



# **Risk Assessment of Toxic Emissions (RATE)**

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# RATE OVERVIEW

- **Three Phases**
  - Toxics Emissions Inventory
  - Risk Assessment
  - Risk Communication

# Purpose

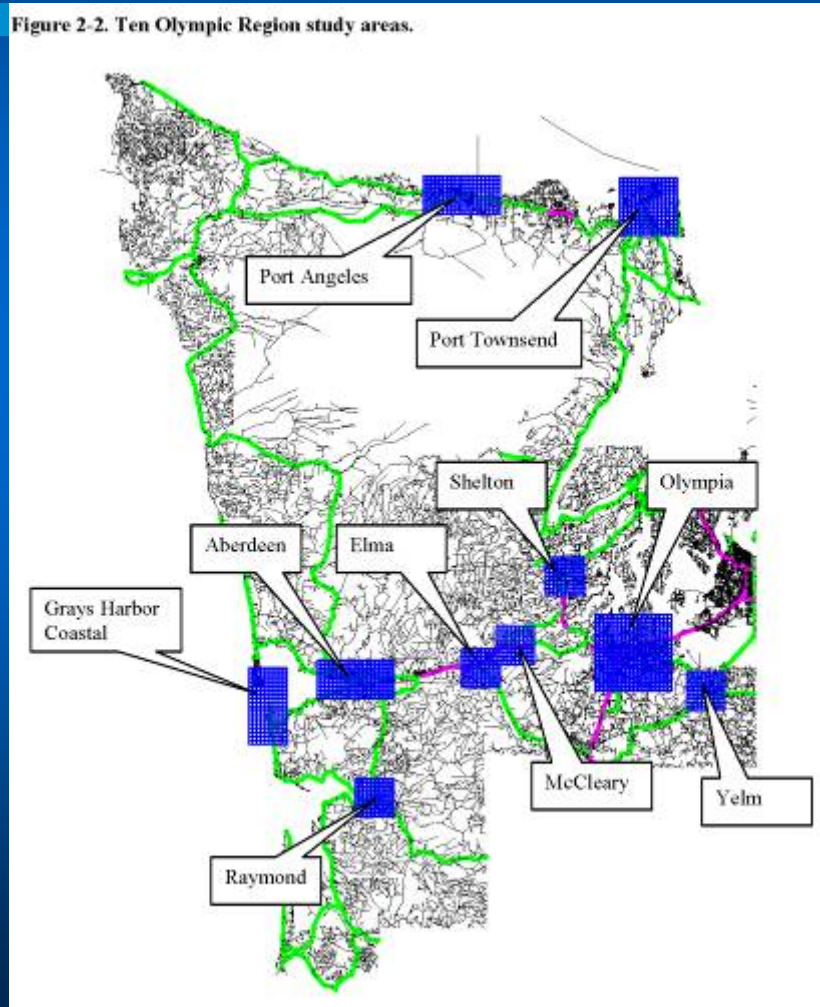
- Which air pollutants are key contributors to health risk?
- What sources are the key contributors to health risk?
- To what degree are different geographic areas in the region impacted by air emissions?

# ORCAA's Jurisdiction



# Ten Study Areas

Figure 2-2. Ten Olympic Region study areas.



# Project Overview

- Phase 1: Emission Inventory
- Phase 2: Dispersion Modeling
- Phase 3: Risk Analysis

# Emission Inventory

- Source location coordinates
- Emissions data: pollutant name, CAS number, annual emissions (lb/yr)
- Source type (point, volume, area)
- Modeling source parameters: stack height, diameter, flow, temp., geometry and dimensions
- Operating schedule

# Emission Inventory Source Types

## Types

- Commercial sources
- Roadway vehicle sources
  - Freeway
  - Artery
  - Collector
  - Local Road
- Wood stoves and fireplaces



# Air Dispersion Modeling

- Step A: ISCST3 Model Run for Dilution Factors
- Step B: Emission Rate Extraction
- Step C: Overlay Grid Creation
- Step D: Risk Calculation

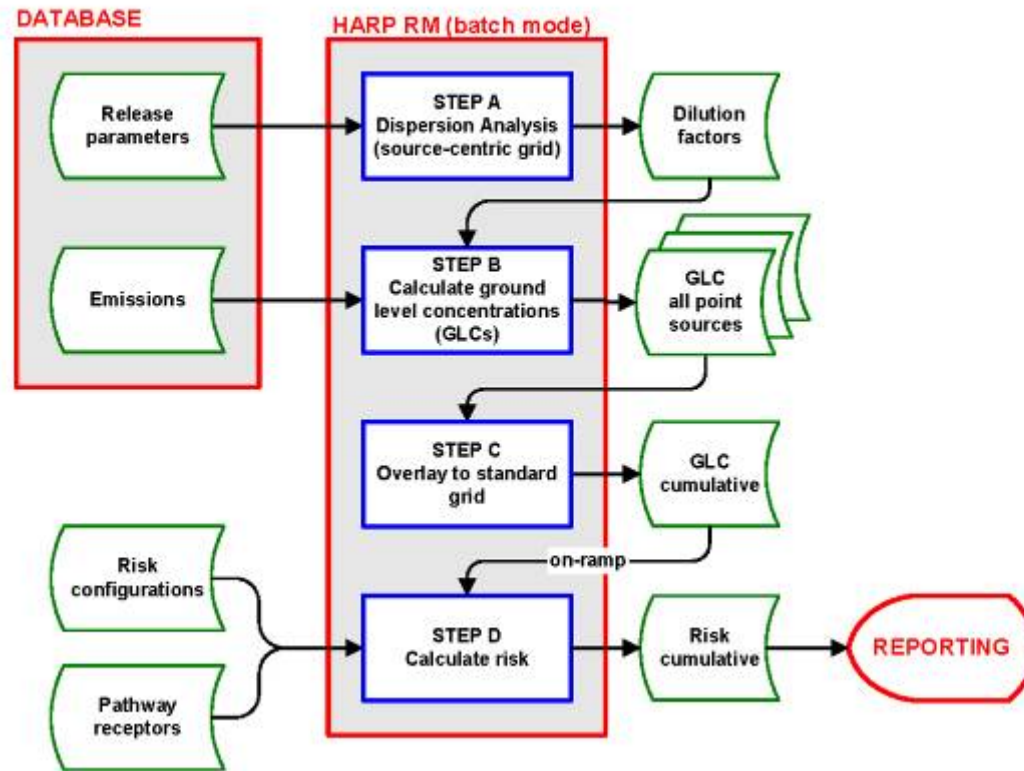
# ISCST3 Dispersion Runs

**Table 4-1. Summary of ISCST3 dispersion runs.**

<i>Source Type</i>	<i>Number of Release Points</i>	<i>Number of ISCST3 runs</i>
Point sources	107	214
Freeways, arteries and collectors	3402	3402
Local roads	2950	2950
Wood stoves	213	213
Total	6672	6779

# HARP Batch Modeling Process

Figure 4-1. HARP batch modeling process.



