Matanuska River Management Plan

Adopted: September, 2010

Matanuska Susitna Borough
350 E Dahlia Avenue
Palmer, Alaska 99645

Prepared by
missal, llc | a limited liability company

CODE ORDINANCE

By: Borough Manager
Introduced: 09/07/10
Public Hearing: 09/21/10
Postponed to 09/27/10: 09/21/10
Adopted: 09/27/10

MATANUSKA-SUSITNA BOROUGH
ORDINANCE SERIAL NO. 10-089

AN ORDINANCE OF THE MATANUSKA-SUSITNA BOROUGH ASSEMBLY ADOPTING THE MATANUSKA RIVER MANAGEMENT PLAN 2010 AND AMENDING MSB 15.24.030 COMPREHENSIVE PLAN AND PURPOSES.

BE IT ENACTED:

Section 1. Classification. This ordinance is of a general and permanent nature and shall become a part of the Borough Code.

Section 2. Adoption of Plan. The Matanuska-Susitna Borough Assembly hereby adopts the Matanuska River Management Plan 2010.

Section 3. Amendment of section. MSB 15.24.030(B) is hereby amended to read as follows:

(26) Matanuska River Management Plan

(Ordinance Serial No. 10-089 dated September 27, 2010

Section 4. Effective date. This ordinance shall take effect upon adoption by the Matanuska-Susitna Borough Assembly.

ADOPTED by the Matanuska-Susitna Borough Assembly this 27 day of September, 2010.

TALIS J. COLBERG, Borough Mayor

ATTEST:

LONNIE R. McKECHNIE, CMC, Borough Clerk

(SEAL)

PASSED UNANIMOUSLY: Woods, Houston, Arvin, Bettine, and Halter

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1.0 Introduction

1.1 Plan Purpose

In response to an ongoing effort to deal with erosion damages and increasing development along the Matanuska River, the Matanuska Susitna Borough (MSB) Planning Department appropriated funds to develop a Matanuska River Management Plan. The purpose of this plan is to generate consensus from riverside communities in order to develop a collaborative plan for addressing river erosion and land use.

1.2 Planning Process

In February 2009, Missal, LLC was selected to lead the planning effort. Through the development of this plan, Missal, LLC led the planning team, facilitated the planning process, developed plan documents, conducted public and agency meetings and developed draft plans based upon planning team input.

The planning process included planning team meetings, public workshops and reviews of plan drafts. Planning team meetings and workshops were held from May 2009 – December 2009 in Palmer, Butte and Sutton. Agencies, groups and individuals were contacted with plan drafts to solicit comments. The final part of the planning process was submission of the plan to the MSB Planning Commission and Assembly for public hearings, review and approval.

The foundation, vision, and planning goals for the Matanuska River Management Plan were developed cooperatively by the members of the Planning Team listed below. Planning team members were chosen to represent communities and neighborhoods along the river and the governmental agencies with land management jurisdiction for river corridor lands and waters. Planning team members were:

Frankie Barker
Matanuska-Susitna Borough

Ken Bouwens
Alaska Department of Fish and Game

Taunnie Boothby
State of Alaska Department of Commerce, Community and Economic Development

Janet Curran
Scientist, US Geological Survey

Jessica Dryden
Sutton Community Council, Chickaloon Village Traditional Council

Sandra Garley, *City of Palmer Community Development Director,*

Patti Huntsman
Circle View Service Area

Gary Klink
Sky Ranch Resident

Allen Kemplen
Planner, Alaska Department of Transportation

Stephen Krueger
Mountain View Resident

Karen Nelson
Regulatory Manager, US Army Corps of Engineers

Hilary Palmer
US Army Corps of Engineers

Lisa Rabbe
US Army Corps of Engineers

Bill Rice
US Fish and Wildlife Service

Michelle Schuman
State Ecologist, Natural Resources Conservation Service

Linda Smith
Board Chair, Circle View Service Area

Kevin Sorenson
Developer, Glacier Ridge Properties LLC

Rick Thompson
Natural Resource Manager, Alaska Department of Natural Resources

Eric Wade, *District Manager*
Palmer Soil & Water Conservation District

Brian Winnestaffer, *Biologist*
Chickaloon Village Traditional Council

Lynne Woods
MSB Assembly

Consultant Team

Jill Missal
Missal LLC.

Christy Miller
Tetra Tech, Inc

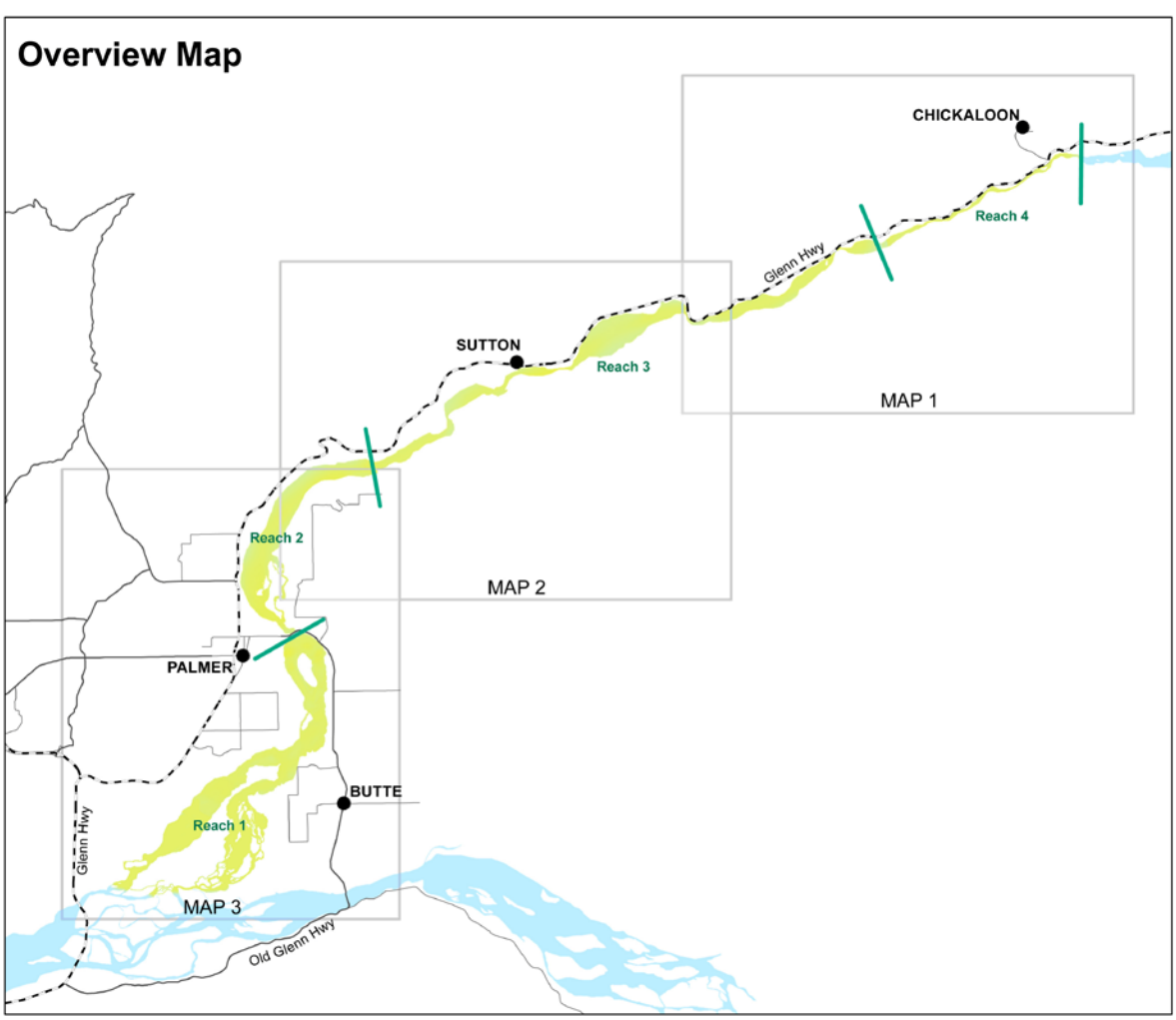
Sarah Barton
RISE Alaska, LLC

Cynthia Oistad
RISE Alaska, LLC

1.3 Plan Study Area and Plan Boundary

The planning area begins upriver at the confluence of the Chickaloon River and the Matanuska River. It includes Sutton to the east/northeast, the Glenn Highway corridor to and including the City of Palmer and the Butte Community Council area and the Old Glenn Highway to the east, and is bounded on the west by the Alaska Railroad corridor. The area includes Circle View and Stampede Estates Flood and Erosion Service Area but does not include any part of the Knik River or Jim Creek. The planning area is comprised of active erosion zones and other affected areas on the Matanuska River; approximately 200 feet from each river bank. The 200 foot buffer was developed to include properties that are likely to be affected by erosion in the near future.

The planning area is highlighted on the map below:



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The Matanuska River watershed encompasses 2,070 square miles, stretching over 90 miles eastward from Palmer to the Eureka Summit, bounded by the Talkeetna Mountains on the north and the coastal Chugach Mountains on the south. The river, from the toe of the Matanuska Glacier to its confluence with the Knik River and Knik Arm, passes through 80 miles of steep rock canyons and a wide flat valley. The Glenn Highway, a National Scenic Byway, follows the river corridor closely. In some areas, the road is mere feet from the riverbanks.

The river's primary source is the 24 mile-long Matanuska Glacier. Many smaller rivers, including Moose Creek, Eska Creek, Granite Creek, Chickaloon River, and Kings River, join the Matanuska River corridor between Palmer and the Matanuska Glacier. The glacier contributes large quantities of sediment and rock, ranging in size from clay particles to boulders. This sediment load results in a dynamic, constantly shifting river channel. As the temperature warms, glacial and snow melt produce a high flow period during which the river moves a large bed load of gravel, sands, and silts. During the lower flow periods, the river deposits the bed load in lower velocity areas of the river. This variation causes the river channel to braid and constantly shift; leading to erosion of its banks which in turn result in redirection of river flow. The river readily erodes any non-cohesive bank material, leading to very rapid changes to the riverbanks in areas not protected by bedrock. During extended high flow events and flooding, an even greater part of the bed load is moved and re-deposited, causing accelerated bank erosion and rapid channel migration. Relic channels and other features are present in the region, reflecting an enormous range of lateral movement of the river channel. Channel migration is particularly rapid in areas such as below the Old Glenn Highway Bridge to the Knik Arm. This river reach is very dynamic and channel migration can be seen with daily observation.

Several studies have estimated the Matanuska River bed load (the material carried by a river, either suspended in the water or being bounced or rolled along the riverbed). The U.S. Geologic Survey estimates the average annual bed load yield in the lower portions of the Matanuska River near Palmer to be 397,000 tons, or 267,000 cubic yards. The State of Alaska Hydrologic Survey study confirmed this estimate by studying three other Southcentral Alaska rivers and coming to a similar conclusion regarding bed load (Long).

1.4 Relationship to Other Plans

Matanuska-Susitna Borough Comprehensive Plan

As noted in the Matanuska-Susitna Borough Comprehensive Plan, the Borough undertakes comprehensive planning in several ways, including community based plans, Borough-wide and regional plans and functional plans such as Lake Management plans or this Matanuska River Management Plan. This plan will follow the normal process of Planning Team review, to Public Review, then to the Planning Commission and finally on to the Borough Assembly.

This Matanuska River Management Plan is most compatible with the borough-wide comprehensive plan land use goals below and the highlighted policies that accompany the goals:

Goal (LU-1): Protect and enhance the public safety, health, and welfare of Borough residents.

- Policy LU1-1: Provide for consistent, compatible, effective and efficient development within the Borough.

Goal (LU-2): Protect residential neighborhoods and associated property values.

- Policy LU2-1: Develop and implement regulations that protect residential development by separating incompatible uses, while encouraging uses that support such residential uses including office, commercial and other mixed-use developments that are shown to have positive cumulative impacts to the neighborhood.

Goal (LU-4): Protect and enhance the Borough's natural resources including watersheds, groundwater supplies and air quality.

- Policy LU4-1: Identify, monitor, protect, and enhance the quantity and quality of the Borough watersheds, groundwater aquifers, and clean air resources.
- Policy LU4-2: Population density standards should accommodate the natural system's ability to sustain varying density levels.

The Matanuska River Management Plan is also prepared to complement the area-wide Parks and Open Space goals and policies including:

Goal (P)-2): Protect and preserve natural resource areas.

- Policy PO2-1: work cooperatively with numerous resource management agencies, community councils, and citizens to care for lakes, wetlands, streams, rivers and wildlife habitat and corridors while providing public access for recreational opportunities that have minimal impacts to such areas.
- Policy PO2-2: Preserve opportunities for people to observe and enjoy wildlife and wildlife habitats.
- Policy PO2-3: Identify, through analysis, potential natural resource areas throughout the Borough that should be protected.

Further, the Matanuska River Management Plan particularly complements the below community quality goals and policies:

Goal (CQ-1): Protect natural systems and features from the potentially negative impacts of human activities, including, but not limited to, land development.

- Policy CQ1: Use a system-wide approach to effectively manage environmental resources. Coordinate land use planning and management of natural systems with affected state and local agencies as well as affected Community Council efforts.
- Policy CQ1-2: Manage activities affecting air, vegetation, water, and the land to maintain or improve environmental quality, to preserve fish and wildlife habitat, to prevent degradation or loss of natural features and functions, and to minimize risks to life and property.
- Policy CQ1-3: Guide development along the Borough's many glacially braided rivers such as the Matanuska River to preserve the resources and ecology of the water and shorelines, avoid natural hazards, minimize erosion and associate property damage and public welfare and safety.
- Policy CQ1-4: Provide site restoration if land surface modification violates adopted policy or development does not ensue within a reasonable period of time.
- Policy CQ1-5: Make available to property owners, prospective property owners, developers, and the general public, information concerning natural systems and associate regulations.

Goal (CQ-2): Manage the natural and built environments to achieve minimal loss of the functions and values of all drainage basins; and where possible, enhance and restore functions, values, and features. Retain lakes, ponds, wetlands, streams, and rivers and their corridors substantially in their natural condition.

- Policy CQ2-1: Using a watershed-based approach, apply best available science in formulating regulations, incentives, and programs to maintain and, to the degree possible, improve the quality of the Boroughs' water resources.
- Policy CQ-2-3: Comprehensively manage activities that may adversely impact surface and ground water quality or quantity.

Matanuska-Susitna Borough Coastal Management Plan

The MSB Coastal Management Plan, which is adopted by The Department of Natural Resources (DNR) Commissioner, its designations, enforceable policies and definitions, form the basis for state decision making for areas within the coastal zone, which includes all of the Matanuska River management planning area. An example is the 75-foot setback from all water bodies which are recreation, development and access (RDA) policies which are applicable throughout the MSB coastal zone (including rivers, lakes and streams).

Matanuska-Susitna Borough All-Hazards Mitigation Plan

The Borough All-Hazard Mitigation Plan contains information on a variety of borough-wide natural hazards, related data, mitigation goals, and community involvement in the planning process and forms the basis for disaster mitigation throughout the Borough. The amount of data specific to riverine erosion and the Matanuska River is limited, but can be added to during regular updates.

Mat-Su Area Plans

DNR manages state lands through area plans. These plans identify state lands to be retained in state ownership and those to be disposed of, classify state lands into resource categories, and form the basis for other DNR decision making in its management of state resources, including forestry, mineral management and development. The Matanuska River Management Plan includes recommendations for state lands that may be included within hazard areas adjacent to the river or alluvial fans.

The State of Alaska is in the process of updating relevant plans, which can be coordinated to assure consistent recommendations in each where this plan boundary coincides and includes state lands.

Community Council Plans and the City of Palmer Comprehensive Plans do not appear to address the risk posed by the Matanuska River.

Matanuska River Bank Erosion Mapping Project

The US Geological Survey (USGS) is cooperating with the Matanuska-Susitna Borough Department of Planning and Land Use to investigate bank erosion along the Matanuska River. This scientific information will help guide users and managers of the river corridor. The present phase of the USGS project consists of a historical analysis of bank erosion and an assessment of bank erodibility for the entire 75-mile length of the river. Analysis of aerial photography from 1949, 1960, 1990, 2004, and 2006 will provide a measure of the location, amount, and types of river banks eroded over various time scales. Field assessment of bank materials, bank height, indicators of surface age, and location of bedrock and erosion control features will be coupled with aerial photo interpretations to determine the location and distribution of various classes of erodible banks along the river.

Identifying erosion threatened areas on the river and determining and describing to the public the risk for the areas is critical to planning and prioritizing mitigation projects, designing appropriate land management and public education for future development. Improved risk identification will enable pro-active measures instead of reactive measures.

2.0 Background

2.1 Matanuska River Hydrology

Two streams comprise the headwaters of the Matanuska River, beginning at river mile 81.7 – the South Fork Matanuska River and the East Fork Matanuska River. The South Fork Matanuska River collects runoff from glaciers within the Chugach Mountains, while the East Fork collects waters from the Chugach and Talkeetna Mountains and the Tahneta Pass. The Matanuska River also collects water in several areas, between miles 68 and 75, from discharge from the Matanuska Glacier, and from many other tributaries, such as the Chickaloon and Kings Rivers.

The river's annual hydrograph is that of a standard Alaskan glacier-fed river. The river's flow gradually declines during the fall and winter months, and then sees a sudden surge in April and May, followed by a slow increase until mid-July. Documented peak flow rates typically range from 12,900 to 46,000 ft^3/s. The Matanuska River also exhibits diurnal flow rate fluctuations, due to the changes in glacier and snow melt between day and night.

The mouth of the Matanuska River discharges primarily into the channels of the Knik River and, secondarily, into channels at the head of the Knik Arm of Cook Inlet. In the past, the Matanuska River discharged solely into the Knik Arm channels.

2.2 Matanuska River Reaches

Broadly speaking, the Matanuska River is classified as a braided, glacial river; however, the river can be subdivided into several distinct geomorphic reaches, each representing a particular combination of characteristics. By focusing on a reach's specific characteristics, special attention is given to issues and approaches appropriate to that area, increasing accuracy of studies and success rate of actions. Eight distinct reaches have been identified within the Matanuska River, four of which are described here. The other four reaches have no population or infrastructure relevant to this plan and have therefore been left out for purposes of brevity and relevance.

2.2.1 Lower River Reach (Reach 1)

The reach of the river commonly referred to as the 'Lower River' generally stretches from the mouth of the Matanuska to just below the Old Glenn Highway bridge. While the rest of the river is confined by mountains, the Lower River Reach traverses an unconfined valley.

The Lower River Reach is the most developed area of the river, being home to the Palmer airport and sewage treatment facility; several subdivisions, agricultural areas, and recreation centers; and individual residences not part of subdivisions.

The Matanuska River is eroding the riverbank near Mile 14 Old Glenn Highway threatening area homes. Photo by Scott Easler

A glacial terrace runs along most of the Palmer side of the river, underlying Palmer and gradually slopes downward to the South and West. This terrace will be referred to as the 'Palmer Terrace' throughout this document. As the Matanuska River cut through the glacial terrace, remnants were left along the left bank above Bodenburg Butte. The height of the terrace, relative to the river, ranges from 20 feet on the left bank to 30 feet on the right bank. South of Bodenburg Butte and along the Old Glenn Highway, the Palmer Terrace has eroded, leaving lower river terraces.

Bedrock in the Lower River Reach is primarily comprised of small, discrete, river-level outcrops overlain by glacial sediment, and a few bluffs 20 to 30 feet in height. A gapped, double-ridge of bedrock influenced the Quaternary course of the Matanuska River, deflecting it away from the Knik River Valley, and anchors natural points in the banks at each end of the Circle View area.

Downstream of bedrock constrictions at river mile 8 and the Old Glenn Highway bridge, bars are periodically created; however, these bars are frequently reworked and currently contain relatively young vegetation. Other bars, with extensive vegetation, exist along the right side of the braid plain, downstream from the river mile 8 constriction. These bars contain a network of clear-water channels that support spawning salmon.

The Lower River Reach contains the widest braid plain of the entire Matanuska River, closing to 2,200 feet at its narrowest point, and is braided throughout the entire reach. Downstream of river mile 5.5, the river broadens to a wide flood plain, 2 to 3 miles wide. In this area and other areas where the Palmer Terrace does not exist, the river banks suffer from flooding and lateral erosion, though the flooding does not appear to have expanded the river's banks.

Recent flooding, most notably in 1971, has flowed through the gap along the Old Glenn Highway into parts of the Butte area. This gap and other conduits, timing and source of floods through them, and channel occupation of them have not been fully researched.

