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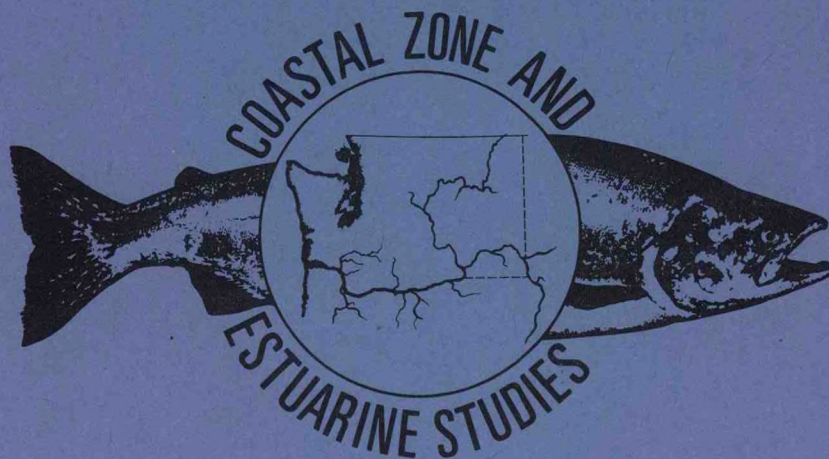
**Bonneville Dam Second Powerhouse
Fish Guidance Research
Velocity Mapping Studies**

FINAL REPORT

by
Alvin L. Jensen

October 1987

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BONNEVILLE DAM SECOND POWERHOUSE
FISH GUIDANCE RESEARCH

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INTRODUCTION

Studies to evaluate the efficiency of the fingerling collection and bypass system at the Bonneville Dam 2nd Powerhouse indicated that hydraulic conditions in and around the turbine intakes might be a factor in the low fish guiding efficiencies (FGE) measured (Krcma et al. 1984; Gessel et al. 1985, 1986). The study reported here was undertaken to obtain measurements of the velocities occurring near the trashracks and within the intakes of Turbines 12 and 15 at the Bonneville 2nd Powerhouse. Earlier studies showed good FGE at the Bonneville 1st Powerhouse and the McNary Powerhouse, so similar measurements were made at these sites for comparison.

EQUIPMENT AND PROCEDURES

The equipment and procedures used were essentially those outlined in a design report by Haner, Ross, and Sporseen, Inc.^{1/} (excerpts are included in Appendix B), with the following exceptions:

- 1) The severe transverse flows encountered at the Bonneville 2nd Powerhouse were strong enough to wash the meter support frame completely off the trashrack. Portions of the frame which were not necessary were removed to reduce the cross-sectional area exposed to these transverse flows.
- 2) The small rollers and guides on the base of the trashrack frame tended to jam when contacting the joints between trashrack sections. These rollers

^{1/} Haner, Ross, and Sporseen, Inc. "Bonneville Second Powerhouse, Fish Guidance Research, Prototype Velocity Mapping Program" Final Report under Portland District, U.S. Army Corps of Engineers Contract No. DACW57-84-D-0073 W/O No. 0003, June 1985, revised August 1985.

and guides were replaced with 4-inch diameter pipe rollers which extended beyond the sides of the frame itself. This broader base eliminated jamming and reduced the tendency for the frame to be tipped or swept off the trashrack. Center guides built onto the rollers kept the frame in proper alignment (Fig. 1).

- 3) Previous experience indicated that signal cables attached at intervals to the hoisting cables would be likely to tangle or become ensnared at trashrack joints. The cables were therefore hand-fed and retrieved, and tension was maintained on the cables to eliminate excess slack.
- 4) The trashrack frame was handled with a mobile crane rather than a winch system.
- 5) In place of the oscillographic recording suggested by Haner, Ross, and Sporseen, the output from the velocity sensors was fed into a multiplexer and an analog-to-digital converter which scanned the entire sensor array at preset intervals and stored the data in a computer file. This allowed much faster and more accurate recording of data. In addition, pressure sensors were used to determine the depth of the trashrack frame, the folding frame, and bulkhead frame sensors, and this information was fed directly to the computer.

DESCRIPTION OF TESTS

Measurements were made in front of the trashracks and in the intake of Turbine 5B of the Bonneville 1st Powerhouse, Turbine 12B of the Bonneville 2nd Powerhouse, and Turbine 5B of the McNary Powerhouse (Fig. 2).

Velocities at all sites were measured at high, intermediate, and low turbine loads with the full powerhouse (or as nearly so as could be obtained)

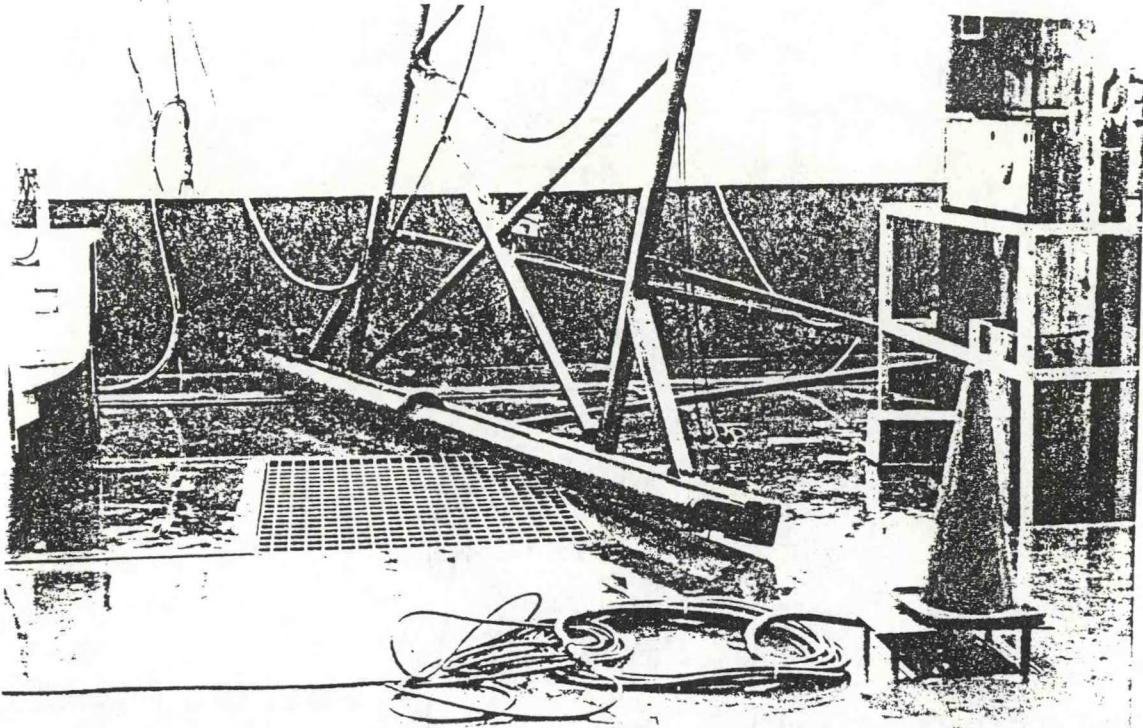


Figure 1. Modified trashrack frame for supporting velocity meter probes, bottom roller and center guide are shown.

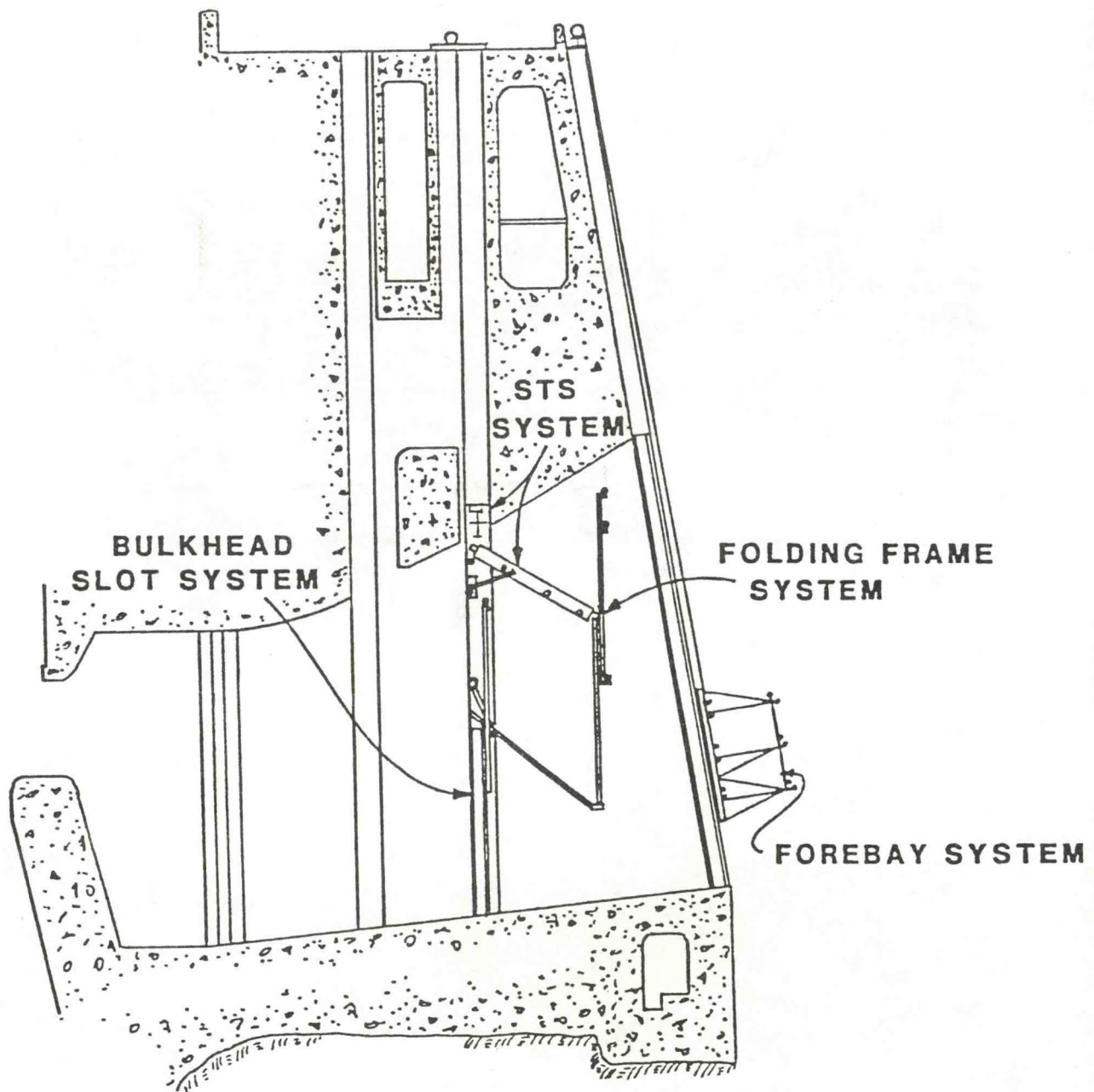


Figure 2. Dam cross-section showing locations of the velocity measurement systems.

in operation. In addition, at the Bonneville 2nd Powerhouse, measurements were made for each of the three loads with only selected turbines operating and with the submersible traveling screen (STS) removed. A series was also made at high load at the trashrack of Intake 15B. Advantage was taken of an opportunity to take measurements on the trashracks of Intake 12B of the Bonneville 2nd Powerhouse while intake ceiling extensions were in place for other experiments. These ceiling extensions were attached to the face of the dam to simulate the intake design of the McNary and Bonneville 1st powerhouses (Fig. 3). Table 1 identifies the conditions prevailing during the individual tests at each dam.

More extensive measurements were desired, but testing was constrained by the need to schedule the required river flows, electrical production, availability of cranes, other equipment, manpower, and other necessary operations and activities at the test dams. This severely limited the time tests could be run and precluded "shake-down" testing of the equipment and procedures or replication of tests.

The testing went smoothly, due in large part to the support of U.S. Army Corps of Engineers personnel at the test dams. Their assistance and suggestions made it possible to complete the testing within the limited time available.

RESULTS AND DISCUSSION

Figures 4 through 14 present the results of the velocity mapping tests. The values for the movable sensors (forebay or trashrack system, folding frame system, and bulkhead slot system) are the averages of readings taken at the rate of 5/s for 15 s. For the fixed sensors (STS system), the values

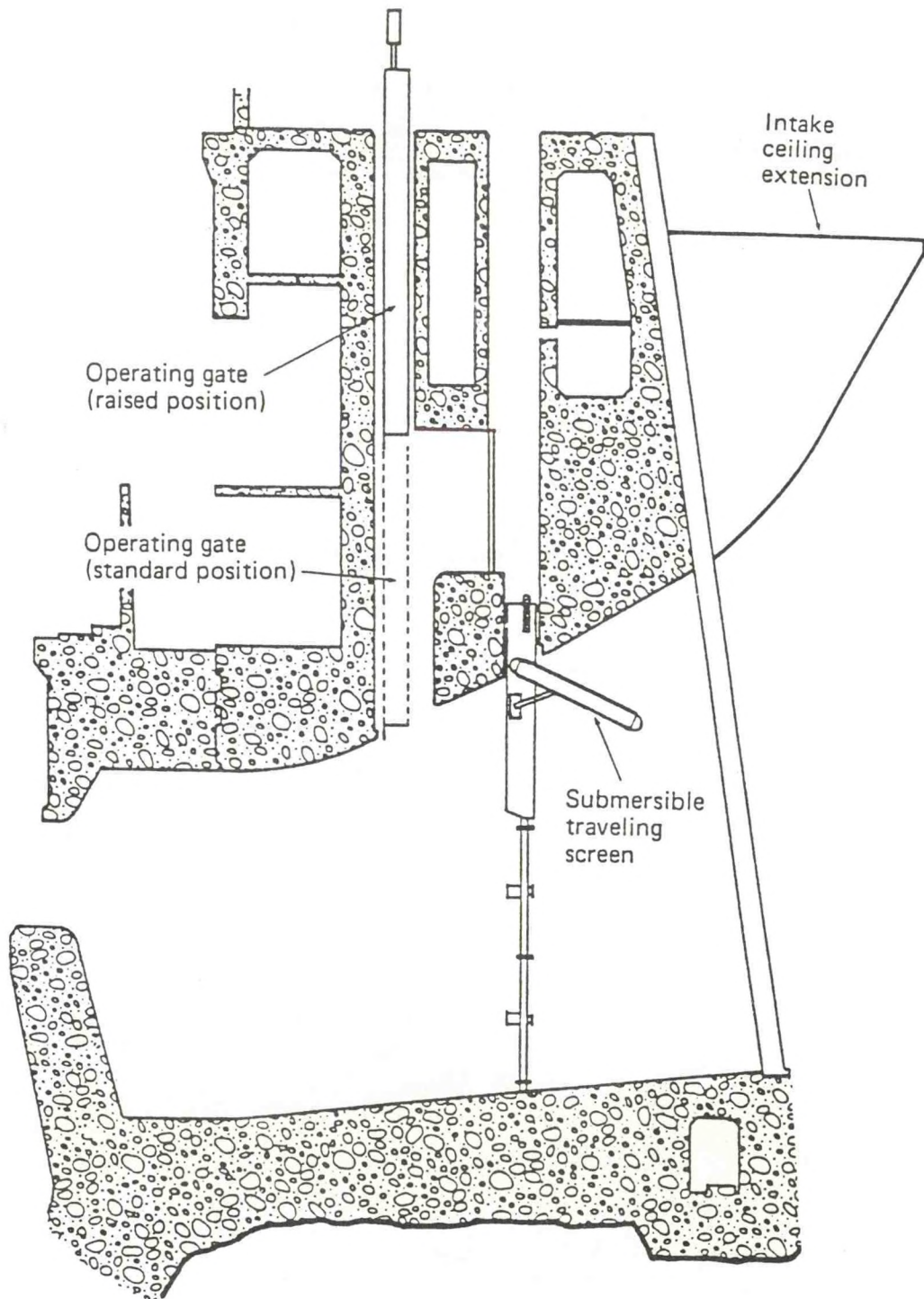


Figure 3. Cross-section of a Bonneville 2nd Powerhouse turbine intake with ceiling extension used to simulate the intakes at the Bonneville 1st and McNary powerhouses.

Table 1. DESCRIPTIVE INFORMATION FOR VELOCITY MAPPING TESTS

TEST GROUP	TEST DATE	DAM	FOREBAY ELEVATION (MSL)	TAILRACE ELEVATION (MSL)	TURBINE INTAKE	TURBINE LOAD	LOAD DESIGNATION	TURBINES OPERATING	REMARKS ^{a/}
1	8/26/86	BONNEVILLE II	76.5		12B	60	LOW	PARTIAL POWERHOUSE - UNITS 11-13, 17, 18	With Roof Extension in place.
2	8/26/86	BONNEVILLE II	76.5		12B	68	MEDIUM	PARTIAL POWERHOUSE - UNITS 11-13, 17, 18	With Roof Extension in place.
3	8/26/86	BONNEVILLE II	76.5		12B	76	HIGH	PARTIAL POWERHOUSE - UNITS 11-13, 17, 18	With Roof Extension in place.
4	10/7/86	BONNEVILLE II	76	14	15B	60	HIGH	FULL POWERHOUSE - UNITS 11-18	
5	10/7/86	BONNEVILLE II			15B		MEDIUM	FULL POWERHOUSE - Data discarded - unable to maintain meters on trashrack.	
6	10/7/86	BONNEVILLE II	75	16	12B	68	MEDIUM	FULL POWERHOUSE - UNITS 11-18	
7	10/8/86	BONNEVILLE II	76	15	12B	60	LOW	FULL POWERHOUSE - UNITS 11-18	
8	10/8/86	BONNEVILLE II	75	16	12B	76.5	HIGH	FULL POWERHOUSE - UNITS 11-18	
9	10/9/86	BONNEVILLE II	76	13	12B	76.5	HIGH	PARTIAL POWERHOUSE - UNITS 11-13, 15, 18	
10	10/9/86	BONNEVILLE II	76	13	12B	66	MEDIUM	PARTIAL POWERHOUSE - UNITS 11-13, 15, 18	
11	10/9/86	BONNEVILLE II	76	13	12B	60	LOW	PARTIAL POWERHOUSE - UNITS 11-13, 15, 16, 18	
12	10/15/86	BONNEVILLE I	75	14	5B	60	HIGH	FULL POWERHOUSE - UNITS 1-10	
13	10/16/86	BONNEVILLE I	74	13	5B	50	MEDIUM	FULL POWERHOUSE - UNITS 1-10	
14	10/16/86	BONNEVILLE I	74	13	5B	40	LOW	FULL POWERHOUSE - UNITS 1-10	
15	10/22/86	MCHARY	339	264	5B	40	LOW	FULL POWERHOUSE - UNITS 1-11	
16	10/22/86	MCHARY	339	265	5B	60	MED	FULL POWERHOUSE - UNITS 1-11	
17	10/22/86	MCHARY	339	267	5B	80	HIGH	FULL POWERHOUSE - UNITS 1-11	
18	3/3/87	BONNEVILLE II	74		12B	75	HIGH	FULL POWERHOUSE	NO STS IN PLACE
19	3/3/87	BONNEVILLE II	74		12B	68	MEDIUM	FULL POWERHOUSE	NO STS IN PLACE

a/ See attached page.

Table 1. Continued.

a/ Tests #4,5 Much difficulty was encountered with frame hanging up on trashracks. Further tests on this unit were abandoned due to concerns about gear loss or damage.

Test #6 Severe southerly transverse flows were present in the area above the mouth of the intake. Frame was difficult to hold on trashracks and was swept off several times.

Tests #7,8 No attempt was made to take measurements at elevations above the level of the intake mouth due to the transverse flow problem. Transverse flows were present below this level, but the flows into the turbine helped to hold the frame in place.

Test #8 Cables to sensors on trashrack frame snagged and separated. Testing was suspended while cables were repaired.

Tests #6-8 During the full-powerhouse operations, severe turbulence was noted in front of the trashracks, with large vortices forming and moving about. Large logs and debris would be sucked into a vortex and disappear for a while, then return to the surface.

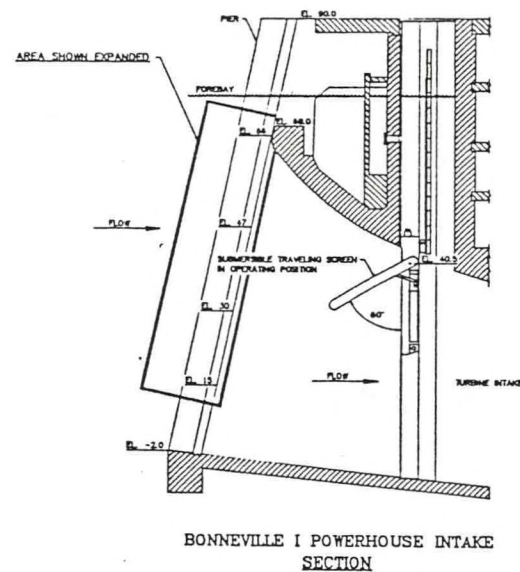
Tests #6-11 When equipment was brought up following the test series, both of the upper probe arms on the folding frame had their inboard mounting bolts sheared and were hanging by the outer bolt only. The actual position of the sensors while readings were being made is therefore not certain. More rigid support was provided for bolting.

Tests #12-14 In spite of reinforcing, both upper arms of the folding frame again had the inboard bolts sheared and the bubbler tubing had been damaged. Depth and velocity readings for these meters are therefore not certain.

Tests #15-17 Wheels on the inner side of the folding frame trolley were found to be crushed when the frame was removed. The upper arms had contacted the travelling screen and were broken loose. The collapse of the wheels probably occurred near the beginning of test #16, as it was noted that movement of the trolley was abnormal at that time.

Tests #18 & 19 Considerable turbulence was evident. Test 19 was terminated when sensor cables became tangled and lodged, and the excessive strain caused the cables to separate. One probe was lost entirely, and another severely damaged.

A flow deflector was mounted on the trash rack of Turbine 12B of the Bonneville II powerhouse and was left in place during these tests, but was placed at a 'neutral' angle (ie, parallel to intake flow).



0 5 10 15
 APPROX. SCALE

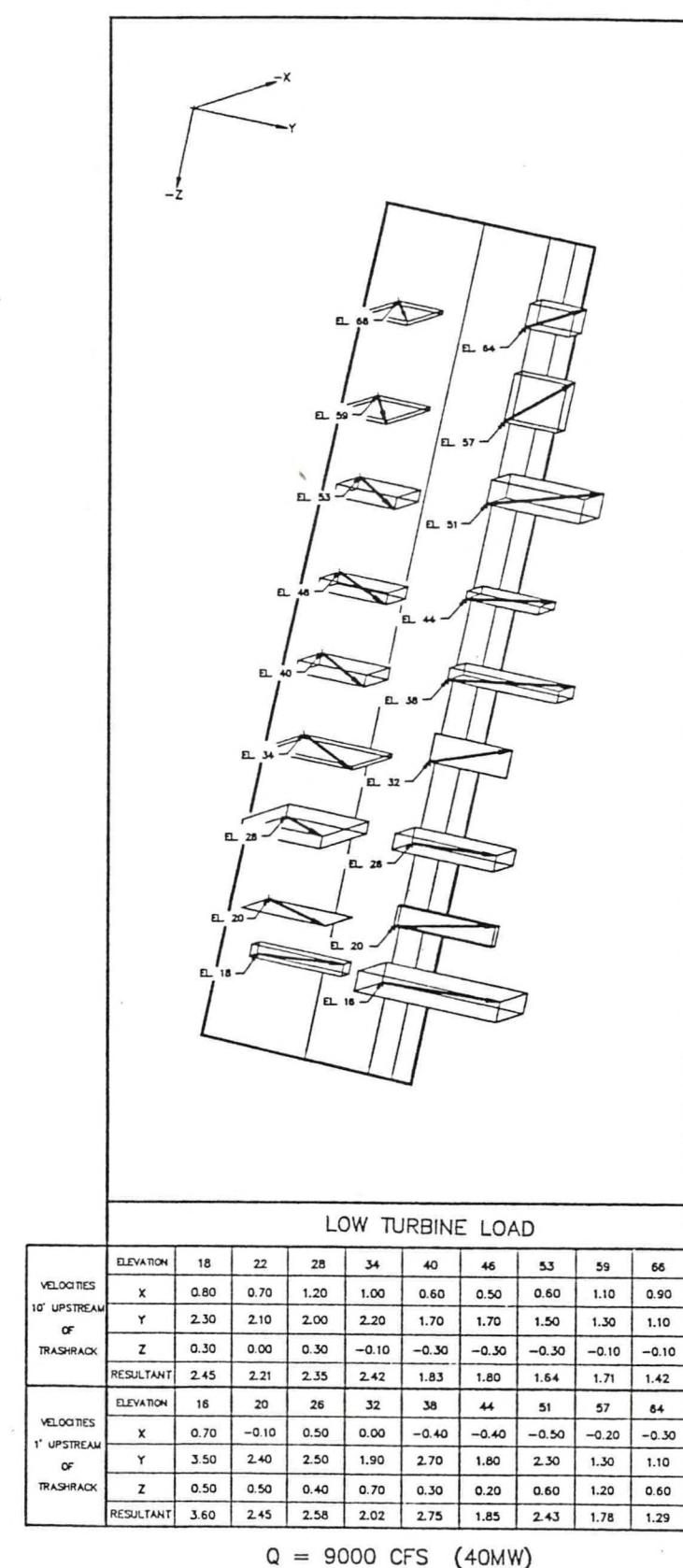
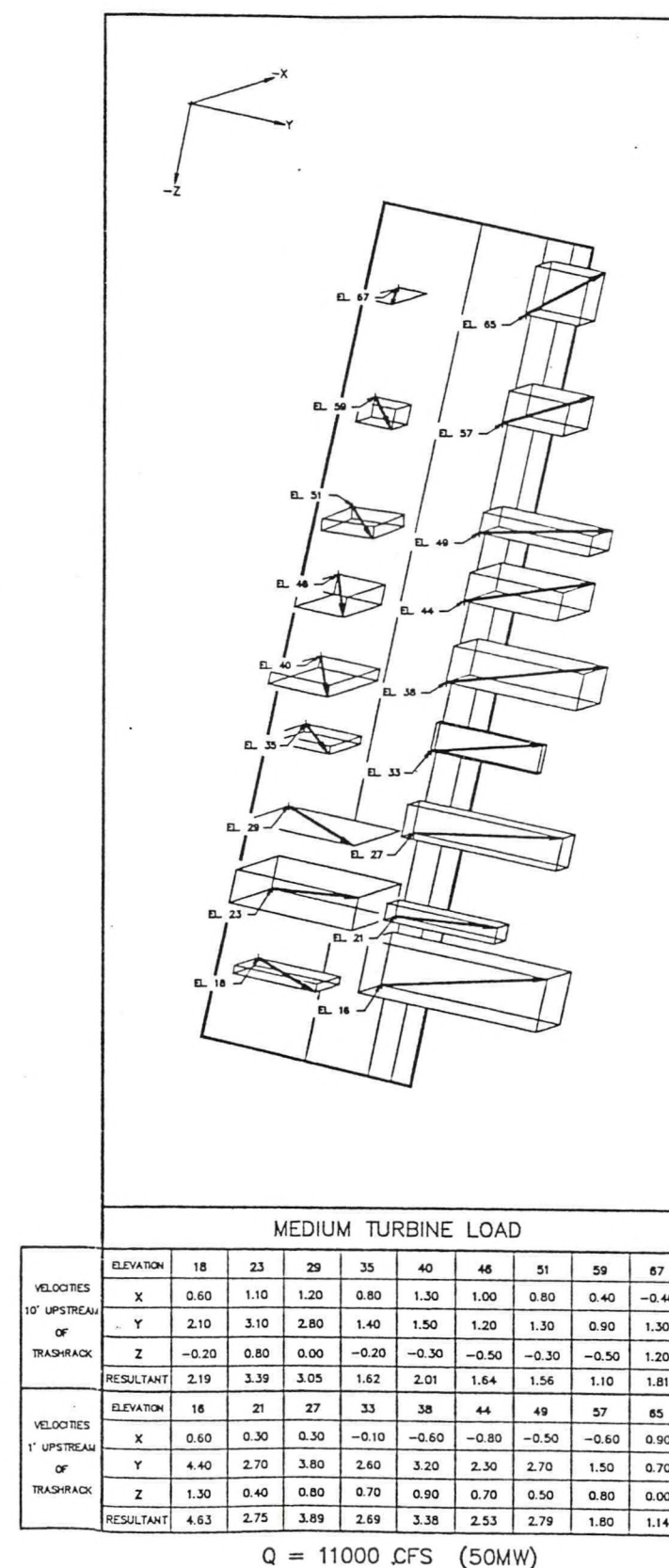
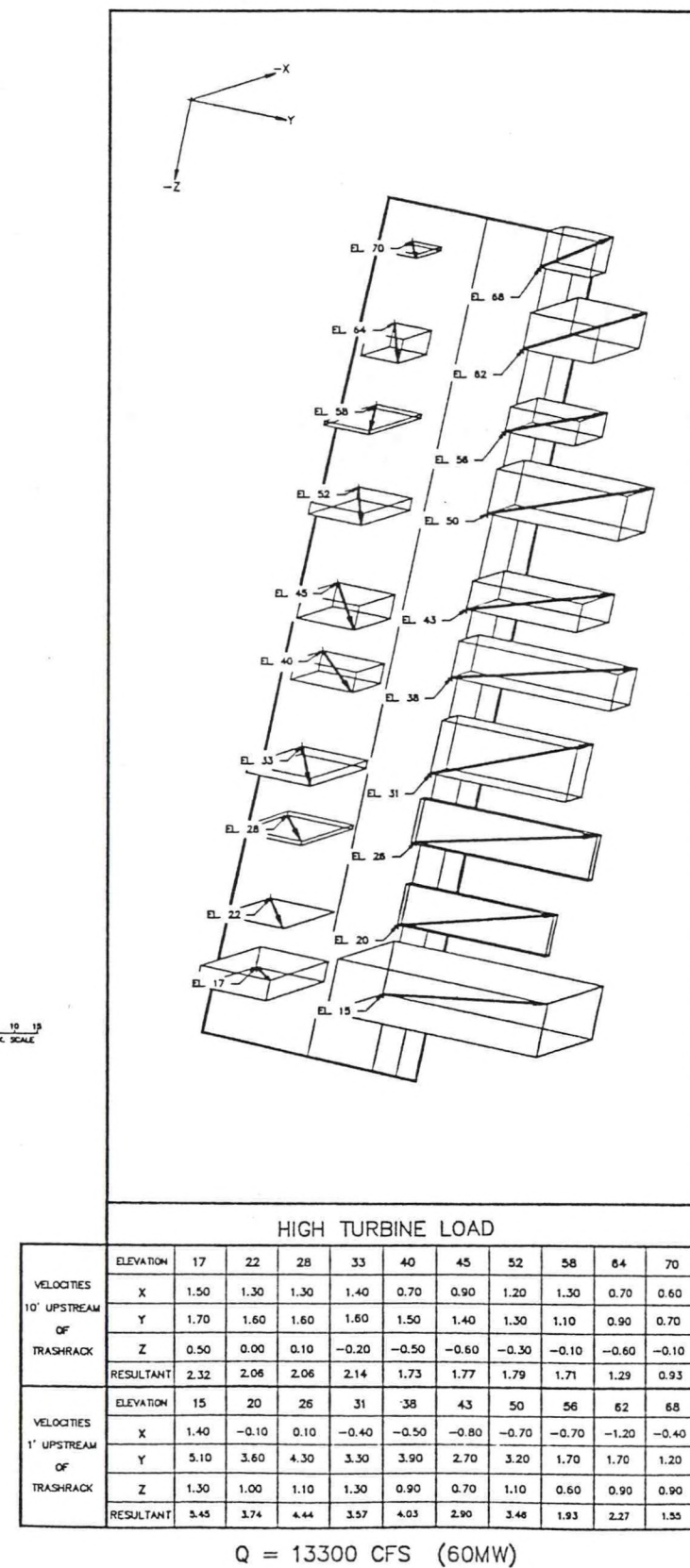


Figure 4. Three-dimensional Velocity Vectors at Bonneville 1st Powerhouse Turbine Bay 5B Trashrack Under High, Medium, and Low Turbine Loads with Units 1-10 Operating.

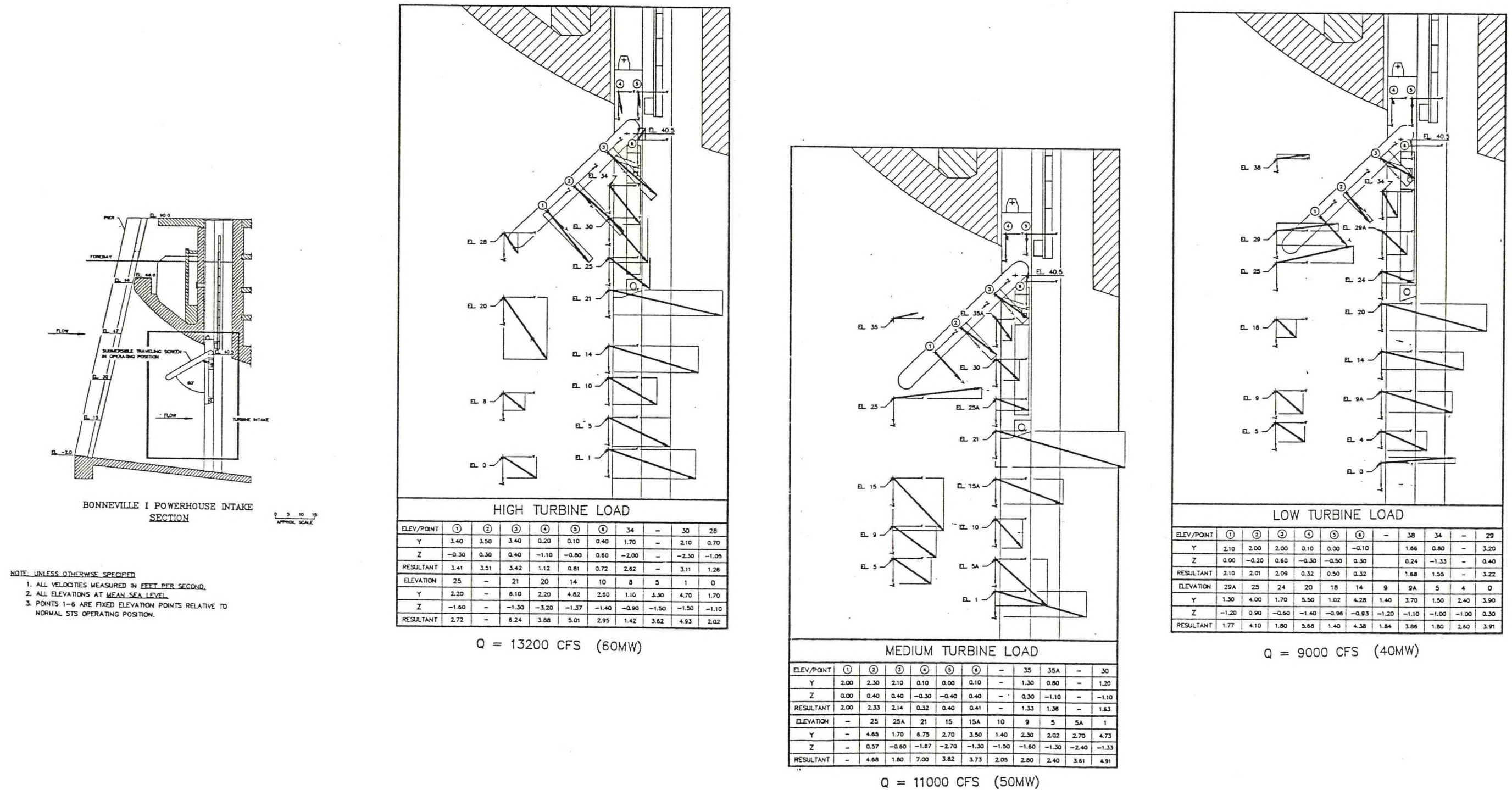
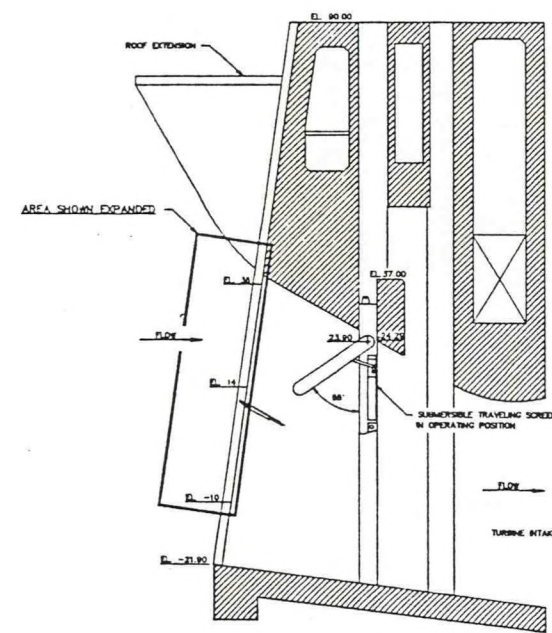


Figure 5. Two-dimensional Velocity Vectors at Bonneville 1st Powerhouse Turbine Bay 5B Intake Under High, Medium, and Low Turbine Loads with Units 1-10 Operating.



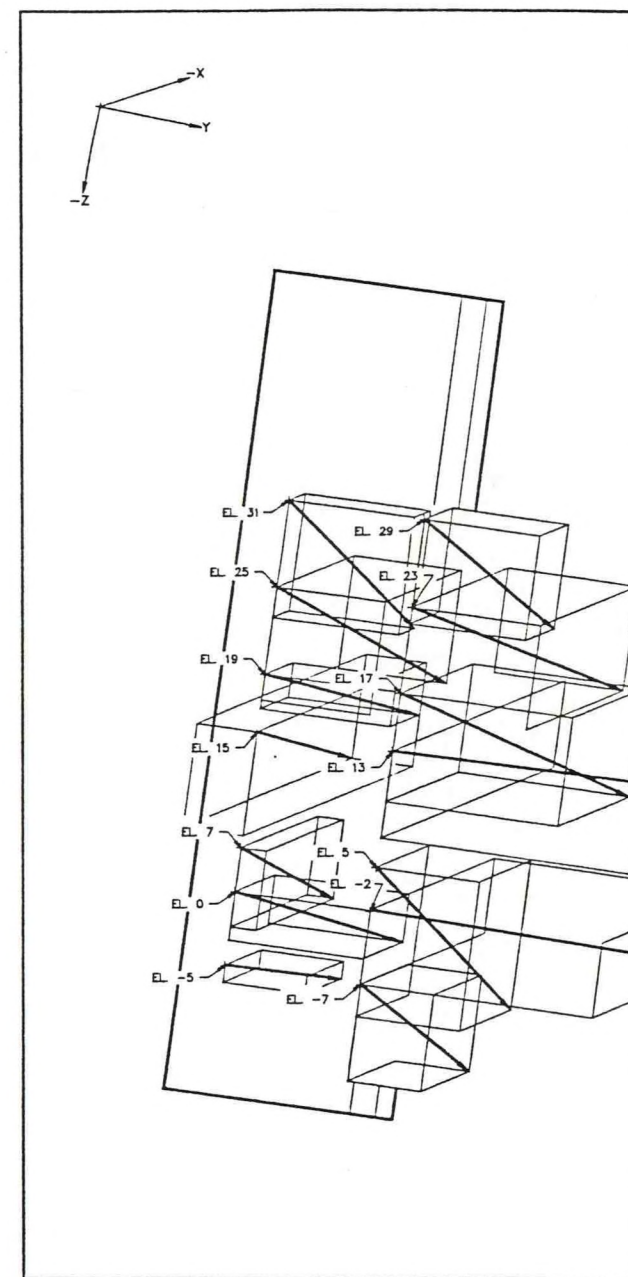
BONNEVILLE II POWERHOUSE INTAKE
SECTION

WITH ROOF EXTENSION

NOTE: UNLESS OTHERWISE SPECIFIED

1. ALL VELOCITIES MEASURED IN FEET PER SECOND.
2. ALL ELEVATIONS AT MEAN SEA LEVEL.

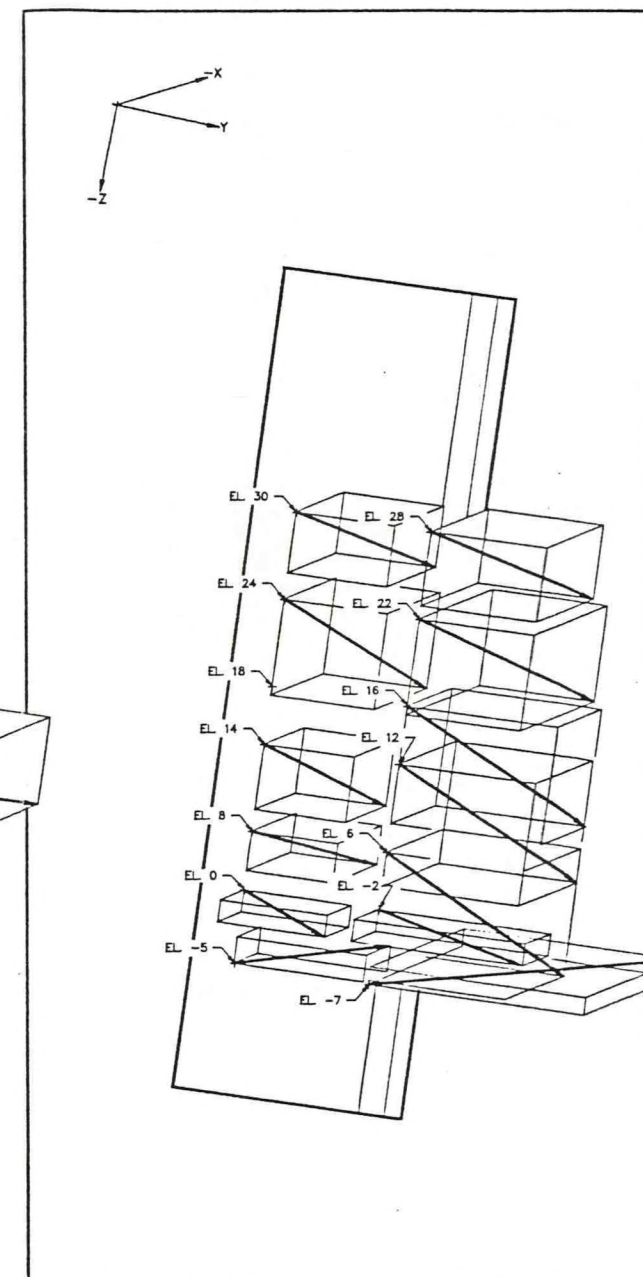
0 5 10 15
APPROX. SCALE



HIGH TURBINE LOAD

VELOCITIES 10' UPSTREAM OF TRASHRACK	ELEVATION	-5	0	7	15	19	25	31
	X	-0.90	-1.00	-1.90	-4.20	-0.70	-1.90	-0.40
	Y	1.90	3.10	0.60	-1.40	3.00	2.50	2.90
	Z	-0.40	-1.10	-1.80	-2.40	-0.80	-2.60	-2.70
	RESULTANT	2.14	3.44	2.69	5.04	3.18	4.08	3.98
VELOCITIES 1' UPSTREAM OF TRASHRACK	ELEVATION	-7	-2	5	13	17	23	29
	X	-1.20	-3.10	-1.30	-4.30	-1.80	-2.40	-0.70
	Y	1.70	5.40	2.40	5.90	4.00	3.00	2.70
	Z	-2.20	-1.70	-3.40	-2.00	-2.50	-2.40	-2.40
	RESULTANT	3.03	6.45	4.36	7.57	5.05	4.53	3.68

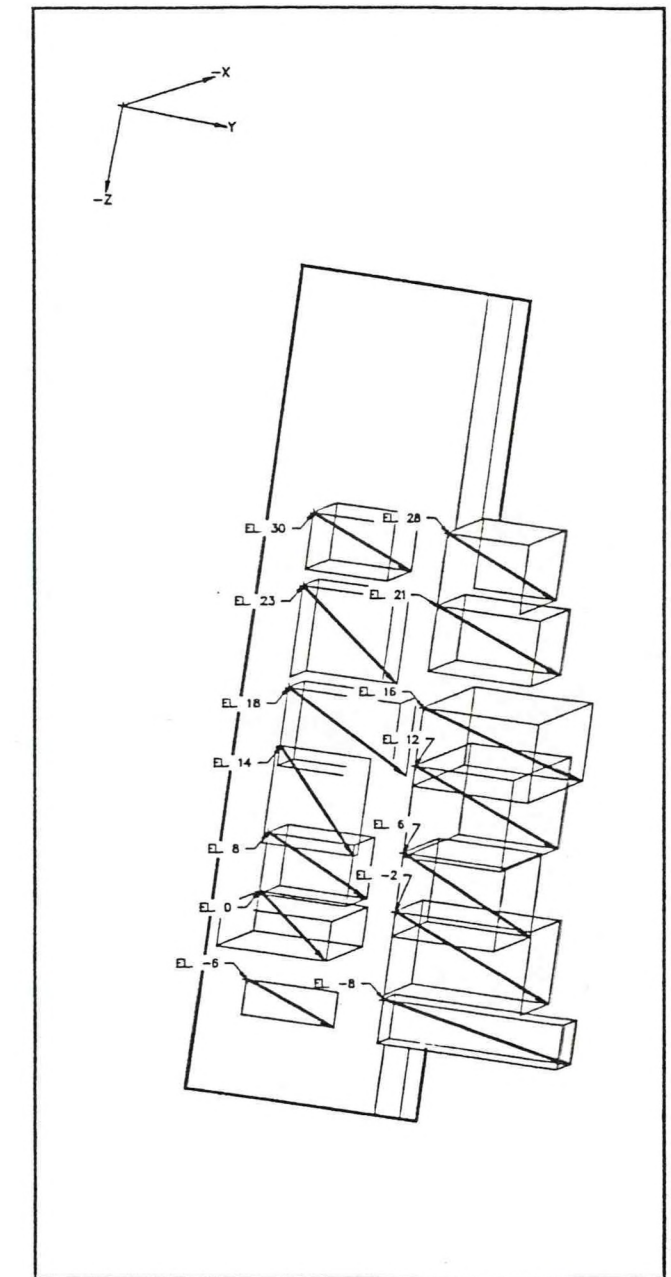
Q = 17500 CFS (76.5MW)



MEDIUM TURBINE LOAD

VELOCITIES 10' UPSTREAM OF TRASHRACK	ELEVATION	-5	0	8	14	18	24	30
	X	-0.60	0.60	-0.80	-1.10	-1.00	-1.30	-1.20
	Y	3.00	2.50	2.10	2.00	2.10	2.40	2.30
	Z	0.60	-0.50	-1.80	-0.90	-1.50	-2.20	-1.40
	RESULTANT	3.12	2.62	2.88	2.45	2.77	3.51	2.95
VELOCITIES 1' UPSTREAM OF TRASHRACK	ELEVATION	-7	-2	6	12	16	22	28
	X	-2.30	0.60	-1.40	-1.40	-1.10	-1.80	-1.40
	Y	4.90	3.90	3.10	3.10	3.40	2.60	2.60
	Z	0.40	-0.50	-2.90	-2.80	-2.70	-2.20	-1.70
	RESULTANT	5.43	3.98	4.47	4.41	4.48	3.85	3.41

Q = 15300 CFS (68MW)

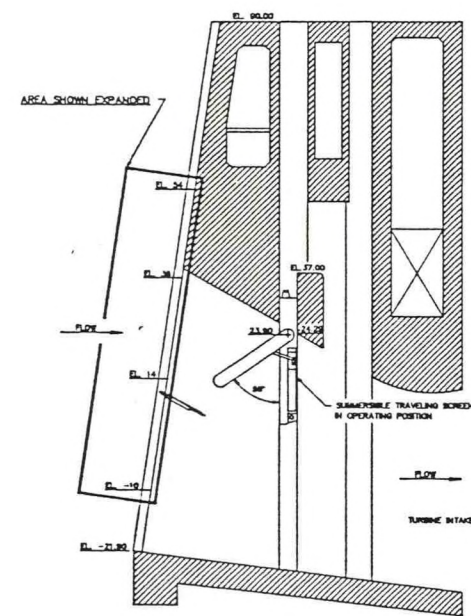


LOW TURBINE LOAD

VELOCITIES 10' UPSTREAM OF TRASHRACK	ELEVATION	-6	0	8	14	18	23	30
	X	0.00	0.90	-0.50	0.10	-0.40	-0.40	-0.60
	Y	2.10	2.50	2.00	2.10	2.60	2.10	1.90
	Z	-0.80	-0.90	-1.40	-2.20	-1.80	-2.10	-1.30
	RESULTANT	2.25	2.81	2.49	3.04	3.19	3.00	2.38
VELOCITIES 1' UPSTREAM OF TRASHRACK	ELEVATION	-8	-2	6	12	16	21	28
	X	-0.30	-0.70	-0.90	-1.40	-1.30	-0.70	-0.90
	Y	4.20	3.20	2.40	2.30	2.70	2.40	1.90
	Z	-1.00	-1.90	-1.90	-2.10	-1.80	-1.50	-1.60
	RESULTANT	4.33	3.79	3.19	3.41	3.50	2.92	2.64

Q = 13300 CFS (60MW)

Figure 6. Three-dimensional Velocity Vectors at Bonneville 2nd Powerhouse Turbine Bay 12B Trashrack Under High, Medium, and Low Turbine Loads with Units 11,12,13, and 17 Operating and Ceiling Extensions in place.

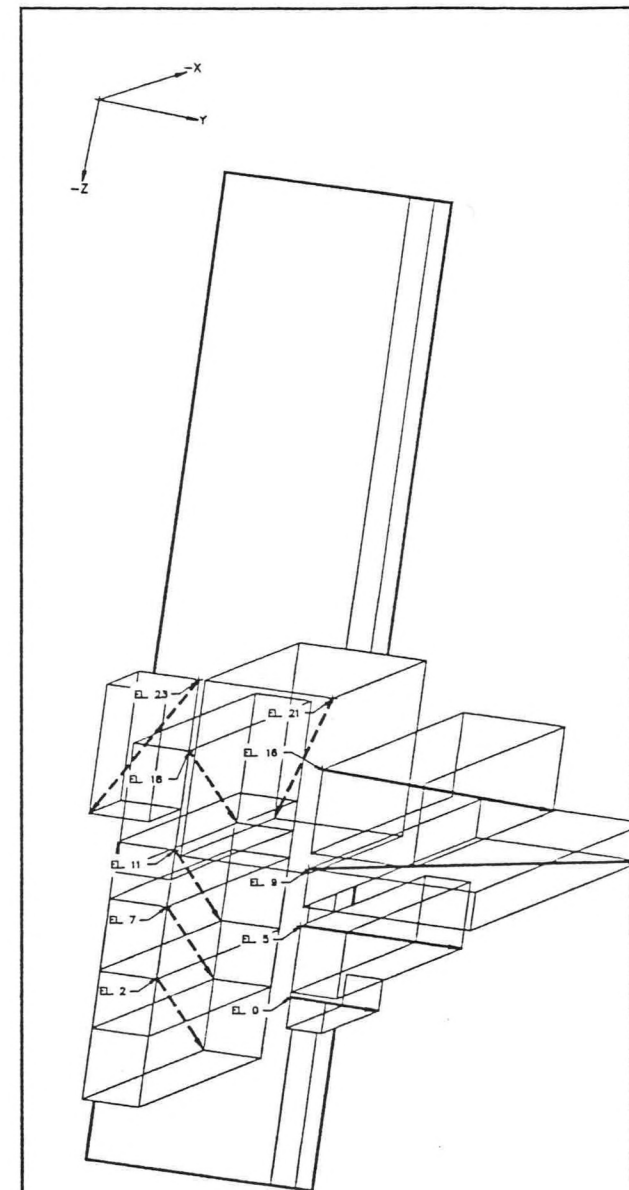


BONNEVILLE II POWERHOUSE INTAKE SECTION

0 5 10 15
FEET SCALE

NOTE: UNLESS OTHERWISE SPECIFIED

1. ALL VELOCITIES MEASURED IN FEET PER SECOND.
2. ALL ELEVATIONS AT MEAN SEA LEVEL.

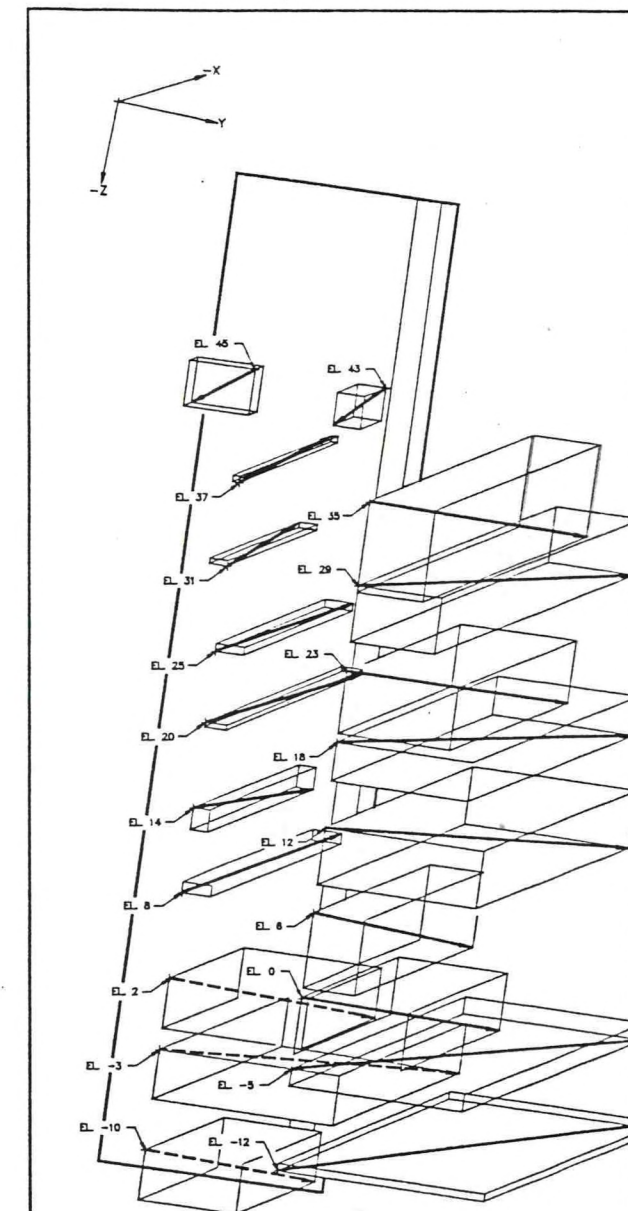


HIGH TURBINE LOAD

	ELEVATION	2	7	11	18	23
VELOCITIES 10' UPSTREAM OF TRASHRACK	X	-30.67*	-30.65*	-30.66*	-30.64*	8.05*
	Y	-1.34	-1.34	-1.35	-1.30	-1.42
	Z	-30.30*	-30.31*	-30.29*	-30.29*	-30.27*
	RESULTANT	43.13*	42.13*	43.12*	43.10*	31.35*
	ELEVATION	0	5	9	16	21
VELOCITIES 1' UPSTREAM OF TRASHRACK	X	-1.40	-3.12	-4.34	-3.54	-23.45*
	Y	0.83	1.07	3.92	2.39	-29.88*
	Z	-0.74	-1.56	-0.90	-1.97	-4.11
	RESULTANT	1.79	3.65	5.92	4.70	38.20*

* NOTE: THESE VELOCITY VECTORS ARE GRAPHICALLY REDUCED BY BOX THEIR RESULTANT IS NOTED BY A DASHED LINE. ALTHOUGH THIS DATA HAS BEEN RETAINED, ITS RELIABILITY IS UNKNOWN.

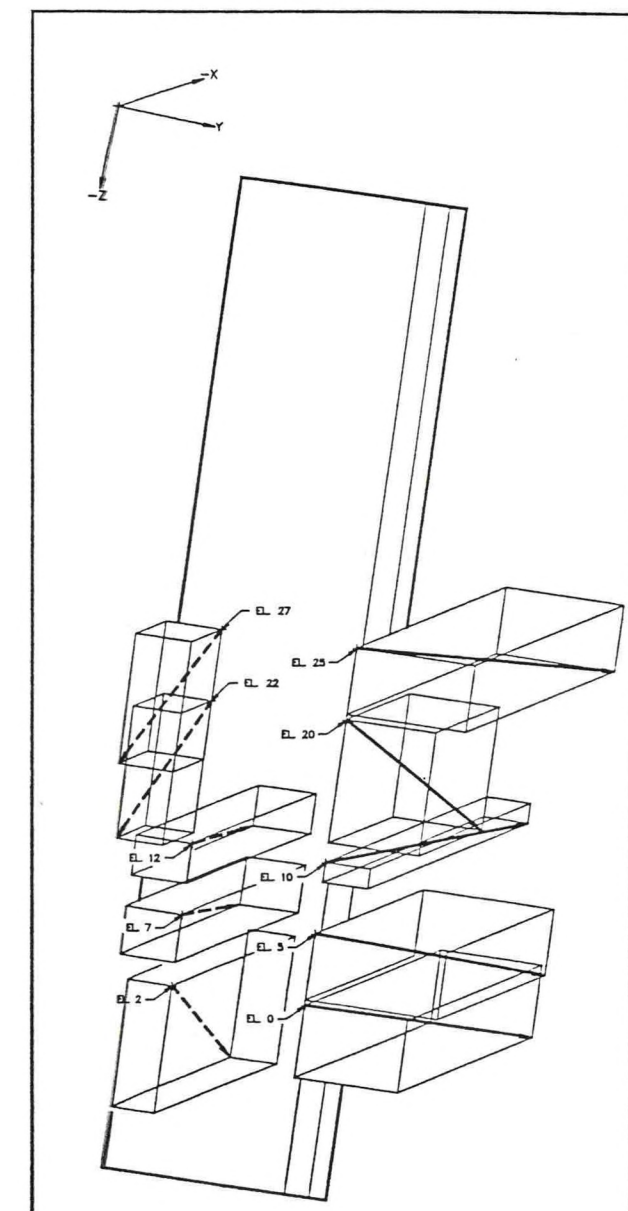
Q = 17500 CFS (76.5MW)



MEDIUM TURBINE LOAD

	ELEVATION	-10	-3	2	8	14	20	25	31	37	45
VELOCITIES 10' UPSTREAM OF TRASHRACK	X	-2.00	-3.28	-1.91	-3.31	-2.68	-3.48	-2.77	-2.28	-2.50	-0.21
	Y	2.31	4.29	3.30	0.70	0.41	0.51	0.68	-0.43	-0.18	-1.56
	Z	-11.58*	-11.59*	-11.70*	0.25	-0.52	-0.12	0.18	0.13	0.15	-1.08
	RESULTANT	11.98*	12.79*	12.31*	3.39	2.76	3.52	2.86	2.30	2.51	1.91
	ELEVATION	-12	-5	0	6	12	18	23	29	35	43
VELOCITIES 1' UPSTREAM OF TRASHRACK	X	-4.44	-4.50	-2.52	-3.02	-3.82	-4.13	-2.94	-4.99	-4.12	0.54
	Y	4.96	4.18	2.59	1.27	3.83	3.29	2.71	2.02	1.58	-0.67
	Z	0.17	-0.40	-1.34	-1.76	-1.35	-0.91	-1.47	-1.32	-2.16	-0.78
	RESULTANT	6.66	6.15	3.85	3.72	5.58	5.36	4.26	5.54	4.91	1.16

Q = 15300 CFS (68MW)



LOW TURBINE LOAD

	ELEVATION	2	7	12	22	27
VELOCITIES 10' UPSTREAM OF TRASHRACK	X	-31.06*	-31.07*	-31.24*	0.79	0.79
	Y	-1.07	-1.35	-1.33	-1.15	-1.34
	Z	-29.69*	-1.12	-0.94	-30.79*	-30.41*
	RESULTANT	42.98*	31.12*	31.28*	31.81*	31.45*
	ELEVATION	0	5	10	20	25
VELOCITIES 1' UPSTREAM OF TRASHRACK	X	-3.47	-2.76	-4.13	-1.62	-3.83
	Y	2.44	3.15	1.06	2.16	2.86
	Z	-1.68	-1.54	-0.47	-2.87	-1.56
	RESULTANT	4.56	4.46	4.29	3.94	5.03

Q = 13300 CFS (60MW)

Figure 7. Three-dimensional Velocity Vectors at Bonneville 2nd Powerhouse Turbine Bay 12B Trashrack Under High, Medium, and Low Turbine Loads with Units 11-18 Operating.

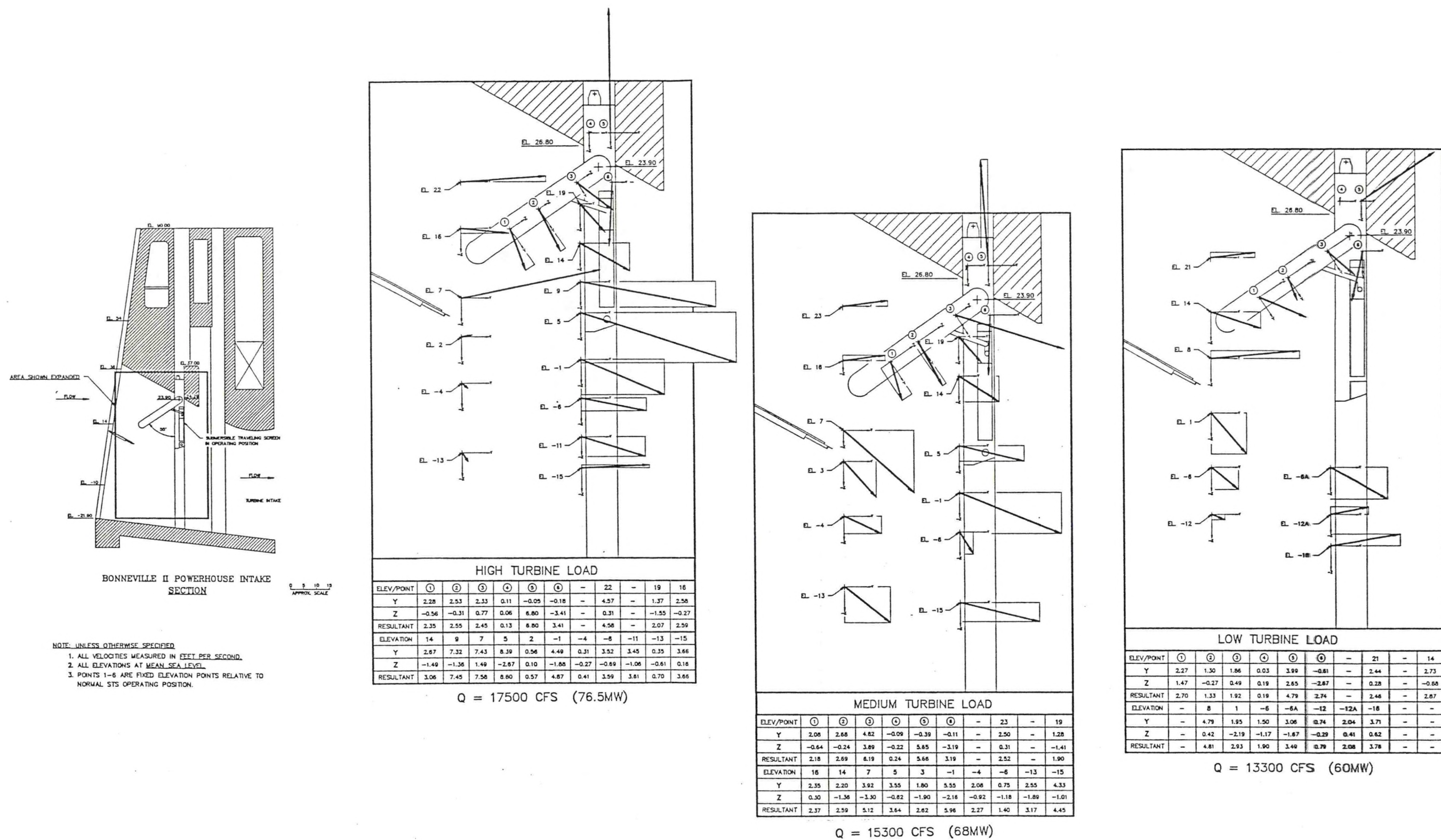
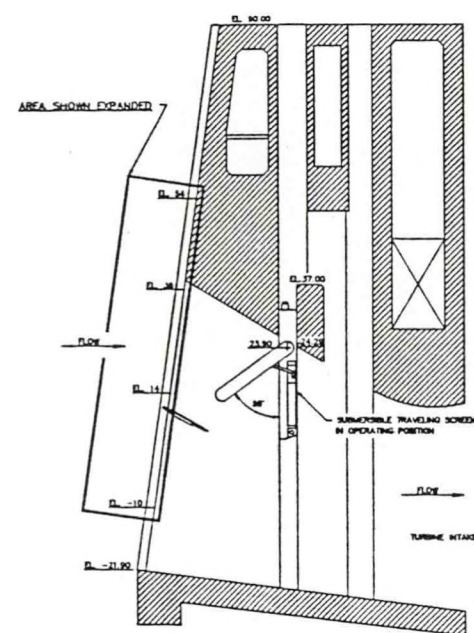


Figure 8. Two-dimensional Velocity Vectors at Bonneville 2nd Powerhouse Turbine Bay 12B Intake Under High, Medium, and Low Turbine Loads with Units 11-18 Operating.



