# Effects of boat wakes on the nearshore of the Spokane River in North Idaho

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## Abstract

Cultural eutrophication is the occurrence of excess nutrients in water bodies resulting from anthropogenic activities that stimulate plant growth. Excess nutrient loading and associated algal blooms are increasing worldwide including northern Idaho. The Coeur d'Alene watershed is increasingly impacted by eutrophication which includes the occurrence of cyanobacteria and associated cyanotoxins that can be detrimental to human health.

Anthropogenic activities such as watersports that generate wakes in the nearshore (Fig. 13) are likely to contribute to cultural eutrophication via the release of nutrients (particularly phosphorus) associated with the resuspension of sediment as disturbances are created.

The first phase of this study examined turbidity caused by sediment resuspension in relation to disturbance regime and frequency (both natural and anthropogenic) in the Spokane River at the mouth of Coeur d'Alene Lake, Idaho.

Boating activity directly increased turbidity and measured wakes were larger in magnitude compared to naturally occurring waves.

## Background

Nutrients such as phosphorus and nitrogen are commonly bound to sediments. Boat activity and wakes can cause turbidity in the form of sediment resuspension, potentially releasing sediment-associated nutrients and contributing to eutrophication (Figs. 1 and 2)

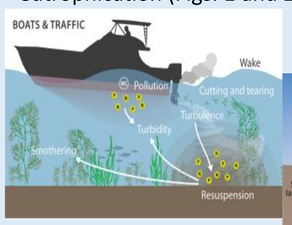


Figure 1. Illustration of mechanisms by which recreational boating activities generate turbidity. Graphics: J. Lokrantz/Azote

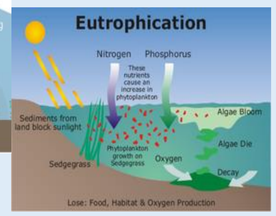


Figure 2. Eutrophication graphic showing connection with sediment resuspension and turbidity.

Phosphorus is typically a limiting nutrient in many freshwater systems, but excess phosphorus from nutrient resuspension can cause overgrowth of cyanobacteria, also known as blue-green algae.

Some species of cyanobacteria produce toxins that can have direct adverse effects on human health including acute poisoning, neurotoxicity, respiratory distress, and other illnesses.

Recreational water activities and contaminated drinking water encompass the majority of known cyanotoxin exposure in humans.

## Materials and Methods

### 1. Site Selection


Figure 3. Maps of area: Google Maps, Google Earth.

- Location in Coeur d'Alene, ID
- Shoreline of Spokane River; outside of 'no wake' zone
- Natural riparian zone; substrate composed of mostly silt, sand, and minimal gravel

Figure 4. Shoreline substrate composed of fine silt and sand; wet (left) and dry (right).

### 2. Site set-up

- Measure 3 m (118.1 in) from waterline; measure depth of water column and set reference flags for water sample collection
- Deploy water level logger 3 m from waterline and measure depth

Figure 5. Sample site consistently measured and set up at 3 m (118 in) from water line. Depth of water column measured; reference marker set 12 cm from bottom.

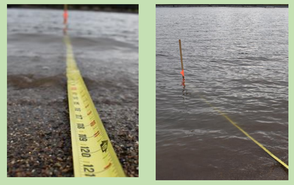

Figure 6. Picture of sample site shoreline with natural riparian zone located south of Blackwell Island boat launch; outside of 'no-wake' zone.

### 3. Data: Collection and Analysis

Water Sampling Method

- Collect three water samples at 15-minute intervals; measure turbidity with a calibrated turbidimeter

Boat Data

- Count each boat that passes sample location
- Document time and type of boat

Figure 7. Collecting water samples from the nearshore and testing turbidity.

Analysis

- Graph data from water logger, turbidimeter, and boat type/counts

## Results

- Wave/wake frequency and height was related to boating activity (Figs. 8 & 9)

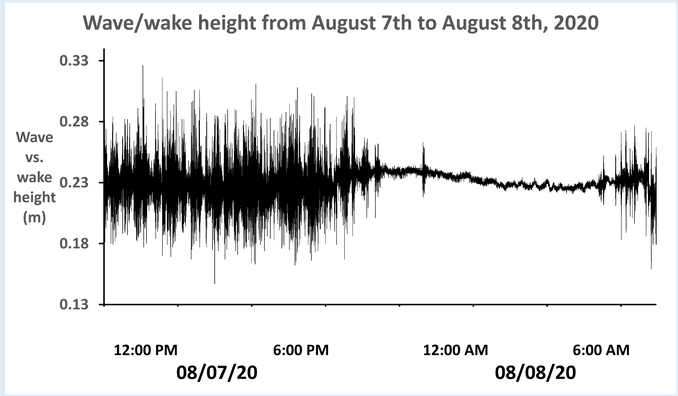


Figure 8. Water level height showing wave/wake activity from 11:15 am on 08/07/20 to 8:15 am on 08/08/20.

