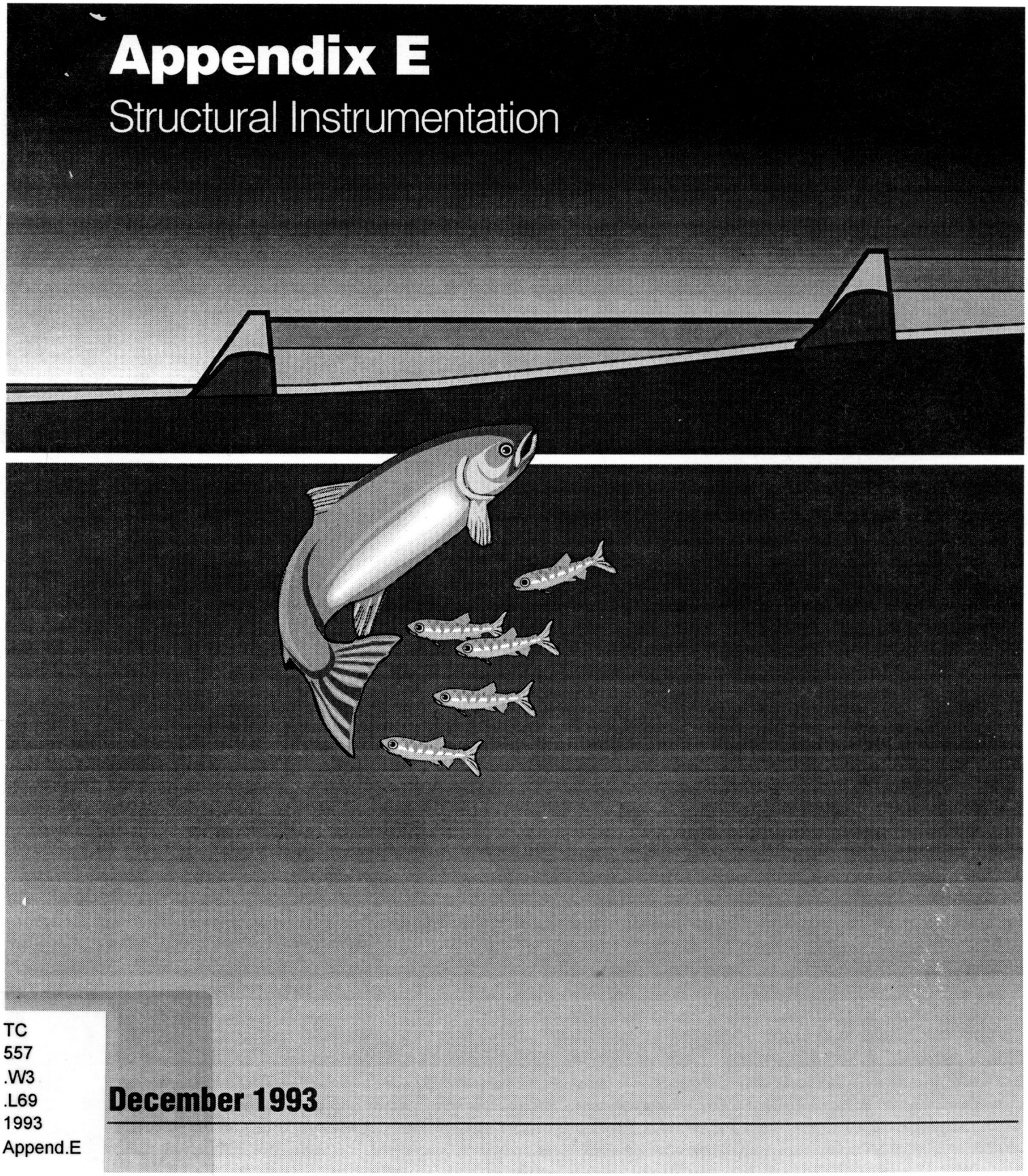
US Army Corps
of Engineers
Walla Walla District

1992 Reservoir Drawdown Test

Lower Granite and Little Goose Dams

Appendix E

Structural Instrumentation



TC
557
.W3
.L69
1993
Append.E

December 1993

APPENDIX E

STRUCTURAL INSTRUMENTATION

1992 Reservoir Drawdown Test

Lower Granite and Little Goose Dams

Robert Berger
Walla Walla District
U.S. Army Corps of Engineers

APPENDIX E

1992 DRAWDOWN TEST

LITTLE GOOSE AND LOWER GRANITE DAMS

STRUCTURAL INSTRUMENTATION

Robert M. Berger
U.S. Army Corps of Engineers
Walla Walla District
December 1993

1992 DRAWDOWN TEST
LITTLE GOOSE AND LOWER GRANITE DAMS
STRUCTURAL INSTRUMENTATION

1. INTRODUCTION.

In accordance with recommendations contained in the draft Options Analysis Document/Environmental Impact Statement for the Columbia River Salmon Flow Measures, a test drawdown of Little Goose and Lower Granite Reservoirs was conducted during the period of 1 to 31 March 1992.

The structural monitoring of Little Goose and Lower Granite Lock and Dam was established prior to the drawdown and discussed in Addendum A, Engineering Division - Surveillance Plan as provided in the Lower Snake Reservoir Drawdown Test Plan, March 1992 (Appendix S). The instrumentation data to be discussed in this after action report on the test drawdown is for "Group 3 - Concrete Structural Instrumentation" as described in that Addendum. The condition created by lowering Lower Granite and Little Goose reservoirs was determined to be of no structural significance and would not adversely affect the stability of either project. A recommendation was made that the tailwater at Lower Granite, which is created by the back water from Little Goose reservoir, be raised before or simultaneously with the re-impoundment of Lower Granite reservoir. Data from existing dam safety instrumentation is collected, processed, and evaluated on a monthly basis, except for precise level and trilateration survey data which are collected every two years, alternating with precise levels being performed one year and trilateration the next.

2. STRUCTURAL INSTRUMENTATION AND MONITORING SCHEDULE.

Precise Levels

Both projects had precise level surveys performed before and after the drawdown. The surveys were performed across the concrete structures taking elevations from brass caps embedded in the roadway deck of selected concrete monoliths. The surveys were completed by Corps surveys crews and were a first-order class II accuracy. The equipment used was a Zeiss Ni 1 Micrometer level and two matching Zeiss/Oberkochen 3 meter invar rods with stabilizers. Standards and tolerances are set using NOAA Manual NOS NGS 3 on Geodetic Leveling, August 1981. The precise level survey performed before the drawdown was a scheduled survey according to the two year cycle, the precise level survey performed after the drawdown was an extension of the surveys being accomplished on the embankments. The information provides background data on vertical control of the project, but was not

considered essential.

A plan view of Lower Granite Dam, information on survey point locations, settlement data, and plots of settlement data for the before and after survey as compared to each other; and to the base line of 1976 with other selected dates, is provided in Appendix E-1. The same information for Little Goose is provide in Appendix E-2.

