River Level Reporting and Forecasting on the Columbia River

These gauges are strategically placed on the Columbia River from Portland to the River mouth at Astoria. They are approximately 15 miles apart and are regularly checked for operational accuracy.

40’ Project Channel Design

Design Ship	34’ Salt Water Draft*
+ Sinkage	9’’
+Drag/Trim	15’’
+Squat	29’’
+Underkeel	24’’
Equals	77’’ = 6.5’ rounded to 6’

Channel Depth = 34’ + 6’ = 40’

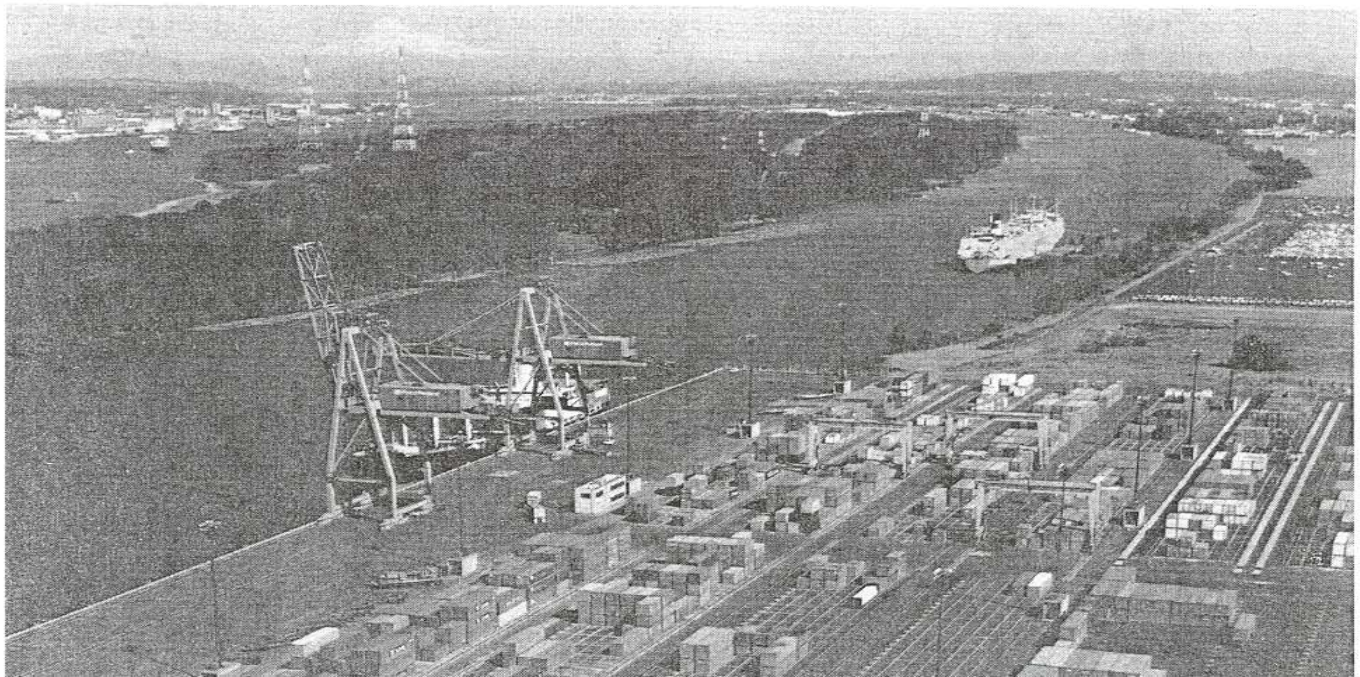
*30,000 – 33,000 DWT

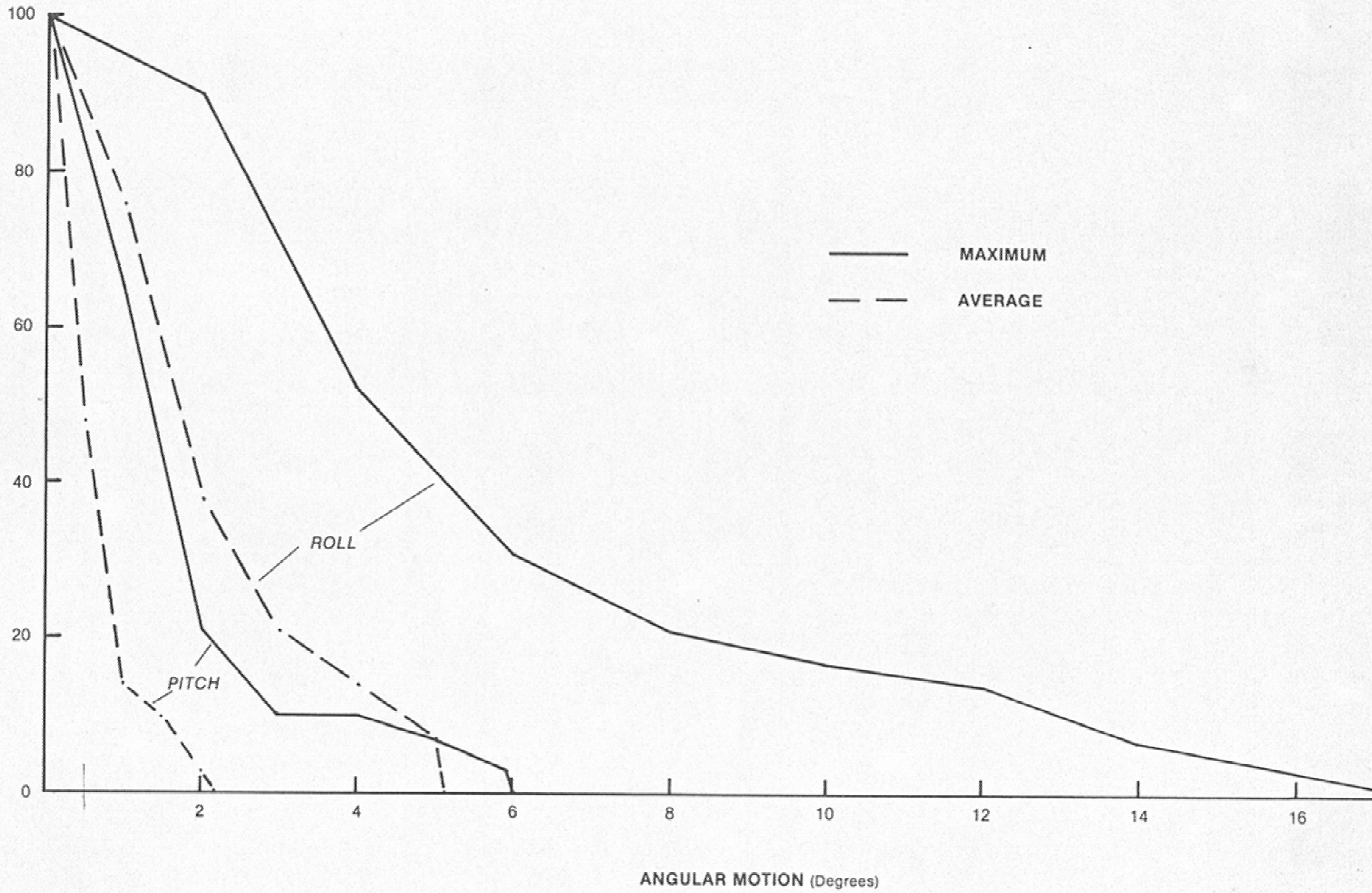
Source: 40’ Channel Study, USACE 1962

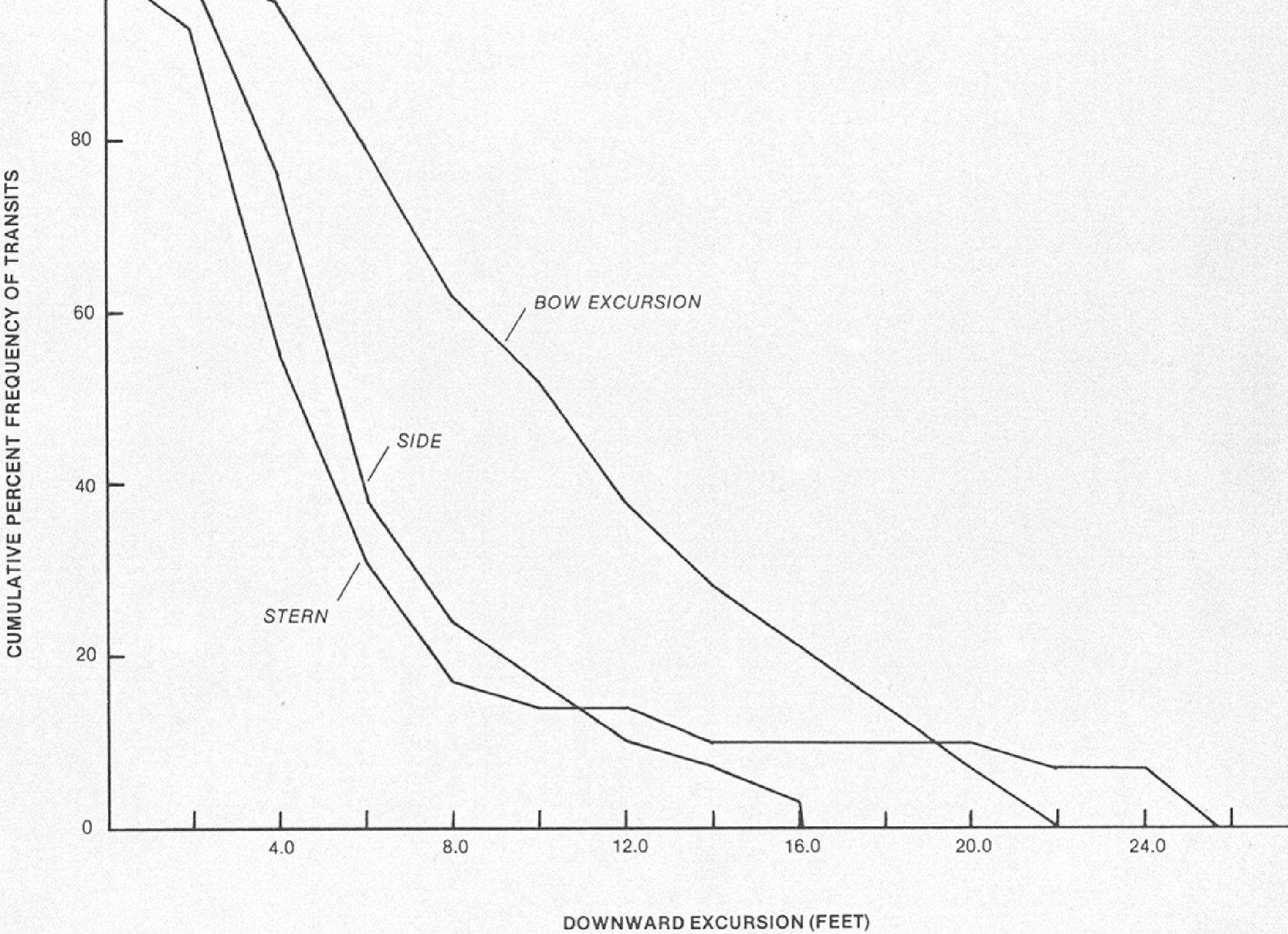
SHIP MOTION STUDY AT THE COLUMBIA RIVER ENTRANCE

Scott M. Noble

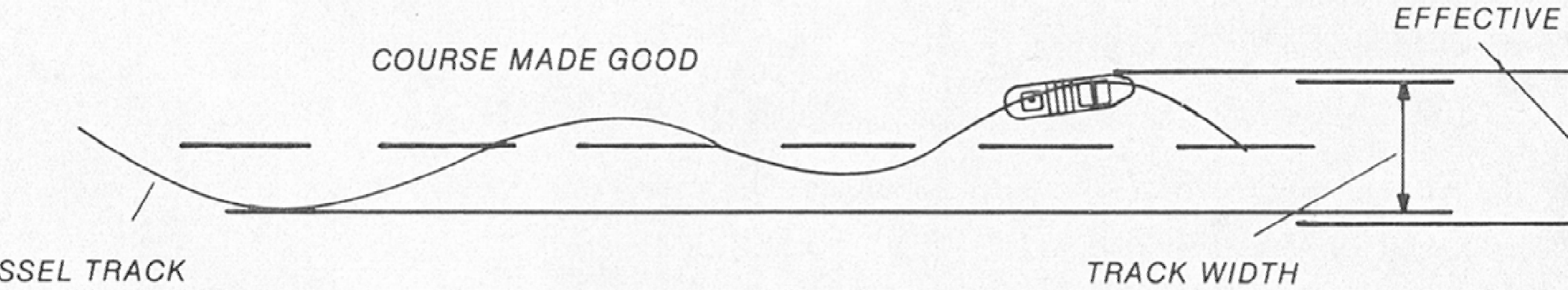
ASCE Convention & Exposition
Where civil engineers go to learn
PORTLAND
April 14-18, 1980




