U.S. Army Corps
of Engineers
Alaska District

# Economic Analysis for City of Dillingham Shoreline Emergency Bank Stabilization

## Dillingham, Alaska

## June 2009

# Economic Analysis for City of Dillingham Shoreline Emergency Bank Stabilization

***prepared by:***


Alaska District

U.S. Army Corps of Engineers


*This report is a compilation of two previous reports prepared by Tetra Tech Inc.: the* Economic Analysis for Dillingham Harbor Shoreline Erosion *dated September 2005 and the* Dillingham City Shoreline Emergency Bank Protection *dated January 2006. The previous reports have been updated by the Corps to reflect a change in the federal discount rate, revised design and construction costs, and a merge of the reports in order to assess this community's needs in a comprehensive fashion.*

June 2009

# TABLE OF CONTENTS

*COVER PHOTO: Aerial View Dillingham Harbor 1992. Source: Alaska Economic Information System - Department of Commerce, Community & Economic Development*

# LIST OF TABLES

# LIST OF FIGURES

# 1 INTRODUCTION

## 1.1 Study Purpose

This feasibility study was initiated to define problems and identify and evaluate solutions related to shoreline erosion in and around the small boat harbor in Dillingham, Alaska (Dillingham Harbor). The economic analysis documented in this report was performed to support the definition of expected conditions with and without implementation of an array of shoreline protection alternatives. A benefit cost analysis was conducted to identify the net benefits of each alternative considered.

## 1.2 Appendix Purpose

This report documents the economic evaluation of existing and future without-project economic conditions associated with ongoing erosion in and around the small boat harbor and surrounding area. Without-project conditions are defined as the expected future conditions that would occur in the study area without Federal project alternatives implemented. This report documents the economic methodologies, data, and assumptions applied to estimate baseline without-project conditions and National Economic Development (NED) economic effects of with-project conditions. This appendix is a compilation of two previous reports prepared by Tetra Tech Inc.: *Economic Analysis for Dillingham Harbor Shoreline Erosion* dated September 2005 and *Dillingham City Shoreline Emergency Bank Protection Economic Analysis Report* dated January 2006. Those two reports documented separable benefits and costs for projects on the West End of the Dillingham Harbor and the City Dock Side. For the remainder of this report, we will examine these two sides of the Dillingham Harbor individually.

## 1.3 Economic Analysis Factors

Cost data for the West End and for the City Dock Side are presented in April 2008 prices. Project costs and benefits are evaluated over a fifty-year period of analysis. Amortization calculations are based upon the current (fiscal year 2008) federal discount rate of 4 $^{7}/_{8}$ percent. Presented results of financial calculations are rounded to the nearest one hundred dollars. Due to rounding, in some cases rounded totals may not equal the summation of rounded values.

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# 2 STUDY AREA AND ASSOCIATED ECONOMIC PROBLEMS

## 2.1 Regional and Local Economy

The Dillingham Census Area is located in Southwestern Alaska and includes 11 small communities along the northeast edge of Bristol Bay. These communities are supported primarily by commercial fishing and subsistence activities. The economic base is small, seasonal, and primarily concentrated on Bristol Bay sockeye salmon. Most full-time and private sector jobs are located in the City of Dillingham.

The City of Dillingham is the economic, transportation, and public service hub for western Bristol Bay. Primary economic activities include commercial fishing, fish processing, cold storage, and support of the fishing industry. Multiple fish processors, including Icicle, Peter Pan, Trident, and Unisea have operations in the vicinity of Dillingham. According to the Alaska Department of Fish and Game Commercial Fisheries Entry Commission, 230 residents held commercial fishing permits in 2007. During spring and summer, the population doubles. The city's role as the regional center for government and services helps to stabilize seasonal employment. Many residents depend on subsistence activities; and trapping of beaver, otter, mink, lynx, and fox provide cash income. Salmon, grayling, pike, moose, bear, caribou, and berries are harvested. (Alaska Economic Information System - Department of Commerce, Community & Economic Development, 2005) Summary economic data for Dillingham is presented in **Table 1**.

**Table 1: Dillingham Population, Employment, and Income**

| | |
|---|---|
| Current Population: | 2,404 (2007 State Demographer est.) |
| Incorporation Type: | 1st Class City |
| Borough: | Unorganized |
| School District: | Dillingham City Schools |
| Regional Native Corporation: | Bristol Bay Native Corporation |
| **Income:** | |
| Per Capita Income: | $21,537 |
| Median Household Income: | $51,458 |
| Median Family Income: | $57,417 |
| Persons in Poverty: | 287 |
| Percent Below Poverty: | 11.7% |
| **Employment:** | |
| Total Potential Work Force (Age 16+): | 1,702 |
| Total Employment: | 1,154 |
| Civilian Employment: | 1,150 |
| Military Employment: | 4 |
| Civilian Unemployed (And Seeking Work): | 88 |
| Percent Unemployed: | 7.1% |
| Adults Not in Labor Force (Not Seeking Work): | 460 |
| Percent of All 16+ Not Working (Unemployed + Not Seeking): | 32.2% |
| Private Wage & Salary Workers: | 597 |
| Self-Employed Workers (in own not incorporated business): | 111 |
| Government Workers (City, Borough, State, Federal): | 436 |
| Unpaid Family Workers: | 6 |
| *Source: Alaska Economic Information System - Department of Commerce, Community & Economic Development, 2005. Employment and Income data based on 2000 U.S. Census data.* | |

The Bristol Bay commercial fishery is vital to the economy of the region. The Alaska Department of Fish and Game (ADF&G) issued its 2005 Bristol Bay Salmon Fishery Season Summary Report in October 2005 reporting a 2005 salmon harvest of approximately 26 million fish. Sockeye salmon accounted for approximately 95% of the catch. The report presents a preliminary estimate of the ex-vessel value (amount fisherman were paid for their catch) of the 2005 Bristol Bay salmon fishery of $93,121,351. While this amount is only 80% of the 20-year average value for Bristol Bay, it is the highest value since 1999. According to the Alaska Department of Fish and Game, Bristol Bay sockeye salmon account for over 33% of the total value of the state's salmon fisheries.

With the only protected boat harbor in Bristol Bay, Dillingham serves as the center of the fishery. ADF&G's 1997 report, Catch and Production in Alaska's Commercial Fisheries, lists Dillingham as the fifth largest port in the State of Alaska based upon total number of fish landings in 1995. The Commercial Fisheries Entry Commission Permit and Vessel database reports 237 commercial fishing permit holders residing in Dillingham and 15,136,461 pounds landed in 2006; with estimated gross earnings of $7,552,235. The 16-year average (1990-2006) for gross earnings of Dillingham based commercial fisherman is $8,810,706. Amortizing this value over a fifty-year period of analysis at the FY08 federal discount rate of 4 7/8 % results in an estimated present value of the local fishery of $172,815,384 over the period.

Other fishery-related economic activities include fish processing, cold storage, and support of the fishing industry. The ADF&G Bristol Bay Area Annual Management Report 2004 reports 35 commercial salmon processors and buyers operated in Bristol Bay in 2004, including 3 locally based companies (Alaska Family Seafoods; Banacon, Inc; and Dancing Salmon Company, LLC). Seattle-based Peter Pan Seafoods' onshore processing facility is just east of the harbor's eastern dredged material disposal area.

Dillingham also offers non-fishery related employment and income opportunities. The University of Alaska Fairbanks' Bristol Bay Campus is based in Dillingham. This, together with the city's role as the regional center for government and services, helps to stabilize seasonal employment during the non-fishing months.

## 2.2 Study Area

Because Dillingham is the primary operating center for fishermen and fish processing in the Nushagak District (one of the five districts that make up the Bristol Bay fisheries area), Dillingham Harbor is a major factor in the local and regional economy.

### 2.2.1 West End

The study of erosion at the harbor (West End) is identified as Dillingham Harbor and surrounding lands as shown in **Figure 1**. The primary problem is coastal erosion at the west side of the harbor entrance. This condition results in increased wave activity within the harbor which results in further erosion within the harbor, loss of surrounding land, damages to moored vessels, added maintenance costs, and in some cases accelerated replacement of harbor infrastructure. The harbor erosion also threatens bulk fuel storage facilities along the harbor's west bank that will likely require emergency protection in the future if no action is taken. The study area was delineated into three planning reaches for analysis. The reaches were identified based upon common historic erosion patterns and land uses. The planning reaches for the West End are presented in **Figure 2**.