Little Goose

The drawdown of the Little Goose reservoir was to occur over a two-week period with a maximum drawdown depth of approximately 15 feet. A decision was made not to monitor any instrumentation systems other than the normal monthly instrumentation readings during the drawdown test for the concrete structures. These scheduled readings are generally taken during the first week of each month. The drawdown provided an opportunity and a method to verify the reliability of data being collected from an observation hole, located in the central non-overflow monolith. This hole was drilled to a base elevation of 358 from elevation 651, the structures roadway deck, to monitor artesian flow in a aquifer below the dam's foundation. The drill hole was left open and the data became suspect as possibly being reactive to the forebay. The data shown in Appendix E-4 indicate that the data may indeed be subject to the forebay. From the information gathered during the drawdown of the Little Goose reservoir, this instrument, will be dropped until the zone of influence is identified and the hole sealed from other water sources. Specific instruments selected to be read at Little Goose Project during the drawdown are shown in Appendix E-3. The piezometers indicated on this sheet are discussed elsewhere.

Lower Granite

The drawdown of Lower Granite reservoir was to occur over a 31-day period and the maximum depth of drawdown was to be approximately 32 feet, based on inflow. It was decided, at Lower Granite, to monitor selected instruments located in powerhouse bay 2 and 3, spillway bay 4, the central non-overflow, and navigation lock monolith 22. Readings were to be taken at the end of February, the middle of March, and the first of April. The February and April readings were to be the normal monthly readings. The March readings were to be from selected instruments which are listed in Appendix E-5. Again the piezometer data shown in Appendix E-5 are discussed elsewhere. Two uplift meters, one located under powerhouse bay 2 intake and one in powerhouse bay 3 intake, were hard-wired to a data logger to record data every four hours as well as being read mid-March. In powerhouse bay 2 that instrument was PF22 and under powerhouse bay 3 it was instrument PF33.

Individual instruments or instruments group selected to be

monitored were grouped as follows: in powerhouse bay 2 and 3, uplift pressure transducers and deformation meters were monitored; in spillway bay 4 closed cell uplift meters were monitored; in the navigation lock monolith 22 uplift pressure transducers were monitored; and two crack meters were monitored in the central non-overflow. In addition to these instruments flow meters were set up in the drainage and grouting gallery to monitor any changes in drainage flow. The primary cause for any detectable changes in data for the instruments being monitored during the drawdown would be the decrease or increase in reservoirs levels. Because of this the tailwater and forebay were closely monitored at both projects. Plan and section views for some of the instruments, including time history plots and actual data, are located in the appendices. A plan and section view of powerhouse bay 3 is not shown in Appendix E-7, but is similar to the ones presented for powerhouse bay 2. The location of instrument number PF31 for bay 3 is the same as for PF21 in bay 2 and so on. There are no corresponding uplift transducers in bay 3 monitoring uplift under the draft tube area as in bay 2.

3. INSTRUMENTATION REACTION TO DRAWDOWN.

Precise Level Surveys

The surveys that were performed and the data presented here, are for information only, and should not be analyzed as direct physical response or movement due to change in reservoir level. There are many factors that may cause a change in elevation. One factor is the survey itself which includes the survey crew, instrument person, the accuracy of the equipment, and the survey method used. The accepted accuracy for a first order, class II precise level survey is plus or minus 0.005 of a foot. Another major factor in vertical control for concrete structures is thermal expansion and contraction of the concrete structure due to ambient air or water temperatures. Survey data will generally oscillate around a specific elevation depending on the time of year and reservoir levels. Settlement data is most often presented as a random pattern of data points which can be evaluated using a statistical approach for concrete structures. Settlement may be apparent in concrete structures due to creep or shrinkage of the concrete over many decades or due to initial settlement of the foundation during construction, but short-term settlement on an existing project would be difficult to evaluate unless multiple surveys were taken and some data points fell outside the standard deviation using mean elevations.

The maximum differential settlement at Lower Granite was 0.011 feet as computed between the surveys on 0 5-15-92 and 02-14-92. The location of these changes occurred in several powerhouse bays. The maximum differential settlement at Little Goose was 0.022 feet as computed between the surveys accomplished on 05-30-92 and 01-30-92. The maximum differential settlement again has occurred in the powerhouse bay. The

interpretation of this data relating to the drawdown should be avoided and should be accepted as seasonal fluctuation due to temperatures changes in the concrete mass.

Little Goose

Except for the observation hole in the central non-overflow monolith no other instruments were monitored. There is a definite correlation between the forebay elevation and the static water level in this instrument hole. The monitoring of this instrument has been discontinued until the zone of influence can be isolated.

Lower Granite

Data collected from selected instruments under powerhouse bay 2 are located in Appendix E-6. The data proved to be inconclusive for uplift pressure transducers under the powerhouse intake. The monitoring was not continuous and the reactivity or lag in each instruments is not known. Three uplift pressure transducers PF28, PF29, and PF30 located under the draft tube slab did indicate up to a 10-foot drop in pressure and was assumed, due to their proximity to the tailrace, to be under the influence of tailwater elevations. The deformation meters being monitored under the foundation were also inconclusive. The data from PF22 data logger were determined to be in error, due to a large difference in ratio readings as compared to normal monthly readings and the mid-monthly readings, and was not used.

Data collected from selected instruments under powerhouse bay 3 are located in Appendix G. The data looked similar to information collected in powerhouse bay 2, except there are no uplift pressure transducers under the draft tube of bay 3. The information from the data collector hooked up to meter PF33 is included, but does not indicate any drop in uplift measurement due to a drop in the forebay.

Data collected from instruments under spillway bay 4 are located in Appendix E-8. The closed cell piezometers did react to the drawdown, but because there was only one set of readings it was difficult to determine which reservoir drawdown created the desired effect, Little Goose or Lower Granite. It is assumed that the two piped uplift cells P41 and P42 are influenced by the forebay and P43 through P55 were influenced by tailwater.

Data collected from uplift pressure transducers under navigation lock monolith 22 are presented in Appendix E-9. The data indicate the lowering of the tailwater at Lower Granite did reduce uplift measured under the structure.

Data collected on two crack meters located in the central

non-overflow drainage and grouting gallery did not indicate any changes. Information can be found in Appendix E-10. The crack meters were monitored, due to the crack's location and shape of the monolith and the fact that the crack is parallel to the axis of the dam. It was thought that if there was any rebound of the foundation, due to reduced water load, either upstream or downstream, the cracks might indicate some activity, but none was apparent.

Drainage flow was monitored before, during, and after the drawdown in the drainage and grouting gallery. Weirs and flumes installed in the drainage and grouting gallery were operational just prior to the drawdown and have become a permanent part of the project dam safety monitoring. Forebay and tailwater data along with drainage flows are presented in Appendix E-11. It was anticipated that there would be an increase in flow rates after the re-impoundment of Lower Granite reservoir, but that was not apparent. When the navigation lock is left full for more than an hour, drainage flow will more than double in the drainage and grouting gallery due to water leakage into the gallery. This unwanted flow hinders more exact measurements. It was assumed that during the drawdown the lock would be left empty so constant flow rates could be established, but that was not the case, as there was a need to move a survey boat upstream and downstream. The data did indicate a reduction in drainage flow during the drawdown and a return to normal drainage flow with the re-impoundment. The problem with leakage from the navigation lock, when the lock is full is to be addressed, so normal leakage can be determine more easily.

