APPENDIX A

HYDRAULIC DESIGN

SAINT PAUL, ALASKA

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Harbor Improvements - St. Paul, Alaska

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APPENDIX A: HYDRAULIC DESIGN

1. INTRODUCTION

1.1 Appendix Purpose

This hydraulic design appendix describes the technical aspects of the St. Paul Harbor Improvements Project. It provides the basis for determining the Federal interest in the construction of a small boat harbor. The small boat harbor is located in the Bering Sea within the confines of protection afforded by the 1996 Federal Harbor Improvement Plan, which forms the basis for the deeper-draft harbors. A location and vicinity map are shown in Figure A-1. Three model studies were performed and form the basis for design of the small boat harbor, which is located within the embayment formed by the deeper-draft harbor breakwaters.

The first modeling effort was a three-dimensional harbor model used to check the relative differences in harbor wave action, currents, and sedimentation. The model compares the conditions before and after the modifications to the deeper - draft harbor now authorized for construction. Modifications included deepening of the entrance channel, construction of a maneuvering basin, construction of a spending beach, construction of a sediment management area, and construction of energy dissipation berms to reduce wave activity on the existing West breakwater. Details of most of those authorized improvements are contained in the *Harbor Improvements Interim Feasibility Report*, Saint Paul Alaska, August 1966.

The second modeling effort also used the three dimensional model. The purpose of the second effort was to study wave induced currents and flushing within the Salt Lagoon. Incidental to that purpose was a study to determine the impacts of a small boat basin situated in the approximate location of the new proposed basin on waves, currents, sedimentation and tidal flushing. The study concluded that improving the Salt Lagoon channel, constructing a sediment management area and constructing a detached breakwater between the East inlet and the proposed harbor would enhance water quality in the lagoon and allow the development of a small boat harbor. The results of that modeling effort can be found in Bottin and Acuff's *Study for Flushing of Salt Lagoon and Small Boat Harbor Improvements at St. Paul Harbor*, St. Paul Alaska, August 1997.

The third modeling effort also used the previously mentioned three-dimensional model to:

- Define the potential for harbor surge,
- Define small boat harbor wave activity,
- Ensure Salt Lagoon flushing with the proposed harbor in place,

- Maximize the exchange of water in the small boat harbor,
- Test ultimate development in other areas of the embayment,
- Test ice circulation patterns,
- Locate the interior detached breakwater to best enhance circulation in the small boat harbor and Salt Lagoon, and
- Ensure that the decrease in elevation of the spending beach did not have a major impact on waves or circulation. The reduction in elevation was requested by environmental interests to reduce seal haul-out potential.

NOTE: The report from the third modeling effort is appended hereto and is entitled Miscellaneous Paper ERDC/CHL-01, Design of Small Boat Harbor Improvements and Tidal Flushing at St. Paul Harbor, St. Paul Island, Alaska.

1.1 Project Purpose

The following objectives were identified for the small boat basin at St. Paul Harbor before beginning this engineering analysis.

1. Develop a harbor facility for a day fishing fleet within the general confines of the existing St. Paul Harbor embayment without conflicting in a significant manner with other land use and other development plans.

2. Design and construct improvements to provide a safe and efficient harbor, which satisfies the above objectives in an environmentally and economically sound manner.

Five harbor designs were analyzed in varying degrees to develop the economic and environmental data to assure that the correct harbor was selected. Those configurations were a 30-, 60- and 90-vessel harbor at the 12-foot depth and 60-vessel harbors at the 8- and 10-foot depths. First cost of those configurations can be found in Tables A-1 through A-5.

1.2 Background

The Alaska District Corps of Engineers initially examined small boat harbor development on a preliminary basis. The City of St. Paul contracted for the development of an Information Report in 1996 to define the Federal interest in a small boat Harbor at St. Paul. That report identified a Federal interest in the development. On the basis of that report a small boat harbor was authorized by congress. Additional work was required to assure economic and engineering viability. This report results from that requirement.

Table A-1: Alternative #1 (Preferred), 60 Vessel Harbor, 12-foot Depth
Summary of Cost by Major Items

Item	Unit	Quantity	Unit Cost ($)	Cost ($)	Local
Mob/Demob 1st season	LS	1	$522,031	$522,031	
* Mob/Demob 2nd season	LS	1	$932,254	$932,254	$932,254
Dredging: Federal channels and associated areas including dredging tolerance (3500cy)	cy	99000	$7.52	$744,008	
* Dredging: Local harbor including dredging tolerance (2500cy)	cy	41000	$7.52	$308,124	$308,124
*Floats installed pile stabilized	sf	13438	$69.10	$928,581	$928,581
*Walkway Ramps	sf	960	$81.15	$77,901	$77,901
*Boat Launch Ramp	sf	7000	$20.06	$140,407	$140,407
*South Side Dock	sf	8000	$181.40	$1,451,192	$1,451,192
*Breakwater East Side Floating Dock and Ramp	sf	7800	$81.15	$632,945	$632,945
Breakwater	cy	12653	$41.85	$529,473	
*Revetment	cy	2625	$48.13	$126,344	$126,344
Erosion protection	cy	6500	$40.47	$263,030	
Circulation Berm	cy	27300	$2.56	$69,920	
*Boat Lift Trailer	LS	1	$200,000.00	$200,000	$200,000
Total Direct Costs (including contractor's Overhead and Profit)				$6,926,210	$4,797,748
Contingencies (Excludes boat lift trailer)		20%		$1,345,242	$919,549.65
Subtotal				$8,271,452	$5,717,298
E&D (Excludes boat lift trailer)		10%		$807,145	$551,730
Subtotal				$9,078,597	$6,269,028
S&A (Excludes boat lift trailer)		8%		$710,288	$485,522
TOTAL				**$9,788,885**	**$6,754,550**

* Local Associated Costs

NOTE: Federal Costs are limited to 80% of costs not marked as Local Associated Costs.

Table A-2: Alternative #2, 60 Vessel Harbor, 10-foot Depth Summary of Cost by Major Items

Item	Unit	Quantity	Unit Cost ($)	Cost ($)	Local
Mob/Demob 1st season	LS	1	$467,955	$467,955	
* Mob/Demob 2nd season	LS	1	$932,254	$932,254	$932,254
Dredging: Federal channels and associated areas including dredging tolerance (3500cy)	cy	88407	$7.57	$669,334	
* Dredging: Local harbor including dredging tolerance (2500cy)	cy	32000	$7.57	$242,274	$242,274
*Floats installed pile stabilized	sf	13438	$69.10	$928,581	$928,581
*Walkway Ramps	sf	960	$81.15	$77,901	$77,901
*Boat Launch Ramp	sf	7000	$20.06	$140,407	$140,407
*South Side Dock	sf	8000	$181.40	$1,451,192	$1,451,192
*Breakwater East Side Floating Dock and Ramp	sf	7800	$81.15	$632,945	$632,945
Breakwater	cy	12653	$41.85	$529,473	
*Revetment	cy	2625	$48.13	$126,344	$126,344
Erosion protection	cy	6500	$40.47	$263,030	
Circulation Berm	cy	27300	$2.56	$69,920	
*Boat Lift Trailer	LS	1	$200,000.00	$200,000	$200,000
Total Direct Costs (including contractor's Overhead and Profit)				$6,731,610	$4,731,898
Contingencies (Excludes boat lift trailer)		20%		$1,306,322	$906,379.55
Subtotal				$8,037,932	$5,638,277
E&D (Excludes boat lift trailer)		10%		$783,793	$543,828
Subtotal				$8,821,725	$6,182,105
S&A (Excludes boat lift trailer)		8%		$689,738	$478,568
TOTAL				**$9,511,463**	**$6,660,673**

* Local Associated Costs

NOTE: Federal Costs are limited to 80% of costs not marked as Local Associated Costs.

Table A-3: Alternative #3, 60 Vessel Harbor, 8-foot Depth Summary of Cost by Major Items

Item	Unit	Quantity	Unit Cost ($)	Cost ($)	Local
Mob/Demob 1st season	LS	1	$413,879	$413,879	
* Mob/Demob 2nd season	LS	1	$932,253	$932,253	$932,253
Dredging: Federal channels and associated areas including dredging tolerance (3500cy)	cy	77814	$7.65	$595,241	
* Dredging: Local harbor including dredging tolerance (2500cy)	cy	22797	$7.65	$174,387	$174,387
*Floats installed pile stabilized	sf	13438	$69.10	$928,581	$928,581
*Walkway Ramps	sf	960	$81.15	$77,901	$77,901
*Boat Launch Ramp	sf	7000	$20.06	$140,407	$140,407
*South Side Dock	sf	8000	$181.40	$1,451,192	$1,451,192
*Breakwater East Side Floating Dock and Ramp	sf	7800	$81.15	$632,945	$632,945
Breakwater	cy	12653	$41.85	$529,473	
*Revetment	cy	2625	$48.13	$126,344	$126,344
Erosion protection	cy	6500	$40.47	$263,030	
Circulation Berm	cy	27300	$2.56	$69,920	
*Boat Lift Trailer	LS	1	$200,000.00	$200,000	$200,000
Total Direct Costs (including contractor's Overhead and Profit)				$6,535,553	$4,664,010
Contingencies (Excludes boat lift trailer)		20%		$1,267,111	$892,801.92
Subtotal				$7,802,664	$5,556,812
E&D (Excludes boat lift trailer)		10%		$760,266	$535,681
Subtotal				$8,562,930	$6,092,493
S&A (Excludes boat lift trailer)		8%		$669,034	$471,399
TOTAL				**$9,231,964**	**$6,563,892**

* Local Associated Costs

NOTE: Federal Costs are limited to 80% of costs not marked as Local Associated Costs.

Table A-4: Alternative #4, 30 Vessel Harbor, 12-foot Depth Summary of Cost by Major Items

Item	Unit	Quantity	Unit Cost ($)	Cost ($)	Local
Mob/Demob 1st season	LS	1	$504,007	$504,007	
* Mob/Demob 2nd season	LS	1	$910,134	$910,134	$910,134
Dredging: Federal channels and associated areas including dredging tolerance (3500cy)	cy	99000	$7.53	$745,930	
* Dredging: Local harbor including dredging tolerance (2500cy)	cy	33500	$7.53	$252,411	$252,411
*Floats installed pile stabilized	sf	9696	$69.14	$670,403	$670,403
*Walkway Ramps	sf	960	$81.15	$77,901	$77,901
*Boat Launch Ramp	sf	7000	$20.06	$140,407	$140,407
*South Side Dock	sf	8000	$181.40	$1,451,192	$1,451,192
*Breakwater East Side Floating Dock and Ramp	sf	7800	$81.15	$632,945	$632,945
Breakwater	cy	12653	$41.85	$529,473	
*Revetment	cy	2625	$48.13	$126,344	$126,344
Erosion protection	cy	6500	$40.47	$263,030	
Circulation Berm	cy	27300	$2.56	$69,920	
*Boat Lift Trailer	LS	1	$200,000.00	$200,000	$200,000
Total Direct Costs (including contractor's Overhead and Profit)				$6,574,097	$4,461,737
Contingencies (Excludes boat lift trailer)		20%		$1,274,819	$852,347.35
Subtotal				$7,848,916	$5,314,084
E&D (Excludes boat lift trailer)		10%		$764,892	$511,408
Subtotal				$8,613,808	$5,825,493
S&A (Excludes boat lift trailer)		8%		$673,105	$450,039
TOTAL				**$9,286,913**	**$6,275,532**

* Local Associated Costs

NOTE: Federal Costs are limited to 80% of costs not marked as Local Associated Costs.

Table A-5: Alternative #5, 90 Vessel Harbor, 12-foot Depth Summary of Cost by Major Items

Item	Unit	Quantity	Unit Cost ($)	Cost ($)	Local
Mob/Demob 1st season	LS	1	$612,158	$612,158	
* Mob/Demob 2nd season	LS	1	$955,511	$955,511	$955,511
Dredging: Federal channels and associated areas including dredging tolerance (3500cy)	cy	99000	$7.44	$736,533	
* Dredging: Local harbor including dredging tolerance (2500cy)	cy	80500	$7.44	$598,898	$598,898
*Floats installed pile stabilized	sf	18806	$69.32	$1,303,631	$1,303,631
*Walkway Ramps	sf	960	$81.15	$77,901	$77,901
*Boat Launch Ramp	sf	7000	$20.06	$140,407	$140,407
*South Side Dock	sf	8000	$181.40	$1,451,192	$1,451,192
*Breakwater East Side Floating Dock and Ramp	sf	7800	$81.15	$632,945	$632,945
Breakwater	cy	12653	$41.85	$529,473	
*Revetment	cy	2625	$48.13	$126,344	$126,344
Erosion protection	cy	6500	$40.47	$263,030	
Circulation Berm	cy	27300	$2.56	$69,920	
*Boat Lift Trailer	LS	1	$200,000.00	$200,000	$200,000
Total Direct Costs (including contractor's Overhead and Profit)				$7,697,943	$5,486,829
Contingencies (Excludes boat lift trailer)		20%		$1,499,589	$1,057,365.81
Subtotal				$9,197,532	$6,544,195
E&D (Excludes boat lift trailer)		10%		$899,753	$634,419
Subtotal				$10,097,285	$7,178,614
S&A (Excludes boat lift trailer)		8%		$791,783	$558,289
TOTAL				**$10,889,068**	**$7,736,903**

* Local Associated Costs

NOTE: Federal Costs are limited to 80% of costs not marked as Local Associated Costs.

2. CLIMATOLOGY, METEOROLOGY, AND HYDROLOGY

2.1 Climatology

St. Paul is the northernmost and largest of the Pribilof Islands. It is located at latitude 57°10' N and longitude 170°10' W in the central southeast Bering Sea, as illustrated in Figure A-1. The region has a maritime climate, with considerable cloudiness, heavy fog, high humidity, and limited daily temperature fluctuations. The humidity remains uniformly high from May to late September. There is almost continuous low cloudiness and occasional heavy fog during the summer months.

Maritime influence in the Pribilof Islands keeps seasonal temperatures mild and daily variations to a minimum. The average difference between maximum and minimum daily temperatures for the year is only slightly above 7° F, with the greatest monthly variation being slightly less than 12° F in March. Summer temperatures are low, with the highest recorded temperature being 64° F in August of both 1936 and 1941. Extreme high temperatures in summer are usually in the mid-fifties. Although record low temperatures fall well below 0° F, such cold days are rare. On the average, temperatures fall below zero only 5 days each winter. Table A-6 lists meteorological data collected by the U.S. Department of Commerce, National Oceanographic and Atmospheric Administration (NOAA).

The island area has periods of high wind throughout the year. Frequent storms occur from October to April, often accompanied by gale-force winds to produce blizzard conditions. The average sea surface temperature in the Bering Sea surrounding the Pribilof Islands varies from 32.5° F in February to 47° F in August.

2.2 Tides and Water Levels

Tide levels at Village Cove on St. Paul Island, referenced to MLLW, are shown in Table A-6. Extreme high tide levels result from the combination of astronomic tides and rises in local water levels due to atmospheric pressure and wave conditions.

TABLE A-6: St. Paul Tide Levels (feet)

Highest Tide (estimated)	+6.0
Mean Higher High Water (MHHW)	+3.2
Mean High Water (MHW)	+3.0
Mean Sea Level (MSL)	+2.0
Mean Low Water (MLW)	+1.0
Mean Lower Low Water (MLLW)	0.0
Lowest Tide (estimated)	-2.5

Source: NOAA Tide Tables, 1980.

The design still water level (SWL), or highest tide, has likely been underestimated in previous studies. Our analysis after modeling and measuring seiche conditions indicates that a still water level of 6 feet above Mean Lower Low Water (+6'

MLLW) is probably correct. Harbor seiche, or wave beat, accounts for varying levels of higher water. The model indicates that long-period surges (about 2-minute oscillations) further increase those levels by as much as four feet.

Still water levels have been previously estimated by analyzing videotapes of 1994 storms. Several reference points of known elevation in the video were used as datums to estimate the SWL during these storm events. An elevation of +7.0' MLLW was estimated based on these observations, which represents a 2-foot increase from the SWL used for design purposes in the 1988 St. Paul GDM. Further analyses of the videotapes and survey information using reference points on the *Unisea* (a fish processing vessel moored in the harbor) indicated that the water surface in the harbor during the November 1994 storm was approximately +5.4' MLLW. The St. Paul harbormaster indicated that the highest water surface level observed in the harbor has been approximately +7.4' MLLW. A review of the tapes indicates that part of the maximum elevations observed might have came from a long-period harbor surge. An examination of model results indicates that as much as 4 feet of surge elevation with a period between 110 seconds and 140 seconds probably occurs in the harbor at several locations. The design high water level when surges are accounted for is approximately 9 feet MLLW.

2.3 Currents

The *U.S. Coast Pilot No. 9* and *Tidal Current Tables, Pacific Coast of North America and Asia* (NOAA 1986) indicate that currents near Village Cove are primarily tidal and are typically 1 to 2 knots, occasionally increasing to 3 knots when augmented by strong winds. The strongest nearby currents (to 3 knots) are encountered southeast of Village Cove between Reef Point and Otter Island. Currents within the localized area of the harbor are however dominated by storm surge and wave setup. Model studies of the harbor without planned improvements indicated that currents of up to 8 fps more than double the magnitude of currents associated with tides. Figure A-2 shows the current patterns and current prototype magnitudes that can be expected during extreme storm periods with proposed improvements in place. Those currents are similar to maximums encountered without the proposed small boat harbor, as shown in Figure A-3. Figure A-4 shows currents under average wave and tide conditions with the harbor in place. The boundaries for the major currents within the harbor area without interior harbor modifications appear to be Boulder Spit on the East with a flow separation and an eddy forming the boundary on the southeast corner. The currents then rejoin the shoreline near the historic Western terminus of the Salt Lagoon channel (the small boat harbor rubble breakwater). They then proceed to the docked shoreline on the south, and thence to the western main breakwater. The flow separation and eddy in the historic migration path of the Salt Lagoon entrance is a phenomenon that has probably existed for centuries, and its implications on sediment size in the eddy pocket may be profound, as transport of the boulder-size material found on Boulder Spit should be limited to the eddy area. It is suspected that sediments in the eddy area will have very few large boulders to at least a depth of -12' MLLW.

2.4 Wind Data

Wind data and return point period information for the St. Paul area were collected from the *Climatic Atlas* (Bureau of Land Management 1977) and *Extreme Wind Predictions for First Order Weather Stations in Alaska* (Alaska Climatic Center 1984). The maximum sustained wind speed in the 1984 Alaska Climatic Center report is approximately 51 miles per hour for a 1-year return period. Sustained winds are winds averaged over a period of 1 minute. Figure A-5 extracted from the St. Paul Feasibility Report displays the extreme wind speed predictions in miles per hour. Wind speeds in excess of 40 mph of several days duration occur and create water level differential around the Island. Monthly and annual wind roses (Figures A-6.1 through A-6.13) indicate that navigation within the harbor could be difficult when arriving or leaving, and that channels will on occasion need to accommodate vessel drift caused by high wind. The wind roses also indicate that mixing of interior harbor waters will occur and that there will be mass transport of water caused by wind setup.

2.5 Ice Conditions

The icepack in the Northern Bering Sea occasionally moves south and surrounds the island during periods of prolonged north and northeast winds between January and May. NOAA charts warn mariners against the possibility of entrapment in Village Cove. An icebreaker has never been necessary for access to the island. Interior harbor currents at most times will allow ice to bypass the small boat harbor; however, winds can drive float ice into the harbor. Ice conditions may therefore interfere with the proposed day fishery mooring facilities during the months of January through May. Vessel removal for short periods may be a requirement in some years. The photo in Figure A-7 is taken from the island towards the northeast and shows sea ice in the vicinity of the small boat harbor.

3. WAVES

3.1 Wave Exposure

The existing deep-draft harbor in Village Cove is in direct alignment with deep-water waves approaching between the west-northwest and southwest sectors, with an exposure window bounded approximately by azimuths between 210° and 294° relative to true north, as shown in Figure A-8. Deep-water waves approaching from the south and southeast sectors are partially sheltered by St. George Island and Otter Island, and would diffract around Reef Point before impinging on the project site. Southerly and southeasterly deep-water waves therefore undergo considerable energy reduction before arriving at the project site. Village Cove is in the lee of St. Paul Island for waves approaching clockwise from northwest through southeast. Waves in the Bering Sea are extremely large, and around the shallower waters of St. Paul Island their heights are depth-limited during numerous events each year. Maximum wave height to be expected near the entrance to the present harbor is 27 feet.

3.2 Deep-Water Waves

Deep-water waves cover an extreme range of periods. Based on buoy data, those periods can extend to 26 seconds. Harbor seiche waves and the resulting surf beat due were of concern after currents and vessel motions were examined in the previous model. Thus harbor seiche was identified as one aspect of modeling. Data from the NDBC.EMDA at latitude 57.0 N Longitude 177.7 W are included as Tables A-7.1 through A-7.3. The data are a compilation of the annual and monthly records accumulated from 9/85 through 12/93 and show the percent frequency of significant wave heights versus dominant wave period in seconds on the basis of percent frequency of occurrence. That data set can be supplemented prior to construction by a recent 15-year wave hindcast for the months of June through November at latitude 57.0 N, Longitude 189.9 W, which is adjacent to St. Paul Island. That information is not yet in a format suitable for publication but is an indicator of summer wave conditions.

BUOY: 46035 POR: 9/1985 - 12/1993 (66899 RECORDS) LATITUDE 57.0 N LONGITUDE 177.7W

1 - MONTHLY AND ANNUAL FREQUENCY AND CUMULATIVE PERCENT FREQUENCY (10THS)

ELEMENT: SIGNIFICANT WAVE HEIGHT (METERS) POR: 9/1985 - 12/1993 (66899 RECORDS, 95.8% HAVE ELEMENT)

	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC		ANN	
	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF
13.0																			1	#			6	#	7	#
12.5	1	#																					3	999	4	999
12.0																			2	999			1	999	3	999
11.5	5	999																	2	999			2	998	9	999
11.0	9	999															1	#	4	999	2	#	3	998	19	999
10.5	11	997															4	999	2	999	2	999	7	998	26	999
10.0	13	995	5	#	1	#											3	999	3	998	4	999	10	996	39	999
9.5	17	993	8	999	2	999	4	#									2	998	9	998	9	999	12	995	63	998
9.0	29	990	6	997	9	999	4	999									4	998	6	996	14	997	17	993	89	997
8.5	45	985	17	996	29	998	6	999											11	995	29	995	29	990	166	996
8.0	40	977	33	993	20	993	16	997									6	997	14	994	48	990	39	985	216	993
7.5	55	970	31	987	34	989	18	995	1	#							8	996	18	991	62	982	64	979	291	990
7.0	76	960	47	980	30	983	31	991	3	999							18	995	42	989	89	972	82	969	418	985
6.5	127	946	89	971	88	978	42	986	9	999					2	#	20	991	65	982	111	957	146	956	699	979
6.0	192	924	146	954	132	963	50	978	14	998					6	999	31	987	75	972	185	939	206	932	1037	968
5.5	270	889	176	925	170	939	68	969	12	995					24	998	47	981	130	960	275	909	307	899	1479	952
5.0	388	841	232	891	238	909	112	957	24	993	9	#	1	#	13	993	86	972	235	939	322	863	426	849	2086	929
4.5	447	772	346	846	335	868	146	937	49	988	31	998	5	999	51	990	135	956	320	902	401	810	528	781	2794	896
4.0	518	692	412	778	448	809	194	910	120	979	56	991	28	999	78	978	240	929	460	851	608	744	651	696	3813	853
3.5	585	600	567	697	481	730	240	875	209	956	72	979	65	992	150	959	329	883	720	778	864	644	843	591	5125	793
3.0	664	495	576	586	726	645	493	832	351	916	112	963	99	977	268	925	567	819	782	664	947	502	904	455	6489	713
2.5	724	377	872	474	890	518	772	743	595	849	256	939	228	953	492	862	781	710	997	540	833	346	926	309	8366	612
2.0	696	248	820	303	883	361	1015	603	1020	736	448	883	484	900	730	747	989	559	1061	382	785	209	734	160	9665	481
1.5	540	123	495	143	830	206	1134	420	1259	542	1108	786	1028	786	1229	577	1158	368	968	213	393	80	212	42	10354	331
1.0	151	27	211	46	320	60	993	215	1303	303	1838	545	1575	543	1097	291	699	144	369	60	94	16	45	8	8695	169
.5	1	*	25	5	23	4	195	35	292	56	669	145	732	172	152	35	44	9	7	1	1	*	2	*	2143	33
MEAN		3.6		3.2		3.0		2.3		1.8		1.4		1.3		1.8		2.3		2.9		3.5		3.7		2.7
S.D.		1.8		1.5		1.5		1.4		.9		.8		.7		.9		1.2		1.4		1.5		1.6		1.6
TOTAL		5604		5114		5689		5533		5261		4599		4245		4292		5172		6303		6078		6205		64095
MAX		12.4		10.2		10.1		9.5		7.6		5.2		4.8		6.5		10.8		12.9		10.8		13.1		13.1
DATE		90011916		92020413		87032106		87040216		92051110		88061219		90072117		88083106		87092204		89101004		92111301		87121516		87121516
MIN		.7		.4		.6		.4		.4		.4		.4		.4		.5		.6		.5		.7		.4
DATE		93012006		86022801		86031406		91040915		87052810		93061418		86071002		87082821		86092114		88100405		88111520		88121213		93061418

(* < 0.05% , # = 100.0%)

Table A-7.1

BUOY: 46035 POR: 9/1985 - 12/1993 (66899 RECORDS) LATITUDE 57.0N LONGITUDE 177.7W

1 - MONTHLY AND ANNUAL FREQUENCY AND CUMULATIVE PERCENT FREQUENCY (10THS)

ELEMENT: AVERAGE WAVE PERIOD (SECONDS) POR: 9/1985 - 12/1993 (66899 RECORDS, 95.8% HAVE ELEMENT)

	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC		ANN	
	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF
13																							1	#	1	#
12	1	#			5	#											2	#	5	#	3	#	21	999	37	999
11	53	999	10	#	25	999	8	#									11	999	17	999	45	999	59	996	228	999
10	296	990	117	998	111	995	51	999	7	#							31	997	118	997	248	992	218	987	1197	996
9	608	938	467	975	510	975	318	989	56	999			2	#	29	#	200	991	412	978	767	951	903	952	4272	977
8	1373	829	1102	884	1237	886	638	932	333	988	95	#	36	999	175	993	586	953	1290	912	1505	825	1859	806	10229	911
7	1796	584	1615	668	1436	668	1071	817	1168	925	485	979	389	991	1064	952	1557	840	2237	708	2050	577	2073	507	16941	751
6	1230	264	1355	353	1740	416	1884	623	1914	703	1796	874	1613	899	1996	705	1882	538	1695	353	1248	240	888	173	19241	487
5	237	44	417	88	582	110	1344	282	1594	339	1966	483	1918	519	967	240	864	175	508	84	205	35	179	29	10781	186
4	10	2	31	6	43	8	219	40	188	36	255	56	282	68	60	14	39	8	21	3	7	1	4	1	1159	18
3									1	*	2	*	5	1	1	*									9	*
MEAN		7.3		7.0		6.9		6.3		6.0		5.6		5.5		6.0		6.5		6.9		7.3		7.5		6.6
S.D.		1.2		1.2		1.2		1.3		1.0		.8		.7		.8		1.1		1.1		1.2		1.2		1.3
TOTAL		5604		5114		5689		5533		5261		4599		4245		4292		5172		6303		6078		6205		64095
MAX		11.6		10.9		12.0		11.0		10.2		8.3		8.7		9.2		11.6		11.9		11.8		12.7		12.7
DATE		90011916		89020504		93031613		87040219		88051100		88060811		90070121		88083106		92091023		89101007		92111307		87121519		87121519
MIN		3.8		3.8		3.9		3.5		3.4		3.4		3.4		3.4		4.0		3.8		4.2		4.3		3.4
DATE		93012009		86022803		92032820		92041921		92053123		92060104		92073101		87082909		92090212		91102421		85110223		89123003		92073101

(* < 0.05% , # = 100.0%)

Table A-7.2

BUOY: 46035 POR: 9/1985 - 12/1993 (66899 RECORDS) LATITUDE 57.0N LONGITUDE 177.7W

1 - MONTHLY AND ANNUAL FREQUENCY AND CUMULATIVE PERCENT FREQUENCY (10THS)

ELEMENT: DOMINANT WAVE PERIOD (SECONDS) POR: 9/1985 - 12/1993 (66899 RECORDS, 95.8% HAVE ELEMENT)

	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC		ANN	
	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF	F	CPF
25.0	1	#																	2	#			1	#	4	#
20.0	4	999	2	#	13	#			3	#							3	#	7	999	3	#	7	999	42	999
16.7	65	999	37	999	68	998	27	#	27	999	5	#	4	#	23	#	37	999	34	999	91	999	102	999	520	999
14.3	318	988	254	992	316	986	166	995	73	994	24	999	20	999	119	995	116	992	174	993	268	985	299	982	2147	991
12.5	768	931	594	943	661	930	480	965	132	980	47	994	52	994	238	967	146	970	541	966	793	940	930	934	5382	958
11.0	995	794	836	827	907	814	646	878	445	955	132	983	133	982	201	911	436	942	812	880	1224	810	1399	784	8166	874
10.0	1111	616	805	663	767	655	684	762	671	871	274	955	211	951	333	865	814	857	1331	751	1278	609	1353	559	9632	746
9.0	857	418	691	506	655	520	626	638	585	743	416	895	339	901	632	787	938	700	1184	540	906	398	967	341	8796	596
8.0	923	265	1060	371	1158	405	1090	525	1184	632	1164	805	1007	821	1203	640	1434	519	1354	352	1081	249	800	185	13458	459
7.0	350	100	502	163	684	201	806	328	1012	407	1112	552	1068	584	770	360	687	241	570	137	284	71	206	56	8051	249
6.0	164	38	232	65	341	81	658	182	767	215	979	310	886	332	580	180	404	108	226	46	111	25	105	23	5453	123
5.0	39	9	71	20	104	21	278	63	306	69	368	97	407	123	163	45	127	30	53	10	27	6	35	6	1978	38
4.0	9	2	25	6	15	3	68	13	52	11	73	17	105	28	22	7	29	6	13	2	11	2	1	*	423	7
3.0			5	1			4	1	4	1	5	1	12	3	8	2	1	*							39	1
MEAN		10.1		9.6		9.6		8.8		8.2		7.4		7.3		8.3		8.7		9.5		10.1		10.4		9.1
S.D.		2.2		2.3		2.5		2.4		2.1		1.7		1.8		2.2		2.0		2.0		2.1		2.0		2.3
TOTAL		5604		5114		5689		5533		5261		4599		4244		4292		5172		6301		6077		6205		64091
MAX		25.0		20.0		20.0		16.7		20.0		16.7		16.7		16.7		20.0		25.0		20.0		25.0		25.0
DATE		92010707		92021321		93031610		93042812		89050516		93061505		89071404		93081307		92091009		86101105		93110619		93121622		93121622
MIN		3.7		3.0		4.0		3.2		3.1		3.2		3.0		2.8		3.4		3.8		3.7		4.2		2.8
DATE		93012010		86022803		90033121		92041920		92053123		89061802		92072407		87082907		86092114		88100408		85110300		90120900		87082907

(* < 0.05% , # = 100.0%)

Table A-7.3

3.3 *Waves Inside the Deep-Draft Harbor*

3.3.1 Short-period waves

Previous model studies indicate the source of wave activity in the harbor and (within a reasonable error range) the magnitude of the energy. Short-period wave heights in the present harbor are greatly modified by the breakwaters and spending beaches. Waves are attenuated to less than three feet by existing protection. Wave energy enters through both the east and west entrances, with the dominant energy entering through the west entrance (the deep-draft navigation channel). Shallow water conditions in the eastern end are effective in reducing short wave energy.

3.3.2 Long-period waves

Long-period waves from 35-second to 170-second periods exist in the harbor and are a combination of the external surf beat phenomenon and interior seiche waves. Heights associated with these waves are all less than three feet under extreme storm conditions and much less during lower energy periods. The longest period waves (> 110 seconds) oscillate on the east west axis of the harbor on a dominant period between 110 seconds and 140 seconds. The slow oscillation and low current velocities in the small boat harbor associated with the seiche allow harbor mooring development in an East-West direction as depicted in the drawing for the 60-vessel harbor. The maximum strengths of the oscillating currents are 1 fps or less, as shown in Figure A-9. Mooring pile heights must exceed the maximum surge level by several feet and vessel moorings must be secured to offset the stresses developed during the seiches. The surges create navigation concerns in the entrance channel, as there are negative oscillations of nearly 1.5 feet at MLLW. Oscillations are severely dampened as the tides become negative because of the shallow zone between the Spending Beach and East shore. Offshore winds during extreme negative tides will eliminate both the potential to oscillate and the short period waves in the harbor. Cross-channel currents also occur during events in which vessels would leave the harbor. During the most severe storms, waves external to the deep-draft harbor will prevent movement to sea, and thus the currents at that time are not a major concern. Under more modest conditions design channel widths are adequate to assure safe passage. Current velocities also require that erosion protection be added between the spending beach and the interior detached breakwater.

4. EXISTING HARBOR

4.1 General Description and Background

The present St. Paul Harbor was completed in 1990 and consists of a main breakwater 1,800 feet long, a detached breakwater 970 feet long, and space for 900 feet of docks on the lee side of the main breakwater. Currently the city has 200 feet of concrete caisson dock and 100 feet of steel pile dock. Tanadgusix (TDX), the local Native corporation, has also constructed a 300-foot dock. A plan view of the harbor layout is shown in Figure A-10.1. The drawing shows both existing and planned facilities, in addition to the proposed 60-vessel small boat harbor. Figure A-10.2 shows the 30-vessel harbor layout. Figure A-11 shows the 60-vessel harbor with wave gauge locations shown.

4.2 Improvements Underway

Three offshore reefs shown in Figure A-10.1 are under construction. The reefs are each 1250 feet long and will extend above the sea floor to an elevation of -12' MLLW. The reefs' alignments are parallel to the existing breakwater. The reefs' center- lines follow a -28' MLLW contour offshore of the existing breakwater. The purpose of the reefs is to attenuate wave energy on the main breakwater.

4.3 Authorized Improvements to be Constructed Prior to or Concurrently with the Small Boat Harbor

A dredged entrance channel at -30' MLLW with an additional 2 feet for advanced maintenance. A 415-ft by 830-ft maneuvering basin at -29' MLLW. A spending beach on the lee side of the detached breakwater. A realigned Salt Lagoon entrance channel, a sediment management area immediately inside of east entrance, and a detached breakwater located between the new lagoon entrance and the remainder of the harbor complex to direct flows within the total harbor complex. These elements are mitigation measures to restore circulation and water quality to the Salt Lagoon.

4.4 Future Improvement Possibilities

Deepening of the harbor for commercial use on the West side of the proposed small boat harbor rubble breakwater. Cleanup of oil contamination in the vicinity of the Salt Lagoon entrance channel.

5. MODEL STUDY

5.1 General

The same model was used as in previous design efforts. The model reproduced approximately 2,865 m (9,400 ft) of the St. Paul Island shoreline. This produces an extent from Tolsti Point easterly and then southerly to a point south of the existing breakwater trunk. It also reproduces the existing harbor and underwater topography in the Bering Sea to an offshore depth of 12.2 m (40 ft) with a sloping transition to the wave generation pit elevation of -30.5 m (-100 ft). A small connecting channel to the Salt Lagoon (located east of the harbor) also was included in the model as well as the tidal prism of the Salt Lagoon. The total area reproduced in the model was approximately 605 sq m (6,500 sq ft), representing about 6 sq km (2.3 sq mi) in the prototype. Vertical control for model construction was based on mean lower low water (MLLW), and horizontal control was referenced to a local prototype grid system. A general view of the model is shown in the model report appended to this document.

5.2 Analysis of Model Data

Relative merits of the various plans were evaluated by:

1. Comparison of short-period wave heights and long-period wave heights (seiches) at selected locations in the model.
2. Comparison of wave-induced current patterns and magnitudes.
3. Comparison of tidal flows.
4. Visual observations.

In the wave-height data analysis, the average height of the highest one-third of the waves (H_s) was computed using data from each gauge location. All wave heights then were adjusted by application of Keulegan's equation to compensate for excessive model wave height attenuation due to viscous bottom friction. From this equation, reduction of model wave heights (relative to the prototype) can be calculated as a function of water depth, width of wave front, wave period, water viscosity, and distance of wave travel. The model data can then be corrected and converted to their prototype equivalents.

Wave data were filtered, and both short-period storm wave conditions as well as long-period wave conditions were presented at the various gauge locations. In addition, wave-induced current velocities obtained in the model were the maximum that occurred during the wave spectra (usually occurring after a series of large waves in the wave signal and at long-period nodal points).

5.3 *Previous Experiments*

Twelve study plans were evaluated during the initial portion of this investigation (Bottin 1996), and 15 plans were evaluated during the first reactivation of the model (Bottin and Acuff 1997). Therefore, plan numbering for this experimental series began with Plan number 28.

5.4 *New Experiments*

Three principal conditions were studied in the model: A 60-vessel harbor, a 30-vessel harbor, and expansion of the dredged area in front of the TDX Docks. The 60-vessel harbor was first examined with varying levels of protection and entrance hydraulic efficiency to obtain desirable flushing. Gyre circulation in this model indicated that further expansion either to the South or East would result in some difficulty in obtaining adequate flushing. The 90-vessel harbor was not examined in the model as both land use and flushing conditions would make satisfactory development difficult. The 60-vessel harbor configurations were then checked to see if a 30-vessel harbor could be accommodated. When performance of the system was confirmed a separate study was conducted to see if further deep-draft harbor expansion could be accommodated.

The new study was initiated with a model consisting of a 9.8-m-deep (32-ft-deep) draft entrance channel, an 8.8-m-deep (29-ft-deep) maneuvering area, a 3-m-deep (10-ft-deep) sediment trap, a 0.9-m-deep (3-ft-deep) connecting channel from the harbor to the Salt Lagoon, a wave-dissipating spending beach inside the harbor [el 0.0 m (0.0 ft) with a +1.2 m (+4 ft) berm along its perimeter], and an interior detached breakwater. These conditions were developed in previous studies and are authorized for construction and remained in the model for all experiments with the exception that the interior detached breakwater position and orientation were modified. Proposed improvement plans for this experimental series consisted of dredging a new small boat channel and boat basin as well as installation of a shore-connected breakwater and adjustment of the interior detached breakwater. The interior detached breakwater is used to manage water quality in the Salt Lagoon and interior harbor. Modifications also were made to the existing shoreline and depths in the existing harbor. Wave heights and wave-induced current patterns and magnitudes were obtained for variations in the harbor that consisted of changes in shoreline configurations, depths and/or structure lengths and alignments. Experiments of tidal flushing were conducted for changes in the orientation of the interior detached breakwater and depths in the harbor. Study plans that consisted of shoreline and depth changes in the harbor were expeditiously constructed in the model using gravel to determine optimum layouts. A total of 12 plans were tested in this series. Descriptions and layouts of the small boat harbor improvement plans are presented in the model study report appended to this document. The conditions measured in plan 37 (the optimized 60-vessel harbor) are shown in Figures A-2 and A-9, and Tables A-8.1 and A-8.2. These conditions were used to design various aspects of the harbor. Figure A-3 shows current patterns and maximum surge velocities without the small boat harbor in place.

Table A-8.1: Short-Period Wave Heights for Plan 37

Experimental Wave		Wave Height at Indicated Gauge Location, ft										
Period (s)	Height (ft)	Gauge 1	Gauge 2	Gauge 3	Gauge 4	Gauge 5	Gauge 6	Gauge 7	Gauge 8	Gauge 9	Gauge 10	Gauge 11
swl = +3.2 ft												
10	10	2.1	0.6	0.3	0.7	0.5	0.3	0.2	0.3	0.2	0.2	0.6
16	19	4.2	1.4	0.6	1.6	1.0	0.8	0.4	0.4	0.6	0.4	1.5
20	14	3.5	1.2	0.5	1.5	1.0	0.7	0.4	0.4	0.4	0.4	1.1
25	10	3.1	0.9	0.4	1.5	0.9	0.6	0.2	0.3	0.4	0.3	0.9
swl = +7.0 ft												
10	10	3.7	1.0	0.3	0.8	0.6	0.3	0.3	0.3	0.5	0.3	0.8
16	19	5.4	1.8	0.7	1.8	1.5	0.9	0.6	0.7	0.8	0.6	2.3
20	14	4.8	1.7	0.6	1.8	1.4	0.8	0.6	0.6	0.8	0.6	2.0
25	10	4.5	1.5	0.5	2.0	1.2	0.6	0.5	0.5	0.7	0.5	1.7

Table A-8.2: Long-Period Wave Heights for Plan 37

Experimental Wave		Wave Height at Indicated Gauge Location, ft										
Period (s)	Height (ft)	Gauge 1	Gauge 2	Gauge 3A	Gauge 4	Gauge 5	Gauge 6	Gauge 7	Gauge 8	Gauge 9	Gauge 10	Gauge 11
swl = +3.2 ft												
10	10	2.5	0.9	2.1	1.3	1.0	1.0	1.2	1.2	0.8	0.9	1.2
16	19	4.7	1.9	3.4	2.7	2.0	1.9	2.2	2.2	1.6	2.0	2.3
20	14	4.1	1.8	3.0	2.4	2.0	1.7	1.9	2.0	1.3	1.6	2.0
25	10	3.5	1.3	2.6	2.3	1.6	1.4	1.9	1.8	1.8	1.6	1.4
swl = +7.0 ft												
10	10	3.7	1.2	2.2	1.3	1.3	1.1	1.3	1.4	0.9	1.0	1.2
16	19	5.8	2.4	4.0	3.1	2.7	1.8	2.4	2.4	1.9	2.1	3.5
20	14	5.3	2.3	4.0	2.9	2.5	1.9	2.4	2.7	1.8	2.0	2.8
25	10	4.8	1.9	2.9	2.7	1.9	1.5	2.0	2.1	1.5	1.7	2.3

5.5 Wave Height Experiments

Wave height experiments were conducted for the initial and most promising improvement plans for the waves from 8 to 25 seconds. Experiments involving some proposed plans, however, were limited to the most critical wave conditions (i.e., 16-sec, 19-ft waves). Wave gauge locations are shown in the model study

5.6 Wave-Induced Current Patterns and Magnitudes

Wave-induced current patterns and magnitudes were obtained for selected improvement plans for various wave conditions. These experiments were conducted by timing the progress of a dye tracer relative to a known distance on the model surface at selected locations in the model.

5.7 Tidal Flow Experiments

Tidal flow experiments were conducted for selected improvement plans to determine flushing action throughout the harbor. Tidal current patterns and magnitudes were obtained with a dye tracer similarly to those obtained for wave-induced currents.

5.8 Experimental Results

In analyzing results, the relative merits of various improvement plans were based on measured wave heights, wave-induced current patterns and magnitudes, and tidal flow currents. Model wave heights (significant wave heights or H_s) were tabulated to show measured values at selected locations. Wave-induced and tidal current patterns and magnitudes are shown in the figures in the report as previously cited.

5.9 Conclusions

Based on results of the coastal model investigation reported herein, it is concluded that:

1. Preliminary experiments indicated that all improvement plans would result in wave heights of less than 0.3 m (1.0 ft) in the small boat mooring area for short-period storm wave conditions.

3. Preliminary experiments indicated that the harbor would experience long-period (surge) conditions for all improvement plans. These surges are at their extremes at maximum tide conditions, exceeding 3 feet some places in the harbor at the extreme tide of 7+ feet. When water depths are decreased, the East entrance depths decrease the available energy. They are insignificant at the extreme minus tide condition and estimated at about 1.5 ft at the 0-MLLW tide condition.

3. Preliminary experiments indicated that the area between the wave-dissipating spending beach and the interior detached breakwater should be constructed to an elevation of -0.6 m (-2.0 ft) to reduce wave heights in the small boat harbor mooring areas. Excessive wave-induced currents in this area, however, indicated that the area should be hardened (capped with riprap) to prevent scour.

4. Preliminary experiments indicated that strong wave-induced currents in the interior channel might cause navigation difficulties for extreme storm wave events. Strong wave-induced currents along the area east of the shore-connected breakwater also may pose problems for vessels mooring in this vicinity. These current magnitudes also indicate that toe protection at the head of the structure may be required.

5. Preliminary experiments indicated that the angled interior detached breakwater would result in enhanced circulation and better distribution of flow in the small boat harbor basin for ebb tidal currents as opposed to the straight structure.

6. Preliminary experiments indicated that the -4.9-m-deep (-16-ft-deep) interior channel would result in enhanced wave-induced circulation and stronger eddies in the small boat basin as opposed to the -3.7-m-deep (-12-ft-deep) channel.

7. Experiments indicated that the 60-vessel plan configuration (Plan 37) would provide adequate wave and surge protection to the small boat harbor as well as adequate harbor circulation.

8. Experiments indicated that the 30-vessel plan configuration (Plan 38) will provide adequate wave and surge protection to the small boat harbor as well as adequate harbor circulation

9. Experiments indicated that a reduction of depths in the harbor to -6.7 m (-22 ft) west of the interior shore-connected breakwater (Plan 39) would have no negative impacts on wave and surge conditions or harbor circulation in the small boat harbor.

10. Experiments indicated that long-period surge conditions would occur in the harbor. Problems resulting from those conditions should be limited provided dock systems are properly oriented and vessels properly moored.

11. Experiments indicated that the 0.0-m (0.0-ft) elevation of the wave-dissipating spending beach (with the +1.2-m (+4.0-ft) berm along its perimeter) studied during this period will provide essentially the same level of protection from storm waves in the mooring area as the +3.7-m (+12.0-ft) elevation spending beach tested in earlier studies.

6. HARBOR DESIGN

6.1 General

Input parameters for harbor design were based on input from public meetings as far as harbor layout and basic criteria for dock facilities to maintain a given size and composition fleet. The physical controls for design were extracted from model studies, climatological data and common practice for harbor depths and channel dimensions. Previous sections identify most of this input data.

6.2 Design Vessel and Design Fleet

The 60-vessel harbor economic analysis was based upon the boat sizes presented in Table A-9. Other harbor sizes assumed a similar ratio of vessel sizes. The design vessel length was estimated at 60 ft. The average beam was estimated to be in excess of 30 percent of the length, and 22 feet was used. The loaded draft used for the major part of the harbor was 8.0 feet and in the shallower section it was assumed the drafts were 4.5 feet or less.

Table A-9: Distribution by Vessel Size Class in the 60-Vessel Harbor

Size Class	Number of Vessels in Moorage
0 to 26 feet	28 [1]
>26 to 39 feet	17
>39 to 55 feet	13
>55 feet	22
Local fleet total [2]	80
Local fleet w/o hand-launched skiffs	60

[1] The allocated harvest justifies 8 vessels based on the income threshold. We have included an estimated 20 local skiffs in this class. All are tailored or carried and are anticipated to be users of the launch ramp.
[2] Includes hand-launched skiffs not kept in the harbor

6.3 Harbor and Channel Depth for Navigation

The harbor was designed to provide ingress and egress for vessels for all reasonable conditions. The entrance channel design depth was based on the following requirements:

- Vessel draft of 8 ft.
- Safety Clearance of 2 ft when long and short-period waves are present. This safety clearance was selected even though boulders may be present at dredged

depth. Movement of sand and boulders after construction is not expected and no dredging tolerance will be allowed during construction.

- Long-period oscillation at MLLW condition + or – 1.5 feet.
- Short-period oscillations at MLLW + or – 0.5 feet.

The combination of the above requirements resulted in an entrance and maneuvering channel depth of -12' MLLW. A minus tide was then selected, which would allow entrance and exit under all but the most extreme conditions of offshore winds if safety clearances were adequate. 2.5 MLLW tide elevation was selected, as it is an approximate 99% use condition. Depth requirements were based on the following assumptions:

- Long- and short-period waves were blocked by shallow water conditions at the East entrance and by offshore winds. Long- and short-period oscillations are 0 ft.
- The channel depth of 12 feet required at MLLW was found to be usable at the –2.5' MLLW tide with a safety clearance of 1.5 feet entailing either minor waiting or very minor risk therefore no economic analysis was undertaken to study the incremental costs and benefits of channel use between MLLW and –2.5 MLLW.
- Harbor depths in the mooring areas were selected at 1.5 feet below the lowest expected tide for the various vessels in the fleet.

6.4 Channel Depth Required for Flushing

The harbor was tested for its flushing characteristics using both a 3.2-foot tide and a 7-foot tide with the navigation channel at the -12' MLLW elevation. This was combined with the smallest persistent wave that would normally be encountered during the non-storm periods. Circulation within the harbor was developed under these conditions but the multiple gyre system was weaker than without project conditions. To improve gyre strength the hydraulic efficiency of the small boat basin entrance was improved by deepening by 4 feet to an elevation of -16' MLLW. Gyres were strengthened to the point that the mass transfer of water by this mechanism was similar to the without project conditions. Wind and wave setup in the harbor are other major mechanisms for mass transfer and mixing. These remain unchanged under with and without project conditions. Entrance channel depth required for water quality levels similar to existing conditions on the southeastern shoreline is -16' MLLW.

6.5 Entrance and Maneuvering Channel Width

The entrance channel was designed for two-way traffic under optimum conditions of wind and currents and was initially 5 vessel beams in width or 110 feet. The breakwater was extended and the channel reduced to 100 feet to preserve breakwater and spending beach integrity within the confines of the authorized channel depths. The 100-foot width allows 2-way traffic where vessel speeds are not constrained under most conditions. One-way traffic is possible under the more adverse wind and current conditions. The maneuvering channel was widened to 120 feet to account for the wind and current drift associated with constrained vessel speeds. Congestion-associated arrivals and departures from the docks also make additional maneuvering room beneficial.

6.6 Basis of Breakwater Design

The breakwater is designed in accordance with guidance given in the Corps of Engineers Shore Protection Manual. The design was then checked to see if the velocities caused by the harbor seiche at this location could control design.

- Maximum wave in the Harbor = 3 feet
- K_{rr} = 2.5 Non-breaking wave (Table 7-8 SPM)
- Hudson Formula:

$$W_{50} = wr \cdot H^3$$

$$K_{rr} \cdot (S-1)^3 \cot(o)$$

W_{50} = 50% size of rock gradation
W_r = Unit weight of rock
H_{zz} = Design wave height
K_{rr} = Stability coefficient for grade rubble
cot(o) = Cotangent of the slope

- $W_{50} = 165 \cdot 9/2.5 \cdot (4.86) \cdot (1.5) = 600$ lbs.

The maximum size was selected as 2 tons. A well-graded mix without zoning is to be used in the construction as that size material makes up a high percentage of material that can be produced at both St. Paul and at St. George quarries. By using this mix a bedding layer will not be required. Rock sizes based on velocities encountered near the nose of the breakwater were established using the Corps of Engineers ChanlPro program for sizing rock on stream banks.

BREAKWATER VELOCITY CHECK

PROGRAM OUTPUT FOR A CHANNEL WITH A KNOWN LOCAL DEPTH-AVERAGED VELOCITY, BENDWAY

INPUT PARAMETERS

SPECIFIC WEIGHT OF STONE, PCF	165.0
MINIMUM CENTER LINE BEND RADIUS, FT	200.0
WATER SURFACE WIDTH, FT	200.0
LOCAL FLOW DEPTH, FT	15.0
CHANNEL SIDE SLOPE	1 VER: 1.5 HOR
LOCAL DEPTH AVG VELOCITY, FPS	8.00

SIDE SLOPE CORRECTION FACTOR K1	.71
CORRECTION FOR VELOCITY PROFILE IN BEND	1.22
RIPRAP DESIGN SAFETY FACTOR	1.10

SELECTED STABLE GRADATIONS (ETL GRADATION)

LIMITS OF STONE WEIGHT (LB)
FOR PERCENT LIGHTER BY WEIGHT

100		50		15	
36	15	11	7	5	2
86	35	26	17	13	5

Wave activity dominates the design; therefore, 2 ton minus stone is to be used on the breakwater.

6.7 Wave Height in the Moorage Area

The desirable maximum wave heights in a small boat harbor are established by EM 1110-2-1615, "Hydraulic Design of Small Boat Harbors," which contains the following statements:

Purpose and Scope. This manual provides guidance for planning, layout and design of small boat harbor projects. These projects include boat basins, boat ramps, and channels. Small boats are classified as recreational craft, fishing boats, or other small commercial craft with lengths less than 100 feet. . . . Moorage areas need sufficient area to allow berthing piers and interior channels to accommodate the intended fleet. Anchorage areas must safely accommodate the intended fleet considering vessel movement when at anchor. Maximum allowable wave heights generally are limited to one foot in berthing and two feet in anchorage areas.

This manual guidance is in reference to short-period waves in the harbor. Guidance on long-period waves (seiches) indicates that considerable seiche sizes can be accommodated if vessels and docks are properly oriented and moorings account for the forces imposed by the seiche activity.

Some clarification of that guidance with respect to seiches is given in Special Report No. 2, *Small-Craft Harbors: Design, Construction and Operation*, U.S. Army Corps of Engineers (December 1974):

The normal criteria for acceptable wave actions are that the significant height of any wave episode not exceed about 2 to 4 feet in the entrance channel and 1 to 1.5 feet in the berthing areas, depending on the characteristics of the using craft. Generally, if waves can be attenuated to a height of about 1 foot in the berthing areas, their horizontal oscillations will not be troublesome, and any longer-period resonant effects will go unnoticed.

Based on model studies, short-period wave heights of less than 1 foot prevailed in the harbor under all test conditions (see APPENDED model study report). Long-period waves in the 110-second to 140-second range will, however, be present in the harbor. The Southeastern corner of the harbor has the maximum vertical response in a seiche mode under these conditions. The seiche is oriented in an East to West direction and therefore boat moorages must be oriented in that direction to allow a vessel to ride with the seiche when moored. The harbor layout shown in the recommended plan responds to this orientation. Seiches in other harbors are managed by moorage orientation and close control of moorings. Harbor oscillation horizontal velocities are quite low, and mooring stresses should be easily accommodated. Velocities off the end of the breakwater and across the wave control zone between the spending beach and detached interior breakwater will require erosion protection. The dock lying adjacent to and east of the small boat harbor rubble breakwater will see vertical oscillations but has been set back from the end of the breakwater to avoid horizontal current velocities. Sponsor management of dock use and tie up will be required but curtailed use is only expected less than 10% of the time during the winter season based on wave information contained in this report.

6.8 Erosion Protection

The areas requiring erosion protection were determined from model studies. The zones that have high velocities are in the vicinity of the breakwater nose and the high insitu ground that supplies natural harbor wave protection. The high ground is that area between the spending beach and the interior detached breakwater. The -2' MLLW grade must be maintained at that location for wave protection and also retained for flushing control for the harbor, The area will be excavated so that erosion protection can be placed to the -2' MLLW elevation. The erosion protection was sized using ChanlPro.

PROGRAM OUTPUT FOR A CHANNEL WITH A KNOWN LOCAL DEPTH-AVERAGED VELOCITY, STRAIGHT REACH

INPUT PARAMETERS

SPECIFIC WEIGHT OF STONE, PCF	165.0
LOCAL FLOW DEPTH, FT	12.0
CHANNEL SIDE SLOPE,	1 VER: 3 HOR
LOCAL DEPTH AVG VELOCITY, FPS	8.00
SIDE SLOPE CORRECTION FACTOR K1	.99
CORRECTION FOR VELOCITY PROFILE IN BEND	1.00
RIPRAP DESIGN SAFETY FACTOR	1.10

SELECTED STABLE GRADATIONS (ETL GRADATION)

LIMITS OF STONE WEIGHT (LB)
FOR PERCENT LIGHTER BY WEIGHT

100		50		15	
36	15	11	7	5	2

A fifty-pound minus riprap was chosen with a two-foot layer thickness. The added thickness was selected in lieu of a gravel filter. A plus or minus tolerance of 6 inches is to be allowed over an area not exceeding 200 square feet to allow ease in placement. Insitu boulders need not be removed if they lie within this tolerance, and erosion protection can be continuous without sand pockets.

6.9 Interior Harbor Design

The orientation of moorings depicted on the drawings is critical to the harbor functioning satisfactorily during periods of seicheing. Other elements of the mooring docks, floating dock, boat ramp and boat haulout trailer have not received detailed design analysis but are in use at other harbors. Detailed design should be undertaken prior to installation of these facilities.

6.10 Future Harbor Dredging Modifications

Deepening in front of the TDX docks is always a future possibility. The harbor lying West of the small boat harbor was examined to see the impacts on the small boat harbor, other portions of the harbor, and water quality. The area was modeled, and the differences between conditions with existing topography and with deepening to -22' MLLW were examined and found to be minor. Harbor circulation is adequate to allow development, and there do not appear to be obvious environmental or technical reasons to constrain future development. There are technical items that must be considered. The harbor seiche manifests itself in this segment of the harbor also. The surge is a gain oscillating on an East to West axis making mooring perpendicular to this direction difficult. Local desire to place a fixed dock parallel to the small boat harbor breakwater will need to take the seiche conditions under consideration. A more elaborate finger pier arrangement may be desirable.

7. THE RECOMMENDED PLAN

7.1 Description

The recommended small boat harbor consists of a federally developed entrance and maneuvering channel and a West breakwater. The entrance and maneuvering channels in the interior of the harbor are constructed to a depth of -12' MLLW to within 100 feet of the harbor breakwater. The entrance is initiated at the boundary of the turning basin and extends from that point to a position about 100 feet inside the harbor. The depth as required for flushing in this segment is -16' MLLW. At that position it transitions to a depth of -12' MLLW. The width of the entrance channel segment where vessel speed allows reasonable control is 100 feet with a depth of -12' MLLW. In the speed-restricted maneuvering channel the width increases to 120 feet at a 12-foot depth. The entrance channel narrows to 65 feet at the eastern segment of the harbor that is used by smaller craft in the fleet. The Federal breakwater is 445 feet in length and is constructed to an elevation of +10' MLLW. The breakwater elevation assumes an extreme tide of 6' MLLW plus a surge of 4 feet. Model results show that surges may exceed this value under certain circumstances. Those circumstances, however, are infrequent and added elevation is not deemed necessary. Breakwater construction is a randomly placed rubble mound with 1.5 on 1 side slopes. Erosion control is required in the areas shown between the spending beach and the interior detached breakwater and in the channel along the end of the harbor breakwater. The Eastern end of the harbor is bounded by a circulation berm requested by environmental interests. The berm will control waters that might enter from the relic channel lying East of Grass Islands. The berm is built from the constructed +10' MLLW elevation in the services area to the Grass Islands. The berm is constructed to a top elevation of +10' MLLW and capped with filter and revetment. The revetment will be composed of the 12 inch minus boulders removed during excavation of the harbor.

7.2 Locally Developed Portions of the Project Consist of:

- A mooring basin comprising about 3.5 acres.
- Mooring floats for a 60-vessel harbor
- Launch ramp 50 feet by 140 feet capable of retrieving the larger vessels in the fleet.
- A boat launch trailer.
- A 50-foot by 160-foot dock at the southwestern boundary of the project.
- A 20-foot by 275-foot pile-anchored floating dock along the eastern side of the federal breakwater.
- Revetment on the southern bank of the harbor
- Associated onshore facilities
- Intertidal fill along the Southern bank line
- A +10' MLLW berm from shore to Grass Islands on the East Bank

7.3 *Harbor Water Quality*

Harbor water quality is dominated by the exchange of tide-generated flow through the harbor on its way to and from the Salt Lagoon combined with wave driven currents. The differential head between the western and eastern entrance to the deep-draft harbor created by minor wave activity creates an almost continuous flow through the deep-draft and small boat harbor. An added mechanism that creates both mixing and exchange is the high predominance of winds from the North. Other winds create mixing but the north winds create mass transport of water through the harbor. The Salt Lagoon surface is also more than three times that of the harbor and more than double the tidal prism. The impact of the Salt Lagoon is that when wind mixing occurs, the harbor waters are mostly exchanged in one tidal cycle. The winds eliminate the stagnation potential of the waters that are partially isolated from the Salt Lagoon effects. Circulation is generally good. The winds that assail this site will do an excellent job of mixing the water.

7.4 *Salt Lagoon Water Quality*

The Salt Lagoon water exchange is dominated by tides. Because of the small range in tidal elevation and length of basin, several tide cycles are required before all the water is exchanged. Mixing of water in the tidal lagoon should be good because waters are shallow and winds are frequent and strong enough to stir from top to bottom. Storm surge water elevations of up to three or four feet above normal tidal elevations cause supplemental exchange in the lagoon and periodically improve water quality. The shaping and deepening of the lagoon entrance channel will improve water exchange. The placement of the detached interior breakwater favors waters entering the lagoon directly from the ocean source rather than through the harbor complexes and should guarantee high-quality entrant waters. Those modifications will be undertaken concurrently with other authorized components of the deep-draft harbor. The combination of planned improvements minimizes the risk of degrading water quality through harbor activities and greatly enhances the system now in existence.

7.5 *Sedimentation*

Shoaling within the small boat harbor will be very limited as the deep-draft harbor entrance channel forms a trap at the western end of the system and the sediment management area forms a trap on the eastern end. Wind blown sands will however continue to contribute a small amount of sediment on the eastern boundary of the project.

Sediments in the harbor area are gap graded. The sediments consist of sands and well-rounded boulders. The dominant transport mechanism for both is the current generated by the storm surges. A secondary and important transport mechanism is wind transport. Wave generated currents under more minor storm conditions are probably also capable of moving sands along the shoreline. Currents in the pocket where the harbor resides are generally in a clockwise direction and prior to deep-draft harbor construction probably resulted in the harbor area fluctuating between being a sediment sink and a sediment source for down-flow beaches. The position of the Salt Lagoon entrance has shifted several hundreds of feet over brief periods of time, indicating insufficient boulders in the material being transported to armor and hold its position beyond its present northerly location.

Prior to deep-draft harbor construction, sediment accumulation in the area was limited and most accumulations were shifted in down transport after brief periods of storage in the lagoon entrance. Since construction of the breakwaters the currents have been modified, and the sediments reaching the harbor are retained in the area south of the east entrance in the general area from the entrance to the historic Salt Lagoon channel. Storm surges and the current driving mechanisms, however, are still similar to pre-construction. Since construction sediment accumulation within the confines of the deep-draft harbor appears to be less than 2000 cubic yards per year, however, precise measurements of infill have not been made and the 2000 yards could be exceeded. The observed accumulation is in the northeastern segment of the harbor and is not expected to encroach on Federal facilities for 5 years. A sediment management area (sediment trap) just inside the north breakwater between Boulder Spit and the wave dissipater island will trap and control most sediment entering the harbor. A sediment trap in this area when over dredged also helps prevent water quality degradation in Salt Lagoon.

Much of the sediment approaching the harbor is diverted westward along the deep-draft exterior detached breakwater and recirculated to the ocean about 1000 ft offshore of its previous location to the existing project circulation path shown in Figure A-12. This probably results in some deficit of sediments along the headlands to the west and may extend into Zolotoi Bay. The small boat harbor does not affect these conditions.

The dunes at the southern end of the harbor development are evidence of wind transport. It is expected that some sediment accumulation in the southeastern portion of the small boat harbor will result from the strong northerly winds blowing along the length of the spit.

7.6 Construction Dredging

Initial construction dredging quantities were derived from the June 1995 Corps of Engineers survey. Initial construction would involve dredging material consisting of up to 50 percent boulders to the project limits in the deep-draft entrance channel, maneuvering basin, sediment management area and entrance to the Salt Lagoon. Dredging in the small boat harbor should encounter a lower concentration of boulders. Dredging for the small boat harbor and other project elements will be conducted within a single contract to minimize the mobilization costs (a sizable portion of all dredge contracts in remote locations). Dredge equipment will be adapted to the more severe conditions in the deep-draft entrance channel and other non-small boat harbor components. The small boat harbor dredging will comprise 137,00 cy of a total of 549,000 cy. Disposal will be at an upland disposal area, in the spending beach island on the south side of the detached breakwater, and on the beach fill on the southern boundary of the harbor.

Work will be accomplished with a large clamshell dredge, since sand, boulders, and possibly hard layers of consolidated material could be encountered during construction. Also, for the entrance channel dredging, a barge-mounted clamshell is needed because of wave action.

7.7 Operation and Maintenance Plan

Operation of the completed project would for the major part be the city of St. Paul's responsibility. The federal government would be responsible for the breakwater, entrance and maneuvering channel. The Alaska District would conduct hydrographic surveys at 3- to 5-year intervals for dredging areas. The hydrographic surveys would be used to verify whether the predicted maintenance-dredging interval is adequate for the entrance and maneuvering channel. Local and Federal dredging requirements would probably be combined, so there would be only a single mobilization and demobilization cost. The expected maintenance costs are listed in the following subparagraphs for the Preferred Plan.

7.7.1 Federal Channel Dredging

Minor accumulations can be managed in conjunction with deep-draft harbor maintenance. Sea source sediments enter through the deep-draft channel on the West and will accumulate in the maneuvering basin of the deep-draft harbor. Minor amounts of suspended fines may find their way into the Federal channel associated with the small boat harbor, but the amounts should be negligible. Sea source sediments at the western end of the project enter along the spit and accumulate in the deep-draft harbor and Salt Lagoon sediment management area. Minor amounts of fines may enter the federal channel of the small boat harbor but can be managed with the periodic management of in the deep-draft maneuvering area. It is assumed that 10,000 cyds will require removal on a 10-year frequency and assumed that mobilization and the deep-draft project will absorb any special costs for development of disposal areas. The cost of dredging will be $9.63/cy or $96,300/10yr. Annual cost of dredging is $6,500.

7.7.2 Harbor Dredging

4,000 cyds at 10-year intervals is the expected harbor dredging volume. Wind-driven sands from the boulder spit will cause the accumulation. The sands will accumulate in the Eastern portion of the harbor. The unit cost of removal will be $9.63/cy or $38,520 in ten years. Annual cost of dredging is $2,600.

7.7.3 Breakwater

The breakwater maintenance is anticipated to be less than 1%/yr with periodic maintenance of 20% of first cost or $139,183 plus mobilization of $1,200,000 at years 20 and 40. Annual cost of maintenance is $31,500.

7.7.4 Boat Ramp

The boat ramp will require 50% replacement at years 20 and 40. Those replacements will coincide with major breakwater repairs or with the major construction so as to negate the need for major mobilization costs. Repairs are expected to be $100,000 at 20-year intervals. Annual cost of maintenance is $2,300.

7.7.5 Floats and walkway ramps

Floats and walkway ramps will be left in place throughout the winter. They will require annual repairs of surfaces, mooring bits, pile attachments, piles, hinges and other items. The annual maintenance is estimated at 2.5% of the initial cost for years 1 through 5 and at 5% of the initial cost annually throughout the remainder of project life. Annual cost of maintenance is $34,700.

7.7.6 Breakwater Eastside Floating Dock

The floating dock will be left in place throughout the winter and receive heavy use throughout the year. It will require annual repairs of surfaces, mooring bits, pile attachment, piles, hinges and other items. The annual maintenance is estimated at 2.5% of the initial cost for years 1 through 5 and at 5% of the initial cost annually throughout the remainder of project life. Annual cost of maintenance is $31,200.

7.7.7 South Side Dock

The dock will require annual repairs of surfaces, mooring bits, piles, and other items. The annual maintenance is estimated at 2.5% of the initial cost for year 1 through 5 and at5% of the initial cost annually throughout the remainder of project life. Annual cost of maintenance is $49,600.

7.7.8 Boat Lift Trailer

The boat lift trailer will require $1,000 in annual maintenance. The maintenance will consist of lubrication, periodic replacement of straps, tires, hydraulic seals and general minor repairs. Annual cost of maintenance is $1,000.

Total annual cost of maintenance is$159,400.

7.8 Aids to Navigation

For the deep-draft channel a self-contained signal lantern has been installed at the head of the existing breakwater as an aid to navigation. Discussions with the U.S. Coast Guard have been conducted to assure that necessary marking of reefs and/or the entrance channel with ranges or lights would be considered. The small boat basin will require some additional buoys to mark the channel.

8. Quantity and Cost Estimates

8.1 Preferred Plan

Detailed estimates of quantities for dredging, and the local sponsor's costs for associated items were made for the recommended harbor plan. Other plans required to develop the NED or recommended plan were estimated based on this single detailed estimate. Dredging quantities were estimated for general navigation features and for other features. The general navigation features include the entrance channel, maneuvering channel, and the breakwater. The detailed cost estimate and associated quantities for the recommended plan are shown in MCACES format in the Economic Appendix. All the cost estimates are based on construction being accomplished at the same time as previously authorized harbor improvements as listed in section 4.3. First-year mobilization costs are shown based on the shared costs of that mobilization.

8.2 Other Alternatives

A total of five plans were analyzed to arrive at the NED plan. The preferred plan is thoroughly described elsewhere in this report. A brief cost summary of the preferred plan and others are shown in Tables A-1 through A-5.

Of the plans examined 3 are variation in depths for a 60-vessel harbor. All of the 60-vessel harbors require the deep inlet channel to obtain adequate flushing gyres. They also require a vessel haul-out ramp and most facilities needed in alternative depth harbors. Therefore, costs are similar to one another.

A 30-vessel harbor cost was examined at the -12' MLLW depth. Modeling efforts indicate that this harbor would perform adequately, but most major cost items are similar to the 60-vessel harbor.

A 90-vessel harbor was examined and may appear desirable based on harbor costs alone; however, there are both land use and environmental faults with this plan. The 90-vessel harbor expansion would require land either on the eastern or southern boundary of the proposed 60-vessel harbor. Model studies indicate that the 60-vessel harbor approaches the limits of secondary gyre, and transfer of basin waters will occur in a satisfactory manner. Further penetration into the shorelines will adversely affect water quality in those penetrations. There is a further problem with the 90-vessel harbor: Adjacent lands must be foregone for basin development. The giving up of these lands constrains reasonable associated harbor development.

9. CONSTRUCTION SCHEDULE

9.1 General

Major construction items to be undertaken concurrently with this project include constructing the spending beach and dredging the entrance channel, maneuvering basin, sediment management area and new Salt Lagoon entrance. In addition, the Salt Lagoon entrance would be stabilized and the spending beach constructed. The spending beach would be one area for disposal.

The time needed for construction is estimated at less than 6 months but will represent two construction seasons, as mobilization, demobilization and entrance dredging must be scheduled around seasons conducive to their accomplishment. Moorings and docks would be constructed during a second season,

Construction scheduling would facilitate the continued use of the harbor by local fishermen, fish processing facilities, and cargo vessels during construction. Project specifications would direct the contractor to conduct certain activities during specified time periods to allow continued harbor usage.

9.2 Effects of Harbor Improvements Construction

Construction of the St. Paul Harbor improvements would not impact the relatively quiescent waters within Village Cove and would not affect the wave climate or sediment supply of adjacent shorelines south and west of Village Cove. Improvements in the Federal project area (maneuvering and entrance channel) would not adversely impact the adjacent inner harbor areas or tidelands outside the harbor. Shoaling at the deep-draft harbor entrance or inside the deep-draft harbor would not be increased by development of the small boat harbor.

Water circulation within Village Cove is driven predominantly by tidal action and high wind fields, which the proposed improvements would not impact. Model studies indicate that circulation would be considerably enhanced by wave action during storm conditions and that enhancement is not compromised by the small boat harbor development.

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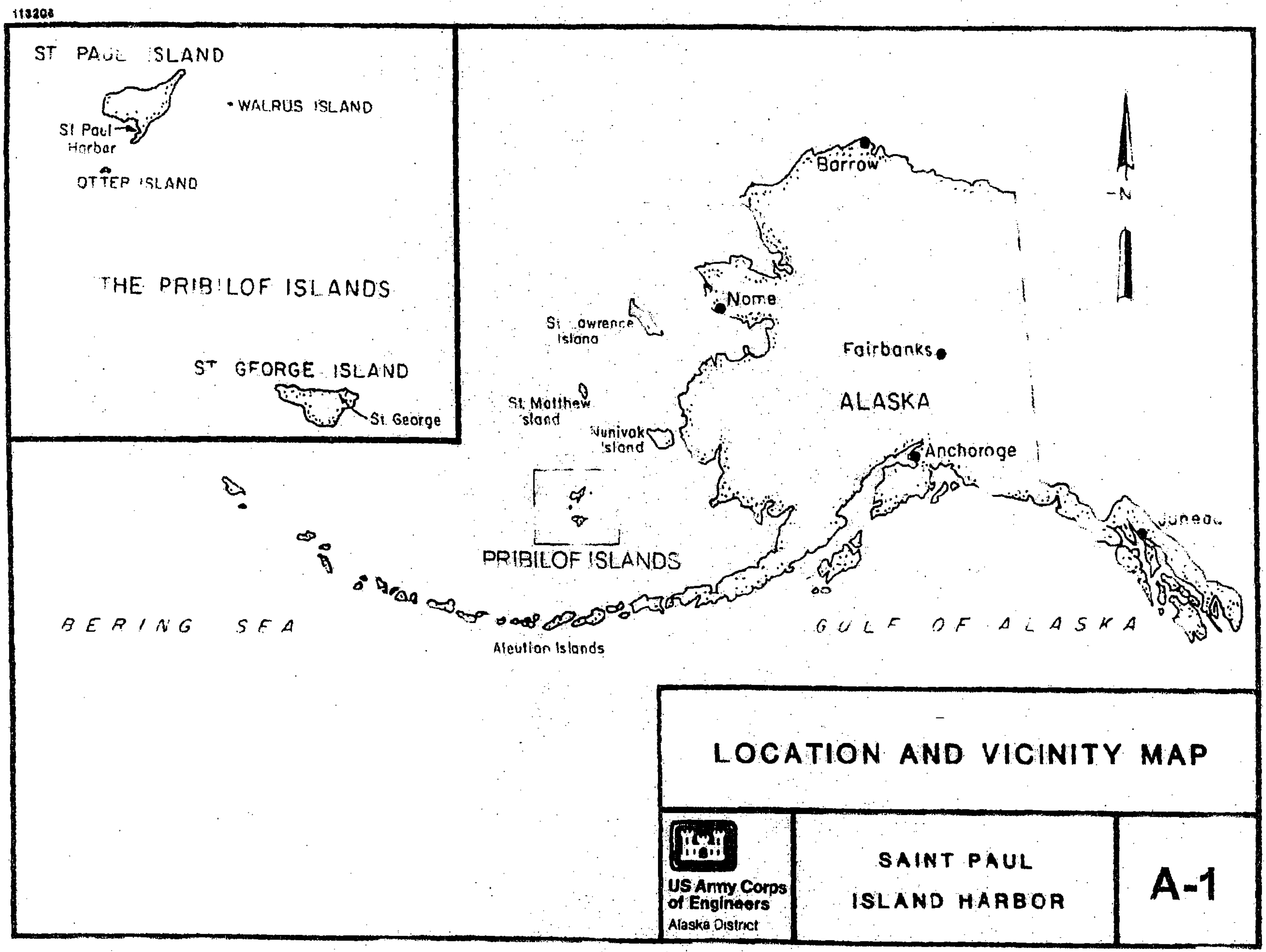
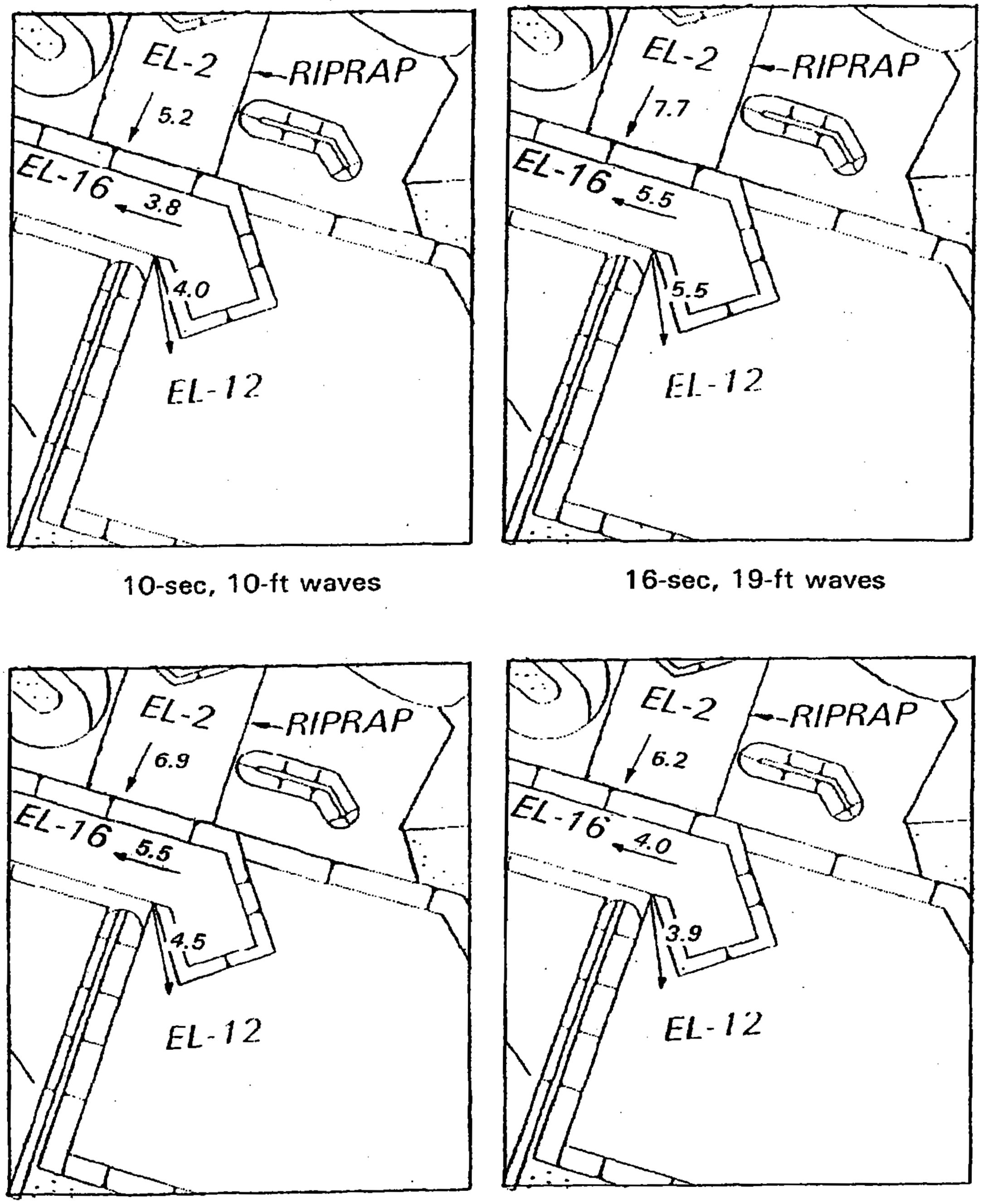

113208
ST PAUL ISLAND
WALRUS ISLAND
St Paul Harbor
OTTER ISLAND
THE PRIBILOF ISLANDS
ST GEORGE ISLAND
St. George
N
Barrow
Nome
St Lawrence Island
Fairbanks
ALASKA
St Matthew Island
Nunivak Island
Anchorage
Juneau
PRIBILOF ISLANDS
BERING SEA
Aleutian Islands
GULF OF ALASKA
LOCATION AND VICINITY MAP
US Army Corps of Engineers
Alaska District
SAINT PAUL ISLAND HARBOR
A-1

Figure A-1



10-sec, 10-ft waves

16-sec, 19-ft waves

20-sec, 14-ft waves

25-sec, 10-ft waves

Wave induced current patterns and magnitudes (prototype feet per second) for Plan 37, swl = +3.2 ft

Figure A-2

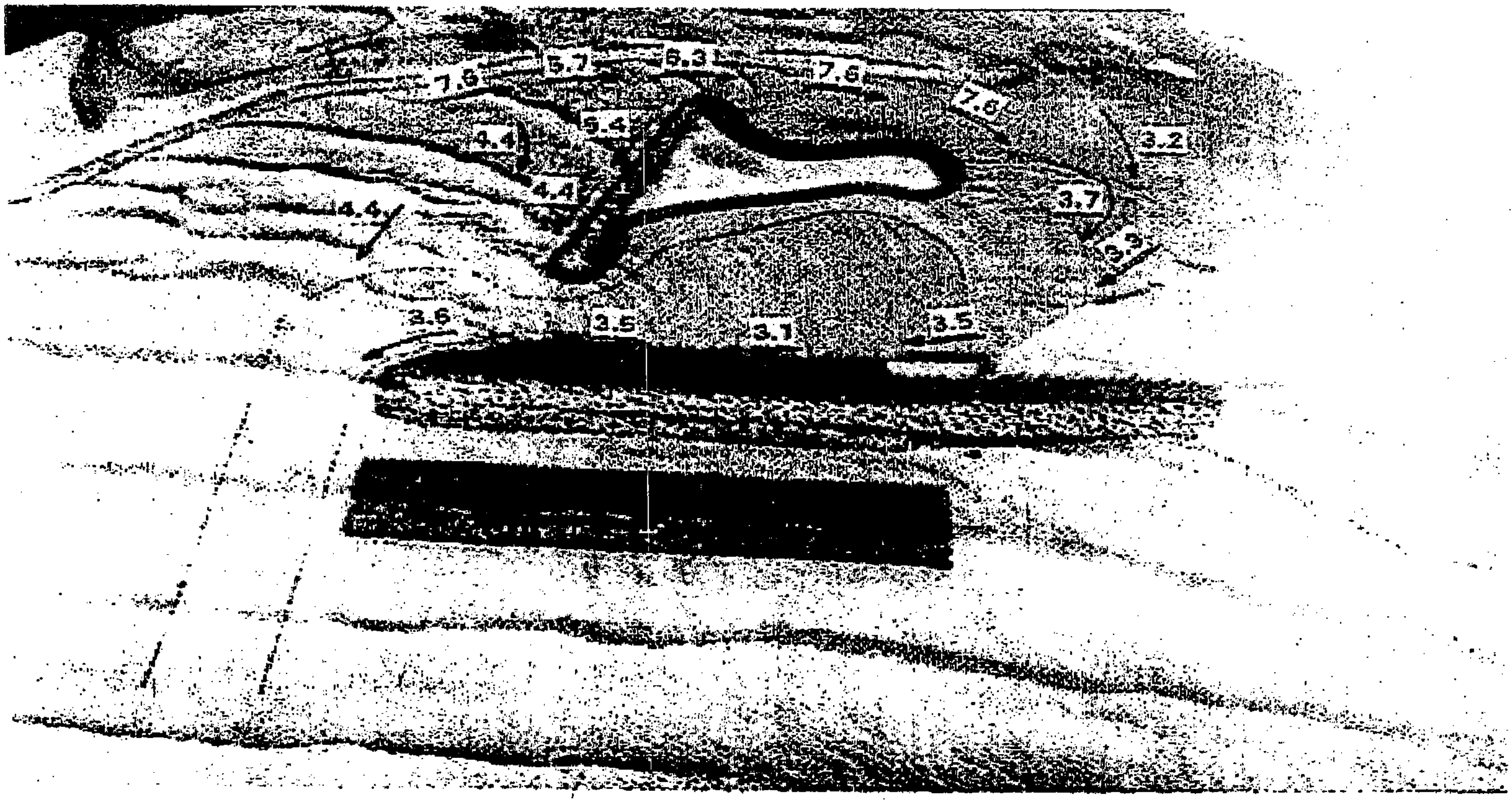
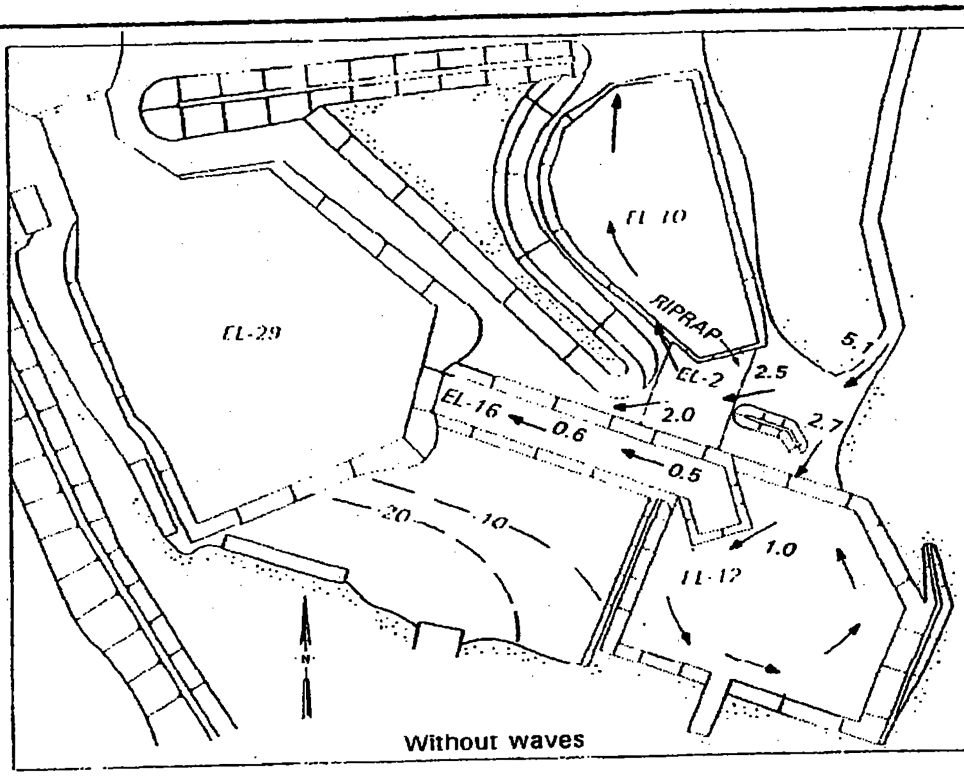
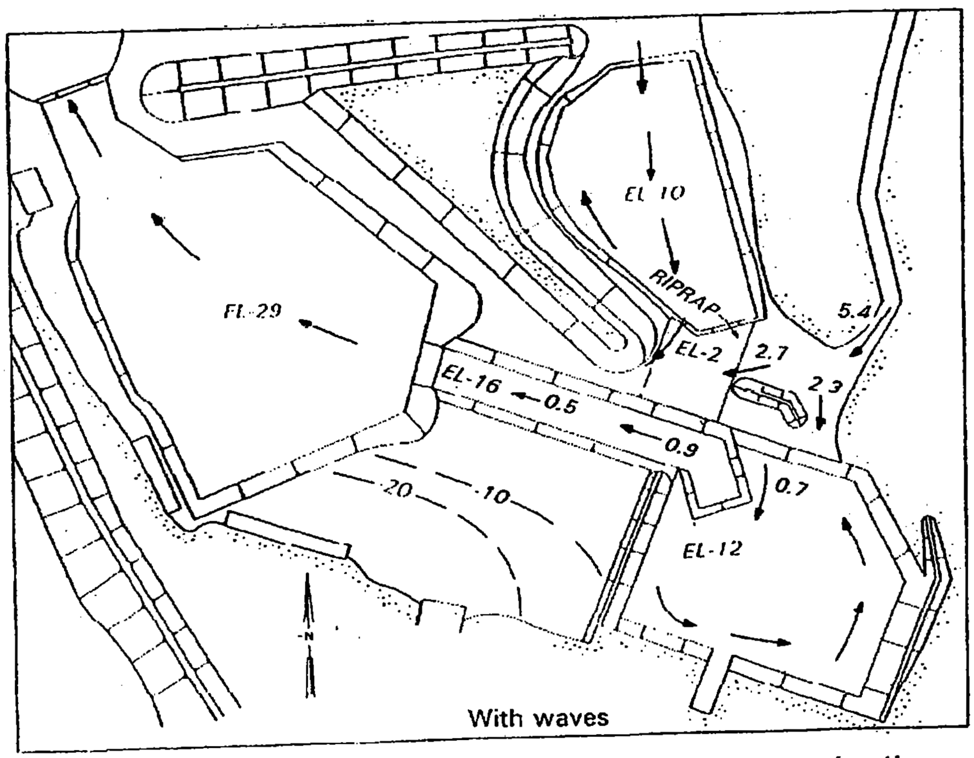


PHOTO 47.--Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for plan 11; 12-sec, 16-ft test waves from west; SWL = +3.2 ft.

