

REVISED SCOPE OF WORK
Geomorphology and Sediment Transport Study of
Skagit River Flood Hazard Mitigation Project
Skagit County, Washington
Phase 1

HART CROWSER
CONTRACT NO. DACW67-01-R-0205, DELIVERY ORDER NO. 3

1.0 DESCRIPTION

U.S. Army Corps of Engineers (Corps) in cooperation with Skagit County (local project sponsor) has initiated a study to develop, evaluate, and compare flood hazard mitigation alternatives for the lower Skagit River. The Corps will evaluate five alternatives that have been proposed to reduce flood damage for lands along the lower Skagit River including the cities of Sedro Woolley, Burlington and Mount Vernon. One element of reviewing each alternative requires an assessment of the interaction between geomorphic processes and project implementation and operation. Physical modifications to the channel and floodplain may interrupt or change ongoing geomorphic processes. Similarly, geomorphic processes may affect the function and effectiveness of the proposed flood hazard mitigation project. The geomorphic assessment and sediment transport analysis will provide a basis for evaluating the potential interactions between ongoing geomorphic processes and each alternative for flood hazard mitigation.

2.0 BACKGROUND AND OBJECTIVES

This statement of work (SOW) details the contractual work to be performed to complete the first phase of the geomorphic assessment and the sediment transport analysis. The complete study will evaluate the potential interactions between geomorphic processes and flood hazard mitigation efforts for each of the following three alternatives:

1. Bypass channel that functions for all floods larger than the 10-year event
2. Bypass channel that functions for all floods larger than the 25-year event
3. Setback levees with full range of events
4. Baseline existing conditions
5. No action (catastrophic event)

The study area will include the lower Skagit River from approximately 2 river miles upstream of Sedro Woolley to the confluence with Skagit Bay. The study area includes the bypass channel to the proposed confluence with the Swinomish Channel. The model will use the same channel geometry survey information collected for the COE hydraulic

model. This survey data set does not extend beyond the mouth of each fork of the Skagit. The output of the sediment transport study could provide sediment delivery input for the Padilla Bay and Skagit Bay hydrodynamic models currently under consideration under a separate contract. The proposed geomorphology and sediment transport study (phases 1 and 2) will include the following components described as individual tasks under the Scope of Work:

- Task 1 – Assess historic and current channel conditions (this will include historic over flow channels and distributaries and include a literature review) within the project area providing description of present river morphology and changes that have occurred over time.
- Task 2 – Develop a conceptual geomorphic model that characterizes the geomorphic process that form and modify river morphology.
- Task 3 – Map the spatial distribution of channel morphology and geomorphic processes.
- Task 4 – Provide a screening-level analysis comparing sediment delivery to the Swinomish Channel for two scenarios: (1) catastrophic levee break, and (2) proposed bypass channel.
- Task 5 – Model bank erosion, bed scour, sediment transport, and deposition within the project area to quantify potential changes in channel morphology associated with each alternative. If the modeling results do not provide an appropriate level of certainty to support alternative selection, the contractor will present these concerns to the project sponsors and determine whether additional work would be necessary. The roughness coefficient for both channel and floodplain is critical for this element in each alternative. Some of the analysis may need to wait until further design details have been developed.
- Task 6 – Evaluate each alternative to determine the nature and effects of interaction between channel morphology, geomorphic processes, and proposed flood hazard mitigation actions.
- Task 7 – Communicate and interact with stakeholders including municipal governments, state agencies, federal agencies, and tribes. Present the findings of the study in a technical report with supporting figures, maps, and data. Digital mapping data and an electronic copy of the model will be provided. Maps and figures will be produced and presented in files compatible with ArcInfo and AutoCad.
- Task 8 – Provide for an optional task to model an additional scenario to incorporate design modifications that may become evident or in response to new questions may that arise.

There will be a phased approach to completing the tasks described above. This approach will allow the contractor to use the information and initial results generated under the first phase to refine the Scope of Work and cost estimate for phase 2. The current Scope of Work only includes Tasks 1, 2, 3, and 4 as the initial phase. Tasks 5, 6, 7, and 8 will be described in detail under a separate scope of work and delivery order based on the completion of Tasks 1 through 4.

3.0 CONTRACTOR SERVICES

With the exception of Government furnished property or services (Section 10.0), the Contractor shall supply all services, labor, materials, supplies and equipment necessary to conduct the work required under this SOW. The Contractor shall be responsible for obtaining all necessary permits and compliance with all Federal, State and local regulations.