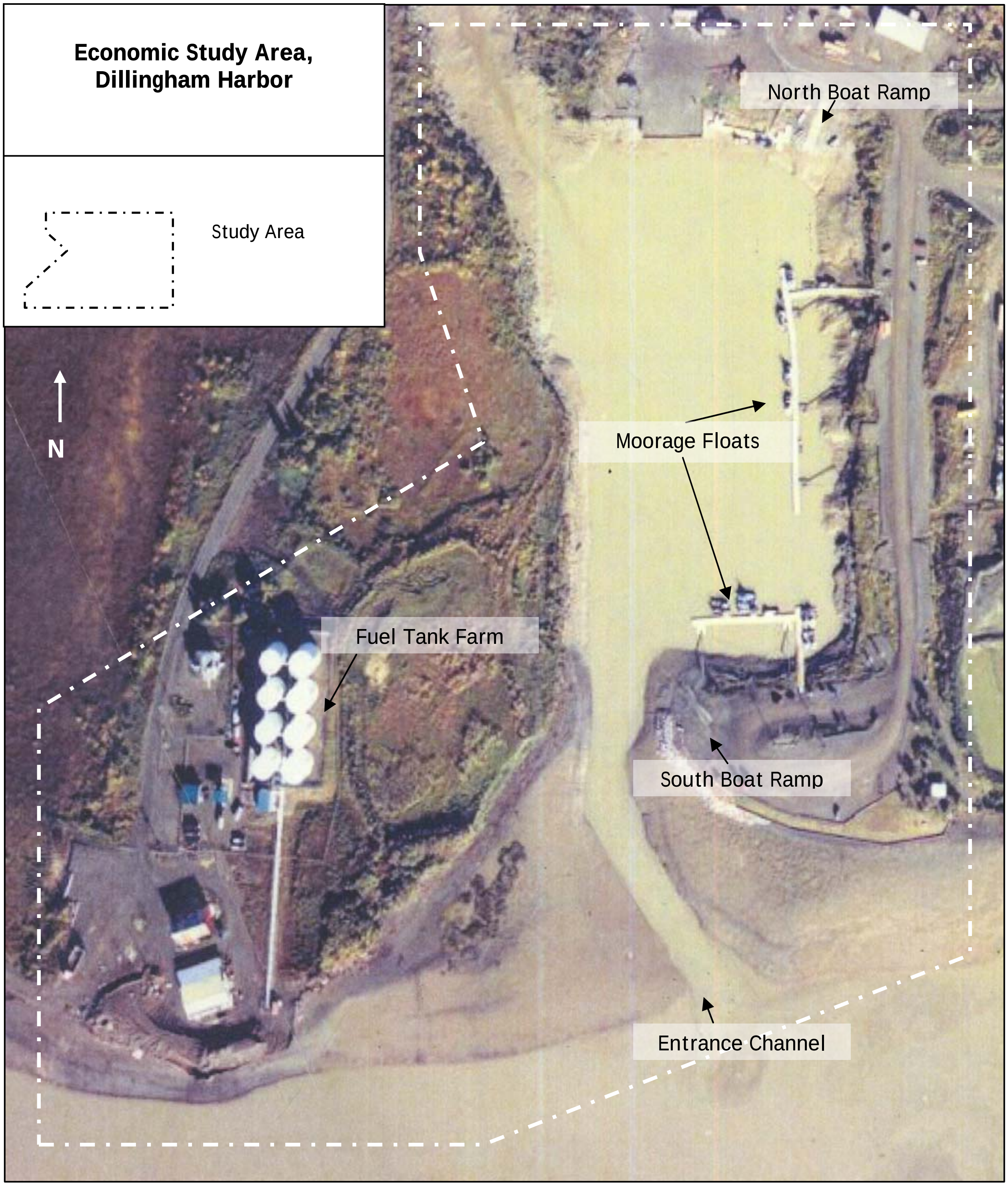


**Figure 1: West End Economic Study Area, Dillingham Harbor**

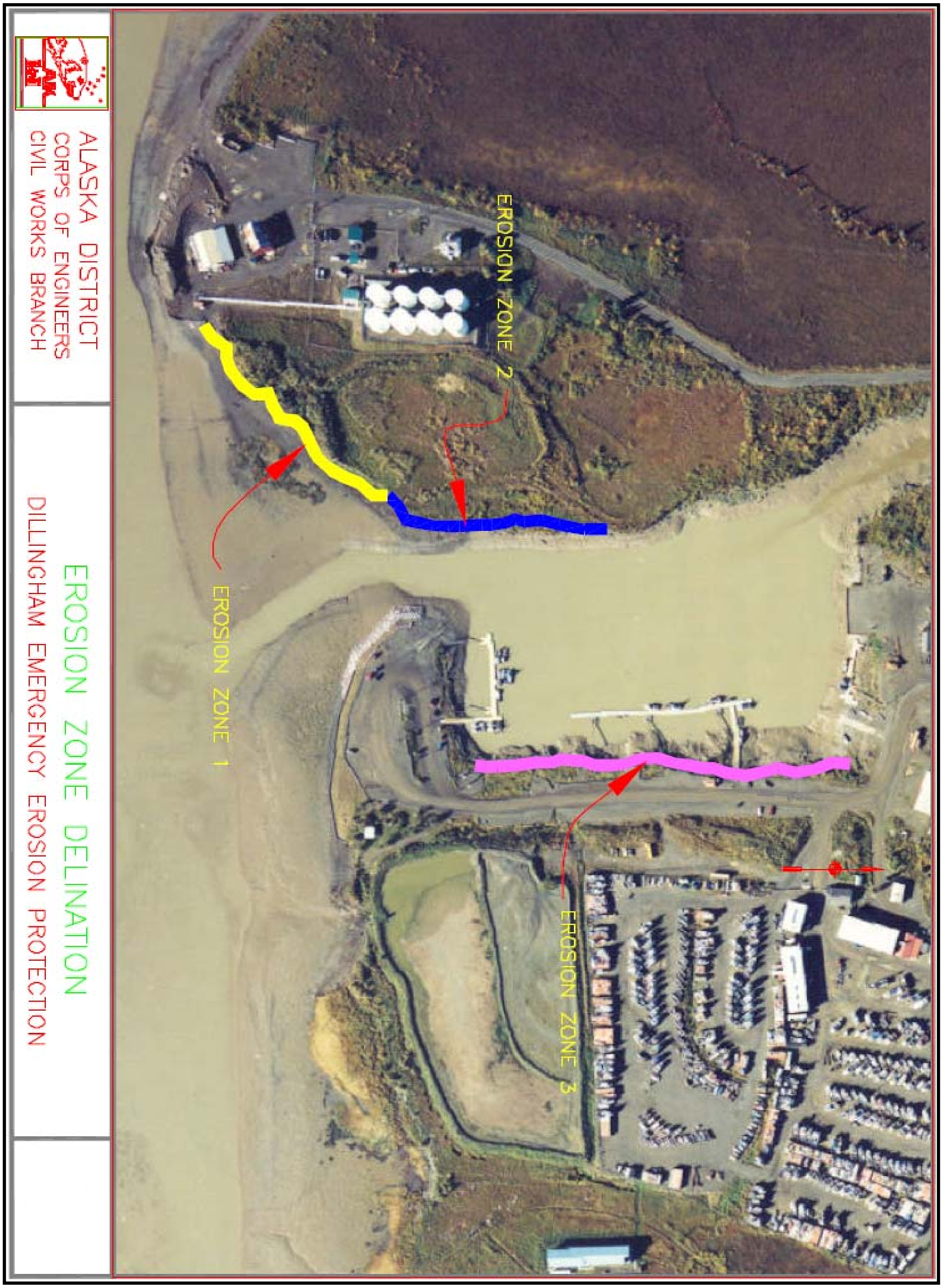


**Figure 2: West End Erosion Zone Delineation, Dillingham Harbor**

### 2.2.2 City Dock Side

For the examination of the City Dock Side at the harbor, the focused study area is identified as Dillingham Harbor, the Dillingham Harbor Disposal Area (no longer in use for further disposal), and surrounding lands as shown in **Figure 3**.

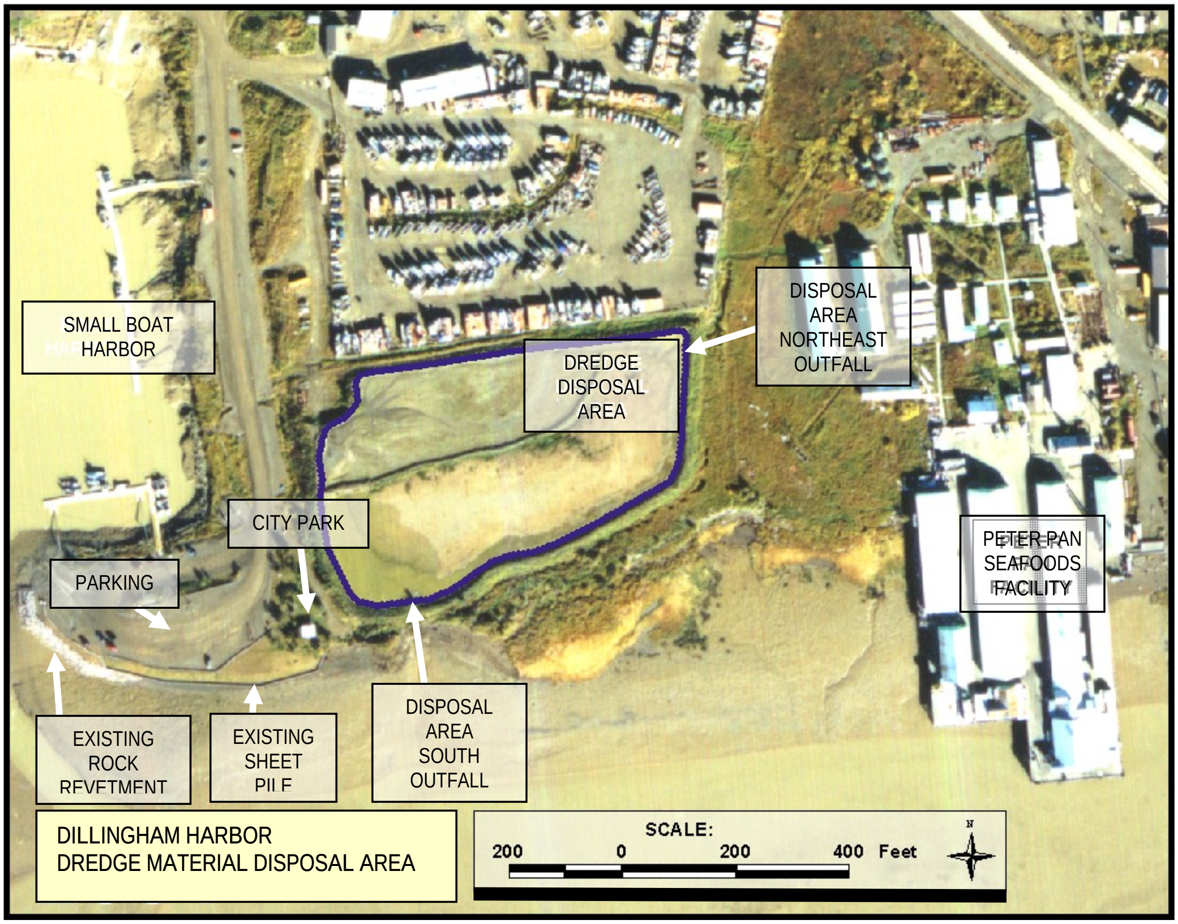


**Figure 3: City Dock Side Area, Dillingham Dredged Material Disposal Area and Vicinity**

The primary problem is coastal erosion along the outside of the dredged material disposal berm and adjacent lands to the east and west of the disposal area. This condition currently results in loss of land, damages to public infrastructure, and recreational losses. If erosion is left unchecked these problems will continue and additional losses are expected including damages to the small boat harbor and associated infrastructure. In time, the coastal erosion will also threaten the small boat harbor itself. The study area was delineated into two planning reaches for analysis. The reaches were identified based upon common historic erosion patterns and land uses. The planning reaches are presented in **Figure 4**.

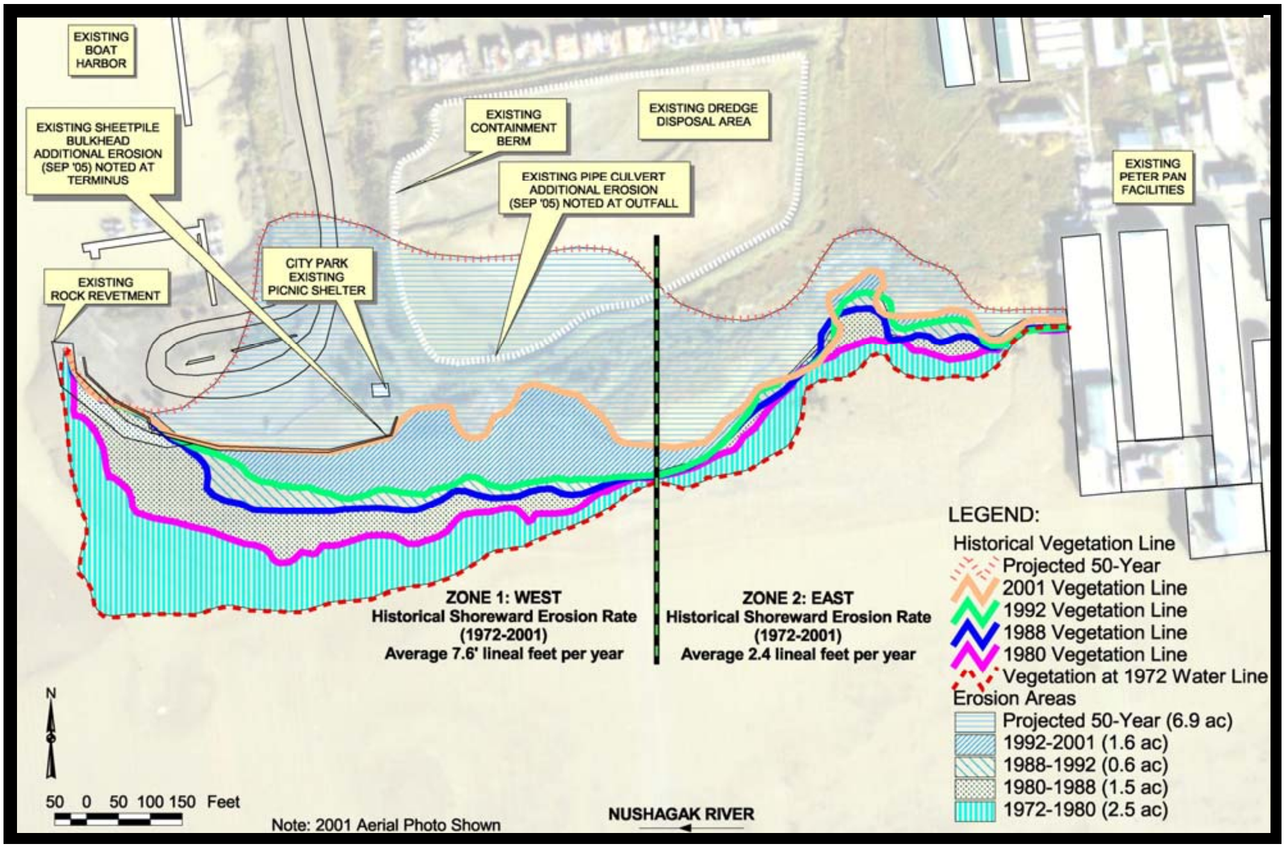


**Figure 4: Study Area Erosion and Erosion Planning Zones**

# 3 HISTORIC AND EXISTING CONDITIONS

Extreme tides, currents, storm surges, and wave and ice conditions are creating land erosion at the west bank of the Dillingham Harbor entrance channel that is allowing for increased wave action in the harbor. In addition to land losses; the winds, waves and tides in the harbor resulting from the erosion are presently causing damages to harbor infrastructure and vessels.

Extreme tides, currents, storm surges, and wave and ice conditions are also creating land erosion in the vicinity of Dillingham Harbor and its southeastern dredged material disposal site. These conditions have resulted in significant land loss to the east and to the south of the disposal site and currently threaten not only the disposal site but also public infrastructure in the vicinity.

The south disposal site berm is actively in the process of failure from erosion which poses an imminent threat of loss of the contained dredged materials into the river. Erosion at the west end of the berm has resulted in damage to Dillingham's public park in the area and currently poses a threat to public safety.

Active erosion in this area was identified as a threat to the harbor which resulted in construction of bank protection by the Corps of Engineers in 1999 at the south end of the harbor. This protection included a rock revetment extending from the east bank of the harbor's entrance channel eastward for 184 feet where it transitions into a sheetpile seawall for an additional 429 feet. Currently, the eastern terminus of the seawall has been outflanked by the coastal erosion in the area and the project's function is compromised.

## 3.1 Historic Erosion Rates

### 3.1.1 West End

Hydrologic and hydraulic studies conducted as part of the feasibility study evaluated historic rates of erosion for each of the three erosion zones identified in **Figure 2** over the 29-year period of 1972-2001. The average erosion rates across this period are presented in **Table 2**. The average annual erosion rates correspond to the average number of linear feet that the bank retreated landward per year across the entire erosion zone. Refer to the **Hydrology and Hydraulics Appendix** for additional detail on the analysis of erosion rates.

**Table 2: West End Average Annual Erosion Rates for Each Zone**

| Erosion Zone 1 | |
|---|---|
| Comparison Years | Erosion Per Year (ft/yr) |
| 1972 to1980 | 17.14 |
| 1980 to 1988 | 3.11 |
| 1988 to 1992 | 15.54 |
| 1992 to 2001 | 7.75 |
| *Average Erosion Per Year – Zone 1* | *10.89* |
| **Erosion Zone 2** | |
| Comparison Years | Erosion Per Year (ft/yr) |
| 1972 to1980 | 2.06 |
| 1980 to 1988 | 2.24 |
| 1988 to 1992 | 0.042 |
| 1992 to 2001 | 1.22 |
| *Average Erosion Per Year – Zone 2* | *1.39* |
| **Erosion Zone 3** | |
| Comparison Years | Erosion Per Year (ft/yr) |
| 1972 to1980 | 1.06 |
| 1980 to 1988 | 0.28 |
| 1988 to 1992 | 3.45 |
| 1992 to 2001 | 0.71 |
| *Average Erosion Per Year – Zone 3* | *1.38* |

### 3.1.2 City Dock Side

Hydrologic and hydraulic studies conducted as part of the feasibility study evaluated historic rates of erosion on the City Dock Side for the two erosion zones identified in **Figure 4** over the 29-year period of 1972-2001. The average erosion rates across this period are presented in **Table 3**. The average annual erosion rates correspond to the average number of linear feet that the bank retreated landward per year across the entire erosion zone.

