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Toxic Contaminants in the Surficial Sediments of the Fore River, Maine

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Toxic Contaminants in the Surficial Sediments of the Fore River, Maine

- Natural Resource Damage Assessment Trustees
- Casco Bay Estuary Partnership

Sediment Contaminants

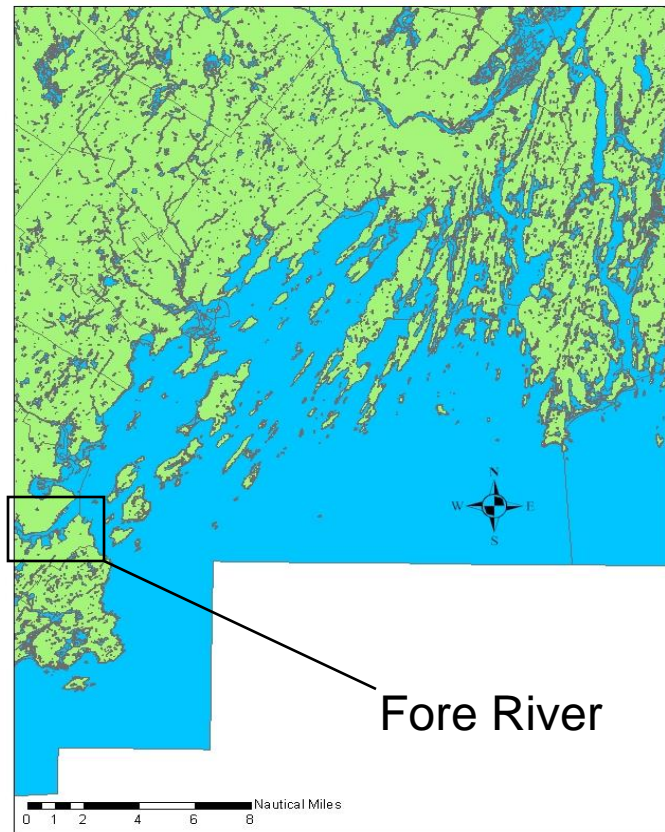
- Serious threat to estuarine ecosystems worldwide.
- Adverse effects include loss of biodiversity and abundance of benthic organisms, and bioaccumulation further up the food chain.
- Introduced via direct discharge, run-off, and atmospheric deposition.
- Most contaminants quickly bind to fine-grained sediment near source.

2004 Fore River Study

- Goal: Produce a baseline
- Determine the potential for adverse effects
- Polycyclic Aromatic Hydrocarbon concentrations – Natural Resource Damage Assessment
- Metals, Polychlorinated Biphenyls, and Dioxin concentrations – Casco Bay Estuary Partnership

Fore River

Casco Bay, Maine

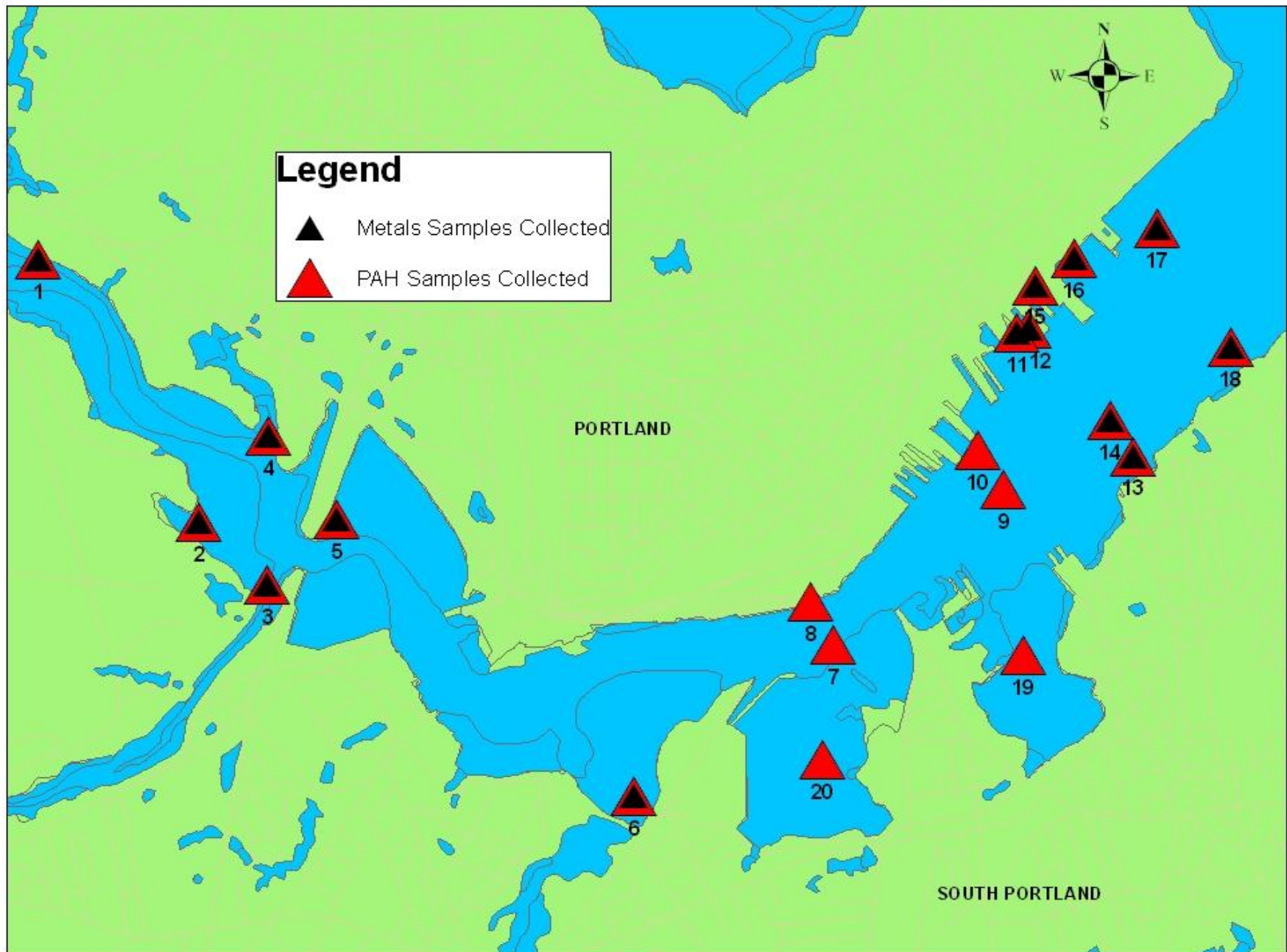


- Industrial History
 - Coal Gas Plants
 - Electrical Plants
 - Factories
 - Foundries
 - Gas Stations
 - Tanneries
- Population Center
- Busiest Oil Port on East Coast

