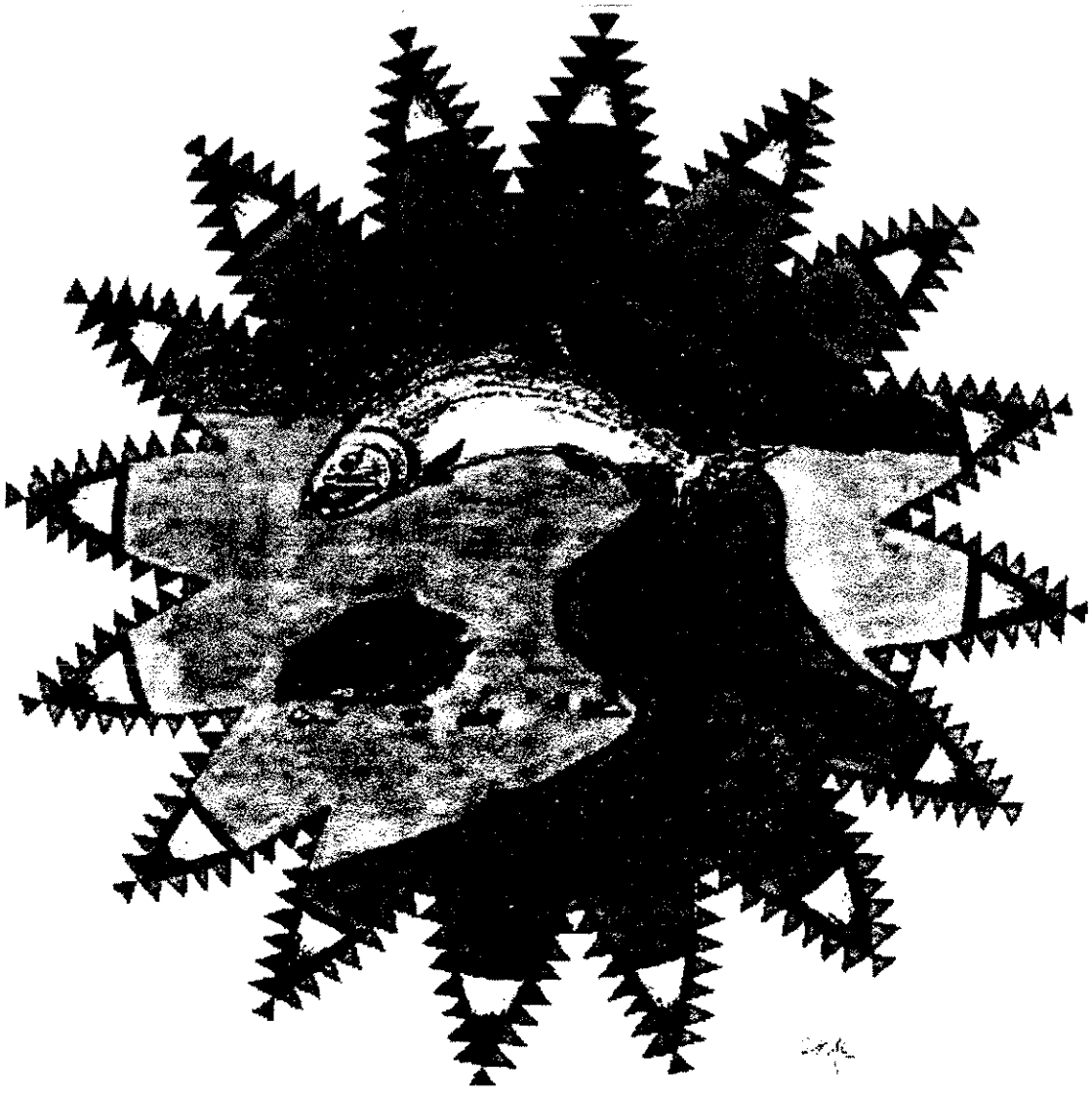
Hoopa Valley Tribe

Pine Creek Sediment Monitoring Project
Contract No. 14-48-0001-92507



15 September 1997

Abstract

Pine Creek is a tributary to the lower Klamath River. The 49 sq. mile watershed has been heavily logged. Bulk sediment samples were collected with a McNeil sampler over a three-year period at 7 stations in Pine Creek and at one in Little Pine Creek . The samples show no change with location and no change over time.

Introduction

The Hoopa Tribal Fisheries Department developed and implemented a watershed restoration project in the Pine Creek watershed. Pine Creek is a tributary of the lower Klamath River. Pine Creek has been identified as having high potential to produce anadromous Chinook salmon and steelhead trout. Pine Creek was chosen as a model watershed to implement and monitor the effectiveness of watershed restoration techniques. A Cooperative Agreement between the US Fish & Wildlife Service and the Hoopa Valley Tribe was used to fund this demonstration project.

Description of the Study Area

The Pine Creek watershed has an area of 49 square miles (Figure 1). The watershed is in part located on the Hoopa Reservation (approximately 21 square miles), in part on the Yurok Reservation, with the remainder in fragmented federal, industrial, and private landholdings. The headwaters of the watershed have elevations in excess of 3,000 feet and the confluence with the Klamath River has an elevation of approximately 300 feet. Pacific Watershed Associates completed a detailed assessment of the Pine Creek watershed for Hoopa Valley Fisheries Dept. in 1990. That work should be consulted for more detailed information. The entire watershed has been heavily logged and has more than 100 miles of logging roads.

Methods and materials

Study design was the standard approach developed by Pacific Watershed Associates (PWA). Eight study sites were identified at the end of the 1991/1992 winter. These sites are shown in Figure 2.

Local survey control monuments (1/2" rebar) were placed at each site in 1992. Longitudinal channel profiles and cross-sections were surveyed using techniques advocated by PWA. Hoopa Valley Fisheries Dept. technical staff were trained in the use of these techniques by PWA principals.

After longitudinal profiles and cross-sections were surveyed, scour chains and crest-stage gauges were installed at selected locations. The scour chains and crest-stage gauges were intended to assess the depth of streambed scour and associated flood stages at selected locations during the study period. These installations were made during the fall of 1992.

At the same time that scour chains and crest-stage gauges were installed, bulk sediment samples were collected using a modified McNeil sampler. Bulk sediment samples were taken at eight sites in 1992, 1993, and 1994. Sample site selection methods were standard for the techniques developed by PWA.

All samples were sieved through a series of screens with mesh sizes as follows:

124 mm
90 mm
63.5 mm
31.5 mm
12 mm
4 mm
1 mm
0.5 mm
0.125 mm

Samples passing through the 0.125 mm screen were settled out in Imhoff cones. All samples were measured volumetrically, using PWA modifications of the method described by McNeil (1963).

There was some variability in bulk sample processing. Some samples from the more inaccessible sites were processed in the field. This process was somewhat weather dependent. Samples from the more accessible sites were processed at the Hoopa Valley Fisheries Dept. facility in Hoopa.

Results and discussions

Pine Creek is a very high energy stream with steep gradients and a very flashy hydrograph. Local flood peaks rise to relatively remarkable heights following intense rainstorms or rain-on-snow events. Prolonged drought conditions preceding the study period led site design and layout personnel to make errors in selecting the locations of site survey control monuments. Most of these were lost in the 1992-1993 storm season, along with most of the crest-stage gauges and scour chains. The flood peaks associated with the 1996-1997 winter storms completely removed staff gauges and sediment sampling stations installed by personnel who had worked on the 1992-1995 study in what were believed to be secure locations . No scour chain or crest-stage data are available for the study period.

Longitudinal Profiles

Longitudinal profile data are presented by Site in Appendix 1.

Cross-sections

Cross-section data are presented by Site in Appendix 1.

Bulk sediment samples

Quantitative details of the bulk sediment samples are presented in Appendix 2.

There is a general consensus among hydrologists that streams are at their most efficient at performing work (i.e., moving sediment) at bankfull discharges. The quantitative streamflow regime associated with bankfull discharge can usually be calculated from on-site evidence and does not require contemporary discharge measurements.

High-flow or bankfull discharge marks at several cross-sections were used to estimate bankfull discharge and therefore water velocities associated with bankfull events. Average maximum velocities in the Pine Creek channel sites will range between 2.25 ft/sec (@ 70 cm/sec) and 6.25 ft/sec (190 cm/sec). The classic Hjulstrom diagram was used to predict the percentage of bulk sediment sample material that is likely to be moved during a bankfull event.

The Hjulstrom diagram predicts that a 70 cm/sec velocity will move a particle less than or equal to 5.4 mm diameter and a 190 cm/sec velocity will move a particle less than or equal to 16 mm diameter. Minimum and maximum percentages of mobile substrate moved during a bankfull event are shown by site and sample in the table below:

Site	Sample	Min %	Max %
1	1992a	46	70
1	1992b	41	66
1	1993c	19	48
2	1992a	44	69
2	1993b	41	66
2	1994c	40	65
3	1992a	40	63
3	1993c	37	60
3	1994d	43	71
12	1992a	41	72
12	1993b	39	64
19	1992a	46	72
19	1993b	35	59
20	1992a	50	70
20	1993b	37	62
21	1992a	45	66
21	1993b	41	66
Lpine	1992a	41	66

These data indicate that the substrate sampled from 7 sites in the main Pine Creek channel and from one site in Little Pine Creek are quite uniform. They do not indicate that there has been any change in the character of the substrate either by location or over time.

Summary and conclusions

Inspection of existing geological maps, USGS topographic maps, and existing stereo aerial photographs of the Pine Creek watershed indicate the high probability of one or more geologic contacts and fault controlled drainage patterns in the watershed. Coast Range watersheds with this type of geomorphology normally receive a large portion of their annual sediment loads from mass movements. Streams with fault controlled drainage patterns frequently have a large portion of their substrate made up of finer material. In an undisturbed state, such watersheds exhibit quite variable but frequently high sediment loads, with a relatively large portion of those sediment loads made up of the smaller size classes.

These Coast Range watersheds have historically produced variable sized runs of anadromous fish, often large but sometimes even extirpated as a result of tectonically- and fluvially controlled sedimentation. Sediment delivery rates have increased following decades of virtually uncontrolled road building and logging. There is no dispute that Pine Creek's channels are filled with sediment. This high energy stream may once have been in a supply-dependent mode but it is now in an energy-dependent mode and can be expected to remain in that state for some time to come. The results of this study quantitatively demonstrate this statement.

Qualitatively, any efforts which decrease the amount of sediment that can enter Pine Creek at any time in the future are desirable. Given the "erosional hangover" quantified by PWA's analysis (in excess of 120,000 CY or 160,000 tons), a major erosion control effort is clearly justified. But to expect to be able to demonstrate a direct cause-and-effect reduction in sediment in Pine Creek as the result of completing two erosion control projects is unrealistic. Only 10 to 15 percent of the accessible erosional overload was stabilized. This amount, although considerable, may not even be within the margin of error associated with the PWA inventory. Inaccessible quantities were not treated. The amount of entrained sediment, certainly large, was not addressed.

If nothing else, this study justifies the expense of sediment-budget based programs and demonstrates the cost-effectiveness of erosion control programs based on avoidance design, strict enforcement of contract provisions, and the adoption of "Best Management Practices".

These statements are not intended to say that this study was a waste of time or money. The highly mobile nature of the non-bedrock substrate in Pine Creek has been quantitatively described. Revisiting adequately monumented sites after high-flow years or on a periodic basis is recommended. This study provides some base-line data that would otherwise not have been collected. The real benefits of this study lie in its potential to influence Hoopa's resource management activities in the future.

Summary of expenditures

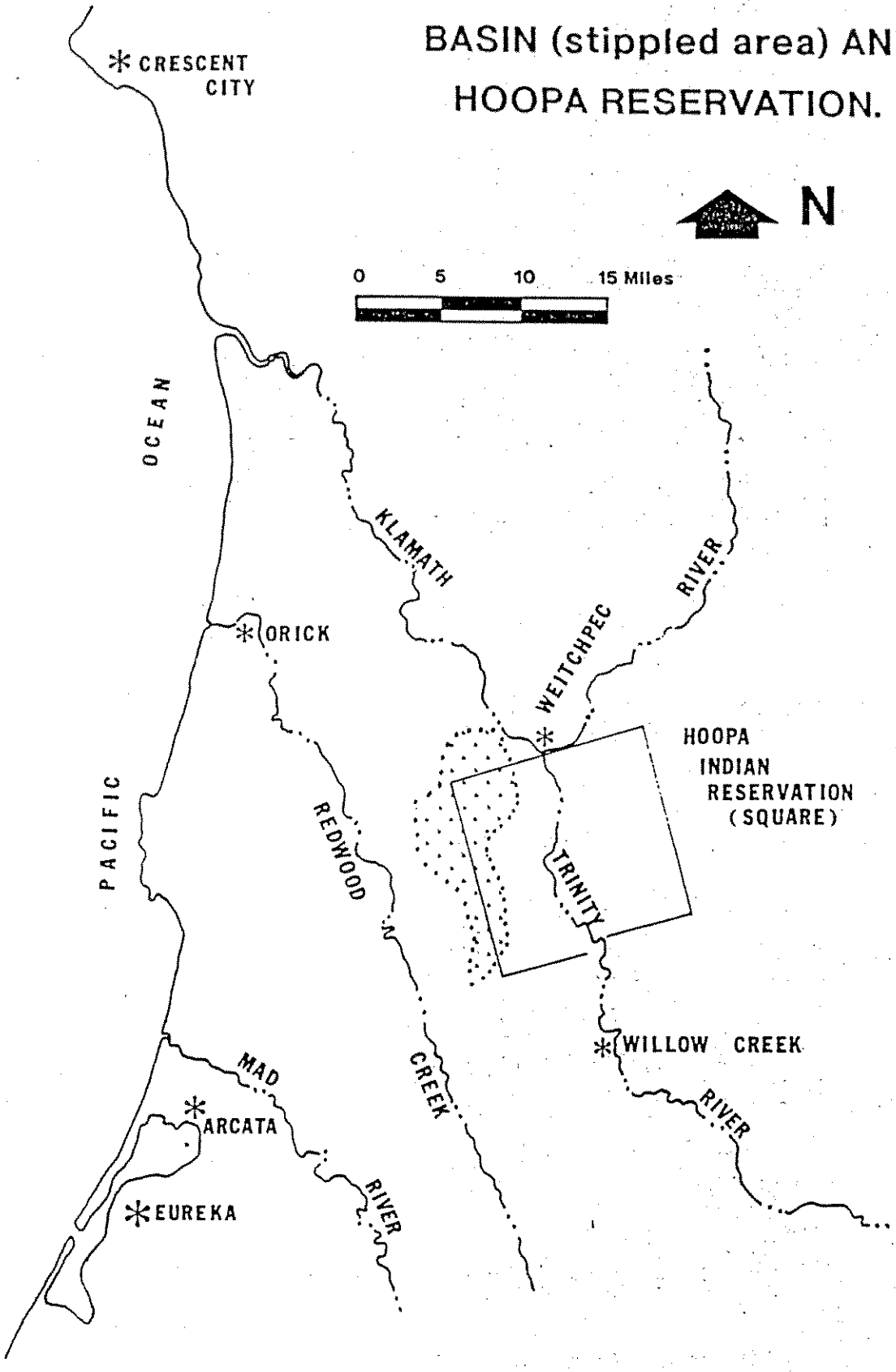
See following sheet

Section G. Summary of expenditures, including a list of major property purchased during the project.

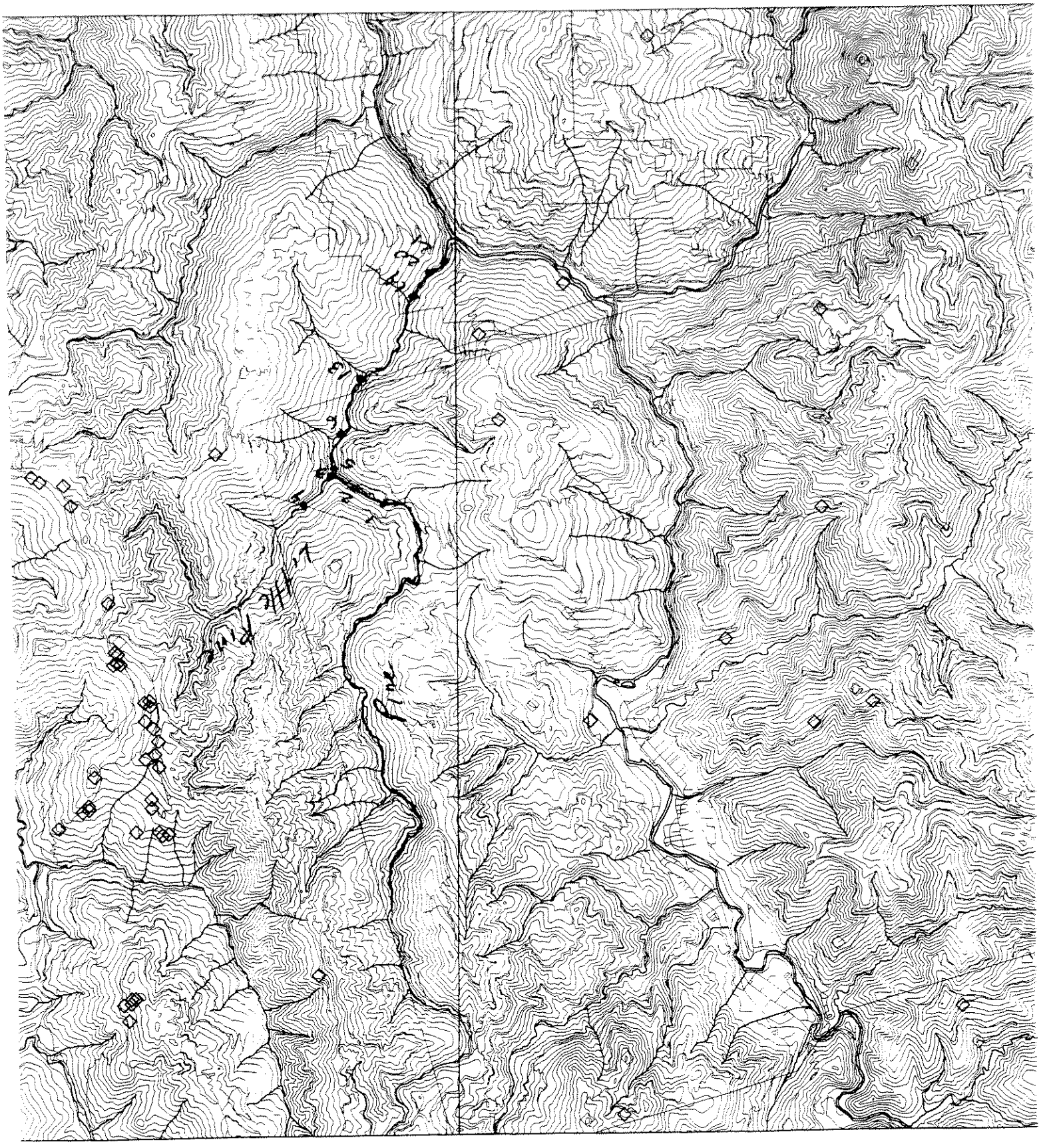
CATEGORY	1992	1993	1994	1995	1996
Personnel and Fringe	1,564	18,042	8,373	5,250	968
Supplies[1]	0	1,704	236	0	0
Travel	0	200	0	0	0
Total	1,564	19,946	8,609	5,250	968

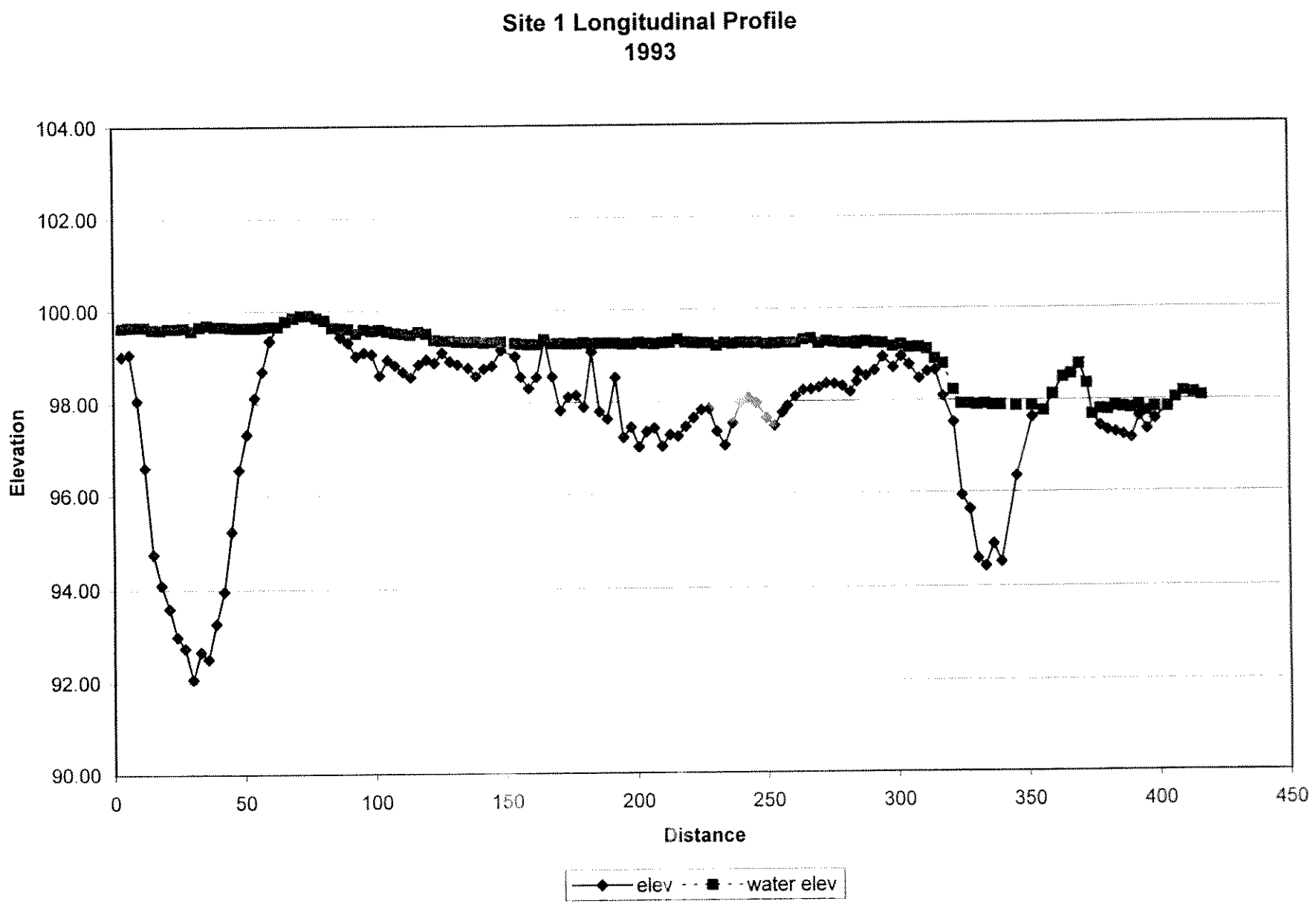
[1] Supplies/equipment purchased included: McNiel sampler, collection bottles, fence stakes, pvc pipe

Figure 1. LOCATION OF PINE CREEK DRAINAGE BASIN (stippled area) AND HOOPA RESERVATION.