100
80
60
40
20
0
2
4
6
8
10
12
14
16
MAXIMUM
AVERAGE
ROLL
PITCH
ANGULAR MOTION (Degrees)



PERCENT FREQUENCY OF OCCURRENCE OF MAXIMUM VESSEL EXCURSIONS



E LANE WIDTH

River Level Reporting and Forecasting on the Columbia River

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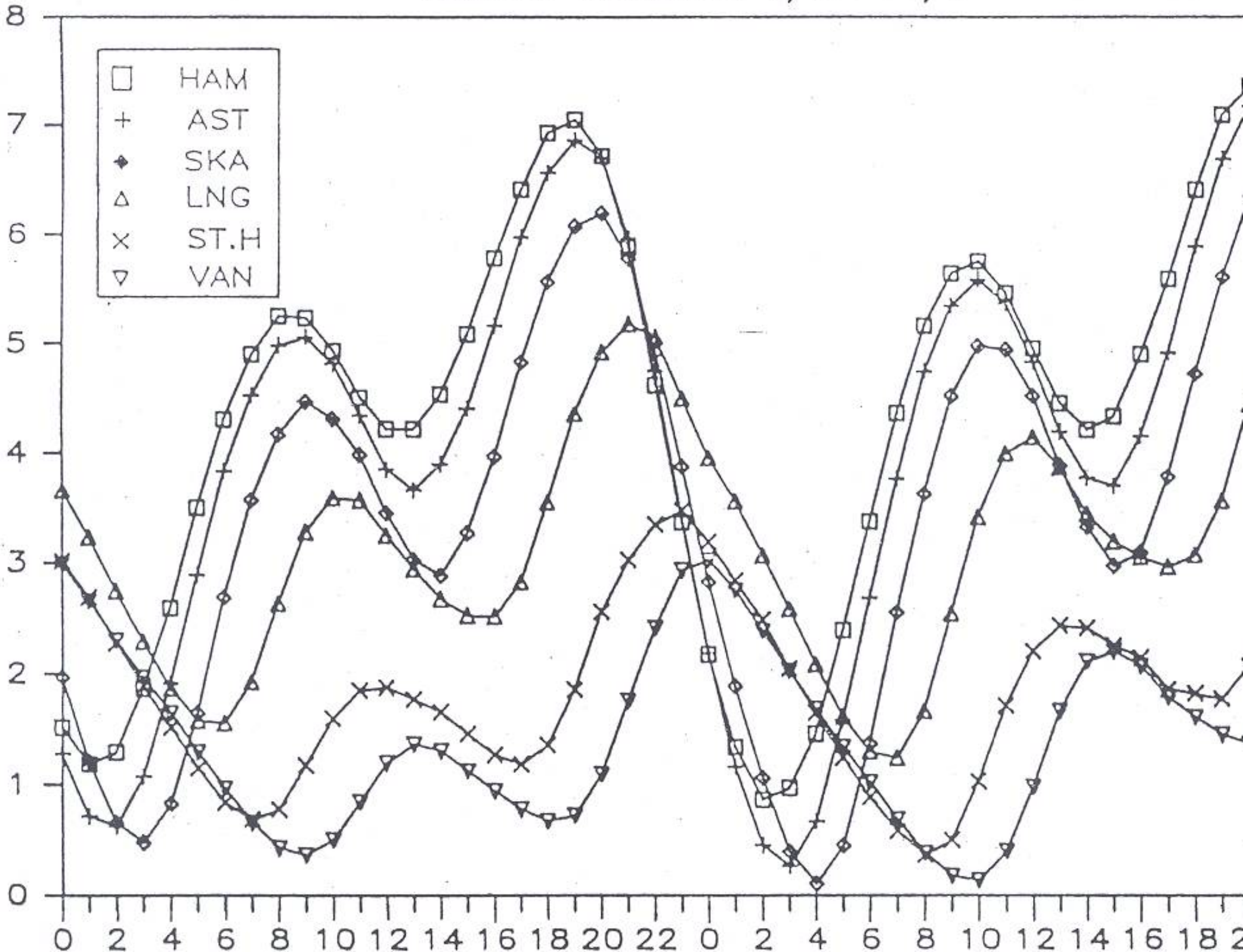
HOURLY READINGS 9/8 – 9/9

