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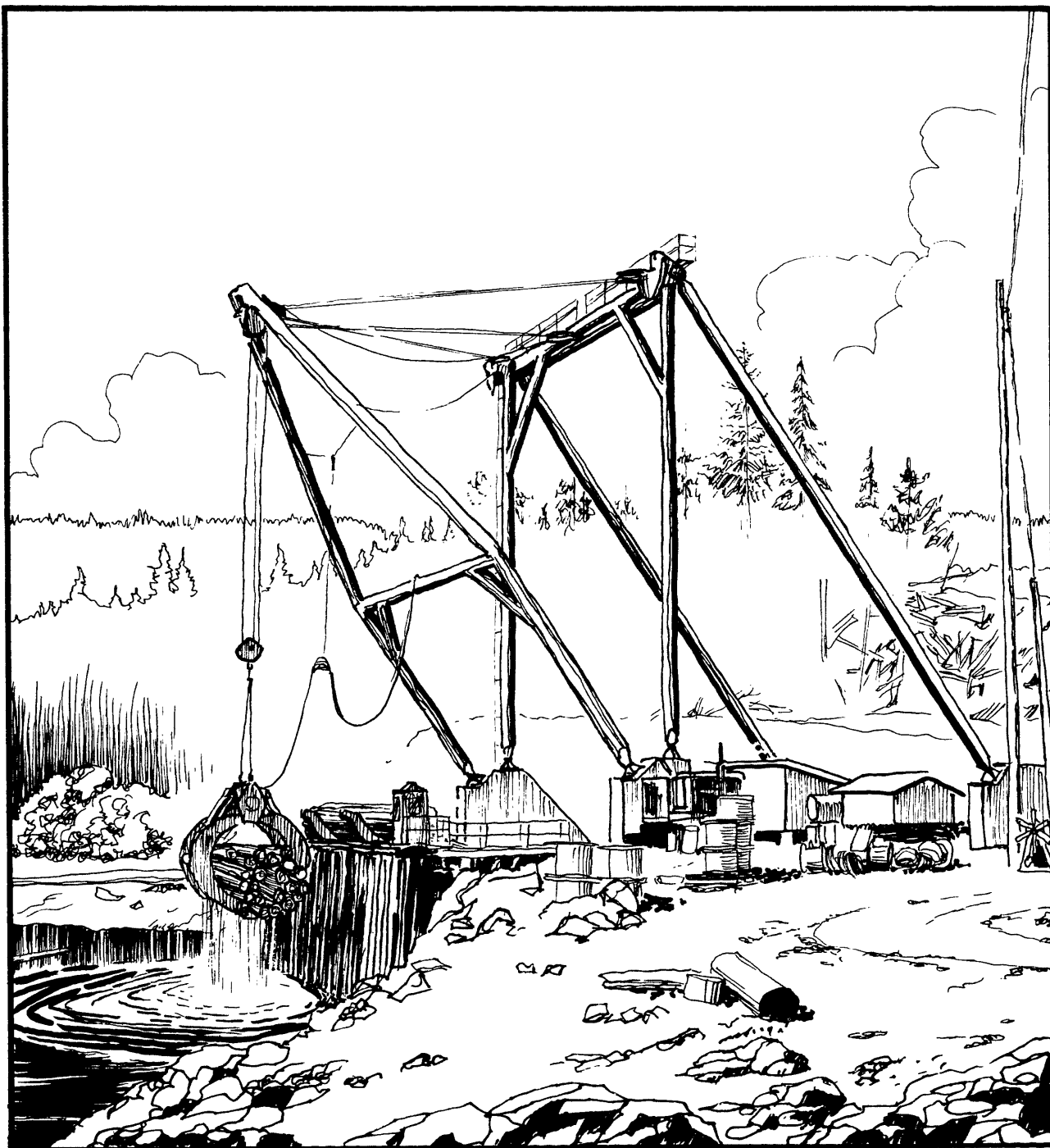
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Log Transfer and Storage Facilities in Southeast Alaska: A Review

Tamra L. Faris and Kenneth D. Vaughan

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Abstract

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The volume of timber harvested in southeast Alaska between 1909 and 1983 was 14,689 million board feet; nearly all was transported on water to various destinations for processing. In 1971 there were 69 active log transfer and storage facilities and 38 raft collecting and storage facilities in southeast Alaska. In 1983 there were 90 log transfer sites, 49 log storage sites, 228 sites proposed for log transfer development, and 12 sites proposed for log storage development. We calculated that there were 176 acres of estuarine habitat covered by bark from 90 log transfer sites in 1982. Additional habitat was covered by bark at log storage sites. In 1981, approximately 1,388 acres would have been covered by log rafts at some time. The statistics for numbers of log transfer and storage sites no longer in use are too incomplete for use in estimating bark coverage.

The options for handling logs at a saltwater facility are land-to-water (rafting), land-to-vessel (barging or shipping), and land-to-water-to-ship (loading barge or ship from water). The A-frame has been the preferred device for log transfer because of operating economy and availability. Other transfer methods include chain conveyors, "beaver slide" ramps, and rockfill ramps.

Keywords: Log transfer, log storage, Alaska (southeast), southeast Alaska.

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Introduction

Timber harvest was begun in the early 1900's in southeast Alaska, but became a major economic influence only in the 1950's (Selkregg 1974). The total volume of timber harvested from the Tongass National Forest between 1909 and 1983 was 14,689 million board feet;¹ nearly all of this timber was transported on water to various destinations for processing. Because fishery resources are related to habitat quality, fish habitat needs to be protected where log transfer and storage sites occur over biologically productive portions of the estuaries.

Log transfer activities and their related effects on the marine environment of southeast Alaska have been of concern since the early 1970's. Several reviews discuss the types of environmental problems encountered with log transfer and storage in estuarine habitat² (Hansen and others 1971, Koski and Walter 1978, Sedell and Duval in press, Toews and Brownlee 1981).

Environmental concern centers on five basic types of disturbance caused by log transportation activities:

1. Bark and wood lost into the marine environment with resultant physical, chemical, and biological effects.
2. Compression of substrate, shading of water column, and breakwater effect of rafts.
3. Modifications to the shoreline and intertidal areas to accommodate the facilities and equipment.
4. Presence of log transfer and storage facilities, which create conflicts over access among resource users.
5. Effects of facilities associated with logging and log transfer operations, such as fuel transfer facilities, camps, and docks, that increase the likelihood of other environmental impacts.

Coves and bays are often the most biologically productive portions of an estuarine system. They also provide the best protection from wind and swell and, therefore, are preferred locations for log transfer and storage. The topography of the islands and mainland of southeast Alaska is mountainous with steep cliffs and slopes: a stream at the head of each valley drains into an estuary. "Natural corridors" for roads also terminate near the valley head rather than traverse steep topography to connect with another drainage. Areas with adjacent freshwater inputs are also chosen for log storage because of the assumption that an area with lower salinity has increased protection from marine borers (*Bankia setacea*). Although fresh water does kill marine borers, the effectiveness of freshwater influence has not been documented for intertidal waters in southeast Alaska.

¹Reports on file, USDA Forest Service, Alaska Region, Federal Office Building, Box 1628, Juneau, AK 99802.

²Unpublished report, 1980, "A Review of the Impacts of Log Handling on Coastal Marine Environments and Resources," by Wayne S. Duval and F. F. Slaney, prepared for the Council of Forest Industries. On file at Environmental Sciences Limited, Vancouver, British Columbia.

Estuaries used for log transfer and storage are affected to varying degrees by the accumulation of bark and woody debris around the entry and storage sites and by physical modifications such as fill, riprap, and piling. Bark sluffed during transfer and storage can accumulate, cover the bottom, and smother existing habitat and sessile organisms. There are indications that water quality around or in bark accumulations is also affected to varying degrees³ (Pease 1974). The amount of dilution or flushing is the main factor determining effects near the transfer or storage sites.

This paper consolidates information on the numbers of log transfer and storage sites and presents an overview of the design and biological problems that arise from location of these facilities. Included is a summary of the features of transfer facilities and ideas on siting and engineering design. The purpose is to review and quantify, in part, impacts the timber harvest industry has on intertidal and estuarine habitat. Such a review may be useful for planning and evaluation of future tideland uses.