BONNEVILLE II POWERHOUSE INTAKE SECTION

0 3 10 15
APPROX. SCALE

NOTE: UNLESS OTHERWISE SPECIFIED

1. ALL VELOCITIES MEASURED IN FEET PER SECOND.
2. ALL ELEVATIONS AT MEAN SEA LEVEL.

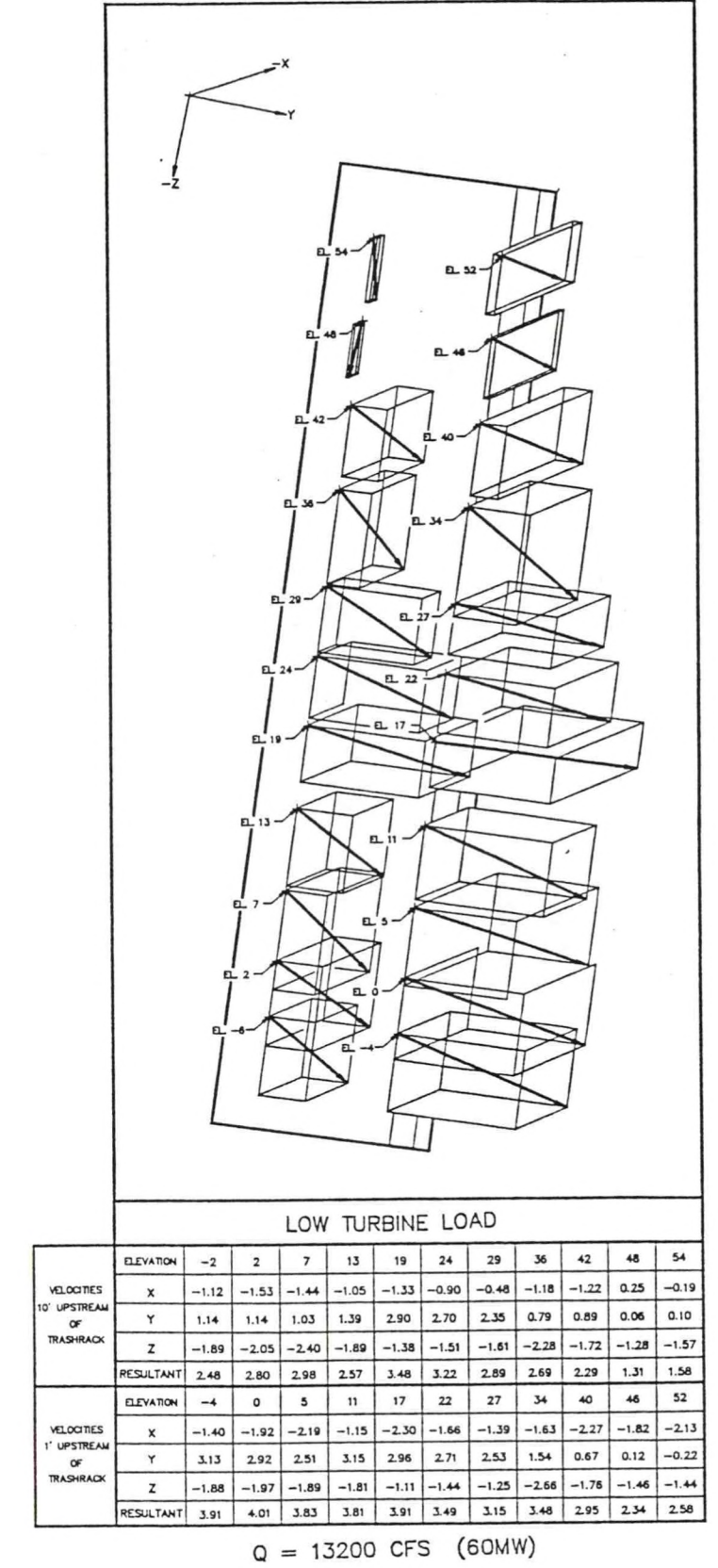
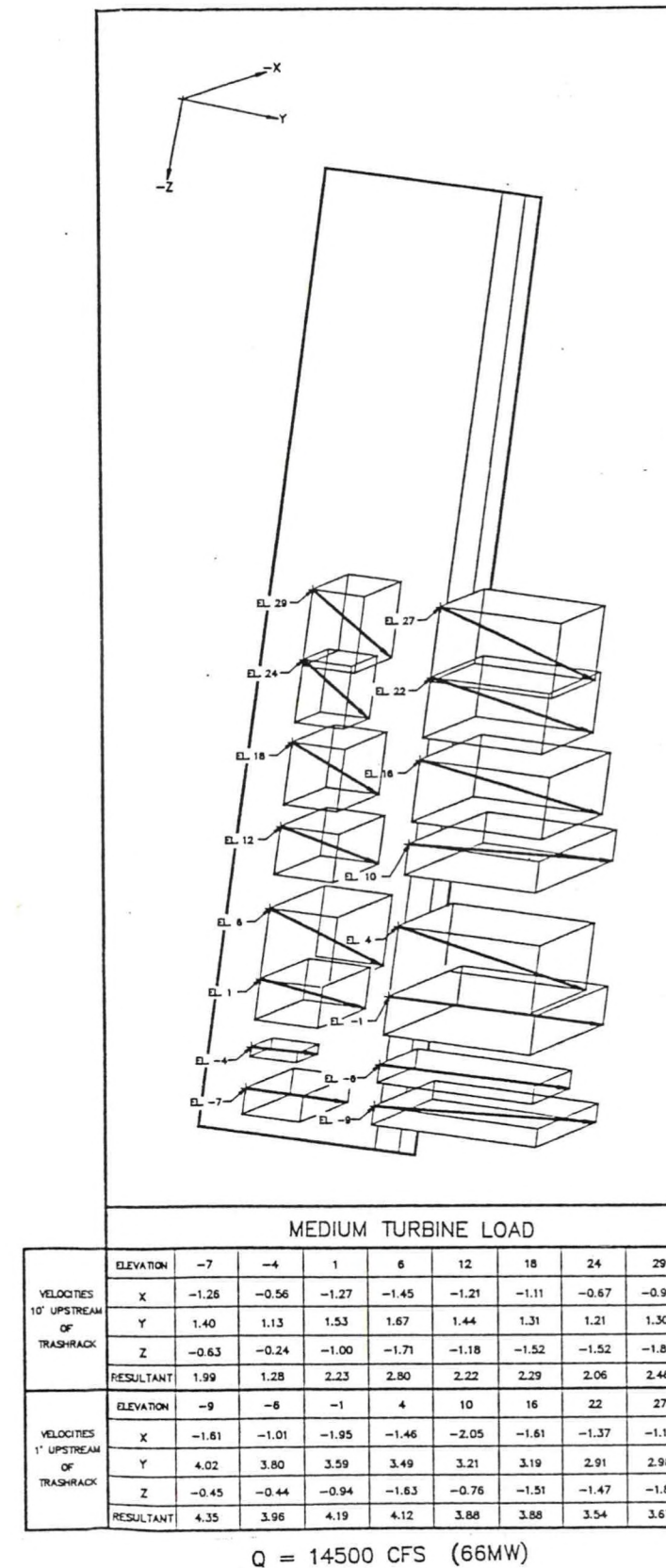
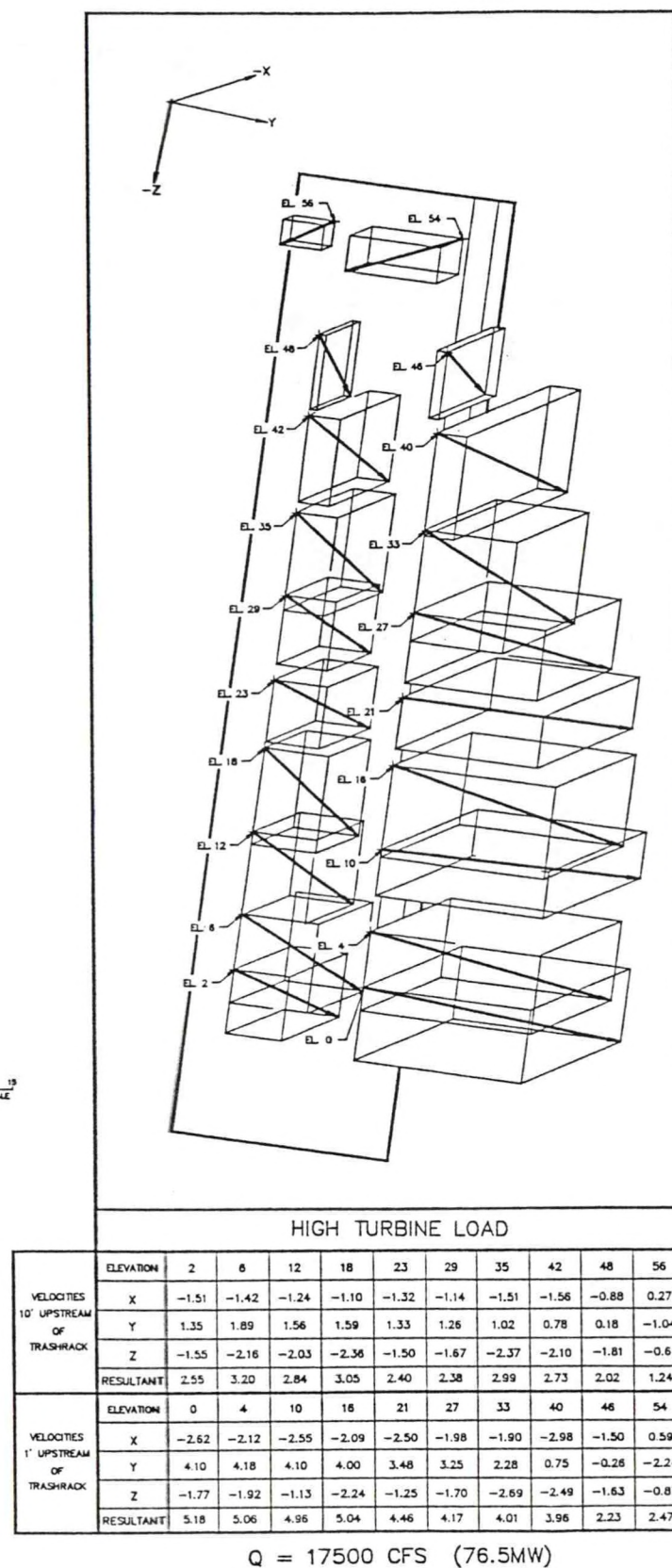
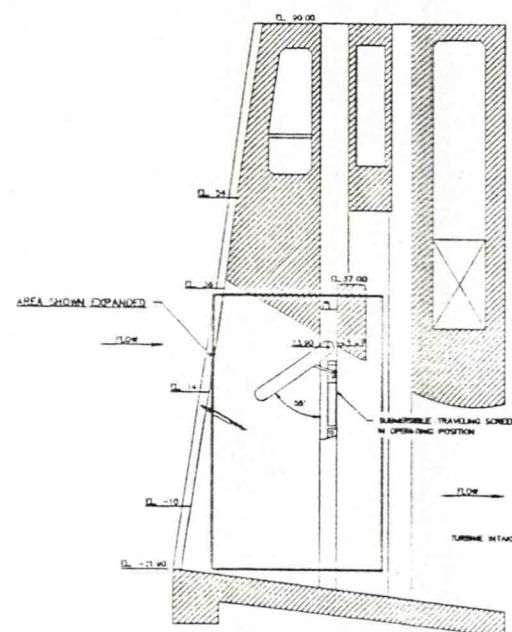


Figure 9. Three-dimensional Velocity Vectors at Bonneville 2nd Powerhouse Turbine Bay 12B Trashrack Under High, Medium, and Low Turbine Loads with Units 11,12,13,15, and 18 Operating.

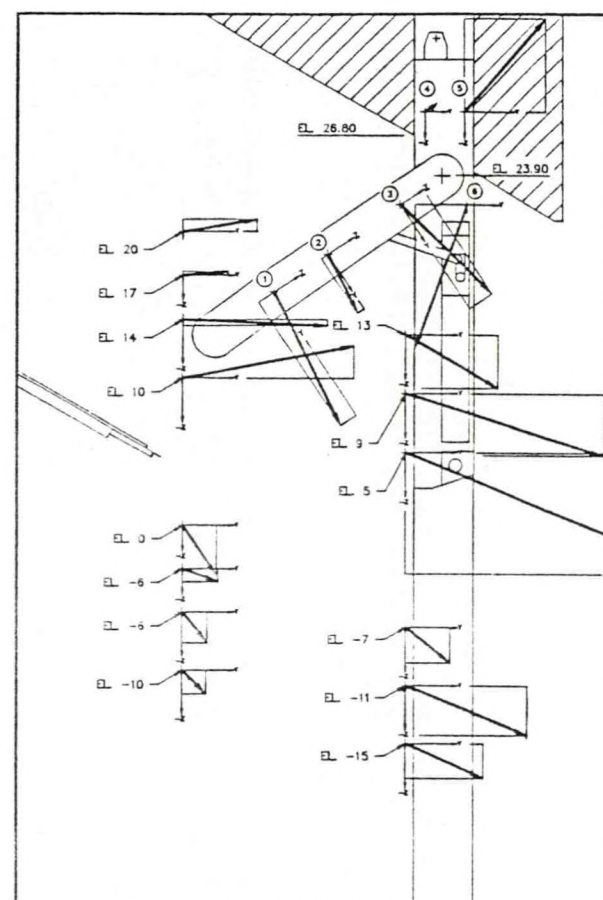


BONNEVILLE II POWERHOUSE INTAKE
SECTION

2 1 10 15
APPROX. SCALE

NOTE: UNLESS OTHERWISE SPECIFIED

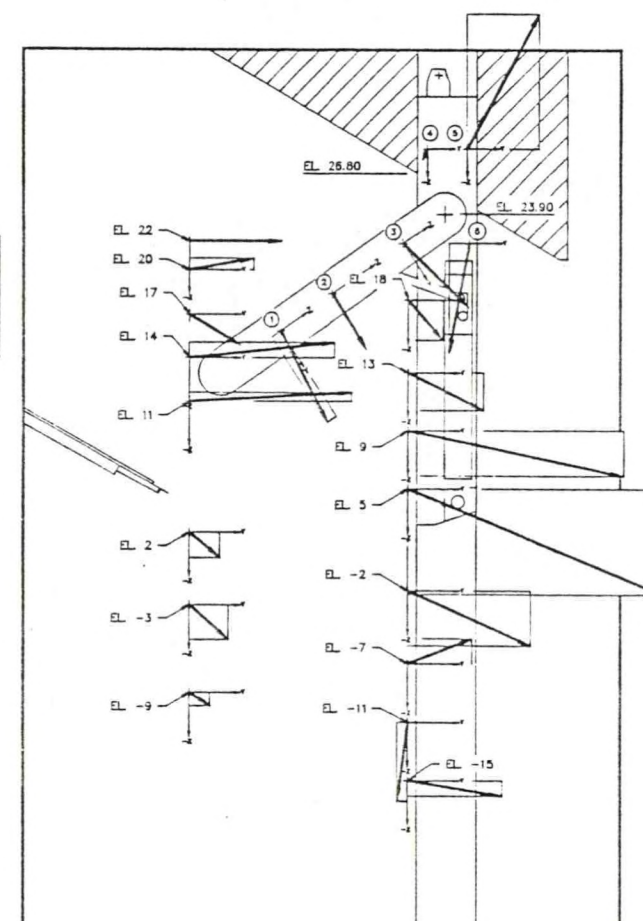
1. ALL VELOCITIES MEASURED IN FEET PER SECOND.
2. ALL ELEVATIONS AT MEAN SEA LEVEL.
3. POINTS 1-6 ARE FIXED ELEVATION POINTS RELATIVE TO NORMAL STS OPERATING POSITION.



HIGH TURBINE LOAD

ELEV/POINT	①	②	③	④	⑤	⑥	20	17	14	13
Y	4.17	1.85	2.54	0.31	2.39	-1.47	2.17	1.28	4.16	2.65
Z	-0.53	-0.22	0.78	0.23	2.65	-4.04	0.54	0.11	-0.18	-1.51
RESULTANT	4.20	1.86	3.82	0.39	3.57	4.30	2.20	1.28	4.16	3.05
ELEVATION	10	9	5	0	-3	-6	-7	-10	-11	-15
Y	4.92	5.72	8.65	0.95	0.99	0.69	1.27	0.66	3.52	2.23
Z	0.91	-1.74	-3.43	-1.45	-0.38	-0.88	-1.01	-0.68	-1.41	-0.98
RESULTANT	5.00	5.98	9.31	1.73	1.06	1.12	1.62	0.95	3.79	2.44

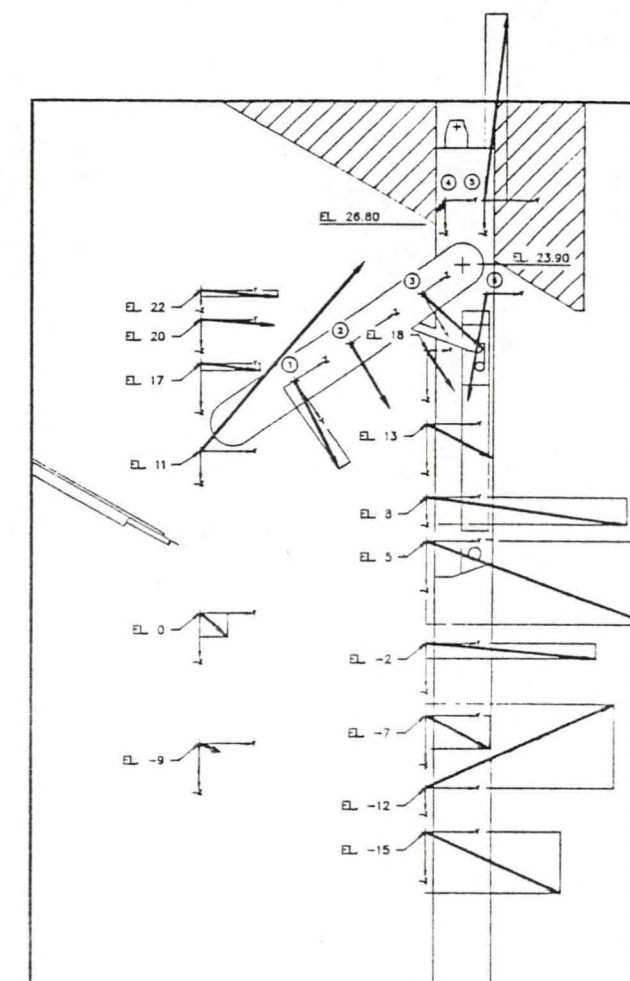
Q = 17500 CFS (76.5MW)



MEDIUM TURBINE LOAD

ELEV/POINT	①	②	③	④	⑤	⑥	22	20	18	17	14
Y	2.94	1.86	2.55	-0.13	2.07	-0.57	2.67	1.85	0.99	1.47	4.23
Z	-0.32	-0.08	0.55	-0.30	3.81	-3.09	0.00	0.33	-1.14	-0.88	0.44
RESULTANT	2.96	1.86	2.61	0.33	4.34	3.14	2.67	1.86	1.51	1.71	4.25
ELEVATION	13	11	9	5	2	-2	-3	-7	-9	-11	-15
Y	2.15	4.74	6.21	7.34	0.89	3.51	1.13	1.83	0.60	-0.31	2.69
Z	-1.07	0.28	-1.28	-2.99	-0.73	-1.56	-0.99	0.71	-0.38	-2.24	-0.44
RESULTANT	2.40	4.75	6.34	7.93	1.15	3.84	1.50	1.96	0.71	2.26	2.73

Q = 14500 CFS (66MW)

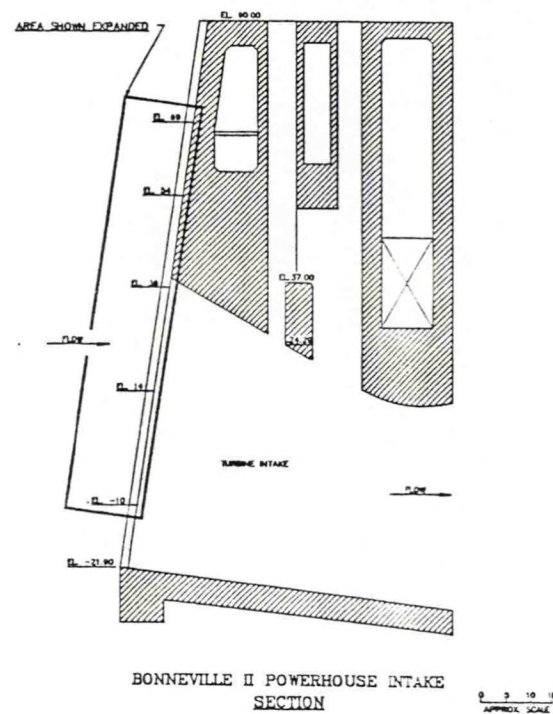


LOW TURBINE LOAD

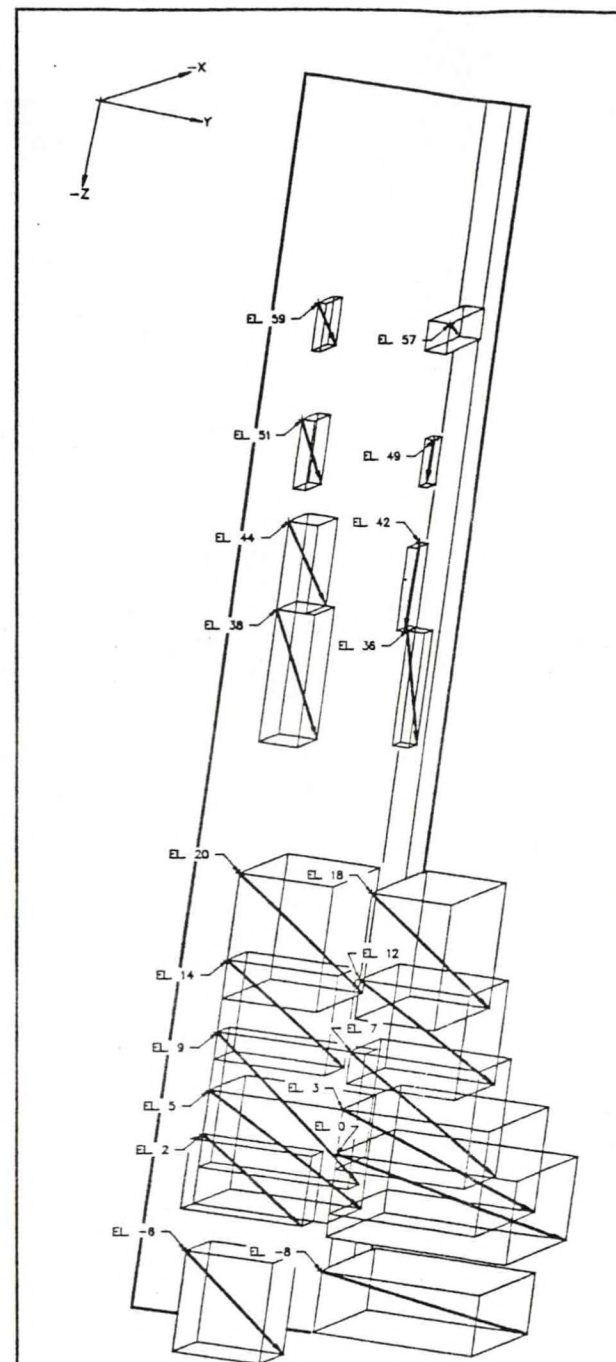
ELEV/POINT	①	②	③	④	⑤	⑥	22	20	18	17
Y	2.75	2.13	2.35	-0.24	0.64	-0.52	2.19	2.09	0.83	1.70
Z	-0.37	-0.10	0.65	-0.33	3.28	-3.00	-0.19	-0.16	-1.14	-0.21
RESULTANT	2.77	2.13	2.44	0.41	5.32	3.04	2.20	2.10	1.41	1.71
ELEVATION	13	11	9	5	0	-2	-7	-9	-12	-15
Y	1.94	4.57	5.80	5.57	0.79	4.94	1.90	0.57	3.47	3.95
Z	-0.97	3.37	-0.76	-2.35	-0.68	-0.43	-0.94	-0.24	2.40	-1.74
RESULTANT	2.17	7.05	5.85	5.98	1.04	4.96	2.12	0.62	3.97	4.32

Q = 13300 CFS (60MW)

Figure 10. Two-dimensional Velocity Vectors at Bonneville 2nd Powerhouse Turbine Bay 12B Intake Under High, Medium, and Low Turbine Loads with Units 11,12,13,15, and 18 Operating.



NOTE: UNLESS OTHERWISE SPECIFIED
 1. ALL VELOCITIES MEASURED IN FEET PER SECOND.
 2. ALL ELEVATIONS AT MEAN SEA LEVEL.

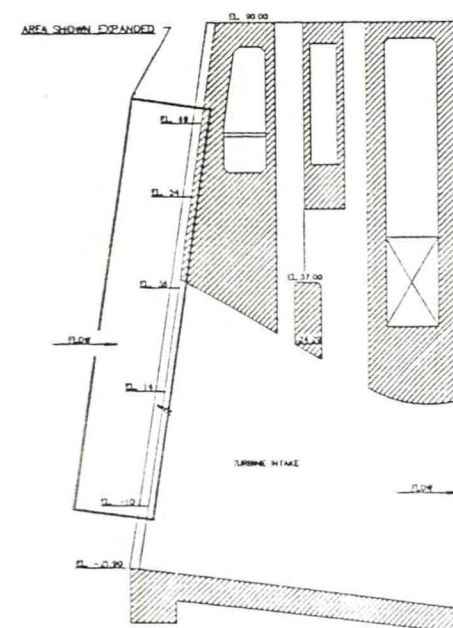


HIGH TURBINE LOAD

VELOCITIES 10' UPSTREAM OF TRASHRACK	ELEVATION	-8	0	3	7	12	18	36	42	49	57
	X	-1.40	-1.50	-1.50	-0.80	-1.00	-1.40	-0.20	0.30	-0.20	-0.90
	Y	3.80	4.30	3.50	3.10	2.60	1.90	0.40	0.20	-0.20	-0.50
	Z	-1.40	-1.90	-2.40	-2.70	-2.40	-2.90	-2.60	-1.90	-1.10	-0.70
	RESULTANT	4.28	4.93	4.50	4.19	3.68	3.74	2.64	1.93	1.14	1.24
VELOCITIES 1' UPSTREAM OF TRASHRACK	ELEVATION	-6	2	5	9	14	20	38	44	51	59
	X	-0.60	0.30	-0.90	-0.30	-0.50	-1.20	-0.50	-0.50	-0.40	-0.40
	Y	2.00	2.80	3.10	3.50	2.60	2.20	0.90	0.70	0.30	0.20
	Z	-2.30	-1.60	-2.60	-3.10	-2.30	-2.90	-3.00	-2.00	-1.60	-1.10
	RESULTANT	3.11	3.24	4.14	4.69	3.51	3.83	3.17	2.18	1.68	1.19

Q = 13300 CFS (60MW)

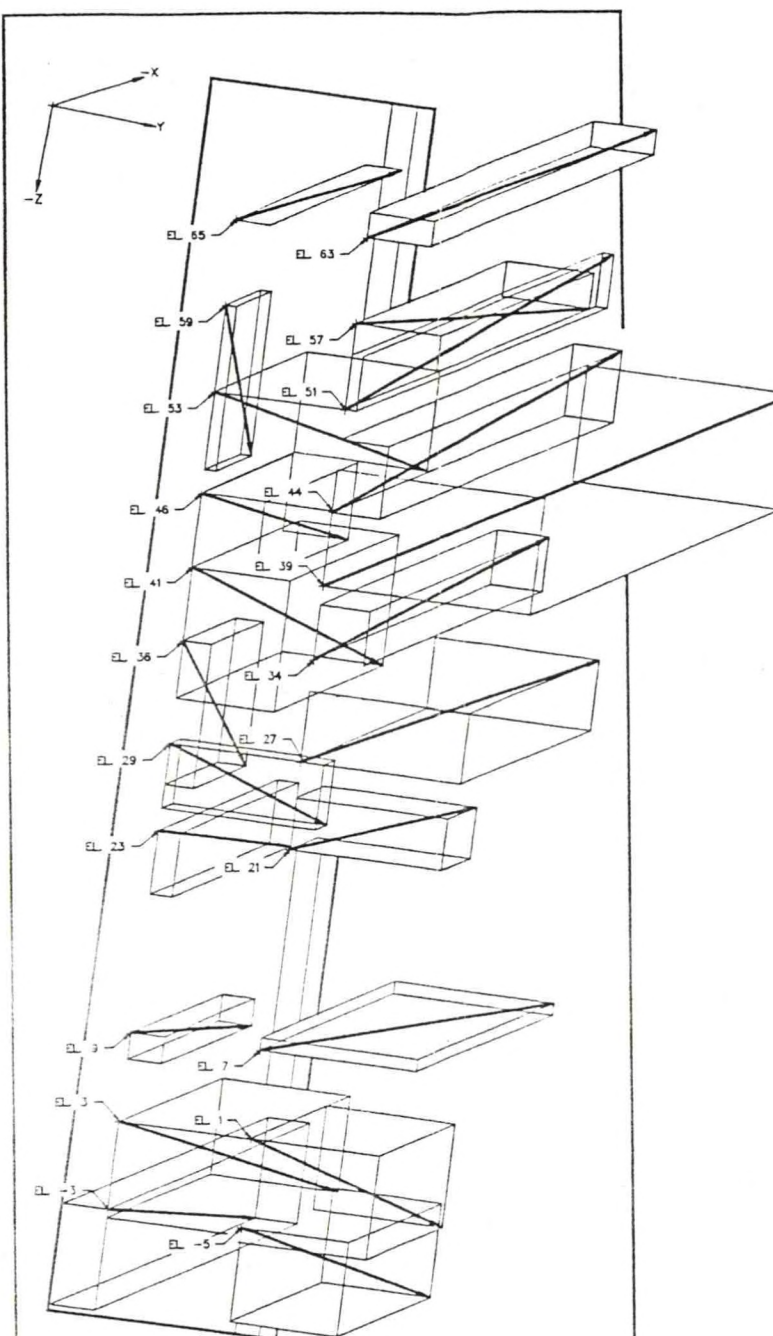
Figure 11. Three-dimensional Velocity Vectors at Bonneville 2nd Powerhouse Turbine Bay 15B Trashrack Under High Turbine Load with Units 11-18 Operating.



BONNEVILLE II POWERHOUSE INTAKE SECTION

0 1 2 3
FEET SCALE

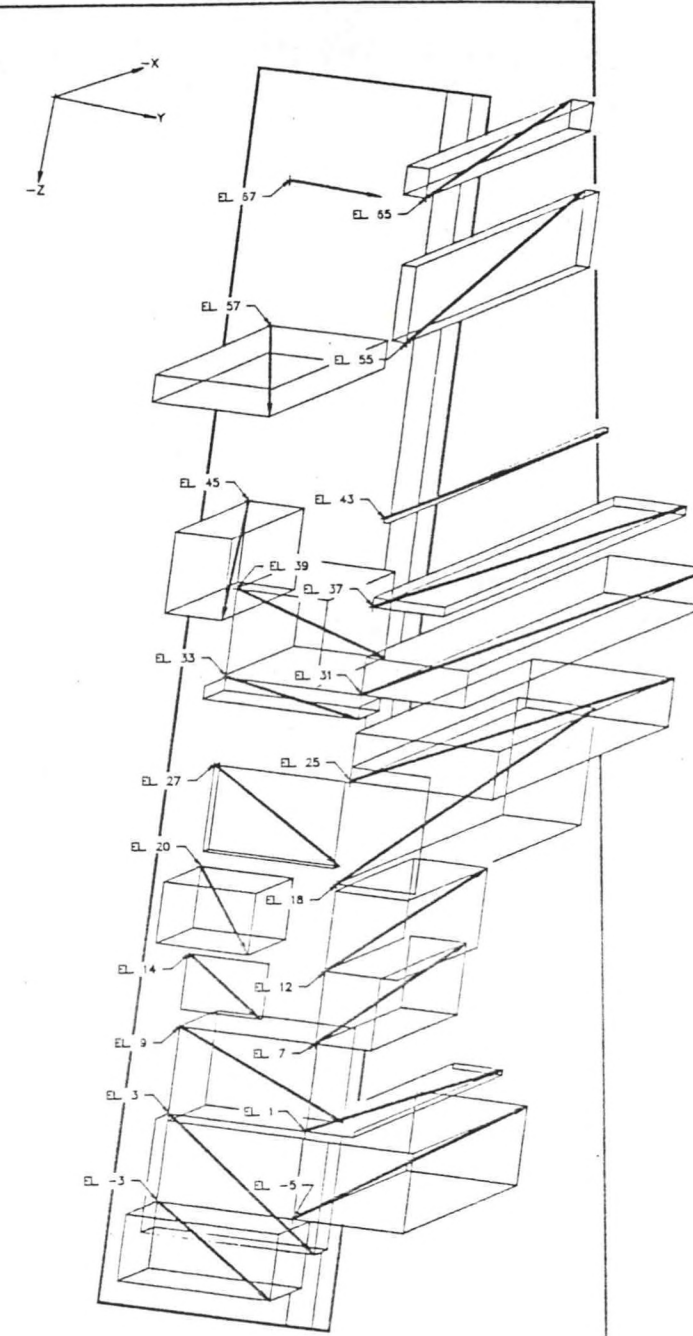
NOTE: UNLESS OTHERWISE SPECIFIED
1. ALL VELOCITIES MEASURED IN FEET PER SECOND.
2. ALL ELEVATIONS AT MEAN SEA LEVEL.



HIGH TURBINE LOAD

	ELEVATION	-3	3	9	23	29	36	41	46	53	59	65
VELOCITIES 10' UPSTREAM OF TRASHRACK	X	-5.11	-2.58	-2.29	-3.05	-0.28	-1.35	-2.76	-2.36	-2.39	-0.92	-3.33
	Y	-1.00	3.05	0.78	0.51	3.67	0.67	2.35	1.53	3.13	0.27	0.84
	Z	-2.30	-2.20	-0.62	-1.46	-1.49	-3.28	-2.97	-1.75	-2.31	-3.79	-0.03
	RESULTANT	5.69	4.56	2.50	3.42	3.97	3.61	4.69	3.31	4.57	3.91	3.43
	ELEVATION	-5	1	7	21	27	34	39	44	51	57	63
VELOCITIES 1' UPSTREAM OF TRASHRACK	X	-2.35	-1.94	-3.39	-0.72	-3.19	-4.45	-6.24	-5.79	-6.24	-3.77	-5.55
	Y	2.55	3.04	3.69	3.59	3.77	1.17	4.82	1.13	0.27	1.99	1.49
	Z	-2.15	-2.37	0.28	1.18	1.61	1.24	2.64	1.65	1.25	-0.82	0.58
	RESULTANT	4.08	4.32	5.02	3.85	5.19	4.77	8.32	6.13	6.37	4.34	5.78

Q = 17500 CFS (76.5MW)

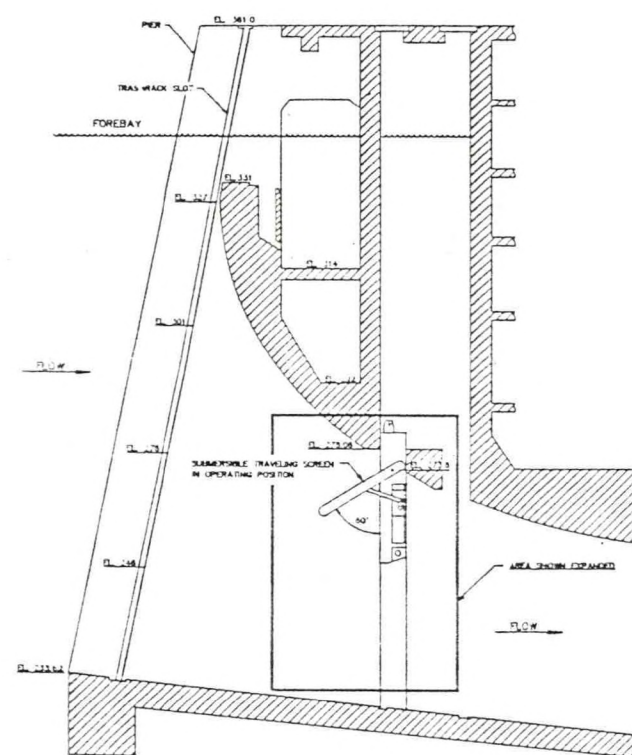


MEDIUM TURBINE LOAD

	ELEVATION	-3	3	9	15	20	27	33	39	45	57	67
VELOCITIES 10' UPSTREAM OF TRASHRACK	X	0.76	0.32	-0.94	0.04	0.91	-0.14	0.52	-1.69	1.80	2.85	-0.02
	Y	3.51	3.99	3.17	1.84	2.12	3.01	3.58	2.09	1.29	2.70	2.10
	Z	-1.52	-2.58	-2.17	-1.26	-1.41	-2.00	-0.30	-1.95	-1.85	-0.63	-0.12
	RESULTANT	3.90	4.76	3.95	2.23	2.70	3.62	3.63	3.32	2.89	3.98	2.10
	ELEVATION	-5	1	7	12	18	25	31	37	43	55	65
VELOCITIES 1' UPSTREAM OF TRASHRACK	X	-2.83	-3.69	-2.13	-1.96	-4.14	-4.37	-6.07	-6.02	-5.47	-4.56	-4.09
	Y	2.55	1.14	1.28	1.68	1.82	3.30	2.36	1.64	0.12	-0.33	-0.51
	Z	1.81	0.12	1.64	1.83	2.68	1.11	0.84	0.21	-0.09	1.75	0.67
	RESULTANT	4.22	3.86	2.98	3.16	5.26	5.59	6.57	6.24	5.47	4.90	4.18

Q = 15300 CFS (68MW)

Figure 12. Three-dimensional Velocity Vectors at Bonneville 2nd Powerhouse Turbine Bay 12B Trashrack Under High and Medium Turbine Loads with Units 11-18 Operating. No Travelling Screen in 12B.

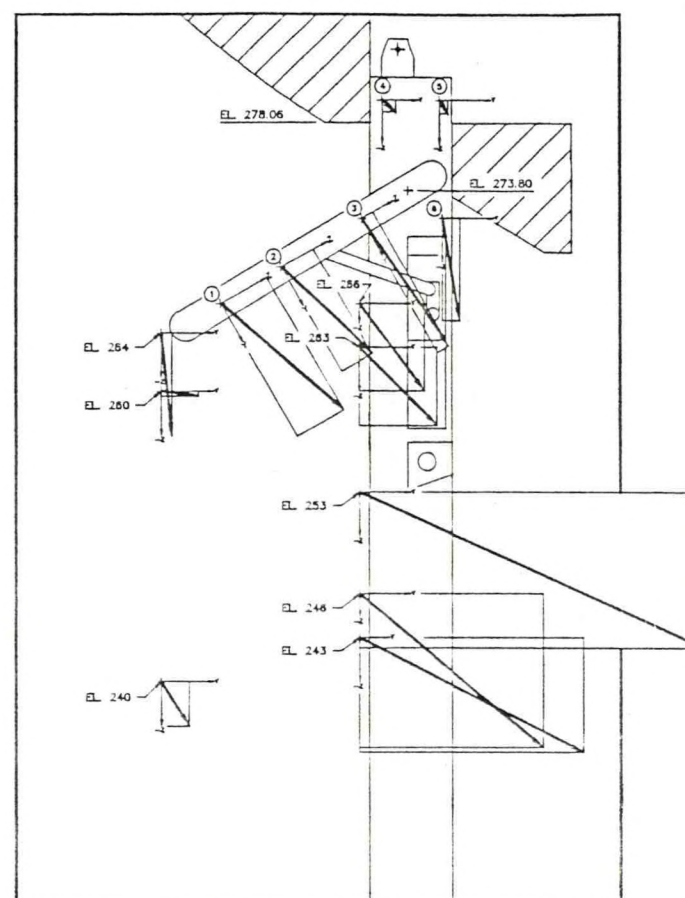


McNARY POWERHOUSE INTAKE
SECTION

0 5 10 15
FEET SCALE

NOTE: UNLESS OTHERWISE SPECIFIED

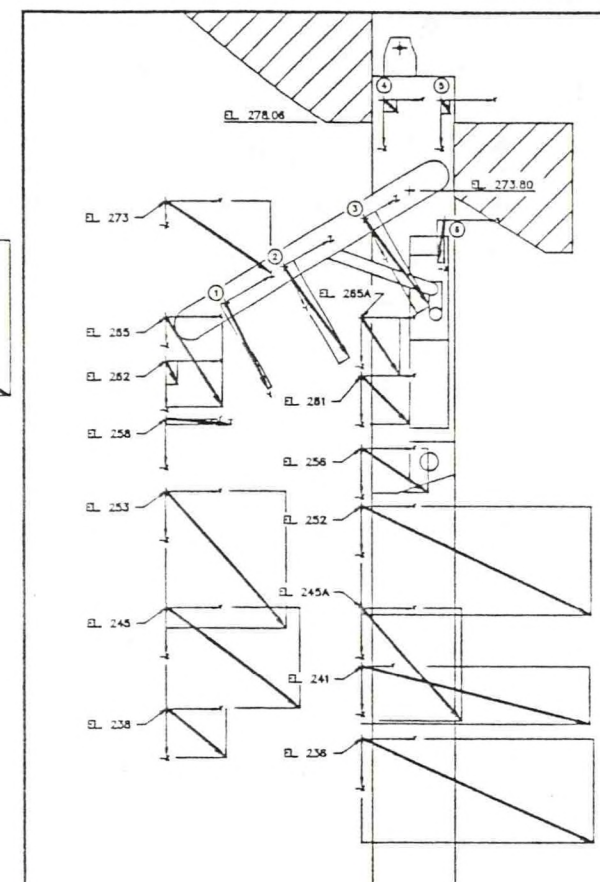
1. ALL VELOCITIES MEASURED IN FEET PER SECOND.
2. ALL ELEVATIONS AT MEAN SEA LEVEL.
3. POINTS 1-6 ARE FIXED ELEVATION POINTS RELATIVE TO NORMAL STS OPERATING POSITION.



HIGH TURBINE LOAD

ELEV/POINT	①	②	③	④	⑤	⑥	268
Y	4.35	3.42	4.40	3.39	0.25	0.51	1.88
Z	1.51	1.03	0.38	-0.35	-0.39	-2.92	-2.48
RESULTANT	4.60	3.57	4.42	0.52	0.46	2.96	3.11
ELEVATION	264	263*	260	253	246	243	240
Y	0.30	2.25	1.03	9.92	5.29	8.48	0.78
Z	-2.94	-2.22	-0.15	-4.41	-4.37	-3.25	-1.28
RESULTANT	2.98	3.18	1.04	10.86	8.68	7.23	1.50

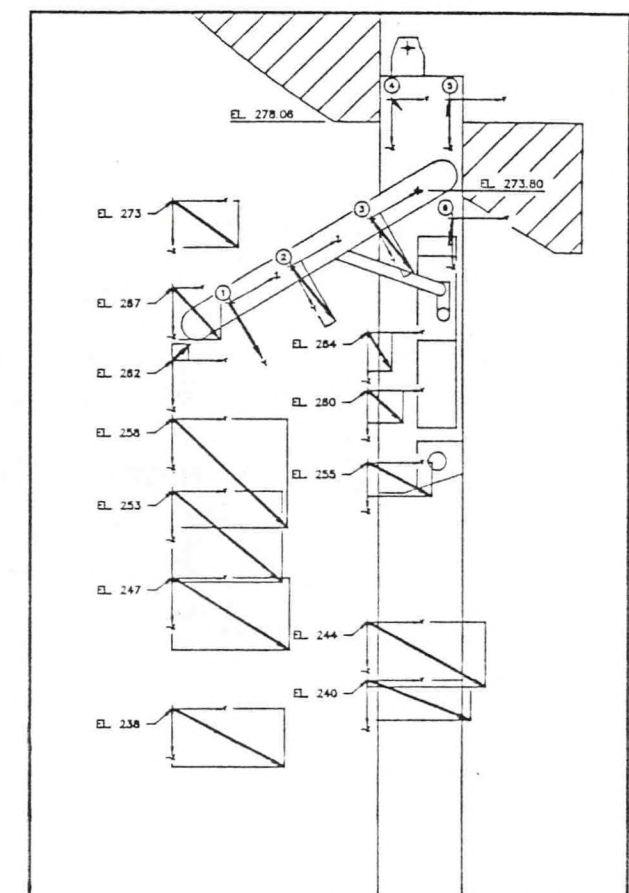
Q = 15900 CFS (80 MW)



MEDIUM TURBINE LOAD

ELEV/POINT	①	②	③	④	⑤	⑥	-	273	-	265	255A
Y	2.75	3.18	3.12	0.39	0.25	-0.21	-	3.03	-	1.63	1.14
Z	-0.14	0.35	0.42	-0.35	-0.39	-1.22	-	-2.04	-	-2.54	-1.84
RESULTANT	2.75	3.20	3.15	0.52	0.46	1.24	-	3.65	-	3.02	2.00
ELEVATION	262	261	258	256	253	252	245	245A	241	238	236
Y	0.36	1.43	1.06	1.95	3.48	8.66	3.68	2.91	6.62	1.71	8.73
Z	-0.66	-1.37	-0.18	-1.25	-3.88	-3.07	-2.86	-3.20	-1.64	-1.37	-2.92
RESULTANT	0.75	1.98	1.87	2.32	5.21	7.33	4.82	4.33	8.82	2.19	7.34

Q = 11100 CFS (60 MW)



LOW TURBINE LOAD

ELEV/POINT	①	②	③	④	⑤	⑥	-	273	-	267
Y	1.81	1.98	1.93	0.23	-0.08	-0.11	-	1.93	-	1.42
Z	0.03	0.35	0.32	-0.27	-0.48	-0.78	-	-1.32	-	-1.46
RESULTANT	1.81	2.01	1.96	0.35	0.47	0.77	-	2.34	-	2.04
ELEVATION	264	262	260	258	255	253	247	244	240	238
Y	0.70	0.49	1.02	3.33	1.83	3.18	3.39	3.38	2.97	3.25
Z	-1.10	0.48	-0.93	-3.10	-0.96	-2.59	-2.04	-1.84	-1.14	-1.66
RESULTANT	1.30	0.69	1.38	4.55	2.07	4.10	3.96	3.65	3.18	3.65

Q = 7500 CFS (40 MW)

Figure 14. Two-dimensional Velocity Vectors at McNary Powerhouse Turbine Bay 5B Intake Under High, Medium, and Low Turbine Loads with Units 1-11 Operating.

represent the pooled averages of a series of readings, and where repeated readings were made without movement of the movable sensors, these were also pooled.

The flows in front of the trashrack are represented as the resultant vector of the 3-dimensional Cartesian coordinate system, and those within the turbine intake are shown in a 2-dimensional format. Only vertical and longitudinal flows were measured within the intake, as transverse flows were limited to the effects of turbulence because the intake walls prevented any net lateral flow. Flows into the turbine are represented by the Y axis, with downstream flow being a positive sign. Transverse flows across the face of the dam are represented by the X axis, with flows to the right (when facing downstream) being a positive sign. Vertical flows are represented by the Z axis, with upward flows being positive. These flow components are represented as the edges of a box, with their resultant or observed flow indicated as the diagonal.

When the velocity patterns at the trashracks of the three dams are compared, a definite difference is apparent in the pattern of velocities. McNary and Bonneville 1st powerhouses, where FGEs >70% have been measured, showed very little transverse flow even at high turbine loads whereas at Turbine 12B of the Bonneville 2nd Powerhouse, where FGE is only 20 to 30%, the transverse flows were severe, and erratic flows and vortices were common. At Turbine 15B of the Bonneville 2nd Powerhouse, the transverse flows were present to a lesser degree than at Turbine 12B. The flow through the forebay of this powerhouse appears to be nearly straight to this turbine, at which point it divides and flows to both shores, with the major flow going to the south, creating the strong transverse flows across the face of the other turbine intakes.

Another reason for lower FGE at Bonneville 2nd Powerhouse may be the 2.3-2.5 ft/s velocities measured behind the STS (Fig. 8), compared to 3.4-3.5 ft/s at Bonneville 1st Powerhouse (Fig. 5) and 3.4-4.4 ft/s at McNary (Fig. 14). Lower FGE probably results when an STS is of lower porosity because more water and fish are deflected under the STS.

In addition to the 15-s measurements, velocity measurements were taken at 1-s intervals for an additional 30 min under each of the turbine test conditions. There is frequently a wide difference in the average velocity values derived from the 15-s test and the 30-min tests, indicating that 15 s is probably not sufficient time to obtain a representative velocity. Several of the 30-min series plots of velocity vs time for selected probes are shown in Figures 15-19. The standard measurements were taken during the initial 15 s of these series and obviously do not accurately represent the average flow conditions at that time and location. Although not all cases are as striking as these, they clearly indicate that the flows are often not stable, and that the accuracy of the velocity measured could vary greatly depending upon the time at which a 15-s measurement was taken.

The data from each of the tests are summarized in Appendix A.

A number of concerns were raised about the validity of some of the velocity measurements because of the differences between the measured values and those anticipated. These concerns are as follows:

- 1) Under some conditions, velocities of over 30 ft/s were indicated, with a sudden shift in direction to the opposite sign. The meters used were calibrated to measure from -10 to +10 ft/s. The manufacturer's engineering department checked their design to verify whether or not the equipment was capable of measuring higher velocities. They determined that it was

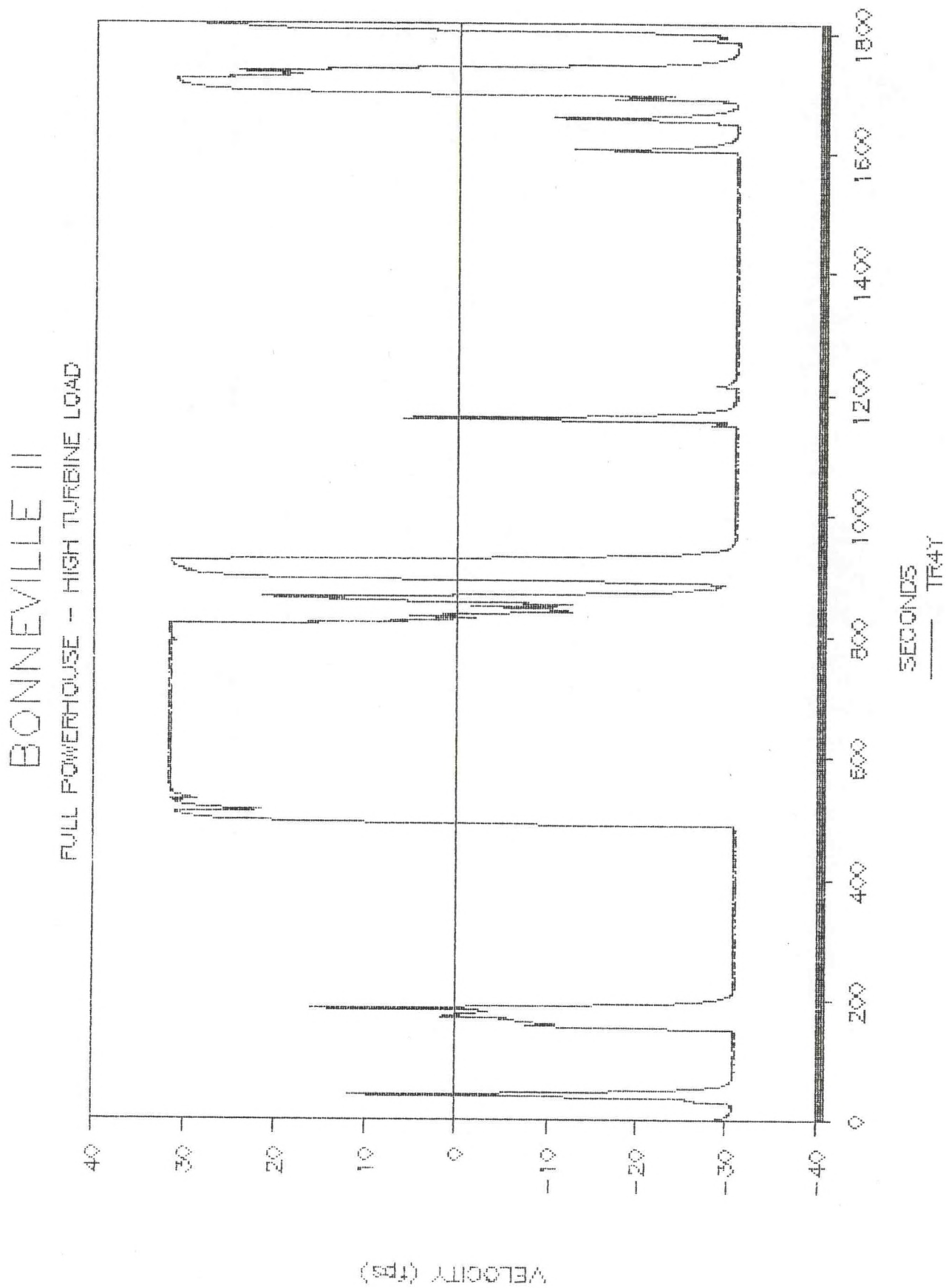


Figure 15. An example of variable velocities encountered at the trashrack of Turbine 12B. Longitudinal Flows.

BONNEVILLE II

FULL POWERHOUSE - HIGH TURBINE LOAD

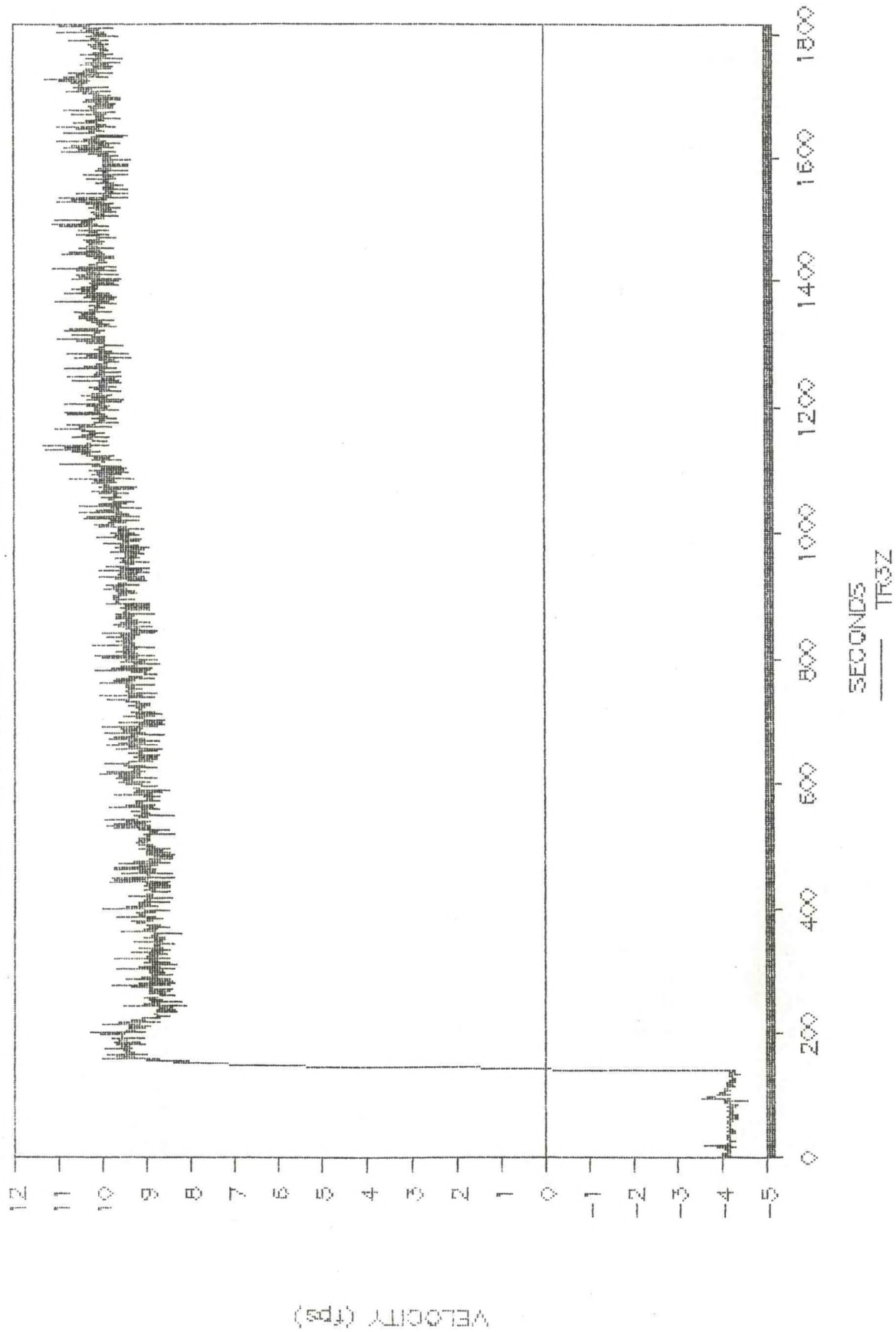


Figure 16. An example of variable velocities measured at the trashrack of Turbine 12B. Vertical Flows.

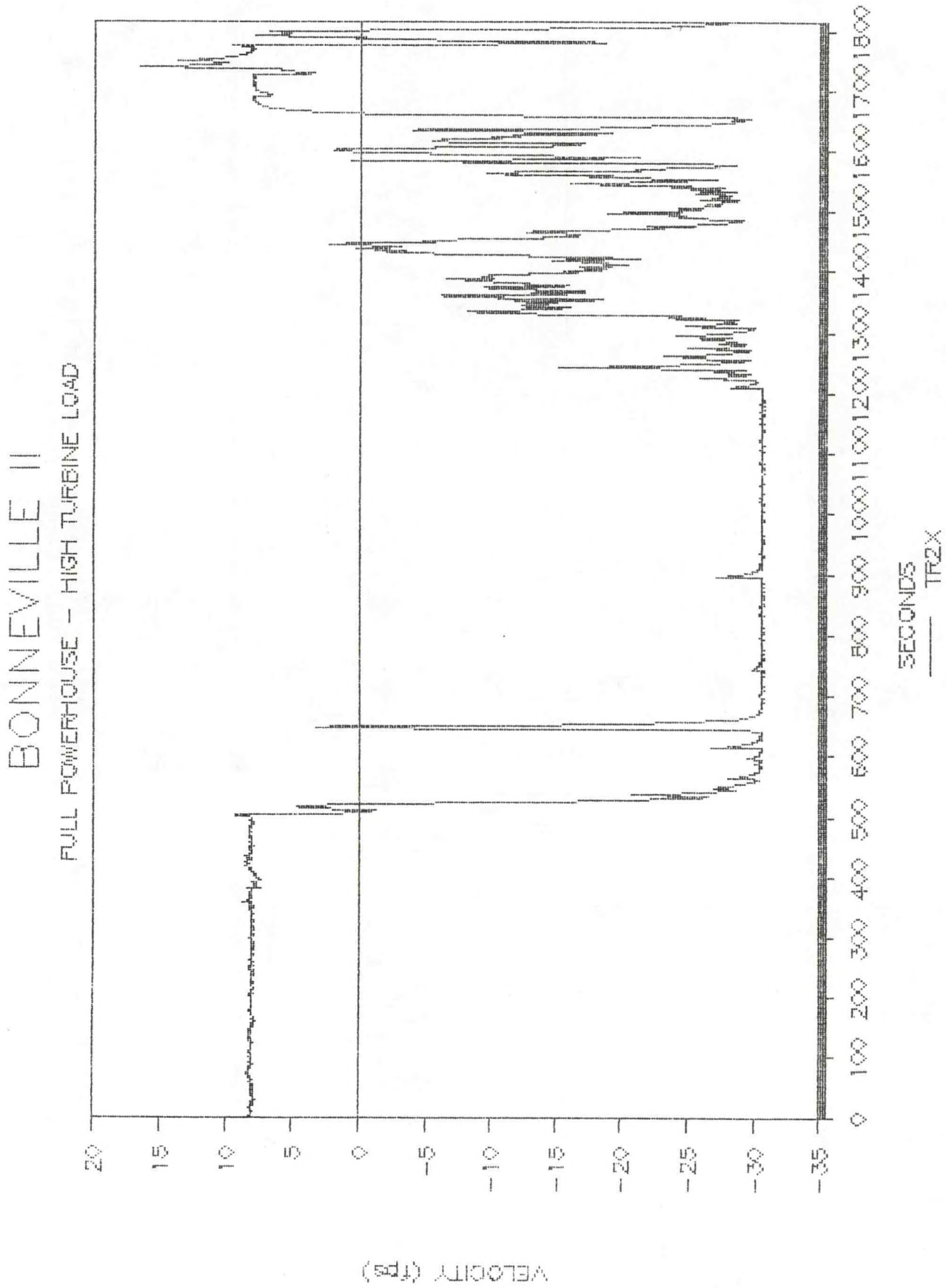


Figure 17. An example of variable velocities measured 10 feet upstream of the trashrack of Turbine 12B. Transverse Flows.

BONNEVILLE II

FULL POWERHOUSE - MEDIUM TURBINE FLOW

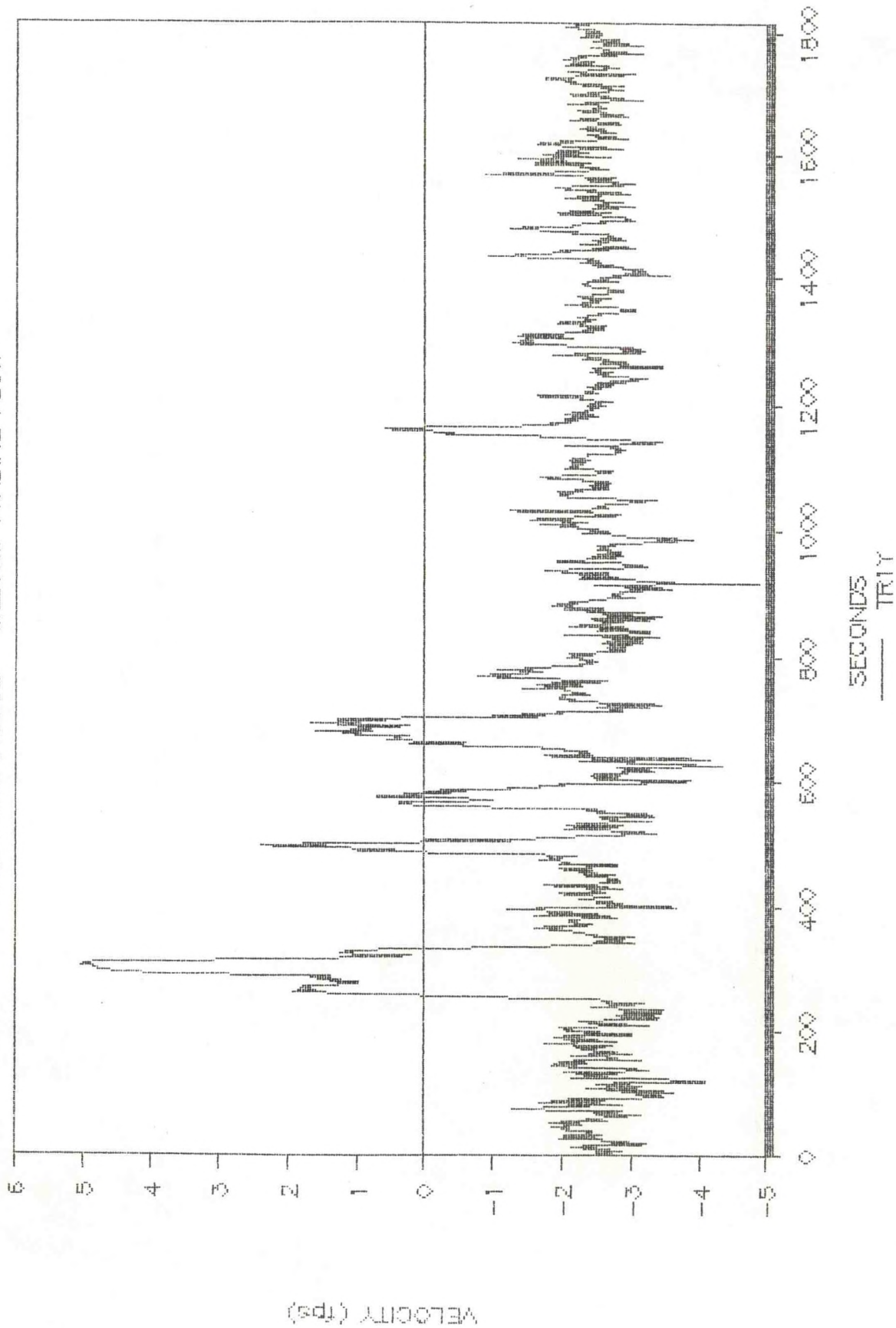


Figure 18. An example of variable velocities measured 10 feet upstream of the trashrack of Turbine 128. Longitudinal Flows.

BONNEVILLE II

FULL POWERHOUSE - LOW TURBINE LOAD

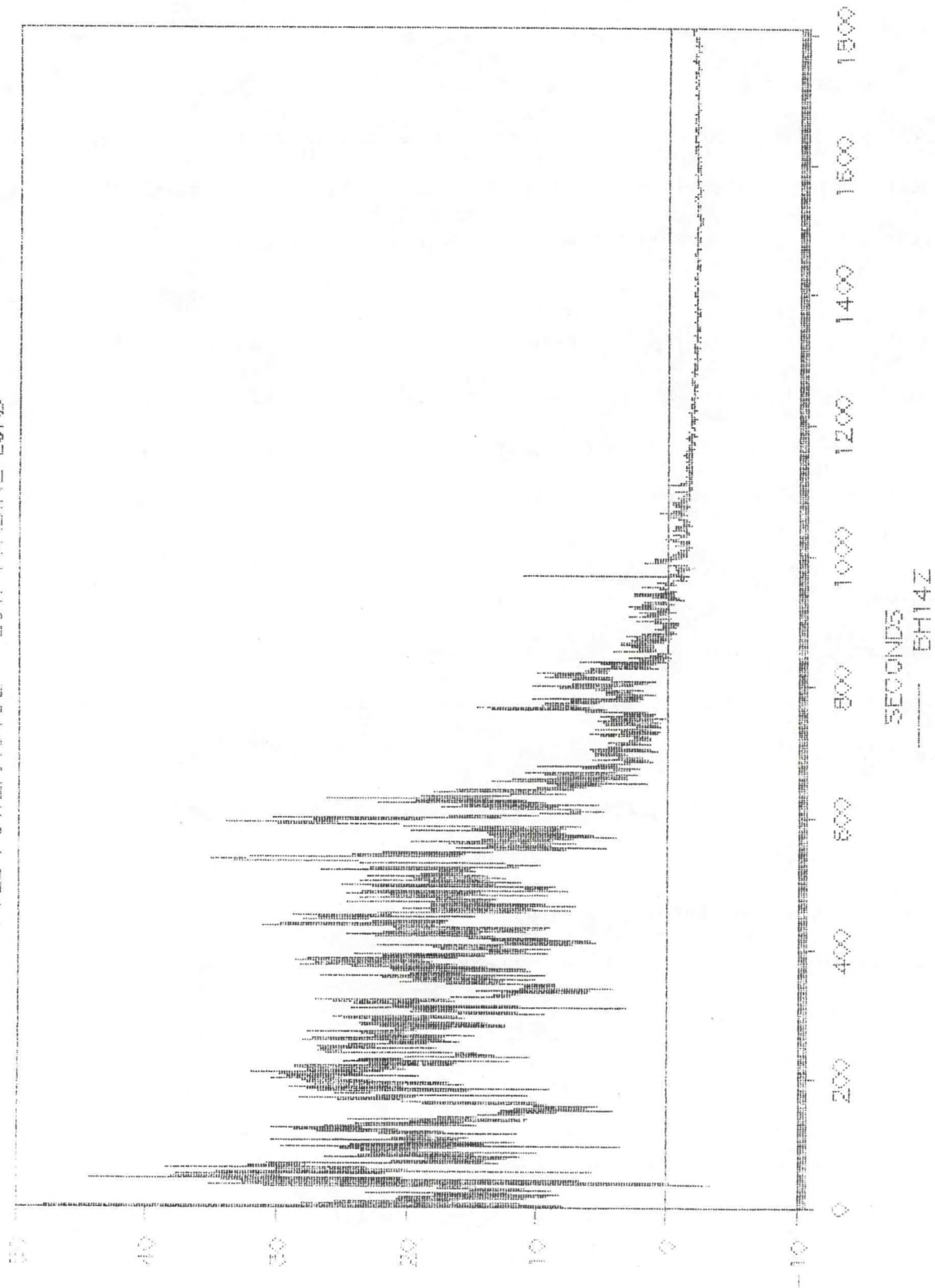


Figure 19. An example of variable velocities measured at the bulkhead slot of Turbine 128. Vertical Flows.

possible to measure velocities up to approximately 45 ft/s, depending upon the level of battery charge. They felt that the velocities encountered exceeded the capacity of the equipment, and that the amplifier circuit had become saturated and in effect "peaked out" around 30 ft/s. The sudden shift in direction can be accounted for most reasonably as a movement of a vortex from one side of the meter probe to the other. Velocities on one side of a vortex are opposite in direction from those on the other side.

- 2) Measured velocities sometimes appeared to be in a different direction than would be expected (e.g., Points 4 and 5 on Figure 4). It must be remembered that these are measurements of velocities at a point in space and time and do not necessarily represent an overall velocity. The placement of the probes at Points 4 and 5 apparently was such that they were within an eddy, rather than in the main flow into the gatewell.
- 3) Very erratic flows were measured at high turbine load in front of Turbine 12 at the Bonneville 2nd Powerhouse. The high velocities and seemingly inconsistent directions measured would bring into question the reliability of the equipment, except for the fact that the same equipment was used in the same arrangement both before and subsequent to this test and worked as expected. The presence of high transverse flows generates an extreme amount of turbulence under full powerhouse load conditions which is obvious on the surface of the forebay and apparently extends through the entire depth of the intake.

CONCLUSIONS AND RECOMMENDATIONS

- 1) In the presence of relatively smooth flows, a short time may be adequate to collect a representative velocity sample. Where flows are more variable, a

longer sample time is necessary. Establishing an "adequate" sampling time, however, may be difficult due to the erratic flow patterns which exist under many operating conditions. Extensive long-term sampling would be required to determine the optimal sampling time.

- 2) The reliability of a single point sample as representative of the mass flow characteristics is questionable in the presence of highly variable flows. A large array of sensors sampling simultaneously may be required to properly characterize the velocity patterns in the turbine intakes.
- 3) The following changes to the equipment are needed:
 - a) The wheels on the movable trolleys of the folding frame and the bulkhead frame should be replaced with more substantial wheels to withstand the forces encountered.
 - b) The modified rollers on the trashrack frame worked well and should be used in the future.
 - c) The hand-operated winches on the bulkhead and folding frame cables were difficult to operate and required extended reaching over the open gatewell, a marginal safety situation. These winches should be mounted so that they can be operated from outside the gatewell railings or should be replaced with powered winches.
 - d) The sensor cables to the trashrack sensors are difficult to handle in the presence of transverse flows. They are also subject to a great deal of abrasion. Enclosing these cables in a protective hose and using a powered capstan to feed and retract them should be considered.
- 4) Velocities behind the STS are approximately 1 ft/s lower at the Bonneville 2nd Powerhouse than at the Bonneville 1st Powerhouse or the McNary Powerhouse. Part of the lower FGE at the Bonneville 2nd Powerhouse may be because more water and fish are deflecting under the STS.