Photograph taken from the Corps of Engineers Alaska District Harbor Improvements Draft Feasibility Report

CURRENTS UNDER STORM CONDITIONS

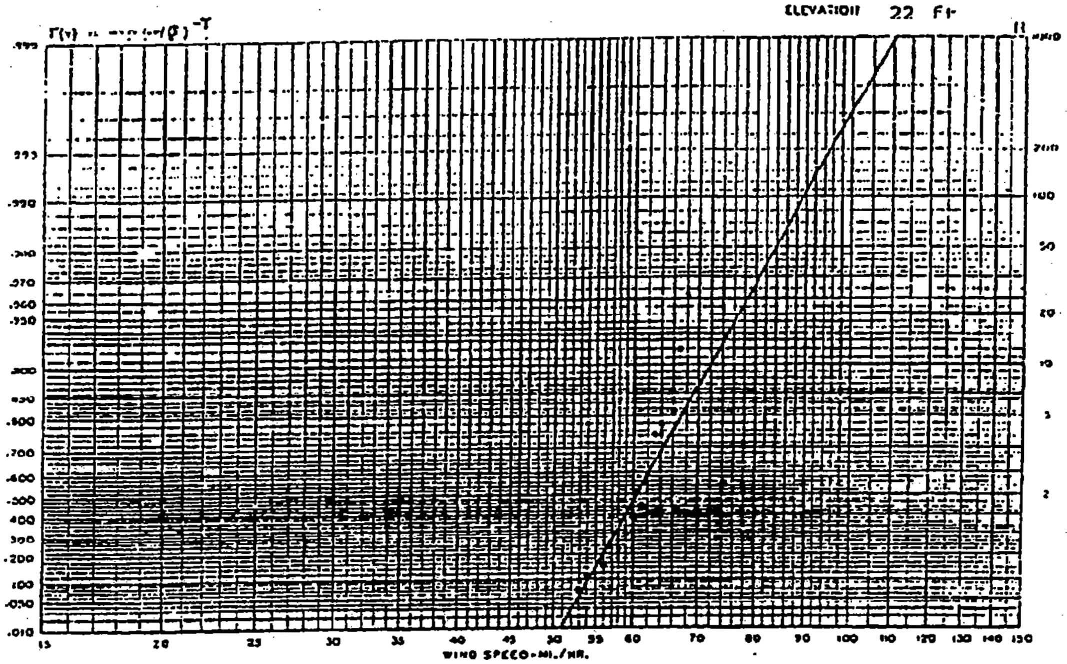




Ebb tidal currents for Plan 37 with and without waves for the +7.0-ft tidal range

95786

LATITUDE 57 09'N
LONGITUDE 170 13'W
ELEVATION 22 Ft



MAXIMUM-VALUE PROBABILITY PAPER, FISHER TIPPET TYPE II DISTRIBUTION

$\bar{v}$ = 61.4 σ^2 = 24.5 σ = 4.9

μ = 62 β = 59 γ = 10.9

PERIOD OF RECORD: 1956-1982

EXTREME VALUE PREDICTIONS IN MILES PER HOUR

	RETURN PERIOD IN YEARS		
	25	50	100
WIND ESTIMATE	79.1	84.4	90.0

SOURCE: UNIVERSITY OF ALASKA. 1984

EXTREME WIND PREDICTIONS

FROM TETRA TECH
FEB. 1987 ST. PAUL
HARBOR REPORT.

US Army Corps of Engineers
Alaska District

SAINT PAUL
ISLAND HARBOR

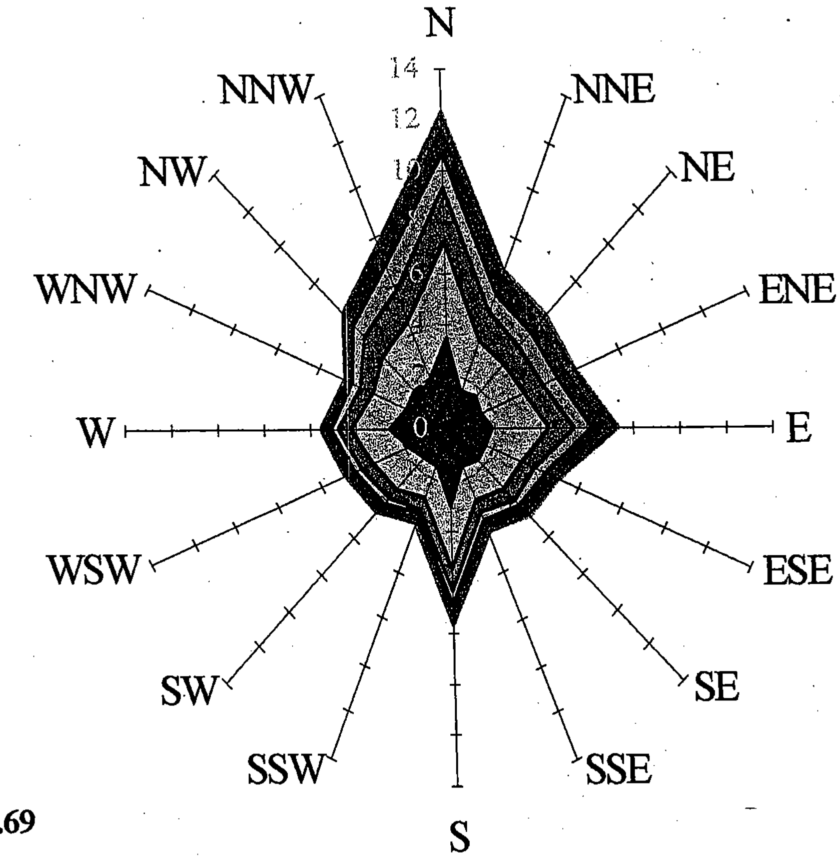
POR: 1973-1999

St Paul Island, AK

Latitude 57.09N Longitude 170.13W

Elevation 13Ft

Annual Wind Summary



Percent Frequency Calm Winds: 1.69

Labels of Percent Frequency on North Axis

>55kts 48-55kts 41-47kts 34-40kts 28-33kts 22-27kts 17-21kts 11-16kts 7-10kts 1-6kts

Figure A-6.1

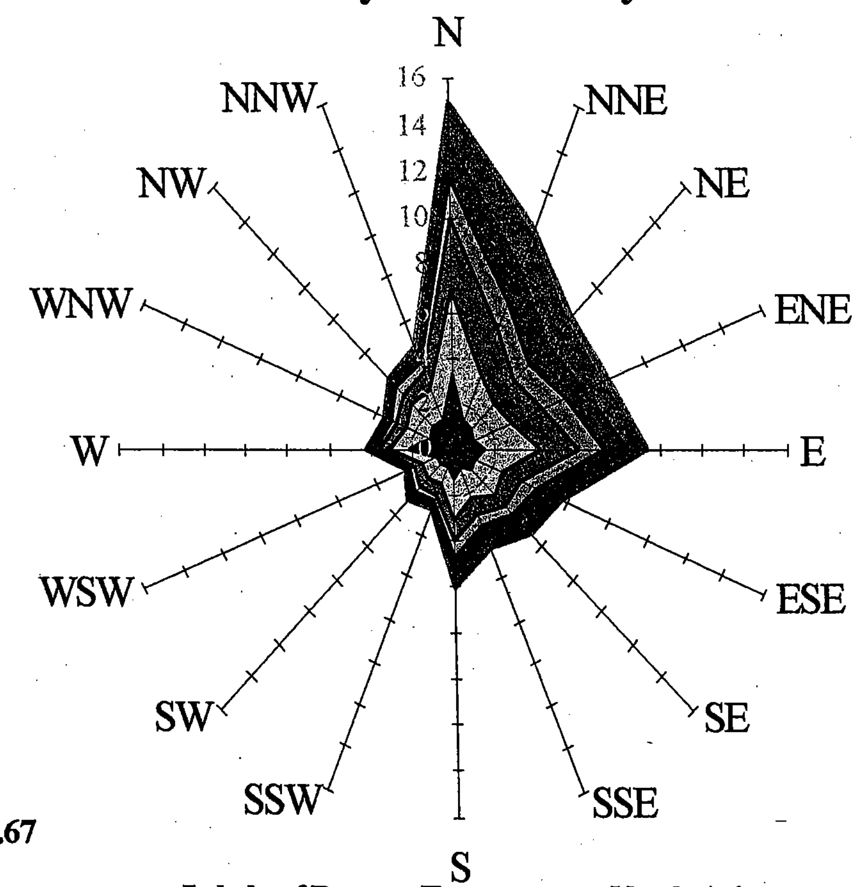
St Paul Island, AK

POR: 1973-1999

Latitude 57.09N Longitude 170.13W

January Wind Summary

Elevation 13Ft



Percent Frequency Calm Winds: 1.67

Labels of Percent Frequency on North Axis

>55kts 48-55kts 41-47kts 34-40kts 28-33kts 22-27kts 17-21kts 11-16kts 7-10kts 1-6kts

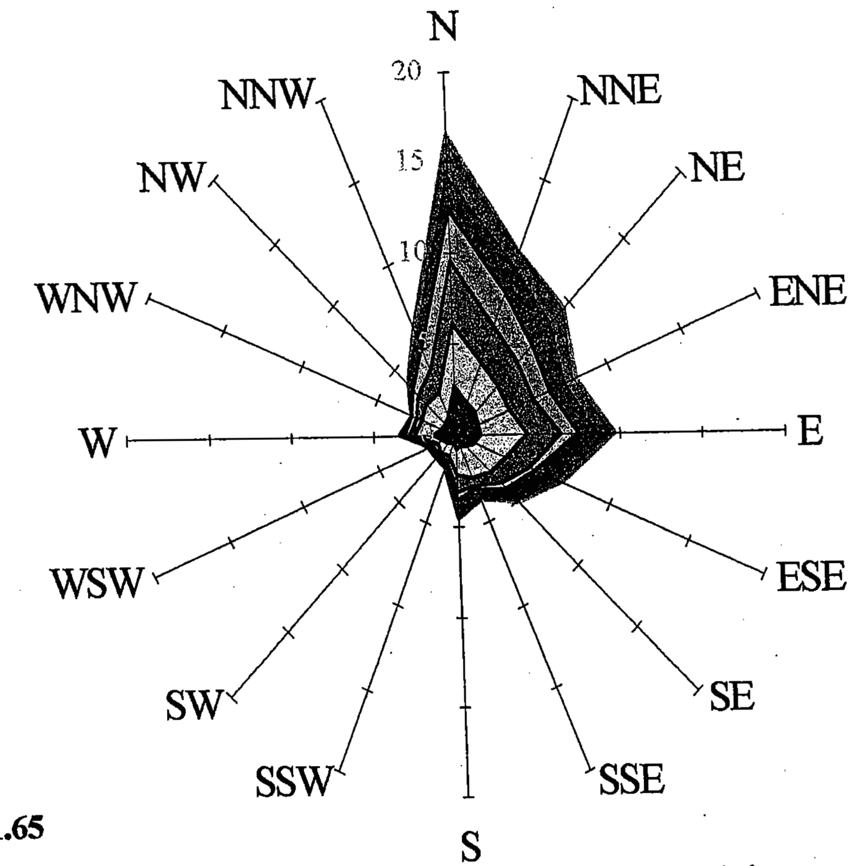
Figure A-6.2

St Paul Island, AK

POR: 1973-1999

Latitude 57.09N Longitude 170.13W
Elevation 13Ft

February Wind Summary



Percent Frequency Calm Winds: 1.65

Labels of Percent Frequency on North Axis

>55kts 48-55kts 41-47kts 34-40kts 28-33kts 22-27kts 17-21kts 11-16kts 7-10kts 1-6kts

Figure A-6.3

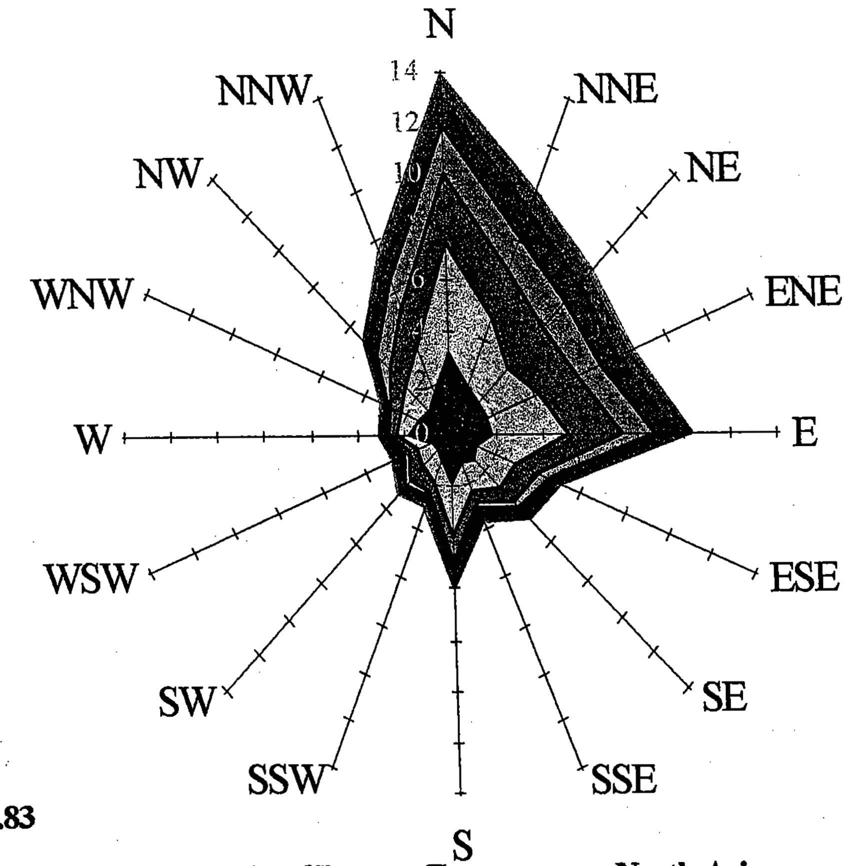
St Paul Island, AK

POR: 1973-1999

Latitude 57.09N Longitude 170.13W

Elevation 13Ft

March Wind Summary



Percent Frequency Calm Winds: 1.83

Labels of Percent Frequency on North Axis

>55kts 48-55kts 41-47kts 34-40kts 28-33kts 22-27kts 17-21kts 11-16kts 7-10kts 1-6kts

Figure A-6.4

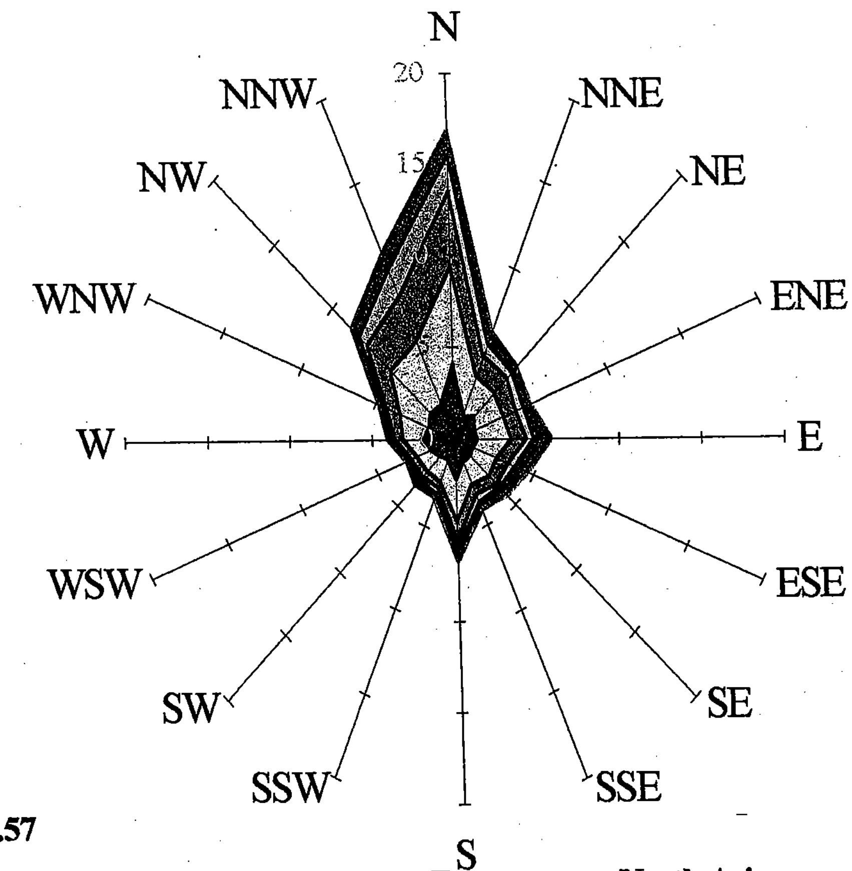
POR: 1973-1999

St Paul Island, AK

Latitude 57.09N Longitude 170.13W

Elevation 13Ft

April Wind Summary



Percent Frequency Calm Winds: 1.57

Labels of Percent Frequency on North Axis

> 55kts 48-55kts 41-47kts 34-40kts 28-33kts 22-27kts 17-21kts 11-16kts 7-10kts 1-6kts

Figure A-6.5

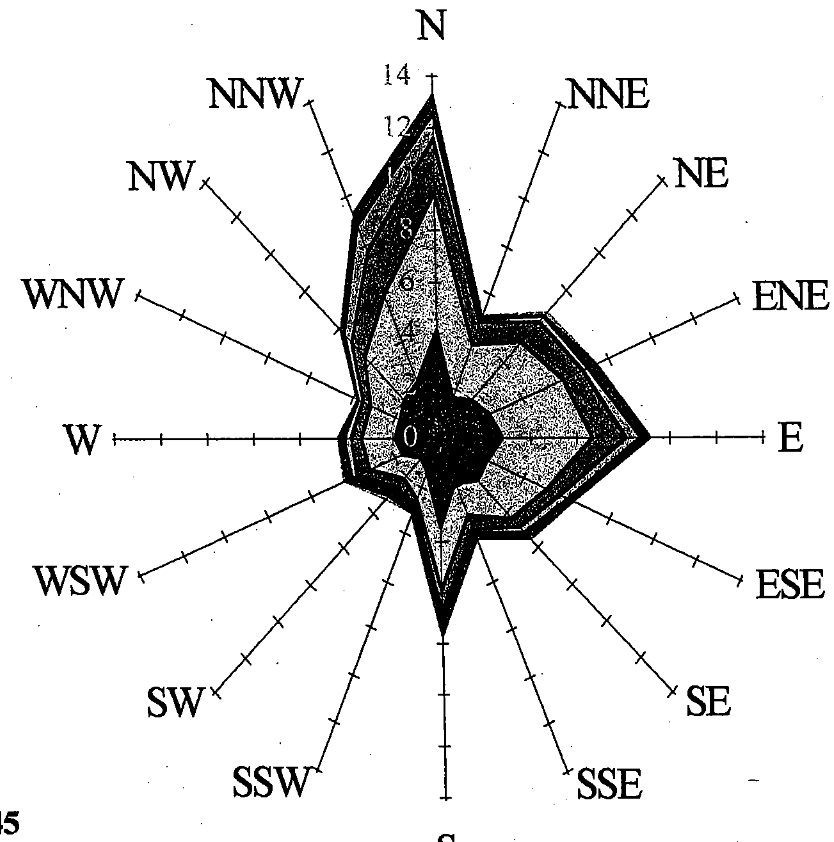
St Paul Island, AK

POR: 1973-1999

Latitude 57.09N Longitude 170.13W

Elevation 13Ft

May Wind Summary



Percent Frequency Calm Winds: 1.45

Labels of Percent Frequency on North Axis

> 55kts 48-55kts 41-47kts 34-40kts 28-33kts 22-27kts 17-21kts 11-16kts 7-10kts 1-6kts

Figure A-6.6

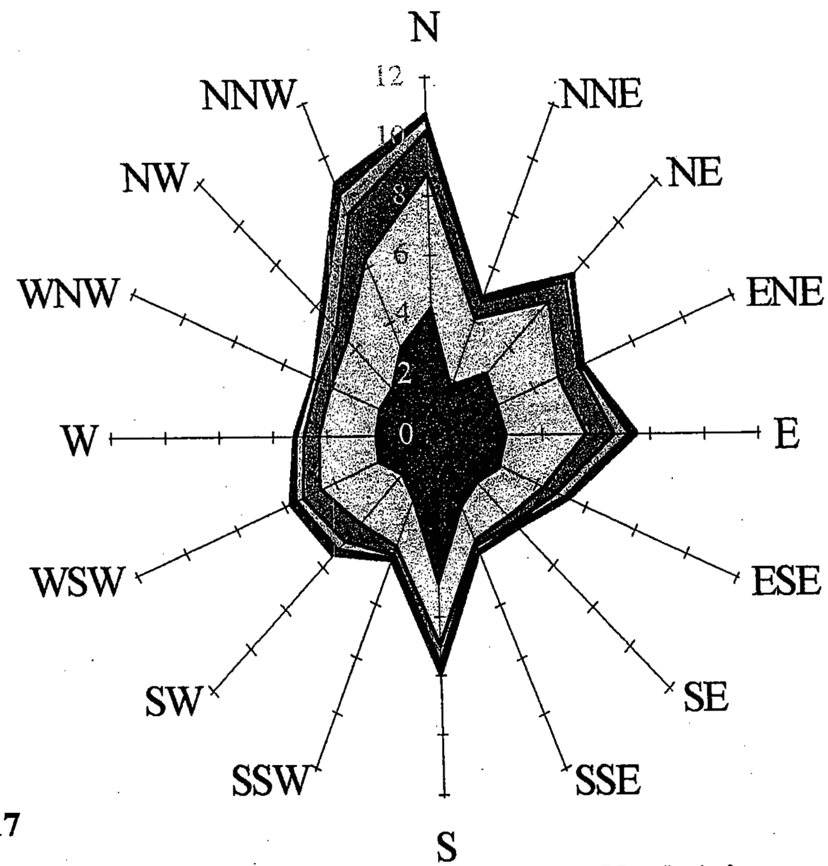
POR: 1973-1999

St Paul Island, AK

Latitude 57.09N Longitude 170.13W

Elevation 13Ft

June Wind Summary



Percent Frequency Calm Winds: 1.17

Labels of Percent Frequency on North Axis

> 55kts 48-55kts 41-47kts 34-40kts 28-33kts 22-27kts 17-21kts 11-16kts 7-10kts 1-6kts

Figure A-6.7

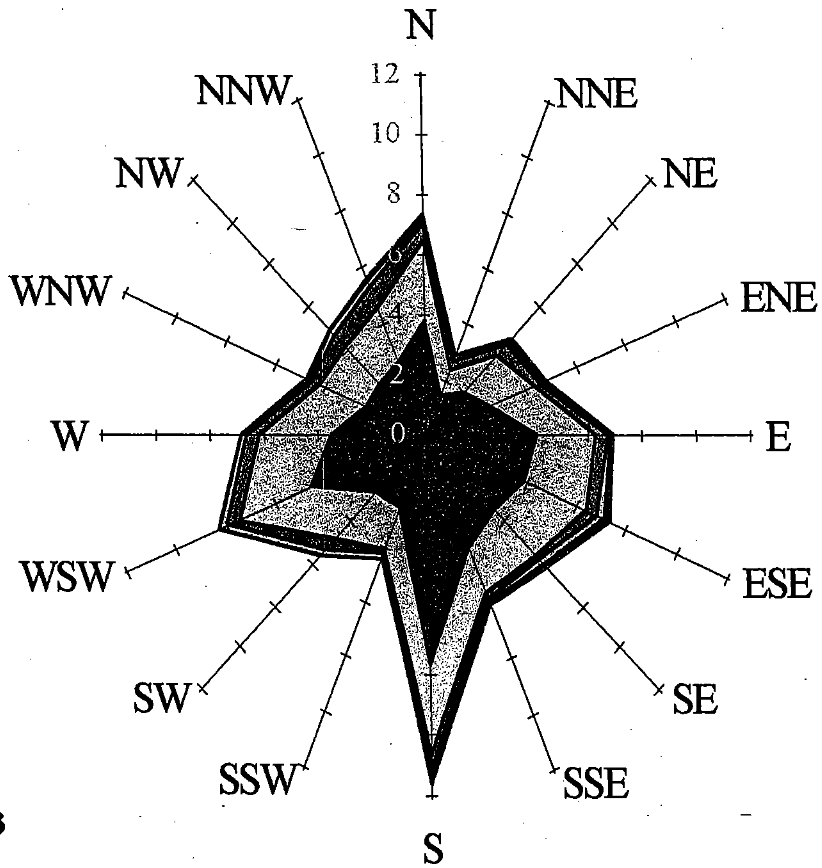
St Paul Island, AK

POR: 1973-1999

Latitude 57.09N Longitude 170.13W

Elevation 13Ft

July Wind Summary



Percent Frequency Calm Winds: 2.33

Labels of Percent Frequency on North Axis

> 55kts | 48-55kts | 41-47kts | 34-40kts | 28-33kts | 22-27kts | 17-21kts | 11-16kts | 7-10kts | 1-6kts

Figure A-6.8

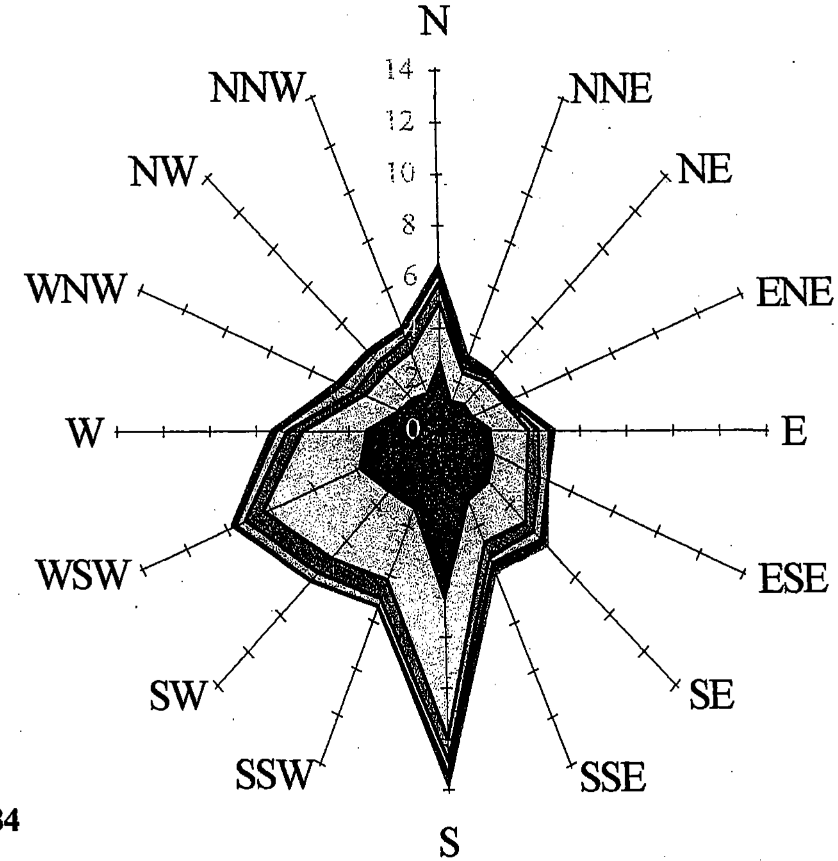
POR: 1973-1999

St Paul Island, AK

Latitude 57.09N Longitude 170.13W

Elevation 13Ft

August Wind Summary



Percent Frequency Calm Winds: 2.84

Labels of Percent Frequency on North Axis

> 55kts 48-55kts 41-47kts 34-40kts 28-33kts 22-27kts 17-21kts 11-16kts 7-10kts 1-6kts

Figure A-6.9

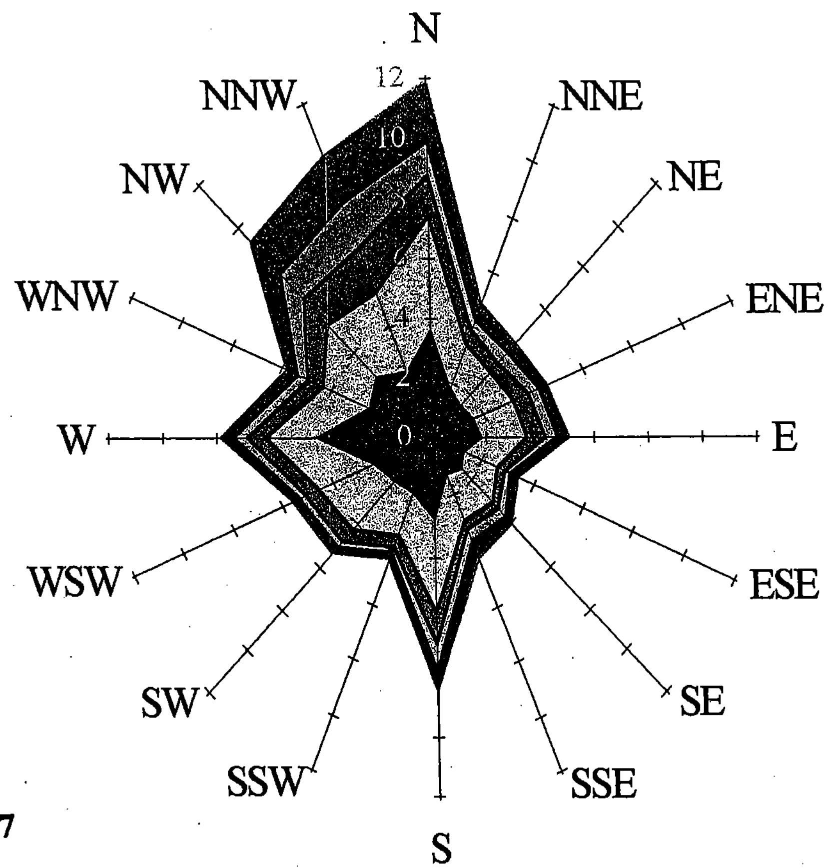
St Paul Island, AK

POR: 1973-1999

Latitude 57.09N Longitude 170.13W

Elevation 13Ft

September Wind Summary



Percent Frequency Calm Winds: 1.27

Labels of Percent Frequency on North Axis

> 55kts | 48-55kts | 41-47kts | 34-40kts | 28-33kts | 22-27kts | 17-21kts | 11-16kts | 7-10kts | 1-6kts

Figure A-6.10

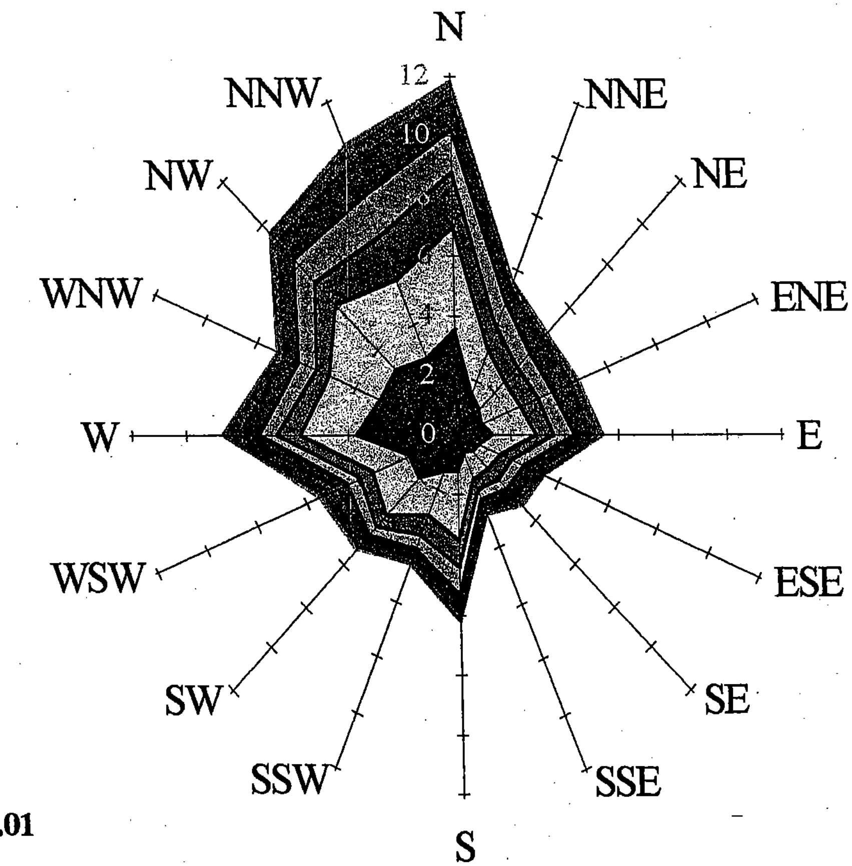
POR: 1973-1999

St Paul Island, AK

Latitude 57.09N Longitude 170.13W

Elevation 13Ft

October Wind Summary



Percent Frequency Calm Winds: 1.01

Labels of Percent Frequency on North Axis

> 55kts 48-55kts 41-47kts 34-40kts 28-33kts 22-27kts 17-21kts 11-16kts 7-10kts 1-6kts

Figure A-6.11

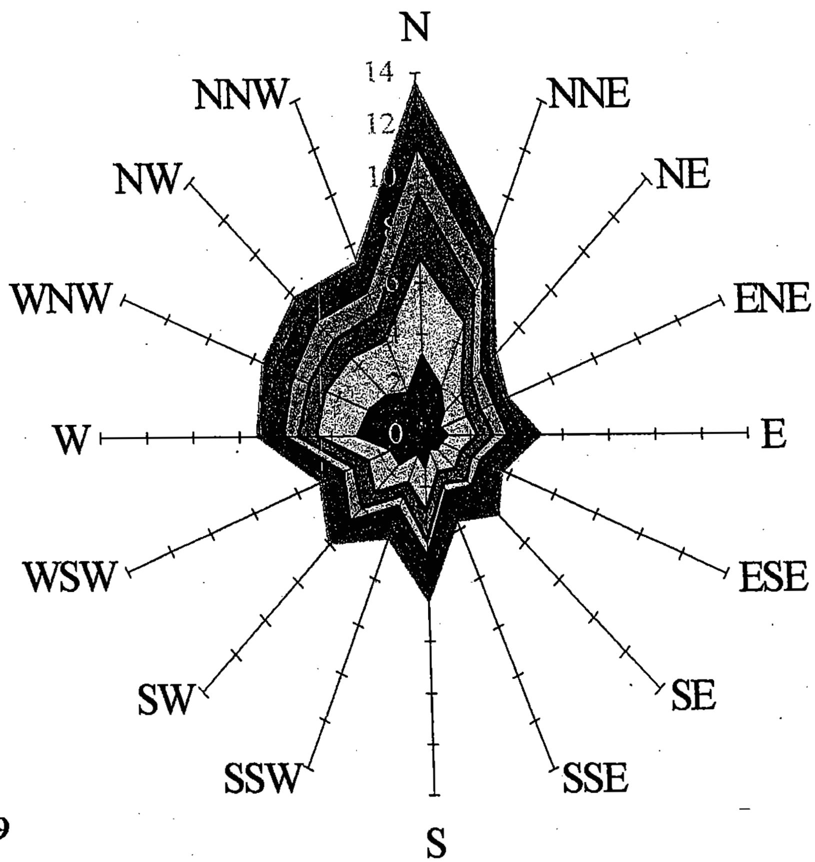
St Paul Island, AK

POR: 1973-1999

Latitude 57.09N Longitude 170.13W

Elevation 13Ft

November Wind Summary



Percent Frequency Calm Winds: 1.49

Labels of Percent Frequency on North Axis

>55kts 48-55kts 41-47kts 34-40kts 28-33kts 22-27kts 17-21kts 11-16kts 7-10kts 1-6kts

Figure A-6.12

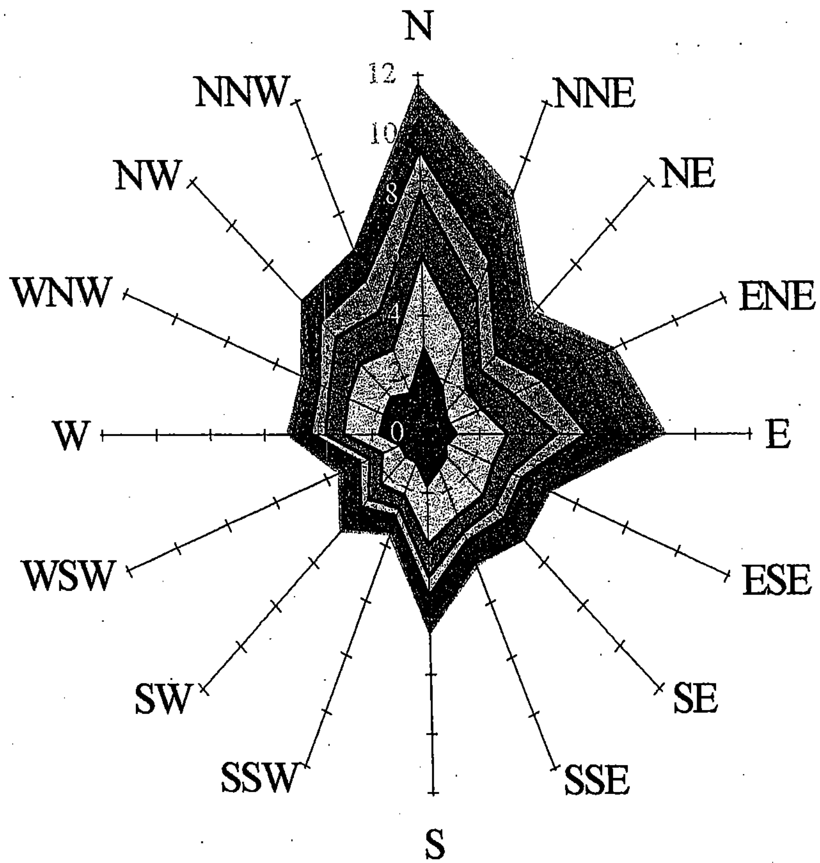
St Paul Island, AK

POR: 1973-1999

Latitude 57.09N Longitude 170.13W

Elevation 13Ft

December Wind Summary



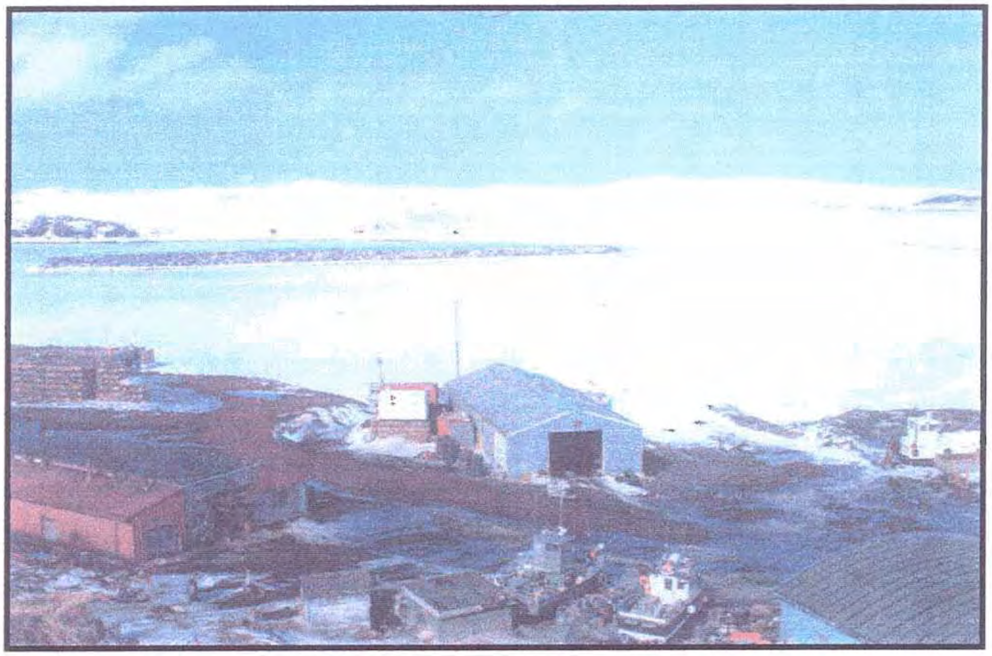
Percent Frequency Calm Winds: 2

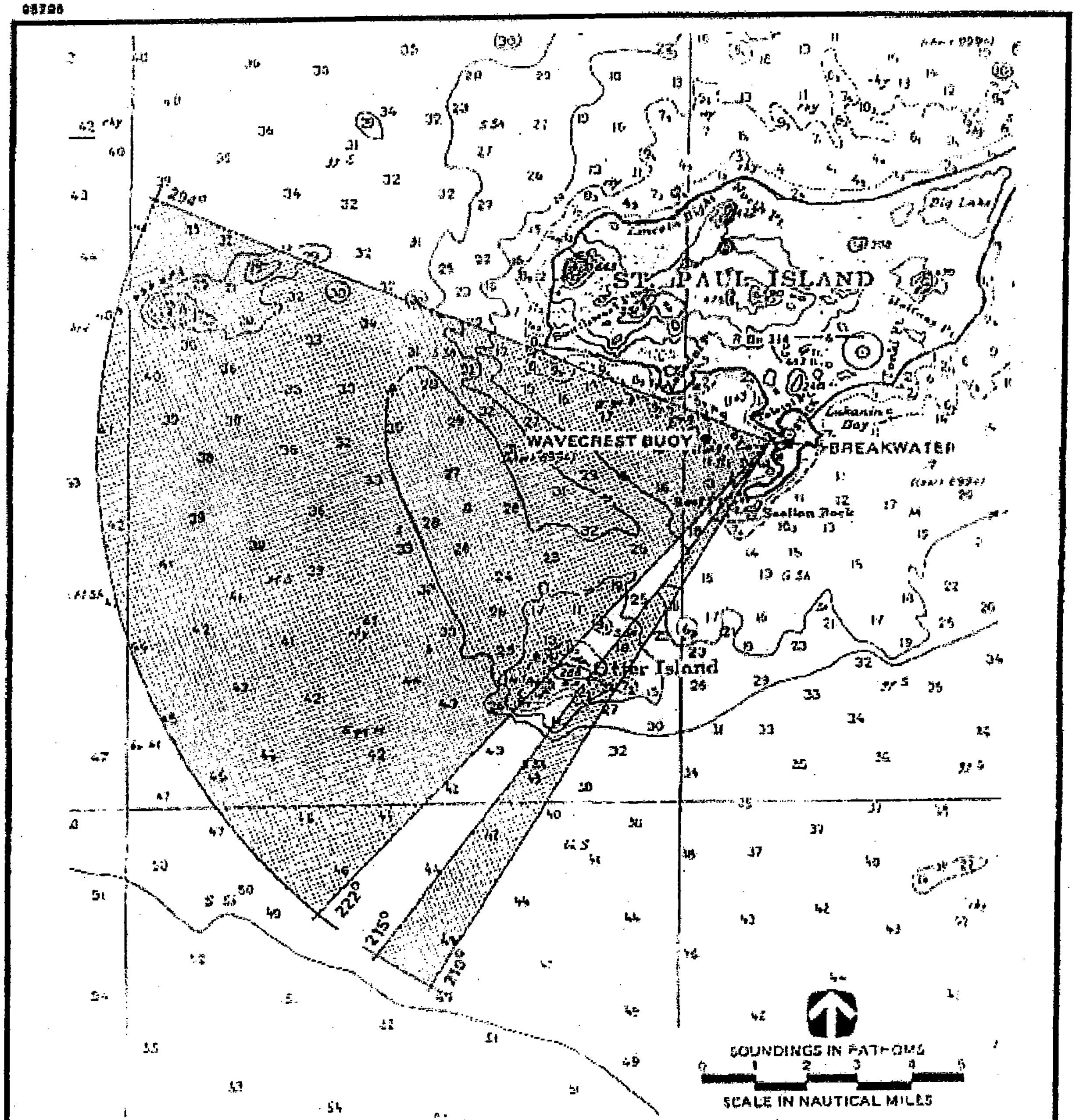
Labels of Percent Frequency on North Axis

>55kts 48-55kts 41-47kts 34-40kts 28-33kts 22-27kts 17-21kts 11-16kts 7-10kts 1-6kts

Figure A-6.13

Figure A-7: St. Paul Harbor Sea Ice





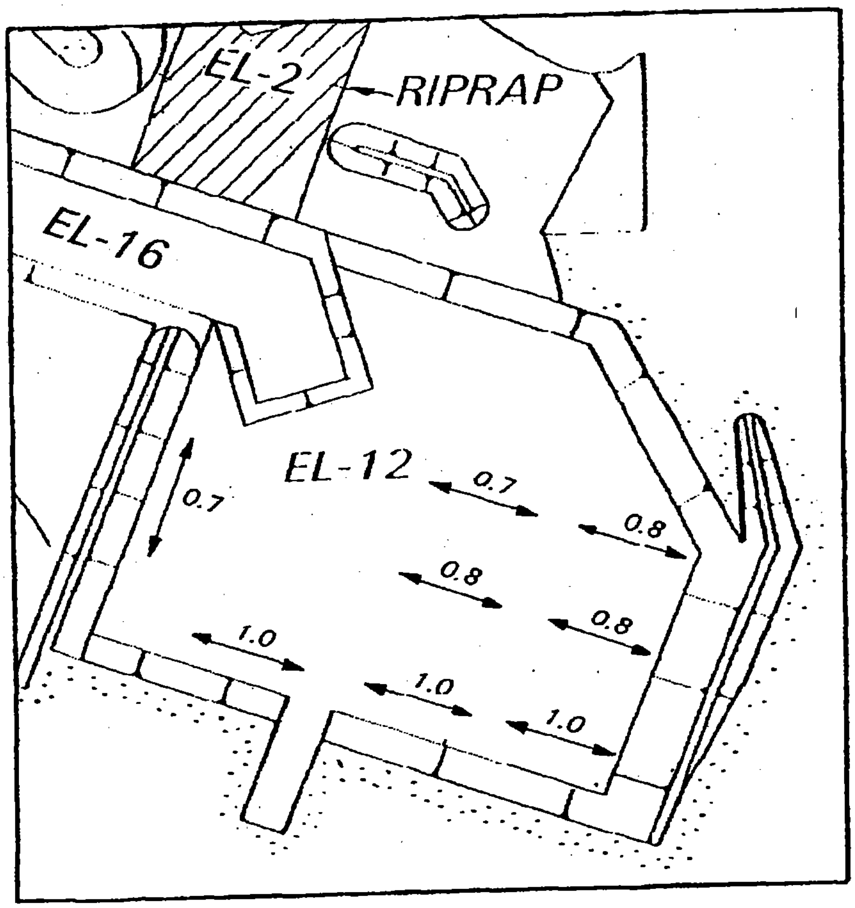
WAVE EXPOSURE WINDOWS

FROM TETRA TECH FEB. 1987 ST. PAUL HARBOR REPORT.

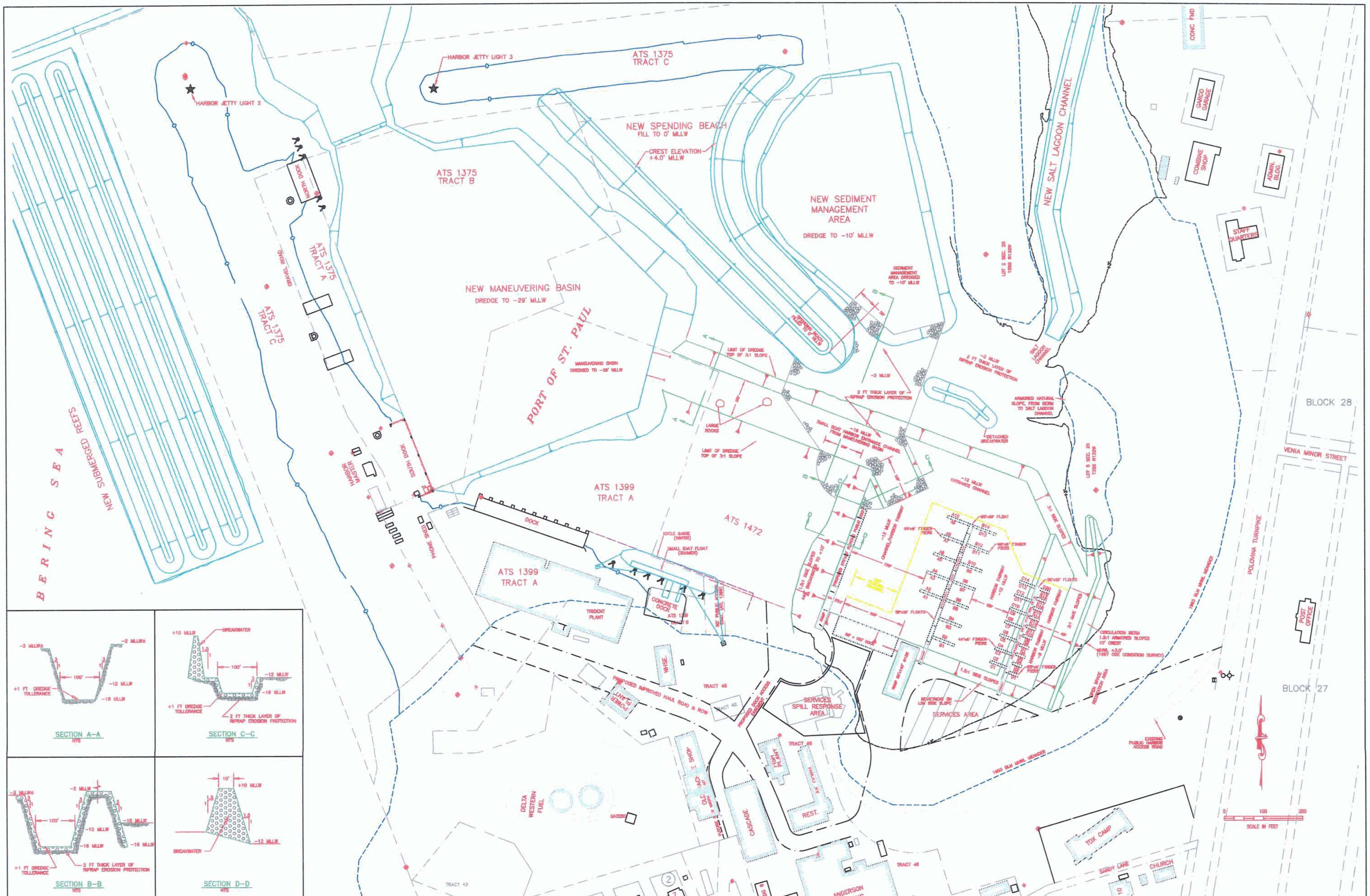
US Army Corps of Engineers
Alaska District

SAINT PAUL ISLAND HARBOR

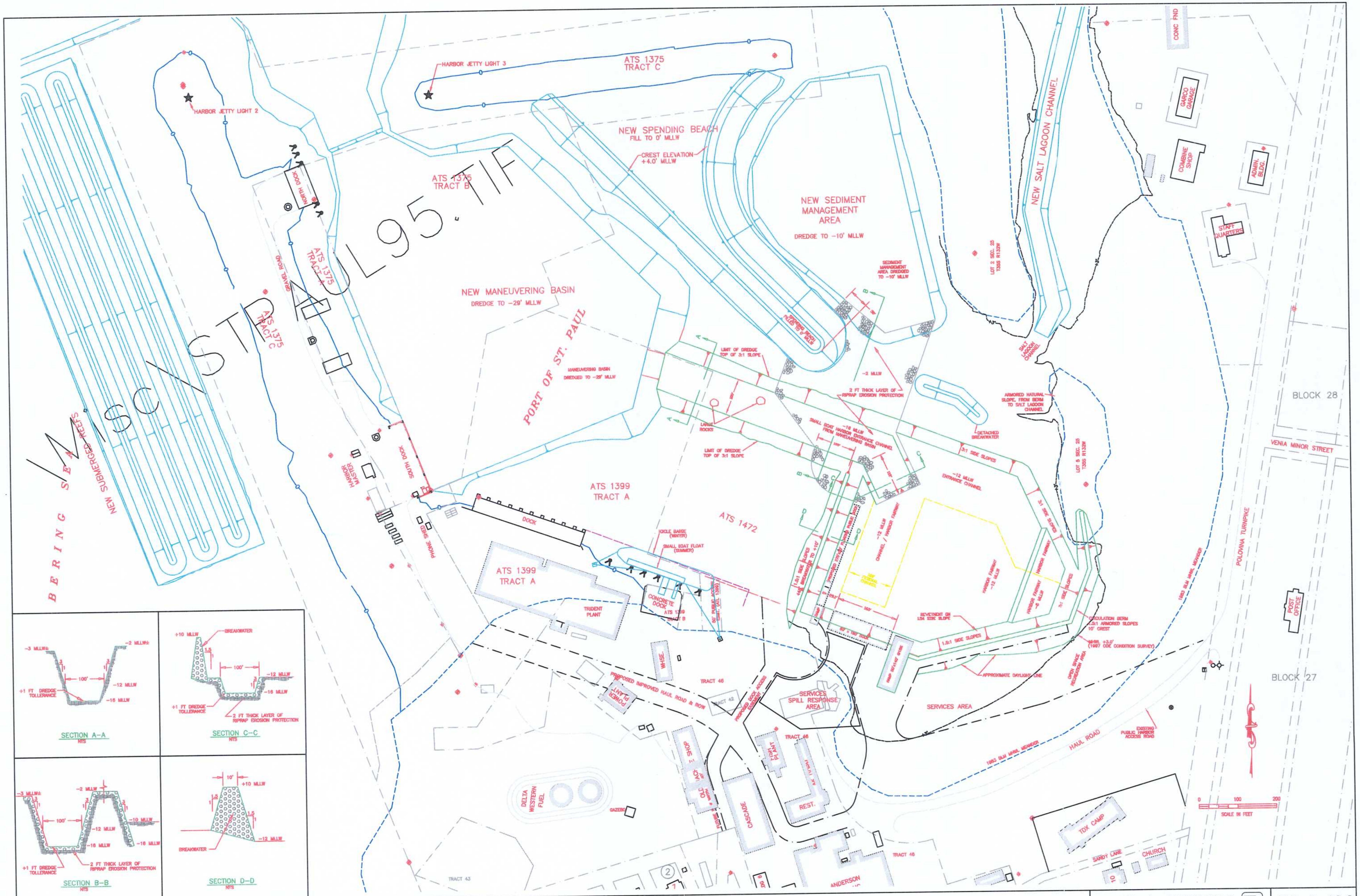
Figure A-8



Current directions and maximun velocities (prototype feet per second) associated with harbor seiche for 60-vessel configuration



JANUARY 30, 2001	ST. PAUL 60 VESSEL SMALL BOAT HARBOR – TDX/IRA SUGGESTED LAYOUT #1 – ENTRANCE CHANNEL DREDGED TO –12 TO –16 FEET	OLIVER & ASSOCIATES	FIG. A–10.1



JANUARY 30, 2001

ST. PAUL 30 VESSEL SMALL BOAT HARBOR – TDX/IRA SUGGESTED LAYOUT #2 – ENTRANCE CHANNEL DREDGED TO –12 TO –16 FEET

OLIVER & ASSOCIATES

FIG. A–10.2

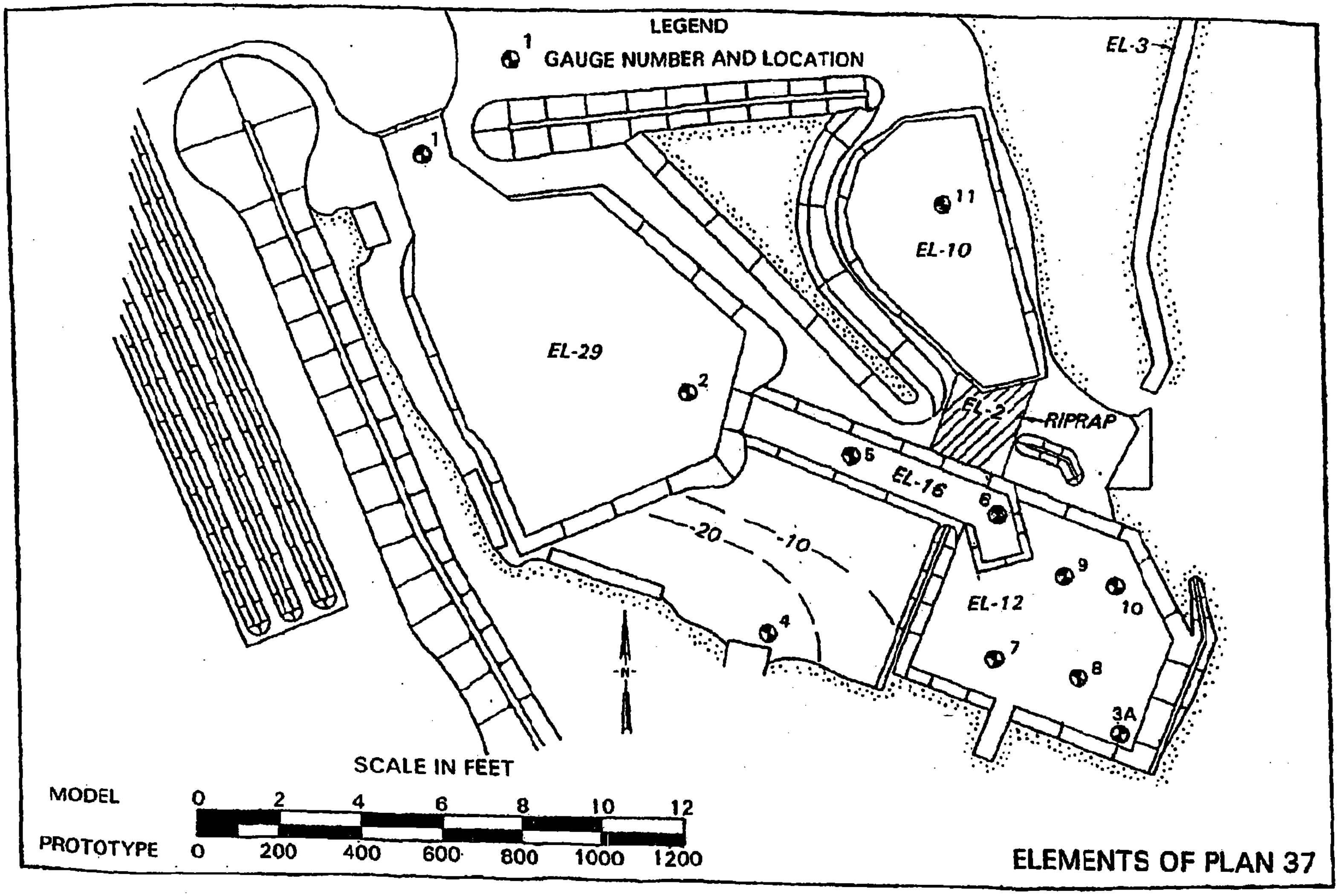
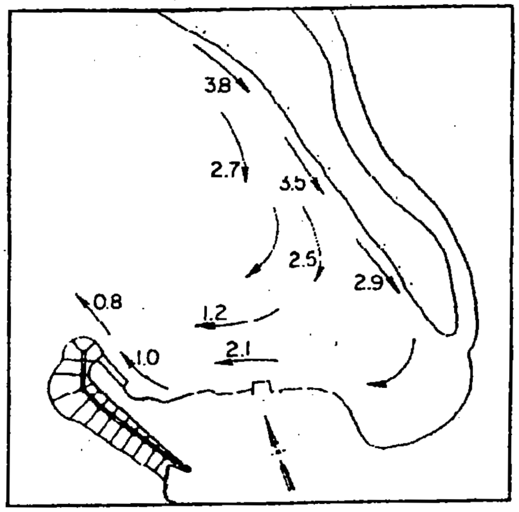
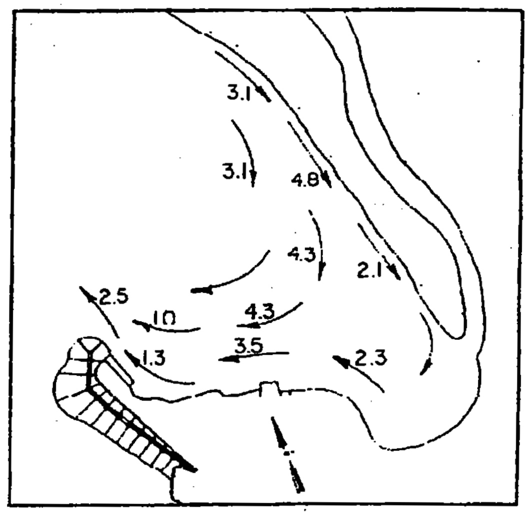

LEGEND
1 GAUGE NUMBER AND LOCATION
EL-3
EL-10
EL-29
EL-2
RIPRAP
EL-16
EL-12
-20
-10
N
1
2
3A
4
5
6
7
8
9
10
11
SCALE IN FEET
MODEL 0 2 4 6 8 10 12
PROTOTYPE 0 200 400 600 800 1000 1200
ELEMENTS OF PLAN 37

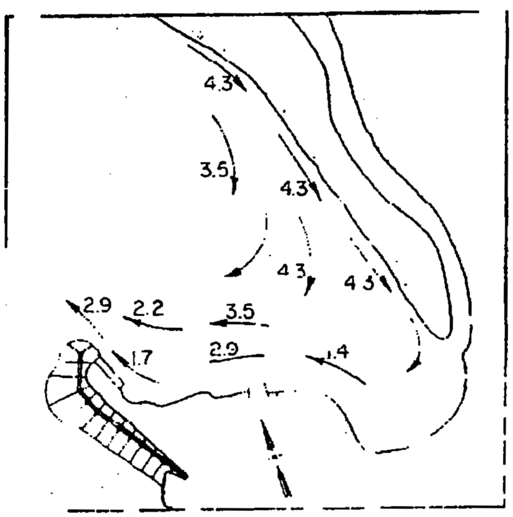
Figure A-11



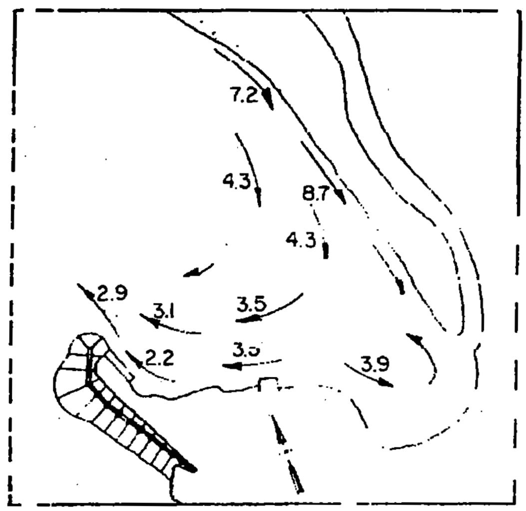
a. 8-sec, 7-ft test waves



b. 10-sec, 13-ft test waves



c. 14-sec, 16-ft test waves



d. 16-sec, 19-ft test waves

Figure 10. Typical current patterns and magnitudes (prototype feet per second) for existing conditions for test waves from west-northwest; swl 3.2 ft

Figure A-12

MISCELLANEOUS PAPER ERDC/CHL-01-

DESIGN FOR SMALL-BOAT HARBOR IMPROVEMENTS AND TIDAL FLUSHING AT ST. PAUL HARBOR, ST. PAUL ISLAND, ALASKA

Coastal Model Investigation

by

Robert R. Bottin, Jr., Hugh F. Acuff

DEPARTMENT OF THE ARMY
Engineer Research and Development Center, Corps of Engineers
3909 Halls Ferry Road, Vicksburg, Mississippi 39180-6199

February 2001

Draft Report

Prepared for US Army Engineer District, Alaska
Anchorage, Alaska 99506-0898

PREFACE

A request for a model investigation to study harbor modifications at St. Paul Harbor, St. Paul Island, Alaska, was initiated by the US Army Engineer District, Alaska, (CEPOA) in a letter to the US Army Engineer Division, Pacific Ocean (CEPOD). Authorization for the US Army Engineer Research and Development Center (ERDC), Coastal and Hydraulics Laboratory (CHL), to perform the study was subsequently granted by Headquarters, US Army Corps of Engineers (HQUSACE). Funds were provided by CEPOA in December 2000.

Model experiments were conducted at ERDC during January 2001 by personnel of the Harbors and Entrances Branch (HEB), CHL, under the direction of Messrs. Thomas W. Richardson and Thomas J. Pokrefke, Jr., Acting Director and Acting Assistant Director of CHL, respectively; and under direct supervision of Mr. Dennis G. Markle, Chief of HEB. Model experiments were conducted by Messrs. Hugh F. Acuff and Glenn B. Myrick, Larry R. Tolliver, and MS Kristi L. Evans, Civil Engineering Technicians, and Mr. William G. Henderson, Computer Assistant, under the supervision of Mr. Robert R. Bottin, Jr., Research Physical Scientist. This report was prepared by Messrs. Bottin and Acuff.

Messrs. Ken Eisses and Alan Jeffries were technical points of contact for CEPOA. The following personnel visited ERDC to observe and participate in model operations during the study.

Mr. Ken Eisses	CEPOA
Mr. Alan Jeffries	CEPOA
Mr. John Burns	CEPOA
Mr. John Oliver	Consultant, CEPOA

Initial results for the model were reported in Technical Report CERC-96-7, "Study of Harbor Improvements at St. Paul Harbor, St. Paul Island, Alaska," dated September 1996, and results for the initial reactivation of the study were reported in Miscellaneous Paper CHL-97-7, "Study for Flushing of Salt Lagoon and Small-Boat Harbor Improvements at St. Paul Harbor, St.

Paul Island, Alaska," dated August 1997. Results for the reactivated model finalizing the design of small-boat harbor improvements and flushing at St. Paul Harbor are reported herein.

Dr. James R. Houston was Director of ERDC during model operation and the preparation and publication of this report. COL James S. Weller, EN, was Commander.

CONTENTS

CONVERSION FACTORS, NON-SI TO SI (METRIC) UNITS OF MEASUREMENT

Non-SI units of measurement used in this report can be converted to SI (metric) units as follows:

Multiply	By	To Obtain
acres	4046.873	square meters
cubic feet per second	0.02831685	cubic meters per second
cubic yards	0.7646	cubic meters
degrees (angle)	0.01745329	radians
feet	0.3048	meters
feet per second	0.3048	meters per second
inches	2.54	centimeters
knots (international)	1.8532	kilometers per hour
miles (US statute)	1.609347	kilometers
miles per hour	1.609347	kilometers per hour
pounds (mass)	0.4536	kilograms
pounds (mass) per cubic feet	16.02	kilograms per cubic meter
square feet	0.09290304	square meters
square miles (US statute)	2.589988	square kilometers
tons (2,000 lb, mass)	907.1848	kilograms

DESIGN FOR SMALL-BOAT HARBOR IMPROVEMENTS AND TIDAL FLUSHING AT ST. PAUL HARBOR ST. PAUL ISLAND, ALASKA

Coastal Model Investigation

PART I: INTRODUCTION

Prototype

1. St. Paul Island is the northernmost and largest island of the Pribilofs in the eastern Bering Sea (Figure 1) with a land area of 114 sq km (44 sq mi)[1]. The Pribilofs are of volcanic origin, and St. Paul Island is composed predominantly of volcanic materials in the form of lava

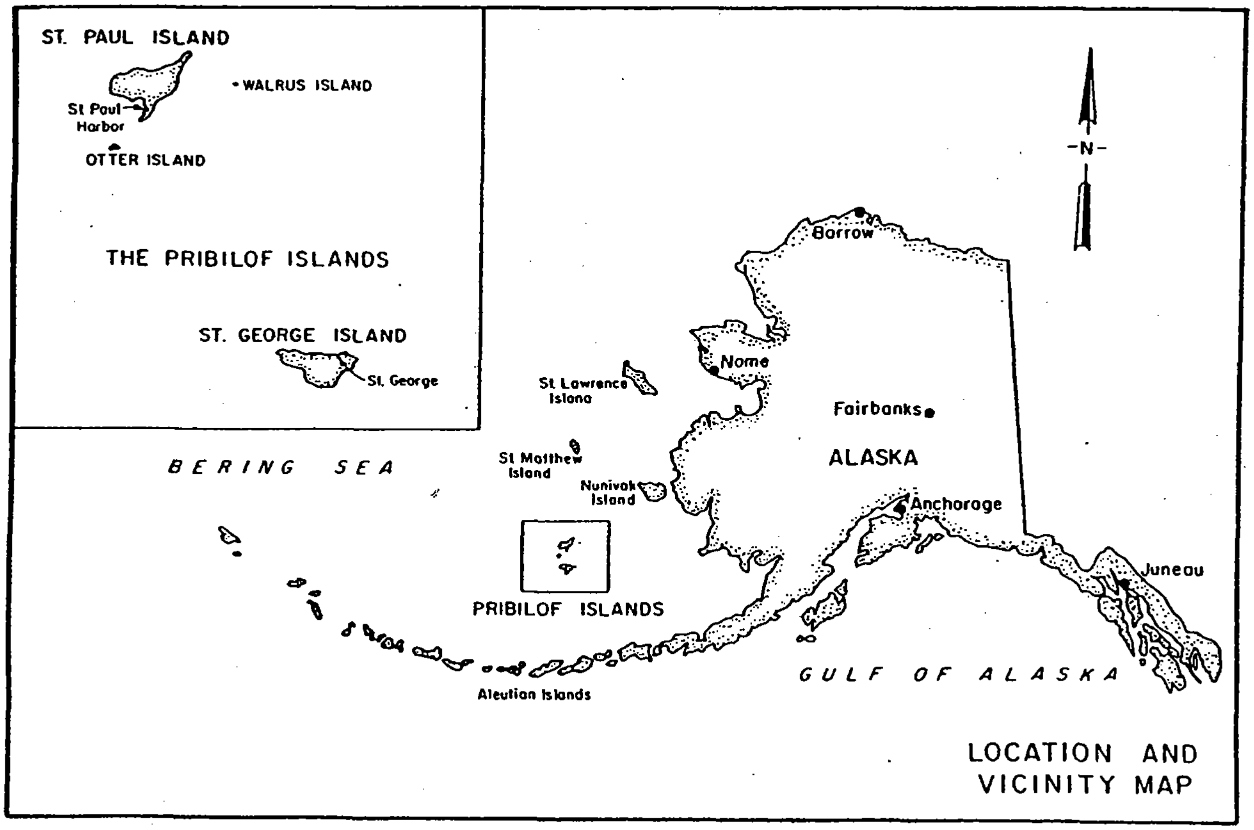


Figure 1. Project location

[1]Units of measurement in this report are shown in SI (metric) units, followed by non-SI (British) units in parenthesis. In addition, a table of factors for converting Non-SI units of measurement used in figures, plates, and tables in this report to SI units is presented on page 4.

flows and loose cinders with sandy deposits. The west and southwest portions of the island are relatively high and mountainous with precipitous cliffs along the coast. The remainder of the island is relatively low and rolling with a number of extinct volcanic peaks scattered throughout. Only two of the Pribilof Islands are populated, St. Paul with about 800 people and St. George with approximately 300 residents. Two-thirds of the St. Paul population is Alaska Native.

2. The Pribilof Islands support large populations of birds, mammals, fish, and invertebrates. The Pribilofs are the primary breeding ground for northern fur seals where approximately two-thirds of the world's population (1.3 to 1.4 million) migrate annually (US Army Engineer District, Alaska (CEPOA 1981). More than a quarter million seabirds nest on St. Paul Island each year, mainly along the coastal cliffs. The uplands are inhabited by song birds, white and blue foxes, and a transplanted herd of approximately 250 reindeer. The island is treeless and covered with grasses, sedges, and wildflowers. The eastern Bering Sea near St. Paul supports populations of shrimp, commercially harvestable species of crab, and bottom fish.

3. The city of St. Paul is located on a cove on the southern tip of the island and is the island's only settlement. The islands were originally settled by the Russians to harvest fur seals. The treaty for the purchase of Alaska from Russia by the United States in 1867 placed the Pribilofs under United States control. The National Marine Fisheries Service (NMFS) and its predecessor Federal agencies were responsible for the fur seal industry in the Pribilofs since 1911, managing the harvest according to a series of international agreements between the United States, Canada, Japan, and the Soviet Union. In 1983, the harvest of fur seals was discontinued due to a seal harvest moratorium. The NMFS terminated administration, management, and employment at St. Paul. This event had a significant adverse impact on the economy, and the standard of living could not be maintained. At that time the village had no other economic base, no harbor infrastructure, inadequate and unpermitted utilities, overcrowded housing, high unemployment, and limited air and vessel transportation. Development of a harbor, and associated marine related industries, fulfilled the need for new sources of employment and income on the island.

Harbor Development

4. A breakwater was constructed at St. Paul in Village Cove during 1983, but subsequently failed during storms of 1984. A new breakwater was designed and constructed by Tetra Tech, Inc., consultants to the City of St. Paul (Tetra Tech, Inc. 1987). The structure was 229 m (750 ft) in length and functioned well, in regard to stability, during the 1985 and 1986 winter seasons. A 61-m-long (200-ft-long), vertical-wall dock was installed in the lee of the breakwater in 1986 to accommodate fishing vessels. The breakwater, however, was not of sufficient length to provide wave protection to vessels using the dock, particularly during storm events.

5. In 1989, construction of the current harbor configuration was completed. A layout of the harbor is shown in Figure 2. It consisted of a 549-m-long (1,800-ft-long) main breakwater, a 296-m-long (970-ft-long) detached breakwater, and space for 274 m (900 ft) of docks on the lee side of the main breakwater. The main breakwater, generally, follows the -7.6-m (-25-ft)[2] contour in Village Cove and results in a harbor with 32,375 to 40,470 sq m (8 to 10 acres) of area and water depths of 5.5 to 7.6 m (18 to 25 ft) on the lee side of the breakwater. The center line of the detached breakwater makes an interior angle of 75 deg with the main structure at sta 17+00, and provides a 91-m-wide (300-ft-wide) harbor entrance. A 61-m-wide (200-ft-wide) opening between the eastern end of the detached breakwater and the shore is maintained to enhance harbor circulation. An aerial photograph of the existing St. Paul Harbor is shown in Figure 3.

6. The main breakwater has a design crest elevation (el) of +11.3 m (+37 ft) from sta 7+50 to a point approximately 15.2 m (50 ft) north of the northernmost dock. The remaining portion of the structure has a crest el of +9.1 m (+30 ft). Armor stone used on the breakwater trunk was 16,330 kg (18 ton), and 21,770 kg (24 ton) armor stone was used on the head. The slope of the trunk is 1V:2H with a 1V:2.5H slope around the breakwater head. Special placement

[2] All contours and elevations cited herein are in meters (feet) referred to mean lower low water (mllw) unless otherwise noted.

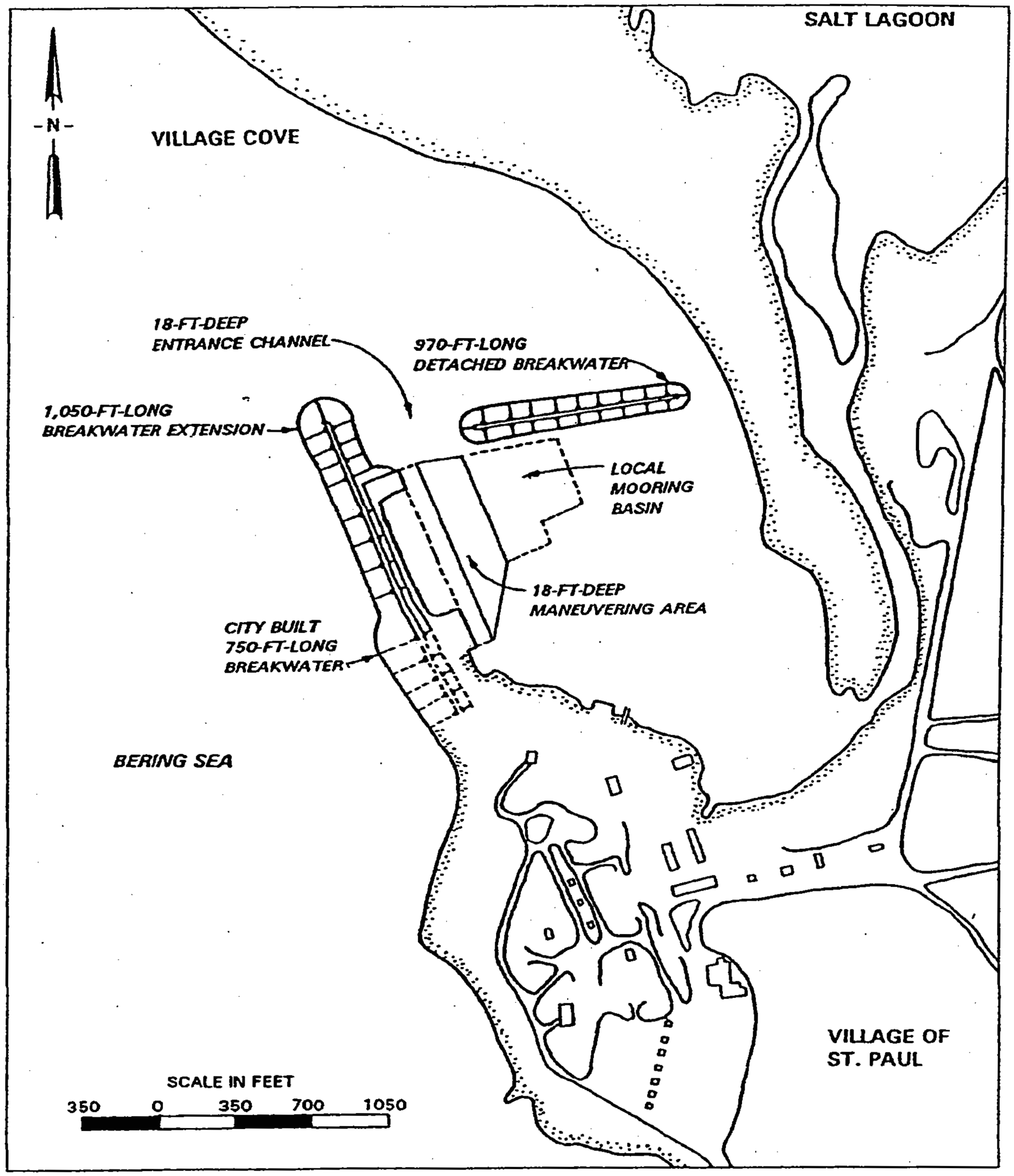


Figure 2. Layout of St. Paul Harbor

of the armor stone was specified in the contract documents which required orientation of the long axis of each stone normal to the breakwater slope. A roadway was constructed on the lee side of the main breakwater adjacent to the proposed docks. The detached breakwater has a crest el of +5.5 m (+18 ft) with 4,535 kg (5 ton) armor stone placed on a slope

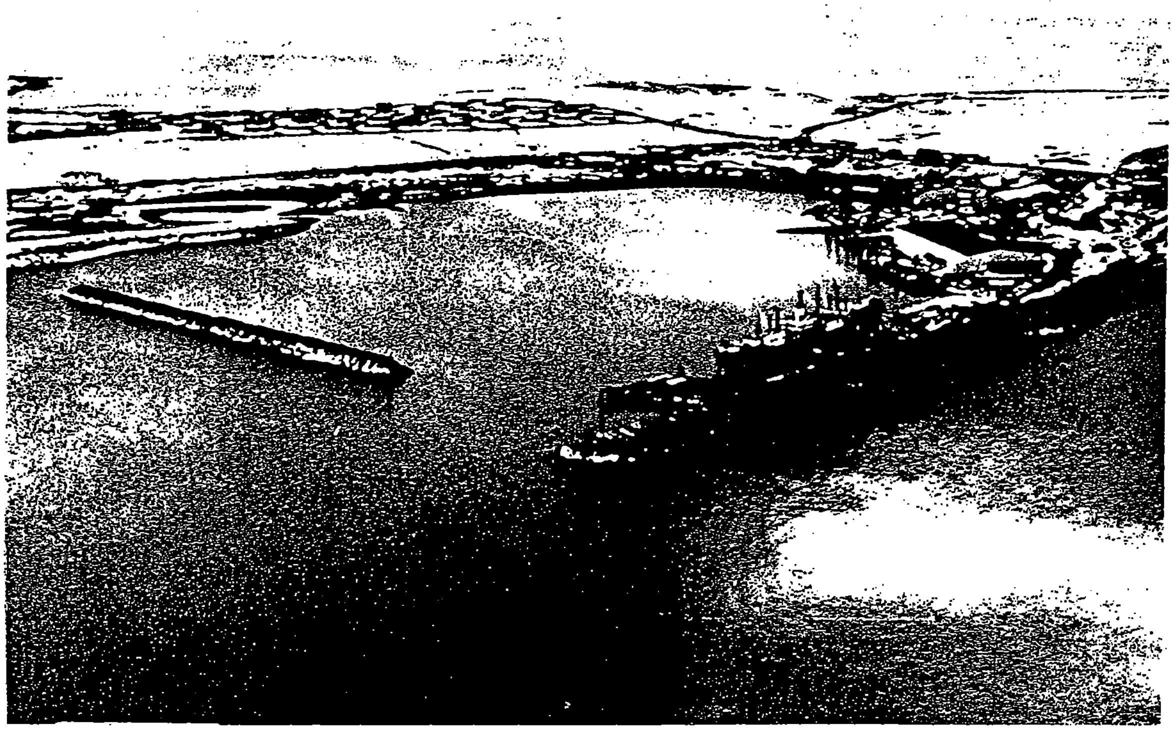


Figure 3. Aerial view of St. Paul Harbor

of 1V:1.5H. Prior to construction of the 1989 improvements, both two-dimensional (Ward 1988) and three-dimensional (Bottin and Mize 1988) hydraulic model investigations were conducted at the U.S. Army Engineer Research and Development Center (ERDC) to optimize structural and functional design of the harbor.

7. After construction of the harbor in 1989, it experienced a rapid growth cycle and quickly became overcrowded. In the mid 1990s, St. Paul Harbor served a fleet of 230 transient vessels during the crabbing season. A total of 27 floating processors were located within a 4.8-km (3-mi) limit of the harbor. In addition, three processing plants had permanently located within the harbor complex (CEPOA 1995). Subsequent to harbor construction, significant overtopping of the main breakwater had been experienced during the winter seasons. Overtopping may have been caused by larger than design storm waves and/or still water levels or possible settlement and consolidation of the breakwater stone. Overtopping caused the roadway in the lee of the breakwater to wash out, and repairs were required frequently during the storm season.

Due to these problems and needs, the harbor was again studied at ERDC in 1996. The feasibility of deepening the entrance channel and dredging a deeper and larger maneuvering basin was proposed to relieve the congestion in the harbor. In addition, a submerged reef breakwater concept was studied as a means of reducing wave overtopping of and wave transmission through the main breakwater. Two- and three-dimensional model investigations wer conducted by Ward (1996) and Bottin (1996), respectively, to optimize reef breakwater cross sections and layout as well as wave and current conditions in the harbor.

8. Construction of three parallel, submerged reef breakwaters seaward of the main breakwater was initiated during the 2000 construction season. The reef structures were constructed with 455- to 3,630-kg (1,000- to 8,000-lb) stone at an el of -3.7 m (-12 ft) with side slopes of 1V:1.5H. They were 380 m (1,250 ft) in length. The shoreward crest of the innermost reef was 52 m (170 ft) from the toe of the existing main breakwater. The crest widths of the reefs were 21.3 m (70 ft) apart. The reefs were placed on bedding stone that ranged from 9 to 225 kg (20 to 500 lb). A layout of the reef breakwaters is shown in Figure 4. In addition, the contract included that a total of 25 selected armor stones be placed in voids that had occurred in the main breakwater due to displacement as a result of storms. In June 2000 these armor stones were placed on the breakwater along the water line between stas 8+80 and 9+70. Also included in the contract was the placement of 75 selected armor stones in damaged areas of the detached breakwater at St. Paul Harbor. Offshore reef construction was only partially completed during the 2000 season, and final construction will be completed during the summer of 2001.

Previously Reported Model Experiments and Conclusions

9. The St. Paul Harbor model was constructed initially to investigate the feasibility of deepening the entrance channel and dredging a deeper and larger maneuvering basin to relieve the current congestion. The impacts of proposed harbor improvements on wave conditions, wave-induced current patterns and magnitudes, and sediment patterns and subsequent deposits in the harbor were studied. In addition, the impacts of a proposed submerged reef breakwater were investigated relative to wave-induced current patterns and magnitudes and sediment tracer patterns

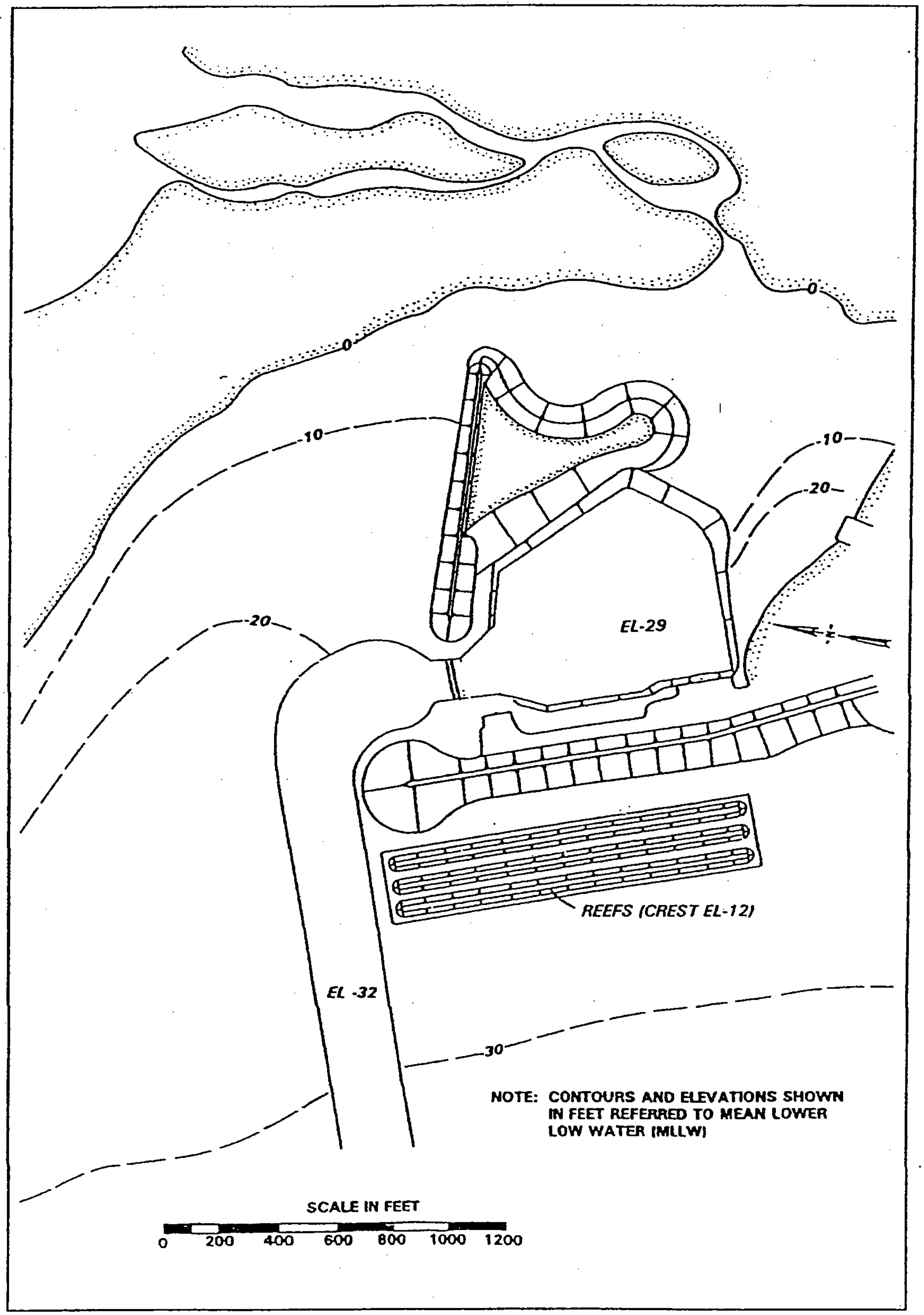


Figure 4. Layout of submerged reef breakwaters

and subsequent deposits seaward of the main breakwater. Details of the investigation were published (Bottin 1996), and conclusions derived from results of those experiments are shown below. Plan numbers refer to those in the initial investigation.

a. During periods of severe storm wave activity with high tide conditions, wave heights in the existing harbor will exceed 1.7 m (5.5 ft) along the dock in the lee of the main breakwater and 0.8 m (2.5 ft) at the TDX dock.

b. For existing conditions, currents enter the harbor through the opening at the shoreward end of the detached breakwater and move in a clockwise direction exiting through the entrance. Maximum velocities along the shoreline inside the harbor will exceed 2.5 mps (8 fps). Currents also move seaward along the seaside of the detached breakwater across the harbor entrance.

c. For existing conditions, sediment moves southerly along the boulder spit and enters the harbor through the opening at the shoreward end of the detached breakwater. Sediment also moves westerly along the seaside of the detached breakwater toward the harbor entrance.

d. Experimental results obtained for the initial submerged reefs (Plans 1 and 2) indicated the structures would have no adverse impact on current patterns and magnitudes or sediment tracer patterns and deposits seaward of the main breakwater.

e. An extension of the initial submerged reefs northerly by 122 m (400 ft) in length (Plan 4) will decrease wave heights in the approach and entrance channels and result in improved navigation conditions.

f. A 15.2 m (50 ft) reduction in the length of the submerged reefs (from 396 to 381 m (1,300 to 1,250 ft)) on their southern end (Plan 9) will not increase wave conditions in the harbor.

g. Experimental results for the deepened channel and maneuvering area and the 381-m-long (1,250-ft-long) submerged reefs of Plan 10 indicated that wave heights would increase at the TDX dock and the inner harbor area when compared to existing conditions.

h. Installation of the wave-dissipating spending beach in the harbor (Plan 11) with the deepened channel and maneuvering area and the 381-m-long (1,250-ft-long) submerged reefs will result in reduced wave conditions. Wave heights throughout the harbor will be significantly less than those obtained for existing conditions.

i. Installation of Plan 10 (deepened channel and maneuvering area and the 381-m-long (1,250-ft-long) submerged reefs) or Plan 11 (addition of the wave-dissipating spending beach) will have no adverse impact on current patterns and magnitudes and/or sediment patterns and subsequent deposits in the vicinity of the harbor.

j. The 120-m-long (400-ft-long) breakwater spur of Plan 12 will have no adverse impact on wave or current conditions in the harbor. It will, however, redirect sediment movement and subsequent deposits from the entrance channel to the northerly edge of the channel, and thus, reduce the potential for shoaling.

