Hi Samantha —

Thanks again for meeting with us regarding the Penn East Pipeline. Per your request the attached contains additional information about the project.

Also, we raised the issue of Emmission Control Areas (ECA's) and the special fuel standard for ships in those areas. You requested further information on that issue as well and that is the second packet of information in the attached.

Please do not hesitate to contact us and we will be in touch to request a meeting on the ECA issue.

Thank you.

Ed

202-714-0348

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PennEast Pipeline Project Background and Required Federal Authorizations

1. Project Background

- The PennEast Pipeline Project involves the construction and operation of an approximately 120-mile, primarily 36-inch diameter underground pipeline extending from receipt points in Luzerne County, Pennsylvania, to various delivery points along the system with a terminus near Pennington, Mercer County, New Jersey.

- PennEast will have capacity to transport approximately 1.1 billion cubic feet of natural gas per day on a year-round basis and will provide service to numerous shippers who, in turn, provide critical natural gas supplies to major Northeast utilities such as UGI Utilities, New Jersey Natural, Elizabethtown Gas, South Jersey Gas, PSEG Power, and ConEd.

- PennEast will also serve major producers in the Marcellus Shale area by providing a much needed outlet for their production, and independent power generators that have proposed to connect to the PennEast system.

- PennEast will reduce energy costs and support thousands of jobs by constructing the infrastructure necessary to deliver clean-burning, American natural gas.

    - Reduce Energy Costs: PennEast will solve supply constraints by delivering lower cost natural gas produced in the Marcellus Shale region to utilities and other end users serving homes and businesses in Pennsylvania, New Jersey, New York and adjacent states.

    - Job Creation: All phases of the Project lifecycle will generate economic benefits.

        - *Design and Construction*: A Drexel University study estimates over $1.6 billion in economic benefits, 12,160 jobs supported from the investment, and $740 million in labor income generated from design and construction.

        - *Ongoing Regional Benefits*: Combined with an estimated $893 million of potential annual energy savings, PennEast represents a potential *ongoing* annual economic benefit of $1.21 billion and 8,041 jobs to the region.

        - *Other Industry Benefits*: The Project also will support jobs in numerous industries. The Project will create hundreds of architectural and engineering jobs, as well as positive employment impact in industries other than construction, including: food services, landscaping, legal services, and real estate.

- The approximate capital cost estimate for the Project is $1 billion.

- The projected in-service date for the Project is the second half of 2018.

2. Federal Energy Regulatory Commission (FERC) Certificate Authorization

   - Application for a Certificate of Public Convenience and Necessity under the Natural Gas Act (NGA) filed with FERC on September 24, 2015, after spending approximately 1 year in FERC's pre-filing process.

   - Requested Order Date – August 1, 2016.

   - Expected Order Date – Summer of 2017.

3. National Environmental Policy Act (NEPA) and Other Federal Authorizations

   - Under the NGA, FERC is the lead agency for coordinating federal authorizations and for the NEPA process (primary responsibility for preparing the environmental impact statement) for applications to construct natural gas pipeline facilities pursuant Section 7 of the NGA.

   - Multiple federal authorizations are necessary for the construction and operation of the Project (for example, state water quality certifications under Section 401 of the Clean Water Act (CWA), permits under Sections 402 and 404 of the CWA, Section 408 permission to cross civil works under the River & Harbors Act, air permit under the Clean Air Act, and consultations under Section 7 of Endangered Species Act and Section 106 of the National Historic Preservation Act).

4. Current Procedural Status

   - FERC issued the Final Environmental Impact Statement on April 7, 2017. FERC's stated deadline for other federal authorizations is July 6, 2017.

Overview of Federal-State Approval Authorities for Interstate Natural Gas Pipelines Under the Natural Gas Act and Clean Water Act

This memorandum provides a brief overview of the roles of federal and state agencies in the system of cooperative federalism established by the *2005 Energy Policy Act Amendments* (*EPAct 2005*) to the federal *Natural Gas Act* (*NGA*) for the review and approval of new interstate natural gas transmission pipelines.

FERC Certificate Process

New interstate natural gas pipelines are subject to the approval of the Federal Energy Regulatory Commission (FERC). Under Section 7 of the *NGA*, FERC issues Certificates of Public Convenience & Necessity (Certificates). The issuance of a Certificate preempts any other conflicting state or local requirements. A Certificate is a determination by the FERC that a project is needed to serve the public interest. In making this public interest determination, the FERC balances the public benefits against the potential adverse consequences of a new pipeline. Adverse effects may include increased rates for preexisting customers, degradation in service, unfair competition, or negative impact on the environment or landowners' property. Public benefits may include meeting unserved demand, eliminating bottlenecks, access to new supplies, lower costs to consumers, providing new interconnects that improve the interstate grid, providing competitive alternatives, increasing electric reliability, or advancing clean air objectives.

FERC's Environmental Impact Study

In determining whether a proposed new pipeline will have a negative impact on the environment, the FERC conducts an environmental impact study (EIS) pursuant to the *National Environmental Policy Act* (*NEPA*). *NEPA* requires that before a federal agency may undertake a major federal action significantly affecting the quality of the human environment—including the FERC decision to issue a Certificate authorizing the construction of a new natural gas pipeline—it must study the environmental impact of the project, any adverse environmental effects which cannot be avoided, and alternatives to the project. The *NGA* designates the FERC as the lead agency for preparing the EIS for any new interstate natural gas pipeline. Other federal agencies, including the Environmental Protection Agency (EPA), and state agencies with environmental permitting authority delegated under federal laws, typically participate in the review process as cooperating agencies.

Other Federal Environmental Authorizations

In addition to the requirements of *NEPA*, construction of a new interstate pipeline may not proceed without other "federal authorizations." 15 *U.S.C.* §717n. These are authorizations required under Federal law with respect to an application for a Certificate, including any permits, special use authorizations, certifications, opinions, or other approvals as may be required under Federal environmental laws. The most pertinent federal authorizations for new interstate natural gas pipelines are state water quality certifications under Section 401 of the *Clean Water Act* (*CWA*), wetlands permits under Section 404 of the *CWA*, and air permits under Sections 165 and 173 of the *Clean Air Act* (CAA).

Concurrent, Expedited Review

It long has been the policy of the federal government, implemented through federal legislation, federal regulations, federal guidance documents, and a succession of Executive Orders by

Republican and Democratic Administrations, alike, to expedite environmental reviews and approvals of energy infrastructure projects, including new interstate natural gas pipelines needed to ensure an adequate supply of natural gas to meet the essential national and regional economic needs.

In 2001, President Bush issued Executive Order 13212, *Actions to Expedite Energy-Related Projects,* which sought to expedite the approval of energy-related projects and to ensure that federal agencies set and adhere to timelines for the completion of environmental reviews. President Bush's EO 13212 created an Interagency Task Force that includes EPA. EPA and other members of the Task Force are required to monitor and assist other federal agencies in their efforts to expedite their review of permits or similar actions, as necessary, to accelerate the completion of energy-related projects, increase energy production and conservation, and improve transmission of energy. EPA and other members of the Task Force are required to monitor and assist agencies in setting up appropriate mechanisms to coordinate Federal, State, tribal, and local permitting in geographic areas where increased permitting activity is expected.

In 2002, the eleven Federal agencies with some level of responsibility for approving interstate natural gas pipelines, including the EPA, entered into an interagency agreement to implement EO 13212. *Interagency Agreement on Early Coordination of Required Environmental and Historic Preservation Reviews Conducted With the Issuance of Authorizations to Construct and Operate Interstate Natural Gas Pipelines Certificated by the Federal Energy Regulatory Commission* (*2002 MOA*). The *2002 MOA* directs EPA and participating agencies to expedite the environmental permitting and review for natural gas pipeline projects and to work with applicants and other stakeholders, as appropriate, *before complete applications for the necessary authorizations are filed,* to identify and resolve issues as quickly as possible.

In 2005, the Congress codified the duty of federal and state agencies responsible for issuing federal authorizations necessary for the construction of interstate natural gas pipelines to cooperate with the FERC and to expedite their approvals coincident with the FERC *NEPA* process. Since states are delegated authority under federal environmental laws to issue certain federal authorizations, such as *CWA* 401 state water quality certificates and in a few cases *CWA* 404 wetlands permits, FERC is required to coordinate with the states on their issuance of these federal authorizations and to establish a schedule for the states to complete their Federal authorizations. The new law designates the FERC as the lead agency for the purposes of complying with the *NEPA*, coordinating all applicable Federal authorizations, and establishing a mandatory schedule for Federal and State agencies to complete the federal authorizations. The *EPAct 2005* directs that the FERC shall, "in establishing the schedule…ensure expeditious completion of all such proceedings and comply with applicable schedules established by Federal law." 15 U.S.C. 717n(c). Thus, *EPAct 2005* imposes mandatory obligations upon Federal and State agencies with responsibility for issuing "Federal authorizations" necessary for FERC to exercise its Certificate authority under Section 7(c) of the NGA. A "state agency considering an aspect of an application for Federal authorization shall cooperate with the FERC *and comply with the deadlines established by the FERC.*" 15 *U.S.C.* §717n(b)(2) (emphasis supplied).

Accordingly, the overriding purpose of *EPAct 2005* was to expedite the review and approval of interstate natural gas infrastructure by (i) codifying the existing federal inter-agency agreement under EO 13212, (ii) bringing state agencies squarely into the duty to expedite approvals for federal authorizations, and (iii) vesting FERC with the authority to set deadlines for federal and state agencies to act on applications for federal authorizations. *See Oversight Hearing to Review The Permitting of Energy Projects, before the United States Senate Committee on*

Environment and Public Works, S. Hrg. 109-856, May 25, 2005, pp. 7-10, Statement of J. Mark Robinson, Director Office of Energy Projects, Federal Energy Regulatory Commission. These mandatory provisions of the *EPAct 2005* codified a duty of federal and state agencies responsible for issuing federal authorizations necessary for the construction of interstate natural gas pipelines to cooperate with the FERC and to expedite their approvals, coincident with the FERC *NEPA* process.

In 2006, the FERC issued regulations implementing *EPAct 2005*. The regulations provide that states must make a final decision on an application for a Federal authorization, including a *CWA* 401 water quality certificate or in the case of the two states with delegated wetlands authority, the CWA 404 permit, no later than 90 days after the FERC issues the EIS, unless an alternative schedule is provided under Federal law. 18 *C.F.R.* §157.22. The FERC defines "schedule established by Federal law" as schedules specified either in the United States Code or in the Code of Federal Regulations. 71 *Fed. Reg.* 62914, note 12 (Oct. 27, 2006). For example, *CWA* 401 provides that a state must act on an applicant's request for a water quality certificate "within a reasonable period of time (which shall not exceed one year) after receipt of such request."

In 2012, President Obama issued Executive Order 13604 *Improving Performance of Federal Permitting and Review of Infrastructure Projects*, which reaffirmed the federal policy and directed federal agencies to coordinate early with state agencies to avoid duplication of effort and delays, and to allow for concurrent rather than sequential reviews of infrastructure projects, including natural gas pipelines and electric transmission lines.

In 2017, President Trump reaffirmed in *Executive Order Expediting Environmental Reviews for Infrastructure Projects* (January 24, 2017) the longstanding federal policy of expediting the review and approval of energy infrastructure projects. EO 13766 reaffirms the policy of the executive branch to streamline and expedite in a manner consistent with the law environmental reviews and approvals for all infrastructure projects, including natural gas pipelines.

Judicial Review of Inconsistent State Decision-making

The failure of a federal or state agency to take action on a permit required under Federal law, in accordance with the FERC's schedule "shall be considered inconsistent with Federal law." 15 *U.S.C.* §717r(d)(2). In the event a federal or state agency fails to complete a proceeding for an approval that is required for a Federal authorization in accordance with the FERC's schedule, the applicant may pursue remedies under section 19(d) of the *NGA*, 15 *U.S.C.* §717r. This provision authorizes an applicant to file a civil action with the applicable Federal Circuit Court of Appeals. If the state agency with the authority to issue the federal authorization improperly conditions or denies the federal authorization, the applicant can file a civil action with the Federal Circuit Court of Appeals where the project is located. If the state agency unreasonably delays taking an action on the application, then the applicant can file a civil action with the Federal Circuit Court of Appeals for the District of Columbia for the review of an alleged failure to act by the state agency. In either case, if the Court finds that such order or action is inconsistent with the Federal law governing such permit and would prevent the construction, expansion, or operation of the facility, the Court shall remand the proceeding to the agency to take appropriate action consistent with the order of the Court. If the Court remands the order or action to the Federal or State agency, the Court shall set a reasonable schedule and deadline for the agency to act on remand.

The Senate Report Language contained in this packet was included in the Omnibus

North American Emission Control Area Realignment

The U.S. Environmental Protection Agency (EPA) and the Government of Canada have recently established a North American Emission Control Area (ECA) of 200 nautical miles around the contiguous U.S. and Canadian coasts, including the inland waters of the Great Lakes and St. Lawrence River. Among other requirements, the ECA mandates reductions in sulfur emissions for all vessels operating within the ECA-zone by limiting the sulfur content of fuel to 1% on August 1, 2012 and 0.1% as of January 1, 2015.

The goal of the North American ECA is to reduce emissions from ships that might be harmful to human health and coastal environments – an objective that the marine industry and the broader industrial cargo-shipper community fully support as demonstrated by industry's consistent efficiency improvements, major investments in fleet renewal and ability to meet 2012 ECA requirements.

Shipping companies are concerned, however, about the cost increases arising from the ECA that have already taken effect in 2012 and, more particularly, the significant increases in fuel costs in order to meet the requirement of 0.1% sulfur-content fuel. Equally concerned are the industrial shippers that depend on inexpensive, efficient and environmentally smart marine transportation who foresee a ballooning of costs so severe they will kill competitiveness and cost jobs.

At greatest risk is the movement of bulk commodities (iron ore, gypsum, steel, grain, aggregates, coal, salt, sugar, etc.) along North America's coastal shipping lanes, typically referred to as short-sea shipping1. Unlike the very large, transoceanic vessels that operate in the ECA only 5-15% of the time and which the EPA did not separately consider, short-sea shipping vessels operate almost entirely within the 200-mile ECA zone, where they often compete with land-based modes of transportation such as rail and trucking. As such, these ships are forced to use the higher cost low sulfur fuel at least 80 to 90% of their operational time.

The cost increases for short-sea marine transport are expected to be so severe that significant amounts of freight will be forced off ships and onto shore-based modes of transport (ie. to rail or to less safe, already congested roadways) which are less efficient, higher emitting modes, thus resulting in increased emissions and worse environmental outcomes.

Furthermore, important new research[2] which uses EPA-approved meteorological modeling conclusively shows that the smaller, lower horsepower, short-sea ships used in the coastal trades have virtually no impact on the east and west coasts of North America at or beyond 50 nautical miles, even when using a sulfur content fuel as high as the current global average of 2.6%. Nevertheless, the sulfur content fuel mandates of the ECA need not change. Rather, it is the boundary at which the maximum 0.1% sulfur content fuel requirement applies that needs to change to respect the unique operating realities and efficiencies of short-sea shipping.

It is therefore proposed that the North American ECA be modified so that, smaller, short-sea shipping vessels under 20,000 horsepower be required to use 0.1% sulfur content fuel, not within 200 nautical miles but rather within 50 nautical miles from shore, and that from 51-200 nautical miles they continue to use maximum 1% sulfur content fuel.

By modifying the ECA requirements as proposed, the U.S. and Canadian governments can actually yield better environmental outcomes and continue to allow short-sea shipping to provide its inherent economic advantages along the North American coasts rather than risking the economic hardship and adverse unintended outcomes of the ECA.

1 More broadly, short-sea shipping, also referred to by the U.S. Maritime Administration as the "Marine Highway," is the movement of people and cargo on water routes that do not cross an ocean that could also be served by truck or rail.
2 *Modeling the Air Quality Impacts of Short-Sea Shipping Emissions and Implications for the North American Emission Control Area*, Dr. Ranajit Sahu and Dr. H. Andrew Gray, April 2012.

Maritime Industrial Transportation Alliance
Emission Control Area Facts & Issues

Maritime Industrial Transportation Alliance (MITA) represents a broad coalition of American and Canadian companies that rely on efficient, safe, environmentally smart maritime transportation to deliver product. MITA members serve a range of industries, including: mining, steel-making, construction, power generation and agriculture.

Facts About the North American Emission Control Area (ECA)

Required Fuel Not Readily Available: Ultra-low Sulfur Intermediate Fuel Oil (IFO) (0.1% sulfur) is required under the ECA as of January 1, 2015 for ALL vessels regardless of size, out to 200 Nautical Miles. This suphur reduction is on top of a 2012 EPA regulation that reduced U.S. standard levels to 1%. The World standard of sulfur content is 3.5%.

Fuel suppliers in the United States and Canada **do not produce ultra-low sulfur IFO.** As a result, fuel premiums in North American ports range from 34% - 40% more than standard IFO. In some places, fuel prices are double.

Impact: Making America Uncompetitive

Twenty to twenty-five percent cost increases of Short Sea Shipping is hurting American industry.

National Gypsum: The increased gypsum import costs requires National Gypsum to re-think their dry-wall manufacturing model, impacting 500 employees at plants in Georgia, Loiusianna, Maryland, New Hampshire and Vermont.

Westwego, LA Impact

Because of ECA implimentation, transportation costs on raw materials have increased 22% since December. Forcing the company into one of two choices:

Options A: Move from 3 shifts 7 days a week to 1 or 2 shifts 5 days a week.

Result: 30-60 jobs impacted

Options B: Close the facility.
Result: 140 jobs impacted

Eagle Rock Aggregates: California-based Eagle Rock Aggregates entered into a lease to develop a marine distribution terminal within the Port of Long Beach. Imports 3 million tons of aggregate annually into the greater Los Angeles to support construction of roads, bridges & other infrastructure.

San Diego, California Impact

- Planned sister facility in San Diego, designed to buttress a regional aggregate shortage, stalled because of the ECA's 20% cargo rate increases
  - Result: Uncreated jobs

Cost to the U.S. Economy

Higher Cost of Building Materials: ECA cargo increases adds $8.39 million to the price tag of each 100 miles of interstate.[1]

New Potential Infrastructure Costs

Modal shift will kill short sea shipping industry. Unintended consequence, 7.1 million additional truck trips per year along with all the related pollution which is more than 400% greater than 2014 marine polution outputs.

Increased reliance on trucks would cause

incremental traffic delays to other vehicles would costing between $346 and $380 million.

$4.6 billion in additional highway maintenance costs[2]

Increased reliance on rail would cause

Public delays at rail crossings

Estimated annual impact of $46 million.[3]

For relevance to this issue - in the Marine Corridor Mexico/USA/Canada on both coasts – more cargo moves via Short Sea Ships than do all the tons moved in the St. Lawrence Seaway system. These "Coastal tons" currently move without any Federal Government Infrastructure requirements.

Modal Shift is Strife with Consequences:

a. **2011 San Diego Aggregate Supply Study**

SANDAG study examined regional aggregate resources and the modes of the transportation used to deliver construction aggregates.

Marine transportation is the **most** fuel efficient and **least emitting** transportation option[4]

This conclusion was based on fuel sulfur and emissions data before the ECA took effect.

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[1] California Department of Conservation 2012 Aggregate Sustainability in California Report, Page 18.
[2] Environmental and Social Impacts of Marine Transport in the Great Lakes and Seaway Region 2013, Page 14
[3] Define, Defend, Promote, 2013, Page 23
[4] SANDAG Study, Table 4-4, Page 4-10

Committee on Transportation and Infrastructure
U.S. House of Representatives
Washington, DC 20515

Bill Shuster
Chairman

Nick J. Rahall, II
Ranking Member

Christopher P. Bertram, Staff Director

James H. Zoia, Democrat Staff Director

October 16, 2013

The Honorable Regina A. McCarthy
Administrator
United States Environmental Protection Agency
William Jefferson Clinton Federal Building
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Dear Administrator McCarthy:

In August, new rules went into effect requiring the use of lower sulfur fuels or scrubbers in the North American Emission Control Area (ECA). The ECA consists largely of the United States and Canadian Exclusive Economic Zones, excluding the Arctic. Further reductions in sulfur emissions will go in to effect in the ECA in 2015. The use of lower sulfur fuels will increase vessel operating costs, and your agency has shown a willingness to work with vessel operators on a number of methods of meeting lower sulfur emission standards, including the installation of LNG-powered engines or scrubbers. Some operators will change their routes to avoid operating in the ECA wherever possible. Unfortunately, the Environmental Protection Agency (EPA) has been unwilling to allow vessels with smaller horsepower engines that operate in the short sea trade between the United States and Canada to achieve the goal of lower landside pollution by using lower sulfur fuel only within 50 miles of shore. I urge you to reconsider that position.

Most vessels in the U.S.-Canadian short-sea shipping trade are powered by engines with less than 20,000 horsepower and carry low value commodities, including aggregates, gypsum, grain, salt, iron ore, and coal. Due to their size and route, vessels operate almost exclusively in the ECA. I understand that no scientific rationale was prepared that established a relationship between the emissions from these vessels and shoreside sulfur dioxide levels. I also understand that industry has submitted studies to EPA showing that the use of low sulfur fuels only when operating within 50 miles of shore, rather than in the entire ECA, shows no net changes in landside sulfur dioxide levels. I urge you to review these studies.

Increased costs for the minimum 0.1% sulfur content fuel that will be required in 2015 will be particularly hard for short-sea shipping operating predominantly within the ECA to absorb. Such increases may lead to a modal shift where cargo moves off the water and on to trucks and rail. Given that every short-sea ship taken out of service is equal to approximately

2,000 heavy trucks, I am concerned such a shift would lead to new environmental challenges and infrastructure concerns.

Beyond the negative environmental impact and infrastructure implications of inducing modal shift from sea to surface, imposing increased fuel costs on short-sea shipping in the ECA also threatens the competitiveness of American industry and manufacturing as many of the U.S. industries. For example, gypsum is currently mined and produced by our trade partners in Canada and Mexico and shipped to American manufacturers in California, New Hampshire, and Maryland. Increases in short-sea shipping freight rates could increase the use of Chinese or European wallboard in American.

Applying the lower sulfur fuel standards to vessels with engines smaller than 20,000 horsepower only when those vessels are operating within 50 miles of shore would lead to significant cost savings, and increase the competitiveness of U.S. products and exports. If the use of higher sulfur fuel results in no additional shoreside sulfur reductions, then I urge you to apply the lower sulfur fuel standards to these vessels only when they are operating within 50 miles of shore. These vessels operate almost exclusively within the 200 mile ECA, and bring American industry commodities that are vital building blocks for the U.S. economy. We should not discourage this trade.

It appears the implementation of a 50 mile rule for certain vessels may preserve the intent of the ECA, but not disrupt an established transportation system that is critical to our nation's economy. I strongly urge you to review this proposal. I look forward to your reply.

Sincerely,

Duncan Hunter
Chairman
Subcommittee on Coast Guard
and Maritime Transportation

Calendar No. 521

114TH CONGRESS
2d Session

SENATE

REPORT
114–281

DEPARTMENT OF THE INTERIOR, ENVIRONMENT, AND RELATED AGENCIES APPROPRIATIONS BILL, 2017

JUNE 16, 2016.—Ordered to be printed

Ms. MURKOWSKI, from the Committee on Appropriations, submitted the following

REPORT

[To accompany S. 3068]

The Committee on Appropriations reports the bill (S. 3068) making appropriations for the Department of the Interior, environment, and related agencies for the fiscal year ending September 30, 2017, and for other purposes, reports favorably thereon and recommends that the bill do pass.

Total obligational authority, fiscal year 2017

Total of bill as reported to the Senate	$32,762,011,000
Amount of 2016 appropriations	32,925,579,000
Amount of 2017 budget estimate	33,176,164,000
Bill as recommended to Senate compared to—	
2016 appropriations	−163,568,000
2017 budget estimate	−414,153,000

recently completed a preliminary step. As growers need additional modes of action to most effectively deal with this pest, the Committee notes its strong interest in a timely completion of the registration for this new mode of action.

Ecolabels for Federal Procurement.—Multiple forest certification programs have been recognized throughout the Federal Government as supporting the use of sustainable products in building construction and other uses. The Committee urges EPA to add additional forest certification standards that have been recognized by other Federal programs, including USDA's BioPreferred Program, to its Interim Recommendations under Executive Order 13693. The Committee urges EPA to report back on progress on implementation of the Committee's recommendation within 60 days of enactment.

Glyphosate Reregistration.—The Committee is aware that the Agency is currently in the process of reviewing the registration for glyphosate, which is a very important crop protection tool for America's farmers. Furthermore, glyphosate has been used for decades and, when properly applied, has been found to present a low risk to humans and wildlife by regulatory bodies around the world, including Australia, Canada, the European Union, Japan, and by the Joint FAO/WHO Meeting on Pesticide Residues. The Committee urges the Agency to complete its reregistration of glyphosate expeditiously.

