

EFFECTS OF FLOW ON THE MIGRATORY BEHAVIOR AND SURVIVAL
OF JUVENILE FALL AND SUMMER CHIOOK SALMON
IN JOHN DAY RESERVOIR

BY

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Annual Report of Research (FY81)
Financed by
Bonneville Power Administration
(Contract DE-A179081BP-27602)

and

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June 1982

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ABSTRACT

Research was conducted by NMFS in 1981 to define the effects of instream flows on the passage time, survival, and migrational behavior of O-age chinook salmon in John Day Reservoir. Fourteen groups (74,683 fish) of marked O-age chinook salmon were wire-tagged, branded, and released into the tailrace at McNary Dam, fourteen groups (13,746 fish) were branded and released into the reservoir at River Kilometer 375, and 34 groups (14,273) were branded and released into the reservoir at various other sites. More than 55,000 O-age chinook salmon were sampled at the John Day Dam airlift facility. This sample included 623 mark recoveries. Four hundred and eight (408) additional marks were recovered from purse seine samples taken at various sites throughout the reservoir. The average passage time of marked O-age chinook salmon released in the McNary tailrace was 22 days in 1981. There was no statistically significant evidence to indicate that instream flows affected either the rate of movement or residence time of O-age chinook salmon in John Day Reservoir in 1981.

INTRODUCTION

Regulation of the Columbia River system for power production has had an adverse effect on salmon and steelhead runs. In response to this problem, the fisheries agencies have developed minimum instream flow recommendations and have at times requested special flows during periods of peak juvenile migration to enhance fish passage through the system. Scientific evidence supporting these actions is based for the most part on data relating to yearling spring chinook salmon and steelhead smolt migrations (Raymond 1979; Sims and Ossiander 1981). Minimum in-stream summer flow recommendations and requests for summer fish flows have been made based on the assumption that the fish passage enhancement benefits of increased flows demonstrated for yearling spring chinook salmon smolts apply equally to O-age chinook salmon migrating during the summer. This may or may not in fact be true.

Past research has shown that even during high-flow years, large numbers of juvenile summer and fall chinook salmon remain for considerable periods of time in John Day Reservoir (Raymond et al. 1975; Sims et al. 1976). The reason for this is not known, but it is suspected that a significant number of O-age chinook salmon entering the reservoir are not smolting. In the past, length frequencies at McNary and John Day Dams have shown the average size of fish leaving the reservoir to be considerably larger than those entering. This indicates an extended period of reservoir rearing not representative of smolting fish. It is also possible that many of the fish that are smolting revert to parr after entering the reservoir. Zaugg et al. (1972) found that smolting steelhead reverted to parr if exposed for significant periods to water temperatures

above 54°F. Water temperatures are usually above 60°F when the O-age chinook salmon migration begins to enter John Day Reservoir in early July. By mid-August water temperatures approach 76°F.

There is little evidence to support the assumption that delays in John Day Reservoir adversely affect the survival of O-age chinook salmon. On the contrary, adult returns of fall and summer chinook salmon stocks in the mid-Columbia River have not declined at the rate of spring chinook salmon and steelhead stocks. It is possible that the extended periods of rearing in John Day Reservoir actually benefit O-age chinook salmon survival.

If increased summer in-stream flows do not significantly reduce O-age chinook salmon residence time in John Day Reservoir, or if reduced residence time in the reservoir does not result in increased survival, recommended summer in-stream flows could be reduced and special fish flows eliminated. This would provide Bonneville Power Administration (BPA) with additional water management flexibility and result in significant savings of water which could be used to augment flows during critical periods of the spring migration and provide additional power production.

Research was started by the National Marine Fisheries Service (NMFS) (under contract to BPA) in June 1981 to define the effect of flow on the migratory behavior and survival of juvenile fall and summer chinook salmon in John Day Reservoir. The objectives of this research were to: (1) define the effect of in-stream flow on the passage time of O-age chinook salmon in John Day Reservoir, (2) define the relationship between reservoir passage time and the survival of O-age chinook salmon in John Day Reservoir, and (3) define the effect of in-stream flow levels on the distribution and behavior of O-age chinook salmon in John Day Reservoir.

In 1981, research activities concentrated on the development of purse seine sampling techniques needed to define O-age chinook salmon

distribution and behavior in John Day Reservoir and on releasing and recapturing marked fish needed to define flow/travel time relationships. This report summarizes 1981 research activities.

METHODS

Groups of 0-age chinook salmon from early (15-29 June), middle (10 July-3 August), and late (10-26 August) segments of the 1981 migration entering John Day Reservoir were collected at McNary Dam, wire-tagged, freeze branded, and released into the tailrace below the dam. Recoveries of these marks from the airlift fish collection facility at John Day Dam (Sims et al. 1981) were used to define reservoir travel and residence time.

Travel time for each release group was computed based on the first 25% of mark recoveries. This ensured that travel time estimates for each release group were based on actively migrating fish and adjusted for the possibility that later release groups may contain larger percentages of nonsmolting fish than earlier releases. Average in-stream flows affecting each release group were calculated by averaging the daily river discharge at McNary Dam for the 10-d period following each release. Regression analysis was used to define the significance of travel time/flow relationships.

Residence time was calculated from the mean of the mark recoveries from each group. This ensured that the slower nonsmolting fish were included in the computation. The residence times calculated must be considered as minimum since they were based only on recoveries at John Day Dam through 17 December. Surviving fish still in the reservoir were not included. Subsequent recaptures, if any, at John Day Dam in the spring and summer of 1982 will increase the average residence time calculations.

An 11 m power block seiner (NMFS research vessel Columbia) was used to purse seine sample John Day Reservoir throughout the summer and fall of fall of 1981. Purse seine fishing techniques were generally as described by Johnsen and Sims (1973). Sampling extended from the forebay at John Day Dam [River Kilometer (Rkm) 348) to the McNary Dam tailrace (Rkm 470). Nine sampling sites were established (Table 1). These sites were grouped into three major areas of the reservoir: lower (Rkm 348-380), middle (Rkm 381-433), and upper (Rkm 434-470). Recoveries of marked fish in the purse seine from releases in the McNary Dam tailrace, at Rkm 375, and from the Columbia were used to define O-age chinook salmon distribution and migrational behavior in John Day Reservoir.

Purse seine catches were processed aboard the Columbia. Catches at John Day Dam were processed on site. All fish were anesthetized with MS-222, counted, and examined for marks. Those fish to be marked were freeze branded. A subsample was measured for fork-length. After processing, all fish were allowed to recover from the anesthetic and released. Fish marked on the Columbia were released on site, whereas fish marked at John Day Dam were released into the reservoir at Rkm 375.

RESULTS AND DISCUSSION

A total of 102,702 O-age chinook salmon were marked and released into John Day Reservoir in 1981. Fourteen groups (74,683 fish) were wire-tagged, branded, and released into the tailrace at McNary Dam (Table 2). Of the 14 groups released, four groups (17,723 fish) were released during the early migration (15-29 June), five groups (45,092) during the middle migration (10 July-3 August), and five groups (11,868 fish) during the late migration (10-26 August). Additional mark releases of 13,746 fish

Table 1.--Purse seine sampling site locations, John Day Reservoir, 1981.^{a/}

River Kilometer	Area
348-351	John Day Dam forebay
359-364	Goodnoe
373-378	Blalock
385-390	Arlington
406-412	Willow Creek
422-431	Crow Butte
438-447	Coyote-Blalock Islands
454-459	Irrigon
462-469	Umatilla River - McNary tailrace

^{a/} See Appendix B for location detail.

Table 2.--Summary of 0-age chinook salmon wire-tagged, cold branded, and released in the McNary Dam tailrace (16 June-26 August)^{a/} and recovered at John Day Dam.

Brand ^{b/}	Median release date	Total released	Total recaptured	Date of 1st recapture	Mean recapture date	Date of last recapture	Minimum residence time (days)
LAID1	6/15	3,325	28	6/30	7/4	7/13	19
LAID2	6/18	4,654	44	6/25	7/8	8/8	20
LAID3	6/24	3,458	37	6/26	7/8	8/10	14
LAID4	6/29	6,286	38	7/4	7/10	8/7	11
LAIM1	7/10	10,115	79	7/14	8/5	12/17 ^{d/}	26
LAIM3	7/16	10,143	65	7/24	8/13	11/16	28
LAIM2	7/22	10,012	50	7/27	8/9	10/23	18
LAIM4	7/29	12,310	64	7/31	8/23	11/12	25
LAUP1	8/3	2,512	11	8/8	8/14	9/8	11
LAUP3	8/10	2,663	15	8/21	9/18	12/17	39
LAUP4	8/13	2,545	12	8/21	9/20	12/17	38
LA3X1	8/17	2,547	10	8/21	9/4	9/20	18
LA3X2	8/20	2,536	22	8/25	9/19	12/17	30
LA3X3	8/26	1,577	6	8/31	9/15	9/28	19
Total		74,683	481				

^{a/} Released at 2100 h.

^{b/} Position, brand, and orientation. LA indicates left anterior, LD indicates left dorsal, and LP indicates left posterior. Orientation refers to rotation of the brand around its center point (i.e., 1 equals normal orientation, ID; 2 equals , 3 equals  and 4 equals ).

^{c/} Difference between mean date of recovery and median release date.

^{d/} Last day of sampling.

were made at Blalock Canyon, RRm 375 (Table 3), and 14,273 fish from purse seine catches were marked and released at various sites in the reservoir (Table 4).

The airlift collection facility at John Day Dam captured 55,498 O-age chinook salmon between 31 May and 17 December 1981 (Table 5). Total passage of O-age chinook salmon at John Day Dam during this period was estimated at 4.3 million fish (Sims et al. 1982). Airlift catches at John Day Dam included 481 marked fish from the McNary Dam tailrace releases, 107 marked fish from the Blalock releases, and 35 marked fish from purse seine releases. Detailed mark recovery information is included in Appendix Table A1.

Purse seine sampling began on 24 June and continued on a 3-d per week basis (when possible) through 11 November. In the 249 purse seine sets that were made, 17,437 O-age chinook salmon were taken (Table 6). Purse seine catches included 256 marks from the McNary Dam tailrace releases, 89 marks from the Blalock Canyon releases, and 63 marks from purse seine releases. Detailed purse seine mark recovery information is included in Appendix Table A2.

Incidental purse seine catches of species other than juvenile salmonids in John Day Reservoir are summarized in Table 7. Juvenile shad were by far the most abundant species taken; only small numbers of other species were taken. It is interesting to note that only 207 squawfish were caught over the entire season, and most of these were taken from the forebay area above John Day Dam.

Other types of fishing gear were used to sample shallow water areas of the reservoir where the purse seine could not be used. These included a tow net (61 x 122 cm), a mid-water trawl (6 x 6 m), and a beach seine (91 x 5 m). All proved ineffective, and no additional efforts with these types of gear appear warranted.

Table 3. --Summary of O-age chinook salmon cold branded at John Day Dam and released into John Day Reservoir (Blalock Canyon RRm 375) 3 July-8 September 1981.

Mark^{a/}	Release date	Number released
LAHE1	July 3	1,313
LASPI	July 6	721
RASP1	July 13	124
RASP2	July 14	543
RASP3	July 20	2,168
RASP4	July 21	929
RDSP1	July 22	613
RDSP2	July 27	2,370
RDSP3	Juy 28	1,424
RDSP4	July 29	952
LASP2	July 30	716
LASP3	August 8	895
LASP3	August 17	475
LDSP1	September 8	<u>503</u>
		13,746

^{a/} Position brand and orientation. LA indicates left anterior, LD indicate; left dorsal, and LP indicates left posterior. Orientation refers to rotation of the brand around its center point (i.e., 1 equals normal orientation, ID; 2 equals , 3 equals , and 4 equals ).

Table 4.--Summary of O-age chinook salmon captured by purse seining, cold branded, and released at various locations In John Day Reservoir, 26 June-27 October 1981.

Mark^{a/}	Release date	Number released	Release site(RKm)
LA01	June 26	177	351
LAX1	June 30	140	422
LAX2	July 1	565	388
LDX1	July 2	389	375
LAWV1	July 8	157	430
LAWV2	July 14	264	373
LAWV3	July 15	117	361
LAWV4	July 16	654	351
LDWV1	July 23	366	359
LDWV2	July 24	570	351
LDWV3	July 30	328	359
LDWV4	July 31	614	351
LPWV1	August 4	1,110	373
LPwv2	August 5	1,070	359
LPwv3	August 6	1,238	351
LPwv4	August 13	332	425
LAAR1	August 18	472	375
LAAR2	August 19	206	359
LDAR1	August 26	512	409
LDAR2	August 27	623	390
LPAR1	September 2	246	377
LPAR2	September 3	795	359

a/ Position, brand, and orientation. LA indicates left anterior, LD indicates left dorsal, and LP indicates left posterior. Orientation refers to rotation of the brand around its center point (i.e., 1 equals normal orientation, ID; 2 equals \perp , 3 equals \llcorner , and 4 equals \lrcorner).

Table 4. --Continued

Marka/	Release date	Number released	Release site(RKm)
LAD1	September 10	522	425
LAD2	September 11	596	388
LAD3	September 15	268	377
LAD4	September 16	64	259
LDD1	September 23	327	425
LDD2	September 24	213	410
LDD3	September 25	212	390
LDD4	September 29	217	377
LPD1	October 15	135	377
LPD2	October 21	301	425
LPD3	October 22	297	390
LPD4	October 27	<u>176</u>	377
		14,273	

Table 5.--Weekly summary of sample catch and estimated passage of 0-age chinook salmon at John Day Dam, 31 May-19 December 1981.

