To: Ken Merrill[kmerrill@kalispeltribe.com]; zwelker@kalispeltribe.com[zwelker@kalispeltribe.com]
Cc: Bray, Dave[Bray.Dave@epa.gov]; dosterman@kalispel.com[dosterman@kalispel.com]
From: Khatibi, Mehrdad
Sent: Tue 7/25/2017 8:20:08 PM
Subject: FW: Response to June 29, 2017 EPA Letter RE Class I Redesignation Proposal of the Kalispel Tribe
07.24.2017_Kalispell Tribe_OAW.pdf

Good afternoon Ken and Zach,

We have confirmation from the RA's office that your letter has been received. That is the good news. Unfortunately, it appears the thumb drive didn't make it with the letter. The envelope was partially torn and we're assuming the thumb drive fell out.

Zach, I know you emailed me all the attachments, but I've had some technical issues copying over a few of them.

Would you terribly mind sending another thumb drive? You can send it to my attention at the address below. May be best not using a typical envelop as those are processed by the post office through equipment that will strip out odd shaped objects in envelopes. I had it happen to me once when some keys were being mailed to me.

Sorry to inconvenience you all, and please let me know if you have any questions.
Mehrdad

Mehrdad Khatibi
Tribal Air Team Lead
Tribal Programs, Diesel, and Indoor Air Unit - Office of Air and Waste
U.S. Environmental Protection Agency
Suite 900, OAW-150 - Seattle, WA 89101
Ph: (206) 553-1603 - Khatibi.Mehrdad@epa.gov

From: Gahner, Pamela
Sent: Monday, July 24, 2017 12:22 PM
To: Khatibi, Mehrdad <khatibi.mehrdad@epa.gov>
Subject: RE: Response to June 29, 2017 EPA Letter RE Class I Redesignation Proposal of the Kalispel Tribe

Mehrdad,

We will put this original in the OAW mailbox. It is not going to go into CMS so Linda said you can decide how you want to handle the missing thumb drive.

If any questions please let us know.

Pam Gahner, Executive Asst.
Office of the Regional Administrator
U.S. EPA, Region 10
1200 Sixth Avenue, Mail Stop RA-210
Seattle, Washington 98101-3140
(206) 553-2598

From: Khatibi, Mehrdad
Sent: Thursday, July 20, 2017 4:07 PM
To: Tyson, Linda <Tyson.Linda@epa.gov>; Gahner, Pamela <gahner.pamela@epa.gov>
Subject: FW: Response to June 29, 2017 EPA Letter RE Class I Redesignation Proposal of the Kalispel Tribe

Hello Linda and Pam –

Please see email below and attached letter that we were told was mailed to the RA's attention last week Thursday. If you do happen to receive this by COB tomorrow please let me know.

Otherwise, I will need to contact the tribe and ask that they submit it again.

Thanks
Mehrdad

Mehrdad Khatibi
Tribal Air Team Lead
Tribal Programs, Diesel, and Indoor Air Unit - Office of Air and Waste
U.S. Environmental Protection Agency
Suite 900, OAW-150 - Seattle, WA 89101
Ph: (206) 553-1603 - Khatibi.Mehrdad@epa.gov

From: Zach Welcker [mailto:ZWelcker@kalispeltribe.com]
Sent: Thursday, July 13, 2017 10:30 AM
To: Khatibi, Mehrdad <khatibi.mehrdad@epa.gov>
Cc: Ken Merrill <kmerrill@kalispeltribe.com>; Bray, Dave <Bray.Dave@epa.gov>; Deane Osterman <dosterman@kalispeltribe.com>
Subject: Response to June 29, 2017 EPA Letter RE Class I Redesignation Proposal of the Kalispel Tribe

Mehrdad,

Please find attached a letter from Chairman Nenema responding to EPA's June 29, 2017 request for additional information regarding the Kalispel Tribe's proposal to redesignate the lands within the exterior boundaries of its original Reservation to a Class I area under the Clean Air Act's PSD Program. The original letter, along with a thumb drive containing the requested information, will be mailed to Ms. Pirzadeh later today.

I will also send the requested information in a series of emails to follow. Sorry for the inconvenience, but the files are too large to send in a single email.

Please let us know if you have additional questions.

Thanks,
Zach

Zach Welcker
Senior Policy Analyst
Kalispel Tribe of Indians
(509) 447-7448 (office)
Ex. 6 (cell)

Kalispel Tribe of Indians
P.O. Box 39
Usk, WA 99180

(509) 445-1147
(509) 445-1705 *fax*
www.kalispeltribe.com

RECEIVED ON:

JUL 24, 2017

EPA Region 10
Office of the Regional Administrator

July 13, 2017

Michelle Pirzadeh
Acting Administrator, Region 10
Environmental Protection Agency
1200 Sixth Avenue, Suite 900
Seattle, WA 98101

RE: Supplemental Information for EPA's Review of the Kalispel Tribe's Class I Redesignation Proposal

Dear Ms. Pirzadeh:

Thank you for your letter dated June 29, 2017 regarding the Kalispel Tribe's proposal to redesignate the lands within the exterior boundaries of our original Reservation to a Class I area under the Clean Air Act's Prevention of Significant Deterioration Program. For the record, the Tribe is requesting that EPA effectuate the redesignation by promulgating a revision to the current Federal Implementation Plan for the Kalispel Tribe of Indians codified in 40 C.F.R. Part 49. The Tribe does not intend to submit a Tribal Implementation Plan for EPA's approval.

The following documents are attached in response to your requests for information:

- A copy of the transcript of the April 10, 2017 public hearing regarding the Tribe's Class I redesignation proposal.
- A supplemental certification from Taylor S. Fielding, Staff Attorney for the Kalispel Tribe, that the Tribe complied with all requirements of 40 C.F.R. § 51.102(a) and (d) with respect to the public hearing on the Tribe's Class I redesignation proposal.
- Notifications to state and local governmental officials.
- Copies of written comments received by the Tribe in response to our Class I redesignation proposal.

Please also find attached an economic profile prepared for Pend Oreille County by a regional labor economist for reasons unrelated to the Tribe's Class I redesignation proposal. The County has asked us to include this profile as an addendum to our Technical Report in order to more specifically describe economic conditions in Pend Oreille County. The Tribe is willing to honor

ED_002139_00004719-00001

this request as a courtesy to the County with the understanding that the Tribe did not solicit or perform the economic profile and does not necessarily agree with the analytical choices made therein. The Tribe also wishes to emphasize that the scope of the attached economic profile is too narrow for purposes of our Class I redesignation proposal, and that the Technical Report's existing regional economic analysis appropriately considers the data it contains. With this understanding, the Tribe requests that EPA include the economic profile as an addendum to our Technical Report.

Please contact Deane Osterman, Executive Director of the Kalispel Natural Resources Department, if you have any questions or need additional information. His phone number is (509) 447-7282.

Respectfully,

Glen Nenema

Glen Nenema
Chairman, Kalispel Business Council

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KALISPEL
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Kalispel Tribe of Indians
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Usk, WA 99180

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ADDRESSED UNABLE TO FORWARD

Michelle Pirzadeh
Acting Director, Region 10
Environmental Protection Agency
1200 Sixth Avenue, Suite 900
Seattle, WA
98101

98101SE140 C002

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KALISPEL TRIBE OF INDIANS

Kalispel Tribe of Indians
P.O. Box 39
Usk, WA 99180

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Michelle Pirzadeh
Acting Director, Region 10
Environmental Protection Agency
1200 Sixth Avenue, Suite 900
Seattle, WA
98101

ED_002139_00004719-00006

To: Khatibi, Mehrdad[khatibi.mehrdad@epa.gov]
Cc: Bray, Dave[Bray.Dave@epa.gov]; Ken Merrill[kmerrill@kalispeltribe.com]
From: Zach Welcker
Sent: Thur 7/13/2017 5:46:33 PM
Subject: Supp Info 6 -- The Final Frontier

Proposed Air Quality Change to Class 1.
Proposed Air Quality change
RE: Comments on Air Quality 4/6/17
Redesignation
Transcripts - Clean Air Class I Public Hearing 04-10-2017.pdf
Attachment
Attachment
Your recent post.

This is it. Have a good day.

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Thur 4/6/2017 6:40:25 PM

After reading the April 5th Miner article what I see is if the standards are changed to Class 1 any industry who might want to locate here will have second thoughts. You folks are probably one of the reasons that the High Test Sands Project went to Addy Wa. We have enough restrictions EPA ,Shoreline Management Act, Clean Air Act , that we don't need any more . The other part is that it would impact a 60 mile radius of the Reservation. We voted Donald Trump in as President to scale back the EPA. You can do whatever you want within the Reservation but don't think you can change my life when I am not on your Reservation. Take your Casino money and keep it on your reservation to help the very few that live there . Leave us out of it and let it stay Class 2. Ex. 6

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Fri 4/7/2017 8:20:06 PM

Ex. 6

Ex. 6

04.07.17

To: KalispelTribeEPACleanAirRedesignationClassIItoClassIComments

My comments about the Kalispel Tribe of Indians reservation at Usk, WA, redesignating to a Class I Clean Air entity:

1. My name is Ex. 6 I live Ex. 6 from the Kalispel Tribe's headquarters. My family has enjoyed Ex. 6 WA, at Ex. 6 By Ex. 6, 2017, I will reach 70 years of age. I have difficulty breathing, especially when my neighbors are producing smoke and pollutants. We sit in a flood plain valley where foggy weather inversions and stagnant air frequently welcomes us to each new day, in a rural setting. What wind we have usually blows in from the direction of a 40 year old paper newsprint mill in Usk, WA, with a Ex. 6 wind.

2. Past air pollution at my home from 1961 to 1980 came from fires, slash, wood, leaves, trash burning and autos. With the paper mill, came sometimes stinky pollutants at night, but today's air pollution here is still from smoke.

3. My state, county and town government officials are pushing hard for more tax revenues related to increased jobs and property values, planning commercial and industrial developments immediately South of me. I resist most of those efforts and deeply respect the traditional rural culture and lifestyle, along with the expertise in the protection of these traditions by the Kalispel Tribe.

4. Although a sovereign nation, the Kalispel reservation's activities have culturally and economically benefited the surrounding agricultural and recreational community tremendously. Their vision has been spot-on.

Respectfully,

Ex. 6

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Wed 4/5/2017 8:06:02 PM
Subject: Proposed Air Quality Change to Class 1.

I am completely against the proposed changes! There is absolutely NO reason for the change!

I have lived in the valley for Ex. 6 and have heated my home with wood for that entire time.

This proposal appears to be an issue of good neighbors turning into bad neighbors, because they now have the money to force the rest of us under their whims of control! NOT A GOOD IDEA!

I view this proposal as an act of domestic terrorism!

By forcing the huge area in question under a Class1 AQR you will effectively removed my ability to economically and comfortably heat my home during cold weather.
You will also be responsible for both state and federal government interference in the lives if thousands of residents in the proposed area!
I will fight this stupidity in any way possible!
STOP IT NOW! PULL THE PROPOSAL!

Ex. 6

Sent from BlueMail

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Thur 4/6/2017 6:44:20 PM
Subject: Proposed Air Quality change

We object strongly to this proposal. This effectively could change all industry, farming, wood stove emissions, car emissions, etc.

These issues should be important and are important in our livelihoods, way of life, etc.

We have voiced our concern with Cathy Morris Rogers as well as the County Commissioners. We will attend this meeting to further object to this proposal.

Ex. 6

Sent from my iPhone

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Thur 4/6/2017 9:13:11 PM
Subject: RE: Comments on Air Quality 4/6/17

Kalispel Tribe:

My husband and I are residents of Ex. 6 Washington and have lived in this area for many years. We do not believe there is any reason that justifies more regulation regarding your proposal to re-designate the lands within the exterior boundaries of the Kalispel Indian Reservation as a Class I area of the Clean Air Act's prevention of Significant Deterioration Program. We are absolutely opposed to more stringent air regulations that affect our industries and small businesses when it is totally unjustified.

The cost of the permits, testing and supervision by numerous state and federal agencies when there is no problem whatsoever is detrimental to the citizens of Pend Oreille County.

Thank you,

Ex. 6

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Thur 4/6/2017 9:45:41 PM
Subject: Redesignation

I am opposed to the redesignation proposal. We have ClassII currently and have some of the cleanest air in the United States but also some of the highest unemployment rates. I feel further restrictions could negatively effect business expanding to our area.

Ex. 6 and registered voter.

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Fri 4/7/2017 7:52:50 PM
Subject: Your recent post.
IMG_1839.JPG
ATT00001.txt
IMG_1840.JPG
ATT00002.txt

I am for clean air but this seems over reaching and your scramble with this last minute post does not seem to be well thought out.

What guarantees after you turn over policing of the clean air do you have that the rules, laws and expectation won't change like they have in other places once they get their foothold in to police your tribes historic land boundaries.

Doesn't this help from the government then give them more of a foothold to dictate what happens on tribe lands? It sure has in other areas.

Class I Redesignation of the Kalispel Indian Reservation
Frequently Asked Questions

On March 8, 2017, the Kalispel Tribe of Indians issued public notice of a proposal to redesignate the Kalispel Indian Reservation a Class I air quality area under the Clean Air Act. The Tribe is accepting written comments on the proposed redesignation until April 7, 2017 and will be accepting oral testimony at a public hearing at the Camas Center for Community Wellness on April 10, 2017. A Technical Report describing the potential effects of Class I redesignation is currently available for public review at Tribal Headquarters, the Newport Public Library, and on the web at http://kalispeltribe.com/kalispel-natural-resources-department/overview. This FAQ addresses some of the questions the Tribe has received to date regarding the redesignation.

1. Why is the Tribe proposing to redesignate the Reservation a Class I area?

The Tribe wants to better protect our people and resources from problems caused by air pollution. The Reservation is the Tribe's only home, which makes Reservation residents particularly vulnerable to localized environmental pollution.

2. What gives the Tribe the right to redesignate its Reservation a Class I area?

The Clean Air Act, 42 U.S.C. § 7474, specifically authorizes states and federally recognized Indian tribes to redesignate their sovereign lands as Class I areas. A number of tribes have already redesignated their reservations as Class I areas.

3. Which Kalispel lands will the Class I redesignation include?

The redesignation will only apply to lands within the exterior boundaries of the Tribe's reservation near Usk, WA.

4. How will Class I redesignation better protect air quality on the Reservation?

The Reservation is currently part of a Class II area under the Clean Air Act's Prevention of Significant Deterioration (PSD) program. This designation prevents Reservation air quality from being degraded up to the level allowed by National Ambient Air Quality Standards. Class I redesignation will provide significantly more protection than Class II status.

5. Are there other Class I areas in Washington?

Washington has nine Class I areas including five wilderness areas, three national parks, and one Indian reservation.

6. What pollutants are addressed by the PSD area classification system?

The PSD program currently regulates three pollutants under the PSD area classification system: sulfur dioxide, nitrogen dioxide, and particulate matter. For these three pollutants, PSD "increments" have been established for Class I, II, and III areas that define the allowed amount of degradation.

Class I Redesignation of the Kalispel Indian Reservation
Fact Sheet

The Kalispel Tribe is seeking to redesignate our Reservation a Class I air quality area under the Federal Clean Air Act's Prevention of Significant Deterioration (PSD) program. This fact sheet is intended to help explain what this means for the community and address any misunderstandings. More information is available in the Technical Report supporting the Tribe's redesignation proposal, and in an FAQ addressing common questions we have received concerning our redesignation. Both of these documents may be reviewed by visiting http://kalispeltribe.com/kalispel-natural-resources-department/overview.

Misunderstanding	Fact
If the Kalispel Reservation is redesignated a Class I PSD area, people in Pend Oreille County won't be allowed to use wood stoves, burn slash piles, drive on unpaved roads, sand roads in winter, or plow fields.	Class I redesignation will not affect these day-to-day rural activities. The PSD program may only impose pollution limits on new or modified "major stationary sources." This term includes facilities such as steel mill plants and petroleum refineries capable of emitting at least 100 tons of regulated pollutants.
If air quality in the Pend Oreille Valley gets too bad during the winter, people will not be able to use their wood stoves.	The PSD program does not impose any limitations on the use of wood stoves. Accordingly, Class I redesignation will have no effect on the Department of Ecology's existing authority to regulate the use of wood stoves and other activities that may impair air quality.
Class I redesignation will stop all industrial development on and near the Reservation.	Class I redesignation will affect very few types of businesses, mainly large industrial facilities capable of generating significant enough emissions to require a PSD permit. In all of Eastern Washington, for example, only 11 facilities have PSD permits.
Class I redesignation will force more businesses to go through a PSD review if they want to locate in Pend Oreille County.	Class I redesignation will not increase the number of businesses that have to go through a PSD review. The Reservation is already a Class II PSD area and the same types of large industrial facilities that currently have to go through a Class II PSD review are the only types of facilities that will have to go through a Class I review.
Class I redesignation will require a reduction in all emissions on and near the Reservation.	The PSD program does not require a general reduction in existing emissions. Rather, it places tighter limits on the amount of pollution new or modified major stationary sources can emit in addition to existing emissions.
Class I redesignation will adversely impact all counties in northeastern Washington and beyond.	Due to the prevailing wind patterns and topography of the area, Class I redesignation is unlikely to impact economic development outside of Pend Oreille County. The likelihood of adverse impacts in Pend Oreille County is low given the limited number of PSD-permitted facilities in Eastern Washington, the availability of pollution-control technology, and the ability of the County to attract new businesses with low or no emissions.

If you are interested in giving public testimony regarding the Class I redesignation of the Kalispel Reservation, we invite you to attend a public hearing at the Tribe's Camas Center for Community Wellness (1821 LeClerc Rd N, Cusick, WA) on Monday, April 10th at 5:30 pm. We appreciate your input and feedback.

To: Khatibi, Mehrdad[khatibi.mehrdad@epa.gov]
Cc: Bray, Dave[Bray.Dave@epa.gov]; Ken Merrill[kmerrill@kalispeltribe.com]
From: Zach Welcker
Sent: Thur 7/13/2017 5:45:03 PM
Subject: Supp Info 5

Comments regarding Class 1 Air Quality designation
Draft EDC Transmittal Letter 05-26-17 (002).docx
FW: air Public comment - White
Fwd: Class I Redesignation Comment - Cain
Fwd: Comment - Kalispel Tribe Class I air quality -Schutte
Kalispel Tribe Clean Air Redesignation Request
Kalispel Tribes Air Quality Control Change Proposal
Kalispel Tribes request to reclassify clean air act.
Opposition to Clean air quality change to class 1
Opposition to Reclassifcation of EPA Level 2 to Level 1

more

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Fri 4/7/2017 8:47:38 PM
Subject: Comments regarding Class 1 Air Quality designation

I would like to provide you with my point of view regarding the proposed redesignation from Class 2 to Class 1 air quality categories. Although we should constantly strive to improve the condition of our entire environment, I feel this change imposes restrictions reaching far beyond the simple discharge limits of present facilities and resources. Regardless of where you draw boundary lines, this is a Federal Standard, to be upheld. If limits (present or proposed) are exceeded, steps would be absolutely mandated to correct the situation. Just one example: Let's say Ponderay Newsprint decided to put in a Co-Gen Plant, so they could generate electricity, rather than drawing on Hydroelectric power at their present rate. More water then becomes available, to flush and support our continued efforts to improve Salmon movements and habitat. But wait...Co-Gen, as studies show, creates air discharges. Sorry, no Co-Gen for Ponderay Newsprint. Instead of looking at the big picture, we choose tunnel vision and come up with untenable solutions. (Like...yes, you can have Co-Gen, but you have to shut down half of your production, so as not to exceed present discharges). So who "won" there?

Your latest fact sheet, addressing many public concerns, also reiterates that existing practices are "Grandfathered", with present levels of SO2, NOX, Particulates, etc. being acceptable. However, as a Federal Standard and classification, if particulate matter exceeds Class 1 margins, required steps are mandated, and cannot be shoved aside. Without digressing into the whole original study that looks into a very large region, (Most of which it also states doesn't apply to our unique geographic area), the bottom line is that accurate measurement of air quality in a Class 1 area dictates everything that has effect on that designated area. So, it would be virtually impossible to ignore any factors that would take the Class 1 area out of compliance. By Law, steps would be required, to bring all discharges back down, to stringent Class 1 levels. These specific steps would not be dictated by the Federal Government, unless we did not come back into compliance to the Class 1 Standards. Initially, it would be US who decides what activities to limit or shut down. Would that be Logging? Travelling dirt roads? Shutting down 200+ local jobs, and the tax base they pump up? Restricting vehicle travel, or setting up emission testing? Etc.

It would be in our hands, to try to achieve the new, much more restrictive standards. Are we choosing to ignore the releases of Hanford radioactivity into our air and water? Some of that has a half-life of 250,000 years! Bottom line for me: I feel that our present Class 1 designation is restrictive enough to support quality of life in Pend Oreille County. Once again, I recognize any efforts to improve our habitat. I also think that the present systems within that classification allows accommodations for growth, a supportive tax base, employment, as well as leeway for adapting what we do to improve present air quality. Stepping into a much more restrictive designation disallows the freedom to weigh what we choose to do, and also relinquishes our ability to govern our very unique geographic region. Thank you. Ex. 6

May 30, 2017

Honorable Glen Nenema
Chairman, Kalispel Business Council
Kalispel Tribe of Indians
P.O. Box 39
Usk, WA 99180

RE: Class 1 Redesignation Pend Oreille County Economic Analysis

Dear Chairman Nenema:

As a follow-up to our recent conversations with Deane Osterman and his staff we have attached a copy of a recent economic analysis prepared for Pend Oreille County. This analysis was prepared in September of 2016 Washington State Employment Security Regional Labor Economist, Doug Tweedy. As you know, Pend Oreille County has historically suffered double digit unemployment numbers and has been slow to come out of the recession. There are encouraging opportunities for growth on the horizon however it has been slow development with a higher level of poverty and an aging workforce. Many find themselves commuting to bigger towns nearby within an hour drive to find livable wage jobs.

We respectfully request that this document be included as an addendum to the Technical Report prepared in support of the Tribe's request for redsesignation of the Kalispel Reservation as a Class I area under the provisions of the Clean Air Act. Unfortunately, the Technical Report is based on an assessment of an economic area that predominately reflects the economic prosperity being realized in the city and county of Spokane and does not accurately reflect the economic conditions and challenges that we face in Pend Oreille County. While Spokane is experiencing population and economic growth, Pend Oreille County, including the Kalispel Reservation is not. We continue to have one of the highest unemployment rates in the state and one of the lowest per capita income levels.

As we previously noted, the Technical Report also fails to address the perilous economic situation that the Pend Oreille County government faces. Simply stated, the general fund budget of Pend Oreille County is over $10 million dollars a year, and their annual revenues are closer to $9 million a year. Over the past four years the County's operating expenses have increased by over thirty percent and our revenues have increased by two percent. This is clearly not a sustainable situation and the County must actively attract new private investment if the County is to sustain

301 W. Spruce ▪ PO Box 1616 ▪ Newport, WA 99156 ▪ (509) 447-5569 ▪ jwyrobek@pendoreille.org

basic services. Our ability to attract new businesses to our community is critical to our future well-being and we want to make sure that there is no misunderstanding about our economic condition and the many challenges that we face in our efforts to establish a more secure economic future. Your support in setting the record straight is greatly appreciated!!

Sincerely,

Jamie Wyrobek
Director
Pend Oreille County EDC

CC: County Commissioner Mike Manus
County Community Development Director Greg Snow
Ray Pierre, EDC Chair
Deane Osterman, Kalispel Natural Resource Department Director
Zach Welcker, Kalispel Natural Resources Department

301 W. Spruce ▪ PO Box 1616 ▪ Newport, WA 99156 ▪ (509) 447-5569 ▪ jwyrobek@pendoreille.org

To: Ken Merrill[kmerrill@kalispeltribe.com]
From: Mike Lithgow
Sent: Thur 4/13/2017 4:23:31 PM
Subject: FW: air Public comment - White

FYI

Mike Lithgow
Information and Outreach Coordinator
Kalispel Tribe Natural Resource Dept.
P.O. Box 39
Usk, WA 99180
Desk: 509-447-7435
Cell: Ex. 6
Email: mlithgow@kalispeltribe.com

-----Original Message-----
From: Ex. 6
Sent: Thursday, April 13, 2017 9:23 AM
To: Mike Lithgow
Subject: Public comment

April 13, 2017

From: Ex. 6
Ex. 6

Regarding:
The Kalispel Tribe of Indians' redesignation from current Class 2 status to Class 1.

To whom it may concern;
I am pleased to have the opportunity to support The Tribe in their efforts to further protect the quality of our air, our water, land and our quality of life in Pend Oreille County. They have been continual community leaders, respecting and helping their neighbors at every turn. I salute them once again in their efforts to step up and do what they can to protect both our environment and the quality of life for today and for generations yet to come.

The typical argument against protecting our environment is based on fear of the impact on jobs. I ask you, what good are jobs if the very quality of our lives, our health and our children's health, is undermined in the process? Yes, the prospect of certain short term opportunities must be scientifically weighed, but with an eye to our long term sustainability, our health dependent on a healthy environment. If Pend Oreille has anything going for it, it is it's quality of life. It is our duty to protect it. It is our duty to seek out future employers who are looking for that quality of life for their employees as well, no matter what part of the county they may be looking to locate themselves. There are companies looking for just that. I am not speaking against any particular company here, but that we strive to protect our future, which means taking any steps we can to protect our environment and by extension, our quality of life. I put environment first in that last sentence because, without a sustainably healthy environment, the possibility of quality of life is forfeited, for today and into the future.

I'd like to thank you once again for this opportunity to speak up and to support our good neighbors, The Kalispel Tribe of Indians, in their efforts to change designation. In honoring their intentions to remain good neighbors and thoughtful community leaders, I urge you to do all in your power to grant this redesignation.

Sincerely,

Ex. 6

Sent from my iPhone

To: Ken Merrill[kmerrill@kalispeltribe.com]
From: Mike Lithgow
Sent: Fri 4/14/2017 5:00:19 AM
Subject: Fwd: Class I Redesignation Comment - Cain

Sent from my Verizon, Samsung Galaxy smartphone

-------- Original message --------
From: Ex. 6
Date: 4/13/17 8:38 PM (GMT-08:00)
To: Mike Lithgow <MLithgow@kalispeltribe.com>
Subject: Class I Redesignation Comment

April 14, 2017

Mike Lithgow
Information and Outreach Coordinator
P.O. Box 39
Usk, WA 99180
mlithgow@kalispeltribe.com

I write in support of the Class I Redesignation of the Kalispel Indian Reservation from a Class II to a Class I air quality area under the Federal Clean Air Act's Prevention of Significant Deterioration (PSD) program.

There are not enough opportunities in today's greed over our children's future to offer support for those who take positive action toward protecting our environment for generations to come.

Our family applauds your efforts to protect families in Pend Oreille County.

Please keep us informed about the progress of your efforts in this matter – Ex. 6 **or** Ex. 6

Sincerely,

Ex. 6

To: Ken Merrill[kmerrill@kalispeltribe.com]
From: Mike Lithgow
Sent: Tue 4/11/2017 2:30:40 AM
Subject: Fwd: Comment - Kalispel Tribe Class I air quality -Schutte

Sent from my Verizon, Samsung Galaxy smartphone

-------- Original message --------
From: Ex. 6
Date: 4/10/17 6:50 PM (GMT-08:00)
To: Mike Lithgow <MLithgow@kalispeltribe.com>
Subject: Fw: Kalispel Tribe Class I air quality

Mike: Sorry for the error [address] on the prior message. Ex. 6

On Monday, April 10, 2017 6:48 PM, Ex. 6 wrote:

Mike: I support the Tribe's redesignation for Class I air quality area under the Federal Clean Air Act. [PSD Program]. Any potential deterioration of air quality is not acceptable for the Tribe or our County.

I am not sure if you need our location in reference to tribal boundaries. Ex. 6 is located approximately Ex. 6 of tribal lands, just off Ex. 6

Thank you.

Ex. 6

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Fri 4/7/2017 5:12:20 PM
Subject: Kalispel Tribe Clean Air Redesignation Request
Tribal Redesignation Letter-040617.docx

Kalispel Tribe:
I sent this to your email address, Congresswoman Rodgers and Pend Oreille County Supervisors yesterday but your email was returned.

Honorable Public Representatives:
Attached are my comments about the subject listed above. I have great respect for my neighbors at the Kalispel Tribe but I believe that this request is harmful to the other citizens of the County as stated in my letter.
Thank you for time and attention.
Regards,
Ex. 6

Ex. 6

April 6, 2017

To: Congresswoman Cathy McMorris Rodgers

Pend Oreille County Supervisors

Subject: Kalispel Tribe of Indians – Air Quality Redesignation Attempt

As a resident of Pend Oreille County and neighbor of the Tribe, I would like to express my view regarding the Air Quality Redesignation Request proposed by the Tribe. First of all I object to the lack of proper and reasonable notification of the Public Meeting scheduled for April 10th at the Tribal Headquarters in Usk. Had my neighbor not informed me of this meeting I would have had no awareness of it. It is my understanding that this notice was published in the local newspaper (The Minor) just yesterday (April 5th) alerting residents that written comments on the proposed Redesignation "must be submitted by April 7, 2017" and forwarded to the Tribe for collection.

Pend Oreille County is generally considered a rural area with two primary contributors to employment; manufacturing and Government. Government employment accounts for more than 50% of the jobs in the County and that is declining due to budget reductions. Manufacturing jobs are limited and include logging mills one of which is located in Usk and a close neighbor to the Tribal HQ. According to the Employment Security Department:

The civilian labor force increased slightly in the first six months of 2016 to 4,737, from the same period in 2015 of 4,646 The number of employed residents showed an increase in 2016 to 4,276 (99).

The average unemployment rate in the first half of 2016 was 9.7 percent, down from 10.1 percent in 2015. *The county continues to have one of the highest unemployment rates in the state.* But things are improving as the drop in the unemployment rate was due to an increase in jobs.

It seems to me that the Tribal Request is at odds with the overall good of the neighboring County area. Making the Air Quality Standards to Class 1 level could affect the Lumber Mills in the County and a paper manufacturing plant located only miles from the Tribal Headquarters. What impact would that have on an already high unemployment rate experienced County wide? Is the Tribe prepared to subsidize those businesses impacted by their request for cleaner air for Tribal Members? **It is my understanding that the Tribe does not pay any property taxes for their large real estate holdings in Pend Oreille County nor is any revenue generated by the Tribe taxed and realized by the County**.

All Americans want better quality air for themselves, family members and fellow citizens. The key question that needs to be addressed here is what cost will this have to the remaining citizens of Pend Oreille County. It is well documented that this County does not attract service oriented businesses at least historically speaking it has not. If this action is approved, what will the effect be on **already regulated businesses** that by the very nature of what they produce contribute particulates to the atmosphere? Since the Tribe effectively does not contribute to the County in monetary fashion they have nothing to lose by making this request. The only losers could potentially be their neighbors they allegedly embrace.

I look forward to receiving your response and hope that your actions support the constituency that voted you into office.

Ex. 6

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Fri 4/7/2017 5:44:24 PM
Subject: Kalispel Tribes Air Quality Control Change Proposal

I am writing in total opposition to the Kalispel Tribes Air Quality Change proposal. Regardless of what the tribes intentions are for stopping the smelter plant from being built near reservation land. Changing to Class I AQC would adversely affect the residents outside the reservation. Rural citizens that rely on burning wood fuel to heat homes cannot be affected by broad sweeping regulations that are enacted because one entity is trying to protect interest their borders.

Ex. 6

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Fri 4/7/2017 5:46:26 PM
Subject: Kalispel Tribes request to reclassify clean air act.

My name is Ex. 6 I am a lifetime resident and of Ex. 6

I am writing this email **in opposition** of the Kalispel Tribe of Indians request to the US Environmental Protection Agency asking for a Clean Air Act reclassification from the present Class 2 air quality area to a Class 1 air quality area.
Pend Oreille County has become a depressed rural area due to the loss of industries. Industries create and sustain quality, stable jobs with the county and are already subject to EPA and Washington State Department of Ecology standards and guidelines. I do not believe it is the right of the Kalispel Tribe of Indians or any sole entity to determine my counties future.
By imposing this change I believe it would cause job loses, close down existing industries and impose a heavy burden on both the county residents and the local government by creating unneeded and costly inspections and increased taxes to cover the large amount of increased costs.
Pend Oreille County is a great place to live. It needs to re establish growth and be able to flourish through the building of industries and business throughout the county. These industries and businesses bring and retain families that support the county and towns infrastructure, emergency services, hospitals and schools.

Regards,

Ex. 6

To: AirQuality[AirQuality@kalispeltribe.com]
Cc:
From: Ex. 6
Sent: Fri 4/7/2017 9:35:08 PM
Subject: Opposition to Clean air quality change to class 1

To whom it may concern,

I, Ex. 6 oppose to the Kalispel Tribe attempt to enforce regulations upon my private property. As a tax payer, private property owner, farmer and timberland owner the right to pursue the lifestyle that is based on natural resources could be hindered by a more stringent air quality act. Since our agricultural land needs to be maintained through plowing, and diseased or dying timber to be managed through burning as a fuel or slash burning, your proposed new classification may infringe on my pursuit of a managing our property. Since I have had two days to see this report and no time to confirm the stats and their email links or the contributing entities, I will rebuttal statements with my past knowledge and experience. and to put forth questions that should be answered in public not in a single email to me. I am requesting full disclosure.

Statement from Kalispel Tribe Techincal Report on Air quality Reclassification will be refered to as Kalispel Tribe Air Class Redesignation (KTACR) below:

"1.1 Purpose and Objectives
The Kalispel Tribe of Indians (Tribe) is considering requesting reclassification of tribal lands to Class I status under the Clean Air Act Prevention of Significant Deterioration (PSD) program. Only the primary Reservation lands near Usk (about 4,500 acres) are proposed for reclassification to Class I PSD status. Other lands owned by the Tribe external to the primary reservation, such as the Airway Heights hotel and casino property, are not part of the proposed "

My rebuttal statements and questions to above (KTACR):

Class I reclassification." Since the area included in the new designation area "100" mile radius does include Steven, Spokane, and Pend Oreille county, how can all lands around the reservation land, the Casino, be made to comply and the Casino reservation land not be required to comply ? Air quality in smoking facilities would not pass lower classifications.

Statement from (KTACR) page 12:
"Climate Change
The Washington Climate Change Impacts Assessment (CIG-UW, 2009) presents climate scenarios from global climate models that predict that annual average temperatures in the Pacific Northwest may increase by 2.0°F by the 2020s, 3.28°F by the 2040s, and 5.3°F by the 2080s (relative to the 1979 through 1999 average temperatures). Snowpack is projected to
decrease by 28 percent across the state by the 2020s, 40 percent by the 2040s, and 59 percent by the 2080s (relative to the 2006 through 2014 average). Due to increased summer temperatures and decreased summer precipitation, areas burned by wildfires will likely increase through the next few decades."

My rebuttal statements and questions to above (KTACR):

These? blanket statements is based on what? No one can predict the future.
https://friendsofscience.org/index.php?id=711#UHI Myth explained of global warming. This site tells of the myth that has been perpetrated about global warming. More and more scientists are debunking this myth.

Statement from (KTACR) 2.0 pages 2-1 to 2.2.

There are many "hypothetical" statements within this technical report that I question. The "Hypothetical"

energy plant pages. Are these to put in to drive away possible new industry as the inserting of the name of a Hi-Tech was?

Statement from (KTACR) below:

"4.4.2.3 The Potential Economic Benefits or Costs of Blocking the Permitting of an Industrial Facility
The Class I designating? does not categorically ban any particular type of industrial operation. It focuses instead on whether a facility s emissions would violate Class I increments. Industrial facilities have a broad range of technologies they can deploy for their production processes and to control their air pollution emissions. Industrial facilities also control where to locate and the scale of production to pursue. Those business choices will determine the impact that the operations will have on air quality both at the facility and an area beyond the facility. Complying with regulations restricting air quality impacts is part of the business analysis that guides a business to consider particular technology choices, scale of production, and particular locations for their operations. Environmental restrictions are part of a broad range of economic considerations a new facility evaluates."

My rebuttal statement cr (KTACR):

Hypothetical and not fact should not be a basis for reports. Page 4-4 Table 4-3 Predicted ..... but states past years results in the table. It can not be both predicted and based on the past, that is not logical.

There are pages of hypothetical industry information has been used are us

Statement from Kalispel Tribe Techincal Report on Air quality Reclassification will be referred to as (KTACR) below:

Figure 10, no page number 24-hour Particulate Matter Average chart

My rebuttal statement cr (KTACR):

This chart has 1 report for 2006, 2 for 2007, 2 for 2008, 1 for 2009, 1 for 2010 and 2 for 2011. So for a 5 year period there are 9 samplings to base a major conclusion on. Statically this does not seem accurate enough. If future samplings are done as infrequent, the conclusions can be swayed with only reporting certain 24-hour periods. Times of the day, weather conditions all play a part in determining particulates in the air, for instance was it snowing or raining and since there is so much more rain in this area as compared to the southern county information referred to in other parts of this report, the air is cleaned naturally more often.

Chart 13 listed as page 2 of 2 lists tons of particulates by industry, wood stoves, etc. but does not include US. Forest Service or Kalispel under burning as a contributor to air quality particulates. Why is this non reporting possible? Lack of information changes the outcome

3-4 PSD (Prevention of Significant Deterioration) Baseline chart has 4 samplings.

My rebuttal statement (KTACR):

I did sampling for years and never was a major determination for a statical report done on so few samples as these charts are using. I did hundreds per year over time to get as accurate as any analysis can be. Stats can easily be manipulated by deleting samples to as I said before sway the outcome.

Statement from (KTACR) page 43 below:

"5.0 Conclusion
Redesignation will also provide a variety of off-Reservation environmental
and socioeconomic benefits and is expected to have minimal, if any, negative impacts on the economic

vitality of the surrounding area. "

A business has already relocated, no doubt partially due to the more stringent air quality requirements the Class 1 air quality classification looming over head. "

Statement from Kalispel Tribe Technical Report on Air quality Reclassification will be referred to as (KTACR) page 43 below:

"Appendix Defining Area Which Kalispel Tribe is Embedded page 63

"There are three industrialized areas within approximately 50 km (31 miles) of the Kalispel Reservation. One is northern Spokane County; another is the Colville-Kettle Falls area of Stevens County; and the third is the Sandpoint area of Bonner County, Idaho. Given prevailing winds, the Kalispel Reservation tends to be downwind from pollution sources in Stevens and Spokane Counties and upwind from pollution sources in Bonner County. For that reason it is more likely that expansions of industrial activities
in Pend Oreille, Spokane, and Stevens Counties might threaten air quality on the Kalispel Reservation than expansions of industrial activities in Bonner County to the east of the Reservation and across two mountain ranges."

My rebuttal statement to above declaration of attempted control of industries in 2 states and three counties by this redesignating classification of air quality to those of national parks and wilderness areas is totally against community growth, jobs, and progress. Vaagen Bros Lumber in Usk, Pend Oreille Newsprint, among others, are named in this tech report. Will they now be under extreme air quality rules?

In conclusion there are air quality laws in place now that if enforced will do more good. I see no mention of the health problems caused by cigarettes, and drugs in this technical report which contribute to unhealthy lives and death. Once again leave out certain things and the stats will be lean the way the stat keeper wants.

Thanks,

Ex. 6

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Wed 4/5/2017 5:42:20 PM
Subject: Opposition to Reclassifcation of EPA Level 2 to Level 1

I am greatly concerned about the Kalispell Tribe's proposed EPA reclassification from Level 2 to Level 1 for counties surrounding tribal land. Along with the below reasons, I have a very real concern about the possibility of limiting sanding of rural highways in the winter time. As it is, Hwy 291 from Suncrest to Hwy 231 is given priority level 4 from DOT. Because of the high volume of accidents on this stretch, ***more*** sanding and deicing is needed, not less. I am concerned that new restrictions will mean less winter maintenance for a stretch of highway that is already very dangerous.

Additionally, I am opposed to the reclassification of counties surrounding the Kalispell Tribe from Level 2 to Level 1 for the following reasons:

• Currently the County sands our roads in the winter. According to the DOE this can still be done but if there are problems with emissions meeting or exceeding the limits then the County must take action to reduce dust into the air (they already sweep either with water or when it rains, which helps eliminate the dust). If the County were to add more dirt roads, then other industries in the area would have to reduce their emissions output. This means increases in pollution controls for our existing businesses. Are these businesses going to stay if they have to make huge investments to keep operating?

• The Tribe's report talks about the Economic Region but that does not reflect Pend Oreille County alone – it uses generalizations which includes Spokane County which is growing. Pend Oreille County needs more businesses with living wages, not just minimum wage jobs. A re-classification can have an impact on Ponderay Newsprint, Vaagen's, Pend Oreille Mines and others that employ the citizens in Pend Oreille County.

• The report also states that there are approximately 400 Kalispel members, one third of which live on the reservation (roughly 133). Of this, 54% are under the age of 18 (72 approximate) which then leaves approximately 61 Kalispel adults making a decision that affects this entire County as well as our neighboring counties and states.

• The County revenues have increased in total 2% since 2012 but expenses have gone up 30%. Without new businesses to help offset this discrepancy we can expect either a reduction in county services and/or an increase in our taxes.

I don't know anyone who doesn't love our area including our water, forests and clean air and we want it to stay that way – the way it is now, which is Class 2. Most of us would love to have our kids grow up, live close, and be able to work in jobs which provide living wages (not minimum wage) and benefits. Without some common sense to this we won't be having new businesses even take a look at our County, and surrounding areas. Who is going to pick up the taxes for services that are needed to maintain law enforcement, medical services, and road department services if we don't increase our business climate and property values? It is going to be those of us who live in the county paying the property taxes. Drive out existing businesses and you will be picking up the cost of power as well.

Thank you,

Ex. 6

To: Khatibi, Mehrdad[khatibi.mehrdad@epa.gov]
Cc: Bray, Dave[Bray.Dave@epa.gov]; Ken Merrill[kmerrill@kalispeltribe.com]
From: Zach Welcker
Sent: Thur 7/13/2017 5:43:34 PM
Subject: Supp 4

Air Quality
air
Class 1 air quality - yes!
Class 1
Class I air quality redesignation
Class I clean air - OPPOSED
Class I clean air - OPPOSED
Clean Air Act Comment
Clean air
comments on air quality petition

And more

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Fri 4/7/2017 7:54:46 PM
Subject: Air Quality

To Whom It May Concern:

I am against you regulating our air and changing it to class 1. We need to attract more jobs and people in our towns as well as have less regulation! This is too much!

Sent from my iPhone

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Thur 4/6/2017 9:46:13 PM
Subject: air

As a Pend Oreille resident and voter, I am completely against your air quality proposal. You would severely damage our potential economy.
Sincerely

Ex. 6

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Thur 4/6/2017 1:18:32 AM
Subject: Class 1 air quality - yes!

I'm a pend oreille county resident and THANK YOU for taking the lead on preserving our air and environment for future generations. I'm all for the restrictions and changes. Thank you for being an excellent steward of this beautiful land that I happen to be a guest in. You have my support.

Sincerely,
Ex. 6

Typed with thumbs

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Mon 4/10/2017 3:11:16 PM
Subject: Class 1

I am **opposed** to the Tribe's requesting that our area be designated a Class I clean air area. I believe that the smelter is going to be built in Addy and that more government regulations are the last thing that Pend Oreille County residents need or want .

Thank you.

Ex. 6

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Thur 4/6/2017 4:44:14 PM
Subject: Class I air quality redesignation

To whom it may concern at the Kalispel Tribe,

I am writing this letter to express my opposition to the proposed redesignation to a Class I air quality area for lands within the exterior boundaries of the Kalispel Indian Reservation. Upon reviewing the Technical Report prepared it seems the justification for the change is inadequate. The Report states that data is limited, and that the data used does not come from areas reasonably similar to the Reservation (monitoring stations in Tacoma Creek and the town of Newport specifically). How does it make good sense to propose a change based on data that doesn't represent the conditions of the area being proposed for a change? There does not appear to be sufficient information to demonstrate clearly that air quality above or adjacent to the Reservation is of concern; in fact, the Report states that the area is considered to have "good" air quality, with no real justification that more stringent air quality standards are necessary. The Report did not adequately disclose that air quality is degrading or that the proposed change will result in increased air quality.
The proposed change does not appear to provide any tangible benefits to Tribal members or members of surrounding communities within the reasonably foreseeable future, therefore I cannot support such a change. Thank you for your time.

Regards,

Ex. 6

To: AirQuality[AirQuality@kalispeltribe.com]
Cc:
From: Ex. 6
Sent: Fri 4/7/2017 1:44:18 AM
Subject: Class I clean air - OPPOSED

I am **opposed** to the Tribe's requesting that our area be designated a Class I clean air area. I believe that the smelter is going to be built in Addy and that more government regulations are the last thing that Pend Oreille County residents need or want .

Thank you.

Ex. 6

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Fri 4/7/2017 3:20:23 PM
Subject: Class I clean air - OPPOSED

I am **opposed** to the Tribe's requesting that our area be designated a Class I clean air area. I believe that the smelter is going to be built in Addy and that more government regulations are the last thing that Pend Oreille County residents need or want .

Thank you.

Ex. 6

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Tue 4/11/2017 9:19:56 PM
Subject: Clean Air Act Comment

Dear Tribe,

I watch your actions to protect your lands, air and water, and know that those also affect us who live nearby, but off your lands. You have my admiration and backing in your endeavors that will have far reaching results. We all need clear lands, clean air, and clean water.

Thank you for working on my behalf, neighbor,

Ex. 6

To: AirQualityIAirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Sat 4/8/2017 6:01:14 AM
Subject: Clean air

I am for clean air but not for any restrictions this puts on any bisiness, anything or anyone not living on the kalispel reservation.

I have seen these types of restrictions hurt my extended family in Ex. 6 and give the federal government a foothold to policing unconstitutional laws on tribal lands.

Ex. 6

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Thur 4/6/2017 6:44:28 PM
Subject: comments on air quality petition

To Whom it may concern:

If the Kalispel Indian Reservation wants to change the air quality designation from class 2 to class 1, let them do it in the area of their Reservation only. They have no right to impose such changes to affect the communities around them. Why should a handful of people adversely affect over 200,000 innocent people in the surrounding areas who probably know nothing about the proposed changes. The impact of these changes on industry in the area could cause employers to move their operations to other areas because of government regulations, thus causing lost jobs, greater unemployment, and ultimately higher taxes for everyone in the area to compensate for needed services. Many areas affected by this proposed redesignation are rural farm areas that rely on being able to use some of the industries in the region for their operations. We do not need or want more government regulation in the region.

Please leave the redisgnation from class 2 to class 1 to ONLY the reservation if they so desire. Do not impose it on surrounding areas. If you are really interested in the voice of the people, make this known to people and more readily accessible for comment to those impacted than having the hearing in Cusick and at such a short notice.

Sincerely,

Ex. 6

To: Khatibi, Mehrdad[khatibi.mehrdad@epa.gov]
Cc: Bray, Dave[Bray.Dave@epa.gov]; Ken Merrill[kmerrill@kalispeltribe.com]
From: Zach Welcker
Sent: Thur 7/13/2017 5:41:24 PM
Subject: Supp Info 3

Air quality
Air quality
Air quality
Air quality
Air Quality Classification - Do not Support
Air quality comments
AIr quality comments
air quality proposal identify me as truthful elk
Air Quality redesignation comments
Air Quality Redesignation

Even more

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Thur 4/6/2017 1:03:28 PM
Subject: Air Quality Classification - Do not Support

To whom it may concern,

Our company, Ex. 6 does NOT support any action to reclassify Stevens County from EPA Classification from Level 2 to Level 1 as it will directly impact our land development and home rental business.

We request the Kalispel Tribe forward or provide a copy of this email to the EPA or any other relevant government agency involved; however, you are not authorized to provide it or our email address to anyone else or 3rd person without our permission.

Ex. 6
Owners, Ex. 6

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Sat 4/8/2017 12:22:04 AM
Subject: Air quality comments

To whom it concerns,
I am writing this to provide comment on the issue of moving to a class 1 designation. I see no need to place anything in this county under such strict rule. Even in an inversion our air quality is above most places in the state. I've seen first hand the hinderance this places on the agricultural and private land management. I believe that the views of few should not hinder the livelihood of those around them. This would be a kill switch for any manufacturing or production companies to move into this area, and that is what we need to become economically stable moving forward.

Ex. 6

Sent from my iPhone

Sent from my iPhone

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Thur 4/6/2017 6:40:46 PM
Subject: Air quality comments

Seeing as how our air quality in this area is currently great. I am questioning why we need to change our status. Most of us only have wood heating in our homes. We don't have the financial resources to change over to any other form of heat. We need to be able to burn the slash we have to cut to keep our property safe from wild fires.
We live here in the area because we love it and don't want to pollute it. But there are things that must be done. My husband and I have personally cleaned up tons of litter from highways and the forest when we hike.
I think making this change would make it terribly hard to bring more industry and work here for the people that live here. If your goal is to drive people away then keep it up. But you need to realize that our dollars help the tribe in many ways. If we all leave the tribe will be the ones losing out.

My take on this is that ten percent of the local population is trying to make the laws and rules for the other 90 percent of us. Shame on you!

Thank you for your consideration.
Ex. 6

Sent from my iPad

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Wed 4/5/2017 11:06:36 PM
Subject: air quality proposal identify me as truthful elk

The short notice the tribe has given was intentional.
The tribe do not want community involvement.
They are not really required to listen to it.
The EPA makes the final decision and makes it based on whether the applicant followed the proper procedures when going thru the application phase.
If the Tribe has already made the decision (and I assume they have) and they follow protocol then that is ALL that is needed.

A public hearing is a farce and is part of the application and required by law, which is likely the only reason they are having it.

Licensing your vehicle will now require the emissions inspection in this county.
If you have a farm within 100 air miles of Usk, you are going to take this one up the bum. 100 miles goes over into other counties and states. How dare the tribe impose this on anyone else.

They are just going through the motions and we HAVE NO REAL SAY IN THIS.
We will not be able to burn brush, fields, or have wood stoves. No more fires in the Lodge (teepee). You and your elders along with the rest of us will live cold in the winter during air inversions.

Eventually you will say goodbye to the campfires in the yard.
Using wood for back up heat in the winter will be almost un heard of. We had air inversions and stagnation many of the coldest days this last winter in North Pend Oreille.

It will be a catch 22. You can t get insurance with wood stoves but you can t rely on electric affordably heating the older homes in this county.
The mills small and large will slowly disappear.
Never again will concrete be mined and milled in North Pend Oreille. And NO I am not talking about the old mill that put dust in everyone s lungs and made the earth unable to be used for food plants.
Even the new concrete mills will not pass these new standards and be built in this county.
The pulp mill that we are all worried about closing will close sooner.
This will not attract business to this county. It will push it away and the only thing people will come here for will not sustain the way of life here. Just ask your local restraint owner or hotel owner.
If the tribe cared about this county they would of built their casino closer to their people so they could of benefited from the jobs.
Unpaved county roads will be closed to reduce dust and maintain compliance.

This will also affect your waste water up and down the county that is using aerators to stir your waste water to aid in evaporation.

The state and fed will say but we will help with those costs and sure they will.
But it will be at the loss of more control of your way of life from your tap and waste water, to river usage and all recreation.
Forestry will be impacted and the health of the forest will again suffer because of restrictions on them and the need to reduce forest fire fuel.
Grazing will be impacted too.

I agree with someone else s comments that were posted on the internet whole heatedly and have listed them in detail below.

I am glad they were shared so the layman who cant understand most of what is in the proposal can comment intelligently.

The Kalispel Tribe of Indians have requested, as allowed by the Clean Air Act, to have this area reclassified from a Class 2 to a Class 1 air quality area. The classification from a Class 2 (which is what we are at right now and what most of the U.S. is at) to a Class 1 requires a 10% reduction in emissions. The emissions includes dust (unpaved county roads, winds blowing across a plowed field, smoke from your wood stove as well as permitted uses for industries based upon current state and/or federal standards). Forest Fires do not get included in emissions. Prescribed fires are not under the act. Does this mean the burning of slash for your own timber cutting?

The map shows the 100 km radius (as the crow flies) that would be included in this request. This Clean Air re-designation would include ALL of Pend Oreille County, ALL of Stevens County, parts of Ferry County, goes into Canada, Bonner and Boundary County and into Montana. The closer a parcel of land is to the reservation the more restrictive the requirements on emissions. Class 1 areas can increase the impact zone up to 250 miles. Class 1 re-designations require a minimum of 10% reductions in current emissions.

Although this is a federal program through the Environmental Protection Agency, the Washington State Department of Ecology monitors and sets standards for rural areas of Washington State. (Side note -That means once again the West side liberal agenda will control one more area of our lives.)

If a new business wants to come into the area they must use best control qualities available and they cannot take the emissions above the limits set with a Class 1 designation. There is a very technical review and there is an impact evaluation/analysis done on neighboring properties. There can be punitive action on those who violate the process.

The Pend Oreille Valley traps area, especially in winter with inversions. If things were to get too bad, then only certified wood stoves could be used unless wood is your ONLY source of heat. It won t be the Tribe that decides if you can use your wood stove, it will be the federal government, through the Washington State Department of Ecology. If emissions get too high during our inversions (foggy days) then something has to change- that s when you get announcements like your wood burning stoves cannot be used, businesses have to make changes to their emissions, etc. (Side note are you going to tell PNC and Tech they cannot run until the inversion is gone my question, but I have no answer to that. Again, it won t be the Tribe that gets to decide it will be the State enforcing federal law).

If an area exceeds standards three years in a row, then the feds get a plan to get the area back to below federal standards. This can mean things like vehicle emission testing and more.

Specifics mentioned at the meeting:

Currently the County sands our roads in the winter. According to the DOE this can still be done but if there are problems with emissions meeting or exceeding the limits then the County must take action to reduce dust into the air (they already sweep either with water or when it rains, which helps eliminate the dust). If the County were to add more dirt roads, then other industries in the area would have to reduce their emissions output. This means increases in pollution controls for our existing businesses. Are these businesses going to stay if they have to make huge investments to keep operating?

The Tribe s report talks about the Economic Region but that does not reflect Pend Oreille County alone it uses generalizations which includes Spokane County which is growing. Pend Oreille County needs more businesses with living wages, not just minimum wage jobs. A re-classification can have an impact on Ponderay Newsprint, Vaagen s, Pend Oreille Mines and others that employ the citizens in Pend Oreille County.

The report also states that there are approximately 400 Kalispel members, one third of which live on the reservation (roughly 133). Of this, 54% are under the age of 18 (72 approximate) which then leaves approximately 61 Kalispel adults making a decision that affects this entire County as well as our neighboring counties and states.

The County revenues have increased in total 2% since 2012 but expenses have gone up 30%. Without new businesses to help offset this discrepancy we can expect either a reduction in county services and/or an increase in our taxes.

I don t know anyone who doesn t love our area including our water, forests and clean air and we want it to stay that way the way it is now, which is Class 2. Most of us would love to have our kids grow up, live close, and be able to work in jobs which provide living wages (not minimum wage) and benefits. Without some common sense to this we won t be having new businesses even take a look at our County, and surrounding areas. Who is going to pick up the taxes for services that are needed to maintain law enforcement, medical services, and road department services if we don t increase our

business climate and property values? It is going to be those of us who live in the county paying the property taxes. Drive out existing businesses and you will be picking up the cost of power as well. We will not be able to burn brush, fields, or have wood stoves. No more fires in the Lodge (teepee)

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To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Thur 4/6/2017 10:54:12 PM
Subject: Air Quality redesignation comments

6 April, 2007

To whom it may concern:

I am writing in response to the request to change the air quality designation of the Kalispel Reservation from a Class 2 designation to a Class 1 designation. In my review of this issue, I have determined that this is an ill-advised effort that will show to be rife with unintended consequences that will be significant to ALL residents of the area, tribal and non-tribal alike. Experience has shown when a single issue is allowed to dominate thinking and discussions; many other crucial factors are forced to change, generally with negative results. Additionally, I must add that while the consultants that were hired to write the technical report compiled a lengthy report, they did not hesitate to pick and choose information that met their objective while not comprehensively addressing the factors that do not support this redesignation request.

In this particular case, there is no one that will deny that having pure air is a good thing. That, however, is a simplistic statement that does not allow for the development of critical balances that must be recognized as necessary for support of a smoothly functioning society. A partial list of the balances that must be struck is: 1) the ability for employers in the affected area to remain competitive with employers outside of the affected area due to the cost of increased regulation; 2) the relocation of employers in total due to increased regulation (consider the number of companies leaving Southern California for Texas due to lower regulatory environment in Texas); 3) the impact on local social safety nets due to wage stagnation, wage reduction or employee lay-off due to employer actions to remain competitive from items 1 and 2 above; 4) the reduction of government services or increase in taxes to compensate for lost tax revenue due to employers leaving the area, lost jobs and/or reduced wages; 5) the social costs associated with perceptions that inevitably develop when a special cause is promoted by a single entity rather than a broad based coalition of parties. These cannot be adequately addressed with even a 237 page report and a comment period.

It is interesting to me that the report clearly identifies the adjudicated lands that the Kalispel Tribe feels is their native land beyond the current reservation. What is not addressed is why the justifications for the economic and social impacts are not associated at all with these lands but instead focus on the large metropolitan area sixty miles south of the reservation. Is it because the only way this redesignation can be justified is to ride on the success of a large population center so that specific analyses cannot be performed or be made to appear as not necessary or are simply a diversion from the socioeconomic success (read failures) on the reservation? Look at Section 4.4.2 and specifically 4.4.2.2 where it is stated, *"There currently are no proposed facilities seeking air quality permits that might be impacted by Class I redesignation of the Kalispel Reservation. That makes the analysis of how a Class I redesignation might or might not limit a particular type of economic activity in the economic region speculative."* This is disingenuous to make a statement like this but then build the entire case for either no economic impact or actual improvement with no more data than that the significantly sized and distant off-reservation area has been growing for 40 years so it is not likely that much harm can come from this or it can be absorbed. Further, considering the Spokane area as the Kalispel Reservation Economic Area, even limiting it to the North Spokane area, (see 4.4.2.1 ¶ 1, 4.4.2.2 ¶ 2 and many others) is a display of incredible hubris. Along these same lines, why did the tribe open a casino on NON-TRIBAL lands and why are they now trying to stop another tribe from doing the same thing? If the Kalispel Tribe really has so much economic impact that they can legitimately refer to the Greater Spokane area as their Economic Area, why wasn't Northern Quest built in Cusick? This whole thing smacks of selfishness to use special treatment so as to be the only ones who can have their cake and eat it too.

Having even a few employers in an area that pay higher wages is significant to the overall economic health of the area. Keeping them there is critical for everyone in the area, even if they do not work directly for those employers. In the

Newport area, Zodiac Aerospace is one of those types of employers. Through my experience in the aerospace industry, I know that Zodiac Aerospace walks a fine line to pay well and yet remain competitive with a proliferation of low-cost international aerospace suppliers. I think that this, in large part, is a testament to the work ethic of the people in this area. The point here is that it would not take a lot of increased regulatory costs to make Zodiac Aerospace's operation here unprofitable and lead their parent corporation to relocate their work. I have worked where even leaving a cap off of a squirt bottle of solvent while wiping down a part results in a $300 plus dollar fine due to Class 1 air quality requirements. I also have first-hand experience working in the Ex. 6 area where regulation has depressed wages to the point that highly skilled welders working on critical titanium flight hardware are being paid less than $15.00 per hour. I have no idea how anyone can live in that area on those wages and I would hate to see Pend Oreille County wages become similarly depressed due to regulation causing an employer to choose between paying a good wage and staying in business. The technical report states that it is very unlikely that this redesignation will affect current employers; however, the writers of this report have no power or authority to make that guarantee. Once the change is made and this area becomes a Class 1 Air Quality area, the decisions will be out of local hands and will be determined as government employees interpret the regulations. DO NOT BELIEVE ANY PROMISES OF FUTURE GUARANTEES BY ANY GOVERNMENT AGENCY OR INDIVIDUAL OR SPECIAL INTEREST REPRESENTATIVE. YOU WILL HAVE NO CONTROL AND LITTLE IF ANY LEGAL STANDING TO CHALLENGE FUTURE INTERPRETATIONS OF THE REGULATIONS!

The technical report, in an apparent effort to build credibility and influence of the tribe, considers the counties of Spokane, Stevens and Pend Oreille as the "Kalispel Reservation Economic Area". Why is it not called the Spokane Reservation Economic Area? After all, the Spokane Tribe Reservation is 10 miles closer to Spokane than the Kalispel Reservation. Why not just admit that the Greater Spokane area is not beholden to the tribes and that the tribes do not influence the economy of the area and so remove from this report the inferences that the Kalispel Reservation has any real influence on the Greater Spokane area other than the money removed from the area through its off-reservation gambling operation? In section 3.8 paragraph 5 of the report, the writers attempt to claim that there are 5,400 workers that commute from Stevens and Pend Oreille counties into Spokane and that somehow makes the Kalispel petition to redesignate the air quality standard more acceptable because of the wages that are brought into those counties. How is this a positive future effect when the likelihood of automobile emission standards being tightened and testing put in place increases and will also affect people that do not commute outside of their local area? How does this help low income residents of these counties when they are forced to purchase newer cars to meet standards because their old car still runs but is too expensive to repair to the point of meeting newer standards? The money brought as wages into Stevens and Pend Oreille counties will go right back to Spokane when rural residents are coerced into purchasing newer vehicles. If you wish to argue that this will not happen, please refer to the last two sentences of the paragraph above. It has happened elsewhere and will happen here if this redesignation is allowed.

Addressing even the partial list I made in the first paragraph would be exceptionally time consuming to address and what little I have had time to state here certainly shows how involved these impacts become. In my undergraduate education, I spent some time studying environmental economics and so am somewhat conversant with the issues at hand. In general, industry has come to recognize the economic value of limiting pollutant emissions either by converting them to a useful product, mitigating their production or lastly filtering them. Industry is also incentivized to not become the poster child for social and environmental irresponsibility. Given these conditions of complexity of the problems and industry's general desire to be responsible, it is most definitely in everyone's best interest to find a solution outside of government intervention. The closer the solution can be created to and by those affected by it, the more effective and less onerous it will be.

Growing up in the Ex. 6 area, I am familiar with widespread temperature inversions that blanket the Ex. 6 for weeks at a time and the concern for air quality. There are usually smaller areas that are more impacted by the inversions than other areas, generally, in the winter time because of a higher residential concentration where wood burning for heat is more prevalent. I also found this to be the case in the Ex. 6 area where I lived for over 30 years. Interestingly enough, the government air quality regulations allow for those with wood as their sole source of heat to continue to use wood heat regardless of the air quality. I suspect that the major source of the measured air quality issues

in the Cusick and Usk area is from wood heating being done in a relatively small zone of the Pend Oreille River valley. It is most definitely not the full 60 mile radius impact zone (or larger if regulators are unsatisfied with results) that the regulation change would create. Perhaps, rather than relying on the heavy hand of government regulation with its certain followers of ill consequences, the Kalispel Tribe should consider developing, promoting or leading an effort to incentivize making changes to mitigate the development of poor air quality in the first place. Through identification of the specific sources of poor air quality and then assisting in ways that provide an economic benefit for reducing or eliminating the pollutant, the tribe would receive the air quality benefit they desire without being seen as significant social disruptor.

By way of disclosure, I am a Ex. 6 from the Ex. 6 and have seen the cause and effects of this type of action in multiple areas over the course of my career. I chose to retire to the Newport area mostly because of the life-style, the general attitude of self-reliance of the population, their independence and yet their willingness to assist and help their neighbors. I have found this with my neighbors as well as with Pend Oreille County officials (which has been exceptionally refreshing). I would hate for this area to begin drifting toward the same social values (i.e. let government fix all of the problems) as have been repeatedly shown to be detrimental to personal responsibility, individual freedom and happiness.

Sincerely yours,

Ex. 6

Email: Ex. 6

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Thur 4/6/2017 7:54:52 PM
Subject: Air Quality Redesignation

Dear Sirs,

After reviewing the Air Quality Redesignation Document I have several concerns about the potential scope and impact of the proposed Redesignation. For the sake of clarity and brevity, I will address two of these concerns that seem to be of primary importance.

Quoting from the Executive Summary of the Redesignation Document:
"The Kalispel Tribe of Indians (Kalispel Tribe) is proposing to redesignate the Kalispel Indian Reservation (Reservation) a Class I air quality area under the Clean Air Act's Prevention of Significant Deterioration (PSD) program. The purpose of this redesignation is to obtain and provide the most stringent air quality protections available under the PSD program to better protect air quality on and near the Reservation. Protecting air quality is critical to furthering the Tribe's sovereign interest in protecting its people, as well as its natural and cultural resources."

According to this statement the purpose for the Redesignation is to "protect air quality", on the Kalispel Reservation but the "Kalispel Reservation Economic Area" map at the end of the document is drawn purely on political lines. It does not include any of the State of Idaho or the Province of British Columbia, both of which are closer to the Kalispel Reservation than other areas on the map, and obviously, could potentially impact air quality on the Reservation. Indeed, the map is neatly confined to the political borders of Spokane, Stevens, and Pend Oreille Counties. This is a classical case of "bait and switch" where the supposed purpose is based on environmental criteria, but the actual purpose is political and economic. This brings me to my second concern.

The political boundary of the Kalispel Reservation is very clearly defined, and as someone who is not a Kalispel, and who does not live within the Reservation Boundary, this part of the world is simply not any of my business, unless it encroaches on my land and my home. My point here is very clear. The redesignation of air quality on the Kalispel Reservation has nothing to do with environmental concern and everything to do with political and economic manipulation and control. In other words, you are attempting to encroach on my land and my home. This is a recipe for continuous conflict that does not benefit anyone in the long run. I suggest you reconsider.

Sincerely,

Ex. 6

Sent from Mail for Windows 10

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Fri 4/7/2017 7:54:30 PM
Subject: Air quality

To Whom It May Concern:

I am against you regulating our air and changing it to class 1. We need to attract more jobs and people in our towns as well as have less regulation! This is too much!

Sent from my iPhone

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Fri 4/7/2017 5:09:22 PM
Subject: Air quality

I am for clean air.

I am not for this type of big brother, big government.

I have read much of the information available.
I see from it the tribe just going through the motions required so the EPA can run the show.
They offered more then the tribe could refuse and someone probably received a job and or tribe received grants and training to make it happen.
They hired someone suggested by the EPA from another reservation who had done it all before to come help them get it done here.
Other firms from other tribes were consulted all of them set up by the EPA to continue their self sustaining programs and jobs.
All with our tax dollars and air quality fines.

I left the reservation I grew up on in Ex. 6 because of the over reaching big brother federal involvement going on there.
I was tired of our elders and community members freezing to death in their homes because they were no longer allowed to burn wood, pellets or gas on air inversion days that stretched into weeks as restrictions increased over proceeding years to months.

Restrictions continued to increase and the EPA determined in later years, if you had electricity to your home you had alternate sources of heat.
So no one, not even people who had the permission in past years to burn wood as their sole form of heat where allowed to on inversion or air quality red, brown or yellow days.
The next years you could not burn anything. Not even pellet stoves.

In the beginning the EPA made loans available to people to purchase pellet stoves, gas furnaces and electric furnaces. Then over years they slowly fazed out those being allowed to burn on inversion days.

Last time I visited one of the local tribal leaders he had in his home in the middle of over 100 acres of timber land he owns,

a wood stove that he had not been able to legally use in ten years.

A natural gas stove that has no gas to it any more.
The EPA shut down the tribes own natural gas facility from air quality restrictions. The tribe used to employ many of the people in the area.

A pellet stove that just the year before he used as heat during the winter. This year was not allowed on red or brown days.

He told me the plan was to get a new forced air electric furnace installed with a approved loan and was expecting it any day.

He is still waiting.
He ended up burning his pellet stove during this last cold winter and was fined.
Since he was already getting fined and other family members had to move in with him to keep warm he burned wood too.
But
The environmental industry has given the tribe money to force the local governments to remove hydro electric dams.

The price of electricity has skyrocketed.
The area now is relying on more gas, coal and solar generated power.
Solar farmers get fined for windmills killing birds and for panels heating up the area the glare pollution.

My friends fines equal more then the value of his home now.
His plan is to cut timber to sell to pay fines but the air quality act will have to be considered before its approved. On HIS own land.
Sadly over the last few years no timber has been allowed to be harvested on tribal lands even if privately owned. Or the timber was burned in catastrophic wild fires caused by mismanagement of other federal and state entities.

These air quality standards have Farmers fined for plowing on windy days later they were fined for spreading manure on fields and even later during wet year for particulates and mild spores coming off their fields. During harvest they were fined for chaff and dust blowing.
Ranchers are fined for dust coming off fields of dairy and beef cattle.
Stockyards were fined for to much methane and other gasses coming off manure piles.

The tribes own composting and peat-moss facility was closed down because of air quality standards they could not correct. Another employer gone.

Waste water facilities fined for aerators and evaporators running.

Even the owners of a natural hot springs and artisan wells that flowed before mans time were fined for mineral and particulates in the air and had to cap them to never flow freely again.

Forestry, farming, and even solar farmer are fined for pollen, dust and temperature variants the EPA say are out of the guide lines they set for air quality.

All this went on while big chemical companies were sited and fined and as long as they paid those fines to the EPA they never had to clean up their act. The result is the lake became a super mosquito breading ground.
No pesticide will kill them.
To combat the problem the EPA encouraged the tribe to force the county to bring in midges from china that would eat the mosquito larva and only live long enough to do so, bread, lay eggs and die.
Well the midges did their job for 50 years and now each year for the whole summer the area has few mosquitoes but each morning people wake up to drifts a foot high of midges against anything that was motionless during the night.
Dead and decomposing midges everywhere.
Their cars get plastered with green slime from driving through the soupy clouds of midges.

Fishing used to be great in the lake and now the algae is so bad it is the only thing harvested from the lake. The dead midges that blow and flow with rain into the lake have caused many new problems.

Last year the all Indian rodeo was fined for to much dust raised at the parking area, stockyards, rodeo grounds, carnival and dance grounds. The air quality people said it was a hazard to the public gathered there. So over past years....No more camp fires. No more sweet grass burning in ceremonies. No more sweat lodges. No more traditional skinning or tanning lessons. No more pounding of roots to make food or medicine taught. Because of being fined in the past for air quality standards at the event.

The tribe was also fined for the wild horse round up raising to much dust.

Last but not least the vehicles most tribal members own did not pass emissions tests. Cars were dumped or sit rusting away on tribal lands and tribe members property.
It became so bad with everyone walking that elders and kids where getting hit by vehicles walking the roads of he area.
Then the local dirt roads were shut down because of dust.

Farm to market roads closed.
During one summer in August the highway, the only paved road had cars parked along the shoulder for miles because no one was allowed to drive on the closed dirt roads to their houses.
People said enough when the state came and towed or ticketed parked vehicles.
Trying to follow the rules and restrictions of one entity became a battle for the law abiding community members.

It has truly made life miserable for the tribe and the neighboring communities on the thousands of square miles of historic tribal lands around them.

The only thing making money for the tribe is a casino so far away from tribal lands everyone of the tribe members who works there had to move away from the reservation to do so.
Their children no longer have their elders and family close by, no longer have their traditional tribal leaders to fall back on or tribal police and doctors to help.
It's a culture shock to many of them and the new younger generation grow up with no history, no guidance and no respect for what was. They marry into non culture related families and their kids when they come home to the reservation even for a visit with aunties and uncles, are outsiders with no real connections to the land or the people.
If they had stayed these same aunts and uncles would of been a huge part of their lives and often closer to them then their parents in many ways.
I know this.
My grandmother who would be 100
and my husband who is 50
and my dad who would be 72
were those kids.

There is a big picture that is going to be effected for generations because of the interfering air quality act.
It is going to change the tribes life forever and not in any good way that we would all want.

Ex. 6

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Thur 4/6/2017 3:12:35 PM
Subject: Air quality

Dear Kalispel Tribe,

I recently became aware of the request to have this area reclassified from a Class 2 to a Class 1 air quality area. This concerns me. In an area that is already so economically depressed, this change could tip the scale for community members that are just hanging on by a thread financially. If the job situation, power costs, taxes, or transportation regulations are impacted it will cause distress for people of all ages. I love the land and natural beauty of our region, but I don't agree with more government regulation and intervention. I will not be in the state at the time of the scheduled meeting, so please include my written comments.

Regards,

Ex. 6

Sent from my iPhone

To: AirQuality[AirQuality@kalispeltribe.com]
From: Ex. 6
Sent: Thur 4/6/2017 2:35:34 PM
Subject: Air quality

We have been asked to post this by a local man regarding what he is sending to the Tribe regarding the air quality proposal. He says anyone is allowed to re post, copy or glean from the content to make their comments to the tribe.

AirQuality@kalispeltribe.com

The short notice the tribe has given was intentional.
The tribe do not want community involvement.
They are not really required to listen to it.
The EPA makes the final decision and makes it based on whether the applicant followed the proper procedures when going thru the application phase.
If the Tribe has already made the decision (and I assume they have) and they follow protocol then that is ALL that is needed.

A public hearing is a farce and is part of the application and required by law, which is likely the only reason they are having it.

Licensing your vehicle will now require the emissions inspection in this county.
If you have a farm within 100 air miles of Usk, you are going to take this one up the bum. 100 miles goes over into other counties and states. How dare the tribe impose this on anyone else.

They are just going through the motions and we HAVE NO REAL SAY IN THIS.
We will not be able to burn brush, fields, or have wood stoves. No more fires in the Lodge (teepee). You and your elders along with the rest of us will live cold in the winter during air inversions.

Eventually you will say goodbye to the campfires in the yard.
Using wood for back up heat in the winter will be almost un heard of. We had air inversions and stagnation many of the coldest days this last winter in North Pend Oreille.

It will be a catch 22. You can't get insurance with wood stoves but you can't rely on electric affordably heating the older homes in this county.
The mills small and large will slowly disappear.
Never again will concrete be mined and milled in North Pend Oreille. And NO I am not talking about the old mill that put dust in everyone's lungs and made the earth unable to be used for food plants.
Even the new concrete mills will not pass these new standards and be built in this county.
The pulp mill that we are all worried about closing will close sooner.
This will not attract business to this county. It will push it away and the only thing people will come here for will not sustain the way of life here. Just ask your local restraint owner or hotel owner.
If the tribe cared about this county they would of built their casino closer to their people so they could of benefited from the jobs.
Unpaved county roads will be closed to reduce dust and maintain compliance.

This will also affect your waste water up and down the county that is using aerators to stir your waste water to aid in evaporation.

The state and fed will say but we will help with those costs and sure they will.
But it will be at the loss of more control of your way of life from your tap and waste water, to river usage and all recreation.
Forestry will be impacted and the health of the forest will again suffer because of restrictions on them and the need to reduce forest fire fuel.
Grazing will be impacted too.

I agree with someone else s comments that were posted on the internet whole heatedly and have listed them in detail below.

I am glad they were shared so the layman who cant understand most of what is in the proposal can comment intelligently.

The Kalispel Tribe of Indians have requested, as allowed by the Clean Air Act, to have this area reclassified from a Class 2 to a Class 1 air quality area. The classification from a Class 2 (which is what we are at right now and what most of the U.S. is at) to a Class 1 requires a 10% reduction in emissions. The emissions includes dust (unpaved county roads, winds blowing across a plowed field, smoke from your wood stove as well as "permitted" uses for industries based upon current state and/or federal standards). Forest Fires do not get included in emissions. Prescribed fires are not under the act. Does this mean the burning of slash for your own timber cutting?

The map shows the 100 km radius (as the crow flies) that would be included in this request. This Clean Air re-designation would include ALL of Pend Oreille County, ALL of Stevens County, parts of Ferry County, goes into Canada, Bonner and Boundary County and into Montana. The closer a parcel of land is to the reservation the more restrictive the requirements on emissions. Class 1 areas can increase the "impact zone" up to 250 miles. Class 1 re-designations require a minimum of 10% reductions in current emissions.

Although this is a federal program through the Environmental Protection Agency, the Washington State Department of Ecology monitors and sets standards for rural areas of Washington State. (Side note -That means once again the West side liberal agenda will control one more area of our lives.)

If a new business wants to come into the area they must use best control qualities available and they cannot take the emissions above the limits set with a Class 1 designation. There is a very technical review and there is an impact evaluation/analysis done on neighboring properties. There can be punitive action on those who violate the process.

The Pend Oreille Valley traps area, especially in winter with inversions. If things were to get too bad, then only "certified" wood stoves could be used unless wood is your ONLY source of heat. It won't be the Tribe that decides if you can use your wood stove, it will be the federal government, through the Washington State Department of Ecology. If emissions get too high during our inversions (foggy days) then something has to change- that's when you get announcements like your wood burning stoves cannot be used, businesses have to make changes to their emissions, etc. (Side note – are you going to tell PNC and Tech they cannot run until the inversion is gone – my question, but I have no answer to that. Again, it won't be the Tribe that gets to decide it will be the State enforcing federal law).

If an area exceeds standards three years in a row, then the feds get a plan to get the area back to below federal standards. This can mean things like vehicle emission testing and more.

Specifics mentioned at the meeting:

• Currently the County sands our roads in the winter. According to the DOE this can still be done but if there are problems with emissions meeting or exceeding the limits then the County must take action to reduce dust into the air (they already sweep either with water or when it rains, which helps eliminate the dust). If the County were to add more dirt roads, then other industries in the area would have to reduce their emissions output. This means increases in pollution controls for our existing businesses. Are these businesses going to stay if they have to make huge investments to keep operating?

• The Tribe's report talks about the Economic Region but that does not reflect Pend Oreille County alone – it uses generalizations which includes Spokane County which is growing. Pend Oreille County needs more businesses with living wages, not just minimum wage jobs. A re-classification can have an impact on Ponderay Newsprint, Vaagen's, Pend Oreille Mines and others that employ the citizens in Pend Oreille County.

• The report also states that there are approximately 400 Kalispel members, one third of which live on the reservation (roughly 133). Of this, 54% are under the age of 18 (72 approximate) which then leaves approximately 61 Kalispel adults making a decision that affects this entire County as well as our neighboring counties and states.

• The County revenues have increased in total 2% since 2012 but expenses have gone up 30%. Without new businesses to help offset this discrepancy we can expect either a reduction in county services and/or an increase in our taxes.

I don't know anyone who doesn't love our area including our water, forests and clean air and we want it to stay that way – the way it is now, which is Class 2. Most of us would love to have our kids grow up, live close, and be able to work in jobs which provide living wages (not minimum wage) and benefits. Without some common sense to this we won't be having new businesses even take a look at our County, and surrounding areas. Who is going to pick up the taxes for services that are needed to maintain law enforcement, medical services, and road department services if we don't increase our business climate and property values? It is going to be those of us who live in the county paying the property taxes. Drive out existing businesses and you will be picking up the cost of power as well.

We will not be able to burn brush, fields, or have wood stoves. No more fires in the Lodge (teepee).

To: Khatibi, Mehrdad[khatibi.mehrdad@epa.gov]
Cc: Ken Merrill[kmerrill@kalispeltribe.com]; Bray, Dave[Bray.Dave@epa.gov]
From: Zach Welcker
Sent: Thur 7/13/2017 5:40:04 PM
Subject: Supp Info 2

Air comment - Ex. 6
Air comment - Ex. 6
Air Comment - Ex. 6
Air comment - Ex. 6 revised comment.pdf
Air comments - Ex. 6 .pdf
Air comments - Ponderay Newsprint.pdf
Air comments - Teck Washington.pdf
Air Comments- PDO County Comm.pdf

More

Comment on Class 1 air quality designation. April 4, 2017

As a life-long resident and business person in Pend Oreille county I am concerned that the proposed designation will stifle existing business and scare away any new business that may want to locate here.

I have read the Technical report and find it to be very vague with very little local data to back up some of the assumptions. The table of emission sources seems to cover all human activity from wood stoves, road dust, motorboats, all the way to commercial aircraft flying miles above the area.

The economic impact report encompasses Spokane, Stevens and Pend Oreille counties as the economic analysis area. It is true that these three counties are interrelated but to say that Pend Oreille County has a vibrant economy because the statistics of the area look good is not reality. Pend Oreille County has a population of 13,000, Stevens 43,500, while Spokane County is near one-half million with thousands of health care, education and retail jobs. Our rural county is traditionally more resource jobs that support our limited services.

Due to the fact that over 60% of the county is either Federal, State or Tribal land, thus un-taxable, we have a very limited tax base from which to draw funds to provide services to all county residents. To put constraints on any economic development, above those already in place, in the name of adding special status to a reservation with a population of about 1% of the total county population, is not acceptable.

To compare the potential benefits of a Class 1 area here to our National Parks, is not a responsible comparison.

The use of the Kalispel Tribe's sovereign status is contrary to the concept of a UNITED STATES.

Please register my opposition to the Class 1 air quality designation of the Kalispel reservation application.

Sincerely,

Ex. 6

Ex. 6

04.07.17

To: KalispelTribe

P.O.Box 39

Usk, WA 99180-0039

Re: EPACleanAirRedesignationClassIItoClassIComments

My comments about the Kalispel Tribe of Indians reservation at Usk, WA, redesignating to a Class I Clean Air entity:

1. My name is Ex. 6 I live Ex. 6 Ex. 6 My family has enjoyed Ex. 6 Ex. 6 since 1961. By June 1, 2017, Ex. 6 I have difficulty breathing, especially when my neighbors are producing smoke and pollutants. We sit in a flood plain valley where foggy weather inversions and stagnant air frequently welcomes us to each new day, in a rural setting. What wind we have usually blows in from the direction of a 40 year old paper newsprint mill in Usk, WA, with a South South Westerly wind.

2. Past air pollution at my home from 1961 to 1980 came from fires, slash, wood, leaves, trash burning and autos. With the paper mill, came sometimes stinky pollutants at night, but today's air pollution here is still from smoke.

3. My state, county and town government officials are pushing hard for more tax revenues related to increased jobs and property values, planning commercial and industrial developments immediately South of me. I resist most of those efforts and deeply respect the traditional rural culture and lifestyle, along with the expertise in the protection of these traditions by the Kalispel Tribe.

4. Although a sovereign nation, the Kalispel reservation's activities have culturally and economically benefited the surrounding agricultural and recreational community tremendously. Their vision has been spot-on.

Respectfull Ex. 6

Ex. 6

Public Comments Re-Designation Tribal Lands
April 11, 2017

Ex. 6

Thank you for welcoming community to a public hearing held at the Camas Center April 10.

As I understand it, in a pro-active move to secure some measure of control over future air and water quality for the Pend Oreille River Valley, the Tribe is seeking to upgrade the standard permitted for air and water quality such that 'some' pollution comes our way, but not so much as was on the menu before the upgrade. The net result of the change will be 1/10th the degradation that would have been ours without the re-classification. There will still be a decline in air and water quality, but the amount of degradation won't be as great under Class 1.

In my cursory look at the issue, it seems the actual yardstick of how much is too much pollution isn't just arbitrary, but is scientifically measurable, correlating with health risks from drinking water and breathing the air in places with contamination. My understanding is that children are most impacted by pollutants, not just because they're in the process of growing, but also because they're lower to the ground, are more apt to have contact by touching, and because they spend more time outdoors.

I learned that contaminants from years gone by are already impacting how many fish we should eat from the river and some lakes, and that abiding by such restrictions on consumption is particularly important for pregnant women and children. The contemplated change from Class II to Class 1 would endeavor to prevent that kind of risk from being repeated, or from worsening.

I understand that there are places in our nation where it's not safe to drink water from faucets, and where a garden is no longer able to provide produce safe to eat. There are places in the US where contamination falls down like rain upon the soils, people, pets, wildlife and open waters. In those places, residents become prisoners in their homes, school yards are empty of children for fear of health risks. Residents who once gardened to live within their means must buy lesser quality groceries at greater costs.

These strike me as real world risks affecting the ability to live in rural lands, to farm, to graze animals, even affecting how much time can be spent outdoors.

The Kalispel Tribe is sparing us such a fate.

Thank you for steward this valley. We support your efforts to re-designate to Class 1.

Respectfully,

Ex. 6

I would like to provide you with my point of view regarding the proposed redesignation from Class 2 to Class 1 air quality categories. Although we should constantly strive to improve the condition of our entire environment, I feel this change imposes restrictions reaching far beyond the simple discharge limits of present facilities and resources. Regardless of where you draw boundary lines, this is a Federal Standard, to be upheld. If limits (present or proposed) are exceeded, steps would be absolutely mandated to correct the situation. Just one example: Let's say Ponderay Newsprint decided to put in a Co-Gen Plant, so they could generate electricity, rather than drawing on Hydroelectric power at their present rate. More water then becomes available, to flush and support our continued efforts to improve Salmon movements and habitat. But wait...Co-Gen, as studies show, creates air discharges. Sorry, no Co-Gen for Ponderay Newsprint. Instead of looking at the big picture, we choose tunnel vision and come up with untenable solutions. (Like...yes, you can have Co-Gen, but you have to shut down half of your production, so as not to exceed present discharges). So who "won" there?

Your latest fact sheet, addressing many public concerns, also reiterates that existing practices are "Grandfathered", with present levels of SO2, NOX, Particulates, etc. being acceptable. However, as a Federal Standard and classification, if particulate matter exceeds Class 1 margins, required steps are mandated, and cannot be shoved aside. Without digressing into the whole original study that looks into a very large region, (Most of which it also states doesn't apply to our unique geographic area), the bottom line is that accurate measurement of air quality in a Class 1 area dictates everything that has effect on that designated area. So, it would be virtually impossible to ignore any factors that would take the Class 1 area out of compliance. By Law, steps would be required, to bring all discharges back down, to stringent Class 1 levels. These specific steps would not be dictated by the Federal Government, unless we did not come back into compliance to the Class 1 Standards. Initially, it would be US who decides what activities to limit or shut down. Would that be Logging? Travelling dirt roads? Shutting down 200+ local jobs, and the tax base they pump up? Restricting vehicle travel, or setting up emission testing? Etc.

It would be in our hands, to try to achieve the new, much more restrictive standards. Are we choosing to ignore the releases of Hanford radioactivity into our air and water? Some of that has a half-life of 250,000 years! Bottom line for me: I feel that our present Class 2 designation is restrictive enough to support quality of life in Pend Oreille County. Once again, I recognize any efforts to improve our habitat. I also think that the present systems within that classification allows accommodations for growth, a supportive tax base, employment, as well as leeway for adapting what we do to improve present air quality. Stepping into a much more restrictive designation disallows the freedom to weigh what we choose to do, and also relinquishes our ability to govern our very unique geographic region. Thank you.

Ex. 6

Ex. 6

4-10-17

Kalispel Tribal Land Re-Designation to Class 1
Public Comment of Ex. 6
April 11, 2017

I'm writing today to lend support for the proposed re-designation of Tribal Land from Class II to Class I but I'd also like to address the citizen concerns voiced at the public hearing of 4/10 at the Camas Center.

Because the re-designation increases the footprint of oversight on areas outside the Tribal boundaries, and because any fixed source of pollution outside Tribal land that might have been allowed under Class II will not necessarily be allowed under Class I, there is concern in population that prospective employers might be put-off and take their business elsewhere.

As I understand what I heard last night, to site a business in relative proximity to the Kalispel Tribal land, any potential business would be required to better-control (under Class 1) that fixed plants' emissions.

So if such a business produces pollution, the Class 1 designation would require the business exert more control over any harm to the air or water.

I'm fine with that.

The human toll of finding employment in or near Pend Oreille County should not cost citizens their health and should not compromise anyone's ability to enjoy a rural lifestyle, to hunt, fish, farm and raise their families in a safe environment.

Employers we'd welcome to operate nearby wouldn't ask we sacrifice clean air or water. The employers we would want would be good neighbors, partners in protecting natural resources.

Ex. 6

To: Wilson, Wenona[Wilson.Wenona@epa.gov]
Cc: Bray, Dave[Bray.Dave@epa.gov]; Zach Welcker[ZWelcker@kalispeltribe.com]; Deane Osterman[dosterman@kalispeltribe.com]
From: Ken Merrill
Sent: Tue 9/27/2016 11:46:02 PM
Subject: Preliminary screening model for air impacts from Smelter near Kalispel Reservation

Hi Wenona,
Thank you for your time today, and as we discussed, the Tribe needs to understand how the proposed smelter might impact the home of the Kalispel people and understand how a redesignation of the Tribes airshed to Class 1 might affect the PSD permitting outcome and the Tribe's air quality. If there were a way that EPA could help to do some screening modeling, we think it would help the Kalispel develop the capacity to best protect our right to clean air on the reservation.
Thanks for the consideration --Ken

Kenneth R. Merrill
Manager - Water Resources Program
Kalispel Tribe Natural Resources
PO Box 39, Usk, WA, 99180
(509) 447-7276 (office)
Ex. 6 (cell)

To: Wilson, Wenona[Wilson.Wenona@epa.gov]
Cc: Bray, Dave[Bray.Dave@epa.gov]
From: Ken Merrill
Sent: Wed 9/28/2016 9:43:32 PM
Subject: RE: Preliminary screening model for air impacts from Smelter near Kalispel Reservation
HiTest Sand Inc Project Overview - USK, WA.pdf

FYI- Attached is some info on the smelter project sent to us by the project proponent. PM numbers are omitted for some reason --Ken

Ken Merrill
Water Resources Program
(509) 447-7276 (office)
Ex. 6 (cell)

From: Ken Merrill
Sent: Tuesday, September 27, 2016 4:46 PM
To: Wilson, Wenona
Cc: 'Bray, Dave'; Zach Welcker; Deane Osterman
Subject: Preliminary screening model for air impacts from Smelter near Kalispel Reservation

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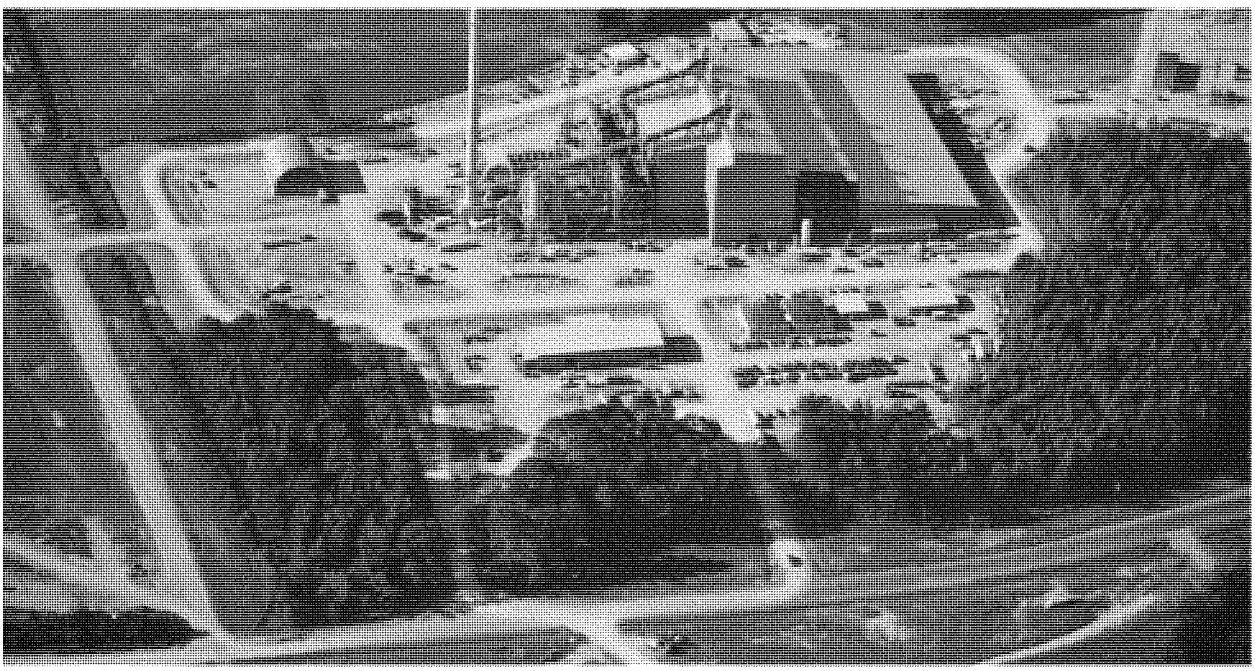
(509) 447-7276 (office)
Ex. 6 (cell)

HiTest Sand

Responsibly supplying Hi-quality silica

HiTest Sand Inc. Silicon Project Overview

September, 2016

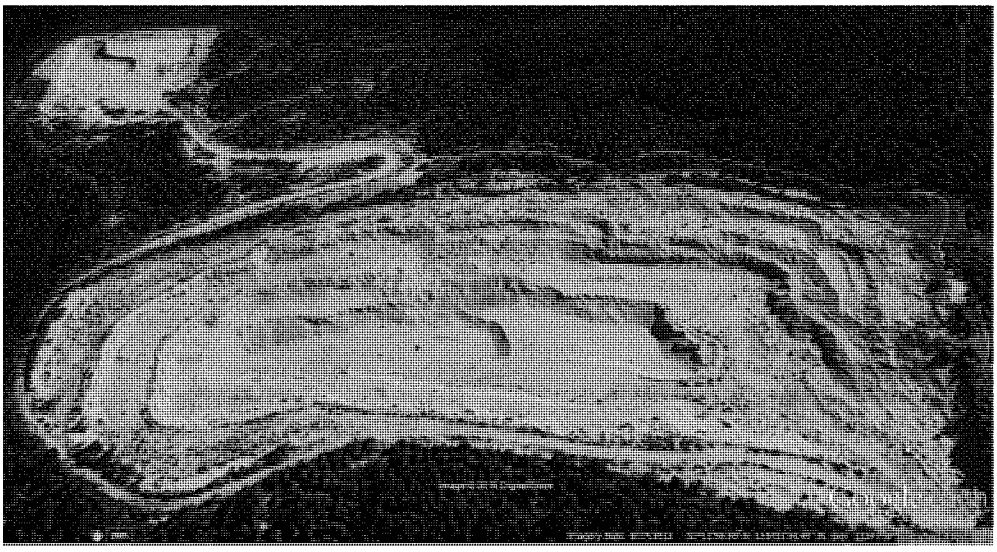


Overview of recently built silicon plant

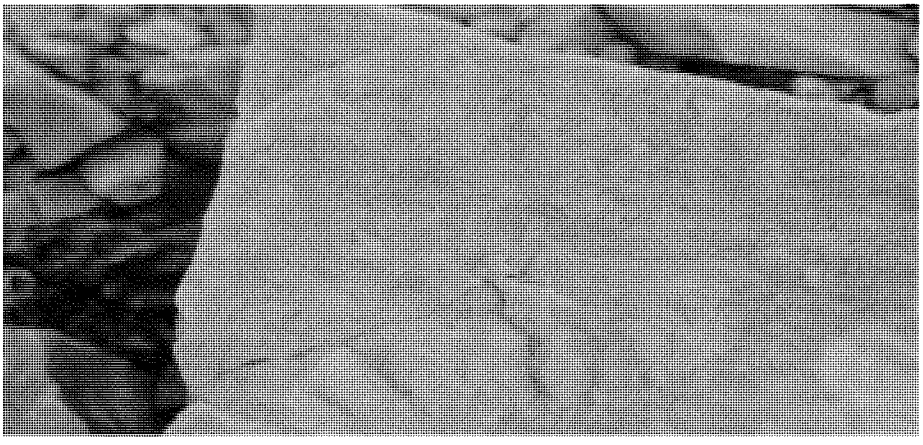
I. Introduction

HiTest Sand is an integrated silica quartz mining and silicon metals processing company based in Edmonton, Alberta. HiTest is the 100% owner of a high quality, large silica quartz mine deposit located near Golden, British Columbia. The existing open pit quarry is currently fully

permitted for 800,000 tonnes/year and was in operation from 1980-1999 with peak production rates of 110,000 tonnes/year shipped to Dow Corning for use in its Silicon Metal smelters in Washington and Oregon, USA.



In 2013, the lease deposits were assessed by third-party analysis to possess 51,000,000 tonnes of proven reserves with an additional 28,000,000 tonnes of probable reserves. In addition to over 300 historical tests showing the mine's Silica Ore samples contained 99.85% SiO_2 purity (Bondar-Clegg Certificate of Analysis), recent analysis in 2014 by Sintef Labs (Norway) on purity and thermal stability showed quartz samples have excellent resistance towards thermal shock heating and greater than 99.82% SiO_2 purity. These chemical and purity attributes (low Boron, low Phosphorous) make the HiTest silica quartz and processed silicon optimal for the premium processed silicon metals market, including polysilicon products, solar panels, LCD screens and aluminum alloys.



The combination of large proven reserves, high SiO_2 purity, and low regulated power prices provide a competitive environment for the construction and operation of an integrated silica quartz mining and silicon metals processing plant facility. The project's strategic advantages are

our ability to pull high quality silica raw materials from a single large mining operation into a co-located processing facility with low power rates, and to produce high grade silicon metals at competitive operating costs.

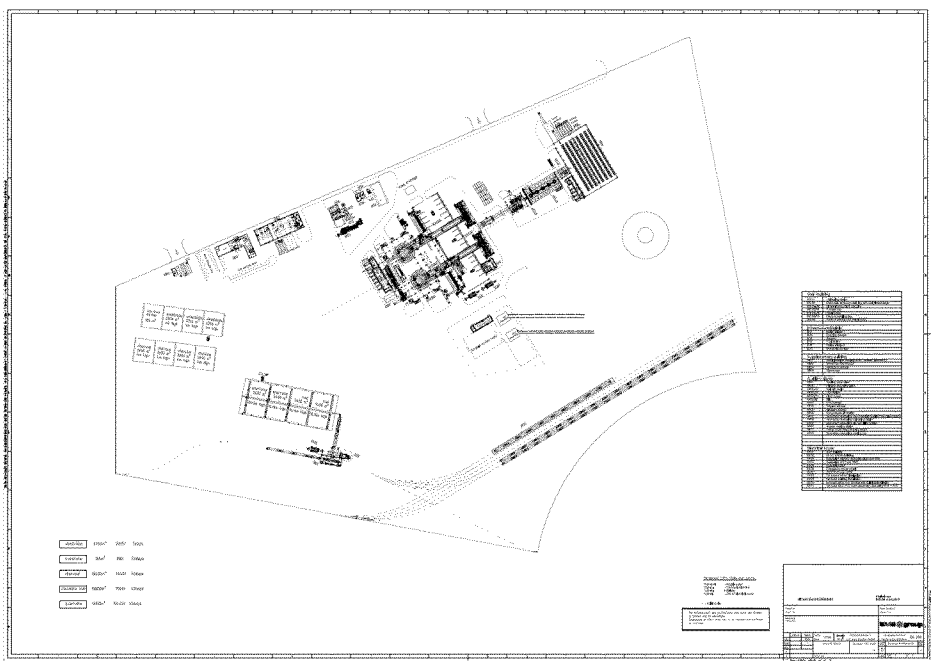
The submerged arc plant design will use two furnaces to produce 55,000 tonnes of tapped Silicon per year. Once commissioned in early 2019, the first HiTest plant will achieve 55,645 tonnes production.

Due to the high quantity of silica quartz supply available, the project is considering the development of two successive process plant projects, one co-located with the mine in Golden, BC and the other in Washington State, both with significant government support.

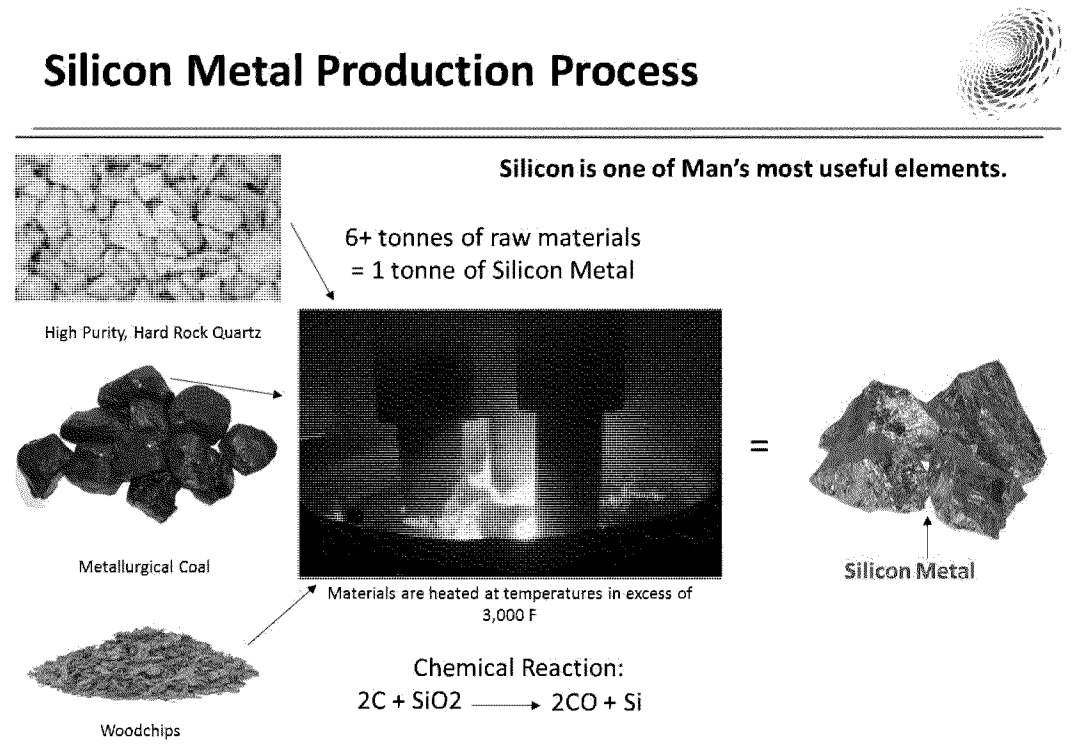
The project requires an estimated capital budget of USD $300M to design, engineer, procure, construct and commission the first plant over a 22-month period with site construction targeted to start by Q2 2017. To date HiTest has spent approximately $20Million of its own capital. Additionaly, HiTest has secured debt finance options for up to USD $200M and is finalizing terms with strategic equity investment partners for up to an additional $150M in equity by Q4 2016 for the detailed project.

2. USK, WA Site

One of the potential sites is in USK, WA utilizing approx. 80 acres of un-developed land on the PNC property. A preliminary site layout is shown:



3. Process Description



Silicon Metal is produced at a temperature of about 2,000C in submerged-arc electric furnaces. The process requires about 13,000 kwh/MT of silicon metal produced. The main raw materials are high purity quartz rock, low ash metallurgical coal, wood chips and carbon electrodes. No hazardous waste or chemicals are involved in the process.

The plant will consume approximately:

143,000 tonnes of high quality quartz (brought by rail)

143,000 tonnes of local wood chips (brought by truck)

66,000 tonnes of low ash metallurgical coal (brought by rail)

4. Environmental Parameters

Typical Off-Gas Analysis and Data:

N_2 = 76 Vol%

O_2 = 18 Vol%

CO_2 = 4 Vol%

H_2O = 2 Vol%

Temperature = approx.. 200C

Off-gas Generation = approx. 70,000 nm3 per MT of silicon

Estimated Emissons of controlled gases

COX = 150,000 – 200,000 MT/year depending on furnace operating conditions

SOX = 1,500 – 2,000 MT/year depending on raw material selections

NOX = 1,000 – 2,000 MT/year depending on furnace operating conditions

Opacity = 5 – 15 % depending on operating conditions

Water Usage and Parameters

1. Closed loop system utilizing makeup water only = 200 – 300 gal/day.

2. Sanitary water for approx.. 170 employees

3. Storm water collection system

Solid Waste Parameters

1. Furnace Dust – approx.. 20,000 MT/year collected and sold – no waste

2. Refining slag and dross – approx. 4,000 MT/year collected and sold – no waste

3. Small amounts of misc. bag house dust collected and recycled – minimal waste

4. No hazardous wastes or heavy metals

For additional questions please contact:

Jim May – Chief Operating Officer HiTest Sand

jmay@hitestsand.com

To: kmerrill@knrd.org[kmerrill@knrd.org]; Wilson, Wenona[Wilson.Wenona@epa.gov]
From: Bray, Dave
Sent: Thur 9/29/2016 9:22:50 PM
Subject: RE: Preliminary screening model for air impacts from Smelter near Kalispel Reservation

Thanks Ken.
Interesting stuff.
If we do end up doing some screening modeling, our modeler will need to get some more detailed information from the company (or Ecology if they've got something from the company yet).
Look forward to talking more soon.
Dave

David C. Bray
Associate Director for Air
Office of Air and Waste
EPA Region 10
Seattle, WA
(206) 553-4253

From: Ken Merrill [mailto:kmerrill@knrd.org]
Sent: Wednesday, September 28, 2016 2:44 PM
To: Wilson, Wenona
Cc: Bray, Dave
Subject: RE: Preliminary screening model for air impacts from Smelter near Kalispel Reservation

FYI- Attached is some info on the smelter project sent to us by the project proponent. PM numbers are omitted for some reason --Ken

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Water Resources Program
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Ex. 6 (cell)

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Ex. 6 (cell)

To: Bray, Dave[Bray.Dave@epa.gov]; Wilson, Wenona[Wilson.Wenona@epa.gov]
From: Ken Merrill
Sent: Tue 10/4/2016 11:21:53 PM
Subject: RE: Spokane Class 1 airshed redesignation submission document - Preliminary screening model for air impacts from Smelter near Kalispel Reservation
removed.txt
Pages from Spokane Tribe of Indians Redesignation Document - Main Document.pdf
Pages from Spokane Tribe of Indians Redesignation Document - Appendix Section.pdf

Dave and Wenona,
Here is the Spokane's Class 1 redesignation submission documents they so kindly sent us. I told them I would forward it on to you with their permission. --Ken
Ken Merrill
Water Resources Program
(509) 447-7276 (office)
Ex. 6 (cell)

From: Bray, Dave [mailto:Bray.Dave@epa.gov]
Sent: Thursday, September 29, 2016 2:23 PM
To: Ken Merrill; Wilson, Wenona
Subject: RE: Preliminary screening model for air impacts from Smelter near Kalispel Reservation
Thanks Ken.
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Kalispel natural resources

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Kalispel Tribe Natural Resources
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(509) 447-7276 (office)
Ex. 6 (cell)

APPENDIX

APPENDIX A

ATMOSPHERIC STABILITY

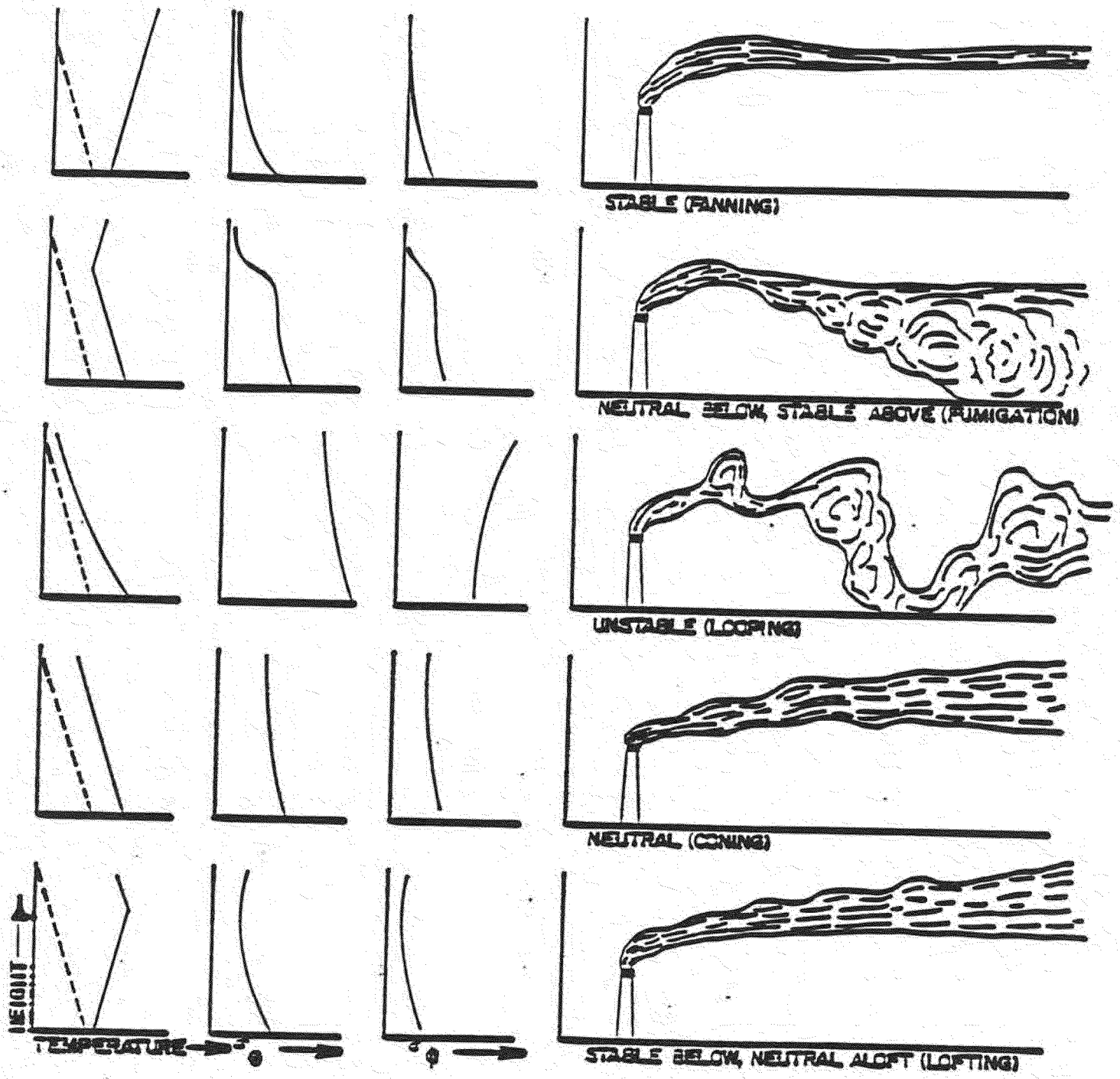

Figure D-1.

Various Types of Smoke-Plume Patterns Observed in the Atmosphere. The dashed curves in the left-hand column of diagrams show the adiabatic lapse rate, and the solid lines are the observed profiles. The abscissas of the columns for the horizontal and vertical wind direction standard deviations (and) represent a range of about 0° to 25°.

Source: Marlatt and Associates, 1978.

Atmospheric stability is a measure of the atmosphere's capability to horizontally and vertically disperse pollutants. A standard measure of stability has been the Pasquill stability classification. The Pasquill stability classes are defined as follows:

A - Extremely unstable
B - Moderately unstable
C - Slightly unstable
D - Neutral
E - Slightly stable
F - Moderately stable

This coding system defines each category as follows: (1) unstable conditions (Classes A, B, and C) occur when layers of air close to the ground undergo warming with associated low wind speeds, (2) stable conditions (Classes E and F) occur when the layers of air close to the ground undergo cooling with associated low wind speeds; (3) drainage winds occur under E and F stability conditions; and (4) neutral conditions (Class D) occur with cloudy skies and/or high wind speeds.

Figure D-1 illustrates smoke plume patterns from an elevated source for some of the various conditions discussed above. As a general rule, stable conditions of fumigation are the conditions which produce the highest groundlevel concentrations of air pollutants.

APPENDIX B

SPOKANE, WASHINGTON, NATIONAL WEATHER SURFACE WIND DATA STAR FORMAT

(1 JANUARY 1968 - 31 DECEMBER 1977)

RELATIVE FREQUENCY DISTRIBUTION NORMALIZED AVERAGE-ANNUAL BASIS
PASQUILL-GIFFORD STABILITY A

Direction	Wind Speed, Knots 0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	Greater than 21	Total
N	.000054	.000171	.000000	.000000	.000000	.000000	.000225
NNE	.000032	.000103	.000000	.000000	.000000	.000000	.000135
NE	.000123	.000103	.000000	.000000	.000000	.000000	.000225
ENE	.000112	.000068	.000000	.000000	.000000	.000000	.000180
E	.000099	.000171	.000000	.000000	.000000	.000000	.000270
ESE	.000043	.000137	.000000	.000000	.000000	.000000	.000180
SE	.000032	.000103	.000000	.000000	.000000	.000000	.000135
SSE	.000032	.000103	.000000	.000000	.000000	.000000	.000135
S	.000099	.000171	.000000	.000000	.000000	.000000	.000270
SSW	.000045	.000000	.000000	.000000	.000000	.000000	.000045
SW	.000043	.000137	.000000	.000000	.000000	.000000	.000180
WSW	.000032	.000103	.000000	.000000	.000000	.000000	.000135
W	.000032	.000103	.000000	.000000	.000000	.000000	.000135
WNW	.000067	.000068	.000000	.000000	.000000	.000000	.000135
NW	.000032	.000103	.000000	.000000	.000000	.000000	.000135
NNW	.000045	.000000	.000000	.000000	.000000	.000000	.000045
TOTAL	.000925	.001644	.000000	.000000	.000000	.000000	

Relative Frequency of Occurrence of A Stability = .002568
Relative Frequency of Calms Distributed Above with A Stability = .000616

ED_002139_00021156-00006

STABILITY B

Direction	Wind Speed, Knots 1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	Greater than 21	Total
N	.000550	.001986	.000651	.000000	.000000	.000000	.003187
NNE	.000490	.001438	.000753	.000000	.000000	.000000	.002682
NE	.000734	.002123	.001130	.000000	.000000	.000000	.003987
ENE	.000733	.002089	.001644	.000000	.000000	.000000	.004465
E	.000673	.002363	.000548	.000000	.000000	.000000	.003584
ESE	.000761	.001096	.000342	.000000	.000000	.000000	.002200
SE	.000434	.000959	.000274	.000000	.000000	.000000	.001667
SSE	.000327	.000959	.000205	.000000	.000000	.000000	.001491
S	.000715	.001678	.000856	.000000	.000000	.000000	.003249
SSW	.000337	.001199	.000993	.000000	.000000	.000000	.002529
SW	.000703	.001404	.001267	.000000	.000000	.000000	.003374
WSW	.000432	.001747	.000856	.000000	.000000	.000000	.003035
W	.000324	.000890	.000548	.000000	.000000	.000000	.001762
WNW	.000486	.000514	.000240	.000000	.000000	.000000	.001240
NW	.000348	.000616	.000240	.000000	.000000	.000000	.001204
NNW	.000241	.000616	.000137	.000000	.000000	.000000	.00994
TOTAL	.008288	.021678	.010685	.000000	.000000	.000000	

Relative Frequency of Occurrence of B Stability = .040651
Relative Frequency of Calms Distributed Above with B Stability = .001233

ED_002139_00021156-00007

STABILITY C

Direction	Wind Speed, Knots 0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	Greater than 21	Total
N	.000381	.002295	.002192	.000103	.000034	.000000	.005004
NNE	.000234	.002192	.003082	.000137	.000000	.000000	.005645
NE	.000577	.003562	.008904	.000582	.000000	.000000	.013625
ENE	.000608	.003459	.008938	.000411	.000034	.000000	.013451
E	.000440	.003699	.003219	.000137	.000000	.000000	.007495
ESE	.000170	.001507	.002192	.000034	.000000	.000000	.003903
SE	.000204	.001473	.002363	.000000	.000000	.000000	.004040
SSE	.000214	.001712	.003836	.000000	.000000	.000000	.005762
S	.000306	.002192	.005856	.000445	.000000	.000000	.008799
SSW	.000191	.001164	.006336	.000822	.000068	.000034	.008616
SW	.000167	.001438	.006712	.001747	.000103	.000034	.010201
WSW	.000250	.001712	.005582	.001233	.000034	.000034	.008846
W	.000208	.001575	.003082	.000548	.000034	.000000	.005448
WNW	.000107	.000856	.000993	.000103	.000000	.000000	.002059
NW	.000250	.000856	.001199	.000068	.000000	.000000	.002373
NW	.000250	.000856	.001199	.000068	.000000	.000000	.002373
NNW	.000144	.000890	.000719	.000034	.000000	.000000	.001788
TOTAL	.004452	.030582	.065205	.006404	.000308	.000103	

Relative Frequency of Occurrence of C Stability = .107055

Relative Frequency of Calms Distributed Above with C Stability = .001404

ED_002139_00021156-00008

STABILITY D

Direction	Wind Speed, Knots 0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	Greater than 21	Total
N	.001579	.005753	.004555	.002363	.000205	.000000	.014456
NNE	.002292	.008151	.007774	.003390	.000377	.000068	.022053
NE	.002092	.011610	.020000	.005377	.000890	.000137	.040106
ENE	.002725	.011199	.019281	.006062	.000685	.000034	.039986
E	.002344	.006507	.005856	.001678	.000205	.000034	.016625
ESE	.001550	.004486	.006199	.001233	.000000	.000000	.013468
SE	.001592	.006370	.012260	.003836	.000034	.000034	.024126
SSE	.001296	.006370	.025171	.010514	.001130	.000000	.044481
S	.002149	.008664	.033562	.024555	.003767	.000445	.073142
SSW	.001059	.004829	.024863	.041610	.010856	.002260	.085477
SW	.001182	.004521	.025000	.049521	.019315	.007192	.106730
WSW	.001081	.003733	.014041	.022568	.007808	.002534	.051766
W	.001132	.003904	.006610	.008185	.002740	.000788	.023358
WNW	.000530	.001507	.001712	.001815	.000308	.000000	.005872
NW	.000413	.001438	.001712	.000514	.000034	.000034	.004146
NNW	.000647	.001130	.001370	.001267	.000274	.000034	.004723
TOTAL	.023664	.090171	.209966	.184486	.048630	.013596	

Relative Frequency of Occurrence of D Stability = .570514
Relative Frequency of Calms Distributed Above with D Stability = .008562

ED_002139_00021156-00009

STABILITY F

Direction	Wind Speed, Knots 0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	Greater than 21	Total
N	.003271	.005000	.000000	.000000	.000000	.000000	.008271
NNE	.004371	.005788	.000000	.000000	.000000	.000000	.010158
NE	.004470	.008459	.000000	.000000	.000000	.000000	.012929
ENE	.004984	.010274	.000000	.000000	.000000	.000000	.015258
E	.005073	.005205	.000000	.000000	.000000	.000000	.010279
ESE	.002746	.003116	.000000	.000000	.000000	.000000	.005862
SE	.003336	.004212	.000000	.000000	.000000	.000000	.007548
SSE	.003029	.005925	.000000	.000000	.000000	.000000	.008954
S	.004393	.009178	.000000	.000000	.000000	.000000	.013571
SSW	.003303	.004486	.000000	.000000	.000000	.000000	.007789
SW	.003868	.006130	.000000	.000000	.000000	.000000	.009998
WSW	.003403	.006233	.000000	.000000	.000000	.000000	.009636
W	.003714	.004075	.000000	.000000	.000000	.000000	.007789
WNW	.001986	.001507	.000000	.000000	.000000	.000000	.003493
NW	.001049	.000959	.000000	.000000	.000000	.000000	.002008
NNW	.001456	.000993	.000000	.000000	.000000	.000000	.002449
TOTAL	.054452	.081541	.000000	.000000	.000000	.000000	

Relative Frequency of Occurrence of F Stability = .135993
Relative Frequency of Calms Distributed above with F Stability = .020000

ED_002139_00021156-00010

STABILITY E

Direction	Wind Speed, Knots 0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	Greater than 21	Total
N	.000000	.004144	.002226	.000000	.000000	.000000	.006370
NNE	.000000	.004795	.002363	.000000	.000000	.000000	.007158
NE	.000000	.007397	.005959	.000000	.000000	.000000	.013356
ENE	.000000	.008116	.007842	.000000	.000000	.000000	.015959
E	.000000	.004726	.001678	.000000	.000000	.000000	.006404
ESE	.000000	.003459	.000411	.000000	.000000	.000000	.003870
SE	.000000	.004178	.003425	.000000	.000000	.000000	.007603
SSE	.000000	.005856	.014966	.000000	.000000	.000000	.020822
S	.000000	.006986	.011267	.000000	.000000	.000000	.018253
SSW	.000000	.003219	.006027	.000000	.000000	.000000	.009247
SW	.000000	.004110	.009760	.000000	.000000	.000000	.013870
WSW	.000000	.003596	.007534	.000000	.000000	.000000	.011130
W	.000000	.002397	.002055	.000000	.000000	.000000	.004452
WNW	.000000	.001164	.000685	.000000	.000000	.000000	.001849
NW	.000000	.000788	.000753	.000000	.0000000	.000000	.001541
NNW	.000000	.000582	.000753	.000000	.000000	.000000	.001336
TOTAL	.000000	.065514	.077705	.000000	.000000	.000000	

Relative Frequency of Occurrence of E Stability = .143219
Relative Frequency of Calms Distributed above with E Stability = .000000

ED_002139_00021156-00011

APPENDIX C

Birds Known or Expected In The General Region Of The Spokane Reservation

Common Name	Scientific Name
Order Gaviiformes	
Common loon	Gavia immer
Order Policipediformes	
Red-necked Grebe	Podiceps grisegena
Horned Grebe	Podiceps auritus
Eared Grebe	Podiceps nigricollis
Western Grebe	Aechmorphorus occidentalis
Pied-billed Grebe	Podilymbus podiceps
Order Pelecaniformes	
White Pelican	Pelecanus erythrorhynchos
Order Ciconiiformes	
Great Blue Heron	Ardea herodias
American Bittern	Botaurus lentiginosus
Order Anseriformes	
Whistling Swan	Cygnus columbianus
Trumpeter Swan	Cygnus buccinator
Canada Goose	Branta canadensis
Snow Goose	Chen caerulescens
Mallard	Anas platyrhynchos
Gadwall	Anas strepera
Pintail	Anas acuta
Green-winged Teal	Anas carolinensis
Blue-winged Teal	Anas discors
Cinnamon Teal	Anas cyanoptera
American Wigeon	Anas americana
Shoveler	Spatula clypeata
Wood Duck	Aix sponsa
Redhead	Aythya americana
Ring-necked Duck	Aythya collaris
Canvasback	Aythya valisineria
Lesser Scaup	Aythya affinis
Barrow's Goldeneye	Bucephala islandica
Common Goldeneye	Bucephala clangula
Bufflehead	Bucephala albeola
White-winged Scoter	Melanitta fusca

Common Name	Scientific Name
Order Anseriformes cont'd.	
Ruddy Duck	Oxyura jamaicensis
Common Merganser	Mergus merganser
Hooded Merganser	Lophodytes cucullatus
Order Falconiformes	
Turkey Vulture	Cathartes aura
Goshawk	Accipiter gentilis
Sharp-shinned Hawk	Accipiter striatus
Cooper's Hawk	Accipiter cooperii
Red-tailed Hawk	Buteo jamaicensis
Swainson's Hawk	Buteo swainsoni
Rough-legged Hawk	Buteo lagopus
Ferruginous Hawk	Buteo regalis
Golden Eagle	Aquila chrysaetos
Bald Eagle	Haliaeetus leucocephalus
Marsh Hawk	Circus cyaneus
Osprey	Pandion haliaetus
Gyrfalcon	Falco rusticolus
Prairie Falcon	Falco mexicanus
Peregrine Falcon	Falco peregrinus
Merlin	Falco columbarius
American Kestrel	Falco sparverius
Order Galliformes	
Wild Turkey	Meleagris gallopavo
Blue Grouse	Dendragapus obscurus
Ruffed Grouse	Bonasa umbellus
Sharp-tailed Grouse	Tympanuchus phasianellus
Gray Partridge	Perdix perdix
Bobwhite	Colinus virginianus
California Quail	Lophortyx californicus
Ring-necked Pheasant	Phasianus colchicus
Chukar	Alectoris chukar
Order Gruiformes	
Sandhill Crane	Grus canadensis
Virginia Rail	Rallus limicola

Common Name	Scientific Name
Order Gruiformes cont'd.	
Sora	Porzana carolina
American Coot	Fulica americana
Order Charadriiformes	
Killdeer	Charadrius vociferus
Black-bellied Plover	Pluvialis squatarola
Common Snipe	Gallinago gallinago
Long-billed Curlew	Numenius americanus
Upland Sandpiper	Bartramia longicauda
Spotted Sandpiper	Actitis macularia
Solitary Sandpiper	Tringa solitaria
Greater Yellowlegs	Tringa melanoleuca
Lesser Yellowlegs	Tringa flavipes
Pectoral Sandpiper	Calidris melanotos
Baird's Sandpiper	Calidris bairdii
Least Sandpiper	Calidris minutilla
Dunlin	Calidris alpina
Stilt Sandpiper	Calidris himantopus
Western Sandpiper	Calidris mauri
Long-billed Dowitcher	Limnodromus scolopaceus
American Avocet	Recurvirostra americana
Wilson's Phalarope	Phalaropus tricolor
Northern Phalarope	Phalaropus lobatus
Herring Gull	Larus argentatus
California Gull	Larus Californicus
Ringed-billed Gull	Larus delawarensis
Bonaparte's Gull	Larus philadelphia
Forster's Tern	Sterna forsteri
Caspian Tern	Sterna caspia
Black Tern	Chlidonias niger
Order Columbiformes	
Mourning Dove	Zenaida macroura
Rock Dove	Columba livia
Band-tailed Pigeon	Columbia fasciata
Order Strigiformes	
Barn Owl	Tyto alba
Screech Owl	Otus asio
Flammulated Owl	Otus flammeolus

ED_002139_00021156-00016

Common Name	Scientific Name
Order Strigiformes cont'd.	
Great Horned Owl	Bubo virginianus
Snowy Owl	Nyctea scandiaca
Northern Hawk-Owl	Surnia ulula
Northern Pygmy-Owl	Glaucidium gnoma
Burrowing Owl	Athene cunicularia
Barred Owl	Strix varia
Great Gray Owl	Strix nebulosa
Long-eared Owl	Asio otus
Short-eared Owl	Asio flammeus
Saw-whet Owl	Aegolius acadicus
Order Caprimulgiformes	
Poor-will	Phalaenoptilus nuttallii
Common Nighthawk	Chordeiles minor
Order Apodiformes	
White-throated Swift	Aeronautes saxatilis
Vaur's Swift	Chaetura vauxi
Black-chinned Hummingbird	Archilochus alexandri
Rufous Hummingbird	Selasphorus rufus
Calliope Hummingbird	Stellula calliope
Order Coraciiformes	
Belted Kingfisher	Ceryle alcyon
Order Piciformes	
Common Flicker	Colaptes auratus
Pileated Woodpecker	Dryocopus pileatus
Lewis' Woodpecker	Melanerpes lewis
Yellow-bellied Sapsucker	Sphyrapicus varius
Williamson's Sapsucker	Sphyrapicus thyroideus
Hairy Woodpecker	Picoides villosus
Downy Woodpecker	Picoides pubescens
White-headed Woodpecker	Picoides albolarvatus
Black-backed Woodpecker	Picoides arcticus
Three-toed Woodpecker	Picoides tridactylus

Common Name	Scientific Name
Order Passeriformes.	
Eastern Kingbird	Tyrannus tyrannus
Western Kingbird	Tryannus verticalis
Ash-throated Flycatcher	Myiarchus cinerascens
Say's Phoebe	Sayornis saya
Willow Flycatcher	Empidonax traillii
Least Flycatcher	Empidonax minimus
Hammond's Flycatcher	Empidonax hammondii
Dusky Flycatcher	Empidonax oberholseri
Western Flycatcher	Empidonax difficilis
Western Wood Pewee	Contopus sordidulus
Olive-sided Flycatcher	Contopus borealis
Horned Lark	Eremophila alpestris
Violet-green Swallow	Tachycineta thalassina
Tree Swallow	Tachycineta bicolor
Bank Swallow	Riparia riparia
Rough-winged Swallow	Stelgidopteryx serripennis
Barn Swallow	Hirundo rustica
Cliff Swallow	Hirundo pyrrhonota
Gray Jay	Perisoreus canadensis
Steller's Jay	Cyanocitta stelleri
Black-billed Magpie	Pica pica
Common Raven	Corvus corax
Common Crow	Corvus brachyrhynchos
Clark's Nutcracker	Nucifraga columbiana
Black-capped Chickadee	Parus atricapillus
Mountain Chickadee	Parus gambeli
Chestnut-backed Chickadee	Parus rufescens
White-breasted Nuthatch	Sitta carolinensis
Red-breasted Nuthatch	Sitta canadensis
Pygmy Nuthatch	Sitta pygmaea
Brown Creeper	Certhia familiaris
Dipper	Cinclus mexicanus
House Wren	Troglodytes aedon
Winter Wren	Troglodytes troglodytes
Marsh Wren	Cistothorus palustris
Canyon Wren	Catherpes mexicanus
Rock Wren	Salpinctes obsoletus
Catbird	Dumetella carolinensis
Sage Thrasher	Oreoscoptes montana
Robin	Turdus migratorius
Varied Thrush	Ixoreus naevius
Hermit Thrush	Catharus guttatus
Swainson's Thrush	Catharus ustulatus
Veery	Catharus fuscescens

Common Name	Scientific Name
Order Passeriformes cont'd.	
Western Bluebird	Sialia mexicana
Mountain Bluebird	Sialia currucoides
Townsend's Solitaire	Myadestes townsendii
Golden-crowned Kinglet	Regulus satrapa
Ruby-crowned Kinglet	Regulus calendula
Water Pipit	Anthus spinoletta
Bohemian Waxwing	Bombycilla garrulus
Cedar Waxwing	Bombycilla cedrorum
Northern Shrike	Lanius excubitor
Loggerhead Shrike	Lanius ludovicianus
Starling	Sturnus vulgaris
Solitary Vireo	Vireo solitarius
Red-eyed Vireo	Vireo olivaceus
Warbling Vireo	Vireo gilvus
Orange-crowned Warbler	Vermivora celata
Nashville Warbler	Vermivora ruficapilla
Yellow Warbler	Dendroica petechia
Yellow-rumped Warbler	Dendroica coronata
Townsend Warbler	Dendroica townsendi
Common Yellowthroat	Geothypis trichas
Yellow-breasted Chat	Icteria virens
MacGillivray's Warbler	Oporornis tolmiei
Wilson's Warbler	Wilsonia pusilla
American Redstart	Setophaga ruticilla
House Sparrow	Passer domesticus
Bobolink	Dolichonyx oryzivorus
Western Meadowlark	Sturnella neglecta
Yellow-headed Blackbird	Xanthocephalus xanthocephalus
Red-winged Blackbird	Agelaius phoeniceus
Northern Oriole	Icterus galbula
Brewer's Blackbird	Euphagus cyanocephalus
Brown-headed Cowbird	Molothrus ater
Western Tanager	Piranga ludoviciana
Black-headed Grosbeak	Pheucticus melanocephalus
Lazuli Bunting	Passerina amoena
Evening Grosbeak	Hesperiphona vespertinus
Cassin's Finch	Carpodacus cassinii
House Finch	Carpodacus mexicanus
Pine Grosbeak	Pinicola enucleator
Gray-crowned Rosy Finch	Leucosticte tephrocotis
Common Redpoll	Acanthis flammea
Pine Siskin	Carduelis pinus
American Goldfinch	Carduelis tristis
Red Crossbill	Loxia curvirostra
Rufus-sided Towhee	Pipilo erythrophthalmus
Savannah Sparrow	Passerculus sandwichensis

Common Name	Scientific Name
Order Passeriformes cont'd.	
Grasshopper Sparrow	Ammodramus savannarum
Vesper Sparrow	Pooecetes gramineus
Lark Sparrow	Chondestes grammacus
Oregon Junco	Junco oreganus
Dark-eyed Junco	Junco hyemalis
Tree Sparrow	Spizella arborea
Chipping Sparrow	Spizella passerina
Brewer's Sparrow	Spizella breweri
White-crowned Sparrow	Zonotrichia leucophrys
Fox Sparrow	Passerella iliaca
Lincoln's Sparrow	Melospiza lincolnii
Song Sparrow	Melospiza melodia
Snow Bunting	Plectrophenax nivalis

Source: Dames and Moore 1974; Larrison 1981 Nisbet n.d., and Robbins et. al. 1966.