Grant Guidelines.—The Committee is extremely concerned about reports that an Agency grant was used to support an anti-agriculture advocacy campaign. The campaign, funded in part by Federal funding, included billboards and a Web site that explicitly accused the agriculture industry as being a primary polluter of local waterways and urged increased regulation of agriculture. The use of Federal funds for such advocacy is inappropriate and may be in violation of Federal lobbying prohibitions. In response to this, the Agency must ensure there is sufficient oversight and training in place to avoid similar misuse of grant funds in the future. To achieve this goal, within 90 days of enactment, the Agency is directed to update its grant policies, training, and guidelines to ensure Federal funds are not used in this manner, including an update of the mechanism by which the Agency tracks the use of its grants, and to provide the Committee with a copy of its updated grant policies, training, and guidelines.

Fuel Standards.—The Committee supports efforts to reduce pollution from marine vessels that may be harmful to human health and coastal environments. While that is the case, the Committee is concerned the mandate for fuel with a sulfur content of 0.1% in the North American Emission Control Area is having a disproportionately negative impact on vessels which have engines that generate less than 32,000 horsepower. This impact may cause some shippers to shift from marine based transport to less efficient, higher emitting modes. In an effort to avoid negative environmental consequences and modal shifting, the Committee directs the Agency to consider exempting vessels with engines that generate less than 32,000 horsepower and operate more than 50 miles from the coastline. Within 180 days of enactment of this act, the Agency

should provide the Committee with a report detailing their decision.

Interagency Consultations.—Several provisions of the Federal Insecticide, Fungicide and Rodenticide Act [FIFRA] require the Agency and the United States Department of Agriculture [USDA] to coordinate activities related the products regulated under the law. USDA has a robust history of collecting and analyzing data related to agricultural economics and the environmental impacts of farming tools and practices, including crop protection and pest management. However, there have been recent instances in which the USDA has not been consulted or informed of key regulatory actions and decisions by the EPA as prescribed by FIFRA. In two of these cases USDA has publicly commented on their exclusion from the process. Consequently, the Committee directs the Administrator of the EPA to consult with the Secretary of the Department of Agriculture on economic analyses, rules and other regulatory actions that impact products currently approved under FIFRA.

Lead Test Kit.—In 2008, EPA adopted the Lead Renovation, Repair and Painting rule which included criteria by which the Agency could certify a test kit that contractors could use onsite to comply with the rule. The Committee is concerned that 8 years later, no kit has been developed that meets these standards. The Committee is concerned that this action is not adequate and is concerned that progress is not being made to identify a solution to this issue. If no solution is reached by the end of the fiscal year, EPA should reopen the rule and determine whether it is possible to include an opt-out provision until a test kit is certified that can comply with the rule.

Methane.—The Committee is concerned about the Agency's efforts to regulate methane from existing petroleum and gas sources. Over the past decade, the United States added more than 86,000 new petroleum and natural wells, during which methane emissions from petroleum and natural gas systems fell by 11 percent. Based on the data suggesting that methane emissions are declining, the Committee believes that States are adequately regulating methane emissions.

National Ambient Air Quality Standards.—The Committee remains concerned about potentially overlapping implementation schedules related to the 2008 and 2015 standards for ground-level ozone. Because the Agency did not publish implementing regulations for the 2008 standard of 75 parts per billion [ppb] until February 2015 and then revised the standard to 70 ppb in October 2015, States now face the prospect of implementing two national ambient air quality standards for ozone simultaneously. Based on Agency data, the Committee expects a number of counties to be in non-attainment with both the 2008 standard and the 2015 standard. Additionally, Agency data suggests that a number of marginal non-attainment counties will meet the 2015 standard by 2025 due to other air regulations. In an effort to find the most sensible path to reduce ground level ozone, some flexibility must be granted to States that face the burden of implementing these potentially overlapping standards. Within 90 days of the date of enactment of this act, the Agency is directed to provide the Committee with a report examining the potential for administrative options to enable States

Calendar No. 501

114TH CONGRESS, *2d Session* | SENATE | REPORT 114–264

DEPARTMENT OF HOMELAND SECURITY APPROPRIATIONS BILL, 2017

MAY 26, 2016.—Ordered to be printed

Mr. HOEVEN, from the Committee on Appropriations, submitted the following

REPORT

[To accompany S. 3001]

The Committee on Appropriations reports the bill (S. 3001) making appropriations for the Department of Homeland Security for the fiscal year ending September 30, 2017, and for other purposes, reports favorably thereon and recommends that the bill do pass.

Total obligational authority, fiscal year 2017

Total of bill as reported to the Senate [1 2 3 6]	$49,739,632,000
Amount of 2016 appropriations [4 5]	49,431,955,000
Amount of 2017 budget estimate [1 2 6]	48,999,303,000
Bill as recommended to Senate compared to—	
2016 appropriations	+307,677,000
2017 budget estimate	+740,329,000

[1] Committee recommendation includes $1,231,574,000 in rescissions compared to $420,000,000 in proposed cancellations.

[2] Includes a permanent indefinite appropriation of $176,000,000 for the Coast Guard healthcare fund contribution.

[3] Includes $162,692,000 for the Coast Guard for the cost of overseas contingency operations.

[4] Includes rescissions totaling $1,506,152,000 pursuant to Public Law 114–113. Includes permanent indefinite appropriation of $169,306,000 for the Coast Guard healthcare fund contribution. Includes $160,002,000 for the Coast Guard for the cost of overseas contingency operations.

[5] Includes $6,712,953,000 for the FEMA Disaster Relief Fund designated by the Congress as disaster relief pursuant to Public Law 112–25.

[6] Includes $6,709,000,000 for the FEMA Disaster Relief Fund designated by the Congress as disaster relief pursuant to Public Law 112–25.

20–241 PDF

PUGET SOUND FEDERAL CAUCUS

The Committee commends the Thirteenth Coast Guard District for signing the Puget Sound Federal Caucus Memorandum of Understanding [MOU] on April 21, 2014. The recovery and cleanup of Puget Sound is essential to our Nation's economy and continued coordination and sharing of expertise among Federal partners is critical to furthering current efforts. The Committee directs the Thirteenth Coast Guard District to work with its counterparts in the Puget Sound Federal Caucus to renew and strengthen the MOU prior to its expiration on March 27, 2017.

COAST GUARD BAND

The Committee is concerned that the Coast Guard is planning to expend unnecessary funds to move the Coast Guard Band from the Coast Guard Academy Campus in New London, Connecticut to Washington, DC and therefore directs that no funds provided in this act shall be expended for the relocation of the Coast Guard Band from its current home.

MARINE ENVIRONMENT PROTECTION

The Coast Guard, jointly and cooperatively with the Environmental Protection Agency, is charged with enforcing the International Maritime Organization's Marine Pollution [MARPOL] convention focused on preventing different forms of marine pollution, including oil, noxious liquid substances, harmful substances, waste water, garbage, and emissions of sulfur oxide and nitrogen oxide at sea. In accordance with MARPOL Annex VI Regulation 13, all vessels entering the North American and Caribbean Emission Control Areas [ECA] as of January 1, 2015, are required to use Ultra-low (0.1%) Sulfur Intermediate Fuel Oil [IFO]. The Committee remains concerned about potential modal shifts related to ECAs and directs the Coast Guard to provide an update to the briefing, mandated in House Report 114–215, on ECA-related enforcement actions, fuel availability, waivers, and exemptions for ECA compliance.

The Committee is concerned that despite issuing a final rule on Ballast Water Discharge Standards in 2012, the Coast Guard has yet to approve a single Ballast Water Management System [BWMS]. This is particularly challenging for BWMS vendors who must submit to lengthy, expensive testing at independent laboratories or seek to have existing test data validated also through independent laboratory review. In seeking to validate the results of certain BWMS technology it is clear that testing protocols have not necessarily kept pace. The lack of comprehensive protocols to test BWMS technologies, some of which are widely accepted in other water treatment industries, is causing the industry harm in the maritime sector and must be addressed. To continue the development of more appropriate testing methods, the Committee directs the Coast Guard, in conjunction with the Environmental Protection Agency, to reexamine the applicability of the most probable number method for evaluating the efficacy of certain treatment technologies.

114TH CONGRESS
1st Session
HOUSE OF REPRESENTATIVES
REPORT
114–215

DEPARTMENT OF HOMELAND SECURITY APPROPRIATIONS BILL, 2016

JULY 21, 2015.—Committed to the Committee of the Whole House on the State of the Union and ordered to be printed

Mr. CARTER of Texas, from the Committee on Appropriations, submitted the following

R E P O R T

together with

MINORITY VIEWS

[To accompany H.R. 3128]

The Committee on Appropriations submits the following report in explanation of the accompanying bill making appropriations for the Department of Homeland Security for the fiscal year ending September 30, 2016.

INDEX TO BILL AND REPORT

95–508

each denied request. The report shall also include the number of service members served by the Special Victim Counsel program.

Fishing Safety Training

Section 309 of the Coast Guard Reauthorization Act of 2014 (Public Law 113–281) authorizes competitive grant funding for Fishing Safety Training and Fishing Safety Research grants programs that support collaborative training and research into emerging and useful technologies to enhance safety on fishing vessels. The Committee directs the Coast Guard to provide, within 90 days after the date of enactment of this Act, a plan for carrying out a pilot for a training program, potentially involving an expansion of the Coast Guard's current collaboration with the National Institute for Occupational Safety and Health related to data on commercial fishing safety. Although no specific funding is provided for implementing a pilot training program, the Coast Guard is encouraged to use funds recovered from prior obligations for this purpose.

MARITIME POLLUTION CONTROL

The Coast Guard, jointly and cooperatively with the EPA, is charged with enforcing U.S. laws, international conventions, and regulations of the International Maritime Organization (IMO). The IMO's Marine Pollution (MARPOL) convention focuses on preventing different forms of marine pollution, including oil, noxious liquid substances, harmful substances, waste water, garbage, and emissions of sulfur oxide and nitrogen oxide at sea. In accordance with MARPOL Annex VI Regulation 13, all vessels entering the North American and Caribbean Emission Control Areas (ECA) as of January 1, 2015, are required to use Ultra-low (0.1%) Sulfur Intermediate Fuel Oil (IFO). In response to concerns that the availability of this type of fuel in U.S. ports is limited, the Committee directs the Coast Guard to provide a briefing, not later than 90 days after the enactment of this Act, on the following:

a) the number of ECA-related enforcement actions taken since January 1, 2015;

b) the number of fuel non-availability reports received since January 1, 2015; and

c) the number of vessels that received waivers, exemptions, or other special consideration for ECA compliance, including application and expiration dates.

Coast Guard Auxiliary Uniforms

The Committee is aware that members of the U.S. Coast Guard Auxiliary are not eligible for reimbursement for the cost of uniforms they are required to wear while performing official duties. The Committee encourages the Coast Guard to examine the feasibility, rationale, and cost to the Coast Guard of providing such reimbursements and to report to the Committee on the results.

Small Response Boats

The Coast Guard has a long-standing requirement to replace aging and obsolete small response boats and awarded a competitive contract to replace these important watercraft. The Committee notes, however, that the Coast Guard is not procuring enough

MARITIME INDUSTRIAL
TRANSPORTATION ALLIANCE

North American ECA must be amended to help rather than hurt the economy and the environment

Summary

The U.S. Environmental Protection Agency (EPA) and the Government of Canada have recently established a North American Emission Control Area (ECA) of 200 nautical miles around the contiguous U.S. and Canadian coasts, including the inland waters of the Great Lakes and St. Lawrence River. Among other requirements, the ECA mandates reductions in sulfur emissions for all vessels operating within the ECA-zone by limiting the sulfur content of fuel to 1% on August 1, 2012 and 0.1% as of January 1, 2015.

The goal of the North American ECA is to reduce emissions from ships that might be harmful to human health and coastal environments – an objective that the marine industry and the broader industrial cargo-shipper community fully support as demonstrated by industry's consistent efficiency improvements, major investments in fleet renewal and ability to meet 2012 ECA requirements.

Shipping companies are concerned, however, about the cost increases arising from the ECA that have already taken effect in 2012 and, more particularly, the significant increases in fuel costs to come in order to meet the requirement of 0.1% sulfur-content fuel by 2015. Equally concerned are the industrial shippers that depend on inexpensive, efficient and environmentally smart marine transportation who foresee a ballooning of costs so severe they will kill competitiveness and cost jobs.

At greatest risk is the movement of bulk commodities (iron ore, gypsum, steel, grain, aggregates, coal, salt, sugar, etc.) along North America's coastal shipping lanes, typically referred to as short-sea shipping[1]. Unlike the very large, transoceanic vessels that operate in the ECA only 5-15% of the time and which the EPA did not separately consider, short-sea shipping vessels operate almost entirely within the 200-mile ECA zone, where they often compete with land-based modes of transportation such as rail and trucking. As such, these ships are forced to use the higher cost low sulfur fuel at least 80 to 90% of their operational time.

The cost increases for short-sea marine transport are expected to be so severe that significant amounts of freight will be forced off ships and onto shore-based modes of transport (ie. to rail or to less safe, already congested roadways) which are less efficient, higher emitting modes, thus resulting in increased emissions and worse environmental outcomes.

Furthermore, important new research[2] which uses EPA-approved meteorological modeling conclusively shows that the smaller, lower horsepower, short-sea ships used in the coastal trades have virtually no impact on the east and west coasts of North America at or beyond 50 nautical miles, even when using a sulfur content fuel as high as the current global average of 2.6%. Nevertheless, the sulfur content fuel mandates of the ECA need not change. Rather, it is the boundary at which the maximum 0.1% sulfur content fuel requirement applies that needs to change to respect the unique operating realities and efficiencies of short-sea shipping.

It is therefore proposed that the North American ECA be modified so that in 2015, smaller, short-sea shipping vessels under 20,000 horsepower be required to use 0.1% sulfur content fuel, not within 200 nautical miles but rather within 50 nautical miles from shore, and that from 50-200 nautical miles they continue to use maximum 1% sulfur content fuel.

By modifying the ECA requirements in 2015 as proposed, the U.S. and Canadian governments can actually yield better environmental outcomes and continue to allow short-sea shipping to provide it's inherent economic advantages along the North American coasts rather than risking the economic hardship and adverse environmental outcomes most certainly forthcoming if the current ECA regulation comes into effect in 2015.

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[1] More broadly, short-sea shipping, also referred to by the U.S. Maritime Administration as the "Marine Highway," is the movement of people and cargo on water routes that do not cross an ocean that could also be served by truck or rail.

[2] *Modeling the Air Quality Impacts of Short-Sea Shipping Emissions and Implications for the North American Emission Control Area*, Dr. Ranajit Sahu and Dr. H. Andrew Gray, April 2012.

About the Maritime Industrial Transportation Alliance (MITA)

MARITIME INDUSTRIAL
TRANSPORTATION ALLIANCE

MITA represents a broad coalition of North American companies that rely on efficient, safe, environmentally smart marine transportation to deliver products and materiel that serve people all over the world. Besides shipping companies, MITA includes cargo shippers in major industrial sectors including mining, steel-making, construction, power generation and agriculture.

MITA's advocacy on marine and transportation issues extends to North American governments and agencies and occasionally to international bodies such as the International Maritime Organization. Marine transportation is vital to our prosperity by enabling efficient trade within North America and around the world.

As the safest, most efficient and environmentally smart method of carrying bulk freight, the increased use of marine transportation alleviates highway congestion, reduces greenhouse gas emissions and is a vital catalyst to overall economic prosperity.

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I. Background

On March 27, 2009, the U.S. and Canada submitted a formal joint proposal to the International Maritime Organization (IMO) for the establishment of a North American Emission Control Area (ECA). The proposal was accepted at the 60th session of the IMO Marine Environment Protection Committee (MEPC) on March 26, 2010. The ECA extends 200 nautical miles (nm)[3] from the coasts of the United States and Canada, yet excludes Alaska and the Arctic.

On August 1, 2012, the North American ECA came into effect, mandating that all vessels operating within the 200nm zone off the east and west coasts of the United States and Canada use fuel containing no more than 1% sulfur. This fuel sulfur restriction will be further reduced to 0.1% beginning on January 1, 2015.

In the United States, the U.S. Environmental Protection Agency (EPA) promulgated ECA requirements under authority provided by the *Act to Prevent Pollution from Ships, 33 U.S.C. §§ 1901-1915*, to implement Regulation 14 of Annex VI to the *International Convention on the Prevention of Pollution from Ships (1973/78) (MARPOL Annex VI)*.

In Canada, Transport Canada has proceeded under authority of the *Canada Shipping Act* to implement the ECA provisions through formal regulatory approval, first published in *Canada Gazette I*, July 21, 2012, as *Regulations Amending the Vessel Pollution and Dangerous Chemicals Regulations*.

With respect to the U.S. and Canada's rationale for seeking and establishing a North American ECA, the aims and objectives, also articulated in IMO's MARPOL *Annex IV*, include:

- To control NO_X, SO_X, and PM in order to reduce "ambient concentrations of air pollution in cities and coastal areas around the world." (Annex VI, App. III 1.2.)
- To restrict such forms of pollution because they can contribute to "premature death, cardiopulmonary disease, lung cancer, chronic respiratory ailments, acidification and eutrophication." (Id.)
- The criteria for designating an ECA include an assessment of emissions from ships operating in the proposed area that contribute to ambient concentrations of air pollution causing human health or adverse environmental impacts in the coastal areas described above. (Id. 3.1.4.)
- Other criteria include an assessment of meteorological conditions in the proposed ECA, nature of ship traffic (including patterns and density), measures to address land-based sources of emissions in the coastal regions, and costs of reducing emissions from ships relative to land-based controls. (Id. 3.1.5-.8)

It is clear that the U.S. and Canada's overriding goal for the North American ECA is to reduce emissions from ships that might be harmful to human health and coastal environments, objectives which industry supports. But as demonstrated in this brief, particularly for a class of relatively smaller, lower horsepower ships operating under what is commonly referred to as short-sea shipping, the ECA as proposed will not only needlessly hurt American and Canadian economies, it will likely result in diminished environmental outcomes.

II. The ECA will needlessly hurt the economy

In analyzing the emissions from ships to justify its application to the IMO for the ECA, the U.S. EPA and Canada took a blanket approach and did not extract for separate analysis the short-sea shipping sector from the roughly 50,000 vessel inventory many of which operate with extremely large engines and emission footprints, quite unlike short-sea ships. Indeed, they did not look at, study or otherwise take into account the relatively small number of short-sea vessels that are smaller with smaller horsepower engines and which transport vital bulk raw materials up and down along the North American coasts in the supply and support of North American industry.

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[3] One nautical mile is equivalent to 1.15 statute miles or 1.852 kilometres. 200 nautical miles is therefore equivalent to 230 statute miles or 370.4 kilometres.

These smaller, specialized, innovative, mostly self-unloading ships – plying waters in the trade typically referred to as short-sea shipping[4] – not only have uniquely different engine and horsepower characteristics (less than 20,000 horsepower), they have markedly different efficiency and emission footprints. Most importantly in terms of economics, these short-sea shipping vessels uniquely operate almost their entire service lives (80-90%) within the 200nm area now classified as an ECA zone, where they often compete with land-based modes of transportation such as rail and trucking. As such, these ships are forced to use the higher cost low sulfur fuel during most of their operational time. In stark contrast, transoceanic vessels only operate approximately 5-15% of the time[5] within ECAs and are thus significantly less burdened with the higher fuel costs.

The result is that vessels in the short-sea shipping trade are being disproportionately disadvantaged with higher fuel and operating costs. While this cost increase under the current ECA (2012 = 1% sulfur-content fuel) is certainly proving challenging, the cost increases are expected to balloon when the 0.1% sulfur-content fuel restriction takes effect in 2015, assuming such fuel eventually becomes available.

With a blanket analysis of the global fleet of predominantly very large ships operating a small fraction of their time in the ECA without land-based (truck/rail) competitors, the U.S. EPA and Canada have rationalized that ECA cost increases will simply be passed on to customers and consumers by way of higher prices:

> "For the vast majority of goods currently moved by ship, there are no close transportation alternatives. Therefore ship owners are expected to be able to pass all or nearly all of the additional costs associated with complying with the ECA NO_X and fuel sulphur control measures to the purchasers of marine transportation services. These increases in transportation costs ultimately would be passed on in the form of slightly higher prices for the goods being shipped."[6]

Unfortunately, the effect of those cost increases won't be quite so easily transferable for the short-sea shipping sector. On the contrary, the impact of the 2015 ECA on short-sea shipping is expected to result in a 50-80% increase in fuel costs, which will:

- Significantly increase manufacturing and production costs to U.S. and Canadian industrial sectors, translating into lower competitiveness, lost jobs, even more downward economic pressures;
- Lead to a shift in sourcing of bulk materials away from U.S. and Canada towards offshore countries, (S. America, China, etc.) where quality and health and safety standards for material like gypsum, aggregates, salt, iron ore, etc. may be less stringent.

III. The ECA will needlessly hurt the environment

A. The Purpose of the ECA is to protect human health and the coastal environment

The IMO's MARPOL Annex VI is concerned with the reduction of emissions in order to avert the public health, welfare, and environmental harms to which such emissions contribute. As this is a treaty for the global shipping industry, the particular emissions of concern are those from marine vessels. Nothing in the treaty, however, precludes any nation from considering the emission reductions in the aggregate as they impact its citizens' health and welfare, or its sensitive coastal, marine, or terrestrial environments. Indeed, with specific reference to ECAs, Annex VI notes that the purpose for which these areas of heightened vessel emission control may be established is to minimize "adverse impacts on human health and the environment" and to reduce "ambient concentrations of air pollution in cities and coastal areas around the world."[7] Nations "which have ships navigating in the area are encouraged to bring to the Organization any concerns regarding the operation of the area."[8] In short, Annex VI does not require nations to adhere strictly with the Regulation 14 fuel standards if doing so would result in greater air pollution within its territory.

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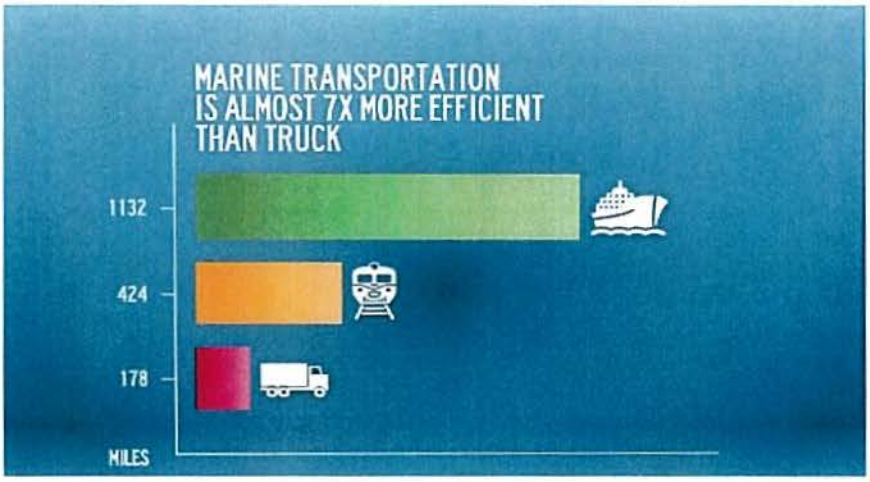
[4] More broadly, short-sea shipping, also referred to by the U.S. Maritime Administration as the "Marine Highway," is the movement of people and cargo on water routes that do not cross an ocean that could also be served by truck or rail.
[5] BP Marine, *2015 and Beyond*, London, September 13, 2012.
[6] *Proposal to Designate an Emission Control Area for Nitrogen Oxides, Sulphur Oxides and Particulate Matter Submitted by the United States and Canada*, International Maritime Organization, Marine Environment Protection Committee, 2 April 2009, p. 7.
[7] *Id.* Regulation 1(8) & Annex VI, App. III § 1.2.
[8] *Annex VI*, App. III § 5.1.

B. Marine Transportation is an Environmentally Preferable Form of Transportation

Shipping has long been recognized as the most efficient form of transportation boasting an ability to move more ton-miles per gallon of fuel than any other mode. According to the U.S. Maritime Administration's (MARAD) 2011 Report to Congress,

> while trucks, on average, can carry one ton of freight for approximately 155 miles on a gallon of diesel fuel (i.e., 155 ton-miles of freight per gallon, equivalent to 842 BTU per ton-mile), rail achieves 413 ton-miles of freight per gallon (316 BTU per ton-mile), and a tug-and-barge operation can get as much as 576 ton-miles of freight to a gallon of fuel (227 BTU per ton-mile).[9]

Additionally, self-propelled oceangoing vessels, such as short-sea ships, have significant energy efficiencies over land-based modes beyond those achieved by tug and barge. The image below represents a separate analysis by the short-sea shipping company CSLI which shows the same trends.



CSLI Vessel Ton-miles per gallon

"From an environmental perspective . . . short sea shipping can offer air quality improvement, reduce traffic and mitigate noise pollution . . . marine shipping tends to have lower environmental and social impacts than land transport."[10]

> America's Marine Highway offers the potential of significantly enhancing the environmental sustainability of the nation's transportation system. In particular, water transportation is often the most energy-efficient means of moving cargo between two points, with corresponding reductions per ton-mile in greenhouse gas (GHG) emissions. Similarly, with appropriate technology and regulation, water transportation is an environmentally-friendly transportation mode that can reduce noise and air pollution and have minimal impacts on water quality.[11]

Short-sea shipping, therefore, offers an efficient alternative to surface transportation (i.e., via roads or rail) that reduces associated transportation emissions. As a result, a shift from marine transportation to other modes of transportation over routes comprising the North American Marine Highway and associated land routes will have a net adverse impact not only on aggregate NO_X, SO_X, and PM emissions sought to be addressed by the ECA, but also other important pollutants, such as GHGs.