<u>Date</u>	<u>Catch</u>	<u>Estimated passage</u>
5/31-6/06	429	70,849
6/07-6/14	1,250	193,636
6/14-6/20	1,181	185,154
6/21-6/27	553	89,066
6/28-7/04	6,274	642,423
7/05-7/11	2,220	258,993
7/12-7/18	5,377	472,928
7/19-7/25	5,625	356,107
7/26-8/01	11,906	822,755
8/02-8/08	7,006	569,097
8/09-8/15	3,624	185,688
8/16-8/22	3,012	165,564
8/23-8/29	566	29,031
8/30-9/05	997	40,979
9/06-9/12	1,007	36,824
9/13-9/19	712	23,411
9/20-9/26	619	23,038
9/27-10/03	511	20,280
10/04-10/10	293	12,014
10/11-10/17	194	8,098
10/18-10/24	108	4,546
10/25-10/31	160	6,639
11/01-11/07	196	7,254
11/08-11/14	138	6,349
11/15-11/21	345	15,500
11/22-11/28	200	8,333
11/29-12/05	336	14,545
12/06-12/12	185	10,278
12/13-12/17	474	27,558
Total	55,498	4,306,937

Table 6.--Summary of purse seine catches of O-age chinook salmon in John Day Reservoir, June through November 1981.

Date	Area	No. sets	Total catch	Catch/set
June	Lower (Rkm 348-380)	6	354	59
	Middle (Rkm 381-434)	3	150	50
	Upper (Rkm 435-476)	2	0	0
July	Lower	38	3,359	88
	Middle	20	1,171	59
	Upper	16	130	8
August	Lower	26	4,775	184
	Middle	20	2,043	102
	Upper	9	67	7
September	Lower	33	1,974	60
	Middle	18	1,992	111
	Upper	7	44	6
October	Lower	21	439	21
	Middle	11	631	57
	Upper			
November	Lower	10	158	16
	Middle	9	150	17
	Upper			
Totals		249	17,437	70

Table 7 .--Catch summary of salmonid and nonsalmonid fish captured by purse seine in John Day Reservoir, June to November 1981.

	June	July	August	Sept.	Oct.	Nov.	Total
Adult chinook		2		15	6		23
Jack chinook		1		5	13	3	22
Adult sockeye		8					8
Adult steelhead		20	22	10	4	5	61
carp			8				8
Peamouth chub		4	2	1			7
Chiselmouth chub	1	16	5			1	23
Adult shad		30	9				39
Juvenile shad			1,200	81,000	24,000	500	106,700
Squawfish	3	77	115	12			207
Sucker		1					1
Adult walleye		1					1
Juvenile walleye		1		1			2
Whitefish	1	3					4

Radio-tracking of O-age chinook salmon was attempted in the McNary Dam tailrace area in August and September. No successful tracks were completed. High water temperatures during this period resulted in almost 100% tagging mortality. No additional radio tagging will be attempted.

Migrational Behavior

The 1981 migration of O-age chinook salmon began to enter John Day Reservoir in mid-May, peaked about the first week in July, and continued through mid-September. The migratory behavior exhibited by O-age chinook salmon within the reservoir was markedly different from spring run yearling chinook salmon. The average reservoir residence time of branded O-age chinook salmon released into the McNary Dam tailrace was 22 d (range 3 to 160+ d). This compared to 6 d (range 3 to 20 d) for branded yearling chinook salmon released in the same area in the spring of 1981 (Sims et al. 1982) (Table 8). The minimum residence time for both O-age and yearling chinook salmon from the McNary Dam tailrace to John Day Dam was the same (3 d), however, the maximum residence time for yearling fish was only 20 d compared to 160 d plus for O-age fish. This indicates that a large portion of the O-age chinook salmon that entered John Day Reservoir were not actively smolting. Average residence time increased from 16 d for the early run to 30 d for the late run. This indicates that either the percentage of nonsmolting fish increased as the run progressed, or the residence time increased with decreased flows,

Purse seine recoveries of marked fish released at various locations within the reservoir (excluding McNary Dam tailrace releases) also indicated the presence of significant numbers of nonsmolting O-age chinook salmon in John Day Reservoir. Nearly 50% of all such recoveries (71 out of

Table 8. --Residence time of marked yearling and O-age chinook salmon in John Day Reservoir based on mean date of recovery at John Day Dam, 1981.

Species	Residence time (days)	
	Mean	Range
Yearling chinook salmon	6	3-20
O-age chinook salmon	22	3-160+a/
Early run (15-29 June)	16	3-50
Mid-run (10 July-3 August)	24	3-160+a/
Late run (10-26 August)	30	3-130+a/

a/ Marked fish still in reservoir on last day of sampling, 17 December 1981.

146) were upstream from the original release site (Appendix Table A2). For example, one fish released at Rkm 351 was recaptured at Rkm 430, 79 km upstream, 6 d later. Such behavior is certainly not representative of smolting fish,

Flow/Survival Relationships

Samples of the three segments of the O-age chinook salmon migration (early, middle, and late) entering John Day Reservoir in 1981 were wire-tagged and released into the tailrace at McNary Dam (Table 9). Adult returns from these releases will be used to determine relative survival of each segment. By plotting the survival estimates against the appropriate river flows, a regression line will be developed to determine if a significant flow/survival relationship existed.

Flow/Travel Time Relationships

Travel time from McNary Dam to John Day Dam was calculated for the 14 groups of marked fish released into the McNary tailrace in 1981 (Table 9). Average river flow for the 10-d period following each release ranged from 126 to 345 kcfs. As can be seen, average travel time ranged from 5 to 17 d. Considerable variance in travel time occurred regardless of river flow. Overall, average travel time for the early, middle, and late groups were nearly the same even though river flows declined from an average of 298 kcfs for the early group to 145 kcfs for the late group. A regression line was constructed by plotting the travel time of each release group against the appropriate river flow (Figure 1). The regression coefficient b (slope) of the line $y = 7.48 + 0.02X$ can be tested for significance by testing the hypothesis that the population regression coefficient is equal

Table 9.--Recoveries of O-age chinook salmon (wire-tagged, cold branded, and released In McNary Dam tailrace, 16 June to 26 August 1981 at John Day Dam.

Wire tag code	Brand ^{a/}	Release date	Average river flow(kcfs)b/	Recovery date ^{c/}	Trave 1 time
031731	LAID1	6/15	345	7/2	17
031731	LAID2	6/ 18	327	7/3	15
031731	LAID3	6/24	265	7/2	8
031731	LAID4	6/29	253	7/4	5
Average			298		11
031732	LAIM1	7/10	225	7/27	17
031732	LAIMB	7/16	210	8/2	17
031732	LAIM2	7/22	200	7/29	7
031732	LAIM4	7/29	192	8/6	8
031732	LAUPI	8/3	179	8/9	6
Average			201		11
031733	LAUP3	8/10	165	8/22	12
031733	LAUP4	8/13	153	8/21	8
031733	PA3X1	8/17	146	8/25	8
031733	LA3X2	8/20	137	9/4	15
031733	LA3x3	8/26	126	9/8	13
Average			145		11

a/ Position, brand, and orientation. LA indicates left anterior, LD Indicates left dorsal, and LP indicates left posterior. Orientation refers to rotation of the brand around its center point (i.e., 1 equals normal orientation, ID; 2 equals \perp , 3 equals \llcorner , and 4 equals \lrcorner).

b/ For the 10-d period following each release date. Daily average river discharges at McNary Dam from 10 June to 24 September are shown in Appendix A.

c/ 25 percentile recovery.

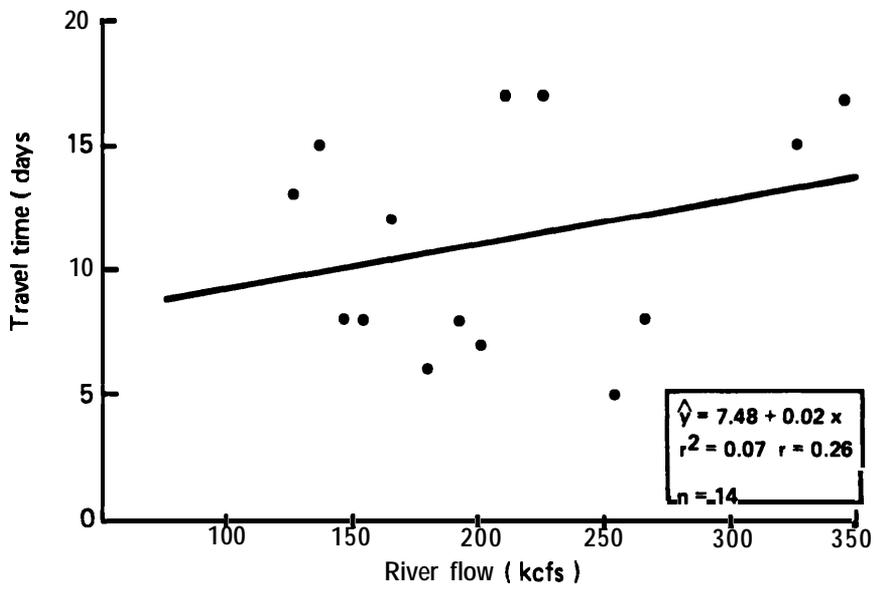


Figure 1.--Relationship of river flow and O-age chinook salmon travel time (McNary Dam tailrace to John Day Dam) in John Day Reservoir, 1981.

to zero ($H_0: b = 0$). This has been done by applying a sample t test according to the formula:

$$t = \frac{b-0}{\sqrt{\frac{1}{n-2} S_{yx} (X-\bar{X})^2}} \quad \text{where } b = \text{slope}$$

x = flow, y = travel time, and S_{yx}^2 = pool variance of x and y, or in this case, $t = 1.104$. Since $t_{0.05}$ with 12 degrees of freedom = 2.179, $H_0: b = 0$ is accepted, and we conclude that the slope (b) of the line is not statistically significantly different from zero.

Based on the 14 data points developed in 1981, there was no statistical evidence to indicate that river flows were affecting the rate of migration or residence time of O-age chinook salmon in John Day Reservoir. It should be remembered, however, that this analysis was based on only 1 year's data and represents a limited number of data points. Results could change significantly as additional data points are added in 1982 and 1983.

SUMMARY AND CONCLUSIONS

Research was initiated by NMFS in 1981 to define the effects of instream flows on the passage time, survival, and migrational behavior of O-age chinook salmon in John Day Reservoir. This report summarizes 1981 research activities.

1. Fourteen (14) groups of O-age chinook salmon (74,683 fish) were wire-tagged and branded at McNary Dam and released into the McNary tailrace during the period 15 June - 26 August 1981.

2. Additional mark releases of 13,746 and 14,273 O-age chinook salmon were made at Blalock, Oregon, (RRm 375) and at various purse seine sampling sites, respectively.

3. Approximately 55,000 O-age chinook salmon were sampled at the John Day Dam airlift collection facility between 31 May and 17 December 1981. Total passage, based on these collections, was estimated to be approximately 4.3 million fish.

4. Six hundred and twenty-three (623) marked fish were recovered at John Day Dam.

5. During the O-age chinook salmon migration, 249 purse seine sets were made in John Day Reservoir. Purse seine catches amounted to 17,437 O-age chinook salmon.

6. Attempts to radio-tag O-age chinook salmon were not successful due to extreme marking mortality. No additional radio-tagging will be attempted.

7. The average residence time in John Day Dam Reservoir for marked O-age chinook salmon released into the McNary Dam tailrace was 22 d. This compares to 6 d for yearling chinook salmon.

8. A significant percentage of purse seine mark recaptures were made upstream from original release sites.

9. From their length of residence and upstream movement, it appears that a significant number of O-age chinook salmon in John Day Reservoir were not actively migrating.

10. Based on the limited data developed in 1981, there was no statistically significant evidence to indicate that instream river flows were affecting the rate of downstream movement or residence time of O-age chinook salmon in John Day Reservoir.

SUMMARY OF EXPENDITURES

Personnel	\$54,514
Travel and Transportation	8,568
Contract Services (Fish Markers)	9,312
Supplies and Materials	3,665
Capital Equipment	0
Overhead (NOAA and DOC)	21,834
Miscellaneous	<u>107</u>
Total	\$98,000

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APPENDIX A

Brand Recapture and River Flow Data, 1981

Appendix Table A1.--Brand recapture summary, O-age chinook salmon, John Day Dam (Turbine Unit 3), 1981.

Brand	Release site	Number released	Date released	Recaptures		Date recapture
				No.	Cumulative	
LAID1	Rkm 470 (McNary Dam)	3,325	6/15	1	1	6/30
				3	4	7/01
				9	13	7/02
				5	18	7/03
				5	23	7/04
				1	24	7/06
				1	25	7/07
				2	27	7/08
				1	28	7/13
				LAID2	Rkm 470	4,654
1	2	6/26				
1	3	6/30				
7	10	7/02				
2	12	7/03				
9	21	7/04				
8	29	7/06				
1	30	7/07				
1	31	7/08				
7	38	7/13				
2	40	7/14				
1	41	7/15				
1	42	7/28				
1	43	7/29				
1	44	8/08				
LAID3	Rkm 470	3,458	6/24	4	4	6/26
				3	7	6/30
				1	8	7/01
				3	11	7/02
				3	14	7/03
				3	17	7/04
				9	26	7/06
				1	27	7/14
				1	28	7/16
				3	31	7/17
				3	34	7/20
				1	35	7/30
				1	36	8/02
				1	37	8/10
				LAID4	Rkm 470	6,286
8	21	7/06				
2	23	7/07				
1	24	7/08				
1	25	7/10				
1	26	7/13				
1	27	7/14				
4	31	7/15				
3	34	7/16				
1	35	7/20				

Appendix Table A1.--Continued.

Brand	Release site	Number released	Date released	Recaptures		Date recapture
				No.	Cumulative	
LAID4	Rkm 470	6,286	6/29	1	36	7/23
				1	37	7/29
				1	38	8/07
LAIMI	Rkm 470	10,115	7/10	2	2	7/14
				1	3	7/15
				2	5	7/17
				5	10	7/20
				1	11	7/21
				3	14	7/22
				2	16	7/24
				11	27	7/27
				10	37	7/28
				2	39	7/29
				2	41	7/30
				6	47	7/31
				4	51	8/01
				2	53	8/03
				4	57	8/04
				6	63	8/05
				2	65	8/07
				1	66	8/08
				1	67	8/11
				1	68	8/12
1	69	8/13				
1	70	8/14				
1	71	8/17				
1	72	8/24				
1	73	9/02				
1	74	9/15				
1	75	9/20				
1	76	9/28				
1	77	10/09				
1	78	10/26				
1	79	12/17				
LAIN2	Rkm 470	10,012	7/22	7	7	7/27
				4	11	7/28
				4	15	7/29
				3	18	7/30
				2	20	7/31
				1	21	8/01
				1	22	8/03
				3	25	8/04
				6	31	8/05
				3	34	8/06
				5	39	8/07
				3	42	8/09
				1	43	8/12
				1	44	8/13
				1	45	8/14
				1	46	9/02

Appendix Table A1.--Continued.