2.2.2 Palmer Overlook Reach (Reach 2)

The Palmer Overlook Reach of the Matanuska River contains the Palmer Overlook and Wolverine and Moose Creeks; it stretches from the Old Glenn Highway Bridge to a constriction area upstream of Moose Creek. Steep banks and bluffs are found along both sides of the river throughout the Palmer Overlook Reach, forming a modern river valley. This modern river valley is contained within the broader Matanuska River Valley, which is marked by 100 to 200 foot tall bluffs of bedrock or glacial sediment; these are interrupted only by the fans of Wolverine and Moose Creeks. Bedrock exists along most of this

reach, on both banks. In some areas the bedrock is obviously present, while in others it must be inferred.

The braid plain in the Palmer Overlook Reach is an average of 3,000 feet wide, and the channel within this reach is entirely braided except near the Old Glenn Highway Bridge, where the river is narrowed by bedrock; even here, the channel sometimes maintains a braided pattern. USGS records show that the cross section is constantly shifting.

Active bars, lacking any vegetation, are a common occurrence in this reach, interspersed within small channels and stretching across the entire river valley in some locations; however, a large, forested island between miles 13 and 15 is the only island in the Matanuska River that has remained relatively unchanged since 1949. This island is one mile long and rests amidst an island-bar-channel complex on the left bank. Clearwater side channels in this area accounted for 15% of the spawning chum, coho, and sockeye salmon in the Matanuska River in 2008, according to the USFWS tagging and tracking statistics. The mainstream river water periodically inundates these clearwater channels, and analysis shows that the large island has previously, including the time between 1949 and 1962, been separated from the left bank by a large channel of the mainstream Matanuska river.

The protection afforded by the bedrock present throughout the reach has mitigated the need for erosion control; a small amount of riprap near the Old Glenn Highway Bridge is the only significant, installed erosion protection. Several of the bluff tops in this reach support private or public resources, including school fields, residential and agricultural areas, and Alaska Native properties. Many of these properties are threatened by bluff erosion, though evidence gathered from a railroad grade constructed in 1917 indicates that the actual cause of at least some of the bluff erosion in this reach should be attributed to removal of vegetation, drainage of alterations, and exposure to high speed winds, rather than to riverine erosion.

2.2.3 Sutton Reach (Reach 3)

The Sutton Reach has four major tributaries – Kings River and Eska, Granite, and Carpenter Creeks – and runs alongside the town of Sutton. The primary defining characteristic of this reach is a series of alternating wide river areas followed by narrow constrictions.

The right bank of the Sutton Reach varies, with some stretches of bedrock bluffs hundreds of feet high right alongside the river, and other areas of low sediment banks. The lower portions of the right bank support both the Glenn Highway and some residential properties, many of which have already been lost to bank erosion. Conversely, the left bank

has been left mostly undeveloped, as it is primarily composed of inaccessible, steep, bedrock bluffs, 100 to 300 feet high. These bluffs define the edge of the braid plain for most of the reach. In the areas of the Sutton Reach constricted by bedrock features, the valley floor is covered almost entirely by the river braid plain; in the wider sections, the valley contains a mixture of tributary fans and terraces along the edge of the valley walls.

The width of the Sutton Reach braid plain shifts rapidly and varies dramatically, from 150 to 4,800 feet wide. Throughout this reach, except near Eska Creek, attached bars are small and discrete; near Eska Creek there is a complex of vegetated bars and Clearwater side channels, though it has recently been intruded by small mainstream channels.

Several attempts have been made to mitigate erosion in the Sutton Reach, including lining the highway embankment with riprap and constructing dikes, only one of which remains. It is no longer in the main channel.

2.2.4 Chickaloon Reach (Reach 4)

The Chickaloon Reach stretches from approximately the intersection of Glenn Highway and Fish Lake Road, up to Coal Creek. The downstream portions of this reach have bedrock walls close to the river, while the upstream portions have bedrock walls set farther away from the river. The Chickaloon Reach has rocks from the Matanuska and Chickaloon Formations and several intrusive rocks; it is the only reach of the Matanuska River with resilient, intrusive rocks close to the river, which contributes to the narrowness of the river in this reach, with an average braid plain width of 500 feet.

Discontinuous sections of bedrock outcrops in this reach indicate a high potential of bedrock at shallow depths below the river. The banks of the braid plain where bedrock is not present are relatively low in height, typically fewer than 15 feet. Near Chickaloon and downstream, the there are several one-mile long terraces on the valley floor. A coalesced apron of fan and undifferentiated sediments, two miles long, can also be found in this area.

This reach has one main channel, with an occasional secondary channel in a few locations forming small islands. The attached bars in this reach are often visibly coarser than other reaches, containing cobbles and boulders. The sinuosity of the river here is low and the river lacks distinct pool-riffle structure.

Structures along this reach include several privately owned structures along the left bank and the King Mountain State Recreation Site, the King Mountain Inn, several more privately owned structures, two miles of the Glenn Highway, and the Chickaloon General Store, all on the right bank. Just under 2 miles of this reach have protected banks, including 1.8 miles of riprap along highway embankments and 0.1 miles of reinforced banking along the King Mountain State Recreation Site.

2.3 Erosion Hazards and Mitigation

Junk cars have been used unsuccessfully and illegally by private property owners in an attempt to slow erosion along lower reaches of the river.

Erosion along the Matanuska River is only a problem where it affects human development. Development along the Matanuska River has occurred without much knowledge of or consideration to river channel migration. As a result, homes have been destroyed, agricultural land lost, infrastructure damaged, and tax base lost as the river has shifted back and forth across its plain. The most recent major shift in channel migration direction was in the early 1990s, when the main channel migrated to the left bank of the river, resulting in major loss of homes and land. There are no existing regulations for development based on riverine erosion, and such development in threatened areas is continuing. The MSB requires a 75-foot setback from water bodies.

Residents in erosion risk areas have stated over the years that they were not informed of erosion hazards when they purchased their properties. As a result, in 2007 the MSB requested the State of Alaska Real Estate Commission (REC) to add disclosure of erosion hazards to the Residential Real Property Transfer Disclosure Statement. This addition was approved by REC and is now on the current disclosure form.

In 2007, the MSB contracted with Alaska Rim Engineering to prepare a “non-structural” erosion control ordinance for the Matanuska River in an attempt to limit future development in erosion hazard areas. This ordinance was strongly rejected by area residents. Alaska Rim Engineering prepared a project report with recommendations for erosion mitigation including the development of a Matanuska River Management Erosion Damage Mitigation Plan and the establishment of a Matanuska Erosion Mitigation Authority. A similar recommendation for a river management plan, including looking at the recreation potential of the river bed, was made by a developer with properties on the Palmer side of the river.

Structural erosion control projects performed to protect community and MSB property and/or residential interests are listed by community in the community sections. Other erosion-related projects installed to protect State and other agency infrastructure or to study the erosion problem include:

- *Glenn Highway Erosion Control (North of Palmer)* - a series of projects were constructed in the late '80s through the early '90s to address bank erosion problems along the Glenn Highway. All of these projects implemented structural techniques such as bank armoring with riprap (Watershed Plan).
- *Old Glenn Highway Bridge Protection* - bank protection in the form of riprap has been placed in the area of the Old Glenn Highway Bridge to protect the bridge approaches (Watershed Plan).
- *Alaska Railroad Sheet Pile Bank Protection* – approximately 4,000 feet of dike was constructed between 1947 and 1951 to divert river flow away from the Alaska Railroad (Watershed Plan).
- *Repairs to Power Poles in Riverbed* – power poles have eroded in the past near the Butte (dates unknown) (Watershed Plan).
- *Erosion Risk Mapping* – The United States Geological Survey has undertaken a multi-year technical analysis of river hydraulics to provide information about erosion risk areas and erosion rates. The project is scheduled for completion in 2009 (Mat-Su Borough).

2.4 Erosion Information by Community

2.4.1 Butte

Butte is a census designated place (CDP) with a population of 3,262 (2008 population estimate by Department of Labor and Workforce Development), located east and south of Palmer, stretching along both sides of the Old Glenn Highway between mile 9 and mile 16. The Butte Community Council area is a 40.3 square mile, unincorporated area, bounded on the west by the Matanuska River, on the east by the Chugach Mountains, on the south by the Knik River, and on the north by the Clark-Wolverine community. The prominent namesake Bodenburg Butte (545 foot glacial bedrock remnant outcropping) stands out in otherwise relatively flat terrain. Butte is primarily comprised of large lot, single family residences as well as agricultural development; with increasing residential development.

Circle View Subdivision in Butte has a concentration of five finger dikes, like the one shown above, to protect against erosion.

Past Damages in Butte

- 1971 – a large flood breached a dike near Butte, causing widespread flood damages to the area (Watershed Plan).
- July 1991 – Severe bank erosion near Circle View destroyed one home and threatened others (Watershed Plan).
- July 1994 – Erosion near Circle View caused serious damage and threatened more property and homes. The State declared a disaster and loaned $500,000 to MSB to construct four dikes to protect Circle View and Stampede Estates Subdivisions. The loan was later converted to a grant. (EIP-Butte).
- 2004 – Unstated riverine erosion damages in the Circle View area (EIP-Butte).
- 2005 – Unstated riverine erosion damages in the Butte area (EIP-Butte).
- Since 1992 (exact dates unspecified) – "Several homes, a triplex, a 120-foot long greenhouse, and a horse barn have fallen into the river…About another dozen homes have been relocated or demolished to avoid [riverine] erosion…" (EIP-Butte).
- Over the past 20 years, a particular one-mile stretch of riverbank has eroded more than 1,000 feet towards Butte (EIP-Butte).

Construction of Dike #5 in Circle View Subdivision.

Past Projects in Butte

- 1940s – a dike was constructed along the Old Glenn Highway near the Bodenburg Butte. This dike was breached during the 1971 flood event and subsequently repaired and enlarged (Watershed Plan).
- A series of three erosion control dikes along Old Glenn Highway/Ye Old River Road were constructed by the MSB in 1986. Two additional dikes, one upstream and one downstream, were constructed in 1989. (Watershed Plan)
- 1992 – In response to the erosion threat in the Butte area during the 1990s, MSB managed the construction of a series of four finger dikes in the Circle View Subdivision area, a project funded by the State of Alaska. A service area was established comprised of two subdivisions totaling approximately 70 homes. Residents of this newly-formed Circle View and Stampede Estates Flood and Water Erosion Service Area agreed to pay a portion of their property tax to maintain the dikes (EIP-Butte).
- 2004 - $172,000 was used to repair the four dikes near Circle View and Stampede estates (EIP-Butte).
- 2006 – MSB, USDA and Natural Resources Conservation Service (NRCS), utilizing $594,000 in funds from the Emergency Watershed Protection Program, administered a buy-out program for homeowners threatened by the river's erosion. Over 40 property owners in the Circle View area and Sutton applied for the buy-outs. Properties were evaluated and ranked according to their proximity to the river. Three properties that were at greatest risk were acquired in the Sutton area (EIP-Butte).
- 2007 – A fifth dike was built near Circle View and Stampede Estates at a cost of $580,000 with funds from USDA/NRCS (MSB).

Current Erosion Situation in Butte

The continuing erosion of banks near Circle View and Stampede Estates poses an ongoing threat to dozens of homes, private wells, septic systems, utility and power lines, farm land, and both MSB and State-maintained roads. There are now less than 50 feet between Bodenburg Loop Road and the river bank, where the Alaska Department of Transportation and Public Facilities (DOT/PF) has stockpiled armor rock to slow erosion before it hits the road. Several hundred feet of East Brian Drive has already eroded.

Current and Ongoing Mitigation Projects in Butte

The Circle View and Stampede Estates Flood and Erosion Control Service Area meets quarterly to plan and review river erosion control measures and funds the annual inspection of the five spur dikes to determine if repairs are needed.

Planned Mitigation Projects in Butte

No known future mitigation projects are planned.

2.4.2 Chickaloon

In the Chickaloon area, the Matanuska River is contained by canyon walls and some areas of bedrock, making a narrower, swifter riverbed.

The unincorporated community of Chickaloon is located within the MSB, northeast of the community of Sutton. The area has a nonprofit Chickaloon Community Council. Its western boundary is in the vicinity of the Kings River (Mile 66.4 on the Glenn Highway) and its eastern boundary is in the vicinity of Purinton Creek. The Talkeetna Mountains lie to the northwest, and the Chugach Mountains and Matanuska River lie to the southeast. The Chickaloon River and the Kings River are the two major tributaries to the Matanuska River. The area encompasses 79.4 sq. miles of land and 0.8 sq. miles of water. The Chickaloon CDP has an estimated population of 249 in 2008 (DCED).

Past Damages in Chickaloon

Within the reviewed documents, no reference to past damages was found.

Past Mitigation Projects in Chickaloon

Within the reviewed documents, no reference to past projects was found. However, some preliminary USGS maps show erosion control in the form of bank armoring, most likely installed by AKDOTPF to protect the Glenn Highway.

Current Erosion Situation in Chickaloon

There are homes close to the Matanuska River in Chickaloon. No documented erosion damages could be found within the reviewed documents.

Current and Ongoing Mitigation Projects in Chickaloon

The only current or ongoing riverine erosion mitigation project is the continued bank armoring and maintenance of armor used to protect the Glenn Highway between Sutton and Chickaloon (EIP-Sutton).

Planned Mitigation Projects in Chickaloon

No projects appear to be planned in Chickaloon at this time.

2.4.3 Palmer

The river corridor near Palmer exhibits the wide, braided characteristics of many glacial rivers.

Palmer is a Home Rule City with an estimated population of 5,559 (2008, DOLWD). The MSB delegated to the City of Palmer the power of land use regulation over property within the city. [Ord. 454 § 4, 1992, pursuant to Alaska Statutes Title 29.40.010(b).] The city also controls zoning and subdivision of land. Palmer lies on the western bank of the Matanuska River. The active channel of the river in this area runs along the eastern bank; thus, Palmer does not face an immediate riverine erosion threat. However, the natural evolution of the river may result in erosion threats to Palmer in the future. The City is concerned about potential erosion threats to its Water Treatment Plant.

Past Damages in Palmer

- 1971 – Heavy rainfall and the outburst of a mountain lake caused flooding in the Palmer area, generally outside the city limits.

Past Mitigation Projects in Palmer

Past riverine erosion mitigation projects within the Palmer area have included the use of armor rock, construction of groins using riverbed material, and the cabling together of vehicles and machinery to form bank shielding. Within the reviewed documents, there are no references to significant physical mitigation projects.

- In 2007, the City of Palmer, along with the other MSB communities, submitted a resolution to the state requesting a river management plan. The State responded that the MSB should take the lead.
- 1969 – The Corps of Engineers (COE) under authority of Section 14 of the Flood Control Act of 1946, placed emergency bank protection consisting of three rock-filled groins on the right bank of the Matanuska River adjacent to the Palmer wastewater treatment lagoons. The project protects approximately 1,500 feet of bank and was constructed for about $80,000 (ERS).
- Bank protection at the Old Glenn Highway Bridge (Watershed Plan)
- Structural erosion control installed in 1969 to protect the Palmer Sewage Lagoon (Watershed Plan)
- 2002 – 3,000 feet of rock toe protection in front of Sky Ranch subdivision (Watershed Plan)

- Complete slope and toe protection and re-vegetation were installed at the River Bend Subdivision (EIP-Palmer).

Current Erosion Situation in Palmer

If the active channel were to shift back to the western bank, according to both the *EIP – Palmer* and the *NRCS Report*, the following could be damaged by riverine erosion:

- Agricultural fields
- Homes and surrounding land
- Palmer Wastewater Treatment Plant
- Palmer Golf Course
- Palmer Airport

While outside of the Palmer city limits, the Mountain View Estates and Sky Ranch subdivisions face current riverine erosion threats of an unspecified nature.

Current and Ongoing Mitigation Projects in Palmer

According to the *Palmer All-Hazards Mitigation Plan*, construction is no longer allowed along the river in some areas, though the plan did not specify exactly what restrictions were in place. Apart from these possible restrictions, within the reviewed documents, there are no known ongoing riverine erosion mitigation projects in the Palmer area. Private landowners have indicated they might be pursuing private projects, but details are not known.

Planned Mitigation Projects in Palmer

Within the reviewed documents, there are no references to future riverine erosion mitigation projects in the Palmer area.

2.4.4 Sutton

Sutton is an unincorporated area of the MSB between Milepost 52 and 72 of the Glenn Highway that commences 11 miles northeast of Palmer. The area encompasses 151.3 sq. miles of land and 0.4 sq. miles of water. The Sutton CDP has an estimated 2008 population of 1,310 (DCED). Chickaloon Village Traditional Council is a federally-recognized tribe headquartered in Sutton.

The residents of this Sutton home have taken immaculate care of the property since 1959 as the Matanuska River continues to advance.

Sutton lies along the northern bank of the Matanuska River. Riverine erosion in this area is very active. Channels can shift within an hour and losses have been reported up to 50 feet inland within a 24-hour period. Over the past ten years, near mile 63 of the Glenn Highway, the river has eroded more than 1,000 feet inland. The banks in this area vary widely, from sloping beaches to 200-foot tall cliffs; the taller banks are susceptible to severe and sudden undercutting by the river.

Most of the more successful structural erosion protection in the area is owned and regularly maintained by the State of Alaska to protect the Glenn Highway. These projects may provide valuable information for estimating maintenance costs for future or potential structural erosion control projects.

Past Damages in Sutton

- Once the Alaska Railroad Corporation stopped using the railroad tracks running along the northern bank of the river, it ceased maintenance of erosion protection. Most of that old erosion protection has since eroded away (EIP – Sutton).

Ongoing Damage Threats in Sutton

There are several road locations and homes that are now within 50 feet of the banks of the Matanuska River and face an ongoing threat of being undercut by the river (EIP – Sutton).

Past Mitigation Projects in Sutton

- A series of five spur dikes was constructed in 1986 on the right bank (Watershed Plan).
- 1900-1960 – In order to protect the railroad from Palmer to Sutton, the Alaska Railroad protected the north bank of Matanuska River from riverine erosion (Watershed Plan).

- 1984-1986 – Five spur dikes were constructed along Matanuska River near Sutton, at a cost of $470,000; at least four have since eroded away. Funds were from a State Legislative appropriation administered by the Alaska DOT/PF (EIP-Sutton).

- 1987-1996 – $2,000,000 to $3,000,000 was spent to protect the Glenn Highway between Sutton and Chickaloon, mostly involving riprap bank armoring and flow deflecting structures. Exact costs and dates were not listed (EIP-Sutton).

- Portions of the Glenn Highway were relocated away from eroding riverbanks (EIP-Sutton).

- 2006 – MSB, USDA and Natural Resources Conservation Service (NRCS), utilizing $594,000 in funds from the Emergency Watershed Protection Program, administered a buy-out program for homeowners threatened by the river's erosion. Three properties in the Sutton area were successfully acquired through this program. Structures were removed, sites were reclaimed and the properties remain in MSB ownership as river buffer areas not to be developed. MSB and NRCS have requested additional federal funds to continue the project but none have been obtained (NRCS EA).

2006 view of one of three homes in Sutton that was included in the Emergency Watershed Protection Program buyout administered by the USDA Natural Resources Conservation Service with MSB Assistance.

Current and Ongoing Mitigation Projects in Sutton

The only current or ongoing riverine erosion mitigation project is the continued bank armoring and maintenance of armor used to protect the Glenn Highway between Sutton and Chickaloon (EIP-Sutton).

Planned Mitigation Projects in Sutton

No known future erosion mitigation is currently planned.

2.5 Flooding Hazards and Mitigation

Flooding along the river corridor is somewhat rare. Recent flood events are limited to the summer 1971 flood event when the Matanuska River breached the Old Glenn Highway and flooded low-lying areas in the Bodenburg Butte area near Ye Old River Road and east of the highway (Watershed Plan).

The 1971 flood caused the Old Glenn Highway to wash out in four places east of Palmer and, at that time, was the only road link out from Anchorage. Additional washouts of the road occurred at Moose Creek, Granite Creek, Eska Creek, and Kings River. Southcentral Alaska sustained $8 million to $10 million in damage from the floods of August 1971. Of that amount, roughly $6 million was directly from damage occurring in the Matanuska Valley.

Flood insurance is available to homeowners, renters and businesses to purchase due to the MSB's participation in the National Flood Insurance Program. Most homes in the Circle View Estates-Stampede Estates subdivision from 1992-1995 that had flood-related erosion losses were able to have some level of coverage through their flood insurance policies. Homeowner's insurance does not typically cover flooding or flood-related erosion. Separate flood insurance must be purchased should homeowners desire this coverage.

2.6 Fish and Wildlife Habitat

The river corridor is essential habitat to many species of mammal, waterfowl, and aquatic species. Because development is so limited, habitat for species such as moose, bear, small mammal, duck, goose, salmon, and other species can be found along the river corridor in an essentially untouched state. Salmon habitat is the most sensitive to effects of the installation of physical erosion protection.