C. The 0.1% Sulfur Marine Diesel Rule Will Cause a Modal Shift to More Polluting Land-Based Transportation Alternatives

Vessels serving short-sea shipping routes operate extensively within the ECA. By contrast, transoceanic vessels only operate in the ECA for a small fraction of their total voyage. Thus,

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[9] U.S. Maritime Administration, *Report to Congress, America's Marine Highway*, at 22 (April 2011) (hereinafter "MarAd Report to Congress").
[10] Transport Canada, *Making Connections: Short Sea Shipping in Canada*, at 1 (2006).
[11] *MarAd Report to Congress* at 21.

transoceanic operations are able to take advantage of lower cost residual and intermediate fuel oils that simply are not allowable by short-sea ships. These vessels that are engaged in North American short-sea shipping – typically Panamax size and smaller, generally not exceeding 20,000 propulsion horsepower – will face higher average fuel costs per ton-mile traveled compared to transoceanic carriers. As a result, unless exemptions are made for short-sea vessels, the unit increase in costs will make use of the marine highway more expensive relative to land-based forms of transportation, which also have higher per-ton mile emissions.

The difference between the cost of 1.0% and 0.1% marine distillate fuel is significant. Studies show that the cost per ton of 0.1% sulfur fuel ranges from 56.7% to 67.4% higher than that for 1.0% marine distillate fuel. For example:

- A May 2011 study by the California Air Resources Board found that the global average price per ton of 1.0% sulfur IFO and 0.1% marine gas oil was $569 compared to $892.[12] That is a difference of 56.7%.
- A late 2010 report by the European Marine Safety Agency (EMSA) showed the price differential between these two types of low sulfur fuels to have been 67.4% in 2010.[13] EMSA projected that this differential would decline to about 56% in 2015, but then rise again to 62.5% in 2020.

All these studies arrive at a price differential above 50 percent for the switch to the lower sulfur fuels currently set for 2015.

Given the significant increases in fuel costs, the higher relative costs of shipping freight via the marine highway will either reduce margins making certain routes unprofitable or make transport costs by surface modes more attractive. In either event, assuming that demand for those bulk materials currently transported by ship remains unaffected by the relative increase in cost, it is reasonable to expect a modal shift to land-based transportation alternatives.

More importantly, the modal shift caused by applying the 0.1% sulfur content standard to smaller vessels active in the short sea shipping trades within the North American ECA – specifically within the U.S. and between the U.S. and Canada – will result in the unintended consequence of increasing overall CO_2, CO, hydrocarbons, SO_X, NO_X, and fine PM emissions. The U.S. has recognized that any use of surface transportation in lieu of maritime shipping would greatly undermine efforts to curb overall emission of harmful hazardous and greenhouse gas (GHG) emissions. Stated another way, "[t]he greater use of water transportation could generally reduce emissions of carbon dioxide (CO_2), an important GHG relative to other transportation modes."[14] Maritime shipping "is often the most energy-efficient means of moving cargo between two points . . . [and] an environmentally-friendly transportation mode that can reduce noise and air pollution and have minimal impacts on water quality."[15] Allowing such modal shifts to occur will undermine international and domestic goals with respect to environmental and human health.

D. Research Shows that Emissions From Vessels With Engines of 20,000 hp or Less, Using 1.0% Sulfur Fuel Have Negligible Impact on Coastal and Terrestrial Air Quality

A recent study entitled, *Modeling the Air Quality Impacts of Short-Sea Shipping Emissions and the Implication for the North American ECA*, shows that applying ECA standards to short-sea ships (i.e. with 20,000 horsepower engines or less) 200 miles from shore is not warranted to either prevent, reduce, or control air pollution from SOx emissions. The study analyzed short-sea ship emissions using the highly credible, EPA-approved CALPUFF and CALMET meteorological modeling.

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[12] California Air Resources Board, *Proposed Amendments To The Regulations "Fuel Sulfur And Other Operational Requirements For Ocean-Going Vessels Within California Waters And 24 Nautical Miles Of The California Baseline,"* at V-7 (May 2011), available at http://www.arb.ca.gov/regact/2011/ogv11/ogv11isor.pdf.

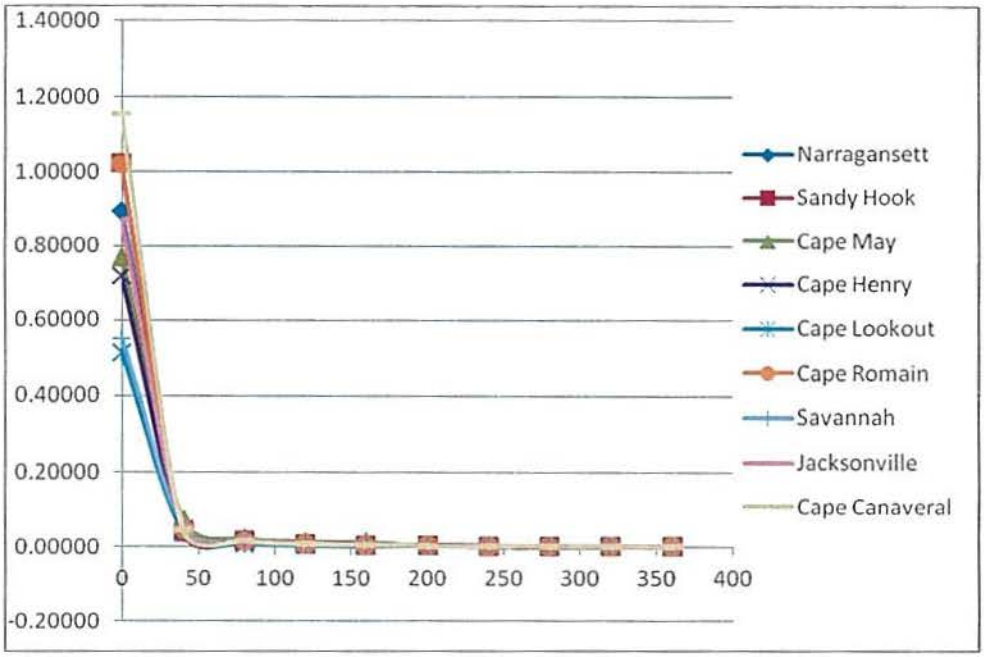
[13] European Marine Safety Agency, *Technical Report, The 0.1% sulfur in fuel requirement as from 1 January 2015 in SECAs - An assessment of available impact studies and alternative means of compliance*, at 7 (Dec. 13, 2010), available at www.cbss.org.

[14] *MarAd Report to Congress*, at 24.

[15] *Id.* at 21. *See also* ECA Proposal at 60 ("[S]hips provide the most efficient method to transport these [world] goods on a ton-mile basis.").

Twelve ships were selected to represent the "typical" short-sea shipping vessel (from a propulsion horsepower perspective and therefore emissions basis). The study analyzed the impact of "worst case" short-sea shipping vessels' emissions data on shore air quality. The study results show that the smaller short-sea shipping vessels (with corresponding lower horsepower propulsion systems) using fuel with 2.6% sulfur content, have virtually no environmental impact on the East or West Coasts of North America beyond 50 miles.

The study demonstrates that SO_2 concentrations along the coasts drop off dramatically as the distance from the ship to shore increased. Based on the modeling analysis, "the outward extent of the ECA could be much smaller (of the order of 50 miles or smaller), while still not adversely impacting coastal air quality." (See figure below). In conclusion, the "study undisputedly supports a performance-based ECA reduction to 50 miles for smaller ships comprising the short-sea shipping demographic."[16]



East Coast Offshore SO_2 Dispersion, y-axis = micrograms/m^3 of SO_2, x-axis = distance from shore, EPA 1-hr SO_2 NAAQS = 196 micrograms/m^3

Short-sea ships, therefore, can meet the EPA National Ambient Air Quality Standards (NAAQS) for sulfur by using a 1% sulfur fuel and also not impact the coastal environment nor communities in doing so 50 miles from shore.

Requiring short-sea vessels to use 0.1% sulfur-content fuel within 50 nautical miles of the North American coasts instead of within 200 nautical miles, would align with the ECA designation authority under MARPOL Annex VI as well as current efforts under Annex VI and the U.S. Clean Air Act to reduce overall emissions while further reducing sulfur emissions.

Given the net benefits it provides the U.S. and Canada in terms of improved air quality and public health and welfare outcomes, such consideration for short-sea vessels is preferable to the status quo. This finding is supported both by the likelihood of a shift in cargo transport to forms of transportation that emit higher levels of pollutants per ton-mile of goods transported, as well as by demonstrable scientific evidence showing that maintaining the 1.0% fuel standard for smaller coastal vessels will not have any adverse environmental impact on coastal communities, the coastal environment, or North America more generally.

[16] *Id.* at 7.

IV. Precedents for ECA Exemptions

Currently, there are two exemptions from the marine fuel standards otherwise applicable to the ECA via Regulation 14, and codified at 40 C.F.R. § 1043.60(b):

i. The first applies to "vessels propelled by steam turbine engines or reciprocating steam engines (also known as steamships), provided they were propelled by steam engines and operated within the Great Lakes before October 30, 2009 and continue to operate exclusively within the Great Lakes." *Id.* § 1043.90(a). This "Great Lakes exemption" may also be extended to other vessels operating exclusively within that region upon a showing of, among other things, "serious economic hardship." *Id.* § (b). These exemptions were developed in response to congressional language in the Conference Report for Department of Interior, Environment, and Related Agencies Appropriations Act, 2010 and concerns raised by the Great Lakes shipping industry.[17]

ii. The second exemption may be applied, upon request, to "historic steamships . . . for operation in U.S. internal waters." *Id.* §1043.60(f). In addition, the United States has petitioned the MEPC for an amendment to Regulation 14 that would waive the sulfur fuel content requirements for existing steamships "that are powered by propulsion boilers that were not originally designed for continued operation on marine distillate fuel . . . or natural gas."[18] This request for consideration is founded solely on serious prudential considerations, including the fact that ships propelled by steam boilers could be susceptible to explosion if converted to marine distillate fuel. In its conclusion, the United States noted that "propulsion steam boilers face significant and unique challenges and the need to comply with the fuel sulphur limits for ECA may introduce unintended safety concerns" and "may result in increased emissions in the long run if these steamships are retained in the fleet longer than intended."[19]

V. Conclusion

The Maritime Industrial Transportation Alliance supports the objectives of the North American ECA and believes that equivalent positive environmental outcomes can be achieved while safeguarding the existing economic impact, benefits and strategic objectives of short-sea shipping.

By taking a blanket approach to ship traffic and emissions inventory measurements – without separately analyzing and considering the relatively small short-sea shipping sector – the ECA as it stands will disproportionately impact short-sea shipping and its large industrial base of customers by saddling it with exorbitantly higher costs leading to a shift in sourcing of material off North American coasts, lost jobs and even greater economic hardship for North America's industrial sector.

In terms of environmental outcomes, the ECA, as it applies to the unique, innovative short-sea shipping sector, runs contrary to the objectives of the U.S. and Canada when they originally went forward to the IMO with their ECA application. Through rigorous analysis using the same meteorological modeling relied upon by the U.S. EPA, Dr. Ranajit Sahu and Dr. Andrew Gray demonstrate that applying a maximum 0.1% sulfur-content fuel standard to short-sea vessels operating more than 50nm from shore has virtually zero positive environmental benefit to human health nor the coastal environment. In other words, in 2015 short-sea shipping companies and the broader industrial economy will be forced to incur tens to hundreds of millions of dollars in added fuel, operational, logistical and related costs – and incur the resulting dire economic consequences – all for the sake of complying with ECA regulations that offer no marginal environmental benefit.

There is a way, however, for the North American ECA to improve environmental outcomes while safeguarding the existing economic impact, benefits and strategic objectives of short-sea shipping. The North American ECA must be amended, as follows:

Effective January 1, 2015, for vessels of 20,000 propulsion horsepower (14,913 kW) or less, the outward extent of the ECA be set at 50 nautical miles from the coastline of Canada and the United

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[17] *See* 75 Fed. Reg. 22896, 22935-36 (April 30, 2010).
[18] *See* MEPC 61/7/6 (July 19, 2010).
[19] *See* MEPC 61/7/6 ¶ 17.

States for use of 0.1% sulfur fuel and from between 50 nautical miles to 200 nautical miles from the coastline for the use of 1.0% sulfur fuel.

MODELING THE AIR QUALITY IMPACTS OF SHORT-SEA SHIPPING EMISSIONS and IMPLICATIONS FOR THE NORTH AMERICAN EMISSION CONTROL AREA (ECA)

Prepared by

Dr. Ranajit (Ron) Sahu and Dr. H. Andrew Gray

Consultants

April 2012

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Shipping has long been recognized as the most efficient form of transportation boasting an ability to move more ton-miles per gallon of fuel than any other mode. Nevertheless, as responsible owners, our clients, CSL, Transport Desgagnés and other short sea ship owners recognize the value of further reducing the carbon foot print as well as the emissions of other pollutants associated with marine transport. On their behalf, we have analyzed important current provisions of the North American Emission Control Area (ECA), designed to reduce air pollution. Based on our technical analysis, we disagree with portions of the ECA. As currently drafted, the ECA isn't fully effective or sustainable to smaller/cleaner operating ships. Although well intended, flaws in current marine air pollution regulations are jeopardizing an important component of the maritime community in the Short Sea Shipping sector.

The pending scheme to align vessels with North American air quality goals does not consider the short sea shipping niche which is challenged by a "one size fits all" ECA employed through Annex VI of the Convention to Prevent Pollution from Ships (MARPOL). As currently written and accepted, the North American ECA extends 200 nautical miles off the East and West coasts of the United States and Canada within which ships must use 1% sulfur fuel starting August 1, 2012. Additionally, this fuel sulfur level will be further reduced to 0.1% in 2015 which will challenge coastal shippers in both fuel availability and its cost. Based on supply issues, studies have shown that future, compliant, North American marine fuel prices could nearly double in 2015. The anticipated increase in 2015 fuel costs will hamper marine competition and could cause a modal shift from energy efficient short sea ships to higher emitting shore-based modes (rail and truck). Such a shift will have the unintended consequence of creating more air pollution closer to population centers.

More effort should be made to align the environmental goals of the ECA with the U.S. Maritime Administration's 2010 Marine Highway Program which seeks to "use the waterways to relieve landside congestion and attain other benefits that waterborne transportation can offer in the form of reduced greenhouse gas emissions and energy savings." While the 200 nautical mile ECA directly conflicts with the transportation goals of the Marine Highway Program, a 50 mile ECA, as we have proposed in this study, could achieve both the environmental goals of MARPOL while reducing land based congestion.

An informal coalition of Short Sea Shipping led by CSL International was formed in 2011 to better understand the impacts of the ECA and seek responsible and sustainable solutions. The Coalition's significant industrial interests include Martin Marietta, Polaris, Vulica Shipping, U.S. Gypsum, and Transport Desgagnés to name a few. In an effort to best understand the air quality issue, the Coalition commissioned Dr. Ranajit Sahu to formally study low horsepower ships as a demographic of the larger maritime community for which the ECA was designed.

This report *Modeling the Air Quality Impacts of Short Sea Shipping Emissions and the Implication for the North American ECA Study* analyzes short-sea ship emissions using the same CALPUFF and meteorological modeling used by the U.S. Environmental Protection Agency in justifying the current 200 nautical mile ECA. Additionally, 12 ships were selected to represent the "typical" short sea shipping vessel (from a propulsion horsepower perspective and therefore emissions basis). The study analyzes the impact of "worst case" short sea shipping vessels' emissions data on shore air quality.

The study indicates that the smaller ships (with corresponding lower horsepower propulsion systems) used in short sea trades, have virtually no environmental impact on the East or West Coasts of North America beyond 50 miles.

More specifically, the results indicate that ships fitted with propulsion systems of 20,000 horse power (14,913 kW) or less had no (or negligible) air quality impact on the coasts even when using fuel with a sulfur content of 2.6% at 50 miles and beyond.

Collectively, as committed environmental stewards, CSL, Groupe Desgagnés and the Short Sea Shipping Coalition continue to seek to reduce their carbon footprint; as such they fully support the ECA. They disagree, however, with a "blanket" approach to developing the ECA boundaries. Specifically, as thus study demonstrates, we don't believe that 200 nautical miles is an appropriate ECA boundary for all vessels, nor do we feel that it has been scientifically justified.

We urge policy makers to revisit the ECA boundary extent and reduce the 200 nautical mile ECA to 50 miles for 0.1% sulfur fuels (in 2015) for lower emitting ships that meet air quality

performance standards. This revision will align with scientifically based data which achieves the same environmental protection goals.

REGULATORY BACKGROUND

MARPOL Annex VI seeks to minimize airborne emissions from ships including Sulfur Oxides (SO_x), Nitrogen Oxides (NO_x), Ozone Depleting Substances, Particulate Matter (PM), and Volatile Organic Compounds.

A. MARPOL Annex VI

- **1997:** Annex VI (Regulations for the Prevention of Air Pollution from Ships) was added to the MARPOL Convention.

- **2005:** The requirements of Annex VI internationally entered into force on May 19. Among the various technical and operational emission reducing measures outlined in Annex VI is the option for member states to establish ECAs in their domestic waters.

- **2005:** Canada domestically ratified Annex VI allowing domestic enforcement and the eligibility to apply for any ECA.

- **2008:** The United States ratified Annex VI.

- **2009:** Annex VI entered into force domestically on January 8, making the United States eligible to domestically enforce the Annex and also to apply for an ECA. In the United States, Annex VI is applied via the Act to Prevent Pollution from Ships, 33 USC. §§ 1901 et seq., (APPS).

- **2010:** The International Maritime Organization (IMO) approved a joint application by the United States and Canada for the creation of an ECA via Marine Environment Protection committee (MEPC) 59/6/5 entitled "Proposal to Designate an Emission Control Area for Nitrogen Oxides, Sulfur Oxides, and Particulate Matter."

B. Emission Control Areas (ECA)

The North American ECA is designed to reduce air pollution from shipping beyond the scope required for most portions of the globe. Strict 1% sulfur in fuel requirements will take effect in the new 200 nautical mile North American ECA on **August 1, 2012.**

- The fuel sulfur reduction in August 2012 will no doubt represent an increase in fuel prices. However, as an industry, this is likely to be a sustainable increase in operational cost. The added fuel cost will be reflected in corresponding cargo rate increases to customers but is not expected to cause a major modal shift.

- Next, however, the ECA fuel sulfur limit is mandated to be not more than 0.1% starting in 2015. By comparison, a world-wide fuel sulfur limit of 0.5% takes effect in the year 2020.

- Also, by comparison, the U.S. adopted an ECA for the Puerto Rico Caribbean Sea area in July 2011 with a geographical area of approximately 40 x 50 nautical miles. The U.S. used very similar environmental and health statistics to justify the 50 nautical mile ECA for this region as it did when justifying the 200 nautical mile North American ECA on both coasts of the United States and Canada.

SHORT SEA SHIPPING

Sometimes referred to in the U.S. as the "Marine Highway," Short Sea Shipping is the movement of people and cargo on water routes that do not cross an ocean that could also be served by truck or rail. Due to its coastal nature, North American Short Sea Shipping is commonly comprised of Panamax size vessels (and smaller), typically not exceeding 20,000 propulsion horsepower. Short Sea Shipping is an important component of the global strategy to improve air quality by reducing land based congestion and subsequent air pollution from less efficient truck and rail carriers.

A. Short Sea Shipping Coalition

The Short Sea Shipping Coalition was founded by CSL in 2011 to promote the environmental benefits of the short sea trade. The coalition is comprised of industry leaders who depend on short sea shipping as well as short sea providers and non-government agencies. The coalition promotes tough performance based air emission standards for smaller and efficient vessels in the short sea trade.

B. Short Sea Shipping Environmental Value

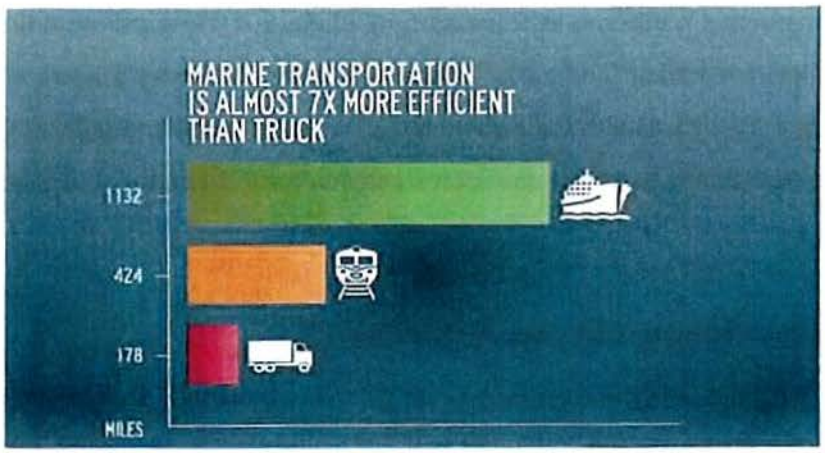
We believe, the inherent environmental value in transporting people and cargo via ship has been undervalued by policy makers in the creation of the North American ECA. When compared to land based options the environmental benefits are obvious. According to Maritime Administration's 2011 Report to Congress: [1]

- "Trucks, on average, can carry one ton of freight for approximately 155 miles on a gallon of diesel fuel (i.e., 155 ton-miles of freight per gallon - equivalent to 842 British Thermal Units (BTU) per ton-mile);
- Rail achieves 413 ton-miles of freight per gallon (i.e., 316 BTU per ton-mile); and
- a tug-and-barge operation can get as much as 576 ton-miles of freight to a gallon of fuel (227 BTU per ton-mile)."

Additionally, self-propelled oceangoing vessels, such as short sea ships, can have significant energy efficiencies over land-based modes beyond those achieved by tug and barge.

[1] America's Marine Highway Report to Congress; Maritime Administration, April 2011 page 22

While the aforementioned was offered in the Maritime Administration's 2011 Report to Congress, the below image represents a separate analysis by CSL which shows the same trends.



CSL Vessel Ton-miles per gallon

"International shipping is currently estimated to have emitted 870 million tons of CO_2 in 2007, no more than about 2.7% of the global total of that year." [2]

"From an environmental perspective...short sea shipping can offer air quality improvement, reduce traffic and mitigate noise pollution...marine shipping tends to have lower environmental and social impacts than land transport."[3]

"America's Marine Highway offers the potential of significantly enhancing the environmental sustainability of the nation's transportation system. In particular, water transportation is often the most energy-efficient means of moving cargo between two points, with corresponding reductions per ton-mile in greenhouse gas (GHG) emissions. Similarly, with appropriate technology and regulation, water transportation is an environmentally-friendly transportation mode that can reduce noise and air pollution and have minimal impacts on water quality. [4]

According to the Maritime Administration's report to Congress delivered in April 2011, water transportation "is available to bring significant freight congestion relief along certain corridors.

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[2] Second IMO GHG Study; 2009, page 3
[3] Making Connections: Short Sea Shipping in Canada; Transport Canada, 2006 page 1
[4] America's Marine Highway Report to Congress; Maritime Administration, April 2011 page 21

A study for U.S. Department of Transportation estimated that there were a total of approximately 78.2 million trailer loads of highway and rail intermodal cargo that moved between origins and destinations 500 miles apart along the United States contiguous coasts in 2003. This long-haul coastal truck and intermodal traffic accounted for 15 percent of total 527 million trailer loads of United States intercity truck and intermodal rail traffic in 2003."[5]

Examining the range of typical CO_2 efficiencies for various loaded cargo carriers; bulk ships produce an average of 2.7 grams of CO_2 per ton-mile while trains range from 10-119 grams per ton-mile. Trucks, by comparison, are the most inefficient of the transportation options ranging from 80-181 grams of CO_2 per ton-mile (data excerpted).[6]

C. Short Sea Shipping Economic Value

Based on an October 18, 2011 study titled: "The Economics of the Great Lakes - St. Lawrence Seaway System,"[7] Short Sea Shipping on the Great Lakes alone contributes to:

- $33.6 Billion in economic activity;
- 227,000 United States and Canadian jobs; and
- $4.6 Billion United States and Canadian tax revenue.

CHALLENGES TO SHORT SEA SHIPPING

Short Sea Shipping is the marine segment most impacted by the pending 200 nautical mile North American ECA. The Short Sea Shipping Coalition, under the leadership of CSL International and Transport Desgagnés, sponsored this detailed independent dispersion study applying the same parameters, metrological data, and CALPUFF modeling used by EPA. The study specifically uses emission data from CSL's North American fleet to best represent the short sea segment of the marine transportation system. This study undisputedly supports a performance-based ECA reduction to 50 miles for smaller ships comprising the Short Sea Shipping demographic.

