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ANNOTATED BIBLIOGRAPHY SERIES IN SUPPORT OF COASTAL COMMUNITY HAZARD PLANNING—NORTHWEST ALASKA

SAINT MICHAEL, ALASKA

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This annotated bibliography is part of a series created to facilitate access to documents useful for coastal geohazard evaluation and community planning in Northwest Alaska. Below is a comprehensive list of community-specific information sources, each with full bibliographic information and an informative-style annotation that highlights content pertaining to the community of Saint Michael, Alaska. For a detailed description of the preparation and scope of this resource, please refer to this bibliography series' foreword. Any notable errors and/or omissions may be reported to the Coastal Hazards Program manager at the Alaska Division of Geological & Geophysical Surveys (DGGS).

Ager, Thomas A., 2003, Late Quaternary vegetation and climate history of the central Bering Land Bridge from St. Michael Island, western Alaska: Quaternary Research, vol. 60, p. 19–32.

This paper presents a pollen record from a sediment core obtained from Zagoskin Lake on St. Michael Island, western Alaska. Pollen record for the past 30,000 years was examined for terrestrial indicators.

Alaska Department of Commerce, Community & Economic Development (DCCED), accessed 2011, Division of Community & Regional Affairs (DCRA) Community Profiles [website]: State of Alaska Department of Commerce, Community & Economic Development.

http://www.commerce.state.ak.us/dca/profiles/profile-maps.htm

This website provides access to community profile maps for community-based planning. The maps are available in 24" by 36" and 30" by 42" formats. The Saint Michael maps were created in 2004, 1996, and 1994 based on land surveys and/or interpretation of aerial imagery. Subsistence hunting grounds, habitat areas, community buildings, and public facilities are delineated. Shoreline position and potential erosion zones are included in the map content. All maps have been sponsored by the Alaska Division of Community & Regional Affairs and contracted to local agencies for production.

Alaska Department of Natural Resources Division of Coastal and Ocean Management (DCOM), accessed February 2011, Alaska Coastal Management Program [website]: Alaska Department of Natural Resources Division of Coastal and Ocean Management.

http://alaskacoast.state.ak.us/Explore/Tour.html

This website outlines the Alaska Coastal Management Plans for each coastal district. It provides stewardship plans "to ensure a healthy and vibrant Alaskan coast that efficiently sustains long-term economic and environmental productivity."

Blier, Warren, Stanley Keefe, Wilson A. Shaffer, and Sung C. Kim, December 1997, Storm surges in the region of western Alaska: Monthly Weather Review, vol. 125 p. 3094–3108.

The authors describe the relationship between storm surges in Alaska and extratropical cyclones. They have identified Norton Sound and the Bering Sea as the two regions most vulnerable to cyclone-linked coastal flooding. A statistical storm-surge model was developed to provide advance warning to coastal villages; however, the author highlights that a more accurate model would be necessary to utilize this warning system as a hazard mitigation strategy. The installation of storm-surge gauges would also be required for this warning system to be used successfully.

Cacchione, David A., and David E. Drake, 1979, Sediment transport in Norton Sound, Alaska: U.S. Geological Survey Open-File Report 79-1555, 88 p.

This report is an investigation of sediment dynamics in Norton Sound and the northern Bering Sea. The major topic of the research was sediment movement and hydrodynamic stresses that occur in the Sound and their relationship to Bering Sea ocean dynamics. Other studies have found sediment accumulation from the Yukon River inconsistent with the rate of supply. The modes of transport for this loss of materials are discussed in the report. This study attempts to provide a description of the bottom transport of sediments, pollutants, nutrients, and other particulate matter, as well as identify hazardous sea floor conditions in Norton Sound.

Chapman, Raymond S., Sung-Chan Kim, and David J. Mark, *for* U.S. Army Corps of Engineers, Alaska District, 2009, Storm damage and flooding evaluation—Storm-induced water level prediction study for the western coast of Alaska: Vicksburg, Mississippi, U.S. Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory, 92 p.

Technical assistance was provided by the U.S. Army Engineer Research and Development Center, Coastal & Hydraulics Laboratory in assessing storm-generated regional water levels and currents at selected sites of ongoing and potential COE projects along the western coast of Alaska. The purpose of this study was to develop frequency-of-occurrence relationships for storm-generated water levels at 17 communities along the western coast of Alaska. Storm wind, pressure, ice, and surge data were generated for each of the areas, and the bathymetry was updated. Fifty-two storm event simulations were performed and a database of water levels versus return period was developed for each site.

