

Packwood Lake Entrainment Study Results

Prepared for Aquatics Work
Group

October 25, 2007

Entrainment Study Goals and Objectives

- The goal of this study was to identify relative abundance, age/sex, timing and species composition of fishes entrained, impinged or otherwise affected by the Packwood Lake Hydroelectric Project intake structure. This information can be used to improve the knowledge base and develop an understanding of the options for natural resource protection, mitigation and enhancement

Packwood Entrainment Study

Objectives

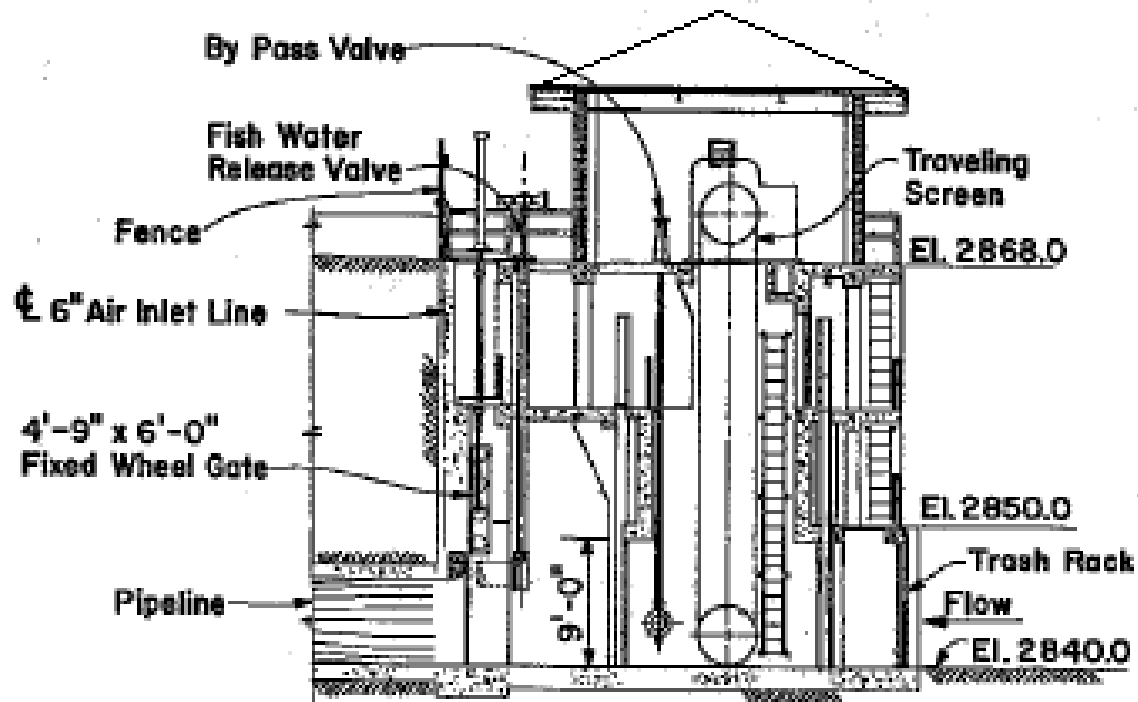
- Determine species relative abundance, age/size, timing and composition at the intake structure.
- Evaluate the effectiveness of the Project's screens in protecting fish.
- Assess the potential entrainment or impingement impacts from the lake elevation and Project flow fluctuations.
- Develop a rule curve for lake level elevation and diversion rate, since approach velocities may exceed the State criteria of 0.33 fps at some operating scenarios.

Methods

- Engineering Criteria and Hydraulic Data
 - EN provided engineering designs
- Approach Velocities at the Intake
 - Acoustic Doppler Current Profile (ADCP) Measurements - 2006
 - Velocity Measurements at the Intake – 2007
- Fisheries Investigations
 - Variable Mesh Gillnet
 - Seine Net at Intake
 - Limited Video Footage

Engineering Methods

- Traveling Screen
 - 4.3 mm X 4.3 mm
 - Set in “manual” position for checking
 - Size:
 - Each 9 ft wide
 - Base at 2840 ft; top at 2868 ft MSL