10. The St. Paul Harbor model was reactivated to determine the impacts of proposed small-boat harbor modifications on wave conditions, current patterns and magnitudes, and sediment movement patterns and subsequent deposits within the complex. In addition, experiments were conducted to study both wave-induced and tidal flushing of the Salt Lagoon. Details of this investigation were published (Bottin and Acuff 1997), and conclusions derived from results of those experiments are shown below. Plan numbering began where they ended in the initial study.

a. Preliminary experiments (Plans 13-18) revealed that all improvement plans would result in wave heights of less than 0.3 m (1.0 ft) in the small-boat mooring areas.

b. Preliminary experiments indicated that with the originally proposed plans, sediment deposits would occur in the small-boat navigation channel. A breakwater extending southeasterly from the wave-dissipating spending beach, or an extension of the spending beach, however, would prevent shoaling of the channel.

c. Preliminary experiments revealed that the location of the north breakwater was critical with respect to diverting tidal currents from the lagoon connecting channel toward the harbor basin and providing circulation.

d. Of the improvement plans investigated with the wave energy channel connected to Salt Lagoon north of the harbor, the 61-m-wide (200-ft-wide), +0.9-m (+3.0-ft) el channel of Plan 21 was optimum with respect to those configurations.

e. The improvement plan configurations of Plans 24 and 25 (26-vessel and 52-vessel basins, respectively) will provide adequate wave protection, shoaling protection, and harbor circulation for the new small-boat harbor.

f. Improvements in shoaling and circulation conditions for the existing harbor will be obtained with the installation of the sediment deposition basin, the southeasterly extension of the wave-dissipating spending beach, and the north breakwater (Plan 26).

Purpose of the Current Investigation

11. At the request of the US Army Engineer District, Alaska (CEPOA), the hydraulic model of St. Paul Harbor was reactivated by the US Army Engineer Research and Development Center (ERDC) to finalize the design of proposed small-boat harbor modifications based on wave conditions and current patterns and magnitudes within the complex. Long-period seiche conditions within the harbor were also evaluated. In addition, experiments were conducted to study tidal flushing of the harbor and Salt Lagoon. An expedited testing program was performed with a minimum number of experimental conditions.

PART II: THE MODEL

Design of Model

12. The St. Paul Harbor model (Figure 5) was constructed to an undistorted linear scale of 1:100, model to prototype. Scale selection was based on the following factors:

a. Depth of water required in the model to prevent excessive bottom friction.

b. Absolute size of model waves.

c. Available shelter dimensions and area required for model construction.

d. Efficiency of model operation.

e. Available wave-generating and wave-measuring equipment.

f. Model construction costs.

A geometrically undistorted model was necessary to ensure accurate reproduction of wave and current patterns. Following selection of the linear scale, the model was designed and operated in accordance with Froude's model law (Stevens, et al., 1942). The scale relations used for design and operation of the model were as follows:

Characteristic	Model-Prototype Dimension*	Scale Relations
Length	L	$L_r = 1:100$
Area	L^2	$A_r = L_r^2 = 1:10,000$
Volume	L^3	$\forall_r = L_r^3 = 1:1,000,000$
Time	T	$T_r = L_r^{1/2} = 1:10$
Velocity	L/T	$V_r = L_r^{1/2} = 1:10$

* Dimensions are in terms of length (L) and time (T).

13. The existing breakwaters at St. Paul Harbor are rubble-mound structures. Experience and experimental research have shown that considerable wave energy passes through the interstices of this type structure; thus, the transmission and absorption of wave energy became a matter of concern in the design of 1:100-scale model. In small-scale hydraulic models,

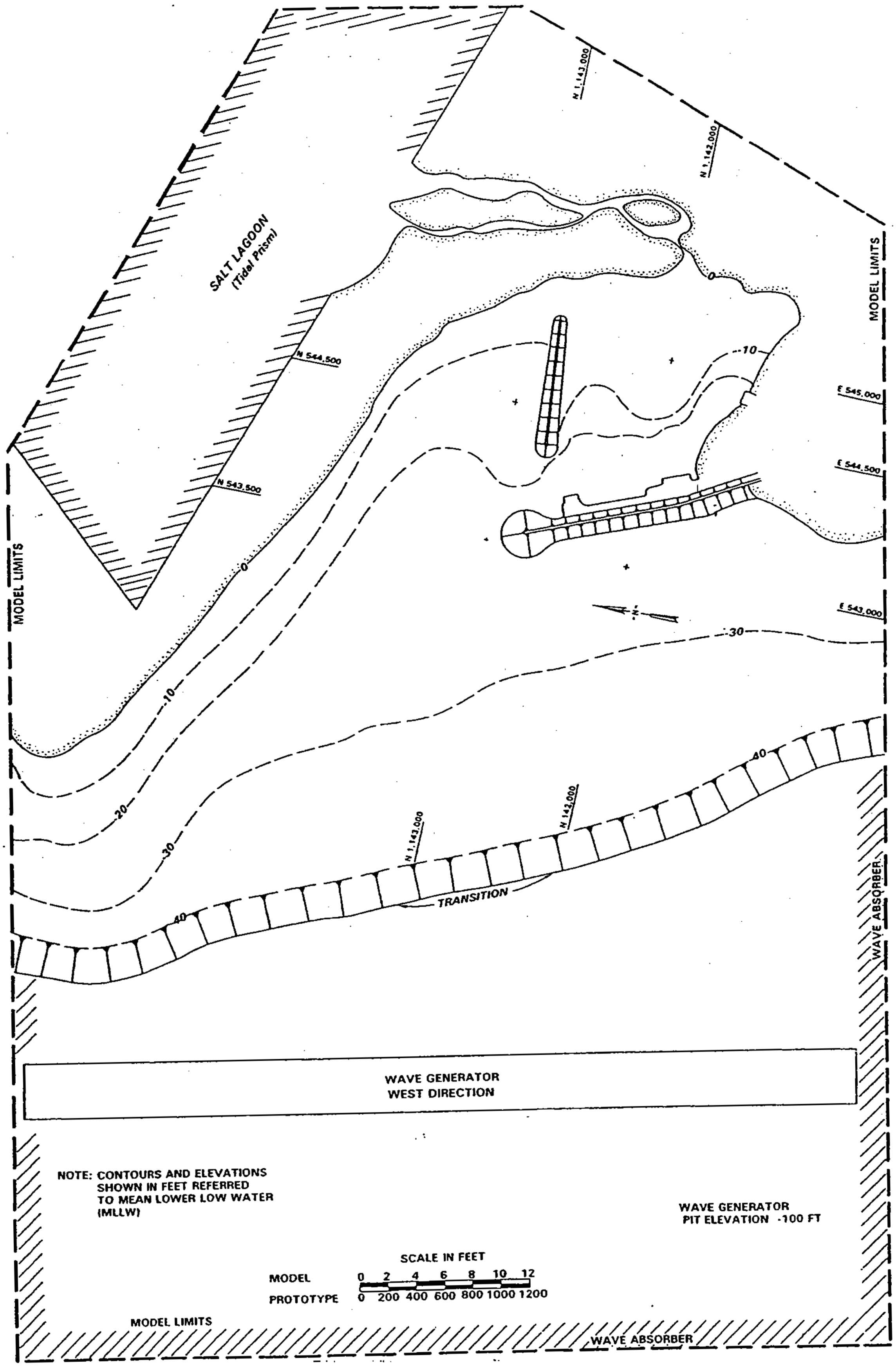


Figure 5. Model layout

rubble-mound structures reflect relatively more and absorb or dissipate relatively less wave energy than geometrically similar prototype structures (LeMehaute 1965). Also, the transmission of wave energy through a rubble-mound structure is relatively less for the small-scale model than for the prototype. Consequently, some adjustment in small-scale model rubble-mound structures is needed to ensure satisfactory reproduction of wave-reflection and wave-transmission characteristics. In past investigations (Dai and Jackson 1966, Brasfeild and Ball 1967) at WES, this adjustment was made by determining wave-energy transmission characteristics of the proposed structure in a two-dimensional model using a scale large enough to ensure negligible scale effects. A cross section then was developed for the small-scale, three-dimensional model that would provide essentially the same relative transmission and reflection of wave energy. Therefore, from previous findings for structures and wave conditions similar to those at St. Paul Harbor, it was determined that a close approximation of the correct wave-energy transmission and reflection characteristics could be obtained by increasing the size of the rock used in the 1:100-scale model to approximately two times that required for geometric similarity. Accordingly, in constructing the rubble-mound structures in the St. Paul Harbor model, rock sizes were computed linearly by scale, then multiplied by 2 to determine the actual sizes to be used in the model.

Model and Appurtenances

14. The model reproduced approximately 2,865 m (9,400 ft) of the St. Paul Island shoreline (from Tolsti Point easterly and then southerly to a point south of the existing breakwater trunk), the existing harbor, and underwater topography in the Bering Sea to an offshore depth of 12.2 m (40 ft) with a sloping transition to the wave generation pit elevation of -30.5 m (-100 ft). A small connecting channel to a salt lagoon (located east of the harbor) also was included in the model as well as the tidal prism of the salt lagoon. The total area reproduced in the model was approximately 605 sq m (6,500 sq ft), representing about 6 sq km (2.3 sq mi) in the prototype. Vertical control for model construction was based on mean lower low water (mllw), and horizontal control was referenced to a local prototype grid system. A general view of the model is shown in Figure 6.

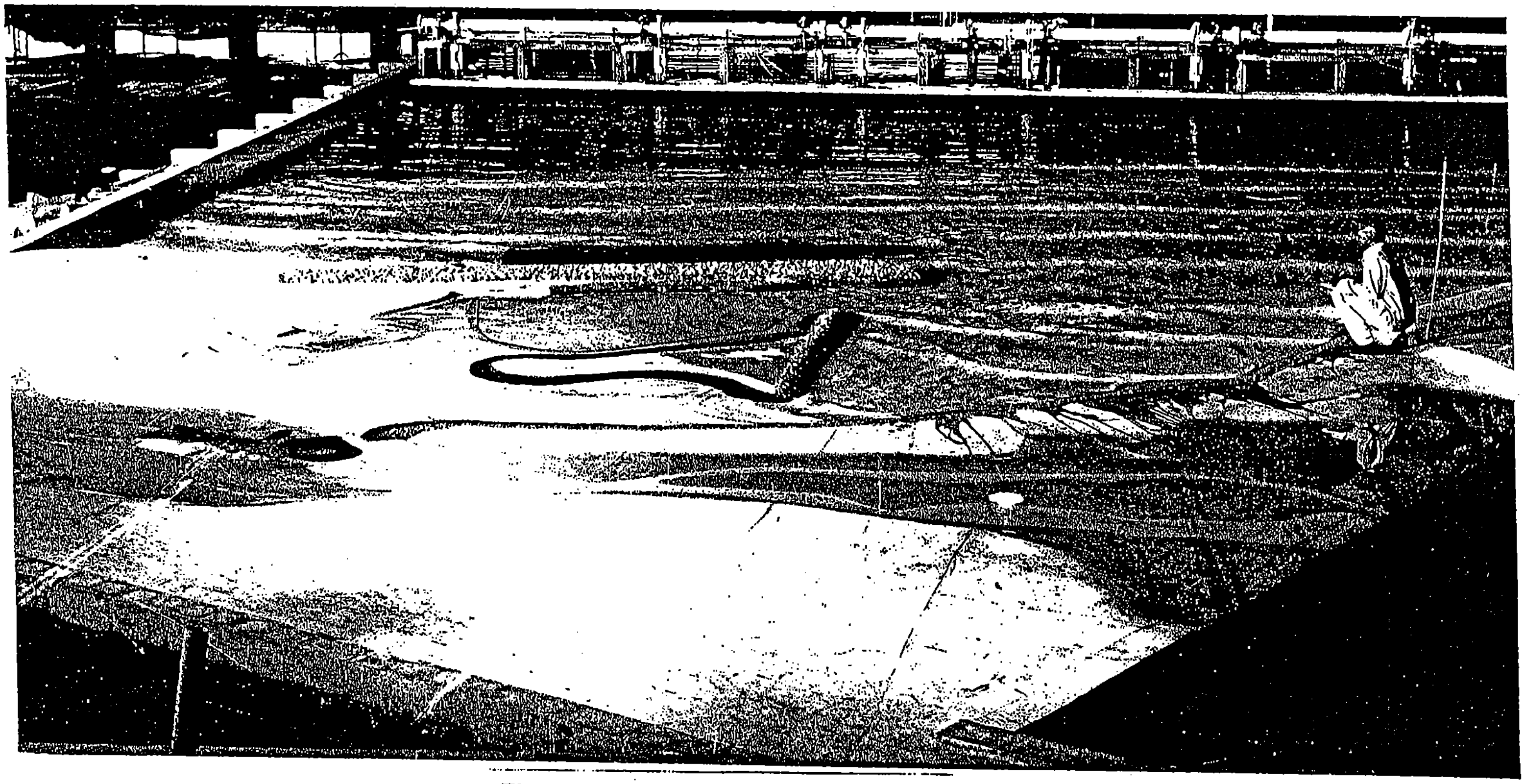


Figure 6. General view of model

15. Model waves were reproduced by an 18.3-m-long (60-ft-long), electrohydraulic, unidirectional, spectral wave generator with a trapezoidal-shaped plunger. The vertical motion of the plunger was controlled by a computer-generated command signal, and movement of the plunger caused a displacement of water which generated required test waves.

16. An Automated Data Acquisition and Control System, designed and constructed at WES, was used to generate and transmit wave generator control signals, monitor wave generator feedback, and secure and analyze wave data at selected locations in the model. Through the use of a microvax computer, the electrical output of parallel-wire, capacitance-type wave gauges, which varied with the change in water-surface elevation with respect to time, were recorded on magnetic disks. These data then were analyzed to obtain the parametric wave data.

17. A 0.6-m (2-ft) (horizontal) solid layer of fiber wave absorber was placed along the inside perimeter of the model to dampen wave energy that might otherwise be reflected from the model walls. In addition, guide vanes were placed along the wave generator sides in the flat pit area to ensure proper formation of the wave train incident to the model contours.

18. The St. Paul Harbor model facility did not include calibrated tidal reproduction facilities. These facilities require an enormous amount of time and funds to prepare. Since time and funds were limited, model tides were reproduced simply by raising (filling the basin) or lowering (draining the basin) the water level. The water level was raised and lowered linearly over the appropriate tidal period (36 min in the model which equates to 6 hr in the prototype).

PART III: EXPERIMENTAL CONDITIONS AND PROCEDURES

Selection of Experimental Conditions

Still-water level

19. Still-water levels (swl's) for wave action models are selected so that various wave-induced phenomena that are dependent on water depths are accurately reproduced in the model. These phenomena include refraction of waves in the project area, overtopping of harbor structures by waves, reflection of wave energy from various structures, and transmission of wave energy through porous structures.

20. In most cases, it is desirable to select a model swl that closely approximates the higher water stages which normally occur in the prototype for the following reasons:

a. The maximum amount of wave energy reaching a coastal area normally occurs during the higher water phase of the local tidal cycle.

b. Most storms moving onshore are characteristically accompanied by a higher water level due to wind, tide and storm surge.

c. The selection of a high swl helps minimize model scale effects due to viscous bottom friction.

d. When a high swl is selected, a model investigation tends to yield more conservative results.

21. Swl's of +1.0, +1.5, and +2.1 m (+3.2, +5.0, and +7.0 ft) were selected by CEPOA for use during the initial experiments with the St. Paul model. Only the +1.0 and +2.1 m (+3.2 and +7.0 ft swl's, however, were used during the reactivated experimental series. The lower value (+1.0 m (+3.2 ft)) represents mean higher high water (mhhw). The higher value (+2.1 m (+7.0 ft)) was an extreme estimate based on observations made in the prototype during storm wave conditions.

Factors influencing selection
of experimental wave characteristics

22. In planning the experimental program for a model investigation of harbor wave-action problems, it is necessary to select heights, periods, and directions for the test waves that will allow a realistic test of the proposed improvement plans and an accurate evaluation of the elements of the various proposals. Surface-wind waves are generated primarily by the interactions between tangential stresses of wind flowing over water, resonance between the water surface and atmospheric turbulence, and interactions between individual wave components. The height and period of the maximum significant wave that can be generated by a given storm depend on the wind speed, the length of time that wind of a given speed continues to blow, and the distance over water (fetch) which the wind blows. Selection of experimental wave conditions entails evaluation of such factors as:

a. Fetch and decay distances (the latter being the distance over which waves travel after leaving the generating area) for various directions from which waves can approach the problem area.

b. Frequency of occurrence and duration of storm winds from the different directions.

c. Alignment, size, and relative geographic position of the navigation structures.

d. Alignments, lengths, and locations of the various reflecting surfaces in the area.

e. Refraction of waves caused by differentials in depth in the area seaward of the site, which may create either a concentration or a diffusion of wave energy.

Wave refraction

23. When waves move into water of gradually decreasing depth, transformations take place in all wave characteristics except wave period (to the first order of approximation). The most important transformations with respect to selection of experimental wave characteristics are the changes in wave height and direction of travel due to the phenomenon referred to as wave refraction. During a previous model investigation (Bottin and Mize 1988), the change in wave height and direction at St. Paul Harbor was determined by using the numerical Regional Coastal

Processes Wave Transformation Model (RCPWAVE) developed by Ebersole (1985). During the previous study, model experiments were conducted for five wave directions. For the current series, however, waves from only the west (259 deg) direction were used. The west direction was the most critical with respect to wave heights, wave-induced current patterns and magnitudes, and sediment tracer patterns at the harbor.

Prototype wave data and selection of experimental waves

24. Measured prototype data covering a sufficiently long duration from which to base a comprehensive statistical analysis of wave conditions were unavailable for the St. Paul Harbor area. However, in the previous model investigation (Bottin and Mize 1988), statistical deepwater wave hindcast data representative of this area were obtained from the CERC Wave Information Studies (WIS). Additional information on WIS may be obtained from Corson (1985). After a review of the data from the previous study, and due to limited time and funds for the current investigation, NPA selected the following waves for use in the current experimental series:

Period, sec	Height, m (ft)
8	3.0 (10)
10	3.0 (10)
16	4.4 (14.4)
	5.8 (19)
20	4.3 (14)
25	1.5 (5)
	3.0 (10)

25. Unidirectional wave spectra were generated based on Joint North Sea Wave Project (JONSWAP) parameters for the selected waves and used throughout the model investigation. Selected waves were defined as significant wave height, the average height of the highest one-third of the waves or H_s. In deepwater, H_s is very similar to H_{mo} (energy based wave) where $H_{mo} = 4 (E)^{1/2}$, and E equals total energy in the spectra, which is

obtained by integrating the energy density spectra over the frequency range.

Analysis of Model Data

26. Relative merits of the various plans were evaluated by:

a. Comparison of short-period wave heights and long-period wave heights (seiches) at selected locations in the model.

b. Comparison of wave-induced current patterns and magnitudes.

c. Comparison of tidal flows.

d. Visual observations.

In the wave-height data analysis, the average height of the highest one-third of the waves (H_s), recorded at each gauge location, was computed. All wave heights then were adjusted by application of Keulegan's equation* to compensate for excessive model wave height attenuation due to viscous bottom friction. From this equation, reduction of model wave heights (relative to the prototype) can be calculated as a function of water depth, width of wave front, wave period, water viscosity, and distance of wave travel and the model data can be corrected and converted to their prototype equivalents.

27. Recent acquisition of National Data Buoy Center data from the Bearing sea near St. Paul Harbor as well as information obtained from Monitoring Completed Navigation Projects at the harbor (Bottin and Eisses 1997) indicate that wave periods as great as 25 sec can occur at the site. Since longer period spectral waves often induce more severe surf beat, and the potential for seiches, previous studies were examined for seiche conditions. It was noted in reviewing earlier model experiments that long-period surges did occur in the harbor basin as a result of various frequencies in the spectral wave signals. Since oscillations

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* G. H. Keulegan, 1950, "The Gradual Damping of a Progressive Oscillatory Wave with Distance in a Prismatic Rectangular Channel," Unpublished data, National Bureau of Standards, Washington, DC, prepared at request of Director, WES, Vicksburg, MS, by Letter of 2 May 1950.

occurred, it was considered important to obtain long-period wave information. Therefore, wave data obtained was filtered, and both short-period storm wave conditions as well as long-period wave conditions were presented at the various gauge locations. In addition, wave-induced current velocities obtained in the model were the maximum that occurred during the wave spectra (usually occurring after a series of large waves in the wave signal and at long-period nodal points).

PART IV: EXPERIMENTS AND RESULTS

Experiments

28. Twelve study plans were evaluated during the initial portion of this investigation (Bottin 1996), and 15 plans were evaluated during the first reactivation of the model (Bottin and Acuff 1997). Therefore, plan numbering for this experimental series began with Plan number 28. A 9.8-m-deep (32-ft-deep) draft entrance channel, an 8.8-m-deep (29-ft-deep) maneuvering area, a 3-m-deep (10-ft-deep) sediment trap, a 0.9-m-deep (3-ft-deep) connecting channel from the harbor to the salt lagoon, and a wave-dissipating spending beach inside the harbor (el 0.0 m (0.0 ft) with a +1.2 m (+4 ft) berm along its perimeter) were developed in previous studies and remained in the model for all experiments. Proposed improvement plans for this experimental series consisted of dredging a new small-boat channel and boat basin as well as installation of a shore-connected breakwater and an interior detached breakwater (for diversion of currents from the salt lagoon) in the existing harbor. Modifications also were made to the existing shoreline and depths in the existing harbor. Wave heights and wave-induced current patterns and magnitudes were obtained for variations in the harbor that consisted of changes in shoreline configurations, depths and/or structure lengths and alignments. Experiments of tidal flushing were conducted for changes in the orientation of the interior detached breakwater and depths in the harbor. Study plans that consisted of shoreline and depth changes in the harbor were expeditiously constructed in the model using gravel to determine optimum layouts. Brief descriptions of the small-boat harbor improvement plans are presented in the following subparagraphs, and dimensional details are shown in Plates 1-10.

a. Plan 28 (Plate 1) consisted of the installation of a 3.7-m-deep, 30.5-m-wide (12-ft-deep, 100-ft-wide) interior channel and a 3.7-m-deep (12-ft-deep) boat basin. It also included a 107-m-long (350-ft-long) interior shore-connected breakwater and a 45.7-m-long (150-ft-long) interior detached breakwater (both at els of +3 m (+10 ft)). The boat basin was revetted along its south and east sides. Slopes were 1V:1.25H on the shore-connected breakwater and 1V:1.5H on the interior detached breakwater and revetments. This configuration represents a 60-vessel boat basin.

b. Plan 29 (Plate 2) included the elements of Plan 28 with the shoreline configuration changed east of the boat basin. The shoreline was moved 33.5 m (110 ft) easterly in an arc and the revetment slope was changed to 1V:5H.

c. Plan 30 (Plate 2) entailed the elements of Plan 29 but the berm along the perimeter of the wave-dissipating spending beach was raised to +2.4 m (+8 ft).

d. Plan 31 (Plate 3) involved the elements of Plan 28, but the shoreline configuration east of the boat basin was moved 24.4 m (80 ft) in an arc and the revetment slope was changed to 1V:10H. The +2.4 m (+8 ft) berm el along the perimeter of the wave-dissipating spending beach was included.

e. Plan 32 (Plate 3) consisted of the elements of Plan 28 but the interior detached breakwater was extended 36.6 m (120 ft) in length. The structure was extended westerly 15.3 m (50 ft) on its original alignment and then angled 21.3 m (70 ft) southwesterly toward the channel. It also included the +2.4 m (+8 ft) berm along the perimeter of the spending beach.

f. Plan 33 (Plate 4) involved the elements of Plan 28, but the slope of the revetment east of the boat basin was changed to 1V:3H.

g. Plan 34 (Plate 5) entailed the elements of Plan 33, but 7.6 m (25 ft) was removed from the western end of the interior detached breakwater resulting in a 38.1-m-long (125-ft-long) structure. In addition, the area between the spending beach and interior detached breakwater was deepened to -1.5 m (-5 ft).

h. Plan 35 (Plate 6) included the elements of Plan 33, but the area between the spending beach and the interior detached breakwater was deepened to -0.9 m (-3 ft) and hardened (capped) with riprap to an el of -0.6 m (-2 ft).

i. Plan 36 (Plate 7) involved the elements of Plan 35 but the eastern 15.2-m (50-ft) portion of the interior detached breakwater was reoriented 45 deg southeasterly toward the small-boat basin.

j. Plan 37 (Plate 8) entailed the elements of Plan 36 but the interior channel was deepened to -4.9 m (-16 ft).

k. Plan 38 (Plate 9) involved the elements of Plan 37 but the area of the small-boat basin was reduced. The southeastern portion of the basin was filled. This configuration represents a 30-vessel basin.

l. Plan 39 (Plate 10) consisted of the elements of Plan 37 but the existing contours in an area west of the interior shore-connected breakwater were deepened (dredged) to an el of -6.7 m (-22 ft).

Wave height experiments

29. Wave height experiments were conducted for the initial and most promising improvement plans for the waves shown in paragraph 24. Experiments involving some proposed plans, however, were limited to the most critical wave conditions (i.e., 16-sec, 19-ft waves). Wave gauge locations are shown in referenced plates.

Wave-induced current patterns and magnitudes

30. Wave-induced current patterns and magnitudes were obtained for selected improvement plans for various wave conditions. These experiments were conducted by timing the progress of a dye tracer relative to a known distance on the model surface at selected locations in the model.

Tidal flow experiments

31. Tidal flow experiments were conducted for selected improvement plans to determine flushing action throughout the harbor. Tidal current patterns and magnitudes were obtained with a dye tracer similarly to those obtained for wave-induced currents.

Experimental Results

32. In analyzing results, the relative merits of various improvement plans were based on measure wave heights, wave-induced current patterns and magnitudes, and tidal flow currents. Model wave heights (significant wave heights or H_s) were tabulated to show measured values at selected locations. Wave-induced and tidal current patterns and magnitudes were shown on plates in the report.

33. Results of wave height experiments for Plan 28 are presented in Tables 1 and 2, respectively, for short- and long-period wave conditions with the +1.0-m (+3.2-ft) and

+2.1-m (+7.0-ft) swls. For short-period wave conditions, maximum wave heights[3] were 0.55 m (1.8 ft) in the interior entrance channel (gauge 5) and 0.18 m (0.6 ft) in the small-boat harbor mooring area (gauge 7) for 16-sec, 5.8-m (19-ft) waves with the +2.1-m (+7.0-ft) swl. For long-period wave conditions, maximum wave heights were 0.8 m (2.6 ft) in the interior channel for 16-sec, 5.8-m (19-ft) waves with the +2.1-m (+7.0-ft) swl, and 0.7 m (2.3 ft) in the mooring area for 16-sec, 5.8-m (19-ft) waves with the +1.0-m (+3.2-ft) swl. All short-period wave heights in the mooring area were within the generally accepted 0.3-m (1.0-ft) wave height criterion for small-boat harbors. In several instances, long-period oscillations resulted in wave heights over 0.6 m (2.0-ft). These heights, when associated with long-period waves, generally do not result in vessel damage; however, horizontal currents between nodes and antinodes in a standing wave system may result in undesirable mooring conditions. Damage to vessel and floating docks generally are not a major problems when moorings are properly oriented and vessels properly moored. Wave periods associated with the maximum long-period (surge) conditions in the mooring area ranged from 112 to 142 seconds.

34. A comparison of short- and long-period wave conditions for Plans 28-32 is shown in Table 3 for 16-sec, 5.8-m (19-ft) waves with the +1.0-m (+3.2-ft) swl. For short-period conditions, maximum wave heights were 0.43 m (1.4 ft) in the interior entrance channel (gauge 5) for Plans 28, 29, 30, and 32, and 0.15 m (0.5 ft) in the small-boat mooring area (gauge 8) for Plans 28, 29, and 31. Maximum wave heights, for long-period conditions, were 0.7 m (2.3 ft) in the entrance channel for Plans 28, 29, and 32 and 0.7 m (2.3 ft) in the mooring area for Plan 28. Short-period conditions resulted in wave heights that were satisfactory for all these plans. It was noted that basin modifications and/or the extension of the interior detached breakwater had little effect, however, on long-period wave heights in the harbor. Wave periods associated with the maximum long-period (surge) conditions in the mooring area ranged from 111 to 144 seconds.

35. Wave heights obtained for representative waves for Plan 32 are presented in

[3]Refers to maximum significant wave heights throughout report.

Tables 4 and 5, respectively, for short- and long-period wave conditions with the +1.0-m (+3.2-ft) and +2.1-m (+7.0-ft) swls. For short-period wave conditions, maximum wave heights were 0.64 m (2.1 ft) in the interior entrance channel (gauge 5) and 0.18 m (0.6 ft) in the small-boat mooring area (gauge 8) for 16-sec, 5.8-m (19-ft) and 20-sec, 4.3-m (14-ft) waves with the +2.1-m (+7.0-ft) swl. For long-period wave conditions, maximum wave heights were 0.91 m (3.0 ft) in the interior channel and 0.76 m (2.5 ft) in the mooring area for 16-sec, 5.8-m (19-ft) waves with the +2.1-m (+7.0-ft) swl. Wave periods associated with the maximum long-period (surge) conditions in the mooring area ranged from 121 to 139 seconds.

36. Wave-induced current patterns and magnitudes obtained for representative waves with Plan 32 installed in the model are presented in Plates 11 and 12, respectively, for the +1.0-m (+3.2-ft) and +2.1-m (+7.0-ft) swls. Maximum velocities were 3.38 mps (11.1 fps) in the area between the spending beach and the interior detached breakwater, 3.0 mps (9.7 fps) in the interior entrance channel, and 1.92 fps (6.3 fps) on the east side of the head of the shore-connected breakwater. These maximum velocities all occurred for 16-sec, 5.8-m (19-ft) conditions.

37. Wave-induced current patterns and magnitudes obtained for Plans 33-35 for 16-sec, 5.8-m (19-ft) waves with the +1.0 m (+3.2-ft) swl are presented in Plate 13. Maximum velocities were 2.26 mps (7.4 fps) in the area between the spending beach and the interior detached breakwater for Plan 35, 1.62 mps (5.3 fps) in the interior entrance channel for Plan 33, and 1.52 mps (5.0 fps) on the east side of the head of the shore-connected breakwater for Plan 34. Plan 35 appeared to be best in regard to current velocities in the channel and mooring area. Due to excessive velocities obtained in the area between the interior detached breakwater and the spending beach, it appears the area should be hardened (covered with riprap) to prevent scour. Excessive current velocities obtained in the interior channel also may pose navigation problems for extreme storm wave events. In addition, strong wave-induced currents along the east side of the head of the interior shore-connected breakwater could cause problems for vessels moored in this vicinity. These values also

indicate that toe protection of the breakwater head may be required.

38. A comparison of short- and long-period wave conditions for Plans 33-35 is shown in Table 6 for 16-sec, 5.8-m (19-ft) waves with the +1.0-m (+3.2-ft) swl. For short-period conditions, maximum wave heights were 0.4 m (1.3 ft) in the interior entrance channel (gauge 5) for Plans 34 and 35, and 0.12 m (0.4 ft) in the small-boat mooring area (gauge 8) for Plans 33, 34, and 35. Maximum wave heights for long period wave conditions were 0.7 m (2.3 ft) in the entrance channel for Plans 34 and 35, and 0.82 m (2.7 ft) in the mooring area for Plan 34. Short-period conditions for Plans 33-35 resulted in satisfactory wave heights in the small-boat harbor. For long-period waves, Plan 35 (the -0.6-m (-2-ft) el between the spending beach and interior detached breakwater) resulted in reduced wave heights, with respect to waves in the mooring areas, versus the other plans. Wave periods associated with the maximum long-period (surge) conditions in the mooring area ranged from 126 to 140 seconds.

39. Ebb tidal current patterns were secured for Plans 35 and 36 and are shown in Plate 14 for the 2.1-m (7.0-ft) tidal range. The current patterns were similar for both plans, but visual observations indicated a better distribution of flow in the small-boat harbor basin with the angled interior detached breakwater of Plan 36. Magnitudes obtained for Plan 36 (also shown in Plate 14) were 0.85 mps (2.8 fps) on each side of the interior detached breakwater, 0.3 mps (0.9 fps) in the small-boat basin, and 0.18 mps (0.6 fps) in the interior channel. Magnitudes were obtained during the mid-range of the tidal cycle.

40. Ebb tidal currents and magnitudes secured for Plan 37 are shown in Plate 15 both with and without waves for the 2.1-m (7.0-ft) tidal range. Results shown in Plate 15 with waves included typical, everyday wave conditions of about 1.2 to 1.8 m (4 to 6 ft). Without waves, magnitudes obtained were 0.82 and 0.76 mps (2.7 and 2.5 fps), respectively, east and west of the angled interior detached breakwater, 0.3 mps (1.0 fps) in the small-boat basin, and 0.18 mps (0.6 fps) in the interior channel. Magnitudes obtained for Plan 37, with waves, were 0.7 and 0.82 mps (2.3 and 2.7 fps), respectively, east and west of the interior

breakwater, 0.21 mps (0.7 fps) in the small-boat basin, and 0.27 mps (0.9 fps) in the interior channel. It was noted that wave conditions improved harbor circulation. Typical wave conditions resulted in increased currents out the main entrance of the harbor, whereas without waves, tidal flows moved out of the harbor predominantly northerly along the shoreline through the -0.3-m-deep (-10-ft-deep) deposition basin.

41. Wave heights obtained with representative wave conditions for Plan 37 are presented in Tables 7 and 8, respectively, for short- and long-period waves with the +1.0-m (+3.2-ft) and +2.1-m (+7.0-ft) swls. For short-period wave conditions, maximum wave heights were 0.46 m (1.5 ft) in the interior entrance channel (gauge 5) and 0.21 m (0.7 ft) in the small-boat mooring area (gauge 8) for 16-sec, 5.8-m (19-ft) waves with the +2.1-m (+7.0-ft) swl. For long-period wave conditions, maximum wave heights were 0.82 m (2.7 ft) in the interior channel for 16-sec, 5.8-m (19-ft) waves and 0.82 m (2.7 ft) in the mooring area for 20-sec, 4.3-m (14-ft) waves with the +2.1-m (+7.0-ft) swl. Wave periods associated with the maximum long-period (surge) conditions in the mooring area ranged from 115 to 132 seconds.

42. Wave-induced current patterns and magnitudes obtained for representative waves with Plan 37 installed in the model are presented in Plates 16 and 17, respectively, for the +1.0-m (+3.2-ft) and +2.1-m (+7.0-ft) swls. Maximum velocities were 2.35 mps (7.7 fps) in the area between the spending beach and the interior detached breakwater for 16-sec, 5.8-m (19-ft) waves, 1.68 mps (5.5 fps) in the interior entrance channel for 16-sec, 5.8-m (19-ft) and 20-sec, 4.3-m (14-ft) waves, and 1.68 mps (5.5 fps) on the east side of the head of the shore-connected breakwater for 16-sec, 5.8-m (19-ft) waves. All maximum velocities occurred for the +1.0-m (+3.2-ft) swl. Visual observations with Plan 37 installed, versus the earlier plans, revealed that the -4.9-m (-16-ft) deep channel enhanced circulation in the small-boat basin. The plan resulted in slightly stronger eddies in the basin.

43. Evaluation of results at this point in the investigation indicated that the layout of Plan 37 was the optimum 60-vessel configuration considering wave and surge conditions in

the small-boat harbor mooring area and harbor circulation (wave-induced current patterns and magnitides and ebb tidal flow conditions).

44. Wave heights obtained with Plan 38 installed for representative wave conditions are presented in Tables 9 and 10, respectively, for short- and long-period waves with the +1.0-m (+3.2-ft) and +2.1-m (+7.0-ft) swls. For short-period wave conditions, maximum wave heights were 0.52 m (1.7 ft) in the interior entrance channel (gauge 5) and 0.21 m (0.7 ft) in the small-boat mooring area (gauge 8) for 16-sec, 5.8-m (19-ft) waves with the +2.1-m (+7.0-ft) swl. For long-period wave conditions, maximum wave heights were 0.82 m (2.7 ft) in the interior channel and 0.91 m (3.0 ft) in the mooring area for 16-sec, 5.8-m (19 ft) waves with the +2.1-m (+7.0-ft) swl. Wave periods associated with the maximum long-period (surge) conditions in the mooring area ranged from from 118 to 139 seconds.

45. Wave-induced current patterns and magnitudes obtained for Plan 38 are presented in Plates 18 and 19 for representative waves for the +1.0-m (+3.2-ft) and +2.1-m (+7.0-ft) swls. Maximum velocities were 2.44 mps (8.0 fps) in the area between the spending beach and the interior detached breakwater for 16-sec, 5.8-m (19-ft) waves with the +1.0-m (+3.2-ft) swl, 2.04 mps (6.7 fps) in the interior entrance channel for 16-sec, 5.8-m (19-ft) waves with the +2.1-m (+7.0-ft) swl, and 1.46 mps (4.8 fps) on the east side of the head of the shore-connected breakwater for 20-sec, 4.3-m (14-ft) waves with the +1.0-m (+3.2-ft) swl.

46. Ebb tidal current patterns and magnitudes for Plan 38 are presented in Plate 20 for the +2.1-m (+7.0-ft) tide range. Magnitudes obtained were 0.98 and 0.88 mps (3.2 and 2.9 fps), respectively, east and west of the angled interior detached breakwater, 0.34 mps (1.1 fps) in the small-boat basin, and 0.12 mps (0.4 fps) in the interior channel. These tidal flow patterns and magnitudes were similar to those obtained for Plan 37.

47. Wave heights obtained for representative wave conditions for Plan 39 are

presented in Tables 11 and 12, respectively, for short- and long- period waves with the +1.0-m (+3.2-ft) and +2.1-m (+7.0-ft) swls. For short-period wave conditions, maximum wave heights were 0.52 m (1.7 ft) in the interior entrance channel (gauge 5) and 0.21 m (0.7 ft) in the small-boat mooring area (gauges 8 and 9) for 16-sec, 5.8-m (19-ft) waves with the +2.1-m (+7.0-ft) swl. For long-period wave conditions, maximum wave heights were 0.79 m (2.6 ft) in the interior channel for 16-sec, 5.8-m (19-ft) waves and 0.91 m (3.0 ft) in the mooring area for 16-sec, 5.8-m (19-ft) and 20-sec, 4.3-m (14-ft) waves with the +2.1-m (+7.0-ft) swl. Wave periods associated with the maximum long-period (surge) conditions in the mooring area ranged from 115 and 130 seconds.

48. Wave-induced current patterns and magnitudes secured for representative waves with Plan 39 installed are presented in Plates 21 and 22, respectively, for the +1.0-m (+3.2-ft) and +2.1-m (+7.0-ft) swls. Maximum velocities were 2.38 mps (7.8 fps) in the area between the spending beach and the interior detached breakwater for 16-sec, 5.8-m (19-ft) waves with the +1.0-m (+3.2-ft) swl, 1.7 mps (5.6 fps) in the interior entrance channel for 16-sec, 5.8-m (19-ft) waves with the +2.1-m (+7.0-ft) swl, and 1.46 mps (4.8 fps) on the east side of the head of the shore-connected breakwater for 16-sec, 5.8-m (19-ft) waves with the +1.0-m (+3.2 ft) swl.

49. Ebb tidal current patterns and magnitudes secured for Plan 39 are shown in Plate 23 for the +2.1-m (+7.0-ft) tidal range. Magnitudes were 0.85 mps (2.8 fps) on each side of the angled interior detached breakwater, 0.3 mps (1.0 fps) in the small-boat basin, and 0.18 mps (0.6 fps) in the interior channel. These tidal flow patterns were similar to those obtained for Plans 37 and 38.

50. During the conduct of the investigation, all improvement plans experienced long-period (surge) conditions in the small-boat harbor mooring area. These surges (heights) generally had amplitudes ranging from about 0.6 to 0.9 m (2 to 3 ft) with associated periods ranging from approximately 110 to 145 seconds (depending on the plan). These vertical wave heights generally do not cause problems, or result in vessel damage, in small-boat

harbors. The horizontal velocities associated with a standing wave system, however, could pose problems for floating dock systems and vessels. Therefore, it is important that these horizontal movements be considered in the small-boat harbor design to ensure proper orientation and anchorage of dock systems as well as proper orientation and mooring of vessels. Current data obtained that was associated with harbor seiching is presented in Plate 24 for the 60-vessel harbor configuration. The vectors depict and directions of the back and forth current movements in the mooring area. Maximum velocities obtained ranged from 0.21 to 0.3 mps (0.7 to 1.0 fps) depending on location.

51. In earlier studies, experiments were conducted with the wave-dissipating spending beach inside the harbor constructed to an el of +3.7 m (+12 ft). Experiements conducted for this series of improvement plans indicated that the spending beach could be reduced to an el of 0.0 m (0.0 ft), (with a +1.2-m (+4.0-ft) berm along it's perimeter) and still provide essentially the same level of protection from storm wave conditions in the small-boat harbor.

PART V: CONCLUSIONS

52. Based on results of the coastal model investigation reported herein, it is concluded that:

a. Preliminary experiments indicated that all improvement plans would result in wave heights of less than 0.3 m (1.0 ft) in the small-boat mooring area for short-period storm wave conditions.

b. Preliminary experiments indicated that the harbor would experience long-period (surge) conditions for all improvement plans.

c. Preliminary experiments indicated that the area between the wave-dissipating spending beach and the interior detached breakwater should be constructed to an el of -0.6 m (-2.0 ft) to reduce wave heights in the small-boat harbor mooring areas. Excessive wave-induced currents in this area, however, indicated that the area should be hardened (capped with riprap) to prevent scour.

d. Preliminary experiments indicated that strong wave-induced currents in the interior channel may cause navigation difficulities for extreme storm wave events. Strong wave-induced currents along the area east of the shore-connected breakwater also may pose problems for vessels mooring in this vicinity. These current magnitudes also indicate that toe protection at the head of the structure may be required.

e. Preliminary experiments indicated that the angled interior detached breakwater would result in enhanced circulation and better distribution of flow in the small-boat harbor basin for ebb tidal currents as opposed to the straight structure.

f. Preliminary experiments indicated that the -4.9-m-deep (-16-ft-deep) interior channel would result in enhanced wave-induced circulation and stronger eddies in the small-boat basin as opposed to the -3.7-m-deep (-12-ft-deep) channel.

g. Experiments indicated that the 60-vessel plan configuration (Plan 37) will provide adequate wave and surge protection to the small-boat harbor as well as adequate harbor circulation.

h. Experiments indicated that the 30-vessel plan configuration (Plan 38) will provide adequate wave and surge protection to the small-boat harbor as well as adequate harbor circulation

i. Experiments indicated that a reduction of depths in the harbor to -6.7 m (-22 ft) west of the interior shore-connected breakwater (Plan 39) will have no negative impacts on wave and surge conditions or harbor circulation in the small-boat harbor.

j. Experiments indicated that long-period surge conditions in the harbor should not cause problems in the small-boat mooring area provided dock systems are properly oriented and vessels properly moored.

k. Experiments indicated that the 0.0-m (0.0-ft) el of the wave-dissipating spending beach (with the +1.2-m (+4.0-ft) berm along its perimenter) studied during this period will provide essentially the same level of protection from storm waves in the mooring area as the +3.7-m (+12.0-ft) el spending beach tested in earlier studies.

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Table 1
Short Period Wave Heights for Plan 28

Experimental Wave		Wave Height at Indicated Gauge Location, ft										
Period (sec)	Height (ft)	Gauge 1	Gauge 2	Gauge 3	Gauge 4	Gauge 5	Gauge 6	Gauge 7	Gauge 8	Gauge 9	Gauge 10	Gauge 11
swl = +3.2 ft												
8	10	2.3	0.6	1.1	0.3	0.6	0.3	0.1	0.2	0.2	0.2	0.7
10	10	2.6	0.7	0.9	0.5	0.8	0.4	0.2	0.2	0.3	0.2	0.9
16	14.4	3.5	1.2	1.5	1.4	1.3	0.9	0.3	0.4	0.5	0.4	1.3
16	19	4.2	1.4	1.7	1.6	1.4	1.0	0.4	0.5	0.6	0.5	1.4
20	14	4.0	1.4	1.7	1.5	1.4	0.9	0.4	0.5	0.6	0.5	1.5
25	5	2.0	1.0	1.7	1.3	1.2	0.6	0.1	0.2	0.3	0.2	0.6
swl = +7.0 ft												
8	10	2.8	1.0	1.0	0.8	0.7	0.5	0.2	0.2	0.3	0.3	0.7
10	10	3.5	1.0	1.1	0.8	0.9	0.7	0.3	0.3	0.4	0.3	1.0
16	14.4	4.6	1.6	2.0	1.6	1.4	1.1	0.5	0.5	0.7	0.6	1.8
16	19	5.6	2.0	2.6	1.9	1.8	1.3	0.6	0.6	0.8	0.7	2.2
20	14	4.8	1.7	2.2	1.8	1.6	1.1	0.5	0.6	0.7	0.6	2.0
25	5	2.5	0.8	1.1	1.1	1.2	0.9	0.2	0.3	0.4	0.3	0.9

Table 2
Long Period Wave Heights for Plan 28

Experimental Wave		Wave Height at Indicated Gauge Location, ft										
Period (sec)	Height (ft)	Gauge 1	Gauge 2	Gauge 3	Gauge 4	Gauge 5	Gauge 6	Gauge 7	Gauge 8	Gauge 9	Gauge 10	Gauge 11
swl = +3.2 ft												
8	10	2.4	0.7	1.2	0.5	0.8	0.6	0.7	0.9	0.6	0.6	1.0
10	10	2.9	1.0	1.3	1.1	1.3	1.1	1.1	1.3	0.8	0.9	1.4
16	14.4	4.0	1.7	2.2	2.4	2.0	1.8	1.7	2.0	1.6	1.6	2.0
16	19	4.7	2.0	2.4	2.6	2.3	1.9	2.3	1.8	1.6	1.8	2.2
20	14	4.5	2.0	2.4	2.4	2.4	1.8	1.9	2.0	1.4	1.6	2.4
25	5	2.1	0.7	1.1	1.0	0.9	0.6	0.5	0.7	0.6	0.6	0.8
swl = +7.0 ft												
8	10	2.8	1.1	1.1	0.9	0.9	0.8	0.9	1.1	0.6	0.7	1.1
10	10	3.6	1.2	1.3	1.2	1.3	1.1	1.2	1.2	0.9	1.0	1.4
16	14.4	5.0	2.0	2.6	2.5	2.2	1.7	1.9	2.1	1.5	1.8	2.6
16	19	6.1	2.6	3.1	3.1	2.6	1.9	2.0	2.1	1.7	1.7	3.2
20	14	5.3	2.2	2.9	2.9	2.5	1.9	2.0	2.2	1.6	1.8	2.8
25	5	2.6	0.9	1.2	1.2	0.9	0.7	0.6	0.7	0.6	0.6	1.0

Table 3
Comparison of Wave Heights for Plans 28-32; 16-sec, 19-ft waves; swl = +3.2 ft

Plan	Wave Height at Indicated Gauge Location, ft										
	Gauge 1	Gauge 2	Gauge 3	Gauge 4	Gauge 5	Gauge 6	Gauge 7	Gauge 8	Gauge 9	Gauge 10	Gauge 11
Short Period Wave Conditions											
28	4.2	1.4	1.7	1.6	1.4	1.0	0.4	0.5	0.6	0.5	1.4
29	4.2	1.3	1.7	1.5	1.4	0.9	0.3	0.5	0.6	0.5	1.4
30	4.0	1.4	1.7	1.5	1.4	0.9	0.4	0.4	0.6	0.5	1.3
31	4.1	1.3	1.8	1.6	1.3	0.9	0.4	0.5	0.5	0.5	1.4
32	4.5	1.4	1.8	1.6	1.4	0.9	0.3	0.4	0.5	0.5	1.4
Long Period Wave Conditions											
28	4.7	2.0	2.4	2.6	2.3	1.9	2.3	1.8	1.6	1.8	2.2
29	4.6	1.9	2.4	2.3	2.3	1.6	1.9	1.8	1.4	1.6	2.1
30	4.6	1.9	2.5	2.3	2.1	1.7	1.8	1.5	1.4	1.5	2.1
31	4.7	1.9	2.4	2.4	2.1	1.6	1.9	1.7	1.4	1.7	2.2
32	5.0	2.0	2.7	2.6	2.3	1.6	1.9	1.6	1.4	1.6	2.1

Table 4
Short Period Wave Heights for Plan 32

Experimental Wave		Wave Height at Indicated Gauge Location, ft										
Period (sec)	Height (ft)	Gauge 1	Gauge 2	Gauge 3	Gauge 4	Gauge 5	Gauge 6	Gauge 7	Gauge 8	Gauge 9	Gauge 10	Gauge 11
swl = +3.2 ft												
10	10	2.5	0.7	0.9	0.7	0.7	0.5	0.2	0.2	0.3	0.2	0.9
16	19	4.5	1.4	1.8	1.6	1.4	0.9	0.3	0.4	0.5	0.5	1.4
20	14	4.0	1.3	1.8	1.5	1.5	0.9	0.3	0.3	0.5	0.4	1.3
25	10	3.3	1.1	1.6	1.5	1.2	0.8	0.3	0.3	0.4	0.4	1.1
swl = +7.0 ft												
10	10	3.3	1.0	0.7	0.6	1.1	0.6	0.2	0.3	0.4	0.3	1.0
16	19	5.0	1.8	1.8	1.7	2.1	1.0	0.4	0.6	0.7	0.6	2.0
20	14	4.6	1.6	1.7	1.7	1.5	1.0	0.4	0.6	0.6	0.6	1.9
25	10	4.4	1.4	1.6	1.8	1.5	0.9	0.3	0.4	0.6	0.5	1.6

Table 5
Long Period Wave Heights for Plan 32

Experimental Wave		Wave Height at Indicated Gauge Location, ft										
Period (sec)	Height (ft)	Gauge 1	Gauge 2	Gauge 3	Gauge 4	Gauge 5	Gauge 6	Gauge 7	Gauge 8	Gauge 9	Gauge 10	Gauge 11
swl = +3.2 ft												
10	10	2.7	1.0	1.4	1.2	1.2	1.0	1.1	1.2	0.8	0.9	1.3
16	19	5.0	2.0	2.7	2.6	2.3	1.6	1.9	1.6	1.4	1.6	2.1
20	14	4.4	1.9	2.6	2.4	2.5	1.6	1.7	1.4	1.3	1.5	2.2
25	10	3.7	1.5	2.2	2.1	1.8	1.3	1.4	1.7	1.2	1.4	1.6
swl = +7.0 ft												
10	10	3.4	1.2	1.1	1.1	1.5	0.9	1.2	1.1	0.7	0.9	1.4
16	19	5.6	2.5	2.6	3.0	3.0	1.7	2.5	2.1	1.5	1.7	2.8
20	14	5.1	2.2	2.5	2.7	2.4	1.6	2.0	2.0	1.5	1.7	2.8
25	10	4.7	1.8	2.1	2.4	2.1	1.5	1.5	1.5	1.2	1.3	2.2

Table 6
Comparison of Wave Heights for Plans 33-35; 16-sec, 19-ft waves; swl = +3.2 ft

Plan	Wave Height at Indicated Gauge Location, ft										
	Gauge 1	Gauge 2	Gauge 3A	Gauge 4	Gauge 5	Gauge 6	Gauge 7	Gauge 8	Gauge 9	Gauge 10	Gauge 11
Short Period Wave Conditions											
33	4.3	1.4	0.5	1.6	1.2	0.8	0.3	0.4	0.5	0.4	1.5
34	4.3	1.4	0.5	1.6	1.3	0.9	0.3	0.4	0.5	0.4	1.6
35	4.2	1.3	0.5	1.6	1.3	0.9	0.3	0.4	0.5	0.4	1.5
Long Period Wave Conditions											
33	4.8	2.1	2.9	2.5	2.2	2.1	2.4	2.2	1.9	1.7	2.5
34	4.7	2.0	3.2	2.8	2.3	1.6	2.3	2.7	1.9	1.9	2.3
35	4.6	1.9	3.1	2.6	2.3	1.8	2.0	2.3	1.5	1.9	2.3

Table 7
Short Period Wave Heights for Plan 37

Experimental Wave		Wave Height at Indicated Gauge Location, ft										
Period (sec)	Height (ft)	Gauge 1	Gauge 2	Gauge 3A	Gauge 4	Gauge 5	Gauge 6	Gauge 7	Gauge 8	Gauge 9	Gauge 10	Gauge 11
swl = +3.2 ft												
10	10	2.1	0.6	0.3	0.7	0.5	0.3	0.2	0.3	0.2	0.2	0.6
16	19	4.2	1.4	0.6	1.6	1.0	0.8	0.4	0.4	0.6	0.4	1.5
20	14	3.5	1.2	0.5	1.5	1.0	0.7	0.4	0.4	0.4	0.4	1.1
25	10	3.1	0.9	0.4	1.5	0.9	0.6	0.2	0.3	0.4	0.3	0.9
swl = +7.0 ft												
10	10	3.7	1.0	0.3	0.8	0.6	0.3	0.3	0.3	0.5	0.3	0.8
16	19	5.4	1.8	0.7	1.8	1.5	0.9	0.6	0.7	0.8	0.6	2.3
20	14	4.8	1.7	0.6	1.8	1.4	0.8	0.6	0.6	0.8	0.6	2.0
25	10	4.5	1.5	0.5	2.0	1.2	0.6	0.5	0.5	0.7	0.5	1.7

Exhibit A5.9.2

Table 8
Long Period Wave Heights for Plan 37

Experimental Wave		Wave Height at Indicated Gauge Location, ft										
Period (sec)	Height (ft)	Gauge 1	Gauge 2	Gauge 3A	Gauge 4	Gauge 5	Gauge 6	Gauge 7	Gauge 8	Gauge 9	Gauge 10	Gauge 11
swl = +3.2 ft												
10	10	2.5	0.9	2.1	1.3	1.0	1.0	1.2	1.2	0.8	0.9	1.2
16	19	4.7	1.9	3.4	2.7	2.0	1.9	2.2	2.2	1.6	2.0	2.3
20	14	4.1	1.8	3.0	2.4	2.0	1.7	1.9	2.0	1.3	1.6	2.0
25	10	3.5	1.3	2.6	2.3	1.6	1.4	1.9	1.8	1.8	1.6	1.4
swl = +7.0 ft												
10	10	3.7	1.2	2.2	1.3	1.3	1.1	1.3	1.4	0.9	1.0	1.2
16	19	5.8	2.4	4.0	3.1	2.7	1.8	2.4	2.4	1.9	2.1	3.5
20	14	5.3	2.3	4.0	2.9	2.5	1.9	2.4	2.7	1.8	2.0	2.8
25	10	4.8	1.9	2.9	2.7	1.9	1.5	2.0	2.1	1.5	1.7	2.3

Exhibit A5.4.3

Table 9
Short Period Wave Heights for Plan 38

Experimental Wave		Wave Height at Indicated Gauge Location, ft										
Period (sec)	Height (ft)	Gauge 1	Gauge 2	Gauge 3B	Gauge 4	Gauge 5	Gauge 6	Gauge 7	Gauge 8	Gauge 9	Gauge 10	Gauge 11A
swl = +3.2 ft												
10	10	2.8	0.8	0.3	0.8	0.6	0.3	0.2	0.2	0.4	0.3	0.7
16	19	4.0	1.3	0.5	1.6	1.1	0.6	0.3	0.5	0.6	0.4	1.6
20	14	3.8	1.3	0.5	1.5	1.2	0.6	0.3	0.5	0.5	0.4	1.5
25	10	3.4	0.9	0.4	1.4	1.0	0.5	0.2	0.4	0.5	0.3	1.5
swl = +7.0 ft												
10	10	3.8	1.1	0.3	0.9	0.8	0.5	0.3	0.3	0.6	0.4	0.7
16	19	5.5	1.9	0.7	1.9	1.7	1.0	0.6	0.7	0.9	0.7	1.9
20	14	4.8	1.7	0.6	1.8	1.4	0.9	0.5	0.6	0.8	0.7	1.8
25	10	4.5	1.5	0.6	2.0	1.3	0.8	0.5	0.5	0.8	0.6	1.8

Table 10
Long Period Wave Heights for Plan 38

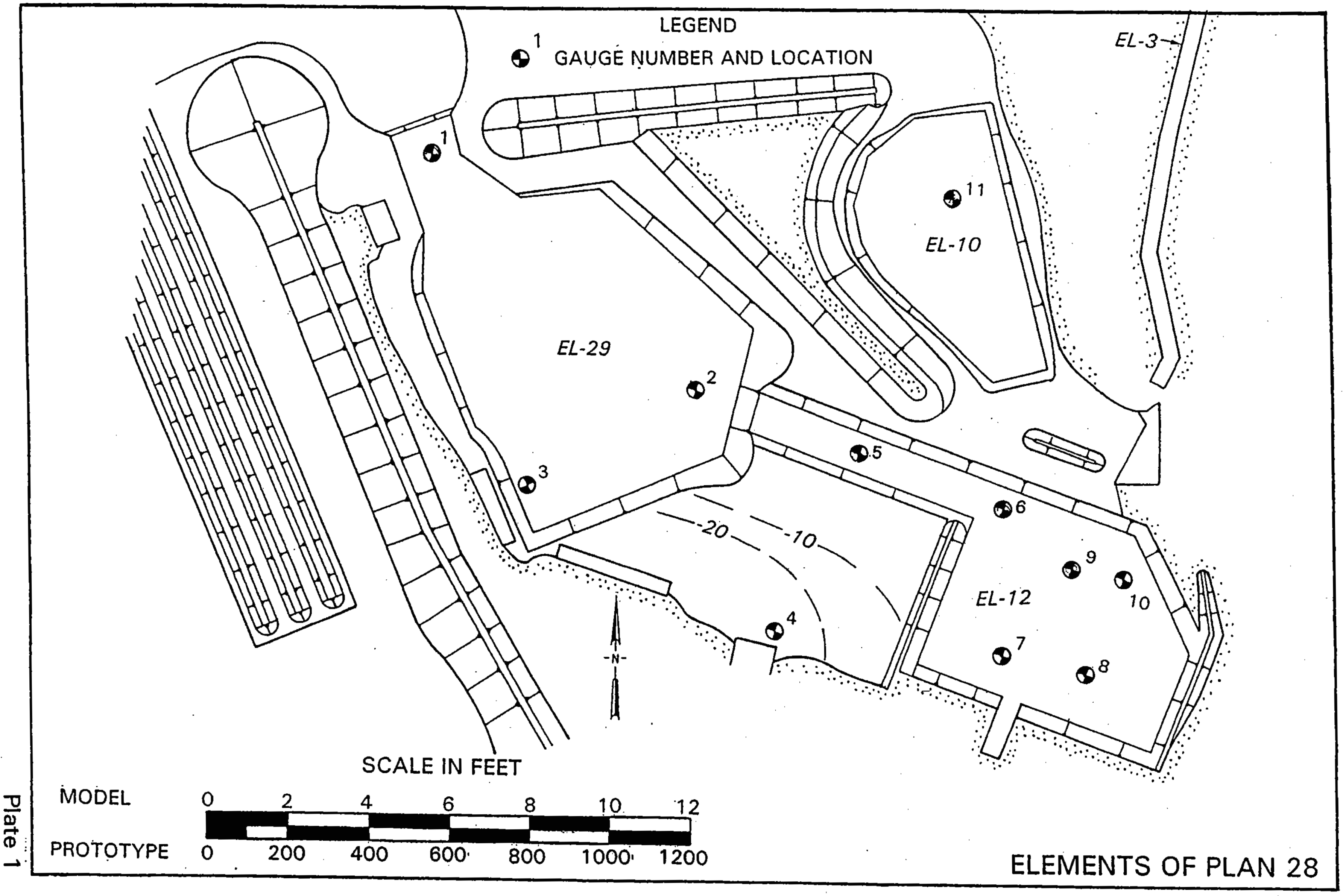
Experimental Wave		Wave Height at Indicated Gauge Location, ft										
Period (sec)	Height (ft)	Gauge 1	Gauge 2	Gauge 3B	Gauge 4	Gauge 5	Gauge 6	Gauge 7	Gauge 8	Gauge 9	Gauge 10	Gauge 11A
swl = +3.2 ft												
10	10	3.2	1.0	2.0	1.4	1.2	1.0	1.6	1.6	1.0	1.4	2.5
16	19	4.6	1.9	3.0	2.6	2.0	1.9	2.1	2.3	1.7	2.2	4.6
20	14	4.3	1.8	2.7	2.4	2.1	1.5	1.8	2.0	1.4	2.2	4.3
25	10	3.8	1.3	2.4	2.2	1.8	1.4	1.8	1.9	1.5	1.8	3.6
swl = +7.0 ft												
10	10	3.9	1.3	1.9	1.4	1.2	1.0	1.4	1.6	1.0	1.2	2.3
16	19	6.0	2.5	3.7	3.3	2.7	1.8	2.7	3.0	1.9	2.6	5.4
20	14	5.3	2.2	3.6	3.0	2.6	1.8	2.5	2.9	1.9	2.5	5.1
25	10	4.9	2.0	2.7	2.8	2.0	1.6	2.1	2.3	1.6	2.0	3.9

Table 11
Short Period Wave Heights for Plan 39

Experimental Wave		Wave Height at Indicated Gauge Location, ft										
Period (sec)	Height (ft)	Gauge 1	Gauge 2	Gauge 3A	Gauge 4	Gauge 5	Gauge 6	Gauge 7	Gauge 8	Gauge 9	Gauge 10	Gauge 11A
swl = +3.2 ft												
10	10	2.2	0.6	0.3	0.8	0.4	0.3	0.2	0.2	0.2	0.2	0.8
16	19	4.1	1.2	0.6	1.8	1.0	0.7	0.4	0.4	0.5	0.4	1.7
20	14	3.9	1.2	0.6	1.7	1.0	0.6	0.4	0.4	0.5	0.4	1.7
25	10	3.2	0.8	1.0	1.5	0.7	0.5	0.3	0.3	0.4	0.3	1.6
swl = +7.0 ft												
10	10	3.6	1.0	1.0	1.3	0.8	0.4	0.2	0.3	0.3	0.3	0.8
16	19	5.8	2.0	1.2	2.4	1.7	1.1	0.7	0.7	0.8	0.6	1.8
20	14	4.9	1.6	1.4	2.2	1.5	0.9	0.6	0.6	0.7	0.5	1.7
25	10	4.6	1.4	1.0	2.2	1.2	0.7	0.5	0.5	0.6	0.4	1.7

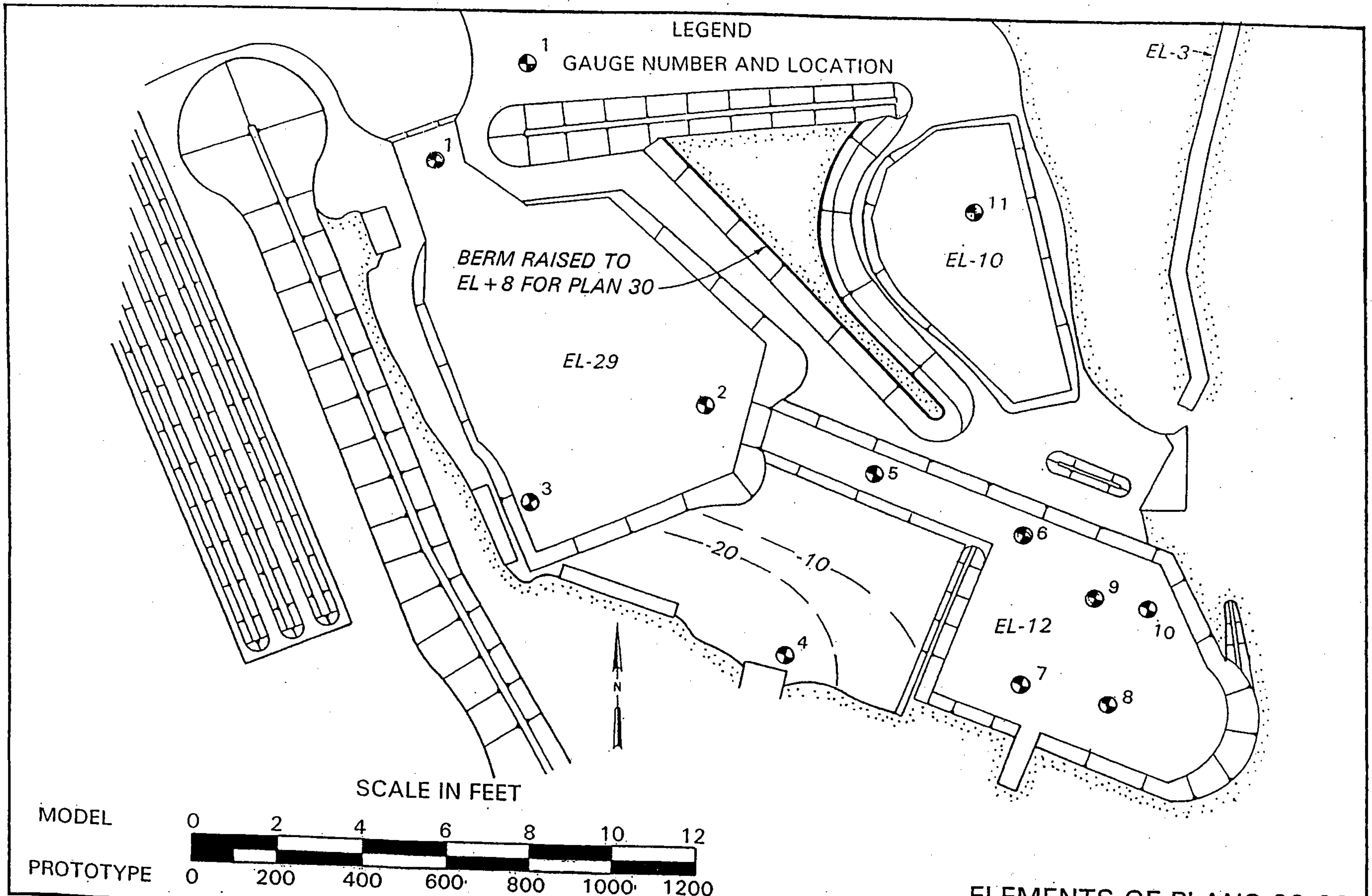
Table 12
Long Period Wave Heights for Plan 39

Experimental Wave		Wave Height at Indicated Gauge Location, ft										
Period (sec)	Height (ft)	Gauge 1	Gauge 2	Gauge 3A	Gauge 4	Gauge 5	Gauge 6	Gauge 7	Gauge 8	Gauge 9	Gauge 10	Gauge 11A
swl = +3.2 ft												
10	10	2.4	0.9	2.2	1.3	1.0	1.3	1.3	1.5	1.2	1.3	2.4
16	19	4.6	1.7	3.5	2.7	2.0	2.0	1.9	2.5	1.8	2.1	4.3
20	14	4.3	1.7	3.6	2.6	1.9	1.8	2.0	2.4	1.5	1.9	4.2
25	10	3.5	1.2	3.6	2.4	1.5	1.7	2.1	2.2	1.6	2.0	3.3
swl = +7.0 ft												
10	10	3.8	1.2	3.2	1.6	1.1	1.2	1.5	1.5	1.0	1.2	1.9
16	19	6.4	2.7	4.1	3.8	2.6	2.1	2.7	3.0	2.1	2.5	4.9
20	14	5.6	2.3	4.1	3.2	2.3	2.1	2.9	3.0	2.1	2.4	4.6
25	10	5.0	1.9	3.6	3.0	1.8	1.7	2.2	2.1	1.6	1.9	3.5