APPENDIX D

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"THE NORTHERN CHEYENNE

AIR QUALITY REDESIGNATION

REPORT AND REQUEST"

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REDESIGNATION REPORT AND REQUEST

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Cover letter from Allen Rowland, President, Northern Cheyenne Tribal Council

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APPENDIX E

SPOKANE RESERVATION

SOILS pH

SPOKANE RESERVATION SOIL pH AND DEPTH BY SOIL MAP UNITS

Soil Series (Map Units)	Depth (inches)	Reaction (pH)
Moscow (159, 160, 161)	0-26	5.1-6.5
Saltese (202)	0-60	5.6-6.5
Huckleberry (105, 106, 107)	0-28	5.6-7.3
	21-32	5.6-6.5
Newbell (166, 167); Springdale (225, 226, 227)	0-6	5.6-7.3
Skanid (209, 210, 211); Mobate (151, 152)	0-15	6.1-7.3
Buhrig (44)	0-22	6.1-7.3
Spens (216, 217); Spokane (218, 219, 221, 222, 223, 224), Rock outcrop Spokane (196	0-26	6.1-7.3
Dragoon (78, 79); Raisio (178, 180)	0-30	6.1-7.3
Hartill (90, 93, 94)	0-37	6.1-7.3
Aits (9, 10); Bernhill (19, 20, 21, 22, 23, 26); Bestrom (27, 29); Bong (32, 33); Clayton (56, 57); Dearyton (61, 62); Dehart (69); Donovan (70, 71, 72, 74, 75); Green Bluff (86, 87); Hardesty (70); Hesseltine (95, 96, 97); Konner (121); Laketon (126, 127); Marble (142); Narcisse (164); Phoebe (174, 175); Wethey (246)	0-6	6.1-7.3
Peone (172, 173)	0-43	6.1-7.3
	43-60	5.6-7.3
Cedonia (45, 46)	0-8	6.1-7.3
	8-32	6.6-8.4
	32-60	7.9-9.0
Republic (184, 185)	0-31	6.1-7.3
	31-60	6.6-8.4
Hogson (99)	0-10	6.1-7.3
	10-28	6.6-8.4
	28-60	7.4-9.0

Soil Series (Map Units)	Depth (inches)	Reaction (pH)
Hunters (108, 109)	0-18	6.1-7.3
	18-30	6.6-8.4
	30-60	7.9-8.4
Ratdrum (181)	0-60	6.6-7.3
Rock outcrop Stevents (197)	0-38	6.6-7.3
	38-60	6.6-7.8
Stevens (230, 231)	0-60	6.6-7.3
Stevens (229, 232, 234)	0-38	6.6-7.3
	38-60	6.6-7.8
Cheney (53, 54)	0-24	6.6-7.8
	24-60	7.4-7.4
Cheney (52)	0-60	6.6-7.8
Koerling (118, 119)	0-9	6.6-7.3
	9-40	6.6-7.8
	40-60	7.4-8.4
Brigesdon (39, 40); Garrison (83, 84)	0-60	6.6-7.8
Colville (58, 59)	0-60	7.4-9.0
Molcal (193)	0-18	7.4-8.4
	18-47	7.9-9.0

APPENDIX F

WATER QUALITY DATA

STORET RETRIEVAL DATE 84/06/18 - INVENT - VERSION OF SEP, 1981

RETRIEVAL FOR DICK PEARL

12433000 543106 54A070
47 50 18.0 117 51 05.0 2
SPOKANE RIVER AT LONG LAKE, WASH.
53063 WASHINGTON SPOKANE
130391

/TYPA/AMBNT/STREAM

112WRD 17010307000
0000 CLASS 00 CSN-RSP 0016510-0287010

INDEX 1310001 006500
MILES 0643.00 0033.30

PARAMETER				RNK	NUMBER	MEAN	VARIANCE	STAN DEV	COEF VAR	STAND ER	MAXIMUM	MINIMUM	BEG DATE	END DATE
00003	VSAMPLOC	DEPTH	FEET		1	4.19999					4.19999	4.19999	73/01/31	73/01/31
00008	LAB	IDENT.	NUMBER		16	236404	.129E+12	360048	1.52302	90011.8	760832	305.000	73/05/11	75/09/24
00010	WATER	TEMP	CENT		370	12.0431	33.5980	5.79638	.481304	.301340	23.0000	.500000	62/10/24	83/11/17
00020	AIR	TEMP	CENT		4	16.3750	53.4697	7.31230	.446553	3.65615	25.4000	9.10000	83/05/19	83/11/17
00022	LENGTH	OF EXPOS	URE-DAYS		3	36.0000	111.000	10.5356	.292657	6.08275	47.0000	26.0000	78/05/02	79/07/30
00025	BAROMTRC	PRESSURE	MM OF HG		7	722.428	69.6667	8.34666	.011554	3.15474	732.000	710.000	82/10/27	83/11/17
00027	COLLECT	AGENCY	CODE		73	14873.9	.990E+09	31471.8	2.11591	3683.50	85343.0	.102000	75/07/23	83/11/17
00028	ANALYZE	AGENCY	CODE		89	37416.4	.156E+10	39595.4	1.05824	4197.10	80020.0	1028.00	75/07/23	83/11/17
00060	STREAM	FLOW	CFS		169	8481.92	.567E+08	7534.11	.888255	579.547	42300.0	180.000	59/10/29	74/03/25
00061	STREAM	FLOW,	INST-CFS		165	8003.78	.551E+08	7425.76	.927781	578.094	42299.9	150.000	71/10/13	83/11/17
00070	TURB	JKSN	JTU		137	7.31383	111.937	10.5801	1.44658	.903915	70.0000	.000000	70/11/30	78/05/02
00076	TURB	TRBIDMTR	HACH FTU		54	3.16111	23.1850	4.81508	1.52323	.655250	23.0000	.300000	78/05/22	83/11/17
00080	COLOR	PT-CO	UNITS		182	12.0769	267.993	16.3705	1.35552	1.21346	123.000	.000000	59/10/29	77/07/25
00095	CNDUCTVY	AT 25C	MICROMHO		333	132.057	1923.67	43.8596	.332127	2.40349	260.000	50.9999	59/10/29	83/11/17
00300	DO		MG/L		309	9.04034	10.0410	3.16876	.350513	.180264	16.9000	2.90000	62/10/24	83/11/17
00310	BOD	5 DAY	MG/L		22	1.47727	.474229	.688643	.466160	.146819	2.90000	.400000	72/10/11	73/09/25
00400	PH		SU		328	7.44737	.129862	.360364	.048388	.019898	8.99999	6.50000	59/10/29	83/11/17
00403	LAB	PH	SU		25	7.74000	.068349	.261437	.033777	.052287	8.30000	7.00000	80/10/21	83/11/17
00405	CO2		MG/L		76	4.12498	24.9474	4.99473	1.21085	.572935	32.0000	.100000	60/07/28	78/05/02
00410	T ALK	CACO3	MG/L		205	51.3020	394.892	19.8643	.387204	1.38738	107.000	17.0000	59/10/29	80/09/22
00440	HCO3 ION	HCO3	MG/L		248	62.6884	645.783	25.4123	.405374	1.61368	130.000	21.0000	59/10/29	78/05/02
00445	CO3 ION	CO3	MG/L		220	.000000	.000000	.000000		.000000	.000000	.000000	59/10/29	78/05/02
00515	RESIDUE	DISS-105	C MG/L		28	79.7500	495.310	22.2566	.279067	4.20591	120.000	44.0000	71/11/02	75/09/24
00530	RESIDUE	TOT NFLT	MG/L		50	10.9800	230.632	15.1866	1.38311	2.14771	71.0000	.000000	71/11/02	78/09/15
				K	2	1.000000	.953E-06	.000977	.000977	.000691	1.00000	1.000000	71/11/29	75/09/24
				TOT	52	10.5961	225.344	15.0114	1.41669	2.08171	71.0000	.000000	71/11/02	78/09/15
00572	BIOMASS	PERPHYTN	G/SQ M		13	2.48376	6.56336	2.56190	1.03146	.710544	7.70000	.079000	74/07/25	80/10/21
00573	BIOMASS	PERPHYTN	DW G/M2		12	3.41991	10.7807	3.28340	.960083	.947836	11.0000	.079000	74/10/22	80/10/21
00600	TOTAL N	N	MG/L		90	1.05510	.302028	.549571	.520868	.057930	3.90000	.270000	73/10/30	81/09/16
00602	DISS.	NITROGEN	MG/L N		25	.850798	.048661	.220592	.259277	.044118	1.30000	.350000	79/09/19	81/09/16
00605	ORG N	N	MG/L		110	.419269	.213252	.461793	1.10142	.044030	3.20000	.010000	72/07/12	81/09/16
00607	ORG N	DISS-N	MG/L		24	.386667	.012910	.113623	.293864	.023193	.630001	.180000	79/10/10	81/09/16
00608	NH3+NH4-	N DISS	MG/L		36	.091389	.003532	.059433	.650337	.009906	.310000	.000000	79/10/10	83/11/17
				K	1	.060000					.060000	.060000	83/09/21	83/09/21
				TOT	37	.090540	.003461	.058829	.649754	.009671	.310000	.000000	79/10/10	83/11/17
00610	NH3+NH4-	N TOTAL	MG/L		147	.152922	.011621	.107802	.704947	.008891	.540000	.000000	70/11/30	81/09/16
				K	6	.010000	-.931E-10	.000000		.000000	.010000	.010000	78/04/06	79/05/15
				TOT	153	.147317	.011937	.109258	.741648	.008833	.540000	.000000	70/11/30	81/09/16
00613	NO2-N	DISS	MG/L		42	.017619	.000916	.030268	1.71791	.004670	.190000	.000000	70/11/30	81/07/21
00615	NO2-N	TOTAL	MG/L		62	.016693	.000113	.010616	.635962	.001348	.060000	.004000	72/10/11	77/09/29
				K	6	.010000	-.931E-10	.000000		.000000	.010000	.010000	75/06/27	77/07/25

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STORET RETRIEVAL DATE 84/06/18 - INVENT - VERSION OF SEP, 1981

RETRIEVAL FOR DICK PEARL

12433000 543106 54A070
47 50 18.0 117 51 05.0 2
SPOKANE RIVER AT LONG LAKE, WASH.
53063 WASHINGTON SPOKANE
130391

/TYPA/AMBNT/STREAM

112WRD 17010307000
0000 CLASS 00 CSN-RSP 0016510-0287010

INDEX 1310001 006500
MILES 0643.00 0033.30

PARAMETER				RMK	NUMBER	MEAN	VARIANCE	STAN DEV	COEF VAR	STAND ER	MAXIMUM	MINIMUM	BEG DATE	END DATE
00615	NO2-N	TOTAL	MG/L	TOT	68	.016103	.000106	.010309	.640190	.001250	.060000	.004000	72/10/11	77/09/29
00618	NO3-N	DISS	MG/L		44	.332045	.065421	.255775	.770304	.038560	1.10000	.040000	60/07/28	81/07/21
00620	NO3-N	TOTAL	MG/L		67	.398951	.026881	.163956	.410966	.020030	.939999	.050000	72/10/11	77/09/29
00623	KJELDL N	DISS	MG/L		48	.354375	.024481	.156463	.441520	.022584	.680001	.080000	77/10/20	81/09/16
00624	KJELDL N	SUSP	MG/L		44	.382499	.381724	.617838	1.61526	.093143	2.90000	.000000	78/02/07	81/09/16
00625	TOT KJEL	N	MG/L		185	.509507	.157727	.397149	.779477	.029199	3.30000	.020000	70/11/30	83/11/17
00630	NO2&NO3	N-TOTAL	MG/L		94	.450952	.065829	.256573	.568957	.026463	1.30000	.030000	73/10/30	81/09/16
00631	NO2&NO3	N-DISS	MG/L		37	.425135	.039987	.199967	.470362	.032874	.790001	.080000	79/09/19	83/11/17
00633	NO2&NO3	NUD D WT	MG/KG-N		1	1.30000					1.30000	1.30000	73/10/30	73/10/30
00650	T PO4	PO4	MG/L		67	.159702	.029591	.172020	1.07713	.021016	1.40000	.020000	60/07/28	79/06/13
00660	ORTHOPO4	PO4	MG/L		98	.296321	2.00448	1.41580	4.77791	.143017	14.0000	.000000	59/10/29	83/01/21
00665	PHOS-TOT		MG/L P		186	.068225	.001932	.043957	.644293	.003223	.250000	.010000	70/11/30	83/11/17
				K	4	.010000	.000000	.000000		.000000	.010000	.010000	78/08/01	82/10/27
				TOT	190	.066999	.001962	.044290	.661045	.003213	.250000	.010000	70/11/30	83/11/17
00666	PHOS-DIS		MG/L P		77	.045558	.004435	.066594	1.46175	.007589	.500000	.010000	72/10/11	83/11/17
				K	6	.010000	-.931E-10	.000000		.000000	.010000	.010000	78/05/02	83/09/21
				TOT	83	.042988	.004196	.064778	1.50689	.007110	.500000	.010000	72/10/11	83/11/17
00668	PHOS MUD	DRY WGT	MG/KG-P		1	210.000					210.000	210.000	73/10/30	73/10/30
00671	PHOS-DIS	ORTHO	MG/L P		110	.041781	.001352	.036764	.879913	.003505	.260000	.000000	70/11/30	83/11/17
				K	5	.010000	.000000	.000000		.000000	.010000	.010000	76/05/11	83/09/21
				TOT	115	.040400	.001335	.036533	.904300	.003407	.260000	.000000	70/11/30	83/11/17
00680	T ORG C	C	MG/L		74	5.51750	113.154	10.6374	1.92794	1.23657	78.0000	.000000	72/10/11	81/09/16
00681	D ORG C	C	MG/L		15	2.08666	.928390	.963530	.461756	.248782	4.50000	.700000	78/01/02	81/07/21
00689	S ORG C	C	MG/L		13	.276923	.041923	.204751	.739379	.056788	.800000	.100000	78/01/02	81/07/21
00745	SULFIDE	TOTAL	MG/L		1	.800000					.800000	.800000	82/05/19	82/05/19
00900	TOT HARD	CACO3	MG/L		321	58.0495	443.512	21.0597	.362789	1.17544	106.000	22.0000	59/10/29	83/03/22
00902	NC HARD	CACO3	MG/L		279	6.57701	12.1011	3.47866	.528912	.208262	19.0000	.000000	59/10/29	81/02/17
00915	CALCIUM	CA,DISS	MG/L		325	14.6319	24.6130	4.96115	.339064	.275195	28.0000	5.90000	59/10/29	83/11/17
00925	MAGNESIUM	MG,DISS	MG/L		325	5.31314	6.52150	2.55372	.480643	.141655	30.0000	1.60000	59/10/29	83/11/17
00930	SODIUM	NA,DISS	MG/L		303	3.13190	.819079	.905030	.288971	.051993	6.79999	.789999	59/10/29	83/11/17
00931	SODIUM	ADSORTION	RATIO		237	.196200	.001724	.041519	.211614	.002697	.500000	.100000	59/10/29	83/03/22
00932	PERCENT	SODIUM	%		219	10.8916	5.36522	2.31629	.212668	.156521	24.0000	.270000	59/10/29	83/03/22
00933	NA+K		MG/L		11	4.97272	1.24424	1.11545	.224314	.336322	6.40000	2.70000	79/05/15	80/03/12
00935	POTASSIUM	K,DISS	MG/L		303	1.40540	.221672	.470820	.335007	.027048	5.30000	.150000	59/10/29	83/11/17
00940	CHLORIDE	TOTAL	MG/L		303	2.17221	1.68230	1.29703	.597104	.074513	10.0000	.100000	59/10/29	83/11/17
00945	SULFATE	SO4-TOT	MG/L		325	9.97930	4.35873	2.08776	.209209	.115808	17.0000	1.80000	59/10/29	83/11/17
00950	FLUORIDE	F,DISS	MG/L		269	.152040	.006984	.083569	.549655	.005095	.500000	.000000	59/10/29	82/10/27
				K	15	.100000	.425E-07	.000206	.002063	.000053	.100000	.100000	73/04/23	83/11/17
				TOT	284	.149291	.006750	.082156	.550309	.004875	.500000	.000000	59/10/29	83/11/17
00955	SILICA	DISOLVED	MG/L		262	9.33466	3.41049	1.84675	.197838	.114093	16.0000	.900000	59/10/29	83/11/17
01000	ARSENIC	AS,DISS	UG/L		56	1.62500	3.51136	1.87386	1.15315	.250405	10.00000	.000000	59/12/02	83/11/17

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12433000 543106 54A070
47 50 18.0 117 51 05.0 2
SPOKANE RIVER AT LONG LAKE, WASH.
53063 WASHINGTON SPOKANE
130391

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112WRD 17010307000
0000 CLASS 00 CSN-RSP 0016510-0287010

INDEX 1310001 006500
MILES 0643.00 0033.30

PARAMETER			RMK	NUMBER	MEAN	VARIANCE	STAN DEV	COEF VAR	STAND ER	MAXIMUM	MINIMUM	BEG DATE	END DATE
01000 ARSENIC	AS,DISS	UG/L	K	2	1.00000	.000000	.000000		.000000	1.00000	1.00000	73/10/30	76/01/22
			TOT	58	1.60345	3.40139	1.84429	1.15020	.242167	10.00000	.000000	59/12/02	83/11/17
01001 ARSENIC	AS,SUSP	UG/L		20	1.00000	1.57895	1.25656	1.25656	.280976	4.00000	.000000	73/10/30	82/07/21
			K	10	1.00000	.000000	.000000		.000000	1.00000	1.00000	74/04/23	78/08/01
			TOT	30	1.00000	1.03448	1.01709	1.01709	.185695	4.00000	.000000	73/10/30	82/07/21
01002 ARSENIC	AS,TOT	UG/L		37	1.97297	1.13814	1.06684	.540726	.175387	5.00000	.999999	73/01/31	82/07/21
			K	1	1.00000					1.00000	1.00000	73/07/23	73/07/23
			TOT	38	1.94737	1.13230	1.06409	.546427	.172619	5.00000	.999999	73/01/31	82/07/21
01005 BARIUM	BA,DISS	UG/L		22	27.8182	65.3945	8.08669	.290698	1.72409	50.0000	20.0000	78/08/01	83/11/17
			K	3	100.000	.000000	.000000		.000000	100.000	100.000	77/10/20	78/04/06
			TOT	25	36.4800	630.344	25.1066	.688230	5.02133	100.000	20.0000	77/10/20	83/11/17
01006 BARIUM	BA,SUSP	UG/L		18	82.2222	28077.1	167.562	2.03792	39.4948	700.000	.000000	77/10/20	82/07/21
01007 BARIUM	BA,TOT	UG/L		11	127.273	42181.8	205.382	1.61372	61.9250	700.000	.000000	77/10/20	82/07/21
			K	9	100.000	.000000	.000000		.000000	100.000	100.000	78/01/02	82/05/19
			TOT	20	115.000	22394.7	149.649	1.30129	33.4625	700.000	.000000	77/10/20	82/07/21
01010 BERYLIUM	BE,DISS	UG/L	K	5	.500000	.000000	.000000		.000000	.500000	.500000	82/10/27	83/11/17
01020 BORON	B,DISS	UG/L		15	20.6667	478.095	21.8654	1.05800	5.64561	80.0000	.000000	61/01/24	69/08/09
01025 CADMIUM	CD,DISS	UG/L		7	3.85714	24.4762	4.94734	1.28264	1.86992	15.0000	1.00000	74/04/23	83/11/17
			K	27	1.51852	.259260	.509176	.335311	.097991	2.00000	1.00000	73/01/31	83/09/21
			U	10	.000000	.000000	.000000		.000000	.000000	.000000	73/04/23	77/10/20
			TOT	44	1.54545	4.99789	2.23560	1.44656	.337029	15.0000	.000000	73/01/31	83/11/17
01026 CADMIUM	CD,SUSP	UG/L		18	2.61111	28.7222	5.35931	2.05250	1.26320	19.0000	.000000	73/10/30	81/04/21
			K	9	9.44444	.277832	.527098	.055810	.175699	10.0000	9.00000	74/07/26	77/10/20
			TOT	27	4.88889	29.6410	5.44436	1.11362	1.04777	19.0000	.000000	73/10/30	81/04/21
01027 CADMIUM	CD,TOT	UG/L		15	3.46666	45.4094	6.73865	1.94384	1.73991	20.0000	.000000	73/01/31	82/07/21
			K	22	15.0909	67.3249	8.20516	.543717	1.74935	20.0000	2.00000	73/04/23	79/07/30
			U	2	.000000	.000000	.000000		.000000	.000000	.000000	75/10/22	78/10/17
			TOT	39	9.84615	91.0284	9.54088	.968996	1.52776	20.0000	.000000	73/01/31	82/07/21
01030 CHROMIUM	CR,DISS	UG/L		41	3.39024	46.7438	6.83695	2.01665	1.06775	30.0000	.000000	59/12/02	82/05/19
			K	11	8.63636	68.4546	8.27373	.958011	2.49462	20.0000	1.00000	75/01/21	83/11/17
			U	23	.000000	.000000	.000000		.000000	.000000	.000000	73/01/31	79/07/30
			TOT	75	3.12000	42.1070	6.48899	2.07981	.749284	30.0000	.000000	59/12/02	83/11/17
01031 CHROMIUM	CR,SUSP	UG/L		31	3.38710	48.9785	6.99846	2.06621	1.25696	25.0000	.000000	73/10/30	81/10/20
			K	1	10.0000					10.0000	10.0000	77/04/18	77/04/18
			TOT	32	3.59375	48.7651	6.98320	1.94315	1.23447	25.0000	.000000	73/10/30	81/10/20
01032 CHROMIUM	HEX-VAL	UG/L		1	.000000					.000000	.000000	71/06/01	71/06/01
01034 CHROMIUM	CR,TOT	UG/L		42	4.09523	66.4785	8.15343	1.99096	1.25810	30.0000	.000000	67/02/22	82/07/21
			K	9	16.6667	25.0004	5.00004	.300003	1.66668	20.0000	10.0000	74/07/25	82/05/19
			U	17	.000000	.000000	.000000		.000000	.000000	.000000	73/04/23	79/07/30
			TOT	68	4.73529	68.7348	8.29064	1.75082	1.00539	30.0000	.000000	67/02/22	82/07/21
01035 COBALT	CO,DISS	UG/L		4	1.75000	.250000	.500000	.285714	.250000	2.00000	1.00000	75/07/23	82/05/19

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112WRD 17010307000
0000 CLASS 00 CSN-KSP 0016510-0287010

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PARAMETER			RMK	NUMBER	MEAN	VARIANCE	STAN DEV	COEF VAR	STAND ER	MAXIMUM	MINIMUM	BEG DATE	END DATE
01035 COBALT	CO,DISS	UG/L	K	21	2.80952	.261908	.511769	.182155	.111677	3.00000	1.00000	73/01/31	83/11/17
			U	19	.000000	.000000	.000000		.000000	.000000	.000000	73/04/23	78/08/01
			TOT	44	1.50000	1.97674	1.40597	.937311	.211957	3.00000	.000000	73/01/31	83/11/17
01036 COBALT	CO,SUSP	UG/L		15	8.40000	326.257	18.0626	2.15031	4.66374	50.0000	.000000	73/10/30	80/04/08
			K	11	49.6363	.656641	.810334	.016325	.244325	50.0000	48.0000	74/04/23	77/10/20
			TOT	26	25.8461	614.616	24.7914	.959193	4.86200	50.0000	.000000	73/10/30	80/04/08
01037 COBALT	CO,TOTAL	UG/L		11	3.18181	53.7635	7.33236	2.30446	2.21079	25.0000	.000000	73/07/23	82/01/19
			K	23	67.5652	2092.89	45.7482	.677097	9.53916	100.000	1.00000	73/01/31	82/07/21
			U	5	.000000	.000000	.000000		.000000	.000000	.000000	74/07/25	79/07/30
			TOT	39	40.7436	2288.09	47.8339	1.17402	7.65956	100.000	.000000	73/01/31	82/07/21
01040 COPPER	CU,DISS	UG/L		80	9.81241	516.129	22.7185	2.31528	2.54000	130.000	.000000	59/12/02	83/11/17
			K	7	12.2857	92.5715	9.62141	.783138	3.63655	20.0000	2.00000	73/07/23	77/07/13
			TOT	87	10.0114	481.035	21.9325	2.19075	2.35141	130.000	.000000	59/12/02	83/11/17
01041 COPPER	CU,SUSP	UG/L		30	8.70000	60.6311	7.78660	.895011	1.42163	31.0000	.000000	73/10/30	82/07/21
			K	5	6.00000	9.00000	3.00000	.500000	1.34164	9.00000	1.00000	74/10/22	77/10/20
			TOT	35	8.31429	53.6925	7.32752	.881316	1.23858	31.0000	.000000	73/10/30	82/07/21
01042 COPPER	CU,TOT	UG/L		43	14.2093	741.643	27.2331	1.91657	4.15301	170.000	.000000	70/11/30	82/07/21
			K	11	20.0000	.000000	.000000		.000000	20.0000	20.0000	74/01/22	79/04/23
			U	2	.000000	.000000	.000000		.000000	.000000	.000000	75/10/22	76/07/06
			TOT	56	14.8393	679.990	24.0830	1.62292	3.21822	170.000	.000000	70/11/30	82/07/21
01044 IRON	FE,SUSP	UG/L		13	107.692	5269.23	72.5895	.674045	20.1327	210.000	10.0000	78/08/01	82/07/21
01045 IRON	FE,TOT	UG/L		58	351.551	497310	705.202	2.00597	92.5975	4000.00	30.0000	62/11/20	82/07/21
01046 IRON	FE,DISS	UG/L		53	38.5093	1158.72	34.0400	.883941	4.67575	150.000	.000000	60/02/16	83/11/17
			K	13	9.46154	3.76925	1.94145	.205194	.538463	10.0000	3.00000	75/01/21	83/09/21
			TOT	66	32.7878	1063.19	32.6065	.994472	4.01359	150.000	.000000	60/02/16	83/11/17
01049 LEAD	PB,DISS	UG/L		59	6.96609	105.481	10.2704	1.47434	1.33709	67.0000	.000000	71/08/15	83/11/17
			K	3	2.00000	.000000	.000000		.000000	2.00000	2.00000	74/01/22	79/04/23
			U	4	.000000	.000000	.000000		.000000	.000000	.000000	76/10/12	79/07/30
			TOT	66	6.31817	97.8199	9.89040	1.56539	1.21742	67.0000	.000000	71/08/15	83/11/17
01050 LEAD	PB,SUSP	UG/L		23	21.7391	748.656	27.3616	1.25863	5.70528	99.0000	.000000	73/10/30	82/07/21
			K	12	97.0833	4.45454	2.11058	.021740	.609272	100.000	92.0000	74/04/23	77/10/20
			TOT	35	47.5714	1802.49	42.4557	.892463	7.17633	100.000	.000000	73/10/30	82/07/21
01051 LEAD	PB,TOT	UG/L		40	17.1750	1076.86	32.8156	1.91066	5.18860	200.000	.000000	70/11/30	82/07/21
			K	16	200.000	.000000	.000000		.000000	200.000	200.000	73/04/23	77/10/20
			TOT	56	69.4107	7709.05	87.8012	1.26495	11.7329	200.000	.000000	70/11/30	82/07/21
01054 MANGNESE	MN,SUSP	UG/L		35	33.0286	950.088	30.8235	.933238	5.21012	100.000	.000000	73/10/30	82/07/21
01055 MANGNESE	MN	UG/L		37	66.2162	4590.84	67.7558	1.02325	11.1390	400.000	10.0000	73/01/31	82/07/21
			K	2	10.0000	.000000	.000000		.000000	10.0000	10.0000	76/07/06	79/07/30
			TOT	39	63.3333	4507.02	67.1343	1.06002	10.7501	400.000	10.0000	73/01/31	82/07/21
01056 MANGNESE	MN,DISS	UG/L		36	33.2500	2710.88	52.0661	1.56590	8.67768	300.000	1.00000	73/04/23	83/11/17
			K	8	8.87500	10.1250	3.18198	.358533	1.12500	10.0000	1.00000	73/01/31	78/08/01

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RETRIEVAL FOR DICK PEARL

12433000 543106 54A070
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SPOKANE RIVER AT LONG LAKE, WASH.
53063 WASHINGTON SPOKANE
130391

/TYPA/AMBNT/STREAM

11PWRD 17010307000
0000 CLASS 00 CSN-RSP 0016510-0287010

INDEX 1310001 006500
MILES 0643.00 0033.30

PARAMETER				RMK	NUMBER	MEAN	VARIANCE	STAN DEV	COEF VAR	STAND ER	MAXIMUM	MINIMUM	BEG DATE	END DATE
01056	MANGNESE	MN,DISS	UG/L	TOT	44	28.8182	2298.62	47.9439	1.66367	7.22781	300.000	1.00000	73/01/31	83/11/17
01060	MOLY	MO,DISS	UG/L	K	5	10.0000	.000000	.000000		.000000	10.0000	10.0000	82/10/27	83/11/17
01065	NICKEL	NI,DISS	UG/L		14	1.50000	1.65385	1.28602	.857349	.343704	4.00000	.000000	69/02/02	83/11/17
				K	4	1.00000	.000000	.000000		.000000	1.00000	1.00000	81/10/20	83/01/21
				TOT	18	1.38889	1.31046	1.14475	.824223	.269821	4.00000	.000000	69/02/02	83/11/17
01066	NICKEL	NI,SUSP	UG/L		10	3.80000	19.2889	4.39191	1.15577	1.38884	15.0000	.000000	79/10/10	82/05/19
01067	NICKEL	NI,TOTAL	UG/L		12	4.91667	24.4470	4.94439	1.00564	1.42732	19.0000	.000000	79/10/10	82/07/21
01075	SILVER	AG,DISS	UG/L		8	.125000	.125000	.353553	2.82843	.125000	1.00000	.000000	79/10/10	81/07/21
				K	9	1.00000	.000000	.000000		.000000	1.00000	1.00000	81/10/20	83/11/17
				U	8	.000000	.000000	.000000		.000000	.000000	.000000	77/10/20	79/07/30
				TOT	25	.400000	.250000	.500000	1.25000	.100000	1.00000	.000000	77/10/20	83/11/17
01076	SILVER	AG,SUSP	UG/L		16	.187500	.162500	.403113	2.14993	.100778	1.00000	.000000	78/01/02	81/10/20
				K	1	10.0000					10.0000	10.0000	77/10/20	77/10/20
				TOT	17	.764706	5.81618	2.41168	3.15373	.584917	10.0000	.000000	77/10/20	81/10/20
01077	SILVER	AG,TOT	UG/L		11	.363636	.454546	.674200	1.85405	.203279	2.00000	.000000	79/10/10	81/07/21
				K	7	4.00000	50.0000	7.07107	1.76777	2.67261	20.0000	1.00000	77/10/20	82/07/21
				U	5	.000000	.000000	.000000		.000000	.000000	.000000	78/04/06	79/07/30
				TOT	23	1.39130	16.9763	4.12023	2.96141	.859127	20.0000	.000000	77/10/20	82/07/21
01080	STRONTUM	SR,DISS	UG/L		8	46.0000	611.999	24.7386	.537796	8.74642	70.0000	.000000	68/02/25	83/11/17
01082	STRONTUM	SR,TOT	UG/L		18	93.8888	15225.1	123.390	1.31422	29.0833	530.000	.000000	70/11/30	71/09/06
01085	VANADIUM	V,DISS	UG/L	K	5	6.00000	.000000	.000000		.000000	6.00000	6.00000	82/10/27	83/11/17
01090	ZINC	ZN,DISS	UG/L		79	110.379	10312.5	101.551	.920018	11.4253	420.000	.000000	61/11/22	83/11/17
				K	4	11.7500	90.9167	9.53502	.811491	4.76751	20.0000	3.00000	77/10/20	81/10/20
				TOT	83	105.626	10264.5	101.314	.959176	11.1206	420.000	.000000	61/11/22	83/11/17
01091	ZINC	ZN,SUSP	UG/L		34	48.5294	7279.59	85.3205	1.75812	14.6323	510.000	.000000	73/10/30	82/07/21
01092	ZINC	ZN,TOT	UG/L		57	143.035	17070.1	130.652	.913431	17.3053	820.000	30.0000	70/11/30	82/07/21
01106	ALUMINUM	AL,DISS	UG/L		2	35.0000	1250.00	35.3553	1.01015	25.0000	60.0000	10.0000	83/01/21	83/05/19
				K	3	10.0000	.000000	.000000		.000000	10.0000	10.0000	82/10/27	83/11/17
				TOT	5	20.0000	500.000	22.3607	1.11803	10.0000	60.0000	10.0000	82/10/27	83/11/17
01130	LITHIUM	LI,DISS	UG/L		7	7.57143	42.9524	6.55381	.865597	2.47711	16.0000	.000000	68/02/25	83/11/17
				K	1	4.00000					4.00000	4.00000	83/09/21	83/09/21
				TOT	8	7.12500	38.4107	6.19764	.869844	2.19120	16.0000	.000000	68/02/25	83/11/17
01132	LITHIUM	LI,TOT	UG/L		18	3.44444	32.3790	5.69025	1.65201	1.34121	20.0000	.000000	70/11/30	71/09/06
01145	SELENIUM	SE,DISS	UG/L		12	.999999	2.36363	1.53741	1.53741	.443812	4.00000	.000000	73/04/23	81/07/21
				K	32	1.00000	.000000	.000000		.000000	1.00000	1.00000	73/01/31	83/11/17
				TOT	44	1.000000	.604651	.777593	.777594	.117227	4.00000	.000000	73/01/31	83/11/17
01146	SELENIUM	SE,SUSP	UG/L		32	.187500	.608871	.780302	4.16161	.137939	4.00000	.000000	73/10/30	81/10/20
01147	SELENIUM	SE,TOT	UG/L		14	1.57143	4.72527	2.17377	1.38331	.580964	7.00000	.000000	73/01/31	81/07/21
				K	25	1.00000	.000000	.000000		.000000	1.00000	1.00000	74/07/25	82/07/21
				TOT	39	1.20513	1.69366	1.30141	1.07989	.208392	7.00000	.000000	73/01/31	82/07/21
01515	ALPHA-D	AS U-NAT	PC/L		10	.910000	.574334	.757848	.832800	.239653	2.90000	.200000	71/11/02	83/05/19

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01515 ALPHA-D	AS U-NAT	PC/L	K	5	.400000	.160000	.400000	1.00000	.178885	1.10000	.100000	72/04/03	80/05/12
			TOT	15	.740000	.476857	.690549	.933174	.178299	2.90000	.100000	71/11/02	83/05/19
01516 ALPHA-S	AS U-NAT	PC/L		6	.566666	.138667	.372380	.657141	.152023	1.20000	.200000	72/02/22	83/05/19
			K	10	.180000	.010667	.103280	.573778	.032660	.300000	.100000	71/11/02	80/10/21
			TOT	16	.325000	.090000	.300000	.923077	.075000	1.20000	.100000	71/11/02	83/05/19
03515 BETA-D	AS CS137	PC/L		38	2.09210	.303469	.550880	.263315	.089365	3.00000	.700000	71/11/02	83/09/21
03516 BETA-S	AS CS137	PC/L		23	1.03043	.539489	.734499	.712807	.153154	2.60000	.400000	71/11/02	83/09/21
			K	15	.400000	.204E-06	.000452	.001130	.000117	.400000	.400000	71/11/29	82/05/19
			TOT	38	.781577	.418301	.646762	.827508	.104919	2.60000	.400000	71/11/02	83/09/21
09510 RA-226-D	PLCHT CT	PC/L	K	1	.100000					.100000	.100000	72/10/02	72/10/02
09511 RA-226-D	RADON MT	PC/L		37	.039189	.000247	.017221	.439429	.002831	.090000	.020000	71/11/02	83/09/21
22703 U-NAT	DISOLVED	UG/L		7	1.10000	.076667	.276888	.251716	.104654	1.50000	.700000	71/11/29	83/09/21
			K	1	.400000					.400000	.400000	78/05/22	78/05/22
			TOT	8	1.01250	.126966	.356323	.351924	.125979	1.50000	.400000	71/11/29	83/09/21
31501 TOT COLI	MPIMENDO	/100ML		93	768.213	9237128	3039.26	3.95628	315.157	28000.0	.999999	70/11/30	77/07/13
			K	9	207.222	274541	523.967	2.52853	174.656	1600.00	.999999	71/03/14	77/03/23
			L	12	233.333	312170	558.721	2.39454	161.289	2000.00	20.0000	71/01/24	73/07/11
			TOT	114	667.620	7615558	2759.63	4.13353	258.463	28000.0	.999999	70/11/30	77/07/13
31507 TOT COLI	MPN COMP	/100ML		83	815.809	7080138	2660.85	3.26161	292.066	23000.0	.000000	62/10/24	70/09/20
31616 FEC COLI	MFM-FCBR	/100ML		34	51.4409	9493.77	97.4360	1.89413	16.7101	389.999	.000000	73/01/18	76/10/12
			B	2	175.000	50.0664	7.07576	.040433	5.00332	180.000	170.000	76/04/12	76/05/11
			K	8	.999998	.817E-06	.000904	.000904	.000320	.999999	.999999	73/02/28	76/08/30
			L	19	27.3684	98.2472	9.91197	.362168	2.27396	40.0000	20.0000	72/10/11	73/09/25
			TOT	63	41.6983	5984.37	77.3587	1.85520	9.74628	389.999	.000000	72/10/11	76/10/12
31625 FEC COLI	M-FCAGAD	/100 ML		37	9.99998	320.833	17.9118	1.79118	2.94468	86.0000	.999999	76/11/30	82/09/01
			B	4	86.9999	8931.34	94.5058	1.08627	47.2529	200.000	7.00000	78/04/06	80/03/12
			K	24	.999999	.000001	.001152	.001152	.000235	1.00000	.999999	76/11/03	82/01/19
			TOT	65	11.4154	998.025	31.5915	2.76746	3.91845	200.000	.999999	76/11/03	82/09/01
31673 FECSTREP	MFKFAGAR	/100ML		45	16.5777	2884.28	53.7055	3.44758	8.00594	360.000	.999999	73/01/31	82/09/01
			B	6	4775.00	.120E+09	10999.0	2.30346	4490.33	27200.0	2.00000	78/06/21	80/03/12
			K	18	1.11111	.104578	.323386	.291047	.076223	2.00000	.999999	73/02/28	81/10/20
			TOT	69	426.666	.107E+08	3274.97	7.69376	394.260	27200.0	.999999	73/01/31	82/09/01
31679 FECSTREP	MF M-ENT	/100ML		32	64.4372	18898.1	137.470	2.13340	24.3016	719.999	.999999	73/10/30	76/08/30
			K	5	.999998	.000001	.001092	.001092	.000488	.999999	.999999	74/07/25	76/10/12
			TOT	37	55.8646	16756.8	129.448	2.31717	21.2811	719.999	.999999	73/10/30	76/10/12
32226 CHL B	PERIPHTN	MG/M2		4	1.82500	5.40916	2.32576	1.27439	1.16288	5.20000	.100000	75/01/21	75/10/22
32228 CHL A	PERIPHTN	MG/M2		4	12.5000	417.153	20.4243	1.63395	10.2122	43.0000	.100000	75/01/21	75/10/22
39025 SIMAZINE	WTR ECM	UG/L	U	8	.000000	.000000	.000000		.000000	.000000	.000000	76/08/30	78/08/01
39034 PERTHANE	WHL SMPL	UG/L	K	2	.100000	.745E-08	.000086	.000863	.000061	.100000	.100000	82/03/23	82/06/02
39250 NAPTHAL	ENES, PC	UG/L	K	2	.100000	.745E-08	.000086	.000863	.000061	.100000	.100000	82/03/23	82/06/02
39251 PCNS	MUD	UG/KG	K	1	1.00000	—				1.00000	1.00000	82/06/02	82/06/02

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39330 ALDRIN		TOT UG/L	K	2	.010000	.000000	.000000		.000000	.010000	.010000	82/03/23	82/06/02
			U	22	.000000	.000000	.000000		.000000	.000000	.000000	75/05/19	80/08/20
			TOT	24	.000833	.000008	.002823	3.38796	.000576	.010000	.000000	75/05/19	82/06/02
39333 ALDRIN	SEDUG/KG	DRY WGT	K	1	.100000					.100000	.100000	82/06/02	82/06/02
			U	1	.000000	—				.000000	.000000	78/05/02	78/05/02
			TOT	2	.050000	.005000	.070711	1.41421	.050000	.100000	.000000	78/05/02	82/06/02
39340 GAMMABHC	LINDANE	TOT.UG/L		1	.010000					.010000	.010000	77/11/30	77/11/30
			K	2	.010000	.000000	.000000		.000000	.010000	.010000	82/03/23	82/06/02
			U	21	.000000	.000000	.000000		.000000	.000000	.000000	75/05/19	80/08/20
			TOT	24	.001250	.000011	.003378	2.70265	.000690	.010000	.000000	75/05/19	82/06/02
39343 GHHC-MUD	LINDANE	DRYUG/KG	K	1	.100000					.100000	.100000	82/06/02	82/06/02
			U	1	.000000					.000000	.000000	78/05/02	78/05/02
			TOT	2	.050000	.005000	.070711	1.41421	.050000	.100000	.000000	78/05/02	82/06/02
39350 CHLRDANE	TECH&MET	TOT UG/L		1	.060000					.060000	.060000	80/08/12	80/08/12
			K	2	.100000	-.372E-08	.000000		.000000	.100000	.100000	82/03/23	82/06/02
			U	21	.000000	.000000	.000000		.000000	.000000	.000000	75/05/19	80/08/20
			TOT	24	.010833	.000904	.030060	2.77480	.006136	.100000	.000000	75/05/19	82/06/02
39351 CDANEDRY	TECH&MET	MUDUG/KG	K	1	1.00000					1.00000	1.00000	82/06/02	82/06/02
			U	1	.000000					.000000	.000000	78/05/02	78/05/02
			TOT	2	.500000	.500000	.707107	1.41421	.500000	1.00000	.000000	78/05/02	82/06/02
39360 DDD	WHL SMPL	UG/L	K	2	.010000	.000000	.000000		.000000	.010000	.010000	82/03/23	82/06/02
			U	22	.000000	.000000	.000000		.000000	.000000	.000000	75/05/19	80/08/20
			TOT	24	.000833	.000008	.002823	3.38796	.000576	.010000	.000000	75/05/19	82/06/02
39363 DDD	MUD	UG/KG	K	1	.100000					.100000	.100000	82/06/02	82/06/02
			U	1	.000000					.000000	.000000	78/05/02	78/05/02
			TOT	2	.050000	.005000	.070711	1.41421	.050000	.100000	.000000	78/05/02	82/06/02
39365 DDE	WHL SMPL	UG/L	K	2	.010000	.000000	.000000		.000000	.010000	.010000	82/03/23	82/06/02
			U	22	.000000	.000000	.000000		.000000	.000000	.000000	75/05/19	80/08/20
			TOT	24	.000833	.000008	.002823	3.38796	.000576	.010000	.000000	75/05/19	82/06/02
39368 DDE	MUD	UG/KG		1	.100000					.100000	.100000	82/06/02	82/06/02
			U	1	.000000					.000000	.000000	78/05/02	78/05/02
			TOT	2	.050000	.005000	.070711	1.41421	.050000	.100000	.000000	78/05/02	82/06/02
39370 DDT	WHL SMPL	UG/L	K	2	.010000	.000000	.000000		.000000	.010000	.010000	82/03/23	82/06/02
			U	22	.000000	.000000	.000000		.000000	.000000	.000000	75/05/19	80/08/20
			TOT	24	.000833	.000008	.002823	3.38796	.000576	.010000	.000000	75/05/19	82/06/02
39373 DDT	MUD	UG/KG	K	1	.100000					.100000	.100000	82/06/02	82/06/02
			U	1	.000000					.000000	.000000	78/05/02	78/05/02
			TOT	2	.050000	.005000	.070711	1.41421	.050000	.100000	.000000	78/05/02	82/06/02
39380 DIELDRIN		TOTUG/L	K	2	.010000	.000000	.000000		.000000	.010000	.010000	82/03/23	82/06/02
			U	22	.000000	.000000	.000000		.000000	.000000	.000000	75/05/19	80/08/20
			TOT	24	.000833	.000008	.002823	3.38796	.000576	.010000	.000000	75/05/19	82/06/02

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39383 DIELDRIN	SEDUG/KG	DRY WGT	K	1	.100000					.100000	.100000	82/06/02	82/06/02
			U	1	.000000	—				.000000	.000000	78/05/02	78/05/02
			TOT	2	.050000	.005000	.070711	1.41421	.050000	.100000	.000000	78/05/02	82/06/02
39388 ENDOSULN	WHL SMPL	UG/L	K	2	.010000	-.145E-10	.000000		.000000	.010000	.010000	82/03/23	82/06/02
39389 ENDOSULN	MUD	UG/KG	K	1	.100000	—				.100000	.100000	82/06/02	82/06/02
39390 ENDRIN		TOT UG/L	K	2	.010000	.000000	.000000		.000000	.010000	.010000	82/03/23	82/06/02
			U	22	.000000	.000000	.000000		.000000	.000000	.000000	75/05/19	80/08/20
			TOT	24	.000833	.000008	.002823	3.38796	.000576	.010000	.000000	75/05/19	82/06/02
39393 ENDRIN	SEDUG/KG	DRY WGT	K	1	.100000					.100000	.100000	82/06/02	82/06/02
			U	1	.000000					.000000	.000000	78/05/02	78/05/02
			TOT	2	.050000	.005000	.070711	1.41421	.050000	.100000	.000000	78/05/02	82/06/02
39398 ETHION	WHL SMPL	UG/L	K	2	.010000	.727E-10	.000009	.000853	.000006	.010000	.010000	82/03/23	82/06/02
			U	21	.000000	.000000	.000000		.000000	.000000	.000000	75/05/19	80/08/20
			TOT	23	.000870	.000008	.002881	3.31320	.000601	.010000	.000000	75/05/19	82/06/02
39399 ETHION	MUD	UG/KG	U	1	.000000					.000000	.000000	78/05/02	78/05/02
39400 TOXAPHEN		TOTUG/L	K	2	1.00000	.000000	.000000		.000000	1.00000	1.00000	82/03/23	82/06/02
			U	22	.000000	.000000	.000000		.000000	.000000	.000000	75/05/19	80/08/20
			TOT	24	.083333	.079710	.282330	3.38796	.057630	1.00000	.000000	75/05/19	82/06/02
39403 TOXAPHEN	SEDUG/KG	DRY WGT	K	1	10.0000					10.0000	10.0000	82/06/02	82/06/02
			U	1	.000000	—				.000000	.000000	78/05/02	78/05/02
			TOT	2	5.00000	50.0000	7.07107	1.41421	5.00000	10.0000	.000000	78/05/02	82/06/02
39410 HEPTCHLR		TOTUG/L	K	2	.010000	.000000	.000000		.000000	.010000	.010000	82/03/23	82/06/02
			U	22	.000000	.000000	.000000		.000000	.000000	.000000	75/05/19	80/08/20
			TOT	24	.000833	.000008	.002823	3.38796	.000576	.010000	.000000	75/05/19	82/06/02
39413 HEPTCHLR	SEDUG/KG	DRY WGT	K	1	.100000					.100000	.100000	82/06/02	82/06/02
			U	1	.000000	—				.000000	.000000	78/05/02	78/05/02
			TOT	2	.050000	.005000	.070711	1.41421	.050000	.100000	.000000	78/05/02	82/06/02
39420 HPCHLREP		TOTUG/L	K	2	.010000	.000000	.000000		.000000	.010000	.010000	82/03/23	82/06/02
			U	22	.000000	.000000	.000000		.000000	.000000	.000000	75/05/19	80/08/20
			TOT	24	.000833	.000008	.002823	3.38796	.000576	.010000	.000000	75/05/19	82/06/02
39423 HPCHLREP	SEDUG/KG	DRY WGT	K	1	.100000					.100000	.100000	82/06/02	82/06/02
			U	1	.000000	—				.000000	.000000	78/05/02	78/05/02
			TOT	2	.050000	.005000	.070711	1.41421	.050000	.100000	.000000	78/05/02	82/06/02
39480 M1HXYCLR	WHL SMPL	UG/L	K	2	.010000	.000000	.000000		.000000	.010000	.010000	82/03/23	82/06/02
			U	22	.000000	.000000	.000000		.000000	.000000	.000000	75/05/19	80/08/20
			TOT	24	.000833	.000008	.002823	3.38796	.000576	.010000	.000000	75/05/19	82/06/02
39481 MTHXYCLR	MUD DRY	UG/KG	K	1	.100000					.100000	.100000	82/06/02	82/06/02
			U	1	.000000	—				.000000	.000000	78/05/02	78/05/02
			TOT	2	.050000	.005000	.070711	1.41421	.050000	.100000	.000000	78/05/02	82/06/02
39504 PCB-1254		TOTUG/L		1	.220000					.220000	.220000	78/02/07	78/02/07
39516 PCBG	WHL SMPL	UG/L	K	2	.100000	-.372E-08	.000000		.000000	.100000	.100000	82/03/23	82/06/02

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RETRIEVAL FOR DICK PEARL

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SPOKANE RIVER AT LONG LAKE, WASH.
53063 WASHINGTON SPOKANE
130391

/TYPA/AMHNT/STREAM

112WRD
0000 CLASS 00 CSN-RSP 0016510-0287010 17010307000

INDEX 1310001 006500
MILES 0643.00 0033.30

PARAMETER				RMK	NUMBER	MEAN	VARIANCE	STAN DEV	COEF VAR	STAND ER	MAXIMUM	MINIMUM	BEG DATE	END DATE
39516	PCBS	WHL SMPL	UG/L	U	11	.000000	.000000	.000000		.000000	.000000	.000000	77/11/30	80/08/20
				TOT	13	.015385	.001410	.037553	2.44097	.010415	.100000	.000000	77/11/30	82/06/02
39519	PCBS	MUD	UG/KG	K	1	1.00000					1.00000	1.00000	82/06/02	82/06/02
				U	1	.000000					.000000	.000000	78/05/02	78/05/02
				TOT	2	.500000	.500000	.707107	1.41421	.500000	1.00000	.000000	78/05/02	82/06/02
39530	MALATHN	WHL SMPL	UG/L	K	2	.010000	.727E-10	.000009	.000853	.000006	.010000	.010000	82/03/23	82/06/02
				U	21	.000000	.000000	.000000		.000000	.000000	.000000	75/05/19	80/08/20
				TOT	23	.000870	.000008	.002881	3.31320	.000601	.010000	.000000	75/05/19	82/06/02
39531	MALATHN	MUD	UG/KG	U	1	.000000					.000000	.000000	78/05/02	78/05/02
39540	PARATHN	WHL SMPL	UG/L	K	2	.010000	.727E-10	.000009	.000853	.000006	.010000	.010000	82/03/23	82/06/02
				U	21	.000000	.000000	.000000		.000000	.000000	.000000	75/05/19	80/08/20
				TOT	23	.000870	.000008	.002881	3.31320	.000601	.010000	.000000	75/05/19	82/06/02
39541	PARATHN	MUD	UG/KG	U	1	.000000					.000000	.000000	78/05/02	78/05/02
39570	DIAZINON	WHL SMPL	UG/L	K	2	.010000	.727E-10	.000009	.000853	.000006	.010000	.010000	82/03/23	82/06/02
				U	21	.000000	.000000	.000000		.000000	.000000	.000000	75/05/19	80/08/20
				TOT	23	.000870	.000008	.002881	3.31320	.000601	.010000	.000000	75/05/19	82/06/02
39571	DIAZINON	MUD	UG/KG	U	1	.000000					.000000	.000000	78/05/02	78/05/02
39600	MPARATHN	WHL SMPL	UG/L	K	2	.010000	.727E-10	.000009	.000853	.000006	.010000	.010000	82/03/23	82/06/02
				U	21	.000000	.000000	.000000		.000000	.000000	.000000	75/05/19	80/08/20
				TOT	23	.000870	.000008	.002881	3.31320	.000601	.010000	.000000	75/05/19	82/06/02
39601	MPARATHN	MUD	UG/KG	U	1	.000000					.000000	.000000	78/05/02	78/05/02
39630	ATRAZINE	WHL SMPL	UG/L	U	11	.000000	.000000	.000000		.000000	.000000	.000000	78/05/02	78/05/02
39730	2,4-D	WHL SMPL	UG/L		1	.040000					.040000	.040000	82/06/02	82/06/02
				K	1	.010000					.010000	.010000	82/03/23	82/03/23
				U	13	.000000	.000000	.000000		.000000	.000000	.000000	75/12/22	79/11/14
				TOT	15	.003333	.000110	.010465	3.13961	.002702	.040000	.000000	76/12/22	82/06/02
39731	2,4-D	MUD	UG/KG	U	1	.000000					.000000	.000000	78/05/02	78/05/02
39740	2,4,5-T	WHL SMPL	UG/L	K	2	.010000	.000000	.000000		.000000	.010000	.010000	82/03/23	82/06/02
				U	13	.000000	.000000	.000000		.000000	.000000	.000000	75/12/22	79/11/14
				TOT	15	.001333	.000012	.003519	2.63899	.000909	.010000	.000000	75/12/22	82/06/02
39741	2,4,5-T	MUD	UG/KG	U	1	.000000					.000000	.000000	78/05/02	78/05/02
39755	MIREX	WHL SMPL	UG/L	K	2	.010000	.000000	.000000		.000000	.010000	.010000	82/03/23	82/06/02
39758	MIREX	BOT MAT	UG/KG	K	1	.100000					.100000	.100000	82/06/02	82/06/02
39760	SILVEX	WHL SMPL	UG/L	K	2	.010000	.000000	.000000		.000000	.010000	.010000	82/03/23	82/06/02
				U	13	.000000	.000000	.000000		.000000	.000000	.000000	75/12/22	79/11/14
				TOT	15	.001333	.000012	.003519	2.63899	.000909	.010000	.000000	75/12/22	82/06/02
39761	SILVEX	MUD	UG/KG	U	1	.000000					.000000	.000000	78/05/02	78/05/02
39786	TRITHION	WHL SMPL	UG/L	K	2	.010000	.727E-10	.000009	.000853	.000006	.010000	.010000	82/03/23	82/06/02
				U	21	.000000	.000000	.000000		.000000	.000000	.000000	75/05/19	80/08/20
				TOT	23	.000870	.000008	.002881	3.31320	.000601	.010000	.000000	75/05/19	82/06/02
39787	TRITHION	MUD	UG/KG	U	1	.000000					.000000	.000000	78/05/02	78/05/02

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112WRD 17010307000
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MILES 0643.00 0033.30

PARAMETER			RNK	NUMBER	MEAN	VARIANCE	STAN DEV	COEF VAR	STAND ER	MAXIMUM	MINIMUM	BEG DATE	END DATE
39790 MTRTHION	WHL SMPL	UG/L	K	2	.010000	.727E-10	.000009	.000853	.000006	.010000	.010000	82/03/23	82/06/02
			U	21	.000000	.000000	.000000		.000000	.000000	.000000	75/05/19	80/08/20
			TOT	23	.000870	.000008	.002881	3.31320	.000601	.010000	.000000	75/05/19	82/06/02
39791 MTRTHION	MUD	UG/KG	U	1	.000000					.000000	.000000	78/05/02	78/05/02
60050 ALGAE	TOTAL	/ML		72	7074.39	.563E+08	7507.02	1.06115	884.711	36000.0	11.0000	73/11/27	81/09/16
70299 RES-SUSP	AT 180 C	MG/L		1	.000000					.000000	.000000	76/08/30	76/08/30
70300 RESIDUE	DISS-180	C MG/L		262	82.5034	512.318	22.6344	.274345	1.39836	133.000	41.0000	59/10/29	83/11/17
70301 DISS SOL	SUM	MG/L		129	80.5116	429.678	20.7287	.257462	1.82506	132.000	40.0000	60/07/28	83/03/22
70302 DISS SOL	TONS/DAY			199	1595.75	1255069	1120.30	.702050	79.4158	7420.00	64.2000	59/10/29	81/09/16
70303 DISS SOL	TONS PER	ACRE-FT		197	.111774	.000924	.030398	.271958	.002166	.180000	.060000	59/10/29	83/01/21
70331 SUSP-SED	PARTSIZE	%<.062MM		70	89.5128	235.662	15.3513	.171498	1.83483	100.0000	28.0000	73/12/17	80/03/12
70950 BIOMASS-	CHLRATIO	PERIUNIT		5	72.5480	7522.03	86.7296	1.19548	38.7867	188.000	.000000	79/07/30	80/10/21
70957 CHLRPHYL	A-PERIPH	CHFLUG/L		7	11.0914	170.653	13.0634	1.17779	4.93751	36.3000	.010000	78/05/02	80/10/21
70958 CHLRPHYL	B-PERIPH	CHFLUG/L		7	3.85286	12.1630	3.48765	.905186	1.31817	8.58001	.000000	78/05/02	80/10/21
71820 DENSITY		GM/ML		1	1.00000					1.00000	1.00000	69/02/02	69/02/02
71845 AMMONIA	TOT-NH4	MG/L		22	.057727	.002552	.050515	.875060	.010770	.160000	.000000	79/04/23	81/01/20
71846 AMMONIA	DISS-NH4	MG/L		33	.116969	.006466	.080409	.687435	.013997	.400000	.000000	79/10/10	83/03/22
71851 NITRATE	DISS-NO3	MG/L		150	1.70533	.675780	.822058	.482052	.067121	3.90000	.200000	59/10/29	81/07/21
71856 NITRITE	DISS-NO2	MG/L		4	.060000	.000400	.020000	.333333	.010000	.070000	.030000	72/07/12	81/07/21
71885 IRON	FE	UG/L		10	112.000	8462.25	91.9905	.821343	29.0899	300.000	20.0000	62/10/24	65/09/25
71886 TOTAL P	AS PO4	MG/L		42	.118095	.015035	.122618	1.03630	.018920	.640001	.000000	79/04/23	83/11/17
71887 TOTAL N	AS NO3	MG/L		90	4.66219	5.78665	2.40555	.515969	.253567	17.0000	1.20000	73/10/30	81/09/16
71890 MERCURY	HG,DISS	UG/L		15	.200000	.090000	.300000	1.50000	.077460	1.10000	.000000	79/10/10	83/11/17
			K	29	.362069	.037438	.193490	.534401	.035930	.500000	.100000	73/01/31	83/05/19
			TOT	44	.306818	.059720	.244376	.796486	.036841	1.10000	.000000	73/01/31	83/11/17
71895 MERCURY	HG,SUSP	UG/L		35	.154286	.153143	.391335	2.53643	.066148	2.00000	.000000	73/10/30	82/07/21
71900 MERCURY	HG,TOTAL	UG/L		55	.529087	.658026	.811188	1.53318	.109381	4.10000	.000000	70/11/30	82/07/21
			K	22	.390909	.033247	.182337	.466443	.038874	.500000	.100000	73/01/31	79/07/30
			TOT	77	.489607	.480679	.693310	1.41605	.079010	4.10000	.000000	70/11/30	82/07/21
80020 U-DISS.	EXT.FLR.	UG/L		30	.393999	.145176	.381020	.967058	.069564	1.20000	.020000	71/11/02	83/05/19
80030 ALPHA-D	AS U-NAT	UG/L		24	2.12500	1.51762	1.23192	.579728	.251464	4.90000	.600000	71/11/02	83/05/19
			K	14	.992857	1.01456	1.00725	1.01450	.269200	4.30000	.400000	72/04/03	83/09/21
			TOT	38	1.70789	1.60616	1.26734	.742051	.205590	4.90000	.400000	71/11/02	83/09/21
80040 ALPHA-S	AS U-NAT	UG/L		17	1.52941	1.94096	1.39318	.910931	.337897	4.80000	.400000	72/02/22	83/05/19
			K	21	.400000	.190E-06	.000437	.001092	.000095	.400000	.400000	71/11/02	83/09/21
			TOT	38	.905261	1.16321	1.07852	1.19140	.174960	4.80000	.400000	71/11/02	83/09/21
80050 BETA-D	AS SR-Y-	90, PC/L		37	1.70270	.150281	.387661	.227674	.063731	2.40000	.700000	71/11/02	83/09/21
80060 BETA-S	AS SR-Y-	90, PC/L		21	.957141	.377673	.614469	.641984	.134088	2.20000	.400000	71/11/02	83/09/21
			K	16	.400000	.127E-06	.000357	.000891	.000089	.400000	.400000	71/11/29	82/05/19
			TOT	37	.716215	.288064	.536715	.749378	.088235	2.20000	.400000	71/11/02	83/09/21
80154 SUSP SED	CONC	MG/L		117	8.88022	93.4611	9.66701	1.08860	.893715	51.9999	.999999	73/01/31	83/09/21

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INDEX 1310001 006500
MILES 0643.00 0033.30

PARAMETER			RMK	NUMBER	MEAN	VARIANCE	STAN DEV	COEF VAR	STAND ER	MAXIMUM	MINIMUM	BEG DATE	END DATE
80155 SUSP SED	DISCHARG	TONS/DAY		96	285.937	399107	631.749	2.20940	64.4776	5140.00	7.00000	73/10/30	81/09/1
81886 PERTHANE	SED DRY	NGTUG/KG	K	1	1.00000					1.00000	1.00000	82/06/02	82/06/0
82068 POTAS-40	K-40,DIS	PC/LITER		10	.870000	.042334	.205751	.236496	.065064	1.20000	.600000	80/10/21	81/07/2
82183 2,4-DP	DICLPROP	TOT UG/L	K	2	.010000	.000000	.000000		.000000	.010000	.010000	82/03/23	82/06/0

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APPENDIX G

POINT SOURCES OF AIR POLLUTION WITHIN 50 KM OF SPOKANE RESERVATION AND AREA SOURCES

POINT SOURCES WITHIN 50 KM OF SPOKANE RESERVATION BORDER
(Emissions in tons/year)

Source	Location	TSP	SO_2	NO_x	VOC	CO
Continental	Spokane				44	
Exxon	"				104	
Yellowstone Pipeline	"				5	
Yellowstone Pipeline	"				56	
Conoco	"				260	
Tosco Corp	"				388	
North Pacific Grain	"	10				
United Paving	"	76				
Central Premix	"	31				
WI Forest Products	"	33		150	39	30
Washington Water Power	"	4	16	200		5
Acme Concrete	"	61				
Inland Asphalt	"	32				
Inland Empire PEA	"	52				
Cenex Western Com	"	3				
Spokane Seed	"	19				
Centennial Mills	"	5				
Ralston Purina	"	77				
Inland Zinc Co	"	52				
Spokane Rock Products	"	24				
Morrison Bros Seed	Spokane	2				
Spokane Prestolog	"	30				
NW Sandblast Co	"	20				
Central Premix	"	63				
Spokane Concrete PR	"	2				
Spokane Steel Foundry	"	16				
Inland Asphalt	"	31				
Central Premix	"	58				
Fairchild Air Force Base	"	27		25	2	5
Kaiser Alum & Chem	"	948	6497	53	3	57604
Inland Foundry	"	1				
S & F	"	37				
Cheney Grain Grower	Cheney	7				
Rozzel Heating Pl	"	1	1	10	1	2
National Biscuit Co	"	40				
Hunters Timber	Hunters	30	4	30	40	468
Saramy Lumber	"	10				
Springdale Lumber	Springdale	25	22	2	24	285
Allied Mineral		75				
Ross Pallet Shop	Chewelah	25				
Manufacture Mineral	"	100				
Phoenix Res	"					
Recovery	"					

POINT SOURCES WITH 50 KM OF SPOKANE RESERVATION BORDER (Cont.)

Source	Location	TSP	SO_2	NO_x	VOC	CO
Northwest Marble	Chewelah	100				
Lake Mount Silica	Valley	20				
Nanome Aggregates	"	43				
Saramy Lumber	"	10				
Peak Paving Co Inc	Addy	1				
Northwest Alloys	"	299	656	67	6	25
Coulee Concrete	Coulee	19				

POINT SOURCE TOTALS

AREA IDENTIFICATION	TSP	SO_2	NO_x	VOC	CO
1 Coulle Concrete	19				
2 Cheney	48				
3 Spokane	1714	6513	428	901	57944
4 Hunters	40	4	36	40	468
5 Springdale	100	22	2	24	285
6 Valley	73				
7 Chewelah	253				
8 Addy	300	656	67	972	58724
TOTALS	2547	7196	543	972	58724

sources: State of Washington, Department of Ecology, Point Source Inventory - Short Form Run Date 2/6/84.

Coulee Concrete; Draft Environmental Impact Statement, Creston Generating Station, Table D-5, Washington State Air Monitoring Data for 1983, Washington State Department of Ecology, June 1984.

Phil Nelson, Washington State Department of Ecology, phone contact 2/28/85. Confirmation of Lincoln Divison of Crown Zellerbach no longer in operation.

note: Spokane point source totals include point sources from one of its suburbs; Mead.

AREA SOURCES

COUNTY	EMMISSIONS IN TONS/YEAR 1982				
Lincoln	1522	120	1397	1815	10617
Pend Orielle	481	62	591	937	5262
Spokane	17312	2597	17333	32163	173623
Okanogan	7325	335	3371	8088	47389
Ferry	559	66	449	826	3860
Stevens	1263	231	1827	2290	11263

Source: State of Washington, Department of Ecology, Summary of Air Contaminant Emissions/Four Counties, letter 3/21/84.

APPENDIX H

DISPERSION CALCULATIONS FOR EXISTING AND PROPOSED AIR POLLUTION SOURCES

DISPERSION CALCULATIONS

I. Wood Burning Stove and Fireplace Emissions

Emissions from wood burning in stoves and fireplaces were calculated from the following assumptions:

- five cords of wood per household burned per year,
- Ponderosa pine and Douglas fir are burned, and it has a density of 22.5 of lb/cubic foot as it is stacked,
- emissions are 42 lb particulate per ton of wood and carbon monoxide emissions are 6.2 times higher (EPA AP-42), and
- there are 431 occupied houses on the reservation (Spokane Housing Dept., 1985).

Ep (tons per year)=431 houses x 5 cords per house x 128 cubic feet per cord x 22.5 lb per cubic foot x 42 lb particulate per ton/2000 lb

Ep=65 tons per year particulates
Eco=404 tons per year carbon monoxide

The wood burning is concentrated in the wintertime. Assuming the burning is over a four-month period at an even rate (worst case), the emissions are 1086 lb particulate and 6734 lb carbon monoxide per day. The Wellpinit area has the highest density of housing on the reservation. It is assumed that in this area of two square miles there are one-fourth of the houses (Spokane Housing Dept., 1985) or 108 houses. On a winter day with no wind the mixing height is at tree top which is about 20 meters. Calm stable conditions can exist for most of the night which can be up to 15 hours. There will be some movement of the air in this 15-hour period. If the pollutants remain in this 2 square mile area for a 12-hour period before being diluted and there is clean air, the remainder of the day, the 24-hour average concentration would be 161 ug/m3. In the latter part of the 12-hour build-up period the carbon monoxide concentrations would be 2.6 mg/m3 as an eight-hour average.

II. Slash Burning

The Spokane Tribe estimates a burn of 600 acres of slash per year. This is done in 3 parcels. The National Forest Service suggests a fuel loading of 40 tons per acre for this area of Washington (Sandberg, 1985). At an emission rate of 21 grams of particulates per kilogram of fuel this prescribed burning will produce 504 tons of particulate per year. The papers by Ward, (1983) and McMahon, (1983) provide much greater detail on these emissions and efforts on visibility. These particulates are predominantly fine-sized and will remain in the atmosphere as if a gas and travel long distances downwind. There is no generally accepted means of estimating the impacts from this activity.

III. Feedlot

The hypothetical feedlot has a capacity of 1000 head of cattle (Spokane Tribe, 1985) and will be confined to an area of approximately 10 acres (40,000 square meters). Emissions from this type of activity are 280 lb/day particulates and 11 lb/day ammonia (AP-42). Emissions of other odorous gases are difficult to define. A

50% dropout rate for the particles was assumed in the modeling (an approximate average of dropout from paved and unpaved road activity AP-42, Section 11.2).

Impacts were estimated assuming the dust creating activity is uniformly spread over the day, the emission height is 5 meters (to account for surface mixing) the area is assumed to be square. This source was modeled using ISCST, two years of meteorological data, and a circle of receptors as a screening analysis. The five days causing maximum 24-hour impacts were used in the ISCST model with a more complete receptor grid.

IV. Mining

The size of operation of the Sherwood and Dawn Mines in the future is unknown so an estimate is made assuming a relatively large project, moving 2,000,000 to 4,000,000 million tons of ore and overburden per year. When initially permitted, the Sherwood Mine was designed to handle about 6,000,000 tons per year but recently was operating at a much reduced rate. From haul distances at Sherwood it is estimated that hauling of the material will require 200,000 miles of travel with an emission factor of 4 lb/mile, a value representing a well controlled haul road. Emissions from other activities such as material transfer and support vehicle activity on the haul roads is neglected as they are generally much less than the emissions from the material hauling. The area of activity is confined to about a one kilometer square. Fifty percent of the dust is assumed to settle immediately and be of no concern downwind. The plume height is assumed to be 5 meters (about the height of the wake from hauling machinery). This source was modeled using the five worst dispersion days from the feedlot analysis and modeled on a detailed grid with receptors at every 10 degrees and at radii of 2, 3, 5, and 10 kilometers.

V. Woodfired Boiler

A woodfired boiler is being considered for the Spokane Reservation because of the availability of wood scraps from saw milling and logging. The boiler is proposed for the Ford area of the reservation. Fuel supply is estimated from the assumptions that there will be 40 tons of slash per acre from the logging and thinning of up to 1400 acres per year of a total to 56,000 tons of wood per year. The sawmill will contribute an amount assumed to be 4000 tons per year for a total of 60,000 tons. The wood will be predominantly Ponderosa pine and Douglas Fir. If the wood is burned in a green condition, the moisture content will be on the order of 40% and the heat value will be about 6000 BTU per lb. The annual fuel supply will be 720,000 MBTU. Operating 24 hours per day and 250 day per year the daily heat input will be 120,000 MMBTU per day (10 tons of chips per day).

A boiler of this size will have a stack of 100 feet or more. One hundred feet is assumed. The temperature rise from ambient to stack exhaust will be approximately 100° C and flux approximately 36 cubic meters per second. Choosing an exit velocity of 12 meters per second determines a diameter of 1.95 meters. Emission factors are taken from AP-42 assuming a wood and bark mixture. Particulate emissions are estimated at 7.2 lb per ton of chips and carbon monoxide at 25 lb per ton of chips. This is equal to a boiler emission rate of 72 lb per hour particulates and 250 lb per hour carbon monoxide.

The ISCST dispersion model was run to estimate the impacts of the boiler. Only particulates were analyzed because the carbon monoxide emissions are very small and impacts of carbon monoxide will be very low compared with the standards. The boiler impacts were modeled with the two years of meteorological data and a receptor grid covering the northeast and southwest quadrants at radii of 500, 1000, 2000, 3000 and 5000 meters.

APPENDIX I

CENSUS DATA

JOHN SPELLMAN
Governor

JOE TALLER
Director

STATE OF WASHINGTON
OFFICE OF FINANCIAL MANAGEMENT
Insurance Building, MS AQ-44 • Olympia, Washington 98504 • (206) 753-5450

October 23, 1984

Mr. Roger Herriot
Chief
Population Division
Bureau of the Census
Washington, D.C. 20233

Dear Mr. Herriot:

The Spokane Indian Tribe contracted for a state certified census of all persons residing on the Spokane Indian Reservation as of September 19, 1984. The count was conducted to allow the tabulation of total residents, total Indians according to the federal census definition, and total Indians according to the Office of Revenue Sharing definition.

A total of 1,494 residents was counted. Table I shows the population including 1,198 Indians, following the Bureau of Census definition.

TABLE I
POPULATION ON THE SPOKANE INDIAN RESERVATION
BUREAU OF THE CENSUS RACIAL DEFINITIONS
SEPTEMBER 19, 1984

TOTAL POPULATION	TRIBAL MEMBERS	OTHER INDIANS	SUBTOTAL INDIANS	NON-INDIANS
1,494	954	244	1,198	296

The Office of Revenue Sharing definition of Indian includes all family members in households of which the householder or spouse is Indian. Use of this definition increases the number of people categorized as Indian by 135, to 1,333 people. Table II sets forth the count following the ORS definition.

TABLE II
POPULATION ON THE SPOKANE INDIAN RESERVATION
OFFICE OF REVENUE SHARING RACIAL DEFINITIONS
SEPTEMBER 19, 1984

TOTAL POPULATION	INDIANS BUREAU OF THE CENSUS DEFINITION	OTHER FAMILY MEMBERS IN INDIAN HOUSEHOLD	SUBTOTAL ALL INDIANS ORS DEFINITION	NON-INDIANS
1,494	1,198	135	1,333	161

I certify these counts to be correct. If you have any questions, or require more detailed tabulations please let me know.

Sincerely,

Theresa J. Lowe
Chief Demographer

TL:lw

cc: Mr. Richard Irwin
Ms. Edna Paisano
Mr. Keith Debus
Dr. Marilyn McCurtin

APPENDIX J

NOTICE LETTERS

REDESIGNATION OF AIR OF

SPOKANE INDIAN RESERVATION

Spokane Tribe of Indians

P. O. Box 385 — Wellpinit, WA 99040 — Ph. (509) 258-4581/838-3465

CENTURY OF SURVIVAL
1881 - 1981

February 3, 1983

Mr. John R. Spencer
Regional Administrator of EPA
M/S 601
1200 Sixth Avenue
Seattle, Washington 98101

Re: Redesignation of Air of Spokane Indian Reservation

Dear Mr. Spencer:

By Resolution dated January 17, 1983, the Spokane Tribal Business Council decided to begin redesignation of the lands of the west side of our Reservation as Class I under the Clean Air Act, 42 USC, Section 7474(c).

The Spokane Tribe of Indians wishes, by this letter, to give the Environmental Protection Agency formal notice of its intent to redesignate the lands of the western part of the Reservation as Class I.

The Spokane Tribe of Indians is beginning immediately to fulfill the procedural requirements of the Clean Air Act. The Spokane Tribe expects to present this redesignation to the Administrator for final approval on or before January 31, 1984.

The Spokane Tribe of Indians plans to work in close cooperation with your office and will appreciate any assistance that you may give us.

Sincerely yours,

James W. Hill

James W. Hill, Vice Chairman
Spokane Tribal Business Council

Spokane Tribe of Indians

P. O. Box 385 — Wellpinit, WA 99040 — Ph. (509) 258-4581/838-3465

CENTURY OF SURVIVAL
1881 - 1981

February 3, 1983

Governor John Spellman
Office of the Governor
Legislative Building
Olympia, Washington 98504

Re: Redesignation of Air of Spokane Indian Reservation

Dear Governor Spellman:

By Resolution dated January 17, 1983, the Spokane Tribal Business Council decided to begin the process of redesignation of the lands of the west end of our Reservation as Class I under the Clean Air Act, 42 USC, Section 7474(c). 40 CFR 52.21 states that consultation with the State in which the Reservation is located is necessary. A formal notice to the State must be given thirty days prior to the public hearing.

The Spokane Tribe of Indians does not expect to have the formal hearing much before the end of 1983. However, to facilitate communication, we are giving notice to our intent in order that amicable communication can take place between the State and the Spokane Tribe of Indians, and furthermore that misunderstandings can be avoided.

It is the intent of the Spokane Tribe of Indians to keep the State informed as to its progress and will certainly be giving the required notices of the public hearing and information as to the required studies.

It would be greatly appreciated if you would contact all State agencies that need to know of our intent. Express to those agencies our willingness to communicate and work with them on this important step that the Spokane Tribe of Indians is taking.

Sincerely yours,

James W. Hill

James W. Hill, Vice Chairman
Spokane Tribal Business Council

Spokane Tribe of Indians

P. O. Box 385 — Wellpinit, WA 99040 — Ph. (509) 258-4581/838-3465

CENTURY OF SURVIVAL
1881 - 1981

February 3, 1983

Mr. Dave Matheson, Chairman
Coeur d'Alene Tribe of Indians
Coeur d'Alene Tribal Office
Plummer, Idaho 83851

Re: Redesignation of Air of West End of
Spokane Indian Reservation

Dear Dave:

By Resolution dated January 17, 1983, the Spokane Tribal Business Council decided to begin redesignation of the lands of the west side of our Reservation as Class I under the Clean Air Act, 42 USC, Section 7474(c). By 40 CFR 52.21, the Spokane Tribe is to give notice to all affected Tribes.

The Environmental Protection Agency determines that all protected parties are those who live within 50 kilometers of the Spokane Indian Reservation. However, we wish to give notice to you because of the importance of this step that we are taking and possible feelings that the Coeur d'Alene Tribe might have regarding this matter.

Formal notice will be given to you towards the end of this year which will invite you to take part in the formal hearing on this matter. However, we are sending you this notice to enable you to begin communication on this matter as soon as you wish. It is our wish to sit down with your council to discuss this matter and the possible affects that it may have on your Reservation anytime that you wish. Obviously, since the redesignation will demand Washington industries to use the utmost diligence in cleaning up their emissions, it cannot help but be of benefit to the Coeur d'Alene Indian Tribe and the State of Idaho.

Please feel free to communicate with us anytime on this matter.

Sincerely yours,

James W. Hill

James W. Hill, Vice Chairman
Spokane Tribal Business Council

Spokane Tribe of Indians

P. O. Box 385 — Wellpinit, WA 99040 — Ph. (509) 258-4581/838-3465

CENTURY OF SURVIVAL
1881 - 1981

February 3, 1983

Mathias David, Chairman
Kootenai Tribal Council
Kootenai Tribal Office
P.O. Box 1002
Bonners Ferry, Idaho 83805

Re: Redesignation of Air on Spokane Indian Reservation in the State of Washington

Dear Mathias:

By Resolution dated January 17, 1983, the Spokane Tribal Business Council decided to begin redesignation of the lands of the west side of our Reservation as Class I under the Clean Air Act, 42 USC, Section 7474(c). By the terms of 40 CFR 52.21, we are instructed to give notice to all Indian Tribes who may be affected by this redesignation. The Environmental Protection Agency has informed us that anyone within thirty-five miles probably has to be notified. However, since you are brothers and sisters, we feel it proper to give you notice even though you are well without the range of any effect.

We feel confident that you will agree with us that redesignation of our air to Class I will be of benefit to your Tribe, to your area, and to the State of Idaho. Class I air will necessitate Washington industries to use the highest degree of diligence in cleaning the emissions from their operations.

We wish to communicate with you on this matter. If you have any questions, communications, or comments about this matter, please do not hesitate to call, write, or visit.

Sincerely yours,

James W. Hill

James W. Hill, Vice Chairman
Spokane Tribal Business Council

Spokane Tribe of Indians

P. O. Box 385 — Wellpinit, WA 99040 — Ph. (509) 258-4581/838-3465

CENTURY OF SURVIVAL
1881 - 1981

February 3, 1983

Mr. Glen Nenema, Chairman
Kalispel Tribal Office
P.O. Box 38
Usk, Washington 99180

Re: Redesignation of Air on Spokane Indian Reservation

Dear Glen:

By now you probably are aware that on January 17, 1983, by Resolution, the Spokane Tribal Business Council decided to begin redesignation of the lands of the west side of our Reservation as Class I under the Clean Air Act, 42 USC, Section 7474(c).

By terms of 40 CFR 52.21, the Spokane Tribe of Indians is to give notice to all parties that may be affected by this redesignation. Obviously, formal notice will be given before the final formal hearings on the matter. However, we are giving notice at this time so that a communication process can begin.

It is the wish of the Spokane Tribal Business Council to meet with the Kalispel Business Council regarding this matter at your wish and convenience. Furthermore, please feel free to communicate with us regarding this matter at anytime you wish.

Sincerely yours,

James W. Hill

James W. Hill, Vice Chairman
Spokane Tribal Business Council

Spokane Tribe of Indians

P. O. Box 385 — Wellpinit, WA 99040 — Ph. (509) 258-4581/838-3465

CENTURY OF SURVIVAL
1881 - 1981

February 3, 1983

Mr. Garrey E. Carruthers
Assistant Secretary Land
and Water Resources
Interior Building
Eighteenth and "C" Streets N.W.
Washington, D.C. 20240

Re: Redesignation of Air of Spokane Indian Reservation in the State of Washington

Dear Mr. Carruthers:

On January 17, 1983, the Spokane Tribal Business Council, the governing body of the Spokane Tribe of Indians, decided to begin the process of redesignation of the lands on the west side of our Reservation as Class I under the Clean Air Act, 42 USC, Section 7474(c). 40 CFR 52.21 requires that the Spokane Tribe of Indians give formal notice to federal land managers whose lands may be affected by the proposed redesignation. Formal notice will not be necessary for purposes of the hearing until the end of 1983. However, the Spokane Tribe of Indians is giving this notice initially to open the process of meaningful communication on this matter.

The Spokane Tribe of Indians is most willing to communicate with you and any of your officers regarding this matter. It is the feeling of the Spokane Tribe of Indians that this proposed redesignation to Class I will be of benefit to the Bureau of Land Management. Please do not hesitate to begin communication of any type with us on this matter.

Sincerely yours,

James W. Hill

James W. Hill, Vice Chairman
Spokane Tribal Business Council

Spokane Tribe of Indians

P. O. Box 385 — Wellpinit, WA 99040 — Ph. (509) 258-4581/838-3465

CENTURY OF SURVIVAL
1881 - 1981

February 3, 1983

Mr. Charles T. Coston
Regional Forester
Northern Region
USDA Forest Service
Box 7669
Missoula, Montana 59807

Re: Redesignation of Air of Spokane Indian Reservation in the State of Washington

Dear Mr. Coston:

On January 17, 1983, the Spokane Tribal Business Council, the governing body of the Spokane Tribe of Indians, decided to begin the process of redesignation of the lands on the west side of our Reservation as Class I under the Clean Air Act, 42 USC, Section 7474(c). 40 CFR 52.21 requires that the Spokane Tribe of Indians give formal notice to federal land managers whose lands may be affected by the proposed redesignation. Formal notice will not be necessary for purposes of the hearing until the end of 1983. However, the Spokane Tribe of Indians is giving this notice initially to open the process of meaningful communication on this matter.

The Spokane Tribe of Indians is most willing to communicate with you and any of your officers regarding this matter. It is the feeling of the Spokane Tribe of Indians that this proposed redesignation to Class I will be of benefit to the forests of the region. Please do not hesitate to begin any communication of any type with us on this matter.

Sincerely yours,

James W. Hill

James W. Hill, Vice Chairman
Spokane Tribal Business Council

Spokane Tribe of Indians

P. O. Box 385 — Wellpinit, WA 99040 — Ph. (509) 258-4581/838-3465

CENTURY OF SURVIVAL
1881 - 1981

February 3, 1983

Mr. Jeff M. Sirmon
Regional Forester
Pacific Northwest Region
USDA Forest Service
Box 3623
Portland, Oregon 97208

Re: Redesignation of Air of Spokane Indian Reservation in the State of Washington

Dear Mr. Sirmon:

On January 17, 1983, the Spokane Tribal Business Council, the governing body of the Spokane Tribe of Indians, decided to begin the process of redesignation of the lands on the west side of our Reservation as Class I under the Clean Air Act, 42 USC, Section 7474(c). 40 CFR 52.21 requires that the Spokane Tribe of Indians give formal notice to federal land managers whose lands may be affected by the proposed redesignation. Formal notice will not be necessary for purposes of the hearing until the end of 1983. However, the Spokane Tribe of Indians is giving this notice initially to open the process of meaningful communication on this matter.

The Spokane Tribe of Indians is most willing to communicate with you and any of your officers regarding this matter. It is the feeling of the Spokane Tribe of Indians that this proposed redesignation to Class I will be of benefit to the forests of the region. Please do not hesitate to begin any communication of any type with us on this matter.

Sincerely yours,

James W. Hill

James W. Hill, Vice Chairman
Spokane Tribal Business Council

Spokane Tribe of Indians

P. O. Box 385 — Wellpinit, WA 99040 — Ph. (509) 258-4581/838-3465

CENTURY OF SURVIVAL
1881 - 1981

February 3, 1983

Governor John V. Evans
Office of the Governor
State House
Boise, Idaho 83720

Re: Redesignation of Air of Spokane Indian Reservation

Dear Governor Evans:

By Resolution dated January 17, 1983, the Spokane Tribal Business Council decided to begin redesignation of the lands of the west side of our Reservation as Class I under the Clean Air Act, 42 USC, Section 7474(c). 40 CFR 52.21 states that we are to give notice to states that may be affected by the proposed redesignation.

The Tribe will be giving the formal notice as required by the regulations thirty days prior to the public hearing. However, the reason for this letter is to begin early communication on this redesignation so that meaningful communication may take place and avoidable difficulties do not arise.

The Spokane Tribe of Indians cannot help but feel that any impact to the State of Idaho would be beneficial inasmuch as a Class I designation would insure a cleaner environment for your state.

Would you please notify all agencies of the State of Idaho that would need to know of this initiation of redesignation process by the Spokane Tribe of Indians. Please communicate to these agencies our desire to communicate meaningfully with them to work for a successful conclusion to this redesignation.

Sincerely yours,

James W. Hill

James W. Hill, Vice Chairman
Spokane Tribal Business Council

Spokane Tribe of Indians

P. O. Box 385 — Wellpinit, WA 99040 — Ph. (509) 258-4581/838-3465

CENTURY OF SURVIVAL
1881 - 1981

February 3, 1983

Mr. Al Aubertin, Chairman
Colville Tribal Council
Colville Tribal Office
Nespelem, Washington 99155

Re: Redesignation of Air on West End of
Spokane Indian Reservation

Dear Al:

By Resolution dated January 17, 1983, the Spokane Tribal Business Council decided to begin redesignation of the lands of the west side of our Reservation as Class I under the Clean Air Act, 42 USC, Section 7474(c).

By terms of 40 CFR 52.21, the Spokane Tribe of Indians is to give formal notice to all affected Indian Tribes. Communication on this matter has previously taken place. A meeting has been scheduled on this matter between the two Tribal Councils. The reason for this letter is to set into writing our formal notification to you regarding this redesignation, and to invite you to begin a communication process with us on this matter.

Formal notice will be given to you regarding the hearing, but this will be only after some months, probably around the end of 1983. We invite you to communicate with us in any way regarding this matter. It is our belief that this redesignation will benefit the lands of your Reservation inasmuch as Washington industry will necessarily have to use the utmost diligence in monitoring their emissions.

Sincerely yours,

James W. Hill

James W. Hill, Vice Chairman
Spokane Tribal Business Council

Spokane Tribe of Indians

P. O. Box 385 — Wellpinit, WA 99040 — Ph. (509) 258-4581/838-3465

CENTURY OF SURVIVAL
1881 - 1981

February 3, 1983

Mr. Ray G. Arnett
Assistant Secretary for
Fish, Wild Life and Parks
Interior Building
Eighteenth and "C" Street N.W.
Washington, D.C. 20240

Re: Redesignation of Air of Spokane Indian Reservation in the State of Washington

Dear Mr. Arnett:

On January 17, 1983, the Spokane Tribal Business Council, the governing body of the Spokane Tribe of Indians, decided to begin the process of redesignation of the lands on the west side of our Reservation as Class I under the Clean Air Act, 42 USC, Section 7474(c). 40 CFR 52.21 requires that the Spokane Tribe of Indians give formal notice to federal land managers whose lands may be affected by the proposed redesignation. Formal notice will not be necessary for purposes of the hearing until the end of 1983. However, the Spokane Tribe of Indians is giving this notice initially to open the process of meaningful communication on this matter.

The Spokane Tribe of Indians is most willing to communicate with you and any of your officers regarding this matter. It is the feeling of the Spokane Tribe of Indians that this proposed redesignation to Class I will be of benefit to the National Park Service. Please do not hesitate to begin communication of any type with us on this matter.

Sincerely yours,

James W. Hill

James W. Hill, Vice Chairman
Spokane Tribal Business Council

APPENDIX K

EPA Region 10 Comments To Draft

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 SIXTH AVENUE
SEATTLE, WASHINGTON 98101

JAN 31 1986

REPLY TO ATTN OF: M/S 532

Lawrence Goodrow
Spokane Tribe of Indians
P. O. Box 100
Wellpinit, WA 99040

Dear Mr. Goodrow:

Thank you for the opportunity to review the draft "Spokane Tribe of Indians Air Quality Redesignation Document." We feel that this is a very commendable effort and is nearly ready for release for public review and comment. We do, however, have two concerns which we feel should be addressed, either before release or during the public review period.

First, we are concerned with the air quality dispersion modeling for the Washington Water Power facility which was performed by the Council of Energy Resource Tribes. The results of the EPA Valley model obtained by CERT should not have differed significantly from those obtained by TERA/TWWPCo for the PSD permit. Also, the Washington Water Power meteorological data is available from EPA and, as such, the Complex I model should have been used instead of the Valley model. We strongly suggest that CERT staff contact Rob Wilson of our Environmental Services Division (telephone 206-442-1531) in order to discuss the need for a revised modeling analysis.

Second, a cursory review of the entire document reveals little, if any, discussion of the "health, environmental, economic, social, and energy" effects on areas outside the Reservation which may be affected by the proposed redesignation. The document appears to concentrate solely upon the effects within the Reservation. The document should be supplemented with a discussion of off-reservation effects of the proposed redesignation.

We have also enclosed some specific comments on the draft report for your consideration.

As we have previously indicated, we will perform a more comprehensive review of the redesignation document during the public comment period. However, if you have any questions on our current concerns or comments, please contact David Bray at (206) 442-4253.

Enclosure

Sincerely,

George A. Abel

George A. Abel, Chief
Air Programs Branch

REGION 10 EPA COMMENTS ON DRAFT
SPOKANE TRIBE OF INDIANS
AIR QUALITY REDESIGNATION DOCUMENT

1. Page 1, Section 1.1 - The document should cite the current PSD regulations for redesignations (40 CFR 52.21(g)) which were promulgated on August 7, 1980.

2. Page 25, Section 3.2.3 - In the second paragraph, the fourth sentence should read "All pollutants monitored were below ambient air quality standards." (Not "levels".)

3. Page 31, Section 3.2.3 - Visibility data from the Spokane and Seattle airports are likely not representative of that on the Spokane reservation. Visibility data collected on Johnny George Mountain in the Colville Indian Reservation as part of the tri-state PANORAMAS study would better represent that on the Spokane Reservation. You should contact Mark Hooper of EPA at (206) 442-1949 to obtain access to that data.

4. Page 72, Section 4.1 - The last sentence in this section should be revised to state "EPA promulgated these new regulations on August 7, 1980."

5. Page 72, Section 4.2 - The last sentence in the first paragraph is incorrect. The concentration levels of the PSD increments cannot be directly compared to those of the national ambient air quality standards. Rather, the PSD increments limit the increase in air pollution above a baseline concentration. However, the increments may allow increases up to the level of the ambient standards. This sentence should be revised to read "PSD increments may limit air pollution to levels which are much lower than those set to protect human health (i.e. NAAQS)."

6. Pages 73 and 74, Section 4.3 - The discussion of increments is technically incorrect. The correct term is "increments," not "standards". As such, the sentence "The concept of these standards is increments." is redundant and should be deleted, and the term "standard" must be replaced by "increment" where appropriate.

7. Page 76, Section 4.5 - The first sentence should be revised to state "The PSD program is administered under the auspices of the EPA through a permit system and state implementation plans." The PSD program embodies more than just permits for new and modified major stationary sources per Section 165 of the Clean Air Act.

8. Page 76 and 77, Section 4.5 and Table 4.2 - Fugitive emissions and mining operations are not exempt from PSD requirements. The recent revisions to the PSD regulations (49 FR 43202, October 26, 1984) clearly indicate that fugitive emissions from mining operations are counted against the NAAQS and PSD increments. Furthermore, the mining operation could be subject to PSD permitting requirements if there are non-fugitive emissions associated with the operation. Finally, EPA has proposed to make surface coal mining operations directly subject to PSD permitting requirements based on their fugitive emissions (see 49 FR 43211, October 26, 1984).

9. Page 76, Section 4.5 - In paragraph 2, the citation should read "Table 4.2" not "Table 4.3."

10. Page 77, Section 4.5 - The final sentence should be revised to read "...after the increment is used up, no more sources, regardless of their merit, are allowed if they would further degrade air quality, and..."

11. Page 77, Table 4.2 - The title of this table should be revised to read "Table 4.2 SUMMARY OF PSD PERMIT REGULATIONS."

12. Page 77, Table 4.2 - The last sentence under the entry for "Applicability" should read "However, sources located in non-attainment areas are exempt from the above for the nonattainment pollutant".

13. Page 81, Section 5.1 - As indicated in comment #8 above, increases in all emissions, including fugitive dust emissions from feedlots, are counted towards increment consumption and therefore, may cause a violation of Class I or II PSD increments. (However, it is unlikely that a feedlot would be subject to PSD permit requirements.) The analysis must be revised to discuss the impact of a Class I redesignation upon the future of the feedlot.

14. Page 84, Section 5.5 - In the last sentence of the first paragraph, the word "of" should be changed to "or."

15. Page 104, Table 7-6 - The primary and secondary ambient standards for ozone are 0.12 parts per million which translates to 235 ug/m^3, not 240 ug/m^3. Also, EPA revoked the hydrocarbon standards several years ago, so it should be deleted from this table.

16. Page 125, Section 7.2.3 - As indicated in comment #3 above, visibility data from the site on Johnny George Mountain should be used for the background visual range in the Level-1 visibility modeling analysis.

REGION 10 EPA COMMENTS ON DRAFT
SPOKANE TRIBE OF INDIANS
AIR QUALITY REDESIGNATION DOCUMENT

1. Page 1, Section 1.1 - The document should cite the current PSD regulations for redesignations (40 CFR 52.21(g)) which were promulgated on August 7, 1980.

2. Page 25, Section 3.2.3 - In the second paragraph, the fourth sentence should read "All pollutants monitored were below ambient air quality standards." (Not "levels".)

3. Page 31, Section 3.2.3 - Visibility data from the Spokane and Seattle airports are likely not representative of that on the Spokane reservation. Visibility data collected on Johnny George Mountain in the Colville Indian Reservation as part of the tri-state PANORAMAS study would better represent that on the Spokane Reservation. You should contact Mark Hooper of EPA at (206) 442-1949 to obtain access to that data.

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6. Pages 73 and 74, Section 4.3 - The discussion of increments is technically incorrect. The correct term is "increments," not "standards". As such, the sentence "The concept of these standards is increments." is redundant and should be deleted, and the term "standard" must be replaced by "increment" where appropriate.

7. Page 76, Section 4.5 - The first sentence should be revised to state "The PSD program is administered under the auspices of the EPA through a permit system and state implementation plans." The PSD program embodies more than just permits for new and modified major stationary sources per Section 165 of the Clean Air Act.

APPENDIX L

Spokane Tribe Response to EPA Comments

Spokane Tribe Response to EPA Comments

1. Citing made a suggested.

2. Correction made as suggested.

3. The results of CERT air quality modeling using the EPA Valley model are different than those used by TERA/TWWPCo for the 24 hour and annual SO_2 concentrations. This difference accurred because of a difference in assumption concerning the elevation of the most sensitive receptor, Johnny George Mountain. CERT used the top elevation of 4090 ft. and TERA used an elevation of 3550 ft. The use of the lower elevation by EPA and by CERT would result in a conclusion that even less capacity under PSD class I would be allowed than was found in the CERT document.

4. Correction made as suggested.

5. Correction made.

6. Correction made.

7. Correction made.

8. Issue clarified.

9. Correction made.

10. Correction made.

11. Correction made.

12. Correction made.

13. Issue clarified.

14. Correction made.

15. Item deleted.

16. Issue clarified.

The issue raised concerning Complex One Modeling:

In regard to the comment of EPA on the use of Complex One the following comments are made. In 1983 when CERT was requesting data from EPA to perform modeling, EPA advised CERT to obtain the meteorlogical data from TWWPCo. A request was made, but the data were

not sent to CERT in a timely manner. The modeling performed at the time reflected the best available data and model. Later in 1984 after the initial study was completed TWWPCo. made the meteorlogical data available to CERT. In order to check all modeling results, the Complex One model should be used with updated TWWPCo. data.

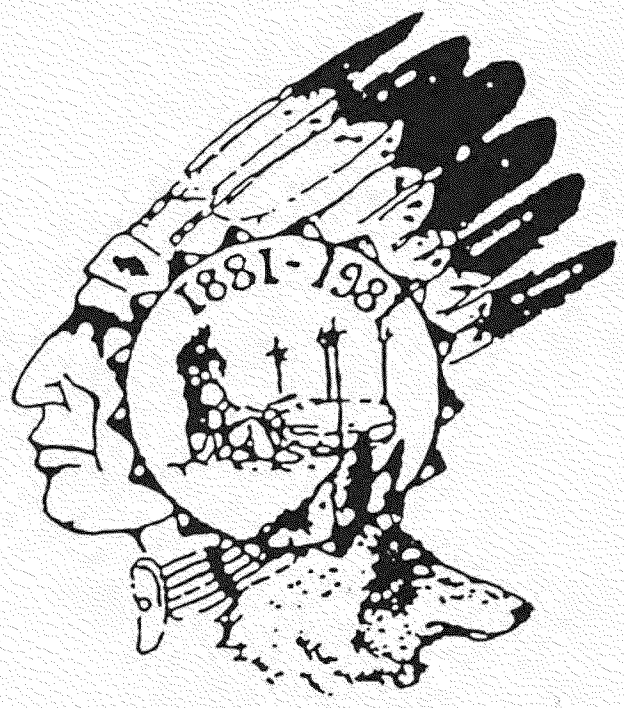
However, it should be recognized that there does not exist any fundamental difference in results from the modeling performed by CERT and that used by TWWPCo. in their PSD permit application. The conclusions reached in the CERT document concerning the construction and operation of the Creston Generating Station remain that, at best, only one unit at 570 MWe could be operated under PSD Class I compliance.

Within section 9.0 the Tribe delineates impacts on that area outside the boundaries of the Reservation.

RECEIVED
APR 1 5 1986
SPOKANE AGENCY

SPOKANE TRIBE OF INDIANS
AIR QUALITY
REDESIGNATION DOCUMENT

BUREAU OF INDIAN AFFAIRS
SPOKANE AGENCY
P.O. BOX 389
WELLPINIT, WASHINGTON 99040



Spokane Reservation
P.O. Box 100
WELLPINIT, WASHINGTON 99040
(509) 258-4581

SPOKANE TRIBE OF INDIANS
AIR QUALITY
REDESIGNATION DOCUMENT

December 13, 1985

Spokane Reservation
P.O. Box 100
WELLPINIT, WASHINGTON 99040
(509) 258-4581

SPOKANE TRIBE OF INDIANS
NOTICE OF PROPOSED REDESIGNATION AND HEARINGS

NOTICE IS HEREBY GIVEN that by Resolution dated January 17, 1983, the Spokane Tribe gave the Environmental Protection Agency formal notice of its intent to redesignate the Spokane Reservation as Class I under the Clean Air Act, 42 USC § 7474(c). As required by the Act, a Redesignation Document discussing the health, environmental, social and energy effects of the redesignation has been prepared and is available for public review and inspection at the Tribal building at Wellpinit, Washington, during the regular office hours of 8:00 a.m. to 4:00 p.m.

Public hearings on the redesignation shall be held at the following dates and places:

10:00 a.m. on September 10, 1986, at the Tribal Building at Wellpinit, Washington.

7:00 p.m. on September 10, 1986, at the Tribal Bingo Hall two miles south of Chewelah on Highway 395.

At these hearings, the Spokane Tribal Business Council will be taking testimony in order to decide finally whether to redesignate the air over the Spokane Reservation. Each party will be allotted fifteen minutes of testimony time. More time can be requested by submitting a request in writing fourteen days before the hearings.

You are encouraged to submit all of your testimony in writing, especially if the information to be submitted is of an expansive or complex nature. This will give the Business Council and staff sufficient opportunity to study your testimony in detail. If parties do not wish to appear personally, but wish to submit written testimony, this testimony can be sent to:

Spokane Tribal Business Council
Class I Air
P.O. Box 100
Wellpinit, WA 99040

All written testimony must be submitted no later than September 10, 1986. Ample time has been accorded all parties in order to prepare such written testimony, so no extensions of time will be granted.

Spokane Tribe of Indians

P.O. Box 100 — Wellpinit, WA 99040 — Ph. (509) 258-4581/838-3465

CENTURY OF SURVIVAL
1881 - 1981

R E S O L U T I O N

Spokane Resolution 1986-157

WHEREAS, throughout history the Spokane Tribal Community has withstood the continuous assault by individuals and groups who have sought the exploitation and degradation of their environment and culture; and

WHEREAS, through litigation and negotiation the tribe has and will continue to protect and preserve the living cycle of the Spokane people; and

WHEREAS, air quality is an important cultural, as well as economic value to the Spokane Tribe, maintaining its pristine quality enhances the quality of life, including the health of residents, scenic beauty of the area, vegetation species of cultural significance and the economic development of the area; and

WHEREAS, all of these require the preservation of the existing clean air quality on the reservation; and

WHEREAS, under the Clean Air Act Amendments of 1977, the Tribal Council has the authority to redesignate the classification of air quality on the Spokane reservation; and

WHEREAS, it is inherent in the tribal sovereignty of tribes that decisions concerning tribal environmental resources be made by the tribe and this right must not be infringed; and

WHEREAS, it is the policy of the United States Government and specifically that of the Environmental Protection Agency to look to tribal governments to play an enhanced role in decision-making and program management affecting reservation environments; and

WHEREAS, President Reagan affirmed in his Indian Policy statement of January 24, 1983 that tribes have a right to determine the best way to meet the needs of their members and to establish and operate programs which best meet those needs; and

WHEREAS, the Spokane Tribal council has been diligent in its efforts to develop environmental policies protecting the life ways of the Spokane Tribal Community; and

WHEREAS, the Federal Prevention of Significant Deterioration (PSD) Program presents the tribe with most clearly defined option for air quality resource management. To this end the tribe has accomplished

the following:

1) An environmental baseline assessment was performed for the tribe to establish existing environmental and socioeconomic conditions on the reservation. Soils, water quality and quantity, vegetation, socioeconomics and air quality were evaluated.

2) An air quality dispersion model was performed.

NOW THEREFORE BE IT RESOLVED, that the Spokane Tribal Council does hereby assert its authority to proceed with the redesignation of air quality standards within the exterior boundaries of the Spokane Reservation; such a determination of a Class One Designation necessitates the tribe request the following assistance from the Environmental Protection Agency:

1) To determine the current air quality conditions on the reservation it is imperative that a complete meteorological and ambient air quality monitoring program be initiated. This is significant to the completion of a report describing and analyzing the health, environmental economic, social and energy effects of redesignation.

BE IT FURTHER RESOLVED, that the Spokane Tribal council does hereby notify all cognizant agencies, municipalities, and interested organizations of its intent to seek a redesignation for Class One Air quality within the external boundaries of the Spokane Indian Reservation; and

BE IT FURTHER RESOLVED, that the Spokane Tribal Council desires and request the impart of all interested parties pursuant making their final decision as it pertains to a Class I air quality redesignation for the Spokane Indian Reservation.

CERTIFICATION

The foregoing was duly enacted by the Spokane Tribal Business Council on the 27th day of March, 1986 by a vote of 3 for and 0 against under authority contained in Article VIII of the Spokane Indians ratified by the Spokane Tribe on November, 1980.

For Joe V. Flett, Chairman
Spokane Tribal Council

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The Spokane Tribal Business Council wishes to acknowledge the contribution of the Council of Energy Resource Tribes staff and associates:

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Lawrence Goodrow
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SPOKANE TRIBE OF INDIANS

AIR QUALITY

REDESIGNATION DOCUMENT

1.0 Introduction

1.1 Purpose

The Spokane Tribe of Indians intends to seek the redesignation of its air quality status to that of Class I air quality. It has asked the U. S. Environmental Protection Agency (EPA) under Tribal Resolution No. 1986-157, for redesignation pursuant to EPA's rule for the Prevention of Significant Deterioration of Air Quality (PSD Rules) written in 1974 (40 CFR 52) and (40 CFR 52.21 (g)) August 7, 1980.

1.2 Background

The Federal clean air act as amended and EPA Indian Policy of 1984 established the authority of the Spokane Tribe to manage the air resources of the Spokane Reservation. It is the prerogative of the Spokane Tribe to provide for protection of its air quality by redesignating the reservation from Class II to Class I pursuant to the Clean Air Act's PSD Program. Redesignation from Class II to Class I would protect to the greatest extent possible under federal law the reservation's air from potential sources of air pollution located on or off the reservation. In order to ensure full air quality protection, some revisions of the Washington State Implementation Plan would be necessary if the Spokane Reservation was redesignated as Class I. The EPA Indian Policy

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supplements the Clean Air Act and clearly recognizes the tribe's sovereign rights to develop a complete air quality management program.

Air Quality is an important cultural, as well as economic, value to the Spokane Tribe. The Spokane Tribal Council takes seriously its mandate and responsibility to maintain or enhance the quality of life of tribal members, including the health of residents, scenic beauty of the area, culturally significant vegetation, wildlife and fishery habitat, and economic development within the reservation. All of these require the preservation of the existing clean air quality on the reservation.

The Spokane Tribe recognizes its responsibility to work in harmony with its neighbors. This concept is inherent in the Clean Air Act. The Spokane Tribe is committed to working with private and public sector organizations adjoining the reservation to insure that all interests have a proper hearing. The Spokane Tribe is not interested in the issue of development versus nondevelopment. No attempt to preempt development or activities occurring on, or planned outside the reservation is being made. The only issue at stake is the tribe's wishes to protect and enhance the reservation's air quality for the betterment of existing and future generations of the Spokane Tribe.

Air quality issues need to be considered in conjunction with other tribal values and goals. The Spokane is pursuing the classification of Class I air in an effort to establish parameters

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for development within the Spokane Reservation. It is imperative that these development goals be structured under environmentally sound guidelines.

1.3 Scope.

The following document will attempt to illustrate the impacts of air quality redesignation through a discussion of the existing environmental and socioeconomic conditions on the Spokane Reservation. Specific policies and regulations will be discussed and analyzed pursuant to the tribe's redesignation request. The various impacts of redesignation on reservation environment and socioeconomic structure will be detailed along with a report on impacts to regional air quality.

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2.0 HISTORY OF THE SPOKANE INDIAN RESERVATION

The following is not meant to be an exhaustive study of the Spokane people, but merely a brief historical synopsis of significant events and their impact on the Spokane Tribe. The writer wishes to acknowledge the writings of Spokane Tribal member David C. Wynecoop, entitled, "Children of the Sun". Much of this synopsis has been influenced by his book.

The Spokane Indians are of the Interior Salish group which has inhabited northeastern Washington, northern Idaho, and western Montana for centuries. Tribal legends tell of the tribe as having always been in this area. The aboriginal lands occupied by the Spokanes laid in eastern Washington along the Spokane River and surrounding area encompassing some three million acres. The tribe originally consisted of three bands who were designated the Upper, Middle and Lower. The reach of the Spokane River and each bands proximity to it defined their geographic status.

The most reliable estimation in 1880 of the Spokane population was 3,000. Small pox and flu epidemics decimated much of the population with and estimated number of 800 living in the early 1900's.

Prior to the advent of white influence the Spokanes living cycle was based on hunting, fishing and gathering within a vast and

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bountiful land. Salmon was perhaps the most important commodity in the early economy of the tribe. It was the major subsistance food and trade item of the Spokanes. Many Tribal histories are replete with the injustices done to Indian Tribes under the doctrine of "Manifest Destiny". The Spokanes were not excluded from this litany of tragic events which forever changed their cultural patterns.

With the advent of opening tribal lands to non-Indian settlement much pressure was placed on the tribal bands to move on to reservations established in Washington and Idaho. The movement of the Spokane people onto reservations was only accomplished after years of confrontation and war. On January 18, 1881 an Executive Order was issued by President Rutherford Hayes establishing the Spokane Indian Reservation. As established, the reservation contained 154,602.57 acres.

The vagaries of exploitation was not uncommon to the many tribes of the northwest. The Spokanes and their neighboring tribes lands were coveted and any resistance by the tribes to the theft of their lands was met with staggering military and political force. The Donation Act opened their lands to homesteading. Military scorched earth policies starved and isolated them further. After given a minuscule amount of land their reservation was opened to mineral entry. During this time, and due to the ever expanding city of Spokane prime fishing sites were destroyed by white interest.

"One of the more recent "gifts" of Indian lands occurred as a result of the Act of march 3, 1905, which provided for the acquisition of water rights in the Spokane River along the Reservation's southern boundary. The act authorized the Secretary of Interior to sell lands along the north bank of the river (Spokane Reservation) to any citizen, association, or corporation of the United States for power purposes. On November 3, 1906, the Secretary approved the sale of a power site to David Wilson resold the water rights to the Washington Water Power Company for $25,000.00. The Little Falls Power Plant, as it is called today is still owned and operated by the Power Company. The transaction was undoubtedly a step toward the development of waster resources, but the Indian again was the victim of white men's exploitations."
(Children of the Sun)

In the early 1900s reservation lands were again open to homesteading and later land was appropriated by the use of fee patents. The tribe countered much of this activity through purchase programs of their own thus they began to consolidate their reservation lands.

The Indian Claims Commission was created on August 13, 1946, to adjudicate claims filed by Indian tribes against the United

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States. As many tribes in the northwest the Spokanes too proceeded with with their claims against the United States, demanding redress for the unreasonably low amount paid the tribe for land ceded in 1887. After years of legal battles, a settlement was reached. On May 29, 1967 the tribe was to receive 6.7 million dollars. Three million was to be paid to individual members. Three million was set aside for the following programs: Land acquisition and consolidation $1,250,000; Resource development $750,000; Credit Program $500,000; Scholarship and Education Grants $250,000. Through the use of these funds and the advent of a variety of resource development projects on the Spokane Reservation the tribe moved rapidly into an era of progressive governmental and economic development. Through their aggressive leadership the tribe constructed new homes, a community center, public utilities and recreational facilities. Timber was harvested; uranium mining was initiated; potential farm lands were reclaimed; small business were developed.

Today the Spokane people are experiencing the same difficulties as many of the neighboring communities. i.e. Timber markets are depressed, farm prices do not support their agricultural development efforts; mining was discontinued due to market conditions. Therefore some of their initial gains have been eliminated by a poor economy. Tribal leadership has met these difficulties with an intense effort to diversify their development efforts. New small businesses have been developed and brought

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under an enterprise corporation. Management systems have been strengthened and new resource development opportunities are being planned.

Throughout history the Spokane Tribe has met tremendous adversity with courage and a deep commitment to preserve their tribal identity through the wise custodianship of their land.

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3.0 ENVIRONMENTAL BASELINE CONDITIONS

In order to understand the effect of air quality on the total reservation ecosystem and human population, identification of existing environmental and socioeconomic conditions needs to be performed. Once this baseline is established, the relationship between tribal air quality values and other tribal resources can be assessed.

Using best-available information, with primary reliance on the Sherwood Project EIS (BIA, 1976) and the Creston Power Plant PSD Permit (TWWPCo, 1982), a baseline assessment of environmental and socioeconomic conditions on the reservation was performed. This analysis includes descriptions of climate and air quality, wildlife, vegetation, soils, hydrology and socioeconomics.

3.1 General Description

The Spokane Reservation is situated within two physiographic provinces of the Pacific Northwest, as described by Franklin and Dyrness (1973). The majority of the area lies within the Okanogan Highlands Province. This province bridges the gap between the northern Cascades in northcentral Washington and the northern Rocky Mountains and is characterized by broad-topped mountains and relatively gently undulating to moderately hilly. Steep slopes are of limited occurrence.

Elevations on the reservation range from approximately 1400 ft along the Spokane River to 3870 ft in the Spokane Mountains. Two major bodies of water, FDR Lake and the Spokane River, border the reservation on the western and southern side, respectively. Other major drainages within the area include Sand Creek, Blue Creek, Little Chamokane Creek and Chamokane Creek, which borders the reservation on the east side.

3.2 CLIMATE AND AIR QUALITY

3.2.1 Regional Climatology

The regional area surrounding the Spokane Reservation and comprising a great portion of the Columbia Basin is relatively arid, with temperature fluctuations. Although the state of Washington is subject to frequent migration of cool, humid Pacific air masses, the majority of this available precipitation falls on the Coast Range and the Cascade Mountains. The resulting drier air mass that reaches the Spokane Reservation tends to combine some of the characteristics of the maritime climate of the coastal area with the arid climate of an interior continental area.

The predominant controls on the climate of the reservation are: (1) location with respect to storm tracks, (2) latitude and (3) location with respect to the mountains. The Pacific Ocean influences the development of coastal storms, which track across the Cascades to the Spokane Reservation area. The relatively high latitude of the area (around 48 °N) tends to modify and cool the air masses from the west; in the winter there is little solar

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radiation to warm the air mass. The coast Range and the Cascade Mountains have a substantial effect on producing the arid conditions in the area; the orographic effect of these mountains causes moisture in the air mass to fall as rain or snow on the windward (west) side of the mountains.

The climate combines some of the characteristics of damp, coastal weather and arid, interior conditions. Most of the air masses which reach Spokane are brought in by prevailing westerly and southwesterly circulations. Frequently, much of the moisture in the storms that move eastward and southeastward from the Gulf of Alaska and the eastern Pacific Ocean is precipitated out as the storms are lifted across the Coast and Cascade ranges. Annual precipitation in the Spokane area is generally less than 20 in. and less than 50% of the amounts received west of the Cascades. However, precipitation and total cloudiness in the Spokane Vicinity is greater than those of the desert areas of southcentral Washington. Lifting of the air masses up the east slope of the Columbia Basin frequently produces the cooling and condensation necessary for formation of clouds and precipitation.

Infrequently, the Spokane area comes under the influence of dry continental air masses from the north or east. On occasions when these air masses penetrate into eastern Washington, the result is high temperature and very low humidity in the summer or subzero temperature in the winter. In the winter, most of the severe arctic air moves southward on the east side of the Continental

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Divide and does not affect Spokane.

In general, the Spokane Reservation weather has the characteristics of a mild, arid climate during the summer months and a cold, coastal climate in the winter. Approximately 70% of the total annual precipitation falls between the first of October and the end of March, and about half of that falls as snow. Winter weather includes many cloudy or foggy days and below-freezing temperatures, with occasional snowfall of several inches. Sub-zero temperatures and traffic-stopping snowfalls are infrequent. The growing season usually extends over nearly six months, from mid-April to mid-October. Irrigation is required for all crops except dryland grains. The summer weather is ideal for full enjoyment of the many mountain and lake recreational areas in the immediate vicinity.

In the region surrounding the Spokane reservation, climate can vary as a function of elevation. For many of the localities above 2000 ft, increased precipitation can occur, due to orographic lifting. Temperatures can be cooler at higher elevations, and wind velocities can vary according to terrain features, with higher winds expected at ridgetops and lower winds expected in protected valleys.

3.2.2 Reservation Climate

A limited amount of climatological data is available for the Spokane Reservation (BIA, 1976). A detailed discussion of climate for the Creston area is found in TERA (1981). In addition, a

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long-term record of over 80 years is available for the town of Spokane, which is located approximately 40 mi southeast of the reservation. The basic data for both areas are shown in tables 3-1, 3-2, and 3-3.

Temperature-The annual average temperature on the reservation is around 45°F with a monthly average variation 22°F in the winter to 71°F in August. This temperature is lower than the annual average temperature measured in the town of Spokane (table 3-1). The highest temperature measured in Spokane was 100°F and the lowest was -25°F (table 3-2). Minimum temperatures of -10°F to -20°F are recorded almost every winter. A substantial variation of temperature From year to year is noted in table 3-3.

Precipitation-Around 16 to 20 in./yr of precipitation falls in the area. The reservation gets more precipitation than does the town of Spokane. Around half of the precipitation occurs in the winter months and a minimum of summer precipitation is noted. The maximum annual precipitation is around 11 in. A large amount of precipitation occurs as snow. The reservation records almost 58 inches of snow fall, on the average, each year; tables 3-2 and table 3-3 indicate that snowfall can vary from 15 to 94 in.

Wind-The annual average wind measured in Spokane is 8.7 mi/hr (table 3-2). The prevailing direction is Spokane is SSW in the summer and NE in the winter. the annual wind rose for Spokane is shown in figure 3-1. However, data collected at the Creston Power Plant would probably be more indicative of the wind conditions on

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Table 3-1. WELLPINIT AND SPOKANE CLIMATOLOGICAL DATA [a]

Location and Parameter [b]	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Wellpinit [c]													
Precipitation	2.57	1.90	1.80	1.45	1.68	1.67	0.49	0.63	1.10	1.79	2.34	2.75	20.17
Snow	16.7	12.4	4.8	0.7	0.1	0.0	0.0	0.0	0.0	0.9	6.6	15.7	57.9
Temperature [d]	21.9	29.4	39.7	41.0	54.3	60.4	65.3	70.9	57.8	44.6	35.3	22.0	44.7
Spokane [e]													
Precipitation	2.11	1.60	1.33	1.08	1.33	1.31	0.49	0.59	0.84	1.26	2.00	2.21	16.15
Snow	15.6	6.1	4.1	0.3	0.1	0.0	0.0	0.0	0.0	1.4	4.8	12.7	46.1
Temperature	26.9	31.7	39.5	47.7	55.9	62.5	70.2	68.7	59.4	48.7	37.1	30.3	48.2
Average Maximum Temperature	32.7	38.8	48.4	58.6	67.6	74.5	84.3	82.9	72.2	59.3	43.6	35.5	58.2
Average Minimum Temperature	21.0	24.5	30.5	36.8	44.2	50.5	56.0	54.5	46.6	38.1	30.5	25.1	38.2

(a) From U.S. Weather Bureau (1955 and 1962) and Environmental Data Services (1972a and 1972b)
(b) Precipitation in inches of total moisture as a water equivalent; snow in inches; and temperature in degrees Fahrenheit.
(c) Data are averages from 1931 through 1960.
(d) 1972 data only.
(e) Data are averages from 1933 through 1972.

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Table 3-2. SPOKANE, WASHINGTON CLIMATOLOGICAL DATA

Meteorological Data For The Current Year

Station: SPOKANE, WASHINGTON — INTERNATIONAL AIRPORT — Standard time used: PACIFIC — Latitude 47° 38' N — Longitude 117° 32' W — Elevation (ground) 2356 feet — Year 1977

Month	Temperature °F: Average Daily Maximum	Average Daily Minimum	Average Monthly	Extremes: Highest	Date	Lowest	Date	Degree days Base 65 °F: Heating	Cooling	Precipitation in inches: Water equivalent: Total	Greatest 24 hr.	Date	Snow, Ice pellets: Total	Greatest 24 hr.	Date	Relative humidity pct. (Local time): 04	10	16	22	Wind: Prevailing Direction	Average Speed m.p.h.	Highest mile: Speed m.p.h.	Direction	Date	Percent of possible sunshine	Average sky cover tenths	Number of days: Sunrise to sunset: Clear	Partly Cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog visibility 1/4 mile or less	Temperature °F: Maximum: 32° and below	32° and below	Minimum: 32° and below	0° and below	Average station pressure mb
JAN	30.0	17.2	23.6	47	18	-8	8	1326	0	0.75	0.40	11-12	6.0	5.3	11-12	91	90	69	90	SW	6.7	45	27	SW	10	21	8.4	3	3	25	9	3	0	0	9	27	30	1	987.6
FEB	42.4	27.8	35.1	57	12	17	24	832	0	0.52	0.25	20	2.5	0.0	23	85	81	66	91	SW	5.5	34	12	SW	10	36	8.3	1	4	21	7	0	0	0	3	23	0	0	986.7
MAR	46.7	29.7	38.2	61	22	24	20	824	0	1.19	0.36	7	2.7	1.2	10	79	67	55	72	SW	7.4	31.0	35	NW	27	40	8.3	0	3	24	11	1	0	0	0	24	0	0	984.5
APR	55.0	36.7	50.4	80	24	25	19	436	10	0.19	0.13	13	T	T	18	60	41	26	63	SW	3.3	9.4	36	SW	8	46	5.9	0	15	9	1	0	0	1	0	10	0	0	981.5
MAY	62.2	46.0	51.6	81	1	35	6	409	2	1.71	0.42	17-18	T	T	21	77	77	43	66	SW	3.7	9.1	38	W	7	70	6.2	5	15	12	7	0	0	1	0	0	0	0	977.5
JUN	70.5	51.6	61.0	90	7	36	2	66	72	1.69	1.13	7-8	0.0	0.0		69	44	30	53																				971.6
JUL	80.5	55.3	67.9	94	25	41	6	37	126	0.11	0.09	24-25	0.0	0.0		62	38	26	62	SW	6.9	10.4	29	W	20	61	3.7	8	11	12	3	0	0	0	0	0	0	0	972.9
AUG	84.0	57.4	71.2	100	10	46	31	36	234	1.25	0.59	23-24	0.0	0.0		59	42	28	66	SW	2.5	9.0	29	NW	4	90	2.9	17	7	7	0	0	0	0	0	0	0	972.8
SEP	64.9	45.2	55.1	81	13	32	22	289	0	1.42	0.47	23-24	0.0	0.0		64	64	51	71	SW	3.6	7.6	26	SW	20	40	6.9	0	3	19	12	0	0	0	0	14	0	0	979.6
OCT	57.3	36.7	46.5	67	24	25	10	565	0	0.64	0.20	29	0.0	0.0		83	70	48	75	SW	2.7	7.8	32	SW	30	56	4.3	0	7	16	5	0	0	1	0	0	0	0	980.6
NOV	40.4	27.6	34.0	55	1	3	21	921	0	2.17	0.67	25	11.3	3.3	0	81	77	69	77	SW	4.7	11.4	40	SW	1	30	7.5	4	0	17	12	2	0	0	0	0	0	1	984.6
DEC	32.2	20.1	26.2	51	2	-9	31	1197	0	4.52	0.90	13-14	30.5	7.8	29	88	87	82	86	SW	3.5	10.5	42	W	8	23	7.5	3	4	22	16	0	0	0	0	0	0	0	992.3
YEAR	56.8	37.0	46.9	100	JUN 18	-9	DEC 31	6974	472	15.57	1.13	JUN 7-8	53.5	7.8	DEC 29	77	63	51	67	SW	3.8	9.1	42	W	DEC 8	51	7.0	63	94	206	106	13	0	50	23	54	142	0	981.0

Normals, Means, And Extremes

Station	Temperature °F: Normal: Daily Maximum	Daily Minimum	Monthly	Extremes: Highest (30)	Year	Lowest (30)	Year	Normal Degree days Base 65 °F: Heating	Cooling	Precipitation in inches: Water equivalent: Normal	Greatest Monthly (30)	Year	Greatest 24 hr. (30)	Year	Snow, Ice pellets: Greatest Monthly (30)	Year	Greatest 24 hr. (30)	Year	Relative humidity pct. (Local time): 04 (18)	10 (18)	16 (18)	22 (18)	Wind: Prevailing Direction (30)	Average Speed m.p.h. (30)	Highest mile: Speed m.p.h. (30)	Direction	Year	Percent of possible sunshine (24)	Average sky cover tenths (30)	Number of days: Sunrise to sunset: Clear (30)	Partly Cloudy (30)	Cloudy (30)	Precipitation .01 inch or more (30)	Snow, Ice pellets 1.0 inch or more (30)	Thunderstorms (30)	Heavy fog visibility 1/4 mile or less (30)	Temperature °F: Maximum: 32° and below (18)	32° and below (18)	Minimum: 32° and below (18)	0° and below (18)	Average station pressure mb (3969 feet MSL)
J	31.1	19.6	25.4	50	1971	-19	1969	1228	0	2.47	6.96	1890	0.50	1949	1.40	1956	56.0	1950	13.0	1956	82	82	77	82	SW	5.5	48	59	SW	1972	24	5.2	3	3	23	19	0	0	9	0	13	27	3	995.0
F	39.0	23.3	32.2	61	1950	-12	1973	910	0	1.00	3.94	1961	0.40	1967	1.11	1968	28.3	1973	8.0	1973	82	76	68	79	SW	5.2	55W	54	SW	1949	40	7.0	4	4	20	11	3	0	7	0	4	22	0	988.6
M	46.2	28.8	37.5	71	1960	-3	1955	893	0	1.33	2.72	1950	0.91	1969	0.91	1950	13.3	1967	5.3	1970	78	67	54	72	SW	5.6	55W	54	SW	1973	33	7.4	4	0	19	11	2	0	3	0	1	27	0	988.4
A	57.0	33.2	45.1	90	1977	17	1946	367	0	1.12	2.08	1948	0.80	1956	0.80	1962	6.6	1964	4.0	1966	73	56	42	64	SW	5.7	5W	50	SW	1962	60	7.1	3	0	17	8	0	0	1	0	0	17	0	981.5
M	66.3	42.0	54.2	92	1964	24	1956	237	0	1.46	3.71	1948	0.45	1964	1.67	1948	3.5	1967	3.0	1967	71	51	40	62	SW	5.9	55W	49	W	1957	63	6.6	6	10	15	9	0	0	1	0	0	7	0	979.6
J	73.6	49.4	61.5	100	1973	34	1962	144	39	1.36	3.06	1964	0.16	1960	2.07	1964	T	1959	T	1954	72	46	35	56	SW	5.9	55W	59	SW	1949	65	6.1	7	11	12	8	0	0	1	0	0	0	0	979.4
J	84.3	55.1	69.7	105	1967	38	1971	31	167	0.68	1.06	1972	T	1972	0.06	1972	0.0		0.0		60	30	23	42	SW	5.3	5W	43	SW	1970	90	3.6	17	5	3	4	0	0	0	0	0	0	0	981.5
A	81.9	54.0	68.0	106	1961	35	1965	47	140	0.50	1.00	1976	T	1969	1.00	1970	0.0		0.0		61	45	28	45	SW	5.1	5W	42	SW	1976	77	4.1	14	6	7	4	0	0	0	0	0	0	0	980.8
S	72.5	44.7	59.6	96	1950	25	1965	196	54	0.83	2.05	1950	0.05	1972	1.12	1972	0.0		0.0		65	50	34	54	SW	5.0	NW	50	SW	1961	76	4.0	12	8	10	6	0	0	0	0	0	0	0	983.0
O	58.1	37.3	47.8	83	1963	18	1971	552	0	1.42	4.05	1950	0.05	1969	0.80	1950	0.1	1957	0.1	1957	79	66	49	71	SW	5.1	55W	56	SW	1950	31	6.3	8	5	13	8	0	0	1	0	1	0	0	982.5
N	41.8	29.2	35.5	67	1975	-11	1955	887	0	2.26	5.10	1973	0.22	1976	1.41	1960	24.7	1955	9.0	1973	86	81	74	83	SW	5.3	NW	54	SW	1949	19	8.0	3	4	11	12	2	0	0	0	0	0	0	992.5
D	33.9	24.0	29.0	56	1957	-25	1968	1116	0	2.37	5.19	1964	0.40	1974	1.60	1951	42.0	1964	12.1	1951	86	86	81	87	SW	5.0	NW	51	SW	1956	20	8.5	3	3	25	16	5	0	12	0	13	26	1	992.0
YR	57.3	37.3	47.3	106	AUG 1961	-25	DEC 1968	6835	386	17.42	5.71	MAY 1948	T	JUL 1973	2.07	JUN 1964	56.9	JAN 1950	13.0	JAN 1950	73	62	51	64	SW	5.7	55W	50	SW	1972	37	6.5	86	87	190	114	10	11	47	21	94	141	0	981.0

Means and extremes above are from existing and comparable exposures. Annual extremes have been exceeded at other sites in the locality as follows: Lowest temperature -30 in January 1888; maximum monthly precipitation 5.85 in November 1897; minimum monthly precipitation 0.00 in July 1881; maximum precipitation in 24 hours 2.22 in June 1888.

(a) Length of record, years, through the current year unless otherwise noted, based on January data.
(b) 70° and above at Alaskan stations.
* Less than one half.
T Trace

NORMALS - Based on record for the 1941-1970 period.
DATE OF AN EXTREME - The most recent in cases of multiple occurrence.
PREVAILING WIND DIRECTION - Record through 1963.
WIND DIRECTION - Numerals indicate tens of degrees clockwise from true north. 00 indicates calm.
FASTEST MILE WIND - Speed is fastest observed 1-minute value when the direction is in tens of degrees.

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Table 3-3. SPOKANE, WASHINGTON CLIMATOLOGICAL DATA

Average Temperature

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1938	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1939	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
*1940	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1941	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1942	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1943	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1944	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1945	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1946	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
*1947	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1948	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1949	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1950	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1951	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1952	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1953	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1954	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1955	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1956	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1957	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1958	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
*1959	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1960	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1961	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1962	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1963	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1964	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1965	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1966	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1967	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1968	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1969	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1970	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1971	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1972	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1973	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1974	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1975	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1976	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1977	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RECORD													
MEAN	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MAX	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MIN	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Heating Degree Days

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1957-58	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1958-59	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
*1959-60	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1960-61	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1961-62	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1962-63	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1963-64	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1964-65	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1965-66	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1966-67	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1967-68	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1968-69	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1969-70	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1970-71	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1971-72	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1972-73	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1973-74	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1974-75	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1975-76	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1976-77	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1977-78	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1970	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1971	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1972	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1973	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1974	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1975	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1976	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1977	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Precipitation

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1938	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1939	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
*1940	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1941	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1942	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1943	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1944	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1945	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1946	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
*1947	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1948	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1949	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1950	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1951	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1952	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1953	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1954	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1955	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1956	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1957	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1958	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1959	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1960	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1961	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1962	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1963	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1964	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1965	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1966	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1967	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1968	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1969	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1970	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1971	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1972	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1973	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1974	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1975	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1976	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1977	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RECORD													
MEAN	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Snowfall

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1938-39	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1939-40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
*1940-41	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1941-42	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1942-43	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1943-44	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1944-45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1945-46	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1946-47	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
*1947-48	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1948-49	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1949-50	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1950-51	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1951-52	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1952-53	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1953-54	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1954-55	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1955-56	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1956-57	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1957-58	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1958-59	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1959-60	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1960-61	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1961-62	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1962-63	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1963-64	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1964-65	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1965-66	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1966-67	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1967-68	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1968-69	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1969-70	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1970-71	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1971-72	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1972-73	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1973-74	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1974-75	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1975-76	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1976-77	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1977-78	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							
RECORD													
MEAN	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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the Spokane Reservation. Figure 3-2 illustrates the wind rose for the Creston Power Plant for a limited amount of data collected in 1980 (TERA, 1981). The prevailing wind directions are SSW and NE. The winds for 1980 at Creston are more evenly distributed than those at the town of Spokane.

Local winds on the reservation would be expected to follow terrain features. Winds are usually moderate to light year around. However, gusty surface winds, associated with frontal passages, can occur. Given the reservation's geographic location, local winds are probably characterized as valley-induced winds systems. Nocturnal cooling of ridges results in downslope drainage along river valleys. The flow of this cold air over the valley floor underlies warmer air aloft, which is usually flowing from the northwest. If the valley ridges are sufficiently warmed, nighttime drainage is replaced by up-valley air. Whether or not this occurs, depends on the balance of daytime radiational heating and nighttime radiational cooling (figure 3-3).

The area has a high frequency of near-calm wind conditions and a moderate frequency of storms. Surface winds are predominantly downslope in the mornings, with speeds generally less than 10 mi/hr; upslope winds in the afternoons and evenings are from some westerly direction, with slightly higher speeds. Spring winds will average approximately 10 mi/hr, although gusts of 40 to 50 mi/hr or more are common.