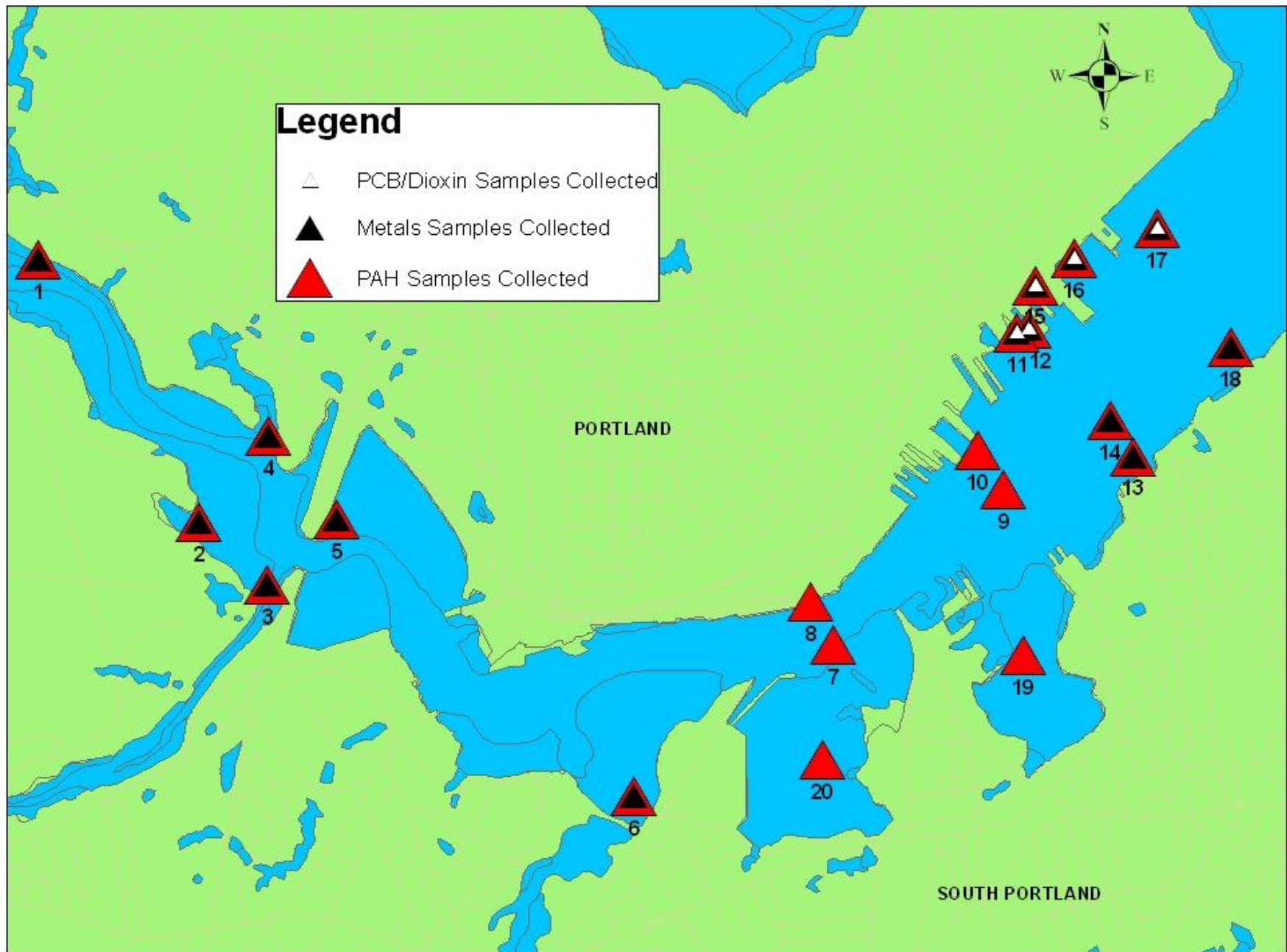
2004 Sediment Stations



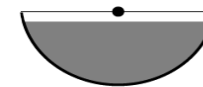
2004 Sediment Stations



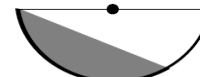
2004 Sediment Stations



Sediment Collection



Acceptable grab
At least 7 cm deep with even surface



Unacceptable grab
Sloping surface



Unacceptable grab
Insufficient volume



Unacceptable grab
Wash-out



Unacceptable grab
Overfilled

Figure 2. Illustration of acceptable and unacceptable grabs for benthic community analysis. An acceptable grab is at least 7 cm in depth (using a 0.04m² Van Veen sampler), but not oozing out of the top of the grab, and has a relatively level surface.



Sediment Quality Guidelines

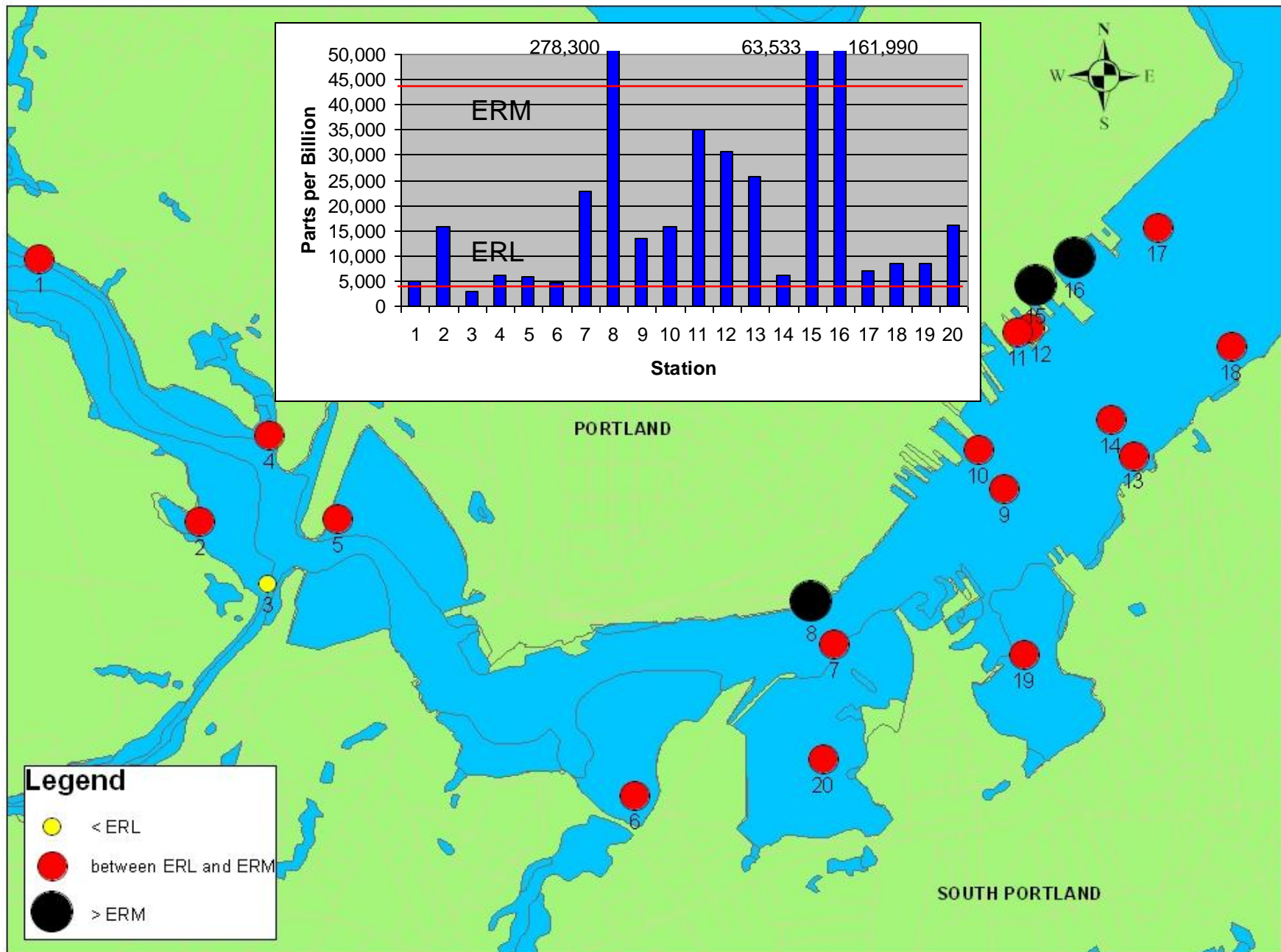
- Assessment of the levels of sediment contaminants.
- Edward Long, NOAA – calculated thresholds based on observed toxic effects.
- ERL – Effects Range-Low: Adverse effects seen in 10% of the data.
- ERM – Effects Range-Median: Adverse effects seen in 50% of the data.
- There are specific ERL & ERM guidelines for each contaminant.