4. CONCLUSIONS.

The data presented from selected instrumentation in this report do not indicate changes or movements that would not have been expected under similar circumstances. At no time was the safety of the structure a concern. The reduction then increase of measured uplift under spillway bay 4, navigation lock monolith 22, and powerhouse bays 2 and 3 was consistent with expected results. The instruments picked to be monitored during the drawdown were for information purposes only and not because there was any concern over stability of the structure. In future drawdowns, if instruments are to be monitored for whatever reason, the reading frequencies should be increased. If the frequencies become a burden to project personnel then automation of each instrument is recommended.

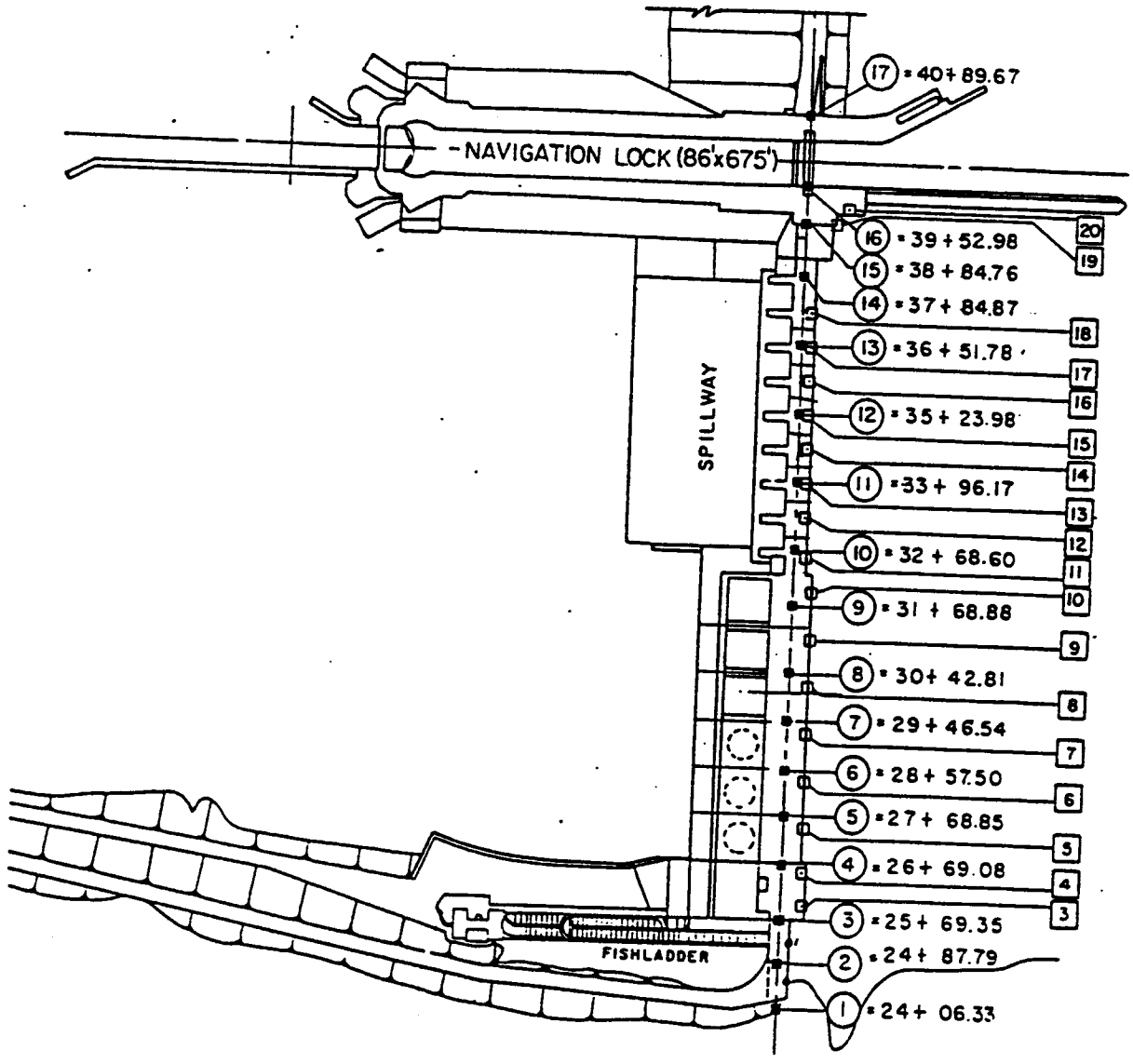
5. APPENDICES

APPENDIX E-1 - Lower Granite Precise Level Data

APPENDIX E-2 - Little Goose Precise Level Data

APPENDIX E-1

LOWER GRANITE PRECISE LEVEL DATA



NTS

□- TRILATERATION POINT

■- PRECISE LEVEL POINT

LOWER GRANITE LOCK AND DAM
TRILATERATION AND PRECISE LEVEL SURVEYS
PLAN VIEW OF SURVEY POINTS' LOCATIONS

PLATE

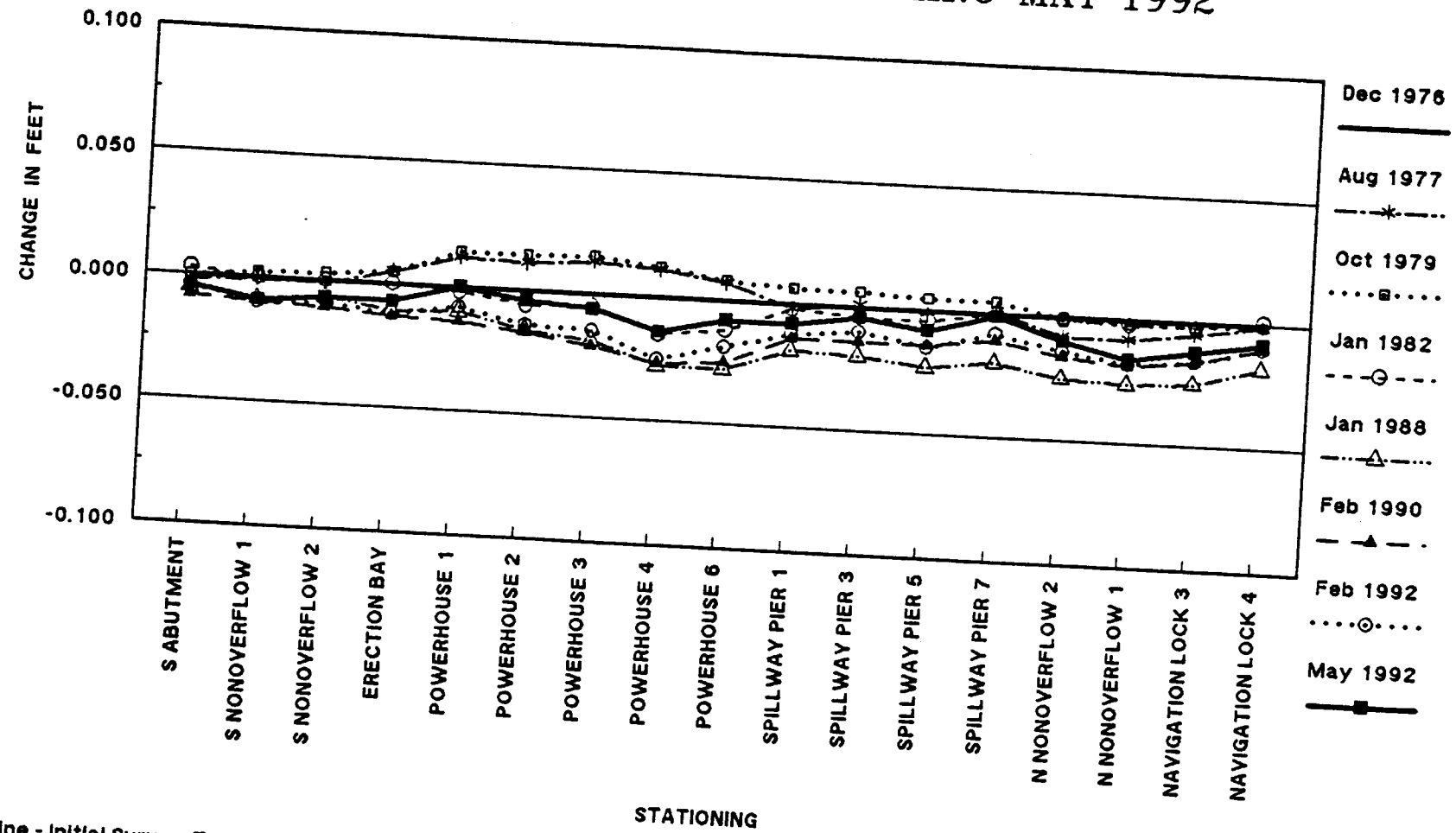
LOWER GRANITE

PRECISE LEVELS - CBL BRASS CAPS

SURVEY POINT ID	STATUS OF SURVEY		FIRST READING	LOCATION	METER ELEV.	COORDINATES	STATIONING
~~CBL-"A"=15+58.04~~	Active	Critical	NO DATA			N1558.04 E8000.00	
