SKAGIT RIVER BRIDGE MODIFICATION AND INTERSTATE HIGHWAY PROTECTION PROJECT

SOCIAL AND ECONOMIC IMPACTS DISCIPLINE REPORT

Prepared for

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November 2009

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List of Abbreviations and Acronyms

ADA	Americans with Disabilities Act
AG-NRL	Agricultural-Natural Resource Lands
Basin	Lower Skagit River Basin
BNSF	Burlington Northern Santa Fe
CFHMP	Comprehensive Flood Hazard Management Plan
cfs	cubic feet per second
Corps	U.S. Army Corps of Engineers
DD #12	Skagit County Dike District Number 12
DD #17	Skagit County Dike District Number 17
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
H:V	horizontal to vertical
I-5	Interstate 5
MSA	metropolitan statistical area
NAIC	North American Industry Classification
NAVD	North American Vertical Datum
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
OFM	Washington State Office of Financial Management
OHWM	ordinary high water mark
OSPA	Open Space, Parks, and Agriculture
RM	River Mile
SEPA	State Environmental Policy Act
SRSC	Skagit River System Cooperative
URARPA	Uniform Relocation Assistance and Real Property Acquisition Policies Act
US BLS	U.S. Bureau of Labor Statistics
USGS	U.S. Geological Survey
WSDOT	Washington State Department of Transportation

EXECUTIVE SUMMARY

The Skagit River Bridge Modification and Interstate Highway Protection Project (Project) Social and Economic Impacts Discipline Report is a study of the social and economic impacts to the community resulting from the implementation of three project alternatives: the No Action, Improved Existing Levee Alignment, and Levee Setback Alignment Alternatives. Per the requirements of the National Environmental Policy Act (NEPA), the socio-economic impacts to populations within a community must be considered prior to the implementation of a planned project with a federal funding nexus.

To characterize the Project within a social and economic framework, an analysis of several key points is included in each of the sections. The social and economic analysis considers the potential impacts by examining the following seven sub-elements:

- Community Profile
- Regional and Community Growth
- Recreation
- Public Services and Community Amenities
- Community Linkages
- Industry and Employment
- Property and Taxes

The existing conditions for the social and economic sub-elements were assessed within and adjacent to the Project area. A primarily white population lacking those between the ages of 18 and 24 exists within the Project area; zoning characteristics show a diverse palette of Residential, Commercial, light industrial, and Open Space, Parks, and Agriculture (OSPA); and the 2000 U.S. Census shows growth in both Mount Vernon and Burlington. Recreation opportunities within or near the study area include the Riverside Health Club located along Riverside Drive. No public parks exist within the study area.

Public services and community amenities include public utilities (e.g., sewer, gas, electricity) available within the study area. Local emergency services and schools as well as other amenities including churches, libraries, Mount Vernon's Lincoln Theater, and shopping centers are located within 2 miles of the study area. The primary community linkages in the study area consist of the I-5, BNSF, and Riverside Bridges. Several local routes are included in the vicinity of the study area including Boulevard/Riverside Drive, Whitmarsh Road, and Stewart/Hoag Road. Most local arterials also include bike routes for alternative transportation.

Skagit County's economy includes a strong natural resources and agricultural production base. Unemployment rates, however, tend to be higher in the Anacortes-Mount Vernon area than in Washington state and the nation. There are approximately 147 parcels totaling approximately 200 acres within the Project area. Parcels consist of a wide variety of land uses including residential, commercial, industrial, and agricultural land.

Potential Project Impacts

Impacts to the community character include temporary construction impacts including increased noise and changed aesthetics in work areas during construction. No impacts to regional or community growth are anticipated from the Project. Recreation impacts include temporary access impediment to the riverbank and temporary recreational fishing impacts due to construction. No impacts to public services and community amenities are anticipated as a result of any of the Project alternatives.

Community linkages could be temporarily impacted during construction and construction noise could impact people walking or biking in the immediate vicinity. Additionally, temporary staging areas will close off specific areas and detour routes may be required during construction. Permanent impacts to community linkages from the No Action Alternative and Improved Existing Levee Alignment Alternative include a moderate realignment of Stewart Road to the south by the I-5 overpass, while the Levee Setback Alignment Alternative includes permanent realignment of two roads.

Constructing the Improved Existing Levee Alignment or the Levee Setback Alignment Alternatives may provide temporary job growth in the construction sector and may lead to regional employment increases in related fields, such as engineering. It is assumed that the social and economic impacts to industry and employment would be positive in nature as a result of the Project. Potential effects of these alternatives to property and taxes would include effects of buying out certain properties and portions of properties within the affected area for needed right of way, and effects on levee certification, which might reduce current National Flood Insurance Program requirements (e.g., mandatory flood insurance) on developments in the vicinity of the Project area (see Section 4.2.7).

If the No Action Alternative is implemented, the Project area will continue to be a source of major flood concern. It is estimated that a 100-year flood could cause approximately $1.3 billion in damages to the Skagit delta, resulting in the closure of the major arterials within the Project area and the flooding of critical residential, commercial, and industrial infrastructure.

Measures to Avoid or Minimize Project Effects

Measures to avoid or minimize temporary Project construction impacts include complying with city ordinances, coordinating with utility providers during construction, and minimizing blockage of access routes for pedestrians or vehicles during construction. Potential mitigation measures include relocating permanently impacted roads and providing detours for all temporary impacted roads.

No unavoidable adverse effects to social or economic elements are anticipated as a result of the Project.

1 INTRODUCTION

1.1 What is the Skagit River Bridge Modification and Interstate Highway Protection Project?

Skagit County, in cooperation with the Cities of Mount Vernon and Burlington, Skagit County Dike Districts Number 12 and Number 17 (DD #12 and DD #17), the Washington State Department of Transportation (WSDOT), and the Federal Highway Administration (FHWA), has initiated the environmental review phase of the Skagit River Bridge Modification and Interstate Highway Protection Project (the Project). This phase of the Project will identify and analyze alternatives for modifying the existing Skagit River levee system within the Project area to provide for various levels of flood protection for Interstate 5 (I-5), the Cities of Mount Vernon and Burlington, and surrounding lands under Skagit County jurisdiction.

The purpose of this phase of the Project is to complete the environmental documentation for the Project as required under the National Environmental Policy Act (NEPA). As part of the NEPA process, Skagit County is investigating three levee design alternatives: two Project alternatives and a No Action Alternative. At the onset of the Project, Skagit County had not identified a preferred design or a desired or goal level of flood protection. However, the preferred alternative resulting from the environmental analysis is intended to be integrated into the Skagit County Comprehensive Flood Hazard Management Plan (CFHMP) to protect urban areas from 100-year flood waters.

Funding for the Project was obtained through a $2.5 million appropriation from FHWA that was submitted by Skagit County to Congressman Rick Larsen's office in 2005.

1.1.1 What is the Background for the Project?

Skagit River major flood events (e.g., 100-year flows) cause extensive property and highway damage. Although major floods are generally infrequent, three major events have occurred in the past 18 years. Studies have shown (Corps 2004a) that a 100-year flood event would cause nearly $1 billion in damage to the Lower Skagit River Basin (Basin) and would shut down I-5 for approximately 15 miles.

As the Basin developed, low levees were constructed to protect productive farm lands. Over the years, these levees were increased in size to provide a greater degree of protection to the farm lands and subsequently to the rapidly growing urban areas of Mount Vernon and Burlington. Today, levees on the right bank of the river extend from upstream of Burlington to the mouth of the Skagit River near La Conner. On the left bank of the river, the levees extend from the Burlington Northern Santa Fe (BNSF) Bridge in Mount Vernon to the mouth of the Skagit River.

The flood risk to the Basin has been widely recognized (Stansbury 2008) and efforts have been underway for many years to develop a cost effective plan for preventing flood damages. The U.S. Army Corps of Engineers (Corps) and Skagit County have been deeply involved in the preparation of a flood control plan for more than 10 years and a draft plan is expected to be produced within the next few years. Although a number of comprehensive flood reduction alternatives are being considered, virtually all of the alternatives include plans for improving the levees that are located along the Skagit River between Mount Vernon and Burlington. This area, known as the "three bridge corridor" due to the presence of the I-5, the Riverside, and the BNSF Bridges within the area, is a significant constriction point in the existing levee system.

The Project is located within the boundaries of the Cities of Mount Vernon and Burlington, and in unincorporated Skagit County, Washington. The Project area begins immediately upstream of the BNSF Bridge and continues to just downstream of the Mount Vernon and Burlington city boundaries, encompassing a linear distance of approximately 1.2 miles between Skagit River Miles (RM) 16.5 and 17.9. Figure 1 is a vicinity map of the Project area.

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Feet
0 275 550 825 1,100

Figure 1
Vicinity Map
Skagit Bridge Modification and
Interstate Highway Protection Plan

The NEPA phase of the Project will identify alternatives to improve the existing levee system within the three bridge corridor. It will not include alternatives for modifying any of the bridges or bridge approaches and it is assumed that all existing bridges and bridge approaches will remain in their existing locations and conditions. Future bridge or bridge approach improvements will be investigated as part of the general investigation of the Skagit River, which is underway by the Corps and Skagit County.

1.1.2 What are the Existing Conditions in the Project Area?

In this existing conditions section and in Section 1.1.3 that outlines the proposed alternatives, the elements of the Project are described in the following order:

- Left bank (Mount Vernon) beginning at the BNSF Bridge and continuing downstream to the Project terminus on the left bank
- Right bank (Burlington) beginning upstream of the BNSF Bridge and continuing downstream to the Project terminus on the right bank

All elevations for the Project are based on the 1929 North American Vertical Datum (NAVD). The RM designations are from the most recent Corps Hydrology and Hydraulics Reports (Corps 2004a and 2004b). The descriptions of the alternatives are based on the 2009 *Final Report: Engineering Analysis of Levee Alternatives* by Michael R. Stansbury, P.E. (Appendix A) and meetings held from March through July 2008 between the Project Team (including representatives from Skagit County, the Cities of Mount Vernon and Burlington, DD #12 and DD #17) and the consultants working on the Project.

The Skagit River within the entirety of the Project area is contained within an existing levee system. Existing levee heights range from approximately 40 to 43 feet (NAVD 1929) and the levee system has the capacity to pass a 25-year Skagit River flood event while maintaining a minimum of 3 feet of freeboard from the top of the levees. The Corps has estimated that the 25-year flood event at the U.S. Geological Survey (USGS) gage in Mount Vernon is 146,000 cubic feet per second (cfs).

The elements of the existing left and right bank levees and existing land use patterns are described in further detail in Sections 1.1.2.1 through 1.1.2.3. Figure 2 is an aerial photo of the existing conditions in the Project area.

City Limits
Existing Levee Alignment

Feet
0 250 500 750 1,000

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Figure 2
Aerial Photo of Existing Conditions in the Project Area
Skagit River Bridge Modification and
Interstate Highway Protection Project

1.1.2.1 Left Bank Levee

The existing left bank (south bank) levee begins at the BNSF Bridge and is tied into BNSF Bridge abutment. Although some erosion of the south bank of the river has occurred upstream of the BNSF Bridge, the bridge abutment is founded on very hard material and no erosion has occurred at this location. Downstream of the BNSF Bridge, the levee is located close to the edge of the river with only a very narrow overbank area between the levee and edge of the river at low flows.

At the Riverside Bridge, the left bank levee ties into the existing abutment of the bridge and the area underneath the bridge is completely armored by riprap. The existing levee is approximately 2 feet lower than the low chord of the bridge as it meets the abutment. West of the Riverside Bridge, the left bank levee parallels a stormwater pond that was designed to accommodate stormwater runoff from the bridge when it was constructed in 2004. The levee parallels the pond for a distance of approximately 900 feet.

West of the stormwater pond, the left bank levee passes underneath the I-5 Bridge and continues westward. Although two of the piers from the bridge are located within the levee prism, the bridge clears the levee crest by approximately 10 to 12 feet. Stewart Road lies just south of the levee in this location and also passes under the I-5 Bridge approach span.

Throughout much of the length of the left bank levee within the Project area, the toe of the river bank has been lined with riprap. In most cases, the riprap is not part of the levee itself but protects the bank waterward of the levee from erosion. Except under the three bridges, there does not appear to be riprap on the levees themselves.

1.1.2.2 Right Bank Levee

The existing right bank (north bank) levee begins upstream of the Project area. Upstream of the BNSF Bridge, the railroad embankment serves as a levee for a distance of approximately 1,600 feet. Immediately upstream of the BNSF Bridge, a smaller levee exists adjacent to the Skagit River's low flow channel. This smaller levee is not maintained, is covered with vegetation, and has a height of only 4 or 5 feet. Except at very low flows, it does not appear to impact river conveyance. However, the small levee may direct flows away from the overbank area adjacent to the bridge at nearly all flow levels. The north end of the BNSF Bridge is composed of a trestle section with seven piers within the overbank area. These piers impair flows during flood events; during the 1995 flood event, scour caused one of the piers to settle several feet and forced closure of the rail line for several days.

Between the BNSF Bridge and the Riverside Bridge, the right bank levee parallels East Whitmarsh Road and crosses over the levee approximately 900 feet to the west of the BNSF Bridge and again immediately upstream of the Riverside Bridge. Consequently, Whitmarsh Road is closed to traffic during moderate to extreme flood events. Whitmarsh Road passes under the Riverside Bridge adjacent to the river. Although the crest elevation of the right bank levee is maintained in this area, the levee height is somewhat discontinuous as it traverses around the road, the Riverside Bridge abutment, and a stormwater pond that provides stormwater detention for the north end of Riverside Bridge.

Between the Riverside and I-5 Bridges, Whitmarsh Road is located immediately north of and constrains the extent of the existing levee. The constriction caused by Whitmarsh Road results in steep levee side slopes and limits potential levee improvements in this area. Whitmarsh Road and the right bank levee then pass under the I-5 Bridge approach. At this location, the existing road clearance is greater than 16 feet and the levee crest is located approximately 10 feet lower than the low chord of the bridge. West of the I-5 Bridge, the levee and Whitmarsh Road parallel each other to the downstream extent of the Project.

As with the left bank levee, riprap has been placed within the toe of the river bank. Similarly, the riprap reduces the erosion potential of the river bank but is seldom actually part of the levee section except at the bridge crossings.

1.1.2.3 Existing Land Use

Existing land uses in the Project vicinity include residential, commercial, agricultural, and open space. Within Mount Vernon, the Project area contains residences, businesses, a RV park, and agricultural lands. Within Burlington, the Project area contains two farmsteads, a RV park, businesses, and agricultural and open space lands. Land uses surrounding the Project area on both sides of the Skagit River are a mix of commercial, residential, and agricultural lands.

1.1.3 What Alternatives are Being Evaluated?

Three alternatives are being considered for the Project:

1. No Action Alternative
2. Improved Existing Levee Alignment Alternative
3. Levee Setback Alignment Alternative

Under both the Improved Existing Levee Alignment Alternative and the Levee Setback Alignment Alternative, new levees will be constructed to meet side slope and top width criteria per the Corps *Design and Construction of Levees Manual* EM 1110-2-301 dated April 30, 2000.

1.1.3.1 What is the No Action Alternative?

Under the No Action Alternative, the existing levees along the Skagit River will be maintained in their current footprint and no structural improvements to the levees will be made. Maintenance activities associated with maintaining the integrity of the existing levee system will still occur (e.g., mowing, grading, etc). For health and safety reasons, the existing alignment of Stewart Road under I-5 in Mount Vernon will be moderately realigned to the south. This allows for Stewart Road to pass under a different span of the I-5 approach but does not require any work on I-5 or the bridge. Additional infrastructure projects within the Project area that do not involve levee improvements may also still occur.