LONGITUDINAL SECTION

INTAKE STRUCTURE

Packwood Lake Monthly Elevations

Figure 3-1. Packwood Lake Monthly Elevations, 2006

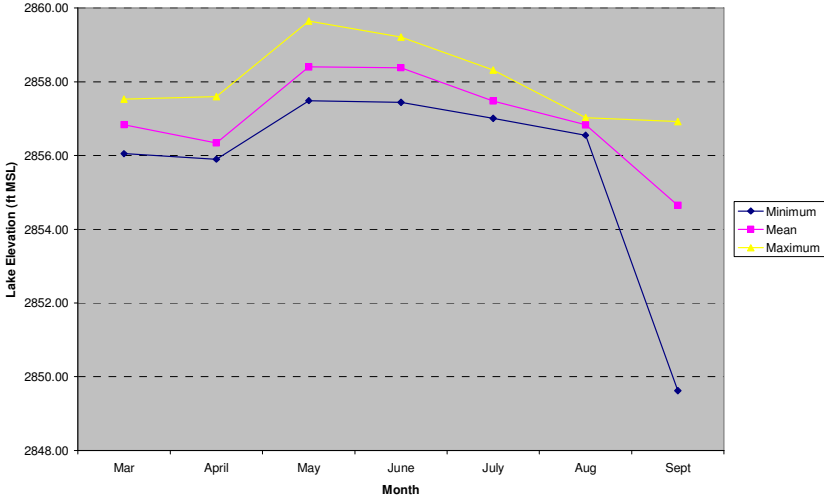
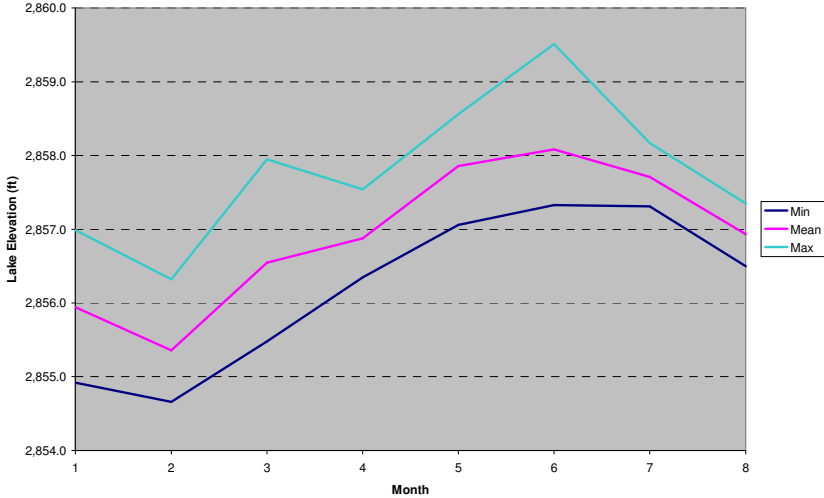


Figure 3-1. Packwood Lake Monthly Elevations, 2007



Mean Daily Lake Levels, 2006 and 2007

Figure 3-2. Mean Daily Lake Levels (ft)

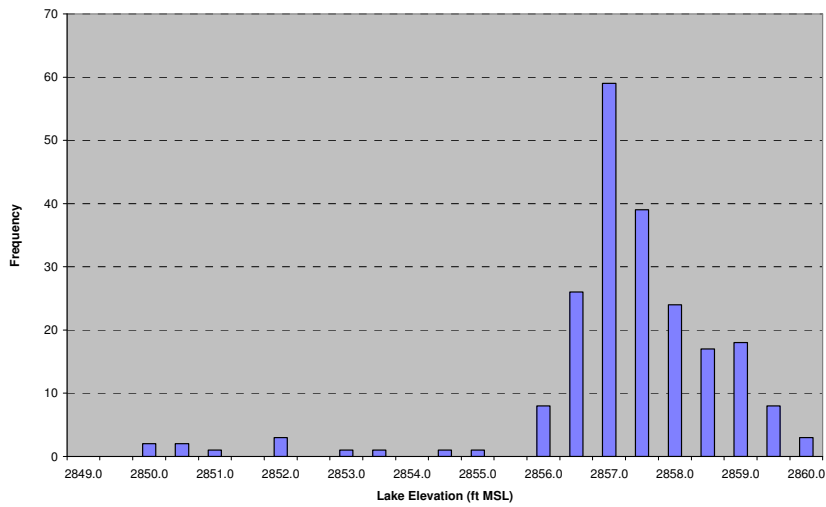
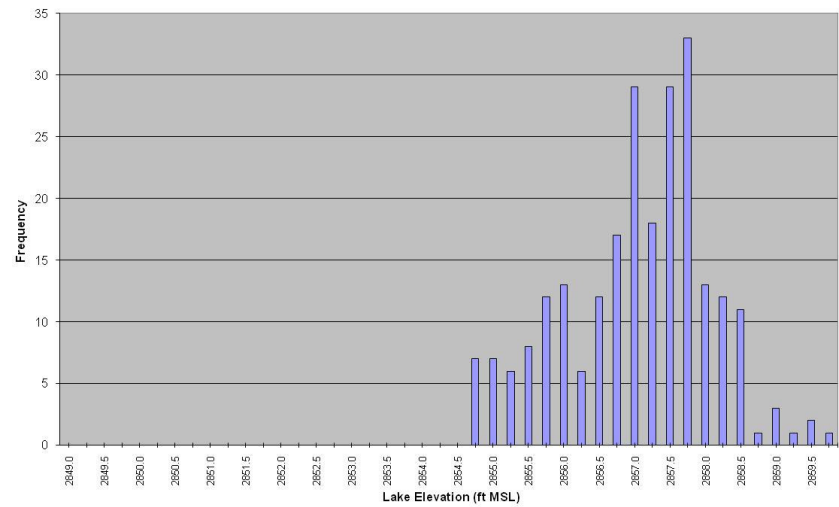