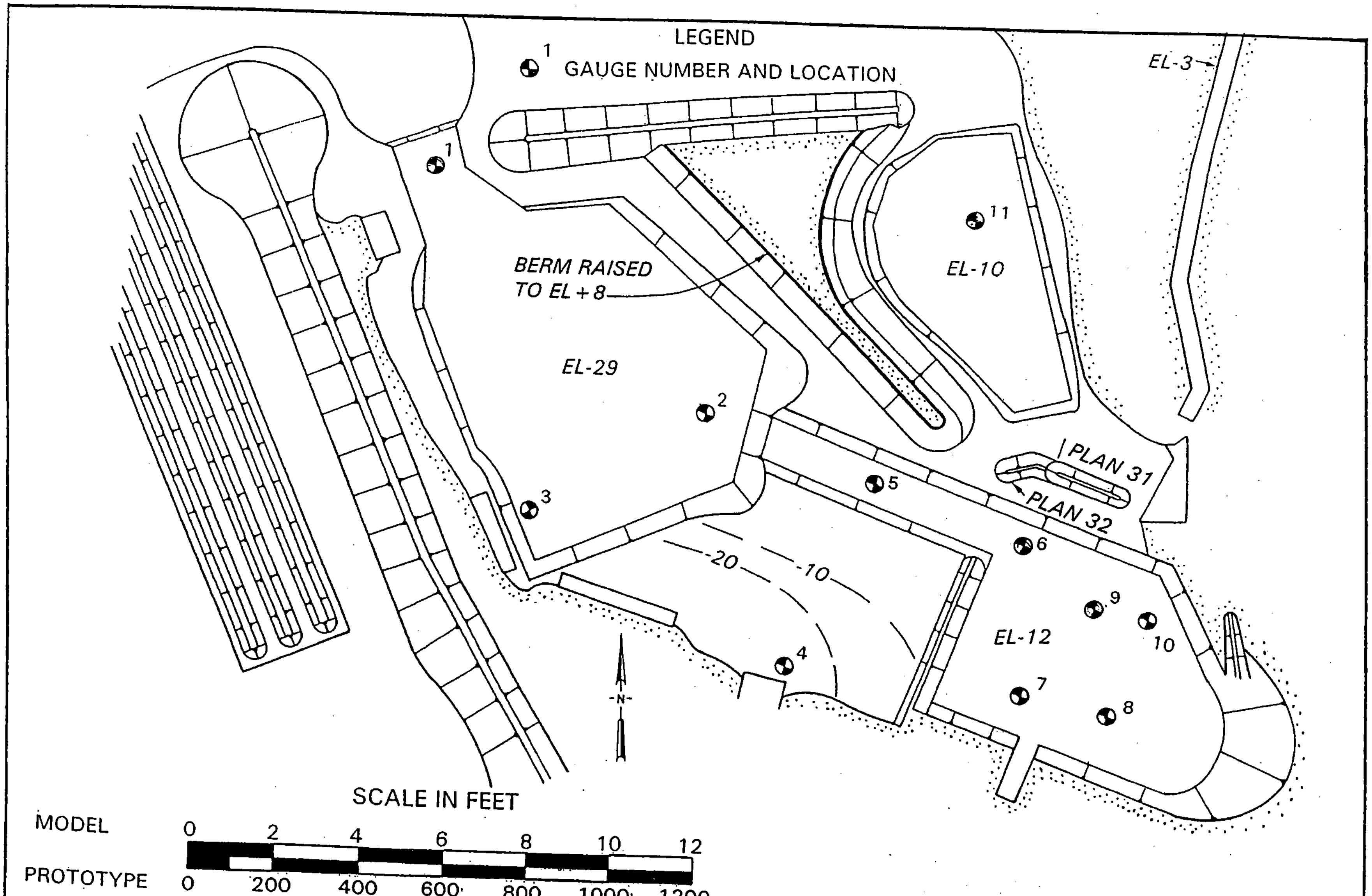


ELEMENTS OF PLAN 28

Plate 1

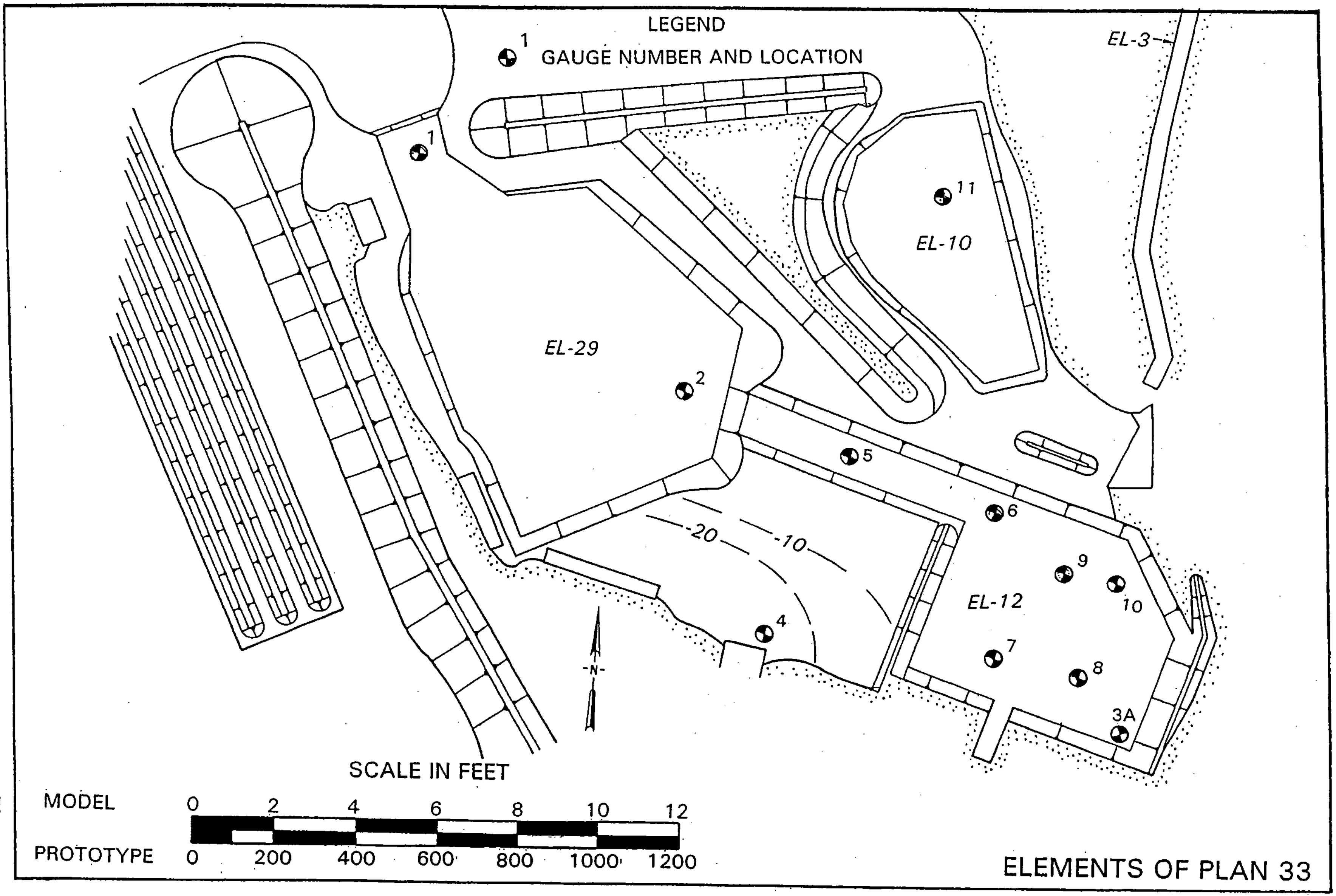


ELEMENTS OF PLANS 29-30

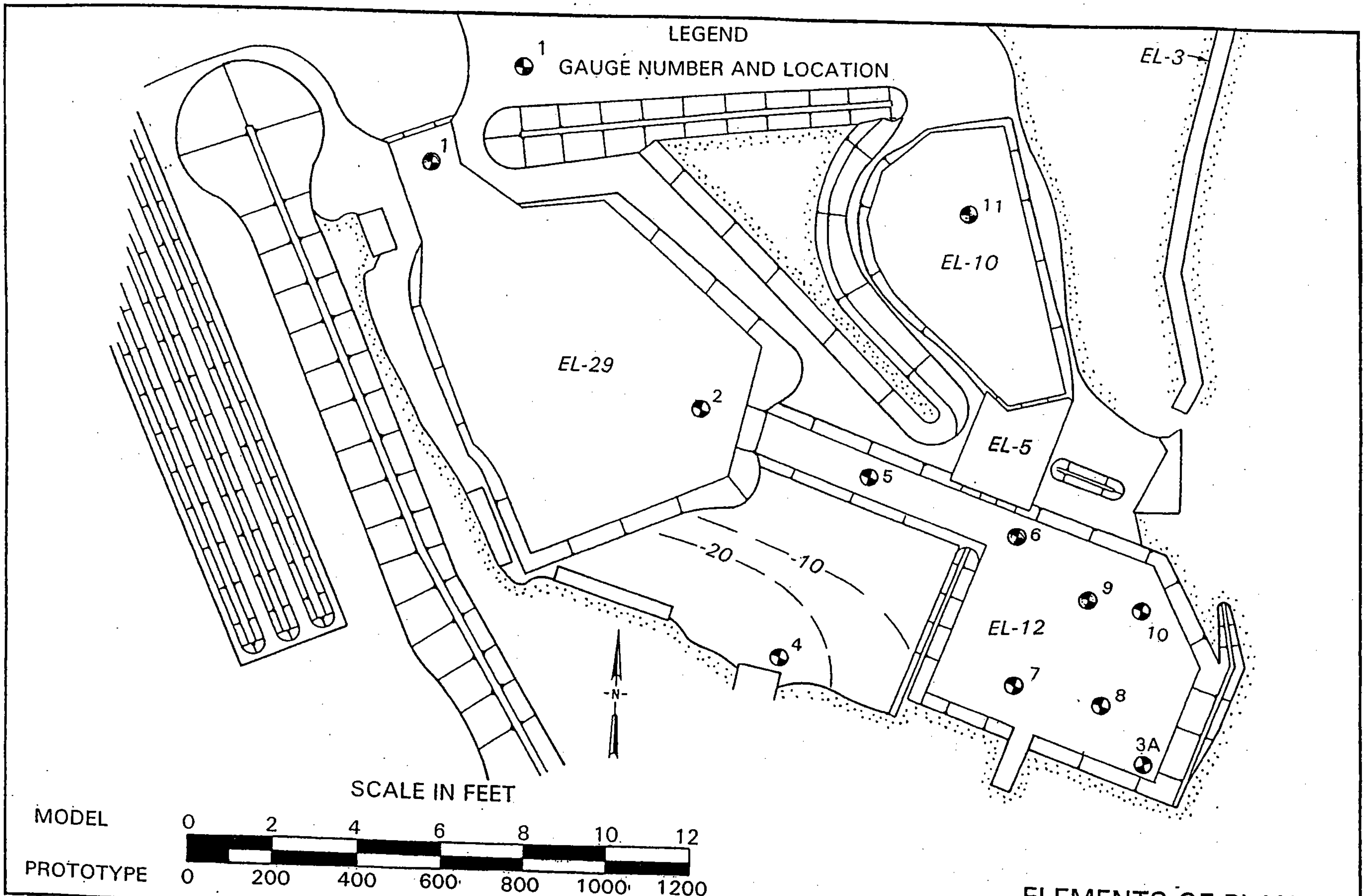


ELEMENTS OF PLANS 31-32

Plate 3

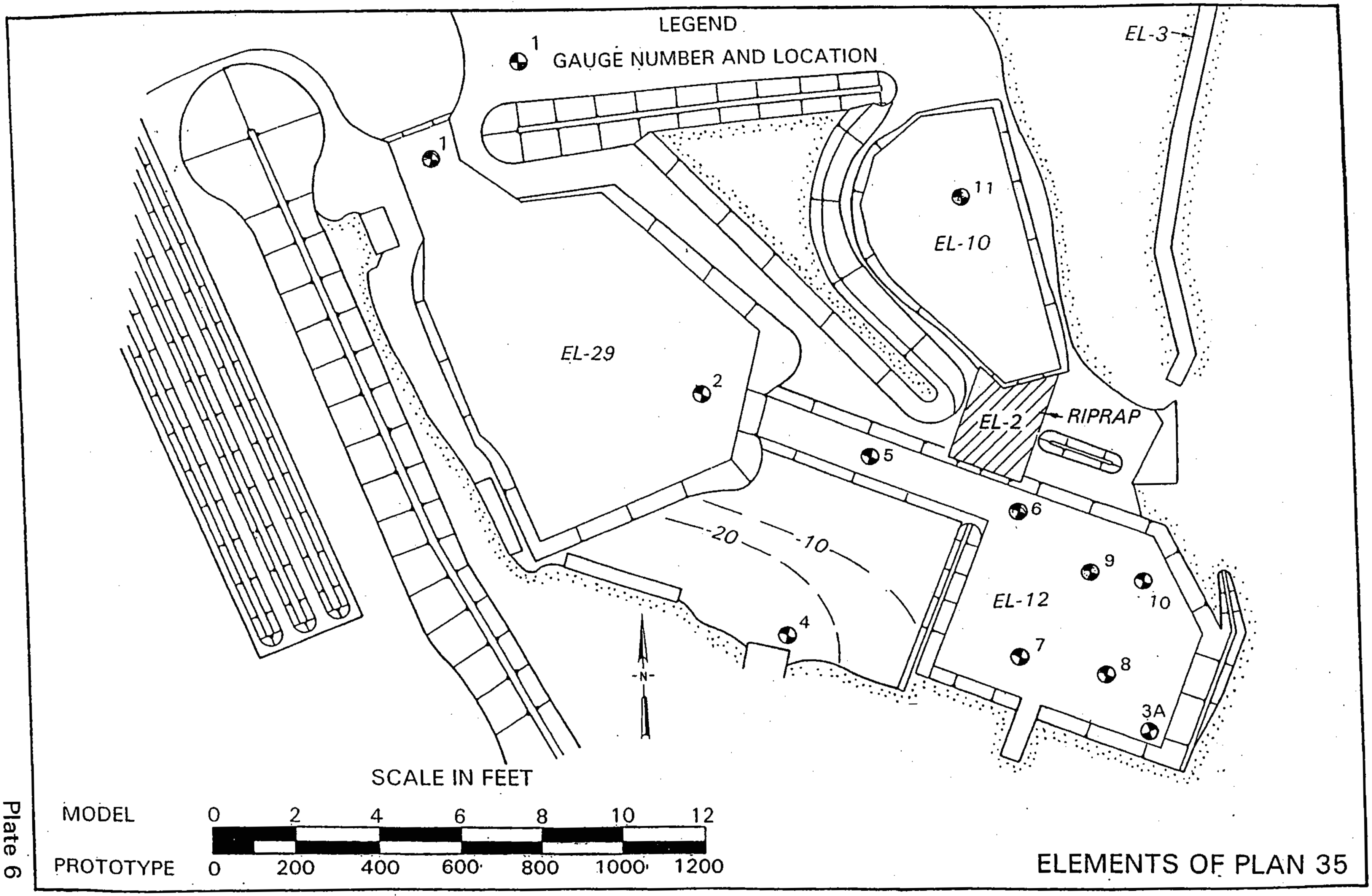


ELEMENTS OF PLAN 33



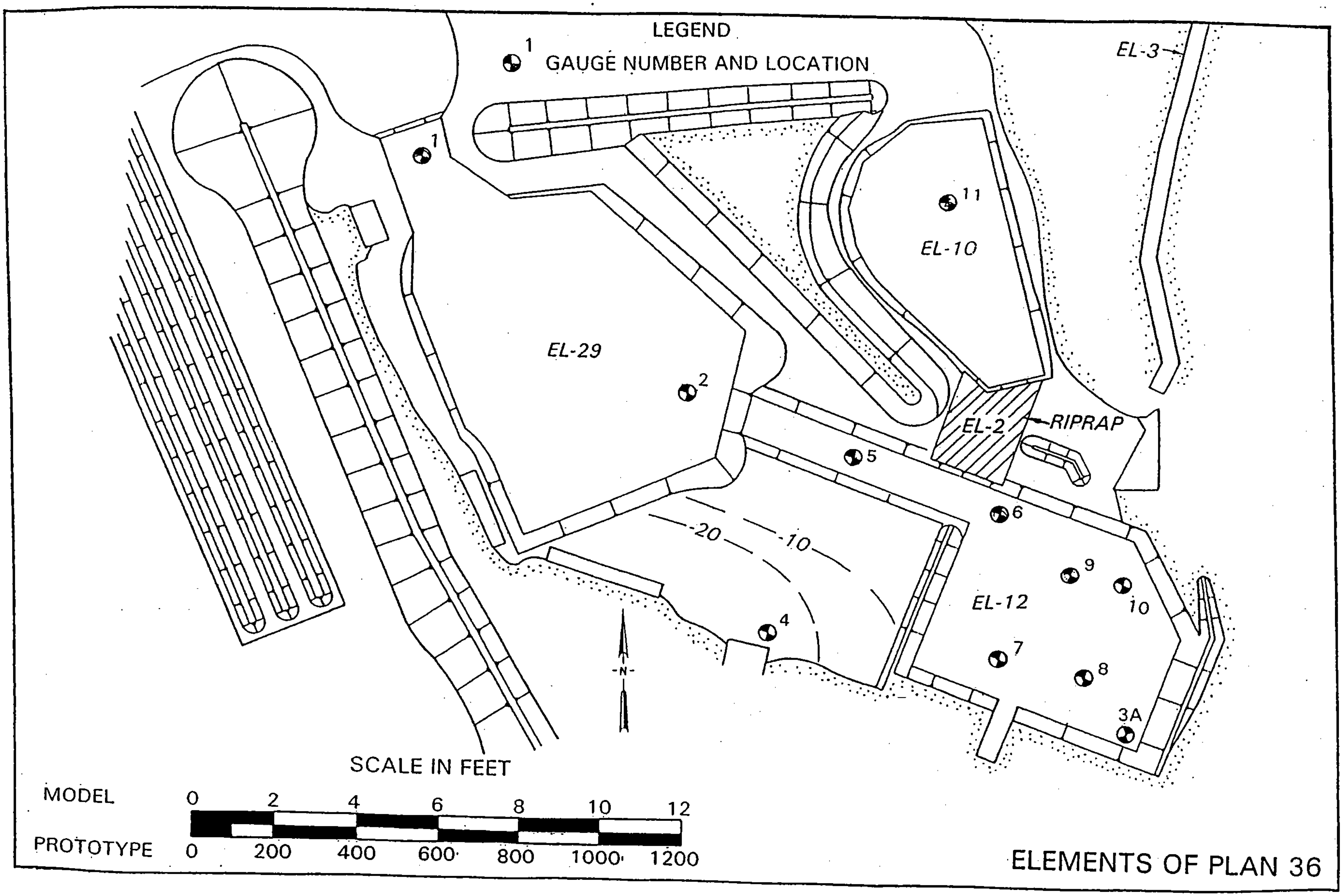
ELEMENTS OF PLAN 34

Plate 5

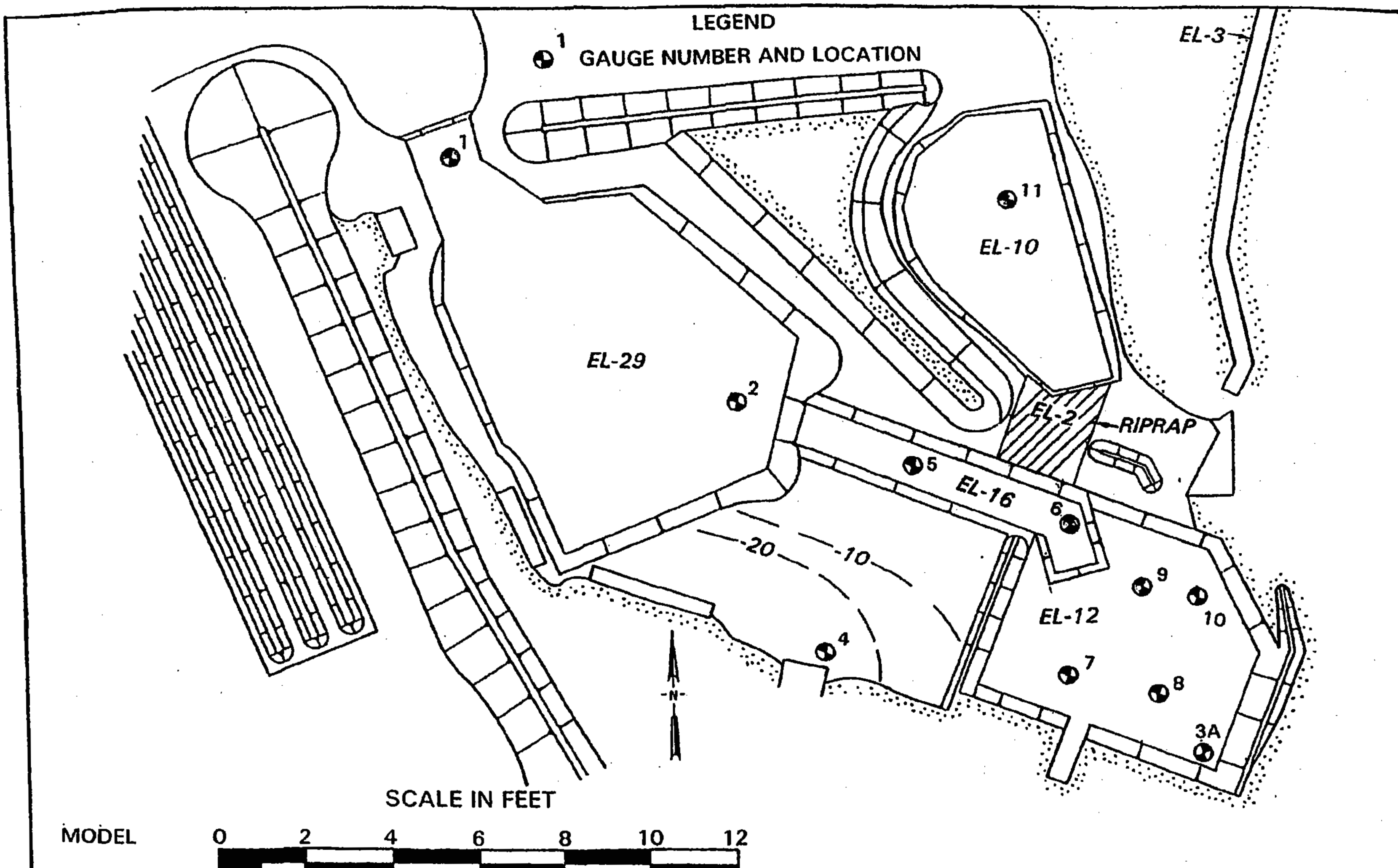


ELEMENTS OF PLAN 35

Plate 6

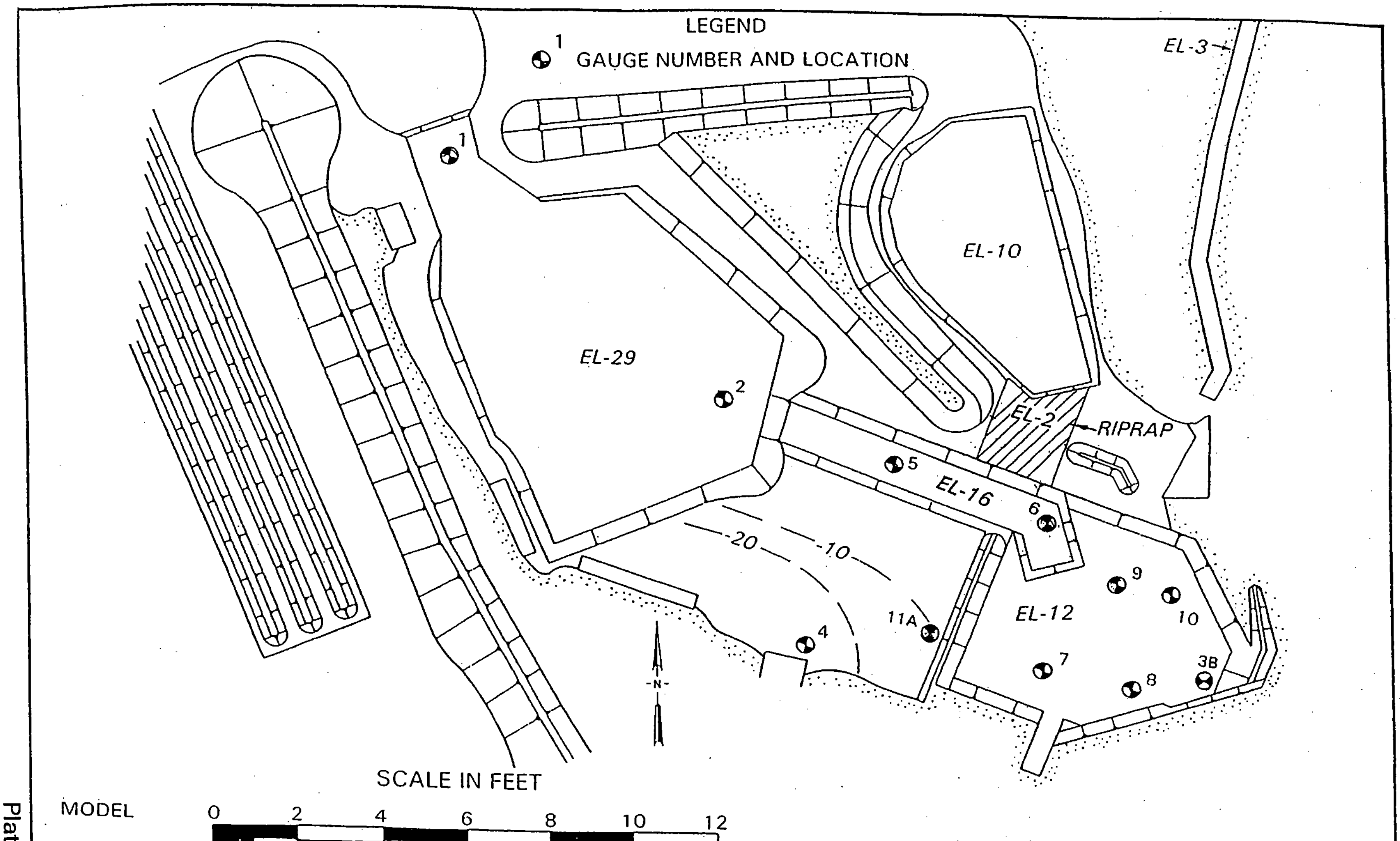


ELEMENTS OF PLAN 36



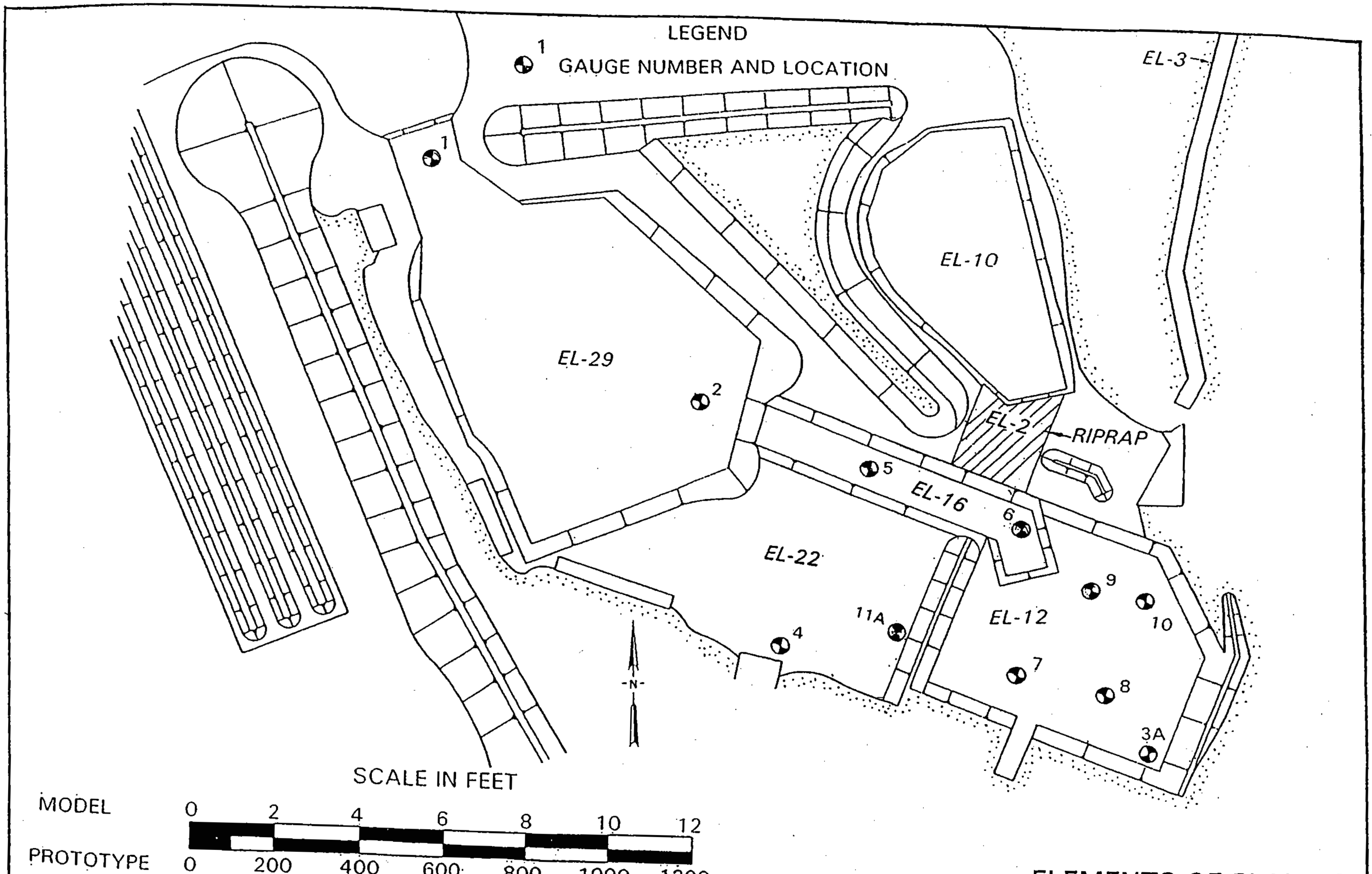
ELEMENTS OF PLAN 37

Exhibit A5.4.1

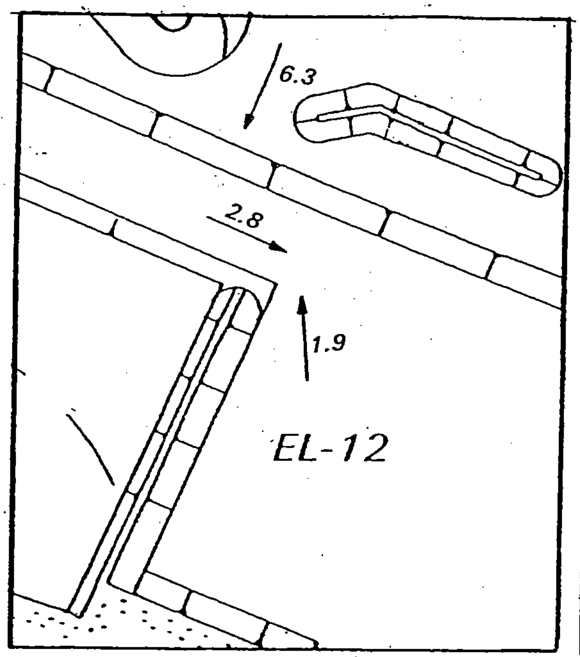


ELEMENTS OF PLAN 38

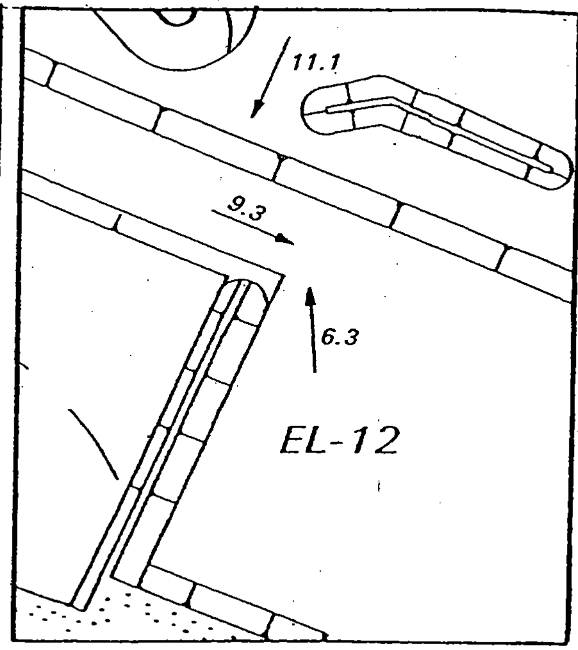
Plate 9



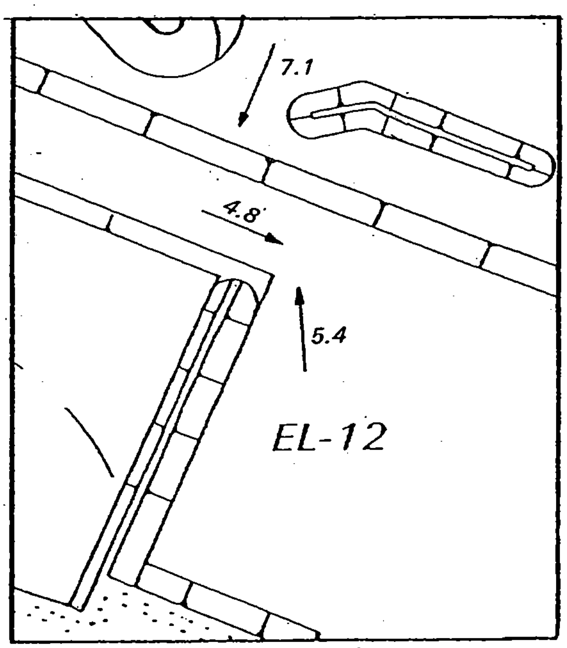
ELEMENTS OF PLAN 39



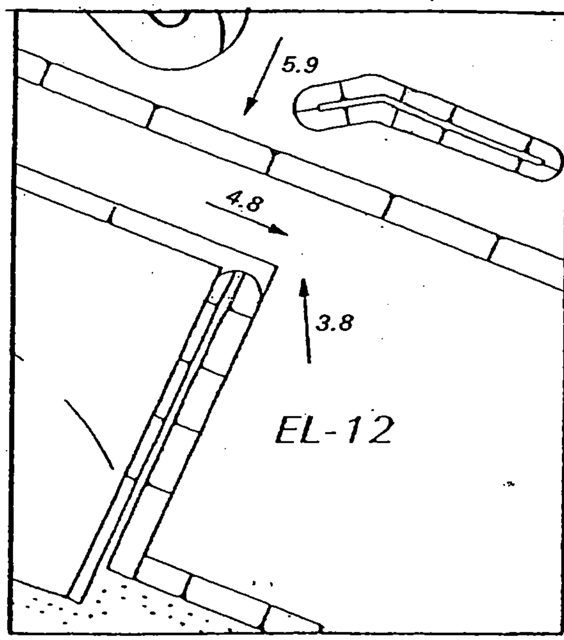
10-sec, 10-ft waves



16-sec, 19-ft waves

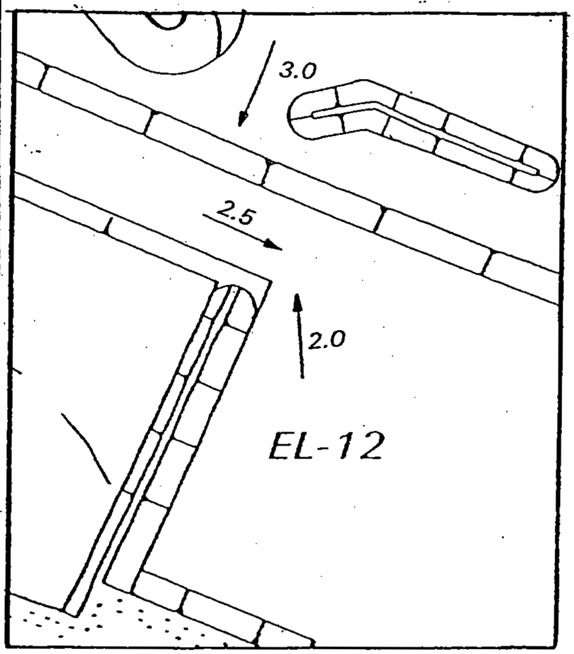


20-sec, 14-ft waves

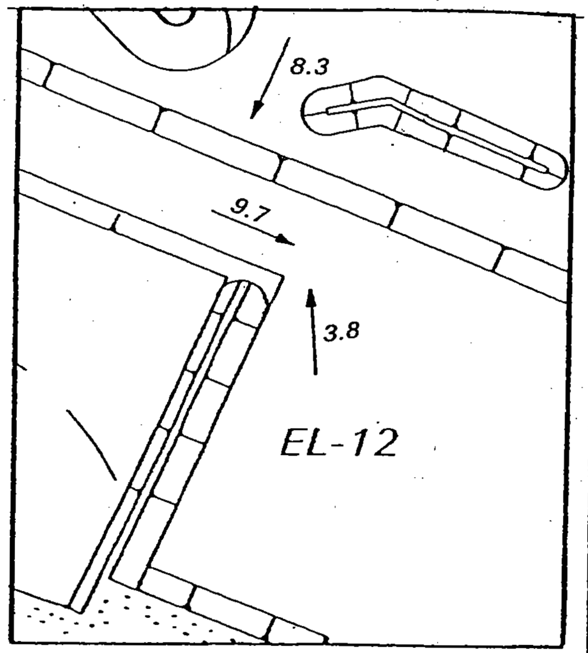


25-sec, 10-ft waves

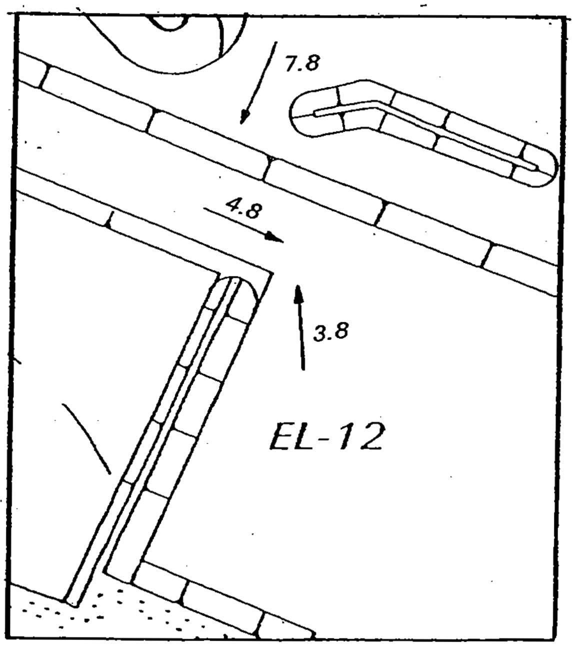
Wave induced current patterns and magnitudes (prototype feet per second) for Plan 32, swl= +3.2 ft



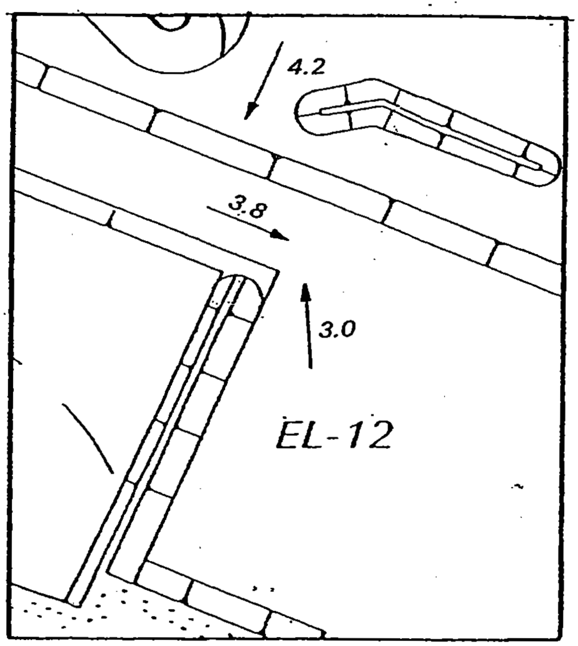
10-sec, 10-ft waves



16-sec, 19-ft waves

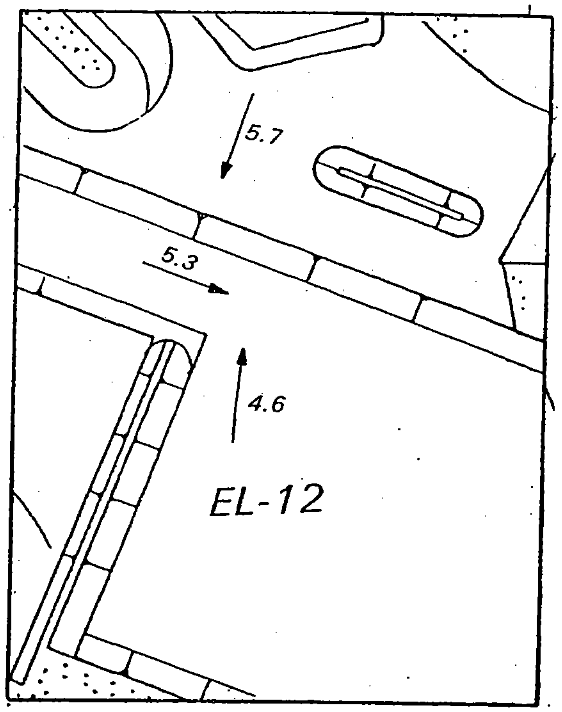


20-sec, 14-ft waves

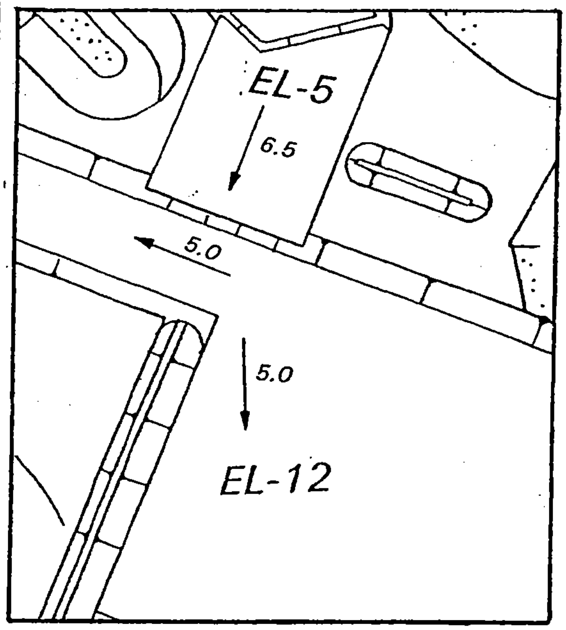


25-sec, 10-ft waves

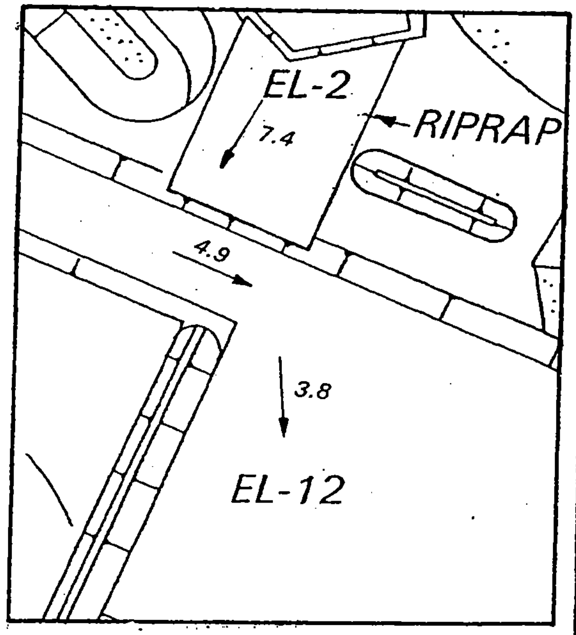
Wave induced current patterns and magnitudes (prototype feet Per second) for Plan 32, swl = +7.0 ft



Plan 33

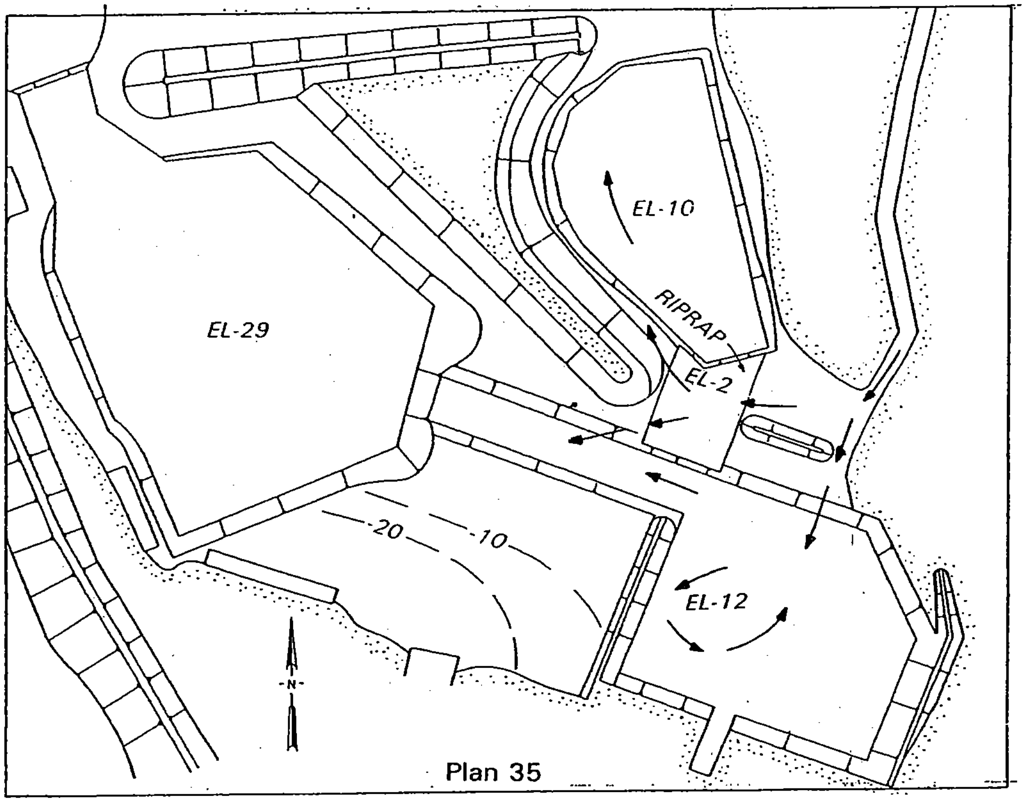


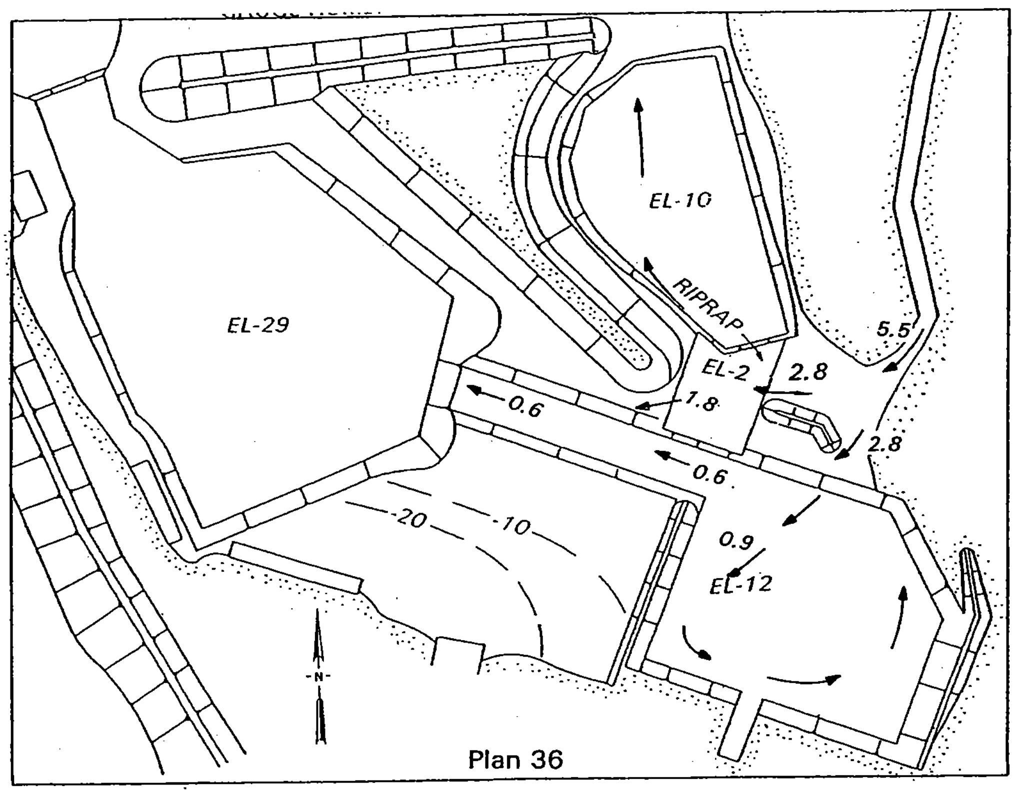
Plan 34



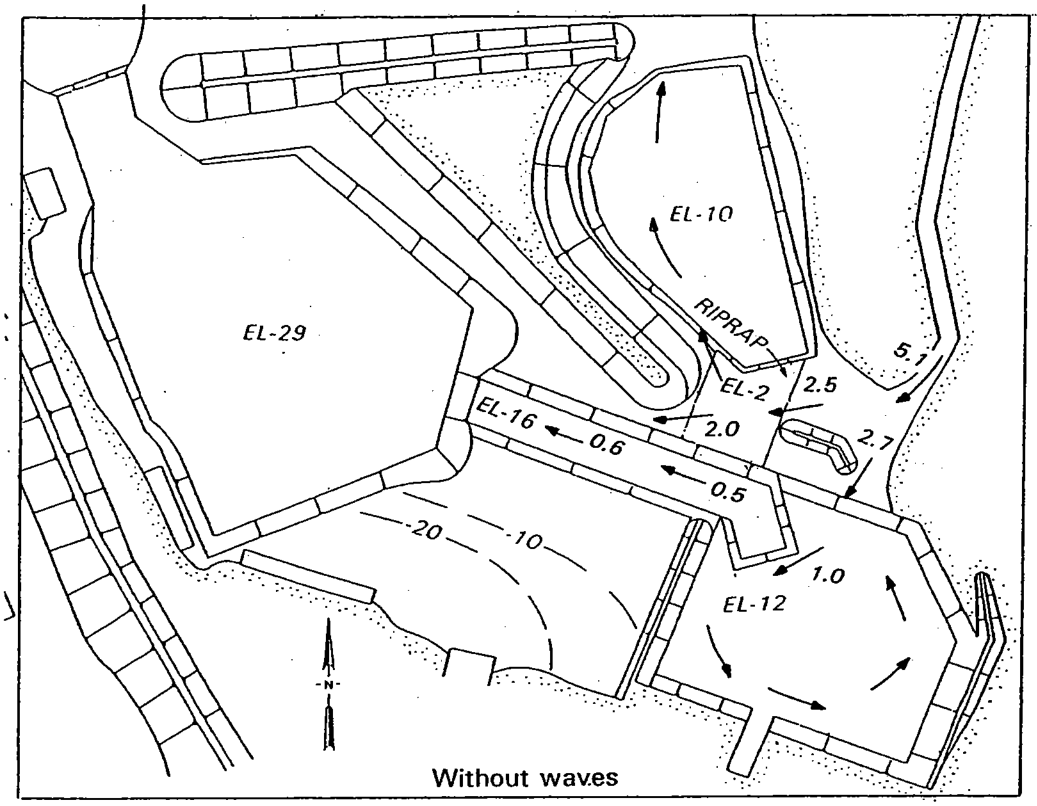
Plan 35

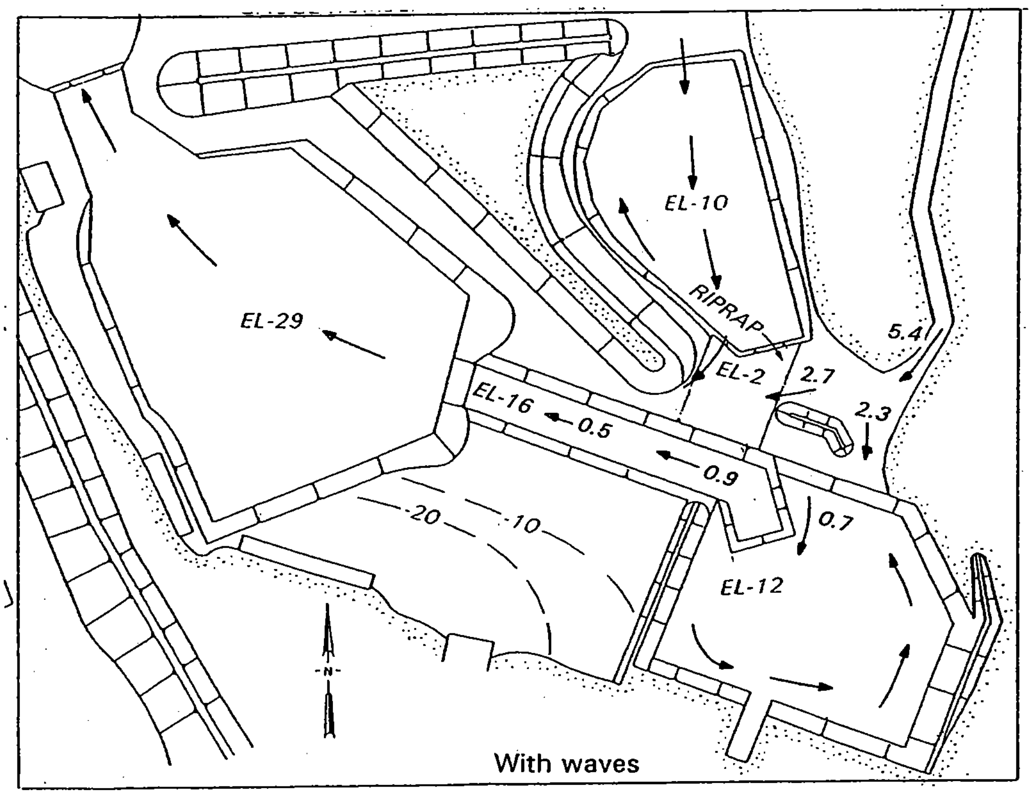
Wave induced current patterns and magnitudes (prototype feet per second) obtained for Plans 33-35, 16-sec, 19-ft waves with the +3.2 ft swl





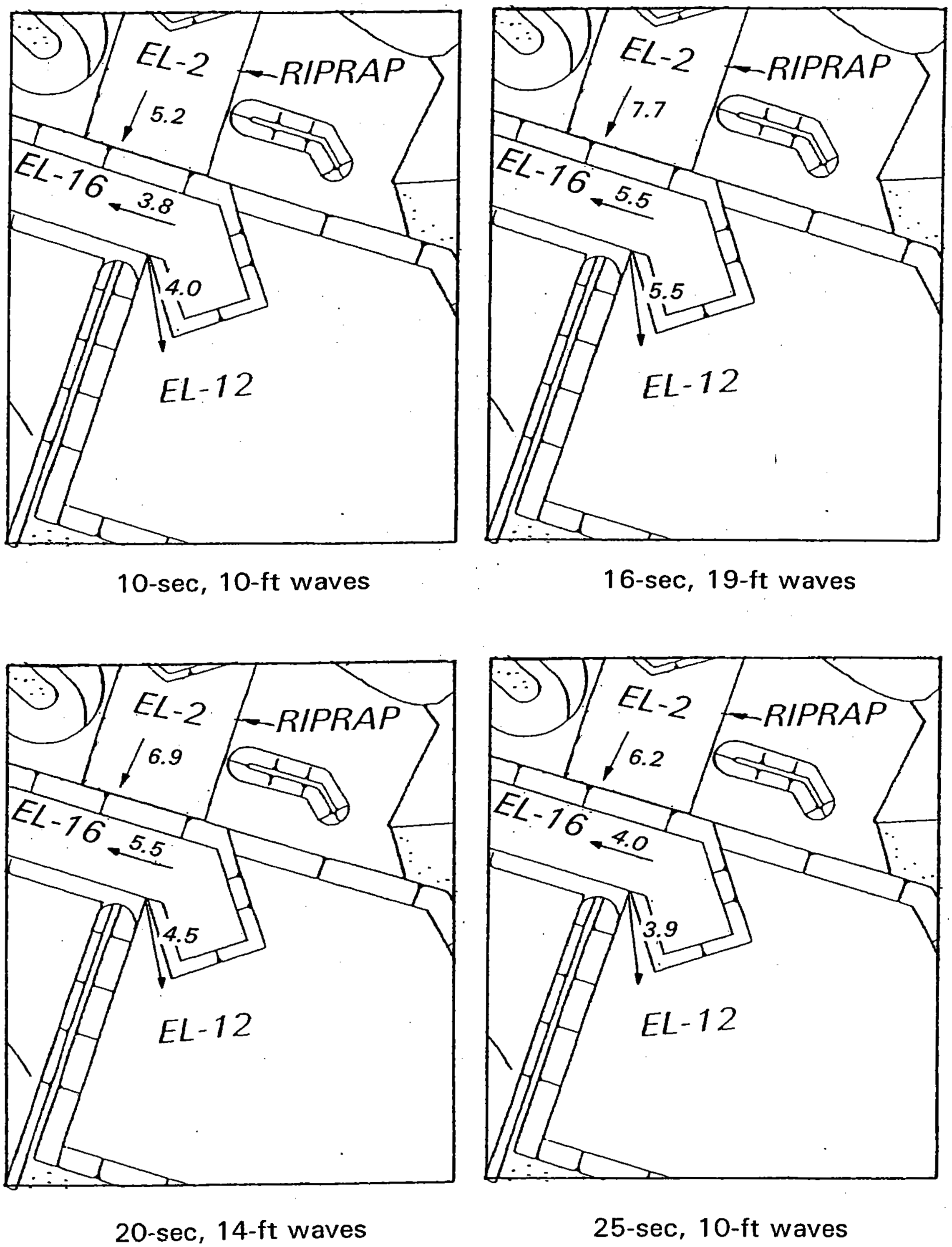
Ebb tidal currents for Plans 35 and 36 for the +7.0-ft tide range



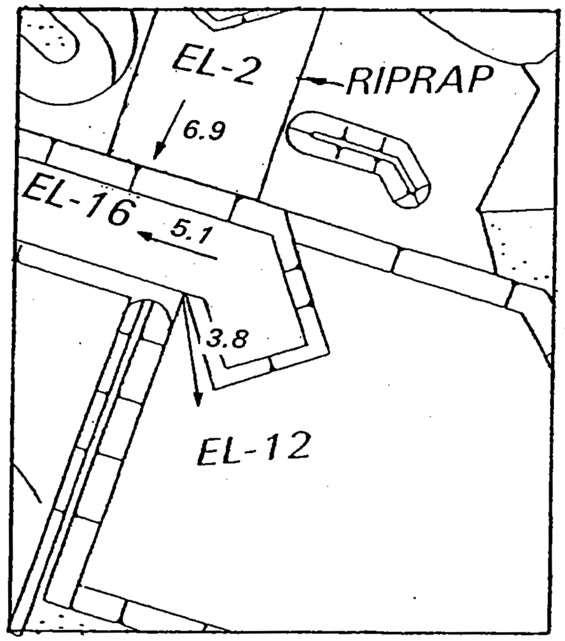


Ebb tidal currents for Plan 37 with and without waves for the +7.0-ft tidal range

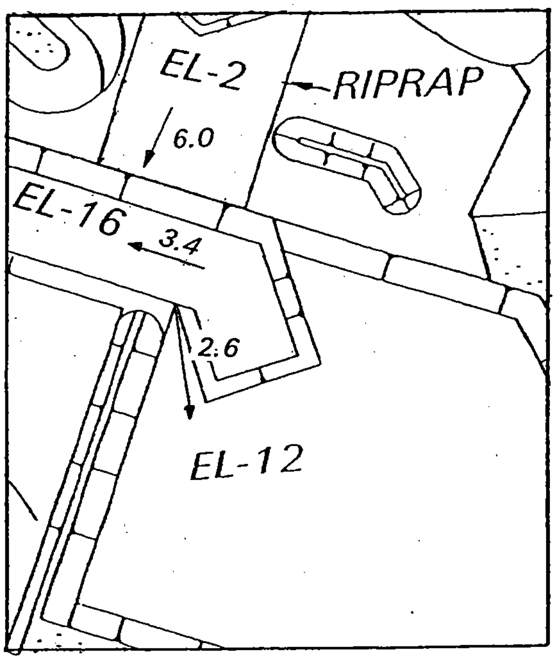
Exhibit A5.4



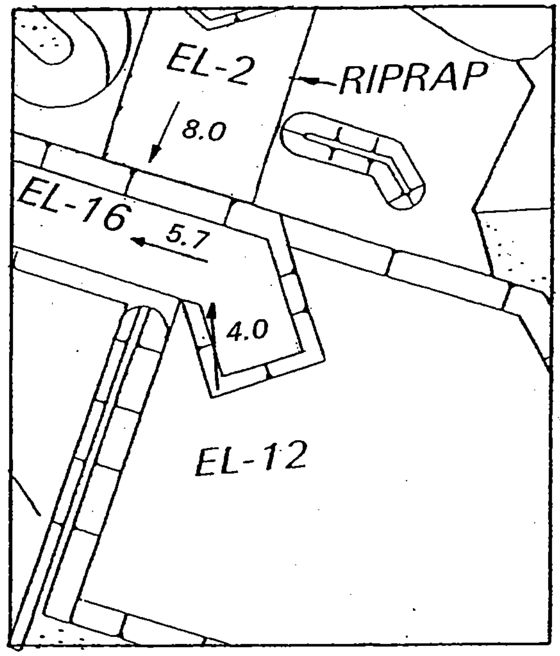
Wave induced current patterns and magnitudes (prototype feet per second) for Plan 37, swl= +3.2 ft



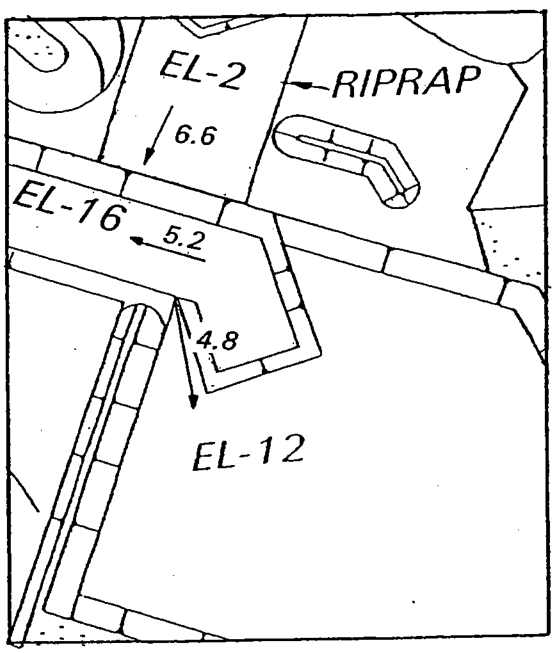
Wave induced current patterns and magnitudes (prototype feet per second) for Plan 37, 16-sec, 19-ft waves, swl= +7.0 ft



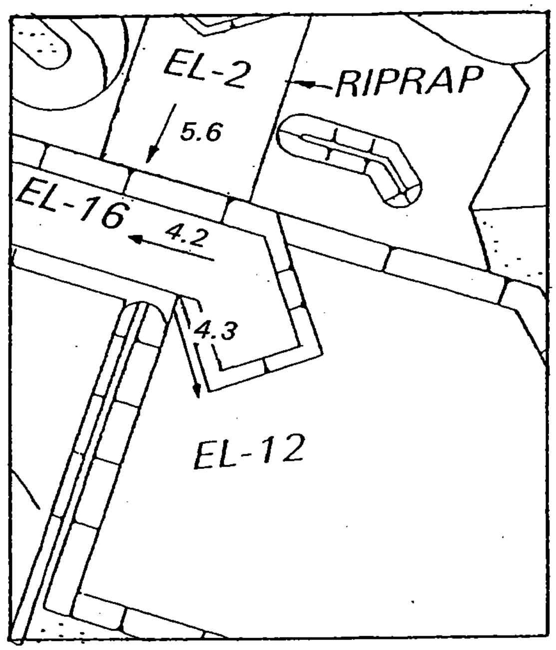
10-sec, 10-ft waves



16-sec, 19-ft waves

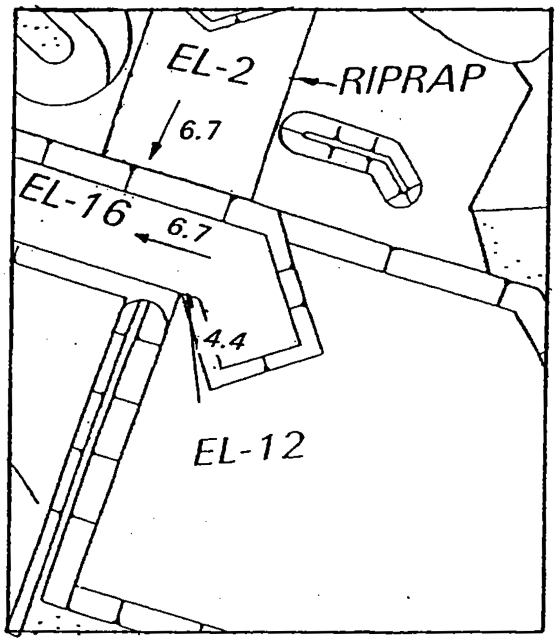


20-sec, 14-ft waves

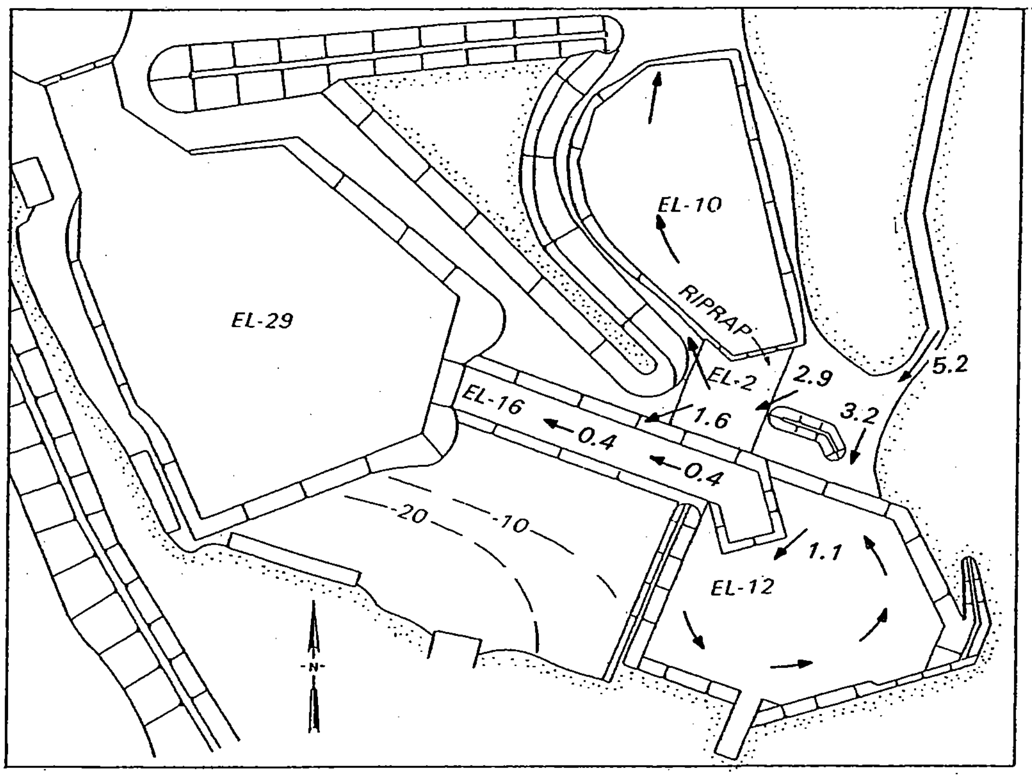


25-sec, 10-ft waves

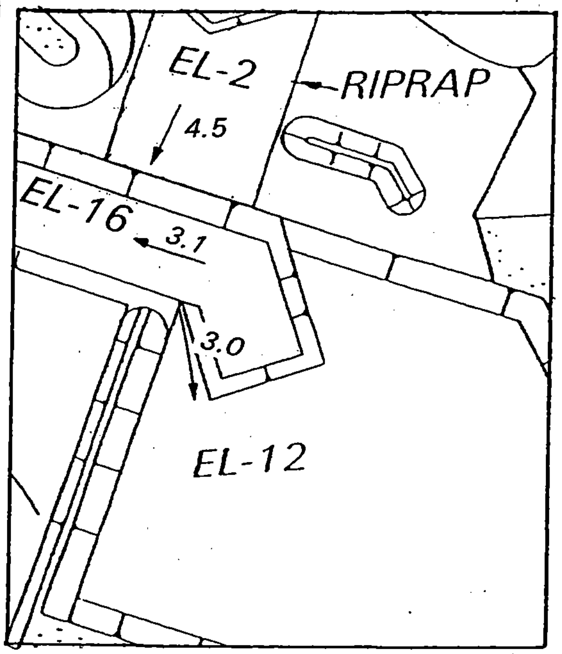
Wave induced current patterns and magnitudes (prototype feet per second) for Plan 38, swl = +3.2 ft



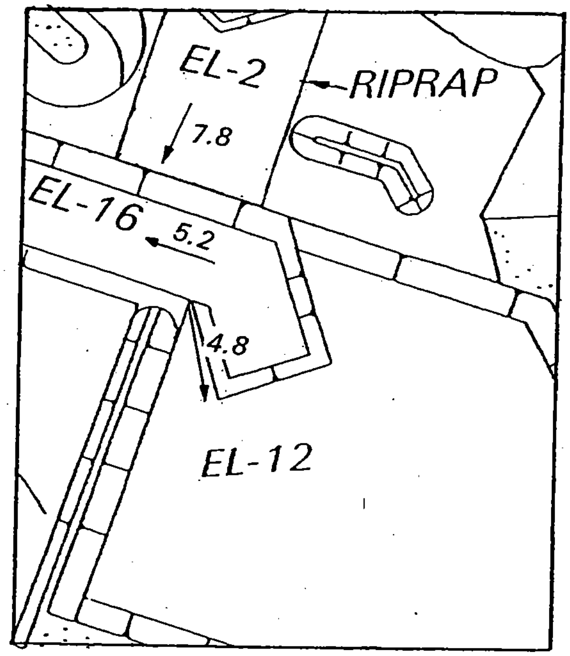
Wave induced current patterns and magnitudes (prototype feet per second) for Plan 38, 16-sec, 19-ft waves, swl= +7.0 ft



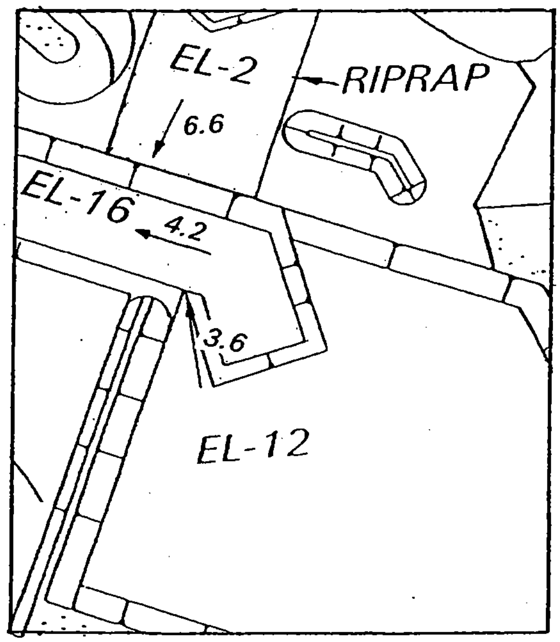
Ebb tidal currents for Plan 38 for the +7.0-ft tide range



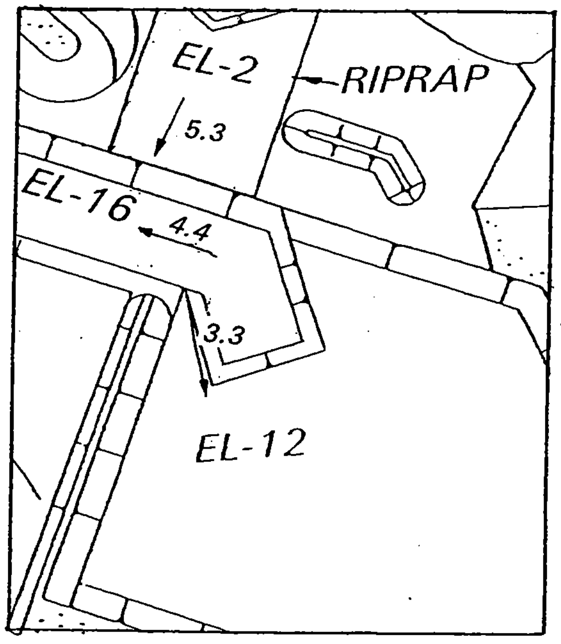
10-sec, 10-ft waves



16-sec, 19-ft waves

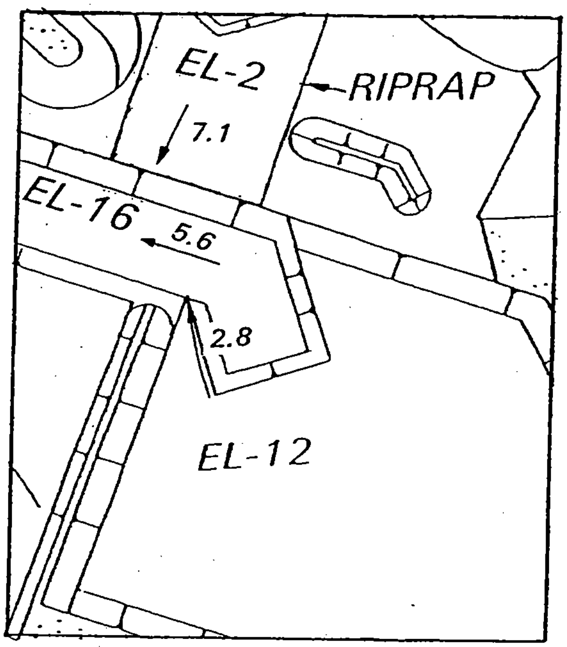


20-sec, 14-ft waves

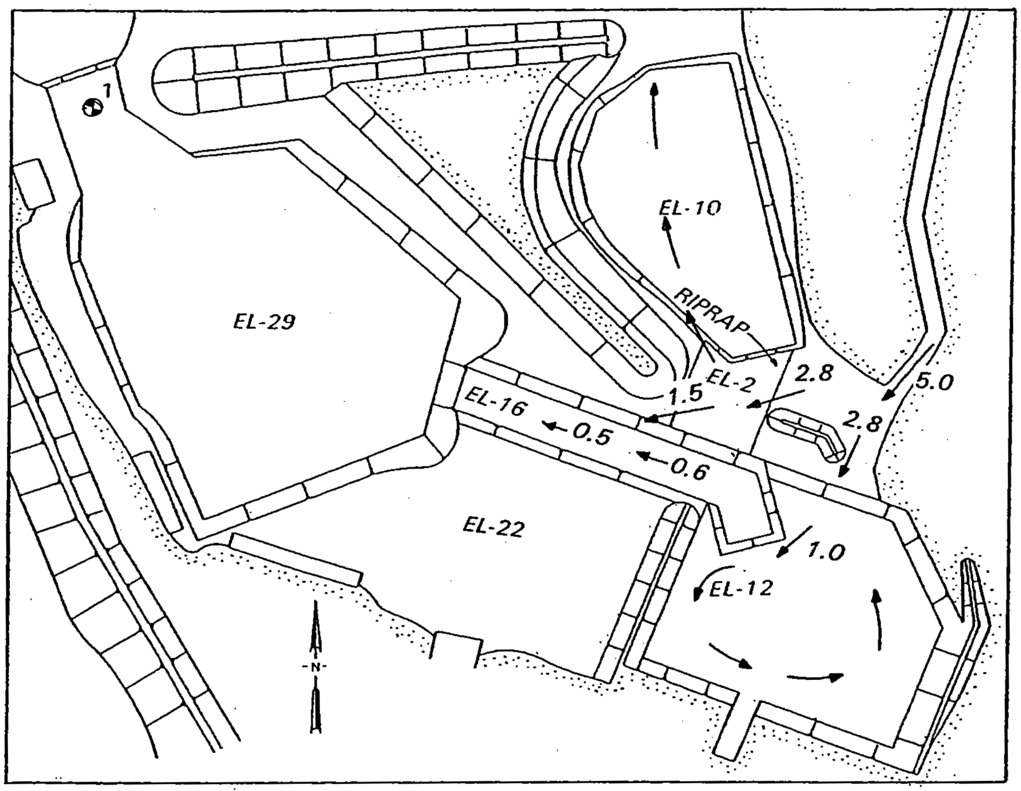


25-sec, 10-ft waves

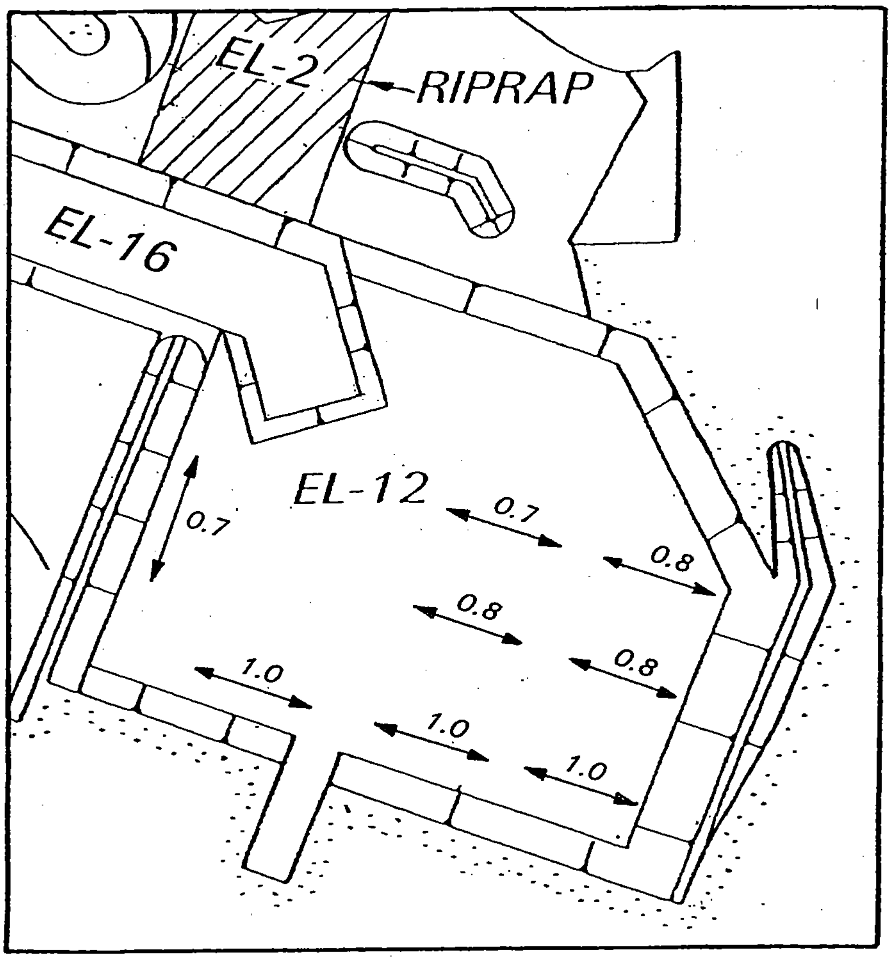
Wave induced current patterns and magnitudes (prototype feet per second) for Plan 39, swl= +3.2 ft



Wave induced current patterns and magnitudes (prototype feet per second) for Plan 39, 16-sec, 19-ft waves, swl = +7.0 ft



Ebb tidal currents for Plan 39 for the +7.0-ft tidal range



Current directions and maximun velocities (prototype feet per second) associated with harbor seiche for 60-vessel configuration

February 2001 Draft Report

Design for Small-Boat Harbor Improvements and Tidal Flushing at St. Paul Harbor, St. Paul Island, Alaska; Coastal Model Investigation

Robert R. Bottin, Jr., Hugh F. Acuff

US Army Engineer Research and Development Center
Coastal and Hydraulics Laboratory
3909 Halls Ferry Road
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Miscellaneous Paper
ERDC/CHL-01-

USAE District, Alaska
Post Office Box 898
Anchorage, Alaska 99506-0898

Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161

A 1:100-scale (undistorted) three-dimensional coastal hydraulic model was initially used to investigate the design of proposed harbor improvements at St. Paul Harbor, St. Paul Island, Alaska, with respect to wave and current conditions in the harbor and sediment patterns at the site. Wave-induced circulation and sediment patterns seaward of the main breakwater as a result of submerged reefs were investigated. Proposed improvements consisted of deepening the entrance channel, constructing a maneuvering area and installing a wave dissipating landfill inside the existing harbor, and constructing submerged reefs seaward of the main breakwater. The model was reactivated in 1997 to study, on a preliminary basis, small-boat harbor improvements and flushing of Salt Lagoon in St. Paul Harbor. In this study, the model was reactivated to finalize the design of small-boat harbor improvements and flushing at St. Paul Harbor. The model reproduced approximately 2,865 m (9,400 ft) ft of the St. Paul shoreline, the existing

Tidal flushing
Harbors
Wave protection
Hydraulic models
Wave-induced currents
St. Paul Harbor, St. Paul Island, Alaska
Wave dissipating landfill

UNCLASSIFIED UNCLASSIFIED

19. ABSTRACT (Continued).

harbor, the surface area of Salt Lagoon with its connecting channel to the harbor, and sufficient offshore area in the Bering Sea to permit generation of the required test waves. An 18.3-m-long (60-ft-long) unidirectional, spectral wave generator and an automated data acquisition and control system were used in model operation. It was concluded from study results that:

a. Preliminary experiments indicated that all improvement plans would result in wave heights of less than 0.3 m (1.0-ft) in the small-boat mooring area for short-period storm wave conditions.

b. Preliminary experiments indicated that the harbor would experience long-period (surge) conditions for all the improvement plans.

c. Preliminary experiments indicated that the area between the wave-dissipating spending beach and the interior detached breakwater should be constructed to an el of -0.6 m (-2.0 ft) to reduce wave heights in the small-boat harbor mooring areas. Excessive wave-induced currents in this area, however, indicated that the area should be hardened (capped with riprap) to prevent scour.

d. Preliminary experiments indicated that strong wave-induced currents in the interior channel may cause navigation difficulities for extreme storm wave events. Strong wave-induced currents along the area east of the shore-connected breakwater also may pose problems for vessels mooring in this vicinity. These current magnitudes also indicate that toe protection at the head of the structure may be required.

e. Preliminary experiments indicated that the angled interior detached breakwater would result in enhanced circulation and better distribution of flow in the small-boat harbor basin for ebb tidal currents as opposed to the straight structure.

f. Preliminary experiments indicated that the -4.9-m-deep (-16-ft-deep) interior channel would result in enhanced wave-induced circulation and stronger eddies in the small-boat basin as opposed to the -3.7-m-deep (-12-ft-deep) channel.

g. Experiments indicated that the 60-vessel plan configuration (Plan 37) will provide adequate wave and surge protection to the small-boat harbor as well as adequate harbor circulation.

h. Experiments indicated that the 30-vessel plan configuration (Plan 38) will provide adequate wave and surge protection to the small-boat harbor as well as adequate harbor circulation.

i. Experiments indicated that a reduction of depths in the harbor to -6.7 m (-22 ft) west of the interior shore-connected breakwater (Plan 39) will have no negative impacts on wave and surge conditions or harbor circulation in the small-boat harbor.

j. Experiments indicated that long-period surge conditions in the harbor should not cause problems in the small-boat mooring areas provided dock systems are properly oriented and vessels properly moored.

k. Experiments indicated that the 0.0-m (0.0-ft) el of the wave-dissipating spending beach (with the +1.2-m (+4.0-ft) berm along its perimeter) studied during this period will provide essentially the same level of protection from storm waves in the mooring area as the +3.7-m (+12.0-ft) el spending beach tested in earlier studies.

APPENDIX B

ECONOMICS ANALYSIS

GENERAL REEVALUATION REPORT
SAINT PAUL SMALL BOAT HARBOR

1. INTRODUCTION AND BACKGROUND

This addendum documents a limited update of the economic evaluation presented in the Saint Paul Small Boat Harbor General Reevaluation Report (GRR). The GRR analysis was completed in 2001 and benefit values were presented in October 2001 dollars. The GRR analysis follows this addendum. Corps policy, as stated in ER 1105-2-100, requires that economic data be current at the time that a decision document is submitted for approval. In order to verify that the conclusions of the evaluation are applicable under current conditions all of the assumptions in the evaluation were reviewed and key components of the benefit calculations were brought to current price levels.

The original evaluation was conducted with a view towards conditions expected to prevail over the long-term, or more specifically over the 50-year planning period of analysis. Given this view, it is not surprising that many of the assumptions made in 2001 are still applicable today. Perhaps most important is that the 2001 evaluation incorporated the expected downturn in regional crab fisheries and anticipated the potential for fleet consolidation when a new rationalization plan was introduced. The industry is indeed undergoing structural changes brought about by regulatory decisions and reduced harvest totals in the crab fisheries. In spite of this consolidation, Saint Paul is well positioned to take advantage under the new regulatory framework because of the locally based processing activities.

The critical link between fishery resources and project benefits is explained in paragraph 3.2.1 of the GRR Economic Appendix and is copied below. The evaluation is essentially based on four key steps: 1) Estimate the harvest value; 2) Estimate the Fleet size (moorage demand); 3) Estimate vessel operating budgets; and 4) calculate the NED benefits that would result from changes in fleet income.

3.2.1. ROLE OF RESOURCE ASSESSMENT IN THE BENEFIT ANALYSIS

The establishment of a defensible estimated harvest from Saint Paul, under the with-project and without-project, was central to an evaluation of benefits for a new harbor. Overall there is no increased catch, however, the increase in Saint Paul based harvest, under with-project conditions, supported a flow of potential project related gross income to the island, which was used to estimate the number of vessels that could be supported there. The resource assessment was therefore the key to predicting the "with-project fleet." The projected gross harvest by the Saint Paul based fleet is summarized in table 3.

After derivation of the fleet, and the gross income, the benefit analysis was linked to identification of cost differences between harvest operations out of Saint Paul and an alternative port. In order for the cost differences to be estimated, sample vessel operating budgets were developed. The budgets were established for vessels typical of the future fleet and show costs incurred in a typical year. Data from fishers, manufacturers, other reports, and published sources were relied on (see budgets and footnotes). The budgets (see tables 6, 7, 8, and 9) were important to the benefit analysis because they were used to derive the hourly cost of operations. Benefits depend to a certain extent on being able to make the case that a harvest out of Saint Paul will require fewer hours and less travel, hence be less costly. The importance of the budgets is further addressed in the risk and uncertainty portion of this report.

Given that the original evaluation incorporated risk and uncertainty analysis and that many of the recent events were anticipated in the benefit analysis, it could be argued that the results of that evaluation are sufficiently current as written and can be used as a basis for decision-making. Many of the structural changes in the fleet are neutral or potentially positive changes for the Saint Paul participants because the island is located in the center of the important fisheries and enjoys a significant location advantage over Akutan and Unalaska where much of the processing infrastructure is located. This location advantage, the local processing quota for the opilio crab fishery, as well as the local harvests taken as part of the Community Development Quota program are expected to ensure that a portion of the harvest will be taken by a small fleet of vessels operating from Saint Paul. The anticipated fleet size should approximate the numbers estimated in the 2001 analysis. Derivation of the fleet size is outlined in the sections that follow and is a replication of the 2001 procedures, using recent harvest data and updated Saint Paul landing data under the rationalization plan.

2. COMMUNITY PROFILE

The socio-economic setting of St Paul is largely unchanged from the conditions in place at the time of the latest economic analysis. The population remains at about 500 residents, with seasonal peaks above 600, and the local economy continues to depend on local government and commercial fisheries for employment opportunities. As stated in the prior economic analysis, problems and opportunities of the community are directly connected to the resources of the Bering Sea, and the community believes that the sea offers the best opportunity for a sustainable local economy. The sea is a critical subsistence resource and also supports the local multi-species processors operated by Trident and American Seafoods. Icicle Seafoods operates a floating processor in the harbor and up to nine other floating processors have operated nearby in recent years. Fish taxes have historically been the largest single revenue source for the community.

The estimated 2004 per capita income is $18,400. Per capita income is utilized in this evaluation as an important threshold for estimating future participation in the fishery. It is expected that income from fishing would have to equal 120 to 140 percent of the per capita income in order to induce entry into the industry by local residents.

The community remains an energetic supporter of the small boat harbor project and is pursuing several initiatives that will allow them to take advantage of the opportunities presented by the development of a locally based day-fleet. The local Community Development Quota (CDQ) group, the Central Bering Sea Fishermen's Association (CBSFA), is the organization spearheading many of these initiatives. Section 2.2 of the GRR economic appendix outlines the problems and opportunities from CBSFA's perspective and briefly addresses their efforts to alleviate these problems. In recent years, the organization has acquired a crane to launch and retrieve vessels, has implemented a vessel repair and maintenance project to support the local fleet, has continued to provide financing for local vessel owners, has acquired ownership interest in local processors, and has created a subsidiary to accumulate quota shares in regional fisheries.

3. STEP ONE: ESTIMATE HARVEST VALUE

Step one of our evaluation is to estimate the harvest value for the anticipated local fleet. This estimate is made by determining the average annual harvest and applying the average ex-vessel value to arrive at harvest value. The GRR correctly assumed that fisheries managers would close the king crab fishery for several years and would limit the harvest of opilio (snow crab) to less than 40 million pounds annually. The following table shows the annual harvest levels of crab in the Eastern Bering Sea from 1990-2004. Average annual harvest of opilio, the most important single species, dropped from 185.4 from 1990-1999 to 132.99 when the 2000-2004 harvests are added to the record.

Table 1. 1990–2004 Crab Harvest Data Eastern Bering Sea

(million lb)

Year	Opilio	Pribilof Red/Blue King	St Matthew Red/Blue King
1990	160.0	0	1.7
1991	325.2	0	3.2
1992	313.0	0	2.5
1993	229.2	2.6	3.0
1994	148.0	1.3	3.7
1995	74.0	2.0	3.1
1996	64.4	1.1	3.0
1997	117.1	1.2	4.4
1998	240.0	1.2	2.9
1999	183.4	0	0
2000	30.8	0	0
2001	25.3	0	0
2002	32.3	0	0
2003	28.3	0	0
2004	23.9	0	0
TOTAL	**1994.9**	**9.4**	**27.5**
AVERAGE	132.99	0.63	1.83

The impact of this reduced harvest on the Saint Paul economy is mitigated however by a new structure in the crab fishery. With the season that started on August 15, 2005, a new three-tiered quota system was put into effect for the Bering Sea-Aleutian Island crab fisheries. This new rationalization plan allocates shares of the crab harvest to fishermen, processors and communities. The plan is intended to increase safety by eliminating the "race to fish" and should also increase efficiency by reducing the overcapitalization in the harvest and processing sectors of the industry. Under the plan, catchers will be able to harvest their quota over the entire season rather than rushing to catch the entire allowable catch within a matter of hours, as has been the case in some fisheries during recent harvests.

Saint Paul is a beneficiary of the new regulations because of its historic participation in the processing industry. Forty-two percent of the processor quota for opilio and 9.5% of Bristol Bay Red King Crab was allocated to the Pribolof Islands and will likely be landed in Saint Paul due to the limited processing infrastructure at Saint George. The 2001 economic evaluation estimated that 35% of the opilio harvest would be landed at Saint Paul, so the requirements of the rationalization plan will increase local landings above the share expected in the GRR. Ex-vessel prices have also increased in recent years due to the limited crab harvests. The combined effect of increased landings and increased average price produce an estimated harvest value for the local fleet that is remarkably similar to the estimate determined in the 2001 economic analysis. Table 2 below shows the relevant calculations. The current harvest value is $2,533,600, compared to $2,530,000 in 2001.

Table 2. Average Annual Crab Harvest From The Eastern Bering Sea, 1990–2004

Species	Exvessel Price ($)	Harvest (lb)
Tanner Crab	1.23	132,990,000
Saint Matthew Blue King	2.89	1,830,000
Pribilof Red and Blue King	3.89	630,000
Total Annual Harvest		135,450,000
Saint Paul Island Landings Using 42% Quota		56,889,000
Weighted Average Price	1.26	
Annual Value of Saint Paul Landings	71,68,140	
Value of Landings by Vessels <60 ft	1,433,600	
Portion of Values In CDQ Allocation	1,100,000	
Estimated Potential Local Fleet Harvest	2,533,600	

4. STEP 2: DERIVATION OF FLEET SIZE (MOORAGE DEMAND)

The fleet size is estimated by comparing the value of the local harvest (and the proportionate share of the harvest that can be realized by individual catchers) to the local per capita income. The 2001 analysis assumed that local participants would be induced into the industry if they could realize incomes 120 to 140 percent of the per capita income. The result of the harvest value calculations in step one indicate that the derivation of fleet size in the 2001 can be accepted as applicable under current conditions, given that the income threshold is relatively equal to the level used in the 2001 report. Tables 4 through 7 of that document do not require updating and are accepted as representative of the day fleet expected to develop in Saint Paul under current conditions. The fleet is still expected to consist of 60 vessels up to 60 feet in length.

5. STEP THREE: ESTIMATE VESSEL OPERATING BUDGETS

A review of the vessel operating budgets indicates that the key components are the investment cost, food, fuel and crew share. Other components were expressed as percentages of the investment costs and would only vary if the investment cost has changed since 2001. The investment costs used for the typical vessels in the original evaluation were gleaned from 200 sample sales listings in the year 2000. A spot check of current sales records indicated that vessels in each category varied around the values shown, however the number of samples is limited so an average value could not be determined with confidence. The current listings are consistent with the 2000 values, so the investment costs were assumed to be the same. Insurance, fees, business expenses and maintenance are proportional to vessel costs so they will remain at the same levels shown in the original evaluation. Crew shares are a percentage of ex-vessel values paid for the vessel harvest. In step one, expected harvest values were determined to be approximately the same, so crew shares will also remain unchanged. Consequently, food and fuel are the only values that have changed appreciably. Fuel costs, estimated to be $1.30 per gallon in 2001, were originally based on weekly observations in Saint Paul and Dutch Harbor over a twenty-month period. Regular observations were not continued following completion of the evaluation; however, the feasibility report prepared for the Unalaska small boat harbor project used a fuel/lube cost of $1.52 per gallon, expressed in 2004 prices, based on regular observations. This value is adopted here. The food cost per crew member has increased by $1 per day, from $20 to $21. Table 3 shows the original and updated operating budgets for the Saint Paul fleet.

Table 3. Typical Operating Budgets Expanded Saint Paul Fleet

	Seine/trawl/crab (58 ft)		Seine/longline/crab (58 ft)		Seine/longline (45 ft)		Longline (32 ft)	
	Yr. 2001	Yr. 2005	Yr. 2001	Yr. 2005	Yr. 2001	Yr. 2005	Yr. 2001	Yr. 2005
Repair/maintenance	90,000	90,000	32,000	32,000	13,500	13,500	6,400	6,400
Hull Insurance @ 5%	45,000	45,000	16,000	16,000	6,700	6,700	3,000	3,000
P&I Insurance @ 2%	18,000	18,000	6,400	6,400	2,700	2,700	1,200	1,200
License/permit fees	47,200	47,200	18,300	18,300	9,000	9,000	5,400	5,400
Association dues	1,000	1,000	1,000	1,000	500	500	300	300
Business expenses	18,000	18,000	7,000	7,000	2,600	2,600	1,200	1,200
Food	16,400	17,200	13,000	13,600	11,800	12,400	4,400	4,600
Fuel	209,800	237,800	92,100	104,400	82,600	96,500	20,500	24,000
Return on capital	59,200	59,200	21,000	21,000	8,900	8,900	4,200	4,200
Crew share	504,600	504,600	206,800	206,800	138,300	138,300	46,600	46,600
TOTAL ($)	**1,009,200**	**1,038,000**	**413,600**	**426,000**	**276,600**	**291,100**	**93,200**	**96,900**

Table 4. Hourly Equivalent Cost Summary

	Seine/trawl/crab (58 ft)		Seine/longline/crab (58 ft)		Seine/longline (45 ft)		Longline (32 ft)	
	Yr. 2001	Yr. 2005	Yr. 2001	Yr. 2005	Yr. 2001	Yr. 2005	Yr. 2001	Yr. 2005
Fuel cost (%)	21	23	22	25	30	33	22	25
Hourly fuel cost	106.50	124.64	47.00	54.72	47.00	54.77	23.60	27.36
Hourly fuel + repair + maintenance	134.30	171.80	56.80	71.49	53.50	62.36	32.50	34.70
Combined hourly variable	26	32	27	32	34	38	30	31
Total hourly cost ($)	**512.80**	**544.03**	**210.20**	**223.27**	**156.80**	**165.00**	**106.40**	**110.62**

6. STEP FOUR: ESTIMATE NED BENEFITS

Reduced Transportation Cost Related to the Harvest Activity

The hourly vessel operating budgets generated for this report are $171.80 and $71.49 for two configurations of 58 ft vessels. The travel cost under the without-project condition is $812,614 (larger 58 ft vessel) and $338,147 (smaller 58 ft vessel) for a without-project harvest related travel cost of $1,228,662. In addition, there are 17 small vessels fishing an average of 22 days out of Saint Paul with an annual variable cost of $77,867. When compared to the with-project condition, travel cost of $744,848, the saving provided by the small boat harbor will be **$483,800** annually.

Table 5. Without–Project Harvest Related Travel Cost

Size	Fishable Days	Days Fished	No. Vessels	RT Hours	Cost/Hour ($)	Total ($)
0–25 ft	48	14	28	Nil		
26–32 ft	73	22	17	2,244	34.70	77,867
58 ft by 17 ft (beam)	159	159	19	4,730	71.49	338,147
58 ft by 23 ft (beam)	159	159	19	4,730	171.80	812,614
						1,228,662

Table 6. With–Project Harvest Related Travel Cost

Size	Fishable Days	Days Fished	No. Vessels	RT Hours	Cost/Hour ($)	Total ($)
0–25 ft	48	14	28	Nil		
26–39 ft	73	22	17	2,244	34.70	77,868
40–55 ft	147	44	13	3,432	62.36	214,020
55–58 ft	159	48	22	6,336	71.49	452,960
						744,848

Prevention of Damages

Benefits estimated for prevention of damage to the expanded fleet are expected to be a function of value as well as crowding. The estimated value of the Saint Paul fleet is unchanged from the 2001 evaluation so the benefit estimate remains unchanged at **$127,900** annually.

Prevention of Theft

Benefits estimated for prevention of theft were based on personal interviews with the local fishermen and were expected to vary according to the value of the fleet. The estimated value of the Saint Paul fleet is unchanged from the 2001 evaluation so the benefit estimate remains unchanged at **$52,000** annually.

Prevention of Vandalism

Vandalism damages (and benefits) were estimated as a function of fleet value, so the annual benefit estimate will remain unchanged at **$21,000**.

Delay Prevented by Water Taxi Service

The hourly operating cost for vessel operating in the without project condition was based on fuel/lube costs of $1.39 per gallon and produced an hourly variable operating cost of $90. Current fuel/lube costs are 9.4% higher at $1.52 per gallon, producing an hourly variable operating cost of $98.40.

Without the project, vessels waiting cost will be $98.4 x 1996 hours = $196,400. Wave activity outside the harbor will make it impractical to provide water taxi service 35% of the time so preventable waiting cost is $127,700. Under the with-project condition, delivery cost will take less than an hour per vessel and will be $71.49 x 650 deliveries = $46,500. Benefits associated with water taxi service made possible by the project are now estimated to equal **$81,200**, an increase of $1,200 from the 2001 estimate.

Transportation Savings for Scheduled Repair

NED benefits are earned from reduction of travel to other facilities outside of the Saint Paul area. The 2001 analysis included a stochastic analysis of delays that does not need to be repeated here. The variables of that analysis are applicable today with the exception of the hourly operating costs. The weighted hourly costs were estimated to be $38 for the vessels seeking repair in Saint Paul. Total hourly operating costs for the Saint Paul fleet have increased by approximately 6 percent since that time, so the costs for the transient vessels seeking repair has been estimated at $40 to reflect a 6 percent increase. In the without-project condition the cost of vessel repair trips to Oregon and Washington is 48 trips x 400 hours per round trip x $40 weighted average hourly cost of the fleet = $768,00.

Under the with-project condition, at least 75% of the customers will still need to travel to Saint Paul from other locations, including Dutch Harbor, False Pass, King Salmon, King Cove, Port Heiden, Nelson Lagoon, Akutan, Nikolski and several smaller villages in the Yukon Delta. With an average round trip travel time of 60 hours in the with-project condition for 75% of the customers or 83, the travel saving of using a repair facility at Saint Paul is $768,000–$199,200 = **$568,800,** an increase of $28,400 from the 2001 estimate.

Port Land Opportunity Cost

The benefit estimate from the 2001 analysis is assumed to be applicable today. Any change would be minimal and would not have a material affect on the formulation of this project.

Opportunity Cost of Launch and Retrieval

The benefit estimate from the 2001 analysis is assumed to be applicable today. Any change would be minimal and would not have a material affect on the formulation of this project.

Transportation Savings for Disabled Vessels

Vessel operating costs for ocean going tugs are estimated to be $494 per hour. The round trip cost equals $494 x 550 miles/6.5 knots = $41,800. An average of five events per year would be prevented, therefore annual benefits for this category are **$209,000**, an increase of $10,700 from the 2001 estimate.

Reduced Harbor Maintenance Cost

The benefit estimate from the 2001 analysis is assumed to be applicable today. Any change would be minimal and would not have a material affect on the formulation of this project.

Improved Subsistence Fishery

The benefit estimate from the 2001 analysis is assumed to be applicable today. Any change would be minimal and would not have a material affect on the formulation of this project.

7. BENEFIT SUMMARY

Table 7 presents a comparison of the 2001 estimate of total NED benefits to the updated estimate. The changes were the result of increased operating costs, largely caused by a six percent increase in the average cost of fuel and lubrication costs. Short-term spikes in costs have recently driven these costs even higher, however this analysis relies on the observed costs used in the 2004 Unalaska feasibility study to reflect a reasonable long-term value.

Table 7. Benefit Summary

(Costs, thousands)

	Yr. 2001	Yr. 2005
Prevention of Damage	127.9	127.9
Prevention of Theft Loss	52.0	52.0
Prevention of Vandal Loss	21.0	21.0
Harvest Cost Reduction	360.3	483.8
Delay Prevented by Water taxi Service	80.0	81.2
Transportation Savings for Scheduled Repair	540.4	568.8
Port Land Opportunity Cost	20.0	20
Vessel Haul Out	69.8	69.8
Transportation Savings for Disabled Vessels	198.3	209
Dock Maintenance	48.1	48.4
Subsistence Fishery	399.6	399.6
TOTAL	**1,917.4**	**2081.5**

The proposed 60-vessel harbor has a construction cost of $11,754,000. Applying a 5 1/8% discount rate over a 50-year period produces average annual costs of $849,000, which includes interest during construction and an annual O&M cost of $159,000. Average annual benefits are $2,082,000, producing a benefit cost ratio of 2.50 and net benefits of $1,233,000.

ECONOMICS ANALYSIS

GENERAL REEVALUATION REPORT
SAINT PAUL SMALL BOAT HARBOR
SAINT PAUL, ALASKA

Prepared for

U.S. Army Corps Of Engineers, Alaska District

Under Contract With Tetra Tech ISG

By

Consulting Economist, Inc.

CONTENTS

TABLES

EXHIBITS

ABBREVIATIONS

ABC	Allowable Biological Catch
ADFG	Alaska Department Of Fish & Game
ADOT	Alaska Department Of Transportation
BSAI	Bering Sea Aleutian Islands
CBSFA	Central Bering Sea Fishermen's Association
CDQ	Community Development Quota
CFEC	Commercial Fisheries Entry Commission
EBS/AI	Eastern Bering Sea/Aleutian Islands
EEZ	Exclusive Economic Zone
F/V	Fishing Vessel
fps	feet per second
ft	foot/feet
ft^2	square feet
FTE	Full Time Equivalent
GHL	Guideline Harvest Level
gph	gallons per hour
hp	horsepower
hr	hour(s)
IFQ	Individual Fishing Quota
I-O	Inboard-Outboard
IPHC	International Pacific Halibut Commission
IRA	Indian Reorganization Act
kW	kilowatt(s)
lb	pound(s)
LLP	Limited License Program
LOA	Length Overall
LRIC	Long Run Incremental Cost
MHHW	Mean Higher High Water
MHW	Mean High Water
MLLW	Mean Lower Low Water
MLW	Mean Low Water
MSL	Mean Sea Level
mt	metric ton
NED	National Economic Development
nm	nautical mile(s)
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRC	Natural Resource Consultants
PNW	Pacific Northwest
TAC	Total Allowable Catch
TDX	Tanadgusix Corporation
WRDA	Water Resources Development Act

EXECUTIVE SUMMARY

Developments in the Bering Sea fishing industry have forced Saint Paul to move rapidly towards development of a small boat harbor able to accommodate vessels (fleet) up to 58 feet. The fleet will operate as a day fleet in the waters surrounding the island. Supported by the advantage of being at the center of the rich Bering Sea fishing grounds, the fleet will target halibut, cod, and crab for commercial and subsistence purposes. A fleet based at Saint Paul will provide transportation efficiencies over alternative ports. Lack of a harbor has restricted the size and number of local vessels.

Seven alternatives were evaluated, and South Village Cove was shown as the most attractive alternative concerning local needs and Corps' guidelines. The South Village Cove has the potential for being developed in phases, and at any scale of development that is economically sound from the local and NED point of view. Significant savings result from a fully developed plan which is demonstrated as having a benefit to cost ratio of 2.4:1. The NED alternative will also provide some relief to harbor congestion and conflicts between smaller and larger vessels vying to use docks at the deep-draft facility. The project will accommodate 60 vessels.

A series of political and business decisions were made in the U.S. and Japan during the 1980s, which structured the full U.S. development of the eastern Bering Sea crab, pollock, cod, and all other groundfish fisheries. When these key political and business decisions were made, Saint Paul was not on the development map from the fishing industry's perspective. Saint Paul, in spite of its location, had no harbor, no fleet, and virtually no infrastructure to support industry development.

Before October 1983, the island was classified as a Federal Government installation. The island was the center of fur sealing activities under the administration of National Marine Fisheries Service (NMFS). National Marine Fisheries Service accounted for more than 60% of the employment on the island, and when they withdrew in 1983, they left behind a community without an economic base.

Seven years later, the deep-draft Saint Paul Harbor was opened. This was in 1990 long after the domestic groundfish industry was fully developed, long after infrastructure investments had been committed, and long after the industry was in full swing at Dutch Harbor and Akutan where it had been built. Even so, the location advantage of Saint Paul attracted some processing, and a crab processor was moved there in 1993. Crab processing facilities were expanded in 1995 and then cut back in 1999. There has been no processing of other species with the exception of a few halibut in 2000.

There is no local harvest income from the crab harvest because the vessels operate out of other ports. There is no local small boat harbor. This has kept the fleet harvest by local fishermen near subsistence levels. To date the local fleet consists of 26 vessels all under 32 feet. With a harbor leading to development of a local fleet, the rich nearby Bering Sea stocks can provide an economic base, stability, employment, and growth. An expanded fleet based at Saint Paul will be the least cost way of harvesting stocks around Saint Paul.

1.0 STUDY SCOPE AND AREA

1.1 Scope of Study

The City of Saint Paul and the Corps share an interest in establishing the viability and Federal interest in development of a small boat harbor consistent with other harbor developments in progress. The shared concern is based on an opportunity for significant savings in mobilization cost should a small boat harbor be constructed concurrent with other work.

The engineering proposals included in this study were limited to proposals for development of a small boat harbor inside of the existing breakwater. The proposed plans were all separable from the completed and under construction (in 2000) deep-draft improvements in the sense they could be considered on a last added basis. None of the proposed small boat harbor alternatives were practical on a first-added basis, because all of the plans required a protected channel to the ocean. The scope of this study therefore included all deep-draft alternatives as if all authorized, under construction or permitted improvements were already in place. The purpose of this report is to support Federal participation in development of a small boat harbor and to identify the best alternative.

1.2 Study Participants

This economic study has been conducted through the cooperation of the City of Saint Paul, the Corps ft Alaska District, Tetra Tech Infrastructure Group, and Kenneth Boire Consulting Economist. Local needs were assessed through meetings with island residents and others who made important technical contributions to the planning process and formed a Citizen Participation Committee. Major contributors to the study include staff at the City of Saint Paul, The Aleut Community of Saint Paul, Pribilof Bering Seafood, Bering Sea Eccotech, Central Bering Sea Fishermen Association, Tanadgusix (TDX) Corporation, Alaska Department of Fish & Game, Island Stewardship Program, National Marine Fisheries Service, North Pacific Fisheries Management Council, International Pacific Halibut Commission, Natural Resource Consultants, and Waterfront Associates. Informally established protocol included coordination with the Alaska District Corps of Engineers through Clarke Hemphill, Project Manager at the time, and Andy Miller, Chief Economist at the time. Coordination with the City of Saint Paul was through Char Kirkwood, City Planner and John Merculief, City Manager. Coordination with the Citizen Participation Committee was through members at large of the Aleut Community of Saint Paul Island, Central Bering Sea Fishermen's Association, TDX Corporation, and the City of Saint Paul.

1.3 Location and Socioeconomic Setting

Saint Paul Island is in the eastern Bering Sea of Alaska, about 775 air miles west of Anchorage and 275 miles north of Dutch Harbor. The rocky, treeless, island has a land area of 44 square miles. It and a smaller adjacent island, Saint George, are the only islands in the Pribilof group, which are populated. Saint Paul has a resident population that fluctuates between 500 and 750. Population in 2000 has been reported to be 585. About 79% are Alaska Natives. The island has a fish processing industry, which imports several hundred seasonal workers when operating at peak production levels. Most of the processing workers are imported for seasonal jobs.