Denali Commission, March 2011, Road and waterfront project selections, fiscal year 2006–2011: Denali Commission, 9 p.

This report contains an overview of all of the funding dispersed by the Denali Commission Transportation Program from 2006–2011. The document is organized by partner agency/project and includes a description of the project status. The village of Saint Michael was awarded $150,000 in 2011 for documentation and design for developing a port.

Drake, D.E., D.A. Cacchione, R.D. Muench, and C.H. Nelson, 1980, Sediment transport in Norton Sound, Alaska: Marine Geology, vol. 36, p. 97–126.

This study examines the suspended sediment and ocean circulation of the northeastern part of the Bering Sea shelf. The authors describe the fate of sediment delivered by the Yukon River to the southwestern corner of Norton Sound and the importance of storm events in Norton Sound associated with erosion and sediment transport. Landsat images were also used to inspect the distribution of sediments and regional circulation in the Sound.

Hartig, Larry, *of* Alaska Department of Environmental Conservation & Governor's Climate Change Sub-Cabinet, October 2010, State of Alaska and State/Federal Executive Roundtable Activities Regarding the Arctic [presentation]: Anchorage, Alaska, Northern Waters Task Force, 53 p.

http://housemajority.org/coms/anw/pdfs/26/NWTF_Powerpoint_Hartig_01Oct10.pdf

This is a powerpoint presentation about the state and federal executive roundtable activities regarding the Arctic. The discussion includes hazards associated with declining Arctic sea ice extent, melting of permafrost, storm surges, and coastal erosion. Thirty-one villages are identified as imminently threatened: Barrow, Kivalina, Selawik, Allakaket, Hughes, Huslia, Shishmaref, Deering, Teller, Koyukuk, Nulato, Golovin, Shaktoolik, Unalakleet, Saint Michael, Kotlik, McGrath, Emmonak, Alakanuk, Chevak, Newtok, Nunapitchuk, Lime Village, Eyak (Cordova), Napakiak, Akiak, Chefornak, Kwigillingok, Dillingham, Clark's Point, and Port Heiden. Specific photos and engineering initiatives for four communities are discussed, including Kivalina, Shishmaref, Unalakleet, and Newtok.

Immediate Action Workgroup (IAWG), Michael Black and Patricia Opheen, eds., March 2009, Recommendations to the Governor's Subcabinet on Climate Change: Immediate Action Workgroup, 162 p.

The Immediate Action Workgroup was established to address known threats to Alaskan communities caused by coastal erosion, thawing permafrost, flooding, and fires. This report is a follow-up to the recommendations made in April 2008 (in which Saint Michael was not mentioned), and provides recommendations for actions and policies to be implemented in 2009 and 2010. The community of Saint Michael has been recognized as receiving agency actions from two of the six agencies working to respond to community needs.

Johnson, Walter R., and Zygmunt Kowalik, April 1986, Modeling of storm surges in the Bering Sea and Norton Sound: Journal of Geophysical Research, vol. 91 no. C4, p. 5119–5128.

Based on the results of a numerical model used to examine sea level, currents, and ice distribution during Bering Sea storm events, the authors suggest that the presence of land-fast ice in Norton Sound has a measurable effect on the size and onshore arrival time of storm-surge events. Both land-fast and pack ice are included as parameters in the model runs. The model is validated using observations and measurements from the February and March 1982, and November 1974 storm events, and reproduces observations of sea ice redistribution during these storm events.

Mason, Owen K., and James W. Jordan, 2002, Minimal late Holocene sea level rise in the Chukchi Sea—Arctic insensitivity to global change?: Global and Planetary Changes, vol. 32, p. 13–23.

In this article, Mason and Jordan outline the apparent disconnect between late Holocene global sea level rise and the moderate sea-level rise observed in Northwest Alaska. Radiocarbon ages taken from peat and storm deposits in Seward Peninsula lagoons allowed for the reconstruction of a sea-level curve spanning the last 6,000 years. The results indicate that sea level in northwestern Alaska has risen an average 0.3 mm per year compared to the global average of 1–2 mm per year. The authors suggest several hypotheses for these differing rates, including cold sea surface temperatures (limited steric expansion), geoid variation, and/or the development of permafrost. Although observed rates of sea-level rise are moderate for the Chukchi Sea, the article cautions that the response of northern Alaska's coasts to future global climate change remains uncertain and requires continued investigation.