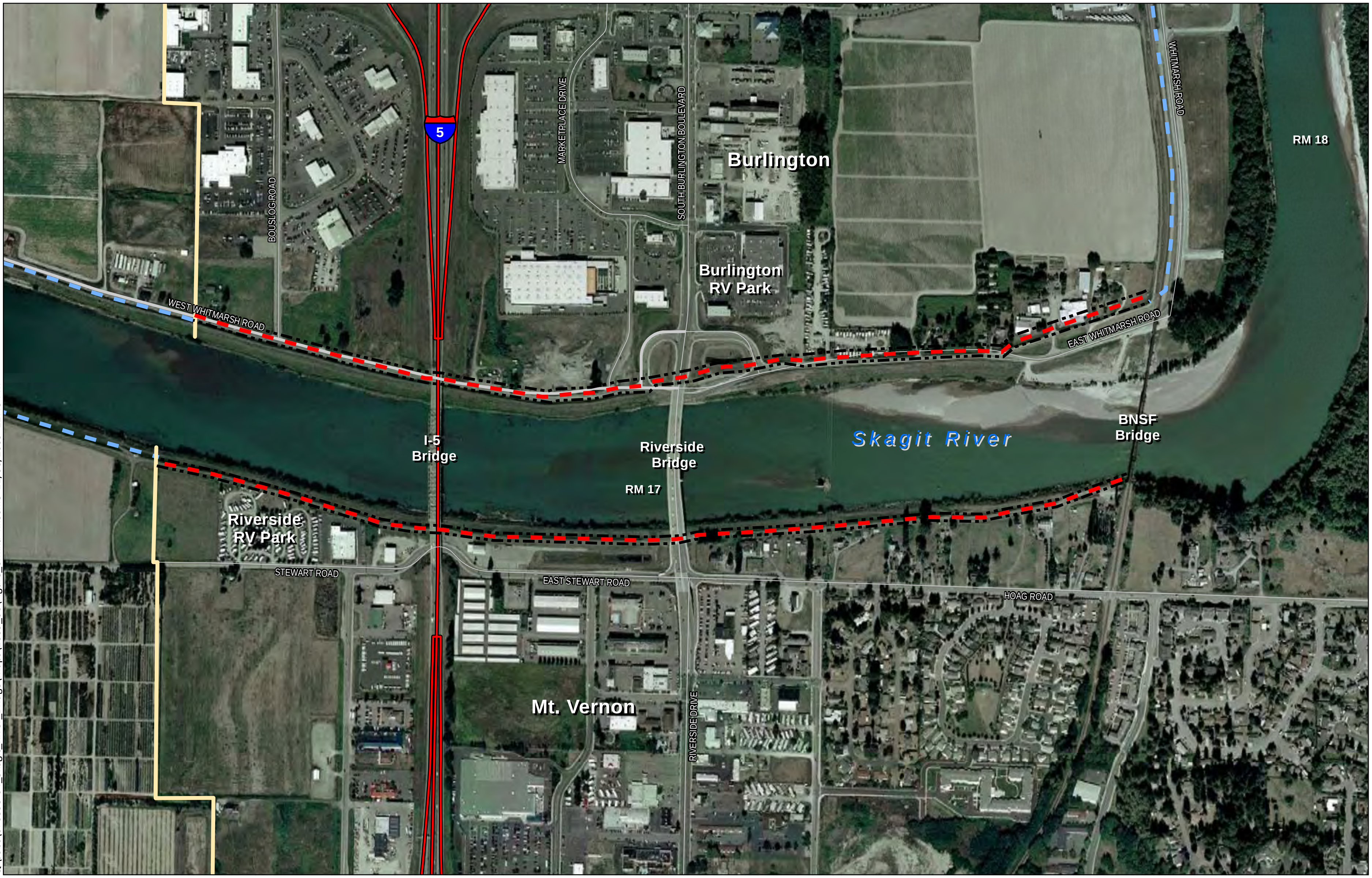
1.1.3.2 What is the Improved Existing Levee Alignment Alternative?

The Improved Existing Levee Alternative is designed to provide a higher degree of flood protection in the Project area than under existing conditions by raising and improving the existing levees in their existing locations. It is assumed that the improved levees will have a top width of 15 to 30 feet and normal side slopes of 3 horizontal to 1 vertical (H:V). This will allow steeper side slopes of 2H:1V and

4H:1V where one side of the levee may be limited by existing structures, roads, or the river bank. It is further assumed that the levees may be built up in increments over several years until they achieve the height required to pass the 100-year flood event. Turn-outs along and access roads to the new levees may also be constructed to provide for vehicle safety.

The improved levees will be raised to a height where they can pass a 100-year flood event, increasing the existing levees approximately 2 feet above their existing elevations. Additionally, all improvements to the levees will be above the normal high water levels of the Skagit River. According to the Hydraulics Report prepared by the Corps (2004a), this elevation (the 2-year flood) is approximately 33 feet NAVD within this reach. Where possible, a distance of 20 feet will be maintained on the landward side of the levee for maintenance purposes. Some new properties are anticipated to be purchased under this alternative; however, the minimum necessary to accomplish design objectives will be acquired. At the downstream terminus of the Project, the improved levees will be tapered to meet existing levee heights.

Figure 3 shows the Improved Existing Levee Alignment Alternative. Elements of this alternative related to the left and right bank levees are discussed in more detail following Figure 3.



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Feet
0 400 800

Improved Existing Levee Alignment
Levee Crest
Existing Levee (outside of improved levee area)
City Limits

Figure 3
Improved Existing Levee Alignment Alternative
Skagit River Bridge Modification and
Interstate Highway Protection Project

Improved Left Bank Levee

The existing left bank levee between the BNSF Bridge and the Riverside Bridge is located close to the river's edge and side slopes are generally similar throughout. This portion of the levee can be improved and raised to the design height without encroaching on the normal high water elevation (approximately 33 feet). In much of this reach, it may be necessary to purchase additional right of way to obtain the desired 3H:1V side slopes. Some of the properties needed to meet the side slope criteria are already owned by DD #17.

Just downstream of the Riverside Bridge, the levee is adjacent to an existing stormwater pond that will remain intact under this alternative. However, the levee can be raised to the desired height without encroaching upon the stormwater pond or the normal high water elevation.

West of the stormwater pond and continuing to the I-5 Bridge, the levee returns to a more standard levee configuration with typical 3H:1V side slopes. Underneath the I-5 Bridge, clearance between the bridge and the levee crest will be reduced by about 2 feet. However, there should still be sufficient clearance for small maintenance vehicles to pass under the bridge.

West of the I-5 Bridge, there should be sufficient area to allow the improved levee to be constructed above normal high water, though additional right of way will need to be obtained on the landward side of the levee. At the west end of the improved levee, an existing drainage pump station is located on the levee and will need to be relocated or modified.

Improved Right Bank Levee

Approximately half way between the BNSF and Riverside Bridges, Whitmarsh Road currently crosses over the existing levee. Improving the right bank levee immediately west of the BNSF Bridge can be accomplished without any changes to Whitmarsh Road and no additional right of way will need to be purchased in this area. If Whitmarsh Road is removed, then an extension will be added to either

Bennett Road or another road near the vicinity of the Project to mitigate for increased traffic.

Levee crest elevations are expected to be 2 feet higher than the existing levees to allow the existing 100-year flood to be passed safely. If the upstream levees are raised and extended, the levee crest will be raised 6 feet higher than the existing levees to allow the 100-year flood to pass safely. If the levee is increased in height by approximately 2 feet, the road grade will have to be raised for about 150 feet on each side of the levee. Since the existing levee is currently set back about 50 feet from the edge of the river bank, the levee can be modified on the river side without encroaching on the river.

In the vicinity of the Riverside Bridge, the roadway passes through the levee prism twice. In each case, the road and levee profiles would be modified to accommodate the increased levee heights. Construction below the ordinary high water mark (OHWM) will not be necessary at this location.

West of the Riverside Bridge, the modifications to the levee are limited by the location of Whitmarsh Road, as it is located at the landward toe of the levee. However, the existing levee is set back slightly from the river's edge such that the levee can be modified without encroaching upon the OHWM. Maintenance vehicles will still be able to traverse the top of the levee under I-5, though the clearance will be slightly decreased from current conditions.

1.1.3.3 What is the Levee Setback Alignment Alternative?

The Levee Setback Alignment Alternative is designed to provide a higher degree of flood protection in the Project area by setting back the existing levees. Although it might be possible to set back the levees almost an infinite distance on each side of the river, the practical setback limit is governed by the level of existing infrastructure (including residential and commercial development, roads, and bridges) and current development regulations. On the left bank of the river, there is extensive development south of Hoag and Stewart Roads. Therefore, these developments represent the limits of the levee setbacks on the left bank. On the right bank, the City of Burlington has designated a 600-foot-wide strip along the Skagit River as floodway, prohibiting future development within this area. Consequently, levee setback along the right bank will occur within the designated floodway.

It is assumed that the setback levees will be constructed with 3H:1V side slopes. This is the same footprint that would be necessary if the levees were constructed with a 2H:1V slope on the water side of the levees and a 4H:1V slope on the landward side. Further, the levees are assumed to have a 15- to 30-foot-wide access road on the crest of the levees and a 20-foot strip of land at the toe of the landward side of the levee for maintenance activities. New toe rock will be keyed into the toe of the new levee and at the junction of the new and existing levees to a depth of approximately 5 to 20 feet. Existing riprap throughout the Project area may remain in place as necessary to ensure stability of the new levees. Turn-outs along and access roads to the new levees will also be constructed. At the downstream terminus of the Project, the newly constructed levees will be tapered to meet existing levee heights. Under the Levee Setback Alignment Alternative, new levees will be constructed to meet side slope and top width criteria per the Corps *Design and Construction of Levees Manual* EM 1110-2-301 dated April 30, 2000.

Under this alternative, the existing Skagit River levees will remain in place for a period of 2 to 5 years to allow the newly constructed levees to settle to a point where they are geotechnically sound and able to withstand the flood events for which they are designed. Once the new levees are determined to be able to withstand the design flood event, the existing levees will be removed.

Figure 4 shows the Levee Setback Alignment Alternative. Elements of this alternative related to the left and right bank levees are discussed in more detail following Figure 4.

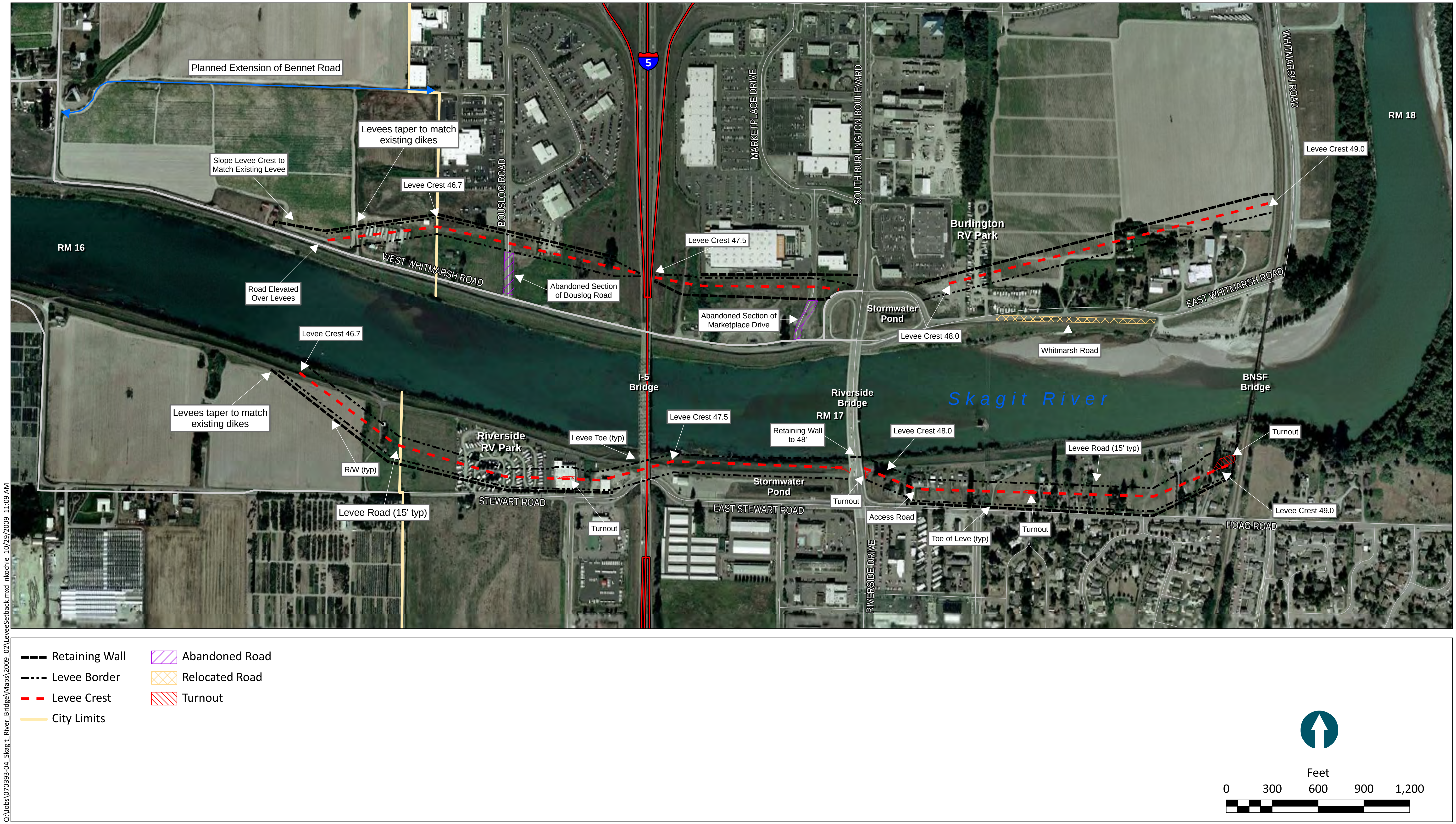

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Figure 4
Levee Setback Alignment Alternative
Skagit River Bridge Modification and Interstate Highway Protection Project

Left Bank Setback Levee

The left bank setback levee ties into the BNSF railroad embankment midway between the Skagit River and Hoag Road and turns southward towards Hoag Road. It then parallels Hoag Road until it is approximately 300 feet east of Riverside Drive. At this point, it angles back to the intersection of the existing levee and the Riverside Bridge. At the upstream face of the Riverside Bridge, the limiting elevation is the low chord of the bridge. A retaining wall will be constructed to 48 feet NAVD to protect the abutment and low chord of the bridge. Consequently, it is necessary to tie the levee into the existing Riverside Bridge abutment. As no bridges will be modified as part of this Project, a smooth transition between the setback levee and the levee under the bridge is necessary to reduce the potential for scour and erosion.

Immediately downstream of the Riverside Bridge, the existing levee is adjacent to a stormwater pond that provides stormwater retention and treatment for the Riverside Bridge. The new levee in this area will be constructed in the same general location as the existing levee and the stormwater pond will remain intact and unchanged. However, the new levee will be constructed with improved side slopes and raised to the height necessary to match the setback levee elevations up and downstream of this levee section.

Between the west end of the stormwater pond and the I-5 Bridge, the levee will be set back approximately 50 feet and Stewart Road will be realigned as described in the No Action Alternative (see Section 1.1.3.1).

West of I-5, the levee parallels Stewart Road for approximately 800 feet. When the setback levee reaches a distance of approximately 350 feet from the river, it then parallels the river. The setback levee follows this alignment until it reaches the western city limits of Mount Vernon. At the city limits, the levee diagonals back towards the river and ties back into the existing levee.

Right Bank Setback Levee

The right bank setback ties into the existing BNSF Bridge approach approximately 700 feet north of the OHWM of the Skagit River. It then extends to the southwest for approximately 2,400 feet to where it ties into the easterly Riverside Bridge interchange with Whitmarsh Road as shown in Figure 3. An approximately 1,000-foot-long section of Whitmarsh Road between the BNSF and Riverside Bridges would need to be relocated to the south of its present location when the existing levees along the right bank are removed.

West of the Riverside Bridge, the levee will tie into the westerly Riverside Bridge interchange with Whitmarsh Road approximately 400 feet from the OHWM of the Skagit River. From there it will parallel the Skagit River and then tie into the east side of the existing I-5 Bridge approach. The levee will also tie into the west side of the existing I-5 Bridge approach and parallel the Skagit River for approximately 1,400 feet. It will then turn to the southwest and extend an additional 800 feet to where it will tie in to the existing levee at the downstream terminus of the Project. In the area between the Riverside Bridge and the downstream terminus of the Project, an approximately 300-foot section of Marketplace Drive (privately owned) and an approximately 300-foot section of Bouslog Road (publically owned) will be abandoned. Additionally, Bennett Road will be extended approximately 0.5 linear miles to connect two existing sections of Bennett Road to accommodate traffic flows from the abandonment of Bouslog Road. No traffic impacts are anticipated as a result of these road abandonments due to the planned extension of Bennett Road that is included as part of the Project.

1.2 Why Do We Consider Social and Economic Impacts as we Plan this Project?

Long-range planning decisions, including flood control measures and habitat restoration, can have far-reaching effects on the social and economic fabric of a community. Public projects should provide an overall benefit to the community and not unduly advance or penalize any particular population. The socio-economic impacts to populations within the community must be considered prior to the implementation of a planned project. A project team that considers all the potential impacts of a project can better optimize a solution that responds to the needs of all populations in the community. This principle of equitable treatment in planning decisions has been incorporated in the NEPA, Title VI of the Civil Rights Act of 1964 (as amended), the Uniform Relocation Assistance & Real Property

Acquisition Policies Act of 1970 (as amended), and the State Environmental Policy Act (SEPA).

1.3 What Are the Key Points of This Report?

This report considers the potential social and economic impacts of the Project. The social analysis considers the potential impacts by examining the following sub-elements:

- **Community Profile:** The Community Profile sub-element considers the general character and image of the community, including characteristics of the population, views and aesthetics, and land uses in the area.
- **Regional and Community Growth:** The Regional and Community Growth sub-element evaluates the potential for future population growth and development within the study area.
- **Recreation:** The recreation sub-element identifies public and private facilities within or near the study area that provide leisure opportunities for those living in the area.
- **Public Services and Community Amenities:** The Public Services and Community Amenities sub-element addresses the public services provided in the study area. This includes schools, police and fire protection, utilities, hospitals, and libraries.
- **Community Linkages:** The Community Linkages sub-element considers how people move to, from, and within in the study area. Access to and from the study area includes consideration of public transit, roads, bike paths, sidewalks, and trails.