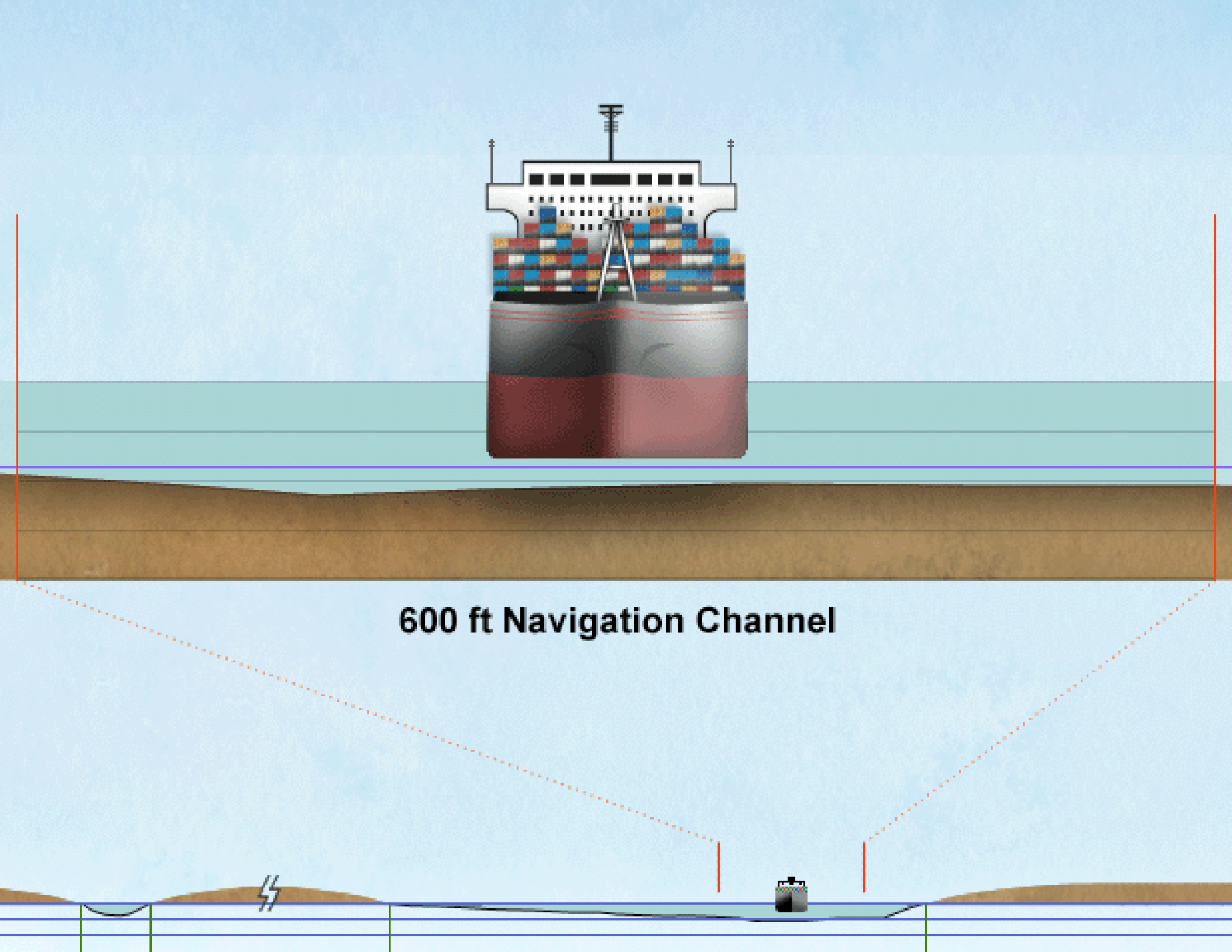


Columbia River flow 5
Willamette River flow

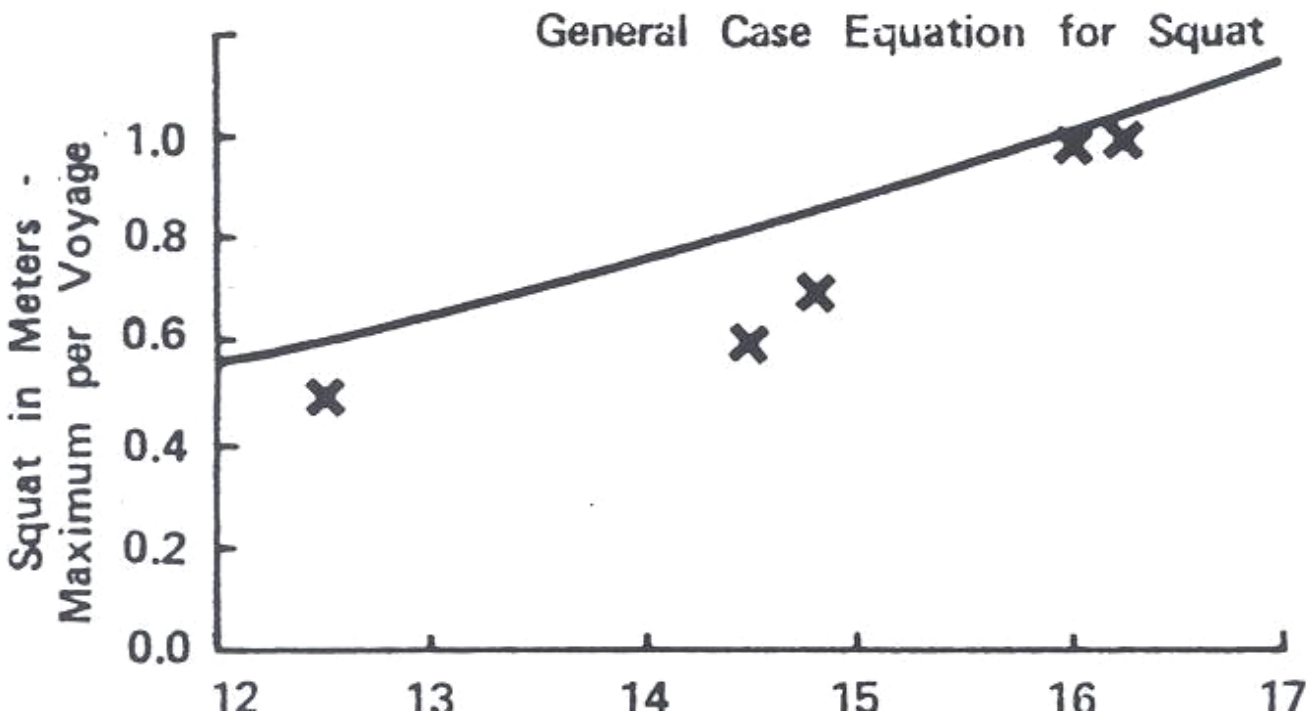
ting date = 9/08/85

GAGE HEIGHT, FEET

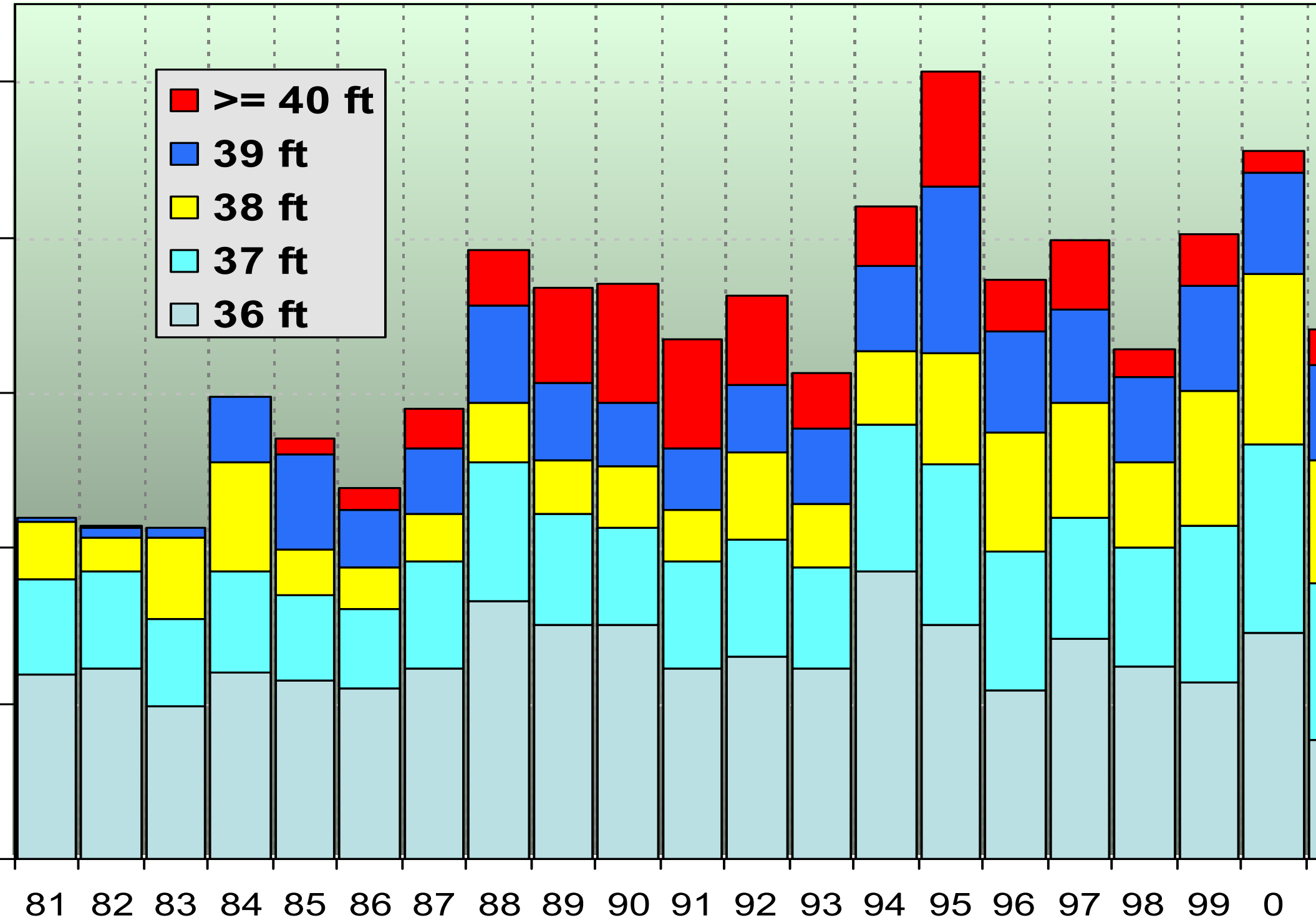
R MILE:	05	15	25	35	45	55	65	75	85	95
00	4.45	5.17	5.13	5.15			4.64		3.84	
00	3.16	3.90	4.34	4.42			4.26	Dep. 1	3.80	
00	1.94	2.59	3.56	3.74			3.88		3.59	
00	1.01	1.45	2.81	3.09			3.53		3.35	
00	0.54	0.68	2.16	2.49			3.19		3.10	
00	0.60	0.40	1.63	1.98			2.85		2.86	
00	1.15	0.68	1.24	1.56			2.53		2.62	
00	2.06	1.48	1.09	1.29			2.25		2.40	
00	3.14	2.60	1.38	1.30			2.02		2.21	
00	4.15	3.78	2.30	1.81			1.89		2.04	
00	4.85	4.74	3.48	2.87			1.95		1.94	
00	5.10	5.25	4.30	3.87			2.30	Dep. 2	1.95	
00	4.94	5.24	4.65	4.37			2.92		2.15	
00	4.54	4.89	4.51	4.39			3.42		2.49	
00	4.06	4.36	4.06	4.02			3.50		2.81	
00	3.70	3.84	3.64	3.59			3.33		2.92	
00	3.61	3.54	3.27	3.24			3.14		2.88	
00	3.88	3.57	3.05	2.99			2.98		2.79	
00	4.47	4.04	3.09	2.91			2.85		2.71	
00	5.25	4.83	3.54	3.16			2.78		2.63	
00	6.02	5.74	4.43	3.85			2.85		2.60	
00	6.58	6.51	5.36	4.82			3.18		2.65	
00	6.80	6.95	6.00	5.59			3.80		2.88	


600 ft Navigation Channel

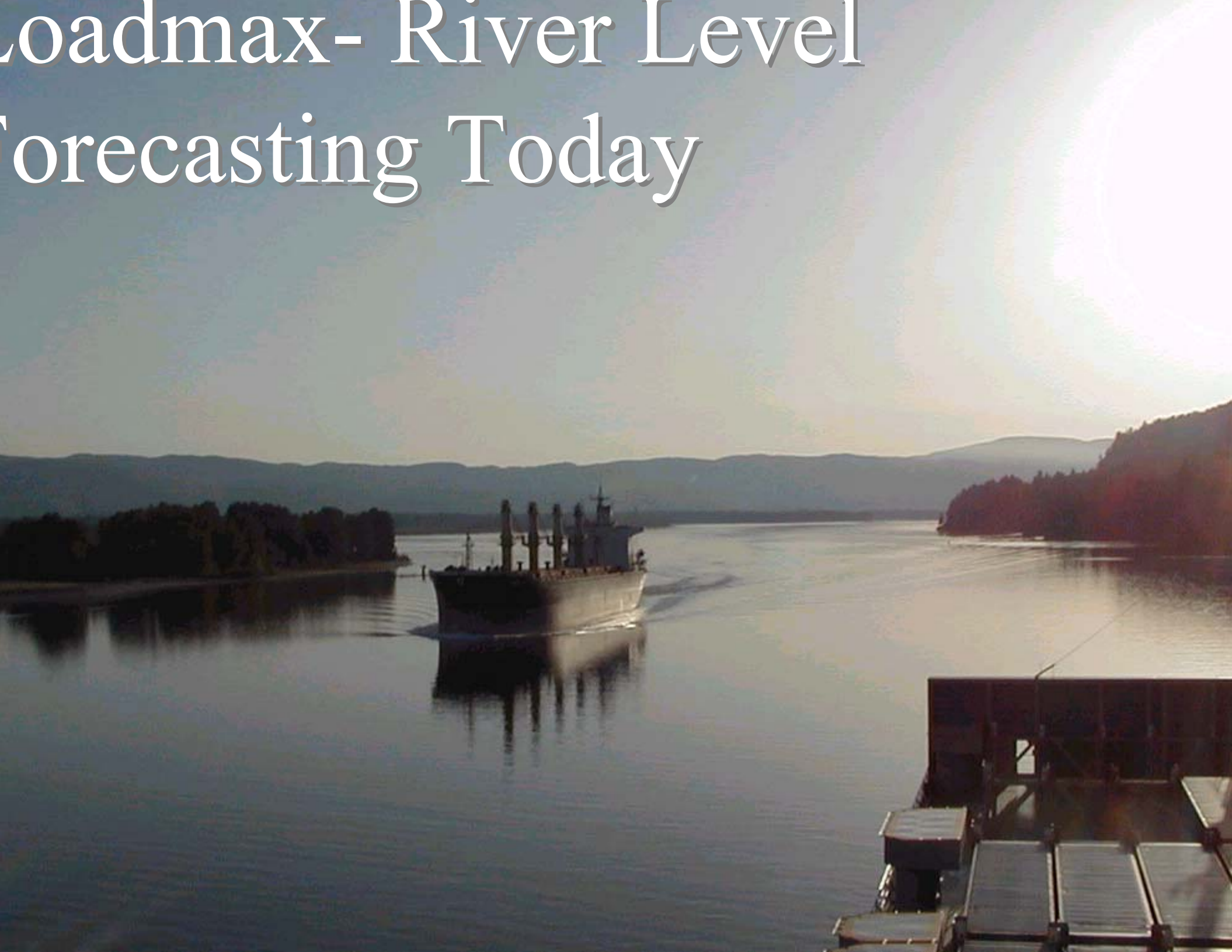
Vessel	Richmond Bridge		Tokyo Maru		Hyuga Maru
River Mile	52	76	52	76	52
Speed-Knots	16.2	14.8	14.5	12.5	16.0
Squat-m					
Bow	0.7	0.7	0.6	0.5	1.0
Mid	0.9	0.7	0.5	0.3	0.8
Stern	1.0	0.5	0.6	0.4	0.7