Polycyclic Aromatic Hydrocarbons



- MANY constituent compounds
- Toxic, carcinogenic, mutagenic
- Sources include:
 - Oil spills
 - Industrial effluent
 - By-product of combustion, including auto exhaust
 - Tires, street and parking lot materials

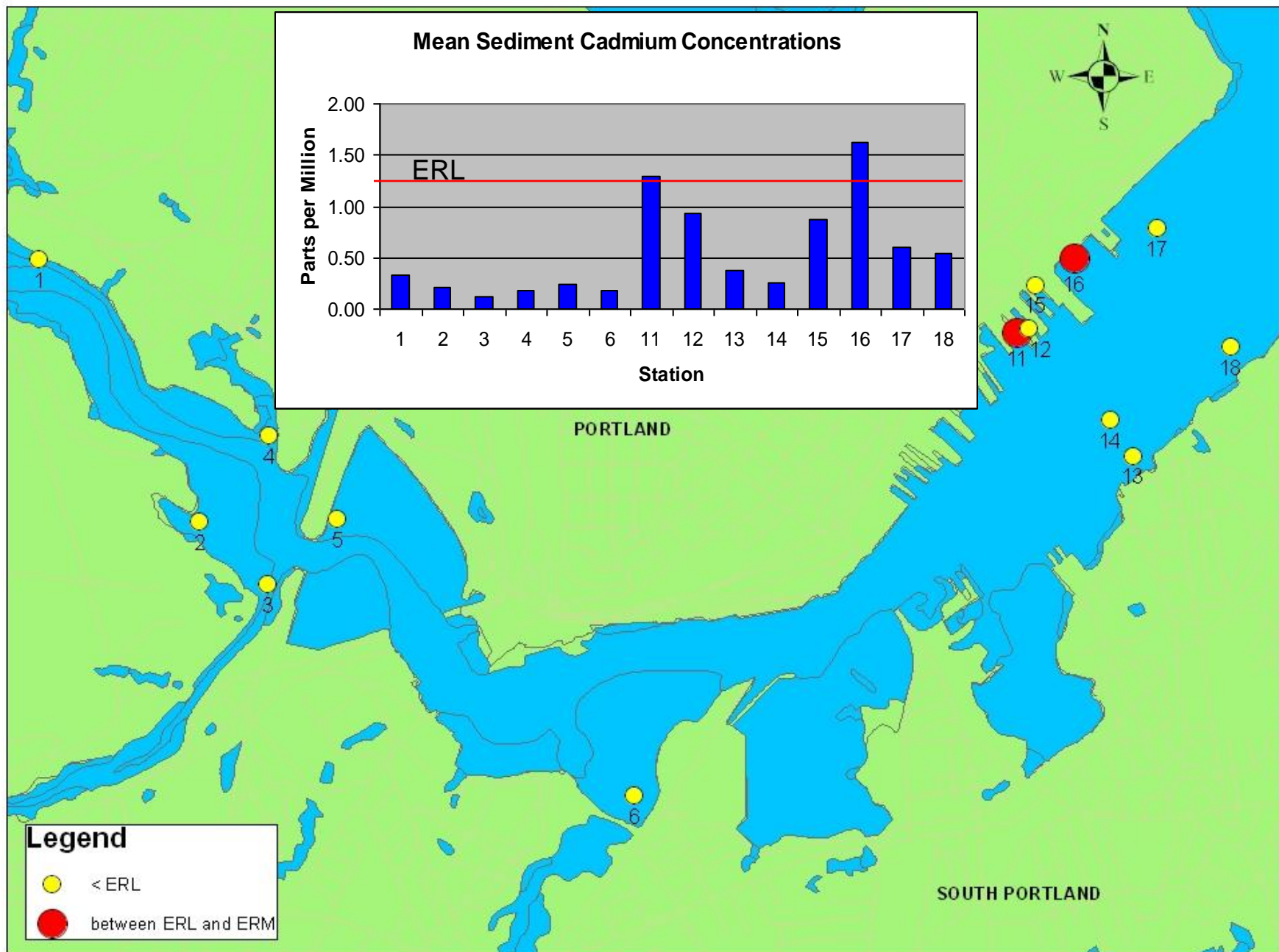
Total PAH Concentrations Grouped by ERL and ERM Guidelines



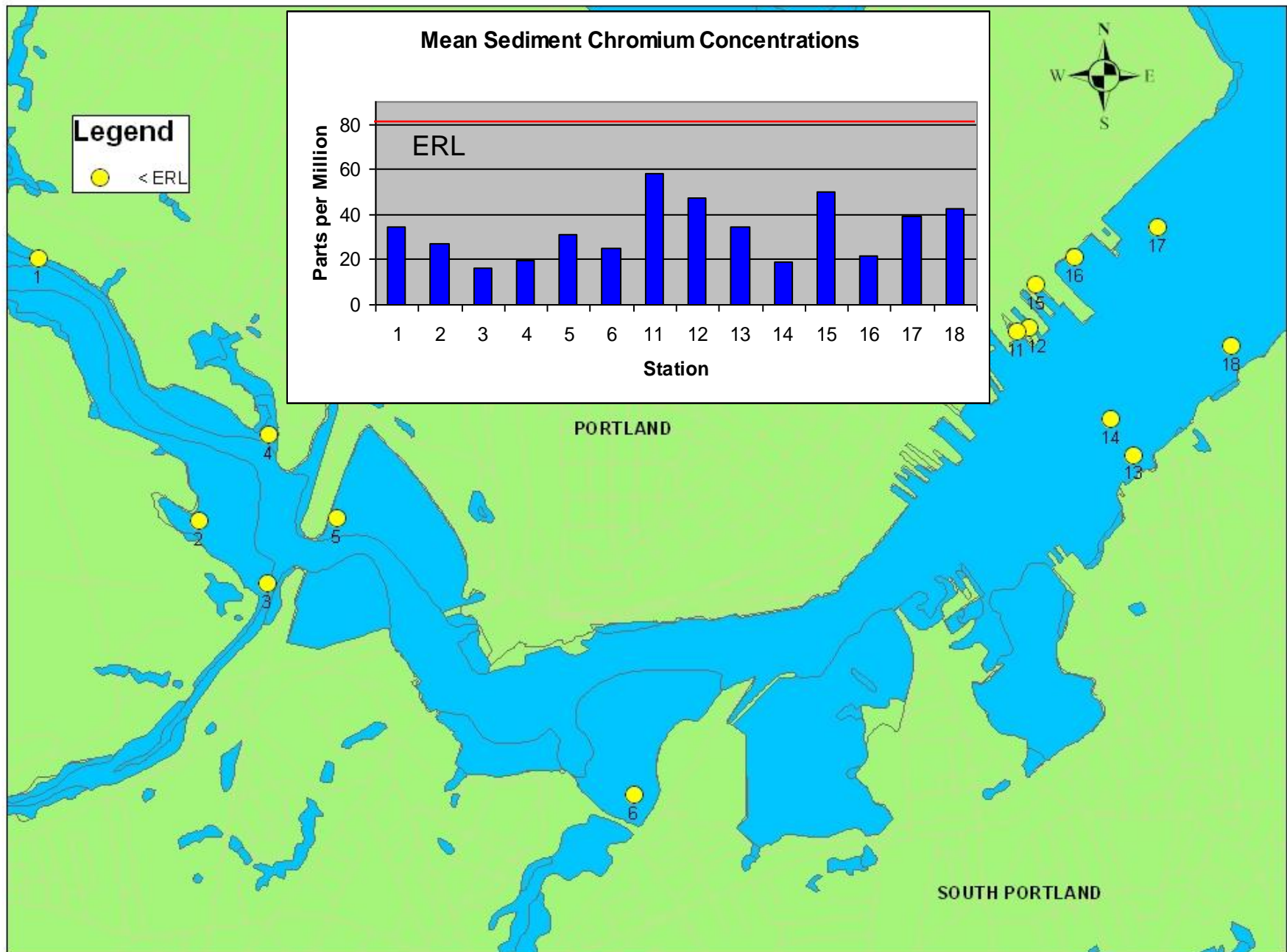
Metals

- Cadmium
- Chromium
- Copper
- Lead
- Mercury
- Nickel
- Silver
- Zinc
- Potential Adverse Effects
 - Toxic
 - Carcinogenic
 - Mutagenic
 - Nervous system damage
 - Adverse developmental and reproductive effects
- Potential Sources
 - Tanneries
 - Metal foundries
 - Coal burning power plants
 - Paint processing
 - Sacrificial anodes
 - Leaded fuels
 - Batteries
 - And many others...

