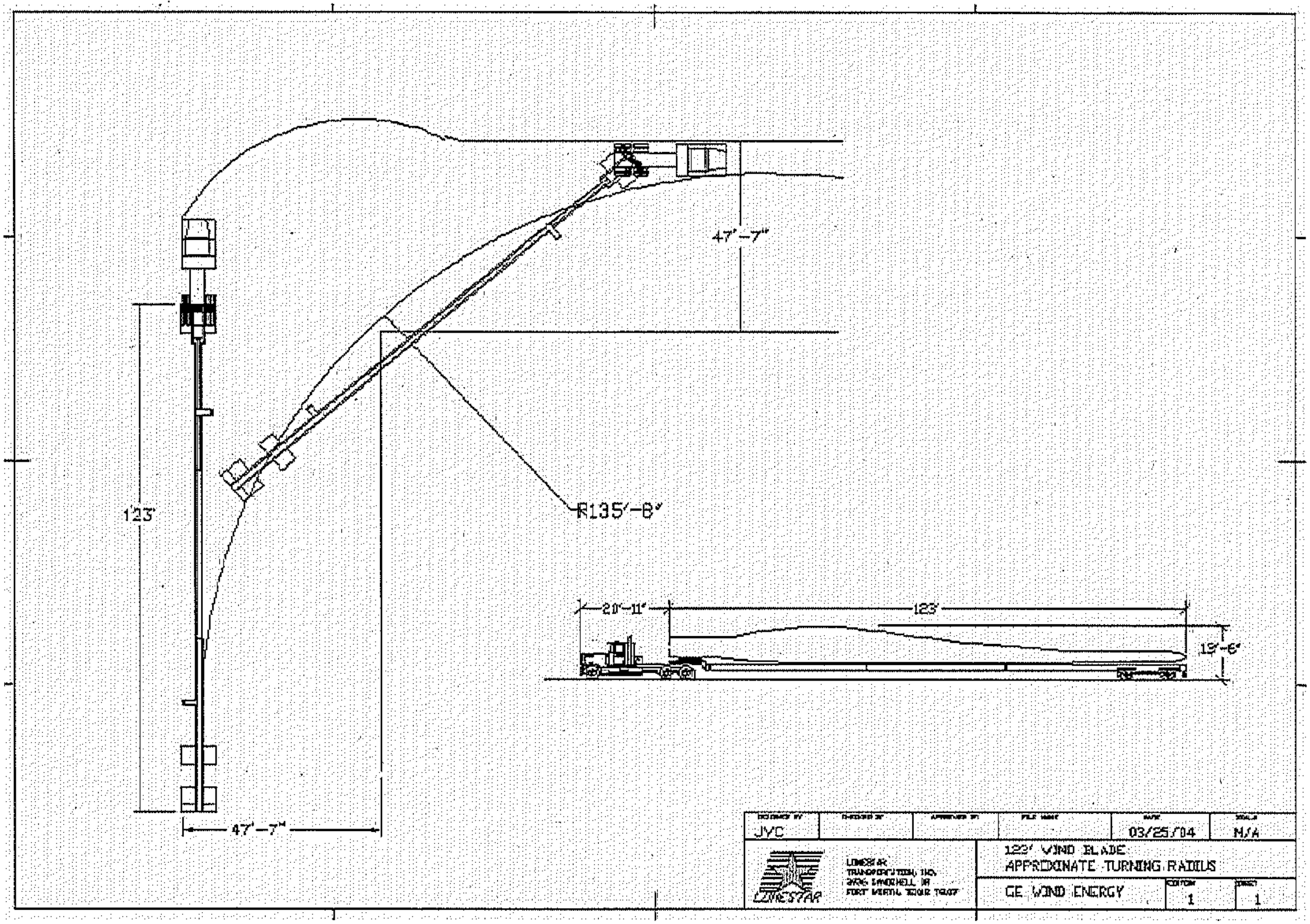


Figure 4
Wind Blade Transport Turning Radius

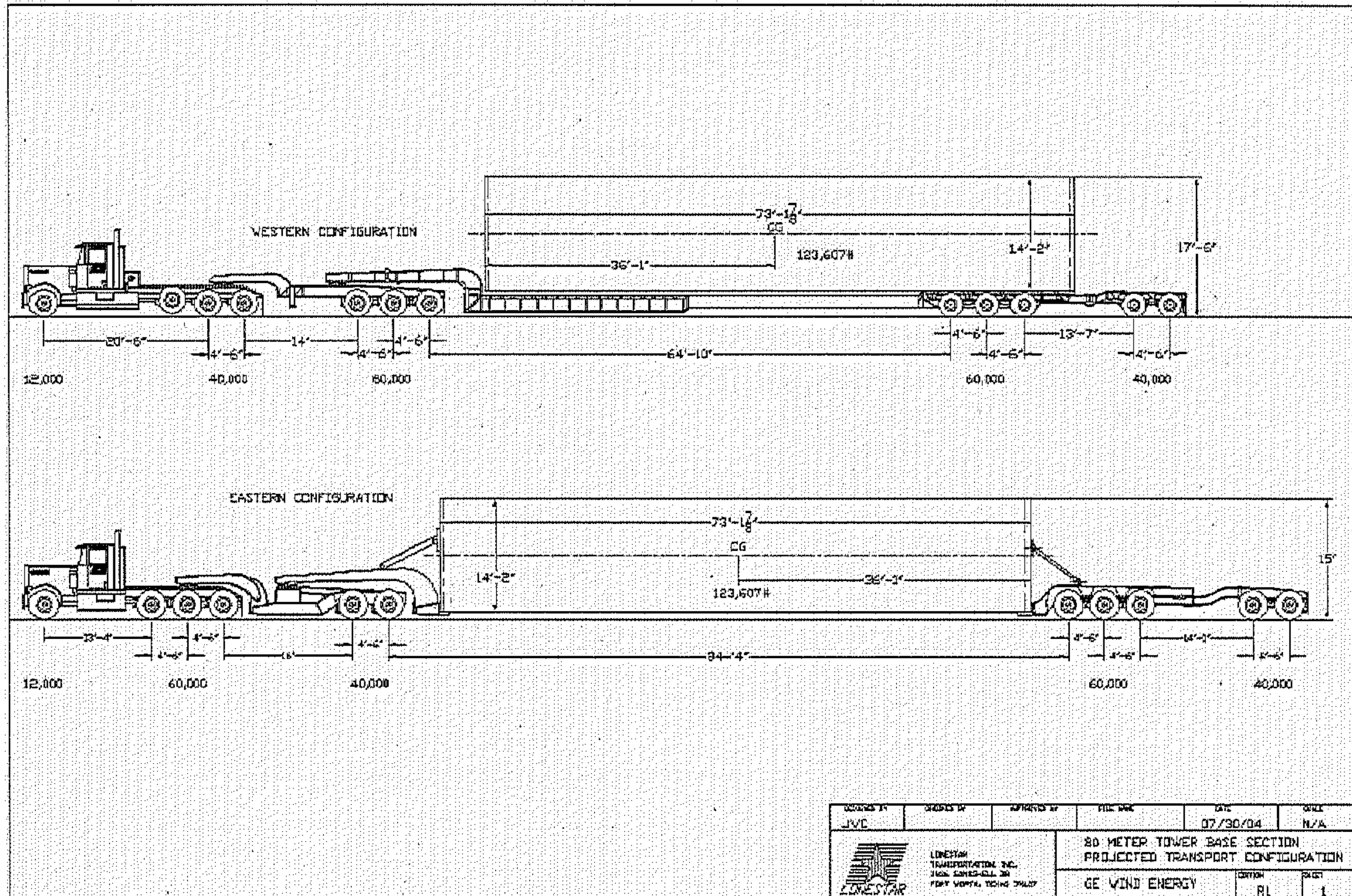


Figure 5
Tower Base Transport

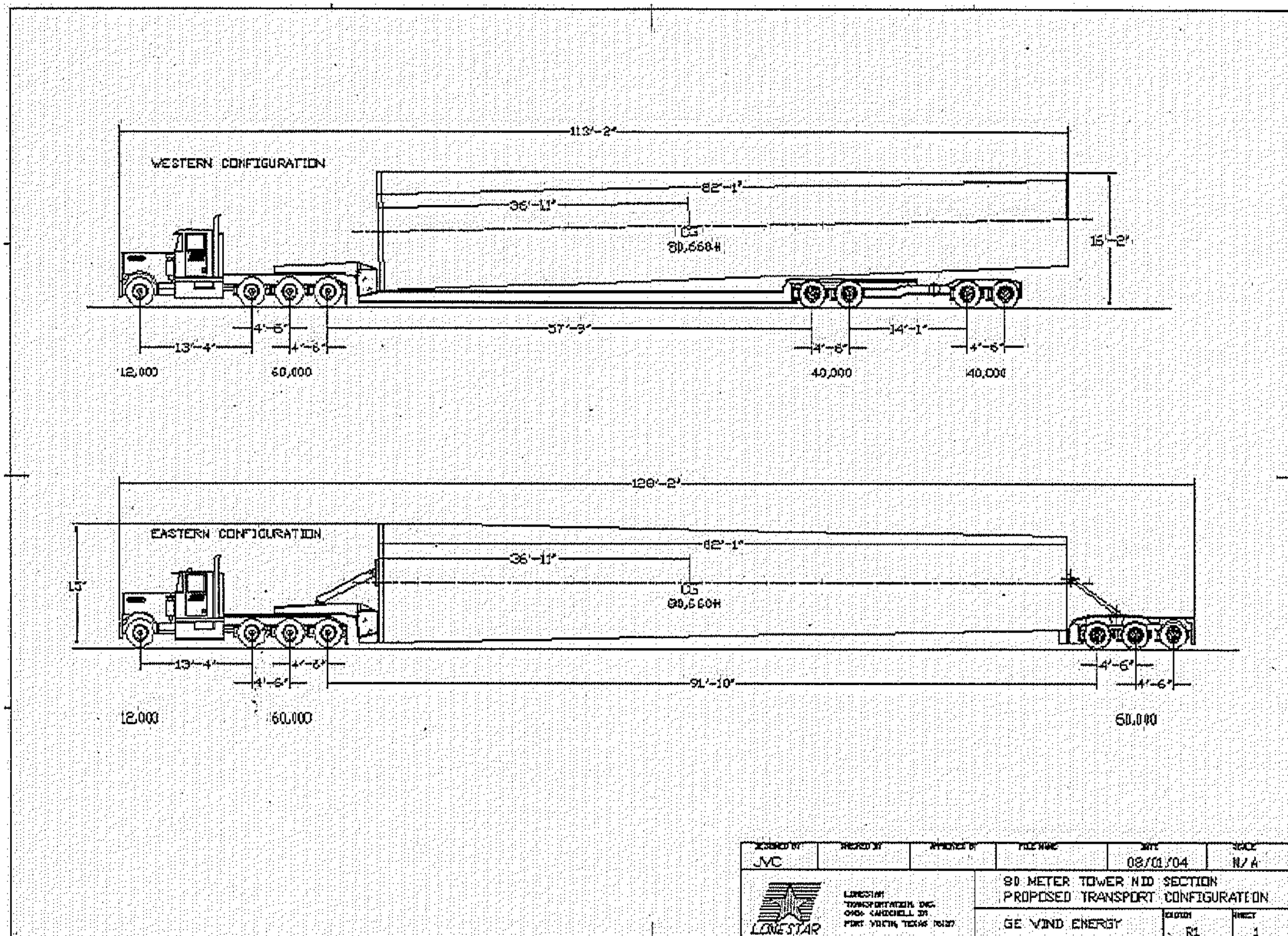


Figure 6
Tower Mid Section Transport

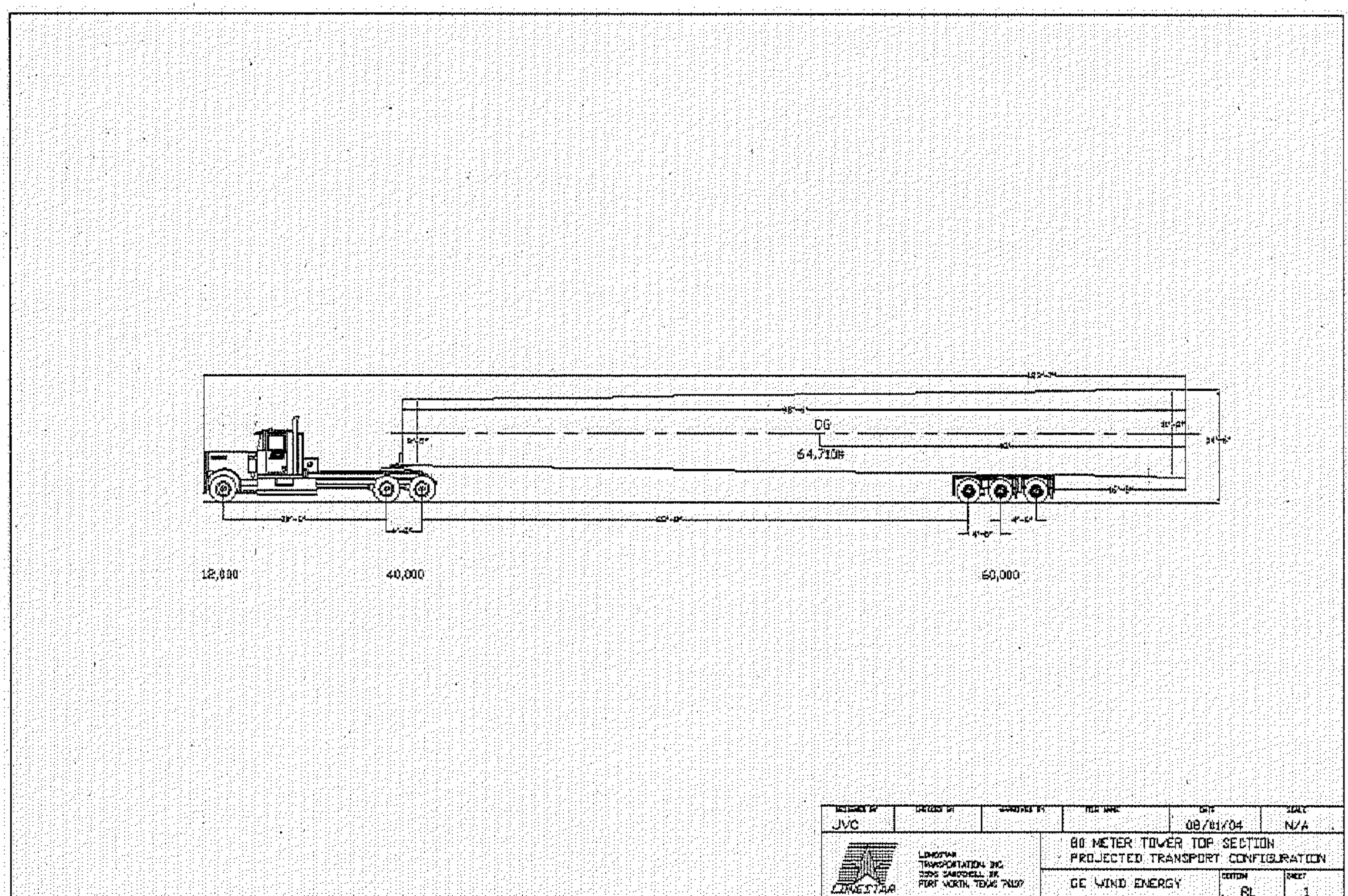


Figure 7
Tower Top Transport

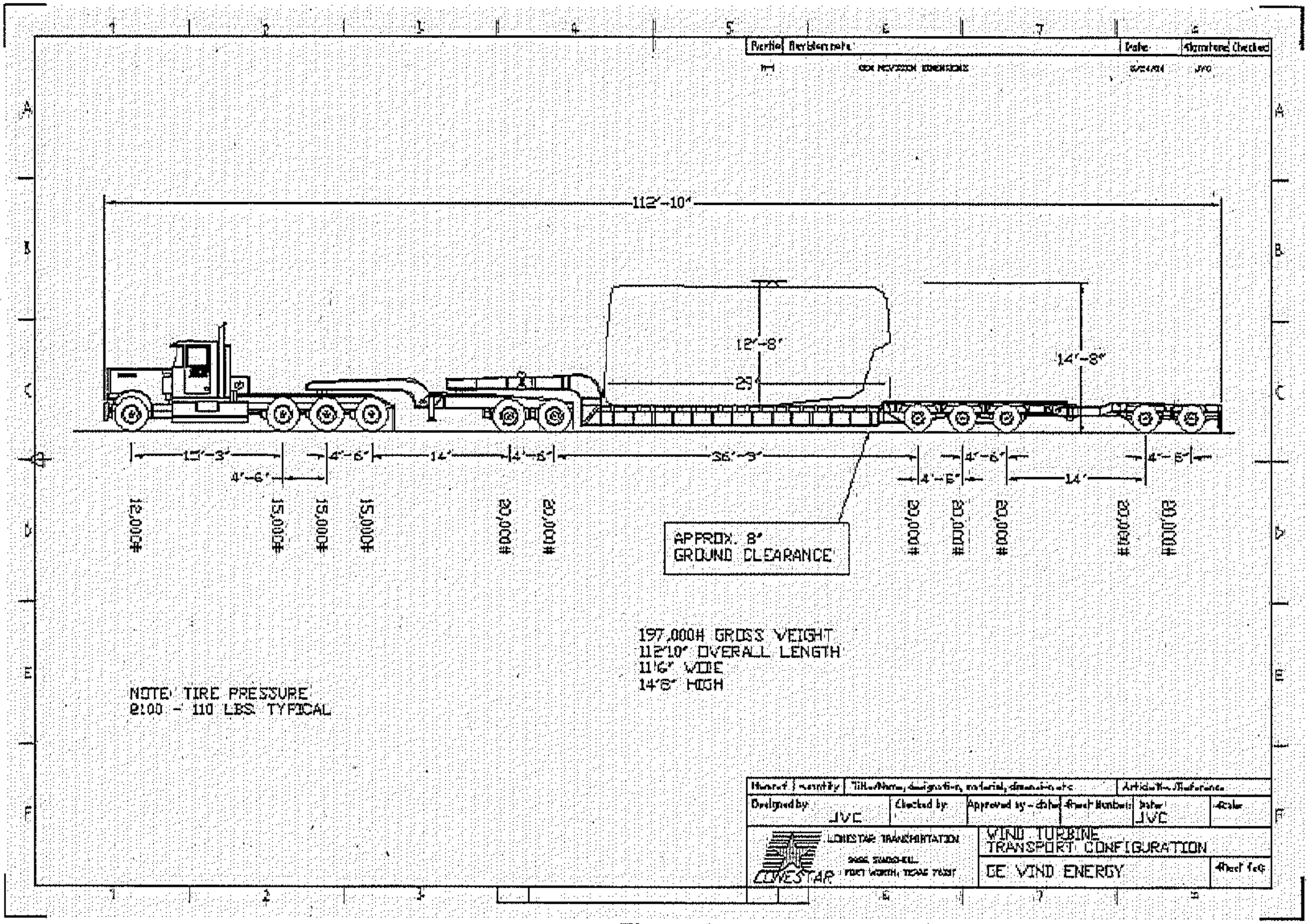
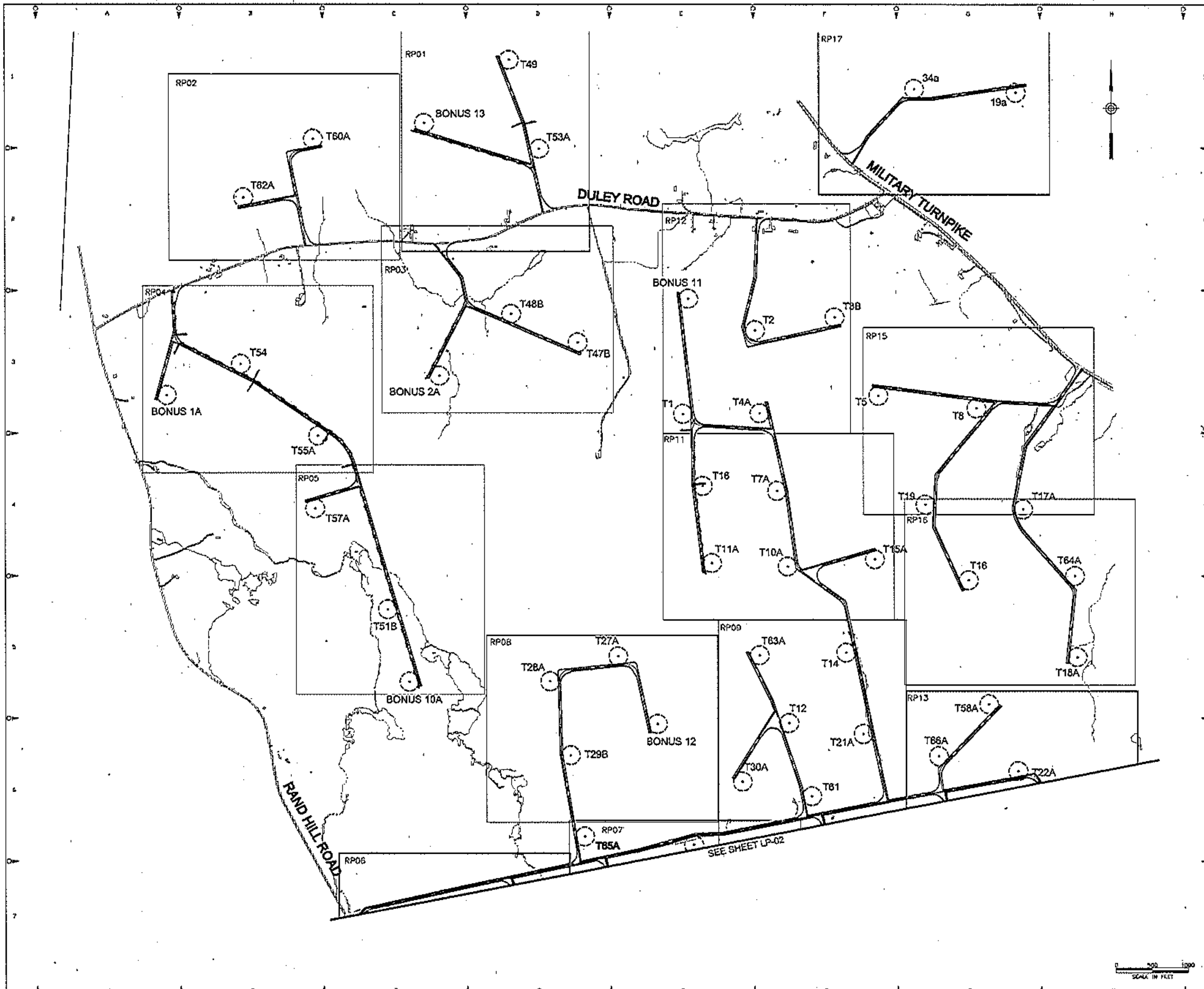


Figure 8
Nacelle Transport

APPENDIX

Turbine Layout and Local Roads



PRELIMINARY
11-7-05
FOR DISCUSSION ONLY

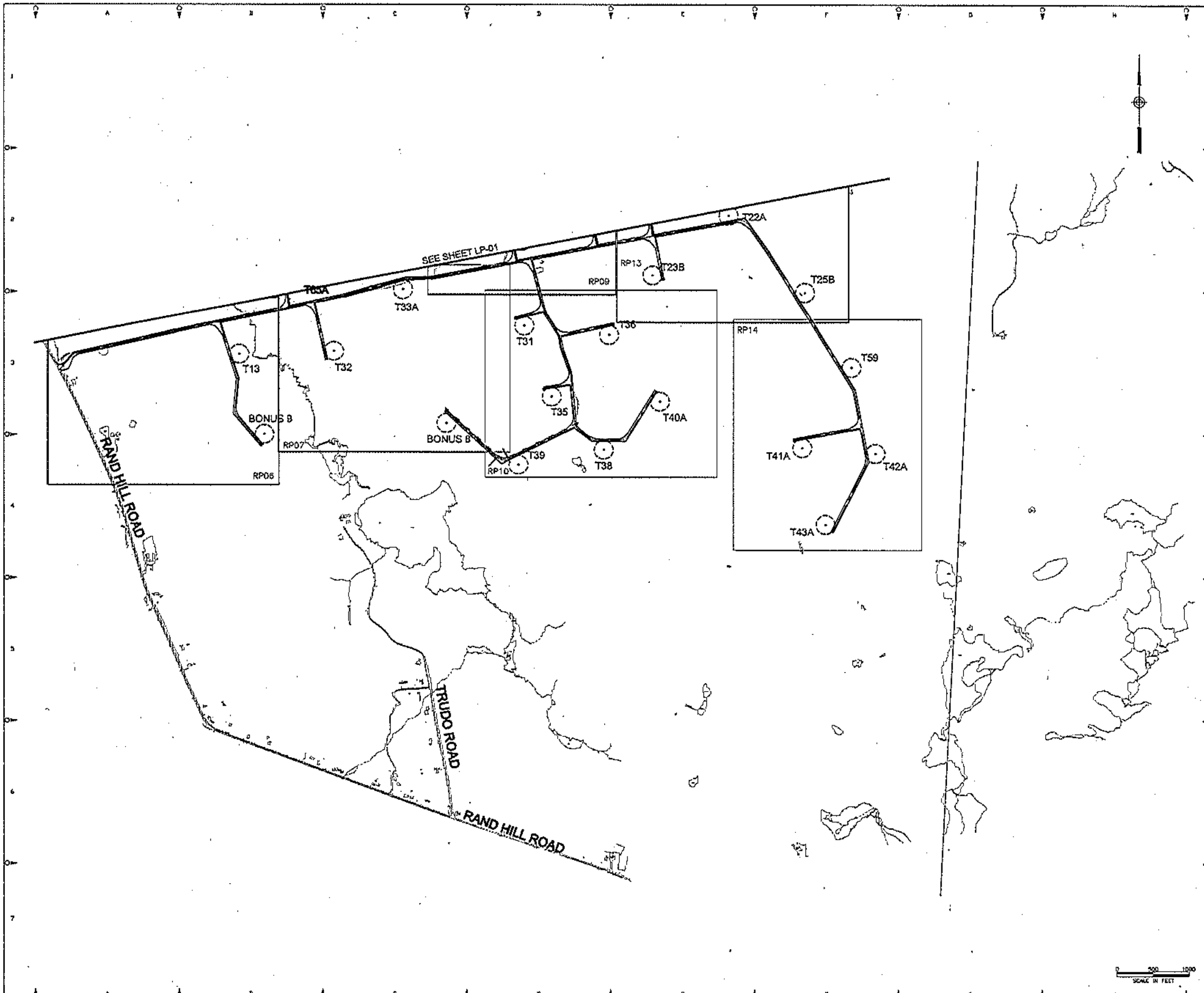
DMJM HARRIS | AECOM

Noble ENVIRONMENTAL POWER

ALTONA WINDFIELD PROJECT
ACCESS ROADWAYS
LOCATION PLAN
SHEET 1 OF 2

AS NOTED

LP-01 | 1



PRELIMINARY
11-7-05
FOR DISCUSSION ONLY

REV	DATE	DESCRIPTION
DRAWN BY	CAD	
CHECKED BY	M. FOSTER	
RESP. ENGR.	M. FOSTER	
CHIEF DISC. ENGR.	T. CLSROTH	
PROJECT MANAGER	M. PACY	

DMJM HARRIS | AECOM

Noble ENVIRONMENTAL POWER

ALTONA WINDFIELD PROJECT
ACCESS ROADWAYS
LOCATION PLAN
SHEET 2 OF 2

SCALE AS NOTED

LP-02

REV 1

http://wyden.senate.gov/newsroom/press/release/?id=081a8b6a-789a-4e22-a014-77e71502fc25

Press Releases

Press Release of Senator Wyden

Wyden, Merkley, Praise DOD Decision to Approve New Wind Farms in Oregon

Announcement Greenlights Much-Needed Job Creation in Eastern Oregon

Friday, October 1, 2010

Washington, DC – After months of working with the Department of Defense (DoD) to strike a balance between domestic energy and national security needs, U.S. Senators Ron Wyden (D-Ore.) and Jeff Merkley (D-Ore.) praised the Department's announcement today that it will no longer block the development of eight new wind farms: six in Oregon and two in Washington state.

Earlier this year DoD halted new wind farm construction in Eastern Oregon and Eastern Washington after determining that the proposed Shepherds Flat wind farm in Eastern Oregon would impact an aging radar system near Fossil, Oregon. While the Shepherds Flat wind farm was ultimately allowed to move forward when DoD announced in April that it would upgrade its radar system, other projects remained on hold until now.

"From our earliest conversations about Shepherds Flat it was clear that the Pentagon had never been asked to factor domestic energy needs into their national security decisions, it literally wasn't on their radar," said Wyden. **"But DoD deserves a lot of credit, not just for, clearing the way for the construction of more than 1,100 wind turbines and the hundreds of jobs that these projects will create, but for working to create a process that will now balance these two important national priorities."**

"I'm grateful that the Department of Defense has given us the green light to allow six wind farms to be built in Oregon," said Merkley **"These new wind farms will mean more jobs for Oregonians and that is exactly what we need right now."**

The following Oregon and Washington Wind Turbine Projects were cleared by DoD this afternoon:

Horseshoe Bend Wind LLC/Caithness, Arlington, Oregon
2010-WTW-8135 to 8148 & 8151 to 8168 & 8171 to 8174-OE

Horseshoe Bend Wind LLC/Caithness, Arlington,Oregon
2010-WTW-9639 to 9641-OE

WLAB, Hardman, Oregon
2010-WTW-7986 to 8970 –OE Oregon

Baseline Wind LLC at First Wind, Arlington, Oregon
2010-WTW-8235 to 8460-OE Oregon

Horizon Wind Energy, Arlington, Oregon
2010-WTW-7234 to 7448-OE Oregon

Iberdrola Renewables Montague, Arlington, Oregon
2010-WTW-2666 to 2890-OE Oregon

Iberdrola Renewables at Juniper Canyon 2, Roosevelt, Washington
2010-WTW-7617 to 7762-OE Washington

Horizon Wind at Heritage Wind, Brickleton, Washington
2010-WTW-7453 to 7565-OE Washington

The total number of turbines under these determinations is 1128.

###

U.S. Department of Energy - Energy Efficiency and Renewable Energy

Wind and Water Power Program - Wind Powering America

Radar, TV, and Radio Signal Interference

Wind turbines, like all structures, can interfere with communication or radar signals when these signals are interrupted by the turbine structure or the rotor plane. **Wind turbines can sometimes cause electromagnetic interference affecting TV and radio reception.** Electromagnetic interference can be caused by near-field effects, diffraction, or reflection and scattering. Such interference can typically be mitigated by using satellite TV or wireless cable TV. Although instances of TV or radio interference are infrequent and typically straightforward to mitigate, the interaction of wind turbines and navigational or defense radar signals is the subject of considerable recent attention.

Interference with Navigational and Defense Radar

Navigational and defense radar interference is an issue that needs to be addressed by wind developers. In the majority of cases, interference is either not present, is not deemed significant, or can be readily mitigated. Understanding the extent of a wind installation's radar interference potential and developing mitigation techniques can be more complicated than for other forms of potential interference, as it depends on turbine height, rotor sweep area, blade rotation speed, and the landscape surrounding a wind energy project.

Types of Interference

Wind turbines, like other large, metallic structures — such as buildings, TV towers, and satellite dishes — are radar reflectors, and as such, all of these types of structures have the potential to cause radar interference if placed in sensitive locations. There are two types of interference: direct interference and Doppler interference. Direct interference happens with high reflectivity and reduces radar sensitivity, sometimes producing false images ("ghosting") or shadow areas ("dead zones"). Doppler interference creates false targets and impacts both airborne and fixed radar.

Federal Aviation Administration

As summarized by the Airspace Issues in Wind Turbine Siting Web page maintained by the Massachusetts Technology Collaborative, "The FAA has oversight of any object that could have an impact on the navigable airspace or communications/navigation technology of aviation (commercial or military) or Department of Defense (DOD) operations. The

FAA requires that a Notice of Proposed Construction (Form 7460-1) be filed for any object that would extend more than 200 feet above ground level (or less in certain circumstances, for example if the object is closer than 20,000 feet to a public-use airport with a runway more than 3,200 feet long). As wind turbine heights have increased during the past couple of decades, this filing requirement has applied to increasing numbers of projects."

"For any filed project, the FAA undertakes an initial aeronautical study within the relevant FAA region, and issues either a Determination of No Hazard to Air Navigation (DNH) — the "green light" for the project — or a Notice of Presumed Hazard (NPH). If an NPH is issued, the FAA will then initiate an in-depth technical analysis (commonly called an extended study), which will explain the cause of the NPH and evaluate impacts on air operations. If after the extended study, which may include a public comment period, there remains an operational impact, the FAA will try to negotiate an acceptable height for a project that has received a NPH. If no agreement can be reached, FAA will issue a Determination of Hazard (DOH). A DOH can be appealed to FAA Washington Headquarters. If the appeal does not secure a DNH, the proponent's main recourse is to bring the issue before a Federal Court."

There have been relatively few cases in which the FAA retroactively determined that a wind farm was interfering with radar equipment, thus requiring the developer to make changes such as moving individual turbines or changing the turbine heights. Such mitigation efforts can trigger unanticipated cost for developers, which can retroactively impair a project's financial viability. As a result, wind developers have sought clearer up-front estimates of potential mitigation costs or a stronger guarantee of FAA approval. Because of the complex nature of radar interference that is affected by many factors other than turbine location and height, the FAA cannot provide a guarantee that a wind farm will not interfere with radar. However, the FAA has stated that it will not halt a project that has begun construction, and developers should be confident in proceeding with construction once they receive a DNH letter from the FAA.

In most cases, radar interference can be corrected with software that deletes radar signals from stationary targets. The Middlegrunden Wind Farm in Denmark is located just 8 miles from the Copenhagen airport, but all airport computers have software that corrects for radar signals from the wind farm. Most turbine and radar interaction problems concerning the FAA can be addressed using available software upgrades.

Department of Defense

In addition, the Department of Defense (DOD) often tracks objects (some of which may be rather small) that might be blocked, or whose characteristics may be distorted or displaced, by turbine interference. For such instances, software fixes alone may be insufficient to resolve potential interference with military radar applications, so additional mitigation techniques may be required. Tests indicate that turbines reduce the probability of radar detections in some cases. Of course, not all cases of turbine-radar proximity lead to interference. Some Air Force runways with turbines located just miles away experience no interference problems.

The National Defense Authorization Act for Fiscal Year 2006 included an amendment requiring DOD to study and report on the effects of wind projects on military readiness. The report concluded that "Given the expected increase in the U.S. wind energy development, the existing siting processes as well as mitigation approaches need to be reviewed and enhanced in order to provide for continued development of this important renewable energy resource while maintaining vital defense readiness. The Department of Defense strongly supports the development of renewable energy sources and is a recognized leader in the use of wind energy." It went on to acknowledge that while wind turbines located in radar line of sight of air defense radars can adversely impact their ability to carry out their national defense mission, the magnitude of the impact will vary. Mitigation tools that currently exist to completely preclude any adverse impacts on air defense radars are limited and require case-by-case analysis. However, DOD is committed to developing additional mitigation approaches. See: U.S. Department of Defense. (2006). "The Effect of Windmill Farms On Military Readiness (PDF 1.3 MB) Download Adobe Reader."

Tools and Practices

A number of tools and practices are available to manage or mitigate the potential impact of wind turbine interference.

- Conducting studies to ensure that the wind farm location is not in an area of high radar activity. Studies should also analyze the potential interference effects of the individual turbines and the wind project as a whole. Farm layout optimization, terrain masking, or reduction of the radar cross-section area may be sufficient to address identified interference problems.
- Coating equipment with absorbent or reflective materials to minimize the turbine's radar signature.
- Starting early communications between wind developers and the potentially affected federal agencies, such as the FAA and the DOD, to mitigate potential radar interference. Often the easiest and least costly approaches involve software optimization. Other options include installing post-processors or adding hardware (such as processors, transmitters, or receivers). When such changes alone are insufficient, more involved approaches can sometimes be implemented. These include deploying extra radars to cover the shadow spots, relocating radar installations to accommodate the new wind farms, or altering air traffic routes around new wind farms.

Even with these mitigation methods, there will be some proposed locations where wind turbines will cause disruptive radar interference. In such cases, wind projects would likely be unable to proceed at the proposed site.

More Information

Some of the following documents are available as Adobe Acrobat PDFs. Download Adobe Reader.

- **Federal Wind Siting Information Center**

  Provides more information about agency efforts to develop ways to test and mitigate turbine effects on radar. This site includes an interactive screening tool that allows the user to enter the location and dimensions of a potential wind project and identify the probability of potential radar interference.

- **Airspace Issues in Wind Turbine Siting**

  Provides more information about wind energy development and the FAA, including case studies, a listing of FAA determinations for proposed Massachusetts wind projects, and guidelines and "best practice" recommendations.

- **Wind Turbines and Radar Interference (PDF 1.0 MB)**

  Idaho National Laboratory's Gary Seifert gave this presentation at the 2006 AWEA conference.

- **Factsheet on Wind Turbines and Radar (PDF 98 KB)**

  Published by the American Wind Energy Association.

- **Feasibility of Modifying Radar Systems to Accommodate Wind Turbines**
  - Project Summary (PDF 74 KB). 2003.
  - Report (PDF 783 KB)
  - Appendix (part 1) (PDF 2.7 MB)
  - Appendix (part 2) (PDF 2.0 MB)

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May 27, 2010

Radar: A Dilemma for DoD and the Wind Power Industry

Eric Lindeman

This is the first of two parts. The conclusion will follow next week.

In a twist of bureaucratic creativity, the Department of Defense and the Federal Aviation Administration may have found a noval way to fund replacement of an aging radar system for commercial and military airports on and around Cape Cod, Mass.—getting an offshore wind farm developer to pay for it.

But that's not what has happened in Oregon where DoD threatened to block a huge, planned onshore wind farm near a 50-year-old radar installation. There, as a result of a negotiated political agreement, DoD and FAA are permitting the wind energy project to move forward, and the government will pay for a new radar system that will not be subject to interference caused by rotating wind turbines.

The two cases—and there are others—point to a policy dilemma: renewable energy and energy security are going head to head with national security. At an Energy and Natural Resources Committee hearing last week, Oregon Sen. Ron Wyden (D), who also sits on the Intelligence Committee, wanted to know what the DoD policy is for evaluating wind energy projects. Grilling DoD Deputy Under Secretary for Installations and Evironment Dorothy Robyn, he demanded, "What's being done to get a system in place so that this country can have national security and energy security?"

Cape Wind, a 468-megawatt wind farm off the coast of Massachusetts' Cape Cod, was approved by Interior Secretary Ken Salazar April 28, ostensibly ending nine years of contentious proceedings. All that remained in the path to construction was FAA approval. And after conducting the legally required "aeronautical study," FAA issued a "determination of no hazard to air navigation" May 17.

But that finding carried with it a proviso that developer Cape Wind Associates LLC set aside $15 million "in escrow or other financial means" to pay for modifications to two outdated air navigation systems—one at Otis Air Force Base in Falmouth and the other at Nantucket. If the modification at Falmouth, the older of the two, doesn't work, then FAA said Cape Wind will be financially responsible for "acquisition, siting and installation" of a newer radar system that is less likely to be affected by the interference that spinning wind turbine blades can cause under certain conditions.

The Falmouth radar system was slated for replacement after 2004, according to an FAA New England region official, but funding for that project was cut and the plan lay dormant since.

"It is what it is," said Mark Rodgers, spokesman for Cape Wind.

The radar interference issue came to head earlier this year with the Shepherds Flat wind farm in Oregon, which at a planned 338 turbines and 845 megawatts, would be the world's largest land-based wind energy project. At the beginning of March, only days before construction was set to begin, DoD intervened, forcing New York City-based Caithness Energy, a privately held independent power producer that is developing the $2 billion Shepherds Flat project, to stop in its tracks.

Wind turbines, the Pentagon had belatedly decided, could interfere with the aging Air Force radar system in nearby Fossil, Ore., and that would be a security threat. DoD and the renewable energy developer were between a rock and a hard place, as the saying goes, neither knowing what to do.

DoD's mission was clear. But so was the Obama administration's and DoD's own renewable energy policy. Moreover, the same clash between aging radar and spinning wind turbine blades could have scuttled three other large wind projects under development in the same region by Iberdrola Renewables, as well as proposed projects from the upper Midwest south to Texas.

The FAA denial of a permit halted Shephards Flat, which was already nine years in development; the Department of Energy stopped working on a loan-guarantee application for the project; and General Electric which, in December, received a $1.4-billion contract to supply the turbines for Shephards Flat—its largest renewable energy contract last year and the first for its advanced 2.5xl (2.5-MW) machines—was in manufacturing limbo.

To add even more to the dilemma, major construction delays threatened the financial underpinning for the project: Caithness Energy officials stressed that building the wind farm will take a year and a half, and it must be finished by the end of 2012 to remain eligible for Recovery Act stimulus funding.

That's not to mention that Southern California Edison (SCE) is scheduled to begin taking power from the project toward the end of 2011 under the first of three 20-year power puchase agreements. Like all large California utilities, SCE must meet an ambitious renewable portfolio standard of getting 20 percent of its electricity from renewable sources by 2010 and 33 percent by 2020. Shephards Flat represents about 10 percent of the utility's contracted renewable electricity.

The stalemate spurred further intervention, this time by the outraged Oregon Congressional delegation, led by Sen. Ron Wyden (D-Ore.) who, in discussions and negotiations with the Pentagon and top Obama administration officials, warned that blocking Shephard Flats would not only undermine that project's promise of employment and financial gains for an economically down trodden region of Oregon, but would have an adverse ripple effect through the Obama administration's entire renewable energy program.

After nearly two months of haggling back and forth, DoD, with little explanation, gave in and said it would not stand in the way of Shephard Flats. At the end of April, it withdrew its objections and FAA granted approval of the project. Triumphantly, Wyden said: "In allowing this project to go forward, both the White House and the Pentagon have underscored their commitment to U.S. energy security.

"As I have said throughout this effort, blocking this project would have had a chilling-effect not just on Shepherd's Flat, but on private investment in new energy projects across the country. As a member of both the Senate Committees on Energy [and Natural Resources] and Intelligence, I am convinced that national security and energy security are not only compatible, they are one and the same."

The radar-wind turbine clash is not new. Nobody has denied that wind turbines could cause radar interference, or "clutter," at many air navigation facilities. But that is because, worldwide, much of the existing radar infrastructure is very old—analogue rather than digital—relies on outdated computer technology and has been patched together for decades while governments search for funding to replace it.

Air navigation systems and technology updates that resolve wind turbine issues have been available for more than 20 years. But there simply weren't that many wind energy facilities until five to ten years ago—when the national security threat of rising and erraditic oil prices and uncertain supplies emerged clearly. Now wind energy projects are proliferating across the United States and comparatively monster sized turbines are being moved offshore.