Columbia River Vessel Transits



Loadmax- River Level Forecasting Today



Strategic Navigation Concerns

Long river transit with many turns

Dynamic river bottom conditions

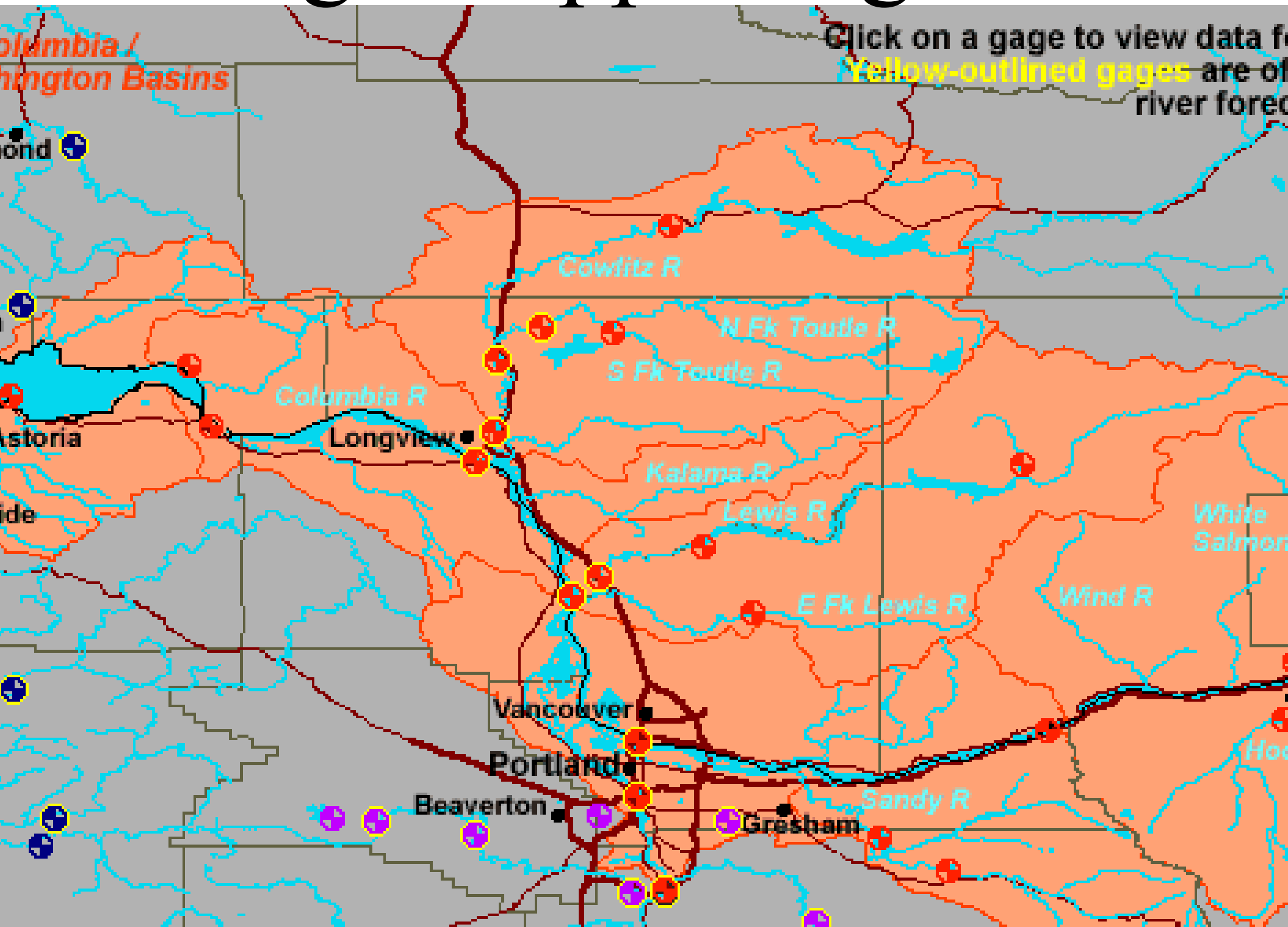
Freshwater immersion factor

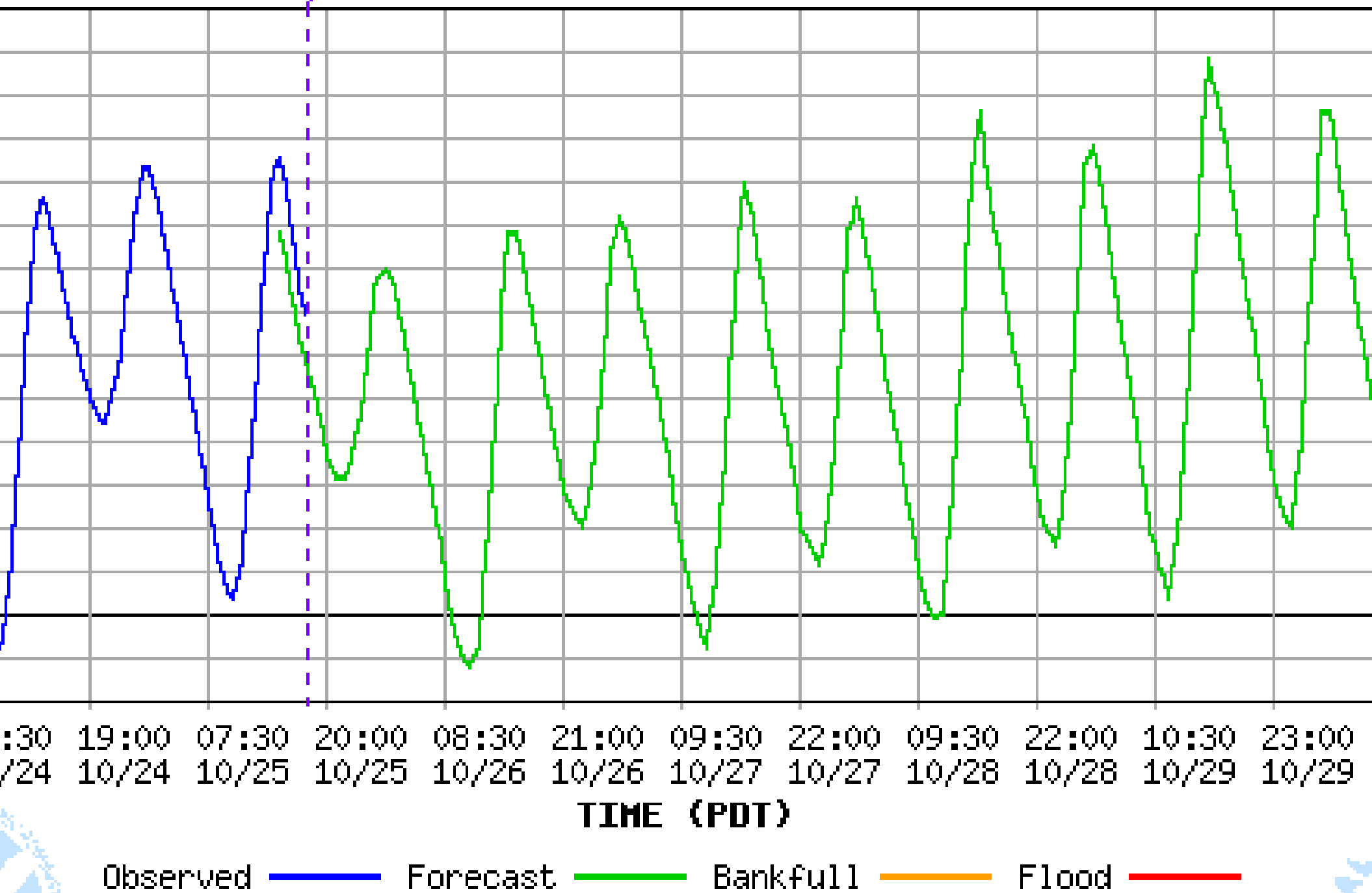
Export-orientation of the regional economy

River Level Reporting and Forecasting on the Columbia River

These gauges are strategically placed on the Columbia River from Portland to the River mouth at Astoria. They are approximately 15 miles apart and are regularly checked for operational accuracy.