# Meteorological Data

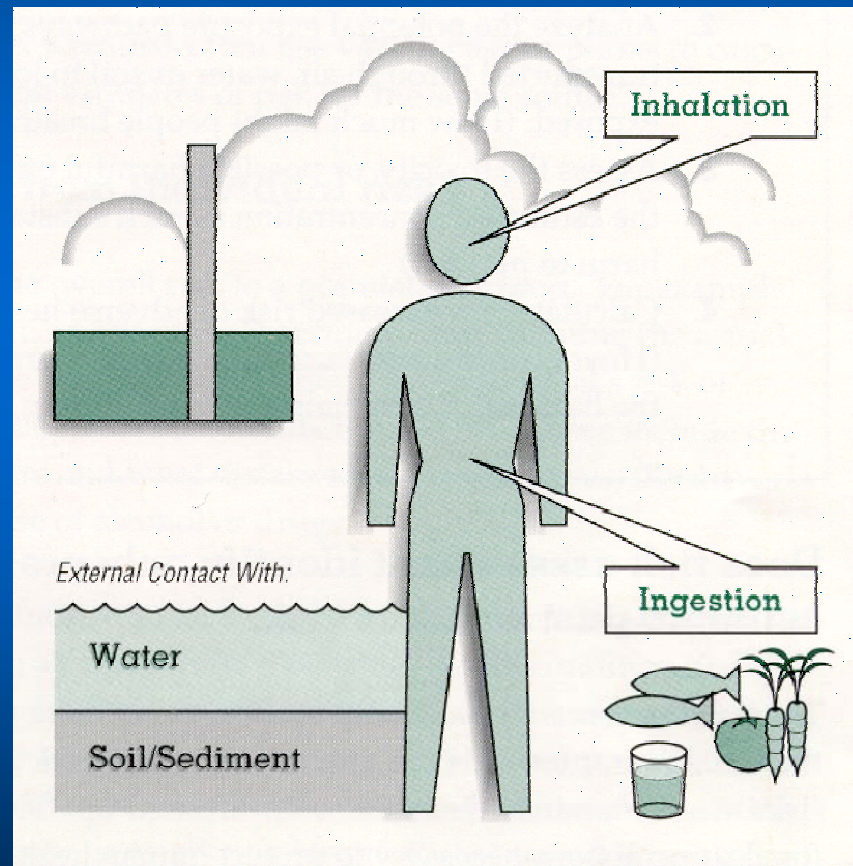
- EPA SCRAMM website
- **NCDC, TD3280 format**
  - **Olympia, Hoquiam, Port Angeles**
- NCDC, SAMSON/HUSWO
- WRCC NOAA/NWS Cooperative Observer Network
- NCDC, ISH data

# Health Risk Assessment

## HARP Health Risk Assessment Module

- Ground Level Concentrations
- Dose
- Cancer Risk (Probability)
- Chronic Non-cancer Risk (Health Hazard Index)

# Exposure Pathways



# Analysis Method

- Average Point Estimate
- High-end Estimate
- 80<sup>th</sup> Percentile Point Estimate (Inhalation)
- **Derived (OEHHA) Method**
  - **Inhalation, dermal (soil), ingestion (soil)**
- Derived (Adjusted) Method
- **70 year Adult Resident Scenario**

# Health Effects

## Cancer Risk

**Inhalation cancer potency factors**

**Oral slope factors (mg/kg-day)<sup>-1</sup>**

## Chronic Non-Cancer (HHI)

**Inhalation reference exposure levels  
(ug/m<sup>3</sup>)**

**Oral reference exposure levels (mg/kg-  
day)**



# Limitations and Assumptions

- **Sources of uncertainty**

- Extrapolation of toxicity data in animals to humans
- Emissions estimates
- Air dispersion modeling
- Exposure estimates

# HARP Uncertainties

- **Intake rates**
- **Chemical toxicities**
  - Polycyclic Organic Matter
  - Acetone
  - $\alpha$ -Pinene
  - Tetrahydrofuran
  - 2-Butoxy-ethyl Acetate
  - 9-Methylbenzanthracene
  - 1-Methylphenanthracene
  - 12-Methylbenzanthracene
  - Chrome III