But little progress has been made coming to a resolution acceptable to all parties and all policies. As part of the 2006 Defense Authorization Act, Congress required DoD to prepare a report on "Effects of Windmill Farms on Military Readiness," including "an assessment of the effects on the operations of military radar installations of the proximity of windmill farms to such installations and of technologies that could mitigate any adverse effects on military operations identified."

In its conclusions to that report, DoD said, "The FAA has the responsibility to promote and maintain the safe and efficient use of U.S. airspace for all users. The Department defers to the FAA regarding possible impacts wind farms may have on the Air Traffic Control radars employed for management of the U.S. air traffic control system. The Department is prepared to assist the FAA in efforts the FAA may decide to undertake in this regard."

Subsequently, the MITRE Corp. was asked by the Department of Homeland Security (DHS) to "review the current status of the conflict between the ever-growing number of wind-turbine farms and air-security radars that are located within some tens of miles of a turbine farm."

In its January 2008 report, the company wrote, "Wind farms interfere with radar. This interference has led the FAA, the DHS, and the DoD to contest many proposed wind turbines in the line of sight of radar, stalling development of several thousands of megawatts of wind energy. A large number of such denials is a serious impediment to the nation's mandated growth of sustainable energy."

Mitre Corp. further concluded, "Current circumstances provide an interesting opportunity for improving the aging radar infrastructure of the United States by replacing radar that inhibits the growth of wind farms with new, more flexible and more capable systems, especially digital radar hardware and modern computing power. Such improvements could significantly increase the security of U.S. airspace."

But the problem is still not resolved—at least not as a matter of consistent DoD policy--and apparently needs more studying, or so Congress believes. The fiscal year 2011 Defense authorization bill, now before the House and Senate, contains as paragraph headed, "Effects of Wind Turbines on Military Operations," that seems vaguely to be calling for additional study:

"As the construction of wind farms across the nation has increased, new challenges associated with the obstruction of military training routes and radar are emerging. To address these issues and better balance our energy security and military readiness, the bill provides tools to the Department to identify potential conflicts and remedy them in a timely manner."

The Pentagon, while agreeing not to further delay the Shephard Flats project, has not said publicly said what it plans to do about the aging radar system at Fossil, Ore. But Congressional officials confirmed that DoD will pay to replace it, which needed to be done long ago anyway.

Not so for Cape Wind, however. It will have to pay—for a technology upgrade or possibly for an entirely new radar system. And there is no guarantee either will work. said, "The guys at FAA have pretty good confidence that this will do the trick," said Cape Wind's Rodgers, "but they want to cover themselves."

Enter Lockheed Martin. In mid-April, just as DoD was backing down at Shephards Flat, the U.S. defense contractor announced that it will be supplying an advanced radar system for a U.K. Ministry of Defense installation.

MoD is not modernizing its radar systems, however. They are not outdated, but they were not designed to see through or around the interference, or "clutter," that large offshore wind turbines would likely cause, creating blind spots in air defenses. And MoD was refusing to sign off on developers' plans for a total of 924 wind turbines, generating 5,500 megawatts, in five offshore wind farms situated in the Greater Wash Strategic Area to the east.

As is in the United States, energy security ran head on into national security in the United Kingdom. MoD refused to approve the massive project until a tested solution to the radar clutter problem was in hand.

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15 January 2011

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Re: Comments on Whistling Ridge Wind Farm and its possible effects on National Defense and airplanes flying in the National Scenic Area; the cumulative effects of all the regional wind farms on defense and civilian radars, TV, and radio signals.

Dear EFSEC,

In my research on the wind farm issue, and on Whistling Ridge in particular, I have come across various references about the effects of wind turbines on airplanes, especially on military aircraft. This was not an issue that was delved into very deeply, if at all, if my memory serves, in the DEIS and I wish to explore this in this memo. As a former officer in the U.S. Air Force Reserve (retired as Major, Intelligence Applications Officer) and a resident of the National Scenic Area, I have seen a lot of military aircraft flying up and down the Gorge on training missions. There are helicopters that fly at very low altitudes, and jets that fly at higher altitudes but sometimes come in low enough so you can see the glint off their cockpit! There are also civilian aircraft, both large and small airplanes—Portland International Airport is just stones throw away, as the plane flies, and small airports throughout the area—life flights (rescue flights, as needed), and helicopters that fly in the allocated airspace.

The cumulative effects of the regional wind farms on the mission of our military aircraft have not been adequately addressed and should be further explored during this assessment period. I don't know, because the issue was not addressed, how and if the wind farms will impact any aircraft. Do you? I do know that last year there was a big stink when the Department of Defense wanted to nix a wind farm in eastern Oregon and the two senators from Oregon put political pressure on DoD so that the project would go forward. **See Attachments R-1 and R-2.** Effectively, DoD patched its ageing radar grid so the $2 billion dollar wind farm project could go on!

As Attachment R-2 clearly shows, Sen. Wyden and Sen. Merkley appear to be more concerned about putting up 1100 turbines than with the cumulative effects of these 1100 turbines on our national defense and on our environment. Without any studies on the cumulative impacts of the thousands of wind turbines in the NW on our regional defense net, without any clear idea if all these turbines are or are not playing havoc with military and civilian radars that are outdated, these two senators pushed DoD hard and DoD responded by withdrawing its opposition. DoD's bad. Now, the taxpayers of America are going to fund the bill for upgrading the regional military radar and the heavily subsidized (by tax dollars) wind industry won't be paying a dime. This is outrageous. It is dangerous. But it shows the depth of the wind industry's insidious political power that they can somehow manage to override the Department of Defense's legitimate concerns about air space safety and our national defense.

Wind farms not only interfere with military and civilian radar, they also interfere with TV and radio signals. **See Attachment R-3**. We live in a very hilly environment and radio signals can sometimes be lost. Our sheriff's office has upgraded its radio equipment and we have more microwave towers in the area so that deputies don't lose radio signal. But, do we know whether wind turbines would affect emergency responders' radio signals? This is something that should be studied to see if mitigation is necessary because of signal loss. Attachment R-3 also mentions the following recommendations used "to manage or mitigate the potential impact of wind turbine interference":

"Tools and Practices

A number of tools and practices are available to manage or mitigate the potential impact of wind turbine interference.

- Conducting studies to ensure that the wind farm location is not in an area of high radar activity. **Studies should also analyze the potential interference effects of the individual turbines and the wind project as a whole.** Farm layout optimization, terrain masking, or reduction of the radar cross-section area may be sufficient to address identified interference problems.
- Coating equipment with absorbent or reflective materials to minimize the turbine's radar signature.
- Starting early communications between wind developers and the potentially affected federal agencies, such as the FAA and the DOD, to mitigate potential radar interference. Often the easiest and least costly approaches involve software optimization. Other options include installing post-processors **or adding hardware (such as processors, transmitters, or receivers)**. When such changes alone are insufficient, more involved approaches can sometimes be implemented. These include deploying extra radars to cover the shadow spots, relocating radar

installations to accommodate the new wind farms, or altering air traffic routes around new wind farms.

Even with these mitigation methods, there will be some proposed locations where wind turbines will cause disruptive radar interference. In such cases, wind projects would likely be unable to proceed at the proposed site." [my emphasis]

It is abundantly clear that the issue of radar interference, from wind farms, with military and civilian aircraft, and with other signals such as TV and radio, is something that needs to be studied early on in the siting process and not after the fact. The taxpayers should not get stuck with the bill so that heavily subsidized wind farms can go on propagating while the safety and welfare of the public, and our national defense, is put at risk.

The Whistling Ridge wind farm proposal should have a radar interference study as a mandatory part of the DEIS process, at the very least. Civilian and military aircraft should not be put at unknown risk.

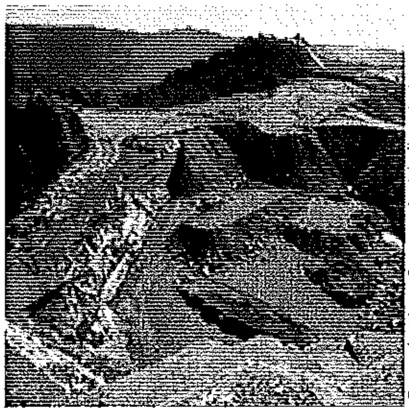
Thank you.

/e-signature/Mary J. Repar
15 January 2011

http://www.allgov.com/Top_Stories/ViewNews/EPA_Stops_Largest_Mountaintop_Removal_Mine_11011

EPA Stops Largest Mountaintop Removal Mine

Saturday, January 15, 2011



Mountaintop removal site in Kayford Mountain, West Virginia (Photo: AP)

For first time in its history, the U.S. Environmental Protection Agency (EPA) has rescinded a clean water permit for a coal mining operation, a move that is likely to provoke backlash from the industry.

The decision in effect kills the Spruce No. 1 Mine and puts a stop to the largest single mountaintop removal permit in West Virginia history. EPA officials decided the project would use destructive and unsustainable mining practices that jeopardized clean water sources for local communities.

Federal scientists determined that Spruce Mountain would have disposed of 110 million cubic yards of coal mine waste into streams; buried more than six miles of high-quality streams in one county; polluted downstream waters as a result of buried streams; and degraded area watersheds, thus killing wildlife and adversely impacting other species.

Officials with Arch Coal, the company behind the project, were "shocked and dismayed" by EPA's ruling. "Absent court intervention, EPA's final determination to veto the Spruce permit blocks an additional $250 million investment and 250 well-paying American jobs," Kim Link, a company spokeswoman, told *The New York Times*.

Arch Coal intends to fight the permit removal in federal court.

-Noel Brinkerhoff

EPA Vetoes Spruce Mine Permit (by Ken Ward Jr., Charleston Gazette)
Agency Revokes Permit for Major Coal Mining Project (by John Broder, New York Times)
Final Determination of the U.S. Environmental Protection Agency Pursuant to § 404(c) of the Clean Water Act Concerning the Spruce No. 1 Mine, Logan County, West Virginia (U.S. Environmental Protection Agency) (pdf)
Coal vs. Wind on a West Virginia Mountain (by Noel Brinkerhoff, AllGov)
EPA Set to Halt Largest Mountaintop Removal Mine ((by Noel Brinkerhoff, AllGov)

INITIATIVE 937

I, Sam Reed, Secretary of State of the State of Washington and custodian of its seal hereby certify that, according to the records on file in my office, the attached copy of Initiative Measure No. 937 to the People is a true and correct copy as it was received by this office.

AN ACT Relating to requirements for new energy resources; adding a new chapter to Title 19 RCW; and prescribing penalties.

BE IT ENACTED BY THE PEOPLE OF THE STATE OF WASHINGTON:

NEW SECTION. **Sec. 1.** INTENT. This chapter concerns requirements for new energy resources. This chapter requires large utilities to obtain fifteen percent of their electricity from new renewable resources such as solar and wind by 2020 and undertake cost-effective energy conservation.

NEW SECTION. **Sec. 2.** DECLARATION OF POLICY. Increasing energy conservation and the use of appropriately sited renewable energy facilities builds on the strong foundation of low-cost renewable hydroelectric generation in Washington state and will promote energy independence in the state and the Pacific Northwest region. Making the most of our plentiful local resources will stabilize electricity prices for Washington residents, provide economic benefits for Washington counties and farmers, create high-quality jobs in Washington, provide opportunities for training apprentice workers in the renewable energy field, protect clean air and water, and position Washington state as a national leader in clean energy technologies.

NEW SECTION. **Sec. 3.** DEFINITIONS. The definitions in this section apply throughout this chapter unless the context clearly requires otherwise.

(1) "Attorney general" means the Washington state office of the attorney general.

(2) "Auditor" means: (a) The Washington state auditor's office or its designee for qualifying utilities under its jurisdiction that are not investor-owned utilities; or (b) an independent auditor selected by a qualifying utility that is not under the jurisdiction of the state auditor and is not an investor-owned utility.

(3) "Commission" means the Washington state utilities and transportation commission.

(4) "Conservation" means any reduction in electric power consumption resulting from increases in the efficiency of energy use, production, or distribution.

(5) "Cost-effective" has the same meaning as defined in RCW 80.52.030.

(6) "Council" means the Washington state apprenticeship and training council within the department of labor and industries.

(7) "Customer" means a person or entity that purchases electricity for ultimate consumption and not for resale.

(8) "Department" means the department of community, trade, and economic development or its successor.

(9) "Distributed generation" means an eligible renewable resource where the generation facility or any integrated cluster of such facilities has a generating capacity of not more than five megawatts.

(10) "Eligible renewable resource" means:

(a) Electricity from a generation facility powered by a renewable resource other than fresh water that commences operation after March 31, 1999, where: (i) The facility is located in the Pacific Northwest; or (ii) the electricity from the facility is delivered into Washington state on a real-time basis without shaping, storage, or integration services; or

(b) Incremental electricity produced as a result of efficiency improvements completed after March 31, 1999, to hydroelectric generation projects owned by a qualifying utility and located in the

Pacific Northwest or to hydroelectric generation in irrigation pipes and canals located in the Pacific Northwest, where the additional generation in either case does not result in new water diversions or impoundments.

(11) "Investor owned utility" has the same meaning as defined in RCW 19.29A.010.

(12) "Load" means the amount of kilowatt-hours of electricity delivered in the most recently completed year by a qualifying utility to its Washington retail customers.

(13) "Nonpower attributes" means all environmentally related characteristics, exclusive of energy, capacity reliability, and other electrical power service attributes, that are associated with the generation of electricity from a renewable resource, including but not limited to the facility's fuel type, geographic location, vintage, qualification as an eligible renewable resource, and avoided emissions of pollutants to the air, soil, or water, and avoided emissions of carbon dioxide and other greenhouse gases.

(14) "Pacific Northwest" has the same meaning as defined for the Bonneville power administration in section 3 of the Pacific Northwest electric power planning and conservation act (94 Stat. 2698; 16 U.S.C. Sec. 839a).

(15) "Public facility" has the same meaning as defined in RCW 39.35C.010.

(16) "Qualifying utility" means an electric utility, as the term "electric utility" is defined in RCW 19.29A.010, that serves more than twenty-five thousand customers in the state of Washington. The number of customers served may be based on data reported by a utility in form 861, "annual electric utility report," filed with the energy information administration, United States department of energy.

(17) "Renewable energy credit" means a tradable certificate of proof of at least one megawatt-hour of an eligible renewable resource where the generation facility is not powered by fresh water, the certificate includes all of the nonpower attributes associated with that one megawatt-hour of electricity, and the certificate is verified by a renewable energy credit tracking system selected by the department.

(18) "Renewable resource" means: (a) Water; (b) wind; (c) solar energy; (d) geothermal energy; (e) landfill gas; (f) wave, ocean, or tidal power; (g) gas from sewage treatment facilities; (h) biodiesel

fuel as defined in RCW 82.29A.135 that is not derived from crops raised on land cleared from old growth or first-growth forests where the clearing occurred after the effective date of this section; and (i) biomass energy based on animal waste or solid organic fuels from wood, forest, or field residues, or dedicated energy crops that do not include (i) wood pieces that have been treated with chemical preservatives such as creosote, pentachlorophenol, or copper-chrome-arsenic; (ii) black liquor byproduct from paper production; (iii) wood from old growth forests; or (iv) municipal solid waste.

(19) "Rule" means rules adopted by an agency or other entity of Washington state government to carry out the intent and purposes of this chapter.

(20) "Year" means the twelve-month period commencing January 1st and ending December 31st.

<u>NEW SECTION.</u> **Sec. 4.** ENERGY CONSERVATION AND RENEWABLE ENERGY TARGETS. (1) Each qualifying utility shall pursue all available conservation that is cost-effective, reliable, and feasible.

(a) By January 1, 2010, using methodologies consistent with those used by the Pacific Northwest electric power and conservation planning council in its most recently published regional power plan, each qualifying utility shall identify its achievable cost-effective conservation potential through 2019. At least every two years thereafter, the qualifying utility shall review and update this assessment for the subsequent ten-year period.

(b) Beginning January 2010, each qualifying utility shall establish and make publicly available a biennial acquisition target for cost-effective conservation consistent with its identification of achievable opportunities in (a) of this subsection, and meet that target during the subsequent two-year period. At a minimum, each biennial target must be no lower than the qualifying utility's pro rata share for that two-year period of its cost-effective conservation potential for the subsequent ten-year period.

(c) In meeting its conservation targets, a qualifying utility may count high-efficiency cogeneration owned and used by a retail electric customer to meet its own needs. High-efficiency cogeneration is the sequential production of electricity and useful thermal energy from a common fuel source, where, under normal operating conditions, the facility has a useful thermal energy output of no less than thirtythree percent of the total energy output. The reduction in load due to high-efficiency cogeneration shall be: (i) Calculated as the ratio of the fuel chargeable to power heat rate of the cogeneration facility compared to the heat rate on a new and clean basis of a best-commercially available technology combined-cycle natural gas-fired combustion turbine; and (ii) counted towards meeting the biennial conservation target in the same manner as other conservation savings.

(d) The commission may determine if a conservation program implemented by an investor-owned utility is cost-effective based on the commission's policies and practice.

(e) The commission may rely on its standard practice for review and approval of investor-owned utility conservation targets.

(2)(a) Each qualifying utility shall use eligible renewable resources or acquire equivalent renewable energy credits, or a combination of both, to meet the following annual targets:

(i) At least three percent of its load by January 1, 2012, and each year thereafter through December 31, 2015;

(ii) At least nine percent of its load by January 1, 2016, and each year thereafter through December 31, 2019; and

(iii) At least fifteen percent of its load by January 1, 2020, and each year thereafter.

(b) A qualifying utility may count distributed generation at double the facility's electrical output if the utility: (i) Owns or has contracted for the distributed generation and the associated renewable energy credits; or (ii) has contracted to purchase the associated renewable energy credits.

(c) In meeting the annual targets in (a) of this subsection, a qualifying utility shall calculate its annual load based on the average of the utility's load for the previous two years.

(d) A qualifying utility shall be considered in compliance with an annual target in (a) of this subsection if: (i) The utility's weather-adjusted load for the previous three years on average did not increase over that time period; (ii) after the effective date of this section, the utility did not commence or renew ownership or incremental purchases of electricity from resources other than renewable resources other than on a daily spot price basis and the electricity is not offset by equivalent renewable energy credits; and (iii) the utility invested at least one percent of its total annual retail revenue requirement that year on eligible renewable resources, renewable energy credits, or a combination of both.

(e) The requirements of this section may be met for any given year with renewable energy credits produced during that year, the preceding year, or the subsequent year. Each renewable energy credit may be used only once to meet the requirements of this section.

(f) In complying with the targets established in (a) of this subsection, a qualifying utility may not count:

(i) Eligible renewable resources or distributed generation where the associated renewable energy credits are owned by a separate entity; or

(ii) Eligible renewable resources or renewable energy credits obtained for and used in an optional pricing program such as the program established in RCW 19.29A.090.

(g) Where fossil and combustible renewable resources are cofired in one generating unit located in the Pacific Northwest where the cofiring commenced after March 31, 1999, the unit shall be considered to produce eligible renewable resources in direct proportion to the percentage of the total heat value represented by the heat value of the renewable resources.

(h)(i) A qualifying utility that acquires an eligible renewable resource or renewable energy credit may count that acquisition at one and two-tenths times its base value:

(A) Where the eligible renewable resource comes from a facility that commenced operation after December 31, 2005; and

(B) Where the developer of the facility used apprenticeship programs approved by the council during facility construction.

(ii) The council shall establish minimum levels of labor hours to be met through apprenticeship programs to qualify for this extra credit.

(i) A qualifying utility shall be considered in compliance with an annual target in (a) of this subsection if events beyond the reasonable control of the utility that could not have been reasonably anticipated or ameliorated prevented it from meeting the renewable energy target. Such events include weather-related damage, mechanical failure, strikes, lockouts, and actions of a governmental authority that adversely affect the generation, transmission, or distribution of an eligible renewable resource under contract to a qualifying utility.

(3) Utilities that become qualifying utilities after December 31, 2006, shall meet the requirements in this section on a time frame comparable in length to that provided for qualifying utilities as of the effective date of this section.

NEW SECTION. **Sec. 5.** RESOURCE COSTS. (1)(a) A qualifying utility shall be considered in compliance with an annual target created in section 4(2) of this act for a given year if the utility invested four percent of its total annual retail revenue requirement on the incremental costs of eligible renewable resources, the cost of renewable energy credits, or a combination of both, but a utility may elect to invest more than this amount.

(b) The incremental cost of an eligible renewable resource is calculated as the difference between the levelized delivered cost of the eligible renewable resource, regardless of ownership, compared to the levelized delivered cost of an equivalent amount of reasonably available substitute resources that do not qualify as eligible renewable resources, where the resources being compared have the same contract length or facility life.

(2) An investor-owned utility is entitled to recover all prudently incurred costs associated with compliance with this chapter. The commission shall address cost recovery issues of qualifying utilities that are investor-owned utilities that serve both in Washington and in other states in complying with this chapter.

NEW SECTION. **Sec. 6.** ACCOUNTABILITY AND ENFORCEMENT. (1) Except as provided in subsection (2) of this section, a qualifying utility that fails to comply with the energy conservation or renewable energy targets established in section 4 of this act shall pay an administrative penalty to the state of Washington in the amount of fifty dollars for each megawatt-hour of shortfall. Beginning in 2007, this penalty shall be adjusted annually according to the rate of change of the inflation indicator, gross domestic product-implicit price deflator, as published by the bureau of economic analysis of the United States department of commerce or its successor.

(2) A qualifying utility that does not meet an annual renewable energy target established in section 4(2) of this act is exempt from the administrative penalty in subsection (1) of this section for that year if the commission for investor-owned utilities or the auditor for

all other qualifying utilities determines that the utility complied with section 4(2) (d) or (i) or 5(1) of this act.

(3) A qualifying utility must notify its retail electric customers in published form within three months of incurring a penalty regarding the size of the penalty and the reason it was incurred.

(4) The commission shall determine if an investor-owned utility may recover the cost of this administrative penalty in electric rates, and may consider providing positive incentives for an investor-owned utility to exceed the targets established in section 4 of this act.

(5) Administrative penalties collected under this chapter shall be deposited into the energy independence act special account which is hereby created. All receipts from administrative penalties collected under this chapter must be deposited into the account. Expenditures from the account may be used only for the purchase of renewable energy credits or for energy conservation projects at public facilities, local government facilities, community colleges, or state universities. The state shall own and retire any renewable energy credits purchased using moneys from the account. Only the director of general administration or the director's designee may authorize expenditures from the account. The account is subject to allotment procedures under chapter 43.88 RCW, but an appropriation is not required for expenditures.

(6) For a qualifying utility that is an investor-owned utility, the commission shall determine compliance with the provisions of this chapter and assess penalties for noncompliance as provided in subsection (1) of this section.

(7) For qualifying utilities that are not investor-owned utilities, the auditor is responsible for auditing compliance with this chapter and rules adopted under this chapter that apply to those utilities and the attorney general is responsible for enforcing that compliance.

NEW SECTION. **Sec. 7.** REPORTING AND PUBLIC DISCLOSURE. (1) On or before June 1, 2012, and annually thereafter, each qualifying utility shall report to the department on its progress in the preceding year in meeting the targets established in section 4 of this act, including expected electricity savings from the biennial conservation target, expenditures on conservation, actual electricity savings results, the utility's annual load for the prior two years, the amount of megawatt-hours needed to meet the annual renewable energy target, the amount of megawatt-hours of each type of eligible renewable resource acquired, the type and amount of renewable energy credits acquired, and the percent of its total annual retail revenue requirement invested in the incremental cost of eligible renewable resources and the cost of renewable energy credits. For each year that a qualifying utility elects to demonstrate alternative compliance under section 4(2) (d) or (i) or 5(1) of this act, it must include in its annual report relevant data to demonstrate that it met the criteria in that section. A qualifying utility may submit its report to the department in conjunction with its annual obligations in chapter 19.29A RCW.

(2) A qualifying utility that is an investor-owned utility shall also report all information required in subsection (1) of this section to the commission, and all other qualifying utilities shall also make all information required in subsection (1) of this section available to the auditor.

(3) A qualifying utility shall also make reports required in this section available to its customers.

<u>NEW SECTION.</u> **Sec. 8.** RULE MAKING. (1) The commission may adopt rules to ensure the proper implementation and enforcement of this chapter as it applies to investor-owned utilities.

(2) The department shall adopt rules concerning only process, timelines, and documentation to ensure the proper implementation of this chapter as it applies to qualifying utilities that are not investor-owned utilities. Those rules include, but are not limited to, rules associated with a qualifying utility's development of conservation targets under section 4(1) of this act; a qualifying utility's decision to pursue alternative compliance in section 4(2) (d) or (i) or 5(1) of this act; and the format and content of reports required in section 7 of this act. Nothing in this subsection may be construed to restrict the rate-making authority of the commission or a qualifying utility as otherwise provided by law.

(3) The commission and department may coordinate in developing rules related to process, timelines, and documentation that are necessary for implementation of this chapter.

(4) Pursuant to the administrative procedure act, chapter 34.05 RCW, rules needed for the implementation of this chapter must be adopted by December 31, 2007. These rules may be revised as needed to carry out the intent and purposes of this chapter.

NEW SECTION. **Sec. 9.** CONSTRUCTION. The provisions of this chapter are to be liberally construed to effectuate the intent, policies, and purposes of this chapter.

NEW SECTION. **Sec. 10.** SEVERABILITY. If any provision of this act or its application to any person or circumstance is held invalid, the remainder of the act or the application of the provision to other persons or circumstances is not affected.

NEW SECTION. **Sec. 11.** SHORT TITLE. This chapter may be known and cited as the energy independence act.

NEW SECTION. **Sec. 12.** CAPTIONS NOT LAW. Captions used in this chapter are not any part of the law.

NEW SECTION. **Sec. 13.** Sections 1 through 12 of this act constitute a new chapter in Title 19 RCW.

--- END ---

Final Determination of the U.S. Environmental Protection Agency
Pursuant to § 404(c) of the Clean Water Act
Concerning the Spruce No. 1 Mine, Logan County, West Virginia

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I. Executive Summary

This document explains the basis for the US Environmental Protection Agency (EPA) Clean Water Act § 404(c) Final Determination to withdraw the specification of Pigeonroost Branch, Oldhouse Branch and their tributaries, all of which are waters of the United States within Logan County, West Virginia, as a disposal site for dredged or fill material in connection with construction of the Spruce No. 1 Surface Mine, as authorized by DA Permit No. 199800436-3 (Section 10: Coal River) (DA Permit).[1] This Final Determination also prohibits the specification of the defined area constituting Pigeonroost Branch, Oldhouse Branch and their tributaries for use as a disposal site associated with future surface coal mining that would be expected to result in a nature and scale of adverse chemical, physical, and biological effects similar to the Spruce No. 1 mine. The DA Permit was issued by the US Army Corps of Engineers, Huntington District (Corps) in January 2007, authorizing the Mingo Logan Coal Company to construct six valley fills, associated sediment structures, and other discharges of fill material to the Right Fork of Seng Camp Creek, Pigeonroost Branch, Oldhouse Branch, and their tributaries. If fully constructed, the project will disturb approximately 2,278 acres (about 3.5 square miles) and bury approximately 7.48 miles of streams beneath 110 million cubic yards of excess spoil. This is among the largest individual surface mines ever authorized in West Virginia.

Under § 404(c) of the Clean Water Act, EPA is authorized to prohibit the specification (including the withdrawal of specification) of any defined area as a disposal site whenever EPA determines that the discharge of such materials into such area will have an unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas (including spawning and breeding areas), wildlife, or recreational areas. EPA is taking this action under § 404(c) of the Clean Water Act because the discharges associated with the DA Permit in Pigeonroost Branch, Oldhouse Branch and their tributaries will have unacceptable adverse effects on wildlife. In addition, the impacts downstream due to the destruction of those streams will result in unacceptable adverse impacts to wildlife and also warrant EPA's action under § 404(c).

The project, as permitted, will bury 6.6 miles of Pigeonroost Branch, Oldhouse Branch, and their tributaries under excess spoil generated by surface coal mining operations.[2] These streams represent some of the last remaining least-disturbed, high quality stream and riparian resources within the Headwaters Spruce Fork sub-watershed and the Coal

[1] While the permit also authorizes construction of valley fills and other discharges to the Right Fork of Seng Camp Creek and its tributaries, EPA is not withdrawing specification of those waters, in part because some of those discharges have already occurred and because the stream resources in Right Fork of Seng Camp Creek were subject to a higher level of historic and ongoing human disturbance than those found in Pigeonroost Branch or Oldhouse Branch. Due to litigation and an agreement with environmental groups, represented by Ohio Valley Environmental Coalition, operations following the issuance of this DA Permit have been limited to the Seng Camp Creek watershed, and as part of that agreement one valley fill is partially constructed.

[2] As noted above, the permit authorizes the filling of approximately 7.48 total miles of stream. For the reasons in footnote 1, EPA's Final Determination only addresses the approximately 6.6 miles of Pigeonroost Branch, Oldhouse Branch and their tributaries subject to the DA Permit.

River sub-basin and contain important wildlife resources and habitat. The quality of these streams is comparable to a West Virginia-designated reference site, and the macroinvertebrate communities found in these streams, which are used as an indicator of quality, rank extremely high in comparison to other streams throughout the Central Appalachia ecoregion and the state of West Virginia. These streams perform critical hydrologic and biological functions, support diverse and productive biological communities, contribute to prevention of further degradation of downstream waters, and play an important role within the context of the overall Headwaters Spruce Fork sub-watershed and Coal River sub-basin.

Unacceptable adverse impacts to Pigeonroost Branch, Oldhouse Branch, and their tributaries include the direct burial of 6.6 miles of high quality stream habitat, including all wildlife in this watershed that utilize these streams for all or part of their life cycles (e.g., macroinvertebrate, amphibian, fish, and water-dependent bird populations). Streams within the Central Appalachian ecoregion have some of the greatest aquatic animal diversity of any area in North America, including one of the richest concentrations of salamander fauna in the world, as well as many endemic and rare species of mayflies, stoneflies and caddisflies. In fact, Pigeonroost Branch and Oldhouse Branch contain extremely high mayfly and stonefly diversity, both within the Central Appalachian ecoregion and within the state of West Virginia. With their adjacent riparian areas, these streams provide important habitat for 84 taxa of macroinvertebrates, up to 46 species of amphibians and reptiles, 4 species of crayfish, and 5 species of fish, as well as birds, bats, and other mammals. As some of the last remaining high quality, least-disturbed headwater stream habitat within the sub-basin, these streams not only support resident wildlife, but also provide ecosystem functions for downstream waters, serve as refugia for aquatic life and potential sources for recolonizing nearby waters, and ultimately serve to maintain the aquatic ecosystem integrity in the sub-basin and the rich animal diversity in the ecoregion.

Burial of Pigeonroost Branch and Oldhouse Branch and their tributaries will also result in unacceptable adverse effects on wildlife downstream through the transformation of the buried areas into sources of pollution that will contribute contaminants to downstream waters and the removal of functions performed by the buried streams. Based on recent peer-reviewed literature, as well as available data from adjacent mine sites and from the active portion of the Spruce No. 1 Surface Mine, EPA has concluded that the full construction of the Spruce No. 1 Surface Mine will transform these headwater streams from high quality habitat into sources of pollutants (particularly total dissolved solids and selenium) that will travel downstream and adversely impact the wildlife communities that utilize these downstream waters. Increased pollutant levels will lead to loss of macroinvertebrate communities and population shifts to more pollution-tolerant taxa, specifically the extirpation of ecologically important macroinvertebrates. Through the loss of stream macroinvertebrate communities, there will be, in turn, substantial effects on fish, amphibian, and bird populations that rely on these communities as a food source.

Furthermore, the increased loading of pollutants to downstream receiving waters increases the potential for harmful golden algal blooms, while increased selenium exposure will result in impaired salamander populations and adverse effects to the reproduction of fish and bird species, thus harming the ability of these local populations to rebound. It is well recognized that the loss of a certain number of individuals of a species in a local ecological community can be tolerated, provided that the species continues to reproduce to replace lost individuals. However, when species are impacted by both acute stressors (e.g., food web changes, algal blooms) and exposure to reproductive toxicants, there is an increased risk of the loss of an entire species within an area. The loss of macroinvertebrate prey populations, increased risk of harmful golden algal blooms, and additional exposure to selenium will have an unacceptable adverse effect on the 26 fish species found in Spruce Fork as well as amphibians, crayfish, and bird species that depend on downstream waters for food or habitat.

The watersheds the project is located in, the Headwaters Spruce Fork sub-watershed and the larger Coal River sub-basin, have been heavily impacted by mining and the streams within this watershed have experienced substantial impairment. Currently, there have been more than 257 past and present surface mining permits issued in the Coal River sub-basin, and the corresponding mines collectively occupy more than 13% of the land area. In the Headwaters Spruce Fork sub-watershed, more than 34 past and present surface mine permits have been issued, and the corresponding mines collectively occupy more than 33% of the land area. If constructed as permitted, the project will occupy an additional 2.8% of the Headwaters Spruce Fork sub-watershed land area, and burial of Pigeonroost Branch, Oldhouse Branch and their tributaries will destroy 5.6% of the streams within the sub-watershed.

As least-disturbed streams in a watershed largely affected by mining, Pigeonroost Branch, Oldhouse Branch and their tributaries represent a high-value resource for the wildlife within the watershed. The Spruce No. 1 Mine will eliminate the entire suite of important physical, chemical and biological functions provided by these streams, including maintenance of biologically diverse wildlife habitat, and will critically degrade the chemical and biological integrity of downstream waters. Because the project will have unacceptable adverse effects on these high quality wildlife resources, EPA believes it is appropriate to withdraw specification to ensure the protection of these resources from discharges of dredged or fill material authorized under this DA permit.

Throughout the history of the Spruce No. 1 Surface Mine DA permit, EPA has raised concerns regarding adverse impacts to the environment. Additional data and information, including peer-reviewed scientific studies of the ecoregion, have become available since permit issuance. The peer-reviewed literature now reflect a growing consensus of the importance of headwater streams; a growing concern about the adverse ecological effects of mountaintop removal mining, specifically with regard to the effects of elevated levels of total dissolved solids discharged by mining operations on downstream aquatic ecosystems; and concerns that impacted streams cannot be easily recreated or replaced. These advances in understanding support EPA's long-standing concerns about this project regarding the potential for unacceptable adverse effects on wildlife, adverse water quality impacts, significant cumulative effects, as well as the shortcomings in avoidance, minimization, and compensatory mitigation measures designed to reduce environmental impacts from the project.

On April 2, 2010, EPA Region III published in the Federal Register a Proposed Determination to prohibit, restrict or deny the specification or the use for specification (including withdrawal of specification) of certain waters at the project site as disposal sites for the discharge of dredged or fill material for the construction of the Spruce No. 1 Surface Mine. EPA Region III took this step because it believed that discharges authorized by the DA Permit would result in a significant loss of wildlife habitat and also cause significant degradation of downstream aquatic ecosystems and therefore could have unacceptable adverse effects on wildlife. A public hearing regarding the Proposed Determination was conducted on May 18, 2010. EPA Region III received more than 100 oral comments and more than 50,000 written comments both supporting and opposing its Proposed Determination.

On September 24, 2010, U.S. Environmental Protection Agency (EPA) Region III submitted to EPA Headquarters its Recommended Determination that the specification embodied in DA Permit No. 199800436-3 (Section 10: Coal River) of Pigeonroost Branch and Oldhouse Branch as disposal sites for discharges of dredged or fill material for construction of the Spruce No. 1 Surface Mine be withdrawn. EPA Region III based this recommendation upon a conclusion that the discharges of dredged or fill material to Pigeonroost Branch and Oldhouse Branch for the purpose of constructing the Spruce No. 1 Surface Mine as authorized would likely have unacceptable adverse effects on wildlife.

The U.S. Fish and Wildlife Service (USFWS), in its comments on both the Proposed and Recommended Determinations, concurred with EPA Region III's conclusion that the project, as authorized, would result in unacceptable adverse effects on wildlife and that this conclusion is supported by the available scientific information. USFWS also notes that it has consistently expressed concerns regarding the loss of headwater streams and adjacent riparian and terrestrial habitats associated with the Spruce No. 1 Surface Mine, as well as its likely impacts on downstream water quality, aquatic organisms, and terrestrial and aquatic wildlife that depend on those resources.

Following review of the public comments received, the past and new scientific data, and EPA Region III's Recommended Determination, EPA Headquarters has concluded that the discharge of dredged or fill material to Pigeonroost Branch, Oldhouse Branch, and their tributaries, in connection with the construction of valley fills and sediment ponds, as authorized by DA Permit No. 199800436-3 (Section 10: Coal River), will result in unacceptable adverse effects on wildlife. The administrative record developed in this case fully supports the conclusion that the Spruce No. 1 Surface Mine will have unacceptable adverse effects to wildlife, due to the filling of Pigeonroost and Oldhouse Branch, and their tributaries. In addition, the administrative record demonstrates that the Spruce No. 1 Surface Mine will have unacceptable adverse effects on wildlife downstream of the project site.

Furthermore, these adverse impacts do not comply with the requirements of the Clean Water Act (CWA) and EPA's implementing regulations under § 404(b)(1). EPA has determined that the Spruce No. 1 Surface Mine fails to adequately evaluate less environmentally damaging alternatives, will cause or contribute to significant degradation of waters of the United States (especially when considered in the context of the significant cumulative losses and impairment of streams across the Central Appalachian ecoregion), and lacks compensatory mitigation to adequately offset the impacts to Pigeonroost Branch and Oldhouse Branch. These failures to comply with the Guidelines serve to strengthen EPA's judgment about the unacceptability of the significant adverse impacts that will occur.

Based on these findings and pursuant to § 404(c) of the CWA, this Final Determination withdraws the specification of Pigeonroost Branch, Oldhouse Branch, and their tributaries, as described in DA Permit No. 199800436-3 (Section 10: Coal River), as a disposal site for the discharge of dredged or fill material for the purpose of construction of the Spruce No. 1 Surface Mine. This Final Determination also prohibits the specification of the defined area constituting Pigeonroost Branch, Oldhouse Branch and their tributaries for use as a disposal site associated with future surface coal mining that would be expected to result in a nature and scale of adverse chemical, physical, and biological effects similar to the Spruce No. 1 mine.

II. Introduction

The purpose of the Clean Water Act is to "restore and maintain the physical, chemical, and biological integrity of the Nation's waters" (33 U.S.C. 1251(a)). The Act also defines "pollution" as "the man made or man induced alteration of the chemical, physical, biological, and radiological integrity of water" (33 U.S.C. § 1362(19)). The Supreme Court has recognized "[t]his broad conception of pollution--one which expressly evinces Congress' concern with the physical and biological integrity of water" (*PUD No. 1 of Jefferson County v. Washington Dep't of Ecology*, 511 U.S. 700, 719 (1994)). Over the years, various definitions have been given to the term "biological integrity." The working definition that has been in place since 1981 is: "the capability of supporting and maintaining a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of the natural habitat of the region." (http://www.epa.gov/bioindicators/html/biointeg.html). This definition includes protection of macroinvertebrate communities, as well as fish populations. This goes beyond protecting the function performed by various members of the aquatic community and extends to protection of the quality of the aquatic community itself.

The CWA, 33 U.S.C. §§ 1251 et seq., prohibits the discharge of pollutants, including dredged or fill material, into waters of the United States (including wetlands) except in compliance with, among other provisions, § 404 of the CWA, 33 U.S.C. § 1344. Section 404 authorizes the Secretary of the Army (Secretary), acting through the Chief of Engineers, to authorize the discharge of dredged or fill material at specified disposal sites. This authorization is conducted, in part, through the application of environmental guidelines developed by EPA, in conjunction with the Secretary, under § 404(b) of the CWA, 33 U.S.C. § 1344(b) (§ 404(b)(1) Guidelines). Section 404(c) of the CWA, 33 U.S.C. § 1344(c), authorizes the EPA to prohibit the specification (including the withdrawal of specification) of any defined area as a disposal site. EPA is authorized to restrict or deny the use of any defined area for specification (including the withdrawal of specification) as a disposal site, whenever it determines, after notice and opportunity for public hearing, that the discharge of such materials into such area will have an unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas (including spawning and breeding areas), wildlife, or recreational areas.

The procedures for implementation of § 404(c) are set forth in 40 CFR Part 231. Under those procedures, if the Regional Administrator has reason to believe that use of a site for the discharge of dredged or fill material may have an unacceptable adverse effect on one or more of the aforementioned resources, he may initiate the § 404(c) process by notifying the U.S. Army Corps of Engineers and the applicant (and/or project proponent) that he intends to issue a Proposed Determination. Each of those parties then has fifteen days to demonstrate to the satisfaction of the Regional Administrator that no unacceptable adverse effects will occur, or that corrective action to prevent an unacceptable adverse effect will be taken. If no such information is provided to the Regional Administrator, or if the Regional Administrator is not satisfied that no unacceptable adverse effect will occur, the Regional Administrator will publish a notice in the Federal Register of his Proposed Determination, soliciting public comment and offering an opportunity for a public hearing.

The procedures provide that the Regional Administrator will decide whether to withdraw the Proposed Determination or prepare a Recommended Determination following the public hearing and the close of the comment period. A decision to withdraw may be reviewed at the discretion of the Assistant Administrator for Water at EPA Headquarters. If the Regional Administrator prepares a Recommended Determination, the recommendation and the administrative record compiled in the Regional Office is forwarded to the Assistant Administrator for Water at EPA Headquarters. The Assistant Administrator for Water makes the Final Determination affirming, modifying, or rescinding the Recommended Determination.[3]

This document explains the basis for the EPA Final Determination to withdraw the specification of Pigeonroost Branch, Oldhouse Branch and their tributaries, all of which are waters of the United States within Logan County, West Virginia, as a disposal site for dredged or fill material in connection with construction of the Spruce No. 1 Surface Mine (hereafter "Spruce No. 1 Mine" or "the project") as authorized by DA Permit No. 199800436-3 (Section 10: Coal River) (hereafter "DA permit").[4] While the permit also authorizes construction of valley fills and other discharges to the Right Fork of Seng Camp Creek and its tributaries, EPA is not withdrawing specification of those waters, in part because some of those discharges have already occurred and because the stream resources in Right Fork of Seng Camp Creek were subject to a higher level of historic and ongoing human disturbance than those found in Pigeonroost Branch or Oldhouse Branch.