The economic analysis characterizes and considers potential impacts to:

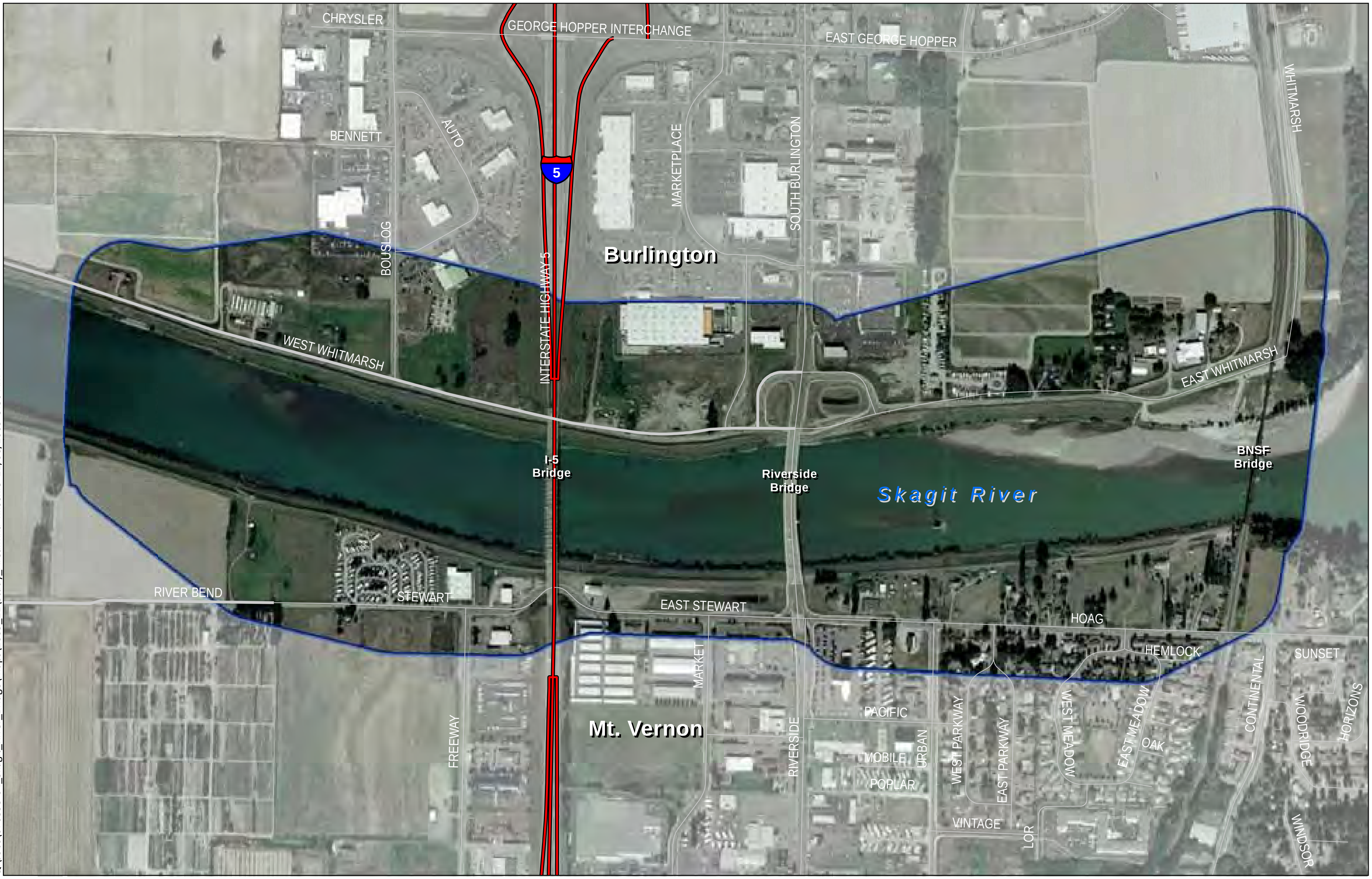
- **Industry and Employment:** This sub-element addresses the amount and type of employment and industry in the area.
- **Property and Taxes:** The Property and Taxes sub-element focuses on the real estate features within the area and their contribution to the property tax base.

1.3.1 What is the Study Approach?

The project team characterized the community and economy potentially affected by the project by reviewing relevant existing studies, photographs, and maps; performing a GIS analysis and a site survey; compiling an economic base analysis; and conducting a property assessment analysis. Given this baseline, we determined the potential impacts to the key sub-elements of the social and economic elements listed in Section 1.3 resulting from the implementation of each alternative. Using photorealistic digital graphics, we also performed a viewshed analysis that shows the present view of the levee system from the Mount Vernon side and how it would appear under each of the proposed Project alternatives. A separate discipline report on environmental justice examines the impacts to vulnerable populations.

1.3.2 What is the Affected Environment?

The affected environment includes those areas that could be directly impacted from implementing the Project alternatives. The Corps is presently conducting a hydraulic analysis of each alternative and, as such, the extent of potential impacts from each alternative is still preliminary and will remain so until the hydraulic analysis is complete. Where potential socio-economic impacts upstream or downstream of the Project are known, those impacts are discussed in this report. However, in general, most of this report is confined to a smaller area where direct potential impacts could occur. For the socio-economic analyses, we assumed that the affected area would be comprised of all parcels that are partially or totally contained within 300 feet landward of the Project area, which begins immediately upstream of the BNSF Bridge and continues to just downstream of the Mount Vernon and Burlington city boundaries, encompassing a linear distance of approximately 1.2 miles between RM 16.5 and RM 17.9. This area is referred to as the study area within this report (see Figure 5).



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Interstate
Arterial
Local Road
Study Area

Figure 5
Study Area
Skagit River Bridge Modification and
Interstate Highway Protection Project

1.3.3 What are the Effects to Social and Economic Elements from the Project?

This section summarizes the potential effects to the sub-elements of the social and economic elements that are associated with implementing one of the Project alternatives within the study area. A more thorough discussion of potential effects is presented in Section 4 of this report.

1.3.3.1 Community Profile

The Project could result in some aesthetic changes to the community landscape, as well as some changes to the population within the affected area. The potential viewshed changes are modeled in Section 4.2.1. Population change as it affects vulnerable populations is addressed separately in the Environmental Justice Discipline Report for the Project.

1.3.3.2 Regional and Community Growth

As discussed in Section 3.1.2, future development potential in most sections of the affected area is already limited by existing land use regulations and ownership patterns. Due to this, the No Build and Improved Existing Levee Alignment Alternatives would not cause any permanent effects to regional and community growth within the study area. Under the Levee Setback Alignment Alternative, there will be a slight reduction in the population within the study area, due to acquisition of some properties to accommodate the setback levees. A more thorough discussion of potential effects to the Regional and Community Growth sub-element is presented in Sections 4.1.2 and 4.2.2.

1.3.3.3 Recreation

The No Build and Improved Existing Levee Alignment Alternatives would not permanently affect recreation in the area. The Levee Setback Alignment Alternative may include a dike-top trail system on the Mount Vernon side of the Skagit River, which would increase recreation opportunities in the project area. Construction work for the Project alternatives would temporarily impede access to the riverbank and would temporarily prevent recreational fishing in the area. Potential effects to recreation are discussed in Sections 4.1.3 and 4.2.3.

1.3.3.4 Public Services and Community Amenities

The Public Services and Community Amenities sub-element would be largely unaffected by the Project, except that the Levee Setback Alignment and Improved Existing Levee Alignment Alternatives would contribute to greater flood protection in areas. This sub-element is discussed in Sections 4.1.4 and 4.2.4.

1.3.3.5 Community Linkages

The Project might lead to the alteration of some roadway alignments, closure of segments of certain roads, or extension of other roads. However, there will be no effect to circulation or traffic in the area due to Project modifications. Effects to this sub-element are discussed in Sections 4.1.5 and 4.2.5.

1.3.3.6 Industry and Employment

The Project will not lead to any long-term substantial changes to industry and employment within the study area. There could be minor reductions to the number or type of businesses within the study area resulting from acquisitions of land necessary under the Levee Setback Alignment Alternative. Any potential temporary or ongoing effects to industry and employment from the Project are discussed in Sections 4.1.6 and 4.2.6.

1.3.3.7 Property and Taxes

The Project could result in a modest reduction in the amount of taxes assessed within the study area due to public acquisition of some private lands as necessary to complete the Project. The Levee Setback Alignment Alternative requires purchase of a greater amount of right of way than the Improved Existing Levee Alignment Alternative. The Project could also lead to changes to existing flood protection levels. The Federal Emergency Management Agency (FEMA) is currently working on revisions to the Flood Insurance Rate Map (FIRM) and base flood elevations within the study area, which could likely lead to an increase in base flood elevations. The levees under the No Action Alternative do not meet 100-year levee certification standards as defined by FEMA. The No Action Alternative would be insufficient in deterring an increase to new base flood elevation calculations. This would affect the new FIRM and has the potential to reduce growth, development, and taxes in the affected area. The Project would likely not directly affect property values in the area. A more detailed discussion of potential ramifications to property and taxes is presented in Sections 4.1.7 and 4.2.7.

1.3.4 What Measures Will be Taken to Avoid or Minimize Effects?

Measures to avoid or minimize adverse effects of the Project on social and economic elements include the following:

- To minimize noise disturbance to the surrounding community, Project construction will only occur as allowed by local noise ordinances.
- If roadway realignments require movement of any utilities, these will be coordinated with the appropriate providers to ensure maintenance of current levels of service.
- The current visibility of businesses from the street would not be blocked by construction of either Project alternative. If construction does block views to businesses, signage will be provided indicating businesses are open during construction.

Measures to avoid or minimize Project effects are covered in context in Section 5.1.

1.3.5 What Are the Potential Mitigation Measures?

Unavoidable effects of the Project on social and economic elements will be mitigated as follows:

- Compliance with all mandates of Uniform Relocation Assistance and Real Property Acquisition Policies Act (URARPA) in the acquisition of private land for public good.
- Extension or improvement of nearby roads to provide the same level of service provided by any roads vacated in the Project. See Section 5.2.5 for more specific information.

Measures to mitigate for Project effects are covered in context in Section 5.2.

1.3.6 What Are the Project Benefits?

The Project has several potential benefits that result from enhancing flood protection within all or some of the surrounding area. Improvements to flood protection levels could alter FIRMs, which can lead to a variety of beneficial effects, including reduced or eliminated mandatory flood insurance premiums and lower flood protection development requirements in some areas. This, in turn, can help promote development or lead to increases in property values. In addition, providing for greater flood protection lessens the probability and severity of flood damage to homes and businesses.

Under the Levee Setback Alignment Alternative, there is also the possibility of incorporating a dike-top trail system on the Mount Vernon side of the Skagit River. This trail system would provide a strong connection between the community and the river.

2 STUDY APPROACH

2.1 What is the Study Area and How Was it Determined?

The study area in this report is a polygon that extends 300 feet landward of the landward side of the levee setback line in the Levee Setback Alignment Alternative on both sides of the river. Figure 5 shows this study area. This area was determined to be the extent of potential impacts to the area from all alternatives. Because each Project alternative does not involve any temporary or permanent disruption to transportation systems (roads, public transit, etc), the potential effects are limited to those areas that might be temporarily impacted by construction noise, or permanently by view changes, which are areas approximately 300 feet or less away from the levee setback in the Levee Setback Alignment Alternative. Where preliminary flood damage information is available for each alternative, it is discussed in this report. Because flood control in the Skagit River is a systemic issue, potentially impacted areas can extend beyond the study area.

2.2 Who Are the Resource, Regulatory, and Jurisdictional Agencies and What Regulations Apply?

Skagit County is working in cooperation with the Cities of Mount Vernon and Burlington, Skagit County DD #12 and DD #17, WSDOT, and FHWA. Given the agencies involved in this action, several regulations are triggered that are relevant to the socio-economic aspects of the Project. Sections 2.2.1 through 2.2.5 briefly outline these regulations and the pertinent sections of these regulations as related to the Project.

2.2.1 National Environmental Policy Act

NEPA was created in 1969 (and thereafter amended several times) to obligate federal agencies to integrate environmental values into their decision-making processes by weighing the environmental impacts of their proposed action and considering all reasonable alternatives to that action. Chapters 410 and 411 of NEPA stipulate that social and economic effects that are intertwined with natural and physical changes must also be identified and considered.

2.2.2 Title VI of the Civil Rights Act and the Executive Order 12898

Title VI of the Civil Rights Act of 1964 prohibits projects and programs that use federal funding from discriminating on the basis of race, color, and national origin. The heart of this title was aptly expressed by John F. Kennedy in 1963, when he stated that "simple justice requires that public funds, to which all taxpayers of all races contribute, not be spent in any fashion which encourages, entrenches, subsidizes or results in racial discrimination." A separate Environmental Justice Discipline Report assesses in detail the equitability of the Project for vulnerable populations.

Presidential Executive Order 12898 that was signed into law in 1994 was aimed at encouraging greater environmental justice through nondiscrimination in federal programs substantially affecting human health and the environment. It also contains measures to provide greater opportunities for minority and low-income communities' participation and access to information regarding programs or projects that affect human health or the environment.

2.2.3 Uniform Relocation Assistance and Real Property Acquisition Policies Act

Congress enacted URARPA, recognizing that programs or projects funded or undertaken by federal agencies often resulted in the displacement of homes or businesses. Subchapter II of URARPA legislates that relocation programs be fair and uniform and that adverse impacts from displacement be minimized. The lead agency of federally undertaken or funded projects (FHWA for this Project) is obligated to reimburse displaced persons or businesses for the fair market value of the lost property, actual reasonable moving expenses, actual reasonable expenses of searching for a new place for a replacement business or farm, and up to $10,000 in actual expenses used to reestablish a farm, non-profit organization, or small business. Subchapter III of the act stipulates the process requirements for undertaking acquisitions of properties that would be displaced by the Project.

2.2.4 Americans with Disabilities Act and Age Discrimination Act

The Americans with Disabilities Act (ADA) was established in 1990 to ensure that individuals with physical or mental disabilities have equal access to the provision of benefits and services from federally funded programs. The Age Discrimination Act of 1975 protects those 65 years old or older. Public projects are prohibited from taking actions that discriminate against or place undue burden on those with disabilities or those 65 years old or older. A separate Environmental Justice Discipline Report examines the potential impacts to protected classes of citizens.

2.2.5 State Environmental Protection Act

SEPA was enacted in 1971 and represents the Washington state counterpart of NEPA. SEPA obligates public agencies to integrate environmental values into their decision-making processes by weighing the environmental impacts of their proposed action and considering all the reasonable alternatives to the action. SEPA also stipulates that social and economic effects that are intertwined with natural and physical changes must also be identified and considered.

2.3 How was Information on the Social and Economic Elements Collected?

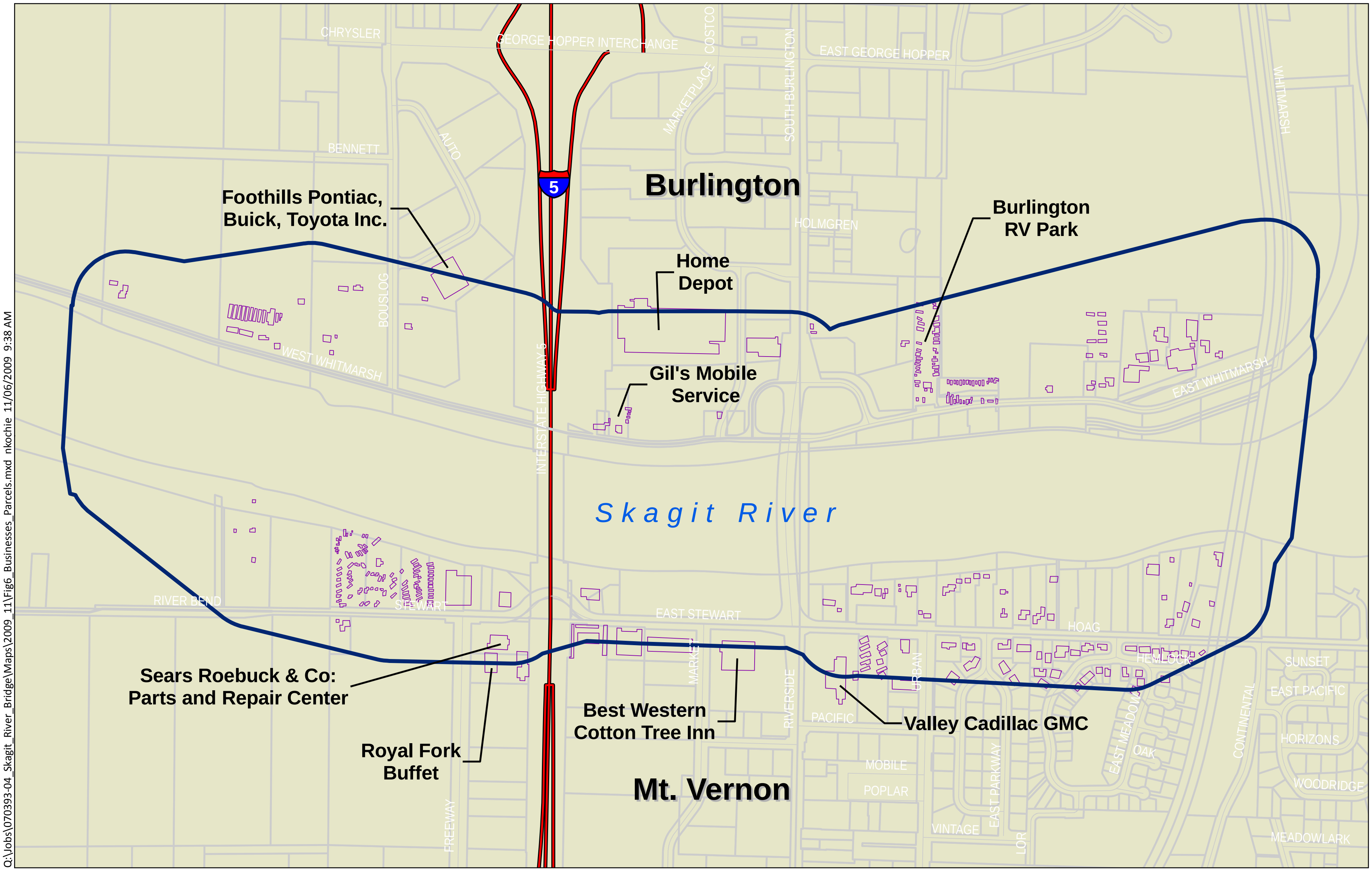
The Project team collected information on the social and economic characteristics of the study area first by reviewing existing information. Next, we addressed informational gaps and ground-truthed data during a windshield survey conducted in February 2008. This windshield survey focused primarily on verifying housing; businesses; and car, pedestrian, and bike circulation within the study area. The photographs taken during the site survey were used to create the photorealistic digital graphics of each of the Project alternatives for the viewshed analysis (see Section 4.2.1). These photographs were taken from the intersection of Hoag Road and West Parkway, facing north toward the Skagit River.