ver Gauges supporting Loadma

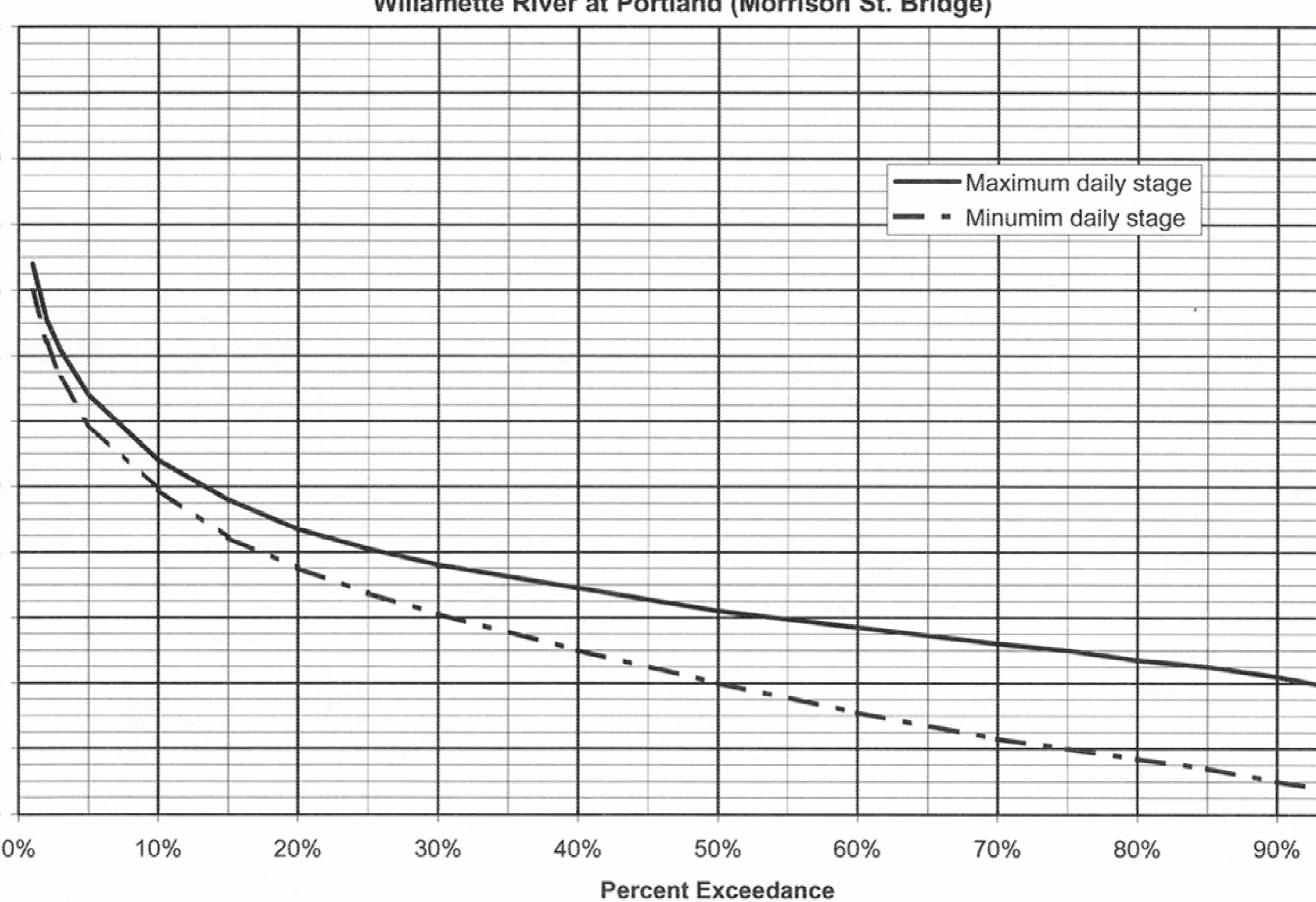




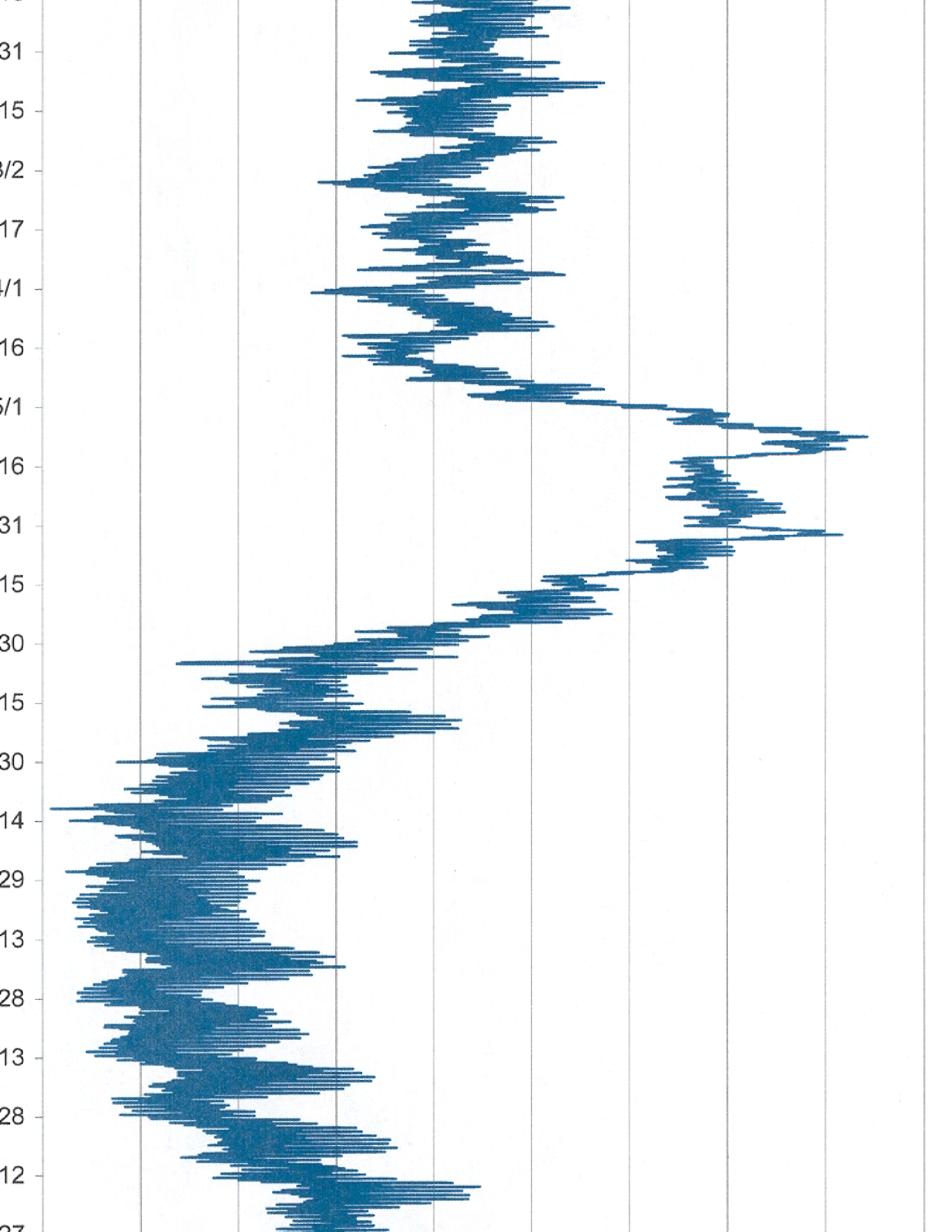
Latest: 1.56 ft [18:00 10/25]
Max: 2.66ft Max Fcst: 3.20ft
Min: -0.22ft Min Fcst: -0.30ft

Outbound Vessel Voyage Planning

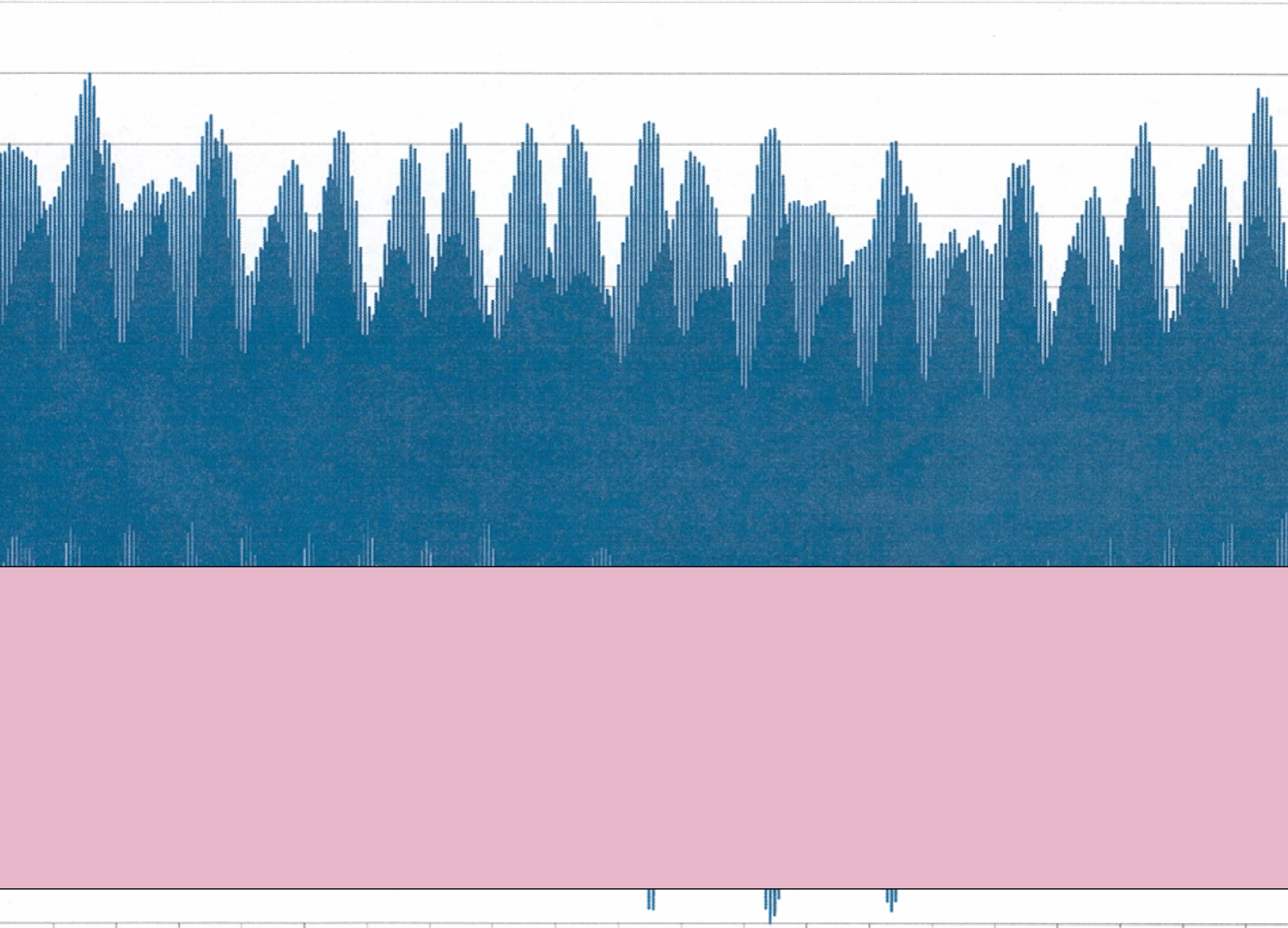
- Transit is 6-8 hrs at 12-15 mph
- Window of arrival at Bar, 3’ on rising, 4’ on falling tide
- Transit will pass low tide on river
- LOADMAX helps inform where low tide will be
- Pilot can determine likely under-keel clearance for entire transit



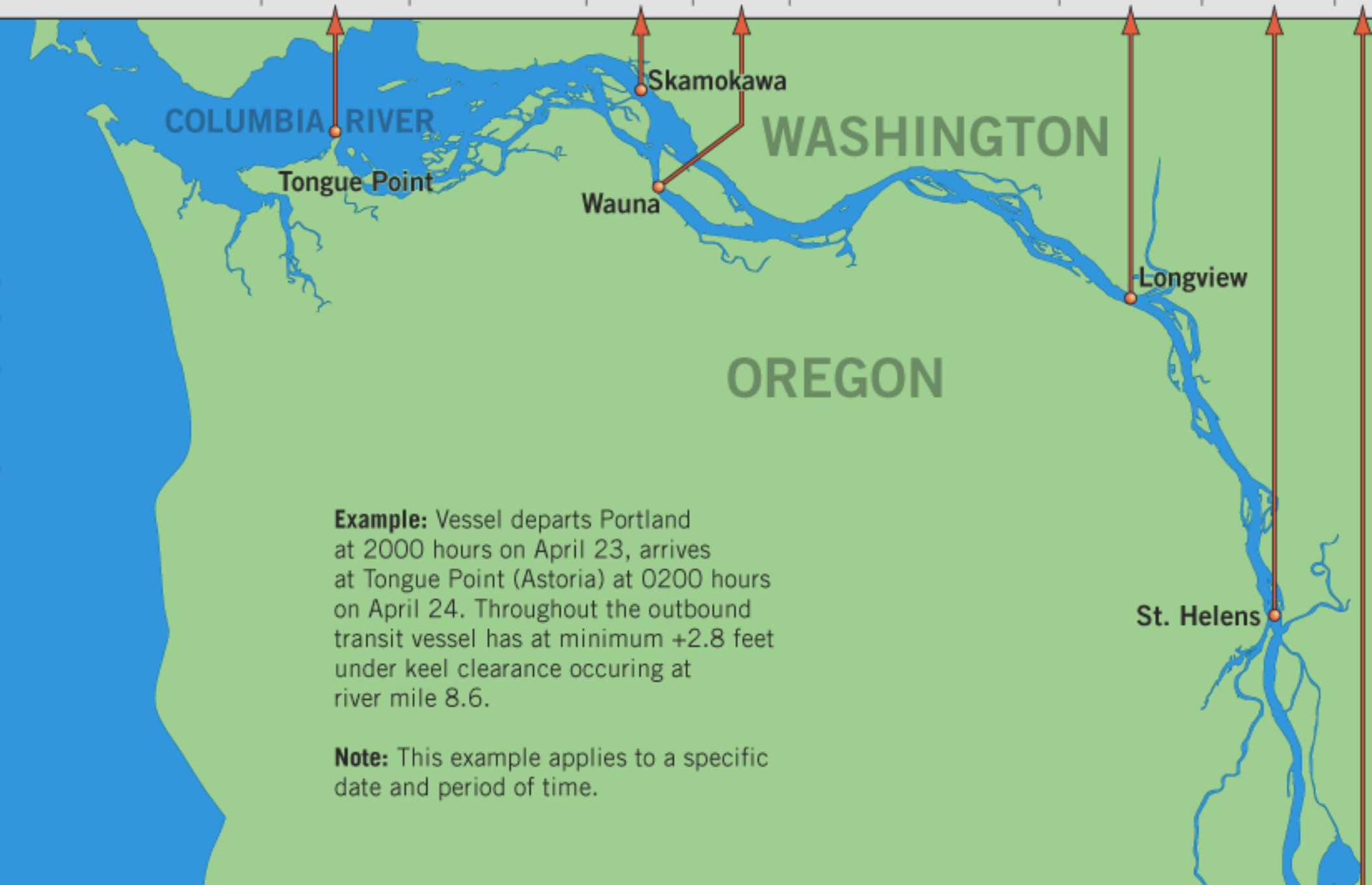
d from the U.S. Army Corps of Engineers.
cord: Oct. 1972 - Sep. 1990, Oct. 1992 - Dec. 1998.
was estimated based on monthly correlation with Columbia River Stage at Vancouver.
he period of record, 0.3% of the data was missing from both Portland and Vancouver.
ues should be considered approximate.