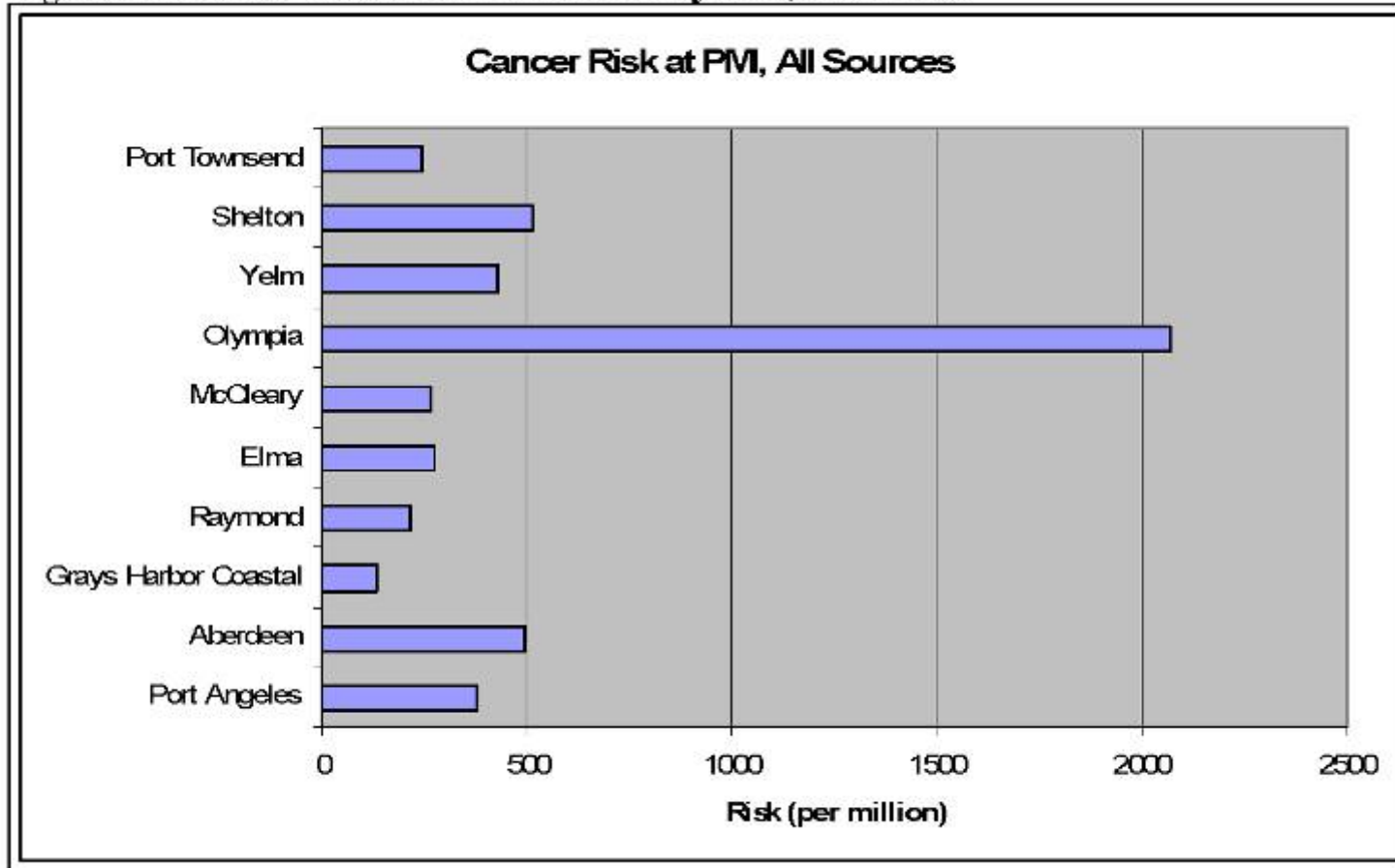
# Results-Cancer Risk

## All Sources

Study Area	PMI Cancer Risk from all sources (per million)
Port Angeles	381
Aberdeen	495
Grays Harbor Coastal	137
Raymond	213
Elma	273
McCleary	266
Olympia	2070
Yelm	432
Shelton	515
Port Townsend	244

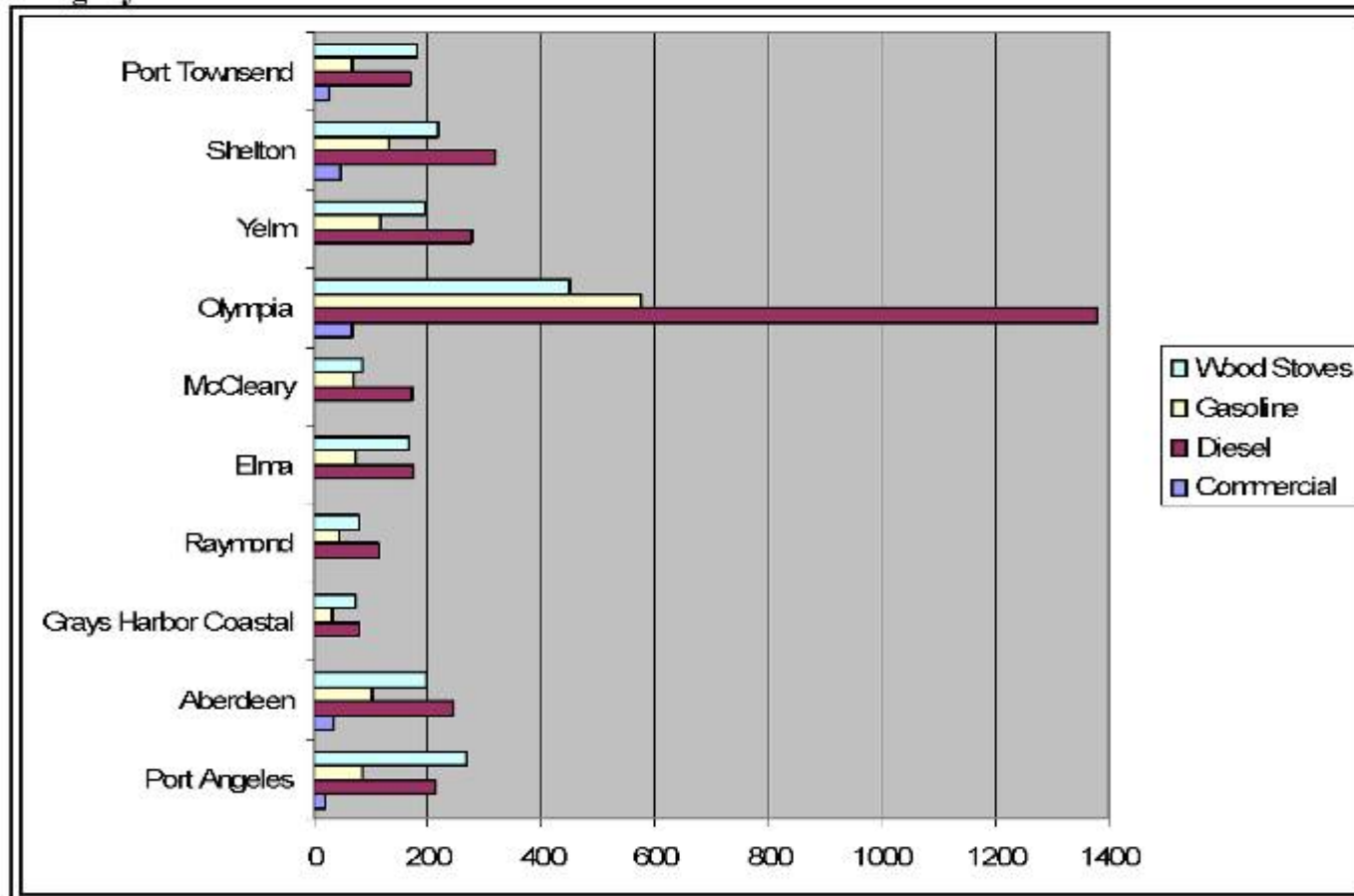
# Results-Cancer Risk

Figure 5-1. Cancer risk at PMI for each study area, all sources.