Existing information reviewed included City of Burlington, City of Mount Vernon, and Skagit County comprehensive plans; U.S. Census Bureau Economic and Population Data; U.S. Bureau of Economic Analysis Regional Economic Analysis Project Information for Skagit County; U.S. Bureau of Labor Statistics (US BLS) employment information at the zip code, metropolitan statistical area (MSA), and county levels; City and County GIS map data; Washington State Office of Financial Management (OFM) data; Cities of Burlington and Mount Vernon 2007 municipal budgets; the Final Engineering Analysis (Stansbury 2009, Appendix A); and Skagit County Assessor's records.

2.4 What Methods Were Used to Evaluate the Potential Effects on Social and Economic Elements?

We employed several methods to assess the potential socio-economic effects of the Project alternatives. Using GIS, we first identified the buildings and properties within the study area. Properties that would be displaced or would require partial purchase under either the Levee Setback Alignment Alternative or the Improved Existing Levee Alignment Alternative were identified based on the Project footprints detailed in the Final Engineering Analysis, Appendix A (Stansbury 2009, Appendix A). Parcel numbers were matched up with Skagit County Assessor's data and from this information we were able to characterize the types of land use, typical housing, and typical businesses in the study area, as shown in Figure 6. We also calculated a 2007 estimate of municipal tax produced by the study area to arrive at the economic impact of property tax loss to each city from implementation of the Project alternatives. We relied on flood damage estimates from the 2009 Final Engineering Analysis to arrive at the approximate potential flood damage impacts resulting from the implementation of each alternative.

In order to understand the potential aesthetic impacts from the project, we utilized existing photos and digitally enhanced them to model the potential viewsheds associated with each alternative. A viewshed represents the natural and constructed physical features visible from a fixed vantage point.



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Study Area
Study Area Buildings
Parcels

Figure 6
Businesses and Parcels
Skagit River Bridge Modification and
Interstate Highway Protection Project

3 AFFECTED ENVIRONMENT

Before we discuss potential effects of any of the Project alternatives, we first characterize the affected environment in the study area as it presently exists. Some information is not available at the specific study area level, so some of the information in this section pertains to an area greater than the study area itself.

3.1 What are the Existing Social and Economic Elements in the Study Area?

The existing social and economic elements in the study area are divided into the following seven sub-elements in Sections 3.1.1 through 3.1.7: Community Profile, Regional and Community Growth, Recreation, Public Services and Community Amenities, Community Linkages, Industry and Employment, and Property and Taxes.

3.1.1 Community Profile

For the purpose of understanding demographics in the study area, we had to rely on data from a greater area to obtain pertinent information. For most demographic information, we used the 2000 Census Block Groups that contained the affected area. A Census Block Group is a geographic unit defined by the U.S. Census Bureau that is a subdivision of the Census tract and is the smallest geographic unit for which the U.S. Census Bureau tabulates sample data. Census Block Groups are comprised of Census blocks, which can be city blocks or encompass several square miles (especially in rural areas). Demographic information is reported for Block Group 1 of Census Tract 9522 and Block Group 2 of Census Tract 9518. When the study area refers to the block groups of the study area, it will be noted as such. Otherwise, the study area refers to the area 300 feet landward of the Levee Setback Alignment Alternative.

We examined the 2000 U.S. Census data for several key characteristics of the population within the study area. In 2000, there were 1,866 people living within the block groups of the study area. If we adjusted this figure by the historical population growth of each city from 2000 to 2007, the estimated 2008 population in this area would be 2,215 people. There were 725 households within Block Groups 1 and 2, with an average household size of 2.6 people. The population in 2000 was predominantly "white alone" (as defined in the 2000 U.S. Census) and comprised of adults 25 to 59 years old and children under

18. The population pyramid in Figure 7 depicts an area with many families with children, elderly, and lacking in young adults 18 to 24 years old (U.S. Census 2000).

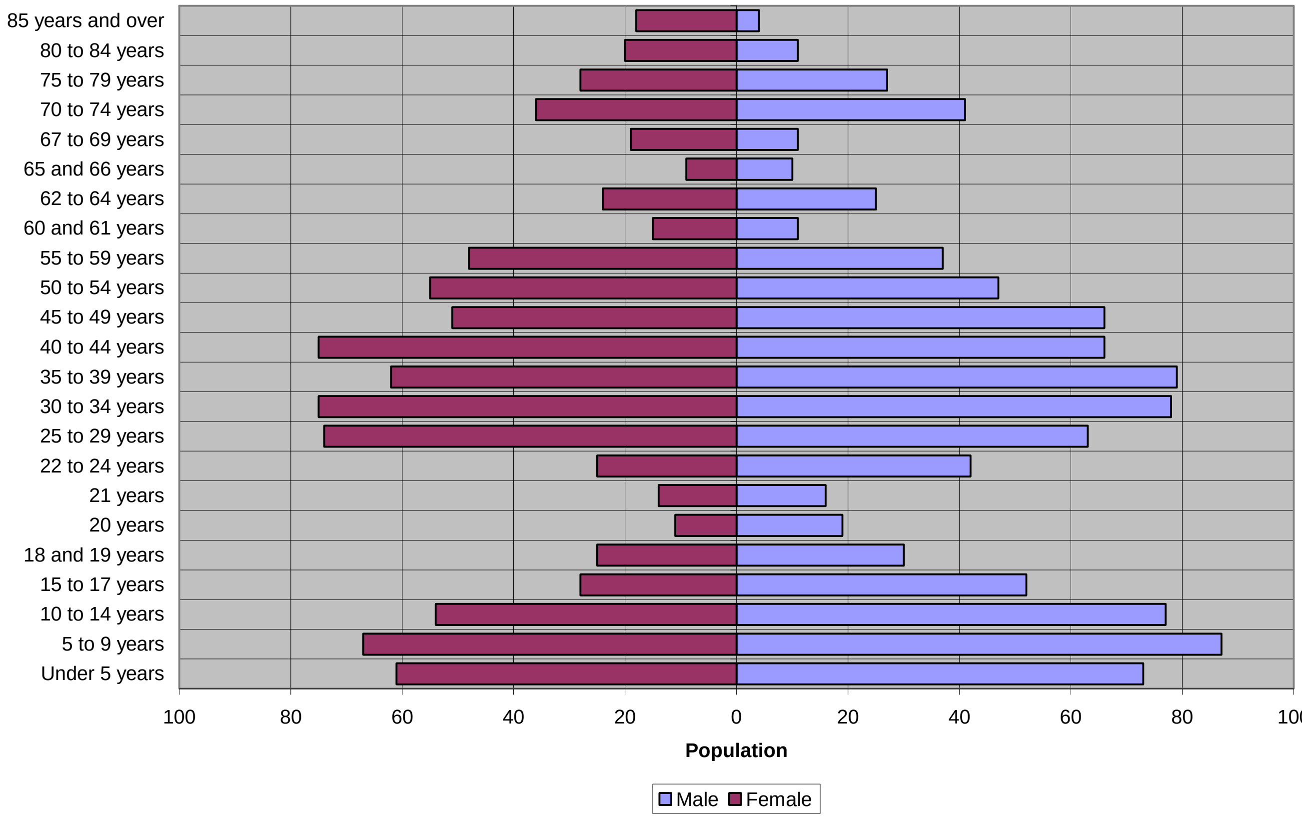

Figure 7
Population Pyramid for Block Groups 1 and 2 of Study Area

The residential zoning within the study area is largely single family housing and is typical of the population pyramid depicted in Figure 7.

In general, the zoning within the Burlington portion of the study area is commercial or Open Space, Parks, and Agriculture (OSPA), whereas the Mount Vernon portion of the study area is primarily residential zoning east of Riverside Drive (Single Family Residential [R1-3.0, R1-4.0, and R1-5.0]; Multi-Family Residential District [R-3]; Residential Office District [R-O]; and Residential Agricultural District [R-A]) and non-residential along Riverside Drive and to the west (General Commercial District [C-2] and Light Manufacturing and Commercial District [M-1]). Areas within the study area outside of either city's limits are zoned by the County as Agricultural-Natural Resource Lands (AG-NRL) (Mount Vernon 2008a; Burlington 2005; Skagit County 2007a).

Specifically, within the study area in Mount Vernon there are roughly 23.5 acres zoned Residential-Agricultural, which extend north of Hoag Road. Approximately 7.5 acres are zoned Residential 1, which allows for five dwelling units per acre. Approximately 6.5 acres of the Mount Vernon study area are zoned Residential to allow for four dwelling units per acre and 0.25 acre is zoned for three dwelling units per acre. Roughly 1.5 acres are zoned for Residential Office. Approximately 2 acres on the Mount Vernon side are zoned for light industrial/commercial. Approximately 4 acres are zoned as Dikes. The remaining 21 acres are zoned General Commercial (Mount Vernon 2008a). It is important to note that residential housing in the study area does occur in some areas that are zoned Commercial. This is the case for two mobile home parks on either side of the Skagit River. For instance, the Burlington study area is zoned Commercial or OSPA in its entirety; however, Burlington RV Park is presently situated along Whitmarsh Road to the southeast of the Sportsman Warehouse (see Figure 6). Figure 8 shows zoning within the study area.

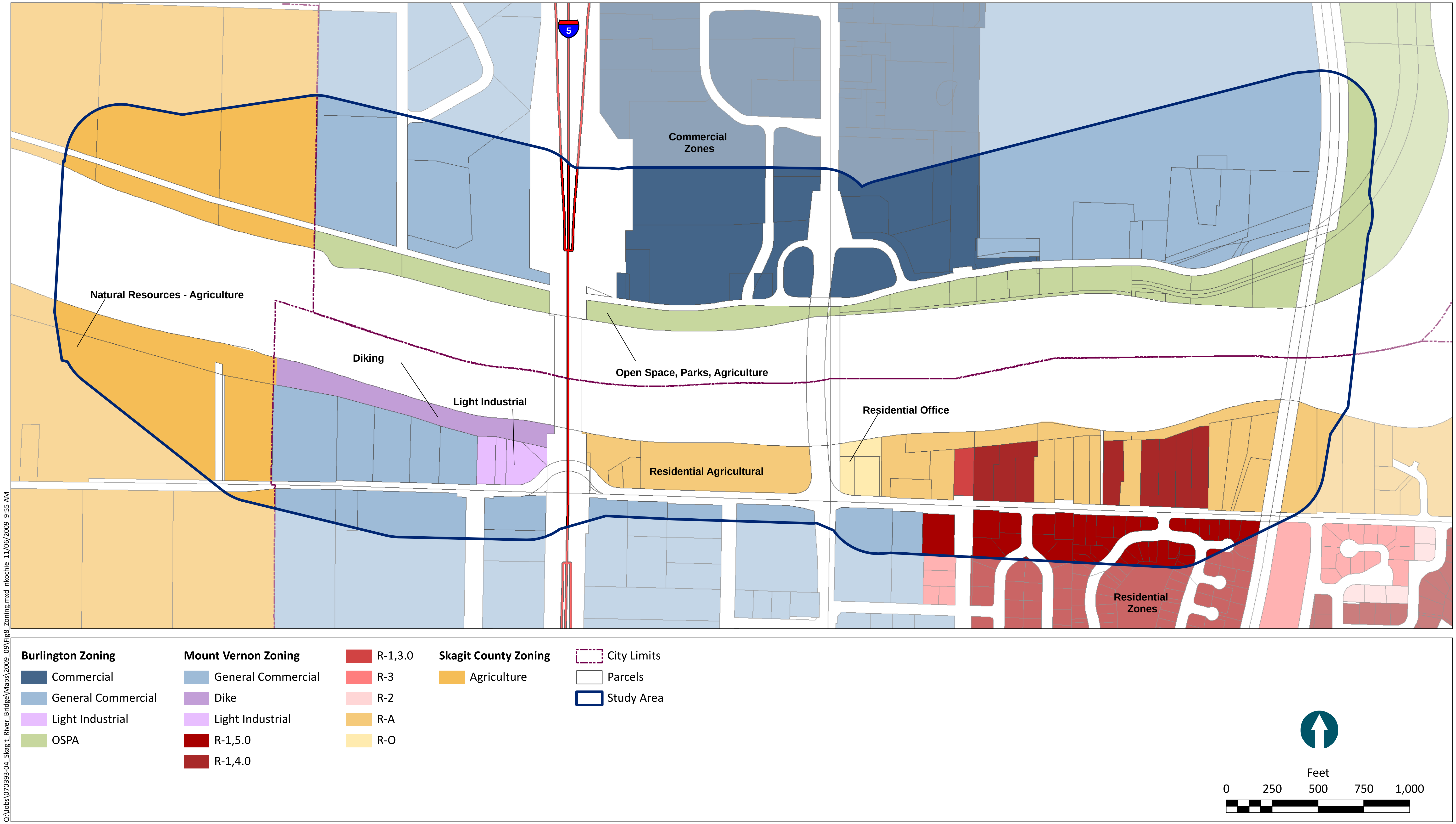

Figure 8
Zoning
Skagit River Bridge Modification and
Interstate Highway Protection Project

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South Burlington Boulevard/Riverside Drive is the main roadway serving commercial activity in the study area from big box retail on the Burlington side to auto-dealers, hotels, and health clubs on the Mount Vernon side. The study area has undergone strong commercial growth starting in the 1990s and continuing during the last 10 years with the introduction of big box retail stores and chain restaurants, which included Home Depot and Sears and Roebuck , Sportsmans Warehouse, Petco, and McDonalds (see Figure 6; Skagit County 2008).

Agricultural uses characterize the western section of the study area outside of each city's limits and west of I-5. Here, small family-owned farms dominate.

More information on the Cities' special planning areas within the study area is provided in Section 3.1.2.

The land in the study area is within the Skagit River 100-year floodplain. The most current FIRM delineates a 100-year floodplain that exists riverward of the commercial properties on either side. The cities are in the process of remapping the FIRM. In general, the area has suffered several major floods, which have resulted in significant losses (Skagit County 2003).

3.1.2 Regional and Community Growth

According to the 2000 U.S. Census, 1,866 people reside in the block groups of the study area (U.S. Census 2000). The 2015 Skagit County population overall is projected to grow anywhere from 9 to 39 percent from its 2005 estimate of 110,900 residents (OFM 2007). As Tables 1 and 2 indicate, the cities of Mount Vernon and Burlington are experiencing strong population growth. In 2006, Mount Vernon permitted 293 new single family homes and 63 new multifamily units. Burlington permitted 22 new single family homes and 18 new multifamily units in 2006 (U.S. Census 2007).

However, most of the residential growth within the study area occurred in the mid-1990s with the introduction of the Meadows subdivision on the Mount Vernon side. The average home within the study area was built in 1971 with a median build date of 1994

(Skagit County 2008)[1]. New commercial and residential development has subsided within the already developed study area. According to the most recent Mount Vernon Comprehensive Plan, most areas within the Mount Vernon side of the study area have been earmarked as having no development potential. There have been no new developments proposed within the study area as of January 2008 (Mount Vernon 2008b). Most areas slotted for development within Mount Vernon are concentrated along the eastern borders and southern areas of the city. Likewise, Burlington's growth is largely outside the study area, as their 2006 Comprehensive Plan has designated the swath along the Skagit River as OSPA, which has limited further commercial expansion to the south. Other Burlington areas zoned Commercial have predominantly been built-out within the study area. DD #12 and DD #17 now possess more than 48 acres within the study area along the Skagit River, which prevents this land from being developed and allows it to serve as open space and provide flood control capacity.