Brand	Release site	Number released	Date released	Recaptures		Date recapture
				No.	Cumulative	
LAIM2	RKxn 470	10,012	7/22	2	48	9/28
				1	49	10/16
				1	50	10/23
LAIM3	RMm 470	10,143	7/16	2	2	7/24
				3	5	7/27
				1	6	7/28
				1	7	7/29
				1	8	7/30
				3	11	7/31
				4	15	8/01
				2	17	8/02
				5	22	8/03
				3	25	8/04
				4	29	8/05
				2	31	8/06
				5	36	8/07
				2	38	8/08
				2	40	8/12
				2	42	8/13
				2	44	8/14
				3	47	8/17
				1	48	8/18
				4	52	8/21
				3	55	8/22
				1	56	8/24
				1	57	9/01
				4	61	9/08
				1	62	9/20
1	63	9/30				
1	64	10/26				
1	65	11/16				
LAIM4	RKm 470	12,310	7/29	1	1	7/31
				1	2	8/02
				1	3	8/03
				2	5	8/04
				8	13	8/05
				4	17	8/06
				8	25	8/07
				3	28	8/08
				2	30	8/09
				1	31	8/12
				2	33	8/13
				1	34	8/14
				4	38	8/17
				5	43	8/21
				2	45	8/22
				2	47	8/24
				2	49	8/31
1	50	9/04				

Appendix Table A1.--Continued.

Brand	Release site	Number released	Date released	Recaptures		Date recapture				
				No.	Cumulative					
LAIM4	RMm 470	12,301	7/29	4	54	9/08				
				1	55	9/14				
				1	56	9/15				
				1	57	9/17				
				1	58	9/18				
				1	59	10/09				
				1	60	10/23				
				1	61	10/26				
				1	62	10/29				
				1	63	11/05				
				1	64	11/12				
				LAUP1	RKm 470	2,512	8/03	2	2	8/08
								3	5	8/09
								1	6	8/10
2	8	8/13								
1	9	8/18								
1	10	8/21								
1	11	9/08								
LAUP 2	RKm 470	2,399	8/06	1	1	10/19				
LAUP 3	RKM470	2,663	8/10	2	2	8/21				
				2	4	8/22				
				1	5	8/24				
				2	7	8/25				
				1	8	8/27				
				1	9	9/04				
				1	10	9/08				
				1	11	9/20				
				1	12	10/13				
				2	14	11/16				
				1	15	12/17				
LAUP4	RKm 470	2,545	8/13	3	3	8/21				
				1	4	8/31				
				1	5	9/02				
				2	7	9/08				
				1	8	9/16				
				1	9	9/20				
				1	10	10/26				
				1	11	10/29				
				1	12	12/17				
				LA3X1	RKm 470	2,547	8/17	1	1	8/21
2	3	8/25								
1	4	9/02								
1	5	9/04								
3	8	9/08								
1	9	9/10								
1	10	9/20								

Appendix Table A1.--Continued.

Brand	Release site	Number released	Date released	Recaptures		Date recapture
				No.	Cumulative	
LA3X2	Rkm 470	2,536	8/20	1	1	8/25
				1	2	8/27
				1	3	8/28
				4	7	8/31
				2	9	9/04
				2	11	9/08
				1	12.	9/10
				3	15	9/14
				1	16	9/15
				2	18	9/20
				1	19	10/26
				1	20	10/29
				1	21	11/09
				1	22	12/17
LA3X3	Rkm 470	1,577	8/26	1	1	8/31
				2	3	9/08
				1	4	9/15
				1	5	9/23
				1	6	9/28
LASP1	Rkm 375 (Blalock Canyon)	721	7/06	1	1	7/08
				1	2	7/13
				1	3	7/15
				1	4	7/16
				1	5	7/20
				1	6	7/28
				1	7	8/08
LASP2	Rkm 375	716	7/30	1	1	8/01
				1	2	8/08
				1	3	8/20
				1	4	9/09
LASP3	Rkm 375	895	8/08	2	2	8/12
				1	3	8/14
				1	4	11/20
RASP 1	Rkm 375	1,204	7/06	3	3	7/16
				1	4	7/17
				1	5	7/22
				2	7	7/27
				1	8	7/28
				1	9	8/04
RASP2	Rkm 375	548	7/14	1	1	7/17
				2	3	7/20
				1	4	7/22
				1	5	7/30
				1	6	8/05
				1	7	8/06

Appendix Table A1.--Continued.

Brand	Release site	Number released	Date released	Recaptures		Date recapture
				No.	Cumulative	
RASP3	Rkm 375	2,168	7/20	1	1	7/21
				5	6	7/22
				1	7	7/23
				2	9	7/24
				4	13	7/27
				2	15	7/28
				1	16	8/04
				2	18	8/05
				1	19	8/08
				1	20	8/12
RASP4	Rkm 375	929	7/21	1	1	7/23
				2	3	7/24
				1	4	7/27
				2	6	7/28
				2	8	7/29
				1	9	8/05
				2	11	8/07
				1	12	8/21
				1	13	9/20
				RDSP1	Rkm 375	613
RDSP2	Rkm 375	2,370	7/27	1	1	7/28
				2	3	7/30
				1	4	7/31
				1	5	8/04
				2	7	8/08
				2	9	8/09
				1	10	8/10
				2	12	8/11
				1	13	8/14
				1	14	8/21
				1	15	8/24
				1	16	8/27
				1	17	8/31
				1	18	9/04
1	19	12/09				
RDSP3	Rkm 375	1,424	7/28	4	4	7/30
				1	5	7/31
				1	6	8/01
				1	7	8/05
				2	9	8/07
				1	10	8/08
				1	11	8/13
				1	12	8/19
				1	13	8/21
				1	14	12/17

Appendix Table A1.--Continued.

Brand	Release site	Number released	Date released	Recaptures		Date recapture
				No.	Cumulative	
RDSP4	Rkm 375	952	7/29	1	1	7/30
				2	3	8/04
				1	4	8/06
				2	6	8/07
				2	8	8/09
				1	9	8/20
LAX2	Rkm 388 (Purse seine)	565	7/01	1	1	7/08
LDWV1	Rkm 359	366	7/23	1	1	8/17
LDWV2	Rkm 351	570	7/24	1	1	8/21
LPwv2	Rkm 357	1,070	8/05	1	1	10/23
LMR1	Rkm 375	472	8/18	1	1	9/20
				1	2	10/09
LAAR2	Rkm 359	206	8/19	1	1	8/27
LDAR2	Rkm 389	623	8/27	1	1	9/08
				1	2	9/09
				1	3	9/20
				1	4	10/23
LPAR2	Rkm 359	795	9/03	1	1	9/20
				1	2	11/05
LAD1	Rkm 427	522	9/10	1	1	10/13
				1	2	10/26
LAD2	Rkm 388	596	9/11	2	2	11/25
LAD3	Rkn 377	268	9/15	1	1	9/23
				1	2	11/02
LAD4	Rlzm 359	64	9/16	1	1	9/28
				1	2	10/23
LDD 1	Rkm 427	327	9/23	1	1	11/02
				1	2	11/12
				1	3	11/16
				2	5	11/20
				1	6	11/25
				1	7	12/17

Appendix Table A1.--Continued.

Brand	Release site	Number released	Date released	Recaptures		Date recapture
				No.	Cumulative	
LDD2	Rkm 410	213	9/24	1	1	11/02
				1	2	11/09
				1	3	12/09
LDD3	Rkm 390	212	9/25	1	1	11/16
				1	2	12/02
LDD4	Rkm 377	217	9/29	1	1	11/05
				1	2	11/12
				1	3	11/20

a/ Position, brand, and orientation. LA indicates left anterior, LD Indicates left dorsal, and LP indicates left posterior. Orientation refers to rotation of the brand around its center point (i.e., 1 equals normal orientation, ID; 2 equals **II**, 3 equals **DI**, and 4 equals **LD**).

Appendix Table A2. --Brand recapture summary, O-age chinook salmon, purse seine catches John Day Reservoir, 1981.

Brand	Release site	Number released	Date released	Recaptures		Date recapture	Recapture site
				No.	Cumulative		
LAID1	Rkm 470 (McNary Dam)	3,325	6/15	3	3	6/25	Rkm 351
				2	5	6/30	Rkm 423
				3	8	7/01	Rkm 390
				2	10	7/02	Rkm 375
				2	12	7/16	Rkm 351
LAID2	Rkm 470	4,654	6/18	1	1	6/25	Rkm 351
				3	4	7/01	Rkm 390
				2	6	7/02	Rkm 375
				1	7	7/09	Rkm 423
				1	8	7/16	Rkm 351
				2	10	8/04	Rkm 373
				1	11	8/05	Rkm 357
				1	12	8/06	Rkm 348
				2	14		Rkm 351
				1	15	8/11	Rkm 439
LAID3	Rkm 470	3,458	6/24	1	1	6/25	Rkm 351
				2	3	7/01	Rkm 390
				3	6	7/02	Rkm 375
				1	7	7/14	Rkm 375
				2	9	8/04	Rkm 373
1	10	8/05	Rkm 357				
LAID4	Rkm 470	6,286	6/29	1	1	7/02	Rkm 375
				1	2	7/14	Rkm 375
				4	6	7/16	Rkm 351
				2	8	8/04	Rkm 373
				1	9	8/05	Rkm 357
				1	10	8/06	Rkm 351
				1	11	8/13	Rkm 390
				1	12	8/18	Rkm 375
LAIMI	Rkm 470	10,115	7/10	2	2	7/14	Rkm 375
				1	3	7/15	Rkm 362
				4	7	7/16	Rkm 351
				4	11	7/24	Rkm 351
				1	12	7/30	Rkm 388
				1	13	7/13	Rkm 348
				4	17		Rkm 351
				5	22	8/04	Rkm 373
				1	23		Rkm 375
				1	24	8/06	Rkm 348
				1	25		Rkm 351
				2	27	8/18	Rkm 375
				1	28	8/25	Rkm 430
1	29	8/27	Rkm 390				

Appendix Table A2.--Continued.

Brand	Release site	Number released	Date released	Recaptures		Date recapture	Recapture site
				No.	Cumulative		
LAIM1	Rkm 470	10,115	7/10	1	30	9/09	Rkm 457
				1	31	9/10	Rkm 423
				3	34		Rkm 430
				1	35	9/11	Rkm 390
				1	36	9/15	Rkm 375
				1	37	9/16	Rkm 361
				1	38	9/23	Rkm 430
LAIM2	RMm 470	10,012	7/22	3	3	7/30	Rkm 388
				2	5	7/31	Rkm 348
				6	11		Rkm 351
				1	12	8/04	Rkm 373
				2	14		Rkm 375
				4	18	8/05	Rkm 357
				1	19	8/06	Rkm 351
				1	20	8/12	Rkm 430
				1	21	8/13	Rkm 390
				2	23	8/18	Rkm 375
				1	24	8/26	Rkm 407
				2	26	8/27	Rkm 390
				2	28	9/03	Rkm 361
				1	29	9/10	Rkm 430
				1	30	9/23	Rkm 430
1	31	10/21	Rkm 430				
LAIM3	Rkm 470	10,143	7/16	1	1	7/24	Rkm 351
				5	6	7/30	Rkm 388
				1	7	8/04	Rkm 373
				2	9		Rkm 375
				3	12	8/05	Rkm 357
				1	13	8/06	Rkm 348
				3	16		Rkm 351
				1	17	8/18	Rkm 375
				1	18	8/19	Rkm 359
				1	19	8/27	Rkm 390
				1	20	9/02	Rkm 375
				3	23	9/03	Rkm 361
				2	25	9/10	Rkm 430
				1	26	9/11	Rkm 390
				1	27	9/16	Rkm 361
1	28	9/23	Rkm 430				
1	29	9/24	Rkm 410				
LAIM4	Rkm 470	12,310	7/29	1	1	7/30	Rkm 388
				3	4	8/04	Rkm 373
				4	8		Rkm 375
				1	9	8/05	Rkm 357
				1	10	8/06	Rkm 348
				2	12		Rkm 351
				1	13	8/12	Rkm 430
				1	14	8/18	Rkm 375

Appendix Table A2.--Continued.

Brand	Release site	Number released	Date released	Recaptures		Date recapture	Recapture site				
				No.	Cumulative						
LATM4	Rkm 470	12,310	7/29	3	17	8/19	Rkm 359				
				2	19	8/26	Rkm 407				
				2	21	8/27	Rkm 390				
				2	23	9/02	Rkm 375				
				4	27	9/03	Rkm 361				
				1	28	9/10	Rkm 430				
				2	30		Rkm 432				
				1	31	9/25	Rkm 390				
				1	32	9/30	Rkm 361				
				1	33	10/15	Rkm 378				
				1	34	10/21	Rkm 430				
				1	35	10/22	Rkm 390				
				1	36	10/28	Rkm 351				
				1	37	11/04	Rkm 388				
				LAUP1	Rkm 470	2,512	8/03	1	1	8/19	Rkm 359
1	2	8/20	Rkm 351								
1	3	8/26	Rkm 407								
1	4	8/27	Rkm 390								
1	5	9/02	Rkm 375								
3	8	9/03	Rkm 361								
1	9	9/11	Rkm 390								
1	10	9/15	Rkm 375								
1	11	9/23	Rkm 430								
1	12	9/24	Rkm 410								
1	13	9/25	Rkm 390								
1	14	11/11	Rkm 348								
LAUP2	Rkm 470	2,399	8/06					1	1	8/13	Rkm 390
								1	2	9/10	Rkm 430
				1	3	9/15	Rkm 375				
				1	4	9/24	Rkm 410				
				1	5	10/21	Rkm 430				
LAUP3	Rkm 470	2,663	8/10	1	1	8/13	Rkm 390				
				1	2	8/19	Rkm 359				
				1	3	9/02	Rkm 375				
				1	4	9/11	Rkm 390				
				1	5	9/23	Rkm 430				
				1	6	10/27	Rkm 378				
LAUP4	Rkm 470	2,545	8/13	1	1	8/18	Rkm 375				
				1	2	8/27	Rkm 390				
				1	3	9/11	Rkm 390				
				1	4	9/23	Rkm 430				
LA3X1	Rkm 470	2,547	8/17	1	1	8/26	Rkm 407				
				3	4	8/27	Rkm 390				
				2	6	9/02	Rkm 375				

Appendix Table A2.--Continued.