4.0 DESCRIPTION OF WORK

The contractor shall perform all work required to conduct the specific tasks in Section 5.0. All work shall be performed in an environmentally acceptable manner, conforming to existing Federal, State and local regulations. The contractor will be responsible for securing any necessary rights of entry for the sampling effort.

5.0 SPECIFIC TASKS

5.1 Task 1 – Historic and Current Channel Conditions Assessment

The historic and current channel conditions assessment provides a description of past and present channel morphology. The current morphology combined with observations of changes over time provides a basis for deducing the processes that form and modify channel morphology and how those processes vary over time.

The Contractor will compile existing technical and historical documents, photographs, and maps relevant to geomorphic conditions within the lower Skagit River Basin. The existing data and studies will provide the basis for the historical channel conditions assessment. The Contractor will review available time-sequential aerial photographs to evaluate changes in river morphology and adjacent riparian conditions over time. Through the literature review, the Contractor will identify data gaps that will be need to be filled to complete the geomorphic study.

The Contractor will develop a narrative describing current channel processes based on historical conditions, field observations, and previous work. Using historic flow records, the narrative will address the effects of the range of flow events the river has experienced over time (i.e. low flow, small frequent flood events, moderate flood events, and extreme flood events). The narrative will include a time line showing significant events pertinent to the geomorphic development of the lower Skagit River over the past 200 years, as information is available. Reconnaissance-level field observations will be used to

characterizing physical processes. Field studies will be used in combination with aerial photographic analysis to map the distribution of channel morphology and geomorphic processes as described under Task 3. Direct observation of the characteristic signs of physical processes will contribute to initial conclusions regarding the potential upstream and downstream effects of the structural alternatives. All data collected from direct observation will become provided to the Government upon completion of the work order.

Characteristics of the sediment load will be determined through sediment sampling and analysis. The contractor will develop and carry out a sediment sampling plan that characterizes the longitudinal changes in the riverbed sediment characteristics within the project area. **The Government will review this sampling plan before the plan is implemented. The contractor will modify the sampling plan as appropriate. This work order could be modified based on the Government's comments.** The surveyed sediment characteristics will be used to model sediment transport for current conditions and for each alternative. The contractor will use the results of the hydraulic modeling performed by the Corps to develop a sediment transport model. The sediment transport model will provide a basis for evaluating sediment routing and channel change within the project area.

Direct observation of physical processes will contribute to initial conclusions regarding the potential downstream effects of the structural alternatives. This task will provide information and analysis to preparation of the technical report described under Task 8 (separate delivery order). That report will include field forms, a narrative describing site selection rationale, and a discussion of the dominant geomorphic processes present in channel reaches with similar characteristics.

This task will provide the information and analysis to support preparation of the maps produced under Task 3 and portions of the technical report described under Task 8 (separate delivery order). The contractor will prepare a technical memorandum that presents a short summary of the results of this review and possible suggestions for changes in study direction.

5.2 Task 2 – Develop Conceptual Geomorphic Model

Building on the work performed under Task 1, the Contractor will reconstruct past channel and floodplain processes at reach- and basin-scales using aerial photographs, historic land surveys, and historic topographic maps. The resolution of the aerial photographs will affect the kinds of measurements that may be taken. At a minimum, the aerial photograph analysis will include measurements of shoreline length, sinuosity, lateral migration, trends in sedimentary features (in-stream sediment bars), and changes in plan form. More intensive measurements may include channel width, sand and gravel bar dynamics, changes in LWD, channel instability (bank erosion), and changes in riparian vegetation.

The Corps will provide aerial photographs of the project area and the upper watershed in order to complete this task.

The Contractor will prepare a short report that describes the conceptual model. This task will inform the sediment transport modeling described under Task 5 (separate delivery order) and it will contribute to portions of the report produced under Task 8 (separate delivery order).

5.3 Task 3 – Map the Distribution of Channel Morphology and Geomorphic Processes

Data compiled under Tasks 1 and 2 will be presented in a map or set of maps that shows the spatial distribution of channel morphology and geomorphic processes within the project area identified under Tasks 1 and 2.

Deliverables for this task will include a set of GIS-based maps of the project area showing existing channel conditions, the spatial distribution of geomorphic features, and the zones in which different sets of geomorphic processes dominate.