Pine Cr, sediment monitoring.

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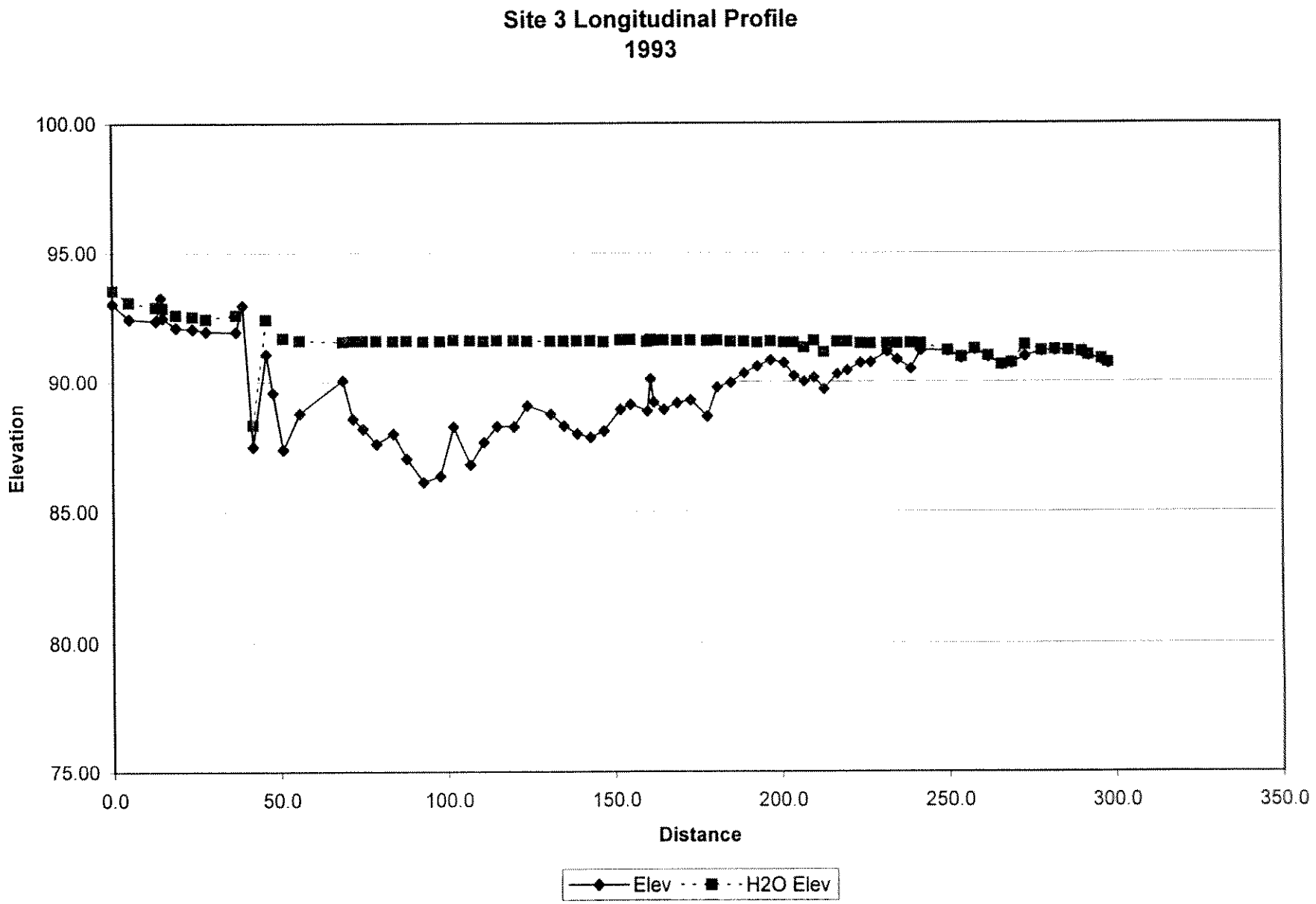
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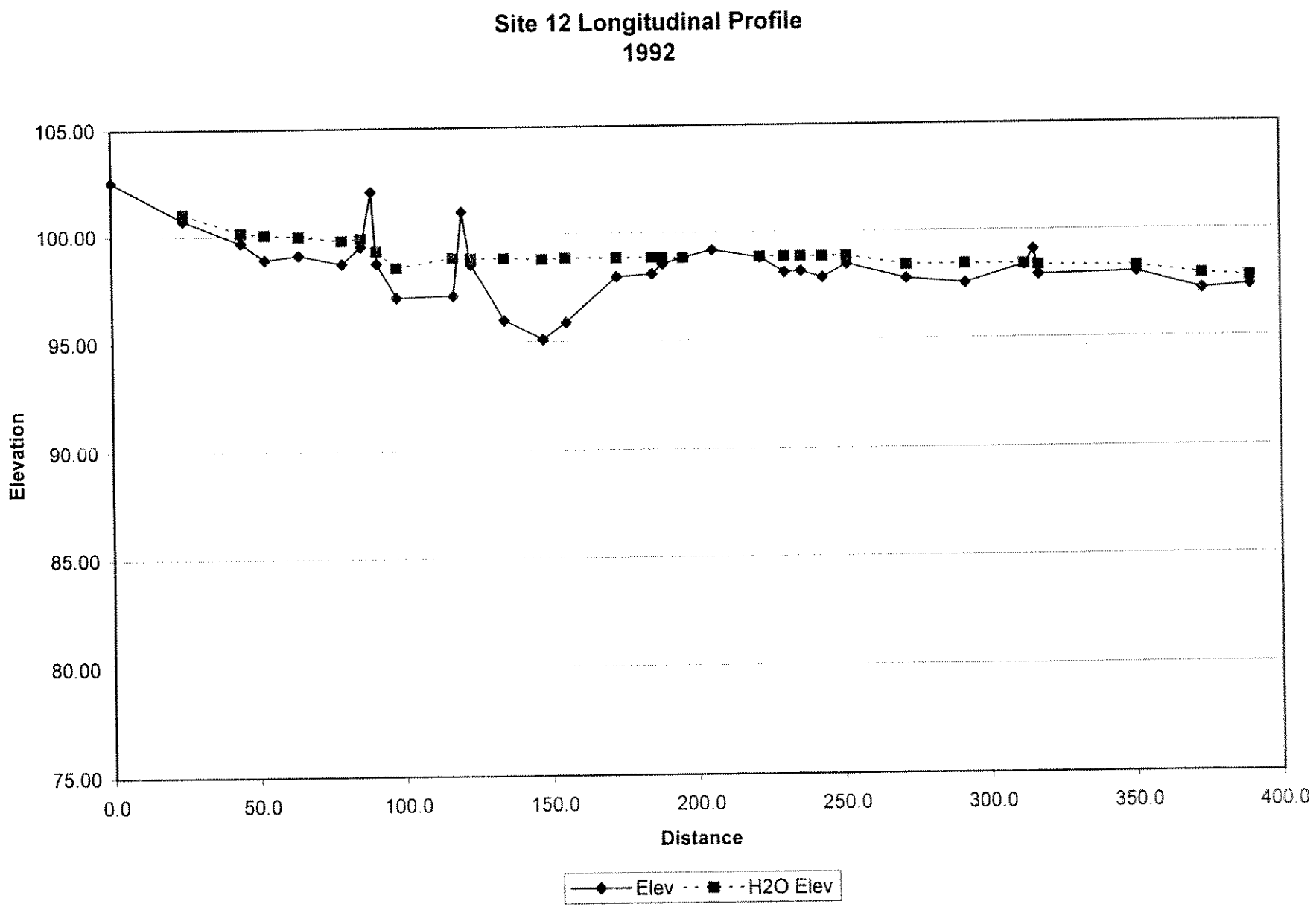
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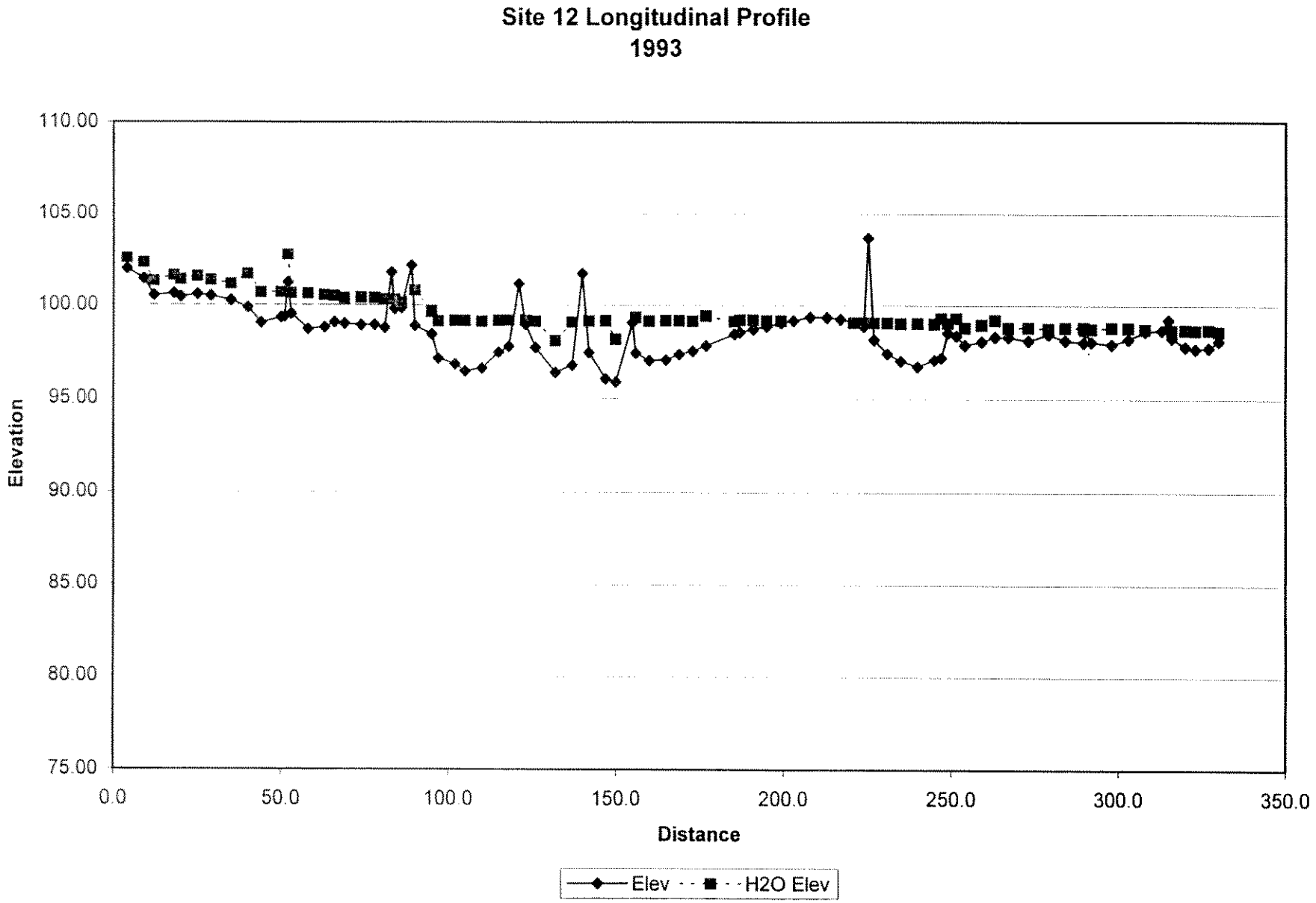
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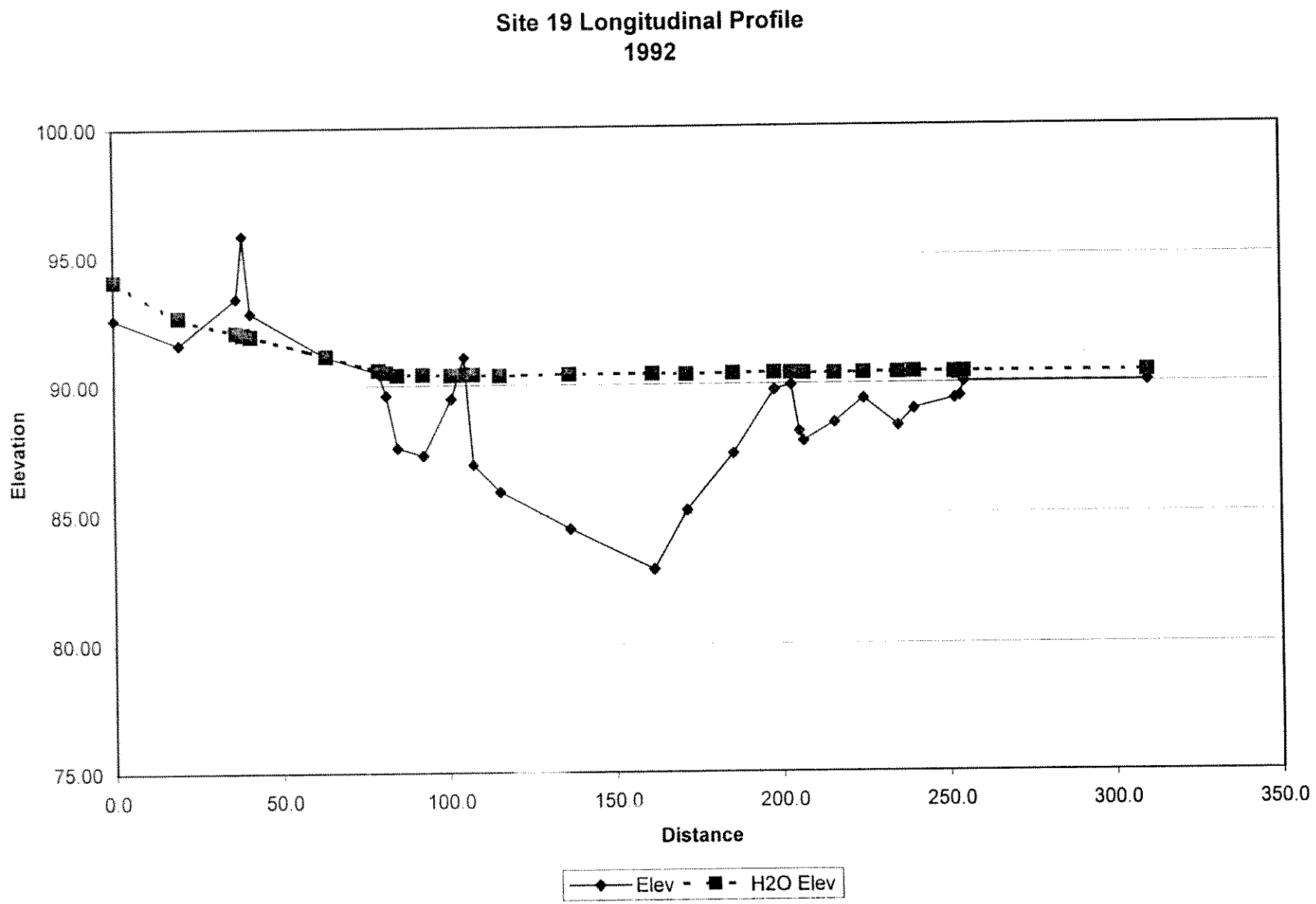
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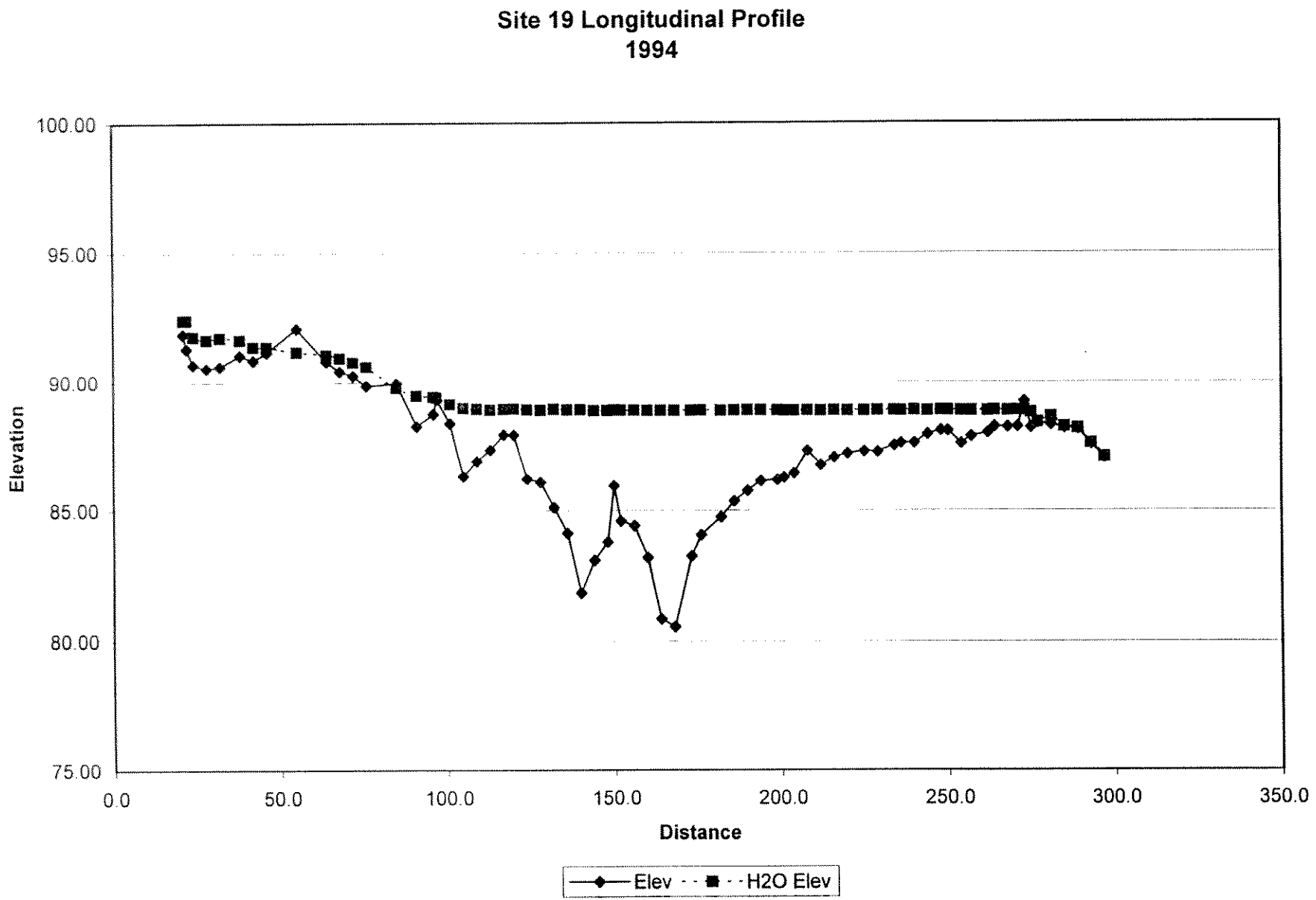
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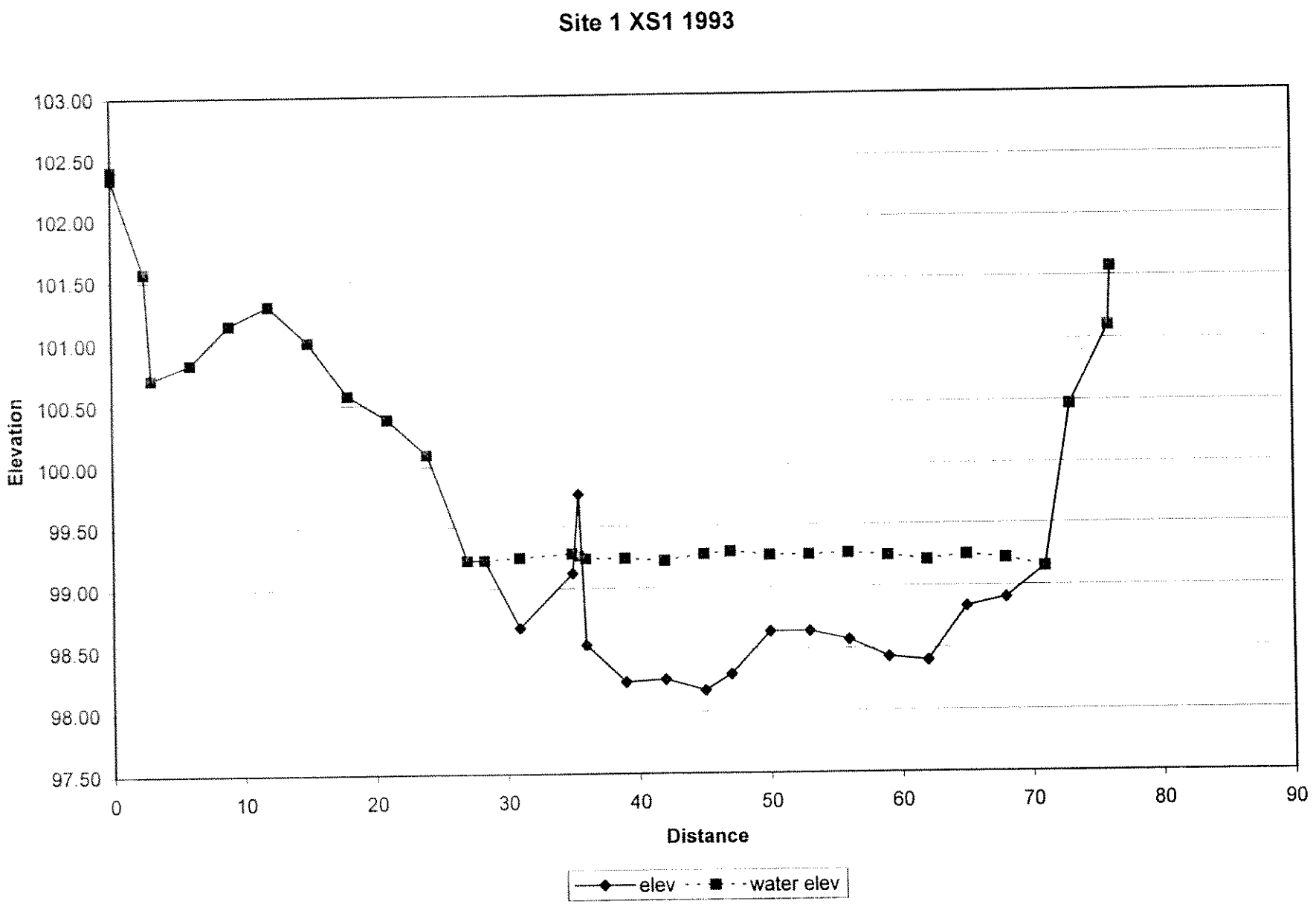
