Penobscot Nation Air Emissions Inventory Development

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Background on Penobscot Nation

- Federally recognized tribe since 1980
- Penobscot Reservation consists of several islands in Penobscot County, Maine totaling almost 4,900 acres
- Indian Island is the largest of the islands (4,000 acres), and the only inhabited island with 562 residents in 2002
- Penobscot Nation holds 60,743 acres of trust land distributed over 3 counties
- Penobscot also own 53,277 acres of fee lands

Indian Island
4,900 acres

(Primary Focus of the 2002 Emissions Inventory)

- Penobscot Nation Administrative Offices
- Elementary School
- Community Center
- Bingo Facility
- Commercial Building used as Packaging Operation
- 200 Residences

Penobscot Trust Lands
60,743 acres

- Spread over several townships
- Uses include timber cutting operations and campsites assigned to Tribe members for recreation

Penobscot Fee Lands
53,277 acres

- Land divided into 10 tracts located in 3 counties
- Uses include timber cutting and other economic activities

CY 2002 Air Emissions Inventory Indian Island

- Criteria and Hazardous Air Pollutant (HAP) emissions quantified
- Stationary (point and area) and mobile sources included in inventory, however, due to emission magnitude there were no true “point” sources in the Penobscot territories

CY 2002 Air Emissions Inventory Indian Island

Stationary Sources

- Most stationary (area) pollution within the Penobscot Nation is emitted by combustion and biogenic sources

  Examples: heating units, wastewater treatment plant, fuel storage tanks, bonfires, biogenic sources

  Comfort Heating = Largest source of anthropogenic stationary source pollution on Indian Island

CY 2002 Air Emissions Inventory Indian Island

Stationary Sources

- Fuels Used for heating: Mostly No. 2 Distillate, but also use some propane and wood
- Fuel use was quantified for each fuel type, and the appropriate AP-42 emission factors were used to estimate emissions
- Emission factors are based on approximate size of combustion unit
  - Residential was assumed to use heating units rated at <0.3 MMBtu/hr
  - Commercial was assumed to use heating units rated between 0.3 and 10 MMBtu/hr

CY 2002 Air Emissions Inventory Indian Island

Stationary Sources: Wastewater Treatment Plant

- The Wastewater Treatment Plant consists of an oxidation ditch system followed by circular clarifiers and a chlorine contact tank
- 0.0704 Million GPD average flow
- EPA emission factors used to calculate emissions

CY 2002 Air Emissions Inventory Indian Island

Stationary Sources: Fuel Storage Tanks

- Volatile pollutant emissions from working and breathing tank losses
- Heating Oil, Kerosene
- Tank sizes and turnovers were estimated based on annual usage, and EPA's TANKS program was used to calculate emissions

CY 2002 Air Emissions Inventory Indian Island

Stationary Sources: Bonfires

- Survey estimated that 60 cords of wood were burned on the island. Half burned in fireplaces and half in bonfires
- Using an estimate of 1.2 tons/cord, the total mass of wood burned in the bonfires was 36 tons
- AP42 uncontrolled fireplace emission factors used to calculate these emissions

CY 2002 Air Emissions Inventory Indian Island

Stationary Sources: Biogenic

- Used EPA's BEIS program to estimate VOC and NOx emissions
- The Penobscot Reservation makes up 0.493% of Penobscot County, so county emissions were multiplied by 0.493%
- BEIS does not supply HAP data, but recent research estimates that the three primary HAP components from biogenic sources are methanol, acetaldehyde, and formaldehyde, comprising a total of approximately 15% of the VOC

CY 2002 Air Emissions Inventory Indian Island

Stationary Sources: Household Products

- Emissions from household products calculated using AP-42 emission factors
- Emission factor is based on per-capita emissions, so the factor was multiplied by the Indian Island population of 562 to calculate VOC emissions
- HAP emissions were assumed to be low considering that the products are used in households

CY 2002 Air Emissions Inventory Indian Island

Mobile Sources

- Light-duty cars and trucks owned by residents and visitors
- Medium- or heavy-duty vehicles such as delivery trucks to the island, garbage trucks, and tour buses serving the bingo facility
- Lawn maintenance equipment

CY 2002 Air Emissions Inventory Indian Island

On-road Mobile Sources

- No industrial traffic
- Cars, trucks, and service vehicles are responsible for the majority of the on-road emissions
- Diesel buses (travel and idle)

CY 2002 Air Emissions Inventory Indian Island

On-road Mobile Sources

- Traffic count data collected for 117 days.
- Most of the buildings on the island are within 3 miles of the bridge
- Average number of bridge crossings per day were multiplied by days in a year
- Mobile 6 used to calculate emissions using an average speed of 25 mph on the island
- Buses traveling to the Bingo Hall only operate 14 days per year.