Sources of Records on Log Transfer and Storage Sites

The number of log transfer facilities in southeast Alaska was determined from the records of permitted or leased facilities and public easements. Management of the tidelands used for that purpose was transferred to the State of Alaska in 1959. Log transfer and storage activities that affect navigable waterways are also regulated by other authorities: Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403), Sections 404 and 401 of the Clean Water Act (33 U.S.C. 1344), the Fish and Wildlife Coordination Act (16 U.S.C. 661-663), and Section 307 of the Coastal Zone Management Act (PL 92-583).

The Corps of Engineers issues Department of the Army permits to perform work in or affecting navigable waters pursuant to Section 10 of the Rivers and Harbors Act, or to discharge dredged or fill material into waters pursuant to Section 404 of the Clean Water Act (Kyle 1982, State of Alaska 1981). The Corps of Engineers identifies activities by name of a nearby waterway and a unique number under the heading of that waterway.

The State of Alaska also has a permit and leasing system for activities on State-owned tideland and submerged land. Applications are numbered, filed consecutively and, when approved, plotted on maps. The facility drawings and location references are usually the same as those submitted for the Department of the Army permits.

Since summer 1982, the Alaska Department of Natural Resources (ADNR) has issued easements for access in the Tongass National Forest. Log transfer is usually the initial purpose for the easement, but it is a permanent easement that also can be used for forest management, contract work, recreation, or other commercial access at the site. Mapping the easement and marking it with monuments are stipulated by the State and by the USDA Forest Service.

³Personal communication, Charles O'Clair, National Marine Fisheries Service, Auke Bay Laboratory, Auke Bay, AK 99821.

Number of Log Transfer and Storage Sites

Spear⁴ notes that permit records were not always accurate representations of actual facilities. For instance, a permit may have been granted, but the facility may never have been built. Many facilities do not resemble the plans that were originally submitted. No studies have quantified the divergencies from actual permitted activities. Spear also noted a lack of uniformity in the information from the Corps of Engineers in terms of timeliness of activities and terminology used. The words "destroyed," "removed," and "abandoned" all mean the facility is not presently in use, but its condition is unknown. Unless the information is provided in applications, the Corps of Engineers or ADNR are not usually aware if a facility is closed permanently or just for a few years until timber harvest in that drainage resumes.

Summaries of the number of permits are not available from either the Corps of Engineers or the ADNR. Records have not been maintained of active log transfer sites or of the degree of activity. The Alaska Department of Environmental Conservation (ADEC) has two inventories of log transfer and storage sites. The first inventory (Wells 1971) found 69 active log transfer and storage facilities and 38 raft collecting and storage facilities in southeast Alaska. The second inventory (see footnote 4) did not summarize the data, but rather plotted on maps those facilities then in use. This 1976 inventory showed 43 active log transfer and storage sites and 47 raft collecting and storage sites. It is not known which of these sites were established since the 1971 inventory. In addition there is a Directory of Permits (Alaska Department of Environmental Conservation 1978 with 1979 update) that lists all tideland users according to location and a marine facilities coastal inventory which lists permits.⁵

The number of sites used for log transfer at any given time depends on timber market and harvest schedules. Most sites are used intermittently; that is, a site is built for a specific harvest period, then after the harvest in that area is completed, the Department of the Army permit and the State tidelands lease may be kept active for future timber harvests or allowed to terminate. The USDA Forest Service is planning for more frequent use of sites for log transfer due to increased activity with salvage sales and for a USDA Forest Service-Small Business Administration set-aside program to direct preparation of smaller sale volumes. This may increase periodic reuse of facilities over an extended period with associated chronic environmental impacts.

⁴A preliminary inventory of coastal timber industry facilities and operations, 1976, by Andrew M. Spear, prepared by Water Programs/Environmental Analysis Section, Alaska Department of Environmental Conservation, through a Reimbursable Services Agreement for the Alaska Coastal Management Program, Juneau, AK. 32 pages and a separate 102-page map section.

Unpublished data, 1975, "Marine Facilities Coastal Inventory," by Tryck, Nyman and Hayes, Juneau, AK. 1,197 pages. On file at the State of Alaska, Department of Environmental Conservation library, Juneau, AK 99802.

Table 1—Summary of the number and type of timber transportation facilities as plotted on the map, “Southeast Alaska Tideland Locations for Log Transfer and Storage” (located in cover pocket)

Type of facility	Forest Service administrative areas			
	Chatham <u>1/</u>	Stikine	Ketchikan	Total
Existing log transfer site	23	24	43	90
Existing log storage site	16	18	15	49
Proposed log transfer site <u>2/</u> <u>3/</u>	103	43	82	228
Alternate proposed log transfer site <u>2/</u> <u>3/</u>	8	18	14	40
Proposed log storage site <u>3/</u>	1	0	11	12
Log transfer site no longer in use	23	10	25	58
Log storage site no longer in use	8	13	19	40
Major processing center	2	2	6	10

1/ Includes Yakutat and State lands in the Haines area.

2/ Alternate sites were not included in the number of “proposed log transfer sites” because presumably only one will be developed--either the one proposed or its alternate.

3/ The time horizon for construction of proposed sites is 50 years.

The map, “Southeast Alaska Tideland Locations for Log Transfer and Storage” (located in cover pocket), reflects information from many sources but is largely based on the ADNR land status maps. No judgments on the economic or biological value of the sites indicated as “proposed for future development” were made. The source maps were prepared based on information provided by the USDA Forest Service, private landowners, and industry. The compiled information in table 1 reflects the summation from all the sources of information. The forest supervisors of the Tongass National Forest provided much of the initial information to the ADNR and refined the information concerning the National Forest. The map was also condensed (fig. 1) to show frequency and distribution of log transfer and storage activities.

The number of active log transfer sites in southeast Alaska, as shown on the map, appears to be related to the volume of timber harvested (roughly 10 million board feet per site was harvested). The total timber volume cut in the Tongass National Forest peaked in 1973 at 588 million board feet, and the peak reported for southeast Alaska occurred the same year at 599 million board feet (table 2). In 1971, during Wells’ inventory, harvest was 528 million board feet from the Tongass National Forest and there were 69 active log transfer and storage facilities. In 1976, harvest was 463 million board feet and there were 43 active log transfer and storage sites (see footnote 4). In 1981, harvest was 386 million board feet and there were 87 log transfer sites under permit, although less than 40 were active. Timber harvest in the Tongass National Forest is now set at 4.5 billion board feet per decade by the Alaska National Interest Lands Conservation Act. The trend toward sales of smaller volume will result in a larger number of permitted sites with each handling a lower volume of timber.

A total of 228 new log transfer sites and 12 new storage sites have been identified for possible development in the next 50 years. Depending on review by State and Federal agencies and the constraints imposed on the developer, alternative sites may be chosen and some may never be developed.

