Effectiveness of a Maximum 25% Streamflow Diversion Rate in Maintaining Macroinvertebrates Communities in Small Headwater Streams in Northern California

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Purpose and goal

The goals of the study were to determine if a maximum drafting rate of 25% is effective in maintaining macro invertebrate richness and diversity downstream of drafting sites in Class II watercourses. The study also evaluated natural diurnal streamflow and effects of water drafting on streamflow in Class II streams. Two drafting sites and four 1,000-foot stream reaches were sampled on private timber company lands in Humboldt County during the summer of 2015.

Background and justification

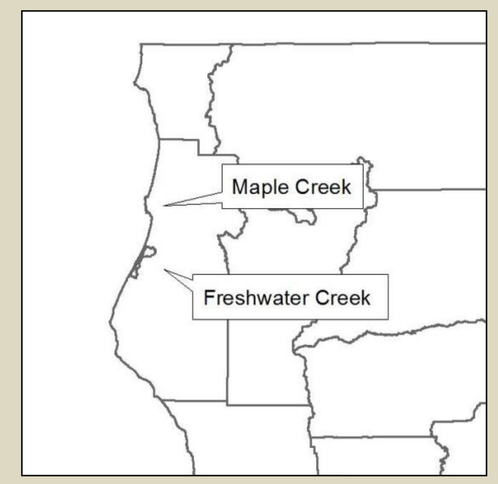
Small water diversions (water drafting, drafting) on private timber lands are primarily used for abating road dust during timber harvesting operations in order to comply with the road maintenance requirements of the Forest Practice Rules. In an effort to minimize substantial adverse impacts to Class II watercourse species, CDFW protective measures commonly include a maximum instantaneous drafting rate of 25% of streamflow. In recent times, the 25% maximum diversion rate in Class II watercourses have been considered too high (Trush, 2002 and NOAA, 2001), or to low (Timber Harvest Plan 1-15-008 HUM).

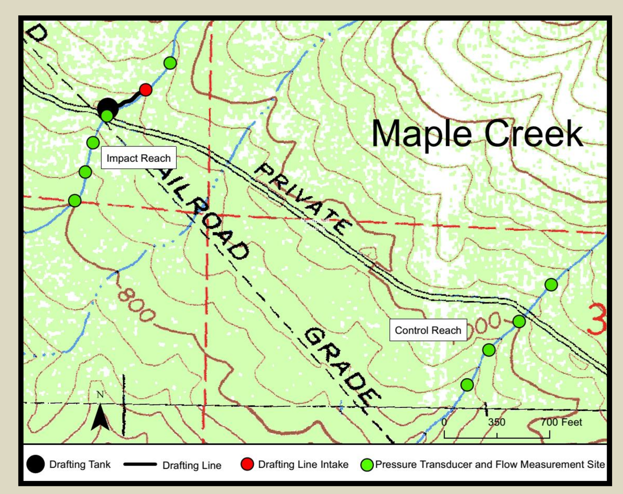
The general negative impacts to Northern California headwater stream aquatic macroinvertebrate communities from altered flow regimes are not well documented. Studies have shown flow diversions reduce macroinvertebrate richness and diversity by inducing pre-mature drift behavior, channel bed dewatering, and increased competition for usable space (Castella et al. 1995; Rader and Bellish, 1999; Minshall and Winger, 1968; Wills et al. 2006).