CY 2002 Air Emissions Inventory Indian Island

Off-road Mobile Sources

- Lawn and garden equipment including lawnmowers, leafblowers and snowblowers
- Emissions calculated using emission factors from the EPA Nonroad Engine and Vehicle Emission Study (NEVES) Report
- Assumptions made to determine the extent of use of each equipment type

CY 2002 Air Emissions Inventory Penobscot Trust Lands

Stationary Sources

- Campfires
  - Estimated based on questioning of the Indian Island residents
  - Fireplace emission factors used
- Biogenic Emission Sources
  - BEIS program used

CY 2002 Air Emissions Inventory Penobscot Trust Lands

Mobile Sources

- Logging operations
  - Estimated based on number and type of equipment used
  - Hours per day and months per year that equipment is used
  - Load Factors
  - NONROADS Model,
- Biogenic Emission Sources
  - BEIS program used

CY 2002 Air Emissions Inventory Penobscot Trust Lands

Mobile Sources

- Recreational Traffic
  - Cars and trucks traveling to campsites
  - Average speed of 25 mph
  - Mobile 6
  - Particulate from the roads calculated based on AP-42 unpaved road emission factors in AP-42 section 13.2.2

TABLE 1.1 CRITERIA POLLUTANT EMISSIONS ON INDIAN ISLAND AND THE PENOBSCOT RESERVATION

Source	Emissions (ton/yr)[a]							
	VOC	CO	Lead	NO_X	PM	PM10	PM2.5	SO_2
Stationary Sources								
Heating Units	4.17	5.05	9.86×10^{-5}	1.71	7.07×10^{-1}	6.70×10^{-1}	6.60×10^{-1}	5.56
Wastewater Treatment	--	--	--	--	--	--	--	--
Bonfires	4.12	4.55	--	4.68×10^{-2}	6.23×10^{-1}	6.23×10^{-1}	6.23×10^{-1}	7.20×10^{-3}
Biogenic Emissions	66.1	--	--	1.27	--	--	--	--
Household Products	1.79	--	--	--	--	--	--	--
Fuel Storage Tanks	1.59×10^{-2}	--	--	--	--	--	--	--
Subtotal	76.2	9.60	9.86×10^{-5}	3.03	1.33	1.29	1.28	5.57
Mobile Sources								
Mobile Vehicles	4.44	59.3	--	6.47	1.77×10^{-1}	1.39×10^{-1}	7.94×10^{-2}	2.70×10^{-1}
Idling Buses	8.25×10^{-1}	7.15×10^{-2}	--	1.10×10^{-1}	8.10×10^{-3}	6.40×10^{-3}	3.64×10^{-3}	5.26×10^{-3}
Lawnmowers	8.50×10^{-1}	1.78	--	5.52×10^{-4}	1.47×10^{-2}	1.16×10^{-2}	6.60×10^{-3}	3.88×10^{-3}
Leafblowers	4.05×10^{-1}	1.20	--	8.46×10^{-4}	3.17×10^{-3}	2.51×10^{-3}	1.43×10^{-3}	1.80×10^{-3}
Snowblowers	1.65	3.42	--	1.07×10^{-3}	2.85×10^{-2}	2.25×10^{-2}	1.28×10^{-2}	7.55×10^{-3}
Subtotal	8.18	65.7	--	6.58	2.31×10^{-1}	1.82×10^{-1}	1.04×10^{-1}	2.79×10^{-1}
All Sources								
Total Emissions	84.4	75.3	9.86×10^{-5}	9.61	1.56	1.47	1.38	5.85

[a]All values are rounded to three significant figures.