| Boat Type | 3 PM | 4 PM | 5 PM | 6 PM | 7 PM | 8 PM | Total |
|---|---|---|---|---|---|---|---|
| Cruiser | 1 | 16 | 4 | 11 | 15 | 1 | 48 |
| Fishing | 1 | 1 | 3 | 2 | 2 | | 9 |
| Houseboat | 1 | | | | | | 1 |
| Jet boat | 1 | 2 | 1 | 1 | 2 | | 7 |
| Pontoon | 4 | 7 | 5 | 6 | 7 | | 29 |
| Raft (Sheriff) | 1 | 1 | 1 | | 1 | | 4 |
| Ski/wake | 24 | 29 | 20 | 21 | 13 | 3 | 110 |
| Speed | | 3 | 2 | 7 | 3 | | 15 |
| Tugboat | | | | 2 | | | 2 |
| Grand Total | 33 | 59 | 36 | 50 | 43 | 4 | 225 |

Figure 9. Types/counts of boats from 3:00 pm to 8:00 pm on 08/07/20; correlation between boat activity and wave vs. wake activity from fig. 8.

- Fluctuations of turbidity occurred throughout the day, based on 15-minute intervals (Fig. 10)
- Turbidity increased as boating activity and wave/wake activity increased (Fig. 11)

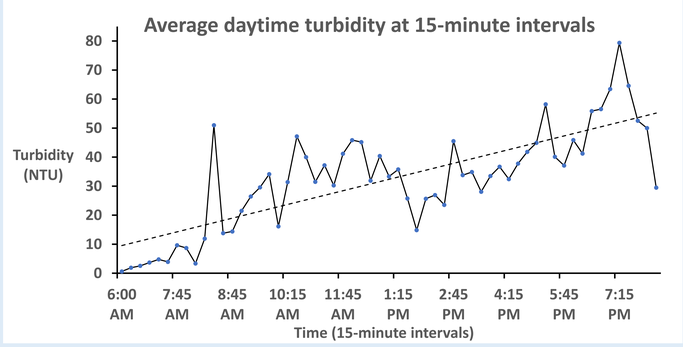


Figure 10. Turbidity increasing throughout daytime; from 08/04, 08/06, 08/07/2020.

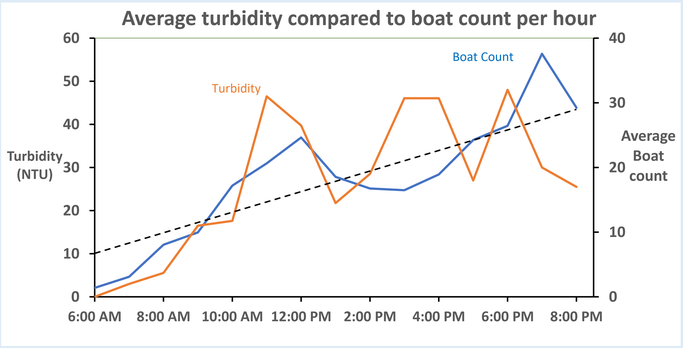


Figure 11. Correlation between average turbidity per hour compared to average boat count per hour; from 8/04, 08/06, 08/07, 08/08, 08/09, 09/12, and 09/13/2020.

## Conclusions

- Wake/wave height increased as boating activity increased throughout the day and decreased overnight
- Increased wake height correlated with increased turbidity, and turbidity increased with boating activity
- Background turbidity settled below 10 NTU overnight and into the early morning, then increased when boating activity began (Fig. 12)

Figure 12. Wakeboard boat creating intentional wakes for recreational activities.


Figure 13. Turbidity samples; low turbidity measured in nephelometric turbidity units (NTU) to high NTU from left to right.

## Future Research

- Sample water for total phosphorus analysis and establish a TP/turbidity relationship
- Collect data for total suspended solids to relate to turbidity
- Expand sample locations that contain differing substrates and identify each substrate via sediment analysis

Additional turbidity data collection using a different instrument that can take continuous measurements over longer periods of time for an accurate baseline turbidity combined with phosphorus analysis will establish a total phosphorus/turbidity relationship.

This relationship can be used as a tool to help identify areas of concern in the Coeur d'Alene watershed and implement better water management practices to minimize eutrophication and possible human contact with toxic cyanobacteria.

## References and Acknowledgements

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**References:**
Fondriest Environmental, Inc. "Turbidity, Total Suspended Solids and Water Clarity." Fundamentals of Environmental Measurements. 13 Jun. 2014. Web. <https://www.fondriest.com/environmental-measurements/parameters/water-quality/turbidity-total-suspended-solids-water-clarity/ >.

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