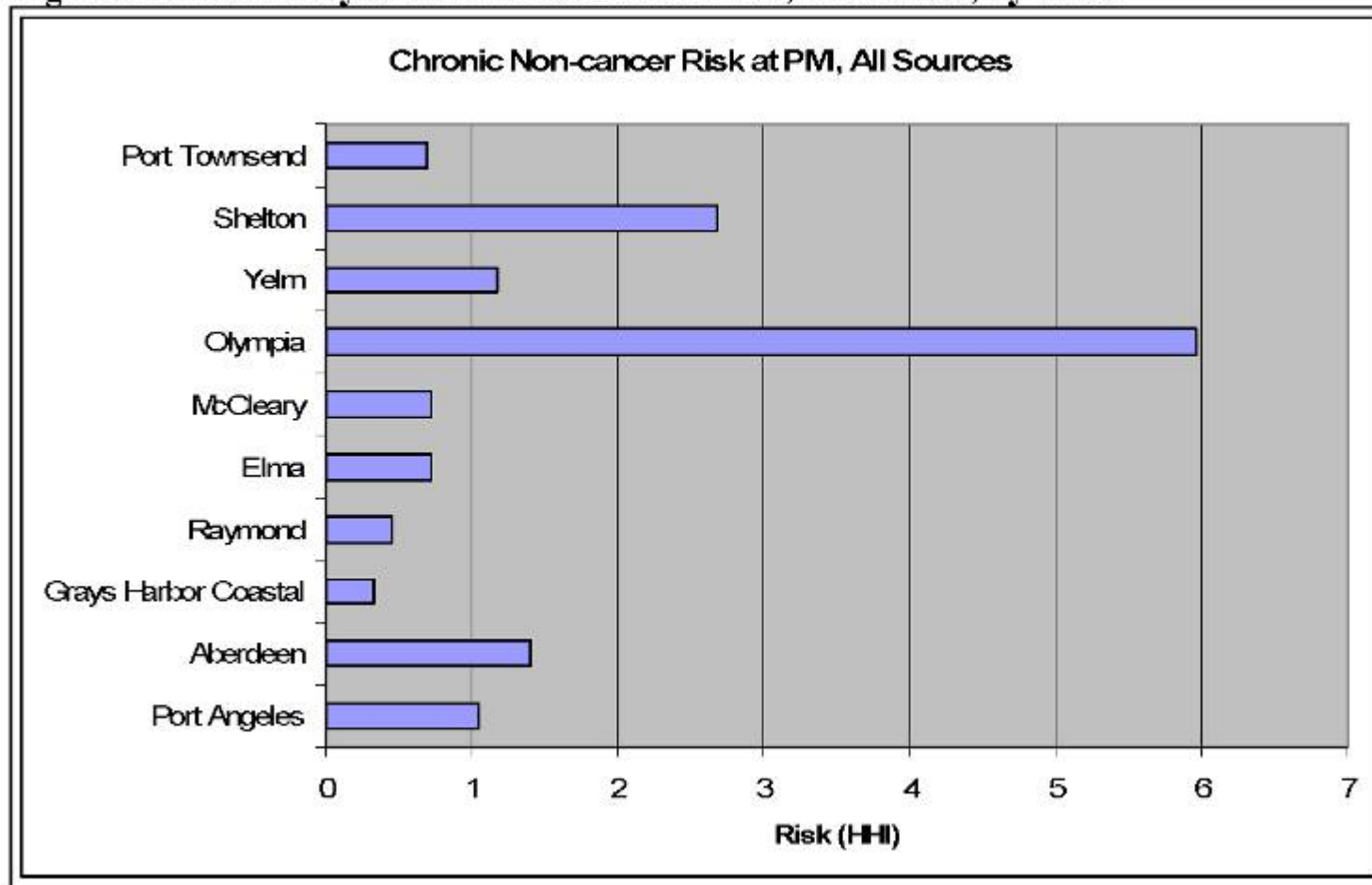
# Cancer Risk- PMI

Figure 5-2. Cancer risk at PMI for each study area, all sources, broken down by source category.



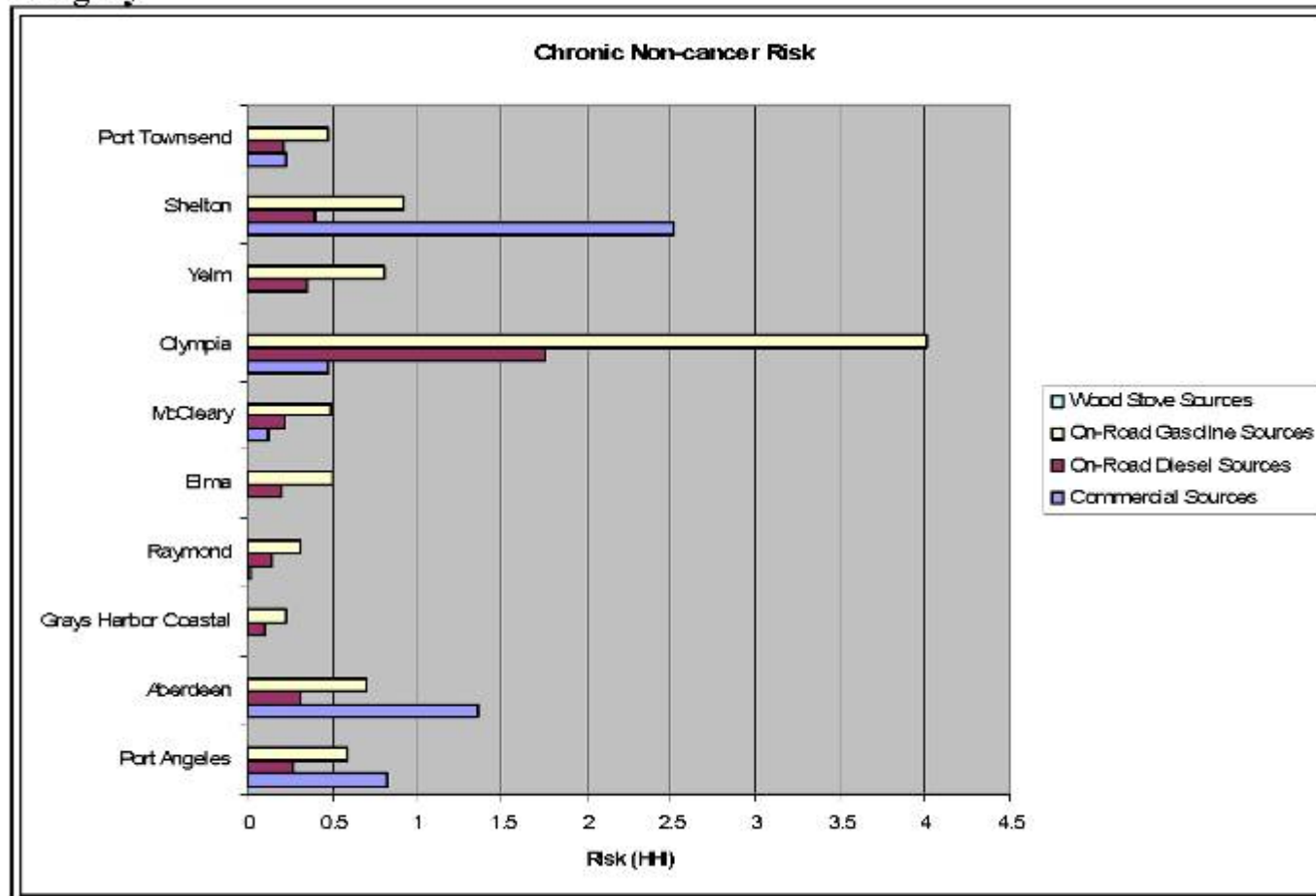
# Chronic Non-cancer Risk

Figure 5-9. Summary of chronic non-cancer risk, all sources, by area.