Brand	Release site	Number released	Date released	Recaptures		Date recapture	Recapture site
				No.	Cumulative		
LA3X1	Rkm 470	2,547	8/17	4	10	9/03	Rkm 361
				1	11	9/10	Rkm 430
				1	12	9/11	Rkm 390
				1	13	9/23	Rkm 430
				1	14	9/24	Rkm 410
				1	15	9/29	Rkm 375
				1	16	10/15	Rkm 378
				1	17	10/28	Rkm 351
LA3X2	Rkm 470	2,536	8/20	1	1	8/25	Rkm 430
				1	2	8/26	Rkm 407
				1	3	9/02	Rkm 375
				2	5	9/03	Rkm 361
				1	6	9/10	Rkm 430
				1	7	9/11	Rkm 390
				1	8	9/24	Rkm 410
				1	9	9/25	Rkm 390
				1	10	9/29	Rkm 375
				1	11	10/22	Rkm 390
				1	12	10/27	Rkm 378
				1	13	10/28	Rkm 351
				LA3X3	Rkm 470	1,577	8/26
1	3	9/15	Rkm 375				
1	4	10/21	Rkm 430				
1	5	10/22	Rkm 390				
1	6	11/03	Rkm 422				
1	6	11/03	Rkm 422				
LASP 1	Rkm 375 (Blalock Canyon)	721	7/06	1	1	7/06	Rkm 351
LASP2	Rkm 375	716	7/30	1	1	8/06	Rkm 348
						9/15	Rkm 375
LASP3	Rkm 375	895	8/08	1	1	8/12	Rkm 430
				2	3	8/19	Rkm 359
				1	4	8/26	Rkm 407
				1	5	9/02	Rkm 375
				1	6	10/21	Rkm 430
				1	7	11/11	Rkm 348
				1	7	11/11	Rkm 348
LDSP 1	Rkm 375	503	9/08	1	1	9/29	Rkm 375
				1	2	10/22	Rkm 390
LDSP3	Rkm 375	475	8/17	1	1	8/26	Rkm 407
				1	2	8/27	Rkm 390

Appendix Table AZ.--Continued.

Brand	Release site	Number released	Date released	Recaptures		Date recapture	Recapture site
				No.	Cumulative		
RASP 1	Rkm 375	1,204	7/13	2	2	7/15	Rkm 362
				1	3	7/16	Rkm 351
				2	5	7/24	Rkm 351
				1	6	8/25	Rkm 430
				1	7	9/10	Rkm 430
				1	8	9/25	Rkm 390
RASP2	Rkm 375	548	7/14	2	2	8/04	Rkm 373
				1	3	8/18	Rkm 375
				1	4	8/26	Rkm 407
				1	5	9/03	Rkm 361
				1	6	9/10	Rkm 423
RASP3	Rkm 375	2,168	7/20	1	1	7/24	Rkm 351
				1	2	7/30	Rkm 388
				1	3	7/31	Rkm 348
				1	4		Rkm 351
				1	5	8/04	Rkm 373
				3	8		Rkm 373
				3	11	8/05	Rkm 357
				1	12	8/11	Rkm 439
				1	13		Rkm 449
				1	14	8/12	Rkm 430
				2	16	8/18	Rkm 373
				1	17	8/26	Rkm 407
				1	18	9/10	Rkm 430
				1	19	9/16	Rkm 361
				1	20	9/23	Rkm 439
				1	21	9/24	Rkm 410
				RASP4	Rkm 375	929	7/21
1	3	8/04	Rkm 375				
1	4	8/06	Rkm 351				
1	5	8/13	Rkm 390				
1	6	9/25	Rkm 390				
RDSP1	Rkm 375	613	7/22	1	1	8/06	Rkm 351
				1	2	9/24	Rkm 410
RDSP2	Rkm 375	2,370	7/27	1	1	7/30	Rkm 388
				1	2	7/31	Rkm 348
				2	4	8/04	Rkm 373
				1	5		Rkm 375
				2	7	8/05	Rkm 357
				2	9	8/06	Rkm 351
				2	11	8/13	Rkm 390
				1	12	8/18	Rkm 375
				1	13	8/19	Rkm 359
				2	15	8/27	Rkm 390
				1	16	9/02	Rkm 375
				1	17	9/15	Rkm 375
				1	18	9/24	Rkm 410

Appendix Table A2.--Continued.

Brand	Release site	Number released	Date released	Recaptures		Date recapture	Recapture site
				No.	Cumulative		
RDSP3	Rkm 375	1,424	7/28	1	1	7/31	Rkm 351
				1	2	8/06	Rkm 348
				1	3	8/13	Rkm 390
				1	4	9/23	Rkm 439
				1	5	9/24	Rkm 410
RDSP4	Rkm 375	952	7/29	4	4	7/31	Rkm 348
				2	6		Rkm 351
				1	7	8/05	Rkm 357
				1	8	8/06	Rkm 348
				1	9	8/13	Rkm 390
				1	10	8/18	Rkm 375
LAWV1	Rkm 431 (Purse seine)	157	7/08	1	1	9/17	Rkm 351
LAW4	Rkm 351	654	7/16	1	1	8/27	Rkm 390
				1	2	9/29	Rkm 359
LDWV2	Rkm 351	570	7/24	1	1	8/13	Rkm 390
				1	2	8/18	Rkm 359
LDWV3	Rkm 386	328	7/30	1	1	8/19	Rkm 359
				1	2	9/02	Rkm 375
				1	3	9/25	Rkm 390
LDWV4	Rkm 351	614	7/31	1	1	9/03	Rkm 361
LPWV1	Rkm 373	1,110	8/04	3	3	8/05	Rkm 357
				3	6	8/06	Rkm 351
				1	7	9/10	Rkm 430
LPWV2	Rkm 359	1,070	8/05	1	1	9/11	Rkm 390
				1	2	9/23	Rkm 430
LPWv3	Rkm 351	1,238	8/06	1	1	8/12	Rkm 430
				1	2	8/18	Rkm 375
				1	3	8/25	Rkm 439
				1	4	8/26	Rkm 407
				1	5	8/27	Rkm 390
				1	6	9/03	Rkm 361
LPWv4	Rkm 430	332	8/13	1	1	9/02	Rkm 375
				1	2	9/15	Rkm 375
LAAR1	Rkm 375	472	8/18	1	1	8/25	Rkm 430
				1	2	8/27	Rkm 390
				1	3	9/02	Rkm 375
				1	4	9/15	Rkm 375
				1	5	9/23	Rkm 430
				1	6	9/24	Rkm 410

Appendix Table A2.--Continued.

Brand	Release site	Number released	Date released	Recaptures		Date recapture	Recapture site
				No.	Cumulative		
LAAR2	Rkm 359	206	8/19	1	1	9/02	Rkm 375
				1	2	9/03	Rkm 361
				2	4	9/15	Rkm 375
				1	5	9/23	Rkm 439
				1	6	10/15	Rkm 378
LDAR1	Rkm 407	512	8/26	1	1	9/03	Rkm 361
				1	2	9/10	Rkm 423
				1	3	9/16	Rkm 361
LDAR2	Rkm 388	623	8/27	1	1	9/10	Rkm 430
				1	2	9/11	Rkm 390
				1	3	9/16	Rkm 361
				1	4	9/25	Rkm 390
LPAR1	Rkm 377	246	9/02	1	1	9/10	Rkm 430
				1	2	9/25	Rkm 390
LPAR2	Rkm 359	795	9/03	2	2	9/11	Rkm 390
				1	3	9/24	Rkm 410
				1	4	10/21	Rkm 430
LAD1	Rkm 430	522	9/10	1	1	9/15	Rkm 375
				1	2	9/23	Rkm 430
				1	3	9/25	Rkm 390
LAD2	Rkm 388	596	9/11	1	1	10/15	Rkm 378
				1	2	10/27	Rkm 378
				1	3	11/11	Rkm 348
LAD3	Rkm 375	268	9/15	1	1	9/23	Rkm 430
				1	2	10/21	Rkm 430
LAD4	Rkm 359	64	9/16	1	1	9/24	Rkm 410
LDD2	Rkm 410	213	9/24	1	1	10/21	Rkm 430
LDD1	Rkm 430	327	9/23	1	1	10/22	Rkm 390
				1	2	11/04	Mm 388

a/ Position, brand, and orientation. LA indicates left anterior, LD indicates left dorsal, and LP indicates left posterior. Orientation refers to rotation of the brand around its center point (i.e., 1 equals normal orientation, ID; 2 equals ID , 3 equals DI , and 4 equals ID).

Appendix Table A3.-- Average daily discharge McNary Dam, 1981.

Date	Disch. (KCFS)	Date	Disch. (KCFS)	Date	Disch. (KCFS)	Date	Disch. (KCFS)
Jun. 10	416.0	Jul. 1	228.4	Aug. 1	198.0	Sep. 1	129.8
11	417.9	2	227.9	2	176.4	2	235.0
12	390.0	3	226.6	3	177.3	3	114.2
13	390.3	4	224.4	4	188.9	4	127.2
14	405.4	5	231.2	5	187.8	5	98.0
15	365.1	6	239.9	6	184.7	6	81.8
16	391.1	7	276.2	7	201.2	7	74.0
17	333.8	8	315.9	8	175.6	8	126.8
18	341.7	9	293.1	9	141.5	9	124.3
19	345.2	10	280.8	10	192.5	10	112.2
20	331.4	11	231.1	11	167.6	11	132.5
21	358.1	12	231.4	12	175.3	12	115.4
22	333.5	13	219.2	13	180.8	13	78.6
23	338.1	14	235.6	14	170.4	14	117.2
24	360.0	15	225.2	15	200.4	15	107.6
25	316.0	16	210.9	16	147.9	16	126.1
26	308.2	17	228.2	17	144.1	17	136.0
27	295.4	18	228.2	18	160.9	18	119.7
28	286.6	19	219.8	19	156.6	19	92.7
29	265.5	20	220.6	20	145.6	20	91.8
30	268.2	21	221.4	21	137.2	21	104.2
		22	213.5	22	152.1	22	120.6
		23	219.2	23	116.4	23	128.6
		24	209.5	24	162.8	24	118.7
		25	170.8	25	141.8		
		26	163.5	26	145.6		
		27	207.2	27	145.6		
		28	210.7	28	138.5		
		29	193.5	29	129.0		
		30	217.6	30	99.7		
		31	213.3	31	147.8		

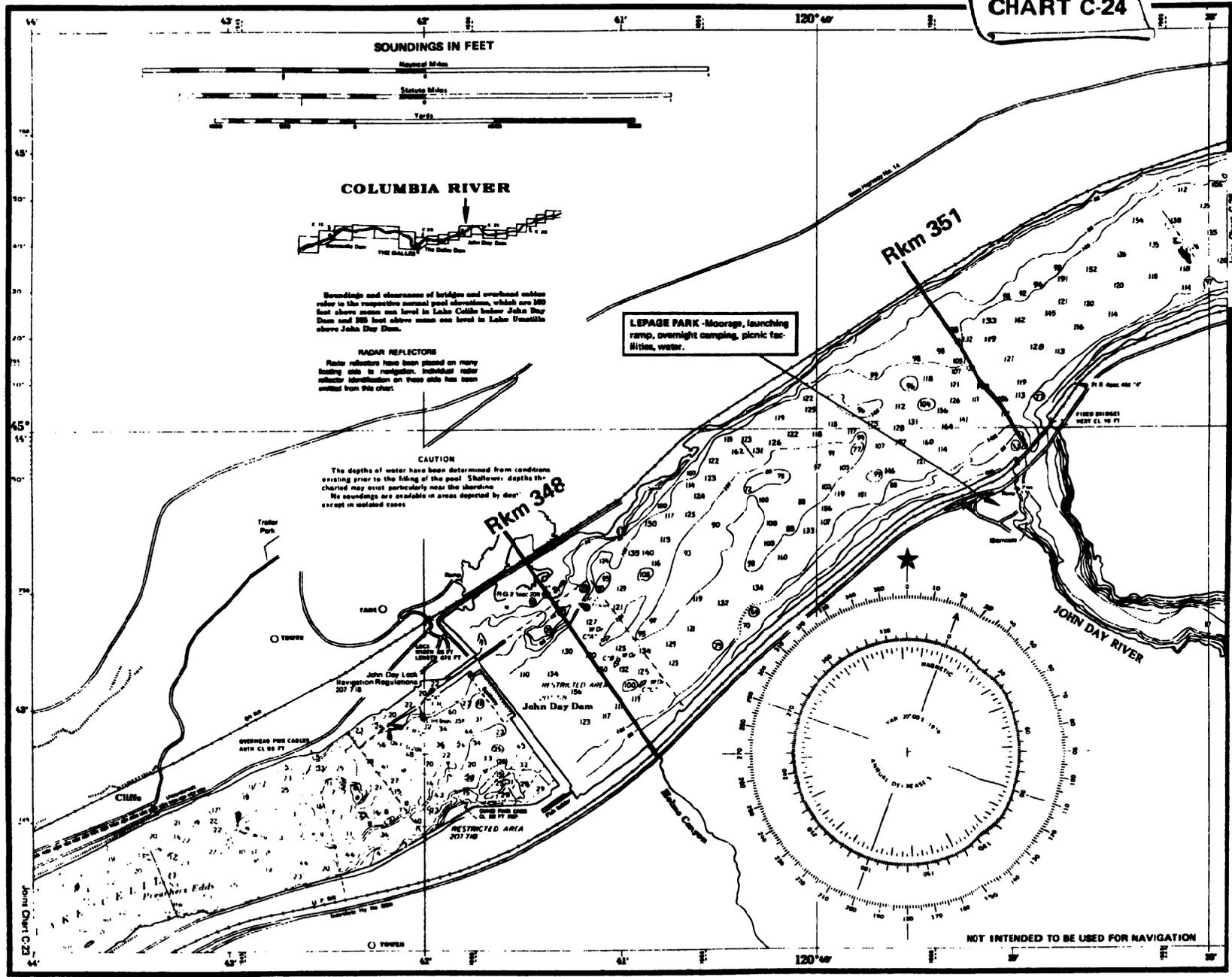
a/ Position, brand, and orientation. LA indicates left anterior, ED indicates left dorsal, and LP indicates left posterior. Orientation refers to rotation of the brand around its center point (i.e., 1 equals normal orientation, ID; 2 equals $\overline{\text{D}}$, 3 equals $\overline{\text{DI}}$, and 4 equals $\overline{\text{D}}$).