5.4 Task 4 – Screening Level Analysis of Sediment Delivery to Swinomish Channel

The Contractor will perform a screening-level analysis of comparing the sediment delivery to the Swinomish Channel for two scenarios. The first scenario corresponds to a catastrophic levee break in which floodwaters transport sediment through overbank flooding to the Swinomish Channel. The second scenario corresponds to the operation of the proposed bypass channel. The analysis will incorporate existing data to characterize the nature of suspended sediment load. The method will include a simple mass balance that considers suspended sediment concentration, total volume and flow rate of floodwaters, and the potential for sediment deposition between the river channel and the Swinomish Channel. This analysis is being performed as an early action item to support Corps project decisions in February. The results of this initial analysis will be checked and verified against the sediment transport modeling results when they are available.

The Contractor will prepare and submit a technical memorandum presenting the results of this analysis.

6.0 GOVERNMENT-FURNISHED PROPERTY

The Government does not anticipate furnishing the Contractor any Government property in order to perform the work required under this Delivery Order except for aerial photos of the project area. These photos will be returned to the Government upon completion of the work order.

7.0 COORDINATION

The Contractor shall maintain close and continual coordination with the USACE POC's, to assure adequate and timely flow of information. Mr. Michael Scuderi, Environmental

Resources Section (206-764-7205), and Mr. Stephen Pierce, Project Management (206-764-3456) are designated as POCs for the Corps of Engineers.

8.0 GENERAL REQUIREMENTS

8.1 Project Manager

Promptly following award of the contract, the Contractor shall designate a project manager. The project manager is responsible for maintaining coordination and execution of the contract. Changes in the designated project manager can only be made upon prior approval of the USACE Project Manager Mr. Stephen Pierce. The project manager shall have the experience and capability to:

- a) Be responsible for the supervision of work and overall quality; and
- b) Serve as liaison between the Contractor and the USACE POC's for all work required under this contract.

8.2 Contracting Officer Representative

The Contracting Officer for the Government will designate a Contracting Officer Representative (COR) who will provide the liaison, supply Government-furnished data and services, and forward other necessary documents. Contract interpretation and associated guidance and direction from the Government shall not be official unless specifically authorized by the COR. The COR will seek timely progress of the work and its satisfactory completion. One or more authorized technical representatives of the Contracting Officer may be designated to monitor the Contractor's performance, verify compliance with contract specifications, and provide technical support to the COR.

9.0 EXTRA SERVICES

The Contractor is advised not to perform any extra services under this contract. Except as otherwise provided in this contract, no payment for extras shall be made unless the Contracting Officer thereof has authorized such extras and price in writing.

10.0 METHOD OF PAYMENT

Payments shall be made in accordance with the payments clause of the base contract. The signed original and two copies of each payment voucher shall be submitted by the Contractor to the COR. The Contractor shall submit with any payment requests, a brief summary of the activities accomplished in the payment period.

11.0 RELEASE OF INFORMATION

The Contractor shall not make available to the news media or publicly disclose any data generated or reviewed under this contract. Reports and data produced under this contract shall become the property of the Government and distribution to any other source by the

Contractor is prohibited, unless authorized by the COR. The Contractor shall direct all questions from the public and media to the Corps' Project Manager, Mr. Stephen Pierce. The Contractor shall be allowed to explain their actions in the field but must inform the Project Manager of this contact within one (1) workday.

12.0 SCHEDULE

The Contractor shall furnish sufficient technical, supervisory, and administrative personnel to ensure completion of work in accordance with the following schedule. The Contractor shall keep the COR fully advised at all times concerning delays or difficulties which may prohibit completion of any or all of the work according to the following schedule:

Task	Completion
Project management (8% of total estimated hours)	
Task 1 – Prepare Sediment Sampling Plan	7 days after receipt of Notice to Proceed (NTP)
Corps of Engineers Reviews Sampling Plan and provides comments	5 days after receipt of sampling plan
Task 1 - Compile and review background literature and existing technical work.	30 days after receipt of NTP
Task 5 - Screening level analysis of sediment delivery to the Swinomish Channel. Prepare technical memorandum.	30 days after receipt of NTP
Task 2 - Aerial photograph analysis. Prepare technical memorandum	60 days after receipt of NTP
Task 1 - Develop Scope of work for Tasks 5 through 8. Prepare technical Memorandum.	45 days after NTP
Task 1 - Fieldwork	90 days after receipt of NTP
Task 3 - Channel conditions map	30 days after completion of fieldwork
Work Order Completed	150 days after NTP

The Contractor shall provide monthly status updates on task completion status.

