Appendix B – Prototype Scope of Work: Rural Alaska Coastal Erosion and Storm Surge Flood Assessment

PROTOTYPE SCOPE OF WORK[1]
RURAL ALASKA COASTAL EROSION AND STORM SURGE FLOOD ASSESSMENT

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Background

Many communities throughout rural Alaska are experiencing escalating threats to their lands, infrastructure, and personal property due to the increasing risk of coastal flooding events. Impacts consist of water damage to homes, snow machines, ATV's and public facilities, damage to transportation systems, contamination of water supplies, dispersion of wastewater and solid waste throughout the community and inaccessible or lost land resources. There are multiple factors influencing flood risk including severity and frequency of storms, relative sea level rise and reduced sea ice during fall and winter storm seasons needed to dissipate storm energy. Typically, there is insufficient data available to community decision makers to fully understand community vulnerability to flood related life-safety risks and damage to critical infrastructure. Both site-specific analysis of historical flood magnitude and frequency as well as modeling of future conditions are necessary for understanding flood risk and to inform long-term community decision making regarding flood mitigation, managed retreat, and/or relocation.

The goal of this assessment is to provide essential site-specific information needed to precisely quantify flood threats to community security and to inform near-term and long-term decision making regarding the development of flood mitigation measures. Specifically, this assessment has the following objectives:

- Identify and analyze historical flood and storm data.
- Collect additional baseline data required for flood modeling.
- Forecast relative sea level rise (based on existing research).
- Develop and calibrate a nearshore hydrodynamic model of storm surge, waves, and wave run-up at the specific community location in order to forecast future water levels and sediment transport.
- Produce predictive flood scenarios maps layered on a community elevation model.
- Evaluate effectiveness and feasibility of structural measures to mitigate flood risk based on modeling. Consider shoreline and bank stabilization, flood resistant building techniques and renovations, and establishment of first floor build elevations.
- Determine long-term viability of the community site (75+ years) based on model projections and the potential to effectively mitigate risks.

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[1] This is a generic scope of work intended as a reference document that can be used to guide the development of a detailed community specific scope of work.

- Evaluate the relative efficacy of non-structural mitigation measures (e.g. managed retreat away from flood threat) in comparison to structural measures.
- Develop recommendations for both near-term and long-term mitigation measures.

Scope of Work

The following tasks will be implemented in order to accomplish the objectives of this project. Professional coastal engineers, scientists, and community planners shall be engaged to complete Tasks 2 to 8 in direct consultation with the community.

Task 1: Project Management (Provided by Community)

A. Develop and implement a solicitation process to contract for the professional services required to carry out the project. In the event that the community already has access to professional engineering services procured in accordance with funding agency requirements, then this task will not be required.

B. Conduct all general project management activities including award management, contract management, scheduling, meeting coordination, and other project activities.

Task 2: Preliminary Assessment

- Conduct a teleconference with community leadership to identify key community contacts and concerns; gather local knowledge about flooding; identify available technical reports and data; and obtain input on the assessment methodology.

- Identify and review existing information including but not limited to the following:
    - Historical imagery and digital elevation or surface models
    - Bathymetric and topographic data sets for the study area
    - Tidal datums
    - Sea ice observations
    - Wind and storm data
    - Wave information: National Buoy Data Center (NBDC) and U.S. Army Corps of Engineers (USACE) Wave Information Studies (WIS)
    - Geotechnical reports from infrastructure projects (school, sanitation facilities, clinic, airport, etc.)
    - Summarize historical and projected climate data for the community using Scenarios Network for Alaska/Arctic Planning (SNAP) resources (https://www.snap.uaf.edu/tools-data/data-downloads)
    - Flood information from local hazard mitigation plan and other hazard analysis reports
    - USACE Floodplain Management resources
    - Alaska Water Level Watch (https://www.facebook.com/AlaskaWaterLevelWatch/ and https://aoos.org/alaska-water-level-watch/)
    - Denali Commission threat assessment database
    - Other relevant technical studies and data sources relating to historical shoreline change, wind, waves, tides, storm surge, sea ice, and sea level rise

- Interpret historical flood elevations from available collated flood data via analysis of photos, ortho-imagery and elevation data to identify co-registered data points of flood height and/or flood extent.

