Recent Air Pollution Control and Permit Experience in the Lime Industry

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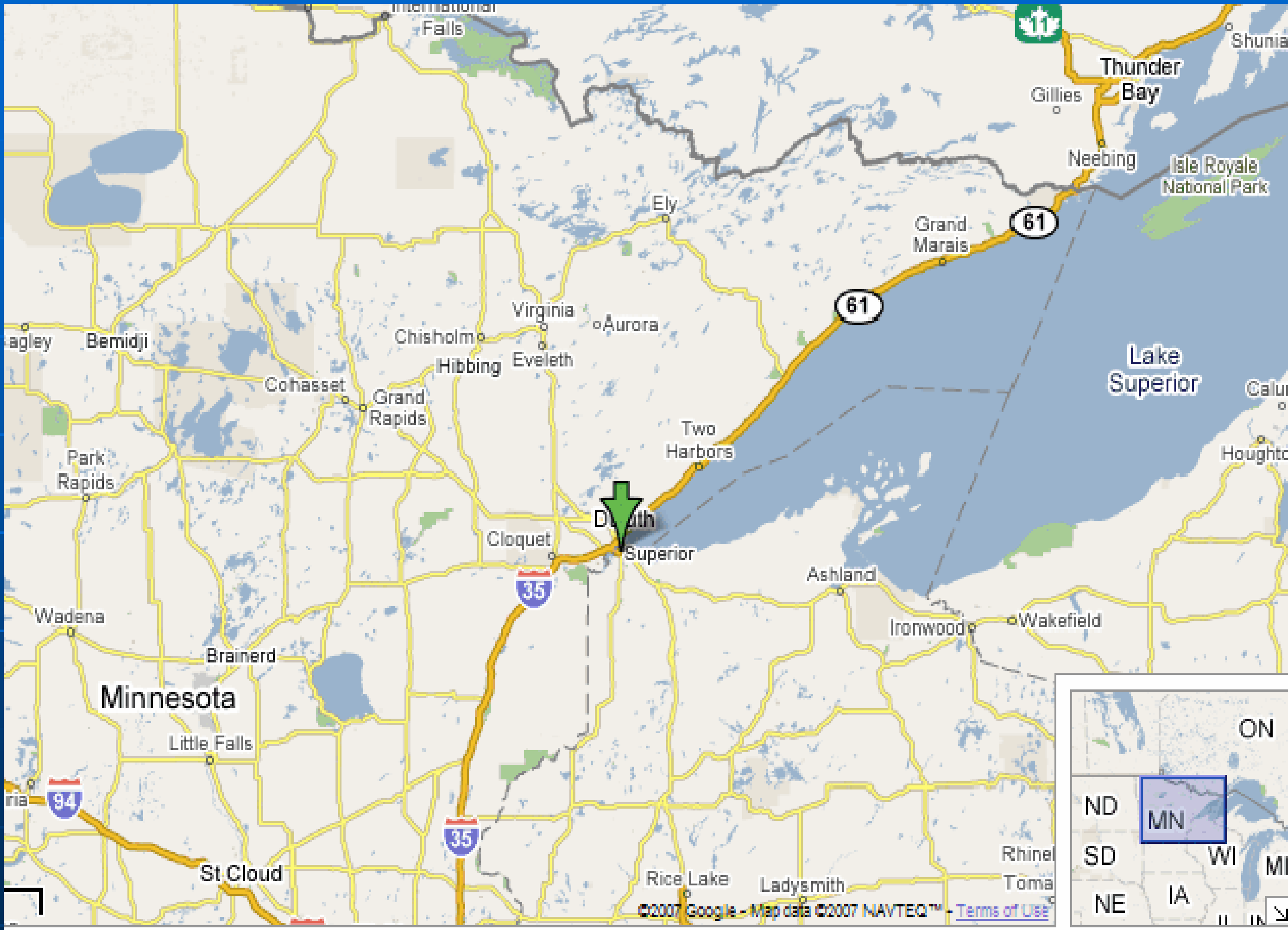
Air Quality Permit for Lime Kiln