CBL-1=24+06.33	Active	Critical	12-03-76		750.9	N2406334 E8000.00	
CBL-2=24+87.79	Active	Critical	12-03-76	SNOF 1	750.9	N2487.79 E8000.00	
CBL-3=25+69.08	Active	Critical	12-03-76	SNOF 2	750.9	N2569.35 E8000.00	
CBL-4=26+69.08	Active	Critical	12-03-76	EB	750.8	N2669.08 E8000.00	
CBL-5=27+68.85	Active	Critical	12-03-76	PH 1	750.9	N2768.85 E8000.00	
CBL-6=28+57.50	Active	Critical	12-03-76	PH 2	750.9	N2857.50 E8000.00	
CBL-7=29+46.54	Active	Critical	12-03-76	PH 3	750.8	N2946.54 E8000.00	
CBL-8=30+42.81	Active	Critical	12-03-76	PH 4	750.9	N3042.81 E8000.00	
CBL-9=31+68.88	Active	Critical	12-03-76	PH 6	750.9	N3168.88 E8000.00	
CBL-10=32+68.60	Active	Critical	12-03-76	SPWY PR 1	750.9	N3268.60 E8000.00	
CBL-11=33+96.17	Active	Critical	12-03-76	SPWY PR 3	750.9	N3396.17 E8000.00	
CBL-12=35+23.98	Active	Critical	12-03-76	SPWY PR 5	750.9	N3523.98 E8000.00	
CBL-13=36+51.78	Active	Critical	12-03-76	SPWY PR 7	750.9	N3651.78 E8000.00	
CBL-14=37+84.87	Active	Critical	12-03-76	NNOF 2	750.8	N3784.87 E8000.00	
CBL-15=38+84.76	Active	Critical	12-03-76	NNOF 1	750.8	N3884.76 E8000.00	
CBL-16=39+52.98	Active	Critical	12-03-76	NL 3	751.9	N3952.98 E8000.00	
CBL-17=40+89.67	Active	Critical	12-03-76	NL 4	751.8	N4089.67 E8000.00	
~~CBL-"H"=59+44.61~~	Active	Critical	NO DATA			N5944.61 E8000.00	
~~CBL-"J"=66+97.06~~	Active	Critical	NO DATA			N6697.06 E8000.00	