Mikulski, Pearl, *of* Kawerak, Inc., *for* Community of Saint Michael and the Bering Straits Development Council, April 2004, Local economic development plan, Saint Michael, 2005–2010: Kawerak, Inc., Nome, Alaska, 62 p.

This plan was completed to facilitate and consolidate efforts to implement development strategies to subsequently increase cultural heritage, local employment opportunities, decrease dependency, and reduce duplication of efforts in various projects and programs. The planning process is based on the methods developed by the Institute of Cultural Affairs and the Denali Commission–USDA–RD–Alaska Humanities Forum Community Strategic Plan Guide and Form. The top 10 overall community development projects include:

1. *More housing—The community is growing, and big families are in small houses, causing overcrowding. Also, old houses need to be fixed.*
2. *Improve roads—Improvements are needed to control dust, erosion, fix potholes, widen roads, and fill sunken areas in the community.*
3. *Build a public safety building—The current building is too small and not equipped with the necessary tools to operate. The town has is no extra office space available. There are inadequate holding cells with no running water, no beds, no bathrooms or showers, no kitchen, no supplies, and no lights.*
4. *Record traditional dances, songs, and stories from St. Michael and other villages—There is a need to revive dances and songs, and getting the youth, elders, and surrounding villages involved. The dances and stories should be documented for the future.*
5. *Make a community comprehensive plan with our entities and Stebbins—Better services are needed to ensure that everyone works together. This involves enhancing communication among all ages. Support is needed between one another on common ground.*
6. *Build shelter cabins along the winter trails and summer waterways—Hunters and travelers need shelters for inclement weather, to provide protection to those who break down or for emergency purposes like bad weather and sunken vehicles.*
7. *Develop a public information system that includes television, radio, newspaper, and local postings.*
8. *Extend the road access from Clear Lake to the canal river and build a small safe boat harbor—needed for subsistence gathering and hunting, berry picking, wood gathering, safe access, and viewing.*
9. *Build a new teen center—The building is needed for fun activities, dances, and a drug-free place for all ages. This will be a place to have teen meetings, youth group activities, and family parties.*
10. *Build a dock on St. Michael Bay—This would be to reduce the cost of living and to increase economic growth.*

Muhs, Daniel R., Thomas A. Ager, Josh Been, J. Platt Bradbury, and Walter E. Dean, *of* U.S. Geological Survey, 2003, A late Quaternary record of eolian silt deposition in a maar lake, St. Michael Island, western Alaska: Quaternary Research, vol. 60, p. 110–122.

Wind-blown sediments are sensitive to overall moisture balance, land-surface stability, and degree of vegetation cover, making eolian sediments one of the most important terrestrial records of climate change. Investigators have demonstrated that it is possible to obtain long and detailed eolian records from lake sediments. Zagoskin Lake, on St. Michael Island, western Alaska, was chosen to test to see whether an eolian record, particularly for the late Wisconsin period, could be obtained.

Rodney P. Kinney Associates, Inc., and Kawerak Transportation Program, *for* Saint Michael IRA Council, March 2007, Saint Michael long-range transportation plan: Saint Michael IRA Council, Saint Michael, Alaska, 16 p.

This plan outlines transportation priorities within the community of Saint Michael and its surrounding boundaries. A prioritized list of long-term transportation road projects is listed below:

1. *Upgrade the community streets in the City of Saint Michael with the appropriate surface material and dust control additive (total estimate $5 million).*
2. *Construct proposed community streets within the City of Saint Michael with the appropriate surface material and dust control additive (total estimate $8 million).*
3. *Construct proposed subsistence and economic routes (total estimate $479 million).*
4. *Construct boardwalks from the east end of Standard Oil Road south to Pioneer Road (total estimate $24,000).*
5. *Upgrade the Saint Michael–Stebbins Highway (total estimate $20 million).*
6. *Provide boardwalk access over utilidors (total estimate $150,000 per mile).*
7. *Construction and upgrades to marine facilities such as boat landings, harbors, ports, barge landings, and breakwater structures (total estimate $7 million).*
8. *Provide route staking, navigational upgrades, and signage to inventory routes to improve safety during winter travel, prevent disorientation, and aid in rescue operations (total estimate $100,000 per mile).*

The updated list of inventory roads that the community feels are needed are for the next 20 years. The routes suggested are necessary to connect communities, allow residents access to their lands and resources for economic growth, cultural development, subsistence activities, and for public safety.