Table 1
Burlington Population 2000 to 2007

Year	Population	Percent Growth	Cumulative Percent Growth
2007	8,400	3.4%	24.3%
2006	8,120	7.5%	20.2%
2005	7,550	1.7%	11.7%
2004	7,425	1.5%	9.9%
2003	7,315	1.7%	8.3%
2002	7,190	2.8%	6.4%
2001	6,995	3.5%	3.5%
2000	6,757		

Source: OFM 2007

[1] Typical year built figures are based on the decade with highest frequency of occurrence over the range of houses within the study area with year-built information available in the Skagit County Assessor Database.

Table 2
Mount Vernon Population 2000 to 2007

Year	Population	Percent Growth	Cumulative Percent Growth
2007	29,390	2.4%	12.0%
2006	28,710	1.8%	9.4%
2005	28,210	1.8%	7.5%
2004	27,720	2.4%	5.7%
2003	27,060	1.5%	3.2%
2002	26,670	0.8%	1.7%
2001	26,460	0.9%	0.9%
2000	26,232		

Source: OFM 2007

The study area is part of the Malls/College Way Planning Area on the Mount Vernon side and part of the Downtown District on the Burlington side (Mount Vernon 2005; Burlington 2005). These planning designations will help to shape what future development and growth looks like within the Project study area. The Mount Vernon Comprehensive Plan outlines a vision for the Malls/College Way Planning Area, which encompasses an area just west of I-5 running along Stewart/Hoag/Martin Road to the north, terminating at Waugh Road to the east, and extending past College Way. Specific to the Project study area, the Mount Vernon Malls/College Way Planning Area proposes a neighborhood park west of the intersection at Hoag Road and the BNSF railroad, higher density and height for motels on either side of I-5, and a bike and pedestrian path system along the Skagit River. The plan mostly calls for the preservation of agricultural and residential uses north of Hoag/Stewart Road. West of Urban Avenue and south of Hoag/Stewart Road, the plan calls for shifting to commercial uses, with more intense uses near I-5 giving way to office uses as one draws closer to Urban Avenue. East of Urban Avenue and south of Hoag Road, the focus shifts toward single family housing with limited multifamily housing (Mount Vernon 2005).

The Burlington Comprehensive Plan incorporates the levee setback line from the Levee Setback Alignment Alternative into its Downtown District Planning Area. Portions of the Project study area are also within the Burlington Retail Core and West Side Commercial Special Planning Areas. The Retail Core is located along Burlington Boulevard, extending south from Rio Vista Avenue/State Route 20 to the Skagit River. The plan focuses on the extension of the commercial retail, dining, and entertainment development that began in 1989, along with implementation of street beautification and setback limitations along streets. The West Side Commercial Area represents a band of land with frontage along I-5, west of the Retail Core. The plan calls for the continuation of freeway-oriented commercial development and limits vehicle dealerships to two already-established general areas. Other plan features call for the inclusion of street trees with development and adherence to a maximum setback requirement. The entirety of Burlington Boulevard is part of the Comprehensive Plan's High Traffic Impact Corridor. New developments in the study area along this section of road would be required to prepare traffic studies and address more traffic considerations than areas outside of High Impact Corridors (Burlington 2005).

3.1.3 Recreation

At present, there are no public parks within the study area limits. The nearest park is Ted Reep Park, which the City of Mount Vernon classifies as a large urban park and which offers a boat launch. This park occupies approximately 48 acres along the eastern shore of the Skagit River, immediately before the river bends into the study area. In Burlington, the 51-acre Skagit River Park is a short distance upstream from the study area and offers 22 soccer fields, eight baseball diamonds, 22 horseshoe pits, and open space. Both of these parks represent the largest parks in each city that affront the water and offer a variety of recreational activities that serve the study area (Mount Vernon 2005; Burlington 2008a). Figure 9 shows public parks and amenities in the area.

The study area includes privately-owned recreational facilities within Mount Vernon. The Riverside Health Club is a private health club located along Riverside Drive in the study area. It presently has one of the two existing membership-accessible swimming pools in the Mount Vernon city limits. The health club is one of 13 other gymnasiums, and one of three other conditioning facilities in Mount Vernon (Mount Vernon 2005).

In addition to established parks and facilities, the stretch of river between the BNSF and Riverside Bridges is popular with recreational fishers.

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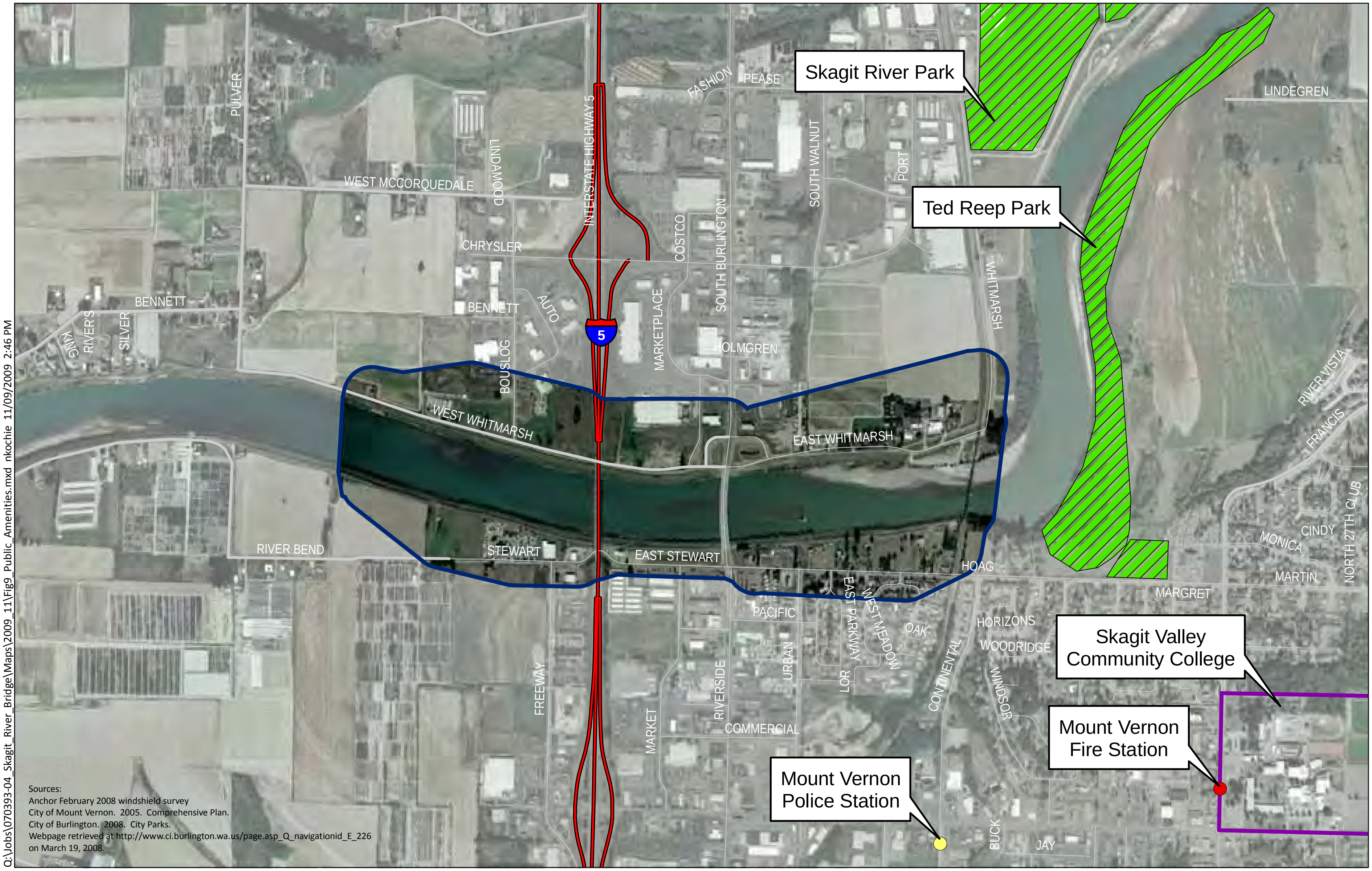

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- Police Station
- Fire Station
- Park (Approximate Area)
- Community College
- Study Area

Figure 9
Public Amenities
Skagit River Bridge Modification and
Interstate Highway Protection Project

3.1.4 Public Services and Community Amenities

The study area within Mount Vernon and Burlington is connected to all public utilities. Both the Mount Vernon and Burlington sides of the study area are serviced by city sewer. Puget Sound Energy provides electrical service to the study area and natural gas service is available through Cascade Natural Gas. Skagit County Public Utility District #1 provides potable water to the study area.

The study area within city limits benefits from local emergency services, including each city's fire and police protection, and nearby Skagit County hospital services. A Mount Vernon Police Station and a Mount Vernon Fire Station are located within 2 miles of the study area. Emergency services to unincorporated areas are provided by Skagit County.

Two school districts serve the area—Mount Vernon School District 320 and the Burlington-Edison School District 100. These districts provide schools serving grades kindergarten through high school (Skagit County 1999). Higher education is also available nearby—the study area is approximately 1 mile away from the Skagit Valley Community College located at 2405 East College Way.

Other local city-wide amenities include several churches, Burlington and Mount Vernon libraries, Mount Vernon's Lincoln Theatre, and regional and local retail shopping centers.

3.1.5 Community Linkages

The study area incorporates the three bridge corridor, which includes the I-5, BNSF, and Riverside Bridges. Burlington Boulevard/Riverside Drive bisects the study area. These bridges provide regional and local north/south circulation by car, train, or foot.

Regionally, I-5 provides quick access to and from the study area off of the George Hopper Interchange at Burlington or the College Way Interchange at Mount Vernon. I-5 provides car and public transport connections to major cities including Seattle and Portland to the south and Vancouver, BC to the north. The section of I-5 adjacent to the study area is rapidly becoming a chokepoint because of the significant amount of local traffic entering and exiting within the corridor mixing with the growing volume of through traffic. Interchange queuing and storage problems occur as congestion increases. A new, wider I-5 bridge across the Skagit River has been recommended to accommodate the additional trips and to improve safety. The new bridge should be built to accommodate proposed dike setbacks for the Skagit River. Currently this is an unfunded project.

I-5 and freeway access are vital to employment in the block groups of the study area, as 93 percent of those workers drove to work in 2000 (U.S. Census 2000). I-5 provides connection to many of the larger regional employment centers, where some people in the study area work. Table 3 shows the reported travel times of the block groups of the study area and matches this with typical drive times and the farthest employment areas accessible within the travel time reported.[2]

Table 3
Range of Commute Times and Distances within the Block Groups of the Study Area

Travel Time	Percent of Commuters	Average 30 mph In Town Driving	Average 60 mph Freeway Driving	Average Maximum Distance Radius	Typical Towns
Less than 20 minutes	63%	5.00 miles	10.00 miles	up to 15 miles	Mount Vernon, Burlington, Stanwood, Sedro Woolley, LaConner
20 minutes to 44 minutes	19%	5.50 miles	33.00 miles	up to 38.5 miles	Everett, Mukilteo, Snohomish, Bellingham, Ferndale, Hamilton, Anacortes
45 minutes to 59 minutes	4%	7.38 miles	44.25 miles	up to 52 miles	Friday Harbor, Oak Harbor, Kirkland, Bothell, Lynwood, Woodinville, Monroe, Edmonds, Shoreline, Concrete
More than 1 hour	11%	24.19 miles	72.56 miles	up to 100 miles	Seattle, Issaquah, Renton, Redmond, Vancouver BC

Passenger rail is also a transportation option, as an Amtrak service station is located in downtown Mount Vernon approximately 3 to 4 miles south of the study area. From the station, passengers can reach Bellingham, Everett, Seattle, Portland, and Eugene. Known as Skagit Station, this multi-modal stop also provides Greyhound bus service

[2] Data does not necessarily take into account peak hour congestion problems in regional areas. Travel times and distance were approximated using average speeds for highway driving and in-town driving and mapping distances along routes through Google Maps.

and Skagit Transit (public bus service) stops for routes connecting to the cities of Everett, Anacortes, and Concrete; Island County; and Whatcom County.

Locally, Burlington Boulevard/Riverside Drive forms the main retail spine within the study area. Whitmarsh Road in Burlington and Stewart/Hoag Road in Mount Vernon run perpendicular to Burlington Boulevard/Riverside Drive and parallel to the Skagit River. Bike routes are available on each of these streets, as well as Market Street, Freeway Drive, Urban Avenue, and Bouslog Road. The study area is pedestrian-friendly. Pedestrians can find sidewalks on local streets in the main commercial and residential areas on both the Burlington and Mount Vernon sides of the study area. The study area is relatively flat and pedestrians are able to cross the river. However, most retail development is designed for car travel, with large parking lots and space between establishments.

Skagit Transit has bus routes along Burlington Boulevard/Riverside Drive and Hoag/Stewart Road. There is one bus stop just outside the study area at the intersection of Hoag Road and Continental. Figure 10 shows street, sidewalk, trail, public transit, and bike connections within the study area.

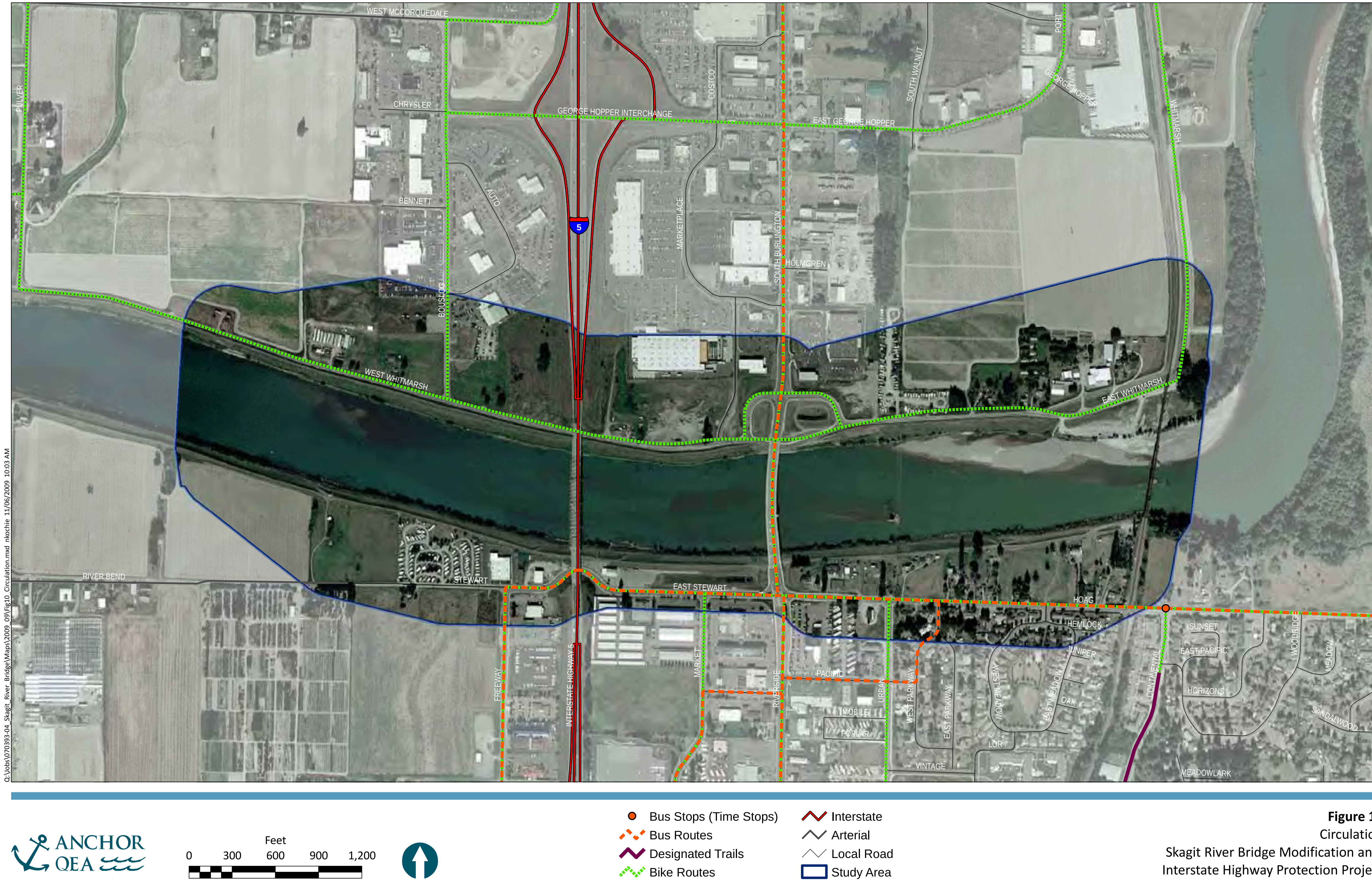

Figure 10
Circulation
Skagit River Bridge Modification and
Interstate Highway Protection Project

3.1.6 Industry and Employment

The commute times in Table 3 of Section 3.1.5 indicate that Mount Vernon and Burlington are themselves significant employment centers for the area—more than half of the block group area spends less than 20 minutes getting to work. In order to understand the type of industries that employ workers in the study area, we relied on an economic base analysis. Economic base analysis is one of two commonly used economic assessments that indicate what industries are particularly strong or weak in an area. The analysis relies on the assumption that there are "base" industries, which supply more goods or services than the local economy consumes. These goods or services are exported to other areas and money is brought into the community from the sale. Some of this money is spent locally, which leads to the viability of other non-base industries in the community. To measure whether or not an industry is a base industry, economists must compare the local economy by some benchmark—most typically the United States. Industries are categorized under their North American Industry Classification (NAIC). By classifying industries according to their NAIC, one can use the US BLS data to determine a local economy's location quotient for each industry in question. Location quotients are calculated based on the following formula:

$$\frac{\text{Local Employment in Year } x \text{ in Industry } i \text{ / National Employment in Year } x \text{ in Industry } i}{\text{Total Local Employment in Year } x \text{ / Total National Employment in Year } x}$$

A location quotient greater than 1 generally indicates a base industry. The higher the number, the more likely that industry contributes to the overall economic base of the community (e.g., it exports more and brings more dollars in to the local economy). A location quotient less than 1 generally indicates a non-base industry. A number significantly less than 1 can also signal that an area is underserved by some service or good and would flag a leakage of money out of the local economy (as people must purchase the good from elsewhere).