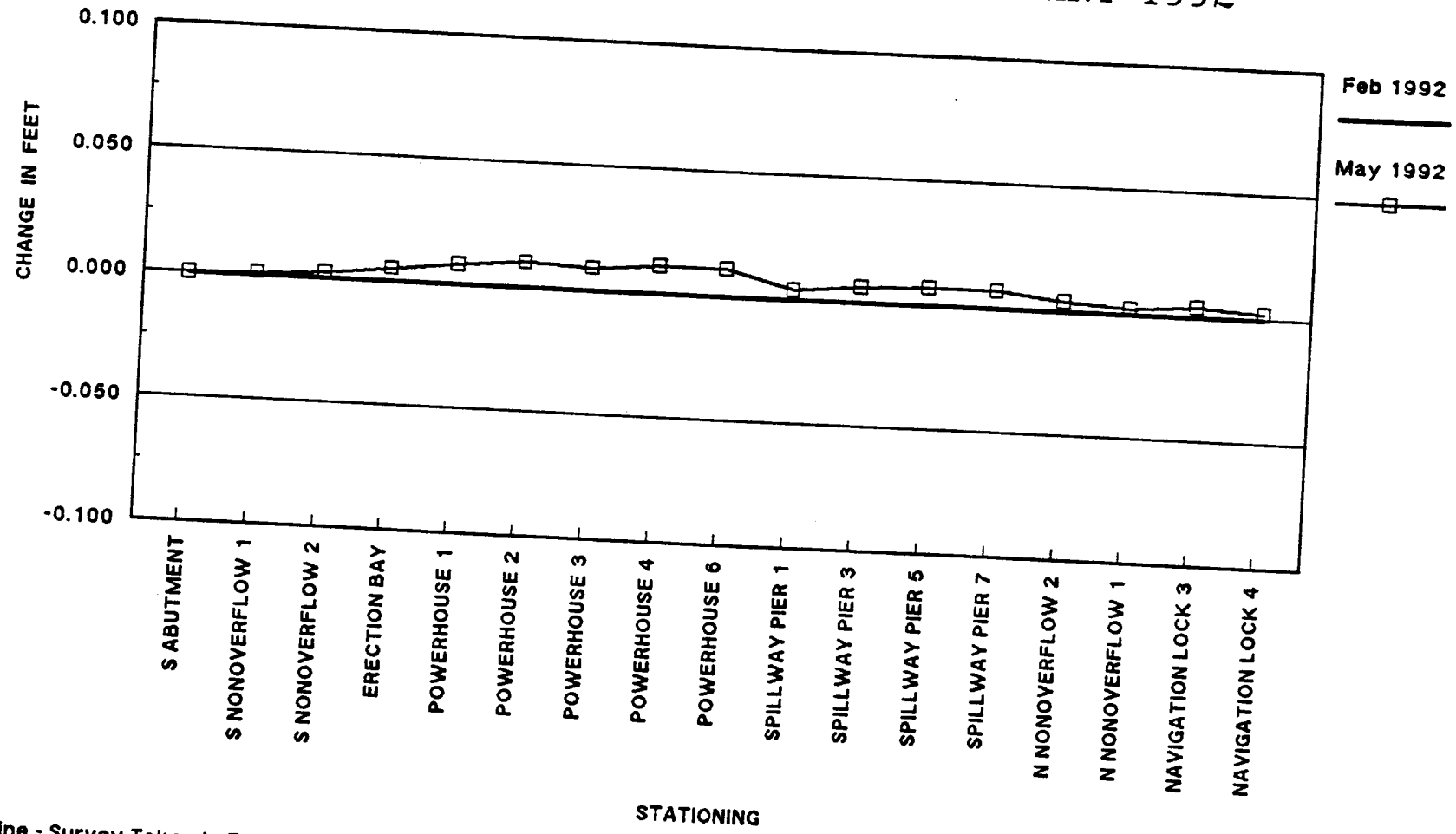
13-Jan-92

LOWER GRANITE LOCK AND DAM
PRECISE LEVEL SURVEY – CBL BRASS CAPS
SETTLEMENT – DECEMBER 1976 THRU MAY 1992



Base Line - Initial Survey Taken In Dec 1976

LOWER GRANITE LOCK AND DAM
PRECISE LEVEL SURVEY – CBL BRASS CAPS
SETTLEMENT – MAY 1992 VERSUS FEBRUARY 1992



Base Line - Survey Taken In February 1992

DEC 3 1976

	ELEVATION
DAM-1A	754.370
CAR-1	744.768
CBL 24+06.33	750.882
CBL 24+87.79	750.896
CBL 25+69.35	750.914
CBL 26+69.08	750.808
CBL 27+68.85	750.858
CBL 28+57.50	750.867
CBL 29+46.54	750.840
CBL 30+42.81	750.872
CBL 31+68.88	750.850
CBL 32+68.60	750.890
CBL 33+96.17	750.934
CBL 35+23.98	750.930
CBL 36+51.78	750.900
CBL 37+84.87	750.792
CBL 38+84.76	750.814
CBL 39+52.98	751.869
CBL 40+89.67	751.796
NE-RIM	750.890

AUG 1977

	ELEVATION
DAM-1A	754.370
CAR-1	744.768
CBL 24+06.33	750.880
CBL 24+87.79	750.895
CBL 25+69.35	750.913
CBL 26+69.08	750.813
CBL 27+68.85	750.870
CBL 28+57.50	750.878
CBL 29+46.54	750.853
CBL 30+42.81	750.883
CBL 31+68.88	750.857
CBL 32+68.60	750.888
CBL 33+96.17	750.935
CBL 35+23.98	750.929
CBL 36+51.78	750.901
CBL 37+84.87	750.784
CBL 38+84.76	750.806
CBL 39+52.98	751.864
CBL 40+89.67	751.795

COMPUTATION DATE: 02-14-1992, DATA FILE DESIGNATION: LOGRNT92

PRECISE LEVELS AT LOWER GRANITE FEB 92 SURVEY BY CERRILLO

BENCH MARK	ELEVATION FEET	ELEVATION METERS	STD. ERR. METERS
CBL 24+06.33	750.878	228.86793	0.00010
CBL 24+87.79	750.886	228.87038	0.00015
CBL 25+69.35	750.905	228.87641	0.00018
CBL 26+69.08	750.796	228.84301	0.00021
CBL 27+68.85	750.850	228.85941	0.00023
CBL 28+57.50	750.853	228.86048	0.00025
CBL 29+46.54	750.825	228.85180	0.00027
CBL 30+42.81	750.847	228.85866	0.00029
CBL 31+68.88	750.831	228.85385	0.00031
CBL 32+68.60	750.878	228.86815	0.00032
CBL 33+96.17	750.924	228.88219	0.00034
CBL 35+23.98	750.915	228.87937	0.00036
CBL 36+51.78	750.892	228.87244	0.00037
CBL 37+84.87	750.778	228.83752	0.00038
CBL 38+84.76	750.796	228.84303	0.00040
CBL 39+52.98	751.853	229.16525	0.00041
CBL 40+89.67	751.786	229.14488	0.00043
BM T-368-2A	748.889	228.26179	0.00057
BM CAR-1	744.768	227.00574 [FIXED]	

COMPUTATION DATE: 05-15-1992, DATA FILE DESIGNATION: LOGRN92A

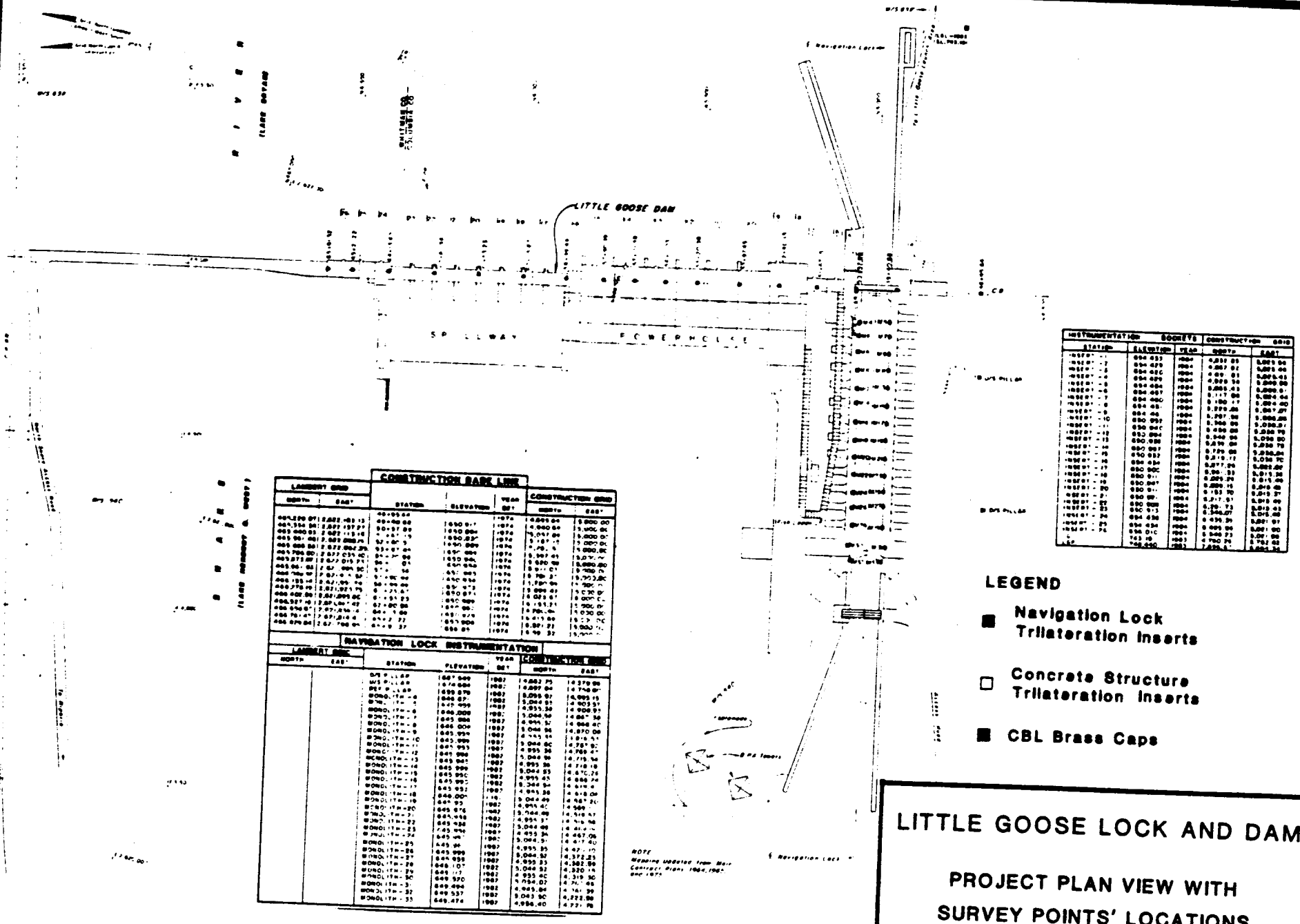
ADJUSTMENT: LOWER GRANITE PRECISE LEVELS - POST DRAWDOWN