- Create a preliminary map of historical floods on a community elevation model. Identify ground elevations that would result in minor, moderate, and major flooding (in accordance with NOAA National Weather Service definitions) at various storm stages.

- Conduct a geotechnical desktop review of available climate projections and subsurface data for the purpose of estimating ground settlement associated with permafrost thaw.

- Identify additional baseline data required to complete a hydro-dynamic model.

- Submit storm photographs to Alaska DGGS for upload to the photo database at http://maps.dggs.alaska.gov/photodb/; add storm elevations to AOOS Alaska Water Level Watch portal.

Task 3: Site Visit and Field Investigation(s)

The consultant's team (engineers, scientists, surveyors) shall travel to the community to conduct field assessment(s) as described below. The field assessment(s) will consist of the following:

A. Kick-off meeting with community stakeholders (including but not limited to the Tribe, City, and Corporation) to present the preliminary flood maps; discuss the project; and discuss community observations regarding current and future flood risk.

B. Complete interviews with community members on flood history in and around the community.

C. Conduct a visual inspection of coastal topography to confirm and/or update the limits of historical storm events.

D. Gather additional baseline data needed to conduct flood modeling exercise:
    - Aerial Survey: Gather new or supplemental aerial photography and/or lidar data required to develop both a digital elevation or surface model of the coastline and built community and co-registered ortho-imagery. Horizontal and vertical accuracy of point cloud data on bare earth surfaces will average 0.1 feet.
    - Land Survey: A land survey shall be completed to coordinate horizontal and vertical control of existing data sets, to develop coastal elevation profiles, to measure finished floor elevations of critical infrastructure (school, clinic, power plant, fuel tank farm, water treatment plant, store, city and tribal offices, evacuations centers, etc.) and occupied homes in the community. Existing survey data shall be utilized to the greatest extent possible to eliminate redundant data collection.
    - Bathymetric Survey: Design and conduct a survey to gather near shore and off shore bathymetry sufficient to conduct storm surge and wave runup analysis. Conduct bathymetry utilizing modern multi-beam, single-beam and/or side scan echosounders. If utilizing a single beam echosounder in a soft bottom environment, it is recommended to utilize a dual frequency system to identify soft surface layers and the harder bottom layer. For communities located on barrier island and spit formations, survey coverage shall include the lagoon side of the community and tidal inlets. Horizontal and vertical accuracy of bathymetry data points will average 0.3 feet.
    - Water Level Data: Collect sufficient water level data to establish a local tidal datum based on simultaneous comparison with an existing tide station. Estimate impact on modeling accuracy due to the distance from an authoritative datum.
    - Current and Sediment Data: Collect sufficient current and sediment data required to model sediment transport and coastal erosion processes. Acoustic Doppler Current Profilers shall be deployed to obtain current information at strategic locations. Sediment grab samples shall be

taken along the ocean beach, lagoon beach (if applicable), at accreting portions of the beach, and other specific sites of interest. Grab samples shall be lab tested to determine classification and particle size.

- Note: Consideration of alternate emerging technologies that may reduce the cost of data collection are encouraged (e.g. topo-bathy lidar).

E. Photograph all infrastructure constructed along the shoreline in the active beach zone. Conduct a structural assessment of identified infrastructure to determine if they can be relocated.

Task 4: Hydrodynamic Flood Modeling

This task includes the development of a 3-dimensional coastal hydraulic model after completion of field investigations. The following elements will be included in the modeling exercise.