- Subject to PSD regulations.
- Best Available Control Technology (BACT) Analysis
- Near-field Modeling Analysis
- Far-field Modeling Analysis
- Additional Impacts Analysis
- MACT for Lime Manufacturing Plants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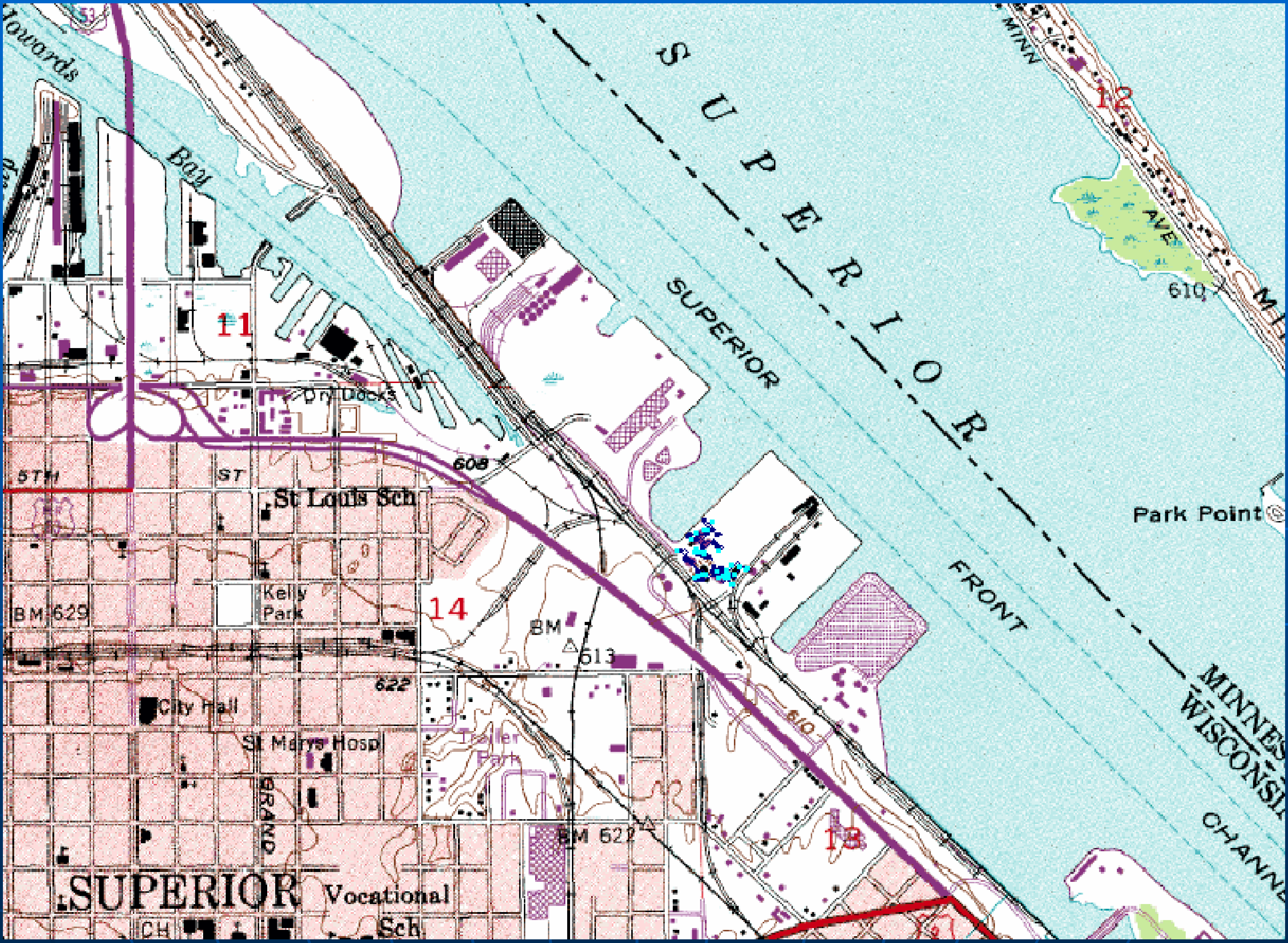
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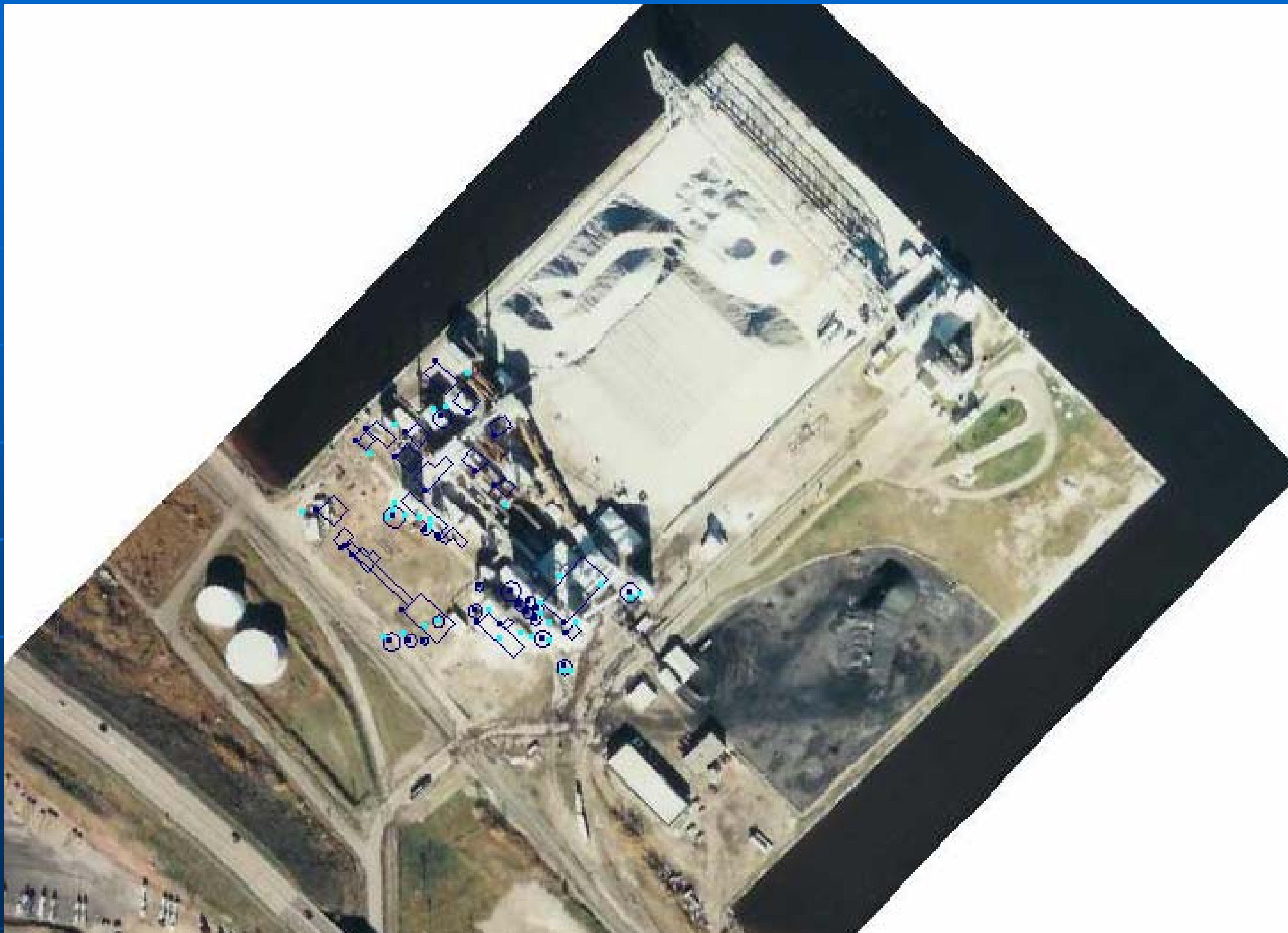