Scope of Work

Preparation of Scope of Work for Assessment of Potential Impact to Padilla Bay from the Proposed Skagit River Flood Damage Reduction Study

Background. The U.S. Army Corps of Engineers, Seattle District (CENWS) and Skagit County are currently assessing the feasibility of reducing potential flood damages in the lower Skagit River basin (e.g., from Sedro Woolley to the mouth of the river). Two action alternatives, set back levees and a bypass to Swinomish Slough, have been identified as feasible options to meet this objective. The bypass alternative could produce significant impacts to Padilla Bay, which has not received floodwaters directly from the Skagit River since the beginning of the 20th century. Almost all of the bay comprises the Padilla Bay National Estuarine Research Reserve (NERR) encompassing 11,000 acres of intertidal and sub tidal habitat and 200 acres of upland. The Corps of Engineers requires that an assessment of potential impacts from the bypass to the natural resources of Padilla Bay be performed to ascertain if mitigation for those impacts will be required. This assessment would involve the identification of sediment and freshwater inputs to Padilla Bay from the bypass option and the no action option, and subsequent identification of the response of the natural resources of Padilla Bay to these inputs.

Of particular concern is the potential impact of flooding and sedimentation on the eelgrass meadows, which grow on about 8,000 acres of the intertidal and sub tidal areas of the NERR. These beds help stabilize the substrate and provide food and shelter for a great number of estuarine creatures including shrimp, Dungeness crab, snails, clams, oysters and numerous infaunal species. The bay also is an important migration route for juvenile Chinook, Coho, Pink and Chum salmon as well as other sport and commercial fishes.

Studies aimed at the potential impacts on Padilla Bay eelgrass beds from freshwater flooding are a critical component of the bypass evaluation. It is expected that the freshwater input, mixing and residence times can be estimated using appropriate numerical modeling techniques, which combine the input of water and sediment.

Scope of Services

- **Task 1. Assess available studies on lower Skagit River and Padilla Bay.**

The studies to be undertaken to assess the hydrodynamic and ecological effects of the Skagit By-pass will depend on the presently available knowledge base and data available from completed or ongoing studies. We are aware of several research efforts that will have relevance to the sedimentation rates in Padilla Bay that are being conducted at the Western Washington University, Huxley College of Environmental Studies. We will contact other state, federal, tribal, and academic organizations to determine the state of knowledge of the hydrodynamic and ecological processes before stating the request for additional studies. This will not be a comprehensive assessment of these studies but will provide information to arrive at the best scientific assessment of impacts. Agencies to be contacted will include: Skagit Coop, Corps of Engineers, Padilla Bay NERR, University of Washington, Western Washington University, Washington Department of Fish and Wildlife, Washington Department of Ecology, Washington Department of Natural Resources, National Marine Fisheries Service.

- **Task 2. Develop Comprehensive Scope of Work Document for assessing the hydrodynamic and ecological impacts of flood routing alternatives.**

We will develop a scope of work (SOW) document and work plan that defines the needs and objectives of the hydrodynamic and ecological studies. Two alternative schedules will be considered for the SOW, one to be completed by September 2003 and the other to be completed by September 2004.

The work plan will describe the objectives of the program and studies to be conducted, characteristics of models to be used, and analyses needed for physical and ecological assessments, including field and laboratory studies required for calibration and verification. The work plan will include schedules for the two alternative periods of performance and will include estimated costs for each task. Deliverables will be coordinated with the development of the Environmental Impact Statement for the Skagit By-pass project.

- **Task 3. Meetings and coordination.**

It is anticipated that, given the high visibility of this project and its potential impact on the sensitive resources of Padilla Bay, several coordination meetings may be required with interest groups. Two such meetings have been included in this work plan, to be held in either Padilla Bay or Seattle.

Period of Performance. The draft scope of work document will be completed one month following notice to proceed. The final scope of work will be submitted two weeks following receipt of all comments on the draft scope of work.

Cost. Total cost for this project is \$29,128.