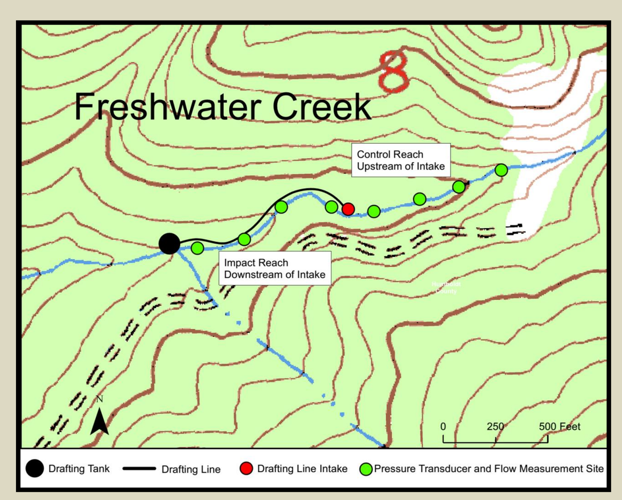
Methods

Two water drafting sites, actively used throughout the year for timber operations, were assessed. Each drafting site had a gravity-fed drafting tank and associated intake and outflow point. A 500-foot reach upstream of the intake served as the control, while a 500- foot reach below the outfall served as the impact. In addition, a similar sized 1,000-foot stream reach, occurring either upstream of the impact reach on the same tributary, or on a similar sized adjacent tributary, served as controls. Continuous pressure transducers (HOBO U20L-04) units were installed within both the treatment and control reaches (See Figure 1 for configuration). A stage discharge relationship was developed throughout the summer (June 1 through September 1), using a measurement of discharge, staff gauge, date/time, and pressure transducer. At each pressure transducer site, discharge was measured by CDFW at least every two weeks using the float method (Molloy and Struble 1988). An additional pressure tranducer was kept out of the water at each drafting site to factor barometric pressure influence.

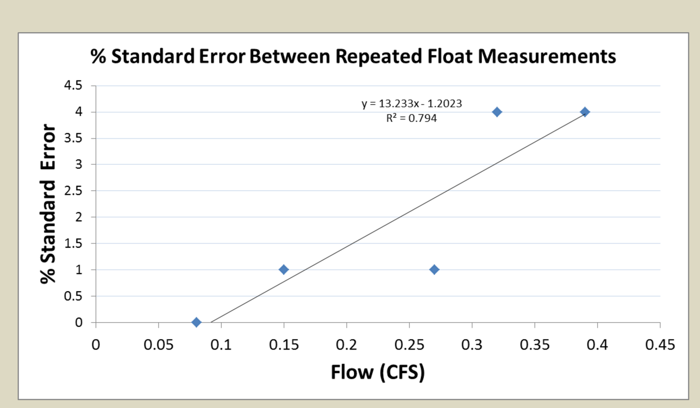
A benthic macroinvertebrate (BMI) survey (Modified Surface Water Ambient Monitoring Protocol) was collected on respective control and impact reaches for each study site. Once collected, composite samples were delivered and analyzed by the CDFW bioassessment laboratory.



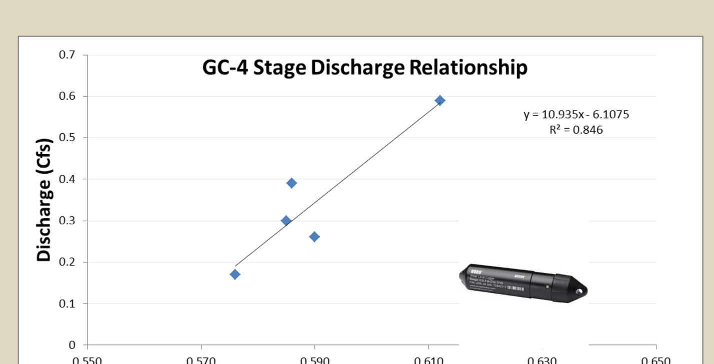




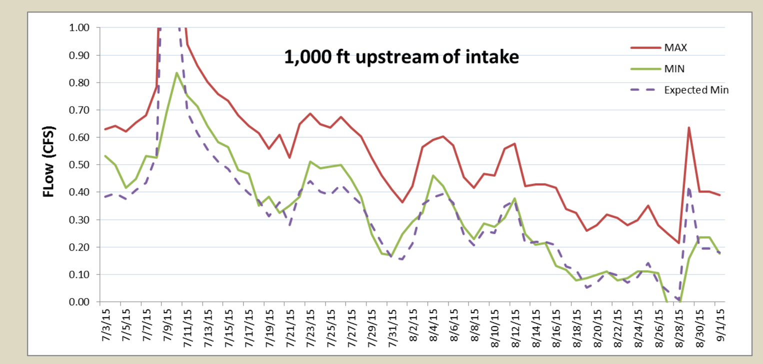
Flow was measured using the float method (Molloy and Struble 1988). This method was selected as other methods (flow meter, or bucket) were not feasible due to low flows and site conditions. We measured the standard error between repeated float measurements. % standard error ranged between 0 and 4%, with % standard error increasing positively with flow.