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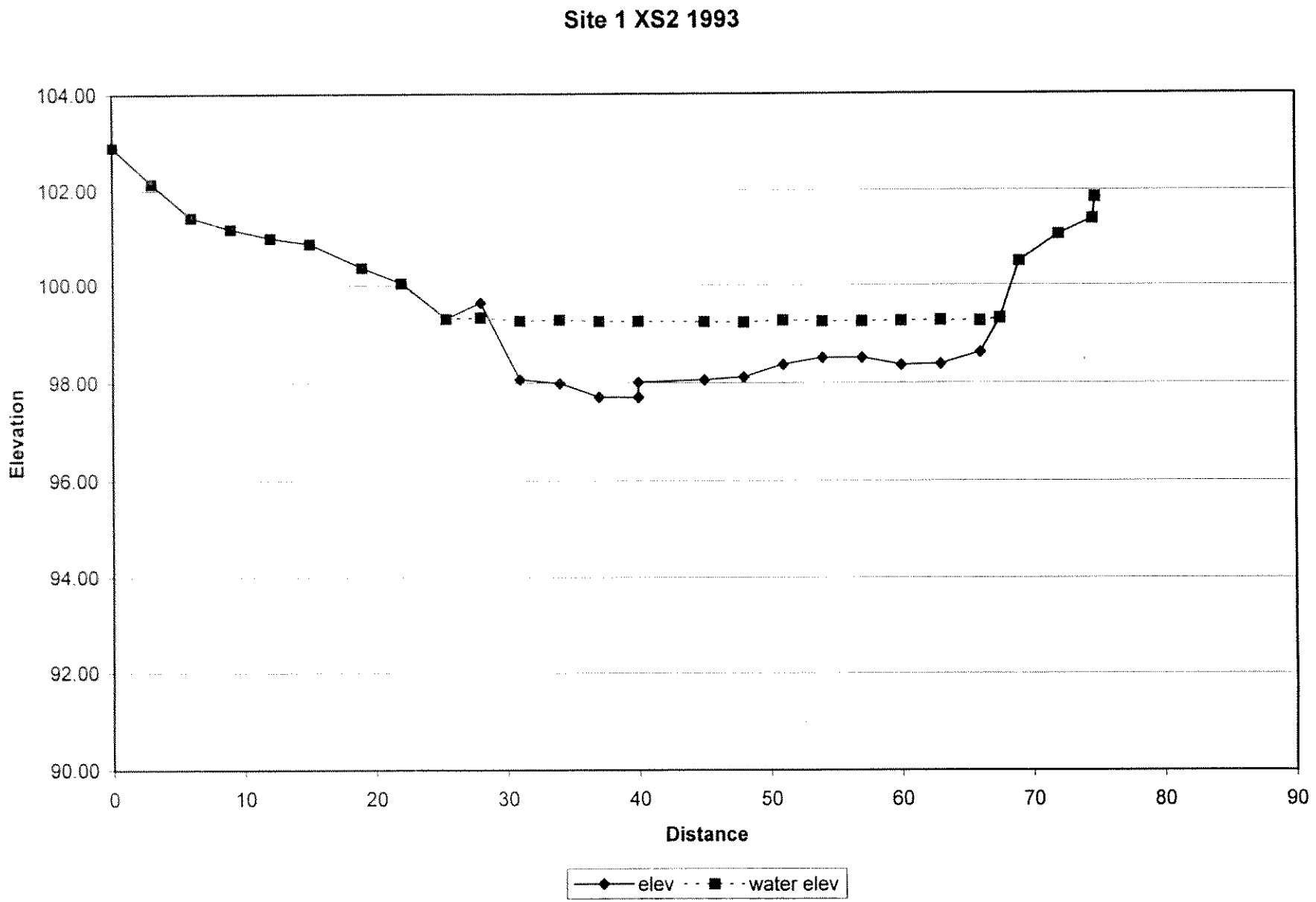
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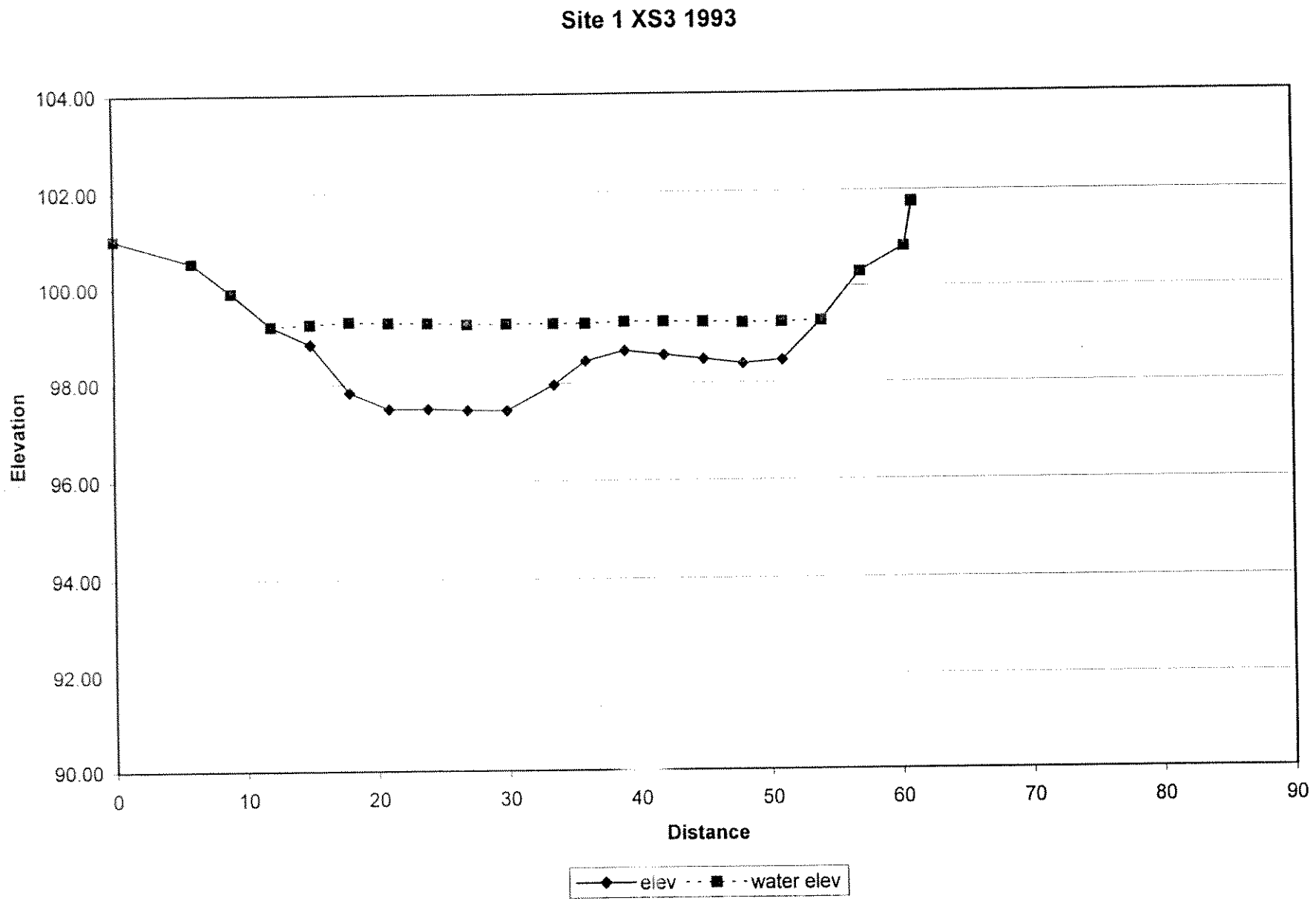
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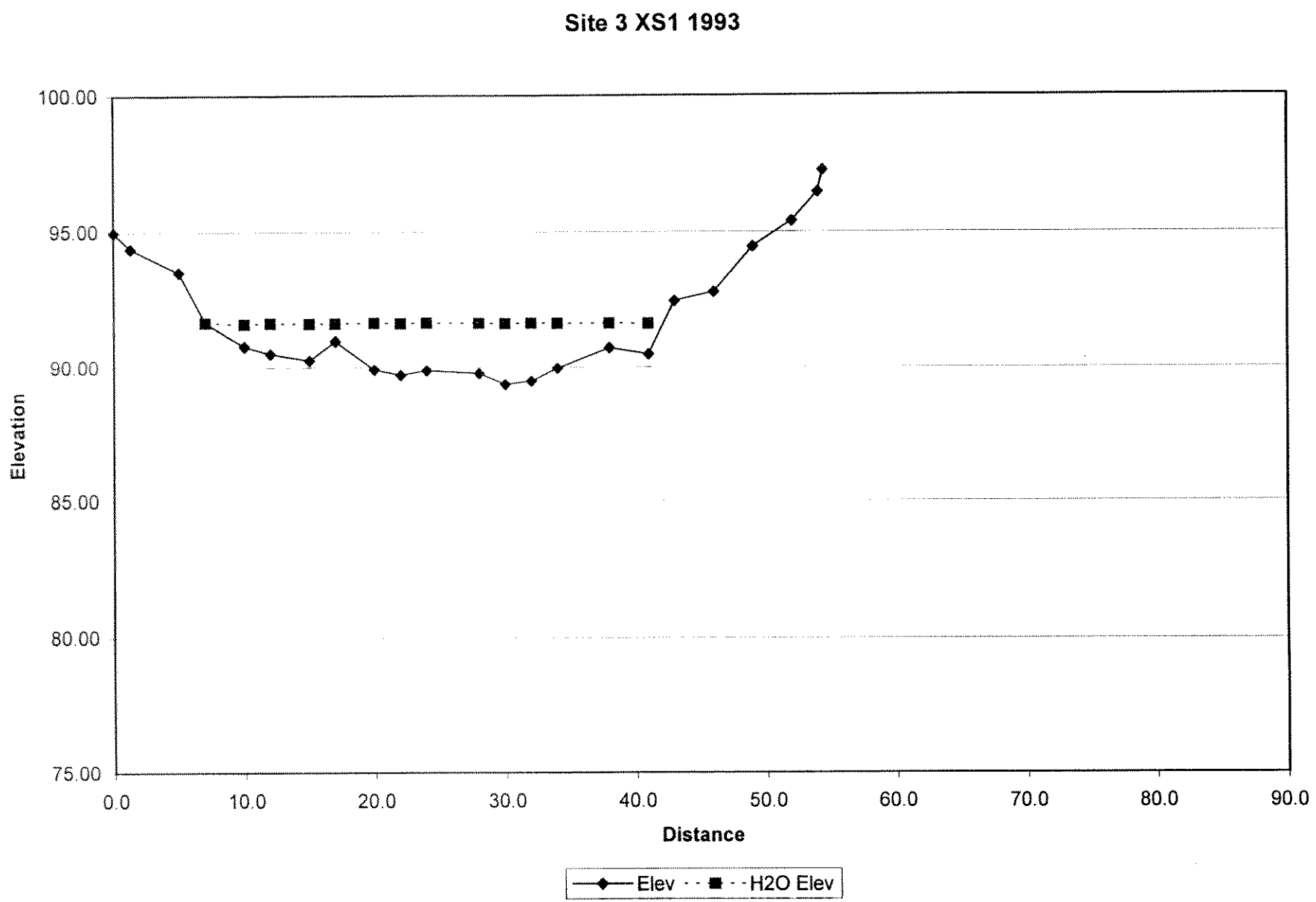
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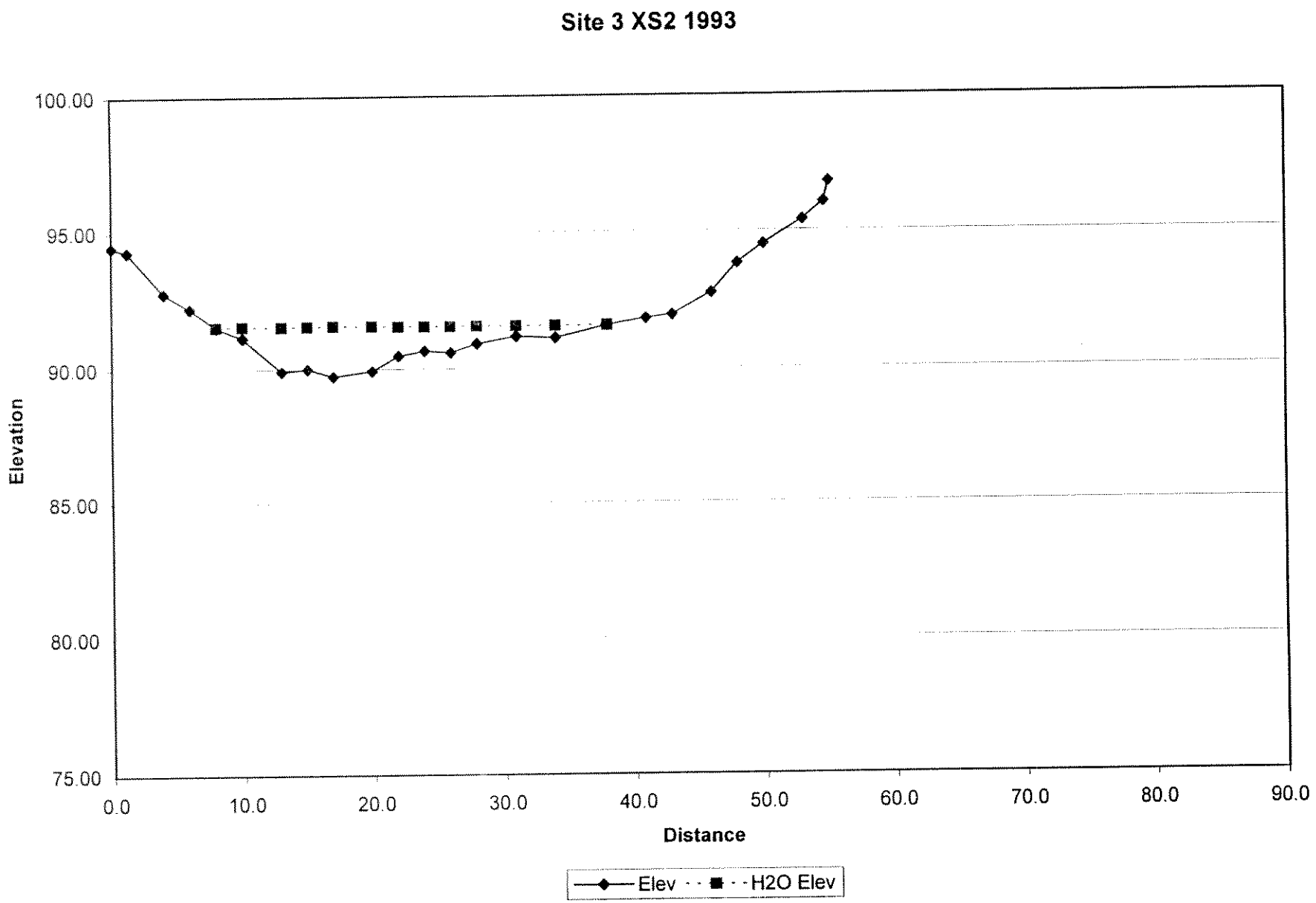
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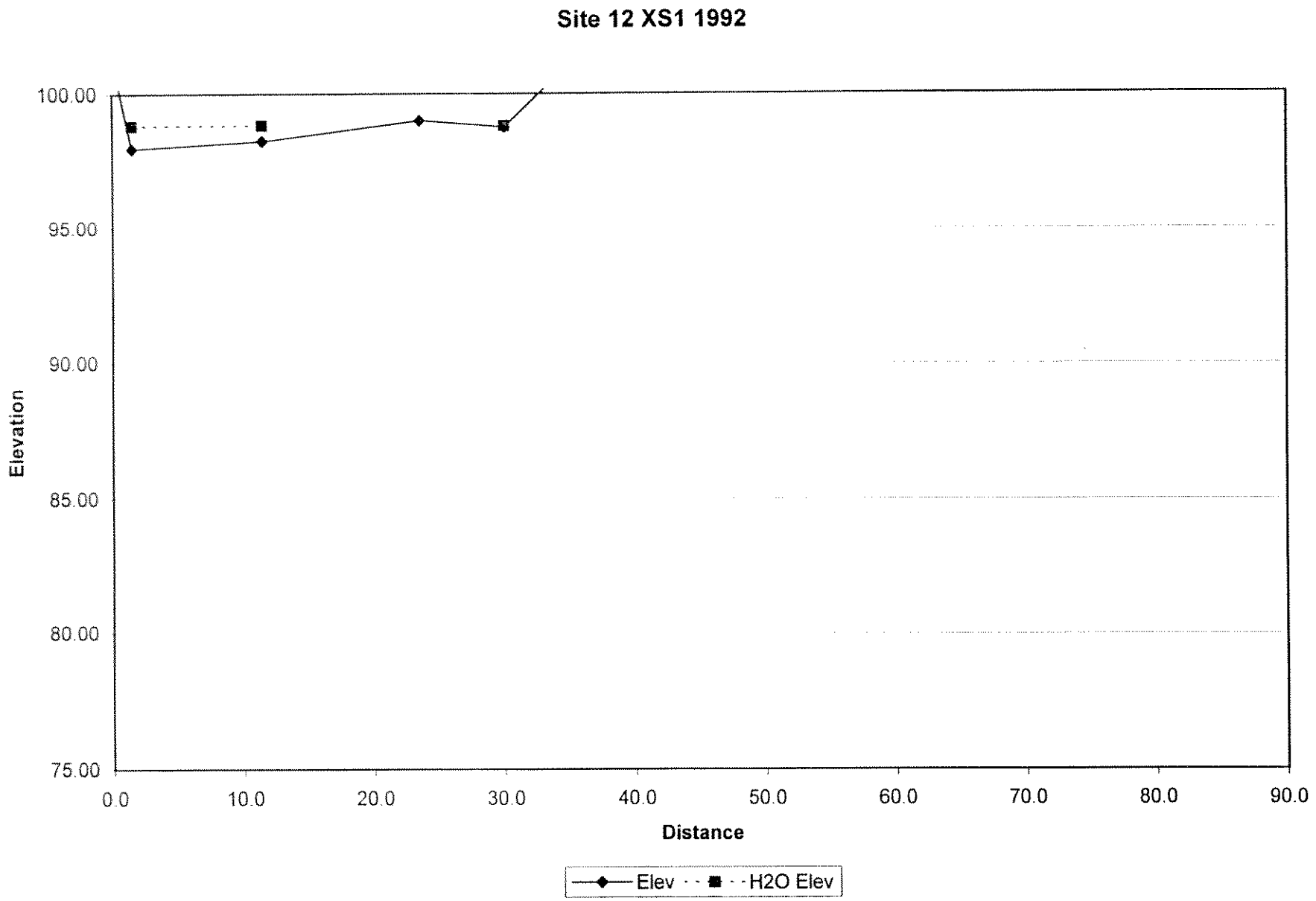
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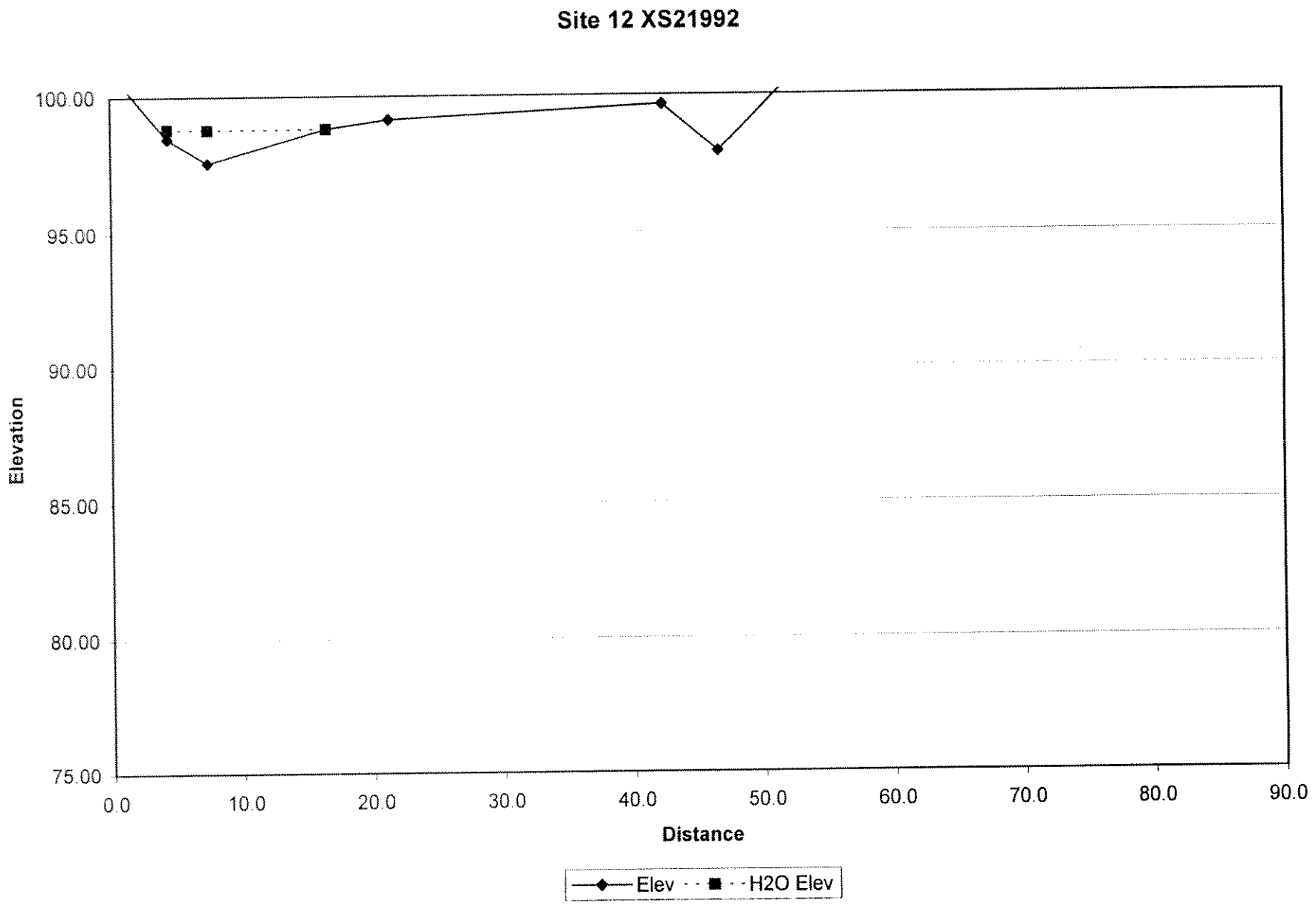