31
15
3/2
17
4/1
16
5/1
16
31
15
30
15
30
14
29
13
28
13
28
12

Year 2001 Tide prediction



	0200		0100	0	2200	2100	2
vel (Feet) Datum (CRD)	8.2		5.8	3.6	3.1	2.8	
le:	17.5		35	41.5	65	86	1



Example: Vessel departs Portland at 2000 hours on April 23, arrives at Tongue Point (Astoria) at 0200 hours on April 24. Throughout the outbound transit vessel has at minimum +2.8 feet under keel clearance occuring at river mile 8.6.

Note: This example applies to a specific date and period of time.

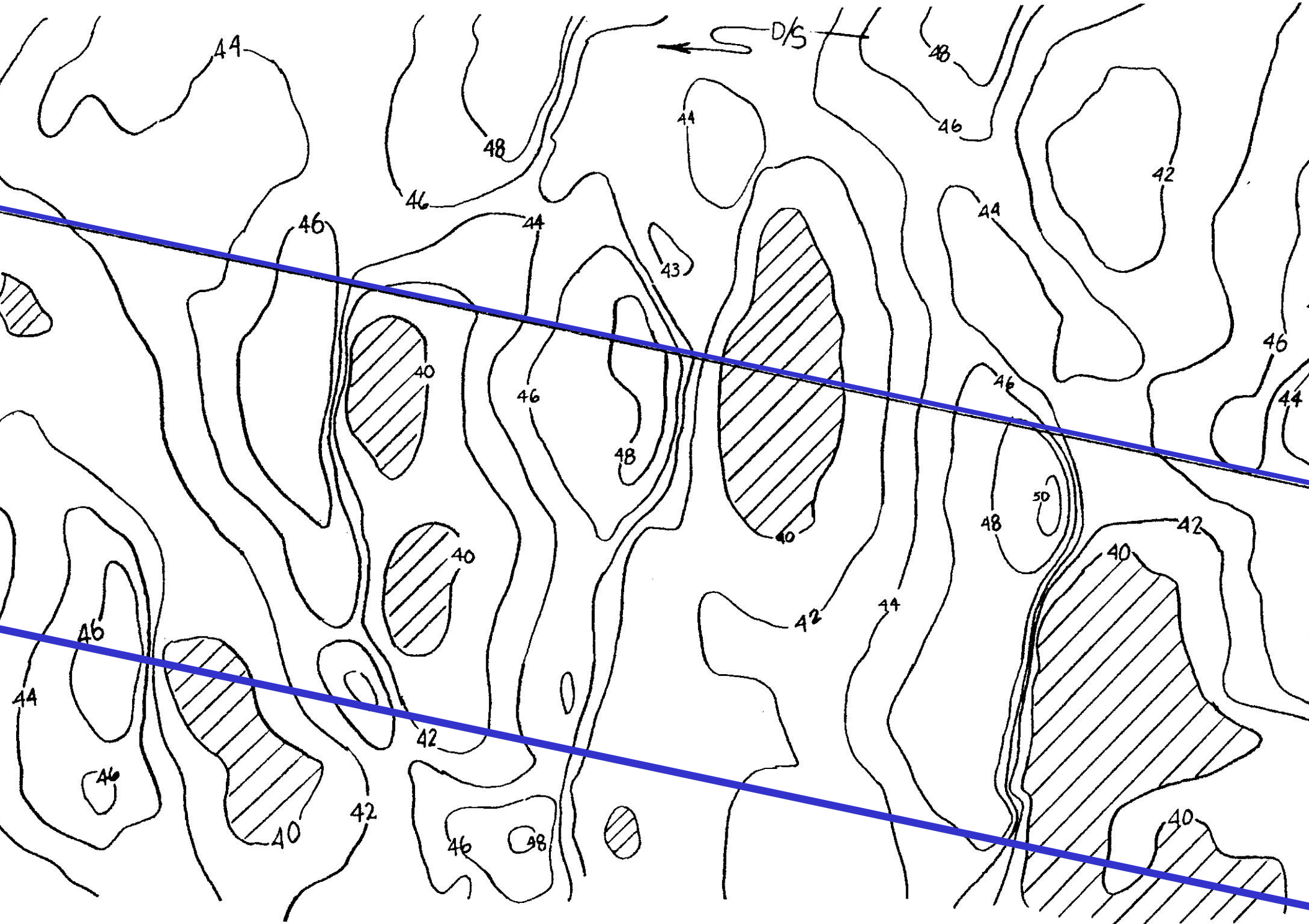
Hour	Astoria	Skamokawa	Wauna	Longview	St. Helens	Vancouver
13	6.05	4.42	4.07	2.38	0.99	1.33
14	6.94	5.79	5.54	3.71	1.09	1.06
15	6.91	6.51	6.45	5.06	1.95	1.01
16	5.86	6.28	6.62	5.85	3.02	1.41
17	4.19	5.14	5.60	6.03	3.56	2.32
18	2.54	3.84	4.35	5.16	3.79	3.18
19	1.19	2.62	3.15	4.38	3.33	3.62
20	0.42	1.53	2.14	3.95	3.06	3.36
21	0.83	0.77	1.35	3.58	2.79	2.93
22	2.31	0.68	1.02	3.13	2.36	2.53
23	4.17	2.04	1.70	2.67	1.92	2.21
0	5.99	3.99	3.57	2.56	1.56	1.89
1	7.42	5.77	5.40	3.36	1.39	1.61
2	8.16	7.03	6.76	4.96	1.84	1.37
3	7.78	7.59	7.55	6.14	3.06	1.49
4	6.34	7.01	7.41	6.78	3.93	2.27
5	4.33	5.65	6.15	6.72	4.38	3.27
6	2.32	4.16	4.68	5.70	4.48	4.04
7	0.49	2.75	3.36	4.87	3.95	4.27
8	-0.83	1.49	2.23	4.39	3.59	3.83

Example 1

Vessel Transit Analysis Results
Portland/Vancouver to Astoria
3 ft. Underkeel Clearance

Draft (ft, Fresh Water)	No Delay	Percent of Time Available					
		2 hr wait	3 hr wait	4 hr wait	5 hr wait	6 hr wait	12 h
36	99.4%	99.8%	100.0%	100.0%	100.0%	100.0%	10
37	95.7%	97.6%	99.0%	99.9%	100.0%	100.0%	10
38	88.6%	92.3%	95.6%	98.3%	99.7%	100.0%	10
39	73.2%	78.8%	83.7%	88.1%	91.7%	94.6%	10
40	43.4%	49.6%	55.0%	59.9%	64.4%	68.9%	83

What’s Next?