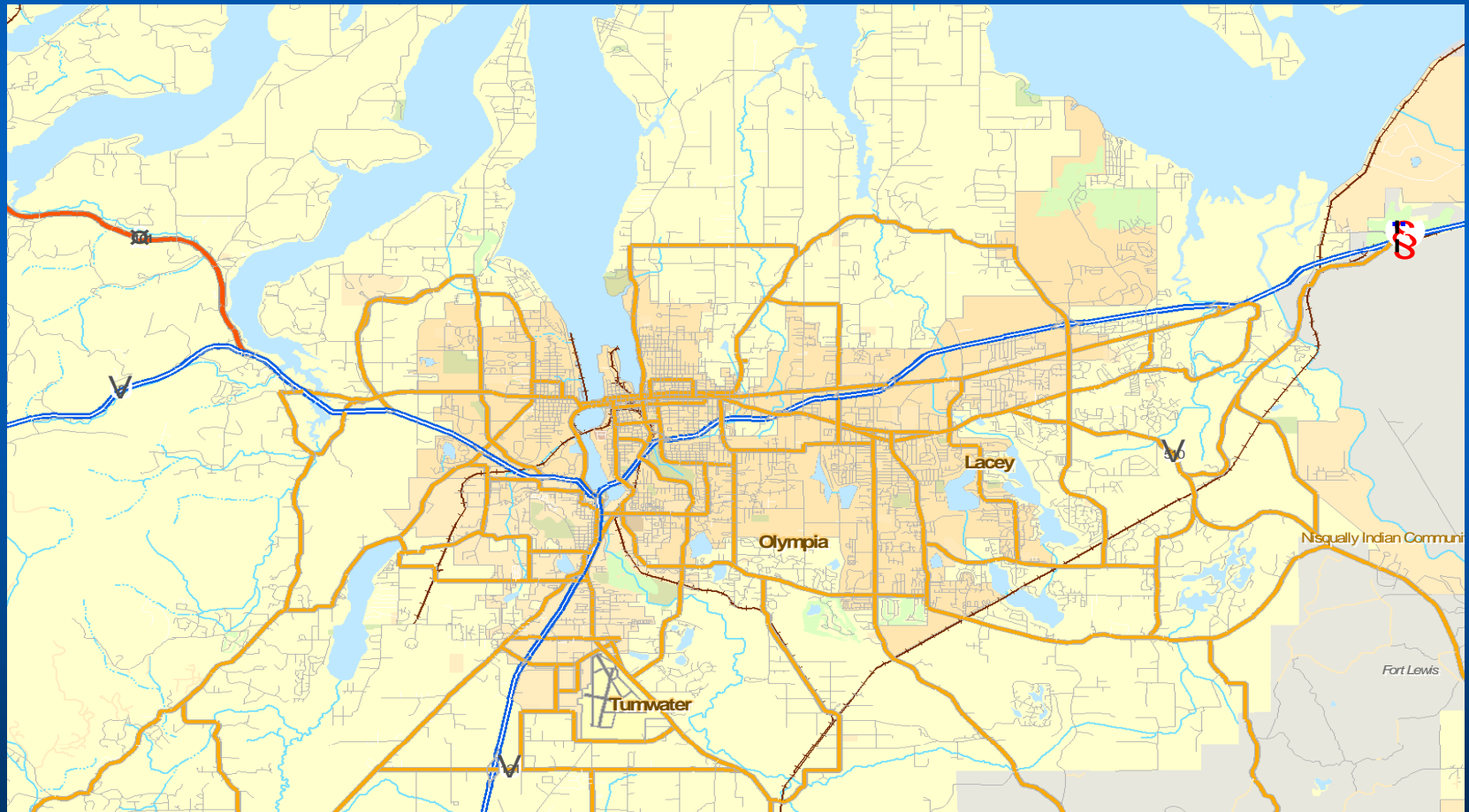


# Chronic Non-cancer Risk

Figure 5-10. Summary of chronic non-cancer risk, all sources, by area, broken down source category.