- 5) Although differences exist in the flow patterns within the turbine intakes of the dams studied, these differences are greatly overshadowed by the differences which exist in front of the trashracks. As long as severe transverse flows exist in front of the trashracks at the Bonneville 2nd Powerhouse, the differences in velocities within the intakes may be moot, insofar as they relate to FGE. The fish migrating downstream may not be able to enter the intakes in their usual manner due to the abnormal flow conditions in front of the trashracks. These flow conditions appear to be extremely variable under certain operating conditions, and their influences are therefore particularly difficult to measure and evaluate. It would be necessary to control or eliminate these transverse flows before other factors which may influence FGE at Bonneville 2nd Powerhouse can be properly studied and evaluated.

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Appendix A

Summaries of Velocity Data

Appendix Table A1. Velocities 10 feet upstream and 1 foot upstream of the trashracks of Turbine 5B at the Bonneville First Powerhouse. Full powerhouse loading. High turbine load.

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		1.78	1.86	0.78		1.71	5.30	1.54
MINIMUM		1.10	1.46	0.12		0.98	4.91	1.07
RANGE		0.68	0.40	0.66		0.73	0.39	0.47
AVERAGE	17.20	1.45	1.69	0.52	15.20	1.43	5.09	1.31
STD. DEV.		0.147	0.090	0.181		0.214	0.077	0.126
VARIANCE		0.022	0.008	0.033		0.046	0.006	0.016
MAXIMUM		1.64	1.86	0.22		0.05	3.71	1.15
MINIMUM		1.10	1.37	-0.17		-0.34	3.34	0.81
RANGE		0.54	0.49	0.39		0.39	0.37	0.34
AVERAGE	22.57	1.32	1.59	-0.00	20.57	-0.13	3.55	0.99
STD. DEV.		0.122	0.096	0.093		0.086	0.076	0.085
VARIANCE		0.015	0.009	0.009		0.007	0.006	0.007
MAXIMUM		1.71	1.83	0.37		0.46	4.52	1.39
MINIMUM		0.98	1.27	-0.42		-0.17	4.17	0.83
RANGE		0.73	0.56	0.79		0.63	0.35	0.56
AVERAGE	28.44	1.34	1.55	0.08	26.44	0.09	4.35	1.06
STD. DEV.		0.204	0.112	0.229		0.168	0.076	0.124
VARIANCE		0.042	0.012	0.052		0.028	0.006	0.015
MAXIMUM		1.56	1.76	-0.05		-0.17	3.44	1.54
MINIMUM		1.17	1.27	-0.32		-0.68	3.05	1.10
RANGE		0.39	0.49	0.27		0.51	0.39	0.44
AVERAGE	33.87	1.39	1.59	-0.18	31.87	-0.40	3.27	1.34
STD. DEV.		0.099	0.108	0.059		0.105	0.105	0.101
VARIANCE		0.010	0.012	0.003		0.011	0.011	0.010
MAXIMUM		0.93	1.81	-0.29		-0.22	4.20	1.00
MINIMUM		0.29	1.15	-0.71		-0.68	3.64	0.68
RANGE		0.64	0.66	0.42		0.46	0.56	0.32
AVERAGE	40.05	0.65	1.49	-0.50	38.05	-0.46	3.93	0.86
STD. DEV.		0.161	0.135	0.090		0.097	0.117	0.079
VARIANCE		0.026	0.018	0.008		0.009	0.014	0.006
MAXIMUM		1.12	1.59	-0.42		-0.63	2.86	0.93
MINIMUM		0.59	1.15	-0.68		-0.98	2.56	0.44
RANGE		0.53	0.44	0.26		0.35	0.30	0.49
AVERAGE	45.77	0.88	1.43	-0.57	43.77	-0.81	2.72	0.71
STD. DEV.		0.136	0.083	0.059		0.074	0.072	0.110
VARIANCE		0.018	0.007	0.004		0.006	0.005	0.012

Appendix Table A1 - continued

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		1.49	1.46	-0.10		-0.37	3.47	1.42
MINIMUM		0.98	1.07	-0.46		-0.88	2.93	0.81
RANGE		0.51	0.39	0.36		0.51	0.54	0.61
AVERAGE	52.47	1.25	1.25	-0.28	50.47	-0.70	3.20	1.11
STD.DEV.		0.116	0.101	0.085		0.084	0.127	0.152
VARIANCE		0.013	0.010	0.007		0.007	0.016	0.023
MAXIMUM		2.88	1.95	0.68		-0.37	2.15	1.12
MINIMUM		-0.10	-0.29	-0.85		-1.27	1.15	0.32
RANGE		2.98	2.24	1.53		0.90	1.00	0.80
AVERAGE	58.66	1.30	1.11	-0.13	56.66	-0.75	1.67	0.63
STD.DEV.		0.786	0.626	0.417		0.194	0.216	0.166
VARIANCE		0.618	0.392	0.174		0.038	0.046	0.027
MAXIMUM		0.83	1.07	-0.54		-1.05	1.83	1.07
MINIMUM		0.54	0.63	-0.78		-1.34	1.56	0.66
RANGE		0.29	0.44	0.24		0.29	0.27	0.41
AVERAGE	64.16	0.71	0.89	-0.63	62.16	-1.21	1.71	0.89
STD.DEV.		0.068	0.099	0.061		0.063	0.062	0.097
VARIANCE		0.005	0.010	0.004		0.004	0.004	0.009
MAXIMUM		0.78	0.90	0.10		-0.20	1.29	1.25
MINIMUM		0.51	0.56	-0.20		-0.59	0.93	0.61
RANGE		0.27	0.34	0.30		0.39	0.36	0.64
AVERAGE	70.08	0.64	0.74	-0.08	68.08	-0.38	1.15	0.90
STD.DEV.		0.052	0.077	0.072		0.090	0.066	0.166
VARIANCE		0.003	0.006	0.005		0.008	0.004	0.028

Appendix Table A2. Velocities 10 feet upstream and 1 foot upstream of trashracks of Turbine 5B at the Bonneville First Powerhouse. Full powerhouse loading. Medium turbine load.

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		1.44	2.71	0.42		1.00	5.15	1.71
MINIMUM		-0.90	1.05	-1.15		0.24	3.98	0.95
RANGE		2.34	1.66	1.57		0.76	1.17	0.76
AVERAGE	18.74	0.62	2.11	-0.17	16.74	0.61	4.42	1.29
STD. DEV.		0.606	0.432	0.381		0.189	0.276	0.214
VARIANCE		0.367	0.187	0.145		0.036	0.076	0.046
MAXIMUM		2.12	3.61	1.15		0.54	3.00	0.76
MINIMUM		0.61	2.06	0.27		0.10	2.22	0.17
RANGE		1.51	0.75	0.88		0.44	0.78	0.59
AVERAGE	23.08	1.14	3.09	0.78	21.08	0.33	2.68	0.44
STD. DEV.		0.429	0.177	0.202		0.104	0.177	0.145
VARIANCE		0.184	0.031	0.041		0.011	0.031	0.021
MAXIMUM		1.42	3.05	0.12		0.46	4.10	0.95
MINIMUM		0.95	2.42	-0.17		0.07	3.39	0.63
RANGE		0.47	0.63	0.29		0.39	0.71	0.32
AVERAGE	29.24	1.22	2.83	0.00	27.24	0.28	3.02	0.80
STD. DEV.		0.098	0.148	0.063		0.089	0.166	0.072
VARIANCE		0.010	0.022	0.004		0.008	0.028	0.005
MAXIMUM		1.17	1.68	0.15		0.24	2.78	0.81
MINIMUM		0.42	1.07	-0.42		-0.27	2.37	0.51
RANGE		0.75	0.61	0.57		0.51	0.41	0.30
AVERAGE	34.99	0.78	1.45	-0.20	32.99	-0.05	2.58	0.66
STD. DEV.		0.166	0.127	0.119		0.103	0.101	0.075
VARIANCE		0.028	0.016	0.014		0.011	0.010	0.006
MAXIMUM		1.64	1.66	0.17		-0.46	3.39	1.03
MINIMUM		1.00	1.27	-0.56		-0.85	3.03	0.68
RANGE		0.64	0.39	0.73		0.39	0.36	0.35
AVERAGE	40.87	1.27	1.50	-0.31	38.87	-0.64	3.22	0.85
STD. DEV.		0.150	0.090	0.168		0.090	0.075	0.065
VARIANCE		0.023	0.008	0.028		0.008	0.006	0.004
MAXIMUM		1.20	1.37	-0.22		-0.56	2.51	1.00
MINIMUM		0.81	0.90	-0.66		-1.00	2.17	0.37
RANGE		0.39	0.47	0.44		0.44	0.34	0.63
AVERAGE	46.44	1.03	1.18	-0.46	44.44	-0.79	2.34	0.68
STD. DEV.		0.095	0.098	0.098		0.118	0.080	0.169
VARIANCE		0.009	0.010	0.010		0.014	0.006	0.029

Appendix Table A2 - continued

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		1.00	1.39	-0.17		-0.32	2.01	0.71
MINIMUM		0.61	1.07	-0.56		-0.76	2.51	0.22
RANGE		0.39	0.32	0.39		0.44	0.30	0.49
AVERAGE	51.79	0.79	1.26	-0.32	49.79	-0.46	2.66	0.49
STD.DEV.		0.077	0.079	0.080		0.107	0.065	0.107
VARIANCE		0.006	0.006	0.006		0.011	0.004	0.011
MAXIMUM		0.68	1.17	-0.42		-0.37	1.68	1.05
MINIMUM		0.12	0.56	-0.73		-0.90	1.22	0.51
RANGE		0.56	0.61	0.31		0.53	0.46	0.54
AVERAGE	59.59	0.45	0.92	-0.55	57.59	-0.59	1.48	0.76
STD.DEV.		0.111	0.116	0.070		0.114	0.109	0.153
VARIANCE		0.012	0.013	0.005		0.013	0.012	0.024
MAXIMUM		1.10	0.90	0.12		-0.22	1.42	1.54
MINIMUM		0.71	0.49	-0.17		-0.61	1.17	0.95
RANGE		0.39	0.41	0.29		0.39	0.25	0.59
AVERAGE	67.30	0.93	0.70	-0.04	65.30	-0.39	1.26	1.25
STD.DEV.		0.084	0.090	0.063		0.094	0.056	0.168
VARIANCE		0.007	0.008	0.004		0.009	0.003	0.028

Appendix Table A3. Velocities 10 feet upstream and 1 foot upstream of trashracks of Turbine 5B at the Bonneville First Powerhouse. Full powerhouse loading. Low turbine load.

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		1.00	2.42	0.46		0.90	3.59	0.78
MINIMUM		0.56	2.05	0.12		0.37	3.25	0.17
RANGE		0.44	0.37	0.34		0.53	0.34	0.61
AVERAGE	18.38	0.80	2.29	0.27	16.38	0.69	3.45	0.49
STD.DEV.		0.083	0.085	0.069		0.132	0.073	0.139
VARIANCE		0.007	0.007	0.005		0.017	0.005	0.019
MAXIMUM		0.95	2.29	0.22		0.10	2.61	0.71
MINIMUM		0.51	1.98	-0.15		-0.22	2.27	0.22
RANGE		0.44	0.31	0.37		0.32	0.34	0.49
AVERAGE	22.66	0.73	2.15	0.04	20.66	-0.06	2.45	0.51
STD.DEV.		0.093	0.070	0.082		0.060	0.071	0.124
VARIANCE		0.009	0.005	0.007		0.004	0.005	0.015
MAXIMUM		1.71	2.25	0.59		0.90	2.95	0.76
MINIMUM		0.71	1.76	-0.10		0.05	1.68	0.02
RANGE		1.00	0.49	0.69		0.85	1.27	0.74
AVERAGE	28.51	1.19	1.97	0.28	26.51	0.48	2.46	0.37
STD.DEV.		0.237	0.118	0.166		0.202	0.294	0.199
VARIANCE		0.056	0.014	0.028		0.041	0.086	0.040
MAXIMUM		1.29	2.42	0.17		0.12	2.17	0.95
MINIMUM		0.66	1.83	-0.32		-0.27	1.68	0.51
RANGE		0.63	0.59	0.49		0.39	0.49	0.44
AVERAGE	34.53	1.01	2.22	-0.11	32.53	-0.05	1.92	0.75
STD.DEV.		0.163	0.128	0.121		0.082	0.090	0.094
VARIANCE		0.027	0.016	0.015		0.007	0.008	0.009
MAXIMUM		1.00	1.98	-0.22		-0.29	2.88	0.46
MINIMUM		0.27	1.56	-0.51		-0.61	2.56	0.02
RANGE		0.73	0.42	0.29		0.32	0.32	0.44
AVERAGE	40.70	0.61	1.74	-0.35	38.70	-0.45	2.74	0.27
STD.DEV.		0.180	0.086	0.071		0.070	0.085	0.103
VARIANCE		0.032	0.007	0.005		0.005	0.007	0.011
MAXIMUM		0.61	1.93	-0.10		-0.17	1.95	0.32
MINIMUM		0.32	1.59	-0.56		-0.66	1.73	0.02
RANGE		0.29	0.34	0.46		0.49	0.22	0.30
AVERAGE	46.75	0.49	1.75	-0.30	44.75	-0.41	1.85	0.20
STD.DEV.		0.076	0.079	0.101		0.099	0.056	0.057
VARIANCE		0.006	0.006	0.010		0.010	0.003	0.003

Appendix Table A3 - continued

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		0.81	1.78	-0.10		-0.27	2.47	1.22
MINIMUM		0.37	1.32	-0.56		-0.81	2.08	0.22
RANGE		0.44	0.46	0.46		0.54	0.39	1.00
AVERAGE	53.04	0.59	1.52	-0.34	51.04	-0.47	2.25	0.64
STD.DEV.		0.092	0.091	0.097		0.117	0.092	0.223
VARIANCE		0.008	0.008	0.009		0.014	0.008	0.050
MAXIMUM		1.37	1.49	0.07		-0.05	1.44	1.34
MINIMUM		0.90	1.10	-0.27		-0.42	1.03	0.93
RANGE		0.47	0.39	0.34		0.37	0.41	0.41
AVERAGE	59.33	1.15	1.33	-0.11	57.33	-0.20	1.27	1.18
STD.DEV.		0.113	0.093	0.072		0.080	0.091	0.103
VARIANCE		0.013	0.009	0.005		0.006	0.008	0.011
MAXIMUM		1.07	1.20	0.02		-0.17	1.39	0.90
MINIMUM		0.71	0.90	-0.22		-0.51	0.90	0.42
RANGE		0.36	0.30	0.24		0.34	0.49	0.48
AVERAGE	66.51	0.85	1.08	-0.09	64.51	-0.32	1.12	0.60
STD.DEV.		0.069	0.058	0.064		0.080	0.123	0.110
VARIANCE		0.005	0.003	0.004		0.006	0.015	0.012

Appendix Table A4. Comparison of 30 minute and 15 second sampling of velocities 10 feet upstream and 1 foot upstream of the trashracks of Turbine 5B at the Bonneville First Powerhouse. Full powerhouse loading.

		UPSTREAM	VELOCITY (in Ft/Sec)			DOWNSTEAM	VELOCITY (in Ft/Sec)		
		PROBE	X	Y	Z	PROBE	X	Y	Z
		ELEV(MSL)	FPS	FPS	FPS	ELEV(MSL)	FPS	FPS	FPS
High Turbine Load									
30 min. sample	MAXIMUM		3.91	5.42	1.54		0.98	5.93	3.47
	MINIMUM		-3.03	-1.00	-3.76		-2.17	1.12	-0.71
	RANGE		6.94	6.42	5.30		3.15	4.81	4.18
	AVERAGE	52.44	1.14	1.17	-0.37	50.44	-0.76	3.12	1.03
	STD.DEV.		0.509	0.414	0.359		0.289	0.417	0.375
	VARIANCE		0.259	0.171	0.129		0.084	0.174	0.141
15 sec. sample	MAXIMUM		1.49	1.46	-0.10		-0.61	3.47	1.42
	MINIMUM		1.00	1.10	-0.46		-0.88	3.00	0.81
	RANGE		0.49	0.36	0.36		0.27	0.47	0.61
	AVERAGE	52.47	1.27	1.26	-0.27	50.47	-0.73	3.24	1.09
	STD.DEV.		0.115	0.096	0.091		0.057	0.109	0.162
	VARIANCE		0.013	0.009	0.008		0.003	0.012	0.026
Medium Turbine Load									
30 min. sample	MAXIMUM		1.59	1.73	-0.02		-0.02	3.25	1.49
	MINIMUM		0.22	0.66	-0.95		-1.22	2.08	-0.12
	RANGE		1.37	1.07	0.93		1.20	1.17	1.61
	AVERAGE	51.95	0.92	1.20	-0.42	49.95	-0.63	2.71	0.59
	STD.DEV.		0.216	0.135	0.123		0.164	0.153	0.221
	VARIANCE		0.047	0.018	0.015		0.027	0.023	0.049
15 sec. sample	MAXIMUM		0.93	1.39	-0.17		-0.32	2.81	0.71
	MINIMUM		0.61	1.07	-0.42		-0.66	2.51	0.32
	RANGE		0.32	0.32	0.25		0.34	0.30	0.39
	AVERAGE	51.78	0.78	1.27	-0.29	49.78	-0.42	2.65	0.52
	STD.DEV.		0.066	0.072	0.058		0.075	0.063	0.094
	VARIANCE		0.004	0.005	0.003		0.006	0.004	0.009
Low Turbine Load									
30 min. sample	MAXIMUM		1.17	2.08	0.00		-0.10	2.61	1.22
	MINIMUM		0.00	1.05	-0.76		-1.15	1.25	-0.32
	RANGE		1.17	1.03	0.76		1.05	1.36	1.54
	AVERAGE	53.07	0.61	1.51	-0.34	51.07	-0.63	2.20	0.43
	STD.DEV.		0.164	0.142	0.112		0.134	0.126	0.173
	VARIANCE		0.027	0.020	0.013		0.018	0.016	0.030
15 sec. sample	MAXIMUM		0.81	1.68	-0.10		-0.27	2.47	1.22
	MINIMUM		0.39	1.32	-0.46		-0.56	2.08	0.44
	RANGE		0.42	0.36	0.36		0.29	0.39	0.78
	AVERAGE	53.04	0.61	1.50	-0.32	51.04	-0.43	2.23	0.71
	STD.DEV.		0.090	0.081	0.096		0.074	0.088	0.199
	VARIANCE		0.008	0.007	0.009		0.006	0.008	0.040

Appendix Table AS. Velocities at the Folding Frame upstream of Travelling Screen.
Bonneville First Powerhouse Turbine 5B. Full powerhouse loading. High turbine load.

	VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)		
	Elevation (MSL)*	Y FPS	Z FPS	Elevation (MSL)*	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		-0.07	7.40		6.40	-0.59		2.64	-0.51
MINIMUM		-0.29	3.56		1.03	-5.93		1.66	-1.22
RANGE		0.22	3.84		5.37	5.34		0.98	0.71
AVERAGE	23.15	-0.16	5.60	19.15	3.80	-2.57	-0.85	2.18	-0.06
STD. DEV.		0.057	1.021		1.593	1.421		0.278	0.154
VARIANCE		0.003	1.043		2.539	2.020		0.077	0.024
MAXIMUM		-0.05	8.94		5.00	-0.68		2.05	-0.54
MINIMUM		-0.27	4.05		-0.42	-5.40		1.37	-1.73
RANGE		0.22	4.89		5.42	4.72		0.68	1.19
AVERAGE	24.71	-0.14	6.49	20.71	2.17	-3.25	0.71	1.68	-1.14
STD. DEV.		0.053	1.414		1.491	1.273		0.140	0.260
VARIANCE		0.003	2.000		2.224	1.620		0.020	0.068
MAXIMUM		-0.05	2.03		6.25	-0.93		2.17	-0.37
MINIMUM		-0.27	-0.37		3.98	-3.71		1.66	-1.39
RANGE		0.22	2.40		2.27	2.78		0.51	1.02
AVERAGE	28.89	-0.14	0.64	24.89	5.25	-1.85	4.89	1.94	-0.87
STD. DEV.		0.058	0.619		0.578	0.639		0.122	0.234
VARIANCE		0.003	0.384		0.334	0.409		0.015	0.055
MAXIMUM		-0.05	1.86		1.10	-1.20		1.66	-0.27
MINIMUM		-0.24	0.29		-0.17	-2.56		1.07	-1.64
RANGE		0.19	1.57		1.27	1.36		0.59	1.37
AVERAGE	31.91	-0.13	1.15	27.91	0.60	-1.86	7.91	1.36	-1.03
STD. DEV.		0.054	0.418		0.367	0.351		0.142	0.359
VARIANCE		0.003	0.174		0.135	0.123		0.020	0.129
MAXIMUM		-0.05	2.34		0.85	-0.59		1.81	-0.37
MINIMUM		-0.27	1.44		0.12	-1.71		1.12	-1.07
RANGE		0.22	0.90		0.73	1.12		0.69	0.70
AVERAGE	32.40	-0.13	1.94	28.40	0.55	-1.16	8.40	1.40	-0.77
STD. DEV.		0.052	0.188		0.187	0.331		0.137	0.159
VARIANCE		0.003	0.035		0.035	0.109		0.019	0.025
MAXIMUM		-0.05	2.59		1.42	-0.05		1.56	-0.76
MINIMUM		-0.24	0.93		0.17	-1.32		1.07	-1.44
RANGE		0.19	1.66		1.25	1.27		0.49	0.68
AVERAGE	32.40	-0.14	1.57	28.40	0.63	-0.68	8.40	1.30	-1.13
STD. DEV.		0.051	0.426		0.282	0.320		0.112	0.158
VARIANCE		0.003	0.182		0.079	0.102		0.013	0.025

Appendix Table A5 - continued

	VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)		
	Elevation (MSL)*	Y FPS	Z FPS	Elevation (MSL)*	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		-0.05	2.03		1.22	0.15		1.37	-0.49
MINIMUM		-0.24	0.78		-0.22	-1.42		0.83	-1.15
RANGE		0.19	1.25		1.44	1.57		0.54	0.66
AVERAGE	32.32	-0.14	1.43	28.32	0.65	-0.54	8.32	1.13	-0.87
STD. DEV.		0.054	0.328		0.257	0.328		0.120	0.147
VARIANCE		0.003	0.108		0.066	0.108		0.014	0.021
MAXIMUM		-0.07	3.10		1.49	-0.27		0.88	-0.42
MINIMUM		-0.29	0.68		0.78	-1.29		0.59	-0.85
RANGE		0.22	2.42		0.71	1.02		0.29	0.43
AVERAGE	32.50	-0.17	1.84	28.50	1.14	-0.88	8.50	0.72	-0.64
STD. DEV.		0.058	0.618		0.211	0.269		0.077	0.098
VARIANCE		0.003	0.382		0.045	0.072		0.006	0.010
MAXIMUM		-0.07	1.59		1.03	-1.34		0.88	-0.29
MINIMUM		-0.29	0.71		0.05	-2.05		0.54	-0.73
RANGE		0.22	0.88		0.98	0.71		0.34	0.44
AVERAGE	32.54	-0.17	1.25	28.54	0.49	-1.61	8.54	0.74	-0.50
STD. DEV.		0.055	0.200		0.216	0.174		0.085	0.089
VARIANCE		0.003	0.040		0.047	0.030		0.007	0.008
MAXIMUM		-0.07	1.95		1.78	-0.76		0.90	-0.07
MINIMUM		-0.29	0.66		0.34	-1.95		0.61	-0.56
RANGE		0.22	1.29		1.44	1.19		0.29	0.49
AVERAGE	32.54	-0.17	1.18	28.54	0.78	-1.38	8.54	0.78	-0.35
STD. DEV.		0.052	0.320		0.257	0.291		0.065	0.131
VARIANCE		0.003	0.102		0.066	0.085		0.004	0.017

* The mounting bolts holding the probe arms sheared during the tests; therefore these readings may differ somewhat from actual values.

Appendix Table A6. Velocities at the Folding Frame upstream of Travelling Screen.
 Bonneville First Powerhouse Turbine 5B. Full powerhouse loading. Medium turbine load.

	VELOCITY(in Ft/Sec)				VELOCITY(in Ft/Sec)				VELOCITY(in Ft/Sec)		
	Elevation	Y	Z	Elevation	Y	Z	Elevation	Y	Z		
	(MSL)*	FPS	FPS	(MSL)*	FPS	FPS	(MSL)	FPS	FPS		
MAXIMUM		-0.17	2.37		1.68	0.59		2.95	-2.32		
MINIMUM		-0.42	2.10		1.00	0.05		2.32	-3.20		
RANGE		0.25	0.27		0.68	0.54		0.63	0.88		
AVERAGE	39.30	-0.27	2.24	35.30	1.33	0.33	15.30	2.70	-2.70		
STD. DEV.		0.054	0.066		0.170	0.103		0.176	0.204		
VARIANCE		0.003	0.004		0.029	0.011		0.031	0.042		
MAXIMUM		-0.17	1.93		0.85	0.42		2.91	-1.68		
MINIMUM		-0.37	1.49		0.20	-0.17		1.78	-2.51		
RANGE		0.20	0.44		0.65	0.59		1.13	0.83		
AVERAGE	37.12	-0.26	1.69	33.12	0.54	0.18	13.12	2.26	-2.14		
STD. DEV.		0.053	0.121		0.126	0.154		0.275	0.199		
VARIANCE		0.003	0.015		0.016	0.024		0.076	0.040		
MAXIMUM		-0.17	1.05		3.93	0.90		2.71	-1.15		
MINIMUM		-0.39	0.27		3.05	0.27		1.78	-2.08		
RANGE		0.22	0.78		0.88	0.63		0.93	0.93		
AVERAGE	33.29	-0.27	0.75	29.29	3.37	0.64	9.29	2.29	-1.58		
STD. DEV.		0.061	0.122		0.205	0.148		0.245	0.199		
VARIANCE		0.004	0.015		0.042	0.022		0.060	0.040		
MAXIMUM		-0.20	3.15		5.20	1.59		2.03	-0.68		
MINIMUM		-0.42	2.25		3.34	-0.51		1.56	-1.86		
RANGE		0.22	0.90		1.86	2.10		0.47	1.18		
AVERAGE	29.77	-0.28	2.73	25.77	4.26	0.51	5.77	1.83	-1.28		
STD. DEV.		0.058	0.252		0.500	0.492		0.101	0.242		
VARIANCE		0.003	0.064		0.250	0.243		0.010	0.059		
MAXIMUM		-0.17	2.76		5.76	1.10		2.47	-0.71		
MINIMUM		-0.42	1.49		4.52	-0.07		1.88	-1.54		
RANGE		0.25	1.27		1.24	1.17		0.59	0.83		
AVERAGE	29.68	-0.29	2.23	25.68	5.20	0.52	5.68	2.19	-1.15		
STD. DEV.		0.064	0.359		0.312	0.299		0.147	0.213		
VARIANCE		0.004	0.129		0.097	0.090		0.022	0.045		
MAXIMUM		-0.17	2.93		5.37	1.71		2.37	-0.66		
MINIMUM		-0.42	2.17		3.71	-0.07		1.49	-2.00		
RANGE		0.25	0.76		1.66	1.78		0.88	1.34		
AVERAGE	29.75	-0.29	2.50	25.75	4.64	0.78	5.75	2.00	-1.48		
STD. DEV.		0.060	0.161		0.500	0.451		0.212	0.416		
VARIANCE		0.004	0.026		0.250	0.203		0.045	0.173		

Appendix Table A6 - continued

	Elevation (MSL)*	VELOCITY(in Ft/Sec)		Elevation (MSL)*	VELOCITY(in Ft/Sec)		Elevation (MSL)	VELOCITY(in Ft/Sec)	
		Y FPS	Z FPS		Y FPS	Z FPS		Y FPS	Z FPS
MAXIMUM		-0.17	3.34		5.52	1.39		2.47	-0.78
MINIMUM		-0.42	2.49		2.91	-0.85		1.93	-1.39
RANGE		0.25	0.85		2.61	2.24		0.64	0.61
AVERAGE	29.64	-0.20	2.92	25.64	4.39	0.41	5.64	2.22	-1.13
STD. DEV.		0.058	0.210		0.741	0.420		0.161	0.146
VARIANCE		0.003	0.044		0.549	0.176		0.026	0.021
MAXIMUM		-0.17	3.69		6.27	2.12		2.32	-0.76
MINIMUM		-0.42	2.61		4.37	0.27		1.56	-1.83
RANGE		0.25	1.08		1.90	1.85		0.76	1.07
AVERAGE	29.76	-0.27	3.06	25.76	5.26	1.09	5.76	1.96	-1.23
STD. DEV.		0.262	0.295		0.463	0.439		0.159	0.274
VARIANCE		0.004	0.087		0.214	0.193		0.025	0.075
MAXIMUM		-0.17	3.88		5.30	1.39		2.10	-1.27
MINIMUM		-0.39	2.08		2.81	-1.29		1.61	-2.12
RANGE		0.22	1.80		2.49	2.68		0.49	0.85
AVERAGE	29.73	-0.27	2.98	25.73	4.14	0.11	5.73	1.86	-1.57
STD. DEV.		0.058	0.471		0.696	0.688		0.098	0.209
VARIANCE		0.003	0.222		0.484	0.474		0.010	0.044

* The mounting bolts holding the probe arms sheared during the tests; therefore these readings may differ somewhat from actual values.

Appendix Table A7. Velocities at the Folding Frame upstream of Travelling Screen.
Bonneville First Powerhouse Turbine 5B. Full powerhouse loading. Low turbine load.

	VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)		
	Elevation (MSL)*	Y FPS	Z FPS	Elevation (MSL)*	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		-0.15	2.61		5.35	2.47		1.64	-0.85
MINIMUM		-0.39	2.03		2.86	-0.90		1.34	-1.25
RANGE		0.24	0.58		2.49	3.37		0.30	0.40
AVERAGE	29.58	-0.25	2.29	25.58	4.00	0.89	5.58	1.51	-1.02
STD.DEV.		0.063	0.117		0.476	0.708		0.070	0.091
VARIANCE		0.004	0.014		0.226	0.501		0.005	0.008
MAXIMUM		-0.15	1.27		3.44	0.73		1.51	-0.98
MINIMUM		-0.37	0.73		2.91	0.02		1.20	-1.34
RANGE		0.22	0.54		0.53	0.71		0.31	0.36
AVERAGE	33.63	-0.25	0.99	29.63	3.16	0.42	9.63	1.36	-1.17
STD.DEV.		0.063	0.114		0.128	0.173		0.084	0.083
VARIANCE		0.004	0.013		0.016	0.030		0.007	0.007
MAXIMUM		-0.17	1.78		0.81	0.34		1.71	-1.12
MINIMUM		-0.37	1.44		0.39	-0.12		1.37	-1.54
RANGE		0.20	0.34		0.42	0.46		0.34	0.42
AVERAGE	37.89	-0.25	1.65	33.89	0.62	0.12	13.89	1.55	-1.33
STD.DEV.		0.063	0.077		0.088	0.110		0.065	0.093
VARIANCE		0.004	0.006		0.008	0.012		0.004	0.009
MAXIMUM		-0.17	2.15		1.51	0.44		1.64	-1.29
MINIMUM		-0.37	1.88		0.81	-0.17		1.27	-1.73
RANGE		0.20	0.27		0.70	0.61		0.37	0.44
AVERAGE	40.01	-0.25	2.03	36.01	1.07	0.14	16.01	1.46	-1.48
STD.DEV.		0.053	0.065		0.175	0.173		0.074	0.087
VARIANCE		0.003	0.004		0.031	0.030		0.005	0.008
MAXIMUM		-0.17	2.25		1.81	0.39		1.49	-1.20
MINIMUM		-0.37	1.93		1.49	0.07		1.15	-1.93
RANGE		0.20	0.32		0.32	0.32		0.34	0.73
AVERAGE	42.28	-0.24	2.12	38.28	1.65	0.28	18.28	1.34	-1.48
STD.DEV.		0.054	0.070		0.079	0.065		0.076	0.174
VARIANCE		0.003	0.005		0.006	0.004		0.006	0.030
MAXIMUM		-0.17	2.37		1.98	0.32		1.44	-1.10
MINIMUM		-0.37	1.78		1.56	-0.02		1.15	-1.54
RANGE		0.20	0.59		0.42	0.34		0.29	0.44
AVERAGE	42.38	-0.24	2.14	38.38	1.74	0.15	18.38	1.33	-1.31
STD.DEV.		0.057	0.125		0.075	0.071		0.068	0.097
VARIANCE		0.003	0.016		0.006	0.005		0.005	0.009

Appendix Table A7 - continued

	Elevation (MSL)*	VELOCITY(in Ft/Sec)		Elevation (MSL)*	VELOCITY(in Ft/Sec)		Elevation (MSL)	VELOCITY(in Ft/Sec)	
		Y FPS	Z FPS		Y FPS	Z FPS		Y FPS	Z FPS
MAXIMUM		-0.17	2.25		1.93	0.51		1.44	-0.93
MINIMUM		-0.37	1.93		1.49	0.07		1.10	-1.49
RANGE		0.20	0.32		0.44	0.44		0.34	0.56
AVERAGE	42.23	-0.25	2.08	38.23	1.73	0.34	18.23	1.27	-1.18
STD. DEV.		0.055	0.077		0.098	0.102		0.074	0.126
VARIANCE		0.003	0.006		0.010	0.010		0.006	0.016
MAXIMUM		-0.17	2.37		2.00	0.49		0.76	-0.27
MINIMUM		-0.39	2.05		1.44	0.07		0.46	-0.56
RANGE		0.22	0.32		0.56	0.42		0.30	0.29
AVERAGE	42.32	-0.26	2.21	38.32	1.74	0.29	18.32	0.62	-0.44
STD. DEV.		0.065	0.065		0.101	0.111		0.072	0.058
VARIANCE		0.004	0.004		0.010	0.012		0.005	0.003
MAXIMUM		-0.17	2.22		1.93	0.42		0.71	-0.32
MINIMUM		-0.37	1.78		1.39	0.02		0.42	-0.56
RANGE		0.20	0.44		0.54	0.40		0.29	0.24
AVERAGE	42.37	-0.26	2.02	38.37	1.61	0.20	18.37	0.57	-0.43
STD. DEV.		0.059	0.102		0.110	0.100		0.063	0.067
VARIANCE		0.003	0.010		0.012	0.010		0.004	0.005

* The mounting bolts holding the probe arms sheared during the tests; therefore these readings may differ somewhat from actual values.

Appendix Table AB. Comparison of 30 minute and 15 second sampling of velocities at the Folding Frame upstream of Travelling Screen. Bonneville First Powerhouse Turbine SB. Full powerhouse loading. High turbine load.

		VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)		
		Elevation	Y	Z	Elevation	Y	Z	Elevation	Y	Z
		(MSL)*	FPS	FPS	(MSL)*	FPS	FPS	(MSL)	FPS	FPS
High Turbine load										
30 min. sample	MAXIMUM		-0.02	3.42		2.25	0.85		1.59	0.15
	MINIMUM		-0.29	-0.12		-0.27	-2.27		0.59	-1.54
	RANGE		0.27	3.54		2.52	3.12		1.00	1.69
	AVERAGE	32.33	-0.15	1.43	28.33	0.74	-0.80	8.33	0.99	-0.68
	STD.DEV.		0.056	0.510		0.378	0.448		0.155	0.254
	VARIANCE		0.003	0.260		0.143	0.200		0.024	0.064
15 sec. sample	MAXIMUM		-0.05	2.03		1.22	0.15		1.34	-0.56
	MINIMUM		-0.24	0.78		0.27	-0.98		0.83	-1.15
	RANGE		0.19	1.25		0.95	1.13		0.51	0.59
	AVERAGE	32.33	-0.14	1.44	28.33	0.66	-0.46	8.33	1.11	-0.91
	STD.DEV.		0.054	0.344		0.234	0.276		0.115	0.110
	VARIANCE		0.003	0.118		0.055	0.076		0.013	0.012
Medium Turbine Load										
30 min. sample	MAXIMUM		-0.17	2.08		4.39	1.93		2.95	-0.46
	MINIMUM		-0.42	-0.56		2.47	-0.46		1.39	-2.66
	RANGE		0.25	2.64		1.92	2.39		1.56	2.20
	AVERAGE	33.51	-0.27	0.78	29.51	3.29	0.79	9.51	2.17	-1.58
	STD.DEV.		0.059	0.341		0.272	0.315		0.242	0.334
	VARIANCE		0.003	0.116		0.074	0.099		0.058	0.111
15 sec. sample	MAXIMUM		-0.17	0.90		3.93	0.90		2.71	-1.20
	MINIMUM		-0.39	0.46		3.05	0.27		1.78	-2.08
	RANGE		0.22	0.44		0.88	0.63		0.93	0.88
	AVERAGE	33.25	-0.27	0.76	29.25	3.38	0.65	9.25	2.27	-1.57
	STD.DEV.		0.060	0.092		0.218	0.140		0.263	0.193
	VARIANCE		0.004	0.008		0.048	0.019		0.069	0.037
Low Turbine Load										
30 min. sample	MAXIMUM		-0.12	2.56		2.03	0.71		1.49	-0.37
	MINIMUM		-0.39	1.54		0.12	-0.12		0.51	-1.68
	RANGE		0.27	1.02		1.91	0.83		0.98	1.31
	AVERAGE	42.26	-0.25	1.99	38.26	1.63	0.26	18.26	1.02	-0.97
	STD.DEV.		0.058	0.124		0.125	0.127		0.192	0.240
	VARIANCE		0.003	0.015		0.016	0.016		0.037	0.058
15 sec. sample	MAXIMUM		-0.17	2.25		1.93	0.51		1.37	-0.93
	MINIMUM		-0.37	1.93		1.51	0.12		1.10	-1.44
	RANGE		0.20	0.32		0.42	0.39		0.27	0.51
	AVERAGE	42.25	-0.25	2.09	38.25	1.74	0.37	18.25	1.25	-1.14
	STD.DEV.		0.057	0.075		0.088	0.088		0.068	0.102
	VARIANCE		0.003	0.006		0.008	0.008		0.005	0.010

* The mounting bolts holding the probe arms sheared during the tests; therefore these readings may differ somewhat from actual values.

Appendix Table A9. Velocities at fixed locations inside Submersible Travelling Screen and on support framework. Bonneville First Powerhouse. Full Powerhouse loading. High turbine Load. 15 second samples.

LOCATION #	1		2		3		4		5		6	
	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS
MAXIMUM	3.83	0.34	5.66	2.71	3.54	0.78	0.29	-0.78	0.37	-0.63	1.12	1.10
MINIMUM	2.08	-1.07	1.90	-2.15	2.71	-0.20	0.00	-1.25	-0.15	-1.05	-0.88	0.34
RANGE	1.75	1.41	3.76	4.86	0.83	0.98	0.29	0.47	0.52	0.42	2.00	0.76
AVERAGE	3.04	-0.31	3.61	0.23	3.26	0.25	0.16	-0.96	0.10	-0.89	0.27	0.72
STD.DEV.	0.456	0.396	0.875	0.925	0.176	0.226	0.070	0.097	0.120	0.095	0.444	0.206
VARIANCE	0.208	0.157	0.765	0.855	0.031	0.051	0.005	0.009	0.014	0.009	0.198	0.042
MAXIMUM	4.13	-0.07	4.98	3.13	3.71	0.66	0.78	-0.46	1.07	0.02	5.59	2.29
MINIMUM	1.56	-1.49	1.88	-2.44	3.32	0.15	-0.56	-1.73	-1.56	-1.73	-5.54	-1.07
RANGE	2.57	1.42	3.10	5.57	0.39	0.51	1.34	1.27	2.63	1.75	11.13	3.36
AVERAGE	3.02	-0.70	3.67	0.33	3.49	0.44	0.16	-1.06	-0.01	-0.79	0.38	0.42
STD.DEV.	0.715	0.384	0.647	1.483	0.094	0.127	0.284	0.287	0.533	0.358	2.132	0.675
VARIANCE	0.512	0.147	0.419	2.200	0.009	0.016	0.081	0.083	0.284	0.128	4.543	0.456
MAXIMUM	4.15	0.37	3.81	0.51	3.81	0.73	0.32	-0.63	0.32	-0.44	0.88	0.88
MINIMUM	2.17	-1.10	3.39	0.10	3.05	-0.10	-0.07	-0.98	-0.17	-1.34	-0.61	0.05
RANGE	1.98	1.47	0.42	0.41	0.76	0.83	0.39	0.35	0.49	0.90	1.49	0.83
AVERAGE	3.49	-0.45	3.64	0.29	3.51	0.41	0.15	-0.82	0.14	-0.87	0.06	0.49
STD.DEV.	0.467	0.369	0.092	0.098	0.192	0.150	0.095	0.085	0.106	0.215	0.367	0.220
VARIANCE	0.218	0.136	0.008	0.010	0.037	0.022	0.009	0.007	0.011	0.046	0.135	0.049
MAXIMUM	3.86	0.10	3.64	0.44	3.39	0.68	0.42	-0.95	0.32	-0.42	1.32	0.88
MINIMUM	2.51	-0.71	3.32	0.10	3.05	0.20	0.00	-1.54	-0.27	-0.85	0.10	0.46
RANGE	1.35	0.81	0.32	0.34	0.34	0.48	0.42	0.59	0.59	0.43	1.22	0.42
AVERAGE	3.23	-0.25	3.47	0.27	3.22	0.45	0.19	-1.20	0.03	-0.65	0.69	0.64
STD.DEV.	0.324	0.179	0.071	0.069	0.078	0.099	0.083	0.140	0.135	0.094	0.311	0.106
VARIANCE	0.105	0.032	0.005	0.005	0.006	0.010	0.007	0.020	0.018	0.009	0.097	0.011
MAXIMUM	5.37	0.49	3.76	0.49	3.52	0.85	0.42	-0.88	0.49	-0.37	0.59	0.95
MINIMUM	3.25	-0.24	3.42	0.12	3.17	0.20	0.05	-1.34	0.02	-0.85	-0.59	0.32
RANGE	2.12	0.73	0.34	0.37	0.35	0.65	0.37	0.46	0.47	0.48	1.18	0.63
AVERAGE	4.16	0.13	3.59	0.30	3.35	0.48	0.25	-1.11	0.25	-0.61	0.10	0.64
STD.DEV.	0.463	0.175	0.060	0.085	0.077	0.138	0.077	0.093	0.093	0.093	0.288	0.161
VARIANCE	0.214	0.031	0.006	0.007	0.006	0.019	0.006	0.009	0.009	0.009	0.083	0.026
MAXIMUM	4.71	0.32	3.71	0.32	3.71	0.51	0.34	-0.63	0.29	-0.49	0.93	0.88
MINIMUM	2.56	-0.85	3.27	-0.02	3.22	0.15	-0.07	-1.25	-0.10	-0.95	0.29	0.32
RANGE	2.15	1.17	0.44	0.34	0.49	0.36	0.41	0.62	0.39	0.46	0.64	0.56
AVERAGE	3.78	-0.23	3.52	0.17	3.48	0.35	0.11	-0.87	0.15	-0.72	0.62	0.56
STD.DEV.	0.496	0.287	0.098	0.075	0.114	0.092	0.091	0.155	0.081	0.106	0.159	0.126
VARIANCE	0.246	0.082	0.010	0.006	0.013	0.008	0.008	0.024	0.007	0.011	0.025	0.016

Appendix Table A9 - continued

LOCATION #	1		2		3		4		5		6	
	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS
MAXIMUM	4.52	0.20	3.59	0.61	3.49	0.49	0.56	-0.85	0.24	-0.37	0.98	0.88
MINIMUM	1.98	-0.44	3.27	0.24	3.05	0.07	0.07	-1.37	-0.20	-0.98	-0.10	0.20
RANGE	2.54	0.64	0.32	0.37	0.44	0.42	0.49	0.52	0.44	0.61	1.08	0.68
AVERAGE	3.05	-0.14	3.45	0.42	3.30	0.32	0.31	-1.10	0.01	-0.70	0.43	0.55
STD.DEV.	0.689	0.127	0.061	0.076	0.097	0.093	0.091	0.134	0.100	0.149	0.255	0.198
VARIANCE	0.474	0.016	0.004	0.006	0.009	0.009	0.008	0.018	0.010	0.022	0.065	0.039
MAXIMUM	4.05	-0.10	3.64	0.66	3.61	0.56	0.37	-1.05	0.12	-0.63	1.12	0.98
MINIMUM	2.64	-1.15	3.15	0.17	3.08	0.00	0.02	-1.44	-0.29	-1.20	-0.20	0.66
RANGE	1.41	1.05	0.49	0.49	0.53	0.56	0.35	0.39	0.41	0.57	1.32	0.32
AVERAGE	3.33	-0.51	3.38	0.40	3.39	0.29	0.21	-1.30	-0.07	-0.92	0.48	0.80
STD.DEV.	0.283	0.283	0.083	0.107	0.108	0.109	0.075	0.078	0.080	0.165	0.315	0.067
VARIANCE	0.080	0.080	0.007	0.012	0.012	0.012	0.006	0.006	0.006	0.027	0.099	0.004
MAXIMUM	5.37	0.68	3.71	0.51	3.78	0.68	0.37	-0.88	0.17	-0.46	1.34	1.07
MINIMUM	2.54	-0.66	3.34	0.20	3.10	0.12	-0.02	-1.44	-0.27	-0.95	0.12	0.32
RANGE	2.83	1.34	0.37	0.31	0.68	0.56	0.39	0.56	0.44	0.49	1.22	0.75
AVERAGE	3.86	0.08	3.53	0.36	3.33	0.43	0.22	-1.13	-0.03	-0.67	0.76	0.66
STD.DEV.	0.654	0.330	0.087	0.079	0.166	0.122	0.096	0.163	0.106	0.117	0.325	0.149
VARIANCE	0.427	0.109	0.008	0.006	0.028	0.015	0.009	0.027	0.011	0.014	0.105	0.022
MAXIMUM	4.52	0.63	3.64	0.34	3.81	0.63	0.37	-0.76	0.37	-0.27	0.98	1.00
MINIMUM	1.64	-0.81	3.25	0.00	3.15	0.05	0.00	-1.37	-0.42	-1.07	-0.27	0.29
RANGE	2.88	1.44	0.39	0.34	0.66	0.58	0.37	0.61	0.79	0.80	1.25	0.71
AVERAGE	3.45	-0.16	3.45	0.16	3.48	0.31	0.18	-1.03	-0.03	-0.69	0.56	0.67
STD.DEV.	0.791	0.299	0.066	0.082	0.134	0.124	0.090	0.130	0.202	0.191	0.280	0.194
VARIANCE	0.625	0.090	0.004	0.007	0.018	0.015	0.008	0.017	0.041	0.036	0.078	0.038

Appendix Table A10. Velocities at fixed locations inside Submersible Travelling Screen and on support framework. Bonneville First Powerhouse. Full Powerhouse loading. Medium turbine Load. 15 second samples.

LOCATION #	1		2		3		4		5		6	
	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS
MAXIMUM	2.76	0.12	2.47	0.51	2.20	0.61	0.22	-0.07	0.37	0.27	0.00	0.56
MINIMUM	1.44	-0.32	2.17	0.12	1.78	0.27	-0.12	-0.39	-0.24	-0.61	-0.56	-0.07
RANGE	1.32	0.44	0.30	0.39	0.42	0.34	0.34	0.32	0.61	0.88	0.56	0.63
AVERAGE	2.30	-0.07	2.35	0.37	2.03	0.45	0.08	-0.23	0.08	-0.07	-0.26	0.30
STD. DEV.	0.278	0.091	0.068	0.077	0.089	0.076	0.083	0.074	0.142	0.258	0.132	0.157
VARIANCE	0.077	0.008	0.005	0.006	0.008	0.006	0.007	0.006	0.020	0.067	0.017	0.025
MAXIMUM	2.47	0.34	2.34	0.46	2.15	0.71	0.32	-0.15	0.29	-0.02	0.39	0.71
MINIMUM	1.37	-0.20	2.08	0.17	1.78	0.32	-0.17	-0.51	-0.27	-0.61	-0.68	0.05
RANGE	1.10	0.54	0.26	0.29	0.37	0.39	0.49	0.36	0.56	0.59	1.07	0.66
AVERAGE	1.92	0.06	2.22	0.34	1.98	0.52	0.08	-0.31	-0.02	-0.31	0.03	0.38
STD. DEV.	0.291	0.123	0.066	0.067	0.084	0.080	0.115	0.081	0.152	0.146	0.208	0.126
VARIANCE	0.085	0.015	0.004	0.004	0.007	0.006	0.013	0.007	0.023	0.021	0.043	0.016
MAXIMUM	3.20	0.29	2.44	0.61	2.27	0.49	0.27	-0.15	0.10	-0.20	1.00	0.59
MINIMUM	1.68	-0.32	1.93	0.22	1.90	0.12	-0.02	-0.49	-0.85	-0.71	-0.27	0.15
RANGE	1.52	0.61	0.51	0.39	0.37	0.37	0.29	0.34	0.95	0.51	1.27	0.44
AVERAGE	2.37	-0.06	2.22	0.41	2.08	0.32	0.12	-0.31	-0.31	-0.46	0.28	0.40
STD. DEV.	0.442	0.131	0.098	0.086	0.075	0.087	0.074	0.085	0.222	0.107	0.247	0.076
VARIANCE	0.196	0.017	0.010	0.007	0.006	0.008	0.005	0.007	0.049	0.011	0.061	0.006
MAXIMUM	2.47	0.12	2.47	0.51	2.29	0.59	0.24	0.00	0.22	-0.22	0.34	0.71
MINIMUM	1.42	-0.46	2.08	0.20	1.98	0.17	-0.12	-0.42	-0.34	-0.95	-0.51	0.05
RANGE	1.05	0.58	0.39	0.31	0.31	0.42	0.36	0.42	0.56	0.73	0.85	0.66
AVERAGE	1.98	-0.17	2.25	0.36	2.14	0.38	0.08	-0.23	-0.04	-0.60	-0.04	0.41
STD. DEV.	0.266	0.153	0.076	0.077	0.072	0.093	0.077	0.107	0.120	0.188	0.182	0.147
VARIANCE	0.071	0.023	0.006	0.006	0.005	0.009	0.006	0.011	0.014	0.035	0.033	0.022
MAXIMUM	2.61	0.32	2.47	0.61	2.27	0.71	0.07	-0.20	0.24	-0.02	0.27	0.56
MINIMUM	1.29	-0.37	2.03	0.12	1.83	0.27	-0.32	-0.56	-0.22	-0.56	-0.46	-0.07
RANGE	1.32	0.69	0.44	0.49	0.44	0.44	0.39	0.36	0.46	0.54	0.73	0.63
AVERAGE	1.93	-0.07	2.28	0.40	2.03	0.51	-0.08	-0.38	-0.00	-0.36	-0.08	0.25
STD. DEV.	0.339	0.161	0.094	0.110	0.093	0.105	0.087	0.083	0.105	0.114	0.153	0.134
VARIANCE	0.115	0.026	0.009	0.012	0.009	0.011	0.008	0.007	0.011	0.013	0.023	0.018
MAXIMUM	2.88	0.27	2.54	0.71	2.34	0.61	0.24	-0.17	0.37	0.12	0.56	0.56
MINIMUM	1.20	-0.46	2.17	0.22	1.95	0.27	-0.22	-0.66	-0.24	-0.81	-0.76	0.07
RANGE	1.68	0.73	0.37	0.49	0.39	0.34	0.46	0.49	0.61	0.93	1.32	0.49
AVERAGE	1.85	-0.03	2.33	0.45	2.14	0.41	0.01	-0.45	0.07	-0.46	-0.02	0.34
STD. DEV.	0.343	0.133	0.084	0.105	0.078	0.076	0.098	0.100	0.158	0.272	0.294	0.095
VARIANCE	0.118	0.018	0.007	0.011	0.006	0.006	0.010	0.010	0.025	0.074	0.086	0.009

Appendix Table A10 - continued

LOCATION #	1		2		3		4		5		6	
	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS
MAXIMUM	2.08	0.27	2.47	0.66	2.37	0.63	0.27	-0.17	0.12	-0.39	1.05	0.71
MINIMUM	0.71	-0.49	2.03	0.22	1.88	0.32	-0.05	-0.81	-0.61	-0.76	-0.02	0.22
RANGE	1.37	0.76	0.44	0.44	0.49	0.31	0.32	0.64	0.73	0.37	1.07	0.49
AVERAGE	1.44	0.01	2.25	0.48	2.12	0.48	0.11	-0.46	-0.18	-0.58	0.55	0.44
STD.DEV.	0.336	0.138	0.096	0.102	0.117	0.070	0.070	0.153	0.177	0.080	0.219	0.113
VARIANCE	0.113	0.019	0.009	0.010	0.014	0.005	0.005	0.023	0.031	0.006	0.048	0.013
MAXIMUM	2.56	0.17	2.47	0.49	2.27	0.63	0.32	-0.05	0.20	-0.12	0.66	0.66
MINIMUM	1.32	-0.34	2.15	0.12	1.93	0.27	-0.07	-0.42	-0.42	-0.76	-0.02	0.29
RANGE	1.24	0.51	0.32	0.37	0.34	0.36	0.39	0.37	0.62	0.64	0.68	0.37
AVERAGE	1.89	-0.07	2.32	0.36	2.11	0.41	0.12	-0.26	-0.13	-0.41	0.18	0.51
STD.DEV.	0.364	0.120	0.079	0.074	0.061	0.088	0.090	0.089	0.137	0.120	0.148	0.097
VARIANCE	0.133	0.014	0.006	0.005	0.004	0.008	0.008	0.008	0.019	0.014	0.022	0.009
MAXIMUM	2.66	0.42	2.27	0.61	2.22	0.61	0.17	-0.02	0.42	-0.02	0.73	0.85
MINIMUM	1.37	-0.46	1.83	0.07	1.56	0.20	-0.27	-0.81	-0.07	-0.85	-0.46	0.05
RANGE	1.29	0.88	0.44	0.54	0.66	0.41	0.44	0.79	0.49	0.83	1.19	0.80
AVERAGE	2.07	0.01	2.10	0.34	1.95	0.41	-0.00	-0.36	0.11	-0.35	0.24	0.28
STD.DEV.	0.355	0.209	0.088	0.099	0.133	0.090	0.082	0.152	0.119	0.210	0.287	0.190
VARIANCE	0.126	0.044	0.008	0.010	0.018	0.008	0.007	0.023	0.014	0.044	0.082	0.036

Appendix Table A11. Velocities at fixed locations inside Submersible Travelling Screen and on support framework. Bonneville First Powerhouse Turbine SB. Full Powerhouse loading. Low turbine Load. 15 second samples.

LOCATION #	1		2		3		4		5		6	
	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS
MAXIMUM	2.03	0.24	2.03	0.51	1.81	0.51	0.20	-0.12	0.20	-0.27	0.42	0.51
MINIMUM	1.17	-0.42	1.73	0.17	1.39	0.17	-0.17	-0.51	-0.27	-0.76	-0.17	0.12
RANGE	0.86	0.66	0.30	0.34	0.42	0.34	0.37	0.39	0.47	0.49	0.59	0.39
AVERAGE	1.63	-0.12	1.88	0.35	1.65	0.36	0.03	-0.33	-0.00	-0.49	0.19	0.33
STD.DEV.	0.233	0.156	0.072	0.067	0.075	0.076	0.084	0.078	0.102	0.107	0.129	0.093
VARIANCE	0.054	0.024	0.005	0.004	0.006	0.006	0.007	0.006	0.010	0.011	0.017	0.009
MAXIMUM	2.86	0.81	2.34	1.00	2.27	0.98	0.22	-0.17	0.22	-0.12	0.32	0.76
MINIMUM	1.93	-0.37	1.95	0.34	1.73	0.37	-0.10	-0.51	-0.24	-0.66	-0.37	0.05
RANGE	0.93	1.18	0.39	0.66	0.54	0.61	0.32	0.34	0.46	0.54	0.69	0.71
AVERAGE	2.34	0.16	2.15	0.71	2.05	0.74	0.07	-0.35	0.00	-0.36	0.03	0.36
STD.DEV.	0.258	0.246	0.083	0.140	0.123	0.128	0.068	0.065	0.097	0.138	0.169	0.146
VARIANCE	0.067	0.061	0.007	0.019	0.015	0.016	0.005	0.004	0.009	0.019	0.029	0.021
MAXIMUM	2.10	-0.02	2.34	0.32	2.20	0.81	0.37	0.02	0.20	-0.42	0.20	0.73
MINIMUM	1.54	-0.51	1.98	-0.17	1.93	0.46	-0.12	-0.37	-0.27	-0.85	-0.10	0.32
RANGE	0.56	0.49	0.36	0.49	0.27	0.35	0.49	0.39	0.47	0.43	0.30	0.41
AVERAGE	1.85	-0.21	2.14	0.07	2.07	0.63	0.07	-0.15	-0.02	-0.56	0.03	0.56
STD.DEV.	0.112	0.109	0.093	0.099	0.067	0.079	0.104	0.078	0.103	0.088	0.067	0.097
VARIANCE	0.013	0.012	0.009	0.010	0.004	0.006	0.011	0.006	0.011	0.008	0.004	0.009
MAXIMUM	2.83	0.22	2.37	0.27	2.22	0.83	0.20	-0.02	0.15	-0.17	0.37	0.56
MINIMUM	1.88	-0.32	1.88	0.02	1.81	0.51	-0.12	-0.39	-0.22	-0.85	-0.07	0.05
RANGE	0.95	0.54	0.49	0.25	0.41	0.32	0.32	0.37	0.37	0.68	0.44	0.51
AVERAGE	2.39	0.02	2.14	0.16	2.02	0.70	0.07	-0.21	-0.01	-0.43	0.14	0.31
STD.DEV.	0.220	0.115	0.121	0.067	0.086	0.078	0.062	0.081	0.085	0.144	0.094	0.111
VARIANCE	0.048	0.013	0.015	0.004	0.007	0.006	0.004	0.006	0.007	0.021	0.009	0.012
MAXIMUM	2.56	0.46	2.27	0.81	2.15	0.93	0.22	-0.42	0.02	-0.37	0.22	0.56
MINIMUM	1.88	-0.39	1.98	0.32	1.81	0.59	-0.20	-0.73	-0.39	-0.76	-0.07	0.00
RANGE	0.68	0.85	0.29	0.49	0.34	0.34	0.42	0.31	0.41	0.39	0.29	0.56
AVERAGE	2.21	0.12	2.14	0.60	1.99	0.77	0.02	-0.55	-0.13	-0.55	0.09	0.32
STD.DEV.	0.161	0.161	0.067	0.122	0.080	0.082	0.088	0.076	0.088	0.078	0.070	0.133
VARIANCE	0.026	0.026	0.004	0.015	0.006	0.007	0.008	0.006	0.008	0.006	0.005	0.018
MAXIMUM	2.83	0.46	2.34	0.32	2.27	0.85	0.22	-0.02	0.27	-0.24	0.29	0.12
MINIMUM	1.20	-0.27	1.88	-0.20	1.98	0.42	-0.07	-0.37	-0.12	-0.81	-0.12	-0.17
RANGE	1.63	0.73	0.46	0.52	0.29	0.43	0.29	0.35	0.39	0.57	0.41	0.29
AVERAGE	1.89	0.05	2.06	0.08	2.13	0.63	0.10	-0.18	0.03	-0.54	0.14	-0.01
STD.DEV.	0.422	0.160	0.116	0.112	0.062	0.107	0.077	0.068	0.081	0.144	0.076	0.067
VARIANCE	0.178	0.026	0.013	0.013	0.004	0.011	0.006	0.005	0.007	0.021	0.006	0.004

Appendix Table A11 - continued

LOCATION #	1		2		3		4		5		6	
	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS
MAXIMUM	2.86	0.12	1.88	0.22	2.22	0.73	0.12	-0.42	0.22	-0.39	0.20	0.59
MINIMUM	1.20	-0.32	1.39	-0.22	1.81	0.29	-0.17	-0.73	-0.12	-0.76	-0.17	0.20
RANGE	1.66	0.44	0.49	0.44	0.41	0.44	0.29	0.31	0.34	0.37	0.37	0.39
AVERAGE	2.14	-0.10	1.65	-0.04	2.06	0.49	-0.00	-0.56	0.06	-0.57	0.04	0.41
STD. DEV.	0.472	0.101	0.103	0.096	0.088	0.089	0.060	0.060	0.078	0.073	0.084	0.078
VARIANCE	0.222	0.010	0.011	0.009	0.008	0.008	0.004	0.004	0.006	0.005	0.007	0.006
MAXIMUM	2.61	0.00	1.93	0.46	2.12	0.76	0.17	-0.07	0.02	0.00	0.42	0.46
MINIMUM	1.15	-0.46	1.49	-0.05	1.83	0.39	-0.10	-0.61	-0.32	-0.27	-0.02	0.07
RANGE	1.46	0.46	0.44	0.51	0.29	0.37	0.27	0.54	0.34	0.27	0.44	0.39
AVERAGE	2.06	-0.26	1.71	0.20	1.99	0.57	0.04	-0.31	-0.17	-0.14	0.19	0.28
STD. DEV.	0.411	0.123	0.088	0.127	0.069	0.076	0.060	0.138	0.080	0.061	0.100	0.090
VARIANCE	0.169	0.015	0.008	0.016	0.005	0.006	0.004	0.019	0.006	0.004	0.010	0.008
MAXIMUM	2.69	0.27	2.37	0.22	2.34	0.76	0.27	-0.22	0.27	0.02	0.32	0.42
MINIMUM	1.29	-0.37	1.98	-0.17	1.98	0.37	-0.10	-0.66	-0.12	-0.85	-0.10	-0.22
RANGE	1.40	0.64	0.39	0.39	0.36	0.39	0.37	0.44	0.39	0.87	0.42	0.64
AVERAGE	2.11	-0.04	2.17	0.04	2.15	0.54	0.06	-0.43	0.04	-0.49	0.11	0.05
STD. DEV.	0.305	0.142	0.088	0.079	0.084	0.078	0.084	0.094	0.091	0.187	0.103	0.138
VARIANCE	0.093	0.020	0.008	0.006	0.007	0.006	0.007	0.009	0.008	0.035	0.011	0.019

Appendix Table A12. Comparison of 30 minute and 15 second samples of velocities at fixed locations inside Submersible Travelling Screen and on support framework, Bonneville First Powerhouse Turbine 5B. Full Powerhouse loading, 15 second samples.

LOCATION #		1		2		3		4		5		6	
		Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z
		FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS
High Turbine Load													
30 min. sample	MAXIMUM	5.18	0.76	3.74	0.61	3.96	1.00	0.51	-0.42	0.59	0.20	1.86	1.27
	MINIMUM	0.61	-1.32	2.93	-0.07	2.83	-0.15	-0.17	-1.56	-0.56	-1.49	-0.59	-0.07
	RANGE	4.57	2.08	0.81	0.68	1.13	1.15	0.68	1.14	1.15	1.69	2.45	1.34
	AVERAGE	3.27	-0.22	3.40	0.27	3.35	0.39	0.22	-1.07	-0.01	-0.71	0.44	0.59
	STD. DEV.	0.713	0.327	0.107	0.116	0.163	0.167	0.102	0.177	0.164	0.237	0.377	0.219
	VARIANCE	0.508	0.107	0.011	0.014	0.027	0.028	0.011	0.031	0.027	0.056	0.142	0.048
15 sec. sample	MAXIMUM	4.52	0.63	3.61	0.34	3.81	0.54	0.37	-0.76	0.37	-0.27	0.98	1.00
	MINIMUM	2.54	-0.46	3.25	0.00	3.15	0.12	0.00	-1.20	-0.42	-1.07	0.29	0.32
	RANGE	1.98	1.09	0.36	0.34	0.66	0.42	0.37	0.44	0.79	0.80	0.69	0.68
	AVERAGE	3.77	-0.07	3.45	0.15	3.47	0.30	0.19	-1.00	-0.00	-0.69	0.66	0.69
	STD. DEV.	0.517	0.250	0.066	0.082	0.137	0.104	0.091	0.104	0.216	0.201	0.183	0.197
	VARIANCE	0.268	0.063	0.004	0.007	0.019	0.011	0.008	0.011	0.047	0.040	0.033	0.039
Medium Turbine Load													
30 min. sample	MAXIMUM	3.98	1.12	2.86	0.90	2.51	0.76	0.46	0.20	0.51	0.20	1.20	0.90
	MINIMUM	0.07	-1.25	1.66	-0.02	1.51	-0.02	-0.27	-0.98	-0.66	-1.22	-0.95	-0.17
	RANGE	3.91	2.37	1.20	0.92	1.00	0.78	0.73	1.18	1.17	1.42	2.15	1.07
	AVERAGE	2.05	-0.04	2.24	0.42	2.06	0.40	0.08	-0.39	-0.10	-0.49	0.04	0.36
	STD. DEV.	0.489	0.264	0.163	0.135	0.135	0.102	0.104	0.207	0.171	0.245	0.293	0.181
	VARIANCE	0.239	0.070	0.027	0.018	0.018	0.010	0.011	0.043	0.029	0.060	0.086	0.033
15 sec. sample	MAXIMUM	2.66	0.42	2.27	0.61	2.22	0.61	0.17	-0.02	0.42	-0.02	0.73	0.42
	MINIMUM	1.37	-0.46	1.86	0.07	1.56	0.22	-0.27	-0.56	-0.07	-0.61	-0.46	0.05
	RANGE	1.29	0.88	0.41	0.54	0.66	0.39	0.44	0.54	0.49	0.59	1.19	0.37
	AVERAGE	2.14	0.01	2.11	0.34	1.93	0.43	-0.00	-0.32	0.10	-0.27	0.28	0.21
	STD. DEV.	0.346	0.231	0.087	0.104	0.135	0.089	0.086	0.123	0.108	0.147	0.292	0.091
	VARIANCE	0.120	0.053	0.008	0.011	0.018	0.008	0.007	0.015	0.012	0.022	0.085	0.008
Low Turbine Load													
30 min. sample	MAXIMUM	3.44	0.51	2.51	0.90	2.37	1.00	0.37	0.42	0.32	0.20	0.51	0.71
	MINIMUM	0.90	-0.76	1.39	-0.27	1.76	0.24	-0.32	-0.85	-0.61	-0.98	-0.51	-0.46
	RANGE	2.54	1.27	1.12	1.17	0.61	0.76	0.69	1.27	0.93	1.18	1.02	1.17
	AVERAGE	2.11	-0.15	1.99	0.13	2.12	0.55	0.04	-0.33	-0.06	-0.39	0.10	0.22
	STD. DEV.	0.412	0.198	0.224	0.149	0.107	0.101	0.090	0.188	0.121	0.201	0.120	0.177
	VARIANCE	0.170	0.039	0.050	0.022	0.011	0.010	0.008	0.036	0.015	0.040	0.014	0.031
15 sec. sample	MAXIMUM	2.69	0.17	2.37	0.22	2.34	0.68	0.20	-0.27	0.27	-0.22	0.32	0.22
	MINIMUM	1.68	-0.37	1.98	-0.17	1.98	0.37	-0.10	-0.66	-0.12	-0.85	-0.10	-0.22
	RANGE	1.01	0.54	0.39	0.39	0.36	0.31	0.30	0.39	0.39	0.63	0.42	0.44
	AVERAGE	2.21	-0.07	2.15	0.03	2.15	0.54	0.04	-0.43	0.06	-0.54	0.10	-0.00
	STD. DEV.	0.242	0.131	0.078	0.077	0.087	0.074	0.064	0.092	0.087	0.160	0.110	0.098
	VARIANCE	0.059	0.017	0.006	0.006	0.008	0.005	0.004	0.008	0.008	0.025	0.012	0.010

Appendix Table A13. Velocities at Bulkhead Slot. Bonneville Dam First Powerhouse.
Turbine 5B. Full powerhouse. High turbine load.