EPA is taking this action under § 404(c) of the Clean Water Act because the discharges to Pigeonroost Branch and Oldhouse Branch and their tributaries for the purpose of constructing Spruce No. 1 Mine as authorized by the permit will have unacceptable adverse effects on wildlife. Pigeonroost Branch and Oldhouse Branch and their tributaries are some of the last remaining streams within the Headwaters Spruce Fork sub-watershed and the larger Coal River sub-basin that represent "least-disturbed" conditions.[5] As such, they perform important hydrologic and biological functions, support diverse and productive biological communities, contribute to prevention of further degradation of downstream waters, and play an important role within the context of the overall Headwaters Spruce Fork sub-watershed and Coal River sub-basin. Within the streams and riparian areas of the project area, over 84 taxa of macroinvertebrates are

[3] In 1984, the EPA Administrator delegated the authority to make final decisions under § 404(c) to EPA's national Clean Water Act § 404 program manager, who is the Assistant Administrator for Water. That delegation remains in effect.

[4] As stated in the Section VII, this Final Determination also prohibits the specification of the defined area constituting Pigeonroost Branch, Oldhouse Branch and their tributaries for use as a disposal site associated with future surface coal mining that would be expected to result in a nature and scale of adverse chemical, physical, and biological effects similar to the Spruce No. 1 Mine.

[5] Least-disturbed conditions reflect a type of reference condition, where these sites have less human disturbance than others and represent the best existing condition within a watershed (Stoddard et al. 2006).

documented to exist, as well as up to 46 species of reptiles and amphibians, 4 species of crayfish, 5 species of fish and at least one water-dependent bird species.

The construction of Spruce No. 1 Mine as authorized will bury virtually all of Oldhouse Branch and its tributaries and much of Pigeonroost Branch and its tributaries under excess spoil generated by surface coal mining operations. These discharges will result in the burial of approximately 6.6 miles of high quality Appalachian headwater streams in a watershed that has already experienced substantial impairment. The loss of the 6.6 miles of high quality Appalachian headwater streams in this watershed will result in a significant loss (over 5.6% of the total stream miles in Headwaters Spruce Fork sub-watershed) of valuable wildlife habitat for many species in this watershed. These direct impacts will result in unacceptable adverse impacts to wildlife in this watershed, within the project boundaries.

Beyond the direct burial of wildlife species and loss of high quality habitat in this watershed, EPA has also determined that the project will result in unacceptable adverse impacts on downstream wildlife. If constructed as permitted, the Spruce No. 1 Mine will result in increased pollutant loadings in Spruce Fork and the Little Coal River. Increased salinity levels will lead to loss of macroinvertebrate communities and population shifts to more pollution-tolerant taxa, specifically the extirpation of ecologically important macroinvertebrates. In addition to these unacceptable adverse impacts, loss of macroinvertebrate prey populations, combined with increased potential for harmful golden algal blooms and additional exposure to selenium will have an unacceptable adverse effect on the 26 fish species found in Spruce Fork as well as amphibians, reptiles, crayfish, and bird species that depend on aquatic organisms and downstream waters for food or habitat.

In addition, EPA has given consideration to the project's compliance with the § 404(b)(1) Guidelines. As stated in the Preamble to the § 404(c) regulations, "one of the basic functions of 404(c) is to police the application of the 404(b)(1) Guidelines" (44 FR 58076, 58078 (Oct. 9, 1979)). Accordingly, EPA has determined that the Spruce No. 1 Mine, as permitted,

- fails to adequately evaluate less environmentally damaging alternatives (for a non-water dependent project such as this one, a failure to adequately evaluate alternatives means that the applicant has failed to rebut the presumption that there are less environmentally damaging practicable alternatives available);
- will cause or contribute to significant degradation of waters of the United States (especially when considered in the context of the significant cumulative losses and impairment of streams across the Central Appalachian ecoregion); and
- lacks compensatory mitigation to offset the impacts to Pigeonroost Branch and Oldhouse Branch to below the level of significance.

These inconsistencies with the Guidelines provide additional support for EPA's conclusion that the adverse impacts are unacceptable.

This document is divided into seven sections. The next section, Section III., describes the Spruce No. 1 Mine as authorized and summarizes the history of the project. Section IV.

describes the environmental characteristics of the project area, specifically Pigeonroost Branch and Oldhouse Branch, and the overall Coal River sub-basin. Section V. examines the anticipated impacts from the Spruce No. 1 Mine, as authorized. Consistent with § 404(c), this discussion focuses on unacceptable adverse impacts to wildlife. Section VI. discusses other considerations, including impacts from activities associated with the Spruce No. 1 Mine that do not include direct discharges of dredged or fill material to jurisdictional waters but which may depend upon authorization of such discharges, and that are likely to cause direct, indirect, and cumulative effects to the environment and to local communities. Section VII. contains EPA's Final Determination.

III. Background

III.A. Project Description

According to the Environmental Impact Statement (EIS) prepared by the Corps in 2006 (Spruce No. 1 EIS) for the project, the Spruce No. 1 Mine is a mountaintop mining project targeting bituminous coal seams overlying and including the Middle Coalburg coal seam in the western portion of the project area. In the eastern portion of the project area, mountaintop mining would be limited to those seams including and overlying the Upper Stockton seam, with contour mining in conjunction with auger and/or highwall/thin-seam mining utilized to recover the Middle Coalburg seam.

The project is located in the East District of Logan County, West Virginia at Latitude 38°52'39" and Longitude 81°47'52" depicted on the United States Geological Survey 7.5-minute Clothier and Amherstdale Quadrangles (Figure 1). The mine site is located approximately two miles northeast of the town of Blair in Logan County, West Virginia.

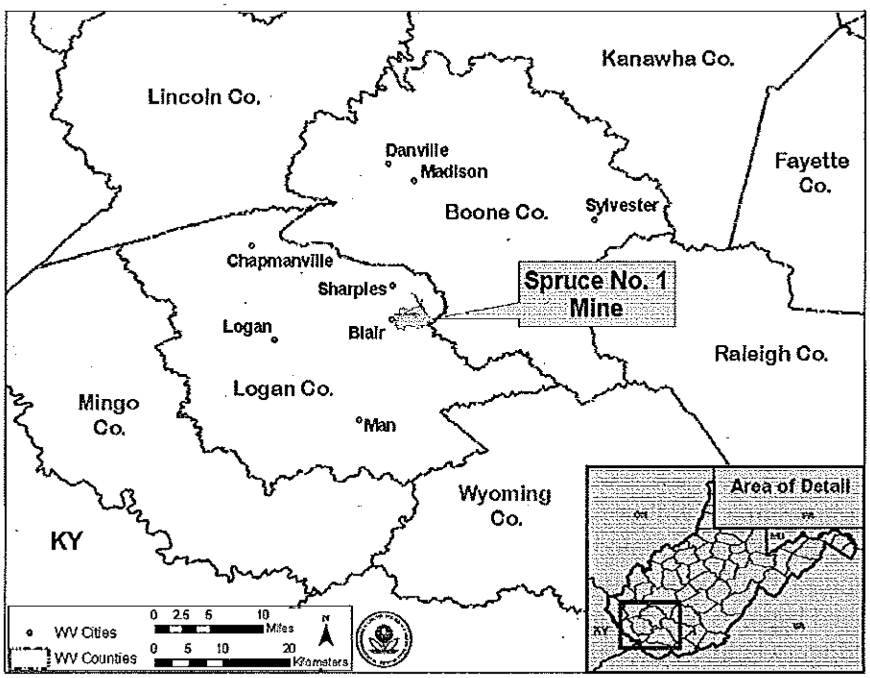

Figure 1. Spruce No. 1 Mine location

The Spruce No. 1 Mine as authorized by DA Permit No. 199800436-3 (Section 10: Coal River), is one of the largest mountaintop mining projects ever authorized in West Virginia. As authorized, it will disturb approximately 2,278 acres (about 3.5 square miles) and bury approximately 7.48 miles of streams. By way of comparison, the project area would take up a sizeable portion of the downtown area of Pittsburgh, PA (Figure 2).

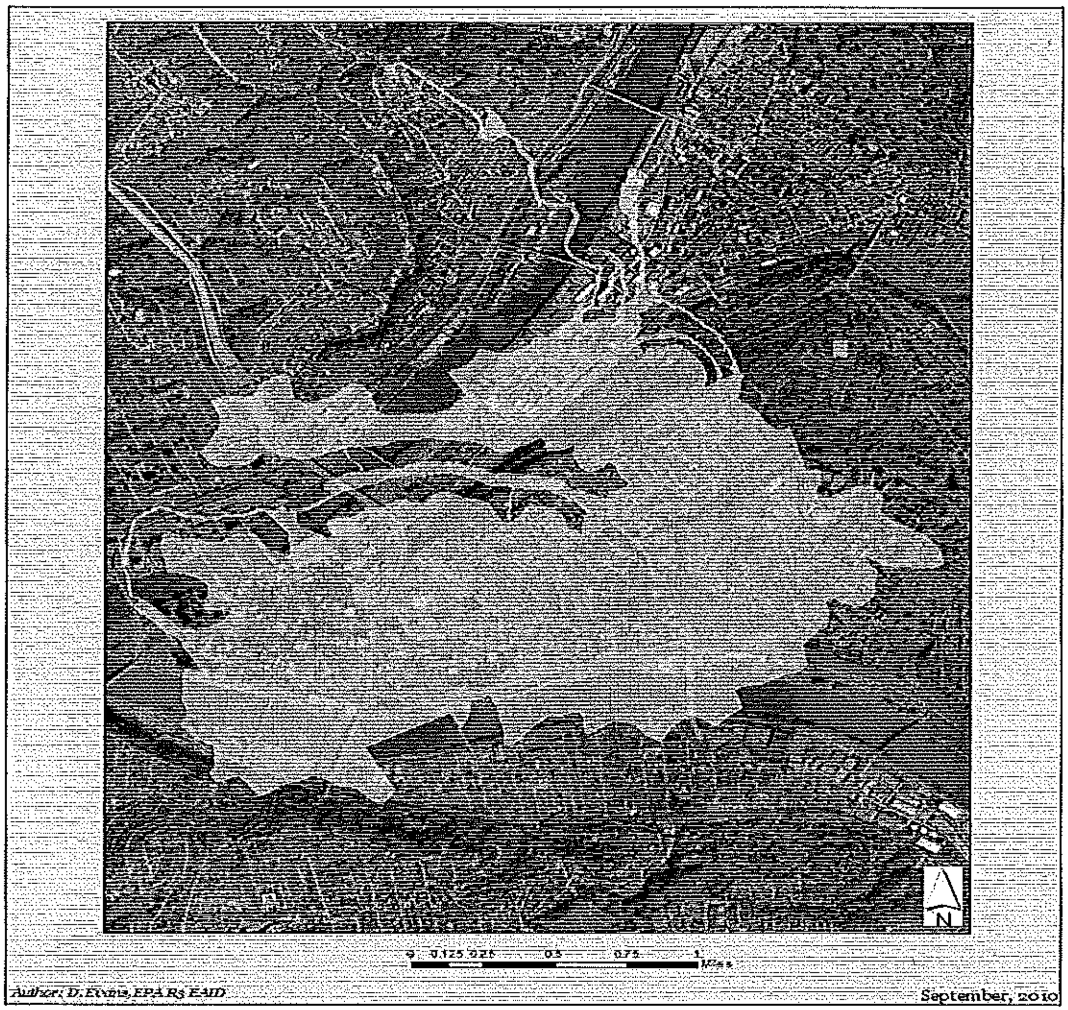

Figure 2. Spruce No. 1 Mine compared to downtown Pittsburgh, PA

Mountaintop mining involves removing the top of a mountain to recover coal seams contained within the mountain. Explosives are used to break apart the mountain's bedrock and earth-moving equipment is used to remove the excess rock, topsoil and debris, called "spoil", which formerly had composed the portions of the mountain above and immediately below the coal seam. The fractured material is larger in volume than when it was consolidated bedrock within the mountain. The amount of spoil that may be placed back on the mined area is limited by this "swell" in volume, as well as by stability concerns. As a result, mountaintop mining generates large quantities of "excess spoil" that cannot be placed back in the mined area. The "spoil" is then typically deposited in adjacent valleys, thereby burying streams that flow through those valleys.

The Spruce No. 1 Mine EIS describes the project impacts as a disturbance of a total of 2,278 acres to recover seventy-five percent (75%) of the coal reserve targeted for extraction within the project area during fifteen (15) phases. The mining process would remove 400 to 450 vertical feet from the height of the mountain, or approximately 501 million cubic yards of overburden material. Nearly 391 million cubic yards of spoil would be placed within the mined area (i.e., back onto the mountains) and the remaining 110 million cubic yards of excess spoil would be placed in six valley fills, burying all or portions of the Right Fork of Seng Camp Creek, Pigeonroost Branch, and Oldhouse Branch and their tributaries (hereafter, references to Seng Camp Creek, Pigeonroost Branch, and Oldhouse Branch also include all tributaries to those waters that will be impacted by the project as authorized). Specifically, the permit authorizes construction of Valley Fills 1A and 1B in Seng Camp Creek; Valley Fills 2A, 2B, and 3 in Pigeonroost Branch; and Valley Fill 4 in Oldhouse Branch, and numerous sediment ponds, mined-through areas and other fills in waters of the U.S. (Figure 3). A detailed discussion of Spruce No. 1 Mine can be found in the Spruce No. 1 EIS on pages 2-35 through 2-61.

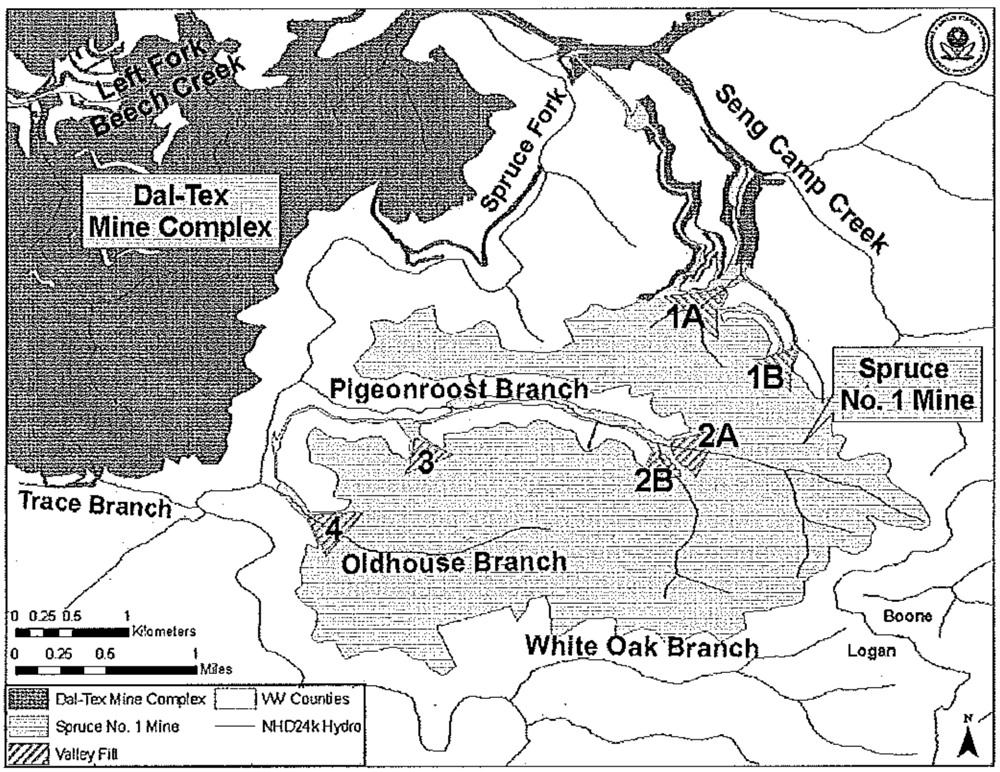

Figure 3. Spruce No. 1 Mine and associated valley fills

The Spruce No.1 Mine Surface Mining Control and Reclamation Act (SMCRA) Permit S-5013-97, Incidental Boundary Revision (IBR4, Modification 11) describes impacts from the project as including placement of dredged and fill material into approximately:

- 0.12 acre of emergent wetlands
- 10,630 linear feet (2.01 miles) of ephemeral stream channels
- 28,698 linear feet (5.44 miles) of intermittent stream channels
- 165 linear feet (0.03 miles) of perennial stream channel

While EPA is providing the foregoing summary from the SMCRA Permit S-5013-97 IBR for descriptive purposes, EPA believes that the description provided in the Spruce No. 1 Mine SMCRA Permit and in the Spruce No. 1 EIS incorrectly characterizes over 5 miles of stream resources that will be impacted, as set forth in more detail in Section V.E.3.b. and in Appendix 3.

III.B. Project History

The Spruce No. 1 Mine has a lengthy and complex regulatory history. The project was originally proposed by Hobet Mining Inc., a subsidiary of Arch Coal, Inc. The project as originally proposed in 1998 was larger than the authorized project and would have directly impacted a total surface area of 3,113 acres and 57,755 linear feet (more than ten miles) of streams. At that time, the Corps tendered and ultimately withdrew a nationwide permit for the project, and Hobet Mining, Inc. advised the Corps it would submit an individual permit application. An EIS was prepared for the Spruce No. 1 Mine by the Army Corps of Engineers Huntington District pursuant to the National Environmental Policy Act, 42 U.S.C. 4332(C). The original project application was also a primary impetus for the Interagency Mountaintop Mining/Valley Fills in Appalachia Programmatic Environmental Impact Statement (PEIS), which was finalized in October 2005. The PEIS is available at www.epa.gov/Region3/mtntop/eis2005.htm.

An initial 2002 Spruce No. 1 Mine Draft EIS considered a proposed project that was similar in scope and size to the original project described above. EPA's review of the 2002 Draft Environmental Impact Statement found gaps in the analyses of the mine and related adverse environmental impacts. EPA was particularly concerned by the lack of information regarding the nature and extent of impacts to the high quality streams that would be buried under valley fills, and recommended additional evaluation to support the analysis of less environmentally damaging alternatives. In a letter dated August 12, 2002, EPA Region III indicated the EIS contained inadequate information for public review and for decision-makers.

Following the transfer of the Spruce No. 1 Mine holdings and responsibilities by Arch Coal, Inc. to its Mingo Logan Coal Company (hereafter Mingo Logan or "permittee") in late 2005, a revised Spruce No. 1 Mine Draft EIS was prepared in 2006. At that time, the project was reconfigured to reduce impacts. The mine plan was revised to eliminate construction of a valley fill in White Oak Branch, a State-designated reference stream (see Section IV.A.) and the project area was reduced from 3,113 to 2,278 acres with direct stream impacts reduced to 7.48 miles.

In EPA's June 16, 2006, comment letter on the 2006 Draft EIS, EPA recognized that impacts from the mine had been reduced and the quality of EIS information had improved. However, the letter also noted that EPA had remaining environmental concerns associated with the Spruce No. 1 Mine. These concerns included potential adverse impacts to water quality (specifically, the potential to discharge selenium and the known association of similar mining operations with degradation of downstream aquatic communities); uncertainties regarding the proposed mitigation; the need for additional analysis of potential environmental justice issues; and the lack of a study related to the cumulative effects of multiple mining operations within the Little Coal River watershed. EPA continued to stress its belief that corrective measures should be required to reduce environmental impacts and that other identified information, data, and analyses should be included in the final EIS.

Concerns regarding the Spruce No. 1 Mine were also raised by the USFWS, Ecological Services West Virginia Field Office in a letter dated May 30, 2006 from the Department of Interior, Philadelphia to the Huntington District Army Corps of Engineers. In that letter, the USFWS expressed concerns over the permittee's compensatory mitigation plan. The USFWS stated there was inadequate compensatory mitigation for the project because the assessment methodology used by the permittee to evaluate stream impacts considered only the physical characteristics of the impacted streams, without considering the equally important biological or chemical characteristics. The USFWS expressed concern the project would impact healthy, biologically functional streams and the mitigation included erosion control structures that were designed to convey water but would not replace the streams' lost ecological services.

The Corps issued the Spruce No. 1 Mine Final EIS on September 22, 2006. On October 23, 2006, EPA commented on the Final EIS, noting that many of EPA's comments had not been adequately addressed. On January 22, 2007, the Corps issued Clean Water Act § 404 Permit, DA Permit No. 199800436-3 (Section 10: Coal River), to Mingo Logan for the Spruce No. 1 Mine. That permit specified the Right Fork of Seng Camp Creek, Pigeonroost Branch and its tributaries, and Oldhouse Branch and its tributaries as disposal sites for the discharge of dredged or fill material from the Spruce No. 1 Mine. In addition to its DA Permit No. 199800436-3 (Section 10: Coal River), the project has received the following authorizations from the West Virginia Department of Environmental Protection (WVDEP): authorization pursuant to the State's surface mining program approved under SMCRA, 30 U.S.C. 1201-1328 (SMCRA permit); a National Pollutant Discharge Elimination System (NPDES) permit for discharges of pollutants pursuant to § 402 of the Clean Water Act (33 U.S.C. 1342); and a Clean Water Act § 401 water quality certification (33 U.S.C. 1341).

On January 30, 2007, a number of environmental groups, represented by Ohio Valley Environmental Coalition, filed a complaint against the Corps in federal district court challenging its decision to issue the permit. In early 2007, Mingo Logan commenced limited operations at Spruce No. 1 Mine pursuant to DA Permit No. 199800436-3 (Section 10: Coal River), subject to an agreement with the environmental groups who are plaintiffs in the litigation. Pursuant to that agreement, Mingo Logan has been operating in a portion of the project site in the Seng Camp Creek drainage area, and has been constructing one valley fill in that area (valley fill 1A). Under the agreement, Mingo Logan must give plaintiffs 20 days' notice before expanding operations beyond the area subject to the agreement, and has done so once without objection from the plaintiffs. Mingo Logan's operations in the Seng Camp Creek watershed have generated data related to impacts from the project as constructed, including discharge monitoring reports submitted to WVDEP. The litigation filed by the environmental groups was stayed for a period of time pending the U.S. Court of Appeals for the Fourth Circuit's decision in *Ohio Valley Environmental Coalition v. Aracoma Coal Co.*, 556 F. 3d 177 (4th Cir. 2009).

During this period, the scientific literature reflected a growing consensus of the importance of headwater streams; a growing concern about the adverse ecological effects of mountaintop removal mining; and concern that impacted streams cannot easily be recreated or replaced. This Final Determination cites to nearly 100 articles and studies developed since the time the Spruce No. 1 Mine DA permit was issued. Many studies now point to the role headwater streams play in the transport of water, sediments, organic matter, nutrients, and organisms to downstream environments; their use by organisms for spawning or refugia; and their contribution to regional biodiversity (Meyer et al. 2007). Additionally, destruction or modification of headwater streams has been shown to affect the integrity of downstream waters, in part through changes in hydrology, chemistry and stream biota (Freeman et al. 2007, Wipfli et al. 2007).

The literature specifically documenting the effects of mountaintop removal mining has also grown, and additional studies have increased EPA's understanding of the effects of elevated levels of total dissolved solids (TDS) discharged through mining operations on downstream aquatic ecosystems (Pond et al. 2008, Simmons et al. 2008, Palmer et al. 2010, Fritz et al. 2010). EPA's understanding of adverse effects from selenium associated with surface coal mining likewise has expanded since issuance of the permit. In February 2009, WVDEP issued out a report entitled: 'Selenium bioaccumulation among select stream and lake fishes in West Virginia.' The WVDEP report confirmed that significant environmental harm due to selenium was a problem in West Virginia. A January 2010 WVDEP report to the West Virginia legislature outlined the issues with selenium in West Virginia watersheds. Other studies that have contributed to a greater understanding of the adverse effects of selenium include additional investigations and discussions have continued increased selenium concerns including: (Chapman et al. 2009, Diehl et al. 2005, Ferreri et al. 2004, Lemly 2009, Palmer et al. 2010, Neuzil et al. 2005, Vesper et al. 2008).

In addition to the growing body of literature documenting the importance of headwater streams and the effects of mountaintop removal mining, additional information on the efficacy of mitigation has also been published. For example, recent research has shown that stream restoration projects based upon channel design can be problematic (Slate et al. 2007, Simon et al. 2007) and are not effective in restoring ecological function and biodiversity (Tullos et al. 2009, Palmer et al. 2009, Fritz et al. 2010). In a study on streams impacted by mountaintop mining and valley fills, Fritz et al. (2010) found that habitat features and aquatic assemblages were very different in constructed channels than natural channels, and suggested that constructed channels should not be used for mitigation on-site. In the 2008 Mitigation Rule, EPA and the Corps acknowledged that headwater streams are a difficult to replace resource and stream creation is among the more difficult and least successful forms of mitigation.

In light of this growing body of scientific data documenting the environmental impacts associated with surface coal mining, EPA and other federal agencies discussed opportunities to reduce those impacts under existing statutory and regulatory authorities. On June 11, 2009, EPA, the Department of the Army, and the Department of the Interior entered into a *Memorandum of Understanding Implementing the Interagency Action Plan on Appalachian Surface Coal Mining,* in which the agencies agreed to take steps to reduce the harmful environmental consequences of Appalachian surface coal mining.

On September 3, 2009, EPA Region III requested that the Corps suspend, modify or revoke DA Permit No. 199800436-3 (Section 10: Coal River) for discharges associated with the Spruce No. 1 Mine. On September 30, 2009, the Corps stated that it would not reconsider the permit authorization. As a result, EPA Region III initiated the Clean Water Act § 404(c) process on October 16, 2009. EPA Region III communicated with representatives of Mingo Logan and the Corps in person, by telephone, and by electronic mail on several occasions to determine whether corrective action would be taken to address EPA Region III's concerns. Earlier in 2009, litigation by the environmental groups had reactivated following the decision in *Ohio Valley Environmental Coalition v. Aracoma Coal Co.,* 556 F. 3d 177 (4th Cir. 2009). The litigation was then stayed until November 3, 2009, a deadline that would be further extended by the Court as EPA's CWA § 404(c) process proceeded.

On April 2, 2010, EPA Region III published in the Federal Register a Proposed Determination to withdraw specification of Pigeonroost Branch and Oldhouse Branch pursuant to CWA § 404(c). EPA Region III solicited public comments on the Proposed Determination and held a public hearing in Charleston, West Virginia on May 18, 2010 that was attended by 520 people, during which 121 oral comments were communicated to EPA. EPA Region III received over 50,000 comments on the Proposed Determination. Of these, approximately 70% of comment letters submitted on the Proposed Determination generally supported EPA's Proposed Determination while 65% of public hearing participants generally opposed EPA's Proposed Determination.

USFWS, in its comments on EPA Region III's Proposed and Recommended Determinations, supported the withdrawal of specification for discharges of dredged or fill material to Pigeonroost Branch and Oldhouse Branch. Its June 2, 2009 comment letter on the Proposed Determination expressed concerns about potential impacts of the project on fish and wildlife resources, including macroinvertebrate genera. In addition, the letter stated

> "[T]he preponderance of available scientific information strongly suggests that construction of the project as authorized would cause or contribute to significant degradation of waters of the United States, both on-site and in receiving waters downstream of the proposed mine."
>
> "Some adverse impacts of the proposed project include:

- the likely loss of macroinvertebrate genera (diversity and abundance) and the cascading biological consequences of that loss on other aquatic and terrestrial wildlife;
- the direct loss of a significant number of salamanders, indirect effects to perhaps as many more, and the effects of these losses on other aquatic and terrestrial wildlife;
- degraded fish communities, including reduced diversity and abundance;
- direct loss of habitat, and direct and indirect loss of food resources for forest interior and riparian-obligate species of migratory birds, including six species the Service considers Birds of Conservation Concern (cerulean, Kentucky, Swainson's, and worm-eating warblers; Louisiana Waterthrush; wood thrush); and
- direct loss of habitat, and direct and indirect loss of food resources, for a variety of bat species, many of which are already threatened by the spread of white-nose syndrome in West Virginia and which may require additional protection in the near future."

EPA's regulations require that the Regional Administrator either withdraw the Proposed Determination or prepare a Recommended Determination within 30 days after the conclusion of the public hearing, in this case by June 16, 2010 (40 CFR 231.5(a)). However, in order to allow full consideration of the extensive record, including the over 50,000 public comments received, EPA Region III extended the time period provided in 40 CFR 231.5(a) for the preparation of the Recommended Determination until no later than September 24, 2010 (75 FR 39691). This time extension was made under authority of 40 CFR 231.8, which allows for such extensions upon a showing of good cause. EPA Region III reviewed the information provided during the public comment period, and completed its review within the extended time period.

The Recommended Determination was signed by the Regional Administrator and submitted to EPA Headquarters along with the complete administrative record on September 24, 2010, concluding EPA Region III's § 404(c) review of the Spruce No. 1 Mine. This action initiated the period for review and final action by EPA's Assistant Administrator for Water.

III.C. EPA Headquarters' Actions

Recognizing the role for EPA Headquarters in taking any final action to withdraw or restrict specification from the project, EPA Headquarters has been engaged in the § 404(c) review since it was initiated on October 16, 2009. Staff from EPA Headquarters attended the public hearing in Charleston, West Virginia, and heard first-hand the testimony provided by those who live and work in the region.

Following receipt of the Recommended Determination, § 404(c) regulations require EPA Headquarters to provide an opportunity for the project's proponents to propose corrective actions intended to prevent the unacceptable adverse environmental impacts presented in the Recommended Determination. EPA Headquarters provided the Region III

Recommended Determination to Arch Coal Inc., the United States Department of the Army, the Corps, WVDEP and four land and mineral rights owners and notified these stakeholders that they would have 15 days to present any corrective actions to EPA Headquarters, consistent with EPA's § 404(c) regulations.

EPA received a response from Hunton & Williams, LLP, on behalf of Arch Coal (i.e., Mingo Logan), Inc. requesting a 30-day extension of this period, to November 29, 2010, in order to review the Recommended Determination. Provided in 40 CFR 231.8, EPA may, upon showing of good cause, extend the time requirements in the § 404(c) regulations. EPA believed it was appropriate to grant the permittee's request for a 30-day extension to the consultation process, and an announcement was published in the Federal Register on November 10, 2010, announcing the deadline for proposing corrective actions was extended to November 29, 2010.

EPA's § 404(c) regulations provide that the Assistant Administrator for Water shall issue a Final Determination within 60 days of receiving the Regional Administrator's Recommended Determination. This 60-day period was scheduled to expire on November 23, 2010. As the consultation period with the permittee was extended to November 29, 2010, EPA believed it was necessary to extend the deadline for issuing a Final Determination until February 22, 2011. This extension was published in the same Federal Register announcement as the extension of the consultation period, and was intended to enable EPA to more carefully consider the Region's Recommended Determination, as well as the public comments received, and information on possible corrective actions presented during the consultation process. In addition, this date was consistent with an order issued by the U.S. District Court for the Southern District of West Virginia on November 2, 2010, granting a continued stay in litigation over the Spruce No. 1 permit until February 22, 2011.

EPA also received a response from one of the land and mineral rights owners, the United Company. In his November 9, 2010 letter to EPA, James McGlothlin, President of the United Company, expressed his opposition to the EPA Region III Recommended Determination and his belief that such an action would represent a "regulatory taking." Mr. McGlothlin's letter included a copy of a May 10, 2010, letter he had submitted to EPA Region III and a request that he be included in any consultation meeting organized by EPA Headquarters regarding EPA Region III's Recommended Determination on the Spruce No. 1 Mine.

On November 16, 2010, a consultation meeting was held at EPA Headquarters in Washington, DC to discuss the Region III Recommended Determination and potential corrective actions that could be undertaken to avoid the unacceptable adverse impacts that were of concern to EPA. Participants at the meeting included the EPA Assistant Administrator for Water, the EPA Region III Regional Administrator and Regional management, Office of Water staff, managers, and legal counsel, representatives from Arch Coal, Inc. and their legal counsel, United Company and their legal counsel, WVDEP, and the Corps' Huntington District.

At the beginning of the meeting, EPA Region III gave an overview of the Recommended Determination, stating that discharges of fill material into Pigeonroost Branch and Oldhouse Branch associated with the Spruce No.1 Mine would likely result in unacceptable adverse effects on wildlife. The EPA Assistant Administrator for Water then stated that a major purpose of the consultation process is to explore corrective actions that might avoid the need for a final § 404(c) action. He noted that while the Agency's regulations make clear that the consultation process is an opportunity for the project's proponents to propose corrective actions, EPA was willing and prepared to discuss potential actions that may effectively reduce anticipated environmental and water quality impacts.

In response, the permittee stated that revisions to the mine plan that Arch Coal, Inc. had previously proposed would be effective in reducing these potential water quality and environmental impacts. These actions included improved best management practices, eliminating two small valley fills at Seng Camp Creek and Pigeonroost Branch, and increased monitoring. The permittee also indicated that other approaches previously discussed, such as "sequencing" or "phasing" of valley fills, remained unacceptable to Arch Coal, Inc., due primarily to economic considerations. In the meeting, the permittee did not propose new or additional corrective actions for EPA's consideration.

As part of the follow-up from the consultation meeting, on November 22, 2010, the Assistant Administrator for Water sent a letter to Arch Coal, Inc. indicating that EPA was prepared to continue discussions regarding corrective actions that effectively reduce anticipated environmental and water quality impacts. The letter noted that EPA's focus in evaluating these alternatives would be on whether they would effectively protect the streams at Pigeonroost Branch and Oldhouse Branch. Noting that the consultation period was set to expire on November 29, 2010, the letter requested a response as soon as possible. On November 29, 2010, EPA received notification via email from Hunton & Williams, LLP, on behalf of Arch Coal, Inc. While this response did not request any further opportunity for consultation, it did include extensive comments, a Technical Evaluation Document and supporting information in response to the Recommended Determination.

EPA reviewed the additional comments, evaluation, and supporting documents provided by Hunton & Williams and, where necessary, clarified the relevant information and analysis in the Final Determination. EPA's detailed responses to the issues raised by Hunton & Williams are contained in Appendix 6. After an EPA Region has submitted a Recommended Determination to the Assistant Administrator for Water, EPA's regulations governing the § 404(c) process allow the company to submit information on corrective actions they intend to take to address the unacceptable adverse effects, but those regulations do not explicitly provide an additional opportunity to submit comments on EPA's action. In addition, EPA's Final Determination is an informal adjudication and unlike the Administrative Procedure Act's (APA) requirements for notice and comment rulemaking to respond to all significant comments, the APA contains no such requirement for adjudications. Nonetheless, consistent with the Agency's transparency goals, EPA has voluntarily chosen to draft responses to many of comments received throughout this process, including those comments received on the Recommended Determination during the consultation process.

In his November 29, 2010 letter to EPA, Colonel Robert Peterson, District Engineer for the Corps' Huntington District, responded on behalf of LTG Robert Van Antwerp, Commanding General for the Corps. Colonel Peterson noted that after reviewing the Recommended Determination, the Corps continued to believe it has no basis to take any corrective actions regarding DA Permit No. 199800436-3 (Section 10: Coal River) and that this position is consistent with the Corps' response to EPA Region III's September 3, 2009 request that Huntington District suspend, modify or revoke this permit.

In a November 29, 2010 letter to EPA, Randy Huffman, the Secretary of WVDEP, provided comments on the Recommended Determination. The letter raised concerns regarding a number of issues in the Recommended Determination including its analysis of the project's potential effects on water chemistry, the project's likely impacts to wildlife and the conclusions drawn regarding the proposed compensatory mitigation. In response to these comments, a number of clarifications have been made to the information and analysis in the Final Determination and detailed responses to Secretary Huffman's comments have been included in Appendix 6.

Finally, on December 16, 2010, the USFWS sent a letter to EPA in support of the Recommended Determination. In the letter, USFWS states that the available scientific information supports the EPA Region III recommendation and that USFWS concurs with EPA Region III's conclusion that construction of the Spruce No. 1 Mine, as authorized, would result in unacceptable adverse effects on wildlife. The letter highlights the fact that the USFWS has consistently expressed concerns regarding the loss of headwater streams and adjacent riparian and terrestrial habitats associated with the Spruce No. 1 Mine, as well as its likely impacts on downstream water quality, aquatic organisms, and terrestrial and aquatic wildlife that depend on those resources.

IV. Site Characteristics and Ecological Functions

The resources that will be impacted by the Spruce No. 1 Mine include Central Appalachian headwater stream ecosystems in Pigeonroost Branch and Oldhouse Branch. These waters connect via surface flow directly to Spruce Fork, which in turn flows to the Little Coal River and eventually to the Coal River. Because of the connectivity between headwater systems and downstream waters, Spruce Fork, the Little Coal River and the Coal River would be adversely impacted by discharges to Pigeonroost Branch and Oldhouse Branch because such discharges would transform these streams into sources that contribute contaminants to these downstream waters. Accordingly, the characteristics and functions of the resources that will be adversely impacted by discharges of dredged or fill material associated with the Spruce No. 1 Mine are best viewed from the perspective of the ecological functions performed by Appalachian headwater stream ecosystems and within the context of the larger Headwaters Spruce Fork sub-watershed and Coal River sub-basin.

Information on the aquatic and terrestrial ecosystem and the predicted impacts of the project comes from several sources. The Final (October 2005) Interagency Mountaintop Mining/Valley Fills in Appalachia PEIS represents important inter-agency efforts designed to inform more environmentally sound decision-making for future permitting of mountaintop mining and associated valley fills. The PEIS had a geographic focus of 12 million acres encompassing most of eastern Kentucky, southern West Virginia, western Virginia, and scattered areas of eastern Tennessee; and included the Spruce No. 1 Mine project area and the Coal River sub-basin. EPA also incorporated information gathered by the WVDEP, including an assessment of the Coal River sub-basin conducted in 1997, data collected to support the 2006 Coal River sub-basin total maximum daily load (TMDL), and WVDEP and nationally available GIS data. EPA also reviewed the 2006 Spruce No.1 EIS, and other sources of site-specific data including studies conducted by EPA scientists and discharge monitoring reports generated by Mingo Logan. In addition, EPA consulted a wide range of peer reviewed studies and literature. EPA Region III also communicated with the US Fish and Wildlife Service Elkins Field Office on impacts to fish and wildlife resources in the project area.

Headwater streams play an important role in the ecosystem far beyond the mere transport of water from one point to another. In many ways, headwater streams are similar to capillaries, the smallest blood vessels within the human circulatory system. In the same way capillaries are critical to the movement of carbon dioxide, oxygen, water and other essential compounds between the blood and surrounding tissues, small headwater streams, which make up over two-thirds of the total stream length in a stream network (Leopold et al. 1964), are critically important to the movement of water, sediments, organic matter, and nutrients from within their watersheds to downstream environments (Ensign and Doyle 2006). And just as a loss of blood flow through capillaries can lead to organ failure, alteration of headwater streams has the potential to affect the ecological integrity of aquatic ecosystems at broad spatial scales (Freeman et al. 2007). Thus, headwater streams, as the early stages of the river continuum, provide the most basic and fundamental building blocks to the remainder of the aquatic environment.

Appalachian headwaters provide habitat for wildlife including a wide variety of macroinvertebrates, amphibians, reptiles, birds, fish and mammals. They also are a significant interface between the river system and the terrestrial environment. Appalachian headwater streams and their wildlife inhabitants, such as macroinvertebrates, convert organic matter (e.g., leaf litter) from the surrounding landscape and transform it into nutrients and energy that can be transported and consumed by downstream ecological communities. They also play an important role in storing, retaining and transporting nutrients, organic matter and sediment. In addition they perform hydrologic functions related to downstream flow regimes, moderating flow rate and temperature (USEPA 2003, Fischenich 2006).

As authorized, the Spruce No. 1 Mine will bury under valley fills or impact through construction of sediment ponds nearly all of Oldhouse Branch and its tributaries and a substantial portion of Pigeonroost Branch and its tributaries. Oldhouse Branch and Pigeonroost Branch support healthy ecosystems consistent with least-disturbed conditions in the Coal River sub-basin. As such, they are valuable in and of themselves and for the functions they perform within the context of the Headwaters Spruce Fork sub-watershed and the Coal River sub-basin.

IV.A. Watershed and Stream Conditions

The Spruce No. 1 Mine is located within the Headwaters Spruce Fork sub-watershed (12-digit hydrologic unit code (HUC)) and the Coal River sub-basin (8-digit HUC) (Figure 4). Pigeonroost Branch and Oldhouse Branch flow to Spruce Fork, which in turn flows into the Little Coal River and then into the Coal River. The Coal River sub-basin encompasses nearly 891 square miles within West Virginia. Major tributaries within the Coal River sub-basin include Marsh Fork, Clear Fork, Pond Fork, Spruce Fork, and Little Coal River. Marsh Fork and Clear Fork join at Whitesville, WV to form the Big Coal River. Pond Fork and Spruce Fork join at Madison, WV to form the Little Coal River. The Little Coal and Big Coal Rivers join to form the Coal River at Forks of the Coal, WV.

The Coal River sub-basin has been impacted by past and present surface mining. Based upon the National Land Cover Database (NLCD) Retrofit Land Cover Change Product for 1992-2001 and the WVDEP's Geographic Information System (GIS) mine permit data, more than 257 past and present surface mining permits have been issued in the Coal River sub-basin, and the corresponding mines collectively occupy more than 13% of the land area. Some sub-watersheds in the Coal River sub-basin have more than 55% of the land occupied by historic, ongoing or permitted surface mines.

Spruce Fork is a fourth order tributary that combines with Pond Fork to form the Little Coal River, which in turn flows into the Coal River. Spruce Fork is located in the southwestern portion of the Coal River sub-basin and drains approximately 126.4 square miles. The dominant land cover in the Headwaters Spruce Fork sub-watershed is forest. Other significant land cover types include urban/residential and barren/mining land.

According to the WVDEP Division of Mining and Reclamation permit maps, more than 34 surface mine permits have been issued within the Headwaters Spruce Fork sub-watershed, and the resulting mines do or will collectively occupy more than 33% of the land area. Assuming full construction of these projects along with projects associated with known future surface mining permits, more than 40% of the land area of the sub-watershed will be occupied by surface mining permits.