Figure 3-2. Packwood Lake Elevations, January 1 - August 31, 2007



Monthly Plant Flow 2006 and 2007

Figure 3-3. Monthly Plant Flows, Packwood Lake Project, 2006

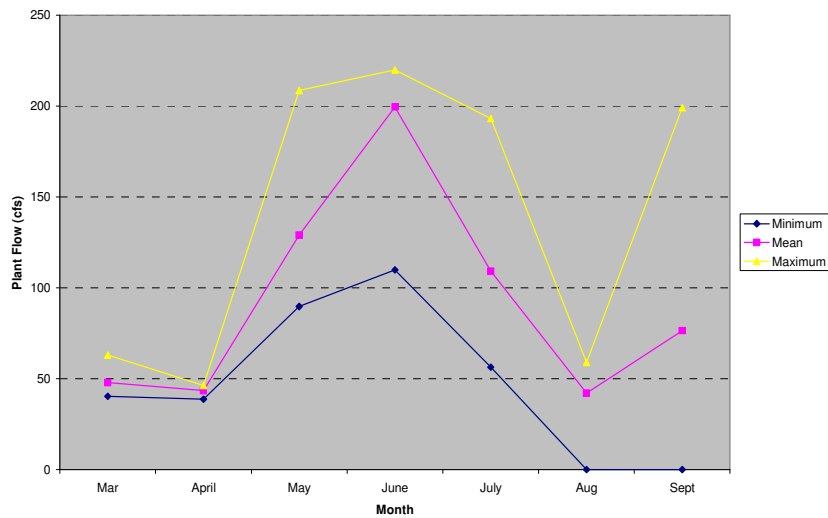
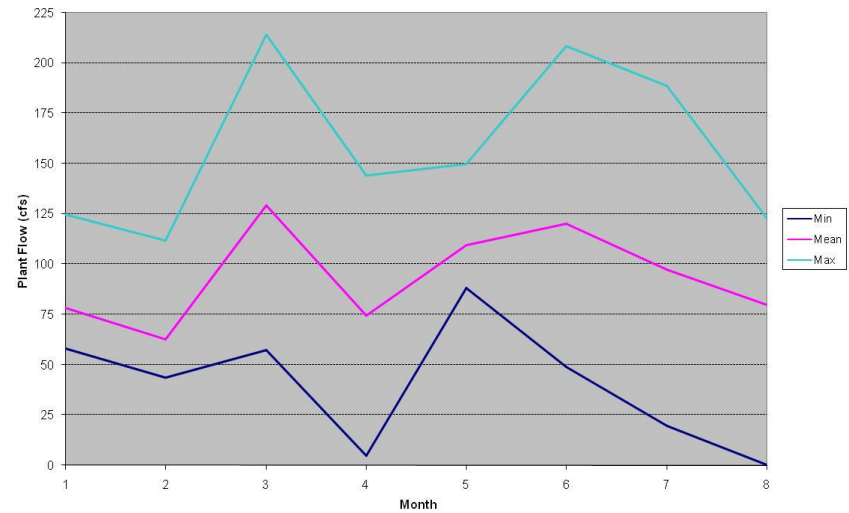


Figure 3-3. Monthly Packwood Lake Plant Flows, 2007



Daily Plant Flow 2006 and 2007

Figure 3-4. Packwood Lake Daily Plant Flow (cfs)

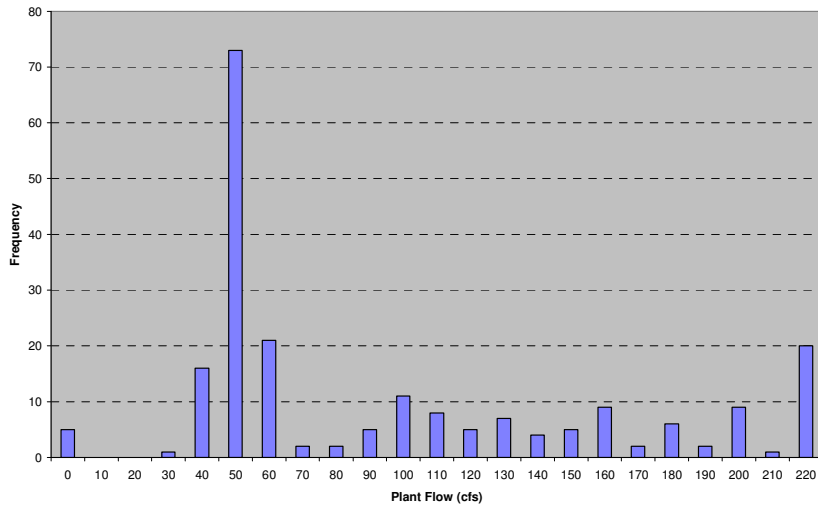
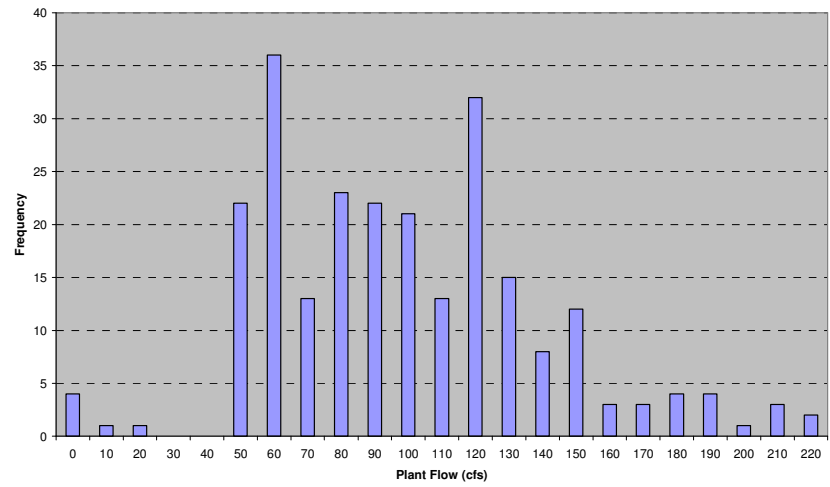