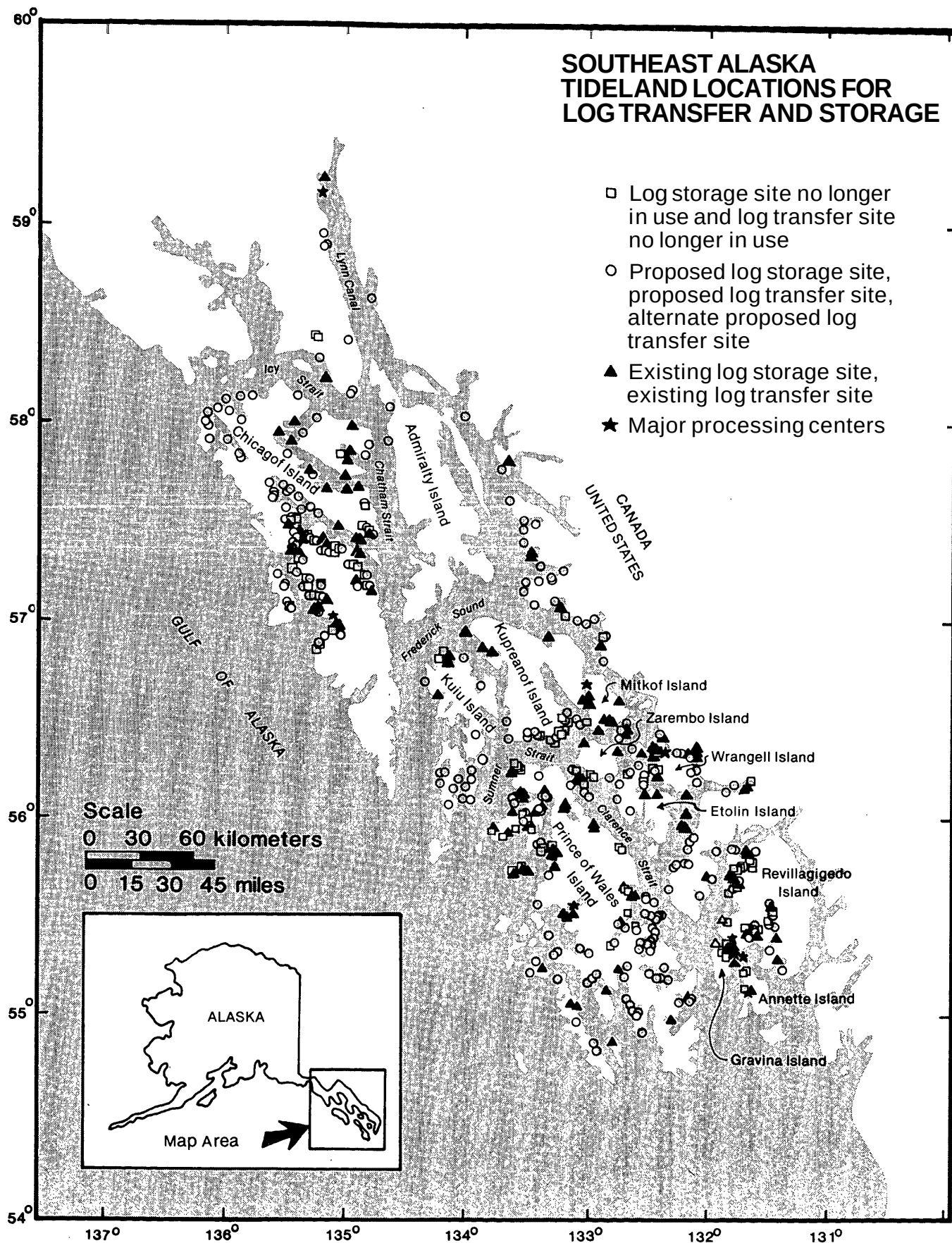


Figure 1.—A condensed map of the log transfer and storage activities in southeast Alaska (large map is located in cover pocket).

Table 2—Timber harvested in southeast Alaska, including the Yakutat area, in thousand board feet

Year	Tongass National Forest 1/	Alaska State lands 2/	Private lands 3/	Total
1909-16	234,488	--	--	234,488
1917	41,002	--	--	41,002
1918	43,114	--	--	43,114
1919	37,374	--	--	37,374
1920	45,609	--	--	45,609
1921	11,651	--	--	11,651
1922	20,623	--	--	20,623
1923	40,463	--	--	40,463
1924	48,646	--	--	48,646
1925	53,723	--	--	53,723
1926	50,992	--	--	50,992
1927	52,000	--	--	52,000
1928	33,766	--	--	33,766
1929	42,015	--	--	42,015
1930	38,517	--	--	38,517
1931	18,234	--	--	18,234
1932	14,699	--	--	14,699
1933	14,664	--	--	14,664
1934	28,151	--	--	28,151
1935	30,454	--	--	30,454
1936	39,964	--	--	39,964
1937	35,316	--	--	35,316
1938	25,585	--	--	25,585
1939	26,492	--	--	26,492
1940	30,861	--	--	30,861
1941	35,787	--	--	35,787
1942	38,535	--	--	38,535
1943	73,590	--	--	73,590
1944	86,840	--	--	86,840
1945	58,268	--	--	58,268
1946	48,952	--	--	48,952
1947	83,385	--	--	83,385
1948	81,010	--	--	81,010
1949	49,220	--	--	49,220
1950	54,435	--	--	54,435
1951	52,894	--	--	52,894
1952	63,357	--	--	63,357
1953	59,196	--	--	59,196
1954	109,237	--	--	109,237
1955	213,785	--	--	213,785
1956	230,198	--	--	230,198
1957	226,383	--	--	226,383
1958	167,520	--	--	167,520
1959	266,591	--	--	266,591

Table 2—Timber harvested in southeast Alaska, including the Yakutat area, in thousand board feet (continued)

Year	Tongass National Forest <u>1/</u>	Alaska State lands <u>2/</u>	Private lands <u>3/</u>	Total
1960	347,496	210	--	347,706
1961	338,207	<u>4/</u> 1,967	--	340,174
1962	366,276	<u>4/</u> 6,872	--	373,148
1963	395,143	<u>4/</u> 10,633	--	405,776
1964	443,736	<u>4/</u> 18,144	--	461,880
1965	397,610	<u>4/</u> 24,161	--	421,771
1966	474,277	20,594	--	494,871
1967	474,337	45,701	--	520,038
1968	529,496	41,411	--	570,907
1969	519,343	33,506	--	552,849
1970	560,081	35,876	--	595,957
1971	527,737	26,737	--	554,474
1972	547,500	24,920	--	572,420
1973	588,491	10,419	--	598,910
1974	544,025	6,806	--	550,831
1975	408,371	3,289	--	411,660
1976	462,776	350	--	463,126
1977	447,332	4,636	--	451,968
1978	398,700	3,453	--	402,153
1979	453,194	729	--	453,923
1980	452,122	5,111	70,300	527,533
1981	385,685	6,786	<u>5/</u> 122,000	514,471
1982	344,857	<u>5/</u> 5,400	<u>5/</u> 209,200	559,457
1983	251,177	<u>5/</u> 2,500	<u>5/</u> 232,000	485,677
Total	13,715,555	340,211	633,500	14,689,266

1/ "USDA Forest Service Cut & Sold Report," and other reports, assembled by Dan MacPherson, U.S. Department of Agriculture, Forest Service, Alaska Region, Juneau, AK 99802. Figures include utility grade logs.

2/ Personal communication, Craig Olson, Alaska Department of Natural Resources, Pouch 7-005, Anchorage, AK 99510. Almost all the cut was from the Haines area and was milled at the Schnabel Lumber Co. mill and did not go into the water for transport.

3/ Saddler 1982.

4/ Figures for these years include northern Alaska harvest which was a small amount compared to southeast Alaska harvest.

5/ Values taken from the draft report, "Timber Supply Demand Report, 1983," U.S. Department of Agriculture, Forest Service, Alaska Region, Juneau, AK 99802.

The number of long-term raft storage sites has remained fairly constant over the past 20 years. Forty-nine log storage sites are now permitted; 40 storage sites have been abandoned; 12 storage sites are proposed. This ratio is as expected since the sites are located in protected areas along established raft-towing routes; therefore, the best sites have already been developed and remain in use. This could change following a change in location of harvest areas or raft-towing routes. The intensity with which a storage site is used depends on the weather and timber market in the short term and trends in transportation in the long term.

Effects of Primary Manufacture Requirements

Timber harvested from National Forest and State lands must, by law, undergo primary processing in Alaska. Primary manufacture usually consists of cutting suitable saw logs into waney and cants or of chipping the logs for pulp usage. Distance from harvest location to the mill ranges from 5 to 280 miles (Sedlac 1982). Timber harvest on State-owned or privately owned land has been very small in the past (table 2). The only significant sales from State-owned land in southeast Alaska were near Haines where the timber was trucked directly to the mill. This has changed since the Statehood and Alaska Native Claims Settlement Acts transferred extensive areas of forested land in southeast Alaska to private ownership.