Atmospheric Dispersion-The atmosphere's ability to disperse

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pollutants is measured by a number of parameters. The mixing height, the depth of the inversion, measures the vertical extent of mixing of atmospheric pollutants. The lower the mixing height, the less dispersion.

Low-level, radiation-induced inversions form in arid climates. In addition, wintertime synoptic inversions can be formed in the area. Figures 3-4 and 3-5, from Holtzworth (1972), illustrate the average annual morning and afternoon mixing height is around 400 m, and the afternoon mixing height rises to almost 1600 m. Table 3-4, taken from TERA 91981), one-half of the time at night and one-third of the time overall. Although the data are limited, it seems appropriate to assume that a high frequency of temperature inversions occur in the fall and winter on the reservation. The continental climate, producing nighttime radiative cooling, coupled with occurrences of upper air high pressure induced subsidence, tends to form temperature inversions.

Another atmospheric dispersion parameter is atmospheric stability. Stability is a measure of the atmosphere's relative ability to disperse pollutants at small scales. Appendix A illustrates atmospheric stability in more detail. Other stability Information for the town of Spokane is shown in Appendix B. A stability array (STAR) for Spokane is summarized in table 3-5; very stable conditions (D, E, and F) are the most prevalent. Atmospheric pollutants, on the average, are not easily dispersed on the reservation unless strong winds are present.

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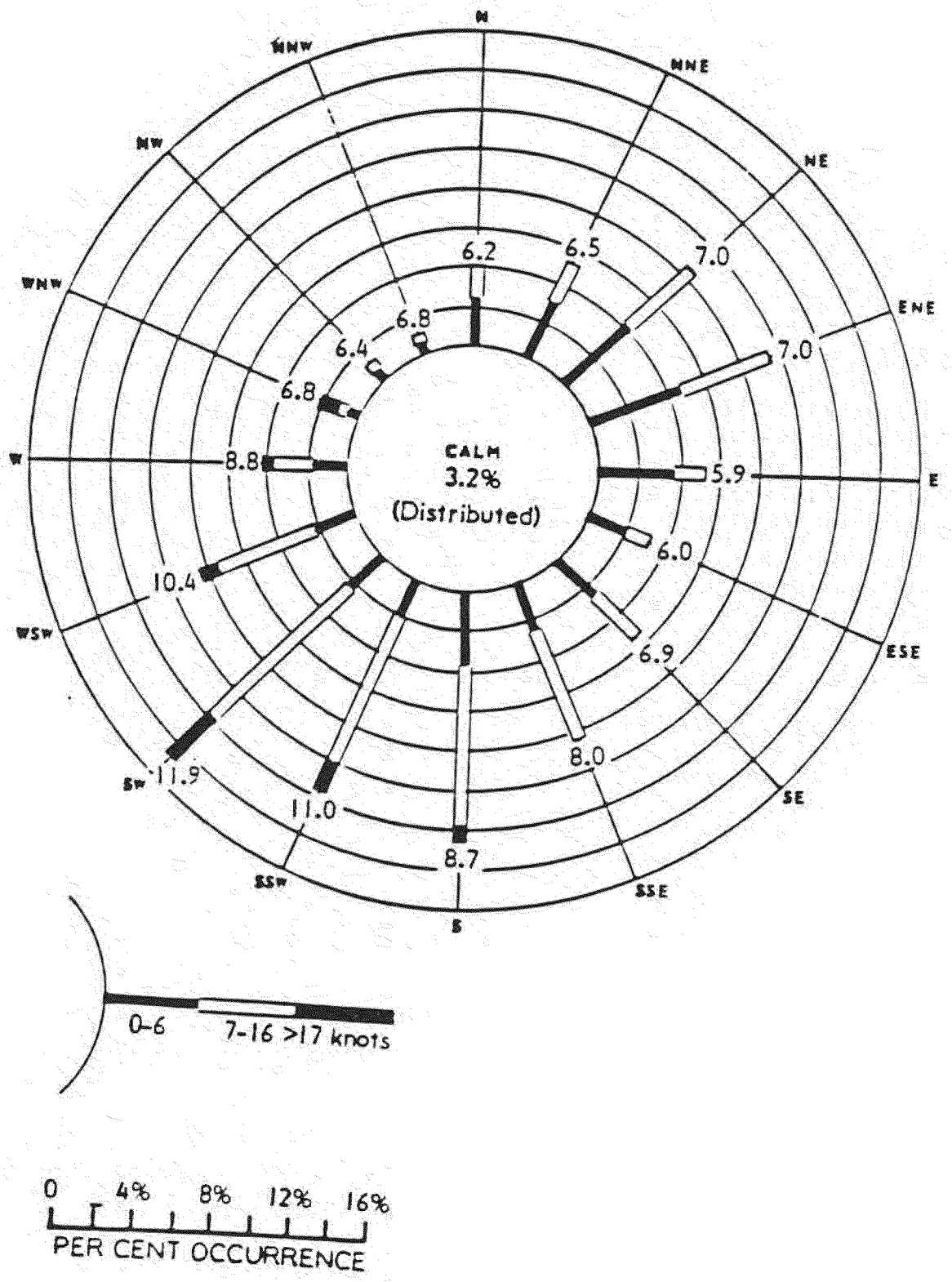

Figure 3-1. ANNUAL WIND ROSE FOR SPOKANE INTERNATIONAL AIRPORT (1968-77)

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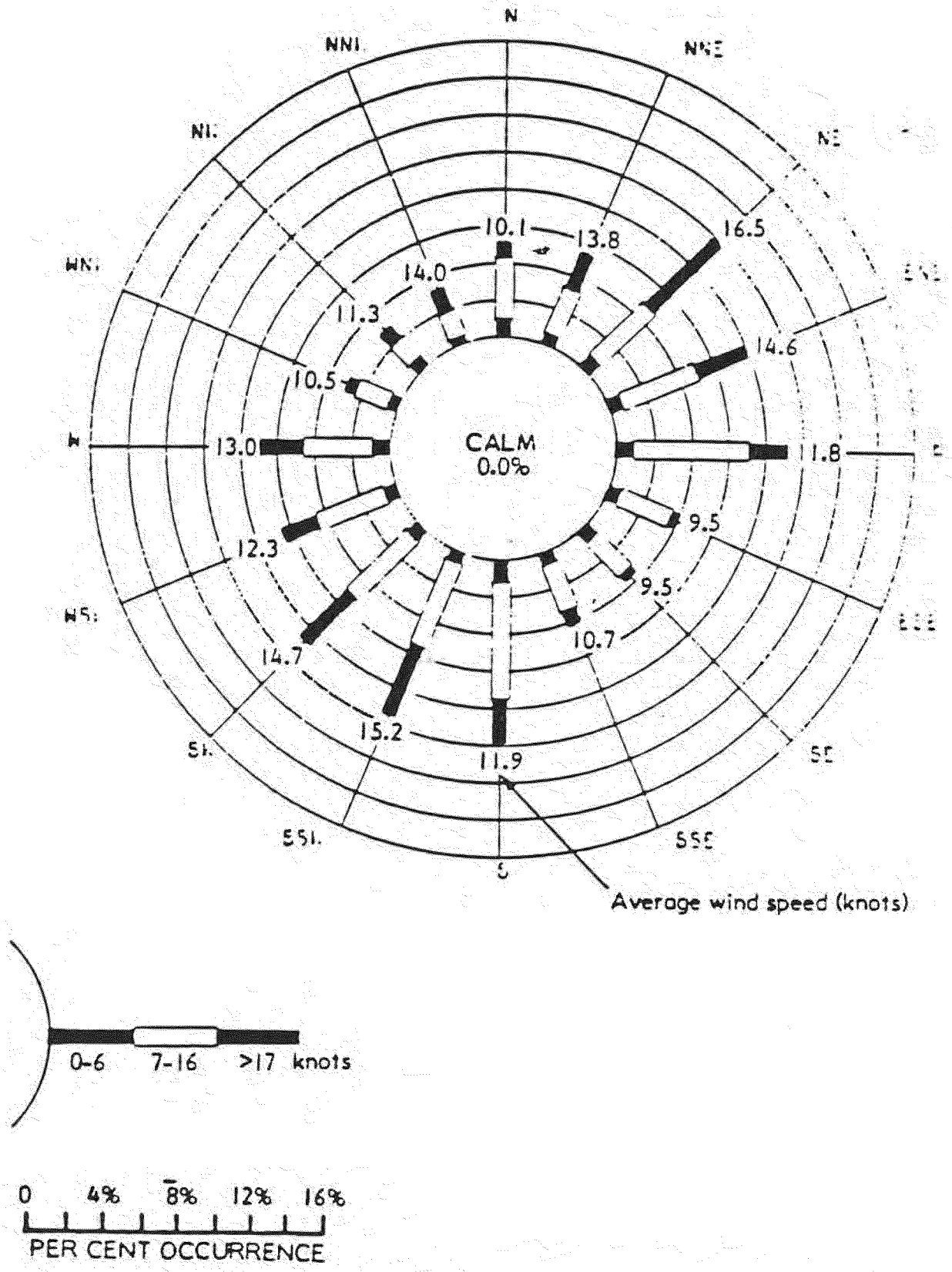

Figure 3-2. CRESTON GENERATION STATION
WIND ROSE FOR 1980 FROM TWWPCO CRESTON BUTTE TOWER, 100-M LEVEL

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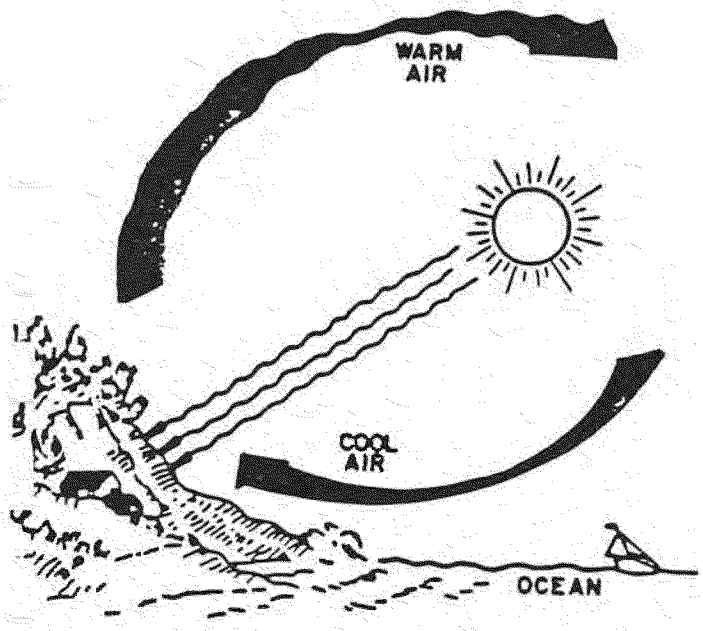
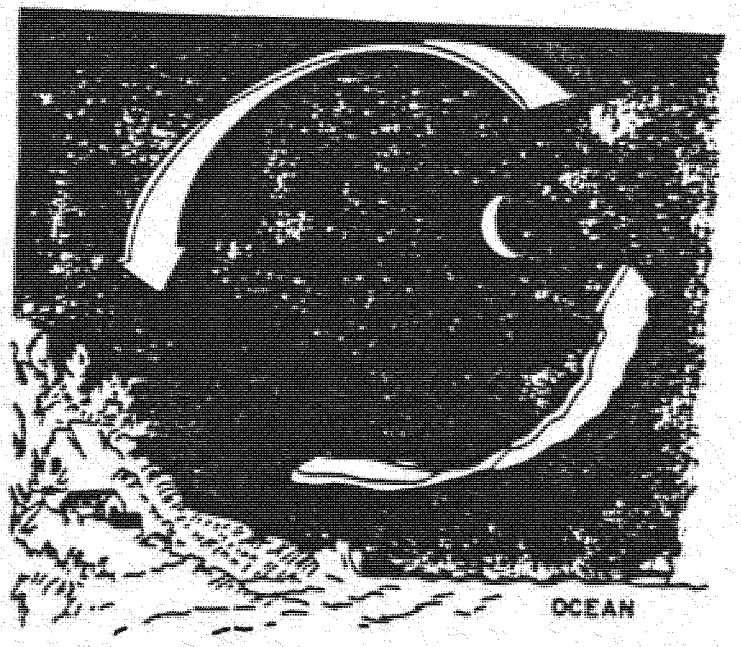
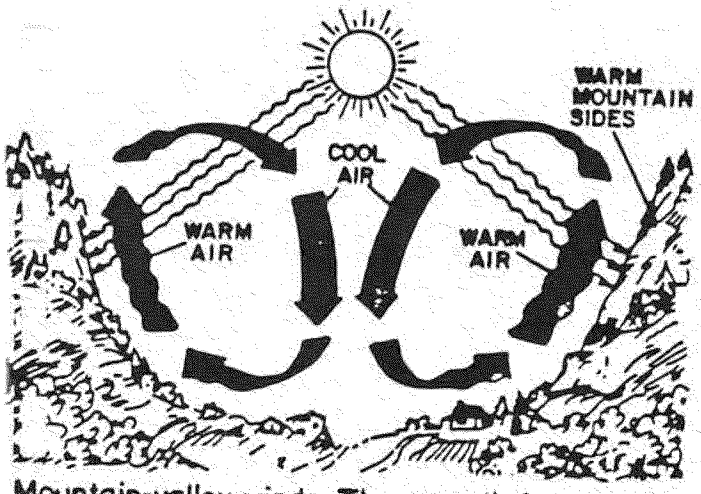
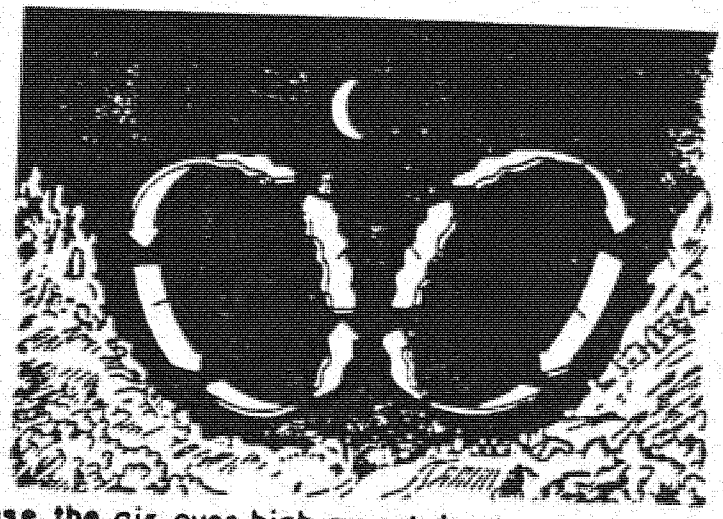




Sea-land winds occur because adjacent land and ocean masses have different rates of heating and cooling. On-shore breezes occur during the day and off-shore breezes at night.





Mountain-valley winds. These gentle breezes occur because the air over high mountain slopes warms faster by day and cools down more rapidly at night.

Figure 3-3. DAYTIME RADIATIONAL HEATING AND NIGHTTIME RADIATIONAL COOLING

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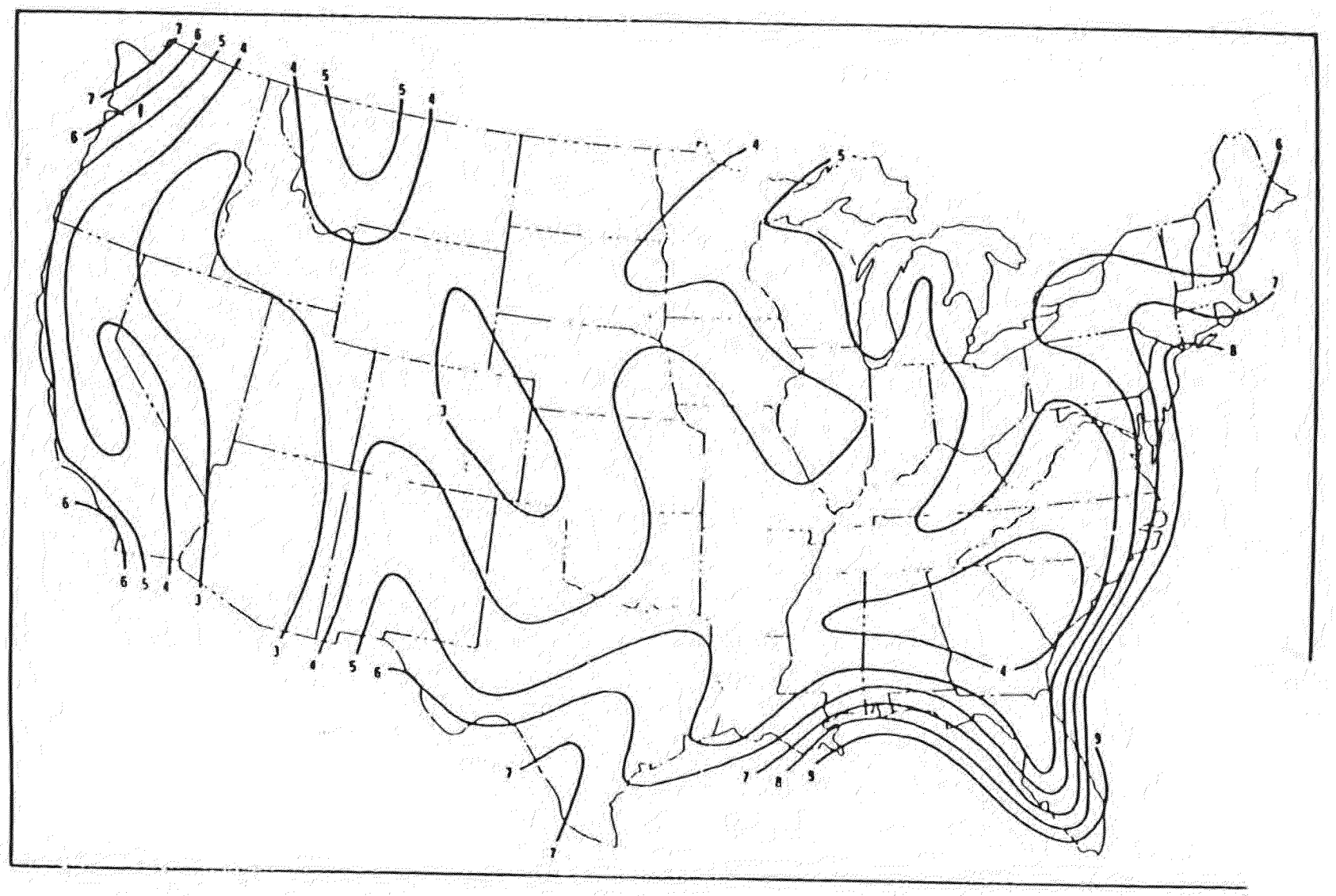

Figure 3-4. ISOPLETHS (M X 10^2) OF MEAN ANNUAL MORNING MIXING HEIGHTS

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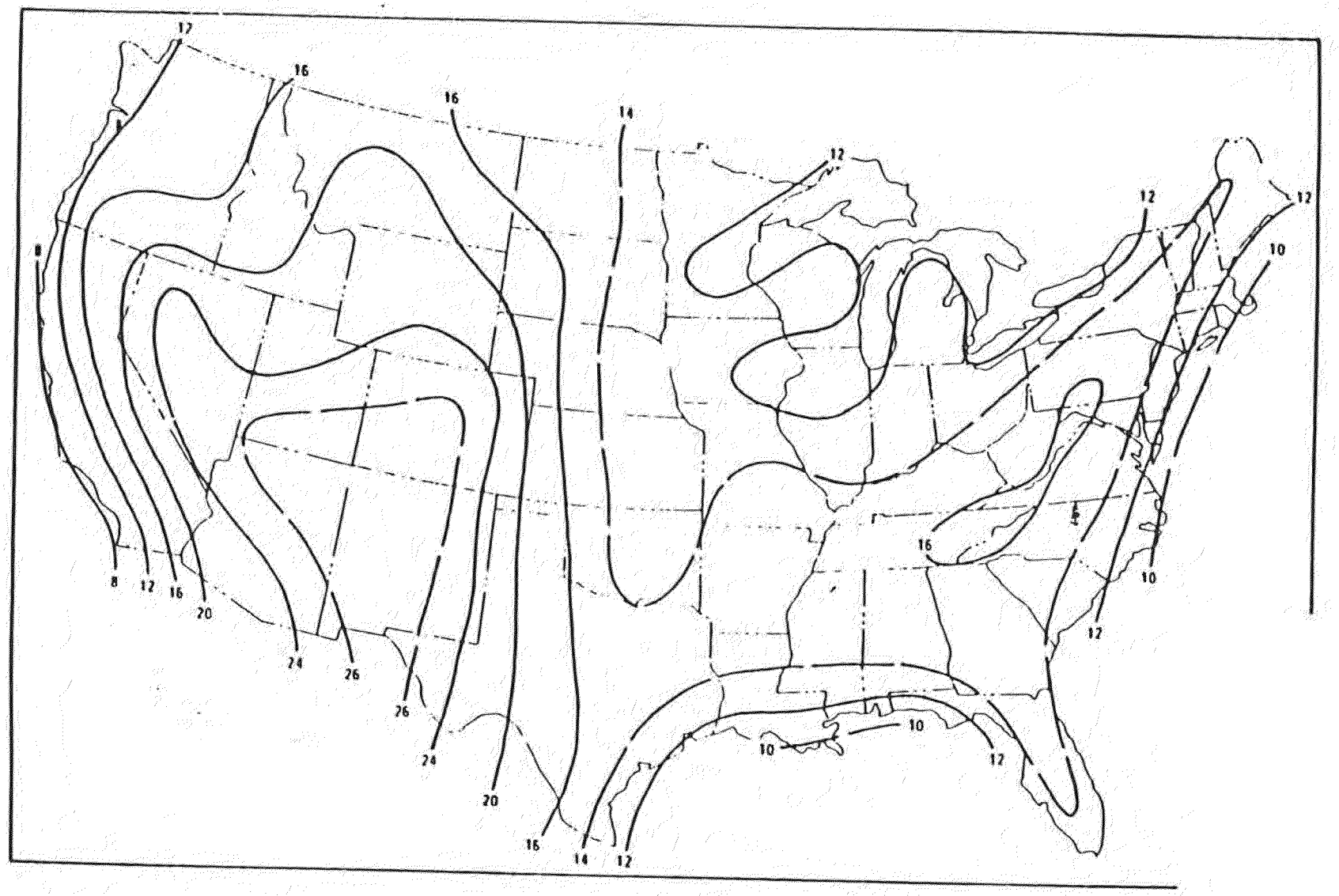

Figure 3-5. ISOPLETHS (M X 10^2) OF MEAN ANNUAL AFTERNOON MIXING HEIGHTS

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Table 3-4. LOW-LEVEL INVERSION FREQUENCY IN PROJECT AREA

Period	Frequency of Inversion (% of total time)	Frequency of Nighttime Inversion (% of total time) indicated by		
		Wind Speed ≤ 7 mph	Cloud Cover ≤ 3/10	Average
Spring	29	57	39	48
Summer	31	66	62	64
Fall	40	68	47	57
Winter	37	55	19	40
Annual	34	61	42	52

Source: Hosler, 1961.

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Other. The pan evaporation rate on the reservation is approximately 50 in./yr (BIA, 1976). The heating degree days at Spokane average over 6800/yr. The number of cloudy days in Spokane exceeds 190 days/yr.

3.2.3 Air Quality

Air quality data for the Spokane Reservation are lacking. The state of Washington operates a monitoring network in the area, with TSP stations at Spokane, Cheney, Clarkston and Colfax. The Washington Water Power Company (TWWPCo) is currently monitoring air quality near Creston, but recent data are not yet available.

Ambient Air Quality Data-Ambient air quality data have been collected at Spokane, Davenport and the Creston site. Data for Spokane are not appropriate for use on the reservation, since they represent an urban environment. Table 3-6, taken from TERA (1981), summarizes existing air quality, as measured in the Creston area by TWWPCo. All pollutants monitored were below ambient air quality levels. Only Total Suspended Particulates (TSP) levels are close to the standards.

Emissions of Air Pollutants. A complete emissions inventory has not been prepared for the reservation. Information collected for the Creston Project (TERA, 1981) indicated that only very minimal emissions of air pollutants from stationary sources were produce in the area. Clearly, the most significant sources of air pollutants were from vehicles travelling over unpaved roads, from agricultural activities and from forest management

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activities. None of these sources is subject to PSD control by permit.

Given the terrain of the area and the lack of existing sources on or near the reservation, it is assumed that reservation air quality is excellent.

Classification of Air Quality and Location of Air Quality Designated Areas. The Spokane Reservation is currently designated as a class II PSD area, with no violations of human health-related ambient air quality standards noted on the reservation. The Class II designation applies to most of the United States and implies that a moderate level of industrial growth would be permitted on the reservation.

All of the area near the reservation is also designated as Class II air quality. Over 100 mi from the reservation, Class 1 areas exist at Cabinet Mountains (Montana), Glacier Peak Wilderness Area, Pasayten Wilderness Area and North Cascades National Park. As previously indicated, the Class I designation is reserved for clean, pristine areas and would permit little or no industrial development on or near these areas.

The extent of these Class I areas would not affect energy development on the reservation.

Ambient Air Quality Standards. Air quality standards have been set by the federal and state governments to protect human health and welfare and to ensure that air quality is not significantly degraded. For most development on the reservation, two sets

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Table 3-5. STABILITY ARRAY (STAR) FOR SPOKANE, WASHINGTON
1968 - 1977

Period	Frequency of Stability Occurrence (Percent)					
	A	B	C	D	E	F
Annual	0.3	4.1	10.7	57.1	14.3	13.6
Winter	-	0.5	3.8	74.9	10.2	10.6
Spring	0.1	3.9	10.8	59.4	14.6	11.2
Summer	0.8	8.8	18.3	38.8	16.9	16.3
Fall	0.0	3.0	9.7	55.5	15.6	16.2

Period	Average Wind Speed (Knots)						
	A	B	C	D	E	F	Average
Annual	3.3	5.2	7.4	10.4	6.8	3.8	8.4
Winter	-	2.2	5.8	9.9	6.4	3.6	8.7
Spring	2.1	5.0	7.2	11.1	6.8	3.8	9.0
Summer	3.5	5.6	8.2	11.1	7.0	4.0	8.1
Fall	-	4.7	6.8	9.7	6.7	3.6	7.8

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Table 3-6. EXISTING AIR QUALITY RELATIVE TO APPLICABLE STAND IN THE CGS IMPACT AREA

Pollutant	Averaging Time	Estimated Existing Air Quality[a] (ug/m^3)	Standards[a,b] National Primary (ug/m^3)	National Secondary (ug/m^3)	Washington State (ug/m^3)
TSP	Annual	36[c,h]	75	60	60
	24-Hour	112[g]	260	150	150
SO_2	Annual	5.2[c,d]	80	—	52
	24-Hour	15.6[c,d,e]	365	—	260
	3-Hour	20.8[c,d,e]	—	1,300	—
	1-Hour	20.8[c,d,e]	—	—	1,040
NO_2	Annual	4.0[c,d]	100	100	100
O_3	1-Hour	137[e,f]	235	235	235
CO	8-Hour	571[e,f]	10,000	10,000	10,000
	1-Hour	1,371[e,f]	40,000	40,000	40,000
Lead	3-Month (Calendar Quarter)	Negligible	1.5	1.5	—

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of ambient air quality standards apply: National Ambient Air Air Quality Standards (NAAQS) and Prevention of Significant Deterioration (PSD) increments.

National Ambient Air Quality Standards. Ambient air quality standards set by the federal government to protect human health and welfare are shown in table 3-7. The national primary standards are those set to protect human health only, and the national secondary standards are those set to protect human welfare (i.e., protection of vegetation, property, esthetics, etc.).

Prevention of Significant Deterioration (PSD) Increments. Through court-initiated action in 1974, the EPA promulgated regulations to prevent emissions of sulfur dioxide (SO_2) and total suspended particulates from significantly degrading air quality in those areas of the country where their concentrations were below national ambient air quality standards. Prevention of Significant Deterioration regulations require that an operator of certain new or modified facilities demonstrate compliance with the law and obtain a permit from the EPA or its delegated authority before construction and operation of the facility can commence. These regulations stipulate that the source (1) would not cause ambient air quality levels which would significantly degrade existing air quality and (2) would use Best Available Control Technology to limit emissions.

There are three area classifications for the prevention of Significant Deterioration: Class I, Class II and Class III.

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Generally speaking, Class I is the designation for clean, pristine areas and would permit little or no development; Class II designation is for clean areas where a moderate amount of development would be permitted; and Class III is the designation for clean areas where a significant amount of development would be permitted, as long as national ambient air quality standards were not exceeded.

The PSD classifications were initially defined in the Clean Air Act as follows:

- Class I: International parks, all national wilderness areas over 5,000 A, all national memorial parks over 5,000 A and all national parks over 6,000 A;
- Class II: All other areas in country which are not exceeding the National Ambient Air Quality Standards; and
- Class III: None.

The Clean Air Act specified that Indian tribes could redesignate from Class II to Class I, if certain procedures were followed. To date, the Northern Cheyenne, Fort Peck and Flathead Indian reservations have been redesignated as Class I.

The PSD standards are defined as ambient air increments above the baseline air quality. The PSD incremental standards were shown in table 2-1. Since some of the values in table 2-1 are below air quality instrumentation sensitivity, the primary determination of compliance with PSD standards is by air pollution dispersion

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modeling. In fact, the levels measured are very low and are close to minimum detectable ranges of the monitoring equipment.

Visibility. Visibility or visual-range-related measurements have been made at Spokane and Seattle. (visual range is the greatest distance one can discern objects or targets.) Visual range data collected at these and other national sites were used to develop the information presented. The Spokane Reservation is located in an area of average visual range (greater than 25 mi. on the average).

It is concluded from this information that air quality on the reservation is excellent. However, any energy development proposed in the area could affect air quality on the reservation. In order to properly track energy growth, a reservation ambient air quality monitoring program should be initiated.

3.3 FISH AND WILDLIFE RESOURCES

This section presents a baseline description of the wildlife resources of the Spokane Reservation, based on existing published and nonpublished reports. Since site-specific wildlife data have not been collected on a majority of the reservation, this description should be considered preliminary until a detailed survey is conducted.

3.3.1 Habitats

The Spokane Reservation is dominated by coniferous forest which provides habitat for a wide variety of wildlife species. The coniferous forest can be divided into two types of habitat, the

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open and closed canopy coniferous forests. The open canopy coniferous forest is generally located on southern exposures, with stands of ponderosa pine and Douglas fir predominating and an understory of grass species. The closed canopy coniferous forest is usually on north slopes on moist sites and consists primarily of grand fir and Douglas Fir. Other important habitats on the reservation are openings created by logging and agricultural practices, lakes, ponds and marshes. In addition, many creeks are found within the reservation, and the Spokane River and Franklin D. Roosevelt (FDR) Lake, the reservoir created by Grand Coulee Dam, border the reservation. These waters provide excellent aquatic habitats for fishes and other aquatic species and also provide riparian habitat for terrestrial animals that depend on the edges between terrestrial and aquatic habitats.

3.3.2 Mammals

Mammals known or expected to occur in the general vicinity of the Spokane Reservation are listed in table 3-8.

Major big game species occuring in the area include white-tailed deer, mule deer and black bear. Other less common big game species on the reservation are elk and moose. There are occasional sightings of elk on the reservation (BIA, 1983); these are probably resident elk.

According to Poelker and Hartwell (1973), the subspecies of black bear that occurs within the reservation proper is the *Ursus americana cinnomomum*. The black bear population in the

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general area has been on the increase. This increase is reflected in the Harvest data of the Huckleberry Mountain Management Area just north of the reservation (Zender, 1984). Zender indicated more bears in young age classes are taken during harvest in the management area. Although the bear population is on the increase, poaching and lack of berry-producing forage species for fall use are thought to be the primary limiting factors of the Huckleberry Mountain management area. This may also be the case for the reservation.

The reservation provides year-round habitat for both species of deer. The population ratio is approximately 90% whitetail and 10% mule deer in the Huckleberry Mountain Management Area (BLM,n.d.). The mule deer population has been decreasing, whereas the whitetail population has been increasing for the last three years (Zender, 1984). Zender attributes this to change in habitat. For example, logged areas are being replaced by brushy vegetation which the whitetail prefers. There is also succession of conifers into open areas typical of mule deer ranges in northeastern Washington (BLM,n.d.). In addition, the whitetail tends to be more adaptable to human presence and to change in habitat.

Carnivorous species present on the reservation are coyote, cougar, bobcat, raccoon, weasel, mink, marten, badger and skunk. Major species of small mammal in the area include porcupine, cottontail, jackrabbit, beaver, muskrat and numerous smaller rodents such as chipmunk, squirrel, pocket gopher, mice and rats.

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Table 3-7. NATIONAL AMBIENT AIR QUALITY STANDARDS[a]

Averaging Pollutant	Time	Primary	Secondary
Carbon Monoxide	1 - hour 8 - hour	9 ppm 35 ppm	same as primary same as primary
Lead	90 - day	1.5 ug/m^3	same as primary
Nitrogen Oxide	Annual	0.05 ppm (100 ug/m^3)	same as primary
Ozone	1 - hour	0.12 ppm (240 ug/m^3)	0.08 ppm (160 ug/m^3)
Sulfur Dioxide	3 - hour 24 - hour Annual	0.5 ppm (1,300 ug/m^3) 0.14 ppm (365 ug/m^3) 0.03 ppm (80 ug/m^3)	- - -
Total Suspended Particulates	24 - hour Annual	260 ug/m^3 75[b] ug/m^3	150 ug/m^3 60[b] ug/m^3

[a] All long-term standards (i.e., greater than 30 days) are not to be exceeded. Unless otherwise noted, all short-term standards (i.e., 1-, 8-, and 24-hour) are not to be exceeded more than once per year. Unless otherwise noted, all averages are computed on an arithmetic basis.

[b] Geometric average, the secondary value is a guideline.

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Table 3-8. MAMMALS KNOWN OR EXPECTED TO OCCUR IN THE GENERAL VICINITY OF THE SPOKANE RESERVATION.

COMMON NAME	SCIENTIFIC NAME
Order Insectivora	
Masked Shrew	Sorex cinereus
Merriam's Shrew	Sorex merriami
Vagrant Shrew	Sorex vagrans
Water Shrew	Sorex palustris
Pygmy Shrew	Microsorex hoyi
Order Chiroptera	
Little Brown Myotis	Myotis lucifugus
Yuma Myotis	Myotis yumanensis
Long-eared Myotis	Myotis evotis
Fringed Myotis	Myotis thysanodes
Long-legged Myotis	Myotis volans
California Myotis	Myotis californicus
Small-footed Myotis	Myotis subulatus
Silver-haired Bat	Lasionycteus noctivagans
Big brown Bat	Eptesicus fuscus
Hoary Bat	Nycteris cinerea
Townsend's Big-eared Bat	Plecotus townsendi
Pallid Bat	Antrozous pallidus
Order Lagomorpha	
Nuttall's Cottontail	Sylvilagus nutalli
Snowshoe Hare	Lepus americanus
White-tailed Jackrabbit	Lepus townsendii
Order Rodentia	
Yellow-pine Chipmunk	Eutamias amoenus
Red-tailed Chipmunk	Eutamias ruficaudus
Yellow-bellied Marmot	Marmota flaviventris
Red Squirrel	Tamiasciurus hudsonicus
Northern Flying Squirrel	Glaucomys sabrinus
Northern Pocket Gopher	Thomomys talpoides
Great Basin Pocket Mouse	Perognathus parvus
Beaver	Castor canadensis
Western Harvest Mouse	Reithrodontomys megalotis
Deer Mouse	Peromyscus maniculatus
Bushy-tailed Wood Rat	Neotoma cinerea

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Table 3-8 (Continued)

COMMON NAME	SCIENTIFIC NAME
Gapper's Redback Vole	Clethrionomys gapperi
Heather Vole	Phenacomys intermedius
Meadow Vole	Microtus pennsylvanicus
Montane Vole	Microtus montanus
Long-tailed Vole	Microtus longicaudus
Richardson Vole	Microtus richardsoni
Muskrat	Ondatra zibethicus
House Mouse	Mus musculus
Western Jumping Mouse	Zapus princeps
Porcupine	Erethizon dorsatum
Order Carnivora	
Coyote	Canis latrans
Gray Wolf	Canis lupus
Red Fox	Vulpes vulpes
Black Bear	Ursus americanus
Raccoon	Procyon lotor
Marten	Martes americana
Fisher	Martes pennanti
Ermine	Mustela erminea
Long-tail Weasel	Mustela frenata
Mink	Mustela vison
Wolverine	Gulo luscus
Badger	Taxidea taxus
Striped Skunk	Mephitis mephitis
River Otter	Lutra canadensis
Mountain Lion (Cougar)	Felis concolor
Bobcat	Lynx rufus
Order Artiodactyla	
Elk	Cervus elaphus
Mule Deer	Odocoileus hemionus
White-tailed Deer	Odocoileus virginianus
Moose	Alces alces

Source: Dames and Moore (1974); Hall (1981)

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3.3.3 Birds

Bird species whose geographic range overlap the reservation are listed in Appendix E.

The area offers good habitat for a variety of bird species. Habitat features associated with major drainages are adequate to support nesting species of raptors, including redtailed hawk and golden eagle. Other common raptors include kestrel, sharp-shinned hawk, Cooper's hawk, goshawk and Great horned owl.

The most common upland game species on the reservation is probably the ruffed grouse. The nearby Huckleberry Mountain Management Area has good populations of ruffed grouse (Zender, 1984). Blue grouse are more prevalent in open areas of the ponderosa pine/ Douglas fir habitat and populations are probably low near rivers. Other upland game species present are ringed-neck pheasant, Chinese pheasant, Merriam's turkey, Hungarian partridge, mourning dove and California quail. Chukar may also be present in small numbers on the reservation (Zender, 1984).

Waterfowl and shorebirds utilize the waters of the reservation. Major bodies of water in the area are FDR Lake and the Spokane River, which is a tributary of Columbia River and an arm of FDR Lake. Principal resident waterfowl on the reservation probably include mallard, golden-eye, pintail, widgeon, green-winged teal, blue- winged teal, cinnamon teal, wood duck, redheads, scaup and ring-billed gull. Canada geese and swan probably include killdeer, common snipe, spotted sandpiper, least sandpiper, western

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sandpiper, Wilson's phalarope, ring-billed gull and black tern.

3.3.4 Reptiles and Amphibians

A list of reptiles and amphibians whose geographic ranges overlap the reservation is presented in table 3-9.

Surface waters scattered throughout the reservation provide good habitat for amphibian and reptile populations. These areas are known to have more abundant and diverse populations of amphibians and reptiles than do the coniferous forest and open shrublands in the Sherwood project site (BIA,n.d.). Common amphibian species probably includes the Pacific tree frog, spotted frog and bullfrog. Major species of reptile on the reservation are probably the painted turtle, garter snake and gopher snake.

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Table 3-9. AMPHIBIANS AND REPTILES WHICH ARE KNOWN OR EXPECTED TO OCCUR ON THE SPOKANE RESERVATION

COMMON NAME	SCIENTIFIC NAME
Class Reptilia	
Painted Turtle	Chrysemys picta
Western Skink	Eumeces skiltonianus
Rubber Boa	Charina bottae
Racer	Coluber constrictor
Gopher Snake	Pituophis melanoleucus
Western Terrestrial Garter Snake	Thamnophis elegans
Common Garter Snake	Thamnophis sirtalis
Western Rattlesnake	Crotalus viridis
Class Amphibia	
Long-toed Salamander	Ambystoma macrodactylum
Tiger Salamander	Ambystoma tigrinum
Western Toad	Bufo boreas
Pacific Tree Frog	Hyla regilla
Bullfrog	Rana catesbeiana
Spotted Frog	Rana pretiosa

Source: Nussbaum, Brodie and Storm (1983); Dames and Moore (1974)

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3.3.5 Fisheries

The status of fisheries on the reservation is largely unknown. Information on fish species composition in the Columbia and Spokane rivers does not exist (BIA, 1976). A list of representative fish species on the reservation is presented in table 3-10. The Washington Department of Game and Fish has been stocking lakes and ponds on the reservation for over 20 years (Johns, 1984). Table 3-11 indicates the types and numbers of fish stocked in the waters on the reservation since 1980. Species stocked are primarily rainbow trout and eastern brook trout.

3.3.6 Threatened and Endangered Species

The Endangered Species Act of 1973 (Public Law 93-205) provides for the protection of endangered and threatened species, not only true species, but subspecies and distinct populations thereof. The act establishes two groups of protected species: an endangered species is "any species which is in danger of extinction throughout all or a significant portion of its range"; a threatened species is "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."

Washington's threatened and endangered categories are very similar to the federal classification. An endangered species is a species "seriously threatened with extirpation throughout all or a significant portion of its range within Washington"; a threatened

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Table 3-10. REPRESENTATIVE FISH SPECIES OF THE SPOKANE RESERVATION

COMMON NAME	SCIENTIFIC NAME
White Sturgeon	Acipenser transmontanus
Lake Whitefish	Coregonus clupeaformis
Coho Salmon *	Oncorhynchus kisutch
Sockeye Salmon (kokanee) *	Oncorhynchus nerka
Mountain Whitefish	Prosopium williamsoni
Rainbow Trout	Salmo gairdneri
Eastern Brook Trout	Salvelinus sp.
Brown Trout	Salmo trutta
Chiselmouth	Acrocheilus alutaceus
Carp	Cyprinus carpio
Peamouth	Mylocheilus caurinus
Northern Squawfish	Ptychocheilus oregonensis
Dace	Rhinichthys sp.
Largescale Sucker	Catostomus macrocheilus
Sucker	Catostomus sp.
Black Bullhead	Ictalurus melas
Burbot	Lota lota
Pumpkinseed	Lepomis gibbesus
Largemouth Bass	Micropterus salmoides
Black Crappie	Pomoxis nigromaculatus
Yellow Perch	Perca flavescens
Walleye	Stizostedion vitreum vitreum
Sculpin	Cottus sp.

* planted but possibly not established

Source: Dames and Moore (1974)

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Table 3-11. STOCKING DATA OF SPOKANE RESERVATION WATERS.

YEAR	FISH SPECIES STOCKED	STOCKING LOCATION GALBREATH	BC Mill	TURTLELAKE	BENJAMIN	MCCOY
1980	Rainbow Trout	1,000		4,015	4,015	
	Eastern Brook Trout	585				10,050F*
1981	Rainbow Trout	1,503	504	4,000	4,000	
	Eastern Brook Trout	315				10,680F
1982	Rainbow Trout	715	132	4,012	4,012	5,003
	Eastern Brook Trout	220	435			3,005
		(plus 10,000F)				(plus 10,430F)
1983	Rainbow Trout	1,080	540	6,075	6,075	
	Eastern Brook Trout	1,000				3,000
						(plus 10,500F)

* F = fingerlings; all other numbers represent legal or catchable fish stocked.
Source: Johns (1984); Albert (1984)

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species is "not presently endangered but could become so in the foreseeable future" (Washington Department of Game, n.d.). All species federally classified as federally endangered or threatened are protected by Washington state law.

There are five vertebrate species listed as federally and/or state endangered whose geographic ranges overlap the reservation. they are the American white pelican, peregrine falcon, sandhill crane, upland sandpiper and wolf. Information presented on these species is largely from "Washington's Threatened and Endangered Wildlife" (Washington Department of Game, n.d.).

* The white pelican, classified as state endangered, occurs in Washington as a spring and fall migrant, primarily east of the Cascade Mountains, and as a summer resident in the Columbia Basin. Historically, this species bred regularly on Moses Lake and on several other lakes in eastern Washington. Loss of breeding habitat, as a result of land reclamation and irrigation projects, is thought to be the major reason for the decline of the white pelican in Washington.
* The pergrine falcon is listed as federally and state endangered. In Washington, there are three subspecies of the peregrine falcon: the Arctic peregrine stops over in Washington during migration to and from its wintering area; the Peale's peregrine (state endangered) is limited to marine habitat in Washington, British Columbia and Alaska; the American peregrine (federally endangered), once found

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throughout North America, is largely confined to the western states and provinces. They nest on cliffs, particularly along the ocean and less commonly inland; along the coast, they forage over adjacent tideflats and beaches and, in the interior, over marshes and prairies (Larrison, 1981). Their decline is primarily related to the use of pesticides.

* The sandhill crane, classified as state endangered, concentrates in central Washington during migration, with smaller flocks migrating along both sides of the Cascade Mountains. Basic habitat requirements of the sandhill crane include large areas of shallow water, nesting cover, feeding pasture and isolation from human disturbance. Destruction of habitat, such as swamp drainage and prairie cultivation, is the main reason for decline in sandhill crane populations. Also, other human disturbances, such as illegal shooting, threaten this species.

* The upland sandpiper is listed as state endangered. The habitats of this species include prairies, grassy uplands and open bogs. Only one breeding site is known, in Spokane, and this site is threatened by development. Agricultural practices and commercial development have eliminated most of its habitat.

* The wolf is classified as federally and state endangered. This species is occasionally sighted in the Selkirk and Cascade mountains. Their decline is largely due to conversion

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of habitat to farms and logging areas and to predator control practiced by early settlers.

Two species, the bald eagle and the ferruginous hawk, are listed as threatened species. The bald eagle breeds primarily west of the Cascade Mountains and winters along major rivers and coastlines throughout the state. Some of the reasons the bald eagle is threatened are illegal shooting, use of pesticides and destruction of habitat. The ferruginous hawk nests east of the Cascades and prefers habitat consisting of flat, arid, sagebrush country with occasional rock outcrops or scattered trees.

In addition to the threatened and endangered species, some species have been assigned special species status by the state (Washington Department of Game, 1983). Special species categories include Proposed Endangered (proposed for State Endangered classification), Proposed Threatened (proposed for State Threatened classification), Sensitive Species ("a species that could become threatened if current water, land, and environmental practices continue"), Proposed Sensitive (proposed for State Sensitive classification), Monitor Species ("species of special interest because they: have significant popular appeal; require limited habitat during some portion of their life cycle; are indicators of environmental quality; require further field investigations to determine population status; have unresolved toxonomic problems which may bear upon status classification; or were justifiably removed from endangered, threatened, or sensitive

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classification") and Proposed Monitor (proposed for State Monitor classification). Species with special species status that are known or expected to occur on the reservation are listed below.

* Proposed Threatened: Townsend's big-eared bat.
* Proposed Sensitive: Merriam's shrew, Long-eared myotis, pallid bat, whitetailed jackrabbit, marten, wolverine, horned grebe, trumpeter swan, goshawk, Swainson's hawk, golden eagle, gyrfalcon, prairie falcon, merlin, flammulated owl, burrowing owl, gray owl, pileated woodpecker, downy woodpecker, northern three-toed woodpecker, ash-throated flycatcher, sage thrasher, loggerhead shrike and grasshopper sparrow.
* Proposed Monitor: Yuma myotis, fringed myotis, long-legged myotis, smallfooted myotis, red-tailed chipmunk, western grebe, great blue heron, turkey vulture, long-billed curlew, Forster's tern, caspian tern, snowy owl, black-backed three-toed woodpecker, western bluebird and tiger salamander.

3.4 VEGETATION

3.4.1 Coniferous Forest.

The vegetation on the reservation is largely coniferous forest, varying from relatively moist fir forest to stands of ponderosa pine on drier sites.

Stands of ponderosa pine (also known as western yellow pine) are generally located on southern slopes at the lower elevations of the coniferous forest, with a predominantly grass understory

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(Zender, 1984). They usually occupy drier sites than other forest types (Franklin and Dyrness, 1973). Common grass species include bluebunch wheatgrass, beardless wheatgrass, Idaho fescue, neddlegrass, needle-and-thread, prairie junegrass, sandberg bluegrass, rough fescue, red three-awn and pinegrass (Soil Conservation Service, 1981). Principal shrubs noted by the Soil Conservation Service are rose, common snowberry, snowbrush ceanothus, redstem ceanothus, spirea and serviceberry. In the sherwood mine and mill lease area, located in the southwestern part of the reservation, bitter brush is the dominant understory species, with an herbaceous cover consisting mostly of grass species (Dames and Moore, 1974). Daubenmire and Daubenmire (1968) include this ponderosa pine/bitterbrush association in the pine-grass group; they found that much of this area has been heavily grazed and used extensively for logging and crops, activities which may have contributed to deteriorated range conditions.

Forb species in the ponderosa pine forest may include common yarrow, eriogonum, lupine and arrowleaf balsamroot. Other tree species sometimes found in association with ponderosa pine stands are quaking aspen, lodgepole pine, western larch, grand fir and Douglas fir, which are usually restricted to specific habitat types within the ponderosa pine forest. For example, pure stands of lodgepole pine are widely distributed throughout forested areas of eastern Washington (Franklin and Dyrness 1973). The

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majority of these stands have developed after fire or logging. Also, aspen groves occur in riparian areas throughout the ponderosa pine forest (Franklin and Dyrness, 1973). Douglas fir, lodgepole pine, western larch and grand fir can be found at higher elevations on moist sites throughout the ponderosa pine forest.

The fir forest generally classified as a closed canopy coniferous forest is commonly located on moist sites on north-facing slopes and consists primarily of Douglas fir and grand (or white) fir. Other common tree species include lodgepole pine, western larch and ponderosa pine. Many other species, such as Englemann spruce, subalpine fir, sugar pine, western white pine, red cedar, mountain hemlock and red fir are probably present in limited numbers or in specific habitat types. Common snowberry, creambush oceanspray, spirea, rose, kinnikinnick, strawberry, huckleberry, mallow nine bark, pachystima and currant are characteristic shrub species found in the fir forest. The most dominate herbaceous understory species is probably pinegrass. Other common herbaceous (both forb and grass) species include lupine, violet, wild ginger, piper anemone, trail plant, penstemon, elk sedge, Idaho fescue, needle-and-thread and broadleaf arnica.

3.4.2 Shrubland and Grassland

Open areas found on the driest sites in the area include grass and bitterbrush-grass communities (BIA, 1976). The dominant species found in this vegetation type is bitterbrush, with an understory ground cover of yellow salsify, tufted phlox, autumn

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willow herb, snow buckwheat, tumbleweed, annual brome grasses, needlegrass, prairie Junegrass, yarrow, rabbitbrush, bluegrass and fescue. In small depressions, small patches of Columbia Hawthorne are found, and scattered ponderosa pine is found on hillsides.

Subshrubs, primarily rabbitbrush, buckwheat and velvet lupine, are scattered among a sparse to moderate cover of grasses and forbs on large, open plateaus (BIA 1976). These herbaceous species include bluegrass, fescue, prairie Junegrass, brome, wheatgrass, yarrow, arrowleaf balsamroot, cut-leaf daisy and Indian wheat. Some of these open areas have been converted to agricultural lands to cultivate alfalfa for cattle feed (BIA, 1976).

3.4.3 Riparian and Marsh

The riparian areas on the reservation generally consist of hardwood tree species. Mountain alder, willow, aspen, cottonwood and limited amounts of hawthorne are found on moist sites, generally located on north slopes. On southern slopes, aspen, cottonwood, willow, dogwood and hawthorne in greater numbers occur (Zender, 1984). Mountain alder and dogwood are usually found along perennial streams. Shrub species in this habitat type include common snowberry, pearhip rose, squaw currant, serviceberry, mock orange, mallow ninebark, Oregon grape, spirea, thimbleberry, Douglas' maple, chokecherry, strawberry and kinnikinnick (BIA, 1976. Marsh vegetation is found around small lakes and ponds and probably consists of cattails and rushes.

3.5 SOILS

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The soils of the Spokane Reservation are located in the Northern Rocky Mountains Major Land Resource Area (USDA, 1981). These soils are found on mountains, foothills, terraces and flood plains. The soils are found on mountains, foothills, terraces and flood plains. The soils are mostly very deep, although the soils on mountains are moderately deep and well-drained. The mean annual soil temperature ranges between 0°and 8°C.

The Soil Conservation Service has surveyed the reservation soils (USDA, 1982). Soil descriptions presented here were obtained from this document. Appendix F lists the individual soils with pH ranges at various depths; the soils are mapped by associations in figure 3-6. The soils are described as follows.

* Spokane-Moscow-Rock Outcrop Association. These soils are moderately deep, well-drained and nearly level to very steep. Drainageways are deeply dissected. The soil parent material was mostly weathered granite, loess, volcanic ash and rock outcrops. These soils are in the mountainous areas, mostly in the southcentral and northcentral parts of the reservation. They are found on rounded ridgetops and smooth mountain toe slopes, foot slopes and side slopes at elevations from 1,800 to 4,000 ft. Land use is mainly for grazing of woodland areas; suitable lands are used for cropping and homesite development. Other land uses are wildlife habitat, water management and recreation. Spokane soils are found on slopes with southern aspects and on ridgetops. The surface soil

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layer is loam, covered with a mat of partially decomposed organic litter. The subsoil is a gravelly sandy loam; weathered granite is at depths of 20 to 40 in. Moscow soils are similar to Spokane soils, but are on north-facing slopes. They also have a surface soil layer of very fine sandy loam, and the subsoil is silt loam underlain by sandy loam. Rock outcrops are exposed granite.

* Huckleberry-Raisio-Hartill Association. These soils are similar to the Spokane-Moscow-Rock Outcrop soils in location, depth, drainage, topography and slope characteristics. However, the soils in this association were formed in weathered shale rather than granite. These soils have a layer of partially decomposed organic litter, and phyllite material is below the soils. They are found in the same elevations and higher, up to 6,000 ft. Huckleberry soils are on north-facing slopes. They are formed in residuum weathered from shaly rock and are mantled with volcanic ash and loess. The surface soils and subsoil are silt loams. Raisio soils are south-facing and are formed in residuum weathered from shaly rock that is modified in places by glacial till and volcanic ash. The surface soils are shaly loam over a very flaggy loam subsoil. Hartill soils are mainly north-facing, at elevations of 2,000 to 3,000 ft. They are formed in colluvium and residuum weathered from shaly rock and are mantled with volcanic ash. They very fine sandy loam surface soil is

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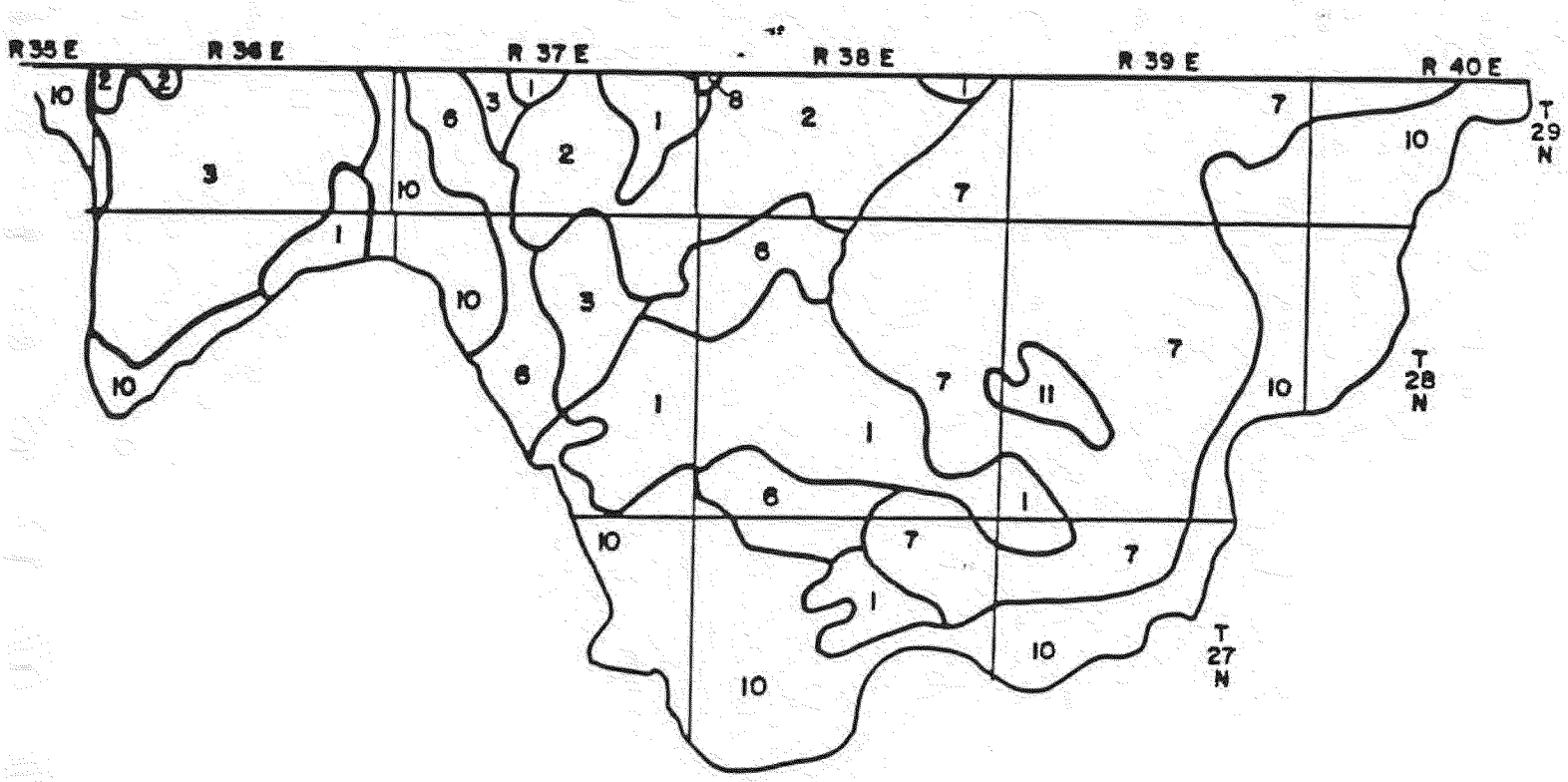

Figure 3-6. SOIL ASSOCIATIONS OF THE SPOKANE RESERVATION

Legend

Soil Associations

1. Spokane-Moscow - Rock Outcrop
2. Huckleberry - Raisio-Hartill
3. Aits-Newbell-Donovan
6. Stevens-Rock Outcrop
7. Bernhill-Green Bluff- Dearyton
8. Clayton-Cedonia - Martella
10. Springdale - Spens - Bisbee
11. Colville-Peone-Narcisse

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underlain by a silt loam.

* Aits-Newbell-Donovan Association. These very deep soils are found on foothills with slopes from nearly level to very steep. They are formed in mixed glacial till, with a mantle or admixture of volcanic ash and loess. These well-drained soils are covered with a mat of partially decomposed organic letter. The land use is mainly for grazing of woodlands; other uses are for recreation, wildlife, watershed, homesite development and nonirrigated cropland. The elevation ranges from 2,000 to 5,000 ft. Aits soils are well-drained soils on toe slopes and side slopes of foothills. Newbell and Donovan soils are similar to Aits soils. However, Newbell soils were derived from weathered granite and their surface soil and subsoil are silt loam, and Donovan soils have a surface layer that is loam in the upper part and gravelly loam in the lower part.

* Stevens-Rock Outcrop - Dragoon Association. These nearly level to very steep soils occur on foothills along the Columbia and Spokane rivers and in alpine meadows at elevations ranging from 1,700 to 3,000 ft. The soils are moderately deep to very deep and well-drained. They are formed in residuum from granite and glacial till and rock outcrop. Land use for these sites occurring in woodland areas is mainly grazing land; some areas are used for nonirrigated and irrigated cropland. Other uses are recreation, rangeland,

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watershed, wildlife habitat and homesite development. Stevens soils are on south-facing slopes and on ridgetops of foothills. They are very deep and well-drained and are formed in mixed glacial till with mixed loess and volcanic ash. The surface soil layer is silt loam and is underlain by a gravelly loam layer. Rock Outcrop are outcrops of granite, argillite, quartzite, limestone and phyllite. Dragoon soils are nearly level to steep, moderately deep and well-drained soils on foothill slopes. They are formed in residuum weathered from granite with mixed loess and volcanic ash. The surface soil is silt loam underlain by a clay loam subsoil, and beneath this is weathered granite.

* Bernhill-Green Bluff-Dearyton Association. The association is similar to the Aits-Newbell-Donovan association. these soils are found on foothills and basalt plateaus, and range in elevation from 1,800 to 3,000 ft. They are formed in glacial till and are mantled with volcanic ash and loess. The surface layer is silt loam; the subsoil is gravelly loam. The land uses are the same as those of the previously mentioned association. Green Bluff soils are nearly level to strongly sloping on basalt plateaus. Soil, beneath a layer of matted partially decomposed organic litter, is very fine sandy loam; the subsoil is silt loam. Dearyton soils are nearly level to steep on toe slopes of basalt plateaus and foothills. They are moderately well-dranined. The surface layer and upper

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part of the subsoil are are silt loam, over a loam subsurface layer.

* Clayton - Cedonia - Martella Association. These soils occur to a very limited degree on the northcentral border of the reservation. These are very deep soils located along terraces and terrace escarpments of main drainageways. They are well-drained to moderately well-drained, nearly level to very steep soils formed in lake sediment and glaciofluvial material. The elevations range from 1,400 to 3,000 ft. The main land use is grazing of woodlands and for nonirrigated and irrigated cropland; other uses are for recreation, homesite development, watershed and wildlife habitat. Clayton soils are well-drained soils that are nearly level to strongly sloping. They are formed in mixed glociofluvial material. The surface soil, of very fine sandy loam, is overlain by a mat of partially decayed organic litter; the subsoil is fine sandy loam. On terraces, Cedonia soils are nearly level to moderately steep; steep to very steep soils occur on terrace escarpments. These well-drained silt loams are formed in glacial lake sediment and are mantled with volcanic ash and loess. Martella soils are moderately well-drained soils that are nearly level to steep. They formed in glacial lake sediment and are mantled with volcanic ash and loess. The surface soils, of very fine sandy loam, are overlain by a matted layer of partially decayed organic

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litter. The subsoil has an upper part of silt loam and a lower part of silt loam and silty clay loam.

* Springdale-Spens-Bisbee Association. These soils are on terraces and terrace escarpments near the Columbia River, Spokane River and Chamokane Creek. They are somewhat excessively-drained soils formed in glacial outwash. The elevation ranges from 1,400 to 2,300 ft; the tribal farm is located in these soils. In other respects, these soils are similar to the previous association. Springdale soils are nearly level to strongly sloping and were formed in glacial outwash with an admixture of volcanic ash and loess. The surface soil, of gravelly sandy loam, is covered with a mat of partially decayed organic litter. The Subsoil has an upper layer of gravelly sandy loam and a lower layer of very gravelly loamy coarse sand and extremely cobbly coarse sand. Moderately steep to very steep Spens soils occur on terrace escarpments. These soils are formed in wind worked mixed sandy outwash material. The surface soil, of loamy fine sand, is covered with a matted, partially decomposed organic material and is underlain by loamy fine sand and sand.

* Colville-Peone-Narcisse Association. These soils make up a small percentage of the reservation. They are all very deep and nearly level and are found on bottom lands, flood plains, alluvial fans, perimeters of lakes and in depressional areas. A good example of these soils is located near Wellpinit. The

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soils are formed in mixed alluvium and alluvium from volcanic ash and are moderately well-drained to poorly drained. Colville soils are on bottom lands that formed in mixed alluvium. The surface soil, of silt loam, is underlain by silty clay loam. Narcisse soils are on bottom lands and in depressional areas. These moderately well-drained soils are formed in mixed alluvium. The surface soil, of silt loam, is underlain by a loam subsoil. Poorly drained Peone souls are on flood plains, in depressional areas and on alluvial fans. They are formed in mixed alluvium, including volcanic ash and diatomite. The surface soil layer is silt loam, and the subsoil has an upper layer of silt loam and a lower layer of sandy loam.

3.6 HYDROLOGY

The waters of the arid West are a valuable resource required to sustain existing activities, as well as to provide for future growth and development. With increased development and environmental awareness has come the realization that the West's limited water resources need to be protected.

The Spokane Reservation of Washington has more than adequate amounts of good quality surface and groundwater supplies that could be developed. The freshwater resources of the Spokane Reservation are one of the most important resources the tribe has available to them. In order that this, presently underused and underdeveloped resource will be available in years to come, it

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must be protected from possible contamination and degradation. The Spokane Reservation, located within the Columbia River basin, is bounded on the west by the Columbia River arm of Franklin D. Roosevelt Lake (FDR Lake), on the south by the Spokane River arm of FDR Lake and on the east by Chamokane Creek, a tributary of the Spokane River. FDR Lake is the reservoir formed by the Grand Coulee Dam, downstream and to the west of the reservation. The lake extends 151 mi north and east up the Columbia River almost to the International Border and up to the Spokane River to within 37 mi of Spokane, Washington.

3.6.1 Surface Waters

The only major perennial river in the area is the Spokane River, the discharge of which is regulated by upstream dams and usage. The U. S. Geological Survey has established and maintains three stream gaging stations on or adjacent to the reservation on the Spokane River or its tributaries (figure 3-7). Table 3-12 summarizes the annual discharge of these rivers, as measured at these stations. Water quality data have been reported by the U. S. Geological Survey and U. S. Environmental Protection Agency for the Spokane River at Long Lake, Washington. (Appendix F shows that the waters are a calcium bicarbonate type and contain less than 100 mg/l of the total dissolved solids.) From west to east across the reservation the major tributaries of the Spokane River are: Orazada Creek, Sand Creek, Blue Creek, Little Chamokane Creek, 6,400 A-ft; Blue Creek, 3,660 A-ft; Little Chamokane Creek, 10,300

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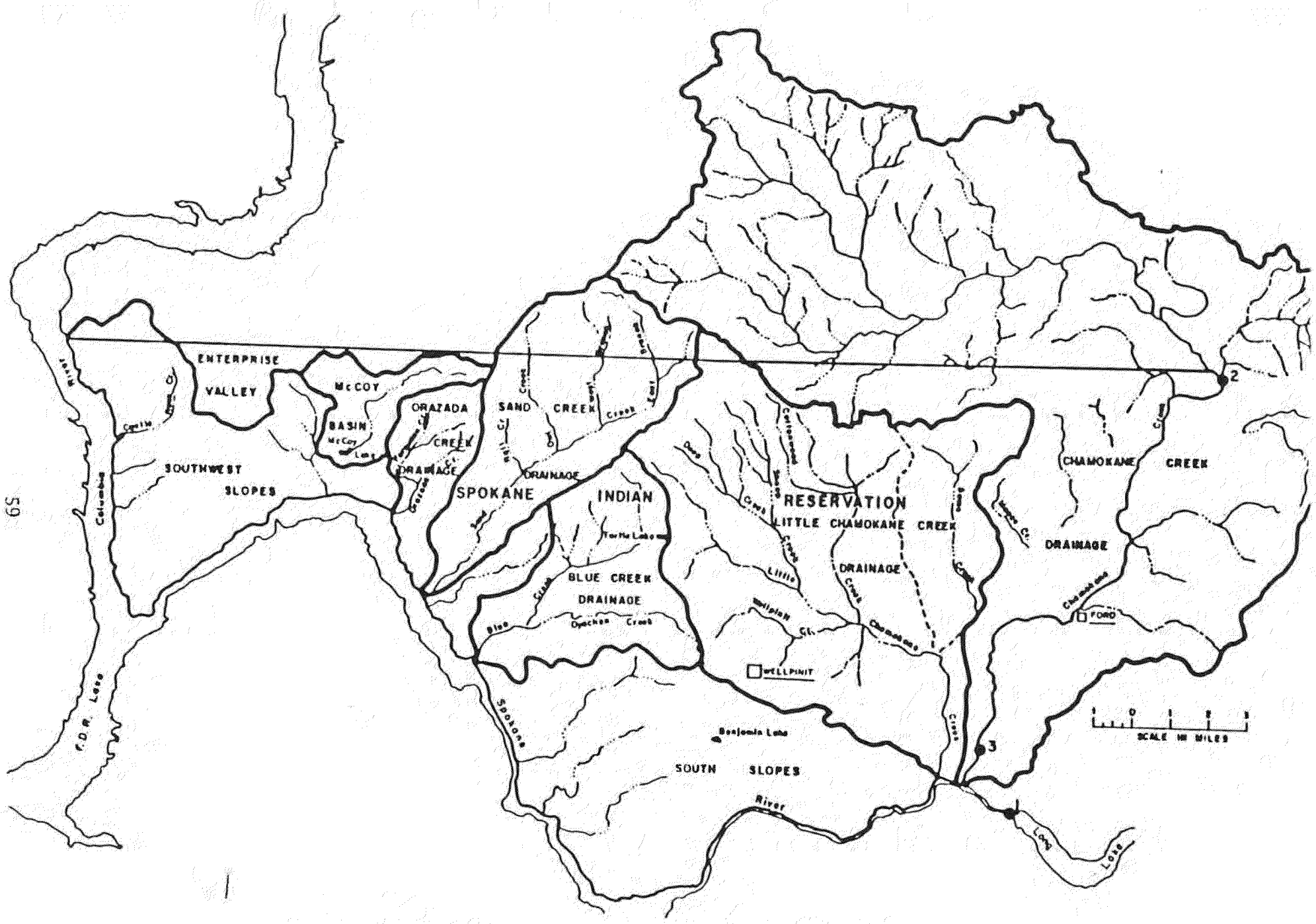

Figure 3-7. USGS GAGING STATIONS ON OR ADJACENT TO THE RESERVATION ON THE SPOKANE RIVER AND ITS TRIBUTARIES

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Table 3-12. MEAN DAILY RIVER FLOWS (cfs) AT SITES OF THE SPOKANE RESERVATION

Spokane River at Long Lake Washington. Period of record: 4/1939-present

	Oct.	Nov.	Dec.	Jan.	Feb.	March
Min.	1868(1943)	2059(1940)	2341(1940)	2991(1940)	2118(1977)	3808(1977)
Max.	4327(1960)	9065(1960)	15820(1965)	23830(1974)	19500(1961)	27400(1972)

	April	May	June	July	August	Sept.
Min.	4206(1977)	5812(1977)	3932(1944)	1798(1977)	1356(1973)	14769(1963)
Max.	29410(1943)	33520(1948)	27480(1974)	7951(1950)	3178(1948)	3122(1960)

Chamokane Creek near Springdale, Wash. Period of record: 1973-1979

	Oct.	Nov.	Dec.	Jan.	Feb.	March
Min.	0(1973&79)	0(1973&79)	0(1973&79)	0(1973&79)	0(1973&79)	0(1973&79)
Max.	7.63(1976)	38.70(1974)	247(1974)	218(1974)	105(1974)	298(1974)

	April	May	June	July	August	Sept.
Min.	0(1973&79)	0(1973&79)	0(1979)	0(1979)	0(1979)	0(1979)
Max.	506(1975)	282(1975)	21.30(1975)	9.62(1975)	7.45(1976)	4.86(1975)

Chamokane Creek below falls near Long Lake, Wash. Period of record: 1971-79

	Oct.	Nov.	Dec.	Jan.	Feb.	March
Min.	0(1971&79)	0(1971&79)	0(1971&79)	0(1971&79)	0(1979)	0(1979)
Max.	40.30(1976)	47.50(1974)	236(1974)	221(1974)	154(1974)	351(1974)

	April	May	June	July	August	Sept.
Min.	0(1979)	0(1939)	0(1979)	0(1979)	0(1979)	0(1979)
Max.	564(1975)	257(1975)	67.90(1975)	45.90(1975)	41.40(1975)	39.10(1975)

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A-ft. Woodward (1973) estimated the annual flow into McCoy Lake in the Orazada Creek drainage to 1,150 A-ft.

Chamokane Creek, the largest Spokane River tributary, represents 50% of the reservation waters. The creek flows through a fairly broad flood plain bordered on the west by plateau terrain. The plateau develops into mountainous terrain in the northcentral part of the reservation, which in turn gives way to steep rock bluffs and a series of terraces overlooking the Spokane River arm of FDR Lake in the southern part of the reservation (U. S. Bureau of Reclamation, 1975). Although water quality on the reservation is generally excellent, one exception has been noted. Previous studies at the Midnite Mine on the Spokane Reservation (CERT, 1980 and CERT, 1982) indicated seepage of leached contaminants from the mining activities into surface waters. Specifically, a yellow-white precipitate, containing a mixture of aluminum salt, gypsum and M_3O_8 was detected at the toe of a mine waste dump. This finding let to further monitoring, which demonstrated that elevated nitrate and ammonia levels exist in the surface waters of the area. The tribe is in the process of correcting this problem.

3.6.2 Groundwater

Groundwater is an important, though not fully defined, resource within the Spokane Reservation. The location, quantity, quality and recoverability of a groundwater resource are dependent upon the characteristics of the geologic formation that serves as the resource reservoir. The general geologic setting of the Spokane

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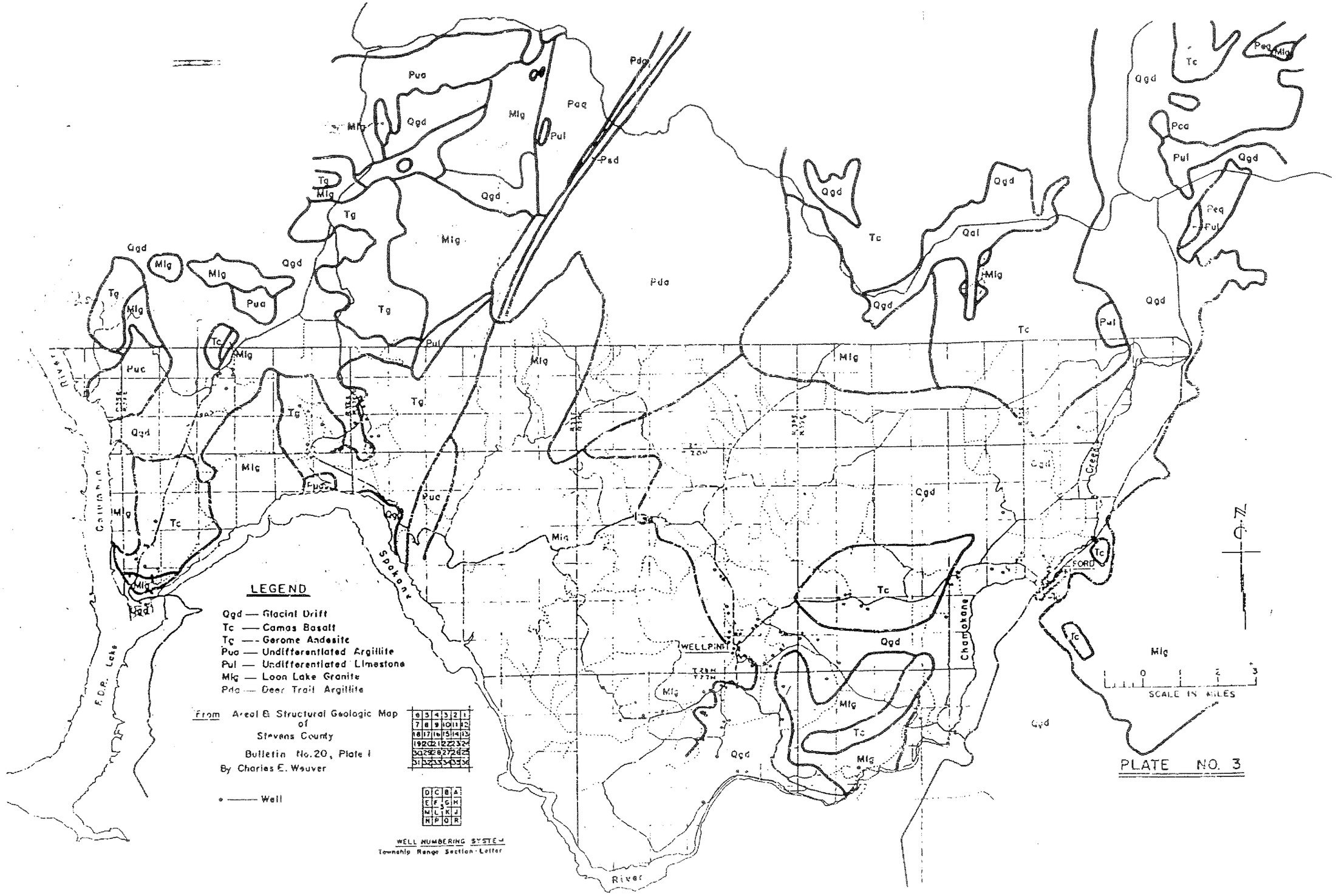

Figure 3-8. GEOLOGIC CONDITIONS AND MAJOR GROUNDWATER SOURCES OF THE SPOKANE RESERVATION

Reservation is summarized in a report by the U. S. Bureau of Reclamation (1975), which states:

> "The reservation lies in the southern part of the Okanogan Highlands physiographic division. Some of the earth's oldest rocks are exposed in the mountainous terrain of the Okanogan Highlands. These Precambrian metamorphic rocks include phyllite, quartzite, and dolomite. Paleozoic metasedimentary rocks overlie the older rocks at places. During Cretaceous time the area was intruded by a large mass of Loon Lake granite. Tertiary volcanic material then partially covered the older rocks. Large glacial deposits were distributed over much of the area during Pleistocene time. These glacial deposits form the extensive terraces that now border much of the Spokane River, the Columbia River, and the reservoirs on these rivers, including the project area. Considerable folding and some faulting have taken place in the older rocks."

Woodward (1973) has published the only comprehensive review of the hydrogeological conditions of the reservation. Based on Woodward's report and the geological conditions of the reservation as shown in figure 3-8, major groundwater sources of the reservation have been indentified. Fractured Loon Lake Granite, which underlies all

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of the reservation, is the principal bedrock aquifer of the reservation. While yields as great as 10 gpm have been reported from wells tapping this unit, the well yields (5-10 gpm) are generally adequate only for stock and domestic purposes.

Other rock units know to yield groundwater to wells on the reservation are Gerome Andesite, Camas Basalt and sand and gravel glacial deposits. Locally, those rocks may yield large quantities of water to wells, but, generally, the yields are only adequate for stock or domestic purposes. No information is available on the quality of the groundwaters found on the reservation. While the groundwaters should be of good quality, they should be checked for purity before any supply is used for domestic purposes.

Numerous springs are found throughout the reservation. In some instances, the discharge of these springs is quite large and accounts for a large part of the annual flow of the rivers. For example, Woodward (1973) noted that Chamokane Creek is dry during the summer months above Ford, Washington, while below Walker's Prairie, it is a live river, due to spring outflow. Woodward estimated that large capacity springs in this reach contribute 17,000 to 22,000 A-ft of water annually to the creek. This groundwater inflow accounts for approximately one-half of Chamokane Creek flow (Woodward, 1973).

3.7 EXISTING SOCIOECONOMIC CONDITIONS

3.7.1 Background

The Spokane Indians are part of the Salish Indian group which

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for centuries has lived in the area east of the Cascade Mountain Range. Traditionally members of a nomadic hunting and fishing culture, the tribe now has a limited land base, consisting of approximately 155,000 A in eastern Washington state. Of these acres, 104,000 belong to the tribe, 26,000 are owned by individual tribal members, 3,000 are under the control of federal agencies and 22,000 are owned by individuals not members of the tribe. This reservation, located at the confluence of the Columbia and Spokane rivers 50 mi northwest of the city of Spokane, represents a smaller land base than was originally established by presidential executive order in 1881. At that time 194,000 A were decreed to the Spokane Tribe.

Based on available information, the following is a summary analysis of social and economic conditions on and near the Spokane Reservation.

3.7.2 Population

In September of 1984, the Spokane Tribe commissioned a special census of the Spokane Reservation for the purposes of determining an accurate and up-to-date assessment of population, income, unemployment, and age. The Census was conducted by Opinion Research Laboratory of Seattle, Washington and has been certified by the state of Washington as accurate.

The total reservation population is 1,494 of this population 945 are tribal members, 244 are from other tribes and 296 are non-Indian.

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3.7.3 Labor Force Characteristics

Data compiled in early 1984 indicates a reservation work force totalling 969 individuals, including 881 Indians; of that work force, 338 are employed on the reservation in the government (230) and private (108) sectors. This represents a considerable decline in the number of jobs on the reservation since 1980, when 717 were available, and is principally the result of a downturn in mining activity. In February 1984, 65% of the resident labor force on the reservation was unemployed, with only 250 of the 881 Indians in the work force actually working. Table 3-13 summarizes the total number of jobs on the reservation, by employer. As the data indicate, less than one-third of the jobs on the reservation are in the private sector.

3.7.4 Economic Base

The current high rate of unemployment, following the downturn in mining activity, reflects the extent to which the reservation economy has been dependent on the Western Nuclear Mine and the Dawn Mine. Besides the jobs at the mine, the tribe benefited directly as a result of mining activity in the form of royalties, which in 1979 exceeded $3 million. Other elements of the reservation economy include agriculture, through the tribal farm enterprise, and land leases, the forest products industry and tribal retail enterprises.

Table 3-14 reflects the regional economic character by identifying the number of employees in various private sector industries

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Table 3-13. EMPLOYED WORK FORCE ON RESERVATION AS OF FEBRUARY 15, 1984

EMPLOYER	TOTAL	INDIAN	NON-INDIAN
Spokane Tribe			
Tribal Government	57	53	4
Trading Post	6	6	0
Home Improvement	7	6	1
EWIC	23	23	1
Moyer Construction	4	3	1
Bureau of Indian Affairs	56	50	6
Indian Health Service	20	11	9
U.S. Postal Service	2	1	1
Wellpinit School District	40	11	29
Housing and Urban Development	8	8	0
Private Sector			
Western Nuclear, Inc.	79	59	20
Dawn Mining Co.	3	1	2
Galbraith's Store	7	4	3
Tribal Cafe	4	2	2
Little Squaw Smoke Shop	2	2	0
Kieffer's Store	1	1	0
Keiffer's Logging	7	4	3
Bair's Logging	7	4	3
D & B Radiator's	1	1	0
TOTAL EMPLOYED WORK FORCE	338		
TOTAL INDIAN PREFERENCE WORK FORCE		250	
TOTAL NON-INDIAN WORK FORCE			88

Source: The Spokane Tribe

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within a five county area in 1981. Stevens County, which includes the Spokane Reservation, shows a high number of individuals involved in manufacturing (including lumber and wood products), mining, retail trade and services. With mining considered a base industry, its recent decline in the area has resulted in a decline in the number of people employed in that industry, as well as in other non basic sectors of the economy.

Spokane County data, which include the city of Spokane, reflect that city's role as a large regional center. Many people are employed in wholesale and retail trade, finance, insurance, real estate and other service-oriented positions. The other three employment categories are rural in nature, including agriculture, lumber and wood products.

3.7.5 Tribal Services

Most tribal services are provided by the tribal government and the Bureau of Indian Affairs (BIA). The tribal government consists of the tribal council, a general manager and a technical and support staff.

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Table 3-14. NUMBER OF EMPLOYEES BY INDUSTRY

FIVE COUNTY REGION 1981

INDUSTRY	STEVENS COUNTY	SPOKANE COUNTY	FERRY LINCOLN PEND OREILLE COUNTIES	TOTAL
Agricultural Services, Forestry, Fisheries	0-19	267	0-57	267-343
Mining	404	268	100-249	627-821
Contract Construction	159	6771	59-78	6989-7008
Manufacturing (including lumber and wood products)	1929	17,713	966	20,608
Transportation and other Public Utilities	149	5477	58-137	5684-5763
Wholesale Trade	134	10,345	366	10,845
Retail Trade	989	23,860	747	25,596
Finance, Insurance, Real Estate	160	9047	150-229	9357-9436
Services	1572	29,508	290-369	31,370-31,449
Non-Classifiable Establishments	20-99	879	46-204	945-1182
TOTAL	5496-5594	104,135	2,782-3402	112,411-113,131

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Source: County Business Patterns- Washington 1981, Bureau of Census, U. S. Department of Commerce.

The tribal government and staff perform the normal administrative duties of the tribe and operate a farm enterprise, a trading post and a home improvement program. A housing authority also exists to serve the needs of tribal members, and police protection is provided by the tribal government through a 96-638 contract with the BIA.

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4.0 PSD PROGRAM DESCRIPTION FOR SPOKANE TRIBE

4.1 History

Through court initiated action, in 1974 the EPA promulgated regulations to prevent emissions of sulfur dioxide (SO_2) and total suspended particulate (TSP) from significantly deteriorating air quality in those parts of the country where concentrations of these pollutants were below the National Ambient Air Quality Standards (NAAQS) for SO_2 and TSP. The PSD regulations prohibited the construction and operation of certain new or modified emission sources without a determination by the EPA (or its delegated authority) that the source would (1) not cause ambient air quality levels which would significantly deteriorate existing air quality and (2) use Best Available Control Technology (BACT).

In the 1977 Clean Air Act Amendments, the PSD requirements were modified (see Sections 160-169 of the 1977 Clean Air Act Amendments). These new requirements were more complex and, in some regards, more stringent than the previous requirements. Subsequently, in June 1978, the EPA promulgated a modified set of PSD regulations.

A number of environmental and industrial groups sued EPA over these regulations in the United States Court of Appeals for District of Columbia. In the legal decision of Alabama Power Company v. Costle in June 1979, the court upheld some of the

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regulations, but overturned others. Further, the court stayed the implementation of its court decision to enable the EPA to propose new regulations. In September 1979, the EPA proposed amendments to the PSD regulations in response to the court decision. In December 1979, the Court of Appeals, in a final opinion, reaffirmed its earlier decision. EPA has completed the new regulations that were proposed in September 1979.

4.2 Philosophy

Simply stated, the intent of the PSD program is to keep clean air areas of the country clean. Before the PSD concept was developed, the air quality control effort in this country was directed almost entirely toward clean-up of air pollution in polluted urban areas. PSD, on other hand, is directed to the clean portions of the country and attempts to prevent any further significant pollution of the air in those areas. PSD levels are much lower than those set to protect human health (i.e., NAAQS).

The purposes of the PSD program are identified in Section 160 of the 1977 Amendments and are:

* to protect public health;
* to preserve, protect and enhance certain areas of the country;
* to insure that economic growth will occur in a manner consistent with air quality goals;
* to protect intrastate interests; and
* to insure careful evaluation of all consequences and

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assure informed public participation.

4.3 Affected Areas and Increments

There are three area classifications for PSD: Class I, Class II, Class III. Generally speaking, Class I is the designation for clean, pristine areas and would permit little or no development; Class II designation is for clean areas where a moderate amount of development would be permitted; and Class III is the designation for clean areas where a significant amount of development (up to the health standards) would be permitted.

Initial Designated Areas. In the 1977 Clean Air Act Amendments, an initial determination of PSD designated area was made. These designations are:

* Class I: International parks, all national wilderness areas over 5,000 A, all national memorial parks over 5,000 A, all national parks over 6,000 A;
* Class II: All other portions of the country which do not violate NAAQs (Health Standards);* and
* Class III: None.

Increments. Although the 1977 Clean Air Act Amendments indicate that all pollutants which have established NAAQS may be covered under PSD, to date only PSD standards for SO_2 and TSP have been set. The concept of these standards is increments. Increments are those ambient air concentrations produced by a source or a group of sources, irrespective of the existing background or baseline air quality in the region. Once the baseline is set, the

* All CERT tribal lands were therefore initially designated in 1977 as Class II areas.

contributions of emission sources are accumulated up to the standard. It may be seen that, by the use of increments, PSD fosters the policy of "first come, first Served" for new or modified emission sources. The maximum allowable increments over baseline are listed in table 4.1. The upper limit for these increments is the NAAQs for each pollutant.

Table 4.1 PSD INCREMENTS

Pollutant and Averaging Time	Maximum Allowable Increment Average (micrograms/cubic meter)		
	Class I	Class II	Class III
Total Suspended Particulates			
Annual Geometric Mean	5	19	37
24-hour maximum	10	37	75
Sulfur Dioxide			
Annual Arithmetic Mean	2	20	40
24-hour maximum	5	91	182
3-hour maximum	25	512	700

4.4 Redesignation

Certain areas can be redesignated from their initial classification (see Section 164 of the 1977 Amendments). Of particular interest to tribes is the provision that states, "Lands within the exterior boundaries of reservations of federally

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recognized Indian tribes may be redesignated only be the appropriate Indian governing body." In order to redesignate, the following actions must be performed.

(1) Announce the intent to redesignate to the appropriate regional office of the EPA.

(2) Announce the intent to redesignate to the public in any area affected by the redesignation.

(3) Prepare a report which describes and analyzes the health, environmental, economic, social and energy effects of the redesignation.

(4) Schedule and hold public hearings in the area to be redesignated.

(5) Answer public comments and possibly revise report.

(6) Submit to EPA the revised report for its determination.

A number of tribes have expressed an interest in redesignating from Class II to Class I. To date, the Northern Cheyenne Tribe, the Salish-Kootenai (Flathead) and the Assiniboine and Sioux Tribes (Fort Peck) are the only tribes to request and obtain redesignation from Class II to Class I. Attachment A references the procedures and schedule that the Northern Cheyenne followed for their redesignation. Additionally, a general outline of their report, entitled "The Northern Cheyenne Air Quality Redesignation Report and Request," is presented in Attachment D.

Section 164 of the 1977 Clean Air Act Amendments also provides for the settlement of disputes between an Indian tribe and a state

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over any redesignation proposed by either the tribe or the state. In such a situation, the affected tribal reservation or state may request the EPA administrator enter into negotiations with the parties involved to resolve the dispute. If a resolution cannot be gained in the negotiations, the EPA will decide on a solution. this is generally the same approach used by the EPA to settle disputes among states.

4.5 Administration and Enforcement

The PSD program is administered under the auspices of the EPA through a permit system. Certain new sources or modifications to existing sources must demonstrate that they are in compliance with the appropriate PSD increment before a permit can be granted. The Clean Air Act provides for the delegation of PSD enforcement by EPA to local air pollution agencies through approved implementation plans. Although it is not directly mentioned in the Act, it seems that tribes could be eligible forms of government to receive this delegation to enforce their own PSD programs.

The Administration and enforcement of the PSD program is governed by regulations that EPA promulgates. Although recent circumstances will probably result in additional changes to the existing regulations, it is possible to outline the general requirements of the regulations (Table 4.3). Of particular note to the tribes is the recent exemption of mining operations from PSD requirements Also implied in table 4.2 are two important elements of the PSD program: (1) sources are granted permits on a first

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come, first served basis; after the increment is used up, no more sources, regardless of their merit, are allowed and (2) demonstration of PSD increment compliance is a time-consuming and very complex technical activity.

Table 4.2 SUMMARY OF PSD REGULATIONS

Type of Program:	Permit.
Enforcement Agency:	EPA or delegated authority.
Type of Compliance:	PDS Incremental Ambient Air Standards for different classes for sulfer dioxide and total suspended particulates.
Sources Affected:	Major stationary and/or modifications of stationary sources listed in the Clean Air Act. Fugitive emissions are exempt (i.e., mining operations are exempt).
Geographic:	Applies to all sources affecting an area.
Applicability:	These sources could be located within an area or adjacent to an area. However, sources located in non-attainment areas are exempt from the above.
Demonstration of Compliance:	Responsibility of the proponent to

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demonstrate compliance with standards. This is done by collecting baseline air quality data for a period of at least one year and by performing air quality predictive modeling to estimate ultimate impact.

4.5 Implications to Tribes

The implications and effects of the federal PSD program on tribes could be significant. Although the focus of PSD is not necessarily on protecting human health, PSD is an air quality program oriented toward protecting clean areas of the country, such an Indian reservations, from further air quality degradation. Since Indian tribes are specifically given certain options under the legislation to designate what levels of PSD should be allowed, tribes can use the PSD program to pursue the following objectives.

* Protect and preserve the air quality environment on reservation lands. this is certainly the primary intent of the PSD program. The degree of protection desired by the tribe can be specified by either accepting the existing Class II designation or requesting a redesignation to Class I.
* Protect and preserve cultural and religious elements on reservation lands. Certain aspects of air quality degradation could interfere with the pursuit of necessary cultural or religious activities. If the Class II designation does not offer adequate protection, a redesignation to Class I may be

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necessary.

* Provide for oderly economic growth on reservation lands. As a general rule, energy-related economic growth and air pollution are directly related. If any desired economic growth is associated with energy facility construction, either on or adjacent to the reservation, it was probably necessary for the tribes to maintain the Class II designation. On the other hand, if the tribe wishes to pursue its own energy development, but is concerned that non-tribal development off reservation lands would use up its PSD increment first, the tribe could request a redesignation to Class I to "bank" the increment for themselves at a later date. (It must be pointed out that this strategy could be risky and not entirely acceptable to EPA because it does not fit the intent of the PSD legislation).

* Obtain a greater degree of self-determination for Indian tribes. As indicated previously, PSD can be used by the tribes so that they can make their own decisions concerning air quality and, indirectly, energy development. Additionally, further control can be obtained by the tribe if authority to enforce and manage air quality programs is sought. If such a delegation were obtained by the tribes, the tribes could make decisions on siting of air pollution sources.

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5.0 IMPACTS OF REDESIGNATION ON RESERVATION

The Spokane Tribe is considering several types of economic development options for the reservation. Possible initiatives include projects to expand agriculture and tourism. Such projects, when properly designed and operated, will have little effect on air quality. On the other hand, other economic initiatives may include a wood-fired boiler to heat and power a new manufacturing operation, which with dust controls could have a significant impact on reservation air quality. The scope of such an endeavor could be influenced by the PSD classification of the reservation. The two temporarily closed uranium mines on the reservation will also affect local air quality conditions if reopened.

5.1 Feedlot

Development of a feedlot in the southern area of the reservation may have a local effect on the dust concentrations and odors in the area. The lot would be designed for transition feeding which would last for two months per lot of cattle and would have a capacity of 1,000 head of cattle to be fattened on hay and silage. The air quality impacts are difficult to define due to widely varying feedlot designs and practices, but effects are generally limited to the area very near to the feedlot. These emissions are of dirt and dried manure from movement of cattle about the pens, ammonia from the urine and decomposition of manure, and odorous

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gases from decomposition of manure. Emissions are estimated (AP-42) at 280 lb of particulate per day and 11 lb ammonia per day. The results of the analysis are shown in table 4-1. The down wind impacts will be highest to the southwest of the lot, and concentrations decrease to about one third of the highest values at equal distances to the northwest and southeast. Highest impacts occur at the boundary and decrease with downwind distance. To the southwest, second-high 24 hour concentrations could be 68 ug/m^3 at 400 meters downwind and decrease rapidly to 32 ug/m at one kilometer distance and 3.5 ug/m^3 at 5 kilometer distance. When large particle drop-out is considered the calculated concentrations decrease to about half or 16 and 1.7 mg/m^3 at 1 and 5 kilometers, respectively. These impacts are well below the federal standard of 150 ug/m^3. In accordance with current EPA regulations, such fugitive dust impacts are not considered in PSD analyses.

5.2 Tourism

The Spokane Tribe is considering further development of tourism in the scenic western portion of the reservation. The principal emissions from such activity would be vehicular exhaust and particulate matter from travel over unpaved roads. Diesel engine exhausts can be locally noxious as well as a source of fine particulates. With proper design and management, tourism development should not jeopardize the PSD increments for either particulate matter of sulfur dioxide. Appropriate practices can

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also minimize increases in concentrations of the principal vehicle emissions--carbon monoxide, nitrogen oxides and hydrocarbons.

Table 5.1 MAXIMUM PARTICULATE IMPACTS FROM EXISTING AND PROPOSED SOURCES ON THE SPOKANE RESERVATION (24-hour 2nd high concentrations in ug/m3)

Source	Location of Impact	Magnitude of Impact	Federal Secondary Standard
Slash burning	within 70km of fire	10	150
wood burning for heat	in Wellpinit	161	150
Feedlot	1km southwest of feedlot	32	150
	5km south of feedlot	3	150
mine	2km southwest of mine	81	150
	5km southwest of mine	31	150
wood-fired boiler	1km southwest of boiler	25	150
	5km southwest of boiler	7	150

5.3 Sawmill and wood treating facility

Consideration is being given to building a sawmill near the community of Ford in the eastern region of the reservation. For purposes of this review the sawmill is assumed to handle 10 million board-feet annually with an auxiliary pressure treatment system. No boiler or waste incinerator is envisioned. Such a

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facility would not have a significant impact on air quality in the region and would not be constrained by any PSD classification.

5.4 Sherwood Mine and Dawn Mine

The Sherwood and Dawn uranium mines on the reservation are currently inactive. If these open-pit mines are reopened, they may be significant sources of particulate matter. Both are open-pit mines which move a substantial amount of overburden and uranium ore by truck. The vehicular activity and material handling produce fugitive dust. The Sherwood mine also has an adjacent mill which would produce minor amounts of dust, some of which is radioactive. Mill emissions are not addressed herein, but can be found in the Sherwood environmental impact reports (BIA, 1976). If the mines were to be activated with a material movement rate in the range of 2,000,000 to 4,000,000 tons per year, and the haul roads were well- controlled for dusting, emissions would be about 400 tons per year from each. About half these emissions will be large particles which will fall out rapidly. The remaining 200 tons per year of particulate are of concern, and will travel longer distances downwind from each of these operations.

On a work schedule of 24 hours per day, 250 days per year, the daily emissions of fine-sized dust would be approximately 800 lb. Downwind impact spatial patterns are similar to those of the feedlot and the concentrations would be higher. Second highest 24-hour impacts from each of these operations would be 81 ug/m^3, two kilometers downwind and 31 ug/m^3 five kilometers downwind.

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The effect of PSD reclassification on the reopening of these mines is highly dependent upon the nature of resumed mixing and milling activities. Regardless, a PSD Class I designation, if applied to mining, would be somewhat more limiting than the current Class II designation.

5.5 Uranium Mills

In addition to the reopening of the mines, the potential exists for the uranium mills to be reactivated. However, it is not possible to estimate specifically the magnitude of air quality impact of any mill activation at this time. In addition, the regulatory status of the mills in terms of being classified as existing sources or new sources is clouded. This would affect whether the mills would be considered a part of the baseline for PSD purposes or a new source which has to meet Class I or II increments.

Nevertheless, a generalized analysis of potential non-radiological* impacts from a generic mill can be performed. Using information on a typical 2,000 ton per day acid-leach uranium mill a maximum potential particulate rate of 2,390 lb/day is estimated (CERT, 1983). Most of these emissions result from the tailings piles. This emission rate would be greater than that of the feedlot or wood burning for heat, and comparable to the mine's emission rate.

Therefore, the renewed milling operations would constitute a major particulate source and, if subject to PSD review as a new

* Radiological impacts from both gaseous and particulate emissions can occur from mills (CERT, 1985 and BIA, 1976). These impacts are not part of EPA PSD requirements, and are therefore, not covered in this report. However, radiological impacts from mills should be an important consideration for future tribal uranium development plans.

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source, could be affected by any PSD reclassification. Further analysis should be performed on any proposed milling operations.

5.6 Wood-Fired Boiler

The tribe has wood in the form of slash, sawdust and chips available from logging and perhaps sawmill. Depending upon the size of these operations, there may be up to 60,000 tons of wood per year available as boiler fuel. This wood has a heat value of about 720,000 MBTU per year. A boiler operation 24 hours per day, 250 days per year could operate at a design rate of 120 MMBTU heat consumption per your (which is a chip consumption of 10 tons per day). A hypothetical boiler used for this impact analysis has a stack height of 100 ft and no particulate control system.

The air quality impacts of particulate emissions are estimated to be 25 ug/m^3 as a medium 24-hour average at a downwind distance of one kilometer. At a distance of five kilometers the maximum 24-hour average would be 7 ug/m^3. The maximum concentration of 25 ug/m^3 would be allowable under the current Class II designation. However reclassification to Class I which establishes a maximum allowable increment of 10 ug/m^3 as a 24-hour average, would exceed the standard. Consequently an emissions control system would be required on the boiler described above or the facility could not be constructed.

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6.0 EFFECT OF REDESIGNATION TO PSD CLASS I ON VEGETATION AND WILDLIFE

6.1 Overview

Important natural resources on the Spokane Reservation include vegetation and wildlife, and the natural soils, waters and air quality which support them. Both particulate matter and sulfur dioxide in the ambient air can threaten the lives of plants and mammals if present in sufficient concentrations. This discussion examines the sensitivity of vegetation (including crops) and wildlife found on the reservation to those concentrations of air pollutants regulated under Class I and Class II designations of the Prevention of Significant Deterioration (PSD) program. Table 2-1 presents the applicable allowable increases in concentration of particulate matter and sulfur dioxide (SO_2).

6.2 EFFECT OF PSD DESIGNATION ON SOILS AND VEGETATION

6.2.1 Soils

The characteristics of soils found on the Spokane Reservation are described in the Spokane Air Quality Analysis (1984), section 3.5. Major features are summarized in section 3.3 of this document. The integrated system of soils, surface waters and groundwater on the reservation has evolved to the natural balance which currently characterizes the area.

Increases in reactive compounds in the air may alter the acidity

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or alkalinity of precipitation and hence that of the receiving soils. Sulfur dioxide and nitrogen oxides are thought to be a contributor to acid rain or acid deposition, a major and growing concern in many areas of North America and Europe. The causes and effects of this complex phenomenon are widely debated.

Limiting concentrations of sulfur dioxide on the reservation by redesignation to Class I may have some effect on the acidity of rainfall. Any such effect would not be expected to affect rainfall on the reservation, but precipitation many miles away. The location of receiving soils would be dependent upon atmospheric chemistry and climatological conditions. Best available information indicates that soil characteristics on the reservation are unlikely to be affected by a Class I or Class II designation.

6.2.2 Vegetation

Plant life on the Spokane Reservation is an extremely valuable resource. The forested areas provide necessary habitat for wildlife and important raw material for the forest products industry. Croplands produce foodstuffs for both human and livestock consumption. Detailed descriptions of natural vegetation are presented in the Spokane Air Quality Analysis (1984), section 3.4, and are summarized in section 3.0 of this document.

A common plant on grasslands and shrublands in Junegrass. Damage to Junegrass has been observed when exposed to SO_2 concentration of 0.02 to 0.10 parts per million (ppm) over growing season (Dodd et al., 1978). The incremental increases in SO_2 concentration now

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permitted as a Class II area are 0.007 ppm-annual average, and 0.034 ppm-maximum 24-hour average. Under worst conditions some damage to this sensitive specie may occur under Class II limitations. Corresponding limitations under Class I designation, 0.0007 ppm-annual, and 0.002 ppm-24-hour, would protect Junegrass from any known effects.

Most natural vegetation found on the reservation is not known to be affected by low concentration of SO_2. Ponderosa pine, for example, is resistive to injury until subjected to SO at 1.0 ppm for a four-hour period (Evans et al., 1975). Injury to aspen, found in the riparian areas of the reservation, first appeared at an SO_2 concentration of 0.35 ppm for three hours.

Alfalfa is the principal crop produced on the Spokane Reservation lesser quantities of corn, wheat and barley. Alfalfa was identified in 1969 as one of the most sensitive plans of sulfur dioxide. A study by Tingey et al. (1975) indicated alfalfa damage due to SO_2 at 0.05 ppm for five days/week over five weeks. Reduced yields of wheat and barley were found at 0.15 ppm of SO_2 over the growing season (Wilhour et al., 1978). These concentrations are above the allowable increases in SO_2 concentrations in areas designated Class I or Class II.

Although a significant amount of scientific data suggest limited or no adverse impacts to the vegetation on the reservation at Class I or Class II PSD levels, outstanding questions still remain about the effects of long-term, low-level exposures of SO_2 and TSP.

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More studies need to be performed before absolute relationships can be determined.

6.3 EFFECT OF PSD DESIGNATION ON FISH AND WILDLIFE

6.3.1 Fish

The freshwater resources on the Spokane Reservation including fisheries are important and should be protected. Information ofn local species of fish is limited as discussed in section 3.3. The impact of sulfur dioxide and particulate matter in the ambient air on surface waters is not well documented. Although not at issue in this analysis, the effects of increased acidity in precipitation have been found to vary widely with the hydrology and geology of receiving waters. It is not known whether a Class I or Class II designation will adversely affect fish on the reservation.

6.3.2 Mammals

The effects of particulate matter and sulfur dioxide on the health of mammals in the wild are not well understood. Some evidence suggests that other mammals may respond in a manner similar to humans. Respiratory impairment and other health effects have been attributed to both contaminants. All PSD increments (Classes I, II and III) are intended to assure protection from adverse health effects with an adequate margin of safety.

Reservation wildlife may also be affected by any changes in vegetation caused by air pollution. Many mammals are dependent upon plants for both food and shelter. Livestock is also dependent upon forage crops as food supply. Among the many vegetation

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species found on the Spokane Reservation, only Junegrass has been found to be sensitive to SO_2 in the ranges of Class I and Class II. Wildlife would be better protected under a Class I designation to the extent it is dependent on Junegrass and any other species with corresponding sensitivity to sulfur dioxide.

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7.0 AIR QUALITY IMPACTS ANALYSIS

A preliminary predictive modeling analysis was conducted to determine potential air quality and visibility impacts to the Spokane Reservation due to operation of the principal air emission source in the general region, the proposed 2280 Mwe Creston Coal-fired electric power generating station (CGS). Primary emphasis was placed upon a preliminary evaluation of potential environmental impacts to the presently designated Class II air quality area encompassing the Spokane Reservation with respect to compliance with the National Ambient Air Quality Standards (NAAQS) and the Prevention of Significant Deterioration (PSD) increments. A brief synopsis on visibility is included.

7.1 PRELIMINARY AIR QUALITY DISPERSION MODELING ANALYSIS

7.1.1 Methodology

Perusal of the geographic region of interest, in terms of predictive air dispersion modeling techniques, dictates utilization of a complex terrain model, due to the irregular regional topographic features illustrated in map 1. Rather large surface elevational variations, extending from about 1,500 ft MSL to over 4,000 ft MSL, are evidence within the boundaries of the Spokane Reservation.

Although the Washington Water and Power Company has undertaken an extensive baseline environmental monitoring program in the

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immediate vicinity of the CGS site, entailing the measurement of pertinent climatological, meteorological and air quality parameters that are a requirement for the most sophisticated air quality dispersion models, these data compilations were not available to the CERT staff for utilization in this analysis. Consequently, all air quality dispersion modeling modeling screening analyses for this study were performed with the EPA VALLEY Model (Burt, 1977), utilizing both the rural, long-term (annual) and short-term (24-hr) complex terrain options of the program.

The long-term option of the model requires surface meteorological data in the STAR format, which entails relative frequency distributions of the sixteen cardinal compass wind directions (N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SE, WSW, W, WNW, NW and NNW) as a function of six wind speed intervals (0-3 knots, 4-6 knots, 7-10 knots, 11-16 knots, 17-21 knots, and greater than 21 knots) for each of six Pasquill-Gifford stability categories (A, B, C, D, E, and F). the best available long-term STAR data compilations, represented by the 10-yr (1 January 1968 through 31 December 1977) normalized annual averages for the Spokane, Washington, National Weather Station (NWS) (included as Appendix D in this report), were used in the long-term VALLEY modeling analysis.

The short-term (24-hr) VALLEY <model complex terrain program option is also recommended by the EPA Office of Air Quality

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Planning and Standards (OAQPS) Guideline on Air Quality Models (1981) in preliminary screening evaluations for regions exhibiting irregular terrain features where detailed site-specific surface (hourly) and upper atmospheric (twice daily as a minimum) meteorological data are not available. Additionally, worst case meteorological assumptions of 2.5 m/sec surface wind speed and a Pasquill-Gifford F stability (moderately stable) persisting for the entire 24-hr interval were utilized for all short-term screening analysis in this study, as further recommended by the EPA guidelines.

Geometric representations incorporated in the VALLEY complex terrain modeling analysis are presented in table 7-1. Terrain considerations are summarized in table 7-1 for the significant 22.5 degree cardinal compass wind directions and radial distances (in miles) from the point source model representation of the Creston Generating Station to the pertinent receptor locations near or within the Spokane Reservation. Receptor elevations and the base elevation of the station site are therefore included in table 4-1. Since the VALLEY program internally divides the radial distances from the site origin to the receptor locations into six equal radial segments, two separate radial intervals of 3.714 mi and 4.286 mi were also included in the modeling analysis, as shown in table 7-1. Figure 7-1 provides a visual perspective of the geometric parameters for the preliminary air quality screening analysis presented in table 7-1. Pertinent atmospheric emissions

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data and physical stack parameters were derived principally from the PSD application submitted to the EPA (Region X) by Washington Water Power Company (TWWPCo) for the Creston Generating Station (TERA, 1981 and 1982).

A number of candidate sources of low sulfur western coals are currently under consideration by TWWPCo for use at the CGS. For purposes of this analysis, five coals (A, B, C, D and E) can be considered representative of the range of fuels that could be used at CGS. The proximate and ultimate analysis and the ash mineral analysis for each coal are presented in table 7-2 and include the average value, as well as the range of values, for each constituent, based upon multiple samples.

The CGS stack emission rates for all four 570 Mwe units, operating simultaneously at the maximum guaranteed rating, are presented in table 7-3. The air emission rates shown in table 7-3 conservatively represent the maximum calculated values, assuming the particular coal yielding the highest value for a specific pollutant.

Similarly, the CGS physical stack parameters for each 570 Mwe unit are shown in table 7-4. It should be noted that the requirements of the recent EPA Good Engineering Practice (GEP) stack regulations were also factored into the air dispersion modeling analysis. The GEP stack height regulations (Federal Register, Vol. 47, No. 26, 8 February 1982 were invoked by the EPA under Section 123 of the Clean Air Act, which was added by the

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Table 7-1 CRESTON GENERATING STATION - GEOMETRIC PARAMETERS FOR VALLEY AIR QUALITY DISPERSION MODELING ANALYSIS OF SPOKANE RESERVATION

CARDINAL COMPASS PLUME DIRECTION	RADIAL DISTANCE FROM PLANT SITE ORIGIN (MI)													
	3.71	4.29	7.43	8.57	11.14	12.86	14.86	17.143	18.57	21.42	22.29	25.71	26.00	30.00
N	2435	2435	2520	2540	2000	1800	2600	2230	3450	2350	3800	2370	4050	2300
NNE	2200	2455	2200	2500	2200	2650	4090	1350	2000[a]	2400[a]	2400[a]	3870[a]	2400	4050
NE	2400	2070	2200	2000	2200	2250	2640	2280	2650	1500[a]	2000[a]	4010[a]	3200[a]	3500[a]
ENE	2350	2350	2500	2420	1750	2380	2500	2560	1800	1720[a]	2100[a]	3415[a]	2500[a]	2350

Notes:

1. Receptor elevations in units of ft MSL; base elevation: 2370 ft MSL.
2. Receptor locations within the boundaries of the Spokane Reservation are designated by superscript "a".

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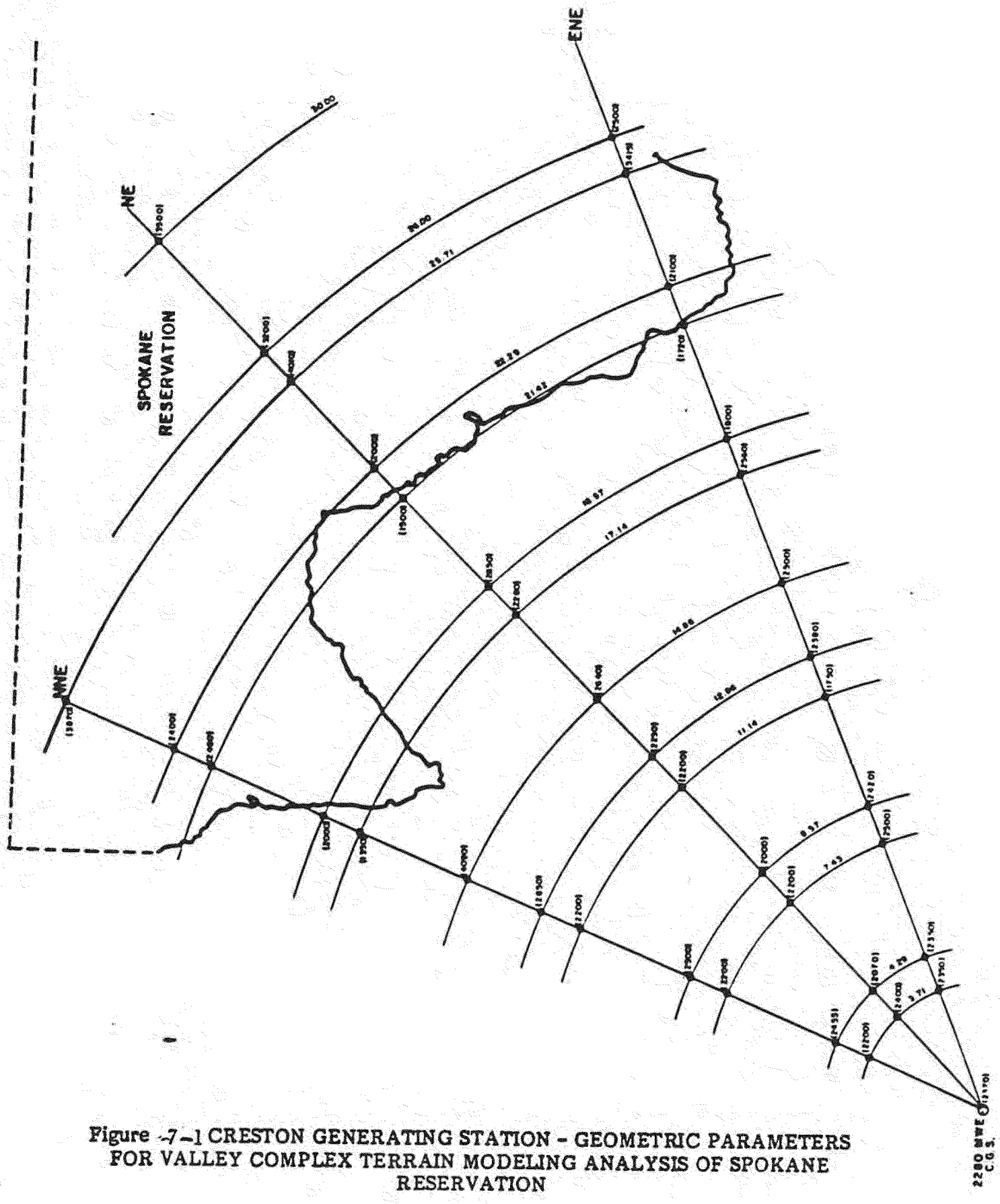

Figure 7-1 CRESTON GENERATING STATION - GEOMETRIC PARAMETERS FOR VALLEY COMPLEX TERRAIN MODELING ANALYSIS OF SPOKANE RESERVATION

Table 7-2 SUMMARY OF COAL AND ASH CHARACTERISTICS

Characteristic	Coal A Average	Coal A Range	Coal B Average	Coal B Range	Coal C Average	Coal C Range	Coal D Average	Coal D Range	Coal E Average	Coal E Range
Proximate Analysis (%) As Recived Basis										
Moisture	21.00	19.00-22.00	23.63	—	24.02	23.57-24.33	23.41	20.25-24.69	12.00	—
Volatile Matter	36.00	34.80-37.00	32.25	—	31.21	29.81-32.39	29.76	26.15-32.59	34.10	29.90-40.40
Fixed Carbon	37.90	37.62-40.24	38.50	—	40.30	40.25-40.36	36.56	34.29-39.20	45.20	34.60-52.70
Ash	6.00	4.15-6.91	5.62	—	4.47	3.68-5.68	10.27	8.65-11.73	8.80	7.60-33.60
Heating Value, BTU/lb	9500	9475-9908	9268	9056-9523	9200	9194-9711	8654	8501-9029	10661	10500-11100
Ultimate Analysis (%) As Received Basis										
Moisture	21.00	—	23.63	22.00-26.25	24.02	—	23.41	20.25-24.69	12.00	11.2-12.6
Carbon	55.14	52.76-57.16	53.80	51.93-55.20	54.44	53.26-55.69	50.65	49.18-52.94	61.18	59.1-63.1
Hydrogen	4.19	4.16-4.36	3.76	3.70-3.80	3.79	3.59-3.83	3.43	3.09-3.62	4.44	4.3-4.6
Nitrogen	1.04	1.00-1.19	0.95	0.90-1.00	0.89	0.83-0.95	0.74	0.49-1.16	1.54	1.3-1.8
Chlorine	0.02	0.02-0.03	0.01	0.00-0.02	0.01	0.00-0.02	0.01	0.00-0.02	0.00	0.00
Sulfur	0.40	0.30-1.00	0.46	0.32-0.55	0.50	0.40-0.50	0.73	0.60-0.89	0.73	0.6-1.2
Ash	6.00	4.15-6.91	5.62	3.00-8.00	4.47	3.68-5.68	10.27	8.^5-11.^3	8.^	6.^-11.^
Oxygen	14.12	12.19-14.32	11.77	10.50-12.40	11.88	11.2^-12.33	10.76	9.98-12.42	11.31	10.2-12.3
Ash Mineral Analysis Ignited Basis										
Silica, SiO	53.31	49.37-54.71	34.29	30.00-40.00	32.48	27.10-41.33	38.64	35.41-42.58	43.63	38.30-48.95
Alumina, Al_2O_3	10.45	8.14-13.63	18.91	11.00-20.00	17.13	16.34-18.58	18.27	16.68-21.27	24.96	22.42-27.50
Ferric Oxide, FE_2O_3	6.25	5.81-11.63	—	—	6.13	4.90-8.46	6.25	4.18-8.25	—	—
Titania, TiO_2	0.64	0.46-0.75	—	—	1.05	1.00-1.11	0.67	0.38-1.36	—	—
Phos. pentoxide, P_2O_5	0.40	0.06-0.67	—	—	0.92	0.49-1.06	0.41	0.18-1.70	—	—
Lime, CaO	12.19	8.36-15.52	—	—	15.12	11.65-17.28	14.80	12.64-16.82	—	—
Magnesia, MgO	5.18	3.16-6.03	—	—	4.26	2.75-5.11	2.82	1.21-4.43	—	—
Sodium Oxide, Na_2O	0.44	0.28-0.57	4.74	3.00-6.5	6.44	6.10-9.00	2.53	0.46-3.67	3.51	3.39-3.63
Potassium oxide, R_2O	0.59	0.39-0.69	—	—	0.74	0.45-0.^8	1.06	0.^7-1.46	—	—
Sulfur trioxide, SO_3	8.56	6.39-11.46	—	—	15.26	11.16-19.26	13.63	10.48-15.77	—	—
Undetermined	1.99	—	—	—	0.67	—	0.92	—	—	—

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Table 7-3 CGS STACK EMISSION RATES
FOUR 570 Mwe UNITS

Pollutant	Maximum CGS Emission Rate Four Units[a] (gm/sec)	Coal Yielding Maximum Emission Rate
Pollutants Regulated Under Clean Air Act:		
Carbon Monoxide	153.2	D
Nitrogen Oxides	1593.2	E
Sulfur Dioxide	574.5[b]	D
Particulate Matter	79.6	All
Ozone (Volatile Organic Compounds)	1.52	D
Lead	0.14	B
Asbestos	Negligible	All
Beryllium	0.009	B
Mercury	0.015	A,C
Vinyl Chloride	Negligible	All
Flourides	0.578	D
Sulfuric Acid Mist	40.78	D
Total Reduced Sulfur (incl. H_2S)	Negligible	All
Reduced Sulfur Compounds (incl. H_2S)	Negligible	All
Hydrogen Sulfide	Negligible	All
Other Pollutants:		
Antimony	0.0013	D
Arsenic	0.0065	D
Barium	12.915	B
Boron	0.813	B
Cadmium	0.0361	C
Cobalt	0.0263	B
Chromium	0.1363	B
Copper	0.1622	B
Manganese	0.5501	B
Nickel	0.0909	B
Selenium	0.0147	A
Vanadium	0.287	B
Zinc	0.4362	B

[a] Four units operating simultaneously at maximum guaranteed rating.
[b] After 86.5% SO_2 removal by flue gas desulfurization system.

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1977 Clean Air Act Amendments. Section 123 prohibits stacks taller than Good Engineering Practice (GEP) height and other dispersion techniques from affecting the emission limitations required to meet the National Ambient Air Quality Standards (NAAQS) or PSD air quality increments. These regulations do not limit the physical stack height or any source. Instead, they set limits on the maximum stack height credit to be used in ambient air quality modeling for the purpose of setting an emission limitation and for calculating the air quality impact of a source. Sources are generally modeled at the physical stack height unless that height exceeds their GEP stack height. The regulations apply to all stacks constructed and all dispersion techniques implemented since 31 December 1970.

7.1.2 Air Quality Dispersion Modeling Results

Since the most stringent air quality regulations are currently the PSD incremental standards, the preliminary air dispersion modeling analysis is predicated upon compliance of the CGS with the annual and 24-hr PSD increments for SO_2 and particulate emissions, as set forth in 40 CFR Part 52.21 and modified in Section 160-169 of the Clean Air Act Amendments of 1977, at selected receptor locations on the Spokane Reservation. The PSD air quality increments for SO_2 and particulate matter are again provided in table 7-5. Areas in the United States that presently have lower ambient air quality than that specified in the NAAQS are designated as nonattainment areas; the remainder of the United States is designated Class II.

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Redesignation by the state of Class II areas to either Class I or Class III is possible.

Table 7-4 CGS STACK PARAMETERS

FOR EACH 570 Mwe UNIT

STACK PARAMETER [a]	ENGLISH UNITS	METRIC UNITS
Height	555 ft	169.2 m
Inside Diameter	22 ft	6.7 m
Exit Temperature	170 F	350 K
Exit Velocity	85.1 ft/sec	26.1 m/sec.

[a] All parameters based upon operation at maximum guaranteed rating, firing Coal D; one stack per 570 Mwe boiler unit.

[b] The stack height listed is the Good Engineering Practice (GEP) stack height; in accordance with EPA's proposed regulations (Federal Register, Vol. 47, No. 26 8 February 1982).

Additionally, the PSD allowable increments for SO_2 and particulate matter cannot exceed the allowable concentrations for those pollutants, as specified in the National Ambient Air Quality Standards (NAAQS), when combined with the respective measured ambient background concentrations of these species within the area of interest, i.e., the Spokane Reservation. Areas in the United

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States that presently have lower ambient air quality that specified in the NAAQS, presented in table 7-6, are designated by EPA as nonattainment areas. Since the region encompassing the Spokane Reservation is currently an area of light to moderate industrial development activity, the less stringent NAAQS would probably not be exceeded at the present time for SO_2 or particulate matter. However, an on-reservation environmental air quality monitoring program would be needed and is recommended to adequately establish ambient background concentrations for the two aforementioned pollutants.

The results of the preliminary screening analysis for the Creston Generating Station (CGS) are summarized in table 7-7 for pertinent receptor locations within the boundaries of the Spokane Reservation. Predicted concentrations on both an annual and a 24-hr basis at specific on-reservation receptor locations for both SO_2 and particulate matter are presented in table 7-7. The pollutant values shown in table 7-7 are based upon a maximum CGS generating capacity of 2280 Mwe. Additionally, and SO_2 emission control efficiency of 86.5% is assumed in the analysis to reflect the minimum requirement for Class II air quality compliance, as set forth in the TWWPCo application for the CGS PDS permit (TERA, 1981-1982). The particulate matter emission rates are based upon limits of 0.03 lb particulate matter per million Btu plant energy equivalent, as prescribed by EPA's New Source Performance Standard (NSPS) for coal- fired electric power generating stations.

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Table 7.5 PSD AIR QUALITY INCREMENTS

Pollutant	Averaging Time	Maximum Allowable Increase (ug/m^3) Class I[b]	Class II[c]	Class III[d]
Particulate	Annual	5	19	37
Matter	24-hr	10	37	75
SO_2	Annual	2	20	40
	24-hr	5	91	182
	3-hr[e]	25	512	700

[a] 40 CFR 52.21 and 42 USC 7401 Et seq. Section 163.

[b] Class I: Pristine areas, larger National Parks and Wilderness Areas, etc; subject to highest control.

[c] Class II: areas of moderate growth.

[d] Class III: areas of major industrialization.

The annual concentrations for particulate matter emanating from the 2280 Mwe CGS are shown in table 7-7 to vary from 0.1 to 0.7 ug/m^3 at pertinent receptor locations on the Spokane Reservation. Similarly, the 24-hr concentrations for particulate matter at the same receptor locations are shown to vary from 0.1 to 5.8 ug/m^3 . It may be concluded that particulate matter concentrations on the Spokane Reservation resulting from emissions from the 2280 Mwe CGS would be well within the allowable annual and 24-hr Class I and Class II PSD incremental standards for particulate matter, on the

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basis of the previously described, conservative VALLEY model screening analysis methodology employed in this analysis. Thus, the existing control technology, based upon NSPS requirements (0.03 lb particulate matter/ 10^6Btu), would also be sufficient to satisfy the requirements for compliance with the very stringent Class I PSD increment for particulate matter concentrations at receptor locations on the Spokane Reservation.

The preliminary screening analysis results for SO_2 concentrations on the Spokane Reservation due to operation of the 2280 Mwe CGS, employing flue gas desulfurization (FGD) with a design capability for an emission control efficiency of 86.5%, are also presented in table 6-7 on both a 24-hr and an annual basis. Annual SO_2concentrations at pertinent receptor locations on the Spokane Reservation are shown in table 7-7 to vary from 0.4 to 5 ug/m^3. The maximum annual SO_2concentration of 5.0 ug/m^3 is in compliance with the standard for the annual Class II PSD increment of 20 ug/m^3, but exceeds the more stringent allowable annual Class I PSD increment of 2 u/m^3 . Similarly, the range of predicted values for 24-hr SO_2concentrations on the reservation is shown to vary from 0.1 to 53.9 ug/m^3. Thus, the peak 24-hr SO_2concentration of 53.9 ug/m^3at on-reservation receptor locations is in compliance with the allowable 24-hr Class II PSD increment of 91 ug/m^3 , but exceeds the allowable 24-hr Class I PSD increment of 5 ug/m^3.

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Table 7-6 NATIONAL AMBIENT AIR QUALITY STANDARDS

	AVERAGING TIME	PRIMARY STANDARD (ug/m^3)	SECONDARY STANDARD (ug/m^3)
SO_2	Annual	80	-
	24-hr.	365	-
	3 hr.	-	1,300
Particulate matter	Annual	75	60
	24-hr.	260	150
NO_x (as NO_2)	Annual	100	100
Ozone	1 hr.	240	240
Carbon monoxide	8 hr.	10,000	10,000
	1 hr.	40,000	40,000
Lead	Quarterly	1.5	1.5
Hydrocarbons (non-CH_4)	3 hr.	160[b]	160[b]

[a] 40 CFR Part 50. Reference conditions = 760 mm Hg and 25°C.

[b] Not a standard; a guide to show achievement of the ozone standard.

It may be concluded that the CGS at a maximum generating capacity of 2280 Mwe with an FGD system capable of 86.5% SO_2 emission control efficiency, as specified in the TWWPCo application for the PSD permit for the CGS, will meet both the allowable annual and 24-hr Class II SO_2PSD increments at pertinent receptor locations on the Spokane Reservation (TERA, 1982). However, a higher

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Table 7 - 7 PRELIMINARY SCREENING ANALYSIS - 2280 Mwe CGS ANNUAL AND 24-HR SO_2 AND PARTICULATE MATTER CONCENTRATIONS (ug/m^3) AT RECEPTOR LOCATIONS ON THE SPOKANE RESERVATION.

PLUME DIRECTION	POLLUTANT	SAMPLING TIME INTERVAL	RADIAL DISTANCE FROM CGS SITE ORIGIN (MI)					
			18.57	21.42	22.29	25.71	26.00	30.00
NNE	SO_2	24-hr	0.1	0.1	0.1	34.6	-	-
		Annual	0.5	0.6	0.6	3.3	-	-
	PM	24-hr	<0.01	<0.1	<0.1	4.8	-	-
		Annual	0.1	0.1	0.1	0.5	-	-
NE	SO_2	24-hr	-	0.2	0.2	28.8	35.0	41.8
		Annual	-	0.7	0.7	4.3	3.3	5.0
	PM	24-hr	-	<0.1	<0.1	5.0	-	5.8
		Annual	-	0.1	0.1	0.6	0.5	0.7
ENE	SO_2	24-hr	-	0.1	0.1	53.9	0.1	-
		Annual	-	0.4	0.4	4.6	0.4	-
	PM	24-hr	-	<0.1	<0.1	5.5	0.1	-
		Annual		0.1	0.1	0.6	0.1	-

Notes: 1. SO_2 emission rate is based upon 86.5% emission control efficiency to satisfy NSPS and Class II PSD increment.

2. Particulate matter (PM) emission rate is based upon NSPS allowable requirement of 0.03 lb of particulates per million Btu energy released.

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emission control efficiency for CGS So_2 atmospheric emissions would have to be effected in order to comply with the more stringent Class I PSD incremental standard, based upon the modeling techniques employed for this analysis.

The predictive results presented in table 7-7 may be considered reasonable in terms of emission control requirements, since it must be emphasized that the CGS emission control systems were designed for compliance with the existing NAAQS and Class II PSD incremental standards for the general region surrounding the CGS facility, which includes both the Colville and Spokane reservations, as shown in map 1.

An additional comparison of predictive results utilizing the VALLEY air dispersion model, the EPA COMPLEX I model and the EPA CRSTER model is presented in table 7-8 for both annual and 24-hr SO_2 concentrations at the Johnny St. George Mountain receptor location on the Colville Reservation (see map 1).

EPA considers CRSTER to be a "refined" dispersion modeling technique. The CRSTER model is a steady-state Gausian plume dispersion model designed by EPA for evaluation of point source impacts (EPA, 1977). The model has been used primarily in simulating the behavior of stack effluents from combustion sources. Each model "run" of CRSTER calculates pollutant concentrations for each hour of a calendar year at up to 180 receptor locations located on a radial grid. Thus, the CRSTER model affects more sophistication than the VALLEY model in terms

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of simulation of both surface and upper atmospheric meteorological data (not available to CERT for this analysis), as well as more geometric flexibility in terms of establishing a more detailed receptor grid. The model also has the ability to account for uneven terrain of land forms below the elevation of the stack, which in the case of this CGS scenario includes any elevation below 2925 ft MSL.

The EPA COMPLEX I is a multiple point source code with terrain adjustment. It uses the same basic dispersion algorithm as the VALLEY program, including consideration of buoyancy-induced dispersion, and modifies the algorithm to incorporate a half-height correction for unstable plumes and actual hourly surface wind data as input. Thus, COMPLEX I is considered to be a somewhat more refined screening technique that the 24-hr short-term version of the VALLEY MODEL, IN THAT COMPLEX I used actual hour-by-hour surface meteorological data and twice daily upper atmosphere mixing height data as input, rather than the conservative, hypothetical, short-term meteorological conditions assumed by VALLEY.

The predicted 24-hr SO_2 concentrations obtained utilizing the CERT VALLEY modeling methodology are shown in table 4-8 to be comparable to the COMPLEX I analysis performed by TERA for TWWPCo utilizing 1977 Spokane NWS hourly surface meteorological data; comparable annual SO_2 concentrations are shown for COMPLEX I utilizing site-specific TWWPCo hourly surface meteorological data

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compiled in 1980. The considerably lower predicted values for both maximum annual SO_2 concentrations (2.5 ug/m^3 vs. 6.3 ug/m^3) and 24-hr maximum SO_2 concentrations (34.5 ug/m^3 vs 49.7 ug/m^3) obtained by utilization of the CRSTER model, as compared with the CERT VALLEY modeling methodology, may be explained at least in part by the fact that the receptor elevation of 4,090 ft MSL at Johnny St. George Mountain exceeds the upper limit of the CGS stack elevation (2,925 Ft MSL) by about 1,165 ft. Therefore, in accordance with EPA guidelines, those areas, including the on-reservation reception locations exhibiting the maximum SO concentrations, that are greater than 3,000 ft MSL elevation cannot be properly simulated with the CRSTER model for purposes of assessing compliance with NAAQS and PSD increments.