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		6.42	-1.03		7.40	0.32
MINIMUM		5.76	-1.61		2.64	-3.22
RANGE		0.66	0.58		4.76	3.54
AVERAGE	1.00	6.07	-1.34	21.00	4.74	-1.52
STD. DEV.		0.166	0.125		1.333	1.032
VARIANCE		0.028	0.016		1.778	1.065
MAXIMUM		2.47	-1.42		12.74	4.00
MINIMUM		2.03	-1.76		-3.10	-6.42
RANGE		0.44	0.34		15.84	10.42
AVERAGE	5.52	2.25	-1.61	25.52	3.32	-1.47
STD. DEV.		0.094	0.082		3.710	2.751
VARIANCE		0.009	0.007		13.761	7.567
MAXIMUM		2.29	-2.12		5.05	0.12
MINIMUM		2.03	-2.42		-1.51	-2.91
RANGE		0.26	0.30		6.56	3.03
AVERAGE	10.11	2.15	-2.26	30.11	2.64	-1.40
STD. DEV.		0.061	0.063		1.598	0.846
VARIANCE		0.004	0.004		2.554	0.715
MAXIMUM		1.88	-1.86		12.89	4.22
MINIMUM		1.56	-2.20		-2.15	-5.05
RANGE		0.32	0.34		15.04	9.27
AVERAGE	14.48	1.71	-2.02	34.48	3.56	-1.81
STD. DEV.		0.067	0.070		3.642	1.895
VARIANCE		0.005	0.005		13.267	3.589
MAXIMUM		1.81	-1.95		6.62	-0.20
MINIMUM		1.56	-2.25		-4.30	-5.88
RANGE		0.25	0.30		10.92	5.68
AVERAGE	14.49	1.69	-2.08	34.49	0.96	-3.26
STD. DEV.		0.054	0.064		3.082	1.672
VARIANCE		0.003	0.004		9.500	2.797
MAXIMUM		1.81	-1.90		15.82	3.61
MINIMUM		1.56	-2.25		1.29	-4.08
RANGE		0.25	0.35		14.53	7.69
AVERAGE	14.54	1.69	-2.06	34.54	8.79	-0.26
STD. DEV.		0.063	0.067		3.935	2.093
VARIANCE		0.004	0.005		15.482	4.383

Appendix Table 13 - continued

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		1.78	-1.90		11.82	1.34
MINIMUM		1.54	-2.15		-3.66	-5.76
RANGE		0.24	0.25		15.48	7.10
AVERAGE	14.54	1.67	-2.02	34.54	3.24	-2.45
STD. DEV.		0.055	0.062		4.486	2.087
VARIANCE		0.003	0.004		20.129	4.354
MAXIMUM		1.78	-1.86		9.89	2.22
MINIMUM		1.49	-2.15		2.39	-3.86
RANGE		0.29	0.29		7.50	6.08
AVERAGE	14.58	1.65	-1.99	34.58	6.88	-0.17
STD. DEV.		0.066	0.071		1.931	1.816
VARIANCE		0.004	0.005		3.730	3.298
MAXIMUM		1.83	-1.86		14.45	5.37
MINIMUM		1.54	-2.22		0.32	-4.61
RANGE		0.29	0.36		14.13	9.98
AVERAGE	14.60	1.67	-2.05	34.60	8.49	1.16
STD. DEV.		0.062	0.079		3.962	2.970
VARIANCE		0.004	0.006		15.696	8.821
MAXIMUM		1.83	-1.83		6.84	-0.22
MINIMUM		1.56	-2.15		-2.32	-5.54
RANGE		0.27	0.32		9.16	5.32
AVERAGE	14.64	1.71	-2.01	34.64	1.76	-2.83
STD. DEV.		0.061	0.065		2.528	1.243
VARIANCE		0.004	0.004		6.389	1.546

Appendix Table A14. Velocities at Bulkhead Slot, Bonneville Dam First Powerhouse.
Turbine 5B. Full powerhouse. Medium turbine load.

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		6.96	-1.64		6.05	0.81
MINIMUM		6.45	-2.22		2.42	-2.61
RANGE		0.51	0.58		3.63	3.42
AVERAGE	1.28	6.73	-1.93	21.28	4.08	-0.52
STD. DEV.		0.120	0.142		0.866	0.814
VARIANCE		0.014	0.020		0.749	0.663
MAXIMUM		6.96	-1.66		6.42	0.02
MINIMUM		6.47	-2.51		3.03	-2.56
RANGE		0.49	0.85		3.39	2.58
AVERAGE	1.29	6.73	-1.97	21.29	4.39	-1.21
STD. DEV.		0.114	0.199		0.746	0.710
VARIANCE		0.013	0.040		0.556	0.504
MAXIMUM		7.30	-1.29		8.72	0.24
MINIMUM		6.71	-1.88		4.47	-2.76
RANGE		0.59	0.59		4.25	3.00
AVERAGE	1.30	6.96	-1.62	21.30	6.07	-1.22
STD. DEV.		0.156	0.145		1.093	0.774
VARIANCE		0.024	0.021		1.196	0.600
MAXIMUM		6.96	-1.54		8.59	0.17
MINIMUM		6.49	-2.03		3.91	-3.39
RANGE		0.47	0.49		4.68	3.56
AVERAGE	1.32	6.73	-1.81	21.32	5.83	-1.88
STD. DEV.		0.113	0.129		1.280	1.024
VARIANCE		0.013	0.017		1.639	1.049
MAXIMUM		7.01	-1.64		7.89	0.07
MINIMUM		6.45	-2.32		2.54	-2.17
RANGE		0.56	0.68		5.35	2.24
AVERAGE	1.35	6.75	-1.95	21.35	5.41	-1.17
STD. DEV.		0.112	0.162		1.562	0.461
VARIANCE		0.013	0.026		2.439	0.212
MAXIMUM		6.79	-1.59		4.81	-0.24
MINIMUM		6.27	-2.32		0.32	-3.15
RANGE		0.52	0.73		4.49	2.91
AVERAGE	1.41	6.61	-1.95	21.41	2.60	-2.04
STD. DEV.		0.098	0.218		1.176	0.681
VARIANCE		0.010	0.048		1.383	0.463

Appendix Table A14 - continued

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		1.86	-0.37		5.96	-0.17
MINIMUM		1.49	-0.83		-1.73	-4.42
RANGE		0.37	0.46		7.69	4.25
AVERAGE	5.35	1.66	-0.61	25.35	2.68	-2.43
STD. DEV.		0.083	0.080		2.079	1.114
VARIANCE		0.007	0.006		4.324	1.240
MAXIMUM		1.34	-1.00		4.71	0.27
MINIMUM		1.00	-1.25		-2.64	-3.03
RANGE		0.34	0.25		7.35	3.30
AVERAGE	10.22	1.18	-1.11	30.22	1.41	-1.53
STD. DEV.		0.070	0.059		2.019	0.851
VARIANCE		0.005	0.004		4.077	0.725
MAXIMUM		0.93	-0.93		8.20	1.10
MINIMUM		0.61	-1.25		-1.10	-4.20
RANGE		0.32	0.32		9.30	5.30
AVERAGE	15.43	0.78	-1.07	35.43	3.50	-1.31
STD. DEV.		0.068	0.071		2.244	1.397
VARIANCE		0.005	0.005		5.035	1.952

Appendix Table A15. Velocities at Bulkhead Slot. Bonneville Dam First Powerhouse.
Turbine 5B. Full powerhouse. Low turbine load.

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		5.79	-1.15		5.86	1.20
MINIMUM		5.27	-1.54		2.20	-0.56
RANGE		0.52	0.39		3.66	1.76
AVERAGE	0.53	5.51	-1.40	20.53	3.95	0.27
STD.DEV.		0.094	0.090		1.112	0.386
VARIANCE		0.009	0.008		1.236	0.149
MAXIMUM		1.98	-0.46		4.13	0.85
MINIMUM		1.44	-0.81		0.07	-2.81
RANGE		0.54	0.35		4.06	3.66
AVERAGE	4.61	1.71	-0.63	24.61	2.39	-1.04
STD.DEV.		0.117	0.085		0.884	0.748
VARIANCE		0.014	0.007		0.781	0.560
MAXIMUM		1.49	-1.05		6.76	1.39
MINIMUM		1.20	-1.34		2.15	-2.66
RANGE		0.29	0.29		4.61	4.05
AVERAGE	9.38	1.35	-1.18	29.38	3.71	-1.12
STD.DEV.		0.066	0.072		1.128	0.783
VARIANCE		0.004	0.005		1.273	0.613
MAXIMUM		1.00	-1.29		6.67	1.25
MINIMUM		0.68	-1.59		-0.61	-2.81
RANGE		0.32	0.30		7.28	4.06
AVERAGE	14.43	0.85	-1.45	34.43	3.45	-0.93
STD.DEV.		0.069	0.070		1.714	0.953
VARIANCE		0.005	0.005		2.937	0.908
MAXIMUM		0.81	-0.85		10.18	2.22
MINIMUM		0.54	-1.22		3.34	-0.76
RANGE		0.27	0.37		6.84	2.98
AVERAGE	14.49	0.69	-1.02	34.49	6.09	0.54
STD.DEV.		0.066	0.078		2.115	0.752
VARIANCE		0.004	0.006		4.473	0.566
MAXIMUM		1.00	-1.17		6.08	0.10
MINIMUM		0.76	-1.49		2.25	-3.64
RANGE		0.24	0.32		3.83	3.74
AVERAGE	14.52	0.90	-1.30	34.52	3.54	-1.48
STD.DEV.		0.061	0.059		1.009	0.919
VARIANCE		0.004	0.003		1.017	0.844

Appendix Table A15 - continued

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		1.00	-1.20		4.98	-0.37
MINIMUM		0.71	-1.49		-1.59	-2.15
RANGE		0.29	0.29		6.57	1.78
AVERAGE	14.55	0.90	-1.32	34.55	2.29	-1.18
STD. DEV.		0.061	0.071		1.598	0.407
VARIANCE		0.004	0.005		2.553	0.166
MAXIMUM		0.85	-1.20		6.91	-0.07
MINIMUM		0.56	-1.59		4.08	-1.88
RANGE		0.29	0.39		2.83	1.81
AVERAGE	14.56	0.73	-1.44	34.56	5.81	-1.22
STD. DEV.		0.060	0.073		0.640	0.440
VARIANCE		0.004	0.005		0.410	0.194
MAXIMUM		0.93	-1.32		7.64	1.83
MINIMUM		0.54	-1.59		2.71	-1.90
RANGE		0.39	0.27		4.93	3.73
AVERAGE	14.60	0.79	-1.47	34.60	4.49	-0.30
STD. DEV.		0.088	0.060		1.388	1.009
VARIANCE		0.008	0.004		1.926	1.019

Appendix Table A16. Comparison of 30 minute vs 15 second samples of velocities at the Bulkhead Slot. Bonneville Dam First Powerhouse. Turbine 5B. Full powerhouse.

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
High Turbine Load						
30 min. sample		1.88	-1.61		15.19	5.62
MINIMUM		1.44	-2.25		-8.01	-9.38
RANGE		0.44	0.64		23.20	15.00
AVERAGE	14.44	1.67	-1.99	34.44	4.44	-1.54
STD.DEV.		0.072	0.078		3.898	2.249
VARIANCE		0.005	0.006		15.192	5.059
15 sec. sample		1.88	-1.86		9.33	1.00
MINIMUM		1.56	-2.20		-2.15	-5.05
RANGE		0.32	0.34		11.48	6.05
AVERAGE	14.48	1.72	-2.03	34.48	2.81	-2.24
STD.DEV.		0.069	0.071		2.882	1.631
VARIANCE		0.005	0.005		8.307	2.660
Medium Turbine Load						
30 min. sample		2.27	-0.27		12.23	1.88
MINIMUM		1.39	-0.98		-2.51	-6.67
RANGE		0.88	0.71		14.74	8.55
AVERAGE	5.55	1.79	-0.65	25.55	4.00	-2.45
STD.DEV.		0.130	0.103		2.303	1.281
VARIANCE		0.017	0.011		5.305	1.641
15 sec. sample		1.86	-0.37		5.69	-0.17
MINIMUM		1.49	-0.83		-1.73	-4.42
RANGE		0.37	0.46		7.42	4.25
AVERAGE	5.34	1.66	-0.62	25.34	2.46	-2.24
STD.DEV.		0.082	0.078		2.218	1.081
VARIANCE		0.007	0.006		4.920	1.169
Low Turbine Load						
30 min. sample		1.05	-1.20		8.59	1.93
MINIMUM		0.56	-1.73		-2.59	-5.44
RANGE		0.49	0.53		11.18	7.37
AVERAGE	14.47	0.84	-1.39	34.47	3.81	-1.26
STD.DEV.		0.072	0.086		1.650	1.005
VARIANCE		0.005	0.007		2.724	1.010
15 sec. sample		1.00	-1.29		6.67	0.32
MINIMUM		0.68	-1.59		0.95	-2.69
RANGE		0.32	0.30		5.72	3.01
AVERAGE	14.44	0.85	-1.45	34.44	3.56	-1.06
STD.DEV.		0.071	0.068		1.668	0.838
VARIANCE		0.005	0.005		2.783	0.702

Appendix Table A17. Velocities 10 feet upstream and 1 foot upstream of trashracks of Turbine 5B at the McNary Powerhouse. Full powerhouse loading. High turbine load.

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		0.20	1.70	-0.12		-0.22	5.35	2.71
MINIMUM		-0.12	1.22	-0.44		-0.66	4.96	1.90
RANGE		0.32	0.56	0.32		0.44	0.39	0.73
AVERAGE	255.83	0.04	1.58	-0.28	253.83	-0.45	5.15	2.36
STD. DEV.		0.07	0.10	0.07		0.09	0.10	0.20
VARIANCE		0.00	0.01	0.01		0.01	0.01	0.04
MAXIMUM		0.05	1.90	-0.37		-0.42	5.57	0.83
MINIMUM		-0.27	1.56	-0.66		-0.71	5.30	0.59
RANGE		0.32	0.34	0.29		0.29	0.27	0.24
AVERAGE	264.95	-0.13	1.76	-0.50	262.95	-0.55	5.46	0.70
STD. DEV.		0.07	0.08	0.07		0.06	0.06	0.06
VARIANCE		0.01	0.01	0.00		0.00	0.00	0.00
MAXIMUM		0.02	2.00	-0.29		-0.27	5.30	0.54
MINIMUM		-0.27	1.59	-0.61		-0.59	5.05	0.22
RANGE		0.29	0.41	0.32		0.32	0.25	0.32
AVERAGE	267.40	-0.10	1.83	-0.40	265.40	-0.42	5.19	0.39
STD. DEV.		0.06	0.09	0.07		0.06	0.06	0.08
VARIANCE		0.00	0.01	0.00		0.00	0.00	0.01
MAXIMUM		0.02	1.88	-0.42		-0.17	4.81	0.71
MINIMUM		-0.24	1.51	-0.68		-0.56	4.52	0.42
RANGE		0.26	0.37	0.26		0.39	0.29	0.29
AVERAGE	273.10	-0.11	1.75	-0.53	271.10	-0.36	4.69	0.54
STD. DEV.		0.07	0.08	0.07		0.09	0.06	0.07
VARIANCE		0.00	0.01	0.00		0.01	0.00	0.01
MAXIMUM		-0.05	1.81	-0.46		-0.10	4.93	-0.17
MINIMUM		-0.32	1.46	-0.73		-0.42	4.66	-0.46
RANGE		0.27	0.35	0.27		0.32	0.27	0.29
AVERAGE	278.79	-0.17	1.68	-0.59	276.79	-0.25	4.79	-0.30
STD. DEV.		0.07	0.08	0.06		0.08	0.06	0.06
VARIANCE		0.00	0.01	0.00		0.01	0.00	0.00
MAXIMUM		-0.07	1.42	-0.51		-0.15	4.03	-0.90
MINIMUM		-0.37	1.07	-0.78		-0.37	3.71	-1.15
RANGE		0.30	0.35	0.27		0.22	0.32	0.25
AVERAGE	290.22	-0.24	1.29	-0.66	288.22	-0.24	3.85	-0.99
STD. DEV.		0.06	0.09	0.06		0.06	0.08	0.06
VARIANCE		0.00	0.01	0.00		0.00	0.01	0.00

Appendix Table A17 - continued

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		-0.10	1.54	-0.44		-0.22	4.22	-0.15
MINIMUM		-0.32	1.22	-0.88		-0.49	3.93	-0.42
RANGE		0.22	0.32	0.44		0.27	0.29	0.27
AVERAGE	284.14	-0.22	1.42	-0.64	282.14	-0.35	4.09	-0.26
STD.DEV.		0.05	0.07	0.08		0.06	0.06	0.06
VARIANCE		0.00	0.00	0.01		0.00	0.00	0.00
MAXIMUM		-0.12	1.83	-0.49		-0.22	4.96	-0.27
MINIMUM		-0.42	1.49	-0.76		-0.56	4.66	-0.51
RANGE		0.30	0.34	0.27		0.34	0.30	0.24
AVERAGE	278.49	-0.26	1.66	-0.60	276.49	-0.36	4.82	-0.38
STD.DEV.		0.07	0.08	0.06		0.07	0.07	0.06
VARIANCE		0.00	0.01	0.00		0.01	0.00	0.00
MAXIMUM		-0.20	1.34	-0.49		-0.22	2.93	-0.59
MINIMUM		-0.51	0.98	-0.76		-0.51	2.66	-0.88
RANGE		0.31	0.36	0.27		0.29	0.27	0.29
AVERAGE	295.83	-0.35	1.21	-0.63	293.83	-0.36	2.81	-0.71
STD.DEV.		0.07	0.08	0.06		0.06	0.06	0.06
VARIANCE		0.00	0.01	0.00		0.00	0.00	0.00
MAXIMUM		-0.37	1.17	-0.49		-0.37	2.86	-1.22
MINIMUM		-0.68	0.81	-0.78		-0.63	2.59	-1.54
RANGE		0.31	0.36	0.29		0.26	0.27	0.32
AVERAGE	301.93	-0.50	1.02	-0.63	299.93	-0.48	2.73	-1.36
STD.DEV.		0.07	0.07	0.07		0.06	0.06	0.07
VARIANCE		0.01	0.00	0.00		0.00	0.00	0.00
MAXIMUM		-0.46	1.00	-0.51		-0.44	1.98	-0.98
MINIMUM		-0.85	0.71	-0.76		-0.73	1.71	-1.27
RANGE		0.39	0.29	0.25		0.29	0.27	0.29
AVERAGE	307.85	-0.65	0.85	-0.62	305.85	-0.57	1.85	-1.12
STD.DEV.		0.07	0.07	0.06		0.06	0.06	0.07
VARIANCE		0.01	0.01	0.00		0.00	0.00	0.01
MAXIMUM		-0.56	0.95	-0.44		-0.49	1.64	-0.85
MINIMUM		-0.90	0.44	-0.73		-0.76	1.34	-1.22
RANGE		0.34	0.51	0.29		0.27	0.30	0.37
AVERAGE	313.93	-0.71	0.68	-0.59	311.93	-0.61	1.52	-1.05
STD.DEV.		0.08	0.09	0.07		0.07	0.07	0.06
VARIANCE		0.01	0.01	0.00		0.00	0.00	0.00

Appendix Table A17 - continued

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		-0.63	0.61	-0.44		-0.29	1.32	-0.56
MINIMUM		-0.98	0.29	-0.76		-0.66	0.90	-0.90
RANGE		0.35	0.32	0.32		0.37	0.42	0.34
AVERAGE	320.07	-0.01	0.51	-0.55	318.07	-0.46	1.08	-0.73
STD. DEV.		0.07	0.08	0.07		0.08	0.08	0.08
VARIANCE		0.00	0.01	0.00		0.01	0.01	0.01
MAXIMUM		-0.76	0.63	-0.17		0.93	0.85	0.22
MINIMUM		-1.25	0.22	-0.68		0.42	0.34	-0.27
RANGE		0.49	0.41	0.51		0.51	0.51	0.49
AVERAGE	326.52	-0.93	0.39	-0.45	324.52	0.66	0.60	-0.01
STD. DEV.		0.10	0.10	0.11		0.14	0.11	0.12
VARIANCE		0.01	0.01	0.01		0.02	0.01	0.01
MAXIMUM		-0.83	0.22	-0.34		1.22	-0.17	0.22
MINIMUM		-1.15	-0.07	-0.59		0.88	-0.56	-0.17
RANGE		0.32	0.29	0.25		0.34	0.39	0.39
AVERAGE	333.26	-0.97	0.09	-0.46	331.26	1.06	-0.36	0.05
STD. DEV.		0.07	0.08	0.06		0.08	0.08	0.10
VARIANCE		0.01	0.01	0.00		0.01	0.01	0.01

Appendix Table A18. Velocities 10 feet upstream and 1 foot upstream of trashracks of Turbine 5B at the McNary Powerhouse. Full powerhouse loading. Medium turbine load.

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		0.22	1.27	-0.24		0.05	3.47	1.56
MINIMUM		-0.10	0.90	-0.54		-0.17	3.20	1.32
RANGE		0.32	0.37	0.30		0.22	0.27	0.24
AVERAGE	255.15	0.07	1.09	-0.39	253.15	-0.06	3.34	1.45
STD.DEV.		0.06	0.08	0.06		0.05	0.06	0.06
VARIANCE		0.00	0.01	0.00		0.00	0.00	0.00
MAXIMUM		0.22	1.25	-0.34		0.07	3.20	1.37
MINIMUM		-0.07	0.88	-0.59		-0.37	2.83	1.10
RANGE		0.29	0.37	0.25		0.44	0.37	0.27
AVERAGE	260.25	0.08	1.12	-0.44	258.25	-0.16	3.02	1.26
STD.DEV.		0.07	0.08	0.05		0.08	0.08	0.06
VARIANCE		0.00	0.01	0.00		0.01	0.01	0.00
MAXIMUM		0.24	1.29	-0.37		0.07	3.44	0.32
MINIMUM		-0.07	0.98	-0.59		-0.27	3.15	0.07
RANGE		0.31	0.31	0.22		0.34	0.29	0.25
AVERAGE	267.10	0.07	1.14	-0.47	265.10	-0.08	3.32	0.21
STD.DEV.		0.08	0.08	0.05		0.06	0.07	0.06
VARIANCE		0.01	0.01	0.00		0.00	0.00	0.00
MAXIMUM		0.07	1.27	-0.37		0.05	3.27	0.37
MINIMUM		-0.27	0.88	-0.66		-0.46	3.03	0.10
RANGE		0.34	0.39	0.29		0.51	0.24	0.27
AVERAGE	272.81	-0.07	1.12	-0.51	270.81	-0.16	3.14	0.24
STD.DEV.		0.07	0.08	0.06		0.11	0.06	0.06
VARIANCE		0.00	0.01	0.00		0.01	0.00	0.00
MAXIMUM		-0.02	1.15	-0.42		-0.12	3.15	-0.07
MINIMUM		-0.27	0.78	-0.68		-0.32	2.91	-0.32
RANGE		0.25	0.37	0.26		0.20	0.24	0.25
AVERAGE	278.55	-0.13	1.04	-0.53	276.55	-0.21	3.04	-0.20
STD.DEV.		0.07	0.08	0.05		0.05	0.06	0.06
VARIANCE		0.00	0.01	0.00		0.00	0.00	0.00
MAXIMUM		-0.07	1.10	-0.44		-0.02	2.76	-0.07
MINIMUM		-0.27	0.71	-0.71		-0.46	2.34	-0.37
RANGE		0.20	0.39	0.27		0.44	0.42	0.30
AVERAGE	283.92	-0.14	0.99	-0.54	281.92	-0.25	2.50	-0.19
STD.DEV.		0.05	0.07	0.06		0.10	0.11	0.06
VARIANCE		0.00	0.01	0.00		0.01	0.01	0.00

Appendix Table A18 - continued

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		0.61	1.00	-0.42		0.02	2.64	-0.37
MINIMUM		-0.12	0.15	-1.22		-0.51	2.15	-0.71
RANGE		0.73	0.85	0.80		0.53	0.49	0.34
AVERAGE	290.20	0.23	0.62	-0.76	288.20	-0.26	2.35	-0.52
STD. DEV.		0.23	0.24	0.20		0.14	0.11	0.08
VARIANCE		0.05	0.06	0.04		0.02	0.01	0.01
MAXIMUM		0.02	1.00	-0.46		-0.05	2.08	-0.42
MINIMUM		-0.32	0.59	-0.76		-0.29	1.78	-0.68
RANGE		0.34	0.41	0.30		0.24	0.30	0.26
AVERAGE	295.73	-0.15	0.83	-0.60	293.73	-0.17	1.95	-0.55
STD. DEV.		0.07	0.08	0.06		0.06	0.06	0.06
VARIANCE		0.00	0.01	0.00		0.00	0.00	0.00
MAXIMUM		-0.12	0.90	-0.46		-0.07	1.88	-0.95
MINIMUM		-0.39	0.56	-0.71		-0.32	1.66	-1.20
RANGE		0.27	0.34	0.25		0.25	0.22	0.25
AVERAGE	301.85	-0.25	0.77	-0.59	299.85	-0.18	1.79	-1.06
STD. DEV.		0.06	0.08	0.06		0.06	0.06	0.06
VARIANCE		0.00	0.01	0.00		0.00	0.00	0.00
MAXIMUM		-0.24	0.76	-0.46		-0.07	1.34	-0.76
MINIMUM		-0.49	0.32	-0.71		-0.37	1.10	-1.00
RANGE		0.25	0.44	0.25		0.30	0.24	0.24
AVERAGE	307.79	-0.36	0.61	-0.56	305.79	-0.22	1.22	-0.88
STD. DEV.		0.06	0.09	0.07		0.06	0.06	0.05
VARIANCE		0.00	0.01	0.00		0.00	0.00	0.00
MAXIMUM		-0.17	0.59	-0.46		-0.05	1.00	-0.85
MINIMUM		-0.42	0.27	-0.71		-0.32	0.71	-1.10
RANGE		0.25	0.32	0.25		0.27	0.29	0.25
AVERAGE	314.07	-0.28	0.45	-0.55	312.07	-0.19	0.86	-0.96
STD. DEV.		0.06	0.07	0.06		0.05	0.06	0.07
VARIANCE		0.00	0.00	0.00		0.00	0.00	0.00
MAXIMUM		-0.07	0.51	-0.39		-0.05	0.73	-0.59
MINIMUM		-0.37	0.20	-0.66		-0.27	0.42	-0.85
RANGE		0.30	0.31	0.27		0.22	0.31	0.26
AVERAGE	320.05	-0.24	0.36	-0.52	318.05	-0.16	0.55	-0.71
STD. DEV.		0.07	0.07	0.06		0.07	0.06	0.07
VARIANCE		0.01	0.00	0.00		0.00	0.00	0.00

Appendix Table A18 - continued

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		-0.17	0.71	-0.37		-0.20	1.56	-0.17
MINIMUM		-0.46	-0.17	-0.61		-0.42	1.27	-0.46
RANGE		0.29	0.88	0.24		0.22	0.29	0.29
AVERAGE	326.28	-0.31	0.31	-0.47	324.28	-0.30	1.42	-0.32
STD. DEV.		0.07	0.25	0.06		0.07	0.06	0.06
VARIANCE		0.00	0.06	0.00		0.00	0.00	0.00
MAXIMUM		-0.17	0.56	-0.27		-0.15	1.44	0.02
MINIMUM		-0.46	-0.39	-0.56		-0.42	1.17	-0.22
RANGE		0.29	0.95	0.29		0.27	0.27	0.24
AVERAGE	333.57	-0.31	0.15	-0.42	331.57	-0.29	1.31	-0.10
STD. DEV.		0.08	0.28	0.06		0.07	0.06	0.06
VARIANCE		0.01	0.08	0.00		0.00	0.00	0.00

Appendix Table A19. Velocities 10 feet upstream and 1 foot upstream of trashracks of Turbine 5B at the McNary Powerhouse. Full powerhouse loading. Low turbine load.

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		0.22	0.98	2.08		2.25	2.17	1.22
MINIMUM		-0.12	0.42	1.01		1.98	1.95	0.93
RANGE		0.34	0.56	0.27		0.27	0.22	0.29
AVERAGE	254.70	0.03	0.80	1.95	252.70	2.13	2.06	1.10
STD. DEV.		0.07	0.10	0.06		0.07	0.06	0.06
VARIANCE		0.00	0.01	0.00		0.00	0.00	0.00
MAXIMUM		0.20	0.95	-0.34		-0.32	3.39	0.88
MINIMUM		-0.07	0.56	-0.59		-0.78	2.91	0.56
RANGE		0.27	0.39	0.25		0.46	0.48	0.32
AVERAGE	260.78	0.06	0.80	-0.45	258.78	-0.47	3.09	0.77
STD. DEV.		0.06	0.08	0.06		0.08	0.09	0.07
VARIANCE		0.00	0.01	0.00		0.01	0.01	0.00
MAXIMUM		0.17	0.95	-0.37		-0.37	3.00	0.37
MINIMUM		-0.05	0.49	-0.61		-0.63	2.76	0.07
RANGE		0.22	0.46	0.24		0.26	0.24	0.30
AVERAGE	266.19	0.07	0.77	-0.48	264.19	-0.50	2.90	0.23
STD. DEV.		0.06	0.10	0.06		0.07	0.06	0.07
VARIANCE		0.00	0.01	0.00		0.00	0.00	0.01
MAXIMUM		0.07	0.95	-0.37		-0.42	3.15	0.32
MINIMUM		-0.15	0.49	-0.66		-0.71	2.88	0.02
RANGE		0.22	0.46	0.29		0.29	0.27	0.30
AVERAGE	272.46	-0.01	0.77	-0.50	270.46	-0.54	3.03	0.17
STD. DEV.		0.05	0.11	0.07		0.07	0.07	0.07
VARIANCE		0.00	0.01	0.00		0.01	0.00	0.00
MAXIMUM		0.07	0.90	-0.42		-0.37	3.00	-0.02
MINIMUM		-0.17	0.42	-0.66		-0.63	2.66	-0.29
RANGE		0.24	0.48	0.24		0.26	0.34	0.27
AVERAGE	278.49	-0.04	0.71	-0.53	276.49	-0.49	2.83	-0.14
STD. DEV.		0.06	0.11	0.07		0.07	0.07	0.07
VARIANCE		0.00	0.01	0.00		0.00	0.00	0.00
MAXIMUM		0.29	0.90	-0.42		-0.37	2.56	0.05
MINIMUM		-0.07	0.29	-0.73		-0.63	2.27	-0.24
RANGE		0.36	0.61	0.31		0.26	0.29	0.29
AVERAGE	284.17	0.11	0.60	-0.53	282.17	-0.49	2.43	-0.08
STD. DEV.		0.09	0.16	0.06		0.06	0.06	0.06
VARIANCE		0.01	0.03	0.00		0.00	0.00	0.00

Appendix Table A19 - continued

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		0.05	0.90	-0.42		-0.37	2.34	-0.32
MINIMUM		-0.29	0.12	-0.66		-0.63	2.12	-0.56
RANGE		0.34	0.78	0.24		0.26	0.22	0.24
AVERAGE	290.10	-0.11	0.57	-0.54	288.10	-0.49	2.25	-0.41
STD. DEV.		0.07	0.23	0.06		0.06	0.05	0.05
VARIANCE		0.01	0.05	0.00		0.00	0.00	0.00
MAXIMUM		0.46	1.00	-0.44		-0.32	2.39	-0.22
MINIMUM		0.07	0.12	-0.68		-0.66	2.08	-0.76
RANGE		0.39	0.88	0.24		0.34	0.31	0.54
AVERAGE	296.02	0.28	0.61	-0.54	294.02	-0.47	2.22	-0.41
STD. DEV.		0.08	0.24	0.06		0.07	0.07	0.12
VARIANCE		0.01	0.06	0.00		0.00	0.01	0.01
MAXIMUM		0.27	0.85	-0.44		-0.29	2.12	-0.37
MINIMUM		-0.20	0.02	-0.73		-0.63	1.73	-0.85
RANGE		0.47	0.83	0.29		0.34	0.39	0.48
AVERAGE	301.91	0.05	0.45	-0.55	299.91	-0.46	1.96	-0.60
STD. DEV.		0.08	0.25	0.07		0.07	0.08	0.09
VARIANCE		0.01	0.06	0.00		0.00	0.01	0.01
MAXIMUM		0.29	0.76	-0.39		-0.27	1.86	-0.34
MINIMUM		-0.22	-0.12	-0.71		-0.59	1.59	-0.78
RANGE		0.51	0.88	0.32		0.32	0.27	0.44
AVERAGE	308.00	0.02	0.37	-0.53	306.00	-0.40	1.72	-0.61
STD. DEV.		0.10	0.24	0.07		0.07	0.07	0.07
VARIANCE		0.01	0.06	0.01		0.00	0.00	0.00
MAXIMUM		0.10	0.66	-0.39		-0.27	1.78	-0.49
MINIMUM		-0.32	-0.37	-0.68		-0.56	1.49	-0.76
RANGE		0.42	1.03	0.29		0.29	0.29	0.27
AVERAGE	314.32	-0.10	0.22	-0.53	312.32	-0.42	1.64	-0.62
STD. DEV.		0.09	0.32	0.07		0.07	0.06	0.05
VARIANCE		0.01	0.10	0.00		0.00	0.00	0.00
MAXIMUM		0.07	0.59	-0.37		-0.22	1.64	-0.27
MINIMUM		-0.27	-0.42	-0.66		-0.56	1.37	-0.51
RANGE		0.34	1.01	0.29		0.34	0.27	0.24
AVERAGE	320.39	-0.07	0.19	-0.49	318.39	-0.38	1.51	-0.39
STD. DEV.		0.08	0.28	0.06		0.07	0.07	0.06
VARIANCE		0.01	0.08	0.00		0.00	0.00	0.00

Appendix Table A19 - continued

UPSTREAM	VELOCITY (in Ft/Sec)			DOWNSTREAM	VELOCITY (in Ft/Sec)		
	PROBE	X	Y		PROBE	X	Y
	ELEV(MSL)	FPS	FPS		ELEV(MSL)	FPS	FPS
MAXIMUM		-0.05	0.51			-0.17	1.56
MINIMUM		-0.39	-0.56			-0.46	1.25
RANGE		0.34	1.07			0.29	0.31
AVERAGE	326.52	-0.21	0.02		324.52	-0.30	1.41
STD. DEV.		0.07	0.34			0.06	0.07
VARIANCE		0.00	0.11			0.00	0.01
MAXIMUM		-0.22	0.56			-0.05	1.49
MINIMUM		-0.46	-0.56			-0.34	1.20
RANGE		0.24	1.12			0.29	0.29
AVERAGE	333.37	-0.35	-0.02		331.37	-0.22	1.35
STD. DEV.		0.06	0.36			0.06	0.06
VARIANCE		0.00	0.13			0.00	0.00

Appendix Table A20. Comparison of 30 minute vs 15 second samples of velocities 10 feet upstream and 1 foot upstream of trashracks of Turbine 5B at the McNary Powerhouse. Full powerhouse loading.

UPSTREAM	VELOCITY (in Ft/Sec)			DOWNSTREAM	VELOCITY (in Ft/Sec)				
	PROBE ELEV(MSL)	X FPS	Y FPS		Z FPS	PROBE ELEV(MSL)	X FPS	Y FPS	Z FPS
HIGH TURBINE LOAD									
30 min. sample	MAXIMUM		0.83	2.10	-0.32		0.83	5.49	-0.07
	MINIMUM		-0.56	0.95	-1.12		-0.56	4.32	-0.66
	RANGE		1.39	1.15	0.80		1.39	1.17	0.59
	AVERAGE	278.83	-0.11	1.57	-0.58	276.83	-0.15	4.78	-0.22
	STD.DEV.		0.11	0.12	0.08		0.15	0.11	0.09
	VARIANCE		0.01	0.01	0.01		0.02	0.01	0.01
15 sec. sample	MAXIMUM		-0.05	1.81	-0.46		-0.10	4.93	-0.17
	MINIMUM		-0.32	1.46	-0.73		-0.42	4.66	-0.46
	RANGE		0.27	0.35	0.27		0.32	0.27	0.29
	AVERAGE	278.79	-0.17	1.68	-0.59	276.79	-0.25	4.79	-0.30
	STD.DEV.		0.07	0.08	0.06		0.08	0.06	0.06
	VARIANCE		0.00	0.01	0.00		0.01	0.00	0.00
MEDIUM TURBINE LOAD									
30 min. sample	MAXIMUM		0.22	1.34	-0.27		0.12	3.22	0.02
	MINIMUM		-0.32	0.76	-0.95		-0.37	2.81	-0.37
	RANGE		0.54	0.58	0.68		0.49	0.41	0.39
	AVERAGE	278.54	-0.09	1.05	-0.54	276.54	-0.15	3.03	-0.15
	STD.DEV.		0.07	0.08	0.06		0.08	0.06	0.07
	VARIANCE		0.01	0.01	0.00		0.01	0.00	0.00
15 sec. sample	MAXIMUM		-0.02	1.15	-0.42		-0.12	3.15	-0.07
	MINIMUM		-0.27	0.78	-0.68		-0.32	2.91	-0.32
	RANGE		0.25	0.37	0.26		0.20	0.24	0.25
	AVERAGE	278.55	-0.13	1.04	-0.53	276.55	-0.21	3.04	-0.20
	STD.DEV.		0.07	0.08	0.05		0.05	0.06	0.06
	VARIANCE		0.00	0.01	0.00		0.00	0.00	0.00
LOW TURBINE LOAD									
30 min. sample	MAXIMUM		0.46	0.90	-0.32		-0.32	3.13	0.02
	MINIMUM		-0.24	0.29	-0.68		-0.66	2.22	-0.37
	RANGE		0.70	0.61	0.36		0.34	0.91	0.39
	AVERAGE	278.51	-0.03	0.67	-0.52	276.51	-0.48	2.82	-0.16
	STD.DEV.		0.09	0.11	0.06		0.07	0.07	0.07
	VARIANCE		0.01	0.01	0.00		0.00	0.00	0.00
15 sec. sample	MAXIMUM		0.07	0.90	-0.42		-0.37	3.00	-0.02
	MINIMUM		-0.17	0.42	-0.66		-0.63	2.66	-0.29
	RANGE		0.24	0.48	0.24		0.26	0.34	0.27
	AVERAGE	278.49	-0.04	0.71	-0.53	276.49	-0.49	2.83	-0.14
	STD.DEV.		0.06	0.11	0.07		0.07	0.07	0.07
	VARIANCE		0.00	0.01	0.00		0.00	0.00	0.00

Appendix Table A21. Velocities at the Folding Frame upstream of Travelling Screen.
McNary Powerhouse Turbine 5B. Full powerhouse loading. High turbine load.

	Elevation (MSL)†	VELOCITY(in Ft/Sec)		Elevation (MSL)	VELOCITY(in Ft/Sec)	
		Y FPS	Z FPS		Y FPS	Z FPS
MAXIMUM		2.95	-0.90		1.12	-1.54
MINIMUM		-0.66	-4.57		0.42	-1.78
RANGE		3.61	3.67		0.70	0.24
AVERAGE	259.40	1.50	-2.89	239.40	0.87	-1.65
STD. DEV.		0.84	0.92		0.15	0.07
VARIANCE		0.70	0.85		0.02	0.00
MAXIMUM		3.15	2.37		1.29	-1.59
MINIMUM		-1.64	-1.29		0.90	-1.83
RANGE		4.79	3.66		0.39	0.24
AVERAGE	259.35	0.58	0.49	239.35	1.08	-1.72
STD. DEV.		1.21	0.89		0.09	0.06
VARIANCE		1.47	0.80		0.01	0.00
MAXIMUM		4.96	1.10		0.90	-1.15
MINIMUM		1.39	-2.69		0.46	-1.44
RANGE		3.57	3.79		0.44	0.29
AVERAGE	259.23	3.18	-0.37	239.23	0.70	-1.28
STD. DEV.		0.82	0.80		0.11	0.06
VARIANCE		0.67	0.63		0.01	0.00
MAXIMUM		5.25	1.93		1.20	-1.32
MINIMUM		0.81	-1.05		0.81	-1.73
RANGE		4.44	2.98		0.39	0.41
AVERAGE	259.43	3.00	0.61	239.43	0.97	-1.59
STD. DEV.		1.24	0.69		0.08	0.08
VARIANCE		1.54	0.48		0.01	0.01
MAXIMUM		5.00	1.54		1.22	-1.34
MINIMUM		-0.34	-1.95		0.73	-1.66
RANGE		5.34	3.49		0.49	0.32
AVERAGE	259.43	1.73	-0.67	239.43	1.03	-1.48
STD. DEV.		1.39	0.67		0.11	0.08
VARIANCE		1.93	0.45		0.01	0.01
MAXIMUM		1.46	1.90		0.12	0.20
MINIMUM		-0.07	-1.44		-0.17	-0.07
RANGE		1.53	3.34		0.29	0.27
AVERAGE	259.96	0.75	0.40	239.96	-0.01	0.06
STD. DEV.		0.42	0.93		0.07	0.06
VARIANCE		0.18	0.86		0.00	0.00

Appendix Table A21 - continued

	Elevation (MSL)†	VELOCITY(in Ft/Sec)		Elevation (MSL)	VELOCITY(in Ft/Sec)	
		Y FPS	Z FPS		Y FPS	Z FPS
MAXIMUM		2.17	0.29		0.07	0.20
MINIMUM		0.83	-1.54		-0.17	-0.07
RANGE		1.34	1.83		0.24	0.27
AVERAGE	259.92	1.54	-0.72	239.92	-0.05	0.06
STD.DEV.		0.40	0.50		0.06	0.06
VARIANCE		0.16	0.25		0.00	0.00
MAXIMUM		2.59	1.73		0.07	0.17
MINIMUM		0.00	-1.07		-0.17	-0.07
RANGE		2.59	2.80		0.24	0.24
AVERAGE	259.90	1.31	0.16	239.90	-0.05	0.06
STD.DEV.		0.55	0.83		0.05	0.06
VARIANCE		0.30	0.69		0.00	0.00
MAXIMUM		2.86	1.15		0.07	0.17
MINIMUM		0.02	-0.51		-0.15	-0.07
RANGE		2.84	1.66		0.22	0.24
AVERAGE	259.93	1.18	0.35	239.93	-0.03	0.06
STD.DEV.		0.73	0.43		0.05	0.06
VARIANCE		0.53	0.18		0.00	0.00
MAXIMUM		1.66	1.73		0.10	0.17
MINIMUM		-0.24	-0.39		-0.17	-0.07
RANGE		1.90	2.12		0.27	0.24
AVERAGE	260.00	0.73	0.49	240.00	-0.02	0.05
STD.DEV.		0.51	0.60		0.06	0.06
VARIANCE		0.26	0.36		0.00	0.00
MAXIMUM		2.00	0.66		0.10	0.20
MINIMUM		-0.46	-1.49		-0.15	-0.07
RANGE		2.46	2.15		0.25	0.27
AVERAGE	259.92	0.29	-0.20	239.92	-0.01	0.06
STD.DEV.		0.59	0.51		0.05	0.06
VARIANCE		0.35	0.26		0.00	0.00
MAXIMUM		2.15	0.49		0.07	0.17
MINIMUM		-0.15	-1.29		-0.20	-0.07
RANGE		2.30	1.78		0.27	0.24
AVERAGE	259.99	1.01	-0.27	239.99	-0.06	0.07
STD.DEV.		0.65	0.46		0.06	0.06
VARIANCE		0.42	0.21		0.00	0.00

Appendix Table A21 - continued

	Elevation (MSL)*	VELOCITY(in Ft/Sec)		Elevation (MSL)	VELOCITY(in Ft/Sec)	
		Y FPS	Z FPS		Y FPS	Z FPS
MAXIMUM		1.98	0.49		0.12	0.20
MINIMUM		0.22	-1.64		-0.20	-0.07
RANGE		1.76	2.13		0.32	0.27
AVERAGE	259.92	1.29	-0.56	239.92	-0.02	0.07
STD.DEV.		0.45	0.57		0.06	0.06
VARIANCE		0.20	0.32		0.00	0.00
MAXIMUM		2.47	0.76		0.10	0.17
MINIMUM		-0.42	-1.83		-0.15	-0.07
RANGE		2.89	2.59		0.25	0.24
AVERAGE	259.95	1.20	-0.73	239.95	-0.01	0.06
STD.DEV.		0.64	0.55		0.05	0.06
VARIANCE		0.41	0.30		0.00	0.00
MAXIMUM		1.81	0.71		0.12	0.15
MINIMUM		-0.02	-1.59		-0.12	-0.07
RANGE		1.83	2.30		0.24	0.22
AVERAGE	259.94	1.04	-0.40	239.94	0.00	0.05
STD.DEV.		0.45	0.44		0.05	0.06
VARIANCE		0.21	0.20		0.00	0.00

* The mounting bolts holding the probe arms sheared during the tests; therefore these readings may differ somewhat from actual values.

Appendix Table A22. Velocities at the Folding Frame upstream of Travelling Screen.
McNary Powerhouse Turbine 5B. Full powerhouse loading. Medium turbine load.

	Elevation (MSL)†	VELOCITY(in Ft/Sec)		Elevation (MSL)	VELOCITY(in Ft/Sec)	
		Y FPS	Z FPS		Y FPS	Z FPS
MAXIMUM		3.25	-1.83		4.37	-3.76
MINIMUM		2.78	-2.32		2.86	-4.10
RANGE		0.47	0.49		1.51	0.34
AVERAGE	273.38	3.03	-2.04	253.38	3.48	-3.88
STD.DEV.		0.12	0.11		0.31	0.08
VARIANCE		0.01	0.01		0.09	0.01
MAXIMUM		3.10	-1.83		4.57	-3.44
MINIMUM		2.54	-2.22		3.49	-3.78
RANGE		0.56	0.39		1.08	0.34
AVERAGE	271.55	2.90	-2.00	251.55	4.13	-3.55
STD.DEV.		0.15	0.09		0.27	0.08
VARIANCE		0.02	0.01		0.07	0.01
MAXIMUM		2.42	-1.93		4.17	-2.91
MINIMUM		2.03	-2.27		3.34	-3.30
RANGE		0.39	0.34		0.83	0.39
AVERAGE	267.17	2.28	-2.08	247.17	3.71	-3.08
STD.DEV.		0.10	0.07		0.18	0.09
VARIANCE		0.01	0.01		0.03	0.01
MAXIMUM		1.88	-2.34		4.42	-2.71
MINIMUM		1.39	-2.76		3.15	-3.05
RANGE		0.49	0.42		1.27	0.34
AVERAGE	265.10	1.63	-2.54	245.10	3.88	-2.86
STD.DEV.		0.10	0.09		0.32	0.08
VARIANCE		0.01	0.01		0.10	0.01
MAXIMUM		2.91	1.44		3.25	-2.32
MINIMUM		1.44	-0.66		2.81	-2.71
RANGE		1.47	2.10		0.44	0.39
AVERAGE	259.49	2.28	0.31	239.49	3.04	-2.52
STD.DEV.		0.43	0.53		0.10	0.08
VARIANCE		0.18	0.28		0.01	0.01
MAXIMUM		3.00	1.15		3.10	-2.44
MINIMUM		1.20	-2.08		2.51	-2.76
RANGE		1.80	3.23		0.59	0.32
AVERAGE	259.33	2.35	-0.52	239.33	2.82	-2.59
STD.DEV.		0.40	0.86		0.14	0.08
VARIANCE		0.16	0.73		0.02	0.01

Appendix Table A22 - continued

	Elevation (MSL)*	VELOCITY(in Ft/Sec)		Elevation (MSL)	VELOCITY(in Ft/Sec)	
		Y FPS	Z FPS		Y FPS	Z FPS
MAXIMUM		3.34	1.81		2.98	-1.86
MINIMUM		1.49	-0.22		1.88	-2.22
RANGE		1.85	2.03		1.10	0.36
AVERAGE	258.71	2.35	0.82	238.71	2.57	-2.06
STD.DEV.		0.45	0.59		0.32	0.06
VARIANCE		0.20	0.34		0.10	0.00
MAXIMUM		3.34	1.98		2.91	-1.88
MINIMUM		1.00	-0.81		2.34	-2.22
RANGE		2.34	2.79		0.57	0.34
AVERAGE	258.67	1.90	0.11	238.67	2.60	-2.03
STD.DEV.		0.66	0.67		0.13	0.07
VARIANCE		0.43	0.46		0.02	0.01
MAXIMUM		3.05	-0.02		3.37	-1.59
MINIMUM		1.76	-1.15		2.17	-2.03
RANGE		1.29	1.13		1.20	0.44
AVERAGE	258.74	2.39	-0.49	238.74	2.67	-1.77
STD.DEV.		0.33	0.27		0.29	0.09
VARIANCE		0.11	0.07		0.08	0.01
MAXIMUM		2.71	1.05		2.27	-1.76
MINIMUM		0.42	-1.25		1.59	-2.08
RANGE		2.29	2.30		0.68	0.32
AVERAGE	258.72	1.51	-0.07	238.72	1.97	-1.91
STD.DEV.		0.64	0.57		0.16	0.08
VARIANCE		0.42	0.33		0.03	0.01
MAXIMUM		3.39	0.42		1.42	-0.85
MINIMUM		1.44	-1.15		0.98	-1.20
RANGE		1.95	1.57		0.44	0.35
AVERAGE	258.73	2.20	-0.52	238.73	1.21	-1.03
STD.DEV.		0.39	0.36		0.10	0.07
VARIANCE		0.16	0.13		0.01	0.00
MAXIMUM		2.20	0.10		1.20	-0.78
MINIMUM		0.49	-1.98		0.90	-1.10
RANGE		1.71	2.08		0.30	0.32
AVERAGE	258.85	1.34	-0.83	238.85	1.05	-0.94
STD.DEV.		0.41	0.55		0.07	0.07
VARIANCE		0.17	0.30		0.00	0.01

Appendix Table A22 - continued

	Elevation (MSL)*	VELOCITY(in Ft/Sec)		Elevation (MSL)	VELOCITY(in Ft/Sec)	
		Y FPS	Z FPS		Y FPS	Z FPS
MAXIMUM		3.49	1.15		1.10	-0.76
MINIMUM		0.71	-0.66		0.78	-1.05
RANGE		2.78	1.81		0.32	0.29
AVERAGE	258.75	2.00	0.35	238.75	0.95	-0.88
STD.DEV.		0.79	0.40		0.07	0.06
VARIANCE		0.63	0.16		0.01	0.00
MAXIMUM		2.83	0.49		1.15	-0.76
MINIMUM		-0.17	-1.44		0.78	-1.00
RANGE		3.00	1.93		0.37	0.24
AVERAGE	258.75	0.87	-0.59	238.75	0.95	-0.86
STD.DEV.		0.61	0.47		0.09	0.06
VARIANCE		0.37	0.22		0.01	0.00

* The mounting bolts holding the probe arms sheared during the tests; therefore these readings may differ somewhat from actual values.

Appendix Table A23. Velocities at the Folding Frame upstream of Travelling Screen.
McNary Powerhouse Turbine 5B. Full powerhouse loading. Low turbine load.

	Elevation (MSL)*	VELOCITY(in Ft/Sec)		Elevation (MSL)	VELOCITY(in Ft/Sec)	
		Y FPS	Z FPS		Y FPS	Z FPS
MAXIMUM		3.93	-2.51		3.54	-1.59
MINIMUM		3.52	-2.95		3.03	-1.88
RANGE		0.41	0.44		0.51	0.29
AVERAGE	257.00	3.71	-2.72	237.00	3.30	-1.73
STD.DEV.		0.09	0.09		0.11	0.07
VARIANCE		0.01	0.01		0.01	0.00
MAXIMUM		3.54	-2.86		3.52	-1.44
MINIMUM		3.10	-3.44		3.00	-1.83
RANGE		0.44	0.58		0.52	0.39
AVERAGE	258.26	3.33	-3.10	238.26	3.25	-1.66
STD.DEV.		0.11	0.11		0.11	0.09
VARIANCE		0.01	0.01		0.01	0.01
MAXIMUM		1.37	-1.64		3.39	-1.73
MINIMUM		0.90	-1.93		3.03	-2.15
RANGE		0.47	0.29		0.36	0.42
AVERAGE	264.75	1.18	-1.78	244.75	3.22	-1.98
STD.DEV.		0.12	0.07		0.07	0.09
VARIANCE		0.01	0.00		0.01	0.01
MAXIMUM		1.54	-1.25		3.59	-1.90
MINIMUM		1.25	-1.66		3.20	-2.20
RANGE		0.29	0.41		0.39	0.30
AVERAGE	267.16	1.42	-1.46	247.16	3.39	-2.04
STD.DEV.		0.08	0.08		0.08	0.06
VARIANCE		0.01	0.01		0.01	0.00
MAXIMUM		1.93	-1.07		3.39	-2.27
MINIMUM		1.56	-1.42		3.13	-2.56
RANGE		0.37	0.35		0.26	0.29
AVERAGE	271.17	1.76	-1.25	251.17	3.28	-2.41
STD.DEV.		0.09	0.07		0.06	0.06
VARIANCE		0.01	0.01		0.00	0.00
MAXIMUM		2.08	-1.17		3.59	-2.42
MINIMUM		1.68	-1.51		3.15	-2.73
RANGE		0.40	0.34		0.44	0.31
AVERAGE	273.12	1.90	-1.32	253.12	3.36	-2.56
STD.DEV.		0.11	0.07		0.11	0.06
VARIANCE		0.01	0.01		0.01	0.00

Appendix Table A23 - continued

	Elevation (MSL)†	VELOCITY(in Ft/Sec)		Elevation (MSL)	VELOCITY(in Ft/Sec)	
		Y FPS	Z FPS		Y FPS	Z FPS
MAXIMUM		2.08	-1.25		3.69	-2.47
MINIMUM		1.56	-1.49		2.49	-2.73
RANGE		0.52	0.24		1.20	0.26
AVERAGE	273.06	1.84	-1.35	253.06	2.93	-2.59
STD. DEV.		0.12	0.07		0.23	0.06
VARIANCE		0.01	0.00		0.05	0.00
MAXIMUM		2.08	-1.25		3.49	-2.42
MINIMUM		1.64	-1.54		2.86	-2.81
RANGE		0.44	0.29		0.63	0.39
AVERAGE	273.15	1.87	-1.38	253.15	3.21	-2.60
STD. DEV.		0.10	0.07		0.15	0.09
VARIANCE		0.01	0.01		0.02	0.01
MAXIMUM		2.17	-1.17		3.54	-2.42
MINIMUM		1.78	-1.64		3.10	-2.76
RANGE		0.39	0.47		0.44	0.34
AVERAGE	273.17	2.00	-1.38	253.17	3.31	-2.60
STD. DEV.		0.08	0.10		0.10	0.07
VARIANCE		0.01	0.01		0.01	0.01
MAXIMUM		2.03	-1.05		3.34	-2.47
MINIMUM		1.73	-1.44		2.88	-2.81
RANGE		0.30	0.39		0.46	0.34
AVERAGE	273.17	1.91	-1.26	253.17	3.09	-2.62
STD. DEV.		0.07	0.07		0.10	0.07
VARIANCE		0.00	0.00		0.01	0.01
MAXIMUM		2.05	-1.15		3.49	-2.47
MINIMUM		1.73	-1.49		3.00	-2.78
RANGE		0.32	0.34		0.49	0.31
AVERAGE	273.10	1.90	-1.29	253.10	3.22	-2.61
STD. DEV.		0.08	0.07		0.12	0.08
VARIANCE		0.01	0.00		0.02	0.01
MAXIMUM		2.08	-1.15		3.22	-2.42
MINIMUM		1.71	-1.44		2.81	-2.81
RANGE		0.37	0.29		0.41	0.39
AVERAGE	273.07	1.96	-1.27	253.07	3.01	-2.58
STD. DEV.		0.07	0.06		0.10	0.08
VARIANCE		0.01	0.00		0.01	0.01

Appendix Table A23 - continued

	Elevation (MSL)*	VELOCITY(in Ft/Sec)		Elevation (MSL)	VELOCITY(in Ft/Sec)	
		Y FPS	Z FPS		Y FPS	Z FPS
MAXIMUM		2.22	-1.15		3.61	-2.47
MINIMUM		1.83	-1.59		2.95	-2.78
RANGE		0.39	0.44		0.66	0.31
AVERAGE	273.11	2.06	-1.36	253.11	3.27	-2.61
STD.DEV.		0.10	0.11		0.15	0.07
VARIANCE		0.01	0.01		0.02	0.01
MAXIMUM		2.15	-1.10		3.44	-2.39
MINIMUM		1.73	-1.46		2.91	-2.66
RANGE		0.42	0.36		0.53	0.27
AVERAGE	273.00	1.92	-1.27	253.00	3.18	-2.53
STD.DEV.		0.09	0.08		0.16	0.07
VARIANCE		0.01	0.01		0.02	0.00

* The mounting bolts holding the probe arms sheared during the tests; therefore these readings may differ somewhat from actual values.

Appendix Table A24. Comparison of 30 minute vs 15 second samples of velocities at the Folding Frame upstream of Travelling Screen. McNary Powerhouse Turbine 5B. Full powerhouse loading.

		VELOCITY(in Ft/Sec)		VELOCITY(in Ft/Sec)	
		Elevation	Y	Elevation	Y
		(MSL)†	FPS	(MSL)	FPS
			Z		Z
			FPS		FPS
High Turbine Load					
30 min. sample	MAXIMUM		6.57		1.05
	MINIMUM		-3.71		-0.56
	RANGE		10.28		0.20
	AVERAGE	259.32	8.15	239.32	0.85
	STD.DEV.		0.12		0.88
	VARIANCE		2.34		0.56
15 sec. sample	MAXIMUM		1.45		-0.90
	MINIMUM		1.32		0.13
	RANGE		2.10		0.19
	AVERAGE	259.23	4.96	239.23	0.02
	STD.DEV.		1.39		0.90
	VARIANCE		-2.69		-1.15
Medium Turbine Load					
30 min. sample	MAXIMUM		3.79		0.46
	MINIMUM		3.57		-1.44
	RANGE		0.22		0.29
	AVERAGE	258.75	-0.37	238.75	0.44
	STD.DEV.		0.82		0.70
	VARIANCE		0.80		-1.28
15 sec. sample	MAXIMUM		0.67		0.11
	MINIMUM		0.63		0.06
	RANGE		0.04		0.00
	AVERAGE	258.72	2.71	238.72	0.90
	STD.DEV.		0.42		-1.15
	VARIANCE		-1.25		-1.44
Low Turbine Load					
30 min. sample	MAXIMUM		2.29		0.44
	MINIMUM		2.30		0.29
	RANGE		0.01		0.22
	AVERAGE	271.25	-0.07	251.25	0.68
	STD.DEV.		0.64		0.32
	VARIANCE		0.57		0.08
15 sec. sample	MAXIMUM		0.42		0.16
	MINIMUM		0.33		0.08
	RANGE		0.09		0.00
	AVERAGE	271.17	1.93	251.17	0.03
	STD.DEV.		1.56		0.27
	VARIANCE		-1.42		-2.27

† The mounting bolts holding the probe arms sheared during the tests; therefore these readings may differ somewhat from actual values.

APPENDIX Table A25. Velocities at fixed locations inside Submersible Travelling Screen and on support framework. McNary Powerhouse. Turbine 5B. Full powerhouse loading. High turbine load. 15 second samples.

LOCATION #	1		2		3		4		5		6	
	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z
	FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS
MAXIMUM	2.08	0.15	2.17	0.46	2.15	0.49	0.49	-0.10	0.15	-0.66	0.17	-0.42
MINIMUM	1.64	-0.12	1.68	0.12	1.90	0.12	0.10	-0.51	-0.24	-1.25	-0.32	-1.00
RANGE	0.44	0.27	0.49	0.34	0.25	0.37	0.39	0.41	0.39	0.59	0.49	0.58
AVERAGE	1.89	0.00	1.91	0.31	2.04	0.30	0.30	-0.28	-0.06	-0.93	-0.09	-0.77
STD. DEV.	0.11	0.07	0.09	0.08	0.06	0.07	0.09	0.08	0.08	0.15	0.10	0.14
VARIANCE	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.02	0.01	0.02
MAXIMUM	2.10	0.17	2.08	0.49	2.08	0.46	0.39	-0.10	0.22	0.46	0.07	-0.56
MINIMUM	1.56	-0.12	1.68	0.02	1.81	0.12	-0.05	-0.42	-0.22	-0.37	-0.37	-1.05
RANGE	0.54	0.29	0.40	0.47	0.27	0.34	0.44	0.32	0.44	0.83	0.44	0.49
AVERAGE	1.82	0.03	1.90	0.30	1.97	0.34	0.18	-0.24	0.04	-0.02	-0.12	-0.82
STD. DEV.	0.11	0.06	0.08	0.07	0.07	0.07	0.09	0.07	0.10	0.19	0.09	0.11
VARIANCE	0.01	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.04	0.01	0.01
MAXIMUM	2.03	0.12	2.12	0.46	2.08	0.51	0.46	-0.10	0.02	-0.37	0.05	-0.44
MINIMUM	1.49	-0.20	1.68	0.07	1.68	0.22	0.02	-0.61	-0.34	-0.95	-0.37	-0.90
RANGE	0.54	0.32	0.44	0.39	0.40	0.29	0.44	0.51	0.36	0.58	0.42	0.46
AVERAGE	1.74	-0.01	1.86	0.29	1.91	0.36	0.27	-0.39	-0.17	-0.69	-0.17	-0.71
STD. DEV.	0.11	0.07	0.09	0.08	0.09	0.06	0.09	0.10	0.08	0.14	0.08	0.09
VARIANCE	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.02	0.01	0.01
MAXIMUM	2.32	0.37	2.15	0.51	1.98	0.81	0.42	-0.02	0.49	0.02	0.27	-0.44
MINIMUM	1.64	-0.32	1.71	0.07	1.51	0.27	0.12	-0.46	-0.07	-0.42	-0.39	-1.10
RANGE	0.68	0.69	0.44	0.44	0.47	0.54	0.30	0.44	0.56	0.44	0.66	0.66
AVERAGE	1.97	-0.01	1.98	0.26	1.74	0.52	0.25	-0.24	0.21	-0.18	-0.05	-0.76
STD. DEV.	0.16	0.14	0.08	0.10	0.10	0.13	0.07	0.11	0.12	0.10	0.15	0.13
VARIANCE	0.03	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.02	0.02
MAXIMUM	2.08	0.10	2.08	0.46	2.05	0.66	0.37	0.02	0.22	-0.32	0.17	-0.51
MINIMUM	1.59	-0.20	1.78	0.07	1.68	0.17	-0.07	-0.51	-0.29	-0.78	-0.27	-1.00
RANGE	0.49	0.30	0.30	0.39	0.37	0.49	0.44	0.53	0.51	0.46	0.44	0.49
AVERAGE	1.79	-0.04	1.94	0.27	1.86	0.42	0.13	-0.18	-0.04	-0.54	-0.04	-0.69
STD. DEV.	0.09	0.06	0.06	0.09	0.07	0.11	0.10	0.14	0.11	0.10	0.10	0.12
VARIANCE	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01
MAXIMUM	1.93	0.15	2.17	0.51	2.12	0.44	0.27	-0.07	0.20	-0.05	0.17	-0.46
MINIMUM	1.59	-0.17	1.73	0.17	1.73	0.12	-0.05	-0.42	-0.42	-0.73	-0.37	-1.03
RANGE	0.34	0.32	0.44	0.34	0.39	0.32	0.32	0.35	0.62	0.68	0.54	0.57
AVERAGE	1.74	-0.01	1.98	0.34	1.93	0.30	0.17	-0.23	-0.09	-0.38	-0.14	-0.84
STD. DEV.	0.07	0.06	0.11	0.07	0.07	0.07	0.07	0.06	0.13	0.18	0.10	0.11
VARIANCE	0.01	0.00	0.01	0.01	0.00	0.00	0.01	0.00	0.02	0.03	0.01	0.01

Appendix Table A25 - continued

LOCATION #	1		2		3		4		5		6	
	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS
MAXIMUM	2.22	0.39	2.03	0.81	2.08	0.51	0.42	-0.02	-0.12	-0.34	0.17	-0.49
MINIMUM	1.64	-0.22	1.73	0.07	1.68	0.15	0.07	-0.39	-0.44	-1.29	-0.27	-1.05
RANGE	0.58	0.61	0.30	0.74	0.40	0.36	0.35	0.37	0.32	0.95	0.44	0.56
AVERAGE	1.94	-0.01	1.88	0.32	1.95	0.32	0.23	-0.20	-0.26	-0.78	-0.06	-0.76
STD. DEV.	0.14	0.09	0.06	0.13	0.08	0.08	0.07	0.08	0.08	0.26	0.08	0.11
VARIANCE	0.02	0.01	0.00	0.02	0.01	0.01	0.00	0.01	0.01	0.07	0.01	0.01
MAXIMUM	2.05	0.12	2.17	0.46	2.08	0.42	0.42	-0.12	0.22	-0.12	0.12	-0.42
MINIMUM	1.59	-0.17	1.66	0.07	1.68	0.12	0.07	-0.44	-0.27	-0.76	-0.24	-0.85
RANGE	0.46	0.29	0.51	0.39	0.40	0.30	0.35	0.32	0.49	0.64	0.36	0.43
AVERAGE	1.81	-0.01	1.94	0.31	1.90	0.30	0.30	-0.27	0.01	-0.51	-0.09	-0.65
STD. DEV.	0.09	0.07	0.13	0.08	0.08	0.08	0.07	0.07	0.12	0.17	0.07	0.10
VARIANCE	0.01	0.00	0.02	0.01	0.01	0.01	0.00	0.01	0.01	0.03	0.01	0.01
MAXIMUM	1.93	0.12	2.00	0.51	2.15	0.42	0.34	-0.12	0.17	0.34	0.15	-0.39
MINIMUM	1.49	-0.27	1.68	0.10	1.76	0.12	0.02	-0.46	-0.29	-0.46	-0.29	-0.93
RANGE	0.44	0.39	0.32	0.41	0.39	0.30	0.32	0.34	0.46	0.80	0.44	0.54
AVERAGE	1.76	-0.01	1.86	0.36	2.01	0.31	0.20	-0.28	-0.05	-0.10	-0.07	-0.67
STD. DEV.	0.10	0.09	0.07	0.08	0.08	0.07	0.08	0.07	0.10	0.20	0.09	0.13
VARIANCE	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.04	0.01	0.02
MAXIMUM	1.88	1.15	2.03	1.39	2.37	0.39	0.42	-0.17	-0.10	-0.15	0.20	-0.71
MINIMUM	0.81	-0.27	1.56	0.02	1.71	-0.24	0.02	-0.56	-0.76	-0.63	-1.29	-1.17
RANGE	1.07	1.42	0.47	1.37	0.66	0.63	0.40	0.39	0.66	0.48	1.49	0.46
AVERAGE	1.48	0.38	1.83	0.63	1.97	0.14	0.20	-0.36	-0.43	-0.40	-0.38	-0.94
STD. DEV.	0.21	0.32	0.12	0.27	0.16	0.15	0.09	0.07	0.17	0.11	0.27	0.11
VARIANCE	0.04	0.10	0.01	0.07	0.02	0.02	0.01	0.01	0.03	0.01	0.07	0.01
MAXIMUM	1.98	0.15	1.98	0.44	2.08	0.46	0.46	-0.07	0.00	0.12	0.17	-0.61
MINIMUM	1.49	-0.17	1.73	0.15	1.78	0.20	0.12	-0.46	-0.42	-0.71	-0.32	-1.17
RANGE	0.49	0.32	0.25	0.29	0.30	0.26	0.34	0.39	0.42	0.83	0.49	0.56
AVERAGE	1.79	0.03	1.87	0.31	1.95	0.32	0.26	-0.24	-0.21	-0.37	-0.04	-0.84
STD. DEV.	0.10	0.06	0.07	0.07	0.07	0.06	0.08	0.08	0.08	0.18	0.09	0.11
VARIANCE	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.03	0.01	0.01
MAXIMUM	2.12	0.12	1.98	0.51	2.10	0.42	0.37	-0.22	0.22	-0.12	0.12	-0.32
MINIMUM	1.66	-0.17	1.66	0.10	1.78	0.17	0.00	-0.56	-0.22	-0.61	-0.22	-0.85
RANGE	0.46	0.29	0.32	0.41	0.32	0.25	0.37	0.34	0.44	0.49	0.34	0.53
AVERAGE	1.89	0.01	1.86	0.33	1.94	0.29	0.20	-0.36	0.01	-0.38	-0.04	-0.63
STD. DEV.	0.11	0.07	0.07	0.09	0.07	0.06	0.08	0.07	0.09	0.09	0.08	0.10
VARIANCE	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01

Appendix Table A25 - continued

[illegible]

APPENDIX Table A26. Velocities at fixed locations inside Submersible Travelling Screen and on support framework. McNary Powerhouse. Turbine 5B. Full powerhouse loading. Medium turbine load. 15 second samples.