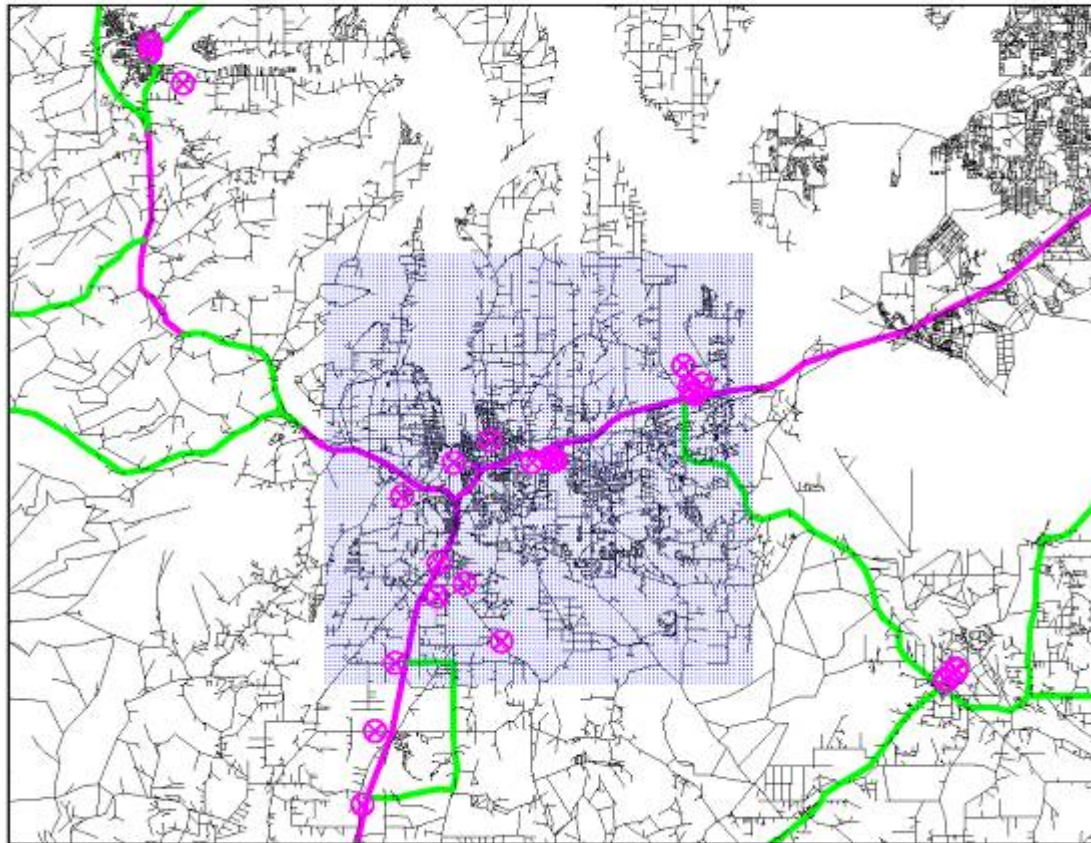
# Olympia Study Area





# Olympia Study Area-Commercial

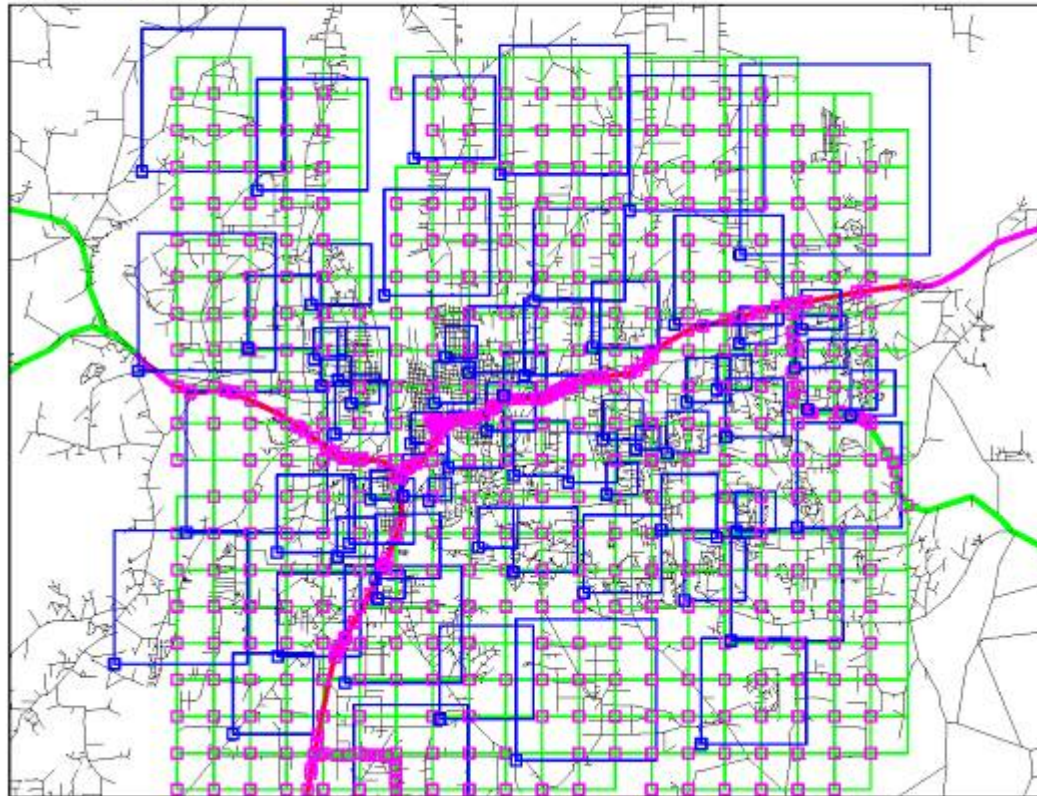
**Figure 5-101. Analysis grid and locations of commercial sources. Source locations are indicated by circled X's.**



# Olympia Study Area - Non-commercial

**Figure 5-102. Locations of non-commercial sources.**

Small magenta squares are locations of on-road freeway, artery, collector and local road sources. Green squares are the boundaries of local road area sources. Blue squares are locations of wood stove sources.



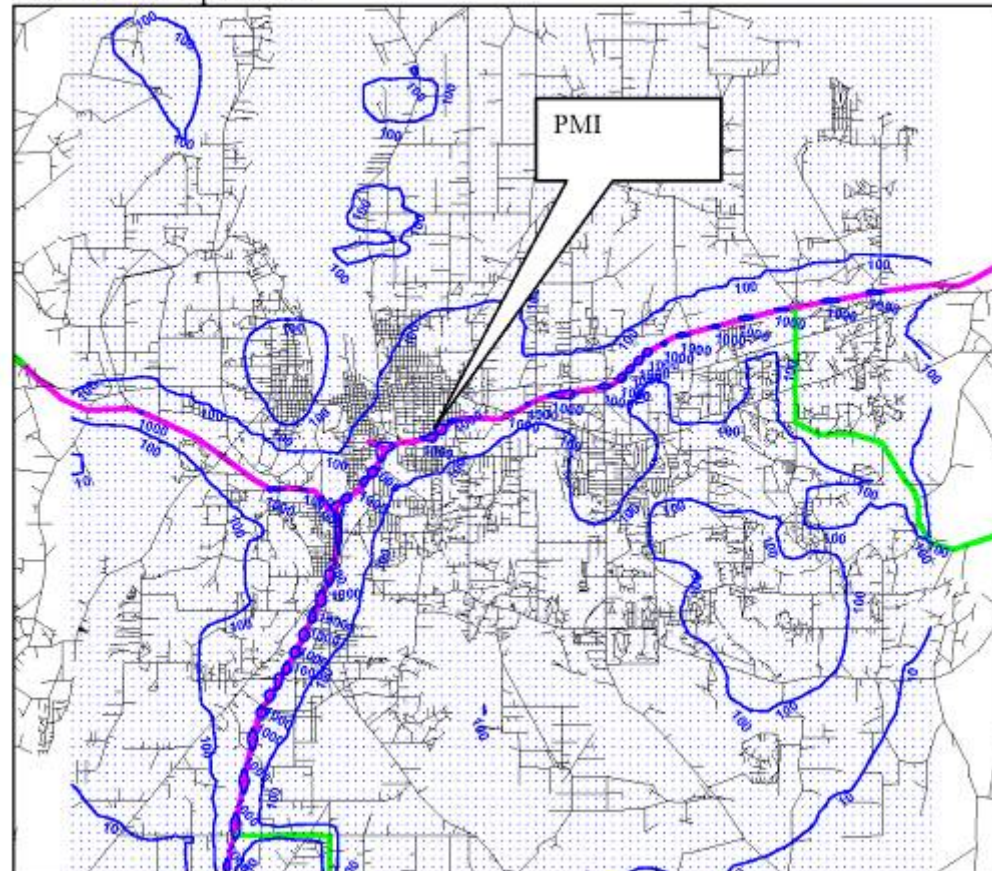
# Total Cancer Risk Contours-Olympia

Figure 5-103. Contours of total cancer risk from all sources.