Before October 1983, the island was classified as a Federal Government installation. The island was the center of fur sealing activities under the administration of National Marine Fisheries Service (NMFS). National Marine Fisheries Service accounted for more than 60% of the employment on the island, and when they withdrew in 1983, they left behind a community without an economic base. Almost immediately the residents began to establish themselves as a strong, self-directed, viable community independent of NMFS.

The residents pulled together, and the City of Saint Paul proved itself as a forward thinking, active, and positive force. The City now provides utility services and numerous community services, including cooperation in health, housing, education, and environmental awareness. The City planning staff and management have been essential to the success of Saint Paul as an American city that works.

1.4 Economic Base

Despite a dedicated effort, the island has not fully developed a stable locally owned economic base. It has many low paying seasonal jobs to offer, and local managers must import workers to keep the food processing factories running. Existing local industry is the result of city development of a harbor to accommodate large fish catching and processing vessels. About 79% of adult residents have income from some form of employment, with the largest number involved in government, some 36%. Employment in local government is large because the government role is woven into almost every aspect of the local economy, which is based on the fishing industry. The island economy is closely tied to a transient fishing fleet and elements of the economy function as a trans-shipment point and processing station. Management of this industry support role is a focal point for local government. Major sectors of employment of island residents in the local economy are summarized below.

Table 1. Major Sectors of Employment

Sector	% Employed
Local Government	36
Education	19
Services	14
Trade	12
Fishing	18

At the time of the NMFS pullout, there was no harbor on the island. Supply ships had to anchor out and be unloaded to open skiffs, which took the cargo to the beach where it was carried ashore. Lack of a harbor kept a local fleet from developing, because sea conditions are too harsh for beachable skiffs. When the city developed the deep-draft harbor to create its own opportunity to enter the fishing industry, everything was scaled to the Bering Sea crab vessels and large trawlers of the groundfish industry. Even after the harbor was constructed, the protected area was far too rough to accommodate smaller vessels that the island residents were interested in owning, and able to afford for subsistence fishing. Today the fragile island economy is almost totally dependent on the boom–bust cycles of the trawler fleet and crab vessels that call at Saint Paul to off-load and re-provision. With a small boat harbor, the island residents will be able to look forward to participation in the fishing industry as owners of modern harvesting vessels.

The most recent data available shows average household earned income among the island permanent residents was $39,900 in 1999, and average income per employed person was $18,100.

Problems and opportunities of the community are tied to the resources of the Bering Sea. Therefore, the study area includes the Bering Sea area available to harvesters who would operate from Saint Paul, and the area of those based elsewhere but who would deliver to processors based at Saint Paul. Also included are the alternative harbors that would be used in the absence of Saint Paul. The most likely alternative harbor is Dutch Harbor, about 275 miles across the Bering Sea, to the south.

1.5 Environmental Setting

An estimated 250,000 sea birds of 11 species use Saint Paul Island for nesting and rearing young. The most abundant species are thick-billed murre, common murre, black-legged kittiwake, parakeet auklet, and least auklet. A large least auklet colony exists on Village Cove beach. Lesser numbers of waterfowl, shore birds, and songbirds are found on the island either as migrants or residents. Salt Lagoon, the only salt estuary in the Bering Sea, is an important resource for migrating sandpipers and turnstones as well as migratory Eurasian species. Waterfowl occasionally use the freshwater ponds on Saint Paul Island.

Land mammals inhabiting Saint Paul Island include reindeer, house mouse, Pribilof shrew, and arctic fox (blue phase). Reindeer were transplanted to Saint Paul Island in 1911 to provide subsistence meat for the Native population. Reindeer now roam freely on the island and are managed by the Saint Paul tribal government. Foxes are relatively abundant, particularly near bird colonies and on the main breakwater.

Northern fur seals, Steller sea lions, and harbor seals are abundant on Saint Paul Island during portions of the year. The northern fur seal is the most abundant. Seals come to the Pribilofs for breeding and pupping from early May to October, feeding within a 200-mile radius of the islands. Fur seals began migrating toward Southern California and Northern Japan during October and remain at sea until returning to the Pribilofs in May. They feed on anchovy, hake, herring, Alaska pollock, and other fish and squid. Other marine mammals, principally whales and porpoises, frequently are observed offshore at Saint Paul. Fur seals are seen inside the harbor and in the entrance to Salt Lagoon.

1.5.1 Endangered and Threatened Species

Two species of birds, six species of whales, and one sea mammal listed in the "United States List of Endangered and Threatened Wildlife and Plants" have been reported on or in the vicinity of the Pribilof Islands. The short-tailed albatross is reported as accidental in the Pribilofs, while a confirmed sighting of the Eskimo curlew has not occurred since the late 1880s. The six whales are the blue, finback, sei, humpback, right, and sperm. The sea mammal is the Steller sea lion, which occurs at two locations on Saint Paul Island but not in the vicinity of the harbor.

1.5.2 Climate

The climate is maritime, resulting in considerable cloudiness, heavy fog, high humidity, and restricted daily temperature fluctuations. The humidity remains uniformly high from May to late September. There is almost continuous low cloudiness and occasional heavy fog during summer months. The maritime influence in the Pribilofs keeps seasonal temperatures mild, and daily variations are kept to a minimum.

The island area has periods of high wind throughout the year. Frequent storms occur from October to April, often accompanied by gale-force winds to produce blizzard conditions. Under the influence of prolonged north and northeast winds between January and May, the sea ice occasionally moves south to surround the island.

1.5.3 Ice Conditions

The icepack in the Northern Bering Sea occasionally moves south and on occasion surrounds the island during periods of prolonged north and northeast winds between January and May. Mariners are warned by National Oceanic and Atmospheric Administration (NOAA) charts against the possibility of entrapment in Village Cove. An icebreaker has never been necessary for access to the island. It is conceivable that sea ice might possibly interfere with small vessel harvest activity of the proposed day fishery on some days during the months of January through May.

1.5.4 Waves

The existing harbor in Village Cove is in direct alignment with deep-water waves approaching between the west-northwest and southwest sectors. Deep-water waves approaching from the south and southeast sectors are partially sheltered by Saint George Island and Otter Island and would diffract around Reef Point before impinging on the project site. Southerly and southeasterly deep-water waves therefore undergo considerable energy reduction before affecting the project site. Village Cove is in the lee of Saint Paul Island for waves approaching from northwest clockwise through southeast. Waves in the Bering Sea are extremely large, and around the shallower waters of Saint Paul Island, their heights are depth limited during numerous events each year. Maximum wave height, expected near the entrance to the present harbor, is 27 feet. Wave heights in the present harbor are greatly modified by the breakwaters and spending beaches.

1.5.5 Harbor Water Quality

Harbor water quality is dominated by the exchange of tide-generated flow through the harbor on its way to and from Salt Lagoon and by wave driven currents. The Salt Lagoon surface is more than three times that of the harbor and more than double the tidal prism. The harbor waters are generally exchanged in one tidal cycle by just tidal flows. Harbor water is also exchanged by wave-generated setup even under minor storm conditions.

1.5.6 Salt Lagoon Water Quality

Salt Lagoon water quality appears to be dominated by tidal exchange. Because of the small range in tidal elevation and length of the basin, several tide cycles may be required before all the water is exchanged. Mixing of water in the tidal lagoon should be good because waters are shallow, and winds are frequent and strong enough to stir the lagoon from top to bottom. Storm surge causes supplemental exchange in the lagoon and periodic improvement of water quality.

2.0 PROBLEMS OF THE WITHOUT-PROJECT CONDITION

2.1 Existing Harbor

Historically, the island did not have a small vessel fleet until about 1995. During the NMFS years, the island residents depended on NMFS marine mammal programs for employment, and before 1983, the island was classified as a Federal Government installation. When NMFS withdrew in 1983, the community had to find other sources of employment. The community constructed the first deep-draft harbor consisting of a channel, breakwater, and dock in 1986, but the project was ineffective. The Corps of Engineers modified it and put it into service fully in 1995. Until this harbor facility was installed, there was no small vessel fleet at Saint Paul except a few skiffs and traditional skin vessels used to lighter for vessels delivering freight to the island. The local fleet grew from a few open outboard powered skiffs to 26 ft, aluminum, I-O driven vessels in less than a five-year period. Most of the vessels are in the 20 ft to 30 ft class, and they are used in a day fishery for halibut, within sight of the island.

2.2 Local Concerns

The Central Bering Sea Fishermen's Association (CBSFA) is a non-profit corporation originally formed by the halibut fishermen of Saint Paul Island. It has status as the Community Development Group with the purpose of qualifying for regional Community Development Quota (CDQ) allocations. It is open to all residents of the Saint Paul community. The Central Bering Sea Fishermen's Association has been the successful recipient of five CDQ allocations (1992–1993, 1994–1995, 1996–1998, and 1998–2000). All of the owners of Saint Paul based vessels belong to CBSFA.

The Central Bering Sea Fishermen's Association working with other members of the community, established a Citizen Participation Committee, which has developed a plan to deal with the disadvantages of an isolated economy overly dependent on the boom-bust cycles of the Bering Sea crab harvest. The plan includes a strategy for maximizing income from the regional fisheries by developing a diversified harvest-processing complex. The centerpiece of the complex will be the small boat harbor. Local concerns about the without-project condition were documented in public meetings at the community. On behalf of the Citizen Participation Committee, CBSFA has stipulated the problems associated with the without-project condition as follows:

- The fleet is moored at temporary docks. When threatened by wave conditions, the vessels and the docks must be removed from the water. It is a costly and time-consuming operation, and it brings an end to all harvesting. The fleet needs all weather protection for as much of the year as possible.
- Vessel security is a concern, due to theft and vandalism problems related to the large number of short-term visitors. The island has become a popular visiting place for eco-tourists. It is also the host to several hundred temporary workers when local processing facilities are in full swing.
- The smaller vessels must use the deep-draft dock to unload their catch. When they arrive, they must wait for larger vessels to clear the area. Frequently they find themselves

working while vessels in the 100–200 ft class are docking next to them. This can lead to extensive waiting periods, crowding, and safety concerns. There is a need to minimize congestion caused by small vessels using the deep-draft facility.

- The existing temporary dock, launch ramp, and haul-out machinery have a practical limit of 32 ft vessels. Resources next to the island are plentiful, but the small vessels are unsuited to the Bering Sea conditions. Upgrading of the fleet will require a protected moorage and an improved haul-out facility. The Central Bering Sea Fishermen's Association has determined local moorage needs to be for 30–60 or possibly more vessels up to 58 feet.
- The temporary dock is impractical for managing heavy gear. With a protected moorage, a breakwater could be modified to provide for loading and off-loading. It could also serve as a place to tie-up vessels, such as equipment barges too large to fit into the small boat harbor. It could also be used for temporary moorage of disabled or oversized vessels.
- Salt Lagoon is a sensitive environmental area, southeast of the temporary dock and moorage. Small vessel traffic congestion and reefs near the dock could be the cause of accidents, causing pollution spills.
- The temporary floating dock does not have adequate space for all of the local vessels involved in commercial fishing, or aspiring to be involved. A concern of the Aleut Tribal Community is that members have no room to launch or tie-up skiffs for purposes of subsistence harvest. There is no direct economic consequence to the commercial harvest, but there is a consequence in the form of family subsistence hardship. The tribe needs a facility that will support subsistence use.
- There are reefs near the existing docks. The approach is so limited by the reefs that several captains, familiar with the approach, have damaged their vessels. An adequate and safe approach channel is needed in connection with a new moorage facility.
- There is an existing launch ramp, but the surface is broken and sheets of concrete have been displaced, causing an uneven traction surface. The ramp is too narrow to accommodate launch trailers sized to handle the larger vessels. Its use is further discouraged by the fact the ramp terminates at the waters' edge, causing vehicles to be stuck and damaged as they roll off the edge. The launch ramp is not protected from wave action, and it is frequently unusable for that reason.
- Overall, the existing temporary dock has practically no dedicated staging area. There is no designated or reserved area for people waiting to use the launch or waiting to unload equipment onto the dock. The shore side area is not dedicated to providing support for the harbor operation so parking of trucks, trailers, vessels, and gear is neither guaranteed nor secure. This creates a situation where juggling of equipment causes a great deal of lost time and frayed tempers. All of the potential users of a small boat harbor insist that adequate uplands be provided as part of the moorage facility.
- The vessels and the docks must be removed by a rented crane (owned by a local contractor), using an operator and spotter. To be used for haul out, the crane must be moved from a work area to the haul-out location, resulting in high haul-out costs. Limited uplands, causing a bottleneck during the haul out and stretching out the time the crane is

needed, also increases cost. Future users argue that a small boat harbor must provide a means to remove vessels and docks efficiently at low cost.

- The small vessel fleet is required to move anytime space is needed for barges, container vessels, or larger fishing vessels. During the winter crab season, there is no moorage available for local fishermen at all. Potential users of an improved small boat harbor suggest that moorage facilities should be adequate to accommodate the expanded future fleet and that there be space to accommodate disabled vessels unable to leave Saint Paul.
- Dock space is inadequate, and rafting is sometimes required. Since there is no wave and wind protection, the vessels get banged together, and damages are a concern. Damages to vessels and docks cause the cost of harvest to increase unnecessarily. A new harbor would eliminate the damages, which the vessel owners consider to be part of their operating budget. To them, some of the cost appears as lost time since the vessels and docks are removed when there is a threat of storm damages.
- Congestion in the launch process, limited crane services, and ramp limitations stretch out the amount of time it takes to launch the entire fleet. At times, the launch process can be so challenging as to eat away the fair weather window to the point that fishing trips are canceled.
- Since the existing temporary facility is not protected, storms require dock haul out and storage. A new small boat harbor will need to be protected to save the cost of repeated dock haul out.
- The temporary docks and launch facilities are essentially limited to vessels no larger than 32 feet. This limitation of vessel size causes severe limits on the harvest. Larger vessels would be able to venture further out to sea and would be used in a wider range of weather conditions. Larger vessels would also be able to be more effective in targeting more distant stocks and would have higher production rates. Future users of a small boat harbor urge that the harbor be sized to accommodate vessels up to 58 ft by 23 ft by 8 feet.
- The limitation on vessel sizes has caused development of multi-species harvesting to be discouraged. Larger vessels are needed to profitably target cod, halibut, and crab. Since the fisheries occur over an eight to nine month period, large vessels are more likely to be compatible with weather conditions. A desire to capture the advantage of developing a multi-species fishery has caused future users of a new small boat harbor to urge that the harbor be planned in a way that will maximize the time vessels can be left in the water. They maintain that, without a protected moorage facility, they will be unable to compete, and that stocks available adjacent to the island will be harvested by vessels operating out of other ports.
- A repeated concern is that the island lacks a convenient vessel repair facility. Vessel repair, maintenance, and improvements require repair crews to be flown to Saint Paul or require vessels to be taken elsewhere, sometimes under tow or aboard a freighter. The local fleet will become a major source of employment and economic stimulation. For a few weeks in the summer, the halibut fishery conducted by this fleet employs more than 115 residents—by far the largest single source of employment on Saint Paul Island. Yet, the fishermen still use a fleet of vessels less than 32 ft length overall (LOA) in some of

the harshest conditions in the world. Helping the fleet maintain their vessels, is not just an economic issue, but also one of human safety.

An ongoing Vessel Repair and Maintenance project sponsored by CBSFA has been one of the most important undertakings for the local fleet. Currently, the vessel work, done during these clinics, takes place in the open or in a temporary shop. Future users of a small boat harbor have urged that the harbor be planned in such a way that community development of a vessel repair facility can be integrated into the overall harbor plan.

The community has a well-developed land use plan, however, major changes in the management of the island since 1983, and the continued evolution of the island to a self-sufficient economy, have created land use issues. One such land use opportunity that will be complicated by a new small boat harbor will be competition for use of high valued waterfront for income supporting activities. Some of the land is now in use as storage area for marine equipment while local preferences are that development of a harbor should incorporate elements that make use of non-waterfront land for marine equipment storage. This should be done in a way that works to alleviate congestion and conflicts of use by adapting more distant areas for marine equipment storage.

At present large vessels come into the harbor for crew changes and for re-provisioning. The large number of such service calls adds to congestion outside the harbor, in the approach channel, and at the port facility. Because the harbor is very busy, vessels often have to wait outside for dock space to become available. Future users of a small boat harbor have explored the possibility of tending waiting vessels with a water taxi service that would operate out of the small boat harbor. It would move people and supplies to and from waiting vessels, at their option, and would reduce the number of vessel hours spent waiting for service.

3.0 RESOURCE ASSESSMENT AND POTENTIAL LOCAL HARVEST

3.1 Responsible Institutions

Responsibility for management and development of the fishery resources in the study area is shared between Federal, state, and quasi-governmental agencies. These agencies include the National Marine Fisheries Service (NMFS), the North Pacific Fishery Management Council (NPFMC), the Alaska Department of Fish and Game (ADF&G), and the International Pacific Halibut Commission (IPHC). The Magnuson Fishery Conservation and Management Act of 1976 (Public Law 94-265, as amended), often referred to as the Magnuson Act, provides for the conservation and exclusive management of all fishery resources within the U.S. Exclusive Economic Zone (EEZ). The U.S. EEZ extends from the seaward boundaries of the territorial sea (3 nautical miles from shore) to 200 nautical miles offshore around the coast of the United States.

3.1.1 National Marine Fisheries Service (NMFS)

National Marine Fisheries Service is responsible for planning and implementing fishery management conservation programs of the EEZ, including implementation of fishery management plans recommended by the NPFMC. The regional office also coordinates Federal and state resource management and research, monitors harvest, and sets openings and closures in federally managed fisheries. The Alaska Fishery Science Center in Seattle, Washington, along with its research laboratories on Kodiak Island and at Auke Bay, Alaska, plan and conduct fishery research studies to assess stock abundance, collect biological information, and study factors affecting production in the U.S. EEZ off Alaska and in adjoining international and foreign waters.

3.1.2 North Pacific Fishery Management Council (NPFMC)

The Magnuson Act created eight regional fishery management councils. The NPFMC has responsibility for fishery management in the U.S. EEZ off Alaska. This geographic area of authority includes fisheries in the U.S. EEZ of the Arctic Ocean, Bering and Chukchi Seas, and the Pacific Ocean seaward of Alaska, including the Gulf of Alaska. The 15-member council regulates resources through fishery management plans developed with input from Federal, state, industry, environmental, and other interested parties. These plans serve as the base reference documents for management of fisheries within the U.S. EEZ, and contain detailed descriptions of stocks fished, and participation and management goals. Through amendments to these plans, fisheries are structured to meet the changing needs of society. The NPFMC makes management recommendations to the NMFS in the form of amendments that are then approved or rejected by the U.S. Department of Commerce.

The NPFMC also has responsibility for establishing annual harvest levels for target groundfish, for setting the non-target bycatch levels allowed in each fishery, and for recommending a percentage of the pollock total allowable catch (TAC) for Community Development Quotas (CDQ). These recommendations are approved or rejected by the U.S. Department of Commerce. National Marine Fisheries Service is responsible for regulating the U.S. EEZ fisheries to assure compliance with TAC. The State of Alaska allocates CDQ to local communities that file applications. Although crab and other shellfish are covered under the Magnuson Act, the Federal Government has allowed the State of Alaska, through the

Board of Fisheries and the ADF&G, to manage these resources under the Federal fishery management plan.

3.1.3 Alaska Department of Fish and Game (ADF&G)

Alaska Department of Fish and Game is the research, management, and regulatory agency for the State of Alaska. Its activities are regulated by the Board of Fisheries, the policy-making arm of the state government. The Division of Commercial Fisheries, within ADF&G, is charged with research and management of commercial fisheries in Alaska waters (within three nautical miles of shore), and under agreement with the NMFS, crab and shellfish fisheries in the U.S. EEZ. Alaska Department of Fish and Game conducts research similar to that conducted by the NMFS and makes recommendations to the Board of Fisheries for area openings and closings to keep fishing within established harvest guidelines.

3.1.4 International Pacific Halibut Commission (IPHC)

The International Pacific Halibut Commission was established in 1923 by a convention between Canada and the United States for the preservation of Pacific halibut in the North Pacific Ocean and the Bering Sea. Three IPHC commissioners are appointed by the Governor General of Canada and three by the President of the United States. The commissioners appoint a director, who supervises the scientific and administrative staff of the IPHC, located in Seattle, Washington. The IPHC conducts stock assessment surveys, collects biological data, and recommends policy and regulatory actions and harvest guidelines for approval by the two governments.

3.2 Resource Assessment

The following discussion focuses on eastern Bering Sea crab, cod, and halibut harvest because they are the species that would be targeted by small vessels operating out of a new harbor at Saint Paul. The assessment depicts harvests by Saint Paul based vessels as they are anticipated with the project. Saint Paul is the least cost base of operations for a size-constrained fleet. Except for current activity of the existing Saint Paul fleet, the harvest in the without-project condition is by vessels operating out of alternative ports instead of from Saint Paul.

There is a huge amount of data available regarding resource availability and the cyclical nature of the Bering Sea fisheries, especially crab stocks. This summary assessment has relied on published data from the above-described responsible agencies.

Crab stocks and harvest activities are continually monitored. The managing agencies develop guideline harvest levels (GHL), which are designed to promote long-term health of the resource. The stocks are dynamic and tend to be very unpredictable over short time frames. It is therefore acceptable practice to amend the GHL, as needed, to make short-term, and often, short-notice changes in the allowable harvest during the course of a year. On occasion complete closure of a fishery has been continued for as much as 1–3 years to allow stocks to recover. In order to incorporate the cyclical nature of annual harvest data, an average of harvest data over the last ten years was used as an estimate of future harvest activity. The ten-year average, shown in table 2, includes boom years and bust years. It also is recent enough to capture productivity effects of present day capital and technology.

Table 2. 1990–1999 Crab Harvest Data Eastern Bering Sea

(million lb)

Year	Tanner	Pribilof Red/Blue King	St Matthew Red/Blue King
1990	160.0	0	1.7
1991	325.2	0	3.2
1992	313.0	0	2.5
1993	229.2	2.6	3.0
1994	148.0	1.3	3.7
1995	74.0	2.0	3.1
1996	64.4	1.1	3.0
1997	117.1	1.2	4.4
1998	240.0	1.2	2.9
1999	183.4	0	0
TOTAL	**1,854.3**	**9.4**	**27.5**
AVERAGE	185.4	0.9	2.8

Generally, the resource assessments and harvest estimates in this report are based on data for the eastern Bering Sea. Since Saint Paul is centrally located to all of the stocks, a small vessel fleet, operating out of Saint Paul, should enjoy an economic advantage over similar vessels operating from other ports. This report defends the proposition by illustrating that operations out of Saint Paul are a low cost option. Individual Fishing Quota (IFQ) and CDQ are therefore not material factors.

3.2.1 Role of Resource Assessment in the Benefit Analysis

The establishment of a defensible estimated harvest from Saint Paul, under the with-project and without-project, was central to an evaluation of benefits for a new harbor. Overall there is no increased catch, however, the increase in Saint Paul based harvest, under with-project conditions, supported a flow of potential project related gross income to the island, which was used to estimate the number of vessels that could be supported there. The resource assessment was therefore the key to predicting the "with-project fleet." The projected gross harvest by the Saint Paul based fleet is summarized in table 3.

After derivation of the fleet, and the gross income, the benefit analysis was linked to identification of cost differences between harvest operations out of Saint Paul and an alternative port. In order for the cost differences to be estimated, sample vessel operating budgets were developed. The budgets were established for vessels typical of the future fleet and show costs incurred in a typical year. Data from fishers, manufacturers, other reports, and published sources were relied on (see budgets and footnotes). The budgets (see tables 6, 7, 8, and 9) were important to the benefit analysis because they were used to derive the hourly cost of operations. Benefits depend to a certain extent on being able to make the case that a harvest out of Saint Paul will require fewer hours and less travel, hence be less costly. The importance of the budgets is further addressed in the risk and uncertainty portion of this report.

3.2.2 Near-Term Crab Stock Assessment and Harvest

Crab fisheries in the Bering Sea/Aleutian Islands (BSAI) are managed under the Federal Fishery Management Plan (FMP) for Bering Sea/Aleutian Islands, king and tanner crab. This

FMP defers crab fishery management to the State of Alaska, including the setting of guideline harvest levels (GHL). It is typical for GHL to show extreme variations over 1–3 years.

Based on ADF&G near term evaluations and NMFS annual crab assessment, the harvest in the next 1–3 years will be very low. Key dynamics are growth rates, natural mortality rates, allowed harvest rates, and pre-recruitment abundance by size/sex categories. In the near term, GHL will be driven by spawning stock abundance and abundance of young crab expected to grow into legal size (males) and spawning size (females). The GHL are set on an annual basis and sometimes are changed during the course of a year. The nature of the dynamics of the resource and the broad range of uncertainty in assessments requires GHL to be administered as an adaptive management technique. When the dynamics are out of balance, the resource managers act to protect the stocks until they recover. At present, it appears that the ADF&G might put a moratorium on harvest of king crab, possibly for as long as the next three years. It is also highly likely that for the next three years ADF&G will restrict GHL of tanner stocks in the BSAI to under 40 million lb[1]. Average annual harvest during the 1990s was 188 million lb, and the range during the decade was from 64 million to 325 million pounds.

As a means of assuring itself a place in the long-term crab harvest, the community of Saint Paul offered a proposal to the ADF&G Crab Plan Team in 2000 that was designed to maintain community participation in the crab fisheries. This proposal recommended a minimum amount (percentage) of crab to be delivered to specific geographic regions (Pribilofs, Aleutians, and Kodiak) based on historical delivery rates (both floating and shore-based in each area). This proposal suggested qualifying years that go back no further than five years. Historically, over the 1995–1999 period, when large scale processing has been taking place, Saint Paul deliveries have averaged about 35% of the total. Even at the short-term harvest level of 40 million lb, this would result in over 14 million lb delivered at Saint Paul. The smaller vessels based at Saint Paul would be at even a greater economic advantage for the designated Saint Paul delivery.

3.2.3 Long-term Crab Stock Assessment and Harvest

All of the management plans and policies drive toward a long-term sustained yield fishery. In some years there will be large harvests, allowed because of healthy stocks and dynamics. In other years harvests may be restricted to low levels or perhaps not allowed at all. Because of the many uncontrollable variables and the general unpredictability of GHL beyond the 1–3 year time horizon, the long-term assumption is that management will be successful in achieving historic harvest levels of the last decade.

3.2.4 Long-term Small Boat Crab Harvest From Saint Paul With- and Without-Project

Although Saint Paul is practically at the center of the crab fishery, the fleet operates out of other ports. The typical crab harvester is too large to find moorage at Saint Paul in both the with-project and without-project condition. Depending on the year, there are about 10–40 vessels under 60 ft that operate successfully in the Bering Sea crab fishery, but they also must do so from other ports. Generally, the higher the GHL the more the smaller vessels are

[1] Dr Jerry Reeves, retired NMFS Chief Bering Sea Crab Biologist, in Economic Impact of Bering Sea Crab Stock Disaster on Saint Paul and the Need for Fisheries Diversification in Years 2000 and Beyond, Natural Resources Consultants, 1999.

likely to participate. In harvest years before the huge specialized crabbers were introduced (early 1980s), vessels under 60 ft could compete and were in the fishery in greater numbers. It is vessels in this under 60 ft size class that will realize lower operating cost if based at Saint Paul in the with-project condition. In year 2000, crab fishers under 60 ft made up 215 of the 1,035 active crab harvesters statewide.

The under 60 ft vessels are favored under a new capacity reduction program. A year 2000 Amendment to the Magnuson-Stevens Fishery Conservation and Management Act[2] introduced a capacity reduction program for the BSAI crab fisheries. The amendment seeks to obtain the maximum sustained reduction in fishery capacity, at the least cost, by establishing bidding procedures that allow permits to be relinquished. The procedure sets a bidding structure that favors buying of permits from the larger harvesters first. It also includes provisions that allow vessels up to 60 ft to remain in operation, providing they participate in a repayment fee program. The overall effect will be to reduce the total number of fishers with emphasis on reducing the number of larger size vessels and increasing the amount of harvest by the smaller vessels.

According to Commercial Fisheries Entry Commission (CFEC) data, there are vessels under 60 ft that make up about 2% of the total. The with-project condition allocated the harvest of these smaller vessels to a Saint Paul based fleet on the strength of a demonstrated economic advantage of operating from there. Harvest data indicates these vessels historically account for about 1,340,000 lb per year, valued at $1,430,000. This is considered to be a low-side value because the Limited License Program (LLP) will lead to increased crab harvest by smaller and smaller vessels as the fleet goes through a downsizing, starting in 2001.

Table 3. Average Annual Crab Harvest From The Eastern Bering Sea, 1990–1999

Species	Exvessel Price ($)	Harvest (lb)
Tanner Crab	1.00	185,400,000[3]
Saint Matthew Blue King	2.80	2,750,000[4]
Pribilof Red and Blue King	4.20	940,000[5]
Total Annual Harvest		191,980,000
Saint Paul Island Landings Using 35% Historic[6]		68,100,000
Weighted Average Price	1.05	
Annual Value of Saint Paul Landings	71,500,000	
Value of Landings by Vessels <60 ft	1,430,000	
Portion of Values In CDQ Allocation[7]	1,100,000	
Estimated Potential Local Fleet Harvest	2,530,000	

[2] Amendment to sec 144. (a) (16 UCS 1801 et. Seq.) Excerpted from the Congressional Record–HR 4577, Department of Labor Health, and Human Services and Education and related agencies Appropriation Act 2001 House of Representatives—December 15, 2000. The program is referred to as LLP in this report.

[3] Ten year average during the 1990s

[4] Ten year average during the 1990s

[5] Data includes zero catch during 4 years of closure

[6] From 1995–99 Saint Paul deliveries ranged from 25–42 % of the total EBS harvest

[7] CDQ stands for Community Development Quota. It is an exclusive harvest share allocated to residents of Saint Paul

3.3 Future Cod Harvest

Pacific cod inhabit most of the eastern Bering Sea shelf region and are also found in less abundance in the Aleutian Islands. Pacific cod are most abundant inshore along the north coast of the Alaska Peninsula, around the Pribilof Islands, and north on the outer continental shelf to Saint Matthew Island. Pacific cod concentrate in the deeper water of the outer continental shelf edge for spawning from January to March and migrate into shallower waters on the continental shelf to feed in the summer and fall. Pacific cod enter the fishery at about age four or five and may live up to 12 years.

Pacific cod are targeted by large shore-based and offshore fleets operating bottom and mid-water trawls as well as a long-line catcher/processor vessels, and a smaller jig vessel and pot fleet. The length of the Pacific cod fishery depends mainly on halibut and crab bycatch quota attainment. The fishery begins on January 20, but full participation does not occur until after the pollock "A" season is completed in mid-February. The majority of the Pacific cod harvest occurs in the spring and early summer. The entire fishery is active for 90 to 120 days each year in the EBS/AI. Pacific cod are not allocated between shore-based and at-sea fisheries. Long-line fishermen concentrate their efforts in the vicinity of Saint Paul Island during much of the year.

The total allowable catch (TAC) for Pacific cod in the EBS/AI has varied between 164,500 metric ton (mt) to 250,000 mt in the 1990s. The harvest of Pacific cod varied from 206,000 mt to 167,000 mt during the decade. Pacific cod have been exploited at a rate of between 10% and 26% of available biomass, a very conservative harvest strategy. Pacific cod harvest has been limited by halibut and crab bycatch limits, not the available resource. Saint Paul's harbor is well positioned for the development of cod processing activities. Its proximity to cod and other fisheries resources make it an economically viable activity from the perspective of the fishing industry. The Pribilof area contains 76% of the cod population of the entire eastern Bering Sea.

With the planned introduction of cod processing, the Saint Paul fleet is one step closer to full participation in the cod fishery. The Central Bering Sea Fishermen's Association (CBSFA) has entered into an agreement with American Seafoods to develop a shore-side cod processing operation as early as June 2001. This will be one of the community's most important steps towards a sustainable multi-species economy.

National Marine Fisheries Service action taken this year to protect the endangered Steller Sea Lion[8] has dispersed the existing cod fishery away from critical habitat areas in the Aleutian Chain and the Pribilofs. The Pribilofs are a critical habitat, and some fishing restrictions for cod will apply out to 20 nautical miles (nm). As accommodation for restrictions on harvest activity, the vessel operating scenarios in this report allow for clearing the habitat zone before fishing. Nevertheless, fishing will be concentrated around Saint Paul, and the cod industry is anticipated to seek processing sites that are closer to where the fishing effort will be concentrated, such as Saint Paul.

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[8] Endangered Species Act, Section 7 Consultation, Biological Opinion, and Incidental Take Statement, Authorization of Bering Sea/Aleutian Islands Groundfish Fisheries Based on the Fishery Management Plan for the Bering Sea Aleutian Islands Groundfish; and Authorization of Gulf of Alaska Groundfish Fisheries Based on the Fishery Management Plan for Groundfish in the Gulf Of Alaska, NMFS, November 20,2000.

3.3.1 Infrastructure Development for Cod Processing

Saint Paul is working with the Department of Commerce, Alaska's Congressional Delegation, and the State of Alaska to ensure that Federal assistance will be directed at several infrastructure projects to support diversification, including the development of new cod harvesting and processing capacity.

Central Bering Sea Fishermen's Association has entered into a Multi-Species Development (MSD) agreement with American Seafoods, which will accelerate Saint Paul's entry into multi-species processing. The agreement will result in deployment of a state-of-the-art catcher processor to Saint Paul to operate inside the harbor as a shore-based processing platform. The vessel has a fishmeal plant, which will allow Saint Paul to commence new processing activities several years sooner than permitting and construction of new facilities would allow for. The investment and operating cost are self-liquidating through royalty arrangements in the agreement.

The City, CBSFA, and other entities are working together to try to accelerate the construction of the small boat harbor and the development of new programs that will allow the local fleet to fully participate in the cod fishery as soon as practical.

3.3.2 Cod Opportunity within Existing Allocations Framework

Within the existing framework, cod processing capabilities can be developed to supplement dependence on crab, halibut, and other species. Now 80% of the cod TAC goes to the freezer longliners, 18.3% to the pot codders, and 1.4% to pot and longline vessels less than 60 ft long, which are exempted from the cod LLP. Within the three-mile state waters, however, the LLP and the split do not apply. There is an opportunity within this framework to develop a local cod fishery and cod processing activities on the island as early as 2001.

The framework plan includes the following elements:

<u>Accommodation of a Pribilof critical habitat zone</u>. The limitations will not interfere with the gross income potential of cod longliners. This is because of temporal dispersal of effort throughout January 20–October 31, with closure between November 1 and January 19. The rookeries are already no fishing zones.

<u>Access for local fishermen to the 1.4% allocation for pot and longline vessels less than 60 ft long.</u> By tapping into the 1.4% and the cod located within the proposed Pribilof Cod Fishery Zone, Saint Paul could begin to develop a small vessel cod fishery that coincides temporally with the CDQ halibut fishery. Also, that part of the overall harvest by the cod fleet under 60 ft (a large portion of the fleet is under 60 ft but does not restrict itself to small vessel quotas) will have an economic advantage if operated from Saint Paul.

Planned delivery of cod to Saint Paul, with a focus on the production of high quality value-added fillets. This product will maximize revenues and minimize water requirements.

Use of the community investment in the modern harvesters, F/V Ocean Cape and the F/V Zolotoi, for harvest of CDQ cod allocations. These specialized vessels will fish further from the island than the small vessel fleet. Their larger capacity will provide the quantities necessary to keep a processor operating above the break-even level.

3.3.3 Saint Paul Cod Harvest Projection Under With- and Without-Project Condition

The December 1999 stock assessment prepared by National Resource Consultants (NRC) indicated allowable biological catch (ABC) for eastern Bering Sea cod over the past 20 years has been 140,000–240,000 metric tons. With this as a baseline 200,000 mt is the assumed long-run ABC for purposes of this report. The applicable Commercial Fisheries Entry Commission (CFEC) database for year 2000 shows 1,717 longline, jig, and pot permits, for vessels under 60 feet. With a harbor at Saint Paul providing year-round moorage for 60 vessels, about 3.5% of the total fleet under 60 ft would be based there. We have estimated 3.5% of the harvest of Pacific cod would be by vessels from Saint Paul, an annual harvest of 7,000 metric tons. For vessels under 60 ft the cod harvest in the eastern Bering Sea has been increasing steadily . For example in 1996, 1997, 1998, and 1999, the average lb harvested by vessels under 60 ft were 204,000, 151,800, 127,500, and 87,500. The take per vessel has been increasing at a rate of 20–50% per year. Although the data for year 2000 is not available at the time of this writing, it is expected to show a per vessel harvest of over 240,000 pounds. This is consistent with our 7,000 mt estimate for the 60 vessels in the with-project fleet. At an exvessel value of $.45 lb (average price in the 1999 and 2000 west coast market), the total annual value of harvest taken by the Saint Paul fleet will be $6,930,000. In the without-project condition, the harvest will be by vessels operating out of Dutch Harbor.

3.4 Halibut Harvest Opportunities Under With- and Without-Project Condition

The year 2001 Individual Fishing Quota[9] (IFQ) halibut quota (Area 4c) was 1,015,000 lb, but it is distributed among permit holders home ported outside of Saint Paul. In 2001, the Saint Paul fleet's halibut quota included 1,015,000 lb of CDQ, which gave Saint Paul exclusive rights to these stocks. The annual average halibut landings at Saint Paul during the last three years has been 100% of the 3-year average CDQ. Activity by the local fleet accounted for all of the CDQ halibut landings.

With the project, it is anticipated that the economic advantage of the location of Saint Paul will result in half the area IFQ being harvested by vessels home ported at Saint Paul. Over half of the Area 4 halibut fleet will be based at Saint Paul in the with-project condition. These vessels will arrive with IFQ. In addition, CBSFA is actively seeking IFQ for the local fleet. With reliance on IFQ, there will be an increase in average annual landings at Saint Paul of at least 508,000 pounds. At exvessel prices of $2.00 per lb, this will yield an estimated increased gross long-term average annual income of the local fleet of $1,016,000. Without the project, the balance of the area harvest would be by vessels continuing to operate out of Dutch Harbor with some incidental participation by vessels possibly from King Cove, Sandpoint, and False Pass.

[9] IFQ is individual fishing quota

4.0 FLEET DEVELOPMENT UNDER WITH-PROJECT CONDITION

4.1 Operating Profile of the Saint Paul Fleet

A fleet projection was derived by determining the gross harvest income that would be captured by a Saint Paul based fleet and calculated the number of vessels that this income would support. The vessel operating data that was used to arrive at a relation between gross income and net income to the owner was publicly available through the University of Alaska (U of A)[10], and was gathered from studies of the halibut fleet before establishment of the IFQ. This was used because the halibut fleet is the largest of all and therefore provides a huge data sample. The U of A data was compared against information in the 1989 Alaska Seafood Industry Study[11] and found it to fall near the middle of the range of a skipper's pay percentage for non-salmon vessels under 50 feet. The U of A data is also attractive as a data source, because over 80% of the vessels in the halibut fishery are under 55 ft, and most of them are involved in multiple fisheries. The operating profile of this fleet is more like the future Saint Paul fleet than any other data identified during the study. Based on the U of A data, exvessel values were sorted out as follows:

Table 4. Exvessel Values of Saint Paul Fleet

Operating Expense = 24%	This includes fuel, gear, bait, food, and special payments to hired captains and vessel owners.
Crew Share = 49%	This includes crew payments net of expenses shared by the crew.
Operators Share = 27%	This includes fixed cost such as license, insurance, moorage, maintenance, and vessel payments.
Net Operators Share = 12%[12]	This excludes deductions for fixed costs estimated at 15%. Using the above 12% as a basis for estimating operators income, the fleet based at Saint Paul will provide a total net operators share of $1,308,000.

4.1.1 New Operators

A growing fleet at Saint Paul would actually result primarily from relocation of existing vessels from other locations. The vessels would be relocated to Saint Paul under existing owners or new owners. There is economic support for the idea that new owners would develop out of the Saint Paul population. The community has a strategy for emphasizing marine related economic development and capital for vessel financing is available.

At Saint Paul, the average income per working person, based on 1999 Department of Community Development data was $18,100. For new owners, it was assumed, the income from fishing must exceed the average earned non-fishing income by a significant level to induce people into the fishery. Most of the historical experience with fishing has been for subsistence purposes rather than commercial enterprises, and there are other employment

[10] Alaska Review of Social and Economic Conditions Vol. XXIX, No 2.

[11] Alaska Seafood Industry Study, Appendix A, The McDowell Group, Juneau Alaska, 1989.

[12] 12% is most typical of the Saint Paul fleet which is made up of multiple purpose vessels less than 58 ft which operate as longline or pot harvesters. Radtke and Davis in State and Coastal Communities Economic Assessment Project Contribution From Distant Water Fisheries to Oregon's Economy in 1996, Oregon Coastal Zone Management Association, Oregon Department of Fish and Wildlife, Oregon Economic Development Department, Oregon Sea Grant Program, January 1999, Radtke and Davis, The Research group, Corvallis Oregon., show net income of the Alaska longline and pot harvesters that deliver to shore-based plants at 18%. The fleet in Radtke and Davis is not size constrained.

opportunities available. Even with capital available[13] for financing new owners of vessels, permits, and gear, there must be adequate profit to induce them to undertake the lifestyle change and associated risk.

There is no certainty of the income level that would provide an adequate incentive to induce development of a local fleet. Therefore, two threshold levels have been set above the average income, and high enough to present entry into fishing as among the better opportunities on the island. The threshold levels for entry are 120%, and 140% of the community average earned income. The average earned income is $18,100, and the rounded threshold income levels are $21,700 and $25,600 respectively. The expanded fleet will increase landings by local fishermen by about $10,900,000 annually as shown in table 5.

Saint Paul residents have an unusual history. Even though they have lived on an isolated island, they have not had the opportunity to learn about the fishing industry and participate in it, except for the last few years. New developments in the fishery for halibut and other species are getting the attention of the island residents, and they are beginning to position themselves to take advantage of career opportunities. They are well aware of the risks involved and are sensitive to the fact that fishing must present itself as an attractive economic opportunity for them to be induced into major life style changes. Based on an increase in landings by the Saint Paul fleet of $10,900,000, a net operators share of 12%, and threshold income levels of $21,700 and $25,600, the number of vessels that will be added to the local fleet will be a low of 50 and a high of 60.[14]

The vessels will range in size up to 58 ft, and their gross income during the year will range from zero (small vessel subsistence fishers) to over $413,000 for the 58 ft vessels. The net share of the operator will range from zero to $50,000. These threshold levels represent averages for the fleet.

4.2 Fleet Size Distribution

Given that a with-project condition could support a fleet of up to 60 vessels, a fleet configuration was needed. Vessel sizes were distributed to mirror the make up of Alaska's multi-species fleet. To do this we used the fleet most typical of the multi-species fishers, which was the registered halibut fleet before the IFQ effects of 1995. At that time entry to the fishery was unlimited, and all of the vessels in that fleet were also employed in other fisheries. Therefore, the size distribution of the halibut fleet was used to distribute Saint Paul harvest by vessel size with one modification. The modification was dictated by the nature of the crab harvest because in the Saint Paul fleet only the largest vessels are practical as crab harvesters. In order to handle the necessary equipment and operate at a scale that is profitable, minimum crab vessel size is at the upper limit of the Saint Paul fleet. Therefore, crab harvest was allocated to the vessel size class above 55 feet.

[13] CBSFA has funded a revolving fund for financing purchases by CBSFA members.

[14] Among Alaska commercial fishing permits issued in 2002 about 55% of them were actually employed in the harvest. It follows that this very large pool of inactive vessels will provide a resource for the risk taking profit seekers that will become new operators out of St Paul.

Table 5. Distribution of Harvest by Vessel Size Class Under the With-Project Condition

Class (ft)	Crab ($)	Cod ($)	Halibut ($)	Subsistence ($)	Harvest Total ($)	No. Vessels
0–26	0	970,000	142,200	399,600[15]	1,516,800	28[16]
26–39	0	2,772,000	406,400	0	3,178,400	14–17
40–55	0	2,079,000	304,800	0	2,383,800	11–13
55+	2,530,000	1,108,800	162,600	0	3,801,000	17–22
Total	2,530,000	6,930,000	1,016,000	399,600	10,900,000	70–80
Moor age Demand without Trailerable Vessels						**50–60**

4.2.1 Advantages of the 40–58 Foot Class

Vessels as small as 40 ft could be marginally practical for the near island crab harvest. Vessels under 60 ft are restricted to 40 pots for king crab. No matter how much larger the vessels are, only ten additional pots are allowed. The main constraint on size will be the smallest vessel, which can efficiently and safely fish an adequate number of pots to break even. According to a consensus arrived at in a meeting with fifteen local fishermen, vessels in the 40 ft to 58-ft class are practical, and 58 ft are ideal. Capability of vessels in this class to fish commercial pots was verified with west coast vessel facilities.

The 58 ft vessels are also in great demand, because of salmon fishing profits and rules, which establish this as the maximum size vessel allowed in some salmon fisheries. Demand for the 58 ft size is so strong that, in many cases, larger size vessels have been selling at lower prices. A balancing force is that the success of fish farms is driving salmon prices down, and these vessels are no longer as desirable as they once were for exclusive salmon fishing. Some of the formerly exclusive salmon vessels are being outfitted for multi-use fisheries. The newly constructed 58 ft vessels are designed to perform in a multi-use fishery.

Vessels larger than 58 ft may be cheaper to buy but would require a deeper harbor, and depth is a major local concern influencing planning of the harbor. In addition, the larger vessels would require more dock space and more substantial moorage facilities. This fleet projection is based on concerns for overall cost minimization while maximizing efficiency of the fishery. It is anticipated that vessels may vary from the ideal 58 ft size. Buyers may be able to save 10%–20% by shopping in the sizes closer to 55 ft and 68 feet. The 68 ft vessels will not be able to use the harbor when fully loaded, but the 55 ft vessels will, and they may perform nearly as cost effectively as the 58 ft vessels. It is therefore expected the multi-use fleet, which will primarily target near shore crab stocks, will be in the 55 ft to 58 ft range, and the maximum draft will be 8 feet.

[15] Evaluated at an equivalent market price based on substitute values. Includes only the project related harvest increase.

[16] The allocated harvest justifies 8 vessels based on the income threshold. An estimated 20 local skiffs were included in this class. All are trailered or carried and are anticipated to be users of the launch ramp.

5.0 FLEET DEVELOPMENT UNDER WITHOUT-PROJECT CONDITION

The local economy and the harbor will not undergo significant changes without the project. The strategy of the community, to develop a multi-species harvest and processing complex, will not be economically viable without a small boat harbor. Therefore, there are few changes expected for the local fleet in the without-project condition. The existing CBSFA fleet of 26 vessels, all under 32 ft plus about 20 skiffs used for occasional subsistence harvest, will remain in use.

5.1 Operating Scenario

Under the without-project condition, most of the harvest of the resource around the island will be by vessels operating out of Dutch Harbor and delivering there. It is the closest alternative port with processing and moorage facilities available. The smaller sized vessels that are kept at Saint Paul are too small to harvest crabs efficiently and safely. From Dutch Harbor, a run of between 215 and 340 miles is necessary to reach concentrations of the main crab stocks of the eastern Bering Sea fishing grounds. This is generally a radius of 65 miles around Saint Paul Island. This open water trip from Dutch Harbor and other ports has increased risk for vessels under 58 feet.

The 58 ft vessels operating out of Dutch Harbor will use a three day trip out of which about 30 hours will be spent fishing compared to the 6-hour fishing periods for day trips out of Saint Paul. This allows harvesting to the maximum potential of vessel capacity and is the most economical mode of operation under the with- and without-project condition.

The operating scenarios, under the with- and without-project condition, would differ in that with the project, the vessels are anticipated to be actively involved in the fishery on every day when the weather is suitable for 58 ft vessels. In the without-project condition, there are more vessel days restricted by weather because there are many smaller vessels in the fleet. Also there are adjustments necessary due to local customs, and the nature of a developing infrastructure. Taken together, these factors give the Dutch Harbor vessels an advantage in terms of catch per harvest day. As a result of the higher harvest rate and larger vessels, fewer vessels are needed to conduct the harvest in the without-project condition. This advantage is somewhat offset by the increased travel time to and from Dutch Harbor.

All harvest activity regardless of specie is tightly controlled by restrictions on time and place of harvest. Harvest season varies from year to year. For example, in 2000 there was a complete closure of tanner crab fishing, but the snow crab season lasted 67 days and resulted in a taking of almost 184 million pounds. In contrast to this, the 2000 snow crab season lasted 8 days. For 2001, the snow crab guideline harvest level is set at 27.3 million pounds. This harvest level could be reached in 8 days or less.

Without all of these temporal constraints and given a fixed Guideline Harvest Level (GHL) at the ten year average, it would be theoretically possible to conduct the entire harvest of crab stocks that would otherwise be harvested from Saint Paul, by operating only four vessels out of Dutch Harbor. At the other extreme, given a fixed GHL, if there were to be a 20-day active crab harvest, 38 vessels would be needed. Our example of a 20-day season is based on a cycle of two 30-day seasons followed by a year of closure and is purely hypothetical. Fleet availability is not a concern as there are 38 vessels under 60 ft, which could be available from the 295 under 60 ft that currently occupy moorage at Dutch Harbor, Sandpoint, and King Cove.

The vessels are theoretically "available," because all of them enjoy the prospect of generating a higher gross income by harvesting crabs near Saint Paul if they are one of 38 vessels doing so. The average gross income would be over $65,000 for a 30-day harvest. In 1998 there were 38 Aleutian Island vessels under 60 ft that had smaller gross income in other fisheries. This was verified by reviewing the CFEC income summaries available by quartile for the Aleutian Island fishers. Since salmon seiners are under 58 ft, the salmon seine income records were a reasonable representation of income for the BSAI fleet under 60 feet.

5.2 Vessel Description

Regardless of the number of vessels needed, it was assumed all of them would be 58 ft, however, half would be a heavier version with a capacity of 90,000 pounds. Vessels under 58 ft are unacceptable due to sea conditions and over 60 ft introduces significant regulatory restrictions. They would be 58 ft by 23 ft by 9 ft, and be rated at about 1,700 hp, having capacity to operate as mid-water trawlers. They would have on-board processors and freezers. The other half would be more conventional sized "limit seiner" combination vessel with a capacity of 60,000 pounds. They would be 58 ft by 17 ft by 8 ft, and would be rated at 420–870 horsepower. For all of them, the hold capacity was reduced by half to allow for ice, salt, and/or refrigeration needed to preserve the catch for the 30 hours of fishing, plus more than 20 hours of travel before offloading at Dutch Harbor. Offloading and preparation times were included in travel. The capacity adjustment also allows for trips that are cancelled or cut short by mechanical problems, weather, low success rate, and crew needs.

After hourly costs were established for particular vessel types, they became a constant although the fleet size would vary depending on number of open season days allowed for the harvest. It does not matter how many vessels are required, because the number of vessel hours needed for the harvest is the same regardless. The sensitivity of benefits to variations in fleet size was limited by keeping total vessel operating hours constant regardless of number of vessels in the fleet.

In our calculation of hourly cost, the number of days fished was adjusted for unacceptable sea conditions 35% of the time. Because the vessels are large, lay up for minor repairs, gear change, crew rotation, and maintenance was limited to 60 days. Ten days were allowed for shut down at the holiday season. Within this criteria there would be a total of 222 round trips, and each round trip would require about 43 more hours of travel time to and from Dutch Harbor than daily trips in and out of Saint Paul.

Using the hourly vessel operating budgets generated for this report at $134.30 and $56.80, the travel cost under the without-project condition is $635,200 for the 19 larger vessels and $268,600 for the 19 smaller vessels, for a total of $903,800.

6.0 VESSEL OPERATING BUDGETS

6.1 Vessel Characteristics and Performance Criteria

Data regarding the characteristics of the fleet was gathered in meetings with members of the Central Bering Sea Fishermen's Association (CBSFA) in the summer and fall of 2000. The membership was unanimous that, under the with-project condition, the day fishery fleet will exploit the fishery within a 1–3 hour daily run from Saint Paul. The area immediately adjacent to Saint Paul and out to 65 miles from the island is reported to support 65% of the Bering Sea commercial fishing activity.

The Bering Sea conditions generally require stout vessels, however the maximum size of the future Saint Paul fleet as determined by the local fishermen's association is 58 feet. These sized vessels offer a scale of operation that is profitable for the day fleet, and they also happen to be the maximum size allowed for salmon harvest. There is no commercial salmon fishery at Saint Paul, but the multi-use potential adds to the vessel resale value. Resale value is a major concern to the local fishermen, because they will be going through a transitional phase of fleet development by increasing the size of vessels. Vessels under 60 ft do not require observers thus saving at least $20,000 in annual operating cost, and they are in the size range eligible for increased crab harvest opportunities under the new LLP criteria.

Vessels near the limit of the 58 ft class that are designed for use in Alaska waters are generally wider, deeper, and more powerful than vessels designed for use elsewhere. This adds to the versatility of use as harvesters of cod, halibut, and crab. There are 58 ft vessels in operation that are up to 29 ft wide. One, mid-sized 58 ft vessel discussed, had overall dimensions of 58 ft by 23 ft by 9 ft with about 1,700 horsepower. Though not the largest in operation, it was regarded as being the maximum size of any fleet addition at Saint Paul. Vessels typically sized at 58 ft by 17 ft by 7 ft are substantially less costly and in a day fishery can do everything that the larger vessel can do with the exception of mid-water trawling and will be the most common.

Vessels need to be large enough to operate in a wide range of sea conditions with the versatility of effectively harvesting with longline and pot gear. They should be able to operate at their maximum level of efficiency with a crew of 3–5 persons. A preference was expressed for welded aluminum construction, diesel power, fast running speed in all sea conditions, a clear deck area from the rear of the deckhouse to the stern, and readily accessible fish storage.

6.2 Operating Days

The number of operating days is important to establishing an operating budget. At Saint Paul the number of operating days varies by vessel size. Some of the smaller vessels will be used for subsistence use only during fair weather periods and others will only be used occasionally for harvest of CDQ allocations. Either way the annual harvest of these smaller craft can be completed well inside of 90 days.

For any vessel under 58 ft operating out of Saint Paul, the operating scenario allowed for a 120 day winter lay up period, subject to ice and sea conditions, is generally unacceptable for small vessel operations. In addition to the winter closure, possible fishing days were reduced by adjusting for the annual frequency of exceedence of limiting waves. In this report a "limiting wave" is defined as being a non-breaking wave equivalent in height to 10% to 25% of vessel length. According to CBSFA fishers, it is a limiting wave in terms of comfort and safety of the crew working a longline operation on an open deck. For this report deepwater wave data was used, and the informed judgment was made that a limiting wave exceedence frequency corresponded to an annual deepwater wave height at the lower end of the 10%–25 % of vessel overall length. On an annual basis critical waves would close down harvest operations 70%, 40%, and 35% of the time for 32 ft, 45 ft, and 58 ft vessels respectively. Number of potential operating days would be 73, 147, and 159 respectively.

Of the total potential operating days, about 30% are actually fished. Some vessels go out every day, but others sit out most, if not all, of the commercial season. Observations of harvest activity during a period when halibut CDQ and IFQ were available and weather conditions were good indicated about a third of the vessels were active on a daily basis. There are many reasons for the entire fleet not fishing every day. Among the reasons that will be factors for the without- and with-project conditions are crew availability and vessel breakdown. Crew availability is a factor because some of the crew and owners are active on other vessels at other locations during certain seasons. This is anticipated to be a normal long-term part of life at Saint Paul. There are limited employment opportunities on the island and many people seek work elsewhere for part of the year. Vessels can be out of service for long periods due to breakdown because of difficulty in getting parts and repairs at Saint Paul.

From operating scenarios developed, during interviews and public meeting participation with CBSFA fishermen at Saint Paul in 2000, a typical day requires a three-hour run to the grounds at a high power setting, six hours of fishing at minimum power, and a high power run back. An additional 1–4 hours is spent in preparation and unloading with the main engine shut down. Daily harvest was generally less than vessel capacity. This was due to the fact fishing trips were short and that vessel trip limits apply to the CDQ halibut fishery. Details in support of estimated budgets are included as table footnotes.

Table 6. Typical Expanded Saint Paul Fleet Day Fishery[17]

Description[18]	Seine/trawl/crab	Seine/longline/crab	Seine/longline	Longline
	58 ft	58 ft	45 ft	32 ft
Investment ($)	900,000	321,000	135,000	62,000
Length by Beam	58 by 23	58 by 19	45 by 17	32 by 13
Draft feet.	9	8	6	4
Fish hold (lb)	90,000	60,000	30,000	12,000
Main Power	Triple Cat 3176[19]	Twin 3208 Cat	Twin 3208 Cat	Single Cat 3208

[17] Day fishery will be a fleet that can fully exploit the fishery within a daily run from Saint Paul. The Bering Sea conditions require stout vessels, however the maximum size based on input form the local fishermen's association is 58 ft. This is because the vessels are the maximum size allowed to fish for salmon and multi-use potential adds to the vessel resale value.

[18] This choice of "typical vessels" is based on actual vessels in service in the area adjacent to the Pribilof Islands and in the fisheries to be targeted in the with-project condition. Characteristics were gleaned from 200 sample sales listings in 2000. The vessels used to depict operating budgets are near the center of the size range distributions used in the fleet projection.

[19] Based on manufacturers data for a vessel constructed in 1997. Other designs trade off main power needed for trawling for increased auxiliary power. A 2000 design uses less main power but incorporates freezers and processors supported by one 1320-kW Cat 3406, one 190-kW Cat 3306, and a 105-kW Cat 3304. Total hourly fuel use is equal for both designs. This vessel was used in scenarios of the without-project condition.

Table 7. Operating Data Typical Expanded Saint Paul Fleet Day Fishery

	Seine/trawl/crab (58 ft)	Seine/longline/crab (58 ft)	Seine/longline (45 ft)	Longline (32 ft)
H.P.	1710–1980	420–870	420–870	210–435
Fuel use[20]	69–96 gph, 82 avg.	24–48 gph, 36 avg.	24–48 gph, 36 avg.	12–24 gph, 18 avg.
Crew	5	4	4	3
Number of 12-hr fishing days[21] with 6 hrs at max hp and 6 hrs at min[22]	159	159	147	73

Table 8. Typical Operating Budgets Expanded Saint Paul Fleet

	Seine/trawl/crab (58 ft)	Seine/longline/crab (58 ft)	Seine/longline (45 ft)	Longline (32 ft)
Repair/maintenance[23] ($)	90,000	32,000	13,500	6,400
Hull Insurance @ 5% ($)	45,000	16,000	6,700	3,000
P&I Insurance @ 2% ($)	18,000	6,400	2,700	1,200
License/permit fees[24] ($)	47,200	18,300	9,000	5,400
Association dues ($)	1,000	1,000	500	300
Business expenses[25] ($)	18,000	7,000	2,600	1,200
Food[26] ($)	16,400	13,000	11,800	4,400
Fuel ($)	209,800	92,100	82,600	20,500
Return on capital ($)	59,200	21,000	8,900	4,200
Crew share[27] ($)	504,600	206,800	138,300	46,600
TOTAL	**1,009,200**	**413,600**	**276,600**	**93,200**

[20] From Caterpillar technical services library for Marine Applications.

[21] Number of days allows for a 120 day winter period subject to ice and sea conditions unacceptable for small boat operations at Saint Paul. Fishing days have been reduced by the annual frequency of exceedence of limiting waves. Height of a limiting wave for small boat longline operations is generally 10% to 25% of vessel length. Limiting wave exceedence frequency is based on annual deepwater events exceeding 10% of vessel length. About 30% of potential days are actually used for harvest.

[22] From operating scenarios developed during interviews and public meeting participation with CBSFA fishermen at Saint Paul in 2000. A typical day requires a three hour run to the grounds at maximum power, six hours of fishing at minimum power, a maximum power run back. An additional 1–4 hours is possible in preparation and unloading with the engine shut down.

[23] Annual vessel, machinery, and maintenance estimated at 10% of vessel value as a range midpoint. Includes an allowance for the hourly equivalent of overhaul cost and routine maintenance (lube, oil, filters etc.). A study of Alaska fishers, by The Research Group in 1999 tabulated a range of 8%–20% depending on vessel type. Longline and pot fishers were near the low end of the range and they are more typical of the Saint Paul fleet. Alaska District Cost Engineering Branch estimates for the False Pass report in 2000 show the annual cost at 11% of vessel value.

[24] Using $2,200 as an average of <100 ft pot and trawl vessels, it was prorated by length of the harvest activity. An amount equal to 5% of vessel value was added to allow for IFQ end of season fees at 3% of gross harvest. Data from Study and Houston et al in 1997 indicates license and fees range from 2%–5% of annual gross harvest.

[25] 2% of capital investment. Includes tax filing and tax accounting, business income and expense record keeping, payroll and personnel management, contract negotiation, legal review, account and credit management, travel and entertainment.

[26] Anecdotal based on at site conversations with fishers in 1998 and 1999 estimating dollar expenditures for a season. Also see Radtke and Davis, table 8. Percentages averaged across five fisheries and presented as a percentage of total costs range from 2% to 3% depending on type of vessel. Type of vessel determines size of crew and length of time at sea. In contrast, the Alaska District Cost Engineering Branch estimated crew support cost at $20 per person per day for seine and net vessels working the False Pass fishery in 2000.

[27] Alaska Review of Social and Economic Conditions University of Alaska, Institute of Social and Economic Research, Nov 1994, Vol. XXIX, No 2, Fig 14 page 9 showing halibut fleet operating expenses are 17% of exvessel value, and crew shares are 49%. Figure 26 page 14 shows sablefish ex vessel value divided 54% to crew shares and 6% to operating expenses. Crew shares calculate out to an hourly equivalent of $35, $24, and $26. This contrasts with the Fleet Survey in 1997, which reported a documented average hourly earning of $44. Pacific States marine Fisheries Commission analysis of Dept of Labor statistics for covered earnings shows average earnings per employee in all fisheries related industries (assuming a 160 hour month) ranged from $12 to $20 in 1999. 50% was used for the budgets and later had to reduce that to 20% to show the entire fleet could be profitable. The Alaska Seafood Industry Study explains crew shares in the 20% range for smaller vessels. At 20% average annual earning per crew person was $25,600, average per hour was $32.50.

Table 9. Hourly Equivalent Summary

	Seine/trawl/crab (58 ft)	Seine/longline/crab (58 ft)	Seine/longline (45 ft)	Longline (32 ft)
Fuel cost (%)	21	22	30	22
Hourly fuel cost[28] ($)	106.50	47.00	47.00	23.60
Hourly fuel+repair+maintenance ($)	134.30	56.80	53.50	32.50
Combined hourly variable[29] ($)	26	27	34	30
Total hourly cost ($)	**512.80**	**210.20**	**156.80**	**106.40**

[28] Fuel use at $1.30 is based on survey of actual sales at Saint Paul and Dutch Harbor on consecutive Tuesdays during a 20 month period of 1999 and 2000.

[29] Total hourly operating cost ranges from 26% to 34% of the total cost compared to 31% after price level adjustments to Radtke and Davis.

7.0 WITHOUT-PROJECT CONDITION

7.1 Harbor Problems

The community is aggressively pursuing opportunities to develop a local fleet. Even though Saint Paul is centrally located with regard to the fisheries, the community will not be able to use the advantage without some modification to small vessel facilities. Saint Paul's remote location is the factor that gives the community a location advantage for harvest of certain fish stocks. The existing fleet is without a permanent moorage area, and there are no permanent docks to tie up to. Crowding results in damages to vessels and lost time to operators. Vessels are stored on trailers or cradles in busy areas, tying up land needed for highly valued marine services, given that there is limited commercial and industrial land available on the island. Because most of the island is preserved as open space for wildlife use, lease value per acre of commercial/industrial harbor land offered is as high as $392,000 per acre per year. Damage, theft, and vandalism are common problems at the insecure storage areas.

7.2 Fleet Restrictions

The limitation on vessel sizes, caused by lack of moorage, has caused development of multi-species harvesting to be discouraged. Larger vessels are needed to profitably target cod, halibut, and crab. Since the fisheries occur over an eight to nine month period, vessels over 32 ft are more likely to be compatible with weather conditions. A desire to capture the advantage of developing a multi-species fishery has caused future users of a new small boat harbor to urge the harbor to be planned in a way that will accommodate vessels up to 58 feet. The fishers also desire to maximize the number of days that the fleet can be left in the water, and there are hopes that a year-round harbor will be possible at Saint Paul. They maintain that, without a protected moorage facility, they will be unable to compete, and stocks available adjacent to the island, will be harvested by vessels operating out of other ports.

7.3 Boat Launch And Retrieval

Vessels are often damaged during launch and retrieval. Launching of vessels is a confused, crowded, and risky activity. Because there is no ramp usable by local vehicles, launching is with a crane, and on occasion, with a large wheeled loader. Until 1999, Tanadgusix Corporation (TDX) owned an operational crane and had established rates for the crane at $280 per hour, and $60 per hour for the operator = $340 total per hour. The minimum charge is four hours. In 1999 the TDX crane was damaged in operation and has been inoperable since. As a substitute, the fishermen have been able to use a crane that had been brought to the island to work on the breakwater. When any crane is used to lift vessels, it is necessary to provide an operator and a spotter. Based on a maximum daily rate for the crane, limited to $1967 (TDX rate), an operator at $60 per hour (TDX rate), and volunteer vessel crewman for a spotter, a 24-hour equivalent would be $142 an hour, not including overtime. In this report, the short-term total hourly cost of using the equipment has been adjusted down to $240 from $340. There are expected to be many events where a haul out of the fleet takes place over a period of time longer than four hours but less than 24 hours. The midpoint between the hourly rate and hourly equivalent of the 24-hour rate is $240 per hour, used as an estimate for the use of any crane.

Use of the loader is ordinarily avoided by the fishermen, because the ramp and channel at the put-in point is narrow. During the launch, the rock shoals are difficult to avoid even when the tide is not running and winds are light. Each year several out drives are damaged, and at least one vessel has been sunk. The launching and retrieval frequently demand the attention of six people for a single vessel.

A new haul-out arrangement is needed to handle larger vessels. This could include a hydraulic trailer-tractor combination and an improved ramp. A large mobile unit would be the least cost method of haul out. A new launch ramp could be included as part of the project. The ramp and hydraulic trailer will be practical support for a vessel repair facility that the community needs very badly. Without proper haul-out and transport equipment, development of a needed vessel repair facility is impractical. Lack of a small boat harbor places constraints on more intensive use of some highly valued industrial/commercial waterfront.

Fishermen attempt to maximize use of short, fair-weather periods, and when the weather changes, there is a rush to put vessels in and to take vessels out of the water. If the crane is busy on other work, the wait causes extensive lost time, and vessels in the water are often bumped together and blown aground. Conditions inside the outer breakwater are often so bad that the harbor is closed to vessels of any size, and even vessels over 100 ft are ordered to leave.

At present the only choice open to vessel operators is to leave the harbor when storms arrive, or have the vessel hauled out and put on a cradle or trailer in dry storage. Under present conditions, Saint Paul cannot be used as a place for vessels of any size to seek refuge from storms. Vessels have sunk in the harbor and just outside of it.

7.4 Transportation Cost For Vessel Repair

Saint Paul does not have adequate moorage, haul-out facilities, crane capacity, or a dockside work area for repair crews to fix larger vessels. Because of limited tie-up space, lack of protection against wave activity, and lack of a haul-out facility, vessels in the over 32 ft class, which are in need of repair, must be towed to Dutch Harbor. A sample of 1680 vessels of all sizes calling at Saint Paul in 1999 revealed 56 visits for the purpose of maintenance, repair, and parts replacement. A sample of harbor records indicates that each year there are 5–10 damaged or disabled vessels that must risk the open water trip to Dutch Harbor for repairs not available at Saint Paul. Frequently the vessels must be taken in tow for the entire trip. Vessels have sunk on the way to Dutch Harbor, because it was not possible for them to be repaired at Saint Paul.

7.5 Local Dock Cost

When storm conditions cause wave activity inside the harbor, floating docks for the small vessel fleet are required to be removed. The crane lifts the three approximately 60 ft units from the water and stores them alongside the waterfront at a documented cost per event of $30,000, not including the opportunity cost associated with storage of the dock units on valuable industrial land. The docks had an overall useful life of five years when they were new. By project year one they will be due for replacement at a cost of over $215,000.

7.6 Lost Time

Lack of a protected moorage translates to less fishing time. Operators must use valuable weather windows for launching and retrieval. Fishing for subsistence and for commercial purposes is interrupted, and to a great extent limited. Because of the need to wait on availability of a crane or loader and because everyone rushes to launch and retrieve within a limiting weather window, each launch can take two hours to mobilize the crane and 45 minutes for each vessel. In many instances the lift of one vessel has taken more than two hours. For the fleet under the without-project condition, the total time per launch or retrieval of all vessels is estimated to be 36 to 39 hours. In addition, it takes three hours to move the vessel into storage and secure it. Excluding waiting time between arrival at the haul-out point and beginning of actual haul out, each vessel ties up two or three crew persons.

Under the without-project condition, the vessels will be subject to storm damage if left in the water, hence when one needs to be removed for protection against damage, it is likely all of the others will as well. Average waiting time to beginning of haul out for a specific vessel is estimated at half the expected total fleet haul-out time of 36 to 39 hours, or 18 to 19 hours. During this waiting period the entire crew of each vessel that cannot be trailer launched and retrieved is tied up waiting for crane service, a total loss of an additional 972–1,064 person hours (18–19 hours x 27–28 vessels x 2 crew).

Since it is weather conditions that limit the time the local fleet fishes, each hour saved in the launch and retrieval process is an hour of additional harvest time for the subsistence fishery. There is considerable room for expansion of local fleet activities, and local fishermen have stated a small boat harbor is needed so they can increase their subsistence harvest. Lost time, during the nine months per year the fleet is expected to be used, is summarized in table 10.

Table 10. Lost of Fishing Time

Haul Out	216–351 Hours
Waiting For Haul Out Service	972–1064 Hours
Put In	216–351 Hours
Waiting For Put In	972–1064 Hours
Number Of Times Per Year	5–10[30]
Total Lost Time Estimate Range	**11,880–28,300 Hours**

7.7 Harvest Near Saint Paul

Since Saint Paul does not have a small boat harbor, the rich stocks near the island are harvested by vessels working out of Dutch Harbor and more distant ports. Costs are higher for vessels working out of Dutch Harbor due to the added travel distance. Dead loss of crab also results from the added time and distance. In this report dead loss of crab has not been quantified.

[30] Deep water waves from the N and NW +6 ft approximately 20% of the time x 90 day in-water period for the fleet x and assumed 2 to 4 days storm duration. Initial estimate was provided by CBSFA operators.

7.8 Water Taxi

Large trawler and crabbers regularly call at Saint Paul for crew change, supplies, and medical assistance. Because the harbor is so busy, vessels frequently wait outside for a clear channel or vacant tie-up space. Vessels occasionally wait eight or more hours. They have no choice because the next port is 275 miles away. With a small boat harbor, a water taxi service could call on vessels waiting outside, and deliver people and supplies.

7.9 Subsistence Harvest

For the Aleutian Island area, data gathered by ADF&G in 1994, reveals average per person subsistence harvest is 378 lb per year. At Saint Paul it has been 267 pounds. Alaska's highest per capita subsistence harvest is at Hughs where it is 1,498 pounds. A study by ADF&G in 1989, Alaskan's Per Capita Harvest of Wild Foods, summarized the following as factors accounting for some communities having extraordinarily large per capita consumption rates:

- The subsistence harvest is high because it is used as a substitute for milk products (the single largest item in the American diet), fruits, vegetables, and grains. In the U.S., average meat and poultry consumption is 255 lb per year, but in Saint Paul the subsistence harvest also provides clothing, home goods, trade, items, ceremony, arts and crafts, and other uses (Saint Paul has a single retail outlet.).
- Native communities harvest more wild foods than communities with higher non-Native populations (The Saint Paul resident population is 79% Native.).
- Generally, harvests increase as the distance from road systems increase (Saint Paul is a remote location.).
- Because of high cost of transportation and storage, store bought foods in rural areas can be expensive, and many choices very limited (Most passengers and freight are delivered to Saint Paul by air.).
- Lack of a protected launch area and lack of a protected moorage limit the number of days that small vessels can be used for harvest. Residents are very vocal in their need for a safe place to serve as a center for traditional subsistence practices.

8.0 LOCAL PLANNING CRITERIA

In community meetings with the sponsor, local fishermen, and community groups, a list of planning criteria surfaced. Popular support was voiced for the following:

Navigation Season. Local fishermen desire a plan that can be in use all year. Harbor plans that call for seasonal removal of docks and vessels will be a low priority option. The project would need to provide all weather, year-round protection.

Security. The harbor would need to be in a secure location. Locations that minimize access by visitors would be given a preference.

Location. The project would need to be out of the way of larger vessels. Previous analysis indicates the preferred location for a small boat harbor is within the general confines of the existing Saint Paul Harbor. There are several alternative configurations under study, but all are within the confines of the existing area protected by the outer breakwater.

Size. The harbor alternatives should evaluate sizes ranging from 30 to upwards of 60 vessels and should accommodate vessels up to 58 feet.

Economic Efficiency. Benefits would need to exceed costs. From the community point of view, alternatives that maximize local benefits at minimum local cost would be preferred.

Adverse Environmental Impact. Island residents indicated that any small boat harbor plan must first consider avoidance of all adverse environmental impact and secondarily consider mitigation of effects. Disruption of nesting and feeding habitat should be minimized. There are four sensitive areas associated with any additional harbor improvements within Village Cove: water quality, Salt Lagoon, fur seals, and Boulder Spit with its least auklet colony.

Water quality has remained high within Village Cove with the present vessel traffic and ancillary uses. All three processors that have operated in the harbor have used untreated Village Cove water in their crab processing operations.

Salt Lagoon is an extremely productive, unique habitat. None of the proposed small boat harbor alternatives would physically impact Salt Lagoon nor do they lend themselves for future development, which would physically impact the lagoon. Potential impacts associated with the construction of a small boat harbor would be associated with water quality.

The number of juvenile fur seals using Village Cove appears to be increasing. An estimated 1,000 animals were present in Village Cove in the fall of 1996. They appear to congregate near the entrance to Salt Lagoon in the area of the proposed north breakwater and proposed Federal access channel. The fur seal juveniles will probably haul out on the proposed north breakwater and will swim in the access channel. The potential impacts associated with the vessel/fur seal interaction are not known.

Boulder Spit provides nesting habitat for about 16,000 least auklets. It does not appear that any of the proposed small boat harbor alternatives would have a significant adverse effect on Boulder Spit. The dredging of the sediment management area may be restricted to periods when the least auklets are not nesting.

There does not appear to be any practicable means to avoid impacts associated with the design of the proposed small boat harbor in Village Cove. The proposed design does however seek to minimize impacts by giving flood flow preference to the eastern harbor entrance channel. Mitigation to avoid impacts will have to be in the manner of operations and management practices. In order for this kind of mitigation to be effective, the local sponsor must develop a harbor management plan with specific criteria to minimize both water quality degradation and interaction with fish and wildlife resources. An effective plan would probably require that these regulations become city ordinances, and that a strategy and policy in support of enforcement be developed.

Existing Port. Development of plans must be consistent with and complementary to the existing deep-water harbor. Alternatives must not physically interfere with the present configuration of the deep-water facilities. To the maximum extent possible, operation of the small boat harbor alternative plans must alleviate congestion and safety concerns associated with small boat traffic in the vicinity of the deep-draft facility.

Phased Development. The sponsor wants a plan which is flexible enough to allow for incremental addition to, or changes in configuration of docks, as local needs demand. The advantage to them is that this could allow them to more carefully time expenditure of some construction funds, timing to needs as they develop. It is also a means of applying adaptive management to address the uncertainty inherent in fleet and harvest projections.

Harbor Water Quality. The objective is for the day fishery and main harbor water to be exchanged in a pattern as similar as possible to the without-project condition. Steps need to be taken to assure trash, sewage, and oil and greases are collected. Normal ebb tide flows from the Salt Lagoon through the harbor should remain as they currently exist.

Salt Lagoon Water Quality. Tidal flushing is not to be impaired by the small boat harbor.

Waves. Waves in the small boat harbor are to be reduced to 1.5 ft or less under the most adverse storm conditions.

Currents. Currents should be less than three fps. Engineering should maximize opportunities to develop circulation gyres to enhance flushing under normal tidal exchange.

Sedimentation. Sediments are to be managed so their interference, with the small boat harbor and main harbor facilities, is minimized. Maximum effort should be extended to develop beneficial uses for dredged material.

Compliance with the Saint Paul Ataqan Akun Community Plan. Alternative plans must not conflict in any significant manner with other land use and development plans. Many of the values specified in the plan emphasize (1) stewardship of the island; and (2) preservation of unique aspects of the Aleut community as important, fundamental concerns steering development of the community. Planning activity represented in this report is consistent with community guidelines related to expansion of the harbor, development of a small boat harbor, preservation of adequate harbor space for processors, and minimization of environmental impact. The planning activities in this report are consistent with local policy related to keeping the harbor expansion generally within the area presently developed within the harbor, making the best use of available land, provision for adequate moorage, loading facilities, and storage and repair facilities to support local fishermen.

9.0 IDENTIFICATION OF ALTERNATIVE PLANS

During local planning meetings that spanned the November 1996–October 2000 timeframe, a local planning committee consisting of representatives from the City, Aleut Community, Pribilof Bering Seafood, Bering Sea Eccotech, CBSFA, and TDX, continued a mission to develop concept plans. The priorities put on the planning criteria by the committee reflected the following concerns:

- Design must be beneficial or non-harmful to Salt Lagoon.
- Beneficial use of the IRA Tribal Operation area is necessary as part of the project.
- A pro-active role by the Aleut Community and TDX seeking future permits for development of inner waters and adjacent land could be expected.
- Respect for existing property rights and land use plans was required.
- Accommodation of future changes in the local fleet was a stated goal.

During the planning sessions three basic alternatives were identified, and through follow-up input from Aleut Community of Saint Paul, Pribilof Bering Seafood Ltd., Bering Sea Eccotech, CBSFA, and TDX Corporation, four other concept plans emerged. The plans differ in (1) their breakwater configuration and location; (2) two major factors impacting the ability of the plans to serve as an all weather, year-round harbor and to do so in a cost effective way.

Hammerhead. This plan, near the vicinity of the spending beach and maneuvering basin, is a rubble fill foundation with a timber trestle. The trestle allowed access to the head that could be utilized as wharf space for the trans-shipment of goods. The plan was discarded as it concentrated storm generated current in the mooring area and would not have reduced wave activity to the extent other plans could.

Floating Breakwater. Located adjacent to the TDX docks at the south end of Village Cove, this plan would use an anchored vessel to dampen wave activity. Wave attenuation of such a structure in the long period wave climate would be primarily by reflection. The added wave activity in the reflected wave path would adversely affect other harbor operations. Currents in the harbor, under design storm conditions, could make mooring the structure very difficult. The alternative was rejected from this study, based on its adverse affects on harbor waves.

South Village Cove. Also suggested as TDX plan 3A, this plan is at the same location as the floating breakwater plan. It consists of a short north breakwater and a west breakwater near the public access area. The small boat harbor consists of two docks and occupies about twelve acres. Of the plans examined, it is the plan that has the maximum potential for meeting planning and engineering goals. It could also meet late surfacing goals of a tribal dock and temporary moorage of the 100 ft plus vessels. Six size and depth variations of this plan were pursued in the later stages of study to develop the NED plan.

TDX Plan 4A and TDX Plan 2A. TDX conceptual plans 4A and 2A are variations of a two dock concept that incorporate moorings for vessels larger than anticipated for the small boat harbor and also include a major dock facility. As the financial benefit of the added facilities is not obvious, and the analysis is beyond the needs stated in this study, the additional cost have not been estimated. The increased cost will however be significant. Both of the plans have one environmental characteristic, which also was a factor in eliminating them from further consideration. Both plans are configured so as to require the major proportion of flood flow water entering Salt Lagoon to pass through the harbor complex before entering the lagoon. This is an ideal situation for the harbor but puts a higher potential for Salt Lagoon contamination in the system than agencies will probably deem reasonable. Both plans will also have major problems with high velocities during and immediately after storm events.

Salt Lagoon. Also suggested as TDX plan 1A, this is a harbor located in the entrance to Salt Lagoon. It would be well protected from waves but would suffer from exposure to high velocity flows when storm surge water volumes are purged from the Salt Lagoon. A harbor in this location would also eliminate bird-feeding habitat and expose Salt Lagoon to a higher potential for contamination than may be desirable. The harbor would be located in what should be sand deposits, and the excavation costs, other than for the approach channel, should be minimal. An in-depth evaluation was not undertaken due to the potential for Salt Lagoon contamination.

Westerly Harbor. A harbor site about 200 ft west of the site adopted was examined as water depths appeared favorable. Examination of the wave climate and currents during storms, depicted in model studies, indicated that both a wave barrier and current barrier extending out from the south shoreline would be required to protect moorage on the south shoreline. When such a structure was placed near the Icicle Seafood barge, most of the existing depth advantage was eliminated by the breakwaters footprint. Placement of the harbor in that location also constrained other potential harbor uses. As there was no major cost advantage to a harbor at this site, and there would be major losses in benefits to other users, the site was not studied in detail.

10.0 ECONOMIC EVALUATION

10.1 Overview

The projected fleet was used as the basis for an expression of moorage needs to be addressed by the concept plans. The seven concept plans were developed first with regard to the fleet projection and second with regard to other planning criteria previously described. Using the above criteria to guide a plan formulation process, engineering analysis was applied to determine cost and performance of the projects. That process narrowed the seven concept plans down to one preferred location (South Village Cove), which presented the least cost option for meeting all planning criteria while still being the best performer. The selected site was then used for various breakwater and harbor layouts to generate various scales of harbor plans.

During refinement of the South Village Cove site, three harbor sizes were identified for engineering studies; 30, 60, and 90 vessel harbors. The 60-vessel harbor was evaluated at three depths. The character of the site is such that after the basic pieces of the project are in place, expansion from a 30-vessel harbor to a 60-vessel harbor can be done at low incremental cost. Beyond 60 vessels, fast land and dredging cost began to drive up the incremental cost.

10.2 Evaluation Criteria

The identification of project benefits under the NED criteria is based on increases in the net value of national output of goods and services, expressed in monetary units. It includes the value of goods and services that are marketed and those that are not. Benefit cost analysis is the technique used to identify and value the effects.

10.3 Evaluation Framework

Corps' planning is conducted in a with-project and without-project context. By comparing forecasts of future conditions in a study area without a project to forecasts of conditions with a project, the differences in costs incurred by and benefits accruing to the study area, as a result of the project, are more readily identified. In order to ensure that plan alternatives are economically efficient, it is necessary to impose the condition of economic rational behavior on individuals and firms in both the with- and without-project condition. The result of the evaluation is identification of a theoretical willingness to pay for the project outputs and is used to express the NED benefit, regardless of who will actually pay. In this analysis four techniques had a role in estimating willingness to pay:

Actual market prices. Used to determine exvessel harvest values

Changes in net income. Used to estimate fleet development

Cost of the most likely alternative. Used to estimate benefits due to project caused improvements in harbor efficiency, travel cost, and subsistence harvest

Administratively established values. Used to estimate opportunity cost of time

10.4 Application

Benefits were evaluated for alternatives that could meet the planning criteria, and NED evaluation principles were applied. If an alternative plan was judged not able to meet the planning criteria, and not able to be modified to meet it, the plan was dismissed on grounds of non-performance. Since the plan alternatives are in the same locale (varying in distance from one another by less than a mile), benefits are essentially the same for each project when the alternatives are similarly scaled. The prime difference in benefits will be the number of vessels accommodated.

10.5 Uncertainty in the Evaluation Procedure

The process used in this report is based on a comparison of the conditions with the project against conditions without the project. This comparison method captures the economic behavior of fishers and the harvest activity they would be involved in with the harbor and without it. In this particular harbor study, both the without-project condition and the with-project condition are subject to significant uncertainty. This resulted from the fact that Saint Paul does not now have a small boat harbor, and small vessels are overall a relatively small part of the Bering Sea fleet. The uncertainty, however, is mitigated by the fact that Saint Paul enjoys the obvious economic advantage of being at the center of the resource.

There are elements of the evaluation where basic data was lacking and which had to be analyzed with use of anecdotal information, data from small samples, or data transfer. These areas of uncertainty are discussed in the Risk and Uncertainty section of this report.

An economic evaluation uses estimating procedures for purposes of resource economics, because there is an absence of markets to rely on for some direct benefit measures. Estimating procedures generally need to pass the test of reasonableness, completeness, reproducibility, and accuracy. In this report the reasonableness of scenarios has been checked through independent review by industry participants. In addition, the scenarios and data had to be demonstrated as being rational in an economic sense to meet the test of independent professional review, which also verified reproducibility. Completeness was verified using side by side comparisons of with-project and without-project cost comparisons. Accuracy was also verified by independent review. Where sensitive areas of data or methodology were discovered, they were evaluated as range values in the Risk and Uncertainty section of the report.

10.6 Methodology in the Evaluation

The evaluation started with an assessment of the resource. This was central to drawing some inference about what type of fleet might operate out of Saint Paul. To be viable a Saint Paul fleet will need to operate at a profit and be the least cost location from which to operate. The resource assessment provides the basis for estimating potential gross income.

In the analysis, the daily Saint Paul harvest was constrained by vessel size. This is an important concept and is a serious limit on the potential of a small boat harbor at Saint Paul. Typically the Bering Sea resource is harvested by vessels in the 90–230 ft class, much larger than the maximum 58 ft size that will be accommodated at Saint Paul. The huge vessels stay on the fishing grounds for a longer time. They also enjoy certain economies of scale and are more able to withstand the sea conditions in which they must operate for long periods. A harbor at Saint Paul offers a harbor of refuge just a few miles from the fishing grounds, thus allowing local vessels under 60 ft to maximize harvest on a daily basis and return to port nightly. Vessels under 60 ft will be profitable at Saint Paul.

Generally, the stocks near the island were inventoried in terms of allowable catch. The allowable catch was allocated to a Saint Paul fleet, based on the portion of the eastern Bering Sea fleet, that was under 60 feet. This was supported by a demonstration that Saint Paul is the least cost base of operations for vessels under 60 feet.

The total number of vessels that the gross income could support was determined using published net to gross ratios. It was then necessary to determine the size distribution of the future fleet. For this, it was assumed that the Saint Paul fleet would mirror the distribution of vessel sizes in the prior IFQ halibut fleet. This assumption was supported by the fact that the Saint Paul fleet will be a multi-species harvest, and the pre-1995 halibut fleet also had the characteristic of being 100% multi-species. In addition 80% of the halibut fleet was made up vessels under 60 feet. There is no other Bering Sea fleet with comparable characteristics.

While deriving the size and characteristics of the fleet, an evaluation of the vessel operating scenarios was also in progress. This resulted in a rationale for the typical harvest, operating days, and cost details. Vessel operating budgets drew on published studies and allocated the harvest costs between fixed and variable components.

Given the make up of the fleet, the cost of operations, and the harvest income, a comparison was made of operating out of Saint Paul and out of alternative ports. This is the heart of the benefit evaluation. In addition alleviation of the problems incurred by the limited fleet operating at Saint Paul in the without-project condition were also identified and quantified as benefits. The part of the evaluation that is directly related to benefit evaluation is detailed in the following discussion. Assessment of the resource, estimate of the harvest, and derivation of the fleet are in preceding sections of this report.

10.7 Use of Opportunity Cost as a Basis for NED Benefits of Harbor Improvements

For NED analysis of transportation, the Corps estimates the difference in cost of delivering a commodity[31]. For the NED analysis of harbor improvements that benefit commercial fishing, one looks into the difference in cost of the harvest[32]. Generally, in the NED frame of reference, capital costs are a necessary input to estimating hourly costs[33].To the extent capital

[31] Published paper version of Economic and Environmental Principles and Guidelines for Water and Related Land Resource Implementation Studies, (P&G as presented in Corps of Engineers Engineer Regulation ER 1105-2-100, paragraph 6-59, 6-75).

[32] Ibid Para 6-117

[33] Ibid, Para 6-59 a. ."the benefit is the reduction in economic cost of using the waterway.", and para 6-117"...Harvest costs include...cost of equipment ownership and operation..."

costs are affected by a project, they are a NED consideration[34]. For this report it was assumed that relevant NED costs are limited to differences in short-run variable cost outlays of the harvester. This can be argued as a significant understatement of NED effects because the literature indicates it is not costs that are relative to the fisher, or to the shipper, it is costs that are relative to the nation that matter. The net effect on the nation is the basis for NED economics[35]. This is an important concern and is a subject of discussion in the section on Risk and Uncertainty.

10.8 Reduced Transportation Cost Related to the Harvest Activity

The local economy and the harbor will not undergo significant changes without the project. The strategy of the community is to develop a multi-species harvest and processing complex that will not be economically viable without a small boat harbor. Therefore, there are few changes expected for the local fleet if a harbor is not built.