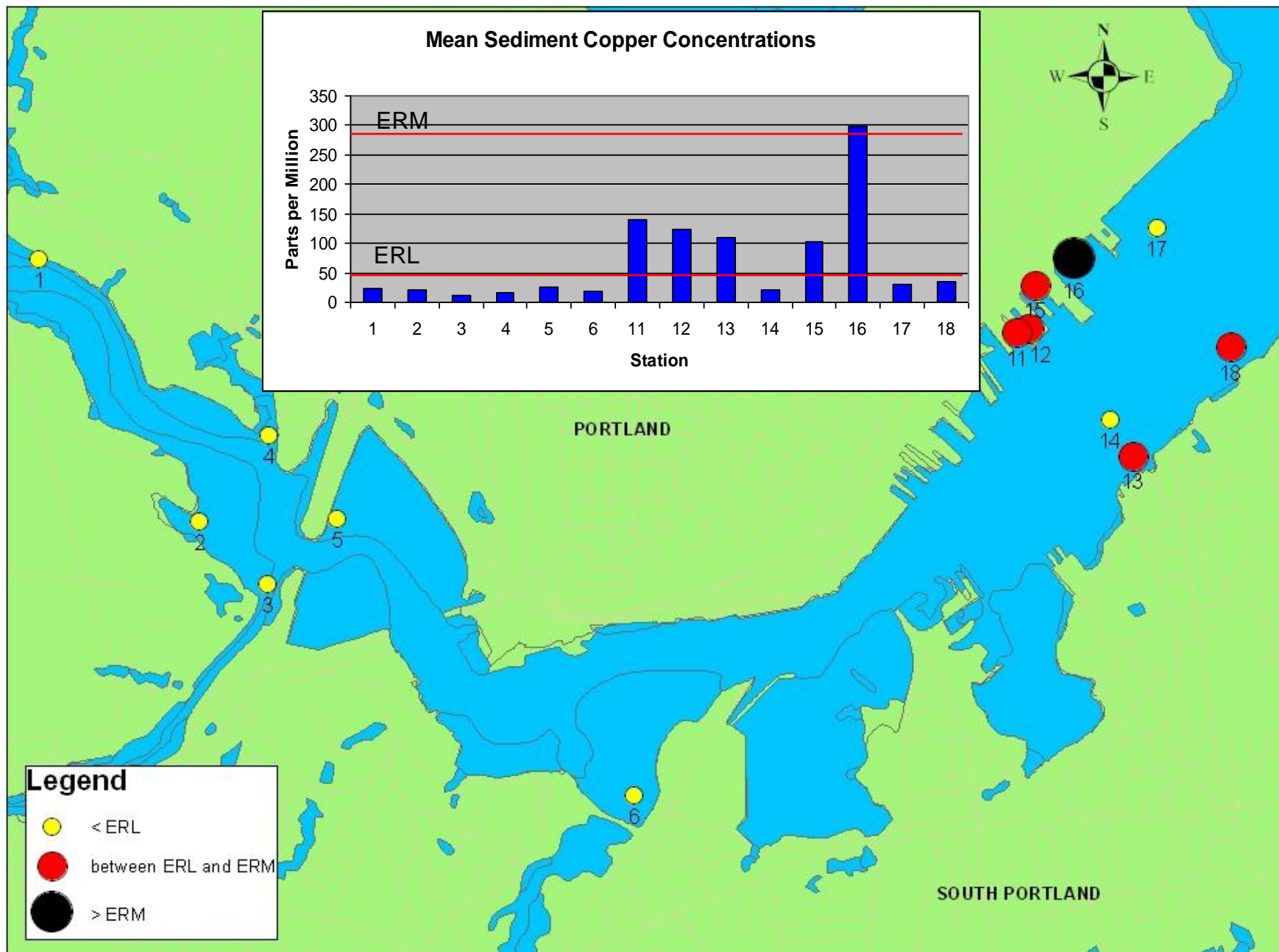
Cadmium Concentrations Grouped by ERL and ERM Guidelines



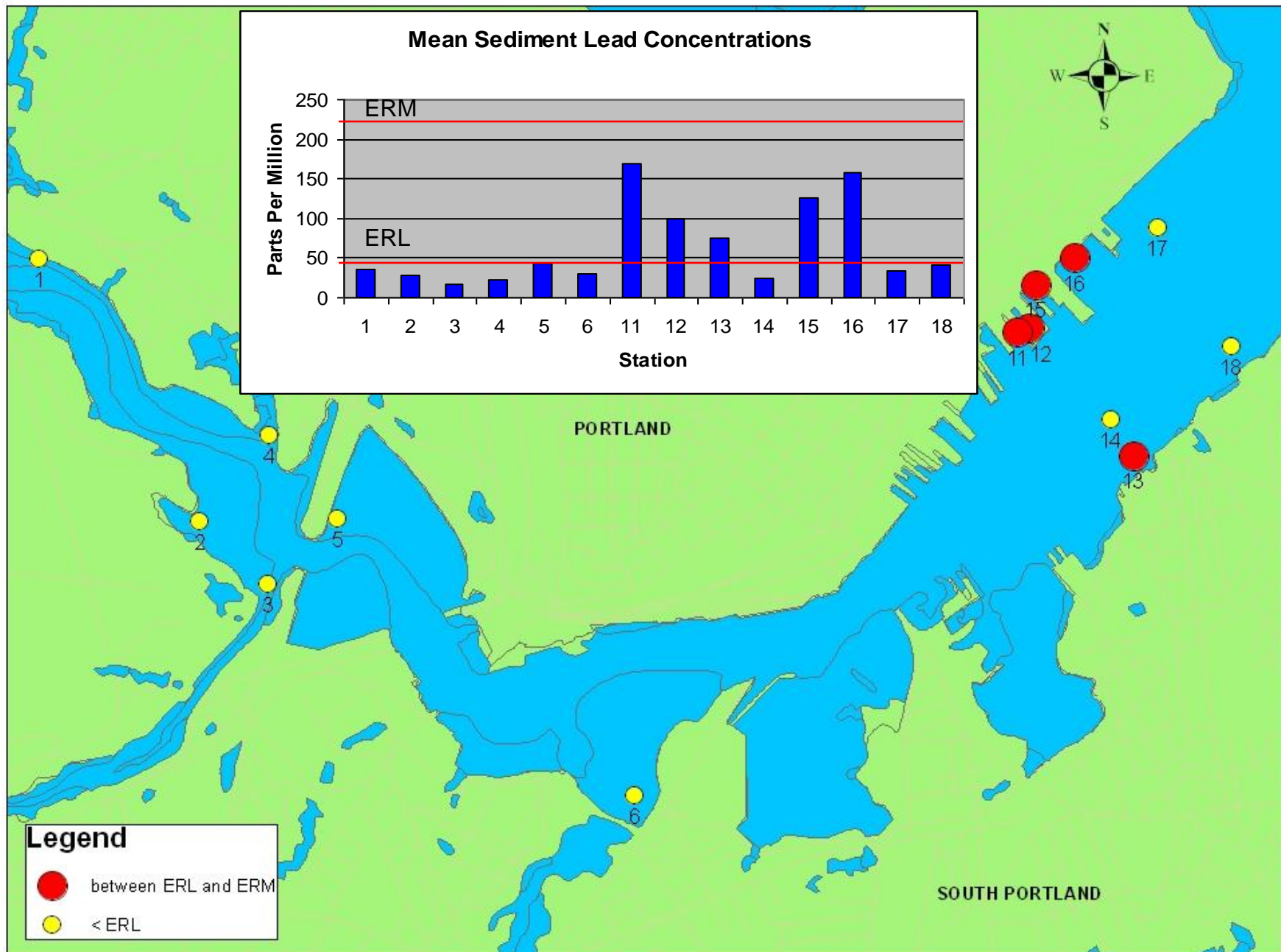
Chromium Concentrations Grouped by ERL and ERM Guidelines