It is more financially rewarding to export round rather than processed logs⁶ and private landowners have taken advantage of this. As mentioned, timber from National Forest and State lands must undergo primary manufacture within the State prior to export or interstate shipment. Transportation from the harvest site to a milling location is necessary prior to shipping to a market. For round-log export, loading points from land to water to ship, or from land to ship, are needed reasonably near the harvest site. If land-to-ship loading facilities are constructed, the potential environmental impacts change from debris accumulation in the water to quantity of habitat used to construct the facility and to facility-related pollutants.

Estuarine Area Affected by Bark and Debris Accumulations

The percentage of estuarine or cove and bay areas currently covered by bark deposits from log transfer activities is based on an estimate of the total area of estuary in southeast Alaska. This is complicated because southeast Alaska consists of many islands and large fiords; thousands of streams and rivers are associated with these features. Depending on the definition of an estuary, the entire Inland Passage of southeast Alaska can be called an estuary, or it can be divided into hundreds of smaller estuaries.

⁶Unpublished administrative report, 1984, "Timber Supply and Demand, 1983," by Joseph R. Mehrkens, U.S. Department of Agriculture, Forest Service, Alaska Region, Federal Office Building, Box 1628, Juneau, AK 99802.

Table 3—Estuarine area for Tongass National Forest, southeast Alaska

Management area	Major drainages with estuarine area	Total estuarine area	Estuarine area less than 60 ft. deep	Area less than 60 ft. deep
	<u>Number</u> ^{1/}	<u>Acres</u>		<u>Percent</u>
Chatham	242	807,047	312,058	39
Stikine	87	339,360	225,080	66
Ketchikan	214	425,831	192,364	45
Total	543	1,572,238	729,502	46

^{1/} These numbers are not intended to represent the number of estuaries, but rather, drainages that terminate in estuaries.

In 1976, the area of all protected bays and estuaries 100 acres or more in size and adjacent to the Tongass National Forest was determined? The areas were calculated by use of a planimeter on maps scaled at 1 inch to the mile. Total estuarine area and the area within each estuary with a depth of 60 feet or less were calculated (table 3). The 60-foot-depth distinction was selected as a result of observations by various resource agency diver-biologists. They observed that the abundance of large macrophytic algal vegetation occurring in the subtidal zone was limited mostly to water depths shoreward of 60 feet.⁸ Glacier Bay, upper Lynn Canal, and Annette Island were not included in the original data. Data were recorded for 543 individual areas, which in total do not equal the entire southeast Alaska waterway. Deep, open waterways between islands, such as parts of Chatham, Icy, Sumner, and Clarence Straits and Frederick Sound, were not considered estuaries, although they are definitely influenced by fresh water. This is appropriate for our use because these waterways are not protected areas desirable for log transfer or storage. The estuaries were often divided for the convenience of associating specific areas with major streams, so it was not reasonable to sum the area counts or to conclude that there are 543 estuaries. We therefore summed from data in Blankenship's report (see footnote 7) and found that there are approximately 1,572,238 acres of protected estuarine waters in southeast Alaska.

Unpublished report, 1976, "Estuary Rating Forms for Tongass Land Management Plan," by John Blankenship, U.S. Fish and Wildlife Service, Box 1287, Juneau, AK 99802.

*Personal communication, Ron Berg, U.S. Department of Commerce, National Marine Fisheries Service, Alaska Region, Box 1668, Juneau, Alaska 99802.

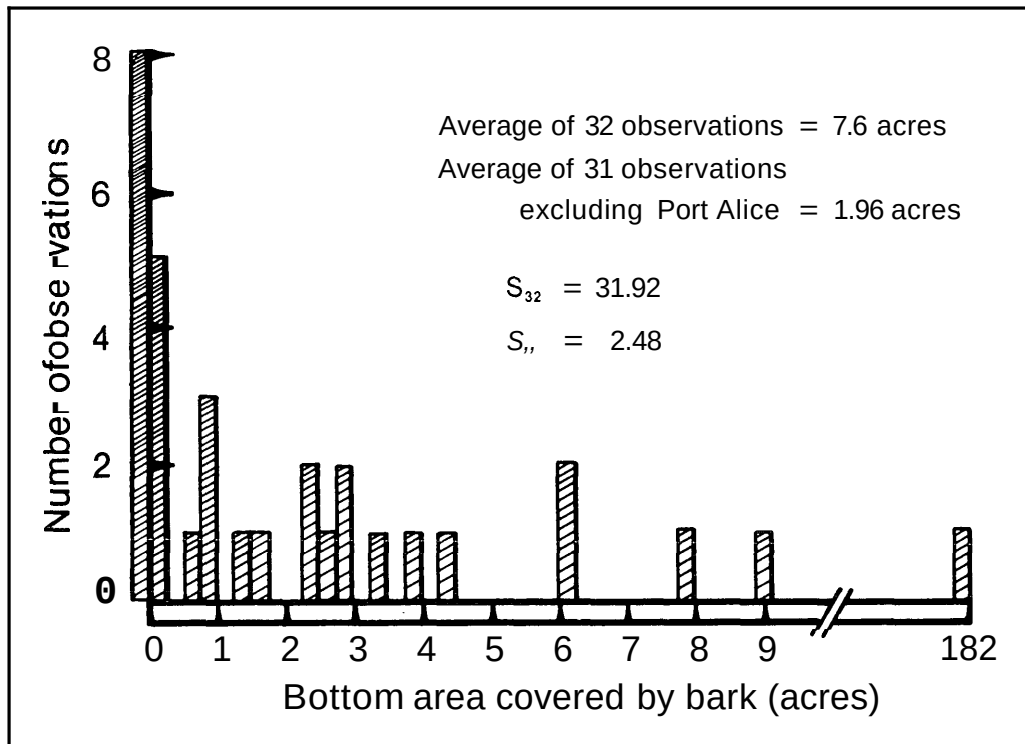


Figure 2.—Occurrences of observations of specific acreages of bark coverage (data from Schultz and Berg 1976). S_{32} is the standard deviation of 32 observations; S_{31} is the standard deviation of 31 observations.

A study of 32 inactive log transfer facilities was conducted in southeast Alaska to measure the area of bark coverage to the 60-foot depth near each transfer facility (Schultz and Berg 1976). For 31 of the sites, the areas covered by bark ranged from 0 to 9.0 acres. The 32d site (Port Alice) had 182.0 acres of bark coverage. Port Alice was not included in calculations in Schultz and Berg (1976) because the location of the site was thought to correspond with an extensive rafting area, and natural accumulation of debris was such that it was not possible to distinguish bark accumulation caused by the transfer facility. Where bark accumulations were too small to measure, or spotty over the area, Schultz and Berg (1976) recorded the area affected as having a "trace." In this report, a "trace" has been approximated at 0.1 acres. The mean bark coverage for the 31 observations was 1.96 acres with a mode of 1.0 acre (fig. 2). This 1.96-acre value represents a weighted average of conditions at only one point in time.

The sites examined ranged from those having recent usage to those not actively used for many years. The amount and location of bottom that is covered by bark may be affected by currents, deposits of silt, and changes in the log transfer operation. Recolonization rates are not known, and it is also uncertain whether or not the habitat is recolonized by the original species present before bark deposition occurred.

A histogram (fig. 2) was developed using data presented by Schultz and Berg (1976), and an empirical probability curve (fig. 3) was generated. The function appearing in figure 3 shows a strong negative exponential fit to the data.