Project Design

- $CaCO_3$ + heat = CO_2 + CaO (lime)
- 600 ton per day lime kiln
- Coal-fired
- Preheater design
- 30% reduction in energy usage

Project Operations and Air Pollution Control Methods

Operation	*Air Pollutant*	*Control Method*
P50 - Kiln 5	SO2	92% removal by kiln and baghouse 2.0% Sulfur Fuel
	NOx	30% reduction by use of preheater-type kiln
	CO	30% reduction by use of preheater-type kiln
	Pb	Pulse Jet Baghouse; 3.5:1 Air to Cloth Ratio
	TSP/PM10	Pulse Jet Baghouse; 3.5:1 Air to Cloth Ratio
P51 - Lime Crushing	TSP/PM10	Pulse Jet Baghouse; 5.0:1 Air to Cloth Ratio
P52 - Lime Storage	TSP/PM10	Pulse Jet Baghouse; 5.0:1 Air to Cloth Ratio
P53 - Truck Loading	TSP/PM10	Pulse Jet Baghouse; 5.0:1 Air to Cloth Ratio
P54 - Truck Loading	TSP/PM10	Pulse Jet Baghouse; 5.0:1 Air to Cloth Ratio
P55 - Coal Storage	TSP/PM10	Pulse Jet Baghouse; 5.0:1 Air to Cloth Ratio
P56 - Fines Storage	TSP/PM10	Pulse Jet Baghouse; 5.0:1 Air to Cloth Ratio