Without a project, harvest of the resources around the island will be by vessels operating out of Dutch Harbor and delivering there. A run of between 215 and 340 miles is necessary to reach the main eastern Bering Sea fishing grounds from Dutch Harbor. This open-water trip would need to be made with vessels heavily loaded and under frequent adverse weather conditions. This is not consistent with use of vessels much under 58 ft, therefore, the small vessel fleet anticipated in the with-project condition will not develop without the project. Nor will there be fleet expansion at any other location without the project.

Existing vessels operating out of Dutch Harbor will use a three day trip out, of which about 30 hours will be spent fishing, compared to the six-hour fishing periods for day trips out of Saint Paul. This allows both fleets to harvest to the maximum potential of vessel capacity and is the most economical mode of operation. The operating scenario for the two fleets would also differ in that the Dutch Harbor vessels are anticipated to be actively involved in the fishery every day when the weather is suitable. This gives the Dutch Harbor vessels an advantage in terms of catch per harvest day and fewer vessels are needed to conduct the harvest. This advantage is somewhat offset by the increased travel time to and from Dutch Harbor.

To harvest stocks near Saint Paul (assuming GHL is maintained at the average of the last ten years and seasons characteristic of serious cut backs in low harvest years), it would take a fleet of 38 vessels. However, if season restrictions are set aside, it would be theoretically possible to conduct the entire harvest of stocks that would have been harvested from Saint Paul by operating only four vessels out of Dutch Harbor. A fleet of four was used merely for purposes of simplicity in the benefit calculation. With a larger fleet, the number of operating hours, the total operating time, and variable cost will remain the same and is merely spread among more vessels. All four would be 58 ft, however, two would be a larger version with capacity of 90,000 pounds. They would be 58 ft by 23 ft by 9 ft and would be rated at over 1,700 horsepower. The heavier version has the capacity to operate as mid-water trawlers. The

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[34] Ibid 6-117, ...The NED benefits are conceptually measured as the change in consumer's and producer's surplus as a result of a plan."

[35] Ibid page 5-16, "Resource use is broadly defined to include all aspects of the economic value of the resource. This broad definition requires consideration of the direct private and public uses that producers and consumers are currently making of available resources and are expected to make of them in the future."

two lighter, standard type vessels would be a more conventional sized "limit seiner" combination vessels. They would be 58 ft by 17 ft by 8 ft, and would be rated at 420–870 horsepower. This scenario, based on a fleet of four vessels, is an ideal situation where every harvest day results in a maximum harvest within a 30-hour period. For this scenario each vessel would make 55 round trips with each round trip requiring about 43 hours more travel time to and from Dutch Harbor than daily trips in and out of Saint Paul. The trips would result in average payload at 50% of vessel capacity. This reserves 50% of the capacity for ice, sea water, salt, or harvest shortfall due to weather, mechanical problems, low success rates, or unanticipated difficulty. At present, there are vessels in this size range operating out of Dutch Harbor targeting stocks of the eastern Bering Sea.

The hourly vessel operating budgets generated for this report are $134.30 and $56.80 for two configurations of 58 ft vessels. The travel cost under the without-project condition is $635,200 (larger 58 ft vessel) and $268,600 (smaller 58 ft vessel) for a without-project harvest related travel cost of $956,800. In addition, there are 17 small vessels fishing an average of 22 days out of Saint Paul with an annual variable cost of $53,000. When compared to the with-project condition, travel cost of $596,500, the saving provided by the small boat harbor will be **$360,300** annually.

Table 11. Without–Project Harvest Related Travel Cost

Size	Fishable Days	Days Fished	No. Vessels[36]	RT Hours	Cost/Hour ($)	Total ($)
0–25 ft	48	14	28	Nil[37]		
26–32 ft	73	22	17	2,244	23.60	53,000
58 ft by 17 ft (beam)	159	159	19[38]	4,730	56.80	268,600
58 ft by 23 ft (beam)	159	159	19	4,730	134.30	635,200
						956,800

Table 12. With–Project Harvest Related Travel Cost

Size	Fishable Days	Days Fished	No. Vessels	RT Hours	Cost/Hour ($)	Total ($)
0–25 ft	48	14	28	Nil		
26–39 ft	73	22	17	2,244	23.60	53,000
40–55 ft	147	44	13	3,432	53.50	183,600
55–58 ft	159	48	22	6,336	56.80	359,900
						596,500

10.9 Prevention of Damage

Based on discussions with fifteen local fishermen, existing damages to vessels and equipment is related to the following:

[36] Of the total 26 use the seasonal docks, 20 are hand launched skiffs, and the balance operate out of Dutch Harbor.

[37] The trailerable fleet fishes within one mile of the harbor and travel distance and cost is negligible. These are primarily subsistence fishers.

[38] These 58 ft vessels operate out of Dutch Harbor. Without season restrictions the harvest of these 38 vessels could be accomplished by a fleet of four.

- Wind tidal currents and wave action that pushes vessels into one another as they wait to be hauled out.
- Wind, tidal currents, and wave action that set vessels onto shoals near the launching area.
- Larger vessels, which take the right of way, squeeze the local fleet away from tie-up locations.

Skippers gave examples of incidents involving several vessels. Most of the damages are preventable by proper fendering, assembly of rafts, and continuous attention to lines. The incidents, which are not preventable by anything other than a new moorage area are those which involve individual vessels or groups of vessels being set onto the rocky shoal at the narrow, constricted location where they queue up for haul out. Each year there are three or more vessels receiving major damage to shafts, outdrives, or hulls. The extent of damage has varied from replacement of outdrive units to sinking of a vessel. Preventable damage for three recent years was reported to be $6,000, $22,000, and $9,000. Average annual preventable damages are estimated at $12,300. This represents damage preventable to the existing 26-vessel fleet.

The fleet, under the with-project condition, is expected to expand to 50–60 vessels as early as the year 2002 and no later than 2005. The vessels, which will be added, are larger than the local fleet and will be relocated from other ports where they experience similar damage. For example, average annual damage per vessel at Dutch Harbor was reportedly estimated at $5,000 in 1999. [39] Relocated vessels will add to crowding problems in the harbor, but the harbor will have been expanded and improved. These vessels will be more maneuverable inside the new harbor, and to some extent, they will be less susceptible to damage. The vessels also will be able to avoid some of the harbor congestion by waiting outside.

Benefits estimated for prevention of damage to the expanded fleet are based on judgment that larger vessels will be less likely to be damaged, but due to potential contact with smaller vessels, damages to the smaller vessels will increase. In addition, damages to the overall fleet are expected to be a function of value as well as crowding. Potential increase in value of the fleet (estimated at 2.2 for a 50 vessel fleet and 10.4 for a 60 vessel fleet), combined with fewer incidents resulting in damages to the larger vessels, has been accommodated with the following expression, (26 vessel fleet damages x 2) x (fleet value factor/2). The value factor for the 60-vessel fleet reflects the addition of four large dimension 58 ft vessels, which are not present in the 50-vessel fleet. Preventable damages for the 50 vessel fleet are ($12,300 x 2) x (2.2/2) = **$27,000** and for the 60 vessel fleet are ($12,300 x 2) x (10.4/2) = **$127,900.**

10.10 Prevention of Theft

Presently the vessels are stored wherever there is useable space available. This finds them scattered throughout the industrial area and around the island. Little of the outside area of the island is illuminated at night, and there are no fences to allow vessel security. In addition, the community is host to hundreds of vessel stops each year, and there are frequently large numbers of outsiders coming in to work at the processors or waiting to be picked up as crew

[39] In 1999 Corps staff gathered information regarding operations at Dutch Harbor in connection with potential navigation improvements there.

replacements. Sometimes the number of transient people almost outnumber the local residents. Local fishermen have taken to removing their equipment, when the vessels are stored, and locking their vessels. Still when vessels are left unattended for short periods just before or just after a fishing trip, theft is common. The most common items taken are electronic navigation equipment, safety equipment, survival suits, gas cans, and fuel. All of the theft would be preventable in a secure harbor with controlled access, a 24-hour security service, and fenced area.

There is no solid statistical data available to estimate the losses associated with theft, although at a local meeting with a group of fishermen, one person speaking for others suggested that average losses were about $1,000 per year for each theft event. Others in the room agreed to this estimate, and of the fifteen fishermen present, none of them were willing to state that theft was not a big problem. All of them expressed some experience with theft loss. Preventable theft loss is estimated at **$5,000** per year for the present fleet. Vessels expected to be added to the fleet will be much larger and of more value. It is presumed these vessels will experience equivalent theft losses at other locations. With fleet value increases of 2.2 and 10.4 for the 50 and 60 vessel fleets, preventable theft losses are estimated at **$11,000**, and **$52,000** respectively.

10.11 Prevention of Vandalism

Vandalism is a continual problem for vessel owners and happens in any open moorage. There is some overlap of complaints of vandalism problems with theft problems. The vandalism, however, differs in that the stolen items are usually discovered damaged, broken, or discarded. Recent complaints included anecdotes involving slashed survival suites, gas cans recovered empty, VHF radios recovered with the cases smashed or removed, skiffs used and abandoned, and broken windows in stored vessels. All of the vandalism could be prevented if vessels were in a secure moorage. Preventable damages are estimated at $2,000 annually for the current fleet and are adjusted by estimated fleet value factors to arrive at **$4,400** and **$21,000** for the 50 and 60 vessel fleets respectively.

10.12 Water Taxi

Prospects for a water taxi service were verified with local interests, who have been in the business and who have evaluated profitability of the venture at Saint Paul;[40] and others that support its need and practicality. The benefit evaluation for the local water taxi idea originated from statements made by members of the community. Data is considered to be reliable as persons interviewed had actual experience with the water taxi operation; and had actually initiated one at Saint Paul but had to abandon it due to lack of a protected local moorage for the taxi vessel.

There is no lead-time required to re-establish the taxi operation at Saint Paul beyond that associated with the construction of the project. The time line for project construction will be the controlling factor regarding when a water taxi can again become operable, because

[40] Onsite interview with John R Merculief as principal participant and former water taxi operator. Other related discussions on the subject included active participation by Andrey Mandregan, Jason Bourdukofsky, Anthony Philemonoff, Ricardo Merculief, Jeff Kauffman, Pat Baker, Jacob Merculief, Richard Zakarof, Jason Bourdofsky, Bill Arterburn; and passive participation by others making up a total of 19 contacts.

without the project, a water taxi is impractical. It is valid to assume that the taxi operation will be initiated in project year one, because that is the schedule that maximizes prospects for net income, and there are no hurdles in the way of implementation of the taxi operation.

Large trawlers and crabbers over 90 ft regularly call at Saint Paul for crew change, supplies, and medical assistance. During a 1999 sample period of port records for a 300-day period, harbor records show 1,680 tie-ups at dockside by these deep-draft commercial vessels. Some of the sample data was during an extended season closure, so vessel calls for offloading at local processors, and some refueling and repair calls are not included. Season closures are common, and in this case, the extended closure resulted in calls at Saint Paul being reduced to about half of what they would be without a closure. Nevertheless, because the harbor is so busy, many of these vessels were frequently required to wait outside for a clear channel and a place to tie up. Vessels occasionally waited eight or more hours, but the normal waiting period was generally two hours or less. If they wanted to use the harbor when it was full, they had no choice but to wait because the nearest alternative port is 275 miles away.

The harbor records identified the vessels by name and purpose of the visit. The record also showed the arrival and departure time. It did not reveal how long the vessel had to wait outside before being allowed to enter the harbor. There is ample data, however, to serve as a guide for assumptions necessary to make an estimate of waiting time.

During the 300-day sample period there were 1680 arrivals, with a peak daily number of 25. Mean of the distribution was 12, and the standard deviation was six. The average time at dockside was eight hours. During the 300 days, the average occupancy rate allowing for one vessel at each of three docks was 62%. Average service rates do not bear any relationship to waiting problems so queuing analysis ordinarily relies on a complete record or a simulation. For this report, four simulation approaches were used. In one it was assumed that one of the docks would be useable for double berthing, and all of the arrivals were therefore distributed to four berths over a 300-day period using a random number simulation. The arrivals were sorted to identify the number of days there were over four arrivals. This is the theoretical beginning of waiting events, because after four arrivals, it is possible the fifth might arrive when all four berths are taken.

Next, the daily arrivals over four were grouped into 16 one-hour periods to denote the number of vessels that would be competing for use of the docks during the theoretical open period. A normal distribution of arrivals was assumed. It was also assumed that waiting would actually become significant after eight arrivals in a day. The simulation showed there would be 998 such arrivals. Since it is common practice to call ahead to clear arrivals with the harbormaster, there is already some scheduling strategy at work. This works to reduce congestion in the harbor and places a reasonable limit on waiting outside. If a long wait is anticipated, vessels slow down or fish longer, or in the worst case, seek an alternative port. There is no recorded data, however personal communications on this subject indicate waiting outside has been up to eight hours but is generally one to three hours or less. For the fleet during the sample period, this would be a range of 998 to 2,994 hours, and the midpoint would be 1,996 hours.

A second approach to narrow down the waiting estimate was use of an Erlang type C queuing simulator[41]. For this simulation, a maximum daily capacity of 32 was used, which overstated the actual historical maximum by 22% to allow for outliers anticipated to be present in a larger sample. The initial iteration assumed zero downtime and zero time required for transition of berths from one vessel to another. The model estimated there would be 135 waiting events and 607 delay hours. A second iteration incorporated downtime and turnover time into the service estimate, and this expanded delay to 2688 hours, and the midpoint of the two estimates was 1,647 hours.

The distributive properties of the sample data were calculated and applied the assumption that waiting would become a problem when service exceeded a 50% use rate[42]. This indicated 780–2340 hours of waiting or about 1560 as a midpoint estimate. A fourth verification used a Simul8 Model purchased for this study, and it yielded a wait estimate of 2520 hours for the two configurations.[43]

The most acceptable estimate of 1996 hours was settled on largely because of ease of explanation and reproducibility. However, this and the others were regarded as low-side estimates because early season closure reduced the number of vessel calls by as much as half.

With a small boat harbor, a water taxi service could service vessels waiting outside and deliver people and supplies. With the call-ahead strategy in place, a water taxi service, based at the small boat harbor, could be on the scene with supplies, parts, and personnel as the customer arrived, thus reducing waiting time. Since a water taxi should be able to service vessels, waiting outside in a wide range of weather conditions, the operating cost of the taxi was based on a 58 ft vessel. Hourly operating cost of the water taxi was estimated at $56.80 per hour.

For purposes of estimating delay cost of the waiting commercial vessel, horsepower data gathered from 57 of the Bering Sea fleet of vessels ranging in size from 90 ft to over 160 ft was used to estimate a fleet median fuel use rate. The horsepower range was 582–4,033 with a median of 2,307. Based on information from the Caterpillar Company, a Cat 3516B marine diesel was selected to estimate fuel consumption rates. Depending on the power setting, the fuel burn rate varied from 13.7 gallons per hour (gph) at idle to 100.7 gph at maximum power. A rate of 57.2 gph was used as a mid-range setting, based on judgment that the vessel would need a moderate power setting to hold a position in an adverse sea and wind condition. The fuel price used ($1.30 per gallon), which adjusted the total hourly fuel cost up by a factor of 1.21 to include non-fuel, variable-operating cost. The result was an hourly cost of $90 for holding outside of the harbor.

As a check on the estimate data, was compared from a 2000 study of Dutch Harbor/Unalaska by the Corps', Alaska District, which estimated the hourly cost of the 100–159 ft deep-draft commercial vessels. Hourly cost of the 100–159 ft vessels were based on a transient fleet that spends 285 days, participating in a number of fisheries in the Aleutian Island region. In the referenced study, data was obtained from interviews with BSAI fishers and from statistics

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[41] Erlang Software, 3 Barker Place, Bicton WA 6157 Australia

[42] Based on classic Erlang distribution interpretation.

[43] SUMULAT8 200v6, Sumulat8 Corporation, 141 Saint James Road, Glasgow G4 OLT Scotland UK

provided by the Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, as well as other reliable sources. Fuel consumption estimates were based on interviews with fishermen, Alaska Department of Fish and Game, a major diesel engine manufacturer, and two vessel companies. Based on their knowledge and experiences, it was determined that a 100–159 ft crabber/tender class consumes approximately 60 gallons of fuel per hour. Lube oil expenses were estimated at 7% of fuel costs. In that study, average daily costs were calculated by averaging the total costs over the total number of operating days, 285. Hourly costs were computed by dividing the daily operating costs by 24 hours.

The hourly operating cost for maintenance and stores ($179,000 divided by 285 operating days) divided by 24 hours was $26.17. Based on the fuel consumption rate of 60 gallons per hour and an average fuel cost of $1.30 per gallon and lube oil, 9 cents per gallon (60 gallons x $1.39), fuel and lube was $83.40. Therefore, the total hourly operating cost ($26.17 + $83.40) is $109.57 or $110. Ninety dollars per hour was used to adjust for the fact that the waiting vessels would be at a low power setting, and this lower setting was not necessarily a consideration in the Unalaska/Dutch Harbor study.

Information on cost of 18 actual short-term charters of crab vessels by ADF&G for research purposes, during the 1990s, was used as additional verification. The charters were for sampling work, during the fair weather periods of August through October with most of the work during September. The charters were hired through a publicly advertised bidding process, announcing the dates the vessels were intended to be used and inviting competitive bidding to identify the least cost source. The charter periods were from 15–35 days and the 18 winning low bids had a median cost of $173 per hour when adjusted to a 2000 price level. (see table 13)

A complication in adapting the data to estimate hourly variable cost is that some of the bids appear to be based on recovery of variable cost while others are based on recovery of total cost. This is evident from the skewed nature of the data. After contacting people associated with the bidding process, it was assumed that the lowest three winning bids represented attempts for skippers to cover variable cost in the short-run and that the highest three were based on recovery of total cost. The lowest three winning bids came out at $94 per hour and the highest came out at $269. Inclusion of variable and fixed cost by 83% of the winning bids would appear to be an appropriate market statement that opportunity cost of tying up a vessel is larger than the out of pocket variable cost. The data was interpreted as verification that our estimate of $90 per hour is valid as an estimate of short-run variable cost.

Table 13. ADFG Bering Sea Test Fish Project Vessel—Charter Statistics Between 1990–1999

Year	Contract Award	Charter Dates	Total Days	Rate/Day ($)	Total Cost ($)	Index[44]	2000/	hr
1990	F/V Kristen Gail	8/7 to 9/7	30	3,600.00	109,500.00	1	3,600	150
1991	F/V Kristen Gail	9/2 to 10/7	35	5,500.00	192,500.00	112	6,160	257
1991	F/V Western Viking	8/20 to 9/20	30	5,950.00	178,500.00	112	6,660	277
1992	F/V Kristen Gail	10/8 to 10/23	15	1,650.00	24,750.00	113	1,860	77
1993	F/V Cascade	8/20 to 9/20	31	1,800.00	37,800.00	113	2,030	85
1994	F/V Kristen Gail	9/25 to 10/25	30	2,942.00	88,260.00	112	3,290	137
1995	F/V Kristen Gail	8/1 to 8/31	30	3,990.00	123,690.00	113	4,510	188
1995	F/V Notorious	8/1 to 8/21	21	2,500.00	52,500.00	113	2,820	117
1996	F/V Rosie G	8/1 to 8/31	31	3,000.00	93,000.00	115	3,450	144
1996	F/V Peggy Jo	8/1 to 8/25	25	3,836.00	95,900.00	115	4,410	184
1997	F/V Grand Duchess	7/25 to 8/21	28	3,350.00	93,800.00	117	3,920	163
1997	F/V Spirit of the North	7/25 to 8/28	35	3,900.00	136,500.00	117	4,560	190
1998	F/V Viking Queen	8/1 to 8/28	28	3,250.00	91,000.00	114	3,700	154
1998	F/V Notorious	8/1 to 8/28	28	3,880.00	108,640.00	114	4,420	184
1999	F/V Peggy Jo	7/22-8/10	19	5,395.00	102,505.00	117	6,310	263
1999	F/V Notorious	8/1 to 8/15	15	5,470.00	82,050.00	117	6,400	267
1999	F/V Obession	9/25-10/11	17	2,450.00	41,650.00	117	2,870	120
2000	Prelim data	No detail		2,950		130	3,830	160
							Average	**173**

Without the project, vessels waiting cost will be $90 x 1996 hours = $180,000. Wave activity outside the harbor will make it impractical to provide water taxi service 35% of the time so preventable waiting cost is $117,000. Under the with-project condition, delivery cost will take less than an hour per vessel and will be $56.80 x 650 deliveries = $36,900. Benefits associated with water taxi service made possible by the project are **$80,000**.

10.13 Reduced Cost of Vessel Repair

Serious planning is well under way for the design and construction of a vessel repair facility at Saint Paul. Some of the actions that have already taken place include the Central Bering Sea Fishermen's Association (CBSFA) facilitation of a vessel engine repair and maintenance program with Coastal Marine Engine, Inc. Through the program, a certified mechanic will be performing the work on Saint Paul. In addition CBSFA is finalizing a building plan for the vessel repair facility including construction finance, land acquisition, and operations. They have contracted with Polar Consultants as the main engineering firm. Polar sent CBSFA two conceptual layouts for the vessel repair facility in February 2001. Development of the final building plans, including construction finance and land acquisitions are ongoing.

The repair facility cannot become operational until after completion of the harbor because moorage and haul out are essential to a successful operation. The new small boat harbor will supply moorage needed to make a vessel repair operation viable. The repair facility will exist only under the with-project condition.

[44] Department of Labor, Producer Price Index for water transportation class 4424

The repair facility analysis starts with evaluation of regional demand for services and establishes the potential economic viability of a facility at Saint Paul. The evaluation incorporates all of the capital and operating cost of the facility and demonstrates the expenditures to be self-liquidating and in that manner nets them out of the benefit evaluation. Benefits are based on reduced operating cost for vessels at large, because the location of Saint Paul will save the cost of travel to other locations for repair work. Reduction in variable operating cost was used to estimate willingness to pay for reduced travel to alternate facilities.

It was recognized that the delayed or out of service vessels would be unable to recover necessary fixed and variable cost, and these non-recovered costs represent an upper limit on opportunity cost from the NED point of view. In the with-project condition, the opportunity to recover operating costs by reducing lay up and travel time represents the vessel owner's willingness to pay for local facilities. Losses or gains related to fixed costs were not addressed.

10.14 Vessel Repair Benefit Evaluation

NED benefits are earned for reduction in trips to use repair facilities elsewhere. The saved trips relate to the entire customer base throughout the eastern Bering Sea small vessel fleet that would seek repairs and maintenance at Saint Paul.

Parameters used in the analysis include the following:

- The numbers of in-water holding spaces needed for vessel repairs are three. These are not dedicated moorage slots but the transient and auxiliary dock availability on a short-term basis while vessels are preparing to depart after repairs have been completed.
- Composite vessel delay time is $38 per hour, which is a weighted average variable hourly cost of the Saint Paul fleet in the with-project condition.
- Service records at competing facilities, and expert opinion indicate weighted average facility dwell time is 22 days based on the following:

Percentage	34	24	14	18	10
Days	4	10	30	45	60

- 270 day demand period with 200 work days.
- With-project condition has 10 upland facility spaces in 1/2 acre.
- Associated cost of facility development and operation is included at $180,900 annually.
- Without-project practical capacity of 0 vessels per year because of moorage constraints.
- Average water storage time equals dwell time.
- With-project condition has available haul out, transportation, storage, and repair facilities. These associated costs are shown to be self-liquidating.

10.15 Vessel Service Problems

Lack of moorage at Saint Paul places an absolute limit on the number of vessels that can receive repair and maintenance, and adds considerably to the cost and amount of time required to provide service. Without-project solutions available to vessel owners at Saint Paul are the following:

- Bring in a repair crew, tools, and equipment by air from Seattle.
- Ship the vessel aboard a barge to Dutch Harbor, Seattle, or some other repair facility.
- Tow the vessel to Dutch Harbor.

In most cases, even vessels able to move under their own power are required to leave Saint Paul in search of service at alternative ports due to lack of local facilities. Plans are underway for expanded haul-out and repair service facilities at Saint Paul contingent on construction of a harbor and breakwater. Development of repair facilities in Saint Paul will center on the characteristics and needs of vessels in the market around Saint Paul. The market area is a radius of about 300 miles from Saint Paul, which includes the primary alternative harbor and repair facilities at Dutch Harbor.

10.16 Characteristics of the Market for Vessel Service

For purposes of this study a commercial vessel is any vessel that is used in coastwise trade or engaged in American fisheries. Coastwise trade includes the transportation of passengers or merchandise between points within the U.S. According to the U.S. Coast Guard (USCG) reports, there were 31,909 such vessels registered in Alaska as of January 10, 1995. The number of vessels registered with harbormasters in the state is about half the total number of vessels reported by USCG. About 15,500 vessels hold commercial permits.

10.17 Demand for a Haul-Out Facility at Saint Paul

Discussions with fishers at Saint Paul were conducted in 2000 in cooperation with the City of Saint Paul. In response to plans for a vessel repair facility, under the with-project condition, the planning team explored the local interest, regional need, and viability of a proposed mobile vessel hoist facility and vessel repair facility. Of those involved, 100% expressed acceptance of the proposed facility for a variety of reasons. The predominant concern was that, without a haul-out and repair facility, repair crews were being flown in, which more than doubled the annual cost normally faced by fishers. In some cases, vessels remained out of service for long periods due to high cost.

The closest full-service facility, which would compete with Saint Paul's based supply and service is Dutch Harbor. Dutch Harbor is about 275 miles from Saint Paul. However, Dutch Harbor rarely has slips readily available to accommodate vessels and customers may need to wait indefinitely for repair.

Where repairs are concerned, the majority of fishers base their decision of whether to use a port by its available moorage, lift, repair facilities, and reputation. Owners look secondarily to the cost at each facility in making final decisions. Moorage space or dry storage is of critical importance because rarely can vessels be serviced immediately. Waits for service, even with months of advance reservations, are an expected part of the industry. After a vessel has been hauled out and land-based repairs are completed, it is expected to be put back into the water at an available moorage to have other work completed.

There are several repair facilities in Alaska, but there are 31,909 vessels in the state. Prudent practice is that vessels are taken out of the water for cleaning, inspection, and repainting every year or two. Commercial vessels adopt a cycle of planned maintenance that minimizes conflicts with active harvest opportunities. Of the 31,909 vessels, 15,500 hold commercial permits, and 11,300 of these are 58 ft or less in length. Within the state, there are fewer than 20 operating travel lifts and hydraulic trailers with capacity adequate for haul out of commercial vessels over 32 feet.[45] Statewide, there are 13 harbor cranes. Lack of haul-out facilities causes many of the 15,500 commercial vessels in need of maintenance to travel to the Puget Sound area for service. This is a round trip of about 4,000 miles from the Pribilof Island area.

10.18 Facility Requirements

The proposed repair facility must be complete and must encompass adequate work area. Optimum upland sites would be no less than 1/2 acre. On average, 10 vessels 32–42 ft may be stored on 1/2 acre of land allowing for access lanes, buffer areas, and separation. The layout and size of the vessels will determine actual storage capacity. The site must be in the vicinity of water, electrical, sewer, and telephone utilities. A reconnaissance level cost estimate was made, which is limited to the purpose of explaining associated cost. Consulting Economist and Oliver Consulting did the estimate. The estimate was influenced by knowledge of other existing west coast facilities and problems and opportunities relating to the Saint Paul location. It is not intended to be equivalent in detail, reliability, and documentation to construction cost estimates in this report.

There are a number of potential haul-out systems, which could handle vessels coming into Saint Paul. The preferred equipment for lifting vessel types at Saint Paul is a hydraulic trailer. Coupled to a tractor the unit can be used to move vessels to a repair facility or to a seasonal storage area. The trailer offers versatility, as it is ideal for work vessels, fleet vessels, barges, and pleasure craft. One man can operate the trailer and tractor. Additionally, the trailer is one of the safest means of moving a vessel up to an upland area. Maneuverability of vessels within an upland area is relatively easy with the hydraulic trailer. An added advantage is that it can be operated on a ramp thus saving the cost of special dock facilities required for tall-legged vessel lifts.

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[45] Data gleaned from Pilot House Guide, Alaska Fishermen's Journal, Vol. 23 No. 5, May 2000.

Table 14. Capital Requirement For Vessel Repair

Component	Cost ($)
Site Preparation	75,000
Utilities	50,000
Restrooms	90,000
Lighting	5,000
Fencing	50,000
(1) High Power Wash System	3,500
Waste Oil Disposal Tank (exlcudes opertor)	5,000
Wash down Pad	50,000
Work Station Building	250,000
Trailer and Shipping	200,000
TOTAL CAPITAL	778,500
ANNUAL EQUIVALENT	51,000

Table 15. Annual Cost Associated With A Repair Facility

Associated Cost	High Cost Estimate ($)	Low Cost Estimate ($)
Annual Insurance	17,000	3,500
Manager Salary	45,400	22,000
Office equipment Rental	5,000	No fee
Land Lease or Rental	0[1]	0[1]
Maintenance/Repairs	20,000	12,000
Annual Capital Cost	51,000	51,000
Total Annual Associated Cost	138,400	88,500
MEDIAN VALUE	**113,400**	**113,400**

[1]Land use is unchanged from w/o project condition.

10.19 Repair Facility Revenue Assessment

The revenues from the proposed facility are a function of the number of vessels that can be accommodated at the facility. The number of vessels, which can be accommodated, is both a function of potential demand or market size, and the number of vessels, which the proposed vessel facility can accommodate. Potential market demand exists according to market survey results. The facility capacity is thus the underlying determinant of revenue. The site is ½ acre, which has been proposed for the development of the facility. An estimated 10 vessels can be stored on ½ acre and an estimated 30 to 60 vessels can be accommodated on a 1½ to 3 acre site.

In order to explore the economic viability of a local repair facility, the lift revenues have been estimated according to various levels of use. Based on average number of lifts per hydraulic trailer or vessel lift at other facilities, and potential demand, the facility should be able to ultimately handle 100 to 500 vessels a year, providing workspace is available to handle the vessels on dry land and adequate moorage is available. To determine a hypothetical break-even level of operation, estimates have been based on high, medium, and low lift volumes. The revenues are based upon a 42 ft average sized vessel with charges of $7.00 per ft round trip plus $50 for blocking.

Table 16. Break Even Analysis

Revenues	Low	Med./Low	Medium	Med./High	High
Vessel haulouts	100	200	300	400	500
@ $7.00/ft (42 ft)	$29,400	$58,800	$88,200	$117,600	$147,100
Sheltered work space at $100 per vessel day	400 vessel days = $40,000	$40,000	$40,000	$40,000	$40,000
Blocking	$20,000	$40,000	$60,000	$80,000	$100,000
Facility Storage @ $5.00/ft/mo					
Number of vessels	10	45	60	80	100
Amount	$25,200	$85,000	$113,400	$151,200	$189,000
Total Revenues[1]	**$114,600**	**$223,800**	**$301,600**	**$388,800**	**$476,100**
Expenses					
Management	$45,000	$45,000	$45,000	$45,000	$45,000
Maintenance	$15,000	$15,000	$15,000	$15,000	$15,000
Insurance	$12,000	$12,000	$12,000	$12,000	$12,000
Capital I&A	$51,000	$51,000	$51,000	$51,000	$51,000
Total Expenses[2]	**$123,000**	**$123,000**	**$123,000**	**$123,000**	**$123,000**

[1]Revenues should be regarded as an understatement. They do not include charges for electricity, wash down, inspection, work pier moorage, garbage, or security. As a basis for comparison, a recent market analysis for a travel lift at Port Townsend estimated income in excess of $800,000 for 100 lifts per year. Three other west coast repair facilities with lift capacity ranging from 88 to 100 tons reported revenue of up to $4.9 million in 1994, according to Dunn and Bradstreet. It was concluded that the facility would be viable at the smallest scale investigated despite the negative cash flow.

[2]As facility activities get busier the increment of income from sales and service liquidates the incremental cost of servicing the added units. This self-liquidating aspect of the business activity is a local economic effect, not an NED effect. In this NED analysis the self-liquidating expenses of the operation are displayed as constant at varying scales.

10.20 Vessel Facility Operating Practices

Customers must make reservations 6 to 18 months ahead of time for haul out at competing facilities. Some advance reservations are made to carry out routine maintenance and are scheduled during an off-season period. Since there is an economic incentive to keep the vessel in the water during potential open season periods, demand for facility services are heavier during the off season. After the appointment is made, and even if the customer arrives on time, he often runs into waiting because of delays finishing up vessels already in the facility. Many of the competing facilities have limited storage space and must keep vessels in the haul-out facility while work is being performed. A major advantage of hydraulic trailer lifts, such as the one planned at Saint Paul, is that they can haul a vessel and move it to a work area and be available for other lifts.

Versatility of the lift is limited, if there is inadequate facility space to store vessels, or if there is inadequate dock space to tie them up while the in-water phase of repair is being completed. At Saint Paul, there will be adequate facility space where a hydraulic lift could be used to dry dock up to 10 vessels.

The theoretical daily capacity of the hydraulic lift (potential 24 hour operation) is based on it being comfortably and safely able to allow 8 haul outs per day or 2,160 annually, while allowing for 95 days of downtime due to weather, equipment repair, holiday closures, etc. Using present facility workdays at other facilities as a proxy, there would be about 240 actual lift workdays during the year, and generally one shift per day. In practice the lift is easily capable of 3–4 haul outs per day. So the theoretical limit at Saint Paul under current policy and practice in the industry would be about 720–960 lifts per year providing demand is present. However, the congested harbor and lack of dock storage area will not allow either of the above capacities to be reached. Without a storage area and some moorage expansion, a hydraulic lift will not add any capacity.

Based on discussions in 1998 with four independent vessel repair facilities, common facility practice is to put vessels into the water as soon as possible after work requiring dry land storage is completed. This immediate return to the water is a practical requirement for all vessel facility operators, because hulls are stressed very differently out of the water. Work such as alignment of shafts and other mechanical connections can cause serious damage if done in dry storage. Without in-water storage for vessels to be finished off, overall facility throughput rates are constrained.

An industry rule of thumb is that the amount of time a vessel is in the water during repair is at least equal to the time spent out of the water. There is a wide variation in time requirements, and in some cases, such as for routine inspection or bottom cleaning, the work time needed while the vessel is in the water is zero.

In 1996, Natural Resource Consultants of Seattle did a west coast facility study. The study disclosed that commercial vessels waited between 1 and 3 months for service during the peak period at one-third of the facilities. Some of the facilities require scheduling up to 18 months ahead of time and others as little as 6 months. Without advance scheduling a vessel seeking repair at the peak of the season might find itself waiting three months to a year. Advance scheduling, however, is a rule in the industry. The waiting happens even with advance scheduling of all jobs, because jobs often are more complicated and time consuming than originally thought. Therefore, the facilities with typically the more straightforward and routine maintenance jobs have the least waiting time. These facilities are comparable to the type of facility services planned for Saint Paul. To the extent the addition of moorage at Saint Paul can reduce service delay and trips to alternative ports, there is a NED benefit.

10.21 Competing Facilities

The Saint Paul facility will compete against other facilities able to haul-out and service vessels up to 150 tons. Only the facilities with rubber tired lifts, similar to the one planned at Saint Paul, offer the flexibility to move vessels into and around a work area, taking advantage of available land storage space. There are sixteen such lifts in the state, including hydraulic trailers and travel lifts.

Outside of Alaska, mobile lifts are more common. The 1996 NRC report identified 33 facilities with lifting capacities over 70 tons in Washington, including two travel lifts. There are ten lifts over 70 tons in Alaska, including five travel lifts. Oregon has ten lifts over 70-tons, including one travel lift. So of a total of 53 west coast facilities having lifts over 70 tons, there are eight travel lifts offering capability similar to the 150 ton capacity lift planned at Saint Paul.

With regard to competitiveness, location of the facility is generally not important. Owners are willing to travel great distances to seek satisfaction in three other areas:

- Quality of work.
- Availability of supplies and contractors.
- Satisfactory scheduling and turn around time

Price is also not a primary consideration. Not only will owners typically travel great distances for service, but also they will do so knowingly passing up cheaper facilities on the way.

10.22 Delay Analysis

In this analysis, a 3-month maximum wait was established. In other words, the facility and its in-water work locations will accommodate vessels until average waiting time is equal to 3 months. There is a practical limit to the facility capacity, because within the market area, there are more vessels needing facility service than the facility can accommodate. If a 3-month wait is expected, customers will travel to an alternate facility.

NED benefits are earned from reduction of travel to other facilities outside of the Saint Paul area. A simple queuing model was developed to estimate waiting time with no additional in-water storage space (without-project condition). Appointments were on a random basis, in the sense that, customers were scheduled to arrive at a specific time, but the amount of time required for the work was assigned based on sample dwell time data at other facilities as summarized below:

Percentage	34	24	14	18	10
Days	4	10	30	45	60

In the model, all facility spaces were vacated as the jobs were completed. Vessels were moved into a water storage area where they were kept for a period equal to the dwell time. Delay time was counted for vessels that occupied the facility after dwell time was complete but could not be moved into water storage, because all spaces were full. This simulation was applied only to analyze what would happen in terms of delay, without a new small boat harbor, but with a repair facility and haul out in place. The purpose was to judge the appropriateness of using average data for evaluation of the with-project condition and to provide a basis for adjusting data based on results of the simulation, if indicated. Indications were that averages underestimated total delay and overestimated capacity by about 60%, because as the queue built to approximate 3 months, it became cost effective for new customers to seek service elsewhere, and they were taken off the queue.

A simulator identifies grouped arrivals and departures that are ignored if average daily traffic is used. For example, if average daily arrivals are two per day and departures are two per day, there will be no waiting. But a simulator might select six vessels to arrive in a day and one to depart, putting five in the queue. The difference in approaches, however, does not seem to significantly affect the estimate of throughput capacity, because residual demand indicates the facility is always full. In addition, vessel turnover is a function of available waiting area not waiting time. Since the benefit analysis was based on savings related to throughput, the simulation did not enter the picture except to put an emphasis on the need to limit average delay to 90 days. It was therefore discarded in favor of a simpler static approach.

The stochastic approach inputted a specific number of potential customers, a fixed number of dry land workspaces, and varied the number of moorage/storage spaces. The procedure used a weighted average dwell time of 22 days and calculated average waiting time. Waiting was based on total vessel workdays needed, plus the difference between facility dwell time in terms of vessel days, and post-repair storage available in terms of vessel days. For example in the present without-project condition, 10 storage spaces will produce 2,400 storage days during a 240-day period. Full use of the facility will require an equal number of post-repair storage spaces of which none are available. During the 240-day period, each of the 10 storage spaces can accommodate about 11 vessels for a total potential throughput of about 110 vessels. However, the 110 vessel potential cannot be met, because there will be no storage as they are moved back into the water. There will be 10 vessels stranded in storage and unused throughput capacity of up to 100 vessels.

Every moorage space that was added, increased throughput by up to 11 vessels. Adding three transient moorage spaces enabled the facility to reach a maximum throughput of 33 vessels annually. Ten moorage spaces are needed to allow the facility to reach a break-even operation. With 10 transient spaces, the facility will be able to service 110 vessels a year.

Based on statements from 138 vessel owners operating in Alaska, 43% find it necessary to take their vessels to facilities in Oregon and Washington for service. The balance use Alaska facilities. These statements were made to University of Alaska (U of A) interviewers assessing repair practices of vessel owners in 1996. The U of A study was concerned about planned improvements at Wrangell and was conducted with assistance from the City of Wrangell[46]. There is no comparable data available for Saint Paul. At the Port of Dutch Harbor each year, there are 75 vessels turned away due to lack of moorage that look for space elsewhere. They seek moorage at King Cove and Sand Point, and ports along the Pacific northwest (PNW). Out of the 75 vessels, 56 vessels (75%) find it necessary to travel to the PNW.[47]

Due to lack of comparable data sources specifically for Saint Paul, University of Alaska work was used as a basis for assumptions about the effect of moorage and facility expansion elsewhere in Alaska. The study was for assessment of repair practices statewide, but before using assumptions derived from the U of A work, we verified our intentions with industry sources. We contacted the Fishing Vessel Owners Association (founded in 1914), and United Fishermen of Alaska (founded in 1974), which together represent over 18,000 fishermen. They were asked if expanded moorage and amenities, including haul out and repair, were to be added in Alaska what portion of new customers would save trips to the PNW. One offered that a 50% trip saving to the PNW would be an accurate estimate, and the other estimated

[46] Christina A. Young, Research Assistant, and Carol E. Lewis, Professor of Resources Management, School of Agriculture and Land Resources Management, Agricultural and Forestry Experiment Station University of Alaska Fairbanks, with funding by University of Alaska Center for Economic Development, City of Wrangell, and Agricultural and Forestry Experiment Station, 1996.

[47] Personal communications by District staff developing an economic analysis of proposed harbor improvements at Dutch Harbor in 1999.

that trip saving to PNW facilities would be realized by more than half the new customers. Both of these are higher than the 43% estimate derived from the U of A data.

Given a with-project throughput of 111 vessels serviced in a typical year at Saint Paul, the lower estimate associated with the U of A data indicates 48 customers will save the time and cost of a trip to Washington or Oregon facilities. Trips to Alaskan facilities would be saved by 63 vessels. In the without-project condition the cost of vessel repair trips to Oregon and Washington is (48 trips x 400 hours per round trip x $38 weighted average hourly cost of the fleet = $729,600.

There are 14 locations in Alaska, which serve as alternative haul-out locations for vessels up to 58 ft and which offer hull, machinery, electronic, and hydraulic repair facilities. They are Anchorage, Seward, Valdez, Kenai, Homer, Sitka, Petersburg, Ketchikan, Juneau, Kodiak, King Cove, King Salmon, Dutch Harbor, and Sand Point. All of the harbors are wait listed. These locations vary in distance from 300 to 1,300 miles. The largest, most versatile haul outs are at Seward, Valdez, and Homer. These three facilities have respective distance from Saint Paul of over 1,000 miles (average round trip distance of say 2,000 miles). In the without-project condition, trips to Alaska facilities will cost (63 trips x 200 hours per round trip including trip preparation x $38 average hourly cost of the fleet = $478,800. We discounted the estimate to zero due to the uncertainty of trip length and frequency.

Under the with-project condition, at least 75% of the customers will still need to travel to Saint Paul from other locations, including Dutch Harbor, False Pass, King Salmon, King Cove, Port Heiden, Nelson Lagoon, Akutan, Nikolski and several smaller villages in the Yukon Delta. With an average round trip travel time of 60 hours in the with-project condition for 75% of the customers or 83, the travel saving of using a repair facility at Saint Paul is ($729,600–$189,200 = **$540,400** providing that moorage, dry storage, or some other means of keeping vessels in the queue is available. This benefit estimate discounts benefits for saving trips to other Alaska facilities, due to lack of supporting data, although it is obvious that service must be obtained somewhere.

There is no moorage contemplated specifically for vessel repair, however, the new marina will include an expanded heavy-duty haul out. As vessels arrive they will be immediately hauled out and moved to an interim storage area near the Post Office. When facility space is available, they will be moved to the facility or work building. Vessels being returned to the water will be able to tie up temporarily at the auxiliary dock on the breakwater or at the space provided for transient customers. Some customers will opt to keep their vessels in dry storage at Saint Paul until they are needed again for the harvest.

The strategy of immediate haul out and storage for arriving customers, coupled with allowing the final stage of work to be done at the transient or auxiliary dock, provides the equivalent of 10 spaces. Allowing for more than 10 spaces is impractical, because beyond 10, the facility throughput will be a benefit only if facility spaces are expanded as well. Therefore the benefit function for moorage spaces is linear, but the related cost curve must capture incremental cost of facility expansion. In this report only one scale of facility development (the break even facility size defined as an annual throughput of 111) has been evaluated, and costs have been included as associated cost.

The next least costly alternative, of getting a vessel to the Puget Sound area from the eastern Bering Sea, is aboard one of the freighters operated by Western Pioneer. Rate data from the company (dated 1996) shows $2.31 per 100 cubic ft or per 100 lbs, whichever is the larger. In 1996, the cost per vessel would have been estimated from $10,000 to $70,000 each way, depending on the size of the vessel being shipped. Adjusted to year 2000 values, the cost per customer would range from over $13,000 to over $90,000. Making the trip under the vessels own power is the least cost solution in all cases.

10.23 Port Opportunity Cost

The city's land use plan shows only a small portion of the island is available for potential development, and most of the developable area has already been improved. Some valuable port lands are tied up because the local fleet is required to be stored out of the water. After a harbor is built the fleet will be accommodated in the water most of the year and formerly used port lands will become available for other income producing activities. To a certain extent this results in a net economic gain. The principle that allows us to quantify this as a benefit also leads us to recognize that lands consumed by the project are an economic cost that must be included in the NED analysis. Ordinarily lands are included in the cost estimate as financial outlays, but larger scales of this project will consume navigation servitude lands, the value of which will escape the formal estimate prepared for tracking financial cost. In the economic analysis these navigation servitude lands are estimated to have a value, based on their use in the without-project condition; hence they become an economic cost of the project.

In the without-project condition, storage of 26 vessels, trailers and gear takes about one acre, year round. In the with-project condition, the fleet expands to 60 vessels including 36 that are larger sizes. If the entire fleet is hauled out due to freeze-up in the with-project condition, it will take a layout space of up to 3.8 acres for up to three months. The layout assumes an access lane at one side and a shared gear storage area at the other side of each vessel, plus access at the front and rear. The number of vessel storage acre/months is practically the same for the with-project and without-project conditions. However, the with-project condition enables the storage to be on lower valued lands.

Presently vessels are stored on cradles or trailers tying up land needed for highly valued marine services. Vessels are stored in small groups where land is available at the waterfront. They are parked in ways where it is often not possible to access a vessel without moving others.

Lease information indicates that annual lease values of bare industrial land in the harbor district ranges from $214,000 per acre per year ($.41 per ft^2 per month) to over $393,000 per acre per year ($75 per square ft per year). The basic storage rate for authorized port storage is $.75 per ft^2 per month and for secure inside storage, $.95 per ft^2 per month. Open, unlighted, unfenced, non-patrolled areas far away from the harbor district can be leased for as little as $52,000 per acre per year.

Lease values appear abnormally high, but they have been verified by review of actual lease information. One lease is held to reserve port land for future use. The location of Saint Paul is so unique it provides promise of exceptionally high profits to harvesters and processors. It is the high profits and limited land area that combine to justify extraordinarily high lease values.

Some port lands are under the control of the TDX Corporation, a Native Village Corporation under Alaska Native Claims Settlement Act, and the City of Saint Paul. All of the CBSFA vessel owners are in "shareholder" families, and as such, they do not pay to have their vessels stored on the TDX land. Tanadgusix Corporation officials are aware of the opportunity cost of storage areas, used by shareholders, is measurable in terms of what the storage areas would otherwise earn. Some of the vessels have been stored on the most valuable lands in the harbor district.

This report has assumed that by project year one, the fleet will be moved to the least cost storage area that can be made secure and convenient with appropriate utilities, and that the economic cost of the area can be represented by averaging the two least expensive storage options, or about **$133,000** per year. A second choice is to assume half the fleet will be stored at the least cost location, and half at the second least cost location, but the results are the same. In the without-project condition, high valued lands will continue to be used for storage. The difference in annual land lease cost for storage of the existing fleet with the 30-vessel harbor, compared to without it is $260,000.

Alternative plans that consider expansion beyond 30 vessels require navigation servitude lands, having a high opportunity cost. The value of these lands is not recognized elsewhere in this report so is treated as a non-monetary economic cost in this aspect of the economic analysis. This non-monetary opportunity cost effectively cancels out much of the economic gain of using less valuable lands for storage. At the scale of a 60-vessel harbor, the economic cost of the navigation servitude lands is so high as to reduce the overall gain, in terms of port land use opportunity cost, to **$20,000** annually. For alternatives larger than the 60 vessel harbor, the benefit becomes a net opportunity cost. At the scale of the 90-vessel harbor, the annual economic loss is $943,000 annually.

10.24 Opportunity Cost of Launch and Retrieval

Launching is done with a crane, and on occasion, with a large wheeled loader. Cost of using the equipment is $100 per hour for the loader and an operator, and $240 per hour for the crane, including an operator and volunteer spotter. Use of the loader is ordinarily avoided by the fishermen because the channel at the put-in point is narrow with rock shoals that are difficult to avoid, even when the tide is not running, and winds are light. Each year several outdrives are damaged, and at least one vessel has been sunk. The launching and retrieval often demand the attention of six people for a single vessel. Labor cost is a flat charge of $50 per hour, and any equipment fees are additional and are based on current rental Blue Book rates.

A new heavier capacity crane with extended reach will be needed to lift larger vessels, coming in to work the CDQ crab fishery, and hourly rates are anticipated to be higher. For this analysis it is assumed each vessel will be put in and taken out six times during the year; the crane, one operator, one spotter, and two persons aboard the vessel can handle one vessel every 45 minutes; and it will take 2 hours to service, warm, and relocate the crane.

Skippers must use valuable weather windows for launching and retrieval. Fishing for subsistence and for commercial purposes is interrupted, and to a great extent limited. Because of the need to wait on availability of a crane or loader, and the fact everyone rushes to launch and retrieve within a limiting weather window, each launch can take 2 hours and 45 minutes of crane time for the first vessel and 45 minutes for each additional vessel, for a total crane time of 22 hours to service the 26 vessel fleet. At an average opportunity cost of $240 per hour, without the project, there would be seven round trips for storm protection over a period of nine months at an annual cost of $73,900. With the project, a hydraulic trailer will be used instead of a crane. Only one haul out each year will be required taking a half hour per vessel also at an hourly cost of $240, for a total fleet cost of $3,100. Annual savings are estimated to be **$69,800** for the 26-vessel fleet.

For unpaid hourly labor, the total time for launch or retrieval of the fleet is estimated to be 22 hours, and from start to end, each vessel ties up three, two or three crew persons for $275 for the fleet. The project will reduce these events by a net of six round trips per year, labor requirements will be reduced to one person, and launch time to 15 minutes, saving about $200.

10.25 Transportation Savings For Disabled Vessels

Presently vessels over 32 ft, which are in need of repair, must be towed to Dutch Harbor. Saint Paul does not have adequate haul-out facilities, crane capacity, or dockside work area for repair crews to fix larger vessels. Each year there are 5–10 vessels that must risk the open water trip to Dutch Harbor for repairs, and frequently, the vessels must be taken in tow for the entire trip. Sometimes the owners elect to return vessels to Seattle where they contract with the manufacturer for repair. Manufacturers typically accommodate distant water operators with added flexibility, because they prefer to service vessels they produce. Vessels have sunk on the way to Dutch Harbor, because it was not possible for them to be repaired at Saint Paul.

It takes time to arrange for a tow thus adding lost income to the financial damages. The Ocean Challenger was in the harbor 3 months, Smokey Point 2 months, and the High Seas 6 months. Since there is typically no harbor space available, disabled vessels need to be moved daily to minimize interference with processor operations. Numerous other vessels have been towed into Saint Paul disabled and have had to wait shorter periods for a tug.

In addition to the lost harvest time and added travel cost for repairs, there are adverse impacts on processing operations. Processors contract with harvesters to keep the production lines going. When the raw material flow is interrupted, the economics of the processing operation grow less profitable. Benefits associated with preventing the negative impact on processor operations, or lost harvest time of the vessels, or lost earnings of the crew, were not estimated.

Since there is not an ocean going tug stationed at Saint Paul, one must make the trip from Dutch Harbor to take the disabled vessel in tow. The cost of a tug for the round trip is $466 hour cost at sea x 550 miles/6.5 knots = $39,600. Benefit of preventing five events per year is $198,000, and for 10 events, the benefit would be $396,100. For purposes of this report, average number of trips reported during the last three years is five. Benefits for this category are **$198,300.**

10.26 Harbor Congestion

Without a small boat harbor, the deep-draft part of the harbor is used for offloading catch from the small vessels. This requires them to tie up at spaces reserved for deep-draft vessels. The large commercial vessels have a priority of use and frequently displace the small fishing vessels.

The outer harbor is typically very busy with vessels waiting outside to get in. During a sample period of 300 consecutive days, there were 1,680 users. The average time at the dock face was 8 hours. This included 56 vessels that were in need of maintenance, damaged, or disabled. There is no recorded data, showing the number of times that smaller vessels were either displaced or forced to wait, until a larger vessel had finished its business and departed. Discussions with the local fishermen indicated this was a daily occurrence, during times when the fleet was most active.

A benefit for alleviating congestion was not estimated because of the huge uncertainty in the amount of time lost and number of occasions. To some extent the cost of the delay reduction is already measured in other benefit categories. The beneficial effect on large commercial vessels that use the outer harbor on a priority basis has not been quantified, however, it is an overall net gain in benefits to them. It was concluded, however, that a small boat harbor is consistent with the needs of the outer harbor and will increase efficiency to all users.

10.27 Reduced Harbor Dock Maintenance Cost

When storm conditions cause wave activity inside the harbor, floating docks, used for temporary tie ups for the small vessel fleet, are required to be removed. The crane lifts the three approximately 60 ft units from the water and stores them alongside the waterfront at a documented cost per event of $30,000, not including the opportunity cost associated with storage of the dock units on valuable industrial land. During an assumed "normal year" this removal activity will take place one time. The docks will be due for replacement by project year one, and estimated cost by that time will exceed the $215,000 originally paid. Annual savings from eliminating the need to remove the docks and the annual savings in replacement cost total **$48,100** annually.

10.28 Improved Subsistence Fishery

Weather conditions limit the time the local fleet fishes, and each hour saved in the launch and retrieval process is an hour of additional harvest time for the subsistence fisheries. There is considerable room for expansion of local fleet activities, and local fishermen have stated a small boat harbor is needed so they can increase their subsistence harvest.

For the Aleutian Island area (ADF&G, 1994), data reveals average per person subsistence harvest is 378 lb per year. At Saint Paul it has been 267 pounds. Alaska's highest per capita subsistence harvest is at Hughs, where it is 1,498 pounds. A study by ADF&G in 1989, Alaskan's Per Capita Harvest of Wild Foods, summarized the following as factors accounting for some communities having extraordinarily high per capita consumption rates:

- The subsistence harvest is high, because it is used as a substitute for milk products (the single largest item in the American diet), fruits, vegetables, and grains. In the U.S. average meat and poultry consumption is 255 lb per year, but in Saint Paul, the subsistence harvest also provides clothing, home goods, trade, ceremony, arts and crafts, and other uses.

- Native communities harvest more wild foods than communities with higher non-Native populations.
- Generally, harvests increase as the distance from road systems increase.
- Because of the high cost of transportation and storage, store bought foods in rural areas can be expensive, and many choices are very limited.

A survey of the community by ADF&G revealed that 89% of the people are involved in subsistence harvests, but 99% use subsistence resources. Pressure on harvesters is indicated by 1994 ADF&G statistics, which reveal over 14,000 lb of halibut were removed from the commercial harvest to be used for subsistence purposes. This is an indication that fish, which the islanders harvested for commercial purposes, were more valuable to the islanders for subsistence use. There is an obvious unmet need for subsistence harvest.

For purposes of this analysis, discussions with residents support the assumption that the community would harvest at least enough halibut to bring the community subsistence harvest up to that of other Aleutian villages. Subsistence harvests by residents of Akutan, Atka, False Pass, King Cove, Nelson Lagoon, Nikolski, Sand Point, and Unalaska were used to establish an average harvest level. Based on this baseline, the Saint Paul harvest would be an increase from 267 to 378 lb per year for the 492 subsistence harvesters on the island, merely to equal the average for the Aleutian area. The highest per capita subsistence harvest was at Nikolski, 550 lb per person, and the average per capita harvest of the highest four villages (Akutan, Atka, False Pass and Nikolski) in the sample was 470 lb per person. A projected harvest of 470 lb at Saint Paul would put island residents equal to the average of the top quartile but at only 85% of Nikolski, the top harvester.

This is a total increase of 99,900 lb for all Saint Paul permanent residents. Studies by ADF&G use replacement food values for subsistence harvest in the \$3–\$5 range. Using \$4.00 per pound, the value of the increased subsistence harvest is **\$399,600** annually. It is neither gross value nor net. It is an implied value from secondary sources. The value is not directly supported by a market because it is a subsistence value estimate that does not necessarily bear a relation to market value of commercially caught fish, or the cost incurred in getting them. Food is an important use of the subsistence harvest, but there are other important uses including clothing, home goods, ceremony, trade, and arts and crafts. These other uses are not recognized in the value of commercially caught fish. For example, persons with resources to trade frequently have advertised wares on area radio programs. The following is a sample of such advertisements made on the Kotzebue Swap-N-Shop program. The list would translate roughly to \$11.00 per pound.

- Gunny sack of whitefish, \$1.00 per pound.
- Five to six pound blocks of black muktuk for sale at \$15.00 per pound.
- Plain seal oil for sale, \$2.00 per pound.
- Dried ugruk meat, \$3.50 per pound.
- Paniqtuq mixed with cooked meat, \$2.50 per pound.

- One whole ugruk skin for mukluk bottoms, $105.00.
- Beluga muktuk for sale, $4.00 per pound.
- Blueberries and cranberries for sale, $100.00 for 5 gallons.
- Five marten skins for sale from Huslia, $50.00 each.
- One large dark wolverine skin with long hair for sale, $500.00.
- 70 muskrats from Noovik for sale. Also a wolf and wolverine skin. (no price mentioned).

We have no basis for estimating the cost of taking the subsistence harvest. However, our largest concern with a "netting out" of cost is that we feel the estimate is already a serious understatement. This concern is based on the fact that we have totally discounted the NED "existence value" of the experience itself. We would argue that the experience should be viewed as a benefit instead of a cost. It is possible that even the $11 per lb tallied from the above could be a serious understatement. We used $4.00 per lb and are reluctant to validate that figure by making harvest cost adjustments to it.

Table 17. Benefit Summary

(Costs, thousands)

	30 Vessel Fleet[1]	50 Vessel Fleet	60 Vessel Fleet	90 Vessel Fleet
Prevention of Damage	12.3	27.1	127.9	188.7
Prevention of Theft Loss	5.0	11.0	52.0	76.7
Prevention of Vandal Loss	2.0	4.4	21.0	30.9
Harvest Cost Reduction	168.8	287.1	360.3	360.3
Delay Prevented by Water taxi Service	80.0	80.0	80.0	80.0
Transportation Savings for Scheduled Repair	0[4]	540.4	540.4	540.4
Port Land Opportunity Cost[5]	260.0	162.6	20.0	(943)
Vessel Haul Out	69.8[3]	69.8	69.8	69.8
Transportation Savings for Disabled Vessels	0[2]	198.3	198.3	198.3
Dock Maintenance	48.1	48.1	48.1	48.4
Subsistence Fishery	399.6	399.6	399.6	399.6
TOTAL	**1,045.6**	**1,828.4**	**1,917.4**	**1,050.1**

[1]The 30 vessel fleet is the existing fleet but with 4-5 vessels in the 30–40 ft class as replacements for some of the smaller vessels. It is derived in the fleet projection part of this report in that it is consistent with-projections for the halibut fleet. The 30-vessel fleet is included at the request of the project sponsor.

[2]Transportation benefits would not exist because the small harbor would not accommodate vessels significantly larger than the existing fleet. Vessels larger than 32 ft would still be towed to Dutch Harbor for repair.

[3]Only 4 vessels in the 30-40 ft range would be long season fishers. The rest of the fleet is too small to safely fish anything but months of summer. In the without-project condition they could be left in the water at the city temporary dock but would need to be hauled out often to prevent damage from minor storms.

[4]Inadequate moorage to accommodate the transient customers necessary to support a break-even operation.

[5]Some benefit is associated with freeing up valuable land used for marine storage, but larger projects require additional high valued navigation servitude lands otherwise not recognized as a cost.

11.0 COMPARISON OF ANNUALIZED BENEFITS AND COSTS AND IDENTIFICATION OF NED PLAN

Benefits were estimated for four different fleet sizes and configurations: 30 vessels, 50 vessels, 60 vessels and 90 vessels. Fleets of the different sized harbors are characterized as follows:

- 30 vessels, primarily a halibut fleet in the under 32 ft class with most of them in the 20–30 ft class. Vessels under 26 ft are considered trailerable and are primarily subsistence fishers.
- 50 vessels, which include most of the above fleet and the addition of vessels on the 40–58 ft class, with most of the larger class vessels being close to the lower end of the 40–58 ft range. The fleet would target halibut and cod within 15 miles of the island.
- 60 vessels, which include the day use halibut fleet plus a larger fleet of primarily 40–58 ft multi-use vessels. During most of the year, these larger vessels would be capable of targeting all species available to the island. They would be the primary wintertime crab harvesters. Benefits and annual costs for different size fleets are summarized below.
- 90 vessels, which would be the 60-vessel resident fleet with transient moorage for 30 more.

Costs were estimated for harbor sizes scaled to serve 30, 60, and 90 vessels with the same fleet mix as used in the benefit evaluation. Comparison of these cost and benefits are provided in the main report, tables 6 and 8. After that, the annualized cost and benefit estimates for various sized harbors at the South Village Cove location were plotted against each other as shown in exhibit 1. The chart in exhibit 1 illustrates that benefits for all plans, except the largest, exceed costs, and that a project scaled for 60 vessels provides the most net NED benefits. It has a construction cost of $10,445,000 (October 2003 price level). To determine a benefit to cost ratio this cost was deflated to the price level of the economic analysis, October 2001 with an interest rate of 6 1/8%. This provided an annual NED investment cost of $831,000 including an annual operation and maintenance cost of $159,000. Average annual NED benefits are $1,917,000. The project's benefit to cost ratio is 2.3 with annual net benefits of $1,086,000.

Table 18. NED Plan

(costs, thousands)

Fleet	Annual Benefit ($000)	Annual Costs ($000)	Net NED Benefits ($000)
30 vessels	1,046	788	258
50 vessels	1,829	817	1,012
60 vessels	1,917	831	1,086
90 vessels	1,050	919	131

12.0 NED DEPTH

12.1 Depth Requirements

Required depth is determined by draft of the fleet and under keel clearance requirements. Under keel requirements account for extreme low water levels, which are lower that predict lower water levels, squat, pitch roll and heave, and a factor of safety. The under keel clearance assures that the fleet can access the project under all conditions.

Some economic studies of NED depth trade off fleet delay cost against the cost of deepening the project. In some cases, it has been shown that waits will be so infrequent and by so few vessels that provision of an increment of depth is not justifiable. In the case of Saint Paul, waiting was not considered to be an option. The reason is the fleet must be able to shelter without delay due to the sudden arrival of treacherous sea conditions, which could jeopardize human life. This was considered to be an unacceptable and unnecessary risk.

Concerning the depth of the entrance channel, it was necessary to provide a depth of 16 feet. This was a specified hydraulic design constraint on all alternatives. Lesser depths at the entrance could not provide tidal cycle water exchange achieved by the without-project condition. Greater depths were not evaluated in the economic analysis, because the entire fleet would be able to pass unhindered with a 16 ft depth, and there would be no incremental benefits to be achieved.

12.2 Fleet Requirements

The largest vessel anticipated to use the project is 58 ft by 23 ft by 8 ft. There will be 23 vessels over 55 ft but most of them will draft under 8 feet and 13 vessels between 40–55 ft with a draft less than 6 ft. There are 17 between 26–39 ft and 27 under 26 ft, including 20 hand launched skiffs. The under keel clearance needed to assure reasonably safe, undelayed passage on days when harbor water is shallow due to wind and tide, added 4 ft to all of the drafts. Fleet requirements and benefits were therefore expressed as follows:

Table 19. NED Depth

Required Project Depth (ft, MLLW)	Vessel Draft	No. Vessels	Annual Benefit ($000)	Annual Cost ($000)	Net Annual Benefit ($000)
12	8	2	1,917	831	1,086
10	7	21	1,829	812	1,017
9	6	13	1,046	802	244
8	<4	24	797	792	5

12.3 NED Depth

The comparison of benefits and costs for the various depths indicates 12 ft to be supportable as the NED depth. It was not bracketed by a deeper project. It was the maximum depth evaluated, because it accommodates the entire fleet being planned by CBSFA, and the incremental benefit from added depth would be zero. There is no residual delay.

13.0 RECONCILIATION OF FLEET COST AND INCOME

Reconciliation is necessary to demonstrate that the claimed difference between the with-project and without-project conditions is actually achievable. Estimated cost reductions cannot be so great as to reduce costs below reasonable operating levels. Nor can without-project costs be so high as to remove the prospect of profitability. Reasonableness was verified by tallying all of the benefits related to fleet operating cost and added them to the vessel operating budgets to determine if the fishers could actually operate and show profitability in both the with-project and without-project conditions. The following tabulations illustrate the comparisons. It was concluded that the fishers will be profitable in both cases, and the estimated savings are reasonable.

Table 20. Annual Variable Operating Cost With The Project (For Saint Paul Based Vessels)

Class	Fuel, Repair, Maintenance ($1,000)	# Vessels	Cost ($1,000)
0-26	$2.0	27	$56.0
26-39	26.9	17	$457.3
40-55	96.1	13	$1,249.3
+55	124.1	23	$2,854.3
		TOTAL	**$4,616.9**

Table 21. Annual Operating Margin

	Cost ($1,000)
Saint Paul fleet variable operating cost wth-project	4,619.9
Add estimated operating savings	631.2
Estimated operating cost without-project	5,251.1
Operating income	10,900.0
Less: Saint Paul variable cost w/o	5,251.1
Operating margin w/o	5,648.9

Table 22. Total Fleet Budget With-Project (For Saint Paul Based Vessels)

Class	Total Cost ($1,000)	No. Vessels	Cost ($1000)
0–26	10	27	280.0
26–39	92.3	17	1,569.1
40–55	276.6	13	3,595.8
+55	413.6	23	9,512.8
		TOTAL	**14,957.7**
Saint Paul fleet total annual cost with-project			14,957.7
Less: Income at Saint Paul			10,900.0
Deficit			**4,057.7**

13.1 Reconciliation

As can be seen in the above tables, the total cost of the with-project fleet would exceed the gross harvest income, projected earlier in the report if the budgets were not adjusted, or if the predicted harvest were not increased. The indicated deficit is $4,057,700. This would be a matter of concern except that the budgets include the cost of fishing outside of the Saint Paul area without counting the related income. They also allow a generous portion for crew share. The following discussion illustrates that crew share can be cut back adequately to safely make up the shortfall. After that, a reconciliation of cost and income limited to Saint Paul operations is presented to illustrate profitability without adjustment of crew shares.

Reducing the crew share from 50% to 20% is still adequate to allow the higher income threshold of $25,600 to be exceeded. At a 20% level of crew share, the fleet will generate 86,400 person hours of income, and hourly earnings will be $32.80. There will be 42 FTE jobs, and the fleet will cover all fixed and variable cost. Use of crew shares at either 20% or 50% does not change the benefit analysis, because savings were based entirely on variable operating cost.

For the size of vessel anticipated in the Saint Paul fleet, 20% crew shares are generally less than the fleet average for Alaska overall. Data in the Alaska Seafood Industry Study showed average crew shares of 18%, 27%, 37%, 26% for halibut long line under 5 net tons, long line for miscellaneous fin fish, tanner and king crab statewide under 50 ft, and tanner and king crab statewide under 75 ft respectively. Aleutian Island set net and statewide halibut troll operators showed average crew shares of 10% and 3% respectively. When the crab LLP has the intended effect of reducing the number of large vessels, harvest by the crab fishers 60 ft and under will increase. There are no projections available regarding anticipated shifts in the harvest, but the amendment is designed to accomplish this. Since most of the harvest has historically been taken by the large vessels that are going to be taken out of service, the smaller vessels will receive a windfall opportunity. It is conceivable that harvest by vessels under 60 ft will double in a year or two, and 50% crew shares will be easily affordable.

13.2 Matching Costs and Revenues With Season Fished

At Saint Paul as with other Alaska harbors, the permanently moored fleet operates in a number of different fisheries at different locations during the year. The Saint Paul fleet will also be available for other harvests at other locations such as herring and salmon. This is especially true of the larger vessels, expected to be relocated from other ports under new ownership. The vessels will have been active in salmon fisheries and will maintain their permits. Therefore, the income and expense of the Saint Paul fleet should be matched with the days of operating at Saint Paul.

The fleet operating budgets in tables 6, 7, 8 and 9 reflect season operating days unadjusted for days fished out of Saint Paul. The fleet costs, estimated at $4,616,900 and $14,957,900, are therefore overstated, because they include the cost of operating in fisheries away from Saint Paul. If the relevant cost is defined as being related to activities out of Saint Paul, the number of days fished out of Saint Paul must be incorporated into the reconciliation. Limiting the cost and revenue to Saint Paul based activities reduces variable cost and total cost of the fleet to $1,765,000 and $6,317,500 respectively. The operating margin is $8,513,800, and the net income is $3,951,300 with crew shares fixed at 50%.

Table 23. Fleet Budget Variable Costs Limited To Saint Paul Operations

Size Class	Hourly Variable Cost	Trip Hours	Days Fished	Number In Size Class	Fleet Cost
0-26	3	12	14	27	10,000
26–39	32.50	12	22	17	145,900
40–55	53.50	12	13	13	350,900
+55	95.00	12	23	23	1,258,600
				TOTAL	**1,765,000**

Table 24. Fleet Budget Total Costs Limited To Saint Paul Operations

Size Class	Hourly Total Cost	Trip Hours	Days Fished	No. Size Class	Fleet Cost
0–26	6	12	14	27	30,000
26–39	106.40	12	22	17	477,500
40–55	156.80	12	13	13	1,027,400
+55	361.00	12	23	23	4,782,600
				TOTAL	**6,317,500**

Table 25. Income And Cost Limited To Days Fished Out Of Saint Paul

	Variable Cost Analysis ($)	Total Cost Analysis ($)
Income	10,900,000	10,900,000
Fleet cost with-project	1,765,000	6,317,500
Add operating savings (benefit)	631,200	631,200
Cost without-project	2,386,200	6,948,700
Margin	8,513,800	3,951,300

Table 26. Illustration Of Crew Activity With A Hourly Earning Rate Of $32.50

Class	Days Fished	#	Average Crew	Crew Days
0-25	14	27	1	400
26-39	22	17	2	700
40-55	44	13	3	1,700
+55	48	23	4–5	4,400
			Total	7,200
			Multiplied By	12 Hrs
			Grand Total	**86,400**

$2,838,000 reduced crew share/86,400 fishing hours = $32.80 per hour

87,000 hours/2,040 = 42 FTE

14.0 PHASED CONSTRUCTION

14.1 Phased Construction

Phased construction has some significant advantages, which minimizes risk to the sponsor, without foregoing other opportunities and without adversely impacting viability of the project. It is attractive financially as a means of relieving a small community from the burden of major cash requirements, and it allows time for the community to adjust and take advantage of a major change in the heart of the city.

14.2 Economic Implications

Changes will take place rapidly in the fishery now that CDQ and IFQ programs are in effect and a crab LLP has been approved. A phased small boat harbor will allow the community to develop in step with the rate of transition to fishing as a livelihood that residents prefer. It also leaves open the prospect to accelerate expansion as the sponsor may elect to do later. The impact on the benefit cost analysis will be minimal. An initial phase would be comparable to development of a 30 vessel harbor, which displayed a benefit to cost ratio of 1.7:1. Additional phases would improve the economics as increments proved to be better with each unit added. A present worth adjustment to the economics will influence both sides of the benefit and cost equation, hence future additions will also be attractive investments.

15.0 UNCERTAINTY ASSESSMENT

Since this particular project enjoys a very healthy benefit to cost ratio, and since some sensitivity has been demonstrated in the text, this risk and uncertainty discussion was limited to a summary analysis. The summary analysis identified potentially significant areas of risk and uncertainty and associated them with five categories as follows: uncertain, reasonably certain, reliable and supported, analysis used in the report, and high side assumptions. Factors influence uncertainty on the benefit side of the equation in the following areas:

15.1 Development of Saint George Harbor in the Without-Project Condition for Saint Paul Harbor

The neighboring island of Saint George has begun planning a local harbor improvement, which was not specifically included in the without-project condition for Saint Paul. The issue is whether work at Saint Paul would remain justified, and whether the NED plan would be changed by insertion of Saint George in the basic without-project condition. Study of a harbor improvement at Saint George is not yet at the reconnaissance stage. However, it is reasonably certain that improvements are economically justified and that a plan can be implemented there, even after a new harbor has been built at Saint Paul. The scale and timing of the improvement are highly uncertain. The plan formulation and justification at Saint Paul is not sensitive to development at Saint George, because the Saint George Harbor economics are oriented to larger vessels than can be accommodated at Saint George. Economic justification of the harbor hinges on commercial transportation savings for quarry product. In addition, the Saint George Harbor is highly likely to provide harbor development at an incremental cost lower than Saint Paul after the NED scale of Saint Paul has been reached. This will be particularly true for the fleet that is oversized for the Saint Paul Harbor. This makes it an ideal increment of development for the eastern Bering Sea regardless of progress being made at Saint Paul.

15.2 Damage Estimates

Damage data is from persons experiencing damages at Saint Paul. Data is reliable and supported, but it is an uncertain analysis due to hypothesis about damages prevented to vessels, appearing in the with-project condition. In addition, it was assumed damage will bear a relation to vessel and fleet value as the fleet expands. There are no high-side assumptions.

15.3 Vandal Loss

Data is from persons experiencing damages at Saint Paul. Data is reliable and supported, but it is an uncertain analysis due to conjecture about losses experienced in the without-project condition by the vessels that would relocate to Saint Paul. In addition, it was assumed that vandalism losses bear a relation to vessel and fleet value. There are no high-side assumptions.

15.4 Theft Loss

Data is from persons experiencing losses at Saint Paul. Data is reliable and supported, but it is an uncertain analysis due to conjecture about the without-project condition for vessels that would relocate to Saint Paul with the project. In addition, it was assumed that theft loss bears a linear relation to vessel and fleet value. There are no high-side assumptions.

15.5 Water Taxi Service

Prospects for a water taxi service were verified with local interests, who have evaluated profitability of the venture. Data is reliable and supported. High-side assumptions would be linked to choice of simulation model, loading of data, and interpretation of the sample operating data, and to adjust for season closure that would rule out processor deliveries. However, the specific high side variable used in the sensitivity analysis was the $90.00 hourly operating cost of a 90–160 ft vessel waiting off shore at a 50% power setting. A 25% power setting was also presented and is characterized as reasonably certain.

15.6 Port Land Use

The land use plan has status as a local ordinance. Lease values were verified with land owners. Data is reliable and supported. There are no high-side assumptions.

15.7 Haul Out Problems

Problems were taken wholly from first person accounts. Data is reliable and supported. There are no high-side assumptions.

15.8 Dock

Cost and operating practice were provided by the owner. Data is reliable and supported. There are no high-side assumptions.

15.9 Scheduled Repair

Reliance on transfer of data from other studies was necessary. The significant difference in the fleet with the project and without the project creates uncertainty about repair practices. Development of a repair facility at Saint Paul would require significant leadership and innovation, and the time it would take to demonstrate profitability is uncertain. High-side assumptions relate to throughput capacity and vessel transportation cost. Benefits are based on reduction in trips to alternative repair facilities and are considered to be a low-side estimate.

15.10 Verification of With-Project and Without-Project Condition

The without-project condition and problems are the result of testimony at public meetings at Saint Paul. Problems described were verified publicly with the community. The with-project condition is more of a result of engineering judgment, regarding what physical accomplishments are likely to result from a project. The with-project condition is a consensus of the planning team and was coordinated and verified at a public meeting. Although a result of judgment and expert opinion the consensus among parties indicates this to be a reliable and supported estimate. There are no high-side assumptions.

15.11 Exvessel Prices

Annual averages were used to adjust for seasonal and yearly changes in prices. Data is reliable and supported. There are no high-side assumptions.

15.12 Fuel Cost

Fuel sales were sampled on consecutive Tuesdays for the most recent 24-month period. Samples were at Dutch Harbor and Saint Paul. An average value was calculated for all sales at the two ports. Data is reliable and supported. There are no high-side assumptions.

15.13 IFQ as an Incentive for Fleet Development

This is a rational assumption. It was based on data, which showed that concentrations of IFQ resulted in increased net income to harvesters. This is a rational model, and data is reliable and supported. There is no high-side assumption.

15.14 Income Threshold

The level necessary to induce people into fishing as a livelihood is uncertain. One hundred and forty percent of average earned income was used. Use of a lower threshold would encourage a larger fleet. Average incomes in the industry are well below the threshold. This is an untested estimate and could be on the high side. As a high-side estimate, the benefit estimate that was derived from it could be an underestimate. The threshold is based on judgment and is uncertain. The value used in the report is considered to be a high-side estimate.

15.15 Future Guideline Harvest Levels and CDQ Allocations

Ranges, based on the most recent ten years, were used to compensate for the cyclical nature of stock health and harvests uncertainty. The estimate is a solution of convenience, due to lack of other forward-looking estimates. It was based on recent harvest history and is considered reasonably certain, if taken as a general picture of the long-term future. There is no high-side estimate.

15.16 Fleet Structure

This was based on the net income advantages offered by the location of Saint Paul for certain IFQ and CDQ resources. Fleet structure was demonstrated as providing net income to all harvesters. Net income estimates are subject to variation based on vessel production rates and operating budgets. Historical data, based on similar operations was used for net income estimates. Fleet structure is reasonably certain. There is no high-side estimate.

15.17 Vessel Operating Cost

This is a sensitive factor in estimating transportation cost. Documented cost and estimates of other reports were used to bracket costs in this report. Number of trips was coordinated with local operators. Cost estimates are reasonably certain for a multi-species fleet based at Saint Paul, although they would probably not be valid if applied to other fleets at other ports targeting other harvest mixes. A high-side estimate would depend mainly on being able to explain higher fuel consumption rates based on higher power settings.

One significant variable in determination of operating cost is the vessels main power unit and the manner in which it is used. Of equal concern is auxiliary power used to run on board freezers, processing equipment, and generate auxiliary power. Short trips out of Saint Paul will minimize dependence on freezers so the related power plant has not been included in the hourly cost of the with-project fleet. For the Dutch Harbor based fleet operating in the without-project condition, we have allowed for auxiliary power needed for fast freezing, glazing, and on-board processing. The needed power is included in the estimated total vessel horsepower for the larger sized vessel. The generator sets include one 320-kW Cat 3406, one 190-kW Cat 3306, and a 105-kW Cat 3304. The 3406 will run all of the time the vessel is fishing or in route, and the 3306 will run while the vessel is harvesting and steaming back. The 3304 is only used during port stops. The two larger generator sets consume 43 gph, which was included in the average overall vessel consumption rate of 82 gph, noted in the operating budgets.

15.18 Haul-Out Time

This was based on testimony of local fishermen and facility operators. Value of leisure time was based on procedures in prior Corps' studies, and hourly earnings from alternative employment opportunities in the fishing industry. Data is reliable and supported. There is no high-side estimate.

15.19 Subsistence Fishery Evaluation

Basic data was provided by ADF&G. Sources depend on numerous first person interviews and are well documented. Data is reliable and supported. The with-project condition was based on comparison with other similar areas and an assumed value of $4 per pound. State of Alaska studies use $5 per lb to illustrate the value of subsistence to the cash economy of the state. Exvessel values were not used, because subsistence patterns reflect needs extended beyond an alternative food source or diet supplement. Since this is a non-market based value estimate and the analytical methods are not well developed, the value estimate is considered reasonably certain. High-side estimates would apply to value per pound.

15.20 Intended Affect of CDQ and IFQ on Spreading Out of Harvest Periods

The result would be to allow Tanner Crab harvest during periods of favorable weather. This is consistent with historical harvest during the 1970s but not consistent with recent openings. Biological criteria and market aspects were not investigated. The intended effect is uncertain, however, the impact on the benefit analysis is of no consequence.

15.21 Use of Opportunity Cost as a Basis for NED Benefits of Harbor Improvements

This issue crosses over between interpretation of agency policy and guidelines. The different possible interpretations can result in a major impact on the benefit analysis. For this report, low-side assumptions and interpretations were used. This is an overarching issue and is considered to create a benefit evaluation that could be considered to be uncertain. Although uncertain, it is also self-mitigating, in the sense the bias is to the conservative side. The issue is whether one uses out of pocket costs, (short-run variable cost) or opportunity cost (long-run incremental cost) to measure economic cost. A high-side estimate would depend on being able to apply long-run incremental cost to determine transportation cost.

Corps' guidance indicates that when dealing with NED analysis of transportation, the Corps is supposed to be estimating the difference in cost of delivering a commodity[48] For the NED analysis of harbor improvements that benefit commercial fishing, one looks into the difference in cost of harvest[49] Analysts should not assume costs are limited to differences in short-run variable cost outlays of the harvester. From the NED frame of reference, capital costs are a necessary input to estimating hourly costs[50] To the extent capital costs are affected by a project they are a NED consideration[51]. This would imply that hourly cost of vessels should be estimated using opportunity cost consistent with Corps' source documents (These documents describe derivation of hourly or daily costs of vessels and other types of equipment while concerning themselves with both fixed and variable costs.). Some of the source document methodologies reduce all costs of ownership and operation to daily or hourly equivalents because more than hourly variable costs are required to make the entire bundle of resources embodied in the vessel or equipment available.

The total value of the bundle of resources tied up in the vessel has an hourly equivalent that must be accounted for. The reason is that the opportunity cost of taking a vessel out of productive use is the income it might otherwise be earning, and the minimum income it would be expected to earn in the long-run, would have to be at least equal to all of its costs. The cash savings from an hours worth of vessel time is based on variable cost, however, the opportunity cost would reflect that if you save an hour worth of wear and tear now, you essentially extend the useful earning life of the vessel by that amount. One hour of life added to the vessel would be measured by total cost not just variable cost.

An hour's loss of production time has to be at least equal to long-run marginal cost. The cost of a vessel owner to lease a similar vessel would include the hourly equivalent of fixed and variable cost. That is the cost the owner must recover to remain viable[52]. Hourly variable costs make up only 26%–34% of total hourly costs. It may be appropriate to use total hourly cost as an estimate of hourly opportunity cost in some parts of this study. The implication to this study is that NED benefits may have been somewhat understated by reliance on variable cost as a substitute for opportunity cost in all cases.

15.22 Basis for Opportunity Cost

NED guidance and economic literature in general supports the concept that economic cost and opportunity costs are equal. Guidance supports the proposition that effects on the nation are to be evaluated. Corps' studies use long-term planning periods and their end result is a

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[48] Published paper version of Economic and Environmental principles and Guidelines for Water and Related Land Resource Implementation Studies, (P&G as presented in Corps of Engineers ER 1105-2-100, paragraph 6-59, 6-75).

[49] Ibid Para 6-117.

[50] Ibid, Para 6-59 a. ."the benefit is the reduction in economic cost of using the waterway.", and para 6-117"...Harvest costs include...cost of equipment ownership and operation..."

[51] Ibid 6-117, ...The NED benefits are conceptually measured as the change in consumer's and producer's surplus as a result of a plan."

[52] See appropriate Planning/Economic Guidance Letters for a breakdown of total cost to daily equivalents for the deep-draft vessel fleet, inland waterway tugs and barges, and appropriate EP for illustration of the methods used to derive cost of other tug and work-boat equipment cost. See IWR Report 91-R-11 for a good discussion of opportunity cost.

capital investment decision, therefore use of long-run costs are appropriate in NED analysis. When referring to cost effects on net income, it is not costs that are relative to the fisher or to the shipper, it is costs that are relative to the nation that matter. The net effect on the nation is the basis for NED economics.[53] [54] In harbor studies, net income to the owner/operator is a measure of benefits only when charter vessels are evaluated and only for existing charter users.[55] This project does not have charter operators as beneficiaries, however, net income to the owner was used as a basis for NED benefits in some parts of this analysis to demonstrate cash flow effects instead of opportunity cost effects. The net income estimates are considered to be reasonably certain given the fleet, harvest estimates, and number of days of activity. A high-side estimate would depend on use of opportunity cost.

15.23 Complications of Long Run Costs v. Short Run Costs

In harbor studies, limited entry fisheries complicate the NED analysis. When a vessel is delayed in a without-project condition, it might lose harvest time and therefore might not recover its costs. Where individual fishing quotas apply, such as in the halibut fishery, it is likely that the delay might result in a decreased harvest for the fleet taken as a whole. Regardless of the potential impact on harvest, costs are higher in the without-project condition due to inefficiencies related to delay and increased travel distance. This is an important NED concern.

A with-project condition can result in saving hours of wear and tear. This will effectively extend the productive earning life of a vessel and the fleet. Because there will be an extension of the productive life of capital (fleet replacement, individual vessel replacement, overhaul, modification, etc.), there is a lesser amount of capital used up hourly and annually in the harvest activity. This need to measure differences in capital consumption, without the project and with the project, requires consideration of long-run costs.

It follows that estimates of benefits for reduction in related transportation cost or benefits for commercial fishing in general should be based on the hourly equivalent of Long-Run Incremental Cost (LRIC). For NED analysis, the relevant difference in cost, with a project and without a project, are estimated by multiplying the hourly LRIC times the number of vessel operating hours with the project and without the project. This report used short-run costs, which are considered to be uncertain as a indication of long-run effects. A high-side estimate would depend on use of long-run incremental cost.

15.24 Accounting for all Effects

Some reports have used changes in short-run variable cost as a basis for NED benefits while others have used long-run or opportunity cost. The literature and official Corps' guidance indicates that use of short-run costs creates a potential mis-statement of NED economic effects in some cases by failing to account for all resource effects. However, it is also true that misapplication of long-run costs can overstate effects.

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[53] Ibid page 5-16, resource use is broadly defined to include all aspects of the economic value of the resource. This broad definition requires consideration of the direct private and public uses that producers and consumers are currently making of available resources and are expected to make of them in the future."

[54] Ibid para 5-3.

[55] Ibid paragraph 6-172 a.

Application of opportunity cost is typical of navigation projects where the entire cost of ocean going vessels or inland vessels is ordinarily reduced to an hourly equivalent. These costs include capital, insurance, maintenance, fuel, stores, and crew compensation. Projects that result in savings of time or travel distance derive benefits for delay reduction using differences in the total hourly equivalent costs not just differences in short-run variable cost. For example, the NED analysis of inland transportation or deep-draft transportation, looks into the difference in transportation cost not short-term variable cost outlays of the shipper.

In addition to comparison of with-project and without-project conditions, Corps guidance is emphatic in its use of opportunity cost to evaluate resources and project effects.[56] Limitation of an analysis to variable costs ignores the need to recover the huge capital investment in equipment and the project impact on capital recovery, which would be revealed by comparing LRIC with the project and without the project. This is an important issue when a project frees up resources that could extend the useful life of a vessel and increase the amount of income it can generate. It is also important, in the sense, that a project can reduce the amount of capital needed to support a vessel, or it can extend the number of years before more capital is needed. Use of long-run cost is standardized in Corps' data sources, such as used for inland navigation, deep-draft navigation, and rail cost.[57] A deviation from use of long-run marginal cost may result in an understatement of the benefits. The understatement is particularly present in the estimate of benefits for transportation savings, such as in reduction of trips to alternative ports. However, there is uncertainty regarding the estimated reduction in trips that probably overshadows the issue of which cost measure best accounts for all effects. Taken together these two issues mix over-counting and under-counting, and present a combined uncertain assessment for all transportation related benefits.

Table 27. Uncertainty Relation To Benefit Estimate

	Uncertain Analysis	Reasonably Certain	Reliable and Supported Analysis	Analysis Used in the Report	High Side Assumption and Analysis
Prevention of Damage	127.9			127.9	127.9
Prevention of Theft Loss	52.0			52.0	52.0
Prevention of Vandal Loss	21.0			21.0	21.0
Harvest Cost Reduction		360.3		360.3	377.0
Delay Prevented by Water Taxi Service		40.0	80.0	80.0	105.1
Transportation Savings for Scheduled Repair		540.4		540.4	1,018.8
Port Land Use Opportunity Cost			20.0	20.0	20.0
Vessel Haul Out			69.8	69.8	69.8
Transportation Savings for Disabled Vessels			198.3	198.3	396.6
Dock Replacement and Dock Haul Out			48.1	48.1	48.1
Subsistence Fishery		399.6	399.6	399.6	479.5
TOTAL	**200.9**	**1,340.3**	**815.8**	**1,917.4**	**2,715.8**

[56] Ibid paragraph 6-140. "NED costs are the opportunity costs of resource use."

[57] Ibid paragraph 6-59 e. This section justifies use of rates on the grounds they can be viewed as an estimate of LRIC.

16.0 LOCAL ECONOMIC IMPACT

16.1 Alaska Native Population

Beneficial impacts of the project will accrue to a population that is largely Alaska Native. Population of Saint Paul in 2000 was reported to be 585, of which 79% are Alaska Natives.

16.2 Impact Analysis

One way of measuring the contribution of a particular economic activity is to look at the amount of goods and services it sells and buys outside the local economy. A local economy has imports and exports similar to state and national imports and exports. Seafood, harvested by a fleet from Saint Paul, processed there, and then shipped to Washington, is an export that benefits the local economy. As a result of fishing success, the crew of the fishing vessel brings money to Saint Paul by supplying a product that is sold outside of the local economy. Exports from the local economy stimulate local economic activity.

Money from the local economic activity does not all stay there. This is particularly true of smaller economies, which are generally not self-sufficient. For them, many of the goods and services must be brought in from the outside. They are imports to the local economy. The money that flows out of the local economy to pay for these imports is referred to as leakage.