**Table 3: City Dock Side Average Annual Erosion Rates for Each Zone**

| Erosion Zone 1 | | |
|---|---|---|
| Comparison Years | Total Linear Erosion (ft) | Avg. Annual Erosion (ft/yr) |
| 1972 to1980 | 87 | 10.8 |
| 1980 to 1988 | 53 | 6.6 |
| 1988 to 1992 | 20 | 4.9 |
| 1992 to 2001 | 60 | 6.7 |
| **1972-2001** | **219** | **7.6** |
| **Erosion Zone 2** | | |
| Comparison Years | Total Linear Erosion (ft) | Avg. Annual Erosion (ft/yr) |
| 1972 to1980 | 29 | 3.6 |
| 1980 to 1988 | 16 | 2.0 |
| 1988 to 1992 | 12 | 2.9 |
| 1992 to 2001 | 14 | 1.5 |
| **1972-2001** | **70** | **2.4** |

As shown in **Figure 4**, Zone 1 encompasses the portion of the study area where historical erosion has been more pronounced (7.6 feet per year over the period 1972-2001). Zone 2 has experienced a slower erosion rate (2.4 feet per year over the same period).

Within Zone 2, erosion was predominantly in the western and central portions of the zone. Only minimal erosion over the 29-year period was observed at the eastern end of Zone 2, where Peter Pan Seafoods' facilities are located. The reduced level of erosion within Zone 2 is likely a result of the wave energy dissipation provided by the extensive set of pilings under the Peter Pan Seafoods' docks and the attenuation provided by the natural wetland to the west of those docks. Refer to **Appendix C** for additional detail on the analysis of erosion rates.

As a result of the analysis of historic erosion rates in the area, formulation and evaluation of protective features was focused within the two erosion zones (between the eastern terminus of the existing sheetpile bulkhead at the harbor and the westernmost dock of Peter Pan Seafoods).

## 3.2 Existing Erosion Damage Categories

### 3.2.1 West End

Presently, the following categories of damages are occurring in the West End study area as a result of erosion and its effects:

- Land losses from erosion
- Incremental maintenance and advanced replacement of harbor infrastructure due to harbor erosion
- Vessel damages

Existing damages in these categories are described in the following paragraphs.

#### 3.2.1.1 Land Losses from Erosion – West End

**Table 2** presented historic rates of erosion in the study area over the period of 1972-2001. Over this 29-year period, erosion was responsible for landward bank line erosion of approximately 396 linear feet in the study area, corresponding to 5.7 acres of lost land or 0.2 acres annually. The value of this land in current prices is $157,900, based upon an average land value for the study area of $28,000 per acre or $5,600 annually. **Table 4** presents this data by erosion zone. **Figure 5** presents a photo of active Zone 1 erosion taken in 2004.

Bristol Alliance Fuels (BAF) owns the land to the west of the harbor and also owns the fuel tanks that presently hold the fuel supply for the City of Dillingham (shown in **Figure 6**). The fuel farm is the largest fuel facility in the Bristol Bay area. BAF also supplies fuel to surrounding communities when the need arises (in recent years to Aleknagik, Manokotak, Clarks Point, and Koliganek) and to snowmachiners and boat operators in the region. BAF stores fuel for Crowley Marine barges (formerly Yukon Fuels) so that Crowley can avoid sending large barges upriver and bottoming out in shallow spots. In recent years a rock crushing facility was installed at the BAF site. The BAF dock is a good location for rolling on and off and supports the construction industry in the region with loading and off/loading capabilities. Erosion of BAF-owned lands used for offloading fuel to the west of the entrance channel resulted in the need for BAF to construct shoreline protection measures approximately 650 feet southwest of the harbor entrance channel in 2003 (**Figure 7**). Although not currently threatened, it is expected that if erosion is allowed to continue unchecked, the fuel tanks will become threatened within 10 years (by 2015).

**Table 4: Historic Land Loss to Erosion at West End (1972-2001)**

| | |
|---|---|
| ***ZONE 1*** | |
| Linear Feet of Landward Bank Erosion: | 316 |
| Lost Acreage: | 4.5 |
| Value of Lost Acreage: | $124,800 |
| ***ZONE 2*** | |
| Linear Feet of Landward Bank Erosion: | 40 |
| Lost Acreage: | 0.4 |
| Value of Lost Acreage: | $11,600 |
| ***ZONE 3*** | |
| Linear Feet of Landward Bank Erosion: | 40 |
| Lost Acreage: | 0.8 |
| Value of Lost Acreage: | $21,600 |
| ***TOTAL ZONES 1-3*** | |
| Linear Feet of Landward Bank Erosion: | 396 |
| Lost Acreage: | 5.7 |
| Value of Lost Acreage: | $157,900 |

*Note:* See **Figure 2** for West End erosion zones.

**Figure 5: Erosion/Land Loss, West End Erosion Zone 1**

**Figure 6: Dillingham Fuel Tank Farm Dock Protection**

### 3.2.1.2 Incremental Maintenance and Advanced Replacement of Harbor Infrastructure

Damages associated with incremental maintenance and advanced replacement to harbor infrastructure are occurring as a result of erosion in the study area. Types of infrastructure damages include: repairs and advanced replacement of moorage floats, damage to moorage float swing arms, damage to concrete boat ramps, and damages to the harbor bulkhead. Cost data for infrastructure damages was obtained through interviews with staff of the City of Dillingham, Dillingham Department of Public Works (DPW), Dillingham Harbormaster, and review of 2005 unit cost data. Labor costs are based on RS Means 2005 cost data and discussions with the DPW. The labor rates include overhead and profit. Equipment costs are based on RS Means 2005 cost data and discussions with the DPW. The equipment rates include overhead and profit. Material costs were developed by obtaining quotes from Dillingham DPW, previous project experience, and by utilizing RS Means 2005 cost data. Labor, equipment, and material costs have been adjusted from 3rd quarter 2005 to 3rd quarter 2008 using the Civil Works Construction Cost Index differential for Navigation Ports and Harbors.

### 3.2.1.3 Moorage Floats

The Dillingham Harbor moorage float system is made up of three float systems, one each at the north, south, and east sides of the harbor. Each of the systems is comprised of multiple modular floats which are connected and secured to the shore with driven swing arm piles. The float system is comprised of 34 floats 30’ in length that provide 1,020’ of moorage space for Dillingham Harbor users on a first-come first-served basis. Photos of the floats and swing arms are included as **Figures 8** and **9**, respectively.

**Figure 7: Dillingham Harbor Float Modules (on shore for winter) – West End study area**

Wave action in the harbor as a result of erosion at the harbor entrance results in excessive banging of vessels against one another and the floats. As a result, the floats require annual maintenance and repair for damages in excess of normal wear and tear. Dillingham harbor staff report the increased damage to floats attributable to erosion necessitates repairs to three harbor floats every three years. Replacement of harbor floats is estimated at $31,600 every 30 years. Estimated annual repair costs of harbor floats in excess of normal wear and tear is $3,900 annually. Costs associated with repair of the floats includes planning, project management, supervision and administrative costs; equipment and labor for loading, transport, and offloading of floats to repair shop; and labor and equipment for repairs. Additionally, the Dillingham Department of Public Works estimates that erosion results in a reduction in the useful life of the moorage floats from 30 to 20 years. It is expected that the 34 existing floats will require replacement in 2010 at a cost of $1,072,700. The advanced replacement cost of the floats is addressed in **Section 4.2.2.1** of this report.

**Figure 8: Float-to-Shore Connecting Swing Arms (on shore for winter)**
**West End study area**

**Figure 9: Damaged Swing Arms on East Bank of Dillingham Harbor**
**West End study area**

### 3.2.1.4 Moorage Float Swing Arms

Damages to the harbor's moorage float swing arms are occurring as a result of harbor erosion. Three swing arms need to be reset approximately every 20 years as a result of this activity. As shown in **Figure 9**, the swing arms on the eastern bank of the harbor are listing westward and require pulling and resetting the arms landward. The photo shows two of the three damaged swing arms in the harbor. These were repaired in 2005. The existing swing arms were manufactured in 1985 with a life expectancy of 40 years. As a result the existing swing arms will need replacement in 2025. An estimated total damage cost of $36,000 is expected 20 years after replacement for the three swing arms. This cost includes planning, project management, supervision and administration of the project; labor and equipment for pulling out existing piles and for moving swing arms into new locations to be driven; and labor and equipment for driving the swing arm piles.

### 3.2.1.5 Boat Ramps

Damages to the harbor's north and south concrete boat ramps result from erosion, which undermines the seaward terminus of the ramps and causes loss of prefabricated concrete modular sections and foundation material. Repair cost components include planning, project management, supervision and administration of the project; labor and equipment for spreading gravel base and placing concrete sections; purchase of 12"x 16"x 20' prefabricated concrete sections; and delivery of concrete sections and gravel to the ramp site. The estimated cost of boat ramp repairs is $30,120 for the north ramp and $42,170 for the south ramp. Both the north and the south boat ramps require repair every three years. A photo of the south ramp in 2004 is provided as **Figure 10**. The south ramp is just east of the harbor's entrance channel.

**Figure 10: South Boat Ramp, Dillingham Harbor - West End study area**

### 3.2.1.6 Harbor Bulkhead

Damages at the north end of the harbor are occurring as a result of erosion. The damages are occurring at the western end of the bulkhead. **Figure 11** shows the city dock looking northwestward from the east bank of the harbor. **Figure 12** shows a close up of the erosion-problem area. The erosion has resulted in the bulkhead listing seaward, requiring repair every two years. As shown in the figure, rip-rap was placed at the western end of the bulkhead to protect against further erosion damage. Cost components for required repairs involve: planning, project management, supervision and administration of the project; labor and equipment for uncovering turnbuckles, straightening piles and placing riprap; and delivery of rip-rap to the bulkhead site. The estimated cost is approximately $20,900 and repairs are required within two years.

**Figure 11: Harbor Bulkhead, North End of Dillingham Harbor West End study area**

**Figure 12: Erosion at West End of Harbor Bulkhead**
**West End study area**

#### 3.2.1.7 Vessel Damages Associated with Harbor Erosion

The 2004 commercial fishing fleet utilizing Dillingham Harbor included 750 vessels. The commercial fishing season out of Dillingham Harbor extends primarily from May through July. Herring vessels (approximately 15) can enter the harbor as early as April. Halibut vessels (approximately 15) can enter the harbor as early as May. The remaining vessels fish for salmon during June and July. The majority of fishing vessels are 32’ gill net harvesters. **Figure 13** shows Dillingham Harbor during fishing season.

**Figure 13: Fishing Vessels in Dillingham Harbor**

In 2004, the peak number of commercial vessels that utilized the harbor at any one time was approximately 450 during a salmon fishing closure. The typical number of vessels utilizing the harbor at any one time during the fishing season is between 250 and 300 vessels. To accommodate harbor demand, vessels are rafted 15-20 deep at the dock and reach as high as 30 deep during peak periods.

Most smaller personal and subsistence vessels stay out of the harbor during the fishing season. The majority of these smaller vessels are 25’ in length and utilize the harbor from August through September. During this period 15-25 of these smaller vessels may be in the harbor simultaneously. Between 400 and 500 personal, subsistence, and sport fishing vessels use the harbor each year during this period.

Harbor users typically incur vessel damages as a result of increased wave action during storms. Damaging storms were identified as those causing waves of 2’ or higher within the harbor. Engineering analysis of wind and tide data for the study area confirmed local estimates of annual damaging storm frequency at 7 storms per year during the May-September fishing and boating season. Breakwater designs for this analysis are the 50-year design life and are sufficient to attenuate the 2’ waves and avoid vessel damages. Types of vessel damages attributed to the increased wave activity include: buoy damages; hull damages; swamped vessels; and lost vessels.

Reported buoy damages are that three to four buoys per vessel that utilize the harbor have to be replaced every five years at $88 per buoy. The midpoint of 3.5 buoys per vessel every five years equates to .7 buoys per vessel per year. Applying this value to the 1,250 vessels that utilize the harbor for moorage results in annual damages of approximately $77,300.

Hull damages were reported to occur such that every two years a vessel requires hull repair for cleats that get ripped out at a cost of approximately $2,300. In 2004, two personal/subsistence use vessels were swamped and one lost (damaged beyond repair) due to wave activity within the harbor. The reported wave activity of two foot was sustained for two hours. Rehabilitation costs for the swamped vessel were approximately $700. Replacement cost for the lost vessel was $9,700.

### 3.2.2 City Dock Side

Presently, the following categories of damages are occurring in the City Dock Side study area as a result of erosion and its effects:

- Land losses from erosion
- Damages to public infrastructure

Existing damages in these categories are described in the following paragraphs.

#### 3.2.2.1 Land Losses from Erosion – City Dock Side

**Table 3** presented historic rates of erosion in the study area for the City Dock Side over the period of 1972-2001. Over this 29-year period, erosion was responsible for landward bank line erosion of approximately 290 linear feet in the study area, corresponding to 6.2 acres of lost land (or an average value of 0.22 acres per year over the period), largely under the ownership of the City of Dillingham and Peter Pan Seafoods. The value of this land in current prices is $174,700, based upon an average land value for the study area of $28,000 per acre. **Table 5** presents the resultant land loss and value associated with erosion in each erosion zone. **Figure 4** presents the project area with historic vegetation lines superimposed to show historical erosion. **Figures 14** and **15** show photos of active erosion of the disposal area south berm taken in 2004 and 2005.