The foregoing comparison of air dispersion modeling techniques justifies the use of CERT's VALLEY modeling methodology to conduct the subsequent sensitivity analysis to evaluate additional requirements for the CGS So_2 emission control system to comply with allowable 24-hr and annual SO_2 Class I PSD increments for receptor locations on the Spokane Reservation. The results of the sensitivity analysis are summarized in table 7-9 and figure 6-2. As anticipated, with utilization of the VALLEY model the maximum 24-hr SO_2 predicted concentrations set the upper limit on emission control requirements for Class I PSD compliance, as illustrated in table 7-9 and figure 7-2, since the CGS is unable to comply with the 24-hr Class I PSD increment with an SO_2 emission control

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efficiency of 95%. Conversely, a 94.5% SO_2 emission control efficiency would effect Class I PSD compliance for SO_2 concentrations on an annual basis for the maximum on-reservation receptor. Similarly, with three CGS units operating at a maximum total CGS electrical generating capacity of 1510 Mwe, annual SO_2 Class I PSD compliance would be achieved on the Spokane Reservation with an emission control efficiency of approximately 93%, while 24-hr SO_2 Class I PSD compliance would require an emission control system greater than 95%, as shown in table 4-9 and figure 7-2. Two 570 Mwe CGS units representing 1140 Mwe, or 50% of the maximum generating capacity for the facility, would require about 89% emission control efficiency for Class I SO_2 PSD compliance on an annual basis, with a greater than 95 % emission control system being required for 24-hr SO_2 Class I PSD compliance.

Summarily, the predicted maximum 24-hr SO_2 concentrations are are in table 7-9 and figure 4-2 to be in compliance with the allowable Class I PSD increment with one 570 Mwe CGS unit operating with and SO_2 emission control efficiency of 95%. On an annual basis, however, the lower bound of values assumed for SO_2 emission control efficiency, 86.5%, would satisfy Class I PSD increment requirements for one 570 Mwe CGS unit operating at maximum generating capacity. It may be concluded, on the basis of this preliminary screening analysis, that the CGS would be unable to comply with Class I PSD limits for maximum SO_2 Concentrations within the boundaries of the Spokane Reservation, since vendor or

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Table 7-8 SUMMARY OF COMPARATIVE VALLEY, COMPLEX I AND CRSTER SO_2 MODELING RESULTS FOR 2280 CGS STACK EMISSIONS - JOHNNY ST. GEORGE MOUNTAIN RECEPTOR LOCATION

DISTANCE FROM CGS STACKS (MI)	SO_2 CONCENTRATIONS, ugm^3							
	TERA/TWWPCo[a,b,c] COMPLEX I MODEL		CERT VALLEY MODEL		TERA/TWWPCo[a] VALLEY MODEL		TERA/TWWPCo[a] CRSTER MODEL	
	ANNUAL MAXIMUM	24-HR MAXIMUM	ANNUAL MAXIMUM	24-HR MAXIMUM	ANNUAL MAXIMUM	24-HR MAXIMUM	ANNUAL MAXIMUM	24-HR MAXIMUM
13.69 (Johnny St. George Mountain)	**2.9** (4.8)	**53** (80)	6.3	49.7	9.3	90.9	2.5	34.5

a. Predictive results taken from PSD application submitted by TERA for TWWPCo for CGS (1981 and 1982).

b. 1977 Spokane, Washington NWS meteorological data used to obtain predicted values in bold type.

c. 1980 site specific TWWPCo meteorological data used to obtain predicted values in parenthesis.

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Table 7-9 PRELIMINARY SCREENING ANALYSIS
CGS MAXIMUM ANNUAL AND 24-HR SO_2 CONCENTRATIONS ON THE SPOKANE RESERVATION AS A FUNCTION OF ELECTRICAL GENERATING CAPACITY AND EMISSION CONTROL EFFICIENCY REQUIREMENTS FOR CLASS I AND CLASS II PSD COMPLIANCE

CGS GENERATING CAPACITY, Mwe	MEASURED INTERVAL	MAXIMUM ALLOWABLE PSD INCREMENT (ug/m^3) CLASS I	CLASS II	SO_2 EMISSION CONTROL EFFICIENCY 86.5%	90%	92%	95%
2280	24-hr	5	91	53.9	39.9	31.9	20.0
	Annual	2	20	5.0	3.7	2.9	1.8 (94.5%)
1510	24-hr	5	91	40.4	29.9	23.9	15.0
	Annual	2	20	3.8	2.8	2.2	1.4 (92.8%)
1140	24-hr	5	91	27.0	20.0	16.0	10.0
	Annual	2	20	2.5	1.8 (89.1%)	1.5	0.9
570	24-hr	5	91	13.5	10.0	8.0	5.0
	Annual	2	20	1.2	0.9	0.7	0.4

Notes: 1. Values in parenthesis indicate SO_2 percentage emission control efficiency required to achieve PSD compliance.

2. All concentrations are given in units of micrograms per cubic meter.

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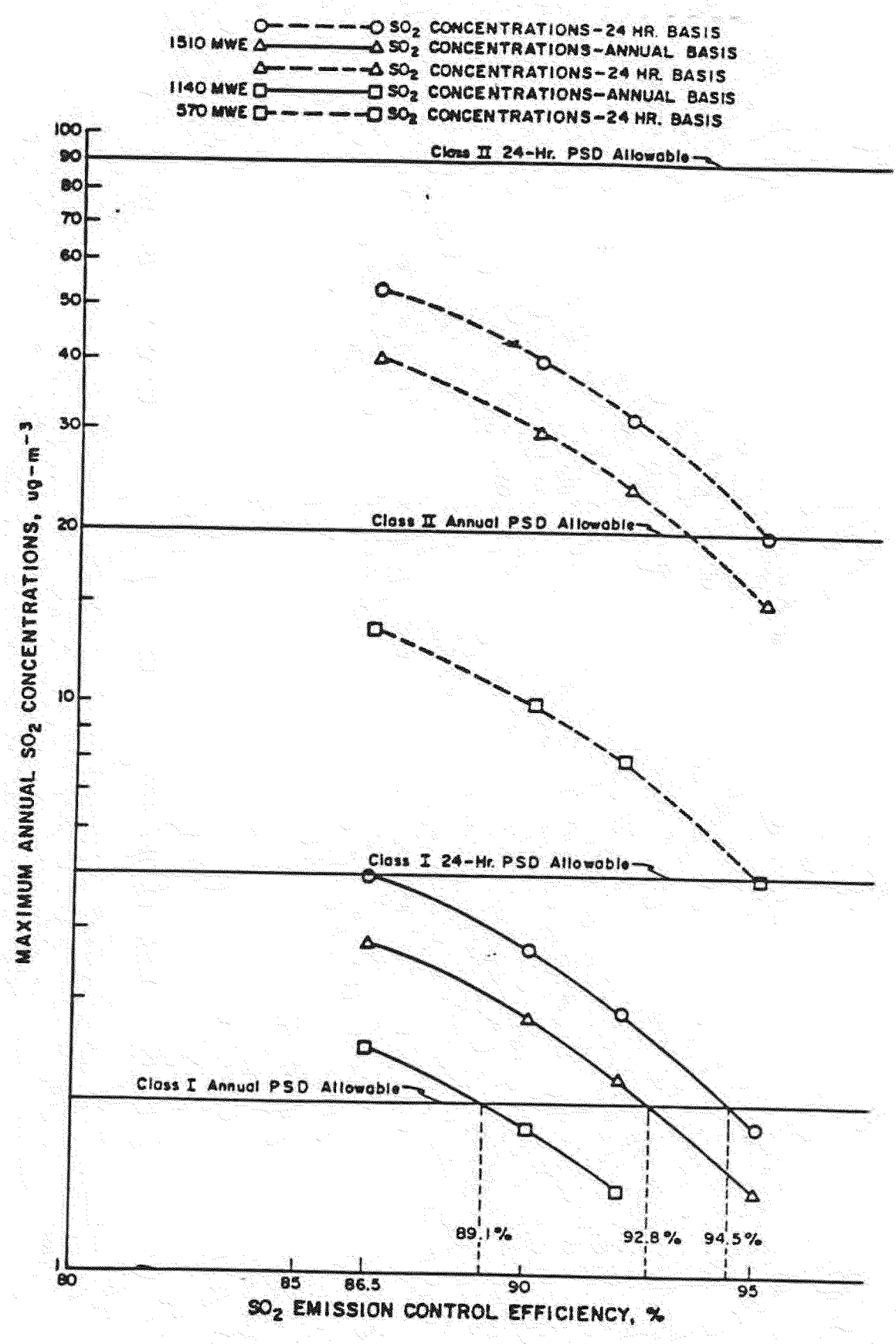

Figure 7-2 PRELIMINARY CGS MAXIMUM ANNUAL AND 24-HR SO_2 CONCENTRATIONS ON THE SPOKANE RESERVATION AS A FUNCTION OF ELECTRICAL GENERATING CAPACITY AND EMISSION CONTROL EFFICIENCY REQUIREMENTS FOR CLASS I AND CLASS II PSD COMPLIANCE

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manufacturer's guarantees for installed FGD systems for large coal-fired electrical power generating stations do not exceed a long-term SO_2 emission control efficiency of 90-92% at the present time.

However, as shown in figure 7-3, and Class II allowable PSD increments for SO_2 and particulate emissions from the CGS at maximum rated capacity of 2280 Mwe could be satisfied to a radial distance of about 25 miles from the CGS site. Hence, the cross-hatched portion of the reservation shown in figure 7-3 would comply with the Class II PSD increment, on the basis of this preliminary assessment.

7.2 PRELIMINARY LEVEL-VISIBILITY MODELING ANALYSIS

Section 169A of the Clean Air Act (40 CFR Part 51) requires the EPA to promulgate regulations to assure reasonable progress toward the congressionally declared goal of "the prevention of any future and the remedying of any existing impairment of visibility in mandatory Class I federal areas which impairment results from man-made air pollution." Since the Spokane Reservation is currently designated as a Class II Air Quality area, the foregoing visibility regulations do not require compliance. In fact, should the tribe redesignate the reservation to a Class I air quality status, there would not presently be a requirement for a visibility analysis, since the reservation would not be a mandatory Class I area. Nevertheless, at the request of the Spokane Tribe, a preliminary Level-1 visibility modeling analysis

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was performed to assess the potential for visibility impairment within the boundaries of the reservation as a result of CGS operation.

7.2.1 Brief Synopsis of Visibility Impairment

Although Congressional guidance on the definition of visibility impairment is significant, a number of important areas are left open for additional specification, interpretation and judgment. Section 169A of the Clean Air Act indicates that visibility impairment includes reduction in visual range and atmospheric discoloration. Visual range, long used as an index of visibility in airport observations, generally is defined as the farthest distance from which one can see a large black object against the horizon sky. Atmospheric discoloration can qualitatively be defined as a pollution-caused change in the color of the sky, distant mountains, clouds or other objects.

Conceptually, virtually any type of visibility impairment could ultimately be expressed as a reduction of visual range or as atmospheric discoloration. Because these effects are often the results of the same pollution impact, it is useful to categorize anthropogenic (man's impact on nature) visibility impairment into three general types: (1) widespread regionally homogeneous haze that reduces visibility in every direction from an observer, (2) smoke, dust or colored gas plumes that obscure the sky or horizon relatively near to sources (this class is also termed "plume blight") and (3) bands or layers of discoloration or veiled haze

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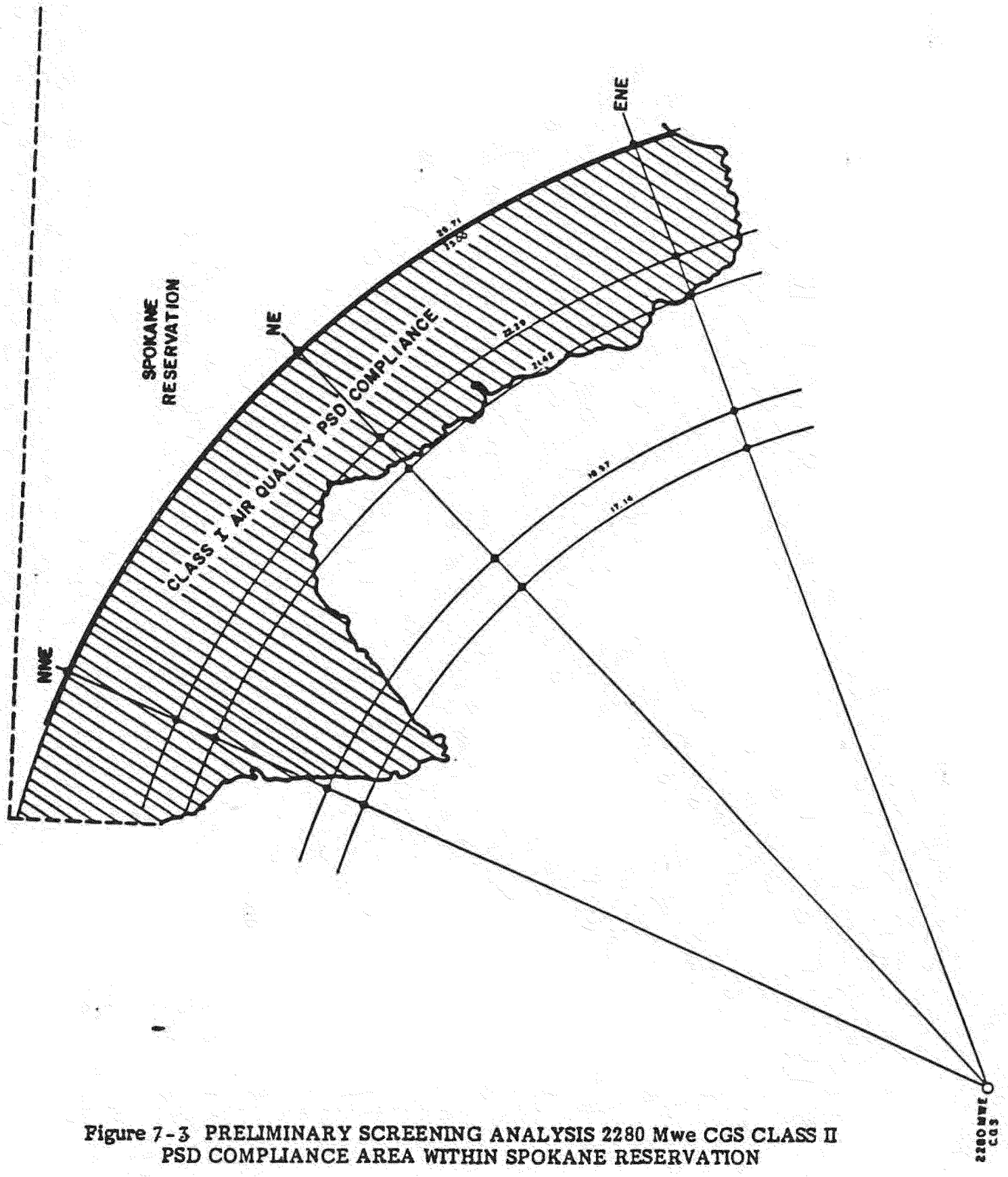

Figure 7-3 PRELIMINARY SCREENING ANALYSIS 2280 Mwe CGS CLASS II PSD COMPLIANCE AREA WITHIN SPOKANE RESERVATION

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appearing above the surrounding terrain.

The location, the degree and the spatial and temporal extent of visibility impairment must be addressed in visibility protection programs. In areas such as the southwest, anthropogenic air pollution occurring outside Class I area boundaries can obscure long-distance vistas normally visible from within the Class I area. Anthropogenic impairment may be frequent, last for long time periods, and be readily apparent to all observers. Conversely, anthropogenic visibility impacts may be so infrequent, short in duration, or small in degree that it is difficult for the unaided observer to distinguish them from existing impairment caused by natural sources.

Some insight into general visibility conditions can be obtained by examining the regional airport visibility (visual range) data depicted in figure 7-4. Although some limitations in airport observations exist, the information is indicative of regional trends. The best visibility occurs in the mountainous southwest, where annual median visibility exceeds 70 mi (110 km). East of the Mississippi and south of the Great Lakes, annual median visibilities are less than 15 mi (24 km) and significantly lower in the summertime. Figure 7-4 does not address plume blight or discoloration. Ironically, these latter problems can be more severe in "clean" regions. For example, in the southwest, the region of highest visual range, visible plumes can be seen from great distances.

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The ability to define, monitor, model and control anthropogenic visibility impairment is dependent on available scientific and technical understanding of the factors that affect atmospheric visibility. Because visibility involves the human perception of the physical environment, evaluation of the effects of air pollution on visibility must include:

* specification of the process of human visual perception, and
* Quantification of the impacts of air pollution on the optical characteristics of the atmosphere.

From a scientific/technical point of view, deterioration of visual air quality is probably the best understood and most easily measured effect of air pollution. However, many important uncertainties and limitations exist in available knowledge. Significant implications of current understanding of visibility in the atmosphere may be summarized as follows.

* Visibility impairment is caused by the scattering and obsorption of light by suspended particles and gases. Fine solid or liquid particles (atmospheric aerosols) and, to a lesser extent, nitrogen dioxide are generally the most important anthropogenic causes of degraded visual air quality. Air molecules, weather variables and natural emissions also affect visibility.
* Light scattering and light absorbing pollutants reduce the amount of light received from viewed objects and scatter

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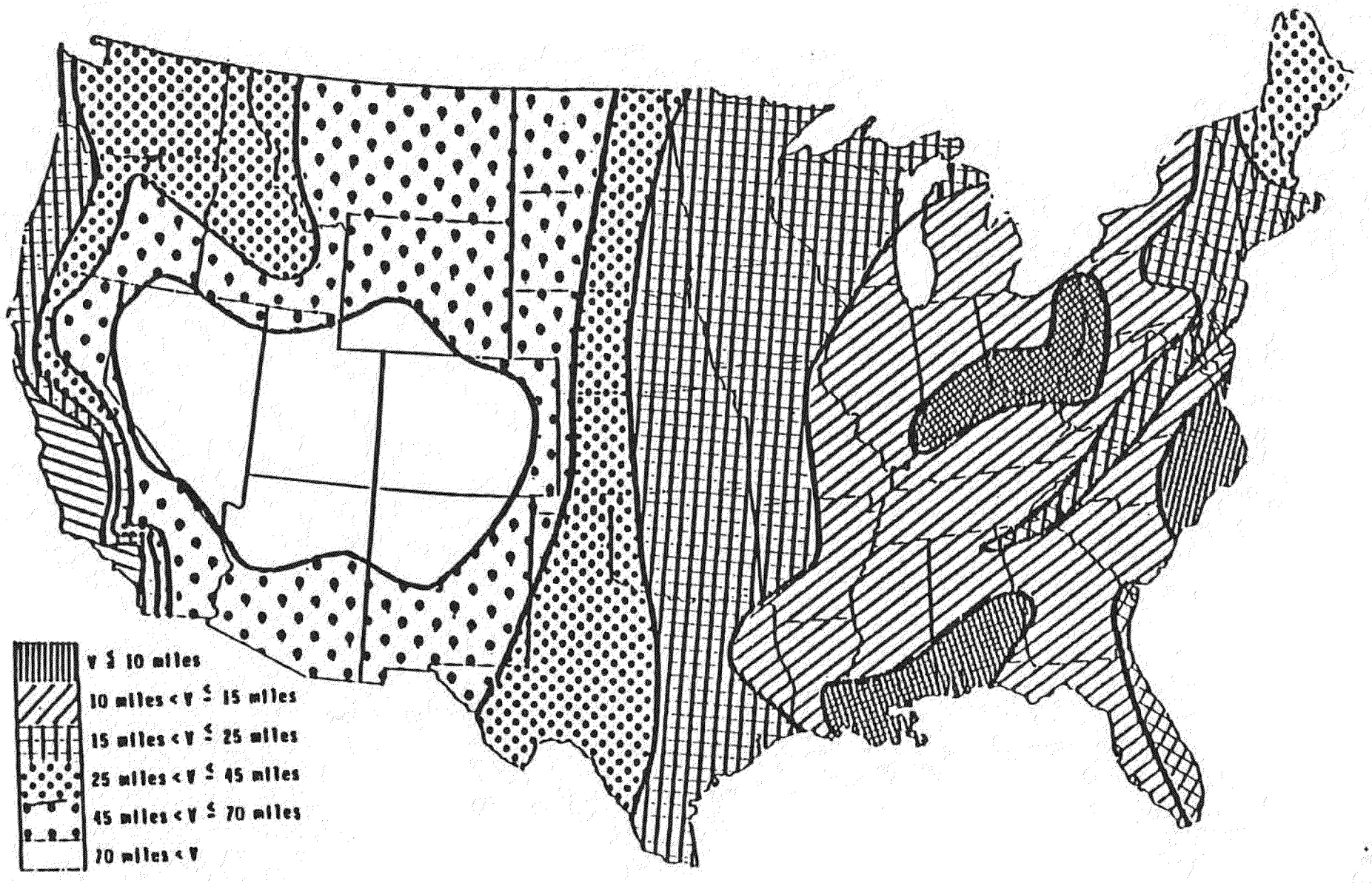

Figure 7-4 VISUAL RANGE ISOPLETHS (MI) FOR SUBURBAN/NONURBAN AREAS, 1974-76.

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ambient (or "air") light into the line of sight. This scattered air light is perceived as haze. Because these effects vary with the wavelength of light, discoloration can result.

* These effects can be quantified or approximated through use of theoretical mathematical treatments and experimentally derived pollutant/optics relationships.
* The perceptibility of pollution effects on light depends on human eye-brain response. Studies of the eye-brain response to visual contrast indicate that typical observers can detect a 0.02 (2%) or greater contrast between large dark objects and the horizon sky. Preliminary studies suggest that observers may be able to detect a 0.02 to 0.05 change in apparent contrast caused by incremental pollution. Additional work is needed on human perception of pollution increments.
* The perception of color in the atmosphere is less understood than contrast. For this reason, theoretical calculations of atmospheric discoloration are useful only as crude indices and guides for experimental measurements. Studies of atmospheric color perception conducted over the next few years should provide an adequate means of predicting atmospheric discoloration, even if a comprehensive theoretical treatment remains unavailable.
* Atmospheric discoloration are useful only as crude indices and guides for experimental measurements. Studies of

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atmospheric color perception conducted over the next few years should provide an adequate means of predicting atmospheric discoloration, even if a comprehensive theoretical treatment remains unavailable.

* In many southwestern Class I areas, visibility on some days can approach the theoretical limit imposed by air molecules (blue sky) scattering (200-mi visual range). Visibility in such areas is extremely sensitive to increased emissions. The addition of 1 ug/m^3 of fine particles, spread throughout the viewing path, to such a clean atmosphere could reduce visual range by about 30%. Addition of the same amount to a dirtier background (20-mi visual range) would produce only a 3% reduction in visual range.

* Since viewing distances in most Class I areas do not exceed 50-100 km (30 to 60 mi), a reduction in calculated visual range from 200 km (120 mi) to 150 km (90 mi) would be noticed principally because of the reduction in contrast and discoloration of nearby objects and sky (haze). Increased haze causes objects to appear "flattened," the horizon sky is whitened, and the aesthetic value of the vista can be degraded, even though the viewing distances are small relative to the visual range.

* When particles and light-absorbing gases are confined to an elevated haze layer or a coherent plume, the main visual impact will be a discoloration of the sky or a white, gray or

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brown plume. The perceived impact depends on a number of factors, such as sun angle and condition of background sky. Contrast and brightness effects of elevated haze and plumes con be approximated by available techniques. Additional work is needed to predict perceived color impacts.

7.2.2 PREVIS Visibility Model (Level-1 Visibility Screening Analysis)

The tentative visibility screening analysis procedure, as currently recommended by EPA guidelines, is presented in Figure 6-5. Potentially, one could analyze a given source at any one of three basic levels of detail. A Level-1 analysis involves a series of quite conservative screening tests that permit the analyst to eliminate sources with little potential for adverse or significant visibility impairment. If the Level-1 analysis, based upon hypothetical, worst-case meteorological conditions, indicates that visibility impairment is highly unlikely, further analysis is unnecessary.

If impairment is indicated by the Level-1 screening procedure as being possible, a Level-2 screening analysis is performed. It is similar to the Level-1 analysis in that its purpose is to estimate impacts during worst-case meteorological conditions; however, more specific information regarding the source, topography, regional visual range and meteorological conditions is assumed to be available. A frequency-of-occurrence analysis is performed to determine conditions representative of the worst day in a year, if possible.

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If both the Level-1 and Level-2 analysis indicate the possibility of significant or adverse visibility impairment, a more detailed Level-3 analysis is recommended. The purpose of a Level-3 analysis is to provide an accurate description of the magnitude and frequency of occurrence of impact. For this level of analysis, the number of days per year and per season in which a given magnitude of impact occurs are calculated from joint frequency tables of wind speed, wind direction, stability, mixing depth, ozone concentration and visual range in the area.

Due to lack of definitive meteorological data and regulatory compliance requirements for the Spokane Reservation and the immediate surrounding area, as well as the time and monetary constraints for this assessment, only a Level-1 screening analysis was deemed practicable. The very conservative Level-1 screening analysis is designed to evaluate two potential types of visibility impairment caused by nitrogen oxide, particulate matter (less than 2 um diameter) and sulfur dioxide emissions. One type of visibility impairment is a discolored, dark plume observed against a bright horizon sky and is caused principally by No_2 gas formed from No_x emissions, although particulates can contribute in some cases. the other type of visibility impairment is caused by a bright plume observed against a dark terrain background.

The PREVIS visibility model developed by CERT is a computer-based, Level-1 visibility screening analysis technique to assess potential visibility degradation or impairment from NO_x (as No_2),

particulate matter and SO_2 plume emissions. PREVIS entails the calculation of three contrast parameters as follows:

- the plume contrast against the sky (C_1);
- the plume contrast against terrain (C_2); and
- changes in sky/terrain contrast caused by primary and secondary aerosols (C_3).

As currently envisioned by the U.S. Environmental Protection Agency, if the absolute value of C_1, C_2 or C_3 is greater than 0.10, the emission source fails the Level-1 visibility screening test, and further, more-detailed screening analysis is recommended to assess potential visibility impairment. If the absolute values of C_1, C_2, and C_3 are all less than 0.1, it is highly unlikely that the emission source would cause adverse visibility impairment in Class I designated area; therefore, further analysis of potential visibility impacts would be unnecessary.

If the emission source fails the emission tests for the three plume contrast criteria (i.e., C_1, C_2, or C_3 greater than 0.1), the PREVIS model performs an additional preliminary (or, first-order) sensitivity evaluation to determine the maximum emission levels or conversely, the degree of control required for NO_x, particulate matter and SO_2 plant plume emissions to meet the Level-1 visibility plume contrast criteria of C_1, C_2, and C_3 less than an absolute value of 0.1.

A more complete derivation and discussion of the Level-1 analysis procedure utilized by the PREVIS model is included in

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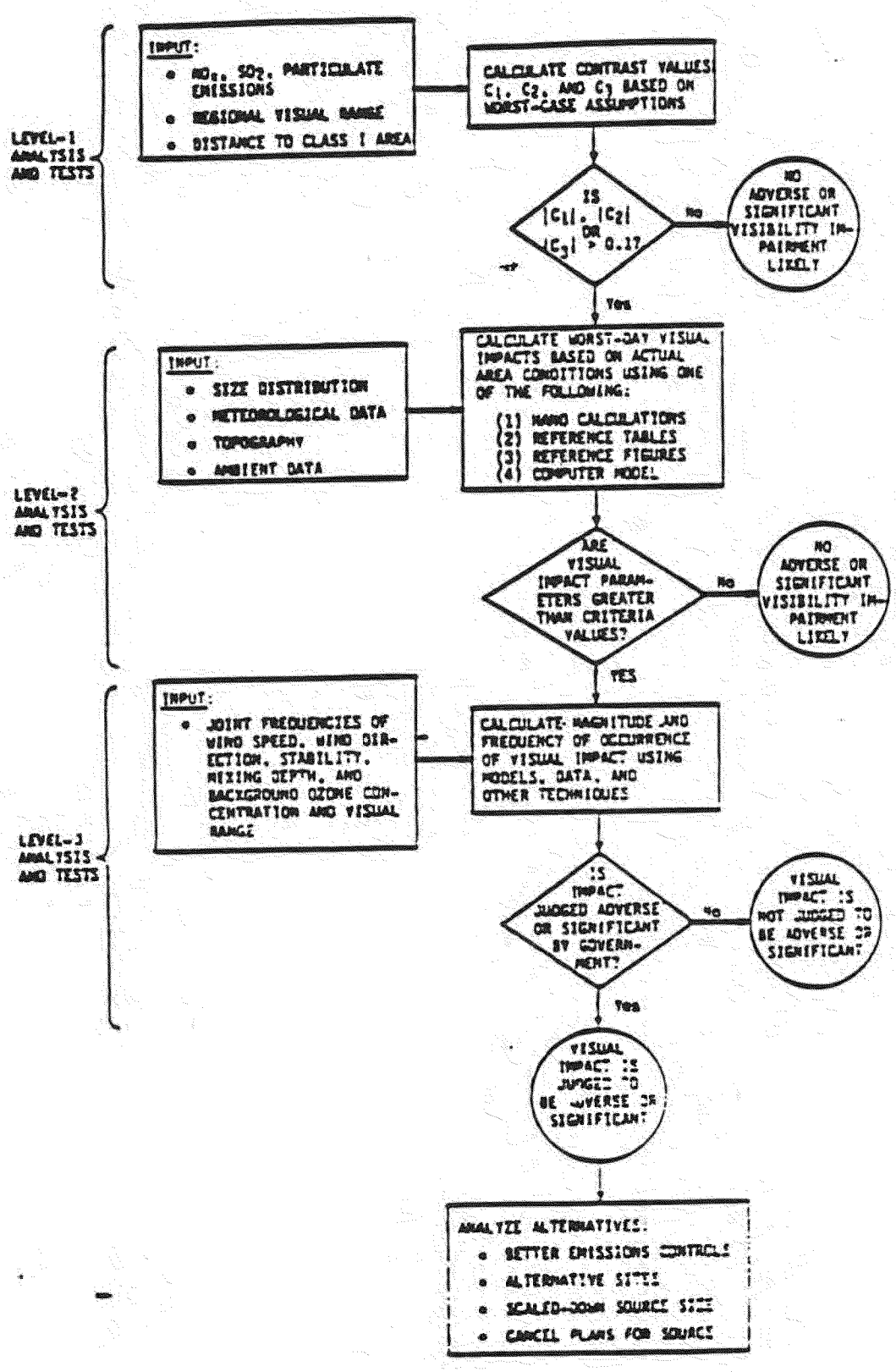

Figure 7-5 SCHEMATIC OF VISIBILITY SCREENING ANALYSIS PROCEDURE

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the Fort Peck Air Quality and Visibility Analysis performed by CERT for the Fort Peck Assiniboine and Sioux Tribes (CERT, 1981).

7.2.3 Level-1 Visibility Modeling Analysis Results

The pertinent input data for the PREVIS Level-1 visibility modeling analysis presented in table 7-10 was derived principally from the CGS operating parameters and pollutant atmospheric emission rates, as presented in tables 7-2, 7-3, and 7-4. Design estimates for emission rates, of SO_2, NO_x and particulate matter are identical to those values presented in table 4-3 for the preliminary air quality screening analysis. They represent SO_2 emission rates for an assumed emission control efficiency of 86.5% and NSPS allowable emission rates for NO_x and particulate matter of 0.7 lb NO_x /10^6 Btu and 0.03 lb particulate matter/10^6 Btu, respectively.

The assumptions for background visual range are based upon a range of values of 25 to 45 mi (40.23-72.42 km) and were derived directly from figure 7-4. The initial PREVIS Level-1 visibility analysis results shown in table 7-10 demonstrate that the CGS, as designed, fails the visibility tests for two of the three plume contrast parameters (C_1 and C_2) over the entire range of CGS electrical generating capacity, 570 Mwe (1 unit) to 2280 Mwe (4 units). Level-1 test failure is due to the close proximity of the CGS facility to the reservation boundary (approximately 16 mi), irrespective of the relatively low value (compared to the southwestern U.S.) for background visual range (25 mi) for this

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region of Washington. In general, major emission sources require separation distances from the source to the Nearest affected area boundary of 80 to 100 km to satisfy the requirements of the Level-1 screening analysis.

Hence, under the EPA visibility screening analysis procedural format outlined in Figure 7-5, a more detailed Level-2 and, possibly, a Level-3 visibility modeling analysis would be required if the Spokane Reservation were classified as a mandatory Class I air quality designated area.

However, a first-order or preliminary sensitivity analysis was performed utilizing the PREVIS computer program to establish the possible emission control requirements for the three primary pollutants affecting visibility impairment (SO_2, and NO_x and particulate matter), and, concomitantly, to reduce contrast parameters C_1 and C_2 such that all three contrast parameters are numerically less than 0.1.

Table 7-10. PRIMARY INPUT PARAMETERS AND INITIAL RESULTS-PREVIS LEVEL-1 VISIBILITY SCREENING ANALYSIS OF THE SPOKANE RESERVATION FOR POTENTIAL VISIBILITY IMPAIRMENT FROM 2280 Mwe CGS OPERATION

STATION RATING, Mwe	2280	1710 (3 units)	1140 (2 units)	570 (1 unit)

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Air Emissions, MT/Day:					
Particulate Matter		7.46	5.60	3.73	1.87
NO_x	137.76	103.32	68.88	34.44	
SO_2	49.76	37.32	24.88	12.44	
Distance to Reservation Boundary, miles		16	16	16	16
Background visual Range, mi	45	45	45	45	
Contrast Parameters					
C_1	.438	.414	.361	.246	
C_2	.356	.342	.309	.231	
C_3	.009	.007	.004	.002	

a. Particulate matter emission rates are based upon NSPS allowable requirement of 0.03 $lb/10^6$ Btu.

b. No_x emission rates are based upon NSPS allowable of 0.7$lb/10^6$ But.

c. SO_2 emission rates are based upon an emission control efficiency of 86.5%.

Since two of the three primary pollutants, i.e., SO_2 and particulate matter, have already been subjected to relatively high levels of emission control in order to achieve compliance with the

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existing Class II PSD increment and NSPS (as discussed previously in the air quality dispersion modeling analysis), additional No_x emission control affords a possible alternative for reduction of potential visibility impact from CGS operation.

Additional perusal of the initial calculated values for the Level-1 contrast parameters presented in table 7-10 reveals two salient factors that structure the subsequent PREVIS sensitivity analysis. Since only sulfur-containing atmospheric pollutants affect the C_3 contrast parameter in the analysis, and it is never exceeded (as shown in table 7-10), it may be concluded that SO_2) is not a significant pollutant for further consideration in the preliminary Level-1 screening procedure. Secondly, operation of no more than one CGS unit, with a maximum electrical generating capacity of 570 Mwe and with additional control of NO_x and /or particulate matter, can possibly satisfy the Level-1 contrast parameter test criteria.

Therefore, the final results of the preliminary PREVIS sensitivity analysis presented in table 6-11 establish possible additional NO_x and particulate matter emission control alternatives for a 570 Mwe (1 unit only) CGS facility.

Table 7-11. PREVIS PRELIMINARY VISIBILITY SENSITIVITY ANALYSIS-570 Mwe CGS-SPOKANE RESERVATION

	ALTERNATIVE 1	ALTERNATIVE 2

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Air Emission, MT/Day:		
Particulate Matter	1.87	1.87
NO_x	34.44	34.44
SO_2	12.44	12.44
Distance to Reservation Boundary, miles	16	16
Background Visual Range, miles	45	45
Additional Particulate Matter Control, %	0	41.2
Additional NO_x Control, %	85.5	76.8
Additional SO_2 Control, %	0	0

The aforementioned results indicate that an 85.5% No_x emission control requirement would be necessary if no additional emission control of particulate matter was invoked on the single 570 Mwe unit of the CGS. Alternatively, the additional NO_x emission control requirement could be decreased to about 77% if a 41% control of particulate matter emissions were included in the CGS facility.

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8.0 REGIONAL IMPACTS

8.1 Introduction

Throughout this section the Spokane Tribe will attempt to assess the impact of redesignation on those communities adjacent to the Spokane Reservation. This assessment should not be considered an exhaustive study of the potential impacts of redesignation but instead should be viewed as a general discussion of impacts as perceived by the Spokane Tribe. As the Tribe proceeds with its request for redesignation they will continue to define important issues through the public hearing process. The Spokane Tribe has requested technical assistance from EPA to refine the following assessment and considers it imperative that all concerned individuals and groups participate within the comment process.

It is the Tribes contention redesignation will enhance and maintain a way of life so important to tribal members and our neighbors. Class I Air is essential to preserving this regions economy based on agriculture, timber and tourism.

Class I redesignation is consistent with international, national and regional environmental goals. Recently the Reagan Administration and Canadian government endorsed a mutual agreement to take what ever steps necessary to eliminate the pernicious affects of acid rain caused by increased levels of sulphur dioxide (SO_2) and other pollutants emitted by burning coal.

Environmental Protection is central to the PSD program and it is to this end that the Spokane Tribe must insist on eliminating the potential for further degradation of Air Quality within this region.

As custodians of their land the Spokane Tribal Council is

charged with preserving their life ways for future generations.

For the purposes of this section we will be concerned specifically with those areas located approximately within a radius of thirty miles. This focus will allow us to predicate our discussion on area similar in physical and socio-economic structures and functions.

8.2 Impact on Environmental Health

It must be understood that Class I redesignation will by its very definition not improve existing air quality nor will it require any measures to make our air cleaner than it already is. The PSD regulations do not have provisions which would affect pollution sources already in operation at the time redesignation is granted. Instead, Class I only protects us and our neighbors from future air quality degradation. A Class I designation will prevent significant deterioration of our present air quality. Specifically Class I will limit the allowable increases in SO- and particulate matter pollution.

8.3 Health Impacts

The following section is in large part extracted from the Ft. Pecks Class I redesignation document.

HEALTH

Redesignation to Class I will have long-term beneficial impacts on the health of reservation residents, and the surrounding populous, by minimizing the probability of health problems associated with sulfur dioxide and particulate matter. Although t present very little data exists on the health effects of low levels of these pollutants, higher concentrations have clearly been implicated as causing adverse impacts to human health.

When sulfur dioxide is inhaled through the nose or mouth, it is rapidly absorbed into the blood stream and distributed throughout the body. Sulfur dioxide in the blood has been observed to react with proteins, inactivate certain enzymes and even interfere with cellular genetic material (DNA), although the significance of these effects is not clear. However, once the sulfur dioxide reaches the lungs, either from direct inhalation or by transportation through the blood, adverse impacts may result.

Numerous studies have confirmed that the lungs are highly sensitive to sulfur compounds, and a relationship has been established between irritation of the throat and lungs by sulfur oxides and increased respiratory problems. Acute levels of sulfur dioxide can act on the small airways of the deep lung to significantly impair lung function, and may also reduce the rate of nasal mucous flow, which is thought to be an important part of the body's defense against infection.

Children and persons with existing respiratory conditions are considered to be particularly vulnerable to sulfur dioxide. Increased incidence of bronchitis and chest colds among school children have been noted in more heavily SO- polluted areas, while a hospital admissions study in Los Angeles identified sulfur dioxide levels as the most consistent influence on lengthened periods of care, particularly for patients with heart and lung diseases. Several epidemological studies have concluded that there is no threshold for sulfur dioxide damage among the most sensitive portion of the population. A study on asthma patients living near a coal-fired power plant found health responses at all pollutant concentrations measured, with attack rates increasing uniformly

from the lowest levels of pollution to the highest. In an extensive literature review recently conducted by the Montana State Air Quality Bureau, their findings on the health effects of sulfur dioxide conclude that:

> The primary effects on human health associated with exposure to sulfur dioxide (a decrease in lung function, an increased incidence of respiratory disease among children, a decline in the health of individuals with chronic obstructive lung conditions to and including death, and an increase in the number of asthma attacks among persons with asthma) present a risk to the health of a vulnerable population group in the community and may result in permanent damage.

Sulfur oxides can also combine with other air contaminants, especially particulates, to form a pollutant complex more hazardous to human health than the sum of their individual effects. Some particulate surfaces are substantially more irritating than an equivalent concentration of sulfur dioxide. In addition, fine particulates can carry sulfur dioxide deep into the human lung, increasing the potential for more serious damage.

Particulates themselves may also have adverse impacts on human health, with the nature of the damage dependent upon particle size and composition. Coarse particles generally settle out of the air close to their source, while fine particles tend to move with the air and remain suspended for much longer periods. This contrast in behavior also causes the two types of particles to act differently when inhaled; the large particles usually collect on the surfaces

of the nose and throat and are thus more likely to flow around the obstructions in the airways and reach the lungs. Very fine particles may remain in the lungs for long periods. If the particle is toxic, or is carrying other toxic materials such as heavy metals or organic substances, these contaminants may be obsorbed into the bloodstream and thus be transported to other parts of the body.

Fine particulates have been related to respiratory illness, cardiovascular disease, neurological damage and cancer. In addition, increased mortality has been shown to accompany higher levels of particulate matter.

In summary, the evidence shows a very real cause and effect relationship between sulfur dioxide and particulate pollution and injury to human health. It is difficult to estimate from the available data exactly what impacts could be expected under the allowable Class II increments. However, the vulnerability of sensitive groups in the population -- such as children, the elderly, and those with existing respiratory conditions -- are of particular concern to the Tribes. The added margin of safety by Class I is necessary to protect human health and would be of long term benefit to all people on the reservation and in the surrounding areas.

8.4 Impacts on Agricultural Activities

Redesignation will greatly enhance the maintenance of agricultural activities within the affected region. Specific impacts of SO- were detailed in section 6.2.2. Due to the paucity of data it is still left unclear what the long term impacts of SO- and TSP on agricultural crops.

Redesignation will assist in preventing major pollution sources from locating within this region thus protecting crops sensitive to SO_2 .

Research has shown agricultural crops noted in this area are sensitive to SO_2. From this we can infer that any significant increases in SO_2 would have a serious impact on crop production in this area.

Class I will not affect agricultural and timber industry waste disposal methods now instituted within this region but it may have an impact on increased disposal activities which degrade air quality. Such activities may be coordinated with the State of Washington.

8.5 Impact on Energy Activities

Redesignation will insure that all new sources of energy produced through the use of fossil fuels may be limited or prohibited. We find this in keeping with the Reagan's just released policy statement limiting pollution sources of Acid rain.

Coal fired generating facilities planned for this region would increase the levels of SO_2 and particulates transmitted thus redesignation by the Spokane Tribe may either eliminate the custom site as proposed or cause the planned facility to consider design changes bringing them under Class I guidelines.

The Northwest Power Planning Council recently adopted its new 1986 Northwest Power Plan. Within this plan the council attempts to delineate and prioritize those energy resources needed over a twenty year span of time. Different growth scenarios were used within the resource priority scheme. A portfolio of new electrical

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resources to meet the projected needs was established. "To be included in the portfolio, a resource must be available, reliable and acceptable"*. The energy resources were listed by placing the most cost effective first. After each was identified, estimated highest power demand forecast needs were shown.

1. Conservation: 3,900 megawatts
2. Better use of existing hydropower system: 700 megawatts
3. New hydropower: 200 megawatts
4. Cogeneration: 320 megawatts
5. Coal: 5,425 megawatts (12 plants)

"This is the last and most expensive resource to come on line and would be used only if high growth made it necessary. (using all 12 plants would require unprecedented high growth) In its plan the Council called for intensified research and testing of renewable energy resources so that they can be ready and cost effective before the region needs to turn to some or all of the coal plants."*

The Council further states that as renewable resources such as geothermal, wind and solar prove to be cost effective and reliable they could replace some coal generation in the future thus some of the environmental problems and expenses - of coal plants might be avoided.

The Spokane Tribe is encouraged by the advent of new technologies enabling the northwest to meet its future energy demands.

Improved design of nuclear facilities - more efficient uses of hydropower - waste energy - increased use of renewable resources - conservation; all have the potential of greatly reducing the

* Extracted from, Northwest Energy News: Vol 5, no. 2, February/March 1986

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demand for fossil fuels as a primary source for energy production.

8.6 Tourism

Redesignation would enhance this regions ability to attract visitors and tourist related development.

The Grand Coulee National Recreation area boarding the Spokane reservation is renowned for its beauty and the availability of a wide variety of recreational uses. Through federal and private sector efforts new facilities are planned enhancing further the economy of this area.

If we are to increase the economic value of tourism it is imperative that air quality be maintained as pristine as possible. Deterioration of air quality will adversely impact an economy now more dependent on the tourist industry.

8.7 Socio - Economic Impacts

Class I air is consistent with the existing agricultural society and economy of the Spokane reservation and adjacent communities. Agriculture, timber and tourism predominate as economic activities.

Redesignation will assist in the maintenance of a social structure based on this spectrum of human endeavor. This is true not because redesignation will prevent all polluting industries from locating in this region, for it will not. Rather it will serve to limit the number of large scale industries capable of degrading our air through the emission of pollutants. This would in turn lessen the probability of large scale population infusions. Populations would tend to be stable with infrastructure needs evolving to meet planned growth patterns. Social and political breakdowns due to fast paced population increases would

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be minimized.

It is difficult to project growth based on speculation therefore we are unable to anticipate the full extent of the impact of Class I air on a projection but we can say Class I air will not hurt the existing economy. Development beneficial to our communities can and will take place. The important lifeways and values of our communities be sustained and enhanced by those actions protecting our environment.

We anticipate redesignation will garner wide support from our neighbors when each community realizes that it is not the intent of the Spokane Tribe to restrict development within our region, but it is to insure the maintenance of an environment supportive of a healthful productive human experience.

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8.0 CONCLUSION

It is the intent of the Spokane Tribe to proceed with the redesignation of air quality within the boundaries of the Spokane Reservation. Such an action will protect and preserve the air quality environment on tribal lands. Although the air quality resources of the Spokane Tribe are assumed to be excellent, an ambient air quality and meteorological monitoring program should be initiated on the reservation. The Spokane Tribe has requested that this action be taken concurrent with the remaining requirements for redesignation.

It is understood by the tribe that action to redesignate tribal lands to the more pristine Class I status may place limits on development activities on the reservation which would produce TSP or SO_2 emissions but it is also felt the maintenance of exceptional air quality standards will have positive long lasting impacts on all aspects of life on the Spokane Reservation.

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Attachment name: [image001.jpg]
Attachment type: [image/jpeg]

To: kmerrill@knrd.org[kmerrill@knrd.org]; Wilson, Wenona[Wilson.Wenona@epa.gov]
From: Bray, Dave
Sent: Tue 10/4/2016 11:31:18 PM
Subject: RE: Spokane Class 1 airshed redesignation submission document - Preliminary screening model for air impacts from Smelter near Kalispel Reservation

Thanks Ken.
And pass our thanks onto the Spokanes the next time that you talk with them. It will be great to have a copy of this back in our records.
Dave

David C. Bray
Associate Director for Air
Office of Air and Waste
EPA Region 10
Seattle, WA
(206) 553-4253

From: Ken Merrill [mailto:kmerrill@knrd.org]
Sent: Tuesday, October 04, 2016 4:22 PM
To: Bray, Dave ; Wilson, Wenona
Subject: RE: Spokane Class 1 airshed redesignation submission document - Preliminary screening model for air impacts from Smelter near Kalispel Reservation

Dave and Wenona,
Here is the Spokane's Class 1 redesignation submission documents they so kindly sent us. I told them I would forward it on to you with their permission. --Ken

Ken Merrill
Water Resources Program
(509) 447-7276 (office)
Ex. 6 (cell)

From: Bray, Dave [mailto:Bray.Dave@epa.gov]
Sent: Thursday, September 29, 2016 2:23 PM
To: Ken Merrill; Wilson, Wenona
Subject: RE: Preliminary screening model for air impacts from Smelter near Kalispel Reservation

Thanks Ken.
Interesting stuff.
If we do end up doing some screening modeling, our modeler will need to get some more detailed information from the company (or Ecology if they've got something from the company yet).
Look forward to talking more soon.
Dave

David C. Bray
Associate Director for Air
Office of Air and Waste
EPA Region 10
Seattle, WA
(206) 553-4253

From: Ken Merrill [mailto:kmerrill@knrd.org]
Sent: Wednesday, September 28, 2016 2:44 PM
To: Wilson, Wenona <Wilson.Wenona@epa.gov>
Cc: Bray, Dave <Bray.Dave@epa.gov>
Subject: RE: Preliminary screening model for air impacts from Smelter near Kalispel Reservation

FYI- Attached is some info on the smelter project sent to us by the project proponent. PM numbers are omitted for some reason --Ken

Ken Merrill
Water Resources Program
(509) 447-7276 (office)

Ex. 6 (cell)

From: Ken Merrill
Sent: Tuesday, September 27, 2016 4:46 PM
To: Wilson, Wenona
Cc: 'Bray, Dave'; Zach Welcker; Deane Osterman
Subject: Preliminary screening model for air impacts from Smelter near Kalispel Reservation

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Thanks for the consideration --Ken

Kenneth R. Merrill
Manager - Water Resources Program
Kalispel Tribe Natural Resources
PO Box 39, Usk, WA, 99180
(509) 447-7276 (office)
Ex. 6 (cell)

To: Wilson, Wenona[Wilson.Wenona@epa.gov]
From: Ken Merrill
Sent: Tue 10/4/2016 11:23:21 PM
Subject: FW: Preliminary screening model for air impacts from Smelter near Kalispel Reservation
MS Silicon air application.pdf
Smelter plant EIS eia_iceland_silizium.pdf

Hi Wenona- Forgot to reply-all with this reply back to Dave. --Ken

Ken Merrill
Water Resources Program
(509) 447-7276 (office)
Ex. 6 (cell)

From: Ken Merrill
Sent: Tuesday, October 04, 2016 4:17 PM
To: 'Bray, Dave'
Subject: RE: Preliminary screening model for air impacts from Smelter near Kalispel Reservation

Hi Dave,
Yes for sure more info is needed. Here are some documents on the Mississippi Silicon plant which Bryan Holtrop of your staff found earlier and a draft impact statement for a new facility in Iceland. I will send you the Spokane Tribe's Class 1 Airshed Redesignation submittal document with the next email for your records.
Thanks --Ken

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Water Resources Program
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Thanks for the consideration --Ken

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1515 East Woodfield Rd. Suite 360
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847-278-7705

Application for Prevention of Significant Deterioration (PSD) Air Permit

14 August 2013

Prepared for

MISSISSIPPI SILICON

Mississippi Silicon, LLC
Proposed Silicon Manufacturing Plant
50 Industrial Drive
Burnsville, MS 38847

K/J Project No. 1341008*00

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Section 1: Introduction

Mississippi Silicon, LLC. (MS Silicon) is proposing the construction of a silicon manufacturing plant located near the city of Burnsville, in Tishomingo County, Mississippi (Figure 1-1). The silicon manufacturing plant is being constructed to produce revolutionary low-cost, high-quality silicon allowing MS Silicon to meet the ever-increasing demand for its silicon. The new facility will enable MS Silicon to produce silicon metal so it can be sold to the company's existing and new customers in the global market.

Several factors were important influences on this choice of site:

- Burnsville is centrally located to both the raw material suppliers and finished product customers for Mississippi Silicon.
- The site is located on the Tennessee-Tombigbee Waterway, with a barge loading and unloading facility immediately adjacent and available for Mississippi Silicon to use for inbound materials and outbound product, if desired. The Tennessee- Tombigbee Waterway provides direct access to both the Gulf of Mexico and the Ohio River.
- A high-voltage TVA line runs past the western boundary of the site. TVA will be a stable, reliable, low-cost long-term supplier of the most important production input for Mississippi Silicon, electricity. The proximity of this power line will minimize the cost and facilitate the link to this input.
- Mississippi has a large and sustainable supply of wood, an important raw material in Mississippi Silicon's production process.
- The state of Mississippi, Tishomingo County, and the TVA enthusiastically support the project, and are providing significant financial incentives to demonstrate that support.

The plant will provide jobs for nearly 150 people. When operational, MS Silicon's Mississippi facility has the potential to catalyze significant economic development for Tishomingo County and the state. The project will also create an estimated 500 construction jobs during the peak period of its construction.

The silicon manufacturing plant being proposed by MS Silicon will be capable of producing a high quality, low cost silicon. The manufacturing plant will utilize four (4) semi-enclosed submerged arc furnaces (SAF) with a capacity of 2.75 tons/hr each (~45 MVA) to produce approximately 84,096 tons/year of 98-99% pure silicon metal. The plant will incorporate into its design proven and highly efficient control technologies and techniques for the reduction of potential emissions of regulated air pollutants. In order to create the silicon metal, quartz, coal, and wood will be processed in the SAF.

The silicon manufacturing plant will involve specific process areas including raw material receiving, handling and storage operations along with operations associated with the actual silicon manufacturing process. The primary process operations associated with silicon manufacturing will include:

- Raw material handling, storage and conveyance (coal, wood, quartz and limestone);

- Loading of these raw materials into four (4) semi-enclosed submerged arc furnaces (SAF) (electric fired) to produce liquid silicon metal (approximately 98% pure); and
- Using ladles and casting molds to produce solid silicon metal (approximately 98% pure).

The process areas that will have the potential to emit regulated air pollutants include:

- Material handling and transfer to and from coal, wood and quartz storage piles;
- Storage yard for coal, wood and quartz storage piles;
- Raw material day bins to support the semi-enclosed submerged arc furnaces;
- Four (4) semi-enclosed submerged arc furnaces (SAF) with four (4) baghouses; and
- Four (4) natural gas-fired ladle pre-heaters.

The following plantwide operations and activities will have the potential to emit regulated air pollutants:

- Tank farm;
- Fugitive emissions from roadways;
- Slag handling;
- Silica fume silos:
- Facility-wide miscellaneous operations; and
- Emergency generator.

The operations identified above reflect a phased construction. Phase I will involve the installation of two (2) SAFs and supporting operations. At the completion of Phase I, MS Silicon will initiate construction of Phase II which will involve the installation of two (2) additional SAFs and supporting operations.

Collectively, these process areas will have the potential to emit major levels of regulated air pollutants and, therefore, will be subject to the Prevention of Significant Deterioration (PSD) regulations of the United States Environmental Protection Agency (USEPA) along with the requirements of the Mississippi Department of Environmental Quality (MDEQ) Air Pollution Code (APC), which contain air quality requirements that must be satisfied prior to construction of this type of plant. Appropriate air pollutant emission controls/techniques to minimize potential emissions of regulated air pollutants, appropriate measurements, testing and recording of operational parameters will be performed to confirm that the plant's major source levels of regulated air pollutant emissions are being achieved. The regulatory requirements imposed by the PSD and MDEQ air regulations, as well as emissions controls/measurements and compliance testing will ensure that the proposed silicon manufacturing plant will have no adverse impact to human health and welfare.

1.1 Summary of the Proposed Silicon Manufacturing Project

The proposed project will involve the construction and operation of a silicon manufacturing plant to be located in Tishomingo County, near the town of Burnsville. The proposed silicon manufacturing plant will be constructed in two (2) phases. After completion of both phases, the manufacturing plant will utilize four (4) semi-enclosed submerged arc furnaces (SAF) with a capacity of 2.75 tons/hr each (~45 MVA) to produce approximately 84,096 tons/year of 98-99% pure silicon metal. The proposed project will have the potential to emit regulated air pollutants in sufficient quantities (i.e., tons/year) to trigger the PSD regulations. Potential emission of regulated air pollutants at the conclusion of Phase II are summarized below:

Regulated Air Pollutant	Potential to Emit Emission Rate (tons per year)
Sulfur Dioxide (SO_2)	2,170.1
Nitrogen Dioxide (NO_2)	1,906.2
Carbon Monoxide (CO)	1,444.3
Particulate Matter (PM)	104.1
Particulate Matter (<10 microns) (PM_{10})	81.6
Particulate Matter (<2.5 microns) ($PM_{2.5}$)	73.1
Volatile Organic Compounds (VOC)	93.5
Lead (Pb)	< 1.0
Regulated HAPs	9.9 (individual), 13.9 (total)
Greenhouse Gases (CO_2e)	402,396.76

Based on the proposed plant's potential emission rates defined above, the proposed silicon manufacturing plant will have the potential to emit regulated air pollutants in excess of 100/250 tons/year and will be considered a Major Stationary Source. Since Tishomingo County is considered attainment for all regulated criteria air pollutants, PSD review was triggered for emissions of SO_2, NO_2, CO, PM_{10}, $PM_{2.5}$, VOCs, and GHGs from the proposed silicon manufacturing plant. The proposed silicon manufacturing plant will be considered Major under the PSD program, as well as under the Title V Operating Permit Program. The proposed silicon manufacturing plant will be considered a minor stationary source of regulated HAP emissions as defined under EPA's Title III program.

As part of the project, the potential air pollutant emission sources associated with the proposed silicon manufacturing plant will implement Best Available Control Technology (BACT) and as a result will not have an adverse impact on human health and welfare. Sections of this application provide the results of the air quality demonstration showing the plant will have no adverse impact on human health and welfare. The proposed silicon manufacturing plant will be implementing the following BACT control measures:

- A baghouse will be installed to control particulate matter on the plant's Submerged Arc Furnaces (SAF) to reduce the potential quantity of $PM/PM_{10}/PM_{2.5}$ emissions. One baghouse will be installed for each individual SAF;

- A baghouse(s) will be installed to control particulate matter from raw material handling to reduce the potential quantity of $PM/PM_{10}/PM_{2.5}$ emissions;
- A baghouse(s) will be installed to control particulate matter from product handling to reduce the potential quantity of $PM/PM_{10}/PM_{2.5}$ emissions;
- Utilization of natural gas as the primary combustion fuel in the ladle pre-heaters associated with the proposed plant. This is the cleanest burning fossil fuel and inherently reduces emissions of regulated air pollutants when compared to other fossil fuels such as coal and oil;
- Implementation of a Fugitive Dust Control Plan to minimize potential emissions of $PM/PM_{10}/PM_{2.5}$ from becoming airborne from various support operations associated with the plant (i.e., slag handling, raw material handling, paved and unpaved roadways);
- Installation of low NO_x burner technology or design on the plant's natural gas combustion devices to reduce potential emission of oxides of nitrogen (NO_x);
- Inclusion of bin vent filters on silica fume silos to reduce potential $PM/PM_{10}/PM_{2.5}$ emissions;
- Energy efficiency techniques to reduce the plant's overall potential for formation of greenhouse gas emissions (GHG);
- Implementation of testing, monitoring, recordkeeping and reporting requirements to ensure the plant will operate in compliance with applicable regulatory requirements and will not cause or contribute significantly to an exceedance of air quality standards developed by EPA to protect human health and welfare.

1.2 Site Information

The proposed silicon manufacturing plant will be located near the town of Burnsville in Tishomingo County, MS. Figure 1-1 shows a county map of Mississippi including the location of the proposed site in Tishomingo County. Figure 1-2 identifies the location of the proposed plant in relationship to Burnsville, MS while Figure 1-3 depicts an aerial view of the proposed plant location. Refer to Figure 2-1 for a general process area layout.

This site was selected based on a variety of factors including existing infrastructures, as well as new infrastructures being constructed in the vicinity of the site. Some of these critical infrastructures are listed below:

- Existing electrical transmission lines;
- Existing natural gas;
- Close proximity to major roadways to allow supply trucks easy access into and out of the proposed plant site;
- Rural location; and

- Located away from sensitive receptors such as hospitals, schools, nursing homes, and highly populated residential areas.

1.3 Anticipated Construction Schedule

The proposed plant will be constructed in two phases, Phase I and Phase II. Provided below is a tentative schedule related to construction and operation of these phases:

- Initiate construction of Phase I – November 2013;
- Complete construction of Phase I and commence operation – November 2015;
- Initial construction of Phase II – Spring 2015; and
- Complete construction of Phase II and commence operation – Spring 2017.

1.4 Maximum Design Silicon Production Rates

The proposed plant will have the following maximum design short term and long term production rates for silicon:

- Short Term (tons/hour)
    - Maximum Hourly Rate – One (1) SAF – 2.75 tons/hour
    - Maximum Hourly Rate – Four (4) SAFs – 11 tons/hour
    - Typical or Average Rate – One (1) SAF – 2.4 tons/hour
    - Typical or Average Rate – Four (4) SAFs – 9.6 tons/hour
- Long Term (tons/year)
    - Maximum Annual Rate – One (1) SAF – 21,024 tons/year
    - Maximum Annual Rate – Four (4) SAFs – 84,096 tons/year.

1.5 Regulatory Drivers – Permission to Construct the Plant

As discussed above, the proposed silicon manufacturing plant will have the potential to emit PSD major levels of regulated air pollutants. New equipment and operations which emit air pollutants within the MDEQ jurisdiction are subject to pre-construction review and approval by MDEQ pursuant to the APC-S-2 Permit Regulation for the Construction and/or Operation of Air Emissions Equipment.

The proposed plant will also be subject to other requirements contained within MDEQ's air quality regulations as well as EPA's federal air quality regulations (i.e., New Source Performance Standards (NSPS) and Maximum Achievable Control Technology (MACT). These regulations impose specific requirements and standards for stationary sources of air pollutants. Detailed discussions of these regulations as they pertain to the air pollutant sources at the proposed plant are provided in Section 3.

According to MDEQ APC-S-2-1-D, "Permitting Requirements", any new stationary source or modification of a stationary source must have a permit to construct or multi-media permit incorporating such permit before beginning construction.

The construction application (as specified in the MDEQ application instructions and MDEQ regulations) must include the data and information necessary to demonstrate that the proposed project, which includes new sources of air pollution, complies with applicable air quality regulations and standards.

1.6 Application Requirements – Construction Application and Instructions

The construction application should include and identify the following:

- **GENERAL FORM** – Includes name, address and contact for the owner/applicant and the facility. Also includes the SIC code, number of employees, principal processes, principal products and raw materials, and operating schedule. This form also requires the signature of a registered official.

  Refer to Appendix A which includes the completed MDEQ application forms.

- **All operations or equipment having air emissions**. Specify the maximum schedule, maximum operating rate and expected operating rate, if different from the maximum.

  Refer to Section 2 of this application which identifies operations/equipment having the potential to emit regulated air pollutants, including supporting calculations and documentation.

- **Emission Rates** (in units of applicable emission standard as well as pounds per year and tons per year for each pollutant subject to regulations that can be reasonably expected to be emitted from each emission point. Emission rate calculations must be provided. The following emission rates shall be provided in the Emissions Summary Section of the form:

  - Potential uncontrolled emissions; and
  - Proposed emission rate (maximum emission rate).

  Refer to Section 2 of this application which identifies operations/equipment having the potential to emit regulated air pollutants, including supporting calculations and documentation.

- **Exhaust or Stack Parameters** for each emission source (height, velocity, diameter, and temperature) should be provided in the Emissions Summary Section of the form.

Refer to Section 2 of this application which identifies operations/equipment having the potential to emit regulated air pollutants, including supporting calculations and documentation.

The following additional information must be submitted in duplicate:

- **Design Calculations and Specifications** including all data and calculations used in selecting or designing process and control equipment;

- **Site Drawings** must be to scale and show at least the following:

    - Property involved with dimensions, clearly defining restricted entry boundaries, and if different, total property boundaries;

    - Location and identification of all existing and/or proposed buildings, structures, and/or equipment, including points of discharge of air contaminants to the atmosphere, drawn to scale and in proper orientation;

    - Dimensions (length, width) of all buildings, structures, and/or equipment, including emission points;

    - Elevation of all buildings, structures, and/or equipment, including emission points, showing heights, grade baseline, and grade baseline height above mean sea level;

    - Primary compass direction indicator; and

    - Location of streets and all adjacent properties. Show location of all buildings outside the property that are within 150 feet of the equipment involved in the application. Identify all such buildings, specifying number of stories, or approximate height, and indicate the prevailing wind direction.

  Refer to Sections 1 and 2 of this application for site drawings related to the proposed plant.

- **Construction Drawings** should be an assembly drawing, dimensioned and to scale, in as many sections as needed to show clearly the design and operation of the equipment and the means by which air contaminants are controlled. The following must be shown:

    - Size and shape of equipment. Show exterior and interior dimensions and features; and

    - Locations, sizes, and shape details of all features which may affect the production, collection, conveying or control of air contaminants of any kind: location, size and shape details concerning all materials handling equipment.

- **Description of Process and Control Equipment –** Include a written description of each process at the facility and the function of the equipment used in the process. Descriptions must be complete and particular attention must be given to explaining all stages in the process where the discharge of any materials might contribute in any way to air pollution. Control procedures must be described in sufficient detail to show extent of control of air contaminants anticipated in the design, specifying the expected efficiencies of the captures systems and control devices. All obtainable data must be supplied concerning the nature, volume, particle size, weights, chemical composition and concentrations of all types of air contaminants; and

- **Block Flow Diagram –** Include a drawing showing the steps of the process and the flow of materials through the process and any control devices.

- Additional information may be required as necessary to evaluate the design adequacy of the facility or to comply with PSD regulations.

  Refer to Section 2 of this application for process related information and diagrams related to the proposed plant.

The following sections are also required for a PSD application:

- **Applicable Requirements** - Provide compliance evaluations for all applicable state, federal and local air pollution control requirements including applicable requirements in MDEQ Regulations, federal new source performance standards, and national hazardous air pollutant standards. **(Refer to Section 3).**

- **BACT -** Provide a demonstration that proposed air pollution control devices and measures comply with Best Available Control Technology (BACT) requirements. **(Refer to Section 4).**

- **Air Quality Impacts Analysis -** Provide an ambient air quality impacts analysis based on modeling facility emissions using EPA approved air dispersion models. The modeling analysis should conform to current EPA modeling guidelines and recommended methods. **(Refer to Section 5).**

- **PSD Threshold Determination** - Provide a PSD threshold determination. **(Refer to Section 3).**

- **Additional Impact Analysis –** Provide an additional impact analysis.

  Refer to Sections 2 through 6 of this application for the design calculations/specifications and appropriate impact analysis.

MS Silicon, based on discussions held during the pre-application meeting with MDEQ and the application requirements listed above, is not aware of any additional information that is required for this application to be deemed complete.

The information required, as listed above, is provided in this construction permit application. It is MS Silicon's understanding that applications containing the required information should satisfy MDEQ's requirements for a complete application.

MS Silicon is confident that it has designed the proposed silicon manufacturing plant such that emissions from the facility will meet the requirements of MDEQ standards and rules, as well as the requirements defined by USEPA. Sufficient information is included in this application to provide MDEQ with reasonable assurance that the standards and rules will be met.

1.7 Application Review Timeline

It is our understanding that upon submission of this application, the MDEQ will conduct a complete and thorough review of its contents to ensure that the plant and its associated air emissions sources will:

- Meet all applicable state and federal air quality regulations and requirements;
- Not cause an adverse impact to human health and welfare; and
- Will employ best available control technologies (BACT) and implement appropriate testing, monitoring, recordkeeping and reporting that will ensure future minimal impacts to human health and welfare.

Upon completing this review, a construction permit will be proposed by the MDEQ (containing specific emission limitations, testing, monitoring, recordkeeping, and reporting requirements) and will be provided to the public including EPA Region IV for review and comment, prior to final issuance. The permit to be issued will allow for construction and limited operation. An operating permit will have to be obtained upon final construction of the plant.

1.8 Request for Construction Permit Issuance

MS Silicon is hereby requesting that MDEQ issue a construction permit to allow for construction of the regulated air pollutant emitting units associated with a stationary source (i.e., the proposed plant). It is MS Silicon's understanding that as defined in MDEQ APC-S-2-1-C-27 "stationary source" is defined as:

"Any building, structure, facility, or installation which emits or may emit regulated air pollutant(s)."

MS Silicon understands based on the definition of "stationary source" contained in APC-S-2 that it is not allowed to perform any construction, installation, or establishment of any stationary source without an approved construction permit.

Upon the completion of construction or installation of an approved stationary source or modification, MS Silicon will notify the MDEQ that construction or installation was performed in accordance with the approved plans and specifications on file with the MDEQ.

The following individual will be the primary contact for answering any questions MDEQ may have related to the application request for construction:

Contact Name: Mr. Steven Frey

Phone Number: 847-278-7705

Email: stevefrey@kennedyjenks.com

It is anticipated that MS Silicon will initiate construction of the project in the November of 2013 and begin operation within 20 to 24 months of commencing construction. MS Silicon hereby agrees as part of the construction issuance process to meet the design criteria as accepted by MDEQ and to abide by the MDEQ rules regarding the quantities and types of materials to be discharged from the installation of the proposed silicon manufacturing plant

1.9 MDEQ Requirements for Public Involvement

It is MS Silicon's understanding that the public will be given an opportunity to express their interest in the construction permit application prior to approval by MDEQ. A brief summary of the involvement is provided below, reflecting MS Silicon's understanding of the public notice requirements. If this understanding is incorrect, MS Silicon is requesting that MDEQ provide appropriate guidance:

- Availability for public inspection in at least one location in the area affected of the information submitted by the owner or operator and of MDEQ's analysis of the effect on air quality;

- A 30-day period for submittal of public comment; and

- A notice, by prominent advertisement in the area affected, of the location of the source information and analysis.

A copy of the notice will be sent to the Administrator of EPA through Region IV, and to all other state and local air pollution control agencies having jurisdiction in the region in which such new or modified installation will be located. A permit to construct issued pursuant to this paragraph is federally enforceable.

1.10 Contents of This Application Request

To assist the MDEQ in approval and issuance of a construction permit, the following information is provided in this application request:

- **Section 2: Description of Proposed Plant** - This section contains a description of the process equipment, a description of control technologies and methods to be used, a description of the methods used to estimate the potential emissions of regulated air pollutants, and tables summarizing the estimated potential to emit (PTE) regulated air pollutant emission rates;
- **Section 3: Regulatory Applicability** - This section discusses the pertinent federal, state, and local air pollution control regulations that may be applicable to the proposed plant. This section also provides a PSD threshold determination;

- **Section 4: BACT Analysis** – This section presents a demonstration that the proposed air pollution control devices and measures comply with Best Available Control Technology (BACT) requirements;
- **Section 5: Air Quality Impact Evaluation –** An air quality impact evaluation was performed to demonstrate that predicted ambient air concentration impacts resulting from emissions of regulated air pollutants from the proposed plant would not adversely impact human health and welfare. These predicted impacts were determined from EPA's approved air dispersion model, referred to as AERMOD;
- **Section 6: Additional Impact Analysis** - This section provides a discussion on the additional impacts that might be caused by the proposed plant including soil and vegetation, endangered species, Class I areas, etc.;
- **Section 7: Suggested Permit Structure –** This section presents suggested permit language;
- **Section 8: Application Forms** – This section provides a list of the application forms required by MDEQ;
- **Appendix A: MDEQ Application Forms** – Appendix A includes the appropriate MDEQ application forms required for a construction permit; and
- **Appendix B**: **Air Quality Impact Evaluation Modeling Results** – Appendix B contains copies of the output files obtained from the air dispersion model "AERMOD", which was used to perform the air quality impact modeling.

Section 2: Description of Proposed Plant

MS Silicon is proposing the construction of a silicon manufacturing plant in Tishomingo County, Mississippi. The plant will consist of two (2) specific process areas:

- Silicon manufacturing; and
- Support operations.

The silicon manufacturing process will involve the mixing of quartz, coal, and wood in a semi-enclosed submerged arc furnace to produce 98% pure silicon. Further processing is performed to produce the 98% pure silicon in the form of an ingot or flake.

The silicon manufacturing process will include the following operations with the potential to emit regulated air pollutants:

- Material handling and transfer to and from coal, wood and quartz storage piles;
- Storage yard for coal, wood and quartz storage piles;
- Wind erosion from coal, wood and quartz storage piles;
- Wood chipper (electric-fired);
- Casting frames;
- Raw material day bins with supporting baghouse(s);
- Four (4) semi-enclosed submerged arc furnaces (SAF) with four (4) baghouses;
- Four (4) ladle pre-heaters; and
- Product refining operations with supporting baghouse(s).

The following plantwide operations and activities will support the entire plant and will also have the potential to emit regulated air pollutants:

- Tank farm;
- Fugitive emissions from roadways;
- Slag handling;
- Silica fume silos:
- Facility-wide miscellaneous operations; and
- Emergency generator.

To provide a visual representation of the plant, several figures are contained in this application. The figures provided are as follows:

- Figure 1-1 provides a county map of the state of Mississippi and the location on the proposed plant
- Figure 1-2 provides the proposed site location in relation to Burnsville, MS;
- Figure 1-3 provides an aerial view of the proposed plant location.

Collectively, the process areas noted above will have the potential to emit major levels of regulated air pollutants and will be subject to the PSD air regulations along with air regulations established by the Mississippi Department of Environmental Quality (MDEQ). Proven and highly efficient air pollutant emission control technologies and techniques will be utilized to minimize potential air emissions from the air emission units associated with the proposed plant. Continuous emission measuring, stack testing, as well as recording of operational parameters will also be performed, as appropriate; to confirm the plant's levels of regulated air pollutant emissions. These emissions will result in the plant having no adverse impacts to human health and welfare.

To support the conclusion that no adverse impacts will occur to human health and welfare, MS Silicon has conducted an air quality impact evaluation for potential emissions of regulated air pollutants from the plant. The results of that evaluation, including a demonstration of compliance with the state and National Ambient Air Quality Standards is included in Section 5 of this PSD construction permit application.

The general layout of the silicon manufacturing process is provided in Figure 2-1. A general process flow diagram of the silicon manufacturing process is presented in Figure 2-2 and process descriptions and definitions are provided in Figure 2-2a. A generic process flow summary of the silicon manufacturing process is provided in Figure 2-2b and representative pictures depicting the silicon manufacturing process are shown in Figure 2-2c. Process flow diagrams depicting other processes and equipment associated with the silicon manufacturing plant are provided in Figures 2-3 through 2-9.

This section contains a discussion of the process equipment, a description of the air pollution control technologies / management practices to be used, the methods used to estimate the potential emissions of regulated air pollutants, and tables summarizing the estimates of these regulated air pollutant emission rates. Tables 2-1 and 2-1a identify the initial list of equipment with the potential to emit regulated air pollutants, including stack information. Summaries of project related estimated PTE of regulated air pollutants including criteria air pollutants, hazardous air pollutants (HAPs) and greenhouse gases (GHG) are provided in Tables 2-9, 2-10 and 2-11, respectively. As shown in these tables, the proposed plant is classified as a major stationary source of regulated air pollutants as defined under state and federal air regulations.

To support the emission estimation process, methodologies involving engineering estimates, vendor suggested emission rates and prior experience were utilized to conservatively estimate PTE regulated air pollutants from the proposed silicon manufacturing plant. As part of the emission estimation process, MS Silicon utilized the best available information/data to determine air pollutant emission levels for each of the four SAFs. Emission estimates for the raw material receiving, handling and storage operations, and

emergency support equipment were based on either a) USEPA established emission factors and methodologies; b) vendor estimates; or c) state/federal emission standards.

For purposes of this application, any reference to particulate matter (PM) also includes particulate matter with an aerodynamic diameter less than or equal to a nominal ten (10) micrometers (PM_{10}) and particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers ($PM_{2.5}$).

Provided below is a discussion on each process area to be performed within the silicon manufacturing process. To assist MDEQ in their development of the plant's construction permit, we have also included emission identification numbers following the numbering scheme typically employed by the MDEQ in their construction and operating permits.

2.1 Silicon Manufacturing Process – AA-100, AA-200 and AA-300

The proposed silicon manufacturing process will utilize four semi-enclosed submerged arc furnaces (SAF) that will convert raw materials including coal, woodchips and quartz to 98-99% pure silicon metal. .

The three (3) primary air pollutant emission activities within the silicon manufacturing process are 1) raw material handling and storage, 2) processing of these raw materials into one of four SAFs and supporting activities to produce silicon ingots, and 3) product refinement and handling. These three (3) activities have been assigned emission ID's AA-100, AA-200, and AA-300, respectively.

2.1.1 Raw Material Handling, Storage and Transfer to/from Storage Piles – AA-101, AA-102, AA-103, AA-104, AA-105 and AA-106

Raw material handling, transferring and storage operations will begin with the receipt of raw materials via truck. Coal, woodchips, and quartz are unloaded in a designated unloading area where various mechanisms will be used to transfer these materials to the appropriate storage piles. These mechanisms will include unloading of the trucks by tilting of the truck or bottom unloading from the truck. The raw materials will be emptied onto the pile or transferred by front end loaders to the piles. From the storage piles, materials will be conveyed via front end loaders to enclosed raw material storage/day bins. From the day bins, the raw materials will be weighed and dropped to a skip bucket from which they will be transferred to the top of one (1) of four (4) semi-enclosed submerged arc furnaces for processing. Limestone will be used as flux and will be delivered in bulk. Provision will be made for its storage in the Raw Material Enclosure area. The same hopper and conveying system will be used to convey limestone to the SAF. Limestone will be fed directly via one of the charging conveyors on the upper floor.

The following emission units have been identified in the raw materials handling, storage and transfer operations process (AA-100):

- AA-101 – Material handling and transfer to and from coal storage pile with a material throughput rate of 105,120 tons/year;

- AA-102 - Material handling and transfer to and from wood storage pile with a material throughput rate of 212,763 tons/year;
- AA-102b – Wood chipper (electric-fired);
- AA-103 - Material handling and transfer to and from quartz storage pile with a material throughput rate of 212,763 tons/year;
- AA-104 – Limestone handling operations with a material throughput rate of approximately 183 tons/year;
- AA-101a, AA-102a, AA-103a, - Material Handling (Coal, Wood, and Quartz Transfer to Day Bins) Baghouse;
- AA-105 – Storage Pile Processing (Bulldozers); and
- AA-106 – Wind erosion on coal, wood and quartz storage piles.

Refer to Figure 2-3 for a process flow diagram of the raw material handling and transfer operations.

2.1.1.1 Potential Air Pollutant Emission Sources

Since the material handling operations will involve solid type materials, potential particulate matter (PM) emissions may occur from a) unloading of raw materials from the trucks; b) moving the materials by front end loaders to the pile areas/day bins; c) conveying the material to the day bins/SAFs; d) fugitive dust from vehicle traffic on the plant roads; and e) wind erosion from the raw material storage areas. It is important to note that the conveyors and conveyor transfer drop points associated with this process area will be covered to the extent physically possible. Potential PM emissions from the covered storage area will be minimal based on the moisture content of the materials, as well as any walls and/or roof that may be used to cover the primary pile, thus minimizing the exposure of the stored materials to wind. PM emissions from the storage areas and equipment to be utilized to place and remove these materials from this storage area will also be negligible due to the use of larger sized pieces of materials, high moisture content of the raw materials and low speed of the vehicles moving the materials.

Potential fugitive dust emission rates were estimated using the recommended methods developed by USEPA (i.e., AP-42). Emission source types for this process includes material handling (i.e., material drop points), paved and unpaved road (truck traffic on the paved and unpaved roads), equipment (i.e., front end loaders) utilized to maintain the storage areas, and wind erosion from the proposed outside storage area. Details of the calculations and the resulting emission estimates can be found in Tables 2-4 through 2-7d. Appropriate control efficiencies have been incorporated to reflect equipment installed to minimize exposure to wind during the actual transfer of material from one conveyor to another or dropping of the material to a storage pile.

2.1.1.2 Air Pollution Control Devices/Technologies

The raw material receiving, handling, storage, and processing system will be designed to minimize fugitive dust emissions through use of best management practices, which include covers on conveyors and, to the extent physically possible, covered chutes for dropping materials to and from conveyors (referred to as conveyor transfer points). It is important to note that specific sections of the conveyor system will be uncovered to allow for visual inspection of the materials. Dropping raw materials onto the outdoor storage areas will also be designed to minimize excessive dust. Raw material day bins, identified as emission group AA-101a, AA-102a and AA-103a, will be used to support the semi-enclosed submerged arc furnaces. The raw materials from the storage piles will be transferred to the raw material day bins using front end loaders before being loaded into the semi-enclosed submerged arc furnaces. The transfer of raw materials to the day bins will be controlled by a common baghouse or a series of smaller baghouses. All of the above techniques represent the best available control technology for minimizing PM emissions from the raw material receiving, handling, and storage operations. The raw materials to be utilized will generally be moist, larger in size than finer materials such as sand, and not prone to dusting. The composition of the materials themselves inherently reduces the potential for PM emissions.

2.1.1.3 Type of Release (Point or Fugitive)

With the exception of the transfer to coal, wood, and quartz to the day bins, all of the PM emissions associated with the raw material receiving, handling and storage operations will be fugitive in nature.

2.1.1.4 Calculation of Air Pollutant Emission Basis and Supporting Documentation

Potential fugitive PM emission rates were estimated using the recommended methods developed by EPA (i.e., AP-42). Emission source types for this process included material handling (i.e., conveyor transfer points or material drop points), paved road (truck traffic on these paved roads), equipment (i.e., front end loaders) utilized to maintain the storage areas, and wind erosion from the proposed outside storage areas. Details of the calculations and the resulting emission estimates can be found in Tables 2-4 through 2-7d.

2.1.2 Silicon Manufacturing Process (i.e., Meltshop Operations)

The silicon manufacturing process (i.e., the meltshop operations) will include melting, transferring and cooling operations. Refer to Figures 2-4 and 2-5 for process flow diagrams related to the furnaces and metal processing, respectively.

The raw material day bins, identified as emission group AA-101a, AA-102a and AA-103a, will be used to support the semi-enclosed submerged arc furnaces. The raw materials from the storage piles will be transferred to the raw material day bins before being loaded into the semi-enclosed submerged arc furnaces. Material will be mechanically (i.e., front end loaders or other types of equipment) moved to reclaim areas where the materials will be conveyed either underground or aboveground to the raw material day bins.

The raw material day bins will then feed into one or more of the four (4) SAFs. The SAFs will then convert the coal, woodchips, and quartz into 98% pure silicon metal in molten form. Each SAF will be rated at approximately 25 megawatts per hour of input and will produce a design maximum of 2.75 tons of silicon per hour. The processes associated with producing the silicon will include raw material handling and silicon metal melting and tapping. Each SAF will be equipped with a baghouse for controlling PM emissions. Appropriate equipment will be installed on each SAF that will be used to duct furnace exhaust gases to the baghouse.

These four (4) SAFs are identified as emission unit AA-201 and will produce 98-99% pure silicon metal. The submerged arc process is a reduction smelting operation. In the production of silicon metal, quartz is the raw material from which silicon is derived. Carbon is necessary as a reducing agent and is supplied by coal and woodchips and limestone is used as flux. Smelting in the SAF is accomplished by conversion of electric energy to heat. An alternating current applied to the electrodes causes a current to flow through the charge from the electrode tips to the furnace hearth. This provides a reaction zone of temperature up to 3600 degrees F. To maintain a uniform electric load, electrode depth is continuously varied automatically, as required. At high temperatures in the reaction zone, the carbon sources react chemically with silicon dioxide gas to form carbon monoxide and silicon metal.

Molten product from the SAFs will then be tapped from the SAF through a taphole located at the bottom of the SAF at hearth level. The molten metal and dross will flow from the taphole into a ladle. The ladle will be moved by a hoist to the casting process. The metal will be poured into low, flat pans that will provide rapid cooling of the molten metal. Fume and dust generated and captured throughout the production process including tapping will be controlled by the baghouses and then collected and reused or sold.

The process will also include four (4) natural gas-fired ladle pre-heaters rated at 10.0 MMBtu/hr each, which will be used to provide additional heat for further processing of the molten silicon to silicon flakes. The natural gas-fired ladle pre-heaters are identified as emission unit AA-202.

2.1.2.1 Potential Air Pollutant Emission Sources

Due to the nature of this operation, potential emissions of criteria air pollutants including carbon monoxide (CO), nitrogen oxide (NO_x), sulfur dioxide (SO_2), volatile organic compounds (VOC), particulate matter (PM) and greenhouse gases (primarily in the form of carbon dioxide (CO_2) may occur from a) smelting in the SAF; b) combustion of natural gas in the ladle pre-heaters; and c) material ladling and casting operations.

Fume and dust generated and captured throughout this manufacturing process including tapping will be controlled by the baghouses which vents to a single exhaust stack associated with each SAF. The collected dust from the meltshop baghouses will then be collected and reused or sold.

2.1.2.2 Air Pollution Control Devices/Technologies

Four (4) baghouses will be used to capture and control PM emissions generated from the four (4) SAF operations. Good work practices will also be employed to minimize the release of regulated air pollutants from the entire meltshop operations.

2.1.2.3 Type of Release (Point or Fugitive)

All of the emissions associated with natural gas combustion in the ladle pre-heater are considered fugitive in natural and will not be routed to a control device or through a stack.

Each of the four (4) SAFs is considered a point source and will be controlled by its own baghouse. Each baghouse will have a stack with the following parameters:

- Stack Height – Approximately 300 feet above grade;
- Stack Diameter - 15 feet in diameter;
- Stack flow rate of 125,000 acfm; and
- Exhaust stack gas temperature of approximately 140 degrees F.

2.1.2.4 Calculation of Air Pollutant Emission Basis and Supporting Documentation

Potential PM emission rates from the SAFs were estimated using the recommended methods developed by EPA (i.e., AP-42). Emissions of other regulated criteria air pollutants were based on engineering design and estimates, recent permits issued or recent BACT determinations. Emissions of regulated criteria air pollutants from natural gas combustion in the ladle pre-heaters were also estimated using the recommended methods developed by EPA (i.e., AP-42). Details of the calculations and the resulting emission estimates for the SAFs can be found in Tables 2-2a, 2-2b and 2-2c. Emissions from natural gas combustion are found in Tables 2-3a, 2-3b and 2-3c. Potential regulated air pollutant emissions from the casting frames are presented in Table 2-2d.

2.1.3 Wood Chipping – AA-102b

A portable electric wood chipper will be used for as needed wood grinding/chipping and will be limited to 2080 hours per year of operation. Fugitive particulate emissions can occur from operation of the wood chipper (AA-102b). The wood chipper will include an enclosure that will minimize fugitive dust emissions. Refer to Figure 2-3 for a process flow diagram of the raw material handling and storage operations.

2.1.3.1 Potential Air Pollutant Emission Sources

Processing wood in the wood chipper has the potential to emit PM. Details of the calculations and the resulting emission estimates can be found in Tables 2-4b.

2.1.3.2 Air Pollution Control Devices/Technologies

The wood chipper will include an enclosure that will minimize fugitive dust emissions.

2.1.3.3 Type of Release (Point or Fugitive)

The PM emissions associated with wood chipping operations with be fugitive sources.

2.1.3.4 Calculation of Air Pollutant Emission Basis and Supporting Documentation

Potential fugitive PM emission rates were estimated using a PM emission factor based on Idaho Department of Environmental Quality factor for similar source (wood debarking) as referenced in Idaho air permit number 4051-00. The emission estimate assumed that PM_{10} emissions are 10% of PM emissions based on North Carolina Department of Environment and Natural Resources study "Estimating Emissions from Generation and Combustion of "Waste" Wood DRAFT" (July 15, 1998), which indicated that PM_{10} generated during milling and sawing is at most 10% of PM. The estimate is also based on the assumption that $PM_{2.5}$ emissions are equal to PM_{10} emissions. Details of the calculations and the resulting emission estimates can be found in Table 2-4b.

2.1.4 Product Refinement and Handling – AA-300

Silicon product refinement and handling occurs after the casting operations. After the metal has been cooled it will be crushed and sized to customer specifications. Any remaining undersized material will be re-melted during the casting process. The following emission units have been identified in the product refinement and handling operation (AA-301):

- AA-301 –Silicon grinding and milling operations.

Refer to Figure 2-6 for a process flow diagram of the silicon product refinement and handling operations.

2.1.4.1 Potential Air Pollutant Emission Sources

Since the silicon product refinement and handling operation will involve solid type materials, potential particulate matter (PM) emissions may occur from grinding, milling and transfer of the product.

The grinding and milling operations will be equipped with either a common baghouse or series of smaller baghouses for controlling PM emissions. Details of the calculations and the resulting emission estimates can be found in Tables 2-4a.

2.1.4.2 Air Pollution Control Devices/Technologies

The grinding and milling operations will be equipped with either a common baghouse or series of smaller baghouses for controlling PM emissions.

2.1.4.3 Type of Release (Point or Fugitive)

All of the PM emissions associated with product refinement and handling operations with be point sources.

2.1.4.4 Calculation of Air Pollutant Emission Basis and Supporting Documentation

Potential PM emission rates were estimated using the manufacturer's specifications for the baghouses and the flow rate of each control device. Details of the calculations and the resulting emission estimates can be found in Tables 2-4a.

2.2 Plantwide Operations and Activities – AA-400

The proposed silicon manufacturing plant will have additional support operations and activities including the following:

- Tank farm identified as emissions unit AA-401 including:
  - One (1) vertical oxygen storage tank with a storage capacity of 6,000 gallons; and
  - One (1) 500-gallon diesel fuel storage tank.
- Plantwide fugitive emissions from roadways identified as emissions unit AA-402 and AA-402a. Emissions represent haul trucks to support plant operations;
- Slag handling and storage identified as emission unit AA-403;
- Silica fume silos identified as emission unit AA-404; and
- Facilitywide Miscellaneous Operations Subject to APC-S-6 identified as AA-405.

2.2.1 Tank Farm – AA-401

The tank farm will include the following tanks:

- One (1) vertical oxygen storage tank with a storage capacity of 6,000 gallons; and
- One (1) 500-gallon diesel fuel storage tank.

2.2.1.1 Potential Air Pollutant Emission Sources

The oxygen storage tank does not have the potential to emit regulated air pollutants. The 500-gallon diesel storage tank has the potential to emit a regulated air pollutant (VOCs).

2.2.1.2 Air Pollution Control Devices/Technologies

All emissions of regulated air pollutants from the storage tanks will be fugitive in nature and will not include any additional control devices, other than those inherent to each tank (i.e., pressure relief valves). Good operating practices will be followed to minimize VOC emissions from the diesel storage tank.

2.2.1.3 Type of Release (Point or Fugitive)

All emissions of regulated air pollutants from the storage tanks will be will be fugitive in nature.

2.2.1.4 Calculation of Air Pollutant Emission Basis and Supporting Documentation

As per Mississippi Title V Air Permit Regulations APC–S-6 Section VII B.7 "Insignificant Activities and Emissions", the 500- gallon diesel storage tank must be listed in the application but emissions do not have to be quantified.

2.2.2 Fugitive Emissions from Roadways – AA-402 and AA-402a

PM emissions may be generated from the use of haul trucks to support plant operations. The empty haul trucks have been assumed to weigh 22 tons and have a cargo capacity of 17 tons. The majority of the trucks to enter and leave the site will be carrying materials to support the plant as well as the silicon product produced by the plant.

2.2.2.1 Potential Air Pollutant Emission Sources

Potential emissions of regulated air pollutants from the roadways will include fugitive PM and dust from trucks on paved or unpaved roads.

2.2.2.2 Air Pollution Control Devices/Technologies

All emissions of regulated air pollutants from the roadways will be fugitive in nature and will not include any additional control devices. However, dust suppression techniques will be used to minimize the amount of dust generated from vehicles on unpaved roads. These techniques include watering the roadways and other fugitive dust control techniques such as limiting the speed of the individual trucks. Good work practices will be followed for the paved road surface which will include implementing procedures to minimize the buildup of materials on the paved roadways.

2.2.2.3 Type of Release (Point or Fugitive)

All emissions of regulated air pollutants from the roadways will be will be fugitive in nature.

2.2.2.4 Calculation of Air Pollutant Emission Basis and Supporting Documentation

Potential emission rates of regulated air pollutants from the roadways were estimated using the recommended methods developed by EPA (i.e., AP-42). Details of the calculations and the resulting emission estimates can be found in Tables 2-6 and 2-6a.

2.2.3 Slag Handling and Storage – AA-403

PM emissions may be generated from the handling and storage of slag. Slag will be processed as needed in the finished product processing area; this process incorporates a fabric filter baghouse.

2.2.3.1 Potential Air Pollutant Emission Sources

Potential emissions of regulated air pollutants from slag handling will include fugitive PM.

2.2.3.2 Air Pollution Control Devices/Technologies

Slag will be processed as needed in the finished product processing area; this process incorporates a fabric filter baghouse.

2.2.3.3 Type of Release (Point or Fugitive)

All emissions of regulated air pollutants from the slag handling will be will be fugitive in nature.

2.2.3.4 Calculation of Air Pollutant Emission Basis and Supporting Documentation

Potential emission rates of regulated air pollutants from the handling of slag were estimated using the recommended methods developed by EPA (i.e., AP-42). Details of the calculations and the resulting emission estimates can be found in Tables 2-4c and 2-7d.

2.2.4 Silica Fume Silos – AA-404

Silica fumes collected in the SAF baghouses will be pneumatically transferred to the silica fume silos. In the silos, the silica fumes will be densified to about 45 lbs/cu.ft., prior to dispatch to cement and refractory manufacturers.

2.2.4.1 Potential Air Pollutant Emission Sources

Potential emissions of regulated air pollutants from the silos will include PM.

2.2.4.2 Air Pollution Control Devices/Technologies

All emissions of regulated air pollutants from the silos will be fugitive in nature and will not include any additional control devices.

2.2.4.3 Type of Release (Point or Fugitive)

All emissions of regulated air pollutants from the roadways will be will be fugitive in nature.

2.2.4.4 Calculation of Air Pollutant Emission Basis and Supporting Documentation

Potential emission rates of regulated air pollutants from the silos were estimated. Details of the calculations and the resulting emission estimates can be found in Table 2-4d.

2.2.5 Facilitywide Miscellaneous Operations Subject to APC-S-6 – AA-405

Several operations will be performed that will result in insignificant air contaminant emission rates and/or may not be regulated under state or federal air permitting requirements. These following

activities/emissions sources are not required to be included in a Title V permit application. These sources may include:

1. New or modified pilot plants, subject to temporary source regulations located in Section III.E.

2. Maintenance and upkeep:

a. maintenance, structural changes, or repairs which do not change the capacity of such process, fuel-burning, refuse-burning, or control equipment, and do not involve any change in quality, nature, or quantity of potential emissions of any regulated air pollutants; and

b. housekeeping activities or building maintenance procedures;

3. Air conditioning or ventilation: comfort air conditioning or comfort ventilating systems which do not transport, remove, or exhaust regulated air pollutants to the atmosphere;

4. Laboratory equipment:

a. laboratory equipment used exclusively for chemical or physical analysis for quality control or environmental monitoring purposes.

5. Hot water heaters which are used for domestic purposes only and are not used to heat process water;

6. Fuel use related to food preparation by a restaurant, cafeteria, residential cooker or barbecue grill where the products are intended for human consumption;

7. Clerical activities such as operating copy machines and document printers, except operation of such units on a commercial basis;

8. Hand held equipment used for buffing, polishing, carving, cutting, drilling, machining, routing, sanding, sawing, surface grinding, or turning of ceramic art work, precision parts, leather, metals, plastics, fiber board, masonry, carbon, glass, or wood;

9. Equipment for washing or drying fabricated glass or metal products, if no VOCs are used in the process and no oil or solid fuel is burned;

10. Water cooling towers (except at nuclear power plants); water treatment systems for process cooling water or boiler feed water; and water tanks, reservoirs, or other water containers not used in direct contact with gaseous or liquid process streams containing carbon compounds, sulfur compounds, halogens or halogen compounds, cyanide compounds, inorganic acids, or acid gases;

11. Domestic sewage treatment facilities (excluding combustion or incineration equipment, land farms, storage silos for dry material, or grease trap waste handling or treatment facilities);

12. Stacks or vents to prevent escape of sewer gases through plumbing traps;

13. Vacuum cleaning systems for housekeeping, except at a source with hazardous air pollutants;

14. Alkaline/phosphate washers and associated cleaners and burners;

15. Mobile sources;

16. *Livestock and poultry feedlots and associated fuel burning equipment other than incinerators;*
17. *Outdoor kerosene heaters;*
18. *Equipment used for hydraulic or hydrostatic testing;*
19. *Safety devices, excluding those with continuous emissions; and*
20. *Brazing, soldering, or welding equipment that is used intermittently or in a noncontinuous mode.*

In addition, the facility may include space heaters utilizing natural or LPG gas and used exclusively for space heating, as listed in APC-S-6, VII, B:

2.3 Emergency Support Equipment – AA-501

Emergency support equipment will also support the proposed assembly plant. This equipment will consist of one (1) 670 HP emergency generator identified as AA-501. This generator will be fueled by low sulfur diesel fuel.

Air emission estimates of regulated air pollutants for the emergency generator were based on USEPA AP-42 emission factors. Hours of operation were limited to 100 per year for the generator. Tables 2-8 and 2-8a provide estimated air emissions associated with the emergency generator.

2.3.1 Potential Air Pollutant Emission Sources

Due to the combustion of diesel fuel in the emergency equipment, potential emissions of criteria air pollutants including CO, NO_x, SO_2, VOC, PM and CO_2 may occur. Minor emissions of regulated HAPs may also occur from the emergency generator.

2.3.1.1 Air Pollution Control Devices/Technologies

The emergency equipment will not have any add-on control devices or technologies. However, minimal operations and good combustion practices will be followed to minimize emissions of regulated air pollutants.

2.3.1.2 Type of Release (Point or Fugitive)

Emissions of regulated air pollutants from the emergency equipment will be a point source.

2.3.1.3 Calculation of Air Pollutant Emission Basis and Supporting Documentation

Potential emission rates of regulated air pollutants from the emergency equipment were estimated using the recommended methods developed by EPA (i.e., AP-42 program) or EPA limits defined by NSPS Subpart IIII. Details of the calculations and the resulting emission estimates can be found in Tables 2-8 and 2-8a.

Section 3: Regulatory Applicability

The proposed silicon manufacturing plant will be subject to regulations incorporated in MDEQ's Air Pollution Code (APC) for air emission sources constructed and operated in Mississippi. These rules impose permitting requirements and specific standards for air emissions. This section discusses the pertinent federal, state, and local air pollution control regulations that may be applicable to the proposed plant. These types of regulations typically include:

- Requirements to obtain a construction permit prior to commencing construction;
- Emission limitations;
- Monitoring and testing requirements; and
- Recordkeeping and reporting requirements.

This section also includes a discussion on how the proposed plant will comply with these applicable regulations.

The following sections are intended to provide the following:

- **Section 3.1. Air Quality Status -** This section identifies the current air quality status for Tishomingo County, which depending on specific air quality designation status will dictate specific air permitting requirements that must be satisfied before a construction / operating permit can be issued.

- **Section 3.2. Permitting Requirements –** This section identifies the permitting requirements required by federal and state regulations, including PSD applicability that must be satisfied prior to construction / operating permit issuance.

- **Section 3.3. State and Local Requirements -** This section identifies the state and local air pollutant regulations. Table 3-4a lists the MDEQ air regulations. Those regulations that have been deemed applicable to the plant's emission sources have been highlighted. Table 3-4b includes a summary of requirements contained in "*APC-S-1 - Section 3. Specific Criteria for Sources of Particulate Matter*" and Table 3-4c includes a summary of requirements in "*APC-S-1 - Section 4. Specific Criteria for Sources of Sulfur Compounds*". A discussion on how MS Silicon will comply with these requirements is provided in the subsections of 3.3.

- **Section 3.4. Federal Requirements, Section 3.5. NSPS Requirements and Section 3.6. NESHAP Requirements -** These sections identify the federal air pollutant regulations and Table 3-1 summarizes the federal air pollution regulations. Included in this section are tables listing the federal air regulations, including Table 3-2a which lists the New Source Performance Standards (NSPS) and Tables 3-3a and 3-3b which list the National Emission Standards for Hazardous Air Pollutants (NESHAPs). Those regulations that have been deemed applicable to the plant's

emission sources have been highlighted in the tables. A discussion on how MS Silicon will comply with these requirements is provided in the subsections of 3.4, 3.5 and 3.6. Highlighted are only those regulations that impose emission standards or limits, establish monitoring and testing requirements or enforce other relevant requirements that are intended to protect human health and welfare. Applicable requirements that identify general administrative type requirements have not been identified.

3.1 Air Quality Status

The proposed project is located in Tishomingo County, Mississippi. The current air quality status of the county is as follows:

AIR POLLUTANT	ATTAINMENT STATUS
Nitrogen Dioxides (NO_2)	Attainment
Sulfur Dioxide (SO_2)	Attainment
Particulate Matter less than 10 microns (PM_{10}) and 2.5 microns ($PM_{2.5}$)	Attainment
Carbon Monoxide (CO)	Attainment
Ozone (O_3)	Attainment
Lead (Pb)	Attainment

Since the proposed site area is classified as attainment for all regulated air pollutants, the proposed project would be governed by the regulations for attainment areas, as defined in the Mississippi rules. Attainment areas are areas defined by EPA as meeting the National Ambient Air Quality Standards (NAAQS) which were established to protect human health and welfare.

3.2 Permitting Requirements

This section identifies the permitting requirements required by state and federal regulations including PSD applicability.

3.2.1 State Requirements

APC-S-5 of the MDEQ regulations includes PSD requirements. The requirements contained in APC-S-5 have been adopted and incorporate the federal PSD requirements. The MDEQ has not created new PSD requirements nor have they modified the federal PSD requirements.

3.2.2 PSD Applicability

The PSD regulations specify that any **major** new stationary source within an air quality attainment area must undergo PSD review. A major source is defined as:

- Any stationary source (or any group of stationary sources that are located on one or more contiguous or adjacent properties, and are under common control of the same person (or persons under common control)) belonging to a single major industrial grouping and that is described in Paragraph a., b., or c. of this APC-S-5-I-A-17. For the purposes of defining "major source", a stationary source or group of stationary sources shall be considered part of a single industrial grouping if all of the pollutant emitting activities at such source or group of sources on contiguous or adjacent properties belong to the same Major Group (i.e., all have the same two-digit code) as described in the Standard Industrial Classification Manual, 1987.

- A major stationary source of air pollutants, as defined in Section 302 of the Federal Act, that directly emits or has the potential to emit, 100 tpy or more of any air pollutant subject to regulation (including any major source of fugitive emissions of any such pollutant, as determined by rule by the Administrator). The fugitive emissions of a stationary source shall not be considered in determining whether it is a major stationary source for the purposes of Section 302(j) of the Federal Act, unless the source belongs to one of the 28 designated categories of stationary sources. A list of the 28 designated source categories is found in Table 3-5a.

If the proposed project is one the 28 designated stationary sources specified in Table 3-5a, then it is subject to a PSD threshold limit of 100 tons per year. Any stationary source which is not one of the 28 designated source categories is subject to a PSD threshold of 250 tons per year or more of a regulated air pollutant.

"Potential to emit" is defined as the maximum capacity of a stationary source to emit any air pollutant under its physical and operational design consistent with 40 CFR 52.21. Any physical or operational limitation on the capacity of a source to emit an air pollutant, including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored, or processed, shall be treated as part of its design if the limitation is established in a construction permit required by the EPA approved Mississippi SIP for New Source Review (NSR) or a Title V permit. This term does not alter or affect the use of this term for any other purposes under the Federal Act, or the term "capacity factor" as used in Title IV of the Federal Act or the regulations promulgated there under.

A PSD review is triggered in certain instances when emissions associated with a new major source or emission increase resulting from a major modification are "significant". "Significant" emission thresholds are defined in two ways. The first is in terms of emission rates (tons/year) for listed air pollutants (refer to Table 3-5b) for which significant emission rates have been established.

Significant increases in emission rates are subject to PSD review in two circumstances:

- For a new source which is major for at least one regulated attainment or non-criteria pollutant (i.e., is subject to PSD review), all pollutants for which the area is not classified as nonattainment and which are emitted in amounts equal to or greater than those specified in Table 3-6 are subject to PSD review; and
- For a modification to an existing major stationary source, if both the potential increase in emissions due to the modification itself, and the resulting new emission increase of any regulated, attainment or non-criteria pollutants are equal to or greater than the respective pollutants' significant emissions rates listed in Table 3-6, the modification is "major" and are also subject to PSD review.

The second type of "significant" emission threshold is defined as any emissions rate at a new major stationary source (or any net emissions increase associated with a modification to an existing major stationary source) that is constructed within 10 kilometers of a Class I area and which would increase the 24-hour average concentration of any regulated pollutant in that area by 1 $\mu g/m^3$ or greater. Exceedance of this threshold triggers PSD review.

PSD review consists of:

- A case-by-case Best Available Control Technology (BACT) demonstration, taking into account energy, environmental, and economic impacts as well as technical feasibility for any new source or source that is physically changed;
- An ambient air quality impact analysis to determine whether the allowable emissions from the proposed project would cause or contribute to a violation of the applicable PSD increments and National Ambient Air Quality Standards (NAAQS) (refer to Table 3-6);
- An assessment of the direct and indirect effects of the proposed project on general growth, soil, vegetation, and visibility;
- Public comment, including an opportunity for a public hearing; and
- Possibly an ambient air quality monitoring program for up to one year.

An applicant may be exempt from the ambient air quality monitoring requirements if there are existing air quality monitoring data representative of the site, or if the impacts from the project are less than the monitoring de minimis concentrations listed in Table 3-6.

Tishomingo County is designated attainment, unclassifiable, or better than the national standards for all criteria air pollutants. Based on the estimated regulated criteria air pollutant emission rates associated with the proposed silicon manufacturing plant (refer to Table 2-9), emissions of $PM/PM_{10}/PM_{2.5}$, NO_x, CO, SO_2 and VOC will exceed the PSD significant emission rate (expressed in tons/year) applicability threshold. The proposed project will be considered a major source since at least one regulated air pollutant exceeds 250 tons/year.

After a careful review of the 28 designed source categories, the proposed plant is not considered one of the 28 designated source categories. One of the listed categories is secondary metal processing, which is described as the processing of metal containing materials to recover and reuse the metal. Since MS Silicon is not proposing to use scrap or other reused metals, this category was determined not to apply to the proposed plant. Thus, the plant would be subject to a 250 tons/year PSD major source applicability threshold.

Subsequently, each of above pollutants will be subject to PSD review. The requirements associated with PSD review for emissions of $PM/PM_{10}/PM_{2.5}$, NO_x, CO, SO_2 and VOC as well as MS Silicon's compliance status with these review requirements, is provided in the following sections (4.0 through 6.0) of this application.

3.3 Applicable State Requirements

Standards and limitations for visible and particulate matter emissions, sulfur emissions, organic material emissions, carbon monoxide emissions, and nitrogen oxide emissions are also contained in the state rules and regulations. These are discussed below, along with emission standards or limitations contained in these rules that may apply to the sources associated with the proposed silicon manufacturing plant. Table 3-4a provides a list of applicable and non-applicable state air pollution regulations.

3.3.1 APC-S-1 - Air Emission Regulations for the Prevention, Abatement, and Control of Air Contaminants

3.3.1.1 Section 3 – Specific Criteria for Sources of Particulate Matter

Smoke – No person shall cause, permit, or allow the emission of smoke from a point source into the open air from any manufacturing, industrial, commercial or waste disposal process which exceeds forty (40) percent opacity subject to the exceptions provided in (b) & (c).

General Nuisances – No person shall cause, permit, or allow the emissions of particles or any contaminants in sufficient amounts or of such duration from any process as to be injurious to humans, animals, plants, or property, or to be a public nuisance, or create a condition of air pollution.

Fuel Burning – Fossil Fuel Burning - The maximum permissible emissions of ash and/or particulate matter from fossil fuel burning installations shall be limited as follows: Emissions from installations of less than 10 million BTU per hour heat input shall not exceed 0.6 pounds per million BTU per hour heat input.

Manufacturing Process – General - Except as otherwise specified, no person shall cause, permit, or allow the emission from any manufacturing process, in any one hour from any point source, particulate matter in total quantities in excess of the amount determined by the relationship

$$E = 4.1\ p^{0.67}$$

Where E is the emission rate in pounds per hour and p is the process weight input rate in tons per hour.

Sampling Ports – New Equipment - The owner or operator of any new air pollution control equipment, obtained after May 8, 1970, and vented to the atmosphere, shall have necessary sampling ports and ease of accessibility.

Compliance with These Requirements

The emission sources associated with the proposed plant will be constructed and operated to satisfy the requirements contained within Section 3 of APC-S-1, refer to Table 3-4b for specific requirements.

3.3.1.2 Section 4 – Specific Criteria for Sources of Sulfur Compounds

Sulfur Dioxide Emissions from Fuel Burning – The maximum discharge of sulfur oxides from any fuel burning installation in which the fuel is burned primarily to produce heat or power by indirect heat transfer shall not exceed 4.8 pounds (measured at sulfur dioxide) per million BTU heat input.

The proposed plant will be using natural gas and low sulfur fuel oil (i.e., emergency equipment only) for plant specific fuel burning operations. Use of these fuels will easily satisfy SO_2 emission limitations required in the section. Refer to Table 3-4c for specific requirements related to this section.

3.3.1.3 Section 6 – New Sources (Subsection 3 – NSPS)

This section incorporates the Federal NSPS standards. The proposed plant will be in compliance with the applicable NSPS standards. Refer to Section 3.5 of this application for a discussion on each applicable NSPS standards.

3.3.1.4 Section 9 – Stack Height Considerations

Stack Height Effect on Emission Limitations – The degree of emission limitation required of any source for control of any air pollutants shall not be affected by so much of any source's stack height that exceeds good engineering practice (GEP) or by any other dispersion technique, except as provided as exemptions or exclusions defined within the regulation itself.

3.3.2 APC-S-2 – Permit Regulations for the Construction and/or Operation of Air Emissions Equipment

3.3.2.1 I – General Requirements (Subpart D "Permitting Requirements")

Unless otherwise provided by Sections XIII and XV, or other provisions of these Regulations, any new stationary source or modification of a stationary source must have a permit to construct or multi-media permit incorporating such permit before beginning construction.

The exhaust stacks associated with the proposed plant will be in compliance with the stack height limitations contained within Section 9.

3.3.2.2 II – General Standards Applicable to All Permits (Subpart B "General Provisions")

Applicants for all permits to construct or operate, or to renew a State Permit to Operate, shall specify in their application the air emission rate for each air pollutant subject to regulations under the Federal Act that can be reasonably expected to be emitted into the air as a result of operations from the source.

Each application must be signed by the responsible official. The signature of the applicant shall constitute an agreement that the applicant assumes the responsibility for any alterations, additions or changes in operation that may be necessary to achieve and maintain compliance with all Applicable Rules and Regulations.

No permit for the construction or relocation of equipment which will cause the issuance of air contaminants shall be issued when said equipment cannot comply with buffer zone requirements as follows: All sources of air emissions must be at least 150 feet from the nearest residential or recreational area.

The proposed plant will not be located within 150 feet of a residential or recreational area.

3.3.2.3 V – Application Review

<u>Subsection A: Standards for Approving an Application for a Permit to Construct</u>

- The stationary source shall be designed and constructed so as to operate without causing a violation of any Applicable Rules and Regulations.
- The stationary source shall be designed and constructed so as to operate without interfering with the attainment and maintenance of State and National Ambient Air Quality Standards.
- The stationary source shall be designed and constructed so as to operate such that the emission of air toxics does not result in an ambient concentration sufficient to adversely affect human health and well-being or unreasonably and adversely affect plant or animal life beyond the stationary source boundaries. The permit board may require the applicant to provide data necessary to evaluate the impacts of air toxics, including the predicted emission rates and ambient concentrations, when it deems necessary. The construction of the stationary source shall be performed in such a manner so as to reduce fugitive dust emission from construction activities to a minimum.

<u>Subsection D: Certification of Construction, Beginning Operation, and Application for Permit to Operate</u>

Upon completion of construction or installation of an approved stationary source or modification, the applicant shall notify the Permit Board that construction or installation was performed in accordance with

the approved plans and specifications on file with the Permit Board. A new stationary source issued a Permit to Construct cannot begin operation until certification of construction by the permittee.

Compliance with APC-S-2 Requirements

MS Silicon has made a good faith effort to submit adequate information required for the permit application review and will make timely efforts to submit any supplemental information requested by the state in the future. As show in the information provided, the identified air emission units will be in compliance with applicable state and federal air statutes. These air emission units were shown through atmospheric dispersion modeling that predicted concentrations should be below state and federal health standards.

3.3.3 APC-S-3 – Mississippi Regulations for the Prevention of Air Pollution Emergency Episodes

3.3.3.1 Section 4 – Emission Control Action Programs

Any person responsible for the operation of a source of air contaminant which emits 0.25 tons per day or more of air contaminants for which air standards have been adopted shall prepare emission control action programs, consistent with good industrial practice and safe operating procedures, for reducing the emission of air contaminants into outdoor atmosphere during periods of an air pollution alert, air pollution warning, and air pollution emergency. Emission control action programs shall be designed to reduce or eliminate emissions of air contaminants into the outdoor atmosphere in accordance with the objectives set forth in Tables 1-5 which are part of this Mississippi Regulation.

MS Silicon is aware of this requirement and the proposed plant will be in compliance with the rules and regulations stated under APC-S-3, Section 4.

3.3.4 APC-S-4 – Mississippi Ambient Air Quality Standards

Except for odor, as covered, below, the ambient air quality standards for Mississippi shall be the Primary and Secondary National Ambient Air Quality Standards as duly promulgated by the U.S. Environmental Protection Agency in (or to be printed in) 40 CFR Part 50, pursuant to the Federal Clean Air Act, as amended. All such standards promulgated by the U.S. Environmental Protection Agency as of June 22, 1988, are hereby adopted and incorporated herein by the Commission by reference as the official ambient air quality standards of the State of Mississippi and shall hereafter be enforceable as such (except that the word “Administrator” in said standards shall be replaced by the words “Executive Director” and the word “Agency” in said standards shall be replaced by the word “Department”)

There shall be no odorous substances in the ambient air concentrations sufficient to adversely and unreasonably:

1. Affect human health and well-being;

2. Interfere with the use or enjoyment of property; or

3. Affect plant or animal life.

In determining that concentrations of such substances in the ambient air are adversely and unreasonably affecting human well-being or the use or enjoyment of property, of plant or animal life, the factors to be considered by the Commission will include, without limiting the generality of the foregoing, the number of complaints or petitioners alleging that such a condition exists, the frequency of the occurrence of such substances in the ambient air as confirmed by the Department of Environmental Quality staff, and the land use of the affected area.

MS Silicon is aware of this requirement and the proposed plant will be in compliance with the rules and regulations stated under APC-S-4.

3.3.5 APC-S-5 – Mississippi Regulations for the Prevention of Significant Deterioration of Air Quality

This section incorporates the Federal PSD standards. The proposed plant will be in compliance with the applicable standards. Refer to Section 3.2.2 of this application for applicable PSD standards.

3.4 Applicable Federal Requirements

USEPA has developed regulations that are designed to control air pollution. These regulations include permitting requirements for new or modified major stationary sources located in non-attainment areas, as well as Standards of Performance for certain types of new sources.

Provided below is a summary of the federal regulatory requirements potentially triggered by the proposed silicon manufacturing plant. Other federal requirements not listed in the table below were determined to be not applicable to the proposed operations.

Summary of Potentially Applicable Federal Regulatory Requirements

Air Regulation	Applicability Determination	Compliance Status
40 CFR Part 60 – New Source Performance Standards (NSPS)		
Subpart A – General Provisions	The proposed plant is subject to this requirement because construction commenced after 1/5/1981. Applicability of the General Provisions is trigged based on the plant triggering Subparts Z and IIII.	The proposed plant will be in compliance with these Subparts

Air Regulation	Applicability Determination	Compliance Status
Subpart Z – Ferroalloy Production Facilities	The proposed semi-enclosed submerged arc furnace is subject to this requirement because the SAF will produce silicon metal and construction commenced after 10/21/1974.	The proposed SAF will be in compliance with this Subpart
Subpart OOO – Nonmetallic Mineral Processing Plants	The proposed silicon manufacturing plant is not subject to this subpart because the plant will not be crushing or grinding any nonmetallic minerals. Quartz will be used in the manufacturing process but will not be crushed prior to use in the semi-enclosed submerged arc furnace.	NA
Subpart IIII – Stationary Compression Ignition Internal Combustion Engines	The proposed diesel-fired emergency generators are subject to this subpart because they have displacement of less than 30 liters per cylinder and are 2007 model year or later.	The proposed emergency generators will be in compliance with this Subpart
40 CFR Part 63 – National Emission Standards for Hazardous Air Pollutants (NESHAPs) (MACT)		
40 CFR Part 63, Subpart A – General Provisions	The proposed plant is subject to this subpart because the plant will be considered an area source of HAP emissions. Applicability of the General Provisions is trigged based on the emergency equipment triggering Subpart ZZZZ.	The plant will be in compliance with this Subpart
Subpart ZZZZ - Stationary Reciprocating Internal Combustion Engines	The proposed emergency generators are subject to this subpart because the emergency equipment meets the definition of a reciprocating internal combustion engines (RICE). This subpart has specific requirements for specified engine types at area and major sources of HAP emissions. The proposed fire pumps will be rated below the applicability threshold under this rule.	The emergency equipment will be in compliance with this Subpart
JJJJJJ - Area Sources: Industrial, Commercial, and Institutional Boilers	This subpart applies to industrial, commercial, or institutional boilers located at an area source of HAPs. The proposed natural gas fired ladle pre-heaters and electric fired semi-enclosed submerged arc furnaces do not meet the definition of a boiler thus are not subject to this subpart.	NA
YYYYYY - Area Sources: Ferroalloys	This subpart applies to ferroalloy production facilities that manufacture silicon metal and are an area source of HAPs. The	The SAF will be in compliance with this

Air Regulation	Applicability Determination	Compliance Status
Production Facilities	proposed plant will manufacture silicon metal and is an area source of HAPs thus is subject to this subpart.	Subpart
Additional Federal Regulations		
40 CFR Part 64 – Compliance Assurance Monitoring (CAM)	The proposed plant is subject to this subpart since the plant is not subject to a MACT standard proposed after 11/15/1990.	The plant will be in compliance with this Subpart
40 CFR Part 68 – Chemical Accident Prevention Provisions	MS Silicon does not anticipate processing any chemicals that would trigger applicability of the accidental release prevention requirements.	NA
40 CFR Part 82, Subpart F – Recycling and Emissions Reduction	MS Silicon does not anticipate producing or consuming any ozone-depleting substances that would trigger applicability of the protection of stratospheric ozone requirements. MS Silicon will abide by the applicable requirements that involve replacement of ozone depleting substances in plant process equipment (i.e., air conditioners, refrigerators, chillers or freezers).	The plant will be in compliance with this Subpart

Refer to Tables 3-1, 3-2a, 3-3a and 3-3b for inclusive lists showing applicable and non-applicable federal air pollution regulations for the proposed plant.

3.5 New Source Performance Standards (NSPS)

The NSPS have been developed by USEPA for specific source categories. These standards, which are codified in the Code of Federal Regulations (CFR) under Part 60 (40 CFR 60), apply to applicable equipment covered under each source category that is constructed, reconstructed or modified after a specific baseline date. A review of the existing NSPS, as well as any NSPS being proposed, was performed to determine applicability to the proposed project. Refer to Table 3-2a for a list of the NSPS regulations.

3.5.1 40 CFR Part 60, Subpart Z – Standards of Performance for Ferroalloy Production Facilities

40 CFR Part 60, Subpart Z applies to the following affected facilities "*electric submerged arc furnaces which produce silicon metal, ferrosilicon, calcium silicon, silicomanganese zirconium, ferrochrome silicon, silvery iron, high-carbon ferrochrome, charge chrome, standard ferromanganese, silicomanganese,*

ferromanganese silicon, or calcium carbide; and dust-handling equipment". This subpart applies to any facility that commences construction or modification after October 21, 1974.

According to Subpart Z, electric submerged arc furnace means "*any furnace wherein electrical energy is converted to heat energy by transmission of current between electrodes partially submerged in the furnace charge*" and silicon metal means *"any silicon alloy containing more than 96 percent silicon by weight"*. The proposed silicon manufacturing plant will be subject to Subpart Z since it meets the definition of a ferroalloy production facility and will commence construction after October 21, 1974.

The proposed silicon manufacturing plant including the semi-enclosed submerged arc furnace will be subject to the emission limitations, testing, monitoring, reporting and recordkeeping requirements contained in this Subpart. According to this Subpart, an initial performance test should be conducted based on 60.8.

Standards for Particulate Matter

Based on 60.262 – Standard for Particulate Matter, the following limits should be met for each submerged arc furnace:

- Exit from a control device and contain PM in excess of 0.45 kg/MW-hr (0.99 lb/MW-hr) while silicon metal, ferrosilicon, calcium silicon, or silicomanganese zirconium is being produced;
- Exit from a control device and exhibit 15 percent opacity or greater;
- Exit from an electric submerged arc furnace and escape the capture system and are visible without the aid of instruments;
- Escape the capture system at the tapping station and are visible without the aid of instruments for more than 40 percent of each tapping period; and
- Dust-handling equipment should not discharge any gases which exhibit 10 percent opacity or greater.

Standards for Carbon Dioxide

According to 60.263 – Standards for Carbon Monoxide, the submerged arc furnace should not discharge any gases which contain, on a dry basis, 20 or greater volume percent of CO.

This subpart states that the owner or operator shall install, calibrate, maintain and operate a continuous monitoring system for measurements of the opacity of emissions discharged into the atmosphere from the control device and also requires the owner/operator of an electric arc furnace to maintain daily records.

Operating Requirements

Section 60.265 of this subpart also states that a continuous monitoring device should be installed to continuously record the furnace power input, and the volumetric flow rate through each separately ducted hood of the capture system.

MS Silicon is aware of the requirements contained in this subpart and will be in compliance with all of the applicable requirements. The applicable requirements of 40 CFR 60, Subpart Z are summarized in Table 3-2b.

3.5.2 40 CFR Part 60, Subpart IIII – Standards of Performance for Stationary Compression Ignition Internal Combustion Engines

This subpart applies to stationary compression ignition (CI) internal combustion engines (ICE) that commence construction after July 11, 2005, where the CI ICE are manufactured after April 1, 2006 (and are not fire pump engines), or manufactured after July 1, 2006 (for certified National Fire Protection Association fire pump engines).

NSPS Subpart IIII specifies emission limitations, monitoring, reporting, and recordkeeping requirements for NO_X, CO, non-methane hydrocarbons (NMHC) and PM. Applicable NSPS IIII emission standards for the emergency generator and fire water pump CI ICEs are summarized as follows:

- Owners and operators of 2007 model year and later emergency stationary CI ICE with a displacement of less than 30 liters per cylinder that are not fire pump engines must comply with the emission standards for new non-road CI engines in 40 CFR 60.4202, for all pollutants, for the same model year and maximum engine power for their 2007 model year and later emergency stationary CI ICE.

- Owners and operators of fire pump engines with a displacement of less than 30 liters per cylinder must comply with the emission standards in Table 4 to NSPS Subpart IIII, for all pollutants.

NSPS Subpart IIII also stipulates specific sulfur requirements for diesel fuels. Beginning October 1, 2007 engines that use diesel fuel must meet a sulfur content of 0.05% by weight (40 CFR 80.510(a)). As of October 1, 2010 engines with a displacement of less than 30 liters/cycle and that use a diesel fuel must meet a sulfur content of 0.0015% by weight.

MS Silicon will be utilizing a diesel fuel with a sulfur content of 0.0015% by weight or less. The emergency generator is designed to have a displacement of less than 30 liters per cylinder and will comply with the applicable requirements of NSPS Subpart IIII. The applicable requirements of 40 CFR 60, Subpart IIII are summarized in Table 3-2c.

3.5.3 40 CFR Part 60, Subpart OOO – Standards of Performance for Nonmetallic Mineral Processing Plants

Applicability of Subpart OOO applies to affected facilities in fixed or portable nonmetallic processing plants, including each crusher, grinding plant, screening operation, bucket elevator, belt conveyor, bagging operation, storage bin, and enclosed truck loading station. Nonmetallic mineral processing plant means any combination of equipment that is used to crush or grind any nonmetallic mineral at any type of plant. Nonmetallic mineral means any of the following minerals or any mixture of which the majority is any of the following minerals *"(1) Crushed and Broken Stone, including Limestone, Dolomite, Granite, Traprock, Sandstone, Quartz, Quartzite, Marl, Marble, Slate, Shale, Oil Shale, and Shell."*

This subpart contains standards for particulate matter, monitoring of operations, test methods and procedures as well as reporting and recordkeeping requirements.

Based on the design of the proposed silicon manufacturing plant, it does not appear that the plant will be considered a nonmetallic mineral processing plant since the quartz used in the process will not be used in any crushing or grinding processes. Thus, this subpart is not applicable to the proposed plant.

3.6 Hazardous Air Pollutant Regulations

The proposed plant will have the potential to emit regulated HAPs in quantities **less than 10 tons/year as an individual HAP and 25 tons/year in aggregate**; therefore, the proposed plant is considered a minor source of HAPs.

On December 15, 1996, the USEPA promulgated the final regulations implementing Section 112(g). This section addresses new and reconstructed major sources of hazardous air pollutants (HAPs). A primary requirement of this section is that those sources apply Maximum Achievable Control Technology (MACT) for control of HAPs. Section 112(g) is intended to address those sources for which USEPA has not yet established an intended source category specific MACT standard. In this sense, Section 112(g) may be seen as the "case-by-case" MACT standard.

The proposed project will not trigger case-by-case MACT since this requirement applies to new or reconstructed major stationary sources of hazardous air pollutant emissions.

USEPA has developed National Emission Standards for Hazardous Air Pollutants (NESHAP) for numerous source categories. Refer to Tables 3-3a and 3-3b for an all-inclusive list of the NESHAP and MACT standards.

3.6.1 40 CFR Part 63, Subpart ZZZZ - National Emission Standards for Hazardous Air Pollutants: Stationary Reciprocating Internal Combustion Engines

Pursuant to 40 CFR 63.6585, the proposed silicon manufacturing plant, is subject to the NESHAP for Stationary Reciprocating Internal Combustion Engines, since it will utilize stationary internal combustion reciprocating engines (RICE). The proposed emergency generator will have an initial rating of 670 HP thus making it an affected source.

MS Silicon is aware of the requirements imposed by 40 CFR 63, Subpart ZZZZ; and selection of the final generator type and size will confirm the general requirements as they pertain to emergency generators located at area sources of HAP emissions.

The applicable requirements of 40 CFR 60, Subpart ZZZZ are summarized in Table 3-3c.

3.6.2 40 CFR Part 63, Subpart JJJJJJ – National Emission Standards for Hazardous Air Pollutants for Area Sources: Industrial, Commercial, and Institutional Boilers

40 CFR Part 63, Subpart JJJJJJ applies to all industrial, commercial, or institutional boilers that are located at, or are part of, an area source of HAPs.

According to this Subpart, boiler means "*an enclosed device using controlled flame combustion in which water is heated to recover thermal energy in the form of steam or hot water. Controlled flame combustion refers to a steady-state or near steady-state, process wherein fuel and/or oxidizer feed rates are controlled. Waste heat boilers are excluded from this definition.*"

This subpart does not apply since no boilers are being installed at the proposed plant.

3.6.3 40 CFR Part 63, Subpart YYYYYY - National Emission Standards for Hazardous Air Pollutants for Area Sources: Ferroalloy Production Facilities

This subpart applies to ferroalloys production facilities in an area source of HAP emissions. A ferroalloy production facility manufactures silicon metal, ferrosilicon, ferrotitanium using the aluminum reduction process, ferrovanadium, ferromolybdenum, calcium silicon, silicomanganese zirconium, ferrochrome silicon, silvery iron, high-carbon ferrochrome, charge chrome, standard ferromanganese, silicomanganese, ferromanganese silicon, calcium carbide or other ferroalloy products using electrometallurgical operations including electric arc furnaces (EAFs) or other reaction vessels. An electrometallurgical operation affected source is new if construction or reconstruction of the EAF or other reaction vessel commenced after September 15, 2008.

This subpart contains opacity standards along with monitoring, testing, notification, reporting and recordkeeping requirements.

The proposed silicon manufacturing plant is considered a ferroalloy production facility and will be installing four semi-enclosed submerged arc furnaces. Since the facility will be considered an area source of HAPs, the requirements of this subpart are applicable. MS Silicon is aware of the requirements contained in this subpart and will be in compliance with all of the applicable requirements. The applicable requirements of 40 CFR 60, Subpart YYYYYY are summarized in Table 3-3d.

3.7 Title V Greenhouse Gas Tailoring Rule

The greenhouse gas tailoring rule sets thresholds for the greenhouse gas (GHG) emissions that define when permits under the PSD and Title V Operating Permit programs are required for new and modified industrial facilities. If the proposed project is one the 28 designated stationary sources specified in Table 3-5a, then it is subject to a criteria pollutant PSD threshold limit of 100 tons per year. Any stationary source which is not one of the 28 designated source categories is subject to a criteria pollutant PSD threshold of 250 tons per year or more. While these thresholds are appropriate for criteria pollutants, they are not feasible for GHGs because GHGs are emitted in much higher volumes. Without the tailoring rule, the lower emissions thresholds would have automatically taken effect on January 2, 2011. EPA has phased in the CAA permitting requirements for GHGs in three steps.

3.7.1 Step 1 - January 2, 2011 – June 30, 2011

Step 1 states that the permitting requirements for GHG emissions would only be subject to those sources currently subject to PSD requirements. BACT would need to be determined for sources that have an increase in total GHG emissions of at least 75,000 tpy, on a CO_2e basis. During this time, no sources would be subject to Clean Air Act permitting requirements due solely to GHG emissions.

3.7.2 Step 2 - July 1, 2011 – June 30, 2013

In Step 2, PSD permitting requirements cover new construction projects that emit GHG emissions of at least 100,000 tpy even if they do not exceed the permitting thresholds for other pollutants. Modifications at existing facilities that cause an increase of at least 75,000 tpy of GHG emissions are also subject to the permitting requirements. During this step, operating permit requirements apply to sources based on their GHG emissions even if they would not apply based on emissions of other pollutants. Facilities that emit at least 100,000 tpy CO_2e are subject to Title V permitting requirements.

3.7.3 Step 3 - June 30, 2013

On February 24, 2012, the U.S. Environmental Protection Agency (EPA) proposed to keep greenhouse gas (GHG) permitting thresholds at current levels. This step continues to focus GHG permitting on the largest emitters by retaining the permitting thresholds that were established in Steps 1 and 2.

As show in Section 2, the potential CO_2e emissions from the proposed silicon manufacturing plant are approximately 403,000 tons/year and are above the 75,000 tons/year threshold. As a result, emissions of GHG's will be subject to PSD review, which essentially entails a BACT evaluation (refer to Section 4 of this document).

3.8 Compliance Assurance Monitoring

Pursuant to requirements concerning enhanced monitoring and compliance certification under the Clean Air Act, EPA has promulgated regulations (40 CFR 64) to implement compliance assurance monitoring (CAM) for major stationary sources of air pollution that are required to obtain operating permits under Title V of the Act. The regulations require owners or operators of such sources to conduct monitoring that satisfies particular criteria established in the rule to provide a reasonable assurance of compliance with application requirements under the Act. Monitoring focuses on emissions units that rely on pollution control device equipment to achieve compliance with applicable standards. The effective date of this rule was November 21, 2007. **Compliance with the requirements of this Part will be addressed as part of the proposed plant's Part 70 Operating Permit initial application process**.

3.9 Accidental Release Provisions

Federal chemical accidental release prevention requirements have been established in 40 CFR Part 68. These requirements cover risk management planning at facilities with more than a threshold quantity of a listed regulated substance in a single process. The rule lists 77 acutely toxic substances with threshold quantities ranging from 500 to 20,000 pounds, and also lists an additional 63 flammable gases and volatile liquids, each with a 10,000 pound threshold quantity as part of the proposed repowering project. **MS Silicon does not anticipate processing any chemicals that would trigger applicability of the accidental release prevention requirements.**

3.10 Protection of Stratospheric Ozone

The requirements for the protection of stratospheric ozone have been established in 40 CFR Part 82. These requirements were created to impose limits on the production and consumption of certain ozone-depleting substances. The purpose of 40 CFR 82 Subpart F, "Recycling and Emissions Reduction", is to reduce emissions of class I and class II refrigerants and their substitutes to the lowest achievable level by maximizing the recapture and recycling of such refrigerants during the service, maintenance, repair, and disposal of appliances. This Subpart applies to the servicing, maintaining, or repairing of appliances and also applies to the disposal of appliances.