The Matanuska River flood plain is unique in that much of the adult spawning and juvenile rearing habitat for salmon occurs in clear water side channels and probably many of the silty braids as well. Side channel spawning areas are dynamic and susceptible to change depending on mainstem migration, so that in some years a spawning area may be obliterated and not active, only to return at some point after another shift by the mainstem. Many of these areas are now documented through a radio telemetry study conducted the past two years by USF&WS. Attached is their first report. Their findings support what has long been suspected and informally observed over the years- the majority (>90%) of chum and sockeye salmon utilized side channel or braid plane habitat for spawning, while coho salmon were mostly split between the braid plain and tributaries.

2.7 Recreation

Common recreation activities on the river include rafting, fishing, all-terrain vehicles, hiking, and sightseeing. Recreational facilities are spare considering the size of the river corridor, with only a few formal parks, campgrounds, and trail systems. Several unofficial trails and camping sites have been

developed via social use, and it is common to find large groups of campers and recreationalists at unofficial access points to the river on any given weekend or holiday.

The Glenn Highway has been designated a National Scenic Byway, which may potentially lead to an increase in tourism. Interpretive sites have been installed along the Byway; areas that should be investigated for potential jumping-off points for recreational development.

2.8 Land Use

The Mat-Su Borough continued in 2008 to be the fastest-growing area in the state, as it has been since 1990. Between 2000 and 2008, it grew at an average annual rate of 4.0 percent, the same annual growth rate during the 1990s. However, its growth slowed to 3.5 percent between 2007 and 2008. The Mat-Su Borough was the only area of the state where growth came primarily from net in-migration. Since the 2000 Census, net in-migration accounted for 17,632 or 76 percent of the Mat-Su Borough's population increase of 23,193. Two of the 15 places in the state with populations greater than 2,000 that have had average annual growth rates above 2.0 percent since the 2000 Census are in the lower Matanuska River - Butte Census Designated Place (+2.9 percent), and the City of Palmer (+2.5 percent). Certainly only a fraction of new homes built end up fronting or near the Matanuska River, but it would be easy to speculate that those that do are not as familiar with the erosion risks the river poses as long-time Borough residents.

Portions of the river corridor are undeveloped wildlands, with no road access. Land use varies on the east side of the Matanuska River near Palmer. The Old Glenn Highway parallels the river along the eastern side, from the bridge to Bodenburg Butte. Near the Old Glenn Highway, the area is primarily residential, with some small businesses and agricultural use. The area downriver includes the Butte community which has extensive residential development, commercial businesses, public infrastructure and active farms. A power transmission line owned by Matanuska Electric Association extends across the river from the Circle View Estates area towards the City of Palmer.

On the western side of the Matanuska River lies the City of Palmer and the Palmer Airport. The airport is in relatively close proximity to the Matanuska River, although it does not appear to be in imminent danger from erosion. Farther downriver, but still within the City of Palmer, is the Palmer Wastewater Treatment Plant (WWTP). This treatment plant was threatened by erosion prior to the mid- to late 1980s, when the active channel

Aerial view of Palmer Wastewater Treatment Plant

was located on the west side of the river. With the exception of the WWTP and a small gravel pit, land use along this area of the bank is typified by residential use.[1]

3.0 Planning Issues

This chapter examines the river corridor in more detail, focusing on the four river reaches identified by the USGS and adopted by the MSB when dealing with river issues. Each reach has distinct qualities, issues, and management options. This chapter also includes discussion on the USGS mapping project that has provided the scientific basis for the river management plan, as well as land use, habitat information, and recreation uses.

3.1 Riverine Erosion Mitigation Options

3.1.1 Structural Options

Bank Stabilization and Protection

This alternative involves the construction of spur dikes, riprap, or other bank protection structures. It would also involve maintenance of the bank protection and require funding for this activity from some source. This approach offers the potential benefits of securing land that might otherwise be subject to erosion risks. The challenges to this approach are finding funds for initial and ongoing costs. In addition, without a comprehensive approach to the construction of bank protection, individual projects could adversely impact property owners, both upstream and downstream of the individual project.

River bank stabilization and protection, including riprap and spur dikes, have been used frequently along the Matanuska River and have proven effective in protecting against riverine erosion. A benefit of this option is that development along protected banks may be allowed to continue with relative safety. Strengthening and extending bank protection can have broader community benefits of preventing flood damage for areas downstream beyond the river's edge such as the Butte community.

The most significant downside to this option is that it only protects a very small area of river bank from erosion; desired areas of protection must be carefully selected. A related problem is that the shifting channels of the river can bypass installed bank stabilization and render protection useless, or damage the stabilization, leading to constant maintenance requirements.

Gravel Extraction

This alternative involves excavating a channel/settling area to capture the flow of the river in the area of Circle View Estates. Proponents of this alternative cite that the yearly maintenance of the channel/settling area would provide gravel for commercial purposes and these funds would more than pay for maintenance of the channel/settling area as well as expenses for maintenance of existing bank

[1] NRCS Report

protection. This alternative may not be as simple as proponents hope, as river dynamics may complicate this method more than they expect. Likewise, gaining necessary environmental permits for such actions may be very challenging and cost prohibitive. This option is open to private enterprises who are willing to take on the necessary permitting processes and invest in the studies required; the fact that no private enterprises have chosen to do so is indicative of the likelihood that cheaper, easier options for sourcing gravel exist elsewhere. Private enterprises may file for the necessary permits, conduct studies, and perform gravel extraction. To date, no private enterprises have deemed this option to be a good return on investment. While this is not proof that gravel extraction is a poor choice, it does weigh heavily against such an approach.

Gravel extraction is not a commonly used option although there is considerable interest in it from residents and stakeholders. The *NRCS Report* makes a much more detailed analysis of this option than has been performed in the past (see appendices). The gravel extraction alternative was also investigated by Peratrovich, Nottingham, and Drage (PND, 1991), under contract with MSB, and was primarily considered in order to protect homes in a three-mile section, on both sides of the river, beginning about half a mile north of North Bodenburg Butte Loop Road.

The gravel excavation option is fraught with many difficulties. Any such excavation would have to be performed during cold weather, when fish migration and river flow are minimal, while allowing greater control over the remaining flow. Intense study of the affect of such operations on fish and other environmental factors must be conducted before attempting gravel extraction. Additionally, there is no guarantee that excavated channels and pits would accurately control river flow; channels could shift unexpectedly upstream from the excavations, causing the active channel to bypass the excavations. Critical structures would still require bank stabilization protection.

Excavation is costly and would require ongoing maintenance to account for constant sediment deposition. Gravel excavation may best be pursued as a revenue-raising activity, if study proves it to be feasible, rather than an erosion reduction measure. An additional possible benefit of this approach is the chance to create new recreation opportunities in the riverbed.

Channel Manipulation

There is repeated interest in this option, which some describe as “controlling the river” or “channelizing” the river; meaning to use heavy equipment to plow a deep channel in the riverbed away from the banks in an attempt to coax the main channel to a particular spot. The feasibility and effectiveness of this option has not been studied in depth. The water flow, size of the river, and the sediment load in the river makes this option’s success unlikely.

Combined Actions

This alternative would allow bringing to bear which of the above three alternatives that would be most appropriate in a given situation at a particular site threatened by river erosion. Again, however, a comprehensive plan should be in place for this approach to be effective.

3.1.2 Nonstructural Options

Nonstructural options are designed to reduce future erosion damages through preventing the development of assets in erosion risk areas, relocating or removing structures and infrastructure in erosion risk areas, providing education to guide residents and stakeholders in making decisions about purchasing or developing property in erosion zones, and regulatory options such as setbacks and land use restrictions.

Relocation

Moving structures and property away from erosion zones is commonly acknowledged as the most cost-effective method for reducing erosion damages to existing structures. This option eliminates future maintenance costs and ensures that development occurs in low-risk areas. Relocation does not resolve ongoing erosion problems that may affect downstream communities.

Public Education

Educating residents and stakeholders about erosion risks is quite possibly the most inexpensive option. It allows current and potential property owners to make educated decisions about their exposure to erosion losses. Public information can include hazard zone delineations, structural protection guidelines, permitting guidance, and any other educational materials designed to inform and educate.

Regulatory Options

Regulatory options include setbacks, land use restrictions, building codes, zoning, and other methods by which a jurisdiction can restrict landowners in an effort to reduce future damages. Typical ways erosion risks are addressed by regulatory options include development restrictions in erosion zones and increased setbacks from water bodies. Regulatory options are a very cost-effective method for reducing future erosion damages because they can ensure that no new structures will be put at risk. Residents can be resistant to regulatory changes and in the past have been reluctant to agree to such changes in the MSB. Regulations for development along the river do not necessarily resolve regional flooding hazards.

In the spring of 2007, Alaska Rim Engineering, Inc. was tasked with developing an erosion mitigation ordinance. During the public participation process it became very evident most people did not want non-structural approaches. Proposed policies restricting new development were particularly unpopular. There was some acceptance of a policy requiring disclosure of the flood hazard risk when property changes hands. It is important to note that the Alaska Rim ordinance suggested restricting all

development within 1,000 feet of the river. Recent study indicates that this boundary may have been too expansive; it is likely that a smaller boundary would be effective in reducing further damages. Additionally, the Borough may be able to utilize information from the upcoming USGS study to determine a scientific basis for establishing areas in which new development should be restricted.

Flood Insurance

Purchase of flood insurance by private property owners should also be considered even though such policies do not specifically address erosion issues. Certain erosion losses may be covered under such a policy should the losses occur during a condition of flooding.

3.2 Fish and Wildlife Habitat

Currently, salmon habitat and populations throughout the Matanuska River watershed are generally healthy, although the findings of the Mat-Su Salmon Strategic Action Plan "points out concerns about long-term sustainability of Mat-Su Basin salmon and some of the habitats they require for survival. For salmon, this assessment suggests that numbers for some sockeye, pink, and chum salmon runs may be below a sustainable level and that some stocks may be seriously degraded in time without conservation action. Data for Mat-Su salmon populations is limited so the status of many stocks, especially in the Matanuska River watershed, is based on anecdotal information, professional judgment, or is unknown. Some habitat alteration, such as blocked migration, will have cumulative impacts over time to successive salmon populations." Salmon habitat is an important consideration when installing physical erosion protection and conducting any activities in or around the river.

3.3 Recreation

Access to recreation areas is a concern for residents and users alike; residents fear their property might be used by others to access the river, and recreationalists are concerned that river access is dwindling as private property is developed along the river corridor. Many residents desire more recreational opportunities along the river, but fear that the Matanuska River may experience heavy ORV use, uncontrolled shooting of firearms, junk car dumping and burning, and other public safety threats and nuisance behavior similar to that demonstrated in the Knik River/Jim Creek areas in recent years.

The Glenn Highway has been designated a National Scenic Byway, which may potentially lead to an increase in tourism and/or visitor activity.

3.4 Land Use

The Mat-Su Borough population growth and demand for riverfront property has led to an increase of structures built in areas susceptible to erosion and to a more limited extent, flood prone lands. Lack of good risk maps for the Matanuska River has contributed to this increase in development in high and moderate risk areas.

3.4.1 Existing Land Use Authorities

Federal

Special legislative appropriations, i.e. "earmark" funding has provided some of the funding for erosion control as well as funding for the numerous studies and technical analysis that have been conducted. The Floodplain Management Easements program under the U.S. Department of Agriculture, Natural Resources Conservation Service in cooperation with the Borough has funded the buy-out of three structures; flood insurance covered a portion of losses of homes displaced in the 1990s. Many of the insurance provisions have since changed.

State

State agencies lack statutory authority for erosion or flood control projects and generally only become involved in assisting with erosion under the following circumstances:

1. to provide technical assistance such as participating in the Planning Team for this Plan, or a special task force (Matanuska River Task Force); flood insurance, floodplain management or State permitting technical assistance;
2. a condition of a declared State disaster emergency (preceded by a Borough emergency declaration), which generally must be a flood event with consequent erosion that is widespread and beyond the capabilities of the Borough government;
3. when the Alaska Legislature appropriates funds for a special flood or erosion purpose; or
4. to protect State infrastructure or property such as the Glenn Highway, Old Glenn Highway, bridges or culverts. However, it is important to note that State agencies do not perform preventative maintenance on erosion control. Response to erosion issues by the State of Alaska Department of Transportation and Public Facilities is limited to direct and imminent impacts to the roadways.

Borough

Service Areas

The Alaska Constitution, Article 10, § 2 Local Government Powers grant local government powers to boroughs and cities"…provides for maximum local self-government with a minimum of local government units…A liberal construction shall be given to the powers of local government units." In addition, Article 10, § 5 allows for the formation of Service Areas. Alaska Statutes Title 29.40.010. Planning, platting, and land use regulation states a 1st or 2nd class borough shall provide for planning, platting, and land use regulation on an area wide basis, and (b) if a city in a Borough consents by ordinance, the assembly may, by ordinance, delegate any of its powers and duties under this chapter to the city. This latter clause was added by the legislature in 1985; prior to this revision some boroughs passed delegated land use regulatory authority to cities.

The two classes of general law boroughs, first class boroughs and second class boroughs, are essentially identical, except that first class boroughs can acquire additional area wide powers by ordinance rather than referendum. The Mat-Su Borough, a 2nd Class Borough under Alaska Statutes Title 29 does not have powers for providing erosion control on an area wide basis. Additional powers can be adopted area wide within the Borough, special Assembly appropriations provided, assistance through existing powers such as planning, platting, zoning, emergency services, or parks; or a service area can be expanded such as the Circle View and Stampede Estates Flood and Water Erosion Control Service Area.

Parcel Analysis

In order to make good future land use decisions that do not add more developable lots in hazardous areas, an analysis of current and future land use is needed. Also, to analyze the land area and financial merits of expanding the existing lower river reach flood and erosion control service area to the entire river, analysis is needed.

The Mat-Su Borough Geographic Information System (GIS) staff used the 2006 outer most banks dataset developed by USGS to estimate the edge of the braid plain and the number of property parcels that have land on the riverside of the outer banks line of the braid plain and of sufficient size to build a structure on. By using this method, 21,490 acres on 684 land parcels are estimated to be at the edge of or within the braid plain. This GIS analysis does not include all of the lots within the subdivisions along the river, i.e. Circle View, Stampede, River Bend, Sky Ranch, Mountain View Estates III, and others. This subdivided land more than one parcel away from the river's current high bank may also benefit from bank armoring or dikes. Only the lots adjacent to the river or within the braid plain were tallied. This is important because an expansion of the existing Circle View Stampede Estates Subdivision Erosion and Flood Control Service Area may be proposed based on inclusion of entire subdivisions adjacent to the river that currently may benefit from erosion control projects. Common practice on developing Service Area boundaries is to include entire subdivisions, not just a portion therein. The Circle View Service Area includes 74 land parcels, where as the GIS parcel analysis used for this description includes only the 18 parcels directly adjacent to the riverbank and erosion control dikes; similarly only 10 parcels from River Bend Subdivision, and 10 parcels from Sky Ranch Subdivision are included for this analysis.

Of the 684 land parcels adjacent to the river or within the braid plain, 106 land parcels are borough, state, Mental Health Trust lands; 67 parcels are owned Native lands (Eklutna Inc, 61 parcels, CIRI or Chickaloon-Moose Creek Native Village Association). 2,847 acres have no data meaning they may be islands, unsurveyed, perhaps significant erosion affecting ownership, or another anomaly.

The following Table is a summary of the estimated number of land parcels within the braid plain or on high banks adjacent to the river by reach:

River Reach	Land Parcels	Comments

All	366	Total parcels; 110 of these parcels are in the Hay Flats SPUD
1	146	Includes 4 city of Palmer parcels
2	121	
3	35	
4	12	1,124 acres

The below Table indicates the Total Taxable Acres and a breakdown by public and private acres:

Total Taxable Acres	**21,490.10**
Mat-Su Borough Taxable	4,437.21
State of Alaska Taxable	237.41
Mental Health Taxable	4,030.08
City of Palmer Taxable	507.91
Total Public Taxable	**9,212.61**
Total Private Taxable	**12,277.49**
Total Land Value for Private	**$16,480,600**

3.5 Funding

Currently there is no funding source for erosion protection on the Matanuska River. Obtaining the necessary funding for erosion control and maintenance may be the biggest hurdle to taking steps to conduct erosion mitigation in the planning area. Funding options include project grants, planning grants, the creation of service areas, taxes, and in-kind contributions.

While inundation-related flood loss is a significant component of flood disasters in the Mat-Su Borough that trigger additional state or even federal disaster assistance, the predominant damage along the Matanuska River has been erosion. Unless combined with widespread flooding impacting a significant number of residents, disaster assistance is not a practical, dependable mitigation approach. However, grant programs such as the Hazard Mitigation Assistance Program (HMGP) and Flood Mitigation Assistance (FMA) Program, and Pre-Disaster Mitigation Program (PDM) should be considered for targeting for the primary purpose of voluntary acquisition or relocation of structures out of the floodplain/erosion-hazard areas.

Most, if not all, homes and barns that were lost to erosion or relocated during the 1990s along the lower river in Circle View subdivision and the adjacent Stampede Estates subdivision had flood insurance policies and collected under terms that were then available through the National Flood Insurance Program.

Mat-Su Borough anticipates developing erosion risk mapping through the USGS Matanuska River Erosion mapping project. The use of planning, and zoning tools, to minimize erosion risks to future subdivided land parcels and structures in mapped areas, is an appropriate method that the MSB can use to implement hazard mitigation efforts on an area-wide basis. Financing of adaptive or structural mitigation measures is not a MSB power that could be financed by area-wide funding.

3.6 Research/Knowledge Gaps

The following are areas where additional research is needed or that there are gaps in knowledge that would assist in making resource management decisions, or in project decisions such as gravel extraction.

Natural Hazard Risk Assessment

- Hydraulic effects of removing gravel from the river both short term and long term. Including economic costs to manage material extraction, impacts on the river habitat.
- Topographic data east of the Old Glenn Highway and lower portions of the river.
- Erosion risks for high bluff, non-braid plain areas particularly along the faster growing areas, (i.e. City of Palmer, lower River both sides.)
- Water surface elevations of the 100-year (1% probability in any given year) flood. (Note: All current Flood Insurance Rate Maps are approximate flood boundaries with no water surface elevation, which are difficult to regulate to and have high flood insurance costs because of the limited risk assessment.)
- Matanuska Glacier thinning or retreat, stagnation, or a combination of these changes; glacial-dammed outburst lakes, What these mean in terms of human impact and more extreme runoff events are not clearly known.
- Mapping of risk on developed alluvial fans (e.g. Eska Creek, Granite Creek).

Wetlands

- Complete functional assessment of wetlands to aid in prioritization for protection.
- Local regulations/mechanisms to protect high value wetlands.

Buffers/Setbacks

- Public education on site design, building design, septic and well locates for minimizing future risk from erosion loss/damage.

Habitat

Excerpts from *2008 Mat-Su Basin Salmon Science & Restoration Symposium: General Research Needs,* Additional notes specific to the Matanuska River are added.

- The impacts to salmon habitat from changes in hydrography.
- Assess the effects of passage barriers on fish populations.
- Develop and assess water quality and quantity baselines.
- Identify and classify critical salmon habitats, and monitor physical and biotic characteristics. (Note: This assessment is particularly needed in the lower Matanuska River and without habitat/environmental assessment can slow or impede project permitting such as erosion control, or gravel mining.)
- Assess the cumulative impacts of development in riparian areas.
- Document value of undeveloped riparian areas for acquisitions and conservation easements.

4.0 Recommendations

4.1 Criteria to Guide Decision Making

4.1.1 General Considerations

Recommendations in Section 4.2 were developed to address the following criteria:

- Does the recommendation take steps to resolve the problem statement?
- Can the recommendation be implemented without a large financial commitment?
- Is the recommendation feasible?
- Is the recommendation acceptable to residents, agencies, and stakeholders?

4.1.2 Erosion-Specific Considerations

Historically, solutions to erosion problems along the river have been sought on an ad hoc basis first by the individuals threatened, then by the citizen groups seeking assistance from local, state, and federal agencies. This will likely not change. Growth along the river in hazardous areas is continuing to occur without regard to cost to the individual or the community as a whole. A suggested framework for consideration of alternatives includes:

Public Infrastructure and Roads at Risk – The Glenn Highway corridor is an area of specific concern in regards to erosion. Protection of the Glenn Highway, Old Glenn Highway and Bodenburg Loop Road has been and will continue to be the State priority for response and protection. Current policy limits State of Alaska DOT/PF response to erosion damages to emergencies only.