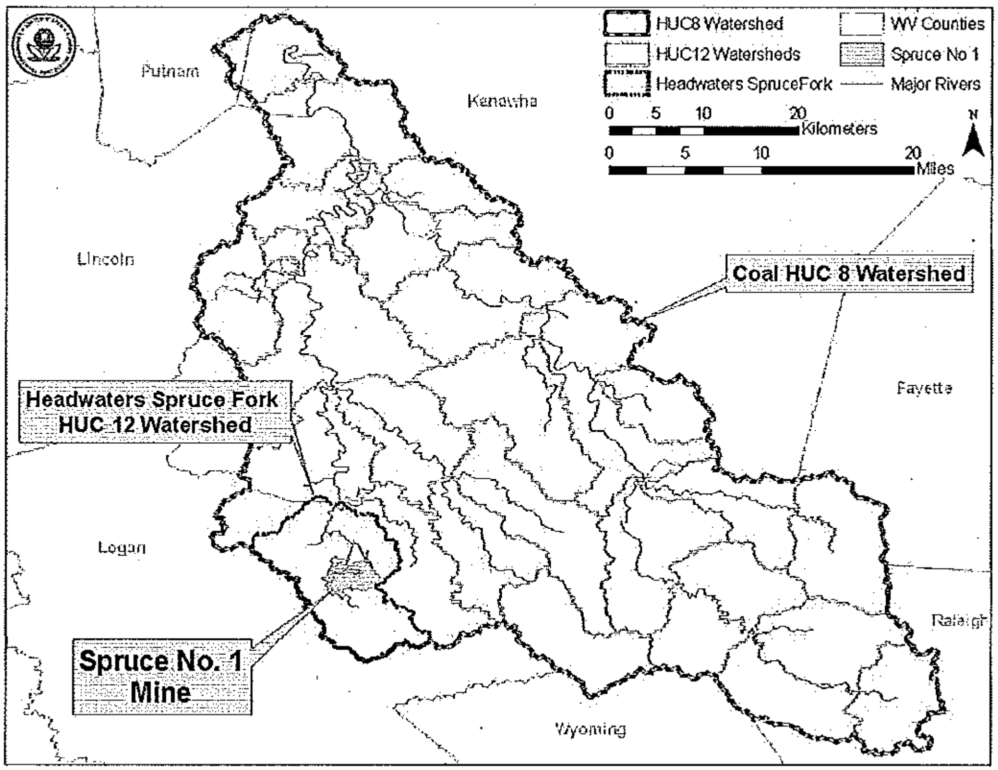

Figure 4. Headwaters Spruce Fork sub-watershed (12-digit hydrologic unit code (HUC)) and the Coal River sub-basin (8-digit HUC)

In 1997, the WVDEP performed its first comprehensive ecological assessment of the Coal River sub-basin.[6] The WVDEP assessed three major aspects of watershed health: water quality, habitat condition, and benthic macroinvertebrate community status. The subsequent report, *An Ecological Assessment of the Coal River Watershed* (1997), indicated that sediments, coal mining and inadequate sewage treatment were the major stressors on streams in this watershed. The WVDEP report also noted the importance and paucity of reference-quality streams in the watershed, stating

> [s]ince reference sites reflect least-disturbed conditions, it is vital that the WVDEP do its part in fulfilling the mission of preserving the high quality of these rare and important streams. It is also important that the agency make a concerted

[6] Report can be found at http://www.dep.wv.gov/WWE/watershed/wqmonitoring/Documents/EcologicalAssessments/EcoAssess_Coal_1997.pdf

effort to find the apparently few remaining streams within the watershed that have not been significantly impacted by human disturbances.

Further the report indicated that because the sub-basin is becoming increasingly impaired due to stressors such as mining, there is a need to protect the remaining quality resources, highlighting the need to "[l]ocate and protect the few remaining high quality streams in the Coal River watershed..." (WVDEP 1997a).

Out of approximately 250 stations sampled by the WVDEP in the Coal River sub-basin since 1996, only 3 (~1%) are designated as reference sites. One of these three reference sites is White Oak Branch, which flows into Spruce Fork immediately upstream of Oldhouse Branch and Pigeonroost Branch. The WVDEP defines reference conditions as those conditions that "describe the characteristics of waterbody segments least impaired by human activities and are used to define attainable biological and habitat conditions.. Final selection of reference sites depends on a determination of minimal disturbance, which is derived from physio-chemical and habitat data collected during the assessment of the stream sites." Reference sites are used to determine the score that represents the threshold between impaired and non-impaired sites. As discussed in detail below, Oldhouse Branch and Pigeonroost Branch are important within the context of the larger Coal River sub-basin and Headwaters Spruce Fork sub-watershed because, like White Oak Branch, they represent some of the few stream systems supporting least-disturbed conditions within those watersheds.

The stream systems that are the subject of this Final Determination, Pigeonroost Branch and Oldhouse Branch, are high quality stream systems supporting diverse aquatic communities, as measured by their benthic macroinvertebrate populations (see Section IV.B.1. and Appendix 2). Macroinvertebrates are used by West Virginia and other states in the Mid-Atlantic region and across the U.S. to assess the quality of their waters and are good indicators of stream health. While Pigeonroost Branch and Oldhouse Branch are not WVDEP-designated reference sites, their quality is comparable to White Oak Branch, a WVDEP-designated reference site, and their macroinvertebrate communities rank highly in comparison to other central Appalachian streams and streams throughout the state of West Virginia (see Section IV.B.1). Accordingly, Oldhouse Branch and Pigeonroost Branch reflect least-disturbed conditions and represent some of the few remaining streams within the Coal River sub-basin that have not been significantly adversely impacted by human disturbances.

Water chemistry data for Pigeonroost Branch and Oldhouse Branch also reflect healthy streams with little human disturbance. Data from the WVDEP indicate that average conductivity values for the unmined streams on the Spruce No. 1 Mine project area are very low.[7] Based on the WVDEP dataset (2002-2003), Oldhouse Branch had an average

[7] Specific conductance, or conductivity, is a measure of the ability of water to conduct an electrical current. It is highly dependent on the amount of dissolved solids (such as salt) in the water, and typically measured as microsiemens per centimeter (µS/cm). Pure water, such as distilled water, will have a very low specific conductance, and seawater will have a high specific conductance. Conductivity is an important water quality measurement because it gives a good idea of the amount of dissolved material in the water.

conductivity level of 90 μS/cm, which is below that of White Oak Branch, a WVDEP-designated reference site, which had an average conductivity level of 118 μS/cm. Conductivity levels described above in Oldhouse Branch and White Oak Branch indicate excellent water quality, comparable to reference-quality streams for this ecoregion. Sulfate concentrations in these streams are also low (28 mg/l in Oldhouse Branch and 24 mg/l in White Oak Branch). Pigeonroost Branch had a conductivity level of 199 μS/cm and sulfate level of 99 mg/l. The slightly elevated average conductivity and sulfate values reflect the relatively small amount of historical mining land use in the Pigeonroost watershed.

During the December 2008 to March 2010 time frame, monitoring reports submitted by the permittee indicate 15 of the 16 selenium measurements at both Pigeonroost Branch and Oldhouse Branch were below the detection limit of 0.6 μg/L. The single detection of selenium on Oldhouse Branch was 0.9 μg/L during July 2009. The single detection of selenium on Pigeonroost Branch was 1.9 μg/L during August 2009. By way of comparison, these readings are far below 5 μg/L, which is the concentration associated with West Virginia's chronic water quality criterion for selenium.[8] These levels are also significantly lower than levels documented immediately downstream of adjacent mining operations (see Section V.D.1.a.).

The relatively high quality of Oldhouse Branch and Pigeonroost Branch also can be demonstrated by comparison to other streams in the Headwaters Spruce Fork sub-watershed that have been impacted by mining operations similar to the Spruce No. 1 Mine, located directly northwest of the Spruce No. 1 Mine, on the west side of Spruce Fork. These streams, in part, are impacted by the Mingo Logan Dal-Tex Mining Operation (Dal-Tex). Section V.D.2.a. compares the health of the relatively unimpacted macroinvertebrate communities in Pigeonroost Branch and Oldhouse Branch with the macroinvertebrate communities in these streams that have been impacted by mining activity. This comparison demonstrates that Oldhouse Branch and Pigeonroost Branch support a much healthier and more diverse assemblage of benthic macroinvertebrates than do the four comparison streams that are impacted by the Dal-Tex operation.

IV.B. Wildlife

The Spruce No. 1 Mine is located in the Central Appalachian ecoregion, which encompasses most of the central Appalachian coalfields (Bryce et al. 1999) (Figure 5). This ecoregion has some of the greatest aquatic animal diversity of any area in North America, especially for species of amphibians, fishes, mollusks, aquatic insects, and crayfishes. Individual watersheds and peaks in the Appalachian chain, isolated for millions of years with benign environmental conditions, provided a perfect setting for the evolution of many unique species of plants and animals. The Nature Conservancy has identified this region as one of North America's prominent biodiversity hotspots of rarity and richness (Figure 6) (Stein et al. 2000). Salamanders, in particular, reach some of the highest levels of North American diversity in the Central Appalachian ecoregion, and are

[8] The West Virginia numeric chronic water quality criterion for selenium defined as a four-day average concentration not to be exceeded more than once every three years

often abundant enough to account for the greatest vertebrate biomass in a given patch of forest (Stein et al. 2000). It has also been documented that other specialized wildlife such as some neotropical migrant birds and forest amphibians rely on the natural headwater stream conditions and adjacent forest types exhibited by Pigeonroost Branch and Oldhouse Branch for maintenance of their populations (Stein et al., 2000).

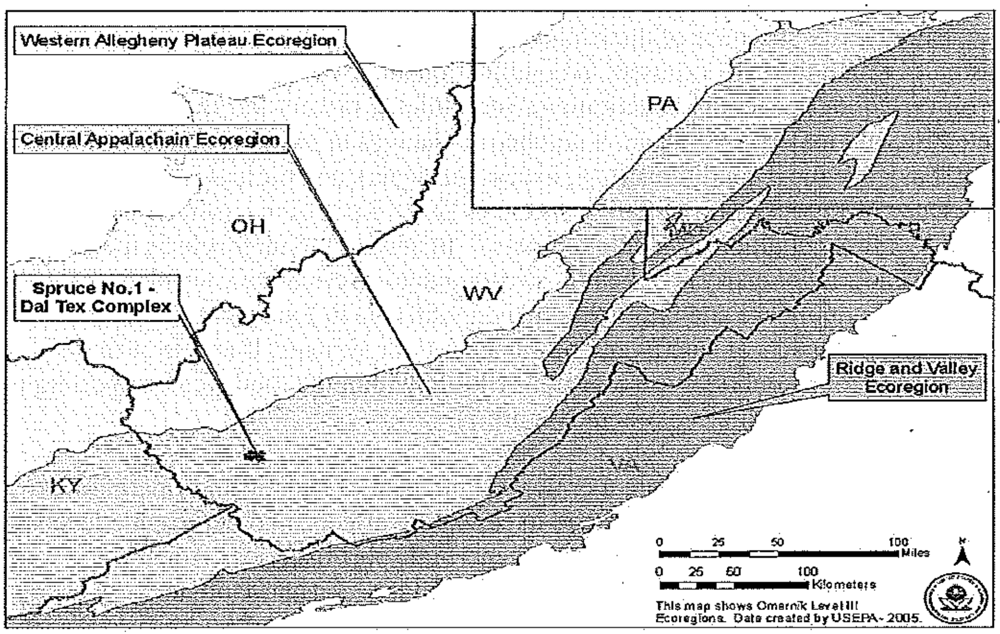

Figure 5. Map of Central Appalachian ecoregion showing Spruce No. 1 Mine location

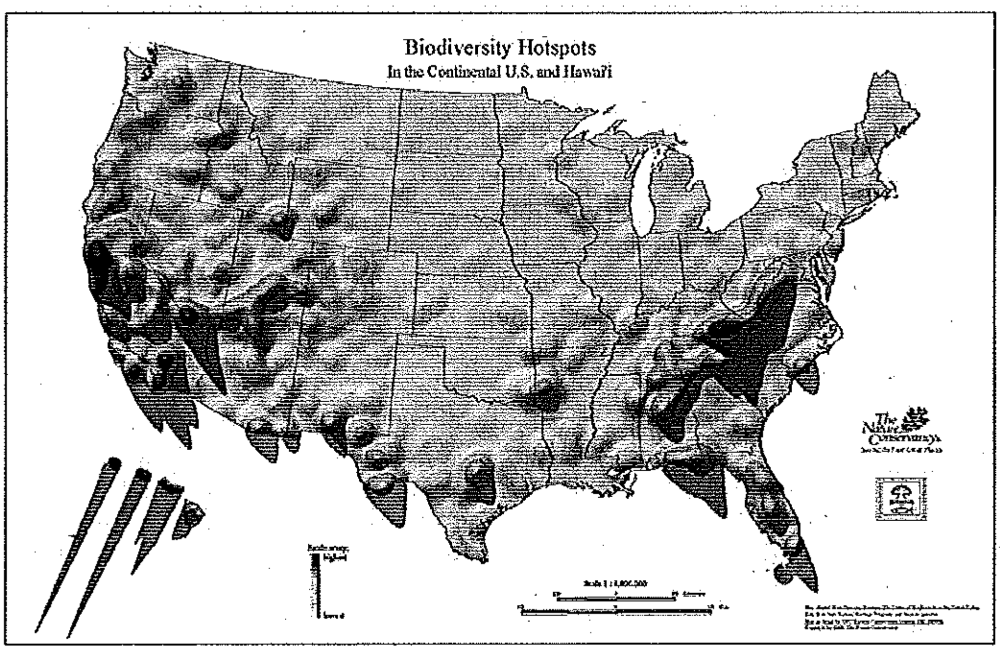

Figure 6. Biodiversity Hotspots in the Continental United States and Hawaii
Map adapted from Precious Heritage: The Status of Biodiversity in the United States.
© The Nature Conservancy http://www.nature.org/wherewework/northamerica/states/westvirginia/science/

IV.B.1. Macroinvertebrates

In a body of water, benthic macroinvertebrates are the bottom-dwelling (benthic) organisms that are large enough to be seen without the aid of microscopes (macro), and do not have backbones (invertebrate). As stated in EPA's Wadeable Stream Assessment (EPA 841-B-06-002 December 2006), macroinvertebrates are good indicators of biological integrity "because of their inherent capacity to integrate the effects of the stressors to which they are exposed, in combination and over time. Stream macroinvertebrates generally cannot move very quickly or very far; therefore, they are affected by, and may recover from, a number of changes in physical conditions (e.g., habitat loss), chemical conditions (e.g., excess nutrients), and biological conditions (e.g., the presence of invasive or non-native species). Some types of macroinvertebrates are affected by these conditions more than others." In addition to their role as indicators of biological integrity or ecosystem health, stream macroinvertebrates, which include aquatic insects, mollusks and crayfishes, play a vital role in food webs and in the processing and transfer of energy and nutrients in river systems. Because of these functions, macroinvertebrates are essential wildlife within the food web, supporting the health of the entire aquatic ecosystem (Figure 7).

Freshwater macroinvertebrates are a critical component of aquatic and riparian food webs, and the loss of these taxa can lead to cascading effects on other trophic levels, with implications for downstream stream ecosystems and sport fisheries. Aquatic macroinvertebrates feed on algae and leaf litter, and this consumption not only cleans excess living and nonliving organic material from stream systems, but the processing of this organic matter makes essential nutrients available to organisms downstream. Additionally, conversion of plant material into nutrient-rich biomass, in the form of fats and proteins, makes these invertebrates a major food source for the fish and amphibian populations within the stream ecosystem. In addition to their role in the aquatic food web, emerging adult aquatic insects are important prey for foraging terrestrial vertebrates, including birds, bats, reptiles, amphibians, and small mammals (Baxter et al. 2005). Many of these terrestrial vertebrates, including ducks and water shrews, have also been known to consume aquatic insect larvae from the stream before emergence as adults (Baxter et al. 2005). Macroinvertebrates, therefore, are necessary components of a functioning aquatic and riparian food web; and they fulfill a critical ecological niche by delivering nutrients along the stream continuum to both aquatic and terrestrial members of the food chain.

EPA recognizes macroinvertebrates as wildlife, along with many other organizations, including the USFWS, USDA Forest Service, The Nature Conservancy, State Natural Heritage programs, and the West Virginia Division of Natural Resources (WVDNR). Currently, within the U.S., the USFWS lists 50 species of insects as endangered under the Endangered Species Act (ESA), and another 10 species as threatened under the ESA. The State of West Virginia also includes insects, mollusks and crayfishes on its list of rare, threatened and endangered species, including 12 species of stoneflies, two species of mayflies, and 73 species of dragonflies and damselflies (West Virginia Natural Heritage

Program 2007). Several States, including West Virginia and Virginia, require a permit to collect macroinvertebrates for scientific sampling.

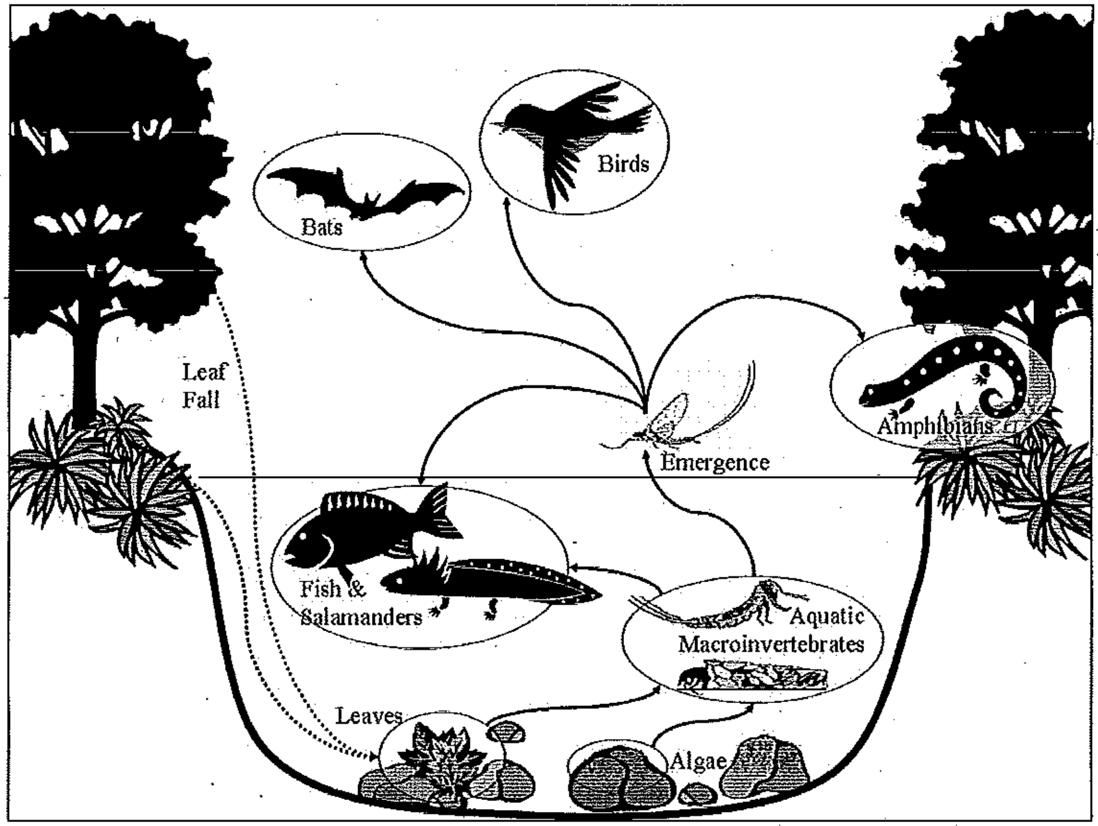

Figure 7: Illustration of a simplified stream food web, highlighting the importance of aquatic macroinvertebrates to other stream and riparian wildlife (adapted from Baxter et al. 2005).

According to Morse et al. (1997), the Central Appalachian ecoregion has many endemic and rare species of benthic macroinvertebrates in the orders Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies).[9] This diversity and unique assemblage has been attributed to the unique geological, climatic, and hydrological characteristics of this region. The Spruce No. 1 Mine project area has been found to be very rich in macroinvertebrate species. Data from the PEIS, the Spruce No. 1 EIS and from the WVDEP monitoring database indicate that high macroinvertebrate diversity exists in Pigeonroost Branch and Oldhouse Branch. Species diversity boosts ecosystem productivity, maintains ecosystem functionality, and is typically seen as an indicator of overall health.

Mayflies are most popularly known among fly-fishermen, where anglers rely on the seasonal hatches of mayflies that coincide with catching trout and other game fish species. Not only do trout rely on mayflies and stoneflies, but a group of colorful benthic fishes known as Darters (Percidae) also feed on mayflies. Darters are an important part of

[9] The orders Ephemeroptera, Plecoptera and Trichoptera (EPT taxa) contain pollution sensitive groups and are used by natural resource agencies such as the WVDEP to assess watershed health.

the fish assemblage and many are hosts for mussel larvae. Five darter species inhabit Spruce Fork in the immediate vicinity of the project area.

Stoneflies also represent an important group of aquatic insects in the structure and functioning of stream ecosystems, filling important trophic roles in stream ecosystems, including detritivory (consumption of dead or decaying organic matter) and predatory functional feeding group designations. As with mayflies, stoneflies are valued and imitated by fly-fishermen and serve as an abundant food source for many salamanders and fishes. Stoneflies are primarily stenothermic, meaning they inhabit cool to cold waters that provide the higher dissolved oxygen concentrations required for their survival.

Pigeonroost Branch and Oldhouse Branch support diverse and healthy communities of benthic macroinvertebrates, which are comparable to WVDEP reference sites. Macroinvertebrate data collected in Oldhouse Branch and Pigeonroost Branch indicate that the quality of the mayfly (Ephemeroptera) and stonefly (Plecoptera) communities in these streams ranks very high in the Central Appalachia ecoregion and statewide. In 1999-2000, EPA collected eighty-four (84) macroinvertebrate genera in riffle complexes of Pigeonroost Branch and Oldhouse Branch (see Table 11 for a complete taxa list by genus).[10] Collectively, Pigeonroost Branch and Oldhouse Branch contain a high number of mayfly and stonefly taxa and individuals (Tables 1 and 2). A total of 19 genera of mayflies and 16 genera of stoneflies have been identified from these headwater streams indicating these systems offer high water quality and optimal habitat.

Based on a comparison of macroinvertebrate communities, Oldhouse Branch and Pigeonroost Branch are of comparable quality to White Oak Branch, a neighboring WVDEP-designated reference site. Using the West Virginia Stream Condition Index (WVSCI), an assessment method developed for use in West Virginia to help evaluate the health of benthic macroinvertebrate communities at the family level in wadeable streams (and used as a measure of the health of stream communities overall), both Oldhouse Branch and White Oak Branch scored comparably well.[11] Oldhouse Branch and White Oak Branch also scored comparably well at the more sensitive genus level (as opposed to family), sharing 55 total genera, many of which are intolerant of pollution, indicating a diverse and healthy aquatic community in Oldhouse Branch similar to the high quality communities of White Oak Branch. The WVSCI assessment of Pigeonroost Branch indicates water quality is relatively good despite the presence of localized historic mining in the watershed. Pigeonroost Branch and White Oak Branch also share many pollution-intolerant macroinvertebrate genera, indicating that the health of Pigeonroost Branch's aquatic community is similar.

Oldhouse Branch and Pigeonroost Branch contain 19 genera of mayflies (Table 1). As many as nine genera of mayflies have been collected in Oldhouse Branch in any one

[10] Riffle and pool complexes are considered special aquatic sites under 40 CFR 230.1(d) and as such the degradation or destruction of these sites is considered to be among the most severe environmental impacts covered by the § 404(b)(1) Guidelines.
[11] For a more detailed discussion of WVSCI, see Section V.B.2.a.iii.

season-specific sample, with an average of seven genera across multiple samples. This observation ranks in the 95th percentile of all samples taken in the Central Appalachian ecoregion (937 samples) by the WVDEP. Out of more than 4000 samples collected statewide in West Virginia, Oldhouse Branch ranks in the 90th percentile. Pigeonroost Branch contained eight mayfly genera in a season-specific sample, ranking it in the 90th percentile in the Central Appalachian ecoregion and 83rd percentile statewide from among more than 4000 single-sample observations.

Table 1. Presence/absence of mayfly (Ephemeroptera) genera in the permit area (Compiled from EPA, WVDEP, and the applicant's consulting firms (Sturm Environmental Services, BMI, Inc.))

Order	Family	Genus	Oldhouse	Pigeonroost
Ephemeroptera	Ameletidae	*Ameletus*	X	X
Ephemeroptera	Baetidae	*Acentrella*	X	X
Ephemeroptera	Baetidae	*Baetis*	X	X
Ephemeroptera	Baetidae	*Diphetor*		X
Ephemeroptera	Baetiscidae	*Baetisca*		X
Ephemeroptera	Ephemerellidae	*Attanella*		X
Ephemeroptera	Ephemerellidae	*Dannella*		X
Ephemeroptera	Ephemerellidae	*Drunella*	X	X
Ephemeroptera	Ephemerellidae	*Ephemerella*	X	X
Ephemeroptera	Ephemerellidae	*Eurylophella*	X	X
Ephemeroptera	Ephemeridae	*Ephemera*	X	X
Ephemeroptera	Heptageniidae	*Cinygmula*	X	X
Ephemeroptera	Heptageniidae	*Epeorus*	X	X
Ephemeroptera	Heptageniidae	*Heptagenia*		X
Ephemeroptera	Heptageniidae	*Maccaffertium*	X	X
Ephemeroptera	Heptageniidae	*Stenacron*	X	
Ephemeroptera	Isonychiidae	*Isonychia*		X
Ephemeroptera	Leptophlebiidae	*Choroterpes*	X	
Ephemeroptera	Leptophlebiidae	*Paraleptophlebia*	X	

Note: Siphlonurus and Pseudocloeon reported by Sturm Environmental Services are likely erroneous identifications. These genera have been excluded from this list.

Oldhouse Branch and Pigeonroost Branch contain 11 genera of stoneflies (Table 2). A single collection in Oldhouse Branch by EPA (Spring 2000) included 9 genera of stoneflies, which ranks greater than the 98th percentile of all Central Appalachian streams sampled by the WVDEP (937 samples). This means that only 2% of stream samples in this ecoregion had more stonefly taxa than Oldhouse Branch within a single sampling event. Pigeonroost Branch had as many as six stonefly genera in any one season-specific sample, ranking it at the 83rd percentile among 937 Central Appalachian streams, and 72nd percentile statewide.

Table 2. Presence/absence of stonefly (Plecoptera) genera in the permit area (Compiled from EPA, WVDEP, and the applicant's consulting firms (Sturm Environmental Services, BMI, Inc.))

Order	Family	Genus	Oldhouse	Pigeonroost
Plecoptera	Capniidae	*Allocapnia*	X	X
Plecoptera	Chloroperlidae	*Alloperla*		X
Plecoptera	Chloroperlidae	*Haploperla*	X	

Plecoptera	Chloroperlidae	*Sweltsa*	X	
Plecoptera	Leuctridae	*Leuctra*	X	X
Plecoptera	Nemouridae	*Amphinemura*	X	X
Plecoptera	Nemouridae	*Ostrocerca*	X	X
Plecoptera	Nemouridae	*Paranemoura*		X
Plecoptera	Peltoperlidae	*Peltoperla*	X	
Plecoptera	Perlidae	*Acroneuria*	X	X
Plecoptera	Perlodidae	*Isoperla*	X	
Plecoptera	Perlodidae	*Remenus*		X
Plecoptera	Perlodidae	*Yugus*	X	
Plecoptera	Pteronarcyidae	*Pteronarcys*	X	X
Plecoptera	Taeniopterygidae	*Taenionema*		X
Plecoptera	Taeniopterygidae	*Taeniopteryx*		X

Note: Podmosta, Paraleuctra, Megaleuctra,and Beloneuria reported by Sturm Environmental Services are likely erroneous identifications. These genera been excluded from this list.

Two Cambarus species of crayfish were collected incidentally during the macroinvertebrate sampling events. Although crayfish were not specifically sampled for, a list of crayfish species potentially present within the Headwaters Spruce Fork sub-watershed can be found in Table 3. Other macroinvertebrates, including mollusks and flatworms (plathyelminthes), are fairly rare in these systems, as aquatic insects make up the majority of the macroinvertebrate taxa in these streams.

Table 3: List of potential crayfish species occurring within permit area

Common Crayfish (*Cambarus bartonii bartonii*)	Upland Burrowing Crayfish (*Cambarus dubius*)
Appalachian Brook Crayfish (*Cambarus b. cavatus*)	Big Water Crayfish (*Cambarus robustus*)

IV.B.2. Salamanders & Other Herpetofauna

There are 46 species of herpetofauna that have been documented as occurring on the project site or in Logan or Boone County, WV, including a wide variety of salamanders (Table 4). The Central Appalachian ecoregion contains one of the richest concentrations of salamander fauna in the world (Petranka 1998, Stein et al. 2000). Nearly ten percent of global salamander diversity is found within streams in the ecoregion (Green and Pauley 1987). Salamanders are a diverse and unique form of Appalachian wildlife that depend on forested headwater habitat and that decline or disappear from surface mined areas. Many species of salamanders are aquatic or semi-aquatic and utilize headwater streams at some point in their life histories. Most of the species found in the project area are water-dependent and belong to the family Plethodontidae, the lungless salamanders, which require high moisture retaining leaf-litter, dense shade, and cool flowing streams to survive and reproduce. Typically, salamanders occupy small, high-gradient headwater streams while fish occur farther downstream.

Salamanders are an important ecological component in the temperate hardwood forests of the ecoregion and are often the most abundant group of vertebrates in both biomass and number (Burton and Lykens 1975, Hairston 1987). Ecologically, salamanders are intimately associated with forest and adjacent aquatic ecosystems acting as predators of small invertebrates and serving as prey to larger aquatic and terrestrial predators, including fish, birds, mammals and reptiles (Pough et al. 1987, Davic and Welsh 2004). Because of their low energy demand, long life span, slow growth rates, and large abundance, salamanders help to maintain long-term ecosystem function and resilience by providing abundant biomass and nutrients for top predators in forest and adjacent aquatic ecosystems (Davic and Welsh 2004). As such, salamanders play a large role in the cycling of nutrients and transfer between terrestrial and aquatic systems via trophic pathways (Davic and Welsh 2004). Some species of salamanders split their lives between forests and headwaters and depend on a close connection to move between the two (Petranka, 1998). The PEIS identified thirty-one species of salamanders in the West Virginia portion of the study area. Of these, twenty-five species are known to occupy mixed mesophytic hardwood forests, like those present within portions of the Spruce No. 1 Mine site.

Table 4: List of documented herpetofauna species occurring in Logan County or Boone County, WV. Source: Spruce EIS and WV Biological Survey, Marshall University, 2010

Eastern hognose snake (*Heterodon platirhinos*)*	Five-lined skink (*Eumeces fasciatus*)*
American toad (*Bufo americanus*)*	Spring peeper (*Hyla crucifer*)*
Spring salamander (*Gyrinophilus porphyriticus*)*	Southern two-lined salamander (*Eurycea cirrigera*)*
Seal salamander (*Desmognathus monticola*)*	Northern dusky salamander (*Desmognathus fuscus*)*
Mountain dusky salamander (*Desmognathus ochrophaeus*)*	Mole salamander (*Ambystoma*)*
Red-spotted newt (*Notophthalmus viridescens*)*	Green salamander (*Aneides aenus*)*
Red salamander (*Pseudotriton ruber*)*	Mountain Chorus Frog (*Pseudacris brachyphona*)
Ring-necked Snake (*Diodophus punctatus*)	Fowler's Toad (*Bufo fowleri*)
Eastern Wormsnake (*Carphophis amoenus*)	Mudpuppy (*Necturus maculosus*)
Box Turtle (*Terrapene carolina*)	Spiny Soft-shelled Turtle (*Apalone spinifera*)
Timber Rattlesnake (*Crotalis horridus*)	Eastern Racer (*Coluber constrictor*)
Northern Slimy Salamander (*Plethodon glutinosus*)	Gray Treefrog (*Hyla versicolor*)
Eastern Fence Lizard (*Sceloporus undulatus*)	Rough Green Snake (*Opheodrys aestivus*)
North American Bullfrog (*Rana catesbeiana*)	Northern Two-lined Salamander (*Eurycea bislineata*)
Painted Turtle (*Chrysemys picta*)	Pickerel Frog (*Rana palustris*)
Snapping Turtle (*Chelydra serpentina*)	Little Brown Skink (*Scincella lateralis*)
Common Garter Snake (*Thamnophis sirtalis*)	Green Frog (*Rana clamitans*)
Northern Water Snake (*Nerodia sipedon*)	Ravine Salamander (*Plethodon richmondi*)
Spotted Salamander (*Ambystoma maculatum*)	Cope's Gray Treefrog (*Hyla chrysoscelis*)
Queen Snake (*Regina septemvittata*)	Coal Skink (*Eumeces anthracinus*)
Black Mountain Salamander (*Desmognathus welteri*)	Marbled Salamander (*Ambystoma opacum*)
Mud Salamander (*Pseudotriton montanus*)	Copperhead (*Agkistrodon contortix*)
Long-tailed Salamander (*Eurycea longicauda*)	Four-toed Salamander (*Hemidactylium scutatum*)
* Documented within the permit area	

With respect to areas in or immediately adjacent to the project area, stream-dwelling salamanders have been surveyed in White Oak Branch (see Appendix B in Patnode et al. 2005). White Oak Branch had good numbers of Northern Dusky (9 adult, 7 larvae), Appalachian Seal (15 adult, 12 larvae), Northern Spring (4 adult), and Two Lined salamanders (1 adult and 15 larvae). These samples were recorded from a 12 square-meter plot that includes dry and wetted portions of the stream channel. Because Oldhouse Branch and Pigeonroost Branch are very close geographically and have similar features as White Oak Branch, salamander populations in Pigeonroost Branch and Oldhouse Branch can be expected to be similar to those in White Oak Branch. Williams (2003) found mean densities within reference reaches of Pigeonroost Branch, Bend Branch (another tributary of Spruce Fork), and Ash Fork (a tributary of the Gauley River) to be more than six salamanders per square meter. In the Williams' study, the majority of the total salamanders were found in Pigeonroost Branch. Using these numbers from White Oak Branch and Pigeonroost Branch, EPA estimates aquatic salamanders are abundant (~5-6 per square meter) along stream channels in Pigeonroost Branch and Oldhouse Branch.

IV.B.3. Fish

Five fish species have been sampled in Pigeonroost Branch, Oldhouse Branch, and White Oak Branch, and the assemblages are typical of small streams in the Coal River sub-basin (Table 5). As fish diversity generally increases with stream order (Meyer et al. 2007), the low diversity in these streams is typical of low order headwater streams. The fish populations are good quality, and are not indicative of impairment. Based upon several sampling efforts, it has been found that Pigeonroost Branch supports a fish assemblage that includes blacknose dace, creek chub mottled sculpin, stonerollers and smallmouth bass; and Oldhouse Branch supports a fish assemblage of blacknose dace and creek chub. The presence of smallmouth bass in Pigeonroost Branch indicates at least seasonal, and possible spawning use of this stream by smallmouth bass.

Fish species collection in Oldhouse Branch, Pigeonroost Branch and White Oak Branch has been variable, likely due to a drought that occurred in 1999. It is likely that perennial reaches of Pigeonroost Branch and Oldhouse Branch were dewatered during this drought period, and thus provided only ephemeral or intermittent habitat at that time. As discussed in Stauffer and Ferreri (2002), drought can act as a major perturbation on fish communities. While fish can recolonize an area after a drought, recolonization rates vary between fish species, and it may take years before the community resembles that which was in place before the drought.

As outlined in the PEIS (Stauffer and Ferreri 2002), a study that was conducted by the U.S. Fish and Wildlife Service in 1998 recorded sculpin (Cottus spp.) in benthic invertebrate samples from White Oak Branch, as well as many fishes in the pools of Oldhouse Branch. Subsequent sampling in May 2000 revealed only blacknose dace (Rhinichthys atratulus) in White Oak Branch, and none in Oldhouse Branch. Stauffer and Ferreri (2002) attributed this to the effects of the drought in 1999. Sampling for the PEIS occurred in 1999, the same year as the drought. When sampled for the PEIS, only blacknose dace and creek chubs were present in Pigeonroost Branch. Similarly, White Oak Branch was also drought-affected and it contained only blacknose dace at the time of sampling. No samples were collected in Oldhouse Branch for the PEIS. Blacknose dace are typically a headwater species that are tolerant of disturbance and can recolonize an area quickly after a drought. Sculpins (Cottus spp.), however, are bottom-dwelling species that typically have a restricted home range, which hinders the dispersal rate and makes it more difficult for them to recolonize an area after a drought.

Additional fish sampling data were collected in 2008 and 2009 by Decota Consulting and revealed a fish assemblage similar to that found by the U.S. Fish and Wildlife Service prior to the drought. Mottled sculpin, as well as sporadic populations of smallmouth bass and stonerollers were collected in Pigeonroost Branch. Similarly, creek chubs and mottled sculpin were collected from White Oak Branch. Data from Oldhouse Branch indicate that blacknose dace and creek chubs are the only species present.

In an analysis of fish community data from Spruce Fork, EPA assessed the small streams impacted by the Spruce No. 1 Mine and three reaches of Spruce Fork: 1) Upstream of Seng Camp Creek, 2) Seng Camp Creek to Spruce Laurel, and 3) Downstream of Spruce Laurel. Other data analyzed included data collected for the PEIS, unpublished data included in the West Virginia Department of Natural Resources (WVDNR) database (including USEPA, WVDNR, and consulting firm data), and data from Decota Consulting supplied to the WVDNR collecting permit program. The data consisted of samples that were intended to assess community composition and were judged to have sufficient numbers of individuals to render a fair assessment.

Table 5: List of fish species occurring within Spruce Fork from samples in 2007 and 2010 (WVDNR unpublished data) (*) represents species also present in Pigeonroost Branch and Oldhouse Branch within the project area

rock bass (Ambloplites rupestris)	striped shiner (Luxilus chrysocephalus)
central stoneroller (Campostoma anomalum)*	smallmouth bass (Micropterus dolomieu)*
mottled sculpin (Cottus bairdii)*	golden redhorse (Moxostoma erythrurum)
greenside darter (Etheostoma blennioides)	silverjaw minnow (Notropis buccatus)
rainbow darter (Etheostoma caeruleum)	silver shiner (Notropis photogenis)
johnny darter (Etheostoma nigrum)	rosyface shiner (Notropis rubellus)
variegate darter (Etheostoma variatum)	sand shiner (Notropis stramineus)
banded darter (Etheostoma zonale)	mimic shiner (Notropis volucellus)
bigeye chub (Hybopsis amblops)	bluntnose minnow (Pimephales notatus)
northern hog sucker (Hypentelium nigricans)	western blacknose dace (Rhinichthys obtusus)
American brook lamprey (Lampetra appendix)	brown trout (Salmo trutta)
green sunfish (Lepomis cyanellus)	creek chub (Semotilus atromaculatus)*
bluegill (Lepomis macrochirus)	blacknose dace (Rhinichthys atratulus)*

For the PEIS, Fulk et al. (2003) used the Mid-Atlantic Highlands (MAHA) Index of Biotic Integrity (IBI), a multi-metric index used to assess biotic health, with some minor modification, to assess the impacts of mountaintop mining and valley fills to fish assemblages. Using this same index, the assemblage upstream of Seng Camp Creek ranged from fair to excellent condition.

The fish assemblage in the main stem of Spruce Fork is in relatively good condition (Table 5) and is made up of 26 species. Spruce Fork is a locally important rock bass and smallmouth bass fishery. Rock Bass and Smallmouth Bass are moderately sensitive gamefish species. While sampling Spruce Fork in 2010, recreational fishing was observed in the lower reaches of the stream and there was evidence of fishing in the upper reaches as well. Species present in Spruce Fork upstream and downstream of Seng Camp Creek are typical of streams of this size within the Coal River sub-basin.

IV.B.4. Birds[12]

Many bird species depend on headwater streams like those of the Spruce Fork for their survival. The ecotone, or transition area, between terrestrial and aquatic habitats results in diverse flora and fauna. This phenomenon is particularly noticeable among bird species. For example, unique avifauna assemblages can be found along the riparian zone of headwater streams, and are often attracted to headwater streams for breeding areas because of the diversity of the habitat and the availability of emergent aquatic insects. Hence Appalachian headwater streams, like Pigeonroost Branch and Oldhouse Branch, support a wide array of sensitive bird species (Table 6) and are an important natural habitat for supporting these species' breeding populations.

Table 6: List of potential bird species occurring within permit area

Ruffed Grouse (*Bonasa umbellus*)	Whip-poor-will (*Caprimulgus vociferous*)
Red-tailed Hawk (*Buteo jamaicensis*)	Hairy Woodpecker (*Picoides villosus*)
Black-billed Cuckoo (*Coccyzus erythropthalmus*)	Pileated Woodpecker (*Dryocopus pileatus*)
Chimney Swift (*Chaetura pelagica*)	Acadian Flycatcher (*Empidonax virescens*)
Belted Kingfisher (*Megaceryle alcyon*)	Yellow-throated Vireo (*Vireo flavifrons*)
Downy Woodpecker (*Picoides pubescens*)	Red-eyed Vireo (*Vireo olivaceus*)
Northern Flicker (*Colaptes auratus*)	American Crow (*Corvus brachyrhynchos*)
Eastern Wood-Pewee (*Contopus virens*)	Carolina Chickadee (*Poecile carolinensis*)
Eastern Phoebe (*Sayornis phoebe*)	White-breasted Nuthatch (*Sitta carolinensis*)
White-eyed Vireo (*Vireo griseus*)	Blue-gray Gnatcatcher (*Polioptila caerulea*)
Blue Jay (*Cyanocitta cristata*)	Wood Thrush (*Hylocichla mustelina*)
Northern Rough-winged Swallow (*Stelgidopteryx serripennis*)	Gray Catbird (*Dumetella carolinensis*)
Tufted Titmouse (*Baeolophus bicolor*)	European Starling (*Sturnus vulgaris*)
Carolina Wren (*Thryothorus ludovicianus*)	Brewster's Warbler (hybrid) (*Vermivora cyanoptera x V. chrysoptera*)
Eastern Bluebird (*Sialia sialis*)	Northern Parula (*Parula Americana*)
American Robin (*Turdus migratorius*)	Yellow-throated Warbler (*Dendroica dominica*)
Blue-winged Warbler (*Vermivora cyanoptera*)	Cerulean Warbler (*Dendroica caerulea*)
Golden-winged Warbler (*Vermivora chrysoptera*)	American Redstart (*Setophaga ruticilla*)
Yellow Warbler (*Dendroica petechia*)	Swainson's Warbler (*Limnothlypis swainsonii*)
Prairie Warbler (*Dendroica discolor*)	Louisiana Waterthrush (*Parkesia motacilla*)
Black-and-white Warbler (*Mniotilta varia*)	Common Yellowthroat (*Geothlypis trichas*)
Worm-eating Warbler (*Helmitheros vermivorum*)	Yellow-breasted Chat (*Icteria virens*)
Ovenbird (*Seiurus aurocapilla*)	Chipping Sparrow (*Spizella passerina*)
Kentucky Warbler (*Oporornis formosus*)	Song Sparrow (*Melospiza melodia*)
Hooded Warbler (*Wilsonia citrina*)	Scarlet Tanager (*Piranga olivacea*)
Eastern Towhee (*Pipilo erythropthalmus*)	Indigo Bunting (*Passerina cyanea*)
Field Sparrow (*Spizella pusilla*)	Brown-headed Cowbird (*Molothrus ater*)
Northern Cardinal (*Cardinalis cardinalis*)	House Sparrow (*Passer domesticus*)
Red-winged Blackbird (*Aegelaius phoeniceus*)	Northern Bobwhite (*Colinus virginianus*)

[12] Much of the discussion related to avian and bat species is based upon communications with the U.S. Fish and Wildlife Service.