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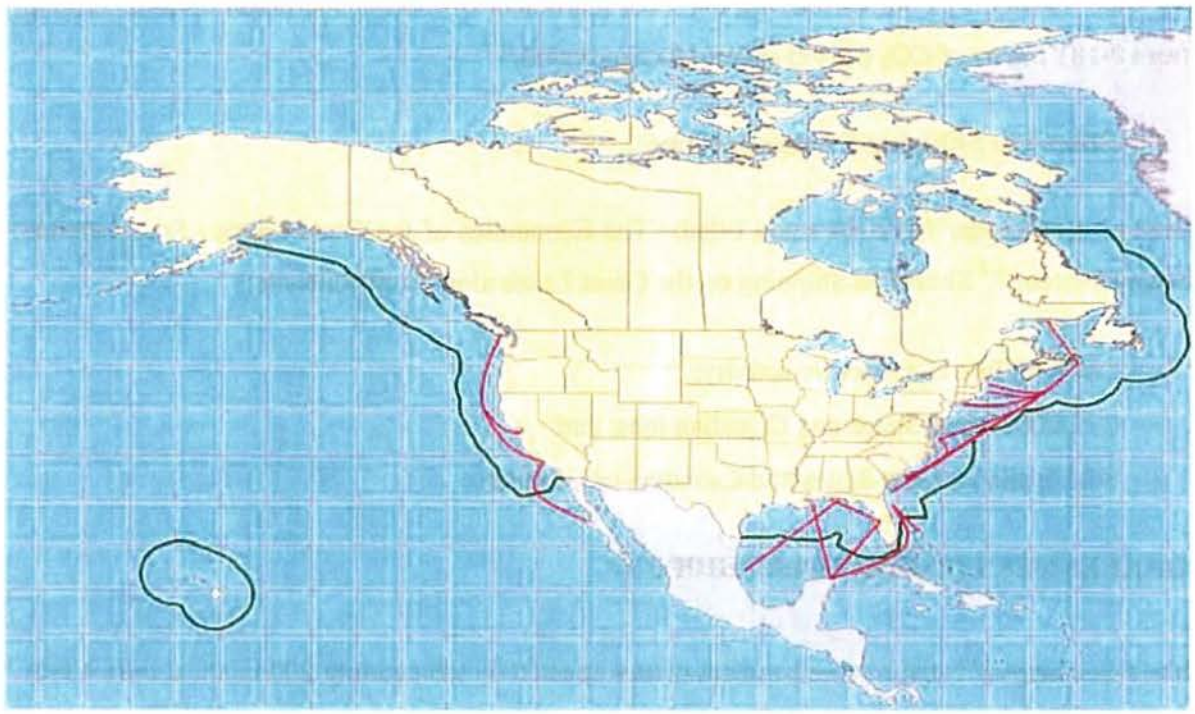
[5] Ibid, page 12
[6] MEPC 59/INF.10 ANNEX; April, 2009
[7] The Economics of the Great Lakes - St. Lawrence Seaway System; Martine Associates, October 18, 2011, Page 5.

Without a change in the ECA boundaries, the impact on the inherently "green" short sea shipping segment will be far greater than for ships engaging in trans-ocean voyages. Short sea shipping routes tend to be more coastal and, in many cases, almost entirely within the ECA, while trans-ocean vessels will only operate in the ECA for a small fraction of their total voyage. The 2012 fuel price impacts, for CSL as an example, while sustainable, will still be measured in millions of dollars. When the 2015 sulfur limits take effect, fuel cost increases for CSL and its customers could easily cause a modal shift to land transportation.



Typical North American Short Sea Routes

A. Air Quality

In this study, in addition to the green-house has emissions discussed above, we focused on sulfur dioxide (SO_2), the major pollutant whose emissions will be affected by the fuel sulfur requirements in the ECA.

- ***The SO_2 Standard***: The U.S. EPA has promulgated various National Ambient Air Quality Standards (NAAQS)[8] and thereby defined acceptable levels of major air pollutants, including for SO_2 in the ambient air to which the public has general access. The purpose of the NAAQS is to protect the public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. The SO_2 NAAQS was recently (June 2010) modified to add a 1-hour average standard of 75 parts per billion (ppb). This corresponds to a concentration of **196 micrograms per cubic meter**. It is currently the most stringent SO_2 standard in the U.S.

Our analysis conservatively predicts that SO_2 concentrations are well below the numerical value of the 1-hour SO_2 NAAQS even when ships are at port. Moreover, this prediction is based on applying a fuel sulfur level of 2.6%, which, as stated above, is expected to drop to 1% fuel sulfur level in August 2012. The study also indicates that SO_2 concentrations along the coasts drop off dramatically as the distance from the ship to shore increases. Thus, based on the modeling analysis, the outward extent of the ECA could be much smaller (of the order of 50 miles or smaller), while still not adversely impacting coastal air quality.

The largest ship (in terms of rating) used in the study for the eastern domain has an engine size of approximately 12000 kW. Thus, for a 12000 kW engine, the maximum hourly SO_2 emissions using 2.6% sulfur in fuel is 9.91 * 12000/1000 = 120.6 kg/hr. The SO_2 emission rate using 1% sulfur in fuel is 3.81 * 12000/1000 = 46.4 kg/hr.

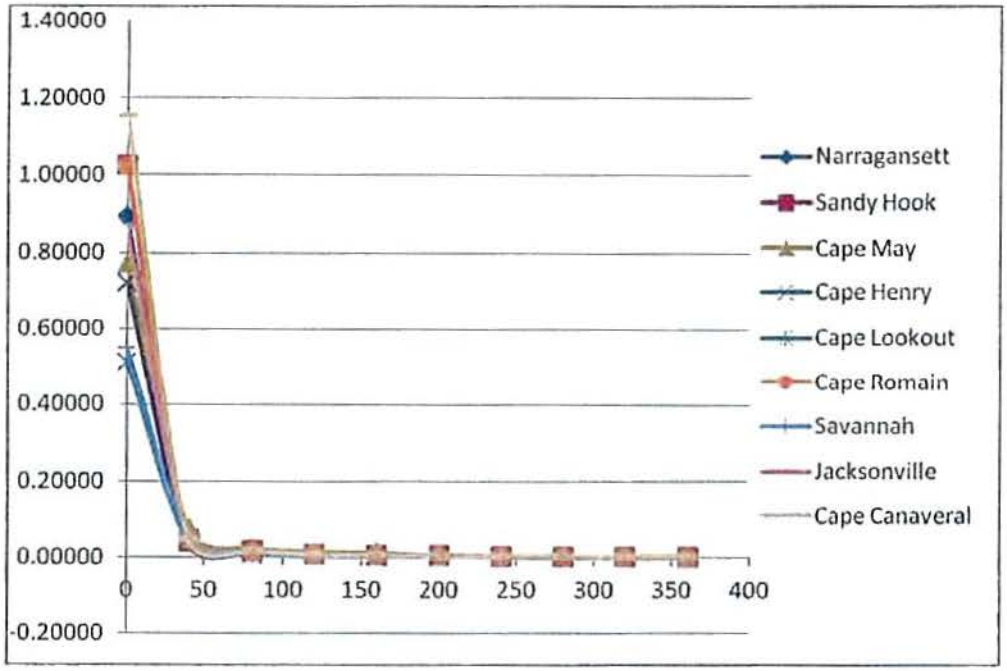
The calculated SO_2 rates above are also conservative in that the engine load is typically 75% of its maximum power during a voyage (as opposed to 100% assumed in the study), and which is even lower as the ship approaches port. While in port, engine power may be a small fraction (20% to 40%) of its maximum power. Thus, the actual SO_2 emission rates would be 20% to 75% of the rates calculated in the study or in range of 24 kg/hr - 95 kg/hr for a 12000 kW ship with 2.6% sulfur in fuel and in the range of 9 kg/hr - 35 kg/hr for this same 12000 kW ship with 1% sulfur in fuel.

[8] See http://www.epa.gov/air/criteria.html.

Similarly, the largest ship studied in the western domain is rated around 11500 kW. Using the same types of calculations above, the range of SO_2 emissions from a ship of this size will be 23 kg/hr - 91 kg/hr (maximum of 114 kg/hr) with 2.6 % sulfur in fuel and in the range of 8.6 kg/hr - 34 kg/hr (maximum of 44 kg/hr) with 1% sulfur in fuel.

Using the highest expected SO_2 emission rate discussed above of 120.6 kg/hr (for the **largest** ship, **at maximum** power, emitting at exactly the meteorological conditions that would provide the **highest** impact, and assuming a fuel sulfur content of **2.6%**), the highest modeled port 1-hour SO_2 concentration would be 1.156*120.6 = 139.4 micrograms/cubic meter: **far lower than even the numerical value of the EPA SO_2 NAAQS of 196.**

The results demonstrate how insignificant the impact of these short-sea ships is on coastal air quality.



East Coast Offshore SO_2 Dispersion

CREATING A "WIN-WIN"

The anticipated significant fuel cost increase in 2015 may trigger a modal shift causing an unintended increase in land based congestion and emissions which can be avoided by reducing the 2015 ECA to 50 miles for 0.1% sulfur fuels in 2015 for smaller ships.

A reduction in the ECA boundary for the 0.1% sulfur fuels in 2015 will deliver the same environmental benefits suggested while supporting an industry which is already a greener alternative. The flexibility in fuel options will assure economic sustainability to those company's already under strain from the current recession.

A. Maximize the Marine Highway Program

The North American ECA, as currently defined, stands as an obstacle to realizing the environmental and economic potential of the Marine Highway Program. "Between 1980-2003 the tons per mile moved by inter-city truck increased by 128%. Also during this period, vehicle miles in the United States have increased by 50% creating more road congestion and noise than ever before."[9]

Marine transportation is credited with removing over 60,000 trucks from congested urban roads of southern Ontario and Quebec.[10]

Considering an average long haul truck can carry 26 tons of cargo and a Handy Size short sea vessel can carry a pay load of over 50,000 tons, the short sea trade removes 1,923 trucks from American and Canadian roads, easing congestion and the emissions they produce. Similarly, the same ship would remove 819 rail cars, assuming a capacity of about 61 tons per rail car. Enhanced Short Sea Shipping will:

- Remove low efficiency trucks from the road;

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[9] America's Marine Highway Report to Congress; Maritime Administration, April 2011 page 16
[10] Making Connections: Short Sea Shipping in Canada; Transport Canada. 2006 page 5

- Lessen higher emitting rail volume; and
- Improve social benefits including reduced road congestion and noise.

All while maintaining the improved marine air quality standards called for in Annex VI.

PRECEDENCE FOR EFFECTIVE ALTERNATIVES

There have been several other examples of recent practical solutions entertained by the EPA, Transport Canada and Environment Canada in achieving mutual clean air goals.

A. Steamship Exemption

Following the adoption of Annex VI and the creation of the ECA, the United States recognized, the unique challenges faced by older steam ships. The older vessels' obsolete technology proved to be incompatible with using ultra low sulfur marine distillate fuels. Thus, the United States formally exempted the entire demographic of steam ships from the ECA requirements until 2020. The United States' submission[11] to the IMO was adopted at the 62nd session of the Marine Environmental Protection Committee in July of 2011.

B. Great Lakes Steamship Repower Incentive Program

Again, as the environmental and economic realities of the North American ECA continued to be assessed, the EPA recognized the environmental advantages of waiving the lower sulfur fuel requirements for Great Lakes steam ships [that were] repowered with more efficient modern diesel propulsion.[12] In January of 2012, the EPA amended Title 40 Code of Federal Regulations Part 1043 to incentivize Great Lakes steamship owners "to repower those steamships with cleaner marine diesel engines. The simplified program will automatically permit the use of residual fuel, through December 31, 2025, in a steamship if it has been repowered with a certified Tier 2 or later marine diesel engine, provided the steamship was operated exclusively on the Great Lakes and was in service on October 30, 2009."[12]

C. Fleet Averaging

[11] MEPC 61/7/6; U.S., July 19, 2010

[12] Federal Register 77 FR 2472; U.S. EPA, January 18, 2012

Transport Canada, in an effort to ease devastating impacts to Canadian Great Lakes ship owners, proposed a Fleet Averaging Program which provides an alternative to improving air quality. The Fleet Averaging Program requires Canadian Great Lakes vessels to gradually reduce their fuel sulfur content from 2012-2020. The program permits a company's fleet of vessels to collectively meet pre-established annual fuel sulfur targets through the use of lower sulfur fuels, exhaust gas treatment, or a combination of measures. Transport Canada will oversee and monitor the industry to assure compliance. By 2020, each ship must individually meet the ECA 0.1% fuel sulfur content standard.

RECOMMENDATION

As responsible carriers, our client CSL and the Short Sea Shipping Coalition proudly support and promote the North American ECA as a valuable tool to reduce maritime contributions to global emissions. Nevertheless, as currently designed, portions of the North American ECA do not consider the value of Short Sea Shipping in the greater environmental picture. Moreover, the impact of the current ECA's flaws could inadvertently reduce air quality through modal shift.

If left uncorrected, the anticipated fuel prices in 2015 will significantly raise cargo rates without gaining any environmental benefit.

Our clients seek to align the 2015 ECA to a sustainable size while exceeding air quality goals set by the EPA and Environment Canada through a performance based approach. Our study indicates that vessels of 20,000 horsepower, are capable of meeting and exceeding desired air quality goals when using fuel with sulfur content of 2.6% at a distance of 50 miles. Therefore, we recommend:

- a 200 nautical mile ECA for 1% sulfur fuels effective August 1, 2012 (as currently accepted);
- a 50 nautical mile ECA for 0.1% sulfur fuels for vessels of less than 20,000 horsepower (14,913 kW); and
- a mechanism to indemnify vessel owners who are unable to purchase low sulfur (0.1% sulfur) fuel due to regional unavailability.

This alternative dove-tails with the Maritime Administration's 2010 Marine Highway program and Transport Canada's short sea shipping initiatives and will best serve the coastal environment by comprehensively improving air quality while reducing risk, hazard and inconvenience of over-used road and rail systems.

I. INTRODUCTION TO THE ANALYSIS

The United States Environmental Protection Agency (U.S. EPA) has proposed the creation of an emission control area (ECA) for nitrogen oxides (NO_X), sulfur dioxide (SO_2), and particulate matter (PM) (U.S. EPA 2009). The proposal would designate an ECA in which emissions from vessel activity would be reduced via lowered fuel sulfur content and other control measures. Presently, the extent of the ECA is 200 nautical miles[13] from the coast. However, when establishing the distance from the shoreline to include as the ECA domain, it is useful to examine the expected air quality impacts that would occur due to shipping activity at varying distances from the shoreline.

Based on guidance provided by Dr. Ranajit (Ron) Sahu,[14] in consultation with Canada Steamship Lines Inc. (CSLI) and Transport Desganges Inc.[15], an atmospheric dispersion modeling study was conducted by Dr. Andrew Gray[16] to determine the air quality impacts (specifically for sulfur dioxide or SO_2) at shoreline receptors due to emissions from a class of oceangoing vessels – namely short-sea shipping[17] vessels that make voyages that are generally parallel of the east and west coasts of the North American continent, transporting various materials in and out of Canadian and U.S. ports.[18] Hypothetical emission sources representing a typical vessel were placed at several locations along east-west lines extending outward from several ports along the east and west coasts of the United States. Dispersion modeling was used to estimate the maximum hourly SO_2 concentration impacts from each of the modeled sources at hundreds of receptors located along the coastlines. The model results provide an indication of the distance at

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[13] 1 nautical mile is 1.852 kilometers. Thus, the 200 nautical mile ECA extends to approximately 370 kilometers from each coast, following the contour of the coast. All distances in this report will be noted in kilometers since that is the customary unit of distance used in dispersion modeling analyses.

[14] The resume for Dr. Sahu is provided in Appendix A to this report.

[15] CSLI and Transport Desgagnes Inc. are key short shipping carriers along both coasts of the North American continent.

[16] The resume for Dr. Gray is provided in Appendix A to this report.

[17] This study analyzes the impact of the ECA on short-sea shipping vessels. Short-sea shipping refers to voyages made by small ships (on a vessel dead weight ton (DWT or engine horsepower basis) that make port calls along numerous ports on the east and west coasts of North America. As such, they transport cargo in direct competition to shore-based counter parts such as rail or trucks. It is well established that on a per-gallon of fuel used basis, short-sea shipping is far more efficient in transporting cargos than any other land-based mode such as road (trucks) or rail. Voyages tend to be generally parallel to the coasts and at distances that are relatively close to the coasts.

[18] , By their nature, short-sea shipping vessels spend substantially more time within the ECA domain as current envisioned. This is in marked contrast to other vessels such as large, trans-continental vessels or even cruise ships, which approach each coast in a generally perpendicular manner, and whose voyages within the ECA domain are therefore a relatively small fraction of their total voyage distance or time.

which the impacts become small relative to the impacts from sources located at the shoreline (i.e., in port).

All modeling, as is customary, was done using "unit" emission rates from the source (i.e., the ship) since predicted concentrations vary linearly with the emissions. Later, selected (i.e., maximum) model-predicted concentration results were converted to predicted maximum emission impacts, using expected maximum emission rates from the ship using maximum current sulfur levels (around 2.5% sulfur) in the fuel.

The modeling approach included the use of a sophisticated spatially-resolved meteorological dataset, developed using the Fifth Generation Penn State/NCAR Mesoscale Model (MM5), which was input to the CALMET model adiagnostic three-dimensional meteorological model (used by the U.S. Environmental Protection Agency (EPA)This was followed by application of the CALPUFF dispersion model to simulate the fate of SO_2 emissions from oceangoing vessels. CALPUFF is a multi-layer, multi-species non-steady-state Gaussian puff dispersion model that simulates the effects of time- and space-varying meteorological conditions on pollutant transport, transformation and removal. CALPUFF can be applied reliably on scales of a few meters to several hundreds of kilometers. It includes algorithms for sub-grid scale effects such as terrain impingement, as well as longer-range effects such as pollutant removal due to wet scavenging and dry deposition (Scire et al., 2001a).

Some of CALPUFF's non-steady-state features include the model's ability to handle transport in complex terrain, stagnant and light wind flow conditions, horizontal and vertical wind shear, nocturnal temperature inversions, and recirculation flows. The CALPUFF model considers the spatial variability in surface conditions (elevation, surface roughness, land use type, vegetation, etc.), as well as the spatial and temporal variability in meteorological conditions. In April 2003, the U.S. EPA revised their Guideline on Air Quality Models to include the CALPUFF modeling system as the preferred air quality modeling tool for assessing long-range transport of pollutants and their impacts on Federal Class I areas and on a case-by-case basis for certain near-field applications involving complex meteorological conditions (U.S. EPA, 2003). Further details of the CALPUFF modeling system, including the scientific formulation, extensive peer-reviews, model validation studies, and regulatory status can be found elsewhere (Scire et al., 2001a,b).

The remainder of this report describes the modeling application. including meteorological data processing using the MM5 data and CALMET, dispersion modeling using CALPUFF, and postprocessing using CALPOST. Model results are then briefly examined. Next, the maximum modeled impact is compared, in a very conservative fashion, to the most stringent (i.e., 1-hour) SO_2 U.S. National Ambient Air Quality Standard (NAAQS).

The study shows that, even with numerous conservative assumptions (namely the use of fuel sulfur level of 2.6%, which is expected to drop to 1% fuel sulfur level, and the selection of the "worst-case" or largest ships) predicted SO_2 concentrations are well below the numerical value of the 1-hour SO_2 NAAQS even when ships are at port. We also show that these concentrations along each coast drop off dramatically as the distance from the ship to shore increases. Thus, based on the modeling analysis, the outward extent of the ECA could be much smaller (of the order of 50 miles or smaller), while still not adversely impacting shore-based receptors. This would allow short-sea shipping to continue to economically operate outside a properly designated ECA, using 1% sulfur fuels for most of their voyage durations, thereby providing a critical parallel path of the transport of numerous goods that would otherwise be shifted over to land-based modes such as rail or trucks, which would have far greater impacts on receptors and population centers.

II. METEOROLOGICAL MODELING (CALMET)

Output data from the Fifth Generation Penn State/NCAR Mesoscale Model (MM5) was utilized to provide the initial conditions for the CALMET diagnostic meteorological model. MM5 is a three-dimensional prognostic weather model maintained by the National Center for Atmospheric Research (NCAR). The model includes four-dimensional data assimilation (FDDA), whereby the resulting meteorological fields are forced to be consistent with surface and upper air observations and satellite data, while maintaining dynamic balance at the same time. The MM5 results using FDDA represent a high resolution vertically-resolved gridded set of meteorological fields, including wind speed and direction, atmospheric pressure and temperature (Dudhia et al., 2003).

The 2001-2003 MM5 data set[19] (Sahu 2011a) includes hourly winds and other meteorological data at each of 34 vertical layers for the entire continental United States on a 36 by 36 km horizontal grid system that follows a Lambert Conformal map projection. The central reference point for the mapping projection (a point where the horizontal and vertical grid lines run true north-south and east-west) was at latitude 40°N and longitude 97°W, with standard parallels at 33°N and 45°N latitudes. The entire domain for which MM5 data were available for this study is shown in Figure 1. Subsets were extracted from the national MM5 data set for modeling the impacts of off-shore shipping emissions along the eastern and western coasts of the United States.

The selected eastern modeling domain is a 900 km x 2,520 km rectangle, as shown in Figure 2a, following the same Lambert Conformal map projection as the MM5 data set. The CALMET computational grid for the eastern CALPUFF simulations contains 28,000 (100 x 280) 9 km horizontal grid cells within the 900 km x 2,520 km modeling domain shown in Figure 2a. Each horizontal grid cell is divided into 11 computational vertical layers, so the total number of computational cells within the model is 308,000 (100 x 280 x 11).

[19] This is a widely used data set for modeling applications for numerous air quality sources. By modeling for three full years of meteorological data, variability in meteorological conditions is expected to be fully captured by the analysis.

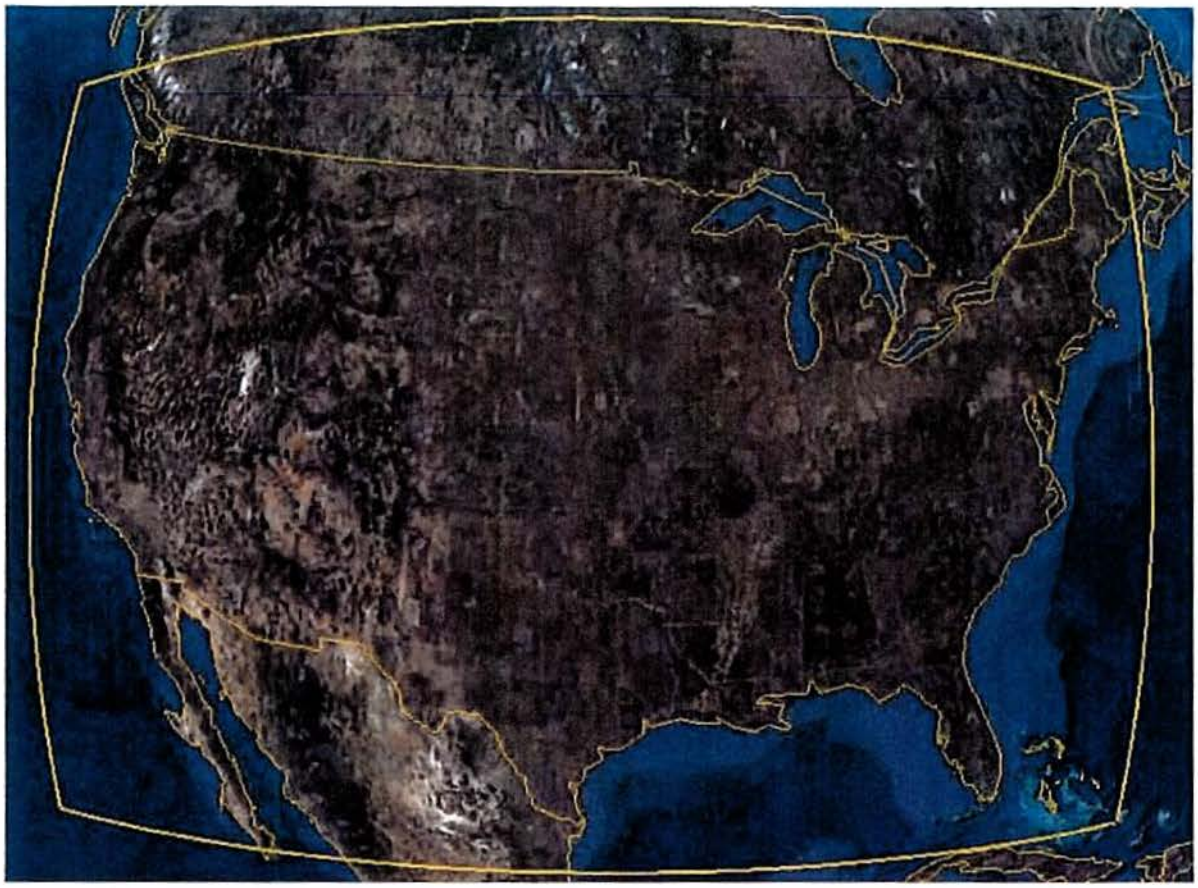

Figure 1. MM5 Modeling Domain

The selected eastern modeling domain is a 900 km x 2,520 km rectangle, as shown in Figure 2a, following the same Lambert Conformal map projection as the MM5 data set. The CALMET computational grid for the eastern CALPUFF simulations contains 28,000 (100 x 280) 9 km horizontal grid cells within the 900 km by 2,520 km modeling domain shown in Figure 2a. Each horizontal grid cell is divided into 11 computational vertical layers, so the total number of computational cells within the model is 308,000 (100 x 280 x 11).