Disaster policy – The state policy for declaring disasters refers to widespread events that damage protective structures, flooding and erosion and threaten large areas. Disaster determination is made by the state based on circumstances of each event. Any smaller event is unlikely to result in outside assistance or a disaster declaration. This is important to understand while considering alternatives involving disaster funding.

Defining Adverse Impacts and Establishing Criteria to Minimize - No Adverse Impact is a growing concept for floodplain management that is an approach that should be considered for Matanuska River erosion management. No Adverse Impact is an approach which assures that the action of one property owner or a community (or a subdivider) does not adversely impact the properties and rights of other property owners, as measured by increased erosion up or downstream, sedimentation, and costs now and costs in the future. The true strength of the No Adverse Impact approach is that it encourages local decision-making to ensure that future development impacts will be considered and mitigated. NAI is consistent with an ancient legal principle “Sic utere tuo ut alienum non laedas,” or “so use your own property that you do not injure another’s property.” Development is currently being allowed that,when

coupled with the erosion protective structures needed to protect the development during its useful life, *may* increase erosion generally up or downstream. Erosion protection structures *will* result in maintenance costs at a minimum. A NAI approach would be residents make the decision to tax and pay for their own protection. Erosion losses are impacts to the community as a whole (i.e. increased emergency services and public works time, decreased revenue for lowered or lost property taxes of at-risk structures) that can be avoided by basing future development decisions on a No Adverse Impact approach.

No Action Alternative - If no action is taken to curtail future riverbank development in risky areas, and no expansion of taxing authority is developed to pay for local erosion mitigation measures, including matching funds for buying out threatened structures, erosion damages can be expected to continue in the Mat-Su Borough.

4.2 Problem Statements and Recommended Resolution Measures

River management issues are complex and involved. To address these issues, recommendations have been listed along with the specific problem they are designed to address. As agencies and communities work to prioritize their river management efforts, these recommendations can be taken into account to address the inevitable issues that will arise.

I. Problem Statement: ***Efforts to address riverine erosion are scattered between different agencies, with many agencies responsible for separate aspects of the issue. This makes it difficult to coordinate efforts to provide effective, sustainable erosion management and response.***

Recommendations:

- Develop a River Management Commission comprised of representatives from all interests to continually monitor and respond to river issues and events.
- Establish MOUs and agreements between agencies to maximize opportunities to address erosion problems before damage to infrastructure occurs.

II. Problem Statement: ***Agencies, local governments and residents may not understand how to assess the potential for erosion along the river.***

Recommendations:

- U.S. Geologic Survey is currently mapping the braid plain of the Matanuska River in detail to determine erosion risks. Once USGS mapping is completed, a public education effort including direct mail to all landowners that fall within the hazard risk areas should be conducted by the MSB to make risk information immediately known to the property owners, realtors, community councils and the general public.

- Use of the USGS Erosion Risk Map information:
    - All areas should be included on any future MSB subdivision/platting action
    - This information should be released directly to all landowners by direct mail to make information immediately known to the property owners, realtors, community councils, and general public.
    - This information should be available to the public through the borough web site or other media/publications.
    - This information should be used to limit future development in high risk areas.

III. Problem Statement: ***Some Mat-Su residents currently live in erosion risk areas along the river and do not know how to protect their own riverfront property when threatened by erosion*.**

Recommendations:

- Relocate at-risk structures.
- Educate residents regarding their options for private structural erosion protection.
- Develop permitting guidance information that is relatively easy to navigate for the average resident.

IV. Problem Statement: ***Development continues to occur in erosion-prone areas.***

Recommendations:

- Lenders in the Mat-Su Borough and Anchorage should be informed of the erosion risk area maps for the Matanuska River once they are finalized and published.
- Potential property owners should be advised to purchase flood insurance and should be informed on the limitations of flood insurance coverage for flood-related erosion losses.
- MSB should limit development in Risk areas via ordinances and land use designations. High erosion hazard areas might be designated as Open Space or developed as parks and recreation areas.
- Developers of new subdivisions with property adjoining the river should be required to provide structural erosion protection.

V. Problem Statement: ***Current information, though extensive, is not enough to determine the feasibility of channelization/gravel extraction as a means to control bank erosion.***

Recommendations:

If channelization/gravel extraction is put forward as an erosion management proposal, further investigations must be conducted to determine feasibility. Important issues include:

- The location and amount of gravel to be extracted
- The nature and variability of the sediment supplied to the extraction area
- Potential impacts to the stability of the system upstream and downstream
- Channelization/gravel extraction may alter braid patterns in a manner that would continue to cause erosion, or may worsen erosion in some areas. Additional study is required to assess how much maintenance or bank protection might be needed if channelization/gravel extraction alters the river course.
- Whether managing the main channel will cause erosion to increase in other river locations and cause channel destabilization
- How channel management might adversely impact migrating adult and juvenile salmon

VI. Problem Statement: ***Borough residents are reluctant to accept land use regulations.***

Recommendations:

- MSB should continue to develop and propose land use regulations and other options to the public; give residents the opportunity to accept or reject these methods regularly.
- Public Education: Communicate to residents regarding river behavior, erosion, and management options.
- Extend buffers requirements beyond the current 75 foot setback and restrict uses within the 75 foot setback along the river. On the smaller streams and creeks, riparian buffers should be viewed as an essential component of a comprehensive approach to erosion risk management.

Bank protection armoring at Riverbend Subdivision below Palmer begins six feet below the river bed to get below the scour level were the erosion will undermine the structure. With a net removal of approximately 40,000 tons of material the slope was reduced to a stable grade. Then 1,100 lineal feet of the bluff was armored. On the remaining 300 feet of bluff the building setback was increased so that on the western end of the bluff the building setback is 150 feet from the toe. The project was paid for privately and supported long-term by the homeowners association. Photo provided by Kevin Sorenson.

VII. Problem Statement: ***Erosion management options are typically very expensive to implement and maintain. Developing a sustainable funding source is a challenge; currently there is limited funding available for erosion protection beyond one-time "project" grants.***

Recommendations:

- Utilize available options such as FEMA Hazard

Mitigation Grant Program and Pre-Disaster Mitigation Grant Program to obtain funds for project grants. MSB Hazard Mitigation plan may need to be updated to reflect erosion problems.

- Develop a Service Area to contribute to costs of dealing with erosion issues river-wide. Expand the Circle View/Stampede Estates Flood and Erosion Control Service Area to cover the entire Matanuska River properties along both banks, excluding the City of Palmer, but including all properties within a common subdivision that abuts the river. Calculate the potential increase in service area revenue based on scenario based areas included in the USGS Risk Areas plus the flood hazard areas (excluding the area east of the Old Glenn Highway).
- Prepare Maps of Service Area boundary options for scenario based presentations/information to be distributed to all property owners in the area.

VIII. Problem Statement: ***Existing structural protection is costly to maintain.***

Recommendations:

- Establish service areas to contribute to the cost of maintaining these structures
- Seek federal and state funding sources for maintenance.

IX. Problem Statement: ***AKDOTPF policy currently allows road maintenance crews to act on erosion damages to roads only when the road bed is immediately affected. The policy does not allow preventative measures or action to be taken before the road bed itself is affected.***

Recommendations:

- Utilizing the erosion risk information, AKDOTPF should develop a planned repair and road maintenance program that provides funding for ongoing highway erosion protection. More permanent erosion protection will lower state response costs, and will provide improved service to residents in securing vital transportation links.

X. Problem Statement: ***Erosion protection construction can damage natural habitat. Habitat information is currently inadequate to determine the effects of construction on habitat.***

Recommendations:

- USFWS and Chickaloon Tribal have identified important fish habitat areas along the upper Matanuska River (primarily Reach 2 and 3), however the lower Matanuska River still needs to have important fish habitat areas delineated.
- Fish habitat areas including spawning/rearing areas need to be identified before engaging in structural erosion projects.

<u>XI. Problem Statement</u>: ***There is inadequate legal public access to the river for recreational purposes.***

Recommendations:

- Create a recreation use plan for the Matanuska River
- Ensure adequate legal public access is maintained when new subdivisions are constructed.
- Consider future designation of the Matanuska River as a Special Management Area

4.2.1 State Management Authority Recommendations

Land Disposal Restrictions

State of Alaska, DNR, and Mental Health Trust Authority that are within the high or medium risk braid plain areas mapped by the USGS should not be subdivided and further disposal of lands within these risk areas should be halted. Low risk areas may be considered for land disposal if lot sizes allow buildable area outside of the high risk areas. Lots mapped with high and medium risk areas with buildable land outside of the risk area should only be offered for land disposal if sufficient local land use ordinances restricting building of structures and utilities in the risk areas can be adopted and enforced.

Eklutna Inc. and Chickaloon Tribal Land managers are encouraged to follow the same restriction of high and medium risk lots that may be under consideration for future development (see River Corridor Protection below).

DNR Land Management

Engage DNR to work jointly with the MSB to stem illegal actions within the riverbed area to avoid public use conflicts; prevent the increase in illegal trespass across private property to access riverbed uses and overuse of public access points.

Permitting of In-Stream Structures

Permit application for the construction and maintenance of in-stream erosion abatement structures must be considered on an individual basis by regulatory agencies consistent with statutes, the public interest, and best professional judgment. These general guidelines are recommended:

- **Maintenance Minor Reconstruction and Reconstruction of Existing Structures** – Permitting agencies expeditiously process permits for maintenance of existing structures as long as a) the original construction of the structure conforms to the conditions of the original permit authorizing construction, and b) the structure does not substantially impede juvenile fish movement.

- **New Erosion Control Structures** – must comply with all current design and construction standards. Adverse impacts of new structures must be accounted for to the extent that they do not impact up or downstream property owners.

Palmer Soil and Water Conservation District

The Palmer Soil and Water Conservation District (PSWCD) was started by local landowners in 1947 and is managed by a volunteer board and covers the Matanuska River Watershed area. According to DNR, the services provided by the soil and water conservation districts include land conservation plans requested by local land owners, erosion control projects, water quality projects, implementation of best management practices, educational programs in local schools, resource development expertise and the synergy that results when all those holding a responsibility for Alaska's resources work together for the common good. As provided by Alaska Statute 41.10.130, the Commissioner of Natural Resources is authorized to "Create Soil and Water Conservation Districts in the state. . . ." and " . . . delegate to the district supervisors powers as the commissioner considers necessary to accomplish the purposes of this chapter within district boundaries." Having the PSWCD play a more active role in managing river issues would be beneficial; particularly in managing Service Areas tasked with erosion and flood control (see below).

4.2.2 Local Management Authority Recommendations

Service Area Expansion

Expand the Circle View and Stampede Estates Flood and Erosion Control Service Area or form additional service areas to cover the entire Matanuska River properties along both banks, excluding the City of Palmer, but including all properties within a common subdivision that abuts the river.

> **Alaska Constitution, Article X, Section 10.5 - Service Areas -** Service areas to provide special services within an organized borough may be established, altered, or abolished by the assembly, subject to the provisions of law or charter. A new service area shall not be established if, consistent with the purposes of this article, the new service can be provided by an existing service area, by incorporation as a city, or by annexation to a city. The assembly may authorize the levying of taxes, charges, or assessments within a service area to finance the special services.

The MSB, working with the Circle View Service Area Board should take the lead. Actions include:

- Establishing a service area in accordance with MSB Code Chapter 5.10.010(A): "A service area may be initiated by filing a petition with the clerk containing signatures of persons owning at least 50 percent of the real property within the proposed service area."

- Calculating the potential increase in service area revenue based on scenario based areas included in the USGS Risk Areas plus the flood hazard areas (excluding the area east of the Old Glenn Highway).

- Preparing Maps of Service Area boundary options for scenario based presentations/information to be distributed to all property owners in the area.

- Prepare public information campaign to educate the property owners of the service area expansion.

- Develop a set of duties and responsibilities of an expanded Service Area, including providing matching funds for an erosion mitigation projects; assisting on setting priorities for mitigation projects, including priorities for 1) matching funds for continued buyout and relocation of threatened structures; 2) maintenance of existing structures, 3) provide match for new erosion control structures.

- Work with community members and neighborhood groups to develop sites in accordance with MSB code.

PSWCD may serve to administer and assist with an expanded Borough Service Area tasked with erosion and flood control, since its district covers the entire Matanuska River Valley.

Background: The only area along the Matanuska River, outside of the City of Palmer, that is organized to collect a portion of property tax revenues to provide for erosion mitigation is the Circle View-Stampede Estates Soil Erosion and Flood Service Area. Expansion of this service area to the entire Matanuska River hazard area, or creating more than one smaller service area would expand revenue options for more erosion protection including matching funds for grants.

Subdivision Erosion Protection

Erosion protection is usually only effective when installed over long stretches of riverbank affected by erosion. Erosion protection installed on small parcels may be ineffective as river forces can easily overpower smaller structures. The example set by developers in the lower reach of the Matanuska River (Riverbend Subdivision) to develop large enough parcels to support structural erosion control installation and maintenance as part of the plat approval action should be analyzed and emulated on all segments of the river. A service area or homeowner's association can be formed to assist with funding maintenance.

Riverbend Subdivision Trail Photo provided by Kevin Sorenson.

4.2.3 Erosion and Floodplain Management Recommendations

Risk Mapping

The braid plain of the Matanuska River is being mapped in detail by the U.S. Geologic Survey. Although final mapping information was not available to use before this river management plan was completed, it is generally understood that areas of erosion risk will be designated on the USGS maps. This report will utilize the same river Reaches as the USGS technical study.

Use of the erosion risk information:

- All risk areas should be included on any future MSB subdivision/platting action
- Determining how to limit future development based on the risk areas should be the next step.

Flood Insurance

Purchase of flood insurance to cover potential *flood-related erosion* loss by all river front property owners for structures in the high risk braid plain or floodplain is recommended. All walled and roofed structures may be flood insured. Any homeowner, renter or business may purchase flood insurance anywhere within the Matanuska-Susitna Borough through the National Flood Insurance Program.

River Corridor Protection

Protecting existing, undeveloped floodplains and low-lying riverine wetlands from development is one of the best ways to limit erosion and flood losses in the long run. These areas serve the essential functions of spreading, slowing, and storing floodwaters as well as sediment. Protecting the undeveloped land along the Matanuska River leaves space for lateral adjustment over time, which is necessary to allow the river to achieve a balanced, equilibrium condition. Protection mechanisms include outright purchase, purchase of development rights, and easement acquisition.(See Buyout discussion). The MSB should retain foreclosed properties in erosion risk areas along the river.

Buy-out

Purchase of the most at-risk homes has been considered to be most cost-effective and is recommended to be continued. Combining local service area matching funds could increase the number of programs that could be tapped for buying out at-risk homes. Relocation may be possible in some circumstances depending upon lot size and type of foundation design. Properties to be bought out would be determined by buy-out program criteria and funding availability.

Land Disposal Restrictions

Mat-Su Borough owned lands that are within the erosion risk areas mapped by the USGS should not be subdivided and further disposal of lands within these risk areas should be halted. Some low risk areas may be considered for land disposal if lot sizes allow buildable area outside of the highest risk areas. Lots mapped within high and medium risk areas with buildable land outside of the risk area should only

be offered for land disposal if sufficient local land use ordinances restricting building of structures and utilities in the risk areas can be adopted and enforced.

Existing Structures

Recommend continuing and expanding annual maintenance of existing dikes and bank armoring projects based on a prioritization of those that 1) protect critical infrastructure, and 2) protect homes and businesses, and 3) have financing to support repairs,

4.2.4 Financial

Tax Collection

The borough has the duty to collect municipal property, sales, and use taxes if these taxes are levied within their boundaries. Beyond these requirements, municipal powers are exercised at the discretion of local governments. Second class boroughs are not authorized by law to provide services other than those authorized by the state. The Mat-Su Borough is not authorized to provide erosion and flood control services without the formation of a service area.

Flood Insurance Purchase

Lenders in the Mat-Su Borough and Anchorage headquarters offices should be informed of the risk area maps for the Matanuska River once they are finalized and published, and the purchase of flood insurance within these areas by existing property owners who own structures should be advised, with information on the limitations of flood insurance coverage for 'flood-related erosion losses.

Consideration should be given to by the MSB Assembly to restoring full value property values to structures protected by dikes or levees.

4.2.5 Public Education and Awareness

USGS Risk Mapping

Once USGS mapping is completed, a public education effort, including direct mail to all landowners that fall within the hazard risk areas, should be conducted by the MSB to make risk information immediately known to the property owners, realtors, community councils and the general public.

Flood Hazard Areas

Areas known to have flooded, whether mapped by the Federal Emergency Management Agency (FEMA) on Flood Insurance Rate Maps (FIRMs) or not, should be publicized. MSB has a regulatory obligation to utilize best available data from any source and should make hazard areas known. If information is available, incorporate annual flooding events such as the extent of the July 2009 flooding in the Sutton-Alpine area into MSB GIS and Code Compliance flood hazard information.

4.2.6 Land Use and Land Management

Buffers/Setbacks

Extending buffers beyond the current 75 foot setback and restricting uses within the 75 foot setback are essential on the Matanuska River. On the smaller streams and creeks, riparian buffers should be viewed as an essential component of a comprehensive, performance-based approach to sediment reduction in the small streams and creeks in the drainage.

Consideration should be given to extending buffers around wetlands based on wetland function, with high and immediate consideration given to increased development restrictions for those wetlands that are within floodplains, contiguous to or overlapping and joining floodplains. These areas should be given the highest and most immediate attention regarding increased restrictions to increase public safety as well as provide water quality and habitat benefits.

Some kettle holes or bogs - shallow, sediment-filled body of water formed by retreating glaciers or draining floodwaters - are near or within the Matanuska River braid plain. These low depression areas, when eroded into by the river, can create local dramatic changes in erosion impacts and development in or near them should be avoided. Again, buffers are suggested to prevent unnecessary exposure of kettle holes to erosion.

Natural Buffers

Add the preservation of natural/riparian buffers, not simply setbacks, once the USGS braid plain risks are identified. Benefits are preservation of the natural corridor for rafting and other recreational use that pays into the economy as a whole. Increasing residential construction benefits a few but also puts additional people and structures at risk in the future. In addition to restricting continued encroachment into hazardous erosion and/or floodprone areas by establishing riparian buffers, some surface runoff and channel erosion in small feeder streams/creeks may keep water quality nonpoint source runoff and additional sedimentation from becoming a problem.[2]

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[2] NOTE: "*A Review of the Scientific Literature on Riparian Buffer Width, Extent and Vegetation*" Seth Wenger, (March 5, 1999) Studies have yielded a range of recommendations for buffer widths; buffers as narrow as 4.6 m (15 ft) have proven
fairly effective in the short term, although wider buffers provide greater sediment control, especially on steeper slopes. Long-term studies suggest the need for wider buffers. It appears that a 30 m (100 ft) buffer is sufficiently wide to trap sediments under most circumstances. This is consistent with the review of Castelle et al (1993), which found that buffers must be 30 m wide to maintain a healthy biota. This width may be extended to account for factors such as steep slopes and land uses that yield excessive erosion. It is possible to also make the case for a narrower width, although the long-term effectiveness of such a buffer would be questionable. An absolute minimum width would be 9 m (30 ft). For maximum effectiveness, buffers must extend along all streams, including intermittent and ephemeral segments. The effectiveness of a network of buffers is directly related to its extent; governments that do not apply buffers to certain classes of streams should be aware that such exemptions reduce benefits substantially. Buffers need to be augmented by limits on impervious surfaces and strictly enforced on-site sediment controls.

4.2.7 Fish and Wildlife Habitat

Fish and Wildlife Habitat

USFWS and Chickaloon Village Tribal Council have identified important habitat areas along the upper Matanuska River (primarily Reach 2 and 3), however the lower Matanuska River still needs habitat areas delineated. Important habitat areas need to be identified and discussed before engaging in erosion control project planning.

As pressure on Susitna River fish streams increase with increased stream fisheries closures and a demand for more access, it is anticipated that pressure on the Matanuska River will increase, whether for recreation or in search of fishing opportunities.

4.2.8 Recreation

Increased trespass incidence on private property and a demand for more access areas are anticipated along the Matanuska River. Development of an **Access Management Plan** and supporting Maps is recommended as a first step to begin to address increased recreational access. The plan should discuss motorized and non-motorized uses and access points, both public and private (e.g. particular emphasis should be placed on identifying trespass issues that are increasing).

4.3 Recommendations By Reach

4.3.1 Reach 1, Lower Matanuska River, Palmer/Butte

Structural River Management, including Dikes and Materials Management

No new engineering or technical analysis was funded as a part of this river management planning effort. Some public input at public meetings repeatedly returned to interest in managing the river flow. In order to move forward with politically, and financially, supportable "structural" river management projects, such as recommended below for materials management and maintenance of existing dikes, the expansion of a local Service Area to pay at least a portion of these costs is recommended. Service Area expansion could also include a look at expanded management authority, or more appropriately companion management authority with the Palmer Soil and Water Conservation District.