American Goldfinch (*Spinus tristis*)	Yellow-billed Cuckoo (*Coccyzus americanus*)
Mourning Dove (*Zenaida macroura*)	Wild Turkey (*Meleagris gallopavo*)
Woodcock (*Scolopax minor*)	Red-bellied Woodpecker (*Melanerpes carolinus*)

Among the many migratory birds likely to breed in the project area, there are six species that the USFWS has designated as Birds of Conservation Concern (BCC) within the Appalachian Mountains Bird Conservation Region (AMBCR). These include the Cerulean Warbler (*Dendroica caerulea*), Kentucky Warbler (*Oporornis formosis*), Swainson's Warbler (*Lymnothlypis swainsonii*), Worm-eating Warbler (*Helmitheros vermivorus*), Wood Thrush (*Hylocichla mustelina*), and the Louisiana Waterthrush (*Seiurus motacilla*). The first five of these are also designated as BCC species within the USFWS's Northeast Region as a whole and nationally (U.S. FWS 2008). The first four are also considered to be among the 100 most at-risk bird species in North America (Wells 2007).

The Louisiana Waterthrush, a neotropical migrant song bird, is considered an obligate headwater riparian songbird (an example of water-dependent wildlife) because its diet is comprised predominantly of immature and adult aquatic macroinvertebrates found in and alongside headwater streams and because it builds its nest in the stream banks. Breeding waterthrushes nest and forage primarily on the ground along medium- to high-gradient, first- to third-order, clear, perennial headwater streams flowing through closed-canopy forest. Good water quality is a key component of the species' breeding habitat. By these criteria, headwater streams like Pigeonroost Branch and Oldhouse Branch that support healthy macroinvertebrate communities provide excellent foraging and breeding habitat for species such as the Louisiana Waterthrush.

The West Virginia population of the Louisiana Waterthrush may serve as a source population within the species' breeding range. The Appalachian Mountain Bird Conservation Region (AMBCR), which extends from southeastern New York south to northern Alabama, is thought to support as much as 45 percent of the Louisiana Waterthrush's breeding population (Mattson and Cooper 2009, Smith, USFWS 2010, personal communication). West Virginia, the only state that lies entirely within the AMBCR, encompasses the largest contiguous area of high relative breeding abundance over the species' entire breeding range, based on North American Breeding Bird Survey (BBS) data from 1994-2003.

The Louisiana Waterthrush is also an area-sensitive species, requiring undisturbed forest tracts of at least 865 acres to sustain a population (Robbins, C.S., J.R. Sauer, R.S. Greenburg, and S. Droege. 1989). The most effective management protocol for the Louisiana Waterthrush includes the protection of forest tracts and water systems that it inhabits in its breeding range. The protection of moderate- to high-gradient headwater streams, which compose 75-80% of stream length in a typical watershed, is therefore of particular importance for this species.

Bird species that rely on mature forest habitats and that are on the Audubon watch list as declining species include the Swainson's Warbler, Kentucky Warbler, and Cerulean Warbler. According to the West Virginia Breeding Bird Atlas, all of these species are likely breeders in and around the project area (Buckelew and Hall 1994).

The Cerulean Warbler is considered to be particularly sensitive to landscape-level changes in habitat, more so than most other North American bird species. A canopy-foraging insectivorous neotropical migrant songbird, the Cerulean Warbler breeds in mature deciduous forests with broken, structurally diverse canopies across much of the eastern United States and winters in middle elevations of the Andes Mountains of northern South America. Robbins (1989) noted that Cerulean Warblers prefer large-blocks of mature interior forest habitat with tall trees and a dense upper canopy.

Important among a number of stressors to the Cerulean's breeding populations are the loss of mature deciduous forest, particularly along stream valleys, and the fragmentation and increasing isolation of remaining mature deciduous forest. The USFWS has designated the Cerulean Warbler a Species of Management Concern and a Species of Conservation Concern throughout its range. It has also been preliminarily designated by the Appalachian Mountains Joint Venture as a Species of Highest Conservation Priority within the Appalachian Mountains Bird Conservation Region, which encompasses West Virginia. The AMBCR is thought to support about 80 percent of the Cerulean Warbler's entire breeding population and as a comprehensive four-year study of the species' breeding population shows, West Virginia is an important source population for Cerulean Warblers (Rosenberg et al.2000).

The Acadian Flycatcher (*Empidonax virescens*) is another bird species that is primarily restricted to forested tracts with understory vegetation along small headwater streams. Acadian flycatchers feed primarily on emergent aquatic insects in riparian forest habitat like Spruce Fork and its tributaries. In addition, many other neotropical migrant songbird species are also often attracted to headwater streams for breeding areas because of the diversity of the habitat and the availability of emergent aquatic insects. Hence Appalachian headwater streams, like Pigeonroost Branch and Oldhouse Branch, support a wide array of sensitive bird species and are an important natural habitat for supporting these species' breeding populations.

IV.B.5. Bats & Other Mammals

Thirteen species of bats are found in West Virginia; and all of these species are insectivorous and either capture their prey by foraging in flight, catch flying insects from a perch, or collect insects from plants. Species that have potential to occur in the area of south-Central West Virginia that encompasses the Spruce No. 1 Mine include the Northern Bat (*Myotis septentrionalis*), Big Brown Bat (*Eptesicus fuscus*), Red Bat (*Lasiurus borealis*), Eastern Small-footed Bat (*Myotis leibii*), Virginia Big-eared Bat (*Corynorhinus townsendii virginianus*), Northern Long-eared Bats *(Myotis septentrionalis)* and the Indiana Bat (*Myotis sodalis*) (Table 7).

Both the Indiana Bat and Virginia Big-eared Bat are listed as endangered under the Endangered Species Act (ESA). The USFWS was also recently petitioned to list the Eastern Small-footed Bat and the Northern Long-eared Bat under the ESA. Both of these species have been documented in the Spruce No. 1 Mine project area. In 2004, five Eastern Small-footed Bats and 16 Northern Long-eared Bats were captured during mist net surveys conducted at the Spruce No. 1 Mine site, representing 7.6 and 24.2 percent, respectively, of all bats captured (U.S. Army Corps of Engineers Huntington District 2006, DEIS Spruce No. 1 Mine. Appendix M).

Indiana Bats are found over most of the eastern half of the United States. Between 1960 and 2001, biologists have documented a 56% population decline in Indiana Bats (Clawson 2002). Indiana Bats feed solely on emerged aquatic and terrestrial flying insects. They are habitat generalists and their selection of prey reflects the environment in which they forage. In a study in the Allegheny Mountains, activity in non-riparian upland forest and forests in which timber harvest had occurred was low relative to forested riparian areas (Owen et al. 2004). This evidence suggests that the forested riparian zones of the project area would be more suitable habitats for Indiana Bat populations than active or restored mining sites.

Mist net surveys were conducted in the project area in 2000 and 2004, and no federally listed bats were captured. Although the capture of bats confirms their presence, failure to catch bats does not absolutely confirm their absence (U.S. Fish and Wildlife Service 2007). The project area occurs roughly halfway between known hibernacula (shelters used for hibernation) in northeastern Kentucky and southeastern West Virginia. Since the most recent surveys at the Spruce No. 1 Mine site, maternity roosts have been documented in central and north-central Boone County within 15 miles of the project area (WVDNR 2010, USFWS 2005).

Table 7: List of potential mammal species occurring within permit area

hoary bat (*Lasiurus cinereus*)	Rafinesque's big-eared bat (*Corynorhinus rafinesquii*)
eastern small-footed bat (*Myotis leibii*)	big brown bat (*Eptesicus fuscus*)
little brown bat (*Myotis lucifugus*)	silver-haired bat (*Lasionycteris noctivagans*)
Northern long-eared bat (*Myotis septentrionalis*)	eastern red bat (*Lasiurus borealis*)
Eastern pipistrelle bat (*Pipistrelle subflavus*)	evening bat (*Nycticeius humeralis*)
Indiana bat (*Myotis sodalist*)	Virginia big-eared bat (*Corynorhinus townsendii virginianus*)
tri-colored bat (*Perimyotis subflavus*)	showshoe hare (*Lepus americanus*)
woodland jumping mouse (*Napaeozapus insignis*)	raccoon (*Procyon lotor*)
deer mouse (*Peromyscus maniculatus*)	red fox (*Vulpes vulpes*)
gray fox (*Urocyon cinereoargenteus*)	bobcat (*Lynx rufus*)
mink (*Mustela vison*)	white-tailed deer (*Odocoileus virginianus*)
opossum (*Didelphis virginiana*)	eastern cottontail (*Sylvilagus floridana*)
muskrat (*Ondatra zibethicus*)	Appalachian cottontail (*Sylvilagus obscures*)
black bear (*Ursus americanus*)	white-footed mouse (*Peromyscus leucopus*)
striped skunk (*Mephitis mephitis*)	southern red-backed vole (*Clethrionomys gapperi*)
woodchuck (*Marmota monax*)	meadow vole (*Microtus pennsylvanicus*)

masked shrew (*Sorex cinereus*)	pine vole (*Microtus pinetorum*)
northern short-tailed shrew (*Blarina brevicauda*)	eastern chipmunk (*Tamias striatus*)
hairy-tailed mole (*Parascalops breweri*)	eastern gray squirrel (*Sciurus carolinensis*)
least Weasel (*Mustela nivalis*)	fox squirrel (*Sciurus niger*)
long-tailed weasel (*Mustela frenata*)	red squirrel (*Tamiasciurus hudsonicus*)
wild boar/ feral pig (*Sus scrofa*)	southern flying squirrel (*Glaucomys volans*)
american beaver (*Castor canadensis*)	

IV.C. Summary

Based on the foregoing information, EPA finds that Pigeonroost Branch and Oldhouse Branch contain high quality, important wildlife resources and habitat. EPA bases this conclusion on several factors including the similarity of macroinvertebrate communities in Pigeonroost Branch and Oldhouse Branch to the reference-quality White Oak Branch; the high-ranking mayfly and stonefly diversity, both within the Central Appalachian ecoregion and statewide; and the use of these streams and associated riparian ecotone by numerous salamander, bird, and mammal species. These streams support least-disturbed conditions and represent some of the last remaining high quality stream and riparian resources within the Headwaters Spruce Fork sub-watershed and the Coal River sub-basin.

V. Basis for Final Determination

V.A. Section 404(c) Standards

CWA § 404(c) provides

> The Administrator is authorized to prohibit the specification (including the withdrawal of specification) of any defined area as a disposal site, and he is authorized to deny or restrict the use of any defined area for specification (including the withdrawal of specification) as a disposal site, whenever he determines, after notice and opportunity for public hearings, **that the discharge of such materials into such area will have an unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas (including spawning and breeding areas), wildlife, or recreational areas**. Before making such determination, the Administrator shall consult with the Secretary. The Administrator shall set forth in writing and make public his findings and his reasons for making any determination under this subsection. [emphasis added]

While EPA strongly prefers to initiate the § 404(c) process prior to issuance of a permit, § 404(c) and EPA's implementing regulations authorize EPA to initiate the § 404(c) process after a permit has been issued by withdrawing specification of a disposal site (See 40 CFR 231.1(a); see also definition of "withdraw specification," 40 CFR 231.2(a)). In this case, Pigeonroost Branch and Oldhouse Branch were specified as disposal sites in DA Permit No. 199800436-3.

§ 404(c) does not define the term "unacceptable adverse effect." EPA's regulations at 40 CFR 231.2(e) define "unacceptable adverse effect" as

> Impact on an aquatic or wetland ecosystem which is likely to result in significant degradation of municipal water supplies or **significant loss of or damage to** fisheries, shellfishing, or **wildlife habitat** or recreation areas. In evaluating the unacceptability of such impacts, consideration should be given to the relevant portions of the § 404(b)(1) Guidelines (40 CFR 230). [emphasis added]

V.B. Evaluation of Impacts

To evaluate the impacts of the Spruce No. 1 Mine, EPA has reviewed the DA Permit No. 199800436-3 (Section 10: Coal River), the Spruce No. 1 Mine EIS, the PEIS, peer-reviewed literature, and available data documenting impacts from similar projects. In addition, EPA communicated with the US Fish and Wildlife Service on impacts to fish and wildlife resources in the project area. EPA also has examined impacts caused by the portion of the Spruce No. 1 Mine that has already been constructed in the Seng Camp Creek watershed (specifically, Valley Fill 1A). In addition, EPA reviewed the nearby Mingo Logan Dal-Tex operation. The data indicate that for the most part, the formations are repeated from the Dal-Tex mine complex to the proposed Spruce No. 1 mine location and all of the formations in the Dal-Tex complex that had in the past showed high selenium levels and have led to environmental releases are present at the Spruce No. 1 Mine. EPA is, therefore, on sound technical footing to use existing data from the Dal-Tex complex as a basis to predict what may happen when mining occurs at Spruce No. 1 Mine. This was acknowledged by the Corps in the Spruce No. 1 EIS, which stated "[t]he past and present impacts to topography, geology, and mineral resources of the previous mining along the western side of Spruce Fork are similar to the anticipated impacts of the Spruce No. 1 Mine, as mining is to occur in the same strata."

EPA completed a review of rock cores and corresponding cross sections for the Dal-Tex mines including the Gut Fork mine, which lies immediately to the west across Spruce Fork from Spruce No.1 (Figure 8) and compared them to those from the Spruce No. 1 Mine. This review, which is set forth in Appendix 4, indicates that the formations are essentially repeated from the Dal-Tex mine complex to the Spruce No. 1 Mine location. According to the EIS, the same coal beds are to be developed for the Spruce No. 1 Mine as for the Dal-Tex mine. These coal bed sequences are also similar to those described in the literature for southern West Virginia coal bed sequences and the geologic column for the Spruce No. 1 Mine.

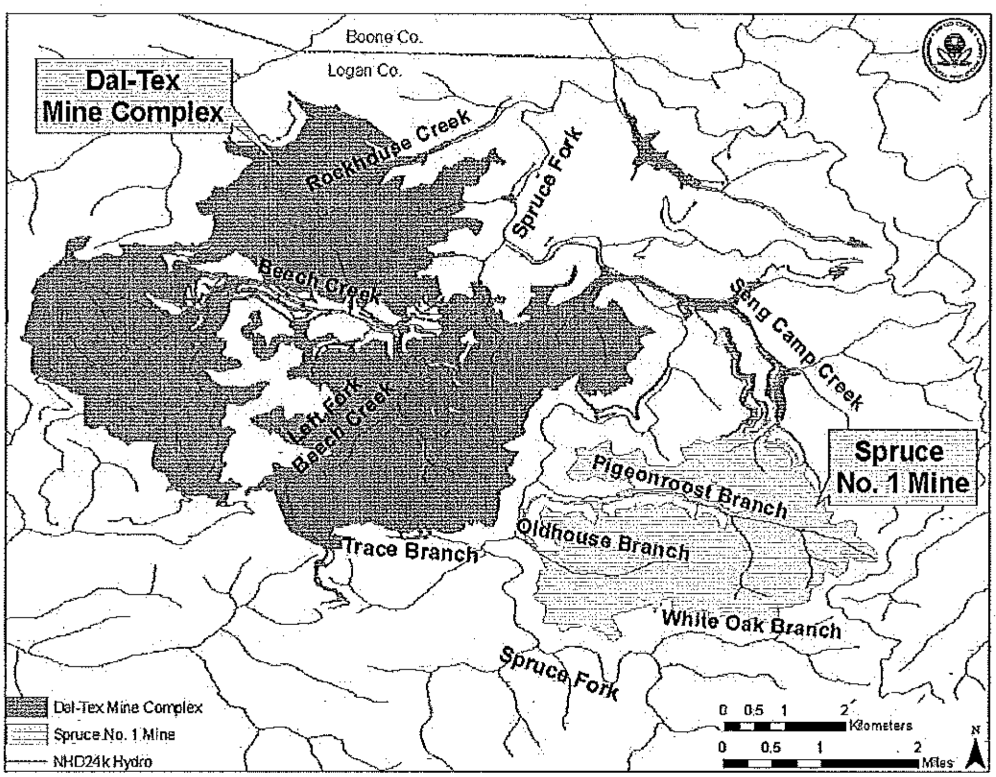

Figure 8. Spruce No. 1 Mine and the Dal-Tex Mine Operation

V.C. Unacceptable Adverse Impacts on Wildlife within the Spruce No. 1 Mine Project Area

The unacceptable adverse impacts from the specification of Pigeonroost Branch and Oldhouse Branch as disposal sites for the discharge of dredged or fill material from the Spruce No. 1 Mine will occur through several different pathways. This section discusses the direct impacts to wildlife and wildlife habitat.

Direct impacts will occur as a result of the discharges of dredged or fill material from the construction of valley fills and sediment ponds that will bury much of Pigeonroost Branch and Oldhouse Branch, including all wildlife living in these streams, their tributaries, and associated riparian areas. Burial of Pigeonroost Branch and Oldhouse Branch also will eliminate habitat for wildlife that depend upon those streams. The loss of these portions of Pigeonroost Branch and Oldhouse Branch will also adversely impact wildlife within this watershed that depend on headwater streams for all or part of their life cycles.

Construction of valley fills and other discharges of dredged or fill material associated with the Spruce No. 1 Mine into Pigeonroost Branch and Oldhouse Branch will result in a significant loss of wildlife habitat. The direct effects of the Spruce No. 1 Mine, as authorized, include permanent placement of fill in approximately 6.6 miles of stream in Pigeonroost Branch and Oldhouse Branch. Based on stream information from the National Hydrography Dataset, this loss represents 5.6% of the total stream length in the Headwaters Spruce Fork sub-watershed. The destruction of 6.6 miles of high quality stream habitat in a watershed where there is little remaining high quality stream habitat, and the subsequent loss of many populations of macroinvertebrates, salamanders, fish and other wildlife dependent upon that aquatic habitat area for survival, including water-dependent birds, will result in a loss of regional biodiversity and the broader ecosystem functions these populations provide.

V.C.1. Macroinvertebrates

Construction of valley fills and other discharges of dredged or fill material authorized by the DA Permit into Pigeonroost Branch and Oldhouse Branch will impact the native macroinvertebrate community directly through loss of stream habitat as a result of fill. Because the macroinvertebrate assemblages in these streams represent least-disturbed conditions within the Coal River sub-basin, the loss of these communities and their habitat will adversely impact regional native biodiversity.

As set forth in Section IV.B.1. above, benthic macroinvertebrates are diverse and healthy in the Spruce No. 1 Mine area and represent an important component of the aquatic community in Pigeonroost Branch and Oldhouse Branch. Also, direct burial of these populations will likely affect food webs and the processing and transfer of energy and nutrients downstream. As primary consumers, macroinvertebrates play an important role in the breakdown of organic matter, allowing for the transport of fine particulate organic matter to downstream organisms, and converting algal and terrestrial plant matter into energy (biomass). Invertebrates are at the base of the faunal food web, and thus they also play a critical role in the delivery of energy and nutrients to downstream reaches (in aquatic life stages) as well as to upland terrestrial habitats (in winged adult life stages), most notably through food web pathways.

V.C.2. Salamanders & Other Herpetofauna

As stated in IV.B.2., the Central Appalachian ecoregion has one of the highest concentrations of salamander fauna in the world. Impacts from the activities authorized will have a significant adverse impact on this form of wildlife located within the project area. Based on literature values (Williams 2003) for mean densities within reference reaches of Pigeonroost Branch, Bend Branch (another tributary of Spruce Fork), and Ash Fork (a tributary of Gauley River) and a 2004 USFWS study in White Oak Branch, EPA estimates aquatic salamander density in Pigeonroost Branch and Oldhouse Branch at approximately 5-6 individuals per square meter along stream channels. The loss of this density over 6.6 miles of stream reflects a substantial loss.

It is not expected that stream salamanders will return to the site due to the burial of their existing habitat. Gingerich (2009) found no expected stream salamanders inhabiting 3-20 year-old sedimentation ditches (5 out of 5 mines) in West Virginia mountaintop mining areas. Furthermore the USFWS has indicated that, to its knowledge, it has not been demonstrated that salamanders return to mined areas at densities similar to those that occurred prior to mining. USFWS also indicated that while range-wide populations of common species may not be significantly impacted, the salamander communities in individual headwater systems behave essentially as isolated populations because there is limited interaction (immigration and emigration) with communities in adjacent watersheds (personal communication with Dr. Thomas Pauley, Marshall University and with Jim Zelenak USFWS West Virginia Field Office).

Because salamanders represent the main vertebrate predator in these headwater streams, and will be eradicated under the project, EPA believes that a key component of the aquatic food web will be lost or significantly reduced from the ecosystem within Pigeonroost Branch and Oldhouse Branch portions of the Spruce No. 1 Mine area. Additionally, the loss of these salamanders will have broader food web implications, as they also serve as prey for numerous terrestrial and aquatic species found within the Spruce No. 1 Mine site, including fish, snakes, birds, mammals, turtles, frogs, crayfish and other salamanders (Davic and Welsh 2004).

V.C.3. Fish

Pigeonroost Branch and Oldhouse Branch are considered least-disturbed streams within the Coal River sub-basin, and as such, they have good water quality and support good quality fish assemblages. While these assemblages have a naturally low diversity, consistent with low order headwater streams within the Coal River sub-basin, they are healthy and productive. Construction of valley fills and other discharges of dredged or fill material authorized by the DA Permit into Pigeonroost Branch and Oldhouse Branch will lead to the total loss of over six miles of high quality, least-disturbed in-stream habitat and thus the total loss of five naturally occurring fish populations within the project area. Fish species that will be directly impacted include blacknose dace, creek chub mottled sculpin, stonerollers and smallmouth bass. Moreover, the permitted fill will reduce the habitat available for fishes within the watershed that use these streams as refugia and seasonal foraging or spawning habitat, including smallmouth bass. Additionally, species like the mottled sculpin, a bottom-dwelling species that has a restricted home range, have a low dispersal rate, which makes it more difficult for them to recolonize an area following disturbance.

V.C.4. Water-dependent Birds

The Spruce No. 1 Mine will impact the Louisiana Waterthrush, a water-dependent bird that requires forested headwater streams for foraging on insects and nesting, by eliminating the headwater areas associated with Pigeonroost Branch and Oldhouse Branch. The Louisiana Waterthrush has been designated by USFWS as a Bird of Conservation Concern (BCC) within the Appalachian Mountains Bird Conservation Region (AMBCR) because of potential impacts from surface coal mining activities.

According to USFWS, the Louisiana Waterthrush is an area-sensitive riparian-obligate species that nests and forages along headwater streams of intact interior forests. Because it requires riparian woodland habitat to forage for macroinvertebrates along streams, approximately 6.6 miles of Louisiana Waterthrush stream and riparian habitat will be lost due to fill being placed in Pigeonroost Branch and Oldhouse Branch and their tributaries. For water-dependent birds like the Louisiana Waterthrush, preservation of large tracts of forest containing headwater streams is needed for the conservation of this species in the central Appalachians. The Waterthrush is particularly vulnerable to degradation of water quality and aquatic insect communities (Mattsson and Cooper 2006, Mulvihill et al. 2008).

V.C.5. Summary

Pigeonroost Branch and Oldhouse Branch and their tributaries are some of the last remaining streams within the Headwaters Spruce Fork sub-watershed and the larger Coal River sub-basin that represent "least-disturbed" conditions and habitat that is essential for many species in the watershed. As such, they perform critical hydrologic and biological functions, support diverse and productive biological communities, contribute to prevention of further degradation of downstream waters, and play an important role within the context of the overall Headwaters Spruce Fork sub-watershed and Coal River sub-basin. Within the streams and riparian areas of the project area, over 84 taxa of macroinvertebrates are documented to exist, as well as up to 46 species of reptiles and amphibians, 4 species of crayfish, 5 species of fish and at least one water-dependent bird species.

Construction of valley fills, sediment ponds, and other discharges authorized by DA Permit No. 199800436-3 (Section 10: Coal River) will eliminate the headwater stream ecosystems in Pigeonroost Branch and Oldhouse Branch. The direct impacts to these headwater stream systems, through burial of these diverse and healthy wildlife communities and their habitat, will result in unacceptable adverse effects on wildlife, particularly to macroinvertebrate, amphibian, fish, and water-dependent bird populations. Through the loss of stream macroinvertebrate and salamander communities, there will be, in turn, substantial effects to both aquatic and terrestrial vertebrate populations that rely on these communities as a food source.

In the preamble to EPA's final rules implementing § 404(c), EPA stated "[t]he term 'unacceptable' in EPA's view refers to the significance of the adverse effect -- e.g. is it a large impact and is it one the aquatic and wetland ecosystem cannot afford" (44 FR at 58078). The filling in and complete destruction of the 6.6 miles of streams at issue here is a large impact and clearly adverse to the wildlife that will be buried under thousands of tons of excess spoil. These adverse impacts are particularly large in context of the evidence that these streams are some of the last, rare and important high quality streams in the watershed. That context also leads EPA to the conclusion that this adverse impact is one that the aquatic ecosystem cannot afford. Based on this information, EPA has concluded that the discharges of dredged or fill material to Pigeonroost Branch and Oldhouse Branch as authorized by DA Permit No. 199800436-3 (Section 10: Coal River) will have unacceptable adverse effects on wildlife in Pigeonroost Branch and Oldhouse Branch.

V.D. Unacceptable Adverse Impacts on Wildlife Downstream of the Discharge of Dredged or Fill Material from the Spruce No. 1 Mine

Unacceptable adverse impacts will also occur to wildlife downstream of the footprint of the fills and sediment ponds. These unacceptable adverse impacts will be caused by removing Pigeonroost Branch and Oldhouse Branch as sources of freshwater dilution and converting them to sources of pollution. Water quality downstream of valley fills and in sediment ditches in mined areas is typically degraded due to high concentrations of solutes, primarily because it has percolated through mine spoil. Mine spoil, made up of fragmented mine rocks, has higher rates of rock weathering than bedrock because of its exposure to air and water, and percolation of water through these exposed rocks leads to increased concentrations of solutes, including total dissolved solids and selenium, in downstream receiving waters. In turn, this will adversely affect the delivery of headwater stream ecosystem functions to downstream waters. Studies have shown a strong correlation between the construction of valley fills for surface coal mining in Appalachia and significant adverse impact on downstream macroinvertebrate communities.

EPA believes that the discharges authorized by DA Permit No. 199800436-3 (Section 10: Coal River) into Pigeonroost Branch and Oldhouse Branch will transform those areas into sources of contaminants (particularly TDS and selenium) contributing to degradation of downstream waters. The project as authorized also will create areas of pooled water and increased conductivity, both of which are among the conditions known to be necessary to support harmful blooms of golden algae.

V.D.1. Increases in Pollutants Harmful to Wildlife

This section identifies increased loads of selenium and TDS (measured as conductivity) that are expected to occur as a result of the discharges of coal overburden as authorized and the unacceptable adverse impacts to wildlife that will occur as a result of these increases. These impacts to water chemistry are identified because they will adversely affect the native aquatic and water-dependent wildlife communities in the Spruce Fork watershed as discussed further below.

V.D.1.a. Selenium

Discharges from the Spruce No. 1 Mine Complex project are expected to increase selenium loading to the immediate receiving streams and downstream waters. Selenium (Se) is a naturally occurring chemical element that is an essential micronutrient, but can also have toxic effects following exposure to excessive amounts. For aquatic animals, the concentration range between essential nutrient and toxin is very narrow, being only a few micrograms per liter in water. Adverse impact of selenium residues in aquatic food chains results not just from the direct toxicity to the organisms themselves, but also from the dietary source of selenium these organisms contribute to fish and wildlife species in the food web that feed on them.

Selenium toxicity is primarily manifested as reproductive impairment and birth defects due to maternal transfer, resulting in embryotoxicity and teratogenicity in egg laying vertebrates (e.g., fish and ducks). The most sensitive toxicity endpoints in fish larvae are teratogenic deformities such as skeletal, craniofacial, and fin deformities, and various forms of edema. Embryo mortality and severe development abnormalities can result in impaired recruitment of individuals into populations (Chapman et al. 2009). The State of West Virginia has established a numeric chronic water quality criterion for selenium (5 µg/L four-day average not to be exceeded more than once every three years) to protect in-stream aquatic life. EPA's conclusion that the Spruce 1 Mine as authorized would cause unacceptable adverse effects on wildlife is not dependent on a conclusion that West Virginia's water quality standards will be violated at or downstream of the site. Rather, reference to this water quality standard provides information and context.

In West Virginia, coals that contain the highest selenium concentrations are found in a region of south-central West Virginia where the Allegheny and Upper Kanawha Formations of the Middle Pennsylvanian are mined (WVGES 2002). The WVDEP reports that some of the highest coal selenium concentrations are found in the central portion of the Coal River sub-basin in the immediate vicinity of the Spruce No. 1 Mine where significant active mining and selenium impaired streams are located. Selenium is discharged when selenium-bearing material exposed by surface mining activities comes in contact with water and contaminated water drains from the mining area to surface waters. The sediment ponds that are the usual form of water treatment at mining sites generally are not effective at treating selenium before effluent is discharged from ponds to downstream waters. The coal beds to be targeted by the Spruce No. 1 Mine include 5-Block of the Allegheny Group and down to the Upper Stockton coal bed in the eastern portion of the project area. In the western portion of the project area, the mine plan includes extraction of coal through the Middle Coalburg coal bed. These coal beds are rich in Se as evidenced by Se distribution data in the Spruce No. 1 column (DT0417) provided by the applicant for the NPDES permit application.

Total Maximum Daily Loads to address impairment from elevated concentrations of selenium have been developed for six other streams affected by mining in the Coal River sub-basin. These include nearby White Oak Creek, a tributary to the Coal River, the left Fork of White Oak Creek, Seng Creek, also a tributary to the Coal River; and Casey Creek, James Creek, and Beaver Pond Branch, all tributaries to Pond Fork. These elevated levels of selenium demonstrate that the geology in the vicinity of the Spruce No. 1 Mine will release selenium during mining activities. See Appendices 1 and 4 for further details.

To evaluate the impact of discharges into Pigeonroost Branch and Oldhouse Branch as authorized by the DA permit, EPA has compared selenium levels in Pigeonroost Branch and Oldhouse Branch with selenium levels in waters that have been impacted by the nearby Dal-Tex operation.[13] In addition, EPA has reviewed data from a mining outlet that drains, among other things, discharges from a portion of the Spruce No. 1 Mine that has been constructed in the Seng Camp Creek watershed (Figure 9).

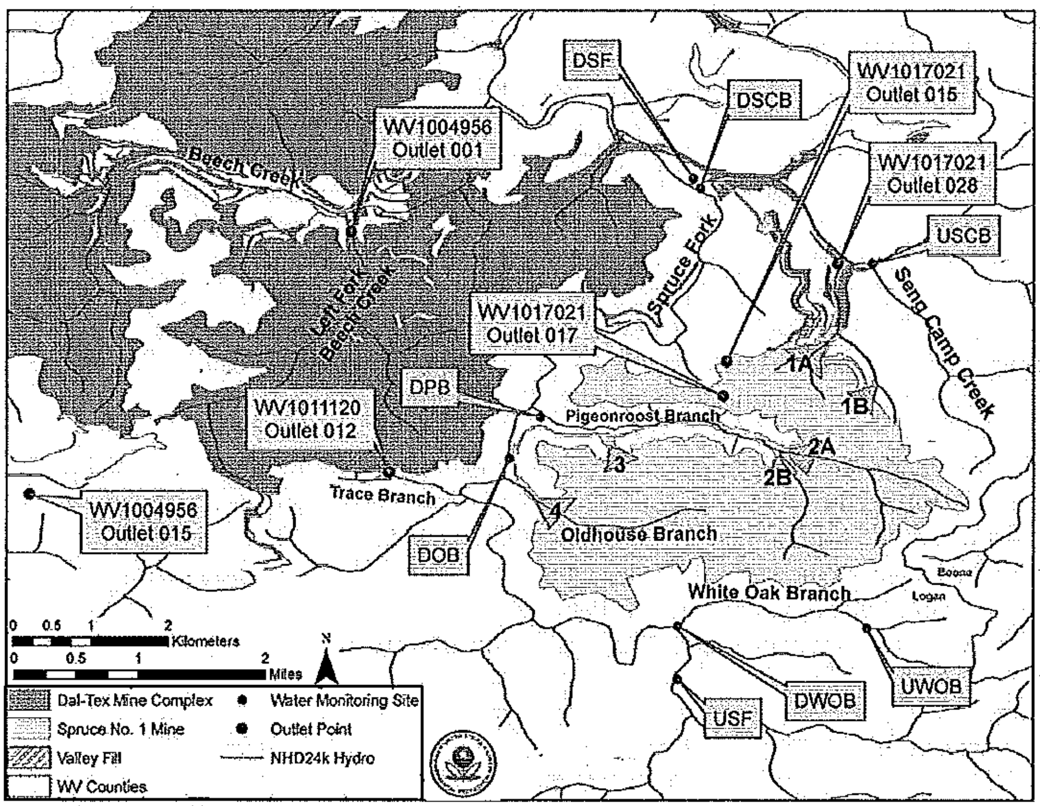

Figure 9. Spruce No. 1 Mine and the Dal-Tex Mine Outlet Locations

[13] Levels of selenium in other nearby waters that have been impacted by surface coal mining activity and generally have similar geology also support a prediction that construction of the Spruce No. 1 Mine as currently authorized will result in elevated levels of selenium in downstream waters.

EPA scientists completed a review of rock cores and corresponding cross sections for the Dal-Tex mines including the Gut Fork mine compared to the Spruce No. 1 Mine. For the most part, the formations are repeated from the Dal-Tex mine complex to the Spruce No. 1 Mine location. Table 8 provides a summary of selenium averages and ranges for Pigeonroost Branch and Oldhouse Branch and streams draining the nearby Dal-Tex operation (Left Fork Beech Creek, Beech Creek, and Trace Branch). The table also contains data for White Oak Branch (upstream of Spruce No. 1 Mine) and Seng Camp Creek (prior to 2007, when the DA permit was issued and filling associated with Spruce No. 1 commenced in that watershed). Summarizing the data in the following table, streams draining the nearby Dal-Tex operation have selenium concentrations in excess of 5 µg/L.

Table 8. Selenium Concentrations (µg/L) near Spruce No. 1 Mine

Stream Name	Sub-basin	Source and time period of data					
		PEIS (2000-2001)		WVDEP (2002-2003)		WVDEP (2005-2007)	
		Se (Avg.)	Se (Range)	Se (Avg.)	Se (Range)	Se (Avg.)	Se (Range)
Average and Range of Se in Tributaries to Spruce Fork that drain Spruce No. 1 Mine area							
White Oak Branch	Spruce Fork	<3 ND		<5 ND		NS	
Oldhouse Branch	Spruce Fork	<3 ND		<5 ND		NS	
Pigeonroost Branch	Spruce Fork	<3 ND		<5 ND		NS	
Seng Camp Creek	Spruce Fork	NS		<5 ND		NS	
Average and Range of Se in Tributaries to Spruce Fork draining Dal-Tex Operation							
Beech Creek[14]	Spruce Fork	7.5	5.6-9.5	6	5.0-9.0	12.3	6.0-22.0
Left Fork of Beech Creek	Spruce Fork	22.7	15.3-31.1	22	5.0-53.0	NS	
Trace Branch	Spruce Fork	NS	NS	7	5.0-10.0	NS	
Rockhouse Branch	Spruce Fork	5.3	3.8-8.0	< 5 ND	< 5 ND	NS	
ND: Se not detected. Detection limit shown. NS: Not sampled. Stream was not sampled for the study shown.							

The data from the Dal-Tex mine complex do not indicate any decrease in selenium concentrations over a period of several years. These data strongly suggest the construction of valley fills and other discharges of dredged or fill material (e.g., associated sediment ponds) from the Spruce No. 1 Mine into Pigeonroost Branch and

[14] In the WVDEP study on selenium bioconcentration factors, selenium was also found in fish tissue in Beech Creek (average 7.55 mg/kg).

Oldhouse Branch will result in elevated levels of selenium in the receiving waters, and lead to degradation of water quality of the receiving and downstream waters. EPA believes such degraded water quality will impact wildlife populations in the receiving and downstream waters, including fish populations.

Graphical trends of selenium concentrations from Discharge Monitoring Report (DMR) records for January 2007 to June 2010 from three outfalls from the Dal-Tex Mine operations demonstrate that the discharges from those outfalls consistently exceed 5 μg/L (Figures 10, 11 and 12).

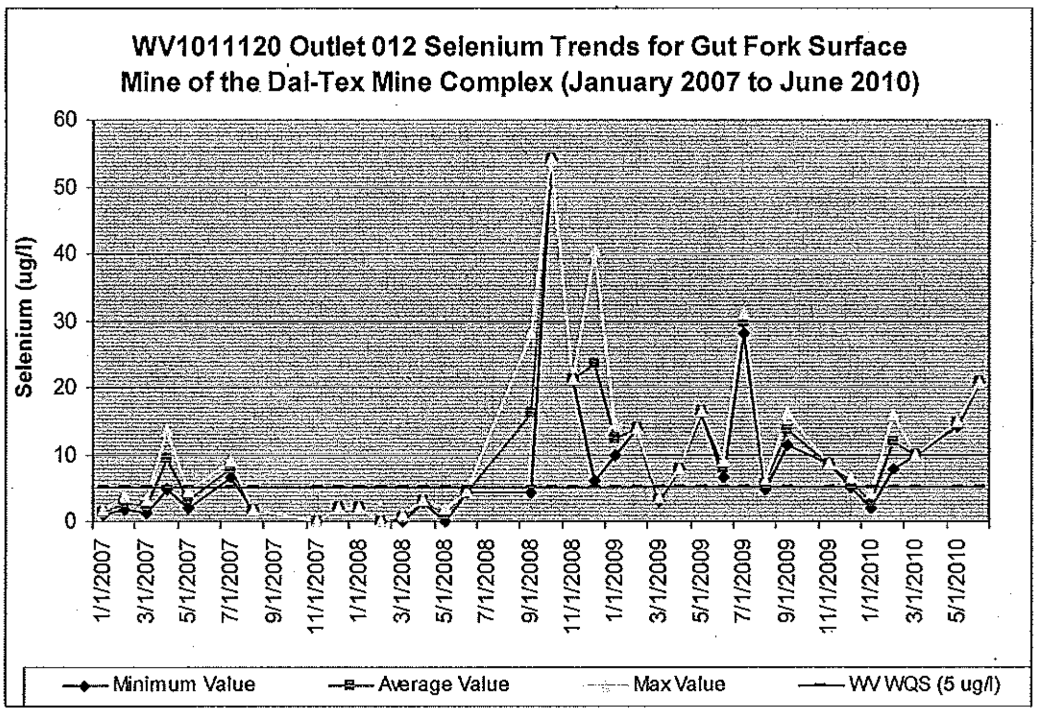

Figure 10. Selenium Trends (January 2007 to June 2010) for NPDES Permit WV1011120 – Outlet 012 (Mingo Logan Coal Company's Gut Fork Surface Mine of the Dal-Tex Mine Complex)

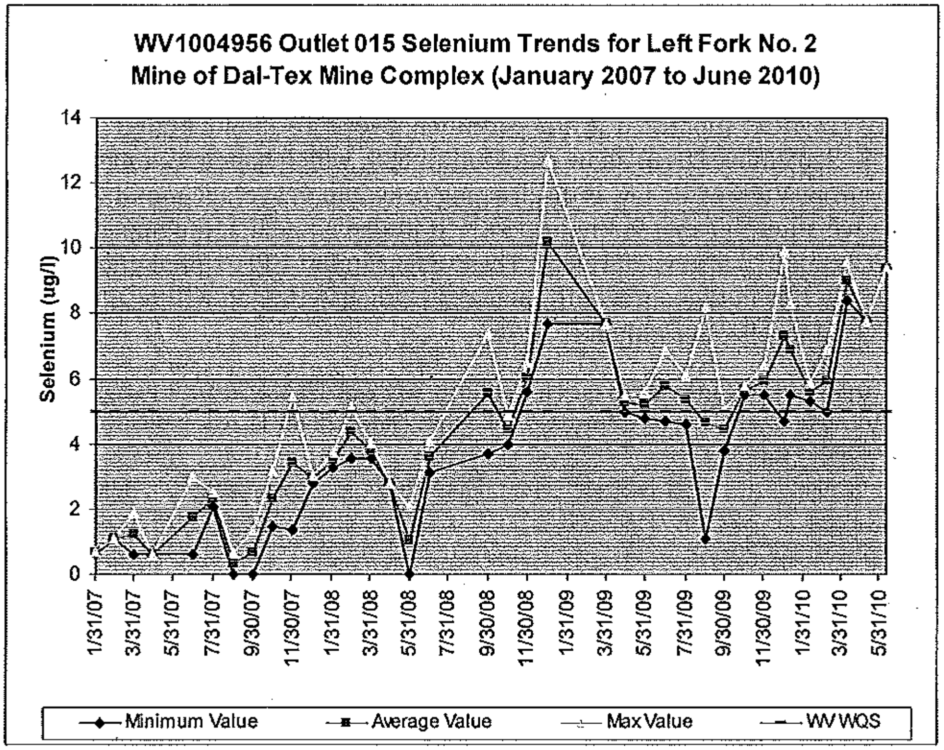

Figure 11. Selenium Trends (January 2007 to June 2010) for NPDES Permit WV1004956 – Outlet 015 (Mingo Logan Coal Company's Left Fork No. 2 Mine of the Dal-Tex Mine Complex)

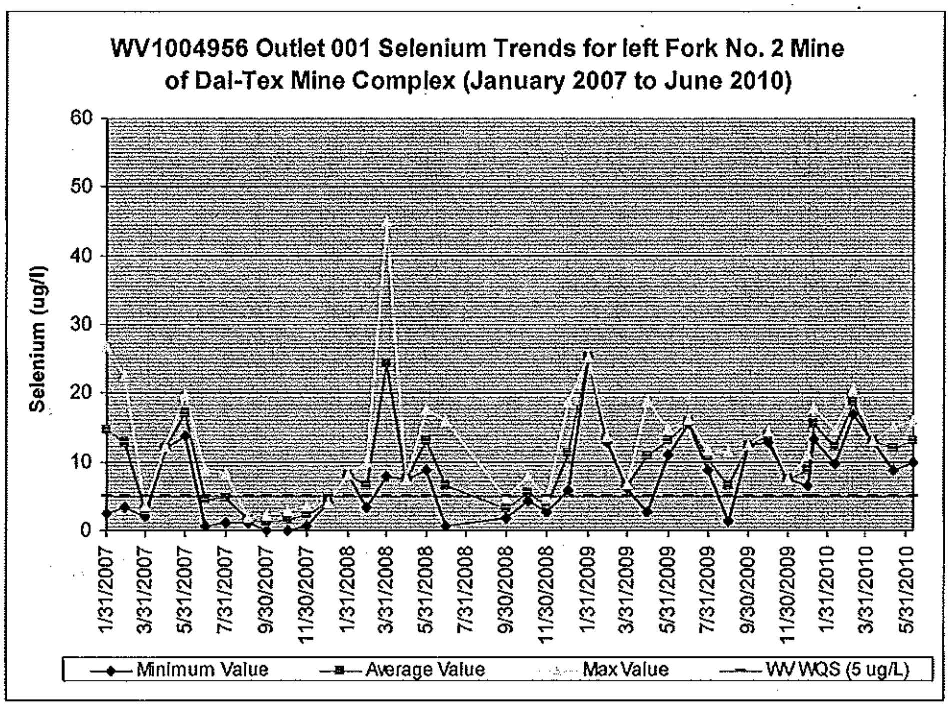

Figure 12. Selenium Trends (January 2007 to June 2010) for NPDES Permit WV1004956 – Outlet 001 (Mingo Logan Coal Company's Left Fork No. 2 Mine of the Dal-Tex Mine Complex)

EPA also reviewed data from the portion of the Spruce No. 1 Mine that is already operational in Seng Camp Creek (Figure 13), including active mining activities in the Right Fork of the Seng Camp Creek sub-watershed. Recent NPDES discharge monitoring reports (DMRs), submitted by the permittee, over a 16-month period (December 2008 to September 2010) show that Outfall 028, which handles, among other things, discharges from Valley Fill 1A, is discharging selenium at average monthly concentrations above 5 µg/L (Table 9, Figure 13).[15] It is also noted that the September 2009 value from Outfall 017 also is elevated. These data support EPA's prediction that construction of valley fills in Pigeonroost Branch and Oldhouse Branch will result in discharges of elevated levels of selenium.