MS Silicon may be involved in the servicing, maintaining or repairing of equipment subject to the handling and recycling provisions of this subpart. MS Silicon will follow the requirements as mandated by this subpart.

3.11 Mandatory Greenhouse Gas Reporting

40 CFR 98 established mandatory greenhouse gas (GHG) reporting requirements for owners and operators of certain facilities that directly emit GHG as well as for certain fossil fuel supplies and industrial GHG suppliers.

Included in this rule is the requirement to quantify and report GHG emissions on an annual basis. The first report was due to USEPA on March 31, 2011 for emissions released during the calendar year 2010.

MS Silicon is aware of this requirement and will evaluate its applicability and reporting requirements upon operation of the proposed plant.

Section 4: Best Available Control Technology (BACT)

4.1 Background

4.1.1 Best Available Control Technology (BACT) Evaluation Process

The following section describes the process of evaluating and defining BACT for emissions of PM_{10}, $PM_{2.5}$, NO_2, CO, SO_2 and GHG associated with the proposed silicon metal manufacturing process. Any major stationary source or major modification subject to PSD must conduct an analysis to ensure the application of best available control technology (BACT). The requirement to conduct a BACT analysis and determination is set forth in section 165(a)(4) of the Clean Air Act (Act), in federal regulations at 40 CFR 52.21(j), in regulations setting forth the requirements for State implementation plan approval of a State PSD program at 40 CFR 51.166(j), and in the SIP's of the various States at 40 CFR Part 52, Subpart A - Subpart FFF.

4.1.2 Process Description

The proposed plant will consist of a silicon manufacturing plant. The silicon manufacturing process consists of the continuous reduction of quartz (SiO_2) into silicon by a reducing mixture according to the simplified relation:

$$SiO_2 + 2C \rightarrow Si + 2CO.$$

As components of the mixture, carbon in the form of mineral carbon, petroleum coke, and wood-chips can be used. The electric current runs through the electrode between the contact plates and the tip of the electrode causing the ignition of the electric arc with its extremely high temperatures (> 2000°C) necessary for the reduction of quartz into silicon. The silicon is then tapped from the bottom of the submerged arc furnace.

The following emission sources will be included in this BACT analysis:

- Silicon Manufacturing Process (as defined in AP 42, Fifth Edition, Volume I, Chapter 12.4: Metallurgical Industry, Ferroalloy Production):
    - Submerged Arc Furnaces - Smelting in an electric arc furnace is accomplished by conversion of electrical energy to heat. An alternating current applied to the electrodes causes' current to flow through the charge between the electrode tips. This provides a reaction zone at temperatures up to 2000°C (3632°F). The tip of each electrode changes polarity continuously as the alternating current flows between the tips. The carbonaceous material in the furnace charge reacts with oxygen in the metal oxides of the charge and reduces them to base metals. The reactions produce large quantities of carbon monoxide (CO) that passes upward through the furnace charge. Large amounts of carbon monoxide and organic materials also are emitted by submerged electric arc furnaces. Carbon monoxide is

formed as a byproduct of the chemical reaction between oxygen in the metal oxides of the charge and carbon contained in the reducing agent (coke, coal, etc.). Reduction gases containing organic compounds and carbon monoxide continuously rise from the high-temperature reaction zone, entraining fine particles and fume precursors. The mass weight of carbon monoxide produced sometimes exceeds that of the metallic product. The heat-induced fume consists of oxides of the products being produced and carbon from the reducing agent. The fume is enriched by silicon dioxide, calcium oxide, and magnesium oxide, if present in the charge.

- Natural Gas Fired Ladle Preheaters;
- Material Handling – Receiving, Material Handling, Storage and Truck Loadout – Includes the following materials:
  - Coal;
  - Wood; and
  - Quartz.
- Product Refining;
- Fugitive Emissions from Roadways; and
- Emergency Support Equipment.

4.1.3 Definition of BACT

The BACT requirement is defined as:

> *"an emissions limitation (including a visible emission standard) based on the maximum degree of reduction for each pollutant subject to regulation under the Clean Air Act which would be emitted from any proposed major stationary source or major modification which the Administrator, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such source or modification through application of production processes or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of such pollutant. In no event shall application of best available control technology result in emissions of any pollutant which would exceed the emissions allowed by any applicable standard under 40 CFR Parts 60 and 61. If the Administrator determines that technological or economic limitations on the application of measurement methodology to a particular emissions unit would make the imposition of an emissions standard infeasible, a design, equipment, work practice, operational standard, or combination thereof, may be prescribed instead to satisfy the requirement for the application of best available control technology. Such standard shall, to the degree possible, set forth the emissions reduction achievable by implementation of such design, equipment, work practice or operation, and shall provide for compliance by means which achieve equivalent results."*

4.1.3.1 BACT Demonstration Approach

BACT by definition is the most effective control option which is technically feasible considering economic, energy, and other environmental impacts. Control options can be eliminated as BACT on a basis of technical, economic, energy, or environmental considerations. The determination of BACT follows a Top-Down approach. In the top-down approach, progressively less stringent control technologies are analyzed until a level of control considered BACT is reached on the basis of environmental, energy and economic impacts. The key steps in the Top-Down process are as follows:

STEP 1: Identify Available Control Technologies: For the source, emissions unit, activity, or process requiring BACT, identify and list all "available" emissions control options for each pollutant. Available control options are those control technologies and techniques with a practical potential for application to the source, emissions unit, activity, or process. In general, any control option in commercial use in the United States at the time the analysis is performed should be included on the list of available control options.

STEP 2: Eliminate Technically Infeasible Options: Considering site-specific factors and constraints, remove from the list compiled in STEP 1 all technically infeasible control options. A control option can be considered as technically infeasible if technical difficulties such as physical, chemical, or engineering constraints would preclude the successful use of the control option in the particular application in question. For all control options eliminated, demonstration that a control option is technically infeasible should be clearly documented in the BACT Analysis and included with the BACT submittal.

STEP 3: Rank Remaining Control Technologies by Control Effectiveness: Rank and list all remaining control options in order of control effectiveness with the most effective control alternative at the top of the list. As noted above, the control technologies to be evaluated and ranked will apply to those associated with controlling emissions from similar emission sources.

STEP 4: Energy, Environmental, and Economic Considerations: Using the "Top Down" procedure specified below, control options may be eliminated as BACT candidates on the basis of energy, environmental, and economic impacts of the option. Energy impacts include but are not limited to energy efficiency impacts, fuel cycle efficiency considerations, and fuel availability. Environmental impacts include but are not limited to ground water and water impacts, solid and hazardous waste impacts, and air quality impacts from increases in emissions of other air pollutants that result from implementing the control option. Economic impacts include the sum of up-front capital cost and annual operation and maintenance costs of implementing the control option.

A control option may be eliminated as a BACT candidate on grounds of significant energy, environmental, or economic impacts. Rationale for eliminating a control option should be well documented and included in the analysis. Economic impacts should be evaluated by comparing the cost effectiveness of the control option with generally acceptable cost effectiveness ranges for control of the particular pollutant in question.

The Top Down process is defined in Steps 4A through 4E below:

- **STEP 4.A:** Start with the most effective control option from the list compiled in STEP 3 (i.e., those associated with controlling emissions from similar emission units.
- **STEP 4.B:** Provide the information specified in items (a) through (g) below for the control option being considered.
  a. **Control Efficiency:** Enter the percent of the pollutant removed by the control option. Control efficiency should be calculated based on the control achieved from the control option in question only.
  b. **Potential Emissions:** Potential emissions in pounds of pollutant per hour and tons of pollutant per year should be calculated based on the maximum potential to emit rather than actual emissions. Potential emissions represent the maximum capacity of a source, emissions unit, process, or activity to emit an air pollutant under physical constraints considering air pollutant emission controls and applicable regulatory limits. Operational factors such as hours of operation or partial loading which influence emissions may be included as constraints which limit the potential to emit provided that the project proponent agrees to incorporate these constraints in enforceable regulatory compliance limits.
  c. **Expected Emissions:** Expected emissions in tons of pollutant per year should be calculated considering expected operational considerations such as down time for maintenance, periods of partial load, capacity factors, etc.
  d. **Annual Expected Emission Reduction:** Using the expected emission rate computed in "c" and control efficiency entered in "a", compute the expected annual emission reduction in tons per year.
  e. **Annual Cost of Control Option:** Compute the annual cost of the control option using standard economic principles. Annual cost should include both the initial capital costs as well as operation and maintenance costs. All costs should be amortized over the expected life of the control option (default is ten years). Include in the analysis the calculations, assumptions, and economic parameters used in the calculations.
  f. **Cost Effectiveness:** Cost effectiveness is the ratio of the annual cost computed in "e" to the annual expected emission reduction computed in "d".
  g. **Other Considerations:** List all other media impacts (water, solid waste, etc.) and energy impacts which are associated with the control option.
- **STEP 4.C:** If there are no outstanding issues regarding energy, environmental and economic impacts the analysis is ended and this control option is proposed as BACT.
- **STEP 4.D:** In the event that the control option is determined to be inappropriate due to energy, environmental, or economic impacts, this control option is eliminated and the analysis proceeds to the next control option on the list. Rationale for elimination of a control option on grounds of significant energy, environmental or economic impacts should be well documented and included with the analysis.
- **STEP 4.E:** Go to STEP 4.B and proceed with the analysis for the next control option on the list.

STEP 5: Documentation: Include with the analysis all information, calculations, assumptions, and data used in making the BACT determination.

Since MS Silicon has selected the "Top-Level" of control or design with inherent control technique, taking into account any technical limitations, the BACT evaluation that follows does not address economic, energy and environmental impacts related to a specific control device. This follows EPA's suggested approach for performing this type of BACT evaluation.

4.2 Best Available Control Technology (BACT) Analysis - Emissions of Greenhouse Gases (GHG)

This evaluation follows the guidance developed by USEPA during 2010 under the Tailoring Rule. Under this rule, any project occurring after July 1, 2011 and having a net increase of equal to or greater than 75,000 tons/year of CO_2 on an equivalence basis triggers a BACT evaluation. As defined in USEPA's document entitled "PSD and Title V Permitting Guidance for Greenhouse Gases", dated March 2011, the BACT evaluation process is required to include five (5) steps. These steps are essentially those steps that make up the Top-Down evaluation process.

This BACT evaluation focused on the control technologies that have been demonstrated and commercially available for equipment associated with silicon production. Because of the importance of controlling GHG emissions, MS Silicon evaluated technologies that have been demonstrated on similar processes so that emissions of GHG will be controlled to the levels specified. Technologies or concepts for controlling GHG emissions are and will continue to emerge on paper and on a trial basis. Since these technologies have not been proven to be reliable (i.e., demonstrated technologies), evaluation of these technologies are not being addressed in this BACT evaluation. MS Silicon is very reluctant to install a non-proven technology that may require significant on-site adjustments, while at the same time not meeting required GHG emission limits.

4.2.1 GHG Emission Sources Subject to Control Technology Evaluation

The following GHG emission sources are present at silicon manufacturing operations:

- Semi-Enclosed Submerged Arc Furnaces (AA-201);
- Natural Gas Combustion Equipment (AA-202); and
- Emergency Equipment (AA-501).

For a summary of the estimated GHG emission rates for the sources identified above, please refer to the following table.

GHG Emission Rates for Sources Evaluated for BACT

Equipment Description	GHG CO_2e Emission Rate (tons/year)
AA-201 - Semi-Enclosed Submerged Arc Furnaces (4 SAFs)	381,866
AA-202 - Natural Gas Combustion Equipment	20,499
AA-501 - Emergency Generator	32
TOTAL	402,397

A summary of the BACT determinations for GHG emissions is presented in Table 4-1.

4.2.2 BACT Analysis for GHG Emissions from Silicon Manufacturing

The production of ferroalloys results in emission of greenhouse gases. In ferroalloy production, raw ore, carbon materials and slag forming materials are mixed and heated to carbon sources. While CO_2 is the main greenhouse gas from ferroalloy production, recent research has shown that CH_4 and N_2O account for an equivalent greenhouse gas emission of up to 5 % of the CO_2 emissions from ferrosilicon (FeSi) and silicon-metal (Si-metal) production.[1]

The most significant greenhouse gas (GHG) emissions are related to the generation of carbon dioxide during the chemical reactions occurring in the metallurgical furnaces, where carbon is used to reduce the quartz to silicon metal. The second source of CO_2 emissions in silicon metal production comes from the use of natural gas in combustion processes. **The use of emergency equipment is limited to 100 hours per year and generates an insignificant amount of GHG and thus will not be included in this BACT analysis.**

4.2.3 BACT Analysis for GHG Emissions from Semi-Enclosed Submerged Arc Furnaces (AA-201)

Step One - Identify Available GHG Control Technologies

The first step of the Top-Down BACT analysis is to assess the proposed emission reduction options. The sources of information on emission reduction options vary for the air emission sources being analyzed. The following information resources were consulted in searching for the alternatives available for

[1] Greenhouse Gas Emissions from Ferroalloy Production. T. Lindstad, S.E. Olsen, G. Tranell, T. Færden and J. Lubetsky, 2007

controlling GHG emissions from semi-enclosed submerged arc furnaces used in silicon production operations:

1. On-line USEPA Control Technology Database;
2. State Air Quality Permits; and
3. Control Technology Vendors.

Review of the above sources did not identify information on controlling GHG emissions from the semi-enclosed submerged arc furnaces used in silicon production processes. In electric arc furnaces, electrical resistance generates the heat required: the resistance in a SAF furnace is the atmosphere, while in a submerged-arc furnace the slag or charge forms the resistance. No control options for emissions from the SAF were identified in this review.

The possible control options that will be evaluated have been divided into two (2) distinct areas; 1) energy efficiency improvement options, and 2) add-on controls. The application of methods, systems, or techniques to increase energy efficiency is a key GHG-reducing opportunity. Use of inherently lower-emitting technologies, including energy efficiency measures, represents an opportunity for GHG reductions. While energy efficiency can reduce emissions of all combustion-related emissions, it is a particularly important consideration for GHGs since the use of add-on controls to reduce GHG emissions is not as well advanced as it is for most combustion-derived pollutants.

Opportunities to further improve energy efficiency from electric arc furnaces in general are described below[2].

Control Measure	Description	Discussion
Improved Process Control	Process control can optimize operations and thereby significantly reduce electricity consumption. Control and monitoring systems for SAF are moving towards integration of real-time monitoring of process variables	This control measure is feasible and will be included in the SAF design.
Adjustable Speed Drives	As flue gas flow varies over time, adjustable speed drives offer opportunities to operate dust collection fans in a more energy efficient manner.	This control measure is feasible and will be included in the SAF design.
Transformer Efficiency—Ultra-High–Power	Ultra-high–power (UHP) transformers help to reduce energy loss and increase productivity. Location of the furnace transformers minimizing the length of the HV	This control measure is feasible and will be included in the SAF design.

[2] Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from the Iron and Steel Industry

Control Measure	Description	Discussion
Transformers	cables, less power losses.	
Post-Combustion of the Flue Gases	Post-combustion is a process for utilizing the chemical energy in the CO and hydrogen evolving to heat the SAF ladle or to preheat other materials 570-1,470°F (300-800°C). It reduces electrical energy requirements and increases the productivity of the SAF.	This control measure is not applicable to the silicon metal production process. There are no post combustion processes for silicon metal. This control measure will be excluded from further consideration in this BACT analysis.
Direct Current Arc Furnace	The direct current (DC) arc furnace was pioneered in Europe, and these single-electrode furnaces have recently been commercialized in North America. The DC arc furnaces use DC rather than alternating current (AC). In a DC furnace one single electrode is used, and the bottom of the vessel serves as the anode. However, compared to new AC furnaces, the savings are limited.	This technology is feasible but the technology has been only tested on an experimental scale with poor results. Direct current arc furnaces have never been performed on a large scale for silicon metal production. This control measure will be excluded from further consideration in this BACT analysis.
Engineered Refractories	Refractories in SAF have to withstand extreme conditions such as temperatures over 2,900°F (1,600°C), oxidation, thermal shock, erosion and corrosion. Refractories can be provided by a controlled microstructure: alumina particles and mullite microballoons coated uniformly with carbon and carbides.	This control measure is feasible and will be included in the SAF design.
Airtight Operation	A large amount of air enters the SAF: around 1,000,000 ft^3 (30,000 m^3) in a standard SAF. This air is at ambient temperature, and the air's nitrogen and non-reactive oxygen are heated in the furnace and exit losses. The potential benefit for an industrial furnace with an airtight process including a post combustion practice and an efficient fume exhaust control are about 100 kWh/ton for an industrial furnace having a current electric consumption of 450 kWh/ton.	The furnace is semi-closed. In order to charge the furnace with the raw materials and place them in the proper position, the furnace doors will need to be open in order to "push the raw materials" using the "stoking machine" into place. Doors will be closed when not needed.
Flue Gas Monitoring and Control	The use of VSDs can reduce energy usage of the flue gas fans, which in turn reduces the losses in the flue gas.	This control measure is feasible and will be included in the SAF design.

Control Measure	Description	Discussion
Bottom Tapping	Bottom tapping leads to slag-free tapping, shorter tap-to-tap times, reduced refractory and electrode consumption, and improved ladle life	This control measure is feasible and will be included in the SAF design.
Carbon Capture and Storage	Carbon capture and storage involves separation and capture of CO_2 from the flue gas, pressurization of the captured CO_2, transportation of the CO_2 via pipeline, and finally injection and long-term geologic storage of the captured CO_2. Several different technologies, at varying stages of development, have the potential to separate and capture CO_2. Some have been demonstrated at the slip-stream or pilot-scale, while many others are still at the bench-top or laboratory stage of development	See below.

Step Two – Eliminate Technically Infeasible Control Options

All of the control options identified under Step 1 with the exception of Direct Current Arc Furnace, Post-Combustion of the Flue Gases, and Carbon Capture and Storage are technically feasible and will be included in this BACT evaluation.

Carbon capture and sequestration (CCS) has not been applied to SAFs in the past and has not been demonstrated in practice for these emission types. CCS is generally used for facilities with sources emitting CO_2 in large amounts, such as fossil fuel-fired power plants, and for industrial facilities with high-purity CO_2 streams.

CCS involves capturing CO_2, transporting it as necessary, and permanently storing it instead of releasing it into the atmosphere. The process involves three main steps:

- Capturing CO_2 at its source by separating it from other gases produced by an industrial process. Once CO_2 is separated and captured, it then can be compressed under high pressure for transport to an appropriate geological storage site;
- Transporting the captured CO_2 to a suitable storage location (typically in compressed form); and
- Storing the CO_2 away from the atmosphere for a long period of time, for instance in underground geological formations, in the deep ocean, or within certain mineral formations.

The process of transporting CO_2 is typically considered via pipeline and has substantial associated logistic hurdles and operational penalties. Transportation infrastructure issues include pipeline routing, acquisition of rights-of-way, and associated environmental impacts. In addition, additional energy must be expended to compress and transport the compressed CO_2. An alternative means of transporting the

compressed CO_2 is via a ship, similar to transporting liquid natural gas. Again, there are similar logistic hurdles and operational penalties for transporting compressed CO_2 via ship that can be substantial.

Carbon sequestration usually involves the injection of CO_2 into deep geological formations of porous rock that are capped by one or more nonporous layers of rock. Injected at high pressure, the CO_2 exists as a liquid that flows through the porous rock to fill the voids. Saline formations, exhausted oil and gas fields, and unmineable coal seams are candidates for CO_2 storage. Also, CO_2 injected for enhanced oil recovery projects can result in long-term sequestration depending on the geologic conditions. Other schemes include liquid storage in the ocean, solid storage by reactions leading to the creation of carbonates, and terrestrial sequestration. This type of infrastructure does not exist at the proposed plant site.

Another important technical consideration is that carbon capture is simpler when CO_2 is produced in high purity and high concentration streams as the byproduct of certain industrial processes, such as natural gas processing, hydrogen production, and synthetic fuel production. In contrast, it is relatively more difficult to capture CO_2 from flue gas emissions, which may require the reengineering of certain established and reliable production techniques. Apart from the technical issues of cleaning such dirty gas streams so they are suitable for CCS, unlike power plants, where CO_2 concentrations are comparatively high and consistent, metallurgical operations have more dilute concentrations of CO_2, the off gas is dirty and difficult to handle, and CO_2 production varies widely depending on the process step.

In summary, CCS is excluded from this BACT evaluation for the following reasons:

- Installation and operate of CCS is not commercially available and has not been installed in conjunction with any SAF process installed and currently operating worldwide;
- Currently there is no infrastructure available at the project site that will allow MS Silicon the ability to capture it's CO_2 gas streams and pipe them to a nearby facility for further processing, such as a beverage plant;
- Currently there is no infrastructure available at the project site that will MS Silicon the ability to capture and store it's CO_2 gas stream for future use in the event a beverage plant would be installed in the vicinity of the proposed plant site;
- CO_2 produced at the proposed plant will require significant enhancements to improve its quality prior to being used by another source to produce a product; and
- Cost estimates are not being provided in support of removing CCS as a cost effective control alternative since EPA has not provided any guidance or established thresholds on what cost, expressed as a dollar per ton would be considered cost excessive.

Because of the various reasons provided above, MS Silicon is eliminating CCS has a viable control option for GHG control based on its 1) not being commercially available and 2) not being shown to be a proven control option that has been demonstrated in actual operation.

Based on the above technical issues, CCS is consequently deemed not technically feasible for controlling GHG emissions from the proposed SAFs.

Step Three – Assessment of Proposed BACT Emission Reduction Options

This step of the Top-Down analysis provides an assessment of the performance and feasibility of the emission reduction options evaluated. MS Silicon is proposing to utilize the newest generation of submerged arc furnace with inherently lower-emitting technologies, including energy efficiency measures. This new generation furnace is designed to more efficiently convert raw materials to the silicon intermediate product. It is almost impossible to evaluate each option defined above and establish a CO_2 percent reduction.

For purposes of this GHG BACT evaluation, MS Silicon has concluded that the new generation furnace is the most effective control at reducing GHG emissions.

Step - Four Evaluate Most Effective Control and Document Results

As discussed above, various emission reduction options (i.e., new generation furnace) are being proposed by MS Silicon that are considered the **Top Level** of emission reduction available for controlling GHG emissions from the production of silicon. Since MS Silicon has selected the "Top-Level" of control or design with inherent control technique, taking into account any technical limitations, the BACT evaluation that follows does not address economic, energy and environmental impacts related to a specific control device. This follows EPA's suggested approach for performing this type of BACT evaluation.

Step Five – Select BACT

A detailed review was conducted to determine the emission reduction options incorporated at other submerged arc furnaces. Review of recently permitted GHG sources and the RBLC database did not reveal BACT determinations for submerged arc furnaces.

BACT for GHG emissions from the semi-enclosed submerged arc furnace has been determined to be:

- **Utilization of a new generation furnace with inherently lower-emitting technologies and energy efficiency measures (i.e., semi-enclosed SAF);**
- **CO_2e emission limitation of 381,866 tons/year; and**
- **Good operation and maintenance to improve energy efficiency.**

4.2.4 BACT Analysis for GHG Emissions from Natural Gas Combustion (AA-202)

The following natural gas combustion emission sources are included in this review:

Description	Heat Input (MMBTU/hr)	Heat Input (MMscf/year)	Total GHG Emissions (CO_2e) (tons/year)
Natural Gas fired Ladle Pre-Heaters – 4 Units – 10.0 MMBtu/hr each	40.0	350,00	20,499

Step One – Identify Available GHG Control Technologies

The first step of the Top-Down BACT analysis is to assess the proposed emission reduction options. The sources of information on emission reduction options vary for the air emission sources being analyzed. The following information resources were consulted in searching for the alternatives available for controlling GHG emissions from natural gas combustion equipment:

1. On-line USEPA Control Technology Database;
2. State Air Quality Permits; and
3. Control Technology Vendors.

The application of methods, systems, or techniques to increase energy efficiency is a key GHG-reducing opportunity from combustion sources. Use of inherently lower-emitting technologies, including energy efficiency measures, represents an opportunity for GHG reductions. Since GHG are the direct result of fuel combustion, any improvement in the efficiency of a process heater will reduce fuel use and GHG emissions. While energy efficiency can reduce emissions of all combustion-related emissions, it is a particularly important consideration for GHGs since the use of add-on controls to reduce GHG emissions is not as well advanced as it is for most combustion-derived pollutants.

Approaches for reducing GHG emissions from fossil fuel-fired equipment could include fuel switching or energy efficiency measures. In the case of natural gas-fired equipment, however, fuel switching to a lower carbon fuel is not an option because natural gas emits less CO_2 per amount of heat derived than other gaseous or liquid fuels commonly used.

Summary of Potentially Applicable GHG Energy Efficiency Measures – Natural Gas Combustion Sources

Control	Removal Effectiveness	Comments
Burner replacement	Replacing old burners with more efficient modern burners can lead to significant energy savings. Energy and cost savings vary widely based on the condition and efficiency of the burners being replaced.	• Energy efficient burners will be installed in the natural gas combustion equipment

Control	Removal Effectiveness	Comments
Boiler process control	Using a combination of CO and oxygen readings, it is possible to optimize the fuel/air mixture for high flame temperature (and thus the best energy efficiency) and lower air pollutant emissions	• Natural gas combustion equipment will optimize the fuel/air mixture for high flame temperature
Reduction of flue gas quantities	Excessive flue gas results from leaks in the boiler and/or in the flue. These leaks can reduce the heat transferred to the steam and increase pumping requirements. However, such leaks are often easily repaired, saving 2 to 5 percent of the energy formerly used by the boiler	• Equipment will be maintained to minimize any leaks
Reduction of excess air	Boilers must be fired with excess air to ensure complete combustion and to reduce the presence of CO in the unburned fuel in exhaust gases. When too much excess air is used to burn fuel, energy is wasted because excessive heat is transferred to the air rather than to the steam.	• Equipment will be maintained to ensure complete combustion
Carbon Capture and Storage	Carbon capture and storage involves separation and capture of CO_2 from the flue gas, pressurization of the captured CO_2, transportation of the CO_2 via pipeline, and finally injection and long-term geologic storage of the captured CO_2. Several different technologies, at varying stages of development, have the potential to separate and capture CO_2. Some have been demonstrated at the slip-stream or pilot-scale, while many others are still at the bench-top or laboratory stage of development	See below.

Step Two – Eliminate Technically Infeasible Control Options

With the exception of carbon capture and sequestration (CCS), all of the control options identified under Step 1 are technically feasible and will be included in this BACT evaluation. CCS was not evaluated in this BACT evaluation. This type of control technology has not been applied to natural gas combustion

sources in the past and has not been demonstrated in practice for these emission types. CCS is generally used for facilities with sources emitting CO_2 in large amounts, such as fossil fuel-fired power plants, and for industrial facilities with high-purity CO_2 streams. Based on this, CCS is consequently deemed not technically feasible for controlling the GHG emissions from the natural gas combustion sources that will support the proposed plant operations.

Thus, the available control options are as follows:

- Combustion of clean-burning fuel - Burners are designed to combust natural gas. Fuel switching to a lower carbon fuel is not an option because natural gas emits less CO_2 per amount of heat derived than other gaseous or liquid fuels commonly used;
- Energy efficiency pollution prevention options that are available for this type of combustion device include the following:
    - Burner efficiency;
    - Preventive Maintenance; and
    - Energy monitoring and management systems.

Step Three – Assessment of Proposed BACT Emission Reduction Options

This step of the Top-Down analysis provides an assessment of the performance and feasibility of the emission reduction options evaluated. Combustion of natural gas, low NO_x burners and good combustion practices and maintenance to improve energy efficiency are considered the top level of emission reduction available for the natural gas combustion equipment.

Step Four - Evaluate Most Effective Control and Document Results

The emission reduction options that are being proposed by MS Silicon that are considered the **Top Level** of emission reduction available for controlling GHG emissions from the combustion of natural gas. Since MS Silicon has selected the "Top-Level" of control or design with inherent control technique, taking into account any technical limitations, the BACT evaluation that follows does not address economic, energy and environmental impacts related to a specific control device. This follows EPA's suggested approach for performing this type of BACT evaluation.

Step Five - Select BACT

A detailed review was conducted to determine the emission reduction options incorporated at other natural gas fired burners. Review of the RACT/BACT/LAER Clearinghouse (RBLC) revealed the following BACT determinations for natural gas combustion equipment.

Facility/ RBLC ID	Permit Date	Basis	Process	GHG BACT Limit	Controls
Cargill, Inc. NE-0054 DRAFT DETERMINATION	3/1/13	BACT-PSD	300 MMBtu/hr Boiler	No Limit	Good combustion practice
Iowa Fertilizer Company IA-0105	10/26/12	BACT-PSD	472.4 MMBtu/hr Auxiliary Boiler	CO_2:117 lb/MMBtu Methane:0.0023 lb/MMBtu N_2O: 0.0006 lb/MMBtu	Good combustion practice
Iowa Fertilizer Company IA-0105	10/26/12	BACT-PSD	110.12 MMBtu/hr Startup Heater	CO_2:117 lb/MMBtu Methane:0.0023 lb/MMBtu N_2O: 0.0006 lb/MMBtu	Good combustion practice
Showa Denko Carbon, Inc. SC-0142	6/8/12	BACT-PSD	5 MMBtu natural gas fired hot oil heater	CO_2e: 3093 tpy	Good combustion practice, annual tune-up low NO_x burner
Port Dolphin Energy LLC FL-0330	12/1/11	BACT-PSD	Four 278 MMBtu/hr boilers	CO_2:117 lb/MMBtu	tuning, optimization, instrumentation and controls, insulation, and turbulent flow
Pyramax Ceramics, LLC GA-0147	2/8/12	BACT-PSD	9.8 MMBtu/hr natural gas fired boiler	CO_2e: 5809 tpy rolling average	Good Combustion Practices, design, and thermal insulation
Entergy Louisiana LLC, Nine Mile Point Electric Generating Plant LA-0254	08/16/11	BACT-PSD	Auxiliary Boiler 338 MMBtu/hr	CO_2:117 lb/MMBtu Methane:0.0022 lb/MMBtu N_2O: 0.0002 lb/MMBtu	Proper operation and good combustion practices

Summary of Potentially Applicable GHG Energy Efficiency Measures – Natural Gas Combustion Equipment

Control	Description	Comments
Use of Low Carbon Fuels	Burners will be combusting natural gas	• Burners are designed to combust natural gas. Fuel switching to a lower carbon fuel is not an option because natural gas emits less CO_2 per amount of heat derived than other gaseous or liquid fuels

Control	Description	Comments
Energy efficient processes and technologies	• Low NOx burners, • Good combustion practices to improve energy efficiency • Good maintenance of combustion equipment	• Burner design will incorporate low NOx burners and good combustion practices and maintenance to improve energy efficiency

Based on information reviewed for this BACT analysis, the GHG control measures focus on fuel type or energy efficiency measures. No other applicable GHG control measures were identified in this review. Provided below is a summary of the emission reduction options being incorporated into the natural gas fired combustion devices associated with the proposed silicon plant. Rationale for selection of BACT includes the use of natural gas as a clean burning fuel, use of low NO_x energy efficient burner technology and good combustion practice.

BACT for this emission unit is as follows:

- CO_2 – 117 lb/MMBtu
- Methane – 0.0022 lb/MMBtu
- N_2O – 0.0002 lb/MMBtu

Control techniques to be implemented to meet these emission limitations will be: 1) good combustion practices, 2) combustion of natural gas only, 3) selection of the most energy efficient burner design based on engineering selection process and 4) periodic maintenance.

4.3 Best Available Control Technology (BACT) Analysis - Emissions of $PM_{10}/PM_{2.5}$

Particulate matter," also known as particle pollution or PM, is a complex mixture of extremely small particles and liquid droplets. Particle pollution is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles. Particulate matter exists in the solid and liquid physical states, and gases or vapors may also condense to form particulate matter. The latter, condensable particulate matter, is of great concern due to the inherently small size of condensation products; overwhelmingly, condensable particulate can be classified as $PM_{2.5}$[3]. $PM_{2.5}$ is defined as particulate matter that has a diameter of 2.5 microns or less and is a subset of PM_{10} which is particulate with a size range of 10 microns or less. Even though both are particulate matter they have separate air quality standards and are considered separate pollutants for permitting purposes. The size of particles is directly linked to their potential for causing health problems. EPA is concerned about particles that are 10 micrometers in diameter or smaller because those are the particles that generally pass through the throat and nose and enter the lungs. Once inhaled, these particles can affect the heart and lungs and cause serious health effects. EPA groups particle pollution into two categories:

- "Inhalable coarse particles," such as those found near roadways and dusty industries, are larger than 2.5 micrometers and smaller than 10 micrometers in diameter.
- "Fine particles," such as those found in smoke and haze, are 2.5 micrometers in diameter and smaller. These particles can be directly emitted from sources such as forest fires, or they can form when gases emitted from power plants, industries and automobiles react in the air.[4]

The BACT evaluation focuses on the control technologies that have been demonstrated and commercially available for the proposed silicon production plant. Because of the importance of controlling these emissions, MS Silicon evaluated technologies that have been demonstrated on similar processes so that emissions of $PM_{10}/PM_{2.5}$ will be controlled to the levels specified. Condensable $PM_{2.5}$ emissions occur when gas molecules are present in the exhaust gas stream that when cooled change into a particulate state. This change from gas vapor to solid is referred to as condensable particulates. USEPA is involved in extensive research on trying to better define this change over, as well as how best to quantify the presence of these condensable particulates. For purposes of this evaluation, since no specific technologies exist (i.e., commercially available and demonstrated), above and beyond that already selected in the form of a baghouse, for controlling $PM_{2.5}$ emissions, additional emphasize was

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[3] Condensable Particulate Matter, Regulatory History and Proposed Policy, January 27, 1998 http://www.ncair.org/enf/sourcetest/cpm/condensweb.pdf

[4] http://www.epa.gov/air/particlepollution/

placed on the availability of controls to reduce emissions of SO_2 and NO_x. Emissions of SO_2 and NO_x can be present in the gas phase that could convert to solids in the form of sulfates and nitrates. USEPA has identified SO_2 and NO_x as potential precursors to the formation of $PM_{2.5}$ emissions. However, USEPA has not provided, as of the date of this application, guidance on the effect of SO_2 and NO_x as potential precursors to the formation of $PM_{2.5}$ emissions. Subsequently, evaluation of the control options to reduce SO_2 and NO_x emissions to further reduce $PM_{2.5}$ emissions have not been included in this BACT evaluation.

4.3.1 $PM_{10}/PM_{2.5}$ Emission Sources Subject to Control Technology Evaluation

The $PM_{10}/PM_{2.5}$ emission sources associated with the proposed plant that are included in this $PM_{10}/PM_{2.5}$ BACT evaluation are as follows:

- Semi-Enclosed Submerged Arc Furnaces (SAFs) (AA-201);
- Casting Frames (AA-201a);
- Silica Fume Silos (AA-404);
- Natural Gas Fired Combustion Equipment (AA-202);
- Diesel Fired Emergency Generator (AA-501);
- Material storage and handling (AA-101, AA-101a, AA-102, AA-102a, AA-103, AA-103a, AA-104, AA-105, AA-106);
- Wood Chipper (AA-102b); and
- Roadways (AA-401, AA-402a).

For a summary of the estimated $PM_{10}/PM_{2.5}$ emission rates for the sources identified above, please refer to the following table:

$PM_{10}/PM_{2.5}$Emission Rates for Sources Evaluated for BACT

Equipment Description	PM_{10} Emission Rate (tons/year)	$PM_{2.5}$ Emission Rate (tons/year)
AA-201 - Semi-Enclosed Submerged Arc Furnaces (SAFs)	61.2	61.2
AA-201a- Casting Frames	0.3	0.3
AA-202 - Natural Gas Fired Ladle Preheaters	0.1	0.1
Diesel Fired Emergency Generator (AA-501)	0.001	0.001

Equipment Description	PM_{10} Emission Rate (tons/year)	$PM_{2.5}$ Emission Rate (tons/year)
Material Handling and Storage:		
• Material Transfer to and from Coal Storage Pile (AA-101)	0.01	0.002
• Material Transfer to and from Wood Storage Pile (AA-102)	0.002	0.0003
• Material Transfer to and from Quartz Storage Pile (AA-103)	1.8	0.3
• Limestone Material Handling (AA-104)	0.0008	0.0001
• Material Handling Area Baghouse (AA-101a, AA-102a, AA-103a)	6.8	6.8
• Product Handling Area Baghouse (AA-301)	3.4	3.4
• Storage Piles Processing (i.e., Bulldozing) (AA-105)	1.7	0.2
• Storage Piles Wind Erosion (AA-106, AA-403)	2.5	0.4
• Silica Fume Silos (AA-404)	0.15	0.15
AA-102b - Wood Chipper	0.042	0.042
AA-402 - In-Plant Gravel Roads	3.7	0.37
AA-402a - In-Plant Paved Roads	0.3	0.3
Total	**81.8**	**73.3**

4.3.2 BACT Analysis for $PM_{10}/PM_{2.5}$ Emissions from Semi-Enclosed Submerged Arc Furnaces

Step One - Identify Available $PM_{10}/PM_{2.5}$ Control Technologies

The first step of the Top-Down BACT analysis is to assess the proposed emission reduction options. The sources of information on emission reduction options vary for the air emission sources being analyzed. The following information resources were consulted in searching for the alternatives available for controlling $PM_{10}/PM_{2.5}$ emissions from plant operations:

1. On-line USEPA Control Technology Database; and
2. State Air Quality Permits;

Particulate control technologies exist today that are proven and reliable that that provide a high level of removal efficiency (i.e., in excess of 99%). These technologies are well suited for controlling particulate matter, including $PM_{2.5}$ in the form of solids or "filterable" particulates. As will be described in the BACT evaluation that follows, MS Silicon is installing a fabric filter bag-house which is considered the top level of $PM_{10}/PM_{2.5}$ control technology for filterable particulates from the semi-enclosed submerged arc furnace. MS Silicon will also be using Best Management Practices to minimize the generation of $PM_{10}/PM_{2.5}$ fugitive emissions.

Technologies will continue to emerge for controlling particulate matter emissions, including $PM_{2.5}$ that are in the vapor phase in the exhaust gas and when cooled by ambient air at the point of the exhaust stack release, change from a vapor phase to a solid phase. This change over is defined as "condensable" particulates. As part of the BACT evaluation that follows we have examined proven technologies that can further reduce these precursors, thus reducing the condensable portion of $PM_{2.5}$ from the exhaust gas stream. Condensable $PM_{2.5}$ emissions should be minimal from the fugitive sources.

The choice of which technology is most appropriate for a specific application depends upon several factors, including particle size to be collected, particle loading, stack gas flow rate, stack gas physical characteristics (e.g., temperature, moisture content, presence of reactive materials), and desired collection efficiency. Emissions of particulate matter are generally controlled with add-on control equipment designed to capture the emissions prior to the time they are exhausted to the atmosphere. In cases where the material being emitted is organic, particulate matter may be controlled through a combustion process. The following control technologies were identified and evaluated to control $PM_{10}/PM_{2.5}$ emissions from the SAF:

(a) Electrostatic Precipitator (ESP) - In an ESP, particles are electrically charged and then exposed to an electric field in which they are attracted to an electrode. Periodically, this electrode is cleaned through vibration and the freed particles are directed into a collection unit. While ESPs have been used on solid fuel combustion devices they have not been used on similar sources as the proposed plant

(b) High Efficiency Cyclones - Cyclones and multicyclones are a commonly used PM control technology in the United States. A cyclone removes particles based the principle of gravity and centrifugal force. A multicyclone uses the same concept as a cyclone but employs multiple, smaller diameter cyclones to improve its capturing capacity. The particle control efficiency of both devices decreases as the particle size decreases and therefore do not adequately control $PM_{2.5}$.

(c) High Energy Scrubbers – High energy scrubbers are a wet scrubbing system that combines a high energy venturi scrubber with a cyclonic separator. These scrubbers are effective in the removal of dusts, fumes, vapors, and mists; as well as a variety of other air pollutants, and

(d) Fabric Filters (i.e., baghouses) - Fabric filters have been widely used for controlling PM emissions from many different types of sources. Large industrial, commercial, and Institutional (ICI) boilers are equipped with these devices and have PM control efficiencies of 99 percent or higher. A fabric filter, or baghouse, is made up of cloth or woven specialty fibers. The flue gases are directed through the filter. The separation efficiency of bag filters is quite high. Because of their design (large surface area of bags and longer residence times in transit), fabric filters may capture a higher fraction of ultrafine particles than ESPs

Step 2 – Eliminate Technically Infeasible Control Options

The test for technical feasibility of any control option is whether it is both available and applicable to reducing $PM_{10}/PM_{2.5}$ emissions from the SAF operations. The previously listed information resources were consulted to determine the extent of applicability of each identified control alternative.

(a) ESPs - use an electrostatic field to charge particulate matter contained in the gas stream and then attract and collect the particles on a collection surface of opposite charge. ESPs have very high removal efficiencies (99% or better) for many sources of particulates. However, they are not suitable for all types of applications. Due to the electromagnetic properties of small charged particles of metal compounds in an electric field, the particles adhere very strongly to the collection plates of an ESP and are extremely difficult to dislodge, resulting in ineffectivity of the ESP. Therefore, ESP is considered technically infeasible for controlling particulate emissions from the SAF.

(b) High Efficiency Cyclones - Particulate removal in cyclone collectors is achieved through the action of inertial forces, especially centrifugal. As the gas stream enters the top of the cyclone, a vortex is induced as it is forced to travel a circular path. Centrifugal forces cause the heavier particles to concentrate near the outer wall of the cyclone and particle of lesser mass to remain closer to the center of the vortex. Frictional and gravitational forces then act on the particles closest to the wall, causing them to fall toward the bottom of the cyclone, where they are collected in a hopper. Within the lower segment of the cyclone, the direction of the gas-flow vortex is reversed, and an inner ascending vortex is formed. The inner vortex consists of comparatively particulate-free air, which is collected through an outlet duct at the top of the cyclone. Cyclone collectors are considered technically feasible. However, they achieve the lowest particulate removal efficiencies (less than 90%) of all particulate control devices, especially for submicron particulates that will be emitted from the SAF.

(c) High Energy Scrubbers - High energy wet scrubbers are technically feasible and can achieve a high particulate collection efficiency (90% or better), but at the expense of a punitive pressure drop (ranging from 6 - 20 inches of water), higher operational utilities, generation of large quantities of sludge along with the associated problem of sludge handling, de-watering, and disposal.

(d) Fabric filters or baghouses are technically feasible for collecting fine particulate matter emissions associated with SAFs or other types of furnaces that have high particulate emissions. They can also achieve the highest control efficiency, among other particulate control devices, as applied to SAF operations.

(i) Positive pressure baghouses operate at internal pressures greater than the atmospheric pressure. Typically, the fans are located before the fabric filters. This allows the fans to pull air from the SAF and push the dust laden air through the fabric filters and into the ambient air via a continuous ridge vent (old design) rather than a stack. The discharge area of a ridge vent is on the order of four times that of a single stack.

(ii) Negative pressure baghouses operate at internal pressure less than atmospheric. The fans are located after the fabric filters. This allows the fans to pull the gas laden air from the SAF, through the fabric filters, and then push the air up through a central stack.

Step 3 – Rank Remaining Control Technologies by Control Effectiveness

The following remaining control options are in order of descending control effectiveness:

(a) Fabric filters or baghouses - 99.9%;

(b) High Energy Scrubbers - 90% or more; or

(c) High Efficiency Cyclones - 50 to 90%.

Step 4 – Evaluate the Most Effective Controls and Document Results

Fabric filtration is the predominant control option for abatement of particulate emissions from SAF operations application due to their effectiveness. Scrubbers and cyclones are not considered as effective as fabric filters or baghouses for controlling particulate emissions from silicon production operations.

Step 5 – Select BACT

A review of USEPA's RACT/BACT/LAER Clearinghouse did not identify any BACT determinations for submerged arc furnaces or any other sources associated with the silicon production operations. Review of state permit information identified the following with respect to electric arc furnaces at silicon production plants:

Facility/	Permit Date	Process	PM_{10} Limit	Add-On Controls
Globe Metallurgical Inc Niagara Falls, NY Permit#: 9-2911-00078/00009	11/26/10	Two submerged-arc semi-enclosed-type electric furnaces (22 MW/hr)	PM: 21.3 lb/hr per furnace (based on process weight rate calculation	Fabric filter (baghouse)

Facility/	Permit Date	Process	PM_{10} Limit	Add-On Controls
Globe Metallurgical Selma, AL 104-0001	9/10/10	20 MW Electric Arc Furnaces (2) producing silicon metal	0.99 lb/MW-hr 6.2 lb/hr	Baghouse
West Virginia Alloy, Inc. Alloy, West Virginia R30-01900001-2006	01/18/06	Electric submerged arc furnace No. 15 for the production of silicon metal and ferroalloys	PM10: 22.71 lb/hr	Baghouse with >99% control
Globe Metallurgical Inc Waterford, OH ID: 06-84-00-0105	10/24/01	Electric Arc Furnaces (Ferrosilicon and Silicon metal production furnaces)	0.03 gr/dscf (filterable) or no visible particulate emissions, whichever is less stringent	Open roof Baghouse

As shown in the above table, PM emissions from submerged electric arc furnaces are controlled exclusively by baghouses and the BACT emission limits vary in how they are expressed. Because of the variations in the plant operations, it is very difficult to identify a consistent BACT emission limitation or permit limitation. For the $PM_{10}/PM_{2.5}$ emission sources associated with the SAFs at the proposed plant, a baghouse was the only control methods evaluated. The proposed BACT limit is at least as stringent as the permit limits presented in the table above.

Thus, BACT for $PM_{10}/PM_{2.5}$ emissions from the semi-enclosed submerged arc furnaces at the proposed plant is as follows:

- **Use of fabric filter control (i.e., baghouse); and**
- **$PM_{10}/PM_{2.5}$ – 0.005 grains per dry standard cubic foot (gr/dscf).**

4.3.3 BACT Analysis for $PM_{10}/PM_{2.5}$ Emissions from Casting Frames (AA-201a)

Molten product from the SAFs will be poured into low, flat pans that will provide rapid cooling and solidification of the molten metal. There is a potential for fume and dust to be generated during the casting process, however the amount of actual dust should be minimal.

Step One - Identify Available $PM/PM_{10}/PM_{2.5}$ Control Technologies

The first step of the Top-Down BACT analysis is to assess the proposed emission reduction options. Potential PM control technologies are identified in the previous section.

Step 2 – Eliminate Technically Infeasible Control Options

The test for technical feasibility of any control option is whether it is both available and applicable to reducing $PM/PM_{10}/PM_{2.5}$ emissions from the casting operations. The exhausting of casting emissions from a central canopy positioned over the casting installations to the SAF baghouse is neither practical nor economically feasible since it is too far away. In addition, the casting frame emissions in question are very low (< 1.0 tons/year) and can also be further minimized by the manner with which the unit is operated. The potential PM emissions are small and installation of a canopy and exhaust dust system is not very effective at capturing these small quantities of PM emissions. Thus, add-on controls are eliminated from further consideration in this BACT evaluation.

Step 3 – Rank Remaining Control Technologies by Control Effectiveness

The following remaining control option is best management practices.

Step 4 – Evaluate the Most Effective Controls and Document Results

Best management practices are the only effective control for this type of emission source.

Step 5 – Select BACT

A review of USEPA's RACT/BACT/LAER Clearinghouse did not identify any BACT determinations for casting operations associated with the silicon production operations. Review of state permit information also did not identify BACT determinations for casting operations associated with the silicon production operations.

MS Silicon will be using Best Management Practices to minimize the generation of $PM/PM_{10}/PM_{2.5}$ fugitive emissions from the casting frame operation.

BACT for $PM/PM_{10}/PM_{2.5}$ for the casting frames (AA-201a) is proposed as:

- Best Management Practices to minimize the generation of $PM/PM_{10}/PM_{2.5}$ fugitive emissions from the casting frame operation; and
- No emission limit is being proposed since there is no formal method for quantifying emissions from this type of indoor operation.

4.3.4 BACT Analysis for $PM_{10}/PM_{2.5}$ Emissions from Natural Gas Combustion (AA-202)

Because natural gas is a gaseous fuel, filterable PM emissions from combustion are typically low. Particulate matter from natural gas combustion has been estimated to be less than 1 micrometer in size and has filterable and condensable fractions. Particulate matter from natural gas combustion is usually

larger molecular weight hydrocarbons that are not fully combusted. Increased PM emissions may result from poor air/fuel mixing or maintenance problems[5].

Natural Gas Combustion Sources – Includes the following:

- AA-202: Ladle Pre-Heaters (Four 10 MMBtu/hr): 0.1 tpy $PM_{10}/PM_{2.5}$;

Step 1 – Identify Control Options, Step 2 – Eliminate Technically Infeasible Control Options, Step 3 – Rank Remaining Control Technologies by Control Effectiveness and Step 4 – Evaluate the Most Effective Controls and Document Results

There are no control options identified in the RBLC that are technically feasible to control $PM_{10}/PM_{2.5}$ that is emitted from small natural gas combustion units. See below table for summary of $PM_{10}/PM_{2.5}$ BACT determinations from the RBLC database:

Facility/ RBLC ID	Permit Date	Basis	Process	PM_{10} BACT Limit	$PM_{2.5}$ BACT Limit	Add-On Controls
SeverCorr LLC Columbus, Mississippi	07/15/11	BACT-PSD	Ladle preheaters, ladle dry-out heaters, Tundish preheaters, Tundish dry-out heaters, vertical ladle holding station, annealing furnaces, vacuum degasser boiler, boilers	None	None	Combustion of natural gas only
Nucor Steel, AR Blytheville, AR	06/10/11	BACT-PSD	Pickle Line Boilers, natural gas fired burners and dryers, ladle dryers	0.0076 lb/MMBtu	None	None
Sasol North America LA-0244	11/29/10	BACT-PSD	87.30 MMBtu/hr charge Heater	Total PM_{10}: 0.01 lb/MMBtu	-	No controls
Sasol North America LA-0244	11/29/10	BACT-PSD	21.00 MMBtu/hr startup Heater	Total PM_{10}: 0.01 lb/MMBtu	-	No controls

[5] AP 42, Fifth Edition, Volume I, Chapter 1.4: External Combustion Sources Natural Gas Combustion, July 1998

Facility/ RBLC ID	Permit Date	Basis	Process	PM_{10} BACT Limit	$PM_{2.5}$ BACT Limit	Add-On Controls
Lake Charles Cogeneration LLC LA-0231	06/22/09	BACT-PSD	34.20 MMBtu/hr Shift Reactor Startup Heater	Total PM_{10}: 0.007 lb/MMBtu	-	Good design and proper operations
Competitive Power Ventures MD-0040	11/12/08	BACT-PSD	1.70 MMBtu/hr Heater	Filterable PM_{10}: 0.0070 lb/MMBtu	Filterable 0.0070 lb/MMBtu (LAER)	No controls
Mid-American Steel and Wire Company OK-0128	09/08/08	BACT-PSD	Ladle Preheater and refractory drying	0.0076 lb/MMBtu (total)	-	Combustion of natural gas
Thysenkrupp Steel and Stainless USA, LLC AL-0230	08/17/07	BACT PSD	33.40 MMBtu/hr Batch Annealing Furnaces	0.0076 lb/MMBtu	-	No controls
Nucor Decatur, LLC AL-0231	06/12/07	BACT-PSD	98.7 MMBtu/hr Galvanizing Furnace	PM: 0.0076 lb/MMBtu	-	No control
Republic Engineered Products, Inc OH-0303	08/30/05	LAER	Ladle Dryers/Preheaters	7.6 lb/mmscf (filterable)	7.6 lb/mmscf (filterable)	Good combustion control with proper natural gas burner design, no add-on controls
6Nucor Steel IN-0090	01/19/01	BACT-PSD	Ladle Preheaters	-	-	Combustion of natural gas or propane
Arkansas Steel Associates AR-0044	01/05/01	BACT-PSD	Ladle Preheaters	0.20 lb/hr (filterable)	-	Natural gas combustion/ Good combustion practices

As shown in the above table, no add-on controls are used for $PM_{10}/PM_{2.5}$ from the natural gas combustion equipment.

Step 5 - Select BACT

The RACT/BACT/LAER Clearinghouse (RBLC) and review of other permits reveal that similar natural gas combustion devices use fuel specifications and good combustion practices for controlling PM emissions. No similar sized natural gas combustion devices were identified add-on PM controls as BACT.

Thus, BACT is defined as combustion of clean fuel and good combustion practices. For the natural gas combustion sources associated with the proposed Plant, combustion of natural gas and good combustion controls were the only control methods evaluated. Since the highest level of PM control as noted above will be implemented by MS Silicon, an analysis of economic, energy and environmental impacts was not performed.

BACT for the natural gas combustion devices is as follows:

- **Combustion of natural gas; and**
- **Good operating practices.**

4.3.5 BACT Analysis for $PM_{10}/PM_{2.5}$ from Material Storage and Handling (AA-101, AA-101a, AA-102, AA-102a, AA-103, AA-103a, AA-104, AA-301)

Raw materials will be received by truck at the site. The primary materials to be handled and stored at the silicon production plant are as follows:

- Coal;
- Wood;
- Limestone and
- Quartz.

Upon receipt the raw materials will be unloaded, conveyed and stored in outside piles. The raw materials will then be transferred via front end loaders to day bins in the submerged arc furnace building.

Add on control devices such as a baghouse or wet suppression will minimize particulate emission rates from material storage and handling. A baghouse is an air pollution abatement device used to trap particulates by filtering gas streams through large fabric bags. Baghouses typically achieve PM control efficiencies of greater than 99%.

Wet suppression systems use liquid sprays or foam to suppress the formation of airborne dust. The primary control mechanisms are those that prevent emissions through agglomerate formation by combining small dust particles with larger aggregate or with liquid droplets. The key factors that affect the degree of agglomeration and, hence, the performance of the system are the coverage of the material by the liquid and the ability of the liquid to wet small particles. There are two types of wet suppression systems: liquid sprays which use water or water/surfactant mixtures as the wetting agent and systems which supply foams as the wetting agent. Wet suppression systems typically achieve PM control efficiencies of 50-70%.

AA-101: Material Transfer to and from Coal Storage Pile

Coal will be delivered to the site either by truck. Fugitive emissions of PM will be generated during the receiving, transferring, and handling of coal.

Step 1 - Identify Available $PM_{10}/PM_{2.5}$ Control Technologies

- Add on control devices such as a fabric filter and enclosed conveyance can be used to minimize particulate emission rates from material storage and handling operations. A baghouse is an air pollution abatement device used to trap particulates by filtering gas streams through large fabric bags. Fabric filters typically achieve PM control efficiencies of greater than 99%.
- Wet suppression systems use liquid sprays or foam to suppress the formation of airborne dust. The primary control mechanisms are those that prevent emissions through agglomerate formation by combining small dust particles with larger aggregate or with liquid droplets. The key factors that affect the degree of agglomeration and, hence, the performance of the system are the coverage of the material by the liquid and the ability of the liquid to wet small particles. There are two types of wet suppression systems: liquid sprays which use water or water/surfactant mixtures as the wetting agent and systems which supply foams as the wetting agent. Wet suppression systems typically achieve PM control efficiencies of 50 to >90%.
- Best management plan (fugitive dust control plans) can provide for additional control of PM through managing the operations/equipment that generates the fugitive PM emissions. Implementation of these plans can reduce PM fugitive emissions by more than 50%.

Review of the RBLC database and recent permit applications indicated that viable PM controls for coal transfer to and from storage piles is a fugitive dust control plan (windscreen barrier, reduced drop heights, use of chemical stabilization dust suppressants and/or watering to reduce any visible emissions as required). Refer to table below for a listing of recent BACT determinations for coal receiving and handling operations.

Step 2 - Elimination of Technically Infeasible Fugitive PM Control Alternatives

The above technologies are technically feasible and will be ranked for evaluation as part of the BACT evaluation for controlling particulate emissions from this operation.

- Fabric Filter control devices: 99% control efficiency – The emissions from this source are fugitive in nature and thus cannot be effectively captured and controlled.

- Wet Suppression: 50 to > 90% control efficiency - The use of wet suppression systems for this source is feasible.

- Implementation of fugitive dust control plan: >50% control efficiency.

Step 3 - Rank the Remaining Control Technologies by Control Effectiveness

The top ranked control option is fugitive dust control plan including the use of wet suppression on an as needed basis. No control options were eliminated for economic reasons.

Step 4 - Evaluate the Most Effective Controls and Document the Results

The table below lists the proposed particulate BACT determination, along with the existing particulate BACT determinations, for coal receiving and handling and coal transferring. All data in the table is based on the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC), and electronic versions of permits available at the websites of other permitting agencies.

The limits being proposed by MS Silicon is equivalent to or lower than the BACT limitations established for coal handling operations at these facilities.

Existing PM/PM_{10}/$PM_{2.5}$ BACT Limits - Material Transfer to and from Coal Storage Pile

Facility	Date	Basis	Source	PM_{10}/$PM_{2.5}$ BACT Limit	BACT Control Method
East Kentucky Power Cooperative KY-0100	4/9/10	BACT-PSD	Coal Stockpile and unloading	PM: 10% opacity 3-minute	Wet suppression, dust suppressant, lowering well and compaction
Ohio River Clean Fuels, LLC OH-0317	11/20/08	BACT-PSD	Coal storage piles	PM_{10}: 12.3 tpy rolling 12-month period	3-Sided windscreen barrier, reduced drop heights, use of chemical stabilization dust suppressants and/or watering to reduce any visible emissions
Martin Marietta Magnesia Specialties OH-0321	11/13/08	BACT-PSD	Coal and coke material handling	PM_{10}: 0.95 tpy rolling 12-month period	Building enclosure and high moisture content coal and coke >5%
Homeland Energy Solutions, LLC IA-0089	08/28/07	BACT-PSD	Coal receiving and handling	Filterable PM_{10}: 0.005 gr/dscf	Use of baghouse and water fogging. (Baghouse used to control storage bins and water fogging used to eliminate PM in unloading area
University of Northern Iowa IA-0086	5/3/07	BACT-PSD	Coal pile receiving and reclaim	Filterable PM_{10}: 095% control	Dust suppressant

Step 5 - Select BACT

BACT for the Material Transfer to and from Coal Storage Pile (AA-101) is proposed as the following:

- Best management practices including the incorporation 3-sided windscreen barrier, reduced drop heights, use of chemical stabilization dust suppressants and/or watering to reduce any visible emissions;
- Development of a fugitive dust control plan to minimize PM emissions; and
- No emission limit is being proposed for this operation since there is no available test method to determine the $PM/PM_{10}/PM_{2.5}$ emission rate

Material Transfer to and from – Wood Storage Pile (AA-102)

Wood will be delivered to the site either by truck. Fugitive emissions of PM will be generated during the receiving, transferring, and handling of this material. Since these operations will have the potential to emit minor levels (due to the inherent moisture content of the wood to be handled and stored) of $PM_{10}/PM_{2.5}$ emissions and will typically be in the form of a fugitive type release, typical PM control technologies are not appropriate for these types of operations. The types of control measures used for materials handling operations can be classified as best management practices and include inherent pollution control techniques (covered conveyors, partially enclosed conveyor drop points, minimization of pile drop discharge distance, etc.).

Step 1 - Identify Available $PM_{10}/PM_{2.5}$ Control Technologies

- Add on control devices such as a fabric filter and enclosed conveyance can be used to minimize particulate emission rates from material storage and handling operations. A baghouse is an air pollution abatement device used to trap particulates by filtering gas streams through large fabric bags. Fabric filters typically achieve PM control efficiencies of greater than 99%.
- Wet suppression systems use liquid sprays or foam to suppress the formation of airborne dust. The primary control mechanisms are those that prevent emissions through agglomerate formation by combining small dust particles with larger aggregate or with liquid droplets. The key factors that affect the degree of agglomeration and, hence, the performance of the system are the coverage of the material by the liquid and the ability of the liquid to wet small particles. There are two types of wet suppression systems: liquid sprays which use water or water/surfactant mixtures as the wetting agent and systems which supply foams as the wetting agent. Wet suppression systems typically achieve PM control efficiencies of 50 to >90%.
- Best management plan (fugitive dust control plans) can provide for additional control of PM through managing the operations/equipment that generates the fugitive PM emissions. Implementation of these plans can reduce PM fugitive emissions by more than 50%.

Review of the RBLC database and recent permit applications indicated that viable PM controls for wood transfer to and from storage piles is a fugitive dust control plan (windscreen barrier, reduced drop heights, use of chemical stabilization dust suppressants and/or watering to reduce any visible emissions as required). Refer to table below for a listing of recent BACT determinations for wood receiving and handling operations.

Step 2 - Elimination of Technically Infeasible Fugitive PM Control Alternatives

The above technologies are technically feasible and will be ranked for evaluation as part of the BACT evaluation for controlling particulate emissions from this operation.

- Fabric Filter control devices: 99% control efficiency – The emissions from this source are fugitive in nature and thus cannot be effectively captured and controlled.
- Wet Suppression: 50 to > 90% control efficiency - The use of wet suppression systems for this source is feasible.
- Implementation of fugitive dust control plan: >50% control efficiency.

Step 3 - Rank the Remaining Control Technologies by Control Effectiveness

The top ranked control option is fugitive dust control plan including the use of wet suppression on an as needed basis. No control options were eliminated for economic reasons.

Step 4 - Evaluate the Most Effective Controls and Document the Results

The table below lists the proposed particulate BACT determination, along with the existing particulate BACT determinations, for wood pile receiving, handling, and transferring. All data in the table is based on the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC), and electronic versions of permits available at the websites of other permitting agencies.

The limits being proposed by MS Silicon is equivalent to or lower than the BACT limitations established for wood handling operations at these facilities.

Existing PM/PM_{10}/$PM_{2.5}$ BACT Limits – Wood Storage and Handling

Facility	Date	Basis	Source	PM_{10}/$PM_{2.5}$ BACT Limit	BACT Control Method
Southeast Regional Fuels, LLC FL-0322	12/23/10	BACT-PSD	Biomass material handling and preparation	5% opacity	To minimize fugitive, PM_{10} and $PM_{2.5}$, biomass conveyors shall be enclosed. Where required to meet the 5 % opacity requirement, the permittee shall install dust collectors on the conveyor transfer and drop points. The dust collectors shall be designed to obtain an outlet PM loading of 0.005 grains per dry standard cubic foot (gr/dscf). Additional practices: Enclosing material drop points, transfer points, shredders and screens wherever practical; Contouring storage piles to minimize wind erosion; Utilizing water sprays on storage piles as needed;

Facility	Date	Basis	Source	$PM_{10}/PM_{2.5}$ BACT Limit	BACT Control Method
Georgia Power Co. GA-0140	12/03/10	BACT-PSD	Biomass storage and handling	-	Partial enclosures for the conveyors; Partial enclosures for the transfer points
Ohio River Clean Fuels, LLC OH-0317	11/20/08	BACT-PSD	Biomass Storage Piles	AP-42 Calculation: 1.0 tpy fugitive PM_{10} No visible emissions except for 13-min in any 60-min period	3-sided windscreen barrier, reduced drop heights, use of chemical stabilization dust suppressants and/or watering to reduce any visible emissions
Weyerhauser Co. LA-0201	05/24/06	BACT-PSD	Chip Handling	Filterable PM_{10} 0.0001 lb/T	Covered conveyors
Kingsford Manufacturing Company MS-0081	09/09/05	BACT-PSD	Wood Receipt	Filterable PM_{10}: 0.0020 lb/T wood	Good work practice standards and partial enclosure of truck dump area
			Wood Storage	Filterable PM_{10}: 0.0065 lb/T wood	Good work practice standards

The above table presents BACT limits for $PM_{10}/PM_{2.5}$ emissions from wood/biomass material handling operations. The limit being proposed by MS Silicon is equivalent to or lower than the BACT limitations established for other material handling operations at other types of facilities.

Review of state permits for similar operations (i.e., ferroalloy operations) revealed the following:

Facility/	Process	PM_{10} BACT Limit	Add-On Controls
Globe Metallurgical Inc Niagara Falls, NY Permit#: 9-2911-00078/00009 Date: 11/26/10	Raw Material Handling - Raw Material Transfer and Storage operations begin with the receipt of raw materials via truck or rail. Coal, coke, charcoal, gravel, woodchips, and turnings are unloaded via crane to piles or directly to a below grade conveyor or pit. Coal is transferred to the pit, from which it is conveyed up to enclosed raw material storage bins or unloaded to outdoor storage piles. Gravel is unloaded to piles, transported by crane to a conveyor, screened, and conveyed up to enclosed storage bins. Wood chips are dumped from a trailer to the pit and transported up to enclosed storage bins. From indoor bins, the raw materials are weighed and dropped to a skip bucket from which they are transferred to the top of the furnace.	No limit	Enclosed storage bins
Globe Metallurgical Selma, AL 104-0001 Date: 9/10/10	Product Handling – Raw material receiving, transfer and storage	Process weight rate limitation 20% opacity in one 6-minute average in any 60 minute period	No add-on controls
West Virginia Alloy, Inc. Alloy, West Virgina R30-01900001-2006 Date: 01/18/06	Raw material storage piles	No limit	None
Globe Metallurgical Inc Waterford, OH ID: 06-84-00-0105 Date: 10/24/01	Raw material unloading and handling	20% opacity as a 3-minute average	Reasonable available control measures that are sufficient to minimize of eliminate visible emissions of fugitive dust

Facility/	Process	PM_{10} BACT Limit	Add-On Controls
	Raw Material and Waste Storage Piles – Load in or load out, wind erosion	No visible particulate emissions except for 13 minutes during any 60-minute period	Reasonable available control measures that are sufficient to minimize of eliminate visible emissions of fugitive dust

Step 5 -Select BACT

BACT for the wood material handling operations (AA-102) is proposed as the following:

- Best management practices including the incorporation 3-sided windscreen barrier, reduced drop heights, use of chemical stabilization dust suppressants and/or watering to reduce any visible emissions;
- Development of a fugitive dust control plan to minimize PM emissions; and
- No emission limit is being proposed for this operation since there is no available test method to determine the $PM/PM_{10}/PM_{2.5}$ emission rate

Material Transfer to and from Quartz/Limestone Storage Piles (AA-103, AA-104)

Quartz and limestone will be delivered to the site either by truck. Fugitive emissions of PM will be generated during the receiving, transferring, and handling of these materials. Since these operations will have the potential to emit $PM_{10}/PM_{2.5}$ emissions and will typically be in the form of a fugitive type release, typical PM control technologies are not appropriate for these types of operations. The types of control measures used for materials handling operations can be classified as best management practices and include inherent pollution control techniques (covered conveyors, partially enclosed conveyor drop points, minimization of pile drop discharge distance, etc.).

Step 1 - Identify Available $PM_{10}/PM_{2.5}$ Control Technologies

- Add on control devices such as a fabric filter and enclosed conveyance can be used to minimize particulate emission rates from material storage and handling operations. A baghouse is an air pollution abatement device used to trap particulates by filtering gas streams through large fabric bags. Fabric filters typically achieve PM control efficiencies of greater than 99%.
- Wet suppression systems use liquid sprays or foam to suppress the formation of airborne dust. The primary control mechanisms are those that prevent emissions through agglomerate formation by

combining small dust particles with larger aggregate or with liquid droplets. The key factors that affect the degree of agglomeration and, hence, the performance of the system are the coverage of the material by the liquid and the ability of the liquid to wet small particles. There are two types of wet suppression systems: liquid sprays which use water or water/surfactant mixtures as the wetting agent and systems which supply foams as the wetting agent. Wet suppression systems typically achieve PM control efficiencies of 50 to >90%.

- Best management plan (fugitive dust control plans) can provide for additional control of PM through managing the operations/equipment that generates the fugitive PM emissions. Implementation of these plans can reduce PM fugitive emissions by more than 50%.

Step 2 - Elimination of Technically Infeasible Fugitive PM Control Alternatives

The above technologies are technically feasible and will be ranked for evaluation as part of the BACT evaluation for controlling particulate emissions from this operation.

- Fabric Filter control devices: 99% control efficiency – The emissions from this source are fugitive in nature and thus cannot be effectively captured and controlled.
- Wet Suppression: 50 to > 90% control efficiency - The use of wet suppression systems for this source is feasible.
- Implementation of fugitive dust control plan: >50% control efficiency.

Step 3 - Rank the Remaining Control Technologies by Control Effectiveness

The top ranked control option is fugitive dust control plan including the use of wet suppression on an as needed basis. No control options were eliminated for economic reasons.

Step 4 - Evaluate the Most Effective Controls and Document the Results

Review of the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC) did not identify quartz handling and storage operations.

Review of state permits for similar operations (i.e., ferroalloy operations) revealed the following:

Facility/	Process	PM_{10} BACT Limit	Add-On Controls
Globe Metallurgical Inc Niagara Falls, NY Permit#: 9-2911-00078/00009 Date: 11/26/10	Raw Material Handling - Raw Material Transfer and Storage operations begin with the receipt of raw materials via truck or rail. Coal, coke, charcoal, gravel, woodchips, and turnings are unloaded via crane to piles or directly to a below grade conveyor or pit. Coal is transferred to the pit, from which it is conveyed up to enclosed raw material storage bins or unloaded to outdoor storage piles. Gravel is unloaded to piles, transported by crane to a conveyor, screened, and conveyed up to enclosed storage bins. Wood chips are dumped from a trailer to the pit and transported up to enclosed storage bins. From indoor bins, the raw materials are weighed and dropped to a skip bucket from which they are transferred to the top of the furnace.	No limit	Enclosed storage bins
Globe Metallurgical Selma, AL 104-0001 Date: 9/10/10	Product Handling – Raw material receiving, transfer and storage	Process weight rate limitation 20% opacity in one 6-minute average in any 60 minute period	No add-on controls
West Virginia Alloy, Inc. Alloy, West Virgina R30-01900001-2006 Date: 01/18/06	Raw material storage piles	No limit	None

Facility/	Process	PM_{10} BACT Limit	Add-On Controls
Globe Metallurgical Inc Waterford, OH ID: 06-84-00-0105 Date: 10/24/01	Raw material unloading and handling	20% opacity as a 3-minute average	Reasonable available control measures that are sufficient to minimize of eliminate visible emissions of fugitive dust
	Raw Material and Waste Storage Piles – Load in or load out, wind erosion	No visible particulate emissions except for 13 minutes during any 60-minute period	Reasonable available control measures that are sufficient to minimize of eliminate visible emissions of fugitive dust

The limit being proposed by MS Silicon is equivalent to or lower than the BACT limitations established for other material handling operations at other types of facilities.

Step 5 -Select BACT

BACT for the quartz and limestone storage pile handling operations (AA-103, AA-104) is proposed as the following:

- Best management practices including the incorporation 3-sided windscreen barrier, reduced drop heights, use of chemical stabilization dust suppressants and/or watering to reduce any visible emissions;
- Development of a fugitive dust control plan to minimize PM emissions; and
- No emission limit is being proposed for these operations since there is no available test method to determine the $PM/PM_{10}/PM_{2.5}$ emission rate.

Material Handling (Coal, Wood, Quartz) Baghouse (AA-101a, AA-102a, AA-103a) and Product Handling Area Baghouse (AA-301 and AA-403)

Material from the storage piles will be conveyed via front end loaders to enclosed day bins. From the day bins, the raw materials will be weighed and dropped to a skip bucket from which they will be transferred to the top of one (1) of four (4) semi-enclosed submerged arc furnaces for processing.

Step 1 - Identify Available $PM_{10}/PM_{2.5}$ Control Technologies

Since these operations will have the potential to emit $PM_{10}/PM_{2.5}$ emissions and will typically be in the form of point source release, these emission can be controlled using the particulate matter controls described in previous sections of this document.

Step 2 - Elimination of Technically Infeasible $PM_{10}/PM_{2.5}$ Control Alternatives

The test for technical feasibility of any control option is whether it is both available and applicable to reducing $PM_{10}/PM_{2.5}$ emissions from the SAF operations. The previously listed information resources were consulted to determine the extent of applicability of each identified control alternative.

(a) ESPs - use an electrostatic field to charge particulate matter contained in the gas stream and then attract and collect the particles on a collection surface of opposite charge. ESPs have very high removal efficiencies (99% or better) for many sources of particulates. However, they are not suitable for all types of applications. Due to the electromagnetic properties of small charged particles of metal compounds in an electric field, the particles adhere very strongly to the collection plates of an ESP and are extremely difficult to dislodge, resulting in ineffectivity of the ESP. Therefore, ESP is considered technically infeasible for controlling particulate emissions from the SAF.

(b) High Efficiency Cyclones - Particulate removal in cyclone collectors is achieved through the action of inertial forces, especially centrifugal. As the gas stream enters the top of the cyclone, a vortex is induced as it is forced to travel a circular path. Centrifugal forces cause the heavier particles to concentrate near the outer wall of the cyclone and particle of lesser mass to remain closer to the center of the vortex. Frictional and gravitational forces then act on the particles closest to the wall, causing them to fall toward the bottom of the cyclone, where they are collected in a hopper. Within the lower segment of the cyclone, the direction of the gas-flow vortex is reversed, and an inner ascending vortex is formed. The inner vortex consists of comparatively particulate-free air, which is collected through an outlet duct at the top of the cyclone. Cyclone collectors are considered technically feasible. However, they achieve the lowest particulate removal efficiencies (less than 90%) of all particulate control devices, especially for submicron particulates that will be emitted from the SAF.

(c) High Energy Scrubbers - High energy wet scrubbers are technically feasible and can achieve a high particulate collection efficiency (90% or better), but at the expense of a punitive pressure drop (ranging from 6 - 20 inches of water), higher operational utilities, generation of large quantities of sludge along with the associated problem of sludge handling, de-watering, and disposal.

(d) Fabric filters or baghouses are technically feasible for collecting fine particulate matter emissions associated with SAFs or other types of furnaces that have high particulate emissions. They can also achieve the highest control efficiency, among other particulate control devices, as applied to SAF operations.

(i) Positive pressure baghouses operate at internal pressures greater than the atmospheric pressure. Typically, the fans are located before the fabric filters. This allows the fans to pull

air from the SAF and push the dust laden air through the fabric filters and into the ambient air via a continuous ridge vent (old design) rather than a stack. The discharge area of a ridge vent is on the order of four times that of a single stack.

(ii) Negative pressure baghouses operate at internal pressure less than atmospheric. The fans are located after the fabric filters. This allows the fans to pull the gas laden air from the SAF, through the fabric filters, and then push the air up through a central stack.

Step 3 – Rank Remaining Control Technologies by Control Effectiveness

The following remaining control options are in order of descending control effectiveness:

(a) Fabric filters or baghouses - 99.9%;

(b) High Energy Scrubbers - 90% or more; or

(c) High Efficiency Cyclones - 50 to 90%.

Step 4 – Evaluate the Most Effective Controls and Document Results

Fabric filtration is the predominant control option for abatement of particulate emissions from material handling operations due to their effectiveness. Scrubbers and cyclones are not considered as effective as fabric filters or baghouses for controlling particulate emissions from silicon production operations.

Step 5 -Select BACT

BACT for the raw material and product handling operations (AA-101a, AA-102a, AA-103a, AA-301, AA-403) is proposed as the following:

- Baghouse for PM control; and
- A $PM_{10}/PM_{2.5}$ limitation of 0.003 gr/dscf.

It should be noted that MS Silicon is voluntarily designing the baghouse to meet 0.0015 gr/dscf to minimize the potential impact on $PM_{10}/PM_{2.5}$ air quality. This emission rate does not constitute BACT.

4.3.6 BACT Analysis for $PM_{10}/PM_{2.5}$ Emissions from Silica Fume Silos (AA-404)

Silica fumes collected in the SAF baghouses will be pneumatically transferred to the silica fume silos. In the silos, the silica fumes will be densified to about 45 lbs/cu.ft., prior to dispatch to cement and refractory manufacturers that can use this dust in their other operations (i.e., cement and refractory).

Step 1 - Identify Available $PM_{10}/PM_{2.5}$ Control Technologies

Since these operations will have the potential to emit $PM_{10}/PM_{2.5}$ emissions and will typically be in the form of point source release, these emission can be controlled using the particulate matter controls described in previous sections of this document.

Step 2 - Elimination of Technically Infeasible $PM_{10}/PM_{2.5}$ Control Alternatives

The test for technical feasibility of any control option is whether it is both available and applicable to reducing $PM_{10}/PM_{2.5}$ emissions from the SAF operations. The previously listed information resources were consulted to determine the extent of applicability of each identified control alternative.

(a) ESPs - use an electrostatic field to charge particulate matter contained in the gas stream and then attract and collect the particles on a collection surface of opposite charge. ESPs have very high removal efficiencies (99% or better) for many sources of particulates. However, they are not suitable for all types of applications. Due to the electromagnetic properties of small charged particles of metal compounds in an electric field, the particles adhere very strongly to the collection plates of an ESP and are extremely difficult to dislodge, resulting in ineffectivity of the ESP. Therefore, ESP is considered technically infeasible for controlling particulate emissions from the SAF.

(b) High Efficiency Cyclones - Particulate removal in cyclone collectors is achieved through the action of inertial forces, especially centrifugal. As the gas stream enters the top of the cyclone, a vortex is induced as it is forced to travel a circular path. Centrifugal forces cause the heavier particles to concentrate near the outer wall of the cyclone and particle of lesser mass to remain closer to the center of the vortex. Frictional and gravitational forces then act on the particles closest to the wall, causing them to fall toward the bottom of the cyclone, where they are collected in a hopper. Within the lower segment of the cyclone, the direction of the gas-flow vortex is reversed, and an inner ascending vortex is formed. The inner vortex consists of comparatively particulate-free air, which is collected through an outlet duct at the top of the cyclone. Cyclone collectors are considered technically feasible. However, they achieve the lowest particulate removal efficiencies (less than 90%) of all particulate control devices, especially for submicron particulates that will be emitted from the SAF.

(c) High Energy Scrubbers - High energy wet scrubbers are technically feasible and can achieve a high particulate collection efficiency (90% or better), but at the expense of a punitive pressure drop (ranging from 6 - 20 inches of water), higher operational utilities, generation of large quantities of sludge along with the associated problem of sludge handling, de-watering, and disposal.

(d) Fabric filters or baghouses are technically feasible for collecting fine particulate matter emissions associated with SAFs or other types of furnaces that have high particulate emissions. They can also achieve the highest control efficiency, among other particulate control devices, as applied to SAF operations.

(i) Positive pressure baghouses operate at internal pressures greater than the atmospheric pressure. Typically, the fans are located before the fabric filters. This allows the fans to pull air from the SAF and push the dust laden air through the fabric filters and into the ambient air via a continuous ridge vent (old design) rather than a stack. The discharge area of a ridge vent is on the order of four times that of a single stack.

(ii) Negative pressure baghouses operate at internal pressure less than atmospheric. The fans are located after the fabric filters. This allows the fans to pull the gas laden air from the SAF, through the fabric filters, and then push the air up through a central stack.

Step 3 – Rank Remaining Control Technologies by Control Effectiveness

The following remaining control options are in order of descending control effectiveness:

(a) Fabric filters or baghouses - 99.9%;

(b) High Energy Scrubbers - 90% or more; or

(c) High Efficiency Cyclones - 50 to 90%.

Step 4 – Evaluate the Most Effective Controls and Document Results

Fabric filtration is the predominant control option for abatement of particulate emissions from these operations. Scrubbers and cyclones are not considered as effective as fabric filters or baghouses for controlling particulate emissions from silicon production operations.

Step 5 -Select BACT

BACT for the silica fume silos (AA-404) is proposed as the following:

- Bin vent filter for PM control; and
- A $PM_{10}/PM_{2.5}$ limitation of 0.01 gr/dscf.

4.3.7 BACT Analysis for $PM_{10}/PM_{2.5}$ Emissions from Emergency Equipment (AA-501)

The emergency equipment includes the following:

- Diesel-Fired Emergency Generator (1 rated at 670-HP): 0.001 tpy $PM_{10}/PM_{2.5}$.

Step 1 – Identify Control Options

There are no control options identified in the RBLC that are technically feasible to control $PM_{10}/PM_{2.5}$ that is emitted from emergency generators. See below table for summary of PM BACT determinations from the RBLC database.

Step 2 - Technical Feasibility of $PM_{10}/PM_{2.5}$ Control Alternatives

The emergency diesel fired generator associated with the proposed project will be used primarily for emergency situations, if any. However, to maintain the integrity of the equipment, the generator will be operated for 100 hours per year or less. The projected annual $PM_{10}/PM_{2.5}$ emissions rate is 0.001 tpy. Based on a review of similar emission sources, these emission sources typically do not have any add-on controls and should be operated per manufacturer's specifications.

Step 3 - Rank Remaining Alternatives by Control Effectiveness

The most effective method for control of $PM_{10}/PM_{2.5}$ emissions from operation of the emergency fuel combustion devices is the use of fuel specifications that employ clean burning fuels, implementation of good combustion practices and use of combustion controls inherent to the design of the individual combustion devices.

Step 4 - Evaluate Most Effective Controls

Since there are no other feasible technologies to control $PM_{10}/PM_{2.5}$ emissions from the emergency equipment, economic, energy and environmental impact analyses were not performed, nor are required by USEPA's Top-Down approach.

The following table lists the existing $PM_{10}/PM_{2.5}$ BACT determinations for diesel fired emergency equipment. All data in the table is based on the information obtained from the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC), and electronic versions of permits available at the websites of other permitting agencies.

Facility/ RBLC ID	Permit Date	Process	$PM_{10}/PM_{2.5}$ BACT Limit	Add-On Controls
Southeast Renewable Fuels (FL-0322)	12/23/10	Emergency ULSD Generators (two 2,682 HP)	Total PM: 0.2 g/KW-H	No controls The emergency generators shall comply with the emission limit and demonstrate compliance in accordance with the procedures given in NSPS 40 CFR 60, Subpart IIII.
		Emergency ULSD Fire Pump (One 600 HP)	Total PM: 0.15-g/HP-hr	No controls The fire pumps shall comply with the emission limit and demonstrate compliance in accordance with the procedures given in NSPS 40 CFR 60, Subpart IIII.
Idaho Power Company ID-0018	6/25/10	750 KW Emergency Diesel Generator	PM: 0.2 g/KW-H -H	Tier 2 Engine, Good combustion practices
Consumers Energy (MI-0389	12/29/09	2000 KW Emergency ULSD Generator	Total PM: 0.2 g/KW-H Total PM_{10}: 0.0573 g/KW-H	Engine design and operation, 15 ppm sulfur fuel Operational Limits: 1 hr/day, 500 hrs/yr for $PM_{2.5}$ NAAQS
Verenium (FL-0318)	12/10/09	2000 KW Emergency generators	Total PM: 0.2 g/KW-H	None

Facility/ RBLC ID	Permit Date	Process	$PM_{10}/PM_{2.5}$ BACT Limit	Add-On Controls
		Emergency ULSD Fired Pump	Total PM: 0.15-g/HP-hr	The fire pump engine is an Emergency Stationary Compression Ignition Internal Combustion Engine (Stationary ICE) and shall comply with applicable provisions of 40 CFR 60, Subpart IIII
Lake Charles Cogeneration, LLC (LA-0231)	06/22/09	Emergency Diesel Power Generator Engines (1341 HP)	Total PM_{10} 0.06 lb/h	Comply with 40 CFR 60 Subpart IIII
Southeast Idaho Energy, LLC (ID-0017)	2/10/09	2 MW Emergency Generator	Comply with NSPS IIII	Good combustion practices, EPA certified per NSPS IIII, ULSD fuel, limited to 100 hours of operation per year
		500 KW emergency generator	Comply with NSPS IIII	Good combustion practices, EPA certified per NSPS IIII, ULSD fuel, limited to 100 hours of operation per year
Associated Electric Cooperative Inc (OK-0129)	1/23/09	2200 HP low sulfur diesel emergency generator	Total PM_{10}: 0.2 g/KW-H	None
		267 HP low sulfur diesel emergency fir pump	Total PM_{10}: 0.4 G/HP-H	

As shown in the table above, BACT for the emergency equipment is compliance with NSPS IIII and good combustion/operating practices.

Step 5 – Select BACT for $PM_{10}/PM_{2.5}$ from Emergency Equipment

BACT is proposed as compliance with NSPS IIII and good combustion/operating practices.

4.3.8 BACT analysis for $PM_{10}/PM_{2.5}$ Emissions from Wood Chipper (AA-102b)

The portable electric wood chipper will be used for as needed wood grinding/chipping and will be limited to 2080 hours per year of operation. Fugitive particulate emissions can occur from operation of the wood

chipper (AA-102b). The wood chipper operation design will include an enclosure that will minimize fugitive dust emissions.

Step 1 – Identify Control Options

Due to the limited hours of operation and the fugitive nature of the operation, there are no control options that are technically feasible to control $PM_{10}/PM_{2.5}$ that is emitted from wood chippers.

Step 2 - Technical Feasibility of $PM_{10}/PM_{2.5}$ Control Alternatives

No wood chippers were identified in the RBLC database. Based on a review of similar emission sources, these emission sources typically do not have any add-on controls and should be operated per manufacturer's specifications.

Step 3 - Rank the Remaining Control Technologies

The only remaining technically feasible method for control of particulate emissions resulting from operation of the wood chipper is an enclosure that will minimize fugitive dust emissions and limited hours of operation. The combination of these control methods represents the Top-Rated control.

Step 4- Evaluate the Most Effective Control

Since there are no other feasible technologies available that could achieve the same level of PM control as that being proposed for the wood chipper, equipment, economic, energy, and environmental impact analyses were not performed, nor are required by USEPA's Top-Down approach.

Step 5 - Select BACT

The following has been proposed as BACT for controlling PM emissions from the wood chipper:

- Operation of the wood chipper with an enclosure or similar that will minimize fugitive dust emissions;
- Limited hours of operation for the wood chipper; and
- No emission limit is being proposed for this operation since there are no available test methods to determine the $PM/PM_{10}/PM_{2.5}$ emission rate.

4.3.9 BACT analysis for $PM_{10}/PM_{2.5}$ Emissions from Bulldozer Storage Pile Processing (AA-105)

Bulldozers will be used to groom and maintain the storage piles. The emissions from these operations are fugitive in nature.

Step 1 – Identify Control Options

Due to the fugitive nature of the operation, there are no add-on control options that are technically feasible to control $PM_{10}/PM_{2.5}$ that is emitted from bulldozing the storage piles. Review of the RBLC database and other silicon plant permits did not identify similar operations.

Step 2 - Technical Feasibility of $PM_{10}/PM_{2.5}$ Control Alternatives

Based on the nature of the operation, the only viable controls are the use of best management practices (i.e., dust minimization techniques including as needed water spray application and wind screens).

Step 3 - Rank the Remaining Control Technologies

The only remaining technically feasible method for control of particulate emissions resulting from bulldozing operations on the storage piles is the use of best management practices (i.e., dust minimization techniques including as needed water spray application and wind screens). The combination of these control methods represents the Top-Rated control.

Step 4- Evaluate the Most Effective Control

Since there are no other feasible technologies available that could achieve the same level of PM control as that being proposed for the storage pile processing operations, equipment, economic, energy, and environmental impact analyses were not performed, nor are required by USEPA's Top-Down approach.

Step 5 - Select BACT

The following has been proposed as BACT for controlling PM emissions from the storage pile processing (AA-105):

The proposed BACT for storage pile processing (bulldozing) associated with this project is:

- The development of a dust control plan including the use of measures designed to eliminate dust such as application of wet suppressants, watering, wind screens and speed reduction, as required; and
- No emission limit is being proposed for this operation since there are no available test methods to determine the $PM/PM_{10}/PM_{2.5}$ emission rate.

4.3.10 BACT Analysis for $PM_{10}/PM_{2.5}$ Emissions from Storage Pile Wind Erosion (AA-106)

PM emissions may be generated by wind erosion from the storage piles. Because the material stored will be fairly heavy and will not consist of a fine dust-like material, potential emissions should be minimal.

Step 1 - Identification of Available $PM/PM_{10}/PM_{2.5}$ Controls

- Add on control devices such as a fabric filter and enclosed conveyance can be used to minimize particulate emission rates from material storage and handling operations. A baghouse is an air

pollution abatement device used to trap particulates by filtering gas streams through large fabric bags. Fabric filters typically achieve PM control efficiencies of greater than 99%.

- Wet suppression systems use liquid sprays or foam to suppress the formation of airborne dust. The primary control mechanisms are those that prevent emissions through agglomerate formation by combining small dust particles with larger aggregate or with liquid droplets. The key factors that affect the degree of agglomeration and, hence, the performance of the system are the coverage of the material by the liquid and the ability of the liquid to wet small particles. There are two types of wet suppression systems: liquid sprays which use water or water/surfactant mixtures as the wetting agent and systems which supply foams as the wetting agent. Wet suppression systems typically achieve PM control efficiencies of 50 to >90%.
- Best management plan (fugitive dust control plans) can provide for additional control of PM through managing the operations/equipment that generates the fugitive PM emissions. Implementation of these plans can reduce PM fugitive emissions by more than 50%.

Step 2 - Elimination of Technically Infeasible PM/PM_{10}/$PM_{2.5}$ Control Alternatives

The above technologies are technically feasible and will be ranked for evaluation as part of the BACT evaluation for controlling particulate emissions from this operation.

- Fabric Filter control devices: 99% control efficiency – The emissions from this source are fugitive in nature and thus cannot be effectively captured and controlled.

- Wet Suppression: 50 to > 90% control efficiency - The use of wet suppression systems for this source is feasible.

- Implementation of fugitive dust control plan: >50% control efficiency

Step 3 - Rank the Remaining Control Technologies by Control Effectiveness

The top ranked control option is fugitive dust control plan including the use of wet suppression on an as needed basis and the implementation of a fugitive dust control plan.

Step 4 - Evaluate the Most Effective Controls and Document the Results

The following table lists existing particulate BACT determinations, for material storage pile operations. All data in the table is based on the information obtained from the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC), and electronic versions of permits available at the websites of other permitting agencies.

Material Storage Areas					
Facility	**Date**	**Basis**	**Source**	**$PM/PM_{10}/PM_{2.5}$ BACT Limit**	**BACT Control Method**
Nucor Steel OH-0341	12/23/10	BACT-PSD	Scrap steel storage piles	Fugitive PM - 0.43 ton/yr Fugitive PM_{10} - 0.22 ton/yr Fugitive $PM_{2.5}$ - 0.06 ton/yr	Minimize drop height
Consolidated Environmental Management – Nucor Steel LA-0239	5/24/10	BACT-PSD	Coal Storage Pile	Total PM - 3.99 ton/yr	BACT is selected to be implementation of wet suppression of dust generating sources by water sprays at each storage pile site
			Slag processing storage piles	Total PM - 1.19 ton/yr	BACT is selected to be wet suppression of dust generating sources by water sprays
			Iron Ore Pellet storage piles	Filterable PM - 13.88 ton/yr	BACT is selected to be implementation of wet suppression of dust generating sources by water sprays at each storage pile site
			Flux storage piles	Filterable PM - 2.18 ton/yr	BACT is selected to be implementation of wet suppression of dust generating sources by water sprays at each storage pile site
			Granulated slag storage piles	Filterable PM - 2.18 ton/yr	BACT is selected to be implementation of wet suppression of dust generating sources by water sprays at each storage pile site
Osceola Steel Company, Georgia	3/15/10	BACT-PSD	Slag storage piles	No Emission limit	The control method is source control, either through minimizing drop height or wet suppression of the material. In addition, roadways and stockpiles of slag to be processed will also be treated by wet suppression

Material Storage Areas					
Facility	**Date**	**Basis**	**Source**	**$PM/PM_{10}/PM_{2.5}$ BACT Limit**	**BACT Control Method**
Ohio River Clean Fuels, LLC OH-0317	11/20/08	BACT-PSD	Coal Storage Piles	Fugitive PM - 12.3 tpy PM_{10}	3-sided windscreen barrier, reduced drop heights, use of chemical stabilization dust suppressants and/or watering to reduce any visible emissions
			Biomass Storage Piles	Fugitive PM - 2.7 tpy PM_{10}	3-sided windscreen barrier, reduced drop heights, use of chemical stabilization dust suppressants and/or watering to reduce any visible emissions
			Slag storage piles	Fugitive PM 1.6 ton/yr from wind 11.7 ton/yr load out	Use of water trucks or fire hoses to maintain high moisture content. Water applied for load out. Minimize free fall distances. Haul trucks covered.
Nucor Steel, Indiana	6/1/12	BACT-PSD	Slag Storage	Opacity limits: Stockpiling of slag adjacent to the grizzly feeder = 3 % Wind erosion of stockpiles = 3% Continuous stacking of processed slag to stockpiles = 3%	Fugitive Dust Control Plan

Step 5 -Select BACT

Proposed BACT for Material Storage Pile Operations (AA-106):

- Implementation of a fugitive dust control plan. Visible emissions from the storage piles shall be controlled by the application of water, other dust suppressants or the use of wind screens, as needed.

- No emission limit is being proposed for these operations since there is no available test method to determine the $PM/PM_{10}/PM_{2.5}$ emission rate.

4.3.11 BACT Analysis for $PM_{10}/PM_{2.5}$ Emissions from Paved and Unpaved Roads

Fugitive particulate emissions can occur from paved and unpaved surfaces.

Step 1: Identify all control technologies

The RACT/BACT/LAER (RBLC) Clearinghouse and review of other permits reveal that the PM control for paved and unpaved roads includes the use dust suppressants, roadway sweeping, covering of transport vehicles, and speed limits.

Add-on Control Technology:

Watering and the use of chemical wetting agents are the principal means for control of emissions from materials handling operations involving transfer of bulk minerals in aggregate form. Dust control can be achieved by: (a) source extent reduction (e.g., mass transfer reduction), (b) source improvement related to work practices and transfer equipment such as load in and load out operations (e.g., drop height reduction, wind sheltering, moisture retention), and (c) surface treatment (e.g., wet suppression).

In most cases, good work practices provide substantial opportunities for emission reduction without the need for investment in a control application program. In particular, spillage of material caused by pile lead-out and maintenance equipment can add a large source component associated with traffic entrained dust. The traffic dust component may easily dominate over emissions from transfer of material and wind erosion. The prevention of spillage and subsequent spreading of material by vehicles traversing the area is essential to cost-effective emission control. If spillage cannot be prevented because of the need for intense use of mobile equipment in the storage pile area, then regular cleanup should be employed as a necessary mitigative measure.

Fugitive emissions from paved roadways can also be controlled by wet suppression systems. These systems use liquid sprays or foam to suppress the formation of airborne dust. The primary control mechanisms are those that prevent emissions through agglomerate formation by combining small dust particles with larger aggregate or with liquid droplets. The key factors that affect the degree of agglomeration and, hence, the performance of the system are the coverage of the material by the liquid and the ability of the liquid to wet small particles. There are two types of wet suppression systems—liquid sprays which use water or water/surfactant mixtures as the wetting agent and systems which supply foams as the wetting agent. The wetting agent can be water or a combination of water and a chemical surfactant. This surfactant, or surface active agent, reduces the surface tension of the water. As a result, the quantity of liquid needed to achieve good control is reduced.

Step 2: Eliminate Technically Infeasible Options

The PM control options noted above are feasible control alternatives. Therefore, there is no elimination of technically infeasible fugitive PM control alternatives. There are no other known control alternatives (per review of the BACT/LAER clearinghouse) that have been utilized on roads.

Step 3: Rank Remaining Technically Feasible Control Options

Development of a fugitive dust control plan which includes removal of deposits on roadways, speed limitation on vehicle traffic and wet suppression techniques as needed will be employed as BACT for paved and unpaved roads.

Step 4: Evaluate the Most Effective Controls and Document the Results

The following table lists the proposed particulate BACT determination along with the existing particulate BACT determinations for the paved and unpaved roads. All data in the table is based on the information obtained from the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC), and electronic versions of permits available at the websites of other permitting agencies.

Step 5 – Select BACT

A review of USEPA's RACT/BACT/LAER Clearinghouse identified the following with respect to paved roads:

Facility/ RBLC ID	Permit Date	Basis	Process	PM BACT Limit	Add-On Controls
V&M Star OH-0344	1/27/11	BACT-PSD	Paved and unpaved roadways and parking areas	Fugitive PM10: 7.7 tpy	Employ best available control measures: watering, sweeping, chemical stabilization, or suppressants applied at sufficient frequencies
Nucor Steel OH-0341	12/23/10	BACT-PSD	Roadways	Fugitive PM10: 5.93 tpy	Best available control measures to include watering, resurfacing, chemical stabilization, and/or speed reduction at sufficient frequency to ensure compliance
Flopam, Inc. LA-0240	06/14/10	BACT-PSD	Roadway Fugitives	Total PM10: 0.04 lb/hr	Main roadway shall be paved where practical. Precautions shall be taken to prevent dust from becoming airborne

Facility/ RBLC ID	Permit Date	Basis	Process	PM BACT Limit	Add-On Controls
Consolidated Environmental Management, Inc LA-0239	05/24/10	BACT-PSD	Unpaved Road Fugitive Dust	18.69 lb/hr 81.85 tpy	BACT for road dust is to pave roadways where practicable including areas where the extra heavy vehicles (greater than 50 tons in weight) will not cause damage to paving. Unpaved roads shall utilize water spray or dust suppression chemicals to reduce emissions. Additionally, reduced speed limits of less than or equal to 15 mph will be enforced on all unpaved roadways
V&M Star OH-0328	04/10/09	BACT-PSD	Roadways and parking areas	Filterable PM_{10}: 12.4 tpy using AP-42 emission factors	Control measures sufficient to minimize or eliminate emissions
Rumke Sanitary Landfill OH-0330	12/23/08	BACT-PSD	Paved roadways and parking areas	Filterable PM_{10}: 15.1 tpy	Best available control measures to minimize or prevent emissions, including water flushing and sweeping of paved roads/parking areas; and applying water or other dust suppressant to unpaved roads..
Southwest Electric Power Company AR-0094	11/05/08	BACT-PSD	Roads	PM: 1.1 lb/hr	Watering/dust suppression chemicals
New Steel International, Inc. OH-0315	05/06/08	BACT-PSD	Paved roadways and parking areas	PM: 153.4 tpy fugitive dust	Control measures include application of wet suppressants, watering, speed reduction and vacuuming or sweeping

Based on information presented reviewed for this BACT analysis, the $PM_{10}/PM_{2.5}$ control measures presented above focus solely on measures designed to eliminate dust such as application of wet suppressants, watering, speed reduction and vacuuming or sweeping. No other applicable $PM_{10}/PM_{2.5}$ control measures were identified in this review.

BACT for paved and unpaved roads associated with this project is proposed as:

- The development of a dust control plan including the use of measures designed to eliminate dust such as application of wet suppressants, watering, speed reduction and vacuuming or sweeping, as required; and
- No emission limit is being proposed for emissions from paved and unpaved roads since there are no available test methods to determine the $PM/PM_{10}/PM_{2.5}$ emission rate.

4.4 Best Available Control Technology (BACT) Analysis - Emissions of NO_x

The BACT evaluation focuses on the control technologies that have been demonstrated and commercially available for control of NO_x emissions. Because of the importance of controlling these emissions, MS Silicon evaluated technologies that have been demonstrated on similar processes so that emissions of NO_x will be controlled to the levels specified.

Nitrogen oxides formation occurs by three fundamentally different mechanisms. The principal mechanism of NO_x formation in natural gas combustion is thermal NO_x. The thermal NO_x mechanism occurs through the thermal dissociation and subsequent reaction of nitrogen (N_2) and oxygen (O_2) molecules in the combustion air. Most NO_x formed through the thermal NO_x mechanism occurs in the high temperature flame zone near the burners. The formation of thermal NO_x is affected by three furnace-zone factors: (1) oxygen concentration, (2) peak temperature, and (3) time of exposure at peak temperature. As these three factors increase, NO_x emission levels increase. The emission trends due to changes in these factors are fairly consistent for all types of natural gas-fired boilers and furnaces. Emission levels vary considerably with the type and size of combustor and with operating conditions (e.g., combustion air temperature, volumetric heat release rate, load, and excess oxygen level). The second mechanism of NO_x formation, called prompt NO_x, occurs through early reactions of nitrogen molecules in the combustion air and hydrocarbon radicals from the fuel. Prompt NO_x reactions occur within the flame and are usually negligible when compared to the amount of NO_x formed through the thermal NO_x mechanism. However, prompt NO_x levels may become significant with ultra-low-NO_x burners. The third mechanism of NO_x formation, called fuel NO_x, stems from the evolution and reaction of fuel-bound nitrogen compounds with oxygen. Due to the characteristically low fuel nitrogen content of natural gas, NO_x formation through the fuel NO_x mechanism is insignificant. [6]

4.4.1 NO_x Emission Sources Subject to Control Technology Evaluation

The NO_x emission sources associated with the proposed plant that are included in this NO_x BACT evaluation are as follows:

- Semi-Enclosed Submerged Arc Furnaces (SAFs);
- Natural gas fired combustion equipment; and
- Emergency equipment.

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[6] AP 42, Fifth Edition, Volume I, Chapter 1.4: External Combustion Sources Natural Gas Combustion, July 1998

For a summary of the estimated NO_x emission rates for the sources identified above, please refer to the following table:

NO_x Emission Rates for Sources Evaluated for BACT

Equipment Description	NO_x Emission Rate (tons/year)
Semi-Enclosed Submerged Arc Furnace (SAFs)	1892.2
Natural Gas Combustion Equipment • Ladle preheaters	14.0
Emergency Equipment: • Emergency Generators	0.02
Total	**1906.2**

4.4.2 BACT Analysis for NO_x Emissions from Submerged Arc Furnaces (AA-201)

Step 1 – Identify Control Options

The first step of the Top-Down BACT analysis is to assess the proposed emission reduction options. The sources of information on emission reduction options vary for the air emission sources being analyzed. The following information resources were consulted in searching for the alternatives available for controlling NO_x emissions from plant operations:

1. On-line USEPA Control Technology Database;
2. State Air Quality Permits; and
3. Control Technology Vendors.

The following control technologies were identified and evaluated to control NO_x emissions from the semi-enclosed submerged arc furnace (SAF):

(a) Combustion Controls;

(b) Selective Catalytic Reduction (SCR);

(c) Non-Selective Catalytic Reduction (NSCR);

(d) $SCONO_x$ Catalytic Oxidation/Absorption; and

(e) Shell $DeNO_x$ System (modified SCR);

(1) Selective Non-Catalytic Reduction (SNCR) options -

(2) Exxon's Thermal $DeNO_x$ ®

(3) Nalco Fuel Tech's NO_xOUT®

(4) Low Temperature Oxidation (LTO).

Step 2 – Eliminate Technically Infeasible Control Options

The test for technical feasibility of any control option is whether it is both available and applicable to reducing NO_x emissions from the SAF. The previously listed information resources were consulted to determine the extent of applicability of each identified control alternative.

(a) Combustion Controls - There is an entire group of combustion controls for NO_x reduction from various combustion units as follows:

1. Low Excess Air (LEA) - This control option is typically used in conjunction with some of the other options. The use of this option will result in the generation of additional CO emissions, which is another pollutant under review in this BACT analysis. In addition, LEA is not very effective for implementation in electric arc furnaces that do not operate with combustion air feeds, since the combustion option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.
2. Oxyfuel Burner - The SAF system does not employ natural gas-fired oxyfuel burners, thus, this option will be excluded for further consideration in this BACT analysis.
3. Overfire Air (OFA) - This control option is geared primarily for fuel NO_x reduction, which is not the major NO_x formation mechanism from SAFs. Further, this option is associated with potential operational problems due to low primary air, creating incomplete combustion conditions. Such conditions can result in inefficient processing and unacceptable increases in tap-to-tap times. Thus, this option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.
4. Burners Out Of Service (BOOS) - BOOS and Load Reduction (or Deration) options - incorporate a reduction in furnace load, thereby, potentially reducing NO_x formation. This reduction must be balanced, however, against a longer period of NO_x generation resulting from the furnace's inability to efficiently melt material. Furthermore, both BOOS and Load Reduction are fundamentally inconsistent with the design criterion for the furnace, which is to increase furnace loadings to achieve enhanced production. Therefore, these control options are not technically feasible for this particular application and will not be considered any further in this BACT analysis.

5. Reduced Combustion Air Temperature - This control option inhibits thermal NO_x production. However, the option is limited to equipment with combustion air preheaters which are not applicable to the silicon production operations. Thus, this option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

6. Flue Gas Recirculation (FGR) - FGR option involves recycling a portion of the cooled exit flue gas back into the primary combustion zone. Typically, FGR is useful in reducing thermal NO_x formation by lowering the oxygen concentration in the combustion zone. The primary limitation of FGR is that it alters the distribution of heat (resulting in cold spots) and lowers the efficiency of the furnace. Since it may be necessary to add additional burners (hence, increasing emissions of other pollutants) to the SAF to reduce the formation of cold spots, FGR technology to reduce SAF NO_x emissions is not considered feasible. Since the SAF does not operate on burner combustion, but relies upon the electric arc and chemical energy for oxidation, neither pathway is amenable to FGR application. Thus, this option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

(b) Selective Catalytic Reduction (SCR) -- In this process, ammonia (NH_3), usually diluted with air or steam, is injected through a grid system into the exhaust gas stream upstream of a catalyst bed. On the catalyst surface the NH_3 reacts with NO_x to form molecular nitrogen and water. The basic reactions are as follows:

$$4NH_3 + 4NO + O_2 \rightarrow 4N_2 + 6H_2O \text{ (i)}$$

$$8NH_3 + 6NO_2 \rightarrow 7N_2 + 12H_2O \text{ (ii)}$$

The reactions take place on the surface of the catalyst. Usually, a fixed bed catalytic reactor is used for SCR systems. The function of the catalyst is to effectively lower the technology include the catalyst reactor design, optimum operating temperature, sulfur content of the charge, catalyst deactivation due to aging, ammonia slip emissions and design of the ammonia injection system.

Depending on system design, NO_x removal of 80 - 90 percent may be achievable under optimum conditions (refer, USEPA "ACT Document - NO_x Emissions from Iron and Silicon productions", Sept., 1994). The reaction of NH_3 and NO_x is favored by the presence of excess oxygen. Another variable affecting NO_x reduction is exhaust gas temperature. The greatest NO_x reduction occurs within a reaction window at catalyst bed temperatures between 600 ^oF – 750 ^oF for conventional (vanadium or titanium-based) catalyst types, and 470 ^oF – 510 ^oF for platinum-based catalysts. Performance for a given catalyst depends largely on the temperature of the exhaust gas stream being treated. A given catalyst exhibits optimum performance when the temperature of the exhaust gas stream is at the midpoint of the reaction temperature window for applications where exhaust gas oxygen concentrations are greater than 1 percent. Below the optimum temperature range, the catalyst activity is greatly reduced, potentially allowing unreacted ammonia (referred to as “ammonia slip”) to be emitted directly to the atmosphere.

The SCR system may also be subject to catalyst deactivation over time. Catalyst deactivation occurs through two primary mechanisms – physical deactivation and chemical poisoning. Physical deactivation is generally the result of either continual exposure to thermal cycling or masking of the catalyst due to entrainment of particulates or internal contaminants. Catalytic poisoning is caused by the irreversible reaction of the catalyst with a contaminant in the gas stream. Catalyst suppliers typically guarantee a 3-year catalyst lifetime for a sustainable emission limit.

In order for an SCR system to effectively reduce NO_x emissions, the exhaust gas stream should have relatively stable gas flow rates, NO_x concentrations, and temperature. In addition, certain elements such as iron, nickel, chrome, and zinc can react with platinum catalysts to form compounds or alloys which are not catalytically active. These reactions are termed "catalytic poisoning", and can result in premature replacement of the catalyst. An SAF flue gas may contain a number of these catalytic poisons. In addition, any solid material in the gas stream can form deposits and result in fouling or masking of the catalytic surface. Fouling occurs when solids obstruct the cell openings within the catalyst. Masking occurs when a film forms on the surface of catalyst over time. The film prevents contact between the catalytic surface and the flue gas. Both of these conditions can result in frequent cleaning and/or replacement requirements. Due to the above effective technical applicability constraints, SCR technology has never been applied to silicon production operations, and will be eliminated for further evaluation in this BACT analysis.

(c) Non-Selective Catalytic Reduction (NSCR) - The NSCR system is a post-combustion add-on exhaust gas treatment system. It is often referred to as a "three-way conversion" catalyst since it reduces NO_x, unburned hydrocarbons (UBH), and CO simultaneously. In order to operate properly, the combustion process must be stoichiometric or near stoichiometric which is not maintained in an SAF and varies widely under regular operation. Under stoichiometric conditions, in the presence of the catalyst, NO_x is reduced by CO, resulting in nitrogen and carbon dioxide. Currently, NSCR systems are limited to rich-burn IC engines with fuel rich ignition system applications. In view of the above limitations, the NSCR option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

(d) $SCONO_x$-Catalytic Oxidation/Absorption -- This is a catalytic oxidation/absorption technology that has been applied for reductions of NO_x, CO and VOC from an assortment of combustion applications that mostly include – small turbines, boilers and lean-burn engines. However, this technology has never been applied to silicon production operations.

An effective $SCONO_x$ application to a SAF has the following reservations:

(1) The technology is not readily adaptable to high-temperature applications outside the 300-700 ^{o}F range and is susceptible to thermal cycling that will be experienced in the MS Silicon application;

(2) Scale-up is still an issue. The technology has not been demonstrated for larger applications;

(3) Optimum $SCONO_x$ operation is predicated by stable gas flow rates, NO_x concentrations and temperature. As discussed earlier, the nature of SAF operations does not afford any of these conditions which will significantly impair the effective control efficiency of the $SCONO_x$ system;

(4) The catalyst is susceptible to moisture interference and the vendor indicates negation of its warranties and performance guarantees if the catalyst is exposed to any quantity of liquid water. However, during certain atmospheric conditions, the catalyst could be potentially exposed to moisture following a unit shutdown;

(5) The prospect of moving louvers that effect the isolation of the saturated catalyst readily lends itself to the possibility of thermal warp and in-duct malfunctions in general. The process is dependent on numerous hot-side dampers that must cycle every 10-15 minutes. Directional flow solutions are not yet known to have been implemented for this technology;

(6) The K_2CO_3 coating on the catalyst surface is an active chemical reaction and reformulation site which makes it particularly vulnerable to fouling. On some field installations, the coating has been found to be friable and tends to foul in the harsh in-duct environment;

(7) During the regeneration step, the addition of the flammable reducing gas (natural gas which contains 85% methane) into the hot flue gas generates the possibility of LEL exceedances and subsequently catastrophic failure in the event the catalyst isolation is not hermetic or there is a failure in the carrier steam flow; and

(8) There is a possibility of some additional SO_2 emissions if the dry scrubber with the tandem "guard-bed" $SCOSO_x$ unit experiences a malfunction. Thus, there are significant reservations regarding effective technical applicability of this control alternative for a silicon production SAF application. Moreover $SCONO_x$ technology has never been proposed nor successfully implemented for similar industry applications. In view of the above limitations, $SCONO_x$ is considered technically infeasible for the present application and will not be considered any further in this BACT analysis.

(e) Shell $DeNO_x$ System (modified SCR) - The Shell $DeNO_x$ system is a variant of traditional SCR technology which utilizes a high activity dedicated ammonia oxidation catalyst based on a combination of metal oxides. The system is comprised of a catalyst contained in a modular reactor housing where in the presence of ammonia NO_x in the exhaust gas is converted to nitrogen and water. The catalyst is contained in a low-pressure drop lateral flow reactor (LFR), which makes best use of the plot space available. Due to the intrinsically high activity of the catalyst, the technology is suited for NO_x conversions at lower temperatures with a typical operating range of 250-660 ^{o}F.

The low temperature operation is the only aspect of the Shell $DeNO_x$ technology that marks its variance from traditional SCR technology. From an SAF application standpoint, there are no additional differences between this technology and SCR technology.

In summary, an effective Shell $DeNO_x$ application to the SAF application has the following reservations:

(1) The Shell $DeNO_x$ system does not suffer from similar placement limitation considerations discussed earlier for SCRs. However, even a downstream of the SAF baghouse placement of the system does not render it completely safe from the prospect of particulate fouling. The catalyst will still be exposed to particulates, which can inflict a masking effect impairing the effective control efficiency of the system;

(2) Optimum Shell $DeNO_x$ operation is predicated by stable gas flow rates, NO_x concentrations and temperature. The nature of silicon production operations does not afford any of these conditions which will significantly impair the effective control efficiency of the Shell $DeNO_x$ system;

(3) The catalyst is particularly susceptible to thermal fluctuations;

(4) The use of relatively large amounts of ammonia - a regulated toxic chemical – will have accidental release and hazardous impact implications; and

(5) Even a 7 parts per million by volume (ppmv) ammonia slip from a 500,000 acfm exhaust gas flow can result in a significant increase of emissions of ammonia which is a regulated hazardous air pollutant with well documented health impacts.

Thus, there are significant reservations regarding effective technical applicability of this control alternative for an SAF application. Moreover Shell $DeNO_x$ has never been proposed nor successfully implemented for similar applications. Therefore, the Shell $DeNO_x$ option is considered technically infeasible and will not be considered any further in this BACT analysis.

(f) Selective Non-Catalytic Reduction (SNCR) - The three commercially available SNCR systems are Exxon's Thermal $DeNO_x$ ® system, Nalco Fuel Tech's NO_xOUT® system and Low Temperature Oxidation (LTO). These technologies are reviewed below for technical feasibility in controlling SAF NO_x emissions.

(1) Exxon's Thermal $DeNO_x$ ® - Exxon's Thermal $DeNO_x$ ® system is a non-catalytic process for NOx reduction. The process involves the injection of gas-phase ammonia (NH_3) into the exhaust gas stream to react with NO_x. The ammonia and NO_x react according to the following competing reactions:

$$2NO + 4NH_3 + 2O_2 \rightarrow 3N_2 + 6H_2O \text{ (i)}$$

$$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O \text{ (ii)}$$

The temperature of the exhaust gas stream is the primary criterion controlling the above selective reaction. Reaction (i) dominates in the temperature window of 1,600 ^oF - 2,200 ^oF resulting in a reduction of NO_x. However above 2,200 ^oF, reaction (ii) begins to dominate, resulting in enhanced NO_x production. Below 1,600 ^oF, neither reaction has sufficient activity to produce or destroy NOx. Thus, the optimum temperature window for the Thermal $DeNO_x$® process is approximately 1,600 ^oF - 1,900 ^oF. The above reaction temperature window can be shifted down to approximately 1,300 ^oF - 1,500 ^oF with the introduction of readily oxidizable hydrogen gas. In addition, the process also requires a minimum of 1.0 second residence time in the desired temperature window for any significant NO_x reduction.

In order for the Thermal $DeNO_x$ ® system to effectively reduce NO_x emissions, the exhaust gas stream should have relatively stable gas flow rates; ensuring the required residence time and be within the prescribed temperature range. Based on review of readily available information, application of Thermal $DeNO_x$® technology to control NO_x emissions from silicon production operations are not

known. Therefore, this option is considered technically infeasible and will not be considered any further in this BACT analysis.

In summary, an effective Thermal $DeNO_x$ ® application to the SAF application has the following reservations:

(A) The placement of the Thermal $DeNO_x$ ® system in an adequate temperature regime. In order to achieve optimum operational efficiency the system should be located in a temperature region of at least 1,300 ^oF and preferably between 1,600 ^oF - 1,900 ^oF which would put it upstream of the SAF baghouse. Such a placement configuration would not afford the desired temperature range, which would be typically in the region of 300 ^oF - 400 ^oF with an entry temperature of 250 ^oF at the inlet to the SAF baghouse. The system cannot be placed further upstream for operational hazard reasons. Also any injection mechanism upstream of the baghouse will be susceptible to prompt particulate fouling;

(B) Optimum Thermal $DeNO_x$ ® operation is predicated by stable gas flow rates, NO_x concentrations and temperature. The nature of silicon production operations does not afford any of these conditions which will significantly impair the effective control efficiency of the Thermal $DeNO_x$ ® system; and

(C) The use of relatively large amounts of ammonia - a regulated toxic chemical - will have accidental release and hazardous impact implications.

(2) Nalco Fuel Tech's NO_xOUT® - The NO_xOUT® process is very similar in principle to the Thermal $DeNO_x$ ® process, except that it involves the injection of a liquid urea (NH_2CONH_2) compound (as opposed to NH_3) into the high temperature combustion zone to promote NO_x reduction. The chemical reaction proceeds as follows:

$$NH_2 + NO \rightarrow N_2 + H_2O \text{ (i)}$$

The reaction involves the decomposition of urea at temperatures of approximately 1,700 ^oF - 3,000 ^oF. Certain proprietary additive developments have allowed the operational temperature window to shift to approximately 1,400 ^oF - 2,000 ^oF. However, the process still has similar constraints as the Thermal $DeNO_x$ ® system. The limitations are dictated by the reaction-controlling variables such as stable gas flow rates for a minimum residence time of 1.0 second in the desired temperature window to ensure proper mixing.

As with the Thermal $DeNO_x$ ® system, the NO_xOUT® system suffers from essentially similar limitations to effectively reduce NOx emissions from SAF operations. Moreover, applications of the NO_xOUT® technology to control NOx emissions from silicon production operations are not known. Therefore, this option is considered technically infeasible and will not be considered any further in this BACT analysis.

Similar to the Thermal $DeNO_x$® application, an effective NO_xOUT® application to the SAF application has the following reservations:

(A) The placement of the NO_xOUT® system in an adequate temperature regime. In order to achieve optimum operational efficiency the system should be located in a temperature region preferably between 1,400 ^oF - 2,000 ^oF which would put it upstream of the SAF baghouse. Firstly, such a placement configuration would not afford the desired temperature range, which would be typically in the region of 300 ^oF -400 ^oF with an entry temperature of 250 ^oF at the inlet to the SAF baghouse. Also any injection mechanism upstream of the baghouse will be susceptible to prompt particulate fouling;

There are significant reservations regarding effective technical applicability of this control alternative for an SAF application. In order for the NO_xOUT® system to effectively reduce NO_x emissions, the exhaust gas stream should have relatively stable gas flow rates, ensuring the requisite residence time requirements and temperature. The temperature of the SAF exhaust gas will vary widely over the melt cycle, and will not remain in the desired temperature window during all phases of operation. Similarly, the gas flow rates will not remain stable during furnace operation, precluding the possibility of adequate residence time. Moreover, NO_xOUT® technology has never been proposed nor successfully implemented to control NO_x emissions from SAFs.

(3) Low Temperature Oxidation (LTO) - LTO technology has never been utilized for any silicon production application. The technology is a variant of SNCR technology using ozone. The ozone is injected into the gas stream and the NO_x in the gas stream is oxidized to nitrogen pentoxide (N_2O_5) vapor, which is absorbed in the scrubber as dilute nitric acid (HNO_3). The nitric acid is then neutralized with caustic (NaOH) in the scrubber water forming sodium nitrate ($NaNO_3$). The overall chemical reaction can be summarized as follows:

$$NO_2 + NO + 2O_3 + NaOH \rightarrow HNO_3 + NaNO_3 + 2O_2 \quad (i)$$

For optimal performance, the technology requires stable gas flows, lack of thermal cycling, invariant pollutant concentrations and residence times on the order of 1 - 1.5 seconds. In addition, LTO technology requires frequent calibration of analytical instruments, which sense the NO_x concentrations for proper adjustment of ozone injection. Since LTO uses ozone injection, it has a potential for ozone slip, which can vary between 5 - 10 ppmv. Also, the technology requires a cooler flue gas of less than 300 ^oF at the point of ozone injection; otherwise the reactive gas is rendered redundant. The technology also suffers from low NO_x conversion rates (40% - 60%), potential for nitric acid vapor release (in the event of a scrubber malfunction) with subsequent regional haze impacts and the handling, treatment and disposal issues for the spent scrubber effluent.

The technology is neither applicable nor proven for silicon production SAF applications and attendant limitations render it technically infeasible in its current manifestation. In view of the above, the LTO control option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

Step 3 – Rank Remaining Control Technologies by Control Effectiveness

All control alternatives identified in Step 2 were eliminated as not technically feasible for controlling NO_x emissions from the silicon production operations, with the exception of good operating combustion practices.

Step 4 – Evaluate the Most Effective Controls and Document Results

Good operating and combustion practices were the only technically feasible control option in controlling NO_x emissions from the SAF.

Step 5 – Select BACT

A review of USEPA's RACT/BACT/LAER Clearinghouse did not identify any BACT determinations for SAFs or any other sources associated with the silicon production operations. Review of state permit information identified the following with respect to SAFs at silicon production plants:

Facility/ RBLC ID	Permit Date	Process	NO_x Limit	Add-On Controls
Globe Metallurgical Inc Niagara Falls, NY Permit#: 9-2911-00078/00009	11/26/10	Two submerged-arc semi-enclosed-type electric furnaces (22 MW/hr)	NOx: 87.6 lb/hr Capacity: 22 MW/hr NOx: 4.0 lbs/MW	No control
Globe Metallurgical Selma, AL 104-0001	9/10/10	20 MW Electric Arc Furnaces (2) producing silicon metal	NOx: 66.0 lb/hr Capacity: 20 MW/hr NOx: 3.3 lbs/MW	No control
West Virginia Alloy, Inc. Alloy, West Virgina R30-01900001-2006	01/18/06	Electric submerged arc furnace No. 15 for the production of silicon metal and ferroalloys	NOx: 462 tpy NOx: 110 lb/hr Nominal Capacity: 18,000 tons/yr NOx: 51.3 lbs/ton silicon	No controls
Globe Metallurgical Inc Waterford, OH ID: 06-84-00-0105	10/24/01	Electric Arc Furnaces (Ferrosilicon and Silicon metal production furnaces)	None	No controls

As shown in the above table, NO_x emissions from SAFs are uncontrolled. None of the sources as reflected in the above table have proposed or successfully implemented any add-on control devices to control NO_x emissions from SAFs operation.

MS Silicon is proposing the NO_x BACT for the SAFs (AA-201) as follows:

- **NO_x emissions from each of the SAFs shall be limited to 45 lbs/ton (averaged over a 30-day period) of silicon produced.**

4.4.3 BACT Analysis for NO_x Emissions from Natural Gas Combustion

Natural Gas Combustion Sources – Includes the following:

- Ladle Pre-Heaters (4 – 10.0 MMBtu/hr): 14 tpy NO_x;

Step 1 – Identify Control Options, Step 2 – Eliminate Technically Infeasible Control Options, Step 3 – Rank Remaining Control Technologies by Control Effectiveness and Step 4 – Evaluate the Most Effective Controls and Document Results

There are no control options identified in the RBLC that are technically feasible to control NO_x that is emitted at from each combustion unit. See below table for summary of NO_x BACT determinations from the RBLC database:

Facility/ RBLC ID	Permit Date	Basis	Process	NO_x BACT Limit	Controls
SeverCorr LLC Columbus, Mississippi	07/15/11	BACT-PSD	Ladle preheaters, ladle dry-out heaters, Tundish preheaters, Tundish dry-out heaters, vertical ladle holding station	0.08 to 0.1 lb/MMBtu	Combustion of natural gas only
Nucor Steel, Marion, Inc. OH-0341	12/23/10	BACT-PSD	Ladle preheaters, tundish preheaters	Mass emission rate of 27.60 lb/hr	Use of natural gas low NO_x burners.
Osceola Steel Co., Adel, Georgia	3/15/10	BACT-PSD	Preheaters	0.1 lb/MMBtu	Combustion of natural gas, good combustion practices

Facility/ RBLC ID	Permit Date	Basis	Process	NO_x BACT Limit	Controls
Mid-American Steel and Wire Company OK-0128	09/08/08	BACT-PSD	3 Ladle Preheater and 2 refractory drying	0.10 lb/MMBtu	Combustion of natural gas
Minnesota Steel Industries, LLC MN-0070	09/07/07	BACT-PSD	Ladle/Tundish Preheater	No limit	Natural gas combustion and low NO_x burners
Gerdau Ameristeel Wilton IA-0087	05/29/07	BACT-PSD	North Ladle Dryer, South Ladle Dryer and Preheaters, Northwest Ladle Dryers	100 lb/mmscf	Good combustion practices
Nucor Steel AR-0090	04/03/06	BACT-PSD	Ladle Dryer	0.1000 lb/MMBtu	Low NO_x burners
Republic Engineered Products, Inc. OH-0303	08/30/05	LAER	Ladle Dryers/Preheaters	0.1000 lb/MMBtu	Low NO_x burners
Charter Manufacturing Co. Inc. Charter Steel OH-0276	06/10/04	BACT-PSD	Ladle Preheater and Dryers	0.98 lb/hr 4.29 ton/yr Limits are for each preheater	None
Nucor Corp TX-0417	1/15/03	BACT-PSD	Process heaters, ladle and tundish	0.100 lb/MMBtu	Low NO_x burners and clean fuel
Nucor Steel IN-0090	01/19/01		6 Ladle Preheaters	0.100 lb/MMBtu, 6.0 lb/hr total	Low NO_x burners

As shown in the above table, no controls other than low NO_x burners, good combustion practices and combustion of clean fuel are used for NO_x emissions from the natural gas combustion equipment.

Step 5 - Select BACT

The RACT/BACT/LAER Clearinghouse (RBLC) and review of other permits reveal that similar natural gas combustion devices use fuel specifications and good combustion practices for controlling NO_x emissions. No similar sized natural gas combustion devices were identified using add-on NO_x controls as BACT.

Thus, BACT is defined as combustion of clean fuel, low NO_X burners, and good combustion practices. For the natural gas combustion sources associated with the proposed Plant, combustion of natural gas and good combustion controls were the only control methods evaluated. Since the highest level of NO_x control as noted above will be implemented by MS Silicon, an analysis of economic, energy and environmental impacts was not performed.

Thus, BACT is defined as:

- **NO_x emission rate of 0.08 lbs/MMBtu;**
- **Low NO_x or equivalent burners/technology;**
- **Combustion of clean fuel; and**
- **Good combustion practices.**

4.4.4 BACT Analysis for NO_x Emissions from Emergency Equipment (AA-501)

Emergency Equipment – Includes the following:

- Diesel-Fired Emergency Generator (1 rated at 670-HP):0.02 tpy $NO_{X;}$

Step 1 – Identify Control Options

There are no control options identified in the RBLC that are technically feasible to control NO_x that is emitted from emergency generators. See below table for summary of NO_x BACT determinations from the RBLC database:

Step 2 - Technical Feasibility of NO_x Control Alternatives

The emergency distillate generator will be used primarily for emergency situations, if any. However, to maintain the integrity of the equipment, the generator will be operated for 100 hours per year or less. The projected annual NOx emissions rate is 0.02 tpy. Based on a review of similar emission sources, these emission sources typically do not have any add-on controls and should be operated per manufacturer's specifications.

Step 3 - Rank Remaining Alternatives by Control Effectiveness

The most effective method for control of NO_x emissions from operation of the emergency fuel combustion devices is the use of fuel specifications that employ clean burning fuels, implementation of good combustion practices and use of combustion controls inherent to the design of the individual combustion devices.

Step 4 - Evaluate Most Effective Controls

Since there are no other feasible technologies to control NO_x emissions from the emergency generator, economic, energy and environmental impact analyses were not performed, nor are required by USEPA's Top-Down approach.

The following table lists the existing NO_x BACT determinations for diesel fired emergency generators. All data in the table is based on the information obtained from the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC), and electronic versions of permits available at the websites of other permitting agencies.

Facility/ RBLC ID	Permit Date	Process	NO_x BACT Limit	Add-On Controls
Southeast Renewable Fuels (FL-0322)	12/23/10	Emergency ULSD Generators (two 2,682 HP)	6.4 G/KW-H NOX+NMHC	No controls The emergency generators shall comply with the emission limit and demonstrate compliance in accordance with the procedures given in NSPS 40 CFR 60, Subpart IIII.
Idaho Power Company (ID-0018)	6/25/10	Emergency Diesel Generator	6.4 G/KW-H NOx+NMHC	Tier 2 Engine, Good combustion practices
Consumers Energy (MI-0389	12/29/09	Emergency ULSD Generator	6.4 G/KW-H NOx+NMHC	Engine design and operation
Verenium (FL-0318)	12/10/09	Emergency generators	6.4 G/KW-H NOx+NMHC	None
Lake Charles Cogeneration, LLC (LA-0231)	06/22/09	Emergency Diesel Power Generator Engines (1341 HP)	17.09 lb/h	Comply with 40 CFR 60 Subpart IIII
Southeast Idaho Energy, LLC (ID-0017)	2/10/09	2 MW Emergency Generator	Comply with NSPS IIII	Good combustion practices, EPA certified per NSPS IIII
		500 KW emergency generator	Comply with NSPS IIII	Good combustion practices, EPA certified per NSPS IIII
Associated Electric Cooperative Inc (OK-0129)	1/23/09	2200 HP low sulfur diesel emergency generator	6.4 G/KW-H NOx+NMHC	None

As shown in the table above, BACT for the emergency equipment is compliance with NSPS IIII; good combustion/operating practices, and the use of ultra-low sulfur diesel (ULSD) fuel.

Step 5 – Select BACT for NO_x from Emergency Equipment (AA-501)

BACT is proposed as:

- **Compliance with NSPS IIII;**
- **Good combustion/operating practices, and**
- **Use of ULSD.**

4.5 Best Available Control Technology (BACT) Analysis - Emissions of CO

The BACT evaluation focuses on the control technologies that have been demonstrated and commercially available for control of CO emissions. Because of the importance of controlling these emissions, MS Silicon evaluated technologies that have been demonstrated on similar processes so that emissions of CO will be controlled to the levels specified.

Large amounts of carbon monoxide and organic materials are emitted by submerged electric arc furnaces. Carbon monoxide is formed as a byproduct of the chemical reaction between oxygen in the metal oxides of the charge and carbon contained in the reducing agent (coke, coal, etc.). Reduction gases containing organic compounds and carbon monoxide continuously rise from the high-temperature reaction zone, entraining fine particles and fume precursors. The mass weight of carbon monoxide produced sometimes exceeds that of the metallic product.[7]

4.5.1 CO Emission Sources Subject to Control Technology Evaluation

The CO emission sources associated with the proposed plant that are included in this CO BACT evaluation are as follows:

- Semi-Enclosed Submerged Arc Furnaces;
- Natural gas fired combustion equipment; and
- Emergency equipment.

For a summary of the estimated CO emission rates for the sources identified above, please refer to the following table:

CO Emission Rates for Sources Evaluated for BACT

Equipment Description	CO Emission Rate (tons/year)
Semi-Enclosed Submerged Arc Furnace	1429.6
Natural Gas Combustion Equipment • Ladle preheaters	14.4

[7] AP-42 Chapter 12.4 Ferroalloy Production, 10/86

Equipment Description	CO Emission Rate (tons/year)
Emergency Equipment: • Emergency Generator	0.19
Total	1444.3

A summary of the BACT determinations for CO is presented in Table 4-4.

4.5.2 BACT Analysis for CO Emissions from Semi-Enclosed Submerged Arc Furnaces (AA-201)

Step 1 – Identify Control Options

The first step of the Top-Down BACT analysis is to assess the proposed emission reduction options. The sources of information on emission reduction options vary for the air emission sources being analyzed. The following information resources were consulted in searching for the alternatives available for controlling emissions from the semi-enclosed submerged electric arc furnaces:

1. On-line USEPA Control Technology Database; and
2. State Air Quality Permits

The following control technologies were identified and evaluated to control CO emissions from the SAFs:

(a) Operating Practice Modifications;

(b) Flaring of CO Emissions;

(c) CO Oxidation Catalysts;

(d) Post-Combustion Reaction Chamber;

(e) Catalytic Incineration; and

(f) Oxygen Injection.