"It has been postulated in past studies that a significant factor causing bank erosion on the Matanuska River is the large supply of bed load that causes deposition and contributes to the dynamic nature of the braided channel. The gravel extraction approach to controlling bank erosion aims at removing a sufficient amount of bed load to eliminate the over-supply and the associated deposition. Additionally, the proposed approach would attempt to relocate the channel to the center of the braided corridor rather than allowing it to impinge upon the outer banks or limits of the corridor…There are many questions that need to be answered prior to establishing the feasibility of (gravel extraction) approach."

- USACE "Reconnaissance Study of Matanuska River Erosion" Study.

Existing Structures

Repair and maintenance of the existing dike system is recommended to continue as a high priority action. Currently the Circle View and Stampede Estates Service Area collects the only property tax revenues that can be applied to these important maintenance needs. Expansion of the Service Area is recommended to take in additional properties, not only in the USGS identified hazard braidplain, but all of the floodplain areas on the west side of the Old Glenn Highway. All subdivisions on the right bank of the river downstream of the City of Palmer should be considered for addition to the Service Area for maintaining the protective dikes.

Other Hazard Identification and Mapping

- Re-evaluation of the 100-year floodplain to include detailed studies with water surface elevations, avoiding "unnumbered A Zones" wherever possible. Consideration should be given to Flood Insurance Rate Map (FIRM) updates in the Butte first on the west side of the Old Glenn Highway in the Maude Road area (including evaluation of the existing remaining diking) then on the east side of the Old Glenn Highway.
- Wetlands that also have floodplain functions should be identified for increased management options to avoid fill in wetlands that are within the 100-year floodplain.
- If fill pads within the floodplains on the westside of the Old Glenn Highway are allowed, MSB needs to assure compliance with MSB compaction requirements and consider requiring armoring of fill pads to lessen foundation erosion impacts caused by high velocity overland flooding.

City of Palmer

- Perform a site assessment of property fronting the river with first priority given to public land and facilities, then private land including wells and septic systems or any other items that if undermined would cause river pollution or hardship to homeowners. Corps of Engineers or NRCS assistance with this site assessment should be considered.
- Using the USGS risk mapping, develop management strategies to avoid future development in the risk areas. The example set by developers in the lower reach of the Matanuska River (Riverbend Subdivision) to install structural erosion control maintenance as part of the plat approval action should be analyzed and followed. Property owners may also work together with owners of adjacent lands to develop erosion control structures to protect longer portions of the riverbed.
- A long term setback/buffer protection plan should be developed that includes the MSB School District and other major riverfront property owners.

4.3.2 Reach 2 – Palmer Overlook Reach

No specific recommendations at this time.

4.3.3 Reach 3 Sutton/Alpine and Reach 4 Chickaloon

Alluvial Fans

Geologic mapping to identify and guide development or protection on alluvial fans outlined in the USGS mapping project is recommended. Since there is a wide diversity in alluvial fans and the current level of development of fans, it is a good opportunity to assure that future development takes into consideration the degree of risk presented by alluvial fans. Alluvial fans form where mountain streams flow into valleys. Floods, debris floods and debris flows build alluvial fans and can pose risks to lives and property, and geologic mapping can help to identify hazardous areas and aid in developing sound land use policies.

Floodplain mapping

Mapping the floodprone areas along the Matanuska River so that they can be regulated according to existing MSB Title 17 Flood Damage Prevention ordinance is recommended. LIDAR mapping is proposed for summer of 2010, which could be used for flood mapping. Coordinating mapping efforts with the LIDAR project would be beneficial.

5.0 Implementation

5.1 Goals and Objectives

Objective	Description	Function	Action Steps	Implementation Responsibility
Goal 1: Utilize regulatory tools to reduce likelihood of future erosion damages.				
1.1 Develop new MSB ordinance to limit development in high erosion risk areas	Develop ordinance restricting construction in high-risk erosion areas to certain types of development; such as temporary or easily relocatable structures.	Reduce future financial damages by preventing new development that will be affected by erosion.	• Define and delineate high risk erosion areas. • Develop ordinance • Put ordinance to vote	MSB
1.2 Develop MSB ordinance to prohibit new development in erosion areas *	Preventing the installation of new structures is a cost effective way to reduce future damages that will occur as a result of the installation of structures in hazardous areas.	Reduce future financial damages by preventing new development that will be affected by erosion.	• Define and delineate high risk erosion areas. • Develop ordinance • Put ordinance to vote	MSB
1.3 Comply with Coastal Management Area Guidelines as required	Matanuska River is a geophysical hazard area under the MSB Coastal Management Plan, thus development is not to be approved by the State or MSB until siting, design, and construction measures for minimizing property damage and	Reduce future financial damages by preventing new development that will be affected by erosion.	• Monitor new development for compliance with Coastal Management Guidelines	MSB

Objective	Description	Function	Action Steps	Implementation Responsibility
	protecting against loss of life have been provided.			
Goal 2: Reduce future structural erosion damages by relocating at-risk structures				
2.1 Develop prioritized list of structures for relocation	Structures must be prioritized in order of importance to Borough, i.e. critical infrastructure, public building, privately held structures. The NRCS prioritization list from the 2006 buyout is a good starting point and the structures on that list should be given first priority.	To remove valuable structures from harm's way, thereby reducing future financial damages	• Determine which structures are in erosion zones • Develop strategy for prioritization (i.e. rate of erosion, value of property, type of property, etc) • Relocate structures in order when funding becomes available	All agencies and governments with jurisdictional authority over river corridor properties
2.2 Establish funding for relocations	Currently there is no additional funding to continue the buyout program that was enacted in 2006, which utilized funds from the Emergency Watershed Protection Program. Continuing the effort to secure more funding for relocations would significantly benefit stakeholders by reducing future financial damages.	To seek funding for continuation of a previously successful relocation program.	• Continue to apply for funding via a variety of grants and in-kind services.	
Goal 3: Ensure that any current structural erosion protection is maintained				

Objective	Description	Function	Action Steps	Implementation Responsibility
3.1 Maintain existing dikes within Circle View service area	Ensure ongoing integrity of Circle View dikes are maintained	To reduce future damages by making repairs when needed; ensuring that financial investment is maintained	• Schedule yearly inspections and maintenance for existing dikes • Dedicate service area funding for maintenance of dikes.	Circle View Service Area Members
3.2 Maintain any existing structural protection	If structural erosion protection has been installed in the Borough to protect public property, it should be properly maintained	Ensure financial investment of installing erosion protection is not wasted.	• Determine whether existing erosion protection exists in a maintainable state • Determine cost of maintenance via study or estimate • Set aside funding to perform yearly maintenance	Land-owners, MSB, State of Alaska
Goal 4: Identify areas in need of structural protection				
4.1 Annual survey of highway protection	Erosion of the highway corridor falls under DOT responsibility. Regular inspection of highway erosion control may help reduce damages by revealing weaknesses early on. Agencies and stakeholders should work with AKDOTPF to develop a	Ensure stability and effectiveness of existing erosion protection along the Glenn Highway.	• Work cooperatively with DOT to monitor and survey areas of highway erosion protection	DOT

OBJECTIVE	DESCRIPTION	FUNCTION	ACTION STEPS	IMPLEMENTATION RESPONSIBILITY
	planned repair and maintenance approach that lowers State costs by avoiding making emergency repairs, then more permanent erosion protection, particularly during high water events, should lower State costs, and provide an improved framework for securing these vital transportation links. This can be emulated by the road service areas along the river that provide local road maintenance and repair.			
4.2 Seek funding sources to upgrade or install erosion protection	Lack of funding is the most-cited reason for the inability to install erosion protection. Establishing funding sources can help.	Ensure that funding is in place to repair and upgrade erosion protection along the Glenn Highway when necessary.	• Develop funding plan for needed upgrades and repairs	DOT
Goal 5 Develop recreation access and opportunities throughout the river corridor				
5.1 Determine current recreation areas and access along river corridor	Identify areas that are currently designated as recreation areas as well as areas that are commonly used as recreation areas	To determine areas in which designated recreation sites would be helpful	• Map recreation areas and social recreation areas	MSB, City of Palmer
5.2 Utilize erosion-prone undeveloped areas for recreation	Designate high hazard erosion areas as open space and/or develop as parks and recreation	To set aside lands for recreation use and to ensure that erosion areas are not	• Determine which open areas may be utilized for this purpose	MSB, CoP, land-owners, State of Alaska

OBJECTIVE	DESCRIPTION	FUNCTION	ACTION STEPS	IMPLEMENTATION RESPONSIBILITY
opportunities	areas	structurally developed	• Agency/Government action to set aside areas for open space or recreation use	
5.3 Develop River Corridor Recreation Master Plan	Develop a specific plan for developing recreational opportunities in the river corridor	To adequately plan for the development of recreation areas	• Identify recreation access needs • Identify areas in which recreation areas would be beneficial • Develop Master Plan to enact the development of these areas into recreation uses	MSB, CoP, DNR
Goal 6: Improve Public Education regarding river issues				
6.1 Include Risk Areas on any future MSB subdivision/ platting action	When any land is subdivided or platted, include its risk designation	To ensure that all landowners and purchasers are educated about the status of their lands in regards to erosion hazards	• Determine boundaries of Risk Areas • Include these designations in subdivisions and plats	MSB, CoP
6.2 Communicate to residents regarding river behavior, erosion, and management options	Provide residents with the information they need to adequately plan for erosion impacts and damages as well as other river issues	To ensure that all residents are informed about river issues and erosion risks	• Develop public education materials • Conduct mailings, presentations, and other public education activities designed to	MSB, CoP

Objective	Description	Function	Action Steps	Implementation Responsibility
			inform the public about river issues	
6.3 Define tax assessment process for land affected by erosion	Provide guidance for landowners to improve understanding of tax assessment process when land is lost or gained via erosion processes	To ensure fair and accurate tax assessment for residents affected by erosion	• Develop public information materials detailing the process and deliver the information to the public	MSB
6.4 Ensure that residents understand their options for privately installed structural erosion control.	Residents seem uncertain of their options regarding how to protect their property without government assistance	Information on installing privately installed erosion control can lead to reducing financial damages	• Create guidance regarding homeowners' options for installing erosion control	MSB, CoP
6.5 Develop permitting guidance for residents	Create instructional materials to provide information to residents regarding how to complete the permitting process.	To provide residents with the tools they need to obtain permits to install private erosion protection	• Create and distribute materials	MSB, CoP
Goal 7: Ensure that environmental issues are considered when river management actions are taken				
7.1 Identify important fish and wildlife habitat in the river corridor	Determine areas of particular environmental sensitivity in regards to fish habitat	To ensure that fish runs and salmon spawning is not adversely affected by river management actions	Continue study of fish habitat Partner with environmental agencies (ADF&G, etc) to help delineate important fish habitat areas	MSB, ADF&G, USFWS, Chickaloon VTC, CoP
Goal 8: Develop river management entities and process for approaching river management issues and continuing the planning effort.				
8.1 Create Hazard Mitigation	Develop multi-agency effort to plan cooperatively for hazard	To continue the hazard plan implementation effort.	• Determine which agencies should	MSB, CoP, USACE, NRCS,

Objective	Description	Function	Action Steps	Implementation Responsibility
Commission to provide ongoing support for hazard issues* ***See appendix for example resolution**	mitigation		participate • Develop Commission roles and responsibilities	State of Alaska, ADF&G, DNR, com-munity councils, AKDOT&PF, USF&W, PSWCD
8.2 Establish Memorandums of Understanding and other working agreements between agencies with river management authority and/or interest in river issues	Cooperative ventures such as MOUs can eliminate duplication of effort, reduce financial investment, and ensure prompt reaction to river issues. Creating these agreements before emergencies or time-critical situations is more efficient and sustainable.	To create a sustainable, cooperative method for responding to river issues	• Collectively determine where efforts are currently duplicated and/or funding sources overlap • Determine how MOUs could eliminate some of the overlap • Implement MOUs	MSB, CoP, USACE, NRCS, State of Alaska, ADF&G, DNR, community councils, AKDOT&PF, USF&W, PSWCD, AKRR
Goal 9: Provide economic incentives for residents and stakeholders to enact erosion mitigation techniques				
9.1 Provide financial incentives to developers to install erosion protection	Give developers additional incentive to install erosion protection when developing subdivisions	To ensure that effort is made to address erosion protection when lands are developed	• Determine what financial incentives would be possible • Develop guidelines for adequate erosion protection installation • Develop mechanism by which installed erosion	MSB

Objective	Description	Function	Action Steps	Implementation Responsibility
			protection can be inspected and approved for financial incentives	
9.2 Create Borough mechanisms to accept and manage river corridor lands (i.e. open space, wetlands, stream buffers)	Development of a system by which the MSB can accept new river corridor lands for designation as open space, wetlands, etc	To provide additional resources for management of river corridor lands	• Determine which mechanisms may be appropriate for use by the MSB when accepting lands for management • Enact necessary ordinance to utilize land transfer and/or management mechanisms	MSB
Goal 10: To develop funding sources to support river management efforts				
10.1 Establish new service areas	Service areas are the only means by which the MSB can legally collect monies designated for erosion and river management use.	To develop a source of funding to contribute to the cost of maintaining erosion control structures and other river corridor management actions	Propose development of new Corridor-wide service area and attempt to obtain approval from residents.	Residents, MSB
10.2 Seek Federal and State funding for structural erosion control construction	Federal and State grants are common sources of funding for construction of mitigation projects.	To adequately fund necessary maintenance on erosion control.	Identify grant programs that may be applicable to erosion projects within the MSB.	MSB, CoP, Service Areas

5.2 Monitoring and Evaluation

If, as recommended, the Matanuska Hazard Mitigation Commission is created, it would be the ongoing work of that group to monitor and evaluate the plan and review the implementation activities on at least an annual basis. If that group is not created, it would be up to the individual organizations to monitor and evaluate the plan elements that apply to them (State, Borough, City of Palmer, etc.) according to their organization's schedules.

5.3 Plan Review and Amendments

The Matanuska River Management Plan will go forward to the MSB Planning Commission and Assembly for public hearings, review and approval. MSB generally reviews plans every ten years unless there is a community request to do so more frequently. Requests for updates and amendments should be addressed to the MSB Planning and Land Use Department. The Planning Director will determine the process for amendments based on the extent of changes requested.

Appendix A

Literature Review

The following publications were reviewed for pertinent information in developing this document. Many documents reviewed contained the same information. Whenever possible, the original source of the information was cited in this document. Abbreviations for citation purposes are listed in parentheses after the publication title. Publications listed without an abbreviation were reviewed but were not original sources or did not contain information not found elsewhere.

- ***Alaska Community Database Community Information Summaries* (DCED):** http://www.commerce.state.ak.us/dca/commdb/CIS.cfm. No date listed.
- ***Background Study for Reconnaissance Study of Matanuska River Erosion*** (Background Study), Prepared by Tetra Tech for the U.S. Army Corps of Engineers, August 2003. Contains a list of erosion control projects as well as alternatives discussion.
- ***Channel Shifting and Bank Erosion of the Matanuska River Near Palmer*,** prepared by William Long, PhD. No date listed. Contains a summary and evaluation of Matanuska River erosion as it relates to erosion damages in the Palmer area.
- ***Chickaloon Comprehensive Plan (Chickaloon Comprehensive Plan),*** Author unknown. Main body of text dated April 1991; Appendices dated between August 1991 and December 1995. The Chickaloon Comprehensive Plan contains little to no useful information regarding riverine erosion.
- ***City of Palmer Comprehensive Plan (Palmer Comprehensive Plan),*** Prepared by the City of Palmer, Palmer Planning Team, and Agnew::Beck Consulting. September 2006. Chapter 4 contains a small amount of data that can also be found within the Corps Palmer Paper. Otherwise the City of Palmer Plan contains little to no useful information regarding riverine erosion.
- ***Conserving Salmon Habitat in the Mat-Su Basin: The Strategic Action Plan of the Mat-Su Basin Salmon Habitat Partnership*.** 2008. The document discusses salmon habitat and possible human-caused impacts to salmon health in the Matanuska River basin.
- ***Erosion Along the Matanuska River:*** An Overview of the Problem with Suggested Mitigation Measures, Prepared by Alaska Rim Engineering, Inc. September 2007.
- ***Expedited Reconnaissance Study (ERS), Matanuska River Erosion***, prepared by the U.S. Army Corps of Engineers, author unknown. 2003.

- ***Erosion Information Paper – Circle View and Stampede Estates*****,** Alaska*,* Prepared by the U.S. Army Corps of Engineers, Alaska District. October 2007. Summarizes in detail erosion damages and effects in the specified area.
- ***Erosion Information Paper – Palmer, Alaska*** **(EIP-Palmer),** Prepared by the U.S. Army Corps of Engineers, Alaska District. September 2007. Summarizes in detail erosion damages and effects in the specified area.
- ***Erosion Information Paper – Sutton-Alpine, Alaska*** **(EIP-Sutton**), Prepared by the U.S. Army Corps of Engineers, Alaska District. December 2007. Summarizes in detail erosion damages and effects in the specified area.
- ***Matanuska River Erosion Assessment; Design Study Report, Volume I: Report (NRCS Report), November 2004,*** Prepared by MWH for the U.S. Department of Agriculture Natural Resources Conservation Service. November 2004. The *NRCS Report* primarily addresses riverine erosion mitigation alternatives near the Palmer and Butte areas of the Matanuska River. It contains a large amount of technical information regarding this section of the river and the considered mitigation alternatives, including projected costs and success rates.
- ***Matanuska River Erosion Projects (*****Mat-Su Borough**), prepared by MSB, no author listed. March 2007. A brief listing of current in-progress erosion projects in the Borough.
- ***Matanuska River Erosion Task Force Interim Report***, State of Alaska Division of Emergency Services. February 1992. The Task Force was assigned to complete a written report to the Governor that assimilated the most up-to-date and objective information available about the capability of the State to react to erosion in the Matanuska River basin. The erosion information was to be used to develop policies and programs designed to reduce or eliminate damages from this erosion problem. Topics investigated were engineering solutions, relocation options, Federal Flood Insurance Program, and land management alternatives. The report included as an attachment, a general outline of the possible engineering solutions prepared by the Alaska Department of Transportation and Public Facilities and the Corps of Engineers.
- ***Matanuska River Terrace Erosion Area Acquisition Pilot Project, Draft Environmental Assessment*** (NRCS EA),Prepared by USDA Natural Resources Conservation Service, April 2006.
- ***Matanuska River Watershed Review of Resources*** **(Long),** Prepared by Palmer Soil and Water Conservation District in cooperation with Alaska Division of Mining and Water Management, William E. Long, Editor. No date listed.
- ***Matanuska River Watershed Plan*** **(Watershed Plan),** Prepared by U.S Department of Agriculture, June 2006. Includes brief discussion on erosion damages and mitigation in the Matanuska River Corridor.
- ***Palmer All-Hazards Mitigation Plan – Phase One: Natural Hazards (PAHMP)****,* Prepared by MSB Department of Emergency Services. October 2008. The *AHMP* contains information on a variety

of borough-wide natural hazards, related data, mitigation goals, and community involvement in the planning process. The amount of data specific to riverine erosion and the Matanuska River is limited.

- ***Reconnaissance Study of Matanuska River Erosion***, Prepared by Tetra Tech Inc., for the Alaska District Corps of Engineers, August 2003. Includes an extensive annotated list of previous studies and projects and alternatives description.
- ***Sutton Comprehensive Plan Public Review Draft (Sutton Comprehensive Plan),*** Prepared by the MSB Department of Planning and Land Use, October 2008. The Sutton Plan contains little to no useful information regarding riverine erosion.

Appendix B

Summary of Erosion Management Recommendations from Prior Matanuska River Erosion Reports

Source Reports:

- Erosion Along the Matanuska River - An Overview of the Problem with Suggested Mitigation Measures, Alaska Rim Engineering Inc., Sept. 2007
- Matanuska River Terrace Erosion Area Acquisition Project Draft Environmental Assessment, USDA, Natural Resources Conservation Service, April 5, 2006
- Reconnaissance Study of Matanuska River Erosion Matanuska-Susitna Borough, Alaska, for U.S. Army Corps of Engineers Alaska District, prepared by Tetra Tech Inc., August 2003
- Matanuska River Erosion Assessment Design Study Report Final Volume 1: Report, Prepared for U.S. Department of Agriculture, Natural Resources Conservation Service, Alaska State Office by MWH, November 2004
- Alaska Task Force - Erosion of the Matanuska River Basin Interim Report, State of Alaska Division of Emergency Services, Feb. 18, 1992

Erosion along the Matanuska River - An Over View of the Problem with Suggested Mitigation Measures, Sept. 2007

Non-Structural Erosion Control Options

In the spring of 2007, Alaska Rim Engineering, Inc. was tasked with developing an erosion mitigation ordinance. During the public participation process it became very evident most people did not want non-structural approaches. Proposed policies restricting new development were particularly unpopular. There was some acceptance of a policy requiring disclosure of the flood hazard risk when property changes hands.