BENCH MARK	ELEVATION FEET	ELEVATION METERS	STD. ERR. METERS
CBL 24+06.33	750.878	228.86821	0.00010
CBL 24+87.79	750.887	228.87081	0.00014
CBL 25+69.35	750.907	228.87702	0.00017
CBL 26+69.08	750.801	228.84459	0.00020
CBL 27+68.85	750.858	228.86205	0.00023
CBL 28+57.50	750.863	228.86354	0.00025
CBL 29+46.54	750.834	228.85469	0.00027
CBL 30+42.81	750.858	228.86196	0.00028
CBL 31+68.88	750.842	228.85703	0.00030
CBL 32+68.60	750.882	228.86916	0.00032
CBL 33+96.17	750.930	228.88395	0.00033
CBL 35+23.98	750.922	228.88147	0.00035
CBL 36+51.78	750.899	228.87442	0.00036
CBL 37+84.87	750.782	228.83877	0.00038
CBL 38+84.76	750.798	228.84380	0.00039
CBL 39+52.98	751.857	229.16649	0.00040
CBL 40+89.67	751.788	229.14531	0.00042
BM T-368-2A	748.888	228.26138	0.00056
BM CAR-1	744.768	227.00574 [FIXED]	

APPENDIX E-2

LITTLE GOOSE PRECISE LEVEL DATA

PLATE



LAMBERT GRID		CONSTRUCTION BASE LINE			CONSTRUCTION GRID	
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LAMBERT GRID		NAVIGATION LOCK INSTRUMENTATION			CONSTRUCTION GRID	
NORTH	EAST	STATION	ELEVATION	YEAR SET	NORTH	EAST
		DS PILLAR	667.849	1987	[illegible]	[illegible]
		WS PILLAR	674.884	1987	[illegible]	[illegible]
		BS PILLAR	699.879	1987	[illegible]	[illegible]
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		BONOLITH-7	645.958	1987	[illegible]	[illegible]
		BONOLITH-8	646.009	1987	[illegible]	[illegible]
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		BONOLITH-11	645.999	1987	[illegible]	[illegible]
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		BONOLITH-13	645.988	1987	[illegible]	[illegible]
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		BONOLITH-15	645.999	1987	[illegible]	[illegible]
		BONOLITH-16	645.955	1987	[illegible]	[illegible]
		BONOLITH-17	645.992	1987	[illegible]	[illegible]
		BONOLITH-18	645.932	1987	[illegible]	[illegible]
		BONOLITH-19	646.007	1987	[illegible]	[illegible]
		BONOLITH-20	645.95	1987	[illegible]	[illegible]
		BONOLITH-21	645.976	1987	[illegible]	[illegible]
		BONOLITH-22	645.938	1987	[illegible]	[illegible]
		BONOLITH-23	645.938	1987	[illegible]	[illegible]
		BONOLITH-24	645.991	1987	[illegible]	[illegible]
		BONOLITH-25	645.95	1987	[illegible]	[illegible]
		BONOLITH-26	645.95	1987	[illegible]	[illegible]
		BONOLITH-27	645.999	1987	[illegible]	[illegible]
		BONOLITH-28	645.938	1987	[illegible]	[illegible]
		BONOLITH-29	646.107	1987	[illegible]	[illegible]
		BONOLITH-30	646.117	1987	[illegible]	[illegible]
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			649.474	1987	[illegible]	[illegible]

INSTRUMENTATION		BOOKETS		CONSTRUCTION GRID	
STATION	ELEVATION	YEAR	NORTH	EAST	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