Step 2 – Eliminate Technically Infeasible Control Options

The test for technical feasibility of any control option is whether it is both available and applicable to reducing CO emissions from the SAF. The previously listed information resources were consulted to determine the extent of applicability of each identified control alternative.

(a) Operating Practice Modifications -- Due to marketplace demands on the type of products to be manufactured and the required product quality, MS Silicon does not propose any additional operating practice modifications that will alter CO emissions from the existing semi-enclosed SAF. Therefore, this control option will be eliminated for further evaluation in this BACT analysis.

(b) Flaring of CO Emissions -- Based upon a review of the previously listed information resources, there is no known application of flaring SAF exhaust gases. Flaring of emissions for CO destruction would require raising the exhaust gas temperature. Thus, based on the relatively large gas volumetric flow at a substantial temperature differential, the auxiliary fuel requirements needed to operate the flare would be overwhelmingly large. Additionally, it can be speculated as to whether the flare would actually result in a decrease of CO emissions or increase thereof from supplemental fuel combustion, which would also result in an increase of NO_X emissions. Consequently, this control alternative is considered technically infeasible for SAF exhausts and thus, will not be considered any further in this BACT analysis.

(c) CO Oxidation Catalysts -- Based upon a review of the previously listed information resources, there is no known application of CO oxidation catalysts to control CO emissions from a SAF. The optimal working temperature range for CO oxidation catalysts is approximately 850 ^{o}F - 1,100 ^{o}F with a minimum exhaust gas stream temperature of 500 ^{o}F for minimally acceptable CO control. Exhaust gases from the SAF will undergo rapid cooling as they are ducted from the furnace. Thus, the temperature will be far below the minimum 500 ^{o}F threshold for effective operation of CO oxidation catalysts. Additionally, the particulate loading in the exhaust gas stream is anticipated to be too high for efficient operation of a CO oxidation catalyst. Masking effects such as plugging and coating of the catalyst surface would almost certainly result in impractical maintenance requirements, and would significantly degrade the performance of the catalyst. Consequently, this control alternative is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

(d) Post-Combustion Reaction Chambers -- Based upon a review of the previously listed information resources, there is no known successful application of duct burners or thermal incinerators to control CO emissions from silicon production operations. The feasibility of these units to effectively reduce CO emissions, without resulting in severe operational problems, is unknown. Further, such units are expected to consume large quantities of natural gas and oxygen; resulting in excessive annual operating costs.

The principle of destruction within post combustion chambers is to raise the SAF exhaust gases to a sufficiently high temperature and for a minimum amount of time to facilitate oxidation. The combustion chamber configuration must provide effective mixing within the chamber with an acceptable residence time. Recuperative heat exchangers can be used with these systems to recover a portion of the exiting exhaust gas heat and reduce the auxiliary fuel consumption.

The amount of CO which could be oxidized with post combustion systems is uncertain, and precise performance guarantees are expected to be difficult to obtain from equipment manufacturers

because of the lack of operating experience. In addition, there is the potential for additional emissions of CO from auxiliary fuel combustion. Further, due to the heat and particulate loading, the burners would have a short life expectancy, and may sustain severe maintenance and reliability problems. Additionally, a single or multiple duct burner system would not be able to heat the relatively cool gases from the SAF during cold cycling. Potentially, there are two locations where post combustion chambers can be installed, i.e., upstream or downstream of an SAF baghouse. Locating upstream of the baghouse would take advantage of slightly elevated temperatures in the exhaust gas stream. However, at this location, the post combustion chamber would be subject to high particulate loading. The units would be expected to foul frequently from the particulate accumulation, and the burners would have severe maintenance and reliability problems. Thus, the installation of the post combustion chamber upstream of the baghouse is considered technically infeasible. Alternatively, the post combustion chamber could be installed downstream of the SAF baghouse. However, even at this location, fouling due to particulate matter can occur and more importantly, even cooler exhaust temperatures would be encountered. These cooler temperatures would greatly increase the auxiliary fuel requirements. Further, the combustion of additional fuel will result in increases in emissions to the atmosphere.

Based upon the above discussions, the use of a post combustion chamber is considered technically infeasible for the silicon production operations and will not be considered any further in this BACT analysis.

(e) Catalytic Incineration -- Based upon a review of the previously listed information resources, there is no known application of catalytic incineration to control CO emissions from silicon production operations. Catalytic incinerators use a bed of catalyst that facilitates the overall combustion of combustible gases. The catalyst increases the reaction rate and allows the conversion of CO to CO_2 at lower temperatures than a thermal incinerator. The catalyst is typically a porous noble metal material which is supported in individual compartments within the unit. An auxiliary fuel-fired burner ahead of the bed heats the entering exhaust gases to 500 ^{o}F – 600 ^{o}F to maintain proper bed temperature. Recuperative heat exchangers are used to recover the exiting exhaust gas heat and reduce the auxiliary fuel consumption. Secondary energy recovery is typically 70 percent.

Catalytic incineration systems are limited in application due to potential poisoning, deactivation, and/or blinding of the catalyst. Lead, arsenic, vanadium, and phosphorus are generally considered poisons to catalysts and deactivate the available reaction sites on the catalyst surface. Particulate can also build up on the catalyst, effectively blocking the porous catalyst matrix and rendering the catalyst inactive. In cases of significant levels of poisoning compounds and particulate loading, catalyst replacement costs are significant.

As in the thermal incineration discussion, potentially, there are two locations where the incinerator can be installed, i.e., upstream or downstream of the SAF baghouse. For the same reasons discussed earlier (e.g., fouling due to particulate matter), the upstream location is considered technically infeasible. Alternatively, the incinerator can be installed downstream of the meltshop

baghouse. However, even at this location, fouling due to particulate matter can occur, and further, the exhaust will be at a lower temperature. These cooler temperatures would greatly increase the auxiliary fuel requirements. The associated combustion of additional auxiliary fuel will result in an unacceptable increase in operating costs. Further, the combustion of additional fuel will result in increases in emissions to the atmosphere.

Due to the lack of application of catalytic incineration for SAFs and potentially adverse technology applicability issues, this control alternative is considered technically infeasible and will not be considered any further in this BACT analysis.

(f) Oxygen Injection -- Based upon a review of the previously-listed information resources, there is no known application of oxygen injection for controlling CO emissions from SAFs.

A theoretical means of reducing CO would be oxygen injection at the entrance of the ductwork to increase oxidation of the available CO to CO_2. The increase in CO oxidation which could be achieved, however, is unknown. This approach would be purely experimental and is a procedure that is currently not conducted in silicon production operations in silicon productions in the United States. Consequently, this control alternative is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

Step 3 – Rank Remaining Control Technologies by Control Effectiveness

All control alternatives identified in Step 2 were eliminated as not technically feasible for controlling CO emissions from the SAF.

Step 4 – Evaluate the Most Effective Controls and Document Results

Good operating practices are only technically feasible control option in controlling CO emissions from the SAF.

Step 5 – Select BACT

A review of USEPA's RACT/BACT/LAER Clearinghouse did not identify any BACT determinations for submerged arc furnaces or any other sources associated with the silicon production operations. Review of state permit information identified the following with respect to submerged electric arc furnaces at silicon production plants:

Facility/ RBLC ID	Permit Date	Process	CO Limit	Add-On Controls
Globe Metallurgical Inc Niagara Falls, NY Permit#: 9-2911-00078/00009	11/26/10	Two submerged-arc semi-enclosed-type electric furnaces (22 MW/hr)	No limit	No control
Globe Metallurgical Selma, AL 104-0001	9/10/10	20 MW Electric Arc Furnaces (2) producing silicon metal	CO: 88.9 lb/hr Capacity: 20 MW/hr CO: 4.4 lbs/MW	No control
West Virginia Alloy, Inc. Alloy, West Virgina R30-01900001-2006	01/18/06	Electric submerged arc furnace No. 15 for the production of silicon metal and ferroalloys	CO: 54.0 lb/hr Nominal Capacity: 2 tons/hr CO: 27 lbs/ton silicon	No controls
Globe Metallurgical Inc Waterford, OH ID: 06-84-00-0105	10/24/01	Electric Arc Furnaces (Ferrosilicon and Silicon metal production furnaces)	None	No controls

As shown in the above table, CO emissions from submerged electric arc furnaces are uncontrolled. None of the sources as reflected in the above table have proposed or successfully implemented any add-on control devices to control CO emissions from SAF operation.

MS Silicon is proposing the BACT for CO as follows:

- **Total CO emissions from the SAF shall be limited to 34 lbs/ton (averaged over a 30-day period) of silicon produced;**
- **Good combustion and operating practices; and**
- **Utilization of a semi-enclosed SAF design.**

4.5.3 BACT Analysis for CO Emissions from Natural Gas Combustion (AA-202)

Natural Gas Combustion Sources – Includes the following:

- Ladle Pre-Heaters (4 – 10.0 MMBtu/hr): 14.4 tpy CO;

Step 1 – Identify Control Options,

According to information available in the RBLC, EPA's Compilation of Air Pollutant Emission Factors and the EPA's CATC Technical Bulletins and Air Pollution Control Technology Fact Sheets, there are no reasonably available add-on control options to control CO emissions from natural gas combustion units. This review did not identify natural gas combustion equipment associated with silicon production employing add-on controls to control combustion related emissions from natural gas combustion sources.

Step 2 – Eliminate Technically Infeasible Control Options

No technically feasible control options were identified to control the small quantities of CO from similar sized natural gas combustion equipment.

Step 3 – Rank Remaining Control Technologies by Control Effectiveness and Step 4 – Evaluate the Most Effective Controls and Document Results

No technically feasible control options were identified.

Step 5 - Select BACT

The RACT/BACT/LAER Clearinghouse (RBLC) and review of other permits reveal that similar natural gas combustion devices use fuel specifications and good combustion practices for controlling CO emissions. No similar sized natural gas combustion devices were identified add-on CO controls as BACT.

Facility/RBLC ID	Permit Date	Basis	Process	CO BACT Limit	Add-On Controls
Mid-American Steel and Wire Company OK-0128	09/08/08	BACT-PSD	Ladle Preheater and refractory drying	0.0840 lb/MMBtu	Combustion of natural gas
New Steel International, Inc OH—0315	5/6/08	BACT-PSD	Tundish Preheaters	0.0840 lb/MMBtu	Natural gas combustion
Gerdau Ameristeel Wilton IA-0087	05/29/07	BACT-PSD	North Ladle Dryer, South Ladle Dryer and Preheaters, Northwest Ladle Dryers	84 lb/mmscf	Good combustion practices

Facility/RBLC ID	Permit Date	Basis	Process	CO BACT Limit	Add-On Controls
Nucor Steel AR-0090	04/03/06	BACT-PSD	Ladle Dryer	0.0840 lb/MMBtu	Good combustion practice
Republic Engineered Products, Inc OH-0303	08/30/05	LAER	Ladle Dryers/Preheaters	84.0 lb/Mmscf	Best operational and engineering practices
Charter Manufacturing Co. Inc. Charter Steel OH-0276	06/10/04	BACT-PSD	Tundish Preheaters	0.0820 lb/MMBtu each preheater	None
Charter Manufacturing Co. Inc. Charter Steel OH-0276	06/10/04	BACT-PSD	Ladle Preheater and Dryers	0.0820 lb/MMBtu each preheater	None
Nucor Steel IN-0090	01/19/01	BACT-PSD	Tundish Preheaters	No limit	Use of natural gas
Nucor Steel IN-0090	01/19/01	BACT-PSD	Ladle Preheaters	No limit	Natural gas or propane combustion

As shown in the above table, no controls other than good combustion practices and combustion of clean fuel are used for CO emissions from the natural gas combustion equipment. The variation of 0.0820 to 0.0840 lb/MMBtu is based on different heating values for natural gas.

Thus, BACT for CO emissions from equipment combusting natural gas is defined as:

- **CO emission rate of 0.0840 lbs/MMBtu;**
- **Combustion of natural gas; and**
- **Good combustion practices.**

4.5.4 BACT Analysis for CO Emissions from Emergency Equipment (AA-501)

Emergency Equipment – Includes the following:

- Diesel-Fired Emergency Generator (1 rated at 670-HP): 0.7 tpy CO.

Step 1 – Identify Control Options

There are no control options identified in the RBLC that are technically feasible to control CO that is emitted from emergency equipment. See below table for summary of CO BACT determinations from the RBLC database:

Step 2 - Technical Feasibility of CO Control Alternatives

The emergency diesel fired generator will be used primarily for emergency situations, if any. However, to maintain the integrity of the equipment, the generator will be operated for less than 100 hours per year. Based on a review of similar emission sources, these emission sources typically do not have any add-on controls and should be operated per manufacturer's specifications.

Step 3 - Rank Remaining Alternatives by Control Effectiveness

The most effective method for control of CO emissions from operation of the emergency fuel combustion devices is the use of fuel specifications that employ clean burning fuels, implementation of good combustion practices and use of combustion controls inherent to the design of the individual combustion devices.

Step 4 - Evaluate Most Effective Controls

Since there are no other feasible technologies to control CO emissions from the emergency generator, economic, energy and environmental impact analyses were not performed, nor are required by USEPA's Top-Down approach.

The following table lists the existing CO BACT determinations for diesel fired emergency generators. All data in the table is based on the information obtained from the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC), and electronic versions of permits available at the websites of other permitting agencies.

Facility/ RBLC ID	Permit Date	Process	CO BACT Limit	Add-On Controls
Southeast Renewable Fuels (FL-0322)	12/23/10	Emergency ULSD Generators (two 2,682 HP)	3.5 G/KW-H	No controls The emergency generators shall comply with the emission limit and demonstrate compliance in accordance with the procedures given in NSPS 40 CFR 60, Subpart IIII.
Idaho Power Company ID-0018	6/25/10	750 KW Emergency Diesel Generator	3.5 G/KW-H	Tier 2 Engine, Good combustion practices

Facility/ RBLC ID	Permit Date	Process	CO BACT Limit	Add-On Controls
Consumers Energy (MI-0389	12/29/09	2000 KW Emergency ULSD Generator	3.5 G/KW-H	Engine design and operation
Verenium (FL-0318)	12/10/09	2000 KW Emergency generators	3.5 G/KW-H	None
Lake Charles Cogeneration, LLC (LA-0231)	06/22/09	Emergency Diesel Power Generator Engines (1341 HP)	0.62 lb/h	Comply with 40 CFR 60 Subpart IIII
Southeast Idaho Energy, LLC (ID-0017)	2/10/09	2 MW Emergency Generator	Comply with NSPS IIII	Good combustion practices, EPA certified per NSPS IIII, limited to 100 hours of operation per year
		500 KW emergency generator	Comply with NSPS IIII	Good combustion practices, EPA certified per NSPS IIII, limited to 100 hours of operation per year
Associated Electric Cooperative Inc (OK-0129)	1/23/09	2200 HP low sulfur diesel emergency generator	3.5 G/KW-H	None

As shown in the table above, BACT for the emergency equipment has been determined to be compliance with NSPS IIII and good combustion/operating practices

Step 5 – Select BACT for CO from Emergency Equipment

BACT for CO emissions from the emergency equipment is proposed as:

- **Compliance with NSPS IIII; and**
- **Good combustion/operating practices.**

4.6 Best Available Control Technology (BACT) Analysis - Emissions of SO_2

The BACT evaluation focuses on the control technologies that have been demonstrated and commercially available for control of SO_2 emissions. Because of the importance of controlling these emissions, MS Silicon evaluated technologies that have been demonstrated on similar processes.

The source of SO_2 emissions is attributable to the sulfur content of the raw materials charged in the SAFs and from the sulfur content of the fuels to be combusted in supporting operations to be performed at the plant.

4.6.1 SO2 Emission Sources Subject to Control Technology Evaluation

The SO_2 emission sources associated with the proposed plant that are included in this SO_2 BACT evaluation are as follows:

- Semi-Enclosed Submerged Arc Furnaces;
- Natural gas fired combustion equipment; and
- Emergency equipment.

For a summary of the estimated SO_2 emission rates for the sources identified above, please refer to the following table:

SO_2 Emission Rates for Sources Evaluated for BACT

Equipment Description	SO_2 Emission Rate (tons/year)
Semi-Enclosed Submerged Arc Furnace	2169.7
Natural Gas Combustion Equipment • Ladle preheaters	0.10
Emergency Equipment: • Emergency Generator	0.27
Total	2170.0

4.6.2 BACT Analysis for SO_2 Emissions from Semi-Enclosed Submerged Arc Furnaces (AA-201)

Step 1 – Identify Control Options

The first step of the Top-Down BACT analysis is to assess the proposed emission reduction options. The sources of information on emission reduction options vary for the air emission sources being analyzed. The following information resources were consulted in searching for the alternatives available for controlling SO_2 emissions from plant operations:

1. On-line USEPA Control Technology Database;
2. State Air Quality Permits; and
3. Control Technology Vendors.

The following control technologies were identified and evaluated to control SO_2 emissions from the SAFs:

(a) Lower-Sulfur Charge Substitution; and

(b) Flue Gas Desulfurization (FGD) options:

(1) Wet Scrubbing;

(2) Spray Dryer Absorption (SDA); and

(3) Dry Sorbent Injection (DSI).

Step 2 – Eliminate Technically Infeasible Control Options

The test for technical feasibility of any control option is whether it is both available and applicable to reducing SO_2 emissions from the SAFs. The previously listed information resources were consulted to determine the extent of applicability of each identified control alternative.

(a) Lower-Sulfur Charge Materials - Substitution with lower sulfur-bearing raw materials is technically feasible and will be included in this analysis. A summary of the charge materials and sulfur content of the materials, are described below.

Coal - The Department of Energy estimates that the use of the lowest sulfur coal can result in up to 85 percent lower SO_2 emissions than the use of many types of higher sulfur coal[8]. In the U.S., coal from eastern states including Ohio, Pennsylvania, and West Virginia has higher sulfur content, accounting for 3 to 10 percent of the coal's weight; coal from western states such as Wyoming, Montana, Utah, and Colorado can have sulfur contents that make up less than 1 percent of its weight[9]. However, low-sulfur coal is significantly more expensive

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[8] ↑ Annual Energy Outlook 2002 with Projections to 2020, US Department of Energy, January 2002

[9] Cleaning up Coal, U.S. Department of Energy

than higher sulfur coal, and often incurs additional transportation costs. MS Silicon will work to utilize the lowest cost effective, available coal source. The success of the plant is to produce a high quality silicon product that is cost competitive within the industry. MS Silicon will be utilizing a best available SAF and supporting equipment to:

1) Produce a cost competitive product;

2) Minimizes emissions of regulated air pollutants; and

3) Utilize good combustion practices and operating equipment to minimize the plant's energy/GHG footprint.

Wood - The low sulfur content of wood (0.007 to 0.08% by weight sulfur) minimizes SO_2 emissions

(b) Flue Gas Desulfurization –

FGD systems currently in use for SO_2 abatement can be classified as wet and dry systems. Based on a review of the RBLC database and state permits, it was revealed that control technologies for SO_2 abatement have not been implemented for SAFs. However, FGD options which have been traditionally applied to utility boilers may be available to control SO_2 from the SAFs. Therefore, the application of these technologies to the SAFs will be examined further.

The suitability of gas absorption as a pollution control method is generally dependent on the following factors:

1) Availability of suitable solvent;

2) Required removal efficiency;

3) Pollutant concentration in the inlet vapor;

4) Capacity required for handling waste gas; and,

5) Recovery value of the pollutant(s) or the disposal cost of the spent solvent.

Gas absorbers are most widely used to remove water soluble inorganic contaminants from air streams with typical pollutant concentrations ranging from 250 to 10,000 ppmv.[10] The SO_2 concentration from the proposed SAFs has been estimated at 8 ppm. For FGD controls in general, the expected variability and low SO_2 concentrations in the gas stream are not amenable to FGD which is typically geared for high sulfur fuel combustion systems.

(1) Wet Scrubbing -- Wet scrubbers are regenerative processes which are designed to maximize contact between the exhaust gas and an absorbing liquid. The exhaust gas is

[10] SO_2 and Acid Gas Controls, Sixth Edition, EPA/452/B-02-001

scrubbed with a 5 - 15 percent slurry, comprised of lime (CaO) or limestone ($CaCO_3$) in suspension. The SO_2 in the exhaust gas reacts with the CaO or $CaCO_3$ to form calcium sulfite ($CaSO_3.2H_2O$) and calcium sulfate ($CaSO_4$). The scrubbing liquor is continuously recycled to the scrubbing tower after fresh lime or limestone has been added.

The types of scrubbers which can adequately disperse the scrubbing liquid include packed towers, plate or tray towers, spray chambers, and venturi scrubbers. In addition to calcium sulfite/sulfate, numerous other absorbents are available including sodium solutions and ammonia-based solutions[11].

There are various potential operating problems associated with the use of wet scrubbers. First, particulates are not acceptable in the operation of wet scrubbers because they would plug spray nozzles, packing, plates and trays. Thus, the scrubber would have to be located downstream of the SAFs baghouses. This would substantially increase the capital cost of the wet scrubber, which is typically two to three times more expensive than the capital cost for a dry scrubber. Wet scrubbers also require handling, treatment, and disposal of a sludge by-product. In this case, air emissions would be exchanged for a large-scale water pollution problem. Treatment of wet scrubber wastes requires advanced wastewater treatment including frequent maintenance by an experienced operator. The SO_2 concentration will vary widely over the SAFs cycle which operates as a batch process. This will preclude efficient application of wet scrubbing. Thus, the wet scrubber option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

(2) Spray Dryer Absorption (SDA) -- An alternative to wet scrubbing is a process known as dry scrubbing, or spray-dryer absorption (SDA). As in wet scrubbing, the gas-phase SO_2 is removed by intimate contact with a suitable absorbing solution. Typically, this may be a solution of sodium carbonate (Na_2CO_3) or slaked lime [$Ca(OH)_2$]. In SDA systems the solution is pumped to rotary atomizers, which create a spray of very fine droplets. The droplets mix with the incoming SO_2-laden exhaust gas in a very large chamber and subsequent absorption leads to the formation of sulfites and sulfates within the droplets. Almost simultaneously, the sensible heat of the exhaust gas which enters the chamber evaporates the water in the droplets, forming a dry powder before the gas leaves the spray dryer. The temperature of the desulfurized gas stream leaving the spray dryer is now approximately 30 - 50 ^{o}F above its dew point.

The exhaust gas from the SDA system contains a particulate mixture which includes reacted products. Typically, baghouses employing Teflon-coated fiberglass bags (to minimize bag corrosion) are utilized to collect the precipitated particulates.

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[11] SO_2 and Acid Gas Controls, Sixth Edition, EPA/452/B-02-001

The SDA process would not have many of the potential operating problems associated with the wet scrubbing systems. The SO_2 concentration will vary widely over the SAFs cycle. Thus, SDA dry scrubbing option is considered technically infeasible for this application and will be not be considered any further in this BACT analysis.

(3) Dry Sorbent Injection (DSI) -- This control option typically involves the injection of dry powders into either the furnace or post-furnace region of utility-sized boilers. This process was developed as a lower cost option to conventional FGD technology. Since the sorbent is injected directly into the exhaust gas stream, the mixing offered by the dry scrubber tower is not realized.

The dry sorbent injection process would not have many of the potential operating problems associated with the wet scrubbing systems. The SO_2 concentration will vary widely over the SAFs cycle. The injection dose of sorbent materials would be hard to control in order to match variability in SO_2 concentrations. Similar control systems are fraught with chronic operational problems with the sensors requiring frequent maintenance and calibration.

Thus, DSI dry scrubbing option is considered technically infeasible for this application and will be not be considered any further in this BACT analysis.

Step 3 – Rank Remaining Control Technologies by Control Effectiveness

All control alternatives identified in Step 2 were eliminated as not technically feasible for controlling SO_2 emissions from the silicon production operations, with the exception of lower sulfur charge and good operating combustion practices.

Step 4 – Evaluate the Most Effective Controls and Document Results

Lower sulfur charge and good operating combustion practices were the only technically feasible control option in controlling SO_2 emissions from the SAF.

Step 5 – Select BACT

A review of USEPA's RACT/BACT/LAER Clearinghouse did not identify any BACT determinations for submerged arc furnaces or any other sources associated with the silicon production operations. Review of state permit information identified the following with respect to submerged electric arc furnaces at silicon production plants:

Facility/	Permit Date	Process	SO_2 Limit	Add-On Controls
Globe Metallurgical Inc Niagara Falls, NY Permit#: 9-2911-00078/00009	11/26/10	Two submerged-arc semi-enclosed-type electric furnaces (22 MW/hr)	Coke which exceeds the 1.7 lb/million Btu maximum and 1.4 lb/million Btu consecutive three month average, sulfur in fuel limits of 6NYCRR, Part 225-1.2 (d) Table 2 for solid fuel, may be used in combination with coal in the furnace charge on a minimum 4:1 coal/coke ratio. Globe is required to demonstrate that when using coke with a sulfur content greater than the allowable limit in combination with coal, the sulfur dioxide emissions will not exceed a maximum 3.4 pounds of sulfur dioxide per million Btu heat input and an average 2.8 pounds of sulfur dioxide per million Btu heat input. No control	
Globe Metallurgical Selma, AL 104-0001	9/10/10	20 MW Electric Arc Furnaces (2) producing silicon metal	SO_2: 94 lb/hr Capacity: 20 MW/hr SO_2: 4.95 lbs/MW	No control
West Virginia Alloy, Inc. Alloy, West Virgina R30-01900001-2006	01/18/06	Electric submerged arc furnace No. 15 for the production of silicon metal and ferroalloys	SO_2: 68.7 lb/hr Nominal Capacity: 2 tons/hr SO_2: 34.35 lbs/ton silicon	No controls
Globe Metallurgical Inc Waterford, OH ID: 06-84-00-0105	10/24/01	Electric Arc Furnaces (Ferrosilicon and Silicon metal production furnaces)	None	No controls

As shown in the above table, SO_2 emissions from SAFs are uncontrolled. None of the sources as reflected in the above table have proposed or successfully implemented any add-on control devices to control SO_2 emissions from SAFs operation.

MS Silicon is proposing the SO_2 BACT for the SAFs as follows:

- **Total SO_2 emissions from the SAF shall be limited to 52 lbs/ton (averaged over a 30-day period) of silicon produced; and**

- **Utilization of low sulfur content material, where technically feasible.**

4.6.3 BACT Analysis for SO_2 Emissions from Natural Gas Combustion (AA-202)

Natural Gas Combustion Sources – Includes the following:

- Ladle Pre-Heaters (4 – 10.0 MMBtu/hr): 0.10 tpy SO_2;

Step 1 – Identify Control Options, Step 2 – Eliminate Technically Infeasible Control Options, Step 3 – Rank Remaining Control Technologies by Control Effectiveness and Step 4 – Evaluate the Most Effective Controls and Document Results

There are no control options identified in the RBLC that are technically feasible to control SO_2 that is emitted at from small natural gas combustion units. See below table for summary of SO_2 BACT determinations from the RBLC database:

Facility/ RBLC ID	Permit Date	Basis	Process	SO_2 BACT Limit	Controls
Lake Charles Cogeneration LLC LA-0231	06/22/09	BACT-PSD	34.20 MMBtu/hr Shift Reactor Startup Heater	0.0006 lb/MMBtu	Combustion of natural gas
Competitive Power Ventures MD-0040	11/12/08	BACT-PSD	1.70 MMBtu/hr Heater	No limit	Exclusive use natural gas with sulfur content not to exceed 2.0 gr/100 scf
Mid-American Steel and Wire Company OK-0128	09/08/08	BACT-PSD	13.30 MMBtu/hr Ladle Preheater and refractory drying	0.0006 lb/MMBtu	Combustion of natural gas
Thysenkrupp Steel and Stainless USA, LLC AL-0230	08/17/07	BACT PSD	33.40 MMBtu/hr Batch Annealing Furnaces	0.0006 lb/MMBtu	No control
Nucor Steel AR-0090	04/03/06	BACT-PSD	Ladle Dryer	0.0006 lb/MMBtu	No control

Facility/ RBLC ID	Permit Date	Basis	Process	SO_2 BACT Limit	Controls
Republic Engineered Products, Inc OH-0303	08/30/05	LAER	14.5 MMBtu/hr Ladle Dryers/Preheaters	0.0006 lb/MMBtu	Use of natural gas with sulfur content less than 0.6 % by weight
Charter Steel OH-0276	06/10/04	BACT-PSD	10 MMBtu/hr Ladle Preheater and Dryer, 4 Units	0.0006 lb/MMBtu	No controls
Nucor Steel IN-0090	01/19/01	BACT-PSD	15 MMBtu/hr Ladle Preheaters	No limit	Combustion of natural gas or propane

As shown in the above table, no add-on controls are used for SO_2 from the small natural gas combustion equipment.

Step 5 - Select BACT

The RACT/BACT/LAER Clearinghouse (RBLC) and review of other permits reveal that similar small natural gas combustion devices use fuel specifications and good combustion practices for controlling SO_2 emissions. No similar sized natural gas combustion devices were identified add-on SO_2 controls as BACT.

Thus, BACT is defined as combustion of clean fuel and good combustion practices. For the natural gas combustion sources associated with the proposed Plant, combustion of natural gas and good combustion controls were the only control methods evaluated. Since the highest level of SO_2 control as noted above will be implemented by MS Silicon, an analysis of economic, energy and environmental impacts was not performed.

Thus, BACT for SO_2 emissions from natural gas combustion equipment to be utilized at the plant is defined as:

- **SO_2 emission rate of 0.0006 lbs/MMBtu;**
- **Combustion of clean fuel; and**
- **Good combustion practices.**

4.6.4 BACT Analysis for SO_2 Emissions from Emergency Equipment (AA-501)

Emergency Equipment – Includes the following:

- Diesel-Fired Emergency Generator (1 rated at 670-HP each): 0.2 tpy SO_2

Step 1 – Identify Control Options

There are no control options identified in the RBLC that are technically feasible to control SO_2 that is emitted at from emergency equipment. See below table for summary of SO_2 BACT determinations from the RBLC database:

Step 2 - Technical Feasibility of SO_2 Control Alternatives

The emergency diesel generator will be used primarily for emergency situations, if any. However, to maintain the integrity of the equipment, the generator will be operated for 100 hours per year or less. Based on a review of similar emission sources, these emission sources typically do not have any add-on controls and should be operated per manufacturer's specifications.

Step 3 - Rank Remaining Alternatives by Control Effectiveness

The most effective method for control of SO_2 emissions from operation of the emergency fuel combustion devices is the use of fuel specifications that employ clean burning fuels, implementation of good combustion practices and use of combustion controls inherent to the design of the individual combustion devices.

Step 4 - Evaluate Most Effective Controls

Since there are no other feasible technologies to control SO_2 emissions from the emergency equipment, economic, energy and environmental impact analyses were not performed, nor are required by USEPA's Top-Down approach.

The following table lists the existing SO_2 BACT determinations for diesel fired emergency equipment. All data in the table is based on the information obtained from the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC), and electronic versions of permits available at the websites of other permitting agencies.

Facility/ RBLC ID	Permit Date	Process	SO_2 BACT Limit	Controls
Southeast Renewable Fuels (FL-0322)	12/23/10	Emergency ULSD Generators (two 2,682 HP)	No limit	No controls Engines will fire ULSD fuel oil or propane and each will be limited to 500 hours per year of operation during emergencies.

Facility/ RBLC ID	Permit Date	Process	SO_2 BACT Limit	Controls
Idaho Power Company ID-0018	6/25/10	Emergency Diesel Generator	No limit	Tier 2 Engine, Good combustion practices
Consumers Energy (MI-0389	12/29/09	Emergency ULSD Generator	No limit	ULSD combustion, 500 hours of operation per year
Verenium (FL-0318)	12/10/09	Emergency generators	0.0015 % S	Comply with applicable provisions of 40 CFR 60, Subpart IIII
Lake Charles Cogeneration, LLC (LA-0231)	06/22/09	Emergency Diesel Power Generator Engines (1341 HP)	0.0100 lb/hr	Comply with 40 CFR 60 Subpart IIII
Southeast Idaho Energy, LLC (ID-0017)	2/10/09	2 MW Emergency Generator	No limit	100 hours of operation per year, ULSD fuel, good combustion practices, EPA certified per NSPS IIII
		500 KW emergency generator	No limit	100 hours of operation per year, ULSD fuel, good combustion practices, EPA certified per NSPS IIII
Associated Electric Cooperative Inc (OK-0129)	1/23/09	2200 HP low sulfur diesel emergency generator	0.89 lb/hr	Low sulfur diesel fuel < 0.05% S

As shown in the table above, BACT for the emergency equipment is compliance with NSPS IIII; good combustion/operating practices, and the use of ultra-low sulfur diesel (ULSD) fuel.

Step 5 – Select BACT for SO_2 from Emergency Equipment

BACT for SO_2 emissions associated with the emergency equipment is proposed as compliance with NSPS IIII; good combustion/operating practices, and use of ULSD.

4.7 Best Available Control Technology (BACT) Analysis - Emissions of VOC

The BACT evaluation focuses on the control technologies that have been demonstrated and commercially available for control of VOC emissions. Because of the importance of controlling these emissions, MS Silicon evaluated technologies that have been demonstrated on similar processes.

4.7.1 VOC Emission Sources Subject to Control Technology Evaluation

The VOC emission sources associated with the proposed plant that are included in this VOC BACT evaluation are as follows:

- Semi-Enclosed Submerged Arc Furnaces;
- Natural gas fired combustion equipment; and
- Emergency equipment.

For a summary of the estimated VOC emission rates for the sources identified above, please refer to the following table:

VOC Emission Rates for Sources Evaluated for BACT

Equipment Description	VOC Emission Rate (tons/year)
Semi-Enclosed Submerged Arc Furnaces	92.5
Natural Gas Combustion Equipment • Ladle preheaters	0.9
Emergency Equipment: • Emergency Generator	0.08
Total	93.5

4.7.2 BACT Analysis for VOC Emissions from Semi-Enclosed Submerged Arc Furnaces (AA-201)

Step 1 – Identify Control Options

The first step of the Top-Down BACT analysis is to assess the proposed emission reduction options. The sources of information on emission reduction options vary for the air emission sources being analyzed. The following information resources were consulted in searching for the alternatives available for controlling emissions from the semi-enclosed submerged electric arc furnaces:

1. On-line USEPA Control Technology Database; and
2. State Air Quality Permits

The following control technologies were identified and evaluated to control VOC emissions from the SAFs:

(a) Operating Practice Modifications;

(b) Flaring of VOC Emissions;

(c) VOC Oxidation Catalysts;

(d) Post-Combustion Reaction Chamber;

(e) Catalytic Incineration; and

(f) Oxygen Injection.

Step 2 – Eliminate Technically Infeasible Control Options

The test for technical feasibility of any control option is whether it is both available and applicable to reducing VOC emissions from the SAF. The previously listed information resources were consulted to determine the extent of applicability of each identified control alternative. MS Silicon is also proposing to utilize a semi-enclosed SAF design that will reduce the quantity of VOC generated during the furnace conversion process. Because of the nature of the furnace process and temperatures that will be achieved during the process, engineering literature suggests VOC emissions will be minimal. For purposes of this application we have conservatively assumed VOCs will be generated and have assigned an emission factor expressed in lbs/ton.

(a) Operating Practice Modifications -- Due to marketplace demands on the type of products to be manufactured and the required product quality, MS Silicon does not propose any additional operating practice modifications that will alter VOC emissions from the existing SAF. Therefore, this control option will be eliminated for further evaluation in this BACT analysis.

(b) Flaring of VOC Emissions -- Based upon a review of the previously listed information resources, there is no known application of flaring SAF exhaust gases. Flaring of emissions for VOC destruction would require raising the exhaust gas temperature. Thus, based on the relatively large gas volumetric flow at a substantial temperature differential, the auxiliary fuel requirements needed to operate the flare would be overwhelmingly large. Additionally, it can be speculated as to whether the flare would actually result in a decrease of VOC emissions or increase thereof from supplemental fuel combustion, which would also result in an increase of NO_X emissions and potential CO_2 emissions. Consequently, this control alternative is considered technically infeasible for SAF exhausts and thus, will not be considered any further in this BACT analysis.

(c) VOC Oxidation Catalysts -- Based upon a review of the previously listed information resources, there is no known application of VOC oxidation catalysts to control VOC emissions from a SAF. The optimal working temperature range for VOC oxidation catalysts is approximately 850 ^{o}F - 1,100 ^{o}F with a minimum exhaust gas stream temperature of 500 ^{o}F for minimally acceptable VOC control. Exhaust gases from the SAF will undergo rapid cooling as they are ducted from the furnace. Thus, the temperature will be far below the minimum 500 ^{o}F threshold for effective

operation of VOC oxidation catalysts. Additionally, the particulate loading in the exhaust gas stream is anticipated to be too high for efficient operation of a VOC oxidation catalyst. Masking effects such as plugging and coating of the catalyst surface would almost certainly result in impractical maintenance requirements, and would significantly degrade the performance of the catalyst. Consequently, this control alternative is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

(d) Post-Combustion Reaction Chambers -- Based upon a review of the previously listed information resources, there is no known successful application of duct burners or thermal incinerators to control VOC emissions from silicon production operations. The feasibility of these units to effectively reduce VOC emissions, without resulting in severe operational problems, is unknown. Further, such units are expected to consume large quantities of natural gas and oxygen; resulting in excessive annual operating costs.

The principle of destruction within post combustion chambers is to raise the SAF exhaust gases to a sufficiently high temperature and for a minimum amount of time to facilitate oxidation. The combustion chamber configuration must provide effective mixing within the chamber with an acceptable residence time. Recuperative heat exchangers can be used with these systems to recover a portion of the exiting exhaust gas heat and reduce the auxiliary fuel consumption.

The amount of VOC which could be oxidized with post combustion systems is uncertain, and precise performance guarantees are expected to be difficult to obtain from equipment manufacturers because of the lack of operating experience. In addition, there is the potential for additional emissions of NO_x and CO_2 from auxiliary fuel combustion. Further, due to the heat and particulate loading, the burners would have a short life expectancy, and may sustain severe maintenance and reliability problems. Additionally, a single or multiple duct burner system would not be able to heat the relatively cool gases from the SAF during cold cycling. Potentially, there are two locations where post combustion chambers can be installed, i.e., upstream or downstream of an SAF baghouse. Locating upstream of the baghouse would take advantage of slightly elevated temperatures in the exhaust gas stream. However, at this location, the post combustion chamber would be subject to high particulate loading. The units would be expected to foul frequently from the particulate accumulation, and the burners would have severe maintenance and reliability problems. Thus, the installation of the post combustion chamber upstream of the baghouse is considered technically infeasible. Alternatively, the post combustion chamber could be installed downstream of the SAF baghouse. However, even at this location, fouling due to particulate matter can occur and more importantly, even cooler exhaust temperatures would be encountered. These cooler temperatures would greatly increase the auxiliary fuel requirements. Further, the combustion of additional fuel will result in increases in emissions to the atmosphere.

Based upon the above discussions, the use of a post combustion chamber is considered technically infeasible for the silicon production operations and will not be considered any further in this BACT analysis.

(e) Catalytic Incineration -- Based upon a review of the previously listed information resources, there is no known application of catalytic incineration to control VOC emissions from silicon production operations. Catalytic incinerators use a bed of catalyst that facilitates the overall combustion of combustible gases. The catalyst increases the reaction rate and allows the conversion of CO to CO_2 at lower temperatures than a thermal incinerator. The catalyst is typically a porous noble metal material which is supported in individual compartments within the unit. An auxiliary fuel-fired burner ahead of the bed heats the entering exhaust gases to 500 ^{o}F – 600 ^{o}F to maintain proper bed temperature. Recuperative heat exchangers are used to recover the exiting exhaust gas heat and reduce the auxiliary fuel consumption. Secondary energy recovery is typically 70 percent.

Catalytic incineration systems are limited in application due to potential poisoning, deactivation, and/or blinding of the catalyst. Lead, arsenic, vanadium, and phosphorus are generally considered poisons to catalysts and deactivate the available reaction sites on the catalyst surface. Particulate can also build up on the catalyst, effectively blocking the porous catalyst matrix and rendering the catalyst inactive. In cases of significant levels of poisoning compounds and particulate loading, catalyst replacement costs are significant.

As in the thermal incineration discussion, potentially, there are two locations where the incinerator can be installed, i.e., upstream or downstream of the SAF baghouse. For the same reasons discussed earlier (e.g., fouling due to particulate matter), the upstream location is considered technically infeasible. Alternatively, the incinerator can be installed downstream of the meltshop baghouse. However, even at this location, fouling due to particulate matter can occur, and further, the exhaust will be at a lower temperature. These cooler temperatures would greatly increase the auxiliary fuel requirements. The associated combustion of additional auxiliary fuel will result in an unacceptable increase in operating costs. Further, the combustion of additional fuel will result in increases in emissions to the atmosphere.

Due to the lack of application of catalytic incineration for SAFs and potentially adverse technology applicability issues, this control alternative is considered technically infeasible and will not be considered any further in this BACT analysis.

Step 3 – Rank Remaining Control Technologies by Control Effectiveness

All control alternatives identified in Step 2 were eliminated as not technically feasible for controlling VOC emissions from the SAF.

Step 4 – Evaluate the Most Effective Controls and Document Results

Good operating practices are only technically feasible control option in controlling VOC emissions from the SAF.

Step 5 – Select BACT

A review of USEPA's RACT/BACT/LAER Clearinghouse did not identify any BACT determinations for submerged arc furnaces or any other sources associated with the silicon production operations. Review of state permit information identified the following with respect to submerged electric arc furnaces at silicon production plants:

Facility/ RBLC ID	Permit Date	Process	VOC Limit	Add-On Controls
Globe Metallurgical Inc Niagara Falls, NY Permit#: 9-2911-00078/00009	11/26/10	Two submerged-arc semi-enclosed-type electric furnaces (22 MW/hr)	No limit	No control
Globe Metallurgical Selma, AL 104-0001	9/10/10	20 MW Electric Arc Furnaces (2) producing silicon metal	VOC: 5.7 lb/hr Capacity: 20 MW/hr VOC: 0.29 lbs/MW	No control
West Virginia Alloy, Inc. Alloy, West Virgina R30-01900001-2006	01/18/06	Electric submerged arc furnace No. 15 for the production of silicon metal and ferroalloys	VOC: 4.15 lb/hr Nominal Capacity: 2 tons/hr	No controls
Globe Metallurgical Inc Waterford, OH ID: 06-84-00-0105	10/24/01	Electric Arc Furnaces (Ferrosilicon and Silicon metal production furnaces)	None	No controls

As shown in the above table, VOC emissions from submerged electric arc furnaces are uncontrolled. None of the sources as reflected in the above table have proposed or successfully implemented any add-on control devices to control VOC emissions from SAF operation.

MS Silicon is proposing the BACT for VOC from the SAFs as follows:

- **Good operating practices; and**
- **Total VOC emissions from the SAF shall be limited to 2.4 lbs/ton (averaged over a 30-day period) of silicon produced.**

4.7.3 BACT Analysis for VOC Emissions from Natural Gas Combustion (AA-202)

Natural Gas Combustion Sources – Includes the following:

- Ladle Pre-Heaters (4 – 100 MMBtu/hr): 0.9 tpy VOC;

Step 1 – Identify Control Options, Step 2 – Eliminate Technically Infeasible Control Options, Step 3 – Rank Remaining Control Technologies by Control Effectiveness and Step 4 – Evaluate the Most Effective Controls and Document Results

There are no control options identified in the RBLC that are technically feasible to control VOC that is emitted in small quantities from each combustion unit. See below table for summary of VOC BACT determinations from the RBLC database:

Facility/ RBLC ID	Permit Date	Basis	Process	VOC BACT Limit	Controls
Mid-American Steel and Wire Company OK-0128	09/08/08	BACT-PSD	Ladle Preheater and refractory drying	0.0055 lb/MMBtu (total)	Combustion of natural gas
Nucor Steel AR-0090	04-03/06	BACT-PSD	Ladle Dryer	0.0006 lb/MMBtu	Good combustion practice
Republic Engineered Products, Inc OH-0303	08030/05	LAER	Ladle Dryers/Preheaters	5.5 lb/mmscf	Best operational and engineering practices, good combustion practices
Charter Manufacturing Co. Inc. Charter Steel OH-0276	06/10/04	BACT-PSD	Ladle Preheater and Dryers	0.005 lb/MMBtu	No controls

As shown in the above table, no add-on controls are used for VOC control from the small natural gas combustion equipment at ferroalloy facilities.

Step 5 - Select BACT

The RACT/BACT/LAER Clearinghouse (RBLC) and review of other permits reveal that similar natural gas combustion devices use fuel specifications and good combustion practices for controlling VOC emissions. No similar sized natural gas combustion devices were identified as using add-on VOC controls as BACT.

Thus, BACT is defined as combustion of clean fuel and good combustion practices. For the natural gas combustion sources associated with the proposed plant, combustion of natural gas and good combustion controls were the only control methods evaluated. Since the highest level of VOC control as noted above will be implemented by MS Silicon, an analysis of economic, energy and environmental impacts was not performed.

BACT for the VOC emissions from small natural gas combustion devices to be used to support the silicon manufacturing processes is as follows:

- **Combustion of natural gas;**
- **Good operating practices; and**
- **Total VOC emission limit of 0.0055 lb/MMBtu (AP-42 Emission Factor).**

4.7.4 BACT Analysis for VOC Emissions from Emergency Equipment (AA-501)

Emergency Equipment – Includes the following:

- Diesel-Fired Emergency Generator (1 rated at 670-HP each): 0.27 tpy VOC.

Step 1 – Identify Control Options

There are no control options identified in the RBLC that are technically feasible to control VOC that is emitted at from each piece of emergency equipment. See below table for summary of VOC BACT determinations from the RBLC database:

Step 2 - Technical Feasibility of VOC Control Alternatives

The emergency diesel generator will be used primarily for emergency situations, if any. However, to maintain the integrity of the equipment, the generator will be operated for 100 hours per year or less. Based on a review of similar emission sources, these emission sources typically do not have any add-on controls and should be operated per manufacturer's specifications.

Step 3 - Rank Remaining Alternatives by Control Effectiveness

The most effective method for control of VOC emissions from operation of the emergency fuel combustion devices is the use of fuel specifications that employ clean burning fuels, implementation of good combustion practices and use of combustion controls inherent to the design of the individual combustion devices.

Step 4 - Evaluate Most Effective Controls

Since there are no other feasible technologies to control VOC emissions from the emergency equipment, economic, energy and environmental impact analyses were not performed, nor are required by USEPA's Top-Down approach.

The following table lists the existing VOC BACT determinations for diesel fired emergency equipment. All data in the table is based on the information obtained from the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC), and electronic versions of permits available at the websites of other permitting agencies.

Facility/ RBLC ID	Permit Date	Process	VOC BACT Limit	Add-On Controls
Idaho Power Company ID-0018	6/25/10	750 KW Emergency Diesel Generator	6.4 G/KW-H	Tier 2 Engine, Good combustion practices
Consumers Energy (MI-0389)	12/29/09	2000 KW Emergency ULSD Generator	6.4 G/KW-H	Engine design and operation
Verenium (FL-0318)	12/10/09	2000 KW Emergency generators	6.4 G/KW-H	The emergency generator and fire pumps are both an Emergency Stationary Compression Ignition Internal Combustion Engine (Stationary ICE) and shall comply with applicable provisions of 40 CFR 60, Subpart IIII
		Emergency ULSD Fired Pump	3.0 g/hp-hr	
Associated Electric Cooperative Inc (OK-0129)	1/23/09	2200 HP low sulfur diesel emergency generator	1.55 lb/hr	Good combustion practices
		267 HP low sulfur diesel emergency fir pump	0.66 lbs/hr	Good combustion practices

As shown in the table above, BACT for the emergency equipment is compliance with NSPS IIII and good combustion/operating practices

Step 5 – Select BACT for VOC from Emergency Equipment

BACT for VOC emissions from the emergency equipment is proposed as:

- **Compliance with NSPS IIII; and**
- **Good combustion/operating practices.**

4.8 Summary of BACT Evaluation

As shown in this BACT evaluation, BACT is being proposed for each regulated air pollutant associated with the equipment/operations at the proposed plant. The emission limitations provided in Tables 4-1 through 4-6 represent BACT taking into account BACT limits established for recently permitted similar operations.

Section 5: Air Quality Impact Evaluation

As stated in the Code of Federal Regulations (40 CFR 52) and MDEQ rule APC-S-5, any application for a permit under the PSD provisions shall contain an analysis of ambient air quality in the area that the major project would affect. This requirement only applies to those air pollutants that would trigger PSD applicability (i.e., PSD review).

The proposed plant will be subject to PSD review for emissions of $PM_{10,}$ $PM_{2.5}$, NO_x, CO and SO_2. It is therefore necessary to determine if the proposed plant will have a significant impact on ambient air quality, defined by predicted impacts in excess of a Significant Impact Level (SIL). If the proposed plant has a significant impact on ambient air quality, then a demonstration of compliance with the National Ambient Air Quality Standards (NAAQS) and the Prevention of Significant Deterioration (PSD) Class II increments will be performed for those pollutants that have a significant impact on ambient air quality. The following subsections present the air quality impact analysis for emissions of $PM_{10,}$ $PM_{2.5}$, NO_x, CO and SO_2 as a result of the proposed plant.

An ozone impact analysis is required if VOC emissions from the proposed plant are more than 100 tons/year. Since VOC emissions from the proposed plant will be below 100 tons/year, an air quality impact evaluation is not required, which is consistent with federal and state PSD requirements.

A detailed description of the modeling approach and data requirements for the assessment of air quality impacts due to the proposed plant is included in this section. Currently, the analyses to estimate whether or not the project will have impacts in excess of the SILs or in excess of the Significant Monitoring Concentrations (SMCs) have been completed. It is our understanding that this project will be the first PSD permit in Tishomingo County. As a result, for each air pollutant that results in a significant impact, the corresponding PSD minor source date will be triggered. Subsequently, the proposed plant will be the only PSD Class II Increment consuming source. The results obtained from evaluating compliance with the PSD Class II Increments are provided as part of this application. Any required multisource impact analyses for demonstration of compliance with the NAAQS are pending. The results of such multisource impact analyses will be provided as an addendum to this document in the near future.

5.1 Selected Air Dispersion Model for the Project

The most recent version of the U.S. EPA regulatory model AERMOD (Version 11103), developed by The American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee (AERMIC) was utilized for this project. Regulatory default options available in the model will be used for the compliance demonstrations.

BREEZE AERMOD was used to prepare the input for and process the output from AERMOD. BREEZE AERMOD provides a graphical interface with geographic information system (GIS) capabilities to enhance the AERMOD model and aid the user with setting up the AERMOD input file and organizing and evaluating AERMOD output files. The U.S. EPA's approved regulatory AERMOD code which is used to predict ambient concentrations is unaltered by BREEZE AERMOD.

The AERMOD model family consists of several supporting pre-processor models. The following list summarizes the versions of AERMOD family software that were used for this air dispersion modeling analysis:

- AERMOD 11103;
- Building Profile Input Program for PRIME (BPIPPRM 04274); and
- AERMAP 11103.

5.2 Model Input and Support Data

Several data elements are required as input to support the dispersion model AERMOD, including:

- Representative hourly meteorological data;
- Potential points of predicted impacts, referred to as receptor points; and
- Terrain elevations for each individual receptor point.

Each of these data elements are discussed in the subsequent sections of this protocol.

5.3 Meteorological Data Selection and Pre-processing

MDEQ provides AERMOD View-ready meteorological (met) data sets consisting of five years of met data on their web site at the following url:

http://www.deq.state.ms.us/MDEQ.nsf/page/epd_AERMET_Preprocessedmetdata?OpenDocument

The North East Region met data set with surface data from the Tupelo Regional Airport and upper air data from Jackson provided by MDEQ is considered representative of the Project site. The met data was processed with AERMET View. The most recent five years of the met data, 2007 through 2011, was used for this air dispersion modeling project.

5.4 Coordinate System and Receptor Network

The AERMOD model objects were located using the Universal Transverse Mercator (UTM) coordinate system and North American Datum of 1983 (NAD83).

The receptor grid was designed to identify the maximum points of air quality impact due to the proposed plant and consisted of receptors extending to 50 kilometers from the proposed plant site. The ambient air boundary is defined by features which preclude public access from the plant site. Receptors were closely spaced (50 meters) along the proposed plant site's ambient air boundary to identify the influence of aerodynamic building downwash. The following receptor spacing was used for the receptor grid:

- 50-meter spacing along the ambient air boundary of the proposed plant site;

- 100-meter spacing from the proposed plant fence line to two kilometers out from the proposed plant site;
- 500-meter spacing from two kilometers to five kilometers from the proposed plant site;
- 1,000-meter spacing from five kilometers to ten kilometers from the proposed plant site; and
- 2,000-meter spacing from ten kilometers to fifty kilometers from the proposed plant site.

Figures 5-1 and Figure 5-2 present the receptor network used in the analysis.

5.5 Terrain Data Selection and Pre-processing

Terrain data was assigned to the receptor networks using the latest version of AERMAP (11103) and national elevation data (NED) files at 1-arc second resolution obtained from the United States Geological Survey (USGS) seamless data warehouse server. The elevation of buildings and sources on the site were based upon the planned finished grading of the site.

5.6 Project Emission Inventory

The emission inventory of the plant was based on the potential to emit emission rates provided in this air permit application to construct. The inventory is described in detail in Section 2.0 of this application with supporting backup calculations.

The emission inventory associated with the proposed plant is provided in Table 5-4, Table 5-5, and Table 5-6. AERMOD model objects – buildings, stacks, receptors on the fence line of the site – are depicted in Figure 5-3 and Figure 5-4.

5.7 Determination of the Significance of Project Contributions to Ambient Air Concentrations and Requirement for Pre-Construction Monitoring

The inventory of the proposed plant air emissions was modeled, and the predicted ambient air concentrations were compared with the PSD Class II SILs and the SMCs.

If the predicted concentrations are less than the SILs, the project is demonstrated to not cause or contribute to a violation of the NAAQS or PSD Class II Increments. If predicted concentrations exceed the SILs, further modeling is required to demonstrate that the project will not cause or contribute to a violation of the NAAQS or PSD Class II Increments. The significant impact area (SIA) is defined as the set of receptors at which predicted concentrations due to emissions from the plant are predicted to equal or exceed the SIL.

If the predicted concentrations are less than the SMCs, the plant will be exempt from the requirements to conduct pre or post construction monitoring under the PSD program. The statistical form of the modeled concentration is based on a 5-year National Weather Service met data set.

Tables 5-4a and 5-4b provides a summary of model predicted ambient air concentrations due to the plant and applicable SILs and SMCs. The statistical form of the modeled concentrations indicated in the footnotes of the table is based on a 5-year National Weather Service met data set. The predicted concentrations are appropriate for comparison with the SILs and SMCs.

The plant is predicted to contribute significantly to ambient air quality impacts for 24-hour and annual average PM_{10}, 24-hour and annual average $PM_{2.5}$, annual average, 1-hour, 3-hour and 24-hour SO_2, and 1-hour and annual average NO_2. The SIA distance for these criteria pollutants and averaging periods is provided in Tables 5-4a through 5-4d. Multisource impact analyses for each of these air pollutants to demonstrate compliance with the corresponding NAAQS is currently underway and will be provided to MDEQ as an addendum to this application under separate cover. The plant was predicted to result in predicted concentrations of emissions of CO below the 1-hour and 8-hour SILs, thus no multisource modeling analysis was required. The proposed plant will be below the corresponding NAAQS for emissions of CO.

5.8 Air Quality Monitoring

In addition to the requirement to conduct an air quality impact analysis, the PSD requirements also stipulate that an analysis be performed to assess ambient air quality for a pollutant in any area that the emission of that pollutant would affect.

To assess the ambient air quality from the proposed plant, an air quality impact assessment is typically performed and the predicted impacts are compared to the Significant Monitoring Concentration (SMC). However, for emissions of VOC, no SMC has been developed by USEPA.

If modeled concentrations are below the SMCs, then the requirement for pre- and post-construction monitoring is typically waived. Table 5-4b provides a comparison of the maximum predicted PM_{10}, $PM_{2.5}$, NO_2, SO_2, and CO concentrations, respectively, due to emissions from the proposed plant with the SMCs. Predicted PM_{10} and $PM_{2.5}$ concentrations are above the SMCs, and predicted NO_2, CO and SO_2 concentrations are below the SMCs.

Based on past discussions with MDEQ, it was concluded that sufficient ambient monitoring has been performed throughout the state of Mississippi and that the requirement to conduct any preconstruction or post construction monitoring for emissions of PM_{10}, $PM_{2.5}$, NO_2, CO and SO_2 will not be required by MDEQ. Thus, the requirement to conduct ambient monitoring is being waived by MDEQ.

5.9 PSD Class II Increment Compliance Demonstration

The PM_{10}, $PM_{2.5}$, SO_2 and NO_2 PSD Class II increment compliance demonstrations did not require preparation of a multisource air modeling inventory because the MS Silicon project sources are the only PSD increment consuming source for these regulated air pollutants, being the first major source of these air pollutants to go through PSD review in the area since the increment was established. The results of the air dispersion modeling, which indicates that the MS Silicon plant will be in compliance with the PSD Class II increments, are provided in Table 5-4c.

5.10 NAAQS Compliance Demonstration

As mentioned in the introduction provided in Section 5.0, a multisource NAAQS analysis is currently ongoing. The results of that analysis will be provided to the MDEQ as an addendum to this application. It should be noted, as summarized in Table 5-4d, the proposed plant's emissions of regulated air pollutants will result in predicted concentrations below the NAAQS. As a result, the proposed plant will not cause an impact to human health and welfare.

Section 6: Additional Impact Analysis

The potential impact of the proposed silicon manufacturing plant's air pollutant emissions associated with construction and related growth are presented in this section. Assessment of the proposed plant's impact on soil, vegetation, and visibility are also presented in this section. A qualitative approach to these analyses was necessary for those areas in which analytical techniques are not well established.

6.1 Construction and Growth Impacts

The project being proposed by MS Silicon will have minimal effect on construction and growth impacts. During the construction phase, MS Silicon will employ various techniques to minimize the potential impact on the surrounding environment. The primary focus will be to reduce the formation of fugitive type particulates that may be generated during the construction phase.

The construction and operation of the proposed silicon manufacturing plant should not result in any noticeable residential growth in the area. Commercial growth is anticipated to occur at a gradual rate in the future. However, this growth will not be directly associated with the proposed plant in Tishomingo County.

6.2 Impact on Soil and Vegetation

The secondary NAAQS are intended to provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings from adverse effects of airborne pollutants. This protection extends to agricultural soil. As demonstrated in Section 5, predicted concentrations of PM_{10}, $PM_{2.5}$, NO_2, CO and SO_2 resulting from the proposed plant will not cause or contribute to a violation of the NAAQS. Since the secondary NAAQS were established to protect human welfare, no significant adverse impacts on soil are anticipated due to the proposed plant in Tishomingo County.

The effects of gaseous air pollutants on vegetation may be classified into three rather broad categories: acute, chronic, and long-term. Acute effects are those that result from relatively short (less than 1 month) exposures to high concentrations of pollutants. Chronic effects occur when organisms are exposed for months or even years to certain threshold levels of pollutants. Long-term effects include abnormal changes in ecosystems and subtle physiological alterations in organisms. Acute and chronic effects are caused by the gaseous pollutant acting directly on the organism, whereas long-term effects may be indirectly caused by secondary agents such as changes in soil pH.

NO_2 may affect vegetation either by direct contact of NO_2 with the leaf surface or by solution in water drops, becoming nitric acid. Acute and chronic threshold injury levels for NO_2 are much higher than those for SO_2.

The maximum predicted NO_2 ambient concentrations due to the proposed silicon manufacturing plant are below the ambient air quality standards, which are designed to protect public health and welfare from any known or adverse effect of air pollutants, including effects on vegetation.

6.3 Analysis of Endangered Species

Potential emissions of regulated criteria pollutants associated with the proposed plant are presented in Section 2.0 of this PSD air permit application. An air quality impact analysis was performed for emissions of PM_{10}, $PM_{2.5}$, NO_2, CO and SO_2. As shown in Section 5.0, emissions of PM_{10}, $PM_{2.5}$, NO_2, CO and SO_2 from the proposed plant will result in potential impacts below the NAAQS that protect human health and welfare.

MS Silicon's facility will be located in Tishomingo County, Mississippi. It is possible there may be endangered species located in Tishomingo County. However, as stated above, air emissions resulting from the proposed plant result in model predicted concentrations below the NAAQS. Therefore, these emissions are not expected to have a significant impact on endangered species which may be present in the county. In addition, maximum impacts from the proposed plant are in the immediate vicinity of the plant and it is unlikely due to the location of the proposed plant that endangered species would reside in these maximum impact areas. Table 6-1a presents the U.S. Fish & Wildlife Service's listing of threatened and endangered species in the State of Mississippi and Table 6-1b presents the list of threatened and endangered species in Tishomingo County.

6.4 Additional Air Quality Impact Analyses

As stipulated in the PSD regulations (40 CFR 52.21(o)) analysis of the impairment that would occur as a result of the proposed silicon manufacturing plant must be conducted. A discussion on this analysis as it relates to the proposed plant is provided below.

6.4.1 Impact on Visibility (Regional Haze Analysis)

As stated previously, the proposed plant will trigger applicability of the PSD regulations. One of the components of the PSD regulations includes the special protection of air quality and air quality related values (AQRV) at potentially affected nearby Class I areas. Assessment of the potential impact to visibility (regional haze analysis) is required if the source is located within 300 km of a Class I area. An evaluation may also be requested if the source's emissions are of sufficient size.

The nearest Class I area to the proposed plant site is identified below:

Class I Area	State	Approximate Distance (Project Site to Class I Area) (km)
Sipsey Wilderness Area	Alabama	100

Figure 6-1 presents the location of the proposed plant in Tishomingo County, Mississippi in relation to the Sipsey Wilderness Class I Area in northern Alabama.

The largest source of regulated air pollutants will occur from the plant's SAFs. As mentioned previously, the SAFs will be installed in phases and will be designed with a baghouse to minimize $PM_{10}/PM_{2.5}$ emissions prior to the associated exhaust gases exiting a 300 foot stack. Predicted concentrations of PM, NO_2 and SO_2 significantly drop with downwind distance from this plant. All other potential emission sources have been shown to result in their maximum concentrations at the property fence line or within one (1) kilometer of the proposed plant based on the configuration of the plant and being located east of the proposed plant site (not downwind of the plant based on the area's predominant wind flow south to north, and southwest to northeast), the proposed plant should have no effect on visibility impairment or resulting concentrations above the Class I increments.

The USDA Forest Service has requested that an AQRV Modeling Analysis for Sipsey Wilderness be included in the PSD permit application. The results of this analysis will be submitted as an addendum to this application upon completion.

Section 7: Suggested Permit Structure

Refer to the following tables for suggested permit language:

- Table 7-1 – Proposed Permit Conditions – Part II – Emission Point Descriptions;
- Table 7-2 – Proposed Permit Conditions – Part III – Emission Point Specific Limitations and Standards;
- Table 7-3 – Proposed Permit Conditions – Part IV – Emission Point Specific Compliance / Performance Requirements; and
- Table 7-4 – Proposed Permit Conditions – Part V – Emission Point Specific Recordkeeping / Reporting Requirements

Section 8: MDEQ Application Forms

Included in this Section are the relevant application forms that are required to accompany a request for a construction permit. The follow forms are provided in Appendix A:

- General Form;
- Additional Information Required for Applications, Existing Source Operating Permits, and for Approval to Construct;
- Emission Summary Section – Part I Stack Parameters;
- Emission Summary Section – Part II Regulated Air Pollutant Emission Rates;
- Emission Summary Section – Part III Regulated Hazardous Air Pollutant Emission Rates;
- Application Summary Section;
- Fuel Burning Equipment;
- Manufacturing Process Operations;
- Tank Summary; and
- L4 - Air Pollution Control Devices – Baghouse.

For purpose of streamlining the application, the forms make reference to tables within the application that provide the required information.

PCC SE

SILICON METAL PLANT AT BAKKI IN HÚSAVÍK
WITH PRODUCTION CAPACITY OF UP TO 66,000 TONS

ENVIRONMENTAL IMPACT ASSESSMENT

Environmental Assessment Statement
May 21st 2013

DRAFT VERSION

ATTN: The official document is in Icelandic.
English translation by EFLA Consulting Engineers

EFLA
CONSULTING ENGINEERS

Front page photo: Mats Wibe Lund

Information sheet – Silicon metal plant at Bakki by Húsavík Environmental Impact Statement				
Authors: **Ólafur Árnason** **Alexandra Kjeld** **Friðrik Klingbeil Gunnarsson**	*Date.* **21.05.2013**	*Project:* **4507-001**		*Report number:* **N/A**
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SUMMARY

PCC SE plans to build a Silicon Metal plant at Bakki in Húsavík, with the production capacity of 33,000 tpa and power requirement of approx. 52 MW. The plant will be designed with the further expansion capacity of up to 66,000 tpa and a 104 MW load. The plant will be allocated on approximately 22 ha area within the industrial area at Bakki in Norðurþing municipality. The energy required for the production will be provided by geothermal plants in the geothermal region of Northeast Iceland. It is estimated that the plant will create 150 new jobs, not accounting for auxiliary positions created due to purchase of services and energy.

The project is subject to environmental assessment, in accordance with Annex 1 of the Environmental Assessment Act no. 106/2000. PCC SE has appointed EFLA Consulting Engineers to carry out the project's EIA.

Environmental Impact Assessment

This EIS addresses the environmental aspects that may be subject to considerable impacts due to the project's realization, both during construction and operation.

Emphasis is put on the following environmental aspects: Air Quality and Climate, Noise, Marine and coastal areas, Flora, Birds, Landscape and Visual impacts, Archaeological remains, Environmental Impacts during Construction, Social impacts, and Risk and security.

Air Quality and Climate

The effects of emissions on the Air Quality were modelled. The results showed an increase in the concentration of particle matter (PM10), sulphur dioxide (SO_2) and ammonia dioxide (NO_2), the estimated concentration is within the regulatory limit. The release of polycyclic organic pollutants (POP), polycyclic aromatic hydrocarbons (PAH) and benzo (a) pyrene (BaP) is low and well within the reference values. The production process will release considerable amounts of carbon dioxide (CO_2), the increase is within the boundaries of the expected increase in CO_2 levels, through 2020, according to the government's action plan on climate change. Emissions from PCC, when combined with emissions from other metal production companies within the assigned industrial area, can result in an increased risk of cumulative effects due to the release of chemicals in the atmosphere. Additional information of the location and release of chemicals by other companies is required for further analysis. The cumulative effects are considered to be local and dependant on specific weather conditions. With regards to the nature and scope of the effects on air quality and climate, the effects of the project are considered to be negligible.

Noise

Noise from the operation of a Silcon metal plant comes from both daily operation of the plant and harbour operations associated with the plant (i.e. unloading, loading and transportation to/from the plant). To estimate the noise effects, a model of the noise distribution was developed and the sound level calculated. Where residential areas are in close proximity to industrial area, the acoustics will meet the regulatory limits for noise due to both traffic and operations. The regulatory limits for noise will not be met without mitigation measures at the plant site boundaries due to close proximity of major noise contributors such as fans on dedusting, transformers and furnaces. The effects of the silicon metal plant in Bakki on noise are considered to be **negligible**, except in close proximity to the plant site and the harbour where tasks associated with it are performed.

Flora

The impact evaluation is based on field research, national registry and previous studies. In total, 108 species of high plants were found in the research area, mostly dry land plants since little wetland is in the research area. A few mosses, lichens and fungi species were identified, but no special focus was on the collection or analysis of these organisms. Heathland is prominent in the area but there are also spots where grasses are prevalent and

eroded areas with spreading Alaska lupine. Wetland is mostly found in the northernmost part, in proximity to River Bakkaá . No red list plant species were found during field research or in recent studies. The environmental impact of the project is mainly due to loss of vegetation removed during constructions, i.e. buildings, roads and car parks. Impacts on wetland vegetation near River Bakkaá are not expected due to changes in the riverbed and flow.

The proposed project is considered to have a ***considerable negative impact*** on vegetation and, since vegetation cover will be disrupted and the changes are irreversible. Possible mitigation measures include land reclamation using Icelandic plants, common in the area.

Birds

The impact on birdlife is based on field research, previous studies, international agreements and lists of species in threat of extinction and rare species. Based on observations and previous studies, 17 bird species are believed likely to breed in the research area, many of which are considered responsibility species in international cooperation. Breeding densities of grassland or heathland birds is assumed high in the investigation area. Bird species that are subject to impact due to the project are common, both nationally and within the region. Since the area of impact is relatively small, the construction is not believed to have an impact on the population size of species that breed on the industrial area or use the site in any other way. The proposed project is assumed to have a considerable negative impact on birdlife **within** the site.

Landscape and Visual Impacts

The effects of the Silicon Metal plant on the visual appearance of the area are foremost due to the proposed buildings at the plant site, with contributions from landscaping and land forming

The most apparent proposed structures are the furnace building and casting area with a height of 37,5 m, filter plant and raw material storage facilities at a height of 27 m and product crushing and storing at a height of 24m. All other structures have a considerable less height and therefore impact.

The effects on landscape are only thought to be local, but considerable within the plant site. No areas that are thought to have value due to their landscape features will be disrupted.

The effects on landscape are ***considerably negative*** permanent but reversible.

The Silicon Metal plant will generally not touch the skyline, since the lot is located in a slope and structures are therefore covered by land from most viewpoints. Though, it can be assumed that structures will be visible and touch the skyline seen from the national road and from the houses at Héðinshöfði 1 and 2. A reduction of view is small, but evident from areas north of the plant.

The visual impact is ***considerably negative***, permanent but reversible from areas north of the plant and from above, that is from the national road, from Gónhóll and other areas close to the plant. The impact is permanent but reversible. The plant is not visible from Húsavík.

Archaeological Remains

The impact on archaeological remains was assessed on the basis of two archaeological studies, national registration and the National Heritage Act. A total of 21 remains were found in the studies, including an old path, mounds and a burial site. The mean preservation values of remains situated in the area south of River Bakkaá is 2.5, which is considered low, and none is believed in need of protection. The highest value (7) is assigned to remains at a location with a supposed fox trap. In this area, it is the archaeologist's opinion that the effects of the project are highly acceptable, assuming full consideration during and after construction and taking appropriate mitigation measures if needed. Appropriate mitigation measures include recording the exact location, digging examination ditches and labelling remains. In the study performed in the area at and around River Bakkaá , the remains are

considered to be at risk due to the proposed project. No monumental value was assigned to those remains, but labelling is suggested to reduce the risk of disruption. If disruption cannot be avoided, authorization must be granted by the Archaeological Institute that also decides appropriate procedures and measures to be taken. Assuming all mitigation measures be taken where and when necessary, the impact is regarded as ***negligible***.

Environmental Impacts during construction

The assessment of environmental impacts during constructions focuses mainly on the temporary impacts on residents in Húsavík and nearby areas, i.e. due to transport of building materials, operation of heavy machinery and site preparation during construction. The plant will be constructed on an industrial property north of Húsavík, the closest houses situated approximately 1.2 km away from the south border of the plant's site. Given the distance from the village to the plant's site, it is unlikely that noise from on-site construction work will have an impact on residents of Húsavík. During hot and dry weather periods earth works might however cause dust pollution. This can be avoided by covering truckloads and spraying eroded areas during dry periods. Assuming the new road from the harbour to the plant's site is ready before beginning construction, and that appropriate mitigation measures are taken, the project will have a negligible impact on residents during the plant's construction, mainly due to increased traffic and noise. This impact is estimated to increase to considerable ***negative*** effect if the new road is not ready before plant construction, due to decreased traffic safety and increased noise.

These effects can be limited to an acceptable degree with several methods, such as selected transportation timing, definition of main transportation routes and marking of them.

Social Impacts

The assessment of the social impact of the project, both during construction and operation, is based on a previous EIA study and a study on the infrastructure in Northeast Iceland. The assessment focuses on impacts on population development, the labour market and on the municipalities in the region. The local region of Húsavík showed a population decline over a ten year period 2001-2010, especially among children and young adults. Services and administration within the municipalities can mostly accommodate a significant increase in population without having to expand, with the exception of pre-schools and health services. The construction of the Silicon Metal plant is believed to create around 200 man-years during the construction, and is considered to have a temporary positive impact on population development; labour force and the municipalities, due to jobs created and increased service demands from the municipalities, especially in health services. The operation of the plant will provide new permanent jobs; not including jobs created indirectly in relation to the project, and create revenues for the municipalities. The operation of the plant will therefore have a substantial ***positive*** impact on the population development, labour force and the municipalities.

Risk and Safety

The assessment of impacts due to risks to the health and safety of people and the safety of the environment is based on acts and regulations on buildings and structures; fire safety and other safety regulations; and documents on natural hazards, especially concerning earthquakes. The main risk issues are the risk of explosion where LPG is stored and risk of dust explosion in the material storages. The operation is planned in a seismic region, but other natural catastrophes are no significant threat to the operation. Risk management will be carried out to mitigate risk and to ensure they are dealt with appropriately. Performance based safety design and risk analysis will be carried out for the appropriate buildings, i.e. the storage of flammable gasses and raw materials and the risk factor accounted for in the design. All systems, i.e. fire detection and suppression systems, egress paths, fire fighting facilities etc. be according to regulations. The structures will be designed for appropriate

seismic loads and fire. Risk analysis will be done on the effect of exhaust, waste, gas leakage or other factors and the effect on the health of people, property and the environment. Transformers, large fuel loads in storage facilities and the storage of LPG and oxygen call for the capacities of the fire brigade at Húsavík to be expanded. PCC will prepare a response plan on acute pollution of the sea in connection with an application for an operation permit. No raw materials transported through the port and used by PCC can cause acute pollution of the sea. Oils within transformers and fuel oil will be kept on site and proper safety cautions will be carried out for those. With appropriate measures, the emerging risks from the operation at Bakki can be minimised and the environmental impact due to hazardous events kept to a minimum. The effects are therefore considered to be ***negligible***.

Ocean and coastal areas (*Other alternatives – Sea water cooling*)

One option for cooling heat formed during the production is the use of seawater. This option can cause effects due to heat dispersion from cooling water and direct effects on the biota at the coast of Bakki. The cooling system itself will be closed and therefore no risk of pollution due to emission from the system. Calculations of the impact of the release of warm seawater at 5 meters depth show an impact area where the temperature rises by 1.2°C, which is below the maximum temperature of 2°C allowed to rivers and lakes outside of dilution zones. This calculation was carried out for both phases with similar results.

The construction of the seawater intake infrastructure will cause considerable disruption and alteration of the environment on a limited area at the Bakkakrókur shoreline, when parts of the shore will be excavated and covered with course wave breaking material. Although the construction itself is considered insignificant in comparison with the area it is affecting the long term impact is considered to be significant if sediments accumulate along the outlet and cause changes in the sea floor and benthic fauna. Furthermore, the accumulation could reduce diversity and quantity of costal biota. A possible mitigation measure is to situate the outlet pipe in shallow basins between the bedrock cuts to minimize the coastal surface impacted. It is therefore the conclusion that the impact of the option of sea water cooling can cause a ***considerable negative impact*** on a limited area on the Bakkakrókur coast.

Other aspects of the proposed Silicon Metal plant will not affect marine and coastal areas in any way.

Results

There will always be some environmental impact with a project of this magnitude. The direct effects of major factors, i.e. visual impact, are isolated to the plant site and areas in close proximity. The proposed PCC Silicon Metal plant will be located on an industrial site, just to the north of Húsavík. During the construction and operation of the plant, mitigation measures will be taken to minimize the environmental impact from the plant. The positive effect on the community is most apparent and would reach Norðurþing as well as neighbouring municipalities. Overall, the developer concludes that the environmental impact of the proposed PCC Silicon Metal plant is ***acceptable.***

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1 INTRODUCTION

1.1 General

PCC is an internationally operating group of companies under the leadership of PCC SE (formerly PCC AG) based in Duisburg, Germany. PCC today employs approximately 2,200 employees in 13 countries around the world. The company's sales generate from three main divisions: chemicals division, energy division and logistics division. The company plans to begin operations in Iceland, with the development of a Silicon Metal plant in Northeast Iceland. The production amounts to 33,000 tpa of Silicon Metal for a 52 MW power load, with a future expansion capacity of up to 66,000 tpa and a total of 104 MW power load. It is estimated that the plant will create 150 new jobs, not accounting for auxiliary positions created due to purchase of services and energy. The energy required for the production will be provided by geothermal plants located in the county of Þingeyjarsýsla, Northeast Iceland

1.2 Environmental Impact Assessment

1.2.1 Reference to EIA requirements

The project is subject to environmental assessment, in accordance with Annex 1 of the Environmental Assessment Act no. 106/2000. The Annex lists projects that are always subject to environmental impact assessment: „Plants running operations of primary production and remelting of metals".

This Environmental Impact Statement is based on a Scoping Plan approved by the National Planning Agency on February 2, 2012.

1.2.2 EIA management

The project developer PCC SE has appointed EFLA Consulting Engineers to carry out the environmental impact assessment for the project. Project management is summarized in Table 1 and the experts for assessments of individual environmental issues in Table 2.

Table 1: *EIA management for PCC SE's Silicon Metal plant at Bakki in Húsavík.*

Company	Function	Employee
PCC SE	Project Development Management	Dr. Sabine König
EFLA Consulting Engineers	EIA Management and IEIS editorial	Ólafur Árnason

Table 2: *Expert Consultation for PCC SE's Silicon Metal plant at Bakki in Húsavík.*

Company	Function	Employee
EFLA Consulting Engineers	Air pollution	Friðrik K. Gunnarsson
EFLA Consulting Engineers	Noise	Gígja Gunnlaugsdóttir
Ólafur Einarsson, biologist	Birdlife and vegetation study	Dr. Ólafur Einarsson
North East Iceland Nature Center	Marine Biology	Þorkell Lindberg Þórarinsson
The Archaeological Office	Archaeological remains	Dr. Bjarni F. Einarsson Oddgeir Isaksen
EFLA Consulting Engineers	Risk and security	Böðvar Tómasson

1.2.3 Summary of the EIA process

The method used for the environmental impact assessment is in accordance with the Environmental Assessment Act no. 106/2000 and regulation no. 1123/2005. The assessment process is detailed in Figure 1.

Further information on the EIA process can be found on the NPA website, www.skipulag.is. This IEIA report will be submitted to the NPA for examination. According to the law the NPA has 4 weeks to deliver their opinion on the EIA for the project.

1.2.4 EIA and project schedule

The Initial Environmental Impact Statement is scheduled for submission to the National Planning Agency in May 2013. The agency's opinion is subsequently expected in July 2013.

The construction of the PCC Silicon Metal plant is set to begin in 2014 and finish in 2015 for the first project stage with 33,000 tpa production capacity.

1.2.5 Changes from the approved Scoping Plan

During the preparation of the project two alternatives have been up for consideration in regards to cooling. The first alternative is air cooling where cooling tower will be located within PCC's premises. A second alternative is cooling using sea water. For the second alternative it is proposed that a pumping station is located by the shoreline outside of PCC's lot. During the environmental impact assessment, additional information where gathered for potential effects on the shoreline's biology and birds by the shore. This information is provided in chapter 7.1.

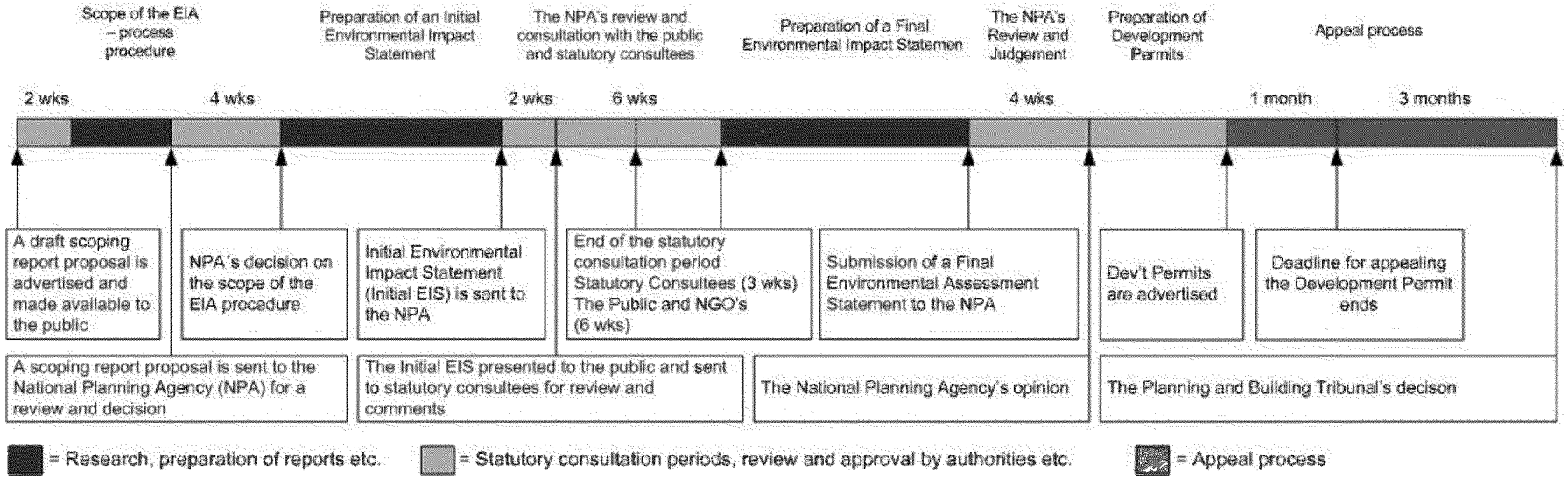

Figure 1: *Environmental Impact Assessment Process, in accordance with the Environmental Assessment Act no. 106/2000.*

2 PROJECT INFORMATION – ALTERNATIVE 1

2.1 Purpose and objectives

Industrial development at Bakki in the town of Húsavík is in accordance with the urban development plan of Norðurþing municipality. The industry's energy requirement will be provided by geothermal plants in the geothermal region of Northeast Iceland. The development of PCC SE's silicon metal plant is underway and located within the industrial area.

The plant will produce approximately 33,000 tpa of silicon metal during the first stage. The plant's total estimated power load is 52 MW for the operation of two electric arc furnaces (SAF, see chapter 2.3) and the relative auxiliary and peripheral equipment and facilities. The plant will be designed for future expansion, i.e. the addition of two SAFs of same dimensions, adding a total estimated plant load of 104 MW and production capacity of 66,000 tpa. Raw materials, i.e. quartzite (or quartz, see chapter 2.4.1), coals, wood, limestone and consumption material such as carbon electrodes, spare and wearing parts and refractory materials will be imported and shipped to the harbour at Húsavík, situated in proximity of the plant. The plant output, i.e. silicon metal and by-products of silicon-containing material in the form of slag and contaminated residues, will be exported to the worldwide market.

The plant will be built according to Best Available Technology (BAT), applying high heat utilization, closed cycle processes, best control of process performance, emissions without measurable discharges to surface water and ground water. No hazardous waste is associated with this silicon production process. The plants applied technology for the production and treatment facilities will be detailed later in this chapter.

2.2 Construction area and location of buildings and infrastructure

The plant will be built on a premises of approximately 22 ha (219,800 m^2), within an assigned 201 ha industrial area of Norðurþing municipality (see **Figure 12** and **Figure 13** in chapter 4). Plant dimensions, including building sizes and storage spaces, are listed in Table 3 and displayed in **Figure 3**. A preliminary model of the plant layout is displayed in **Figure 2**.

Total ground area is approximately 60,000 m^2 and total floor surface approximately 160,000 m^2. Total building volume is around 1 million m^3. Most of the buildings will be 5 – 12 m high, but highest points of elevation, the tip of the furnace building are approx. 37,5 m.

Figure 4 shows a photomontage of the actual PCC SE Silicon Metal plant as seen from the north.

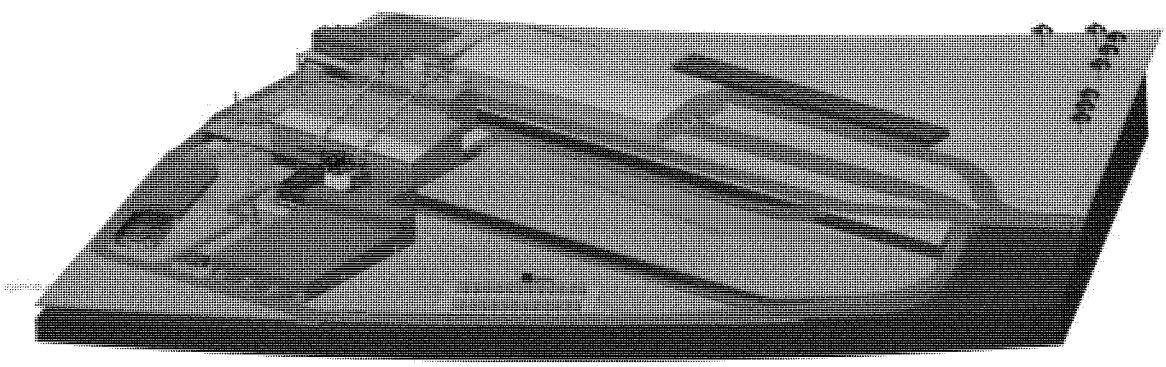

Figure 2: *Preliminary model of the PCC SE Silicon Metal plant layout at Bakki in Húsavík.*

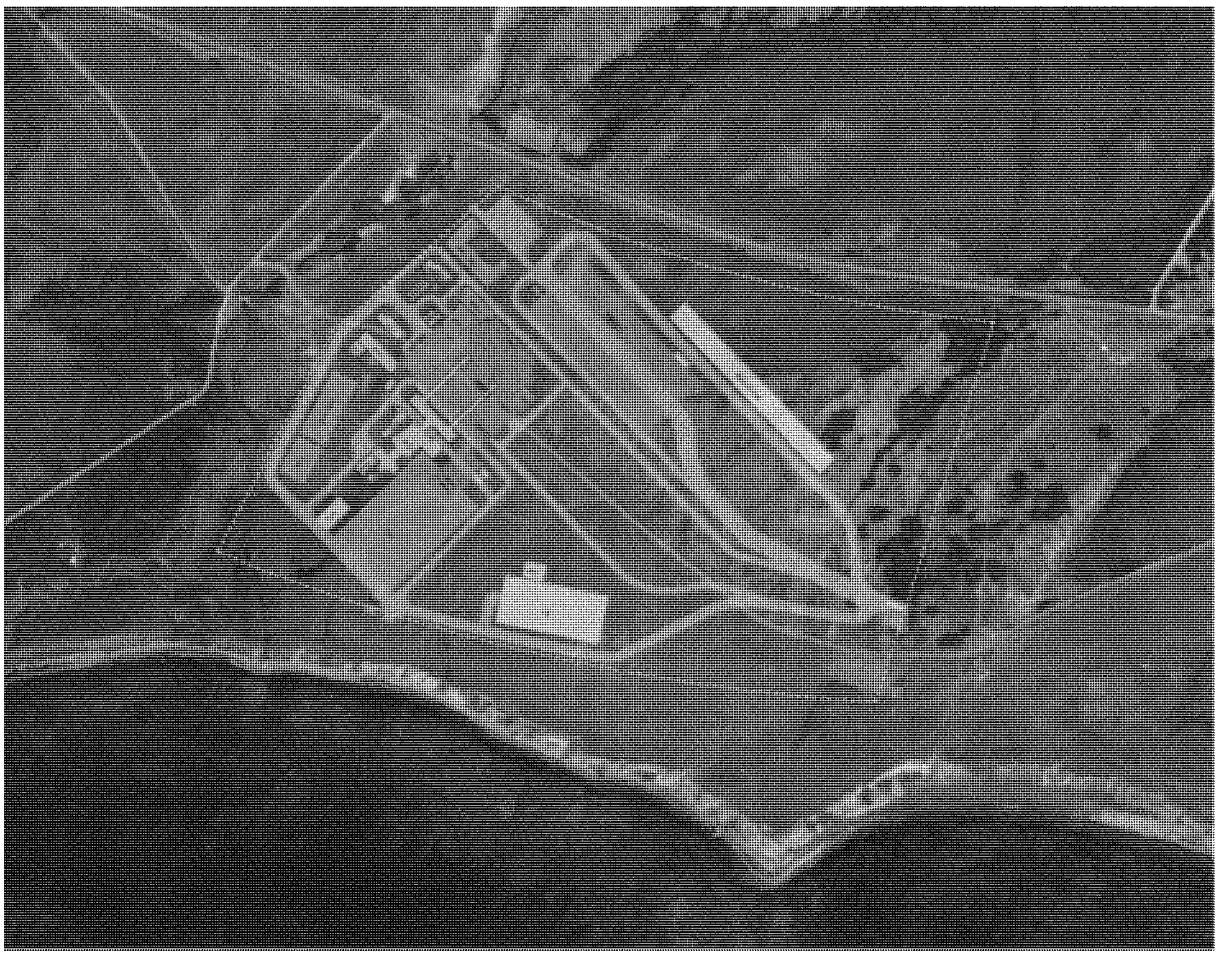

Figure 3: *Overview of PCC SE Silicon Metal plant layout, showing location of plant buildings on the plant's assigned premises at Bakki in Húsavík.*

Table 3: *Building and infrastructure dimensions for the PCC SE Silicon Metal plant layout at Bakki in Húsavík.*

Facilities	Ground area (m^2) for 33,000 tpa	Ground area (m^2) for 66,000 tpa	Height (m)
Furnace building, casting area	8.160	16.320	14 - 37,5
Bag house filter plants	4.210	8.420	27
Product storage, product crusher	8,450	8,450	23,6
Raw material storage facilities/logging area	10.880	21.760	27
Workshops and warehouse	1.625	1.625	8
Log area	3.600	3.600	-
Administration, canteen, social facilities, and central laboratory	2.133		7
Garage	450	450	5
LPG Storage	16,5	16,5	3
Fuel Station	450	450	roofed
Water treatment, etc.	2 x 800	2 x 800	~ 5
Cooling water plant	585	585	7
Substations	4x 150	8x150	6
Parking lot	800	800	-
Container area	4.365	4.365	-
Switchyard			

Figure 4: *Photomontage showing the PCC SE silicon smelter at Bakki by Húsavík as seen from the north. (Photo: Mats Wibe Lund).*

2.3 Production process

The plant will be designed and built to produce Silicon Metal (≥ 98.5%) from imported raw materials; quartzite and the carbon materials; low-ash reactive coal, low ash coal char, char coal, woodchips and small amounts of limestone.

The raw materials will be transported on ship to Húsavík harbour and from there by trucks to the raw material storage on site using an industrial road and tunnel the Icelandic Road Authorities (Vegagerðin) plans to build to serve the industrial area. In this way traffic by-passes the densely populated area in Húsavík. During normal operation of the logistic chain, no storage of bulk materials is foreseen at the harbour area.

The raw material storage will be located south-east of the furnace building on an area of approximately 10,900 m^2. The materials will be stored outdoors in compartments under roof, except for quartz which will not be covered but with a spray-system installation to prevent dust formation. Logs for the production of wood chips will be stored on a 3,600 m^2 outside area located behind the raw material storage, but the preparation and storage of wood chips will be under a roof. Each compartment will have a concrete floor and reinforced concrete walls to provide sufficient fire protection for different materials. The roof is made of steel girders and steel cladding. The maximal height of bulk coals and bulk woodchips will be ~4.5 m to prevent spontaneous combustion. The raw material will be transported from the raw material storage by underground conveyors to the day bins located inside the furnace building.

For the first phase the production will take place in two electrical submerged arc furnaces, each operated at a nominal load of 24 MW, producing ca. 32,000 tpa of finished silicon metal, i.e. producing roughly 33,600 tpa before assumed 5% losses due to tapping/crushing (2%), oxygen blowing (1%) and ladle losses (2%) Operating times of >99% of the available time can be achieved in average, but at the beginning the operating time should be at least

above 95%. A load factor of 100% is expected during operation. The production will use prebaked amorphous carbon electrodes.

In the second phase the production capacity will be increased by adding two further furnaces south of the furnace building. After the second phase the total production capacity of the plant will be 66,000 tpa with a total nominal load of 96 MW. The second phase also involves an increase in other facilities such as the dedusting plants; raw material and product storages; and the log area. An enlargement of the administration and canteen building; the cooling water plant; and the fuel station is not planned in the second phase.

In addition to the electrical load required for the smelter operation, the plant requires approximately 4 MW to operate the exhaust treatment. In total the electrical load required for the plant is estimated to be 52 MW in the first phase. With the further expansion, i.e. the addition of two SAFs of same dimensions, the plant will have an estimated total electrical load of 104 MW.

The quantity and mixing of the raw materials or the preparation of the feed mixes (batches) is controlled be the batching system and the transfer system between batching system and furnace silos. Eight to ten complete batches are prepared every hour and conveyed into the relative furnace silos. The feed mix is loaded into the furnace through charging tubes. The furnace burden is stoked and piled up towards the electrodes by a stoking machine to promote a continuous and uniform flow of the raw materials through the furnace shaft and into the reaction zones.

The major part of the quartz is reduced with reactive reductant coal to SiC which represents the main reducer for the remaining unreacted quartz in the reaction zone underneath the electrode tips.

The overall reactions of the Silicon Metal process follow the equations:

$$SiO_2 + 2C = Si + 2\{CO\}$$
$$SiO_2 + 3C = SiC + 2\{CO\} \quad \text{(furnace shaft)}$$

This reaction transforms about 66% of the Silica and 100% of the Carbon available in the feed mix into Silicon Carbide.

The final reaction takes place in the reaction zone above the furnace hearth at temperatures well above 1.835°C. The arc between the electrode tips and the hearth maintain temperatures up to >2.000°C which are needed for the final reaction between Silicon Carbide and the Silicon Oxides (SiO_2 and SiO):

$$2SiO_2 + 3SiC = 4Si + \{SiO\} + 3\{CO\}$$
$$SiO + SiC = 2Si + \{CO\}$$

These combined reactions transform the available Silicon in form of SiO_2, SiO and SiC at highest temperatures in the reaction crucible to condensed Silicon that accumulates in the metal bath and is tapped as Silicon Metal.

The overall reaction is never complete but Silicon recoveries can be as high as 95% with well controlled Process performance. The correct dimensioning and set-up of the furnaces and auxiliary or peripheral equipment and the skilled operator personnel play a major role in the overall plant performance.

Figures 5 and 6 show a typical submerged arc furnace of similar type as will be used in the PCC plant.

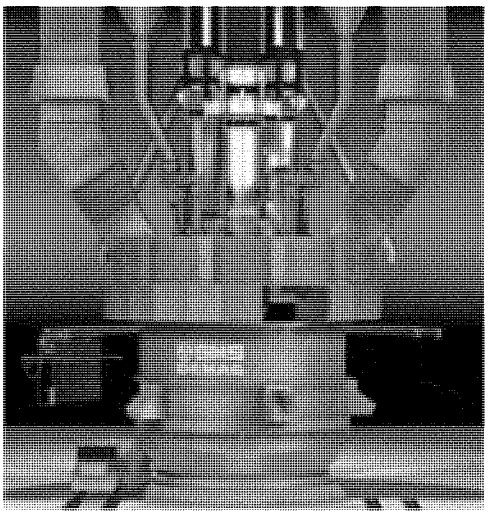

Figure 5: *Submerged arc furnace (Source: SMS Siemag).*

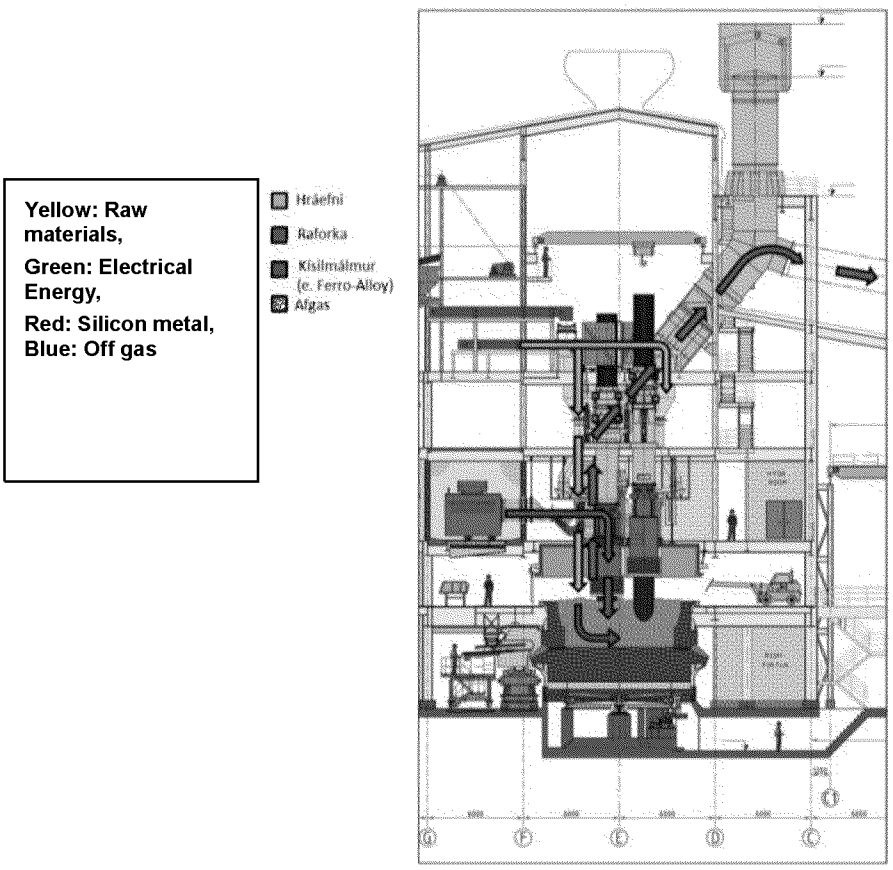

Figure 6: *Submerged Arc Furnace for the production of silicon metal (Source: SMS Siemag).*

The smelting and production of the silicon metal takes place in Submerged Electric Arc furnaces, see Figure 6. The furnace is divided into two sections, an upper part above the smoke hood and a lower part where the actual reaction and the production of the silicon metal takes place.

The raw materials (yellow) are fed from the day-bins through feeding channels in the smoke hood and into the furnace. The pre-baked carbon electrodes are placed in the top of the oven and reach down through the smoke hood into the lower part of the furnace, where the

reaction takes place. In the smoke hood, the off gasses (blue) are collected and transported to the air treatment units/bag house filters and also heat is conveyed out of the furnace building.

Regularly, the metal is tapped from the furnace into ladles, re-fined and casted into moulds in the casting bay. After cooling down, the ingots are pre-crushed and stored in the intermediate storage within the furnace building. From the intermediate storage the product is transported to the product crusher bay. After crushing, the product is screened and packed and stored before transport.

Part of the process involves intermediate compounds such as silicon carbide ($SiC_{(s)}$) and silicon monoxide ($SiO_{(g)}$) gas, which can escape the process and significantly reduce the yield of the silicon metal. In the furnace shaft a major part of the Silicon monoxide can be recovered and recycled into the furnace hearth where it participates in the final process. In the production solid waste is produced only in small amounts, because most of the content of the raw materials is transformed to Silicon Metal; a certain part moves into the slag and a considerable part leaves the furnace as silicon monoxide {SiO}, oxidises and precipitates as Micro Silica captured in the bag house filter. All exhaust from the furnace and the ladle (refining process) is captured.

The production process produces slag only in little amounts and most impurities pass over from the raw materials and consumables into the product or by-product (Micro Silica). A refining step will be implemented to reduce the amount of certain impurities in the tapped metal. The refining is done by injecting Oxygen-enriched air through a porous plug in the bottom of the ladle. Any exhaust from this process will be treated in the same way as any other exhaust from the plant. No water is used in the production or cooling process, therefore no production water is discharged into sewage

Figure 7 provides an overview of processes in the production of silicon metal.

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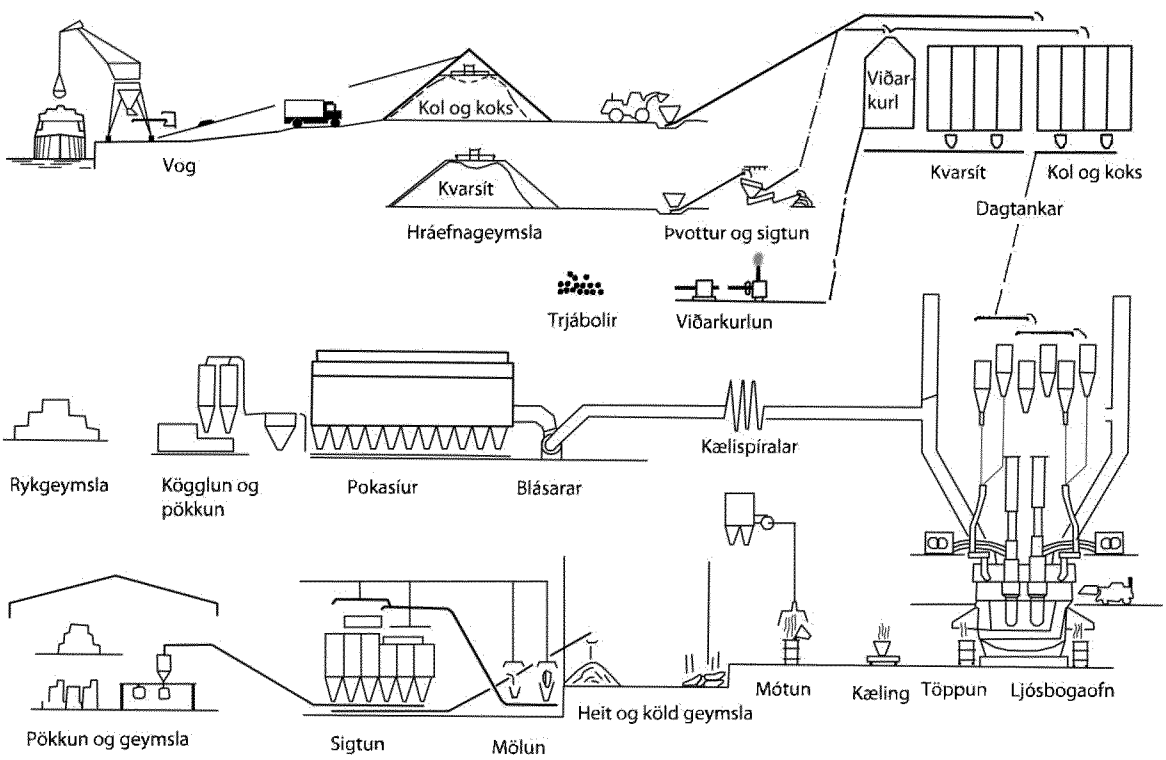

Figure 7: *Simplified diagram for the production of silicon metal.*

2.4 Process materials

The main raw materials used for the production of Silicon Metal are quartzite, low-ash high volatile reactive coals (mainly from Columbia, Venezuela, and USA), char coal, wood chips and small amounts of limestone for metallurgical corrections. Other main consumption materials are pre-baked Carbon Electrodes which might be substituted with the composite electrode system as used today for all furnaces with electrode diameter of ≥45", graphite lances, tapping tools, plugging materials, oxygen, compressed air, porous plugs, fresh water and chemicals for the treatment of the cooling water, graphite crucible for the sampling of liquid metal and disposable thermo-couples for measuring metal temperature. Altered from the initial plan as submitted in the scoping document, ladles will be pre-heated using electricity, which reduces the amount of LPG used in the factory down to only 1,040 tons per year for the 1st phase. A few bottles of nitrogen will also be used every once in a while to refill the hydraulic accumulators.

The cooling circuits that cool the furnaces and transformers will be filled with municipal water and lead through heat exchangers for cooling. The heat exchangers can be cooled by using either air cooling or with seawater. In this IEIS both systems for cooling are presented, see chapters 2.5 and 3.1.

Table 4 displays the main amounts of materials and compounds needed for the annual production of 33,000 – 66,000 tonnes of silicon metal.

Table 4: *Materials used in the production process and annual quantities needed for the annual production of 33,000 – 66,000 tonnes of silicon metal.*

Material	Chemical compound	Quantity for 33,000 – 66,000 tpa production volume	Role
Quartzite	SiO_2	81,000 – 162,000 tpa	Raw material
Coal (high bituminous low ash coal)	C	42,000 – 84,000 tpa	Reductant carbon
Wood chips	C	45,000 – 90,000 tpa	
Coke (low ash coal char)	C	15,000 – 30,000 tpa	"
Char coal	C	8,000 – 16,000 tpa	"
Electrodes	C	4,000 – 8,000 tpa	"
Cooling water (sea water)		1,200 – 2,400 m^3/h	For cooling of heat exchangers
LPG		1,040 tpa	Equipment heating
Oxygen		410 tons	Refining and use at the tap hole
Graphite lances and stinger rods		30-60 tpa	"
Refractory materials (ladles)		500-1000 tons	"
Tap hole plugging materials		70-140 tons	"
Plugs for metal refining		0,7-1,4 tons	"
Disposable thermo elements		0,45-0,9 tons	"

2.4.1 Quartzite

Quartzite will mainly be imported from mines in continental Europe, including a PCC SE mine in Poland, but the possibility is also open for import from other continents. The quantities of quartzite for the production of 33,000 - 66,000 tpa of silicon metal are estimated to be approx. 81,000 – 162,000 tonnes, i.e. the equivalent of 6,750 – 13,500 tonnes per month, taking into account the possible exclusion of shipping during three winter months.

Quartz might also be used for the production instead of quartzite. Quartz and quartzite are closely related substances, i.e. quartzite is actually weathered and deposited quartz that has solidified into sandstone and then undergone a metamorphic event to form quartzite. Quartz and quartzite are mainly composed of Silicon dioxide (SiO_2) or >99%, and the difference between the two compounds are found in trace elements of <1%.

Information on the composition of Quartzite can be found in Annex 1.

2.4.2 Carbon materials

The electro-thermal process of silicon metal takes care of the necessary heat input into the reaction zones below the three electrodes. The reduction of oxides, namely silicon oxides, performs under very high temperatures, reacting to metal (Si), metal oxides (SiO) and metal carbides (SiC). This reaction requires approximately 400 kg C_{fix} per tonne of silica, imported in the form of coals, char coal, coke, wood and Carbon Electrodes made from coke or imported pre-made.

The amount of carbon (C_{fix}) provided by the Carbon material can vary, although stoichiometric amounts are required for the process. The content of effective carbon (C_{fix}), is assumed to be. 55% for the coals and max 20% for the wood chips.

Information on the composition of carbon materials can be seen in Annex 1.

2.4.3 Consumables

Consumables are materials that are used in the production but do not become part of the product. The main consumables are ladle lining, graphite lances for electrical stinger and for opening the tap hole, steel pipes for oxygen lancing of the tap hole, plugging materials to close the tap hole and disposable thermo couples for measurement of the metal temperatures during and after tapping in the ladle.

2.5 Cooling

The cooling system for furnaces, hoods and casting machines consists of closed cooling circuits, which are cooled down using heat exchangers. The water in the cooling circuits will be treated in order to reduce corrosion and eliminate eventual bacteria growth. The circuits are filled and once in operation only small amounts of water are needed for back-up or replacement to compensate for water losses due to leaks and evaporation. A minor discharge of the primary cooling water of around 0.3 m^3/day is expected which will be discharged with other water. The whole system is equipped with a flow monitoring and alarm system to prevent liquid water to enter the furnace crucible.

In this EIS the option of two cooling systems are presented; a cooling water plant (air-cooling) and cooling by means of seawater. Both solutions are based on closed cooling circuits.

Figure 8: *Cooling towers with cooling fans on top [Source SMS Siemag].*

The cooling water plant is seen as a 45 x 13 m large building with an approximate height of 7 meters, located north of the furnace building. This height includes the cooling fans placed on top of the building. Typical cooling towers are shown in **Figure 8**.

Further information on the release of sea water used for cooling and the environmental impact can be found in chapter 3.1 and chapter 7.1.

2.6 Process residues: by-products and solid waste

The production of silicon metal generates a variety of residues that can mostly be recycled or reused within the production or sold as by-products for use in other industrial processes. Those materials are generated at different stages in the production, such as in the production process, during off gas treatment, waste water treatment and general cleaning of the site. The most significant residues from the production process are filter dusts, sludge from water treatment, slag from the reduction process and refining, used furnace linings and diverse packaging materials such as drums and big bags. Ladle linings are replaced every 10 to 15 years.

Design and operation of the production line aims for maximum use of raw materials and minimization of residues that cannot be applied in other processes.

PCC does not plan to landfill any inert residues on site. All residues defined as waste that has to be disposed of will be handed over to qualified waste service providers.

Sorpsamlag Þingeyinga is a licensed service provider and can receive all different types of waste, including inert waste from the area.

2.6.1 By-products

Most of the solid by-products generated during the production of silicon metal can either be reused within the production or recycled. The waste mainly consists of metallurgical slag generated during the production process and dust collected in the dedusting plant.

The production of silicon metal is a nearly slag free process, with the amount of slag amounting to around 25 - 40 kg slag per ton of silicon metal or at an estimated 900 – 1.400 tpa for 33.000 tpa and 1.700 – 2.800 tpa for 66.000 tpa.

Silicon dioxide dust or Micro Silica is generated in furnaces and silica dust (fine material) during the crushing of products, it is then collected from the plant exhaust treatment facilities

and used in different industries. The expected amount is around 12,000 tons for 33,000 tpa and 24,000 tons for 66,000 tpa. The dust, or Micro Silica, can be used as major component in special concrete mixes, as additive in the refractory industries and a great number of applications in the production of, insulating materials, mortar, plaster, etc.

The largest part of waste coming from maintenance on equipment will be recycled.

2.6.2 Solid waste

The operation of the plant will operate on the principle of minimizing waste generation and maximizing recovery and the recycling of waste. All waste generated on site will be sorted as much as possible and, if not used within the operation of the plant, be handed over to qualified waste service companies. Other waste generated during production mainly consists of furnace and brick linings that will be disposed of as inert solid waste in accordance with law and regulations.

Another type of waste is packaging materials and waste generated in maintenance of the plant as well as household waste from offices and canteen. Annual waste quantities and applied treatment is listed in Table 5 below.

Table 5: *Waste types, annual quantities and applied treatment, produced in the annual production of 33,000-66,000 tonnes of silicon metal.*

Waste type	Annual amount [t/year] for 33,000 tpa and 66,000 tpa	Treatment
Filter bags	0,06-0,12	Recycling in Ferro Silicon or Silicon Metal process
Ladle lining	340-680	Inert landfill
Metals	180-360	Metal recycling
Timber	130-260	Timber recycling (not on site)
General waste	70-140	Landfill
Big bags	9-18	Recycling
Cardboard	3-6	Recycling
Earth materials/concrete	2,5-5	Inert landfill
Cyclone dust (*icel. Forskiljuryk*)	840 – 1.680	Landfill
Waste from sieving of raw materials	2.5 – 5	Landfill
Organic household waste	4-8	Recycling
Hazardous waste	1,5-3	Proper treatment through Hazardous Waste Depot

2.7 Emissions to air

Airborne emissions generated in the production can be divided into two categories; dust emissions and gaseous emissions (fumes). Dust emissions can arise by handling and storing of raw material, refining, crushing and packaging of products and by-products as well as by the smelting process in the furnace. Gaseous emissions however arise almost entirely in the furnace.

To minimize dust emissions in the raw material storage, material will either be transported by overhead-cranes from the storage compartments to the conveyor belt feeding the day-tanks or with front end loaders, in which case, spray-systems will be installed so water can be sprayed on the material to prevent dust from arising.

Under the gas hood, silicon monoxide (SiO) oxides into amorphous SiO_2, this is then captured by the filter bags as extremely fine dust (< 1 micron). The clean gas that leaves the

filter has very low dust content (< 5 mg/Nm^3) and the remaining dust leaving the filters cannot be seen.

Gaseous emissions arise mainly from the furnaces. The main components are sulphur dioxide (SO_2), nitrous oxides (NO_x) and carbon dioxide (CO_2). Carbon monoxide (CO) emissions are considered negligible. The emissions contain only very little amounts of organic pollutants, such as polycyclic aromatic hydrocarbons (PAH) and polycyclic organic pollutants (POP). High surface temperature prevents the creation of dioxins and furans.

Metals are present as trace elements in the raw materials and are as such carried into the process. Metals that have high vapour pressure will escape the process as gases but most of them will be collected through the fume collection system and removed from the off-gas.

The release of CO_2 from the operation has been calculated to be 181,500 tons annually for the 1st phase and 363,000 tons annually after construction of the 2nd phase. PCC will obtain the necessary allowances under the EU European Trading System (ETS), by application to the Environmental Agency of Iceland.

Currently, two other projects are being considered in the Bakki industrial area but both of them are only in preliminary stages. Both use similar raw materials and the same type of pollutants are emitted, i.e. sulphur dioxide (SO_2), ammonia dioxide (NO_2), carbon monoxide (CO), particle matter (PM10), and Polycyclic aromatic hydrocarbons (PAH).

The proximity of industries in the area can lead to an accumulation of pollutants inside the industrial area. However, detailed data allowing for the modelling and evaluation of air quality from the other two projects are at this point not available since location and specifications on technology have not been decided. Therefore the cumulative effect of air pollution in the area cannot be assessed fully at this stage, but will be done in the EIA for the respective projects. In chapter **Error! Reference source not found.** the potential cumulative effects are however addressed to the extent possible considering the data available from other possible projects within the area.

2.8 Noise

Main sources of noise and vibration at the PCC SE plant in Bakki are related to the materials and product handling systems and fans of the dedusting systems and the furnace bottom cooling system. Another source of noise is from chipping of wood logs at the storage area. Noise generated inside buildings will only escape to a little extent and will not cause significant increase in the noise level on site.

Some noise will occur from the unloading and loading at the harbour area and from transport to and from the site.

Further information on noise due to production can be found in chapter **Error! Reference source not found.**

2.9 Energy requirement

The total energy requirement for the first stage is estimated to be 52 MW or 455 GWh per year, for the production volume of 33,000 tpa. The plant will be designed for a future expansion with a total energy requirement of 104 MW or 915 GWh per year, for 66,000 tpa production volume.

Negotiation is on-going between PCC and Landsvirkjun on electric power provision for the plant.

2.10 Transport and storage of materials

The main transport is due to the import of raw materials for the production; quartzite, coal, coke and wood and export of products and by-products, through the harbour in Húsavík. The amount of wood logs is based on the assumption that all wood is imported and shipped to the harbour in Húsavík. If feasible amounts of wood meeting the requirements of the production can be found, domestic sources will be favoured.

The transport categories and amounts for 33,000 and 66,000 tons production volume can be found in **Table 6Table 4 - Table 8**.

Quartzite and low ash coals will mostly be transported as bulk, other materials in containers. Wood will be transported as logs in stacks or as wood chips. The transhipment volume is around 20,000 tons per month or 250,000 tons yearly for 33,000 tpa production volume and 40,000 and 500,000 tons for 66,000 tpa.

The material storages of the plant will have enough quantities of materials and other consumables in stock in case of a temporary transport stop because of bad weather or failure in equipment. The expansion of the supply storage facilities will not be done alongside the expansion of the plant from 33.000 tpa to 66.000 tpa productions. The increase in materials will be met with more frequent imports.

Table 6: *Transport and storage of materials.*

Material	Form of transport	Amount/frequency for 33,000 tons yearly production	Amount/frequency for 66,000 tons yearly production
Quartzite	Bulk	~ 6,800 tons/month	~ 13,600 tons/month
High bituminous low ash coals	Bulk	~ 3,500 tons/month	~ 7,000 tons/month
Char coal	40 feet containers	~ 700 tons/month	~ 1,400 tons/month
Low ash coke	20 feet containers	~ 1.250 tons/month	~ 2,500 tons/month
Wood logs	Stacks in containerships	~ 3,750 tons/month	~ 7,500 tons/month
Electrodes	Containers	~ 350 tons/month	~ 700 tons/month
Other consumables	20 feet containers	~ 50 tons/month	~ 100 tons/month

Table 7: *Transport of material from the production.*

Material	Form of transport	Amount/frequency (for 33,000 and 66,000 tpa)
Silicon metal	20 feet containers	~ 2.750 – 5.500 tons/month
Micro Silica dust	20 feet containers	~ 1.200 – 2.400 tons/month
Slag	20 feet containers	~ 350 – 700 tons/month

Table 8: *Maximum amount of material in stock.*

Materials	Maximum amount [tons] on stock for 33,000 and 66,000 tpa
Quartzite	47,200
High bituminous low ash coals	16,300
Coal	7,500
Low ash coke	600
Wood	21,000
LPG	350

2.11 Construction information

During the construction period the work camp will be located inside the proposed construction area. Offices, dining area and toilets will be located within the camp. Sleeping/living facilities for temporary workers will be required; the bulk of the workers will take advantage of the facilities available in Húsavík. The exact location of the camp has not been decided, but will most likely be situated at the location of the proposed office building.

All surface material will be used for landscaping in the area, except for rocks and gravel which will be used to the fullest for areas/lots, foundations and roads, for both PCC built roads and the municipality projects.

The channel of Bakkaá will not be altered by the construction and strived at not to disrupt the wetlands on the NW part of the proposed site.

2.12 Related projects

The project is dependent on electric power and its transmission to the plant. Electric power will be provided by geothermal plants in the geothermal region of Northeast Iceland.

An EIA has already been carried out for transmission lines (220 kV) from Krafla and Þeistareykir to Bakki at Húsavík, to Skútustaðahreppur, Aðaldælahreppur, Þingeyjarsveit and Norðurþing, and the NPA has issued an opinion of the EIA, dated November 24th, 2010. An EIA has also been carried out for geothermal power plants Þeistareykjavirkjun (up to 200 MW) and Kröfluvirkjun II (up to 150 MW), with a Reasoned Opinion of the NPA also dated November 24th, 2010.

The transport of materials from the harbour will be done with a trailer train through a new industrial road and tunnel through cape Húsavíkurhöfði which will be built and operated by the Icelandic road authorities and the Norðurþing municipality. The use of this road will prevent transport via the populated area in Húsavík. No storage of materials is foreseen at the harbour, except possible temporarily storage of container units in case of transport delay.

A proposed layout of the industrial road from the harbour towards the industrial site is shown in **Error! Reference source not found.**.The trailer trains consist of special low speed vehicles (max 30-35 km/h) designed for transport on roads that are meant for industrial transport.

In the event of a temporarily blockage on the industrial road or the tunnel, for example due to weather conditions, maintenance, or accidents, materials will be transported on the public roads using regular transport vehicles available.

Figure 9: *Proposal (Bökugarðsleið) of the industrial road from the Húsavík harbour to the industrial area at Bakki. (Map: National Road Authorities).*

2.13 Review and comments on project information and PCC's answers

2.13.1 Review and comments on transport through the harbour

The Health Inspectorate of NE Iceland (HNE) comments on the storage of raw materials in the harbour area comments: "*It's stated in Chapter 2:3 Production Process that during*

regular operation no storage of goods (materials) is foreseen at the harbour area. Chapter 2.12 on related projects states that no storage is for seen in the harbour area, with the exception of temporary storage of bulk materials if there is a delay in transport. Chapter 6.2.4.3 Transport between harbour and industrial area this is described more preponderantly: "Much storage at the harbour area is not foreseen, because it is planned that materials will be transported immediately to and from the harbour area". It cannot be avoided to conclude that some storage will be at the harbour area. The HNE believes it should be clearly explained which materials will be stored there and how, i.e. with respect to the risk of fines from coals and Quartzite and other substances blowing away. It should be checked if there is a reason to build over all materials where there is a risk of materials blowing away."

Answer PCC: As mentioned in the EIS it is expected that all raw materials will be transported to the raw material storage on the company site after unloading and therefore no materials will be stored at the harbour area, expect in exceptional circumstances for a short time when there is a delay in the regular logistics to the site. If it becomes clear that there will be delays in transport, further unloading will be stopped and the suspension of materials prevented using irrigation or coverings. That is therefore PCC's estimation that there is no reason to build over materials that might be stored temporarily at the harbour.

2.13.2 Review and comments on water use and cooling

The Icelandic Met Office comments: "*The IEIS is lacking information on water and water stress, but those issues need to be well addressed. Thus should, for example, a better explanation be given on the water use, compared with available water in the area and if it is awaited that the water source will withstand. The impact of cooling, amount of water used, which chemicals will be used to prevent corrosion and to prevent bacteria growth needs to be addressed. It is also important to mention where leakages from the cooling system will most likely occur. It is necessary to study the impact if all water is lost from the system in a relatively short time.*

Answer PCC: No water is used in the production process itself or for the cooling of metal. Drinking water will be used to tap the cooling water circulation of furnaces and transformers (~0.3 m^3/day), for cleaning of equipment. The maximum water demand of the plant will be 180,000 m^3/year for 66,000 tons production capacity. In the statement with the local plan for the industrial area at Bakki (Mannvit, February 2013) is stated that to provide the total industrial area with its demand for drinking water, cold water will be fed to the site from sources in Rivers Bakkaá, Reyðará and Kaldakvísl. It is planned to activate springs at the source of River Bakká, in around 2.5 km distance from the planning area. To meet requirements on available amount of water for fire extinguishing, it is proposed to build a reservoir with a dam about 150 m east of Highway 85, in the gorge of River Bakkaá resulting in a water surface level in around 60-65 m over sea level.

Information on which chemicals will be used to prevent corrosion are not available, but there will likely be an addition of molybdate or phosphate, but the decision on which chemical will be used will be taken in the final design stage and tendering of the cooling systems for the plant. The concentration of the additive will likely be around 1g/L. Information on which chemicals will be used to prevent bacteria growth is not yet available.

For the 66,000 ton production capacity, there will be around 350 m^3 of cooling water in the cooling circuits for furnaces and 80 m^3 in the cooling systems for transformers. The main points of water leakage from the circuits are circuit packs in the heat exchangers, mechanical seals of pumps and security valves. An alarm will be installed for the case of leakage from the cooling system. Containers will be installed for smaller leaks from the cooling system. Corrosion of pipes is not expected, as the material of piping will be chosen

in respect of the cooling agent. In the event of a large leak from the cooling system the water will go into drains and to the sea, and the impact on soil and groundwater therefore considered negligible.

2.13.3 Review and comments on by products and solid waste

2.13.3.1 Review of the Icelandic Met Office

The Icelandic Met Office comments: "There is need for better explanation of possible hazardous chemicals in waste that could pollute water or soil in the area. Information is missing on chemicals that might derive from solid waste that gathers/accumulates or is handed over for disposal in the municipality. It must be stated if it is likely that the waste can contain heavy metals or something else and can be infiltrated into the ground and affect the water quality. It can be considered abnormal to base the EIA on certain given assumptions, which are not yet available and it is of importance to get a statement on those tasks or conditions from the respective parties. For example, it is stated that waste collected from the production will to a large extent be disposed of by authorized service providers. Up to 2,513 thousand tons of waste will be generated in the production and it is necessary to further explain its disposal within the area and if authorized service providers are capable to receive such amounts and the specific waste generated in such production.

Answer PCC: It is not clear where the amount 2,513 (thousand) tons is obtained. As stated in the EIA it is not expected that any waste will be landfilled within the site. A temporary storage of by-products or waste is possible, but the storage will be on a lot with a closed surface (asphalt or concrete) so no chemicals can be carried into the soil. According to information from PCC it is expected that a large amount of by-products can be marketed, so that the amount of materials that needs to be disposed of is significantly lower than shown in the EIS. It can be assumed that ladle linings and dust (other than Micro Silica) can be used rather than disposed. Thus, the estimated amount for disposal from 33,000 and 66,000 tons production capacity is around 70-140 tons and around 5-10 tons that can be disposed of as inert waste.

Some of the helping agents used for ladle- and furnace linings are of such nature that if they are exposed as single compounds without mixing they can cause a negative impact to the environment. To prevent this, the handling and use of chemicals for ladle- and furnace linings will be in designated areas with closed surfaces. In the lining itself the chemicals in question are bound together with other chemicals and therefore don't cause any risk. In the Annex SDS for every chemicals used in linings can be found. It is expected that linings will pass the leaching test and can be disposed of as inert waste.

2.13.3.2 Review of the Health Inspectorate of NE Iceland

The Health Inspectorate of NE Iceland (HNE) comments on by-products and solid waste: "*It is stated that PCC plans not to landfill any inert waste within its site and all products that will be declared as waste will be handed over to an authorized service provider for treatment. That party will be Sorpsamlag Þingeyinga [comment EFLA: Municipal Waste service provider], which is an authorized service provider and accepts all sorts of waste in the area, incl. inert waste. According to this, Sorpsamlag Þingeyinga will have to receive waste of annually around 1250 tons per year for 33,000 tons production capacity and 2500 tons if the plant will be enlarged up to 66,000 tons production capacity. HNE has several remarks. Firstly, there is no place within Norðurþing municipality that has a valid operational permit to landfill waste. Secondly, it shall be pointed out that Article 11 of regulation 737/2003 says:" The generation of waste shall be reduced as possible. Reuse and recycling shall be aimed at as much as possible. Best available technique shall be applied for treatment of waste." The HNE points out that in the operation permit of Elkem Iceland, that produces silicon- and ferro-silicon, the company may dispose diverse waste groups in flood pit, with leaching of*

chemicals into the sea as the concentration of the pollutants are not higher than reference values in regulations. The report from the National Planning Agency regarding the Agency's decision if the production of polysilicon at the Elkem Iceland plant at Grundartangi is a subject of full scale EIA states: " the permission of Elkem Iceland ehf. in the operation permit to put waste materials in the port filling at Grundartangi are only used to a limited extent, because methods of recycling have been found for a greater deal of materials then it is allowed to dispose of." With reference to this, the HNE believes that PCC should investigate available recycling possibilities in the purpose of minimizing waste for landfill as much as possible

Answer PCC: The operation of the silicon metal plant will seek to maximize the amount of sellable products from the production and reduce the amount of waste deriving from the production. According to new information the amount of sellable by-products is higher than stated in the IEIS, for example cyclone dust (840-1,680 t/year) and used linings (350 – 700 t/year) are sellable materials and not waste. The main sources of waste will therefore be packaging waste, i.e. plastic wrappers and timber, that are suitable for recycling as well as household waste, that can be directed in the same path together with other waste materials in the region. Waste for recycling is therefore estimated at 326 t/year for phase 1 and 652 t/year for both phase 1 and 2. Waste for landfill is estimated at 70 t/year for phase 1 and 140 t/year for both phase 1 and 2. Inert waste that is generated and not recyclable can be landfilled at the inert landfill at Laugarbakki after passing a leaching test. The amount of inert waste that can be disposed in this manner is estimated at 5 t/year for phase 1 and 10 t/year for both phase 1 and 2.

2.13.3.3 Comments from residents and landowners of Héðinshöfði

Residents and land owners of Héðinshöfði comment: *"If waste from the production will be landfilled close to the town of Kópasker, an assessment of the increased traffic on the highway, as well as emissions and other discomforts this traffic will cause is demanded".*

Answer PCC: As stated in the IEIS all waste from the plant will be handed over to Sorpsamlag Þingeyinga (municipal waste service provider). At this point in time it cannot be answered what are the future solutions of SÞ and where they will be located. It is not assumed that there will be a significant increase in traffic because of this transport nor that waste will be transported to Kópasker.

2.13.4 Review and comments on the construction

The Health Inspectorate of NE Iceland (HNE) comments: „*... during construction it is assumed that work camps will be within the construction site. There will be offices, canteen and toilet facilities. Furthermore it is foreseen to provide housing facilities for staff working temporarily on site, but that the main part of the staff will use sleeping facilities in Húsavík. The location of the work camp has not yet been decided, but the facilities will probably be located at the prospected location of the future office building. The HNE considerers it to be necessary to provide information on the location of those structures. Laws and regulations that relate to the construction and operation of work camps should be covered, that is for waste water, energy use, water use and waste disposal.*

Answer PCC: The sleeping accommodation for staff working on site will be located on a concrete lot, designated for storage of wood logs during operation of the plant. Office facilities during construction will be located where later the office building will be located. Norðurþing municipality will provide the area with drinking water and electricity, but sewage from offices and sleeping accommodation will be pumped around 2 km into the sewage system of Húsavík. All necessary licences and approvals for the installation of work camps will be required in cooperation with the Health Inspectorate, municipality and the Environment Agency of Iceland.

3 PROJECT INFORMATION - OTHER ALTERNATIVES

3.1 Sea water cooling

The second system alternative for cooling presented in this IEIS is the usage of seawater to cool down the heat exchangers like previously described in chapter 2.5. For this case a cooling tower will not be required, instead a pumping station will be built by the shoreline outside of PCC's lot and inlet and outlet pipes will be built. This alternative does not involve changes to other systems previously described in chapter 2.

For this alternative the sea water runs in a closed circuit and does not come into contact with any substances used in the process. The requirement of sea water for cooling is estimated at approximately 1,200 m^3/h for the first phase and 2,400 m^3/h for the second phase. The cooling increase of sea water temperature is approximately 15°C, but the increase of sea water temperature at the outlet will be below 2°C, see chapter 7.1. The intake of seawater will in this case take place through a filtration bed, where a trench is excavated into the coastline reaching to about 5 m below LWL. The trench is filled with blasted rock material and filter layers covering a core made of pit run. The filtration takes place inside the core, which is filled of blasted material screened for fines. To increase reliability, two independent trenches will be made. The concept of the seawater filtration is shown in **Figure 10**.

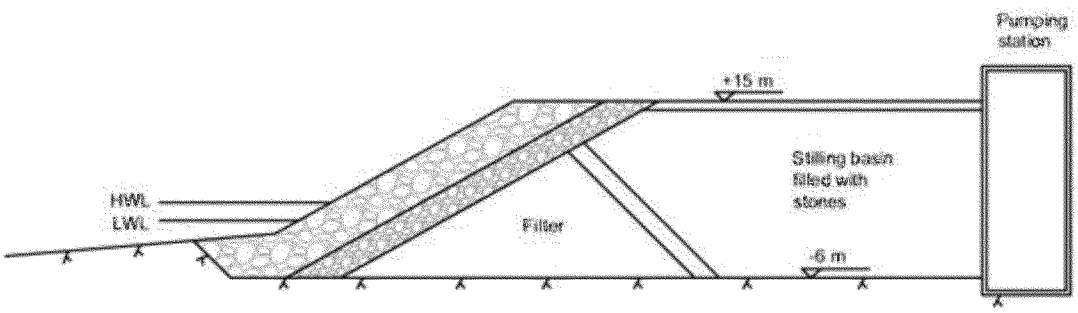

Figure 10: *Seawater intake with filtration (EFLA Consulting Engineers, 2012).*

The location of the possible seawater intake will be chosen in the final design of the Silicon Metal plant, but the most likely position is directly west of the furnace building, well outside the area of the coastline Bakkafjara that is listed in the Natural Conservation Register. The position of the outlet of warm seawater will be chosen with a sufficient distance to prevent all disruption to the seawater intake.

3.2 Zero-option

The zero-option entails that the PCC silicon metal factory will not be constructed at Bakki by Húsavík. The zero-option involves no jobs being created at the Silicon Metal plant, and no derived jobs related to the construction of the smelter or other service related tasks during the operation of the smelter.

Furthermore, the zero-option entails land not being disturbed because of buildings and areas surrounding of the plant.

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4 SITE LOCATION AND LAND USE PLANS

4.1 Project site

PCC SE's project site is located in an industrial area at Bakki, in Húsavík town of Norðurþing municipality. In the 2010 – 2030 Municipal Plan for Norðurþing, a 201 ha area at Bakki is reserved for heavy industries and related industries. The industrial area is situated approximately 3 km north of the town of Húsavík. National Road no. 85 passes through the area. The size of the area west of the road is 143 ha and the area east of the road is 58 ha in size. PCC SE's Silicon Metal plant will be situated in a southern part of the industrial area, west of the national road, see Figure 11 - **Figure 13**.