The selected western modeling domain is a 792 km x 2,808 km rectangle, as shown in Figure 2b, also following the same Lambert Conformal map projection as the MM5 data set. The CALMET computational grid for the western CALPUFF simulations contains 27,456 (88 x 312) 9 km horizontal grid cells within the 792 km by 2,808 km modeling domain shown in Figure 2b. Each horizontal grid cell is divided into 11 computational vertical layers, thus the total number of computational cells within the model is 302,016 (88 x 312 x 11).

Figure 2b. Western Domain

Figure 2a. Eastern Domain

Figure 2. Eastern and western modeling domains

The CALMET meteorological model (version 6.326, July 9, 2008; Scire et al., 2000b), part of the CALPUFF modeling system, was used to prepare the meteorological data necessary for CALPUFF execution. The CALMET model combined the vertically-resolved MM5 data (specified horizontally every 36 km) with fine-scale terrain effects, to develop three-dimensional wind fields on the 9 km computational grid. No additional surface or upper-air data were necessary (i.e., NOOBS=2). In addition to the time-varying wind fields, other meteorological data are needed to characterize atmospheric conditions. Using the MM5 model output data, CALMET generated a set of time-varying micrometeorological parameters (hourly 3-dimensional temperature fields, and hourly gridded stability class, surface friction velocity, mixing height, Monin-Obukhov length, convective velocity scale, air density, short-wave solar radiation, surface relative humidity and temperature, precipitation type, and precipitation rate) for input to CALPUFF.

In addition to meteorological input data, CALMET requires a number of geophysical data sets, including terrain elevation, land use type, surface characteristics (roughness length, albedo, Bowen ratio, soil heat flux parameter, and vegetation leaf area index) and anthropogenic heat flux. Gridded terrain elevation data for the eastern and western offshore modeling domains were obtained from the Global 30 Arc-Second Elevation Data Set (GTOPO30) distributed by the U.S. Geological Survey (USGS, 1997). Four "tiles" of the global data set, representing the area north of the equator, between 60°W and 140°W longitude were obtained to provide elevation data for the two modeling domains. Elevations in GTOPO30 are regularly spaced at approximately 1 km horizontal intervals. The TERREL preprocessing program was used to extract the required elevation data from the GTOPO30 data for use in CALMET.

The North America Land Cover Characteristics Data Base (Version 2.0) is part of a global land cover characteristics data base containing a number of land use classifications, and includes the USGS Land Use/Land Cover (LULC) System. The Lambert Conformal LULC data set for North America (USGS, 1999), consisting of gridded fractional land use data, was re-mapped into the 14 default CALMET land use categories on the gridded modeling domain. These data were then used to develop gridded fields of the surface parameters (roughness length, albedo, etc.) and anthropogenic heat flux which are required inputs to CALMET. In the process of allocating the raw LULC data to the modeling domain (using the CTGPROC program), at least 68 "hits" were recorded in each of the 9 km x 9 km grid cells, providing confirmation that the land use and land cover characteristics are well represented statistically within each computational grid cell.

The CALMET model produced complete sets of hourly three-dimensional wind fields and other micrometeorological data on the 9 km x 9 km gridded eastern and western modeling domains, as shown in Figures 2a and 2b for the years 2001, 2002 and 2003. These data were then used as input to the CALPUFF dispersion model.

III. DISPERSION MODELING (CALPUFF)

The CALPUFF dispersion model was used to estimate the air quality (concentration) impacts due to a number of identical stationary sources, placed along approximate east-west lines, extending outward from a number of selected ports. The modeled ports in the eastern domain are, from north to south, Providence, RI (Narragansett); Sandy Hook, NJ; Cape May, NJ; Cape Henry, VA; Cape Lookout, NC; Cape Romain, SC; Savannah, GA; Jacksonville, FL; and Cape Canaveral, FL. A source was located at each port. Additional sources were placed every 40 km extending eastward out to 360 km from each port (with the exception of Narragansett, for which sources only extend out to 280 km). This is shown in Figure 3a.

The modeled ports in the western domain are, from north to south, Vancouver, BC (located near Pt. Renfrew at the mouth of the Juan de Fuca Strait); Portland, OR (located near Astoria at the mouth of the Columbia River); Bay Area, CA (located at the "Golden Gate" – the western edge of San Francisco Bay); Los Angeles, CA (Harbor); San Diego, CA; and Ensenada, MX. Additional sources were placed every 40 km on approximate east-west lines extending westward out to 360 km from each port (with the exception of the Bay Area, for which sources only extend out to 240 km). This is shown in Figure 3b.

The emissions and stack characteristics for all modeled sources were identical. The SO_2 emissions rate for each source was set to a unit rate (1 kg/hr). The stack parameters were for a "typical" vessel and were obtained by averaging stack data from various different vessels (Sahu 2011b), as shown in Table 1.[20] In turn, Dr. Sahu obtained these parameters from

[20] For the six vessels (labeled A through F), for which all required stack data were available, additional model runs were later performed using these vessel-specific stack parameters to examine the sensitivity of the model results to the selection of stack parameters. Additional details for these vessels, demonstrating their relatively small size (as compared to the larger trans-oceanic cargo/tanker or cruise ships) is provided in Appendix B.

Table 1. Vessel Stack Characteristics

Vessel	Stack Height (m)	Stack Diameter (m)	Exit Velocity (m/s)	Exit Temp (deg C)
A CSL Atlas	29.4	1.3	12.8	613
B Sheila Ann	28.1	0.8	27.3	566
C CSL Acadian	29.0	1.6	7.9	593
D CSL Argosy	29.9	1.35	10.6	533
E Eastern Power	25.24	1.1	13.3	563
Average used for modeling	**28.1**	**1.23**	**14.4**	**575**
F Cape Vessel Generic	37.0	1.1	27.6	623

Figure 3b. Western Modeled Sources **Figure 3a. Eastern Modeled Sources**

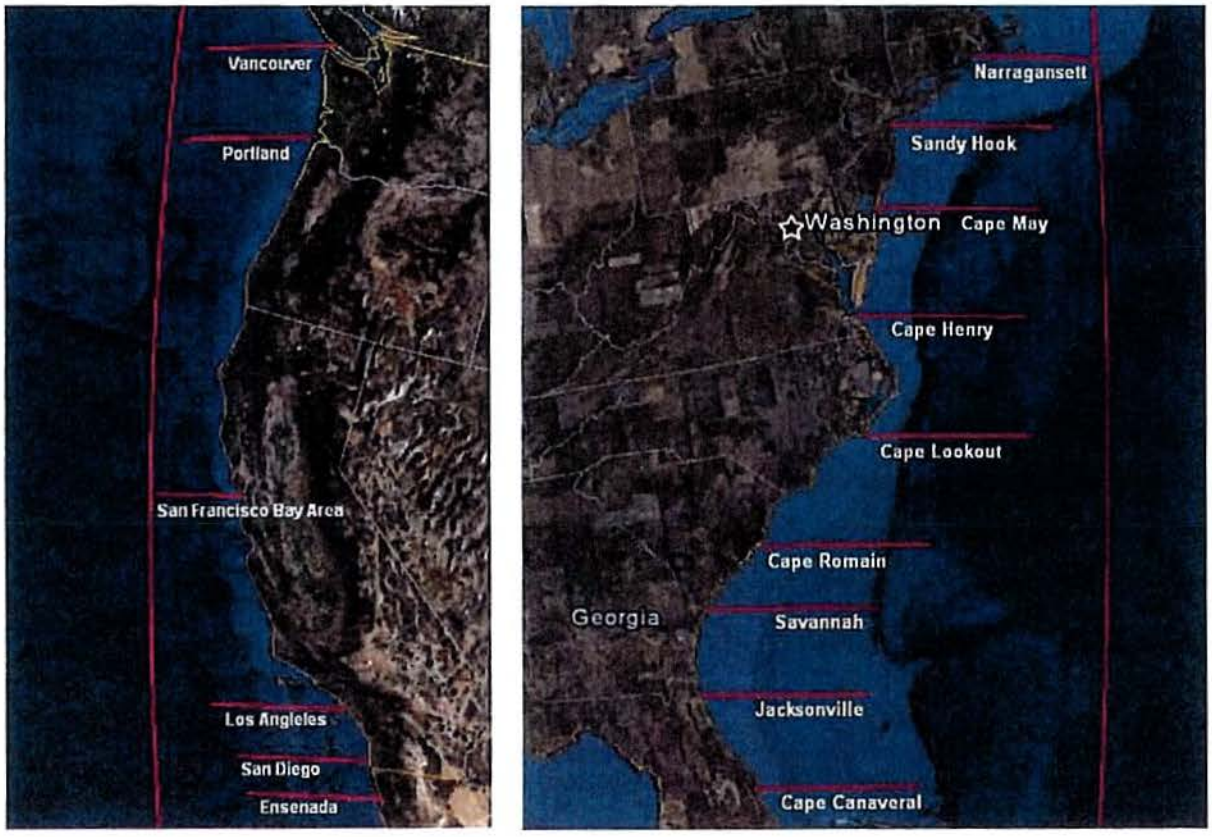

Figure 3. Modeled Source Lines.[21] Emission sources (i.e., the ship) were placed at 40 km intervals along each of the red east-west lines extending from each port)

[21] As noted earlier, except for Naragansett in the eastern domain and the Bay Area in the western domain, all of the other port east-west lines extend to 360 km from the coast. This is approximately the same distance as the ECA

Receptors were placed along both coastlines[22], spaced approximately every 8 to 10 km (the maximum distance between any two adjacent receptors is 13 km). There were 272 receptors placed between Gloucester, MA and Jupiter, FL along the east coast, accounting for a cumulative distance (from receptor to receptor) of 2,655 km. Along the west coast, 348 receptors were placed from northern Vancouver Island, BC, southward to San Quintin (Baja California). The cumulative distance for the west coast receptors is 2,910 km. There was a receptor placed at each port (coinciding with the location of the modeled source at each port). The elevation at each receptor height was determined by interpolating the GTOPO30 elevation data set using the TERREL preprocessor.

The CALPUFF dispersion model (version 6.262, 25 July 2008; Scire et al., 2000a) was run using the output from the CALMET meteorological model. CALPUFF was run separately for each source, located either at one of the modeled ports, or along the east-west lines extending out to sea from each port. The model was run in an inert mode, i.e., the atmospheric chemistry module within CALPUFF that accounts for the oxidation and conversion of SO_2 to sulfate was turned off.[23] The model's output consisted of hourly estimates of ambient SO_2 concentrations at each coastal receptor due to the emissions from each source.

Upon completion of the CALPUFF modeling, the predicted hourly SO_2 concentrations were summarized using the CALPOST postprocessor. CALPOST was used to determine the maximum one-hour average SO_2 concentration for the entire model year at each receptor (and also the 99th percentile, which corresponds to the 4th highest daily maximum one-hour average), for each of the modeled sources.

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domain. The Naragansett and Bay Area lines were truncated since meteorological data beyond what is shown by the vertical red lines in Figures 3a and 3b, was not available.

[22] Model test runs were performed using inland receptors. It was observed that the concentration impacts dropped off rapidly as the receptors moved further inland, relative to the impact at the coastline. Receptors placed along the coastline would therefore be expected to capture the peak impacts from each modeled coastal or off-shore source. Therefore additional inland receptors were not used.

[23] The oxidation of SO_2 in the atmosphere is a relatively slow process, typically accounting for the conversion of, at most, a couple percent per day (especially over the ocean). By ignoring the SO_2 chemistry within the CALPUFF model, the resulting predicted SO_2 concentrations are very slightly overestimated, and therefore represent conservative estimates of the air quality impacts associated with the emissions from the modeled sources.

The CALPUFF model was run for a full year (2001) for all sources along all source lines, as shown in Figure 3. Additional model runs were performed to examine the impacts for two additional years (2002 and 2003) for one of the source lines (Cape Henry).

IV. MODEL RESULTS

The CALPUFF model was used to estimate hourly average SO_2 concentrations at each coastal receptor due to a constant unit (1 kg/hr) of SO_2 emissions from each modeled source. The model results for the individual sources located along each source line were plotted together in order to compare the relative impacts from shipping sources as they move further out to sea. Example plots for a subset of the modeled ports (and the sources extending outward to 240 km away from each port) are shown in Figures 4 through 9 (the value in parentheses following each port name indicates the receptor number that is co-located at the port).

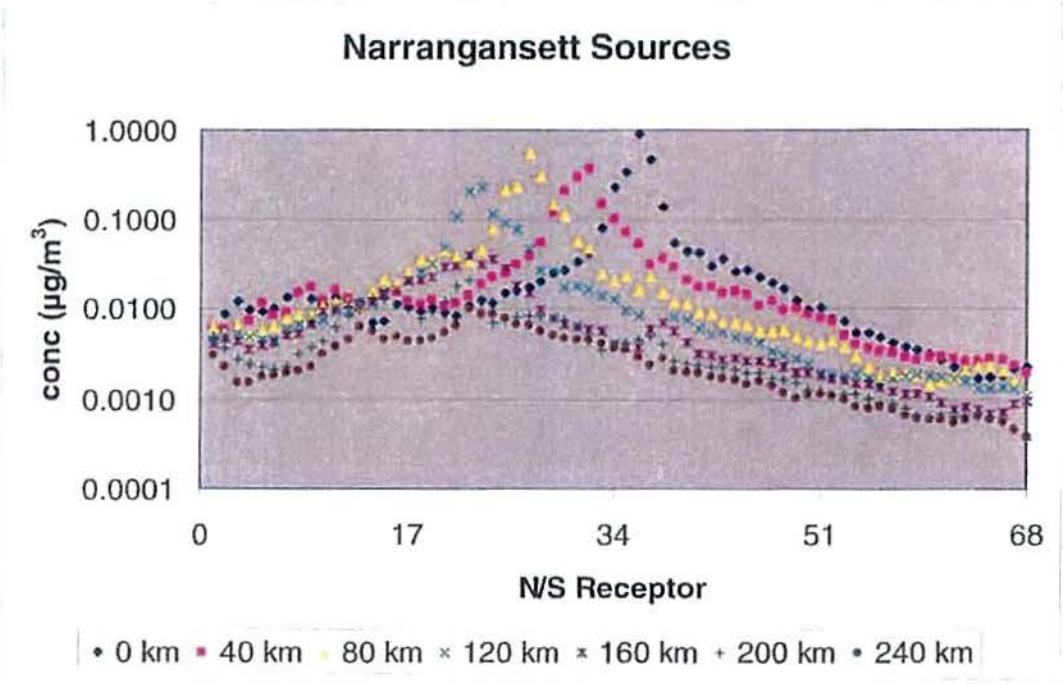

Figure 4. Peak 1-hr SO_2 Concentrations for Sources along Narragansett Line (36)

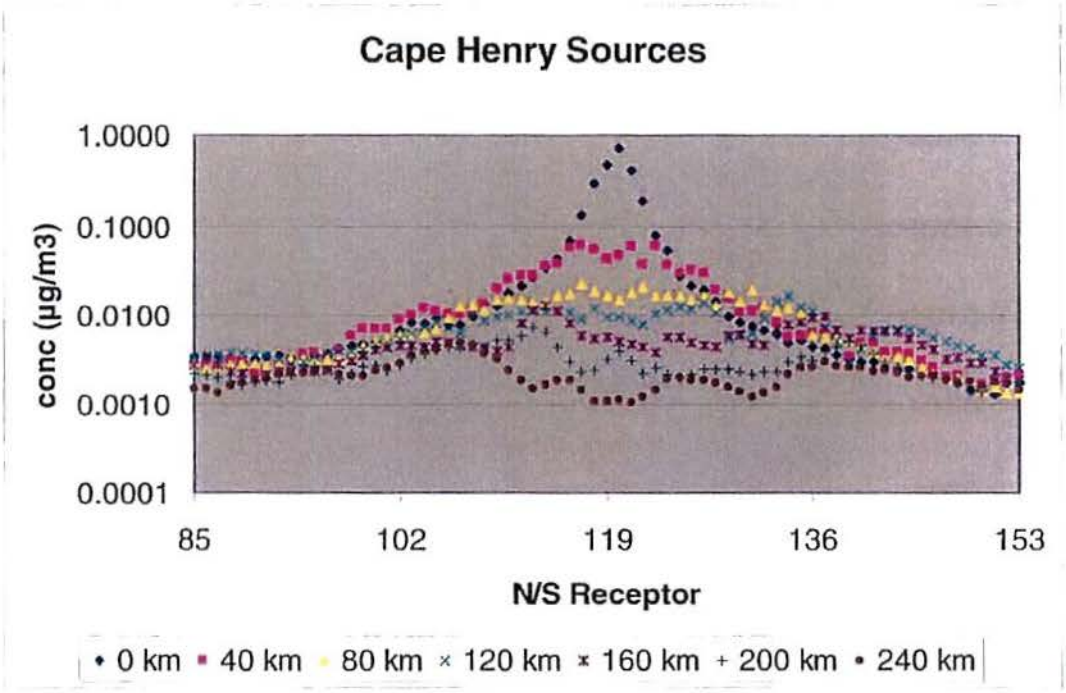

Figure 5. Peak 1-hr SO_2 Concentrations for Sources along Cape Henry Line (120)

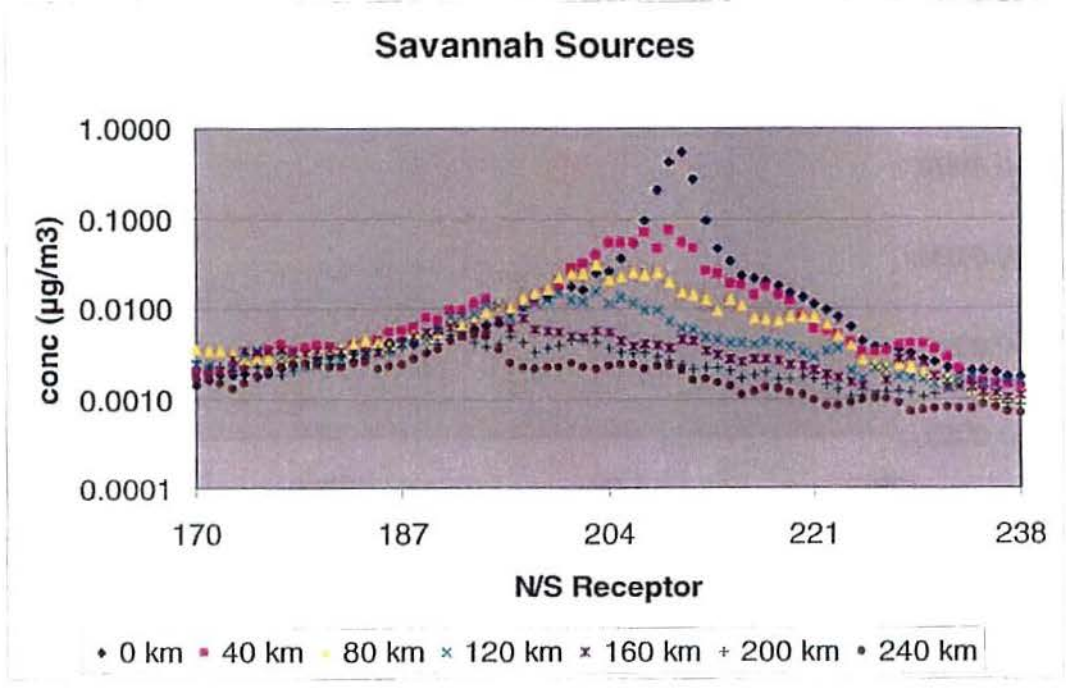

Figure 6. Peak 1-hr SO_2 Concentrations for Sources along Savannah Line (210)

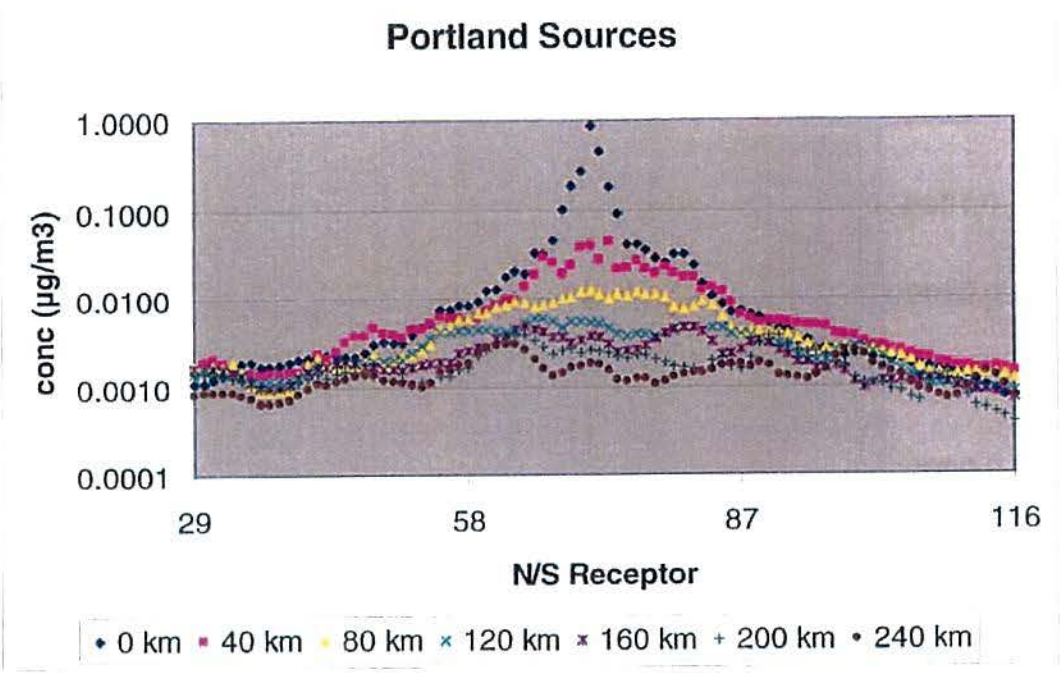

Figure 7. Peak 1-hr SO_2 Concentrations for Sources along Portland Line (71)

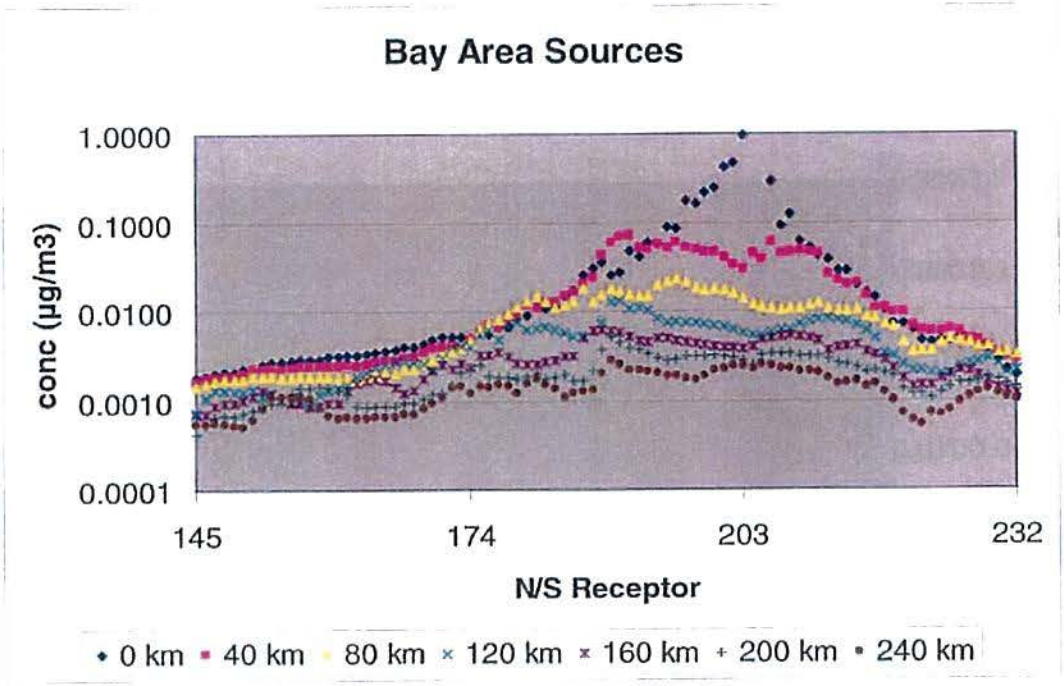

Figure 8. Peak 1-hr SO_2 Concentrations for Sources along Bay Area Line (204)

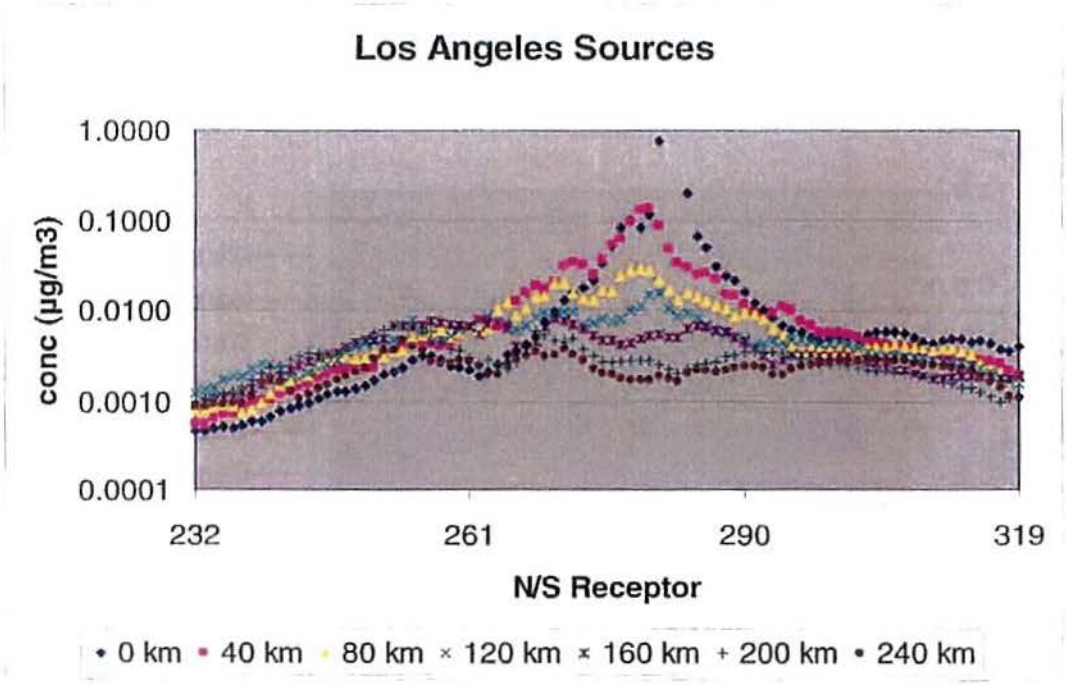

Figure 9. Peak 1-hr SO_2 Concentrations for Sources along Los Angeles Line (282)

As can be seen in Figures 4-9, the peak modeled impacts were at or near the port (at the origin of each source line). The peak impacts decrease dramatically for receptors up or down the coast located away from each port (origin of source line). Depending on the shape of the coastline, the impacts reduce approximately two orders of magnitude relative to the peak impacts (at or near the port) as one moves to receptors located about 140 to 200 km away from the port.