A. Delineate modeling boundaries and assumptions.

B. Develop model to simulate near shore wave action including wave set-up and run-up in the waters surrounding the community, incorporating collated topographic, bathymetric, storm, wind, and water level data.

C. Calibrate the model via hindcast simulations of historical flood events documented during field reconnaissance.

D. Complete predictive flood simulations (25, 50, 100-year horizons) based on adopted projections of sea level rise, storm, and ice conditions. Develop return interval flood scenarios mapped on community elevation model.

Task 5: Sediment Transport Modeling and Erosion Analysis

This task includes sediment transport modeling to predict coastal erosion and aid in the development of mitigation measures. The following elements will be included in the modeling and analysis.

A. Develop model to simulate near shore sediment transport for past high-water high-wave events and for storm magnitudes predicted in the future, incorporating sediment characteristics based on samples collected during site investigation activities.

B. Quantify erosion rates and formulate predictions of future changes that will impact near term infrastructure mortality (5-10 years) and the long-term stability (75+ years) of the community.

Task 6: Engineering Analysis

This task includes performing the following engineering analysis upon completion of flood and erosion modeling.

A. Establish hydraulic and hydrodynamic forcing criteria required for engineering design of mitigation measures.

B. Develop a list of recommended structural solutions to mitigate damage from flooding and coastal erosion.

C. Compare the feasibility and cost effectiveness of structural solutions with a managed retreat response.

D. Evaluate whether the community can stay and defend at its current site (including managed retreat), or whether complete relocation will be required over the next 75-year horizon. The determination shall be primarily based on livability of the site based on flood modeling projections and the ability to mitigate flood risk in both a feasible and socially acceptable manner.

E. Develop a prioritized list of conceptual-level structural mitigation measures based on community input. For each of the top three priorities, develop a detailed project scope, schedule, and budget sufficient to support an application for grant funding.

F. Develop a list of recommended non-structural best practices that can be immediately implemented by the community to mitigate flood impacts.

G. Cross reference recommended mitigation measures with the community's existing Local Hazard Mitigation Plan (LHMP) in order to develop a list of recommended updates to the LHMP.

Task 7: Reporting

Develop a final report documenting the entire modeling and analysis. The report shall be supported by maps, images, figures, conceptual drawings, and graphics of the model runs in order to maximize the usage of the report as a tool for community planning and decision-making. Upon completion of the report, the consultant will schedule a final meeting in the community to present the results.

The final report shall incorporate the following sections:

A. Introduction and Background: Describe the purpose and scope of the flood assessment.

B. Baseline data: Describe baseline data needs, available information, and supplemental data that was collected as part of the study.

C. Investigation Methodology: Describe the methodology used to develop the flood assessment. Include a description of the desktop evaluation, community meetings and interviews, and field investigations, and modeling.

D. Existing Conditions: Present the results of the study related to current conditions and include a discussion of the following topics: 1) historical flooding; 2) identification of the specific infrastructure found to be imminently threatened; and 3) a summary of the structural assessments of threatened buildings.

E. Projected Future Impacts: Summarize expected flood and erosion impacts based on modeling projections. Delineate community infrastructure that may be at risk based on predicted return interval flooding. Utilize both maps and tables to present the results. (Include poster-sized maps for community presentations.)

F. Best Practices and Solutions: Provide a narrative description of the non-structural practices that can be locally implemented to mitigate flood risk and impacts. Define recommended structural solutions and present the scope, schedule, and estimated cost for the identified priority community projects.

G. Next Steps and Long-term Recommendations: Discuss additional data collection recommendations and provide concluding recommendations that may be used by the community to develop long-term responses to flood hazards.

H. Appendices (Documentation): The report will include appendices as required to capture project records including trip reports, photographs, relevant survey and field notes. The section will include a bibliography of all previous plans, studies, designs, geotechnical reports, and other technical documents identified and used in the evaluation.