Hazardous Air Pollutants

- Hydrogen chloride (HCl)
- Calcium oxide (CaO)
- Calcium hydroxide (CaOH)
- Sulfuric acid (H_2SO_4)
- TCDD Equivalents (dioxins & furans)
- Wisconsn Ambient Air Standards

MACT for Lime Manufacturing

- NESHAPS for Lime Manufacturing Plants under 40 CFR Part 63, Subpart AAAAA adopted January 5, 2004.
- New source PM limitation 0.1 lbs/tsf (Front-half, filterable emissions)

“Top-Down” BACT analysis

1. Identify All Control Technologies
2. Eliminate Technically Infeasible Options
3. Rank Remaining Control Technologies by Control Effectiveness
4. Evaluate Most Effective Controls and Document Results
5. Select BACT

Prior BACT Determinations

2005	Arkansas Lime Co., Batesville, AK 687 TPD Preheater Lime Kiln #3
	Western Lime & Cement, Gulliver, MI 900 TPD Preheater Lime Kiln #1
	Chemical Lime Co., Calera, AL 1,500 TPD Preheater Lime Kiln #2
2004	Graymont (PA), Inc., Bellefonte, PA 1,200 TPD Preheater Lime Kiln #6
2003	Carmeuse Lime Co., Maple Grove, OH Two 650 TPD Conventional Lime Kilns

TSP/PM_{10} BACT Alternatives

- Cartridge Collectors
- Fabric Filters
- Electrostatic Precipitators
- Venturi Scrubbers
- Gravel Bed Filters
- Cyclones

TSP/PM_{10} BACT Determination

Lime Kiln

- Baghouse
- 0.1 lbs/tsf and 0.012 gr/dscf

Ancillary Operations

- Baghouse
- 0.005 gr/acf

TSP/PM_{10} BACT Issues

- Lime kiln limits include back-half PM.
- No prior kiln tested for back-half.
- Current Method 202 inaccuracy due to formation of back-half PM.
- Lime Kiln outlet concentration limit dependent on accurate estimation of exhaust flow rate.

SO_2 BACT Alternatives

- Preheater Kiln Design (92% Removal)
- Low-Sulfur Fuel (2.0 – 5.5%)
- Wet Scrubbers (CE> $10,000/ton)
- Emerging Technologies
- Solios “*Semi-wet Scrubber*”
- ECO Power Solutions “*Comply 2000*”
- Tri-Mer “*TriNOx Multi-chem System*”

SO_2 BACT Determination

- Use of a preheater lime kiln that achieves 92% collection of fuel sulfur.
- Maximum fuel sulfur content of 2.0% while burning coal, or a coal/petroleum coke blend.
- 0.62 lbs per ton of stone feed, 24-hour rolling average and not more than 33.7 lbs/hr (3-hour average).

NO_x BACT Alternatives

- Selective Catalytic Reduction (SCR)
- Selective Non-Cat Reduction (SNCR)
- Wet Scrubbing Oxidation/Reduction
- Combustion Modifications
- Low-NO_x Burners
- Efficient Combustion
- Preheater Kiln Design

NO_x BACT Alternatives

- SNCR, combustion modifications, and low-NOx burners were considered technically infeasible.
- SCR was economically infeasible
- *Comply 2000 System* and *Tri-NO_x System* were economically feasible for NO_x alone, but considered unproven.

NO_x BACT Determinaion

- Efficient combustion conditions.
- Oxygen combustion monitor.
- Use of a preheater lime kiln with 30% less energy usage and NO_x.
- 1.83 lbs per ton of stone feed, 24 hour rolling average.

CO BACT Alternatives

- Thermal Oxidation
- Catalytic Incineration
- Efficient Combustion
- Preheater Kiln Design

CO BACT Determination

- Efficient combustion conditions.
- Oxygen combustion monitor.
- Use of a preheater lime kiln with 30% less energy usage and CO.
- 1.56 lbs per ton of stone feed, 24-hour rolling average.