The northernmost houses of Húsavík are situated around 1.2 km from the southern border of the industrial area. The area has been used for grazing until now, with agriculture practiced north of the planned industrial area. Reyðará River delimits the northern border of the industrial area, with River Bakkaá running into it. Before construction work in the area begins, the courses of River Bakkaá and other brooks in the vicinity will be modified.

A large part of the planned industrial area is situated in a basin south of Reyðará River, but the northernmost part of the area is lowland (8 m.a.s.l.) and elevates in the direction towards the national road. The land elevates rapidly to the east towards the slopes of Húsavík Mountain. South of Reyðará River the land descends rapidly, but then elevates towards Bakkahöfði Cape (24 m.a.s.l.) only to descend again south of the Cape. The area is vegetated and the ground vegetation cover is nearly continuous. The area is characterized by grasslands and heather fields and by wetlands in the basin, especially north of the River Bakkaá outside of PCC's lot.

The area's bedrock consists mainly of basalt. Tuff lies on top of the basalt and the soil consists mainly of glacier discharge and gravel. Soil covers the whole area, constituting a thick cover in the wetland basin, but thin cover in the vicinity of River Bakkaá .

The plant will not be located within conservation areas under the Nature Conservation Act no. 44/1999. Protected areas (in Nature Conservation Register) are however located near the industrial area.

Figure 11: *A view of the industrial area from the north. The photograph is taken from a basin south of River Bakkaá .*

4.2 Existing plans

4.2.1 Municipal Plan

The current 2010-2030 Municipal Plan of Norðurþing was confirmed by the Minister for the Environment in December 22nd, 2010. The industrial area and expected project site is presented in the urban outline plan, see **Figure 12**.

4.2.2 Local plan

A local plan is in preparation by the Norðurþing municipality for parts of the industrial area at Bakki.

4.2.3 Regional Plan

Norðurþing is a part of the 2007-2025 Þingeyjarsýsla Geothermal Area Regional Plan, confirmed by the Minister of Environment on January 16, 2008.
The regional plan does not cover the industrial area in Bakki.

4.3 Property

The land at Bakki is the property of Norðurþing municipality. The land has been used for grazing and for horses, in agreement with Húsavík town.

4.4 Authorization

The following permits and authorizations have to be acquired for the project:

- Norðurþing municipality: The municipality provides development permits and building permits in accordance with the Planning Act no. 160/2010, on the basis of confirmed Regional and Municipal Plans and the NPA's reasoned opinion on a project's EIA.
- The Environmental Agency: An operation permit is issued by the Environmental Agency, based on the law on health and pollution control no. 7/1998, regulation no. 785/1999 on operation permits for industries that can lead to pollution and law no. 65/2007 on greenhouse gas emissions. A draft of the operation permit has been prepared together with this IEIS and the draft is shown in Annex 5.
- The Health Inspection of Northeast Iceland: Work camps are subject to authorization by local health inspectorates, based on regulation no. 941/2002 and law no. 7/1998.
- The Cultural Heritage Agency of Iceland: An archaeological audit has been carried out at the construction area. Should archaeological remains be in danger during construction or operation, a permit must be obtained from the The Cultural Heritage Agency of Iceland.

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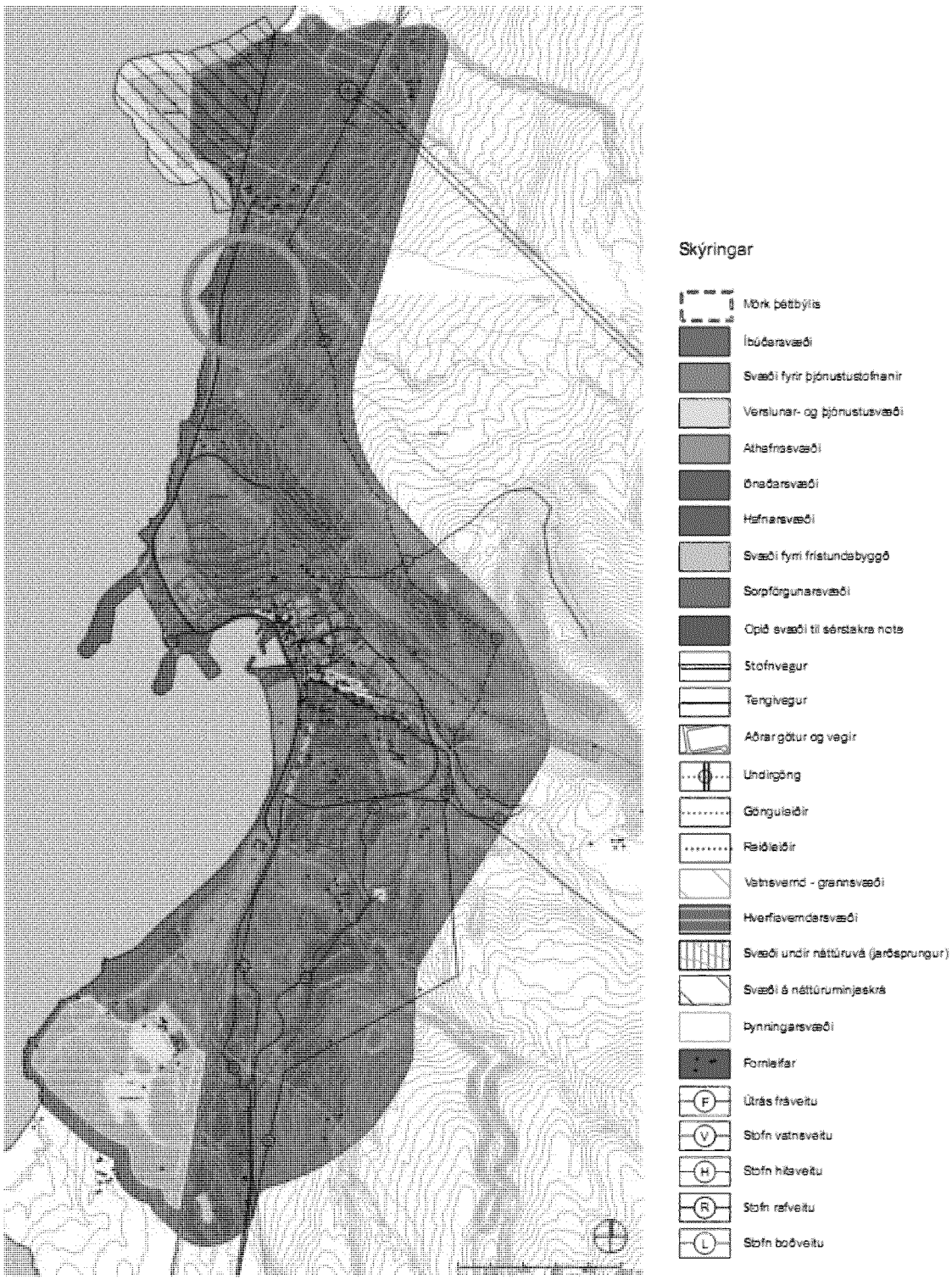

Figure 12: *From the urban master plan for the town of Húsavík in Norðurþing municipality. The industrial area at Bakki is shown in grey at the top of the figure. PCC SE's Silicon Metal plant will be located in the southernmost part of the industrial area, west of the national road, marked with a blue ring (from the 2010 – 2030 Norðurþing Municipal Plan).*

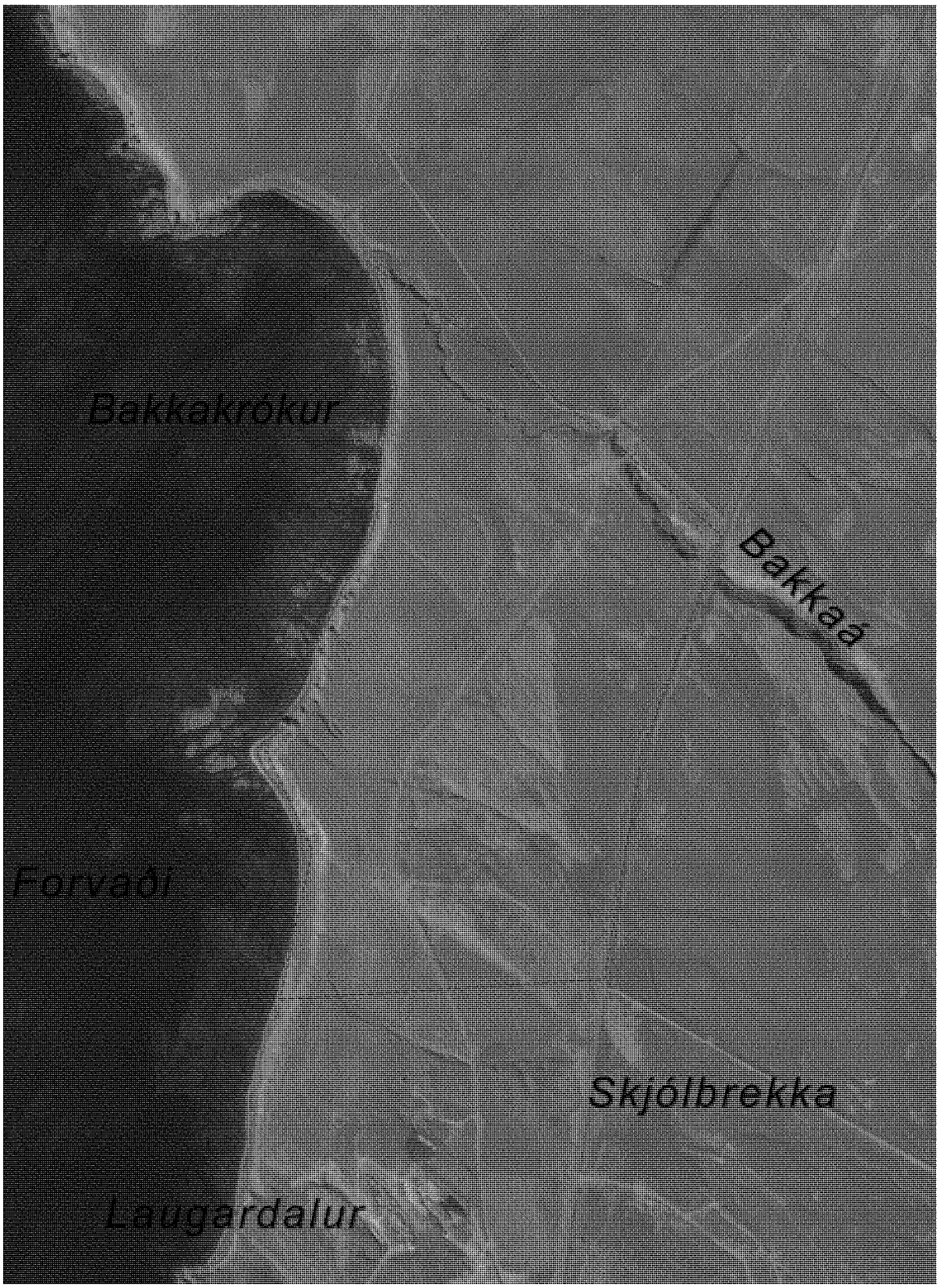

Figure 13: *An aerial view of the proposed project location at Bakki, north of Húsavík town. PCC SE's* Silicon Metal plant *will be allocated an approx. 22 ha area within the 45 ha area demarcated by the broken blue line, west of the national road and in the southernmost part of the planned industrial area, sea figure 3 in chapter 2. (Source: Loftmyndir ehf.).*

5 ENVIRONMENTAL IMPACT ASSESSMENT – SCOPE OF ASSESSMENT

5.1 General

Environmental impacts are discussed and evaluated in the Environmental Impact Assessment. Environmental aspects baseline and impact weight are discussed, based on expert statements on each environmental aspect.

5.2 Definition of the project's impact area

The project's area of impact is the area that is subject to environmental impacts caused by the project, both during construction and operation. During the environmental impact assessment, the impact area can be divided into three main categories:

- Direct impact on the environment: In order to assess direct impacts on flora, geographical formations and birdlife the area is defined to be about 100 meters outside the industry lot. This is a larger area than the defined construction area.. In order to assess emissions to air and noise, a larger perimeter is demarcated, based on calculations and models.
- Impact on landscape and visual impacts: A part of the EIA process is assessing the project's impacts on landscape and its visual impacts. The project area of impact for these factors expands to the north from the proposed plant. The plant can also be seen from the sea, the hills of Mt. Húsavíkurfjall and beyond.
- Social impacts: The boundaries of an impact area due to a project's social impacts can often be unclear. Húsavík and places in the town's vicinity are examined in this regard.

5.3 Criteria for the environmental impact assessment

Criteria for the environmental impact assessment area based on:

- References in laws and regulations, government strategies and international treaties.
- Specialist's analysis on the nature of the impact on special environmental aspects within the impact area.
- Comments and remarks from statutory consultees, stakeholders and the public.

The impact following the project is evaluated and given weight by comparing the characteristics of the impact to references for each environmental aspect. The results of the assessment forms a specific weight rating for every environmental aspect and the impact can be assessed between significantly negative to significantly positive. The weighted ratings are defined in The environmental impact assessment is carried out according to the Environmental Assessment Act no. 106/2000 and Environmental Assessment Regulation no. 1123/2005. The EIA procedure is equally carried out according to the NPA's guidelines on 1) Environmental Impact Assessment and 2) Classification of Environmental Aspects, Criteria, Characteristics and Environmental Impacts that are listed in **Error! Not a valid bookmark self-reference.**. Relevant criteria are used in assessing impact weight of individual environmental aspects, i.e. government strategies, international treaties, laws and regulations.

The IEIS details mitigation measures, where applicable, in regard to each individual environmental aspect under examination. Proposed environmental monitoring during the plant's operation is also presented.

Table 9. They are based on guidelines from the NPA from December 2005.

5.4 Environmental aspects examined in the EIA

The IEIS addresses environmental aspects that might be subject to significant impacts due to the project's realization, both during construction and operation. In the scoping document the environmental aspects considered to be relevant to the EIA process were presented. In the scoping process, existing documents and studies, laws and regulations were examined and primary stakeholders and relevant bodies consulted.
In the Environment Impact Statement focus will be on:

- Air quality and climate
- Noise
- Marine and coastal areas
- Flora
- Birds
- Landscape and visual impacts
- Archaeological remains
- Environmental impacts during construction
- Social impacts
- Risk and safety

The environmental assessment on these environmental aspects is provided in chapter 6 for alternative 1 and in chapter 7 for other alternatives.

The environmental impact assessment is carried out according to the Environmental Assessment Act no. 106/2000 and Environmental Assessment Regulation no. 1123/2005. The EIA procedure is equally carried out according to the NPA's guidelines on 1) Environmental Impact Assessment and 2) Classification of Environmental Aspects, Criteria, Characteristics and Environmental Impacts that are listed in **Error! Not a valid bookmark self-reference.**. Relevant criteria are used in assessing impact weight of individual environmental aspects, i.e. government strategies, international treaties, laws and regulations.

The IEIS details mitigation measures, where applicable, in regard to each individual environmental aspect under examination. Proposed environmental monitoring during the plant's operation is also presented.

Table 9: *Definitions of weight ratings used in the EIA process.*

Weighted rating	Definition
Substantial positive impact	The impact of the project or plan on the environmental aspect/s benefits the interest of a large number of people and/or has positive impact on an extensive area. The change or benefits resulting from the project/plan is usually permanent. The impact is often regional, national and/or global, but can also be local. The impact is in agreement with laws and regulations, general policy of the government or international treaties which Iceland is a member of.
Considerable positive impact	The impact of the project or plan on the environmental aspect/s do not cover an extensive area, however the area may be sensitive to changes, i.e. due to nature or archaeological remains. The impact can be positive for the area and/or positive for a large number of people. The impact can be permanent or in some cases reversible. The impact can be local, regional or national. The impact is in agreement with laws and regulations, general policy of the government or international treaties which Iceland is a member of.
Negligible	The impact of the project or plan on the environmental aspect/s is minor, with respect to the extent of the area and its vulnerability to changes, as well as the number of people affected by the changes. In many cases the impact is temporary and reversible to a large extent. The impact is in agreement with laws and regulations, general policy of the government or international treaties Iceland is a member of.
Considerable negative impact	The impact of the project or plan on environmental aspect/s does not cover an extensive area; however the area may be sensitive to changes, i.e. due to nature or archaeological remains. The impact can be negative for the area and/or cause disturbance or inconvenience for a large number of people. The impact can be permanent and in some cases irreversible. The impact can be local, regional and/or global. The impact can to some extent be in disagreement with laws and

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	regulations, general policy of the government or international treaties Iceland is a member of.
Substantial negative impact	The impact of the project or plan on environmental aspect/s affects an extensive area and/or an area that is sensitive to changes, i.e. because of nature or archaeological remains, and/or depreciates the interest of a large number of people. The change or damage caused by the projects is usually permanent and irreversible. The impact is in disagreement with laws and regulations, general policy of the government or international treaties Iceland is a member of
Uncertainty	The nature and extent of the impact on certain environmental aspects is unknown, i.e. because of lack of information, technical deficiency or lack of knowledge. It may be possible to obtain information on the impact with further research or systematic monitoring.

5.4.1 Comments on the Environmental impact assessment and PCC's answers

Residents and land owners at Héðinshöfði comment: "*The EIA for the PCC Silicon Metal plant at Bakki, prepared by EFLA Consulting Engineers does not explain the environmental impact on the habitation and agriculture at Héðinshöfði. The farm houses are located around 2 km from the proposed Silicon Metal plant. We believe that the PCC construction excludes agriculture and habitation at Héðinshöfði for good.*"

Answer PCC*:* It is the conclusion of the EIA for the PCC Silicon Metal plant that the direct impact of the plant is limited to the company lot. This also applies to emissions to air and noise (after considering noise protections). The results of dispersion of chemical emission show that their concentration is under the reference values of regulations and furthermore that the direction of the dispersion is not towards Héðinshöfði. The noise assessment shows that the demands of the regulation are fulfilled at Héðinshöfði 1 and 2 for the day and night period. In the conclusion chapter of the assessment of landscape and visual impacts it says that. "[…] seen from the national road and partly from the houses at Héðinshöfði 1 and 2 they structures will touch the skyline or reduce view. The reduction of view is low in general, but there will be an impact on view from those specific areas north of the plant. For the final design of the plant and choice of colour an effort will be made to reduce the visual impact from the plant as much as possible. Visible structures from this distance will not have an impact on residence or agriculture.

Residents and land owners of Héðinshöfði further comment: *„The impact of emissions, visual pollution, noise- and light pollution is not taken into account. A demand is made for calculations that will take residential areas and agriculture into account that we believe will not be here in the future if industry will be built at Bakki."*

Therefore the demand is made that the impact will be assessed of visual pollution, sound level, light pollution that will occur for inhabitants at Héðinshöfði, during construction and when the plant is in full operation. The demand that measurements of those factors will begin today so allow comparison of the conditions for residents at Héðinshöfði today, during the construction period and after beginning of operation"."

Answer PCC: In the EIA for the Silicon Metal plant, the emission into air, noise as well as the visual impacts are assessed. Also the impact during construction was assessed and the mitigation measures described that will be implemented to reduce the impact and to increase the consideration for the neighbours of the construction area. When using flood lighting during construction care will be taking in reducing the impact on far surroundings as much as possible. During operation no special lighting of building is foreseen, other than lighting of gates, driving paths and walking paths within site because of security reasons. During design and installation of lighting care will be taken to reduce the impact outside of site as much as possible. Before beginning of the construction baseline research will be conducted

to enable an assessment of the impact from the plant on its close surroundings during operation and to verify calculations conducted in the EIA.

The residents and land owners of Héðinshöfði comment: "*Information is requested for information on a comparable plant in terms of residential areas, agriculture, vegetation and animal life".*

Answer PCC: ELKEM has operated a ferro-silicone plant at Grundartangi since 1978 with a yearly production capacity of around 140,000 tons per year. The industrial plants at Grundartangi perform environmental monitoring in accordance with an approved monitoring plan. A report with the results of the monitoring for 2012 can be found under: http://elkem.is/Files/Skra_0061082.pdf.

Furthermore, residents and land owners of Héðinshöfði comment: *„Is it possible to say there will be no pollution in Tjörneshreppur municipality because of the PCC Silicon Metal Plant and what PCC's measures to prevent this are?"*

Answer PCC: The results of the EIA are that the impact from the construction and operation of the Silicon Metal plant are limited to the lot and the nearest surroundings. Due to the distance from the municipal boarders and the nature and the magnitude of the impact it is assumed no pollution is expected in Tjörneshreppur municipality. PCC's own measures include mitigation measures that are described in the IEIS and to insure that the operation of the plant is within requirements of the operation permit at all times.

Finally, residents and land owners at Héðinshöfði comment: „ *The construction of the Silicon Metal plant at Bakki will reduce the life quality of residents of Héðinshöfði, also reduce property value and agriculture for the future. In the report says: In the view of the developer the environmental impact of the Silicon Metal plant is acceptable". We doubt that such a claim can be supported. A confirmation is requested that the Silicon Metal plant will not reduce the living quality of residents and landowners of Héðinshöfði, cultivation, agriculture and ecosystem on the land will not be reduced and that the PCC Silicon Metal plant will not reduce the value of properties and buildings at Héðinshöfði during construction and when the PCC plant is in full operation.*

Answer PCC: The results of the EIA are that although the project has some impact on the environment, it is restricted to the lot boundary and close surroundings. The visual impact on the farm houses at Héðinshöfði is considered to be considerably negative, permanent but reversible. Other impact of the Silicon Metal plant on Héðinshöfði is considered negligible

6 ENVIRONMENTAL IMPACT ASSESSMENT – ALTERNATIVE 1

6.1 Air quality and climate

6.1.1 Assessment criteria

In the assessment of emissions from the production of silicon metal the references are limits set in Icelandic Ambient Air Quality Regulations

- Regulation 251/2002 on sulphur dioxide, nitrogen oxides, benzene, carbon monoxide, particulate matter and led in the atmosphere and information to the public.
- Regulation 410/2008 on arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in the air.
- Regulation 739/2003 on waste incineration.

6.1.2 Documents and studies

In the assessment of air quality the emissions of sulphur dioxide (SO_2), nitrogen oxides (NO_x), particle matter (PM10), persistent organic pollutants (POP), polycyclic aromatic hydrocarbons (PAH) and benzo(a)pyrene (BaP). .According to information from SMS Siemag carbon monoxide (CO) is nearly fully burnt, and therefore CO emissions are considered to be insignificant and not further evaluated.

Emission values for sulphur dioxide, nitrogen oxides, particle matter and polycyclic aromatic hydrocarbons were provided by SMS Siemag. Emission values for benzo(a)pyrene were taken from a German guideline on emission control from the production of i.e. silicon metal (VDI, 2010) and the emission value for persistent organic pollutants were taken from the BAT document (BAT, 2001) The emission values used in the study are listed in Table 10.

Table 10 *Emission values for pollutants from PCC.*

Substance	mg/m^3	per $t_{product}$	per year for 33,000 tons	per year for 66,000 tons
Sulphur dioxide (SO_2)	180	12,6 kg/t	416 tons	832 tons
Nitrogen oxides (NO_x)	100-250	7 - 17,5 kg/t	235 - 588 tons	470 - 1.160 tons
Particle matter (PM10)	5	0,84 kg/t	28 tons	56 tons
PAH (polycyclic aromatic hydrocarbon)	0,026	1,86 g/t	60 kg	120 kg
BaP (Benzo(a)pyrene)*	0,0004	0,03 g/t	1 kg	2 kg
POP (persistent organic pollutants)**	2,1 *10^{-10}	15 ng/t	0,495 mg	0,99 mg

* Emission values for BaP are taken from VDI report (VDI, 2010). Discharge limits for BaP in exhaust according to a German Regulation (TA-Luft) are 0,05 mg/m^3 but are referred to here as limit for Ambient Air Quality.

** Values taken from BAT (BAT, 2001). Value for PCDD/F is used, that also covers PCB (Polychlorinated biphenyl) and HCB (Hexachlorobenzene).

Wind measurements were provided by the Icelandic Met Office (Veðurstofa Íslands).for the weather station at Bakkahöfði for the time period September 2002 to February 2009 and wind stability measurements between Bakkahöfði and Mt. Húsavíkurfjall for the period September 2002 to May 2005. Figure 14 shows the wind rose for Bakkahöfði.

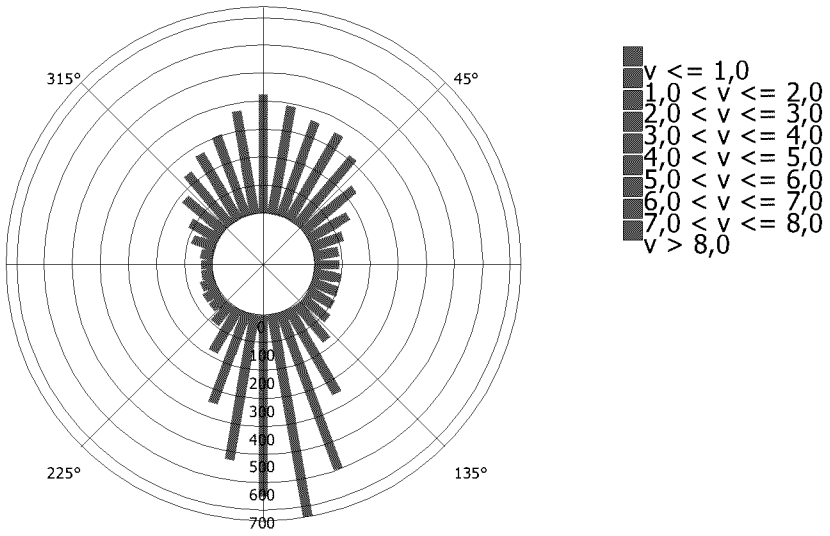


Figure 14: *Wind rose for Bakkahöfði by Húsavík 2002 - 2009*

Dispersion calculations were done with the use of a Gaussian dispersion model and are part of the software Soundplan 7.1. The weather station is located on the Bakkahöfði peninsula north of the site and therefore considers the effect of the landscape south of it.

Requirements for ambient air quality outside of company sites and defined dilution areas are listed in Table 11.

Table 11: *Requirements for ambient Air Quality.*

Substance	Reference time/Value	Limit	Number of yearly deviations allowed	Regulation
Sulphur dioxide (SO_2)	1 hour (Human health)	350 µg/m^3	24	251/2002
	24 hours (Human health)	125 µg/m^3	3	
	24 hours (Vegetation) / (Human health)	50 µg/m^3	7	
	Year and winter (Vegetation)	20 µg/m^3	-	
Particle matter (PM_{10})	24 hours (Human health)	50 µg/m^3	7	"
	Year (Human health)	20 µg/m^3	-	"
Nitrogen dioxide (NO_2) and nitrogen oxide (NO)	1 hour (Human health)	200 µg/m^3	18	"
	1 hour (Human health)	110 µg/m^3	175	"
	24 hours (Human health))	75 µg/m^3	7	"
	Year and winter (vegetation human health)	30 µg/m^3	-	"
Persistent organic pollutant (POP)	Year	0,001 µg/m^3	-	739/2003**
Benzo[*a*]pyrene	Year	0,001 µg/m^3	-	410/2008
Polycyclic aromatic hydrocarbon (PAH)	Year	1 µg/m^3	-	*

* No regulations apply for the concentration of PAH. Benzo[a]pyrene (BaP) belongs to the PAH group of pollutants. Assuming that BaP is around 0,3-1,5% of PAH, a high reference value of 1 µg/m ^{3} is chosen as reference value.

** No reference values area for POP in Icelandic regulations. POP contains amongst others doxine and furanes and the value used for the calculations covers both chemicals. Therefore the discharge limit for dioxin and furans in the exhaust from incinerators according to regulations nr 793/2003 used as reference values for the concentration of POP in the atmosphere

Information from SMS Siemag were used for the modelling of the source. Stack height was assumed 30 m, the stack volume 265,000 Nm^3/h and the estimated gas stack temperature 220 °C. The design of the plant assumes one stack for each phase. Calculations on the release of particle matter also cover the raw material treatment (160,000 Nm^3/h, ambient temperature), casting bay (144,000 Nm^3/h, 65°C) and product handling (95,00 Nm^3/h,

ambient temperature). The total emissions of particle matter is 664,000 Nm^3/h. The ambient temperature was chosen as 10°C.

A conservative assessment on the concentration of nitrogen dioxide assumes that all nitrogen oxide (NO) reacts into nitrogen dioxide (NO_2)

Maps with the results of the dispersion calculations can be found in Annex 10.

6.1.3 Characteristics of impacts

Particle matter (PM10)

The results of the dispersion calculation show that the annual mean values and the 24 hours value are within the requirements of regulation nr. 251/2002 for ambient air quality, for both phases 1 and 2. The dispersion calculation results for the 24 hours value for phase 2 can be seen in **Figure 15**. Additional results for calculations can be seen in maps nr. 101, 102, 201 and 202 in Annex 10.

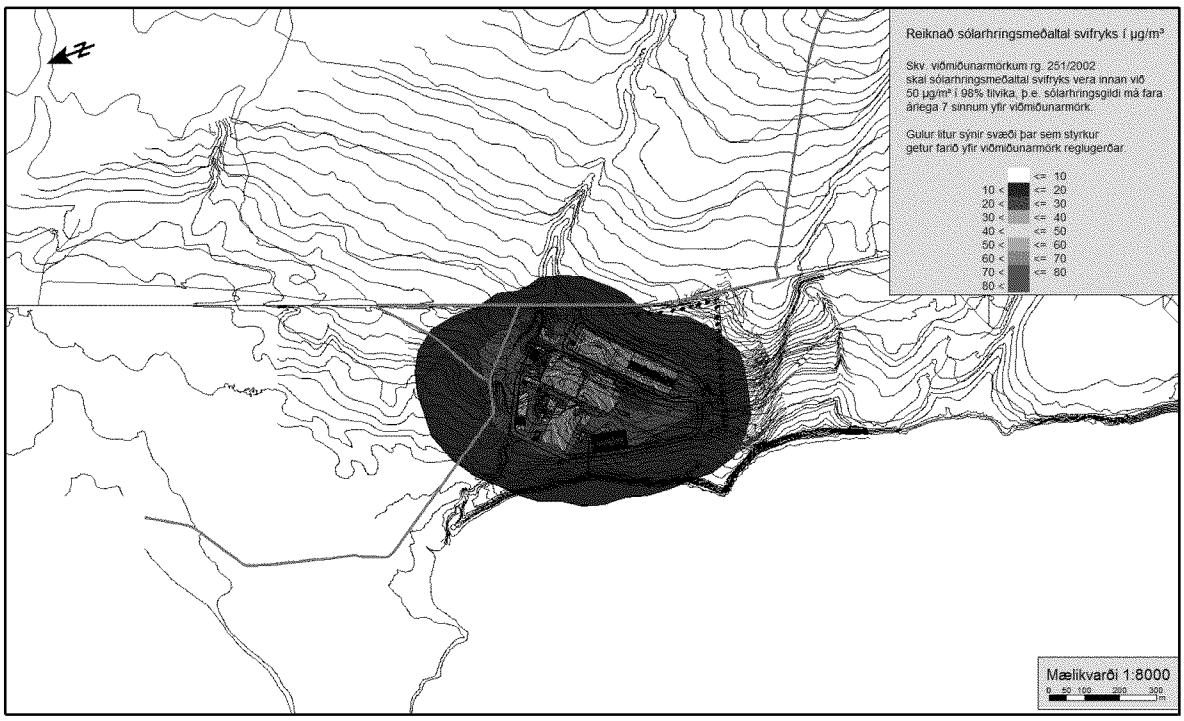


Figure 15: *24 hour mean concentration for particle matter for phase 2.*

Sulphur dioxide (SO_2)

The results of the dispersion calculation show that the annual and winter mean value, the 24 hours values for health and for vegetation and the 1 hour value are within the requirements of regulation nr. 251/2002 for ambient air quality, for both phases 1 and 2. The results for the annual and 24 hours values for vegetation, for phase 2, can be seen on **Figure 16** and **Figure 17**. The results of the dispersion calculation can be seen on air quality maps nr. 111-114 and 211-214 in Annex 10.

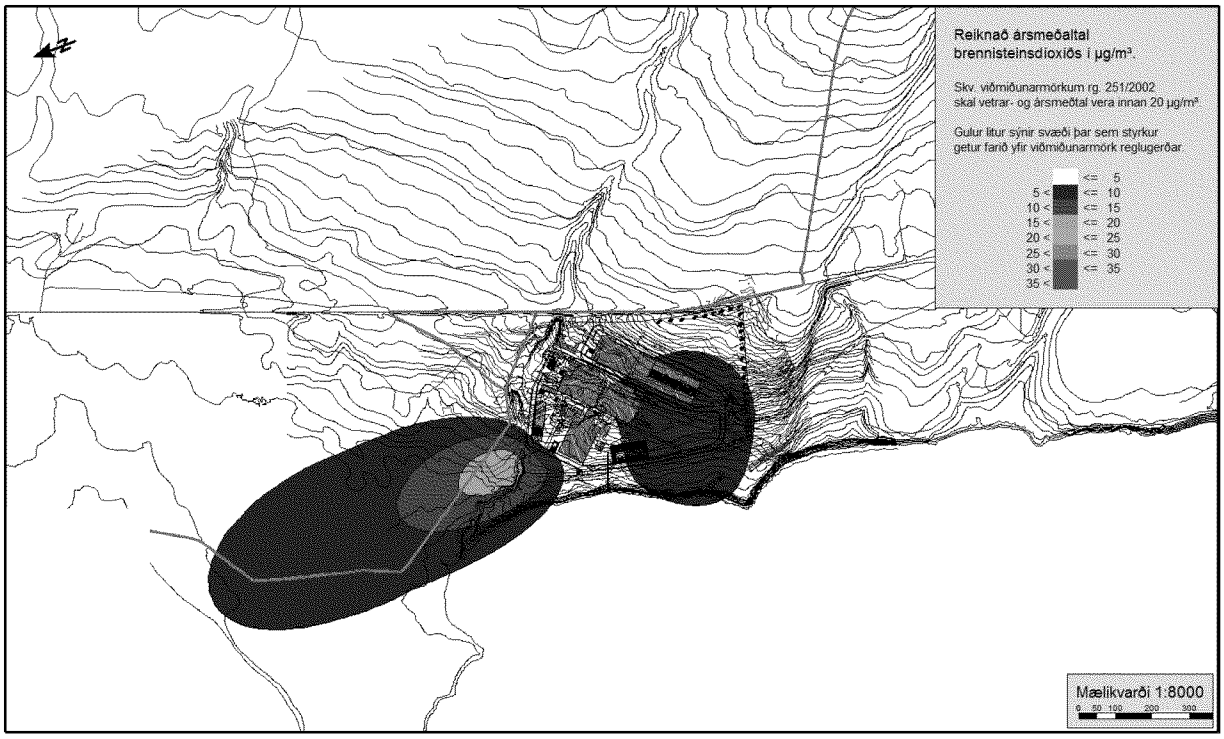


Figure 16: *Annual mean values for sulphur dioxide, for phase 2.*

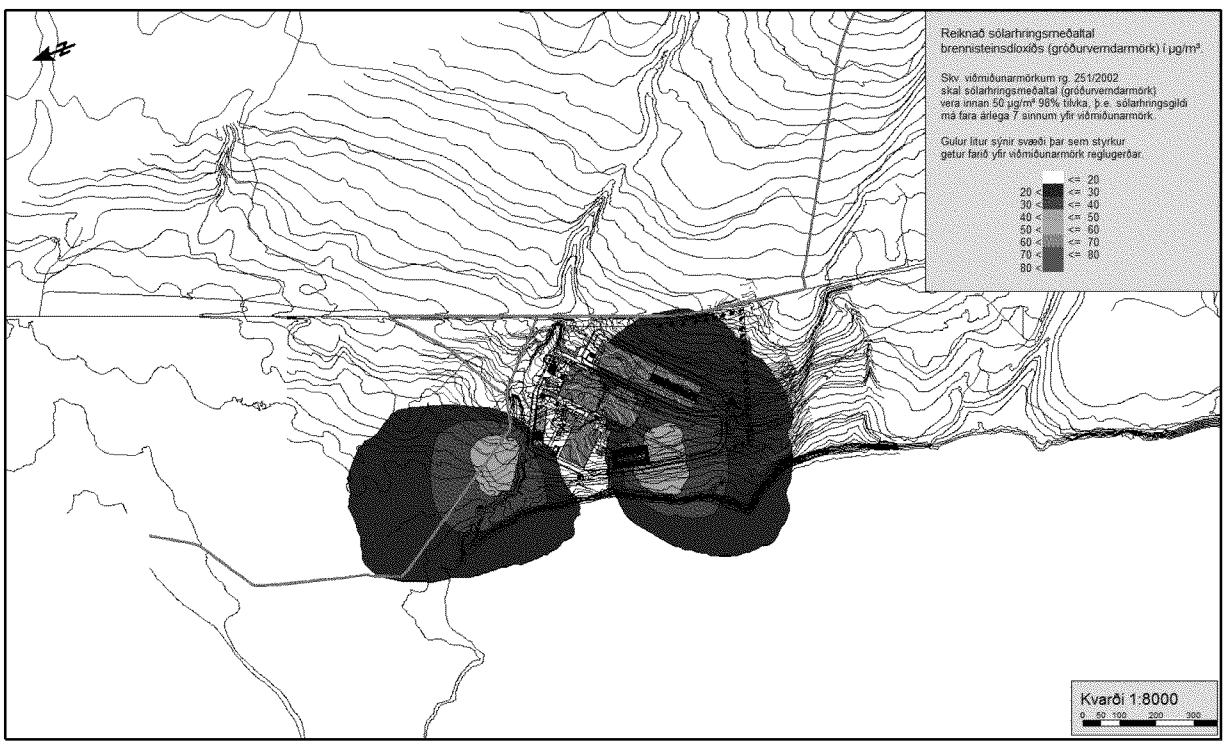


Figure 17: *24 hours mean values (for vegetation) for sulphur dioxide, for phase 2.* The concentration of sulphur dioxide is below the health requirement limits, the area is not both inside and outside the defined PCC plant boundaries

Since the concentration of sulphur dioxide is under the reference value for health in and outside of the lot, it is not believed to cause danger to men. The concentration of SO_2 is under the vegetation preservation value according to regulation 251/2002 at all times. Research shows that SO_2 in the atmosphere can have a long time effect on sensitive vegetation such as lichens and moss who have the lowest resistance against sulphur (value 15-30 µg/m^3) (Friðrik Pálmason and Borgþór Magnússon, 1998) and cause long time change

in the vegetation covers within the impact area, so that more vulnerable plants depart for others that are stronger. If the concentration of SO_2 in the atmosphere is high, SO_2 can oxidise to form SO_4 (sulphide) when coming into touch with static water. It is not assumed that the release from PCC will cause the concentration of sulphate in River Bakkaá to increase, because of the flow of the river.

Nitrogen dioxide (NO_2)

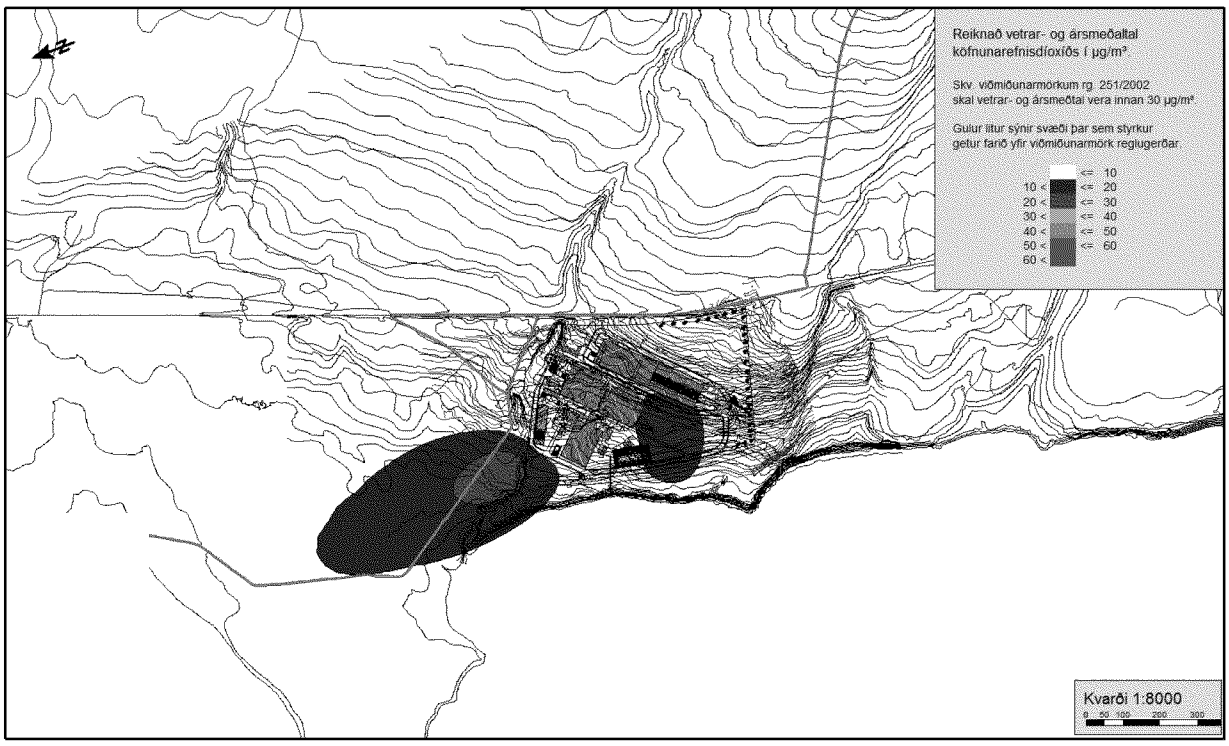


Figure 18: *Year and winter mean value of nitrogen dioxide according to phase 2*

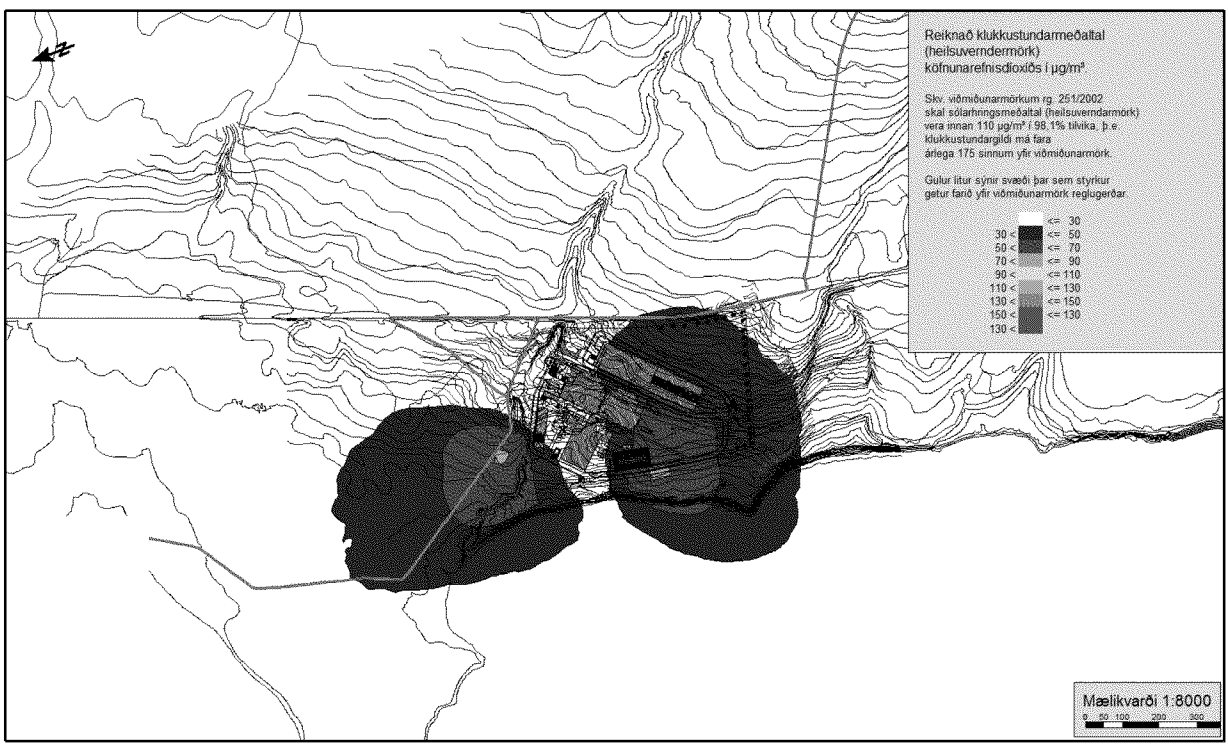


Figure 19: *Hourly value (110 µg/m^3) for nitrogen dioxide according to phase 2.*

The results of the dispersion calculation show that the annual and winter mean value, 24 hour value and 1 hour values are within the requirements of regulation nr. 251/2002 for ambient air quality for both phases 1 and 2, assuming a total conversion of NO_x into NO_2. The results of the dispersion calculation can be seen on air quality maps nr. 121-124 and 221-224 in Annex 10.

Persistent organic pollutants (POP)

The results of the dispersion calculation show that the maximum value for POP is 144 fg/m^3 (10^{-15} grams) for phase 2, which is within the reference value of regulation 739/2003 (discharge limits for incinerators). The concentration is lower than values that can be shown on maps.

Polycyclic aromatic hydrocarbons (PAH), Benzo(a)pyrene (BaP)

Results of dispersion calculation on the concentration of PAH and BaP show that the annual mean value of BaP is within the requirements of regulation 410/2008 for both phase 1 and phase 2. The calculation also show that the annual mean value is under the limit (1 µg/m^3) that was used as reference value. Results of the calculation can be shown on Figure 20. Other results for the PAH are shown on maps 131 and 231 in Annex 10.

Table 12 shows calculated maximum values of the dispersion calculations.

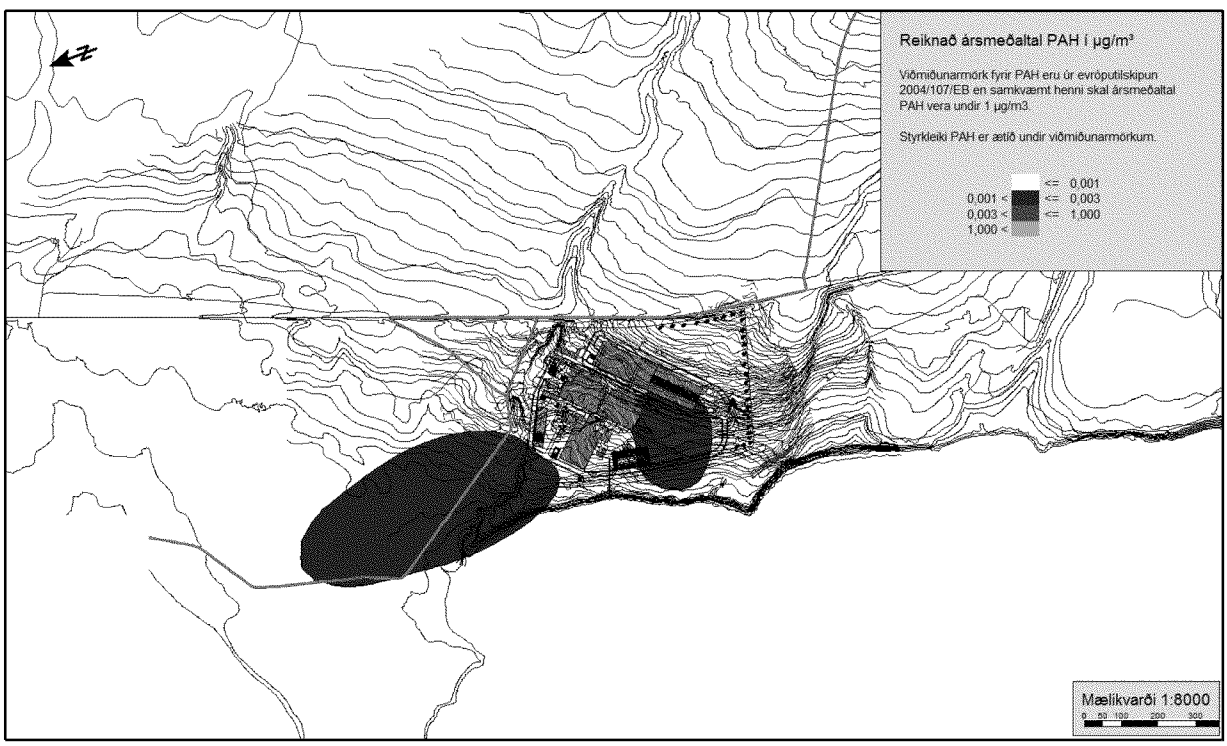


Figure 20: *Annual mean value PAH according to phase 2.*

Table 12: *Estimated maximum values of the dispersion calculation.*

Substance / Reference value	Calculated maximum value for 33,000 – 66,000 tpa and stack release (30 m)	Calculated maximum value for 33,000 – 66,000 tpa and release through roof of the filter bag house (30 m)	Reference value	Reference to Annex 10
Particle matter (PM10)				
Year	3,9 - 5,9 µg/m^3	4,1 – 6,1 µg/m^3	20 µg/m^3	101/201
24 - hours	31,0 – 34,0 µg/m^3	32,0 – 34,5 µg/m^3	50 µg/m^3	102/202
Sulphur dioxide (SO_2)				
Year and winter	10,3 - 17,9 µg/m^3	12,0 – 18,7 µg/m^3	20 µg/m^3	111/211
24 hours – human health	27,0 – 46,6 µg/m^3	28,0 47,6 µg/m^3	125 µg/m^3	112/212
24 hours – vegetation.	27,7 – 47,3 µg/m^3	31-50,6 µg/m^3	50 µg/m^3	113/213
1 hour	63,8 – 112,3 µg/m^3	65,0 – 114 µg/m^3	350 µg/m^3	114/214
Nitrogen dioxide (NO_2)				
Year and winter	14,4 – 24,9 µg/m^3	15 - 25,5 µg/m^3	30 µg/m^3	121/221
24 hours	42,0 – 65,8 µg/m^3	43 – 66,7 µg/m^3	75 µg/m^3	122/222
1 hour	46,7 – 66,0 µg/m^3	47 -71,0 µg/m^3	110 µg/m^3	123/223
1 hour	124,6 – 184,1 µg/m^3	130,8 – 190,3 µg/m^3	220 µg/m^3	124/224
Other substances				
PAH - Year	0,001 µg/m^3	0,002 -0,003 µg/m^3	1 µg/m^3	131/231
BaP - Year	2,88 ng/m^3	5,0 ng/m^3	0,001 µg/m^3	-
POP - Year	144 fg/m^3	150 fg/m^3	0,001 µg/m^3	-

EFLA Consulting Engineers have also evaluated the air quality when other methods for release of emissions are used instead of a 30 m stack. Two version were assessed, firstly the impact from three 8 m high stacks located on top of the roof of the filter bag house, that is ca. 35 m above ground. Secondly the impact from release through a 15 m long line source through the roof of the bag house. The results show that the concentration in the air remains under the reference values of the regulations when those methods are used.

The results of calculations for the annual mean value of sulphur dioxide when released through three 8 m high stacks and through the roof are shown on Figures 21 and 22 below. The results of calculation for other values are also under the reference values.

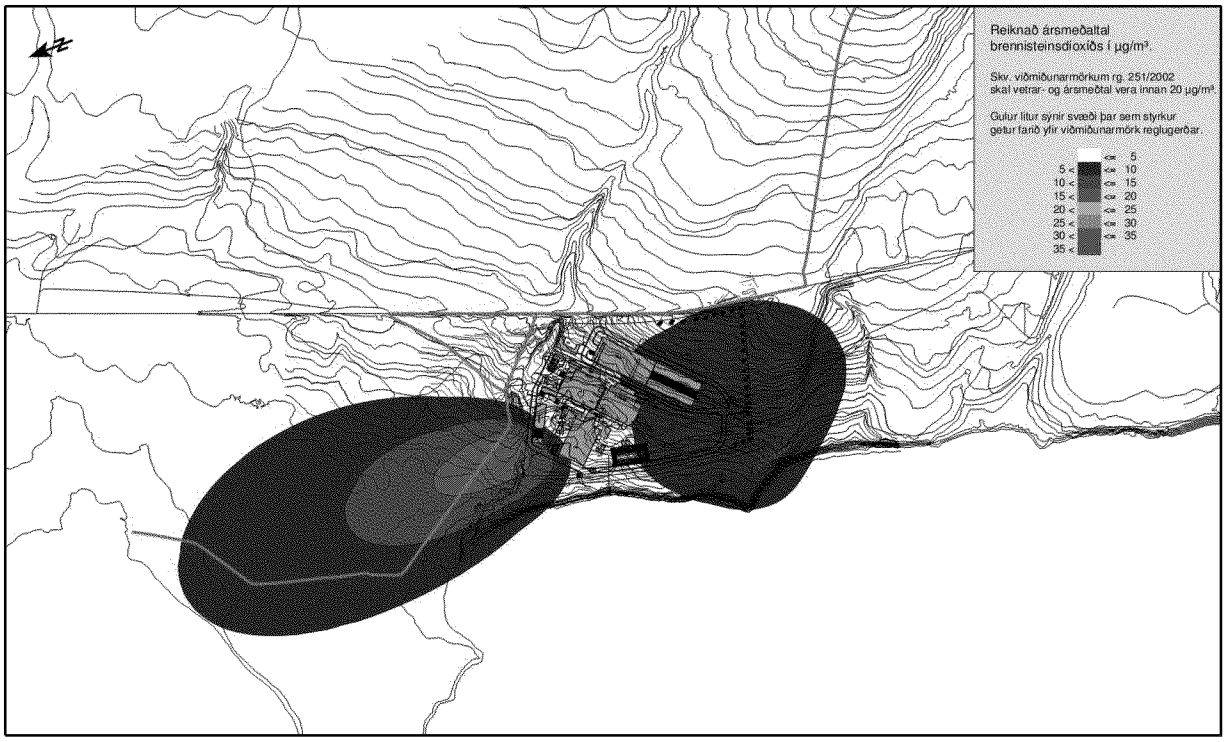


Figure 21: *Annual mean value of sulphur dioxide according to phase 2 for release through three 8 m stacks.*

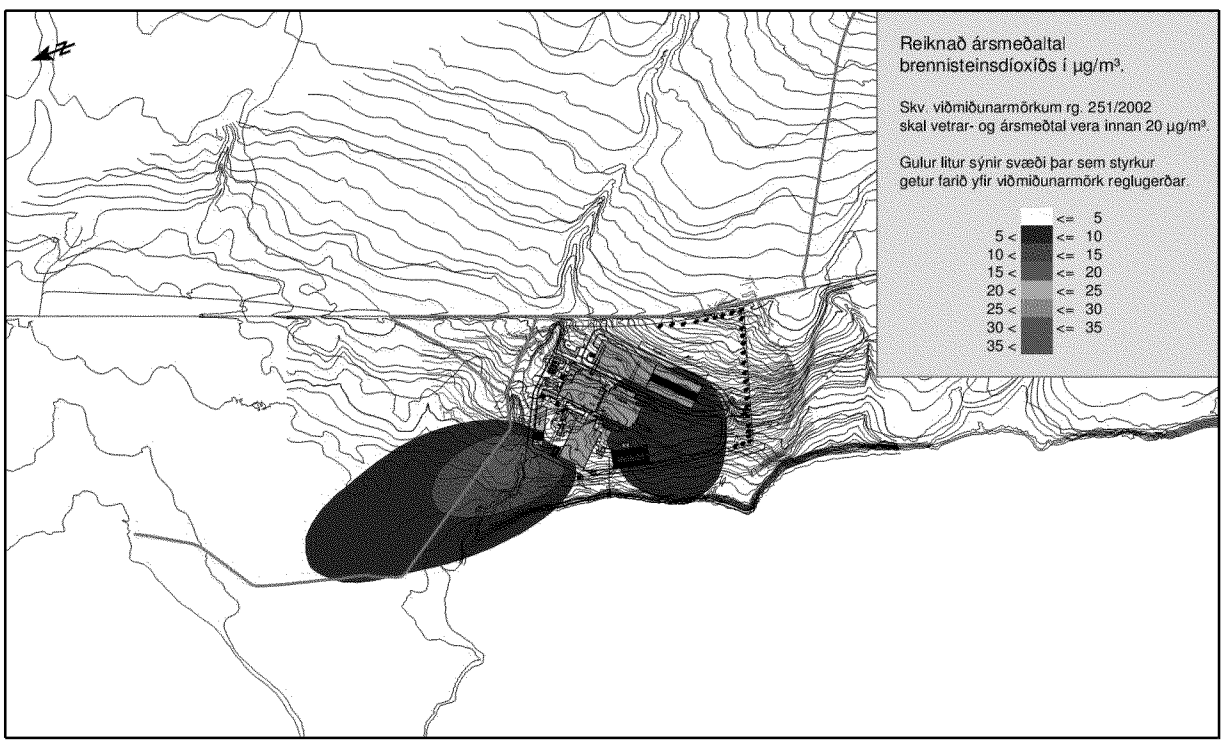


Figure 22: *Annual mean value of sulphur dioxide according to phase 2, for release through roof of the filter house.*

Release of greenhouse gasses

The operation of PCC at Bakki involves the release of carbon dioxide (CO_2) which acts as a greenhouse gas (GHG) in the earth's atmosphere, playing a major role in global warming and anthropogenic climate change. The general policy of the government of Iceland on GHG and climate change was set in 2007 and published in the government's action plan on

climate change that was agreed on in 2010 (Umhverfisráðuneytið, 2010). The objectives are long term and they reduction in net greenhouse gas emissions by the year 2050 compared to net emissions in 1990, and a participation in a joint effort of the EU to reduce GHG emissions by 30% until 2020.

In the general policy document of the government from 2010 it is, based on two scenarios of the EPA (UST), considered realistic to aim that the release of GHG from the aluminium and ferro alloys heavy industry will rise from the base year 1990 where the emission of GHG was 761 Gg. The release was 1,857 Gg in 2008 (+41% compared to 1990) and expected to be 1,742 – 2,918 Gg in 2020 (+129 - 283% compared to 1990). The policy document of the government expects that the changes in the release of GHG between the years 2008 and 2020 can be between a decrease of 115 Gg (- 6%) to an increase by 1,060 Gg (+57%). The release of the GHG carbon dioxide (CO2) from the operation of PCC will be approximately 181,500 tons (181.5 Gg) annually for the 1st phase and 363,000 (363 Gg) tons annually for the 2nd phase and is therefore within the expected increase of emissions until 2020.

Since 1992, Iceland has committed to the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC), who sets binding obligations to reduce emissions of GHG into the atmosphere. In the 1st commitment period of the Protocol Iceland made use of clause 14/CP.7 that allowed Iceland to increase GHG emissions by 1.6 tpa in the period 2008-2012 for new industry projects using the countries renewable energy sources. In 2011 Iceland has committed to participate in the 2nd commitment period (2013-2020) of the Kyoto Protocol. On the Climate Changes Conference of the Parties of the UNFCCC in Doha, Qatar, in December 2012 Iceland together with the EU member States and Croatia committed to reducing their total emission of 1990 by 20% by 2020. Later negotiations between the nations following the conference will decide the commitments of each individual participating state.

Iceland will partly fulfil its commitments by participating in the EU trading system for emissions (ETS) which is the EU's main control instrument in the reduction of GHG. As of January 1st 2013 the ETS also covers stationary industry such as the production of silicon metal (according to Directive 2003/87/EC). Therefore other rules apply for the release of GHG from stationary industry than other release from Iceland since under the ETS stationary industry will be allocated release allowances from a pan-European source. In Iceland, the ETS System is a subject of law nr. 70/2012. PCC will apply for emission allowances to the Environmental Agency for the company's discharge of Greenhouse gasses during the operation as a new participant in the system.

Cumulative effects with future industrial installations at Bakki

Currently, the construction of two further metal producing plants is in planning at Bakki, the Thorsil silicon metal plant and the Saint Gobain silicon carbide plant. Due to the similar nature of the raw materials and processes in those installations, the main emissions to air from all three plants will be sulphur dioxide (SO_2); nitrogen oxides (NO_x) and particle matter (PM10). The operation of similar plants in the industrial zone creates a certain risk of cumulative effect of emissions and lead to situations where the requirements of ambient air quality cannot be met, which calls for a dilution zone for the area to be defined.

By the time of the submission of this EIA report information on emissions and locations could not be provided by Thorsil and therefore an estimation of possible cumulative effect of emissions is not possible. The current suggested site for Thorsil lies approximately 200 m north of PCC site. The most common wind directions in the area (measured at the Bakkahöfði weather stations) are the north and south directions, with south directions being the prevailing wind directions. This means that emissions can possibly be distributed between the two sites with the risk of a cumulative effect.

Information could be provided by Saint Gobain on the expected emission from the operation. Because of a great uncertainty in the actual location of the source on site a reliable estimation of the possible cumulative effect cannot be done. Saint Gobain expects to emit around 1,400 – 1,900 tons of sulphur dioxide (SO_2) per year, which is around 1,7-2,2 times

higher than emissions from the operation of PCC according to phase 2. Emissions of particular matter (PM10) are between 150-200 tons per year, or 6,2-8,3 times higher than dust emissions from PCC according to phase 2. Nitrogen oxide (NOx) emissions from Saint Gobain are expected to be less than 60 tons, or 5% of the NOx emissions from PCC according to phase 2. There are insignificant carbon monoxide (CO) emissions from the operation of PCC and therefore no risk of cumulative effect.

The main wind directions that can possibly lead to cumulative effects between PCC and Saint Gobain are N-NA and S-SW directions, with the north directions being more frequent. Considering the amount of emissions, the risk is highest for SO2 and also considerable for PM10 due to the rather strong source from Saint Gobain.

However due to the uncertainty of information on the sources and locations of the operations of Thorsil and Saint Gobain no detailed analysis on the risk of cumulative effect arising can be made at this stage.

6.1.4 Mitigation measures – monitoring

No mitigation measures are needed. PCC will assign 3rd party with point measurements of the ambient air quality at the site premises on a regular basis and also within site on points that might be frequently visited by visitors (i.e. visitor parking lot). Main emphasis will be put on measurements on the northern side of the lot where the most impact is expected. Base line studies will be conducted on the concentration of sulphur dioxide in grass and in leaves in designated areas and the possible increase in the concentration will be assessed every other year. PCC will furthermore assign 3rd party with regular sulphate and pH measurements in River Bakkaá. PCC will participate in monitoring programmes in the area on possible impact to the environment that can be related to the operation of PCC.

6.1.5 Conclusion

The results of the air dispersion calculation and the evaluation of the air quality show that an increase in emissions but that the ambient air quality for sulphur dioxide, nitrogen dioxide and particle matter outside of the PCC site, will meet the requirements of regulations. The emissions of persistent organic pollutants (POP), Polycyclic aromatic hydrocarbons (PAH) and Benzo[a]pyrene (BaP) are very low and well within all limits. The release of carbon dioxide from the operation will increase the emissions of Greenhouse gasses from Iceland, but is within the limits of realistic increase in release until 2020. According to current plans two further operations are planned in the area. Due to the closeness of the plants a cumulative effect of emissions is possible. This can only be studied fully when information on all operations are available. The impact following the emissions from the operation of PCC are considered to be ***negligible***

6.1.6 Review and comments on Air Quality and PCC's answers

6.1.6.1 Comments of The Environment Agency of Iceland

The comments of the Environment Agency of Iceland states: „*Table 10 shows the airborne emissions of different air pollutants. The table reveals a total release of sulphur dioxides (SO_2) for annual production of 66,000 ton of 832 ton. The Agency does not comment on the amount, but points out that it might be useful to provide information on the prerequisite for the release calculations, that is the sulphur content of each group raw materials and the total amount of raw materials.*

Answer PCC: Based on the amount of raw materials and the estimated composition the emissions of SO_2 were estimated based on the following:

Table 13: *Estimated discharge of sulphur dioxide (SO_2).*

kg S/t_{Si}	kg/t_{Si}	%S	kg S/t_{Si}
Quartzite	2,400	0.01	0.24
Wood chips	1,350	0.01	0.14
Coal	1,250	0.45	5.63
Electrodes	100	0.45*	0.45
		Total	6.45
Discharge SO_2 (for. 66,000 t annual production)			~ 850 ton

Furthermore, it says in the comments from The Environment Agency of Iceland: „ *The Environment Agency also requests information on dust pollution from the handling of raw materials where appropriate, in the BAT for this type of activity it is expected to be a loss of up to 0.2% from material handling.*

Answer PCC: Dust creation from handling of raw materials that can escape from the handling of raw materials has not been calculated. However, the dust creation is estimated to be negligible, since the coals are washed before being loaded on ship, to avoid fines in the material. Therefore the coals are relatively moist when unloaded in Húsavík. If any dust pollution will be noticed when unloading of raw materials they will sprayed with water to avoid dust pollution

Also the Environment Agency points out that: " the third draft of a new BAT and ?BAT conclusion? has been issued for the aforementioned industries. The Agency requests the operator to account for if he can meet the conditions and limits set out in the BAT conclusions draft (see chapter 14 in the BAT report *http://eippcb.jrc.es/reference/BREF/NFMbw_17_04-03-2013.pdf*).”

Answer PCC: According to information from the furnace producer, SMS Siemag, the operation and monitoring of the Silicon Metal plant will be accordance with the conditions and limits set out in the draft BAT conclusions.

Furthermore it says in the comments of the Environment Agency: „ *The Environment Agency considers it desirable to discuss the topic of dust pollution during construction and to explain possible mitigation measures to reduce dust pollution during construction. Dust pollution during the construction of the plant can be significant, even greater than emissions from the plant itself when it is in full operation. Around the world mitigation measures are being engaged during construction, and as an example, the US contractor Bechtel defines dust as the main environmental impact from construction“.*

Answer PCC: Chapter 6.8 discusses dust pollution during construction and describes mitigation measures to prevent dust pollution during construction. It states that if a new industrial road (connection road) will be in operation all traffic during the construction will be on that road, which will prevent traffic related dust pollution in the urban areas. Also that dust pollution will be prevented by covering the loads of trucks. On the construction site irrigation will the applied if there is a risk of dust pollution arising

The Environment Agency points out in its comments: „*The introduction of the silicon metal plant will increase air pollution. The air pollution is mostly confined to the area close to the plant and the calculated emissions will not go over the reference values of Icelandic regulations. Some values can however go near to the regulatory limits. It is expected that the annual mean value of SO_2 can go up to 17.9 µg/m^3 but the reference value for the annual*

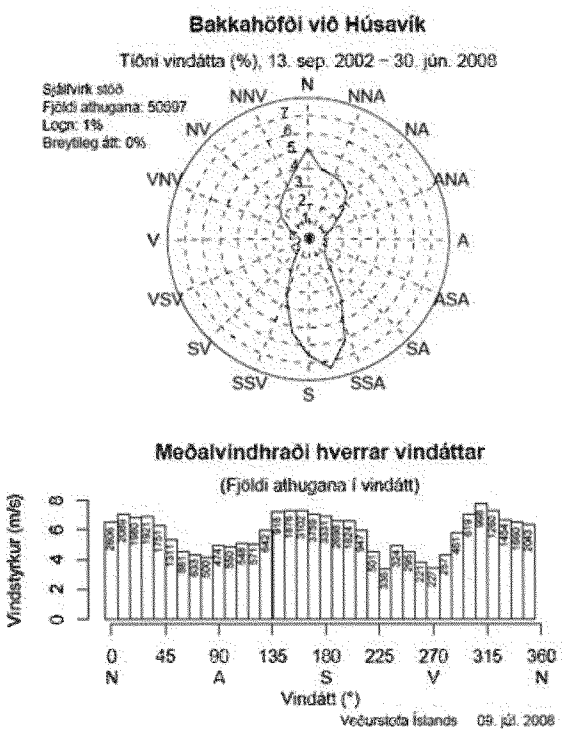
mean value is 20 µg/m^3. No measurements exist on the current concentration of SO_2 in the area, but for reference the annual mean value of SO_2 on Grensásvegur road in Reykjavík has been between 2-4 µg/m^3. It can be assumed that SO_2 can be clearly measured in the town of Húsavík, but according to available data, it is not expected that air pollution levels are above reference levels of regulation 251/2002. In that regulation are the 24 h health limits for SO_2 125 µg/m^3. Those are the same values as in European Air Quality Regulations. The Environment Agency points out that the World Health Organization (WHO) issued in 2005 new limits for guideline values for Air Quality http://whqlibdoc.who.int/hq/2006/WHO_SDE_PHE_OEH_06.02_eng.pdf There the WHO defines the suggested 24 h reference value for SO_2 as 20 µg/m^3. Those values are considerably more stringent than in Icelandic and European regulations where the 24 hour value is set to 125 µg/m^3. No decisions have been made if rules in Europe will be tightened in view of the WHO guideline values. The presented data do not suggest that the WHO guideline values will be exceeded in the town of Húsavík.

Finally, the Environment Agency comments: *„On page 33 of the IEIS discusses the potential cumulative effect from the discharge of other factories that are in the pipeline at Bakki, such as the possible Thorsil and Saint Gobain plants. It is stated that there are still insufficient data from other potential operators to calculate the potential cumulative effect. In relation to other planned development in the area the Environment Agency points out the need for further study of potential cumulative effect of polluting substances, especially SO_2"*

Answer PCC: Potential cumulative effect is assessed in the EIA based on available data at the time of the assessment. In order to evaluate the cumulative effect, PCC will provide other parties who pursue development in the area with data, if and when it comes to assessment of Air Quality for the respective project.

6.1.6.2 Comments of the Icelandic Met Office

The Icelandic Met Office comments: "*In chapter 6.2.1 in the IEIS Figure 14 shows a wind rose for Bakkahöfði for the period September 2002 to February 2009. This wind rose is unreadable as presented here. A large and empty ring is in the middle and the wind rose is lacking a scale that shows the wind direction or wind speed. The wind rose below which is in the possession of the Met Office (for a slightly shorter period), shows that calms are only around 1% of the time at Bakkahöfði. The most common wind directions are from S and SSE directions, but also wind from N is rather frequent. Winds blowing from clear E or W are very rare at Bakkahöfði. Also the column bar chart below the wind rose shows that winds from S and SSE are the directions with the strongest wind speeds, although winds from NW can be rather sharp in the few occasions it occurs.*



Answer PCC: At the beginning of the assessment process the Icelandic Met Office was consulted on which date should be the base for the Air Quality calculations. Available observations from the last few years were analysed and the suggestions from the Met Office followed which data was to be used. The wind rose used for the calculations and shown in the IEIS was made using measurements from the Met Office at Bakkahöfði. And updated image with enlarged wind rose and wind classes is now presented in the EIS

The Met Office further comments: „*The same section says that the emission calculations of the emissions of particulate matter were investigated the air temperature was selected 10°C. This is a much higher temperature then the mean temperature measured in weather stations in the area. At Mánárbakki the annual mean temperature is 3.9°C and 3.3°C at Raufarhöfn. The highest temperature ever to be measured at Bakkahöfði since 2002 is 25°C. Therefore it can be assumed that there might be some error in the emission calculations, but the exhaust velocity (and exhaust distance) depend on the temperature difference of the exhaust and the air around it. If the difference is small the emissions travel a shorter distance than if the difference is great. Therefore it can be assumed, that the exhaust travels a longer distance at temperatures around freezing point or just above it, than when the air is 10°C".*

Answer PCC: Air temperature in the EIA refers to heat of the exhaust from the handling of raw materials and from crushing and packaging of products which is connected to the outside temperature to some extent. In the modelling a constant exhaust temperature of 10°C was chosen. The calculation model does not calculate with the outside temperature, but measurements of the vertical temperature gradient between Bakkahöfði and Mt. Húsavíkurfjall were received from the Icelandic Met Office for the period September 2002 – September 2003 and were used along with wind measurements from Bakkahöfði for the distribution calculations.

Furthermore the Met Office comments: *"Chapter 6.1 does not seem to explain the impact on Air Quality from transport to and from the plant. It is necessary to provide estimations on this matter and to estimate the impact of transport on climate."*

Answer PCC: The total transportation of raw materials and products between the harbour area and the plant are on average 243,300 tons for 33,000 tons production capacity and 486,600 tons for 66,000 tons production capacity. Assuming slow moving trailer trains with 85 tons capacity that drive on the industrial road (3 km), around 2,900 trips can be assumed annually (for 33,000 tons). Using values from Life Cycle Analysis database (GaBi 6) it can be assumed that the emissions from transport are around 79 tons CO_2 – equivalents per year.

The Met Office also comments*: "In Chapter 6.1.3 it is necessary to provide clearer information on the calculated values and the concentration of pollutants according to dispersion models and to explain them clearly in the text of the report. It is of importance to explain which concentration is the highest mean concentration of each time. Air Quality maps of the dispersion cannot stand alone as information on this aspect. It is necessary to provide the error margins of such calculations"*

Answer PCC: The highest calculated concentration and reference values are in Table 12, that shows the highest average values (percentiles), as they are defined in regulation 251/2002, for 33,000 and 66,000 ton production capacity and their comparison to the reference values of the regulations. The model calculations all assume constant operation of the plant, all days of the year. Therefore the release into the atmosphere in the model is constant over the whole time, without changes in emissions as they would be shown in measurements on site. The aspects that influence the accuracy of the dispersion calculations are mainly the quality of the available data, such as the accuracy in the digital ground model, weather measurements and information on the source. However, it is not possible to quantify the error in the factors. The dispersion model is considered to give a good idea of the situation in the area during the operation of the plant. The dispersion calculations will be verified by monitoring and the results of the monitoring will be responded to if necessary.

The Met Office furthermore comments*: "In those cases where the concentration is close to the reference values, they need to be clarified further, such as the maximum value of the dispersion calculation, highest possible concentration, under what circumstances/conditions they might arise and the frequency of such situations. This applies i.e. for the 24 h mean value of particulate matter. The calculated winter and year mean values, 24 h mean value and hourly mean value of nitrogen dioxide for 66,000 ton production capacity also seems to be close to the reference values, and therefore the maximum values should be further clarified. The scale on the Air Quality maps needs to be further explained, since it is hard to realize the meaning of the green colour code in the maps."*

Answer PCC: The calculated maximum values for the values mentioned above are in all cases below the reference values of regulation nr. 251/2002, see Table 12. The colour code of the maps indicates the area between equal concentration lines, which is the calculated strength within each area, is in the same range as showed on the scale with each individual map. White and green colours indicate areas where the concentration of pollutants is below or equal to the reference values. Yellow colour indicates areas where the concentration can go over the reference values. Higher concentrations are then indicated with orange, red and blue colour. This colour sequence is used to enable a better recognition of areas where the concentration is above the reference values. If an Air Quality map is only with green colour then the calculated concentration is always below the reference values.

Also the Met Office comments that*: " According to Air Quality maps in Annex 8 [comment EFLA: Annex 10] the calculated 24 h mean value for 33,000 tons production capacity seems to be close to the reference values. The calculated 24 h mean value for 66,000 tons production capacity seems to have a similar distribution to the north, but even not achieve the same strength, that is not get close to the 40 µg/m^{3}limit value. This needs to be clarified."*

Answer PCC: The highest calculated 24 h mean value for particulate matter is 31.0 µg/m^3 for 33,000 ton production capacity (1st phase) and 34,0 µg/m^3 for 66,000 tpa production (2nd

phase) capacity as can be seen in Table 12. The reference values of regulation 251/2002 for the 24 h mean value is 50 µg/m^3, so therefore the calculated values fulfil the requirements of the regulation. The images of the distribution phase 1 and phase 2 are unlike, since the source for phase 2 lies south of the source for phase 1. Furthermore, it is stressed that monitoring during operation will confirm the results of the dispersion calculations.

The Met Office comments further*: "Table 12 in Chapter 6.1.3 shows the estimated maximum values of the Air Quality Assessment. The numbers seem to be what can be expected from average values, and not maximum values. It would be desirable to present both numbers and the error margin."*

Answer PCC: The values in Table 12 are calculated maximum values for annual mean values, 24 h mean values and hourly mean values. Individual maximum values were not calculated.

Finally, the Met Office comments: "Finally chapter 6.1.3 states that other methods of discharge were evaluated then release through 30 m stack. It must be clear if those methods are part of the EIA in this report. If so, then similar information has to be presented as for the 30 m stack."

Answer PCC: According to information from the furnace manufacturer, SMS Siemag, the expected height of release from the filter house is between 30-32 m above ground. Calculations were release through the top of the open bag house in 30 m height. The results shows that this method of release increases the calculated values, but also that the impact is negligible, that is that the operation fulfils all requirements of the regulations. Table 12 in the Environmental Impact Statement (EIS). Table 12 in the EIS shows updated values with assessment of other form of release than was initially presented in the IEIS. Air Quality maps showing the results of the calculations are shown in Annex.

6.1.6.3 Comments from Verkís Consulting Engineers

Verkís Consulting Engineers comments: *"A letter from The National Planning Agency, dated September 17, 2012, the Agency requests a joint assessment of the impact of the concentration of pollutants due to airborne emissions from 3 parties preparing the production of silicon products in the industrial zone at Bakki by Húsavík. Verkís, on behalf of Saint Gobain sent Efla on behalf of PCC all necessary information on the estimated emissions from the proposed plant of SG together with the coordinates of the outlet. Therefore it is wrongly stated in Chapter 6.1.3 on page 33 in the IEIS which is now in presentation, that PCC received data which shows the location of the lot, but uncertainty about the location of the plant within the lot hinders a reliable estimation of cumulative effects. Efla did not request any further information than those who were sent."*

Answer PCC: On November 22, 2012 Verkís sent EFLA and email containing a table on the amount of emissions as presented in the Scoping Document for the proposed Saint Gobain plant.

Same email also contained a description of the outlet and a drawing file (.dwg) with the location. The e-mail from Verkís states that the coordinates of the outlet are "very rough" and that the height of the surface/lot is "an estimate". A telephone call with the author of the local plan (Mannvit Consulting Engineers in Húsavík) stated that work on the local plan of the area was not completed and that the final lot boundaries and locations within lots were not definitely determined.

With regards to the uncertainty described above it was decided that necessary requirements were lacking to assess the possible cumulate effect between PCC and Saint Gobain in another way than was done in the IEIS. In early January 2013 Verkís inquired about the progress of the cumulative assessment and in the same telephone call Verkís was informed about the progress and an explanation given why the option was chosen. Verkís made no comments. In the same conversation no indications were made by Verkís that new

information on the more precise location of the outlet was available. It should be pointed out that it is the responsibility of each respective company to assess the impact of airborne emissions from its operations and thereby to take into consideration the information presented in this Environmental Impact Assessment on the impact of airborne emissions from PCC's silicon metal plant.

6.1.6.4 Comments from residents and landowners at Héðinshöfði

Residents and landowners at Héðinshöfði comment: "*Which weather studies are used? In 2010 weather stations at Bakki were stopped [EFLA comment: measurements were discontinued] after ca. 7-8 years and after 3 years at Héðinshöfði. The weather station in the harbour area has been inactive for a long time. It's unacceptable that these measurements are cancelled, wind direction and weather conditions have a great influence on our environment in terms of exhaust from the proposed plants, including PCC. The undersigned demand that those weather stations will be taken into operation immediately and not only old data used from those stations that have not been in operation in recent years.*"

Answer PCC: The data used comes from wind measurements conducted by the Icelandic Met Office at Bakkahöfði for the period September 2002 – February 2009. In preparation of the assessment, the Icelandic Met Office was consulted on which weather station was best suitable for the calculations and it was the conclusion of the meteorologists that measurements from Bakkahöfði would describe better the wind conditions in the area, then other nearby stations. The developer assumes that no changes have occurred in the area after the measurement period ended that might cause changes in the wind scenario in the area.

Furthermore, residents and landowners at Héðinshöfði comment: "*What is the exhaust of machinery and vehicles [...] after the beginning of productions and what will be the impact on residential areas, land cultivation and agriculture in Héðinshöfði?*"

Answer PCC: All transportation between the harbour area and the PCC site will be through the industrial road that runs along the coastline, far away from Héðinshöfði, except in those exceptional cases when the transportation will be through the public road to Húsavík, as is described in the EIS. Neither regular transportation through the industrial road, nor temporary transport through the public road will be directed by the Héðinshöfði farms. Possible regular traffic passed Héðinshöfði that can be connected to the plant, is the driving of staff residing north of Héðinshöfði to work.

6.2 Noise

6.2.1 Assessment of criteria

The Icelandic regulation on noise nr. 724/2008 requires that sound level from traffic and industry does not exceed a given value, depending on the circumstances. Sound level from traffic should not exceed 55 dB(A) in front of windows in residences located in a residential area and where people dwell within premises. In front of windows (that can be open) in residences, located on shopping, service and central areas the sound level may reach up to 65 dB(A).

Greater demands are made on the sound pressure level from industry in residential area, and then the requirements are divided into three periods of time, see Table 14.

Table 14: The criteria from the Icelandic regulation on noise nr. 724/2008 regarding noise from industry in front of a window of a residence in a residential area.

Period of time	Criteria (L_{Aeq})
Day (07-19)	50 dB (A)
Evening (19-23)	45 dB(A)
Night (23-07)	40 dB(A)

The Icelandic regulation on noise also requires a certain sound level criteria, from industry in industrial areas is met at the outside wall of houses. The criteria are defined at the boundary of industry site since it is possible that neighbouring houses are built directly at the boundary. This is also done to avoid possible cumulative effects from many operations. Sound pressure level on boundaries of industry sites shall not exceed 70 dB(A) over the day-, evening- and night period

6.2.2 Documents and studies

Noise emission from the PCC Silicon Metal plant can be divided into two parts. From the operation of the silicon smelter and from harbour activities related to the plant in form of unloading, loading and transport to and from the plant.

A model of the noise propagation from the factory site was conducted. The software SoundPlan 7.1 was used for the modelling and the noise level calculated in accordance with the Nordic Prediction Method from 1996. The model takes into account the contours of the landscape, the main buildings at the factory site and the main noise sources on the site and the nearest surroundings. The main noise sources found at the factory site are following:

- Fans
- Wood chipper
- Deep Bunker
- Crusher
- Silostation
- Sieve
- Transformer and cooling fans on the roof of the cooling tower.

The impact of other noise sources is considered negligible. Two noise maps were conducted for the factory site and the vicinity can be found in Annex. The map show a colour scale indicating the noise propagation from the plant in 2 m height above ground. Reflections from the buildings are taken into account. The impact of the noise emission from the plant at the nearest residential area are compared with the criteria of the Icelandic regulation on noise but also the criteria for the boundary of the site is examined and compared to limits in the noise regulation nr. 724/2008. The maps shows the A-weighted equivalent noise level of the site calculated over 12 hours, daytime 07-19 and night-time 19-07. The calculations assume that cooling towers and dedusting for the production is in full operation 24 hours, every day. Other operations, crushing and packing of products and dedusting of air is in operation 8 hours on weekdays.

The activity on the harbour related to the PCC Silicon Metal plant will be located at Bökugarður. The activities at the harbour will be irregular but it is planned that no activities will take place during the night time or on Sundays. It is assumed that the shipping scenario on a monthly basis will be 6 ships, whereas three of these six ships will be used for both import and export. The three others will only be used for import. On a yearly basis there will be seventy two ships related to the PCC Silicon Metal plant coming into the Húsavík harbour. Thirty six of them are only importing cargo and therefore there is no loading related to them. The other half will both be loading and unloading.

The main noise sources related to the activities at the PCC Silicon Metal plant at the harbour are following:

- Loading and unloading
- Cranes
- Machines
- Transport between the factory site and harbour
- Motors of ships

6.2.3 Baseline

Presently there is no activity at Bökugarður and there is no industry at the proposed factory site. The area proposed for the factory site is planned as an industrial area in accordance to the municipal plan. Whereas there is no industry at this planned industry area there is no traffic between the port and the industrial area.

6.2.4 Characteristics and weight of impact

The noise emission from the PCC Silicon Metal plant has impact in two locations, at the factory site and by the harbour.

6.2.4.1 Factory site and surroundings

The main noise sources on the factory site are: fans, wood chipper, crusher and cooling fans.

A wood chipper has a noise level of 100 dB(A) in 1 m distance and is located inside to minimize the noise emission.

A crusher has a noise level of 105 dB(A) and is also located inside to minimize the noise emission.

The fans on the secondary dedusting have a noise level of 95-100 dB(A). They will be insulated such that they will not emit more than 85 dB(A). It is not clear on which side of the building the fans are located or in which height. The noise mapping is therefore conducted such that the fans are located on all sides and spread all over the façade. More detailed location of those sources can lead to reduction of the noise.

The furnace and transformer on the top of the cooling water plant have a noise level around 80 dB(A).

The criteria from the Icelandic regulations states that the equivalent noise level during the day-, evening- and night-time period on the boundaries of the site shall not exceed 70 dB(A).

In Figure 23 the distribution of the noise for the daytime of the factory site can be seen. The map shows the A-weighted noise level equivalent over 12 hours and it is assumed that the activity of the site is driven on maximum effort 8 hours over the 12 hours that defines the daytime, 07-19. The operation time for the secondary dedusting fans and crushers is 8 hours during the daytime. Other noise sources are driven at the same effort 24 hours per day.

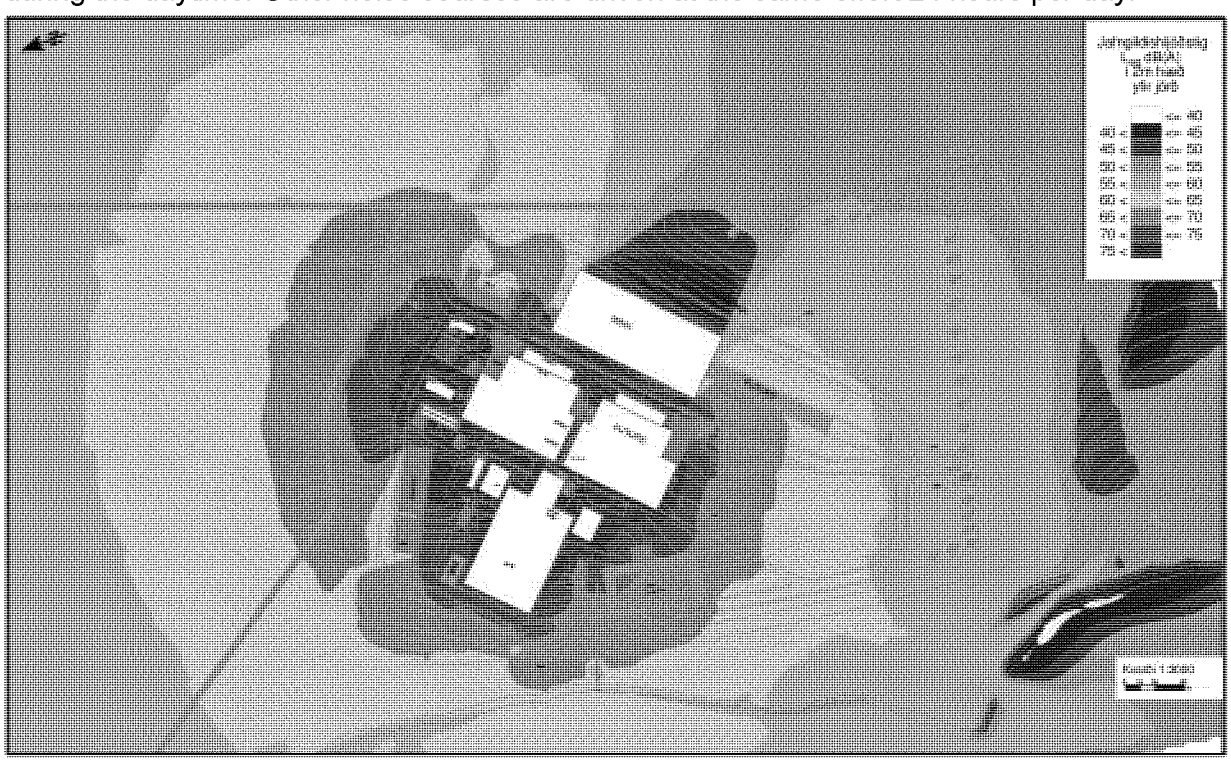


Figure 23: *The noise map for the factory at daytime, 07-19. The main noise sources during the day are equipment (fans) on top of the cooling tower, the secondary dedusting fans, the chipmaker and crushers.*

Figure 23 and 24 show that the criteria of 70 dB(A) at the boundary of the site is not fulfilled for the daytime nor the night-time period whereas the secondary dedusting fans and equipment (fans) on the top of the cooling tower are located near the boundaries. As stated before this is the worst possible case scenario where it is assumed that the fans are located on every side of the building, covering every façade. Therefore it can be predicted that the noise level will be somewhat lower on the boundaries but it is unlikely that it will fulfil the criteria.

The nearest residential area is Héðinshöfði I and II. Figure 25 and Figure 26 show the noise emission from the factory site reaching Héðinshöfði I and II at day- and night-time.

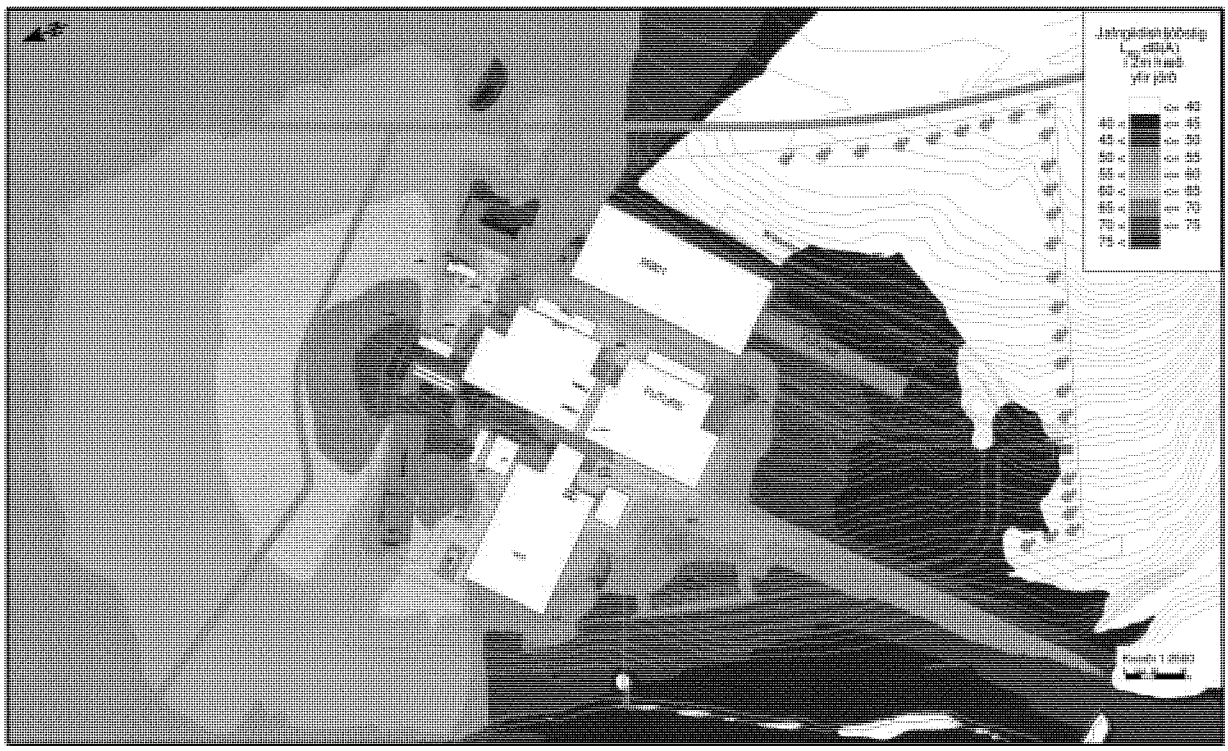


Figure 24: *The noise map for the factory at night time, 19-07. The main noise sources at night are the equipment (fans) on top of the cooling system.*

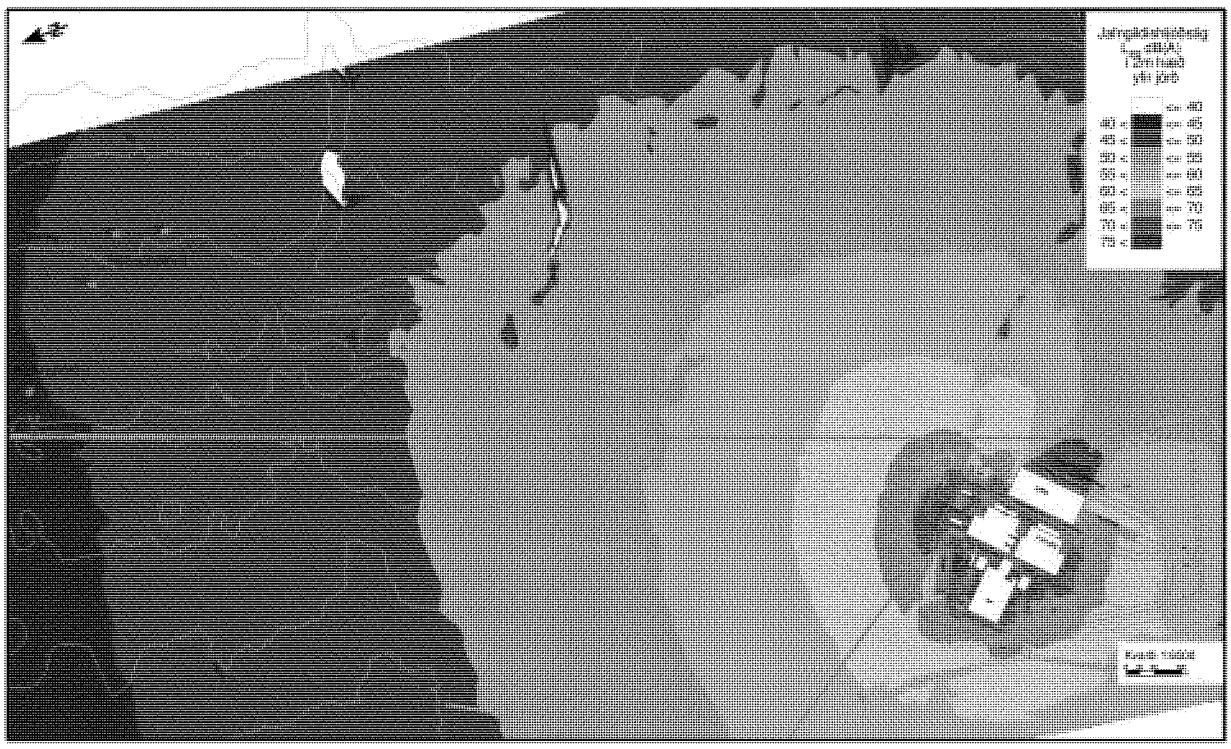


Figure 25: *The noise map shows how the noise distribution from the factory site reaches the residential area with Héðinshöfði I and II at daytime. The criteria for the daytime ” 50 dB(A) are fulfilled.*

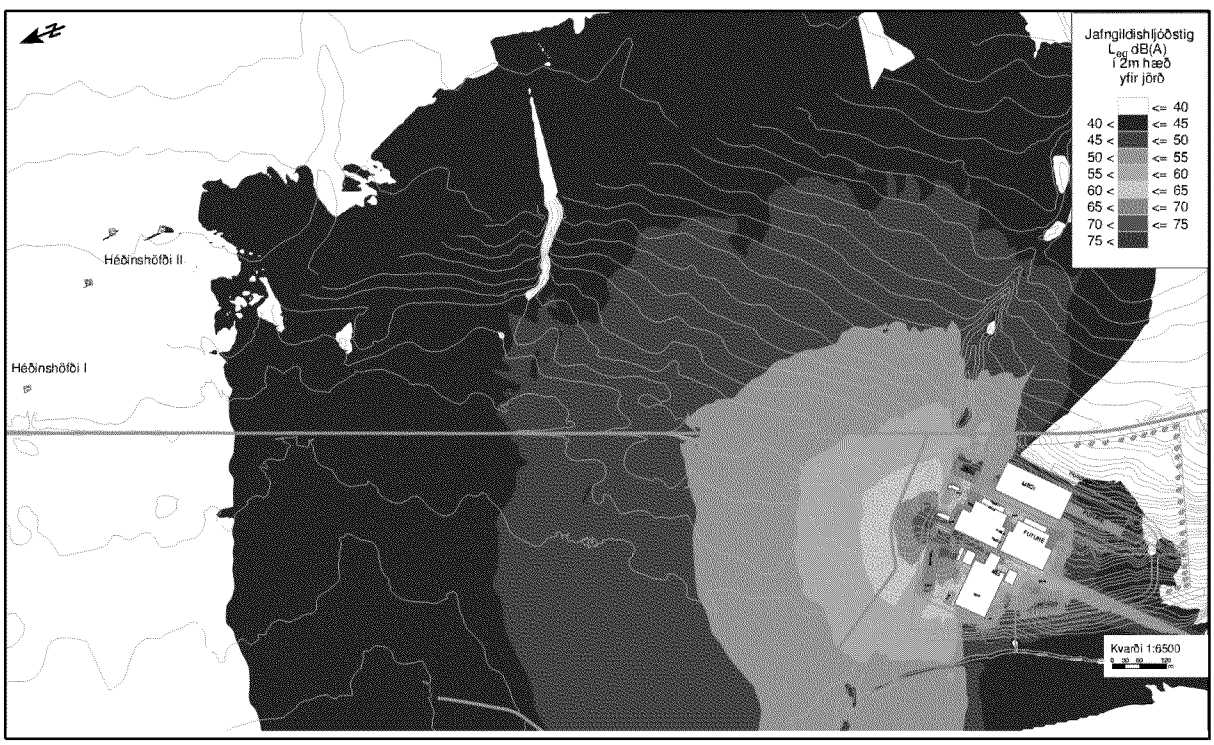


Figure 26: *The noise map shows how the noise distribution from the factory site reaches the residential area with Héðinshöfði I and II at night time. The criteria for the night time ” 40 dB(A) is fulfilled.*

The criteria for residential areas affected by noise from industry are divided into periods of time, day, evening, night. It can be seen that the noise level at Héðinshöfði I and II for all the periods of the day will fulfil the Icelandic regulations with the given premises. Figure shows that the noise levels at the houses nearest the factory are in the ” 40 dB(A) zone but some

green area can be seen in front of them. A calculation of a single point receiver at these sides of the houses showed that they are all ” 40 dB(A) and range from 37-40 dB(A).

6.2.4.2 The harbour and nearest surroundings

It is planned that there will be no activities at the harbour regarding the PCC Silicon Metal plant at night-time. Cranes and other machines will emit considerable noise.

A reach-stacker for container handling has a sound power level for an operational cycle 114.5 dB (A). In 10 m distance from the machine the sound power will be approximately 85 dB(A). Hydraulic grab crane for discharging resources has a sound power level for an operational cycle 105 dB(A). It is planned to use a grab crane with an electric motor, in order to reduce noise emissions. Noise level from ship motors will also influence the noise emission from the harbour. The most dominant noise source will be the loading and discharging of containers where empty containers create more noise than the loaded ones. This is a single noise event and not a steady noise. Single noise events are more disturbing than steady ones. It is difficult to estimate the noise level from these events but with experienced crane drivers the noise level will be minimized.

Whereas the criteria is for an equivalent noise level and because of the distance from Bökugarður to the nearest residential area, it is assumed that the nearest residential area will not be exposed to noise levels higher than given criteria in the Icelandic regulations.

In an evaluation report made for the Alcoa aluminium smelter in September 2010 a noise map was conducted for the premises at the harbour, see Figure 27.

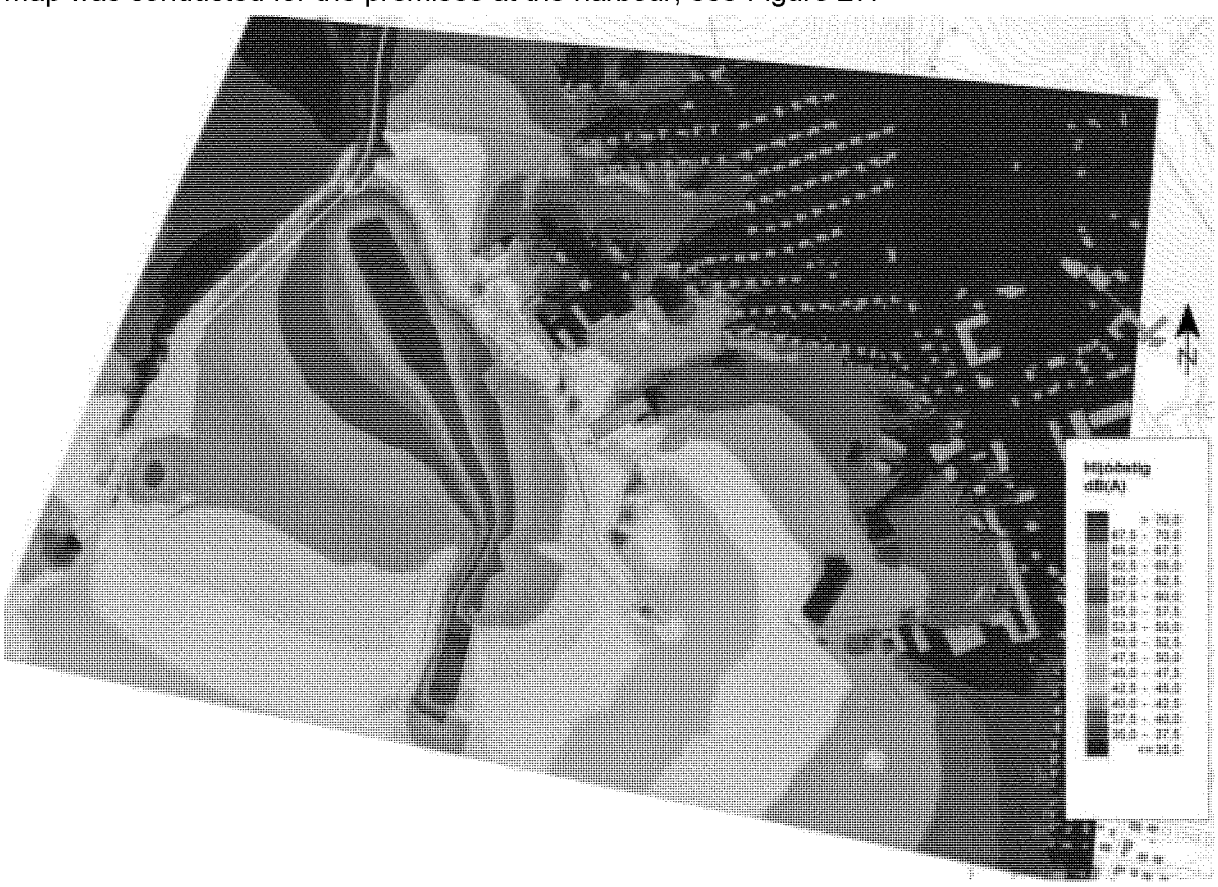


Figure 27: *A noise map for the proposed premises of Alcoa aluminium smelter at the Húsavík harbour. (Source: Alcoa Environmental Statement from September 2010). The map was conducted by HRV engineering in 2009.*

For the Alcoa premises it was planned that activity would take place during both day and night at the time when the ships are at the harbour. The noise sources for the proposed

premises for Alcoa are comparable to the noise sources on the harbour premises for the PCC Silicon Metal plant. The difference lies in the rate of ships and night activities. By looking at **Error! Reference source not found.**27 it can be seen that the nearest residential area is not exposed to more noise than the Icelandic regulations require. The distance from Bökugarður to the residential area is greater than from the proposed harbour premises for Alcoa and therefore indicates that the noise level from the PCC harbour premises will fulfil the Icelandic regulation criteria.

6.2.4.3 Transport between the harbour and factory site

It is assumed that there will not be a lot of storage at the harbour itself but rather that transport from the harbour to the site will take place promptly. This leads to increase in traffic those days that the ships are at the harbour. It is planned to construct a road along the coastline from the harbour to the factory site where most of the road will be in a tunnel. All transportation regarding the PCC Silicon Metal plant between the harbour and the site will be directed into this tunnel and thereby the traffic will not have impact on the traffic on the public road nor the noise emission on the nearest residential area. Trailer trains and tipping trails will mainly be used for the transportation between the harbour and the factory site. These vehicles operate at 30 km/h and it is therefore preferable to minimize their transportation on public roads. In the case of the tunnel being closed, for example due to external circumstances, the transportation between the harbour and the site will be directed temporarily through the public road. This will lead to increased load on the public road and increase in noise emission on the residential area. In this case regular vehicles will be used instead of the low speed vehicles. The use of the public road will be avoided as possible and will preferably only take place in emergencies.

6.2.5 Mitigation measures – monitoring

In the design and layout of the activity regarding the PCC Silicon Metal plant the noise emission will be taken into account and arrangements made such that the impact of the noise emission will be minimized.

To fulfil the noise criteria at the site boundary it is advised to simply move the northern boundaries to the road. In Figure 28 the proposed boundary of the site is shown as a dark blue line. Then the noise criteria at the site boundaries would be fulfilled.

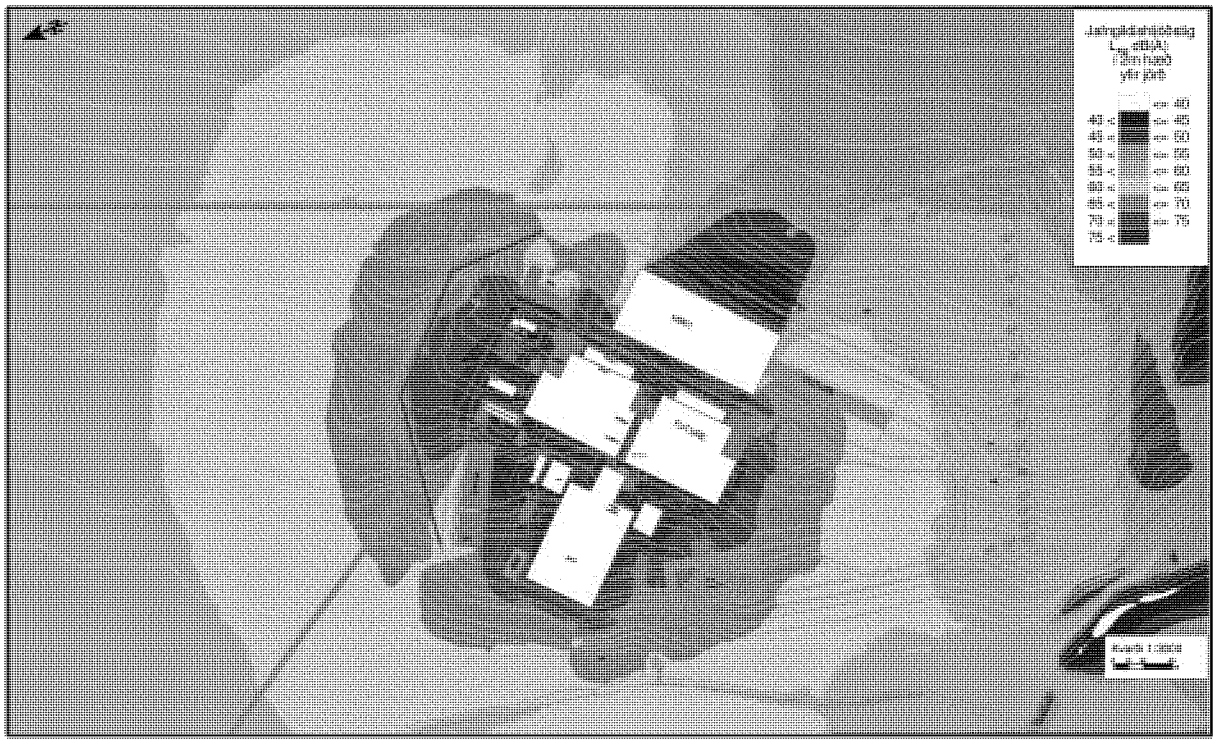


Figure 28: *The dark blue line is the proposed boundaries of the site such that the sound level at the boundaries will fulfil the Icelandic regulations.*

There is also the possibility to use noise barriers but whereas the noise sources are high up the effectiveness of the barrier is not considered enough to decrease the level significantly at the boundaries, unless the barriers is relatively high. However, it is preferable to move the crushing and its secondary dedusting from the boundary of the site to a more central location at the site if possible, whereas there is an administration building right beside the secondary dedusting which can lead to discomfort for the employees in the administration building, which leads to higher building costs due to acoustic actions. It is assumed that the employees would want to have the possibility to open windows.

It is planned to perform noise measurements when the 1st phase is ready and then again when the and 2nd phase is complete. Routine measurements will be performed in the future as a part of the monitoring program.

6.2.6 Conclusion

The impact of noise emission from the PCC Silicon Metal plant is negligible except in the nearest surroundings. That applies to the factory itself and the premises at the harbour. The impact on the nearest residential areas will be in accordance with the Icelandic regulations on noise nr. 724/2008 regarding both to traffic and activity. The requirements on the noise level on the boundary of the factory site are though not fulfilled. This is due to high noise levels from the secondary dedusting fans for the crusher and equipment on the cooling tower located very near the boundaries.

6.2.7 Review and comments on noise and PCC's answers

6.2.7.1 Comments of the Health Inspectorate of NE Iceland

The Health Inspectorate of NE Iceland (HNE) comments: „ *It is stated that the impact from noise from the operation of the silicon metal plant will be negligible except in the nearest surroundings of the plant and in the harbour area. At those locations it is considered that the noise criteria cannot be met without mitigation measures. The HNE believes it is natural to set strict requirements to mitigation measures with the purpose of the requirements of the noise regulation to be met."*

Answer PCC: It is stated in the IEIS that the noise criteria will not be met on the northern boundaries without implementation of mitigation measures on the lot boundaries. The possible mitigation measures are described in the document, but they are, use of sound barriers, transfer of secondary dedusting away from the boundary and also transfer the lot boundaries to the north. In this context it should be mentioned that the area north of the northern lot boundary where the noise can be above the limits is an area where no construction is planned. Those who are subject to the impact are those walking along the road or the river.

6.2.7.2 Comments of the Environment Agency of Iceland

The Environment Agency of Iceland comments: *„It is assumed that the noise level in residential areas in the immediate vicinity of the plant will be within the limits of regulation 724/2008 on noise. On the lot boundaries however, it is assumed that the requirements of the regulation can only be met if mitigations measures for further noise reduction are implemented. The Environment Agency wishes to raise the question whether those measures are actual mitigation measures, since those measures would be undertaken so the noise on the lot boundary will be in accordance with the above mentioned regulation."*

Answer PCC: In the opinion of the developer this is one of several possible options regarding mitigations measures to comply with the noise regulations and to reduce disturbance from the plant to the area north of the site boundary.

6.2.7.3 Comments from inhabitants and landowners of Héðinshöfði

Residents and landowners at Héðinshöfði comment: *„Are there any plans to reduce negative impact, such as […] such as impact of noise on the residents of Héðinshöfði?"*

Answer PCC: Results of noise calculations show that requirements on the noise level will be fulfilled at Héðinshöfði farm and therefore no mitigation measures for noise are needed there.

6.3 Flora

6.3.1 Assessment criteria

The assessment of the impact on flora is based on the following criteria and policy documents:

- The Icelandic Institute of Natural History Red List on indigenous species in threat of extinction (plants)
- List of 31 protected plants according to notice nr. 184/1978
- Rare plants and national value
- Definitions and types of habitats

* The protective character done for highland, however assumed to apply for lowlands

The Bern Convention (on the Conservation of European Wildlife and Natural Habitats) came into force in 1982 and was introduced in Iceland in 1993. The convention sets out to conserve European wild flora and fauna species and their habitats, especially the species that need to be protected internationally. There are four appendices and the first three set out particular flora and fauna species that need to be protected as well as the appropriate requirements on their protection.

6.3.2 Documents and studies

The assessment of the impact on flora is based on the results of fieldwork and assessment carried out by biologist Ólafur Einarsson. The specialist report on vegetation and birdlife can be found in Annex 4. A field research on the area was done on September 4th 2011. Field research in the autumn are well suited for observation on vegetation, but early-season high plants (vascular plants) are generally not prominent during that period. Vegetation within the

area was described, species recorded and photographs taken of vegetation and land on site. The ground cover and the composition of plant species was investigated in 5 areas in order to obtain a more detailed picture of the vegetation than a plants index would provide. During investigation, cover frames of 50 x 50 cm were used. Plant species were identified and the coverage evaluated visually and presented in percentages. The total cover can thus be higher than 100%, given that the cover of one species is e.g. 50% and another 95%. A few mosses, lichens and fungi species were identified, but no focus was on collection or analysis of those organisms.

Furthermore, sources on natural conditions at Bakki were investigated. Extensive research has been conducted in this area and its surroundings in relation to a proposed aluminium smelter project.

6.3.3 Baseline

In total, 108 species of high plants were found in the research area. Most of them were dry land plant, as little wetland is in within the research area. Three moss species, six lichens species and two fungi species were recorded in the area, but there was not a strong emphasis on recording low plants (non-vascular plants) and fungi. Some scattering plants and garden plants such as red champion, large yellow loosestrife and willows exist within the area since garden waste and soil has been disposed of on various locations within the site.

There are a few vegetation groups in the suggested project site. Heathland is prominent. Heather is very dynamic and diverse vegetation found in the heathland. The highest number of species was identified and recorded in the heathland. Erosion was affecting parts of the land, mainly due to overgrazing in the area. Erosion spots were visible and appear clearly on aerial photographs. In most areas west of the road passing through the area and also in the northernmost part, near River Bakkaá, grasses were more prevalent than heath. A wetland spot is located at River Bakkaá. The wetland is partly an old field, still wet despite drainage. Furthermore, streams and brook channels were found within the area with diverse vegetation by the embankments. A slight depression in the south part of the area provides conditions for more diverse vegetation, e.g. bog blueberry, bilberry (aðalbláber), matgrass and several other plants. In the southern part a significant number of birch plants have been planted.

Figure 29: *Heathland (dwarf shrub heath) at Bakki, September 4th 2011. Heather and crowberry are dominating. (Ólafur Einarsson, 2012).*

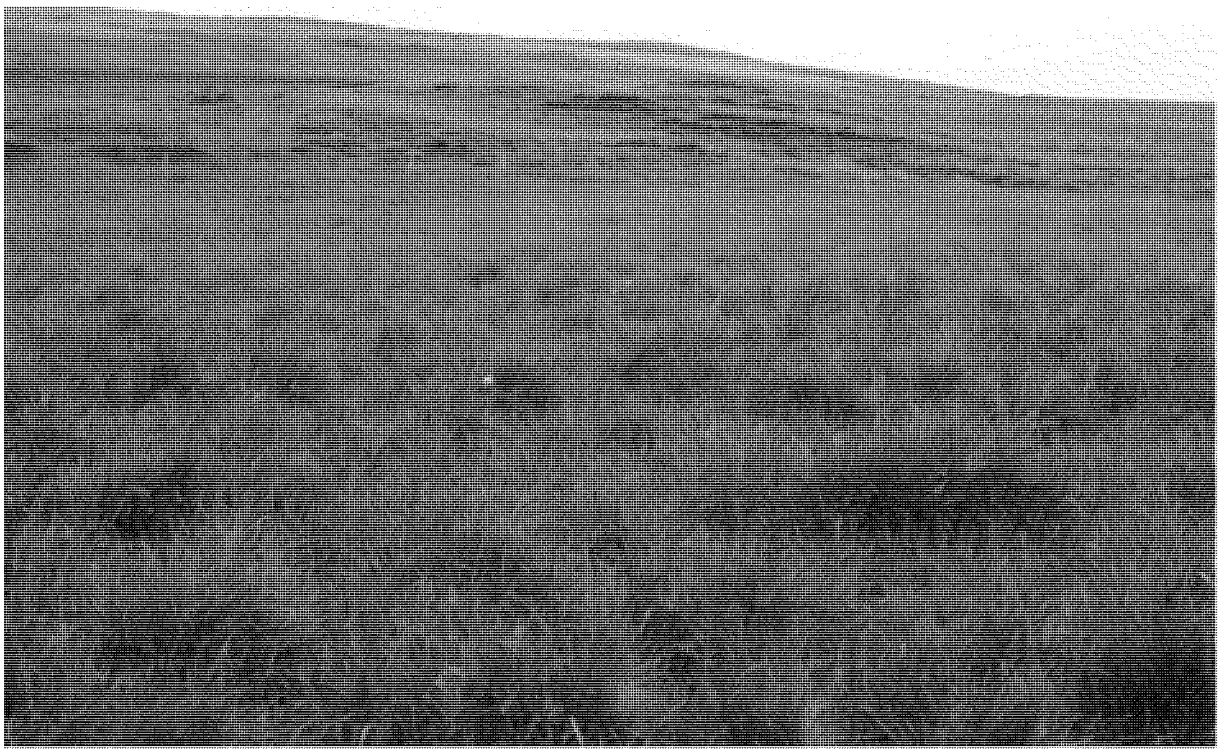


Figure 30: *Wetland spot at River Bakkaá, partly an old field, wet despite drainage, September 4th 2011. (Ólafur Einarsson, 2012).*

In stony gravelly cambric vitrisol cover (melur), vegetation was poor and only a few species recorded. Alaska lupine was spreading over the stony gravelly cover and was the dominant species in some spots in the southern part between the highway and the road passing the research area. Examples of areas where lupine grows are shown in **Figure 32** and in ***Figure 33***.

Figure 31: *Diverse vegetation at Bakki September 4th 2011. (Ólafur Einarsson, 2012).*

Figure 32: *Birch plants planted close to Skjólbrekka on September 4th 2011. Cambric vitrisol (Icelandic: melur) with lupine in the back (Ólafur Einarsson, 2012).*

Figure 33: *Alaskan lupine close to Bakki September 4th 2011. (Ólafur Einarsson, 2012).*

Information on many different species has been registered using a reference grid that was initially thought for the registration of plants. The system is made out of 10x10 km grid which

has been used in Iceland for decades to register the expansion of species. Now work has begun on the registration of plants in a more detail, in 5x5 km grid, but this work is not completed and the information not available as is for information from the 10x10 grid which is available on the Plöntuvefsjá [e. Plant Webview] of the Icelandic Institute of Natural History

According to the 10 x 10 km reference grids the research area is in squares no. 5737 and 5738 and the flora is considered to be well known according to information in Plöntuvefsjá of the Icelandic Institute of Natural History (IINH). Most of the area is in square 5738. According to the Plant Webview a total of 242 high plant species and ferns, 125 moss species, 80 lichens species and 25 species of fungi are recorded within this square. In square 5737, a total of 199 species of high plants and ferns, 165 species of moss, 110 species of lichens and 9 species of fungi were recorded. In the research area only a part of the plants recorded in these squares could actually be found.

In a research conducted by the East Iceland Environmental Research Institute (EIERI) (Náttúrustofa Austurlands) on the suggested industrial site north of the River Bakkaá, a total of 117 species of high plants were found, which is similar to the number of plants found south of the river (108 species). The number of wetland plants south of the river is lower since the wetland area is considerably smaller than north of the river.

Plant species on the red list of plants considered to be in threat of extinction were neither found in the research area nor in the research conducted by the EIERI north of River Bakkaá. A study conducted by the Icelandic Institute of Natural History on nature in Héðinsvík bay and surroundings is consistent with the above findings, no high plants listed on the red list or plants considered to be rare nationwide could be found. Of the 238 recorded species of high plants, 219 are considered to be wild and the other 19 to be scattering plants. A total of 177 species of fungi were found in the study, none of them on the red list but one of them is considered rare nationwide; the Dotted Thyme-moss (*Rhizomnium punctatum)* and two are considered to be rare; Didymodon Moss (*Didymodon brachyphyllus) and* Spiral Extinguisher-moss (*Encalypta streptocarpa).* A total of 123 species of lichens were recorded, none of them on the red list, but one of them, Aquatic aspicilia (*Aspicilia aquatica),* is considered rare nationwide. Furthermore, three species of fungi were found that are similar to lichens and are rare nationwide. According to the red list, the lichen species Monk's-hood lichen (*Hypogymnia physodes)* and Tube lichen (*Hypogymnia tubulos)* have been found in the area, species that are considered to be somewhat threatened (LR). Both of these lichen species grow on birch and in histosol soil (*icel. móajarðvegur*) and are mainly found in the Eastern part of Iceland. The lichens were found on fence posts in the mid-20th century and it is not certain if can be found there. A great deal of fences has been removed as a result of less farming in the area; it is therefore unlikely that these lichens still grow in the area.

The IINH has in the last years recorded habitats in Iceland. This work has mainly been confined to the highlands but work on lowlands started in 2012 but no results have been published yet. Habitats on lowlands have not yet been classified. Heathland was prominent in the research area and has for a long time characterized the area. Heath land is common across the country, especially in the Þingeyjarsýslur counties as can clearly be seen in the area. According to the EUNIS habitat classification, heath land would classify as *Subarctic and alpine dwarf willow scrub* (F2.1). The heathland in the research area was flusher and had a higher coverage than highland heath lands. The conservation value of heath land in the highland is considered high, so it can be reasoned that the same applies for heathland in the lowlands.

In the area south of River Bakkaá there are a few wetland spots, less than 3 ha, as opposed to the area north of River Bakkaá, where the construction of an aluminium smelter was planned, but it has been assumed that the size of the wetlands in that area covers around 36 ha.

Vegetation in sea- and bird cliffs haven been little studied in Iceland because of how difficult it is to get to these places. The effect of the proposed construction will probably be low on vegetation in the sea cliffs, expect for a potential impact if the option with the sea cooling will be chosen, see chapter 7.1.

6.3.4 Characteristics of impacts

The impact on vegetation is mainly due to the loss of vegetation that goes under structures, i.e. factory buildings, roads and car parks. The size of the site for the PCC SE Silicon Metal plant is around 20 ha. The total surface of the plant is 160,000 m^2 and parking around 800 m^2. It is very difficult to reclaim heathland or to develop it from scratch, therefore it cannot be considered as a mitigation measure. It would be desirable to disrupt the heathland and the wetland spots close to River Bakkaá as little as possible. It is possible to reduce the environmental impact by locating the plant on wind eroded stony cambric vitrisol (melur) in the middle of the area, where the vegetation is more restricted.

In the scoping document for the project it is stated that it is planned to change the riverbed of River Bakkaá and creeks in the area as a part of constructions by the Norðurþing municipality. In a study conducted on the biota of Rivers Bakkaá and Reyðará, the impact of the operation of an aluminium smelter on the habitat of the rivers was assessed. The authors believe that there are three kinds of impact on the rivers, i) impact due to changes in the riverbed and flow, ii) impact on the biota due do discharges from the site, iii) negative impact from chemicals in airborne emissions. These chemicals could mix into soil and surface waters and cause changes in the aquatic ecosystem in the vicinity of the plant. It is expected that the same impacts apply for this project.
The proposed Silicon Metal plant and planned construction is considered to have a considerable negative impact on vegetation and wetland on land where vegetation disappears and the impact is reversible on land that goes under structures.

6.3.5 Mitigation and monitoring

In the opinion of the specialist, a few ways are possible to compensate for the disruption caused by the construction of the silicon metal plant and these are discussed in general. It is for example discussed to what extent reclamation in other areas should be considered given that most original vegetation is removed from the area. It is however noted that this is not common practice for other types than wetlands. Given that the vegetation within site is common and does not have specific conservation value, this is not considered necessary.

It is recommended as a mitigation measure that PCC reclaims wetlands to the same extent as disturbed. A relatively small area of wetland is disturbed within the site and no wetland above 3 ha exists within the site. During design, the disturbance of wetlands will be avoided as possible and no changes are planned to the River Bakkaá or because of the construction

It is also recommended that local plants, especially heath vegetation growing in the area are used to reclaim green areas within the site. Furthermore heathland could be removed before disruption of the area, and put on eroded areas on site.

6.3.6 Conclusion

The proposed silicon metal plant is considered to have a considerable negative impact on vegetation and, since vegetation cover will be disrupted and the changes are irreversible. Possible mitigation measures include land reclamation, using Icelandic plants or i.e. Alaskan lupine, common in the area. The vegetation within the area is common and is not a subject of protection. When considering the criteria above and the characteristics of the impact it is assumed that the impact of the construction on vegetation and wetland is ***considerably negative.***

6.3.7 Review and comments on Flora and PCC's answers

The Environment Agency of Iceland comments: *„There are a few vegetation groups in the suggested project site and heathland is prominent. Grassland is also prominent. Diversity of species is quite high, but plants are neither considered to be on the red list of plants considered to be in threat of extinction or plants considered to be rare nationwide. The IEIS*

discusses possible mitigation measures that can be implemented due to disturbance of vegetation. It is pointed out that the recovery of some of the vegetation groups present on the construction site can be difficult. Wetlands have for several years been recovered with good success. The Environment Agency therefore suggests recovery of wetlands as implementation of mitigation measures, regardless of any disturbance of wetlands or not."
Answer PCC: The impact of the plant on vegetation is not considered to be of an extent that requires the implementation of special mitigation measures. Therefore it is not considered necessary to make the recovery of wetlands or land reclamation an obligational mitigation measure for the disturbance of land within an industrial area, which has partly already been disturbed or is covered with lupine and common and widespread plants. The same would not apply for disruption of wetlands or rare vegetation groups.

6.4 Birds

6.4.1 Assessment criteria

The assessment of the impact on birdlife is based on the following criteria and policy documents:

- List of species in threat of extinction and rare species
- Responsibility species
- Important species nationwide
- Species covered by international agreements
- A total of 32 bird species are on the list of species in threat of extinction. Those include small populations, new settlers and birds that are on the border of their distribution in the area. Although relatively few bird species breed in Iceland the number of individuals is often very high and therefore often a high proportion of the European or world population.
- In international cooperation these species are called *responsibility species*.

If referring to a 30% minimum of the European population, there are at least 16 bird species that breed here that Iceland carries a great responsibility for. Some of the species stop in Iceland on their way from their more northern nesting grounds but do not lay eggs in Iceland. They are called migrant birds. Iceland is an important resting place for those birds and Iceland carries a great responsibility for migrant species.

- All European bird species have been classified *by BirdLife International* in relation to their protection status within the region. The species are divided into four groups, so called SPEC groups *(Species of European Conservation Concern)* or European bird species that need protection.
- SPEC 1: Species of global conservation concern.
- SPEC 2: Concentrated in Europe, unfavourable conservation status.
- SPEC 3: Not concentrated in Europe, unfavourable conservation status.
- SPEC 4: Concentrated in Europe, favourable conservation status.

Other species not belonging to these groups are either in no danger or have major coverage in Europe.

The Bern Convention (on the Conservation of European Wildlife and Natural Habitats) came into force in 1982 and was introduced in Iceland in 1993. The convention sets out to conserve European wild flora and fauna species and their habitats, especially the species that need to be protected internationally. There are four appendices and the first three set out particular flora and fauna species that need to be protected as well as the appropriate requirements on their protection.

6.4.2 Documents and studies

The assessment of the impact on birdlife is based on results of observations and the assessment of biologist Ólafur Einarsson (Ólafur Einarsson, 2012). The specialist report on vegetation and birdlife can be found in Annex 2. A field research on the area was done on September 4th 2011. Most laying birds had then left, but since information on the area and its surroundings were available, including studies carried out for the environmental impact assessment of a proposed aluminium smelter in the industrial area at Bakki, it was assumed unnecessary to perform more extensive research on birds.

All birds seen or heard during the observation were registered. When fog reduced visibility during observation, birds were identified by their noise.

6.4.3 Baseline

During the field work on September 4th, 2011, 19 bird species were found on and around the investigation site. Only parts of the species were seen using the site as their habitat. The birds that use it as habitat are mostly grassland birds (*icel. mófuglar*) such as the European Golden Plover (*icel. heiðlóa*) and Ptarmigan (*icel. rjúpa*) that were seen with fully fledged young that possibly hatched at Bakki. Redwing (*icel. skógarþröstur*) was seen looking for food and a Meadow pipit (*icel. þúfutittlingur*) could be heard. A Merlin (icel. smyrill) flew over looking for pray, probably one of the grassland birds. Thirteen of the bird species that were seen could possibly breed in the research area.

As was described above, no further research on birds were conducted.

The observation in September 2011 only gave information to a little extent on which birds might lay eggs south of River Bakkaá. The East Iceland Environmental Research Institute (EIER) performed a study on bird life in the area north of River Bakkaá where the construction of an aluminium smelter was proposed. In this study 24 species were found, 20 of which were layers (breeders) in the area north of River Bakkaá. Most of the species registered north of River Bakkaá probably also lay their eggs in the area south of the river, where 17 species are believed to be layers. Unlikely layers in the southern part of the area include Pewit (*icel. hettumáfur*), Godwit (*icel. jaðrakan*) and Red-necked Phalarope (*icel. óðinshani*), because the wetland south of the River Bakkaá is smaller than the wetland north of the river.

EIER counted grassland (or heathland) birds in the summer of 2007 and found that the highest breeding density of birds is at Bakki, or 319 couples per km^2 in heathland and 301 couples per km^2 in wetland. This is one of the highest densities of grassland birds found in Iceland. Since heath land covers the majority of the research area south of River Bakkaá it can be assumed that the breeder density is high, compared to the above study. The density of grassland birds is probably similar north and south of the river.

The following summary of likely layers in the research area is based on information taken from a report of EIER, combined with an estimation of the number of layers/breeders based on the circumstances at the research area south of River Bakkaá. A summary of these birds is presented below.

Fulmar is a responsibility species and it is likely that a few couples breed in the rocks by the coast. There is no mention of the number of couples that breed north of River Bakkaá, but the Fulmar is said to breed there.

Graylag goose is on the list of species in threat of extinction as a vulnerable species (VU) and a responsibility species. A few couples probably breed south of River Bakkaá but the number of couples breeding north of the river is not mentioned.

Golden plover is a responsibility species and in SPEC group no. 4. Golden plover is one of the most common birds in sections north of River Bakkaá and the density in heathland was estimated to be 89 couples per km^2, which is a high number. In comparison, in the lava fields by Road Þrengslavegur (nr.39) in SW-Iceland the density is 19 couples per km^2. Since

grassland and heathland is dominant south of River Bakkaá, a similar density as north of the river can be assumed.

Snipe found in Iceland are of the sub-species *Gallinago gallinago faroeensis.* It is one of the more common birds in the northern part and found both in wetlands and grassland. In grassland the density was assessed to be 35 couples per km^2 and a similar density can be assumed south of the river.

Artic tern is a responsibility species. North of River Bakkaá it was assumed that 70 couples were laying/breeding in total. Since the research area south of the river is smaller than the area north of the river it can be assumed that the number of terns is by far less, a few dozen at most.

Dunlin is a responsibility species and in Iceland the sub-species is *Calidris alpina schinzii*. It breeds both in grasslands and wetlands north of River Bakkaá. The density in the grasslands is about 28 couples per km^2 and it is likely that the density in grasslands south of the river is similar.

Ptarmigan is an endemic sub-species, in Iceland *Lagopus mutus islandorum* breeds. North of River Bakkaá the density of ptarmigan was not estimated since the period of observation, June, was not suitable. There are probably a few female birds that lay in an area south of the river. Tjörnes peninsula is one of the better breeding grounds for ptarmigan in Iceland, with one of the highest breeding densities, but in the area round the farm Hóll, the median density of male birds was around 14.4 birds per km^2.

Ringed plover is a responsibility species and in Iceland represented by the sub-species *Charadrius hiaticula hiaticula.* It is believed to breed north of the river, but it is not stated how many couples breed there. Since cambric vitrisol (melur) covers are prominent in the southern area a few couples of ringed plover can be expected there. It may be in retreat south of River Bakkaá with the continuing spread of Alaskan lupine in the area.