Publicly available employment data from the Washington State Department of Labor and Industries and the US BLS is only specific to the county or metropolitan statistical area level. For this reason, the economic base analysis contained here is a regional snapshot beyond that of the affected area. We qualitatively compared this regional snapshot with our observations of industries from our field survey within the study area.

The economic base analysis was performed using 2006 US BLS data and demonstrates that Skagit County's economy is rooted solidly in natural resources and agricultural production of goods. The analysis also highlights that vehicle dealerships support an area greater than Skagit County. The top 10 industries in Skagit County with the highest location quotients are presented in Table 4. On the other hand, Skagit County is lacking in many of the high-tech communications, computers, and management classifications. The industries with the lowest location quotients are shown in Table 5.

Table 4
Skagit County Top 10 Base Industries

Skagit County NAIC Industry	Location Quotient
NAICS 114 Fishing, hunting and trapping	12.64
NAICS 111 Crop production	11.72
NAICS 11 Agriculture, forestry, fishing and hunting	7.73
NAICS 113 Forestry and logging	6.55
NAICS 112 Animal production	4.74
NAICS 115 Agriculture and forestry support activities	3.22
NAICS 814 Private households	2.52
NAICS 311 Food manufacturing	2.26
NAICS 487 Scenic and sightseeing transportation	2.19
NAICS 441 Motor vehicle and parts dealers	2.12

Source: US BLS 2007a

Table 5
Skagit County Industries with the Lowest Location Quotients

Skagit County NAIC Industry	Location Quotient
NAICS 561 Administrative and support services	0.33
NAICS 21 Mining, quarrying, and oil and gas extraction	0.23
NAICS 334 Computer and electronic product manufacturing	0.23
NAICS 425 Electronic markets and agents and brokers	0.21
NAICS 551 Management of companies and enterprises	0.21
NAICS 515 Broadcasting, except Internet	0.2
NAICS 523 Securities, commodity contracts, investments	0.17
NAICS 485 Transit and ground passenger transportation	0.16
NAICS 518 Data processing, hosting and related services	0.16
NAICS 323 Printing and related support activities	0.14

Source: US BLS 2007a

If we examine 2005 employment data gathered from the U.S. Census Bureau's Business Patterns Survey, a different picture emerges at the MSA level. A comparison of Mount Vernon-Anacortes MSA to the 2006 U.S. employment data (US BLS 2007b) shows that this area serves a different role than the greater Skagit County economy. Here, Arts, Entertainment, and Recreation and Retail industries dominate. While agriculture is still strong in comparison to the U.S. with a location quotient of 1.92, it is less so than Skagit County's overall location quotient for this industry. This trend toward stronger retail, hospitality, healthcare, and construction is reflected even at the more specific zip code level of the 2005 U.S. Census Bureau Business Patterns employment data. While there is no employee data for the 98233 zip code, the count of establishments under each category shows this area to be a hub for the larger county and beyond when it comes to retail, healthcare, and hospitality. Similarly, our survey of the study area coincided with the information from the employment data.

We gathered other employment data at the most local level available that shows the historical trend for employment and income in the area as compared to Washington state and the nation. Unemployment rates generated for the Anacortes-Mount Vernon Statistical Area indicate that unemployment rates in this statistical area tend to be higher than Washington state and the nation. Interestingly, this tendency has abated within the last 2 years where the MSA unemployment rate meets that of the nation and state, indicating that the latest oil and housing crisis has affected this area to a lesser degree to date (US BLS 2007c). The greater volatility in unemployment rates for the MSA could likely be attributed to its smaller sample size. Likewise, per capita income at the county level has mirrored the national trend but income is generally less in the county than in the nation (US BEA 2006). Figures 11 and 12 display the unemployment and per capita income trends in the regional area compared to Washington state and the U.S.

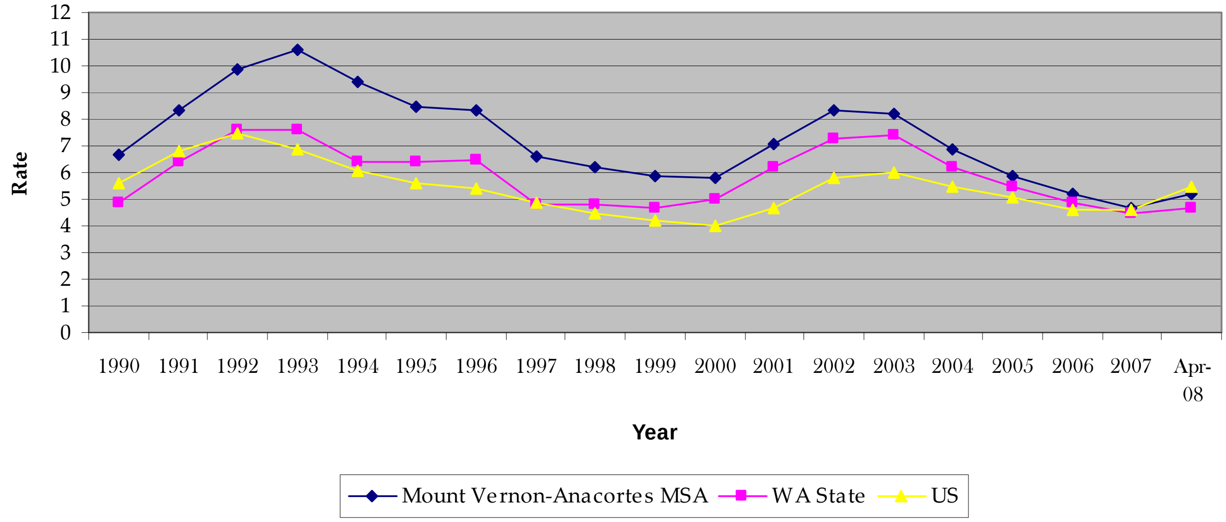

Figure 11
Unemployment Rates 1990 to 2008
Source: US BLS 2007c

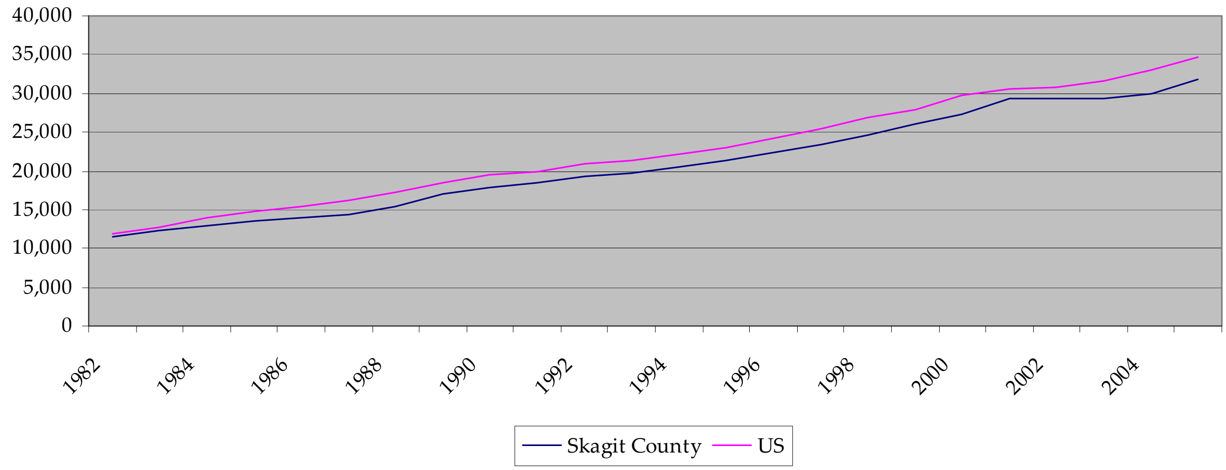

Figure 12
Per Capita Income (non-adjusted) 1982 to 2005
Source: US BEA 2006

3.1.7 Property and Taxes

The Project team compiled and reviewed a database from 2008 Skagit County Assessor records for the Project study area. Skagit County assessed values reflect market values in the study area (Ellestad 2008).

There are 147 parcels totaling roughly 200 acres within the study area; 29 of these are publicly owned and comprise approximately 60 acres of land. Public owners include the Cities of Burlington and Mount Vernon, DD #12 and DD #17, the Public Utility District, and WSDOT. The remaining properties are privately owned. Of the remaining parcels, approximately 58 are in residential use, 45 are commercial or industrial, and 20 are residential-agricultural or agricultural and resource lands (Skagit County 2008). Property value and tax characteristics of each land use type within the study area are described further below. For the purpose of this analysis, when parcels had the same owner and were adjacent to each other, we classified them as one property. In 2007, 9.48 percent of the property taxes in Skagit County went to the City's general fund and 12.69 percent to the County's general fund. Special districts' bonding for hospitals, schools, and fire protection; drainage; libraries; cemeteries; county roads; and the Washington State levy also receive allocations from property taxes (Skagit County 2007b). Information on sales tax and business tax is not available for this report.

3.1.7.1 Commercial Industrial and Retail

The commercial and industrial properties within the study area include retail, commercial, and industrial establishments. There are 28 properties within the study area. These include retail establishments like Home Depot, restaurants, such as McDonalds, and industrial establishments (see Figure 6 in Section 2.4). The average total market value for these establishments is approximately $2.56 million and the median value is $1.47 million. Aggregate total market value for the properties included in the study area reaches just over $66.7 million. Property taxes assessed for these properties within 2008 amounted to $712,069. Approximately $419,601 of this taxable base is within the city of Burlington and approximately $292,468 is within Mount Vernon (Skagit County 2008).

3.1.7.2 Agriculture

There are 18 residential-agricultural or agricultural-natural resources properties within the study area, comprising approximately 110 acres. The average total market value for these parcels is $230,706 and the median value is $237,000. The smallest total market value is $1,200 for a .81 acre parcel and the largest total market value is $352,100 for a 2.27 acre parcel. Aggregate total market value for these properties is just over $4.15 million. The aggregate property tax assessed in 2008 for these properties amounts to $45,469 (Skagit County 2008).

3.1.7.3 Residential

There are 60 residential parcels within the study area, including four identified multifamily properties and residential-agricultural zoned properties (also included in Section 3.1.7.2). Most of these properties are on the Mount Vernon side of the Skagit River. The typical home is a 3 bedroom, 1 to 1.5 bath house. The average total market value for single family properties is $210,605 and the median value is $204,450. Multifamily parcels include apartment buildings and two mobile home parks located on either side of the Skagit River. The average total market value for identified multifamily parcels is just over $1.99 million and the median is just under $1.95 million. The combined total market value for all properties in the study area is approximately $20.20 million. All residential properties within the study area have an aggregate 2008 property tax assessed at $216,095 (Skagit County 2008).

4 POTENTIAL EFFECTS

Each of the alternatives, including the No Action Alternative, could result in some temporary and permanent effects within the study area. The potential impacts of each alternative are discussed in light of the temporary and permanent effects to the community profile, regional and community growth, recreation, public services and community amenities, community linkages, industry and employment, and property and taxes.

4.1 Will Construction of the Alternatives Temporarily Affect Social and Economic Elements?

This section addresses any potential temporary effects to social and economic elements resulting from construction of each alternative. The information is presented according to the seven sub-elements of the social and economic elements identified in Section 3.

4.1.1 Community Profile

Temporary effects within the Community Profile sub-element involve effects that could temporarily change the overall character and image of the community as it exists now. Under each alternative, some construction will take place. Temporary effects to the community character could involve increased noise and changed aesthetics in work areas during construction. These effects are described for each alternative in Sections 4.1.1.1 through 4.1.1.3.

4.1.1.1 No Action Alternative

For health and safety reasons, the existing alignment of Stewart Road under I-5 in Mount Vernon will be moderately realigned to the south. This allows for Stewart Road to pass under a different span of the I-5 approach but does not require any work on I-5 or the bridge. Construction could lead to noise increases in the affected area and an aesthetic impact in the immediate vicinity, which could make the outdoor character of the area temporarily less appealing.

4.1.1.2 Improved Existing Levee Alignment Alternative

Construction under the Improved Existing Levee Alignment Alternative will include the proposed realignment of Stewart Road described under the No Action Alternative and work on both the left bank and right bank levees to bring the levees to 100-year levee certification standards as defined by FEMA. Construction could lead to noise increases in the affected area and an aesthetic impact in the immediate vicinity, which could make the outdoor character of the area temporarily less appealing. However, construction will not impair access to any establishments or residential areas within the affected area, except for portions of those properties discussed in Section 4.2.7, which would be purchased.

4.1.1.3 Levee Setback Alignment Alternative

Construction under the Levee Setback Alignment Alternative will include the proposed realignment of Stewart Road described under the No Action Alternative, construction of new levees landward of the existing levees, realignment of a section of East Whitmarsh Road, and vacation of sections of Marketplace Drive and Bouslog Road that would be waterward of the new levees. Construction could lead to noise increases in the affected area and an aesthetic impact in the immediate vicinity, which could make the outdoor character of the area temporarily less appealing. However, construction will not impair access to any establishments or residential areas within the affected area, except for those properties discussed in Section 4.2.7, which would be permanently displaced.

4.1.2 Regional and Community Growth

Temporary effects to the Regional and Community Growth sub-element involve any effects that would temporarily alter the trajectory of land development or population within the study area. Construction work under any of the alternatives would not lead to any temporary impacts to regional and community growth.

4.1.3 Recreation

The Recreation sub-element relates to public parks and public and private facilities that serve the study area's leisure needs. This can include health clubs, sports fields, nature trails, and other features. Construction work would impede access to the riverbank and would temporarily prevent recreational fishing in the area.

4.1.4 Public Services and Community Amenities

The Public Services and Community Amenities sub-element addresses the services provided to residents and businesses within the study area, including fire and police protection, utilities, hospitals, education, and libraries. The alternatives do not include any interruptions in the services currently provided within the study area. There are no anticipated temporary effects to the Public Services and Community Amenities sub-element. If roadway realignments require movement of any utilities, these will be coordinated with the appropriate providers to ensure maintenance of current levels of service.

4.1.5 Community Linkages

The Community Linkages sub-element relates to how people move to, from, and within the study area, whether via car, bicycle, public transit, or on foot. While noise from construction on any of the Project alternatives could make walking or bicycling in the immediate vicinity less appealing, construction will not physically block any of the sidewalks or bike paths within the study area. Potential temporary effects unique to each alternative are discussed in Sections 4.1.5.1 and 4.1.5.2.

4.1.5.1 No Action Alternative and Improved Existing Levee Alignment Alternative

The moderate realignment of Stewart Road to the south by the I-5 overpass could lead to a temporary reduction of lanes along this section of road during construction. It is not anticipated that this reduction would lead to a significant delay of drivers.

4.1.5.2 Levee Setback Alignment Alternative

The moderate realignment of Stewart Road to the south by the I-5 overpass could lead to a temporary reduction of lanes along this section of road during construction. It is not anticipated that this reduction would lead to a significant delay of drivers. Realignment of a section of East Whitmarsh Road on the right bank would be conducted prior to levee construction so that access along Whitmarsh Road would not be interrupted. There is a possibility that construction of the levee retaining wall parallel to Hoag Road could require that a portion of Hoag Road be utilized for construction staging. If this is the case, there may be lane reductions along Hoag Road and possible delays during rush hour traffic. There is the potential that Skagit

Transit may elect to temporarily re-route bus service on Hoag Road during this construction period.

4.1.6 Industry and Employment

The Industry and Employment sub-element relates to the economic character of the community in regard to the types of businesses, employment levels, and economic health of the area. Temporary impacts to industry and employment are discussed specific to each of the alternatives in the following sections. Due to the preliminary information available at the time of this report, potential temporary effects are identified but not explicitly quantified.