Figure 3-4. Packwood Lake Daily Plant Flow
January 1 - August 31, 2007



Packwood Lake Inflows

2006 and 2007

Figure 3-5. Monthly Inflow for Packwood Lake, 2006

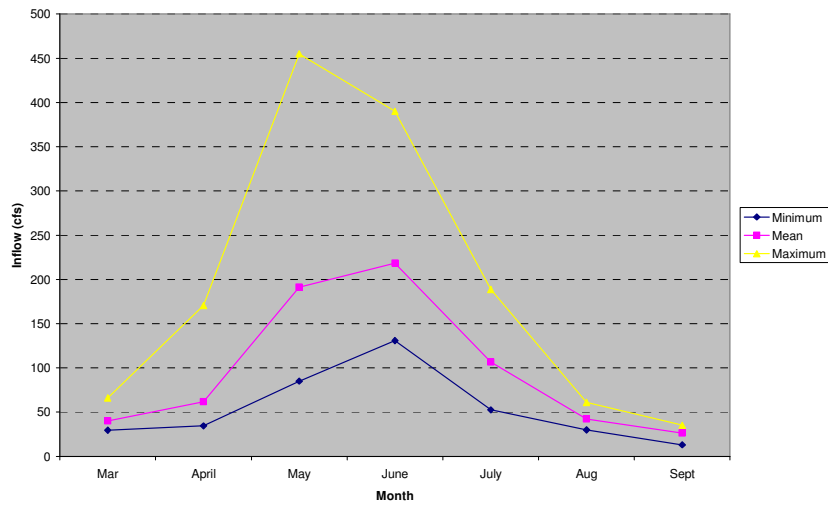


Figure 3-5. Monthly Packwood Lake Inflows January - August, 2007