Task 8: Records Management

A. All data collected and/or generated by this effort will be archived for public access. Data will be provided both to Alaska Division of Geological and Geophysical Surveys and will be added to the Denali Commission Statewide Threat Assessment geodatabase in ArcGIS.

Project Schedule

\Ideally, this assessment can be completed in 12 -18 months, depending on the magnitude of baseline data collection that is required, availability of funding and the date of the Notice to Proceed (NTP). Under the ideal scenario, the solicitation would be completed in January and February, the preliminary assessment from March to May, field work from June to September, and modeling, analysis and reporting from October to December. The field investigation must take place during summer months free from snow and ice. The schedule and key milestones will be adjusted based on the NTP date to accommodate the field investigation.

A general schedule is presented below.

Task 1A (project management by the community): Months 1-12
Task 1B (engineering consultant solicitation): Months 1-2
Task 2 (preliminary assessment): Months 1-5
Task 3 (site visit): Month 6-9
Tasks 4 - 6 (modeling, analysis, and reporting): Months 9-10
Task 7 (reporting): Months 11-12

Appendix C – Prototype Scope of Work: Rural Alaska Riverine Erosion Assessment

PROTOTYPE SCOPE OF WORK[2]
RURAL ALASKA RIVERINE EROSION ASSESSMENT

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Background

In 2009, the U.S. Army Corps of Engineers (USACE) completed the *Alaska Baseline Erosion Assessment* (BEA). The report found that most Alaskan communities are facing some level of infrastructure threat due to erosion. Drivers of erosion are variable and include naturally occurring changes in river channels, diminishing winter ice, storm surge, relative sea level rise, flooding, and human activities which impact shoreline ecosystems. The impacts of erosion on Alaskan communities range from minor damage to landscapes, to damage to transportation and utility infrastructure, to loss of individual or multiple structures, up to and including wholescale threats to community viability.

In the BEA, USACE identified 27 Priority Action communities, concluding that additional site-specific data and information was required for these communities in order to develop informed responses to the identified threats. Since 2009, little additional progress has been made to address the information gap identified by USACE. Too often, community decision-makers lack the scientific data and assessments required to fully forecast the magnitude and timing of erosion threats.

The goal of this assessment is to provide essential information needed to precisely quantify erosion threats to community security and to inform near-term and long-term decision making and mitigation measure development. Specifically, this assessment has the following objectives:

- Delineate near term (5-10 years) threats to community infrastructure based on an assessment of historical linear erosion rates
- Identify primary factors driving active erosion (geomorphic and anthropogenic)
- Establish long-term erosion projections based on hydrologic and hydraulic river modeling
- Evaluate effectiveness and feasibility of structural mitigation measures (barriers and bank stabilization) based on design criteria established through river modeling
- Evaluate the relative efficacy of non-structural mitigation measures (e.g. managed retreat away from erosion threat) in comparison to structural measures
- Determine long term viability of the current community site based on model projections

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[2] This is a generic scope of work intended as a reference document that can be used to guide the development of a detailed community specific scope of work.

- Develop recommendations for both near-term and long-term mitigation measures
- Build local capacity to address harmful environmental trends

Scope of Work

The following tasks will be implemented in order to accomplish the objectives of this project. Professional engineers, geologists, and community planners shall be engaged to complete Tasks 2 - 6 in direct consultation with the community.

Task 1: Project Management (Provided by Community)

A. Develop and implement a solicitation process to contract for the professional services required to carry out the project. In the event that the community already has access to professional engineering services procured in accordance with the requirements of 2 CFR 200, then this task will not be required.

B. Conduct all general project management activities including award management, contract management, scheduling, meeting coordination, and other project activities.

Task 2: Preliminary Assessment

A. Conduct a teleconference with community leadership to identify key community contacts and concerns; gather local knowledge about erosion, identify available technical reports and data, and obtain input on the assessment methodology.