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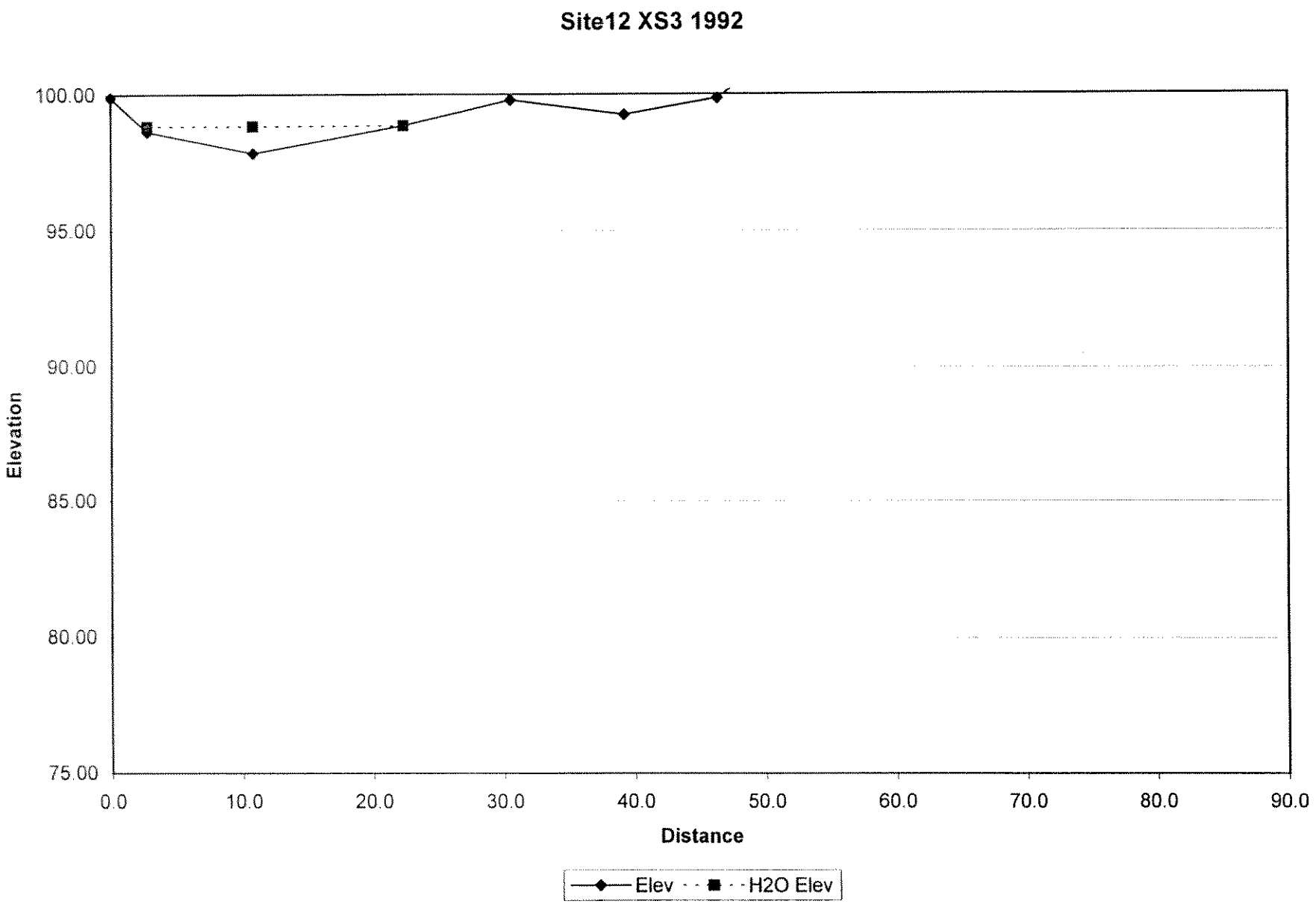
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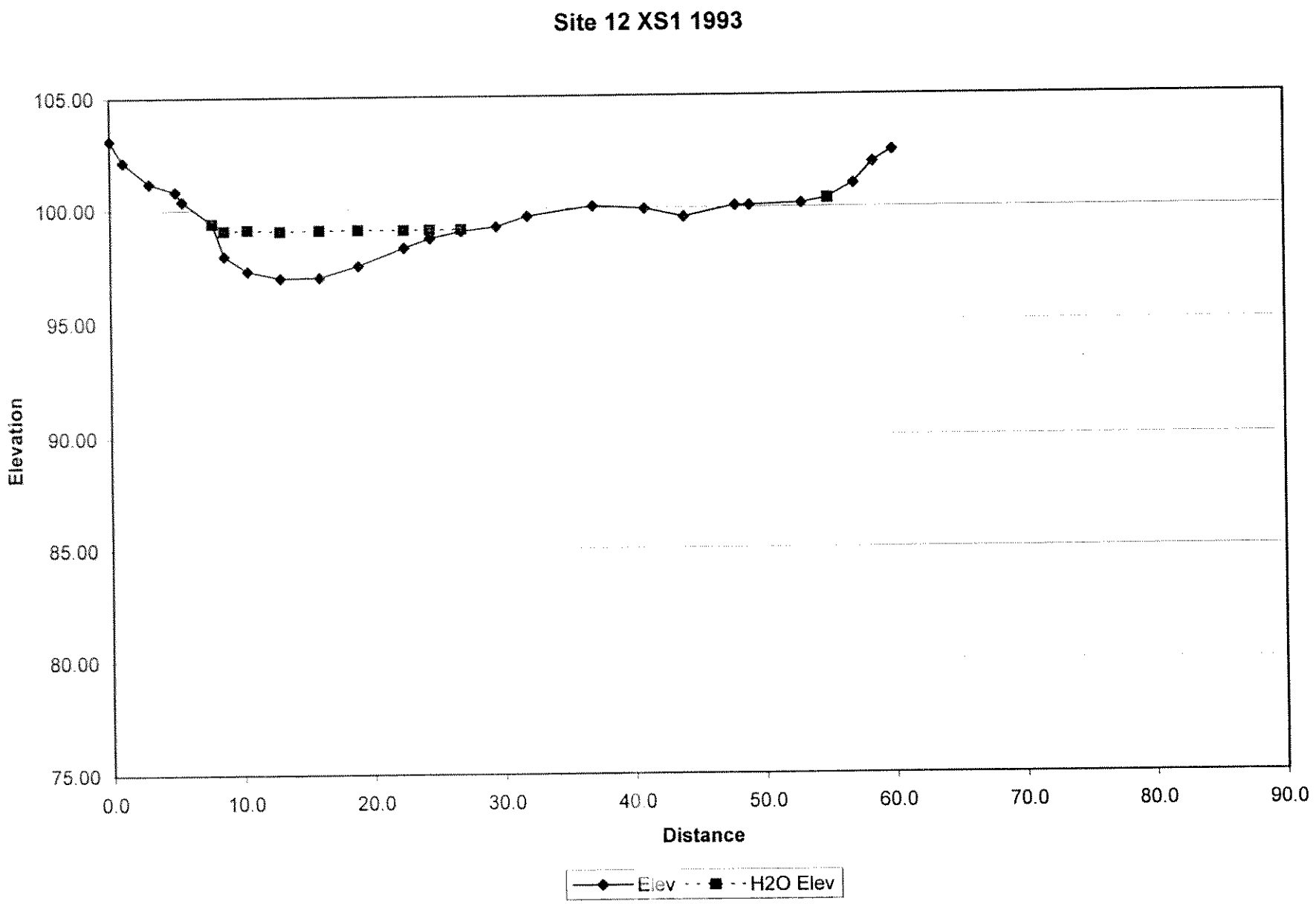
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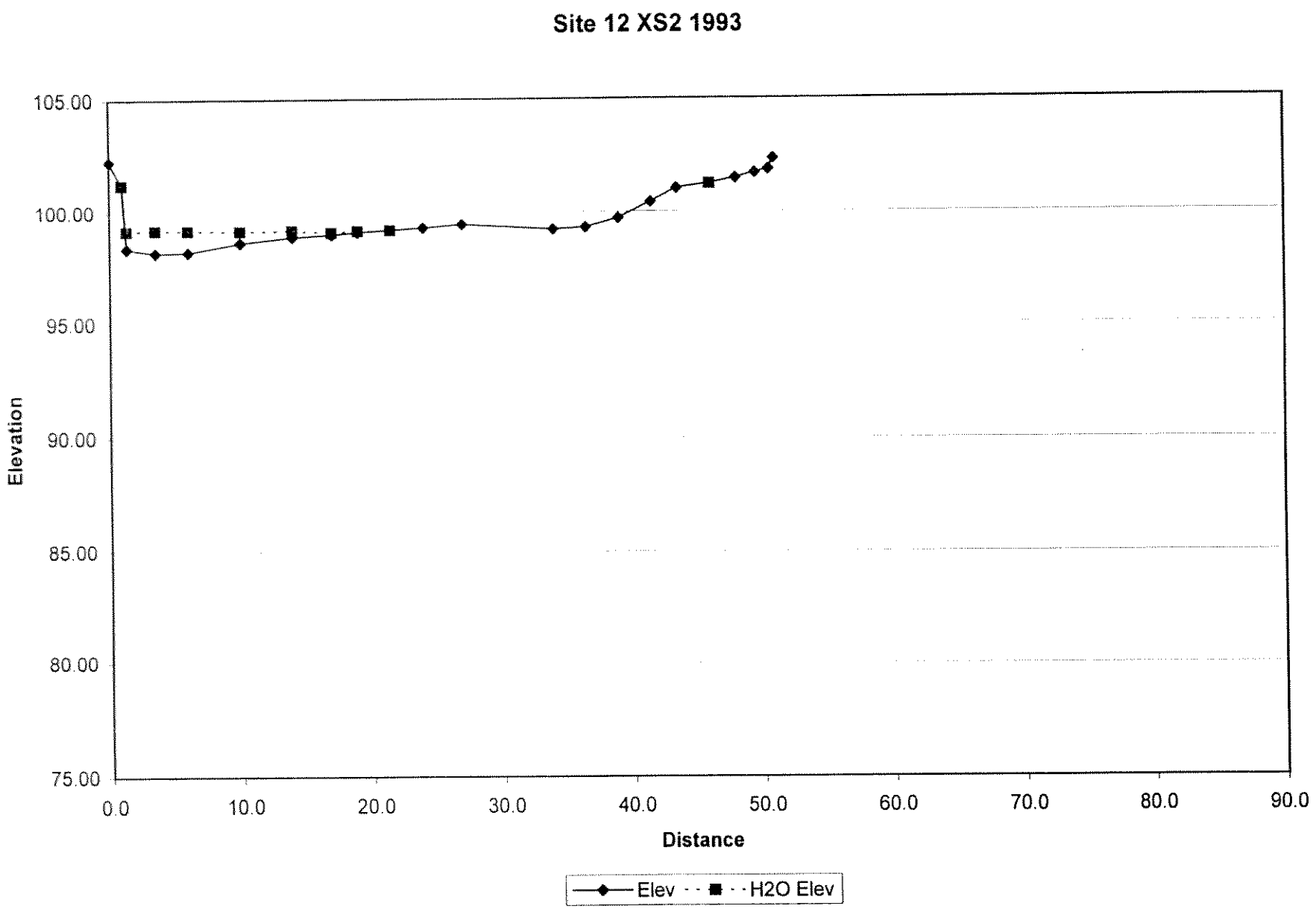
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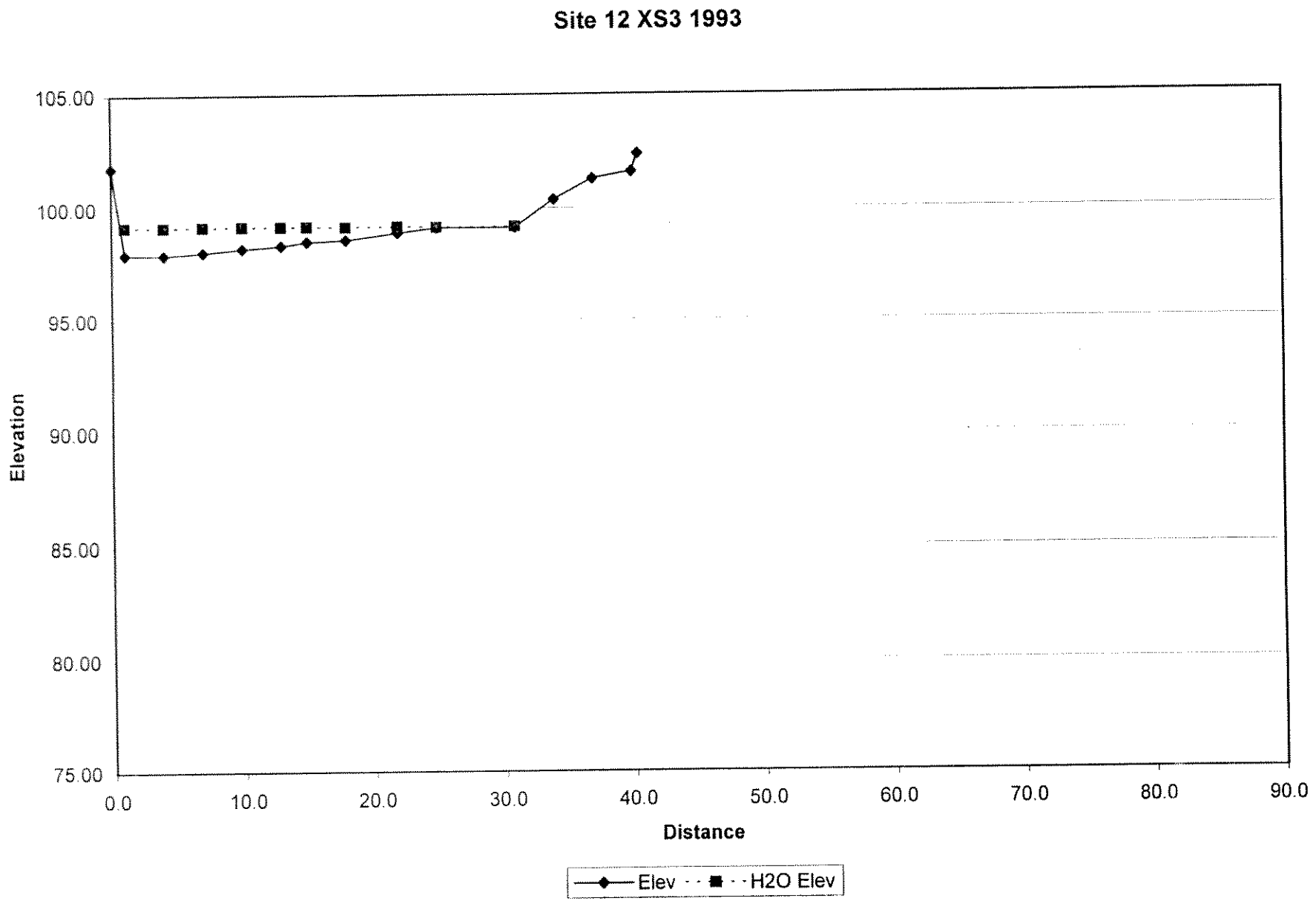
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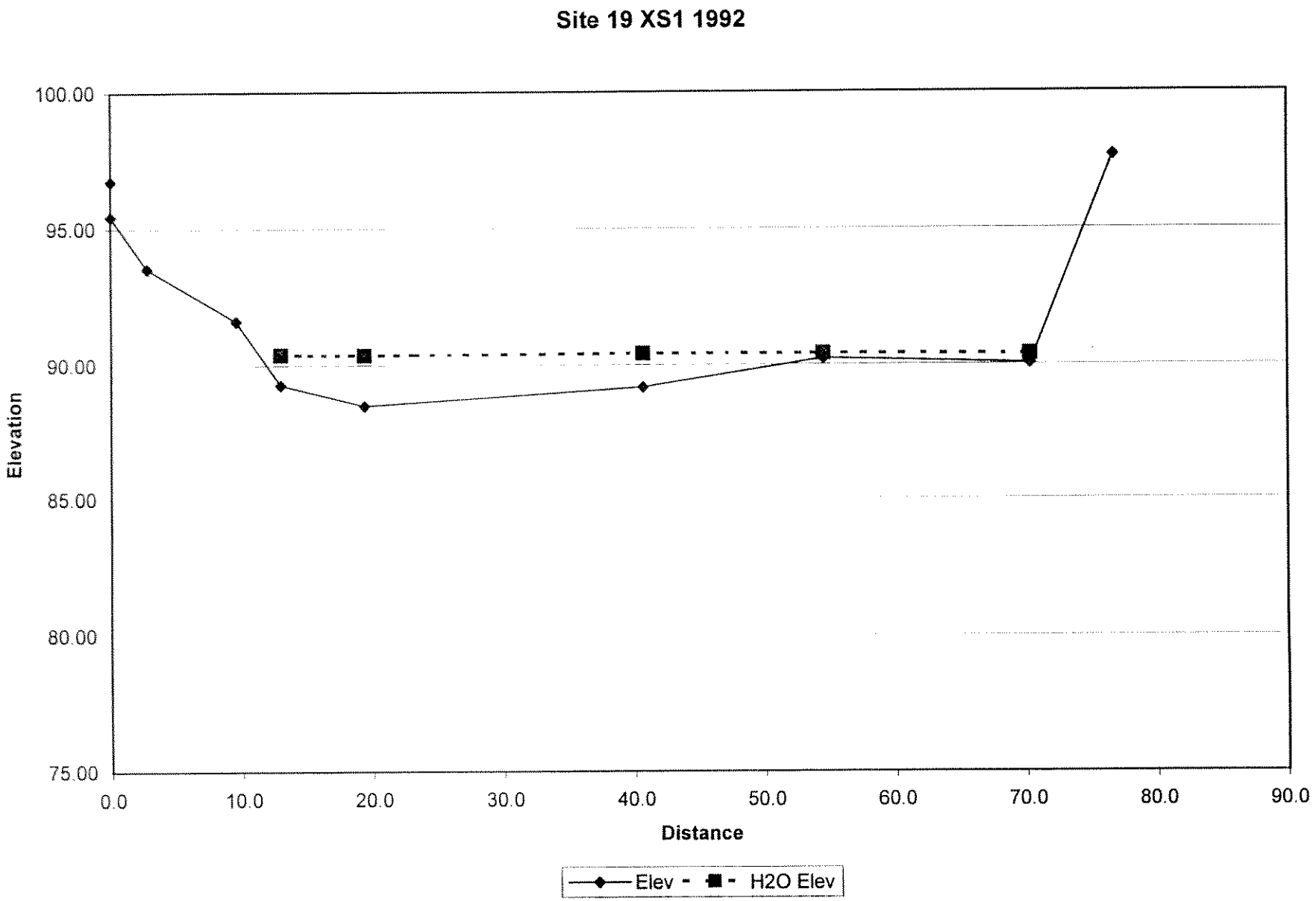
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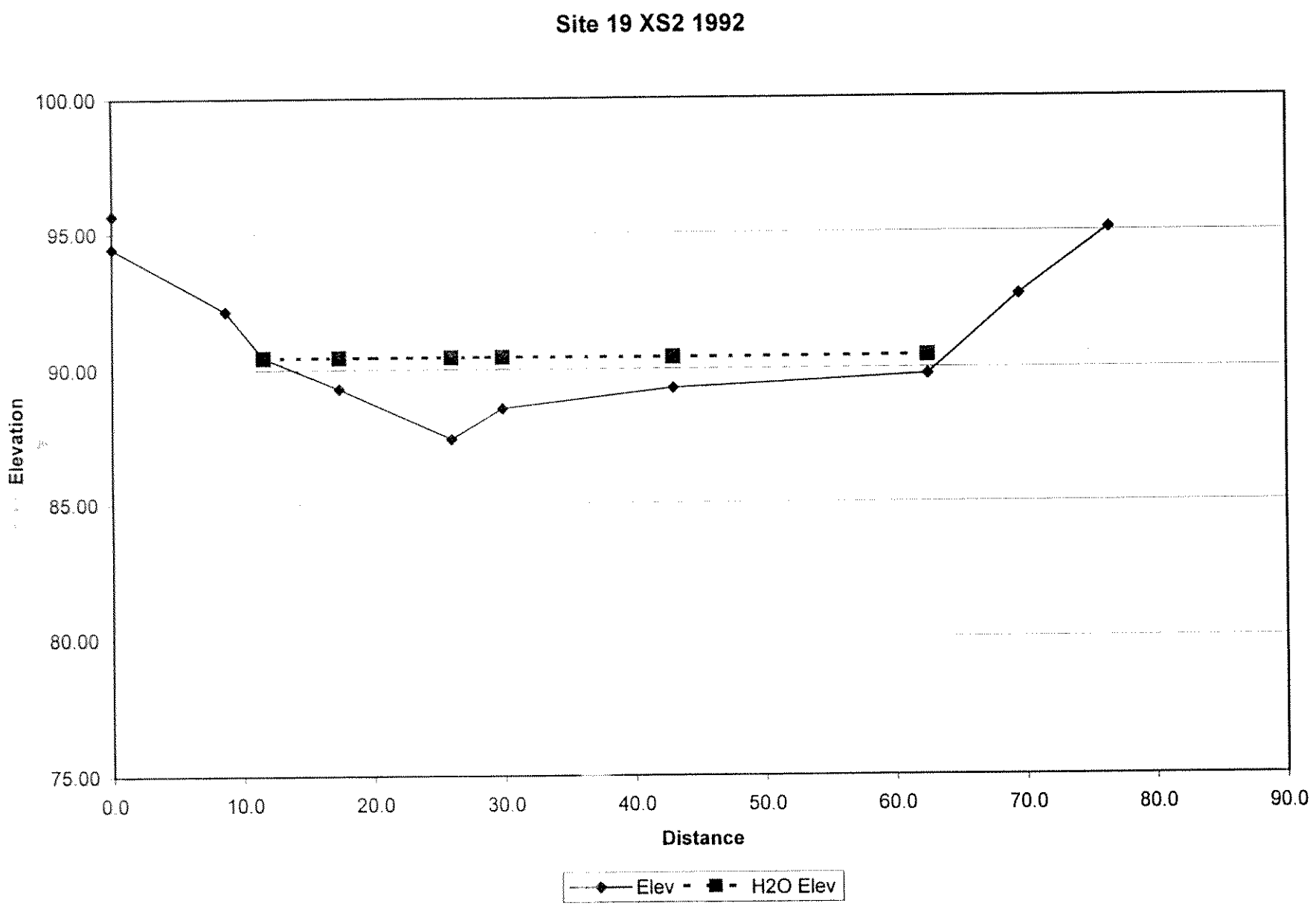