Gravel Removal

This alternative involves excavating a channel/settling area to capture the flow of the river in the area of Circle View Estates. Proponents of this alternative cite that the yearly maintenance of the channel/settling area would provide gravel for commercial purposes and these funds would more than pay for maintenance of the channel/settling area and expenses for maintenance of existing bank protection. This alternative may not be as simple as proponents hope, as river dynamics may complicate this method more than they expect. Likewise, gaining needed environmental permits for such actions may be very challenging. An additional possible benefit of this approach is the chance to create new recreation opportunities in the river bed.

Bank Protection

This alternative involves the construction of spur dikes, riprap, or other bank protection structures. It would also involve maintenance of the bank protection and require funding for this activity from some source. This approach offers the potential benefits of securing land that might otherwise be subject to erosion risks. The challenges to this approach are finding funds for initial and ongoing costs. In addition, without a comprehensive approach to the construction of bank protection, individual projects could adversely impact property owners, both upstream and downstream of the individual project.

Non-structural Approaches

This alternative includes buyouts of property in the areas threatened by river erosion and regulatory mechanisms to prohibit or limit development in areas threatened by river erosion. There have been a small number of buyouts by the MSB to date, but this method is totally dependent on a source of continuing available funding. The regulatory approach has been investigated by the Borough and was found to be objectionable to the majority of the residents who attended information meetings on this approach. It appears that the most palatable non-structural approach would be requiring comprehensive disclosure of flood hazard risk when property changes hands.

Combined Actions

This alternative would allow bringing to bear which of the above three alternatives that would be most appropriate in a given situation at a particular site threatened by river erosion. Again, however, a comprehensive plan should be in place for this approach to be effective.

No Action

This alternative would allow continued loss of property to river erosion and economic loss to property owners and loss of tax base to MSB.

Comprehensive Erosion Damage Mitigation Plan

A comprehensive plan for erosion damage mitigation should be developed for the Matanuska River from Matanuska Glacier to Knik Arm. The ongoing erosion study by USGS can be used to determine the erosion hazard at specific points in that stretch of the river. Then these sites should be prioritized in terms of level of erosion risk, economic impacts and infrastructure damage. Prioritization insures that potential projects are in a ready mode to accept funding as it becomes available and demonstrates to the funding source that a rational rating system is in place by MSB.

Matanuska River Terrace Erosion Area Acquisition Project Draft Environmental Assessment, USDA, Natural Resources Conservation Service, April 5, 2006

Alternatives Considered But Not Developed in Detail

A number of alternatives, both structural and non-structural in nature, have been considered to address the erosion related problems on the Matanuska River. In August 2003, the U.S. Army Corps of Engineers undertook a preliminary investigation of various structural measures, as well as relocation of property owners out of the erosion area. Additionally, a Matanuska River Erosion Study suggesting alternative recommendations was performed for NRCS in 2004 (MWH Report, 2004).

Although none of these alternatives were studied in detail, it is useful to examine the preliminary findings. One finding to date is that structural measures may reduce erosion in the area but have very high negative cost/benefit ratios and high environmental impact concerns. And, Structural measures are very expensive since they are vulnerable to the erosive forces of the Matanuska River, requiring armoring and high ongoing maintenance costs. Due to high costs (each spur dike is estimated to cost $625,000), limited area protections, long time frame for study and implementation, and potential detrimental ecological impacts, structural measures were not developed.

Structural control measures in and adjacent to rivers, also present inherent technical, economic and social concerns regarding the continuing use of public funds to relieve/compensate private landowner losses for what is largely believed to be avoidable personal actions. This is especially true where young glacially driven natural river systems need to geomorphically adjust to widely varying environmental and climatic conditions. Braided river systems such as the Matanuska River, need the ability to move laterally carrying water flows and sediment loads, developing an energy balance. State and Federal government conservation and permitting agencies, contemporary political leadership and others are increasingly requiring local administrative procedures as remedy for site treatment, in lieu of structural protection features, to be utilized in addressing these river resource and human concerns.

Description of Alternatives Considered

No Action - Under the No Action alternative, current erosion induced problems will persist. Homes and businesses are and will continue to be at high risk for damage or destruction. Emergency and public utilities workers in the performance of required assistance will continue to risk life and health in some circumstances, to provide services within budgeted allowances. Risk of loss of life will remain relatively unchanged or could possibly worsen as the Matanuska River continues its migration toward existing buildings. Federal, State and local emergency agencies, private insurance companies and individuals will incur costs of recovery. Anadromous fish populations will remain potentially negatively impacted by built-environment structural debris. Water quality will remain threatened by active fuel storage tanks, septic system collapse, and the potential for hazardous contamination from unknown household substances.

The cumulative impacts of the No Action alternative consist of both short - and long-term effects. In one scenario, a "no action" effect would generally sanction unfettered development adjacent to the river in the floodplain and terrace area. If no restrictions are implemented, the short-term effects would be the continued danger for property damage as a result of erosion activities. In the long-term, potentially as more structures, features and buildings fall into the river, there will be equivalent economic and social hardships as insurance rates rise to off-set losses. There will be an increasing call for State and Federal intervention for rescue of affected sites by emergency personnel as well as requests for streambank and river structural mechanisms to attempt to protect perceived high-risk erosion areas, utilizing such engineering features as rip-rap and spur dikes. Increasing pressure will come to bear on local, State and Federal manpower and on public financial resources to address these loss issues.

Environmentally, buildings, septic systems, fuel storage tanks, and a wide variety of commercial and household toxins will be added to Matanuska River water, imperiling fisheries and wildlife populations as well as downstream water users. The other general option for the future without the project is the MSB Administration will propose to the Borough Assembly, an ordinance that would implement a suite of administrative actions to limit development of the riparian, floodplain and at-risk terrace erosion areas adjacent to the river. The MSB is interested in implementing these administrative features, as it is increasingly aware that structural measures extending into the river and providing only limited area protection, are considerably out of favor with State and Federal regulatory agencies as well as with State and Federal lawmakers who have assisted in acquiring funds for such limited area treatments (i.e. spur dikes).

Part of the Borough's strategy is to enact zoning codes, restricting allowable activities adjacent to the river. With these provisions in place, future building and development within these areas would likely be constrained to conditions not requiring extraordinary and expensive emergency measures, and therefore the cost of property damage prevention from erosion would be expected to be borne by the private citizen. Without strong Borough initiated zoning codes, the river terrace area would continue to be developed with the high risk of continued erosion and damage to property.

Zoning ordinances alone will not reduce the pre-existing risk associated with the current on-going erosion problem. Acquisition of the high risk properties would mitigate the danger of personal property damage and restore the natural riverine values on the properties acquired. Removing the structures would also save Borough funding currently spent on emergency services. Borough funds would be decreased due to the loss of tax revenue on the acquired lands and structures. In each No Action project scenario, several residential homes with septic appurtenances and some actively used fuel tanks and other hazardous features will still be subject to loss. Lives will still be endangered and water pollution will occur as high water erodes the terrace and erosion area and affects residence and business structures in the 2006 high water year.

Residual impacts are those that remain, whether positive or negative, after the implementation of appropriate mitigating measures. The residual impacts of the proposed action would include the

Boroughs on-going expense to manage the acquired lands and the loss of property tax revenue for the Borough on the acquired lands. The Borough would, however, theoretically save revenue on emergency services. An acquisition without structural measures would not reduce the erosion itself, only its impact to homeowners and business.

Terrace Acquisition - Preferred Alternative - As an alternative to structural erosion proofing measures, fee title acquisition by the MSB of the most severely threatened homes and businesses is proposed. The project would focus on acquiring the most vulnerable properties on a voluntary basis by offering the landowner's fair market value for their property. Interested landowners would apply for participation in the program and the highest priority properties, as determined by ranking criteria, would be acquired relative to available funding (see below). Buildings and other facilities would be demolished and removed from each acquired site. The property would be vegetatively restored and maintained in perpetuity as terrace and riparian land use, unless otherwise accommodated by an NRCS compatible use agreement. Construction of buildings for human use or occupancy and other uses that are incompatible with the natural terrace and riparian function would not be allowed. A Restrictive Covenant governing allowable uses and management providing NRCS oversight would be recorded and filed with the Borough-acquired fee title deed. The MSB would retain fee title to the acquired properties, while elements of the Borough-NRCS agreement and Restrictive Covenant would provide vegetative restoration and ecologic stabilization of the at-risk terrace and riparian erosion area. This alternative will not entrain or otherwise restrict the Matanuska River from eroding and/or claiming the acquired property area(s) in its natural geomorphic adjustments. No engineered features or measures would be installed into or adjacent to the river corridor.

Preferred Alternative Benefit Summary

- Reduces potential loss of human life from event-oriented river bank erosion affecting human habitations.
- Removes approximately 3-4 residential homes or businesses and attending structural and building features from certain loss to the Matanuska River in the 2006 calendar year. Landowners of these properties will be compensated fair market value for their properties on a voluntary participation basis.
- Decommissions water wells, public utilities and infrastructure, reducing the damage to these facilities, their repair and maintenance. Eliminates the deposition of structural debris, household and built-environment chemicals and generally inseparable residential toxic materials , into the Matanuska River as a result of structure loss. Thus, providing less potentially polluted or otherwise altered water quality conditions for downstream users and fish and wildlife populations.
- Revegetates native ecological conditions on the terrace and riparian areas of the project sites, restoring function and values of these geomorphic and landscape features. Upland and riparian wildlife habitat will be restored on approximately 10-40 acres to pre-disturbance conditions.

Long-term human impacts, land use and development will be strictly controlled to manage the sites for ecological and geomorphic stability.

- Assist and encourage the Borough to develop administrative land use management strategies. These strategies should be developed to facilitate restrictions and control of human developments in at-risk landscape areas along waterways in the Borough. If enacted, these procedures would reduce the need for repetitive, expensive, limited-treatment-area engineering structural features.
- Addresses a public need by providing a pilot project for water, soil and wildlife resource treatment to use as a model for landowners, business and local government officials, demonstrating and educating about issues of river corridor management, zoning and land use development.
- Reduces potential costs of protecting the 3-4 acquired properties through structural treatments (i.e., spur dikes) from 2.5 million ($625,000 x 4) dollars to $594,000, through the use of the fee title acquisition concept.

Reconnaissance Study of Matanuska River Erosion Matanuska-Susitna Borough, Alaska, for U.S. Army Corps of Engineers Alaska District, August 2003

Flow Deflecting Structures

Flow deflecting structures function to protect riverbanks by moving the erosive force of water away from the toe of the bank. Flow deflecting structures are typically utilized in a series to move the flow away from the bank over a significant length of the river; however, in some cases, they are used as a single unit to eliminate a single point of flow impingement on a bank. When spur dikes are used in a series, finer sediments tend to deposit in the slack water and eddies between the structures. This further protects the banks and in some cases, allows for the establishment of vegetation.

This type of structure has been used at several locations along the Matanuska River and is one of the solutions proposed in several of the past reports. The structures proposed have been spur dikes, which protrude nearly perpendicular from the bank into the flow. Spur dikes have been used in the area of Circle View Estates and at several locations along the Glenn Highway. Additionally, shorter spurs or groins have been utilized to protect the Palmer sewage lagoons.

Pros:

- Have shown some success in controlling bank erosion on the Matanuska
- Moves high velocity flow away from eroding bank
- Creates channel thalweg at tip or nose of dikes due to channel deepening by scour, thus tending to stabilize the alignment
- Typically requires less rock to construct than armoring the banks with riprap
- Vegetation may become established on deposits between structures

Cons:

- Earlier investigations indicated a low B/C ratio for the treatment
- Concern over shifting erosion problems upstream or downstream of structure
- Concern over potential for shifting erosion to opposite side of river (May not be warranted in areas where the channel is several thousand feet wide as is often the case in the study area)
- Changing river conditions, primarily shifting channel braids, could alter angle of attack and reduce effectiveness or cause failure

- Maintenance at tip is likely to be required due to large scour potential
- Concern over environmental impacts

Bank Armoring

This is the most common method of protecting banks from erosion. In this approach, a blanket of less erodible material is placed along the banks to prevent the flow from removing native bank material. Depending on the conditions, this may be accomplished using vegetation (biotechnical), rock (riprap), rock filled gabions or other manufactured revetments such as articulated concrete mattresses. Because of the hydraulic conditions, including velocities on the order of 10 feet per second and shear stresses exceeding 2 pounds per square foot, biotechnical approaches have not been considered on the Matanuska as a primary element for stabilization of main channel erosion sites. However, biotechnical means could be employed to protect upper banks and enhance the environmental aspects of bank armoring measures. Gabions and concrete mattresses are typically used when sources of suitable quality riprap are not readily available. Since riprap is available in the area, this would be the likely approach utilized for the bank armoring category of protection.

Bank armoring can either be applied directly to the banks by regrading the bank slopes and applying appropriate filters/bedding, or by construction of a training dike. The latter approach is utilized when the bank is irregular, has sharp bends or poor alignments that may create adverse hydraulic conditions. Additionally, the protection of a smooth training dike may require less riprap than an irregular shaped, eroded bank line. Both approaches to bank armoring have been proposed and applied to the Matanuska River.

Pros:

- Has shown some success in controlling bank erosion on the Matanuska River
- Maintenance may be less than spur dikes because the severe scour conditions that occur at the tip of spur dikes is absent
- Less susceptible to changes in alignment of braids than spur dikes
- Less likely than spur dikes to transfer erosion problems to the opposite bank, upstream or downstream

Cons:

- Earlier investigations indicated a low B/C ratio for the treatment
- Typically requires more riprap than spur dikes
- Thalweg tends to form at base of riprap, bringing main flow of channel along protected bank
- Concern over environmental impacts

- Extensive length would be required to prevent flanking of the protection – not suitable for protection of localized area

Gravel Extraction

It has been postulated in past studies that a significant factor causing bank erosion on the Matanuska River is the large supply of bed load that causes deposition and contributes to the dynamic nature of the braided channel. The gravel extraction approach to controlling bank erosion aims at removing a sufficient amount of bed load to eliminate the over supply and the associated deposition. Additionally, the proposed approach would attempt to relocate the channel to the center of the braided corridor rather than allowing it to impinge upon the outer banks or limits of the corridor. The approach would utilize an excavated channel to direct the flow into a large expansion or settling area where the bed load would be deposited. An excavated channel would convey the flow out of the settling area. The settling area would be used as the extraction point for the gravel and cobble. A fundamental requirement of this approach is that the economic value of the gravel extracted would fund the continued removal activities. It has not been established that this requirement can be met. A market analysis of gravel demand should be part of a more detailed feasibility study to further examine this issue.

There is considerable merit to attempt to solve the problem by attacking one of the causes of bank erosion (i.e., over supply of sediment) than by addressing the symptoms by protecting the banks. However, there are many questions that need to be answered prior to establishing the feasibility of such an approach.

Pros:

- Attempts to address the cause of bank erosion rather than the symptoms
- Operation and maintenance may be self funding by the sale of the aggregate
- Would reduce the likelihood of a channel avulsion across the Bodenburg Butte area, should this possibility actually be a reality

Cons:

- Addresses portion of erosion problem related to oversupply but banks' erosion may have other contributing factors such as nature of the banks, hydrologic conditions, and hydraulic conditions
- Management of gravel for reduction in oversupply to reduce or control bank erosion may conflict with management needed for operating a profitable gravel mining operation
- Gravel supply by the river may vary considerably from year to year and has no correlation to variations in demand
- If economics of gravel extraction change, cessation of extraction will terminate any bank erosion control afforded by the project

- It may be difficult to successfully control the gravel supply for very large events
- If not properly conducted, gravel extraction could adversely impact upstream and downstream areas
- Agency concerns over adverse environmental impacts
- Potential impacts to the groundwater fed channels that currently provide fish habitat through possible lowering of the groundwater level as a result of lowering the water level in the channel
- Stabilization of the channel could result in significant alterations in existing habitat functions and values

Non Structural Measures

Non-structural solutions aim to reduce expected future erosion damages by moving homes and infrastructure out of harms way and to discourage further development in erosion prone areas. Non-structural solutions could include some combination of acquisition and/or relocation of threatened properties and land management including land use controls and zoning regulations. These non-structural measures would reduce expected future erosion damages and would have less environmental impacts within the river corridor than structural solutions. However, some environmental impacts could be transferred to other areas as growth that would have occurred in the river corridor occurs in other areas.

Pros:

- Non structural measures such as relocations and limitations of future development would reduce potential for future damages because fewer homes and other improvements would be in the path of future bank erosion episodes
- Likely to be most environmentally acceptable solution
- Less or no permitting relative to structural measures
- Would not alter the riverine environment

Cons:

- Land Use controls alone (without relocation) do not protect current property from loss
- Relocation of existing properties alone (without land use controls) does not preclude future development in erosion prone areas
- Potential opposition by property owners within the corridor

Specific Erosion Damage Reduction Opportunities (Alternative Plans and Preliminary Evaluation of Alternatives)

To investigate the potential feasibility of controlling erosion on the Matanuska River, specific locations were identified that presented opportunities for implementation of erosion control measures. Locations were selected based on two primary criteria: 1) locations where valued resources are at risk of damage from erosion, and 2) where implementation of erosion control measures appears feasible.

The primary opportunities identified to address erosion problems in the study areas extend from approximately four miles upstream of the Glenn Highway crossing of the Matanuska at the Knik Arm to just above Chickaloon (Mile Post 77). Two primary erosion reaches were initially identified along this length of the river. The first erosion reach identified is in the more populated area near Palmer, from the Old Glenn Highway crossing downstream for approximately seven miles. The second erosion reach identified includes intermittent erosion areas along the Glenn Highway from Mile Post 61 (near Sutton) to Mile Post 78 (near Chickaloon). In the lower reach, the most significant problems have centered around bank erosion threatening and in some cases actually destroying homes. In the upper reach the problem has to a large part been associated with bank erosion threatening and damaging the highway, although, there have been several homes threatened by erosion near Sutton.

Discussions with Alaska Department of Transportation and Public Facilities indicated that past efforts have resulted in controlling erosion of the upstream reaches of the Matanuska River along the Glenn Highway to the extent that erosion is now primarily a maintenance issue. AKDOTPF did not feel that there was a need for a significant effort to implement new bank protection measures along the Glenn Highway. The site visit conducted as part of this effort confirmed this opinion.

In contrast to the upstream reaches of the Matanuska River, the bank erosion problems in the Palmer area, below the Old Glenn Highway Bridge are still a major concern. Currently, attention is focused on the left side (left defined facing downstream) of the river, though erosion of the right bank in the area of the Palmer wastewater lagoons and the Mountain View Estates were both problems prior to the Matanuska shifting to the south in the period following the 1986 high flows. Based on the evaluation of active bank erosion, the highest opportunities for control of bank erosion exist along the reach of the Matanuska River in the Palmer area, below the Old Glenn Highway Bridge.

For a viable bank erosion control project to exist, not only do eroding banks need to be present, but also there must be threatened land and improvements that are of sufficient value to justify the expense associated with providing significant bank erosion protection. In the Palmer area below the Old Glenn Highway Bridge, it was determined that both these conditions existed at a level to warrant their further consideration in this study.

To further investigate the feasibility of implementing bank protection along the Matanuska River in this area, the general erosion damage reduction measures were formulated into specific erosion damage reduction plans at specific locations in the study area. The first alterative plan involves implementing a program of gravel extraction to stabilize the river system. The second alternative plan involves providing bank armoring to prevent erosion. Various groups and individuals have expressed interest in

both of these alternatives over the past decades as documented by previous reports and input provided by local agencies. Additionally, a non-structural erosion damage reduction alternative was evaluated.

The gravel extraction alternative was formulated by Peratrovich, Nottingham and Drage (PND, 1991) under contract with the Borough and is primarily intended to protect homes from about half a mile north of North Bodenburg Butte Loop Road on downstream for approximately three miles on both sides of the river. It should be noted that the PND plan is very conceptual and numerous important questions and issues, both in terms of engineering and economics, need to be further investigated before a determination of whether the plan will actually work can be made. The bank armoring alternative would protect the Old Glenn Highway and buildings on the left bank from the bridge on downstream to near the Triple Crown Estates subdivision. The non-structural alternative would involve acquisition of erosion-prone lands and improvements for conversion to open space or other beneficial uses.