B. Complete interviews with key community stakeholders regarding the history of erosion in and around the community.

C. Identify and review existing information including but not limited to the following:
   - Historical aerial imagery datasets.
   - Bathymetric and topographic data sets for the study area.
   - Geotechnical reports for major infrastructure development projects (school, sanitation facilities, clinic, airport, etc.).
   - The current hazard mitigation plan and other reports related to environmental hazard analysis.
   - Denali Commission threat assessment database.
   - Other relevant technical studies and data sources relating to historical shoreline change, wind, waves, tides, storm surge, sea level rise, and river hydrology.

D. Collaborate with relevant agencies and entities to ensure that all available information is considered (Alaska DGGS, Alaska DOT&PF, NOAA, USACE, NWS, VSW and ANTHC).

E. Summarize historical climate data and projected climate scenarios for the community using Scenarios Network for Alaska/Arctic Planning (SNAP).

F. Summarize projected changes to frozen ground and resulting implications for long-term erosion rates using public resources from SNAP, CRREL and UAF.

G. Create a preliminary decadal erosion projection map for the developed community and any surrounding areas proposed for future development. Overlay linear erosion projections on a map of community infrastructure to estimate the timing of the erosion impact on specific community infrastructure. Convert annual rate of change to anticipated time of impact. Use site maps and charts to summarize and communicate the findings.

Task 3: Site Visit / Field Investigation

A team minimally consisting of a structural engineer, a hydrologist or geologist, and surveyors shall travel to the community to conduct a field assessment. It is expected that the assessment will require a minimum of 3 full days in the field. The field assessment will consist of the following:

A. Kick-off meeting with community stakeholders (including but not limited to the Tribe, City, and Corporation) to present the preliminary erosion projections; discuss the project; and discuss community observations regarding current and future erosion threats.

B. Visually survey the reach of river above, below, and through the community.

C. Conduct a visual inspection of site topography and terrain features to confirm and/or update the preliminary erosion projections. Employ additional field investigation techniques, including aerial drone photography, to improve the erosion projections and further document the current shoreline.

D. Complete topographic, bathymetric, and river flow surveys to gather baseline data necessary to conduct hydrologic and hydraulic modeling of the river system.
   - Topographic surveys will be conducted using an Unmanned Aerial Vehicle (UAV) with an on-board survey-grade global positioning system (GPS) technology. Horizontal and vertical accuracy of point cloud data on bare earth surfaces will average 0.1 feet.
   - Bathymetric surveys will be conducted utilizing dual frequency eco-sounder technology to identify soft surface layers and the hard bottom. Horizontal and vertical accuracy of bathymetry data points will average 0.1 feet.
   - Topographic and bathymetric data will be merged and complemented with available LiDAR data to extend the range of upstream and downstream river analysis.

E. Observe and/or investigate daily practices in the community that may contribute to erosion. These practices may include but are not limited to pedestrian and vehicular travel ways, river access, and boat landing and parking.

F. Photograph all infrastructure along the shoreline expected to be impacted within ten years based on the preliminary results and knowledge from the community.

G. Conduct a structural engineering assessment of all infrastructure expected to be impacted within five years in order to determine if structures can be relocated to a new site. If relocation is feasible, provide recommendations on relocation methodology.

H. Coordinate with community stakeholders to identify and evaluate least two new sites within the community or on property immediately adjacent to the exiting community, to which imminently threatened infrastructure may be relocated. Site analysis will include the following considerations:
   - Determination of minimum acreage required based on a review of threatened structures
   - Surface and subsurface characterization with respect to constructability
   - Evaluation of flood, erosion, and permafrost degradation risk
   - Delineation of site control issues
   - Site access
   - Utility service potential

- Environmental permitting
- Development costs
- Cultural considerations and/or other factors identified by the community

Task 4: Hydrologic and Hydraulic Modeling and Analysis

Upon completion of the field study, the following tasks will be completed prior to proceeding to the final report.