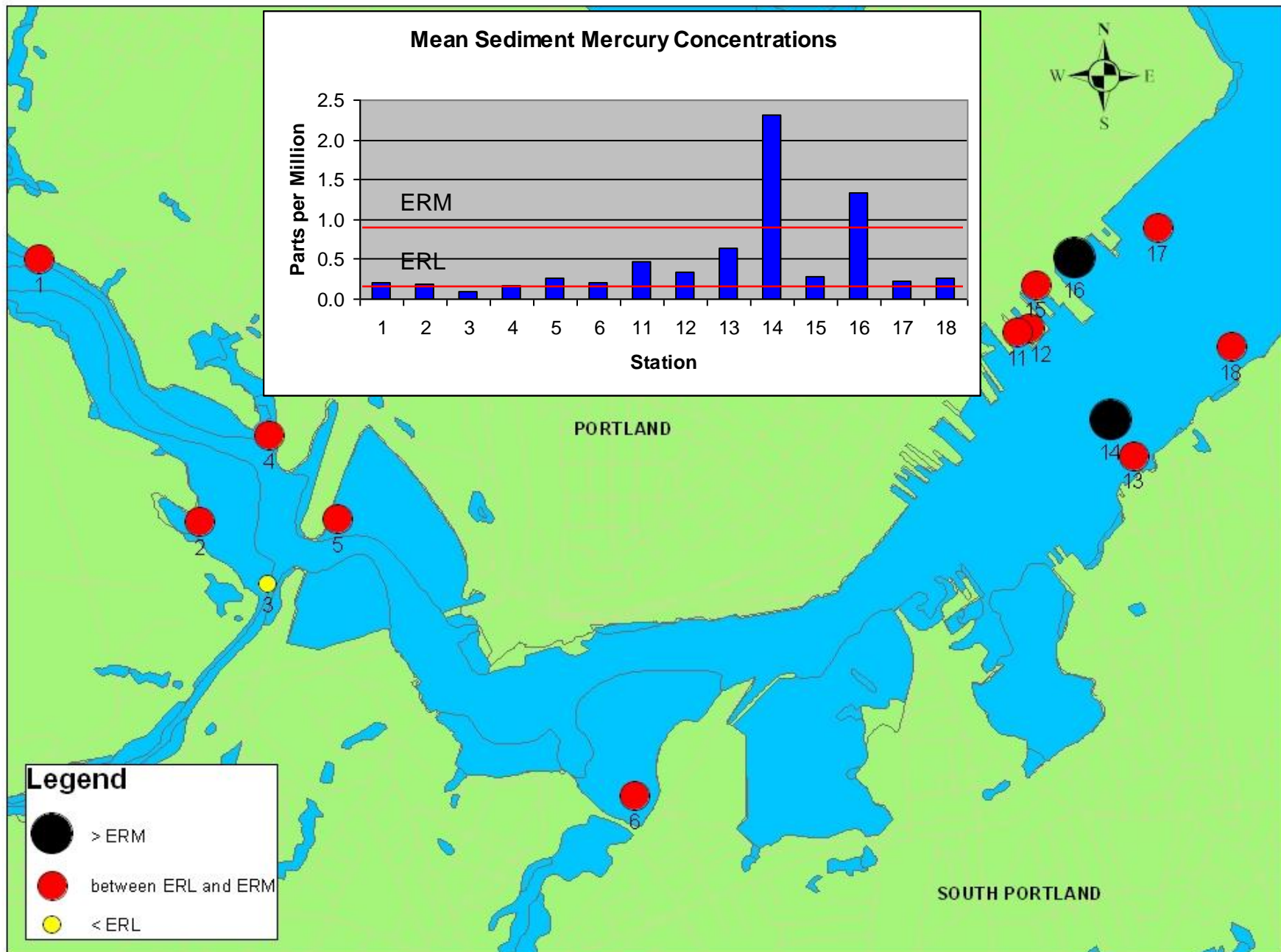
Copper Concentrations Grouped by ERL and ERM Guidelines



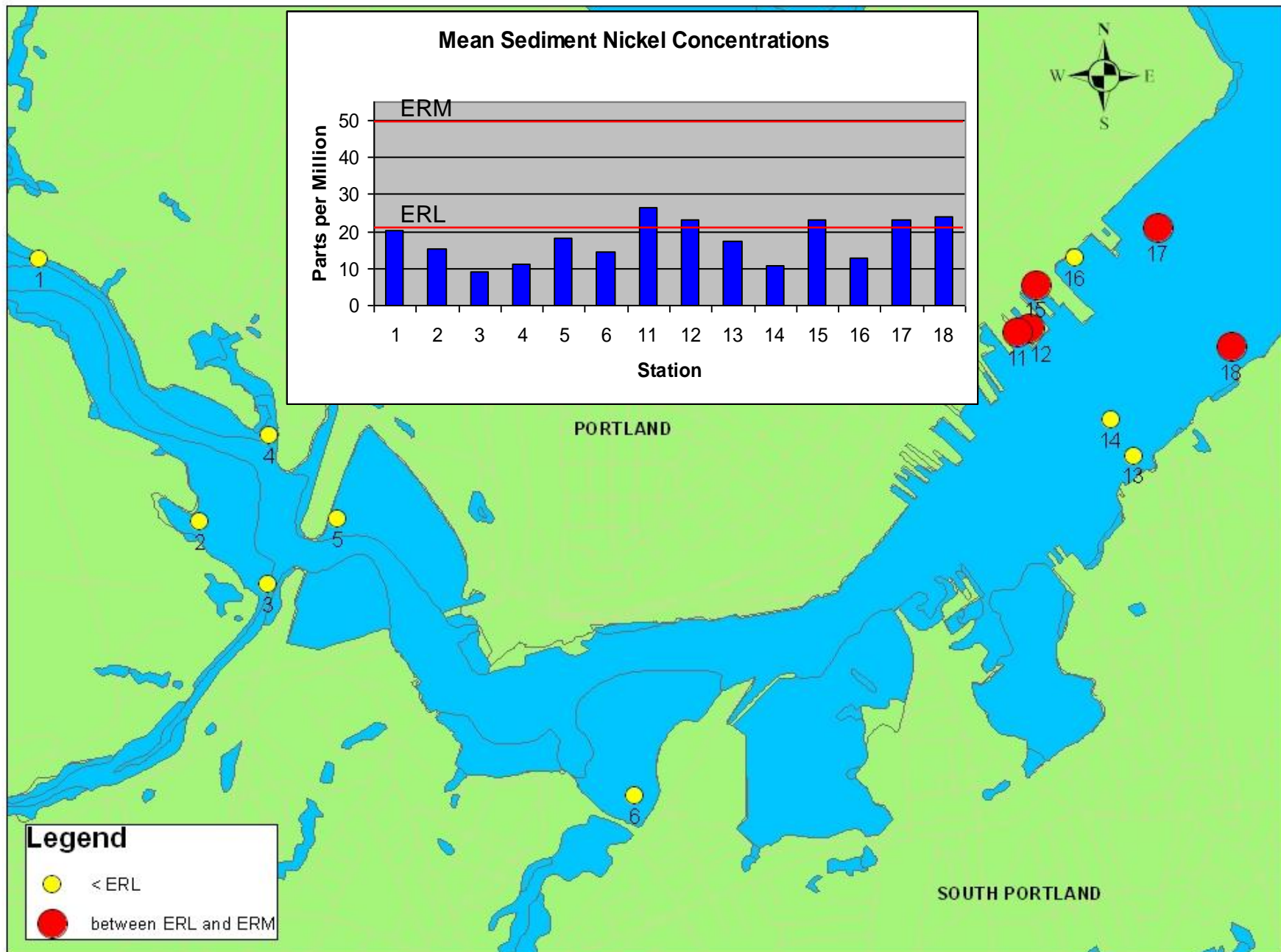
Lead Concentrations Grouped by ERL and ERM Guidelines



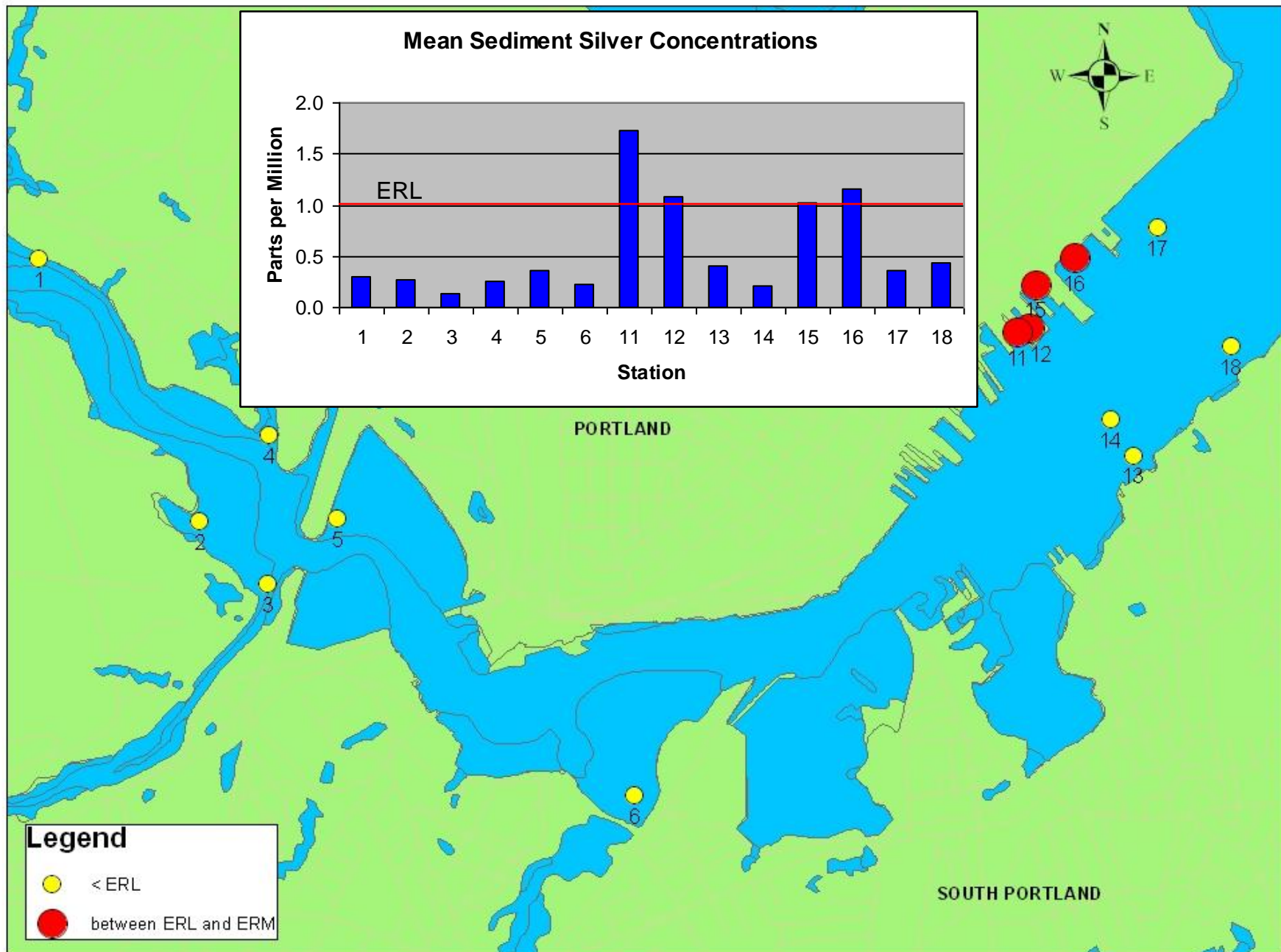
Mercury Concentrations Grouped by ERL and ERM Guidelines



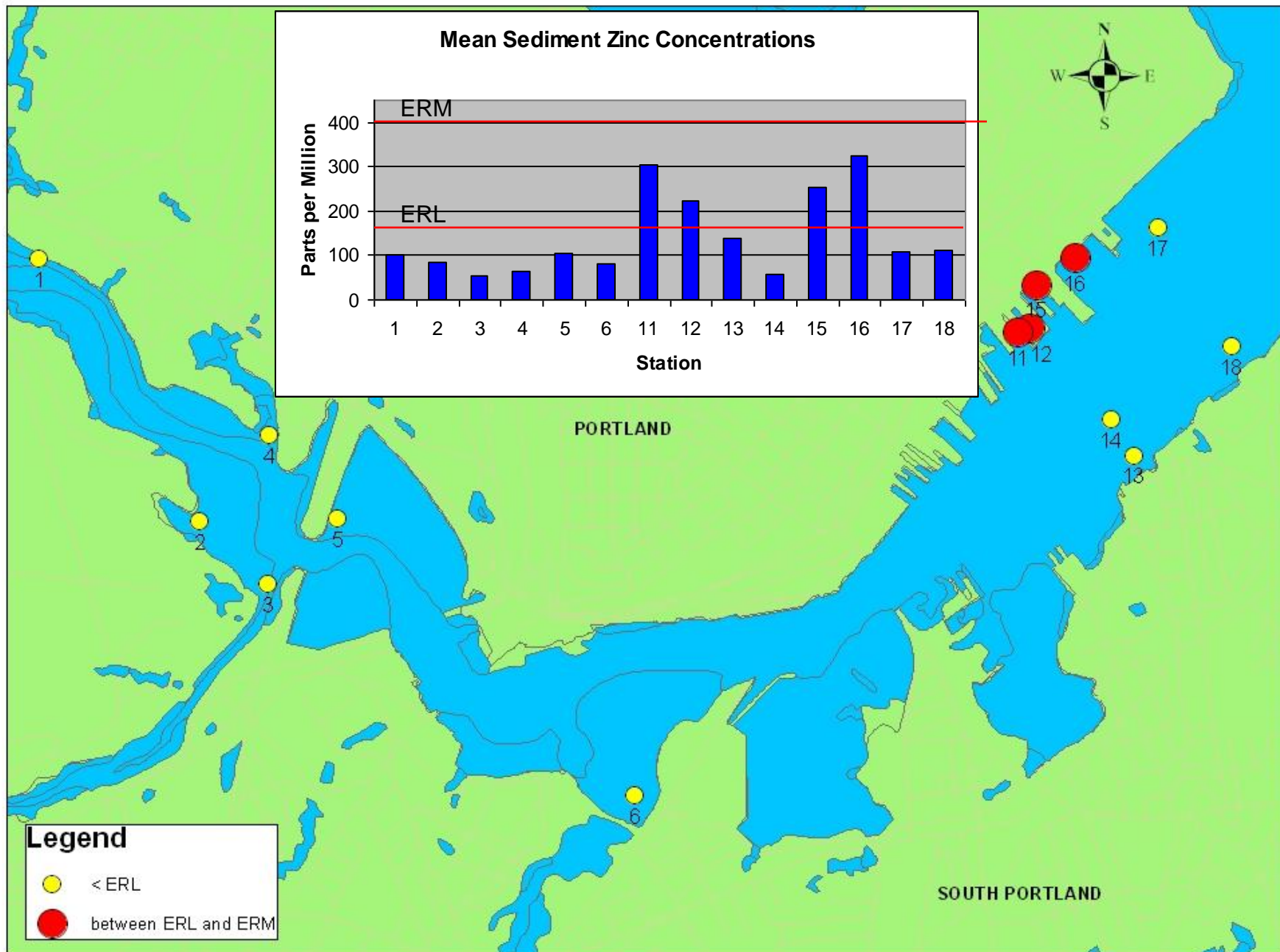
Nickel Concentrations Grouped by ERL and ERM Guidelines



Silver Concentrations Grouped by ERL and ERM Guidelines



Zinc Concentrations Grouped by ERL and ERM Guidelines



Polychlorinated Biphenyls

- Sources

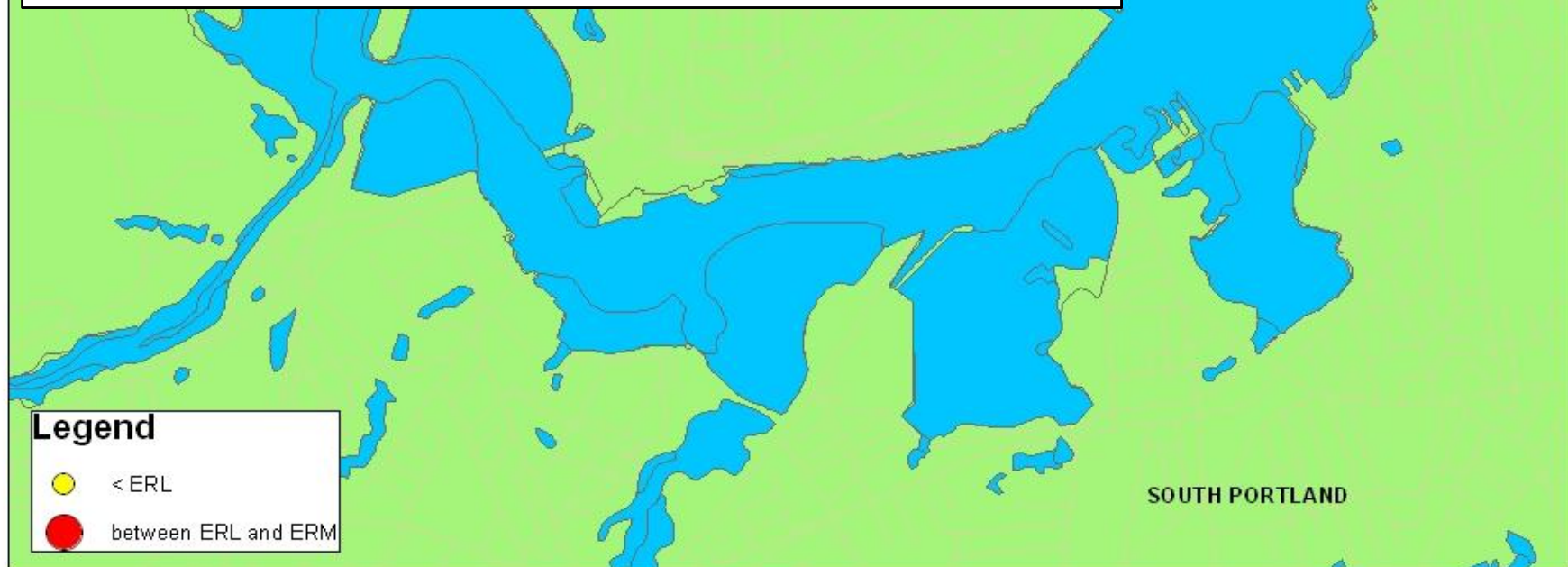
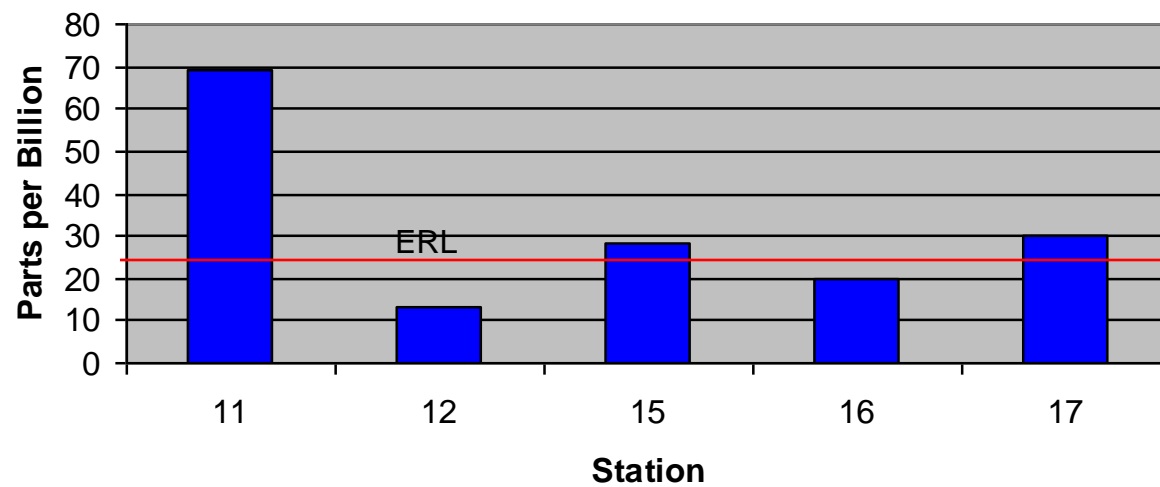
- Electrical transformers
- Capacitors
- Hydraulic fluids
- Banned for use in new equipment in 1977, still found in older equipment

- Adverse Effects

- Mutagenic
- Carcinogenic
- Developmental abnormalities and reduced growth
- Adverse reproductive effects

Total PCB Concentrations Grouped by ERL and ERM Guidelines

Mean Total PCB Concentrations



Dioxin

- Sources

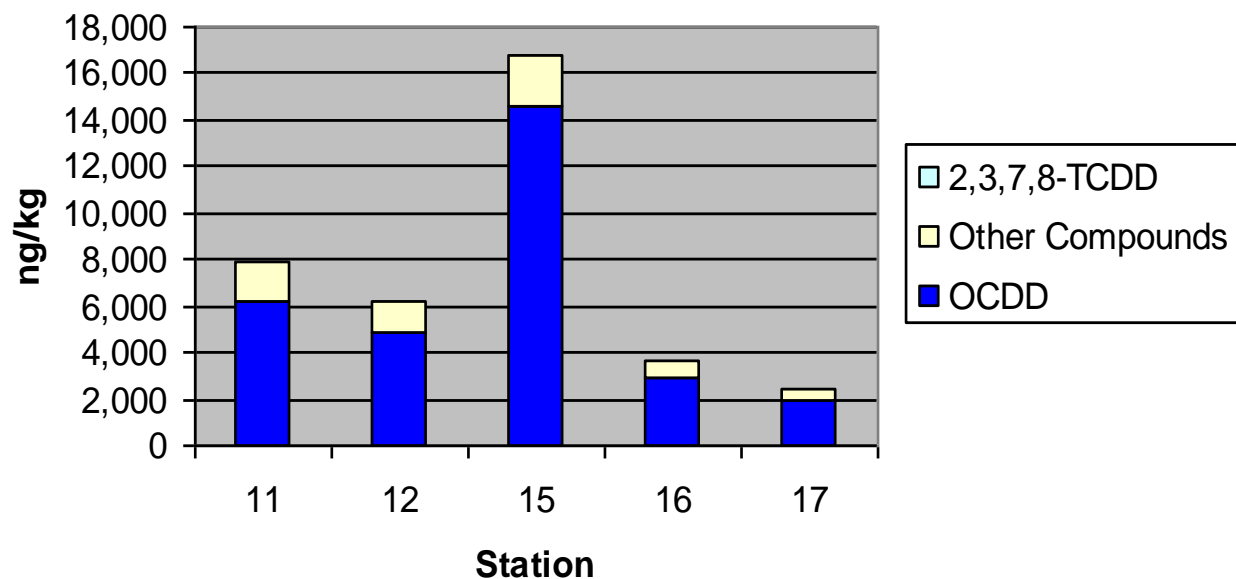
- Processing plants that include chlorination
- Most notable in the Casco Bay region are pulp and paper mills
- Trash incinerators

- Adverse Effects

- 2,3,7,8-tetrachlorodibenzo-*p*-dioxin most toxic
- Lethal, carcinogenic, and mutagenic
- Tissue damage and immunotoxic effects
- octachlorodibenzo-*p*-dioxin least toxic

Stations Monitored for Sediment Dioxin Concentrations

Total Dioxin Concentrations



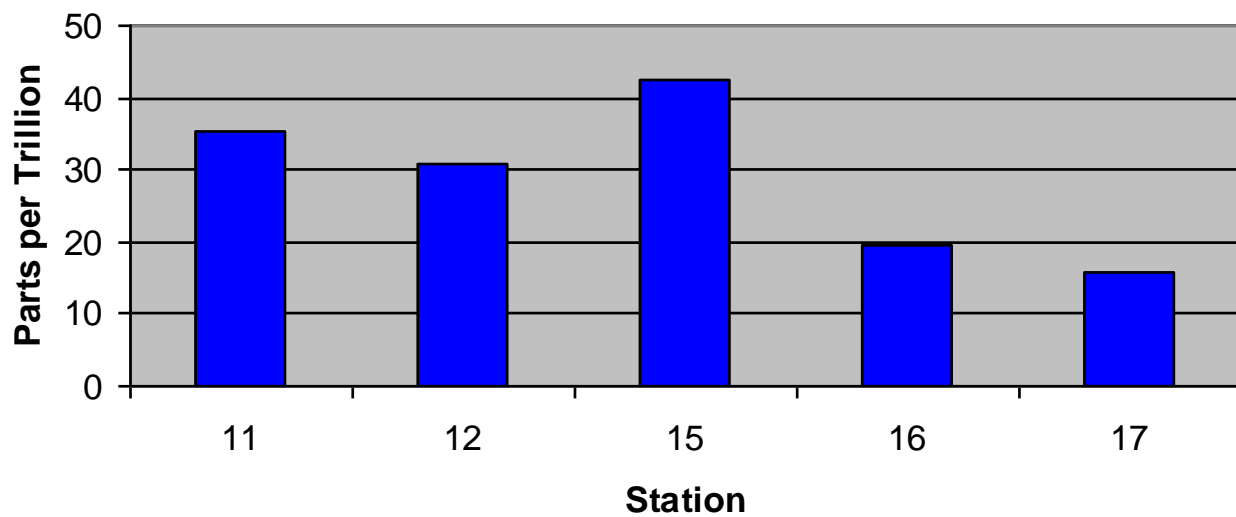
Legend

▲ 2004 Stations

SOUTH PORTLAND

Stations Monitored for Sediment Dioxin Concentrations

Total Dioxin TEQ

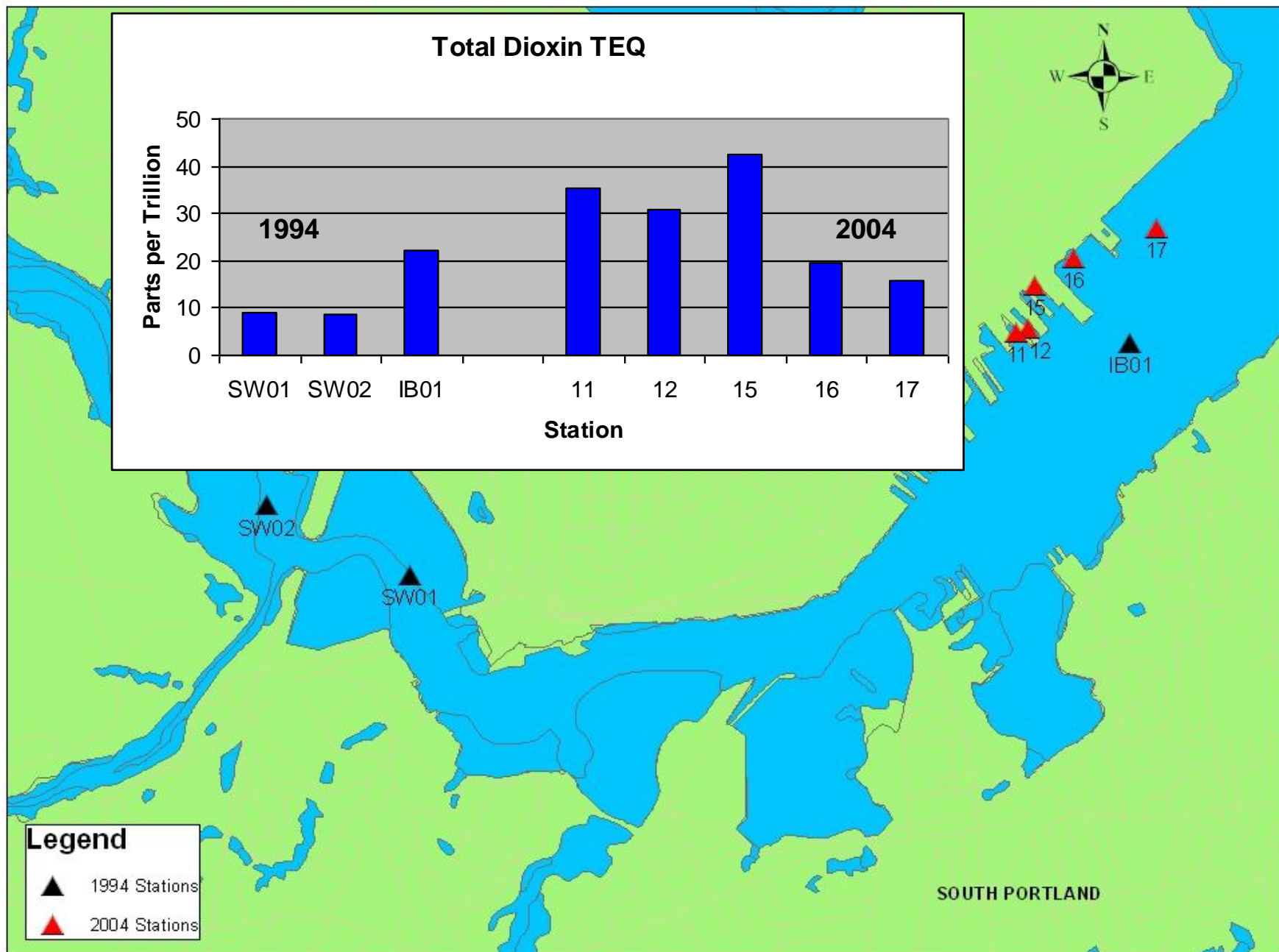


Legend

 2004 Stations

SOUTH PORTLAND

Stations Monitored for Sediment Dioxin Concentrations



Conclusions

- Fulfilled goal of producing a baseline of sediment contaminants.
- Levels of PAH's, Mercury and Copper are high enough at some sites to produce frequent toxic effects.
- Levels of almost all measured contaminants are high enough at many sites to produce occasional toxic effects.

Questions?



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