D/S
44
48
46
44
48
46
42
44
46
44
43
40
46
48
46
44
50
48
42
40
40
42
44
46
44
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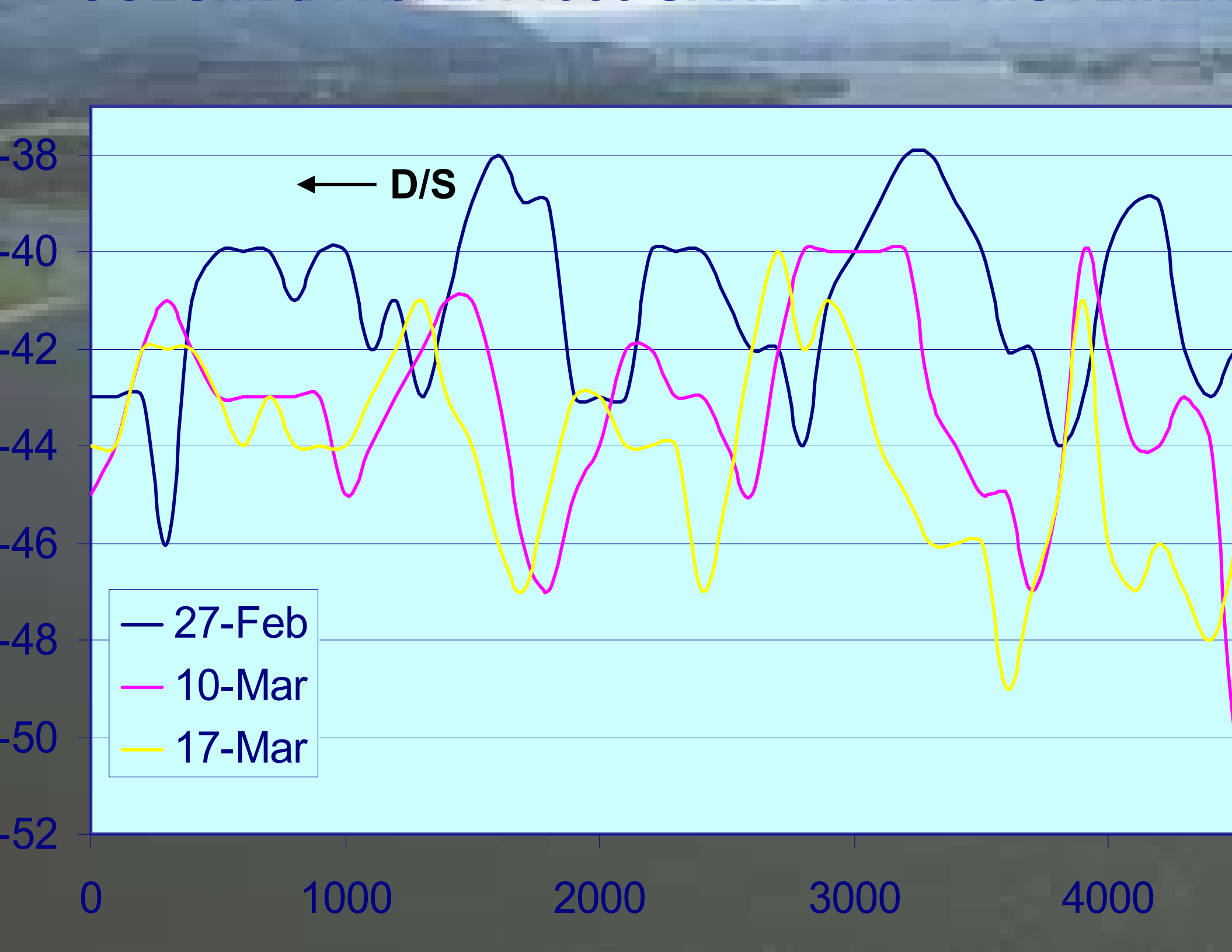
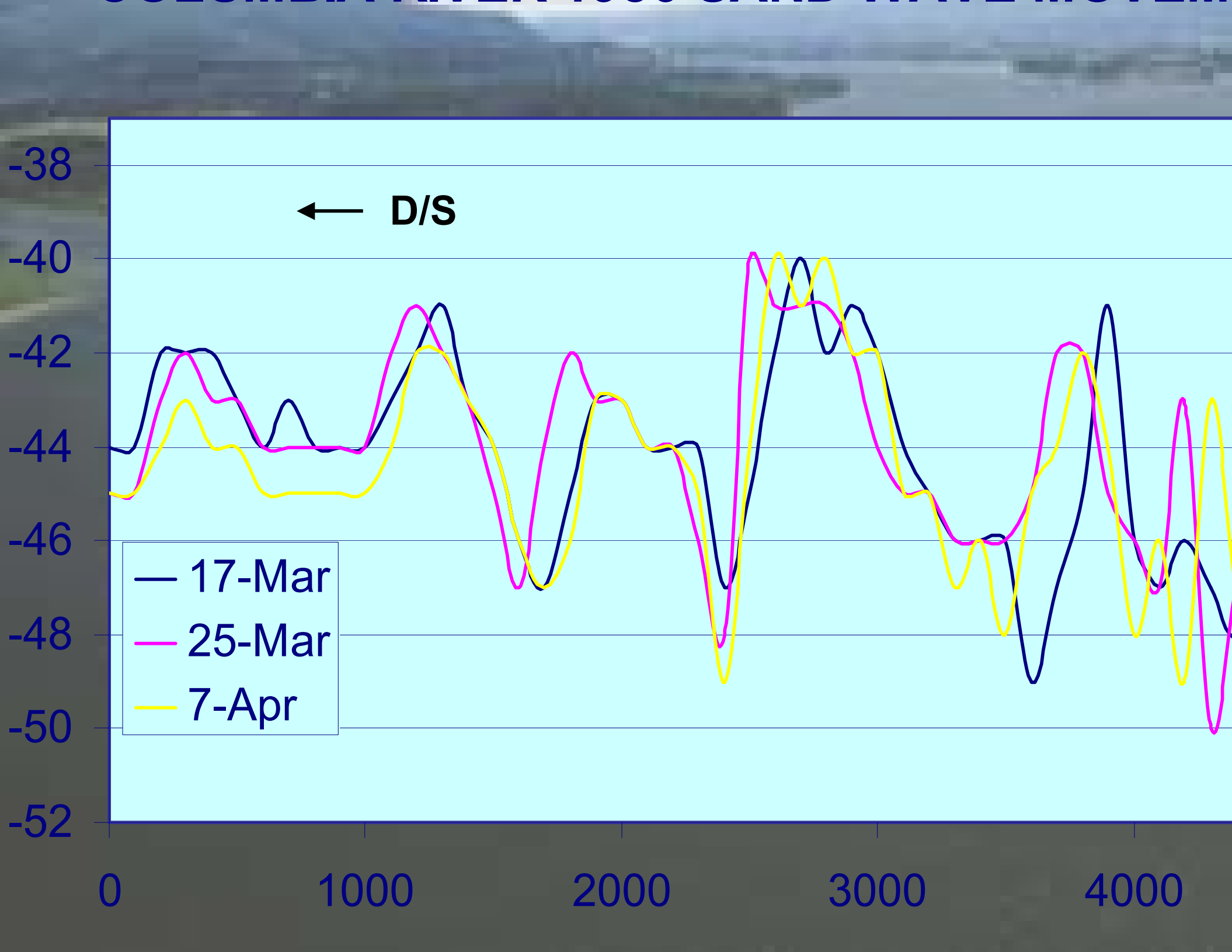
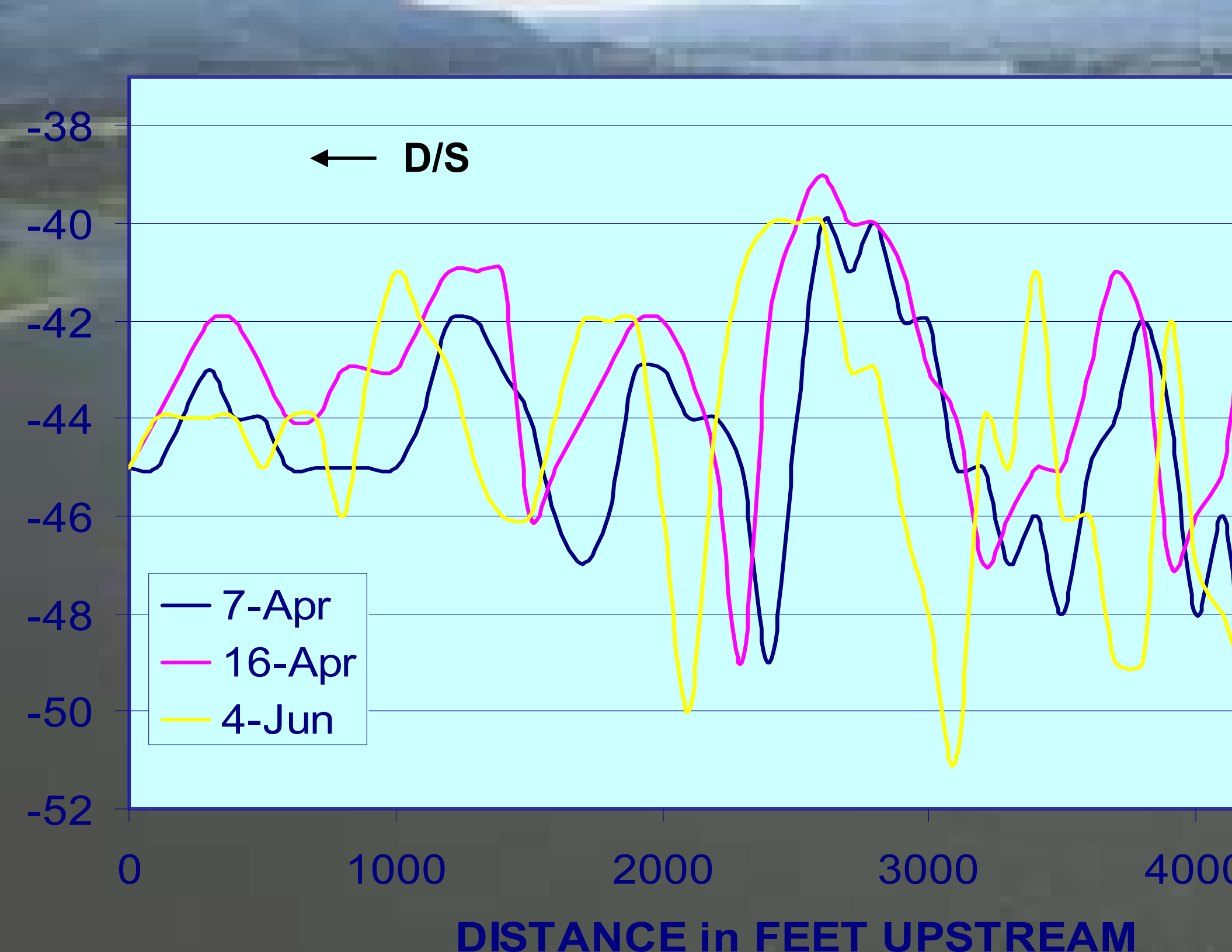
46
40
42
46
48
40


D/S
27-Feb
10-Mar
17-Mar
-38
-40
-42
-44
-46
-48
-50
-52
0
1000
2000
3000
4000

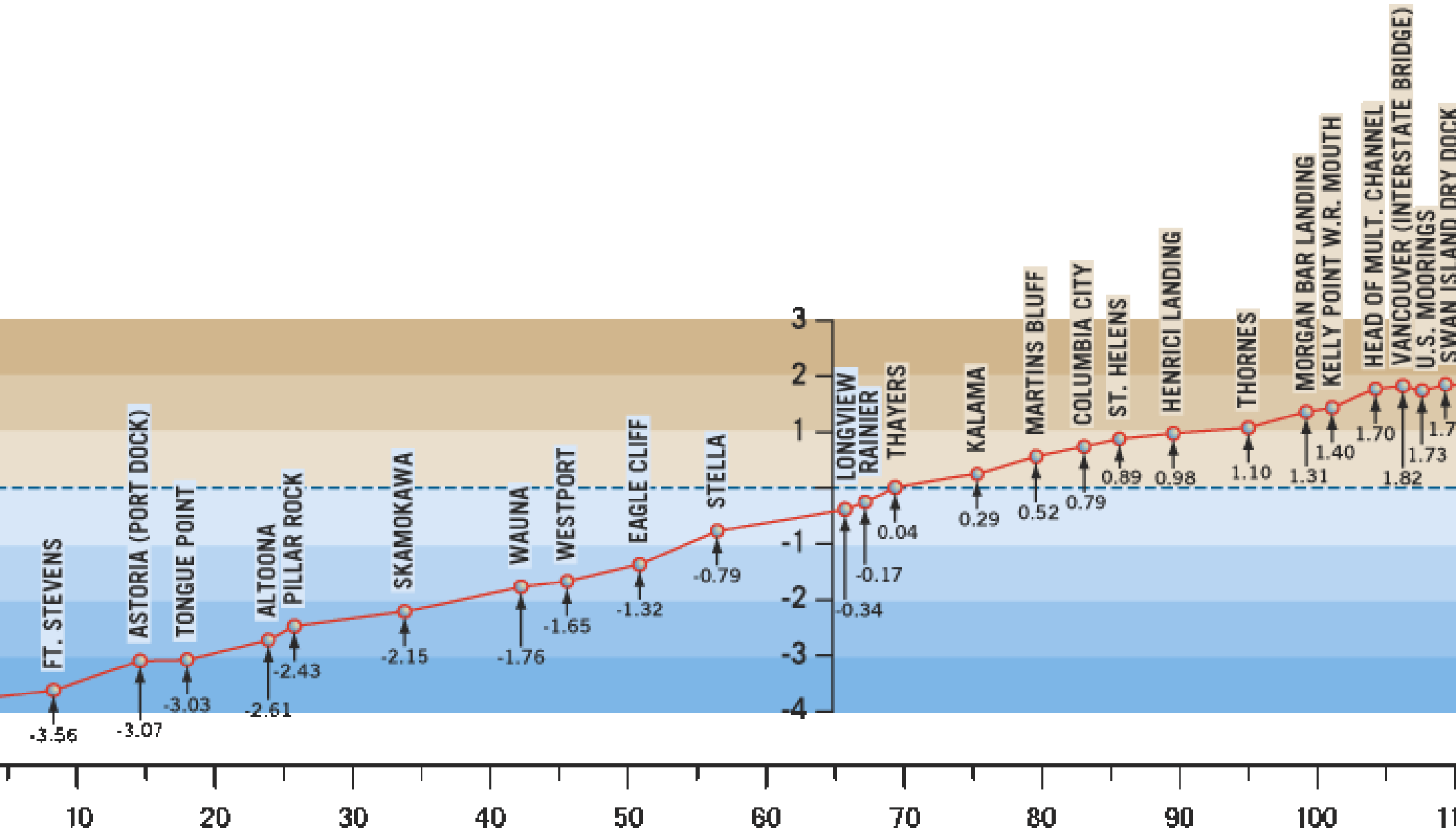

D/S
-38
-40
-42
-44
-46
-48
-50
-52
0
1000
2000
3000
4000
17-Mar
25-Mar
7-Apr


D/S
-38
-40
-42
-44
-46
-48
-50
-52
0
1000
2000
3000
4000
7-Apr
16-Apr
4-Jun
DISTANCE in FEET UPSTREAM