Table 9. Total Recoverable Selenium (µg/L) for Outfalls 015, 017 and 028 for NPDES Permit WV1017021, Mingo Logan Coal Company Spruce No. 1 Mine. Note: Shaded areas indicate selenium concentrations exceeding 5 µg/L.

Site Code	Site Location	Report Date	Min Value	Avg. value	Max value
015	Outlet 015	12/31/2008	0.00	0.00	0.00
017	Outlet 017	12/31/2008	0.00	0.00	0.00
017	Outlet 017	9/30/2009	19.20	19.20	19.20
028	Outlet 028	12/31/2008	5.70	5.70	5.70
028	Outlet 028	1/31/2009	9.80	9.80	9.80
028	Outlet 028	2/28/2009	3.90	3.90	3.90
028	Outlet 028	3/31/2009	0.60	1.00	1.40
028	Outlet 028	4/30/2009	1.70	1.70	1.70
028	Outlet 028	5/31/2009	2.50	2.50	2.50
028	Outlet 028	6/30/2009	3.20	3.30	3.40
028	Outlet 028	8/31/2009	1.25	3.48	5.70
028	Outlet 028	9/30/2009	4.60	6.05	7.50
028	Outlet 028	10/31/2009	3.00	3.00	3.00
028	Outlet 028	11/30/2009	1.40	1.85	2.30
028	Outlet 028	12/31/2009	1.80	1.85	1.90
028	Outlet 028	1/31/2010	3.40	3.80	4.20
028	Outlet 028	2/28/2010	3.80	4.50	5.20
028	Outlet 028	3/31/2010	4.70	6.10	7.50
028	Outlet 028	4/30/2010	3.8	4.40	5.00
028	Outlet 028	5/31/2010	4.70	7.60	10.50
028	Outlet 028	6/30/2010	11.40	11.50	11.60
028	Outlet 028	7/31/2010	6.40	8.50	10.40
028	Outlet 028	8/31/2010	4.80	10.65	14.80
028	Outlet 028	9/30/2010	4.80	9.40	11.00

[15] While Outfall 028 receives discharges from other portions of the site, it handles the discharges from valley fill 1A. EPA notes that WVDEP sampling from 2002-2003 (prior to construction of Spruce No. 1 Mine in Seng Camp Creek) found selenium levels in Seng Camp Creek to be below detection levels.

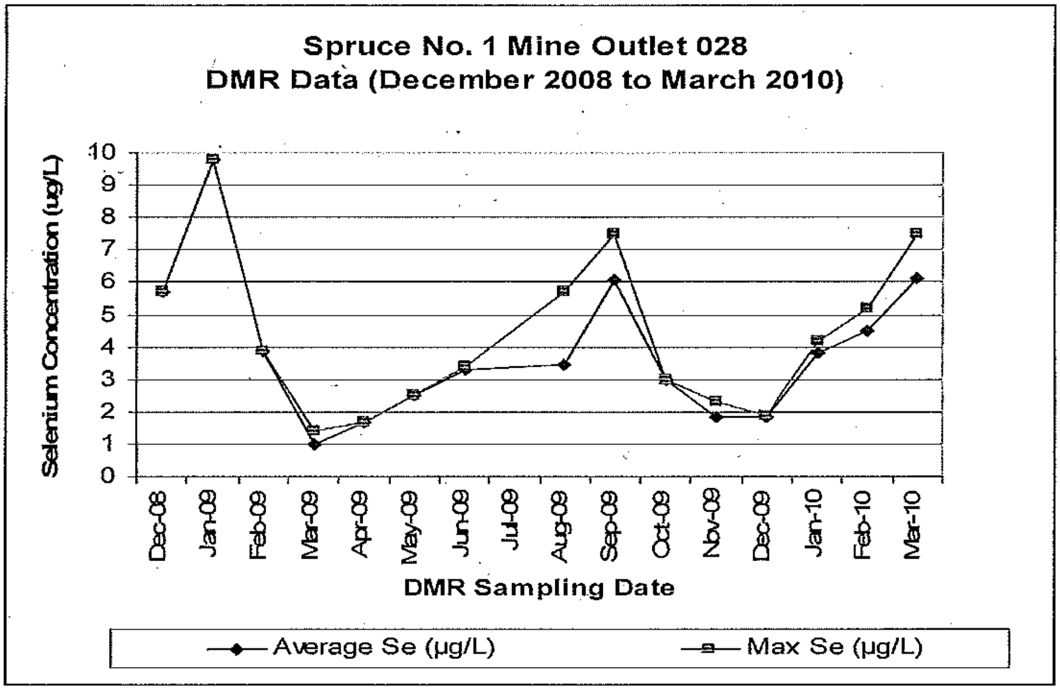

Figure 13. Selenium concentrations in discharge from outlet 028.

In addition to discharges of elevated concentrations of selenium, the project also will have the effect of increasing selenium concentrations in downstream waters by removing Pigeonroost Branch and Oldhouse Branch as sources of dilution that moderate downstream selenium concentrations. EPA evaluated the in-stream DMR monitoring data from December 2008 to March 2010 from several ambient monitoring stations associated with the Spruce No. 1 mine as authorized project: Stations DSCB (Downstream Seng Camp Creek, located at the mouth of Seng Camp Creek), USCB (Upstream Seng Camp Creek), USF (Upstream Spruce Fork), DSF (Downstream Spruce Fork, located downstream of Seng Camp Branch), DPB (downstream Pigeonroost Branch, at mouth of Pigeonroost Branch) and DOB (Downstream Oldhouse Branch, at mouth of Oldhouse Branch). As explained below, this analysis shows that Pigeonroost Branch and Oldhouse Branch are providing dilution that is helping to maintain reduced selenium concentrations in Spruce Fork.

The Spruce Fork watershed upstream of Pigeonroost Branch and Oldhouse Branch (Station USF) has average monthly selenium concentrations ranging from 0.9 µg/L to 10.90 µg/L (August 2010), with nine monthly average concentrations greater than 5 µg/L based on the in-stream DMR data for the December 2008 to September 2010 time period. It should be noted that the last 6 months of available DMR data (April 2010 to September 2010) for USF had monthly selenium concentrations above the 5 µg/L potentially indicating new selenium contamination sources. The downstream Spruce Fork (DSF) site has concentrations that are significantly lower, and does not have any average monthly selenium concentrations above 5 µg/L, with the highest monthly average selenium concentration during the time period (December 2008 to September 2010) being 2.50 µg/L (May 2010). This suggests that Pigeonroost Branch and Oldhouse

Branch (along with other tributaries that enter Spruce Fork between the monitoring stations) provide clean dilution water to the main stem of Spruce Fork. This conclusion is supported by the very low levels of selenium in Pigeonroost Branch and Oldhouse Branch. During the same December 2008 to September 2010 time frame, the DMR reports indicate almost all of the average monthly selenium measurements at both Pigeonroost Branch and Oldhouse Branch were below the detection limit of 0.6 µg/L. The single detection of selenium during the time period in Oldhouse Branch was 0.9 µg/L during July 2009 (a maximum value). All monthly average selenium concentrations in Pigeonroost Branch were below the detection limit from December 2008 through June 2010 except the monthly average in August 2009 which had a value of 1.3 µg/L (maximum value was 1.9 µg/L). However, the monthly average selenium concentrations for the July 2010 to September 2010 time period documented a developing selenium problem in Pigeonroost Branch. The monthly average selenium concentration in July 2010 was 2.7 µg/L, August 2010 was 2.6 µg/L and September 2010 was 1.4 µg/L.

By way of example, the average monthly selenium concentration at the USF monitoring location for the month of April 2010 is reported on the DMR as 10.60 µg/L. The average monthly concentration at the DSF location for April 2010 is reported on the DMR as 0.90 µg/L. For April 2010, the DMR reports average monthly selenium concentrations at Pigeonroost Branch and Oldhouse Branch as below the detection level of 0.60 µg/L. While Pigeonroost Branch and Oldhouse Branch are not the only contributing tributaries between the USF and DSF stations, this data strongly suggests that they are contributing dilution.

In summary, water quality from streams and discharges draining both the Dal-Tex Mine Complex and the current operational portions of the Spruce No. 1 Mine confirm EPA's concern that the Spruce No. 1 Mine, if constructed as authorized, would contribute additional loads of selenium to downstream waters at concentrations that, as a monthly average, will exceed 5 µg/L.

V.D.1.b. Total Dissolved Solids

To understand the water quality impacts from increased total dissolved solids (TDS), it is helpful to understand the relationship between salinity, TDS, and specific conductivity. For purposes of this action, when this document discusses increased conductivity or TDS, it refers to an increase in salinity in otherwise dilute freshwater, an increase that is inconsistent with background levels in central Appalachian streams.

Salinity is the amount of dissolved salt in a given body of water. TDS is a measure of the combined content of all inorganic and organic substances contained in a solution in molecular, ionized or micro-granular (colloidal) suspended form and is normally reported in the unit mg/l. Because the majority of TDS in many waters consist primarily of salts, salinity effectively reflects the amount of TDS in water.

Salinity is often expressed in terms of specific conductivity (hereafter referred to as conductivity). Conductivity is the ability of a solution to carry an electric current at a specific temperature (normally 25° C) and is normally reported as microsiemens per centimeter (µS/cm). Whereas "salinity" refers to the environmental property that is being measured, "conductivity" refers to the *measure* of salinity. Conductivity and TDS both increase as the concentration of ions in a solution increase and are very strongly correlated. Conductivity itself is not a pollutant, but is an excellent indicator of the total concentration of all ions, and is typically reported by state and federal monitoring agencies because it is an instantaneous measurement that can be collected in situ with a meter, does not require a laboratory analysis, and is precise and accurate.

Data from the WVDEP indicate that average conductivity values for Pigeonroost Branch and Oldhouse Branch are very low and are consistent with dilute background conditions in central Appalachian headwater streams. Construction of valley fills and other discharges of dredged or fill material from the Spruce No. 1 Mine into Pigeonroost Branch and Oldhouse Branch will cause an increase in conductivity and TDS in those receiving waters downstream of such discharges. These discharges will have two effects: first, they will eliminate Pigeonroost Branch and Oldhouse Branch as sources of freshwater dilution to downstream waters, including Spruce Fork; and second, they will transform Pigeonroost Branch and Oldhouse Branch into sources of increased conductivity and TDS to downstream waters. Sediment ponds, which are a typical form of water treatment for surface coal mines, appear to be ineffective in removing TDS and decreasing conductivity. For example, average conductivity and sulfate levels are highly elevated in other tributaries to Spruce Fork where historical mining has occurred compared with Pigeonroost Branch and Oldhouse Branch (Table 10) (see Appendix 1).

Table 10. Average conductivity and sulfate values for streams in project area

Stream	Conductivity Values (µS/cm)	Sulfate Values (mg/l)
Rockhouse Creek	1012	407
Left Fork of Beech Creek	2426	1019
Beech Creek	1432	557
Trace Branch	971	569
Oldhouse Branch	90	28
Pigeonroost Branch	199	99

Average conductivity and sulfate concentrations in the main stem of Spruce Fork into which Pigeonroost Branch and Oldhouse Branch flow are elevated to as much as ten times above natural background levels in Oldhouse Branch. Average conductivity at almost every monitoring site on the main stem Spruce Fork exceeded 500 µS/cm. Only one site had an average conductivity of less than 500 µS/cm, which was located upstream of the project area, upstream of Adkins Fork, and southeast of Blair, WV.

EPA expects that these additional conductivity increases will have significant adverse effects on native aquatic macroinvertebrates and other wildlife that are not tolerant to increased conductivity. Invertebrate health depends upon an organism's ability to maintain certain concentrations of ions in their blood and tissues, which they pull from the water via specialized cells on their gills and body surfaces and lose through defecation/urination and diffusion. Native headwater invertebrates are adapted to streams with low dissolved solids (i.e., conductivity). In Central Appalachian surface coal mining, the ionic mixture emanating from valley fills is fairly predictable, and tends to be alkaline or circumneutral (pH 5.5-7.4), have highly elevated concentrations of four major ions (SO_4, HCO_3, Mg, Ca) and have only slightly elevated concentrations of K, Na, and Cl. Elevated levels of ions can be individually toxic, but mixtures of these ions can be more toxic than the individual ions, since more than one ion is a potential toxicant. Elevated ion concentrations can also create a general osmoregulatory stress on organisms that are adapted to environments with low dissolved solids (i.e., conductivity) (Pond et al. 2008). Elevated conductivity can have a toxic effect because the ions, regardless of type, can overwhelm the respiratory system and other physiological processes leading to impaired breathing, dehydration, and decreased survival or reproduction. Thus, native Appalachian taxa adapted to naturally dilute streams can be harmed by elevated conductivity for these physiological reasons. See Appendix 1 for further detail on water quality and wildlife.

EPA modeled post-mining conductivity levels in Spruce Fork downstream of the project area using a watershed area weighted deterministic model with two post-mining average (500 and 1000 μS/cm) and maximum (1000 and 1500 μS/cm) conductivity values for Oldhouse Branch, Pigeonroost Branch and Seng Camp Creek. These values likely underestimate the post-mining conductivity values. For example, when compared to Left Fork Beech Creek, which is completely mined and filled, the average and maximum conductivity values are 2425 and 3000 μS/cm respectively. In Beech Creek, which is partially mined and filled, the respective average and maximum conductivity values are 1432 and 1776 μS/cm based on 2002-2003 WVDEP data. In every case, since the measured average and maximum conductivity levels in Spruce Fork are currently greater than 500 μS/cm pre-mining, the modeled post-mining conductivity values are also greater than 500 μS/cm. When using the maximum post-mining values identified above, EPA predicts that average conductivity in Spruce Fork downstream of Seng Camp Creek could increase from 552 μS/cm pre-mining to 748 μS/cm post-mining and maximum conductivity could increase from 960 μS/cm pre-mining to 1228 μS/cm post-mining.

Thus, EPA has determined that that the construction of the Spruce No. 1 Mine will cause changes to water quality downstream of the mine site, particularly with regard to selenium and total dissolved solids. The following subsections discuss the adverse impacts on specific fauna caused by these changes in water quality.

V.D.2. Macroinvertebrates

Construction of valley fills and other discharges of dredged or fill material authorized by the DA Permit into Pigeonroost Branch and Oldhouse Branch will impact the native macroinvertebrate community downstream of the fill due to adverse changes in water quality. These adverse changes, such as increased selenium and conductivity, will result in subsequent changes in the aquatic community. Sensitive species of mayflies, stoneflies, and caddisflies currently inhabiting downstream waters will be extirpated following increasing chemical loading of contaminants, and the remaining taxa will likely serve as vectors for selenium bioaccumulation in higher trophic levels. Vertebrates dependent upon macroinvertebrates as a food source, including salamanders, fish, birds and bats, will be subsequently affected, not only by the bioaccumulation of selenium, but also by the reduction in prey availability. Additionally, shifts in macroinvertebrate communities will likely affect important stream ecosystem functions, including organic matter breakdown (Fritz et al. 2010).

V.D.2.a. Impacts Due to Changes in Water Chemistry

Construction of valley fills and other discharges of dredged or fill material associated with the Spruce No. 1 Mine into Pigeonroost Branch and Oldhouse Branch will result in altered and degraded macroinvertebrate communities in downstream environments (Appendix 2). The downstream effects of mining on macroinvertebrate communities include non-lethal effects and bioaccumulation of selenium, and extirpation of native, sensitive taxa. These effects can be significant, and are largely influenced by degraded water quality conditions downstream of valley fills. If the Spruce No. 1 Mine is constructed as authorized, these effects will occur in the receiving waters, including the unfilled portions of Pigeonroost Branch and Oldhouse Branch, and also further downstream in Spruce Fork. This conclusion is supported by numerous peer-reviewed studies, as well as empirical data collected and analyzed for the PEIS and permit application and discussed below.

Although there is little research on the direct effects of increased selenium loading on aquatic macroinvertebrates, some studies indicate the potential for macroinvertebrate populations to be adversely affected by selenium, even at concentrations below water quality thresholds established to protect fish and bird populations. For example, a review by Debruyn and Chapman (2007) found that the range of selenium water quality thresholds established to protect higher trophic levels consuming selenium-contaminated invertebrates could, in some cases, have substantial toxic effects on invertebrates, including reduced growth, reduced abundance, and mortality. Similarly, this review estimated that sublethal toxic effects can be associated with a range of water concentrations of 1-30 μg Se/L, which is consistent with experimental studies that found that some macroinvertebrate taxa exhibited approximately 50% reduction in abundance at Se water concentrations in the range of 5-10 μg Se/L. The remaining individuals that do survive accumulate the contaminants, thus exposing higher trophic levels (e.g., fish and amphibians) to concentrations that have the potential to cause population-level effects. Both the lethal and non-lethal effects on macroinvertebrate prey will result in significant impacts to higher trophic level organisms and food webs in the downstream ecosystem.

As outlined in Section V.D.1.b above, construction of valley fills and other discharges from the Spruce No. 1 Mine into Pigeonroost Branch and Oldhouse Branch will cause an increase in salinity and TDS in receiving waters immediately downstream of valley fills. Bryant et al. (2002) found substantially higher average measurements of alkalinity, calcium, sulfate and total dissolved solids in nearby streams affected by mining than in streams unaffected by mining streams in the Spruce No. 1 project area. Increased concentrations of TDS can have significant implications for native wildlife. While many of the elements that comprise mineral salts are essential nutrients, aquatic organisms are adapted to specific ranges of salinity and experience toxic effects from excess salinity.

Due to the sensitivity of native macroinvertebrate wildlife to elevated and increasing levels of conductivity, the predicted levels of these contaminants will have significant adverse effects on these biological communities. While changes in community composition downstream of mined sites are likely due to a combination of factors, it is likely that water quality changes, including water quality degradation from valley fills and in-stream mining impoundments, are the primary cause of aquatic life impacts below valley fills (Appendix 2). EPA's draft report, *A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams* (USEPA 2010a), also recognizes stream aquatic life impacts associated with conductivity, concluding that impacts to the biological community can occur at conductivity levels as low as 300 μS/cm.

The effects of mining on macroinvertebrate communities are evident when comparing the least-disturbed streams in the project area (Oldhouse Branch and Pigeonroost Branch) with nearby streams directly affected by valley fills (Beech Creek and Left Fork Beech Creek). Collectively, Pigeonroost Branch and Oldhouse Branch support 84 unique macroinvertebrate genera, in contrast with Beech Creek and Left Fork Beech Creek, which only support 56 unique macroinvertebrate genera. Additionally, many Ephemeroptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddisfly) genera (collectively known as EPT taxa)[16] were extirpated from these nearby streams affected by mining (Table 11). Pigeonroost Branch and Oldhouse Branch support 42 EPT genera (14 mayfly genera, 12 stonefly genera and 14 caddisfly genera), in contrast with Beech Creek and Left Fork Beech Creek, which only support 12 EPT genera (2 mayfly genera, 3 stonefly genera, and 7 caddisfly genera).

At Beech Fork and Left Fork Beech Fork, in addition to the presence of relatively pollution-tolerant mayfly and stonefly genera, there were also several tolerant taxa that were not found in the Spruce project area. These taxa, which are indicative of altered environmental conditions (i.e., atypical of Appalachian headwater streams), include highly tolerant snails (Lymnaeidae, *Physella, Helisoma*), as well as other tolerant beetles and fly larvae (Table 11). Similar patterns of taxonomic loss were observed at 20 other West Virginia sites downstream of valley fills when conductivity was greater than 500 μS/cm (Pond et al. 2008) and in the eastern Kentucky coalfields (Pond 2010), and it is likely that these effects on wildlife taxa and their habitat will occur following the Spruce No. 1 Mine operations (Appendix 2).

[16] EPA focused on genus-level taxa richness (i.e., the number of genera) of Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) taxa (EPT taxa), as it can be used to detect shifts in community composition and extirpation of sensitive taxa (Appendix A2.7).

Table 11. Comparison of macroinvertebrate taxa identified on the Spruce No. 1 Mine site and Dal-Tex site.

			Oldhouse +Pigeonroost	Beech + Left Fork Beech
Order	**Family**	**Genus**	**Spruce No. 1 Mine**	**Dal-Tex Mine**
Oligochaeta	Oligochaeta	Oligochaeta	X	X
Nematoda	Nematoda	Nematoda		X
Proseriataoela	Plagiostomidae	*Hydrolimax*	X	
Tricladida	Planariidae	Planariidae	X	
Basommatophora	Lymnaeidae	Lymnaeidae		X
Basommatophora	Physidae	Physella		X
Basommatophora	Planorbidae	*Helisoma*		X
Coleoptera	Dryopidae	*Helichus*	X	
Coleoptera	Elmidae	*Dubiraphia*		X
Coleoptera	Elmidae	*Macronychus*		X
Coleoptera	Elmidae	*Microcylloepus*		X
Coleoptera	Elmidae	*Optioservus*	X	X
Coleoptera	Elmidae	*Oulimnius*	X	X
Coleoptera	Psephenidae	*Ectopria*	X	
Coleoptera	Psephenidae	*Psephenus*	X	X
Decapoda	Cambaridae	*Cambarus*	X	
Diptera	Ceratopogonidae	*Atrichopogon*		X
Diptera	Ceratopogonidae	*Bezzia/Palpomyia*	X	X
Diptera	Ceratopogonidae	*Dasyhelea*	X	X
Diptera	Chironomidae	*Acricotopus*		X
Diptera	Chironomidae	*Chaetocladius*	X	X
Diptera	Chironomidae	*Corynoneura*	X	X
Diptera	Chironomidae	*Cricotopus*	X	X
Diptera	Chironomidae	*Diamesa*	X	X
Diptera	Chironomidae	*Eukiefferiella*	X	X
Diptera	Chironomidae	*Metriocnemus*		X
Diptera	Chironomidae	*Micropsectra*	X	X
Diptera	Chironomidae	*Microtendipes*	X	
Diptera	Chironomidae	*Orthocladius*	X	X
Diptera	Chironomidae	*Parachaetocladius*	X	
Diptera	Chironomidae	*Parametriocnemus*	X	X
Diptera	Chironomidae	*Paraphaenocladius*		X
Diptera	Chironomidae	*Paratanytarsus*		X
Diptera	Chironomidae	*Polypedilum*	X	X
Diptera	Chironomidae	*Rheotanytarsus*	X	X
Diptera	Chironomidae	*Smittia*		X
Diptera	Chironomidae	*Stempellinella*	X	
Diptera	Chironomidae	*Stenochironomus*		X
Diptera	Chironomidae	*Stilocladius*	X	
Diptera	Chironomidae	*Sympotthastia*	X	
Diptera	Chironomidae	*Tanytarsus*	X	
Diptera	Chironomidae	*Thienemanniella*		X
Diptera	Chironomidae	*Thienemannimyia*	X	X
Diptera	Chironomidae	*Tvetenia*	X	X
Diptera	Chironomidae	*Zavrelimyia*	X	
Diptera	Empididae	*Chelifera/Metachela*	X	X
Diptera	Empididae	*Clinocera*	X	
Diptera	Empididae	*Hemerodromia*		X
Diptera	Simuliidae	*Prosimulium*	X	
Diptera	Simuliidae	*Simulium*	X	X

Diptera	Tabanidae	Tabanidae		X
Diptera	Tipulidae	*Antocha*		X
Diptera	Tipulidae	*Cryptolabis*	X	
Diptera	Tipulidae	*Dicranota*	X	
Diptera	Tipulidae	*Hexatoma*	X	
Diptera	Tipulidae	*Limnophila*	X	
Diptera	Tipulidae	*Limonia*	X	X
Diptera	Tipulidae	*Pseudolimnophila*	X	
Diptera	Tipulidae	*Tipula*	X	X
Ephemeroptera	Ameletidae	*Ameletus*	X	
Ephemeroptera	Baetidae	*Acentrella*	X	
Ephemeroptera	Baetidae	*Baetis*	X	X
Ephemeroptera	Baetiscidae	*Baetisca*	X	
Ephemeroptera	Ephemerellidae	*Drunella*	X	
Ephemeroptera	Ephemerellidae	*Ephemerella*	X	
Ephemeroptera	Ephemerellidae	*Eurylophella*	X	
Ephemeroptera	Ephemeridae	*Ephemera*	X	
Ephemeroptera	Heptageniidae	*Cinygmula*	X	
Ephemeroptera	Heptageniidae	*Epeorus*	X	
Ephemeroptera	Heptageniidae	*Stenacron*	X	
Ephemeroptera	Heptageniidae	*Maccaffertium/ Stenonema*	X	
Ephemeroptera	Isonychiidae	*Isonychia*	X	X
Ephemeroptera	Leptophlebiidae	*Paraleptophlebia*	X	
Megaloptera	Corydalidae	*Corydalus*		X
Megaloptera	Corydalidae	*Nigronia*	X	X
Odonata	Aeshnidae	*Boyeria*		X
Odonata	Gomphidae	*Lanthus*	X	X
Plecoptera	Capniidae	Capniidae	X	
Plecoptera	Chloroperlidae	*Haploperla*	X	
Plecoptera	Leuctridae	*Leuctra*	X	
Plecoptera	Nemouridae	*Amphinemura*	X	X
Plecoptera	Nemouridae	*Ostrocerca*	X	
Plecoptera	Nemouridae	*Prostoia*		X
Plecoptera	Peltoperlidae	*Peltoperla*	X	
Plecoptera	Perlidae	*Acroneuria*	X	
Plecoptera	Perlodidae	*Isoperla*	X	
Plecoptera	Perlodidae	*Remenus*	X	
Plecoptera	Perlodidae	*Yugus*	X	
Plecoptera	Pteronarcyidae	*Pteronarcys*	X	
Plecoptera	Taeniopterygidae	*Taenionema*	X	
Plecoptera	Taeniopterygidae	*Taeniopteryx*	X	X
Trichoptera	Glossosomatidae	*Agapetus*	X	
Trichoptera	Glossosomatidae	*Glossosoma*	X	
Trichoptera	Goeridae	*Goera*	X	
Trichoptera	Hydropsychidae	*Ceratopsyche*	X	
Trichoptera	Hydropsychidae	*Cheumatopsyche*	X	X
Trichoptera	Hydropsychidae	*Diplectrona*	X	X
Trichoptera	Hydropsychidae	*Hydropsyche*	X	X
Trichoptera	Hydroptilidae	*Hydroptila*		X
Trichoptera	Limnephilidae	*Pycnopsyche/ Hydatophylax*	X	
Trichoptera	Philopotamidae	*Chimarra*	X	X
Trichoptera	Philopotamidae	*Dolophilodes*	X	
Trichoptera	Polycentropodidae	*Polycentropus*	X	
Trichoptera	Psychomyiidae	*Psychomyia*	X	X
Trichoptera	Rhyacophilidae	*Rhyacophila*	X	X

Trichoptera	Uenoidae	*Neophylax*	X	
		Total Distinct Taxa	**84**	**56**
		Total EPT Taxa	**42**	**12**

In order to support the determination that unacceptable adverse effects will occur downstream, EPA applied an accepted and peer reviewed approach, called an Observed/Expected index (O/E), where O/E ratios represent the number of the expected taxa that are observed in a sample (O), compared to the number of taxa expected in the sample (E), after predicting the probability that a sample site is a member of one or more fixed sets of reference site types (Hawkins 2006a, Van Sickle 2005) (Figure 14). This method uses a suite of regional reference sites to determine the number of expected taxa; and deviation from this number can be used to identify an degradation threshold (see Appendix 2 for detailed methods and results). A site that is a perfect match to the reference site O/E scores will score 1.0, while downward deviation from 1.0 indicates loss of expected taxa compared to regional reference (e.g., a score of 0.50 indicates a 50% loss of the expected taxa). Upward deviation (greater than 1.0) indicates that more taxa were collected than expected. EPA chose the 5th percentile of reference site O/E scores as a degradation threshold to correspond to the WVDEP's bioassessment threshold for aquatic life use impairment. This O/E 5th percentile was 0.64, indicating a loss of 36% of expected taxa would indicate degradation of the in-stream biota.

Based upon the O/E index, EPA found that the macroinvertebrate assemblages in Pigeonroost Branch, Oldhouse Branch and the upstream White Oak Branch are comparable to the regional reference sites, while nearby streams affected by valley fills (Dal-Tex sites) were well below the degradation threshold (O/E less than 0.64) (Table 12). Mean scores for the Dal-Tex sites were 0.26 in the summer and 0.32 in the spring, indicating they support, on average, 74% and 68% less taxa, respectively, than the regional reference sites. Thus, past mining has led to the estimated extirpation of ~70% of the native expected taxa in the adjacent Dal-Tex Mine operation.

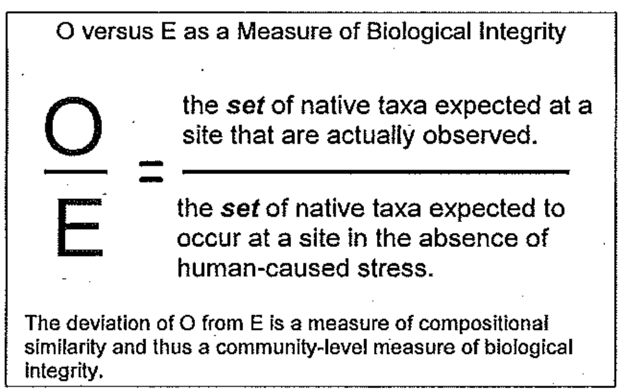

Figure 14. Measure of biological integrity; Observed vs. Expected (C.P. Hawkins, Utah State Univ.)

Extirpation of macroinvertebrate taxa, documented by the O/E index, is largely caused by water quality degradation. Using the regional reference sites and genus-level data from Pond et al. (2008), O/E scores showed a negative correlation with conductivity (R^2=0.63). Water quality degradation caused by elevated conductivity explained more than twice the variance in O/E scores than did Rapid Bioassessment Protocol (RBP) habitat scores (R^2=0.28), confirming that conductivity is an excellent predictor of native taxa loss from Appalachian streams. Sediment deposition, substrate embeddedness, channel alteration, riparian zone width, pH, or temperature had no significant influence on O/E scores (see Appendix 2).

Table 12. Summary of West Virginia O/E null model results for the Spruce No. 1 Mine area. The biological degradation threshold is 0.64 (corresponding to the 5th percentile of WVDEP reference site distributions).

Mean (Standard Deviation) O/E			
	Spruce No. 1 Mine	Dal-Tex	
	Pigeonroost Branch, Oldhouse Branch, White Oak Branch	Beech Creek, Left Fork Beech Creek	Rockhouse
Spring	0.98 (0.20); n=9	0.26 (0.06); n=5	0.31 (0.10); n=3
Summer	0.85 (0.15); n=2	0.32 (0.08); n=2	0.38 (0.08); n=2

To provide additional support that aquatic life use degradation occur downstream of valley fills and that these impairments result from water quality degradation, streams that are affected by mining were compared to streams that are not affected by mining using the West Virginia Stream Condition Index (WVSCI), WVDEP's family-level multi metric index (see Appendix 2 for detailed methods and results). Currently, the WVDEP uses WVSCI index scores greater than 68 to indicate streams fully supportive of the aquatic life use.[17] Streams unaffected by mining within and near the project area, including White Oak Branch, Oldhouse Branch and Pigeonroost Branch, generally scored above the 68 threshold index value, indicating they are high quality streams that fully support the aquatic life use (see Appendix 2). The streams located in the historically mountaintop mined areas with valley fills located nearby (Rockhouse Branch, Beech Creek, and the Left Fork of Beech Creek) generally scored below the 68 threshold index value, indicating they do not fully support aquatic life use.

In Pond et al. (2008) elevated conductivity greater than 500 µS/cm caused by alkaline mine effluents was strongly associated with high probability of degradation of native biota, and 17 of the 20 mined study sites (85%) did not fully support aquatic life, based upon the family-level WVSCI index. In addition, WVDEP ambient monitoring macroinvertebrate data from the Cumberland Mountains of the Central Appalachians subecoregion, the subecoregion where the project is located, were analyzed to determine the potential effects of elevated conductivity levels on aquatic life use. When conductivity levels were elevated above 500 µS/cm, the analysis showed that a majority of the sites were not fully supportive of aquatic life use, even when accounting for the possible confounding effects of acidic pH and habitat degradation. For example, after removing low pH sites, only 100 sites out of 417 sites attained WVSCI scores greater than 68 when conductivity levels were greater than 500 µS/cm (76% of the sites reflected WVSCI scores less than 68). When the potential confounding effect of habitat

[17] This score represents the lower 5th percentile of the range of scores of the 107 reference site scores used in the 2000 report (Gerritsen et al. 2000). As noted elsewhere, in its 2008 Section 303(d) List, WVDEP identified a WVSCI score of 68 as the lowest score at which a waterbody was considered to "fully support" aquatic life. A score of less than 68 indicates degradation of the aquatic life use.

degradation was completely removed (this subset includes only sites with Rapid Bioassessment Protocol habitat scores greater than 140, indicating reference quality habitat), 62% of the sites still had WVSCI scores less than 68.

In addition to changes in community structure and loss of sensitive taxa, functional feeding group composition (based on WVDEP group designations) is also significantly altered below mountaintop mining operations with valley fills. An analysis of functional feeding groups revealed categorical dose-response for unmined, low (<500), medium (500-1000), and high (>1000) conductivity (Table 13; data from Pond et al. 2008). Functional feeding group relative abundance of scrapers (herbivorous grazers) and functional feeding group richness for scrapers, shredders, and collector-gatherers was higher at unmined sites and declined with increasing conductivity category, while the relative abundance of collector-filterers increased. In a comparison of sites with conductivity <500 μS/cm (n=17) to sites with conductivity >500 μS/cm (n=20), there were significant alterations of trophic composition, with increased %collector-filterer abundance and declines in genus-level scraper richness, shredder richness, collector-gatherer richness and %scraper abundance at sites with higher conductivity (Table 13). Further, several functional feeding group metrics were strongly correlated to specific conductance (Table 13).

Table 13. Mean richness and relative abundance of functional feeding groups among conductivity categories (data from Pond et al. 2008). Additional comparisons of sites (<500 μS/cm and >500 μS/cm) include P-values for Mann-Whitney U-tests shown. Spearman correlations of FFGs with conductivity are also shown. Bold values are significant ($p<0.05$).

FFG (Richness)	Unmined	Low	Medium	High	Combined Unmined + Mined (low)	Combined Mined (Medium+ High)	Mann-Whitney U-test	*P*	Correlation to Conductivity: Spearman *r*
# Scraper Genera	**7.4**	**5.0**	**2.1**	**0.9**	**6.4**	**1.4**	**333.5**	**0.000**	**-0.85**
# Shredder Genera	**4.5**	**3.4**	**2.0**	**2.0**	**4.1**	**2.6**	**244.0**	**0.021**	**-0.50**
# Coll-Gatherer Genera	**10.5**	**9.1**	**7.3**	**7.3**	**9.9**	**7.9**	**240.0**	**0.031**	**-0.48**
# Coll-Filterer Genera	3.0	4.7	3.6	3.6	3.7	3.9	143.0	0.389	0.10
# Predator Genera	7.2	4.7	3.7	3.7	6.2	4.3	232.0	0.057	**-0.44**
# Piercer-Herb Genera	0.1	0.0	0.0	0.1	0.1	0.1	171.5	0.907	-0.03

FFG (Rel. Abundance)	Unmined	Low	Medium	High	Combined Unmined +Mined (low)	Combined Mined (Medium+ High)	Mann-Whitney U-test	*P*	Correlation to Conductivity: Spearman *r*
% Scraper	**29.1**	**7.6**	**9.1**	**1.6**	**18.4**	**5.4**	**304.0**	**0.000**	**-0.79**
% Shredder	24.8	43.0	28.8	19.3	33.9	24.1	224.5	0.097	-0.23
% Coll-Gatherer	29.5	28.5	32.3	33.7	29.0	33.0	149.0	0.437	0.04
% Coll-Filterer	**7.7**	**14.6**	**17.5**	**41.2**	**11.2**	**29.4**	**78.5**	**0.005**	**0.60**
% Predator	8.4	6.0	11.9	3.9	7.2	7.9	199.0	0.376	-0.40
% Piercer-Herbivores	0.1	0.0	0.0	0.2	0.1	0.1	167.0	0.920	0.01

Construction of valley fills, sediment ponds, and other discharges of dredged or fill material into Pigeonroost Branch and Oldhouse Branch as authorized by the DA permit will contribute increased loadings of TDS to downstream receiving waters within the Headwaters Spruce Fork sub-watershed and Coal River sub-basin, further exacerbating biological impairments. The WVDEP data from the Spruce Fork, Pond Fork and Little Coal River watersheds indicate that nearby streams affected by mines, as well as the main stem of Spruce Fork, Pond Fork and the Little Coal River currently do not fully support aquatic life use (see Appendix 1). The adverse impacts in the main stem of Spruce Fork, Pond Fork, and the Little Coal are likely due to a combination of stressors, including mining and residential stressors (WVDEP 1997a). Because these downstream waters have existing biological impairments, increased loading of TDS from this project will further reduce the ability of these waters to support aquatic life use.

V.D.2.b. Food Web Effects of Altered Macroinvertebrate Communities

The direct burial of streams and subsequent water quality changes downstream associated with the authorized project will significantly alter macroinvertebrate assemblages, as well as the overall abundance and productivity of macroinvertebrate communities; and thus, through cascading food web effects, likely adversely impact vertebrate species which depend upon the macroinvertebrate community within these streams for nourishment (Figure 7). Project impacts on these aquatic invertebrates will likely alter in-stream functions (e.g., organic matter processing and transport, and nutrient cycling and transport), in part because research has shown that processing rates of terrestrial plant material inputs are reduced in mine-affected streams with altered macroinvertebrate assemblages (Fritz et al. 2010). Also, it is likely that impacts to aquatic invertebrates will have adverse effects on animals dependent on insect larvae and emergent adults as prey, including fish, amphibians, bats, birds, reptiles and small mammals (Baxter et al. 2005). In particular, mayflies (Ephemeroptera) tend to be a preferred prey item for juvenile Smallmouth Bass (Easton et al. 1996), an important sport fish in Spruce Fork, and anticipated declines in mayfly immediately downstream of valley fills will have adverse effects on this sport fishery, as reduced mayfly populations will be present and there will be a reduced pool of colonizers to repopulate areas where populations were impacted.

In addition, research has shown that selenium often has non-lethal effects on macroinvertebrates, allowing them to act as vectors in the movement of selenium to higher levels of the food chain.

V.D.3. Salamanders & Other Herpetofauna

Impacts from the activities authorized will have a significant adverse impact on salamanders and other herpetofauna downstream of the project area due to changes in water chemistry, as well as subsequent food web effects. Adverse impacts to salamanders as a result of construction of valley fills and other discharges authorized by the DA Permit into Pigeonroost Branch and Oldhouse Branch will not be localized to the area to be filled. Because construction of the valley fills and other discharges will increase conductivity and selenium levels in the downstream receiving waters (see Section V.D.1.), salamanders that are not directly buried and killed beneath the fills will also be impacted; directly via exposure to these contaminants and indirectly via impacts of contaminants on food sources and reduced prey abundances. Studies have documented elevated selenium levels in salamander tissue downstream of valley fills and that salamander assemblages were more likely to be impaired downstream of valley fills than in other locations (Patnode, et al. 2005). Such impacts will occur as far downstream as elevated conductivity, selenium or other contaminants persist, and to affect any salamanders that spend some part of their life in the aquatic environment or in immediately adjacent riparian terrestrial habitats.

Furthermore, as set forth in Section V.D.4.a., the construction of valley fills, sediment ponds, and other discharges into Pigeonroost Branch and Oldhouse Branch will create conditions considered favorable to the growth of golden algae *(Prymnesium parvum)*, which can produce a toxin that is highly toxic to aquatic life and was associated with an extensive aquatic life kill of both fish and lungless salamanders in Dunkard Creek in West Virginia in September 2009.

V.D.4. Fish

The fish assemblages in Pigeonroost Branch and Oldhouse Branch downstream of the project area, as well as in Spruce Fork, are neither impaired nor representative of pristine or reference condition. Basin size is a particularly important factor when assessing the potential effects of valley fills on streams because small streams (less than 10 square kilometer) have shown effects to the fish assemblage while larger streams have not (e.g., Fulk et al. 2003). Nevertheless, Fulk et al. (2003) found significant differences in total IBI scores between streams that are affected by mines and those that are not. This difference was attributed to changes in cyprinid species richness and the percent of the assemblage composed of benthic invertebrate feeders.

Studies have shown that mountaintop mining for coal and construction of valley fills has had a harmful effect on the composition of stream fish communities (Fulk et al., 2003, Stauffer and Ferreri, 2002). Comparison of streams without mining in the watershed and sites downstream of valley fills in Kentucky and West Virginia indicate that streams affected by mining had significantly fewer total fish species and fewer benthic fish species than streams without mining in the same areas (Stauffer and Ferreri, 2002), likely due to changes in water quality. Surface coal mining and associated increases in conductivity and total dissolved solids and construction of sediment ponds have been shown to create conditions considered favorable to the growth of golden algae (*Prymnesium parvum)*, which has caused large aquatic life kills; and conditions favorable to golden algae growth will occur in Pigeonroost Branch and Oldhouse Branch. Fish also will be exposed to increases in selenium concentrations, which will lead to bioaccumulation in fish tissues and to reproductive effects (see Section V.D.1.a.). Additionally, increases in conductivity and total dissolved solids will have a significant adverse effect on aquatic macroinvertebrates, some of which are preferential prey items for the fish species present in these streams, and, as a result, these fish will likely be similarly adversely affected (see Section V.D.2.b.).