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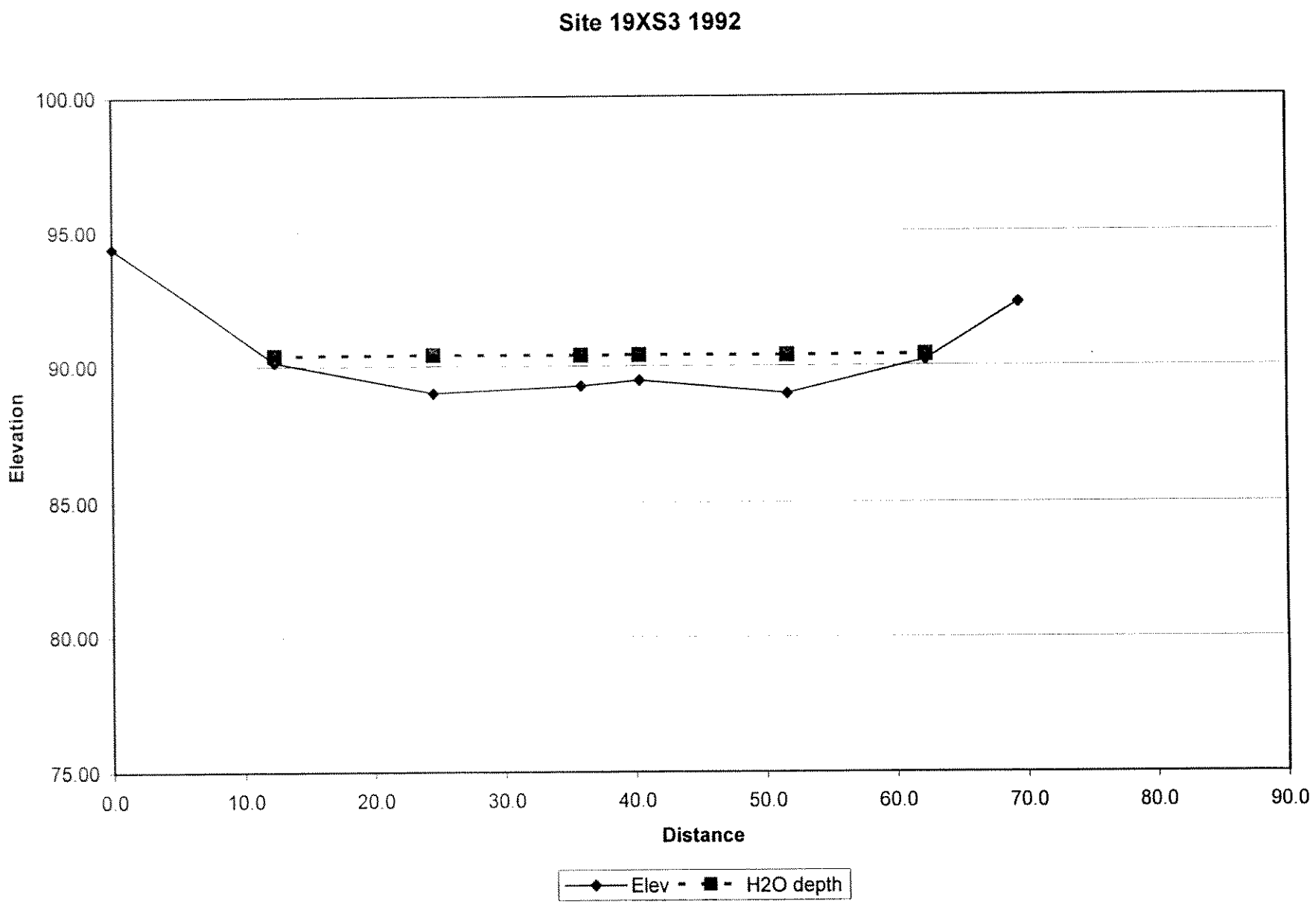
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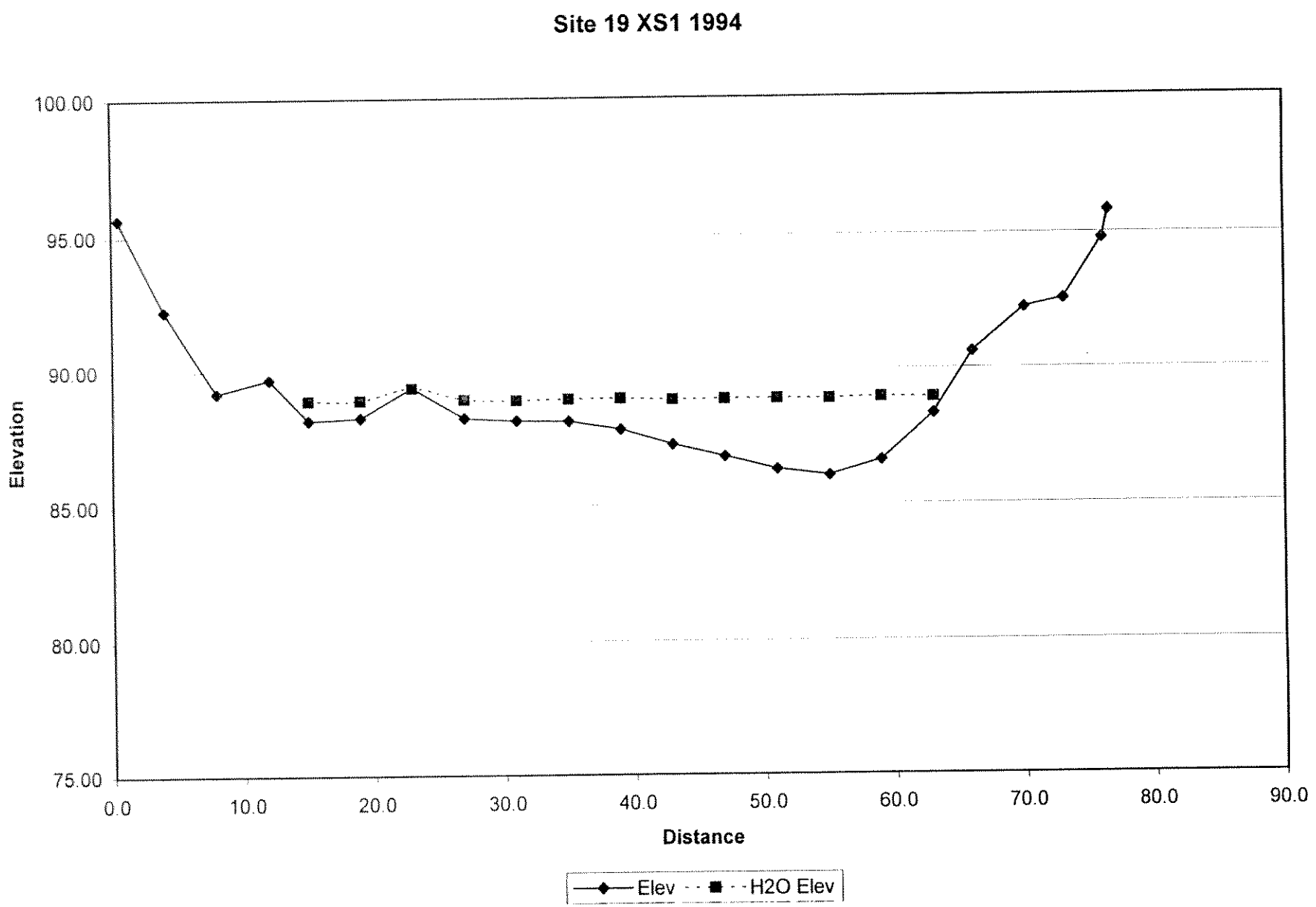
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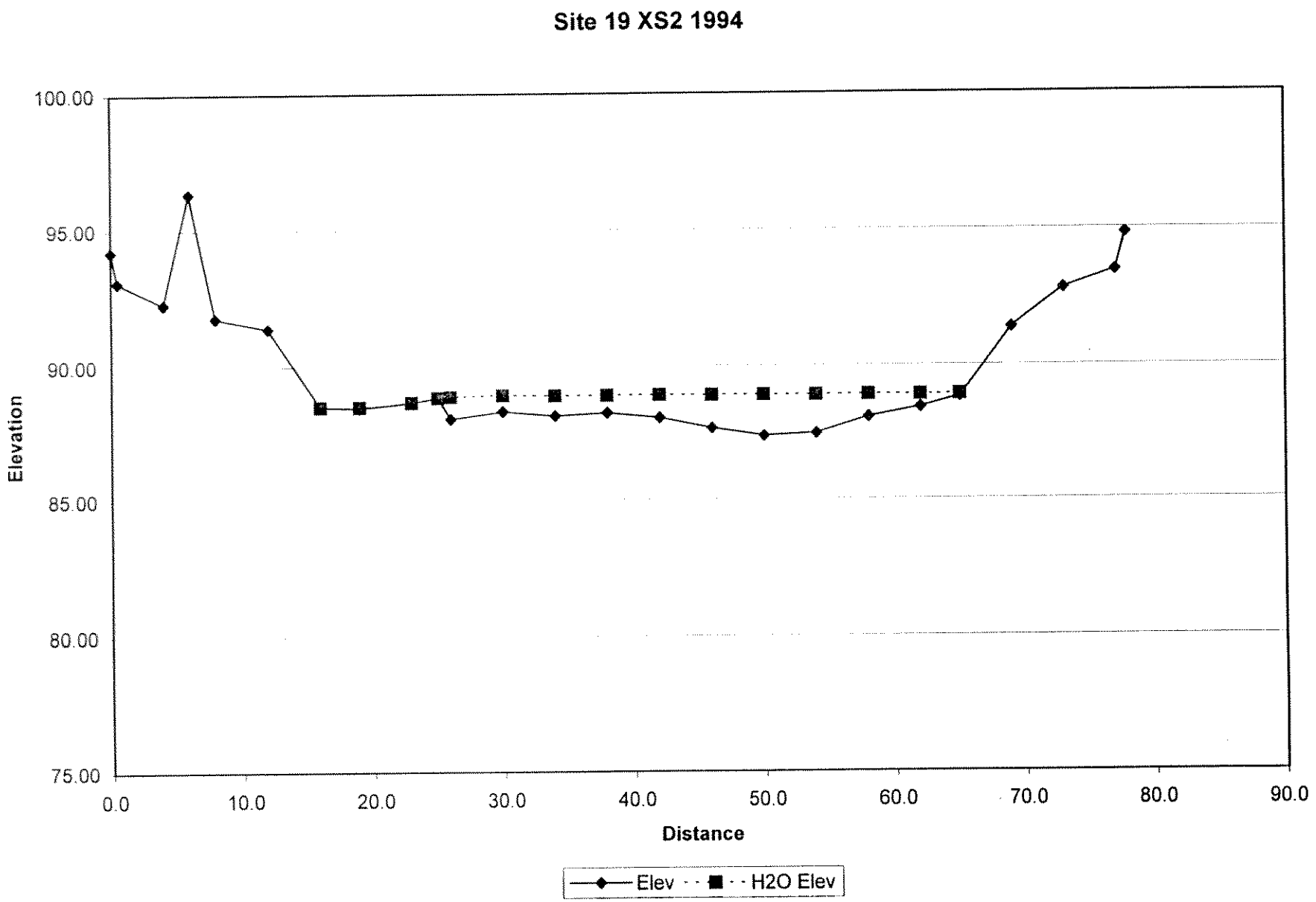
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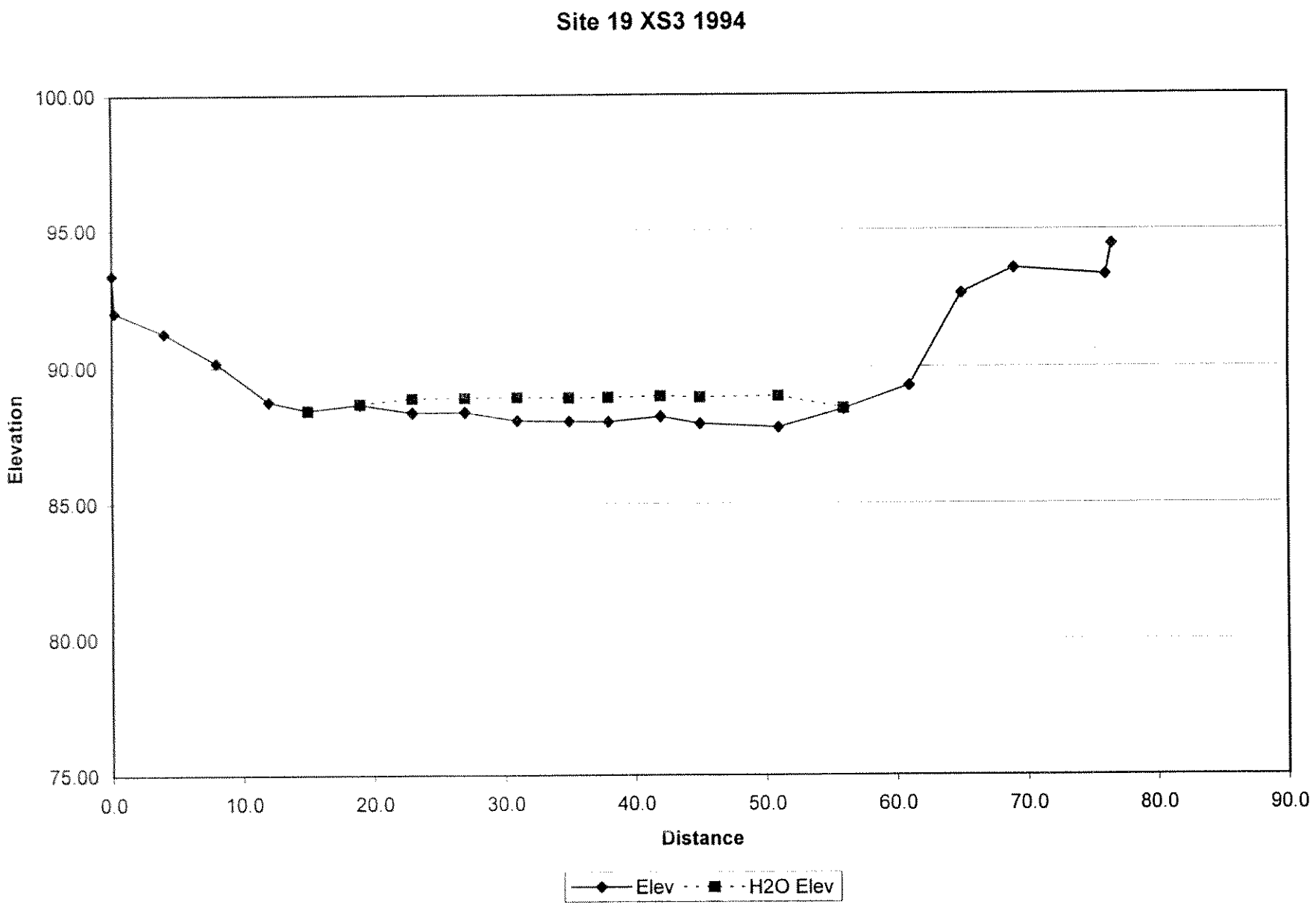
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Distance
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GEOMETRIC MEAN & PERCENT FINES BREAK DOWN FOR PINE1A
ILLECTED -9/3/92
ERCENT FINES FOR THIS SAMPLE ARE BASED ON GRAIN SIZES < 1.000 mm