AIR QUALITY IMPACT ANALYSES

- Near-field Analysis - Compliance with the National Ambient Air Quality Standards (NAAQS), PSD increments and state Ambient Air Standards for hazardous air pollutants.

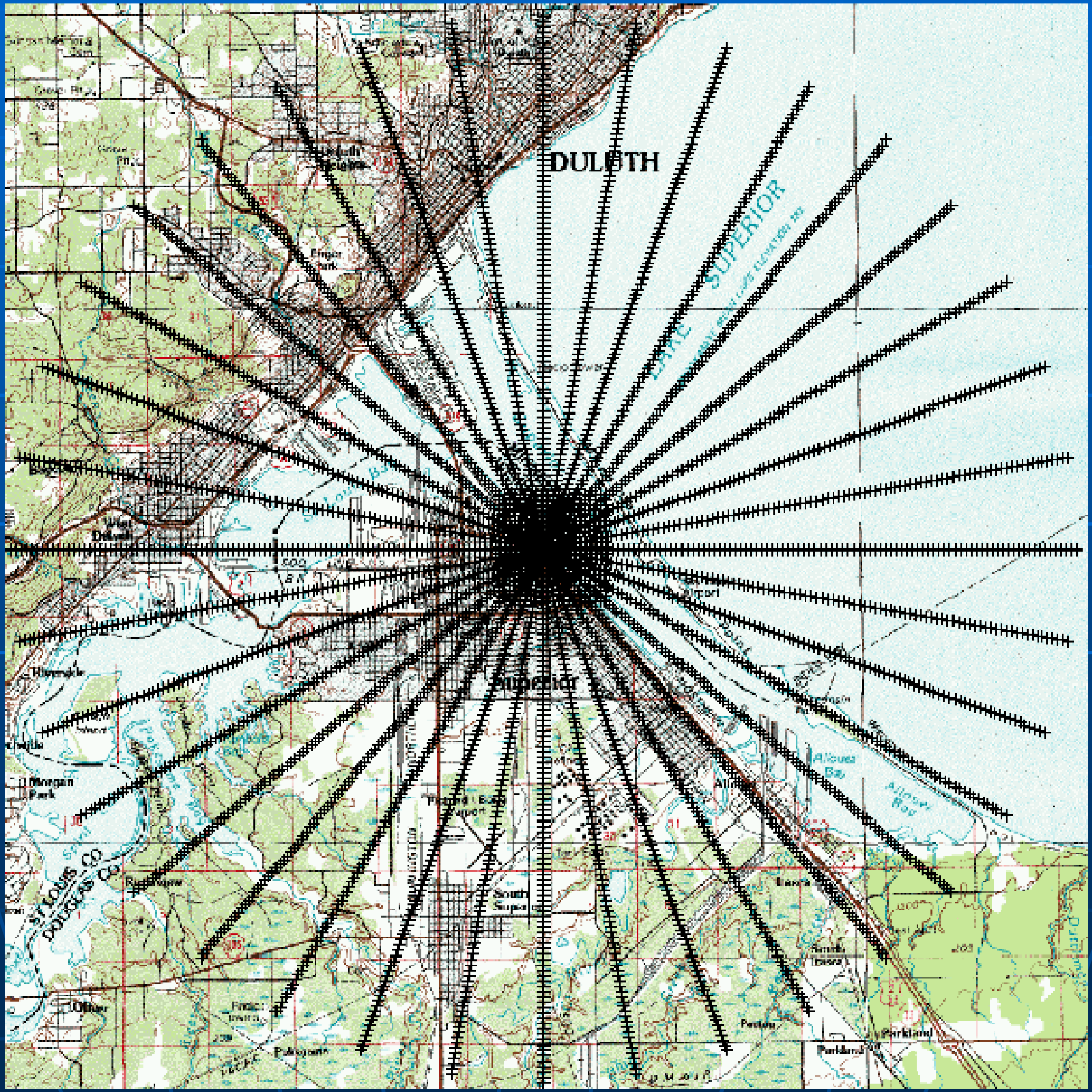
- Far-field Analysis - Impacts on Class I air quality areas located within 200 kilometers of the project site in Superior, Wisconsin.

- Additional Impacts Analysis - Impacts on growth, visibility, and soils and vegetation.