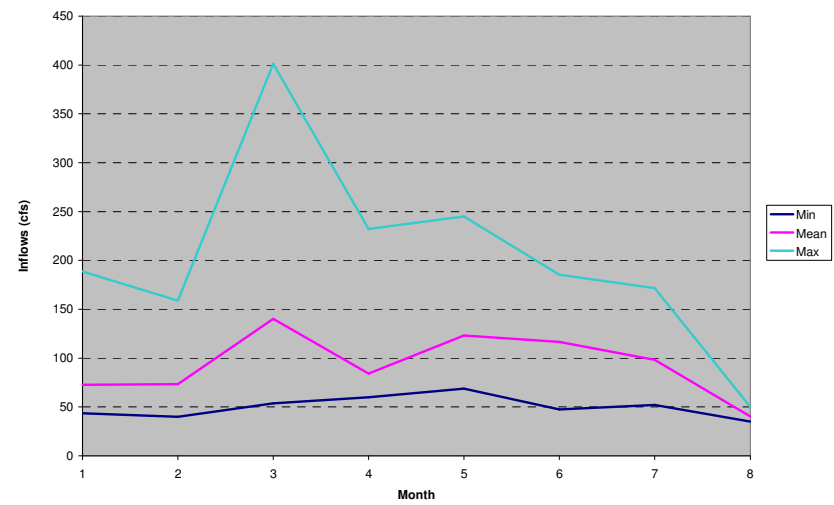


Figure 3-6. Calculated Mean Screen Velocities at Packwood Lake Intake Structure

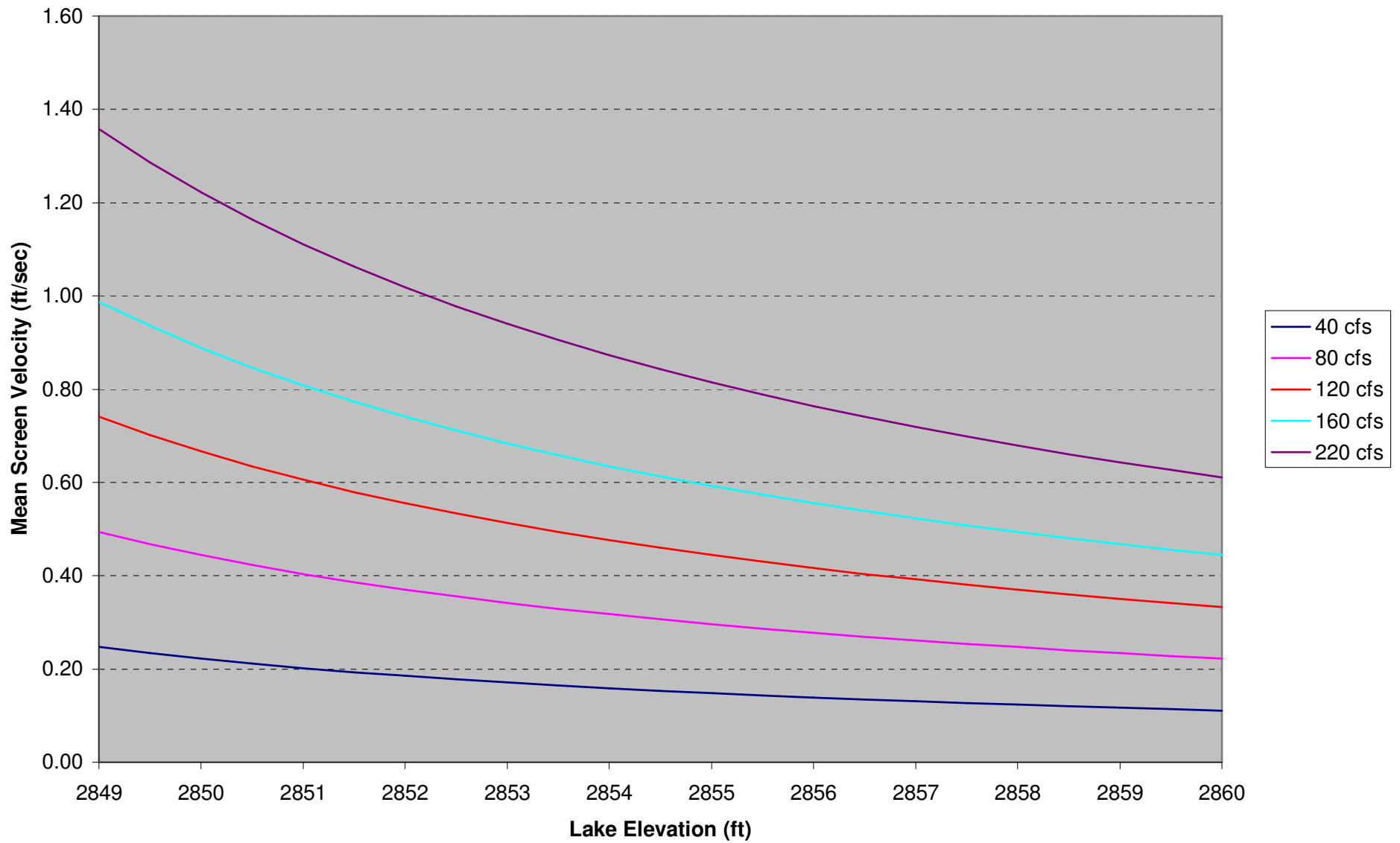
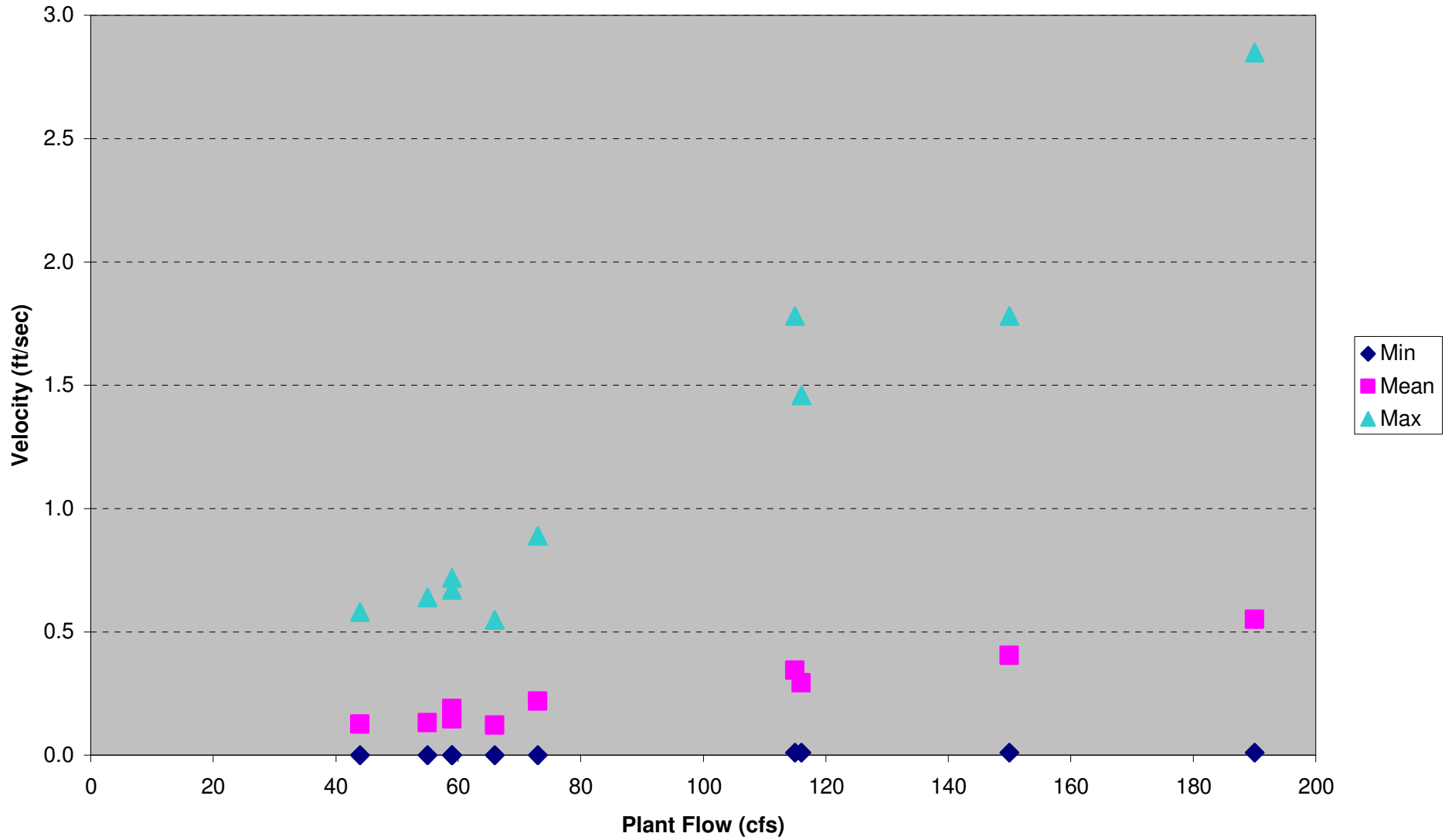