APPENDIX B

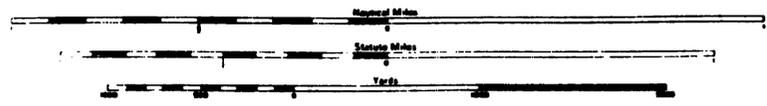
Chart of Purse Seine Sampling Areas

Showing John Day Reservoir, 1981

CHART C-24



SOUNDINGS IN FEET



COLUMBIA RIVER



Soundings and clearance of bridges and overhead cables refer to the respective normal pool elevations, which are 100 feet above mean sea level in Lake Celilo below John Day Dam and 200 feet above mean sea level in Lake Vanatta above John Day Dam.

RADAR REFLECTORS

Radar reflectors have been placed on many floating aids to navigation. Individual radar reflector identification on these aids has been omitted from this chart.

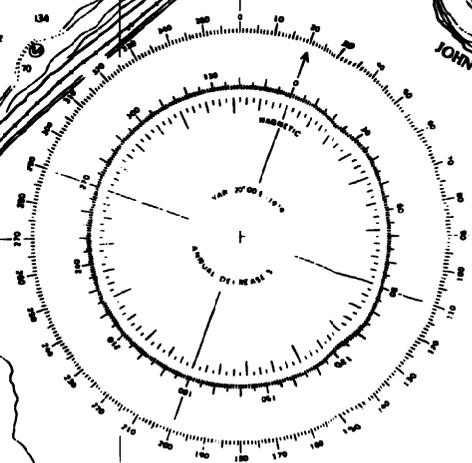
CAUTION

The depths of water have been determined from conditions existing prior to the filling of the pool. Shallow depths indicated may exist particularly near the shoreline. No soundings are available in areas depicted by dots except in isolated cases.

LEPAGE PARK - Moorage, launching ramp, overnight camping, picnic facilities, water.

Rkm 351

Rkm 348



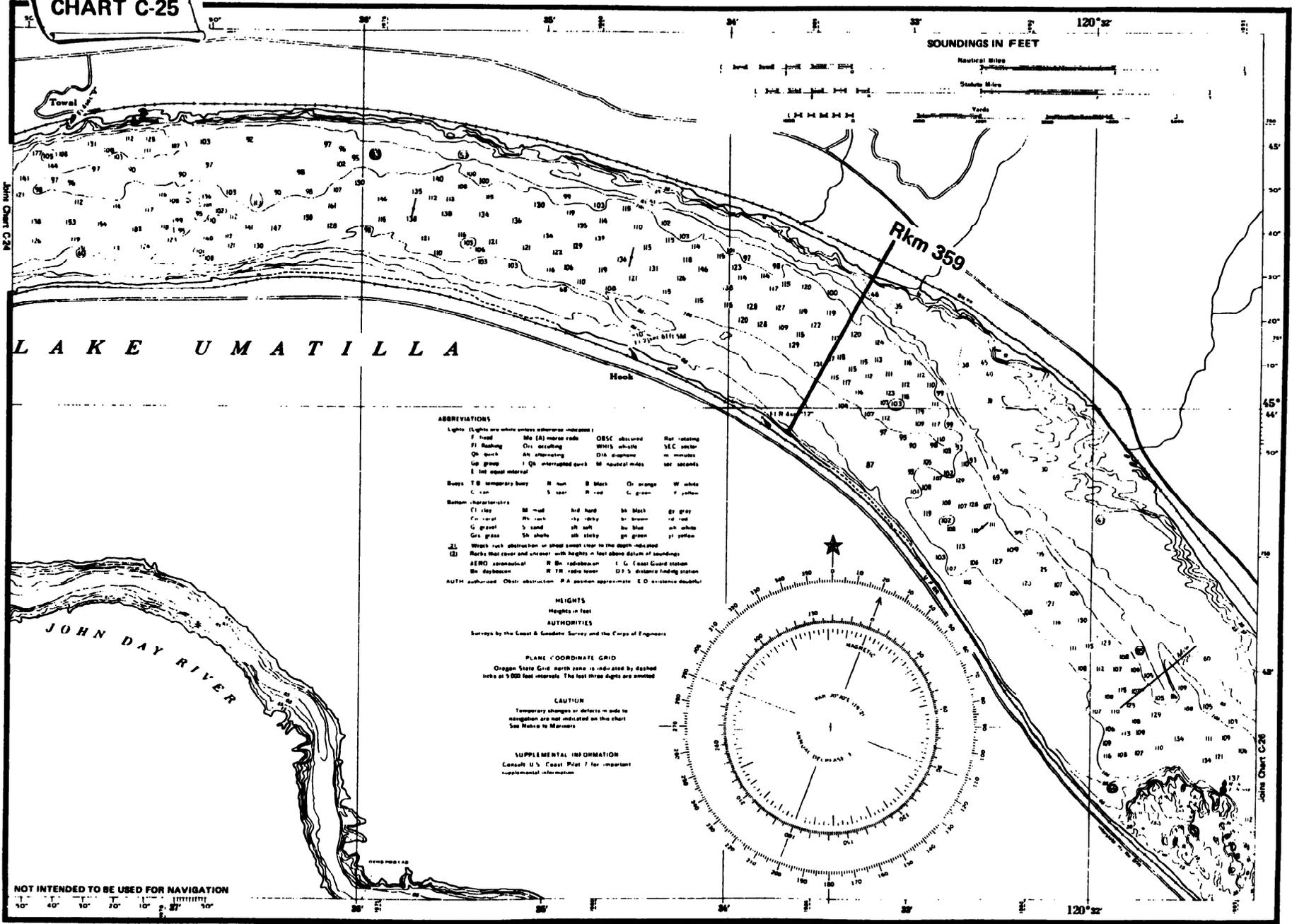
NOT INTENDED TO BE USED FOR NAVIGATION

Join Chart C-23

Join Chart C-25

CHART C-25

SOUNDINGS IN FEET



ABBREVIATIONS

Lights (lights are white unless otherwise indicated)
 F. fixed Mo (M) moored OBS obscured Rot rotating
 Fl flashing Or oscillating WH white SEC sector
 Qr quaternary Al alternating DR daymark m moored
 Gt green I Qn interrupted quick M moored marks set marks
 E led light moored

Buoys T B temporary buoy R nun B black Or orange W white
 C can S spar R red G green Y yellow

Bottom characteristics M mud H hard Sh shell Gt gravel
 C clay S sand sh soft bl blue wh white
 Gt gravel S sand sh soft bl blue wh white
 Grs grass Sh shells slt silt gy green Y yellow

(1) Weak rock obstruction or shoal except close to the depth indicated
 (2) Marks that cover and enclose with heights in feet above datum of soundings
 AERO aeronautical R Bu radio beacon I G Coast Guard station
 Bu daybeacon R TR radio tower D F S distance landing station
 AUTH authorized Obsc obstruction P A position approximate E D existence doubtful

HEIGHTS

Heights in feet

AUTHORITIES

Surveys by the Coast & Geodetic Survey and the Corps of Engineers

PLANE COORDINATE GRID

Oregon State Grid north zone is indicated by dashed lines at 5 000 foot intervals. The last three digits are omitted

CAUTION

Temporary changes or defects in aids to navigation are not indicated on this chart. See Notice to Mariners

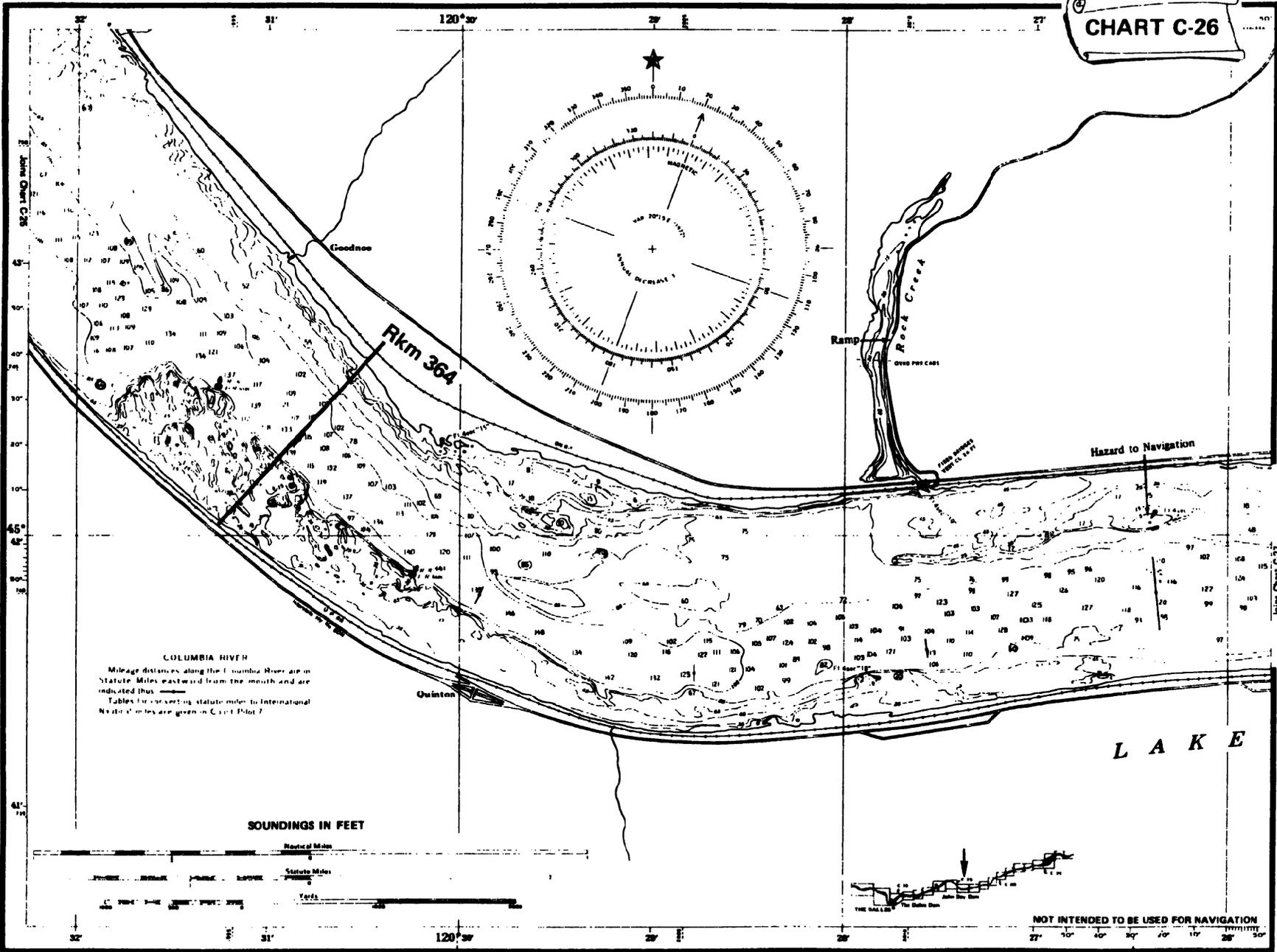
SUPPLEMENTAL INFORMATION

Consult U.S. Coast Pilot for important supplemental information

NOT INTENDED TO BE USED FOR NAVIGATION

Join Chart C-26

CHART C-26



COLUMBIA RIVER
Mileage distances along the Columbia River are in Statute Miles eastward from the mouth and are indicated thus ————
Tables for converting statute miles to International Nautical Miles are given in Chart Pilot 7.