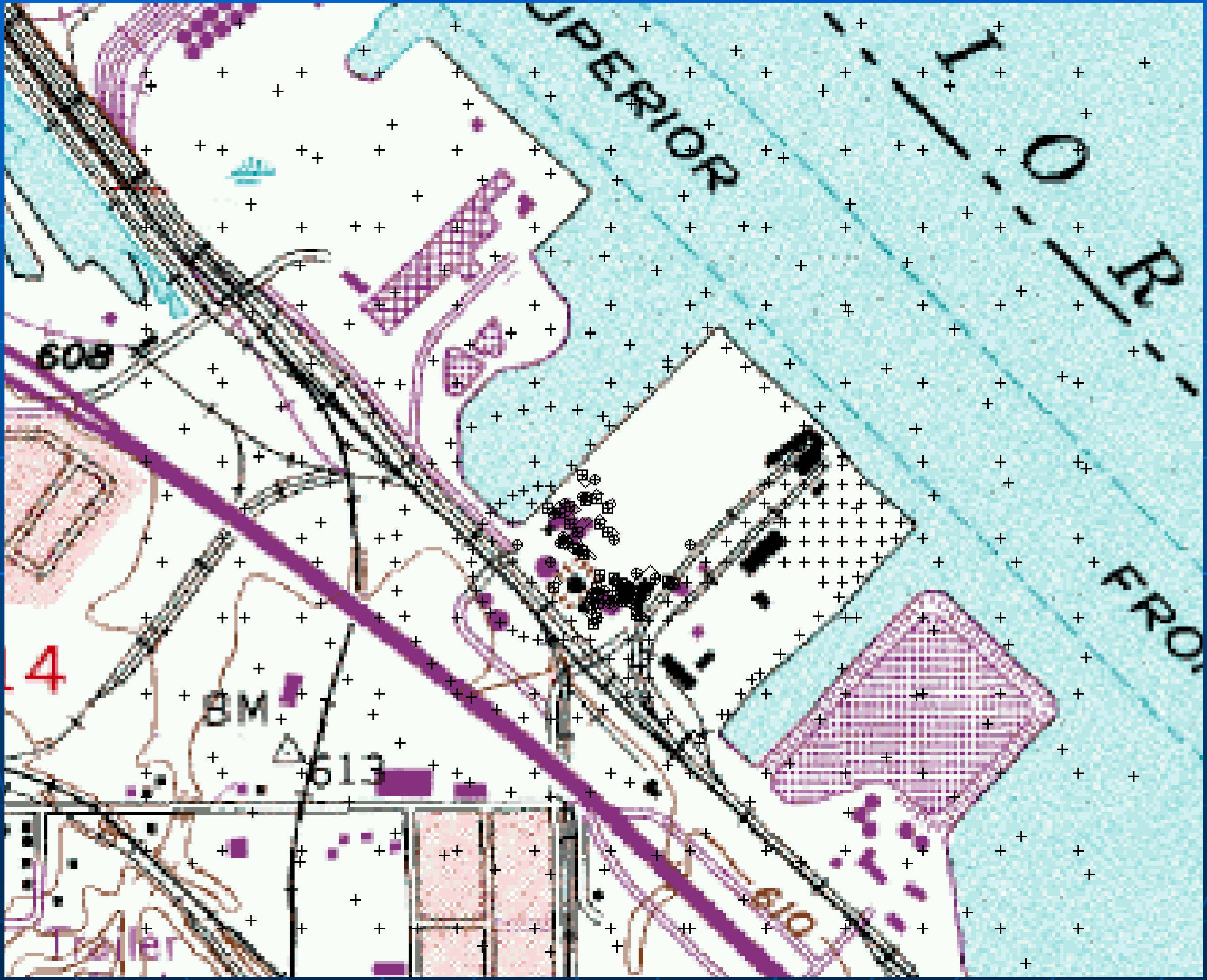
Near-field Analysis Procedures

- NAAQS for TSP, PM_{10}, SO_2, NO_x, CO
- PSD Increments for PM_{10}, SO_2, NO_x
- AAS for CaO, CaOH, HCl and H2SO4
- 40 facility stacks and vents
- ISC3 & BPIP Models
- 5-years meteorological data
- 4,000 receptors out to 10 km
- Terrain elevations