**Table 5: Historical Land Loss Due to Erosion on City Dock Side (1972-2001)**

| | |
|---|---|
| ***ZONE 1*** | |
| Linear Feet of Landward Shoreline Erosion: | 219 |
| Average Feet per Year: | 7.6 |
| Lost Acreage: | 5.0 |
| Value of Lost Acreage: | $140,800 |
| Average Annual Equivalent (1972-2001): | $9,200 |
| ***ZONE 2*** | |
| Linear Feet of Landward Shoreline Erosion: | 70 |
| Average Feet per Year: | 2.4 |
| Lost Acreage: | 1.2 |
| Value of Lost Acreage: | $33,900 |
| Average Annual Equivalent (1972-2001): | $1,800 |
| ***TOTAL ZONES 1&2*** | |
| Linear Feet of Landward Shoreline Erosion: | 289 |
| Lost Acreage: | 6.2 |
| Value of Lost Acreage: | $174,700 |
| Average Annual Equivalent (1972-2001): | $11,000 |

**Figure 14: Disposal Area Berm at South Outfall, October 2004**

**Figure 15: Disposal Area Berm at South Outfall, September 2005**

#### 3.2.2.2 Damage to Public Infrastructure – City Dock Side

Damages to public facilities and infrastructure are occurring as a result of shoreline erosion in the study area. These damages include damage to the shore protection project constructed in 1999 for harbor protection, damage to the harbor's southeast dredged material disposal site berm, and damage to Dillingham's city park located south of the harbor.

Cost data for infrastructure damages was obtained through interviews with staff of the City of Dillingham, Department of Public Works (DPW), local utilities, contractor quotes, and review of 2005 unit cost data. Labor costs are based on RS Means 2005 cost data and discussions with the DPW. The labor rates include overhead and profit. Equipment costs are based on RS Means 2005 cost data and discussions with the DPW. The equipment rates include overhead and profit. Material costs were developed by obtaining quotes from Dillingham DPW, previous project experience, and by utilizing RS Means 2005 cost data. Labor, equipment, and material costs have been adjusted from $4^{th}$ quarter 2005 to $3^{rd}$ quarter 2008 using the Civil Works Construction Cost Index differential for Navigation Ports and Harbors.

#### 3.2.2.3 Existing Harbor Protection (Rock Revetment and Sheetpile Seawall) – City Dock Side

In 1999, the Corps of Engineers constructed 613 feet of bank protection along the bluff in front of the Dillingham small boat harbor. The west end of the bluff is bordered by Scandinavian Creek as it enters the Nushagak River. Scandinavian Creek is the entrance channel to the Dillingham small boat harbor. On this western end of the bluff, approximately 184 feet was protected by a rock riprap revetment. The remainder of the shoreline protection, approximately 429 feet, was protected by a sheetpile seawall with gravel backfill (~4,200 cy of gravel). The construction cost of the sheetpile portion of the project in 1999 prices was $1,160,000. Using the Civil Works Construction Cost Index for Breakwater and Seawalls, the 2008 indexed cost for constructing this project is $1,425,500. In recent years, land at the eastern terminus of the seawall has experienced continued erosion. A large storm in September of 2005 resulted in significant erosion in this area that resulted in the seawall being outflanked and erosion behind the seawall. Photos of this area taken after the storm are presented in **Figures 16-18**.

**Figure 16: Erosion Outflanks West Terminus of Seawall – City Dock Side (September 2005)**

**Figure 17: Seawall Erosion looking Eastward (September 2005)**
**City Dock Side**

**Figure 18: Seawall Erosion looking Westward**
**Peter Pan Seafoods in background (September 2005)**

### 3.2.2.4 Dillingham Harbor Disposal Area Berm – City Dock Side

Since 1974, Dillingham Harbor is dredged annually to +2 feet MLLW to prevent excessive shoaling of sediment that would strand vessels in the harbor. Seven to nine feet of fine sediment accumulate annually. Two upland disposal sites have been used, one to the west of the harbor and one to the east; which is the subject of this study. The primary disposal site on the east side of the harbor is on property owned by Peter Pan Seafoods Inc. The site has reached full capacity and is no longer in use. The riverbank along the north side of the Nushagak River has been actively eroding towards the south berm of the disposal area and has eroded the outside toe of the berm in the vicinity of the south outfall. **Figures 4, 14,** and **15** showed erosion along the disposal area berm.

### 3.2.2.5 Dillingham City Park

Erosion in the area between the east terminus of the sheetpile seawall and the northwest corner of the disposal berm is impacting Dillingham's City Park. This park is a popular local attraction for residents during the summer and hosts community events. The park includes recreational features and a covered picnic shelter facility. Erosion along the south end of the park has created a public safety concern. Storm surge in the September 2005 storm swept a picnic table from the park area several hundred feet eastward. Erosion in the western end of the park is evident in **Figure 16**. **Figures 19 - 21** depict the effects of erosion within the park.

**Figure 19: Erosion at Dillingham City Park looking North (September 2005)**

**Figure 20: Erosion at Dillingham City Park looking West (September 2005)**

**Figure 21: Picnic Table washed from City Park (September 2005)**
**City Dock Side**

## 3.3 Existing Conditions Summary

### 3.3.1 West End

As a result of extreme tides, storm surges, and other factors, the shorelines of Dillingham harbor are eroding an average of 0.2 acres annually, a loss of land valued at $2,800. Extreme wave conditions in the harbor during storms are causing annual damages of $3,900 to the moorage floats and have reduced the floats' life cycle from 30 years to 20 years. Repairs are required for damages to moorage float swing arms every 20 years, estimated at $36.000. Repairs are required within 3 years for existing damages to the harbor's north boat ramp, estimated at $30,120. Repairs to the harbor bulkhead are required within 2 years, estimated at $20,900. Reported vessel damages include required replacement of 3-4 buoys every 5 years at a cost of $88 each and hull repairs to one vessel every two years at a cost of $2,300. Vessels are routinely swamped or damaged beyond repair each year amounting to $6,200 in repair/replacement cost.

**Section 4.1** of this report presents expected annual damages without implementation of a bank protection project in the West End study area. The section includes a summary of expected without-project annual damages for all damage categories (see **Table 14 in Section 4.5**).

### 3.3.2 City Dock Side

As a result of extreme tides, storm surges, and other factors, the shorelines on the east side of Dillingham Harbor are eroding an average of 0.12 acres annually, a loss of land valued at $3,300. The public investment in harbor erosion protection made in 1999 is experiencing structural damage and reduction in functional life. The publicly operated dredged material disposal site on the east side of the harbor is in eminent threat of berm failure, and Dillingham's City Waterfront Park is experiencing active erosion and is currently a public safety concern.

**Section 4.4** of this report presents expected annual damages without implementation of a bank protection project in the City Dock Side study area. The section includes a summary of expected without-project annual damages for all damage categories (see **Table 15 in Section 4.5**).

# 4 FUTURE WITHOUT-PROJECT – NO ACTION ALTERNATIVE

Given present conditions, erosion at high tide and storm conditions will result in continued land losses, damages beyond normal wear and tear to vessels, and losses to harbor and public infrastructure in the study areas. In addition, it is expected that with no action the city's fuel tanks will be threatened requiring emergency bank protection within 10 years. Following is a discussion of expected annual conditions and damages without implementation of protection projects in the study areas. The West End and the City Dock Side study areas are described individually as the damages for these two areas are considered separable.

## 4.1 Expected Without-Project Erosion for West End

The study's hydrologic and hydraulic analyses concluded that erosion is expected to continue in the West End study area at historic rates as identified in **Table 2**. **Table 6** summarizes the expected annual erosion rates that were applied for future without-project damage calculations for the three erosion zones previously identified in **Figure 2**.

**Table 6: Expected Without-Project Erosion Rates**

| Study Area | Expected Erosion Per Year (ft/yr) |
|---|---|
| Erosion Zone 1 | 10.89 |
| Erosion Zone 2 | 1.39 |
| Erosion Zone 3 | 1.38 |

## 4.2 Without-Project Damage Categories for West End

Without bank stabilization, the City of Dillingham, Dillingham residents, and Dillingham Harbor users will continue to incur the following categories of damages identified in **Section 3.2.1**:

- Land losses from erosion
- Incremental maintenance and advanced replacement of harbor infrastructure
- Vessel damages
- Emergency bank stabilization

### 4.2.1 Land Losses from Erosion – West End

The expected without-project erosion rates in **Table 6** were applied to the three erosion zones at the West End to determine the aerial extent of erosion in the study area. The conversion of annual erosion rates to areas of lost land was performed as part of the study's hydrologic and hydraulic analyses. The resultant expected annual loss of acreage within each erosion zone is presented in **Table 7**.

**Table 7** also presents the value of expected annual lost acreage and the present value of expected land loss over the 50-year period of analysis. Erosion was assumed to continue at the annual rate for the entire 50-year period of analysis in Erosion Zones 2 and 3. Erosion in Zone 1 was assumed to continue for 9 years at which time it is expected that emergency bank stabilization measures will be implemented to protect the BAF fuel tank farm.

**Table 7: Expected Without-Project Land Losses at the West End Study Area**

| | |
|---|---|
| ***ZONE 1*** | |
| Annual Lost Acreage (years 1-9): | 0.154 |
| Value of Annual Lost Acreage (years 1-9): | $4,300 |
| Present Value over Pd. of Analysis: | $30,700 |
| Average Annual Equivalent: | $1,700 |
| ***ZONE 2*** | |
| Annual Lost Acreage: | 0.014 |
| Value of Annual Lost Acreage: | $400 |
| Present Value over Pd. of Analysis: | $7,400 |
| Average Annual Equivalent: | $400 |
| ***ZONE 3*** | |
| Annual Lost Acreage: | 0.027 |
| Value of Annual Lost Acreage: | $700 |
| Present Value over Pd. of Analysis: | $13,800 |
| Average Annual Equivalent: | $700 |
| ***TOTAL ZONES 1-3*** | |
| Annual Lost Acreage (years 1-9): | 0.194 |
| Annual Lost Acreage (years 10-50): | 0.041 |
| Value of Annual Lost Acreage (years 1-9): | $5,400 |
| Value of Annual Lost Acreage (years 10-50): | $1,100 |
| ***Present Value over Period of Analysis:*** | ***$51,900*** |
| ***Average Annual Equivalent:*** | ***$2,800*** |

This analysis estimated annual lost land to erosion in the study area at 0.194 acres, corresponding to an annual damage valued at $5,400 per year for the first 9 years and then $1,100 per year for the remainder of the period of analysis.

***This stream of land loss damages was estimated to have a present value of $51,900; with an average annual equivalent value of $2,800 per year.***

### 4.2.2 Incremental Maintenance and Advanced Replacement of Harbor Infrastructure – West End

The existing damages identified in **Section 3.2.1.2**, associated with incremental maintenance and advanced replacement to harbor infrastructure are expected to continue over the 50-year period of analysis. Categories of damages expected to continue include damages to (and advanced replacement of) moorage floats, damages to float swing arms, damages to concrete boat ramps, damages to the harbor bulkhead, and damages to vessels in the harbor. Expected without-project damages in these categories are described in the following paragraphs.

#### 4.2.2.1 Moorage Floats

The estimated annual cost of additional float repairs due to erosion identified in **Section 3.2.1.3** for existing conditions is expected to continue over the period of analysis. This expected annual value for additional float repairs is estimated at approximately $3,900 as reported by Harbormaster and Dillingham Public Works Department.

***This stream of moorage float damages was estimated to have a present value of $72,900; with an average annual equivalent value of $3,900 per year.***

As identified in **Section 3.2.1.3**, the cost for float replacement is $1,072,700 ($31,551 per float x 34 floats). Under without-project conditions it is expected that the float system would need to be replaced every 20 years. Under more typical wave conditions the float system would be expected to last 30 years. Under without-project conditions, the floats are expected to be replaced in 2010, 2030, and 2050. Under normal conditions with a 30-year float life, replacement would be required in 2020 and 2050.

***The difference in the expected stream of replacement costs under without-project conditions relative to replacement costs under normal wave conditions within the harbor was estimated to have a present value of $930,000; with an average annual equivalent value of $50,000 per year.***

***The combined total of estimated moorage float damages has a present value of $1,002,900; with an average annual equivalent value of $53,900 per year. (Note: totals may not be exactly the same as the sum of the reported values of the two components due to rounding).***

#### 4.2.2.2 Moorage Float Swing Arms – West End

**Section 3.2.1.4** identified the estimated cost of pulling and resetting three moorage float swing arms at $35,900. The swing arms life expectancy is 40 years and will require replacement in 2025 and it is anticipated that under without-project conditions, these swing arms will need to be repaired in 2045 during the 50-year period of analysis.

***This stream of moorage float swing arm damages was estimated to have a present value of $5,900; with an average annual equivalent value of $300 per year.***

#### 4.2.2.3 Boat Ramps – West End

**Section 3.2.1.5** identified the estimated cost of boat ramp repairs from erosion damage at $85,100 ($35,500 for the north ramp and $49,700 for the south ramp). Under without-project conditions, it is expected that damages to the north and south ramps will require repairs in 2008 and every three years thereafter over the period of analysis. Erosion from the City Dock Side is expected to impact the south ramp in 2020 so repairs will end at that time.

***This stream of expected boat ramp damages (both ramps) was estimated to have a present value of $348,000; with an average annual equivalent value of $18,700 per year.***

#### 4.2.2.4 Harbor Bulkhead – West End

**Section 3.2.1.6** identified the cost of repairs to erosion damage to the harbor bulkhead at approximately $20,900. Under without-project conditions it is expected that these repairs will need to be made in 2007 and every two years thereafter over the period of analysis.

***This stream of expected harbor bulkhead damages was estimated to have a present value of $186,100; with an average annual equivalent value of $10,000 per year.***

#### 4.2.2.5 Summary of Incremental Maintenance and Advanced Replacement Damages

**Table 8** presents a summary of expected damages to floats, float swing arms, boat ramps, and the harbor bulkhead under without-project conditions.