As a reconnaissance study, the development and evaluation of the alternatives is at a conceptual level. The purpose is not to identify a definitive project, but to determine if there is a possibility that a technically and economically feasible project may exist that warrants further consideration. The specific alternatives were chosen since they appear to have the highest potential for protecting features of economic value. The gravel extraction alternative and the non-structural alternative concentrate on reducing erosion damages to homes, while the bank protection alternative reduces potential damages to both infrastructure (Old Glenn Highway) and homes. Collectively, the alternatives offer an assessment of the potential range of benefits from bank erosion damage reduction projects in the study area.

Alternative 1 – Gravel Extraction

Description: Much of the bank erosion problem within the Matanuska River in the Palmer area is the result of the channel exhibiting a highly braided plainform. The braided channel is characterized by multiple and shifting channels within the overall river corridor. This behavior results in areas of high bank erosion when one of the channel braids shifts against a bank along the edge of the corridor, as was the case at Circle View Estates a decade ago. A primary factor contributing to the braided channel condition is a high rate of bed load supply in excess of the flow's capacity to transport the material. The gravel extraction alternative would remove the oversupply of bed load with the intent of controlling the channel's tendency to braid, and therefore greatly reduce bank erosion.

PND prepared a report for the Matanuska-Susitna Borough presenting the conceptual design and basis for a gravel extraction scheme to control erosion along a portion of the Matanuska River. In addition to eliminating the over-supply of bed load to reduce erosion, the plan also incorporates excavation and channel training associated with the gravel extraction plan to initially move the flow of the river towards the center of the corridor and away from the banks. The alternative presented in this section is a summary of the alternative presented in the PND report. It is cautioned that the actual ability of this alternative to control the erosion problems has not been addressed to the extent that it is considered

technically feasible. This section also presents some of the questions and concerns related to the gravel extraction plan to fully evaluate its feasibility.

Alternative 1 would be located in the Matanuska River from about three miles downstream (south) of the Old Glenn Highway Bridge to below the Sky Ranch subdivision. The downstream location would be approximately one mile upstream of the Matanuska Dike constructed to protect the Alaska Railroad. The length of the project would be about three miles. In this configuration, the project would be intended to provide erosion protection for both sides of the river within this three-mile reach. Refer to **Figure 2** above for location of potential gravel extraction site.

As presented by PND (1991) the project would consist of five major components:

1. The first component would be a gravel extraction pit constructed in the center of the channel corridor adjacent to Mountain View Estates. The pit is proposed to be 20 feet deep and 1,200 feet in diameter with a volume of 600,000 cubic yards.

2. The second component would be an 8,000 foot long upstream supply channel extending from the extraction pit upstream to the narrow area in the channel corridor just upstream of North Bodenburg Loop Road and adjacent to the Triple Crown Subdivision.

3. The third component would be a similar channel extending downstream of the extraction pit for 3,000 feet. The channels are proposed to have widths of 300 feet and require 400,000 cubic yards of excavation. The channels are designed to be a total of ten feet deep with five feet of depth created by excavation and the remaining five feet created by pushing up berms along the channel from the channel excavation material. This size channel in this configuration is designed to convey the two-year flood. The design depends on the channel incising to create sufficient capacity to carry larger floods.

4. The fourth component would be a 1,000 foot wide flared transition into the 8,000 foot long upstream channel.

5. The fifth component of the system would be the gravel transportation facilities. This would consist of a 6,500 foot long railroad spur constructed to haul gravel from the site and connect with the existing Alaska Railroad tracks, gravel loading facility, haul road from the pit, and a gravel stockpile pad.

The facility described above would be utilized to extract an average of 250,000 cubic yards per year of gravel. PND indicates the intention of this volume roughly equaling the estimated annual bed load supply. Separate estimates of the average annual bed load supply in the Matanuska River resulted in values of 267,000 cubic yards (USGS) and 300,000 cubic yards (AHS).

Engineering Considerations: It is not possible to determine the engineering feasibility of gravel extraction as a means to control bank erosion along the Matanuska River based only on existing

information. Thus, this alternative cannot be considered technically feasible until further investigations have been conducted (technical feasibility has not been ruled out at this time). The following paragraphs identify specific issues that need to be addressed to determine engineering feasibility.

An extremely important question to answer is the expected amount of the gravel to be extracted. Uncertainty in this area arises from two aspects of the plan. First, the proposed plan calls for extraction of the entire estimated bed load supply; however, this may not be a wise approach. Extracting the entire bed load supply will leave the channel downstream of the project starved of coarse material and could adversely impact the downstream channel. Typically in-stream gravel mining is conducted under the concept of "safe yield," where safe yield is the difference between the bed load sediment supply into the reach and the bed load sediment transport capacity within the reach. The safe yield may be much smaller than the actual supply. The second level of uncertainty involves the actual estimate of bed load. The predictions of 267,000 to 300,000 cubic yards are based on only 9 measurements for the first value and an approximate relationship from other Southcentral Alaska streams for the second value.

Another important question to answer is what will be the upstream impact of the proposed gravel extraction project? The method assumes that a headcut will occur, but there is not an analysis indicating that the headcut will be confined to the intended area. If the headcut proceeded upstream of the controlled channel, it could result in damages to other locations. Similarly, downstream impacts to the channel morphology must also be assessed.

The nature and variability of the sediment supplied to the extraction area must also be better understood. In low flow years, the bed load supply would likely be much smaller than the predicted average annual yield. Conversely, in high flow years the yield would be significantly larger. In the former case, it could create a hardship for any entity that was expecting to remove 250,000 cubic yards to make the gravel extraction economically viable. In the second case, the extraction area or upstream supply channel might be overwhelmed with sediment, resulting in a massive amount of deposition and shifting of the channel in the same manner as the project was intended to arrest. A better understanding of these two possibilities can only be obtained by analyzing the variability of sediment supply over a period of record and simulating the trapping characteristics of the gravel extraction pit.

The sediment trapping characteristics of the extraction pit under varying flow conditions must also be understood to identify the sizes of sediment trapped and their volumes. Though the plan is written as if the only material being trapped is gravel, it is inevitable that appreciable sand and some silt will be trapped. To estimate their volumes, the incoming supply must be estimated and the trapping characteristics of the proposed pit simulated over a range of flows. It is expected that the percentage of sands and silts in the sediments trapped in the extraction pit will be greater than that typically found in the channel deposits. This is due to the fact that the sediments trapped in the extraction pit will be deposited under a much lower energy environment than currently or historically existed, on the average, in the main channel of the Matanuska River.

Potential impacts to the stability of the system upstream and downstream, including existing bank protection structures needs to be addressed. This would relate to the potential for upstream headcuts, downstream channel degradation and migration or filling of the upstream supply channel.

Reduction in sediment supply would change the expected channel form from braided to single thread, but the single threaded channel may ultimately adopt a meandering form. This in turn would cause erosion of gravel and supply additional sediments. Thus, additional study is required to assess how much maintenance or bank protection might be needed to maintain the straight approach and exit channels from the settling area.

Preliminary Cost: The PND report did not provide a detailed cost breakdown of Alternative 1, but provided an estimated initial construction cost for the entire project of $3,000,000 in 1989 dollars. Applying a cost escalation factor of 1.5 (based on Engineering News Record's historic construction cost index to bring the estimate to the current price level) to this value results in an estimated cost of $4,500,000 in 2003 dollars. The PND report does not indicate the costs associated with extracting the gravel nor the value of the extracted gravel.

In addition to the initial construction cost, there would be costs associated with the annual extraction of gravel as well as maintenance of the facilities such as conveyor belts, roadways and the channels. For this analysis, the cost of extracting the gravel and stockpiling in the project area is estimated to be $3.00 per cubic yard. The annual cost of extracting 250,000 cubic yards of gravel is then $750,000. If it is assumed that maintenance costs of the other project components averages 2 percent of the initial construction cost, this is an additional annual expense of $90,000 per year. The estimated annual O&M cost is then $840,000. Calculated over a fifty-year period at the current Federal interest rate of 5.875%, this O&M has a present value of $13,474,500. The average annual equivalent cost is $1,120,530. A separate analysis was conducted assuming that the O&M costs were self-liquidating (that is, they pay for themselves by the sale of the extracted gravel). In this self liquidating scenario, the total present value of the gravel extraction alternative is $4,500,000, with an average annual equivalent value of $280,530. Adding the O&M and Construction costs results in a cost (present value) of $17,974,500 (average annual equivalent value of $1,120,530).

Economic Considerations: Implementation of the gravel extraction project would affect the study subareas delineated as Lower Left Bank and Right Bank. The erosion zones defined in Section 5.2 of this report were compared with GIS-based county assessors data to determine the value of lands and improvements. Land in the lower left bank was determined to have an average value of $2,755 per acre. Structures (all residential) within 1,000 feet of the current left bank totaled 28 with an average value of $119,170, and an average replacement value of $156,170. In the right bank, the land was valued at $5,894 per acre and there were 13 residential structures within 500 feet of the current bank with an average value of $182,585 and an average replacement value of $224,680. Total expected erosion losses averted by this plan range from approximately 110 to 131 acres of land and 10 to 12 residential structures. The calculated present value of prevented damages in these subareas ranged from

approximately $762,000 to $774,000 (average annual equivalent value of $47,500 to $48,250). The range is based upon the different analysis methodologies employed (assumptions of normal vs. actual distribution). The estimated costs of this alternative exceed the expected benefits by a factor of approximately 23.2 to 1. Therefore this gravel extraction alternative does not appear to be economically justified. In the case where O&M costs are assumed to be self-liquidating, the value of prevented damages remains the same but the cost decreases. As a result, the estimated costs of this version of the alternative exceed the expected benefits by a factor of approximately 5.8 to 1.

If the two growth factors are applied to approximate development in the study area, expected damages and the value of prevented damages increase while the costs of the alternative remains constant. With the assumed 2% annual growth rate, expected damages prevented range from $1,000,100 to $1,018,000. Costs exceed benefits by a factor of approximately 17.7 to 1. In the self-liquidating O&M scenario, the ratio of costs to benefits is approximately 4.4 to 1.

Going to the assumed 4.1% growth rate, expected damages prevented range from $1,432,300 to $1,459,100. Costs exceed benefits by a factor of approximately 12.3 to 1. In the self-liquidating O&M scenario, the ratio of costs to benefits is approximately 3.1 to 1.

If this alternative were studied further, economic questions related to demand for gravel and gravel extraction/processing requirements and costs must be answered to determine if long term demand would exist for the gravel and if annual operation and maintenance of the project would be self liquidating. Demand for gravel varies based on regional construction trends, which are subject to changes in the local economy and government funding levels for large infrastructure projects. Additional demand for gravel may be possible through export out of the region. Even without considering any operation and maintenance costs, the project is not economically justified (that is, its annual costs far exceed its annual benefits).

Environmental Considerations: Applicable regulatory agencies expressed concern that gravel extraction within the river channel could adversely impact migrating adult and juvenile salmon and might actually result in channel destabilization. Agencies recommended a comprehensive watershed management study to document fisheries use and potential impacts of any proposed in-channel gravel extraction project.

Alternative 2 – Bank Armoring by Riprap

Description: Alternative 2 consists of a riprap bank armoring extending along the left bank (east side) of the Matanuska River from the Old Glenn Highway Bridge downstream for 3.5 miles to near the Triple Crown Subdivision. The purpose of the bank armoring would be to control erosion in order to protect homes and the Old Glenn Highway. In this area, the Matanuska River ranges from less than 100 feet to approximately 1,600 feet from the Old Glenn Highway. Approximately 3,800 feet of the river currently has a combination of riprapped bank and dike installed. The riprap armoring may also help to protect

the area from flooding that can result as the channel erodes into low lying overbank areas and abandoned channels, such as occurred in 1971.

A detailed site-specific design of bank protection for this reach would utilize a combination of riprap armoring applied directly to the banks that have been cut back to an appropriate slope, rip-rap armoring applied to fill or a berm where the current bank alignment is not suitable for applying armor and possibly some flow deflecting structures such as spur dikes and groins. Armored banks would be used in areas where the existing bank has a suitable alignment for protecting as is sufficiently high to prevent flood flows from flanking the protection. Armored dikes could be used in other areas where the bank is low or an irregular bank line makes the job of protecting the existing bank difficult and expensive.

Engineering Considerations: Use of a riprap bank armoring to control erosion and also reduce possible flooding is a feasible engineering approach in the area proposed. This type of structure has already been successfully utilized in a 4,000 foot long section of river in the area of Ye Old River Road. On a larger scale, the ability to control erosion using similar measures has been proven by AKDOTPF on the reach of the Matanuska River from Sutton to Chickaloon. Further site-specific design efforts may result in including flow-deflecting structures, which have also been shown to be effective in controlling erosion in the Sutton to Chickaloon reach as well as within portions of the Matanuska in the Palmer area.

Although feasible, the use of the riprap bank armoring or any other bank protection measure, in a river as dynamic as the Matanuska will require that there be a commitment for significant long-term maintenance. All of the previous measures given as examples of current applications have required maintenance over the years. Finally, the alternative has been formulated with the intent of controlling bank erosion along the entire reach, rather than just applying protection to areas identified as currently eroding, because the dynamic nature of the Matanuska River could quickly shift erosion to new locations. Thus, in the long run, protection would be applied along the entire reach, assuming a strategy to control erosion by structural measures was adopted. By formulating a single project, the risk of smaller individual projects failing is eliminated and an integrated approach is implemented.

Preliminary Cost: It is estimated that riprap bank armoring would cost approximately $400 per foot or roughly $2,000,000 per mile. Of the 3.5-mile reach, approximately 2.7 miles are not currently diked. The resulting 14,000 feet of dike is estimated to cost on the order of $5,600,000. In addition, the current dike is in need of repair in several places. Allowing $100 per foot for repairs on the 4,000 feet of existing dike adds $400,000 to the cost of the project. The total first cost would be $6,000,000. Maintenance would be required to ensure long-term performance of the project. It is assumed that annual maintenance would average two percent of the initial construction cost. Based on this the estimated annual maintenance is $120,000 per year. The present value of first costs and O&M costs over the 50-year period of analysis amounts to $7,924,930 (average annual equivalent cost of $494,000).

The cost of protecting approximately 2,000 feet of bank along Circle View Estates in 1992 with spur dikes was $500,000. Escalating the price to current dollars by a factor of 1.33 (Engineering News Record's historic construction cost index) results in a cost of $666,000 for 2,000 feet ($1,800,000 per mile), which is in the same range of cost as constructing the armored bank protection. Therefore, whether armored bank protection or spur dikes are used, the cost of continuously protecting a significant length of the Matanuska will be similar with either option or a combination of the two.

Economic Justification: Implementation of the bank armoring by riprap alternative would affect the study subarea delineated as Upper Left Bank. The erosion zones in this report were joined with county assessors data to determine the value of lands and improvements within each zone. Additionally, expected damages to the Old Glenn Highway in the Upper Left Bank subarea were calculated. The average per acre value of land in the upper left bank was found to be $2,676 per acre. The estimated value of the Old Glenn Highway was $400 per foot. The average value of the seven residential structures in the estimated potential erosion zone of 500 feet width was $119,170, with an average estimated replacement cost of $156,168. Assuming no new development, total expected erosion losses averted by this plan range from approximately 37 to 39 acres of land, 2 to 3 residential structures, and 987 to 1168 feet of Old Glenn Highway. In the no new development scenario, the combined present value of prevented damages in the Upper Left Bank subarea ranged from approximately $262,000 to $266,000 (average annual equivalent value of $16,330 to $16,580). The range is based upon the different analysis methodologies employed (assumptions of normal vs. actual distribution). The estimated costs of this alternative exceed the expected benefits by a factor of approximately 29.8 to 1. Therefore this bank armoring alternative does not appear to be economically justified.

If the two growth factors are applied to approximate development in the study area, expected damages and the value of prevented damages increase while the costs of the alternative remains constant. With the assumed 2% annual growth rate, expected damages prevented range from $298,100 to $301,200. Costs exceed benefits by a factor of approximately 26.6 to 1. Going to the assumed 4.1% growth rate, expected damages prevented range from $357,000 to $373,000. Costs exceed benefits by a factor of approximately 22.2 to 1.

Environmental Considerations: Applicable environmental agencies expressed concern that any kind of hard structural and protruding bank protection measures would create near-shore velocity barriers to upstream migrating juvenile salmon species. Any proposal for implementing these controls will need to evaluate and minimize these potential velocity barriers. Agencies recommended a comprehensive watershed management study to document fisheries use and potential impacts of any proposed bank protection project.

Alternative 3 – Non Structural Measures Plan

Description: A non-structural plan would aim to reduce expected future erosion damages by moving homes and infrastructure out of harms way and to discourage further development in erosion prone areas. A non-structural measures plan could include a combination of nonstructural features, including

land acquisition in erosion hazard areas, control of future development in erosion hazard areas, and public education to foster awareness of erosion risks along the river corridor. These non-structural measures would reduce expected future erosion damages and would have less environmental impacts within the river corridor than the structural solutions identified in this report. Conversion of developed areas in erosion hazard zones to open space could provide environmental benefits for wildlife in the study area. Additional opportunities would exist for utilization of converted lands for low-impact recreational activities such as camping and walking/cross-country ski trails or for conversion of lands to agricultural production.

Several previous studies of erosion in the Matanuska River valley have concluded that non-structural erosion control measures should be implemented in the study area:

The Alaska District conducted a study resulting in the 1972 report Matanuska and Little Susitna Rivers, Flood Control, Alaska. Study findings stated "the District Engineer concludes that economic justification does not exist for structural solutions to flooding or bank erosion in either area studied; and that local interests should avail themselves of technical information regarding non-structural alternatives for wise management of the floodplain." The report further recommends "additional clearing and development within the established floodplain should be discouraged by institution of borough planning and zoning controls.

Alaska Governor, Walter Hickel, in 1991 convened the Alaska Task Force on Erosion in the Matanuska River Basin. The task force considered several alternatives for addressing erosion problems, including housing relocations and land use management options. Task Force recommendations published in their February 1992 report included the following non-structural measures:

- House relocations where appropriate, including land swaps and in some cases demolition
- Operate an "education campaign" to inform local officials, developers, and other interested parties of the state's policy regarding erosion hazard area management and the severity of the erosion risk along the Matanuska River.
- Identify Erosion Hazard areas and erosion rates in developed areas and areas of high development potential. The State and Borough should adopt minimum standards and definitions for riverine hazards and when delineating shorelines subject to erosion. These should include areas subject to imminent erosion hazards (within 10 years, E-10 zone), intermediate hazard (within 30 years, E-30 zone), and long-term hazard (within 60 years, E-60 Zone)
- Require the adoption of appropriate land use ordinances for communities adjacent to erosion hazard areas.
- Create building standards for buildings on or near erosion prone areas. Also, an analysis of erosion control measures should be made when plans for development in erosion prone areas

are proposed. Erosion control should be required by the local government when needed for proper development.

These recommendations are still relevant at this time and should be considered for implementation by local governments.

A nonstructural alternative to erosion control was identified for evaluation in this reconnaissance study that includes items similar to those listed in the 1992 Task Force report:

- Identification of riverine erosion hazard areas.
- Developing a land acquisition program for privately owned land within erosion hazard areas
- Establishing set back distances from the river banks for all future development
- Educating riverfront property owners about riverine erosion and the potential for damage to land and structures built within erosion hazard areas

Identification of Riverine Erosion Hazard Areas

An initial step in the river management plan would be to identify the riverine erosion hazard areas (REHA). This is done by evaluating historic changes in channel behavior and projecting areas where the river may migrate or erode its banks in the future. The preliminary geomorphic assessment prepared in the structural alternatives section of this reconnaissance study can be used as a model and starting point for a more in-depth engineering assessment.

A more detailed identification of REHA's based upon findings of engineering studies would provide a more defensible basis to define erosion hazard areas on maps, establish set back distances and delineate buffer zones. A buffer is the region immediately beyond the banks of the river. It acts as a "right-of-way" for the river and allows for lateral movement of the channel. Added benefits of such buffers are that they can provide a foundation for present or future greenways. The linear nature of the buffer can provide connected corridors for the migration of plant and animal populations and allows recreational visitors to move more efficiently through the recreation zone.

Land Acquisition (Buyout) Program

Property acquisition, often times referred to as a buyout, is the most permanent step to reduce the risks of land failure in erosion hazard areas. Usually structures on the acquired property will be demolished. However, relocating the structure outside the hazard area may be an alternative in some cases. Of course, the structural condition of the house and the feasibility of transporting it are considerations for moving structures to safer ground. As a simplifying assumption for this reconnaissance level analysis, property demolition is assumed for all structures.