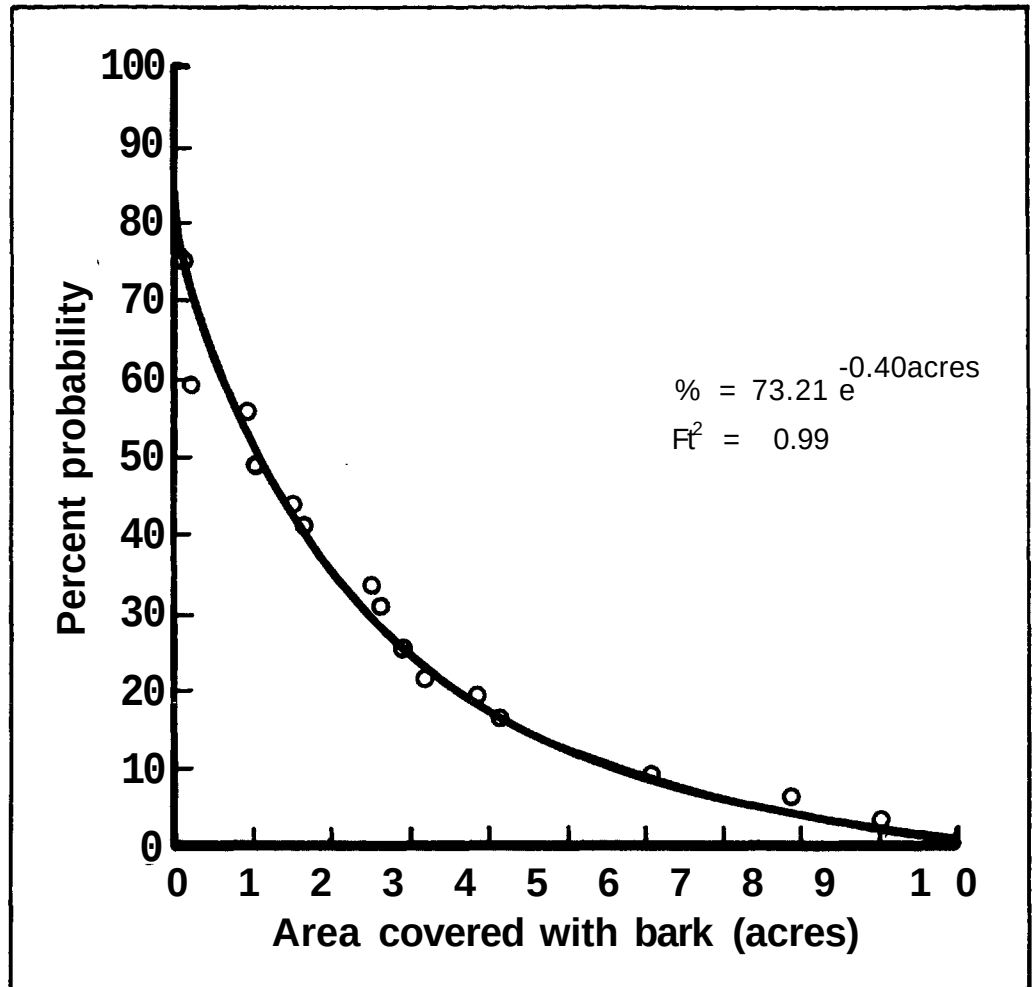


Figure 3.—A predictive model of the probability of exceeding a given acreage of bark covering the estuarine bottom. The curve is a plot of the 31 points of data (excluding Port Alice) in Schultz and Berg (1976).

The length of time debris remains in place after a site becomes inactive is not known and is likely to be highly variable. Bark and debris decay slowly and can remain for many years because of the cold water in the area (Ellis 1970). Fifteen of the sites studied by Schultz and Berg (1976) had been active within the previous 1 to 10 years. The average bark accumulation of these sites was 2.8 acres. Sixteen of the sites had been inactive for periods of 10 to 16 years and had retained an average accumulation of 1.2 acres. This difference suggests the bark and debris accumulation had decreased over time. There have also been changes in sale routine, transfer methods, and size of logs harvested. This may account for differences in area of debris accumulation.

Although 13 of the sites in Schultz and Berg's (1976) study had no accumulation or just a trace of bark or debris directly around the site, the transfer process presumably generated debris that was (1) transported by gradient, currents, or tide to deeper water, (2) covered with sediment, or (3) decayed. Regardless of the dispersal process, accumulations of bark were not measurable at these sites.

Using the 729,502 acres of estuarine area that was less than 60 feet deep (table 3) and the total number of transfer sites shown in inventories, it was possible to estimate the percentage of estuarine area covered by bark accumulations as a result of land-to-water log transfer facilities. This usage was based on the assumption that measurements obtained by divers using scuba gear would not extend to depths much greater than 60 feet. In 1982, there were 90 permitted transfer sites; assuming that an average of 1.96 acres of estuarine bottom at each site was covered with bark and debris, then the total area covered was 176 acres, or 0.02 percent of the total estuarine area that is less than 60 feet deep.

This estimate applies only to log transfer facilities now in use. Additional estuarine habitat is covered by bark and debris from related uses such as (1) log transfer sites no longer in use, (2) log storage sites no longer in use, (3) log storage sites presently in use, and (4) accumulations at depths greater than 60 feet. No data are available for estimating coverage caused by these sources.

Depending on the geophysical aspects of the site, a debris accumulation can decrease by (1) dispersal to deeper water by tidal currents (perhaps accelerated by storms), (2) burial by sedimentation, or (3) decomposition in place. In most cases, a combination of these actions probably occurs. A fourth method of decreasing debris accumulation is mechanical removal by suction dredge, clamshell, or similar equipment. No mechanical removal has yet occurred in southeast Alaska, although it has been stipulated in some Department of the Army permits.

Potential area of coverage by bark and debris can be predicted. The total potential number of log transfer sites (currently permitted plus proposed) is 317, and the average area of expected bark coverage is 1.96 acres per site. The expected area of accumulation is 621 acres, or 0.09 percent of the available estuarine area that is less than 60 feet deep.

Log storage sites are additional contributors of bark and debris. Beil⁹ assumed that the average log raft is approximately 70 feet by 550 feet, or 0.88 acres, and contains 400,000 board feet (2.2 acres per million board feet). Current estimates are shown in table 4. In 1981, timber harvested from the Tongass National Forest totaled 386 million board feet; nearly 100 percent of this timber was bundled into rafts. Approximately 964 rafts were assembled, which in total would have covered 1,388 acres if all rafts had been in the water at the same time. Actual acres occupied at any one time for raft storage were probably much less as the logs were fed continuously through the various mills, but debris could be deposited over an area of approximately equal size. The debris from the rafts will probably accumulate in pockets beneath the most intensively used areas where currents are weakest.

⁹Unpublished report, 1974, "The Economics of Rafting vs. Barging as a Means of Transporting Logs in Southeast Alaska Waters," by Kenneth E. Beil, International Forestry Consultants, Inc. Report prepared for contract no. 19-200 and is on file at U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, P.O. Box 3890, Portland, OR 97208.

Table 4—Average log storage area required for various purposes

(In acres)

Use or purpose	Land area	Rafting water area
Unloading of trucks	0.9	0.4
Log bundle storage, log space only	1.0 per million board feet	1.8 per million board feet
Log bundle storage including needed maneuvering space	1.6 per million board feet	3.6 per million board feet

Although the worst case scenario indicates that only a fraction of the estuarine area would be covered by bark, a strong rationale remains to locate that fraction on the least biologically productive portion of the estuary and in places that minimize interference with fishery resources. Changes in water quality that result from bark deposits may affect the entire estuary even though only a small area may be physically impacted.

Design Comparisons for Loading From Land to Water and From Land to Ship or Barge

The methods of putting logs into salt water for transportation to mills have evolved over several decades. In the early years of timber harvest in southeast Alaska (1909 to the 1930's), trees were selected and cut so that they would fall or slide directly into the water (Jackson and Dassow 1974, Rakestraw 1981). As mechanization increased (1940 to 1960), more remote logs were harvested and put into the water with floating A-frame yarders and transfer devices anchored offshore.

The impact on tideland areas from floating A-frame transfer equipment was considered greater than the impact by the more permanent centralized log transfer facilities that came into use in the 1970's. This was because the A-frame breakout points were much more numerous and affected larger areas of habitat. Instead of one large accumulation of debris in the water, the A-frames resulted in continuous deposition of debris and disruption of vegetation along the shoreline. It is not known whether environmental impacts from bark deposits are greater if the bark is spread thinly over a larger area or accumulated more deeply over a small area.

Bark is introduced into estuarine waters at the point of log entry and while the log is handled in the water. Little information is available concerning the differences in amount of debris generated by various methods of transfer into water. The selection of particular processes and equipment is complex.