SOUNDINGS IN FEET



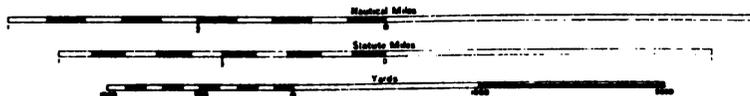
NOT INTENDED TO BE USED FOR NAVIGATION

Join Chart C25

Join Chart C27

CHART C-27

SOUNDINGS IN FEET



Rkm 378

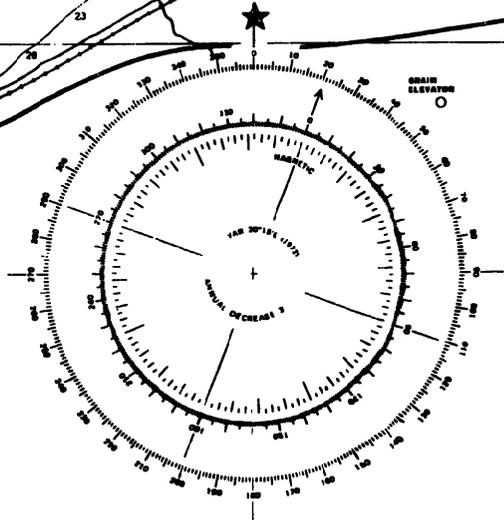
Rkm 373

Small Boat Access

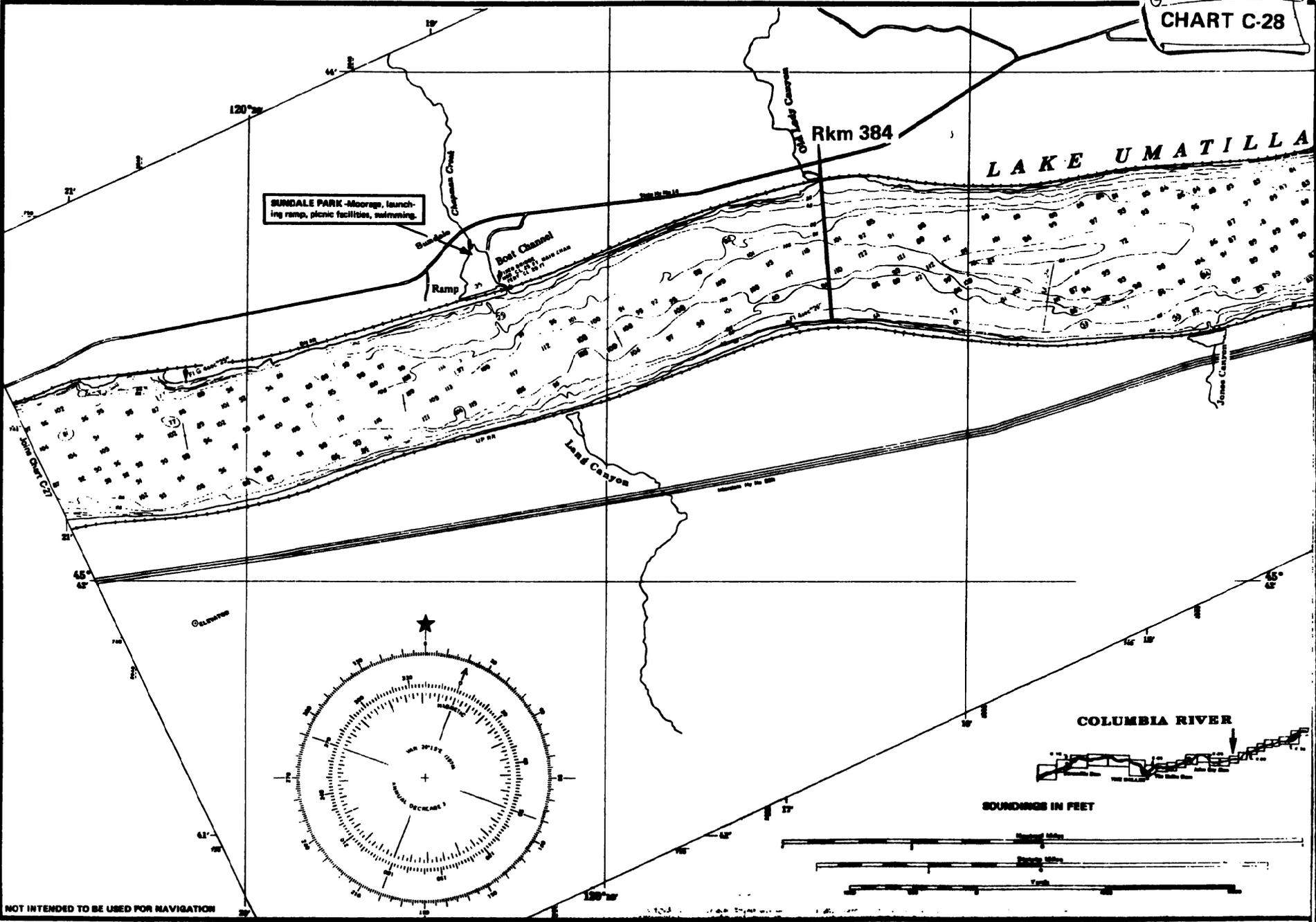
Blalock

Blalock Canyon

U M A T I L L A



NOT INTENDED TO BE USED FOR NAVIGATION



SUNDAL PARK - Moorage, launching ramp, picnic facilities, swimming.

Boat Channel

Ramp

Rkm 384

LAKE UMATILLA

Lead Canyon

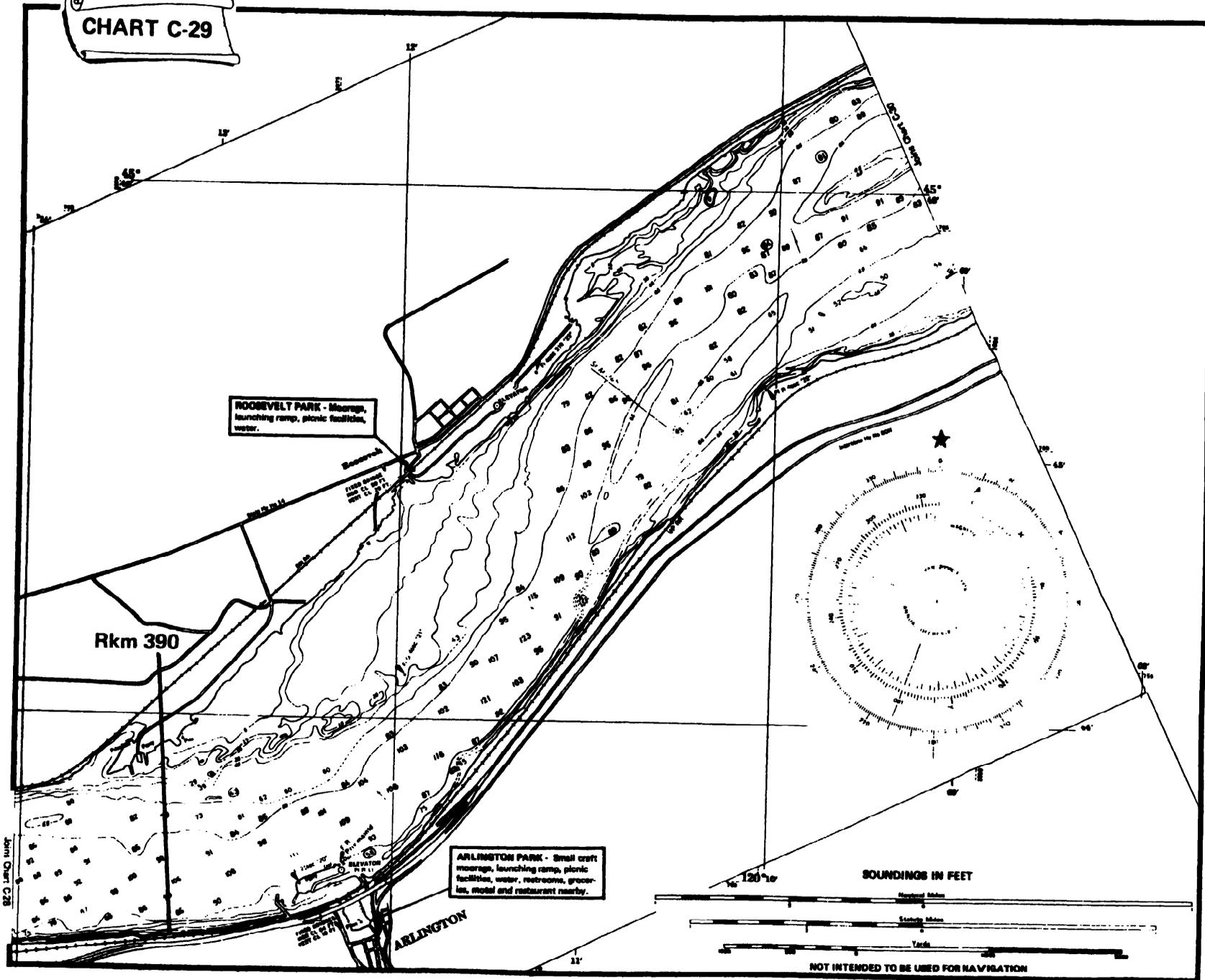
Jones Canyon

COLUMBIA RIVER

SOUNDINGS IN FEET

NOT INTENDED TO BE USED FOR NAVIGATION

CHART C-29



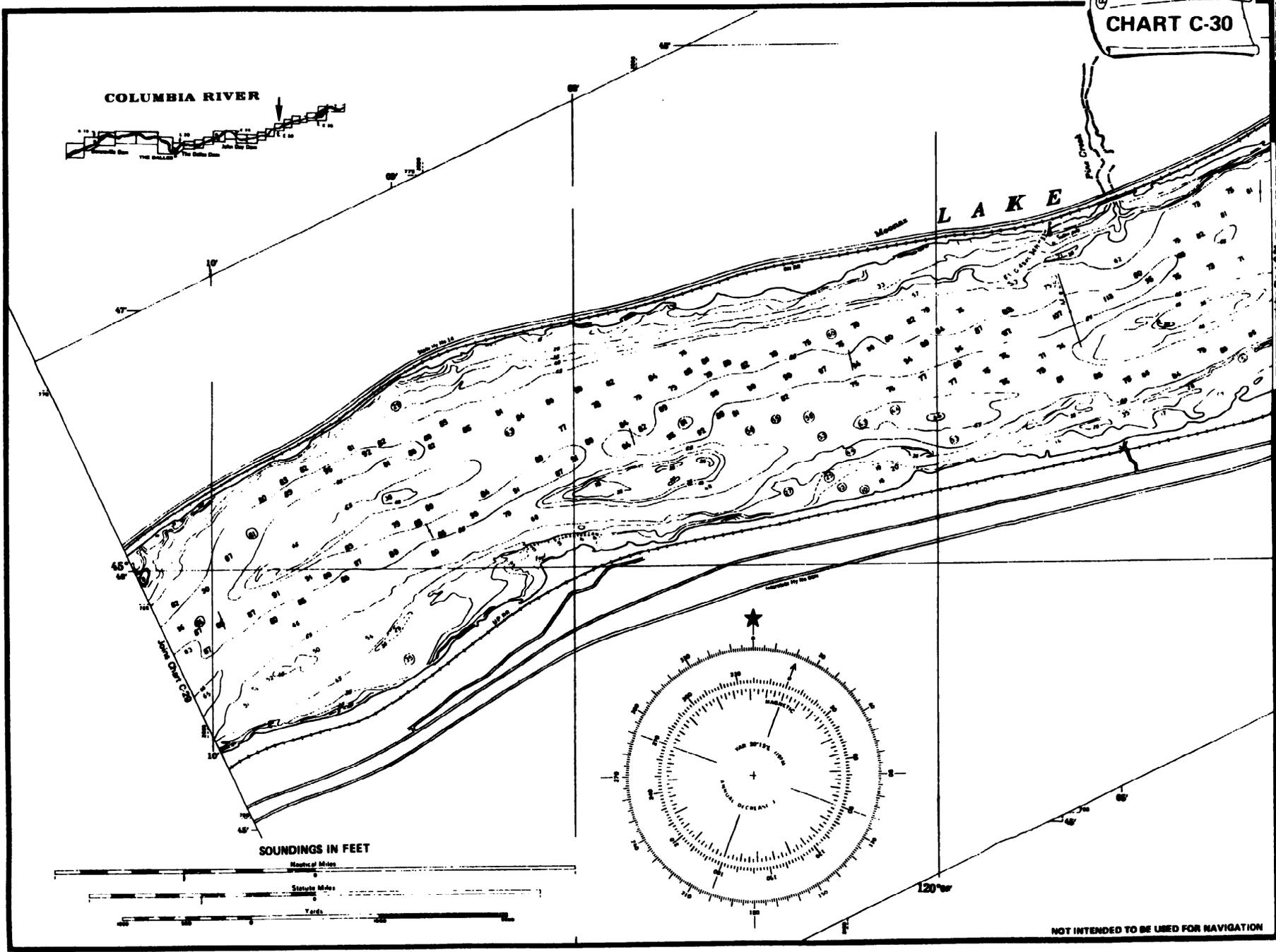
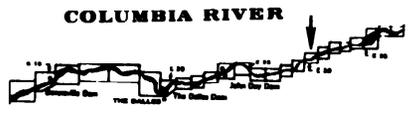
ROOSEVELT PARK - Moorage, launching ramp, picnic facilities, water.

Rkm 390

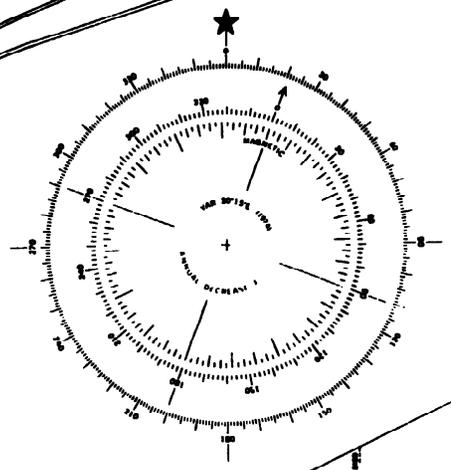
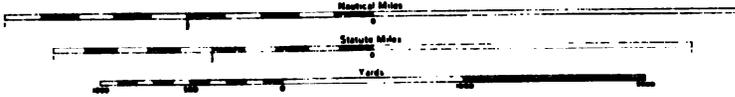
ARLINGTON PARK - Small craft moorage, launching ramp, picnic facilities, water, restrooms, groceries, motel and restaurant nearby.