As each ship moves further away from the port (out to sea), the peak impact also decreases rapidly. Figures 10 and 11 show the peak (maximum) modeled hourly SO_2 concentrations for each modeled source, normalized (divided) by the peak hourly concentration for the source located at the port, as a function of the distance from the port.

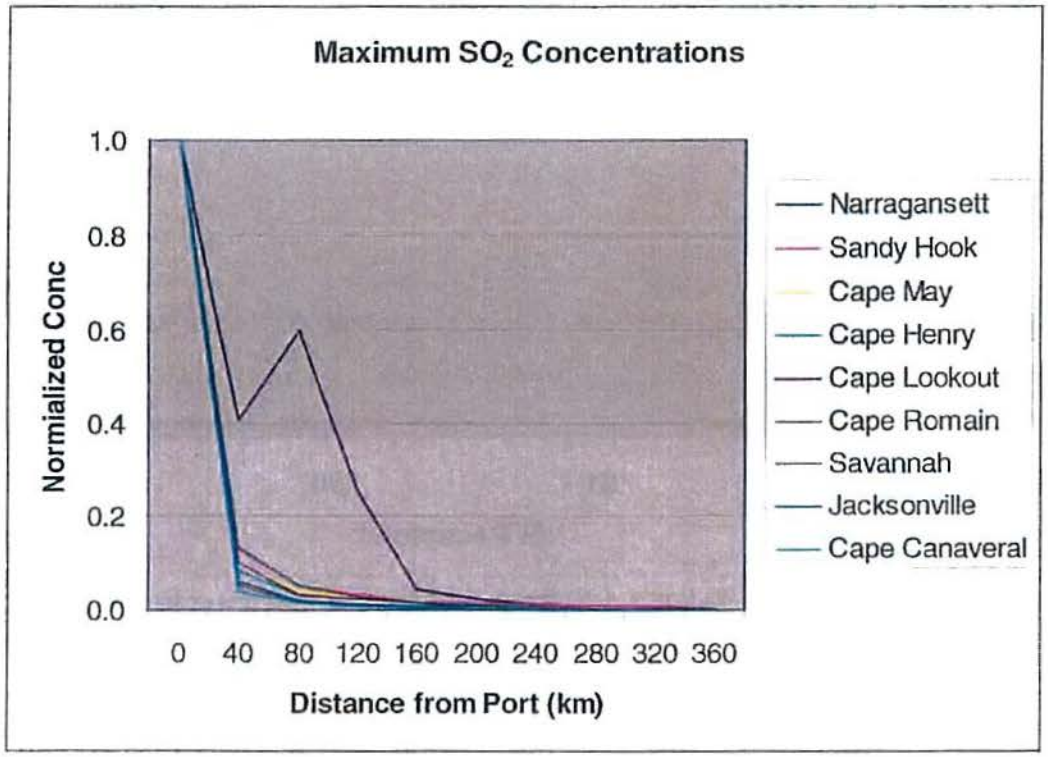

Figure 10. Normalized Peak 1-hr SO_2 Concentrations for Eastern Sources

For the eastern modeled sources (Figure 10), the maximum impact (highest one-hour average SO_2 concentration) for a source located 40 km from port (other than for Naragansett) is between 4 and 13 percent of the impact from the same source located at the port. At 80 km away from the port, the concentration impact is predicted to be between about 2 to 5 percent of the impact from a similar source located at the coastal port. At 120 km from the port, the impact drops to between 1 and 3 percent; at 160 km, the impact was less than 2 percent, and at 200 km from the port, the impacts were one percent (or less) of the impact from similar ships located at the ports.[24]

[24] The higher impact and the shape of the curve in Figure 10 for Naragansett is easily explained. The coastline near Naragansett curves directly eastward so that sources located further out from this port on the east-west source line were, in fact, fairly close to receptors located along the shorelines of Rhode Island and Massachusetts. That is why the impact (at the coast) along this source line out to about 160 km is larger than for all other source lines. A similar feature exists for the Vancouver source in the western domain, which is located in the Juan de Fuca Strait and has coastal receptors located to the west of the port on the Olympic Pennisula. The shape of the coastline and resultant proximity of the shore receptors also explains the small "spike" in concentration seen in the Naragansett curve in Figures 10 and 12 (later).

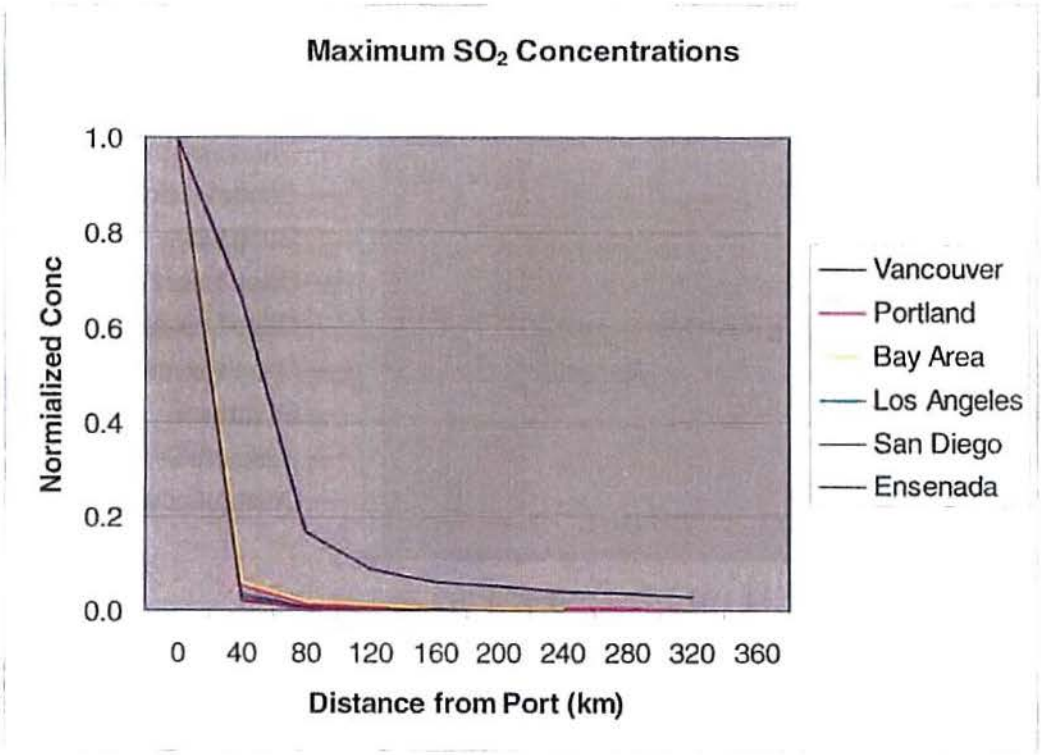

Figure 11. Normalized Peak 1-hr SO_2 Concentrations for Western Sources

The maximum impact (highest one-hour average SO_2 concentration) for a western source located 40 km from port (other than Vancouver; see footnote[12]) is predicted by the model to be between 2 and 6 percent of the impact from the same source located at the port (Figure 11). At 80 km away from the port, the concentration impact is predicted to be less than 2 percent of the impact from a similar source located at the coastal port. At 120 km from the port, the impacts were one percent (or less) of the impacts from similar ships located at the western ports.

The average of the top ten peak hourly average concentration impacts (the ten nearby receptors that experienced the highest peak hourly average concentration impacts from each modeled source) were computed for each source along each source line. This "top-ten" spatial average represents the overall concentration impact along a stretch of coastline extending approximately 40 to 50 km both north and south of the port. These top-ten concentration averages are shown in Figures 12 and 13, normalized by the top-ten average concentration for the source located at the port (origin of the source line), as a function of the distance from the port.

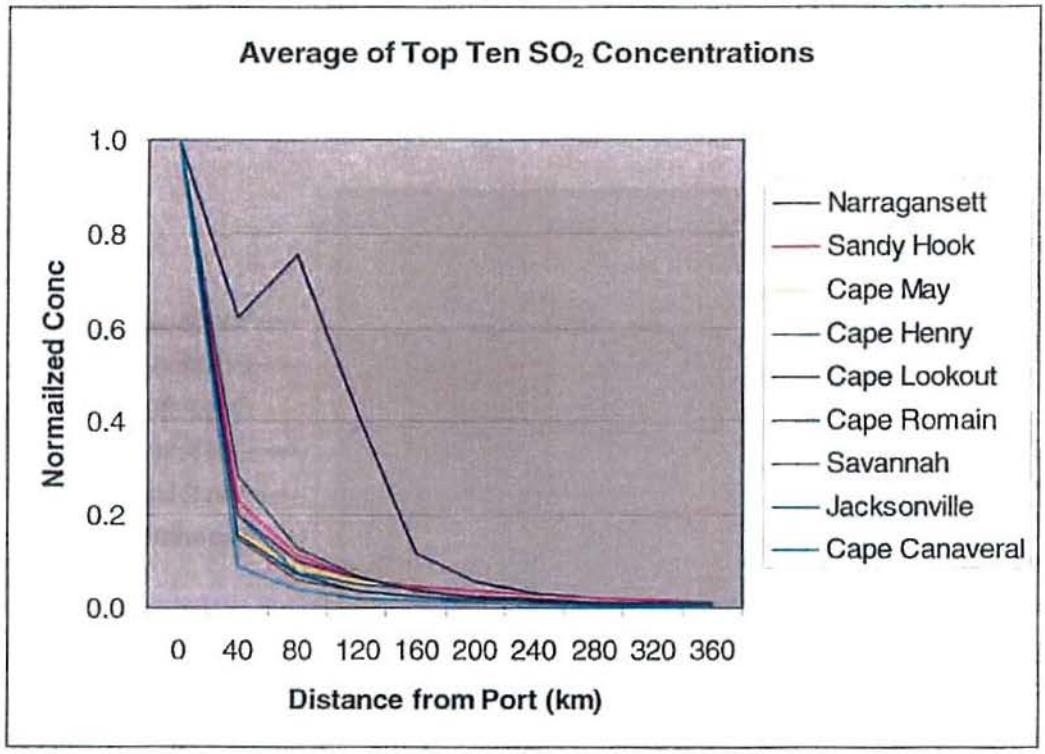

Figure 12. Normalized "Top Ten" 1-hr SO_2 Concentrations for Eastern Sources

The CALPUFF model results indicate that a source located 120 km from an eastern port (other than for Narragansett) will have an overall impact at the 10 "highest" receptor locations that is between 2 and 7 percent of the concentration that would be contributed by a similar source located at the port (Figure 12). For a source located 120 km from a western port (other than Vancouver), the concentration impacts at the ten most highly-impacted receptors are predicted by the model to be less than 2 percent of the impacts of a similar source located at the port (Figure 13).

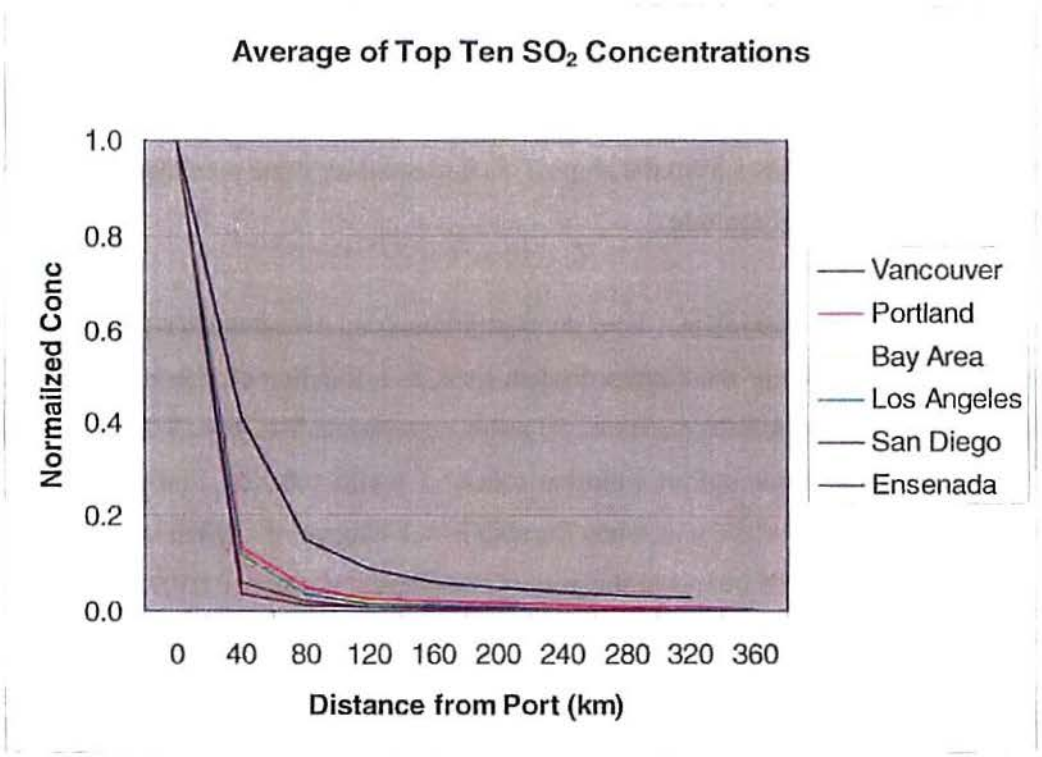

Figure 13. Normalized "Top Ten" 1-hr SO_2 Concentrations for Western Sources

The results of the modeling exercise described in this report (SO_2 concentration impacts at coastal receptors due to unit emission sources) can be superimposed onto typical shipping travel patterns to estimate the expected impacts along the coastline from individual ships or shipping fleets. The results for all model runs are available in MS EXCEL spreadsheets[25], including the maximum one-hour SO_2 concentrations and the 4th highest hourly SO_2 concentrations at every model receptor due to emissions from each modeled source for 2001. Model results are also available for additional sensitivity model runs that were performed using sources on the Cape Henry source line (examining the effects of various vessel characteristics, and for the additional model years 2002 and 2003).

[25] Computer files associated with this project, including the results spreadsheets (transfer coefficients) are available upon request.

V. EMISSION CALCULATIONS

As noted earlier, all of the modeled concentrations were predicted assuming a "unit" emission rate of 1 kg/hr of SO_2 emissions from the ship. This is customary since predicted concentrations scale directly with mass emission rate.

Table 2a below shows the maximum 1-hour concentrations (i.e., over the 2001-2003 model time period) at each port for each of the eastern domain lines, as a function of ship distance from the coast. The suggested revised ECA extent of 50 miles corresponds roughly to the 80 km row in the table. For example, assuming an emission rate of 1 kg/hr, the SO_2 concentration is 0.89 micrograms per cubic meter at the port when the ship is at Naragansett. When the ship moves to 40 km away from the port, the impact at the port of Naragansett drops to 0.0509 micrograms per cubic meter and so on.

Ship Distance from Coast (km)	Narragansett*	Sandy Hook	Cape May	Cape Henry	Cape Lookout	Cape Romain	Savannah	Jacksonville	Cape Canaveral
0	0.8930	1.0250	0.7684	0.7181	0.5145	1.0230	0.5493	0.8701	1.1560
40	0.0509	0.0384	0.0738	0.0482	0.0395	0.0482	0.0536	0.0499	0.0455
80	0.0162	0.0165	0.0251	0.0151	0.0090	0.0159	0.0150	0.0152	0.0168
120	0.0084	0.0069	0.0156	0.0095	0.0039	0.0094	0.0059	0.0090	0.0070
160	0.0037	0.0037	0.0134	0.0049	0.0031	0.0058	0.0045	0.0057	0.0053
200	0.0045	0.0063	0.0052	0.0038	0.0018	0.0036	0.0023	0.0021	0.0034
240	0.0029	0.0030	0.0035	0.0011	0.0016	0.0022	0.0020	0.0016	0.0028
280	0.0015	0.0029	0.0022	0.0008	0.0012	0.0012	0.0018	0.0019	0.0011
320		0.0021	0.0012	0.0005	0.0010	0.0008	0.0012	0.0008	0.0009
360		0.0013	0.0012	0.0004	0.0006	0.0005	0.0007	0.0005	0.0007

*As discussed earlier in the text, the impacts shown are at the port. Slightly higher impacts occur at other than port-locations given the shape of the coast-line for Naragansett.

Table 2a. Summary of 1-hour maximum predicted concentration of SO_2 (using an emission rate of 1 kg/hr) at each eastern domain port for various ship locations.

Table 2b below shows similar model concentrations for the western domain.

Distance from Coast (km)	Vancouver*	Portland	Bay Area	Los Angeles	San Diego	Ensanada
0	0.0358	0.8778	1.1380	3.6790	3.9400	3.4640
40	0.5903	0.0391	0.0436	0.0481	0.0669	0.0299
80	0.0313	0.0122	0.0121	0.0168	0.0156	0.0088
120	0.0123	0.0055	0.0054	0.0103	0.0077	0.0058
160	0.0055	0.0038	0.0040	0.0050	0.0050	0.0036
200	0.0034	0.0026	0.0025	0.0022	0.0035	0.0020
240	0.0028	0.0018	0.0023	0.0017	0.0028	0.0020
280	0.0021	0.0009		0.0017	0.0023	0.0017
320	0.0019	0.0011		0.0013	0.0018	0.0017
360	0.0009	0.0013		0.0009	0.0012	0.0016

*As discussed earlier in the text, due to the shape of the coastline at Vancouver, maximum impacts can occur at locations other than the port. Data shown are the maximum impacts.

Table 2b. Summary of 1-hour maximum predicted concentration of SO_2 (using an emission rate of 1 kg/hr) at each western domain port for various ship locations.

As discussed, it is evident that, in general, as the ship moves farther away from the port, the impacts at the port diminish rapidly. When the ship is located at port, the concentrations diminish rapidly along the coast as well. We also see from the Tables 2a and 2b, that the maximum impacts can occur at some of the western domain ports, as compared to the eastern domain ports, keeping in mind the same 1 kg/hr emission rate used in all of these calculations. However, it should be kept in mind, that of the modeled ships, the larger ships (and therefore those with the greatest emissions) voyage along the eastern domain.

Rather than conduct emission calculations for every instance, some example emission calculations are offered. First, the study calculated the SO_2 emission rate expected from each ship. This was done using the same approach used by the U.S. EPA (EPA 2009).[26] Assuming a brake-specific fuel consumption rate of 195 grams/kWh for slow-speed diesel as used by EPA and consistent with vessel speeds in this instance, and a maximum fuel sulfur content of 2.6%, the SO_2 emission factor is calculated to be:

SO_2 Emission Factor (grams/kWh) = (195)*(64/32)*(0.97753)*(0.026)
= 9.91 grams/kWh

Using a fuel sulfur content of 1%, the SO_2 emission factor, using the same equation above, is 3.81 grams/kWh.

Next, since the maximum engine rate for each ship's main engine, (in kW) as shown in Appendix B is known, it is straightforward to calculate the maximum hourly SO_2 emissions from each ship as follows

Maximum SO_2 Emission Rate (kg/hr) = SO_2 Emission Factor (grams/kWh) * Maximum Engine Rating (kW)/1000 (grams/kg).

Of the various ships considered in this short-sea shipping impact analysis, the largest ship (in terms of rating) for the eastern domain has an engine size of approximately 12000 kW. Thus, for a 12000 kW engine, the maximum hourly SO_2 emissions are:

SO_2 Emission Rate (@ 2.6% S in fuel) = 9.91 * 12000/1000 = 120.6 kg/hr
SO_2 Emission Rate (@ 1% S in fuel) = 3.81 * 12000/1000 = 46.4 kg/hr.

It should be kept in mind that the SO_2 rates calculated above are also conservative in the sense that none of the engines operates at its rated maximum power. Typically, the engine load is 75% of maximum power during cruise mode, diminishing to much lower levels as the ship approaches port. At port, engine power may be a small fraction (20% to 40%) of maximum power. Thus,

[26] See equation 2-3 on page 17 of U.S. EPA 2009.

actual SO_2 emission rates would be 20% to 75% of the rates calculated above or in range of 24 kg/hr – 95 kg/hr for a 12000 kW ship with 2.6% S in fuel and in the range of 9 kg/hr – 35 kg/hr for this same 12000 kW ship with 1% S in fuel.

Similarly, of the ships considered in the analysis, the biggest ship voyaging in the western domain is rated around 11500 kW. Using the same types of calculations above, the range of SO_2 emissions from a ship of this size will be 23 kg/hr – 91 kg/hr (maximum of 114 kg/hr) with 2.6 % S in fuel and in the range of 8.6 kg/hr – 34 kg/hr (maximum of 44 kg/hr) with 1% S in fuel.

Combining these expected maximum SO_2 emission rates with the modeled concentrations, we can determine the following:

For the eastern domain, the highest modeled port concentration (Cape Canaveral) was 1.156 microgram/cubic meter per kg/hr. Further, when a ship is located at 80 km (or 50 mile) from any of the ports, the maximum predicted concentration at the closest coast is 0.025 micrograms/cubic meter per kg/hr at Cape May.

Using the highest expected SO_2 emission rate discussed above of 120.6 kg/hr (for the biggest ship, at maximum power, emitting at exactly the meteorological conditions that would provide the highest impact, and based in using a high S content of 2.6% in the fuel), the highest modeled port 1-hour SO_2 concentration would be 1.156*120.6 = 139.4 micrograms/cubic meter. Of course, with the other rates discussed above (i.e., at various loads, at 1% S in fuel, etc.) the expected maximum 1-hour SO_2 concentration would be much lower.

Similarly, using the highest expected SO_2 emission rate of 120.6 kg/hr, the highest shore impact when the largest ship is located at 80 km or 50 miles from shore is 0.025*120.6 = 3 micrograms/cubic meter. Again, impacts would be much smaller using lower load factors and lower S content in the fuel.

For the western domain, the highest modeled port concentration (San Diego) was 3.94 micrograms/cubic meter per kg/hr. And, when a ship is located at the 80 km (or 50 mile) distance from any of the ports, the maximum predicted concentration at the closest coast is 0.03

micrograms/cubic meter per kg/hr near Vancouver. In this instance, the presence of the largest ship, operating at full power with a S content of 2.6% located at 50 miles from shore would result in a maximum 1-hour SO_2 concentration of 0.03*114 = 3.42 micrograms/cubic meter.

VI. THE SULFUR DIOXIDE STANDARD

Under authority provided by the Clean Air Act, the U.S. EPA has promulgated various NAAQS[27] and thereby defined acceptable levels of major air pollutants, including SO_2 in the ambient air to which the public has general access. The purpose of the NAAQS is to protect the public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly.

The SO_2 NAAQS was recently (June 2010) modified to add a 1-hour average standard of 75 parts per billion (ppb). This corresponds to a concentration of 196 micrograms per cubic meter. It is currently the most stringent SO_2 standard in the U.S.

Although the study will compare the predicted results of the modeling described above with this numerical value (i.e., to 196 micrograms per cubic meter), a one-time exceedance of this value, by itself, does not constitute an exceedance of the standard. Rather, the form of the 1-hour SO_2 NAAQS requires that the 99th percentile of the 1-hour daily maximum concentrations averaged over 3 years be below this numerical value.

[27] See http://www.epa.gov/air/criteria.html.