LOCATION #	1		2		3		4		5		6	
	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS
MAXIMUM	3.71	-0.07	3.39	0.44	3.42	0.61	0.27	0.12	0.39	-0.42	0.15	-0.90
MINIMUM	2.42	-0.44	2.91	0.07	2.95	0.24	-0.22	-0.37	-0.02	-0.88	-0.32	-1.49
RANGE	1.29	0.37	0.48	0.37	0.47	0.37	0.49	0.49	0.41	0.46	0.47	0.59
AVERAGE	3.10	-0.25	3.17	0.26	3.24	0.44	0.04	-0.08	0.21	-0.66	-0.08	-1.13
STD. DEV.	0.36	0.09	0.10	0.07	0.10	0.08	0.11	0.12	0.09	0.11	0.12	0.13
VARIANCE	0.13	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
MAXIMUM	3.39	0.29	3.34	0.54	3.52	0.46	0.42	-0.17	0.22	0.02	-0.02	-1.10
MINIMUM	1.95	-0.37	2.98	0.12	3.05	0.10	0.10	-0.51	-0.12	-0.46	-0.71	-1.73
RANGE	1.44	0.66	0.36	0.42	0.47	0.36	0.32	0.34	0.34	0.48	0.69	0.63
AVERAGE	2.61	-0.11	3.19	0.34	3.35	0.27	0.26	-0.34	0.07	-0.18	-0.34	-1.47
STD. DEV.	0.38	0.13	0.09	0.10	0.10	0.08	0.07	0.08	0.08	0.10	0.17	0.18
VARIANCE	0.14	0.02	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.03	0.03
MAXIMUM	3.15	0.12	3.37	1.25	3.49	0.66	0.46	-0.17	0.37	0.12	0.05	-0.88
MINIMUM	2.42	-0.49	2.93	0.22	3.10	0.29	0.12	-0.56	-0.32	-0.22	-0.37	-1.44
RANGE	0.73	0.61	0.44	1.03	0.39	0.37	0.34	0.39	0.69	0.34	0.42	0.56
AVERAGE	2.77	-0.24	3.18	0.61	3.33	0.46	0.29	-0.33	0.01	-0.07	-0.20	-1.10
STD. DEV.	0.14	0.11	0.10	0.28	0.08	0.07	0.07	0.09	0.15	0.09	0.09	0.12
VARIANCE	0.02	0.01	0.01	0.08	0.01	0.00	0.00	0.01	0.02	0.01	0.01	0.01
MAXIMUM	2.76	0.22	3.34	0.46	3.52	0.71	0.37	-0.02	0.32	-0.27	0.07	-0.90
MINIMUM	2.12	-0.37	2.95	0.02	2.69	0.22	-0.07	-0.49	-0.07	-0.85	-0.39	-1.39
RANGE	0.64	0.59	0.39	0.44	0.83	0.49	0.44	0.47	0.39	0.58	0.46	0.49
AVERAGE	2.47	-0.11	3.20	0.24	3.26	0.43	0.14	-0.22	0.12	-0.52	-0.16	-1.18
STD. DEV.	0.12	0.10	0.08	0.11	0.18	0.13	0.10	0.11	0.08	0.14	0.11	0.11
VARIANCE	0.01	0.01	0.01	0.01	0.03	0.02	0.01	0.01	0.01	0.02	0.01	0.01
MAXIMUM	3.27	0.07	3.25	0.61	3.44	0.51	0.32	0.05	0.42	-0.02	0.10	-0.85
MINIMUM	2.51	-0.32	2.71	0.12	3.03	0.22	-0.05	-0.37	-0.02	-0.71	-0.49	-1.56
RANGE	0.76	0.39	0.54	0.49	0.41	0.29	0.37	0.42	0.44	0.69	0.59	0.71
AVERAGE	2.92	-0.15	3.02	0.35	3.20	0.38	0.14	-0.17	0.21	-0.48	-0.18	-1.25
STD. DEV.	0.18	0.07	0.12	0.11	0.10	0.07	0.09	0.11	0.11	0.16	0.14	0.18
VARIANCE	0.03	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.03	0.02	0.03
MAXIMUM	2.66	0.42	3.74	0.81	3.44	0.76	0.42	-0.17	0.34	0.17	0.07	-0.90
MINIMUM	1.73	-0.42	3.25	0.17	2.76	0.29	0.02	-0.51	0.02	-0.42	-0.46	-1.56
RANGE	0.93	0.84	0.49	0.64	0.68	0.47	0.40	0.34	0.32	0.59	0.53	0.66
AVERAGE	2.31	0.01	3.44	0.46	3.14	0.50	0.22	-0.32	0.17	-0.06	-0.20	-1.19
STD. DEV.	0.23	0.21	0.10	0.12	0.16	0.10	0.07	0.08	0.07	0.13	0.13	0.15
VARIANCE	0.05	0.04	0.01	0.01	0.03	0.01	0.01	0.01	0.00	0.02	0.02	0.02

Appendix Table A26 - continued

LOCATION #	1		2		3		4		5		6	
	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS
MAXIMUM	2.86	0.88	3.56	0.66	3.44	0.73	0.61	-0.29	0.22	0.12	0.07	-0.78
MINIMUM	2.15	-0.46	2.64	0.20	2.95	0.02	0.17	-0.63	-0.42	-0.61	-0.37	-1.56
RANGE	0.71	1.34	0.92	0.46	0.49	0.71	0.44	0.34	0.64	0.73	0.44	0.78
AVERAGE	2.57	0.04	3.02	0.41	3.22	0.26	0.35	-0.44	-0.19	-0.29	-0.15	-1.14
STD. DEV.	0.16	0.34	0.18	0.10	0.10	0.16	0.10	0.07	0.15	0.18	0.10	0.18
VARIANCE	0.03	0.12	0.03	0.01	0.01	0.02	0.01	0.00	0.02	0.03	0.01	0.03
MAXIMUM	3.20	0.07	3.54	0.49	3.54	0.98	0.42	-0.10	0.32	-0.02	-0.05	-0.95
MINIMUM	2.61	-0.37	2.81	-0.05	2.71	0.24	0.02	-0.42	-0.12	-0.42	-0.46	-1.49
RANGE	0.59	0.44	0.73	0.54	0.83	0.74	0.40	0.32	0.44	0.40	0.41	0.54
AVERAGE	2.91	-0.18	3.21	0.24	3.20	0.44	0.21	-0.25	0.09	-0.17	-0.24	-1.21
STD. DEV.	0.13	0.10	0.16	0.13	0.17	0.11	0.08	0.07	0.09	0.10	0.09	0.12
VARIANCE	0.02	0.01	0.02	0.02	0.03	0.01	0.01	0.00	0.01	0.01	0.01	0.01
MAXIMUM	3.42	0.20	3.30	0.51	3.98	0.46	0.56	-0.17	0.39	-0.07	0.07	-0.85
MINIMUM	1.49	-0.46	3.00	-0.10	3.05	-0.12	0.20	-0.51	-0.22	-0.51	-0.42	-1.64
RANGE	1.93	0.66	0.30	0.61	0.93	0.58	0.36	0.34	0.61	0.44	0.49	0.79
AVERAGE	2.64	-0.19	3.16	0.21	3.48	0.23	0.37	-0.36	0.12	-0.27	-0.23	-1.29
STD. DEV.	0.52	0.12	0.08	0.13	0.22	0.13	0.07	0.07	0.15	0.11	0.09	0.14
VARIANCE	0.27	0.01	0.01	0.02	0.05	0.02	0.01	0.01	0.02	0.01	0.01	0.02
MAXIMUM	3.44	-0.02	3.34	0.61	3.08	1.42	0.42	0.00	0.42	0.12	0.22	-0.81
MINIMUM	2.56	-0.66	3.05	0.22	2.51	0.32	0.07	-0.46	-0.10	-0.51	-0.27	-1.25
RANGE	0.88	0.64	0.29	0.39	0.57	1.10	0.35	0.46	0.52	0.63	0.49	0.44
AVERAGE	3.04	-0.28	3.20	0.37	2.88	0.68	0.25	-0.28	0.14	-0.21	-0.02	-1.02
STD. DEV.	0.22	0.15	0.07	0.08	0.12	0.27	0.07	0.10	0.15	0.16	0.10	0.10
VARIANCE	0.05	0.02	0.00	0.01	0.01	0.07	0.00	0.01	0.02	0.03	0.01	0.01
MAXIMUM	3.74	0.63	3.71	0.81	3.32	0.59	0.56	-0.07	0.22	0.54	0.29	-0.68
MINIMUM	1.98	-0.51	2.93	0.02	2.73	0.07	0.10	-0.68	-0.22	-1.07	-0.78	-1.76
RANGE	1.76	1.14	0.78	0.79	0.59	0.52	0.46	0.61	0.44	1.61	1.07	1.08
AVERAGE	2.79	-0.07	3.34	0.34	3.00	0.32	0.32	-0.40	0.05	-0.26	-0.15	-1.08
STD. DEV.	0.41	0.30	0.21	0.20	0.15	0.10	0.10	0.13	0.09	0.43	0.31	0.29
VARIANCE	0.17	0.09	0.04	0.04	0.02	0.01	0.01	0.02	0.01	0.19	0.10	0.08
MAXIMUM	2.98	0.29	3.34	0.61	3.37	0.66	0.42	-0.15	0.27	-0.10	-0.12	-1.10
MINIMUM	2.27	-0.59	2.95	0.07	2.95	0.32	0.12	-0.63	0.00	-0.59	-0.61	-1.68
RANGE	0.71	0.88	0.39	0.54	0.42	0.34	0.30	0.48	0.27	0.49	0.49	0.58
AVERAGE	2.65	-0.21	3.13	0.34	3.15	0.51	0.25	-0.37	0.15	-0.33	-0.35	-1.36
STD. DEV.	0.17	0.20	0.10	0.12	0.08	0.07	0.07	0.09	0.06	0.11	0.12	0.15
VARIANCE	0.03	0.04	0.01	0.02	0.01	0.00	0.00	0.01	0.00	0.01	0.02	0.02

Appendix Table A26 - continued

LOCATION #	1		2		3		4		5		6	
	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS
MAXIMUM	3.44	0.17	3.27	0.63	3.32	0.98	0.66	-0.27	0.12	-0.51	-0.20	-1.20
MINIMUM	2.47	-0.32	2.93	0.20	2.64	0.15	0.29	-0.78	-0.34	-1.25	-0.66	-1.86
RANGE	0.97	0.49	0.34	0.43	0.68	0.83	0.37	0.51	0.46	0.74	0.46	0.66
AVERAGE	2.93	-0.08	3.10	0.40	2.94	0.56	0.49	-0.50	-0.09	-0.85	-0.37	-1.41
STD. DEV.	0.24	0.11	0.07	0.11	0.14	0.16	0.09	0.13	0.09	0.16	0.10	0.15
VARIANCE	0.06	0.01	0.01	0.01	0.02	0.03	0.01	0.02	0.01	0.03	0.01	0.02

APPENDIX Table A27. Velocities at fixed locations inside Submersible Travelling Screen and on support framework. McNary Powerhouse. Turbine 5B. Full powerhouse loading. Low turbine load. 15 second samples.

LOCATION #	1		2		3		4		5		6	
	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS
MAXIMUM	18.38	10.96	3.64	5.47	4.39	0.81	0.39	0.22	0.37	-0.46	2.81	-2.51
MINIMUM	0.32	-2.51	-0.02	-2.22	3.74	-0.66	-0.12	-0.42	-0.17	-1.20	-1.83	-4.57
RANGE	18.06	13.47	3.66	7.69	0.65	1.47	0.51	0.64	0.54	0.74	4.64	2.06
AVERAGE	9.55	4.71	1.83	1.90	4.04	0.13	0.16	-0.07	0.15	-0.86	0.14	-3.58
STD. DEV.	5.84	4.01	0.84	2.52	0.16	0.48	0.14	0.16	0.11	0.17	1.40	0.59
VARIANCE	34.08	16.07	0.71	6.36	0.02	0.23	0.02	0.02	0.01	0.03	1.96	0.34
MAXIMUM	10.91	5.49	8.72	3.83	5.10	1.25	0.71	0.02	0.61	0.56	0.42	-1.76
MINIMUM	-5.66	-6.91	2.15	-3.05	4.37	0.07	0.10	-0.66	0.12	-0.71	-1.68	-3.66
RANGE	16.57	12.40	6.57	6.88	0.73	1.18	0.61	0.68	0.49	1.27	2.10	1.90
AVERAGE	2.55	-0.56	4.78	0.42	4.72	0.72	0.42	-0.33	0.36	-0.17	-0.63	-2.79
STD. DEV.	4.79	3.58	1.88	1.91	0.13	0.32	0.18	0.18	0.13	0.39	0.53	0.41
VARIANCE	22.92	12.85	3.54	3.65	0.02	0.10	0.03	0.03	0.02	0.15	0.28	0.16
MAXIMUM	12.96	12.82	8.37	1.98	4.91	1.39	0.56	0.05	0.66	0.12	3.49	-1.68
MINIMUM	-9.64	-9.86	2.71	-3.91	4.32	-0.29	0.07	-0.42	0.22	-0.78	-1.44	-3.91
RANGE	22.60	22.68	5.66	5.89	0.59	1.68	0.49	0.47	0.44	0.90	4.93	2.23
AVERAGE	-0.12	1.05	5.53	-0.71	4.61	0.43	0.34	-0.19	0.44	-0.35	0.16	-3.09
STD. DEV.	6.06	8.33	1.43	1.59	0.12	0.46	0.11	0.11	0.10	0.24	1.32	0.59
VARIANCE	36.67	69.37	2.03	2.54	0.01	0.21	0.01	0.01	0.01	0.06	1.74	0.34
MAXIMUM	15.50	8.76	7.54	3.54	4.47	1.37	0.66	-0.37	0.51	0.02	1.39	-1.68
MINIMUM	-6.98	-6.93	-2.98	-5.42	3.83	-1.15	0.27	-0.76	0.02	-0.61	-2.64	-4.49
RANGE	22.48	15.69	10.52	8.96	0.64	2.52	0.39	0.39	0.49	0.63	4.03	2.81
AVERAGE	1.36	-1.40	2.58	-1.63	4.23	0.03	0.41	-0.57	0.26	-0.29	-0.61	-3.28
STD. DEV.	5.74	4.07	2.58	2.46	0.13	0.77	0.09	0.09	0.14	0.13	1.14	0.74
VARIANCE	32.94	16.54	6.66	6.03	0.02	0.59	0.01	0.01	0.02	0.02	1.29	0.55
MAXIMUM	15.33	9.74	2.95	4.49	4.81	1.20	0.78	-0.05	0.37	0.15	2.47	-1.86
MINIMUM	0.98	-2.78	-1.64	-0.66	4.13	0.12	0.20	-0.93	-0.07	-0.78	0.20	-4.54
RANGE	14.35	12.52	4.59	5.15	0.68	1.08	0.58	0.88	0.44	0.93	2.27	2.68
AVERAGE	7.90	3.87	0.74	2.45	4.46	0.69	0.45	-0.44	0.18	-0.30	1.16	-3.16
STD. DEV.	4.10	3.36	1.01	1.57	0.19	0.23	0.15	0.24	0.11	0.25	0.58	0.64
VARIANCE	16.77	11.27	1.02	2.48	0.04	0.05	0.02	0.06	0.01	0.06	0.34	0.41
MAXIMUM	21.46	13.50	7.54	6.40	5.10	2.15	0.88	-0.12	0.71	0.00	5.54	-0.88
MINIMUM	3.34	0.46	-0.34	1.10	3.86	0.15	0.32	-0.59	0.00	-0.81	0.07	-3.10
RANGE	18.12	13.04	7.88	5.30	1.24	2.00	0.56	0.47	0.71	0.81	5.47	2.22
AVERAGE	12.97	7.11	2.77	4.13	4.38	0.98	0.59	-0.40	0.40	-0.36	2.18	-2.26
STD. DEV.	5.87	3.76	1.79	1.47	0.32	0.53	0.12	0.12	0.18	0.22	1.49	0.48
VARIANCE	34.51	14.14	3.22	2.16	0.10	0.28	0.02	0.02	0.03	0.05	2.23	0.23

Appendix Table A27 - continued

LOCATION #	1		2		3		4		5		6	
	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS
MAXIMUM	4.91	11.11	6.40	1.88	4.88	2.71	0.51	0.44	0.37	0.07	3.05	-1.49
MINIMUM	-8.96	-9.86	3.64	-2.83	3.93	-0.32	-0.27	-0.54	-0.15	-1.05	-1.20	-3.49
RANGE	13.87	20.97	2.76	4.71	0.95	3.03	0.78	0.98	0.52	1.12	4.25	2.00
AVERAGE	0.22	-1.69	5.10	-0.04	4.40	0.96	0.11	-0.10	0.13	-0.57	1.57	-2.50
STD. DEV.	3.30	4.80	0.61	1.24	0.22	0.73	0.20	0.31	0.11	0.26	0.99	0.50
VARIANCE	10.88	23.02	0.37	1.55	0.05	0.54	0.04	0.10	0.01	0.07	0.98	0.25
MAXIMUM	2.61	10.57	7.40	1.98	4.88	0.98	1.15	-0.12	0.22	-0.51	4.27	-0.56
MINIMUM	-9.35	-9.74	2.71	-2.05	3.83	-0.78	0.37	-0.95	-0.44	-1.15	0.22	-3.47
RANGE	11.96	20.31	4.69	4.03	1.05	1.76	0.78	0.83	0.66	0.64	4.05	2.91
AVERAGE	-2.68	-2.00	5.32	0.49	4.38	-0.14	0.79	-0.52	-0.11	-0.86	2.00	-1.82
STD. DEV.	2.96	4.28	1.18	1.01	0.22	0.42	0.22	0.18	0.15	0.14	1.00	0.75
VARIANCE	8.74	18.31	1.40	1.02	0.05	0.18	0.05	0.03	0.02	0.02	0.99	0.56
MAXIMUM	22.97	14.43	4.98	6.71	5.25	1.10	0.49	0.15	0.78	0.00	2.59	-2.17
MINIMUM	-1.61	-4.54	-3.54	-0.85	4.00	-0.51	0.05	-0.42	0.24	-0.46	-2.12	-4.49
RANGE	24.58	18.97	8.52	7.56	1.25	1.61	0.44	0.57	0.54	0.46	4.71	2.32
AVERAGE	10.57	5.35	0.83	2.44	4.64	0.41	0.22	-0.11	0.50	-0.20	0.11	-3.48
STD. DEV.	7.49	5.92	2.11	2.28	0.31	0.47	0.09	0.14	0.11	0.10	1.40	0.70
VARIANCE	56.08	35.06	4.45	5.22	0.10	0.22	0.01	0.02	0.01	0.01	1.95	0.49
MAXIMUM	10.86	8.08	4.79	3.81	4.76	0.66	0.61	-0.17	0.46	0.07	0.98	-2.51
MINIMUM	-2.37	-2.86	0.71	-0.02	3.74	-0.42	0.12	-0.66	0.12	-0.71	-2.88	-4.32
RANGE	13.23	10.94	4.08	3.83	1.02	1.08	0.49	0.49	0.34	0.78	3.86	1.81
AVERAGE	3.81	2.19	2.87	1.94	4.18	0.08	0.39	-0.39	0.29	-0.20	-0.69	-3.39
STD. DEV.	3.98	3.07	0.91	1.03	0.24	0.30	0.10	0.11	0.08	0.17	0.95	0.39
VARIANCE	15.82	9.42	0.83	1.06	0.06	0.09	0.01	0.01	0.01	0.03	0.89	0.15
MAXIMUM	10.91	5.35	5.49	2.47	4.88	1.03	0.63	-0.24	0.37	-0.12	2.54	-0.78
MINIMUM	-0.05	-4.08	-0.90	-1.20	3.74	-0.32	0.12	-0.66	-0.10	-0.56	-2.95	-4.57
RANGE	10.96	9.43	6.39	3.67	1.14	1.35	0.51	0.42	0.47	0.44	5.49	3.79
AVERAGE	4.34	-0.31	2.24	0.31	4.22	0.22	0.39	-0.46	0.15	-0.32	0.80	-2.33
STD. DEV.	2.67	2.22	1.55	0.91	0.30	0.29	0.11	0.11	0.11	0.10	1.28	0.67
VARIANCE	7.14	4.91	2.41	0.83	0.09	0.08	0.01	0.01	0.01	0.01	1.63	0.45
MAXIMUM	12.38	6.35	7.67	3.54	5.30	1.66	0.88	-0.02	0.63	0.10	3.15	-1.73
MINIMUM	-3.98	-3.44	3.22	-1.88	3.74	-0.42	0.12	-1.00	-0.17	-1.00	-1.73	-3.69
RANGE	16.36	9.79	4.45	5.42	1.56	2.08	0.76	0.98	0.80	1.10	4.88	1.96
AVERAGE	5.41	2.19	5.35	1.35	4.53	0.49	0.48	-0.56	0.24	-0.37	0.77	-2.89
STD. DEV.	4.54	2.74	1.08	1.43	0.45	0.61	0.20	0.24	0.22	0.28	1.37	0.50
VARIANCE	20.64	7.51	1.17	2.06	0.20	0.37	0.04	0.06	0.05	0.08	1.88	0.25

Appendix Table A27 - continued

LOCATION #	1		2		3		4		5		6	
	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS
MAXIMUM	11.87	6.47	6.45	3.49	4.88	0.88	0.61	-0.32	0.37	-0.32	2.49	-1.39
MINIMUM	-0.51	-2.08	1.22	-0.44	3.88	-1.10	0.22	-0.63	-0.07	-0.98	-1.44	-2.81
RANGE	12.38	8.55	5.23	3.93	1.00	1.98	0.39	0.31	0.44	0.66	3.93	1.42
AVERAGE	5.75	2.17	3.62	1.49	4.45	0.21	0.44	-0.47	0.12	-0.64	0.40	-2.28
STD. DEV.	3.72	2.33	1.48	1.00	0.25	0.50	0.10	0.07	0.11	0.15	1.02	0.32
VARIANCE	13.85	5.45	2.20	1.01	0.06	0.25	0.01	0.01	0.01	0.02	1.05	0.10
MAXIMUM	6.96	4.54	6.47	2.61	4.71	0.85	0.49	-0.05	0.68	0.42	1.39	-1.93
MINIMUM	-9.01	-8.47	2.86	-3.64	3.86	-0.76	0.02	-0.46	0.17	-0.24	-2.44	-5.10
RANGE	15.97	13.01	3.61	6.25	0.85	1.61	0.47	0.41	0.51	0.66	3.83	3.17
AVERAGE	-0.69	-1.60	4.26	-0.06	4.32	0.08	0.24	-0.24	0.46	0.03	-0.30	-4.01
STD. DEV.	3.64	2.88	0.76	1.68	0.18	0.41	0.11	0.09	0.11	0.15	0.99	0.74
VARIANCE	13.28	8.27	0.57	2.83	0.03	0.17	0.01	0.01	0.01	0.02	0.98	0.55

APPENDIX Table A2B. Comparison of 30 minute vs 15 second samples of velocities at fixed locations inside Submersible Travelling Screen and on support framework at McNary Dam.

LOCATION #		1		2		3		4		5		6	
		Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z
		FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS
HIGH TURBINE LOAD													
	MAXIMUM	24.24	16.60	10.33	8.81	5.35	2.64	1.03	0.44	0.90	0.37	6.18	0.59
30 min.	MINIMUM	-18.65	-16.50	-3.49	-7.40	3.15	-1.88	-0.17	-1.05	-0.56	-1.56	-4.52	-5.98
sample	RANGE	42.89	33.10	13.82	16.21	2.20	4.52	1.20	1.49	1.46	1.93	10.70	6.57
	AVERAGE	3.63	0.33	3.13	0.43	4.36	0.46	0.34	-0.30	0.18	-0.55	0.95	-2.65
	STD. DEV.	7.18	5.41	1.86	2.56	0.30	0.67	0.17	0.24	0.19	0.34	1.68	1.01
	VARIANCE	51.49	29.23	3.47	6.54	0.09	0.45	0.03	0.06	0.04	0.11	2.82	1.02
MAXIMUM		21.51	13.38	4.35	6.35	4.61	1.73	0.49	-0.07	0.12	-0.71	5.30	-0.66
15 sec.	MINIMUM	5.08	1.49	-0.61	1.00	3.86	-0.32	0.02	-0.56	-0.27	-1.15	-0.37	-4.17
sample	RANGE	16.43	11.89	4.96	5.35	0.75	2.05	0.47	0.49	0.39	0.44	5.67	3.51
	AVERAGE	13.47	7.71	1.82	3.50	4.24	0.79	0.22	-0.34	-0.07	-0.87	2.13	-2.17
	STD. DEV.	3.86	2.96	1.28	1.49	0.23	0.62	0.10	0.12	0.08	0.10	1.32	0.85
	VARIANCE	14.92	8.76	1.63	2.23	0.05	0.38	0.01	0.02	0.01	0.01	1.75	0.72
MEDIUM TURBINE LOAD													
	MAXIMUM	3.83	1.29	3.69	1.20	5.03	1.22	0.78	0.56	0.51	0.37	0.59	-0.56
30 min.	MINIMUM	1.88	-0.95	2.66	-0.27	0.37	-0.42	-0.37	-0.85	-0.59	-1.34	-0.90	-2.03
sample	RANGE	1.95	2.24	1.03	1.47	4.66	1.64	1.15	1.41	1.10	1.71	1.49	1.47
	AVERAGE	2.84	-0.18	3.17	0.32	3.08	0.42	0.23	-0.23	0.11	-0.36	-0.19	-1.23
	STD. DEV.	0.33	0.21	0.15	0.18	0.20	0.16	0.15	0.20	0.16	0.25	0.19	0.20
	VARIANCE	0.11	0.05	0.02	0.03	0.04	0.02	0.02	0.04	0.03	0.06	0.03	0.04
	MAXIMUM	2.91	0.12	3.49	0.61	3.30	0.61	0.66	-0.24	0.51	0.07	0.07	-0.85
15 sec.	MINIMUM	2.08	-0.37	2.91	0.02	2.76	0.22	0.10	-0.68	0.10	-0.42	-0.42	-1.49
sample	RANGE	0.83	0.49	0.58	0.59	0.54	0.39	0.56	0.44	0.41	0.49	0.49	0.64
	AVERAGE	2.50	-0.16	3.24	0.19	3.12	0.41	0.42	-0.50	0.29	-0.16	-0.13	-1.12
	STD. DEV.	0.18	0.10	0.12	0.11	0.11	0.08	0.11	0.10	0.09	0.13	0.10	0.13
	VARIANCE	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.02
LOW TURBINE LOAD													
	MAXIMUM	2.34	0.73	2.25	1.20	2.91	1.93	0.61	0.12	0.42	0.37	0.85	-0.12
30 min.	MINIMUM	1.17	-0.76	1.39	-0.27	1.22	-1.15	-0.07	-0.63	-0.56	-1.15	-0.63	-1.34
sample	RANGE	1.17	1.49	0.86	1.47	1.69	3.08	0.68	0.75	0.98	1.52	1.48	1.22
	AVERAGE	1.76	-0.01	1.92	0.34	1.88	0.34	0.27	-0.27	-0.07	-0.46	-0.06	-0.70
	STD. DEV.	0.15	0.13	0.10	0.13	0.15	0.21	0.10	0.11	0.16	0.25	0.15	0.17
	VARIANCE	0.02	0.02	0.01	0.02	0.02	0.04	0.01	0.01	0.03	0.06	0.02	0.03
	MAXIMUM	2.20	0.32	2.22	0.71	2.91	0.44	0.37	-0.10	0.17	0.07	0.49	-0.44
15 sec.	MINIMUM	1.49	-0.37	1.73	0.07	1.90	-1.15	0.05	-0.56	-0.46	-0.56	-0.22	-1.05
sample	RANGE	0.71	0.69	0.49	0.64	1.01	1.59	0.32	0.46	0.63	0.63	0.71	0.61
	AVERAGE	1.75	0.04	1.98	0.41	2.25	-0.13	0.22	-0.32	-0.19	-0.23	0.01	-0.76
	STD. DEV.	0.14	0.14	0.10	0.13	0.27	0.41	0.08	0.11	0.16	0.13	0.15	0.11
	VARIANCE	0.02	0.02	0.01	0.02	0.07	0.17	0.01	0.01	0.02	0.02	0.02	0.01

Appendix Table A29. Velocities at Bulkhead Slot. McNary Dam Turbine 5B.
Full powerhouse. High turbine load.

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		10.35	-3.74		8.11	-0.12
MINIMUM		9.64	-4.93		4.13	-4.74
RANGE		0.71	1.19		3.98	4.62
AVERAGE	253.31	9.95	-4.30	233.31	5.99	-2.03
STD.DEV.		0.17	0.31		1.05	1.03
VARIANCE		0.03	0.09		1.10	1.05
MAXIMUM		10.06	-3.83		8.86	-0.95
MINIMUM		9.42	-4.96		5.91	-4.08
RANGE		0.64	1.13		2.95	3.13
AVERAGE	253.26	9.75	-4.49	233.26	7.68	-2.49
STD.DEV.		0.11	0.23		0.70	0.76
VARIANCE		0.01	0.05		0.49	0.57
MAXIMUM		10.35	-4.08		8.13	1.10
MINIMUM		9.79	-5.10		3.98	-5.22
RANGE		0.56	1.02		4.15	6.32
AVERAGE	253.27	10.07	-4.58	233.27	6.19	-2.03
STD.DEV.		0.14	0.27		1.19	1.48
VARIANCE		0.02	0.08		1.42	2.20
MAXIMUM		10.16	-3.64		8.86	-0.32
MINIMUM		9.59	-4.86		5.47	-4.44
RANGE		0.57	1.22		3.39	4.12
AVERAGE	253.30	9.90	-4.25	233.30	6.74	-2.34
STD.DEV.		0.11	0.27		0.86	1.25
VARIANCE		0.01	0.07		0.74	1.57
MAXIMUM		4.39	-1.88		8.96	-1.83
MINIMUM		3.83	-2.37		5.69	-6.42
RANGE		0.56	0.49		3.27	4.59
AVERAGE	256.66	4.11	-2.16	236.66	7.21	-3.91
STD.DEV.		0.13	0.12		0.88	1.09
VARIANCE		0.02	0.01		0.78	1.18
MAXIMUM		2.47	-2.03		7.71	-1.68
MINIMUM		2.15	-2.42		4.64	-5.05
RANGE		0.32	0.39		3.07	3.37
AVERAGE	263.05	2.30	-2.22	243.05	6.14	-3.55
STD.DEV.		0.08	0.09		0.78	0.83
VARIANCE		0.01	0.01		0.61	0.69

Appendix Table A29 - continued

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		2.51	-1.98		8.69	-1.32
MINIMUM		1.98	-2.47		3.20	-3.91
RANGE		0.53	0.49		5.49	2.59
AVERAGE	263.05	2.25	-2.21	243.05	6.23	-2.68
STD. DEV.		0.14	0.10		1.68	0.76
VARIANCE		0.02	0.01		2.81	0.58
MAXIMUM		2.51	-2.08		8.59	-1.59
MINIMUM		2.17	-2.47		5.59	-3.32
RANGE		0.34	0.39		3.00	1.73
AVERAGE	263.05	2.32	-2.26	243.05	6.92	-2.39
STD. DEV.		0.08	0.08		0.75	0.41
VARIANCE		0.01	0.01		0.56	0.17
MAXIMUM		2.47	-1.76		10.50	-1.98
MINIMUM		2.22	-2.51		3.39	-4.57
RANGE		0.25	0.75		7.11	2.59
AVERAGE	262.98	2.37	-2.29	242.98	6.84	-3.38
STD. DEV.		0.06	0.10		2.08	0.66
VARIANCE		0.00	0.01		4.31	0.43
MAXIMUM		2.51	-1.78		9.35	-0.59
MINIMUM		1.93	-2.44		4.10	-4.76
RANGE		0.58	0.66		5.25	4.17
AVERAGE	263.04	2.20	-2.03	243.04	6.30	-2.46
STD. DEV.		0.13	0.15		1.40	1.25
VARIANCE		0.02	0.02		1.95	1.56
MAXIMUM		2.49	-1.78		8.64	-3.39
MINIMUM		2.15	-2.42		3.61	-5.44
RANGE		0.34	0.64		5.03	2.05
AVERAGE	263.09	2.35	-2.19	243.09	5.82	-4.40
STD. DEV.		0.08	0.16		1.32	0.46
VARIANCE		0.01	0.03		1.73	0.21
MAXIMUM		2.47	-1.83		9.99	-2.86
MINIMUM		1.95	-2.34		5.59	-4.49
RANGE		0.52	0.51		4.40	1.63
AVERAGE	263.09	2.23	-2.09	243.09	8.00	-3.62
STD. DEV.		0.13	0.13		1.24	0.38
VARIANCE		0.02	0.02		1.55	0.14

Appendix Table A29 - continued

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		2.49	-2.00		8.81	-2.12
MINIMUM		2.00	-2.34		5.00	-4.00
RANGE		0.41	0.34		3.81	1.88
AVERAGE	263.08	2.32	-2.16	243.08	6.90	-3.05
STD. DEV.		0.09	0.09		0.97	0.52
VARIANCE		0.01	0.01		0.94	0.27
MAXIMUM		2.03	-2.29		7.81	-3.44
MINIMUM		1.73	-2.64		2.71	-5.20
RANGE		0.30	0.35		5.10	1.76
AVERAGE	266.47	1.87	-2.45	246.47	5.63	-4.33
STD. DEV.		0.06	0.08		1.36	0.35
VARIANCE		0.00	0.01		1.85	0.12
MAXIMUM		2.10	-2.15		6.18	-2.44
MINIMUM		1.68	-2.81		2.86	-5.15
RANGE		0.42	0.66		3.32	2.71
AVERAGE	266.52	1.88	-2.51	246.52	4.96	-3.75
STD. DEV.		0.08	0.12		0.92	0.79
VARIANCE		0.01	0.02		0.84	0.63

Appendix Table A30. Velocities at Bulkhead Slot. McNary Dam Turbine 5B.
Full powerhouse. Medium turbine load.

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		1.32	-1.49		5.22	-2.76
MINIMUM		0.90	-1.83		1.20	-3.69
RANGE		0.42	0.34		4.02	0.93
AVERAGE	265.52	1.14	-1.64	245.52	2.91	-3.20
STD.DEV.		0.07	0.08		1.13	0.26
VARIANCE		0.00	0.01		1.27	0.07
MAXIMUM		1.64	-1.22		7.54	-0.81
MINIMUM		1.25	-1.59		5.49	-2.56
RANGE		0.39	0.37		2.05	1.75
AVERAGE	261.43	1.43	-1.37	241.43	6.62	-1.64
STD.DEV.		0.09	0.08		0.52	0.50
VARIANCE		0.01	0.01		0.27	0.25
MAXIMUM		2.22	-1.05		7.54	-1.44
MINIMUM		1.73	-1.46		6.08	-4.47
RANGE		0.49	0.41		1.46	3.03
AVERAGE	256.48	1.95	-1.25	236.48	6.73	-2.92
STD.DEV.		0.14	0.09		0.32	0.62
VARIANCE		0.02	0.01		0.10	0.39
MAXIMUM		6.74	-2.81		5.30	-0.66
MINIMUM		6.32	-3.15		3.83	-2.34
RANGE		0.42	0.34		1.47	1.68
AVERAGE	252.33	6.54	-3.00	232.33	4.64	-1.56
STD.DEV.		0.10	0.08		0.40	0.37
VARIANCE		0.01	0.01		0.16	0.14
MAXIMUM		6.91	-2.93		5.52	0.12
MINIMUM		6.52	-3.30		3.25	-2.42
RANGE		0.39	0.37		2.27	2.54
AVERAGE	252.24	6.71	-3.13	232.24	4.37	-1.31
STD.DEV.		0.07	0.09		0.64	0.72
VARIANCE		0.01	0.01		0.40	0.52
MAXIMUM		6.86	-2.86		6.47	-2.25
MINIMUM		6.47	-3.34		3.54	-3.78
RANGE		0.39	0.48		2.93	1.53
AVERAGE	252.20	6.68	-3.03	232.20	4.98	-3.05
STD.DEV.		0.08	0.11		0.77	0.36
VARIANCE		0.01	0.01		0.60	0.13

Appendix Table A30 - continued

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		6.81	-2.91		5.98	-0.98
MINIMUM		6.47	-3.34		2.81	-4.27
RANGE		0.34	0.43		3.17	3.29
AVERAGE	252.18	6.64	-3.16	232.18	4.38	-2.44
STD. DEV.		0.07	0.13		0.95	0.87
VARIANCE		0.01	0.02		0.91	0.75
MAXIMUM		6.86	-2.81		7.10	-1.10
MINIMUM		6.52	-3.25		2.66	-3.54
RANGE		0.34	0.44		4.44	2.44
AVERAGE	252.20	6.69	-3.04	232.20	5.12	-2.45
STD. DEV.		0.08	0.08		1.28	0.65
VARIANCE		0.01	0.01		1.64	0.42
MAXIMUM		6.74	-2.83		5.98	-0.93
MINIMUM		6.42	-3.30		3.69	-3.30
RANGE		0.32	0.47		2.29	2.37
AVERAGE	252.19	6.58	-3.07	232.19	4.76	-2.26
STD. DEV.		0.08	0.10		0.62	0.66
VARIANCE		0.01	0.01		0.39	0.44
MAXIMUM		6.81	-2.83		7.23	-0.85
MINIMUM		6.42	-3.30		4.66	-3.54
RANGE		0.39	0.47		2.57	2.69
AVERAGE	252.17	6.62	-3.07	232.17	6.25	-2.22
STD. DEV.		0.10	0.09		0.69	0.83
VARIANCE		0.01	0.01		0.48	0.69
MAXIMUM		6.88	-2.93		5.69	0.22
MINIMUM		5.96	-3.32		2.08	-3.34
RANGE		0.92	0.39		3.61	3.56
AVERAGE	252.13	6.65	-3.15	232.13	3.27	-1.05
STD. DEV.		0.13	0.08		0.94	0.88
VARIANCE		0.02	0.01		0.88	0.78
MAXIMUM		6.96	-2.86		5.71	-1.20
MINIMUM		6.52	-3.25		2.83	-3.54
RANGE		0.44	0.39		2.88	2.34
AVERAGE	252.14	6.76	-3.03	232.14	4.42	-2.42
STD. DEV.		0.09	0.09		0.73	0.67
VARIANCE		0.01	0.01		0.53	0.44

Appendix Table A30 - continued

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		6.86	-2.76		6.03	-0.44
MINIMUM		6.27	-3.22		3.54	-2.27
RANGE		0.59	0.46		2.49	1.83
AVERAGE	252.11	6.66	-2.98	232.11	4.97	-1.20
STD.DEV.		0.12	0.11		0.55	0.51
VARIANCE		0.01	0.01		0.30	0.26
MAXIMUM		6.86	-2.91		5.76	-0.27
MINIMUM		6.35	-3.34		3.71	-2.47
RANGE		0.51	0.43		2.05	2.20
AVERAGE	252.07	6.66	-3.11	232.07	4.65	-1.41
STD.DEV.		0.13	0.10		0.46	0.60
VARIANCE		0.02	0.01		0.21	0.36

Appendix Table A31. Velocities at Bulkhead Slot. McNary Dam Turbine 5B.
Full powerhouse. Low turbine load.

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		4.59	-1.90		5.44	-1.03
MINIMUM		4.27	-2.29		2.59	-2.81
RANGE		0.32	0.39		2.85	1.78
AVERAGE	251.85	4.40	-2.09	231.85	3.99	-1.99
STD.DEV.		0.07	0.07		0.83	0.37
VARIANCE		0.01	0.01		0.68	0.14
MAXIMUM		2.12	-0.78		5.35	-0.73
MINIMUM		1.56	-1.15		2.91	-2.32
RANGE		0.56	0.37		2.44	1.59
AVERAGE	255.05	1.83	-0.96	235.05	4.15	-1.55
STD.DEV.		0.12	0.08		0.64	0.47
VARIANCE		0.01	0.01		0.41	0.22
MAXIMUM		1.17	-0.78		7.81	-0.37
MINIMUM		0.81	-1.12		-3.66	-1.81
RANGE		0.36	0.34		11.47	1.44
AVERAGE	260.08	1.02	-0.93	240.08	2.97	-1.14
STD.DEV.		0.08	0.07		3.18	0.33
VARIANCE		0.01	0.01		10.10	0.11
MAXIMUM		1.00	-0.61		4.47	-1.54
MINIMUM		0.59	-1.32		2.95	-2.37
RANGE		0.41	0.71		1.52	0.83
AVERAGE	264.93	0.82	-0.92	244.93	3.60	-1.96
STD.DEV.		0.08	0.17		0.43	0.22
VARIANCE		0.01	0.03		0.19	0.05
MAXIMUM		0.90	-0.85		4.17	-1.34
MINIMUM		0.34	-1.64		2.98	-2.17
RANGE		0.56	0.79		1.19	0.83
AVERAGE	264.92	0.64	-1.25	244.92	3.54	-1.76
STD.DEV.		0.11	0.19		0.29	0.21
VARIANCE		0.01	0.04		0.08	0.04
MAXIMUM		0.90	-0.95		3.91	-1.25
MINIMUM		0.51	-1.44		2.95	-1.93
RANGE		0.39	0.49		0.96	0.68
AVERAGE	264.88	0.72	-1.16	244.88	3.43	-1.62
STD.DEV.		0.09	0.11		0.27	0.17
VARIANCE		0.01	0.01		0.07	0.03

Appendix Table A31 - continued

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		0.85	-0.98		3.74	-1.73
MINIMUM		0.56	-1.37		3.05	-2.17
RANGE		0.29	0.39		0.69	0.44
AVERAGE	264.88	0.70	-1.18	244.88	3.36	-1.97
STD. DEV.		0.07	0.08		0.14	0.09
VARIANCE		0.00	0.01		0.02	0.01
MAXIMUM		0.98	-0.88		3.88	-1.46
MINIMUM		0.46	-1.32		2.91	-2.27
RANGE		0.52	0.44		0.97	0.81
AVERAGE	264.89	0.74	-1.08	244.89	3.17	-1.99
STD. DEV.		0.09	0.10		0.21	0.14
VARIANCE		0.01	0.01		0.04	0.02
MAXIMUM		0.95	-0.83		4.13	-1.54
MINIMUM		0.63	-1.25		3.00	-2.22
RANGE		0.32	0.42		1.13	0.68
AVERAGE	264.89	0.80	-0.99	244.89	3.58	-1.82
STD. DEV.		0.07	0.09		0.26	0.13
VARIANCE		0.00	0.01		0.07	0.02
MAXIMUM		0.83	-0.85		4.20	-1.39
MINIMUM		0.51	-1.29		3.52	-1.78
RANGE		0.32	0.44		0.68	0.39
AVERAGE	264.91	0.70	-1.07	244.91	3.79	-1.59
STD. DEV.		0.07	0.11		0.14	0.08
VARIANCE		0.01	0.01		0.02	0.01
MAXIMUM		0.85	-1.00		4.03	-1.39
MINIMUM		0.51	-1.42		2.73	-2.12
RANGE		0.34	0.42		1.30	0.73
AVERAGE	264.88	0.73	-1.19	244.88	3.31	-1.84
STD. DEV.		0.08	0.08		0.34	0.14
VARIANCE		0.01	0.01		0.12	0.02
MAXIMUM		0.83	-0.76		3.88	-1.54
MINIMUM		0.46	-1.20		2.91	-2.03
RANGE		0.37	0.44		0.97	0.49
AVERAGE	264.88	0.64	-1.03	244.88	3.45	-1.78
STD. DEV.		0.08	0.08		0.26	0.09
VARIANCE		0.01	0.01		0.07	0.01

Appendix Table A31 - continued

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		0.88	-0.76		3.69	-1.54
MINIMUM		0.54	-1.25		2.91	-2.08
RANGE		0.34	0.49		0.78	0.54
AVERAGE	264.85	0.72	-0.98	244.85	3.33	-1.77
STD. DEV.		0.08	0.13		0.19	0.14
VARIANCE		0.01	0.02		0.04	0.02
MAXIMUM		0.85	-0.83		4.03	-1.54
MINIMUM		0.51	-1.29		3.22	-2.17
RANGE		0.34	0.46		0.81	0.63
AVERAGE	264.83	0.68	-1.07	244.83	3.60	-1.89
STD. DEV.		0.08	0.11		0.19	0.16
VARIANCE		0.01	0.01		0.04	0.03

Appendix Table A32. Comparison of 30 minute vs 15 second samples of velocities at Bulkhead Slot. McNary Dam Turbine 5B. Full powerhouse.

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
High Turbine Load						
MAXIMUM		5.05	-1.71		19.53	21.07
30 min. MINIMUM		3.59	-2.86		-1.34	-11.01
sample RANGE		1.46	1.15		20.87	32.08
AVERAGE	256.72	4.32	-2.26	236.72	7.08	-3.37
STD. DEV.		0.25	0.15		1.66	1.85
VARIANCE		0.06	0.02		2.75	3.42
15 sec.						
MAXIMUM		4.39	-1.88		8.96	-1.83
MINIMUM		3.83	-2.37		5.69	-6.42
sample RANGE		0.56	0.49		3.27	4.59
AVERAGE	256.66	4.11	-2.16	236.66	7.21	-3.91
STD. DEV.		0.13	0.12		0.88	1.09
VARIANCE		0.02	0.01		0.78	1.18
Medium Turbine Load						
MAXIMUM		7.30	-2.61		8.03	0.85
30 min. MINIMUM		5.98	-4.20		1.66	-4.42
sample RANGE		1.32	1.59		6.37	5.27
AVERAGE	252.15	6.58	-3.05	232.15	4.97	-1.60
STD. DEV.		0.12	0.13		1.00	0.86
VARIANCE		0.01	0.02		1.00	0.75
15 sec.						
MAXIMUM		6.81	-2.83		7.23	-0.85
MINIMUM		6.42	-3.30		4.66	-3.54
sample RANGE		0.39	0.47		2.57	2.69
AVERAGE	252.17	6.62	-3.07	232.17	6.25	-2.22
STD. DEV.		0.10	0.09		0.69	0.83
VARIANCE		0.01	0.01		0.48	0.69
Low Turbine Load						
MAXIMUM		1.15	-0.63		4.66	-1.25
30 min. MINIMUM		0.34	-1.64		2.22	-2.66
sample RANGE		0.81	1.01		2.44	1.41
AVERAGE	264.95	0.73	-1.14	244.95	3.50	-1.81
STD. DEV.		0.09	0.14		0.39	0.20
VARIANCE		0.01	0.02		0.15	0.04
15 sec.						
MAXIMUM		0.90	-0.85		4.17	-1.34
MINIMUM		0.34	-1.64		2.98	-2.17
sample RANGE		0.56	0.79		1.19	0.83
AVERAGE	264.92	0.64	-1.25	244.92	3.54	-1.76
STD. DEV.		0.11	0.19		0.29	0.21
VARIANCE		0.01	0.04		0.08	0.04

Appendix Table A33. Velocities 10 feet upstream and 1 foot upstream of trashracks of Turbine 12B at the Bonneville Second Powerhouse. Partial powerhouse loading. High Turbine load.

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		-1.73	1.49	-1.44		-2.91	5.10	-1.44
MINIMUM		-2.51	1.10	-1.78		-3.66	4.00	-1.78
RANGE		0.78	0.39	0.34		0.75	1.10	0.34
AVERAGE	1.13	-2.03	1.32	-1.50	-0.87	-3.31	4.46	-1.62
STD. DEV.		0.156	0.092	0.089		0.176	0.260	0.084
VARIANCE		0.024	0.008	0.008		0.031	0.068	0.007
MAXIMUM		-1.20	1.56	-1.34		-2.34	4.27	-1.51
MINIMUM		-1.90	1.10	-1.83		-2.91	3.93	-2.22
RANGE		0.70	0.46	0.49		0.57	0.34	0.71
AVERAGE	1.99	-1.51	1.35	-1.55	-0.01	-2.62	4.10	-1.77
STD. DEV.		0.132	0.116	0.116		0.124	0.082	0.179
VARIANCE		0.018	0.013	0.013		0.015	0.007	0.032
MAXIMUM		-1.27	2.17	-1.98		-1.93	4.37	-1.54
MINIMUM		-1.64	1.64	-2.42		-2.44	3.93	-2.12
RANGE		0.37	0.53	0.44		0.51	0.44	0.58
AVERAGE	6.48	-1.42	1.89	-2.16	4.48	-2.12	4.18	-1.92
STD. DEV.		0.073	0.136	0.118		0.124	0.100	0.144
VARIANCE		0.005	0.019	0.014		0.015	0.010	0.021
MAXIMUM		-1.05	1.71	-1.76		-2.32	4.22	-0.95
MINIMUM		-1.54	1.32	-2.22		-2.86	3.81	-1.25
RANGE		0.49	0.39	0.46		0.54	0.41	0.30
AVERAGE	12.67	-1.24	1.56	-2.03	10.67	-2.55	4.10	-1.13
STD. DEV.		0.104	0.079	0.108		0.137	0.096	0.071
VARIANCE		0.011	0.006	0.012		0.019	0.009	0.005
MAXIMUM		-1.25	1.64	-2.05		-1.98	4.20	-1.90
MINIMUM		-1.59	1.27	-2.56		-2.86	3.66	-2.61
RANGE		0.34	0.37	0.51		0.88	0.54	0.71
AVERAGE	18.23	-1.40	1.47	-2.26	16.23	-2.38	3.99	-2.15
STD. DEV.		0.082	0.087	0.125		0.261	0.114	0.128
VARIANCE		0.007	0.008	0.016		0.068	0.013	0.016
MAXIMUM		-0.85	1.81	-2.22		-1.76	4.22	-2.08
MINIMUM		-1.34	1.29	-2.54		-2.44	3.71	-2.51
RANGE		0.49	0.52	0.32		0.68	0.51	0.43
AVERAGE	18.24	-1.10	1.59	-2.36	16.24	-2.09	4.00	-2.24
STD. DEV.		0.093	0.136	0.079		0.202	0.136	0.098
VARIANCE		0.009	0.019	0.006		0.041	0.019	0.010

Appendix Table A33 - continued

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		-1.12	1.61	-2.03		-2.22	3.64	-1.68
MINIMUM		-1.56	1.29	-2.54		-2.71	3.17	-2.12
RANGE		0.44	0.32	0.51		0.49	0.47	0.44
AVERAGE	23.85	-1.29	1.49	-2.23	21.85	-2.41	3.42	-1.84
STD. DEV.		0.093	0.083	0.119		0.097	0.107	0.085
VARIANCE		0.009	0.007	0.014		0.009	0.011	0.007
MAXIMUM		-1.10	1.49	-1.29		-2.27	3.66	-0.95
MINIMUM		-1.68	1.15	-1.73		-2.76	3.20	-1.66
RANGE		0.58	0.34	0.44		0.49	0.46	0.71
AVERAGE	23.75	-1.32	1.33	-1.50	21.75	-2.50	3.48	-1.25
STD. DEV.		0.100	0.083	0.111		0.122	0.094	0.170
VARIANCE		0.010	0.007	0.012		0.015	0.009	0.029
MAXIMUM		-0.95	1.39	-1.54		-1.76	3.42	-1.54
MINIMUM		-1.29	1.03	-1.83		-2.20	3.10	-1.93
RANGE		0.34	0.36	0.29		0.44	0.32	0.39
AVERAGE	29.68	-1.14	1.26	-1.67	27.68	-1.98	3.25	-1.70
STD. DEV.		0.077	0.080	0.067		0.088	0.072	0.084
VARIANCE		0.006	0.006	0.004		0.008	0.005	0.007
MAXIMUM		-1.29	1.20	-2.22		-1.49	2.59	-2.34
MINIMUM		-1.73	0.81	-2.59		-2.32	1.95	-3.00
RANGE		0.44	0.39	0.37		0.83	0.64	0.66
AVERAGE	35.80	-1.51	1.02	-2.37	33.80	-1.90	2.28	-2.69
STD. DEV.		0.096	0.090	0.081		0.174	0.180	0.150
VARIANCE		0.009	0.008	0.006		0.030	0.032	0.022
MAXIMUM		-1.39	1.03	-1.93		-2.34	1.00	-2.29
MINIMUM		-1.71	0.51	-2.34		-3.25	0.49	-2.73
RANGE		0.32	0.52	0.41		0.91	0.51	0.44
AVERAGE	42.42	-1.56	0.78	-2.10	40.42	-2.98	0.75	-2.49
STD. DEV.		0.073	0.114	0.093		0.196	0.122	0.089
VARIANCE		0.005	0.013	0.009		0.038	0.015	0.008
MAXIMUM		-0.46	0.39	-1.59		-1.12	0.02	-1.49
MINIMUM		-1.29	-0.02	-2.12		-1.86	-0.76	-1.83
RANGE		0.83	0.41	0.53		0.74	0.78	0.34
AVERAGE	48.57	-0.88	0.18	-1.81	46.57	-1.50	-0.26	-1.63
STD. DEV.		0.264	0.086	0.120		0.177	0.188	0.077
VARIANCE		0.070	0.007	0.014		0.031	0.035	0.006

Appendix Table A33 - continued

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		1.10	-0.66	-0.24		1.15	-1.83	-0.56
MINIMUM		-0.37	-1.51	-0.95		-0.15	-2.69	-1.34
RANGE		1.47	0.85	0.71		1.30	0.86	0.78
AVERAGE	56.43	0.27	-1.04	-0.61	54.43	0.59	-2.24	-0.87
STD.DEV.		0.402	0.235	0.163		0.310	0.177	0.186
VARIANCE		0.162	0.055	0.026		0.096	0.031	0.034

Appendix Table A34. Velocities 10 feet upstream and 1 foot upstream of trashracks of Turbine 12B at the Bonneville Second Powerhouse. Partial powerhouse loading. Medium Turbine load.

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		-0.81	1.73	-0.12		-1.15	4.37	0.02
MINIMUM		-1.54	0.98	-1.07		-2.17	3.49	-0.78
RANGE		0.73	0.75	0.95		1.02	0.88	0.80
AVERAGE	-7.54	-1.26	1.40	-0.63	-9.54	-1.61	4.02	-0.45
STD. DEV.		0.175	0.200	0.271		0.290	0.250	0.213
VARIANCE		0.031	0.040	0.073		0.084	0.063	0.045
MAXIMUM		-0.37	1.29	0.37		-0.76	4.22	0.59
MINIMUM		-0.81	0.85	-0.98		-1.34	3.44	-1.03
RANGE		0.44	0.44	1.35		0.58	0.78	1.62
AVERAGE	-4.65	-0.56	1.13	-0.24	-6.65	-1.01	3.80	-0.44
STD. DEV.		0.098	0.096	0.401		0.126	0.205	0.497
VARIANCE		0.010	0.009	0.161		0.016	0.042	0.247
MAXIMUM		-1.07	1.68	-0.81		-1.73	3.74	-0.71
MINIMUM		-1.46	1.39	-1.25		-2.12	3.39	-1.20
RANGE		0.39	0.29	0.44		0.39	0.35	0.49
AVERAGE	1.38	-1.27	1.53	-1.00	-0.62	-1.95	3.59	-0.94
STD. DEV.		0.072	0.063	0.107		0.072	0.073	0.106
VARIANCE		0.005	0.004	0.011		0.005	0.005	0.011
MAXIMUM		-1.20	1.93	-1.42		-1.20	3.81	-1.29
MINIMUM		-1.66	1.39	-1.93		-1.73	3.22	-1.86
RANGE		0.46	0.54	0.51		0.53	0.59	0.57
AVERAGE	6.53	-1.45	1.67	-1.71	4.53	-1.46	3.49	-1.63
STD. DEV.		0.084	0.125	0.115		0.157	0.141	0.127
VARIANCE		0.007	0.016	0.013		0.025	0.020	0.016
MAXIMUM		-1.00	1.61	-0.90		-1.66	3.42	-0.46
MINIMUM		-1.44	1.22	-1.44		-2.42	3.03	-1.15
RANGE		0.44	0.39	0.54		0.76	0.39	0.69
AVERAGE	12.27	-1.21	1.44	-1.18	10.27	-2.05	3.21	-0.76
STD. DEV.		0.125	0.084	0.126		0.210	0.091	0.177
VARIANCE		0.016	0.007	0.016		0.044	0.008	0.031
MAXIMUM		-0.71	1.44	-1.37		-1.20	3.42	-1.68
MINIMUM		-1.20	1.05	-1.93		-1.76	2.95	-2.12
RANGE		0.49	0.39	0.56		0.56	0.47	0.44
AVERAGE	18.04	-0.93	1.27	-1.63	16.04	-1.50	3.24	-1.91
STD. DEV.		0.121	0.098	0.121		0.132	0.083	0.101
VARIANCE		0.015	0.010	0.015		0.017	0.007	0.010

Appendix Table A34 - continued

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		-0.85	1.54	-1.25		-1.25	3.52	-1.29
MINIMUM		-1.29	1.10	-1.76		-2.05	2.95	-1.76
RANGE		0.44	0.44	0.51		0.80	0.57	0.47
AVERAGE	18.06	-1.11	1.31	-1.52	16.06	-1.61	3.19	-1.51
STD. DEV.		0.084	0.083	0.130		0.227	0.117	0.111
VARIANCE		0.007	0.007	0.017		0.052	0.014	0.012
MAXIMUM		-0.51	1.34	-1.25		-1.10	3.05	-1.25
MINIMUM		-0.83	1.00	-1.73		-1.64	2.76	-1.76
RANGE		0.32	0.34	0.48		0.54	0.29	0.51
AVERAGE	24.37	-0.67	1.21	-1.52	22.37	-1.37	2.91	-1.47
STD. DEV.		0.065	0.073	0.111		0.124	0.064	0.106
VARIANCE		0.004	0.005	0.012		0.015	0.004	0.011
MAXIMUM		-0.76	1.44	-1.73		-0.90	3.10	-1.59
MINIMUM		-1.15	1.12	-1.98		-1.37	2.54	-2.03
RANGE		0.39	0.32	0.25		0.47	0.56	0.44
AVERAGE	29.39	-0.96	1.30	-1.85	27.39	-1.15	2.88	-1.81
STD. DEV.		0.093	0.078	0.068		0.117	0.143	0.108
VARIANCE		0.009	0.006	0.005		0.014	0.021	0.012

Appendix Table A35. Velocities 10 feet upstream and 1 foot upstream of trashracks of Turbine 12B at the Bonneville Second Powerhouse. Partial powerhouse loading. Low Turbine load.

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		-1.34	0.90	-0.42		-1.83	3.56	-0.66
MINIMUM		-1.86	0.44	-1.64		-2.76	2.98	-1.98
RANGE		0.52	0.46	1.22		0.93	0.58	1.32
AVERAGE	-9.68	-1.61	0.66	-0.91	-11.68	-2.31	3.23	-1.19
STD. DEV.		0.132	0.106	0.378		0.231	0.148	0.349
VARIANCE		0.017	0.011	0.143		0.053	0.022	0.122
MAXIMUM		-0.37	1.51	-1.54		-1.00	3.71	-1.64
MINIMUM		-1.68	0.81	-2.25		-1.81	2.86	-2.22
RANGE		1.31	0.70	0.71		0.81	0.85	0.58
AVERAGE	-2.17	-1.12	1.14	-1.89	-4.17	-1.40	3.13	-1.88
STD. DEV.		0.364	0.185	0.177		0.240	0.208	0.187
VARIANCE		0.132	0.034	0.031		0.057	0.043	0.035
MAXIMUM		-0.66	1.71	-0.12		-1.05	4.03	-0.07
MINIMUM		-1.10	1.22	-1.10		-1.93	3.42	-1.15
RANGE		0.44	0.49	0.98		0.88	0.61	1.08
AVERAGE	-4.56	-0.89	1.53	-0.60	-6.56	-1.46	3.77	-0.74
STD. DEV.		0.090	0.112	0.249		0.214	0.161	0.276
VARIANCE		0.008	0.013	0.062		0.046	0.026	0.076
MAXIMUM		-1.17	1.34	-1.64		-1.42	3.05	-1.44
MINIMUM		-1.76	0.90	-2.51		-2.39	2.66	-2.51
RANGE		0.59	0.44	0.87		0.97	0.39	1.07
AVERAGE	1.91	-1.53	1.14	-2.05	-0.09	-1.92	2.92	-1.97
STD. DEV.		0.120	0.106	0.277		0.302	0.088	0.346
VARIANCE		0.014	0.011	0.077		0.091	0.008	0.120
MAXIMUM		-1.10	1.25	-2.15		-1.64	2.76	-1.54
MINIMUM		-1.76	0.81	-2.73		-2.81	2.27	-2.25
RANGE		0.66	0.44	0.58		1.17	0.49	0.71
AVERAGE	7.90	-1.44	1.03	-2.40	5.90	-2.19	2.51	-1.89
STD. DEV.		0.162	0.098	0.121		0.327	0.108	0.185
VARIANCE		0.026	0.010	0.015		0.107	0.012	0.034
MAXIMUM		-0.49	1.56	-1.56		-0.81	3.49	-1.44
MINIMUM		-1.59	1.12	-2.12		-1.54	2.83	-2.32
RANGE		1.10	0.44	0.56		0.73	0.66	0.88
AVERAGE	13.97	-1.05	1.38	-1.89	11.97	-1.15	3.15	-1.81
STD. DEV.		0.313	0.093	0.147		0.156	0.169	0.267
VARIANCE		0.098	0.009	0.021		0.024	0.028	0.071

Appendix Table A35 - continued

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		-1.15	3.25	-0.73		-2.10	3.20	-0.42
MINIMUM		-1.54	2.44	-2.00		-2.66	2.49	-1.61
RANGE		0.39	0.81	1.27		0.56	0.71	1.19
AVERAGE	19.30	-1.33	2.90	-1.38	17.30	-2.30	2.96	-1.11
STD. DEV.		0.087	0.225	0.351		0.120	0.160	0.256
VARIANCE		0.008	0.050	0.123		0.014	0.026	0.066
MAXIMUM		-0.78	2.91	-1.37		-1.44	2.88	-1.34
MINIMUM		-1.05	2.47	-1.68		-1.83	2.54	-1.59
RANGE		0.27	0.44	0.31		0.39	0.34	0.25
AVERAGE	24.29	-0.90	2.70	-1.51	22.29	-1.66	2.71	-1.44
STD. DEV.		0.059	0.107	0.076		0.103	0.085	0.060
VARIANCE		0.003	0.011	0.006		0.011	0.007	0.004
MAXIMUM		0.02	2.61	-1.34		-1.10	2.78	-0.95
MINIMUM		-0.90	1.98	-1.88		-1.76	2.27	-1.51
RANGE		0.92	0.63	0.54		0.66	0.51	0.56
AVERAGE	29.83	-0.48	2.35	-1.61	27.83	-1.39	2.53	-1.25
STD. DEV.		0.264	0.136	0.130		0.174	0.112	0.135
VARIANCE		0.070	0.018	0.017		0.030	0.013	0.018
MAXIMUM		-0.95	1.00	-2.12		-1.20	1.71	-2.44
MINIMUM		-1.44	0.56	-2.42		-2.32	1.37	-2.86
RANGE		0.49	0.44	0.30		1.12	0.34	0.42
AVERAGE	36.45	-1.18	0.79	-2.28	34.45	-1.63	1.54	-2.66
STD. DEV.		0.098	0.095	0.083		0.271	0.083	0.092
VARIANCE		0.010	0.009	0.007		0.073	0.007	0.009
MAXIMUM		-0.98	1.10	-1.49		-1.56	0.93	-1.49
MINIMUM		-1.44	0.59	-2.03		-2.88	0.39	-1.98
RANGE		0.46	0.51	0.54		1.32	0.54	0.49
AVERAGE	42.10	-1.22	0.89	-1.72	40.10	-2.27	0.67	-1.76
STD. DEV.		0.092	0.113	0.129		0.331	0.128	0.099
VARIANCE		0.008	0.013	0.017		0.109	0.016	0.010
MAXIMUM		1.86	0.37	-0.07		-1.05	0.61	-1.29
MINIMUM		-0.59	-0.90	-1.83		-2.54	-0.49	-1.68
RANGE		2.45	1.27	1.76		1.49	1.10	0.39
AVERAGE	48.61	0.25	0.06	-1.28	46.61	-1.82	0.12	-1.46
STD. DEV.		0.523	0.260	0.361		0.476	0.244	0.088
VARIANCE		0.274	0.068	0.130		0.227	0.059	0.008

Appendix Table A35 - continued

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		0.12	1.00	-1.34		-1.83	0.17	-1.29
MINIMUM		-1.29	-0.51	-1.90		-2.34	-0.56	-1.68
RANGE		1.41	1.51	0.64		0.51	0.73	0.39
AVERAGE	54.47	-0.49	0.10	-1.57	52.47	-2.13	-0.22	-1.44
STD.DEV.		0.374	0.418	0.145		0.149	0.212	0.082
VARIANCE		0.140	0.175	0.021		0.022	0.045	0.007
MAXIMUM		-1.59	0.29	-0.83		-2.05	0.12	-0.46
MINIMUM		-2.22	-0.02	-1.25		-2.66	-0.22	-0.90
RANGE		0.63	0.31	0.42		0.61	0.34	0.44
AVERAGE	60.55	-1.91	0.15	-1.06	58.55	-2.34	-0.05	-0.69
STD.DEV.		0.156	0.067	0.112		0.152	0.069	0.101
VARIANCE		0.024	0.004	0.013		0.023	0.005	0.010
MAXIMUM		-2.10	0.24	-0.37		-1.12	0.02	0.05
MINIMUM		-3.15	-0.24	-0.90		-1.81	-0.39	-0.46
RANGE		1.05	0.48	0.53		0.69	0.41	0.51
AVERAGE	66.94	-2.52	-0.04	-0.66	64.94	-1.45	-0.16	-0.18
STD.DEV.		0.301	0.105	0.125		0.170	0.096	0.134
VARIANCE		0.091	0.011	0.016		0.029	0.009	0.018

Appendix Table A36. Comparison of 30 minute vs 15 second samples of velocities 10 feet upstream and 1 foot upstream of trashracks of Turbine 12B at the Bonneville Second Powerhouse. Partial powerhouse loading.

		UPSTREAM	VELOCITY (in Ft/Sec)			DOWNSTREAM	VELOCITY (in Ft/Sec)		
		PROBE	X	Y	Z	PROBE	X	Y	Z
		ELEV(MSL)	FPS	FPS	FPS	ELEV(MSL)	FPS	FPS	FPS
High Turbine Load									
30 min. sample	MAXIMUM		-0.66	1.68	-1.27		-0.59	3.98	-0.46
	MINIMUM		-2.12	0.85	-3.13		-3.69	2.76	-3.10
	RANGE		1.46	0.83	1.86		3.10	1.22	2.64
	AVERAGE	23.80	-1.27	1.35	-1.99	21.80	-2.26	3.47	-1.77
	STD.DEV.		0.245	0.131	0.352		0.413	0.161	0.381
	VARIANCE		0.060	0.017	0.124		0.170	0.026	0.145
15 sec. sample	MAXIMUM		-1.15	1.49	-1.29		-2.27	3.66	-0.95
	MINIMUM		-1.46	1.15	-1.71		-2.76	3.30	-1.37
	RANGE		0.31	0.34	0.42		0.49	0.36	0.42
	AVERAGE	23.73	-1.31	1.34	-1.48	21.73	-2.49	3.48	-1.18
	STD.DEV.		0.066	0.081	0.102		0.126	0.087	0.104
	VARIANCE		0.004	0.006	0.010		0.016	0.008	0.011
Medium Turbine Load									
30 min. sample	MAXIMUM		-0.95	1.44	-1.25		-1.25	3.34	-1.37
	MINIMUM		-1.29	1.15	-1.76		-2.05	2.95	-1.76
	RANGE		0.34	0.29	0.51		0.80	0.39	0.39
	AVERAGE	18.06	-1.12	1.30	-1.51	16.06	-1.61	3.16	-1.54
	STD.DEV.		0.080	0.072	0.136		0.238	0.096	0.099
	VARIANCE		0.006	0.005	0.019		0.056	0.009	0.010
15 sec. sample	MAXIMUM		0.00	1.83	-0.42		-0.37	3.83	-0.39
	MINIMUM		-1.73	0.90	-3.00		-2.61	2.86	-2.93
	RANGE		1.73	0.93	2.58		2.24	0.97	2.54
	AVERAGE	18.10	-0.95	1.35	-1.66	16.10	-1.51	3.35	-1.61
	STD.DEV.		0.258	0.120	0.359		0.344	0.133	0.349
	VARIANCE		0.067	0.014	0.129		0.118	0.018	0.122
Low Turbine Load									
30 min. sample	MAXIMUM		-0.07	3.42	-0.49		-0.27	3.34	-0.37
	MINIMUM		-1.76	1.39	-3.22		-2.83	2.22	-2.64
	RANGE		1.69	2.03	2.73		2.56	1.12	2.27
	AVERAGE	19.25	-0.87	2.62	-1.78	17.25	-1.49	2.90	-1.58
	STD.DEV.		0.344	0.335	0.444		0.488	0.176	0.398
	VARIANCE		0.118	0.112	0.197		0.238	0.031	0.159
15 sec. sample	MAXIMUM		-1.15	3.25	-0.73		-2.10	3.20	-0.42
	MINIMUM		-1.54	2.44	-2.00		-2.66	2.49	-1.61
	RANGE		0.39	0.81	1.27		0.56	0.71	1.19
	AVERAGE	19.30	-1.33	2.90	-1.38	17.30	-2.38	2.96	-1.11
	STD.DEV.		0.087	0.225	0.351		0.120	0.160	0.256
	VARIANCE		0.008	0.050	0.123		0.014	0.026	0.066

Appendix Table A37. Velocities at the Folding Frame upstream of Travelling Screen.
 Bonneville Second Powerhouse. Turbine 12B. Partial powerhouse loading. High turbine load.

	VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)		
	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		-0.61	4.52		8.69	6.05		1.29	-0.02
MINIMUM		-0.85	1.78		0.98	-1.64		-0.63	-2.22
RANGE		0.24	2.74		7.71	7.69		1.92	2.20
AVERAGE	14.34	-0.72	3.03	10.34	5.46	2.33	-9.66	0.35	-1.19
STD.DEV.		0.059	0.746		2.127	1.899		0.508	0.523
VARIANCE		0.003	0.557		4.525	3.604		0.258	0.274
MAXIMUM		-0.69	4.66		6.35	1.15		1.05	0.00
MINIMUM		-0.90	0.90		1.07	-2.47		0.00	-2.03
RANGE		0.22	3.76		5.28	3.62		1.05	2.03
AVERAGE	14.53	-0.78	2.46	10.53	4.11	-0.44	-9.47	0.46	-0.91
STD.DEV.		0.048	0.874		1.406	0.781		0.299	0.524
VARIANCE		0.002	0.763		1.977	0.610		0.089	0.274
MAXIMUM		-0.66	6.76		7.89	1.68		1.59	0.56
MINIMUM		-0.88	2.95		-0.85	-1.32		0.73	-0.93
RANGE		0.22	3.81		8.74	3.00		0.86	1.49
AVERAGE	14.56	-0.73	4.71	10.56	3.65	0.08	-9.44	1.10	-0.11
STD.DEV.		0.054	1.206		2.233	0.770		0.224	0.389
VARIANCE		0.003	1.454		4.987	0.594		0.050	0.151
MAXIMUM		-0.66	5.00		10.03	4.32		1.05	0.10
MINIMUM		-0.85	2.51		5.00	-1.34		-0.22	-1.05
RANGE		0.19	2.49		5.03	5.66		1.27	1.15
AVERAGE	14.57	-0.74	3.74	10.57	7.58	1.55	-9.43	0.47	-0.52
STD.DEV.		0.053	0.650		1.392	1.429		0.314	0.295
VARIANCE		0.003	0.422		1.938	2.043		0.099	0.087
MAXIMUM		-0.44	5.35		7.69	2.86		1.90	0.68
MINIMUM		-0.66	1.64		2.95	-0.46		0.24	-1.76
RANGE		0.22	3.71		4.74	3.32		1.66	2.44
AVERAGE	14.64	-0.53	3.48	10.64	4.73	1.04	-9.36	1.01	-0.60
STD.DEV.		0.061	0.694		1.107	0.808		0.490	0.622
VARIANCE		0.004	0.482		1.226	0.652		0.240	0.387
MAXIMUM		-0.42	4.03		5.44	3.25		1.12	-0.17
MINIMUM		-0.66	0.12		2.76	-0.32		-0.27	-1.86
RANGE		0.24	3.91		2.68	3.57		1.39	1.69
AVERAGE	14.65	-0.52	1.68	10.65	3.96	1.76	-9.35	0.30	-1.09
STD.DEV.		0.052	1.293		0.664	0.744		0.380	0.449
VARIANCE		0.003	1.671		0.442	0.554		0.144	0.201

Appendix Table A37 - continued

	VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)		
	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		-0.61	5.47		6.32	2.15		1.49	0.34
MINIMUM		-0.85	2.34		2.61	-1.56		0.22	-0.76
RANGE		0.24	3.13		3.71	3.71		1.27	1.10
AVERAGE	14.65	-0.72	3.57	10.65	4.92	0.08	-9.35	0.96	-0.31
STD. DEV.		0.055	0.976		0.932	0.909		0.406	0.277
VARIANCE		0.003	0.953		0.869	0.826		0.165	0.077
MAXIMUM		-0.42	2.76		6.81	0.81		1.44	0.32
MINIMUM		-0.66	0.29		2.03	-1.29		0.44	-1.39
RANGE		0.24	2.47		4.78	2.10		1.00	1.71
AVERAGE	18.93	-0.51	1.44	14.93	4.29	-0.16	-5.07	0.84	-0.66
STD. DEV.		0.063	0.662		1.456	0.422		0.205	0.445
VARIANCE		0.004	0.438		2.119	0.178		0.042	0.198
MAXIMUM		-0.42	3.83		5.05	1.15		1.05	-0.56
MINIMUM		-0.66	0.71		2.88	-1.07		-0.15	-1.49
RANGE		0.24	3.12		2.17	2.22		1.20	0.93
AVERAGE	18.97	-0.51	2.03	14.97	4.03	-0.20	-5.03	0.53	-1.09
STD. DEV.		0.059	0.843		0.521	0.652		0.261	0.228
VARIANCE		0.003	0.710		0.272	0.425		0.068	0.052
MAXIMUM		-0.42	4.37		3.25	1.25		1.54	0.46
MINIMUM		-0.63	1.44		-0.54	-1.10		0.42	-1.07
RANGE		0.21	2.93		3.79	2.35		1.12	1.53
AVERAGE	21.10	-0.50	3.22	17.10	1.28	0.11	-2.98	0.99	-0.38
STD. DEV.		0.052	0.822		1.032	0.548		0.270	0.339
VARIANCE		0.003	0.676		1.064	0.301		0.073	0.115
MAXIMUM		-0.42	4.64		2.98	0.90		1.68	-0.34
MINIMUM		-0.59	1.44		0.71	-1.10		0.71	-2.12
RANGE		0.17	3.20		2.27	2.00		0.97	1.78
AVERAGE	24.40	-0.49	3.34	20.40	1.77	-0.14	0.40	1.12	-1.30
STD. DEV.		0.052	0.704		0.527	0.594		0.237	0.499
VARIANCE		0.003	0.496		0.278	0.353		0.056	0.249
MAXIMUM		-0.34	4.52		3.74	1.12		1.59	-0.46
MINIMUM		-0.59	2.47		1.88	-0.12		0.07	-2.37
RANGE		0.25	2.05		1.86	1.24		1.52	1.91
AVERAGE	24.57	-0.46	3.48	20.57	2.72	0.44	0.57	0.83	-1.61
STD. DEV.		0.060	0.493		0.452	0.302		0.364	0.425
VARIANCE		0.004	0.244		0.205	0.091		0.133	0.181

Appendix Table A37 - continued

	VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)		
	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		-0.34	4.76		3.15	1.46		1.34	-0.73
MINIMUM		-0.59	2.12		0.95	-0.27		0.56	-2.27
RANGE		0.25	2.64		2.20	1.73		0.78	1.54
AVERAGE	24.59	-0.47	3.65	20.59	2.01	0.71	0.59	0.91	-1.45
STD.DEV.		0.055	0.600		0.563	0.403		0.223	0.396
VARIANCE		0.003	0.360		0.317	0.162		0.050	0.157

* The mounting bolts holding the probe arms sheared during the tests; therefore these readings may differ somewhat from actual values.

Appendix Table A38. Velocities at the Folding Frame upstream of Travelling Screen.
 Bonneville Second Powerhouse. Turbine 12B. Partial powerhouse loading. Medium turbine load.

	VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)		
	Elevation (MSL)*	Y FPS	Z FPS	Elevation (MSL)*	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		-0.68	3.05		6.03	1.76		0.98	-0.10
MINIMUM		-0.90	1.68		3.56	-1.29		0.32	-0.81
RANGE		0.22	1.37		2.47	3.05		0.66	0.71
AVERAGE	15.04	-0.77	2.49	11.04	4.74	0.26	-8.96	0.60	-0.38
STD. DEV.		0.056	0.384		0.620	0.902		0.173	0.136
VARIANCE		0.003	0.148		0.385	0.814		0.030	0.018
MAXIMUM		-0.71	2.66		4.88	1.34		1.25	-0.27
MINIMUM		-0.93	1.46		3.56	-0.37		0.54	-1.18
RANGE		0.22	1.20		1.32	1.71		0.71	0.83
AVERAGE	18.94	-0.78	2.01	14.94	4.23	0.44	-5.06	0.87	-0.64
STD. DEV.		0.054	0.275		0.332	0.409		0.151	0.193
VARIANCE		0.003	0.075		0.110	0.167		0.023	0.037
MAXIMUM		-0.68	3.15		3.25	0.10		1.61	0.00
MINIMUM		-0.90	1.88		0.42	-1.93		0.59	-1.25
RANGE		0.22	1.27		2.83	2.03		1.02	1.25
AVERAGE	21.07	-0.77	2.54	17.07	1.47	-0.88	-2.93	1.13	-0.99
STD. DEV.		0.056	0.332		0.840	0.637		0.267	0.171
VARIANCE		0.003	0.111		0.705	0.406		0.071	0.029
MAXIMUM		-0.68	3.32		2.25	1.10		0.95	-0.85
MINIMUM		-0.93	2.61		1.27	-0.46		0.20	-1.54
RANGE		0.25	0.71		0.98	1.56		0.75	0.69
AVERAGE	24.16	-0.78	2.96	20.16	1.85	0.33	0.16	0.67	-1.08
STD. DEV.		0.059	0.143		0.266	0.396		0.195	0.168
VARIANCE		0.003	0.021		0.071	0.157		0.038	0.028
MAXIMUM		-0.71	3.08		4.32	0.22		1.03	-0.46
MINIMUM		-0.93	2.17		2.47	-1.68		0.44	-1.25
RANGE		0.22	0.91		1.85	1.90		0.59	0.79
AVERAGE	26.01	-0.80	2.53	22.01	3.47	-0.83	2.01	0.76	-0.74
STD. DEV.		0.065	0.255		0.564	0.491		0.138	0.200
VARIANCE		0.004	0.065		0.318	0.241		0.019	0.040
MAXIMUM		-0.71	3.25		2.86	0.90		1.17	0.51
MINIMUM		-0.95	2.66		1.61	-0.27		0.61	-1.07
RANGE		0.24	0.59		1.25	1.17		0.56	1.58
AVERAGE	26.08	-0.81	2.86	22.08	2.22	0.37	2.08	0.89	-0.43
STD. DEV.		0.054	0.127		0.309	0.223		0.136	0.403
VARIANCE		0.003	0.016		0.095	0.050		0.018	0.162

Appendix Table A38 - continued

	VELOCITY(in Ft/Sec)				VELOCITY(in Ft/Sec)				VELOCITY(in Ft/Sec)		
	Elevation (MSL)	Y FPS	Z FPS		Elevation (MSL)	Y FPS	Z FPS		Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		-0.68	3.74			3.20	0.90			1.44	-0.44
MINIMUM		-0.90	2.54			1.76	-0.46			0.51	-1.39
RANGE		0.22	1.20			1.44	1.36			0.93	0.95
AVERAGE	26.20	-0.80	3.25	22.20	2.61	0.25	2.20	2.20	0.99	-1.04	
STD. DEV.		0.056	0.218			0.357	0.250			0.221	0.229
VARIANCE		0.003	0.048			0.128	0.063			0.049	0.052
MAXIMUM		-0.76	3.25			3.15	0.81			1.37	-0.54
MINIMUM		-0.98	2.20			1.98	-0.98			0.51	-1.25
RANGE		0.22	1.05			1.17	1.79			0.86	0.71
AVERAGE	26.36	-0.85	2.67	22.36	2.68	-0.09	2.36	2.36	0.98	-0.86	
STD. DEV.		0.061	0.272			0.237	0.507			0.194	0.181
VARIANCE		0.004	0.074			0.056	0.257			0.038	0.033
MAXIMUM		-0.76	3.47			3.44	0.98			1.44	-0.07
MINIMUM		-0.98	2.54			1.44	-0.59			0.02	-1.25
RANGE		0.22	0.93			2.00	1.57			1.42	1.18
AVERAGE	26.23	-0.84	2.94	22.23	2.35	0.26	2.23	2.23	0.84	-0.57	
STD. DEV.		0.059	0.205			0.508	0.430			0.387	0.254
VARIANCE		0.003	0.042			0.258	0.185			0.150	0.065

* The mounting bolts holding the probe arms sheared during the tests; therefore these readings may differ somewhat from actual values.

Appendix Table A39. Velocities at the Folding Frame upstream of Travelling Screen.
Bonneville Second Powerhouse. Turbine 12B. Partial powerhouse loading. Low turbine load.

	VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)		
	Elevation (MSL)*	Y FPS	Z FPS	Elevation (MSL)*	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		-0.71	3.76		6.08	3.13		0.85	-0.02
MINIMUM		-0.95	2.69		3.78	-1.64		0.24	-0.46
RANGE		0.24	1.07		2.30	4.77		0.61	0.44
AVERAGE	15.14	-0.83	3.18	11.14	4.51	1.02	-8.86	0.57	-0.25
STD. DEV.		0.060	0.289		0.409	1.238		0.137	0.099
VARIANCE		0.004	0.084		0.167	1.533		0.019	0.010
MAXIMUM		-0.76	2.47		7.03	2.81		0.85	-0.05
MINIMUM		-0.95	1.78		3.52	-0.02		0.32	-0.42
RANGE		0.19	0.69		3.51	2.83		0.53	0.37
AVERAGE	15.15	-0.82	2.12	11.15	5.65	1.34	-8.85	0.61	-0.24
STD. DEV.		0.051	0.162		0.830	0.812		0.126	0.085
VARIANCE		0.003	0.026		0.689	0.660		0.016	0.007
MAXIMUM		-0.78	3.44		5.54	0.46		0.93	-0.07
MINIMUM		-1.03	2.47		2.91	-1.59		0.42	-0.56
RANGE		0.25	0.97		2.63	2.05		0.51	0.49
AVERAGE	15.24	-0.89	3.02	11.24	4.51	-0.52	-8.76	0.67	-0.31
STD. DEV.		0.059	0.266		0.616	0.580		0.121	0.119
VARIANCE		0.004	0.071		0.379	0.336		0.015	0.014
MAXIMUM		-0.78	4.03		5.05	3.59		0.68	-0.10
MINIMUM		-1.05	2.54		2.66	-0.27		0.17	-0.59
RANGE		0.27	1.49		2.39	3.86		0.51	0.49
AVERAGE	15.36	-0.91	3.20	11.36	3.68	1.79	-8.64	0.46	-0.35
STD. DEV.		0.065	0.441		0.777	1.034		0.117	0.100
VARIANCE		0.004	0.195		0.603	1.069		0.014	0.010
MAXIMUM		-0.78	3.42		5.84	2.12		0.68	0.02
MINIMUM		-1.05	2.34		3.52	-0.07		0.32	-0.59
RANGE		0.27	1.08		2.32	2.19		0.36	0.61
AVERAGE	15.42	-0.91	2.87	11.42	4.55	1.11	-8.58	0.52	-0.28
STD. DEV.		0.063	0.259		0.649	0.611		0.078	0.150
VARIANCE		0.004	0.067		0.421	0.373		0.006	0.023
MAXIMUM		-0.78	3.64		5.44	2.10		0.95	-0.05
MINIMUM		-1.00	2.34		3.39	-4.22		0.37	-0.42
RANGE		0.22	1.30		2.05	6.32		0.58	0.37
AVERAGE	15.45	-0.89	2.98	11.45	4.50	-1.26	-8.55	0.70	-0.22
STD. DEV.		0.051	0.275		0.481	1.712		0.113	0.095
VARIANCE		0.003	0.076		0.231	2.931		0.013	0.009

Appendix Table #39 - continued

	VELOCITY(in Ft/Sec)				VELOCITY(in Ft/Sec)				VELOCITY(in Ft/Sec)		
	Elevation (MSL)	Y FPS	Z FPS		Elevation (MSL)	Y FPS	Z FPS		Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		-0.78	3.59			5.44	2.66			0.85	0.00
MINIMUM		-1.00	2.27			3.44	-1.68			0.37	-0.42
RANGE		0.22	1.32			2.00	4.34			0.48	0.42
AVERAGE	15.48	-0.88	2.86	11.48	4.63	0.29	-8.52	0.60	-0.16		
STD. DEV.		0.054	0.369			0.598	1.277			0.126	0.095
VARIANCE		0.003	0.136			0.358	1.630			0.016	0.009
MAXIMUM		-0.78	3.59			7.25	2.25			0.90	0.07
MINIMUM		-1.00	2.56			3.44	0.24			0.20	-0.44
RANGE		0.22	1.03			3.81	2.01			0.70	0.51
AVERAGE	15.49	-0.89	2.97	11.49	4.98	1.14	-8.51	0.61	-0.14		
STD. DEV.		0.063	0.269			1.093	0.440			0.196	0.112
VARIANCE		0.004	0.073			1.194	0.194			0.039	0.012
MAXIMUM		-0.78	2.73			5.47	0.73			0.63	-0.17
MINIMUM		-1.00	1.76			3.32	-1.93			0.24	-0.61
RANGE		0.22	0.97			2.15	2.66			0.39	0.44
AVERAGE	15.56	-0.89	2.34	11.56	4.50	-0.40	-8.44	0.47	-0.38		
STD. DEV.		0.054	0.256			0.604	0.649			0.078	0.095
VARIANCE		0.003	0.066			0.365	0.422			0.006	0.009
MAXIMUM		-0.78	2.98			5.08	2.69			0.63	0.27
MINIMUM		-1.05	1.98			3.25	-1.88			0.32	-0.37
RANGE		0.27	1.00			1.83	4.57			0.31	0.64
AVERAGE	15.75	-0.88	2.47	11.75	4.15	0.86	-8.25	0.48	-0.07		
STD. DEV.		0.059	0.264			0.414	1.128			0.082	0.167
VARIANCE		0.003	0.070			0.171	1.272			0.007	0.028
MAXIMUM		-0.73	2.12			3.83	1.37			1.05	0.10
MINIMUM		-0.95	1.59			2.39	-1.46			0.37	-0.37
RANGE		0.22	0.53			1.44	2.83			0.68	0.47
AVERAGE	19.03	-0.82	1.87	15.03	3.35	0.35	-4.97	0.73	-0.13		
STD. DEV.		0.054	0.101			0.393	0.594			0.152	0.104
VARIANCE		0.003	0.010			0.155	0.353			0.023	0.011
MAXIMUM		-0.76	2.95			2.37	0.81			0.90	-0.37
MINIMUM		-0.95	2.12			1.37	-1.93			0.34	-0.85
RANGE		0.19	0.83			1.00	2.74			0.56	0.48
AVERAGE	21.37	-0.83	2.62	17.37	1.70	-0.21	-2.63	0.65	-0.60		
STD. DEV.		0.058	0.200			0.225	0.742			0.145	0.116
VARIANCE		0.003	0.040			0.051	0.550			0.021	0.013

Appendix Table A39 - continued

	VELOCITY(in Ft/Sec)				VELOCITY(in Ft/Sec)				VELOCITY(in Ft/Sec)		
	Elevation (MSL)	Y FPS	Z FPS		Elevation (MSL)	Y FPS	Z FPS		Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		-0.76	2.95		2.64	1.39		1.15	-0.51		
MINIMUM		-0.95	2.34		1.59	-1.93		0.68	-1.00		
RANGE		0.19	0.61		1.05	3.32		0.47	0.49		
AVERAGE	24.51	-0.64	2.60	20.51	2.04	-0.05	0.51	0.95	-0.71		
STD. DEV.		0.061	0.146		0.248	0.743		0.098	0.105		
VARIANCE		0.004	0.021		0.061	0.552		0.010	0.011		
MAXIMUM		-0.73	3.10		2.71	1.39		1.07	-0.37		
MINIMUM		-0.95	1.98		1.68	-2.03		0.37	-0.90		
RANGE		0.22	1.12		1.03	3.42		0.70	0.53		
AVERAGE	24.75	-0.82	2.52	20.75	2.14	-0.27	0.75	0.79	-0.65		
STD. DEV.		0.061	0.310		0.261	0.900		0.142	0.123		
VARIANCE		0.004	0.096		0.068	0.809		0.020	0.015		
MAXIMUM		-0.71	3.32		3.05	0.51		1.12	-0.42		
MINIMUM		-0.95	2.54		1.59	-0.78		0.56	-0.95		
RANGE		0.24	0.78		1.46	1.29		0.56	0.53		
AVERAGE	26.58	-0.81	2.90	22.58	2.19	-0.19	2.58	0.78	-0.63		
STD. DEV.		0.052	0.175		0.427	0.388		0.120	0.102		
VARIANCE		0.003	0.030		0.182	0.151		0.014	0.010		

* The mounting bolts holding the probe arms sheared during the tests; therefore these readings may differ somewhat from actual values.

Appendix Table A40. Comparison of 30 minute vs 15 second samples of velocities at the Folding Frame upstream of Travelling Screen, Bonneville Second Powerhouse, Turbine 12B, Partial powerhouse loading.

		VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)		
		Elevation	Y	Z	Elevation	Y	Z	Elevation	Y	Z
		(MSL)*	FPS	FPS	(MSL)*	FPS	FPS	(MSL)	FPS	FPS
High Turbine Load										
30 min. sample	MAXIMUM		-0.44	6.96		10.47	5.54		1.93	1.44
	MINIMUM		-0.85	0.00		-0.66	-3.39		-0.66	-2.71
	RANGE		0.41	6.96		11.13	8.93		2.59	4.15
	AVERAGE	14.50	-0.62	3.20	10.58	4.84	1.04	-9.42	0.72	-0.72
	STD. DEV.		0.077	1.143		1.529	1.338		0.402	0.646
	VARIANCE		0.006	1.306		2.337	1.789		0.162	0.417
15 sec. sample	MAXIMUM		-0.44	4.47		6.96	2.56		1.90	0.68
	MINIMUM		-0.66	2.03		2.95	-0.46		0.24	-1.76
	RANGE		0.22	2.44		4.01	3.02		1.66	2.44
	AVERAGE	14.67	-0.53	3.56	10.67	4.63	0.90	-9.33	0.97	-0.49
	STD. DEV.		0.062	0.600		1.038	0.779		0.512	0.641
	VARIANCE		0.004	0.360		1.076	0.606		0.262	0.410
Medium Turbine Load										
30 min. sample	MAXIMUM		-0.68	3.74		3.20	0.90		1.39	-0.44
	MINIMUM		-0.90	2.98		1.93	-0.42		0.51	-1.39
	RANGE		0.22	0.76		1.27	1.32		0.88	0.95
	AVERAGE	26.24	-0.79	3.30	22.24	2.67	0.24	2.24	0.94	-1.09
	STD. DEV.		0.058	0.157		0.333	0.234		0.194	0.210
	VARIANCE		0.003	0.025		0.111	0.055		0.037	0.044
15 sec. sample	MAXIMUM		-0.68	4.30		4.37	1.73		1.98	0.66
	MINIMUM		-0.98	1.93		1.22	-1.37		-0.07	-2.42
	RANGE		0.30	2.37		3.15	3.10		2.05	3.08
	AVERAGE	26.28	-0.83	3.09	22.28	2.70	0.14	2.28	0.95	-0.98
	STD. DEV.		0.059	0.386		0.460	0.499		0.301	0.440
	VARIANCE		0.003	0.149		0.212	0.239		0.090	0.193
Low Turbine Load										
30 min. sample	MAXIMUM		-0.71	4.35		7.40	5.25		1.20	0.32
	MINIMUM		-1.03	1.51		0.78	-4.30		0.05	-0.88
	RANGE		0.32	2.84		6.62	9.55		1.15	1.20
	AVERAGE	15.71	-0.86	2.87	11.31	4.65	0.50	-9.69	0.60	-0.25
	STD. DEV.		0.060	0.385		0.848	1.265		0.178	0.176
	VARIANCE		0.004	0.148		0.720	1.600		0.032	0.031
15 sec. sample	MAXIMUM		-0.71	3.76		6.08	3.13		0.85	-0.02
	MINIMUM		-0.95	2.69		3.78	-1.64		0.24	-0.46
	RANGE		0.24	1.07		2.30	4.77		0.61	0.44
	AVERAGE	15.14	-0.83	3.16	11.14	4.51	1.02	-8.86	0.57	-0.25
	STD. DEV.		0.060	0.289		0.409	1.238		0.137	0.099
	VARIANCE		0.004	0.084		0.167	1.533		0.019	0.010

* The mounting bolts holding the probe arms sheared during the tests; therefore these readings may differ somewhat from actual values.

APPENDIX Table A41. Velocities at fixed locations inside Submersible Travelling Screen and on support framework, Bonneville Second Powerhouse, Turbine 12B. Partial powerhouse loading. High turbine load. 15 second samples.

LOCATION #	1		2		3		4		5		6	
	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z
	FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS
MAXIMUM	5.22	-0.07	2.08	0.02	3.91	0.98	0.39	0.59	9.89	7.25	-1.34	-3.17
MINIMUM	3.74	-0.76	1.66	-0.46	3.59	0.51	-0.59	-0.42	2.15	0.78	-2.66	-5.05
RANGE	1.48	0.69	0.42	0.48	0.32	0.47	0.98	1.01	7.74	6.47	1.32	1.88
AVERAGE	4.51	-0.44	1.87	-0.19	3.76	0.79	-0.17	-0.06	4.95	5.66	-1.98	-4.09
STD. DEV.	0.426	0.139	0.099	0.127	0.069	0.092	0.214	0.242	1.892	1.334	0.320	0.482
VARIANCE	0.182	0.019	0.010	0.016	0.005	0.009	0.046	0.058	3.578	1.779	0.103	0.233
MAXIMUM	4.61	-0.10	2.27	0.20	3.83	0.98	-0.17	0.29	49.98	7.45	-1.10	-3.83
MINIMUM	3.27	-1.05	1.71	-0.51	3.27	0.61	-1.05	-0.85	1.03	6.37	-2.34	-5.66
RANGE	1.34	0.95	0.56	0.71	0.56	0.37	0.88	1.14	48.95	1.08	1.24	1.83
AVERAGE	3.87	-0.58	2.00	-0.12	3.59	0.77	-0.60	-0.14	5.86	6.83	-1.81	-4.83
STD. DEV.	0.312	0.230	0.135	0.183	0.138	0.070	0.214	0.277	6.337	0.250	0.290	0.511
VARIANCE	0.097	0.053	0.018	0.034	0.019	0.005	0.046	0.077	40.163	0.063	0.084	0.261
MAXIMUM	4.79	0.07	1.95	-0.02	3.91	0.90	0.12	-0.12	24.78	6.88	-1.05	-2.71
MINIMUM	2.86	-0.71	1.59	-0.59	3.32	0.61	-0.85	-0.76	-2.86	-4.17	-2.12	-4.57
RANGE	1.93	0.78	0.36	0.57	0.59	0.29	0.97	0.64	27.64	11.05	1.07	1.86
AVERAGE	4.00	-0.35	1.80	-0.33	3.62	0.77	-0.34	-0.53	5.29	4.65	-1.76	-3.56
STD. DEV.	0.479	0.211	0.060	0.112	0.138	0.076	0.294	0.129	3.991	2.278	0.266	0.467
VARIANCE	0.229	0.045	0.006	0.013	0.019	0.006	0.086	0.017	15.926	5.189	0.071	0.218
MAXIMUM	4.93	-0.27	2.17	0.10	3.91	0.95	0.12	-0.85	7.47	6.27	-0.90	-2.22
MINIMUM	3.54	-1.05	1.68	-0.46	3.34	0.54	-0.59	-1.83	-8.33	-1.00	-2.17	-3.81
RANGE	1.44	0.78	0.49	0.56	0.57	0.41	0.71	0.98	15.80	7.27	1.27	1.59
AVERAGE	4.31	-0.68	1.91	-0.20	3.63	0.72	-0.19	-1.41	1.19	2.83	-1.51	-3.19
STD. DEV.	0.346	0.167	0.096	0.119	0.126	0.091	0.194	0.244	2.752	2.049	0.250	0.283
VARIANCE	0.119	0.028	0.009	0.014	0.016	0.008	0.038	0.059	7.575	4.199	0.062	0.080
MAXIMUM	4.17	-0.07	2.27	-0.02	4.25	1.00	0.66	-0.27	17.19	7.28	-0.81	-3.42
MINIMUM	3.27	-0.90	1.49	-0.46	3.64	0.63	-0.07	-1.10	-3.49	-1.15	-2.27	-4.74
RANGE	0.90	0.83	0.78	0.44	0.61	0.37	0.73	0.83	20.68	8.43	1.46	1.32
AVERAGE	3.72	-0.51	1.97	-0.26	3.96	0.80	0.37	-0.70	1.98	2.64	-1.58	-4.10
STD. DEV.	0.213	0.219	0.177	0.114	0.150	0.081	0.171	0.188	4.170	2.400	0.409	0.341
VARIANCE	0.045	0.048	0.031	0.013	0.023	0.007	0.029	0.036	17.389	5.761	0.167	0.117
MAXIMUM	5.59	-0.17	2.05	-0.07	3.83	1.07	0.22	-0.27	5.93	6.49	-0.17	-3.00
MINIMUM	3.69	-0.71	1.54	-0.49	3.22	0.66	-0.56	-0.95	-0.27	-0.66	-1.54	-4.74
RANGE	1.90	0.54	0.51	0.42	0.61	0.41	0.78	0.68	6.20	7.15	1.37	1.74
AVERAGE	4.39	-0.49	1.80	-0.26	3.56	0.87	-0.22	-0.70	2.24	1.76	-0.82	-3.73
STD. DEV.	0.398	0.137	0.116	0.083	0.133	0.094	0.178	0.153	1.717	1.410	0.413	0.417
VARIANCE	0.159	0.019	0.013	0.007	0.018	0.009	0.032	0.024	2.949	1.987	0.171	0.174

Appendix Table A41 - continued

LOCATION #	1		2		3		4		5		6	
	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS
MAXIMUM	5.30	-0.46	1.83	-0.02	4.10	1.03	0.46	0.81	49.98	6.37	-1.42	-3.78
MINIMUM	3.83	-1.05	1.49	-0.37	3.20	0.66	-0.63	-0.93	-4.76	-7.40	-2.05	-5.54
RANGE	1.47	0.59	0.34	0.35	0.90	0.37	1.09	1.74	54.74	13.77	0.63	1.76
AVERAGE	4.69	-0.74	1.66	-0.21	3.69	0.85	-0.03	-0.31	1.74	1.40	-1.73	-4.59
STD. DEV.	0.342	0.109	0.086	0.077	0.217	0.077	0.274	0.340	6.317	4.174	0.145	0.482
VARIANCE	0.117	0.012	0.007	0.006	0.047	0.006	0.075	0.116	39.903	17.423	0.021	0.233
MAXIMUM	5.35	-0.02	1.83	-0.02	3.83	1.00	6.69	14.58	40.45	5.69	-0.27	-2.83
MINIMUM	3.74	-1.22	1.29	-0.51	3.15	0.46	-0.66	-11.04	-20.65	-7.62	-3.32	-5.69
RANGE	1.61	1.20	0.54	0.49	0.68	0.54	7.35	26.42	61.10	13.31	3.05	2.86
AVERAGE	4.64	-0.44	1.50	-0.25	3.57	0.81	1.51	2.92	-1.08	-1.75	-2.11	-4.95
STD. DEV.	0.410	0.225	0.101	0.120	0.146	0.104	1.943	3.930	8.282	2.906	0.699	0.716
VARIANCE	0.168	0.051	0.010	0.014	0.021	0.011	3.777	15.445	68.595	9.443	0.488	0.513
MAXIMUM	4.91	-0.02	2.12	-0.07	3.64	1.07	13.79	1.25	30.49	13.28	-0.12	-2.81
MINIMUM	3.74	-1.20	1.68	-0.56	3.13	0.61	-0.15	-0.05	-9.96	-9.74	-1.56	-4.52
RANGE	1.17	1.18	0.44	0.49	0.51	0.46	13.94	1.30	40.45	23.02	1.44	1.71
AVERAGE	4.32	-0.47	1.94	-0.34	3.39	0.85	2.01	0.22	0.77	-1.67	-0.63	-3.54
STD. DEV.	0.310	0.296	0.126	0.120	0.124	0.093	3.297	0.177	7.406	5.396	0.319	0.473
VARIANCE	0.096	0.088	0.011	0.014	0.015	0.009	10.872	0.031	54.855	29.119	0.102	0.224
MAXIMUM	4.98	-0.12	2.10	0.02	3.83	0.98	6.86	17.36	8.91	10.94	-0.66	-3.20
MINIMUM	3.54	-0.59	1.68	-0.32	3.39	0.59	-0.95	0.12	-6.76	-9.35	-2.73	-5.05
RANGE	1.44	0.47	0.42	0.34	0.44	0.39	7.81	17.24	15.67	20.29	2.07	1.85
AVERAGE	4.05	-0.35	1.90	-0.15	3.62	0.78	0.84	2.60	1.58	0.69	-1.63	-4.26
STD. DEV.	0.383	0.097	0.087	0.078	0.109	0.077	2.051	2.858	3.209	4.194	0.549	0.430
VARIANCE	0.147	0.009	0.007	0.006	0.012	0.006	4.207	8.169	10.298	17.592	0.302	0.185
MAXIMUM	5.05	-0.42	2.08	0.07	3.54	0.88	2.10	1.86	4.93	6.27	-0.56	-2.93
MINIMUM	3.25	-1.15	1.73	-0.32	2.91	0.42	-0.32	-0.46	-1.90	-4.10	-1.98	-4.76
RANGE	1.80	0.73	0.35	0.39	0.63	0.46	2.42	2.32	6.83	10.37	1.42	1.83
AVERAGE	4.19	-0.76	1.89	-0.14	3.15	0.62	0.02	-0.20	1.97	5.27	-1.19	-3.83
STD. DEV.	0.513	0.188	0.077	0.074	0.105	0.090	0.280	0.257	0.897	1.356	0.370	0.510
VARIANCE	0.264	0.035	0.006	0.005	0.011	0.008	0.078	0.066	0.804	1.839	0.137	0.260
MAXIMUM	4.52	-0.32	1.93	-0.12	3.54	0.90	7.15	4.17	3.27	4.47	-0.27	-3.25
MINIMUM	3.49	-0.78	1.61	-0.51	3.10	0.56	-0.27	-0.20	-8.40	-4.05	-1.93	-6.23
RANGE	1.03	0.46	0.32	0.39	0.44	0.34	7.42	4.37	11.67	8.52	1.66	2.98
AVERAGE	4.04	-0.56	1.76	-0.29	3.33	0.75	0.99	1.47	1.31	1.59	-1.02	-4.35
STD. DEV.	0.214	0.101	0.074	0.084	0.079	0.080	1.719	1.005	1.531	2.156	0.445	0.801
VARIANCE	0.046	0.010	0.005	0.007	0.006	0.006	2.956	1.009	2.344	4.647	0.198	0.642

Appendix Table A41 - continued

LOCATION #	1		2		3		4		5		6	
	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS
MAXIMUM	4.17	-0.02	2.17	0.02	3.59	1.05	1.51	5.88	49.88	6.62	-0.71	-2.61
MINIMUM	2.86	-0.76	1.68	-0.27	2.86	0.61	-0.56	-0.59	0.95	-1.42	-1.54	-4.47
RANGE	1.31	0.74	0.49	0.29	0.73	0.44	2.07	6.47	48.93	8.04	0.83	1.86
AVERAGE	3.57	-0.46	1.99	-0.13	3.19	0.86	-0.19	-0.23	3.24	5.56	-1.16	-3.55
STD.DEV.	0.347	0.172	0.091	0.060	0.147	0.091	0.253	0.719	5.633	1.037	0.186	0.504
VARIANCE	0.121	0.029	0.008	0.004	0.022	0.008	0.064	0.517	31.732	1.076	0.035	0.254

APPENDIX Table 442. Velocities at fixed locations inside Submersible Travelling Screen and on support framework, Bonneville Second Powerhouse, Turbine 12B, Partial powerhouse loading, Medium turbine load, 15 second samples.

LOCATION #	1		2		3		4		5		6	
	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS
MAXIMUM	4.27	-0.05	1.93	0.10	3.05	0.71	0.10	-0.37	3.10	3.15	-0.76	-2.83
MINIMUM	3.15	-0.56	1.49	-0.20	2.71	0.44	-0.46	-0.66	-4.17	-6.25	-1.66	-3.91
RANGE	1.12	0.51	0.44	0.30	0.34	0.27	0.56	0.29	7.27	9.40	0.90	1.08
AVERAGE	3.76	-0.29	1.74	-0.04	2.90	0.58	-0.19	-0.50	0.44	-0.23	-1.20	-3.42
STD. DEV.	0.339	0.116	0.100	0.071	0.076	0.059	0.125	0.072	1.646	2.361	0.263	0.221
VARIANCE	0.115	0.013	0.010	0.005	0.006	0.003	0.016	0.005	2.710	5.574	0.069	0.049
MAXIMUM	3.91	-0.17	2.05	0.12	3.03	0.81	-0.20	0.27	5.59	4.71	-0.27	-2.91
MINIMUM	3.13	-0.66	1.71	-0.34	2.64	0.42	-0.59	-0.29	-1.86	-3.93	-0.95	-3.88
RANGE	0.78	0.49	0.34	0.46	0.39	0.39	0.39	0.56	7.45	8.64	0.68	0.97
AVERAGE	3.44	-0.43	1.89	-0.12	2.86	0.65	-0.44	-0.00	1.68	2.05	-0.54	-3.37
STD. DEV.	0.173	0.096	0.068	0.108	0.096	0.083	0.085	0.177	1.549	2.396	0.169	0.285
VARIANCE	0.030	0.009	0.005	0.012	0.009	0.007	0.007	0.031	2.399	5.740	0.029	0.081
MAXIMUM	3.44	-0.10	2.22	0.15	2.86	0.88	0.02	0.42	49.98	5.00	0.07	-2.71
MINIMUM	2.06	-0.66	1.78	-0.29	2.47	0.32	-0.56	-0.59	-6.71	-3.20	-0.85	-3.49
RANGE	0.58	0.56	0.44	0.44	0.39	0.56	0.58	1.01	56.69	8.20	0.92	0.78
AVERAGE	3.21	-0.30	1.98	-0.06	2.68	0.61	-0.23	-0.03	4.59	3.02	-0.48	-3.01
STD. DEV.	0.142	0.124	0.102	0.097	0.073	0.133	0.127	0.310	6.904	1.922	0.255	0.207
VARIANCE	0.020	0.015	0.010	0.009	0.005	0.018	0.016	0.096	47.669	3.693	0.065	0.043
MAXIMUM	3.76	-0.27	2.17	0.02	3.05	0.73	0.15	-0.32	6.93	5.69	-0.20	-2.81
MINIMUM	3.05	-0.71	1.83	-0.37	2.47	0.37	-0.51	-1.00	0.37	-0.51	-0.88	-3.71
RANGE	0.71	0.44	0.34	0.39	0.58	0.36	0.66	0.69	6.56	6.20	0.68	0.90
AVERAGE	3.40	-0.47	2.01	-0.15	2.75	0.57	-0.16	-0.53	2.73	4.74	-0.50	-3.28
STD. DEV.	0.204	0.099	0.075	0.071	0.144	0.088	0.160	0.142	1.838	0.851	0.150	0.246
VARIANCE	0.042	0.010	0.006	0.005	0.021	0.008	0.026	0.020	3.376	0.724	0.023	0.060
MAXIMUM	3.74	0.00	2.08	0.00	2.83	0.71	0.17	-0.51	6.45	5.79	-0.10	-2.76
MINIMUM	2.47	-0.66	1.83	-0.42	2.47	0.34	-0.27	-1.15	0.61	3.30	-0.66	-3.64
RANGE	1.27	0.66	0.25	0.42	0.36	0.37	0.44	0.64	5.84	2.49	0.56	3.88
AVERAGE	3.02	-0.40	1.97	-0.18	2.67	0.55	-0.08	-0.87	2.17	4.98	-0.43	-3.05
STD. DEV.	0.387	0.162	0.065	0.092	0.075	0.079	0.101	0.140	1.411	0.623	0.186	0.194
VARIANCE	0.150	0.026	0.004	0.008	0.006	0.006	0.010	0.020	1.991	0.388	0.011	0.038
MAXIMUM	3.61	-0.02	2.22	0.10	3.10	0.81	0.42	-0.37	15.97	6.18	-0.20	-2.71
MINIMUM	2.71	-0.76	1.76	-0.29	2.64	0.27	-0.37	-0.90	0.17	4.05	-0.93	-3.71
RANGE	0.90	0.74	0.46	0.39	0.46	0.54	0.79	0.53	15.80	2.13	0.73	1.00
AVERAGE	3.22	-0.42	2.02	-0.11	2.84	0.62	-0.05	-0.63	5.55	5.37	-0.59	-3.11
STD. DEV.	0.221	0.185	0.092	0.105	0.104	0.088	0.176	0.146	4.849	0.552	0.166	0.268
VARIANCE	0.049	0.034	0.009	0.011	0.011	0.008	0.031	0.021	23.511	0.305	0.028	0.072

Appendix Table A42 - continued

LOCATION #	1		2		3		4		5		6	
	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS
MAXIMUM	3.64	-0.12	2.27	0.10	2.83	0.78	0.32	0.00	1.56	6.37	0.20	-2.71
MINIMUM	2.54	-0.56	1.88	-0.42	2.44	0.37	-0.51	-1.34	0.15	4.10	-1.34	-3.74
RANGE	1.10	0.44	0.39	0.52	0.39	0.41	0.83	1.34	1.41	2.27	1.54	1.03
AVERAGE	3.07	-0.33	2.11	-0.14	2.64	0.62	-0.12	-1.05	0.88	5.98	-0.37	-3.18
STD. DEV.	0.285	0.090	0.090	0.101	0.091	0.080	0.165	0.282	0.391	0.264	0.282	0.192
VARIANCE	0.083	0.008	0.008	0.010	0.008	0.006	0.027	0.080	0.153	0.070	0.080	0.037
MAXIMUM	3.38	-0.10	2.34	0.02	2.81	0.81	0.32	-0.17	0.90	6.15	-0.12	-2.91
MINIMUM	2.08	-0.73	2.08	-0.27	2.17	0.34	-0.46	-0.66	0.20	5.49	-0.54	-3.69
RANGE	1.22	0.63	0.26	0.29	0.64	0.47	0.78	0.49	0.70	0.66	0.42	0.78
AVERAGE	2.75	-0.36	2.21	-0.09	2.57	0.56	-0.06	-0.38	0.55	5.80	-0.34	-3.24
STD. DEV.	0.322	0.152	0.073	0.074	0.139	0.085	0.186	0.114	0.185	0.134	0.107	0.162
VARIANCE	0.104	0.023	0.005	0.005	0.019	0.007	0.035	0.013	0.034	0.018	0.011	0.026
MAXIMUM	3.08	-0.27	2.47	0.10	3.08	0.88	0.42	0.46	1.15	6.08	-0.27	-2.64
MINIMUM	2.17	-0.59	2.20	-0.27	2.42	0.56	-0.37	0.00	-0.20	5.32	-1.00	-4.03
RANGE	0.91	0.32	0.27	0.37	0.58	0.32	0.79	0.46	1.35	0.76	0.73	1.39
AVERAGE	2.61	-0.41	2.35	-0.05	2.69	0.72	0.01	0.27	0.65	5.64	-0.62	-3.23
STD. DEV.	0.200	0.083	0.075	0.073	0.160	0.077	0.187	0.102	0.276	0.196	0.206	0.383
VARIANCE	0.040	0.007	0.006	0.005	0.026	0.006	0.035	0.010	0.076	0.038	0.042	0.147

APPENDIX Table A43. Velocities at fixed locations inside Submersible Travelling Screen and on support framework, Bonneville Second Powerhouse, Turbine 12B, Partial powerhouse loading, Low turbine load, 15 second samples.

LOCATION #	1		2		3		4		5		6	
	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS
MAXIMUM	3.49	-0.10	2.37	-0.02	2.69	0.81	-0.02	0.49	1.05	5.91	-0.12	-2.51
MINIMUM	2.73	-0.59	2.05	-0.37	2.22	0.42	-0.68	-0.07	0.10	5.32	-0.61	-3.39
RANGE	0.76	0.49	0.32	0.35	0.47	0.39	0.66	0.56	0.95	0.59	0.49	0.88
AVERAGE	3.13	-0.31	2.20	-0.16	2.47	0.63	-0.37	0.21	0.69	5.70	-0.39	-2.88
STD. DEV.	0.198	0.104	0.075	0.069	0.114	0.077	0.154	0.132	0.231	0.133	0.132	0.187
VARIANCE	0.039	0.011	0.006	0.005	0.013	0.006	0.024	0.017	0.054	0.018	0.017	0.035
MAXIMUM	3.15	-0.10	2.29	0.05	2.47	0.95	-0.20	-0.27	1.03	5.98	-0.29	-2.44
MINIMUM	2.42	-0.51	1.80	-0.22	2.17	0.66	-0.66	-0.63	0.22	5.35	-1.20	-3.44
RANGE	0.73	0.41	0.41	0.27	0.30	0.29	0.46	0.36	0.81	0.63	0.91	1.08
AVERAGE	2.79	-0.31	2.14	-0.07	2.33	0.77	-0.39	-0.43	0.70	5.66	-0.72	-3.00
STD. DEV.	0.195	0.082	0.077	0.067	0.066	0.065	0.101	0.083	0.186	0.134	0.212	0.281
VARIANCE	0.038	0.007	0.006	0.004	0.004	0.004	0.010	0.007	0.035	0.018	0.045	0.079
MAXIMUM	3.13	-0.02	2.32	0.02	2.47	0.81	0.27	0.46	1.20	5.84	-0.05	-2.34
MINIMUM	2.34	-0.49	1.75	-0.27	2.12	0.49	-0.34	-0.27	0.15	5.18	-0.63	-3.32
RANGE	0.79	0.47	0.56	0.29	0.35	0.32	0.61	0.73	1.05	0.66	0.78	0.98
AVERAGE	2.77	-0.20	2.04	-0.10	2.29	0.67	-0.00	0.13	0.70	5.57	-0.50	-2.85
STD. DEV.	0.193	0.090	0.132	0.068	0.075	0.067	0.133	0.154	0.213	0.178	0.161	0.255
VARIANCE	0.037	0.008	0.018	0.005	0.006	0.004	0.018	0.024	0.046	0.032	0.026	0.065
MAXIMUM	2.81	-0.15	2.34	0.00	2.54	0.81	-0.24	-0.07	0.71	5.27	-0.12	-2.37
MINIMUM	2.34	-0.60	1.93	-0.29	2.17	0.51	-0.59	-0.90	0.02	4.71	-0.68	-3.22
RANGE	0.47	0.53	0.41	0.29	0.37	0.30	0.35	0.83	0.69	0.56	0.56	0.85
AVERAGE	2.55	-0.44	2.15	-0.12	2.38	0.68	-0.38	-0.37	0.32	5.00	-0.35	-2.76
STD. DEV.	0.103	0.112	0.071	0.062	0.088	0.063	0.073	0.257	0.169	0.134	0.120	0.188
VARIANCE	0.011	0.013	0.005	0.004	0.008	0.004	0.005	0.066	0.029	0.018	0.014	0.035
MAXIMUM	3.25	0.12	2.34	0.02	2.47	1.10	-0.05	0.42	1.49	7.08	-0.12	-1.56
MINIMUM	2.56	-0.78	1.88	-0.37	1.93	0.24	-0.76	-0.78	-0.71	3.56	-0.66	-3.59
RANGE	0.69	0.90	0.46	0.39	0.54	0.86	0.71	1.20	2.20	3.52	0.54	2.03
AVERAGE	2.95	-0.42	2.13	-0.17	2.21	0.71	-0.34	-0.11	0.26	5.64	-0.37	-2.53
STD. DEV.	0.153	0.236	0.090	0.076	0.109	0.201	0.165	0.280	0.551	0.739	0.120	0.572
VARIANCE	0.023	0.056	0.008	0.009	0.012	0.040	0.027	0.078	0.303	0.546	0.014	0.327
MAXIMUM	3.32	-0.07	2.42	-0.02	2.81	0.71	0.02	0.00	1.64	6.30	-0.02	-3.00
MINIMUM	2.37	-0.63	2.08	-0.42	2.27	0.42	-0.51	-1.22	0.20	4.79	-0.68	-3.81
RANGE	0.95	0.56	0.34	0.40	0.54	0.29	0.53	1.22	1.44	1.51	0.66	0.81
AVERAGE	2.75	-0.39	2.26	-0.17	2.62	0.58	-0.23	-0.65	0.80	5.25	-0.37	-3.37
STD. DEV.	0.190	0.147	0.064	0.072	0.125	0.062	0.106	0.287	0.354	0.373	0.150	0.180
VARIANCE	0.036	0.021	0.004	0.005	0.016	0.004	0.011	0.083	0.125	0.139	0.022	0.032

Appendix Table A43 - continued

LOCATION #	1		2		3		4		5		6	
	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS
MAXIMUM	3.05	-0.15	2.22	0.12	2.54	0.83	0.51	0.88	1.44	5.54	-0.07	-2.03
MINIMUM	2.27	-0.90	1.73	-0.42	2.03	0.34	-0.76	-1.05	-0.49	3.91	-0.83	-3.61
RANGE	0.78	0.75	0.49	0.54	0.51	0.49	1.27	1.93	1.93	1.63	0.76	1.58
AVERAGE	2.70	-0.47	2.05	-0.12	2.32	0.60	-0.16	-0.14	0.63	4.77	-0.44	-2.83
STD. DEV.	0.160	0.180	0.098	0.119	0.102	0.097	0.309	0.485	0.425	0.352	0.132	0.327
VARIANCE	0.026	0.032	0.010	0.014	0.010	0.009	0.095	0.235	0.181	0.124	0.017	0.107
MAXIMUM	3.10	-0.10	2.37	0.05	2.44	0.85	-0.02	-0.56	1.46	5.86	-0.32	-2.42
MINIMUM	2.59	-0.76	1.98	-0.42	2.10	0.49	-0.66	-1.42	0.59	4.52	-0.81	-3.30
RANGE	0.51	0.66	0.39	0.47	0.34	0.36	0.64	0.86	0.87	1.34	0.49	0.88
AVERAGE	2.90	-0.42	2.15	-0.16	2.26	0.65	-0.29	-0.97	1.03	5.28	-0.58	-2.74
STD. DEV.	0.104	0.133	0.081	0.104	0.080	0.083	0.151	0.206	0.178	0.373	0.109	0.193
VARIANCE	0.011	0.018	0.007	0.011	0.006	0.007	0.023	0.042	0.032	0.139	0.012	0.037
MAXIMUM	3.47	-0.10	2.29	0.22	2.81	0.88	0.05	-0.17	1.46	5.74	-0.42	-2.59
MINIMUM	2.47	-0.56	1.95	-0.22	2.34	0.59	-0.51	-0.66	0.32	4.52	-0.81	-3.39
RANGE	1.00	0.46	0.34	0.44	0.47	0.29	0.56	0.49	1.14	1.22	0.39	0.80
AVERAGE	2.94	-0.34	2.14	0.01	2.48	0.74	-0.19	-0.41	0.87	5.08	-0.62	-2.91
STD. DEV.	0.294	0.104	0.077	0.097	0.085	0.070	0.140	0.118	0.251	0.329	0.095	0.174
VARIANCE	0.086	0.011	0.006	0.010	0.007	0.005	0.020	0.014	0.063	0.108	0.009	0.030
MAXIMUM	3.05	-0.02	2.34	0.15	2.51	0.90	0.10	-0.20	1.15	6.03	-0.29	-2.81
MINIMUM	2.44	-0.59	1.98	-0.24	2.03	0.51	-0.46	-0.76	-0.12	4.91	-0.78	-3.39
RANGE	0.61	0.57	0.36	0.39	0.48	0.39	0.56	0.56	1.27	1.12	0.49	0.58
AVERAGE	2.79	-0.35	2.15	-0.05	2.27	0.71	-0.17	-0.46	0.52	5.43	-0.53	-3.06
STD. DEV.	0.126	0.128	0.071	0.081	0.100	0.088	0.132	0.152	0.361	0.352	0.115	0.140
VARIANCE	0.016	0.016	0.005	0.007	0.010	0.006	0.018	0.023	0.130	0.124	0.013	0.019
MAXIMUM	2.86	0.12	2.47	0.22	2.76	0.85	0.00	0.37	1.66	5.84	-0.42	-2.88
MINIMUM	2.29	-0.66	1.98	-0.20	2.20	0.37	-1.34	-1.12	0.22	4.10	-1.15	-4.27
RANGE	0.57	0.78	0.49	0.42	0.56	0.48	1.34	1.49	1.44	1.74	0.73	1.39
AVERAGE	2.58	-0.28	2.28	0.03	2.55	0.63	-0.64	-0.47	1.00	5.09	-0.69	-3.70
STD. DEV.	0.127	0.171	0.110	0.097	0.108	0.105	0.405	0.409	0.347	0.477	0.158	0.298
VARIANCE	0.016	0.029	0.012	0.009	0.012	0.011	0.164	0.167	0.120	0.228	0.025	0.089
MAXIMUM	2.98	-0.17	2.37	0.10	2.34	0.71	0.49	0.27	1.20	5.13	-0.27	-2.71
MINIMUM	2.25	-0.61	1.83	-0.22	1.86	0.37	-0.27	-0.37	0.12	4.37	-1.10	-3.44
RANGE	0.69	0.44	0.54	0.32	0.48	0.34	0.76	0.64	1.08	0.76	0.83	0.73
AVERAGE	2.67	-0.38	2.12	-0.05	2.16	0.57	0.07	-0.04	0.74	4.76	-0.76	-3.11
STD. DEV.	0.135	0.095	0.110	0.077	0.113	0.088	0.183	0.139	0.262	0.170	0.186	0.184
VARIANCE	0.024	0.009	0.012	0.006	0.013	0.006	0.033	0.019	0.068	0.029	0.035	0.034

Appendix Table A43 - continued

LOCATION #	1		2		3		4		5		6	
	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS
MAXIMUM	2.81	-0.10	2.17	0.12	2.47	0.76	0.29	-0.22	0.88	5.49	-0.29	-2.44
MINIMUM	2.20	-0.66	1.81	-0.49	2.05	0.24	-0.42	-1.05	0.02	4.54	-1.00	-3.88
RANGE	0.61	0.56	0.36	0.61	0.42	0.52	0.71	0.83	0.86	0.95	0.71	1.44
AVERAGE	2.48	-0.37	1.96	-0.09	2.25	0.56	-0.12	-0.66	0.39	5.13	-0.63	-3.21
STD. DEV.	0.135	0.125	0.067	0.154	0.090	0.116	0.145	0.170	0.167	0.215	0.154	0.378
VARIANCE	0.018	0.016	0.005	0.024	0.008	0.014	0.021	0.029	0.028	0.046	0.024	0.143
MAXIMUM	2.93	-0.27	2.25	0.12	2.32	0.73	0.17	0.56	1.17	5.40	-0.17	-2.39
MINIMUM	2.22	-0.71	1.90	-0.37	1.98	0.37	-0.49	-0.37	0.22	4.76	-0.68	-3.27
RANGE	0.71	0.44	0.35	0.49	0.34	0.36	0.66	0.93	0.95	0.64	0.51	0.88
AVERAGE	2.57	-0.49	2.12	-0.10	2.15	0.57	-0.15	0.24	0.62	5.17	-0.41	-2.81
STD. DEV.	0.159	0.098	0.076	0.101	0.063	0.078	0.145	0.256	0.199	0.156	0.121	0.216
VARIANCE	0.025	0.010	0.006	0.010	0.004	0.006	0.021	0.066	0.040	0.024	0.015	0.047
MAXIMUM	3.05	-0.05	2.27	0.12	2.54	0.81	0.02	-0.07	0.78	6.15	-0.12	-2.76
MINIMUM	2.17	-0.66	1.93	-0.24	2.15	0.46	-0.46	-0.90	-0.10	5.27	-0.85	-4.03
RANGE	0.88	0.61	0.34	0.36	0.39	0.35	0.48	0.83	0.88	0.88	0.73	1.27
AVERAGE	2.68	-0.35	2.13	-0.03	2.34	0.69	-0.26	-0.39	0.37	5.64	-0.46	-3.28
STD. DEV.	0.189	0.123	0.077	0.070	0.082	0.067	0.120	0.238	0.204	0.190	0.164	0.335
VARIANCE	0.036	0.015	0.006	0.005	0.007	0.005	0.014	0.057	0.041	0.036	0.027	0.112

Appendix Table A44. Comparison of 30 minute vs 15 second samples of velocities at fixed locations inside Submersible Travelling Screen and on support framework. Bonneville Second Powerhouse. Turbine 12B. Partial powerhouse loading.

LOCATION #		1		2		3		4		5		6	
		Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z
		FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS
High Turbine Load													
30 min. sample	MAXIMUM	5.93	0.07	2.27	0.20	4.35	1.07	6.69	49.46	40.45	6.84	0.07	-1.73
	MINIMUM	2.56	-1.29	1.27	-0.56	2.93	0.37	-1.00	-11.84	-23.80	-9.16	-3.32	-5.93
	RANGE	3.37	1.36	1.00	0.76	1.42	0.70	7.69	61.30	64.25	16.00	3.39	4.20
	AVERAGE	4.23	-0.54	1.86	-0.19	3.53	0.75	-0.00	0.49	1.46	2.80	-1.40	-4.04
	STD. DEV.	0.562	0.202	0.189	0.115	0.232	0.109	0.806	3.100	4.260	3.239	0.527	0.726
	VARIANCE	0.316	0.041	0.036	0.013	0.054	0.012	0.649	9.611	18.146	10.491	0.277	0.527
15 sec. sample	MAXIMUM	5.35	-0.02	1.76	-0.02	3.83	1.00	6.69	14.58	40.45	5.69	-1.49	-4.47
	MINIMUM	3.74	-0.78	1.29	-0.51	3.34	0.66	-0.66	-11.84	-20.65	-5.44	-3.32	-5.69
	RANGE	1.61	0.76	0.47	0.49	0.49	0.34	7.35	26.42	61.10	11.13	1.83	1.22
	AVERAGE	4.70	-0.39	1.57	-0.22	3.62	0.83	1.64	3.04	-0.75	-1.31	-2.35	-5.27
	STD. DEV.	0.392	0.191	0.100	0.116	0.103	0.088	2.056	3.890	9.092	2.800	0.522	0.264
	VARIANCE	0.154	0.036	0.010	0.014	0.011	0.008	4.226	15.133	82.667	7.838	0.273	0.070
Medium Turbine Load													
30 min. sample	MAXIMUM	4.08	0.22	2.54	0.22	3.10	0.90	0.44	0.61	2.39	6.69	0.37	-1.95
	MINIMUM	1.59	-0.85	1.54	-0.42	2.08	0.32	-0.78	-1.86	-0.66	4.10	-1.68	-4.76
	RANGE	2.49	1.07	1.00	0.64	1.02	0.58	1.22	2.47	3.05	2.59	2.05	2.81
	AVERAGE	2.96	-0.35	2.15	-0.07	2.59	0.63	-0.16	-0.54	0.81	5.84	-0.58	-3.26
	STD. DEV.	0.330	0.155	0.132	0.096	0.164	0.093	0.201	0.415	0.375	0.270	0.282	0.411
	VARIANCE	0.109	0.024	0.017	0.009	0.027	0.009	0.040	0.172	0.141	0.073	0.079	0.169
15 sec. sample	MAXIMUM	3.52	-0.12	2.27	0.02	2.81	0.78	0.32	-0.95	1.56	6.37	0.20	-2.71
	MINIMUM	2.54	-0.56	1.88	-0.42	2.44	0.37	-0.51	-1.34	0.20	4.10	-0.66	-3.54
	RANGE	0.98	0.44	0.39	0.44	0.37	0.41	0.83	0.39	1.36	2.27	0.86	0.83
	AVERAGE	3.01	-0.33	2.10	-0.17	2.65	0.63	-0.10	-1.14	0.96	5.99	-0.30	-3.15
	STD. DEV.	0.279	0.089	0.093	0.087	0.088	0.080	0.174	0.091	0.389	0.270	0.219	0.181
	VARIANCE	0.078	0.008	0.009	0.008	0.008	0.006	0.030	0.008	0.151	0.073	0.048	0.033
Low Turbine Load													
30 min. sample	MAXIMUM	3.47	0.46	2.49	0.59	3.00	1.12	0.90	1.37	2.61	7.32	0.29	-0.59
	MINIMUM	2.05	-1.12	1.64	-0.59	1.78	0.12	-1.17	-2.12	-0.68	2.42	-1.20	-6.25
	RANGE	1.42	1.58	0.85	1.18	1.22	1.00	2.07	3.49	3.29	4.90	1.49	5.66
	AVERAGE	2.77	-0.36	2.10	-0.07	2.34	0.64	-0.25	-0.30	0.81	5.06	-0.57	-3.02
	STD. DEV.	0.239	0.106	0.136	0.149	0.163	0.133	0.232	0.490	0.449	0.599	0.199	0.535
	VARIANCE	0.057	0.034	0.019	0.022	0.027	0.018	0.054	0.240	0.201	0.359	0.040	0.286
15 sec. sample	MAXIMUM	3.05	-0.15	2.22	0.12	2.54	0.83	0.51	0.88	1.44	5.54	-0.07	-2.03
	MINIMUM	2.27	-0.90	1.73	-0.42	2.03	0.34	-0.76	-1.05	-0.49	3.91	-0.83	-3.61
	RANGE	0.78	0.75	0.49	0.54	0.51	0.49	1.27	1.93	1.93	1.63	0.76	1.58
	AVERAGE	2.70	-0.47	2.05	-0.12	2.32	0.60	-0.16	-0.14	0.63	4.77	-0.44	-2.83
	STD. DEV.	0.160	0.100	0.098	0.119	0.102	0.097	0.309	0.485	0.425	0.352	0.132	0.327
	VARIANCE	0.026	0.032	0.010	0.014	0.010	0.009	0.095	0.235	0.181	0.124	0.017	0.107

Appendix Table A45. Velocities at bulkhead slot in turbine intake.
 Bonneville Second Powerhouse, Turbine 12B. Partial Powerhouse loading.
 High turbine load.

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		8.67	-2.98		8.62	1.51
MINIMUM		8.18	-3.78		-0.90	-4.49
RANGE		0.49	0.80		9.52	6.00
AVERAGE	5.24	8.43	-3.37	-14.76	2.92	-1.15
STD. DEV.		0.092	0.173		2.722	1.232
VARIANCE		0.008	0.030		7.408	1.518
MAXIMUM		8.96	-3.05		3.74	-0.56
MINIMUM		8.57	-3.78		-5.15	-4.76
RANGE		0.39	0.73		8.89	4.20
AVERAGE	5.29	8.75	-3.40	-14.71	0.35	-2.63
STD. DEV.		0.080	0.152		2.439	1.115
VARIANCE		0.006	0.023		5.951	1.243
MAXIMUM		8.91	-2.95		6.27	-0.07
MINIMUM		8.47	-3.81		-0.98	-3.74
RANGE		0.44	0.86		7.25	3.67
AVERAGE	5.29	8.66	-3.43	-14.71	2.42	-1.93
STD. DEV.		0.081	0.215		1.857	0.780
VARIANCE		0.007	0.046		3.449	0.609
MAXIMUM		8.81	-3.15		4.71	1.44
MINIMUM		8.47	-3.88		-1.15	-4.37
RANGE		0.34	0.73		5.86	5.81
AVERAGE	5.30	8.64	-3.48	-14.70	1.99	-1.14
STD. DEV.		0.077	0.158		1.612	1.411
VARIANCE		0.006	0.025		2.597	1.990
MAXIMUM		8.81	-3.10		5.98	2.27
MINIMUM		8.37	-3.96		-0.22	-3.10
RANGE		0.44	0.86		6.20	5.37
AVERAGE	5.32	8.59	-3.54	-14.68	2.78	-0.93
STD. DEV.		0.104	0.222		1.631	1.246
VARIANCE		0.011	0.049		2.661	1.552
MAXIMUM		8.86	-2.95		2.81	2.22
MINIMUM		8.18	-3.88		-1.15	-2.83
RANGE		0.68	0.93		3.96	5.05
AVERAGE	5.33	8.56	-3.38	-14.67	0.99	-1.09
STD. DEV.		0.159	0.244		1.057	1.291
VARIANCE		0.025	0.059		1.117	1.666

Appendix Table A45 - continued

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		9.01	-3.00		6.62	2.81
MINIMUM		8.64	-3.78		-0.05	-3.49
RANGE		0.37	0.78		6.67	6.30
AVERAGE	5.35	8.84	-3.33	-14.65	4.10	-0.59
STD. DEV.		0.081	0.199		1.346	1.573
VARIANCE		0.007	0.040		1.811	2.476
MAXIMUM		9.20	-3.25		7.01	4.57
MINIMUM		8.57	-4.03		0.42	-1.07
RANGE		0.63	0.78		6.59	5.64
AVERAGE	5.43	8.88	-3.65	-14.57	3.88	1.04
STD. DEV.		0.159	0.218		1.702	1.742
VARIANCE		0.025	0.047		2.897	3.033
MAXIMUM		8.81	-2.86		2.51	2.27
MINIMUM		8.23	-3.64		-1.78	-2.81
RANGE		0.58	0.78		4.29	5.08
AVERAGE	5.43	8.56	-3.25	-14.57	0.54	-0.39
STD. DEV.		0.133	0.196		1.106	1.352
VARIANCE		0.018	0.038		1.223	1.828
MAXIMUM		6.08	-1.03		5.00	0.90
MINIMUM		5.37	-2.69		1.73	-3.61
RANGE		0.71	1.66		3.27	4.51
AVERAGE	9.48	5.72	-1.74	-10.52	3.52	-1.41
STD. DEV.		0.205	0.434		0.844	1.134
VARIANCE		0.042	0.189		0.712	1.287
MAXIMUM		2.76	-1.39		8.03	-1.34
MINIMUM		2.29	-1.86		-1.44	-4.42
RANGE		0.47	0.47		9.47	3.08
AVERAGE	13.88	2.54	-1.64	-6.12	4.14	-2.76
STD. DEV.		0.091	0.121		2.776	0.760
VARIANCE		0.008	0.015		7.706	0.578
MAXIMUM		2.91	-1.22		6.05	-0.02
MINIMUM		2.51	-1.73		-2.61	-3.81
RANGE		0.40	0.51		8.66	3.79
AVERAGE	13.92	2.69	-1.50	-6.08	2.09	-2.01
STD. DEV.		0.087	0.116		2.288	0.838
VARIANCE		0.008	0.013		5.235	0.703

Appendix Table A45 - continued

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		2.93	-1.15		2.88	-0.42
MINIMUM		2.51	-1.61		-6.96	-4.59
RANGE		0.42	0.46		9.84	4.17
AVERAGE	13.93	2.71	-1.40	-6.07	-2.42	-1.74
STD. DEV.		0.097	0.088		2.119	1.092
VARIANCE		0.009	0.008		4.492	1.191

Appendix Table A46. Velocities at bulkhead slot in turbine intake.
 Bonneville Second Powerhouse, Turbine 12B. Partial Powerhouse loading.
 Medium turbine load.