**Table 8: Expected Without-Project Maintenance & Advanced Replacement Damages**

| Item | Present Value | Average Annual Cost: |
|---|---|---|
| Moorage Floats | $ 1,002,800 | $ 53,900 |
| Float Swing Arms | 5,900 | 300 |
| Concrete Boat Ramps | 348,000 | 18,700 |
| Harbor Bulkhead | 186,100 | 10,000 |
| ***Total:*** | **$ 1,542,800** | **$ 82,900** |

### 4.2.3 Vessel Damages – West End

It is expected that use of the harbor by commercial fishing vessels would remain at similar levels as the existing conditions. Most Bristol Bay commercial fishing vessels fish for salmon. Review of historical Bristol Bay salmon catch data published by the Alaska Department of Fish and Game (ADF&G) indicates that catch in 2004 (27.3 million fish) was above the average catch over the previous six years (19.4 million fish). **Table 9** presents the annual Bristol Bay salmon harvest by species from 1999-2004. This data is presented graphically in **Figure 22**.

Over this nine-year period, sockeye salmon accounted for approximately 95% of the salmon catch in the fishery. Chum salmon accounted for approximately 4.5%; and the remaining stocks (Chinook, Pink, and Coho) accounted for less than 1% each. The ADF&G Bristol Bay sockeye forecast for 2008 is for a commercial harvest of 31.4 million fish (more than the 2007 preliminary sockeye harvest).[1]

**Table 9: Bristol Bay Salmon Catch by Species (Number of fish - 1999-2007)**

| Year | Sockeye Salmon | Chinook Salmon | Chum Salmon | Pink Salmon | Coho Salmon | Total |
|---|---|---|---|---|---|---|
| 1999 | 26,100,000 | 30,000 | 250,000 | 0 | 20,000 | 26,390,000 |
| 2000 | 20,530,000 | 20,000 | 380,000 | 60,000 | 130,000 | 21,120,000 |
| 2001 | 14,180,000 | 20,000 | 830,000 | <1,000 | 20,000 | 15,060,000 |
| 2002 | 10,679,000 | 45,000 | 468,000 | <1,000 | 8,000 | 11,200,000 |
| 2003 | 14,766,000 | 48,000 | 933,000 | <1,000 | 43,000 | 15,790,000 |
| 2004 | 26,265,000 | 115,000 | 733,000 | 53,000 | 72,000 | 27,237,000 |
| 2005 | 24,525,000 | 77,000 | 1,397,000 | 3,000 | 75,000 | 26,077,000 |
| 2006 | 28,493,000 | 107,000 | 2,244,000 | 146,000 | 79,000 | 31,069,000 |
| 2007-P | 29,463,000 | 63,000 | 2,040,000 | <1,000 | 50,000 | 31,616,000 |

*Source:* Alaska Department of Fish and Game Commercial Fisheries Division.
*Note:* 2007 harvest numbers are preliminary.

[1] 2008 Bristol Bay Sockeye Salmon Forecast - http://www.cf.adfg.state.ak.us/region2/finfish/salmon/bbay/brbfor08.pdf.

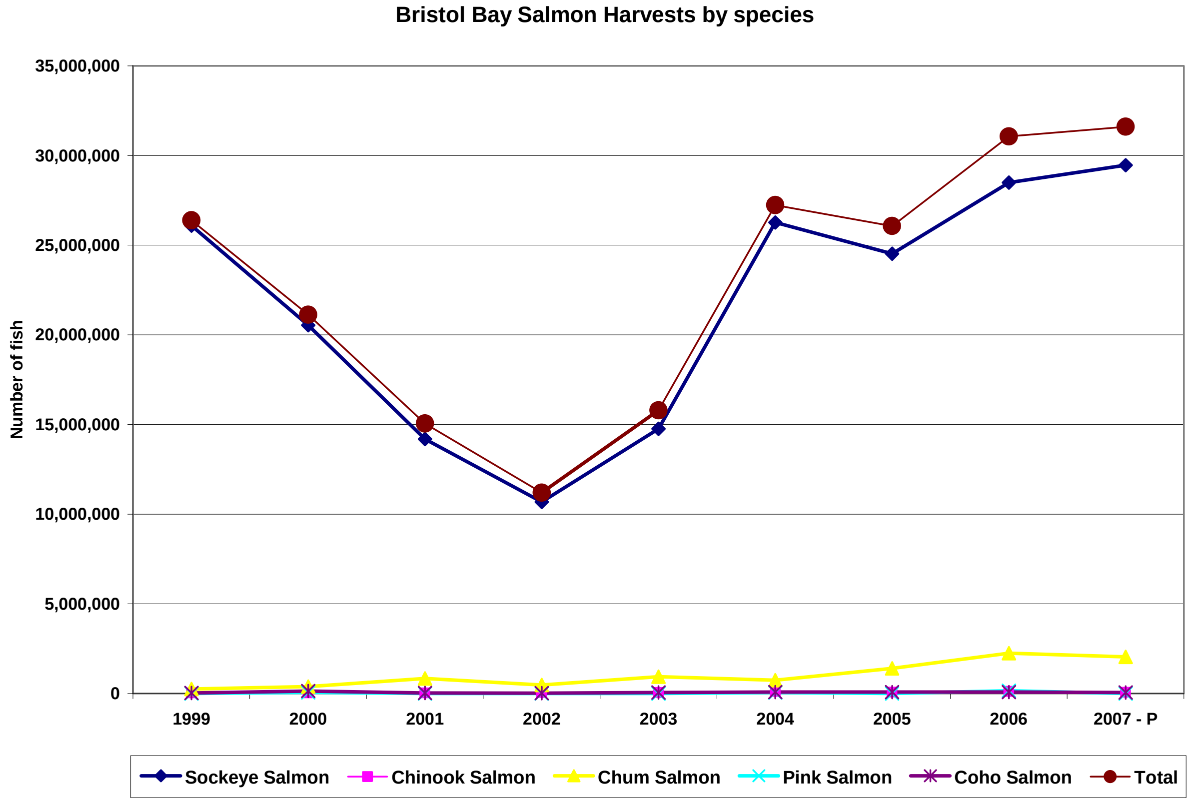


**Figure 22: Bristol Bay Salmon Harvest by Species (1999-2007)**

**Table 10** presents the ex-vessel value of the catch identified in **Table 9**. The 2005 ex-vessel value of the Bristol Bay salmon harvest was estimated at $101,796,000, which is above the nine year average catch ex-vessel value of $61,940,000; but below the recent 20-year average value of $121 million published by ADF&G. **Figure 23** is a graph of the **Table 10** ex-vessel value data.

**Table 10: Ex-Vessel Value of Bristol Bay Salmon Harvest (1999-2007)**

| Year | Ex-Vessel Value | Inflation Adjusted Dollars |
|---|---|---|
| 1999 | $ 115,070,000 | $ 140,503,000 |
| 2000 | 81,080,000 | 97,360,000 |
| 2001 | 41,000,000 | 47,869,000 |
| 2002 | 32,393,000 | 37,102,000 |
| 2003 | 48,330,000 | 53,892,000 |
| 2004 | 77,682,000 | 84,439,000 |
| 2005 | 96,515,000 | 101,796,000 |
| 2006 | 31,069,000 | 31,752,000 |
| 2007 - P | 31,616,000 | 31,616,000 |

*Source:* Alaska Department of Fish and Game Commercial Fisheries Division.
*Note:* Inflation adjusted dollars are based on Anchorage Annual Average Consumer Price Index.

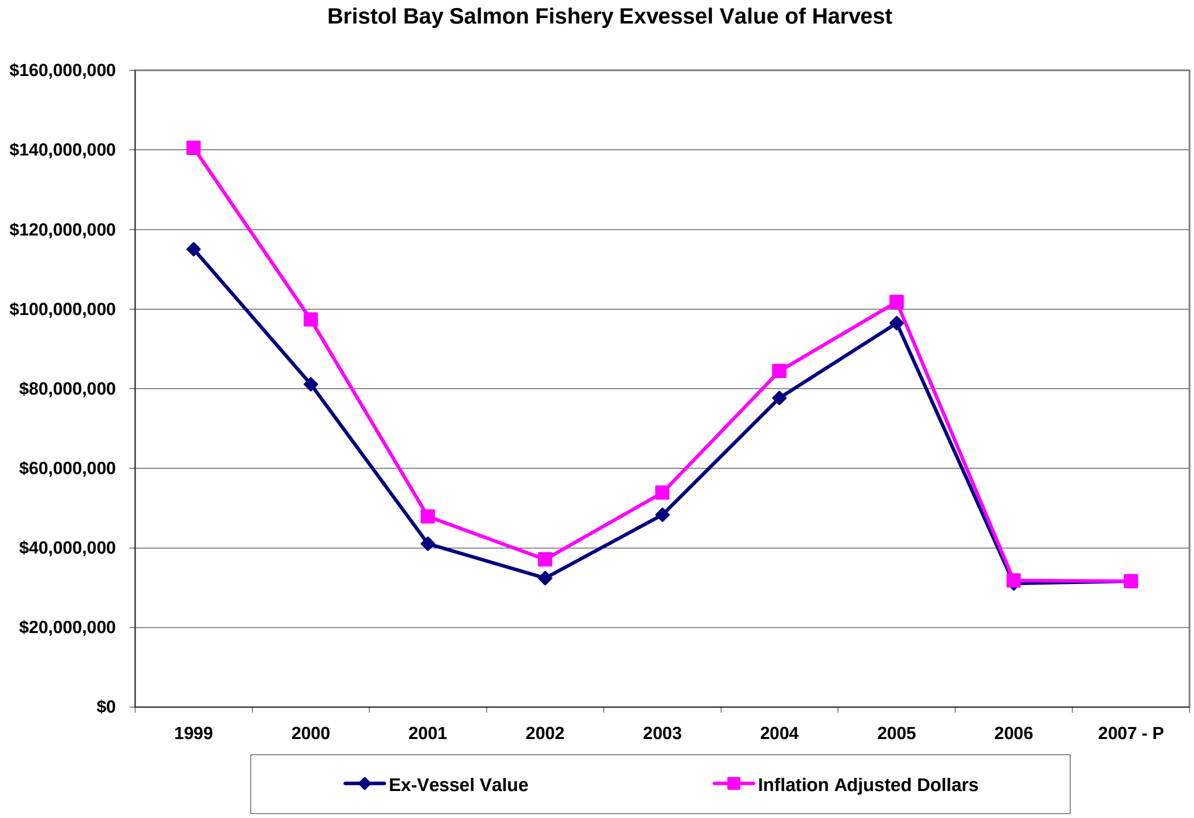


**Figure 23: Ex-Vessel Values for Bristol Bay Salmon Harvest (1999-2007)**

**Section 3.2.1.7** identified existing categories of damages to vessels attributable to erosion as damages to buoys and hulls from excessive banging of rafted commercial vessels as well as swamped and lost (damaged beyond repair) personal vessels. It is expected that vessel damages in the future without-project condition will remain the same as in the existing conditions.

Buoy damages due to increased wave activity in the harbor were estimated at $77,300 per year. Hull repairs attributable to the increased wave activity were estimated to cost $1,180 per year. It is further expected that 2 smaller vessels will be swamped per year in the harbor and one damaged beyond repair every other year at an average annual cost of $6,200. Average annual damages to vessels under without-project conditions would total $84,700.

***This stream of expected vessel damages was estimated to have a present value of $1,576,900; with an average annual equivalent value of $84,700 per year.***

### 4.2.4 Emergency Bank Stabilization – West End

Bristol Alliance Fuels (BAF) owns the fuel tank farm that holds the fuel supply for the city of Dillingham. The tank farm is located at the west bank of the harbor and consists of eight 321,000-gallon tanks. If no protective action is taken from erosion in the future these tanks would be destroyed.

Since loss of the tanks would require erosion of the harbor's west bank to the site of the tanks, loss of the tanks into the harbor would result in catastrophic damage to the harbor, the economic infrastructure it supports, and the environment if erosion were left unchecked and the tank farm remained at its present location. If fuel spilled into the water there could be disastrous impacts to marine resources and the fishery.

Similarly, the cost of relocating the tank farm would be significant. Estimated cost of relocation includes purchasing new fuel tanks, acquisition of needed real estate, and construction of supporting facilities. Based on recent Denali Commission projects completed in Unalakleet, Kwethluk, and Selawik, fuel tank projects in the 500,000 to 1.5 million gallon range have actual construction costs of $6.79 to $10.09 per gallon. Using the midpoint of these costs ($8.44), it is estimated that relocation of the tank farm would occur in 2014 at year 7 of the 50-year study period at a total cost of $21,674,000. This relocation cost was estimated to have a present value of $18,293,800; with an average annual equivalent value of $982,800 per year.

This economic analysis is based upon the assumption that emergency bank stabilization measures would be implemented to protect the BAF fuel tank farm prior to loss of the fuel tanks to erosion and precluding the need for relocation of the fuel tanks. Based upon engineering analysis, it is estimated that the emergency bank protection would be required in 2016 at year 9 of the 50-year study period at an estimated total cost of $6,717,100. This emergency bank stabilization cost was estimated to have a present value of $4,556,200; with an average annual equivalent value of $244,800 per year.