AMPLE #	Dg1 mm	Dg2 mm	Percent Fines	Percent of Sample retained by given Sieve <.125	<1.0	<4.0	<32.0	<100
1	7.77	5.50	11.88	1.65	10.24	26.96	50.40	10.75
2	6.32	4.50	20.54	2.43	18.11	23.35	42.26	13.84
3	8.29	5.17	18.47	5.50	12.97	16.32	41.51	23.71
4	6.45	3.84	26.37	5.75	20.62	10.95	44.96	17.72

VERAGES FOR ALL 4 SAMPLES:

7.21	4.75	19.31	3.83	15.48	19.40	44.78	16.51

ESULTS FOR PINE1A COLLECTED - 9/3/92

AMPLE #	QUALITY INDICES: GEOM. MEAN	SORT. COEF.	FREDLE INDEX	DISTRIBUTION DESCRIPTORS: STANDARD DEV.	SKEW	KURTOSIS
1	7.77	2.584	3.005	4.1094	0.2013	0.6357
2	6.32	3.443	1.836	6.1485	0.1120	0.4242
3	8.29	4.023	2.062	5.9066	-.0061	0.5391
4	6.45	4.804	1.343	8.5686	-.0233	0.3755
VERAGES	7.21	3.714	2.061	6.433	0.0710	0.4936

INDEX	SAMPLE #	MEAN	STANDARD DEV	95 % CONFID. INTRVL
Dg	4	7.208	0.975	(5.658 - 8.758)
SO	4	3.714	0.937	(2.224 - 5.203)
FI	4	2.061	0.697	(0.953 - 3.170)

SS TO EMERGENCE SURVIVAL RATES FOR STEELHEAD, COHO & CHINOOK SALMON BASED ON
5 PERCENT CONFIDENCE INTERVALS for Dg & FI.

	Confidence Interval Ranges Lower		Higher	Based on Average Dg and FI
EELHEAD	16.48 %	to	65.35 %	48.32 % *
HO	-5.60 %	to	48.61 %	27.92 % *
INOOK	6.08 %	to	16.19 %	10.22 %

STEELHEAD & COHO SURVIVAL RATES BASED ON FI
CHINOOK SURVIVAL RATES BASED ON (Dg/Egg diameter) RELATIONSHIP

EOMETRIC MEANS, STAND. DEV.'S, & PERCENTILES FOR PINE1A
ILLECTED -9/3/92

MPL #	Dg1	Sd	D5	D16	D25	D50	D75	D84	D95
1	7.77	4.11	0.38	1.34	2.19	5.84	14.61	22.60	38.35
2	6.32	6.15	0.23	0.73	1.36	5.16	16.08	27.65	40.77
3	8.29	6.91	0.12	0.75	1.85	8.39	29.92	35.71	45.68
4	6.45	8.57	0.12	0.45	0.91	6.78	20.94	32.91	42.93
verages for all 4 samples									
	7.21	6.43	1.25	0.82	1.57	6.54	20.39	29.72	41.93

GEOMETRIC MEAN & PERCENT FINES BREAK DOWN FOR PINE1B
COLLECTED - 10/9/92
PERCENT FINES FOR THIS SAMPLE ARE BASED ON GRAIN SIZES < 1.000 mm

SAMPLE #	Dg1 mm	Dg2 mm	Percent Fines	Percent of Sample retained by given Sieve <.125	<1.0	<4.0	<32.0	<100
1	9.13	5.18	18.47	7.83	10.64	16.34	30.05	35.13
2	8.64	6.93	11.85	6.22	5.63	23.22	44.03	20.90
3	10.41	6.95	13.61	6.49	7.12	17.22	37.84	31.32
4	5.08	3.01	17.79	4.58	13.21	28.80	51.76	1.65

AVERAGES FOR ALL 4 SAMPLES:

	8.32	5.52	15.43	6.28	9.15	21.40	40.92	22.25

RESULTS FOR PINE1B COLLECTED - 10/9/92

SAMPLE #	QUALITY INDICES: GEOM. MEAN	SORT. COEF.	FREDLE INDEX	DISTRIBUTION DESCRIPTORS: STANDARD DEV	SKEW	KURTOSIS
1	9.13	4.380	2.085	7.6361	-.1119	0.5296
2	8.64	3.225	2.678	4.9710	0.0642	0.8666
3	10.41	3.594	2.897	5.5309	-.0575	0.7814
4	5.08	2.317	2.193	3.6465	0.1234	0.9071
AVERAGES	8.32	3.379	2.463	5.446	0.0046	0.7712

INDEX	SAMPLE n	MEAN	STANDARD DEV	95 % CONFID. INTRVL
Dg	4	8.316	2.281	(4.689 - 11.944)
SO	4	3.379	0.856	(2.018 - 4.740)
FI	4	2.463	0.387	(1.847 - 3.080)

EGG TO EMERGENCE SURVIVAL RATES FOR STEELHEAD, COHO & CHINOOK SALMON BASED ON
95 PERCENT CONFIDENCE INTERVALS for Dg & FI

	Confidence Interval Ranges Lower		Higher	Based on average Dg and FI
STEELHEAD	43.88 %	to	64.23 %	55.46 % *
COHO	22.15 %	to	45.35 %	35.65 % *
CHINOOK	4.43 %	to	33.50 %	14.49 %

* STEELHEAD & COHO SURVIVAL RATES BASED ON FI
CHINOOK SURVIVAL RATES BASED ON (Dg/Egg diameter) RELATIONSHIP

GEOMETRIC MEANS, STAND. DEV.'s, & PERCENTILES FOR PINE1B
COLLECTED - 10/9/92

SMPL #	Dg1	Sg	D5	D16	D25	D50	D75	D84	D95
1	9.13	7.64	0.10	0.68	1.85	11.46	35.41	39.57	49.39
2	8.64	4.97	0.11	1.39	2.42	7.79	25.21	34.44	44.44
3	10.41	5.53	0.11	1.26	2.65	11.49	34.26	38.42	48.30
4	5.08	3.65	0.14	0.82	1.51	4.33	8.13	10.97	19.93
Averages for all 4 samples									
	8.32	5.45	1.25	1.04	2.11	8.77	25.75	30.85	40.51

GEOMETRIC MEAN & PERCENT FINES BREAK DOWN FOR PINE1C
OLLECTED :10/14/93
PERCENT FINES FOR THIS SAMPLE ARE BASED ON GRAIN SIZES < 1.000 mm

SAMPLE #	Dg1 mm	Dg2 mm	Percent Fines	Percent of Sample retained by given Sieve <.125	<1.0	<4.0	<32.0	<100
1	6.81	4.60	14.83	2.36	12.47	26.22	50.40	8.55
2	4.16	2.19	20.34	2.85	17.49	35.28	44.38	0.00
3	43.96	32.73	2.21	1.44	0.77	0.77	18.78	78.23
4	19.32	12.70	10.99	2.16	8.83	5.28	37.30	46.43
5	7.28	5.50	14.55	1.62	12.93	27.55	44.20	13.70
6	12.29	7.79	11.90	3.22	8.68	14.63	43.41	30.05
7	18.78	10.75	3.60	1.30	2.31	21.61	26.89	47.90

VERAGES FOR ALL 7 SAMPLES:

	16.08	10.89	11.20	2.14	9.07	18.76	37.91	32.12

ESULTS FOR PINE1C COLLECTED : 10/14/93

SAMPLE #	<----QUALITY INDICES----> GEOM. MEAN	SORT. COEF.	FREDLE INDEX	<--DISTRIBUTION DESCRIPTORS----> STANDARD DEV.	SKEW	KURTOSIS
1	6.81	2.628	2.590	4.2510	0.1685	0.6928
2	4.16	2.097	1.986	3.0233	0.2163	0.7274
3	43.96	1.188	36.996	1.5391	0.2749	1.5851
4	19.32	2.298	8.406	3.3620	-.2739	1.0646
5	7.28	2.976	2.445	5.0079	0.1710	0.4934
6	12.29	3.091	3.976	4.8756	-.0074	0.6631
7	18.78	3.133	5.995	4.0064	-.2755	0.3534
AVERAGES	16.08	2.487	8.913	3.724	0.0391	0.7971

INDEX	SAMPLE n	MEAN	STANDARD DEV	95 % CONFID. INTRVL
DG	7	16.085	13.632	(3.461 - 28.709)
SO	7	2.487	0.697	(1.842 - 3.133)
FI	7	8.913	12.594	(0.000 - 20.575)

EGG TO EMERGENCE SURVIVAL RATES FOR STEELHEAD, COHO & CHINOOK SALMON BASED ON
95 PERCENT CONFIDENCE INTERVALS for Dg & FI.

	Confidence interval Ranges Lower		Higher	Based on Average Dg and FI
TEELHEAD	43.88 %	to	95.00 %	95.00 % *
OHO	23.15 %	to	95.00 %	91.50 % *
HINOOK	2.36 %	to	94.17 %	56.61 %

* STEELHEAD & COHO SURVIVAL RATES BASED ON FI
CHINOOK SURVIVAL RATES BASED ON (Dg/Egg diameter) RELATIONSHIP

GEOMETRIC MEANS, STAND. DEV.'s, & PERCENTILES FOR PINE1C
OLLECTED :10/14/93

SMPL #	Dg1	Sd	D5	D16	D25	D50	D75	D84	D95
1	6.81	4.25	0.27	1.08	1.86	5.33	12.85	19.53	36.41
2	4.16	3.02	0.21	0.72	1.25	3.28	5.48	6.62	9.65
3	43.96	1.56	6.39	*21.27	32.86	39.05	46.40	50.38	59.35
[illegible]	[illegible]	[illegible]	[illegible]	2.78	7.30	26.92	38.54	42.58	52.37

6	12.29	4.88	0.25	1.60	3.54	12.43	33.62	37.99	41.88
7	18.78	4.01	1.23	2.68	3.97	27.52	38.92	43.06	52.67

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verages for all 7 samples

	16.08	3.72	1.14	4.60	7.52	17.15	27.49	32.54	42.72

GEOMETRIC MEAN & PERCENT FINES BREAK DOWN FOR PINE2
LLECTED :7/1/92
ERCENT FINES FOR THIS SAMPLE ARE BASED ON GRAIN SIZES < 1.000 mm

AMPLE #	Dg1 mm	Dg2 mm	Percent Fines	Percent of Sample retained by given Sieve <.125	<1.0	<4.0	<32.0	<100
1	9.92	5.97	16.53	3.81	12.72	16.09	38.25	29.13
2	8.20	5.37	16.16	5.11	11.05	15.27	54.12	14.45
3	7.08	5.00	18.20	3.39	14.80	21.50	45.12	15.18
4	6.09	4.84	17.63	3.99	13.64	28.61	39.88	13.88

ERAGES FOR ALL 4 SAMPLES:

7.83	5.30	17.13	4.08	13.05	20.37	44.34	18.16

SULTS FOR PINE2 OOLLECTED : 7/1/92

		<----QUALITY INDICES----->	<--DISTRIBUTION DESCRIPTORS---->				
AMPLE #	GEOM. MEAN	SORT. COEF.	FREDLE INDEX	STANDARD DEV.	SKEW	KURTOSIS
1	9.92	3.889	2.551	6.3047	-.0155	0.5125
2	8.20	2.844	2.884	5.4825	0.0403	0.7066
3	7.08	3.309	2.141	6.0747	0.0841	0.4867
4	6.09	3.191	1.909	5.6898	0.1470	0.5768
ERAGES	7.83	3.308	2.371	5.888	0.0637	0.5707

INDEX	SAMPLE n	MEAN	STANDARD DEV	95 % CONFID. INTRVL
DG	4	7.825	1.641	(5.216 - 10.434)
SO	4	3.308	0.435	(2.617 - 3.999)
FI	4	2.371	0.433	(1.683 - 3.059)

GG TO EMERGENCE SURVIVAL RATES FOR STEELHEAD, COHO & CHINOOK SALMON BASED ON
5 PERCENT CONFIDENCE INTERVALS for Dg & FI.

	Confidence Interval Ranges Lower		Higher	Based on Average Dg and FI
EELHEAD	40.10 %	to	63.97 %	53.94 % *
HO	19.12 %	to	45.06 %	34.00 % *
INOOK	5.33 %	to	24.21 %	12.60 %

STEELHEAD & COHO SURVIVAL RATES BASED ON FI
CHINOOK SURVIVAL RATES BASED ON (Dg/Egg diameter) RELATIONSHIP

EOMETRIC MEANS, STAND. DEV.'s, & PERCENTILES FOR PINE2
OLLECTED :7/1/92

MPL #	Dg1	Sd	D5	D16	D25	D50	D75	D84	D95
1	9.92	6.30	0.18	0.95	2.22	10.23	33.50	37.67	47.57
2	8.20	5.48	0.12	0.98	2.36	7.66	19.07	29.46	41.18
3	7.08	6.07	0.19	0.82	1.65	6.09	18.08	30.37	41.58
4	6.09	5.69	0.17	0.85	1.53	4.72	15.58	27.54	40.85
verages for all 4 samples									
	7.83	5.89	1.25	0.90	1.94	7.17	21.56	31.26	42.80

GEOMETRIC MEAN & PERCENT FINES BREAK DOWN FOR PINE2B
COLLECTED :7/1/93
PERCENT FINES FOR THIS SAMPLE ARE BASED ON GRAIN SIZES < 1.000 mm

SAMPLE #	Dg1 mm	Dg2 mm	Percent Fines	Percent of Sample retained by given Sieve <.125	<1.0	<4.0	<32.0	<100
1	7.81	4.91	21.55	1.88	19.67	15.12	44.00	19.33
2	8.56	6.46	12.31	1.65	10.66	24.62	47.24	15.83
3	10.40	7.63	9.31	1.24	8.07	24.81	43.46	22.42

AVERAGES FOR ALL 3 SAMPLES:

	8.92	6.34	14.39	1.59	12.80	21.52	44.90	19.19

RESULTS FOR PINE2B COLLECTED : 7/1/93

SAMPLE #	!<----QUALITY INDICES----> GEOM. MEAN	SORT. COEF.	FREDLE INDEX	!<--DISTRIBUTION DESCRIPTORS----> STANDARD DEV.	SKEW	KURTOSIS
1	7.81	4.033	1.936	6.8685	0.0434	0.3340
2	8.56	2.919	2.932	4.9013	0.1560	0.4918
3	10.40	3.207	3.243	4.6091	0.1385	0.4749
AVERAGES	8.92	3.387	2.704	5.460	0.1127	0.4336

INDEX	SAMPLE n	MEAN	STANDARD DEV	95 % CONFID. INTRVL
DG	3	8.923	1.336	(5.607 - 12.239)
SO	3	3.387	0.578	(1.950 - 4.823)
FI	3	2.704	0.683	(1.008 - 4.400)

EGG TO EMERGENCE SURVIVAL RATES FOR STEELHEAD, COHO & CHINOOK SALMON BASED ON 95 PERCENT CONFIDENCE INTERVALS for Dg & FI.