NOTE
Mapping updated from Blair Contract Plans 1964,1967 BHC 1974

LITTLE GOOSE LOCK AND DAM

PROJECT PLAN VIEW WITH SURVEY POINTS' LOCATIONS

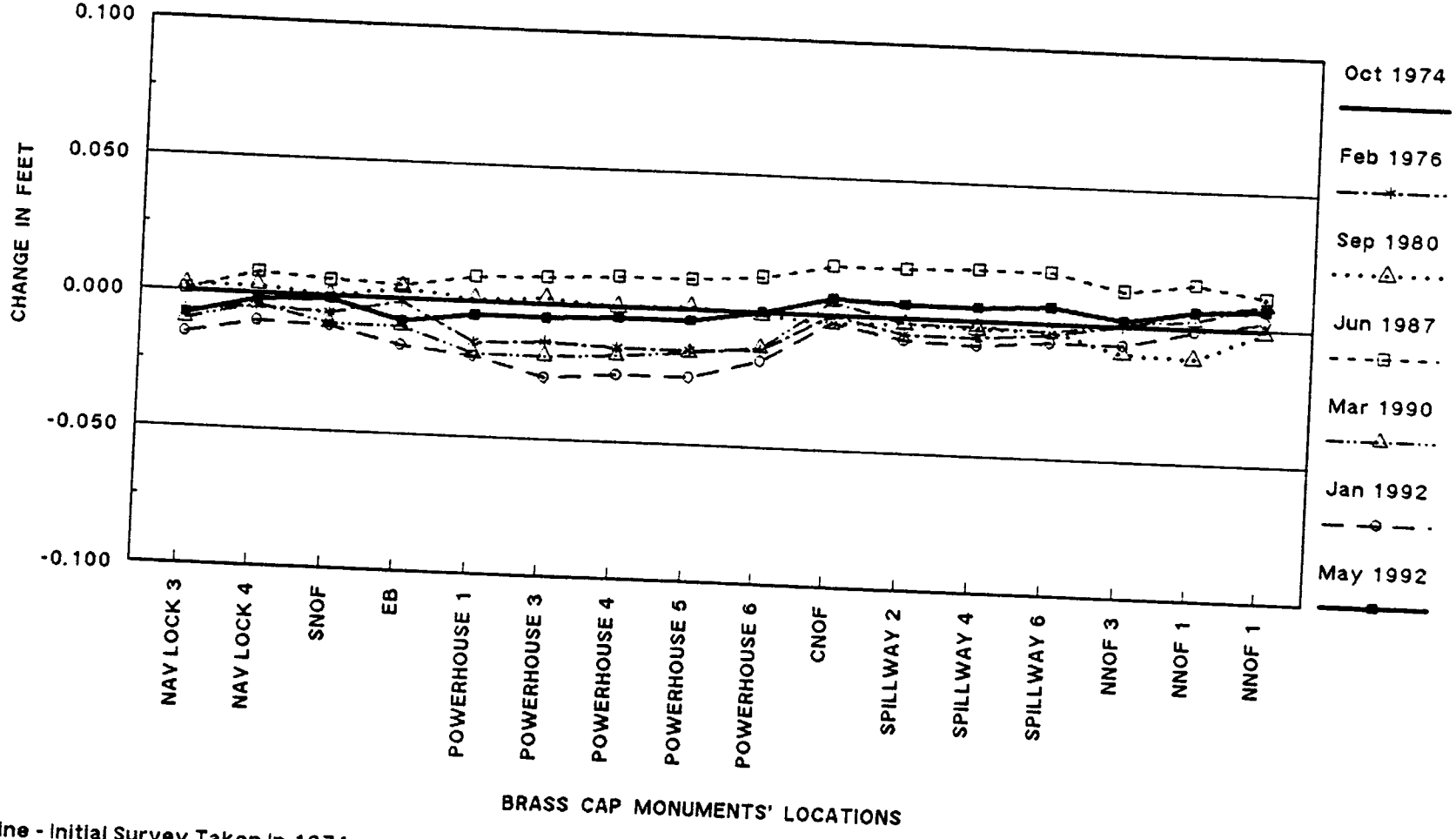
LITTLE GOOSE

PRECISE LEVELS - CBL BRASS CAPS

SURVEY POINT ID	STATUS OF SURVEY		FIRST READINNG	LOCATION	ELEV.	COORDINATES	STATIONING
49+40.68	Active	Non-Critical	10-22-74	NL 3	650.9	N4941 E5000	
50+57+89	Active	Non-Critical	10-22-74	NL 4	650.9	N5058 E5000	
51+67.15	Active	Non-Critical	10-22-74	SNOF	650.8	N5167 E5000	
52+80.51	Active	Non-Critical	10-22-74	EB	650.9	N5281 E5000	
53+97.45	Active	Non-Critical	10-22-74	PH 1	651.0	N5397 E5000	
55+20.98	Active	Non-Critical	10-22-74	PH 3	650.9	N5521 E5000	
56+11.03	Active	Non-Critical	10-22-74	PH 4	651.0	N5611 E5000	
57+01.38	Active	Non-Critical	10-22-74	PH 5	650.9	N5701 E5000	
57+90.99	Active	Non-Critical	10-22-74	PH 6	650.9	N5791 E5000	
58+99.49	Active	Non-Critical	10-22-74	CNOF/SPPR1	651.0	N5899 E5000	
60+25.67	Active	Non-Critical	10-22-74	SP PR 2	651.0	N6026 E5000	
61+53.23	Active	Non-Critical	10-22-74	SP PR 4	651.0	N6153 E5000	
62+80.96	Active	Non-Critical	10-22-74	SP PR 6	651.0	N6281 E5000	
64+13.69	Active	Non-Critical	10-22-74	NNOF 3	650.9	N6414 E5000	
65+21.22	Active	Non-Critical	10-22-74	NNOF 1	650.9	N6521 E5000	
65+91.32	Active	Non-Critical	10-22-74	NNOF 1	655.9	N6591 E5000	