10-Kilometer Receptor Grid



Refined Receptor Grid



NAAQS Compliance Results

Pollutant	Averaging Period	Impact (ug/m^3)	Background (ug/m^3)	Total (ug/m^3)	NAAQS
TSP	24	60.5	67	127.5	150
	24	60.5	27.4	87.9	150
PM10	Annual	3.1	9.2	12.3	50
	3	436.3	128.3	564.6	1300
	24	233.9	33.5	267.4	365
SO2	Annual	26.1	7.9	34	80
NOx	Annual	6.3	4.7	11	100
	1	127	3188	3315	40,000
CO	8	57.1	890.4	947.5	10,000

Increment Compliance Results

Pollutant	Averaging Period (ug/m^3)	Impact (ug/m^3)	PSD Increment (ug/m^3)
PM10	24	21.9	30
	Annual	3.1	17
SO2	3	93.1	512
	24	49.4	91
	Annual	2.3	20
NOx	Annual	1.1	25

HAP Compliance Results

Pollutant	Averaging Period	Impact (ug/m^3)	AAS (ug/m^3)
HCl	1	60	746
	Annual	2	20
CaO	24	44	48
CaOH	24	44	120
H2SO4	24	2.8	24

Far-field Analysis

- Evaluated impacts on Class I areas within 200 km
- Rainbow Lake NWA ~68 km
- Boundary Waters Canoe Area ~128km
- Voyageurs National Park ~179 km
- National Park Service did not require analysis for Voyageurs National Park.

Class I Areas within 200 km

Figure 5 - Location of Class I Areas

Far-field Analysis Procedures

- CALPUFF “Lite” Screening Analysis
- Simpler and more conservative.
- Same weather data as ISC3.
- Impacts predicted in 360 directions.
- Use maximum at same distance as Class I area, regardless of direction.
- Predict air concentrations and AQRV impacts (nitrogen/sulfur deposition, and visibility impairment)

Rainbow Lake NWA Concentration Results

Pollutant	Averaging Period	Impact (ug/m^3)	Class I SIL (ug/m^3)
SO_2	3 Hour	0.683	1
	24 Hour	0.198	0.2
	Annual	0.01	0.1
PM_{10}	24 Hour	0.041	0.3
	Annual	0.002	0.2
NO_x	Annual	0.022	0.1

Boundary Waters Visibility Impacts Change in Desiview (▲dv)

Year 1	Year 2	Year 3	Year 4	Year 5	Significant Impact Level
0.43	0.41	0.39	0.43	0.49	0.5

Rainbow Lake NWA Deposition

Pollutant	Impact (kg/ha/year)	Deposition Analysis Threshold (kg/ha/year)
Sulfur	0.0047	0.01
Nitrogen	0.0053	0.01

USFS Red - Green Line Values

- Analysis unique to USFS.
- Add project impacts to currently monitored background deposition.
- Compare total with red and green line values for acceptable deposition.
- Project increase <0.1%.
- Both areas below red line values.

Existing Emissions Comparison

Pollutant	County	1997 - 2001 Average (TPY)	Project (TPY)	Increase (%)
SO2	Douglas, WI	3,419	-	-
	St. Louis, MN	10,472	-	-
	Total	13,891	148	1.10%
NOx	Douglas, WI	3,491	-	-
	St. Louis, MN	48,488	-	-
	Total	51,979	433	0.80%

Additional Impacts Analysis

- Comparison of project SO_2 and NO_x impacts with thresholds for vegetation damage (USEPA, 1980).
- 1-hour and annual average SO2 concentrations exceeded thresholds.
- Verified the location of maximum impacts did not have the sensitive plant species (i.e. lichens and mosses) on which the screening thresholds were based.

Conclusions

- Permit requirements similar to kilns approved in other states.

- Site-specific interpretations of regulations influenced requirements including:

  1. - The emission control options to be evaluated for the BACT analysis.
  2. - The cost effectiveness threshold at which a control option was considered infeasible.
  3. - The modeling procedures to evaluate Class I area impacts.

Project Schedule

Month	Action
0	Pre-application meeting
1	Submit permit application.
2-8	Respond to agency questions and comments.
8	Draft permit and public comment period.
9	Final permit issued and construction begins.

Recommendations

1. Anticipate and demonstrate compliance with all emission limitations and requirements.
2. Review and compare requirements for similar projects.
3. Design the project so air quality impacts are less than significant impact thresholds.

Product Outlet of Kiln

Preheater Inlet to Kiln