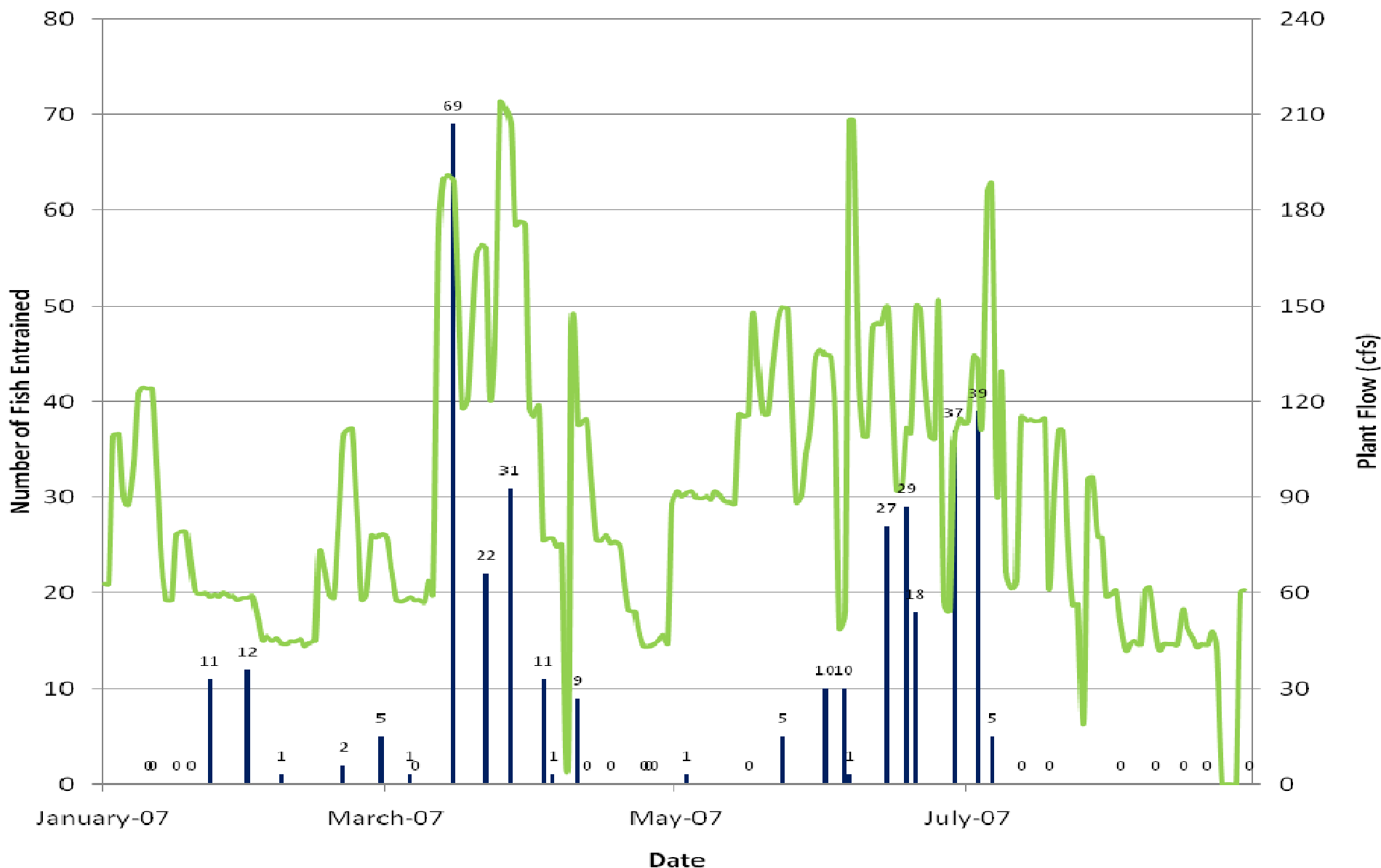
Table 3-2
Comparison of Mean Screen Velocities with Calculated Mean Velocities

Date	Lake Elevation	Plant Flow	Mean Velocities (ft/sec)			Calculated
			Screen 1	Screen 2	Both Screens	
6/20/2007	2857.64	150	0.33	0.48	0.40	0.47
6/28/2007	2857.72	115	0.37	0.32	0.35	0.36
7/5/2007	2857.55	190	0.57	0.53	0.55	0.60
7/13/2007	2858.15	116	0.29	0.29	0.29	0.36
7/18/2007	2857.84	59	0.15	0.14	0.15	0.18
7/24/2007	2857.71	55	0.15	0.11	0.13	0.17
8/2/2007	2857.26	66	0.14	0.10	0.12	0.21
8/9/2007	2857.08	44	0.14	0.11	0.12	0.14
8/16/2007	2856.77	59	0.19	0.19	0.19	0.20
8/29/2007	2856.80	73	0.24	0.20	0.22	0.24

Figure 3-7. Measured Monthly Minimum, Mean and Maximum Approach Velocities at Packwood Lake Intake Screens, January - August, 2007