LITTLE GOOSE LOCK AND DAM

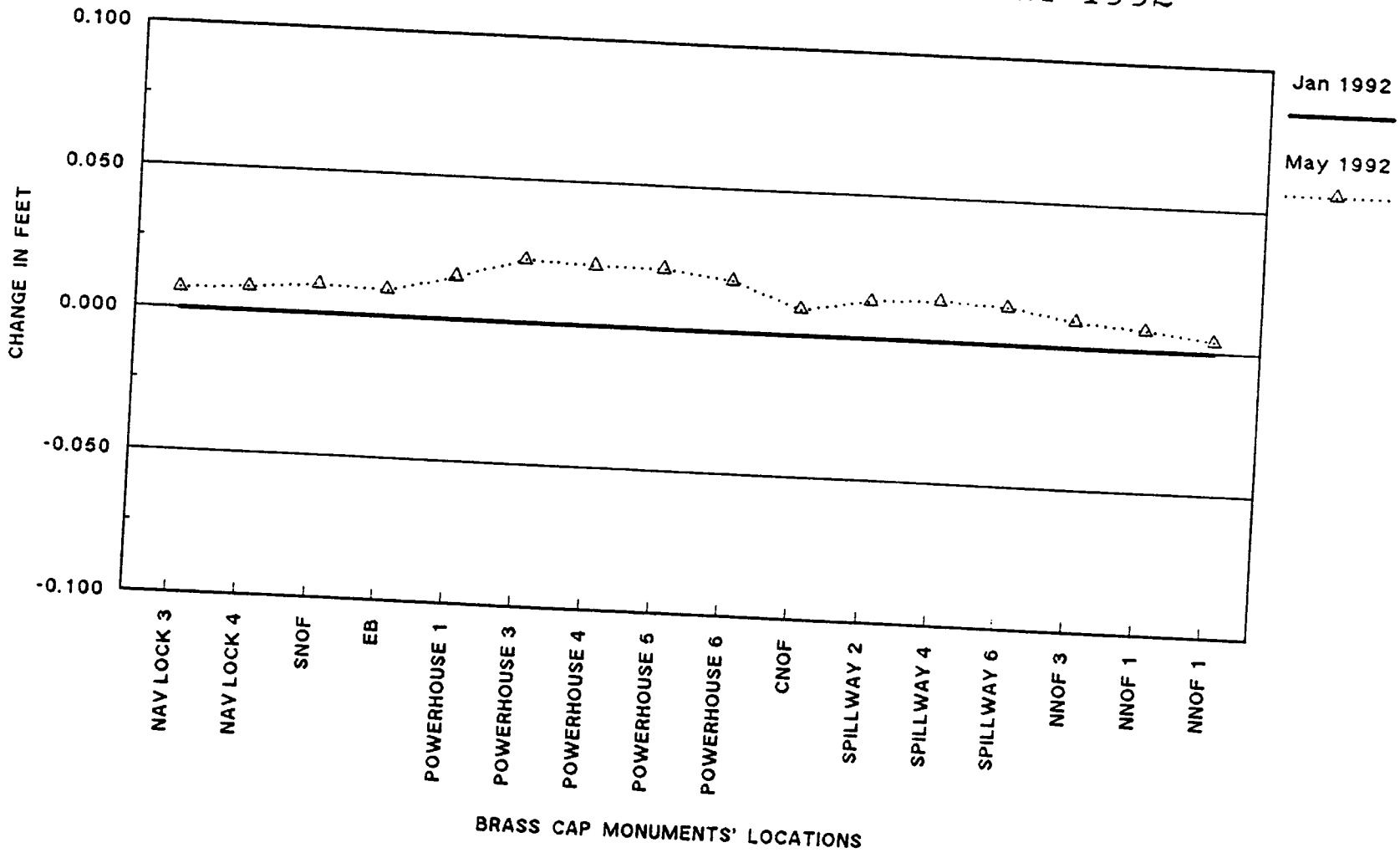
PRECISE LEVELS - CBL BRASS CAPS
SETTLEMENT - FEBRUARY 1974 THRU MAY 1992



Base Line - Initial Survey Taken in 1974

LITTLE GOOSE LOCK AND DAM

PRECISE LEVELS – CBL BRASS CAPS
SETTLEMENT – MAY 1992 VERSUS JANUARY 1992



LITTLE GOOSE LOCK AND DAM - PRECISE LEVELS - CBL BRASS CAPS

10-22-74	ELEVATION
CBL 49+40.68	650.917
CBL 50+57.89	650.894
CBL 51+67.15	650.830
CBL 52+80.51	650.889
CBL 53+97.45	650.969
CBL 55+20.98	650.940
CBL 56+11.03	650.958
CBL 57+01.38	650.945
CBL 57+90.90	650.934
CBL 58+99.49	650.973
CBL 60+25.67	650.973
CBL 61+53.23	650.989
CBL 62+80.96	650.962
CBL 64+13.69	650.929
CBL 65+21.22	650.908
CBL 65+91.32	655.851

02-13-76	ELEVATION
CBL 49+40.68	650.910
CBL 50+57.89	650.889
CBL 51+67.15	650.824
CBL 52+80.51	650.888
CBL 53+97.45	650.954
CBL 55+20.98	650.926
CBL 56+11.03	650.943
CBL 57+01.38	650.930
CBL 57+90.90	650.920
CBL 58+99.49	650.973
CBL 60+25.67	650.967
CBL 61+53.23	650.983
CBL 62+80.96	650.958
CBL 64+13.69	650.929
CBL 65+21.22	650.914
CBL 65+91.32	655.860

LITTLE GOOSE LOCK AND DAM - PRECISE LEVELS - CBL BRASS CAPS

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CBL 57+01.38	650.945
CBL 57+90.90	650.934
CBL 58+99.49	650.973
CBL 60+25.67	650.973
CBL 61+53.23	650.989
CBL 62+80.96	650.962
CBL 64+13.69	650.929
CBL 65+21.22	650.908
CBL 65+91.32	655.851

02-13-76	ELEVATION
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CBL 50+57.89	650.889
CBL 51+67.15	650.824
CBL 52+80.51	650.888
CBL 53+97.45	650.954
CBL 55+20.98	650.926
CBL 56+11.03	650.943
CBL 57+01.38	650.930
CBL 57+90.90	650.920
CBL 58+99.49	650.973
CBL 60+25.67	650.967
CBL 61+53.23	650.983
CBL 62+80.96	650.958
CBL 64+13.69	650.929
CBL 65+21.22	650.914
CBL 65+91.32	655.860

02-Mar-90

LITTLE GOOSE LOCK AND DAM - PRECISE LEVELS - CBL BRASS CAPS

COMPUTATION DATE: 01-30-1992, DATA FILE DESIGNATION: LTLGSE92

LITTLE GOOSE PRECISE LEVELS JAN 92 SURVEY BY CERRILLO

BENCH MARK	ELEVATION FEET	ELEVATION METERS	STD. ERROR METERS
BM-1	650.950	198.4100	0.00021
CBL 49+40.68	650.902	198.3953	0.00024
CBL 50+57.89	650.884	198.3899	0.00027
CBL 51+67.15	650.819	198.3700	0.00030
CBL 52+80.51	650.872	198.3862	0.00032
CBL 53+97.45	650.949	198.4096	0.00035
CBL 55+20.98	650.913	198.3988	0.00037
CBL 56+11.03	650.933	198.4049	0.00039
CBL 57+01.38	650.920	198.4009	0.00040
CBL 57+90.99	650.916	198.3995	0.00042
CBL 58+99.49	650.970	198.4160	0.00044
CBL 60+25.67	650.965	198.4146	0.00046
CBL 61+53.23	650.980	198.4191	0.00047
CBL 62+80.96	650.955	198.4114	0.00049
CBL 64+13.69	650.922	198.4014	0.00050
CBL 65+21.22	650.907	198.3968	0.00052
CBL 65+91.32	655.854	199.9047	0.00053
BM C-368	643.182	196.0424	0.00067
BM 1A	648.682	197.7187	0.00000

31-Jan-92

LITTLE GOOSE LOCK AND DAM - PRECISE LEVELS - CBL BRASS CAPS

COMPUTATION DATE: 05-30-1992, DATA FILE DESIGNATION: LTLGS92A

ADJUSTMENT: LITTLE GOOSE PRECISE LEVELS - POST DRAWDOWN - MAY 92

BENCH MARK	ELEVATION FEET	ELEVATION METERS	STD. ERR. METERS
BM-1	650.952	198.41051	0.00029
CBL 49+40.68	650.909	198.39748	0.00033
CBL 50+57.89	650.892	198.39225	0.00038
CBL 51+67.15	650.829	198.37297	0.00041
CBL 52+80.51	650.881	198.38893	0.00045
CBL 53+97.45	650.964	198.41424	0.00048
CBL 55+20.98	650.935	198.40535	0.00051
CBL 56+11.03	650.954	198.41130	0.00053
CBL 57+01.38	650.941	198.40718	0.00056
CBL 57+90.99	650.934	198.40507	0.00059
CBL 58+99.49	650.979	198.41871	0.00061
CBL 60+25.67	650.978	198.41850	0.00063
CBL 61+53.23	650.994	198.42322	0.00065
CBL 62+80.96	650.968	198.41541	0.00068
CBL 64+13.69	650.931	198.40415	0.00070
CBL 65+21.22	650.914	198.39906	0.00072
CBL 65+91.32	655.858	199.90592	0.00074
BM C-368	643.188	196.04413	0.00093
BM 1A	648.682	197.71867 [FIXED]	

01-Jun-92

APPENDIX E-3 - Little Goose, Instrument Reading Schedule of selected instruments

APPENDIX E-4 - Little Goose Central Non-overflow

APPENDIX E-5 - Lower Granite, Instrument Reading Schedule of selected instruments

APPENDIX E-6 - Lower Granite Powerhouse Bay 2

APPENDIX E-7 - Lower Granite Powerhouse Bay 3

APPENDIX E-8 - Lower Granite Spillway Bay 4

APPENDIX E-9 - Lower Granite Navigation Lock monolith 22

APPENDIX E-10 - Lower Granite Central Non-overflow

APPENDIX E-11 - Lower Granite forebay, tailwater and drainage flows; and Little Goose forebay

APPENDIX E-3

LITTLE GOOSE

INSTRUMENT READING SCHEDULE OF SELECTED INSTRUMENTS

LITTLE GOOSE LOCK AND DAM - DRAWDOWN 1992

INSTRUMENTATION READING SCHEDULE - DAILY

Date

METER NO.	INSTRUMENTATION READING
	Elevation
F/B	
T/W	
	Depth
PN411	
PN412	
PN404	
RD13	
RD17	
RD15	
RD16	
PN401	
DH2	
PN417	
PN418	
DH1	
CNOF Deck	
CNOF	