VII. CONCLUSIONS

Comparing the maximum predicted model 1-hour SO_2 concentrations as discussed above with even the numerical value of the 1-hour SO_2 NAAQS (i.e., disregarding the form of the standard that requires the 99th percentile of daily 1-hour maximums averaged over 3 years), we see that even under the worst case (with clear conservativeness relating to engine load, meteorological conditions, maximum S content in fuel, etc.) for the eastern domain, the predicted concentration of 139.4 micrograms per cubic meter is much lower than the 196 micrograms per cubic meter in the standard.

Although still conservative (with regard to engine load, S-content etc.), the comparison of the highest shore 1-hour concentrations – whether for the eastern (3 micrograms per cubic meter) or the western domain (3.42 micrograms per cubic meter), with the standard (196 micrograms per cubic meter) shows how insignificant the impact of these short-sea ships is on shore concentrations.

Based on the above analysis, we conclude that the ECA boundary should be reduced to at least 50 miles from the coasts (or to even smaller distances, which would differ on each coast), without causing any adverse impacts of SO_2 emissions on the land.

VIII. REFERENCES

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U.S. Environmental Protection Agency. 2009. Proposal to Designate an Emission Control Area for Nitrogen Oxides. Sulfur Oxides and Particulate Matter. Technical Support Document. Assessment and Standards Division. Office of Transportation and Air Quality. EPA-420-R-09-007. (April 2009).

APPENDIX A – RESUMES

RANAJIT (RON) SAHU, Ph.D, QEP, CCM (Nevada)

CONSULTANT, ENVIRONMENTAL AND ENERGY ISSUES

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Alhambra, CA 91801
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EXPERIENCE SUMMARY

Dr. Sahu has over twenty one years of experience in the fields of environmental, mechanical, and chemical engineering including: program and project management services; design and specification of pollution control equipment; soils and groundwater remediation; combustion engineering evaluations; energy studies; multimedia environmental regulatory compliance (involving statutes and regulations such as the Federal CAA and its Amendments, Clean Water Act, TSCA, RCRA, CERCLA, SARA, OSHA, NEPA as well as various related state statutes); transportation air quality impact analysis; multimedia compliance audits; multimedia permitting (including air quality NSR/PSD permitting, Title V permitting, NPDES permitting for industrial and storm water discharges, RCRA permitting, etc.); multimedia/multi-pathway human health risk assessments for toxics; air dispersion modeling; and regulatory strategy development and support including negotiation of consent agreements and orders.

He has over nineteen years of project management experience and has successfully managed and executed numerous projects in this time period. This includes basic and applied research projects, design projects, regulatory compliance projects, permitting projects, energy studies, risk assessment projects, and projects involving the communication of environmental data and information to the public. Notably, he has successfully managed a complex soils and groundwater remediation project with a value of over $140 million involving soils characterization, development and implementation of the remediation strategy, regulatory and public interactions and other challenges.

He has provided consulting services to numerous private sector, public sector and public interest group clients. His major clients over the past seventeen years include various steel mills, petroleum refineries, cement companies, aerospace companies, power generation facilities, lawn and garden equipment manufacturers, spa manufacturers, chemical distribution facilities, and various entities in the public sector including EPA, the US Dept. of Justice, California DTSC, various municipalities, etc.). Dr. Sahu has performed projects in over 44 states, numerous local jurisdictions and internationally

Dr. Sahu's experience includes various projects in relation to industrial waste water as well as storm water pollution compliance include obtaining appropriate permits (such as point source NPDES permits) as well development of plans, assessment of remediation technologies, development of monitoring reports, and regulatory interactions.

In addition to consulting, Dr. Sahu has taught and continues to teach numerous courses in several Southern California universities including UCLA (air pollution), UC Riverside (air pollution, process hazard analysis), and Loyola Marymount University (air pollution, risk assessment, hazardous waste management) for the past seventeen years. In this time period he has also taught at Caltech, his alma mater and at USC (air pollution) and Cal State Fullerton (transportation and air quality).

Dr. Sahu has and continues to provide expert witness services in a number of environmental areas discussed above in both state and Federal courts as well as before administrative bodies (please see Annex A).

EXPERIENCE RECORD

2000-present **Independent Consultant.** Providing a variety of private sector (industrial companies, land development companies, law firms, etc.) public sector (such as the US Department of Justice) and public interest group clients with project management, air quality consulting, waste remediation and management consulting, as well as regulatory and engineering support consulting services.

1995-2000 Parsons ES, **Associate, Senior Project Manager and Department Manager for** Air Quality/Geosciences/Hazardous Waste Groups, Pasadena. Responsible for the management of a group of approximately 24 air quality and environmental professionals, 15 geoscience, and 10 hazardous waste professionals providing full-service consulting, project management, regulatory compliance and A/E design assistance in all areas.

Parsons ES, **Manager for Air Source Testing Services.** Responsible for the management of 8 individuals in the area of air source testing and air regulatory permitting projects located in Bakersfield, California.

1992-1995 Engineering-Science, Inc. **Principal Engineer and Senior Project Manager** in the air quality department. Responsibilities included multimedia regulatory compliance and permitting (including hazardous and nuclear materials), air pollution engineering (emissions from stationary and mobile sources, control of criteria and air toxics, dispersion modeling, risk assessment, visibility analysis, odor analysis), supervisory functions and project management.

1990-1992 Engineering-Science, Inc. **Principal Engineer and Project Manager** in the air quality department. Responsibilities included permitting, tracking regulatory issues, technical analysis, and supervisory functions on numerous air, water, and hazardous waste projects. Responsibilities also include client and agency interfacing, project cost and schedule control, and reporting to internal and external upper management regarding project status.

1989-1990 Kinetics Technology International, Corp. **Development Engineer.** Involved in thermal engineering R&D and project work related to low-NOx ceramic radiant burners, fired heater NOx reduction, SCR design, and fired heater retrofitting.

1988-1989 Heat Transfer Research, Inc. **Research Engineer.** Involved in the design of fired heaters, heat exchangers, air coolers, and other non-fired equipment. Also did research in the area of heat exchanger tube vibrations.

EDUCATION

1984-1988 Ph.D., Mechanical Engineering, California Institute of Technology (Caltech), Pasadena, CA.

1984 M. S., Mechanical Engineering, Caltech, Pasadena, CA.

1978-1983 B. Tech (Honors), Mechanical Engineering, Indian Institute of Technology (IIT) Kharagpur, India

TEACHING EXPERIENCE

Caltech

"Thermodynamics." Teaching Assistant, California Institute of Technology, 1983, 1987

"Air Pollution Control," Teaching Assistant, California Institute of Technology, 1985.

"Caltech Secondary and High School Saturday Program," - taught various mathematics (algebra through calculus) and science (physics and chemistry) courses to high school students, 1983-1989.

"Heat Transfer." - taught this course in the Fall and Winter terms of 1994-1995 in the Division of Engineering and Applied Science.

"Thermodynamics and Heat Transfer," Fall and Winter Terms of 1996-1997.

U.C. Riverside, Extension

"Toxic and Hazardous Air Contaminants," University of California Extension Program, Riverside, California. Various years since 1992.

"Prevention and Management of Accidental Air Emissions," University of California Extension Program, Riverside, California. Various years since 1992

"Air Pollution Control Systems and Strategies," University of California Extension Program, Riverside, California, Summer 1992-93, Summer 1993-1994.

"Air Pollution Calculations," University of California Extension Program, Riverside, California, Fall 1993-94, Winter 1993-94, Fall 1994-95.

"Process Safety Management," University of California Extension Program, Riverside, California. Various years since 1992-2010

"Process Safety Management," University of California Extension Program, Riverside, California, at SCAQMD, Spring 1993-94.

"Advanced Hazard Analysis - A Special Course for LEPCs," University of California Extension Program, Riverside, California, taught at San Diego, California, Spring 1993-1994.

"Advanced Hazardous Waste Management" University of California Extension Program, Riverside, California. 2005.

Loyola Marymount University

"Fundamentals of Air Pollution - Regulations, Controls and Engineering," Loyola Marymount University. Dept. of Civil Engineering. Various years since 1993.

"Air Pollution Control," Loyola Marymount University, Dept. of Civil Engineering, Fall 1994.

"Environmental Risk Assessment," Loyola Marymount University, Dept. of Civil Engineering. Various years since 1998.

"Hazardous Waste Remediation" Loyola Marymount University, Dept. of Civil Engineering. Various years since 2006.

University of Southern California

"Air Pollution Controls," University of Southern California, Dept. of Civil Engineering, Fall 1993, Fall 1994

"Air Pollution Fundamentals," University of Southern California Dept. of Civil Engineering, Winter 1994

University of California, Los Angeles

"Air Pollution Fundamentals," University of California, Los Angeles, Dept. of Civil and Environmental Engineering, Spring 1994, Spring 1999, Spring 2000, Spring 2003, Spring 2006, Spring 2007, Spring 2008, Spring 2009.

International Programs

"Environmental Planning and Management," 5 week program for visiting Chinese delegation, 1994.

"Environmental Planning and Management," 1 day program for visiting Russian delegation, 1995.

"Air Pollution Planning and Management," IEP, UCR, Spring, 1996

"Environmental Issues and Air Pollution," IEP, UCR, October 1996.

PROFESSIONAL AFFILIATIONS AND HONORS

President of India Gold Medal, IIT Kharagpur, India, 1983.

Member of the Alternatives Assessment Committee of the Grand Canyon Visibility Transport Commission, established by the Clean Air Act Amendments of 1990, 1992-present.

American Society of Mechanical Engineers: Los Angeles Section Executive Committee, Heat Transfer Division, and Fuels and Combustion Technology Division, 1987-present.

Air and Waste Management Association, West Coast Section, 1989-present.

PROFESSIONAL CERTIFICATIONS

EIT, California (# XE088305), 1993.

REA I, California (#07438), 2000.

Certified Permitting Professional, South Coast AQMD (#C8320), since 1993.

QEP, Institute of Professional Environmental Practice, since 2000.

C.I.M, State of Nevada (#IEM-1699). Expiration 10/07/2011.

PUBLICATIONS (PARTIAL LIST)

"Physical Properties and Oxidation Rates of Chars from Bituminous Coals," with Y.A. Levendis, R.C. Flagan and G.R. Gavalas, *Fuel*, 67, 275-283 (1988).

"Char Combustion: Measurement and Analysis of Particle Temperature Histories," with R.C. Flagan, G.R Gavalas and P.S. Northrop, *Comb. Sci. Tech.* 60, 215-230 (1988).

"On the Combustion of Bituminous Coal Chars," PhD Thesis, California Institute of Technology (1988).

"Optical Pyrometry: A Powerful Tool for Coal Combustion Diagnostics," *J. Coal Quality*, 8, 17-22 (1989).

"Post-Ignition Transients in the Combustion of Single Char Particles," with Y.A. Levendis, R.C.Flagan and G.R. Gavalas, *Fuel*, 68, 849-855 (1989).

"A Model for Single Particle Combustion of Bituminous Coal Char." Proc. ASME National Heat Transfer Conference, Philadelphia, **HTD-Vol. 106**, 505-513 (1989).

"Discrete Simulation of Cenospheric Coal-Char Combustion," with R.C. Flagan and G.R.Gavalas. *Combust. Flame*, 77, 337-346 (1989).

"Particle Measurements in Coal Combustion," with R.C. Flagan, in **"Combustion Measurements"** (ed. N. Chigier), Hemisphere Publishing Corp. (1991).

"Cross Linking in Pore Structures and Its Effect on Reactivity," with G.R. Gavalas in preparation.

"Natural Frequencies and Mode Shapes of Straight Tubes," Proprietary Report for Heat Transfer Research Institute, Alhambra, CA (1990).

"Optimal Tube Layouts for Kamui SL-Series Exchangers," with K. Ishihara, Proprietary Report for Kamui Company Limited, Tokyo, Japan (1990).

"HTRI Process Heater Conceptual Design," Proprietary Report for Heat Transfer Research Institute, Alhambra, CA (1990).

"Asymptotic Theory of Transonic Wind Tunnel Wall Interference," with N.D. Malmuth and others, Arnold Engineering Development Center, Air Force Systems Command, USAF (1990).

"Gas Radiation in a Fired Heater Convection Section," Proprietary Report for Heat Transfer Research Institute, College Station, TX (1990).

"Heat Transfer and Pressure Drop in NTIW Heat Exchangers," Proprietary Report for Heat Transfer Research Institute, College Station, TX (1991).

"NOx Control and Thermal Design," Thermal Engineering Tech Briefs, (1994).

"From Puchase of Landmark Environmental Insurance to Remediation: Case Study in Henderson, Nevada," with Robin T. Bain and Jill Quillin, presented at the AQMA Annual Meeting, Florida, 2001.

"The Jones Act Contribution to Global Warming, Acid Rain and Toxic Air Contaminants," with Charles W. Botsford, presented at the AQMA Annual Meeting, Florida, 2001

PRESENTATIONS (PARTIAL LIST)

"Pore Structure and Combustion Kinetics - Interpretation of Single Particle Temperature-Time Histories," with P.S. Northrop, R.C. Flagan and G.R. Gavalas, presented at the AIChE Annual Meeting, New York (1987).

"Measurement of Temperature-Time Histories of Burning Single Coal Char Particles," with R.C. Flagan, presented at the American Flame Research Committee Fall International Symposium, Pittsburgh, (1988).

"Physical Characterization of a Cenospheric Coal Char Burned at High Temperatures," with R.C. Flagan and G.R. Gavalas, presented at the Fall Meeting of the Western States Section of the Combustion Institute, Laguna Beach, California (1988).

"Control of Nitrogen Oxide Emissions in Gas Fired Heaters - The Retrofit Experience," with G. P. Croce and R. Patel, presented at the International Conference on Environmental Control of Combustion Processes (Jointly sponsored by the American Flame Research Committee and the Japan Flame Research Committee), Honolulu, Hawaii (1991).

"Air Toxics - Past, Present and the Future," presented at the Joint AIChE/AAEE Breakfast Meeting at the AIChE 1991 Annual Meeting, Los Angeles, California, November 17-22 (1991).

"Air Toxics Emissions and Risk Impacts from Automobiles Using Reformulated Gasolines," presented at the Third Annual Current Issues in Air Toxics Conference, Sacramento, California, November 9-10 (1992)

"Air Toxics from Mobile Sources," presented at the Environmental Health Sciences (EHS) Seminar Series, UCLA, Los Angeles, California, November 12, (1992).

"Kilns, Ovens, and Dryers - Present and Future," presented at the Gas Company Air Quality Permit Assistance Seminar, Industry Hills Sheraton, California, November 20, (1992).

"The Design and Implementation of Vehicle Scrapping Programs," presented at the 86th Annual Meeting of the Air and Waste Management Association, Denver, Colorado, June 12, 1993.

"Air Quality Planning and Control in Beijing, China," presented at the 87th Annual Meeting of the Air and Waste Management Association, Cincinnati, Ohio, June 19-24, 1994.

Annex A

Expert Litigation Support

1. Matters for which Dr. Sahu has have provided depositions and affidavits/expert reports include:

(a) Deposition on behalf of Rocky Mountain Steel Mills, Inc. located in Pueblo, Colorado – dealing with the manufacture of steel in mini-mills including methods of air pollution control and BACT in steel mini-mills and opacity issues at this steel mini-mill

(b) Affidavit for Rocky Mountain Steel Mills, Inc. located in Pueblo Colorado – dealing with the technical uncertainties associated with night-time opacity measurements in general and at this steel mini-mill.

(c) Expert reports and depositions (2/28/2002 and 3/1/2002; 12/2/2003 and 12/3/2003; 5/24/2004) on behalf of the US Department of Justice in connection with the Ohio Edison NSR Cases. *United States, et al. v. Ohio Edison Co., et al.*, C2-99-1181 (S.D. Ohio).

(d) Expert reports and depositions (5/23/2002 and 5/24/2002) on behalf of the US Department of Justice in connection with the Illinois Power NSR Case. *United States v. Illinois Power Co., et al.*, 99-833-MJR (S.D. Ill.).

(e) Expert reports and depositions (11/25/2002 and 11/26/2002) on behalf of the US Department of Justice in connection with the Duke Power NSR Case. *United States, et al. v. Duke Energy Corp.*, 1:00-CV-1262 (M.D.N.C.).

(f) Expert reports and depositions (10/6/2004 and 10/7/2004; 7/10/2006) on behalf of the US Department of Justice in connection with the American Electric Power NSR Cases. *United States, et al. v. American Electric Power Service Corp., et al.*, C2-99-1182, C2-99-1250 (S.D. Ohio).

(g) Affidavit (March 2005) on behalf of the Minnesota Center for Environmental Advocacy and others in the matter of the Application of Heron Lake BioEnergy LLC to construct and operate an ethanol production facility – submitted to the Minnesota Pollution Control Agency.

(h) Expert reports and depositions (10/31/2005 and 11/1/2005) on behalf of the US Department of Justice in connection with the East Kentucky Power Cooperative NSR Case. *United States v. East Kentucky Power Cooperative, Inc.*, 5:04-cv-00034-KSF (E.D. KY).

(i) Deposition (10/20/2005) on behalf of the US Department of Justice in connection with the Cinergy NSR Case. *United States, et* al. *v. Cinergy Corp., et al.*, IP 99-1693-C-M/S (S.D. Ind.).

(j) Affidavits and deposition on behalf of Basic Management Inc. (BMI) Companies in connection with the BMI vs. USA remediation cost recovery Case.

(k) Expert report on behalf of Penn Future and others in the Cambria Coke plant permit challenge in Pennsylvania.

(l) Expert report on behalf of the Appalachian Center for the Economy and the Environment and others in the Western Greenbrier permit challenge in West Virginia.

(m) Expert report, deposition (via telephone on January 26, 2007) on behalf of various Montana petitioners (Citizens Awareness Network (CAN), Women's Voices for the Earth (WVE) and the Clark Fork Coalition (CFC)) in the Thompson River Cogeneration LLC Permit No. 3175-04 challenge.

(n) Expert report and deposition (2/2/07) on behalf of the Texas Clean Air Cities Coalition at the Texas State Office of Administrative Hearings (SOAH) in the matter of the permit challenges to TXU Project Apollo's eight new proposed PRB-fired PC boilers located at seven TX sites.

(o) Expert testimony (July 2007) on behalf of the Izaak Walton League of America and others in connection with the acquisition of power by Xcel Energy from the proposed Gascoyne Power Plant – at the State of Minnesota, Office of Administrative Hearings for the Minnesota PUC (MPUC No. E002/CN-06-1518; OAH No. 12-2500-17857-2).

(p) Affidavit (July 2007) Comments on the Big Cajun I Draft Permit on behalf of the Sierra Club – submitted to the Louisiana DEQ.

(q) Expert reports and deposition (12/13/2007) on behalf of Commonwealth of Pennsylvania – Dept. of Environmental Protection, State of Connecticut, State of New York, and State of New Jersey (Plaintiffs) in connection with the Allegheny Energy NSR Case. *Plaintiffs v. Allegheny Energy Inc., et al*, 2:05cv0885 (W.D. Pennsylvania).

(r) Expert reports and pre-filed testimony before the Utah Air Quality Board on behalf of Sierra Club in the Sevier Power Plant permit challenge.

(s) Expert reports and deposition (October 2007) on behalf of MTD Products Inc., in connection with General Power Products, LLC v MTD Products Inc., 1:06 CVA 0143 (S.D. Ohio, Western Division)

(t) Experts report and deposition (June 2008) on behalf of Sierra Club and others in the matter of permit challenges (Title V: 28.0801-29 and PSD: 28.0803-PSD) for the Big Stone II unit, proposed to be located near Milbank, South Dakota.

(u) Expert reports, affidavit, and deposition (August 15, 2008) on behalf of Earthjustice in the matter of air permit challenge (CT-4631) for the Basin Electric Dry Fork station, under construction near Gillette, Wyoming before the Environmental Quality Council of the State of Wyoming.

(v) Affidavit/Declaration and Expert Report on behalf of NRDC and the Southern Environmental Law Center in the matter of the air permit challenge for Duke Cliffside Unit 6, under construction in North Carolina.

(w) Dominion Wise County MACT Declaration (August 2008)

(x) Expert Report on behalf of Sierra Club for the Green Energy Resource Recovery Project, MACT Analysis (June 13, 2008).

(y) Expert Report on behalf of Sierra Club and the Environmental Integrity Project in the matter of the air permit challenge for NRG Limestone's proposed Unit 3 in Texas (February 2009).

(z) Expert Report and deposition on behalf of MTD Products, Inc., in the matter of Alice Holmes and Vernon Holmes v. Home Depot USA, Inc., et al. (June 2009, July 2009).

(aa) Expert Report on behalf of Sierra Club and the Southern Environmental Law Center in the matter of the air permit challenge for Santee Cooper's proposed Pee Dee plant in South Carolina (August 2009).

(bb) Statements (May 2008 and September 2009) on behalf of the Minnesota Center for Environmental Advocacy to the Minnesota Pollution Control Agency in the matter of the Minnesota Haze State Implementation Plans.

(cc) Expert Report (August 2009) and Deposition (October 2009) on behalf of Environmental Defense, in the matter of permit challenges to the proposed Las Brisas coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

(dd) Deposition (October 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed Coleto Creek coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH). (October 2009).

(ee) Expert Report, Rebuttal Report (September 2009) and Deposition (October 2009) on behalf of the Sierra Club, in the matter of challenges to the proposed Medicine Bow Fuel and Power IGL plant in Cheyenne, Wyoming.

(ff) Expert report (December 2009), Rebuttal reports (May 2010 and June 2010) and depositions (June 2010) on behalf of the US Department of Justice in connection with the Alabama Power Company NSR Case. *United States v. Alabama Power Company*, CV-01-HS-152-S (Northern District of Alabama, Southern Division).

(gg) Prefiled testimony (October 2009) and Deposition (December 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed White Stallion Energy Center coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

(hh) Deposition (October 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed Tenaska coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH). (April 2010).

(ii) Written Direct Testimony (July 2010) and Written Rebuttal Testimony (August 2010) on behalf of the State of New Mexico Environment Department in the matter of Proposed Regulation 20.2.350 NMAC – *Greenhouse Gas Cap and Trade Provisions*, No. EIB 10-04 (R), to the State of New Mexico, Environmental Improvement Board.

(jj) Expert report (August 2010) and Rebuttal Expert Report (October 2010) on behalf of the US Department of Justice in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana).

(kk) Declaration (August 2010) on behalf of the US EPA and US Department of Justice in the matter of DTE Energy Company, Detroit, MI (Monroe Unit 2).

(ll) Expert Report and Deposition (August 2010) as well as Affidavit (September 2010) on behalf of Kentucky Waterways Alliance, Sierra Club, and Valley Watch in the matter of challenges to the NPDES permit issued for the Trimble County power plant by the Kentucky Energy and Environment Cabinet to Louisville Gas and Electric, File No. DOW-41106-047.

(mm) Expert Report (August 2010) and Rebuttal Expert Report (September 2010) on behalf of Wild Earth Guardians in the matter of opacity exceedances and monitor downtime at the Public Service Company of Colorado (Xcel)'s Cherokee power plant. No. 09-cv-1862 (D. Colo.).

(nn) Written Direct Expert Testimony (August 2010) on behalf of Fall-Line Alliance for a Clean Environment and others in the matter of the PSD Air Permit for Plant Washington issued by Georgia DNR at the Office of State Administrative Hearing, State of Georgia (OSAH-BNR-AQ-1031707-98-WALKER).

(oo) Deposition (August 2010) on behalf of Environmental Defense, in the matter of the remanded permit challenge to the proposed Las Brisas coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

(pp) Expert Report, Supplemental/Rebuttal Expert Report, and Declarations (October 2010) on behalf of New Mexico Environment Department (Plaintiff-Intervenor), Grand Canyon Trust and Sierra Club (Plaintiffs) in the matter of Public Service Company of New Mexico (PNM)'s Mercury Report for the San Juan Generating Station. CIVIL NO. 1:02-CV-0552 BB/ATC (ACE). US District Court for the District of New Mexico.

(qq) Comment Report (October 2010) on the Draft Permit Issued by the Kansas DHE to Sunflower Electric for Holcomb Unit 2. Prepared on behalf of the Sierra Club and Earthjustice.

(rr) Expert Report (October 2010) and Rebuttal Expert Report (November 2010) (BART Determinations for PSCo Hayden and CSU Martin Drake units) to the Colorado Air Quality Commission on behalf of Coalition of Environmental Organizations.

(ss) Expert Report (November 2010) (BART Determinations for TriState Craig Units, CSU Nixon Unit, and PRPA Rawhide Unit) to the Colorado Air Quality Commission on behalf of Coalition of Environmental Organizations.

(tt) Comment Report (December 2010) on the Pennsylvania Department of Environmental Protection (PADEP)'s Proposal to grant Plan Approval for the Wellington Green Energy Resource Recovery Facility on behalf of the Chesapeake Bay Foundation, Group Against Smog and Pollution (GASP), National Park Conservation Association (NPCA), and the Sierra Club.

(uu) Written Expert Testimony (January 2011) to the Georgia Office of State Administrative Hearings (OSAH) in the matter of Minor Source HAPs status for the proposed Longleaf Energy Associates power plant (OSAH-BNR-AQ-1115157-60-HOWELLS) on behalf of the Friends of the Chattahoochee and the Sierra Club).

2. Occasions where Dr. Sahu has provided oral testimony at trial or in similar proceedings include the following:

(vv) In February, 2002, provided expert witness testimony on emissions data on behalf of Rocky Mountain Steel Mills, Inc. in Denver District Court.