The two common options for handling logs at a saltwater facility are land-to-water (rafting) and land-to-vessel (barging or shipping). A third option is placing the **logs** in saltwater and then loading from the water onto barges or ships (land-to-water-to-ship). The types and ranges of impacts are different with each of these methods. Impacts to upland and marine habitats should be evaluated together to determine the best method.

Operating Criteria

The way logs are handled on land affects the range of opportunities for marine handling. The processes used in southeast Alaska are based on the use of log bundles. Logs are sorted on land by species, grade, or intended process. Individual truckloads are normally bundled together using either flat steel bands or, more recently, wire rope. Bundling makes handling easier and significantly reduces the loss of individual logs into the marine environment. Except at mills, sorting of loose logs in the water has been rare for a number of years.

For water storage of logs, the bundles are unloaded and placed in the water in one of several ways. Bundles are moved by boom boats into groups of common species and grades until rafts of approximately 500,000 board feet have been built.

Method of log entry has been the source of much discussion in recent years. The issue of the violence of log entry into the water developed because of the assumption that log entry methods differ in force generated. Greater force may result in greater bark and debris loss. There are no definitive standards for which methods constitute violent or nonviolent entry. The parbuckle system has been examined and found to involve considerable force that dislodges bark (Sedlac **1982**). This system involves pulling log bundles off a truck, over a brow log, and skidding them down a set of log skids at about a 40-degree incline. The resulting disturbance, bark loss, and log breakage as the bundles enter the water set an upper limit in our minds for violent entry.

Many of the resource agencies reviewing the permit process say that nonviolent entry is achieved by use of an "easy letdown device," such as a conventional A-frame. The A-frame has been the preferred device for log transfer because of operating economy and availability. An A-frame is either land based and capable of handling log bundles or is mounted to a barge to use for raising and lowering individual logs. The frame is formed by two spars anchored at the base and bound together at the top. A winch system is mounted behind the frame and the lifting cable is passed through a pulley at the top of the frame.

There are two operating versions of the A-frame in use:

1. The fixed-base or single A-frame has the top of the frame guyed into a fixed position. The frame top is located beyond the edge of the loading face. As each bundle is lifted off a truck, it is swung over the water. If the operator does not release the bundle into the water, it will swing back into the equipment. A single drum winch is used to raise and lower the log bundle. The operator thus has little control of the log bundle once it is lifted off the truck, except to release it into the water.

2. The rotating or double A-frame has spars mounted on pivots so that the top of the frame can be rotated from a point over the truck to an entry point over the water. A double-drum winch system is required. One drum moves the top of the frame and the second drum raises and lowers the log bundle. A second A-frame or a spar is mounted between the winch and the rotating A-frame to provide mechanical advantage. The velocity of the log bundle at the point of entry into the water is dependent on operator control, braking equipment, and care exercised in braking the load. This form of A-frame is the most common and is accepted by both the logging industry and regulatory agencies as appropriate for achieving non-violent log entry. The key feature in the rotating A-frame is that the operator can exercise more control over a log bundle until the attachment arrangement releases in the water. The limiting element on most movable A-frames is the braking capability of the winching systems that lower loads. Almost all existing equipment lacks the capability to brake the loads once they are released without burning out brakes or drums.

Alternative methods to the A-frame include chain conveyors, "beaver slide" ramps, and rockfill ramps. The chain-conveyor systems have been used at a few large installations with high timber volumes. They are relatively more expensive to construct than the A-frames and require the use of a log stacker to unload and handle log bundles. Operational history indicates that breakdowns are frequent and a diver is often required to make repairs. The chain-conveyor systems maximally limit the force applied on entry of bundles into the water.

The beaver slide consists of two to four parallel logs or steel runners set at a 20 to 45 percent angle (11 to 24 degrees). Logs are placed on the runners by a log stacker or end loader and gravity causes them to slide into the water. The initial cost of a slide is lower than the cost of a basic A-frame at a site suitable for either system. The construction cost difference is related to the additional fill near the estuary for the working face and to anchoring an A-frame and winch. The operating costs for the beaver slide devices are expected to be higher, primarily because a log stacker or end loader is needed to handle logs and place them on the runners. A constraint for locating the beaver slide devices is the slope at the site. The runners cannot easily be placed on a slope having less angle than the shore without extensive dredging. The slide is considered a violent entry method by most reviewing agencies because a lot of bark may be dislodged when logs slide down the runners.

The simplest of all log entry systems is a rockfill road that extends to the low tide line. A log stacker moves bundles from the truck to the end of the fill, and the incoming tide floats the bundles off. This method subjects the logs to the least amount of force if logs are unloaded from the trucks carefully and may be the least violent in terms of entry into the water. It is suitable, however, for transferring only the smallest volumes of timber because space on the tideland road for stacking bundles is limited. The tides cycle twice each day and effective use of the available road is possible only on the low and rising tide. The upper portions of the road are not usable because the tide must float the bundle free of the road to avoid blocking the next cycle. The logistics of handling large timber volumes require numerous unloading roads, which would increase impacts to the tidelands.

Land storage of bundles requires clearing of land and construction of operating pads of shot rock. A log stacker or similar equipment capable of handling bundles is required to unload the trucks, lift the bundles back onto trucks, and transport them to the loading face. Land storage is generally required at sites where land-to-barge loading or onsite processing is used. In other circumstances, land storage and sorting is normally at the operator's choice and expense. Table 4 shows the space required for different land and water uses. The space for unloading trucks includes not just unloading space, but turnaround and equipment space. The minimum water area required for moving the log bundles into the water and handling bundles is in addition to this value. Maneuvering area and space between the unloading face and the water storage location are not included. Additional service facilities such as boat docks and unloading ramps are also not included.

Design Guidelines

Log entry facilities are designed to meet a functional purpose at a reasonable cost and reasonable risk of failure. Table 5 contains a summary of physical requirements that must be met to accommodate the various types of log entry systems. These may be considered as guidelines for (1) the operating systems available, (2) the acceptable risks of damage to the facility and operating equipment, (3) safety to the operators, and (4) environmental considerations.

Comparison of Facility Designs

Four designs for marine facilities used for log transfer are compared here to illustrate the range of environmental and logistical constraints. Two of the designs are for land-to-water (rafting) operations at Deep Bay and Little Hamilton Bay. The third and fourth are possible designs for land-to-barge and land-to-water facilities developed for Whitestone Harbor. The projects represent state-of-the-art log transfer facility design practices.

The primary differences among the three sites are the slope of the intertidal and subtidal bottoms, and the upland topography. The area of construction activity on land and in the estuarine zone is much larger for the land-to-barge facility than for the land-to-water facilities. The impact on the marine environment from water storage of logs is larger if rafting is used. Eight rafts of 500,000 board feet each will temporarily occupy 7.2 acres. The respective land and water areas involved for the different designs are compared in table 6.

Differences in design are apparent between Deep Bay and Whitestone Harbor; the former is a pile-supported structure at the working face, and the latter is a cellular structure of sheet piling. There is also a difference in working depth and in the length and area at the face. Figures 4 and 5 are plan views of the Whitestone Harbor and Little Hamilton Bay sites, respectively. Figure 6 shows the cross section typical of the facilities at the two land-to-water sites.

(Text continues on page 22.)

Table 5—Physical requirements, in feet, for log transfer facilities

Design element	Land-to-water transfer	Land-to-barge transfer
Height above-mean low tide 1/	+24	+24
Depth at face below mean low tide 2/	3/ -5	4/ -25
Minimum face length: 5/		
Single bundle	60	60
Double bundle	not used	120
Access width: 6/		
Minimum clearing width	7/ 40	8/ 80
Surface width	16	24
Road grade to operating zone/face: 8/		
Maximum road grade (favorable)	9/ 10	10/ 6
Desirable limits	- — + 4	<u>10/</u> ± 2

1/ The height above mean low tide to the operating surface provides clearance above average high tides. It is accepted that overtopping by waves or storm surges at maximum tidal conditions will occasionally occur.

2/ The working faces of the structures need to be located with a depth and freeboard for the intended water transportation method. The depth at the face below mean low tide is based on acceptance of occasional operational delays when minus tides occur. The effects of the delays are considered minimal when compared to the cost and impacts of construction in deeper water.