SOUNDINGS IN FEET

NOT INTENDED TO BE USED FOR NAVIGATION



SOUNDINGS IN FEET



120°

CHART C-31

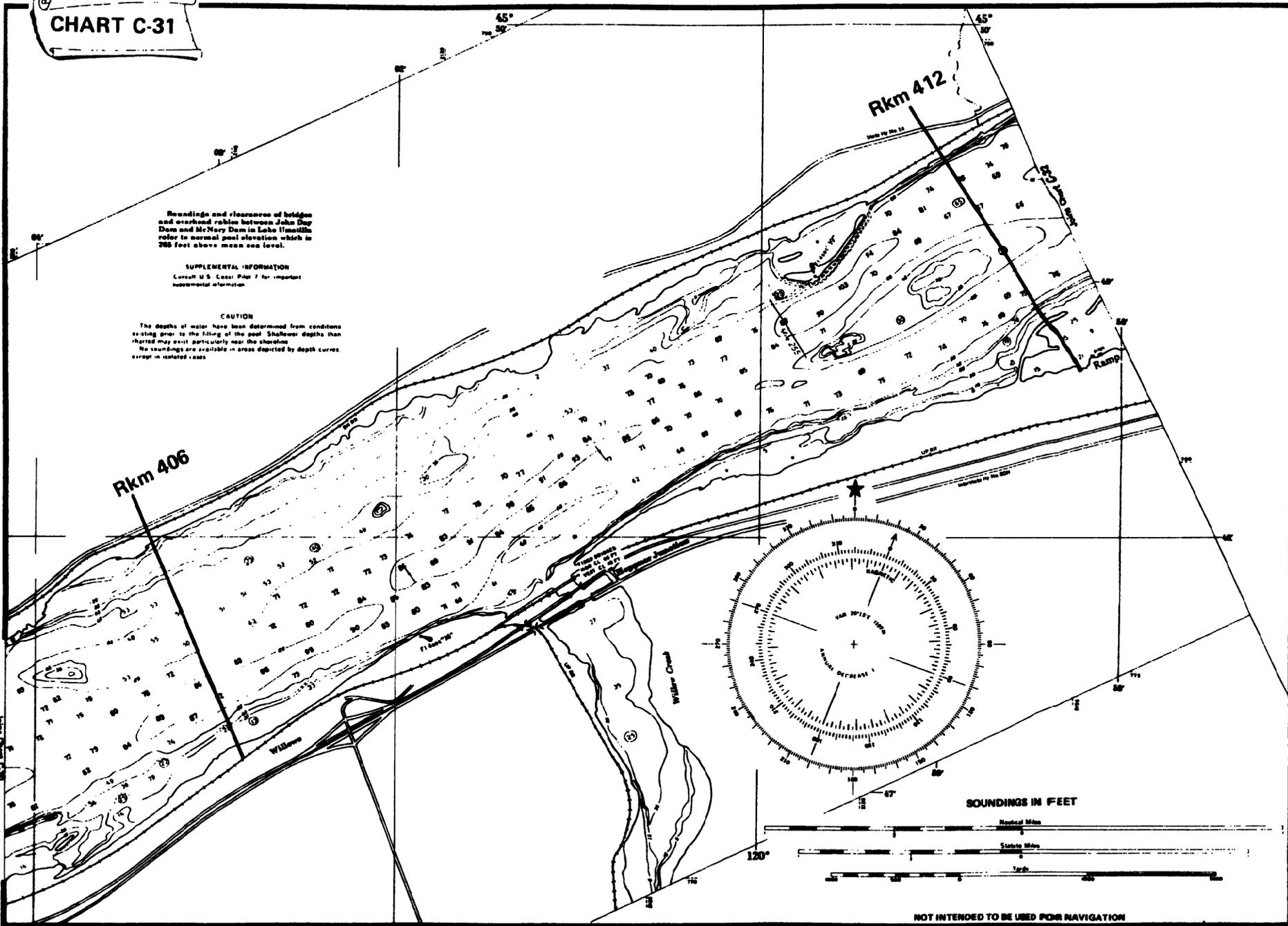
Soundings and clearances of bridges and overhead cables between John Day Dam and McNary Dam in Lake Umatilla refer to normal pool elevation which is 765 feet above mean sea level.

SUPPLEMENTAL INFORMATION
Consult U.S. Coast Pilot 7 for important supplemental information.

CAUTION
The depths of water have been determined from conditions existing prior to the filling of the pool. Shallower depths than charted may exist particularly near the shoreline.
No soundings are available in areas depicted by depth curves except in isolated cases.

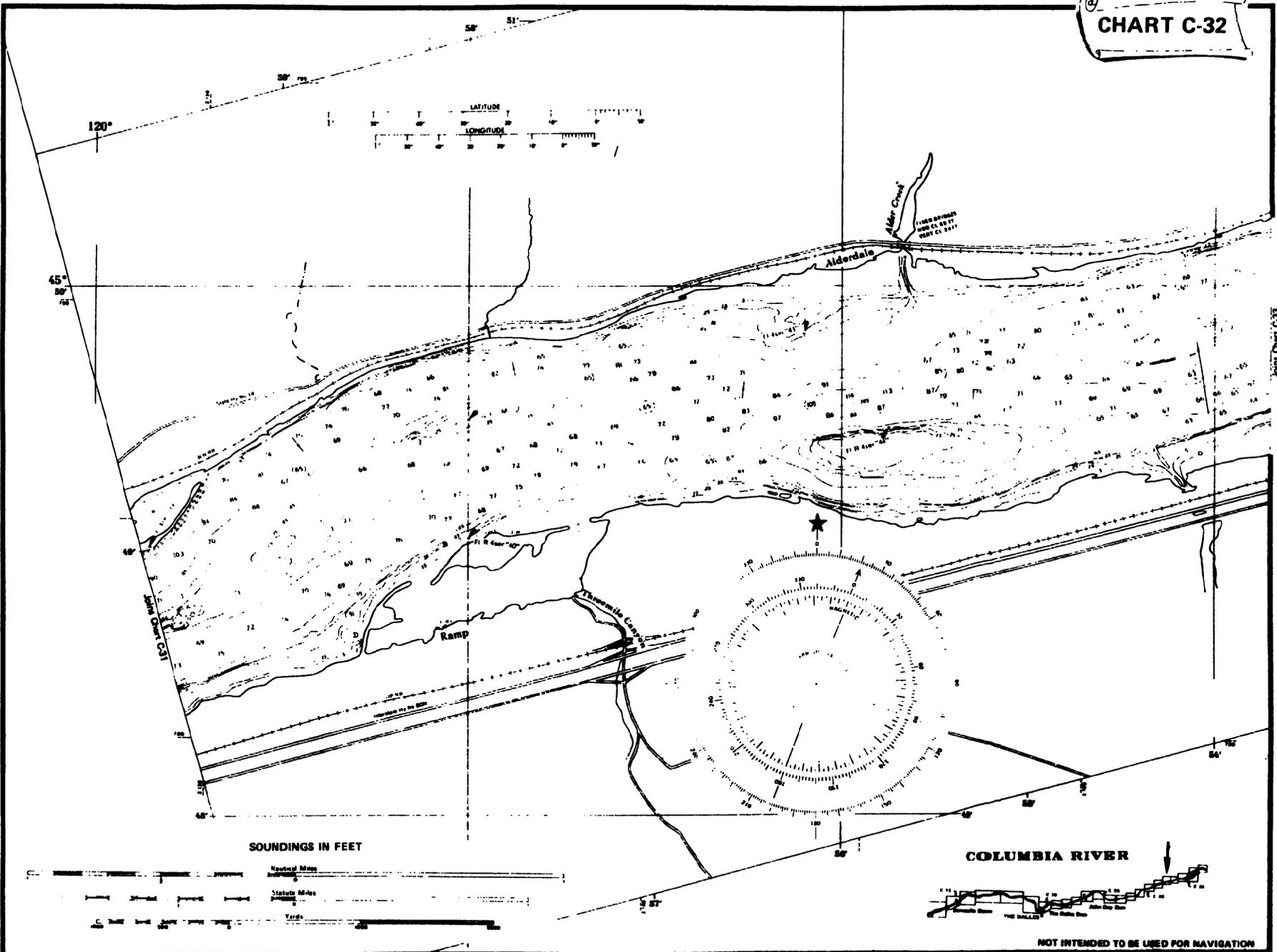
Rkm 406

Rkm 412



NOT INTENDED TO BE USED FOR NAVIGATION

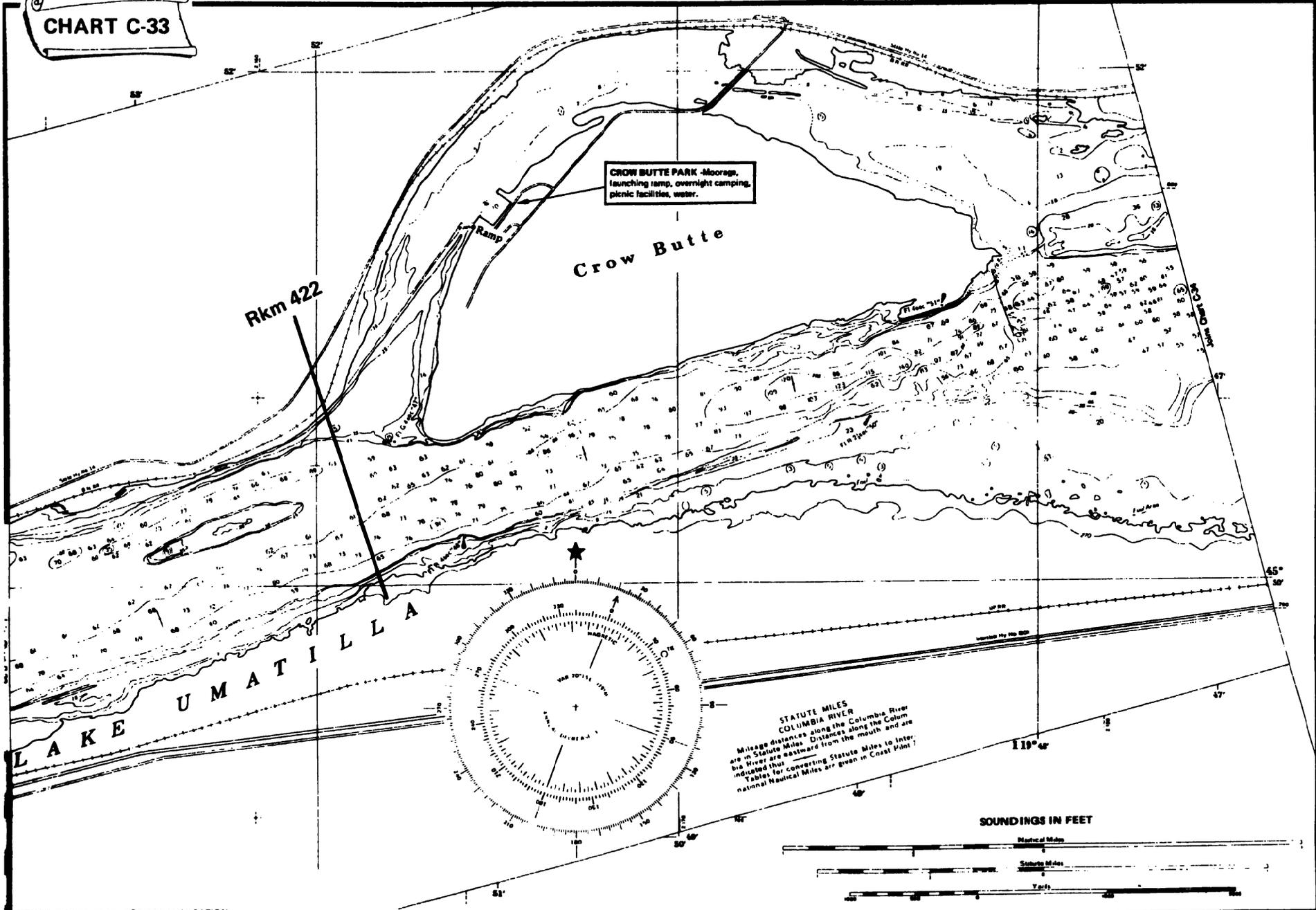
CHART C-32



Joint Chart C-32

NOT INTENDED TO BE USED FOR NAVIGATION

CHART C-33

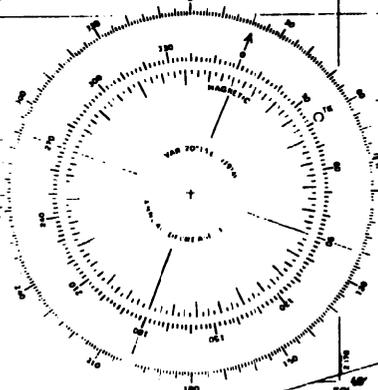


CROW BUTTE PARK -Moorage,
launching ramp, overnight camping,
picnic facilities, water.

Rkm 422

Crow Butte

LAKE UMATILLA



**STATUTE MILES
COLUMBIA RIVER**
Mileage distances along the Columbia River
are in Statute Miles. Distances along the Colum-
bia River are eastward from the mouth and are
indicated thus: .
Tables for converting Statute Miles to Inter-
national Nautical Miles are given in Coast Pilot.

SOUNDINGS IN FEET

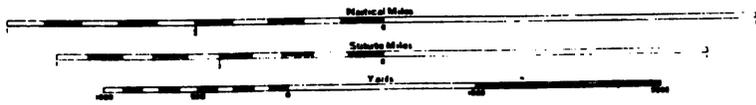
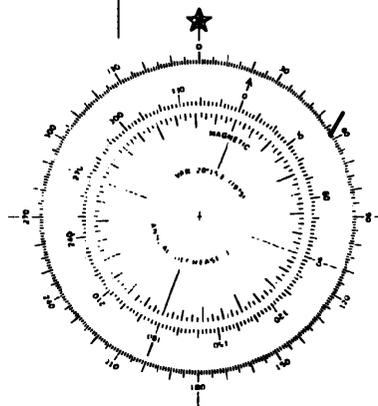
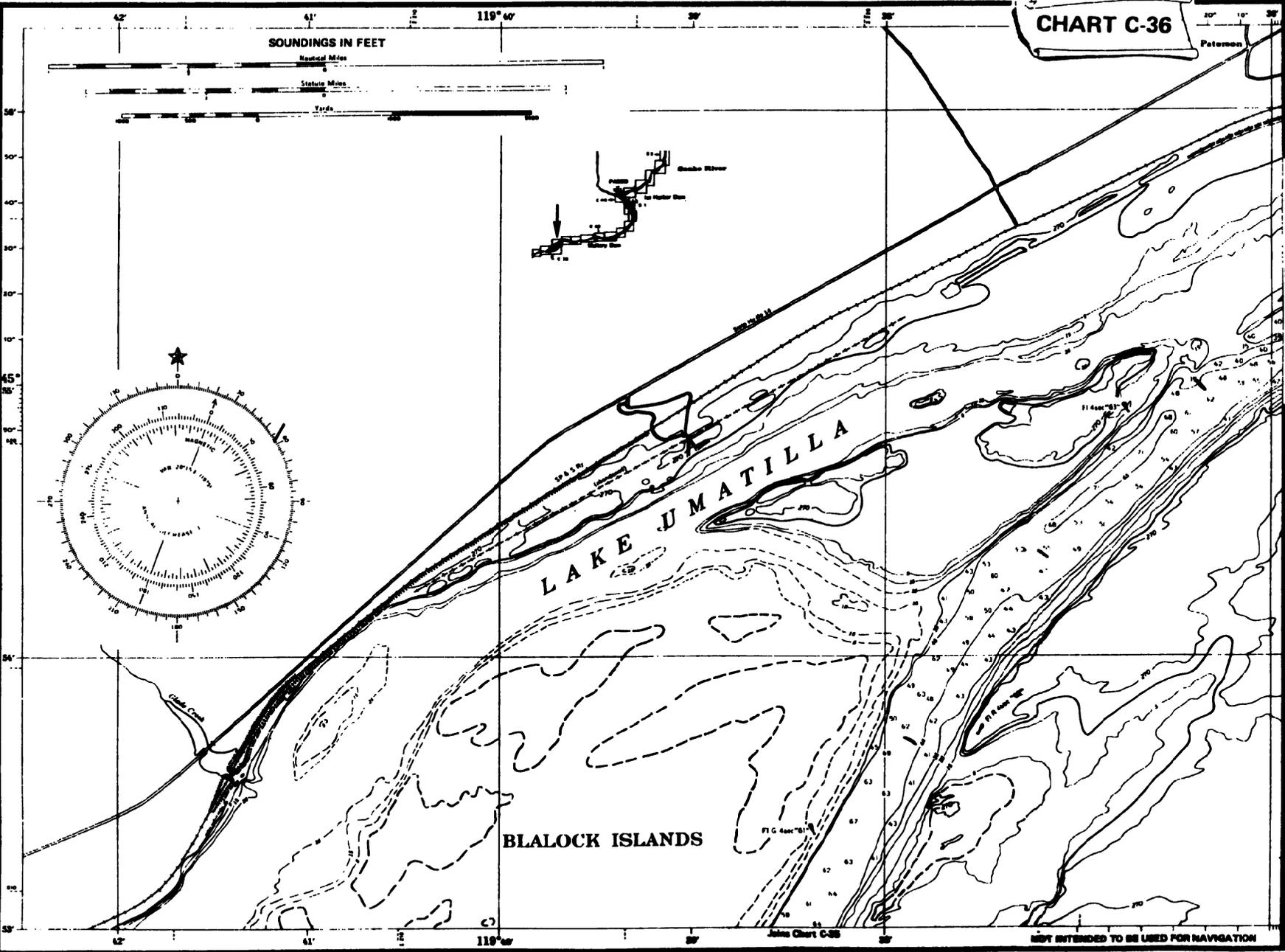