In larger economies there is less leakage, and as a result, the multiplier effect inside of the larger economy is larger as well. In smaller economic regions with less diversity, relatively more goods and services will be purchased from outside and the multiplier effect will be smaller. Therefore, in an island economy like Saint Paul multipliers are expected to be small. Unfortunately there is no input-output model available for Saint Paul nor is there sufficient reliable income and employment data available to generate a basic regional export base model to derive multipliers.

The cash sector of the local economy of Saint Paul is characterized by seasonal employment, a dependence on commercial fishing, local construction, local service jobs supported by the local, Federal and state governments; and relatively low cash incomes.

Development of a local small boat harbor will enhance prospects for development of an economic base that will be able to create jobs and bring money into the community. A harbor is essential to moving Saint Paul in the direction of an equal footing with other communities, which have employment based on development of extractive industries. Without a reliable transportation link, raw materials cannot be delivered to the local processor by a small vessel fleet. The small boat harbor introduces a cost reduction to processing at Saint Paul. It is transportation cost alone that has handicapped any economic development at Saint Paul, and the small boat harbor will alleviate some of the problem.

16.3 Harvest

The with-project condition will produce a minimum of 42 FTE harvest jobs. Under present conditions, the local fleet spends a few weeks fishing during the summer. Among the 26 vessels there are probably less than 10 FTE jobs even though there are a large number of fishers employed for a short period. A net gain in harvest FTE in excess of 32 jobs was estimated.

16.4 Multi-Species Processing

The planned processing expansion has excellent prospects for creating local employment opportunities. The overall market potential exceeds the potential local output, and the residual demand for island products will introduce a stabilizing force into the activity. The planned Saint Paul operation has significant economic advantages because the location indicates output can be achieved at less cost from Saint Paul. One of the crucial links in expanding the operation is that delivery to the processor must be quick, reliable, and cost effective. The harbor development is therefore essential to maximizing development of the community's multi-species processing. In the long term, the local industry offers diversification by developing packaged products that could be manufactured at Saint Paul.

As an upper limit to the future, direct seafood processing employment estimate at Saint Paul, knowledge was transferred from industry studies, related to other locations, and range data from various publications was adapted.[58] The data indicated that, on an annual basis for the Kodiak economy, it took as little as $40,000 of raw product to support one FTE. Reports in other industry journals and articles[59] place production per worker industry wide at 114,000 lb annually. Interviews with staff at two Alaska fish canneries estimated production rates as high as 200,000 lb of raw product annually, and an industry report on the subject set production in excess of 100,000 lb per worker during the 1980s. Production rates depend on the mix of inputs as well as the final product. A cannery, using only whole salmon as input and producing canned salmon, has the highest production per worker. A cannery, using cod or trawl caught groundfish and producing fillets, will have the lowest production rates.

Weighted average exvessel value at Saint Paul is $1.05, indicating a value per worker could be as high as $120,000 at a production rate of 114,000 lb of raw product per person. This was adjusted to one employee per $200,000 of raw product. The range in number of jobs created represents varying assumptions regarding the portion of local harvest that could be processed by new island industry. The multiplier was a downward adjustment from statewide data for the fishing industry as reported by ADF&G.

Near term impacts are a creation of from 10–50 jobs directly in processing, including 5–10 in management product development, packaging, and marketing. Including a multiplier effect assumed to be a factor of 2, based on the isolated nature of the island, indicates total related processing employment will range from 20–100 jobs. Data from Alaska's Economy and Payroll, Institute of Social and Economic Research, prepared for ADOT, dated March 1997, indicates a state-wide basic to non-basic employment ratio of .28, implying a multiplier could be as high as 3.6. Other sources, dealing specifically with the seafood industry in Alaska, indicate a state-wide multiplier for the industry ranging from 1.8–2.1.[60] Multiplier estimates are complicated by presence of non-resident workers and a large amount of non-resident investment, which tends to obscure data needed to analyze leakage estimates. The situation at Saint Paul is further complicated by the emerging nature of the economy, and the fact, the island is heavily dependent on supplies and services imported to the island.

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[58] Alaska Economic Trends, Department of Labor and Workforce Development, Sept 1999, Vol. 19, page 3.

[59] "Alaska Seafood Industry Vibrant Despite Problems", Seafood.com, trade journal, Nov 20, 2000, Laine Welch

[60] Alaska Seafood Industry Study, The McDowell Group, Juneau Alaska, May 1989.

There will be a continued economic leakage due to the isolated island nature of the economy. One estimate has placed leakage as high as 75%. This would imply an equilibrium basic to non-basic job ratio, and employment multiplier between 1:0.25 and 1:0.6.

16.5 Hospitality

The community is moving ahead with plans to promote tourist visits to the community, and the framework plan includes development of bed and breakfast, and restaurant operations for regularly scheduled tours. Community cultural resources, bird watching, and nature walks will entertain visitors, who may also be attracted to future development of local sport fishing opportunities. The small boat harbor provides the community with the opportunity to develop a sport charter fishing operation like no other. The charter operation will add stability to the fleet by diversifying dependence on commercial harvest. A secondary effect of a growing charter business will be an invigorated hospitality industry. Shore-side support for tours and service to vessels, making refueling stops, will create four additional jobs.

16.6 Marine Services

Management, operation, and maintenance of the harbor will require a harbormaster. Development of a vessel repair facility will employ a full time manager and four marine repair specialists.

16.7 Economic Base Impacts

The balance of jobs, which will be created, is a healthy balance between extractive industry and service-based industry. Half of the new jobs are considered to be export based, because they bring in dollars from outside the community. As such they represent the ideal foundation for economic development. There is little prospect of adverse shock impacts, because the new opportunities can be phased in as the community wishes. They are in a unique position to control the flow of local development.

Transfer effects from other communities will be insignificant or invisible as the new jobs are expansion of the economic base not transfers from other locations. The local development opportunities are therefore considered to be socially and economically integrated into the regional economy. Jobs created in the first round of local impacts are summarized below:

Table 28. Local Jobs Created

Basic Industry	Initial Export Based Jobs Created	Future Non-Basic Jobs	**Total Jobs**
Seafood Harvest	32	6–19	**38–51**
Seafood Processing	10–50	2–12	**12–62**
Hospitality	4	1	**5**
Marine	5	1	**6**
JOB ESTIMATE	**51–91**	**10–33**	**61–124**

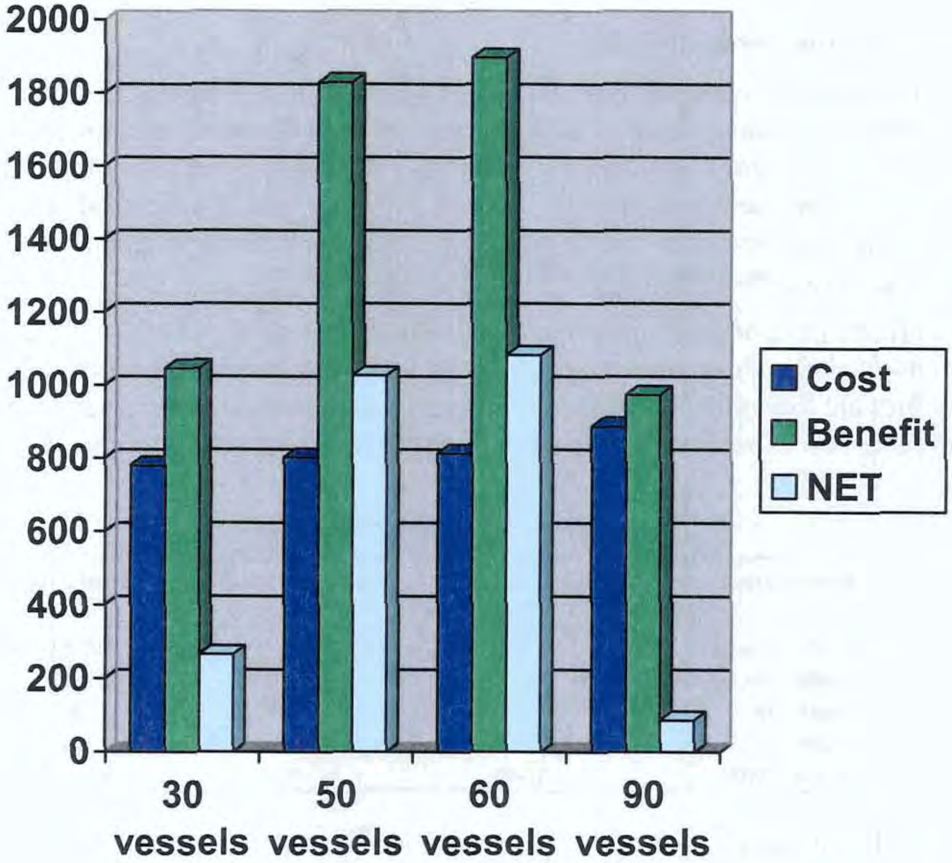
16.8 Social Impact

The community is 79% Native, and ties to traditional subsistence lifestyle are valued. Subsistence becomes more difficult each year as pressure on the extractive resources of the land and sea are increased due to growing regional population and tourism. Saint Paul residents must provide for some regular cash income to fend off hardship during times when subsistence harvests are not bountiful. The community has seized the initiative to guide its own future by developing jobs that will be consistent with the lifestyle.

Development of a small boat harbor will expand opportunities for subsistence gathering and will also create the opportunity for a stable economic base. The economic expansion is not expected to stimulate growth in the population, because a local labor pool exists, and unemployment is a problem. The most likely future is one of expanded job opportunities for the residents, increased family incomes, and decreases in the number of persons at or below the poverty level.

Age and ethnic makeup of the population is not expected to change in the short run. Over the long run, young adults are expected to remain at Saint Paul rather than move to destinations where employment opportunities exist. Since there is not expected to be a measurable in-migration, there are anticipated to be no discernible adverse community effects, such as increases in crime, health problems, administrative expense, or environmental problems.

Exhibit 1. Comparison Of Annual Benefits and Cost ($000) for All Vessel Sizes



APPENDIX C

COST ESTIMATES

SAINT PAUL, ALASKA

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE GENERAL REEAVUATION REPORT, DATED: AUGUST 2003

PROJECT: BOAT HARBOR
LOCATION: SAINT PAUL, ALASKA

DISTRICT: ALASKA
P.O.C.: FRANK ANTOLIN, CHIEF, CE

		CURRENT MCACES ESTIMATE PREPARED: JANUARY 2001 EFFECTIVE PRICING LEVEL: JANUARY 2001				###### EFFECT. PRICING LEVEL: 1 OCT -2			.........FULLY FUNDED ESTIMATE.........		
ACCOUNT NUMBER	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	COST ($K)	CNTG ($K)	TOTAL ($K)	COST ($K)	CNTG ($K)	FULL ($K)
10	MOB DEMOB & PREWORK	$1,454	$291	20%	$1,745	$522	$104	$626	$569	$113	$682
10-00.46	BREAKWATER AND SEAWALLS	$599	$120	20%	$719	$599	$120	$719	$653	$131	$784
12-	NAVIGATION PORTS & HARBORS	$4,812	$962	20%	$5,774	$4,812	$962	$5,774	$5,250	$1,049	$6,299
	TOTAL CONSTRUCTION COSTS ==	$6,865	$1,373	20%	$8,238	$5,933	$1,186	$7,119	$6,472	$1,293	$7,765
01---	LANDS AND DAMAGES	$24	$0	0%	$24	$10	$0	$10	$11	$0	$11
30—	PLANNING, ENG. & DESIGN	$825	$0	0%	$825	$825	$0	$825	$900	$0	$900
31---	CONSTRUCTION MANAGEMENT	$726	$0	0%	$726	$726	$0	$726	$792	$0	$792
	TOTAL PROJECT COSTS ======	$8,440	$1,373	20%	$9,813	$7,494	$1,186	$8,680	$8,175	$1,293	$9,468

TOTAL FEDERAL COSTS ==========> $0

TOTAL NON-FEDERAL COSTS ========> $0

THIS TPCS REFLECTS A PROJECT COST CHANGE OF $

THE MAXIMUM PROJECT COST IS ======> $

DISTRICT APPROVED:

__________ CHIEF, COST ENGINEERING

__________ CHIEF, REAL ESTATE

__________ CHIEF, PLANNING

__________ CHIEF, ENGINEERING

__________ CHIEF, CON-OPS

__________ CHIEF, PROGRAMS MANAGEMENT

__________ PROJECT MANAGER

__________ DDE (PM)

DIVISION APPROVED:

__________ CHIEF, COST ENGINEERING

__________ DIRECTOR, REAL ESTATE

__________ CHIEF, PROGRAMS MANAGEMENT

__________ DIRECTOR OF PPMD

APPROVED DATE: __________

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE GENERAL REEAVUATION REPORT, DATED: AUGUST 2003

PROJECT: BOAT HARBOR DISTRICT: ALASKA
LOCATION: SAINT PAUL, ALASKA P.O.C.: FRANK ANTOLIN, CHIEF, CE

	CURRENT MCACES ESTIMATE PREPARED: JANUARY 2001 EFFECTIVE PRICING LEVEL: JANUARY 2001					###### EFFECT. PRICING LEVEL: 1 OCT -2				.........FULLY FUNDED ESTIMATE.........				
ACCOUNT NUMBER	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
10-	MOB DEMOB & PREWORK	522	104	20%	626	0.0%	522	104	626	Aug 06	9.1%	569	113	682
10	BREAKWATER AND SEAWALLS	599	120	20%	719	0.0%	599	120	719	Aug 06	9.1%	653	131	784
12-02	NAVIGATION PORTS & HARBORS	1,007	201	20%	1,208	0.0%	1,007	201	1,208	Aug 06	9.1%	1,099	219	1,318
	TOTAL CONSTRUCTION COSTS ==	$2,128	$425	20%	$2,553		$2,128	$425	$2,553			$2,321	$463	$2,784
01—	LANDS AND DAMAGES	$10	$0	0%	$10	0.0%	$10	$0	$10	Aug 04	9.1%	$11	$0	$11
30—	PLANNING, ENG. & DESIGN	$256	$0	0%	$256	0.0%	$256	$0	$256	Aug 06	9.1%	$279	$0	$279
31—	CONSTRUCTION MANAGEMENT	$226	$0	0%	$226	0.0%	$226	$0	$226	Aug 06	9.1%	$247	$0	$247
	TOTAL COSTS ==========	$2,620	$425	20%	$3,045		$2,620	$425	$3,045			$2,858	$463	$3,321

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE GENERAL REEAVUATION REPORT, DATED: AUGUST 2003

PROJECT: BOAT HARBOR
LOCATION: SAINT PAUL, ALASKA

DISTRICT: ALASKA
P.O.C.: FRANK ANTOLIN, CHIEF, CE

		CURRENT MCACES ESTIMATE PREPARED: JANUARY 2001 EFFECTIVE PRICING LEVEL: JANUARY 2001				###### EFFECT. PRICING LEVEL: 1 OCT -2				.........FULLY FUNDED ESTIMATE.........				
ACCOUNT NUMBER	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
10-	MOB DEMOB & PREWORK	932	186	20%	1,118	0.0%	932	186	1,118	Aug 06	9.1%	1,017	203	1,220
10-00.46	BREAKWATER AND SEAWALLS	0	0	20%	0	0.0%	0	0	0	Aug 06	9.1%	0	0	0
12-02.99	NAVIGATION PORTS & HARBORS	3,805	761	20%	4,566	0.0%	3,805	761	4,566	Aug 06	9.1%	4,151	830	4,981
	TOTAL CONSTRUCTION COSTS ==	$4,737	$947	20%	5684		$4,737	$947	$5,684			$5,168	$1,033	$6,201
01--	LANDS AND DAMAGES	$14	$0	0%	$14		14	0	14	Aug 06	9.1%	15	0	15
30-01	PLANNING, ENG AND DESIGN (10%)	569	$0	0%	569	0.0%	569	0	569	Aug 06	9.1%	621	0	621
31-01	CONSTRUCTION MANAGEMENT (8%	500	$0	0%	500	0.0%	500	0	500	Aug 06	9.1%	545	0	545
	TOTAL COSTS =========	$5,820	$947	16%	$6,767		$5,820	$947	$6,767			$6,349	$1,033	$7,382

St.Paul Alaska Small Boat Harbor
Alternative #1 (Preferred)
Main Dredging = 12 feet
60 Vessel Harbor

Designed By: Tetra Tech ISG, John Oliver Con.
Estimated By: Tetra Tech ISG

Prepared By: Doug Lantz, P.E.

Preparation Date: 01/29/01
Effective Date of Pricing: 01/01/01

Sales Tax: 0.0%

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St. Paul Alaska Small Boat Harbor - Alternative #1 (Preferred Alternative)
60 Vessel Harbor, 12 foot Depth
MCACES Database: SP1PB0*.*

Project Description:

First Season ---
1) Approximately 140,000 cy of dredging in the entrance channel, maneuvering channel, and boat basin, with disposal adjacent to harbor and in upland areas.
2) Placement of underwater revetment.
3) Construction of a circulation berm.
4) Construction of a breakwater.

Second Season ---
5) Installation of floating docks and boat ramps.
6) Construction of precast concrete docks along the south shore.
7) Boat Lift Trailer.

Basis of Design: General Re-evaluation Report (GRR) Design. January 2001

Overtime: 2 10-hour shifts, 7 days week

Project Construction:

Site Access: Dredging, breakwater, circulation berm, revetment, and floating docks will require marine floating equipment. South side dock will require land based equipment.

Borrow Areas: Rock will be procured on St. Paul Island.

Construction Methodology: Prime contractor will mob the dredging equipment and manpower from the Puget Sound area.

Dredging: Floating crane with a 14 cy bucket and a 10 cy bucket on standby for use during repairs. Two 3000-cy (5000-ton) barges will be used to transport dredged material to spending area. A portion will be off-loaded adjacent to harbor and a portion will be hauled upland.

Breakwater: Rock will be quarried on St. Paul an trucked to breakwater.

Facilities: Floating docks, precast concrete members, and pilings will be fabricated/procured in Seattle/Tacoma area and barged to St. Paul Island. Transport cost is included in Mob/Demob, and is not reflected in the material cost for these itmes.

Pile driving and installation of floating facilities will use a floating crane/piledriving rig. Installation of shoreside facilities will use a combination of land based and floating equipment.

Equipment/Labor Availability & Distance Traveled.
St. Paul Island has a limited amount of heavy equipment and manpower

available for contractors use. Mobilized equipment will require three tows:

First Season ---
TOW #1 - dredging barge, crane, buckets and one 3000 cy barge.
TOW #2 - one 3000 cy barge with earthmoving equipment.

Second Season ---
TOW #3 - pile driving barge/crane, and one 3000 cy barge with precast concrete members, prefabricated docks.

Skilled labor, including crane/equipment operators, oilers, steel workes, and welders will be mobilized from Seattle and provided with per diem of $90 hotel and $40 food on St. Paul. Semi skilled workers will be drawn from local labor pool.

Labor Rates: MCACES Anchorage Davis Bacon Rates, 2000.
Remote pay adjustment of 30% gives approximate 2001 Davis Bacon rates(provided by TDX)for St Paul Island.

Equipment: Region IX Equipment Rates EP 1110-1-8, 1999.

Prime Contractor's profit of 8.8% based on weighted guidelines.
Prime Contractor's overhead estimated at 15%. Travel and perdiem for crews are added separately under Mob/Demob.
Engineering and Design estimated at 10%
Supervision and Administration estimated at 8%

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* * * END TABLE OF CONTENTS * * *

5. 1st Seas. - Tows	QUANTY UOM CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST

10. MOB/DEMOB
The equipment mobe cost for the dedging portion of this project (140,000cy) is computed by prorating the total equipment mobe for all dredging (567,700 cy) by the ratio of the two quantities. The factor = 0.25. The adjustment is made to items: 10.25 1st Seas. - Tows 10.30 1st Seas. Equip Cost During Tow 10.35 1st. Season Labor Travel The cost was adjusted downward by 75% using the "Adjust Pricing" option.

10.25. 1st Seas. - Tows ** ADJUSTED **

Description	QUANTY UOM CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA Mob/Demob Tow #1: Tug, 14 cy			0.00	0.00	0.00	0.00	2500.00	2500.00	
dredge, 3000 cy loading barge	50.00 DA	0.00	0	0	0	0	125,000	125,000	2500.00
USR AA Mob/Demob Tow #2: Tug, 3000 cy			0.00	0.00	0.00	0.00	2500.00	2500.00	
loading barge	50.00 DA	0.00	0	0	0	0	125,000	125,000	2500.00
USR AA Mob/Demob Tugboat from Dutch			0.00	0.00	0.00	0.00	750.00	750.00	
Harbor or Bethel	2.00 DA	0.00	0	0	0	0	1,500	1,500	750.00
TOTAL 1st Seas. - Tows			0	0	0	0	251,500	251,500	

10.30. 1st Seas. Equip Cost During Tow ** ADJUSTED **

Description	QUANTY UOM CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA Hydraulic Shovel			0.00	0.00	0.00	0.00	1250.00	1250.00	
	3.00 MO	0.00	0	0	0	0	3,750	3,750	1250.00
USR AA 14 cy and 10 cy Clam			0.00	0.00	0.00	0.00	1250.00	1250.00	
	3.00 MO	0.00	0	0	0	0	3,750	3,750	1250.00
USR AA 65 CY Off-Highway Truck (3 ea)			0.00	0.00	0.00	0.00	4525.00	4525.00	
	9.00 MO	0.00	0	0	0	0	40,725	40,725	4525.00
USR AA 7 CY FE Loader (2 ea)			0.00	0.00	0.00	0.00	3325.00	3325.00	
	6.00 MO	0.00	0	0	0	0	19,950	19,950	3325.00
USR AA 500-800 ton Dredge Barge			0.00	0.00	0.00	0.00	1912.50	1912.50	
	3.00 MO	0.00	0	0	0	0	5,738	5,738	1912.50
USR AA 3000 cy (5000 ton) Dredge Barge			0.00	0.00	0.00	0.00	4675.00	4675.00	
#1	3.00 MO	0.00	0	0	0	0	14,025	14,025	4675.00
USR AA 3000 cy (5000 ton) Dredge Barge			0.00	0.00	0.00	0.00	4675.00	4675.00	
#2	3.00 MO	0.00	0	0	0	0	14,025	14,025	4675.00
TOTAL 1st Seas. Equip Cost During Tow			0	0	0	0	101,963	101,963	

5. 1st Seas. - Labor Trvl (airfare)	QUANTY UOM CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
10.35. 1st Seas. - Labor Trvl (airfare) Mobe is only for skilled labor. Assume semi-skilled laborers are available on St. Paul.			** ADJUSTED **						
USR AA Crane Ops			0.00	0.00	0.00	0.00	375.00	375.00	
	5.00 EA	0.00	0	0	0	0	1,875	1,875	375.00
USR AA Heavy & Med Equip Op			0.00	0.00	0.00	0.00	375.00	375.00	
	4.00 EA	0.00	0	0	0	0	1,500	1,500	375.00
USR AA Oiler			0.00	0.00	0.00	0.00	375.00	375.00	
	3.00 EA	0.00	0	0	0	0	1,125	1,125	375.00
USR AA Truck Driver - Heavy			0.00	0.00	0.00	0.00	375.00	375.00	
	6.00 EA	0.00	0	0	0	0	2,250	2,250	375.00
TOTAL 1st Seas. - Labor Trvl (airfare)			0	0	0	0	6,750	6,750	
10.38. 1st Seas. - Per Diem									
USR AA Skilled Labor Per Diem ($90			0.00	0.00	0.00	0.00	130.00	130.00	
hotel, $40 food)	439.00 DAY	0.00	0	0	0	0	57,070	57,070	130.00
TOTAL 1st Seas. - Per Diem			0	0	0	0	57,070	57,070	
10.40. 2nd Seas. - Tows									
USR AA Mob/Demob Tow #3: Tug (prefab			0.00	0.00	0.00	0.00	10000.00	10000.00	
docks, piles, boat ramps),	50.00 DA	0.00	0	0	0	0	500,000	500,000	10000.00
USR AA Mob/Demob Tugboat from Dutch			0.00	0.00	0.00	0.00	3000.00	3000.00	
Harbor or Bethel	2.00 DA	0.00	0	0	0	0	6,000	6,000	3000.00
TOTAL 2nd Seas. - Tows			0	0	0	0	506,000	506,000	
10.45. 2nd Seas. Equip Cost During Tow									
USR AA Dredge Barge - pile driving			0.00	0.00	0.00	0.00	7650.00	7650.00	
	3.00 MO	0.00	0	0	0	0	22,950	22,950	7650.00
USR AA Hydraulic Excavator			0.00	0.00	0.00	0.00	10000.00	10000.00	
	3.00 MO	0.00	0	0	0	0	30,000	30,000	10000.00
USR AA Crane - 125T			0.00	0.00	0.00	0.00	18000.00	18000.00	
	3.00 MO	0.00	0	0	0	0	54,000	54,000	18000.00
USR AA Pile Driving Hammer/Leads			0.00	0.00	0.00	0.00	5000.00	5000.00	
	3.00 MO	0.00	0	0	0	0	15,000	15,000	5000.00

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10. MOB/DEMOB

5. 2nd Seas. Equip Cost During Tow	QUANTY UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA Air Comp/Hose	3.00 MO		0.00	0.00 0	0.00 0	0.00 0	0.00 0	3000.00 9,000	3000.00 9,000	3000.00
USR AA Welder	3.00 MO		0.00	0.00 0	0.00 0	0.00 0	0.00 0	700.00 2,100	700.00 2,100	700.00
USR AA 500-800 ton Dock Material Barge	6.00 MO		0.00	0.00 0	0.00 0	0.00 0	0.00 0	7650.00 45,900	7650.00 45,900	7650.00
TOTAL 2nd Seas. Equip Cost During Tow				0	0	0	0	178,950	178,950	
10.50. 2nd Seas. - Labor Trvl (airfare)										
USR AA Crane Ops	2.00 EA		0.00	0.00 0	0.00 0	0.00 0	0.00 0	1500.00 3,000	1500.00 3,000	1500.00
USR AA Oiler	2.00 EA		0.00	0.00 0	0.00 0	0.00 0	0.00 0	1500.00 3,000	1500.00 3,000	1500.00
USR AA Structural Steel Workers	4.00 EA		0.00	0.00 0	0.00 0	0.00 0	0.00 0	1500.00 6,000	1500.00 6,000	1500.00
USR AA Welders	2.00 EA		0.00	0.00 0	0.00 0	0.00 0	0.00 0	1500.00 3,000	1500.00 3,000	1500.00
TOTAL 2nd Seas. - Labor Trvl (airfare)				0	0	0	0	15,000	15,000	
10.53. 2nd Seas. - Per Diem										
USR AA Skilled Labor Per Diem ($90 hotel, $40 food)	348.00 DAY		0.00	0.00 0	0.00 0	0.00 0	0.00 0	130.00 45,240	130.00 45,240	130.00
TOTAL 2nd Seas. - Per Diem				0	0	0	0	45,240	45,240	
TOTAL MOB/DEMOB				0	0	0	0	1,162,473	1,162,473	

20. HARBOR DREDGING (FED & LOCAL)

20. 2. Dredging (Federal) ** OVERTIME **
Hydrographic Survey cost from St. Paul Harbor Improvements, Alaska District (1996).

	QUANTY UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA Manuevering Channel Dredging *Mod*	19586 CY	ZDDREDGE	300.00	0.00 0	0.02 456	1.55 30,325	1.98 38,870	0.00 0	3.53 69,195	3.53

20. HARBOR DREDGING (FED & LOCAL)

2.) Dredging (Federal)	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA Entrance Channel Dredging					0.00	0.02	1.55	1.98	0.00	3.53	
	79414	CY	ZDDREDGE	300.00	0	1,850	122,957	157,605	0	280,562	3.53
USR AS Hydrographic Survey					0.00	0.00	0.00	0.00	35000.00	35000.00	
	2.00	EA	-	0.00	0	0	0	0	70,000	70,000	35000.00
TOTAL Dredging (Federal)	99000	CY			0	2,307	153,282	196,475	70,000	419,757	4.24
20. 5. Dredging (Local) ** OVERTIME ** Hydrographic Survey cost from St. Paul Harbor Improvements, Alaska District (1996).											
USR AA Boat Basin Dredging					0.00	0.02	1.55	1.98	0.00	3.53	
	41000	CY	ZDDREDGE	300.00	0	955	63,480	81,369	0	144,849	3.53
TOTAL Dredging (Local)	41000	CY			0	955	63,480	81,369	0	144,849	3.53
20.10. Disposal - Harbor Adjacent Fill ** OVERTIME **											
CIV AA Hauling, off hwy haulers, 65 CY,					0.00	0.00	0.30	0.45	0.00	0.76	
1 mile RT @ 20 mph (4.2 cyc/hr)	53600	CY	CTDHB34J	240.00	0	225	16,209	24,265	0	40,473	0.76
CIV AA Excavate & load, wheeled loader,					0.00	0.01	0.52	0.44	0.00	0.96	
7 CY, wet rock	53600	CY	CODLB10Z	212.50	0	381	27,759	23,739	0	51,499	0.96
TOTAL Disposal - Harbor Adjacent Fill	53600	CY			0	606	43,968	48,004	0	91,972	1.72
20.15. Disposal with haul ** OVERTIME **											
CIV AA Hauling, off hwy haulers, 65 CY,					0.00	0.01	0.50	0.74	0.00	1.24	
6 mile RT @ 40 mph (2.1 cyc/hr)	86400	CY	CTDHB34J	146.25	0	588	42,880	64,195	0	107,076	1.24
CIV AA Excavate & load, wheeled loader,					0.00	0.01	0.52	0.44	0.00	0.96	
7 CY, wet rock	86400	CY	CODLB10Z	212.50	0	613	44,747	38,267	0	83,013	0.96
TOTAL Disposal with haul	86400	CY			0	1,201	87,627	102,462	0	190,089	2.20
TOTAL HARBOR DREDGING (FED & LOCAL)	140000	CY			0	5,069	348,357	428,310	70,000	846,667	6.05

	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
22. REVETMENT & EROSION PROTECTION											
$4/CYprice quote for rock at quarry on St. Paul (not gauranteed)											
22. 5. REVETMENT W/BEDDING				** OVERTIME **							
USR AA 18" Rock Rip-rap quarried on St.					4.00	0.00	0.00	0.00	0.00	4.00	
Paul	2625.00	CY		0.00	10,500	0	0	0	0	10,500	4.00
B CIV AA Excavate & load, wheeled loader,					0.00	0.02	0.87	1.04	0.00	1.91	
7 CY, blasted rock	3500.00	CY	CODLB10Z	100.00	0	53	3,040	3,648	0	6,687	1.91
USR AA 6" gravel bedding layer, machine					5.00	0.07	3.71	4.02	0.00	12.73	
placed	875.00	CY	ZDBWATER	100.00	4,375	61	3,247	3,516	0	11,138	12.73
L CIV AA Hauling, off hwy haulers, 65 CY,					0.00	0.01	0.57	1.26	0.00	1.83	
3 mile RT @ 30 mph (2.9 cyc/hr)	3500.00	CY	CTDHB34J	100.00	0	35	2,009	4,393	0	6,403	1.83
B CIV AA Handling on barge, wheeled					0.00	0.02	0.87	1.04	0.00	1.91	
loader, 7 CY, blasted rock	3500.00	CY	CODLB10Z	100.00	0	53	3,040	3,648	0	6,687	1.91
B RSM AA Place Revetment					0.00	0.16	8.17	14.52	0.00	22.70	
	2625.00	CY	ZDDREDGE	45.00	0	408	21,454	38,122	0	59,576	22.70
TOTAL REVETMENT W/BEDDING	2625.00	CY			14,875	610	32,790	53,327	0	100,992	38.47
22.10. EROSION PROTECTION IN CHANNEL				** OVERTIME **							
USR AA 24" Rock Rip-rap quarried on St.					4.00	0.00	0.00	0.00	0.00	4.00	
Paul	6500.00	CY		0.00	26,000	0	0	0	0	26,000	4.00
B CIV AA Excavate & load, wheeled loader,					0.00	0.02	0.87	1.04	0.00	1.91	
7 CY, blasted rock	6500.00	CY	CODLB10Z	100.00	0	98	5,645	6,774	0	12,420	1.91
L CIV AA Hauling, off hwy haulers, 65 CY,					0.00	0.01	0.57	1.26	0.00	1.83	
3 mile RT @ 30 mph (2.9 cyc/hr)	6500.00	CY	CTDHB34J	100.00	0	65	3,732	8,159	0	11,890	1.83
B CIV AA Handling on barge, wheeled					0.00	0.02	0.87	1.04	0.00	1.91	
loader, 7 CY, blasted rock	6500.00	CY	CODLB10Z	100.00	0	98	5,645	6,774	0	12,420	1.91
B RSM AA Erosion Protection Placed					0.00	0.16	8.17	14.52	0.00	22.70	
	6500.00	CY	ZDDREDGE	45.00	0	1,011	53,124	94,398	0	147,521	22.70
TOTAL EROSION PROTECTION IN CHANNEL	6500.00	CY			26,000	1,271	68,146	116,105	0	210,251	32.35
TOTAL REVETMENT & EROSION PROTECTION	9125.00	CY			40,875	1,881	100,936	169,432	0	311,243	34.11

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	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
40. CIRCULATION BERM ** OVERTIME **											
M RSM AA Fill, borrow, for embankments,					5.38	0.03	2.38	3.45	0.00	11.21	
load, 1 mile haul, spread w/dozer	2130.00	CY	ZDCBERM	150.00	11,457	71	5,072	7,352	0	23,880	11.21
USR AA Sort Boulders from Dredged					0.00	0.22	14.65	11.36	0.00	26.01	
Material	600.00	CY	ZDBWATER	32.00	0	131	8,791	6,814	0	15,605	26.01
M MIL AA Cap with rounded excavated					0.00	0.16	11.16	16.18	0.00	27.34	
boulders - placement	600.00	CY	ZDCBERM	32.00	0	94	6,697	9,707	0	16,404	27.34
TOTAL CIRCULATION BERM	2730.00	CY			11,457	296	20,560	23,873	0	55,890	20.47

50. BREAKWATER (FEDERAL) ** OVERTIME **
Rock Size 2-ton minus

$4/CY price quote for rock at quarry on St. Paul (not gauranteed)

	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA 2-ton minus, quarried on St.					4.00	0.00	0.00	0.00	0.00	4.00	
Paul	12653	CY		0.00	50,612	0	0	0	0	50,612	4.00
B CIV AA Excavate & load, wheeled loader,					0.00	0.02	1.10	0.94	0.00	2.04	
7 CY, blasted rock	12653	CY	CODLB10Z	100.00	0	190	13,926	11,909	0	25,835	2.04
L CIV AA Hauling, off hwy haulers, 65 CY,					0.00	0.01	0.73	1.09	0.00	1.81	
3 mile RT @ 30 mph (2.9 cyc/hr)	12653	CY	CTDHB34J	100.00	0	127	9,184	13,749	0	22,932	1.81
B CIV AA handling on barge, loader, 7 CY,					0.00	0.02	1.10	0.94	0.00	2.04	
blasted rock	12653	CY	CODLB10Z	100.00	0	190	13,926	11,909	0	25,835	2.04
USR AA Place Rock Fill					0.00	0.16	10.32	13.23	0.00	23.55	
	12653	CY	ZDDREDGE	45.00	0	1,969	130,604	167,412	0	298,016	23.55
TOTAL BREAKWATER (FEDERAL)	12653	CY			50,612	2,475	167,640	204,979	0	423,230	33.45

60. FLOATING DOCK FACILITIES
Floats and Boat Ramps fabricated in Seattle. Transport is covered under mobilization.

60.02. Pile Driving - per Pile ** OVERTIME **
50 foot piles x 17.15/LF = $850 ea
Driving tips for boulders

65 piles driven 30 feet into ground = 1950 vlf

60. FLOATING DOCK FACILITIES

02. Pile Driving - per Pile	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR PD Pile, steel, pipe, 50' L 12"					850.00	0.00	0.00	0.00	0.00	850.00	
dia, 44 lb/LF, conc filled	65.00	EA		0.00	66,853	0	0	0	0	66,853	1028.50
M MIL PD Pile, steel, pipe, heavy duty					137.57	2.35	193.87	24.38	0.00	355.82	
points, 12" dia	65.00	EA	SIWWE14	0.43	10,820	153	15,248	1,918	0	27,985	430.54
B MIL PD Pile driving and concrete fill					0.00	0.30	19.60	27.75	0.00	47.35	
	1950.00	VLF	ZDPLDRVR	20.00	0	585	46,243	65,481	0	111,724	57.29
TOTAL Pile Driving - per Pile	65.00	EA			77,673	738	61,490	67,398	0	206,561	3177.87
60.05. Floating Docks (Main Floats)				** OVERTIME **							
USR AA 1 @ 10' x 25'					30.00	0.14	9.46	0.40	0.00	39.86	
	250.00	SF	ZDDOCK	50.00	7,500	35	2,365	101	0	9,966	39.86
USR AA 6 @ 10' x 50'					30.00	0.14	9.46	0.40	0.00	39.86	
	3000.00	SF	ZDDOCK	50.00	90,000	420	28,383	1,209	0	119,592	39.86
USR AA 7 @ 10' x 36'					30.00	0.14	9.46	0.40	0.00	39.86	
	2520.00	SF	ZDDOCK	50.00	75,600	353	23,842	1,016	0	100,458	39.86
TOTAL Floating Docks (Main Floats)	5770.00	SF			173,100	808	54,591	2,325	0	230,016	39.86
60.10. Finger Floats				** OVERTIME **							
USR AA 12 @ 6' x 60'					30.00	0.14	9.46	0.40	0.00	39.86	
	4320.00	SF	ZDDOCK	50.00	129,600	605	40,872	1,741	0	172,213	39.86
USR AA 7 @ 6' x 44'					30.00	0.14	9.46	0.40	0.00	39.86	
	1848.00	SF	ZDDOCK	50.00	55,440	259	17,484	745	0	73,669	39.86
USR AA 10 @ 6' x 25'					30.00	0.14	9.46	0.40	0.00	39.86	
	1500.00	SF	ZDDOCK	50.00	45,000	210	14,192	605	0	59,796	39.86
TOTAL Finger Floats	7668.00	SF			230,040	1,074	72,548	3,090	0	305,678	39.86
60.17. Float Ramps				** OVERTIME **							
USR AA Float Ramps 2 @ 8' x 60'					55.00	0.14	9.46	0.40	0.00	64.86	
	960.00	SF	ZDDOCK	50.00	52,800	134	9,083	387	0	62,270	64.86
TOTAL Float Ramps	960.00	SF			52,800	134	9,083	387	0	62,270	64.86

60. FLOATING DOCK FACILITIES

). Floating Bwater East Dock & Ramp	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
60.40. Floating Bwater East Dock & Ramp ** OVERTIME **											
USR AA Floating Ramp 20' x 115'	2300.00	SF	ZDDOCK	50.00	55.00 126,500	0.14 322	9.46 21,761	0.40 927	0.00 0	64.86 149,187	64.86
USR AA Floating Dock 20' x 275'	5500.00	SF	ZDDOCK	50.00	55.00 302,500	0.14 770	9.46 52,036	0.40 2,217	0.00 0	64.86 356,753	64.86
TOTAL Floating Bwater East Dock & Ramp	7800.00	SF			429,000	1,092	73,797	3,143	0	505,940	64.86
TOTAL FLOATING DOCK FACILITIES	22198	SF			962,613	3,846	271,508	76,344	0	1,310,465	59.04
62. PRECAST CONCRETE DOCK ** OVERTIME ** $145/sf cost based on 50' x 100' dock installation in 1988 - less mooring dolphins. Adjusted to current price level											
USR AA Precast Concrete Dock in Place	8000.00	SF		0.00	0.00 0	0.00 0	0.00 0	0.00 0	145.00 1,160,000	145.00 1,160,000	145.00
TOTAL PRECAST CONCRETE DOCK	8000.00	SF			0	0	0	0	1,160,000	1,160,000	145.00
70. PRECAST CONCRETE BOAT RAMP ** OVERTIME **											
M MIL AA Base course, compacted to 6" deep, crushed 3/4" stone, large areas	780.00	SY	COFGB36B	625.00	5.08 3,960	0.01 10	0.70 548	0.24 184	0.00 0	6.02 4,692	6.02
M MIL AA Structural precast, slabs, 12" thick, solid, 3000 psi	7000.00	SF	N/A	0.00	14.00 98,000	0.00 0	0.00 0	0.00 0	0.00 0	14.00 98,000	14.00
MIL AA Precast erection, 60' max rad, 90 ton crane, 9-10 ton/pc, floor deck	28.00	EA	ZDPCAST	1.75	0.00 0	4.00 112	256.84 7,192	83.92 2,350	0.00 0	340.76 9,541	340.76
TOTAL PRECAST CONCRETE BOAT RAMP	7000.00	SF			101,960	122	7,739	2,534	0	112,233	16.03
80. 60 TON BOAT LIFT TRAILER ** OVERTIME ** Conolift model Y60 Boat Lift Trailer 60 ton $100K purchase price in Ontario, plus $100K transport and assembly.											
USR AF Conolift model Y60. $100K Transport	1.00	LS		0.00	0.00 0	0.00 0	0.00 0	0.00 0	200000.00 200,000	200000.00 200,000	200000.00
TOTAL 60 TON BOAT LIFT TRAILER					0	0	0	0	200,000	200,000	

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80. 60 TON BOAT LIFT TRAILER

	QUANTY UOM CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
TOTAL St.Paul Alaska Small Boat Harbor			1,167,516	13,688	916,740	905,471	2,592,473	5,582,200	

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** PROJECT OWNER SUMMARY - Feature **

	QUANTITY UOM	CONTRACT COST	Contngy	E&D	S&A	TOTAL COST	UNIT COST
MOB/DEMOB							
.25 1st Seas. - Tows		314,633	62,927	37,756	33,225	448,541	
.30 1st Seas. Equip Cost During Tow		127,558	25,512	15,307	13,470	181,847	
.35 1st Seas. - Labor Trvl (airfare)		8,444	1,689	1,013	892	12,038	
.38 1st Seas. - Per Diem		71,396	14,279	6,854	9,253	101,782	
.40 2nd Seas. - Tows		633,020	126,604	75,962	66,847	902,433	
.45 2nd Seas. Equip Cost During Tow		223,871	44,774	26,865	23,641	319,151	
.50 2nd Seas. - Labor Trvl (airfare)		18,765	3,753	2,252	1,982	26,752	
.53 2nd Seas. - Per Diem		56,596	11,319	6,792	5,977	80,684	
TOTAL MOB/DEMOB		1,454,285	290,857	172,801	155,286	2,073,229	
) HARBOR DREDGING (FED & LOCAL)							
). 2 Dredging (Federal)	99000.00 CY	518,056	103,611	62,167	54,707	738,540	7.46
). 5 Dredging (Local)	41000.00 CY	181,210	36,242	21,745	19,136	258,333	6.30
).10 Disposal - Harbor Adjacent Fill	53600.00 CY	115,060	23,012	13,807	12,150	164,029	3.06
).15 Disposal with haul	86400.00 CY	237,806	47,561	28,537	25,112	339,016	3.92
TOTAL HARBOR DREDGING (FED & LOCAL)	140000.00 CY	1,052,132	210,426	126,256	111,105	1,499,919	10.71
2 REVETMENT & EROSION PROTECTION							
2. 5 REVETMENT W/BEDDING	2625.00 CY	126,344	25,269	15,161	13,342	180,115	68.62
2.10 EROSION PROTECTION IN CHANNEL	6500.00 CY	263,030	52,606	31,564	27,776	374,975	57.69
TOTAL REVETMENT & EROSION PROTECTION	9125.00 CY	389,373	77,875	46,725	41,118	555,090	60.83
0 CIRCULATION BERM	2730.00 CY	69,920	13,984	8,390	7,384	99,678	36.51
0 BREAKWATER (FEDERAL)	12653.00 CY	529,473	105,895	63,537	55,912	754,816	59.66
0 FLOATING DOCK FACILITIES							
0.02 Pile Driving - per Pile	65.00 EA	258,414	51,683	31,010	27,288	368,395	5667.61
0.05 Floating Docks (Main Floats)	5770.00 SF	287,756	57,551	34,531	30,387	410,225	71.10
0.10 Finger Floats	7668.00 SF	382,411	76,482	45,889	40,383	545,166	71.10
0.17 Float Ramps	960.00 SF	77,901	15,580	9,348	8,226	111,056	115.68
0.40 Floating Bwater East Dock & Ramp	7800.00 SF	632,945	126,589	75,953	66,839	902,326	115.68
TOTAL FLOATING DOCK FACILITIES	22198.00 SF	1,639,427	327,885	196,731	173,124	2,337,167	105.29
2 PRECAST CONCRETE DOCK	8000.00 SF	1,451,192	290,238	174,143	153,246	2,068,819	258.60
0 PRECAST CONCRETE BOAT RAMP	7000.00 SF	140,407	28,081	16,849	14,827	200,164	28.59
0 60 TON BOAT LIFT TRAILER		200,000	0	0	0	200,000	
TOTAL St.Paul Alaska Small Boat Harbor		6,926,208	1,345,242	805,431	712,001	9,788,882	

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTITY UOM	TOTAL DIRECT	OVERHEAD	PROFIT	TOTAL COST	UNIT COST
10 MOB/DEMOB						
10.25 1st Seas. - Tows		251,500	37,725	25,408	314,633	
10.30 1st Seas. Equip Cost During Tow		101,963	15,294	10,301	127,558	
10.35 1st Seas. - Labor Trvl (airfare)		6,750	1,013	682	8,444	
10.38 1st Seas. - Per Diem		57,070	8,561	5,766	71,396	
10.40 2nd Seas. - Tows		506,000	75,900	51,120	633,020	
10.45 2nd Seas. Equip Cost During Tow		178,950	26,843	18,079	223,871	
10.50 2nd Seas. - Labor Trvl (airfare)		15,000	2,250	1,515	18,765	
10.53 2nd Seas. - Per Diem		45,240	6,786	4,570	56,596	
TOTAL MOB/DEMOB		1,162,473	174,371	117,442	1,454,285	
20 HARBOR DREDGING (FED & LOCAL)						
20. 2 Dredging (Federal)	99000.00 CY	419,757	62,964	35,335	518,056	5.23
20. 5 Dredging (Local)	41000.00 CY	144,849	21,727	14,634	181,210	4.42
20.10 Disposal - Harbor Adjacent Fill	53600.00 CY	91,972	13,796	9,292	115,060	2.15
20.15 Disposal with haul	86400.00 CY	190,089	28,513	19,204	237,806	2.75
TOTAL HARBOR DREDGING (FED & LOCAL)	140000.00 CY	846,667	127,000	78,465	1,052,132	7.52
22 REVETMENT & EROSION PROTECTION						
22. 5 REVETMENT W/BEDDING	2625.00 CY	100,992	15,149	10,203	126,344	48.13
22.10 EROSION PROTECTION IN CHANNEL	6500.00 CY	210,251	31,538	21,241	263,030	40.47
TOTAL REVETMENT & EROSION PROTECTION	9125.00 CY	311,243	46,686	31,444	389,373	42.67
40 CIRCULATION BERM	2730.00 CY	55,890	8,384	5,646	69,920	25.61
50 BREAKWATER (FEDERAL)	12653.00 CY	423,230	63,485	42,758	529,473	41.85
60 FLOATING DOCK FACILITIES						
60.02 Pile Driving - per Pile	65.00 EA	206,561	30,984	20,868	258,414	3975.60
60.05 Floating Docks (Main Floats)	5770.00 SF	230,016	34,502	23,238	287,756	49.87
60.10 Finger Floats	7668.00 SF	305,678	45,852	30,882	382,411	49.87
60.17 Float Ramps	960.00 SF	62,270	9,340	6,291	77,901	81.15
60.40 Floating Bwater East Dock & Ramp	7800.00 SF	505,940	75,891	51,114	632,945	81.15
TOTAL FLOATING DOCK FACILITIES	22198.00 SF	1,310,465	196,570	132,393	1,639,427	73.85
62 PRECAST CONCRETE DOCK	8000.00 SF	1,160,000	174,000	117,192	1,451,192	181.40
70 PRECAST CONCRETE BOAT RAMP	7000.00 SF	112,233	16,835	11,339	140,407	20.06
80 60 TON BOAT LIFT TRAILER		200,000	0	0	200,000	
TOTAL St.Paul Alaska Small Boat Harbor		5,582,200	807,330	536,678	6,926,208	

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTITY UOM	TOTAL DIRECT	OVERHEAD	PROFIT	TOTAL COST	UNIT COST
20% Contingency (not inc. boat lift)					1,345,242	
SUBTOTAL					8,271,450	
10% Eng & Des (not inc. boat lift)					805,431	
SUBTOTAL					9,076,881	
8% Sup & Adm (not inc. boat lift)					712,001	
TOTAL INCL OWNER COSTS					9,788,882	

St.Paul Alaska Small Boat Harbor
Alternative #2
Main Dredging = 10 feet
60 Vessel Harbor

Designed By: Tetra Tech ISG, John Oliver Con.
Estimated By: Tetra Tech ISG

Prepared By: Doug Lantz, P.E.

Preparation Date: 01/29/01
Effective Date of Pricing: 01/01/01

Sales Tax: 0.0%

St. Paul Alaska Small Boat Harbor - Alternative #2
60 Vessel Harbor, 10 foot Depth
MCACES Database: SP2PB0*.*

Changes from preferred alternative include dredging volumes only.
Changes are not significant enough to affect total equipment/labor calculated for 1st year mobe/demobe costs.
No changes in breakwater, circulation berm, revetment, or erosion protection.
No changes in docks, floats, ramps, or boat lift.

Project Description:

First Season ---
1) Approximately 120,400 cy of dredging in the entrance channel, maneuvering channel, and boat basin, with disposal adjacent to harbor and in upland areas.
2) Placement of underwater revetment.
3) Construction of a circulation berm.
4) Construction of a breakwater.

Second Season ---
5) Installation of floating docks and boat ramps.
6) Construction of precast concrete docks along the south shore.
7) Boat Lift Trailer.

Basis of Design: General Re-evaluation Report (GRR) Design. January 2001

Overtime: 2 10-hour shifts, 7 days week

Project Construction:

Site Access: Dredging, breakwater, circulation berm, revetment, and floating docks will require marine floating equipment. South side dock will require land based equipment.

Borrow Areas: Rock will be procured on St. Paul Island.

Construction Methodology: Prime contractor will mob the dredging equipment and manpower from the Puget Sound area.

Dredging: Floating crane with a 14 cy bucket and a 10 cy bucket on standby for use during repairs. Two 3000-cy (5000-ton) barges will be used to transport dredged material to spending area. A portion will be off-loaded adjacent to harbor and a portion will be hauled upland.

Breakwater: Rock will be quarried on St. Paul an trucked to breakwater.

Facilities: Floating docks, precast concrete members, and pilings will be fabricated/procured in Seattle/Tacoma area and barged to St. Paul Island. Transport cost is included in Mob/Demob, and is not reflected in the material cost for these itmes.

Pile driving and installation of floating facilities will use a floating crane/piledriving rig. Installation of shoreside facilities will use a combination of land based and floating equipment.

Equipment/Labor Availability & Distance Traveled.
St. Paul Island has a limited amount of heavy equipment and manpower available for contractors use. Mobilized equipment will require three tows:

First Season ---
TOW #1 - dredging barge, crane, buckets and one 3000 cy barge.
TOW #2 - one 3000 cy barge with earthmoving equipment.

Second Season ---
TOW #3 - pile driving barge/crane, and one 3000 cy barge with precast concrete members, prefabricated docks.

Skilled labor, including crane/equipment operators, oilers, steel workes, and welders will be mobilized from Seattle and provided with per diem of $90 hotel and $40 food on St. Paul. Semi skilled workers will be drawn from local labor pool.

Labor Rates: MCACES Anchorage Davis Bacon Rates, 2000.
Remote pay adjustment of 30% gives approximate 2001 Davis Bacon rates(provided by TDX)for St Paul Island.

Equipment: Region IX Equipment Rates EP 1110-1-8, 1999.

Prime Contractor's profit of 8.8% based on weighted guidelines.
Prime Contractor's overhead estimated at 15%. Travel and perdiem for crews are added separately under Mob/Demob.
Engineering and Design estimated at 10%
Supervision and Administration estimated at 8%

SUMMARY REPORTS SUMMARY PAGE

DETAILED ESTIMATE DETAIL PAGE

Backup Reports...

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5. 1st Seas. - Tows	QUANTY UOM CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
10. MOB/DEMOB									
The equipment mobe cost for the dedging portion of this project (120,400cy) is computed by prorating the total equipment mobe for all dredging (548,107 cy) by the ratio of the two quantities. The factor = 0.22. The adjustment is made to items: 10.25 1st Seas. - Tows 10.30 1st Seas. Equip Cost During Tow 10.35 1st. Season Labor Travel The cost was adjusted downward by 78% using the "Adjust Pricing" option.									
10.25. 1st Seas. - Tows			** ADJUSTED **						
USR AA Mob/Demob Tow #1: Tug, 14 cy			0.00	0.00	0.00	0.00	2200.00	2200.00	
dredge, 3000 cy loading barge	50.00 DA	0.00	0	0	0	0	110,000	110,000	2200.00
USR AA Mob/Demob Tow #2: Tug, 3000 cy			0.00	0.00	0.00	0.00	2200.00	2200.00	
loading barge	50.00 DA	0.00	0	0	0	0	110,000	110,000	2200.00
USR AA Mob/Demob Tugboat from Dutch			0.00	0.00	0.00	0.00	660.00	660.00	
Harbor or Bethel	2.00 DA	0.00	0	0	0	0	1,320	1,320	660.00
TOTAL 1st Seas. - Tows			0	0	0	0	221,320	221,320	
10.30. 1st Seas. Equip Cost During Tow			** ADJUSTED **						
USR AA Hydraulic Shovel			0.00	0.00	0.00	0.00	1100.00	1100.00	
	3.00 MO	0.00	0	0	0	0	3,300	3,300	1100.00
USR AA 14 cy and 10 cy Clam			0.00	0.00	0.00	0.00	1100.00	1100.00	
	3.00 MO	0.00	0	0	0	0	3,300	3,300	1100.00
USR AA 65 CY Off-Highway Truck (3 ea)			0.00	0.00	0.00	0.00	3982.00	3982.00	
	9.00 MO	0.00	0	0	0	0	35,838	35,838	3982.00
USR AA 7 CY FE Loader (2 ea)			0.00	0.00	0.00	0.00	2926.00	2926.00	
	6.00 MO	0.00	0	0	0	0	17,556	17,556	2926.00
USR AA 500-800 ton Dredge Barge			0.00	0.00	0.00	0.00	1683.00	1683.00	
	3.00 MO	0.00	0	0	0	0	5,049	5,049	1683.00
USR AA 3000 cy (5000 ton) Dredge Barge			0.00	0.00	0.00	0.00	4114.00	4114.00	
#1	3.00 MO	0.00	0	0	0	0	12,342	12,342	4114.00
USR AA 3000 cy (5000 ton) Dredge Barge			0.00	0.00	0.00	0.00	4114.00	4114.00	
#2	3.00 MO	0.00	0	0	0	0	12,342	12,342	4114.00
TOTAL 1st Seas. Equip Cost During Tow			0	0	0	0	89,727	89,727	

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. 1st Seas. - Labor Trvl (airfare)	QUANTY UOM CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
10.35. 1st Seas. - Labor Trvl (airfare) ** ADJUSTED **									
Mobe is only for skilled labor. Assume semi-skilled laborers are available on St. Paul.									
USR AA Crane Ops			0.00	0.00	0.00	0.00	330.00	330.00	
	5.00 EA	0.00	0	0	0	0	1,650	1,650	330.00
USR AA Heavy & Med Equip Op			0.00	0.00	0.00	0.00	330.00	330.00	
	4.00 EA	0.00	0	0	0	0	1,320	1,320	330.00
USR AA Oiler			0.00	0.00	0.00	0.00	330.00	330.00	
	3.00 EA	0.00	0	0	0	0	990	990	330.00
USR AA Truck Driver - Heavy			0.00	0.00	0.00	0.00	330.00	330.00	
	6.00 EA	0.00	0	0	0	0	1,980	1,980	330.00
TOTAL 1st Seas. - Labor Trvl (airfare)			0	0	0	0	5,940	5,940	
10.38. 1st Seas. - Per Diem									
USR AA Skilled Labor Per Diem ($90			0.00	0.00	0.00	0.00	130.00	130.00	
hotel, $40 food)	439.00 DAY	0.00	0	0	0	0	57,070	57,070	130.00
TOTAL 1st Seas. - Per Diem			0	0	0	0	57,070	57,070	
10.40. 2nd Seas. - Tows									
USR AA Mob/Demob Tow #3: Tug (prefab			0.00	0.00	0.00	0.00	10000.00	10000.00	
docks, piles, boat ramps),	50.00 DA	0.00	0	0	0	0	500,000	500,000	10000.00
USR AA Mob/Demob Tugboat from Dutch			0.00	0.00	0.00	0.00	3000.00	3000.00	
Harbor or Bethel	2.00 DA	0.00	0	0	0	0	6,000	6,000	3000.00
TOTAL 2nd Seas. - Tows			0	0	0	0	506,000	506,000	
10.45. 2nd Seas. Equip Cost During Tow									
USR AA Dredge Barge - pile driving			0.00	0.00	0.00	0.00	7650.00	7650.00	
	3.00 MO	0.00	0	0	0	0	22,950	22,950	7650.00
USR AA Hydraulic Excavator			0.00	0.00	0.00	0.00	10000.00	10000.00	
	3.00 MO	0.00	0	0	0	0	30,000	30,000	10000.00
USR AA Crane - 125T			0.00	0.00	0.00	0.00	18000.00	18000.00	
	3.00 MO	0.00	0	0	0	0	54,000	54,000	18000.00
USR AA Pile Driving Hammer/Leads			0.00	0.00	0.00	0.00	5000.00	5000.00	
	3.00 MO	0.00	0	0	0	0	15,000	15,000	5000.00

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10. MOB/DEMOB

5. 2nd Seas. Equip Cost During Tow	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA Air Comp/Hose					0.00	0.00	0.00	0.00	3000.00	3000.00	
	3.00	MO		0.00	0	0	0	0	9,000	9,000	3000.00
USR AA Welder					0.00	0.00	0.00	0.00	700.00	700.00	
	3.00	MO		0.00	0	0	0	0	2,100	2,100	700.00
USR AA 500-800 ton Dock Material Barge					0.00	0.00	0.00	0.00	7650.00	7650.00	
	6.00	MO		0.00	0	0	0	0	45,900	45,900	7650.00
TOTAL 2nd Seas. Equip Cost During Tow					0	0	0	0	178,950	178,950	
10.50. 2nd Seas. - Labor Trvl (airfare)											
USR AA Crane Ops					0.00	0.00	0.00	0.00	1500.00	1500.00	
	2.00	EA		0.00	0	0	0	0	3,000	3,000	1500.00
USR AA Oiler					0.00	0.00	0.00	0.00	1500.00	1500.00	
	2.00	EA		0.00	0	0	0	0	3,000	3,000	1500.00
USR AA Structural Steel Workers					0.00	0.00	0.00	0.00	1500.00	1500.00	
	4.00	EA		0.00	0	0	0	0	6,000	6,000	1500.00
USR AA Welders					0.00	0.00	0.00	0.00	1500.00	1500.00	
	2.00	EA		0.00	0	0	0	0	3,000	3,000	1500.00
TOTAL 2nd Seas. - Labor Trvl (airfare)					0	0	0	0	15,000	15,000	
10.53. 2nd Seas. - Per Diem											
USR AA Skilled Labor Per Diem ($90					0.00	0.00	0.00	0.00	130.00	130.00	
hotel, $40 food)	348.00	DAY		0.00	0	0	0	0	45,240	45,240	130.00
TOTAL 2nd Seas. - Per Diem					0	0	0	0	45,240	45,240	
TOTAL MOB/DEMOB					0	0	0	0	1,119,247	1,119,247	

20. HARBOR DREDGING (FED & LOCAL)

20. 2. Dredging (Federal) ** OVERTIME **
Hydrographic Survey cost from St. Paul Harbor Improvements, Alaska District (1996).

	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA Federal Dredging					0.00	0.02	1.55	1.98	0.00	3.53	
Mod	88407	CY	ZDDREDGE	300.00	0	2,060	136,881	175,453	0	312,333	3.53

2. Dredging (Federal)	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AS Hydrographic Survey					0.00	0.00	0.00	0.00	35000.00	35000.00	
	2.00	EA		0.00	0	0	0	0	70,000	70,000	35000.00
TOTAL Dredging (Federal)	88407	CY			0	2,060	136,881	175,453	70,000	382,333	4.32
20. 5. Dredging (Local) ** OVERTIME ** Hydrographic Survey cost from St. Paul Harbor Improvements, Alaska District (1996).											
USR AA Boat Basin Dredging					0.00	0.02	1.55	1.98	0.00	3.53	
	32000	CY	ZDDREDGE	300.00	0	746	49,546	63,507	0	113,053	3.53
TOTAL Dredging (Local)	32000	CY			0	746	49,546	63,507	0	113,053	3.53
20.10. Disposal - Harbor Adjacent Fill ** OVERTIME **											
CIV AA Hauling, off hwy haulers, 65 CY,					0.00	0.00	0.30	0.45	0.00	0.76	
1 mile RT @ 20 mph (4.2 cyc/hr)	53600	CY	CTDHB34J	240.00	0	225	16,209	24,265	0	40,473	0.76
CIV AA Excavate & load, wheeled loader,					0.00	0.01	0.52	0.44	0.00	0.96	
7 CY, wet rock	53600	CY	CODLB10Z	212.50	0	381	27,759	23,739	0	51,499	0.96
TOTAL Disposal - Harbor Adjacent Fill	53600	CY			0	606	43,968	48,004	0	91,972	1.72
20.15. Disposal with haul ** OVERTIME **											
CIV AA Hauling, off hwy haulers, 65 CY,					0.00	0.01	0.50	0.74	0.00	1.24	
6 mile RT @ 40 mph (2.1 cyc/hr)	66807	CY	CTDHB34J	146.25	0	454	33,156	49,638	0	82,794	1.24
CIV AA Excavate & load, wheeled loader,					0.00	0.01	0.52	0.44	0.00	0.96	
7 CY, wet rock	66807	CY	CODLB10Z	212.50	0	474	34,599	29,589	0	64,188	0.96
TOTAL Disposal with haul	66807	CY			0	929	67,756	79,226	0	146,982	2.20
TOTAL HARBOR DREDGING (FED & LOCAL)	120407	CY			0	4,340	298,150	366,190	70,000	734,340	6.10
22. REVETMENT & EROSION PROTECTION $4/CYprice quote for rock at quarry on St. Paul (not gauranteed)											
22. 5. REVETMENT W/BEDDING ** OVERTIME **											
USR AA 18" Rock Rip-rap quarried on St.					4.00	0.00	0.00	0.00	0.00	4.00	
Paul	2625.00	CY		0.00	10,500	0	0	0	0	10,500	4.00
B CIV AA Excavate & load, wheeled loader,					0.00	0.02	0.87	1.04	0.00	1.91	
7 CY, blasted rock	3500.00	CY	CODLB10Z	100.00	0	53	3,040	3,648	0	6,687	1.91

22. REVETMENT & EROSION PROTECTION

5. REVETMENT W/BEDDING	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA 6" gravel bedding layer, machine					5.00	0.07	3.71	4.02	0.00	12.73	
placed	875.00	CY	ZDBWATER	100.00	4,375	61	3,247	3,516	0	11,138	12.73
L CIV AA Hauling, off hwy haulers, 65 CY,					0.00	0.01	0.57	1.26	0.00	1.83	
3 mile RT @ 30 mph (2.9 cyc/hr)	3500.00	CY	CTDHB34J	100.00	0	35	2,009	4,393	0	6,403	1.83
B CIV AA Handling on barge, wheeled					0.00	0.02	0.87	1.04	0.00	1.91	
loader, 7 CY, blasted rock	3500.00	CY	CODLB10Z	100.00	0	53	3,040	3,648	0	6,687	1.91
B RSM AA Place Revetment					0.00	0.16	8.17	14.52	0.00	22.70	
	2625.00	CY	ZDDREDGE	45.00	0	408	21,454	38,122	0	59,576	22.70
TOTAL REVETMENT W/BEDDING	2625.00	CY			14,875	610	32,790	53,327	0	100,992	38.47
22.10. EROSION PROTECTION IN CHANNEL			** OVERTIME **								
USR AA 24" Rock Rip-rap quarried on St.					4.00	0.00	0.00	0.00	0.00	4.00	
Paul	6500.00	CY		0.00	26,000	0	0	0	0	26,000	4.00
B CIV AA Excavate & load, wheeled loader,					0.00	0.02	0.87	1.04	0.00	1.91	
7 CY, blasted rock	6500.00	CY	CODLB10Z	100.00	0	98	5,645	6,774	0	12,420	1.91
L CIV AA Hauling, off hwy haulers, 65 CY,					0.00	0.01	0.57	1.26	0.00	1.83	
3 mile RT @ 30 mph (2.9 cyc/hr)	6500.00	CY	CTDHB34J	100.00	0	65	3,732	8,159	0	11,890	1.83
B CIV AA Handling on barge, wheeled					0.00	0.02	0.87	1.04	0.00	1.91	
loader, 7 CY, blasted rock	6500.00	CY	CODLB10Z	100.00	0	98	5,645	6,774	0	12,420	1.91
B RSM AA Erosion Protection Placed					0.00	0.16	8.17	14.52	0.00	22.70	
	6500.00	CY	ZDDREDGE	45.00	0	1,011	53,124	94,398	0	147,521	22.70
TOTAL EROSION PROTECTION IN CHANNEL	6500.00	CY			26,000	1,271	68,146	116,105	0	210,251	32.35
TOTAL REVETMENT & EROSION PROTECTION	9125.00	CY			40,875	1,881	100,936	169,432	0	311,243	34.11
40. CIRCULATION BERM			** OVERTIME **								
M RSM AA Fill, borrow, for embankments,					5.38	0.03	2.38	3.45	0.00	11.21	
load, 1 mile haul, spread w/dozer	2130.00	CY	ZDCBERM	150.00	11,457	71	5,072	7,352	0	23,880	11.21
USR AA Sort Boulders from Dredged					0.00	0.22	14.65	11.36	0.00	26.01	
Material	600.00	CY	ZDBWATER	32.00	0	131	8,791	6,814	0	15,605	26.01
M MIL AA Cap with rounded excavated					0.00	0.16	11.16	16.18	0.00	27.34	
boulders - placement	600.00	CY	ZDCBERM	32.00	0	94	6,697	9,707	0	16,404	27.34

	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
TOTAL CIRCULATION BERM	2730.00	CY			11,457	296	20,560	23,873	0	55,890	20.47

50. BREAKWATER (FEDERAL) ** OVERTIME **
Rock Size 2-ton minus

$4/CY price quote for rock at quarry on St. Paul (not gauranteed)

	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA 2-ton minus, quarried on St.					4.00	0.00	0.00	0.00	0.00	4.00	
Paul	12653	CY		0.00	50,612	0	0	0	0	50,612	4.00
B CIV AA Excavate & load, wheeled loader,					0.00	0.02	1.10	0.94	0.00	2.04	
7 CY, blasted rock	12653	CY	CODLB10Z	100.00	0	190	13,926	11,909	0	25,835	2.04
L CIV AA Hauling, off hwy haulers, 65 CY,					0.00	0.01	0.73	1.09	0.00	1.81	
3 mile RT @ 30 mph (2.9 cyc/hr)	12653	CY	CTDHB34J	100.00	0	127	9,184	13,749	0	22,932	1.81
B CIV AA handling on barge, loader, 7 CY,					0.00	0.02	1.10	0.94	0.00	2.04	
blasted rock	12653	CY	CODLB10Z	100.00	0	190	13,926	11,909	0	25,835	2.04
USR AA Place Rock Fill					0.00	0.16	10.32	13.23	0.00	23.55	
	12653	CY	ZDDREDGE	45.00	0	1,969	130,604	167,412	0	298,016	23.55
TOTAL BREAKWATER (FEDERAL)	12653	CY			50,612	2,475	167,640	204,979	0	423,230	33.45

60. FLOATING DOCK FACILITIES
Floats and Boat Ramps fabricated in Seattle. Transport is covered under mobilization.

60.02. Pile Driving - per Pile ** OVERTIME **
50 foot piles x 17.15/LF = $850 ea
Driving tips for boulders

65 piles driven 30 feet into ground = 1950 vlf

	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR PD Pile, steel, pipe, 50' L 12"					850.00	0.00	0.00	0.00	0.00	850.00	
dia, 44 lb/LF, conc filled	65.00	EA		0.00	66,853	0	0	0	0	66,853	1028.50
M MIL PD Pile, steel, pipe, heavy duty					137.57	2.35	193.87	24.38	0.00	355.82	
points, 12" dia	65.00	EA	SIWWE14	0.43	10,820	153	15,248	1,918	0	27,985	430.54
B MIL PD Pile driving and concrete fill					0.00	0.30	19.60	27.75	0.00	47.35	
	1950.00	VLF	ZDPLDRVR	20.00	0	585	46,243	65,481	0	111,724	57.29
TOTAL Pile Driving - per Pile	65.00	EA			77,673	738	61,490	67,398	0	206,561	3177.87

60. FLOATING DOCK FACILITIES

5. Floating Docks (Main Floats)	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
60.05. Floating Docks (Main Floats)				** OVERTIME **							
USR AA 1 @ 10' x 25'					30.00	0.14	9.46	0.40	0.00	39.86	
	250.00	SF	ZDDOCK	50.00	7,500	35	2,365	101	0	9,966	39.86
USR AA 6 @ 10' x 50'					30.00	0.14	9.46	0.40	0.00	39.86	
	3000.00	SF	ZDDOCK	50.00	90,000	420	28,383	1,209	0	119,592	39.86
USR AA 7 @ 10' x 36'					30.00	0.14	9.46	0.40	0.00	39.86	
	2520.00	SF	ZDDOCK	50.00	75,600	353	23,842	1,016	0	100,458	39.86
TOTAL Floating Docks (Main Floats)	5770.00	SF			173,100	808	54,591	2,325	0	230,016	39.86
60.10. Finger Floats				** OVERTIME **							
USR AA 12 @ 6' x 60'					30.00	0.14	9.46	0.40	0.00	39.86	
	4320.00	SF	ZDDOCK	50.00	129,600	605	40,872	1,741	0	172,213	39.86
USR AA 7 @ 6' x 44'					30.00	0.14	9.46	0.40	0.00	39.86	
	1848.00	SF	ZDDOCK	50.00	55,440	259	17,484	745	0	73,669	39.86
USR AA 10 @ 6' x 25'					30.00	0.14	9.46	0.40	0.00	39.86	
	1500.00	SF	ZDDOCK	50.00	45,000	210	14,192	605	0	59,796	39.86
TOTAL Finger Floats	7668.00	SF			230,040	1,074	72,548	3,090	0	305,678	39.86
60.17. Float Ramps				** OVERTIME **							
USR AA Float Ramps 2 @ 8' x 60'					55.00	0.14	9.46	0.40	0.00	64.86	
	960.00	SF	ZDDOCK	50.00	52,800	134	9,083	387	0	62,270	64.86
TOTAL Float Ramps	960.00	SF			52,800	134	9,083	387	0	62,270	64.86
60.40. Floating Bwater East Dock & Ramp				** OVERTIME **							
USR AA Floating Ramp 20' x 115'					55.00	0.14	9.46	0.40	0.00	64.86	
	2300.00	SF	ZDDOCK	50.00	126,500	322	21,761	927	0	149,187	64.86
USR AA Floating Dock 20' x 275'					55.00	0.14	9.46	0.40	0.00	64.86	
	5500.00	SF	ZDDOCK	50.00	302,500	770	52,036	2,217	0	356,753	64.86
TOTAL Floating Bwater East Dock & Ramp	7800.00	SF			429,000	1,092	73,797	3,143	0	505,940	64.86
TOTAL FLOATING DOCK FACILITIES	22198	SF			962,613	3,846	271,508	76,344	0	1,310,465	59.04

	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
62. PRECAST CONCRETE DOCK ** OVERTIME **											
$145/sf cost based on 50' x 100' dock installation in 1988 - less mooring dolphins.											
Adjusted to current price level											
USR AA Precast Concrete Dock in Place					0.00	0.00	0.00	0.00	145.00	145.00	
	8000.00	SF		0.00	0	0	0	0	1,160,000	1,160,000	145.00
TOTAL PRECAST CONCRETE DOCK	8000.00	SF			0	0	0	0	1,160,000	1,160,000	145.00
70. PRECAST CONCRETE BOAT RAMP ** OVERTIME **											
M MIL AA Base course, compacted to 6" deep, crushed 3/4" stone, large areas					5.08	0.01	0.70	0.24	0.00	6.02	
	780.00	SY	COFGB36B	625.00	3,960	10	548	184	0	4,692	6.02
M MIL AA Structural precast, slabs, 12" thick, solid, 3000 psi					14.00	0.00	0.00	0.00	0.00	14.00	
	7000.00	SF	N/A	0.00	98,000	0	0	0	0	98,000	14.00
MIL AA Precast erection, 60' max rad, 90 ton crane, 9-10 ton/pc, floor deck					0.00	4.00	256.84	83.92	0.00	340.76	
	28.00	EA	ZDPCAST	1.75	0	112	7,192	2,350	0	9,541	340.76
TOTAL PRECAST CONCRETE BOAT RAMP	7000.00	SF			101,960	122	7,739	2,534	0	112,233	16.03
80. 60 TON BOAT LIFT TRAILER ** OVERTIME **											
Conolift model Y60 Boat Lift Trailer 60 ton											
$100K purchase price in Ontario, plus $100K transport and assembly.											
USR AF Conolift model Y60. $100K Transport					0.00	0.00	0.00	0.00	200000.00	200000.00	
	1.00	LS		0.00	0	0	0	0	200,000	200,000	200000.00
TOTAL 60 TON BOAT LIFT TRAILER					0	0	0	0	200,000	200,000	
TOTAL St.Paul Alaska Small Boat Harbor					1,167,516	12,959	866,533	843,351	2,549,247	5,426,648	

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTITY UOM	TOTAL DIRECT	OVERHEAD	PROFIT	TOTAL COST	UNIT COST
10 MOB/DEMOB						
10.25 1st Seas. - Tows		221,320	33,198	22,359	276,877	
10.30 1st Seas. Equip Cost During Tow		89,727	13,459	9,065	112,251	
10.35 1st Seas. - Labor Trvl (airfare)		5,940	891	600	7,431	
10.38 1st Seas. - Per Diem		57,070	8,561	5,766	71,396	
10.40 2nd Seas. - Tows		506,000	75,900	51,120	633,020	
10.45 2nd Seas. Equip Cost During Tow		178,950	26,843	18,079	223,871	
10.50 2nd Seas. - Labor Trvl (airfare)		15,000	2,250	1,515	18,765	
10.53 2nd Seas. - Per Diem		45,240	6,786	4,570	56,596	
TOTAL MOB/DEMOB		1,119,247	167,887	113,075	1,400,209	
20 HARBOR DREDGING (FED & LOCAL)						
20. 2 Dredging (Federal)	88407.00 CY	382,333	57,350	31,554	471,237	5.33
20. 5 Dredging (Local)	32000.00 CY	113,053	16,958	11,421	141,432	4.42
20.10 Disposal - Harbor Adjacent Fill	53600.00 CY	91,972	13,796	9,292	115,060	2.15
20.15 Disposal with haul	66807.00 CY	146,982	22,047	14,849	183,879	2.75
TOTAL HARBOR DREDGING (FED & LOCAL)	120407.00 CY	734,340	110,151	67,117	911,608	7.57
22 REVETMENT & EROSION PROTECTION						
22. 5 REVETMENT W/BEDDING	2625.00 CY	100,992	15,149	10,203	126,344	48.13
22.10 EROSION PROTECTION IN CHANNEL	6500.00 CY	210,251	31,538	21,241	263,030	40.47
TOTAL REVETMENT & EROSION PROTECTION	9125.00 CY	311,243	46,686	31,444	389,373	42.67
40 CIRCULATION BERM	2730.00 CY	55,890	8,384	5,646	69,920	25.61
50 BREAKWATER (FEDERAL)	12653.00 CY	423,230	63,485	42,758	529,473	41.85
60 FLOATING DOCK FACILITIES						
60.02 Pile Driving - per Pile	65.00 EA	206,561	30,984	20,868	258,414	3975.60
60.05 Floating Docks (Main Floats)	5770.00 SF	230,016	34,502	23,238	287,756	49.87
60.10 Finger Floats	7668.00 SF	305,678	45,852	30,882	382,411	49.87
60.17 Float Ramps	960.00 SF	62,270	9,340	6,291	77,901	81.15
60.40 Floating Bwater East Dock & Ramp	7800.00 SF	505,940	75,891	51,114	632,945	81.15
TOTAL FLOATING DOCK FACILITIES	22198.00 SF	1,310,465	196,570	132,393	1,639,427	73.85
62 PRECAST CONCRETE DOCK	8000.00 SF	1,160,000	174,000	117,192	1,451,192	181.40
70 PRECAST CONCRETE BOAT RAMP	7000.00 SF	112,233	16,835	11,339	140,407	20.06
80 60 TON BOAT LIFT TRAILER		200,000	0	0	200,000	
TOTAL St.Paul Alaska Small Boat Harbor		5,426,648	783,997	520,963	6,731,608	

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTITY UOM	TOTAL DIRECT	OVERHEAD	PROFIT	TOTAL COST	UNIT COST
20% Contingency (not inc. boat lift)					1,306,322	
SUBTOTAL					8,037,930	
10% Eng & Des (not inc. boat lift)					782,079	
SUBTOTAL					8,820,009	
8% Sup & Adm (not inc. boat lift)					691,451	
TOTAL INCL OWNER COSTS					9,511,461	

St.Paul Alaska Small Boat Harbor
Alternative #3
Main Dredging = 8 feet
60 Vessel Harbor

Designed By: Tetra Tech ISG, John Oliver Con.
Estimated By: Tetra Tech ISG

Prepared By: Doug Lantz, P.E.

Preparation Date: 01/31/01
Effective Date of Pricing: 01/01/01

Sales Tax: 0.0%

St. Paul Alaska Small Boat Harbor - Alternative #3
60 Vessel Harbor, 8 foot Depth
MCACES Database: SP3PB0*.*

Changes from preferred alternative include dredging volumes only.
Changes are not significant enough to affect total equipment/labor calculated for 1st year mobe/demobe costs.
No changes in breakwater, circulation berm, revetment, or erosion protection.
No changes in docks, floats, ramps, or boat lift.

Project Description:

First Season ---
1) Approximately 100,611 cy of dredging in the entrance channel, maneuvering channel, and boat basin, with disposal adjacent to harbor and in upland areas.
2) Placement of underwater revetment.
3) Construction of a circulation berm.
4) Construction of a breakwater.

Second Season ---
5) Installation of floating docks and boat ramps.
6) Construction of precast concrete docks along the south shore.
7) Boat Lift Trailer.

Basis of Design: General Re-evaluation Report (GRR) Design. January 2001

Overtime: 2 10-hour shifts, 7 days week

Project Construction:

Site Access: Dredging, breakwater, circulation berm, revetment, and floating docks will require marine floating equipment. South side dock will require land based equipment.

Borrow Areas: Rock will be procured on St. Paul Island.

Construction Methodology: Prime contractor will mob the dredging equipment and manpower from the Puget Sound area.

Dredging: Floating crane with a 14 cy bucket and a 10 cy bucket on standby for use during repairs. Two 3000-cy (5000-ton) barges will be used to transport dredged material to spending area. A portion will be off-loaded adjacent to harbor and a portion will be hauled upland.

Breakwater: Rock will be quarried on St. Paul an trucked to breakwater.

Facilities: Floating docks, precast concrete members, and pilings will be fabricated/procured in Seattle/Tacoma area and barged to St. Paul Island. Transport cost is included in Mob/Demob, and is not reflected in the material cost for these itmes.

Pile driving and installation of floating facilities will use a floating crane/piledriving rig. Installation of shoreside facilities will use a combination of land based and floating equipment.

Equipment/Labor Availability & Distance Traveled.
St. Paul Island has a limited amount of heavy equipment and manpower available for contractors use. Mobilized equipment will require three tows:

First Season ---
TOW #1 - dredging barge, crane, buckets and one 3000 cy barge.
TOW #2 - one 3000 cy barge with earthmoving equipment.

Second Season ---
TOW #3 - pile driving barge/crane, and one 3000 cy barge with precast concrete members, prefabricated docks.

Skilled labor, including crane/equipment operators, oilers, steel workes, and welders will be mobilized from Seattle and provided with per diem of $90 hotel and $40 food on St. Paul. Semi skilled workers will be drawn from local labor pool.

Labor Rates: MCACES Anchorage Davis Bacon Rates, 2000.
Remote pay adjustment of 30% gives approximate 2001 Davis Bacon rates(provided by TDX)for St Paul Island.

Equipment: Region IX Equipment Rates EP 1110-1-8, 1999.

Prime Contractor's profit of 8.8% based on weighted guidelines.
Prime Contractor's overhead estimated at 15%. Travel and perdiem for crews are added separately under Mob/Demob.
Engineering and Design estimated at 10%
Supervision and Administration estimated at 8%

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. 1st Seas. - Tows	QUANTY UOM CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST

0. MOB/DEMOB
The equipment mobe cost for the dedging portion of this project (100,611 cy)
is computed by prorating the total equipment mobe for all dredging (528,311 cy) by the ratio of the two quantities. The factor = 0.19. The adjustment
is made to items: 10.25 1st Seas. - Tows . 10.30 1st Seas. Equip Cost During Tow 10.35 1st. Season Labor Travel The cost was adjusted downward by 81% using the "Adjust Pricing" option.

10.25. 1st Seas. - Tows ** ADJUSTED **

	QUANTY UOM	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA Mob/Demob Tow #1: Tug, 14 cy			0.00	0.00	0.00	0.00	1900.00	1900.00	
dredge, 3000 cy loading barge	50.00 DA	0.00	0	0	0	0	95,000	95,000	1900.00
USR AA Mob/Demob Tow #2: Tug, 3000 cy			0.00	0.00	0.00	0.00	1900.00	1900.00	
loading barge	50.00 DA	0.00	0	0	0	0	95,000	95,000	1900.00
USR AA Mob/Demob Tugboat from Dutch			0.00	0.00	0.00	0.00	570.00	570.00	
Harbor or Bethel	2.00 DA	0.00	0	0	0	0	1,140	1,140	570.00
TOTAL 1st Seas. - Tows			0	0	0	0	191,140	191,140	

10.30. 1st Seas. Equip Cost During Tow ** ADJUSTED **

	QUANTY UOM	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA Hydraulic Shovel			0.00	0.00	0.00	0.00	950.00	950.00	
	3.00 MO	0.00	0	0	0	0	2,850	2,850	950.00
USR AA 14 cy and 10 cy Clam			0.00	0.00	0.00	0.00	950.00	950.00	
	3.00 MO	0.00	0	0	0	0	2,850	2,850	950.00
USR AA 65 CY Off-Highway Truck (3 ea)			0.00	0.00	0.00	0.00	3439.00	3439.00	
	9.00 MO	0.00	0	0	0	0	30,951	30,951	3439.00
USR AA 7 CY FE Loader (2 ea)			0.00	0.00	0.00	0.00	2527.00	2527.00	
	6.00 MO	0.00	0	0	0	0	15,162	15,162	2527.00
USR AA 500-800 ton Dredge Barge			0.00	0.00	0.00	0.00	1453.50	1453.50	
	3.00 MO	0.00	0	0	0	0	4,360	4,360	1453.50
USR AA 3000 cy (5000 ton) Dredge Barge			0.00	0.00	0.00	0.00	3553.00	3553.00	
#1	3.00 MO	0.00	0	0	0	0	10,659	10,659	3553.00
USR AA 3000 cy (5000 ton) Dredge Barge			0.00	0.00	0.00	0.00	3553.00	3553.00	
#2	3.00 MO	0.00	0	0	0	0	10,659	10,659	3553.00
TOTAL 1st Seas. Equip Cost During Tow			0	0	0	0	77,491	77,491	

35. 1st Seas. - Labor Trvl (airfare)	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
10.35. 1st Seas. - Labor Trvl (airfare)					** ADJUSTED **						
Mobe is only for skilled labor. Assume semi-skilled laborers are available on St. Paul.											
USR AA Crane Ops					0.00	0.00	0.00	0.00	285.00	285.00	
	5.00	EA		0.00	0	0	0	0	1,425	1,425	285.00
USR AA Heavy & Med Equip Op					0.00	0.00	0.00	0.00	285.00	285.00	
	4.00	EA		0.00	0	0	0	0	1,140	1,140	285.00
USR AA Oiler					0.00	0.00	0.00	0.00	285.00	285.00	
	3.00	EA		0.00	0	0	0	0	855	855	285.00
USR AA Truck Driver - Heavy					0.00	0.00	0.00	0.00	285.00	285.00	
	6.00	EA		0.00	0	0	0	0	1,710	1,710	285.00
TOTAL 1st Seas. - Labor Trvl (airfare)					0	0	0	0	5,130	5,130	
10.38. 1st Seas. - Per Diem											
USR AA Skilled Labor Per Diem ($90					0.00	0.00	0.00	0.00	130.00	130.00	
hotel, $40 food)	439.00	DAY		0.00	0	0	0	0	57,070	57,070	130.00
TOTAL 1st Seas. - Per Diem					0	0	0	0	57,070	57,070	
10.40. 2nd Seas. - Tows											
USR AA Mob/Demob Tow #3: Tug (prefab					0.00	0.00	0.00	0.00	10000.00	10000.00	
docks, piles, boat ramps),	50.00	DA		0.00	0	0	0	0	500,000	500,000	10000.00
USR AA Mob/Demob Tugboat from Dutch					0.00	0.00	0.00	0.00	3000.00	3000.00	
Harbor or Bethel	2.00	DA		0.00	0	0	0	0	6,000	6,000	3000.00
TOTAL 2nd Seas. - Tows					0	0	0	0	506,000	506,000	
10.45. 2nd Seas. Equip Cost During Tow											
USR AA Dredge Barge - pile driving					0.00	0.00	0.00	0.00	7650.00	7650.00	
	3.00	MO		0.00	0	0	0	0	22,950	22,950	7650.00
USR AA Hydraulic Excavator					0.00	0.00	0.00	0.00	10000.00	10000.00	
	3.00	MO		0.00	0	0	0	0	30,000	30,000	10000.00
USR AA Crane - 125T					0.00	0.00	0.00	0.00	18000.00	18000.00	
	3.00	MO		0.00	0	0	0	0	54,000	54,000	18000.00
USR AA Pile Driving Hammer/Leads					0.00	0.00	0.00	0.00	5000.00	5000.00	
	3.00	MO		0.00	0	0	0	0	15,000	15,000	5000.00

10. MOB/DEMOB

. 2nd Seas. Equip Cost During Tow	QUANTY UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA Air Comp/Hose				0.00	0.00	0.00	0.00	3000.00	3000.00	
	3.00 MO		0.00	0	0	0	0	9,000	9,000	3000.00
USR AA Welder				0.00	0.00	0.00	0.00	700.00	700.00	
	3.00 MO		0.00	0	0	0	0	2,100	2,100	700.00
USR AA 500-800 ton Dock Material Barge				0.00	0.00	0.00	0.00	7650.00	7650.00	
	6.00 MO		0.00	0	0	0	0	45,900	45,900	7650.00
TOTAL 2nd Seas. Equip Cost During Tow				0	0	0	0	178,950	178,950	
10.50. 2nd Seas. - Labor Trvl (airfare)										
USR AA Crane Ops				0.00	0.00	0.00	0.00	1500.00	1500.00	
	2.00 EA		0.00	0	0	0	0	3,000	3,000	1500.00
USR AA Oiler				0.00	0.00	0.00	0.00	1500.00	1500.00	
	2.00 EA		0.00	0	0	0	0	3,000	3,000	1500.00
USR AA Structural Steel Workers				0.00	0.00	0.00	0.00	1500.00	1500.00	
	4.00 EA		0.00	0	0	0	0	6,000	6,000	1500.00
USR AA Welders				0.00	0.00	0.00	0.00	1500.00	1500.00	
	2.00 EA		0.00	0	0	0	0	3,000	3,000	1500.00
TOTAL 2nd Seas. - Labor Trvl (airfare)				0	0	0	0	15,000	15,000	
10.53. 2nd Seas. - Per Diem										
USR AA Skilled Labor Per Diem ($90				0.00	0.00	0.00	0.00	130.00	130.00	
hotel, $40 food)	348.00 DAY		0.00	0	0	0	0	45,240	45,240	130.00
TOTAL 2nd Seas. - Per Diem				0	0	0	0	45,240	45,240	
TOTAL MOB/DEMOB				0	0	0	0	1,076,022	1,076,022	

20. HARBOR DREDGING (FED & LOCAL)

20. 2. Dredging (Federal) ** OVERTIME **
Hydrographic Survey cost from St. Paul Harbor Improvements, Alaska District (1996).