***This stream of costs associated with expected emergency bank stabilization measures was estimated to have a present value of $4,556,200; with an average annual equivalent value of $244,800.***

## 4.3 Expected Without-Project Erosion for City Dock Side

The study's hydrologic and hydraulic analyses concluded that erosion is expected to continue in the City Dock Side study area although at a reduced rate from the observed historic erosion rates shown in **Table 3**. The average historical rates in each zone were extrapolated to provide the initial basis of the expected erosion zone in the study area over the 50-year period of analysis. Adjustments to the bounds of the expected erosion area were based upon engineering judgment to account for expected without-project conditions in the study area, such as consideration of the stoppage of use of the south dredged material containment area outfall, the relationship between the recession rate of beach slopes and scour depths, and soil characteristics in the project area. Additionally, the erosion bounds were smoothed to depict a more general trend than the maximum rates at any particular point. **Figure 4** showed the historical and projected erosion areas in the project area relative to a 2001 aerial photograph. The total area of the without-project expected erosion zone was estimated at approximately 6 acres (0.12 acres per year for 50 years). **Table 11** summarizes the expected erosion rates that were applied for estimating future without-project damage calculations.

**Table 11: Expected Without-Project Erosion Rates**

| Erosion Zone | Total Erosion | | Avg. Annual Erosion | |
|---|---|---|---|---|
| | ($ft^2$) | (acres) | ($ft^2$) | (acres) |
| Zone 1 | 63,507 | 1.5 | 1,270 | 0.03 |
| Zone 2 | 195,645 | 4.5 | 3,913 | 0.09 |
| TOTAL | 259,152 | 6.0 | 5,183 | 0.12 |

## 4.4 Without-Project Damage Categories for City Dock Side

Without bank stabilization, the following categories of damages as described in **Section 3.2.2**. are expected:

- Continued land losses from erosion
- Loss of function for existing harbor bank protection project
- Failure of Dillingham Harbor east dredged material disposal area
- Loss of Dillingham City Waterfront Park
- Loss of Harbor South Parking Lot
- Impacts to Utilities
- Time delays for fishing vessels

### 4.4.1 Land Losses from Erosion

The methodology for estimation of expected annual erosion rates was described in **Section 4.3**. The conversion of annual erosion rates to area and value of lost land is summarized in **Table 12**.

**Table 12: Expected Erosion Damages over Period of Analysis with No Action**

| Erosion Zone | Total Land Loss | | Avg. Annual Land Loss | | Value of Land Loss | |
|---|---|---|---|---|---|---|
| | ($ft^2$) | (acres) | ($ft^2$) | (acres) | Total Present Value | Average Annual Equivalent Value |
| Zone 1 | 63,507 | 1.46 | 1,270 | 0.03 | $46,800 | $2,500 |
| Zone 2 | 195,645 | 4.49 | 3,913 | 0.09 | $15,200 | $800 |
| TOTAL | 259,152 | 5.95 | 5,183 | 0.12 | $62,000 | $3,300 |

This analysis estimated annual lost land to erosion in the study area at 0.12 acres, corresponding to an annual damage valued at $3,300 per year.

***This stream of land loss damages was estimated to have a present value of $62,000; with an average annual equivalent value of $3,300 per year.***

### 4.4.2 Loss of Harbor Shoreline Protection

The Corps constructed a shoreline protection project in 1999 to protect Dillingham Harbor and the public parking lot from expected erosion damages as shown in **Figure 24** (photo from 2001). The east terminus of the sheetpile wall was outflanked during a September 2005 storm and erosion occurred to the east and behind the eastern end of the wall (see **Figures 16-18**).

Erosion is expected to continue in this area with no action and it is estimated that the structural integrity of the sheetpile wall would be lost in 2015. The design life of the sheetpile wall was 25 years. The construction cost of the sheetpile seawall in current prices is $1,561,400. Given the 25-year design life of the sheetpile, the fact that the existing sheetpile failed within ten years of construction, and the 50-year period of analysis, it is expected that the sheetpile will fail again several more times. The present value of the difference between normal replacement at 25 years and the accelerated replacement at 10 years for sheetpile costs is $2,536,900.

***The accelerated seawall damage was estimated to have a present value of $2,536,900; with an average annual equivalent value of $136,300 per year.***

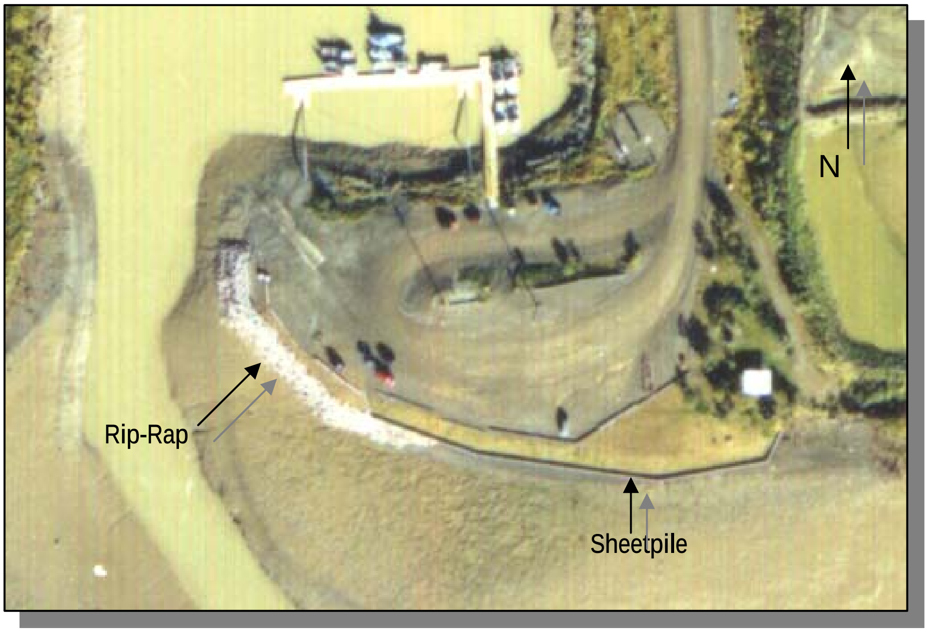


**Figure 24: Existing Harbor Shoreline Protection (2001) – City Dock Side**

### 4.4.3 Failure of Dredged Material Disposal Wall – City Dock Side

The toe of the disposal area's south berm has already been eroded. Based upon the expected Zone 1 erosion rates, the berm is expected to be fully breached in 2008, resulting in the gradual release of dredged material into the Nushagak River. State and federal resource agencies have expressed concern of potential environmental damage to fisheries if the dredged material containment berm is breached.

The Environmental Assessment/Finding of No Significant Impact (EA/FONSI) prepared for the construction of the rock revetment/sheetpile seawall at the south end of the Dillingham Small Boat Harbor (1998) reported that the Nushagak and Wood River systems in the study area are highly productive salmon areas. Sockeye, Chinook, coho, chum, and pink salmon are present in Nushagak and Bristol Bays. Beginning in mid-May, outmigrating salmon smolt are found in the project area. Adult salmon occur in this reach of the river from early May to late September during their upstream movement to spawning grounds.

Pacific salmon are integral to commercial fisheries in western Bristol Bay and as such to the regional economy and local economies (see **Section 3.1**). The effect of failure of the disposal wall on the fisheries is currently unknown. If such failure were to result in damage to the fisheries, there would be negative economic impacts on Dillingham.

### 4.4.4 Loss of Dillingham City Waterfront Park – City Dock Side

At expected erosion rates, the City Park will need to be closed to the public within 2 years because of the risk it poses to public safety. The eroded south end of the park has left unstable bluffs that will increase in height in time posing increased risk of injury. It is expected that the park's picnic shelter will be lost to erosion in 2008. The depreciated replacement cost of the structure is estimated at $6,500. The present value of this cost is $6,200.

***Quantified damage to infrastructure at Dillingham City Park was estimated to have a present value of $6,200; with an average annual equivalent value of $300 per year. Land loss was already accounted for in Section 4.4.1.***

The park is a popular summer activity for local residents and gathering place for social events in the community. The annual Blessing of the Fleet takes place each June and brings up to 150 people to the park. Several weddings and other social events take place at the park each year. Although no written recreation visitation records are maintained for the park, the City estimates that on average at least 25 people visit the park daily during the summer (June-August) and that on average at least 5 people visit the park daily during the remaining months. The daily visitation and special event visitation were combined resulting in estimated annual visitation of 3,800 visitors. If use of the park is lost, this expected annual visitation could not occur.

To estimate the economic value of this lost recreation use, the user day value (UDV) method was applied as described in Corps Economic Guidance Memorandum (EGM-08-02), dated 19 October 2007. The EGM provides guidelines for assigning point values to general recreation activities and provides a table showing the range of daily values that correspond to point value scores.

The guidelines for assigning values address five criteria: recreation experience, availability of opportunity, carrying capacity, accessibility, and environmental. The ratings applied for each criterion for this study are identified in **Table 13**.

***Damages associated with lost recreational opportunities at the City Waterfront Park were estimated to have a present value of $457,300; with an average annual equivalent value of $24,600 per year.***

***Total estimated damages associated with loss of the park (recreational activities and infrastructure) sum to a present value of $463,500; with an average annual equivalent of $24,900 per year.***

**Table 13: Recreational User Day Score and Value**

| Recreation Criteria | Range of Possible Values | Judgment Value | Rationale |
|---|---|---|---|
| Recreation Experience | 0 to 30 | 7.5 | Score corresponds to EGM 08-02 judgment guidelines for general recreation experience at facility with several general recreation activities. The park's main activities include picnicking, playground, and sightseeing. Selected mid-point of corresponding range, which is 5-10 points. |
| Availability of Opportunity | 0 to 18 | 8.5 | Score corresponds to EGM 08-02 judgment guidelines for availability of opportunity where there are one or two similar facilities within one hour. While the Dillingham City Waterfront Park is the only facility in the area that provides all the general recreation activities described in the above criteria, waterfront picnicking and sight seeing opportunities are provided at Lake Aleknagik which is accessible from Dillingham by car. Selected mid-point of corresponding range, which is 7-10 points. |
| Carrying Capacity | 0 to 14 | 4 | Score corresponds to EGM 08-02 judgment guidelines for carrying capacity where there are basic facilities to conduct the provided recreational activities. The guidelines for higher scores requires larger facilities such that recreational experience is not diminished with higher use. Selected mid-point of corresponding range, which is 3-5 points. |
| Accessibility | 0 to 18 | 12.5 | Score corresponds to EGM 08-02 judgment guidelines for facilities with good access roads to site. Selected mid-point of corresponding range, which is 11-14 points. |
| Environmental | 0 to 20 | 8.5 | Score corresponds to EGM 08-02 judgment guidelines for above average aesthetic quality (beautiful views of Nushagak River) but some limiting factors (adjacent dredged material disposal site and harbor protection). Selected mid-point of corresponding range, which is 7-10 points. |
| Total Points | | | 41 |
| Conversion of Points to User Day Value based on FY08 Conversion Chart (EGM 08-02) | | | $6.47 |
| Estimated Annual User-Days | | | 3,800 |
| Estimated Annual Value of Recreation Activities at Park | | | $24,600 |

#### 4.4.5 Loss of Harbor South Parking Lot

Based upon existing erosion rates it is estimated that the harbor will loose access/use of the south parking lot in year 2020. Replacing the parking lot would require acquisition of 2 acres of land, land preparation, and distribution/compaction of gravel. Current prices for land in the vicinity of the harbor average $28,000 per acre. The total cost for construction of a replacement parking lot is estimated at $79,000. The present value of this cost is $42,500. Additional damages in the form of increased transportation costs and time delays will occur if no real estate is available within the same proximity to the harbor as the current lot. Additionally, structural modifications to the harbor moorage float system will be required to provide access to the harbors south float system and Public Works staff will require additional time/cost to place the south float system from the water when vehicular access to the south parking lot is lost.

***Damages associated with replacement of the Harbor south parking lot are estimated to have a present value of $42,500; with an average annual equivalent value of $2,300 per year.***

#### 4.4.6 Impacts to Utilities

The Dillingham Department of Public Works has identified several utilities that run under Harbor Road to the harbor south parking lot and would be impacted on the same schedule as identified for the parking lot (2020). These utilities include electric power lines for the street lights in the south parking lot, a phone line and telephone booth, and a waterline and fire hydrant. Costs were estimated for disconnection of the power lines, relocation of the phone booth/line, and relocation of the fire hydrant. These costs were estimated to total $30,000. The present value of this cost is $16,200. These damages would also result in public safety concerns with loss of the street lights at the south end of the harbor and increased distance from the south harbor float system to relocated fire hydrant.

***Damages associated with impacts to utilities in the study area are estimated to have a present value of $16,200; with an average annual equivalent value of $900 per year.***

#### 4.4.7 Delays in Vessel Launch and Retrieval and Vessel Damages

The 2004 commercial fishing fleet utilizing Dillingham Harbor included 750 vessels. The commercial fishing season out of Dillingham Harbor extends primarily from May through July. Herring vessels (approximately 15) can enter the harbor as early as April. Halibut vessels (approximately 15) can enter the harbor as early as May. The remaining vessels fish for salmon during June and July. The majority of fishing vessels are 32’ gill net harvesters. **Figure 13** shows Dillingham Harbor during fishing season.

In 2004, the peak number of commercial vessels that utilized the harbor at any one time was approximately 450 during a salmon fishing closure. The typical number of vessels utilizing the harbor at any one time during the fishing season is between 250 and 300 vessels. To accommodate harbor demand, vessels are rafted 15-20 deep at the dock and reach as high as 30 deep during peak periods. It is expected that use of the harbor by commercial fishing vessels would remain at similar levels as in existing conditions.

Most smaller personal and subsistence vessels stay out of the harbor during the fishing season. The majority of these smaller vessels are 25' in length and utilize the harbor from August through September. During this period 15-25 of these smaller vessels may be in the harbor simultaneously. Between 400 and 500 personal, subsistence, and sport fishing vessels use the harbor each year during this period.