Sallenger, Asbury H., Jr., 1983, Measurements of debris-line elevations and beach profiles following a major storm, northern Bering Sea coast of Alaska: U.S. Geological Survey Open-File Report 83-394, 12 p.

From introduction: "During November 1974, a severe storm occurred in the Bering Sea; winds gusted to greater than 100 km/hr and barometric pressure dropped 34 mb. Combined storm surge and wave runup reached as high as 5 m along the northern Bering Sea coast of Alaska. Shortly after the storm, the northern Bering Sea froze. Following breakup in 1975 and during the ice-free season of 1976, we surveyed beach profiles and elevations of debris-lines at stations around the northern Bering Sea coast of Alaska. In this open-file report, these data are used to show the approximate magnitude of combined storm surge and wave runup in the study area."

Sallenger, Asbury H., Jr., and John R. Dingler, September 1978, Coastal processes and morphology of the Bering Sea coast of Alaska: Menlo Park, California, U.S. Geological Survey, Research Unit No. 431, 66 p.

The research outlined in this paper was completed in order to characterize the regional physical environment of the Bering Sea coast of Alaska to prepare for potential oil and gas development and subsequent hazards to infrastructure and environment. The net direction of longshore transport, coastal morphology, and reconnaissance-based beach morphology and sediment characteristics were used as indicators. Measurements were taken along the Bering Sea coast of debris line elevations that were reached during the 1974 Bering Sea storm. Coastal change was measured near Nome using nearshore coastal profiling and aerial photography in 1976 and 1977. Wave characteristics and sea-level variations were also measured to check the validity of the wave model used. The specific objective of the research was to develop a coastal setback line, beyond which petroleum development would not occur.

Simpson, J.J., January 1984, Final report, Task Force on Erosion Control: Alaska Department of Transportation & Public Facilities, project no. R-30023, 101 p.

The Erosion Control Task Force was appointed to investigate and inventory potential erosion problems on a statewide basis, to prioritize the erosion problem sites by severity and need, and to provide preliminary design plans where immediate remedial action is required. Sites were rated based on public safety, public property, private property, time of projected loss, ability to move, approximate replacement value, and economic value. Projected costs of erosion protection measures were analyzed and totaled $16,802,300 for all projects. This report outlines specific engineering projects to reduce the effects of coastal and riverine erosion for communities throughout Alaska.

The erosion at Saint Michael is occurring at the end of the airport runway. The coastal bluff that makes up the end of the runway is subject to thermal erosion and wave undercutting. The suggested solution would be to construct a riprap rock wall at the end of the runway, and fill with peat for insulation. The rock source to be used is 2 miles from the construction site.

Tetra Tech, *for* Immediate Action Workgroup: Advisory Group of the Governor's Climate Change Sub-Cabinet, June 2010, Imperiled community water resources analysis: Anchorage, Alaska, Tetra Tech, 47 p.

This report summarizes climate-related threats to water and wastewater infrastructure in Alaskan communities including those at risk from flooding, saltwater intrusion, loss of surface water supply, erosion, and sedimentation of the source region. The primary objectives of the analysis were to:

1. *Identify and select study group communities whose water infrastructure is threatened*
2. *Collect information on the threatened water infrastructure for the study group communities*
3. *Analyze information to determine the climate-related impacts to study group community water infrastructure (p. 2).*

A general community profile is available in the report that outlines the socioeconomic, geologic, and climatic setting, provides an overview of the existing water resources in the community, and summarizes a brief history of documented historical impacts to existing water infrastructure.