4.1.6.1 No Action Alternative

Realignment of Stewart Road could lead to a slight increase in construction employment in the area, though it is likely not to result in a tangible increase on its own. There are no anticipated temporary effects to industry and employment associated with the No Action Alternative.

4.1.6.2 Improved Existing Levee Alignment Alternative

Work conducted under the Improved Existing Levee Alignment Alternative could lead to temporary job growth within the construction sector in the greater Mount Vernon and Burlington areas. Similarly, the Project could lead to slight increases to regional employment in related fields, such as engineering. Businesses within the study area could also likely benefit from the injection of funds into the area as workers in the area spend some of their earnings in the immediate vicinity. This can lead to a cascading benefit from dollars spent in the local system.

Lane delays during rush hours on Hoag Road might lead to some people choosing different routes or abstaining from visiting businesses accessible via Hoag Road due to congestion. Because most businesses are connected via the Riverside Drive arterial, the potential for this occurring is negligible.
The current visibility of businesses from the street would not be blocked by construction of the Improved Existing Levee Alignment Alternative.

4.1.6.3 Levee Setback Alignment Alternative

The temporary effects to industry and employment from construction of the Levee Setback Alignment Alternative would be the same as those described in the Improved Existing Levee Alignment Alternative, except the scale of these benefits would be greater.

The current visibility of businesses from the street would not be blocked by construction of the Levee Setback Alignment Alternative.

4.1.7 Property and Taxes

The Property and Taxes sub-element encompasses both commercial and residential property values and their contribution to the property tax base. Construction under any of the alternatives could create noise and vibrations that could be heard and felt at some properties nearby during hours of construction. However, no known studies have been performed that indicate that construction leads to temporary changes in property values within an area.

4.2 Will the Alternatives Permanently Affect Social and Economic Elements?

This section addresses any potential permanent socio-economic effects resulting from construction of each alternative. The information is presented according to the seven sub-elements of the social and economic elements.

4.2.1 Community Profile

Permanent effects within the Community Profile sub-element involve effects that could permanently change the overall character, population, and image of the community as it exists now. Under each Project alternative, there will be some alteration to the community profile, detailed in Sections 4.2.1.1 and 4.2.1.2. The No Action Alternative would not create any permanent effects to the community profile.

4.2.1.1 Improved Existing Levee Alignment Alternative

Implementation of the Improved Existing Levee Alignment Alternative will result in some aesthetic changes near the improved levee. The social and economic study team took photographs of the view from Hoag Road and West Parkway in February

2008. From here, we digitally enhanced these photographs according to the specifications of this alternative to reflect the view that would occur if the levees were heightened. Figure 13 shows the viewshed from existing conditions and the viewshed if the Improved Existing Levee Alignment Alternative were undertaken. The altered view is largely the same view as current conditions, with a slight increase to levee height. This alternative does not involve the displacement of any whole properties, so populations would not be affected.

View North from Intersection of West Parkway and Hoag Road: Existing Conditions

View North from Intersection of West Parkway and Hoag Road: Improved Existing Levee Alignment Alternative

ANCHOR QEA

Figure 13
Improved Existing Levee Alignment Alternative Viewsheds
Skagit River Bridge Modification and Interstate Highway Protection Project

4.2.1.2 Levee Setback Alignment Alternative

The Levee Setback Alignment Alternative will also result in viewshed changes in the affected area. These changes are shown on Figure 14 along the Mount Vernon side at the intersection of Hoag Road and West Parkway. As Figure 14 illustrates, the implementation of the Levee Setback Alignment Alternative would result in the removal of vegetation and structures north of Hoag Road on the Mount Vernon side. Similar views could be expected on the Burlington side along Whitmarsh Road.

Due to the necessity of property buyouts, there would be a moderate decrease in the population within the study area under this alternative. Some of this population would be lost from residential-agricultural properties north of Hoag Road. A significant portion of the population loss would come from the displacement of the Riverbend RV Park on the Mount Vernon side west of I-5 and the Burlington RV Park just north of Whitmarsh Road.

View North from Intersection of West Parkway and Hoag Road: Existing Conditions

View North from Intersection of West Parkway and Hoag Road: Levee Setback Alignment Alternative

ANCHOR QEA

Figure 14
Setback Viewshed
Skagit River Bridge Modification and Interstate Highway Protection Project

4.2.2 Regional and Community Growth

As discussed in Section 3.1.2, most sections of the affected area are already limited from future development due to local zoning restrictions and available buildable land. Due to this, the No Build and Improved Existing Levee Alignment Alternatives would not cause any anticipated permanent effects to regional and community growth within the study area.

The Levee Setback Alignment Alternative, as mentioned in Section 4.2.1.2 could lead to a decrease in population due to the displacement of properties. The Levee Setback Alignment Alternative could lead to greater flood protection in Reaches 1 and 6, which might reduce Federal Insurance Rates on new FIRMs. This might contribute to greater development in some areas in Reaches 1 and 6 where flood protection would be enhanced and flood insurance rates and regulations potentially lowered. Figure 15 shows the boundaries of the downstream reaches. Information on flood protection levels from each of the Project alternatives and the consequences to FIRMs is still preliminary, so this potential effect is possible but not assured.

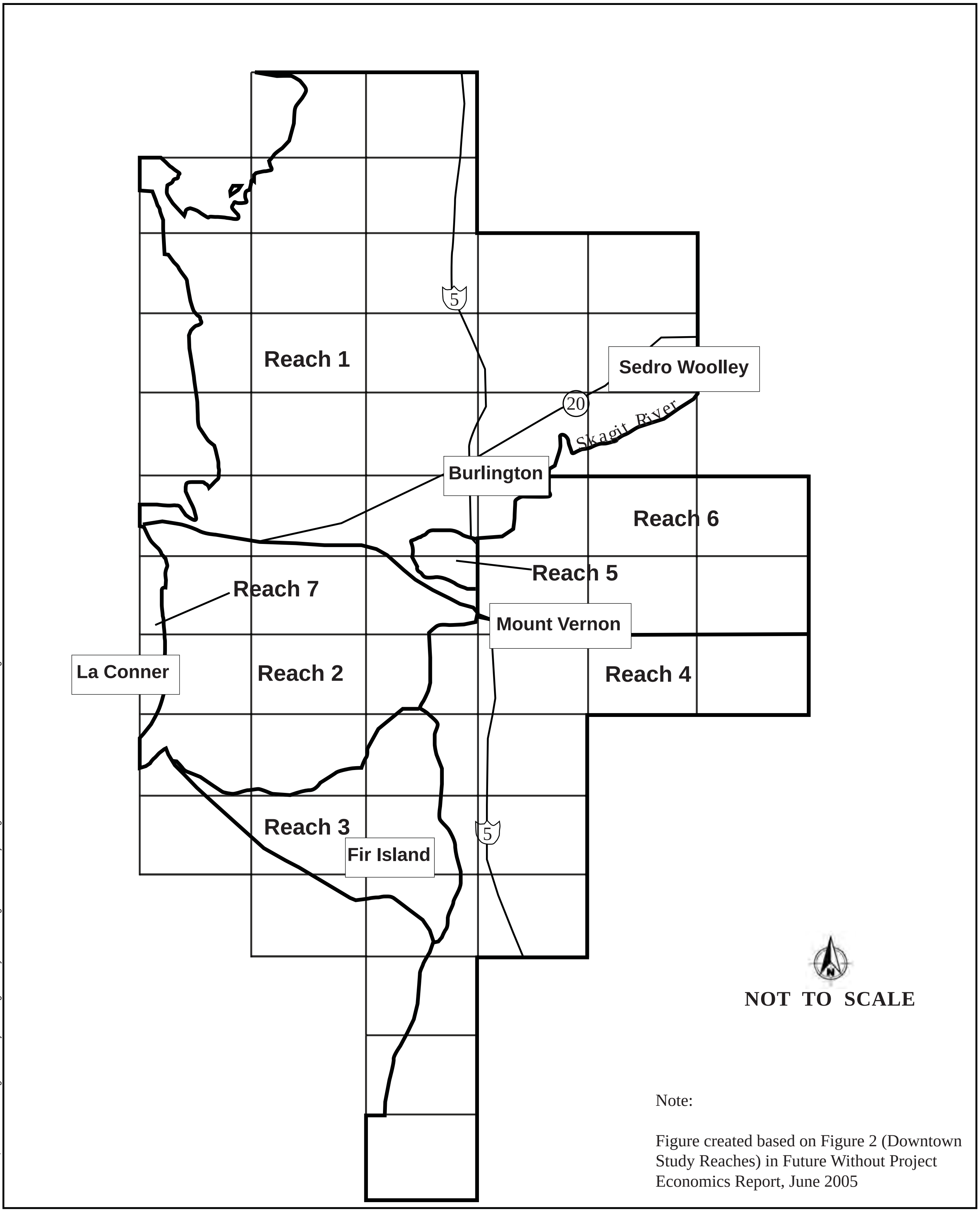

Figure 15
Downstream Reaches
Skagit River Bridge Modification and Interstate Highway Protection Project

4.2.3 Recreation

The Recreation sub-element relates to public parks and public and private facilities that serve the study area's leisure needs. This can include health clubs, sports fields, nature trails, and other features. The No Action Alternative and the Improved Existing Levee Alignment Alternative would not permanently affect the Recreation sub-element within the study area. The Levee Setback Alignment Alternative might include construction of a dike-top trail system along the river in Mount Vernon.

4.2.4 Public Services and Community Amenities

The Public Services and Community Amenities sub-element addresses the services provided to residents and businesses within the study area, including fire and police protection, utilities, hospitals, education, and libraries. None of the alternatives would result in a permanent change in the level of service provided by any of these existing services or amenities. However, flood protection can be considered a public amenity and some permanent effects to flood protection would be associated with each of the Project alternatives, as detailed in Sections 4.2.4.1 and 4.2.4.2. The No Action Alternative would not permanently affect the current level of flood protection.

4.2.4.1 Improved Existing Levee Alignment Alternative

The improved levees will be raised to a height where they can certifiably pass a 100-year flood event and up to 500-year flows by increasing the existing levee height by approximately 2 feet above existing elevations. This increase in elevation allows for 2 feet of freeboard above 100-year flood levels. Additionally, all improvements to the levees will be above the normal high water levels of the Skagit River (Stansbury 2009, Appendix A).

4.2.4.2 Levee Setback Alignment Alternative

Only preliminary hydraulic information exists for the Levee Setback Alignment Alternative. The Corps will be performing modeling on each alternative, but this modeling was not available at the time of this report. Until this modeling is completed, this information should be considered an estimate. The information here was derived from the preliminary analysis performed in the Final Engineering Analysis (Stansbury 2009, Appendix A). The Levee Setback Alignment Alternative could reduce depths of flows in the study area river reach. This, in turn, could potentially reduce the depth of flooding upstream of the BNSF Bridge by approximately 0.4 feet of flows up to the 100-year flood. This causes a reduction in the probability of levee failure or overtopping and a reduction in overflows from the river into the north bank area around Burlington at flows above the 25-year flood event.

4.2.5 Community Linkages

The Community Linkages sub-element relates to how people get around within the study area, whether via car, bicycle, public transit, or on foot. Potential permanent impacts to linkages within the study area associated with each Project alternative are described in Sections 4.2.5.1 and 4.2.5.2. There would be no permanent effects to linkages from the No Action Alternative.

4.2.5.1 Improved Existing Levee Alignment Alternative

Potential effects to linkages from the Improved Existing Levee Alignment Alternative would be minimal. Turn-outs along and access roads to the new levees may be constructed to provide for vehicle safety. Approximately half-way between the BNSF and Riverside Bridges, Whitmarsh Road currently crosses over the existing levee. Improving the right bank levee immediately west of the BNSF Bridge can be accomplished without any changes to Whitmarsh Road and no additional right of way will need to be purchased in this area. If Whitmarsh Road is removed, then Bennett Road or another road will be extended near the vicinity of the Project to mitigate for increased traffic.

4.2.5.2 Levee Setback Alignment Alternative

There are several adjustments to roadway alignments under the Levee Setback Alignment Alternative. However, none of these realignments would lead to any adverse impacts to access within the study area. Between the west end of the stormwater pond and the I-5 Bridge, the levee will be set back approximately 50 feet and Stewart Road will be realigned as described in the No Action Alternative (see Section 4.1.5.1). An approximately 1,000-foot-long section of Whitmarsh Road between the BNSF and Riverside Bridges would need to be relocated to the south of its present location. The new Whitmarsh Road section would be constructed before the old section is abandoned. Whitmarsh Road would sit waterward of the new levees. During flood events, Whitmarsh Road would have to be closed, similar to what occurs presently with the existing road during flood events. While slightly altered in its alignment, access to and from Whitmarsh Road would not be altered.

Along the Burlington side, the Levee Setback Alignment Alternative would result in the abandonment of two approximately 300-foot sections of road—Bennett Road south of the levee and the Marketplace Drive connection to West Whitmarsh Road. No traffic impacts are anticipated as a result of these road abandonments due to the planned extension of Bennett Road that is included as part of the project for this alternative.

4.2.6 Industry and Employment

The Industry and Employment sub-element relates to the economic character of the community in regard to the types of businesses, employment levels, and economic health in the area. The No Action and Improved Existing Levee Alignment Alternatives would not lead to any permanent alterations to the type or amount of industry and employment in the affected area. The purchase of some businesses within the affected area, as part of the implementation of the Levee Setback Alignment Alternative, could reduce the proportion of agricultural lands within the immediate study area as compared to other industry. However, neither of the Project alternatives would lead to any noticeable change in existing unemployment rates and income, as described in Section 3.1.6 and illustrated in Figures 11 and 12.

Estimated monetary damages to businesses, which might result due to changes in flood protection levels from either of the Project alternatives, are discussed within the framework of the Property and Taxes sub-element (see Section 4.2.7)

4.2.7 Property and Taxes

The Property and Taxes sub-element encompasses both commercial and residential property values and their contribution to the property tax base. This section explores any potential permanent effects on properties and taxes arising out of any of the alternatives. Potential damages resulting from not undertaking either of the Project alternatives in the event of a major flood event are discussed in Section 4.3.

4.2.7.1 No Action Alternative

FEMA is currently working with communities throughout the U.S. to develop new FIRMs. The maps report the base flood elevations for areas according to a 100-year flood event. These maps are then used to set Flood Insurance premium rates and development guidelines and requirements for flood protection within floodplains. Higher base flood elevations in areas can result in greater flood insurance requirements and higher premiums and development costs, which could result in decreased development or redevelopment in the area. While the FIRM updates are still pending and the process is outside of the purview of the Project and this study, it is important to note that the No Action Alternative does not respond to a mapped increase in base flood elevations, which has the potential to reduce growth, development, and taxes in the affected area (Martin 2007; Moser 2007). Additionally, only 100-year Corps Certified Levees qualify for credit in the FIRM mapping process. Presently, the levees in the study area do not meet the certification requirements and therefore cannot be included as part of the analysis to determine base flood elevations (Burlington 2008b).

4.2.7.2 Improved Existing Levee Alignment Alternative

The Improved Existing Levee Alignment Alternative could lead to two main effects to property and taxes—buyout of certain portions of properties within the affected area for needed right of way and levee certification, which might reduce current National Flood Insurance Program requirements on developments.

In order to provide for needed right of way space to maintain the levees, a portion of 17 private parcels, equaling approximately 2.43 acres would need to be purchased at fair market value. Fair market value has been preliminarily estimated at $686,000 (Stansbury 2009, Appendix A). If we assume that the total fair market value of these properties would be assessed as a simple reduction of the total fair market value by the estimated amount of purchased property under this alternative, then the Improved Existing Levee Alignment Alternative would result in a loss of $8,233 of

2008 assessed taxes. This amounts to 1 percent of the current study area's property tax contribution (Skagit County 2008). A full list of properties that would need to be partially acquired is provided in the 2009 Final Engineering Analysis (Stansbury 2009, Appendix A). Additionally, a complete list of properties within the Project area and their associated values are included in Appendix B.

The Improved Existing Levee Alignment Alternative would modify existing levees such that they could meet 100-year levee certification standards as defined by FEMA. If levees were certified, then the area protected by the levee might be removed from the special flood hazard area, thus making flood insurance non-mandatory in that area. The special flood hazard area is composed of land within the floodplain, which is subject to a 1 percent or greater chance of flooding in any given year (Burlington 2007). All of the study area is presently within the FEMA 100-year floodplain. A property that no longer is considered to be in the 100-year floodplain could experience a greater market value. A hedonic pricing model used in Fargo-Moorhead, North Dakota found that a house's location in a 100-year floodplain reduced its value by approximately $8,990 and was worth $10,241 less than comparable homes located outside of the floodplain before the major flood of 1997. The model found that required flood insurance on these homes accounted for 81 percent of the noted depreciation (Shultz and Fridgen 2007). (For rough comparison, the 2000 U.S. Census reported Burlington City and Mount Vernon City median home values at $129,200 and $142,000, respectively. The 2000 U.S. Census reported the median home value for the Fargo-Moorhead MSA was $94,200—30.5 percent less than the average of Burlington and Mount Vernon values.)