V.D.4.a. Potential to Promote the Growth of Golden Algae

Construction of valley fills and other discharges authorized by DA Permit No. 199800436-3 (Section 10: Coal River) into Pigeonroost Branch and Oldhouse Branch as authorized will create in-stream conditions in or near Spruce Fork favorable to the growth of golden algae (*Prymnesium parvum),* which releases toxins that kill fish and other gill-breathing aquatic organisms. *P. parvum* is a haptophyte (flagellated) algae now distributed worldwide. This alga has been known to occur in North America since the 1980s (Baker et al., 2007) and has since become established in rivers and reservoirs in several states. *P. parvum* is responsible for harmful algal blooms that have killed millions of fish in Texas and Oklahoma, and has been implicated in kills from North Carolina to Arizona.

P. parvum has also been associated with an extensive and severe aquatic life kill in the central Appalachians, in which thousands of fish, mussels and other aquatic organisms were destroyed in Dunkard Creek in West Virginia and Pennsylvania (Roelke et al.2010, Sager et al.2008). During September 2009, biologists reported observations of thousands of dead fish, mussels and salamanders in Dunkard Creek (Hambright 2010). Mud puppies, an aquatic salamander that lives its entire life underwater, crawled out of the water and onto rocks and the shoreline in an attempt to escape from the toxic water. Field biologists observed numerous individuals as dried up carcasses on rocks and along the shoreline. Fish were observed avoiding the main stem of Dunkard Creek by practically "stacking up" in the mouths of tributaries, subjecting themselves to feeding by blue heron rather than remaining in the toxic water of main stem Dunkard Creek. The identification of *P. parvum* in 2009 in Dunkard Creek was the first identification of this invasive aquatic species in the Mid-Atlantic States (Roelke et al.2010).

The factors that are most closely associated with supporting growth of *P. parvum* are believed to be:

1. Proximity to a known source of *Prymnesium parvum.*
2. TDS in high enough concentrations to support *P. parvum* (estimated to be between 500 and 1000 mg/L (conductivity 714-1428 µS/cm).
3. Nutrients in concentrations high enough to initiate a bloom of *P. parvum* (Baker et al. 2009)
4. pH greater than 6.5. Risk increases with increasing pH (Baker et al. 2009).
5. Areas of habitat that are pooled (large beaver dams, natural residual pools, or manmade ponds)

EPA believes that the Spruce No. 1 Mine will increase the probability that all five factors are met within the Headwaters Spruce Fork sub-watershed, as outlined below.

Proximity to Known Source: P. parvum was identified (in very high numbers) in Cabin Creek of the Kanawha drainage, only 25 miles to the East. Because these algae can easily move with waterfowl, the risk of introducing *P. parvum* in the Spruce Fork drainage is high. Although not currently found in Spruce Fork, the WVDEP has identified Spruce Fork as a "water of concern" because of its potential (due to already high levels of TDS/conductivity) to support *P. parvum* blooms consistent with the factors shown above.

High TDS: The lower TDS limits for the growth of *P. parvum* appears to be ~500 mg/l TDS, or ~700μS/cm conductivity for the ion mixtures typical of alkaline mine drainage (Hambright 2010). Recent data indicate that growth of *P. parvum* increases 200-300% when conductivity increases from 500 μS/cm to 1000 μS/cm (unpublished data, WVDEP, 2010, Hambright 2010). The waters draining the nearby Dal-Tex Mine operation have conductivity levels greater than these values. Many of the sampling sites on the main stem of Spruce Fork, Pond Fork and the Little Coal River also have conductivity levels exceeding these endpoints. Other waters of concern near the Spruce No. 1 Mine include the Little Coal River and West Fork/Pond Fork. As described in SectionV.D.1.b., construction of valley fills and other discharges authorized by DA Permit No. 199800436-3 (Section 10: Coal River) into Pigeonroost Branch and Oldhouse Branch is expected to increase levels of TDS/conductivity in Spruce Fork, thus creating conditions more favorable to *P. parvum*.

Suitable Nutrient Levels: Nutrient levels in the Spruce Fork are very similar to those in Dunkard Creek and other watersheds with *P. parvum* algae present (e.g. Whitely Creek, PA). Phosphorous in Spruce Fork was over 100 μg/L on two sampling occasions during the PEIS.

High pH: Discharges from Spruce No. 1 Mine are likely to be alkaline, consistent with pH of discharges from Dal-Tex and other operations.

Existence of Pooled Habitats: Pooled habitats with little to no flow are common in streams like Spruce Fork in low flow conditions of September and October, when TDS is highest. In addition, DA Permit No. 199800436-3 (Section 10: Coal River) authorizes construction of numerous sediment ponds in Pigeonroost Branch and Oldhouse Branch which will create areas of pooled habitat more favorable to *P. parvum*. During low flows, conductivity is typically highest, increasing the possibility that blooms could occur in very slow moving residual pools within the channel.

V.D.4.b. Increased Exposure to Selenium

The construction of valley fills and other discharges authorized by the DA Permit into Pigeonroost Branch and Oldhouse Branch will result in elevated levels of selenium in the receiving waters. While selenium is a naturally occurring chemical element that is an essential micronutrient, excessive amounts of selenium can have toxic effects on fish. Selenium toxicity is primarily manifested as reproductive impairment and birth defects due to maternal transfer, resulting in embryonic physical mutations and death in egg laying vertebrates such as fish and ducks.

Several nearby streams in the Coal River sub-basin have available data that indicate that construction of the Spruce mine and associated discharges can result in impacts to wildlife. According to the WVDEP's study, "Selenium Bioaccumulation among select stream and lake fishes in West Virginia" (WVDEP 2009), Seng Creek had the highest average water column concentration (27.20 ppb) and a corresponding average fish tissue concentration of 8.16 ppm, while Beech Creek had a water concentration of 12.30 ppb with a corresponding average fish tissue concentration of 7.55 ppm. In Seng Creek, creek chub egg/ovary tissue (mean = 19.9 ppm; range = 16.4 - 23.7 ppm; n= 4) and water measurements (mean = 15.8 ug/L; range = 8-45 ug/L; n = 11) indicate that both fish tissue and water numbers would exceed 5 ug/L and these levels have been documented to resulted in unacceptable tissue concentrations in the reproductive tissue. Similarly, water and fish tissue samples from Mud River also show unacceptable impacts to fish. Creek chub egg ovary (composite measurement of 17.6 in egg/ovary tissue) and water measurements (mean = 9.5 ug/L; range = 4-22 ug/L; n = 21) in Mud River show that selenium concentrations exceed 5 ug/L and has resulted in unacceptably high tissue concentrations in fish.

As discussed in Section V.D.1.a., construction of the Spruce No. 1 Mine will disturb selenium bearing strata consistent with the strata disturbed by the Dal-Tex complex, will remove Pigeonroost Branch and Oldhouse Branch as sources of dilution, and will increase in-stream selenium concentrations to levels comparable with the Dal-Tex complex. The foregoing data supports EPA's view that the increased selenium resulting from the Spruce No. 1 Mine will elevate fish tissue concentrations to levels that will result in unacceptable adverse impacts in wildlife.

V.D.5. Water-dependent Birds

The indirect effects on Louisiana Waterthrush populations are attributable to the loss of aquatic macroinvertebrate food sources and water quality impacts associated with construction of the Spruce No. 1. Mine. As stated in Section IV.B.4. above, the Louisiana Waterthrush is an area-sensitive riparian-obligate species whose breeding success depends on the diverse and productive assemblage of aquatic insects supported by healthy headwater systems (Mattson and Cooper 2009). Birds dependent on aquatic insect larvae and emergent adults as prey, such as the Louisiana Waterthrush, will be adversely affected by the project due to food web effects associated with altered aquatic macroinvertebrate communities (see Section V.D.2.a.).

Studies indicate that breeding territory density and occupancy are reduced along streams where benthic macroinvertebrate communities had been degraded due to anthropogenic land uses including mining (Mulvihill 1999, 2008, Mattsson and Cooper 2009, O'Connell et al. 2003). For example, lower breeding territory densities have occurred along streams impacted by acid mine drainage more so than along circumneutral streams (Mulvihill 1999, 2008). The driver behind these lower densities is decreased food availability, as acid mine drainage has a similar effect on macroinvertebrate populations as alkaline drainage and salinity (Mulvihill 2008). Similarly, some indices of benthic macroinvertebrate integrity are shown to be higher where breeding Louisiana Waterthrushes are present than areas from which they are absent (O'Connell et al.2003). Stream reaches where breeding waterthrushes were present also had a greater proportion of pollution-sensitive benthic macroinvertebrates than reaches where waterthrushes were absent, supporting the concept that good water quality is a key component of the species breeding habitat (Mulvihill 2008).

In addition to impacts resulting from the loss of macroinvertebrate food sources, studies also indicate that the Louisiana Waterthrush will be adversely affected by increased exposure to selenium through prey consumption. Since Waterthrush diet is comprised of aquatic and terrestrial insects, as well as small fish and amphibians, where selenium levels are elevated in macroinvertebrate and salamander populations, Waterthrush will be exposed in a majority of their prey (Patnode et al. 2005) .

As the scientific literature demonstrates, Louisiana Waterthrush populations are vulnerable to impairments in water quality downstream of mining operations. EPA believes that there will be unacceptable adverse impacts to Louisiana Waterthrush populations downstream of the Spruce No. 1 project area as the result of indirect water quality impacts from the filling of Pigeonroost Branch and Oldhouse Branch and their tributaries.

V.D.6. Summary

Construction of valley fills, sediment ponds, and other discharges authorized by DA Permit No. 199800436-3 (Section 10: Coal River) in Pigeonroost Branch and Oldhouse Branch will eliminate headwater stream systems that support some of the last remaining least-disturbed conditions within the Coal River sub-basin and will therefore result in a significant loss of wildlife habitat. The burial of these streams will lead to discharges of TDS and selenium, which will result in unacceptable adverse effects on wildlife in downstream waters. Increased salinity levels will lead to loss of macroinvertebrate communities and population shifts to more pollution-tolerant taxa, specifically the extirpation of ecologically important macroinvertebrates. Through the loss of stream macroinvertebrate and salamander communities, there will be, in turn, substantial effects to both aquatic and terrestrial vertebrate populations that rely on these communities as a food source.

It is well recognized that the loss of a certain number of individuals of a species in a local ecological community can be tolerated, provided that the species continues to reproduce to replace lost individuals. However, when species are impacted by both acute stressors (e.g., food web changes, algal blooms) and exposure to reproductive toxicants, there is an increased risk of the loss of an entire species within an area. The loss of macroinvertebrate prey populations, increased risk of harmful golden algal blooms, and additional exposure to selenium will have an unacceptable adverse effect on the 26 fish species found in Spruce Fork as well as amphibians, reptiles, crayfish, and bird species that depend on downstream waters for food or habitat.

Based on this information, EPA has concluded that the discharges of dredged or fill material to Pigeonroost Branch and Oldhouse Branch as authorized by DA Permit No. 199800436-3 (Section 10: Coal River) will have unacceptable adverse effects on wildlife downstream of the Spruce No. 1 Mine.

V.E Compliance with Relevant Portions of the § 404(b)(1) Guidelines

EPA has broad discretion under § 404(c) in evaluating and determining whether a discharge will result in "unacceptable adverse effects." EPA has concluded, in this case, that burying 6.6 miles of rare and important high quality streams will have an unacceptable adverse impact on the wildlife that rely on those streams for all or part of their life cycles, and that the discharges of TDS and selenium, loss of freshwater dilution from these buried streams, and significant alteration of aquatic macroinvertebrate communities will have an unacceptable adverse effect to aquatic wildlife downstream of the mining operation. Each of these determinations on its own is a sufficient basis to withdraw the specification of these streams as disposal sites and to prohibit the specification of the defined area constituting Pigeonroost Branch, Oldhouse Branch and their tributaries for use as a disposal site associated with future surface coal mining that would be expected to result in a nature and scale of adverse chemical, physical, and biological effects similar to the Spruce No. 1 mine

In addition, EPA's § 404(c) regulations at 40 CFR 231.2(e) provide that in evaluating the "unacceptability" of impacts, consideration should be given to the "relevant portions of the § 404(b)(1) Guidelines." As discussed further below, EPA has identified numerous inconsistencies with the requirements of the § 404(b)(1) Guidelines. In Sections V.C. and V.D., EPA determined that there are unacceptable adverse impacts to wildlife, and the Agency's evaluation of compliance with relevant portions of the Guidelines in this section provides support and confirmation of the conclusion that the impacts are unacceptable.

For purposes of the Spruce No. 1 Mine, the relevant portions of the § 404(b)(1) Guidelines that are particularly important for assessing the unacceptability of environmental impacts include:

- Less environmentally damaging practicable alternatives (40 CFR 230.10(a))
- Significant degradation of waters of the United States (40 CFR 230.10(c))
    - Cumulative effects (40 CFR 230.11(g))
    - Secondary effects (40 CFR 230.11(h))
- Minimization of adverse impacts to aquatic ecosystems (40 CFR 230.10(d))

V.E.1. Less Environmentally Damaging Alternatives/Failure to Minimize Impacts

The § 404(b)(1) Guidelines state at 40 CFR 230.10(a) that no permit may be issued if there is a practicable alternative that would result in less damage to aquatic resources while still meeting the basic project purpose, provided it would not result in other significant adverse environmental impacts. Similarly, 40 CFR 230.10(d) states that steps should be taken to minimize all remaining unavoidable impacts. These two required elements of the Guidelines are typically fulfilled with a thorough analysis of alternatives, including evaluation of alternative project sitings, changes to project design, implementation of best management practices, and adaptive management plans to minimize the risk of adverse impacts. EPA's determination that the Spruce No. 1 Mine will result in unacceptable adverse impacts to wildlife does not depend on the presence or absence of alternatives that would result in less severe environmental impacts to waters of the United States, or on whether there are or are not further opportunities to minimize the impacts from the project. Nonetheless, EPA's evaluation of these portions of the § 404(b)(1) Guidelines serves to strengthen EPA's determination about the unacceptability of the significant impacts that would occur from Spruce No. 1 Mine.

In discussions with the permittee before and during the § 404(c) process, EPA has repeatedly stated its belief that there are alternative mine design and construction practices that would further reduce aquatic resource impacts, while allowing the majority of coal present on site to be mined in a cost effective and technically feasible manner. As referenced in Section III.C., the permittee has presented only limited alterations to the permitted project that it believes would likely result in environmental improvements. These proposals included additional compensatory mitigation projects, new mine construction practices, and increased water quality monitoring.

EPA maintains, however, that there appear to be additional practicable alternative project configurations and practices that would significantly reduce and/or avoid anticipated environmental and water quality impacts to Pigeonroost Branch and Oldhouse Branch. Moreover, § 230.10(a) establishes rebuttable presumptions that, in the case of non-water dependent projects (such as this), practicable, less environmentally damaging alternatives exist. EPA does not believe the permittee has carried its burden to clearly demonstrate that such alternatives do not exist.

EPA is working effectively with mining companies to identify alternative mining configurations and practices to reduce the nature and extent of anticipated adverse environmental and water quality impacts. EPA and mining companies have, for example, coordinated to reduce the volume of excess spoil being placed in valley fills, minimize rainwater and groundwater contact with pollutant-bearing strata, divert stormwater away from streams and other surface waters, phase mining construction to assess the effectiveness of best management practices designed to protect water quality, eliminate and consolidate valley fills, remove treatment ponds from stream beds, compact excess spoil and cant fills to reduce rainwater infiltration, and other cost effective actions for reducing or avoiding environmental and water quality impacts without significantly affecting coal recovery. Mingo Logan Company has expressed a willingness to take some additional steps focusing on best management practices to reduce impacts, but has been consistently unwilling to consider needed actions to further reduce the 35,000 feet of direct impacts of valley fills on headwater streams or to phase valley fill construction in a manner that would allow for effective assessment of, and an adaptive management response to, adverse impacts to wildlife habitat and anticipated water quality problems.

Because the scope of this Final Determination is limited to withdrawal of specification of Pigeonroost Branch and Oldhouse Branch as disposal sites for discharges of dredged or fill material in connection with the Spruce No. 1 Mine, as well as future discharges, within the defined area constituting Pigeonroost Branch, Oldhouse Branch and their tributaries, associated with surface coal mining that would be expected to result in a nature and scale of adverse chemical, physical, and biological effects similar to the Spruce No. 1 mine, EPA takes no position as to whether other, less damaging alternatives would be likely to result in acceptable effects on wildlife or satisfy the § 404(b)(1) Guidelines. However, the facts that such alternatives appear to exist based on extensive experience with other mining operations in Appalachia, and that the permittee has not clearly demonstrated to the contrary, further enhance EPA's assessment of the unacceptability of the impacts that were previously described.

V.E.2. Significant Degradation

The § 404(b)(1) Guidelines direct that no discharge of dredged or fill material shall be permitted if the discharge will cause or contribute to significant degradation of waters of the United States (40 CFR 230.10(c)). Of particular relevance in this instance, the Guidelines state that effects contributing to significant degradation considered individually or collectively, include:

> (1) Significantly adverse effects of the discharge of pollutants on human health or welfare, including but not limited to effects on municipal water supplies, plankton, fish, shellfish, wildlife, and special aquatic sites.
>
> (2) Significantly adverse effects of the discharge of pollutants on life stages of aquatic life and other wildlife dependent on aquatic ecosystems, including the transfer, concentration, and spread of pollutants or their byproducts outside of the disposal site through biological, physical, and chemical processes; and
>
> (3) Significantly adverse effects of the discharge of pollutants on aquatic ecosystem diversity, productivity, and stability. Such effects may include, but are not limited to, loss of fish and wildlife habitat or loss of the capacity of a wetland to assimilate nutrients, purify water, or reduce wave energy

As discussed in Section IV.A. above, Pigeonroost Branch and Oldhouse Branch and their tributaries are some of the last remaining streams within the Headwaters Spruce Fork sub-watershed and the larger Coal River sub-basin that represent "least-disturbed" conditions. As such, they perform important hydrologic and biological functions, support diverse and productive biological communities, contribute to prevention of further degradation of downstream waters, and play an important role with regard to providing necessary habitat for wildlife within the context of the overall Headwaters Spruce Fork sub-watershed and Coal River sub-basin.

The Spruce No. 1 Mine as authorized will bury virtually all of Oldhouse Branch and its tributaries and much of Pigeonroost Branch and its tributaries under excess spoil generated by surface coal mining operations. These discharges will result in the burial of approximately 6.6 miles of high quality Appalachian headwater streams in a watershed that has already experienced substantial impairment. The loss of these portions of Pigeonroost Branch and Oldhouse Branch will result in a significant loss of wildlife habitat and would therefore adversely impact wildlife that depend on those headwater streams for all or part of their life cycles. As detailed in Sections V.C. and V.D., these direct impacts will result in significantly adverse effects on over 84 taxa of macroinvertebrates, as well as up to 46 species of reptiles and amphibians, 4 species of crayfish, 5 species of fish and at least one water-dependent bird species

Beyond the direct burial of wildlife species and loss of habitat, EPA has also determined that the project will result in significantly adverse effects on downstream wildlife. If constructed as permitted, the Spruce No. 1 Mine will result in increased pollutant loadings in Spruce Fork and the Little Coal River. Increased salinity levels will lead to loss of macroinvertebrate communities and population shifts to more pollution-tolerant taxa, specifically the extirpation of ecologically important macroinvertebrates. Further, loss of macroinvertebrate prey populations, increased risk of harmful golden algal blooms, and additional exposure to selenium will result in significantly adverse effects on the 26 fish species found in Spruce Fork as well as amphibians, reptiles, crayfish, and bird species that depend on downstream waters for food or habitat.

The Spruce No. 1 Mine will eliminate the entire suite of important physical, chemical and biological functions provided by the streams of Pigeonroost Branch and Oldhouse Branch including maintenance of biologically diverse wildlife habitat and will critically degrade the chemical and biological integrity of downstream waters. Impacts to these functions at the scale associated with this project will result in significant degradation (40 CFR 230.10(c)) of the Nation's waters, particularly in light of the extensive cumulative stream losses in the Spruce Fork and Coal River watersheds discussed in more detail below.

V.E.2.a Cumulative Effects

Fundamental to the § 404(b)(1) Guidelines "is the precept that dredged or fill material should not be discharged into the aquatic ecosystem, unless it can be demonstrated that such a discharge will not have an unacceptable adverse impact either individually or in combination with known and/or probable impacts of other activities affecting the ecosystems of concern." 40 CFR 230.1(c).

The § 404(b)(1) Guidelines (at 40 CFR 230.11(g)) also direct that factual findings be made regarding cumulative effects on the aquatic ecosystem and that those findings be considered in determining whether the discharge complies with the foregoing restriction. To that end, the § 404(b)(1) Guidelines describe the factual finding that must be made with respect to cumulative effects as follows:

> Cumulative impacts are the changes in an aquatic ecosystem that are attributable to the collective effect of a number of individual discharges of dredged or fill material. Although the impact of a particular discharge may constitute a minor change in itself, the cumulative effect of numerous such piecemeal changes can

result in a major impairment of the water resources and interfere with the productivity and water quality of existing aquatic ecosystems.

Cumulative effects attributable to the discharge of dredged or fill material in waters of the United States should be predicted to the extent reasonable and practical. The permitting authority shall collect information and solicit information from other sources about the cumulative impacts on the aquatic ecosystem. This information shall be documented and considered during the decision-making process concerning the evaluation of individual permit applications, the issuance of a general permit, and monitoring and enforcement of existing permits.

As has been described in Section IV.A., the Coal River sub-basin and the Headwaters Spruce Fork sub-watershed are already impacted by mining activity. Based upon the National Land Cover Database (NLCD) change product for 1992-2001 and the WVDEP's GIS mine permit data, more than 257 past and present surface mining permits have been issued in the Coal River sub-basin, and the corresponding mines collectively occupy more than 13% of the land area. In the Spruce Fork watershed, more than 34 past and present surface mine permits have been issued, and the corresponding mines collectively occupy more than 33% of the land area. The project will affect an additional 2,278 acres (3.56 mi^2), which is equivalent to approximately 2.8% of the Spruce Fork watershed. This percentage of land cover affected by surface mines will continue to increase in the Coal River sub-basin, as additional projects are proposed and authorized.

A 1997 WVDEP ecological assessment of the Coal River sub-basin indicated that because the sub-basin is becoming increasingly impaired due to stressors such as mining, there is a need to protect the remaining quality resources, highlighting the need to "[l]ocate and protect the few remaining high quality streams in the Coal River watershed...." (WVDEP 1997a). Pigeonroost Branch and Oldhouse Branch, two of the streams directly affected by the Spruce No. 1 Mine, are high quality resources that support an exceptionally high number of mayfly taxa, both within the Central Appalachian Region and statewide (see Appendix 2). By directly impacting these streams, which serve as refugia for aquatic life and potential sources for recolonizing nearby waters, the action will have a significant adverse effect on the aquatic ecosystem integrity in the sub-basin.

For purposes of this analysis, EPA considered cumulative effects to the Coal River sub-basin (891 square miles) and the Headwaters Spruce Fork sub-watershed (126.4 square miles) if the Spruce No. 1 Mine is constructed as authorized by DA Permit No. 199800436-3 (Section 10: Coal River) and other reasonably foreseeable (proposed and/or authorized but not constructed) surface mining projects within the Coal River sub-basin are constructed. This cumulative effects analysis also takes into consideration the past and present mining projects within the sub-basin and sub-watershed, and the extent to which they have affected the current baseline conditions within the sub-basin and sub-watershed (Figure 15).

EPA is aware of at least 11 additional mining operations either proposed or authorized but not constructed in addition to Spruce No.1 in the Coal River sub-basin. Construction of valley fills and other discharges authorized by DA Permit No. 199800436-3 (Section 10: Coal River) along with these additional projects in the Coal River sub-basin, if constructed, would directly impact approximately 29.4 miles of stream channels, and will have significant secondary and cumulative effects on downstream waters in the Coal River sub-basin. Downstream impacts from these projects can be expected to include reduced freshwater dilution, reduced headwater stream functional inputs, increased discharges of pollutants, including TDS and selenium, and the potential to contribute to existing water quality impairments within the Spruce Fork watershed and the Coal River sub-basin.

The Coal River sub-basin contains 743 miles of impaired streams, 33% of the total stream length in the sub-basin (WVDEP 2010b). The WVDEP has listed certain of these stream segments for selenium and biological impairment, among other pollutants. The additional fills associated with the Spruce No. 1 Mine, in combination with past and present mining by the applicant and other mining in the sub-basin, will cause or contribute to significant cumulative adverse impacts to the stream resources in the Coal River sub-basin, and will contribute to current water quality impairments within the sub-basin, and result in unacceptable adverse effects on wildlife and their habitat.

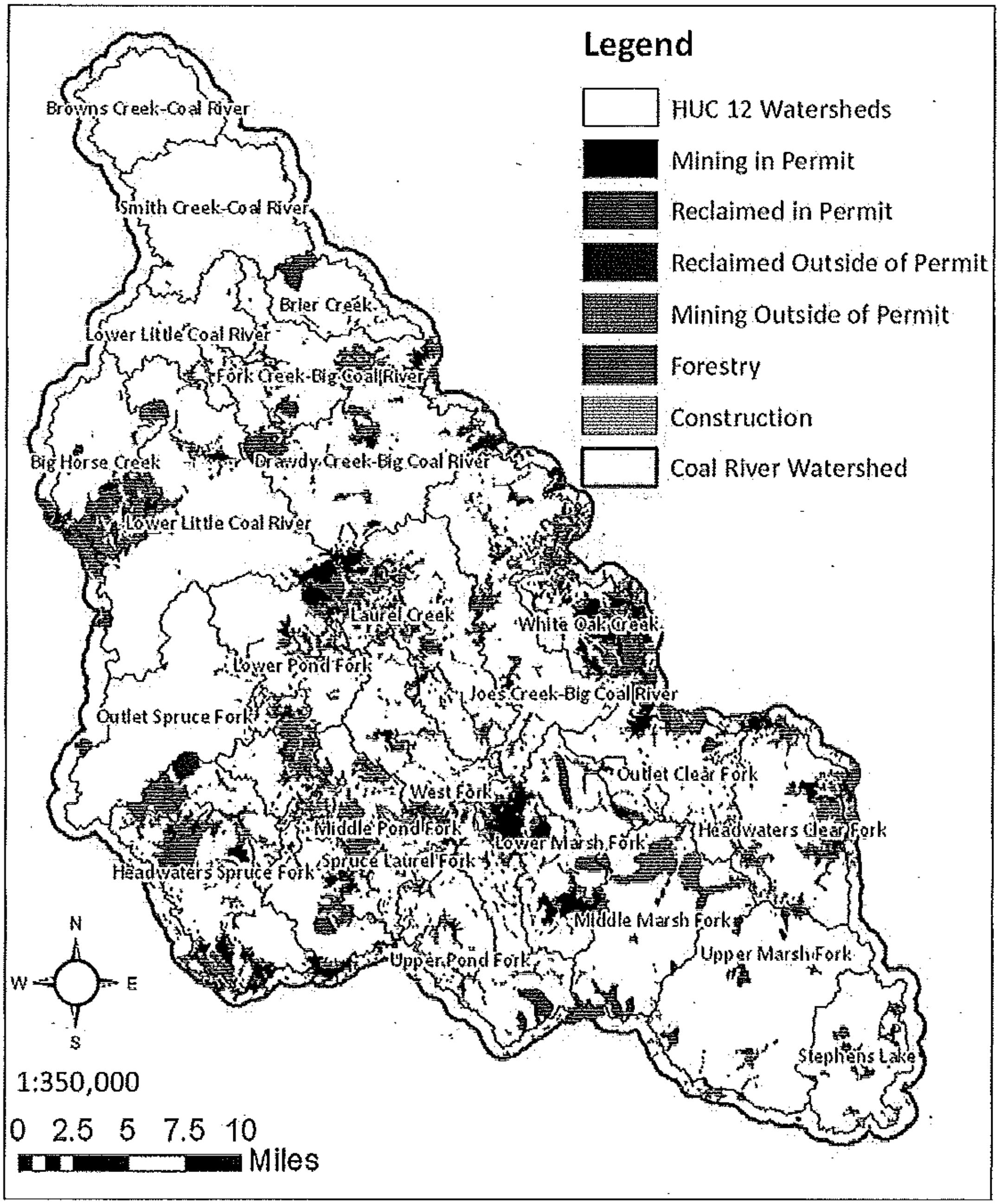

Figure 15. Illustration of the types of disturbance currently found in the Coal River sub-basin

In order to predict cumulative effects from the Spruce No. 1 Mine in conjunction with historic activities, as well as these foreseeable surface mining projects, EPA used mapped landscape data generated from remote sensing techniques and site-specific stream data generated from field sampling techniques to determine the relationship between mining activity and downstream conductivity. This analysis was then used to develop levels of mining activity, measured as percent mining in a watershed, associated with increasing levels of conductivity that reflect increasing extirpation of aquatic life communities (see Appendix 5 for detailed methods and results).

Results of this analysis indicate that there are significant and strong quantitative relationships between mining activities in a watershed and downstream conductivity condition (See also USEPA 2010a, Appendix A and F). The majority of development-only sites had stream conductivity less than 500 µS/cm, with no development-only sites measuring higher than 800 µS/cm (Figure 16). The two regression curves based on the combined mining/development and mining-only sites were similar to each other. The mining-only regression was used to identify percent mining levels related to increasing conductivity conditions.

Using these calculations, a watershed network modeling system was constructed to estimate downstream chemical response to mining activities upstream within the Coal River sub-basin. The calculated percent mining levels were embedded in an alternative futures analysis and used to quantify changes in stream conductivity conditions under three development scenarios; current condition, full construction of the Spruce No. 1 Mine, and full construction of the Spruce No. 1 Mine plus full construction of currently WVDEP-permitted surface mines.[18] For each scenario, the number of stream segments and length of stream were calculated and classified into conductivity ranges.

Based on the results of this model, EPA estimates that summer conductivity is currently below 300 µS/cm in 5.3% (4.6 miles) of the 86.7 miles of stream segments within or downstream of the Spruce No. 1 Mine site to the mouth of the Coal River. If the Spruce No. 1 Mine is constructed as permitted, this analysis shows that there will be no stream segments with conductivity less than 300 µS/cm downstream of the mine site in the Coal River sub-basin. Currently, 2.2% (1.9 mi) of the stream segments within or downstream of the Spruce No. 1 Mine site are calculated to have conductivity greater than 1000 µS/cm. Following full construction of the permitted area, 21.7% (18.8 mi) are projected to have conductivity greater than 1000 µS/cm. As this demonstrates, conductivity is predicted to significantly increase in Spruce Fork as the Spruce No. 1 Mine is constructed.

If other permitted mine areas, in addition to Spruce No. 1, are included in the analyses, the cumulative effects are predicted to result in higher conductivities in both the Little Coal and Coal Rivers. Within the Headwaters Spruce Fork sub-watershed, percent mining is predicted to increase by 15.8% over current conditions under this scenario, which will elevate conductivity from less than 750 µS/cm to greater than 1000 µS/cm at the mouth of Spruce Fork. Similarly, within the Little Coal River watershed, the calculation of full construction of all permitted mines results in percent mining increasing by 11.2% over current conditions, which results in predicted conductivity elevating from less than 750 µS/cm to as much as 1000 µS/cm within the Little Coal River. At the broadest scale analyzed, percent mining is predicted to increase by 9.3% in the Coal

[18] EPA makes no determination at this time regarding whether these other mines comply with the § 404(b)(1) Guidelines or may result in unacceptable adverse impact under § 404(c).

River sub-basin with full construction of all permitted mines. This also resulted in conductivity increasing from less than 750 μS/cm to as much as 1000 μS/cm within the Coal River.

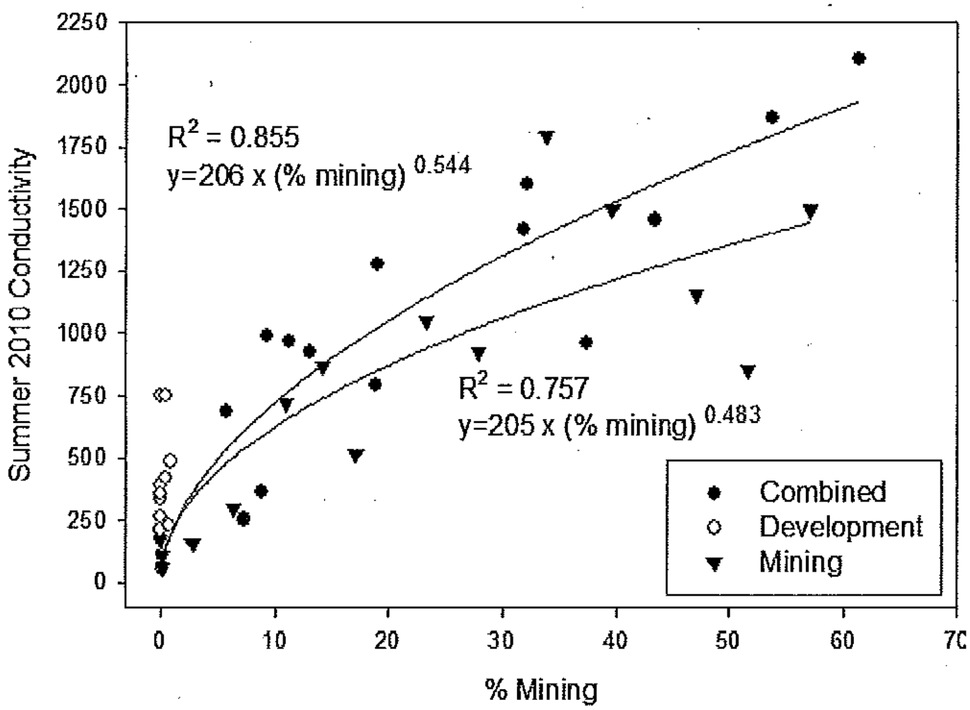

Figure 16. Model of the relationship between percent mining within a watershed and conductivity. The lower regression line is for mining-only sites, and the upper line is for combined mining/development sites.

As detailed in Section V.D.2.a., these conductivity levels have been associated with the impairment and extirpation of macroinvertebrate aquatic life. At this watershed scale, shifts in macroinvertebrate communities, and the loss of the primary food sources that these communities represent for higher trophic levels, will result in cascading ecosystem changes downstream.[19] Combined with increased levels of selenium and other mining-related pollutants, EPA believes these adverse effects will cause or contribute to significant degradation within the Coal River sub-basin. The severity of the cumulative impacts further strengthens EPA's conclusion that this project will result in unacceptable adverse impacts to wildlife and its habitat.

V.E.2.b. Secondary Effects

The § 404(b)(1) Guidelines (at 40 CFR 230.11(h)) also direct that factual findings be made regarding secondary effects on the aquatic ecosystem and that those findings be

[19] In the 2008 West Virginia Integrated Water Quality Monitoring And Assessment Report, WVDEP stated "A "shift" in the benthic macroinvertebrate community of a stream can constitute biological impairment pursuant to 47CSR2 – 3.2.i, and the WVSCI (recognized as a "best science method" in the PEIS) provides a sound scientific basis for assessment."

considered in determining whether the discharge will cause or contribute to significant degradation of the Nation's waters. To that end, the § 404(b)(1) Guidelines describe the factual finding that must be made with respect to secondary effects as follows:

> Secondary effects are effects on an aquatic ecosystem that are associated with a discharge of dredged or fill materials, but do not result from the actual placement of the dredged or fill material. Information about secondary effects on aquatic ecosystems shall be considered prior to the time final section 404 action is taken by permitting authorities.
>
> Some examples of secondary effects on an aquatic ecosystem are fluctuating water levels in an impoundment and downstream associated with the operation of a dam, septic tank leaching and surface runoff from residential or commercial developments on fill, and leachate and runoff from a sanitary landfill located in waters of the U.S.

Section V.D. includes a discussion and analysis of the secondary effects of the Spruce No. 1 Mine including the degradation of downstream water quality by 1) removing streams that currently provide sources of freshwater dilution and 2) transforming those stream areas into sources of contaminants (particularly TDS and selenium). The downstream water quality changes associated with the authorized project would significantly reduce the functional diversity, as well as the overall abundance and productivity of macroinvertebrate communities, thus, through cascading food web effects, adversely impact an extensive list of vertebrate species which depend upon the macroinvertebrate community within these streams for nourishment.

The adverse secondary effects discussed in Section V.D. include substantial changes in aquatic communities, such as loss of fish and salamander diversity and sensitive mayfly and stonefly taxa, as well as shifts to more pollution-tolerant taxa. Through the loss of stream macroinvertebrate and salamander communities, there will be, in turn, substantial effects to both aquatic and terrestrial vertebrate populations that rely on these communities as a food source. In addition, the discharges will increase loading of pollutants to downstream receiving waters, increasing the risk of harmful golden algal blooms and causing or contributing to fish and bird impairments due to selenium exposure.

V.E.3. Mitigation Will Not Adequately Offset Anticipated Impacts

If constructed as authorized the Spruce No. 1 Mine will result in direct impacts through discharge of dredged or fill material to approximately 6.6 miles of stream in Pigeonroost Branch and Oldhouse Branch. The impacts from these discharges are discussed in Sections V.C. While recognizing that the project includes mitigation efforts (including stream creation and enhancement of existing streams) to compensate for unavoidable adverse impacts, EPA believes that known compensatory mitigation techniques will not replace the high quality resources of Pigeonroost Branch and Oldhouse Branch that will be impacted by the project. Additionally, EPA believes that the current mitigation plan does not adequately account for the quality and function of the impacted resources.

Under § 404(c), EPA has discretionary authority to prohibit or withdraw the specification of a defined area as a disposal site whenever the Administrator determines that the discharge will have an unacceptable adverse effect on a number of identified categories. Therefore, as a legal matter, EPA can make a determination that a discharge of dredged or fill material will cause unacceptable adverse effects without consideration of compensatory mitigation. The statutory standard does not mention mitigation directly and authorizes EPA to determine what constitutes an unacceptable adverse effect. In other words, EPA does not need to determine that mitigation is somehow flawed or insufficient in order to conclude that a proposed or authorized discharge would have unacceptable adverse effects. EPA's conclusion that there is noncompliance with the Guidelines with respect to mitigation confirms the unacceptability of the adverse impacts on wildlife within the project area and downstream.

The Compensatory Mitigation Plan (CMP) submitted by Mingo Logan describes on-site and off-site, in-kind mitigation. On-site compensation would include the restoration of 7,132 linear feet of stream segments temporarily impacted by the sediment ponds, and the creation of 43,565 linear feet of on-bench stream channel within the project area. On-bench sedimentation ditches are SMCRA-required Best Management Practices (BMPs) to control runoff. Off-site compensation includes stream enhancements to Spruce Fork and Rockhouse Creek through a combination of physical, aquatic habitat, and stream stabilization improvements. The CMP also proposes to direct surface water flow from the project area in existing drainage ways to promote the development of more defined channels, thus creating 26,625 linear feet of streams.

Both EPA and the USFWS have repeatedly identified problems with the mitigation techniques that are part of the CMP for the Spruce No. 1 Mine. EPA Region III's comments on the 2006 draft and final EISs for the Spruce No. 1 Mine expressed concerns that the compensatory mitigation plan did not adequately mitigate all adverse impacts and was inadequate in terms of its lack of functional assessment, as well as whether proposed headwater stream creation would in fact replace the functions of impacted resources. EPA Region III emphasized the importance of headwater stream functions that would be lost and likely not replaced, particularly by the conversion of existing drainage channels to streams as described in the CMP. In its December 4, 2001, letter the USFWS expressed similar concerns that the proposed mitigation was unlikely "to provide sufficient mitigation for permanent stream and riparian habitat loss and for the losses of the functions and values of the stream to aquatic species in the fill footprint and to the downstream ecosystem." These concerns were reiterated by the USFWS in its June 2, 2010, and December 16, 2010, letters commenting on the EPA Region III Proposed Determination and Recommended Determinations, respectively.

As discussed below and in Appendix 3, the project fails to include all appropriate and practicable steps to minimize and compensate for the project's adverse impacts on the aquatic ecosystem as required by 40 CFR 230.10(d). Further, EPA believes that the anticipated level of adverse impacts associated with the Spruce No. 1 Mine will not be offset by the required compensatory mitigation to the extent necessary to prevent significant and unacceptable effects on wildlife and their habitat.

V.E.3.a. Proposed Mitigation Will Not Replace High Quality Resources in Pigeonroost Branch and Oldhouse Branch

There is no evidence in the peer-reviewed literature that the type of stream creation included in the CMP will successfully replace lost biological function and comparable stream chemistry to high quality stream resources, such as Pigeonroost Branch and Oldhouse Branch. Scientific research has demonstrated that replacement of streams is among the most difficult and frequently unsuccessful forms of mitigation (Bernhardt et al.2007). Even if stream structure and hydrology can be replaced, it is not clear that replacing structure and hydrology will result in true replacement of functions, especially the native aquatic community and headwater functions. Based upon this research, the Corps and EPA stated in the response to comments on the 2008 Compensatory Mitigation for Losses of Aquatic Resources Final Rule:

> We recognize that the scientific literature regarding the issue of stream establishment and re-establishment is limited and that some past projects have had limited success (Bernhardt et al.2007). Accordingly, we have added a new paragraph at 33 CFR 332.3(e)(3) [40 CFR 230.93(e)(3)] that specifically notes that there are some aquatic resources types that are difficult to replace and streams are included among these. It emphasizes the need to avoid and minimize impacts to these 'difficult-to-replace' resources and requires that any compensation be provided by in-kind preservation, rehabilitation, or enhancement to the extent practicable. This language is intended to discourage stream establishment and re-establishment projects while still requiring compensation for unavoidable stream impacts in the form of stream corridor restoration (via rehabilitation), enhancement, and preservation projects, where practicable.[20]

An additional 26,625 feet of high gradient stream credit is sought for connectivity channels. Connectivity channels are areas where surface water flows from the on-bench ditches, passes through NPDES outfalls, and runs downhill to eventually "form a hydrological connection to a surface tributary of a navigable water" (USACE 2007). The premise is that, if properly placed, connectivity channels will enable mine runoff water to travel down natural, steep hill slopes and ephemeral channels and into naturally non-flowing receiving segments. However, based on the changes to water quality discussed in Section V.D.1., they will receive selenium and dissolved solids from the mined area, resulting in degraded water quality and an inability of these channels to provide meaningful ecological functions and values to replace the affected streams. In addition,

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[20] EPA recognizes that the effective date of the regulations governing compensatory mitigation that were promulgated at 73 Fed. Reg. 19594 (April 10, 2008) is June 9, 2008, and therefore were not in effect when the Corps of Engineers issued DA Permit No. 199800436-3 (Section 10: Coal River). Nevertheless, the above-quoted statement, taken from the preamble to those regulations, represents the most recent regulatory statement by the agencies regarding types and effectiveness of mitigation and summarizes scientific research and literature that is applicable to consideration of the likely efficacy of the compensatory mitigation proposed for the Spruce No. 1 Mine.

these channels will function as sources of pollutants, delivering additional selenium and total dissolved solids to downstream headwater streams.