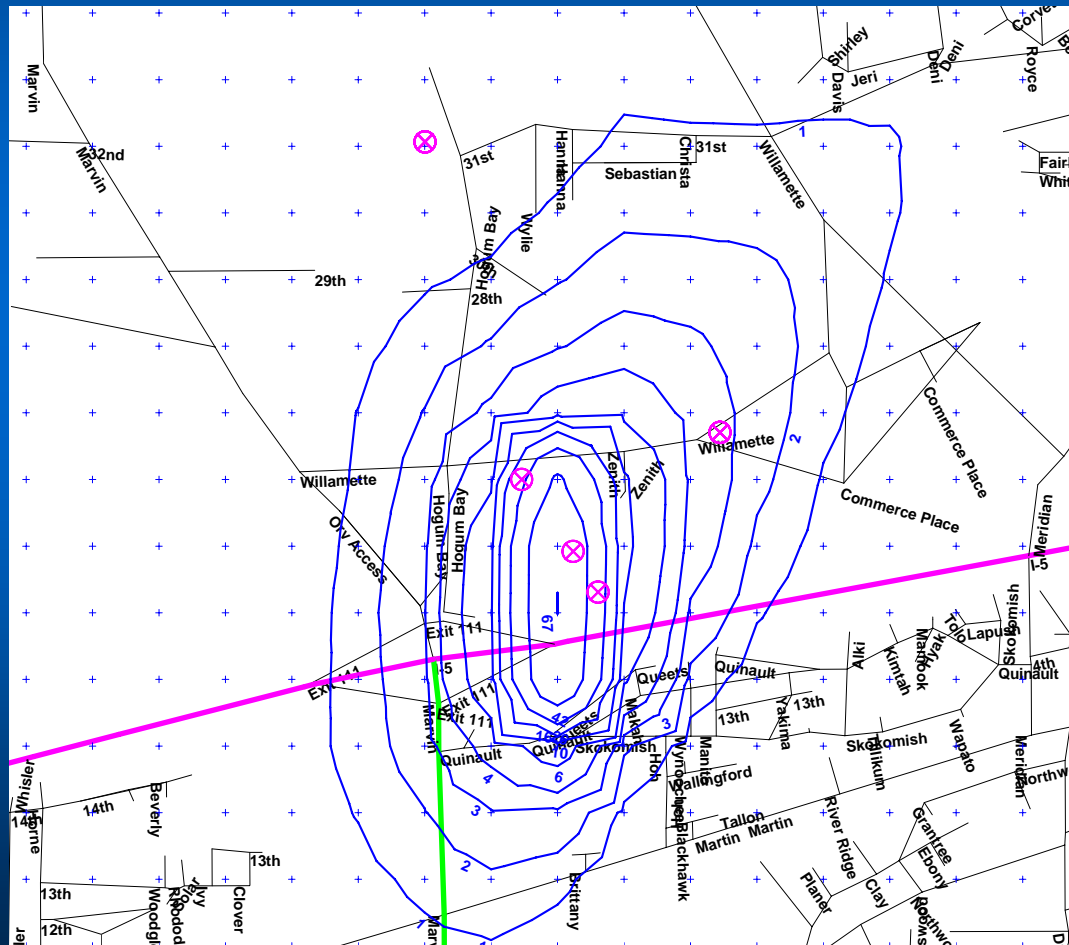


# Total Cancer Risk-Olympia

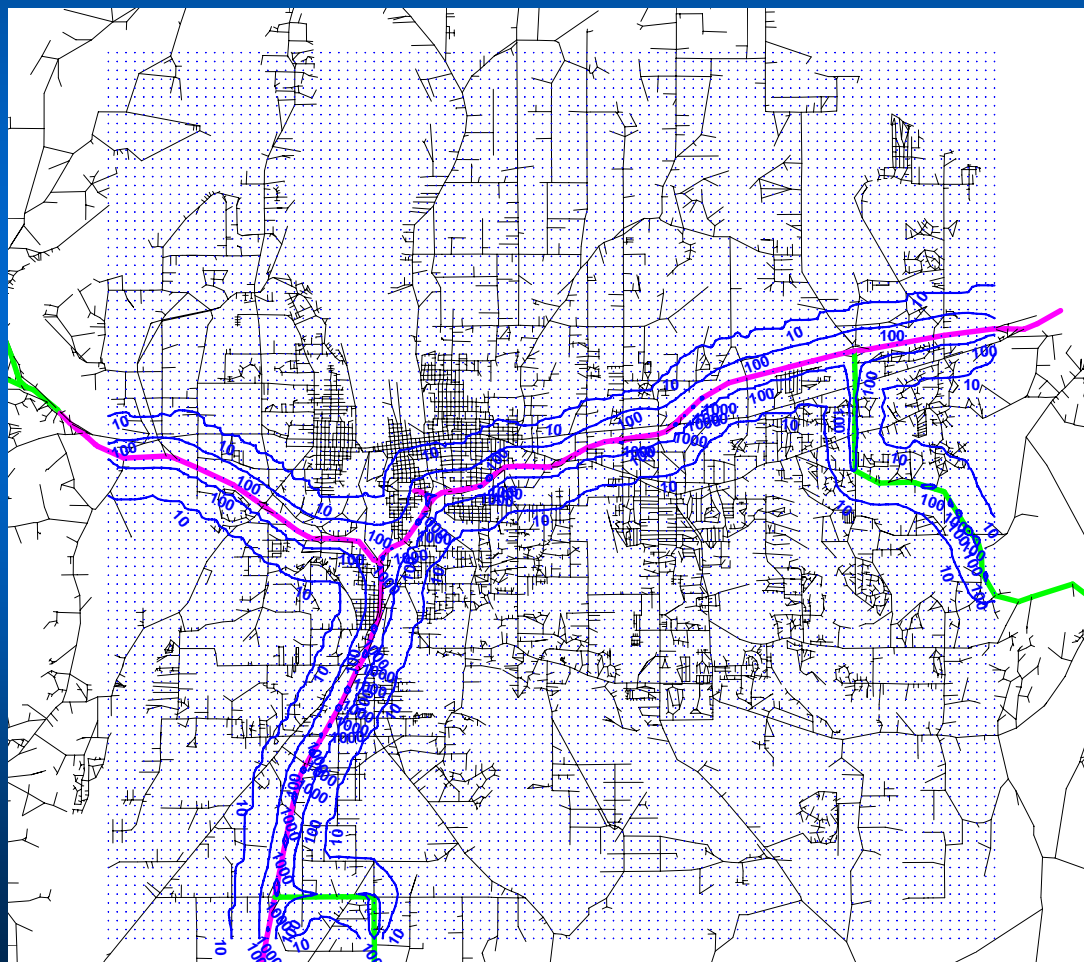
**Figure 5-111. Olympia, all sources, cancer.**  
PMI risk = 2070 per million