3/ The land-to-water loading methods are designed to place log bundles into the water without hitting the bottom substrate (grounding). By limiting operation to plus tides, the fill into the estuarine area can be limited to the area above minus 5-foot levels. The operating limitations are not unnecessarily severe, as the minus tides tend to occur in the spring and in the very early mornings. Trucks loaded with logs would not normally arrive from landings until after the tide had returned to mean low levels.

4/ The depth at the face for land-to-barge loading was selected on the basis of current and anticipated future drafts of barging vessels. Although the draft for small, flat-bottomed barges is as little as 8 feet, these vessels can carry only about 100,000 board feet of timber. The only dedicated log-carrying barge in use in southeast Alaska in 1983 (the Silver Bay) required a minimum loaded draft of 14 feet. Log transportation vessels currently in use in British Columbia have loaded drafts approaching and, in some cases, exceeding 20 feet. With replacement costs of log transport vessels ranging up to \$24 million, and the possibility of hemlock butts sinking, vessel safety requires that a depth of +24 feet below mean low tide be used as the shallowest depth that vessel owners (and insurers) will reasonably risk.

(Footnotes continue on next page.)

Table 5—Physical requirements, in feet, for log transfer facilities (continued)

5/ The face length must be adequate for the log bundles expected at the site. Off-highway loads used on forest development roads do not normally have maximum load length restrictions. The maximum truck load weight of 102.5 tons gross vehicle weight limits the weight of the log bundle to approximately 80 tons. Bundles up to 50 feet in length are not uncommon. With an additional 10 feet needed for equipment operation, the minimum design guideline is approximately 60 feet. The future use of barging ~~will depend~~ on cost and loading efficiency. The most efficient and cost effective vessels are large and fast loading. These vessels use two cranes to move volumes of up to 3 million board feet at a time. Costs associated with delays will create pressure that favors speedier loading. Faces wide enough to allow two cranes to operate simultaneously will be needed to meet the necessary operating efficiency. A ~~tradeoff~~ to be evaluated is the greater quantity of ~~fill~~ placed on the tidelands to create the double width operational advantage for more efficient barge loading.

6/ The handling equipment at land-to-barge facilities is usually a log stacker. This is a massive piece of equipment designed to move 40- to 80-ton bundles of logs. The logs are carried in jaws at the front of the machine. The operator cannot always pick up bundles at the center of the logs; therefore, width of passage must be sufficient to allow the full length of the bundle to pass with a safety allowance on both ends (minimum 80 feet). The width of the stacker and limits on maneuverability require a 24-foot minimum road surface width. Road widths to 30 feet are not unreasonable, particularly where soft shoulders present a risk of overturning.

7/ The equipment used for road construction will usually require a clearing 40 feet wide to provide clearance for the swing of the backhoe.

8/ Access grades are limited by the vehicles using the travelway. Loaded vehicles approach the tidelands on a down grade. A factor limiting design is the operational consideration of braking and stopping as the vehicle nears the face of the water access point. The stacker cannot operate on steep grades--even on grades that a truck could traverse easily. Braking ability and probability of serious equipment damage limit the maximum desirable grade for a log stacker to ± 2 percent. With additional braking kits, disc brakes, and careful operation, grades up to an absolute maximum of 6 percent (downhill) can be safely negotiated by log stackers.

9/ Based on controlling and stopping a U-102 (102.5-ton gross vehicle weight) truck on a grade.

10/ Maximum recommended, sustained, favorable grade for log stackers. Equipment may exceed this grade only at higher risk. Maximum grade is based on disc brakes and installation of additional braking kits. Vehicles when loaded are capable of maximum adverse grade of 15 percent.

Table 6—Land and estuarine areas involved in construction of log transfer facilities at three sites in southeast Alaska

Site	Land area	Estuarine area	Slope of bottom at the face
	- - - - <u>Acres</u>	- - - -	<u>Percent</u>
Deep Bay	<u>1/</u> 0.80	0.44	24
Little Hamilton Bay	<u>1/</u> 1.11	.31	27
Whitestone Harbor:			
Land-to-water	<u>2/</u> 0	.83	14
Land-to-barge	<u>3/</u> 17.7	1.71	11

1/ Land area from site access road to mean high tide.

2/ All construction is beyond mean high tide except access road.

3/ Land area for log storage and access; only width in excess of access road included.

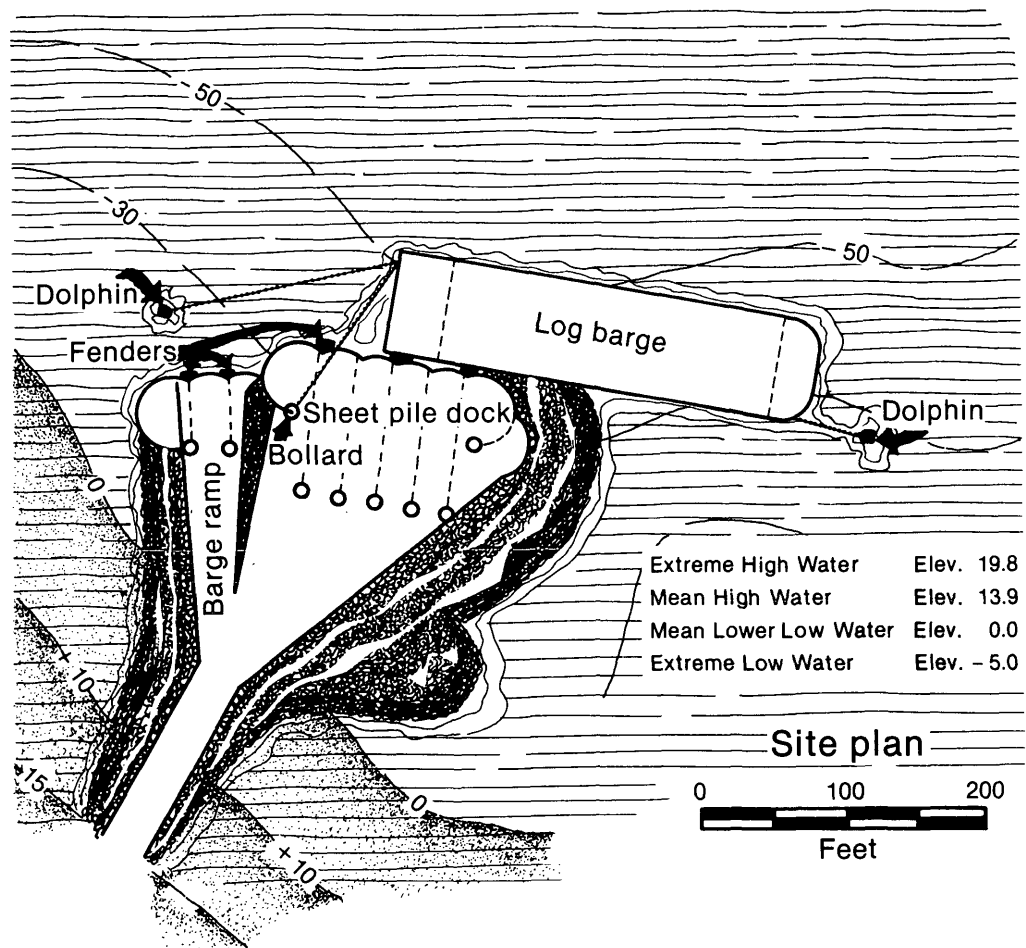


Figure 4.—Plan of a proposed land-to-barge transfer facility at Whitestone Harbor, Chichagof island.