	Confidence Interval Ranges Lower		Higher	Based on Average Dg and FI
STEELHEAD	18.82 %	to	77.74 %	59.14 % *
COHO	-3.17 %	to	60.84 %	39.70 % *
CHINOOK	5.99 %	to	35.32 %	16.82 %

* STEELHEAD & COHO SURVIVAL RATES BASED ON FI
CHINOOK SURVIVAL RATES BASED ON (Dg/Egg diameter) RELATIONSHIP

GEOMETRIC MEANS, STAND. DEV.'s, & PERCENTILES FOR PINE2B
COLLECTED :7/1/93

SMPL #	Dg1	Sd	D5	D16	D25	D50	D75	D84	D95
1	7.81	6.87	0.26	0.72	1.42	7.18	23.04	33.75	43.76
2	8.56	4.90	0.37	1.32	2.25	6.68	19.16	31.66	41.93
3	10.40	4.61	0.50	1.66	2.71	8.42	27.86	35.18	45.17
Averages for all 3 samples	8.92	5.46	1.33	1.23	2.12	7.43	23.35	33.53	43.62

GEOMETRIC MEAN & PERCENT FINES BREAK DOWN FOR PINE2C
OLLECTED :7/1/94
PERCENT FINES FOR THIS SAMPLE ARE BASED ON GRAIN SIZES < 1.000 mm

SAMPLE #	Dg1 mm	Dg2 mm	Percent Fines	Percent of Sample retained by given Sieve <.125	<1.0	<4.0	<32.0	<100
1	10.96	7.80	9.10	1.15	7.95	19.82	52.91	18.17
2	9.39	6.51	13.69	2.11	11.58	21.41	42.35	22.54
VERAGES FOR ALL 2 SAMPLES:								
	10.18	7.15	11.40	1.63	9.77	20.61	47.63	20.36

ESULTS FOR PINE2C COLLECTED : 7/1/94

SAMPLE #	<----QUALITY INDICES----> GEOM. MEAN	SORT. COEF.	FREDLE INDEX	<--DISTRIBUTION DESCRIPTORS----> STANDARD DEV.	SKEW	KURTOSIS
1	10.96	2.660	4.122	4.2520	0.1527	0.5286
2	9.39	3.520	2.668	5.4143	0.0886	0.4854
VERAGES	10.18	3.090	3.395	4.833	0.1207	0.5070

INDEX	SAMPLE n	MEAN	STANDARD DEV	95 % CONFID. INTRVL
DG	2	10.177	1.113	(0.175 - 20.180)
SO	2	3.090	0.608	(0.000 - 8.555)
FI	2	3.395	1.028	(0.000 - 12.636)

GG TO EMERGENCE SURVIVAL RATES FOR STEELHEAD, COHO & CHINOOK SALMON BASED ON
5 PERCENT CONFIDENCE INTERVALS for Dg & FI.

	Confidence Interval Ranges Lower		Higher	Based on Average Dg and FI
TEELHEAD	18.82 %	to	95.00 %	67.99 % *
HO	-3.17 %	to	95.00 %	49.58 % *
INOOK	0.11 %	to	74.91 %	22.63 %

* STEELHEAD & COHO SURVIVAL RATES BASED ON FI
CHINOOK SURVIVAL RATES BASED ON (Dg/Egg diameter) RELATIONSHIP

GEOMETRIC MEANS, STAND. DEV.'s, & PERCENTILES FOR PINE2C
OLLECTED :7/1/94

SMPL #	Dg1	Sd	D5	D16	D25	D50	D75	D84	D95
1	10.96	4.25	0.52	1.83	3.24	8.79	22.90	33.15	43.17
2	9.39	5.41	0.30	1.20	2.26	8.09	27.97	35.25	45.23
Averages for all 2 samples									
	10.18	4.83	1.50	1.52	2.75	8.44	25.43	34.20	44.20

GEOMETRIC MEAN & PERCENT FINES BREAK DOWN FOR PINE3A
NLECTED ·10/1/92
PERCENT FINES FOR THIS SAMPLE ARE BASED ON GRAIN SIZES < 1.000 mm

SAMPLE #	Dg1 mm	Dg2 mm	Percent Fines	Percent of Sample retainef by given Sieve <.125	<1.0	<4.0	<32.0	<100
1	13.54	7.69	12.56	3.61	8.95	17.37	25.98	44.10
2	4.93	2.87	26.84	7.35	19.49	16.83	46.35	9.97
3	11.10	7.09	12.96	2.59	10.38	19.43	36.35	31.24
4	5.73	3.87	23.87	6.00	17.88	19.44	41.42	15.27
VERAGES FOR ALL 4 SAMPLES:								
	8.83	5.38	19.06	4.89	14.17	18.27	37.53	25.15

ESULTS FOR PINE3A COLLECTED · 10/1/92

SAMPLE #	GEOM. MEAN (<----QUALITY INDICES----)	SORT. COEF.	FREDLE INDEX	STANDARD DEV. (<--DISTRIBUTION DESCRIPTORS----)	SKEW	KURTOSIS
1	13.54	3.638	3.723	5.4765	-.2401	0.6145
2	4.93	3.918	1.259	7.3603	-.0083	0.4827
3	11.10	3.668	3.025	5.4157	0.0082	0.5278
4	5.73	4.004	1.432	7.8606	0.0337	0.4311
VERAGES	8.83	3.807	2.360	6.528	-.0516	0.5140

INDEX	SAMPLE n	MEAN	STANDARD DEV	95 % CONFID. INTRVL
DG	4	8.826	4.170	(2.197 - 15.456)
SO	4	3.807	0.182	(3.518 - 4.096)
FI	4	2.360	1.208	(0.439 - 4.280)

GG TO EMERGENCE SURVIVAL RATES FOR STEELHEAD, COHO & CHINOOK SALMON BASED ON
5 PERCENT CONFIDENCE INTERVALS for Dg & FI.

	Confidence Interval Ranges Lower		Higher	Based on Average Dg and FI
TEELHEAD	%-16.36 %	to	76.73 %	53.75 % *
HO	%-39.21 %	to	59.65 %	33.79 % *
HINOOK	1.35 %	to	53.22 %	16.45 %

: STEELHEAD & COHO SURVIVAL RATES BASED ON FI
CHINOOK SURVIVAL RATES BASED ON (Dg/Egg diameter) RELATIONSHIP

EOMETRIC MEANS, STAND. DEV.'s, & PERCENTILES FOR PINE3A
OLLECTED ·10/1/92

MPL #	Dg1	Sd	D5	D16	D25	D50	D75	D84	D95
1	13.54	5.48	0.21	1.40	2.87	20.37	37.96	42.11	51.78
2	4.93	7.36	0.10	0.39	0.87	5.01	13.28	21.12	37.86
3	11.10	5.42	0.28	1.31	2.54	10.94	34.23	38.39	48.27
4	5.73	7.86	0.11	0.49	1.08	5.35	17.36	30.44	41.63
verages for all 4 samples									
	8.83	6.53	1.25	0.90	1.84	10.42	25.71	33.01	44.89

40 63

GEOMETRIC MEAN & PERCENT FINES BREAK DOWN FOR PINE30
OLLECTED - 10/1/93
PERCENT FINES FOR THIS SAMPLE ARE BASED ON GRAIN SIZES < 1.000 mm

SAMPLE #	Dg1 mm	Dg2 mm	Percent Fines	Percent of Sample retained by given Sieve <.125	<1.0	<4.0	<32.0	<100
1	11.39	5.46	17.65	8.02	9.63	6.60	40.31	35.43
2	10.06	5.63	17.03	10.22	6.81	15.08	27.03	40.87
3	9.68	6.81	13.81	8.16	5.65	17.80	38.47	29.92
4	4.28	2.45	25.17	7.79	17.38	23.42	45.98	5.43

VERAGES FOR ALL 4 SAMPLES:

8.85	5.09	18.42	8.55	9.87	15.73	37.95	27.91

ESULTS FOR PINE30 OOLLECTED - 10/1/93

SAMPLE #	<----QUALITY INDICES----> GEOM. MEAN	SORT. COEF.	FREDLE INDEX	<--DISTRIBUTION DESCRIPTORS----> STANDARD DEV.	SKEW	KURTOSIS
1	11.39	2.919	3.900	7.2540	-.1530	0.5727
2	10.06	4.107	2.450	7.3343	-.2375	0.6037
3	9.68	3.646	2.654	5.5705	-.0606	0.8075
4	4.28	3.163	1.355	6.0361	0.0136	0.6133
VERAGES	8.85	3.459	2.590	6.549	-.1094	0.6493

INDEX	SAMPLE n	MEAN	STANDARD DEV	95 % CONFID. INTRVL
DG	4	8.853	3.133	(3.872 - 13.834)
SO	4	3.459	0.528	(2.620 - 4.298)
FI	4	2.590	1.044	(0.931 - 4.249)

GGS TO EMERGENCE SURVIVAL RATES FOR STEELHEAD, COHO & CHINOOK SALMON BASED ON
95 PERCENT CONFIDENCE INTERVALS for Dg & FI

	Confidence Interval Ranges Lower		Higher	Based on Average Dg and FI
TEELHEAD	15.48 %	to	76.46 %	57.44 % *
OHO	-6.63 %	to	59.33 %	37.83 % *
HINOOK	3.05 %	to	44.49 %	16.55 %

* STEELHEAD & COHO SURVIVAL RATES BASED ON FI
CHINOOK SURVIVAL RATES BASED ON (Dg/Egg diameter) RELATIONSHIP

GEOMETRIC MEANS, STAND. DEV.'s, & PERCENTILES FOR PINE30
OOLLECTED - 10/1/93

SMPL #	Dg1	Sg	D5	D16	D25	D50	D75	D84	D95
1	11.39	7.25	0.10	0.75	4.16	15.42	35.47	39.64	49.45
2	10.06	7.33	0.09	0.77	2.20	16.16	37.11	41.27	50.99
3	9.68	5.57	0.10	1.22	2.54	10.74	33.78	37.94	47.84
4	4.28	6.04	0.10	0.41	0.98	4.18	9.84	14.80	32.60
Averages for all 4 samples									
	8.85	6.55	1.25	0.79	2.47	11.62	29.05	33.41	45.22

GEOMETRIC MEAN & PERCENT FINES BREAK DOWN FOR PINE3D
COLLECTED : 10/1/94
PERCENT FINES FOR THIS SAMPLE ARE BASED ON GRAIN SIZES < 1.000 mm

SAMPLE #	Dg1 mm	Dg2 mm	Percent Fines	Percent of Sample retained by given Sieve <.125	<1.0	<4.0	<32.0	<100
1	7.97	5.56	12.79	2.46	10.33	23.68	51.94	11.59
2	3.94	2.51	15.17	2.58	12.59	47.41	37.42	0.00
3	10.03	6.54	13.75	2.76	10.99	15.22	51.60	19.43
4	10.97	6.72	14.12	2.71	11.42	16.42	40.36	29.10
AVERAGES FOR ALL 4 SAMPLES:								
	8.23	5.33	13.96	2.63	11.33	25.68	45.33	15.03

RESULTS FOR PINE3D COLLECTED : 10/1/94

SAMPLE #	<----QUALITY INDICES----> GEOM. MEAN	SORT. COEF.	FREDLE INDEX	<--DISTRIBUTION DESCRIPTORS----> STANDARD DEV.	SKEW	KURTOSIS
1	7.97	2.644	3.015	4.3493	0.1535	0.6697
2	3.94	1.862	2.118	2.4287	0.3484	1.0124
3	10.03	2.888	3.472	5.1653	0.0641	0.5672
4	10.97	3.558	3.083	5.6024	0.0067	0.5171
AVERAGES	8.23	2.738	2.922	4.386	0.1432	0.6916

INDEX	SAMPLE n	MEAN	STANDARD DEV	95 % CONFID. INTRVL
DG	4	8.228	3.119	(3.270 - 13.187)
SO	4	2.738	0.700	(1.625 - 3.851)
FI	4	2.922	0.573	(2.011 - 3.833)

EGG TO EMERGENCE SURVIVAL RATES FOR STEELHEAD, COHO & CHINOOK SALMON BASED ON 95 PERCENT CONFIDENCE INTERVALS for Dg & FI.

	Confidence Interval Ranges Lower		Higher	Based on Average Dg and FI
STEELHEAD	47.33 %	to	72.60 %	62.19 % *
COHO	26.85 %	to	54.85 %	43.07 % *
CHINOOK	2.03 %	to	41.01 %	14.15 %

* STEELHEAD & COHO SURVIVAL RATES BASED ON FI
CHINOOK SURVIVAL RATES BASED ON (Dg/Egg diameter) RELATIONSHIP

GEOMETRIC MEANS, STAND. DEV.'s, & PERCENTILES FOR PINE3D
COLLECTED : 10/1/94

SMPL #	Dg1	Sg	D5	D16	D25	D50	D75	D84	D95
1	7.97	4.35	0.29	1.28	2.25	6.36	15.71	24.17	39.05
2	3.94	2.43	0.25	1.03	1.44	2.89	5.00	6.10	9.07
3	10.03	5.17	0.25	1.27	2.92	9.02	24.34	33.80	43.81
4	10.97	5.60	0.25	1.20	2.65	10.85	33.49	37.66	47.56
Averages for all 4 samples									
	8.23	4.39	1.25	1.19	2.31	7.28	19.64	25.43	34.87

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43

GEOMETRIC MEAN & PERCENT FINES BREAK DOWN FOR PO12A
COLLECTED - 10/14/92
PERCENT FINES FOR THIS SAMPLE ARE BASED ON GRAIN SIZES < 1.000 mm

SAMPLE #	Dg1 mm	Dg2 mm	Percent Fines	Percent of Sample retained by given Sieve <.125	<1.0	<4.0	<32.0	<100
1	11.13	8.05	8.52	1.91	6.61	19.58	53.20	18.69
2	9.60	6.18	8.08	1.54	6.53	20.50	64.51	6.91
3	8.94	6.80	11.14	3.02	8.12	22.59	50.99	15.28
4	7.58	5.44	12.85	4.55	8.30	23.44	52.71	10.99
AVERAGES FOR ALL 4 SAMPLES-								
	9.31	6.62	10.15	2.76	7.39	21.53	55.35	12.97

RESULTS FOR PO12A COLLECTED - 10/14/92

SAMPLE #	QUALITY INDICES: GEOM. MEAN	SORT. COEF.	FREDLE INDEX	DISTRIBUTION DESCRIPTORS: STANDARD DEV.	SKEW	KURTOSIS
1	11.13	2.640	4.216	4.1538	0.1430	0.5962
2	9.60	2.052	4.678	3.1482	0.2640	0.8190
3	8.94	2.720	3.286	4.5164	0.1260	0.6566
4	7.58	2.599	2.915	4.2660	0.1231	0.9048
AVERAGES	9.31	2.503	3.774	4.021	0.1640	0.7466

INDEX	SAMPLE n	MEAN	STANDARD DEV	95 % CONFID. INTRVL
D9	4	9.311	1.475	(6.966 - 11.656)
SO	4	2.503	0.305	(2.018 - 2.987)
FI	4	3.774	0.814	(2.479 - 5.068)

EGG TO EMERGENCE SURVIVAL RATES FOR STEELHEAD COHO & CHINOOK SALMON BASED ON
95 PERCENT CONFIDENCE INTERVALS for Dg & FI.

	Confidence Interval Ranges Lower		Higher	Based on Average Dg and FI
STEELHEAD	55.72 %	to	82.88 %	72.02 % *
COHO	35.94 %	to	66.98 %	54.18 % *
CHINOOK	9.29 %	to	31.73 %	18.31 %

* STEELHEAD & COHO SURVIVAL RATES BASED ON FI
CHINOOK SURVIVAL RATES BASED ON (Dg/Egg diameter) RELATIONSHIP

GEOMETRIC MEANS, STAND. DEV. (G), & PERCENTILES FOR PO12A
COLLECTED - 10/14/92

SMPL #	Dg1	Sg	D5	D16	D25	D50	D75	D84	D95
1	11.13	4.15	0.46	1.94	3.39	9.08	23.59	33.42	43.44
2	9.60	3.15	0.53	1.96	3.34	7.09	14.05	19.46	34.61
3	8.94	4.52	0.27	1.51	2.82	7.39	19.40	30.73	41.63
4	7.58	4.27	0.15	1.27	2.26	6.34	15.26	23.20	38.49
Averages for all 4 samples									
	9.31	4.02	1.25	1.67	2.90	7.47	18.08	26.70	39.54

41

GEOMETRIC MEAN & PERCENT FINES BREAK DOWN FOR RC12B
COLLECTED 9/15/93
PERCENT FINES FOR THIS SAMPLE ARE BASED ON GRAIN SIZES < 1.000 mm

SAMPLE #	Dg1 mm	Dg2 mm	Percent Fines	Percent of Sample retained by given Sieve <.125	<1.0	<4.0	<32.0	<100
1	10.76	7.79	8.62	0.00	8.62	30.41	31.34	29.63
2	10.67	5.80	18.20	1.54	16.66	14.39	34.63	32.79
3	7.34	6.16	14.46	2.03	12.42	32.01	31.99	21.55
AVERAGES FOR ALL 3 SAMPLES:								
	9.59	6.59	13.76	1.19	12.57	25.60	32.65	27.99

RESULTS FOR RC12B COLLECTED 9/15/93

SAMPLE #	<----QUALITY INDICES----> GEOM. MEAN	SORT. COEF.	FREDLE INDEX	<--DISTRIBUTION DESCRIPTORS----> STANDARD DEV.	SKEW	KURTOSIS
1	10.76	3.736	2.881	4.8544	0.1785	0.2992
2	10.67	4.125	2.588	6.6917	-.0330	0.3368
3	7.34	3.765	1.949	5.6434	0.2290	0.4508
AVERAGES	9.59	3.875	2.473	5.730	0.1248	0.3623

INDEX	SAMPLE n	MEAN	STANDARD DEV	95 % CONFID. INTRVL
DG	3	9.591	1.954	(4.741 - 14.442)
SO	3	3.875	0.217	(3.337 - 4.413)
FI	3	2.473	0.477	(1.289 - 3.656)

EGG TO EMERGENCE SURVIVAL RATES FOR STEELHEAD, COHO & CHINOOK SALMON BASED ON
95 PERCENT CONFIDENCE INTERVALS for Dg & FI

	Confidence Interval Ranges Lower		Higher	Based on Average Dg and FI
STEELHEAD	39.09 %	TO	70.82 %	55.61 % *
COHO	7.52 %	TO	52.80 %	35.82 % *
CHINOOK	4.52 %	TO	47.76 %	19.39 %

* STEELHEAD & COHO SURVIVAL RATES BASED ON FI
CHINOOK SURVIVAL RATES BASED ON (Dg/Egg diameter) RELATIONSHIP

GEOMETRIC MEANS, STAND. DEV.'s, & PERCENTILES FOR RC12B
COLLECTED 9/15/93

SMPL #	Dg1	SO	D5	D16	D25	D50	D75	D84	D95
1	10.76	4.85	0.79	1.61	2.41	8.12	33.68	37.84	47.74
2	10.67	6.69	0.30	0.87	2.04	11.37	34.65	38.83	48.69
3	7.34	5.64	0.30	1.09	1.73	4.94	24.50	34.75	44.74
Averages for all 3 samples									
	9.59	5.73	1.33	1.19	2.06	8.14	30.95	37.14	47.05

64

39

GEOMETRIC MEAN & PERCENT FINES BREAK DOWN FOR PO19A

COLLECTED :9/16/92

PERCENT FINES FOR THIS SAMPLE ARE BASED ON GRAIN SIZES < 1.000 mm

SAMPLE #	Dg1 mm	Dg2 mm	Percent Fines	Percent of Sample retained by given Sieve <.125	<1.0	<4.0	<32.0	<100
1	7.40	5.55	15.92	5.49	10.43	21.37	46.87	15.84
2	6.58	4.93	13.80	3.76	10.05	28.68	48.20	9.31
3	11.79	7.86	10.24	1.38	8.86	19.40	43.77	26.59
4	5.61	3.87	15.10	4.60	10.50	30.36	50.15	4.39

AVERAGES FOR ALL 4 SAMPLES:

7.85	5.55	13.77	3.81	9.96	24.95	47.25	14.03

RESULTS FOR PO19A COLLECTED : 9/16/92

SAMPLE #	(<----QUALITY INDICES----> GEOM. MEAN	SORT. COEF.	FREDLE INDEX	STANDARD DEV.	(<--DISTRIBUTION DESCRIPTORS----> SKEW	KURTOSIS
1	7.40	3.142	2.356	5.6109	0.0674	0.5995
2	6.58	2.634	2.498	4.2129	0.1856	0.8254
3	11.79	3.260	3.518	4.6777	0.0796	0.5054
4	5.61	2.393	2.342	3.6638	0.1611	1.0437
AVERAGES	7.85	2.857	2.704	4.541	0.1184	0.7685

INDEX	SAMPLE n	MEAN	STANDARD DEV	95 % CONFID. INTRVL
DG	4	7.846	2.733	(3.501 - 12.191)
SO	4	2.857	0.411	(2.203 - 3.511)
FI	4	2.704	0.614	(1.728 - 3.679)