Associated with the loss of use of the harbor's existing south boat ramp would be delays in vessel launch and retrieval. With a reduction from two boat ramps to one ramp it is expected that there would be delays for commercial fisherman during their launch and retrieval process.

Assuming an hour delay on launch and an hour delay on retrieval results in damages with a present value of $236,500 based upon an average crew size of 2.25 and an average hourly total crew rate of $157.63/hour. This rate is based on *Value of Time Commercial Fishermen in Alaska Could Save with Improved Harbor Facilities* prepared by Cornell University in September 2006. Using the value of fishing time for salmon fishers in Western Alaska of $126.79 for captain and $43.63 for crew along with the survey reports values for percentage of time that would be allocated to additional fishing or leisure activity. Use of 1/3 of the prevailing wage rate is a typical methodology for determination of the value of leisure time; which is what the crew will have to give up to arrive early and stay late due to the increased launch and retrieval time.

| | **Western AK salmon fishers hourly wage** | **Percent fishing** | **Percent leisure** | **Average # crew** | **Effective hourly rate** |
|---|---|---|---|---|---|
| | (a) | (b) | (c) | (d) | (a*b + 1/3(a*c))*d |
| Captain | $126.79 | 0.804 | 0.196 | 1 | $110.22 |
| Crew | $ 43.63 | 0.804 | 0.196 | 1.25 | $ 47.41 |
| **Total Hourly Rate for typical Western Alaska fishing vessel** | | | | | **$157.63** |

***Damages associated with delays in vessel launch and retrieval with the loss of the south boat ramp are estimated to have a present value of $2,290,800; with an average annual equivalent value of $123,100.***

## 4.5 Without-Project Conditions Summary

### 4.5.1 West End

A summary of the annual costs for the without-project condition for the Dillingham West End study area stabilization project is shown in Table 14.

***The present value of the sum of expected erosion damages over the fifty-year period of analysis at Dillingham Harbor is estimated as $7,609,500. The average annual equivalent cost of this value is $408,800 per year.***

**Table 14: Summary of Dillingham Harbor Without-Project Damages for West End**

| | | |
|---|---|---|
| **Economic Analysis Factors** | | |
| Period of Analysis: | 50 | years |
| Discount Rate: | 0.04875 | (FY08 Federal Discount Rate) |
| Price level: | April 2008 | |
| **Incremental Maintenance and Advanced Replacement** | | |
| **Item:** | **Present Value** | **Average Annual Damages:** |
| Moorage Floats: | $ 1,002,800 | $ 53,900 |
| Float Swing Arms: | 5,900 | 300 |
| Concrete Boat Ramps: | 348,000 | 18,700 |
| Harbor Bulkhead: | 186,100 | 10,000 |
| **Total:** | **$ 1,542,800** | **$ 82,900** |
| **Land Lost to Erosion** | | |
| Average Annual Lost Acreage (years 1-9): | | .194 |
| Average Annual Lost Acreage (years 10-50): | | .041 |
| Value of Annual Lost Acreage (years 1-9): | | $5,400 |
| Value of Annual Lost Acreage (years 10-50): | | $1,100 |
| Present Value over Pd. of Analysis: | | $51,900 |
| Average Annual Equivalent Value: | | **$ 2,800** |
| **Vessel Damages due to Erosion** | | |
| Present Value over Pd. of Analysis: | | $1,576,900 |
| Average Annual Equivalent Value: | | **$ 84,700** |
| **Foregone Emergency Actions** | | |
| Expected Year of Emergency Action: | | 2013 |
| Cost of Emergency Action: | | $6,717,100 |
| Present Value of Emergency Action Cost: | | $4,556,200 |
| Average Annual Equivalent Value: | | **$ 244,800** |
| **Damage Category** | | **Value of Damages:** |
| Average Annual Incremental Maintenance and Advanced Replacement | | $ 82,900 |
| Average Annual Land Lost to Erosion | | 2,800 |
| Average Annual Vessel Damages due to Erosion | | 84,700 |
| Average Annual Emergency Action Costs | | 244,800 |
| ***TOTAL AVERAGE ANNUAL NED DAMAGES:*** | | ***$ 415,200*** |
| ***TOTAL PRESENT VALUE OF NED DAMAGES OVER PERIOD OF ANALYSIS:*** | | ***$7,728,600*** |

### 4.5.2 City Dock Side

A summary of the annual costs for the without-project condition for the Dillingham City Dock Side study area stabilization project is shown in Table 15.

***The present value of the sum of expected erosion damages over the fifty-year period of analysis at Dillingham Harbor Disposal Area and Vicinity is estimated as $5,411,900. The average annual equivalent cost of this value is $290,800 per year.***

**Table 15: Summary of Without Project Damages for City Dock Side**

| **Economic Analysis Factors** | | |
|---|---|---|
| Period of Analysis: | 50 | Years |
| Discount Rate: | 0.04875 | (FY08 Federal Discount Rate) |
| Price level: | April 2008 | |
| **Damage Category** | **Average Annual Damage** | **Total Present Value** |
| Land Loss | $ 3,300 | $ 62,000 |
| Loss of Sheetpile Seawall | 136,300 | 2,536,900 |
| Loss of South Harbor Parking Lot | 2,300 | 42,500 |
| Impacts to Utilities | 900 | 16,200 |
| Launch and Retrieve Delay Costs | 123,100 | 2,290,800 |
| Loss of Park | 24,900 | 463,500 |
| **TOTAL QUANTIFIED DAMAGES:** | **$ 290,800** | **$ 5,411,900** |

| **UNQUANTIFIED DAMAGES** |
|---|
| **Economic Impacts and Public Safety Issues associated with Loss of Harbor South Parking Lot:** Additional damages in the form of increased transportation costs and time delays will occur if no real estate is available within the same proximity to the harbor as the current lot. Additionally, structural modifications to the harbor moorage float system will be required to provide access to the harbors south float system and Public Works staff will require additional time/cost to place the south float system from the water when vehicular access to the south parking lot is lost. |
| **Public Safety Issues associated with Impacts to Utilities:** These damages would also result in public safety concerns with loss of the street lights at the south end of the harbor and increased distance from the south harbor float system to relocated fire hydrant. |

# 5 FUTURE WITH-PROJECT CONDITIONS

**Tables 14 and 15** in **Section 4.5** provided a summary of expected erosion damages without implementation of a shoreline protection project in the study area. Alternative plans were developed to address these expected problems. This section provides a summary of National Economic Development (NED) costs and benefits of each alternative evaluated. West End alternatives are addressed first and have the letter "W" preceding the alternative number. City Dock Side alternatives are addressed next and have the letter "C" preceding the alternative number.

## 5.1 NED Cost of Alternatives for West End

For each alternative, life cycle project costs, damages reduced, and residual damages were calculated to characterize with-project economic conditions. The results of these analyses are presented below. Costs are presented in December 2005 price levels. Alternative W-2, the previously selected NED alternative, has been updated to April 2008 price levels and follows at the end of this chapter. Annual costs are based upon the FY08 Federal Discount rate of 4 7/8 percent and a 50-year period of analysis. The following section provides a summary of each alternative that made it to final consideration and its associated NED costs. Detailed cost estimates are provided in the **Engineering Appendix** of the feasibility report.

### 5.1.1 Alternative W1: East and West Revetments with No Breakwater

Alternative W1 consists of a rock revetment on both the west and east sides of the harbor. The west revetment will begin at the Bristol Alliance Fuels sheetpile and extend up the west side of the harbor, following the top of bank for approximately 950 feet. The east revetment will extend the length of the east side of the harbor (approximately 800 feet) and follow the top of bank. The cost estimate for this alternative includes real estate costs, construction costs, and operation and maintenance costs. A summary of the cost estimate for this alternative is shown in **Table 16**.

**Table 16: Alternative W1 Cost Summary**

| Item | Amount ($) |
|---|---|
| Total Project Implementation Cost* | $11,829,000 |
| Project Engineering Design (PED) | $1,095,000 |
| Interest During Construction (IDC) | $78,800 |
| Real Estate | $201,400 |
| Total Project Costs | $13,204,200 |
| Average Annual Equivalent Cost | $694,300 |
| Annual Operation and Maintenance (OMRR&R) | $64,700 |
| TOTAL ANNUAL NED COST | $759,000 |
| **Includes construction contingency and construction supervision and administration costs.* | |

### 5.1.2 Alternative W1A: East Revetment/West Sheetpile with No Breakwater

Alternative W1A consists of sheetpile wall with the associated tieback system on the west side of the harbor and rock revetments on the west and eastern sides of the harbor. The west revetment will begin at the Bristol Alliance Fuels sheetpile and extend up the west side of the harbor for approximately 700 feet. The eastern revetment will extend the length of the east side of the harbor (approximately 800 feet) and follow the top of bank. The sheetpile wall will be directly adjacent to the northern terminus of the west revetment. It will extend up the west side of the harbor for approximately 240 feet. The cost estimate for this alternative includes real estate costs, construction costs, and operation and maintenance costs. A summary of the cost estimate for this alternative is shown in **Table 17**.

**Table 17: Alternative W1A Cost Summary**

| Item | Amount ($) |
|---|---|
| Total Project Implementation Cost* | $10,884,000 |
| Project Engineering Design (PED) | $1,008,000 |
| Interest During Construction (IDC) | $72,500 |
| Real Estate | $201,400 |
| Total Project Costs | $12,165,900 |
| Average Annual Equivalent Cost | $638,900 |
| Annual Operation and Maintenance (OMRR&R) | $63,900 |
| TOTAL ANNUAL NED COST | $702,800 |
| **Includes construction contingency and construction supervision and administration costs.* | |

### 5.1.3 Alternative W2: West Revetment with Breakwater

Alternative W2 consists of a rubble mound breakwater and a rock revetment on the west side of the harbor. The west revetment will begin at the Bristol Fuels sheetpile and extends up the west side of the harbor, following the top of bank for approximately 950 feet. The breakwater will be approximately 391 feet and extend west into the Nushagak River from the west side of the harbor. The cost estimate for this alternative includes real estate costs, construction costs, navigation aids, and operation and maintenance costs. A summary of the cost estimate for this alternative is shown in **Table 18**.

**Table 18: Alternative W2 Cost Summary**

| Item | Amount ($) |
|---|---|
| Total Project Implementation Cost* | $8,036,000 |
| Project Engineering Design (PED) | $744,000 |
| Interest During Construction (IDC) | $53,500 |
| Real Estate | $201,400 |
| Total Project Costs | $9,034,900 |
| Average Annual Equivalent Cost | $471,700 |
| Annual Operation and Maintenance (OMRR&R) | $43,900 |
| TOTAL ANNUAL NED COST | $515,600 |
| **Includes construction contingency and construction supervision and administration costs.* | |

*Note:* Shown here in December 2005 price levels. See 5.1.5 for updated cost estimates.

### 5.1.4 Alternative W5: East and West Revetments with Long Breakwater

Alternative W5 consists of a rubble mound breakwater and rock revetments on the west and east sides of the harbor. The west revetment will begin at the Bristol Alliance Fuels sheetpile and extend up the west side of the harbor, following the top of bank for approximately 950 feet. The east revetment will extend the length of the east side of the harbor (approximately 800 feet) and follow the top of bank. The breakwater will be approximately 391 feet and extend west into the Nushagak River from the west side of the harbor. The cost estimate for this alternative includes real estate costs, construction costs, navigation aids, and operation and maintenance costs. A summary of the cost estimate for this alternative is shown in **Table 19**.

**Table 19: Alternative W5 Cost Summary**

| Item | Amount ($) |
|---|---|
| Total Project Implementation Cost* | $9,370,000 |
| Project Engineering Design (PED) | $868,000 |
| Interest During Construction (IDC) | $62,400 |
| Real Estate | $307,900 |
| Total Project Costs | $10,608,300 |
| Average Annual Equivalent Cost | $550,000 |
| Annual Operation and Maintenance (OMRR&R) | $51,200 |
| TOTAL ANNUAL NED COST | $601,200 |

**Includes construction contingency and construction supervision and administration costs.*

### 5.1.5 Alternative W2: West Revetment with Breakwater (Updated cost estimates)

Cost estimates for the selected alternative were updated to April 2008 price levels and are shown in **Table 20.**

**Table 20: Alternative W2 Cost Summary (Updated 2008 Price Levels)**

| Item | Amount ($) |
|---|---|
| Total Project Implementation Cost* | $11,793,000 |
| Project Engineering Design (PED) | $270,000 |
| Interest During Construction (IDC) | $74,100 |
| Real Estate | $201,400 |
| Total Project Costs | $12,338,500 |
| Average Annual Equivalent Cost | $652,900 |
| Annual Operation and Maintenance (OMRR&R) | $60,800 |
| TOTAL ANNUAL NED COST | $713,700 |

**Includes construction contingency and construction supervision and administration costs.*

## 5.2 NED Benefits for West End

**Table 14** in **Section 4.5** provided a summary of expected erosion damages without implementation of a shoreline protection project in the study area. **Section 5.1** provided an overview of the four alternative plans developed for final consideration to address these expected problems. Engineering studies identified that Alternatives W1 and W1A would both provide a similar level of protection as described in paragraph 5.2.1, below. The studies also showed that Alternatives W2 and W5 would provide similar levels of protection, though different than the level provided by Alternatives W1 and W1A as described in Section 5.2.2 below.

### 5.2.1 Alternatives W1 and W1A West End

Engineering studies conducted for the feasibility study estimate that Alternatives W1 and W1A will each effectively stop land loss from erosion in the study area. This would also eliminate the need for future emergency actions to protect the BAF fuel tank farm and future repairs to the sheetpile swing arms for the harbor floats. However these alternatives would not address the identified damages to moorage floats, concrete boat ramps, the harbor bulkhead, and vessel damages. **Table 21** presents a summary of estimated benefits and residual damages associated with Alternatives W1 and W1A.