(ww) In February 2003, provided expert witness testimony on regulatory framework and emissions calculation methodology issues on behalf of the US Department of Justice in the Ohio Edison NSR Case in the US District Court for the Southern District of Ohio.

(xx) In June 2003, provided expert witness testimony on regulatory framework, emissions calculation methodology, and emissions calculations on behalf of the US Department of Justice in the Illinois Power NSR Case in the US District Court for the Southern District of Illinois.

(yy) In August 2006, provided expert witness testimony regarding power plant emissions and BACT issues on a permit challenge (Western Greenbrier) on behalf of the Appalachian Center for the Economy and the Environment in West Virginia.

(zz) In May 2007, provided expert witness testimony regarding power plant emissions and BACT issues on a permit challenge (Thompson River Cogeneration) on behalf of various Montana petitioners (Citizens Awareness Network (CAN), Women's Voices for the Earth (WVE) and the Clark Fork Coalition (CFC)) before the Montana Board of Environmental Review.

(aaa) In October 2007, provided expert witness testimony regarding power plant emissions and BACT issues on a permit challenge (Sevier Power Plant) on behalf of the Sierra Club before the Utah Air Quality Board.

(bbb) In August 2008, provided expert witness testimony regarding power plant emissions and BACT issues on a permit challenge (Big Stone Unit II) on behalf of the Sierra Club and Clean Water before the South Dakota Board of Minerals and the Environment.

(ccc) In February 2009, provided expert witness testimony regarding power plant emissions and BACT issues on a permit challenge (Santee Cooper Pee Dee units) on behalf of the Sierra Club and the Southern Environmental Law Center before the South Carolina Board of Health and Environmental Control.

(ddd) In February 2009, provided expert witness testimony regarding power plant emissions, BACT issues and MACT issues on a permit challenge (NRG Limestone Unit 3) on behalf of the Sierra Club and the Environmental Integrity Project before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

(eee) In November 2009, provided expert witness testimony regarding power plant emissions, BACT issues and MACT issues on a permit challenge (Las Brisas Energy

Center) on behalf of the Environmental Defense Fund before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

(fff) In February 2010, provided expert witness testimony regarding power plant emissions, BACT issues and MACT issues on a permit challenge (White Stallion Energy Center) on behalf of the Environmental Defense Fund before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

(ggg) In September 2010 provided oral trial testimony on behalf of Commonwealth of Pennsylvania – Dept. of Environmental Protection, State of Connecticut, State of New York, State of Maryland, and State of New Jersey (Plaintiffs) in connection with the Allegheny Energy NSR Case in US District Court in the Western District of Pennsylvania. *Plaintiffs v. Allegheny Energy Inc., et al.*, 2:05cv0885 (W.D. Pennsylvania).

(hhh) Oral Direct and Rebuttal Expert Testimony (September 2010) on behalf of Fall-Line Alliance for a Clean Environment and others in the matter of the PSD Air Permit for Plant Washington issued by Georgia DNR at the Office of State Administrative Hearing, State of Georgia (OSAH-BNR-AQ-1031707-98-WALKER).

(iii) Oral Testimony (September 2010) on behalf of the State of New Mexico Environment Department in the matter of Proposed Regulation 20.2.350 NMAC – *Greenhouse Gas Cap and Trade Provisions.* No. EIB 10-04 (R), to the State of New Mexico, Environmental Improvement Board.

(jjj) Oral Testimony (October 2010) regarding mercury and total PM/PM10 emissions and other issues on a remanded permit challenge (Las Brisas Energy Center) on behalf of the Environmental Defense Fund before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.

(kkk) Oral Testimony (November 2010) regarding BART for PSCo Hayden, CSU Martin Drake units before the Colorado Air Quality Commission on behalf of the Coalition of Environmental Organizations.

(lll) Oral Testimony (December 2010) regarding BART for TriState Craig Units, CSU Nixon Unit, and PRPA Rawhide Unit) before the Colorado Air Quality Commission on behalf of the Coalition of Environmental Organizations.

(mmm) Deposition (December 2010) on behalf of the US Department of Justice in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana).

(nnn) Deposition (February 2011) on behalf of Wild Earth Guardians in the matter of opacity exceedances and monitor downtime at the Public Service Company of Colorado (Xcel)'s Cherokee power plant. No. 09-cv-1862 (D. Colo.).

(ooo) Oral Expert Testimony (February 2011) to the Georgia Office of State Administrative Hearings (OSAH) in the matter of Minor Source HAPs status for the proposed Longleaf Energy Associates power plant (OSAH-BNR-AQ-1115157-60-HOWELLS) on behalf of the Friends of the Chattahoochee and the Sierra Club).

H. ANDREW GRAY

EDUCATION

Ph.D. environmental engineering science, California Institute of Technology, Pasadena, California, 1986

M.S. environmental engineering science, California Institute of Technology, Pasadena, California, 1980

B.S. civil engineering/engineering and public policy, Carnegie-Mellon University, Pittsburgh, Pennsylvania, 1979

EXPERIENCE

Dr. H. Andrew Gray has been performing research in air pollution for over 30 years, within academic, governmental, and consulting environments. He has made significant contributions in the areas of airborne particles and visibility, including the development and application of computer-based air quality models. His areas of expertise are air pollution control strategy design and evaluation, computer modeling of the atmosphere, characterization of ambient air quality and air pollutant source emissions, aerosol monitoring and modeling, visibility analysis, receptor modeling, statistical data analysis, mathematical programming, numerical methods, and analysis of environmental public policy. Dr. Gray is currently an independent contractor focusing on particulate matter and visibility related research issues. Previous Gray Sky Solutions projects include assessment of Clean Air Act and other regulations on visibility in Class I (park and wilderness) areas, development of air pollution control plans and emission inventories for tribal lands, review and development of guidelines for modeling long-range transport impacts using the CALPUFF model, evaluation of particulate air quality impacts associated with diesel exhaust emissions, air quality management plan modeling protocol review, a critical review of Clean Air Mercury Rule (CAMR) documents, and assessment of the regional air quality impacts of power plant emissions. Most recently, Dr. Gray has been carrying out dispersion modeling studies to determine the impacts associated with mercury emissions in the Chesapeake Bay region.

Before starting Gray Sky Solutions, Dr. Gray was the manager of the PM_{10} and Visibility Program at Systems Applications International (SAI / ICF Inc.). At SAI, Dr. Gray conducted and managed a number of varied air pollution research projects. In the early 1990s, Dr. Gray directed a large (over $1 million) air-quality modeling program to determine the impact of SO_2 emissions from a large coal-fired power plant on Grand Canyon sulfate and visibility levels. He managed projects to develop carbon particle emission data for the Denver area, designed a PM_{10} monitoring and modeling program for the El Paso area, determined the appropriate tradeoffs between direct PM_{10} emissions and emissions of PM_{10} precursors, estimated the visibility effects in federal Class I areas due to the 1990 Clean Air Act Amendments (results of which were incorporated into EPA's 1993 Report to Congress on the expected visibility consequences of the 1990 Clean Air Act Amendments), and provided assistance to EPA Region VIII's tribal air programs. Other projects include emission inventory development for Sacramento and carbon monoxide modeling of Phoenix, Arizona to support federal and regional implementation plans in those regions, systematic evaluation of the Interagency Workgroup on Air Quality Modeling (IWAQM) recommendations for the use of MESOPUFF II, a critical assessment of exposures to particulate diesel exhaust in California, and an evaluation of $PM_{2.5}$ and PM_{10} air quality data in support of EPA's review

of the federal particulate matter air quality standards. Later projects included a study of micrometeorology and modeling of low wind speed stable conditions in the San Joaquin Valley (CA), an assessment of the reductions in nationwide ambient particulate nitrate exposures due to mobile source NO_x emission reductions, an evaluation of visibility conditions in the Southern Appalachian Mountains region, a review of cotton ginning emission factors, and a critical review and assessment of the PM_{10} Attainment Demonstration Plan for the San Joaquin Valley. Dr. Gray was a member of the modeling subcommittee of the technical committee of the Grand Canyon Visibility Transport Commission.

Previous to his tenure at SAI, Dr. Gray was responsible for the PM_{10} and visibility programs at the South Coast Air Quality Management District which involved directing monitoring, analysis, and modeling efforts to support the design of air pollution control strategies for the South Coast Air Basin of California. He developed and applied the methodologies for assessing PM_{10} concentrations that have continued to be used by the District through numerous subsequent air quality management plan revisions. Dr. Gray authored portions of the 1989 Air Quality Management Plan issued by the District that describe the results of modeling and data analyses used to evaluate particulate matter control strategies. Dr. Gray was instrumental in promoting the development and application of state-of-science models for predicting particulate matter concentrations. His responsibilities included direction and oversight of numerous aerosol-related contracts, including development of the SEQUILIB and SAFER models, construction of an ammonia emission database, and development of sulfate, nitrate and organic chemical mechanisms. In addition, Dr. Gray was responsible for initiating the District's visibility control program.

In research performed at the California Institute of Technology, Dr. Gray studied control of atmospheric fine primary carbon particle concentrations and performed computer programming tasks for acquisition and analysis of real-time experimental data. He designed, constructed, and operated the first long-term fine particle monitoring network in Southern California in the early 1980s. He also developed and applied deterministic models to predict source contributions to fine primary carbon particle concentrations and constructed objective optimization procedures for control strategy design. In research carried out for the Department of Mechanical Engineering at Carnegie-Mellon University, Dr. Gray developed fuel use data for input to an emission simulation model for the northeastern United States.

Specialized Professional Competence

- Air pollution control strategy design
- Atmospheric air quality characterization
- Aerosols and visibility
- Computer modeling and data analysis
- Dispersion modeling for particulate matter and visibility
- Receptor modeling including Chemical Mass Balance (CMB) and factor analysis
- Analysis of environmental public policy

Professional Experience

- Systems Applications International (SAI)—PM_{10} and visibility program manager—participated in and managed numerous air quality modeling and analysis projects for public and private sector clients, with emphasis on particulate matter and visibility research
- South Coast Air Quality Management District, El Monte, California—air quality specialist—developed and applied air quality modeling analyses to support air pollution control strategy design for the South Coast Air Basin of California
- California Institute of Technology, Pasadena, California—research assistant--Ph.D. candidate in environmental engineering science. Thesis: Control of atmospheric fine primary carbon particle concentrations (thesis advisors: Dr. Glen Cass, Dr. John Seinfeld, and Dr. Richard Flagan)
- California Institute of Technology, Pasadena, California—laboratory assistant—performed computer programming tasks for acquisition and analysis of real-time experimental data
- Department of Mechanical Engineering, Carnegie-Mellon University, Pittsburgh, Pennsylvania—research assistant—developed fuel use data for an emissions simulation model for the northeastern United States. Grant from the U.S. Department of Energy for evaluation of national energy policy
- Department of Civil Engineering, Carnegie-Mellon University, Pittsburgh, Pennsylvania—consultant—analyzed structural retrofit design for Ferrari Dino import automobile for United States five mph crash test

HONORS AND AWARDS

Harold Allen Thomas Scholarship Award, Carnegie-Mellon University

University Honors, Carnegie-Mellon University

PROFESSIONAL AFFILIATIONS

Air and Waste Management Association

American Association for Aerosol Research

SELECTED PUBLICATIONS AND PRESENTATIONS

The Deposition of Airborne Mercury within the Chesapeake Bay Region from Coal-fired Power Plant Emission in Pennsylvania, in press (2010)

Source Contributions to Atmospheric Fine Carbon Particle Concentrations (with G.R. Cass), *Atmospheric Environment*, 32:3805-3825 (1998)

"Monitoring and Analysis of the Surface Layer at Low Wind Speeds in Stable PBL's in the Southern San Joaquin Valley of California" (with others), presented at the American Meteorological Society's 12th Symposium on Boundary Layers and Turbulence, Vancouver, British Columbia (July 1997)

"Estimation of Current and Future Year NOx to Nitrate Conversion for Various Regions of the United States" (with A. Kuklin), presented at the 90th Meeting of the Air and Waste Management Association, Toronto, Ontario (June 1997)

Integrated Monitoring Study (IMS) 1995: Characterization of Micrometeorological Phenomena: Mixing and Diffusion in Low Wind Speed Stable Conditions: Study Design and Preliminary Results (with others), in *Measurement of Toxic and Related Air Pollutants*, Air and Waste Management Association, Pittsburgh, Pennsylvania, pp. 484-500 (1996)

Regional Emissions and Atmospheric Concentrations of Diesel Engine Particulate Matter: Los Angeles as a Case Study (with G.R. Cass), in *Diesel Exhaust: A Critical Analysis of Emissions, Exposure, and Health Effects*, Health Effects Institute, Cambridge, Massachusetts, pp. 125-137 (1995)

"Assessment of the Effects of the 1990 Clean Air Act Amendments on Visibility in Class I Areas", presented at the 86th Annual Meeting & Exhibition of the Air and Waste Management Association, Denver, Colorado (June 1993)

"Source Contributions to Atmospheric Carbon Particle Concentrations" (with others), presented at the Southern California Air Quality Study Data Analysis Conference, Los Angeles, California (July 1992)

"Modeling Wintertime Sulfate Production in the Southwestern United States" (with M. Ligocki), presented at the AWMA/EPA International Specialty Conference on PM10 Standards and Nontraditional Particulate Source Controls, Scottsdale, Arizona (January 1992)

"Deterministic Modeling for the Navajo Generating Station Visibility Impairment Study: An Overview." presented at the 84th Meeting of the Air and Waste Management Association, Vancouver, British Columbia (June 1991)

"Receptor and Dispersion Modeling of Aluminum Smelter Contributions to Elevated PM10 Concentrations" (with R. G. Ireson and A. B. Hudischewskyj), presented at the 84th Meeting of the Air and Waste Management Association, Vancouver, British Columbia (June 1991)

Visibility and PM-10 in the South Coast Air Basin of California (with J.C. Marlia), in *Visibility and Fine Particles*, Air and Waste Management Association, Pittsburgh, Pennsylvania, pp. 468-477 (1990)

Chemical characteristics of PM10 aerosols collected in the Los Angeles area (with others), *J. Air Pollut. Control Assoc.*, 39:154-163 (1989)

Atmospheric carbon particles and the Los Angeles visibility problem (with others), *Aerosol Sci. Technol.*, 10:118-130 (1989)

Receptor modeling for PM10 source apportionment in the South Coast Air Basin of

Quantitative high-resolution gas chromatography and high-resolution gas chromatography/mass spectrometry analyses of carbonaceous fine aerosol particles (with others), *Int. J. Environ. Anal. Chem* , 29:119-139 (1987)

"Development of an Objective Ozone Forecast Model for the South Coast Air Basin" (with others), presented at the 80th Meeting of the Air Pollution Control Association, New York (June 1987)

"PM10 Modeling in the South Coast Air Basin of California" (with others), presented at the 79th Annual Meeting of the Air Pollution Control Association, Minneapolis, Minnesota (1986)

Characteristics of atmospheric organic and elemental carbon particle concentrations in Los Angeles (with others), *Environ. Sci. Technol* , 20:580-589 (1986)

"Chemical Speciation of Extractable Organic Matter in the Fine Aerosol Fraction" (with others), presented at the 1984 International Chemical Congress of Pacific Basin Societies, Honolulu, Hawaii (1984)

"Source Contributions to Atmospheric Carbon Particle Concentrations" (with others), presented at the First International Aerosol Conference, Minneapolis, Minnesota (1984)

Elemental and organic carbon particle concentrations: A long term perspective (with others), *Sci. Total Environ.*, 36:17-25 (1984)

"Meteorological and Chemical Potential for Oxidant Formation" (with others), presented at the Conference on Air Quality Trends in the South Coast Air Basin, California Institute of Technology, Pasadena, California (1980)

Containing recombinant DNA: How to reduce the risk of escape (with others), *Nature*, 281:421-423 (1979)

OTHER PUBLICATIONS

"Cypress Creek Power Plant Modeling: Pollutant Deposition to the Chesapeake Bay and Sensitive Watersheds within the Commonwealth of Virginia." prepared on behalf of the Chesapeake Bay Foundation, Annapolis, MD (2009)

"Virginia City Power Plant Modeling," prepared on behalf of the Chesapeake Bay Foundation, Annapolis, MD (2008)

"Chesterfield Power Plant Modeling," prepared on behalf of the Chesapeake Bay Foundation, Annapolis, MD (2008)

"The Deposition of Airborne Mercury in Pennsylvania," prepared on behalf of the

"Air Quality Modeling and Visibility Impacts Associated with Sammis Power Plant Emissions," prepared on behalf of the United States of America, Washington, D.C. (2003)

"Air Quality Modeling and Visibility Impacts Associated with Baldwin Power Plant Emissions," prepared on behalf of the United States of America, Washington, D.C. (2002)

"Assessment of the Impacts of Clean Air Act and Other Provisions on Visibility in Class I Areas" (with others), prepared for American Petroleum Institute, Washington, D.C. (1998)

"California Regional PM10 Air Quality Study: *1995 Integrated Monitoring Study Data Analysis: Time and Length Scales for Mixing Secondary Aerosols During Stagnation Periods"* (with others), prepared for California Air Resources Board, Sacramento (1997)

"San Joaquin Valley Regional PM10 Study: *Characterizing Micrometeorological Phenomena: Mixing and Diffusion in Low Wind Speed Conditions Phase III: Monitoring and Data Analysis"* (with others), prepared for California Air Resources Board, Sacramento (1997)

"Cotton Gin Particulate Emission Factors," prepared for U.S. Environmental Protection Agency, Region VIII, San Francisco, California (1997)

"Benefits of Mobile Source NOx Related Particulate Matter Reductions" (with A. Kuklin), SYSAPP-96/61, prepared for Office of Mobile Sources, U.S. Environmental Protection Agency, Ann Arbor, Michigan (1996)

"Evaluation of Existing Information on the Effects of Air Pollutants on Visibility in the Southern Appalachians" (with D. Kleinhesselink), SYSAPP-96-95/060, prepared for Southern Appalachian Mountains Initiative, Asheville, North Carolina (1996)

"Statistical Support for the Particulate Matter NAAQS" (with others), SYSAPP-96-95/039, prepared for Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina (1996)

"San Joaquin Valley Regional PM10 Study Support Study 5A: *Characterizing Micrometeorological Phenomena: Mixing and Diffusion in Low Wind Speed Conditions Phase II: Detailed Recommendations for Experimental Plans*" (with others), prepared for California Air Resources Board, Sacramento (1995)

"San Joaquin Valley Regional PM10 Study Support Study 5A: *Characterizing Micrometeorological Phenomena: Mixing and Diffusion in Low Wind Speed Conditions Phase I: Literature Review and Draft Program Recommendations*" (with others), prepared for California Air Resources Board, Sacramento (1995)

"Class I Grouping for Subsequent Assessment of Regional Haze Rules" (with others), SYSAPP-94/129, prepared for Air Quality Strategies and Standards Division, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina (1994)

"Retrospective Analysis of the Impact of the Clean Air Act on Urban Visibility in the Southwestern United States" (with C. Emery and T.E. Stoeckenius), SYSAPP-94/108, prepared for Office of Policy Analysis and Review, Office of Air and Radiation, U.S. Environmental Protection Agency, Washington, D.C. (1994)

"Evaluation of Ambient Species Profiles, Ambient Versus Modeled NMHC:NO_x and CO:NO_x Ratios, and Source-Receptor Analyses" (with G. Yarwood, M. Ligocki, and G. Whitten), SYSAPP-94/081, prepared for Office of Mobile Sources, U.S. Environmental Protection Agency, Ann Arbor, Michigan (1994)

"Diesel Particulate Matter in California: Exposure Assessment" (with M. Ligocki and A. Rosenbaum), SYSAPP-94/077, prepared for Engine Manufacturers Association, Chicago, Illinois (1994)

"Interagency Workgroup on Air Quality Modeling (IWAQM): Assessment of Phase I Recommendations Regarding the Use of MESOPUFF II" (with M. Ligocki and C. Emery), SYSAPP-94/030, prepared for Source Receptor and Analysis Branch, Technical Services Division, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina (1994)

"Analysis of the 1991-1992 Pine Bend Monitoring Data" (with others), SYSAPP-94/007, prepared for Minnesota Pollution Control Agency, St. Paul, Minnesota (1994)

"Assessment of the Effects of the 1990 Clean Air Act Amendments on Visibility in Class I Areas" (with others), SYSAPP-93/162, prepared for Ambient Standards Branch, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina (1994)

"Revised Base Case and Demonstration of Attainment for Carbon Monoxide for Maricopa County, Arizona" (with others), SYSAPP-94-93/156s, prepared for Maricopa Association of Governments, Phoenix, Arizona (1994)

"Sacramento FIP 2005 Modeling Inventory" (with others), SYSAPP-93/237, prepared for Pacific Environmental Services, North Carolina, and U.S. Environmental Protection Agency, Region IX, San Francisco, California (1993)

"Carbon Monoxide Modeling in Support of the 1993 State Implementation Plan for Maricopa County, Arizona" (with others), SYSAPP-93/156, prepared for Maricopa Association of Governments, Phoenix, Arizona (1993)

"Air Quality Modeling of Carbon Monoxide Concentrations in Support of the Federal Implementation Plan for Phoenix, Arizona" (with others), SYSAPP-93/039, prepared for Pacific Environmental Services, North Carolina, and U.S. Environmental Protection Agency, Region IX, San Francisco, California (1993)

"Base Case Carbon Monoxide Emission Inventory Development for Maricopa County, Arizona" (with others), SYSAPP-93/077, prepared for Maricopa Association of Governments, Phoenix, Arizona (1993)

"Sacramento FIP Modeling 3: Future Emissions Inventory" (with others), SYSAPP-93/036, prepared for Pacific Environmental Services, Inc., North Carolina and U.S. Environmental Protection Agency, San Francisco (1993)

"Emissions Inventory Development for the Tribal Air Program" (with M. Causley and S. Reid), SYSAPP-92/146, prepared for U.S. Environmental Protection Agency, Region VIII, Denver, Colorado (1992)

"Carbon Particle Emissions Inventory for Denver Brown Cloud II: Development and Assessment" (with S. B. Reid and L. R. Chinkin), prepared for Colorado Department of Health, Denver, Colorado (1992)

"Analysis to Determine the Appropriate Trade-off Ratios Between NO_x, SO_x, and PM10 Emissions for the Shell Martinez Refinery" (with M. Ligocki), SYSAPP-92/006, prepared for Shell Oil Co., Martinez, California (1992)

"Modeling Program for PM-10 State Implementation Plan Development for the El Paso/Ciudad Juarez Airshed" (with C. Emery and M. Ligocki), SYSAPP-91/134, prepared for U.S. Environmental Protection Agency, Dallas Texas (1991)

"Deterministic Modeling for Navajo Generating Station Visibility Study. Volume I. Technical Report" (with others), SYSAPP-91/045a, prepared for Salt River Project, Phoenix, Arizona (1991)

"Deterministic Modeling in the Navajo Generating Station Visibility Study" (with others), SYSAPP-91/004, prepared for Salt River Project, Phoenix, Arizona (1991)

"Analysis of Contributions to PM10 Concentrations During Episodic Conditions" (with A. B. Hudischewskyj and R. G. Ireson), SYSAPP-90/072, prepared for Kaiser Aluminum and Chemical Corporation (1990)

"Preparation of Elemental and Organic Carbon Particle Emission Inventories for the Denver Area: Work Plan" (with L. R. Chinkin), SYSAPP-90/068, prepared for Colorado Department of Health (1990)

"Evaluation of Control Strategies for PM10 Concentrations in the South Coast Air Basin," Air Quality Management Plan: 1988 Revision, Appendix V-O. South Coast Air Quality Management District, El Monte, California (1988)

"Annual PM10 Dispersion Model Development and Application in the South Coast Air Basin," Air Quality Management Plan: 1988 Revision, Appendix V-L. South Coast Air Quality Management District, El Monte, California (1988)

"PM10 Modeling Approach" (with others), 1987 AQMP Revision Working Paper No. 2, South Coast Air Quality Management District, El Monte, California (1986)

"Workplan for Air Quality Modeling and Analysis," 1987 AQMP Revision Working Paper No. 5, Planning Division, South Coast Air Quality Management District, El Monte, California (1986)

"Control of Atmospheric Fine Primary Carbon Particle Concentrations," (EQL report No. 23), Ph.D. thesis, California Institute of Technology, Pasadena, California (1986)

"Policy on Recombinant DNA Activities: Relaxing Guidelines While Increasing Safety," project report, Department of Engineering and Public Policy, Carnegie-Mellon University, Pittsburgh, Pennsylvania (1978)

"Air Pollution Control Analyses for State Implementation Plan Revisions in Allegheny County," project report, Department of Engineering and Public Policy, Carnegie-Mellon University, Pittsburgh, Pennsylvania (1978)

EMPLOYMENT HISTORY

Systems Applications International	Manager, PM_{10} and Visibility Program	1989–1997
South Coast Air Quality Management District	Air Quality Specialist	1985–1989
California Institute of Technology, Pasadena, California	Research Assistant Laboratory Assistant	1979–1985 1979
Carnegie-Mellon University, Dept. of Mechanical Engineering Pittsburgh, Pennsylvania	Research Assistant	1978–1979