CHART C-36

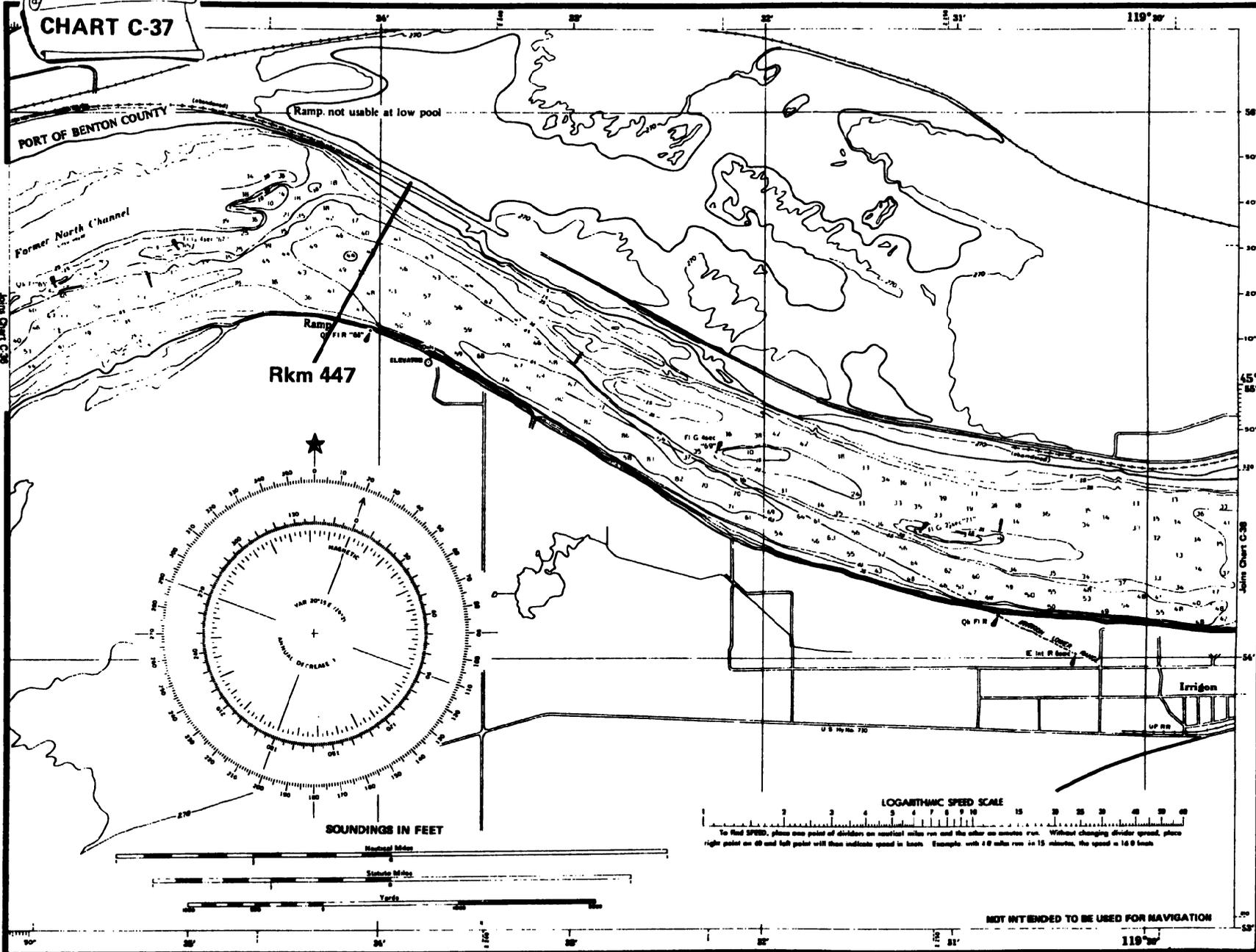


BLALOCK ISLANDS

LAKE UMATILLA

NOT INTENDED TO BE USED FOR NAVIGATION

CHART C-37

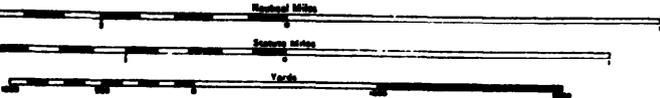


NOT INTENDED TO BE USED FOR NAVIGATION

119° 00'

CHART C-38

SOUNDINGS IN FEET



ABBREVIATIONS

Lights (lights are white unless otherwise indicated):

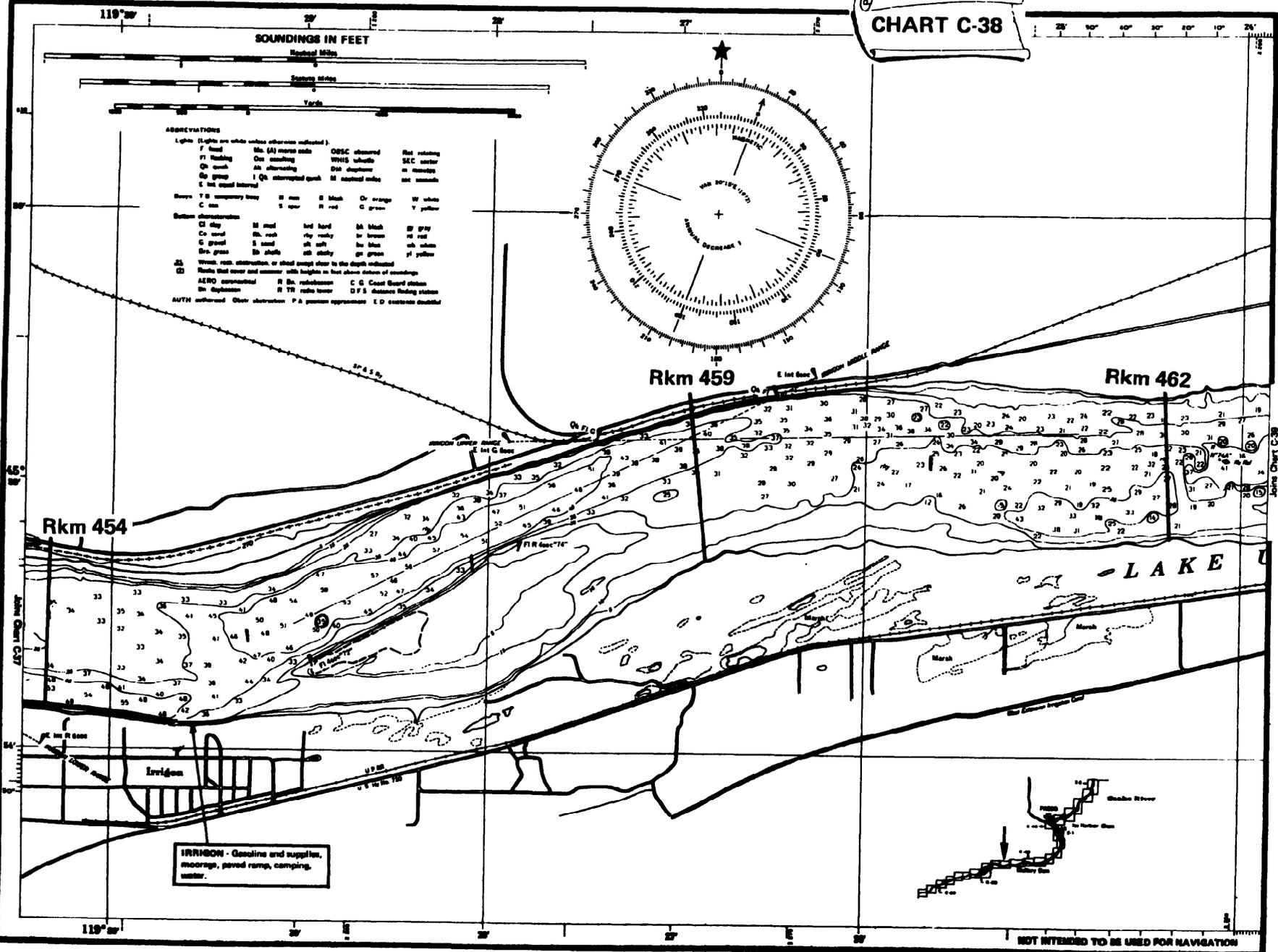
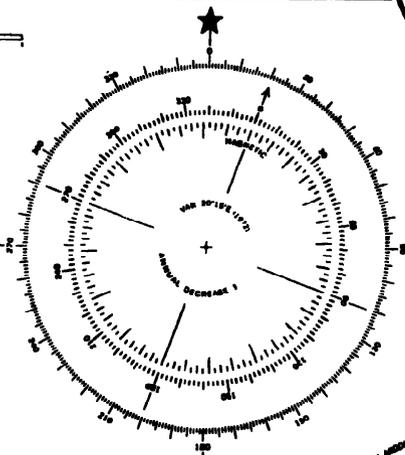
F flashing	M (M) Morse code	QSC obscured	SEC sector
Fl flashing	On sounding	WHIS whistle	in minutes
Qc quick	Al alternating	Dth depth	in minutes
Qp group	I Qc interrupted quick	M marked mile	see marks
E 1st equal interval			

Colors: T B temporary buoy, R red, B black, O orange, W white, C can, S spar, H red, G green, Y yellow

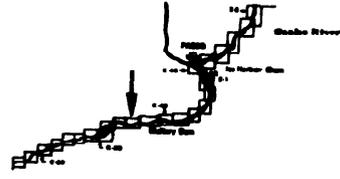
Bottom characteristics

Cl clay	M mud	hd hard	bl black	gr gray
Co coral	bk rock	sh shaly	br brown	bl blue
G gravel	S sand	sl soft	br blue	wh white
Gr. grass	Sh shells	sl shaly	gr green	yl yellow

(S) Weak, rock, obstruction, or shoal except clear to the depth indicated
 (D) Marks that cover and enclose with heights in feet above datum of soundings
 (SRO) soundings, R in, reference, C G, Coast Guard station
 (S) depth, R TR radio tower, (S F) distance bearing station
 AUTH authorized, Obsr observation, P A position, approx, E D distance, actual



IRRISON - Gasoline and supplies, moorage, paved ramp, camping, water.



NOT INTENDED TO BE USED FOR NAVIGATION

CHART C-39

CAUTION
The depths of water have been determined from soundings as being at or to the liking of the pool. Show depths that are not at or to the liking of the pool. No soundings are available in areas depicted by depth curves except in the indicated areas.

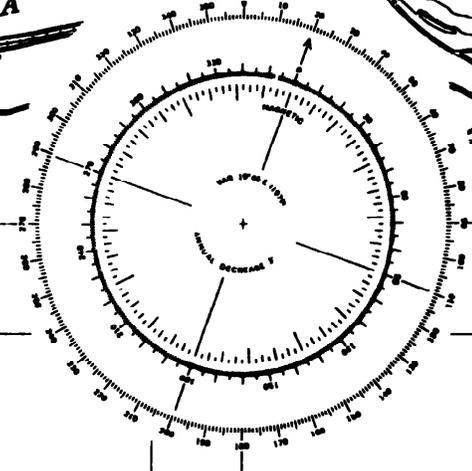
PLYMOUTH PARK - Moorage, launching ramp, overnight camping, picnic facilities, water.

UMATILLA MARINA - Open all year, Chevron gasoline and diesel fuel, moorage, launching ramp, laundry, water, electricity, ice, restrooms.

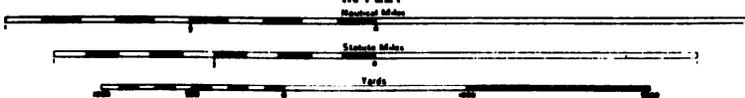
RESTRICTED AREA
20' - 70' (see note A)

Rkm 469

E UMATILLA



SOUNDINGS AND OVERHEAD CLEARANCES IN FEET



NOT INTENDED TO BE USED FOR NAVIGATION

Joint Chart C-40

McNARY

45°

35°

25°

15°

119° 20'

22'

21'

20'

19'

18'

17'

16'

15'

14'

13'

12'

11'

10'

10'

Joint Chart C-38

22'

21'

20'

19'

18'

17'

16'

15'

14'

13'

12'

11'

10'

119° 20'

18'

17'

16'

15'