EGG TO EMERGENCE SURVIVAL RATES FOR STEELHEAD, COHO & CHINOOK SALMON BASED ON 95 PERCENT CONFIDENCE INTERVALS FOR Dg & FI

	Confidence interval Ranges Lower		Higher	Based on Average Dg and FI
STEELHEAD	41.17 %	to	71.06 %	59.14 % *
COHO	20.26 %	to	53.04 %	39.70 % *
CHINOOK	2.42 %	to	35.02 %	12.68 %

* STEELHEAD & COHO SURVIVAL RATES BASED ON FI
CHINOOK SURVIVAL RATES BASED ON (Dg/Egg diameter) RELATIONSHIP

GEOMETRIC MEANS, STAND. DEV.'s, & PERCENTILES FOR PO19A

COLLECTED :9/16/92

SMPL #	Dg1	SD	D5	D16	D25	D50	D75	D84	D95
1	7.40	5.61	0.12	1.01	1.93	6.59	19.08	31.67	41.93
2	6.58	4.21	0.20	1.15	1.89	5.19	13.09	20.36	37.21
3	11.79	4.68	0.45	1.68	3.07	10.43	32.61	36.75	46.63
4	5.61	3.66	0.15	1.06	1.71	4.55	9.82	14.17	29.43

Averages for all 4 samples

7.85	4.54	1.25	1.22	2.15	6.69	18.65	25.74	38.80

72
40

GEOMETRIC MEAN & PERCENT FINES BREAK DOWN FOR RC19B
COLLECTED 8/25/93
PERCENT FINES FOR THIS SAMPLE ARE BASED ON GRAIN SIZES < 1.000 mm

SAMPLE #	Dg1 mm	Dg2 mm	Percent Fines	Percent of Sample retained by given Sieve <.125	<1.0	<4.0	<32.0	<100
1	8.99	6.50	13.28	2.35	10.93	22.31	44.55	19.86
2	9.16	6.92	11.35	2.43	8.92	22.53	49.50	16.61
3	16.68	9.56	9.05	1.64	7.41	13.85	35.04	42.07
4	11.15	6.67	14.36	1.58	12.77	17.74	35.84	31.07

AVERAGES FOR ALL 4 SAMPLES:

11.49	7.41	12.01	2.00	10.01	19.10	41.48	27.40

RESULTS FOR RC19B COLLECTED 8/25/93

SAMPLE #	QUALITY INDICES: GEOM. MEAN	SORT. COEF.	FREDLE INDEX	DISTRIBUTION DESCRIPTORS: STANDARD DEV.	SKEW	KURTOSIS
1	8.99	3.250	2.767	5.2377	0.1041	0.5177
2	9.16	3.816	3.252	4.6747	0.1269	0.5850
3	16.68	2.861	5.828	4.3431	-.1390	0.5991
4	11.15	3.739	2.983	5.7439	0.0101	0.4195
AVERAGES	11.49	3.166	3.707	5.000	0.0253	0.5303

INDEX	SAMPLE #	MEAN	STANDARD DEV	95 % CONFID. INTRVL
DG	4	11.495	3.592	(5.784 - 17.206)
SO	4	3.166	0.428	(2.485 - 3.848)
FI	4	3.707	1.428	(1.437 - 5.978)

EGG TO EMERGENCE SURVIVAL RATES FOR STEELHEAD, COHO & CHINOOK SALMON BASED ON
95 PERCENT CONFIDENCE INTERVALS FOR DG & FI

	Confidence Interval Ranges Lower		Higher	Based on Average DG and FI
STEELHEAD	33.60 %	to	98.69 %	71.35 % *
COHO	12.25 %	to	74.15 %	53.41 % *
CHINOOK	6.29 %	to	61.91 %	30.74 %

* STEELHEAD & COHO SURVIVAL RATES BASED ON FI
CHINOOK SURVIVAL RATES BASED ON (DG/Egg diameter) RELATIONSHIP

GEOMETRIC MEANS, STAND. DEV.'s, & PERCENTILES FOR RC19B
COLLECTED 8/25/93

SMPL #	Dg1	Sd	D5	D16	D25	D50	D75	D84	D95
1	8.99	5.24	0.29	1.24	2.27	7.67	23.97	34.02	44.03
2	9.16	4.67	0.32	1.48	2.59	7.54	20.57	32.33	42.35
3	16.68	4.34	0.47	2.20	4.56	20.45	37.37	41.53	51.24
4	11.15	5.74	0.34	1.16	2.44	10.96	34.17	38.33	48.21
Averages for all 4 samples	11.49	5.00	1.25	1.52	2.97	11.63	29.02	36.55	46.46

59

35

GEOMETRIC MEAN & PERCENT FINES BREAK DOWN FOR PC20A

COLLECTED 19/15/92

PERCENT FINES FOR THIS SAMPLE ARE BASED ON GRAIN SIZES < 1.000 mm

SAMPLE #	Dg1 mm	Dg2 mm	Percent Fines	Percent of Sample retained by given Sieve <.125	<1.0	<4.0	<32.0	<100
1	9.55	7.30	10.66	2.36	7.30	24.72	41.78	22.84
2	5.92	4.68	19.16	7.37	11.79	27.74	33.02	20.09
3	4.22	1.97	25.21	15.95	9.26	21.69	37.62	15.49
4	5.19	3.83	21.71	9.62	12.09	27.91	29.46	20.91

AVERAGES FOR ALL 4 SAMPLES:

	6.22	4.45	19.18	9.07	10.11	25.51	35.47	19.83

RESULTS FOR PC20A COLLECTED - 9/15/92

SAMPLE #	QUALITY INDICES: GEOM. MEAN	SORT. COEF	FREDLE INDEX	DISTRIBUTION DESCRIPTORS: STANDARD DEV.	SKEW	KURTOSIS
1	9.55	3.377	2.827	4.8462	0.1047	0.6394
2	5.92	3.965	1.493	7.2966	0.1065	0.5280
3	4.22	4.181	1.009	15.6009	-.0354	0.1667
4	5.19	4.335	1.200	8.9885	0.1082	0.4172
AVERAGES	6.22	3.962	1.632	9.183	0.0710	0.4378

INDEX	SAMPLE n	MEAN	STANDARD DEV	95 % CONFID. INTRVL
DG	4	6.219	2.325	(2.522 - 9.915)
SO	4	3.962	0.417	(3.299 - 4.625)
FI	4	1.632	0.821	(0.327 - 2.937)

EGG TO EMERGENCE SURVIVAL RATES FOR STEELHEAD, COHO & CHINOOK SALMON BASED ON 95 PERCENT CONFIDENCE INTERVALS for Dg & FI.

	Confidence Interval Ranges Lower		Higher	Based on Average Dg and FI
STEELHEAD	%-29.02 %	TO	62.39 %	38.83 % *
COHO	%-52.03 %	TO	43.29 %	17.78 % *
CHINOOK	1.55 %	TO	21.01 %	7.02 %

* STEELHEAD & COHO SURVIVAL RATES BASED ON FI
CHINOOK SURVIVAL RATES BASED ON (Dg/Egg diameter) RELATIONSHIP

GEOMETRIC MEANS, STAND. DEV.'s, & PERCENTILES FOR PC20A

COLLECTED 19/15/92

SMPL #	Dg1	SD	D5	D16	D25	D50	D75	D84	D95
1	9.55	4.85	0.26	1.51	2.60	8.09	28.53	35.39	45.97
2	5.92	7.30	0.10	0.64	1.41	4.79	22.19	34.13	44.13
3	4.22	15.60	0.07	0.13	0.96	4.65	16.73	30.79	41.75
4	5.19	8.99	0.09	0.43	1.21	4.09	22.63	34.44	44.44

Averages for all 4 samples

	6.22	9.18	1.25	0.68	1.52	5.41	22.52	33.69	43.92

50
70

GEOMETRIC MEAN & PERCENT FINES BREAK DOWN FOR PC20B
COLLECTED 8/5/93
PERCENT FINES FOR THIS SAMPLE ARE BASED ON GRAIN SIZES < 1.000 mm

SAMPLE #	Dg1 mm	Dg2 mm	Percent Fines	Percent of Sample retained by given Sieve <.125	<1.0	<4.0	<32.0	<100
1	10.37	6.78	13.38	2.13	11.25	18.77	42.45	25.39
2	11.33	7.14	13.07	3.20	9.87	14.95	44.65	27.33
3	7.70	5.82	12.84	1.62	11.22	27.57	46.04	13.56
4	14.06	9.08	9.25	1.62	7.64	13.43	48.53	28.79

AVERAGES FOR ALL 4 SAMPLES:

	10.86	7.21	12.14	2.14	10.00	18.68	45.41	23.77

RESULTS FOR PC20B COLLECTED - 8/5/93

SAMPLE #	<----QUALITY INDICES----> GEOM. MEAN	SORT. COEF.	FREDLE INDEX	<--DISTRIBUTION DESCRIPTORS----> STANDARD DEV.	SKEW	KURTOSIS
1	10.37	3.569	2.905	5.3586	0.0591	0.4986
2	11.33	3.232	3.504	5.1846	0.0116	0.6114
3	7.70	2.853	2.700	4.7022	0.1820	0.5283
4	14.06	5.737	5.137	4.1337	0.0496	0.6334
AVERAGES	10.86	3.098	3.562	4.845	0.0755	0.5679

INDEX	SAMPLE #	MEAN	STANDARD DEV	95 % CONFID. INTRVL
DG	4	10.865	2.623	(6.694 - 15.035)
SO	4	3.098	0.379	(2.495 - 3.700)
FI	4	3.562	1.104	(1.806 - 5.317)

EGG TO EMERGENCE SURVIVAL RATES FOR STEELHEAD, COHO & CHINOOK SALMON BASED ON
95 PERCENT CONFIDENCE INTERVALS FOR DG & FI

	Confidence Interval Ranges Lower		Higher	Based on Average Dg and FI
STEELHEAD	42.97 %	TO	84.59 %	69.82 % *
COHO	22.19 %	TO	69.07 %	51.66 % *
CHINOOK	9.25 %	TO	50.96 %	26.86 %

* STEELHEAD & COHO SURVIVAL RATES BASED ON FI
CHINOOK SURVIVAL RATES BASED ON (Dg/Egg diameter) RELATIONSHIP

GEOMETRIC MEANS, STAND. DEV.'s, & PERCENTILES FOR PC20B
COLLECTED 8/5/93

SMPL #	Dg1	Sg	D5	D16	D25	D50	D75	D84	D95
1	10.37	5.36	0.30	1.26	2.52	9.39	32.16	36.31	46.27
2	11.33	5.18	0.23	1.38	3.15	11.11	32.88	37.04	46.97
3	7.70	4.70	0.36	1.24	2.04	5.81	16.59	27.36	40.62
4	14.06	4.13	0.46	2.20	4.46	13.10	33.39	37.55	47.46

Averages for all 4 samples

	10.86	4.84	1.25	1.52	3.04	9.86	28.75	34.56	45.33

37

GEOMETRIC MEAN & PERCENT FINES BREAK DOWN FOR PC21A
COLLECTED - 10/19/92
PERCENT FINES FOR THIS SAMPLE ARE BASED ON GRAIN SIZES < 1.000 mm

SAMPLE #	Dg1 mm	Dg2 mm	Percent Fines	Percent of Sample retained by given Sieve <.125	<1.0	<4.0	<32.0	<100
1	8.13	5.47	14.29	5.71	7.58	26.50	30.62	28.59
2	7.75	6.57	12.79	6.53	6.15	26.78	39.27	21.15
3	8.23	7.23	7.89	2.77	5.12	33.40	42.41	16.29
4	11.09	8.23	7.80	3.15	4.55	25.03	40.29	26.88
AVERAGES FOR ALL 4 SAMPLES:								
	8.80	7.13	10.69	4.82	5.88	27.93	38.15	23.23

RESULTS FOR PC21A COLLECTED - 10/19/92

SAMPLE #	QUALITY INDICES: GEOM. MEAN	SORT. COEF.	FREDLE INDEX	DISTRIBUTION DESCRIPTORS: STANDARD DEV.	SKEW	KURTOSIS
1	8.13	4.179	1.946	5.7882	0.0631	0.7353
2	7.75	3.461	2.239	5.2593	0.0891	0.8147
3	8.23	2.817	2.922	4.4465	0.2328	0.5574
4	11.09	3.351	3.299	4.4822	0.0962	0.6172
AVERAGES	8.80	3.455	2.602	4.994	0.1203	0.6812

INDEX	SAMPLE #	MEAN	STANDARD DEV	95 % CONFID. INTRVL
DG	4	8.802	1.538	(6.355 - 11.2481
SO	4	3.455	0.560	(2.565 - 4.3451
FI	4	2.602	0.619	(1.617 - 3.5871

EGG TO EMERGENCE SURVIVAL RATES FOR STEELHEAD COHO & CHINOOK SALMON BASED ON
95 PERCENT CONFIDENCE INTERVALS FOR Dg & FI

	Confidence interval Ranges Lower		Higher	Based on average Dg and FI
STEELHEAD	35.45 %	to	70.09 %	57.63 % *
COHO	17.38 %	to	41.97 %	28.03 % *
CHINOOK	7.26 %	to	29.22 %	16.35 %

* STEELHEAD & COHO SURVIVAL RATES BASED ON FI
CHINOOK SURVIVAL RATES BASED ON (Dg/Egg diameter) RELATIONSHIP

GEOMETRIC MEANS, STAND. DEV. (s) & PERCENTILES FOR PC21A
COLLECTED - 10/19/92

SMPL #	Dg1	Sg	D5	D16	D25	D50	D75	D84	D95
1	8.13	5.79	0.11	1.12	1.91	7.28	33.92	37.68	47.39
2	7.75	5.28	0.11	1.25	2.08	6.69	24.94	34.55	44.55
3	8.23	4.45	0.40	1.53	2.38	5.82	18.71	32.16	42.18
4	11.09	4.48	0.37	1.84	2.90	9.60	32.72	36.87	46.81

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Averages for all 4 samples

	8.80	4.99	1.25	1.46	2.31	7.35	27.42	35.27	45.23

GEOMETRIC MEAN & PERCENT FINES BREAK DOWN FOR PC21B
OLLECTED : 10/28/93
ERCENT FINES FOR THIS SAMPLE ARE BASED ON GRAIN SIZES < 1.000 mm

SAMPLE #	Dg1 mm	Dg2 mm	Percent Fines	Percent of Sample retained by given Sieve <.125	<1.0	<4.0	<32.0	<100
1	11.21	7.81	9.80	2.06	7.74	23.63	37.52	29.05
2	6.49	4.32	14.46	6.55	7.91	22.59	57.49	5.46
3	8.87	6.54	12.26	2.41	9.85	21.90	50.21	15.62
4	12.95	8.69	9.33	2.42	6.91	14.95	49.39	26.33

VERAGES FOR ALL 4 SAMPLES:

	9.88	6.84	11.46	3.36	8.10	20.77	48.65	19.12

ESULTS FOR PC21B COLLECTED : 10/28/93

SAMPLE #	(<----QUALITY INDICES----)(<--DISTRIBUTION DESCRIPTORS----)) GEOM. MEAN	SORT. COEF.	FREDLE INDEX	STANDARD DEV	SKEW	KURTOSIS
1	11.21	3.508	3.195	4.8213	0.0713	0.5303
2	6.49	2.399	2.717	3.8520	0.0994	1.1158
3	8.87	2.810	3.158	4.7840	0.1207	0.5761
4	12.95	2.807	4.613	4.2188	0.0594	0.6778
VERAGES	9.88	2.879	3.420	4.419	0.0877	0.7250

INDEX	SAMPLE n	MEAN	STANDARD DEV	95 % CONFID. INTRVL
DG	4	9.880	2.810	(5.413 - 14.347)
SO	4	2.879	0.464	(2.141 - 3.617)
FI	4	3.420	0.824	(2.110 - 4.730)

[illegible] EMERGENCE SURVIVAL RATES FOR STEELHEAD, COHO & CHINOOK SALMON BASED ON
% PERCENT CONFIDENCE INTERVALS for Dg & FI.

	Confidence Interval Ranges Lower		Higher	Based on average Dg and FI
EELHEAD	49.27 %	to	80.39 %	68.28 %
HO	28.94 %	to	63.99 %	49.91 %
INOOK	5.66 %	to	47.25 %	20.80 %

STEELHEAD & COHO SURVIVAL RATES BASED ON FI
CHINOOK SURVIVAL RATES BASED ON (Dg/Egg diameter) RELATIONSHIP

EOMETRIC MEANS, STAND. DEV.'s & PERCENTILES FOR PC21B
OLLECTED : 10/28/93

MPL n	Dg1	Sg	D5	D16	D25	D50	D75	D84	D95
1	11.21	4.82	0.39	1.62	2.72	10.02	33.48	37.64	47.55
2	6.49	3.85	0.11	1.12	2.06	5.68	11.76	16.65	32.64
3	8.87	4.78	0.30	1.37	2.48	7.34	19.61	31.31	41.82
4	12.95	4.22	0.37	2.06	4.13	11.89	32.52	36.68	46.62

verages for all 4 samples

	9.88	4.42	1.25	1.54	2.85	8.73	24.34	30.57	42.16

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GEOMETRIC MEAN & PERCENT FINES BREAK DOWN FOR LPINEA
COLLECTED - 10/1/92
PERCENT FINES FOR THIS SAMPLE ARE BASED ON GRAIN SIZES < 1.000 mm

SAMPLE #	Dg1 mm	Dg2 mm	Percent Fines	Percent of Sample retained by given Sieve <.125	<1.0	<4.0	<32.0	<100
1	11.47	7.69	11.42	2.46	8.96	15.45	49.70	23.43
2	7.28	2.83	20.46	14.42	6.04	11.54	41.23	26.77
3	9.02	6.75	12.52	4.89	7.64	20.07	48.42	18.99
4	6.55	4.92	16.21	5.65	10.56	24.59	46.90	12.30
AVERAGES FOR ALL 4 SAMPLES:								
	8.58	5.55	15.15	6.85	8.30	17.91	46.56	20.37

RESULTS FOR LPINEA COLLECTED - 10/1/92

SAMPLE #	<----QUALITY INDICES----> GEOM. MEAN	SORT. COEF.	FREDLE INDEX	<--DISTRIBUTION DESCRIPTORS----> STANDARD DEV.	SKEW	KURTOSIS
1	11.47	2.928	3.919	4.6298	0.0614	0.6226
2	7.28	4.284	1.699	13.0013	-.1142	0.2631
3	9.02	3.009	2.998	4.9711	0.0666	0.8077
4	6.55	2.951	2.219	5.0653	0.0934	0.7941
AVERAGES	8.58	3.293	2.709	5.917	0.0268	0.6219

INDEX	SAMPLE n	MEAN	STANDARD DEV	95 % CONFID. INTRVL
DG	4	8.579	2.190	(5.097 - 12.062)
SO	4	3.293	0.662	(2.241 - 4.345)
FI	4	2.709	0.968	(1.170 - 4.247)

EGG TO EMERGENCE SURVIVAL RATES FOR STEELHEAD, COHO & CHINOOK SALMON BASED ON 95 PERCENT CONFIDENCE INTERVALS for Dg & FI.

	Confidence Interval Ranges Lower		Higher	Based on Average Dg and FI
STEELHEAD	25.07 %	to	76.44 %	59.21 % *
COHO	3.33 %	to	59.31 %	39.77 % *
CHINOOK	5.13 %	to	34.23 %	15.50 %

* STEELHEAD & COHO SURVIVAL RATES BASED ON FI
CHINOOK SURVIVAL RATES BASED ON (Dg/Egg diameter) RELATIONSHIP

GEOMETRIC MEANS, STAND. DEV 's, & PERCENTILES FOR LPINEA
COLLECTED - 10/1/92

SMPL #	Dg1	Sd	D5	D16	D25	D50	D75	D84	D95
1	11.47	4.63	0.32	1.66	3.49	10.44	29.90	35.62	45.59
2	7.28	13.00	0.07	0.22	1.78	9.75	32.68	36.84	46.77
3	9.02	4.97	0.13	1.36	2.57	8.11	23.28	33.57	43.59
4	6.55	5.07	0.12	0.97	1.77	5.63	15.42	24.94	39.67
Averages for all 4 samples									
	8.58	6.92	1.25	1.05	2.40	8.48	25.32	32.74	43.91