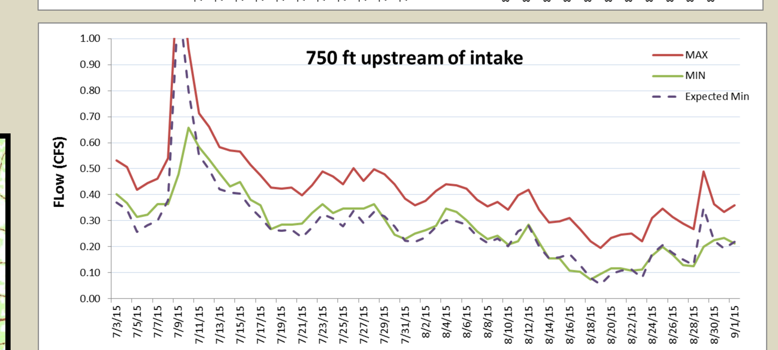


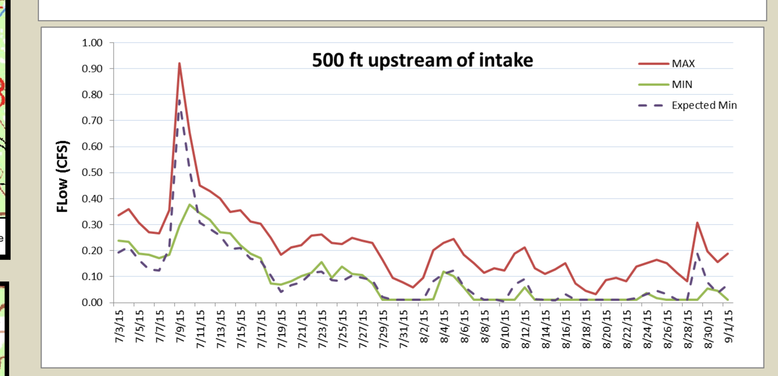
A stage-discharge relationship was developed by measuring streamflow at or near pressure transducer locations throughout the summer. Once the relationship was established, continuous depth readings (every 15 minutes) could be translated to discharge.