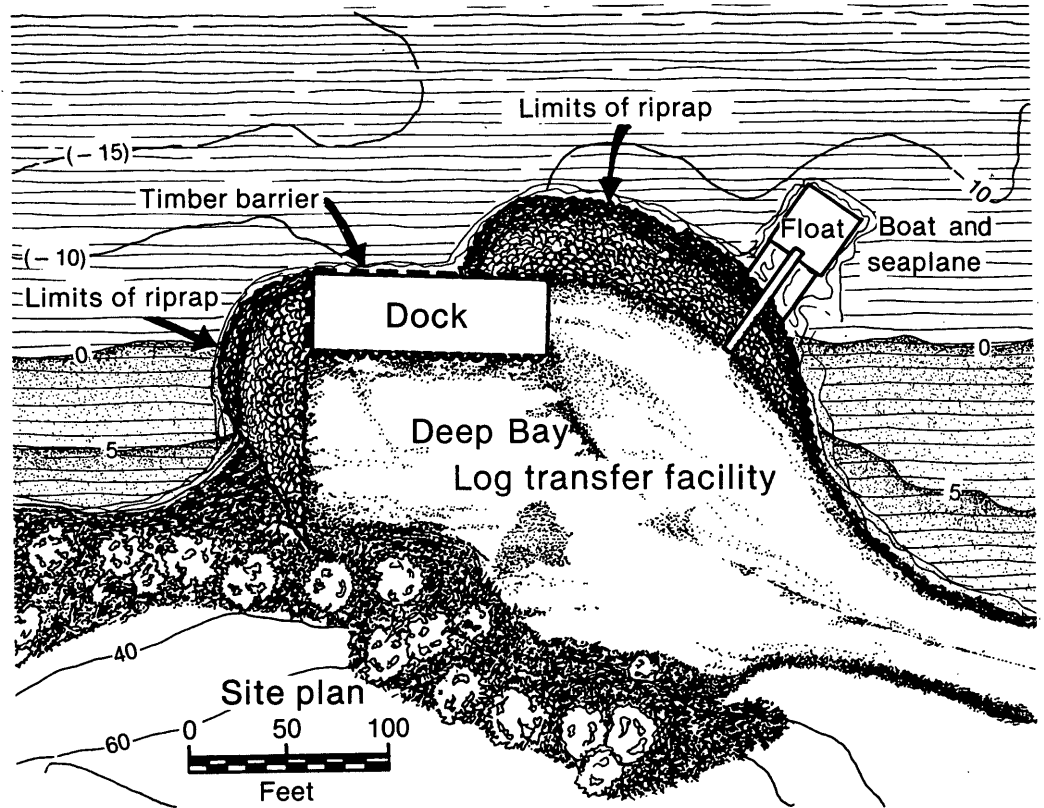


Figure 5.—Plan of a land-to-water log transfer facility at Deep Bay.

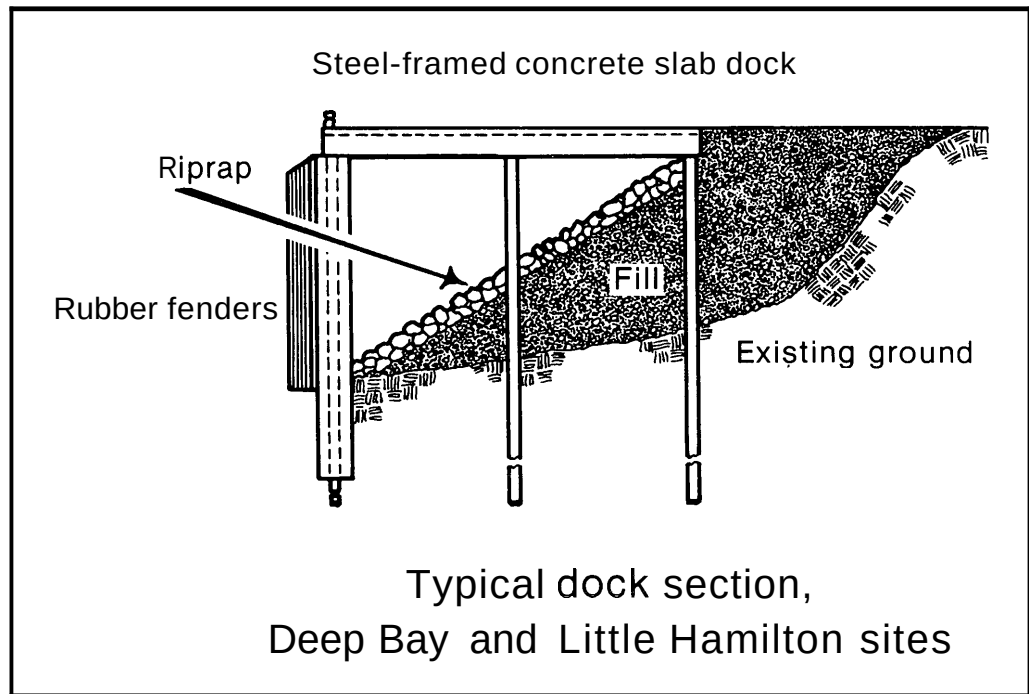


Figure 6.—Cross sectional view of a land-to-water log transfer facility in use at both Little Hamilton Bay and Deep Bay.

The view of the Little Hamilton Bay site (fig. 6) shows the recommended 1-percent slope from working face to the shore. This directs surface drainage away from the face of the fill and into filter strips prior to discharge. The result is less suspended solids in the runoff into the estuarine area. The slope also provides a safety measure for vehicles: vehicles will not tend to roll to or over the edge of the face. The Whitestone Harbor land-to-barge configuration precludes use of this design. The bridge designed to broach the intertidal area creates, in effect, an island with limited options for management of surface runoff. The only moderately practical alternative to overland discharge of runoff at the island is the collection of drainage into a catch basin and subsequent percolation into the rock fill. These installations have short useful lives because the suspended solids rapidly plug the drainage through the fill. Construction of a land-to-water facility at Whitestone Harbor would require less fill in the tidelands, but would result in a similar—although smaller—problem: with less area to collect surface runoff, less water would need to be treated.

The Deep Bay and Little Hamilton Bay facilities are designed to use a combination of pile structure and rockfill. Rockfill is generally cheaper to construct but removes marine habitat from production and may physically interfere with fish movements and currents. The combination design offers the best features of the pile face without the additional cost of a totally pile-supported structure.

Metric Equivalents

1 inch = 2.54 centimeters
1 foot = 0.3048 meter
1 mile = 1.609 kilometers
1 acre = 0.4 hectare
1 ton (2000 pounds) = 907.2 kilograms

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The volume of timber harvested in southeast Alaska between 1909 and 1983 was 14,689 million board feet; nearly all was transported on water to various destinations for processing. In 1971 there were 69 active log transfer and storage facilities and 38 raft collecting and storage facilities in southeast Alaska. In 1983 there were 90 log transfer sites, 49 log storage sites, 228 sites proposed for log transfer development, and 12 sites proposed for log storage development. We calculated that there were 176 acres of estuarine habitat covered by bark from 90 log transfer sites in 1982. Additional habitat was covered by bark at log storage sites. In 1981, approximately 1,388 acres would have been covered by log rafts at some time. The statistics for numbers of log transfer and storage sites no longer in use are too incomplete for use in estimating bark coverage.

The options for handling logs at a saltwater facility are land-to-water (rafting), land-to-vessel (barging or shipping), and land-to-water-to-ship (loading barge or ship from water). The A-frame has been the preferred device for log transfer because of operating economy and availability. Other transfer methods include chain conveyors, "beaver slide" ramps, and rockfill ramps.

Keywords: Log transfer, log storage, Alaska (southeast), southeast Alaska.

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SOUTHEAST ALASKA TIDELAND LOCATIONS FOR LOG TRANSFER AND STORAGE

Pocket Supplement

Pacific Northwest Forest & Range Experiment Station
General Technical Report PNW-174

"Log Transfer And Storage Facilities
In Southeast Alaska: A Review"

1984

By

Tamra L. Faris

Kenneth D. Vaughan

LANDS CLASSIFIED AS:

Wilderness

National Park

National Monument

National Forest Additions (ANILCA)

LUD II (Tongass Land Management Plan)

Lands Released From Wilderness Recommendation (ANILCA)

LEGEND

- ▲ Existing log storage site
- △ Log storage site no longer in use
- ◻ Proposed log storage site
- Existing log transfer site
- Log transfer site no longer in use
- ◻ Proposed log transfer site
- Alternate proposed log transfer site
- ⊙ Major processing centers