	QUANTY UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA Federal Channel Dredging				0.00	0.02	1.55	1.98	0.00	3.53	
Mod	77814 CY	ZDDREDGE	300.00	0	1,813	120,479	154,430	0	274,909	3.53

20. HARBOR DREDGING (FED & LOCAL)

2. Dredging (Federal)	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AS Hydrographic Survey					0.00	0.00	0.00	0.00	35000.00	35000.00	
	2.00	EA		0.00	0	0	0	0	70,000	70,000	35000.00
TOTAL Dredging (Federal)	77814	CY			0	1,813	120,479	154,430	70,000	344,909	4.43
20. 5. Dredging (Local) ** OVERTIME ** Hydrographic Survey cost from St. Paul Harbor Improvements, Alaska District (1996).											
USR AA Boat Basin Dredging					0.00	0.02	1.55	1.98	0.00	3.53	
	22797	CY	ZDDREDGE	300.00	0	531	35,297	45,243	0	80,540	3.53
TOTAL Dredging (Local)	22797	CY			0	531	35,297	45,243	0	80,540	3.53
20.10. Disposal - Harbor Adjacent Fill ** OVERTIME **											
CIV AA Hauling, off hwy haulers, 65 CY,					0.00	0.00	0.30	0.45	0.00	0.76	
1 mile RT @ 20 mph (4.2 cyc/hr)	53600	CY	CTDHB34J	240.00	0	225	16,209	24,265	0	40,473	0.76
CIV AA Excavate & load, wheeled loader,					0.00	0.01	0.52	0.44	0.00	0.96	
7 CY, wet rock	53600	CY	CODLB10Z	212.50	0	381	27,759	23,739	0	51,499	0.96
TOTAL Disposal - Harbor Adjacent Fill	53600	CY			0	606	43,968	48,004	0	91,972	1.72
20.15. Disposal with haul ** OVERTIME **											
CIV AA Hauling, off hwy haulers, 65 CY,					0.00	0.01	0.50	0.74	0.00	1.24	
6 mile RT @ 40 mph (2.1 cyc/hr)	47011	CY	CTDHB34J	146.25	0	320	23,332	34,929	0	58,261	1.24
CIV AA Excavate & load, wheeled loader,					0.00	0.01	0.52	0.44	0.00	0.96	
7 CY, wet rock	47011	CY	CODLB10Z	212.50	0	334	24,347	20,821	0	45,168	0.96
TOTAL Disposal with haul	47011	CY			0	653	47,679	55,750	0	103,429	2.20
TOTAL HARBOR DREDGING (FED & LOCAL)	100611	CY			0	3,603	247,423	303,427	70,000	620,850	6.17
22. REVETMENT & EROSION PROTECTION $4/CYprice quote for rock at quarry on St. Paul (not gauranteed)											
22. 5. REVETMENT W/BEDDING ** OVERTIME **											
USR AA 18" Rock Rip-rap quarried on St.					4.00	0.00	0.00	0.00	0.00	4.00	
Paul	2625.00	CY		0.00	10,500	0	0	0	0	10,500	4.00
B CIV AA Excavate & load, wheeled loader,					0.00	0.02	0.87	1.04	0.00	1.91	
7 CY, blasted rock	3500.00	CY	CODLB10Z	100.00	0	53	3,040	3,648	0	6,687	1.91

22. REVETMENT & EROSION PROTECTION

. REVETMENT W/BEDDING	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA 6" gravel bedding layer, machine					5.00	0.07	3.71	4.02	0.00	12.73	
placed	875.00	CY	ZDBWATER	100.00	4,375	61	3,247	3,516	0	11,138	12.73
, CIV AA Hauling, off hwy haulers, 65 CY,					0.00	0.01	0.57	1.26	0.00	1.83	
3 mile RT @ 30 mph (2.9 cyc/hr)	3500.00	CY	CTDHB34J	100.00	0	35	2,009	4,393	0	6,403	1.83
} CIV AA Handling on barge, wheeled					0.00	0.02	0.87	1.04	0.00	1.91	
loader, 7 CY, blasted rock	3500.00	CY	CODLB10Z	100.00	0	53	3,040	3,648	0	6,687	1.91
} RSM AA Place Revetment					0.00	0.16	8.17	14.52	0.00	22.70	
	2625.00	CY	ZDDREDGE	45.00	0	408	21,454	38,122	0	59,576	22.70
TOTAL REVETMENT W/BEDDING	2625.00	CY			14,875	610	32,790	53,327	0	100,992	38.47
22.10. EROSION PROTECTION IN CHANNEL				** OVERTIME **							
USR AA 24" Rock Rip-rap quarried on St.					4.00	0.00	0.00	0.00	0.00	4.00	
Paul	6500.00	CY		0.00	26,000	0	0	0	0	26,000	4.00
3 CIV AA Excavate & load, wheeled loader,					0.00	0.02	0.87	1.04	0.00	1.91	
7 CY, blasted rock	6500.00	CY	CODLB10Z	100.00	0	98	5,645	6,774	0	12,420	1.91
L CIV AA Hauling, off hwy haulers, 65 CY,					0.00	0.01	0.57	1.26	0.00	1.83	
3 mile RT @ 30 mph (2.9 cyc/hr)	6500.00	CY	CTDHB34J	100:00	0	65	3,732	8,159	0	11,890	1.83
B CIV AA Handling on barge, wheeled					0.00	0.02	0.87	1.04	0.00	1.91	
loader, 7 CY, blasted rock	6500.00	CY	CODLB10Z	100.00	0	98	5,645	6,774	0	12,420	1.91
B RSM AA Erosion Protection Placed					0.00	0.16	8.17	14.52	0.00	22.70	
	6500.00	CY	ZDDREDGE	45.00	0	1,011	53,124	94,398	0	147,521	22.70
TOTAL EROSION PROTECTION IN CHANNEL	6500.00	CY			26,000	1,271	68,146	116,105	0	210,251	32.35
TOTAL REVETMENT & EROSION PROTECTION	9125.00	CY			40,875	1,881	100,936	169,432	0	311,243	34.11
40. CIRCULATION BERM				** OVERTIME **							
M RSM AA Fill, borrow, for embankments,					5.38	0.03	2.38	3.45	0.00	11.21	
load, 1 mile haul, spread	2130.00	CY	ZDCBERM	150.00	11,457	71	5,072	7,352	0	23,880	11.21
w/dozer											
USR AA Sort Boulders from Dredged					0.00	0.22	14.65	11.36	0.00	26.01	
Material	600.00	CY	ZDBWATER	32.00	0	131	8,791	6,814	0	15,605	26.01
M MIL AA Cap with rounded excavated					0.00	0.16	11.16	16.18	0.00	27.34	
boulders - placement	600.00	CY	ZDCBERM	32.00	0	94	6,697	9,707	0	16,404	27.34

40. CIRCULATION BERM

	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
TOTAL CIRCULATION BERM	2730.00	CY			11,457	296	20,560	23,873	0	55,890	20.47

50. BREAKWATER (FEDERAL) ** OVERTIME **
Rock Size 2-ton minus

$4/CY price quote for rock at quarry on St. Paul (not gauranteed)

	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA 2-ton minus, quarried on St. Paul	12653	CY		0.00	4.00 50,612	0.00 0	0.00 0	0.00 0	0.00 0	4.00 50,612	4.00
B CIV AA Excavate & load, wheeled loader, 7 CY, blasted rock	12653	CY	CODLB10Z	100.00	0.00 0	0.02 190	1.10 13,926	0.94 11,909	0.00 0	2.04 25,835	2.04
L CIV AA Hauling, off hwy haulers, 65 CY, 3 mile RT @ 30 mph (2.9 cyc/hr)	12653	CY	CTDHB34J	100.00	0.00 0	0.01 127	0.73 9,184	1.09 13,749	0.00 0	1.81 22,932	1.81
B CIV AA handling on barge, loader, 7 CY, blasted rock	12653	CY	CODLB10Z	100.00	0.00 0	0.02 190	1.10 13,926	0.94 11,909	0.00 0	2.04 25,835	2.04
USR AA Place Rock Fill	12653	CY	ZDDREDGE	45.00	0.00 0	0.16 1,969	10.32 130,604	13.23 167,412	0.00 0	23.55 298,016	23.55
TOTAL BREAKWATER (FEDERAL)	12653	CY			50,612	2,475	167,640	204,979	0	423,230	33.45

60. FLOATING DOCK FACILITIES
Floats and Boat Ramps fabricated in Seattle. Transport is covered under mobilization.

60.02. Pile Driving - per Pile ** OVERTIME **
50 foot piles x 17.15/LF = $850 ea
Driving tips for boulders

65 piles driven 30 feet into ground = 1950 vlf

	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR PD Pile, steel, pipe, 50' L 12" dia, 44 lb/LF, conc filled	65.00	EA		0.00	850.00 66,853	0.00 0	0.00 0	0.00 0	0.00 0	850.00 66,853	1028.50
M MIL PD Pile, steel, pipe, heavy duty points, 12" dia	65.00	EA	SIWWE14	0.43	137.57 10,820	2.35 153	193.87 15,248	24.38 1,918	0.00 0	355.82 27,985	430.54
B MIL PD Pile driving and concrete fill	1950.00	VLF	ZDPLDRVR	20.00	0.00 0	0.30 585	19.60 46,243	27.75 65,481	0.00 0	47.35 111,724	57.29
TOTAL Pile Driving - per Pile	65.00	EA			77,673	738	61,490	67,398	0	206,561	3177.87

60. FLOATING DOCK FACILITIES

Floating Docks (Main Floats)	QUANTY UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
60.05. Floating Docks (Main Floats)			** OVERTIME **							
USR AA 1 @ 10' x 25'				30.00	0.14	9.46	0.40	0.00	39.86	
	250.00 SF	ZDDOCK	50.00	7,500	35	2,365	101	0	9,966	39.86
USR AA 6 @ 10' x 50'				30.00	0.14	9.46	0.40	0.00	39.86	
	3000.00 SF	ZDDOCK	50.00	90,000	420	28,383	1,209	0	119,592	39.86
USR AA 7 @ 10' x 36'				30.00	0.14	9.46	0.40	0.00	39.86	
	2520.00 SF	ZDDOCK	50.00	75,600	353	23,842	1,016	0	100,458	39.86
TOTAL Floating Docks (Main Floats)	5770.00 SF			173,100	808	54,591	2,325	0	230,016	39.86
60.10. Finger Floats			** OVERTIME **							
USR AA 12 @ 6' x 60'				30.00	0.14	9.46	0.40	0.00	39.86	
	4320.00 SF	ZDDOCK	50.00	129,600	605	40,872	1,741	0	172,213	39.86
USR AA 7 @ 6' x 44'				30.00	0.14	9.46	0.40	0.00	39.86	
	1848.00 SF	ZDDOCK	50.00	55,440	259	17,484	745	0	73,669	39.86
USR AA 10 @ 6' x 25'				30.00	0.14	9.46	0.40	0.00	39.86	
	1500.00 SF	ZDDOCK	50.00	45,000	210	14,192	605	0	59,796	39.86
TOTAL Finger Floats	7668.00 SF			230,040	1,074	72,548	3,090	0	305,678	39.86
60.17. Float Ramps			** OVERTIME **							
USR AA Float Ramps 2 @ 8' x 60'				55.00	0.14	9.46	0.40	0.00	64.86	
	960.00 SF	ZDDOCK	50.00	52,800	134	9,083	387	0	62,270	64.86
TOTAL Float Ramps	960.00 SF			52,800	134	9,083	387	0	62,270	64.86
60.40. Floating Bwater East Dock & Ramp			** OVERTIME **							
USR AA Floating Ramp 20' x 115'				55.00	0.14	9.46	0.40	0.00	64.86	
	2300.00 SF	ZDDOCK	50.00	126,500	322	21,761	927	0	149,187	64.86
USR AA Floating Dock 20' x 275'				55.00	0.14	9.46	0.40	0.00	64.86	
	5500.00 SF	ZDDOCK	50.00	302,500	770	52,036	2,217	0	356,753	64.86
TOTAL Floating Bwater East Dock & Ramp	7800.00 SF			429,000	1,092	73,797	3,143	0	505,940	64.86
TOTAL FLOATING DOCK FACILITIES	22198 SF			962,613	3,846	271,508	76,344	0	1,310,465	59.04

	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
62. PRECAST CONCRETE DOCK ** OVERTIME **											
$145/sf cost based on 50' x 100' dock installation in 1988 - less mooring dolphins.											
Adjusted to current price level											
USR AA Precast Concrete Dock in Place					0.00	0.00	0.00	0.00	145.00	145.00	
	8000.00	SF		0.00	0	0	0	0	1,160,000	1,160,000	145.00
TOTAL PRECAST CONCRETE DOCK	8000.00	SF			0	0	0	0	1,160,000	1,160,000	145.00
70. PRECAST CONCRETE BOAT RAMP ** OVERTIME **											
M MIL AA Base course, compacted to 6"					5.08	0.01	0.70	0.24	0.00	6.02	
deep, crushed 3/4" stone, large areas	780.00	SY	COFGB36B	625.00	3,960	10	548	184	0	4,692	6.02
M MIL AA Structural precast, slabs, 12"					14.00	0.00	0.00	0.00	0.00	14.00	
thick, solid, 3000 psi	7000.00	SF	N/A	0.00	98,000	0	0	0	0	98,000	14.00
MIL AA Precast erection, 60' max rad,					0.00	4.00	256.84	83.92	0.00	340.76	
90 ton crane, 9-10 ton/pc, floor deck	28.00	EA	ZDPCAST	1.75	0	112	7,192	2,350	0	9,541	340.76
TOTAL PRECAST CONCRETE BOAT RAMP	7000.00	SF			101,960	122	7,739	2,534	0	112,233	16.03
80. 60 TON BOAT LIFT TRAILER ** OVERTIME **											
Conolift model Y60 Boat Lift Trailer 60 ton											
$100K purchase price in Ontario, plus $100K transport and assembly.											
USR AF Conolift model Y60.					0.00	0.00	0.00	0.00	200000.00	200000.00	
$100K Transport	1.00	LS		0.00	0	0	0	0	200,000	200,000	200000.00
TOTAL 60 TON BOAT LIFT TRAILER					0	0	0	0	200,000	200,000	
TOTAL St.Paul Alaska Small Boat Harbor					1,167,516	12,223	815,806	780,588	2,506,022	5,269,932	

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTITY UOM	TOTAL DIRECT	OVERHEAD	PROFIT	TOTAL COST	UNIT COST
10 MOB/DEMOB						
10.25 1st Seas. - Tows		191,140	28,671	19,310	239,121	
10.30 1st Seas. Equip Cost During Tow		77,491	11,624	7,829	96,944	
10.35 1st Seas. - Labor Trvl (airfare)		5,130	769	518	6,418	
10.38 1st Seas. - Per Diem		57,070	8,561	5,766	71,396	
10.40 2nd Seas. - Tows		506,000	75,900	51,120	633,020	
10.45 2nd Seas. Equip Cost During Tow		178,950	26,843	18,079	223,871	
10.50 2nd Seas. - Labor Trvl (airfare)		15,000	2,250	1,515	18,765	
10.53 2nd Seas. - Per Diem		45,240	6,786	4,570	56,596	
TOTAL MOB/DEMOB		1,076,022	161,403	108,708	1,346,132	
20 HARBOR DREDGING (FED & LOCAL)						
20. 2 Dredging (Federal)	77814.00 CY	344,909	51,736	27,773	424,419	5.45
20. 5 Dredging (Local)	22797.00 CY	80,540	12,081	8,137	100,757	4.42
20.10 Disposal - Harbor Adjacent Fill	53600.00 CY	91,972	13,796	9,292	115,060	2.15
20.15 Disposal with haul	47011.00 CY	103,429	15,514	10,449	129,392	2.75
TOTAL HARBOR DREDGING (FED & LOCAL)	100611.00 CY	620,850	93,127	55,651	769,628	7.65
22 REVETMENT & EROSION PROTECTION						
22. 5 REVETMENT W/BEDDING	2625.00 CY	100,992	15,149	10,203	126,344	48.13
22.10 EROSION PROTECTION IN CHANNEL	6500.00 CY	210,251	31,538	21,241	263,030	40.47
TOTAL REVETMENT & EROSION PROTECTION	9125.00 CY	311,243	46,686	31,444	389,373	42.67
40 CIRCULATION BERM	2730.00 CY	55,890	8,384	5,646	69,920	25.61
50 BREAKWATER (FEDERAL)	12653.00 CY	423,230	63,485	42,758	529,473	41.85
60 FLOATING DOCK FACILITIES						
60.02 Pile Driving - per Pile	65.00 EA	206,561	30,984	20,868	258,414	3975.60
60.05 Floating Docks (Main Floats)	5770.00 SF	230,016	34,502	23,238	287,756	49.87
60.10 Finger Floats	7668.00 SF	305,678	45,852	30,882	382,411	49.87
60.17 Float Ramps	960.00 SF	62,270	9,340	6,291	77,901	81.15
60.40 Floating Bwater East Dock & Ramp	7800.00 SF	505,940	75,891	51,114	632,945	81.15
TOTAL FLOATING DOCK FACILITIES	22198.00 SF	1,310,465	196,570	132,393	1,639,427	73.85
62 PRECAST CONCRETE DOCK	8000.00 SF	1,160,000	174,000	117,192	1,451,192	181.40
70 PRECAST CONCRETE BOAT RAMP	7000.00 SF	112,233	16,835	11,339	140,407	20.06
80 60 TON BOAT LIFT TRAILER		200,000	0	0	200,000	
TOTAL St.Paul Alaska Small Boat Harbor		5,269,932	760,490	505,131	6,535,552	

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTITY UOM	TOTAL DIRECT	OVERHEAD	PROFIT	TOTAL COST	UNIT COST
20% Contingency					1,267,110	
SUBTOTAL					7,802,663	
10% Eng and Des (not inc. boat lift)					758,553	
SUBTOTAL					8,561,215	
8% Sup & Adm (not inc. boat lift)					670,748	
TOTAL INCL OWNER COSTS					9,231,963	

St.Paul Alaska Small Boat Harbor
Alternative #4
Main Dredging = 12 feet
30 Vessel Harbor

Designed By: Tetra Tech ISG, John Oliver Con.
Estimated By: Tetra Tech ISG

Prepared By: Doug Lantz, P.E.

Preparation Date: 01/31/01
Effective Date of Pricing: 01/01/01

Sales Tax: 0.0%

St. Paul Alaska Small Boat Harbor - Alternative #4
30 Vessel Harbor, 12 foot Depth
MCACES Database: SP4PB0*.*

Changes from preferred alternative include harbor dredging and floating docks only. Decrease combined square footage of main and finger floats from 13438 sf to 9696 sf.
Dredging changes will not affect 1st year total mobe - but do affect percentage that is applied to this project.
Assume that 2nd year mobe uses same equipment, same tow, and same number of operators - but decrease duration (and thus per diem) by 39%.
No changes in entrance or manuvering channel dredging volumes, breakwater, circulation berm, revetment, or erosion protection.
No changes in concrete docks, ramps, or boat lift.

Project Description:

First Season ---
1) Approximately 132,500 cy of dredging in the entrance channel, maneuvering channel, and boat basin, with disposal adjacent to harbor and in upland areas.
2) Placement of underwater revetment.
3) Construction of a circulation berm.
4) Construction of a breakwater.

Second Season ---
5) Installation of floating docks and boat ramps.
6) Construction of precast concrete docks along the south shore.
7) Boat Lift Trailer.

Basis of Design: General Re-evaluation Report (GRR) Design. January 2001

Overtime: 2 10-hour shifts, 7 days week

Project Construction:

Site Access: Dredging, breakwater, circulation berm, revetment, and floating docks will require marine floating equipment. South side dock will require land based equipment.

Borrow Areas: Rock will be procured on St. Paul Island.

Construction Methodology: Prime contractor will mob the dredging equipment and manpower from the Puget Sound area.

Dredging: Floating crane with a 14 cy bucket and a 10 cy bucket on standby for use during repairs. Two 3000-cy (5000-ton) barges will be used to transport dredged material to spending area. A portion will be off-loaded adjacent to harbor and a portion will be hauled upland.

Breakwater: Rock will be quarried on St. Paul an trucked to breakwater.

Facilities: Floating docks, precast concrete members, and pilings will be fabricated/procured in Seattle/Tacoma area and barged to St. Paul Island. Transport cost is included in Mob/Demob, and is not reflected in the material cost for these itmes.

Pile driving and installation of floating facilities will use a floating crane/piledriving rig. Installation of shoreside facilities will use a combination of land based and floating equipment.

Equipment/Labor Availability & Distance Traveled.
St. Paul Island has a limited amount of heavy equipment and manpower available for contractors use. Mobilized equipment will require three tows:

First Season ---
TOW #1 - dredging barge, crane, buckets and one 3000 cy barge.
TOW #2 - one 3000 cy barge with earthmoving equipment.

Second Season ---
TOW #3 - pile driving barge/crane, and one 3000 cy barge with precast concrete members, prefabricated docks.

Skilled labor, including crane/equipment operators, oilers, steel workes, and welders will be mobilized from Seattle and provided with per diem of $90 hotel and $40 food on St. Paul. Semi skilled workers will be drawn from local labor pool.

Labor Rates: MCACES Anchorage Davis Bacon Rates, 2000.
Remote pay adjustment of 30% gives approximate 2001 Davis Bacon rates(provided by TDX)for St Paul Island.

Equipment: Region IX Equipment Rates EP 1110-1-8, 1999.

Prime Contractor's profit of 8.8% based on weighted guidelines.
Prime Contractor's overhead estimated at 15%. Travel and perdiem for crews are added separately under Mob/Demob.
Engineering and Design estimated at 10%
Supervision and Administration estimated at 8%

SUMMARY REPORTS — SUMMARY PAGE

DETAILED ESTIMATE — DETAIL PAGE

Backup Reports...

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5. 1st Seas. - Tows	QUANTY UOM CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST

10. MOB/DEMOB
The equipment mobe cost for the dedging portion of this project (132,500cy) is computed by prorating the total equipment mobe for all dredging (560,200 cy) by the ratio of the two quantities. The factor = 0.24. The adjustment is made to items: 10.25 1st Seas. - Tows 10.30 1st Seas. Equip Cost During Tow 10.35 1st. Season Labor Travel The cost was adjusted downward by 76% using the "Adjust Pricing" option.

10.25. 1st Seas. - Tows ** ADJUSTED **

Item	QUANTY UOM	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA Mob/Demob Tow #1: Tug, 14 cy dredge, 3000 cy loading barge	50.00 DA	0.00	0.00 0	0.00 0	0.00 0	0.00 0	2400.00 120,000	2400.00 120,000	2400.00
USR AA Mob/Demob Tow #2: Tug, 3000 cy loading barge	50.00 DA	0.00	0.00 0	0.00 0	0.00 0	0.00 0	2400.00 120,000	2400.00 120,000	2400.00
USR AA Mob/Demob Tugboat from Dutch Harbor or Bethel	2.00 DA	0.00	0.00 0	0.00 0	0.00 0	0.00 0	720.00 1,440	720.00 1,440	720.00
TOTAL 1st Seas. - Tows			0	0	0	0	241,440	241,440	

10.30. 1st Seas. Equip Cost During Tow ** ADJUSTED **

Item	QUANTY UOM	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA Hydraulic Shovel	3.00 MO	0.00	0.00 0	0.00 0	0.00 0	0.00 0	1200.00 3,600	1200.00 3,600	1200.00
USR AA 14 cy and 10 cy Clam	3.00 MO	0.00	0.00 0	0.00 0	0.00 0	0.00 0	1200.00 3,600	1200.00 3,600	1200.00
USR AA 65 CY Off-Highway Truck (3 ea)	9.00 MO	0.00	0.00 0	0.00 0	0.00 0	0.00 0	4344.00 39,096	4344.00 39,096	4344.00
USR AA 7 CY FE Loader (2 ea)	6.00 MO	0.00	0.00 0	0.00 0	0.00 0	0.00 0	3192.00 19,152	3192.00 19,152	3192.00
USR AA 500-800 ton Dredge Barge	3.00 MO	0.00	0.00 0	0.00 0	0.00 0	0.00 0	1836.00 5,508	1836.00 5,508	1836.00
USR AA 3000 cy (5000 ton) Dredge Barge #1	3.00 MO	0.00	0.00 0	0.00 0	0.00 0	0.00 0	4488.00 13,464	4488.00 13,464	4488.00
USR AA 3000 cy (5000 ton) Dredge Barge #2	3.00 MO	0.00	0.00 0	0.00 0	0.00 0	0.00 0	4488.00 13,464	4488.00 13,464	4488.00
TOTAL 1st Seas. Equip Cost During Tow			0	0	0	0	97,884	97,884	

35. 1st Seas. - Labor Trvl (airfare)	QUANTY UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
10.35. 1st Seas. - Labor Trvl (airfare) ** ADJUSTED **										
Mobe is only for skilled labor. Assume semi-skilled laborers are available on St. Paul.										
USR AA Crane Ops				0.00	0.00	0.00	0.00	360.00	360.00	
	5.00 EA		0.00	0	0	0	0	1,800	1,800	360.00
USR AA Heavy & Med Equip Op				0.00	0.00	0.00	0.00	360.00	360.00	
	4.00 EA		0.00	0	0	0	0	1,440	1,440	360.00
USR AA Oiler				0.00	0.00	0.00	0.00	360.00	360.00	
	3.00 EA		0.00	0	0	0	0	1,080	1,080	360.00
USR AA Truck Driver - Heavy				0.00	0.00	0.00	0.00	360.00	360.00	
	6.00 EA		0.00	0	0	0	0	2,160	2,160	360.00
TOTAL 1st Seas. - Labor Trvl (airfare)				0	0	0	0	6,480	6,480	
10.38. 1st Seas. - Per Diem										
USR AA Skilled Labor Per Diem ($90				0.00	0.00	0.00	0.00	130.00	130.00	
hotel, $40 food)	439.00 DAY		0.00	0	0	0	0	57,070	57,070	130.00
TOTAL 1st Seas. - Per Diem				0	0	0	0	57,070	57,070	
10.40. 2nd Seas. - Tows										
USR AA Mob/Demob Tow #3: Tug (prefab				0.00	0.00	0.00	0.00	10000.00	10000.00	
docks, piles, boat ramps),	50.00 DA		0.00	0	0	0	0	500,000	500,000	10000.00
USR AA Mob/Demob Tugboat from Dutch				0.00	0.00	0.00	0.00	3000.00	3000.00	
Harbor or Bethel	2.00 DA		0.00	0	0	0	0	6,000	6,000	3000.00
TOTAL 2nd Seas. - Tows				0	0	0	0	506,000	506,000	
10.45. 2nd Seas. Equip Cost During Tow										
USR AA Dredge Barge - pile driving				0.00	0.00	0.00	0.00	7650.00	7650.00	
	3.00 MO		0.00	0	0	0	0	22,950	22,950	7650.00
USR AA Hydraulic Excavator				0.00	0.00	0.00	0.00	10000.00	10000.00	
	3.00 MO		0.00	0	0	0	0	30,000	30,000	10000.00
USR AA Crane - 125T				0.00	0.00	0.00	0.00	18000.00	18000.00	
	3.00 MO		0.00	0	0	0	0	54,000	54,000	18000.00
USR AA Pile Driving Hammer/Leads				0.00	0.00	0.00	0.00	5000.00	5000.00	
	3.00 MO		0.00	0	0	0	0	15,000	15,000	5000.00

10. MOB/DEMOB

2nd Seas. Equip Cost During Tow	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA Air Comp/Hose					0.00	0.00	0.00	0.00	3000.00	3000.00	
	3.00	MO		0.00	0	0	0	0	9,000	9,000	3000.00
USR AA Welder					0.00	0.00	0.00	0.00	700.00	700.00	
	3.00	MO		0.00	0	0	0	0	2,100	2,100	700.00
USR AA 500-800 ton Dock Material Barge					0.00	0.00	0.00	0.00	7650.00	7650.00	
	6.00	MO		0.00	0	0	0	0	45,900	45,900	7650.00
TOTAL 2nd Seas. Equip Cost During Tow					0	0	0	0	178,950	178,950	
10.50. 2nd Seas. - Labor Trvl (airfare)											
USR AA Crane Ops					0.00	0.00	0.00	0.00	1500.00	1500.00	
	2.00	EA		0.00	0	0	0	0	3,000	3,000	1500.00
USR AA Oiler					0.00	0.00	0.00	0.00	1500.00	1500.00	
	2.00	EA		0.00	0	0	0	0	3,000	3,000	1500.00
USR AA Structural Steel Workers					0.00	0.00	0.00	0.00	1500.00	1500.00	
	4.00	EA		0.00	0	0	0	0	6,000	6,000	1500.00
USR AA Welders					0.00	0.00	0.00	0.00	1500.00	1500.00	
	2.00	EA		0.00	0	0	0	0	3,000	3,000	1500.00
TOTAL 2nd Seas. - Labor Trvl (airfare)					0	0	0	0	15,000	15,000	
10.53. 2nd Seas. - Per Diem											
USR AA Skilled Labor Per Diem ($90					0.00	0.00	0.00	0.00	130.00	130.00	
hotel, $40 food)	212.00	DAY		0.00	0	0	0	0	27,560	27,560	130.00
TOTAL 2nd Seas. - Per Diem					0	0	0	0	27,560	27,560	
TOTAL MOB/DEMOB					0	0	0	0	1,130,384	1,130,384	
20. HARBOR DREDGING (FED & LOCAL)											
20. 2. Dredging (Federal) ** OVERTIME ** Hydrographic Survey cost from St. Paul Harbor Improvements, Alaska District (1996).											
USR AA Federal Channel Dredging					0.00	0.02	1.55	1.98	0.00	3.53	
	99000	CY	ZDDREDGE	300.00	0	2,307	153,282	196,475	0	349,757	3.53
Mod											

2. Dredging (Federal)	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AS Hydrographic Survey					0.00	0.00	0.00	0.00	35000.00	35000.00	
	2.00	EA		0.00	0	0	0	0	70,000	70,000	35000.00
TOTAL Dredging (Federal)	99000	CY			0	2,307	153,282	196,475	70,000	419,757	4.24
20. 5. Dredging (Local) ** OVERTIME ** Hydrographic Survey cost from St. Paul Harbor Improvements, Alaska District (1996).											
USR AA Boat Basin Dredging					0.00	0.02	1.55	1.98	0.00	3.53	
	33500	CY	ZDDREDGE	300.00	0	781	51,868	66,484	0	118,352	3.53
TOTAL Dredging (Local)	33500	CY			0	781	51,868	66,484	0	118,352	3.53
20.10. Disposal - Harbor Adjacent Fill ** OVERTIME **											
CIV AA Hauling, off hwy haulers, 65 CY,					0.00	0.00	0.30	0.45	0.00	0.76	
1 mile RT @ 20 mph (4.2 cyc/hr)	53600	CY	CTDHB34J	240.00	0	225	16,209	24,265	0	40,473	0.76
CIV AA Excavate & load, wheeled loader,					0.00	0.01	0.52	0.44	0.00	0.96	
7 CY, wet rock	53600	CY	CODLB10Z	212.50	0	381	27,759	23,739	0	51,499	0.96
TOTAL Disposal - Harbor Adjacent Fill	53600	CY			0	606	43,968	48,004	0	91,972	1.72
20.15. Disposal with haul ** OVERTIME **											
CIV AA Hauling, off hwy haulers, 65 CY,					0.00	0.01	0.50	0.74	0.00	1.24	
6 mile RT @ 40 mph (2.1 cyc/hr)	78900	CY	CTDHB34J	146.25	0	537	39,158	58,623	0	97,781	1.24
CIV AA Excavate & load, wheeled loader,					0.00	0.01	0.52	0.44	0.00	0.96	
7 CY, wet rock	78900	CY	CODLB10Z	212.50	0	560	40,862	34,945	0	75,807	0.96
TOTAL Disposal with haul	78900	CY			0	1,097	80,020	93,568	0	173,588	2.20
TOTAL HARBOR DREDGING (FED & LOCAL)	132500	CY			0	4,790	329,138	404,531	70,000	803,669	6.07
22. REVETMENT & EROSION PROTECTION $4/CYprice quote for rock at quarry on St. Paul (not gauranteed)											
22. 5. REVETMENT W/BEDDING ** OVERTIME **											
USR AA 18" Rock Rip-rap quarried on St.					4.00	0.00	0.00	0.00	0.00	4.00	
Paul	2625.00	CY		0.00	10,500	0	0	0	0	10,500	4.00
B CIV AA Excavate & load, wheeled loader,					0.00	0.02	0.87	1.04	0.00	1.91	
7 CY, blasted rock	3500.00	CY	CODLB10Z	100.00	0	53	3,040	3,648	0	6,687	1.91

22. REVETMENT & EROSION PROTECTION

REVETMENT W/BEDDING	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA 6" gravel bedding layer, machine					5.00	0.07	3.71	4.02	0.00	12.73	
placed	875.00	CY	ZDBWATER	100.00	4,375	61	3,247	3,516	0	11,138	12.73
CIV AA Hauling, off hwy haulers, 65 CY,					0.00	0.01	0.57	1.26	0.00	1.83	
3 mile RT @ 30 mph (2.9 cyc/hr)	3500.00	CY	CTDHB34J	100.00	0	35	2,009	4,393	0	6,403	1.83
CIV AA Handling on barge, wheeled					0.00	0.02	0.87	1.04	0.00	1.91	
loader, 7 CY, blasted rock	3500.00	CY	CODLB10Z	100.00	0	53	3,040	3,648	0	6,687	1.91
RSM AA Place Revetment					0.00	0.16	8.17	14.52	0.00	22.70	
	2625.00	CY	ZDDREDGE	45.00	0	408	21,454	38,122	0	59,576	22.70
TOTAL REVETMENT W/BEDDING	2625.00	CY			14,875	610	32,790	53,327	0	100,992	38.47
22.10. EROSION PROTECTION IN CHANNEL				** OVERTIME **							
USR AA 24" Rock Rip-rap quarried on St.					4.00	0.00	0.00	0.00	0.00	4.00	
Paul	6500.00	CY		0.00	26,000	0	0	0	0	26,000	4.00
CIV AA Excavate & load, wheeled loader,					0.00	0.02	0.87	1.04	0.00	1.91	
7 CY, blasted rock	6500.00	CY	CODLB10Z	100.00	0	98	5,645	6,774	0	12,420	1.91
CIV AA Hauling, off hwy haulers, 65 CY,					0.00	0.01	0.57	1.26	0.00	1.83	
3 mile RT @ 30 mph (2.9 cyc/hr)	6500.00	CY	CTDHB34J	100.00	0	65	3,732	8,159	0	11,890	1.83
CIV AA Handling on barge, wheeled					0.00	0.02	0.87	1.04	0.00	1.91	
loader, 7 CY, blasted rock	6500.00	CY	CODLB10Z	100.00	0	98	5,645	6,774	0	12,420	1.91
RSM AA Erosion Protection Placed					0.00	0.16	8.17	14.52	0.00	22.70	
	6500.00	CY	ZDDREDGE	45.00	0	1,011	53,124	94,398	0	147,521	22.70
TOTAL EROSION PROTECTION IN CHANNEL	6500.00	CY			26,000	1,271	68,146	116,105	0	210,251	32.35
TOTAL REVETMENT & EROSION PROTECTION	9125.00	CY			40,875	1,881	100,936	169,432	0	311,243	34.11
10. CIRCULATION BERM				** OVERTIME **							
RSM AA Fill, borrow, for embankments,					5.38	0.03	2.38	3.45	0.00	11.21	
load, 1 mile haul, spread w/dozer	2130.00	CY	ZDCBERM	150.00	11,457	71	5,072	7,352	0	23,880	11.21
USR AA Sort Boulders from Dredged					0.00	0.22	14.65	11.36	0.00	26.01	
Material	600.00	CY	ZDBWATER	32.00	0	131	8,791	6,814	0	15,605	26.01
MIL AA Cap with rounded excavated					0.00	0.16	11.16	16.18	0.00	27.34	
boulders - placement	600.00	CY	ZDCBERM	32.00	0	94	6,697	9,707	0	16,404	27.34

40. CIRCULATION BERM

	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
TOTAL CIRCULATION BERM	2730.00	CY			11,457	296	20,560	23,873	0	55,890	20.47
50. BREAKWATER (FEDERAL) Rock Size 2-ton minus — ** OVERTIME **											
$4/CY price quote for rock at quarry on St. Paul (not gauranteed)											
USR AA 2-ton minus, quarried on St.					4.00	0.00	0.00	0.00	0.00	4.00	
Paul	12653	CY		0.00	50,612	0	0	0	0	50,612	4.00
B CIV AA Excavate & load, wheeled loader,					0.00	0.02	1.10	0.94	0.00	2.04	
7 CY, blasted rock	12653	CY	CODLB10Z	100.00	0	190	13,926	11,909	0	25,835	2.04
L CIV AA Hauling, off hwy haulers, 65 CY,					0.00	0.01	0.73	1.09	0.00	1.81	
3 mile RT @ 30 mph (2.9 cyc/hr)	12653	CY	CTDHB34J	100.00	0	127	9,184	13,749	0	22,932	1.81
B CIV AA handling on barge, loader, 7 CY,					0.00	0.02	1.10	0.94	0.00	2.04	
blasted rock	12653	CY	CODLB10Z	100.00	0	190	13,926	11,909	0	25,835	2.04
USR AA Place Rock Fill					0.00	0.16	10.32	13.23	0.00	23.55	
	12653	CY	ZDDREDGE	45.00	0	1,969	130,604	167,412	0	298,016	23.55
TOTAL BREAKWATER (FEDERAL)	12653	CY			50,612	2,475	167,640	204,979	0	423,230	33.45
60. FLOATING DOCK FACILITIES Floats and Boat Ramps fabricated in Seattle. Transport is covered under mobilization.											
60.02. Pile Driving - per Pile — ** OVERTIME ** 50 foot piles x 17.15/LF = $850 ea; Driving tips for boulders; 47piles driven 30 feet into ground = 1410 vlf											
USR PD Pile, steel, pipe, 50' L 12"					850.00	0.00	0.00	0.00	0.00	850.00	
dia, 44 lb/LF, conc filled	47.00	EA		0.00	48,340	0	0	0	0	48,340	1028.50
M MIL PD Pile, steel, pipe, heavy duty					137.57	2.35	193.87	24.38	0.00	355.82	
points, 12" dia	47.00	EA	SIWWE14	0.43	7,824	111	11,025	1,387	0	20,235	430.54
B MIL PD Pile driving and concrete fill					0.00	0.30	19.60	27.75	0.00	47.35	
	1410.00	VLF	ZDPLDRVR	20.00	0	423	33,437	47,348	0	80,785	57.29
TOTAL Pile Driving - per Pile	47.00	EA			56,163	534	44,462	48,734	0	149,360	3177.87

. Floating Docks (Main Floats)	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
60.05. Floating Docks (Main Floats)				** OVERTIME **							
USR AA Main Floats					30.00	0.14	9.46	0.40	0.00	39.86	
	4440.00	SF	ZDDOCK	50.00	133,200	622	42,007	1,789	0	176,997	39.86
TOTAL Floating Docks (Main Floats)	4440.00	SF			133,200	622	42,007	1,789	0	176,997	39.86
60.10. Finger Floats				** OVERTIME **							
USR AA Finger Floats					30.00	0.14	9.46	0.40	0.00	39.86	
	5256.00	SF	ZDDOCK	50.00	157,680	736	49,728	2,118	0	209,526	39.86
TOTAL Finger Floats	5256.00	SF			157,680	736	49,728	2,118	0	209,526	39.86
60.17. Float Ramps				** OVERTIME **							
USR AA Float Ramps 2 @ 8' x 60'					55.00	0.14	9.46	0.40	0.00	64.86	
	960.00	SF	ZDDOCK	50.00	52,800	134	9,083	387	0	62,270	64.86
TOTAL Float Ramps	960.00	SF			52,800	134	9,083	387	0	62,270	64.86
60.40. Floating Bwater East Dock & Ramp				** OVERTIME **							
USR AA Floating Ramp 20' x 115'					55.00	0.14	9.46	0.40	0.00	64.86	
	2300.00	SF	ZDDOCK	50.00	126,500	322	21,761	927	0	149,187	64.86
USR AA Floating Dock 20' x 275'					55.00	0.14	9.46	0.40	0.00	64.86	
	5500.00	SF	ZDDOCK	50.00	302,500	770	52,036	2,217	0	356,753	64.86
TOTAL Floating Bwater East Dock & Ramp	7800.00	SF			429,000	1,092	73,797	3,143	0	505,940	64.86
TOTAL FLOATING DOCK FACILITIES	18456	SF			828,843	3,117	219,076	56,172	0	1,104,092	59.82

2. PRECAST CONCRETE DOCK ** OVERTIME **

$145/sf cost based on 50' x 100' dock installation in 1988 - less mooring dolphins.

Adjusted to current price level

	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA Precast Concrete Dock in Place					0.00	0.00	0.00	0.00	145.00	145.00	
	8000.00	SF		0.00	0	0	0	0	1,160,000	1,160,000	145.00
TOTAL PRECAST CONCRETE DOCK	8000.00	SF			0	0	0	0	1,160,000	1,160,000	145.00

	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
70. PRECAST CONCRETE BOAT RAMP ** OVERTIME **											
M MIL AA Base course, compacted to 6" deep, crushed 3/4" stone, large areas	780.00	SY	COFGB36B	625.00	5.08 3,960	0.01 10	0.70 548	0.24 184	0.00 0	6.02 4,692	6.02
M MIL AA Structural precast, slabs, 12" thick, solid, 3000 psi	7000.00	SF	N/A	0.00	14.00 98,000	0.00 0	0.00 0	0.00 0	0.00 0	14.00 98,000	14.00
MIL AA Precast erection, 60' max rad, 90 ton crane, 9-10 ton/pc, floor deck	28.00	EA	ZDPCAST	1.75	0.00 0	4.00 112	256.84 7,192	83.92 2,350	0.00 0	340.76 9,541	340.76
TOTAL PRECAST CONCRETE BOAT RAMP	7000.00	SF			101,960	122	7,739	2,534	0	112,233	16.03
80. 60 TON BOAT LIFT TRAILER ** OVERTIME ** Conolift model Y60 Boat Lift Trailer 60 ton $100K purchase price in Ontario, plus $100K transport and assembly.											
USR AF Conolift model Y60. $100K Transport	1.00	LS		0.00	0.00 0	0.00 0	0.00 0	0.00 0	200000.00 200,000	200000.00 200,000	200000.00
TOTAL 60 TON BOAT LIFT TRAILER					0	0	0	0	200,000	200,000	
TOTAL St.Paul Alaska Small Boat Harbor					1,033,747	12,681	845,090	861,520	2,560,384	5,300,741	

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTITY UOM	TOTAL DIRECT	OVERHEAD	PROFIT	TOTAL COST	UNIT COST
10 MOB/DEMOB						
10.25 1st Seas. - Tows		241,440	36,216	24,392	302,048	
10.30 1st Seas. Equip Cost During Tow		97,884	14,683	9,889	122,456	
10.35 1st Seas. - Labor Trvl (airfare)		6,480	972	655	8,107	
10.38 1st Seas. - Per Diem		57,070	8,561	5,766	71,396	
10.40 2nd Seas. - Tows		506,000	75,900	51,120	633,020	
10.45 2nd Seas. Equip Cost During Tow		178,950	26,843	18,079	223,871	
10.50 2nd Seas. - Labor Trvl (airfare)		15,000	2,250	1,515	18,765	
10.53 2nd Seas. - Per Diem		27,560	4,134	2,784	34,478	
TOTAL MOB/DEMOB		1,130,384	169,558	114,200	1,414,141	
20 HARBOR DREDGING (FED & LOCAL)						
20. 2 Dredging (Federal)	99000.00 CY	419,757	62,964	35,335	518,056	5.23
20. 5 Dredging (Local)	33500.00 CY	118,352	17,753	11,957	148,062	4.42
20.10 Disposal - Harbor Adjacent Fill	53600.00 CY	91,972	13,796	9,292	115,060	2.15
20.15 Disposal with haul	78900.00 CY	173,588	26,038	17,537	217,163	2.75
TOTAL HARBOR DREDGING (FED & LOCAL)	132500.00 CY	803,669	120,550	74,121	998,341	7.53
22 REVETMENT & EROSION PROTECTION						
22. 5 REVETMENT W/BEDDING	2625.00 CY	100,992	15,149	10,203	126,344	48.13
22.10 EROSION PROTECTION IN CHANNEL	6500.00 CY	210,251	31,538	21,241	263,030	40.47
TOTAL REVETMENT & EROSION PROTECTION	9125.00 CY	311,243	46,686	31,444	389,373	42.67
40 CIRCULATION BERM	2730.00 CY	55,890	8,384	5,646	69,920	25.61
50 BREAKWATER (FEDERAL)	12653.00 CY	423,230	63,485	42,758	529,473	41.85
60 FLOATING DOCK FACILITIES						
60.02 Pile Driving - per Pile	47.00 EA	149,360	22,404	15,089	186,853	3975.60
60.05 Floating Docks (Main Floats)	4440.00 SF	176,997	26,549	17,882	221,428	49.87
60.10 Finger Floats	5256.00 SF	209,526	31,429	21,168	262,122	49.87
60.17 Float Ramps	960.00 SF	62,270	9,340	6,291	77,901	81.15
60.40 Floating Bwater East Dock & Ramp	7800.00 SF	505,940	75,891	51,114	632,945	81.15
TOTAL FLOATING DOCK FACILITIES	18456.00 SF	1,104,092	165,614	111,544	1,381,249	74.84
62 PRECAST CONCRETE DOCK	8000.00 SF	1,160,000	174,000	117,192	1,451,192	181.40
70 PRECAST CONCRETE BOAT RAMP	7000.00 SF	112,233	16,835	11,339	140,407	20.06
80 60 TON BOAT LIFT TRAILER		200,000	0	0	200,000	
TOTAL St.Paul Alaska Small Boat Harbor		5,300,741	765,111	508,243	6,574,095	

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTITY UOM	TOTAL DIRECT	OVERHEAD	PROFIT	TOTAL COST	UNIT COST
20% Contingency					1,274,819	
SUBTOTAL					7,848,914	
10% Eng. & Des (not inc. boat lift)					763,178	
SUBTOTAL					8,612,092	
8% Sup & Adm (not inc. boat lift)					674,818	
TOTAL INCL OWNER COSTS					9,286,910	

St.Paul Alaska Small Boat Harbor
Alternative #5
Main Dredging = 12 feet
90 Vessel Harbor

Designed By: Tetra Tech ISG, John Oliver Con.
Estimated By: Tetra Tech ISG

Prepared By: Doug Lantz, P.E.

Preparation Date: 01/31/01
Effective Date of Pricing: 01/01/01

Sales Tax: 0.0%

Currency in DOLLARS

St. Paul Alaska Small Boat Harbor - Alternative #5
30 Vessel Harbor, 12 foot Depth - 90 vessels
MCACES Database: SP5PB0*.*

Changes from preferred alternative include harbor dredging and floating docks only. Increase combined square footage of main and finger floats from 13348 sf to 18806 sf.
Dredging changes will not affect 1st year total mobe - but do affect percentage that is applied to this project.
Assume that 2nd year mobe uses same equipment, same tow, and same number of operators - but increase length (and thus per diem) by 41%.
No changes in entrance or manuvering channel dredging volumes, breakwater, circulation berm, revetment, or erosion protection.
No changes in concrete docks, ramps, or boat lift.

Project Description:

First Season ---
1) Approximately 179,500 cy of dredging in the entrance channel, maneuvering channel, and boat basin, with disposal adjacent to harbor and in upland areas.
2) Placement of underwater revetment.
3) Construction of a circulation berm.
4) Construction of a breakwater.

Second Season ---
5) Installation of floating docks and boat ramps.
6) Construction of precast concrete docks along the south shore.
7) Boat Lift Trailer.

Basis of Design: General Re-evaluation Report (GRR) Design. January 2001

Overtime: 2 10-hour shifts, 7 days week

Project Construction:

Site Access: Dredging, breakwater, circulation berm, revetment, and floating docks will require marine floating equipment. South side dock will require land based equipment.

Borrow Areas: Rock will be procured on St. Paul Island.

Construction Methodology: Prime contractor will mob the dredging equipment and manpower from the Puget Sound area.

Dredging: Floating crane with a 14 cy bucket and a 10 cy bucket on standby for use during repairs. Two 3000-cy (5000-ton) barges will be used to transport dredged material to spending area. A portion will be off-loaded adjacent to harbor and a portion will be hauled upland.

Breakwater: Rock will be quarried on St. Paul an trucked to breakwater.

Facilities: Floating docks, precast concrete members, and pilings will be fabricated/procured in Seattle/Tacoma area and barged to St. Paul Island. Transport cost is included in Mob/Demob, and is not reflected in the material cost for these itmes.

Pile driving and installation of floating facilities will use a floating crane/piledriving rig. Installation of shoreside facilities will use a combination of land based and floating equipment.

Equipment/Labor Availability & Distance Traveled.
St. Paul Island has a limited amount of heavy equipment and manpower available for contractors use. Mobilized equipment will require three tows:

First Season ---
TOW #1 - dredging barge, crane, buckets and one 3000 cy barge.
TOW #2 - one 3000 cy barge with earthmoving equipment.

Second Season ---
TOW #3 - pile driving barge/crane, and one 3000 cy barge with precast concrete members, prefabricated docks.

Skilled labor, including crane/equipment operators, oilers, steel workes, and welders will be mobilized from Seattle and provided with per diem of $90 hotel and $40 food on St. Paul. Semi skilled workers will be drawn from local labor pool.

Labor Rates: MCACES Anchorage Davis Bacon Rates, 2000.
Remote pay adjustment of 30% gives approximate 2001 Davis Bacon rates(provided by TDX)for St Paul Island.

Equipment: Region IX Equipment Rates EP 1110-1-8, 1999.

Prime Contractor's profit of 8.8% based on weighted guidelines.
Prime Contractor's overhead estimated at 15%. Travel and per diem for crews are added separately under Mob/Demob.
Engineering and Design estimated at 10%
Supervision and Administration estimated at 8%

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25. 1st Seas. - Tows	QUANTY UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST

10. MOB/DEMOB

The equipment mobe cost for the dedging portion of this project (179,500cy) is computed by prorating the total equipment mobe for all dredging (607,200 cy) by the ratio of the two quantities. The factor = 0.30. The adjustment is made to items: 10.25 1st Seas. - Tows 10.30 1st Seas. Equip Cost During Tow 10.35 1st. Season Labor Travel The cost was adjusted downward by 70% using the "Adjust Pricing" option.

10.25. 1st Seas. - Tows ** ADJUSTED **

	QUANTY UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA Mob/Demob Tow #1: Tug, 14 cy dredge, 3000 cy loading barge	50.00 DA		0.00	0.00 0	0.00 0	0.00 0	0.00 0	3000.00 150,000	3000.00 150,000	3000.00
USR AA Mob/Demob Tow #2: Tug, 3000 cy loading barge	50.00 DA		0.00	0.00 0	0.00 0	0.00 0	0.00 0	3000.00 150,000	3000.00 150,000	3000.00
USR AA Mob/Demob Tugboat from Dutch Harbor or Bethel	2.00 DA		0.00	0.00 0	0.00 0	0.00 0	0.00 0	900.00 1,800	900.00 1,800	900.00
TOTAL 1st Seas. - Tows				0	0	0	0	301,800	301,800	

10.30. 1st Seas. Equip Cost During Tow ** ADJUSTED **

	QUANTY UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA Hydraulic Shovel	3.00 MO		0.00	0.00 0	0.00 0	0.00 0	0.00 0	1500.00 4,500	1500.00 4,500	1500.00
USR AA 14 cy and 10 cy Clam	3.00 MO		0.00	0.00 0	0.00 0	0.00 0	0.00 0	1500.00 4,500	1500.00 4,500	1500.00
USR AA 65 CY Off-Highway Truck (3 ea)	9.00 MO		0.00	0.00 0	0.00 0	0.00 0	0.00 0	5430.00 48,870	5430.00 48,870	5430.00
USR AA 7 CY FE Loader (2 ea)	6.00 MO		0.00	0.00 0	0.00 0	0.00 0	0.00 0	3990.00 23,940	3990.00 23,940	3990.00
USR AA 500-800 ton Dredge Barge	3.00 MO		0.00	0.00 0	0.00 0	0.00 0	0.00 0	2295.00 6,885	2295.00 6,885	2295.00
USR AA 3000 cy (5000 ton) Dredge Barge #1	3.00 MO		0.00	0.00 0	0.00 0	0.00 0	0.00 0	5610.00 16,830	5610.00 16,830	5610.00
USR AA 3000 cy (5000 ton) Dredge Barge #2	3.00 MO		0.00	0.00 0	0.00 0	0.00 0	0.00 0	5610.00 16,830	5610.00 16,830	5610.00
TOTAL 1st Seas. Equip Cost During Tow				0	0	0	0	122,355	122,355	

35. 1st Seas. - Labor Trvl (airfare)	QUANTY UOM CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
10.35. 1st Seas. - Labor Trvl (airfare) ** ADJUSTED ** Mobe is only for skilled labor. Assume semi-skilled laborers are available on St. Paul.									
USR AA Crane Ops			0.00	0.00	0.00	0.00	450.00	450.00	
	5.00 EA	0.00	0	0	0	0	2,250	2,250	450.00
USR AA Heavy & Med Equip Op			0.00	0.00	0.00	0.00	450.00	450.00	
	4.00 EA	0.00	0	0	0	0	1,800	1,800	450.00
USR AA Oiler			0.00	0.00	0.00	0.00	450.00	450.00	
	3.00 EA	0.00	0	0	0	0	1,350	1,350	450.00
USR AA Truck Driver - Heavy			0.00	0.00	0.00	0.00	450.00	450.00	
	6.00 EA	0.00	0	0	0	0	2,700	2,700	450.00
TOTAL 1st Seas. - Labor Trvl (airfare)			0	0	0	0	8,100	8,100	
10.38. 1st Seas. - Per Diem									
USR AA Skilled Labor Per Diem ($90			0.00	0.00	0.00	0.00	130.00	130.00	
hotel, $40 food)	439.00 DAY	0.00	0	0	0	0	57,070	57,070	130.00
TOTAL 1st Seas. - Per Diem			0	0	0	0	57,070	57,070	
10.40. 2nd Seas. - Tows									
USR AA Mob/Demob Tow #3: Tug (prefab			0.00	0.00	0.00	0.00	10000.00	10000.00	
docks, piles, boat ramps),	50.00 DA	0.00	0	0	0	0	500,000	500,000	10000.00
USR AA Mob/Demob Tugboat from Dutch			0.00	0.00	0.00	0.00	3000.00	3000.00	
Harbor or Bethel	2.00 DA	0.00	0	0	0	0	6,000	6,000	3000.00
TOTAL 2nd Seas. - Tows			0	0	0	0	506,000	506,000	
10.45. 2nd Seas. Equip Cost During Tow									
USR AA Dredge Barge - pile driving			0.00	0.00	0.00	0.00	7650.00	7650.00	
	3.00 MO	0.00	0	0	0	0	22,950	22,950	7650.00
USR AA Hydraulic Excavator			0.00	0.00	0.00	0.00	10000.00	10000.00	
	3.00 MO	0.00	0	0	0	0	30,000	30,000	10000.00
USR AA Crane - 125T			0.00	0.00	0.00	0.00	18000.00	18000.00	
	3.00 MO	0.00	0	0	0	0	54,000	54,000	18000.00
USR AA Pile Driving Hammer/Leads			0.00	0.00	0.00	0.00	5000.00	5000.00	
	3.00 MO	0.00	0	0	0	0	15,000	15,000	5000.00

. 2nd Seas. Equip Cost During Tow	QUANTY UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA Air Comp/Hose	3.00 MO		0.00	0.00 0	0.00 0	0.00 0	0.00 0	3000.00 9,000	3000.00 9,000	3000.00
USR AA Welder	3.00 MO		0.00	0.00 0	0.00 0	0.00 0	0.00 0	700.00 2,100	700.00 2,100	700.00
USR AA 500-800 ton Dock Material Barge	6.00 MO		0.00	0.00 0	0.00 0	0.00 0	0.00 0	7650.00 45,900	7650.00 45,900	7650.00
TOTAL 2nd Seas. Equip Cost During Tow				0	0	0	0	178,950	178,950	
10.50. 2nd Seas. - Labor Trvl (airfare)										
USR AA Crane Ops	2.00 EA		0.00	0.00 0	0.00 0	0.00 0	0.00 0	1500.00 3,000	1500.00 3,000	1500.00
USR AA Oiler	2.00 EA		0.00	0.00 0	0.00 0	0.00 0	0.00 0	1500.00 3,000	1500.00 3,000	1500.00
USR AA Structural Steel Workers	4.00 EA		0.00	0.00 0	0.00 0	0.00 0	0.00 0	1500.00 6,000	1500.00 6,000	1500.00
USR AA Welders	2.00 EA		0.00	0.00 0	0.00 0	0.00 0	0.00 0	1500.00 3,000	1500.00 3,000	1500.00
TOTAL 2nd Seas. - Labor Trvl (airfare)				0	0	0	0	15,000	15,000	
10.53. 2nd Seas. - Per Diem										
USR AA Skilled Labor Per Diem ($90 hotel, $40 food)	491.00 DAY		0.00	0.00 0	0.00 0	0.00 0	0.00 0	130.00 63,830	130.00 63,830	130.00
TOTAL 2nd Seas. - Per Diem				0	0	0	0	63,830	63,830	
TOTAL MOB/DEMOB				0	0	0	0	1,253,105	1,253,105	
20. HARBOR DREDGING (FED & LOCAL)										
20. 2. Dredging (Federal) ** OVERTIME ** Hydrographic Survey cost from St. Paul Harbor Improvements, Alaska District (1996).										
USR AA Federal Channel Dredging *Mod*	99000 CY	ZDDREDGE	300.00	0.00 0	0.02 2,307	1.55 153,282	1.98 196,475	0.00 0	3.53 349,757	3.53

20. HARBOR DREDGING (FED & LOCAL)

2. Dredging (Federal)	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AS Hydrographic Survey					0.00	0.00	0.00	0.00	35000.00	35000.00	
	2.00	EA		0.00	0	0	0	0	70,000	70,000	35000.00
TOTAL Dredging (Federal)	99000	CY			0	2,307	153,282	196,475	70,000	419,757	4.24
20. 5. Dredging (Local)				** OVERTIME **							
Hydrographic Survey cost from St. Paul Harbor Improvements, Alaska District (1996).											
USR AA Boat Basin Dredging					0.00	0.02	1.55	1.98	0.00	3.53	
	80500	CY	ZDDREDGE	300.00	0	1,876	124,638	159,760	0	284,398	3.53
TOTAL Dredging (Local)	80500	CY			0	1,876	124,638	159,760	0	284,398	3.53
20.10. Disposal - Harbor Adjacent Fill				** OVERTIME **							
CIV AA Hauling, off hwy haulers, 65 CY,					0.00	0.00	0.30	0.45	0.00	0.76	
1 mile RT @ 20 mph (4.2 cyc/hr)	53600	CY	CTDHB34J	240.00	0	225	16,209	24,265	0	40,473	0.76
CIV AA Excavate & load, wheeled loader,					0.00	0.01	0.52	0.44	0.00	0.96	
7 CY, wet rock	53600	CY	CODLB10Z	212.50	0	381	27,759	23,739	0	51,499	0.96
TOTAL Disposal - Harbor Adjacent Fill	53600	CY			0	606	43,968	48,004	0	91,972	1.72
20.15. Disposal with haul				** OVERTIME **							
CIV AA Hauling, off hwy haulers, 65 CY,					0.00	0.01	0.50	0.74	0.00	1.24	
6 mile RT @ 40 mph (2.1 cyc/hr)	125900	CY	CTDHB34J	146.25	0	856	62,484	93,544	0	156,028	1.24
CIV AA Excavate & load, wheeled loader,					0.00	0.01	0.52	0.44	0.00	0.96	
7 CY, wet rock	125900	CY	CODLB10Z	212.50	0	894	65,204	55,761	0	120,965	0.96
TOTAL Disposal with haul	125900	CY			0	1,750	127,688	149,305	0	276,993	2.20
TOTAL HARBOR DREDGING (FED & LOCAL)	179500	CY			0	6,538	449,576	553,545	70,000	1,073,120	5.98
22. REVETMENT & EROSION PROTECTION											
$4/CYprice quote for rock at quarry on St. Paul (not gauranteed)											
22. 5. REVETMENT W/BEDDING				** OVERTIME **							
USR AA 18" Rock Rip-rap quarried on St.					4.00	0.00	0.00	0.00	0.00	4.00	
Paul	2625.00	CY		0.00	10,500	0	0	0	0	10,500	4.00
B CIV AA Excavate & load, wheeled loader,					0.00	0.02	0.87	1.04	0.00	1.91	
7 CY, blasted rock	3500.00	CY	CODLB10Z	100.00	0	53	3,040	3,648	0	6,687	1.91

22. REVETMENT & EROSION PROTECTION

5. REVETMENT W/BEDDING	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA 6" gravel bedding layer, machine					5.00	0.07	3.71	4.02	0.00	12.73	
placed	875.00	CY	ZDBWATER	100.00	4,375	61	3,247	3,516	0	11,138	12.73
L CIV AA Hauling, off hwy haulers, 65 CY,					0.00	0.01	0.57	1.26	0.00	1.83	
3 mile RT @ 30 mph (2.9 cyc/hr)	3500.00	CY	CTDHB34J	100.00	0	35	2,009	4,393	0	6,403	1.83
B CIV AA Handling on barge, wheeled					0.00	0.02	0.87	1.04	0.00	1.91	
loader, 7 CY, blasted rock	3500.00	CY	CODLB10Z	100.00	0	53	3,040	3,648	0	6,687	1.91
B RSM AA Place Revetment					0.00	0.16	8.17	14.52	0.00	22.70	
	2625.00	CY	ZDDREDGE	45.00	0	408	21,454	38,122	0	59,576	22.70
TOTAL REVETMENT W/BEDDING	2625.00	CY			14,875	610	32,790	53,327	0	100,992	38.47
22.10. EROSION PROTECTION IN CHANNEL				** OVERTIME **							
USR AA 24" Rock Rip-rap quarried on St.					4.00	0.00	0.00	0.00	0.00	4.00	
Paul	6500.00	CY		0.00	26,000	0	0	0	0	26,000	4.00
B CIV AA Excavate & load, wheeled loader,					0.00	0.02	0.87	1.04	0.00	1.91	
7 CY, blasted rock	6500.00	CY	CODLB10Z	100.00	0	98	5,645	6,774	0	12,420	1.91
L CIV AA Hauling, off hwy haulers, 65 CY,					0.00	0.01	0.57	1.26	0.00	1.83	
3 mile RT @ 30 mph (2.9 cyc/hr)	6500.00	CY	CTDHB34J	100.00	0	65	3,732	8,159	0	11,890	1.83
B CIV AA Handling on barge, wheeled					0.00	0.02	0.87	1.04	0.00	1.91	
loader, 7 CY, blasted rock	6500.00	CY	CODLB10Z	100.00	0	98	5,645	6,774	0	12,420	1.91
B RSM AA Erosion Protection Placed					0.00	0.16	8.17	14.52	0.00	22.70	
	6500.00	CY	ZDDREDGE	45.00	0	1,011	53,124	94,398	0	147,521	22.70
TOTAL EROSION PROTECTION IN CHANNEL	6500.00	CY			26,000	1,271	68,146	116,105	0	210,251	32.35
TOTAL REVETMENT & EROSION PROTECTION	9125.00	CY			40,875	1,881	100,936	169,432	0	311,243	34.11
40. CIRCULATION BERM				** OVERTIME **							
M RSM AA Fill, borrow, for embankments,					5.38	0.03	2.38	3.45	0.00	11.21	
load, 1 mile haul, spread w/dozer	2130.00	CY	ZDCBERM	150.00	11,457	71	5,072	7,352	0	23,880	11.21
USR AA Sort Boulders from Dredged					0.00	0.22	14.65	11.36	0.00	26.01	
Material	600.00	CY	ZDBWATER	32.00	0	131	8,791	6,814	0	15,605	26.01
M MIL AA Cap with rounded excavated					0.00	0.16	11.16	16.18	0.00	27.34	
boulders - placement	600.00	CY	ZDCBERM	32.00	0	94	6,697	9,707	0	16,404	27.34

40. CIRCULATION BERM

	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
TOTAL CIRCULATION BERM	2730.00	CY			11,457	296	20,560	23,873	0	55,890	20.47

50. BREAKWATER (FEDERAL) ** OVERTIME **
Rock Size 2-ton minus

$4/CY price quote for rock at quarry on St. Paul (not gauranteed)

	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA 2-ton minus, quarried on St.					4.00	0.00	0.00	0.00	0.00	4.00	
Paul	12653	CY		0.00	50,612	0	0	0	0	50,612	4.00
B CIV AA Excavate & load, wheeled loader,					0.00	0.02	1.10	0.94	0.00	2.04	
7 CY, blasted rock	12653	CY	CODLB10Z	100.00	0	190	13,926	11,909	0	25,835	2.04
L CIV AA Hauling, off hwy haulers, 65 CY,					0.00	0.01	0.73	1.09	0.00	1.81	
3 mile RT @ 30 mph (2.9 cyc/hr)	12653	CY	CTDHB34J	100.00	0	127	9,184	13,749	0	22,932	1.81
B CIV AA handling on barge, loader, 7 CY,					0.00	0.02	1.10	0.94	0.00	2.04	
blasted rock	12653	CY	CODLB10Z	100.00	0	190	13,926	11,909	0	25,835	2.04
USR AA Place Rock Fill					0.00	0.16	10.32	13.23	0.00	23.55	
	12653	CY	ZDDREDGE	45.00	0	1,969	130,604	167,412	0	298,016	23.55
TOTAL BREAKWATER (FEDERAL)	12653	CY			50,612	2,475	167,640	204,979	0	423,230	33.45

60. FLOATING DOCK FACILITIES
Floats and Boat Ramps fabricated in Seattle. Transport is covered under mobilization.

60.02. Pile Driving ** OVERTIME **
50 foot piles x 17.15/LF = $850 ea
Driving tips for boulders

92 piles driven 30 feet into ground = 2760 vlf

	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR PD Pile, steel, pipe, 50' L 12"					850.00	0.00	0.00	0.00	0.00	850.00	
dia, 44 lb/LF, conc filled	92.00	EA		0.00	94,622	0	0	0	0	94,622	1028.50
M MIL PD Pile, steel, pipe, heavy duty					137.57	2.35	193.87	24.38	0.00	355.82	
points, 12" dia	92.00	EA	SIWWE14	0.43	15,315	216	21,581	2,714	0	39,610	430.54
B MIL PD Pile driving and concrete fill					0.00	0.30	19.60	27.75	0.00	47.35	
	2760.00	VLF	ZDPLDRVR	20.00	0	828	65,451	92,680	0	158,132	57.29
TOTAL Pile Driving	92.00	EA			109,937	1,044	87,033	95,394	0	292,364	3177.87

. Floating Docks (Main & Finger)	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
60.05. Floating Docks (Main & Finger)				** OVERTIME **							
USR AA Main and Finger Floats					30.00	0.14	9.46	0.40	0.00	39.86	
	18806	SF	ZDDOCK	50.00	564,180	2,633	177,925	7,579	0	749,684	39.86
TOTAL Floating Docks (Main & Finger)	18806	SF			564,180	2,633	177,925	7,579	0	749,684	39.86
60.17. Float Ramps				** OVERTIME **							
USR AA Float Ramps 2 @ 8' x 60'					55.00	0.14	9.46	0.40	0.00	64.86	
	960.00	SF	ZDDOCK	50.00	52,800	134	9,083	387	0	62,270	64.86
TOTAL Float Ramps	960.00	SF			52,800	134	9,083	387	0	62,270	64.86
60.40. Floating Bwater East Dock & Ramp				** OVERTIME **							
USR AA Floating Ramp 20' x 115'					55.00	0.14	9.46	0.40	0.00	64.86	
	2300.00	SF	ZDDOCK	50.00	126,500	322	21,761	927	0	149,187	64.86
USR AA Floating Dock 20' x 275'					55.00	0.14	9.46	0.40	0.00	64.86	
	5500.00	SF	ZDDOCK	50.00	302,500	770	52,036	2,217	0	356,753	64.86
TOTAL Floating Bwater East Dock & Ramp	7800.00	SF			429,000	1,092	73,797	3,143	0	505,940	64.86
TOTAL FLOATING DOCK FACILITIES	27566	SF			1,155,917	4,904	347,837	106,504	0	1,610,257	58.41

62. PRECAST CONCRETE DOCK ** OVERTIME **
$145/sf cost based on 50' x 100' dock installation in 1988 - less mooring dolphins.

Adjusted to current price level

	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AA Precast Concrete Dock in Place					0.00	0.00	0.00	0.00	145.00	145.00	
	8000.00	SF		0.00	0	0	0	0	1,160,000	1,160,000	145.00
TOTAL PRECAST CONCRETE DOCK	8000.00	SF			0	0	0	0	1,160,000	1,160,000	145.00

70. PRECAST CONCRETE BOAT RAMP ** OVERTIME **

	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
M MIL AA Base course, compacted to 6"					5.08	0.01	0.70	0.24	0.00	6.02	
deep, crushed 3/4" stone, large areas	780.00	SY	COFGB36B	625.00	3,960	10	548	184	0	4,692	6.02
M MIL AA Structural precast, slabs, 12"					14.00	0.00	0.00	0.00	0.00	14.00	
thick, solid, 3000 psi	7000.00	SF	N/A	0.00	98,000	0	0	0	0	98,000	14.00

70. PRECAST CONCRETE BOAT RAMP

	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
MIL AA Precast erection, 60' max rad, 90 ton crane, 9-10 ton/pc, floor deck	28.00	EA	ZDPCAST	1.75	0.00 0	4.00 112	256.84 7,192	83.92 2,350	0.00 0	340.76 9,541	340.76
TOTAL PRECAST CONCRETE BOAT RAMP	7000.00	SF			101,960	122	7,739	2,534	0	112,233	16.03

80. 60 TON BOAT LIFT TRAILER ** OVERTIME **
Conolift model Y60 Boat Lift Trailer 60 ton

$100K purchase price in Ontario, plus $100K transport and assembly.

	QUANTY	UOM	CREW ID	OUTPUT	MATERIAL	MANHRS	LABOR	EQUIPMNT	OTHER	TOTAL COST	UNIT COST
USR AF Conolift model Y60. $100K Transport	1.00	LS		0.00	0.00 0	0.00 0	0.00 0	0.00 0	200000.00 200,000	200000.00 200,000	200000.00
TOTAL 60 TON BOAT LIFT TRAILER					0	0	0	0	200,000	200,000	
TOTAL St.Paul Alaska Small Boat Harbor					1,360,820	16,216	1,094,288	1,060,865	2,683,105	6,199,079	

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTITY UOM	TOTAL DIRECT	OVERHEAD	PROFIT	TOTAL COST	UNIT COST
10 MOB/DEMOB						
10.25 1st Seas. - Tows		301,800	45,270	30,490	377,560	
10.30 1st Seas. Equip Cost During Tow		122,355	18,353	12,361	153,069	
10.35 1st Seas. - Labor Trvl (airfare)		8,100	1,215	818	10,133	
10.38 1st Seas. - Per Diem		57,070	8,561	5,766	71,396	
10.40 2nd Seas. - Tows		506,000	75,900	51,120	633,020	
10.45 2nd Seas. Equip Cost During Tow		178,950	26,843	18,079	223,871	
10.50 2nd Seas. - Labor Trvl (airfare)		15,000	2,250	1,515	18,765	
10.53 2nd Seas. - Per Diem		63,830	9,575	6,449	79,853	
TOTAL MOB/DEMOB		1,253,105	187,966	126,598	1,567,669	
20 HARBOR DREDGING (FED & LOCAL)						
20. 2 Dredging (Federal)	99000.00 CY	419,757	62,964	35,335	518,056	5.23
20. 5 Dredging (Local)	80500.00 CY	284,398	42,660	28,732	355,790	4.42
20.10 Disposal - Harbor Adjacent Fill	53600.00 CY	91,972	13,796	9,292	115,060	2.15
20.15 Disposal with haul	125900.00 CY	276,993	41,549	27,984	346,525	2.75
TOTAL HARBOR DREDGING (FED & LOCAL)	179500.00 CY	1,073,120	160,968	101,343	1,335,431	7.44
22 REVETMENT & EROSION PROTECTION						
22. 5 REVETMENT W/BEDDING	2625.00 CY	100,992	15,149	10,203	126,344	48.13
22.10 EROSION PROTECTION IN CHANNEL	6500.00 CY	210,251	31,538	21,241	263,030	40.47
TOTAL REVETMENT & EROSION PROTECTION	9125.00 CY	311,243	46,686	31,444	389,373	42.67
40 CIRCULATION BERM	2730.00 CY	55,890	8,384	5,646	69,920	25.61
50 BREAKWATER (FEDERAL)	12653.00 CY	423,230	63,485	42,758	529,473	41.85
60 FLOATING DOCK FACILITIES						
60.02 Pile Driving	92.00 EA	292,364	43,855	29,537	365,755	3975.60
60.05 Floating Docks (Main & Finger)	18806.00 SF	749,684	112,453	75,739	937,876	49.87
60.17 Float Ramps	960.00 SF	62,270	9,340	6,291	77,901	81.15
60.40 Floating Bwater East Dock & Ramp	7800.00 SF	505,940	75,891	51,114	632,945	81.15
TOTAL FLOATING DOCK FACILITIES	27566.00 SF	1,610,257	241,539	162,680	2,014,476	73.08
62 PRECAST CONCRETE DOCK	8000.00 SF	1,160,000	174,000	117,192	1,451,192	181.40
70 PRECAST CONCRETE BOAT RAMP	7000.00 SF	112,233	16,835	11,339	140,407	20.06
80 60 TON BOAT LIFT TRAILER		200,000	0	0	200,000	
TOTAL St.Paul Alaska Small Boat Harbor		6,199,079	899,862	599,000	7,697,941	
20% Contingency (not inc. Boat Lift)					1,499,588	

** PROJECT INDIRECT SUMMARY - Feature **

	QUANTITY UOM	TOTAL DIRECT	OVERHEAD	PROFIT	TOTAL COST	UNIT COST
SUBTOTAL					9,197,529	
10% Eng. & Des (not inc. boat lift)					898,039	
SUBTOTAL					10,095,568	
8% Sup & Adm (not inc. boat lift)					793,496	
TOTAL INCL OWNER COSTS					10,889,064	

APPENDIX D

REAL ESTATE PLAN

SAINT PAUL, ALASKA

REAL ESTATE PLAN
ST. PAUL SMALL BOAT HARBOR PROJECT
ST. PAUL, ALASKA

Revised

12 November 2004

Project Purpose: The proposed St. Paul Small Boat Harbor (SBH) project will be located within Village Cove, off English Bay and the Bering Sea, in Section 25, Township 35 South, Range 132 West, Seward Meridian, Alaska. Our Federal General Navigation Features (GNF) and related real estate requirements include the following: an entrance channel, breakwater, berm, an ocean floor riprap area, tidal pool mitigation area, an existing breakwater reconstruction area, bank stabilization area, dredge disposal area, and a staging area (to be determined). The local sponsor is the City of Saint Paul and their Local Service Facilities (LSF) consists of a mooring basin with floating docks. The SBH project is being covered under a General Reevaluation Report (GRR) for a Congressional Add under the 1999 Water Resources Development Act (WRDA).

Real Property Interests Required for the Project: The local sponsor, the City of Saint Paul, will be required to provide all Lands, Easements, and Rights-of-Way (LER) necessary for access, construction, and operation and maintenance of the project. The sponsor will have to provide the LER for the mooring basin and floating docks, a 'Channel Improvement Perpetual Easement' and a 'Temporary Work Area Easement' for the berm tie-in to a small island within Village Cove, and a yet to be determined staging area in the vicinity of the project. Project property interests are further defined in the 'Summary of Required Real Estate Interests' and are shown on the attached map.

Current Land Ownership: The City of Saint Paul has submitted an application to the State of Alaska, Department of Natural Resources, Alaska Division of Lands for the tidelands required for the LSF. Portions of the project tidelands are in dispute status pending appeals by the Tanadgusix Corporation (TDX), the Aleut Corporation, and the City of Saint Paul. The TDX and Aleut Corporations own the surface and subsurface estates respectively, which is a majority of the uplands on St. Paul Island, including those that have been identified for the project.

Federally Owned Lands Within the Project Boundary: No Federally owned lands within the project boundary have been identified, nor are any anticipated to be discovered.

Non-Standard Estates: At this time, there have been no identified non-standard estates required for the project, and none are anticipated.

Existing Federal Projects: Harbor work in St. Paul began in 1989 with construction of an entrance channel, main breakwater, maneuvering basin, and a detached breakwater. In 2000 three (3) off shore reefs along with thirteen (13) sills were constructed as Phase I of the St. Paul Harbor Improvements Project to reduce wave action and scouring of the main breakwater. Current construction, known as Phase II, includes dredging of a second maneuvering basin, a spending beach, a small breakwater, and dredging of a sediment management area, and the Salt Lagoon Channel. Phases I and II are both within close proximity of the proposed Small Boat Harbor project, with only the small breakwater reconstruction area containing 1.47± acres falling within the LER identified for both the small boat harbor and Phase II of the harbor improvement project.

Summary of Required Real Estate Interests:

Federal General Navigation Features (GNF)	Acres	Owner	Interest
Entrance Channel, Berm, and Breakwater < MHW*	5.79	City of Saint Paul	Navigation Servitude
Ocean Floor Riprap Area <MHW	2.52	"	Navigation Servitude
Tidal Pool Mitigation Area <MHW	2.45	"	Navigation Servitude
Breakwater Reconstruction Area <MHW	1.47	"	Navigation Servitude
Bank Stabilization Area < MHW	0.48	"	Navigation Servitude
Dredge Disposal Area < MHW	2.03	"	Navigation Servitude
Berm Tie-In Area > MHW**	0.06	TDX Corp & Aleut Corp	Channel Improvement Perpetual Easement
Berm Tie-In Construction Area >MHW	0.10	TDX Corp & Aleut Corp	Temporary Work Area Easement (3-Years)
Staging Area (to be determined)	1.00	Unknown	Temporary Work Area Easement (3-Years)
Temporary Construction Area		N/A	Navigation Servitude
Local Service Facilities (LSF)			
Mooring Basin and Floating Docks Area	3.10	State of Alaska Pending Sale to City***	Fee

*** Below Mean High Water (< MHW)** **** Above Mean High Water (> MHW)**

***** Alaska Division of Lands Tidelands Sale 227190 Application Pending (SAL TDL ADL 227190 APN)**

Navigation Servitude: The Government's dominant right of Navigation Servitude will be exercised for project tidelands below the Mean High Water (MHW) Line for the Federal GNF and real estate related portions of the project. Only a small portion of a project feature is above MHW.

Real Estate Map: A map depicting the real estate required for the St. Paul Small Boat Harbor Project is shown as Attachment 1.

Potential Flooding, Induced by Construction, Operation or Maintenance of the Project: No potential flooding is anticipated due to construction, or operation and maintenance of the harbor project.

Baseline Cost Estimate: An informal value estimate for lands and related costs is shown below. Administrative costs are for mapping, title work, surveying, appraisal, and the final crediting process.

	Federal	**Local Sponsor**
Lands		$04,000.00
Administrative Costs	$15,000.00	$15,000.00
TOTAL Real Estate Costs	**$15,000.00**	**$19,000.00**

Relocation Assistance Benefits: No persons or businesses are anticipated to be displaced by this project. Therefore, no assistance benefits under Public Law 91-646 should be required.

Mineral Activity: There is no known mineral activity occurring within the lands required for the project.

Local Sponsor's Real Estate Acquisition Capability Assessment: Is shown as Attachment 2.

Application or Enactment of Zoning Ordinances: No enactments or applications for zoning have been located that affect the project.

Schedule: A detailed schedule for the SBH project real estate actions has not been developed at this time. Acquisition and certification of project lands is anticipated to take four (4) to six (6) months.

Relocations of Facilities, Roads and Utilities: No utilities, roads, or facilities have been identified that will require relocations.

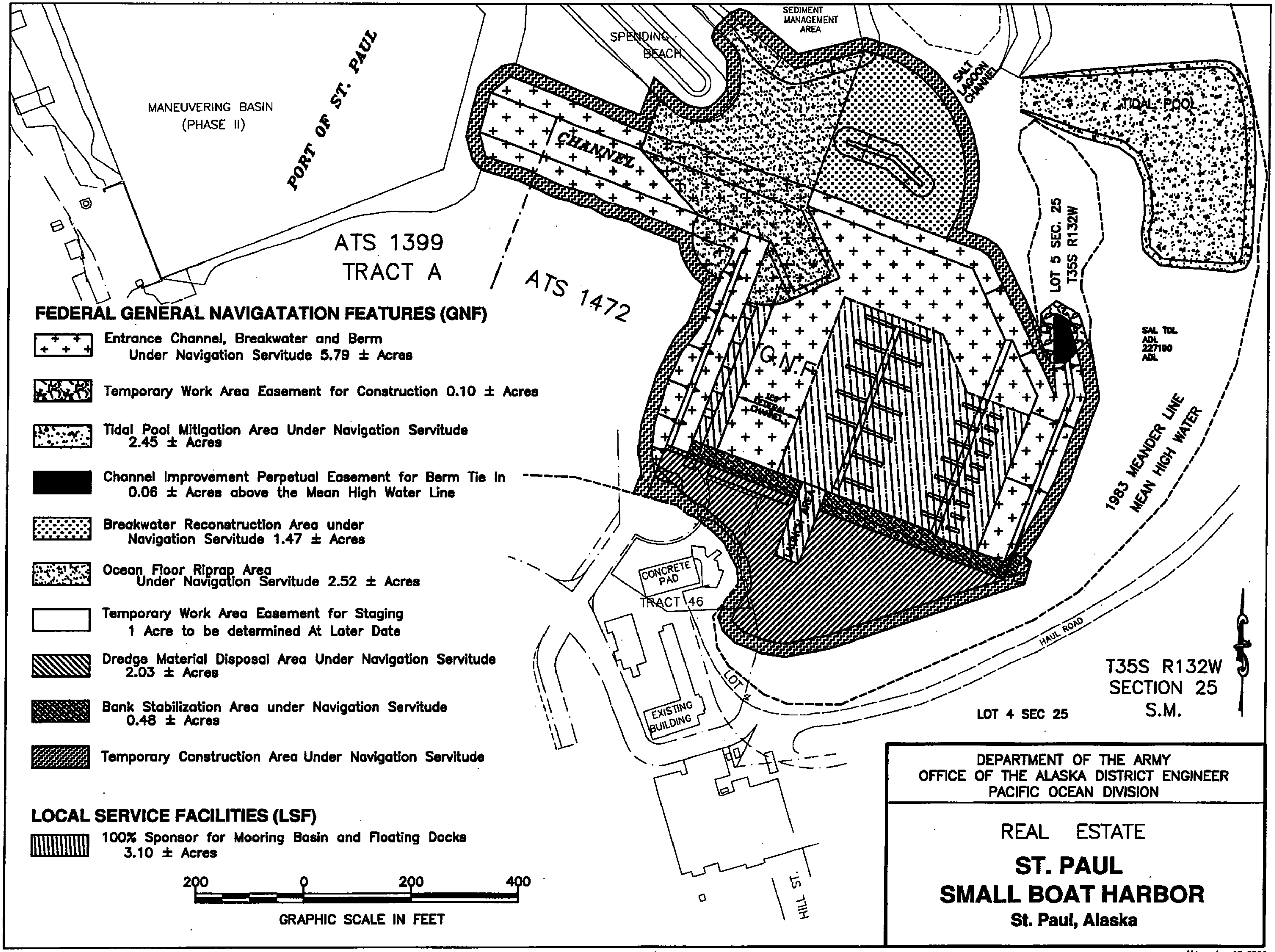
Hazardous, Toxic and Radioactive Waste (HTRW): There are no known hazardous and/or toxic and radioactive waste on the land required for the project.

Known or Anticipated Support or Opposition to the Project: There is strong support for the small boat harbor from the local community. However, there is controversy amongst the City, TDX Corporation and the Tribal Government of St. Paul over who will control the SBH after it is constructed and how it will be managed. The City of Saint Paul anticipates opposition from TDX Corporation regarding the perpetual and temporary work area easements for the berm tie-in required for the project. The City may request the Corps assistance if they are unable to acquire the necessary interests from the TDX Corporation.

Planning Real Estate Issues: Project design and implementation of the project are not anticipated to create any further planning issues.

This Real Estate Plan was prepared, written and revised by Karen L. Pontius, Acquisition Realty Specialist.

CORPS OF ENGINEERS U.S. ARMY



November 12, 2004

ATTACHMENT 1

NON-FEDERAL SPONSOR'S REAL ESTATE ACQUISITION CAPABILITY ASSESSMENT CITY OF SAINT PAUL SMALL BOAT HARBOR PROJECT

I. Legal Authority:

a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes? Yes

b. Does the sponsor have the power of eminent domain for this project? No. The City would have to obtain such authority by ordinance that is submitted to and approved by the voters at a general election or special election called for that purpose. [AS 29.35.030(a)].

c. Does the sponsor have a "quick-take" authority for this project? No

d. Are any of the lands/interests in land required for the project located outside the sponsor's political boundary? No

e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn? Yes, State of Alaska Tidelands below Mean High Water. The City's application for ownership of the tidelands required for the project is pending final approval.

II. Human Resource Requirements:

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including P.L. 91-646, as amended? No

b. If the answer to IIa is yes, has a reasonable plan been developed to provide such training?

c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project? Yes

d. Is the sponsor's projected in-house staffing level sufficient considering its other work load if any, and the project schedule? Yes

e. Can the sponsor obtain contractor support, if required, in a timely fashion? Yes

f. Will the sponsor likely request USACE assistance in acquiring real estate? No

ATTACHMENT 2

NON-FEDERAL SPONSOR'S REAL ESTATE ACQUISITION CAPABILITY ASSESSMENT CITY OF SAINT PAUL SMALL BOAT HARBOR PROJECT

III. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site? Yes

b. Has the sponsor approved the project/real estate schedule/milestones? A real estate schedule has not been determined at this time, however, the City is aware of the process for approval, acquisition and certification of project lands.

IV. Overall Assessment:

a. Has the sponsor performed satisfactorily on other USACE projects? Yes, the City has participated on other Corps projects.

b. With regard to this project, the sponsor is anticipated to be: highly capable/ **fully capable**/moderately capable/marginally capable/insufficiently capable.

V. Coordination:

a. Has this assessment been coordinated with the sponsor? Yes

b. Does the sponsor concur with this assessment? Yes

SOURCE:

John R. Merculief
City Manager, Saint Paul
City Office 907-546-2331
Fax 907-546-3188

Prepared By:

Karen L Pontius

Name: Karen L. Pontius
Title: Realty Specialist/Acquisition Section
Date: 22 Apr 2004

Reviewed and approved by:

Harold D. Hopson

Harold D. Hopson
Chief, Real Estate Division
Alaska District Corps of Engineers

APPENDIX E
SPONSOR LETTER OF INTENT
SAINT PAUL, ALASKA

CITY OF SAINT PAUL
P.O. BOX 901
SAINT PAUL ISLAND, ALASKA
99660-0901
(907) 546-2331
FAX (907) 546-3188

March 22, 2003

Colonel Steven Perrenot
District Engineer
U.S. Army Corps of Engineers
PO Box 898
Anchorage, AK 99506-0898

Subject: Saint Paul Small Boat Harbor Project

Dear Col. Perrenot:

The City of St. Paul, the local sponsor, continue to be actively involved in the development of the Small Boat Harbor component of our Harbor Improvements project. We have participated enthusiastically and financially at every stage of the project, including development of the NED plan.

The Small Boat Harbor is a critical component of the community's effort to establish its role as a fisheries facility within the Central Bering Sea. The city understands the obligation for paying for the local share of the navigation features as well as the local service facilities of the Small Boat Harbor. As you are aware, the local sponsor's share of the Small Boat Harbor Project is contained in the State of Alaska, Governor's budget for 2004. Based on meetings with commissioners, key governor personnel and representatives to the House and Senate, the funds should remain within the budget. It is our understanding that the local sponsor's share of the navigation features is $612,000.

The City of St. Paul is aware of the local service facilities required by this project including docks, mooring area, floating docks, boat ramps, dredging and upland facilities. The Alaska District has estimated that these facilities will cost an additional $ 6,764,584. These costs will be born by the Central Bering Sea Fishermen's Association, who at the direction of the State of Alaska, has been saving funds for the past three years and will continue to set aside revenues to ensure local service facility construction, operation and maintenance (estimated at $60,000 per year) pursuant to terms of a lease agreement between the local sponsor and the lessee. CBSFA's pro rata share of capital costs equal approximately $3,830,289.

The Tribal Council (IRA) of Saint Paul will lease the remaining non-navigation area of the Small Boat Harbor, with associated development costs estimated by the Alaska District of $2,924,311. We believe that some of the estimates are unusually high and will be significantly lowered by using other construction techniques and schedules to reduce mobilization and demobilization costs as well as less expensive dock fabrication and installation. Under our lease with the IRA they will be responsible for leasehold improvements and operation and maintenance expenses (estimated at $60,000 per year) for their leased area.

The City of St. Paul has the financial resources and authority to secure additional funding for the project to ensure benefits accrue according to the NED.

We commend your personnel is working with us on this important project and look forward to our continuing relationship on this important project.

Sincerely,

John R. Merculief

John R. Merculief
City Manager