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		7.50	-2.71		7.03	2.88
MINIMUM		7.13	-3.39		-0.37	-3.49
RANGE		0.37	0.68		7.40	6.37
AVERAGE	5.01	7.34	-2.99	-14.99	2.69	-0.44
STD. DEV.		0.078	0.142		1.658	1.655
VARIANCE		0.006	0.020		2.748	2.740
MAXIMUM		6.47	-1.03		3.91	2.03
MINIMUM		5.98	-1.56		-5.96	-6.52
RANGE		0.49	0.53		9.87	8.55
AVERAGE	9.02	6.21	-1.28	-10.98	-0.31	-2.24
STD. DEV.		0.120	0.127		2.805	2.440
VARIANCE		0.014	0.016		7.870	5.956
MAXIMUM		2.32	-0.88		4.61	3.05
MINIMUM		1.98	-1.27		-1.71	-1.17
RANGE		0.34	0.39		6.32	4.22
AVERAGE	13.83	2.15	-1.07	-6.17	1.83	0.71
STD. DEV.		0.078	0.084		1.669	0.975
VARIANCE		0.006	0.007		2.786	0.951
MAXIMUM		1.22	-1.00		3.96	-0.51
MINIMUM		0.85	-1.54		-2.12	-3.03
RANGE		0.37	0.54		6.08	2.52
AVERAGE	18.57	1.07	-1.21	-1.43	1.03	-2.00
STD. DEV.		0.077	0.135		1.436	0.560
VARIANCE		0.006	0.018		2.062	0.314
MAXIMUM		1.15	-1.05		8.18	0.59
MINIMUM		0.81	-1.37		3.78	-1.64
RANGE		0.34	0.32		4.40	2.23
AVERAGE	18.52	1.00	-1.22	-1.48	5.71	-0.62
STD. DEV.		0.070	0.079		1.071	0.595
VARIANCE		0.005	0.006		1.148	0.354
MAXIMUM		1.12	-1.05		6.23	-1.39
MINIMUM		0.78	-1.44		-2.12	-4.32
RANGE		0.34	0.39		8.35	2.93
AVERAGE	18.57	0.97	-1.22	-1.43	1.33	-3.03
STD. DEV.		0.058	0.097		2.386	0.680
VARIANCE		0.003	0.009		5.693	0.463

Appendix Table A46 - continued

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		1.10	-0.76		6.86	0.27
MINIMUM		0.81	-1.34		-3.98	-4.20
RANGE		0.29	0.58		10.84	4.47
AVERAGE	18.58	0.97	-1.05	-1.42	3.54	-1.89
STD. DEV.		0.072	0.127		2.785	1.046
VARIANCE		0.005	0.016		7.756	1.093
MAXIMUM		1.15	-0.85		10.23	2.47
MINIMUM		0.81	-1.25		2.37	-1.88
RANGE		0.34	0.40		7.86	4.35
AVERAGE	18.63	0.97	-1.06	-1.37	5.64	0.14
STD. DEV.		0.066	0.078		1.854	1.225
VARIANCE		0.004	0.006		3.436	1.502
MAXIMUM		1.07	-0.93		8.47	0.76
MINIMUM		0.78	-1.25		0.88	-3.78
RANGE		0.29	0.32		7.59	4.54
AVERAGE	18.66	0.94	-1.08	-1.34	3.88	-1.97
STD. DEV.		0.067	0.076		2.364	1.349
VARIANCE		0.005	0.006		5.587	1.82

Appendix Table A47. Velocities at bulkhead slot in turbine intake.
 Bonneville Second Powerhouse, Turbine 12B. Partial Powerhouse loading.
 Low turbine load.

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		6.86	-2.17		5.18	-0.17
MINIMUM		6.42	-2.51		3.22	-1.81
RANGE		0.44	0.34		1.96	1.64
AVERAGE	5.29	6.61	-2.35	-14.71	4.10	-1.15
STD. DEV.		0.108	0.078		0.507	0.388
VARIANCE		0.012	0.006		0.257	0.150
MAXIMUM		6.79	-2.12		5.47	-0.88
MINIMUM		5.66	-2.49		0.73	-2.51
RANGE		1.13	0.37		4.74	1.63
AVERAGE	5.30	6.15	-2.27	-14.70	2.67	-2.00
STD. DEV.		0.265	0.096		1.317	0.372
VARIANCE		0.070	0.009		1.735	0.139
MAXIMUM		7.13	-1.73		6.57	-0.51
MINIMUM		5.76	-2.34		3.39	-3.15
RANGE		1.37	0.61		3.18	2.64
AVERAGE	5.31	6.56	-2.07	-14.69	4.71	-1.63
STD. DEV.		0.296	0.129		0.783	0.522
VARIANCE		0.087	0.017		0.613	0.272
MAXIMUM		6.96	-2.05		5.59	-1.05
MINIMUM		6.37	-2.51		2.86	-2.56
RANGE		0.59	0.46		2.73	1.51
AVERAGE	5.33	6.65	-2.27	-14.67	4.00	-1.68
STD. DEV.		0.136	0.097		0.638	0.376
VARIANCE		0.018	0.009		0.408	0.142
MAXIMUM		7.01	-1.93		5.44	-1.88
MINIMUM		6.25	-2.17		1.59	-3.20
RANGE		0.76	0.24		3.85	1.32
AVERAGE	5.35	6.55	-2.04	-14.65	3.32	-2.44
STD. DEV.		0.173	0.066		0.981	0.366
VARIANCE		0.030	0.004		0.962	0.134
MAXIMUM		7.30	-2.42		6.32	-0.98
MINIMUM		6.47	-2.93		3.66	-3.00
RANGE		0.83	0.51		2.66	2.02
AVERAGE	5.43	6.74	-2.65	-14.57	4.85	-1.89
STD. DEV.		0.168	0.118		0.693	0.561
VARIANCE		0.028	0.014		0.480	0.314

Appendix Table A47 - continued

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		7.15	-2.17		5.15	-1.20
MINIMUM		6.37	-2.64		1.15	-2.93
RANGE		0.78	0.47		4.00	1.73
AVERAGE	5.44	6.73	-2.37	-14.56	3.30	-1.94
STD. DEV.		0.210	0.102		1.038	0.371
VARIANCE		0.044	0.010		1.078	0.138
MAXIMUM		6.84	-2.17		7.23	0.02
MINIMUM		6.35	-2.66		4.20	-1.25
RANGE		0.49	0.49		3.03	1.27
AVERAGE	5.44	6.63	-2.38	-14.56	5.37	-0.69
STD. DEV.		0.103	0.132		0.813	0.280
VARIANCE		0.011	0.017		0.660	0.079
MAXIMUM		7.23	-2.25		5.59	-1.71
MINIMUM		6.08	-2.76		3.05	-2.71
RANGE		1.15	0.51		2.54	1.00
AVERAGE	5.46	6.82	-2.50	-14.54	4.42	-2.25
STD. DEV.		0.266	0.122		0.603	0.213
VARIANCE		0.071	0.015		0.363	0.046
MAXIMUM		6.76	-2.15		5.30	-0.71
MINIMUM		6.10	-2.71		1.98	-2.08
RANGE		0.66	0.56		3.32	1.37
AVERAGE	5.47	6.45	-2.46	-14.53	3.99	-1.42
STD. DEV.		0.175	0.120		0.896	0.336
VARIANCE		0.031	0.014		0.803	0.113
MAXIMUM		6.93	-2.12		4.47	-0.71
MINIMUM		5.76	-2.76		-0.07	-3.25
RANGE		1.17	0.64		4.54	2.54
AVERAGE	5.54	6.35	-2.44	-14.46	2.63	-2.02
STD. DEV.		0.345	0.159		1.237	0.604
VARIANCE		0.119	0.025		1.531	0.365

Appendix Table A47 - continued

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		6.08	-0.59		9.50	5.84
MINIMUM		5.47	-0.98		2.56	-0.07
RANGE		0.61	0.39		6.94	5.91
AVERAGE	9.99	5.80	-0.76	-11.01	5.47	2.40
STD. DEV.		0.173	0.094		2.369	2.005
VARIANCE		0.030	0.009		5.613	4.019
MAXIMUM		2.10	-0.68		4.96	0.51
MINIMUM		1.78	-1.15		-1.54	-2.20
RANGE		0.32	0.47		6.50	2.71
AVERAGE	13.43	1.96	-0.91	-6.57	1.90	-0.94
STD. DEV.		0.069	0.087		1.715	0.577
VARIANCE		0.005	0.007		2.940	0.333
MAXIMUM		2.17	-0.78		6.10	2.05
MINIMUM		1.76	-1.25		1.22	-1.54
RANGE		0.41	0.47		4.88	3.59
AVERAGE	13.54	1.91	-1.03	-6.46	3.33	0.29
STD. DEV.		0.099	0.096		1.539	0.890
VARIANCE		0.010	0.009		2.370	0.792
MAXIMUM		0.95	-0.95		7.32	3.03
MINIMUM		0.63	-1.32		1.98	-3.56
RANGE		0.32	0.37		5.34	6.59
AVERAGE	18.57	0.83	-1.14	-1.43	4.94	-0.43
STD. DEV.		0.059	0.075		1.194	2.096
VARIANCE		0.003	0.006		1.426	4.394

Appendix Table A48. Comparison of 30 minute vs 15 second sampling of velocities at bulkhead slot in turbine intake. Bonneville Second Powerhouse, Turbine 12B. Partial Powerhouse loading.

		Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
High Turbine Load							
30 min. sample	MAXIMUM		9.20	-2.22		11.16	5.20
	MINIMUM		8.18	-4.32		-4.47	-6.81
	RANGE		1.02	2.10		15.63	12.01
	AVERAGE	5.29	8.67	-3.39	-14.71	2.98	-0.87
	STD.DEV.		0.169	0.263		2.650	1.638
	VARIANCE		0.029	0.069		7.022	2.683
15 sec. sample	MAXIMUM		8.62	-2.98		8.62	1.51
	MINIMUM		8.18	-3.64		-0.90	-2.66
	RANGE		0.44	0.66		9.52	4.17
	AVERAGE	5.24	8.41	-3.33	-14.76	2.74	-0.96
	STD.DEV.		0.081	0.164		2.691	1.175
	VARIANCE		0.006	0.027		7.241	1.380
Medium Turbine Load							
30 min. sample	MAXIMUM		1.29	-0.76		10.52	1.76
	MINIMUM		0.61	-1.46		-5.88	-6.25
	RANGE		0.68	0.70		16.40	8.01
	AVERAGE	18.63	1.01	-1.14	-1.37	3.55	-1.96
	STD.DEV.		0.082	0.104		2.356	1.212
	VARIANCE		0.007	0.011		5.549	1.469
15 sec. sample	MAXIMUM		1.10	-0.76		6.86	0.27
	MINIMUM		0.81	-1.27		1.34	-3.59
	RANGE		0.29	0.51		5.52	3.86
	AVERAGE	18.58	0.97	-1.03	-1.42	4.78	-1.59
	STD.DEV.		0.074	0.123		1.341	0.914
	VARIANCE		0.005	0.015		1.799	0.835
Low Turbine Load							
30 min. sample	MAXIMUM		7.59	-1.68		8.08	0.27
	MINIMUM		5.30	-2.93		-0.02	-3.59
	RANGE		2.29	1.25		8.10	3.86
	AVERAGE	5.29	6.48	-2.28	-14.71	3.90	-1.64
	STD.DEV.		0.293	0.211		1.168	0.593
	VARIANCE		0.086	0.044		1.365	0.352
15 sec. sample	MAXIMUM		7.13	-1.73		6.57	-0.51
	MINIMUM		5.76	-2.34		3.39	-3.15
	RANGE		1.37	0.61		3.18	2.64
	AVERAGE	5.31	6.56	-2.07	-14.69	4.71	-1.63
	STD.DEV.		0.296	0.129		0.783	0.522
	VARIANCE		0.087	0.017		0.613	0.272

Appendix Table A49. Velocities 10 feet upstream and 1 foot upstream of trashracks of Turbine 12B at the Bonneville Second Powerhouse. Full powerhouse loading. High Turbine load.

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		-30.54	-1.25	-30.18		0.22	3.96	0.93
MINIMUM		-30.84	-1.51	-30.44		-3.88	-2.42	-2.86
RANGE		0.30	0.26	0.26		4.10	6.38	3.79
AVERAGE	1.66	-30.67	-1.34	-30.30	-0.34	-1.40	0.83	-0.74
STD. DEV.		0.065	0.060	0.059		0.914	1.496	1.113
VARIANCE		0.004	0.004	0.003		0.835	2.237	1.239
MAXIMUM		-30.47	-1.22	-30.22		-1.81	3.59	-0.34
MINIMUM		-30.81	-1.46	-30.44		-4.37	-1.73	-2.64
RANGE		0.34	0.24	0.22		2.56	5.32	2.30
AVERAGE	7.01	-30.65	-1.34	-30.31	5.01	-3.12	1.07	-1.56
STD. DEV.		0.066	0.061	0.060		0.548	1.100	0.497
VARIANCE		0.004	0.004	0.004		0.300	1.211	0.247
MAXIMUM		-30.57	-1.25	-30.18		-3.47	5.62	-0.02
MINIMUM		-30.76	-1.49	-30.44		-5.44	2.39	-1.54
RANGE		0.19	0.24	0.26		1.97	3.23	1.52
AVERAGE	11.68	-30.66	-1.35	-30.29	9.68	-4.34	3.92	-0.90
STD. DEV.		0.056	0.065	0.061		0.459	0.933	0.394
VARIANCE		0.003	0.004	0.004		0.211	0.871	0.155
MAXIMUM		-30.54	-1.05	-30.18		-1.93	4.52	-1.05
MINIMUM		-30.76	-1.49	-30.44		-5.27	-0.12	-2.86
RANGE		0.22	0.44	0.26		3.34	4.64	1.81
AVERAGE	18.65	-30.64	-1.30	-30.29	16.65	-3.54	2.39	-1.97
STD. DEV.		0.068	0.102	0.069		0.933	1.147	0.510
VARIANCE		0.005	0.010	0.005		0.870	1.315	0.260
MAXIMUM		0.23	-1.29	-30.15		6.93	-25.49	-3.61
MINIMUM		7.64	-1.56	-30.42		-30.00	-30.84	-4.27
RANGE		0.59	0.27	0.27		36.93	5.35	0.66
AVERAGE	23.35	0.05	-1.42	-30.27	21.35	-23.45	-29.88	-4.11
STD. DEV.		0.095	0.056	0.063		8.180	1.077	0.081
VARIANCE		0.009	0.003	0.004		66.912	1.160	0.007

Appendix Table A50. Velocities 10 feet upstream and 1 foot upstream of trashracks of Turbine 12B at the Bonneville Second Powerhouse. Full powerhouse loading. Medium Turbine load.

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		-2.98	3.34	-3.98		-4.05	6.27	2.05
MINIMUM		-6.54	-0.32	-4.32		-6.42	1.73	-0.29
RANGE		3.56	3.66	0.34		2.37	4.54	2.34
AVERAGE	-12.87	-4.83	1.49	-4.12	-14.87	-5.52	3.46	0.83
STD. DEV.		1.151	0.984	0.073		0.591	1.303	0.650
VARIANCE		1.324	0.968	0.005		0.350	1.697	0.422
MAXIMUM		-0.78	3.20	-11.47		-2.76	6.67	0.98
MINIMUM		-2.98	0.88	-11.72		-5.54	2.78	-0.73
RANGE		2.20	2.32	0.25		2.78	3.89	1.71
AVERAGE	-10.09	-2.00	2.31	-11.58	-12.09	-4.44	4.86	0.17
STD. DEV.		0.545	0.632	0.066		0.773	1.091	0.510
VARIANCE		0.297	0.399	0.004		0.598	1.191	0.260
MAXIMUM		-2.69	4.79	-11.40		-3.86	5.71	0.20
MINIMUM		-4.03	3.83	-11.79		-5.27	2.56	-0.83
RANGE		1.34	0.96	0.39		1.41	3.15	1.03
AVERAGE	-3.44	-3.28	4.29	-11.59	-5.44	-4.50	4.18	-0.40
STD. DEV.		0.354	0.202	0.078		0.427	0.948	0.250
VARIANCE		0.125	0.041	0.006		0.183	0.899	0.062
MAXIMUM		-1.42	3.91	-11.60		-1.88	4.49	-0.88
MINIMUM		-2.25	2.29	-11.84		-3.17	1.46	-1.93
RANGE		0.83	1.62	0.24		1.29	3.03	1.05
AVERAGE	2.10	-1.91	3.38	-11.70	0.10	-2.53	2.59	-1.34
STD. DEV.		0.203	0.441	0.059		0.387	0.729	0.286
VARIANCE		0.041	0.195	0.004		0.150	0.531	0.082
MAXIMUM		-2.37	1.61	0.63		-1.86	3.49	-1.25
MINIMUM		-4.08	-9.47	-0.17		-4.27	-0.76	-2.34
RANGE		1.71	11.08	0.80		2.41	4.25	1.09
AVERAGE	8.00	-3.31	0.70	0.25	6.00	-3.02	1.27	-1.76
STD. DEV.		0.344	1.334	0.216		0.710	1.233	0.340
VARIANCE		0.119	1.780	0.047		0.504	1.520	0.115
MAXIMUM		-1.37	1.81	0.05		-3.37	4.61	-1.34
MINIMUM		-3.66	-1.00	-1.51		-4.57	2.98	-1.76
RANGE		2.29	2.81	1.56		1.20	1.63	0.42
AVERAGE	14.97	-2.68	0.41	-0.52	12.97	-3.82	3.83	-1.55
STD. DEV.		0.728	0.790	0.371		0.294	0.341	0.100
VARIANCE		0.531	0.625	0.138		0.086	0.116	0.010

Appendix Table A50 - continued

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		-1.20	1.68	0.44		-2.95	5.30	-0.27
MINIMUM		-4.49	-0.83	-0.51		-4.96	1.93	-2.05
RANGE		3.29	2.51	0.95		2.01	3.37	1.78
AVERAGE	20.00	-3.48	0.51	-0.12	18.00	-4.13	3.29	-0.91
STD. DEV.		0.042	0.478	0.218		0.420	0.066	0.432
VARIANCE		0.708	0.229	0.048		0.176	0.750	0.187
MAXIMUM		-2.34	1.46	0.37		-2.54	3.20	-0.93
MINIMUM		-3.22	-0.27	-0.10		-3.39	2.12	-1.90
RANGE		0.88	1.73	0.47		0.85	1.08	0.97
AVERAGE	25.49	-2.77	0.68	0.18	23.49	-2.94	2.71	-1.47
STD. DEV.		0.264	0.446	0.104		0.266	0.304	0.212
VARIANCE		0.070	0.199	0.011		0.071	0.092	0.045
MAXIMUM		-1.71	0.10	0.51		-4.54	2.93	-0.81
MINIMUM		-2.78	-1.27	-0.63		-5.49	1.46	-1.66
RANGE		1.07	1.37	1.14		0.95	1.47	0.85
AVERAGE	31.22	-2.26	-0.43	0.13	29.22	-4.99	2.02	-1.32
STD. DEV.		0.265	0.403	0.259		0.240	0.300	0.166
VARIANCE		0.070	0.162	0.067		0.057	0.090	0.028
MAXIMUM		-2.20	0.51	0.44		-2.91	2.76	-1.93
MINIMUM		-3.00	-0.85	-0.20		-5.15	0.49	-2.44
RANGE		0.80	1.36	0.64		2.24	2.27	0.51
AVERAGE	37.56	-2.50	-0.16	0.15	35.56	-4.12	1.58	-2.16
STD. DEV.		0.176	0.382	0.142		0.635	0.621	0.103
VARIANCE		0.031	0.146	0.020		0.403	0.385	0.011
MAXIMUM		-3.20	-0.44	0.49		-3.78	-0.29	-0.66
MINIMUM		-3.81	-1.76	-0.42		-4.79	-1.54	-1.71
RANGE		0.61	1.32	0.91		1.01	1.25	1.05
AVERAGE	42.71	-3.49	-1.04	0.08	40.71	-4.44	-0.70	-1.28
STD. DEV.		0.122	0.352	0.182		0.288	0.253	0.258
VARIANCE		0.015	0.124	0.033		0.083	0.064	0.066
MAXIMUM		0.05	-1.07	-0.76		0.93	1.15	-0.56
MINIMUM		-0.44	-2.44	-1.44		0.15	-2.17	-1.03
RANGE		0.49	1.37	0.68		0.78	3.32	0.47
AVERAGE	45.36	-0.21	-1.56	-1.08	43.36	0.54	-0.67	-0.78
STD. DEV.		0.126	0.322	0.144		0.194	0.927	0.094
VARIANCE		0.016	0.104	0.021		0.038	0.859	0.009

Appendix Table A51. Velocities 10 feet upstream and 1 foot upstream of trashracks of Turbine 12B at the Bonneville Second Powerhouse. Full powerhouse loading. Low Turbine load.

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		-30.93	-0.95	-28.83		-3.05	3.20	-1.20
MINIMUM		-31.20	-1.20	-30.10		-3.83	1.20	-2.12
RANGE		0.27	0.25	1.27		0.78	2.00	0.92
AVERAGE	2.55	-31.06	-1.07	-29.69	0.55	-3.47	2.44	-1.68
STD. DEV.		0.069	0.070	0.293		0.172	0.512	0.254
VARIANCE		0.005	0.005	0.086		0.030	0.262	0.064
MAXIMUM		-30.93	-1.25	-0.32		-2.03	4.10	-1.25
MINIMUM		-31.23	-1.46	-1.73		-3.49	1.83	-1.83
RANGE		0.30	0.21	1.41		1.46	2.27	0.58
AVERAGE	7.93	-31.07	-1.35	-1.12	5.93	-2.76	3.15	-1.54
STD. DEV.		0.076	0.053	0.310		0.363	0.534	0.136
VARIANCE		0.006	0.003	0.096		0.131	0.285	0.019
MAXIMUM		-31.13	-1.20	-0.27		-3.64	2.42	0.02
MINIMUM		-31.40	-1.46	-1.34		-4.71	-0.56	-1.12
RANGE		0.27	0.26	1.07		1.07	2.98	1.14
AVERAGE	12.02	-31.24	-1.33	-0.94	10.02	-4.13	1.06	-0.47
STD. DEV.		0.060	0.057	0.284		0.270	0.655	0.264
VARIANCE		0.004	0.003	0.081		0.073	0.430	0.069
MAXIMUM		8.01	-1.05	-30.66		-0.95	4.61	-2.37
MINIMUM		7.74	-1.27	-30.93		-3.42	1.54	-3.39
RANGE		0.27	0.22	0.27		2.47	3.07	1.02
AVERAGE	22.07	7.90	-1.15	-30.79	20.07	-1.62	2.16	-2.87
STD. DEV.		0.059	0.063	0.066		0.507	0.551	0.237
VARIANCE		0.003	0.004	0.004		0.257	0.304	0.056
MAXIMUM		8.08	-1.25	-30.22		-2.91	4.76	-0.29
MINIMUM		7.76	-1.46	-30.57		-4.01	1.56	-2.17
RANGE		0.32	0.21	0.35		1.90	3.20	1.88
AVERAGE	27.08	7.92	-1.34	-30.41	25.08	-3.03	2.86	-1.56
STD. DEV.		0.068	0.056	0.067		0.385	0.864	0.477
VARIANCE		0.005	0.003	0.005		0.149	0.746	0.228

Appendix Table A52. Comparison of 30 minute vs 15 second samples of velocities 10 feet upstream and 1 foot upstream of trashracks of Turbine 12B at the Bonneville Second Powerhouse. Full powerhouse loading.

		UPSTREAM	VELOCITY (in Ft/Sec)			DOWNSTREAM	VELOCITY (in Ft/Sec)		
		PROBE	X	Y	Z	PROBE	X	Y	Z
		ELEV(MSL)	FPS	FPS	FPS	ELEV(MSL)	FPS	FPS	FPS
High Turbine Load									
30 min. sample	MAXIMUM		16.65	12.60	-29.98		31.86	31.74	11.35
	MINIMUM		-30.76	-3.71	-30.42		-30.00	-30.98	-4.52
	RANGE		47.41	16.31	0.44		61.86	62.72	15.87
	AVERAGE	23.50	-12.78	-1.38	-30.25	21.50	27.45	-14.91	8.10
	STD.DEV.		17.359	0.907	0.062		13.856	25.054	4.321
	VARIANCE		301.319	0.824	0.004		191.997	627.715	18.669
15 sec. sample	MAXIMUM		8.23	-1.29	-30.15		6.93	-25.49	-3.61
	MINIMUM		7.64	-1.56	-30.42		-30.00	-30.84	-4.27
	RANGE		0.59	0.27	0.27		36.93	5.35	0.66
	AVERAGE	23.35	8.05	-1.42	-30.27	21.35	-23.45	-29.88	-4.11
	STD.DEV.		0.095	0.056	0.063		8.180	1.077	0.081
	VARIANCE		0.009	0.003	0.004		66.912	1.160	0.007
Medium Turbine Load									
30 min. sample	MAXIMUM		-0.37	3.81	4.91		-1.37	5.93	0.81
	MINIMUM		-5.37	-2.42	-3.20		-7.23	-1.44	-3.59
	RANGE		5.00	6.23	8.11		5.86	7.37	4.40
	AVERAGE	19.90	-2.88	0.59	0.10	17.90	-3.84	2.68	-1.22
	STD.DEV.		0.827	0.825	0.714		0.877	0.965	0.687
	VARIANCE		0.683	0.680	0.510		0.770	0.931	0.472
15 sec. sample	MAXIMUM		-1.20	1.68	0.44		-2.95	5.30	-0.27
	MINIMUM		-4.49	-0.83	-0.51		-4.96	1.93	-2.05
	RANGE		3.29	2.51	0.95		2.01	3.37	1.78
	AVERAGE	20.00	-3.48	0.51	-0.12	18.00	-4.13	3.29	-0.91
	STD.DEV.		0.842	0.478	0.218		0.420	0.866	0.432
	VARIANCE		0.708	0.229	0.048		0.176	0.750	0.187
Low Turbine Load									
30 min. sample	MAXIMUM		8.18	-1.05	17.41		1.00	6.47	0.83
	MINIMUM		7.71	-1.66	-30.93		-7.50	-2.61	-5.08
	RANGE		0.47	0.61	48.34		8.50	9.08	5.91
	AVERAGE	22.11	7.89	-1.24	-29.99	20.11	-2.98	2.11	-2.19
	STD.DEV.		0.064	0.079	3.737		1.150	1.163	0.671
	VARIANCE		0.004	0.006	13.962		1.322	1.353	0.450
15 sec. sample	MAXIMUM		8.01	-1.05	-30.66		-0.95	4.61	-2.37
	MINIMUM		7.74	-1.27	-30.93		-3.42	1.54	-3.39
	RANGE		0.27	0.22	0.27		2.47	3.07	1.02
	AVERAGE	22.07	7.90	-1.15	-30.79	20.07	-1.62	2.16	-2.87
	STD.DEV.		0.059	0.063	0.066		0.507	0.551	0.237
	VARIANCE		0.003	0.004	0.004		0.257	0.304	0.056

Appendix Table A53. Velocities at the Folding Frame upstream of Travelling Screen.
 Bonneville Second Powerhouse. Turbine 12B. Full powerhouse loading. High turbine load.

	Elevation (MSL)	VELOCITY(in Ft/Sec)		Elevation (MSL)	VELOCITY(in Ft/Sec)		Elevation (MSL)	VELOCITY(in Ft/Sec)	
		Y FPS	Z FPS		Y FPS	Z FPS		Y FPS	Z FPS
MAXIMUM		-0.46	6.30		10.52	1.86		0.51	0.32
MINIMUM		-0.68	1.68		3.98	-1.54		0.20	-0.66
RANGE		0.22	4.62		6.54	3.40		0.31	0.98
AVERAGE	10.57	-0.55	3.46	6.57	7.88	0.03	-13.43	0.37	-0.23
STD. DEV.		0.054	1.051		1.695	0.824		0.072	0.249
VARIANCE		0.003	1.104		2.873	0.679		0.005	0.062
MAXIMUM		-0.44	10.25		9.86	2.39		0.51	-0.17
MINIMUM		-0.68	5.47		4.91	0.68		0.20	-1.07
RANGE		0.24	4.78		4.95	1.71		0.31	0.90
AVERAGE	11.85	-0.54	7.91	7.85	7.43	1.49	-12.15	0.35	-0.61
STD. DEV.		0.057	1.281		1.282	0.394		0.076	0.213
VARIANCE		0.003	1.642		1.644	0.155		0.006	0.045
MAXIMUM		-0.46	2.95		7.23	1.05		0.51	0.07
MINIMUM		-0.66	0.59		4.15	-1.98		0.15	-0.29
RANGE		0.20	2.36		3.08	3.03		0.36	0.36
AVERAGE	18.65	-0.54	1.59	14.65	5.54	0.02	-5.35	0.35	-0.10
STD. DEV.		0.061	0.529		0.754	0.814		0.089	0.093
VARIANCE		0.004	0.280		0.569	0.663		0.008	0.009
MAXIMUM		-0.46	6.13		4.00	0.66		0.51	-0.02
MINIMUM		-0.68	1.88		1.37	-1.20		0.12	-0.51
RANGE		0.22	4.25		2.63	1.86		0.39	0.49
AVERAGE	20.43	-0.56	4.22	16.43	2.56	-0.27	-3.57	0.31	-0.27
STD. DEV.		0.058	0.967		0.647	0.395		0.081	0.107
VARIANCE		0.003	0.934		0.418	0.156		0.007	0.011
MAXIMUM		-0.42	7.03		5.20	0.51		0.51	0.27
MINIMUM		-0.73	0.83		-0.17	-0.95		0.15	-0.73
RANGE		0.31	6.20		5.37	1.46		0.36	1.00
AVERAGE	24.43	-0.52	4.69	20.43	2.16	-0.23	0.43	0.33	-0.16
STD. DEV.		0.070	1.368		1.365	0.341		0.071	0.200
VARIANCE		0.005	1.871		1.863	0.116		0.005	0.040
MAXIMUM		1.00	5.40		8.20	1.50		0.70	0.60
MINIMUM		1.60	-0.80		-0.10	-0.70		0.40	-0.50
RANGE		0.20	6.20		8.30	2.20		0.30	1.10
AVERAGE	26.31	1.74	2.69	22.31	4.57	0.31	2.31	0.56	0.10
STD. DEV.		0.066	1.591		2.294	0.441		0.065	0.283
VARIANCE		0.004	2.532		5.262	0.195		0.004	0.080

* The mounting bolts holding the probe arms sheared during the tests; therefore these readings may differ somewhat from actual values.

Appendix Table A54. Velocities at the Folding Frame upstream of Travelling Screen.
 Bonneville Second Powerhouse. Turbine 12B. Full powerhouse loading. Medium turbine load.

	VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)		
	Elevation (MSL)*	Y FPS	Z FPS	Elevation (MSL)*	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		-0.15	6.74		6.08	-2.25		2.88	-0.29
MINIMUM		-0.37	1.61		2.20	-5.42		1.59	-2.54
RANGE		0.22	5.13		3.88	3.17		1.29	2.25
AVERAGE	12.89	-0.25	3.99	6.89	4.12	-3.57	-13.11	2.13	-1.25
STD. DEV.		0.061	1.434		0.898	0.679		0.380	0.510
VARIANCE		0.004	2.058		0.806	0.461		0.145	0.261
MAXIMUM		-0.15	5.18		8.06	-2.20		3.13	-0.88
MINIMUM		-0.37	1.59		-0.27	-4.30		1.66	-2.56
RANGE		0.22	3.59		8.33	2.10		1.47	1.68
AVERAGE	11.84	-0.24	3.35	7.84	3.92	-3.30	-12.16	2.55	-1.89
STD. DEV.		0.053	0.742		2.325	0.381		0.386	0.409
VARIANCE		0.003	0.551		5.407	0.145		0.149	0.167
MAXIMUM		-0.17	2.08		4.88	0.83		2.27	2.34
MINIMUM		-0.39	-0.15		1.61	-0.56		0.61	-1.03
RANGE		0.22	2.23		3.27	1.39		1.66	3.37
AVERAGE	19.27	-0.25	1.23	15.27	3.95	0.11	-4.73	1.47	0.26
STD. DEV.		0.058	0.619		0.730	0.287		0.338	0.808
VARIANCE		0.003	0.384		0.533	0.082		0.114	0.652
MAXIMUM		-0.17	3.03		4.20	0.88		3.25	-0.05
MINIMUM		-0.37	1.49		0.83	-0.34		1.22	-2.03
RANGE		0.20	1.54		3.37	1.22		2.03	1.98
AVERAGE	20.76	-0.25	2.47	16.76	2.35	0.30	-3.24	2.08	-0.92
STD. DEV.		0.054	0.372		0.727	0.260		0.586	0.536
VARIANCE		0.003	0.139		0.529	0.068		0.343	0.287
MAXIMUM		-0.17	4.08		4.37	0.95		2.49	0.29
MINIMUM		-0.37	2.56		2.05	-0.44		0.78	-4.17
RANGE		0.20	1.52		2.32	1.39		1.71	4.46
AVERAGE	20.18	-0.23	3.21	41.86	2.98	0.24	21.86	1.69	-1.85
STD. DEV.		0.050	0.319		0.611	0.374		0.430	1.104
VARIANCE		0.002	0.101		0.373	0.140		0.185	1.219
MAXIMUM		-0.17	2.98		3.74	0.22		2.91	-0.98
MINIMUM		-0.39	2.20		1.98	-0.46		1.10	-3.15
RANGE		0.22	0.78		1.76	0.68		1.81	2.17
AVERAGE	26.90	-0.25	2.54	22.80	2.75	-0.10	2.80	1.88	-2.15
STD. DEV.		0.056	0.181		0.478	0.136		0.521	0.627
VARIANCE		0.003	0.033		0.228	0.019		0.272	0.393

Appendix Table A54 - continued

	VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)		
	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		-0.17	4.20		4.57	1.15		2.76	-0.85
MINIMUM		-0.39	2.47		0.78	-0.73		0.63	-3.22
RANGE		0.22	1.73		3.79	1.88		2.13	2.37
AVERAGE	27.54	-0.25	3.21	23.54	2.47	0.52	3.54	1.59	-2.04
STD. DEV.		0.061	0.396		0.830	0.363		0.380	0.485
VARIANCE		0.004	0.157		0.689	0.131		0.144	0.235
MAXIMUM		-0.42	2.73		4.00	1.00		2.00	-0.54
MINIMUM		-0.61	1.93		0.90	-0.88		0.98	-2.73
RANGE		0.19	0.80		3.10	1.88		1.02	2.19
AVERAGE	27.39	-0.49	2.32	23.39	2.20	0.33	3.39	1.54	-1.27
STD. DEV.		0.058	0.187		0.729	0.499		0.246	0.562
VARIANCE		0.003	0.035		0.532	0.249		0.060	0.316
MAXIMUM		-0.42	3.17		2.78	1.12		2.69	-1.27
MINIMUM		-0.63	1.93		0.10	-0.17		1.05	-2.54
RANGE		0.21	1.24		2.68	1.29		1.64	1.27
AVERAGE	27.09	-0.48	2.54	23.09	1.56	0.38	3.09	1.84	-1.92
STD. DEV.		0.054	0.300		0.767	0.299		0.432	0.285
VARIANCE		0.003	0.090		0.588	0.089		0.186	0.081
MAXIMUM		-0.42	3.66		4.83	0.49		2.71	-0.42
MINIMUM		-0.61	2.71		2.93	-0.59		1.15	-3.34
RANGE		0.19	0.95		1.90	1.08		1.56	2.92
AVERAGE	27.27	-0.51	3.25	23.27	3.88	0.02	3.27	1.82	-1.91
STD. DEV.		0.056	0.224		0.530	0.279		0.370	0.785
VARIANCE		0.003	0.050		0.281	0.078		0.137	0.616
MAXIMUM		-0.42	3.71		3.83	0.81		2.71	-1.00
MINIMUM		-0.63	2.17		2.08	-0.88		1.37	-2.83
RANGE		0.21	1.54		1.75	1.69		1.34	1.83
AVERAGE	27.27	-0.53	2.84	23.27	3.11	-0.09	3.27	2.06	-1.90
STD. DEV.		0.058	0.459		0.392	0.381		0.358	0.422
VARIANCE		0.003	0.211		0.154	0.145		0.128	0.178
MAXIMUM		-0.42	3.86		3.64	1.29		2.86	-1.51
MINIMUM		-0.66	2.54		-0.34	0.27		1.12	-3.03
RANGE		0.24	1.32		3.98	1.02		1.74	1.52
AVERAGE	27.48	-0.52	3.00	23.48	1.80	0.67	3.48	1.99	-2.33
STD. DEV.		0.059	0.329		1.309	0.233		0.452	0.347
VARIANCE		0.004	0.108		1.713	0.054		0.204	0.120

* The mounting bolts holding the probe arms sheared during the tests; therefore these readings may differ somewhat from actual values.

Appendix Table A55. Velocities at the Folding Frame upstream of Travelling Screen.
Bonneville Second Powerhouse. Turbine 12B. Full powerhouse loading. Low turbine load.

	VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)		
	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		-0.44	5.74		5.47	2.08		0.98	0.10
MINIMUM		-0.66	4.49		4.08	-0.78		0.56	-0.63
RANGE		0.22	1.25		1.39	2.86		0.42	0.73
AVERAGE	12.26	-0.54	5.04	8.26	4.79	0.42	-11.74	0.74	-0.29
STD. DEV.		0.059	0.361		0.355	0.689		0.101	0.138
VARIANCE		0.004	0.130		0.126	0.475		0.010	0.019
MAXIMUM		-0.27	2.81		3.54	-0.20		2.08	-0.56
MINIMUM		-0.49	1.68		1.78	-1.34		1.05	-1.64
RANGE		0.22	1.13		1.76	1.14		1.03	1.08
AVERAGE	18.15	-0.36	2.04	14.15	2.73	-0.88	-5.85	1.50	-1.17
STD. DEV.		0.066	0.236		0.475	0.280		0.203	0.220
VARIANCE		0.004	0.056		0.226	0.078		0.041	0.048
MAXIMUM		-0.20	1.83		2.15	-0.32		3.10	-1.73
MINIMUM		-0.44	0.90		0.85	-1.27		2.00	-3.00
RANGE		0.24	0.93		1.30	0.95		1.10	1.27
AVERAGE	19.98	-0.30	1.25	15.98	1.33	-0.73	-4.02	2.64	-2.44
STD. DEV.		0.057	0.206		0.262	0.231		0.279	0.264
VARIANCE		0.003	0.042		0.069	0.053		0.078	0.070
MAXIMUM		-0.22	2.76		2.37	1.20		2.37	-1.32
MINIMUM		-0.46	1.95		1.25	-0.37		1.73	-2.69
RANGE		0.24	0.81		1.12	1.57		0.64	1.37
AVERAGE	23.57	-0.34	2.35	19.57	1.88	0.45	-0.43	2.05	-2.06
STD. DEV.		0.063	0.176		0.297	0.444		0.138	0.394
VARIANCE		0.004	0.031		0.088	0.197		0.019	0.155
MAXIMUM		-0.22	2.61		3.13	0.66		2.39	-1.49
MINIMUM		-0.46	1.49		1.88	-0.32		1.59	-2.95
RANGE		0.24	1.12		1.25	0.98		0.80	1.46
AVERAGE	25.48	-0.33	2.05	21.48	2.44	0.28	1.48	1.95	-2.19
STD. DEV.		0.053	0.327		0.231	0.241		0.210	0.460
VARIANCE		0.003	0.107		0.053	0.058		0.044	0.212

* The mounting bolts holding the probe arms sheared during the tests; therefore these readings may differ somewhat from actual values.

Appendix Table A56. Comparison of 30 minute vs 15 second samples of velocities at the Folding Frame upstream of Travelling Screen. Bonneville Second Powerhouse. Turbine 12B. Full powerhouse loading.

			VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)			VELOCITY(in Ft/Sec)		
			Elevation	Y	Z	Elevation	Y	Z	Elevation	Y	Z
			(MSL)*	FPS	FPS	(MSL)*	FPS	FPS	(MSL)	FPS	FPS
High Turbine Load											
30 min. sample	MAXIMUM			1.76	11.77		9.30	2.17		0.59	0.51
	MINIMUM			-0.85	-3.76		-3.91	-1.66		0.05	-0.95
	RANGE			2.61	15.53		13.21	3.83		0.54	1.46
	AVERAGE	24.49		0.37	3.86	20.49	3.07	0.21	0.49	0.33	-0.21
	STD.DEV.			0.725	2.082		1.941	0.583		0.079	0.211
	VARIANCE			0.526	4.334		3.768	0.340		0.006	0.045
15 sec. sample	MAXIMUM			-0.42	7.03		5.20	0.51		0.51	0.27
	MINIMUM			-0.73	0.83		-0.17	-0.95		0.15	-0.73
	RANGE			0.31	6.20		5.37	1.46		0.36	1.00
	AVERAGE	24.43		-0.52	4.69	20.43	2.16	-0.23	0.43	0.33	-0.16
	STD.DEV.			0.070	1.368		1.365	0.341		0.071	0.200
	VARIANCE			0.005	1.871		1.863	0.116		0.005	0.040
Medium Turbine Load											
30 min. sample	MAXIMUM			-0.17	4.98		7.52	1.66		3.47	0.54
	MINIMUM			-0.59	-0.29		-1.27	-1.37		0.00	-5.10
	RANGE			0.42	5.27		8.79	3.03		3.47	5.64
	AVERAGE	27.40		-0.37	3.02	23.40	2.51	0.30	3.40	1.78	-1.79
	STD.DEV.			0.091	0.681		1.071	0.487		0.558	0.772
	VARIANCE			0.008	0.464		1.147	0.237		0.311	0.596
15 sec. sample	MAXIMUM			-0.17	4.20		4.57	1.15		2.76	-0.85
	MINIMUM			-0.39	2.47		0.78	-0.73		0.63	-3.22
	RANGE			0.22	1.73		3.79	1.88		2.13	2.37
	AVERAGE	27.54		-0.25	3.21	23.54	2.47	0.52	3.54	1.59	-2.04
	STD.DEV.			0.061	0.396		0.830	0.363		0.380	0.485
	VARIANCE			0.004	0.157		0.689	0.131		0.144	0.235
Low Turbine Load											
30 min. sample	MAXIMUM			-0.27	3.96		4.88	1.59		2.17	0.12
	MINIMUM			-0.66	1.10		1.10	-2.78		0.51	-2.32
	RANGE			0.39	2.86		3.78	4.37		1.66	2.44
	AVERAGE	18.31		-0.44	2.23	14.31	2.87	-0.55	-5.69	1.34	-0.97
	STD.DEV.			0.077	0.366		0.532	0.606		0.280	0.357
	VARIANCE			0.006	0.134		0.283	0.367		0.078	0.127
15 sec. sample	MAXIMUM			-0.27	2.81		3.54	-0.20		2.08	-0.56
	MINIMUM			-0.49	1.68		1.78	-1.34		1.05	-1.64
	RANGE			0.22	1.13		1.76	1.14		1.03	1.08
	AVERAGE	18.15		-0.36	2.04	14.15	2.73	-0.88	-5.85	1.50	-1.17
	STD.DEV.			0.066	0.236		0.475	0.280		0.203	0.220
	VARIANCE			0.004	0.056		0.226	0.078		0.041	0.048

* The mounting bolts holding the probe arms sheared during the tests; therefore these readings may differ somewhat from actual values.

APPENDIX Table A57. Velocities at fixed locations inside Submersible Travelling Screen and on support framework. Bonneville Second Powerhouse. Turbine 12B. Full powerhouse loading. High turbine load. 15 second samples.

LOCATION #	1		2		3		4		5		6	
	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS
MAXIMUM	3.22	-0.32	2.78	-0.32	2.69	1.05	0.56	0.02	1.44	6.84	1.00	-3.13
MINIMUM	1.25	-1.17	2.39	-0.71	2.12	0.59	-0.27	-0.59	-0.27	5.74	-0.90	-4.71
RANGE	1.97	0.85	0.39	0.39	0.57	0.46	0.83	0.61	1.71	1.10	1.90	1.58
AVERAGE	2.25	-0.65	2.57	-0.40	2.36	0.79	0.17	-0.23	0.27	6.29	0.05	-3.75
STD. DEV.	0.461	0.245	0.086	0.087	0.111	0.113	0.178	0.139	0.400	0.211	0.442	0.432
VARIANCE	0.212	0.060	0.007	0.008	0.012	0.013	0.032	0.019	0.160	0.044	0.196	0.187
MAXIMUM	2.95	-0.17	2.56	0.00	2.64	1.00	0.56	0.51	0.71	6.74	0.32	-1.76
MINIMUM	0.88	-1.00	2.25	-0.51	1.95	0.42	-0.44	-0.61	-1.00	5.81	-0.71	-4.57
RANGE	2.07	0.83	0.31	0.51	0.69	0.58	1.00	1.12	1.71	0.93	1.03	2.81
AVERAGE	2.10	-0.61	2.43	-0.29	2.28	0.70	0.06	-0.01	-0.28	6.29	-0.22	-2.94
STD. DEV.	0.547	0.231	0.082	0.119	0.144	0.114	0.225	0.358	0.321	0.258	0.260	0.731
VARIANCE	0.299	0.053	0.007	0.014	0.021	0.013	0.051	0.128	0.103	0.066	0.060	0.534
MAXIMUM	3.25	-0.44	2.78	-0.10	2.56	0.90	0.49	0.81	0.61	7.25	0.24	-2.54
MINIMUM	1.73	-0.88	2.42	-0.42	2.15	0.49	-0.24	-0.10	-0.95	6.49	-1.07	-4.08
RANGE	1.52	0.44	0.36	0.32	0.41	0.41	0.73	0.91	1.56	0.76	1.31	1.54
AVERAGE	2.45	-0.65	2.60	-0.25	2.34	0.73	0.20	0.32	-0.18	6.86	-0.39	-3.37
STD. DEV.	0.401	0.109	0.095	0.070	0.105	0.093	0.175	0.267	0.460	0.167	0.404	0.355
VARIANCE	0.161	0.012	0.009	0.005	0.011	0.009	0.031	0.071	0.212	0.028	0.163	0.126
MAXIMUM	3.47	-0.07	2.66	-0.07	2.86	1.07	0.71	1.15	1.10	7.40	0.37	-2.25
MINIMUM	2.17	-0.95	2.20	-0.51	1.93	0.61	-0.29	-0.59	-1.34	6.35	-1.34	-4.22
RANGE	1.30	0.88	0.46	0.44	0.93	0.46	1.00	1.74	2.44	1.05	1.71	1.97
AVERAGE	2.70	-0.43	2.42	-0.29	2.46	0.88	0.24	0.30	-0.31	6.95	-0.39	-3.25
STD. DEV.	0.289	0.204	0.104	0.111	0.252	0.111	0.286	0.539	0.585	0.260	0.395	0.491
VARIANCE	0.084	0.041	0.011	0.012	0.064	0.012	0.082	0.290	0.342	0.068	0.156	0.241
MAXIMUM	3.71	0.15	2.78	0.12	2.66	0.95	0.49	0.59	1.59	7.74	0.71	-2.44
MINIMUM	1.44	-0.76	2.17	-0.42	2.10	0.51	-0.71	-0.24	-0.56	6.15	-1.37	-4.42
RANGE	2.27	0.91	0.61	0.54	0.56	0.44	1.20	0.83	2.15	1.59	2.08	1.98
AVERAGE	2.16	-0.30	2.50	-0.07	2.36	0.73	-0.03	0.21	0.63	7.30	-0.20	-3.55
STD. DEV.	0.445	0.197	0.136	0.110	0.134	0.094	0.269	0.189	0.483	0.364	0.405	0.393
VARIANCE	0.198	0.039	0.018	0.012	0.018	0.009	0.073	0.036	0.233	0.133	0.164	0.154
MAXIMUM	3.90	-0.40	2.90	-0.30	2.40	1.10	0.70	0.30	0.50	7.50	1.80	-2.80
MINIMUM	0.60	-1.00	2.40	-0.80	1.90	0.40	-1.00	-0.60	-1.60	6.70	-0.90	-4.70
RANGE	3.30	0.60	0.50	0.50	0.50	0.70	1.70	0.90	2.10	0.80	2.70	1.90
AVERAGE	2.01	-0.74	2.65	-0.46	2.15	0.79	0.05	-0.23	-0.44	7.11	0.07	-3.80
STD. DEV.	0.898	0.136	0.106	0.110	0.112	0.189	0.523	0.285	0.500	0.214	0.671	0.478
VARIANCE	0.807	0.019	0.011	0.012	0.013	0.036	0.274	0.081	0.250	0.046	0.450	0.228

APPENDIX Table A5B. Velocities at fixed locations inside Submersible Travelling Screen and on support framework. Bonneville Second Powerhouse. Turbine 12B. Full powerhouse loading. Medium turbine load. 15 second samples.

LOCATION #	1		2		3		4		5		6	
	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS
MAXIMUM	3.27	-0.22	2.88	0.02	5.32	5.10	0.68	-0.02	0.22	6.05	1.05	-2.22
MINIMUM	1.27	-1.05	2.54	-0.46	5.05	4.88	-0.78	-0.73	-1.32	5.37	-0.63	-4.08
RANGE	2.00	0.83	0.34	0.48	0.27	0.22	1.46	0.71	1.54	0.68	1.68	1.86
AVERAGE	2.18	-0.73	2.68	-0.24	5.20	5.00	-0.06	-0.32	-0.64	5.70	0.34	-3.36
STD. DEV.	0.401	0.197	0.070	0.117	0.061	0.053	0.394	0.162	0.411	0.197	0.314	0.470
VARIANCE	0.161	0.039	0.005	0.014	0.004	0.003	0.155	0.026	0.169	0.039	0.099	0.221
MAXIMUM	3.88	0.15	2.83	-0.05	5.30	5.13	-0.05	0.02	1.15	6.67	0.12	-2.17
MINIMUM	0.61	-1.20	2.39	-0.46	5.05	4.88	-0.54	-0.71	-0.76	5.40	-0.98	-3.98
RANGE	3.27	1.35	0.44	0.41	0.25	0.25	0.49	0.73	1.91	1.27	1.10	1.81
AVERAGE	1.77	-0.67	2.66	-0.26	5.19	5.02	-0.29	-0.42	0.19	5.92	-0.52	-3.16
STD. DEV.	0.750	0.300	0.078	0.078	0.067	0.058	0.111	0.191	0.397	0.293	0.352	0.474
VARIANCE	0.563	0.090	0.006	0.006	0.005	0.003	0.012	0.037	0.157	0.086	0.124	0.225
MAXIMUM	3.15	-0.24	2.95	-0.02	5.30	5.10	0.37	0.34	-0.42	5.84	0.90	-2.15
MINIMUM	1.05	-1.03	2.54	-0.39	5.05	4.88	-0.10	-0.49	-1.01	5.32	-0.98	-3.25
RANGE	2.10	0.79	0.41	0.37	0.25	0.22	0.47	0.83	1.39	0.52	1.88	1.10
AVERAGE	2.10	-0.63	2.73	-0.18	5.19	5.00	0.12	-0.09	-1.11	5.60	0.03	-2.81
STD. DEV.	0.468	0.170	0.092	0.072	0.053	0.059	0.108	0.204	0.305	0.116	0.525	0.246
VARIANCE	0.219	0.029	0.008	0.005	0.003	0.003	0.012	0.042	0.093	0.014	0.276	0.061
MAXIMUM	4.37	-0.20	2.76	-0.17	5.30	5.13	0.22	-0.24	0.44	6.42	0.24	-2.37
MINIMUM	2.34	-0.88	2.34	-0.63	5.05	4.88	-0.68	-0.95	-1.54	4.96	-1.05	-4.08
RANGE	2.03	0.68	0.42	0.46	0.25	0.25	0.90	0.71	1.98	1.46	1.29	1.71
AVERAGE	3.14	-0.51	2.55	-0.38	5.19	5.01	-0.22	-0.57	-0.66	5.88	-0.50	-3.39
STD. DEV.	0.438	0.139	0.079	0.109	0.060	0.055	0.224	0.138	0.422	0.312	0.374	0.416
VARIANCE	0.191	0.019	0.006	0.012	0.004	0.003	0.050	0.019	0.178	0.097	0.140	0.173
MAXIMUM	2.44	0.10	2.83	-0.10	5.40	6.03	0.49	0.83	1.86	7.08	-0.02	-3.00
MINIMUM	0.78	-1.66	1.71	-2.00	5.08	4.88	-1.05	-0.76	-0.76	5.91	-2.03	-4.57
RANGE	1.66	1.76	1.12	1.90	0.32	1.15	1.54	1.59	2.62	1.17	2.01	1.57
AVERAGE	1.73	-0.62	2.60	-0.33	5.21	5.01	-0.30	-0.02	0.63	6.53	-0.97	-3.84
STD. DEV.	0.294	0.209	0.128	0.222	0.054	0.133	0.454	0.479	0.690	0.310	0.488	0.418
VARIANCE	0.086	0.044	0.016	0.049	0.003	0.018	0.206	0.229	0.475	0.096	0.239	0.175
MAXIMUM	3.08	-0.22	2.69	-0.24	5.32	5.13	0.68	0.93	0.59	6.35	1.46	-2.39
MINIMUM	1.29	-0.98	2.37	-0.59	5.05	4.88	-0.27	0.05	-0.51	5.40	-1.46	-4.05
RANGE	1.79	0.76	0.32	0.35	0.27	0.25	0.95	0.88	1.10	0.95	2.92	1.66
AVERAGE	2.35	-0.58	2.54	-0.39	5.20	5.00	0.20	0.66	-0.00	5.90	0.20	-3.22
STD. DEV.	0.458	0.162	0.062	0.086	0.071	0.059	0.268	0.203	0.250	0.241	0.841	0.430
VARIANCE	0.210	0.026	0.004	0.007	0.005	0.003	0.072	0.041	0.062	0.058	0.707	0.184

Appendix Table A58 - continued

LOCATION #	1		2		3		4		5		6	
	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS
MAXIMUM	3.49	-0.05	2.93	0.05	5.32	5.13	0.78	0.78	0.95	6.40	0.73	-2.34
MINIMUM	0.83	-1.03	2.37	-0.42	5.05	4.88	-0.63	-0.07	-1.90	5.49	-1.66	-4.25
RANGE	2.66	0.98	0.56	0.47	0.27	0.25	1.41	0.85	2.85	0.91	2.39	1.91
AVERAGE	2.35	-0.41	2.67	-0.13	5.22	5.00	-0.03	0.30	-0.22	5.89	-0.23	-3.15
STD. DEV.	0.756	0.217	0.096	0.097	0.064	0.055	0.310	0.190	0.652	0.181	0.509	0.465
VARIANCE	0.571	0.047	0.009	0.009	0.004	0.003	0.096	0.036	0.425	0.033	0.259	0.216
MAXIMUM	3.32	-0.10	3.03	0.00	2.73	0.81	-0.15	-0.15	2.08	6.84	1.93	-2.05
MINIMUM	1.34	-0.93	2.64	-0.44	2.34	0.24	-1.44	-0.54	-0.07	5.47	-0.34	-3.54
RANGE	1.98	0.83	0.39	0.44	0.39	0.57	1.29	0.39	2.15	1.37	2.27	1.49
AVERAGE	2.44	-0.58	2.81	-0.20	2.56	0.54	-0.49	-0.33	1.04	6.12	0.70	-2.59
STD. DEV.	0.553	0.218	0.089	0.093	0.099	0.147	0.261	0.096	0.565	0.428	0.566	0.337
VARIANCE	0.306	0.048	0.008	0.009	0.010	0.022	0.068	0.009	0.320	0.183	0.320	0.114
MAXIMUM	2.83	-0.12	2.76	-0.20	2.54	0.68	0.59	0.68	0.32	5.71	0.10	-2.83
MINIMUM	1.07	-0.68	2.22	-0.59	2.10	0.29	-0.39	-0.34	-0.95	5.05	-1.95	-3.98
RANGE	1.76	0.56	0.54	0.39	0.44	0.39	0.98	1.02	1.27	0.66	2.05	1.15
AVERAGE	2.12	-0.45	2.54	-0.35	2.29	0.53	0.15	0.20	-0.25	5.45	-1.10	-3.38
STD. DEV.	0.477	0.127	0.116	0.082	0.096	0.083	0.265	0.301	0.387	0.160	0.503	0.246
VARIANCE	0.227	0.016	0.013	0.007	0.009	0.007	0.070	0.091	0.150	0.026	0.253	0.061
MAXIMUM	2.71	-0.32	3.27	-0.15	2.86	0.81	0.27	0.63	0.73	6.37	1.86	-2.61
MINIMUM	1.15	-0.98	2.56	-0.59	2.42	0.44	-0.93	-0.20	-1.10	5.22	-0.17	-4.13
RANGE	1.56	0.66	0.71	0.44	0.44	0.37	1.20	0.83	1.83	1.15	2.03	1.52
AVERAGE	1.85	-0.67	2.96	-0.31	2.66	0.61	-0.38	0.26	-0.14	5.81	0.86	-3.43
STD. DEV.	0.369	0.126	0.197	0.098	0.106	0.087	0.318	0.228	0.519	0.307	0.490	0.390
VARIANCE	0.136	0.016	0.039	0.010	0.011	0.008	0.101	0.052	0.270	0.094	0.240	0.152
MAXIMUM	3.25	-0.27	2.88	0.10	2.93	0.78	0.27	-0.05	0.37	5.79	0.34	-3.03
MINIMUM	2.03	-0.61	2.29	-0.29	2.27	0.34	-0.46	-0.54	-0.73	5.10	-1.64	-4.88
RANGE	1.22	0.34	0.59	0.39	0.66	0.44	0.73	0.49	1.10	0.69	1.98	1.85
AVERAGE	2.67	-0.44	2.60	-0.10	2.59	0.61	-0.09	-0.30	-0.30	5.49	-0.58	-4.06
STD. DEV.	0.367	0.081	0.133	0.105	0.144	0.091	0.178	0.126	0.252	0.153	0.475	0.462
VARIANCE	0.135	0.007	0.018	0.011	0.021	0.008	0.032	0.016	0.063	0.023	0.226	0.214
MAXIMUM	2.95	-0.29	2.86	-0.05	2.71	0.68	0.37	-0.29	0.95	6.08	0.10	-2.71
MINIMUM	0.81	-0.81	2.27	-0.46	2.15	0.34	-0.68	-0.71	-0.95	5.66	-1.59	-4.57
RANGE	2.14	0.52	0.59	0.41	0.56	0.34	1.05	0.42	1.90	0.42	1.69	1.86
AVERAGE	1.81	-0.54	2.59	-0.25	2.38	0.54	-0.13	-0.53	-0.03	5.87	-0.77	-3.61
STD. DEV.	0.391	0.113	0.158	0.106	0.128	0.074	0.266	0.087	0.517	0.106	0.384	0.554
VARIANCE	0.153	0.013	0.025	0.011	0.016	0.006	0.071	0.007	0.267	0.011	0.148	0.307

APPENDIX Table A59. Velocities at fixed locations inside Submersible Travelling Screen and on support framework, Bonneville Second Powerhouse, Turbine 12B, Full powerhouse loading. Low turbine load, 15 second samples.

LOCATION #	1		2		3		4		5		6	
	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS	Y FPS	Z FPS
MAXIMUM	2.86	5.96	1.39	-0.17	2.12	0.61	0.22	0.32	8.08	3.30	-0.17	-2.22
MINIMUM	-1.64	0.20	1.10	-0.46	1.78	0.32	-0.17	-0.15	-20.39	-2.42	-0.85	-2.98
RANGE	4.50	5.76	0.29	0.29	0.34	0.29	0.39	0.47	28.47	5.72	0.68	0.76
AVERAGE	1.73	3.37	1.23	-0.32	1.98	0.46	0.04	0.13	4.07	0.58	-0.54	-2.68
STD. DEV.	1.229	1.633	0.070	0.070	0.077	0.071	0.091	0.100	3.554	1.229	0.147	0.160
VARIANCE	1.510	2.665	0.005	0.005	0.006	0.005	0.008	0.010	12.633	1.511	0.022	0.026
MAXIMUM	3.44	8.23	1.29	-0.27	2.05	0.71	0.27	-0.15	35.57	4.13	-0.51	-2.42
MINIMUM	-0.29	0.00	0.98	-0.59	1.68	0.32	-0.42	-0.54	-8.47	-2.34	-1.03	-3.25
RANGE	3.73	8.23	0.31	0.32	0.37	0.39	0.69	0.39	44.04	6.47	0.52	0.83
AVERAGE	1.87	2.75	1.14	-0.41	1.86	0.53	-0.04	-0.30	5.80	2.24	-0.74	-2.75
STD. DEV.	1.110	2.281	0.082	0.070	0.077	0.093	0.128	0.094	4.949	1.399	0.116	0.190
VARIANCE	1.233	5.203	0.007	0.005	0.006	0.009	0.016	0.009	24.494	1.956	0.014	0.036
MAXIMUM	3.81	0.22	1.27	-0.12	2.15	0.54	0.32	1.00	13.48	4.39	-0.51	-2.15
MINIMUM	2.91	-0.59	0.81	-0.49	1.66	0.27	-0.46	0.44	1.83	-0.56	-1.34	-2.86
RANGE	0.90	0.81	0.46	0.37	0.49	0.27	0.78	0.56	11.65	4.95	0.83	0.71
AVERAGE	3.30	-0.20	1.01	-0.32	1.93	0.40	-0.05	0.73	5.49	2.89	-0.94	-2.49
STD. DEV.	0.208	0.165	0.085	0.083	0.099	0.065	0.166	0.111	2.916	1.216	0.183	0.155
VARIANCE	0.043	0.027	0.007	0.007	0.010	0.004	0.027	0.012	8.504	1.479	0.034	0.024
MAXIMUM	3.39	5.69	1.56	0.00	2.37	0.76	0.49	0.98	27.22	4.03	-0.15	-2.27
MINIMUM	-1.03	-0.15	1.07	-0.32	1.78	0.34	-0.17	-0.15	-17.31	-0.07	-0.95	-3.93
RANGE	4.42	5.84	0.49	0.32	0.59	0.42	0.66	1.13	44.53	4.10	0.80	1.66
AVERAGE	2.02	1.66	1.32	-0.15	2.15	0.58	0.14	0.41	4.45	2.44	-0.48	-2.85
STD. DEV.	1.253	1.652	0.091	0.076	0.121	0.093	0.159	0.232	7.093	0.850	0.170	0.252
VARIANCE	1.570	2.728	0.008	0.006	0.015	0.009	0.025	0.054	50.309	0.722	0.029	0.063
MAXIMUM	2.78	-0.17	1.93	0.02	2.12	0.61	0.27	0.37	0.49	5.37	-0.07	-1.86
MINIMUM	1.98	-0.49	1.56	-0.32	1.68	0.32	-0.20	-0.56	-0.27	4.69	-0.66	-3.30
RANGE	0.80	0.32	0.37	0.34	0.44	0.29	0.47	0.93	0.76	0.68	0.59	1.44
AVERAGE	2.43	-0.30	1.79	-0.16	1.86	0.46	0.05	-0.10	0.12	5.10	-0.34	-2.58
STD. DEV.	0.176	0.081	0.070	0.068	0.094	0.064	0.102	0.262	0.209	0.165	0.162	0.370
VARIANCE	0.031	0.007	0.005	0.005	0.009	0.004	0.010	0.069	0.044	0.027	0.026	0.137

APPENDIX Table A6B. Comparison of 30 minute vs 15 second samples of velocities at fixed locations inside Submersible Travelling Screen and on support framework. Bonneville Second Powerhouse, Turbine 12B, Full powerhouse loading.

LOCATION #		1		2		3		4		5		6	
		Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z
		FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS	FPS
High Turbine Load													
30 min. sample	MAXIMUM	5.18	0.49	3.61	0.32	3.61	1.37	1.59	1.61	3.42	0.50	3.20	-0.42
	MINIMUM	-0.07	-1.61	2.12	-0.85	1.61	0.20	-2.51	-1.56	-2.32	5.79	-4.88	-6.91
	RANGE	5.25	2.10	1.49	1.17	2.00	1.17	4.10	3.17	5.74	2.71	8.08	6.49
	AVERAGE	2.63	-0.56	2.70	-0.24	2.38	0.81	0.05	0.17	-0.00	6.95	-0.33	-3.97
	STD. DEV.	0.773	0.325	0.213	0.163	0.278	0.171	0.473	0.632	0.733	0.409	0.925	0.850
	VARIANCE	0.598	0.106	0.045	0.027	0.077	0.029	0.224	0.399	0.537	0.168	0.856	0.723
15 sec. sample	MAXIMUM	3.71	0.15	2.78	0.12	2.66	0.95	0.49	0.59	1.59	7.74	0.71	-2.44
	MINIMUM	1.44	-0.76	2.17	-0.42	2.10	0.51	-0.71	-0.24	-0.56	6.15	-1.37	-4.42
	RANGE	2.27	0.91	0.61	0.54	0.56	0.44	1.20	0.83	2.15	1.59	2.08	1.98
	AVERAGE	2.16	-0.30	2.50	-0.07	2.36	0.73	-0.03	0.21	0.63	7.30	-0.20	-3.55
	STD. DEV.	0.445	0.197	0.136	0.110	0.134	0.094	0.269	0.189	0.483	0.364	0.405	0.393
	VARIANCE	0.198	0.039	0.018	0.012	0.018	0.009	0.073	0.036	0.233	0.133	0.164	0.154
Medium Turbine Load													
30 min. sample	MAXIMUM	5.40	0.42	3.32	0.15	5.37	5.13	1.15	1.22	2.05	6.79	1.78	-1.42
	MINIMUM	-1.66	-1.34	2.27	-0.66	1.95	0.22	-1.29	-1.37	-2.93	4.74	-2.91	-5.10
	RANGE	7.06	1.76	1.05	0.81	3.42	4.91	2.44	2.59	4.98	2.05	4.69	3.68
	AVERAGE	2.26	-0.52	2.66	-0.21	3.35	2.06	-0.02	-0.15	-0.06	5.79	-0.27	-3.20
	STD. DEV.	0.890	0.255	0.150	0.118	1.310	2.069	0.335	0.499	0.599	0.326	0.676	0.522
	VARIANCE	0.791	0.065	0.023	0.014	1.717	4.282	0.113	0.249	0.359	0.106	0.457	0.273
15 sec. sample	MAXIMUM	3.49	-0.05	2.93	0.05	5.32	5.13	0.78	0.78	0.95	6.40	0.73	-2.34
	MINIMUM	0.83	-1.03	2.37	-0.42	5.05	4.88	-0.63	-0.07	-1.90	5.49	-1.66	-4.25
	RANGE	2.66	0.98	0.56	0.47	0.27	0.25	1.41	0.85	2.85	0.91	2.39	1.91
	AVERAGE	2.35	-0.41	2.67	-0.13	5.22	5.00	-0.03	0.30	-0.22	5.89	-0.23	-3.15
	STD. DEV.	0.756	0.217	0.096	0.097	0.064	0.055	0.310	0.190	0.652	0.181	0.509	0.465
	VARIANCE	0.571	0.047	0.009	0.009	0.004	0.003	0.096	0.036	0.425	0.033	0.259	0.216
Low Turbine Load													
30 min. sample	MAXIMUM	4.08	5.69	2.25	0.00	2.71	0.81	0.68	1.29	30.35	5.59	0.12	-1.73
	MINIMUM	-1.03	-0.93	1.00	-0.61	1.39	0.22	-0.59	-1.15	-17.31	-5.25	-1.44	-4.13
	RANGE	5.11	6.62	1.25	0.61	1.32	0.59	1.27	2.44	47.66	10.84	1.56	2.40
	AVERAGE	2.68	-0.16	1.61	-0.24	1.93	0.55	0.02	0.05	2.22	2.81	-0.44	-2.86
	STD. DEV.	0.471	0.574	0.212	0.094	0.224	0.096	0.185	0.427	3.047	2.044	0.208	0.352
	VARIANCE	0.222	0.329	0.045	0.009	0.050	0.009	0.034	0.182	9.285	4.180	0.043	0.124
15 sec. sample	MAXIMUM	3.39	5.69	1.56	0.00	2.37	0.76	0.49	0.98	27.22	4.03	-0.15	-2.27
	MINIMUM	-1.03	-0.15	1.07	-0.32	1.78	0.34	-0.17	-0.15	-17.31	-0.07	-0.95	-3.93
	RANGE	4.42	5.84	0.49	0.32	0.59	0.42	0.66	1.13	44.53	4.10	0.80	1.66
	AVERAGE	2.02	1.66	1.32	-0.15	2.15	0.58	0.14	0.41	4.45	2.44	-0.48	-2.85
	STD. DEV.	1.253	1.652	0.091	0.076	0.121	0.093	0.159	0.232	7.093	0.850	0.170	0.252
	VARIANCE	1.570	2.728	0.008	0.006	0.015	0.009	0.025	0.054	50.309	0.722	0.029	0.063

Appendix Table A61. Velocities at bulkhead slot in turbine intake.
Bonneville Second Powerhouse, Turbine 12B. Full Powerhouse loading,
High turbine load.