A. Complete a hydrologic analysis using USGS regression equations for Alaska to estimate river flows.

B. Develop a finite element hydro-dynamic model (RiverFlow2D or equivalent) to analyze river hydraulics. Utilize the model to estimate natural erosion and deposition processes along the river.
   - Consider the intersection of other threats (flooding, inundation, permafrost degradation, wave energy) with historical and projected erosion patterns. The overlay of historical erosion rates, geomorphology, and model-derived data will be used to interpret hot spots and areas of concern under expected future climate conditions.
   - Model future shoreline change across the community to predict infrastructure mortality.

C. Develop a list of recommended structural solutions to mitigate damage from erosion. Utilize the hydraulic model to analyze in-place mitigation measures.

D. Compare the efficacy of structural solutions with a managed retreat response.

E. Make a determination whether the community can stay and defend at its current site (including managed retreat), or whether complete relocation will be required. The determination shall be primarily based on viability of the site based on modeled erosion projections and the ability to mitigate erosion risk in both a feasible and socially acceptable manner.

F. Develop a prioritized list of mitigation measures based on community input. For each of the top three priorities, develop a detailed project scope, schedule, and budget sufficient to support an application for grant funding.

G. Develop a list of recommended non-structural best practices that can be immediately implemented by the community to mitigate erosion impacts.

Task 5: Reporting

Develop a final report documenting the entire evaluation. The report shall be supported by maps, images, figures, conceptual drawings, etc. to maximize the usage of the report as a tool for community planning and decision-making. Upon completion of the report, the consultant will schedule a final meeting in the community to present the results.

The final report shall incorporate the following sections:

A. Introduction and Background: Describe the purpose and scope of the vulnerability assessment.

B. Investigation Methodology: Describe the methodology used to develop the erosion assessment. Include a description of the desktop evaluation, community meetings and interviews, and field investigations, and modeling.

C. Existing Conditions: Present the results of the study related to current conditions and include a discussion of the following topics: 1) historical erosion rates and map; 2) summary of the structural assessments; 3) identification of the specific infrastructure found to be imminently threatened.

D. Projected Future Impacts: Summarize expected erosion impacts based on modeling projections. Delineate community infrastructure that may be at risk over the next 50 years due to projected erosion rates. Utilize both maps and tables to present the results.

E. Best Practices and Solutions: Provide a narrative description of the non-structural practices that can be locally implemented to limit and/or slow destructive permafrost degradation. Define recommended structural solutions and present the scope, schedule, and estimated cost for the identified priority community projects.

F. Next Steps and Long-term Recommendations: Discuss additional data collection recommendations and provide concluding recommendations that may be used by the community to develop long-term responses to environmental hazards.

G. Appendices (Documentation): The report will include appendices as required to capture project records including trip reports, photographs, relevant survey and field notes. The section will include a bibliography of all previous plans, studies, designs, geotechnical reports, and other technical documents identified and used in the evaluation.

Task 6: Records Management

B. All data collected and/or generated by this effort will be archived for public access. Data will be provided both to Alaska Division of Geological and Geophysical Surveys and will be added to the Denali Commission Statewide Threat Assessment geodatabase in ArcGIS.

Project Schedule

Ideally, this assessment can be completed in approximately 12 months, depending on the availability of funding and the date of the Notice to Proceed (NTP). Under the ideal scenario, the solicitation would be completed in January and February, the desktop assessment March to May, field work from June to September, and final reporting from October to December. The field investigation must take place during summer months free from snow and ice. The schedule and key milestones will be adjusted based on the NTP date to accommodate the field investigation.

A general schedule is presented below.

Task 1A (project management by the community): Months 1-12
Task 1B (engineering consultant solicitation): Months 1-2
Task 2 (desktop assessment): Months 1-5
Task 3 (site visit): Month 6-9
Task 4 (analysis and reporting): Months 9-10
Task 5 (reporting): Months 11-12
Task 6 (records management): Months 11-12