Redwing is a responsibility species, in SPEC group no. 4. The sub-species *Turdus iliacus coburni* breeds in Iceland and in the Faroe Islands. It is said to breed north of River Bakkaá but the number of couples is not stated. It most likely breeds in the most southern part of the proposed industrial area where birch plants grow. In total a few dozen couples can be expected.

Whimbrel is a responsibility species in SPEC group no. 4 It is a dry-land bird with a high density in the heathland north of River Bakkaá (55.2 couples per km^2) and a similar density can be expected south of the river.

Redshank is a responsibility species in SPEC group no. 2. In Iceland the endemic sub-species *Tringa totanus robusta* breeds. The Redshank is the most common bird that breeds in the area north of the river with an estimated high breeding density in both wetland (147.2 couples per km^2) and heathland (70.0 couples per km^2). The density of Redshank south of the river is probably similar to the density in heathland north of the river.

Harlequin duck is registered as a species that breeds north of River Bakkaá, but the number of breeding couples is not stated. It can be assumed that just a few couples breed south of the river.

Great black-backed gull is on a list of species in threat of extinction as a vulnerable species (VU) and in SPEC group no. 4. It was registered as a breeding bird north of River Bakkaá but the number of breeding couples is not stated. One or two couples might breed south of the river.

Herring gull is also on a list of species in threat of extinction as a vulnerable species (VU) and in SPEC group no. 4, also registered as a breeding bird north of River Bakkaá. The number of breeding couples is not stated, but one or two couples might possibly breed south of the river.

Oystercatcher is registered as a breeding species in the area north of the river, but the number of breeding couples is not stated. It is likely that a few couples breed south of river.

Meadow pipit is in SPEC group no. 4. The density was 55.2 couples per km^2 in heathland in the area north of the river, but they were not registered in the wetland. The density is significantly higher than in the lava fields by Road Þrengslavegur (nr. 39) in SW-Iceland where it was 27.4 couples per km^2. South of River Bakkaá a similar density can be assumed as in the heathland north of the river.

Eiderduck in Iceland belongs to the sub-species *Somateria mollissima borealis.* North of River Bakkaá it is assumed that 20 couples are breeding. South of the river it can be assumed that only a few couples breed.

A **falcon** nest has been found close to the construction site. A direct impact on falcons is not expected, but there is the possibility of an indirect impact since the habitats of tarmigans and other grassland birds will be disrupted and the number of birds in the area will decrease, resulting in less pray for the falcon couple. Research on the Icelandic falcon has shown that it hunts for pray up to 57 km away from its nest. Bakki is within the hunting area of the falcon couple. The falcon is on a list of species in threat of extinction as a vulnerable species (VU). The Icelandic falcon population contains only a few breeding couples, or between 300 and 400.

Considerable birdlife is on the coastline of Bakki during wintertime. The northern end of the bird count area, *Húsavík: Norðurgarður - Reyðará á Tjörnesi,* extends into the research area. During the winter count of bird viewers and the Icelandic Institute of Natural History on January 7th 2012, 17 species or 2416 individuals, including 27 harlequin ducks *(icel. straumönd)*. The Tjörnes peninsula is an important winter habitat for harlequin ducks and is of international value for the species. Harlequin Duck is on a list of species in threat of extinction of some risk (LR) and classified as a responsibility species. No mammals were observed in the area during the observation area. No fox or fox hollows were seen in the research area or close to it and no remains of fox were found. It can be assumed that mink moves along the coastline and rivers and creeks within the area. Field mice probably live where habitats are available.

6.4.4 Characteristics of impacts

The birds that are subject to impact cause of the construction are common, both nationally and within the region (NW-Iceland). Since the area of the impact is relatively small, the construction is not believed to have an impact on the population size of species that breed/lay on the construction area or use the site in any other way. The proposed project is therefore assumed to have a negligible impact on birds.

According to observations many birds, mainly knots, visit the shore at Bakki. In the spring of 2008 a total of 7000 birds were assumed to have visited the shore. The area from Laugardalur valley to Bakkakrókur was the area least visited by birds. Of the whole area at Bakki, Bakkakrókur was one of the important sites for birds. **Table 15** lists species likely to be found in the research area that are on the list of species in threat of extinction or responsibility species. Furthermore it shows the SPEC classification and entries in the Annex to the Bern Convention.

Table 15: *Likely laying/breeding birds in the research area and their classification into species in threat of extinction and responsibility species.*

Species	Latin name	In threat of extinction	Responsibility species	SPEC classification	Bern Annex
Fulmar	Fulmarus glacialis		x		III
Graylag goose	Anser anser	VU	x		III
Golden plover	Pluvialis apricaria		x	4	III
Snipe	Gallinago gallinago				III
Artic tern	Sterna paradisaea		x		III
Dunlin	Calidris alpina		x		III
Ptarmigan	Lagopus muta				III

Ringed plover	Charadrius hiaticula		x		III
Redwing	Turdus iliacus		x	4	III
Whimbrel	Numenius phaeopus		x	4	III
Redshank	Tringa totanus		x	2	III
Harliquin duck	Anas platyrhynchos				III
Great black-backed gull	Larus marinus	VU		4	
Herring gull	Larus argentatus				
Oystercatcher	Haematopus ostralegus				III
Meadow pipit	Anthus pratensis			4	II
Eiderduck	Somateria mollissima		x		III

6.4.5 Mitigation and monitoring

No mitigation measures are suggested for birds.

6.4.6 Conclusion

Considering the criteria mentioned above and the characteristics of the impact it is the conclusion that the impact of the project on birdlife is ***negligible***. A considerable negative impact might occur due to disturbance during construction of the possible seawater intake, if carried out in spring, when the birds frequent the Bakkakrókur coast, see Chapter 7.1.

6.5 Landscape and visual impacts

6.5.1 Assessment criteria

In the NPA's guidelines for the assessment of the impact of individual environmental aspects the discussion of landscape is divided into two categories, the criteria for the natural landscape and the cultural landscape.

The assessment of the impact is divided into two parts. On one hand the direct influence on scenery as a result of land forming. On the other hand the visual impact of the land forming on the adjacent area.

The assessment of the direct impact on scenery focuses on two main aspects:

- Uniqueness/rarity of landscape
- Main characteristics of landscape, i.e. untouched/natural appearance, form, richness of colour, diversity and integrity of landscape.

The rarity of landscape can be assessed in different ways, i.e. certain types of landscape have high value on a national scale due to its scarceness in the nature or the culture, or if it is somehow symbolic. Certain types of landscapes can also be common country-wide but have value on a local level. Indications of rarity or specialties of landscape on a national level can be found in:

- Nature Conservation Register contains the areas that have been preserved or landscapes that are considered important "to preserve due to special scenery or fauna" (Article 53 of Law no. 44/1999 on nature preservation). It also states areas that stand to reason to preserve but have not yet been registered.
- Article 37 of the law no. 44/1999 on nature preservation, regarding the protection status of certain geological formations and ecosystems.
- Criteria defined in the government's policy for sustainable development, where geological formations and ecosystems that the government considers to have conservation value are listed (Ministry for the Environment, 2002)

- Local conservation in the urban development plan of the relevant municipality where areas are listed that are deemed important to preserve, i.e. due to nature, historical value or have outdoor recreational possibilities.

While assessing the impact on the *main characteristics of scenery,* aspects regarding the specialties of the area at the present time is considered, what the main scenery characteristics are and in which way the project will alter these characteristics. The assessment of the scenery shall take into account if the landscape is manmade or natural, its condition and the overall appearance of the area. Prior disruption or land use justifies in no way further disruption or construction. However, prior disruption does affect the value of the area and consequently the possible effects of new or on-going construction.

While assessing the visual aspects the focus is placed on analysing the appearance of landscape after construction from the places that would be most affected. Those places are from roads, where human traffic is most common, and from the farms on Héðinshöfði, which are the residencies where the plant will be seen from. In addition, aerial photographs are taken, from Bakkahöfði and from Gónhóll above the factory to ensure more perspectives of the plant.

The article 35 in Law no. 44/1999 on nature preservation states: "When designing roads, power plants and other structures measures shall be taken to ensure that they best blend into the shape of the land." The assessment of visual aspects is guided by this. Assessing the scale of the influence, that is in which way the structure blends into the shape of the land, the considered aspects are how the structure is located on land, if it touches the skyline, in which way it compromises the view, from which locations and how many are influenced by it.

6.5.2 Documents and studies

To assess the influence of the landscape basic data was acquired on the defining aspects on the local scenery, form of land, geological formations, hydrological formation, vegetation and land use. Sources were gathered on areas with special value due to landscape, local values and the use of the area, in regards to possible effects on the resident, outdoor recreational and industrial areas. Its basis is the published data, e.g. Nature Conservation Register, government strategies on sustainable development to the year 2020 ((Ministry for the Environment, 2002). In addition, the criteria for assessment of environmental impact are considered. They are published by the Icelandic National Planning Agency (the Icelandic National Planning Agency, 2005 and the Icelandic National Planning Agency, 2005 A). To assess the visual impact of construction, trips were taken to the site in June and October of 2012 and photographs were taken on site. The photographs were taken from selected locations, where the plant will be visible in some way. Particular attention was taken to photograph areas where people reside or pass by, i.e. residencies, roads and outdoor recreational areas. In the report photographs are shown from 7 sites, numbered from 2 to 8, on Figure 34. To assess the visual impact, a three dimensional computer model of the plant is inserted into photographs, as seen in Figures 39 to 59. The pictures are published with the preface that the quality of the land model can affect the precision of model figures and that the structures are still in development and can change. The pictures give an idea of the plants look and main dimensions.

Figure 34: *The location of photo shooting sites and their perspective in regards to assessment of the impact of the PCC plant on scenery and visual aspects.*

6.5.3 Baseline

Impact area of visual impact

Figure 35: *Aerial photograph that demonstrates the model of the plant, phase 1. (Photograph Mats Wibe Lund).*

Figure 36: *Aerial photograph that demonstrates the model of the plant, phase 2. (Photograph Mats Wibe Lund).*

Direct impact on the scenery is confined to PCC's lot on Bakki, but the premises are in total 22 ha. Photo 35 demonstrates the location of the plant according to phase 1, photo 36 according to phase 2. The plant will be visible from areas south-east of the plant, e.g. from Mt. Húsavíkurfjall. It will also be visible from areas north of the plant, e.g. from farmhouses at Héðinshöfði and from the national road. The plant will be visible from sea and from the shore both north and south of the property until cape Húsavíkurhöfði blocks the view from the south. The plant will not be visible from Húsavík.

Landscape characteristics

The landscape in the area from Húsavíkurhöfði and north to Tjörnes for many parts resembles coastal regions. The main characteristics of the entire scenery are grass and wetlands, marine capes and rocky beaches. The plot lies in the edge of the hill between Mt. Húsavíkurfjall and beach, just south of River Bakkaá. The northwest area, closest to the coast and to the River Bakkaá bed has a rather smooth terrain but the main part of the lot has an incline that requires some development before the plant is constructed. The area is vegetated and largely fenced grazing land. Despite the natural appearance of the area its use has left its marks on it to some extent. No geological formations are visible on the surface that put their mark on the land.

The construction area is not within the areas on the Nature Conservation Registry and has not been given any special value in regards to criteria in the laws under the Nature Conservation Act no. 44/1999. Bakkafjara and Bakkahöfði that are in proximity of the lot but north of River Bakkaá are however on the Nature Conservation Registry.

Figure 37: *Photo taken to the north over the south part of the area that the plant will be located (Photo PCC SE)*

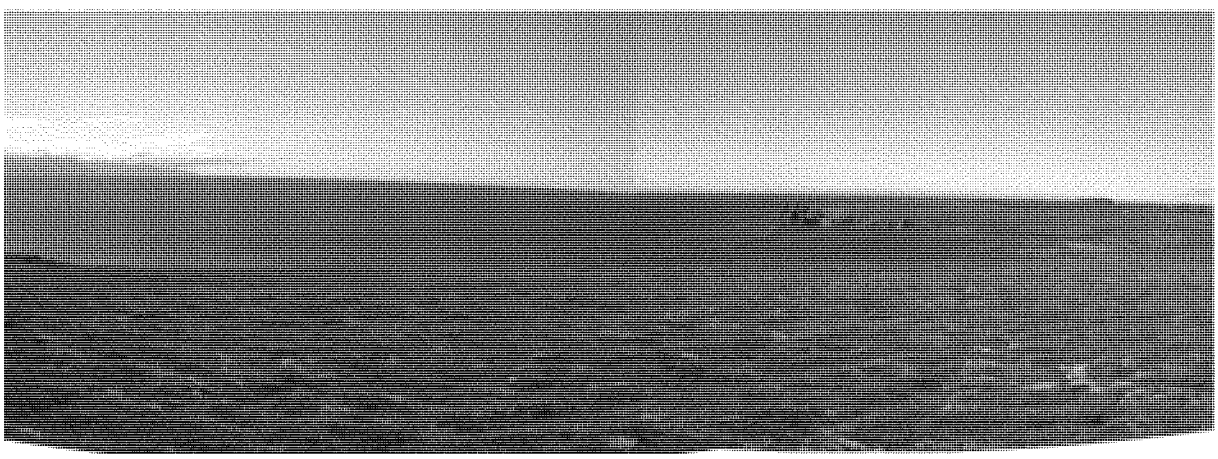


Figure 38: *Photo taken to the northwest over the northern part of the area that the plant will be located (Photo PCC SE)*

6.5.4 Characteristics of impact

The effects are compared with criteria, on one hand in regards to direct impact on scenery and on the other hand in regards to visual aspects and possible changes in experiences from areas around the proposed construction, with the shortcomings an evaluation of such subjective parts entails.

Effect on scenery

Uniqueness/rarity of landscape: The area has not been given any specific protection value and its scenery not considered rare on either a national or local scale, nor is it defined as wild. The effects are as such not on scenery that is considered to have a high protection value.

Untouched/natural appearance: The area is not untouched. No major structures are present and its appearance is in some level natural, though lupine, grazing land and erosion spots are considerably characteristic for the area.

The area will change however, it will be shaped and structures built. The effects are considerable within the limited part of the industrial site and they are considered permanent and irreversible

Visual impact

The effects of the PCC SE Silicon Metal plant on the appearance of the area are first and foremost due to buildings that will be constructed on the lot in addition to land forming

The most prominent structures will be the furnace building and the casting area which have the highest point of 37,5 m, the bag house filter and raw material storage which can be assumed to be 27 m at the highest point. The product storage and product crusher are estimated around 24 m tall. Other structures are considerably lower (see Table 3 in chapter 2.2). The structures will be most visible from the north.

The accompanying photos show a model of the plant. Photos are shown of phase 1 and 2. Assessment work takes into account both phases although the later phase has not been given a deadline. The size of the structures makes them prominent in their close surroundings and from adjacent areas, but in large part consists of traditional industrial, storage and office housing.

Figure 39: *View from Húsavíkurhöfði, current situation. View 2 on photo 34 (Photo PCC SE).*

Figure 40: *View from Húsavíkurhöfði, phase 1. View 2 on photo 34 (Photo PCC SE).*

Figure 41: *View from Húsavíkurhöfði, phase 2. View 2 on photo 34 (Photo PCC SE).*

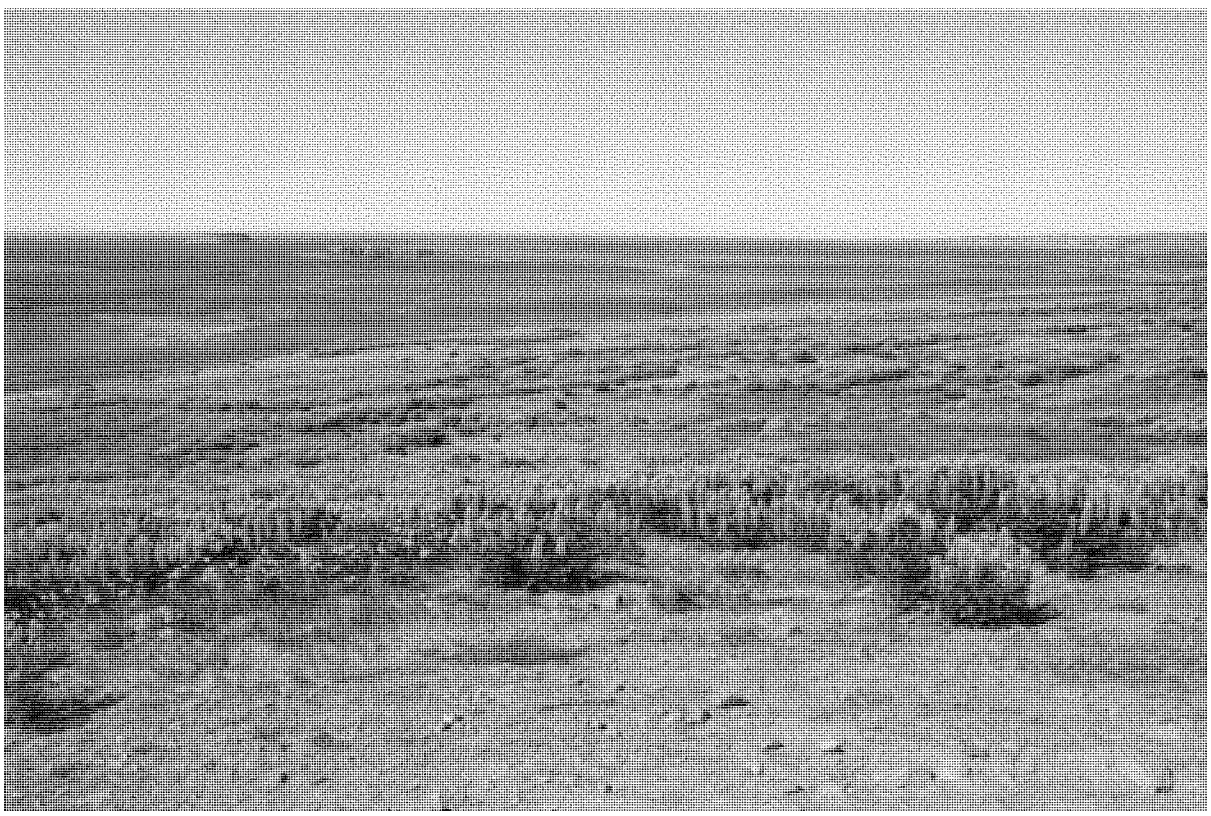


Figure 42: *View from Gónhóll, current state. View 3 on photo 34 (Photo PCC SE).*

Figure 43: *View from just below Gónhóll, phase 1. View 3 on photo 34 (Photo PCC SE).*

Figure 44: *View from just below Gónhóll, phase 2. View 3 on photo 34 (Photo PCC SE).*

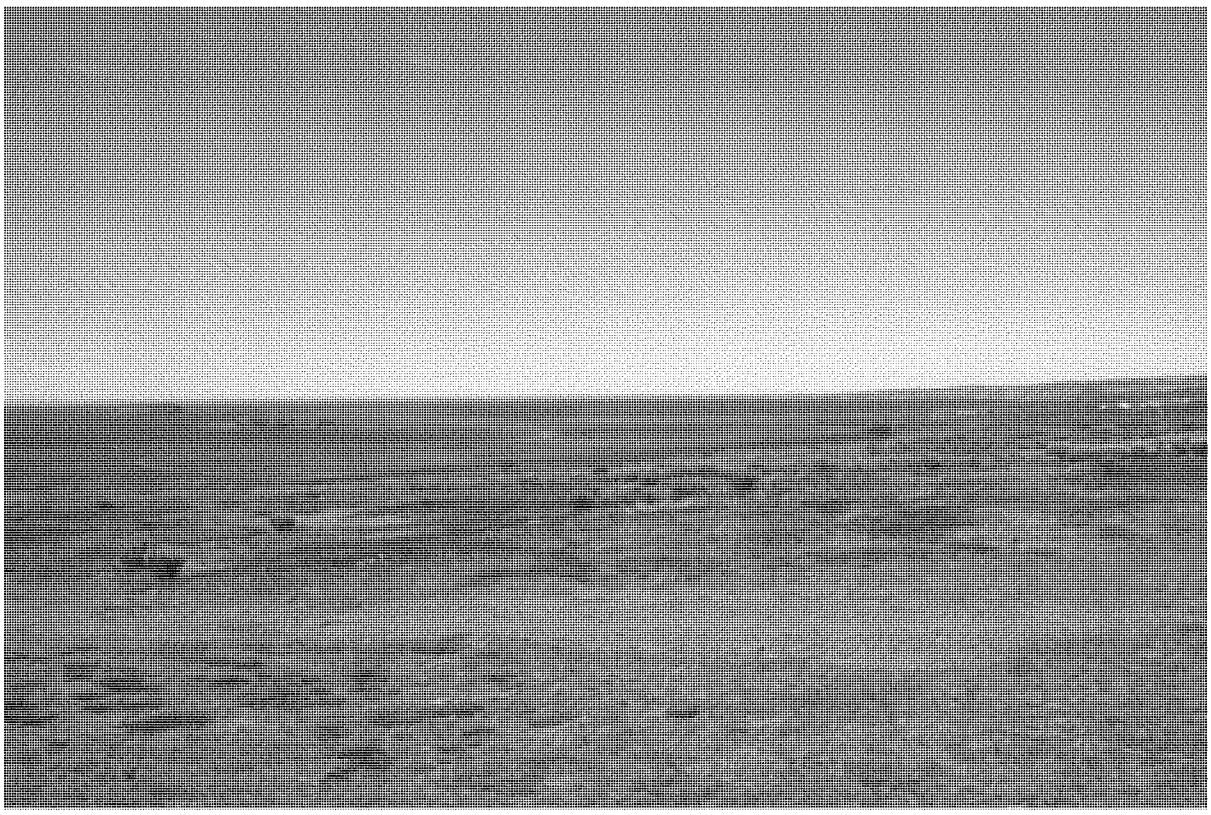


Figure 45: *View from Gónhóll, current situation. View 4 on photo 34 (Photo PCC SE).*

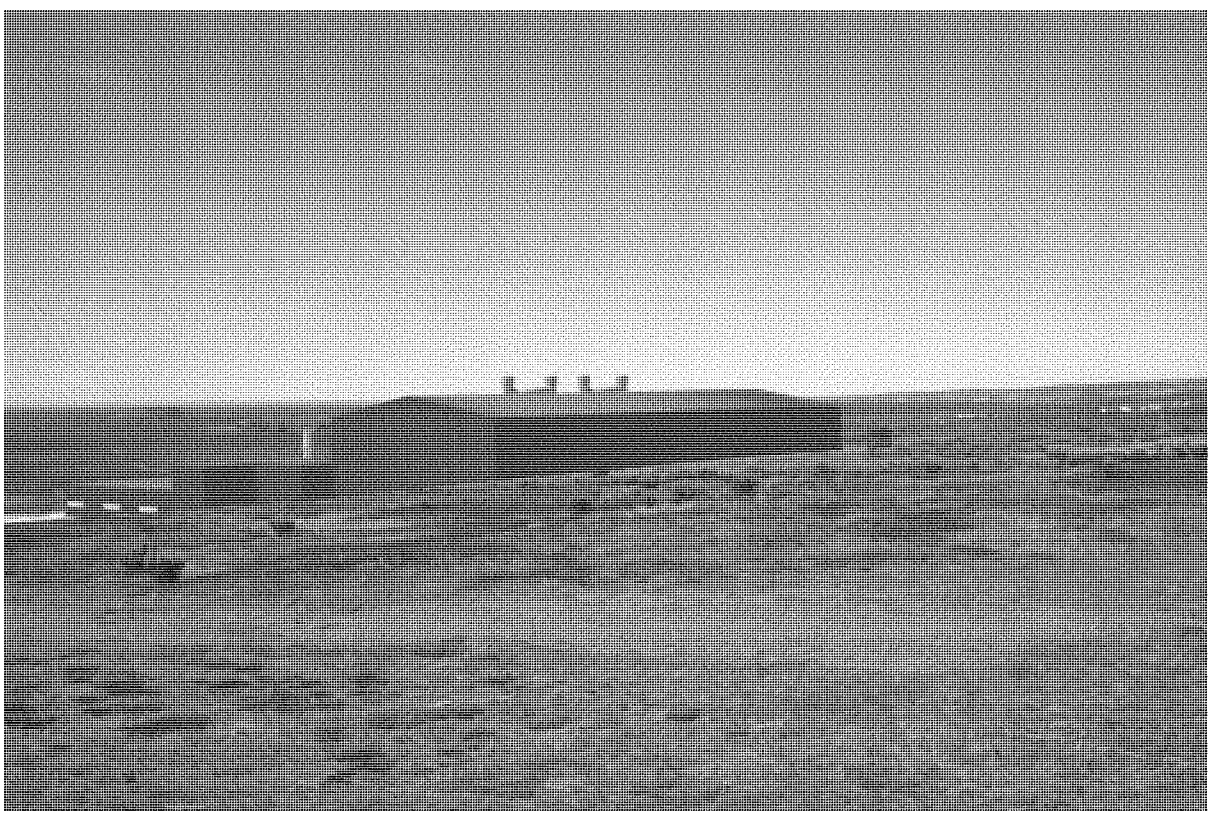


Figure 46: *View from Gónhóll, phase 1. View 4 on photo 34 (Photo PCC SE).*

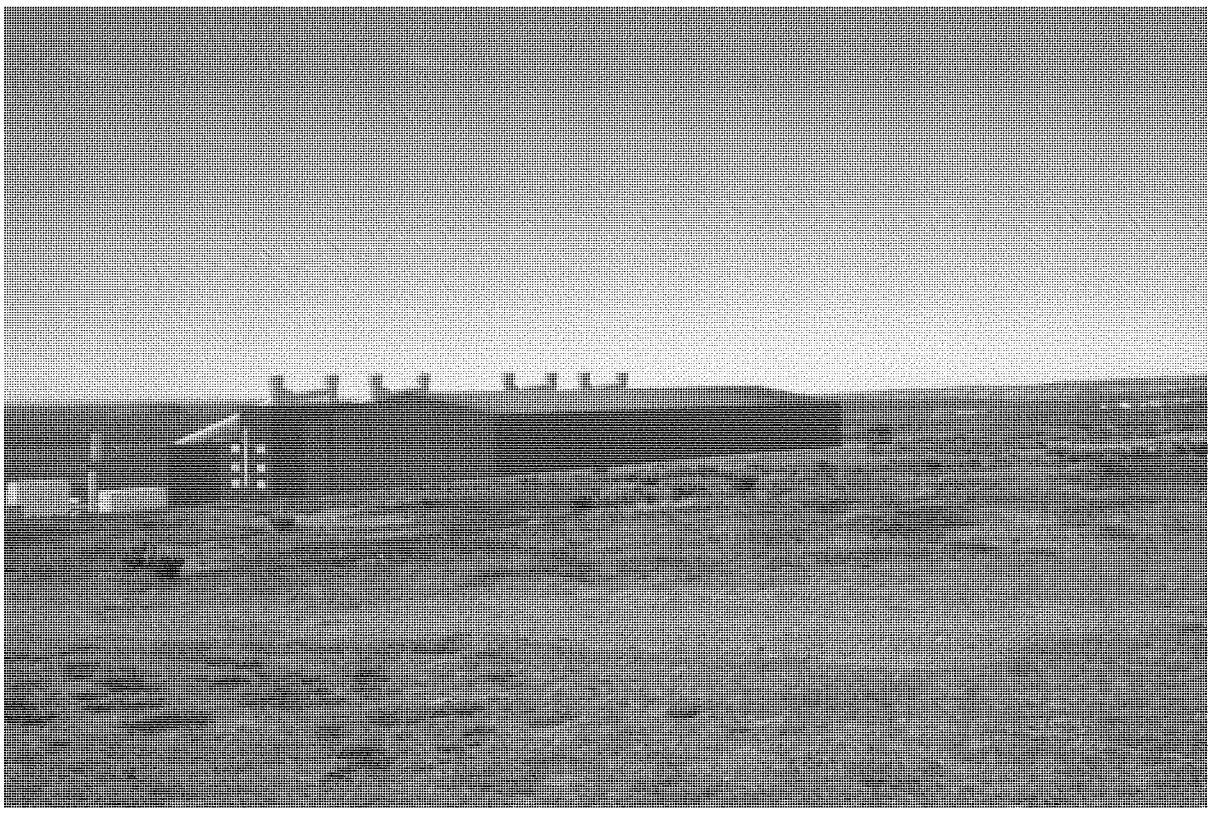


Figure 47: *View from Gónhóll, phase 2. View 4 on photo 34 (Photo PCC SE).*

Figure 48: *View from Héðinshöfði, current situation. View 8 on photo 34 (Photo EFLA Consulting Engineers).*

Figure 49: View from Héðinshöfði, phase 1. View 8 on photo 34 (Photo EFLA Consulting Engineers).

Figure 50: View from Héðinshöfði, phase 2. View 8 on photo 34 (Photo EFLA Consulting Engineers).

Figure 51: View from Héðinshöfði, current situation. View 7 on photo 34 (Photo EFLA Consulting Engineers).

Figure 52: View from Héðinshöfði, phase 1. View 7 on photo 34 (Photo EFLA Consulting Engineers).

Figure 53: View from Héðinshöfði, phase 2. View 7 on photo 34 (Photo EFLA Consulting Engineers).

Figure 54: *View from Bakkahöfði, current situation. View 5 on photo 34 (Photo PCC SE).*

Figure 55: View from Bakkahöfði, phase 1. View 5 on photo 34 (Photo PCC SE).

Figure 56: *View from Bakkahöfði, phase 2. View 5 on photo 34 (Photo PCC SE).*

Figure 57: View from Bakkahöfði, current situation. View 6 on photo 34 (Photo PCC SE).

Figure 58: View from Bakkahöfði, phase 1. View 5 on photo 34 (Photo EFLA Consulting Engineers).

Figure 59: *View from Bakkahöfði, phase 2. View 5 on photo 34 (Photo PCC SE).*

It can be assumed that the visibility of structures will be significant from sea where taller building will be visible from quite some distance. The structures are covered by land from most angles and do not extend over a large part of the horizon above the shore. Effects from sea are therefore considered to have **negligible to considerable negative impact** depending on how close sailing is to the shore.

As previously mentioned the structures will be most visible from the national road, Héðinshöfði and from areas above the plant, i.e. Gónhóll, Skjólbrekka and other areas in the western part of Húsavíkurfjall. In addition there is good visibility to the plant from Bakkahöfði. As pictures 48-53 show, the obstruction of view is probably most from Héðinshöfði when looking towards Húsavíkurhöfði but the plant will not obstruct view except in a small manner when looking at Skjálfandi from Héðinshöfði 1 and 2.The effects from these areas are considered to have **considerable negative impact**. Further away from the plant the effects diminish rather quickly and become **negligible** when a distance of 5 km or more is reached.

The effects on population in Húsavík are none, but the plant is visible from a walking path defined along the coast in the main urban development plan of Norðurþing municipality. If viewed from Laugardalur towards the area the plant will be visible and the effects will have **substantial negative impact** when walking along the proposed industrial road past the plant towards Bakkahöfði.

6.5.5 Mitigation measures - monitoring

When designing the structure and shaping of the land on the industrial site it will be attempted to reduce visual impacts as possible.

6.5.6 Conclusion

The effects of the silicon metal plant on the scenery are local, but their coverage is considerable within the property. Areas of particular value in regards to landscape are not disrupted. The effects are considered to have **considerable negative impact**, according to the definitions of weight ratings used in the EIA process, permanent but mostly reversible. The silicon metal plant will not touch the skyline from many viewpoints since the PCC plot is

located in an incline and structures covered by land from most angles. Though, from the national road and partially from the farms Héðinshöfði 1 and 2 the structures will touch the skyline or obstruct view. Obstruction of view is generally very little but in certain areas north of the plant there is some obstruction.

Visual aspects are considered to have **considerable negative impact**, permanent but reversible from areas north of the plant and above it, i.e. from the national road, Gónhóll and other areas close to the plant. From areas further away from the plant, i.e. from Húsavíkurfjall the effects are less.

6.5.7 Review and comments on Landscape and Visual Impacts and PCC's answers

Residents and land owners of Héðinshöfði comment: "*The report states that the plant has a considerable negative impact, permanent but reversible. An explanation is requested on an impact that is permanent but reversible, and how likely it is after the construction of the plant that it will be removed so the impact will be reversible?"*

Answer PCC: This describes the results of the assessment of landscape and visual impact. The assessment is based on the assumption that if the operation is stopped buildings and traces on the site can be removed. In this respect, the effects are reversible. It is however claimed in the IEIS that despite this possibility, the impact has to be considered permanent, because long term operation is planned in the area.

Residents and landowners of Héðinshöfði further comment *"Are there any plans to reduce negative impact such as visual […] impact on the residents of Héðinshöfði?"*

Answer PCC: During the final design of the plant measures will be taken to minimize the visual impact of structures, i.e. by choice of colours, vegetation, earth mounds as well as the installation of lighting. Also all structures will be lowered, if possible. However, a certain visibility of structures can always be expected, cf. model pictures in this report.

6.6 Archaeological remains

6.6.1 Assessment criteria

The impact on archaeological remains was assessed on the basis of the following criteria:

- Cultural patrimony Act no. 80/2012.
- Archaeological registration of remains

An archaeological survey was carried out and remains registered at each location. All remains found were given a number and/or sub-number. Written references were also used during registration, e.g. lists of natural artefacts, lists of preserved remains, etc.

It is worth noting that roads or other areas outside the project area were not surveyed, except for the area where remains no. 8, seen in **Figure 60**, was found.

According to the National Heritage Act, all remains older than 100 years are protected. They must not be damaged, destroyed, modified, covered, altered or moved, except with permission of the Cultural Heritage Agency of Iceland. If their safety cannot be assured or their distortion is inevitable, the Cultural Heritage Agency of Iceland must grant authorization. Project developer must also comply with any conditions that the Agency may set. If archaeological remains are found during construction, all work on site is to be suspended until the Agency's decision on whether and under what conditions construction can pursue.

6.6.2 Documents and studies

Two studies on archaeological remains have been conducted in the investigation areas that together provide a good overview and coverage of the construction site. The studies were

carried out in 2012 by Bjarni F. Einarsson, archaeologist at the Archaeological Office (Fornleifafræðistofan) (Fornleifafræðistofan, 2012) and Oddgeir Isaksen, archaeologist at the Institute of Archaeology, Iceland (Fornleifastofnun Íslands, 2012). The study carried out by the Archaeological Office concentrates on areas that are in the southern part of the investigation area, whereas the study by the Institute of Archaeology Iceland covers the northern part of the investigation area near River Bakkaá. Both the survey of the Archaeological Office as well as the survey carried out by the Institute of Archaeology Iceland uses the National Heritage Act (no. 107/2001) as criteria, but the Act expired in January 1, 2013 with the entry of the Cultural patrimony Act no. 80/2012 into force.

A map of the area with the location of archaeological remains can be seen in Figure 60. The National Heritage Act was used as a basis for the archaeological registration, i.e. if remains were older or younger than 100 years. Many of the remains registered during the survey could be older than 100 years, i.e. from earlier than 1912, but the only way of assuring this is through analysis. For cautionary purposes they are regarded as protected remains. Decelrated protected remains have a 100 m sanctity zone from their outer perimeter, and for protected remains the distance shall be 15 m, except other is decided..

In the study carried out by Bjarni F. Einarsson, archaeologist at The Archaeological Office, the location, age and condition of archaeological remains were registered and a value assigned to each remain based on monumental and preservation importance. During registry, the Archaeological Office used the registration system already in use for the municipality. Assigned values are on the scale of 1 to 10 and values are categorized into *none*, *low*, *considerable* and *high*.

When assessing the risk that the archaeological remains are currently exposed to the zero-option is assumed, i.e. other factors than the project itself was focused on. The project will have a significant impact on all of the remains, possibly with the exception of no. 8, but the construction process poses a certain danger which is assessed. This danger will disappear when the construction is finished, and the remains considered and/or appropriate mitigation measures applied.

The survey carried out by the Iceland Institute of Archaeology assesses the risk that archaeological remains are exposed to using the categories “great danger” (*icel.* stórhætta) if the remains are located within the construction site and “danger” if the remains are in danger due to their proximity to the construction site.

The reports of The Archaeological Office and the Iceland Institute of Archaeology can be found in Annex 3.

6.6.3 Baseline

Total of 17 remains, or alleged remains, were found within the surveyed area. The location of all of the remains is displayed in Figure 60. No protected remains are in proximity of the studied area. A supposed Þjófadys is registered south of the area, but it was not found during the survey in 2012.

A total of eight remains were found within the south part of the area surveyed at Bakki by the Archaeological Office. On three of the locations remains older than 1900 were found. Other remains are probably younger, although this can only be verified through analysis. It is the archaeologist opinion that the preservation value of these remains is little. The highest heritage value has sites with alleged fox trap. The values of other remains are generally considered low. The conditions of the remains differ. According to expert opinion on the remains’ condition, one of the remains is in good shape, six of the remains are in reasonable shape and one is in poor shape. Risk and risk assessment is not based on the proposed project, but on other potential sources of danger. Animals, namely horses, are the main source of current risk to the remains. One of the remains is at risk due to erosion. Two of the remains are not believed to be at risk.

An expert from the Iceland Institute of Archaeology describes the conditions of the remains with respect to how grassy they are, if they are still standing or if they have sunk in whole or partly (see table 16). . In their expert opinion it would be feasible if the disruption of the remains could be prevented, e.g. by labelling them during construction. Where disruption cannot be avoided, The Cultural Heritage Agency of Iceland should be informed, which will then decide which mitigation measures are needed.

Archaeological remains were found outside of the project's impact zone. Most of the remains north of the surveyed area have been registered in relation to other projects. **Table 16** displays the results from the archaeological surveys performed south of River Bakkaá . The registration numbers follow the numbering systems used by the Archaeological Office and the Institute of Archaeology Iceland in their reports.

6.6.4 Characteristics of impacts

There is a substantial danger connected to the construction of the Silicon Metal plant and it is evident that the construction will almost certainly disturb all remains within the construction site.

It is the Archaeological Office's assessment that none of the remains within the surveyed area is in need of protection.

The project is believed to have a direct and negative impact on all of the registered remains, with the exception of remains no. 8, which are nevertheless temporarily assumed to be in potential danger from the construction. This is assuming consideration of the remains during construction, taking appropriate mitigation measures if needed, and risk eliminated after construction.

According to the expert opinion of the Institute of Archaeology Iceland, the remains registered in the survey, located within the section of PCC's premises that are not investigated by the Archaeological Office, are in great danger due to construction. It is pointed out that damage to them should be avoided during construction if possible, for example by labelling. It is clear that in some cases it cannot be avoided to disrupt remains. In this case authorization from The Cultural Heritage Agency of Iceland is imperative as well as any mitigation measures they propose.

Table 16: *Main results of the archaeological surveys performed in relation with PCC SE's* Silicon Metal plant *at Bakki.*

No.	Type *	n	Risk	Condition	Age	Monumental value	Mitigation measures	
							Recommendations of the The Archaeological Office	Instructions of the Archaeological Office
2:1	Old path	1	Erosion	Bad	1550-1900	Low (3)	Low (3)	
3:1	Mound	1	Animals	Fair	1900-	Low (1)	Low (1)	
4:1	Housing remains	1	Animals	Fair	1900-	None (0)	None (0)	
5:1	Free range	1	Animals	Fair	1900-	Low (2)	Low (2)	
6:1	Mound	1	Animals	Excellent	1900-	Low (2)	Low (2)	
7:1	Free range	1	Animals	Fair	1550-1900	Low (4)	Low	
8:1	Mound (fox trap	1	None	Fair	1550-1900	Considerable (7)	Considerable (7)	
9:1	Mound	1	None	Fair	1900-	Low (1)	Low (1)	
SÞ-311:014	Old path (same as 2:1)	-	Great danger	-	-	-		GPS
SÞ-312:025	Sheepcoote ruins	-	danger	-	-	-		Complete investigation
SÞ-312:064	Burial site	-	Great danger	-	-	-		Complete investigation
SÞ-312:065	Burial site	-	Great danger	-	-	-		Complete investigation
SÞ-312:069	Burial site	-	Great danger	-	-	-		Complete investigation
SÞ-312:070	Burial site	-	Great danger	-	-	-		Complete investigation
SÞ-312:071	Burial site	-	Great danger	-	-	-		Complete investigation
SÞ-312:076	Burial site	-	Great danger	-	-	-		Examination ditch/ Complete investigation
SÞ-312:066	Ruin,	-	Great danger	-	-	-		Examination ditch / Complete investigation
SÞ-312:067	Mound	-	Great danger	-	-	-		Complete investigation

* The old path was not studied outside of the survey area .

Four remains have been registered in the area outside of the PCC site in relation to other projects and therefore are not considered to be in danger due to the plant's construction, but they might be in danger because of other projects. If the sea cooling alternative will be used, these remains will not be in danger. The points are shown in **Figure 60**. A summary of reference numbers and type of remains found outside PCC's plant site are shown in **Table 17**.

Table 17: *Archaeological remains outside of PCC's Silicon Metal plant site.*

No.	Type	Reference
SÞ – 312:025	Sheepcoote ruins	Fornleifastofnun Íslands, 2007
SÞ – 312:072	Mound, unknonwn	Fornleifastofnun Íslands, 2007
SÞ – 313:030	Sheepcoote ruins	Fornleifastofnun Íslands, 2007
SÞ – 312:031	Old path	Fornleifastofnun Íslands, 2007

6.6.5 Mitigation and monitoring

The impact on archaeological remains can be minimised by implementing the following mitigation measures as suggested by the expert of the Archaeological Office.

- Measuring Recording the location of the remains via GPS into the Icelandic system (Isnet-93)
- Digging an examination ditch, i.e. a cross section into the walls of the remains, and then applying the C-14 method to estimate the age of the remains and to find out if older remains are hidden underneath. The archaeologist does not assume that any remains can be found beneath the remains in question. .

- Recommendation to digging “security” holes at certain locations within the survey area to insure that no remains are hidden under fields that have been smoothed out.
- The only thorough investigation recommended by the archaeologist is on the alleged fox trap (no.8).
- Working sheds or other infrastructure should not be erected too close to archaeological remains. Road construction and machine operation should also be in consideration of all remains.

Upon request of the Planning- and building officer of Norðurþing Municipality Fornleifastofnun Íslands performed a study in the area, incl. the PCC site in the fall of 2012 (Fornleifastofnun Íslands 2012 A). This was done in accordance with instructions from the Archaeological Office of NA Iceland on mitigation measures that were considered necessary before the construction could commence. The Archaeological Officer believed it to be necessary to dig examination ditches into the remains to determine on their age and nature as well as measuring their location using GPS. On some of the remains complete investigations should be made. Fornleifastofnun Íslands conducted further studies in the fall of 212 and has issued a report with their findings (Fornleifastofnun Íslands, 2012 A).

Mitigation measures for remains in Table 16 are instructions from the Archaeological Officer of NA Iceland. The results of the examinations on the age and the role of the remains have been sent the Archaeological Officer for review, but the Officer’s results if the mitigation measures are adequate are not yet available.

If it proves necessary to disrupt any of the remains with low preservation value the only necessary mitigation measures are the digging of examination ditches. Those actions require authorization from The Cultural Heritage Agency of Iceland and the enforcement of their terms.

6.6.6 Conclusion

In total, seventeen remains or alleged remains were found in the surveyed area. Even though the Institute of Archaeology Iceland and Archaeological Office do not weigh the impact on the same scale, the result is the same neither oppose construction in the area.

Figure 60: *A map showing the premises of PCC's silicon metal plant, showing locations of archaeological remains found during survey and previously registered remains in relation with other projects.*

If disruption cannot be avoided The Cultural Heritage Agency of Iceland will decide on appropriate procedures and possible mitigation measures

Considering the conservational value of the archaeological remains found on site and the characteristics of the impact, it is regarded as ***negligible*** given that all mitigation measures mentioned above will be implemented.

6.6.7 Review and comments on Archaeological Remains and PCC's answers

The Cultural Heritage Agency of Iceland comments*: "In the IEIS there are two tables, Table 15 [comment EFLA: now Table 16] that shows the main results of archaeological studies in connection with the construction of the PCC Silicon Metal plant at Bakki and table 16 [comment EFLA: Table 17] that shows archaeological remains outside of lot of the plant. Figure 13 in the IEIS shows the boundaries of the construction area and Figures 3 and 60 show the boundaries of the lot. If those figures are compared, more archaeological remains seem to fall outside of the PCC lot than listed in Table 16."*

The Cultural Heritage Agency of Iceland further comments*: " In the discussion on SÞ-312:068 above it is stated that it may be the case that this is the same remains as number 8:1 in the report of the Archaeological Office. Their position on aerial photographs seems to be the same. The remains of SÞ-312:068 were investigated and were found to be a collapsed milestone. In the report of the Archaeological Office it is assumed that 8:1 could be a fox trap. The IEIS suggests that the fox trap is examined in a complete investigation. The Cultural Heritage Agency believes it has to be made sure if those are the same remains and if they have been fully studied. If the alleged fox trap is still undisturbed it has to be fully investigated."*

The Cultural Heritage Agency of Iceland makes no further comments on the EIA of the project. It should be noted that Article 21 of Act nr. 80/2012 on cultural objects says i.e. "Archaeological remains cf. Article 3(3), both those who have been protected as cultural patrimony and those protected by age, may not be damaged, destroyed, modified, covered, altered or moved by land owner, resident/farmer, developer or anyone else, except with the permission of The Cultural Heritage Agency of Iceland. And, to Article 24(2) of the same Act which reads as follows:" If previously undiscovered remains are found during the execution of work, work shall be stopped immediately. The Cultural Heritage Agency of Iceland shall have a site survey conducted without delay so the nature and extent of the findings can be determined. The Agency shall determine as soon as possible if work can be continued and under which conditions. It is forbidden to continue work without the written permission of The Cultural Heritage Agency of Iceland.

Answer PCC: The points marked as other archaeological remains on the maps were taken from the municipal plan to provide an idea of locations of other archaeological remains located near the construction area, and therefore their position on the map is not precise. The points in question are points nr. SÞ-312:028 and SÞ-312:030 (called 313:094 on the map due to wrong registration in the reference). Also point SÞ-312-025 falls out in Table 16 due to double registration. An updated map of archaeological remains is shown in the EIS. In other terms the developer agrees on the comments and suggestions of The Cultural Heritage Agency. The alleged fox trap will be investigated further and a complete investigation made if it turns out that the remains are disrupted. If other, previously undiscovered remains are found, work will be stopped until a site survey on behalf of The Cultural Heritage Agency of Iceland has been carried out and work will not be continued unless with a written permission of The Cultural Heritage Agency of Iceland.

6.7 Social impacts

6.7.1 Assessment criteria

The assessment of the social impacts following the construction and the operation of PCC's Silicon Metal plant focuses on population development, the labour market and on the municipalities in the region.

6.7.2 Documents and studies

The assessment of the social impact is based on an infrastructure analysis prepared by Northeast Iceland: "*Greining innviða á Norðausturlandi. Unnið vegna undirbúnings að uppbyggingu orkufreks iðnaðar í héraðinu skv. viljayfirlýsingu stjórnvalda og sveitarfélaganna á svæðinu dags. 25. maí 2011"* (Northeast Iceland Development Agency , 2012)

The results of the IEIS for the 346,000 tpa Alcoa aluminium smelter from 2010 (HRV, 2010) are also considered.

6.7.3 Baseline

The subject area for the Northeast Iceland infrastructure analysis is divided into three areas: the Húsavík area or the "near region", and two far regions; the Akureyri region and the Northeast corner, see **Figure 61**. In the opinion of the authors of the infrastructure analysis both Kópasker and Raufarhöfn lie outside of the defining parameters of the "near region", providing a "*more realistic assessment of existing conditions and the measures necessary to reinforce infrastructure and stimulate growth in the regional labour market*". (Northeast Iceland Development Agency, 2012).

The subject area defined in the in the IEIS for the aluminium smelter (HRV, 2010) was different, since it defined the western part of Eyjafjörður up to Siglufjörður municipality as investigation areas. Also the Melrakkaslétta area with the villages of Kópasker and Raufarhöfn, was defined as near region.

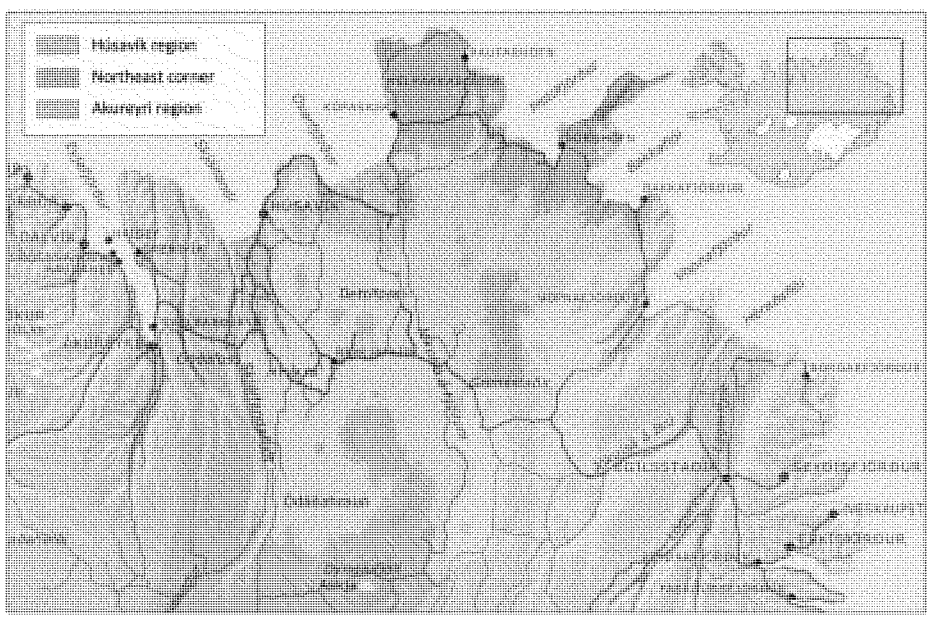


Figure 61: *Subject area for the infrastructure study for Northeast Iceland (Northeast Iceland Development Agency, 2012).*

The recent infrastructure analysis shows that the population development in the total subject area of Northeast Iceland has been positive over the past decade (+6.4% or an increase of 1,397), although below the total population increase in Iceland (+12.4%).
Individual regions within the subject area show disparity in the development. In the Húsavík area, there was a decline of 9.6% over the same period (-422) and in the far region of the

Northeast corner the population decline was by 21.9% (-260). At the same time in the far region of Akureyri and vicinity, the population increase was around 12.9% (2,079).
The total population of the Húsavík near region was 3,977 residents in January 2011, of which 2,237 resided in the town of Húsavík. The total population in the area had declined by 422 during the previous 10 years, thereof 186 in Húsavík. The population decline consists mostly of young people with children, as shown in the age pyramid (Figure 62),

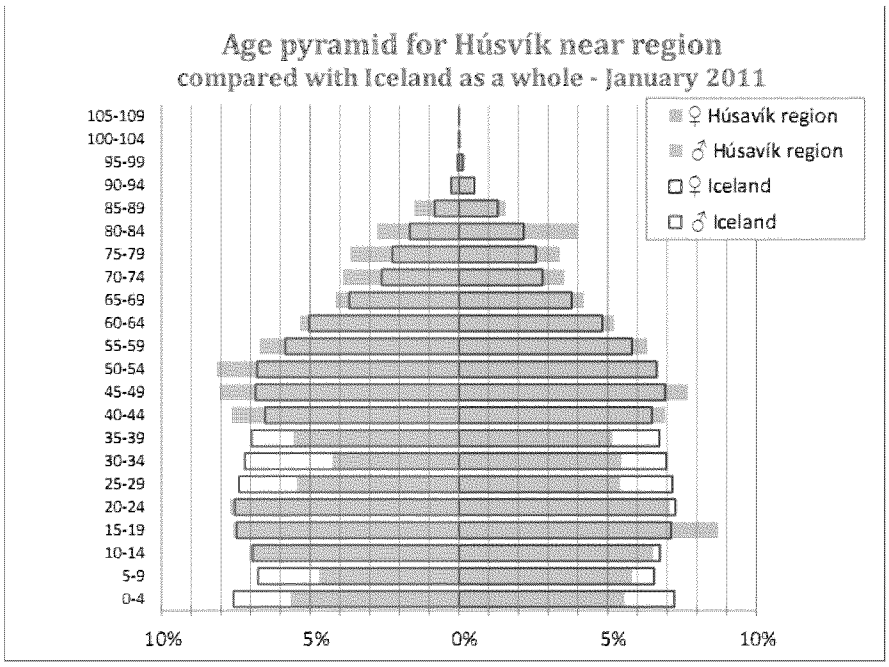


Figure 62: *Age pyramid for Húsavík region compared to the total population of Iceland* It shows a deficit in the number of children under the age of ten as well as in people in the age group from 25 to 40, *(Northeast Iceland Development Agency, 2012).*

The number of children (0-10 years old) in Húsavík decreased by 32.6% and the reduction in people between 25 and 40 was 30.3%. In the age group above 45, the ratio of people has grown. This large gap in the age groups between 25 and 40 in the Húsavík area is a common characteristic of areas with declining population (Northeast Iceland Development Agency, 2012). .The labour market of the Húsavík area has been defined as an urban commuting region, i.e. an area where people travel between home and workplace at least once on a daily basis. According to the definition, the commuting region of Húsavík reaches to Ljósavatnsskarð pass in the west, Mývatn region in the south and as far as Kelduhverfi in the east, an area conforming fairly well to the area defined as near region on Figure 61 (Northeast Iceland Development Agency, 2012).

The population of the entire study area on January 1, 2011 was 24,152, which constitutes a fairly large labour market on an Icelandic scale, in fact the largest outside the capital area. Of the total population, 16,922 people were of working age (16-74 yrs.). Given the activity rate, which is the ratio of the labour force to the total population of working age estimated by Statistics Iceland, the labour force can be estimated at 13,700 in the study area. In the near region, which largely corresponds to the Húsavík commuting region, the population was 3,977 on January 1, 2011. The working age population (16-74 yrs.) was 2,852, indicating a labour force of around 2,300. On January 1, 2011, the total population of the Akureyri region was 19,249 of which 13,419 were of working age, i.e. an estimated labour force of about 10,900. In the Northeast corner, the total population was 926 of which 651 were of working age giving an estimated labour force of about 530 (Northeast Iceland Development Agency, 2012).

Within the total labour force in Iceland in 2010, 35% had compulsory education, 37% upper secondary education and 28% tertiary level education, according to Statistics Iceland. In a

study conducted by The University of Akureyri Research Centre (RHA) on the social impacts of the aluminium plant in East Iceland 2002-2008, Northeast Iceland was within the study area [35]. Though the findings should be interpreted with some reservation due to the small sample size, they do indicate a certain variation from the national level within the labour force. According to the study, 44% had completed the compulsory level, 30% upper secondary level and 26% tertiary level education. While no conclusive factor can is given, one contributing factor could be the age distribution, since the educational level is generally higher among younger adults, which is the age group notably below national mean in this region (Northeast Iceland Development Agency, 2012).

Information on unemployment is only gathered for larger areas of Iceland. The Directorate of Labour calculated the unemployment rate from available information at the end of each month for the period 2010 to November 2011. During that period the unemployment rate in the region went down considerably. The rate remained lowest in the Húsavík region, where the 12 month mean was 5.0%, while the rate was 6.0% in the Akureyri region and 6.8% in the Northeast corner. Unemployment rate was higher among women than men in all three regions. The gender difference is greatest in the Northeast corner. (Northeast Iceland Development Agency, 2012).

Assuming status quo, major changes in the regional economy are not foreseen in the near future though some indicators point to an increased number of jobs rather than a declining labour market. This will for the most part be determined by the national economy in general but on a regional basis there are also expectations for increased tourism in the near region and outlook is also good for fish farming and fish processing in the region.

The subject area covers 10 municipalities with various population and development levels. Consequently, the level of service and administration is different between municipalities but cooperation between them ensures effective access for all residents. With the main impact being in the near region the main focus here is set on that area. The near region has five pre-primary schools or programmes connected with compulsory schools which combined can accommodate over 200 children. One pre-school is operated in Húsavík which is operated close to its maximum capacity and cannot accommodate an increase of enrolment without expanding facilities and teaching staff.

Five comprehensive schools with grades 1-10 for children aged 6-15 are operated in the near region. As a result of a greatly reduced number of students in the near region, the schools have the capacity to meet an increase of almost 60% without having to expand. In the two schools closest to Bakki alone, the unused capacity in the present facility is close to 160 students.

Two upper secondary schools operate within the near region. Nearly 150 students attend the Húsavík Upper Secondary School, thereof 110 attending day school. The current facility could accommodate double the current day school students or 220 in total.

The nearest institution for higher education is the University of Akureyri, with around 1,500 students.

A hospital is located in Húsavík, with smaller Health Centres in other densely populated areas. The hospital provides general health services and dental service. The facilities are well equipped in terms of facilities and could accommodate additional work load such as in emergency reception, which however would require increased staff and employment ratio for various specialists. Industrial development in the area will likely add increased pressure on health service in the area, particularly during the construction phase. It is therefore necessary to increase the capacity of the local health service to achieve acceptable response time in incidents such as accidents and emergencies.

6.7.4 Characteristics of impacts

The construction of the Silicon Metal plant will create around 200 man-years during the construction period. Most of the jobs during the construction are temporary, partly manned with people from other areas and therefore unlikely to have a great impact on the population.

The construction of the silicon metal plant is considered to have a temporary positive impact on population development.

The workforce during construction will come from the local areas as well from other parts in Iceland, but the ratio is dependent on conditions of the country's labour market. A low unemployment rate can lead to more immigration of workforce, either from other areas or from abroad. The construction of the Silicon Metal plant is considered to have temporary positive impact on the labour force.

The construction of the Silicon Metal plant will have a positive effect on the nearby municipalities, due to increased income through labour, more employment and higher income. An increased demand from people working on the construction will lead to an increase in commerce and service. During the construction time, increased pressure on the service of the municipalities is to be expected, especially in health services. The infrastructure is capable of managing increased demand during the construction. The main need for labour increase will be within the health services to achieve acceptable response time when incidents occur. The impact on the municipalities during the construction time is therefore expected to be a temporary but substantial positive impact.

The operation of the Silicon Metal plant will provide jobs in the area and provide a basis for a positive population development, but as described earlier the population in the Húsavík area has been declining for the past decade. In the IEIS for the aluminium smelter, each job at the aluminium smelter is assumed to increase the number of inhabitants by 4-6 (HRV, 2010). Assuming the operation of the plant will create 127 new direct jobs, an increase in the population can be between 500-750 inhabitants if using the same assumption. It is to be expected that this will have an impact on the wider NE-area, though the greatest impact will be in Húsavík and in the Húsavík region.

The operation of the Silicon Metal plant will provide opportunities, especially for young adults, reducing the number of them moving away to other areas and also providing possibilities for people to return. Therefore, the operation of the plant is considered to have a substantial positive effect on population development in the area. In total, the operation of the plant will create about direct 127 new jobs, not including other jobs created indirectly in relation to the operation. Of the 127 jobs, 27 are administrative, 8 are in raw material handling, 63 belong to supervision and operation of the furnace, tapping and operation of the casting bay, dedusting and product handling, 15 are meant for technicians (mechanics, electricians and welders), 8 are for laboratory personnel and 6 for other purposes.

The major impact will be on the local labour market since most of the personnel will come from within the study area. Therefore the operation of the Silicon Metal plant will have a substantial positive impact on the job market, both directly and indirectly.

Based on the status of the regional economy, particularly for the near region, it is clear that job opportunities connected with new industrial development will to some degree draw labour from other sectors in the region (crowding-out effect). The degree of this effect will be determined by the competitiveness of the new industry with regards to employee facilities, wages and benefits. Most of the new jobs will, however, be filled by migration of people who come to work in the new industry or to fill crowded out jobs in existing sectors (Northeast Iceland Development Agency, 2012).

The IEIS for the aluminium smelter (Alcoa 2010) points out that the infrastructure of the municipalities in the subject area is very well capable of receiving new inhabitants in the area. With a smaller size of the Silicon Metal plant, this impact will be even more manageable and the only increase needed is within the health services to achieve acceptable response time when incidents occur. The income of the municipalities will increase substantially, through increased taxes from direct and indirect creation of jobs, and also from land and property tax and through fees from the harbour. The operation of the Silicon Metal plant on the municipalities is therefore considered to have a substantial positive impact for the long term.

6.7.5 Mitigation and monitoring

No mitigation or monitoring measures are suggested for social impacts.

6.7.6 Conclusion

The construction and operation of the Silicon Metal plant is expected to cause a ***considerable positive*** impact on both population development as well as a considerable positive impact on the municipalities due to increase in income, the labour market and increase in trade and commerce.

6.8 Environmental impact during construction

6.8.1 Assessment criteria

The assessment focuses mainly on temporary impacts on the residents of Húsavík and nearby areas during construction, mainly due to noise, risk and safety and air pollution. The construction period entails both the construction of the plant and related constructions, such as the extension of the harbour area. It is assumed that a new access road will be ready when construction begins, if not the current public road from the harbour to the area will be used.

The impact is furthermore assessed on the basis of the following laws and regulations:

- Regulation no. 724/2008 on noise at industrial areas
- Law no. 46/1980 on facilities, health and safety in work places
- Regulations on explosions no. 684/1999

6.8.2 Documents and studies

The temporary environmental impacts during construction are assessed on the basis of previous constructions in Iceland, in particular roadwork and other plant construction.

6.8.3 Baseline

The proposed Silicon Metal plant is located approximately 2.6 km north of the village and port of Húsavík. The current harbour is mainly used for the fishing industry, shipping, shipbuilding, tourism and repair. In the municipal plan from 2010 – 2030 an expansion of the harbour is planned in order to support industries in the new industrial area north of Húsavík. The planned industrial area is accessible from the harbour via residential roads and a national road, lying through Húsavík.

6.8.4 Characteristics of impacts

Road construction and improvements in the harbour area are constructions of the municipality for the industrial area at Bakki. Those activities is connected to the operation of PCC but not performed by the company. This infrastructure can also be used for other operations in the area.

Environmental impacts during construction of the plant will mainly be due to noise and air pollution from traffic, the operation of heavy machinery and explosions in bedrock during construction of the plant.

The northernmost houses of Húsavík are situated approximately 1.2 km away from the south border of the plant's site and to the north the farm Héðinshöfði is located around 2 km from the site. It can therefore be assumed that noise from the plant's site will not be audible to inhabitants of Húsavík and nearby areas. Noise from explosions, which mostly be carried out during the first phases of the constructions, might however be heard and have a temporary negative impact. Due to distance to the nearest buildings no impacts will occur due to vibration caused by blasting or earthworks. It is not assumed that noise from the construction will cause disturbance to neighbours.

It is unlikely that air pollution due to the operation of heavy machinery during earthworks and excavations on site will affect residents of Húsavík or nearby areas. During hot weather periods, earth works and transport of materials can however cause dust pollution. Also, there is a risk of dust getting suspended into the air from areas that are not covered with vegetation or uncovered material mounds. Mitigation measures will be used to reduce all

dust pollution from the plant's site during and after construction, such as covering trucks travelling with materials and covering or watering eroded areas on site to control dust pollution it deemed necessary due to weather conditions.

A substantial amount of traffic due to transport of building materials and equipment is to be expected, mainly from the harbour site.

The plant's construction is expected to take 18 months.

The port extension and the new industrial road connecting the harbour to the plant are planned for construction and completion prior to the construction of the Silicon Metal plant, in order to minimize disturbance to the residents of Húsavík municipality and nearby areas. Should there however be a delay in its construction, it will start at latest in parallel with the plant's construction, causing a temporary negative impact to Húsavík residents due to reduced traffic safety, noise and air pollution following frequent transport. When the new industrial road has been finished, transport will be moved over to that road, significantly reducing the impact on residents.

Excavated material from the plant's site will be used for the final landscaping and preparation of the site before starting the operation. Soil materials intended for concrete production, foundations and road construction will mostly come from the plant's site. If needed, materials will also be taken from local mines with operation permits. A work camp will be erected on site during the plant's construction, but existing infrastructure in the Húsavík area will be used for workers accommodation and services. The facilities on site will be used for coffee breaks, toilets and offices for site engineers and supervision.

It is also assumed that staff staying in the area temporarily can also stay there over night.

6.8.5 Mitigation and monitoring

In order to minimize impacts on residents of Húsavík during the plant's construction, the following mitigation measures will be taken:

- Traffic through residential roads in Húsavík will be avoided by using a new industrial road that is to be built prior to the plant's construction. Should there be a delay in the road's construction, when driving through Húsavík, measures will be taken to reduce speed and therefore reduce traffic risk for residents and its negative impacts. The new industrial road will be used as soon as ready.
- Dust pollution will be avoided by covering truckloads carrying building material. Dry and eroded areas will be sprayed with water to prevent dust from spreading during dry periods of the plant's construction.
- Requirements of regulation no. 724/2008 on noise apply close to or within residential areas. Article 8 specially requires all noise disturbances from construction to be reduced. Also, that construction in or close to residential areas is evidently introduced to the nearby residents before starting the construction. This introduction shall include information such as the duration of the construction, which part of the work is likely to cause the most disturbances and when work on those parts takes place. According to Table IV of the Annex to the regulation, loud construction works shall be limited certain periods of time. These rules will be complied with as relevant for the constructions.
- Strict rules apply on the work and handling of explosives. When preparing tender documents for the construction relevant clauses will be set that bind the contractor working for the comply with those rules. Article 38 of regulation nr. 684/1999 on explosions reads: "When it is to be expected that explosions can cause disturbance to close residents, these should be notified". Therefore, all residents close to the area where explosions will occur will be specially notified.
- The construction site will be marked and clearly delineated. The developer will insure that the contractor complies with laws and regulations regarding the working hours and noise and air pollution.

6.8.6 Conclusion

Considering the above criteria, characteristics of the impact and mitigation measures taken, and assuming that the new road from the harbour to the plant's site is ready before beginning plant construction, it is the view of the developer that the project will have an ***insignificant negative*** effect on Húsavík residents and nearby areas during the plant's construction, mainly due to noise and air pollution. This impact is increased to temporary ***considerable negative*** impact if the new road is not ready before beginning plant construction, due to decreased traffic safety and increased noise and air pollution.

6.8.7 Reviews and comments on Environmental Impact during Construction and PCC's answers

Residents and landowners of Héðinshöfði ask in their comments: "*What are the emissions of machines and vehicles during the construction period [...] and that is the impact on residential areas, cultivation of land and agriculture at Héðinshöfði?"*

Answer PCC: The release of airborne emissions from machines and vehicles during building time has not been specially evaluated. The scale of the project is large, both in terms of landscaping as well as construction of buildings and therefore it is clear that there will be a considerable use of fossil fuels. However, care will be taken to reduce driving of heavy vehicles as much as possible, thus reducing the use of fossil fuels.

Furthermore, residents and landowners of Héðinshöfði comment: *"Environmental impact during construction and after the plant is in full operation will inevitably have a great and permanent impact on animal life, nature and people. The increase of traffic and inconvenience caused to the inhabitants of Héðinshöfði, who are the neighbours of the silicon metal plant in 2 km distance, are not mentioned. It is demanded that the impact on residential areas, land cultivation and agriculture at Héðinshöfði are fully considered during the building time and during operation of the plant".*

Answer *PCC:* Transportation between the harbour area and the industrial area will be directed on an industrial road to prevent it from going through the town of Húsavík. Transport of materials to and from the plant will not be directed passed the farmhouses of Héðinshöfði. Traffic that passes Héðinshöfði could be cars of employees or visitors and transport of delivers related to office operation and canteen, but likely on a very small scale, since it is assumed that the plant is largely serviced from Húsavík. It is estimated that there will not be a significant increase in traffic from the traffic that already drives on Tjörnesvegur road. It is also likely that employees will carpool and so reduce traffic.

Furthermore, residents and landowners of Héðinshöfði ask: "*What will happen to excavated material from the industrial area? Where is it foreseen that construction material will be taken for constructions in the PCC industrial site?"*

Answer PCC: It is expected that excavation material will be used within the site, i.e. for landscaping. Also, a part of the excavation material will be used in projects by the municipality if needed. Material will mostly be taken within the site and from nearby mines with valid operational permits.

6.9 Risk and safety

6.9.1 Assessment criteria

The assessment of the impact due to the emerging risks at Bakki is based on the following Icelandic acts and regulations:

- Building regulation nr. 112/2012.
- Act on fire safety nr. 75/2000 with subsequent updates.
- Act on structures nr. 160/2010.
- Regulation concerning usage of equipment that burns gas nr. 108/1996.
- Regulation concerning catastrophes nr.160/2007 (Seveso).
- Act on protection against ocean and shoreline contamination nr. 33/2004.
- Regulation concerning operations that may cause pollution nr. 785/1999.
- Regulation concerning explosive atmosphere in workplaces nr. 349/2004.
- Regulation concerning equipment and protection systems in explosive atmospheres nr.77/1996.

6.9.2 Documents and studies

The assessment of risks and possible environmental impacts due to them is based on the following documents.

- Páll Halldórsson 2005: Earthquake activity in NA Iceland. Prepared for the Ministry of Industry by the Icelandic Met Office.
- Ragnar Sigbjörnsson and Jónas Þór Snæbjörnsson. Earthquake hazard - Preliminary assessment for an industrial lot at Bakki near Húsavík. Earthquake Engineering Research Centre, University of Iceland.
- Húsavík fire brigade. Fire safety program. Húsavík, Norðurþing, Iceland.

Furthermore to the documents listed above, information from other chapters of this report is used as basis for the assessment of risks and safety.

6.9.3 Characteristics of impacts

The planned operation of the Silicon Metal plant at Bakki accommodates the need for assessing the risks to the health of people and safety of the environment.

There is a risk of explosions both where LPG is stored and in the coal and woodchip storages where there is a risk of dust explosion. Due to the storage of LPG, oxygen and refractory material linings, regulation no. 160/2007 concerning the risk of catastrophes may apply to the operation planned at Bakki, depending on the maximum amount of material in stock.

Transformers, very large fuel loads in storage facilities and the storage of LPG and Oxygen call for significant response capability and capacity of the fire brigade.

The operation is planned in a seismic region where there is a present risk of earthquakes occurring cf. preliminary assessment for an industrial lot at Bakki, Húsavík (Páll Halldórsson, 2005, Ragnar Sigurbjörnsson og Jónas Snæbjörnsson, 2007).

Other natural catastrophes such as avalanches and volcanic eruptions cause very low or no threats to the operation.

6.9.4 Mitigation and monitoring

To mitigate the apparent and emerging risks and to ensure that they are dealt with appropriately, risk management will be applied. The procedure will be according to ISO 31000.

Performance based fire safety design and a risk analyses will be carried out for the appropriate buildings according to article 9.2.4 of the Icelandic building regulation nr.

112/2012. Where regulations and appropriate EN standards are not sufficient, the design will be based on the applicable NFPA standard or calculations based on widely recognised methods.

Storage of flammable gas will be in an isolated storage according to article 12.6 of the Icelandic building regulation nr. 112/2012 and is subject to approval of local authorities according to article 6.11.4 of the same regulation. Where there is a risk of explosion, requirements for pressure relieving systems and structural integrity stated in article 9.4.13 of the Icelandic building regulation nr. 112/2012 will be satisfied. Risk analyses will be carried out for the buildings to minimize risks due to radiation, smoke, toxic gases or explosions according to article 9.2.4 of the building regulations nr. 112/2012.

Location and storage construction for LPG pressure containers will be according to NFPA 58-59, as there are not appropriate EN standards available. LPG pipe systems only extend from the storage facility to a single location within the plant, threats due to transport of LPG within the premises are therefore localised. The general application of instruments that burn LPG will satisfy requirements of regulation nr. 108/1996. On the location, venting, signs etc. in oxygen storages reference will be made to relevant NFPA standard, in lack of appropriate ÍST EN standard.

There is a risk of explosions both where LPG is stored and in the coal and woodchip storages where there is a risk of dust explosion, this needs to be accounted for in the design of these storages and their surroundings. General design of storage facilities, electrical design and design of systems for the prevention/mitigation of explosions reference will be made to EN 16020:2011, EN 14491:2012 and EN 14034-1, 2, 3, 4. Where EN standards are not adequate, reference can be made to NFPA 499, 68, 69 and 77. For compartments where there is a risk of explosion either because of flammable gas or dust, the operation will satisfy the requirements set by regulation nr. 349/2004 concerning explosive atmosphere in workplaces. For such compartments the operation will also satisfy the requirements of regulation nr. 77/1996 concerning equipment and systems for use in potentially explosive atmosphere, as required by risk analysis according to regulation nr. 349/2004.

Detection, alarm and suppression systems, egress paths, smoke control, fire fighting facilities, structural fire design and other special requirements made by the Icelandic building regulation nr. 112/2012 will be satisfied. Detailed fire safety design will refer to the appropriate EN standards. Design of automatic suppression systems will be according to EN 13825 Fixed fire fighting systems — Automatic sprinkler systems, directions for applying sprinkler protection and other instructive documents subject to approval of local authorities.

To control risks due to an earthquake, structures will be designed for the appropriate seismic loads according to EN standards including national annexes. LPG pipe systems and systems that contain toxic gases will be designed with special emphasis on earthquakes according to appropriate EN standards including national annexes.

Risk analyses will be carried out where the health of people, property and the environment can be affected by exhausts, waste, gas leakage or other factors. Response plans will be made for the whole operation with special emphasis on the components that cause risk to people, environment or operation during and after an earthquake, for example gas leakage and undesired waste or air pollution.

The fire brigade in Húsavík does not currently have the capacity to deal with the emerging new risks, planned at Bakki, both with respect to manpower and equipment. The enhancement of the fire brigade and necessary fire fighting water should be decided with respect to what extent the fire protection on site will be and the storage layouts. Transformers, large fuel loads in the storage facilities and risk of explosions call for significant response capability and capacity of the fire brigade and therefore a detailed response plan will be made for the factory and related operations such as transportation and port activities. To ensure sufficient capacity of the fire brigade, the following should be implemented:

- Adding, renewing and maintaining fire fighting vehicles.

- Adding, renewing and maintaining equipment such as pumps, clothing, smoke diving gear and IR cameras.
- Telecommunications equipment.
- Adding manpower, training and retraining.
- Fire safety monitoring.
- Adding, renewing and maintaining equipment to deal with pollution incidents.
- Securing enough fire fighting water, capacity and pressure.
- Securing necessary amount of fire fighting foam and other means of special fire fighting materials.

To fulfil requirements set out in part b of Annex I in Act nr. 33/2004 on prevention against sea and costal pollution and regulation 468/1998 on response to acute pollution of the sea, PCC will have to prepare a response plan on acute pollution of the sea before applying for an operation permit. A risk analysis will be carried out and appropriate measures undertaken to control risk and ensure that the risk of resources contaminating the ocean during loading and unloading is minimised and to prevent environmental impact and pollution due to port activities. PCC will also provide a confirmation of necessary insurance in accordance with article 16 of act 33/2004 and article 3 of regulation 1078/2005 on the insurances of ships and operations on land due to acute pollution. No raw materials transported through the port and used by PCC can cause acute pollution of the sea. Oils within transformers and fuel oil will be kept on site and proper safety cautions will be carried out for those and appropriate ADR certificates will be acquired for all transport and handling.

Storage limits according to regulation nr. 160/2007 concerning the risk of catastrophes compared to annual material usage for the operation is shown in Table 18.

Table 18: *Storage limits according to regulation nr. 160/2007 and storage quantities on site.*

Substance	Storage Limit	Storage quantity on site
LPG	5 tons	90 tons (one month supply)
Refractory material linings	5-50 (depends on type of material)	-
Oxygen	200 tons	70 tons (two months' supply)

Annual quantities of the above mentioned materials are above the threshold limits stated in the catastrophe regulation nr. 160/2007, therefore the arrangement of supplying resources will control whether the catastrophe regulation applies.

If materials are stored in greater quantities than regulation nr.160/2007 states as threshold limits, appropriate measures for reporting obligations, planning and reaction to catastrophes, safety management systems and safety reports will be undertaken according to the regulation.

6.9.5 Conclusion

With appropriate measures such as mentioned above, carrying out risk analyses and controlling risk, implementing proper design methods according to relevant standards, reinforcing the fire brigade at Húsavík and by following regulations strictly, the emerging risks due to the planned operations at Bakki can be minimised and the environmental impact due to hazardous events kept to a minimum. With this in mind the impacts are regarded ***insignificant***.

7 ENVIRONMENTAL IMPACT ASSESSMENT – OTHER ALTERNATIVES

7.1 Sea water cooling

7.1.1 Air quality and climate

The impact of the alternative of using sea water cooling on air quality and climate is considered the same as for alternative 1. See chapter **Error! Reference source not found.**.

7.1.2 Noise

If sea water is used for cooling, a cooling tower will not be required, thus decreasing noise within the site. Noise calculations were performed for alternative 1 and the respective noise maps are located in Annex 11.

7.1.3 Marine and coastal areas

7.1.3.1 Assessment criteria

During the production process at PCC's Silicon Metal plant, considerable heat is formed which requires substantial amounts of water for cooling purposes. The concept of this alternative of cooling is the use of sea water which is collected outside the shore, close to the plant, see chapter 3.1. For the first phase the use of sea water for cooling is on average 1,200 m^3/hour. The cooling system is operated as a closed system where the sea does not get into contact with polluting compounds during the cooling process, as this would be harmful for the production. A pumping and inlet station would be installed on the shore, approximately 6 m below sea level. The preliminary design is to excavate two 15 m wide channels and refill them with fine material in the core and course protective material on the outside. Seawater is filtered through these channels and used for the cooling process. After the cooling process, sea water would be returned to the sea at a temperature between 16-25°C.

A water outlet pipe then lies along either channel on the seabed, with the outlet located 20-40 m beyond the coast line, at approximately 5 meters depth. The instalment would require a 10 m wide disruption of the sea floor, including a gradually decreasing wave breaker going further into the sea. The cooling water would be released from the pipeline through diffusion nozzles, to ensure an even distribution of heat to the sea.

This option can cause effects due heat dispersion from cooling water and direct effects on the biota at the coast of Bakki.

The project's impact on marine and coastal areas is assessed on the basis of the following criteria:

- Act no. 44/1999 on nature conservation.
- Act no. 33/2004 on prevention of marine and coastal pollution.
- Regulation no. 798/1999 on sewer and sewage

7.1.3.2 Documents and studies

The effects of releasing warm sea water into the sea were analysed, both close to the outlet and at the surface, by means of calculations with a simple dispersion model created by Verkfræðistofa Norðurlands based on Dr. Jacob Odgaard formulas (DTU 1970)/K. The main assumptions for the calculations are the following:

- Water cooling system: sea water at an inlet temperature of 5°C
- Temperature in outlet: 20°C
- Sea returned at seabed at 5 m depth (around 20-40 m from coastal line)
- Flow: 1,200 m^3/hour (333 L/s)
- Cooling system power demand: 21 MW
- Number of diffusion nozzles: 3 (horizontal flow). Flow through each nozzle is 400 m^3/hour (111 L/s).

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- Diameter of nozzles: 0.27 m
- Distance between nozzles: 2.6 m
- Temperature of the receiving sea at the outlet (at seabed at 5 m depth) of 5°C

7.1.3.3 Baseline

For the calculations the average temperature of the seawater at the north coast of Iceland is used. It is clear that sea temperature changes with the seasons of the year, but this has proven not to affect the results of the calculations.

The southern part of Bakkakrókur, i.e. the shoreline outside PCC's allocated plant, extending from River Bakká south to Forvaði (see Figure 22), is a rock-bound or boulder shore. Similar shores can be found south of Cape Bakkahöfði, and north of capes Héðinshöfði and Lynghöfði. These shores have solid bases and are very flat, resulting in very long and shallow shores. Gravel of varying grain size can be found along above the coastal line in the south part of Bakkakrókur, reaching up to a grassy bank. There is also a patch of drifted seaweed that has accumulated in strong tidal currents, and spots of sand in between, especially in the lower part of the shore, see **Figure 63** (Þorkell Lindberg Þórarinsson, 2012).

Figure 63: *A view south over the southern part of the Bakkakrókur coast. Rocks, gravel and sand can be seen in the upper and lower parts of the shore, and a patch of drifted seaweed. Larger boulders and bedrock can be observed in the lower part, reaching far into the sea. Shallow basins with solid bedrock floors can be observed between the skerries . (Photo Þorkell Lindberg Þórarinsson, 2012).*

Visible shore skerries during observations were covered with seaweed and between them shallow basins with solid bedrock floors, sometimes covered with sand, rich in Corallinacea algae. The Bakki coastline (Bakkafjara), along with cape Bakkahöfði, is on the Nature Conservation Registry, with the following description: *„Bakkafjara and Cape Bakkahöfði, Húsavík. (1) The Cape, along with coastline, outcrops and offshore. (2) Peculiar bedrock outcrops and intrusions in front of the cape. Biologically diverse shores and outcrops.“*

In the north part of Bakkakrókur, which is similar to the above description, seaweed patches have been studied. Their division by height is apparent, with brown algae species *Fucus spiralis* at the top of the shore, *F. vesiculosus*, *Ascophyllum nodosum* and *F. distichus* lower down the shore. These species were seen in the south part of Bakkakrókur during observation on October 29, 2012. Species communities and their division in patches are probably similar in the north part of the Bakkakrókur shore.

The total count of smaller organisms, number of species and their density in the north part of Bakkakrókur is relatively high compared to shores that have been studied in other parts of the Tjörnes peninsula. Blue mussel (Mytilus edulis), Skeneopsis planorbis and the flat periwinkle (Littorina obtusata) are prominent, with high densities. No rare species nationwide have been found in the area. Considering the nature of the coast and its seaweed cover, it can be assumed that invertebrate fauna in the south part of Bakkakrókur shore is comparable to the north part. Characteristics of impacts

7.1.3.4 Characteristics of impacts

The results show that after dilution the temperature at the surface is around 6.2°C which is only 1.2°C higher than the sea temperature (according to regulation no. 798/1999 the maximum temperature change as a result of discharge to rivers and lakes outside of dilution zones is 2°C). The vertical current velocity 2 m below the sea surface is around 8.8 cm/sec. and the diameter of the area of impact at the surface is approximately 1.3 m per nozzle. **Figure 64** shows the outlet and the estimated area of impact around the outlet in meters.

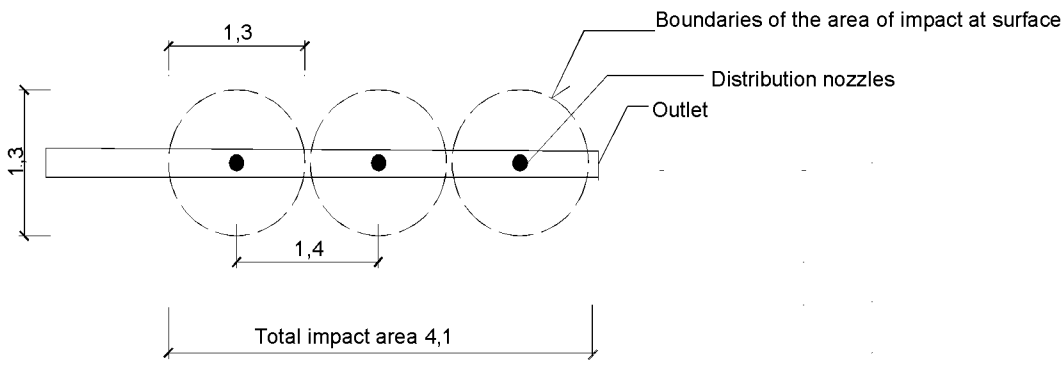

Figure 64: *Schematic figure of the impact area at the sea surface from warmed sea water release.*

Figure 64 shows that the size of the calculated area of impact at the sea surface is approximately 4.1 m x 1.3 m. At the boundaries of the impact area the temperature is around 6.2°C. Outside of the impact area the temperature will decrease rapidly and reach sea water temperature. The calculations show that the impact of emissions of warm sea water has very limited impact on sea temperature. Horizontal ocean currents in Skjálfandaflói are not considered in the calculations, but these currents can be of significance and assist in better mixing of warm seawater with the receiving seawater, resulting in a more rapid decreasing of the temperature. Building of the second phase will require additional sea water for cooling purposes. The cooling system will be identical compared to the system for the first phase. It is expected that the same sump pit and intake installations can be utilised, but an additional pump house and outlet to the sea parallel to the first phase outlet pipe will be constructed. The new outlet will be comparable to the first one and it is estimated that the same effects on temperature will be observed as from the existing outlet. The location and depth of the outlet will be located in appropriate distance from the existing outlet so that synergies will not be observed.

The memo from the NEINC on coastal biota and the effects of warm sea water release is based on preliminary observations, carried out at high tide on October 19, 2012 and

previous studies and records of nearby seaweed shores. More detailed observations on the coastal biota could not be carried out in such late season.

From the above baseline description it is clear that the inlet pumping station and the outlet pipe will cause considerable disruption and alteration of the environment. Parts of the shore will be excavated during construction and covered with course wave breaking material, changing the nature of the shore in that area. Since these changes only take place on a limited and rather small area, they are not expected to have considerable negative impacts on the coastal biota.

Indirect long term impacts could be significant if sediments accumulate along the outlet. The outlet will likely protrude for quite some distance out to sea, given the shallow offshore depths. If there is accumulation, the outlet's impact could be greater than the outlet and wave breaker itself, due to changes in the sea floor and benthic fauna. The project's indirect impact could therefore be substantial and probably negative if sand accumulates on a large area by the outlet. Although rare species are probably not in danger, based on studies on the invertebrate fauna and algae flora in Bakkakrókur, the accumulation of sand would probably reduce the diversity and quantity in the coastal biota at the respective area, of both invertebrates and algae.

As mentioned above, Cape Bakkahöfði and the Bakkafjara coast are in the Nature Conservation Registry, i.e. because of its bio diverse coasts. The conserved area's boundaries may lay somewhat farther out north than the industrial area, but it is part of a larger overall ecosystem lying from Héðinsvík, where the bedrock shores begin, south along the coast to Cape Bakkahöfði, Bakkakrókur and Forvaði, where the sand shores recommence. The proposed project will have an impact to the overall ecosystem formed by Cape Bakkahöfði and Bakkakrókur shore, in spite of defined boundaries of the Nature Conservation Registry (Þorkell Lindberg Þórarinsson, 2012).

7.1.3.5 Mitigation and monitoring

The effects of the outlet could be minimized by situating the outlet pipes in shallow basins between bedrock cuts to minimize coastal surface impacted.

7.1.3.6 Conclusion

Considering the criteria mentioned above and the characteristics of the impact it is the view of the developer that the impact of the project on marine and coastal areas will be ***considerably negative*** in a limited area on the Bakkakrókur coast.

7.1.4 Flora

The difference between this alternative and alternative 1 is that pipes have to be led from PCC to the pumping station, causing an additional impact to flora. Considering the same criteria as in chapter 6.3.1 the additional impact on flora of the alternative of using sea water cooling is considered to be negligible. This alternative is therefore considered to cause a ***considerable negative impact***.

7.1.5 Birds

7.1.5.1 Assessment criteria

The assessment of the impact on birds from the alternative of using sea water cooling on follows the same assessment criteria as for alternative 1, see chapter 6.4.1.

7.1.5.2 Documents and studies

The assessment of the impact of sea water cooling on birdlife is based and a memo on the direct effects of the construction of an inlet basin for seawater pumping and outlet pipe on the biota at the coast of Bakki, issued by biologist Þorkell Lindberg Þórarinsson from the North East Iceland Nature Center (NEINC).Baseline

7.1.5.3 Baseline

The bird population was surveyed regularly in 2008 and the number of individuals counted. The survey shows that the coast at Bakki is very important for migrating birds, but around 10,000 birds pass there in the springtime. Many laying birds use the coast for resting, before continuing to their nesting ground. Many birds pass the area on their way to their northern nesting grounds. The total amount of birds is the most in mid-May when 7,000 birds are in the coastal areas.

The research area of 2008 was divided into 7 areas. Amongst the areas with the highest number of birds was the area around Bakkahöfði and Héðinshöfði. Flat and seaweed covered skerries/reefs, which are accessible during the tide and areas above the seashore covered with mounds of seaweed are important sources of food for birds. This makes areas such as the shoreline Bakkakrókur an important source of food for birds such as The Red Knot (Calidris canutus), the most frequent bird at Bakki during the spring. Another important source is larvae of the seaweed fly or Coelopa frigida found in the seaweed mounds (Þórarinn Lindberg Þórarinsson, 2012).

7.1.5.4 Characteristics of impacts

As described in chapter 2.5 and 3.1, a part of the coastline will be disrupted by the construction of the possible seawater pumping station. According to the specialist of the NEINC this could cause a considerable, but temporary, negative impact on birds during construction if carried out in the springtime when the area is an important source for birds.

7.1.5.5 Conclusion

A considerable negative impact might occur due to disturbance during construction of the possible seawater intake, if carried out in spring, when the birds frequent the Bakkakrókur coast.

7.1.6 Landscape and visual impact

The impact on landscape and the visual impact are considered to increase for this alternative due to the changes to the coastal area. The additional visual impact is from the pumping station infrastructure located at the coastline, see chapter 0.

7.1.7 Archaeological remains

The impact on archaeological remains is considered the same as for alternative 1, see chapter 6.6.

7.1.8 Social impact

Social impact is considered the same as for alternative 1. See chapter 6.7

7.1.9 Environmental impact during construction

The environmental impact during construction is considered to be similar to alternative 1. Additional impact is from the construction of the pumping station, and the inlet and outlet pipes for the sea water. The main difference between the two alternatives is due to a potential temporary impact on birds using the coast as feeding grounds, especially if this is carried out during the springtime. This is however considered not to change the overall impact as assessed for alternative 1, see chapter 0.

7.1.10 Risk and safety

The impact on risk and safety is considered the same as for alternative 1, as described in chapter 6.9.

7.1.11 Review and comments on marine and coastal areas and PCC's answers

In the report from the Marine Research Institute it says: "*It is proposed to use seawater for cooling during the production process in a closed cooling system, where the sea water does not come in contact with any pollutants but does absorb heat before it is pumped back into the ocean. The required amount of cooling water is approx. 1200 m3/h. The proposed plan is to direct the seawater back into the ocean at a depth of 5 m and at a temperature of 15-25°C when it is released through a nozzle in the south of Bakkakrókur. It is not explained in the IEIS what is the offset water level when spoken of 5 m depth of the nozzle. The Marine Research Institute considers it important that the nozzle is at a depth of 5 m in low level water to insure addictive mix to cold sea water. This is also important for the phase 2 expansion, where a cooling system, comparable to the system for phase 1 as has been discussed, will be added. Results from the research on the biology of the area don't indicate that any unique or rare species of organisms are located in the northern part of Bakkakrókur. No research has currently been performed on the southern part of Bakkakrókur, where the proposed cooling sea water will be released back into the ocean. The report (p.81) states that according to a memo from the NEINC, direct observations of the seaweed shores in the southern part of Bakkakrókur, comparable to the research performed in the northern part, are not applicable/realistic due to the season/time of year .Before the construction of the 2nd phase of the plant, the observations could be done and it is recommended that they should be performed as the area is listed in the Natural Conservation Register.*"

PCC comment: Calculations of the mixing of the released cooling seawater are based on placement of the exit nozzle at a depth of 5 m below the minimum sea level. This allows for the sufficient mixing with the colder sea water. If the seawater cooling alternative is chosen, a pre-liminary research on the seaweed shores in the southern part of Bakkakrókur will be performed before construction begins. Efforts will be made for the placement of pipes for seawater cooling to the south of the part of Bakkafjara, that is listed in the Natural Conservation Register.

7.2 Zero-option

7.2.1 Air quality and climate

According to the zero-option, no discharge of pollutants and greenhouse gasses would occur into the atmosphere from PCC's plant. The area is defined as an industrial area in the municipal plan, and other industrial development is therefore likely to be built on the site that may cause (similar) substances to be released into the atmosphere. Therefore the impact of the zero option on the local air quality is considered to be ***negligible***. It may also be argued that if the PCC plant will not be constructed at Bakki it is likely to be built elsewhere, and quite possibly in locations without access to the same amount of renewable energy sources. This may cause more net emissions than if the plant would be constructed at Bakki. Considering this, globally, the impact of the zero-option would have a negative impact, although the magnitude of increase as such may not be considered significant.

7.2.2 Noise

The effect of the zero-option would be that there would be no noise emissions that come from PCC's Silicon Metal plant. However, the area is defined as an industrial area in the municipal plan, and other industrial development likely to be built there. Calculated noise levels show that noise will be within legal requirements for industrial sites and for noise emitted to neighbouring sites. Therefore, the impact of the zero-option is considered to be negligible.

7.2.3 Marine and coastal areas

The impact of the zero option on marine and costal area involves that either alternative 1 will be built (instead of seawater cooling), or that the whole project will not be realized. The zero option involves that the shoreline and shore will remain intact, instead of being disrupted following the construction of the sea water inlet pumping station and the laying of pipes.

There will also be no risk of sediments accumulating at the outlet and the impact on sea floor and benthic fauna as well as no indirect impact following sand accumulation and no release of sea water; however the assessment of the impact of the release is that it is negligible. Considering the above, the impact of the zero-option on marine and coastal areas will be ***considerably positive.***

7.2.4 Flora

The impact of the zero option on flora will be that vegetation that otherwise would be lost under structures of the plant will be preserved. Wetland spots south of River Bakkaá will not be disrupted from this construction. None of the plants or high plants found in the area are considered to be in threat of extinction. The area is defined as an industrial area in the municipal plan. Considering the above, the impact of the zero-option on flora is considered to be ***negligible***.

7.2.5 Birds

The impact of the zero option on birds is considered ***insignificant***, due to the low value of the area for birds within PCC's site, see chapter 0. However, if comparing the zero-option to the sea water cooling alternative, the impacts of the zero option are considered ***negligible***, since the effect of the construction was considered to be only temporary.

7.2.6 Landscape and visual impact

The effect of the zero-option is that no structures will be built and surface not disrupted. Therefore nothing occurs inside the area and the effects are thought to be considerably positive. The same applies to this environmental aspect as for others, that the land use is defined for industrial use and therefore very likely that structures will in the end be built in the area.

7.2.7 Archaeological remains

None of the remains found on site have a high monumental value. Provided that all mitigation measures are followed, the impact on archaeological remains is considered to be insignificant. Considering the above, the impact of the zero option on archaeological remains is considered to be ***negligible***.

7.2.8 Social impacts

The social impact of the zero option is that no temporary work will be created during the construction and operation of the plant, which no temporary or future positive impact on the labour force. Also the income of the municipalities will not rise as it would if the construction and operation of the plant were to take place. Considering the above the social impact of the zero option is ***negative.*** However, the area is defined as an industrial area in the municipal plan, and other industrial development likely to be built in the area that will cause a positive social impact.

7.2.9 Risk and safety

The impact of the zero option on risk and safety is that there will be no risk of explosions from the LPG storage, nor from the material storages. Furthermore there will be no risk from oil spillages, i.e. from transformers or stored fuel. These are however all manageable impacts and the zero option is considered to be ***negligible***.

8 CONSULTATION AND PRESENTATIONS

8.1 Scoping Plan Proposal Draft

The Scoping Plan Proposal Draft was made accessible to the public and stakeholders for three weeks between December 1st and December 22nd, 2011 to fulfil requirements of article 14 of regulation 1123/2005 on environmental impact assessment.

The Scoping Plan Proposal Draft was advertised in Fréttablaðið and Morgunblaðið [national newspapers] and Skráin in Húsavík [local newspaper] on December 1st, 2011. The Scoping Plan Proposal Draft was advertised and accessible on the website of EFLA Consulting Engineers.

On November 13th, an open house was held at Fosshótel Húsavík. There, the company PCC, the project and the Scoping Plan Proposal were presented.

At the same time the developer opened a website, www.pcc.is, there the public and other parties had an opportunity to gather information on the company and the proposed project at Bakki.

8.2 Scoping Plan Proposal

The Scoping Plan Proposal was sent to the National Planning Agency and presented for commenting from January 3rd to January 17th, 2012. The Scoping Plan Proposal was accessible on the website of EFLA Consulting Engineers. Also there was a long from the website of PCC SE, www.pcc.is to the EFLA website.

The NPA consulted with the following statutory consultees in accordance to paragraph 8 of the Environmental Impact Assessment Act; the Cultural Heritage Agency of Iceland, the Marine Research Institute, the Health Inspectorate of NE Iceland, the Icelandic Construction Authority, the Municipality of Norðurþing, the Environment Agency of Iceland, the Meteorological Institute and the Administration of Occupational Safety and Health.

On February 2nd, 2012 the National Planning Agency agreed to the Scoping Plan Proposal with comments.

8.3 Presentation of the Initial Environmental Impact Statement

The Initial Environmental Statement (IEIS) was sent to the National Planning Agency on February 18th, 2013 and was presented for 6 weeks, from February 22nd to April 5th, 2013. While the IEIS was in preparation the National Planning Agency, Environment Agency and Norðurþing municipality were consulted in accordance with the Act on EIA.

The National Planning Agency advertised the proposed project and the IEIS in Skráin in Húsavík on February 21st, 2013 and in Morgunblaðið and Fréttablaðið on Friday February 22nd, 2013.

The report was available at the following locations

- National Planning Agency
- *National Library of Iceland*
- *Húsavík Public Library*
- *Website PCC SE, www.pcc.is*
- *Website EFLA Consulting Engineers,* www.efla.is

The project was introduced to the public and to stakeholders in an open house at Fosshotel in Húsavík on Saturday March 9th between 14:00 and 18:00. Between 200-250 visited the open house

The National Planning Agency sent the IEIS for review and commenting to the following parties in accordance to Article 8 of the law on EIA; The Marine Research Institute, The Health Inspectorate of NE Iceland, Iceland Construction Authority, The Cultural Heritage Agency of Iceland, Norðurþing municipality, Environmental Agency of Iceland, Iceland Met Office and the Administration of Occupational Safety and Health in Iceland.

The National Planning Agency received reviews from the following parties.

- The Marine Research Institute, March 4th, 2013
- The Cultural Heritage Agency of Iceland, March 13th, 2013
- Administration of Occupational Safety and Health in Iceland, March 13th, 2013
- The Health Inspectorate of NE Iceland, March 14th, 2013
- Iceland Met Office, March *14th, 2013*
- Iceland Construction Authority*, March 19th, 2013*
- *Norðurþing municipality, March 20th, 2013*
- Environmental Agency of Iceland*, March 20th, 2013*

The National Planning Agency also received comments from Verkís Consulting Engineers, dated March 27 th, 2013 and for „Héðinshöfði" (Erla Bjarnadóttir, Héðinn Jónasson, Katý Bjarnadóttir, Kjartan Traustason, Sigríður Hörn Lárusdóttir og Sigrún Ingvarsdóttir), April 3rd, 2013.

Table 19 provides an overview over the reveries and there in the EIS the answers of the developer can be found

Table 19: Chapter with reviews and comments and PCC's answers

	Summary of reviews and comments	**Where in the EIS can the answers be found?**
Marine Research Institute	The Marine Research Institute requests further explanation of the height references for the calculation of the mixing of hot sea water. Also the Institute points out that it should be possible to conduct direct observations of seaweed shores in the southern part of Bakkakrókur before the construction of the 2nd phase of the plant, and that it is feasible to do so since this is an area listed in the Natural Conservation Register.	Answers can be found in Chapter 7.1 on sea water cooling
The Health Inspectorate of NE	The Health Inspectorate of NE Iceland (HNE) comments on the temporary storage of raw materials at the harbour area in case of temporary delays of transport between the harbour area and the plant. In the opinion of the HNE it needs to be clearly explained which materials will be stored in the harbour area and how, i.e. regarding the risk of fine blowing. It should be considered if it is necessary to build over all materials there is a risk of materials blowing. Furthermore the HNE believes that PCC should investigate recycling possibilities that are truly available in order to reduce the amount of waste for landfill as much as possible The HNE points out the methods used by the industrial installation at Grundartangi in this respect. In the review of the HNE it is noted that there is no landfill with operational permit within the municipality. The HNE considers it to be necessary to clarify the location of work camps during construction and to cover the laws and regulations on the construction and operation of work camps that is sewage, energy use, water use and waste disposal. Finally comment on noise, it says that since the results of the EIA is that the impact of noise from the operation is negligible except in the closest proximity of the plant and the harbour area it is normal that strong demands will be made on mitigation measures in order to ensure that the demand of the regulation on noise will be fulfilled.	Answers can be found in Chapter 2.13.1 (transport of materials from harbour), Chapter 2.13.3 (solid waste and by products), Chapter 2.13.4 (construction waste) and Chapter 6.2 (noise).
Iceland Construction Authority	The Iceland Construction Authority comments: „ *The report states that the current fire brigade of the municipality cannot manage the situations that can come up in relation with the operation of the plant, that it is necessary to improve both the manpower and equipment. It is important to conditioned from the beginning how*	PCC agrees to the items in the review of the Iceland Construction Agency. An emphasis will be on risk and security during the design and operation of the Silicon

	the participation of the municipality and the company in this shall be, so no licences will be issued for the construction of the plant that can cause a substantial risk of accidents without ensuring the necessary development of the fire brigade in the municipality. Structures for such operation also require fire design and risk assessment for structures and for the operation, in these respect requirements in Articles 22.-24. in the law on fire protection should be pointed out. It is logical to expect that this should be conditioned in licences for the plant, its operation and all transport to and from the plant	Metal plant.
The Cultural Heritage Agency of Iceland	In the review of the Cultural Heritage Agency of Iceland further explanation on remains on Figure 60 is requested [comment: the points in question were inserted into a map taken from the municipality master plan]. The Cultural Heritage Agency discusses those remains that need to be considerate in connection to the construction and which mitigations measures should be implemented at each time. The Agency points at Article 21 of The National Heritage Act (Nr 80/2012) states: "remains, according to Article 3(3), both them who are protected as cultural remains and those who are protected because of their age cannot be damaged, destroyed, modified, covered, altered or moved, except with the authorization of The Cultural Heritage Agency of Iceland. Further, the Agency points out Article 24((2) of the same Act that says: If previously unknown remains are found during work, the constructor shall stop the project without delay. The Cultural Heritage Agency of Iceland shall immediately have a survey performed to determine the nature and scale of the findings. The Agency shall determine as soon as possible if work can continue and define and set conditions. It is not permitted to continue work without the written permission of the Cultural Heritage Agency of Iceland.	Answers to the review of the Cultural Heritage Agency of Iceland can be found in Chapter 6.6 on Archaeological remains. Table 15 and Figure 60 have been updated in the EIS.
Norðurþing municipality	The planning and building Committee of Norðurþing provide a positive review on the IEIS and doesn't make substantial comments on the EIA. The review points out that the project complies with the draft version of the local plan for the industrial site that is currently in presentation. Furthermore, it is stated that although a project of this magnitude always has an impact on the environment, the impact is within the company lot and its closest surrounding. The visual impact has a wide range, as is inevitable for such massive structures, but measures will be taken during the construction and operation period to reduce the negative impact. Further, it is the opinion of the planning and building Committee that the impact of the plant on the society is positive and covers Norðurþing municipality, neighbouring municipalities and the entire country.	

The Environment Agency of Iceland	In its review the Environment Agency of Iceland points out that it can be of use to provide information in the EIS on the basis for the assumptions used for the assessment of the sulphur dioxide discharge. The Agency also points out that a new draft of the report on best available technique (BAT) has been issued and the Agency requests that it will be stated if the operator can comply with the requirements and limits set in the new "BAT conclusions" in the same report. In addition, the Agency calls for a discussion on dust pollution during construction and that mitigation measures against dust during construction will be described. Furthermore, the Agency points out that the operation of the Silicon Metal plant will increase Air pollution greatly, but that the calculated values to be under the reference values, though some values are close to these values. It can be assumed that pollution from sulphur dioxide can be measured in Húsavík, but it is not expected that pollution in the town will exceed the limits of the regulations. The Agency points out the World Health Organization (WHO) guiding reference values which are stricter than reference values in Icelandic and European regulations. The Agency points out the presented data in the EIA do not suggest that the guideline values of the WHO will be exceeded in the Húsavík residential area. The Environment Agency also points out the necessity of assessing possible cumulative effect of air polluting substances following further development in the area, especially for sulphur dioxide. The Environment Agency concludes that air quality will get significantly worse compared with the current situation. The air pollution coming from PCC on Bakki, will though by it is within the reference values of Icelandic regulations. In its review on noise the Environment Agency asks the question if the mitigation measures described in the EIA are actual mitigation measures, since those would be actions that would be undertaken so that noise in the boundaries would comply with the noise regulations during operation of the plant. Also, in its review on Flora the Environment Agency suggests as a mitigation measure the recovery of wetlands instead of any vegetation disturbed, regardless of the disturbed area being wetland or not. The Environment Agency does not comment on Birdlife and Landscape and visual impacts.	Answers to the review of the Environment Agency of Iceland can be found in Chapter 6.1 (Air Quality), Chapter 6.2 (Noise) and Chapter 6.3 (Flora).
Icelandic Met Office	In its review the Icelandic Met Office comments on how wind roses are presented	Answers to the comments of the Icelandic

	in the EIA. Furthermore the Met Office assumes that a possible error might be in emission calculations, since the mean annual temperature in few weather stations in the vicinity is different than the value chosen as exhaust temperature in the calculations. Further, the Met Office believes that the water use of the operation needs to be better explained, taking into consideration the accessibility of water in the area and if the water source will withstand. The impact of cooling needs further explanation as well as which chemicals are used as additives and what danger can be created losing all water from the system in a relatively short time. Furthermore the Met Office believes that possible hazardous materials of waste that can pollute water or soil or will be disposed of in the municipality need to be further explained. Also the Met Office comments that it seems that the impact coming from transport of materials to and from the plant is not taken into consideration in discussion of Air Quality. The Met Office comments on the calculations of Airborne emissions. It says that further explanation is needed on the calculated values and concentration of pollutants according to the calculation models. It needs further explanation what is the highest mean concentration at each time and the uncertainties of such calculations. In those incidents where the concentration is close to the reference values they need to be further explained, that is the maximum values of the dispersion calculation, highest possible concentration and under which circumstances and how frequent this can occur. Also the Met Office comments that the scale used on Air Quality maps needs further explanation. The Met Office also comments that calculations of the 24 mean values for particle matter for 33,000 tpa and 66,000 tpa production capacities need further explanation, since maps seem to have similar dispersion but not reach the same concentration. The Met Office also comments on Table 12, since the values presented resemble mean values rather than maximum values. It is the opinion of the Met Office both values should be shown as well as the uncertainties. Finally, the Met Office comments that if other methods for release of emissions	Met Office can be found in Chapter 6.1 (Air Quality) and Chapter 2.13 (Review and comments on project information and PCC's answers). Figure 14 has been updated.

	are part of the EIA, comparable information need to be presented as are presented for release through stack.	
Administration of Occupational Safety and Health in Iceland	The Administration of Occupational Safety and Health in Iceland (AOSH) does not make substantial comments on the EIA. The AOSH points out that the company needs to apply for an operational permit to the AOSH in accordance to Article 95 of Act 46/1980 on accommodation, health and safety at work. Furthermore, based on the information on the amount of hazardous substances at the plant it is subject of regulation no 160/2007 on protection against major-accident hazard from hazardous substances.	It is pointed out that due to the nature of the Silicon Metal production it is very unlikely that carbon refractory linings will be used, but if that is. The regulations mentioned in the AOSH's review will be complied with.
Verkís Consulting Engineers	Verkís Consulting Engineers comments on that EFLA Consulting Engineers did not request further information from Verkís other than those already submitted to EFLA by Verkís. Verkís says in the comment that it is incorrectly stated in the Chapter on Air Quality that uncertainty of the location of the plant [comment EFLA: The Saint Gobain plant] prevents a reliable assessment of cumulative effects.	Answers to the comments of Verkís Consulting Engineers can be found in Chapter 6.1 (Air Quality)
Comments from residents and land owners of Héðinshöfði	A group of people connected to the Héðinshöfði farms comments on the possible impact on agriculture and residence at Héðinshöfði due to the impact of the construction and operation of the Silicon Metal plant on Air Quality, Noise and because of the visual impact. It is requested that weather measurements that were made for other proposed projects in the area will be continued to provide actual date available on the weather in the region. Also the question is asked what impact machinery and other equipment used for the construction will have on the Air Quality in the area as well as residents and agriculture in the proximity of the construction area. Furthermore it is asked what the impact is for transport of waste, if the future landfill would be located in Kópasker. Also it is asked what will be happened to earth materials from land forming. It is the opinion of the people that made the comments that the impact of the construction and operation of the plant on animal life, land and people is significant and permanent. Also it is their opinion that traffic will increase, with associated discomfort. Information is requested on a comparable plant, and the impact it has on its surroundings. Also it is asked if and how it can be ensured that there is no impact on areas belonging to Tjörneshreppur municipality.	The answers to the comments made by a group of people connected to the Héðinshöfði farms can be found in Chapter 2.13 (Review and comments on project information and PCC's answers), Chapter 5.4 (Environmental aspects examined in the EIA), Chapter 6.1 (Air Quality), Chapter 6.2 (Noise), Chapter 6.5 (Landscape and visual impact) and in Chapter 6.8 (Environmental impact during construction).

	Also, they ask for clarification of the interpretation on the criteria used for the assessment of the visual impact, and what lies in the impact of a construction being permanent but reversible. Also questions are asked regarding the proposed mitigation measures to reduce the visual impact and noise. It is also stated that those signing the letter doubt the result of the EIA that the environmental impact from the PCC Silicon Metal plant at Bakki is acceptable. A confirmation is requested that the Silicon Metal plant will not reduce the quality of life for residents and land owners at Héðinshöfði and that the Silicon Metal plant has no impact on cultivation, agriculture and ecology of Héðinshöfði and that property values of real estates and structures will not be reduced during construction and operation of the plant.	

9 RESULTS

9.1 Summary of the Environmental Impact

Table 20 gives a summary of the impact of the proposed project on the individual environmental aspects, taking into consideration the criteria and the character of the impact over a long period of time. The definitions of the weighted rating used can be found in **Table 9**, in chapter 7.4.

Table 20: *Summary of the Environmental Impact.*

Weighted rating / Environmental aspect	Substantial positive impact	Considerable positive impact	Negligible	Considerable negative impact	Substantial negative impact	Uncertainty
Air quality and climate			X			
Noise			X			
Marine and coastal areas (other alternatives)				V		
Flora				X		
Birdlife			X			
Landscape and visual impacts				X		
Archaeological remains			X			
Social impact		X				
Environmental impact during construction			X	(X)		
Risk and Safety			X			

Table 20 shows that the construction of the PCC SE silicon metal plant will have an negligible impact on Air Quality and climate, noise, marine and coastal areas, birdlife, archaeological remains and risk and safety, negligible or temporary considerable negative environmental impact during construction, considerable positive social impact and considerable negative impact on flora and landscape and visual factors. If the alternative with sea cooling is chosen, the construction will have a considerable negative impact on marine and coastal areas and birdlife, especially if it takes place in the spring, but the impact will be similar on other environmental aspects. The main results for each environmental aspect are as follows:

Air Quality and Climate

The effects of emissions on the Air Quality were modelled. The results showed an increase in the concentration of particle matter (PM10), sulphur dioxide (SO_2) and ammonia dioxide (NO_2), the estimated concentration is within the regulatory limit. The release of polycyclic organic pollutants (POP), polycyclic aromatic hydrocarbons (PAH) and benzo (a) pyrene (BaP) is low and well within the reference values. The production process will release considerable amounts of carbon dioxide (CO_2), the increase is within the boundaries of the expected increase in CO_2 levels, through 2020, according to the government's action plan on climate change. Emissions from PCC, when combined with emissions from other metal production companies within the assigned industrial area, can result in an increased risk of cumulative effects due to the release of chemicals in the atmosphere. Additional information of the location and release of chemicals by other companies is required for further analysis. The cumulative effects are considered to be local and dependant on specific weather conditions. With regards to the nature and scope of the effects on air quality and climate, the effects of the project are considered to be negligible.

Noise

Noise from the operation of a Silcon metal plant comes from both daily operation of the plant and harbour operations associated with the plant (i.e. unloading, loading and transportation to/from the plant). To estimate the noise effects, a model of the noise distribution was developed and the sound level calculated. Where residential areas are in close proximity to industrial area, the acoustics will meet the regulatory limits for noise due to both traffic and operations. The regulatory limits for noise will not be met without mitigation measures at the plant site boundaries due to close proximity of major noise contributors such as fans on dedusting, transformers and furnaces. The effects of the silicon metal plant in Bakki on noise are considered to be **negligible**, except in close proximity to the plant site and the harbour where tasks associated with it are performed.

Flora

The impact evaluation is based on field research, national registry and previous studies. In total, 108 species of high plants were found in the research area, mostly dry land plants since little wetland is in the research area. A few mosses, lichens and fungi species were identified, but no special focus was on the collection or analysis of these organisms. Heathland is prominent in the area but there are also spots where grasses are prevalent and eroded areas with spreading Alaska lupine. Wetland is mostly found in the northernmost part, in proximity to River Bakkaá . No red list plant species were found during field research or in recent studies. The environmental impact of the project is mainly due to loss of vegetation removed during constructions, i.e. buildings, roads and car parks. Impacts on wetland vegetation near River Bakkaá are not expected due to changes in the riverbed and flow.

The proposed project is considered to have a ***considerable negative impact*** on vegetation and, since vegetation cover will be disrupted and the changes are irreversible. Possible mitigation measures include land reclamation using Icelandic plants, common in the area.

Birds

The impact on birdlife is based on field research, previous studies, international agreements and lists of species in threat of extinction and rare species. Based on observations and previous studies, 17 bird species are believed likely to breed in the research area, many of which are considered responsibility species in international cooperation. Breeding densities of grassland or heathland birds is assumed high in the investigation area. Bird species that are subject to impact due to the project are common, both nationally and within the region. Since the area of impact is relatively small, the construction is not believed to have an impact on the population size of species that breed on the industrial area or use the site in

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any other way. The proposed project is assumed to have a considerable negative impact on birdlife **within** the site.

Landscape and Visual Impacts

The effects of the Silicon Metal plant on the visual appearance of the area are foremost due to the proposed buildings at the plant site, with contributions from landscaping and land forming

The most apparent proposed structures are the furnace building and casting area with a height of 37,5 m, filter plant and raw material storage facilities at a height of 27 m and product crushing and storing at a height of 24m. All other structures have a considerable less height and therefore impact.

The effects on landscape are only thought to be local, but considerable within the plant site. No areas that are thought to have value due to their landscape features will be disrupted.

The effects on landscape are ***considerably negative*** permanent but reversible.

The Silicon Metal plant will generally not touch the skyline, since the lot is located in a slope and structures are therefore covered by land from most viewpoints. Though, it can be assumed that structures will be visible and touch the skyline seen from the national road and from the houses at Héðinshöfði 1 and 2. A reduction of view is small, but evident from areas north of the plant.

The visual impact is ***considerably negative***, permanent but reversible from areas north of the plant and from above, that is from the national road, from Gónhóll and other areas close to the plant. The impact is permanent but reversible. The plant is not visible from Húsavík.

Archaeological Remains

The impact on archaeological remains was assessed on the basis of two archaeological studies, national registration and the National Heritage Act. A total of 21 remains were found in the studies, including an old path, mounds and a burial site. The mean preservation values of remains situated in the area south of River Bakkaá is 2.5, which is considered low, and none is believed in need of protection. The highest value (7) is assigned to remains at a location with a supposed fox trap. In this area, it is the archaeologist's opinion that the effects of the project are highly acceptable, assuming full consideration during and after construction and taking appropriate mitigation measures if needed. Appropriate mitigation measures include recording the exact location, digging examination ditches and labelling remains. In the study performed in the area at and around River Bakkaá , the remains are considered to be at risk due to the proposed project. No monumental value was assigned to those remains, but labelling is suggested to reduce the risk of disruption. If disruption cannot be avoided, authorization must be granted by the Archaeological Institute that also decides appropriate procedures and measures to be taken. Assuming all mitigation measures be taken where and when necessary, the impact is regarded as ***negligible***.

Environmental Impacts during construction

The assessment of environmental impacts during constructions focuses mainly on the temporary impacts on residents in Húsavík and nearby areas, i.e. due to transport of building materials, operation of heavy machinery and site preparation during construction. The plant will be constructed on an industrial property north of Húsavík, the closest houses situated approximately 1.2 km away from the south border of the plant's site. Given the distance from the village to the plant's site, it is unlikely that noise from on-site construction work will have an impact on residents of Húsavík. During hot and dry weather periods earth works might however cause dust pollution. This can be avoided by covering truckloads and spraying eroded areas during dry periods. Assuming the new road from the harbour to the plant's site is ready before beginning construction, and that appropriate mitigation measures are taken, the project will have a negligible impact on residents during the plant's construction, mainly due to increased traffic and noise. This impact is estimated to increase to considerable

negative effect if the new road is not ready before plant construction, due to decreased traffic safety and increased noise.

These effects can be limited to an acceptable degree with several methods, such as selected transportation timing, definition of main transportation routes and marking of them.

Social Impacts

The assessment of the social impact of the project, both during construction and operation, is based on a previous EIA study and a study on the infrastructure in Northeast Iceland. The assessment focuses on impacts on population development, the labour market and on the municipalities in the region. The local region of Húsavík showed a population decline over a ten year period 2001-2010, especially among children and young adults. Services and administration within the municipalities can mostly accommodate a significant increase in population without having to expand, with the exception of pre-schools and health services. The construction of the Silicon Metal plant is believed to create around 200 man-years during the construction, and is considered to have a temporary positive impact on population development; labour force and the municipalities, due to jobs created and increased service demands from the municipalities, especially in health services. The operation of the plant will provide new permanent jobs; not including jobs created indirectly in relation to the project, and create revenues for the municipalities. The operation of the plant will therefore have a substantial ***positive*** impact on the population development, labour force and the municipalities.

Risk and Safety

The assessment of impacts due to risks to the health and safety of people and the safety of the environment is based on acts and regulations on buildings and structures; fire safety and other safety regulations; and documents on natural hazards, especially concerning earthquakes. The main risk issues are the risk of explosion where LPG is stored and risk of dust explosion in the material storages. The operation is planned in a seismic region, but other natural catastrophes are no significant threat to the operation. Risk management will be carried out to mitigate risk and to ensure they are dealt with appropriately. Performance based safety design and risk analysis will be carried out for the appropriate buildings, i.e. the storage of flammable gasses and raw materials and the risk factor accounted for in the design. All systems, i.e. fire detection and suppression systems, egress paths, fire fighting facilities etc. be according to regulations. The structures will be designed for appropriate seismic loads and fire. Risk analysis will be done on the effect of exhaust, waste, gas leakage or other factors and the effect on the health of people, property and the environment. Transformers, large fuel loads in storage facilities and the storage of LPG and oxygen call for the capacities of the fire brigade at Húsavík to be expanded. PCC will prepare a response plan on acute pollution of the sea in connection with an application for an operation permit. No raw materials transported through the port and used by PCC can cause acute pollution of the sea. Oils within transformers and fuel oil will be kept on site and proper safety cautions will be carried out for those. With appropriate measures, the emerging risks from the operation at Bakki can be minimised and the environmental impact due to hazardous events kept to a minimum. The effects are therefore considered to be ***negligible***.

Ocean and coastal areas (*Other alternatives – Sea water cooling*)

One option for cooling heat formed during the production is the use of seawater. This option can cause effects due to heat dispersion from cooling water and direct effects on the biota at the coast of Bakki. The cooling system itself will be closed and therefore no risk of pollution due to emission from the system. Calculations of the impact of the release of warm seawater at 5 meters depth show an impact area where the temperature rises by 1.2°C, which is below the maximum temperature of 2°C allowed to rivers and lakes outside of dilution zones. This calculation was carried out for both phases with similar results.

The construction of the seawater intake infrastructure will cause considerable disruption and alteration of the environment on a limited area at the Bakkakrókur shoreline, when parts of the shore will be excavated and covered with course wave breaking material. Although the construction itself is considered insignificant in comparison with the area it is affecting the long term impact is considered to be significant if sediments accumulate along the outlet and cause changes in the sea floor and benthic fauna. Furthermore, the accumulation could reduce diversity and quantity of costal biota. A possible mitigation measure is to situate the outlet pipe in shallow basins between the bedrock cuts to minimize the coastal surface impacted. It is therefore the conclusion that the impact of the option of sea water cooling can cause a ***considerable negative impact*** on a limited area on the Bakkakrókur coast.

Other aspects of the proposed Silicon Metal plant will not affect marine and coastal areas in any way.

Results

There will always be some environmental impact with a project of this magnitude. The direct effects of major factors, i.e. visual impact, are isolated to the plant site and areas in close proximity. The proposed PCC Silicon Metal plant will be located on an industrial site, just to the north of Húsavík. During the construction and operation of the plant, mitigation measures will be taken to minimize the environmental impact from the plant. The positive effect on the community is most apparent and would reach Norðurþing as well as neighbouring municipalities. Overall, the developer concludes that the environmental impact of the proposed PCC Silicon Metal plant is ***acceptable.***

9.2 Mitigation measures

In general it can be said that during the preparation of the project the view prevailed to reduce the impact on most of the environmental aspects. In the EIA, however, mitigation measures listed below have been proposed the minimize the impact of the construction. No mitigation measures were suggested for the impact on air quality or society.

Noise

In the design and layout of the activity regarding the PCC Silicon Metal plant the noise emission will be taken into account and arrangements made such that the impact of the noise emission will be minimized. To fulfil the noise criteria at the site boundary it is advised to simply move the northern boundaries to the road. There is also the possibility to use noise barriers but whereas the noise sources are high up the effectiveness of the barrier is not considered enough to decrease the level significantly at the boundaries, unless the barriers is relatively high. However, it is preferable to move the crushing and its secondary dedusting from the boundary of the site to a more central location at the site if possible gt væri hins vegar að flytja hreinsivirki fyrir afsog frá byggingum sunnar á lóðina, fjær skrifstofubyggingunni.

Flora

Given that the vegetation within site is common and does not have specific conservation value it is not considered necessary to consider reclamation in other areas due to disruption within the site. It is recommended as a mitigation measure that PCC reclaims wetlands to the same extent as disturbed. During design, the disturbance of wetlands will be avoided as possible and no changes are planned to the River Bakkaá or because of the construction. No wetland above 3 ha exists within the site. It is recommended to use local plants to reclaim green areas within the site, i.e. heathland could be removed before disruption of the area, and put on eroded areas on site.area

Landscape and visual impact

When designing the structure and shaping of the land on the industrial site it will be attempted to reduce visual impacts as possible.

Archaeological remains

The impact on archaeological remains can be minimised with i.e.: measuring via GPS, examination ditches, digging of security holes and/or complete investigations. Work sheds or other infrastructures will not be placed to close to the remains. Mitigation measures instructed by the Archaeological Officer of NA Iceland will be followed.

Environmental Impact during Construction

In order to minimize impacts on residents of Húsavík during the plant's construction, all traffic will be directed to a industrial road that is to be built prior to the plant's construction. Should there be a delay in the road's construction; measures will be taken to reduce the impact, i.e by reducing speed. Dust pollution will be avoided by covering truckloads carrying building material and dry and eroded areas will be sprayed with water to prevent dust from spreading during dry periods of the plant's construction. Working hours for blasting and other construction will be limited to fulfil the requirements of the noise regulations. Residents close to the area will be notified before starting the project. When preparing tender documents for the construction relevant clauses will be set on the work and handling of explosives to ensure that disturbance for nearby residents is as little as possible. The developer will insure that the contractor complies with laws and regulations regarding the working hours and npise and air pollution.

Risk and safety

Risk management in accordance to ISO 31000 will be applied to mitigate the apparent and emerging risks. Performance based fire safety design and a risk analyses will be carried out for the appropriate buildings. Storage of flammable gas will be in an isolated storage that is approved by the authorities. Where there is a risk of explosion, requirements for pressure relieving systems and structural integrity will be fulfilled. Risk analyses will be carried out for the buildings to minimize risks due to radiation, smoke, toxic gases or explosions. Location and storage construction for LPG pressure containers will be according to standard and the usage of equipment using LPG in accordance with the regulation. Location, venting and signs for oxygen storages will be according to standard. Risk of explosions both where LPG is stored and in the coal and woodchip storages will be accounted for. General design of storage facilities, electrical design and design of systems for the prevention/mitigation of explosions. Detection, alarm and suppression systems, egress paths, smoke control, fire fighting facilities, structural fire design and other special requirements made by regulations will be satisfied. Design of automatic suppression systems will be according to standard, but they are subject to approval of local authorities. Structures will be designed for the appropriate seismic loads. Risk analyses will be carried out where the health of people, property and the environment can be affected by exhausts, waste, gas leakage or other factors. Response plans will be made for the whole operation with special emphasis on the components that cause risk to people, environment or operation during and after an earthquake.

Marine- and coastal areas and birds (other alternatives)

The effects of the outlet could be minimized by situating the outlet pipes in shallow basins between bedrock cuts to minimize coastal surface impacted. It will be avoided to carry out the construction at springtime when the number of birds is the highest.

Verði sjókæling nýtt til kælingar á kælivatni verður dregið úr áhrifum með því að leggja lagnir sem ná í sjó á grunnsævi milli klappa og skerja til að lágmarka yfirborðsrask. Forðast verður að framkvæmdir séu á vorin þegar fjöldi fugla er í hámarki.

9.3 Suggestion of monitoring and environmental audit

In preparation of the building permit and tender documents for the construction of the silicon metal plant a detailed Health, Safety and Environmental (HSE) program will be prepared which covers issues that are related to risk of pollution, security and conduct during the construction period. Also this will ensure regular inspections and auditing with inspectors from the buyer , the municipality and representatives of the Environment Agency and the Health Inspectorates. PCC will prepare an environmental audit in consultation with the parties mentioned above when the construction is completed.

In terms of monitoring of environmental aspects the following should be mentioned:

- Baseline studies will be conducted on the concentration of sulphur dioxide in grass and in leaves in previously chosen areas and the possible increase in the concentration of sulphur dioxide assessed every 2 years. Also baseline measurements will be conducted on the concentration of sulphate and on the acidity in River Bakkaá at the beginning of the plant operation to asses if there is an impact that can be related to the operation of the silicon metal plant. It this turns out, the measurements will be continued.
- Sound level measurements are for seen after the completion of phase 1 and later after completion of phase 2. Also sound level measurements will be conducted as a part of a monitoring plan in the operation permit.

Parallel to work on the environmental impact assessment a draft proposal of the operation permit for the silicon metal plant has been prepared that can be seen in Annex 5. The draft contains a proposal for a monitoring plan that would act as a part of the operators internal auditing. The monitoring plan covers measurements in the exhaust, in cooling water and of sound pressure levels. The final plan will be presented to the Environmental Agency of Iceland at least one year before start-up of the plant and it is a subject of an approval by the Agency.

Table 21: *Proposal of a monitoring plan according to the operation permit draft proposal.*

Pollutant/ source	Measuring point	Period	Unit	Frequency
Dust	Exhaust from bag house filter	Annual measurement	mg/Nm^3	Yearly
Dust	Treated exhaust from tapping	Annual measurement	mg/Nm^3	Yearly, from stack
Dust	Untreated from casting bay	Annual measurement	mg/Nm^3	Yearly from one exhaust
Dust	Total dust from exhaust	Year	ton dust / year	Calculated amounts from production
Sulphur dioxide (SO_2)	Exhaust from bag house filter	Year	ton SO_2 / year	Calculated amount from measurements of content in raw materials
Cooling water	Cooling system	Annual measurements	pH or mg/l	Yearly sample set
Noise	Lot boundaries	Sound pressure levels for 12 h, day 07-19 and night 19-07	Sound pressure levels	Measurements when each phase is in operation

PCC will also perform an audit on polycyclic aromatic hydrocarbons in the exhaust at least every 5 years and the audit will cover those substances listed in Article 7 of regulation nr. 410/2008. Also, heavy metals in the silica dust will be measured at least every 5 years. PCC will document the results of monitoring in the Environmental Report that will be published parallel to the company's green accounting report.

9.4 Results

There will always be some environmental impact with a project of this magnitude. The direct effects of major factors, i.e. visual impact, are isolated to the plant site and areas in close proximity. The proposed PCC Silicon Metal plant has a proposed location on an industrial site, just to the north of Húsavík. During the construction and operational period, mitigation measures will be taken to minimize the environmental effects of the plant. The positive effect on the community is most apparent and would reach Norðurþing and neighbouring municipalities. Overall, the developer concludes that the environmental effects of the proposed PCC Silicon Metal plant are acceptable.

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Umhverfisstofnun. Leiðbeiningar Umhverfisstofnunnar um mat á röskun/endurheimt votlendis vegna vegaframkvæmda og annarra framkvæmda sem við geta átt.

To: kmerrill@knrd.org[kmerrill@knrd.org]; kmerrill@knrd.org[kmerrill@knrd.org]
Cc: Wilson, Wenona[Wilson.Wenona@epa.gov]; Zach Welcker[ZWelcker@kalispeltribe.com]; Deane Osterman[dosterman@kalispeltribe.com]
From: Bray, Dave
Sent: Mon 10/10/2016 4:30:22 PM
Subject: RE: Call to discuss clarification on scope of analyses in the Kalispel redesignation technical report

Hi Ken,

I'll call you at 10:30.

Dave

From: Ken Merrill [mailto:kmerrill@knrd.org]
Sent: Thursday, October 06, 2016 8:46 PM
To: kmerrill@knrd.org; Bray, Dave <Bray.Dave@epa.gov>
Cc: Wilson, Wenona <Wilson.Wenona@epa.gov>; Zach Welcker <ZWelcker@kalispeltribe.com>; Deane Osterman <dosterman@kalispeltribe.com>
Subject: RE: Call to discuss clarification on scope of analyses in the Kalispel redesignation technical report

Hi Dave,
Forgot about Monday because the Tribe's not really into celebrating Colombus Day:) We do very much appreciate your offer though, and how about a short call at 10:30 AM, Monday? We will wait for your call on my number below.
Thank you --Ken

Ken Merrill
Kalispel Natural Resources
509-447-7276

-----Original Message-----
From: Bray, Dave [Bray.Dave@epa.gov]
Received: Thursday, 06 Oct 2016, 5:49PM
To: Ken Merrill [kmerrill@knrd.org]
CC: Wilson, Wenona [Wilson.Wenona@epa.gov]; Zach Welcker [ZWelcker@kalispeltribe.com]; Deane Osterman [dosterman@kalispeltribe.com]
Subject: RE: Call to discuss clarification on scope of analyses in the Kalispel redesignation technical report

Hi Ken,

Monday is a federal holiday and I'm tied up all day on Tuesday.

If we can make it a short call, I'm willing to do it sometime on Monday, just not too early in the morning. **Ex. 6**

Let me know some times that would work for you and I'll get back to you.

Dave

From: Ken Merrill [mailto:kmerrill@knrd.org]
Sent: Thursday, October 06, 2016 4:12 PM
To: Bray, Dave <Bray.Dave@epa.gov>
Cc: Wilson, Wenona <Wilson.Wenona@epa.gov>; Zach Welcker <ZWelcker@kalispeltribe.com>; Deane Osterman <dosterman@kalispeltribe.com>
Subject: Call to discuss clarification on scope of analyses in the Kalispel redesignation technical report

Hi Dave,
We have reached out to potential consultants for preparing the technical report and have some more questions about the actual scope of analysis necessary for our redesignation. We have the chance to get this done relatively quickly, but we were hoping that you would be available for a call on Monday or early Tuesday to help clarify some of the scope

questions.

Thanks again for your help --Ken

Kenneth R. Merrill
Manager - Water Resources Program
Kalispel Tribe Natural Resources
PO Box 39, Usk, WA, 99180
(509) 447-7276 (office)
Ex. 6 (cell)