COLUMBIA RIVER
1986 SAND WAVE MOVEM

AVERAGE DAILY DISCHARGE (CFS)	AVERAGE DOWNSTREAM MOVEMENT (FT/DAY)	AV R C
410,000	18	
370,000	17	
290,000	6	
310,000	0	
280,000	3	
300,000	4	

r & Columbia River



High Gauge Readings, 1972 - 2001

FIGUR

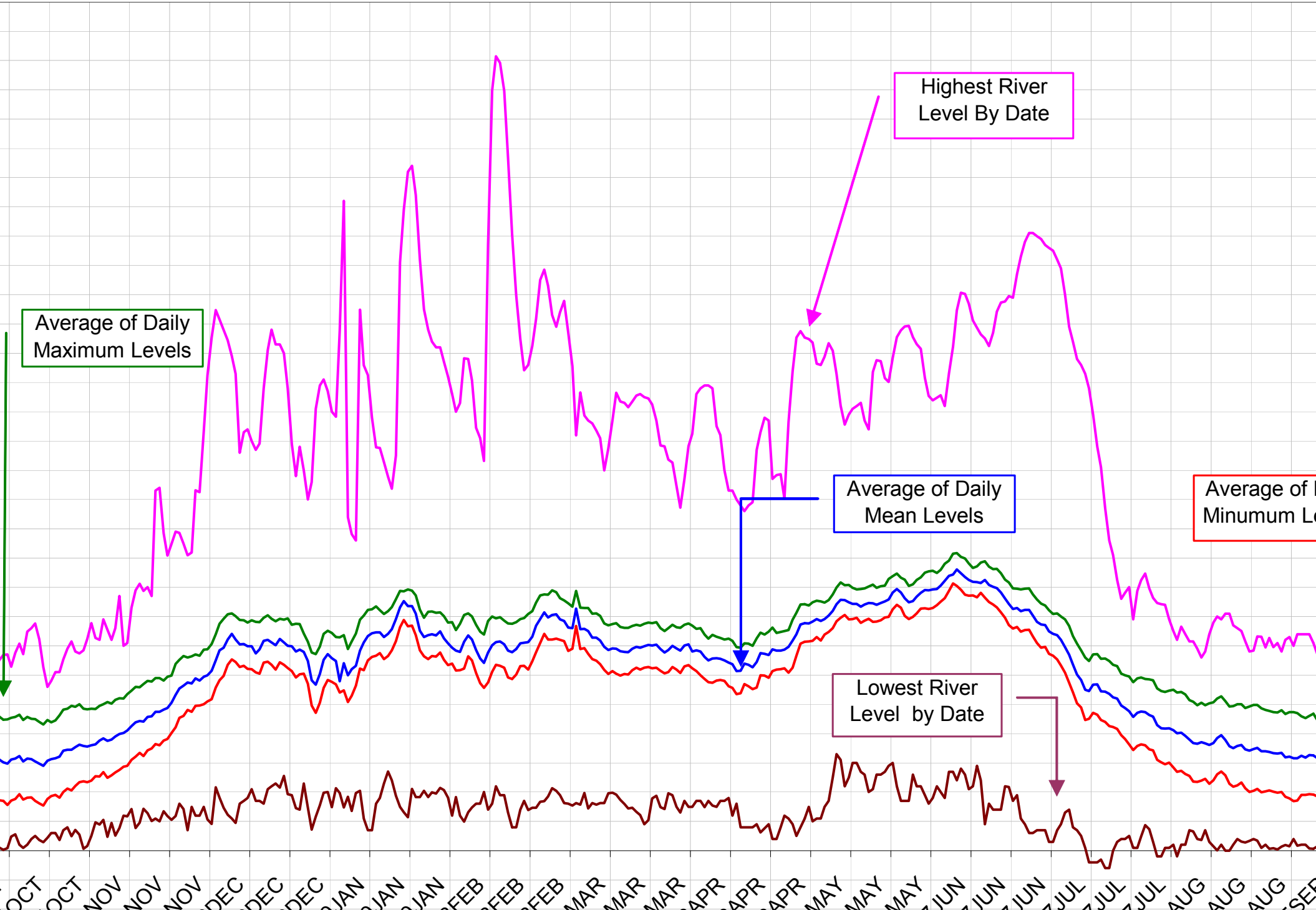
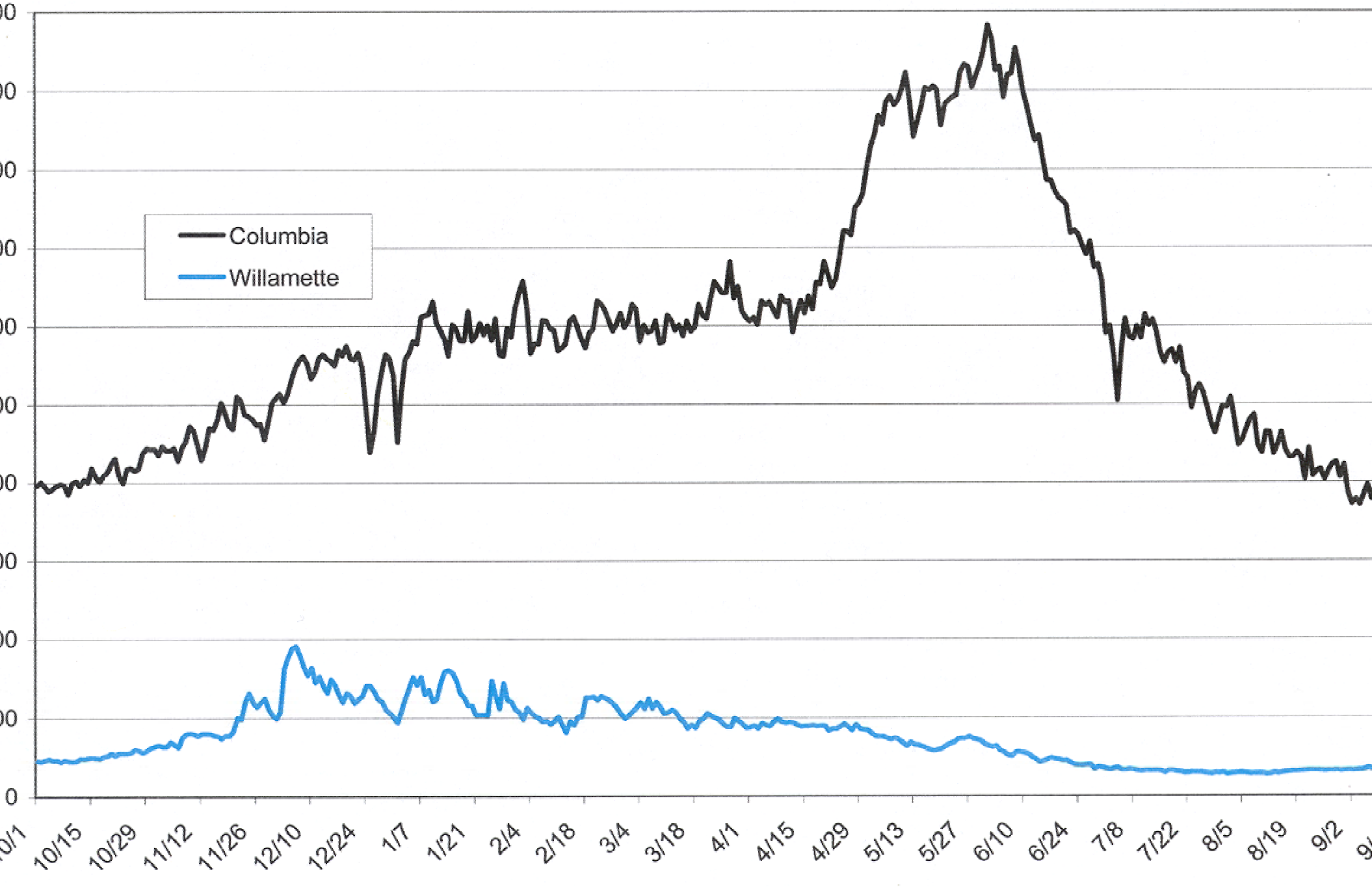
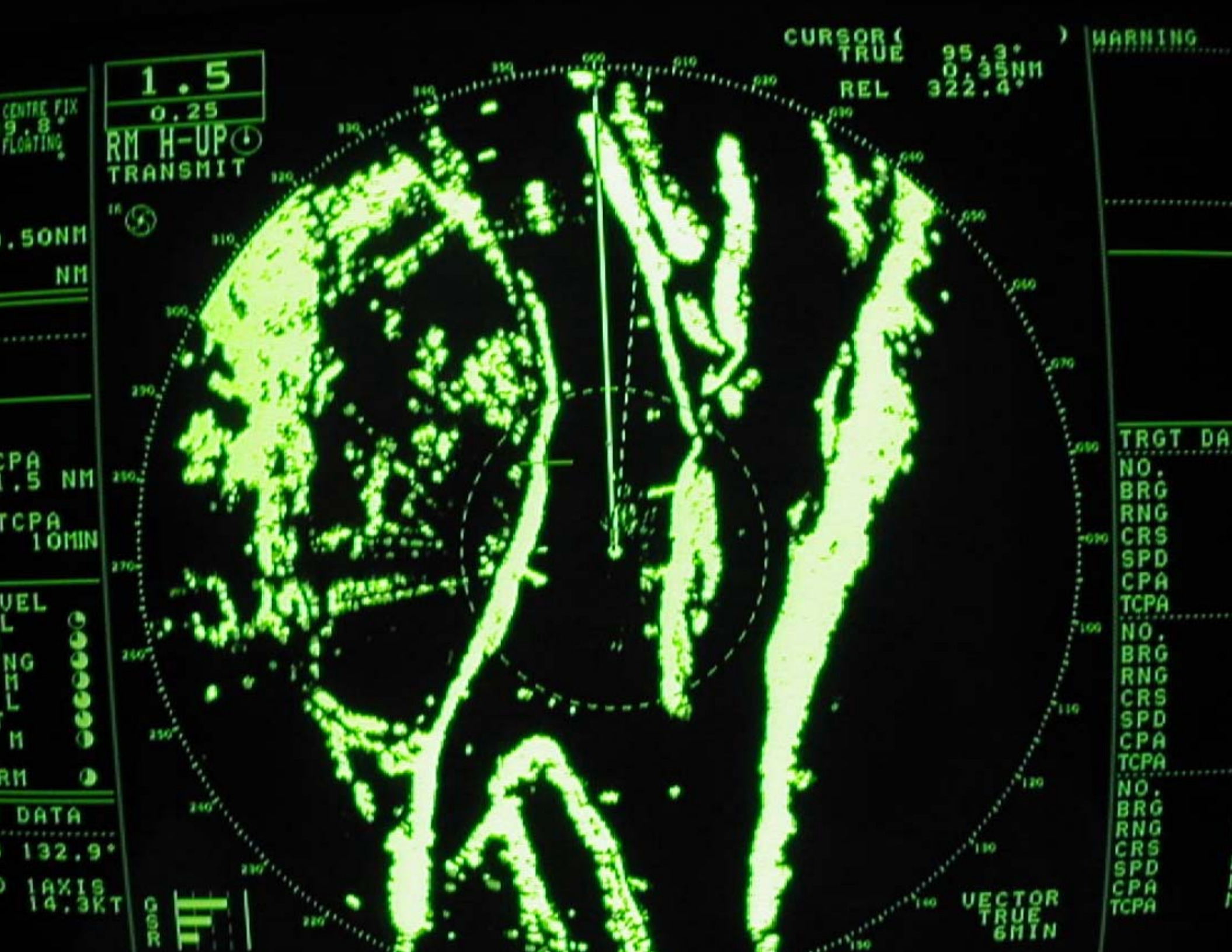


Figure 1. 75% Exceedance; Water Years 1973-1999
Columbia River at The Dalles
Willamette River @ Portland Harbor




1.5
0.25
RM H-UP
TRANSMIT
CURSOR (
TRUE 95.3°
0.35NM
REL 322.4°
WARNING
CENTRE FIX
9.8°
FLOATING
.50NM
NM
CPA
1.5 NM
TCPA
10MIN
VEL
NG
M
L
M
RM
DATA
132.9°
1AXIS
14.3KT
COR
VECTOR
TRUE
6MIN
TRGT DA
NO.
BRG
RNG
CRS
SPD
CPA
TCPA
NO.
BRG
RNG
CRS
SPD
CPA
TCPA
NO.
BRG
RNG
CRS
SPD
CPA
TCPA