As discussed in this document, the streams of Pigeonroost Branch and Oldhouse Branch have been shown to exhibit high water quality and high functional capacity. Given the difficulty of stream re-establishment to mitigate for impacts to streams in general, EPA believes it is extremely unlikely that high-value streams such as these can be replaced by on-site stream creation techniques involving conversion of sedimentation ditches fed by mine spoil runoff and seepage. As explained further in Appendix 3, EPA believes that the mitigation for the Spruce No. 1 Mine will not offset the anticipated impacts to an acceptable level.

V.E.3.b. The Compensatory Mitigation Plan is Based upon a Misclassification of the Impacted Resources

The starting point for an adequate compensatory mitigation plan is accurate characterization of the impacted resources. EPA believes that the Spruce No. 1 Mine CMP is based upon a misclassification of impacts to perennial and intermittent streams, thereby resulting in an insufficient baseline from which to design adequate stream compensation.

The USGS documented the flow origin, drainage areas and hydrologic characteristics of perennial and intermittent streams in this region in 2000 and 2001 (Paybins 2003). A field reconnaissance by EPA during dry conditions in September 1998 (Green and Passmore 1999) found distinct perennial benthic communities (i.e., long-lived taxa representative of perennial conditions) in the upper reaches of Pigeonroost Branch and Oldhouse Branch. Through these onsite visits and biological data collection, combined with USGS drainage estimates, EPA estimates that, within the mine footprints of Pigeonroost Branch, and Oldhouse Branch, approximately four miles of stream (~20,000 feet) are perennial. In this case, "perennial" refers to streams that have either 1) perennial flow and indicator biota requiring at least a 6 month life cycle, or 2) non-contiguous surface flow during drought conditions but indicator biota requiring at least a 6 month life cycle.

This is in contrast to the DA Permit estimation of 165 feet of perennial waters within the entire project area. This misclassification has a critical impact upon the type of mitigation that would be required to offset these impacts. The resource type plays an important role in the types of expected aquatic communities, the degree in which each resource provides structure and function, and the amount of organic matter and nutrients (and contaminants) ultimately retained or loaded to receiving streams. This misclassification means that the compensatory mitigation plan does not properly account for, and therefore will not offset, the full range of adverse impacts related to the project. A more detailed description of EPA's analysis of stream type is described in Appendix 3.

V.E.3.c. The Compensatory Mitigation Plan Lacks an Adequate Functional Assessment

In addition to being based on a misclassification of resource type, the CMP also is based upon an inadequate functional assessment of the impacted resources. The goal of compensatory mitigation is to replace the aquatic resource function lost or adversely affected by authorized activities. Therefore, to ensure that the functions are being replaced, the compensatory mitigation must create or restore streams that sustain comparable biological communities and chemical and physical characteristics and provide comparable physical, chemical and biological functions to the streams that have been eliminated. The § 404(b)(1) Guidelines require the permitting authority to make certain factual determinations addressing the potential short-term or long-term effects of a proposed discharge of dredged or fill material on the physical, chemical, and biological components of the aquatic environment. See, 40 CFR 230.11. Among the factual determinations required of the permitting authority is the following:

> *(e) Aquatic ecosystem and organism determinations.* Determine the nature and degree of effect that the proposed discharge will have, both individually and cumulatively, on the structure and function of the aquatic ecosystem and organisms.

This provision of the Guidelines requires the permitting authority to determine the nature and degree of effect that the proposed discharge will have on both the structure and function of the aquatic ecosystem and organisms. This principal from the Guidelines was reiterated and clarified in a joint Department of the Army/EPA guidance memo, focused specifically on the review of permit applications for Appalachian surface coal mining.[21]

In order to ensure adequate replacement of both structure and function, the impacted streams must be accurately assessed and the proposed compensation must be evaluated using comparable standards for assessment. As discussed above, the baseline assessment of the existing and impacted streams on the site missed and misclassified well over twenty thousand linear feet of headwater streams, which prevented the USACE from identifying the appropriate compensation needs of this project.

In addition, the assessment method used by the permittee was inadequate and led to an improper valuation of compensation needs and proposals. The CMP utilized an assessment method referred to as the Stream Habitat Unit (SHU) method to calculate mitigation debits and credits. This assessment entails a combination of linear lengths of impact, habitat assessment scores, and stream hydrological status.[22] The limitations of the

[21] EPA recognizes that the effective date of this memorandum is July 30, 2010, and therefore was not in effect at the time the Corps issued DA Permit No. 199800436-3 (Section 10: Coal River). Nevertheless, the requirement in the Guidelines regarding the factual determination of the impact to the structure and function of the aquatic ecosystem is applicable and relevant to EPA's evaluation of the Spruce No. 1 compensatory mitigation plan, and the July 30, 2010 memorandum reflects the agencies most recent statement about the meaning of that requirement.

[22] Even though the Corps did not finally rely solely on the SHU for mitigation requirements, the Corps did not categorically prevent the permittee from using this approach as a basis for its mitigation plan, and thereby allowed Mingo Logan to use this approach to help justify their mitigation performance and success criteria.

SHU and need for an adequate functional assessment are further explained in Appendix 3. The SHU as presented in the CMP only accounts for the physical aspects of stream condition and fails to account for the interrelationship of water chemistry and biological resources in stream functioning.

As a result of this EPA believes the current CMP does not adequately account for or replace the structure and function of the lost streams. EPA does not believe that increased ratios of intermittent or ephemeral streams offset this inadequacy. While DA Permit No. 199800436-3 (Section 10: Coal River) refers to biological success criteria and the use of a yet-to-be developed functional assessment method for mitigation monitoring, the permit conditions do not clearly require the replacement of lost biological function and comparable stream chemistry or adequate compensatory mitigation success criteria.

V.E.3.d. Conversion of Erosion Control Channels Will Not Successfully Replace the Impacted Resources

Based on observations of other on-bench SMCRA drainage or erosion control ditches (Kirk 1999a, Green et al. 2000, and Gingerich 2009), EPA believes the CMP's proposed conversion of these ditches will not successfully replace the impacted resources, alone or in concert with other mitigation contained in the CMP. Over 50% of the linear stream length in the Spruce mitigation plan relies on conversion of on-bench SMCRA drainage or control ditches. Data show that water quality in these types of sedimentation ditches in the Appalachian region is typically highly degraded, as a result of the water in these ditches percolating through mine spoil (Gingerich 2009). Even when the sedimentation ditches are enhanced for benthic substrata and riparian vegetation, such as by adding boulder clusters, the resulting water quality will be so degraded that the ditches will not meet pre-mining water chemistry baselines, especially in the case of high quality streams such as Pigeonroost Branch and Oldhouse Branch.

As described previously, degraded water chemistry caused by the addition of TDS and selenium typically leads to degraded biological communities. The proposed constructed stream channels will not meaningfully reduce the concentrations of these ions in the water flowing through them. Because of this degraded water chemistry, any created waterbodies would not support the healthy and diverse biological communities that they are intended to replace. Moreover, the water quality (e.g., salinity) would be so degraded that it will foster conditions favorable to the establishment of toxic Golden Algae.

A comparison of family-level macroinvertebrate data between sediment ditches and Pigeonroost Branch and Oldhouse Branch reveals marked differences in species richness and very little taxonomic overlap. Based upon Kirk (1999a) and EPA data, total familial richness in sediment ditches ranged between 4 to 11 taxa, with 0 to 3 families of Ephemeroptera, Plecoptera or Trichoptera (EPT) taxa present. In contrast, total familial richness at Oldhouse Branch and Pigeonroost Branch was 40, with 26 families of EPT taxa present.

Of the taxa collected in the sediment ditches, only seven were also present in Oldhouse Branch and Pigeonroost Branch. With regards to the taxa present in the sediment ditches that were not found in Oldhouse Branch and Pigeonroost Branch, Pond et al. (2008) found that these taxa do not generally occur at sites unaffected by mining. These data demonstrate that taxonomic assemblages in sediment ditches are not only less diverse than streams unaffected by mining, but include a suite of organisms not found in high quality headwater streams unaffected by mining, such as Oldhouse Branch and Pigeonroost Branch.

EPA believes these created streams converted from erosion control channels would be considered degraded and will not successfully replace Pigeonroost Branch and Oldhouse Branch as sources of freshwater dilution with healthy biological communities and water quality, either alone or in concert with other mitigation contained in the CMP.

A more detailed discussion of the limitations of on-bench sedimentation ditches for mitigation is provided in Appendix 3.

V.E.3.e. The Compensatory Mitigation Plan Does Not Account for the Loss of Ecological Services Provided by Headwater Streams

EPA is also concerned with the separation of the ecological elements into single, separate aspects of the ecology in the Spruce No. 1 Mine CMP, with limited consideration for the interconnectedness of the entire ecosystem. The forested slopes and coves located within the Spruce No. 1 Mine area are drained by a dendritic mosaic of ephemeral, intermittent and perennial headwater streams and watercourses. The watershed is inextricably linked with the stream system that drains it. The overwhelming bulk of the organic matter that sustains the stream biota in Spruce Fork is a function of the upstream environment. While compensatory mitigation is required for the impacts to waters of the United States under the §.404 program, EPA believes that a well-designed compensatory mitigation plan should take into account this terrestrial-aquatic linkage and ensure that restored or created channels provide greater functions than simply service as water conveyance structures.

In a pre-mined condition, these headwater streams are recipients of allochthonous material (i.e., material originating from outside of the stream system) and water inputs (i.e., surface, subsurface, and groundwater) from the surrounding forested communities. The post-mined environment, however, creates severely altered conditions in stream courses that are not destroyed by valley fills. Those alterations include:

a. Elimination of water and processed organic material from former upstream tributaries that will be under valley fills.

b. Altered contributions of water and allochthonous material from the surrounding upland watershed, due to the altered character of the soil and vegetation communities in a post-mine environment.

c. Altered hydrograph with new flow regimes that markedly depart from that under which the streams have evolved.

d. Altered timing, temperature and chemical composition of post-mine discharges of water to receiving streams.

The permittee proposes to restore or create 71 acres of riparian forest as part of its reclamation and stream creation and restoration activities. While EPA agrees that planting trees along any newly created stream channels better recreates pre-mining riparian conditions than no riparian vegetation, EPA has not seen evidence that such practices can effectively replace lost natural riparian ecosystems. The current riparian zone consists largely of basswood, beech, tulip poplar, buckeye, sugar maple, white oak and red oak, yet out of the 11 tree species listed in the Compensatory Mitigation Plan, only two are found within or near the project area. Riparian systems created through this plan are likely to function differently from buried streams because their vegetation communities will differ from those present on the project site.

The Spruce No. 1 Mine will profoundly alter the contributing watershed. Effectively the new landscape widely departs from that within which the stream network has evolved. The subsequent ecosystem is an entirely new system. Based on available information, the mitigation will not replace the structure and function of the pre-mined conditions including those elements that are dependent on contributions from the surrounding watershed. These concerns regarding the mitigation are shared by the USFWS whose comment letter to EPA regarding the Recommended Determination states "...the currently-proposed mitigation for these impacts is unlikely to adequately compensate for the loss and degradation of these streams, their biological productivity and diversity, or their ecological integrity."

V.E.4. Summary

The Spruce No. 1 Mine will eliminate the entire suite of important physical, chemical and biological functions provided by the streams of Pigeonroost Branch and Oldhouse Branch including maintenance of biologically diverse wildlife habitat and profoundly alter the contributing watershed. EPA maintains that impacts to these functions at the scale associated with this project will result in significant degradation (40 CFR 230.10(c)) of the Nation's waters, particularly in light of the extensive cumulative stream losses in the Spruce Fork and Coal River watersheds, and that such degradation will result in unacceptable adverse impacts on wildlife and wildlife habitat. EPA does not believe these impacts can be adequately mitigated to reduce the impacts to an acceptable level by the compensatory mitigation described in the CMP. Finally, the possibility that additional practicable alternative project configurations and practices exist that would significantly reduce and/or avoid much of the discharges to Pigeonroost Branch and Oldhouse Branch further enhances EPA's assessment of the unacceptability of the impacts that were previously described.

VI. Other Considerations

As set forth above, EPA has determined that the impacts from the discharges to Pigeonroost Branch and Oldhouse Branch as authorized by DA Permit No. 199800436-3 (Section 10: Coal River) described in Section V. will have an unacceptable adverse effect on wildlife both within the project area and downstream of the project area, and that the project does not comply with the requirements of the § 404(b)(1) Guidelines. This section identifies other, additional considerations that are of concern to EPA but are not part of the basis for EPA's conclusion that the impacts will have an unacceptable adverse effect on wildlife.

EPA includes this discussion to recognize additional significant environmental, public health, and environmental justice impacts associated with the Spruce No. 1 Mine that are relevant to EPA's and the Corps' broader responsibilities in reaching permit decisions under the Clean Water Act and other statutes and policies, including the National Environmental Policy Act and the Environmental Justice Executive Order (E.O. 12898). EPA understands that the impacts identified in Section VI are not directly relevant to the Agency's determination under § 404(c). However, EPA includes this section to emphasize for the public the broader impacts of the project as they relate to EPA's legal responsibilities. EPA takes seriously each of its responsibilities to assure effective protection for coalfield communities from environmental, human health, and water quality impacts associated with surface coal mining activities.

VI.A. Impacts from Activities Dependent upon Specification of Pigeonroost Branch and Oldhouse Branch as Disposal Sites for the Discharge of Dredged or Fill Material for the Spruce No. 1 Mine

The following sections discuss impacts that depend upon specification of Pigeonroost Branch and Oldhouse Branch for construction of valley fills and sediment ponds for the Spruce No. 1 Mine, but occur as a result of discharges of excess spoil to areas outside of jurisdictional waters, or occur as a result of other mining-related activities, such as deforestation.

VI.A.1. Migratory Birds

The Spruce No. 1 Mine will destroy approximately 2,278 acres of deciduous forests. Among the many migratory birds likely to breed in the project area, there are six species that the USFWS has designated as Birds of Conservation Concern within the Appalachian Mountains Bird Conservation Region that may be impacted. These include the Cerulean, Kentucky, Swainson's and Worm-eating Warblers, the Wood Thrush, and the Louisiana Waterthrush. The water-dependent Louisiana Waterthrush was discussed in Sections V.C.4. and V.D.5. above. The other five avian species are also designated as BCC species within the USFWS's Northeast Region as a whole and nationally (U.S. Fish and Wildlife Service 2008). The first four are also considered to be among the 100 most at-risk bird species in North America (Wells 2007).

Cerulean and Worm-eating Warblers are also both area-sensitive species that rely on large blocks of intact, mature, interior forest habitats to support productive breeding populations. The Cerulean Warbler breeding population is thought to have declined by about 75% over the past 45 years – the most dramatic decline of any North American warbler monitored by the Breeding Bird Survey (Sauer et al. 2005). Both species are threatened by the loss and fragmentation of these habitats (U.S. Fish and Wildlife Service 2007, Wells 2007). Deforestation associated with the Spruce No. 1 Mine can be expected to adversely impact their breeding populations (Weakland and Wood 2005, Wells 2007).

The project also will impact other bird species that rely on mature forest habitats. Bird species that rely on mature forest habitats that are abundant in the Appalachian region are Kentucky warblers in the understory; and Wood Thrush, Swainson's Warbler, Acadian Flycatcher, and Ovenbirds in mesic hardwoods. These and many other avian species are all impacted by forest fragmentation and habitat loss, such as that which would occur in connection with the Spruce No. 1 Mine. Spatial analyses of the effect of Appalachian mountaintop mining on interior forest indicate that interior forest is lost at a rate 1.75-5.0 times greater than the direct rate of loss of overall forest cover due to mountaintop mining (Wickham et al. 2007).

The Spruce No. 1 Mine will impact mature forested habitat, over a substantial timeframe, replacing the impacted areas with reclaimed areas dominated by grasses and herbaceous species. Many reclaimed areas such as those expected at Spruce No. 1 Mine show little or no regrowth of woody vegetation even after 15 years. The PEIS found significant differences in bird populations between forested and reclaimed sites, namely the loss of the above-mentioned species, and subsequent replacement by more opportunistic grassland species. Also, the loss of the healthy headwater areas of Spruce Fork will reduce the feeding and foraging areas available to specialist bird species in this ecoregion. This reduction in available habitat could potentially impact their long-term viability in the Spruce Fork watershed and the larger ecoregion.

The USFWS evaluated the terrestrial habitats of the project area and concluded that construction of the mine was likely to impact migratory birds via the loss and fragmentation of forest habitat, decreasing habitat heterogeneity, increasing isolation of populations, and increasing exposure to nest predators and parasites (USFWS 1998). The USFWS also expressed concerns specific to bird populations within the Coal River sub-basin related to adverse impacts of the Spruce No. 1 Mine. These concerns included the direct loss of habitat and direct and indirect loss of food resources, for forest interior and riparian-obligate species of migratory birds, including six species the Service considers Birds of Conservation Concern (i.e., Cerulean, Kentucky, Swainson's, and Worm-eating Warblers; Louisiana Waterthrush; Wood Thrush) (USFWS, 2008).

The USFWS continues to believe that construction of the Spruce No. 1 Mine will adversely impact these and other forest-breeding migratory birds. The valley fills will result in the permanent loss of headwater streams that may be used by Louisiana Waterthrushes. The USFWS indicates they are unaware of peer-reviewed research that suggests that these birds will simply relocate to an adjacent, unimpacted watershed and have comparable survival and reproductive success. The downstream increases in conductivity, selenium and perhaps other contaminants are also likely to adversely affect those waterthrushes not excluded by the direct impacts of the fill via impacts to their food base. In some freshwater food webs, selenium has bioaccumulated to four times the level considered toxic, which can expose birds to reproductive failure when they eat fish or insects with high selenium levels.

While the work of the Appalachian Regional Reforestation Initiative (ARRI) shows substantial promise for better reclamation of mined lands, it has not been demonstrated that these reclaimed areas will generate and sustain forests that provide habitat characteristics and qualities comparable to those of native forest. For these reasons, the construction of the Spruce No. 1 Mine will result in permanent and/or long-term loss of breeding habitats important to several migratory bird species of conservation concern.

VI.A.2. Bats & Other Mammals

Large-scale mountaintop mining has been identified among the threats to bat species in the region according to the USFWS. Loss of the bat's habitat, foraging areas, and food sources, in conjunction with recently identified concerns related to white-nose syndrome, may result in adverse impacts to these wildlife resources. Similarly, habitat loss from land clearing will also affect numerous other mammal species within the project area that rely on forested landscapes for shelter and foraging.

As set forth in Section IV.B.5., the habitat in the project area is quite suitable for federally endangered Indiana Bats, which have been documented in adjacent counties. It is therefore quite possible that Indiana Bats occur within the project area, and that they could be impacted by the loss of forest habitat associated with the Spruce No. 1 Mine and by the loss of headwater streams, riparian areas and associated aquatic and terrestrial insects, as well as by the downstream degradation of these resources likely to be caused by the project.

In addition to Indiana Bats, the USFWS was recently petitioned to list two other bat species, the Eastern Small-footed Bat and Northern Long-eared Bat, under the Endangered Species Act (Center for Biological Diversity 2010). Both species occur in the vicinity of the Spruce No. 1 Mine, and both were captured during mist net surveys at the project site. Like Indiana Bats, these two species are susceptible to population-level impacts from White Nose Syndrome (WNS), which has devastated some populations of eastern bats. If WNS affects West Virginia bats as it has bats in other states, and if large die-offs occur, it will further complicate the already complex challenge of conserving bat species. Previous mining and logging activities and forest loss have also been identified as having adverse affects on bat populations. Traditionally used reclamation techniques, many of which are designed to minimize erosion and provide backfill stability, are incompatible with re-establishment of trees necessary for successful roosting by bats. Such reclamation techniques have the potential to further stress bat populations.

In addition to bats, forest habitat loss associated with the project could have substantial effects on other mammals that depend upon forest resources. While some mammal species are habitat generalists and will not be greatly affected by conversion to a grassland environment, others require forest habitats for protection from predation, foraging and specific habitat needs. These species will likely be adversely affected by the project. Additionally, healthy forested riparian areas can be important habitat for small mammals that feed on insects and small amphibians, as they are proximate to aquatic food sources. As such, insectivorous small mammals that feed on larval aquatic insects, emergent adult aquatic insects, and salamanders will likely be adversely affected by reduced aquatic macroinvertebrate abundances and increased levels of selenium in their prey.

VI.B. Environmental Justice

Environmental Justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. EPA has this goal for all communities and persons across this Nation. Executive Order 12898 directs: "To the greatest extent practicable…each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations…"

According to the 2000 United States Census, Spruce No. 1 Mine is located in a census block group that contains 335 people. A census block group is a geographical unit used by the U.S. Census Bureau (Bureau) that is between a census tract and a census block in size and scale. It is the smallest geographical unit for which the Bureau publishes data. Census block groups generally contain between 600 and 3,000 people, with a target size of 1,500 people.

Spruce No. 1 Mine is located in a census block group where the average per capita income is $15,411. This is more than $6,000 less than the national average of $21,587 and more than $1,000 less than the West Virginia state average of $16,477. The average median family income is also almost $13,000 less than the national average of $52,029. Moreover, 24% of the residents of Logan County live below the poverty line, which also exceeds state and national averages. Studies have highlighted that, despite the economic benefits provided by coal extraction, coal-producing counties in Central Appalachia continue to have some of the highest poverty and unemployment rates in the region (McIlmoil and Hansen 2010).

The Corps included a discussion of environmental justice in the Spruce No. 1 EIS. However, as noted in comment letters in June and October 2006, EPA's environmental justice analysis indicates that there may be a disproportionately high and adverse impact on the low-income population affected by the mining activity. Additionally, EPA remains concerned that the local community did not have the necessary information, or the opportunity, to meaningfully participate in the EIS process. Specifically, EPA is concerned the community was not informed when changes were made to different aspects of the mine project during the permitting and EIS process and therefore was not able to meaningfully comment on the final aspects of the mine.

The mountains affected by Spruce No. 1 Mine are an important cultural resource for many residents. In many cases the mountains have helped define their culture, and they are an integral part of their daily lives. For example, the mountain ridges of southern West Virginia have for over two centuries been viewed largely as a "commons", where local residents have gathered wild medicinal herbs such as American Ginseng (*Panax quinquefolius*) and Goldenseal (*Hydrastis canadensis*) (Hufford 2003). In many cases, collection of these wild herbs provides much needed extra income to local communities during times of unemployment or economic hardship (Bailey 1999). Removing these mountains may have profound cultural changes on the residents in the area, and so it is important that cultural impacts be considered as well.

EPA considers action pursuant to § 404(c) to be within the scope of the policy directive of Executive Order 12898. A § 404(c) action has the potential to affect human health or the environment of low-income or minority populations. Accordingly, EPA evaluates environmental justice concerns when undertaking an action pursuant to § 404(c). In this case, EPA Region III conducted a public hearing on May 18, 2010 and received comments both orally and in writing. EPA has considered that members of the community expressed concern about loss of jobs and tax revenue (supporting local communities and schools) in the event that EPA's § 404(c) action would preclude any activities authorized at the Spruce No. 1 Mine. At the same time, EPA also has considered that members of the community have expressed concern regarding the adverse environmental and cultural aspects of the project described above. EPA also has received a petition from a variety of stakeholders raising concerns related to environmental justice issues associated with mountaintop mining.

In order to satisfy Executive Order 12898, EPA has considered whether there would be "...disproportionately high and adverse human health or environmental effects..." from its regulatory action. The scope of the inquiry for purposes of EPA's environmental justice analysis is directly tied to the scope of the regulatory action that EPA is taking. In the context of a Clean Water Act § 404(c) action, EPA is authorized to prohibit, restrict, or deny specification (or withdraw specification) of the discharge of dredged or fill material at defined sites in waters of the United States whenever it determines that use of such sites for disposal would have an unacceptable adverse impact on "municipal water supplies, shellfish beds, fishery areas (including spawning and breeding areas), wildlife, or recreational areas."

Accordingly, EPA has considered the potential effects on municipal water supplies, shellfish beds, fishery areas, wildlife and recreational areas (all § 404(c) resources) of the project site in its environmental justice analysis within the context of this Final Determination under § 404(c). EPA has also considered whether the effects, if any, of EPA's § 404(c) action on the § 404(c) resources will have a "disproportionately high and adverse human health or environmental [effect]" on "minority populations and low-income populations" of the project area.

EPA concludes, after performing the EJ analysis contemplated in Executive Order 12898 to the greatest extent practicable, and incorporating public comment, that this Final Determination under § 404(c) will not have a disproportionately high and adverse human health or environmental effect on the low-income and minority populations of the project area. EPA notes that the scope of this Final Determination is limited to withdrawal of specification of Pigeonroost Branch and Oldhouse Branch as disposal sites for the discharge of dredged or fill material for the construction of valley fills and sediment ponds associated with the Spruce No. 1 Mine as authorized, as well as the prohibition of future discharges, within the defined area constituting Pigeonroost Branch, Oldhouse Branch and their tributaries, associated with surface coal mining that would be expected to result in a nature and scale of adverse chemical, physical, and biological effects similar to the Spruce No. 1 mine. This action neither prohibits nor authorizes coal mining.

VI.C. Public Health

Interest in the overall environmental and human health effects from mountain top mining has been increasing during recent years. A growing body of research suggests that health disparities are not uniformly distributed across the Appalachian region, but instead are concentrated in areas where surface coal mining activity takes place (Hendryx et al. 2007, 2008, Hendryx 2008, Hitt and Hendryx 2010, Hendryx and Zullig 2009). This body of research examined study areas that include the Spruce No. 1 Mine project area. EPA has reviewed these studies, which sought to evaluate whether associations between surface coal mining and health exist. These studies do not provide direct assessments of environmental air and water quality in mining areas in relation to individual exposures and health outcomes. More comprehensive research to develop these direct assessments, including environmental chemical analyses and biological monitoring, would require significantly greater study than is appropriate for this Final Determination.

However, the authors of these studies identify significant associations between surface coal mining activity and a variety of health disparities. They indicate that mortality rates in Appalachian coal mining regions for chronic respiratory, cardiovascular, and kidney disease, and for some forms of cancer including lung cancer are disproportionately elevated when compared to other regions (Hendryx 2008, Hendryx et al. 2007, 2008, Hendryx and Zullig 2009). One study also demonstrates that higher cancer mortality rates are strongly associated with lower WVSCI scores even after accounting for smoking, poverty, and urbanization (Hitt and Hendryx 2010). Another study spatially autocorrolates cancer mortality with surface mining intensity as measured by West Virginia permit boundaries after accounting for the same factors (Hendryx et al. 2010). These studies by their nature could not and do not establish any causal linkage between surface coal mining and these elevated rates of adverse health effects, but because they point to significant associations between surface coal mining and elevated rates of adverse health impacts, the results warrant more research using rigorous epidemiological methods. The existing body of literature suggests that various negative health outcomes are not the result of a single exposure, but may reflect chronic exposures to multiple environmental contaminants, both air and/or water, which will vary for each individual.

VII. Conclusions and Final Determination

Based on the foregoing analyses, EPA Region III's Recommended Determination, and upon consideration of the public comments received in response to EPA Region III's Proposed and Recommended Determinations, EPA has determined that discharges of dredged or fill material to Pigeonroost Branch and Oldhouse Branch and their tributaries for the purposes of construction, operation, and reclamation of the Spruce No. 1 Mine as authorized by DA Permit No. 199800436-3 (Section 10: Coal River) will have unacceptable adverse effects on wildlife. DA Permit No. 199800436-3 (Section 10: Coal River) authorizes construction of valley fills and sediment ponds and other discharges into Pigeonroost Branch and Oldhouse Branch and their tributaries that will bury approximately 6.6 miles of high quality headwater streams. Pigeonroost Branch and Oldhouse Branch support diverse and healthy biological communities comparable to nearby White Oak Branch, recognized by the WVDEP as supporting least-disturbed, reference quality conditions. Pigeonroost Branch and Oldhouse Branch represent streams within the larger Headwaters Spruce Fork sub-watershed and Coal River sub-basin that remain relatively free of water quality degradation. As such, Pigeonroost Branch and Oldhouse Branch are valuable in and of themselves and provide essential habitat for wildlife species within the Headwaters Spruce Fork sub-watershed and Coal River sub-basin.

As authorized by the DA Permit, discharges to Pigeonroost Branch and Oldhouse Branch will bury wildlife that live in those streams or within the footprint of the valley fills. Other wildlife will lose important headwater stream habitat on which they depend for all or part of their life cycles. EPA has determined that those impacts alone are unacceptable adverse impacts because of the miles of stream destroyed, the rarity of those streams, and the importance of those streams and their wildlife to the watershed. Unacceptable adverse effects on wildlife from the activities authorized by the permit will not be limited to direct burial of wildlife and significant loss of wildlife habitat. Burial of Pigeonroost Branch and Oldhouse Branch would also result in unacceptable adverse effects on wildlife downstream caused by the removal of functions performed by the buried resources and by transformation of the buried areas into sources that contribute contaminants to downstream waters. In addition, authorized discharges to Pigeonroost Branch and Oldhouse Branch would contribute to conditions that would support blooms of golden algae that release toxins that kill fish and other aquatic life. Thus, EPA has also determined that these adverse impacts on downstream wildlife by themselves are unacceptable.

In addition, these adverse impacts are not in compliance with the requirements of the Clean Water Act (CWA) and EPA's implementing regulations under § 404(b)(1). EPA has determined that the impacts described above may be avoidable and the permittee has failed to demonstrate that there are no less environmentally damaging alternatives; the discharges associated with the Spruce No. 1 Mine will cause or contribute to significant degradation of waters of the United States (especially when considered in the context of the significant cumulative losses and impairment of streams across the Central Appalachian ecoregion); and the compensatory mitigation will not adequately offset the impacts to Pigeonroost Branch and Oldhouse Branch. These failures to comply with the Guidelines serve to strengthen EPA's judgment about the unacceptability of the significant adverse impacts that will occur.

EPA also notes that USFWS, in its comments on both the Proposed and Recommended Determinations, concurred with EPA Region III's conclusion that the project, as authorized, would result in unacceptable adverse effects on wildlife and that this conclusion is supported by the available scientific information. USFWS also notes that it has consistently expressed concerns regarding the loss of headwater streams and adjacent riparian and terrestrial habitats associated with the Spruce No. 1 Mine, as well as its likely impacts on downstream water quality, aquatic organisms, and terrestrial and aquatic wildlife that depend on those resources.

Finally, EPA notes that this Final Determination is a case-specific determination based on the facts and circumstances presented here. EPA's § 404(c) authority does not require a finding that the particular circumstances are unique, rather it requires a finding of unacceptable adverse impacts to protected resources. EPA's authority is discretionary, and the agency evaluates unacceptability based on the context of the adverse impacts, including their relative size and whether or not it is an impact the aquatic resource can incur without significant adverse environmental effects. Similarly, EPA's decision to undertake a § 404(c) action after a permit had been issued is also a case-specific one and does not threaten the tens of thousands of permits and authorizations that are issued by the U.S. Corps of Engineers every year. This determination was initiated based on the substantial number of project-specific considerations focusing on important headwater stream miles impacted in a stressed watershed where a vast majority of the impacts authorized by the permit had not occurred because of third-party litigation. This is a rare circumstance and the fact that this is only the second final determination following permit issuance in the past 40 years demonstrates that EPA does not undertake such an action lightly.

Accordingly, pursuant to § 404(c) of the Clean Water Act and its implementing regulations at 40 CFR Part 231 and for the reasons set forth herein, it is my determination that the specification embodied in DA Permit No. 199800436-3 (Section 10: Coal River) of Pigeonroost Branch and Oldhouse Branch, and their tributaries, as disposal sites for discharges of dredged or fill material for construction, operation, and reclamation of the Spruce No. 1 Mine be withdrawn. This Final Determination also prohibits the specification of the defined area constituting Pigeonroost Branch, Oldhouse Branch and their tributaries for use as a disposal site associated with future surface coal mining that would be expected to result in a nature and scale of adverse chemical, physical, and biological effects similar to the Spruce No. 1 mine.

Date: 1/13/11

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Re: Comments on the Whistling Ridge Wind Farm—Skamania County's jobs issue and the Washington Energy Conservation Initiative, I-937 (2006)

Dear EFSEC,

On January 11th, I heard Skamania County Commissioner Paul Pearce say, under oath (I'm presuming, I came in the afternoon and did not see him take the oath) that he and Mr. Jason Spadaro, SDS president and the public face of the Whistling Ridge Wind Farm proposal, never discussed how many permanent jobs would actually result from this proposal, and what the salary (in American dollars!) would be for these alleged jobs that are always being touted by proponents of this project.

I find this incredible, unbelievable, and really unbelievable. Wouldn't "what are the number of resulting jobs from this proposal" be the first question any reasonable and dutiful elected official would ask of a proposal proponent? Commissioner Pearce is always bragging how many times he has gone to Washington, D.C. to propone for our county and one of the things he is always publicly talking about is how our county needs jobs, jobs, jobs—even though, several years ago, the Economic Development Council's own director, Peggy Bryan, brought in a economic consultant who stated that we had about 150 employable people in the county and we should be helping our small businesses expand rather than looking for big projects for which we did not have the workforce numbers! So, we are to believe that in the case of Whistling Ridge, Mr. Pearce and Mr. Spadaro did not discuss how many actual, alleged family-wage jobs were going to result from this proposal??!? That is unbelievable. If it is true, then either Mr. Spadaro and Mr. Pearce consciously decided not to talk about the issue so neither would have to lie under oath when the time came, or Mr. Pearce is negligent in his duties as a

Skamania County commissioner and never asked how many jobs or what kind of wages this project was going to bring into the county! Mr. Pearce stood up in front of this committee at least twice, during the public comment periods, and stated that the creation of "family-wage jobs" was one of the drivers for the county's support for this project. What, and now we're to believe that he never asked Mr. Spadaro what kind of wages these alleged family-wage jobs were going to pay?!?

If real family-wage jobs are not one of the big results of this proposal, then why would we blast the tops off our ridges and degrade our environment, pollute our waters, erode our mountains, harm human health and welfare, destroy wildlife and its habitats, and generally pillage our own backyard?!? Normal people who have all the facts, and look at the facts critically, would not do this. Even the Environmental Protection Agency has finally stepped up and withdrawn approval for mountaintop mining in West Virginia[1], a first. **See Attachment 1, EPA stops mountaintop removal, and Attachment 2[2], EPA_stops mountain mining.pdf.** [The EPA's final determination pursuant to § 404(c) of the Clean Water Act is an example of how environmental assessments should be done. And, shows why proponents of wind farms should not be allowed to write EISs…] Why would we Washingtonians be blasting our ridges to pieces for an alleged (in the DEIS) four or five jobs?!? [In my previous comments, I have entered into the record one document that states that most of the jobs at a finished wind farm project are not family wage jobs, and one wage figure quoted is an average of $18,000 as a salary for the technicians who maintain the turbines. Skamania County's median income is approximately $27,000, as Ms. Bryan has stated publicly numerous times. Eighteen thousand dollars will not support a family of four in Skamania County.]

The short answer is that we would not because this is not what we the people of Washington State voted for when we passed I-937, the Washington Energy Conservation Initiative, **See Attachment 3**, in 2006. I stood on rainy corners and gathered signatures for this initiative and to my understanding and to those of us who proponed for it, it was not the be all and end all of the energy issues that we are facing in our state. This initiative was about CONSERVATION and renewables. And, certainly subsidizing the

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[1] **EPA Stops Largest Mountaintop Removal Mine**
Saturday, January 15, 2011
Mountaintop removal site in Kayford Mountain, West Virginia (Photo: AP)
For first time in its history, the U.S. Environmental Protection Agency (EPA) has rescinded a clean water permit for a coal mining operation, a move that is likely to provoke backlash from the industry.

The decision in effect kills the Spruce No. 1 Mine and puts a stop to the largest single mountaintop removal permit in West Virginia history. EPA officials decided the project would use destructive and unsustainable mining practices that jeopardized clean water sources for local communities.

[2] Final Determination of the U.S. Environmental Protection Agency Pursuant to § 404(c) of the Clean Water Act Concerning the Spruce No. 1 Mine, Logan County, West Virginia

wind industry to the tune of billions of taxpayer dollars was not one of the primary reasons for the passage of this initiative.

The policy intent of I-937 clearly states that 1) energy conservation is and should be our primary goal, only "appropriately sited renewable energy facilities" would be proposed, and the object is to benefit the people of Washington state—not California or some other state. This initiative was not California's answer to meeting its own renewable energy requirements—which begs the question of why California is not leading the charge on increasing the efficiencies of its existing energy users and facilities. From I-937: **"Increasing energy conservation and the use of <u>appropriately sited renewable energy facilities</u> builds on the strong foundation of low-cost renewable hydroelectric generation in Washington state and will promote energy independence in the state and the Pacific Northwest region. Making the most of our plentiful local resources will stabilize electricity prices for Washington residents, provide economic benefits for Washington counties and farmers, create high-quality jobs in Washington, provide opportunities for training apprentice workers in the renewable energy field, protect clean air and water, and position Washington state as a national leader in clean energy technologies." [my emphasis]**

The term **<u>"appropriately sited renewable energy facilities"</u>** was not put in there on a whim. The people of Washington voted for **<u>"appropriately sited renewable energy facilities"</u>** and Whistling Ridge is definitely not a "appropriately sited" proposal when we would have to blast the tops off our ridges and degrade our environment, pollute our waters, erode our mountains, harm human health and welfare, destroy wildlife and its habitats, and generally despoil and desecrate our own backyard!!! All for an unreliable source of energy that has no way to get to market unless we spend millions more taxpayer dollars on building more and bigger transmission lines that will contribute to the cumulative destruction of our environment and ecosystems?!? No, we should not do this and there are better ways to increase our energy production, increase the efficiencies of our existing grid, increase the efficiencies of the appliances that we use in our everyday life, and, most of all, decrease our energy uses.

As stated in Section 4(a) "By January 1, 2010, using methodologies consistent with those used by the Pacific Northwest electric power and conservation planning council in its most recently published regional power plan, each qualifying utility shall identify its achievable cost-effective conservation potential through 2019. At least every two years thereafter, the qualifying utility shall review and update this assessment for the subsequent ten-year period" it is the NW Power and Conservation Council's methodologies that are to be used. **And, the Council has stated, in its Sixth Power Plan, that Washington State can achieve 85% of the legislated renewable energy requirements by upgrades in the efficiencies of appliances, water heaters, the power grid, etc.**[3] "The Council also expects that there are small-scale resources available at the

[3] In each of its power plans, the Council has found substantial amounts of conservation to be cheaper and more sustainable than most other types of generation. In this Sixth Power Plan, because of the higher costs of alternative generation sources, rapidly developing technology, and heightened concerns about global climate change, conservation holds an even larger potential for the region.

local level in the form of cogeneration or renewable energy opportunities. The plan encourages investment in these resources when cost-effective." The operative word here is cost-effective and since there was no cost-benefit analysis done for Whistling Ridge, in the DEIS, we have no way of really knowing if Whistling Ridge is cost-effective. I'm pretty sure it's not, from everything we have heard at the public hearings, but we need the facts to see the truth of the matter.

The time has come to put a stop to the relentless lobbying from the wind industry that propagates the false idea that wind farms are the only form of energy production that is "renewable" and "green", etc., etc., etc. Wind energy is not green if you have to blast ridges and pollute streams to produce it. It is also time to revisit the intent of I-937 and admit that perhaps increasing efficiencies and decreasing energy use are more worthy objectives than ruining our environment with wind farms that can't power one house with

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The plan finds enough conservation to be available and cost-effective to meet 85 percent of the region's load growth for the next 20 years. If developed aggressively, this conservation, combined with the region's past successful development of energy efficiency could constitute a resource comparable in size to the Northwest federal hydroelectric system. This efficiency resource will complement and protect the Northwest's heritage of clean and affordable power.

Aggressive pursuit of this conservation is the primary focus of the power plan's actions for the next five years. Combined with investments in renewable generation as required by state renewable portfolio standards, improved efficiency will help delay investments in more expensive and less clean forms of electricity until the direction and form of future climate change legislation becomes clearer, and alternative low-carbon energy technologies become cost-effective.

At the same time, the region cannot stand still in maintaining and improving the reliability of its power system. Investments to add transmission capability and improve operational agreements are important for the region, both to access growing site-based renewable energy and to better integrate it into the power system. The Council also expects that there are small-scale resources available at the local level in the form of cogeneration or renewable energy opportunities. **The plan encourages investment in these resources when cost-effective.**

Along with the smart grid, other technologies may be able to provide power when it is needed with low cost, low risk, and low emissions. In the future, the region may find greater value in power generated by geothermal resources, ocean waves, tides, gasified coal with carbon sequestration, advanced nuclear, or currently unknown technologies. New methods to store electric power, such as pumped storage or advanced battery technologies may enhance the value of existing variable generation like wind. Given the uncertainties of the future, the region should not concentrate on any one potential future solution to its power supply, **but should explore a diversity of potential sources of future energy generation and conservation.**

The Council's power plan includes a detailed analysis of efficiency potential in hundreds of applications. The achievable technical potential of efficiency improvements increased from the Fifth Power Plan levels due to advancing technology, reduced cost, and estimates in new areas such as efficiency in electricity distribution systems, consumer electronics, and street, parking, and exterior building lighting. In addition, the cost-effectiveness of these technologies has increased significantly because avoided costs have doubled and carbon-cost risk is several times higher than in the Fifth Power Plan. The estimated achievable potential conservation is nearly 6,000 average megawatts for measures costing under $100 per megawatt-hour. Over 4,000 average megawatts are available at a cost of less than $40 per megawatt-hour. These increased opportunities exclude future savings from efficiencies that have already been secured through building codes and appliance efficiency standards. **[my emphasis]**

the energy they produce because wind is unreliable and the grid has to be balanced for the users of the energy being produced.

There are many real and factual reasons why the Whistling Ridge Wind Farm proposal should be denied a siting permit from EFSEC. You all have sat through numerous public and judicial testimony and have heard a lot of them. Many more have been put into the written record. The above are just a few of the reasons. But they, added to the many other comments that you all have received, indicates that there are more than ample reasons to deny this project and move on to more efficient and meaningful ways of using and producing energy for the people of Washington and the Pacific Northwest region.

Thank you.

/e-signature/Mary J. Repar
15 January 2011