Property acquisition works like other real estate transactions. Property owners are given the opportunity to sell their property at a fair price. The value placed on the property is based on common

real estate practices, including appraisals and market analysis of comparable housing. Besides minimizing erosion damages to specific parcels, land acquisition yields a number of other important benefits. One immediate advantage is that purchasing undeveloped erosion-prone property eliminates the need for structural improvements (such as bank stabilization, levees, etc.) that would otherwise be needed to protect those parcels. In the case of land failure, the cost of insurance or emergency management of affected structures is mitigated. Land acquisition also helps create recreational opportunities, maintaining public open space along the riverbanks, and protecting wildlife habitat. Once the property is acquired, structures are removed and the property must then remain open space land, suitable for wildlife refuges, campgrounds, other public recreational uses, or agriculture.

Establish Setback Distances for Future Development in Erosion Hazard Zones

An integral component to the nonstructural plan is the institution of land use controls to curb future development in identified erosion hazard areas. This serves to protect against future erosion damages. The analysis of expected erosion damages to structures (all residential) in the study area evaluated two growth scenarios, a 2% annual development rate and a 4.1% annual development rate (the 4.1% rate is based upon the average annual population growth rate of the Matanuska-Susitna Borough from 1990-2000). The present value of expected damages to residential structures over the 50-year period of analysis increased from a value of $756,040 assuming no growth in development, to $1,010,220 with the 2% annual growth rate and a value of $1,461,440 with the 4.1% annual growth rate. These added damages expected with development could be averted by steering development outside of erosion hazard areas.

Erosion Hazard Education

An important part of a nonstructural plan would be a planned proactive program of Erosion Hazard Education. Educating developers and riverfront property owners about riverine erosion and the potential for damage to land and structures built within erosion hazard areas would help to build public awareness of the erosion hazards in the study area and could serve to preclude some future development in erosion hazards zones and reduce future damages.

Engineering Considerations: Implementation of the above described non-structural measures involving acquisition of threatened land, relocation of homes where appropriate, and implementation of land use regulations is feasible on an engineering basis.

Preliminary Cost: Costs of the non-structural plan have three major components: 1) costs of land acquisition in erosion hazard areas, 2) removal of existing improvements from erosion hazard areas, and 3) labor costs for a local administrator of a erosion hazard mitigation program that would include erosion education and administration of the land acquisition and land use control functions of the non-structural alternative.

The costs of acquisition and removal of land and improvements would vary depending on the areas planned for acquisition. For this reconnaissance level planning study, costs were developed for each erosion zone and for each study breakout area (upper left bank, lower left bank, right bank). This data is presented in **Table 5**. The costs in Table 5 do not include costs for relocation assistance payments that may be required under Public Law 91-646 (the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970) for any persons, farms, or businesses that are displaced due to the acquisition of their land and improvements. These costs should be assessed and accounted for in any feasibility level investigations.

Table 5. Cost of Land Acquisition and Removal of Improvements (Present Values)

	Zone 1 (0-100 from bank)	Zone 2 (100-200 from bank)	Zone 3 (200-300 from bank)	Zone 4 (300-400 from bank)	Zone 5 (400-500 from bank)	Zone 6 (500-1000 from bank)	All Zones
	PV	PV	PV	PV	PV	PV	PV
Total Right Bank Cost	$202,957	$1,116,157	$796,457	$396,357	$599,056	NA	$3,110,982
Total Upper Left Bank Csot	$332,060	$167,960	$195,886	$146,585	$235,860	NA	$1,078,353
Total Lower Left Bank Cost	$63,241	$112,540	$90,241	$146,140	$199,041	$1,009,407	$1,620,609

Labor costs for a local erosion hazard mitigation program administrator were based upon 20% of a FTE earning a $50,000 salary and a 3.0 overhead multiplier, resulting in an annual cost of $30,000. The present value of this annual labor cost over a fifty-year period of analysis is $481,230.

Economic Justification: A benefit cost analysis of a range of alternative non-structural plans was performed as part of this study. The range of alternatives was based upon various different combinations of land acquisition in specific study breakout areas combined with specific erosion zones. All combinations include the labor cost for a program administrator and assume that land use controls are put in place to eliminate any future development in those zones that are included in the combination. For each erosion zone in each study breakout area that is included in a combination, it is assumed that all parcels are acquired within that zone/breakout area combination.

The non-structural alternative with the highest BC Ratio is the plan for acquisition of all zones in the lower left study area, zoning to preclude future development in that area, and establishment of a erosion hazard mitigation program administrator. With a .4 BC Ratio, the costs of this alternative exceed the benefits by a factor of approximately 2.5 to 1. The analysis was also conducted for the erosion rates based *Environmental Considerations:* During coordination with applicable environmental agencies, a number of agencies advocated that a nonstructural approach be given equal consideration to hard structural or gravel extraction alternatives as a means for reducing erosion damages in the study area.

Additional Potential Benefits with Non-Structural Plan

While the estimated benefits for the various alternatives of the nonstructural plan did not equal their costs, added benefits associated with new and beneficial land uses might provide the difference needed to justify implementation of a nonstructural plan. These new land uses could be incorporated with the non-structural plan by converting acquired lands to other beneficial uses. These potential added benefits could include environmental benefits associated with improvements to wildlife habitats in acquired lands and economic benefits associated with the provision of recreational opportunities on acquired properties, or economic benefits associated with conversion of lands to agricultural production.

An analysis was conducted to illustrate the potential for recreational benefits on acquired lands. This hypothetical analysis assumed that acquired land was converted to natural space with recreational rustic camping facilities and trails for use in the summer season and wintertime activities such as cross country skiing, dog sledding, and/or snow machining. Corps Economic Guidance Memorandum 03-04 was referenced to obtain unit day values that serve to estimate recreationalists willingness to pay for a recreational site visit. The memorandum defines current FY03 values for general recreational activities to range between $2.94 and $8.82 per day. This analysis assumed the midpoint, or $5.88/user day. Yearly visitation was estimated at 7,560 user days (approximately 20 users per day). Applying the user day value of $5.88 to the 7,650 user days resulted in an estimated annual NED benefit of approximately $45,000. The present value of this annual benefit over the 50-year period of analysis equates to approximately $721,600 in NED recreation benefits.

Combining this level of economic benefit to the erosion damage reduction benefits brings some of the non-structural alternatives closer to economic justification (closer to a BC ratio of 1). Non-structural plans focusing on land acquisition in the lower left bank study area had the highest benefit to cost ratio (.819 - .960 to 1). No costs of constructing the recreational features were incorporated into this equation but the analysis does demonstrate the potential for adding other National Economic Development (NED) benefits by beneficial land uses for acquired lands with the non-structural plan. A more detailed recreation study could be performed as part of a feasibility level study to better assess the potential for recreation benefits. A similar approach could be applied during feasibility level studies to assess the economic benefits of agricultural uses of acquired lands. Similarly, lands could be used for fish and wildlife habitat restoration to provide National Ecosystem Restoration Benefits (NER Benefits). These non-monetary benefits can be combined with economic (NED) benefits to jointly contribute to economic justification.

Matanuska River Erosion Assessment Design Study Report, Volume 1, Prepared for U.S. Department of Agriculture, Natural Resources Conservation Service, November 2004

GRAVEL REMOVAL

This alternative provides channel excavations (trenching) to re-route and alter the flow within the river. Channel excavation would be designed to reduce velocities and stresses upon banks during high and moderate flow events. From a geomorphologic perspective, the behavior of the excavated channels is of concern on the Matanuska River, since natural river instability may impact the effectiveness of the trenches to re-direct flows and reduce water levels. Since braided channels characteristically exhibit irregular and unpredictable morphologic development, there can be no guarantee that the proposed excavations will remain stable for a significant time period to reduce flood levels and redirect flows, as intended. In addition, there is a risk that bank erosion could continue due to flow in the smaller subchannels even if the trenched channels are constructed. If an appreciable amount of the flow remains outside of the excavated channel, bank erosion may continue. An adaptive management approach for implementing and maintaining the gravel extraction trenches is highly recommended. Channel bed response in braided river systems is very unpredictable, and a high degree of uncertainty in predicted bed change and channel response…

Advantages

The advantages include:

- Possible revenue generation from gravel mining
- Ability to channel the river away from the susceptible banks
- Ability to reduce the likelihood of bank erosion for the short-term

Disadvantages

The disadvantages of Alternative 1 include:

- Winter operational challenges
- Potential groundwater control challenges
- Revenues not guaranteed, value of gravel and markets are variable
- Bank stability not guaranteed, high flows may still affect the bank

BANK STABILIZATION

The Bank Stabilization Alternative will use conventional river training and bank armoring structures to provide additional bank protection. This alternative was evaluated because gravel mining and other

alternatives may not be feasible due to factors such as environmental regulations, economic viability, community needs, or inadequate technical performance.

Riprap - Riprap has been shown to be effective in protecting river banks in numerous applications. This option simply armors the bank with large rock that can withstand the forces and stresses from the river. Riprap would be installed from several feet above flood stage to several feet below channel bed elevations to the scour depth. Estimates of the length of bank needing protection have not been made in this report due to the subjectivity of these estimates.

Spur Dikes - Four spur dikes were constructed along the Matanuska River (near Bodenburg Butte) in 1992 to protect the bank from erosion. The existing spurs have withstood flows of over 30,000 cfs. These spur dikes have been effective in eliminating bank erosion along the stretches where constructed and should be considered for bank protection. New spurs are best located along the bank at locations that have experienced considerable erosion in the past, since they prevent the thalweg from reaching the bank.

Installed riprap protects a bank from the stresses of higher velocity water along it. This armoring is not meant to alter the flow of the river, but typically does cause some local scour. In addition, riprap usually provides protection only to the section of bank that is armored.

The intended effect of spur dikes is to shift the thalweg away from the bank. The new thalweg alignment may, however, affect the downstream channel or banks. Appropriate spacing and sizing of spur dikes is important to reduce effects on downstream banks.

Advantages - The advantages of riprap and spur dikes include:

- Immediate protection of erosion prone areas.
- Ability to protect specific areas.
- Effectiveness of spur dikes and riprap efforts are known.
- Continued development in protected areas may be acceptable.
- Possible increase in nearby property values.

Disadvantages - The disadvantages of spur dikes and riprap include:

- Stabilization construction efforts can be costly and labor intensive.
- Bank stabilization efforts require long-term access to the property for maintenance of
- structures.
- The bank stabilization is only effective in the immediate vicinity of where it is constructed.
- Spur dikes or riprap generally do not create a favorable habitat for aquatic life due to a lack of vegetation and cover.

- These structures create the need for a long-term maintenance program.

Options Considered and Eliminated From Further Study

Numerous bank stabilization efforts were eliminated from possible further consideration due to constructability, effectiveness, and/or other factors. These alternatives are briefly discussed below.

- **Biotechnical Techniques -** This effort includes woody plantings, or herbaceous cover. It was determined that the Matanuska River is too massive and the banks too easily eroded for these efforts alone to fortify the bank enough to withstand the forces of the river.
- **Subsurface Drainage Systems -** These systems increase slope stability by decreasing soil-pore pressure. Subsurface drainage systems can be installed in a variety of configurations, including chimney drains, collection drains, and gravel seams. They may include gravity or pumped systems. A 1968 soil survey of the Matanuska Valley Area (USDA, 1968) describes the soil type in the Study Area as primarily Bodenburg association with Susitna-Nicklason association, to the south. Both of these soil types are well-draining silt or fine sands, and would not be practical for this application. These systems also appear to be impractical for the Matanuska River, since the river system is too large for this type of an application.
- **Floodplain Roughness -** This technique consists of installing items within the river to reduce energy in the flow. An increase in roughness is affected by the presence of live trees, shrubs, and large woody or other debris in the floodplain. This was determined to be impractical for the Matanuska River, since the river system is too large and variable for this type of an application.
- **Gabions -** These are rocks encased in metal cages that armor the bank. These appear impractical for the Study Area because they are expensive, labor intensive to construct, and can be subject to scour failure.

NON-STRUCTURAL APPROACHES

Non-structural approaches do not require construction or physical alteration of the riverbank. These could include zoning, land use changes, riparian setbacks, easements, public education, or even relocation of human structures and residents.

Land use measures that guide growth and development represent a potentially cost effective means of addressing the impact of river erosion. Northern Economics, Inc. provided the project team with an overview of the planning framework that could be the foundation for land use measures to address the effects of erosion (NEI, 2004b).

One result is a recommendation that the Mat-Su Borough prepare an updated Flood Mitigation Plan. Such a plan would enable the Borough or other entities to qualify for Flood Mitigation Assistance grants. Eligible activities include elevation of structures, relocation of flood threatened (erosion-prone) insurable structures, and acquisition. Monies are available through a state administered, cost-share

program for grants that can cover planning for flood mitigation, technical assistance, and mitigation projects.

In addition, the following is recommended:

- Real estate disclosure is critical in apprising current homeowners and potential homebuyers about flood hazard risk. Disclosure of erosion hazard risk should be required in the real estate transactions.
- Provide local realtors and lending institutions with Global Information System (GIS) copies of the Flood Insurance Rate Maps.
- Utilize GIS and other technologies (e.g. modeling) to analyze erosion risk.
- The Mat-Su Borough should consider seeking public input on utilizing property acquisition as a technique for willing sellers to sell flood-prone property.
- Identify appropriate properties for protection because of flood risks. Depending on public input, the Mat-Su Borough should pursue acquisition, conservation easements, or flood hazard protection regulations.

Some techniques for implementing such non-structural methods are discussed further below.

Zoning and Land Use Change

Zoning along the Matanuska River is described as a “least restrictive” area. This means that there are minimal restrictions on the type of development near the river. In addition to this zoning regulation, land use must comply with the federal Coastal Management Plan requirements near the river. The Mat-Su Borough planning department has proposed more extensive zoning requirements for the Matanuska River area, but these ideas have not been adopted.

An erosion management option involves altering the existing zoning of the area to encourage development that is at lower risk of continual erosion. For example, the City of Palmer or the Mat-Su Borough could use zoning to limit the development of new residences in areas with a high potential for erosion. Zoning and land use issues are politically difficult to resolve and private landowners may be adverse to changes that alter property use or value.

Riparian Setbacks

Setbacks from the river may be another method of ensuring, at least temporarily, that structures are not at risk from erosion of the riverbank. The Mat-Su Borough has setback requirements for the Matanuska River of 75 feet from the high water mark to any structure or footing, although exemptions can be made to come within these limits. However, this setback requirement may not provide an adequate buffer, since 100 linear feet of previously usable land near Circle View Estates eroded in 2004 due to high summer flows.

Public Education

Public education is important in order to relay information to Borough and City officials, potential property owners, developers, and other interested parties who have property interests along the Matanuska River. Real estate transactions particularly should be accompanied by information on erosion risk for affected properties. This information could help influence and alter property use practices in the area voluntarily. Numerous sources such as television, radio, newspapers, real estate professionals, bulletins, flyers, and radio could disseminate information. This would require a long-term effort, avoiding complacency during periods of little active erosion.

Relocation and/or Acquisition

Homes and structures could be relocated to locations away from erosion threats. Public acquisition of conservation easements or whole properties would clearly eliminate the risks to private individuals associated with development of areas at risk. This would likely only occur through voluntary or compensatory methods. Compensation could be an expensive option and may not be acceptable to local landowners.

Anticipated Results

Non-structural approaches can reduce the cost of property damage due to erosion, but are also potentially controversial. Furthermore, non-structural approaches will not eliminate or reduce bank erosion. Costs for these non-structural efforts are potentially much less expensive relative to structural alternatives. They can, however, be difficult to implement.

Advantages

The advantages of a non-structural approach:

- Greatest protection for future development projects.
- Reduces property damage from erosion.
- Enhances riparian habitat.
- Costs could be significantly less than structural alternatives.

Disadvantages

The disadvantages of non-structural approach:

- Community resistance due to perceived loss of property rights.
- Does not reduce erosion.
- Eliminates property from future development potential.

COMBINED ACTIONS

This erosion management approach involves a combination of channel removal, bank stabilization, and non-structural approaches. Models show that trench excavation may help reduce riverbank and property erosion, but may not be all that is required to reduce this risk. Combined actions may be needed.

The combined action considered in this report is:

- Constructing **bank stabilization structures** where bank erosion is at greatest risk. This includes a combination of spur dikes and riprap.
- Adopting new, **non-structural** policies and/or regulations regarding land use planning, zoning, and setbacks for undeveloped land.
- Implementing an annual **gravel removal** operation. Excavation should take place in reaches prone to high velocities and shear stresses that undermine the bank and cause erosion, such as the lower two of three reaches studied for this report. The mining areas would be determined by refining the modeling presented in this report and targeting areas to be protected.

Advantages

The advantages of the COMBINED ACTIONS approach include:

- Most effective of the studied alternatives for erosion management.
- Possible revenue generation from gravel mining.
- Ability to transfer the thalweg of the river away from the susceptible banks.
- Ability to dynamically manage river process changes as they occur.
- Immediate protection of erosion prone areas.
- Development along river remains an option due to protection.
- Possible increase in nearby property values.
- Protection of riparian habitat on land protected from human occupation.

Disadvantages

The disadvantages of COMBINED ACTIONS approach include:

- Loss of some future land development opportunities.
- Winter gravel removal operation challenges.
- Potential groundwater control challenges for gravel removal operation.
- Gravel removal operation revenues not guaranteed, value of gravel and markets are variable.
- Gravel removal operation must be continuous, adaptive, and long-term.

- Spur dike or riprap stabilization generally does not create favorable habitat for aquatic life due to lack of vegetation and cover.
- Bank stabilization structures create the need for a long-term maintenance program.

NO ACTION

The No Action Alternative would include leaving the river, banks, zoning, and land use as is. This alternative would maintain current river dynamics with frequent wild fluctuations in river routing and significant erosion within several areas in the study area. No bank protection would be added, and land use would remain as currently practiced. The results of erosion mapping by **NHC** include a map of the predicted 50-year erosion and the 50-year erosion boundary if no future action is taken. The project team interpreted this map into zones of high, medium, and low risk of future erosion. Almost 10 miles of the Matanuska River banks in the Study Area are potentially at high risk of erosion.

Advantages

- The advantages of No Action include:
- No short-term costs.
- No additional regulations to landowners.
- No planning or permitting efforts required.
- No loss of aquatic habitat due to structural approaches.

Disadvantages

The disadvantages of No Action include:

- Continued risk of erosion of property near Circle View Subdivision and other areas along almost 10 miles of Matanuska River bank in the Study Area.
- Risk of avulsion of the main river channels, resulting in erosion to areas not currently under erosion pressure.
- Continued lack of zoning and land use requirements.
- Catastrophic erosion could be politically unacceptable and possibly legally risky if bank protection efforts are not made.
- Costs to private landowners to protect property.

Alaska Task Force - Erosion of the Matanuska River Basin Interim Report, State of Alaska Division of Emergency Services, Feb. 18, 1992

Task Force recommendations included the following non-structural measures:

- House relocations where appropriate, including land swaps and in some cases demolition
- Operate an "education campaign" to inform local officials, developers, and other interested parties of the state's policy regarding erosion hazard area management and the severity of the erosion risk along the Matanuska River.
- Identify Erosion Hazard areas and erosion rates in developed areas and areas of high development potential. The State and Borough should adopt minimum standards and definitions for riverine hazards and when delineating shorelines subject to erosion. These should include areas subject to imminent erosion hazards (within 10 years, E-10 zone), intermediate hazard (within 30 years, E-30 zone), and long-term hazard (within 60 years, E-60 Zone)
- Require the adoption of appropriate land use ordinances for communities adjacent to erosion hazard areas.
- Create building standards for buildings on or near erosion prone areas. Also, an analysis of erosion control measures should be made when plans for development in erosion prone areas are proposed. Erosion control should be required by the local government when needed for proper development.

The Matanuska River Erosion Task Force also discussed:

- Flood insurance for structures includes flood-related erosion loss.
- Designating a single point of contact.
- Develop a State disaster loan program similar to federal disaster loan programs.

Structural or Engineering Solutions discussed in the report did not include but highlighted questions that need to be answered related to all engineering solutions.

- From a policy standpoint, what is the design standard that will be met?
- What is the environmental impact? Can the appropriate permits be obtained to protect the wildlife depending on the river?
- What is the benefit cost ratio for the project?
- Should erosion control and flood control project be combined or developed separately?

- Is the State willing to accept the liability for further erosion after an erosion protection project has been approved and completed?

Engineering Solutions discussed included, but were not in detail:

- Re-Channeling of the (lower) Matanuska River
- Flow Deflecting Structures
    - Spur Dikes
    - Groins (Broken Concrete or Gabions)
    - Pre-Cast Concrete
    - Training Dike
    - Overflow Dike
- Bank Protection
    - Rock Riprap
    - Bank Paving
- Dam at Old Glenn Highway (not studied in any detail)

Gravel extraction was studied in more detail and included as a separate attachment to the task force report.

Appendix C - Maps