**Table 21: Estimated Benefits and Residual Damages with Alternatives W1 and W1A**

| Category | NED Average Annual Benefits | Average Annual Residual Damages |
|---:|---:|---:|
| Dock Floats | | $53,900 |
| Swing Arms | $300 | |
| Concrete Ramps | | $18,700 |
| Bulkhead | | $10,000 |
| Land Lost to Erosion | $2,800 | |
| Vessel Damages due to Erosion | | $84,700 |
| Foregone Emergency Actions | $244,800 | |
| **TOTAL:** | **$247,900** | **$167,300** |

### 5.2.2 Alternatives W2 and W5 West End

Engineering studies conducted for the feasibility study estimate that Alternatives W2 and W5 will effectively halt erosion in the study area and its resultant economic effects of land loss and damages to nearshore harbor infrastructure. Consistent with Corps shore protection design standards Alternatives W2 and W5 were formulated such that wave height in the harbor would be maintained at under 2’, eliminating the incremental damages identified to floats and vessels in the harbor. As such, each alternative design is expected to eliminate the identified incremental damages associated with erosion in the study area. Therefore, NED benefits attributable to each alternative are equal to the estimated annual damages of $415,200. **Table 22** presents a summary of estimated benefits and residual damages associated with Alternatives W2 and W5.

**Table 22: Estimated Benefits with Alternatives W2 and W5**

| Category | NED Average Annual Benefits |
|---:|---:|
| Dock Floats | $53,900 |
| Swing Arms | $300 |
| Concrete Ramps | $18,700 |
| Bulkhead | $10,000 |
| Land Lost to Erosion | $2,800 |
| Vessel Damages due to Erosion | $84,700 |
| Foregone Emergency Actions | $244,800 |
| **TOTAL:** | **$415,200** |

## 5.3 Summary of Costs and Benefits for West End

**Table 23** provides a summary of the benefits, cost, benefit to cost ratio (B/C ratio), and net benefits associated with each alternative as described in **Sections 5.1** and **5.2**. Alternative W2 is the least cost alternative but does not address significant economic damages in the study area. Alternative W2 provides the greatest net benefits, has the highest BC ratio, and therefore is identified as the NED Plan.

**Table 23: Summary of Benefits and Costs West End**

| ALTERNATIVE: | AVERAGE ANNUAL NED BENEFITS | AVERAGE ANNUAL NED COST | B/C RATIO | NET BENEFITS |
|---|---|---|---|---|
| ALTERNATIVE W2: West Revetment with Breakwater | $415,200 | $515,600 | 0.81 | -$100,400 |
| ALTERNATIVE W5: East &West Revetments with Long Breakwater | $415,200 | $601,200 | 0.69 | -$186,000 |
| ALTERNATIVE W1A: East Revetment/West Sheetpile with No Breakwater | $247,900 | $702,800 | 0.35 | -$454,900 |
| ALTERNATIVE W1: East &West Revetments with No Breakwater | $247,900 | $759,000 | 0.33 | -$511,100 |

## 5.4 NED Cost of Alternatives for City Dock Side

Four alternative plans were considered for emergency bank protection in the City Dock Side area. The four plans were different combinations of two project alignments and two primary types of construction materials. Costs are presented in December 2005 price levels. Alternative C-1, the previously selected NED alternative, has been updated to April 2008 price levels and follows at the end of this chapter. Annual costs are based upon the FY08 Federal Discount rate of 4 7/8 percent and a 50-year period of analysis. The following section provides a summary of each alternative that made it to final consideration and its associated NED costs.

### 5.4.1 Alternative C1: Alignment 1 Rock Revetment for City Dock Side

Alternative C1 includes a rock revetment that extends from the eastern terminus of the existing harbor sheetpile seawall approximately 850 feet to the east and north just outside the alignment of the existing disposal containment berm with a top elevation of 30'MLLW. A beach access ramp is included just east of the seawall. The eastern terminus is set back 100 feet north of the primary alignment and ties into the existing ground with fill material. The total construction footprint for this alternative is 1.61 acres, including an optional extension for accessing the project area and drainage culvert from the northeast side. The cost estimate for this alternative includes real estate costs, construction costs, and operation and maintenance costs. A summary of the cost estimate for this alternative is shown in **Table 24**.

**Table 24: Alternative C1 Cost Summary**

| Item | Amount ($) |
|---|---|
| Total Project Implementation Cost* | $5,040,000 |
| Project Engineering Design (PED) | $467,000 |
| Interest During Construction (IDC) | $33,600 |
| Real Estate | $50,000 |
| Total Project Costs | $5,590,600 |
| Average Annual Equivalent Cost | $295,800 |
| Annual Operation and Maintenance (OMRR&R) | $6,900 |
| TOTAL ANNUAL NED COST | $302,700 |
| *Includes construction contingency and construction supervision and administration costs.* | |

*Note:* Shown here in December 2005 cost levels. See 5.4.5 for updated cost estimates.

### 5.4.2 Alternative C2: Alignment 1 Sheetpile for City Dock Side

Alternative C2 includes a sheetpile seawall that extends from the eastern terminus of the existing harbor sheetpile seawall approximately 850 feet to the east and north just outside the alignment of the existing disposal containment berm with a top elevation of 31' MLLW. A beach access ramp is included just east of the seawall. The eastern terminus is set back 100 feet north of the primary alignment and ties into the existing ground with fill material. The design includes features for drainage and safety ladders, fish net attachments, and corrosion protection. The total construction footprint for this alternative is 1.44 acres, including an optional extension for accessing the project area and drainage culvert from the northeast side. The cost estimate for this alternative includes real estate costs, construction costs, and operation and maintenance costs. A summary of the cost estimate for this alternative is shown in **Table 25**.

**Table 25: Alternative C2 Cost Summary**

| Item | Amount ($) |
|---|---|
| Total Project Implementation Cost* | $7,273,000 |
| Project Engineering Design (PED) | $673,000 |
| Interest During Construction (IDC) | $48,400 |
| Real Estate | $50,000 |
| Total Project Costs | $8,044,400 |
| Average Annual Equivalent Cost | $426,900 |
| Annual Operation and Maintenance (OMRR&R) | $37,000 |
| TOTAL ANNUAL NED COST | $463,900 |
| **Includes construction contingency and construction supervision and administration costs.* | |

### 5.4.3 Alternative C3: Alignment 2 Rock Revetment for City Dock Side

The configuration of Alternative C3 is the same as for Alternative C1 but the alignment extends eastward to the westernmost dock of Peter Pan Seafoods. The rock revetment extends from the eastern terminus of the existing harbor sheetpile seawall approximately 1150 feet to the east with a top elevation of 30'MLLW. A beach access ramp is included just east of the seawall. This alignment crosses an existing drainage channel between the Peter Pan dock and the dredged material disposal area. A drainage culvert with a tide gate would be required through the proposed revetment and fill section in this location. The revetment will allow transfer of energy along its alignment. Excess energy will cause some disruption of the topography at the terminal unless dissipated. The end treatment will be the subject of further investigations and discussions during the draft design phase if this alternative is considered further. The total construction footprint for this alternative is 1.88 acres, including an optional extension for accessing the project area and drainage culvert from the northeast side. The cost estimate for this alternative includes real estate costs, construction costs, and operation and maintenance costs. A summary of the cost estimate for this alternative is shown in **Table 26**.

**Table 26: Alternative C3 Cost Summary**

| Item | Amount ($) |
|---|---|
| Total Project Implementation Cost* | $5,657,000 |
| Project Engineering Design (PED) | $524,000 |
| Interest During Construction (IDC) | $37,700 |
| Real Estate | $50,000 |
| Total Project Costs | $6,268,700 |
| Average Annual Equivalent Cost | $332,100 |
| Annual Operation and Maintenance (OMRR&R) | $7,700 |
| TOTAL ANNUAL NED COST | $339,800 |
| **Includes construction contingency and construction supervision and administration costs.* | |

### 5.4.4 Alternative C4: Alignment 2 Sheetpile for City Dock Side

The configuration of Alternative C4 is the same as for Alternative C2 but the alignment extends eastward to the westernmost dock of Peter Pan Seafoods. The sheetpile seawall extends from the eastern terminus of the existing harbor sheetpile seawall approximately 1150 feet to the east with a top elevation of 31'MLLW. A beach access ramp is included just east of the seawall. This alignment crosses an existing drainage channel between the Peter Pan dock and the dredged material disposal area. A drainage culvert with a tide gate would be required through the proposed revetment and fill section in this location. The revetment will allow transfer of energy along its alignment. Excess energy will cause some disruption of the topography at the terminal unless dissipated. The end treatment will be the subject of further investigations and discussions during the draft design phase if this alternative is considered further. The total construction footprint for this alternative is 1.67 acres, including an optional extension for accessing the project area and drainage culvert from the northeast side. The cost estimate for this alternative includes real estate costs, construction costs, and operation and maintenance costs. A summary of the cost estimate for this alternative is shown in **Table 27**.

**Table 27: Alternative C4 Cost Summary**

| Item | Amount ($) |
|---|---|
| Total Project Implementation Cost* | $9,039,000 |
| Project Engineering Design (PED) | $837,000 |
| Interest During Construction (IDC) | $60,200 |
| Real Estate | $50,000 |
| Total Project Costs | $9,986,200 |
| Average Annual Equivalent Cost | $530,600 |
| Annual Operation and Maintenance (OMRR&R) | $46,500 |
| TOTAL ANNUAL NED COST | $577,100 |
| **Includes construction contingency and construction supervision and administration costs.* | |

### 5.4.5 Alternative C1: Alignment 1 Rock Revetment for City Dock Side (Updated cost estimates)

Cost estimates for the selected alternative were updated to April 2008 price levels and are shown in **Table 28.**

**Table 28: Alternative C1 Cost Summary (Updated to 2008 price levels)**

| Item | Amount ($) |
|---|---|
| Total Project Implementation Cost* | $7,765,000 |
| Project Engineering Design (PED) | $240,000 |
| Interest During Construction (IDC) | $48,800 |
| Real Estate | $50,000 |
| Total Project Costs | $8,103,800 |
| Average Annual Equivalent Cost | $430,000 |
| Annual Operation and Maintenance (OMRR&R) | $10,000 |
| TOTAL ANNUAL NED COST | $440,000 |
| **Includes construction contingency and construction supervision and administration costs.* | |

## 5.5 NED Benefits for City Dock Side

**Table 15** in **Section 4.5** provided a summary of expected erosion damages without implementation of a shoreline protection project for the study area. **Section 5.4** provided an overview of the four alternative plans developed for final consideration to address these expected problems. All four alternatives would provide the same level of protection. **Table 29** provides a summary of the estimated benefits.

**Table 29: Estimated Benefits for City Dock Side Alternatives**

| Category | NED Average Annual Benefits |
|---|---|
| Land erosion | $3,300 |
| Sheetpile seawall | $136,300 |
| South Harbor parking lot | $2,300 |
| Utility impacts | $900 |
| Launch and retrieve delays | $123,100 |
| Public park | $24,900 |
| **TOTAL:** | **$290,800** |

## 5.6 Summary of Costs and Benefits for City Dock Side

**Table 30** provides a summary of the benefits, cost, benefit to cost ratio (B/C ratio), and net benefits associated with each alternative as described in **Sections 5.4** and **5.5**. None of the alternatives have positive net benefits. Alternative C1 has the highest B/C ratio, and therefore is identified as the NED Plan.

**Table 30: Summary of Benefits and Costs City Dock Side**

| ALTERNATIVE: | AVERAGE ANNUAL NED BENEFITS | AVERAGE ANNUAL NED COST | B/C RATIO | NET BENEFITS |
|---|---|---|---|---|
| ALTERNATIVE C1: Alignment 1 Rock Revetment | $290,800 | $302,700 | 0.96 | -$ 11,900 |
| ALTERNATIVE C3: Alignment 2 Rock Revetment | $290,800 | $339,800 | 0.86 | -$ 49,000 |
| ALTERNATIVE C2: Alignment 1 Sheetpile | $290,800 | $463,900 | 0.63 | -$173,100 |
| ALTERNATIVE C4: Alignment 2 Sheetpile | $290,800 | $577,100 | 0.50 | -$286,300 |

## 5.7 Least Cost Alternatives - West End and City Dock Side

Alternative W2 for the West End is the least cost alternative[2] but does not address significant economic damages in the study area. Alternative W2 does not have positive net benefits. It does, however have the highest B/C ratio, and therefore is identified as the NED Plan.

Alternative C1 for the City Dock Side is the least cost alternative and while it does not have positive net benefits, it has the highest B/C ratio, and therefore is identified as the NED plan.

The following table shows the change in net benefits and B/C ratio using costs updated to April 2008 price levels.

**Table 31: Summary of Benefits and Costs - Least Cost Alternatives (Costs updated to April 2008 price levels.)**

| ALTERNATIVE: | AVERAGE ANNUAL NED BENEFITS | AVERAGE ANNUAL NED COST | B/C RATIO | NET BENEFITS |
|---|---|---|---|---|
| **ALTERNATIVE W2**: West Revetment with Breakwater | $415,200 | $652,900 | 0.64 | -$237,700 |
| **ALTERNATIVE C1**: Alignment 1 Rock Revetment | $290,800 | $440,000 | 0.66 | -$149,200 |

[2] Cost estimates for the least cost alternatives, Alternative W2 and Alternative C1, have been updated to April 2008 price levels. All other alternatives are in December 2005 price levels.