U.S. Army Corps of Engineers, accessed 2011, Civil works floodplain management services [website]: U.S. Army Corps of Engineers, Alaska District.

http://www.poa.usace.army.mil/en/cw/fld_haz/floodplain_index.htm

This website provides flood-hazard data for communities throughout Alaska. A link is provided to a flood-hazard-specific bibliography, maintained by the U.S. Army Corps of Engineers. The entire community of Saint Michael is above the 100-year floodplain, and there is no record on this site for previous flooding events. Saint Michael is not participating in the National Flood Insurance Program.

U.S. Army Corps of Engineers, March 2009, Study findings and technical report—Alaska baseline erosion assessment: Elmendorf Air Force Base, Alaska, U.S. Army Corps of Engineers, Alaska District, 68 p.

http://www.poa.usace.army.mil/AKE/Home.html

This statewide assessment was conducted by the U.S. Army Corps of Engineers to coordinate, plan, and prioritize responses to erosion throughout Alaska. The report has designated 26 communities as priority action communities, including Saint Michael.

The erosion at Saint Michael has been determined to be caused by high tides, storm surges, wind and waves, melting permafrost, and early melting sea ice. The average erosion rate is 3 feet per year in front of the community. Some community structures have been moved, but others are still vulnerable to erosion in the next 10 years. The Corps suggests a need for a detailed assessment of the erosion problem that would cost $100,000.

U.S. Government Accountability Office (GAO), June 2009, Report to congressional requestors—Alaska Native villages, limited progress has been made on relocating villages threatened by flooding and erosion: U.S. General Accountability Office Report GAO-040895T, 53 p.

http://www.gao.gov/products/GAO-09-551

This report is a follow-up to the 2003 GAO report on flooding and erosion in Alaska Native villages, and was completed to identify concerns due to climate change that have increased the urgency of federal and state efforts. The GAO developed recommendations for Congress that include:

1. *A flooding assessment to augment the erosion assessment completed by the Army Corps of Engineers.*
2. *An amendment to federal legislation so that 64 more villages may be eligible for grants.*
3. *Designating a federal entity to oversee and coordinate village relocation efforts.*

The report has identified 31 villages as facing imminent flooding and erosion threats, including Saint Michael.

U.S. Government Accounting Office (GAO), 2003 [2004], Alaska Native villages—Most are affected by flooding and erosion, but few qualify for federal assistance: U.S. General Accounting Office Report GAO-04-142, 82 p.

http://www.gao.gov/products/GAO-04-142

This study was conducted to provide recommendations to Congress that would improve how state and federal agencies respond to flooding and erosion in Alaska. This was done by:

1. *Determining the extent to which these villages were affected.*
2. *Identifying federal and state flooding and erosion programs.*
3. *Determining the current status of efforts to respond to flooding and erosion in nine villages.*
4. *Identifying alternatives that Congress may wish to consider when providing assistance for flooding and erosion (see "Highlights" section).*

The recommendations provide alternatives to current actions taken during flooding and erosion responses by including federal agencies and the Denali Commission. The adoption of policies by the Denali Commission would guide investments in infrastructure for Alaska Native villages affected by flooding and erosion. Saint Michael was recognized as one of the 184 Alaska Native Villages facing imminent flooding and erosion threats.

Walters, L., and M. Cushing, 1995 Community profile—Saint Michael: Alaska Department of Community & Regional Affairs (ADCRA), 16 p.

This profile includes information on the community's status in the following areas: Facilities, U.S. Census, economy and employment, schools, rural businesses, contacts, municipal officials, municipal finances, rural grants, and ANCSA land status.

Wise, James L., Albert L. Comiskey, and Richard Becker, 1981, Storm surge climatology and forecasting in Alaska: Anchorage, Alaska, Arctic Environmental Information and Data Center, University of Alaska, 26 p.

The objective of this study was to improve the quality of life and the security of property in flood-susceptible coastal areas by enhancing the decision-making process for human activities and development. This study compiles historical climatological data to develop a surge forecast regression equation.

The Seward Peninsula, Norton Sound, and Lower Yukon areas are identified as having the greatest frequency of reported coastal storms in Alaska. Norton Sound exhibits shallow waters offshore, combined with the open waters of the Bering Sea, allowing for a long fetch for storm wave development. The range of wind directions for the development of storm surges is limited to west–southwest to west; however, flooding is experienced due to rising water levels throughout the Sound. Three storms, in 1913, 1973, and 1974, were documented for Saint Michael and used for this study.