Inventory and Evaluation of Tide Gates and Pump Stations related to Alternatives #5 and #7 of the Skagit River Flood Damage Reduction Feasibility Study

The proposed alternatives will alter the land-use and hydraulics of the river and the surrounding lands. These changes may impact existing tide gates and pump stations and changes proposed by the two alternatives may also create a need for new or additional tide gates and/or pump stations. The proposed alternatives may eliminate the need for some of those that currently exist. To comply with existing and proposed regulations, any existing and new tidegates and pump stations, within the foot print of the two alternatives, must be evaluated for providing fish passage. The inventory of tide gates and pump stations must address the following critical questions or requirements:

- Provide an inventory (location and condition) of all existing tide gates and pump stations within the project area.
- Will the implementation and operation of any of the alternatives require the installation of new tide gates and pump stations? And if so where?
- Will implementation of any of the alternatives require modification and/or repositioning of existing tidegates or pump stations?
- At any particular structure is fish passage desired? Does any beneficial habitat currently exist upstream of any tidegate/pump station?

Methods and Approach

Task 1

The first task in this study will be to create an inventory of existing tidegates and pump stations within the project limits. This will be done by using existing databases and mapping resources to identify known tidegates and pump stations locations. Additional information will be gathered by contacting the appropriate representative from each of the organizations responsible for maintaining existing tide gates and/or pump stations.

Task 2

Using the inventory information from task 1 we will field inspect each facility. This field inventory will include a visual inspection of each structure. The data gathered shall include:

- Physical description of the structure including size, material, type of gate etc.
- Physical condition, functioning?
- Drainage system feeding into the structure.

- Habitat amount and quality above the structure
- Percentage the structure is currently passable
- Location of each structure using Global Positioning System (GPS) to facilitate the preparation of a map.

Task 3

Review data obtained and relate it to the proposed alternatives. This will involve an assessment of a new site of any structure that will need to be relocated. This information shall be overlaid on a map displaying each alternative. Design and/or engineering of any structure are not part of this effort. Suggested upgrading or modification of any new or relocated structure may be provided. Similarly, this review should also determine whether any existing facilities would become unnecessary. Detailed analysis will not be accomplished in this inventory. The results of this inventory will be combined with the analysis being performed for the existing evaluation areas work and the 35% design effort.

Deliverable Items

- Technical report including assessment of feasibility and value of restoring/improving passage within the alternatives footprint.
- Map of all tide gates and pump stations indicating which ones would need to be to be modified and/or repositioned within the footprint of each of the two alternatives. This will also include the proposed location of any new tidegates or other control structure associated with the by-pass alternative.

Estimated Cost

Total estimated cost: \$10,000

Schedule

Duration 3 months - Completion April 2002

Secondary Impacts and Land Use Impacts related to Alternatives #5 and #7 of the Skagit River Flood Damage Reduction Feasibility Study

1.0 Introduction

The implementation of an effective flood control project may result in reduced risk and improved economic factors that in combination could make development within currently designated flood plains more favorable. Critical questions that need to be answered to address the potential land use changes are:

- For each alternative, including no-action, determine what ultimate build-out might be based on existing ordinances and regulations. Vested properties and current development applications will be included.
- Under existing ordinances and regulations, what impact does a change in flood plain status have on development rights?
- What parcels are currently protected from development and what programs are currently in place that protect or could restrict land use conversion.

2.0 Project Team

- Project Manager from the Skagit County Public Works Department.
- One Study Team member each from the Planning and Permit Center and Skagit County GIS.
- Support and administrative staff as required from the Public Works Department.

3.0 Scope of Work

Task 1

Determine current federal, state and local land use regulations that govern development in the project area. Identify the specific impact of flood plain designation on the development potential of agricultural land.

Task 2

Identify the estimated areas to be removed from flood plain for each alternative.

Task 3

Identify areas which are currently subject to additional land use restrictions due to public ownership, restricted development rights, conservation easements, etc. Identify areas likely to be subject to land use restrictions due to each of the alternatives.

Task 4

Based on Tasks 1 through 3, estimate the ultimate build-out condition for each of the alternatives, including the no-action alternative.

4.0 Deliverable Items

- Draft Report reflecting 50% effort, complete with maps, bibliography and references, submitted to Corps of Engineers for review and comment.
- Final Report, both hard copy and in electronic format.

Estimated Cost

See exhibit A.

Schedule

50% Draft Report by July 1, 2002

Final Report by August 1, 2002