# Cancer Risk-Commercial, Olympia

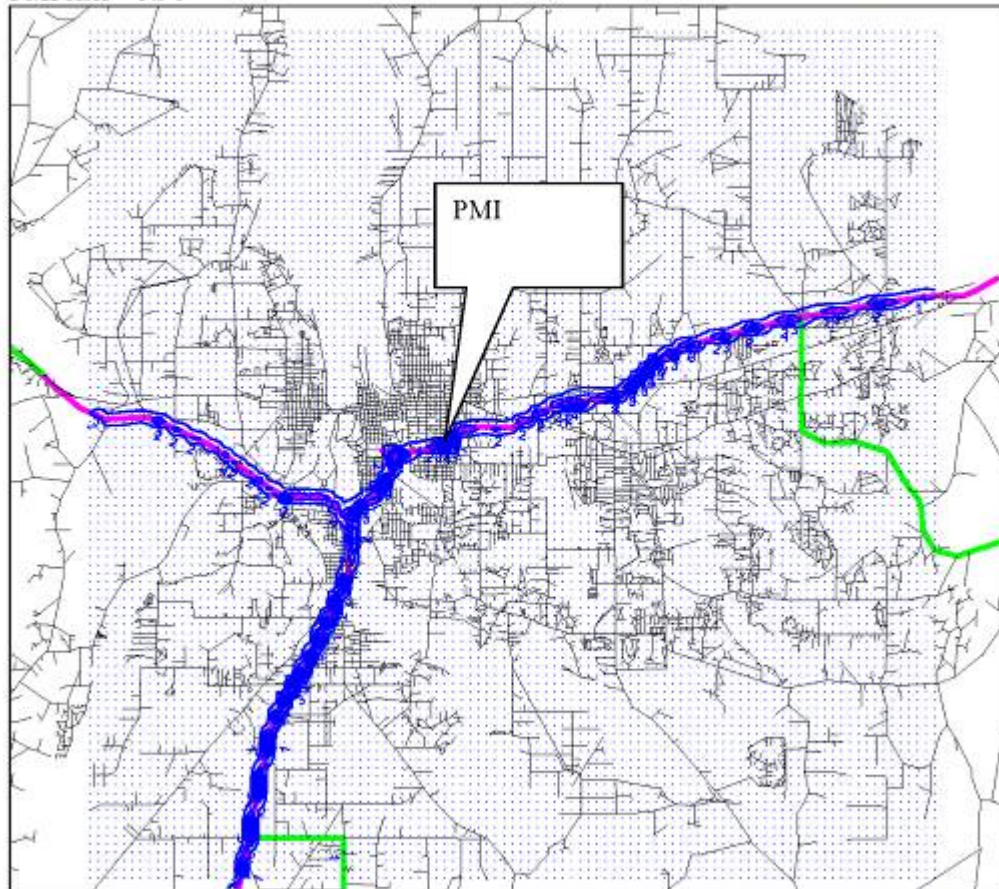


# Cancer Risk-Diesel On-road, Olympia

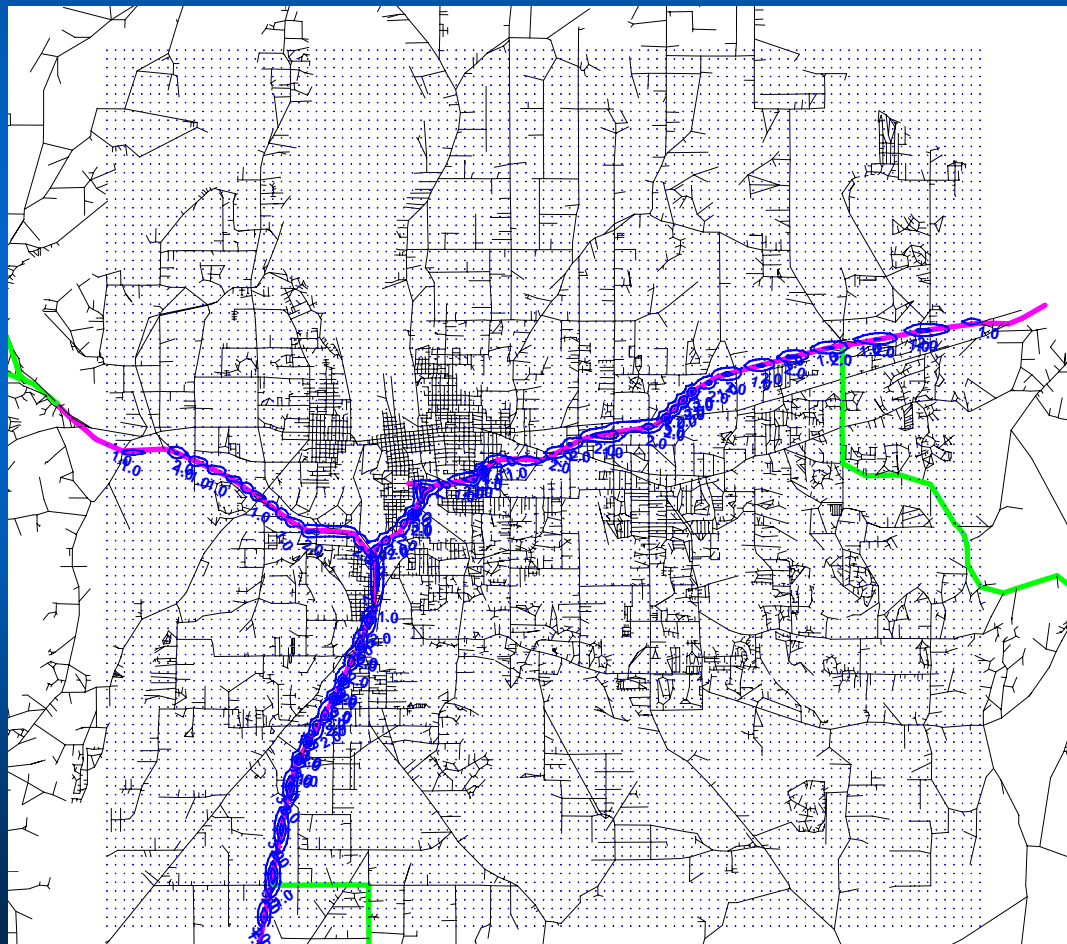


# Total Chronic Non-cancer Risk-Olympia

**Figure 5-116. Olympia, all sources, Chronic non-cancer HHI.**  
PMI risk = 5.96



# Gasoline On-Road Chronic HHI





# Summary and Conclusions

## ● Cancer Risk

- Commercial Sources: 0-67 per million
- On-road Diesel: Typical risk is 200-300 per million, Olympia has 1380 per million
- On-road Gasoline: Typical risk is 50-100 per million, Olympia has 576 per million
- Wood Stoves: Typical risk 100-300 per million, Olympia has 450 per million\*
- All Source PMI: 2070 per million (Olympia)

# Summary and Conclusions

## ● **Chronic Non-cancer Risk**

- Commercial Sources: Below HHI of 1, except in Aberdeen and Shelton
- On-road Diesel: Exceeds 1.0 only for Olympia
- On-road Gasoline: Exceeds 1.0 only for Olympia (2x higher than diesel)
- Wood Stoves: Risk is negligible in all areas
- All Source PMI: 6.0 (Olympia)

# Risk Communication

- Current
  - Tool to use in response to community concerns on a case by case basis
- Future
  - Interactive web-based tool

# Risk Communication

- “risk estimates generated by a health risk analysis **should not be interpreted as the expected rates of disease in the exposed population** but rather as estimates of potential risk, based on current knowledge and a number of assumptions. Additionally, the uncertainty factors integrated within the estimates of non-cancer reference exposure levels (RELS) are meant to err on the side of public health protection in order to avoid underestimation of risk. **Risk assessment is best used as a ruler to compare one source with another and to prioritize concerns.** Consistent approaches to risk assessment are necessary to fulfill this function.”

California OEHHA. (August 2003). The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments