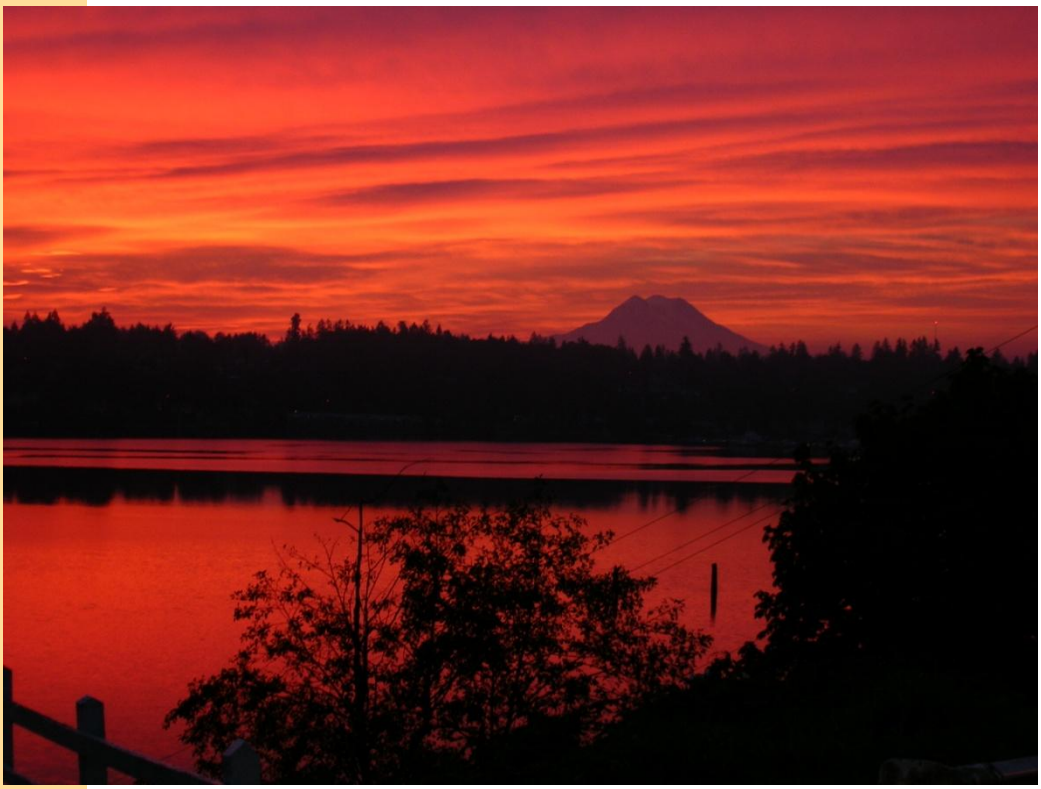

South Puget Sound Dissolved Oxygen Study

Key Findings on Nitrogen Sources from the Data Report

DEPARTMENT OF ECOLOGY
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South Puget Sound Dissolved Oxygen Study

South Puget Sound has low dissolved oxygen levels. The Washington Department of Ecology (Ecology) is conducting a water quality study on low dissolved oxygen levels in South Puget Sound. This study will help determine how human activities, along with natural factors, affect low dissolved oxygen levels in South Puget Sound.

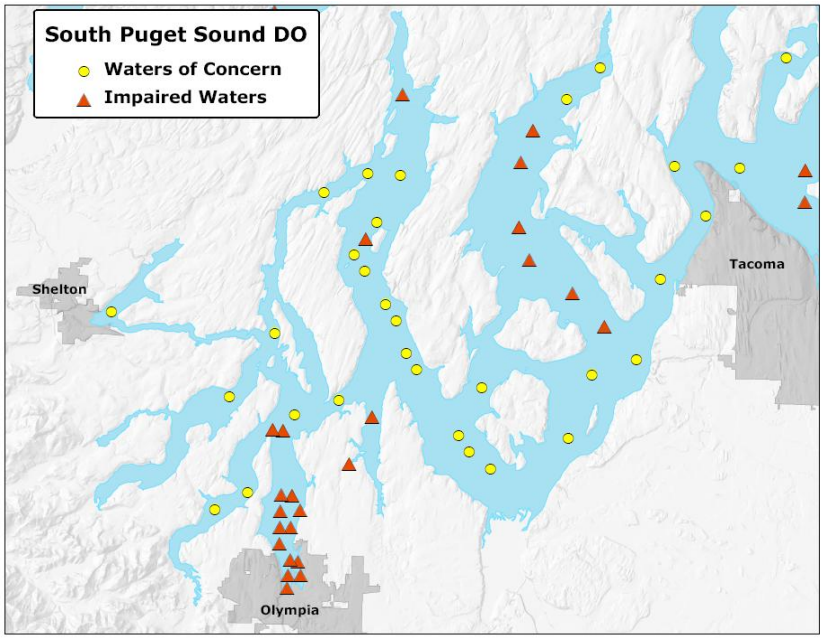

Figure 1. Water Quality Assessment for Dissolved Oxygen

Fish need oxygen

In areas with low levels of dissolved oxygen, fish and other marine life become stressed and die or are forced to flee their habitat. In the 2008 Water Quality Assessment, Ecology found 24 locations in South Puget Sound to be impaired due to a lack of dissolved oxygen. Ecology identified another 27 locations as waters of concern. The locations of greatest concern are Carr, Case, and Budd Inlets (Figure 1).

Nitrogen is the main pollutant that causes low dissolved oxygen levels

Discharges from wastewater treatment plants, septic systems, and other sources add nitrogen to Puget Sound. Excess nitrogen causes excess algae growth. As the algae die and decay, they rob the water of dissolved oxygen. Once released into Puget Sound, nitrogen moves around. Nitrogen discharged at one spot may cause low dissolved oxygen levels many miles away. The form of nitrogen of greatest interest is dissolved inorganic nitrogen (DIN), which is the sum of nitrate, nitrite, and ammonium.

Focus of the study

This effort focuses on South Puget Sound, south of the Tacoma Narrows (Figure 2).

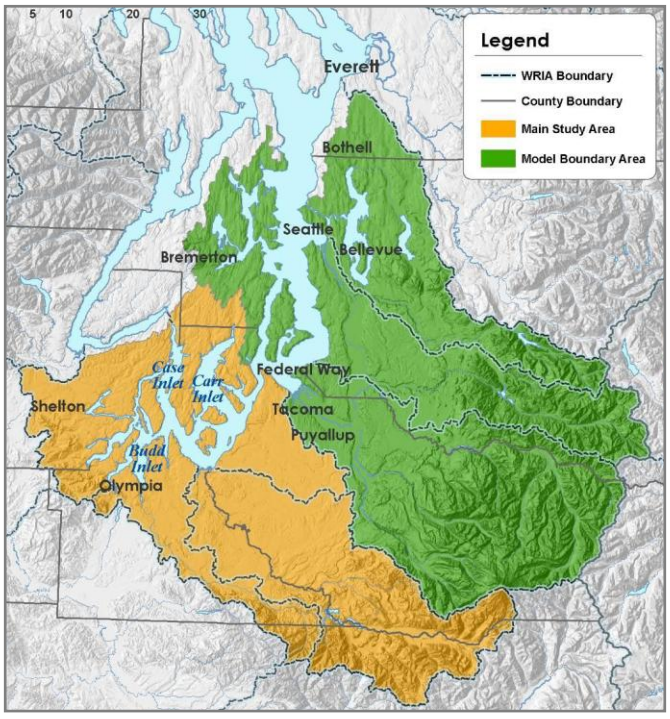

Figure 2. Study Area.

However, because Central Puget Sound sources may influence South Puget Sound water quality, Ecology included the entire South and Central Puget Sound in the initial effort. Ecology will use information from the study to select the appropriate northern boundary.

We need to quantify the effects of nitrogen discharges

The purpose of this study is to determine how nitrogen from a variety of sources affects dissolved oxygen levels in South Puget Sound. This effort is a critical first step in determining what actions may be needed to improve water quality. The results of the study may show that we need to reduce human-related sources of nitrogen to keep South Puget Sound healthy. The study will also help determine where the reductions would be the most beneficial.

Sources of nitrogen

Nitrogen enters South Puget Sound in four ways:

1. *Wastewater Treatment Plants (WWTP):* This study includes 29 wastewater treatment plants that discharge nitrogen directly into Puget Sound.
2. *Rivers:* This study includes 39 rivers and streams that flow into Puget Sound. It also includes other upland areas that drain into Puget Sound. Nitrogen in rivers comes from septic systems, stormwater, WWTPs, upstream atmospheric sources, other point and nonpoint sources, and natural sources.
3. *Atmospheric deposition*, directly on Puget Sound, is a smaller source of nitrogen.
4. *Exchange* of marine water with northern parts of Puget Sound and the Pacific Ocean.

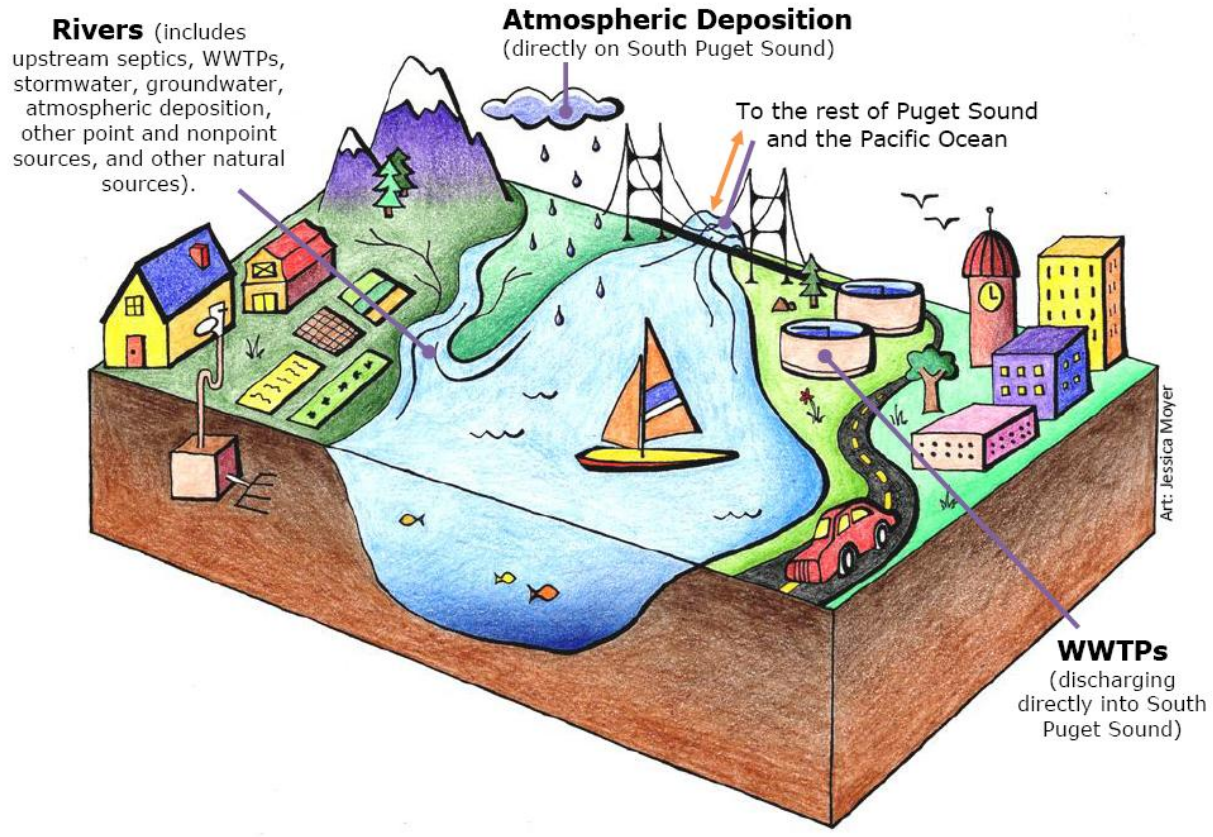

Figure 3. Nitrogen Sources to South Puget Sound.

Nitrogen loads

The data report summarizes information about the amount of nitrogen reaching South Puget Sound each day (called the load). On an annual basis, rivers and wastewater treatment plants produce comparable DIN loads to South Sound, south of the Tacoma Narrows. These two sources of nitrogen, rivers and wastewater treatment plants, are called watershed sources. In September 2007, wastewater treatment plants contributed 80 percent of the watershed DIN load to South Puget Sound (nitrogen loads in late summer are particularly important because this is when dissolved oxygen levels are the lowest). However, the ratio of tributary-to-wastewater treatment plant contribution shifts when the entire South and Central Puget Sound south of Edmonds is considered, due to the larger population centers in Central Puget Sound. On an annual basis, wastewater treatment plants contribute 79 percent and rivers 21 percent of the watershed DIN load south of Edmonds. However, in September 2007, wastewater treatment plants contributed over 90 percent of the watershed DIN load to Central and South Puget Sound. Figure 4 summarizes the measured river and wastewater treatment plant DIN loads.

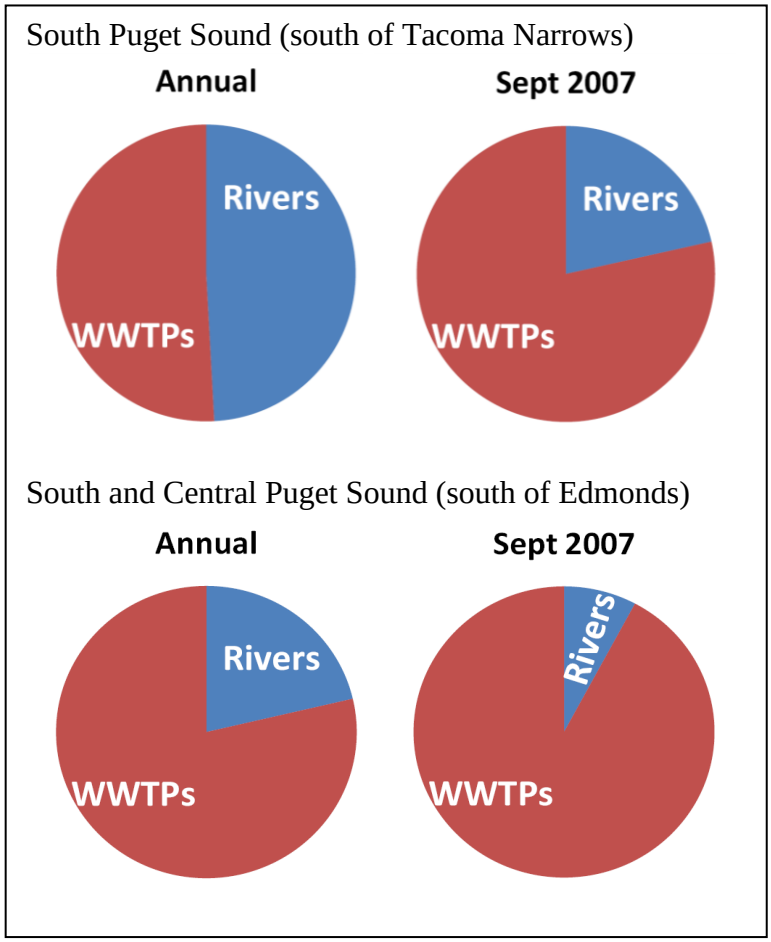

Figure 4. Annual and late summer (September 2007) contributions of DIN load from rivers and wastewater treatment plants that discharge directly to Puget Sound.

River and stream contributions were low but dominated annual loads to many of the western inlets, including Totten, Eld, Henderson, northern Case, and northern Carr (Figure 5). Figure 6 summarizes relative contributions for September 2007, when the river contributions were much lower compared to the wastewater contributions.

Rivers and tributaries south of the Tacoma Narrows produce an annual mean load of 2,720 kilograms (6,000 pounds) per day of dissolved inorganic nitrogen to South Puget Sound. Wastewater treatment plants produce an annual mean load of 2,950 kilograms (6,500 pounds) per day of dissolved inorganic nitrogen to South Puget Sound.

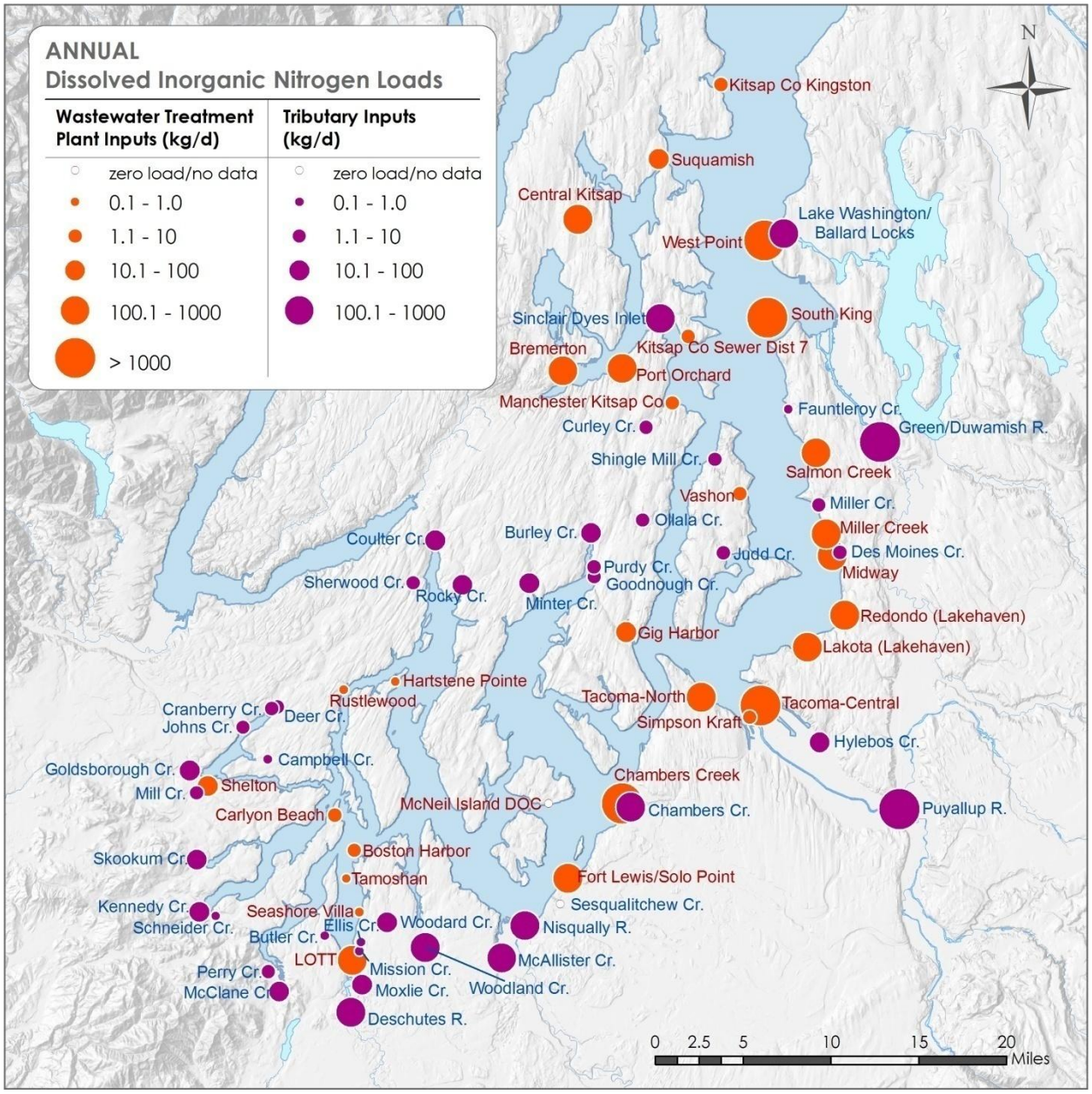

Figure 5. Annual DIN loads from rivers and wastewater treatment plants. Nitrogen in rivers comes from septics, stormwater, groundwater, upstream atmospheric sources and WWTPs, other point (discharge pipe) and nonpoint (diffuse) sources, and natural sources.

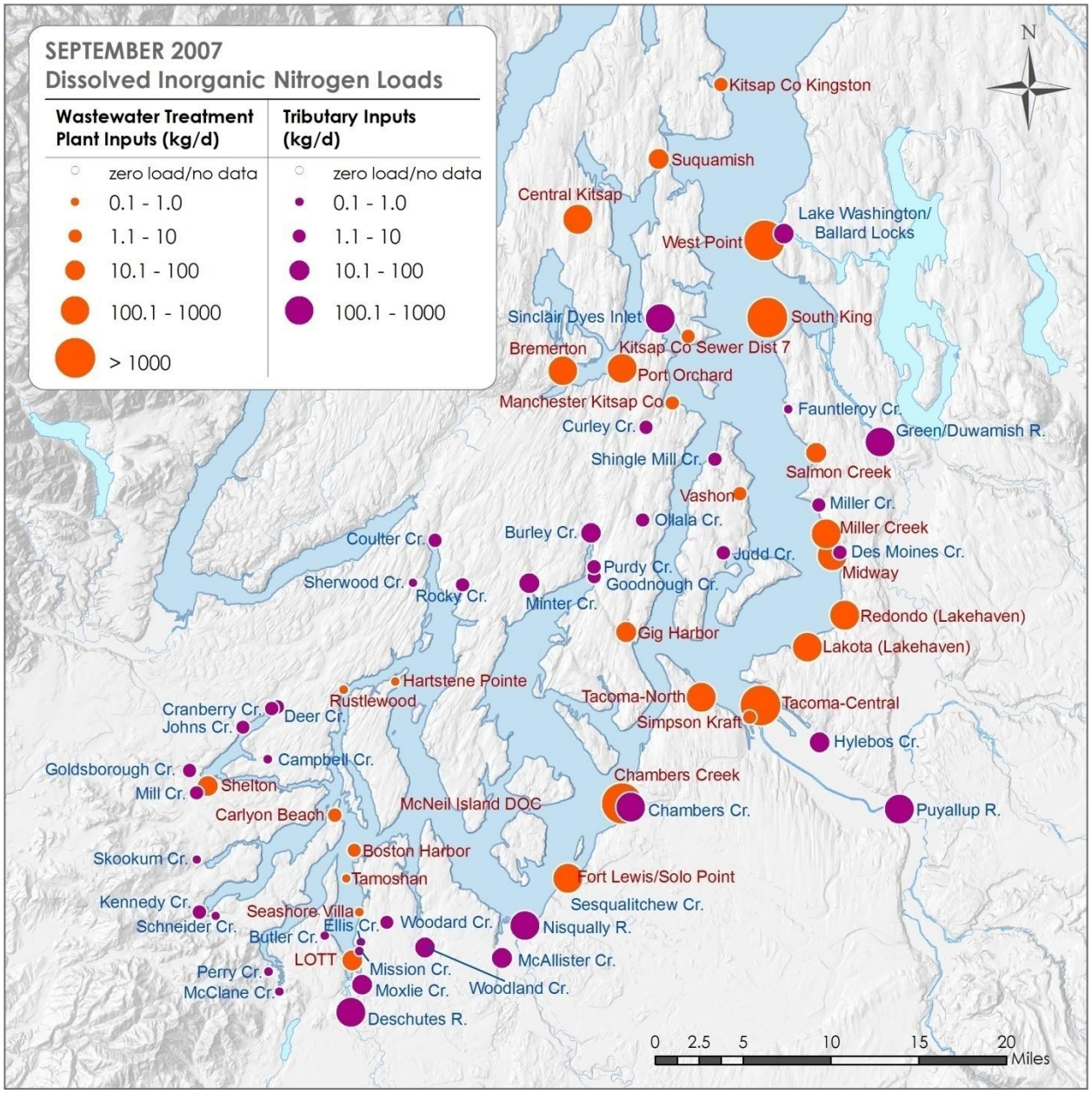

Figure 6. September 2007 DIN loads from rivers and wastewater treatment plants.

Next Steps

Ecology will use the monitoring data and a water quality model to determine the effects of nitrogen discharges on dissolved oxygen levels in South Puget Sound.

Future reports will describe:

- *Water circulation (hydrodynamics) in South Puget Sound*. Ecology expects to release a draft hydrodynamics report in 2009.
- *Water quality model*. For Ecology, water quality models are mathematical, computer-prediction tools it uses to represent a water system. By entering all the data into a model, we

can visualize, predict, and determine water quality factors that may be causing low dissolved oxygen in South Puget Sound. Ecology will provide interim results to the Technical Advisory Group; the report will be released for comment in summer 2009.

- *Alternative management scenarios to improve water quality*. For example, if the amount of nitrogen discharged to South Puget Sound increased by 10 percent, how would it affect dissolved oxygen levels?

Future parts of this study will determine the effects of nitrogen discharges on dissolved oxygen levels in South Puget Sound. If the results indicate that reductions in nitrogen discharges are needed to protect dissolved oxygen levels in South Puget Sound, either a water quality improvement project (also known as a total maximum daily load or TMDL) or some other plan of action to protect water quality will be necessary.

For more information, contact:

Andrew Kolosseus
Washington Department of Ecology
PO Box 47600
Olympia, WA 98504-7600
Phone: 360-407-7543
E-mail: akol461@ecy.wa.gov

Website:

This paper summarizes the South Puget Sound interim data report. The complete data report, a brief focus sheet, and other information are available on our website at:
www.ecy.wa.gov/puget_sound/dissolved_oxygen_study.html