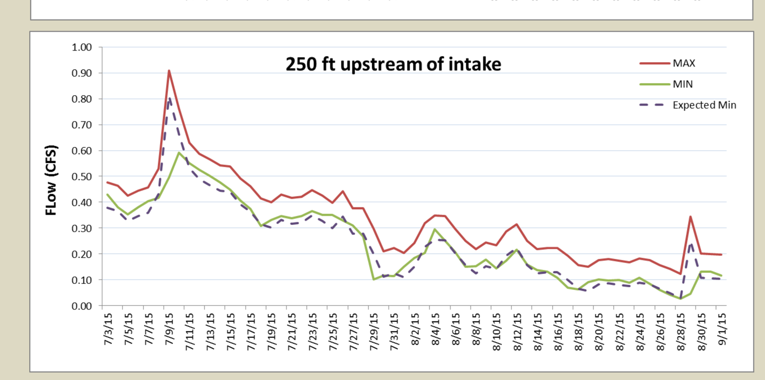


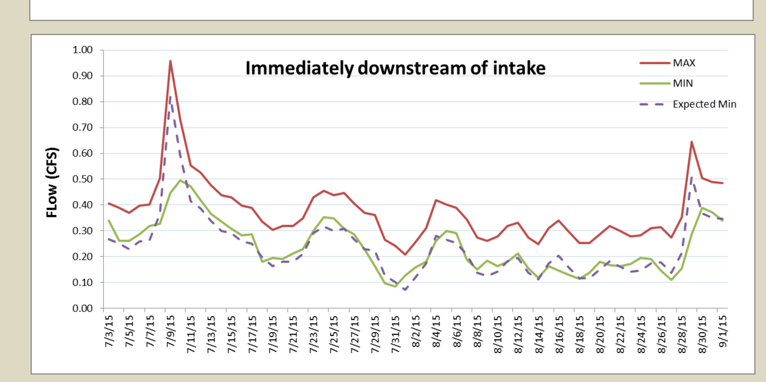
Freshwater Creek

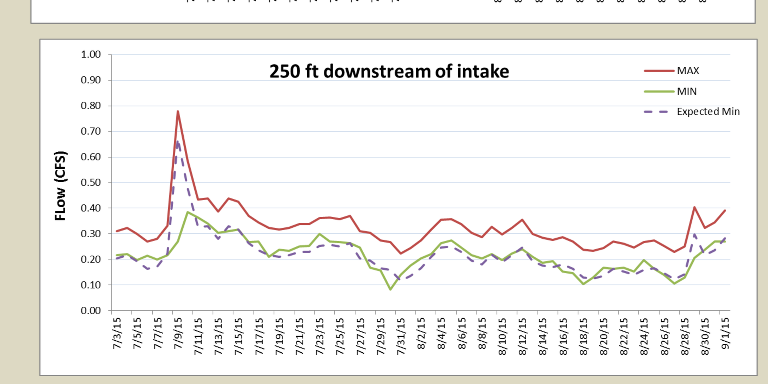


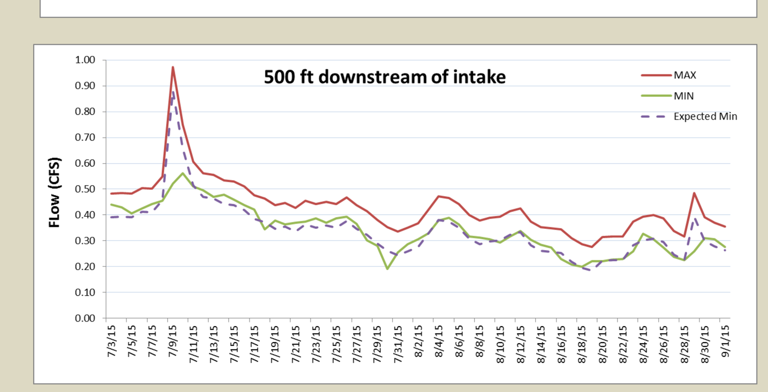


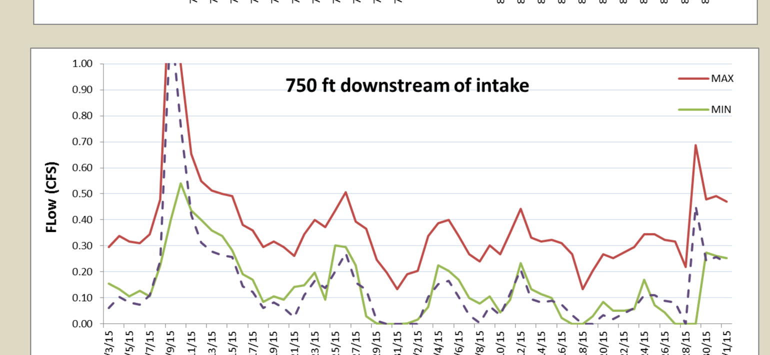




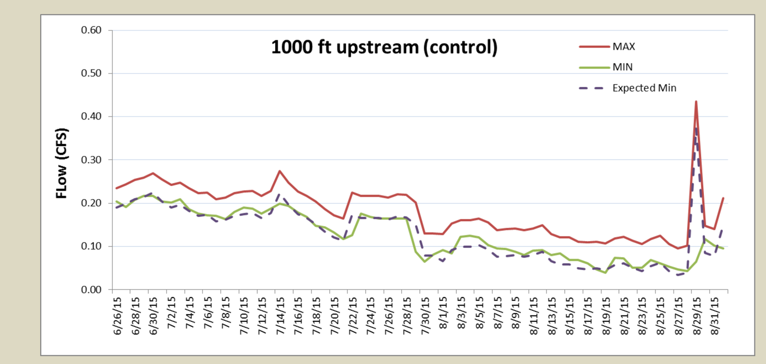


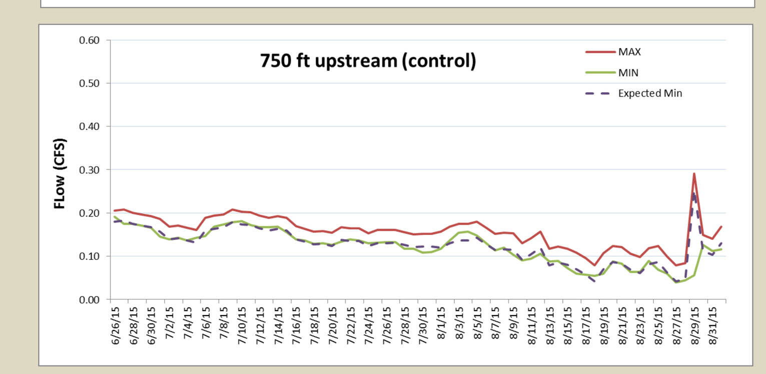


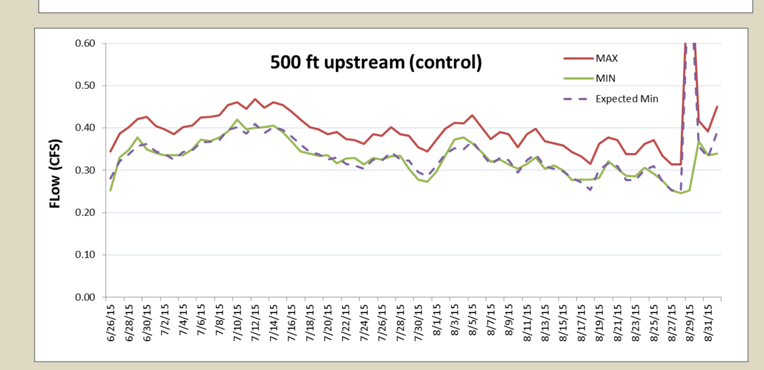


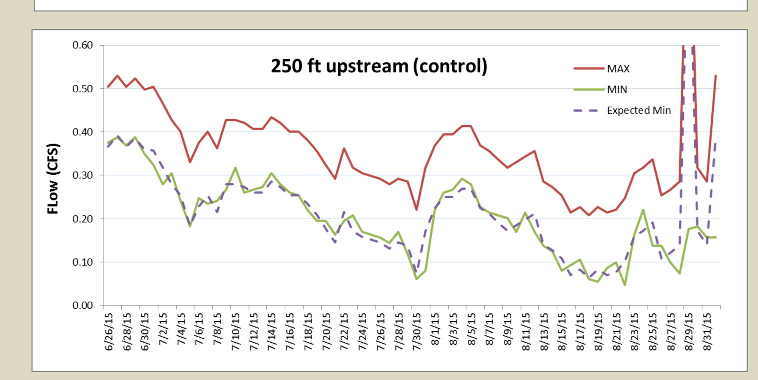


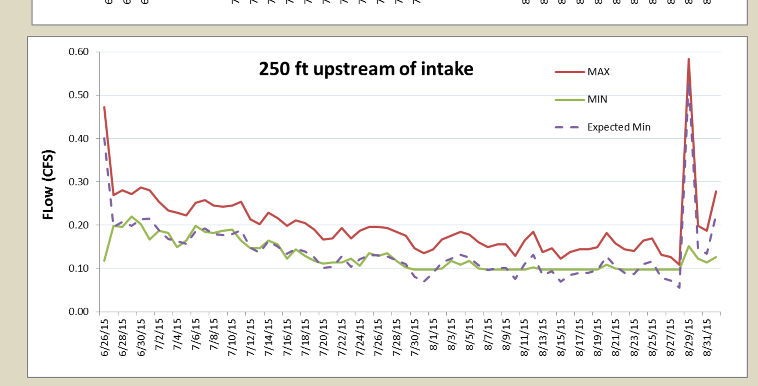
Maple Creek

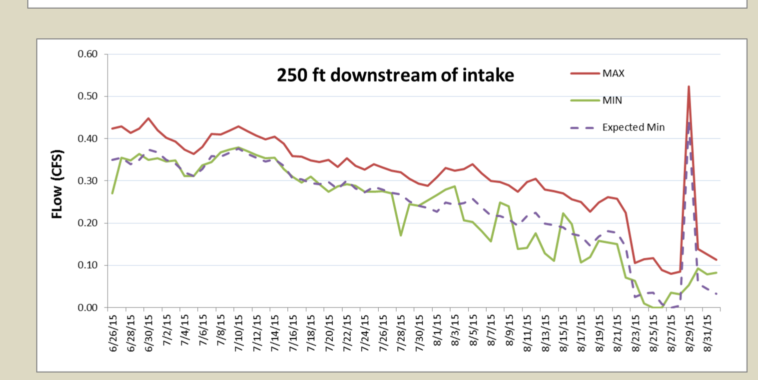


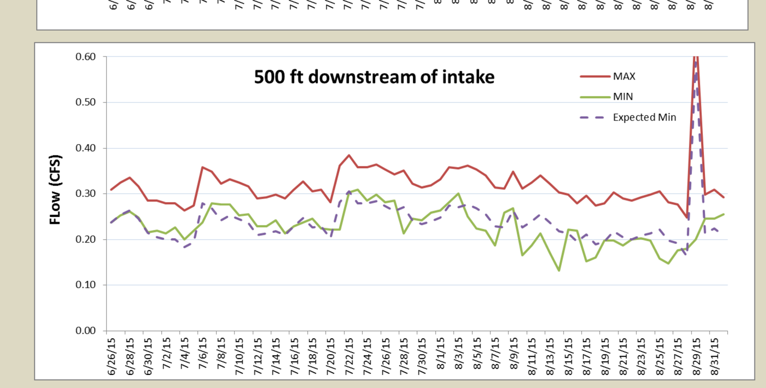


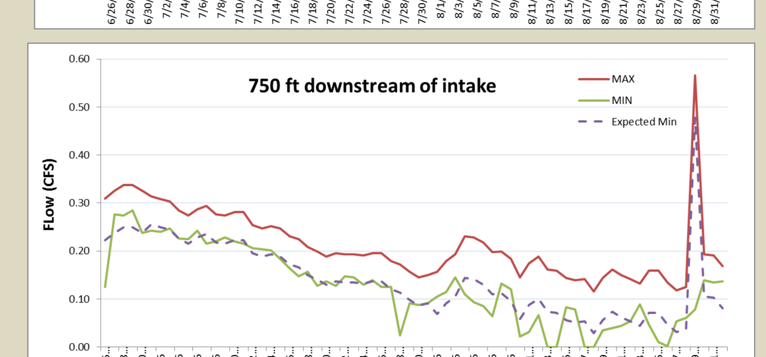