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		8.59	-2.32		8.54	3.15
MINIMUM		8.11	-2.93		0.02	-2.76
RANGE		0.48	0.61		8.52	5.91
AVERAGE	5.98	8.39	-2.67	-14.02	3.66	0.16
STD. DEV.		0.094	0.148		2.277	1.558
VARIANCE		0.009	0.022		5.185	2.426
MAXIMUM		7.67	-1.03		6.74	1.37
MINIMUM		6.96	-1.78		1.15	-2.71
RANGE		0.71	0.75		5.59	4.08
AVERAGE	9.63	7.32	-1.36	-10.37	3.45	-1.06
STD. DEV.		0.141	0.221		1.450	1.130
VARIANCE		0.020	0.049		2.103	1.276
MAXIMUM		2.91	-1.29		6.69	0.85
MINIMUM		2.34	-1.83		-0.61	-2.51
RANGE		0.57	0.54		7.30	3.36
AVERAGE	14.10	2.67	-1.49	-5.90	3.52	-0.69
STD. DEV.		0.112	0.111		1.988	0.761
VARIANCE		0.012	0.012		3.953	0.579
MAXIMUM		1.46	-1.37		6.18	0.32
MINIMUM		1.15	-1.81		2.34	-3.20
RANGE		0.31	0.44		3.84	3.52
AVERAGE	19.22	1.31	-1.58	-0.78	4.36	-1.36
STD. DEV.		0.073	0.100		0.981	0.837
VARIANCE		0.005	0.010		0.963	0.700
MAXIMUM		1.56	-1.34		7.23	-0.27
MINIMUM		1.10	-1.66		-3.39	-4.64
RANGE		0.46	0.32		10.62	4.37
AVERAGE	19.17	1.38	-1.50	-0.83	3.48	-2.14
STD. DEV.		0.084	0.085		3.474	1.071
VARIANCE		0.007	0.007		12.071	1.147
MAXIMUM		1.50	-1.40		9.70	-0.80
MINIMUM		1.30	-1.80		1.70	-5.30
RANGE		0.20	0.40		8.00	4.50
AVERAGE	19.52	1.42	-1.58	-0.48	5.64	-2.13
STD. DEV.		0.067	0.092		2.353	0.912
VARIANCE		0.005	0.008		5.537	0.832

Appendix Table A62. Velocities at bulkhead slot in turbine intake.
 Bonneville Second Powerhouse, Turbine 12B. Full Powerhouse loading.
 Medium turbine load.

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		8.01	-1.93		7.13	0.44
MINIMUM		7.25	-3.10		-2.51	-4.83
RANGE		0.76	1.17		9.64	5.27
AVERAGE	4.39	7.65	-2.43	-15.61	2.45	-2.51
STD. DEV.		0.171	0.299		2.552	0.969
VARIANCE		0.029	0.089		6.515	0.939
MAXIMUM		5.98	-0.63		8.69	0.71
MINIMUM		5.25	-1.07		0.81	-3.22
RANGE		0.73	0.44		7.88	3.93
AVERAGE	5.30	5.55	-0.82	-14.70	4.33	-1.01
STD. DEV.		0.196	0.095		2.024	1.325
VARIANCE		0.038	0.009		4.097	1.756
MAXIMUM		2.34	-1.22		3.83	1.76
MINIMUM		2.05	-1.54		-2.54	-3.49
RANGE		0.29	0.32		6.37	5.25
AVERAGE	14.93	2.20	-1.36	-5.07	0.75	-1.18
STD. DEV.		0.072	0.074		1.624	1.401
VARIANCE		0.005	0.005		2.636	1.963
MAXIMUM		1.32	-1.20		9.52	-1.25
MINIMUM		1.03	-1.51		4.39	-4.20
RANGE		0.29	0.31		5.13	2.95
AVERAGE	19.14	1.18	-1.31	-0.86	6.51	-2.39
STD. DEV.		0.064	0.072		1.108	0.844
VARIANCE		0.004	0.005		1.227	0.712
MAXIMUM		1.46	-1.15		8.69	-1.05
MINIMUM		1.10	-1.73		0.85	-4.66
RANGE		0.36	0.58		7.84	3.61
AVERAGE	19.16	1.28	-1.40	-0.84	4.92	-2.94
STD. DEV.		0.076	0.158		1.967	0.867
VARIANCE		0.006	0.025		3.870	0.752
MAXIMUM		1.46	-1.22		5.84	-0.78
MINIMUM		1.15	-1.66		-0.68	-4.81
RANGE		0.31	0.44		6.52	4.03
AVERAGE	19.23	1.33	-1.44	-0.77	2.83	-2.93
STD. DEV.		0.088	0.092		1.738	1.154
VARIANCE		0.008	0.009		3.022	1.331

Appendix Table A62 - continued

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		1.54	-1.20		8.01	0.24
MINIMUM		1.12	-1.64		1.22	-4.32
RANGE		0.42	0.44		6.79	4.56
AVERAGE	19.26	1.37	-1.34	-0.74	3.73	-1.29
STD. DEV.		0.082	0.084		1.612	0.940
VARIANCE		0.007	0.007		2.597	0.883
MAXIMUM		1.37	-1.25		7.35	-0.71
MINIMUM		1.10	-1.66		1.15	-3.25
RANGE		0.27	0.41		6.20	2.54
AVERAGE	19.29	1.24	-1.45	-0.71	4.17	-1.91
STD. DEV.		0.068	0.098		1.598	0.612
VARIANCE		0.005	0.010		2.554	0.375
MAXIMUM		1.44	-1.27		14.04	-1.07
MINIMUM		1.17	-1.66		6.54	-3.66
RANGE		0.27	0.39		7.50	2.59
AVERAGE	19.29	1.32	-1.43	-0.71	10.68	-2.25
STD. DEV.		0.057	0.084		1.919	0.620
VARIANCE		0.003	0.007		3.684	0.384
MAXIMUM		1.29	-1.05		5.93	0.54
MINIMUM		0.88	-1.51		1.61	-3.17
RANGE		0.41	0.46		4.32	3.71
AVERAGE	19.34	1.11	-1.26	-0.66	3.52	-1.62
STD. DEV.		0.088	0.092		0.970	1.181
VARIANCE		0.008	0.008		0.941	1.394
MAXIMUM		1.42	-1.22		9.06	-0.44
MINIMUM		1.12	-1.76		4.61	-2.32
RANGE		0.30	0.54		4.45	1.88
AVERAGE	19.43	1.30	-1.44	-0.57	7.05	-1.30
STD. DEV.		0.068	0.121		1.108	0.436
VARIANCE		0.005	0.015		1.227	0.190
MAXIMUM		1.49	-1.42		10.01	-0.37
MINIMUM		-0.20	-1.83		-11.99	-4.49
RANGE		1.69	0.41		22.00	4.12
AVERAGE	19.54	1.39	-1.60	-0.46	6.61	-2.80
STD. DEV.		0.191	0.087		2.557	1.029
VARIANCE		0.036	0.008		6.538	1.059

Appendix Table A63. Velocities at bulkhead slot in turbine intake.
 Bonneville Second Powerhouse, Turbine 12B. Full Powerhouse loading.
 Low turbine load.

	Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
MAXIMUM		6.74	-1.73		5.64	2.34
MINIMUM		6.18	-2.08		0.98	-0.78
RANGE		0.56	0.35		4.66	3.12
AVERAGE	4.14	6.47	-1.89	-15.86	3.71	0.62
STD. DEV.		0.125	0.074		1.201	0.756
VARIANCE		0.016	0.006		1.443	0.572
MAXIMUM		6.71	49.98		2.76	0.90
MINIMUM		5.88	-0.81		-2.17	-2.51
RANGE		0.83	50.79		4.93	3.41
AVERAGE	4.22	6.40	21.25	-15.78	-0.02	-1.08
STD. DEV.		0.105	10.270		1.101	0.886
VARIANCE		0.011	105.467		1.213	0.785
MAXIMUM		4.27	32.03		4.32	2.17
MINIMUM		-7.08	-5.81		-0.37	-1.25
RANGE		11.35	37.84		4.69	3.42
AVERAGE	8.35	2.94	8.91	-11.65	2.04	0.41
STD. DEV.		1.329	4.079		1.278	0.839
VARIANCE		1.766	16.637		1.632	0.704
MAXIMUM		1.78	49.98		6.32	1.76
MINIMUM		1.15	-16.67		1.39	-1.10
RANGE		0.63	66.65		4.93	2.86
AVERAGE	12.92	1.46	11.54	-7.08	3.92	0.16
STD. DEV.		0.155	9.779		1.253	0.774
VARIANCE		0.024	95.619		1.569	0.598
MAXIMUM		1.68	49.98		7.52	0.59
MINIMUM		-0.39	-8.76		1.49	-4.57
RANGE		2.07	58.74		6.03	5.16
AVERAGE	14.90	1.41	14.97	-5.10	3.06	-1.67
STD. DEV.		0.241	7.591		1.572	1.294
VARIANCE		0.058	57.617		2.471	1.674

Appendix Table A64. Comparison of 30 minute vs 15 second sampling of velocities at bulkhead slot in turbine intake, Bonneville Second Powerhouse, Turbine 12B. Full Powerhouse loading.

		Elevation (MSL)	Y FPS	Z FPS	Elevation (MSL)	Y FPS	Z FPS
High Turbine Load							
30 min. sample	MAXIMUM		1.83	-1.00		12.84	1.90
	MINIMUM		1.10	-2.03		-4.37	-5.54
	RANGE		0.73	1.03		17.21	7.44
	AVERAGE	19.31	1.44	-1.49	-0.69	4.43	-1.88
	STD.DEV.		0.121	0.134		2.695	1.221
	VARIANCE		0.015	0.018		7.264	1.492
15 sec. sample	MAXIMUM		1.56	-1.34		7.23	-0.27
	MINIMUM		1.10	-1.66		-3.39	-4.64
	RANGE		0.46	0.32		10.62	4.37
	AVERAGE	19.17	1.38	-1.50	-0.83	3.48	-2.14
	STD.DEV.		0.084	0.085		3.474	1.071
	VARIANCE		0.007	0.007		12.071	1.147
Medium Turbine Load							
30 min. sample	MAXIMUM		1.59	-1.07		15.33	1.86
	MINIMUM		1.07	-1.90		-1.49	-6.35
	RANGE		0.52	0.83		16.82	8.21
	AVERAGE	19.20	1.33	-1.41	-0.80	5.00	-1.77
	STD.DEV.		0.084	0.119		2.105	1.092
	VARIANCE		0.007	0.014		4.774	1.191
15 sec. sample	MAXIMUM		1.54	-1.20		8.01	0.24
	MINIMUM		1.12	-1.64		1.22	-4.32
	RANGE		0.42	0.44		6.79	4.56
	AVERAGE	19.26	1.37	-1.34	-0.74	3.73	-1.29
	STD.DEV.		0.082	0.084		1.612	0.940
	VARIANCE		0.007	0.007		2.597	0.883
Low Turbine Load							
30 min. sample	MAXIMUM		7.03	49.98		8.42	3.44
	MINIMUM		5.88	-3.25		-3.64	-4.76
	RANGE		1.15	53.23		12.06	8.20
	AVERAGE	4.25	6.47	6.77	-15.75	2.26	-0.80
	STD.DEV.		0.175	10.654		1.836	1.239
	VARIANCE		0.031	113.502		3.370	1.535
15 sec. sample	MAXIMUM		6.71	49.98		2.76	0.90
	MINIMUM		5.88	-0.81		-2.17	-2.51
	RANGE		0.83	50.79		4.93	3.41
	AVERAGE	4.22	6.40	21.25	-15.78	-0.02	-1.08
	STD.DEV.		0.105	10.270		1.101	0.886
	VARIANCE		0.011	105.467		1.213	0.785

Appendix Table A65. Velocities 10 feet upstream and 1 foot upstream of trashracks of Turbine 12B at the Bonneville Second Powerhouse with no Submersible Travelling Screen in place.
Full powerhouse loading, High Turbine load.

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		1.51	8.42	5.13		-0.98	5.74	4.74
MINIMUM		-11.60	-3.74	-2.81		-6.69	2.61	-6.01
RANGE		13.11	12.16	7.93		5.71	3.13	10.74
AVERAGE	-14.21	-3.06	3.78	0.56	-16.21	-3.87	4.01	0.11
STD. DEV.		3.592	3.238	1.987		1.512	0.787	2.658
VARIANCE		12.903	10.485	3.948		2.286	0.619	7.066
MAXIMUM		2.83	8.33	7.79		2.08	6.52	2.47
MINIMUM		-10.67	-7.01	-5.62		-10.40	-0.29	-6.30
RANGE		13.50	15.33	13.40		12.48	6.81	8.76
AVERAGE	-11.95	-4.52	1.03	-0.31	-13.95	-4.17	3.75	-0.84
STD. DEV.		3.031	4.158	2.855		2.437	1.456	1.742
VARIANCE		9.189	17.289	8.152		5.941	2.120	3.036
MAXIMUM		2.56	7.79	2.76		0.05	7.01	1.66
MINIMUM		-12.04	-5.08	-7.98		-10.03	0.56	-6.10
RANGE		15.41	12.87	10.74		10.08	6.45	7.76
AVERAGE	-8.37	-4.08	1.41	-1.89	-10.37	-4.87	3.48	-2.52
STD. DEV.		3.325	3.319	2.366		2.337	1.116	1.934
VARIANCE		11.058	11.015	5.598		5.461	1.246	3.738
MAXIMUM		3.22	11.69	-0.02		15.38	16.04	13.45
MINIMUM		-12.45	-11.84	-4.93		-15.84	-9.69	-6.86
RANGE		15.67	23.54	4.91		31.23	25.73	20.31
AVERAGE	-2.63	-5.11	-1.00	-2.30	-4.63	-2.35	2.55	-2.15
STD. DEV.		2.774	4.719	1.346		4.557	4.144	4.505
VARIANCE		7.696	22.268	1.813		20.762	17.171	20.293
MAXIMUM		2.32	24.00	2.37		4.91	9.45	1.95
MINIMUM		-7.76	-7.01	-9.62		-9.23	-2.05	-5.37
RANGE		10.08	31.01	11.99		14.14	11.50	7.32
AVERAGE	3.34	-2.58	3.05	-2.20	1.34	-1.94	3.04	-2.37
STD. DEV.		2.309	7.244	2.415		3.995	2.494	1.828
VARIANCE		5.333	52.478	5.834		15.957	6.221	3.343
MAXIMUM		2.71	13.38	3.86		4.15	8.79	7.01
MINIMUM		-6.20	-10.67	-3.71		-10.52	0.59	-6.81
RANGE		8.91	24.05	7.57		14.67	8.20	13.82
AVERAGE	9.15	-2.29	0.78	-0.62	7.15	-3.39	3.69	0.28
STD. DEV.		2.442	6.234	1.563		2.841	1.766	3.228
VARIANCE		5.963	38.860	2.442		8.070	3.118	10.423

Appendix Table A65 - continued

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		4.96	15.19	2.59		11.57	9.77	6.81
MINIMUM		-14.79	-16.87	-7.25		-10.50	-1.90	-4.05
RANGE		19.75	32.06	9.84		22.07	11.67	10.86
AVERAGE	23.44	-3.05	0.51	-1.46	21.44	-0.72	3.59	1.18
STD. DEV.		5.235	7.943	2.135		4.121	2.409	2.797
VARIANCE		27.407	63.086	4.557		16.982	5.802	7.822
MAXIMUM		10.13	14.40	1.12		2.00	11.28	6.45
MINIMUM		-3.74	-3.56	-4.03		-7.40	-4.15	-1.17
RANGE		13.87	17.97	5.15		9.40	15.43	7.62
AVERAGE	29.34	-0.28	3.67	-1.49	27.34	-3.19	3.77	1.61
STD. DEV.		2.807	3.414	1.262		1.887	3.131	2.013
VARIANCE		7.801	11.654	1.594		3.562	9.801	4.052
MAXIMUM		2.59	10.35	14.89		4.20	16.28	5.47
MINIMUM		-5.91	-10.94	-13.70		-12.18	-0.34	-1.32
RANGE		8.50	21.29	28.59		16.38	16.63	6.79
AVERAGE	29.93	-2.06	1.92	-2.12	27.93	-2.69	11.70	1.97
STD. DEV.		2.087	3.315	4.443		2.028	2.121	1.097
VARIANCE		4.358	10.992	19.744		4.111	4.499	1.203
MAXIMUM		1.34	5.08	-2.10		-3.03	2.59	1.68
MINIMUM		-3.03	-3.81	-4.44		-5.59	-2.00	0.71
RANGE		4.37	8.89	2.34		2.56	4.59	0.98
AVERAGE	36.16	-1.35	0.67	-3.28	34.16	-4.45	1.17	1.24
STD. DEV.		0.914	2.435	0.744		0.610	0.997	0.232
VARIANCE		0.836	5.931	0.553		0.372	0.994	0.054
MAXIMUM		-1.44	5.27	-0.10		-4.27	8.89	3.56
MINIMUM		-4.32	0.07	-5.40		-7.45	-1.12	1.32
RANGE		2.88	5.20	5.30		3.17	10.01	2.25
AVERAGE	40.94	-2.76	2.35	-2.97	38.94	-6.24	4.82	2.64
STD. DEV.		0.795	1.508	1.599		0.981	2.983	0.557
VARIANCE		0.632	2.273	2.558		0.963	8.897	0.310
MAXIMUM		0.76	4.39	-0.24		-3.69	2.51	2.73
MINIMUM		-5.13	-1.66	-3.27		-7.98	-0.34	0.42
RANGE		5.88	6.05	3.03		4.30	2.86	2.32
AVERAGE	46.26	-2.36	1.53	-1.75	44.26	-5.79	1.13	1.65
STD. DEV.		1.606	1.618	0.773		0.959	0.686	0.617
VARIANCE		2.580	2.616	0.597		0.920	0.470	0.381

Appendix Table A65 - continued

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		0.24	7.23	-1.22		-5.64	0.78	1.44
MINIMUM		-5.13	0.61	-3.96		-7.45	-0.22	0.98
RANGE		5.37	6.62	2.73		1.81	1.00	0.46
AVERAGE	52.74	-2.39	3.13	-2.31	50.74	-6.24	0.27	1.25
STD. DEV.		1.423	1.403	0.805		0.494	0.260	0.104
VARIANCE		2.025	1.970	0.648		0.244	0.068	0.011
MAXIMUM		0.12	2.73	-2.47		-2.95	3.25	0.20
MINIMUM		-2.49	-3.86	-5.22		-4.57	1.25	-1.54
RANGE		2.61	6.59	2.76		1.61	2.00	1.73
AVERAGE	58.72	-0.92	0.27	-3.79	56.72	-3.77	1.99	-0.82
STD. DEV.		0.585	1.745	0.760		0.497	0.473	0.402
VARIANCE		0.343	3.046	0.577		0.247	0.224	0.161
MAXIMUM		-1.81	2.37	1.20		-4.69	2.61	2.66
MINIMUM		-6.32	-3.15	-1.10		-6.23	-0.02	-2.56
RANGE		4.52	5.52	2.29		1.54	2.64	5.22
AVERAGE	64.95	-3.33	0.84	-0.03	62.95	-5.55	1.49	0.58
STD. DEV.		1.367	1.416	0.533		0.445	0.612	1.601
VARIANCE		1.869	2.006	0.284		0.198	0.375	2.564

Appendix Table A66. Velocities 10 feet upstream and 1 foot upstream of trashracks of Turbine 12B at the Bonneville Second Powerhouse with no Submersible Travelling Screen in place.
Full powerhouse loading. Medium Turbine load.

	UPSTREAM	VELOCITY (in Ft/Sec)			DOWNSTREAM	VELOCITY (in Ft/Sec)		
	PROBE ELEV(MSL)	X FPS	Y FPS	Z FPS	PROBE ELEV(MSL)	X FPS	Y FPS	Z FPS
MAXIMUM		0.32	3.59	2.56		-1.25	3.71	4.86
MINIMUM		-4.20	-2.08	-3.88		-6.35	-0.61	0.90
RANGE		4.52	5.66	6.45		5.10	4.32	3.96
AVERAGE	-14.64	-2.21	0.46	-0.53	-16.64	-3.45	1.89	3.48
STD. DEV.		1.066	1.091	1.172		1.086	0.923	0.926
VARIANCE		1.137	1.190	1.374		1.179	0.852	0.857
MAXIMUM		0.90	2.81	0.51		1.64	3.22	3.61
MINIMUM		-5.76	-0.17	-3.27		-4.71	0.07	1.90
RANGE		6.67	2.98	3.78		6.35	3.15	1.71
AVERAGE	-14.54	-2.48	1.21	-1.42	-16.54	-1.64	1.91	2.75
STD. DEV.		1.747	0.666	0.953		1.265	0.683	0.427
VARIANCE		3.053	0.443	0.908		1.600	0.467	0.182
MAXIMUM		1.03	2.98	2.91		-1.27	2.51	5.08
MINIMUM		-2.51	-0.22	-3.86		-6.27	0.66	-0.85
RANGE		4.35	3.20	6.76		5.00	1.86	5.93
AVERAGE	-9.17	-0.19	1.37	-0.71	-11.17	-2.57	1.88	1.65
STD. DEV.		1.154	0.797	1.437		1.414	0.372	1.708
VARIANCE		1.331	0.636	2.064		1.999	0.138	2.917
MAXIMUM		2.51	4.93	0.73		-0.51	3.39	2.95
MINIMUM		-0.83	2.32	-3.74		-4.22	1.78	0.39
RANGE		3.34	2.61	4.47		3.71	1.61	2.56
AVERAGE	-3.11	0.76	3.51	-1.52	-5.11	-2.83	2.55	1.81
STD. DEV.		0.753	0.580	1.063		0.982	0.439	0.563
VARIANCE		0.566	0.337	1.131		0.964	0.193	0.317
MAXIMUM		1.98	6.18	-1.49		-1.05	1.93	3.76
MINIMUM		-1.93	2.42	-3.69		-4.79	0.59	-0.95
RANGE		3.91	3.76	2.20		3.74	1.34	4.71
AVERAGE	3.08	0.32	3.99	-2.58	1.08	-3.69	1.14	0.12
STD. DEV.		1.034	0.833	0.614		1.030	0.271	1.020
VARIANCE		1.068	0.694	0.377		1.061	0.074	1.041
MAXIMUM		1.25	4.44	-0.66		-0.49	1.98	3.54
MINIMUM		-2.00	2.03	-5.05		-3.00	0.68	0.32
RANGE		3.25	2.42	4.39		2.51	1.29	3.22
AVERAGE	9.03	-0.94	3.17	-2.17	7.03	-2.13	1.28	1.64
STD. DEV.		0.585	0.598	1.243		0.543	0.262	0.747
VARIANCE		0.342	0.358	1.544		0.295	0.069	0.557

Appendix Table A66 - continued

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		3.39	5.44	-0.85		-0.34	2.08	2.51
MINIMUM		-2.12	-2.08	-1.71		-3.44	1.29	0.85
RANGE		5.52	7.52	0.85		3.10	0.78	1.66
AVERAGE	14.95	0.04	1.84	-1.26	12.95	-1.96	1.68	1.83
STD. DEV.		1.424	2.000	0.197		0.971	0.169	0.402
VARIANCE		2.027	4.001	0.039		0.942	0.028	0.162
MAXIMUM		3.27	4.03	0.34		-0.95	2.69	3.74
MINIMUM		-1.93	0.83	-2.27		-5.18	1.15	1.61
RANGE		5.20	3.20	2.61		4.22	1.54	2.12
AVERAGE	20.94	0.91	2.12	-1.41	18.94	-4.14	1.82	2.68
STD. DEV.		1.089	0.772	0.515		1.182	0.480	0.629
VARIANCE		1.186	0.597	0.265		1.398	0.231	0.395
MAXIMUM		2.32	7.84	0.44		-3.74	4.08	1.51
MINIMUM		-2.10	-0.22	-2.95		-5.03	2.44	0.56
RANGE		4.42	8.06	3.39		1.29	1.64	0.95
AVERAGE	27.28	-0.14	3.01	-2.00	25.28	-4.37	3.30	1.11
STD. DEV.		1.030	1.967	0.693		0.376	0.353	0.211
VARIANCE		1.060	3.868	0.480		0.142	0.124	0.044
MAXIMUM		2.83	7.37	1.73		-5.76	2.91	1.20
MINIMUM		-2.44	-2.20	-1.73		-6.42	1.86	0.22
RANGE		5.27	9.57	3.47		0.66	1.05	0.98
AVERAGE	33.42	0.52	3.58	-0.30	31.42	-6.07	2.36	0.84
STD. DEV.		1.304	2.855	0.785		0.143	0.224	0.241
VARIANCE		1.699	8.151	0.616		0.021	0.050	0.058
MAXIMUM		1.46	4.54	-1.29		-5.54	1.98	0.81
MINIMUM		-6.54	-0.63	-2.51		-6.47	1.25	-0.37
RANGE		8.01	5.18	1.22		0.93	0.73	1.17
AVERAGE	39.49	-1.69	2.09	-1.95	37.49	-6.02	1.64	0.21
STD. DEV.		2.556	1.440	0.331		0.178	0.144	0.297
VARIANCE		6.533	2.074	0.110		0.032	0.021	0.088
MAXIMUM		3.25	4.71	-0.83		-5.03	0.83	0.42
MINIMUM		-0.61	-0.93	-3.22		-6.05	-0.93	-0.49
RANGE		3.86	5.64	2.39		1.03	1.76	0.90
AVERAGE	45.03	1.80	1.29	-1.05	43.03	-5.47	0.12	-0.09
STD. DEV.		0.835	1.488	0.537		0.275	0.454	0.178
VARIANCE		0.697	2.215	0.288		0.076	0.207	0.032

Appendix Table A66 - continued

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		1.12	6.52	-0.61		-4.52	1.90	1.03
MINIMUM		-1.78	0.42	-1.78		-5.98	-0.24	-0.66
RANGE		2.91	6.10	1.17		1.46	2.15	1.68
AVERAGE	45.35	-0.51	3.15	-1.19	43.35	-5.30	0.63	0.25
STD. DEV.		0.853	1.260	0.301		0.458	0.437	0.384
VARIANCE		0.728	1.587	0.091		0.210	0.191	0.147
MAXIMUM		4.61	5.52	0.15		-3.86	0.02	2.32
MINIMUM		1.39	0.05	-1.29		-5.22	-0.08	1.27
RANGE		3.22	5.47	1.44		1.37	0.90	1.05
AVERAGE	57.14	2.85	2.70	-0.63	55.14	-4.56	-0.33	1.75
STD. DEV.		0.802	1.290	0.328		0.349	0.204	0.225
VARIANCE		0.643	1.665	0.108		0.122	0.042	0.051
MAXIMUM		1.34	4.47	0.66		-3.52	-0.02	1.27
MINIMUM		-1.34	0.78	-0.90		-4.61	-1.17	0.10
RANGE		2.69	3.69	1.56		1.10	1.15	1.17
AVERAGE	67.20	-0.02	2.10	-0.12	65.20	-4.09	-0.51	0.67
STD. DEV.		0.609	0.981	0.296		0.288	0.286	0.281
VARIANCE		0.371	0.963	0.087		0.083	0.082	0.079
MAXIMUM		0.78	1.64	0.68		-2.81	-1.03	1.25
MINIMUM		-6.18	-1.51	-1.25		-4.15	-2.64	0.29
RANGE		6.96	3.15	1.93		1.34	1.61	0.95
AVERAGE	71.01	-3.32	0.28	-0.18	69.01	-3.41	-1.62	0.81
STD. DEV.		1.852	0.953	0.457		0.289	0.377	0.253
VARIANCE		3.431	0.907	0.209		0.084	0.142	0.064

Appendix Table A67. Comparison of 30 minute vs 15 second samples of velocities 10 feet upstream and 1 foot upstream of trashracks of Turbine 12B at the Bonneville Second Powerhouse with no Submersible Travelling Screen in place. Full powerhouse loading.

UPSTREAM		VELOCITY (in Ft/Sec)			DOWNSTREAM		VELOCITY (in Ft/Sec)		
		PROBE	X	Y	Z	PROBE	X	Y	Z
		ELEV(MSL)	FPS	FPS	FPS	ELEV(MSL)	FPS	FPS	FPS
High Turbine Load									
30 min. sample	MAXIMUM		7.60	17.30	14.90		4.20	16.30	9.10
	MINIMUM		-16.30	-12.30	-17.70		-12.20	-4.00	-4.70
	RANGE		23.90	29.60	32.60		16.40	20.30	13.80
	AVERAGE	30.03	-1.59	2.42	-2.14	28.03	-3.18	6.05	1.95
	STD.DEV.		1.773	2.590	1.945		1.644	3.712	1.282
	VARIANCE		3.142	6.707	3.784		2.704	13.776	1.644
15 sec. sample	MAXIMUM		2.60	10.40	8.30		4.20	16.30	4.40
	MINIMUM		-5.90	-4.30	-13.70		-4.80	10.60	0.50
	RANGE		8.50	14.70	22.00		9.00	5.70	3.90
	AVERAGE	29.87	-2.12	1.90	-2.33	27.97	-2.21	12.14	1.97
	STD.DEV.		2.173	3.012	3.771		1.548	0.977	0.946
	VARIANCE		4.721	9.073	14.219		2.396	0.955	0.895
Medium Turbine Load									
30 min. sample	MAXIMUM		3.50	10.20	1.80		0.50	3.80	4.20
	MINIMUM		-5.90	-5.70	-7.80		-6.00	0.30	-0.10
	RANGE		9.40	15.90	9.60		6.50	3.50	4.30
	AVERAGE	21.07	-1.56	2.35	-1.50	19.07	-3.16	2.13	1.80
	STD.DEV.		1.450	1.858	0.857		1.114	0.371	0.613
	VARIANCE		2.103	3.454	0.734		1.241	0.137	0.376
15 sec. sample	MAXIMUM		3.30	4.00	-0.80		-3.90	2.70	3.50
	MINIMUM		-0.80	0.80	-2.30		-5.20	1.10	1.60
	RANGE		4.10	3.20	1.50		1.30	1.60	1.90
	AVERAGE	20.99	1.15	2.17	-1.59	18.99	-4.65	1.78	2.53
	STD.DEV.		0.961	0.781	0.354		0.407	0.513	0.575
	VARIANCE		0.924	0.611	0.125		0.166	0.263	0.330

Appendix Table A68. Velocities 10 feet upstream and 1 foot upstream of trashracks of Turbine 12B at the Bonneville Second Powerhouse with ceiling extension in place. Partial powerhouse loading. High Turbine load.

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		0.37	3.93	0.93		0.07	3.03	-1.34
MINIMUM		-3.59	-0.15	-1.73		-2.66	-0.10	-3.34
RANGE		3.96	4.08	2.66		2.73	3.13	2.00
AVERAGE	-5.42	-0.06	1.93	-0.40	-7.42	-1.24	1.74	-2.22
STD.DEV.		0.925	0.911	0.682		0.907	0.707	0.497
VARIANCE		0.856	0.830	0.465		0.823	0.500	0.247
MAXIMUM		0.17	5.22	-0.37		-1.86	7.64	-0.05
MINIMUM		-2.22	0.71	-2.17		-3.91	2.54	-2.98
RANGE		2.39	4.52	1.81		2.05	5.10	2.93
AVERAGE	-0.28	-1.05	3.05	-1.13	-2.28	-3.09	5.38	-1.69
STD.DEV.		0.529	0.994	0.393		0.502	1.228	0.924
VARIANCE		0.279	0.988	0.155		0.252	1.508	0.854
MAXIMUM		0.17	5.79	-0.95		-0.10	4.52	-2.66
MINIMUM		-3.30	-3.30	-2.71		-2.00	0.17	-4.00
RANGE		3.47	9.08	1.76		1.90	4.35	1.34
AVERAGE	7.81	-1.93	0.57	-1.05	5.81	-1.29	2.38	-3.36
STD.DEV.		0.773	2.017	0.399		0.438	1.084	0.312
VARIANCE		0.597	4.070	0.159		0.192	1.175	0.097
MAXIMUM		-2.64	2.91	-1.22		-2.61	9.30	-0.66
MINIMUM		-5.49	-4.96	-4.39		-6.13	2.91	-3.25
RANGE		2.86	7.86	3.17		3.52	6.40	2.59
AVERAGE	15.61	-4.21	-1.35	-2.44	13.61	-4.30	5.88	-2.02
STD.DEV.		0.827	1.846	0.826		1.002	2.069	0.724
VARIANCE		0.683	3.407	0.682		1.005	4.282	0.524
MAXIMUM		0.51	5.13	0.24		-0.98	5.71	-1.93
MINIMUM		-1.20	1.61	-2.37		-2.49	2.93	-3.30
RANGE		1.71	3.52	2.61		1.51	2.78	1.37
AVERAGE	19.29	-0.73	2.96	-0.79	17.29	-1.83	4.03	-2.48
STD.DEV.		0.357	1.030	0.646		0.395	0.809	0.335
VARIANCE		0.128	1.060	0.417		0.156	0.654	0.113

Appendix Table A6B - continued

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		-1.54	3.22	-0.66		-2.10	3.39	-2.12
MINIMUM		-2.42	1.73	-4.27		-2.88	2.59	-2.69
RANGE		0.88	1.49	3.61		0.78	0.81	0.56
AVERAGE	25.18	-1.94	2.51	-2.62	23.18	-2.44	2.99	-2.39
STD.DEV.		0.225	0.320	0.872		0.154	0.169	0.154
VARIANCE		0.050	0.102	0.760		0.024	0.029	0.024
MAXIMUM		0.05	3.34	-2.29		-0.07	3.15	-2.22
MINIMUM		-0.90	2.39	-3.30		-1.49	2.17	-2.76
RANGE		0.95	0.95	1.00		1.42	0.98	0.54
AVERAGE	31.24	-0.44	2.92	-2.67	29.24	-0.68	2.70	-2.42
STD.DEV.		0.244	0.232	0.218		0.389	0.280	0.113
VARIANCE		0.059	0.054	0.048		0.152	0.079	0.013

Appendix Table A69. Velocities 10 feet upstream and 1 foot upstream of trashracks of Turbine 12B at the Bonneville Second Powerhouse with ceiling extension in place. Partial powerhouse loading. Medium Turbine load.

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		-0.17	4.66	1.32		-1.66	6.86	1.56
MINIMUM		-1.37	1.07	-0.27		-2.83	3.44	-1.00
RANGE		1.20	3.59	1.59		1.17	3.42	2.56
AVERAGE	-5.58	-0.63	3.05	0.57	-7.58	-2.26	4.91	0.41
STD. DEV.		0.318	0.961	0.324		0.363	1.201	0.661
VARIANCE		0.101	0.924	0.105		0.132	1.442	0.437
MAXIMUM		0.90	2.95	-0.17		0.93	4.57	-0.10
MINIMUM		0.32	1.95	-0.81		0.37	3.30	-0.88
RANGE		0.59	1.00	0.63		0.56	1.27	0.78
AVERAGE	-0.29	0.59	2.54	-0.47	-2.29	0.64	3.88	-0.49
STD. DEV.		0.142	0.229	0.115		0.121	0.295	0.161
VARIANCE		0.020	0.053	0.013		0.015	0.087	0.026
MAXIMUM		-0.27	3.47	0.59		-0.56	4.08	-2.22
MINIMUM		-1.27	0.22	-2.95		-2.34	1.93	-3.69
RANGE		1.00	3.25	3.54		1.78	2.15	1.46
AVERAGE	8.47	-0.84	2.08	-1.82	6.47	-1.39	3.15	-2.94
STD. DEV.		0.241	0.940	0.871		0.416	0.498	0.409
VARIANCE		0.058	0.884	0.758		0.173	0.248	0.167
MAXIMUM		-0.68	3.15	0.20		-0.93	3.66	-1.71
MINIMUM		-1.81	1.27	-3.78		-1.95	2.42	-4.22
RANGE		1.12	1.88	3.98		1.03	1.25	2.51
AVERAGE	14.80	-1.13	2.03	-0.94	12.80	-1.37	3.11	-2.77
STD. DEV.		0.293	0.563	0.723		0.246	0.353	0.495
VARIANCE		0.086	0.317	0.522		0.061	0.125	0.245
MAXIMUM		-0.68	3.08	-0.66		-0.81	4.15	-1.46
MINIMUM		-1.49	1.29	-2.47		-1.44	2.47	-3.61
RANGE		0.81	1.78	1.81		0.63	1.68	2.15
AVERAGE	18.22	-1.03	2.11	-1.51	16.22	-1.12	3.40	-2.75
STD. DEV.		0.191	0.495	0.417		0.146	0.436	0.528
VARIANCE		0.036	0.245	0.174		0.021	0.190	0.278

Appendix Table A69 - continued

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		-0.66	3.69	-0.63		-1.44	3.10	-1.83
MINIMUM		-2.12	1.64	-3.88		-2.15	2.08	-2.61
RANGE		1.46	2.05	3.25		0.71	1.03	0.78
AVERAGE	24.65	-1.35	2.40	-2.23	22.65	-1.80	2.58	-2.24
STD.DEV.		0.381	0.470	0.896		0.154	0.253	0.153
VARIANCE		0.145	0.221	0.802		0.024	0.064	0.023
MAXIMUM		-1.03	2.95	-0.37		-1.22	2.95	-1.32
MINIMUM		-1.61	1.29	-2.51		-1.68	2.37	-2.00
RANGE		0.59	1.66	2.15		0.46	0.59	0.68
AVERAGE	30.06	-1.23	2.26	-1.36	28.06	-1.42	2.60	-1.68
STD.DEV.		0.144	0.426	0.572		0.091	0.132	0.155
VARIANCE		0.021	0.182	0.327		0.008	0.018	0.024

Appendix Table A70. Velocities 10 feet upstream and 1 foot upstream of trashracks of Turbine 12B at the Bonneville Second Powerhouse with ceiling extensions in place. Partial powerhouse loading. Low turbine load.

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		0.42	2.54	-0.22		-0.02	4.52	-0.56
MINIMUM		-0.46	1.68	-1.56		-0.73	3.71	-1.51
RANGE		0.88	0.85	1.34		0.71	0.81	0.95
AVERAGE	-6.51	0.01	2.13	-0.75	-8.51	-0.34	4.22	-1.05
STD.DEV.		0.188	0.171	0.366		0.161	0.177	0.209
VARIANCE		0.035	0.029	0.134		0.026	0.031	0.044
MAXIMUM		1.44	3.10	-0.32		-0.20	3.69	-1.46
MINIMUM		0.39	1.95	-1.61		-1.10	2.81	-2.29
RANGE		1.05	1.15	1.29		0.90	0.88	0.83
AVERAGE	-0.86	0.91	2.48	-0.92	-2.86	-0.65	3.24	-1.90
STD.DEV.		0.226	0.264	0.394		0.240	0.174	0.189
VARIANCE		0.051	0.070	0.155		0.057	0.030	0.036
MAXIMUM		-0.17	2.47	-1.10		-0.51	2.76	-1.59
MINIMUM		-1.05	1.59	-1.81		-1.39	2.10	-2.44
RANGE		0.88	0.88	0.71		0.88	0.66	0.85
AVERAGE	8.02	-0.47	1.97	-1.42	6.02	-0.93	2.41	-1.93
STD.DEV.		0.186	0.245	0.131		0.216	0.137	0.150
VARIANCE		0.035	0.060	0.017		0.047	0.019	0.022
MAXIMUM		0.73	2.95	-1.10		-1.15	2.69	-1.73
MINIMUM		-0.51	1.29	-3.42		-1.93	1.78	-2.44
RANGE		1.25	1.66	2.32		0.78	0.90	0.71
AVERAGE	14.28	0.10	2.11	-2.22	12.28	-1.45	2.31	-2.10
STD.DEV.		0.258	0.411	0.498		0.184	0.218	0.179
VARIANCE		0.067	0.169	0.248		0.034	0.048	0.032
MAXIMUM		-0.05	3.25	-0.90		-1.10	3.03	-1.44
MINIMUM		-1.22	1.66	-2.56		-1.59	2.29	-2.05
RANGE		1.17	1.59	1.66		0.49	0.73	0.61
AVERAGE	18.06	-0.44	2.62	-1.77	16.06	-1.31	2.72	-1.77
STD.DEV.		0.217	0.390	0.467		0.102	0.190	0.106
VARIANCE		0.047	0.152	0.218		0.010	0.036	0.011
MAXIMUM		-0.12	2.47	-1.15		-0.46	2.66	-1.22
MINIMUM		-0.85	1.86	-2.98		-0.98	2.03	-1.78
RANGE		0.73	0.61	1.83		0.51	0.63	0.56
AVERAGE	23.83	-0.42	2.14	-2.09	21.83	-0.67	2.39	-1.46
STD.DEV.		0.138	0.146	0.449		0.109	0.128	0.118
VARIANCE		0.019	0.021	0.201		0.012	0.016	0.014

Appendix Table 70 - continued

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		-0.27	2.73	-0.81		-0.66	2.20	-1.29
MINIMUM		-1.07	1.15	-1.86		-1.20	1.59	-1.86
RANGE		0.81	1.59	1.05		0.54	0.61	0.56
AVERAGE	29.98	-0.61	1.93	-1.27	27.98	-0.93	1.95	-1.57
STD. DEV.		0.204	0.345	0.257		0.085	0.122	0.124
VARIANCE		0.042	0.119	0.066		0.007	0.015	0.015

Appendix Table A71. Velocities 10 feet upstream and 1 foot upstream of trashracks of Turbine 15B at the Bonneville Second Powerhouse. Full powerhouse loading. High Turbine load.

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)			DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS		X FPS	Y FPS	Z FPS
MAXIMUM		1.60	4.70	-0.40		0.80	8.80	0.40
MINIMUM		-3.20	-0.30	-3.90		-3.60	-0.90	-2.90
RANGE		4.80	5.00	3.50		4.40	9.70	3.30
AVERAGE	-6.29	-0.60	2.05	-2.25	-8.29	-1.35	3.83	-1.39
STD.DEV.		1.277	0.972	0.694		1.058	1.956	0.819
VARIANCE		1.630	0.945	0.481		1.119	3.826	0.670
MAXIMUM		1.10	4.70	0.70		0.00	8.30	2.90
MINIMUM		-3.60	-0.90	-3.90		-3.20	-0.40	-2.90
RANGE		4.70	5.60	4.60		3.20	8.70	5.80
AVERAGE	0.80	-1.66	0.96	-0.86	-1.20	-1.50	2.98	0.62
STD.DEV.		1.154	1.199	1.027		0.730	1.618	1.763
VARIANCE		1.331	1.437	1.054		0.533	2.619	3.110
MAXIMUM		2.80	5.20	-0.70		0.00	6.90	-0.90
MINIMUM		-2.40	-0.30	-3.90		-3.00	2.50	-2.90
RANGE		5.20	5.50	3.20		3.00	4.40	2.00
AVERAGE	2.04	0.25	2.83	-1.61	0.04	-1.53	4.26	-1.93
STD.DEV.		1.077	1.263	0.660		0.630	0.823	0.460
VARIANCE		1.159	1.594	0.436		0.397	0.677	0.212
MAXIMUM		1.10	5.10	-2.10		0.00	5.20	-1.60
MINIMUM		-2.50	-0.30	-3.90		-2.50	2.50	-3.20
RANGE		3.60	5.40	1.80		2.50	2.70	1.60
AVERAGE	5.23	-0.86	3.15	-2.57	3.23	-1.50	3.46	-2.36
STD.DEV.		0.822	1.173	0.259		0.460	0.631	0.356
VARIANCE		0.676	1.376	0.067		0.212	0.399	0.127
MAXIMUM		4.50	8.40	-2.10		0.00	4.80	-2.00
MINIMUM		-4.90	-0.90	-4.20		-2.20	1.80	-3.60
RANGE		9.40	9.30	2.10		2.20	3.00	1.60
AVERAGE	9.37	-0.30	3.48	-3.09	7.37	-0.85	3.10	-2.73
STD.DEV.		1.787	2.082	0.512		0.426	0.629	0.308
VARIANCE		3.195	4.334	0.262		0.182	0.395	0.095
MAXIMUM		1.10	4.10	-1.90		0.70	3.70	-2.00
MINIMUM		-1.50	1.50	-2.70		-1.90	1.00	-2.90
RANGE		2.60	2.60	0.80		2.60	2.70	0.90
AVERAGE	14.39	-0.55	2.60	-2.33	12.39	-0.98	2.59	-2.41
STD.DEV.		0.708	0.684	0.167		0.657	0.695	0.211
VARIANCE		0.502	0.468	0.028		0.432	0.484	0.045

Appendix Table 71 - continued

	UPSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)				DOWNSTREAM PROBE ELEV(MSL)	VELOCITY (in Ft/Sec)		
		X FPS	Y FPS	Z FPS			X FPS	Y FPS	Z FPS
MAXIMUM		-0.40	3.30	-2.00			-0.90	2.20	-2.60
MINIMUM		-2.60	1.20	-4.10			-1.90	1.40	-3.20
RANGE		2.20	2.10	2.10			1.00	0.80	0.60
AVERAGE	20.25	-1.17	2.23	-2.89		10.25	-1.38	1.86	-2.86
STD. DEV.		0.523	0.542	0.533			0.200	0.215	0.150
VARIANCE		0.274	0.294	0.284			0.040	0.046	0.022
MAXIMUM		-0.40	1.10	-2.40			0.00	0.70	-2.40
MINIMUM		-0.70	0.60	-3.60			-0.50	0.00	-2.80
RANGE		0.30	0.50	1.20			0.50	0.70	0.40
AVERAGE	38.66	-0.54	0.88	-2.97		36.66	-0.24	0.38	-2.61
STD. DEV.		0.078	0.128	0.264			0.102	0.174	0.097
VARIANCE		0.006	0.016	0.070			0.010	0.030	0.009
MAXIMUM		-0.30	0.90	-1.80			0.50	0.50	-1.80
MINIMUM		-0.70	0.60	-2.20			0.00	0.00	-2.10
RANGE		0.40	0.30	0.40			0.50	0.50	0.30
AVERAGE	44.93	-0.49	0.75	-2.02		42.93	0.27	0.20	-1.93
STD. DEV.		0.065	0.077	0.101			0.103	0.124	0.082
VARIANCE		0.004	0.006	0.010			0.011	0.015	0.007
MAXIMUM		-0.20	0.50	-1.40			0.10	-0.10	-0.90
MINIMUM		-0.80	0.10	-1.90			-0.60	-0.40	-1.40
RANGE		0.60	0.40	0.50			0.70	0.30	0.50
AVERAGE	51.39	-0.40	0.29	-1.65		49.39	-0.22	-0.24	-1.12
STD. DEV.		0.127	0.092	0.123			0.180	0.096	0.109
VARIANCE		0.016	0.008	0.015			0.033	0.009	0.012
MAXIMUM		-0.20	0.40	-1.00			-0.60	-0.30	-0.60
MINIMUM		-0.70	0.10	-1.20			-1.10	-0.70	-1.00
RANGE		0.50	0.30	0.20			0.50	0.40	0.40
AVERAGE	59.49	-0.41	0.23	-1.07		57.49	-0.87	-0.55	-0.73
STD. DEV.		0.109	0.090	0.059			0.101	0.079	0.094
VARIANCE		0.012	0.008	0.003			0.010	0.006	0.009

Appendix Table A72. Comparison of 30 minute vs 15 second samples of velocities 10 feet upstream and 1 foot upstream of trashracks of Turbine 15B at the Bonneville Second Powerhouse. Full powerhouse loading.

UPSTREAM		VELOCITY (in Ft/Sec)			DOWNSTREAM		VELOCITY (in Ft/Sec)		
PROBE		X	Y	Z	PROBE		X	Y	Z
ELEV(MSL)		FPS	FPS	FPS	ELEV(MSL)		FPS	FPS	FPS
High Turbine Load									
30 min. sample	MAXIMUM	9.40	11.60	0.60			1.20	6.10	-1.00
	MINIMUM	-7.20	-5.10	-9.50			-3.80	-0.10	-4.30
	RANGE	16.60	16.70	10.10			5.00	6.20	3.30
	AVERAGE	9.36	-0.47	2.64	7.36		-1.21	2.87	-2.53
	STD.DEV.		1.264	1.646			0.716	0.751	0.484
	VARIANCE		1.597	2.708			0.513	0.564	0.235
15 sec. sample	MAXIMUM		4.50	8.40			0.00	4.30	-2.30
	MINIMUM		-4.90	-0.90			-1.40	1.80	-3.60
	RANGE		9.40	9.30			1.40	2.50	1.30
	AVERAGE	9.37	-0.24	3.78	7.37		-0.78	3.01	-2.79
	STD.DEV.		1.948	2.124			0.344	0.612	0.294
	VARIANCE		3.794	4.509			0.118	0.375	0.087

APPENDIX B - EXCERPTS FROM HANER, ROSS, AND SPORSEEN REPORT

BONNEVILLE SECOND POWERHOUSE
FISH GUIDANCE RESEARCH
PROTOTYPE VELOCITY MAPPING PROGRAM

FINAL REPORT

FOR: PORTLAND DISTRICT
U.S. ARMY CORPS OF ENGINEERS
(Contract No. DACW57-84-D-0073)
W/O No. C003

June 1985
(Revised August 1985)

BY: HANER, ROSS & SPORSEEN, INC.
15 S.E. 82nd Drive
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PREFACE

This final report of the design of velocity measurement systems and of a velocity measurement test program for use at Bonneville second, Bonneville first, and McNary powerhouses was prepared by Haner, Ross & Sporseen, Inc., Engineers-Consultants, Gladstone, Oregon. The work was performed under Contract No. DACW57-84-D-0073, Work Order No. 0003. Peter M. Smith was the contractor project coordinator and Theodore D. Edmister was the Portland District, Corps of Engineers, point of contact.

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Appendices:

- A. Meter Systems
- B. Meter System Design Computations (detached)
- C. Manufacturer & Supplier Literature
- D. Electromagnetic Velocity Meter
- E. Assembly, Installation & Removal
- F. Test Program

BONNEVILLE SECOND POWERHOUSE
FISH GUIDANCE RESEARCH
PROTOTYPE VELOCITY MAPPING PROGRAM

SECTION 1

INTRODUCTION

1.01 THE REPORT. The design of apparatus to support velocity measurement meters and a velocity measurement test program for velocity mapping are presented in this report. The velocity mapping is to be done at Bonneville second powerhouse in the forebay and turbine intake area, principally in the vicinity of the submersible traveling screens (STS). This test program is a part of an overall investigation of the cause of low guidance efficiency of downstream migrant fish at that structure. For comparison, equivalent studies are to be conducted at the Bonneville first and McNary powerhouses, which have intakes and power units similar to those of the Bonneville second powerhouse and have apparent successful passage of downstream migrants.

1.02 PRELIMINARY REPORT. The design of the apparatus and development of the test program were preceded by studies of alternative systems of instrumentation and instrumentation support. Those studies were presented in a preliminary report in April 1985. The type of meter to be used, the support apparatus, and the areas to be mapped were selected from those alternatives by the Portland District.

SECTION 2

DESIGN OF METER SUPPORT SYSTEMS

2.01 DESIGN. Four meter support systems were designed for use in the test program. The systems, shown in Figure 1, will support meters in the forebay near the intake (Forebay System); in the intake at the upstream edge of the STS (Folding Frame System); at the bulkhead slot (Bulkhead Slot System); and inside the STS and in the three flow passages at the top of the STS (STS System). Each system will be adjustable for use at all three powerhouses. The systems were designed to be relatively easy and fast to operate and to require no assistance from powerhouse personnel or project lifting equipment during testing. The apparatus is to be lightweight for ease of handling but adequately strong to prevent failure and possible damage to the turbines. A minimum of modification of existing structures and a minimum use of the project hoists will be required.

2.02 DESIGN DETAILS. Fabrication drawings of the systems are in Appendix A. Calculations showing the loading assumptions and the structural and mechanical adequacy of the systems are in detached Appendix B. Manufacturer and supplier literature and specifications for equipment required in the systems are in Appendix C.

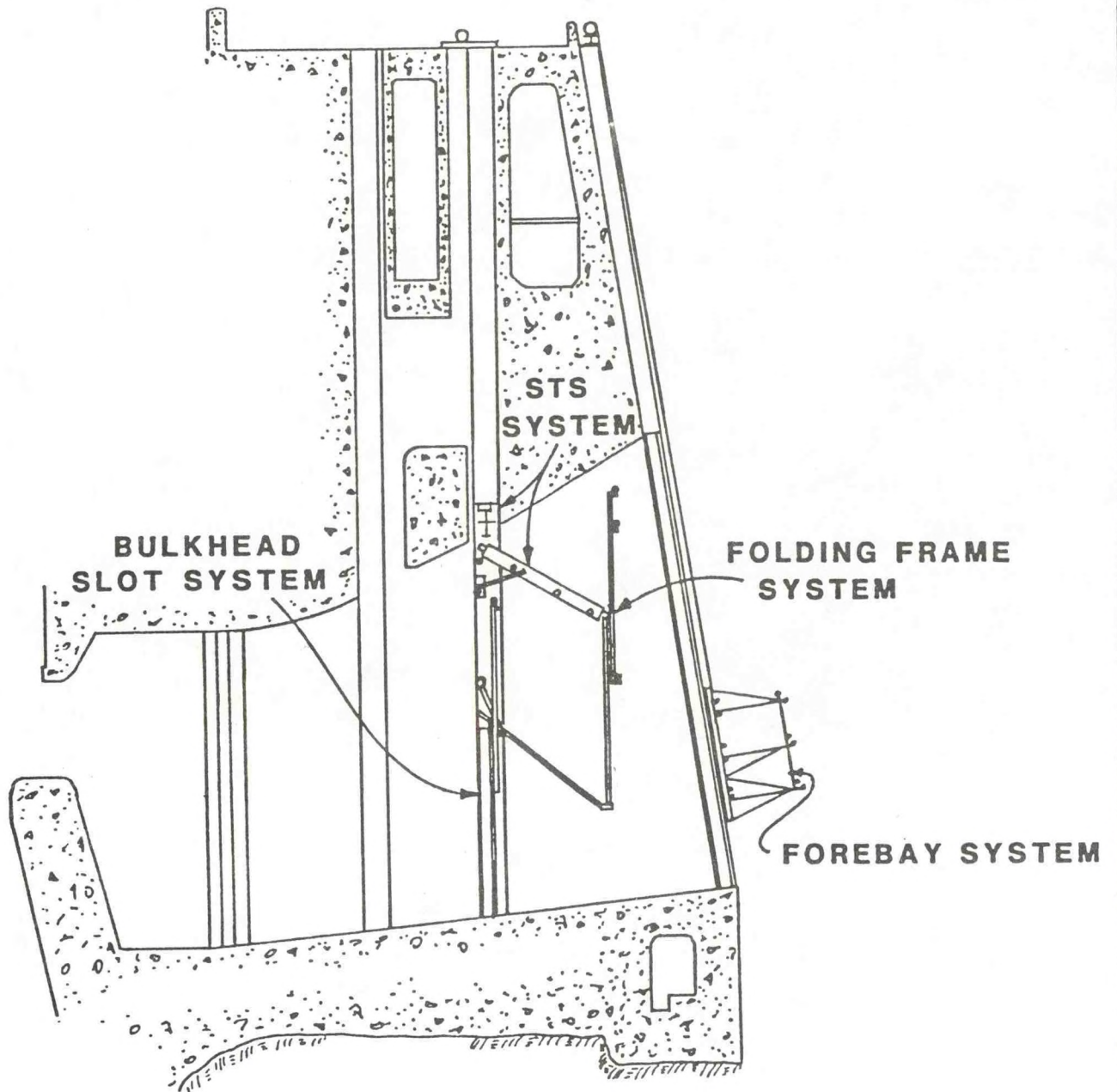


FIG 1



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METER SUPPORT
 SYSTEMS LOCATIONS

SECTION 3

INSTRUMENTATION

3.01 VELOCITY SENSORS. Electromagnetic velocity meters with the capability of measuring X & Y components of velocity within a plane were selected by the Portland District as the best velocity sensors for the proposed test program. The meters are sealed units with no moving parts and are relatively small. Two meters paired perpendicular to one another can measure X, Y, & Z components of velocity at a location. The Marsh-McBirney Model 511 meter or its equivalent has been recommended. With that meter the velocity magnitude of each component is indicated on a separate dial of a display instrument that is calibrated to the meter. The electrical signal from the meter can be recorded. Specifications of the Model 511 meter and an operating manual for it are in Appendix D.

Fifteen velocity meters with 200 feet of sensor cable will be required for the tests. One additional meter should be available as a replacement, if needed, during the tests. The model 511 meter can be leased, but only a small number are available. Coastal Leasing, Inc., 22-1 Peters Street, Cambridge, Massachusetts, 02139-4521 [telephone (617)497-1122] has five Model 511 meters to lease. The cost of leasing for two months is approximately 40 percent of the cost of the meter. With the anticipation that testing will occur in two or three separate periods of site availability during a period as great as six months, purchase rather than lease of the sixteen meters is recommended. The price of a meter with 200 feet of cable was quoted in June 1985 as \$4,345 plus shipping cost with a 5 percent discount for quantity purchase. The delivered cost per meter is estimated to be \$4,150. The price may be increased on July 1, 1985.

The electromagnetic meter is subject to interference from stray electrical currents but not to currents as small as those at the powerhouse. It is recommended, however, that an electromagnetic meter be tested in a powerhouse intake before purchasing one. The National Marine Fisheries Service in Portland has a Marsh-McBirney meter that might be borrowed for testing.

During testing the meter sensor cables must be secured to the support apparatus and connected to the display and recording equipment at the powerhouse deck level. Materials needed to secure the cables are listed in Appendix D. Recommended plans for securing the cables are presented in Appendix E. Costs of the materials are listed in Section 6.

3.02 DATA RECORDER. In one phase of the testing velocities are to be observed simultaneously over an extended period of time. Those data must be recorded relative to one another and to time. Use of two Portland District oscillographs operated by District personnel is recommended.

3.03 INSTRUMENTATION SHELTER. Recording equipment and velocity display instruments should be housed in a shelter that can be placed beside the bulkhead slot of the test bay and easily moved aside when the area is needed for use other than testing. A government van is recommended. Electrical power would be provided by project provided extension cord from the powerhouse.

SECTION 4

ON-SITE PREPARATION AND REMOVAL

4.01 PREPARATION. On-site preparation for testing consists of:

- a. At-project preparation by project personnel,
- b. Assembly of meter support systems by test personnel assisted by project personnel,
- c. Mounting of meters on support systems,
- d. Installation of support systems and STS by project personnel, and
- e. Connection of meters to display and recording equipment.

Care must be taken throughout this phase of the work to protect the velocity meters and cables from damage.

A detailed step-by-step description of the assembly and installation is tabulated in Appendix E.

4.02 REMOVAL. Removal of the test apparatus after testing and preparation of it for transport to the next test site or to storage will be the same as preparation but in the reverse order. Extreme care must again be taken to protect the meters and cables from damage while the STS and support apparatus are withdrawn from the intake. More detailed instructions are tabulated in Appendix E.

SECTION 5

TEST PROGRAM

5.01 PURPOSE. The purpose of the tests is to determine the velocity magnitude, the flow pattern, and any fluctuation of that pattern immediately upstream and within the Bonneville second powerhouse where fish guidance efficiency is low. For comparison, the same velocity tests are to be made at the Bonneville first and McNary powerhouse where guidance efficiency is adequate.

5.02 PLACE AND TIME. Velocity measurements are to be made at and in the center bay of the intake of a main power unit at Bonneville second, Bonneville first, and McNary powerhouses. Units 5 and 12 at Bonneville and unit 4 or 5 at McNary have been recommended as test sites because other fishery data have been collected there. The final selection, however, will have to be made later on the basis of availability at the time of testing and the relative importance of the velocity data to data collected at other power units.

The time of testing at each powerhouse must also be determined later. The time will be dependent upon the availability of the test units to be out of service and the availability of project personnel and hoisting equipment. The fall and winter periods when there is less construction and maintenance at the projects and less fish passage appear to be the best time. The time required to implement the program and fabricate the test apparatus will probably make early spring of 1986 the earliest possible time of testing.

5.03 MEASUREMENT LOCATIONS. Velocity measurements are to be made in a vertical plane parallel to the centerline of the unit 5 feet to the right of centerline. In the forebay at

the intake, velocities are to be measured at 6-foot intervals from the water surface to the bottom along lines parallel to the intake face 1 and 10 feet upstream from the trashracks. In the intake, velocities are to be measured at 2-foot intervals along a vertical line immediately upstream from the STS and at 5-foot intervals at the bulkhead slot. Three measurements will be made behind the perforated plate within the STS, and one measurement will be made in each of the three flow passages at the top of the STS. The location of the measurement points are shown on Figure F1 in Appendix F.

5.04 VELOCITY DATA. In the forebay, X, Y, & Z components of velocity will be measured to indicate the velocity magnitude and inclination from the horizontal in the principal plane of measurement and to indicate the lateral angle of the approach flow to the intake. Within the intake, X & Y components of velocity will be measured to indicate the magnitude and inclination of the flow. Instantaneous observations of velocities will be made at all locations. At a location further described in Appendix F an extended-time observation of velocities will be made to indicate any fluctuations in flow pattern with time. The data will be observed and recorded as scalar values of the velocity components and later reduced to the vector velocity in the plane of measurement.

5.05 TEST PROCEDURE. Details of the tests and test procedure are given in Appendix F.

TEST DETAILSSITE:

Center bay of selected main power units at Bonneville II, Bonneville I, and McNary powerhouses.

TEST CONDITIONS:

Three power unit settings that are reasonable operating conditions having a high, medium, and low discharge.

MEASUREMENT LOCATIONS:

At all sites, in a vertical plane parallel to and 5 feet north of the bay centerline at points shown in Figure F1. The number of points to be measured in the forebay will vary from site to site relative to the depth of the intake sill. Accumulated trash at the bottom of the trash racks at McNary and possibly at Bonneville I will create a false bottom below which measurements cannot be made in the forebay.

MEASUREMENT DEVICES:

Electromagnetic velocity sensors with the capability of measuring X & Y components of velocity in the plane of orientation. In the forebay a pair of meters set perpendicular to one another will indicate the X, Y, & Z components of velocity. Within the intake single meters will be used.

DATA TO BE OBSERVED:

Pool elevation
Tailwater elevation
Water temperature
Power unit setting - output, efficiency, discharge
Location of meters at time of observation
Time of observation
X & Y (Z) components of velocity

DATA RECORD:

Visual readout and hand recording of velocity components indicated on dial displays. Each observation to be made for approximately 15 seconds (instantaneous). During extended-time observations, visual readout of each meter every 5 minutes.

Oscillographic recording of all observations (instantaneous and extended time).

CALIBRATION:

Velocity sensors are factory calibrated with the dial displays to which they are coupled.

Oscillographic record will be calibrated with visual readout data.

METER LOCATIONS:

Location of fixed meters and movable meters in their lowest positions can be determined from fabrication drawings of meter systems and construction drawings of unit being tested. Other positions of movable meters relative to the lowest positions will be determined by marks on the hoist ropes of those meters.

TEST PROCEDURE

1. Set all movable meters at the lowest positions.
2. Read and record distance indicated by marks on the hoist ropes of the movable meters. Pick a convenient spot on the hoist assembly for reference.
3. Allow sufficient time for flow in intake to stabilize after a change of turbine setting.
4. Make instantaneous visual and oscillographic readings of all meters. Repeat readings with forebay meters moved upward 6 feet and folding frame meters moved upward 2 feet. Step by step, repeat readings with only forebay meters moved upward in 6-foot increments to the seventh position, which will align the meters close to the thread of flow past the STS.
5. With the last position of step 4 make an extended-time observation of 30 minutes.
6. Next, move all three sets of movable meters upward step by step as indicated in Figure F1 through the full range of settings for each set. Make instantaneous readings at each setting.
7. Change turbine setting to next test condition and repeat steps 1 to 6.

DATA REDUCTION

1. Resolve each visually observed pair of X & Y components to a vector velocity as instructed in meter operating manual.
2. Plot the vectors computed in step 1 on cross sections of the intake for each turbine setting (cross section parallel to bay centerline and cross section perpendicular to centerline in forebay).
3. With values of visual readout for calibration, reduce oscillographic record of extended-time test of all meters to magnitudes of X & Y components. If significant velocity variation occurred with time, resolve X & Y components at one-minute intervals and at maximum and minimum component magnitudes to vector velocities.
4. If data in step 3 has been resolved to vectors, plot vector magnitudes and angles from horizontal against time.

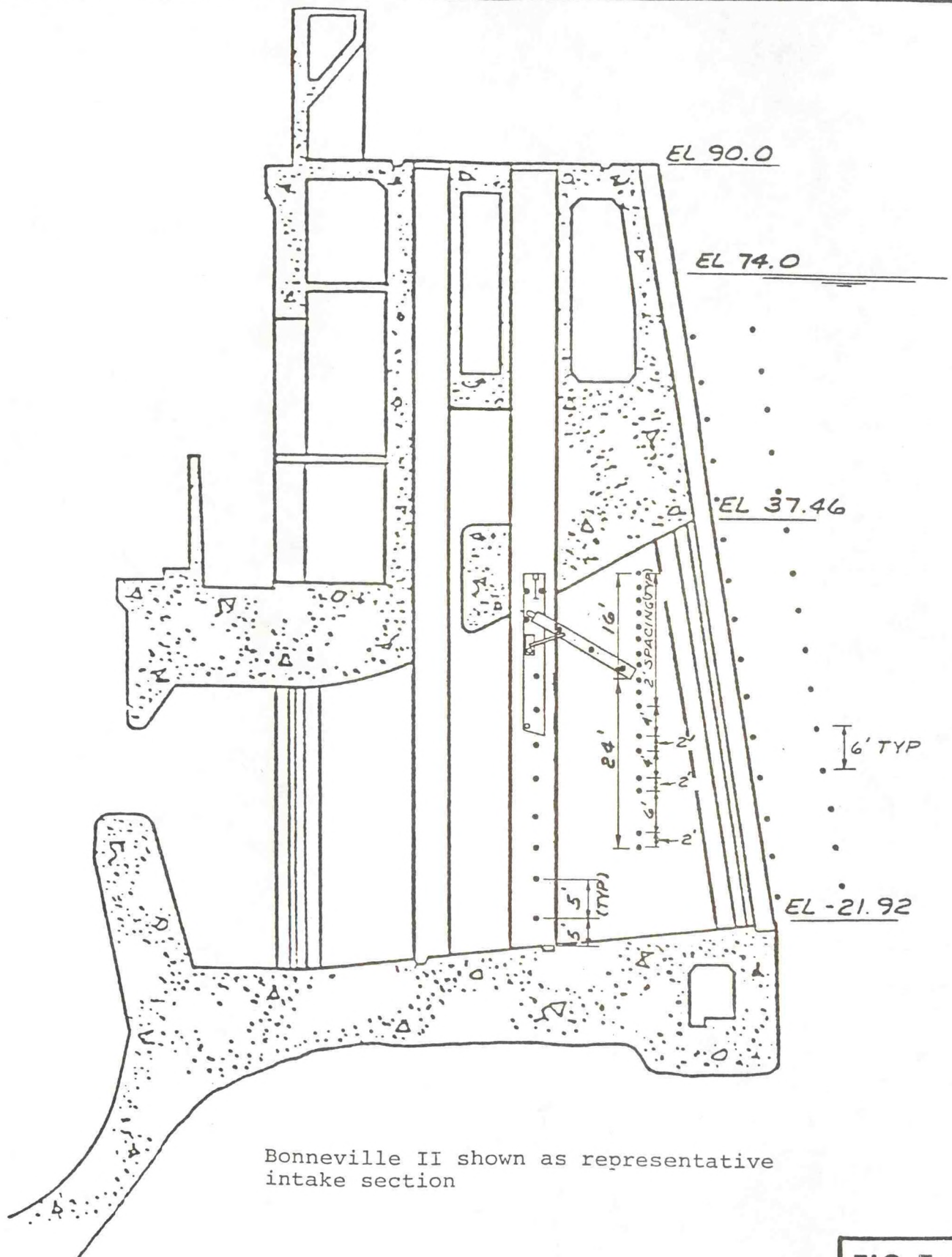


FIG F-1



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MEASUREMENT POINTS