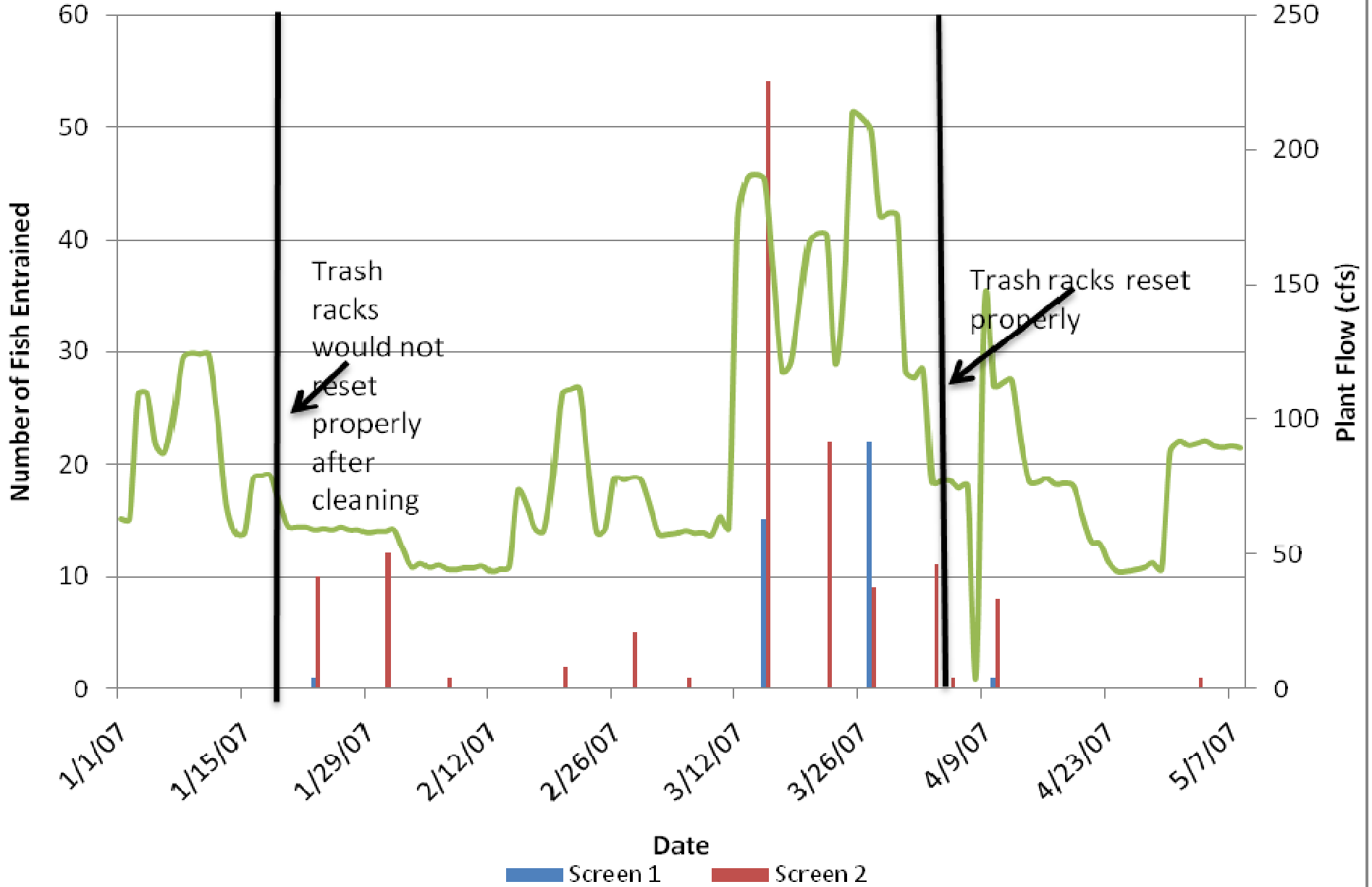
2007 Fish Entrainment Data



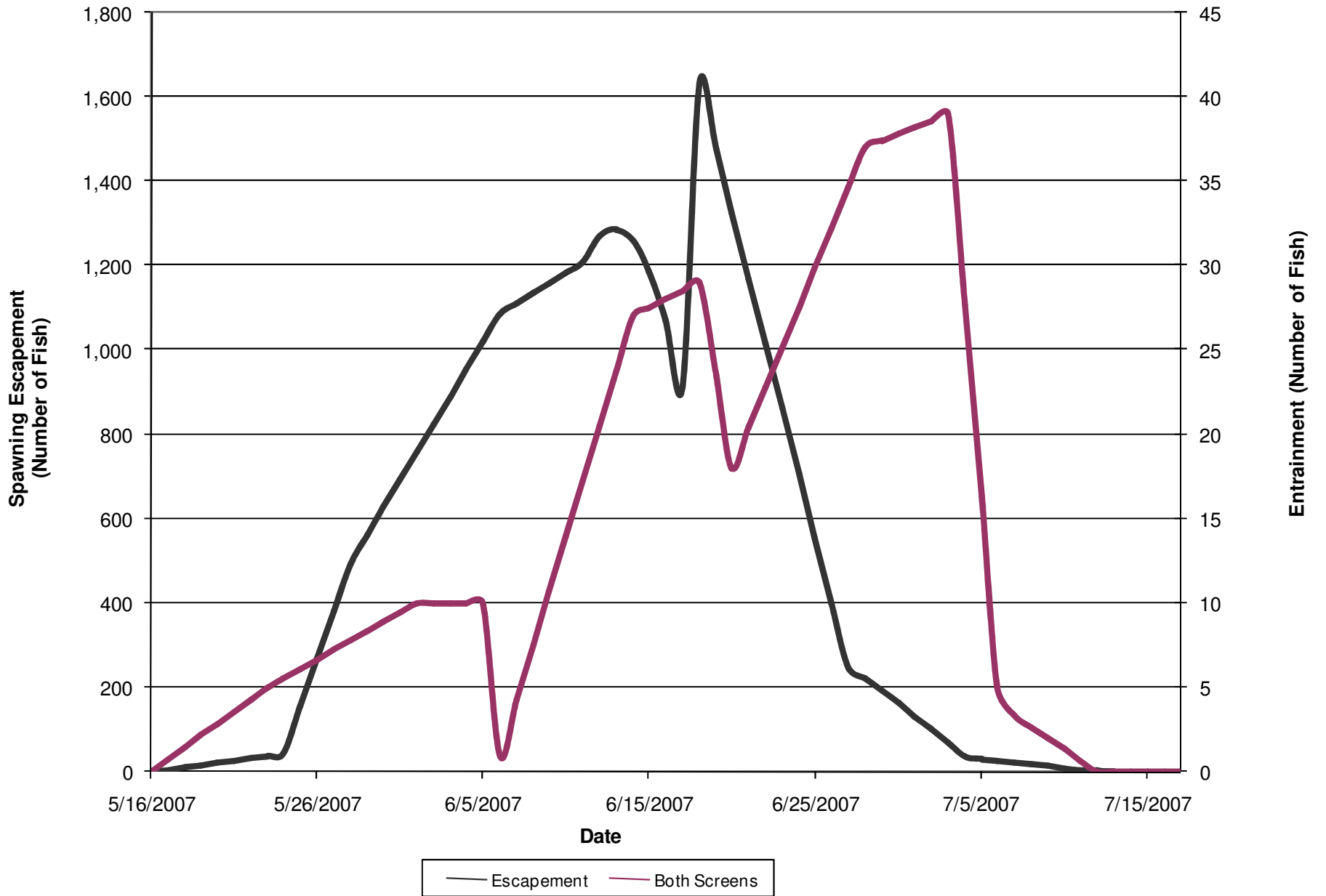
Note: A "0" marks when the traveling screens were checked and no fish were impinged

■ Total Fish

2007 Entrapment Data



Packwood Lake Entrainment and Spawning Timing

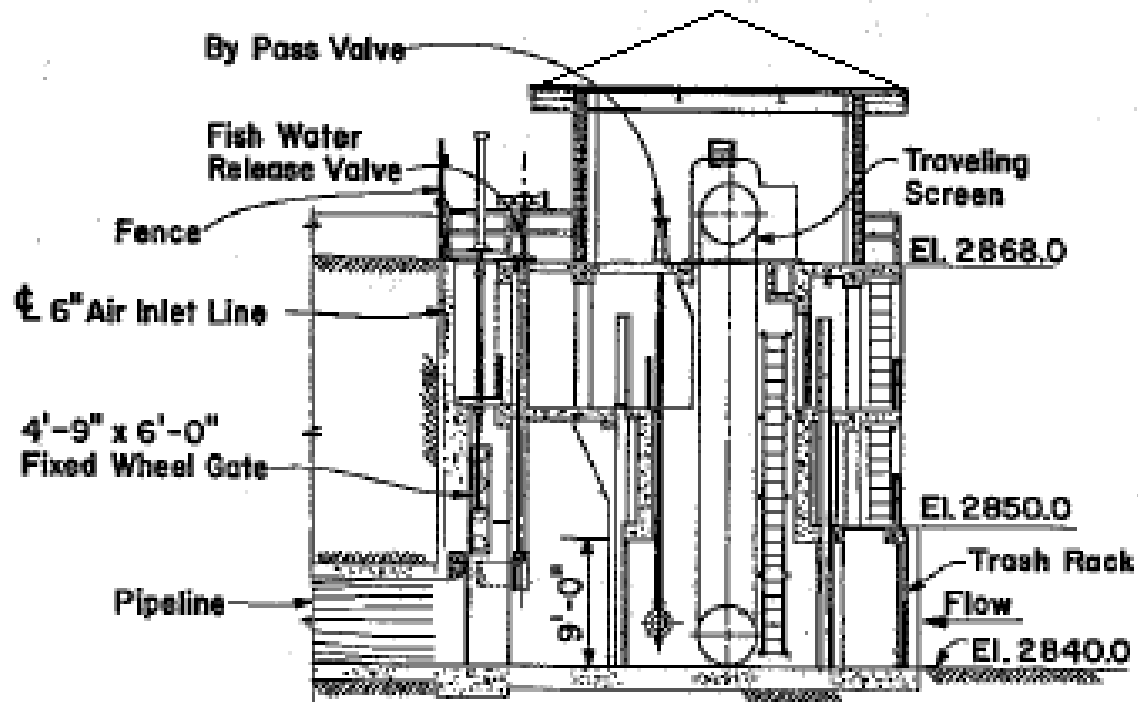


Conclusions

- Fish entrained on the intake screens prior to May are the result of screens not seated properly
- Fish entrained on the intake screens after April closely correlate to the spawning timing of rainbow trout

Recommendations

- Replace the debris screens with better fitting screens
- Locate additional debris screens beneath the boom in front of the intake structure.



LONGITUDINAL SECTION

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