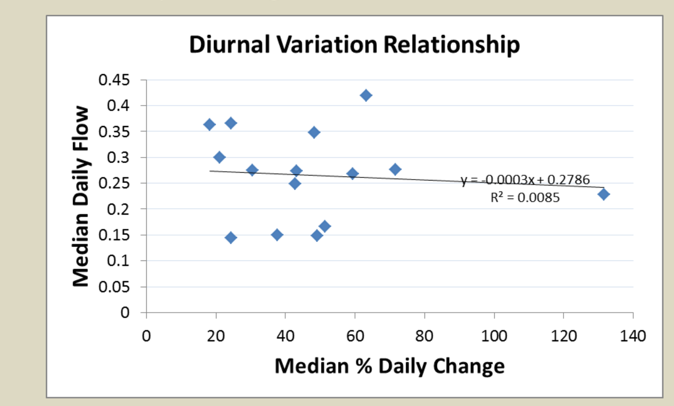




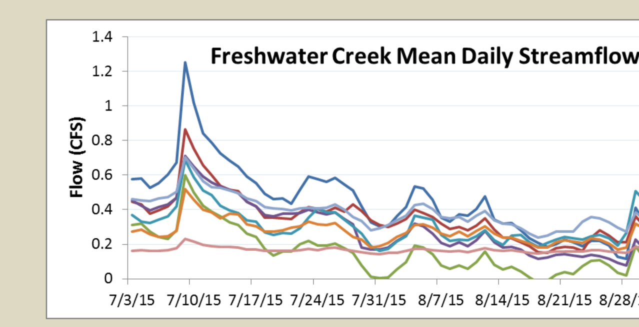


Flow Results

- Flow results suggest both drafting operations stayed between 0 and 25 % of expected daily minimum flows. When flows dropped below 0.1 cubic feet per second (CFS), flow diversions occasionally exceeded 25 % of expected daily minimum flows. Expected daily minimum flows were calculated as Max Q – Avg monthly Q.
- Average daily diurnal fluctuation ranged between 18 and 130 percent. There was no relationship between flow magnitude and percent daily change.

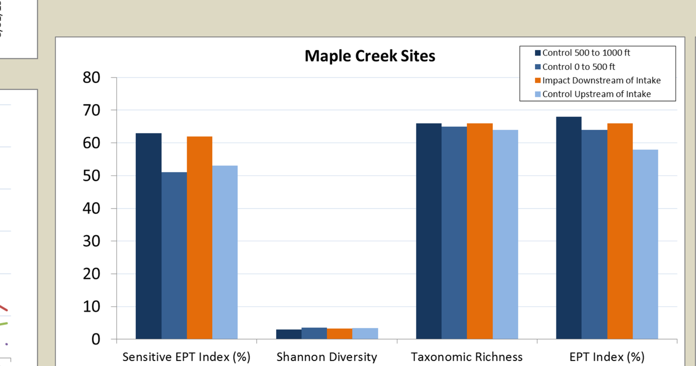