TABLE 1.2 HAP EMISSIONS ON INDIAN ISLAND AND THE PENOBSCOT RESERVATION

Source	Emissions (ton/yr)[a]						
	Arsenic	Cadmium	Formaldehyde	Manganese	Mercury	Methanol	Total HAPs
Stationary Sources							
Heating Units	5.05	1.71	6.70×10^{-1}	5.56	4.17	--	18.5
Wastewater Treatment	--	--	--	--	--	--	1.50×10^{-3}
Bonfires	--	--	--	--	--		6.73×10^{-1}
Biogenic Emissions	--	--	7.60×10^{-1}	--	--	7.93	9.45
Household Products	--	--	--	--	--	--	0
Fuel Storage Tanks	--	--	--	--	--	--	0
Subtotal	5.05	1.71	1.43	5.56	4.17	7.93	28.7
Mobile Sources							
Mobile Vehicles	--	--	5.83×10^{-2}	--	--	--	2.49×10^{-1}
Idling Buses	--	--	6.74×10^{-4}	--	--	--	1.10×10^{-3}
Lawnmowers	--	--	1.08×10^{-5}	--	--	--	1.80×10^{-3}
Leafblowers	--	--	5.14×10^{-6}	--	--	--	8.58×10^{-4}
Snowblowers	--	--	2.09×10^{-5}	--	--	--	3.49×10^{-3}
Subtotal	--	--	5.90×10^{-2}	--	--	--	2.57×10^{-1}
All Sources							
Total Emissions	5.05	1.71	1.49	5.56	4.17	7.93	28.9

[a]All values are rounded to three significant figures.

TABLE 1.3 CRITERIA POLLUTANT EMISSIONS ON PENOBSCOT NATION TRUST LANDS

Source	Emissions (ton/yr)[a]						
	VOC	CO	NO_X	PM	PM10	PM2.5	SO_2
Stationary Sources							
Campfires	15.3	16.8	1.73E-01	2.30	2.30	2.30	$2.66x10^{-2}$
Biogenic Emissions	900	--	15.2	--	--	--	--
Subtotal	915	16.8	15.0	2.30	2.30	2.30	$2.66x10^{-2}$
Mobile Sources							
Alder Stream Logging Activities	7.52	22.8	12.9	$8.65x10^{-1}$	$6.83x10^{-1}$	$3.89x10^{-1}$	1.65
Mattamsicontis Logging Activities	11.9	35.5	15.4	1.14	$9.00x10^{-1}$	$5.13x10^{-1}$	1.97
Recreational Traffic – Roadway Dust Emissions	--	--	--	589	234	34.1	--
Recreational Traffic – Fuel Combustion Emissions	2.01	29.5	1.38	$2.40x10^{-2}$	$1.90x10^{-2}$	$1.08x10^{-2}$	8.72E-02
Subtotal	21.4	87.9	29.7	591	236	35.0	3.72
All Sources							
Total Emissions	937	105	44.7	593	238	37.3	3.74

[a]All values are rounded to three significant figures.

TABLE 1.4 HAZARDOUS AIR POLLUTANT EMISSIONS ON PENOBSCOT NATION TRUST LANDS

Source	Emissions (ton/yr)[a]							
	Acetaldehyde	Formaldehyde	Hexane	Methanol	MTBE[b]	Toluene	Xylene	Total HAPs
Stationary Sources								
Campfires	--	--	--	--	--	--	--	1.07×10^{-3}
Biogenic Emissions	10.3	10.3	--	108	--	--	--	129
Subtotal	10.3	10.3	--	108	--	--	--	129
Mobile Sources								
Alder Stream Logging Activities	8.86×10^{-2}	1.73×10^{-1}	9.37×10^{-2}	--	9.50×10^{-1}	6.49×10^{-1}	7.08×10^{-1}	3.06
Mattamsicontis Logging Activities	1.10×10^{-1}	2.13×10^{-1}	1.53×10^{-1}	--	1.56	1.06	1.15	4.87
Recreational Traffic – Roadway Dust Emissions	--	--	--	--	--	--	--	0
Recreational Traffic – Fuel Combustion Emissions	5.26×10^{-3}	1.52×10^{-2}	--	--	1.33×10^{-3}	--	--	7.83×10^{-2}
Subtotal	2.03×10^{-1}	4.01×10^{-1}	3.07×10^{-1}	--	1.95	1.71	1.86	8.00
All Sources								
Total Emissions	10.4	10.7	3.07×10^{-1}	108	1.95	1.71	1.86	137

[a]All values are rounded to three significant figures.
[b]MTBE = methyl tertiary butyl ether.