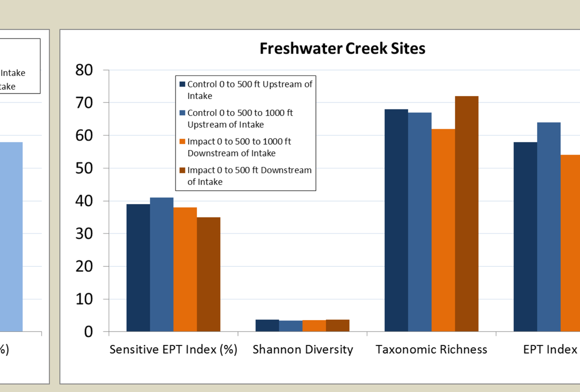
- Spatial variation in mean daily streamflow between sites was relatively high. At the Freshwater reach, flow was three to four times less at downstream sites compared to upstream sites.



BMI Results

There was no significant difference between BMI population health indices above and below drafting sites when an instantaneous maximum 25% diversion rate was implemented. These results suggest a maximum 25% drafting rate maintains aquatic communities in headwater streams.





Conclusion

This study found two timber related water drafting tank operations were able to maintain aquatic macroinvertebrate communities downstream when a maximum 25% instantaneous water drafting rate was implemented appropriately. Given the high spatial variability in flow between sites coupled with high diurnal flow variation, we recommend initial streamflow measurements are conducted at multiple locations downstream of the drafting site to assess reaches which could be potentially dewatered. In addition, it is important to factor in other water users upstream and downstream of the drafting site as well, to ensure simultaneous diversions are not compromising downstream reaches.