4.2.7.3 Levee Setback Alignment Alternative

As a result of setting back the existing levees and the associated assumptions regarding side slopes, crest width, and setbacks at the toe of the landward side of the levees, this alternative requires purchase of a greater amount of right of way than the Improved Existing Levee Alignment Alternative. This would lead to both partial and total acquisition of some properties within the study area. Additionally, changes to flood protection levels would benefit flood protection in some areas while reducing flood protection in other areas (Stansbury 2009, Appendix A).

According to the list of properties within the 2009 Final Engineering Analysis, Appendix A, there are 10 private properties that would be purchased entirely and 17 private properties of which portions would be acquired. This would amount to just under 37 acres of private property being acquired. If we assume that the total fair market value of these properties would be assessed as a simple reduction of the total fair market value by the estimated amount of purchased property under this alternative, then the Levee Setback Alignment Alternative would result in a loss of $117,536 of 2008 assessed taxes. This amounts to 12 percent of the current study area's property tax contribution (Skagit County 2008; Stansbury 2009, Appendix A). A full list of properties that would need to be partially or totally acquired is provided in the 2009 Final Engineering Analysis (Stansbury 2009, Appendix A).

Similar to the Improved Existing Levee Alignment Alternative, the new setback levees could meet the 100-year levee certification standards as defined by FEMA. If levees were certified, then the area protected by the levee might be removed from the special flood hazard area, thus making flood insurance non-mandatory in that area. Properties that are no longer considered to be in the 100 year floodplain could experience a greater market value (Shultz and Fridgen 2007).

The level of flood protection provided by the levees would be heterogeneous, however. The preliminary evaluation of potential cumulative flood damages considered 5-year to 500-year flood events and found that that the Levee Setback Alignment Alternative would reduce flood damages under existing conditions upstream from $46.8 million annually to $43.4 million, resulting in $3.4 million in annual savings. The study found that annualized downstream flood damages would be decreased from $29.9 million pre-project to $26.9 million under the Levee Setback Alignment Alternative, resulting in a $3 million savings in annualized damages. In total, implementation of the Levee Setback Alignment Alternative would result in a $6.4 million decrease in annualized damages upstream and downstream of the project. Areas better served by the Levee Setback Alignment Alternative include Reaches 1 and 6, whereas Reaches 2, 3, 4, 5, and 7 generally would see some degradation to flood protection. However, construction of the setback levees will reduce the potential for flooding in areas adjacent to the new levees in Reaches 1, 4, 5, and 6 (Stansbury 2009, Appendix A). Figure 15 in Section 4.2.2 shows the reaches within the area.

4.3 Will There be Effects on the Social and Economic Elements if the Project is Not Built?

If the Project is not built, the impacts that have been associated with the permanent impacts of the No Action Alternative would result. Additionally, the area would continue to be a source of major flood concern. If a flood the size of the 1917 or 1921 flood occurred, it could breach the levees in Mount Vernon and Burlington. A 100-year flood could cause an estimated $1.3 billion in damages to the Skagit delta, closing down I-5 and State Route 20, potentially wiping out the BNSF Bridge, and flooding the municipal waste water treatment plants in Burlington and Mount Vernon (Seattle Corps 2008). While the Project alternatives could not completely prevent or avoid this level of damage, they are a step in a systematic approach to managing flooding within the Skagit delta and are focused on a major pinch point within the Skagit River system. At a more localized level, a Corps Reconnaissance Report in April 1993 quantified average annual flood damages for the North Mount Vernon area (Mount Vernon 2005). Table 6 shows estimated damage in both 1992 dollars and 2008 dollars. Likewise, damages to the Burlington side of the affected area could suffer major annual damages if the Project was not implemented and a major flood event occurred.

Table 6
Average Annualized Flood Damage Estimates, North Mount Vernon

Category Receiving Damage/Cost	North Mount Vernon 1992 Dollars	North Mount Vernon 2008 Dollars
Residential Structures	$127,000	$191,625
Residential Contents	$56,000	$84,496
Commercial/Industrial	$383,000	$577,893
Public	$111,000	$167,483
Emergency Aid	$321,000	$484,344
Agriculture	$41,000	$61,863
Other	$11,000	$16,597
Total	**$1,050,000**	**$1,584,303**

Source: Mount Vernon Overall Economic Development Plan as part of the Comprehensive Plan, 2005

4.4 What Are the Cumulative Effects to the Social and Economic Elements?

Enhancements to this section of the Skagit River Valley may trigger other flood protection improvements in other areas of the valley where flooding has slightly increased. It may also lead to greater development in areas where buildable land exists in areas where flood protection has been enhanced.

5 MEASURES TO AVOID OR MINIMIZE PROJECT EFFECTS

This section discusses measures that the Project would undertake to avoid or mitigate any of the impacts discussed in Section 4. Avoidance or mitigation measures could include actions to address either temporary or permanent effects.

5.1 What Measures Will be Taken to Avoid or Minimize Effects to the Social and Economic Elements Before and During Construction?

This section discusses potential measures to avoid or minimize effects before or during construction within the context of each sub-element of the social and economic elements that are examined in this report. In Sections 5.1.1 through 5.1.7, potential effects to each sub-element are briefly summarized and then relevant avoidance or minimization measures are detailed.

5.1.1 Community Profile

Temporary effects within the Community Profile sub-element involve effects that could temporarily change the overall character and image of the community as it exists now. Under each alternative, some construction will take place. Effects to the community character could involve increased noise and changed aesthetics in work areas during construction.

To minimize noise disturbance to the surrounding community, Project construction will only occur as allowed by local noise ordinances.

5.1.2 Regional and Community Growth

Temporary effects to the Regional and Community Growth sub-element involve any effects that would temporarily alter the trajectory of land development or population within the study area. Construction work under any of the alternatives would not lead to any temporary impacts to regional and community growth; therefore, there are no avoidance or minimization efforts associated with this sub-element.

5.1.3 Recreation

The Recreation sub-element relates to public parks and public and private facilities that serve the study area's leisure needs. This can include health clubs, sports fields, nature trails, and other features. Construction work under each alternative would not impinge on any of these features and hence there are no potential temporary effects to discuss in this section. Therefore, there are no avoidance or minimization efforts associated with this sub-element.

5.1.4 Public Services and Community Amenities

The Public Services and Community Amenities sub-element addresses the services provided to residents and businesses within the study area, including fire and police protection, utilities, hospitals, education, and libraries. The current alternatives do not include any interruptions in the services currently provided within the study area. There are no anticipated temporary effects to the Public Services and Community Amenities sub-element. If roadway realignments require movement of any utilities, these will be coordinated with the appropriate providers to ensure maintenance of current levels of service.

5.1.5 Community Linkages

The Community Linkages sub-element relates to how people get around within the study area, whether via car, bicycle, public transit, or on foot. While noise from construction on any of the Project alternatives could make walking or bicycling in the immediate vicinity less appealing, construction work will not physically block any of the sidewalks or bike paths within the study area; a protected walkway will be provided if existing sidewalks are temporarily blocked.

5.1.6 Industry and Employment

The Industry and Employment sub-element relates to the economic character of the community as regards types of businesses, employment levels, and economic vitality. Under the Project alternatives, lane delays during rush hours on Hoag Road might lead to some people choosing different routes or abstaining from visiting businesses accessible via Hoag Road due to congestion. Because most businesses are connected via the Riverside Drive arterial, the potential for this occurring is negligible.

The current visibility of businesses from the street would not be blocked by construction of either Project alternative. If construction does block views to businesses, signage will be provided indicating businesses are open and accessible.

5.1.7 Property and Taxes

The Property and Taxes sub-element encompasses both commercial and residential property values and their contribution to the property tax base. There are no temporary effects associated with this sub-element and hence no avoidance or minimization measures are proposed.

5.2 What Measures Will be Taken to Mitigate Effects of Operation?

Potential measures to mitigate effects to social and economic elements before or during operation are discussed within the context of each sub-element of this report. Potential effects to each sub-element are briefly summarized and then any mitigation measures are detailed.

5.2.1 Community Profile

The effects to the Community Profile sub-element associated with the Project alternatives include changes to the viewshed for some properties within the study area and a potential reduction in the population due to acquisition of some properties in the Levee Setback Alignment Alternative. The Project would comply with all mandates of URARPA and other pertinent requirements for the acquisition of needed properties. Potential impacts and measures to reduce impacts to vulnerable populations are addressed in the Environmental Justice Discipline Report. There are no other mitigation measures associated with either of these effects.

5.2.2 Regional and Community Growth

As discussed in Section 3.1.2, most sections of the affected area are already limited for future development. Due to this, the No Build and Improved Existing Levee Alignment Alternatives would not cause any anticipated permanent effects to regional and community growth within the study area. The Levee Setback Alignment Alternative, as mentioned in Section 4.2.1.2, could lead to a decrease in population due to the displacement of properties. The Levee Setback Alignment Alternative could lead to greater flood protection in Reaches 1 and 6, which might reduce Federal Insurance Rates on new FIRMs. This might contribute to greater development in some areas in Reaches 1 and 6 where flood protection would be enhanced and flood insurance rates and regulations potentially lowered. There are no mitigation measures associated with this sub-element.

5.2.3 Recreation

The Recreation sub-element relates to public parks and public and private facilities that serve the study area's leisure needs. This can include health clubs, sports fields, nature trails and other features. The No Action Alternative and the Improved Existing Levee Alignment Alternative would not affect the Recreation sub-element within the study area. The Levee Setback Alignment Alternative may include a dike-top trail system on the Mount Vernon side of the Skagit River, which would increase recreation opportunities in the immediate area. This effect would be beneficial and hence there are no mitigation measures associated with this sub-element.

5.2.4 Public Services and Community Amenities

The Public Services and Community Amenities sub-element addresses the services provided to residents and businesses within the study area, including fire and police protection, utilities, hospitals, education, and libraries. None of the alternatives would result in a permanent change in the level of service provided by any of these services. There are no mitigation measures associated with this sub-element.

5.2.5 Community Linkages

The Community Linkages sub-element relates to how people get around within the study area, whether via car, bicycle, public transit, or on foot. While the Levee Setback Alignment Alternative would result in some roadway realignments and closure of segments of Bennett Road and Marketplace Drive, the Project would extend another section of Bennett Road as part of the City of Burlington's Traffic Improvement Plan so that any impact to traffic or circulation in the study area would be avoided. Similarly, if Whitmarsh Road is removed as part of the Improved Existing Levee Alignment Alternative, then an extension will be added to either Bennett Road or another road near the vicinity of the Project to mitigate for increased traffic.

5.2.6 Industry and Employment

The Industry and Employment sub-element relates to the economic character of the community as regards types of businesses, employment levels, and economic vitality. There are no permanent effects to Industry and Employment under the Improved Existing Levee Alignment Alternative. Under the Levee Setback Alignment Alternative, some businesses would need to be relocated. Acquisition of businesses within the study area would comply with all the requirements of URARPA and other pertinent requirements.

5.2.7 Property and Taxes

The Property and Taxes sub-element encompasses both commercial and residential property values and their contribution to the property tax base. Purchase of property under either Project alternative will comply with all requirements of URARPA. Either of the Project alternatives could lead to changes in flood protection for properties and the FIRM. There are no mitigation measures associated with this change.

6 UNAVOIDABLE ADVERSE EFFECTS

This section explores whether there are any substantial adverse effects of the Project that cannot be avoided. The Project will not cause any substantial adverse effects to social or economic elements that cannot be avoided.

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APPENDIX A

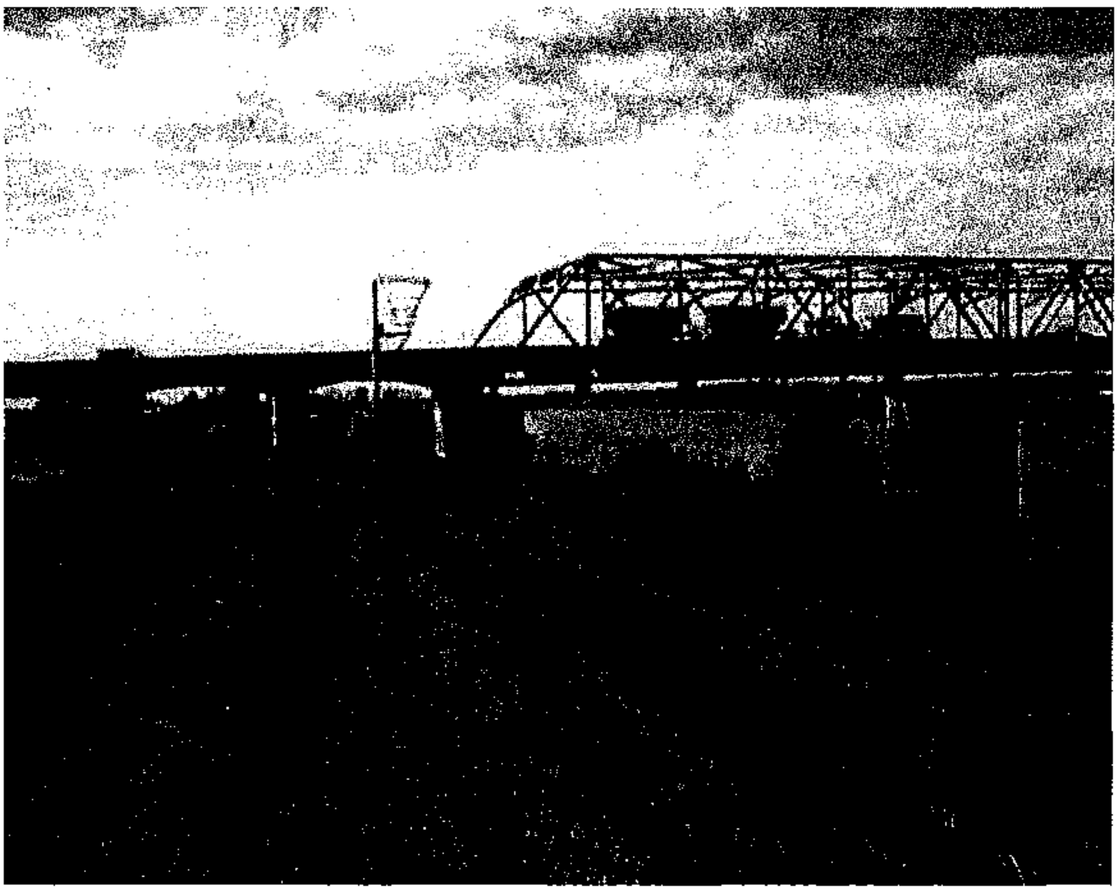
FINAL REPORT
ENGINEERING ANALYSIS OF LEVEE ALTERNATIVES

Final Report

ENGINEERING ANALYSIS OF LEVEE ALTERNATIVES

Skagit River Bridge Modification and Interstate Highway Protection Project

June 2009



Final Report

ENGINEERING ANALYSIS OF LEVEE ALTERNATIVES

Skagit River Bridge Modification and Interstate Highway Protection Project

Prepared for

Skagit County Department of Public Works

June 2009

Prepared by

Michael R. Stansbury, P. E.

Engineering Analysis of Levee Alternatives

Final Report

Skagit River Bridge Modification and Interstate Highway Protection Project

Engineering Analysis of Levee Alternatives

1.0 INTRODUCTION

The Skagit River is subject to extensive property and highway damage during major flood events. Although major floods are generally infrequent, three major events have occurred in the past 18 years. Studies (1) have shown that a 100-year flood event would cause nearly $1 billion in damage to the basin and would shut down Interstate 5 for approximately 15 miles.

As the lower Skagit River Basin developed, low levees were constructed to protect the very productive farm lands in the lower basin. Over the years, these levees were increased in size to provide a greater degree of protection to the farm lands and to the rapidly growing urban areas around Mount Vernon and Burlington. Today, levees on the north side of the river extend from upstream of Burlington to the mouth of the Skagit River near La Conner. On the south side of the river, the levees extend from the Burlington Northern Santa Fe railroad bridge in Mount Vernon to the mouth. Figure 1 shows the lower Skagit River Basin and the location of these levees in the vicinity of the study area.

The flood risk to the lower Skagit River Basin has been widely recognized and efforts have been underway for many years to develop a cost effective plan for preventing flood damages. The U. S. Army Corps of Engineers (Corps) and Skagit County have been deeply involved in the preparation of a flood control plan for the past 10 years and a draft plan is expected to be available within the next few years. Although a number of alternatives are still on the table and being investigated, virtually all alternatives include plans for improving the levees that are located in the corridor between Mount Vernon and Burlington. This area, historically called the "Three Bridge Corridor", is a significant pinch point in the levee system as shown in Figure 1. The three bridges in this reach of the river are the Interstate 5 Bridge, the Riverside Bridge (now known as the Old Highway 99 Bridge), and the Burlington Northern Santa Fe (BNSF) railroad bridge.

The levee reach being studied in this project is from just upstream of the BNSF railroad bridge to just downstream of the Mount Vernon and Burlington city boundaries, a distance of about 1.2 miles. The scope of the project is to look at ways to improve the system of levees in this reach but does not include modification of the three bridges or the approaches to the bridges. It is assumed that the bridge related improvements, if needed, will be included in the much larger General Investigation of the Skagit River now being undertaken by the Corps and Skagit County.

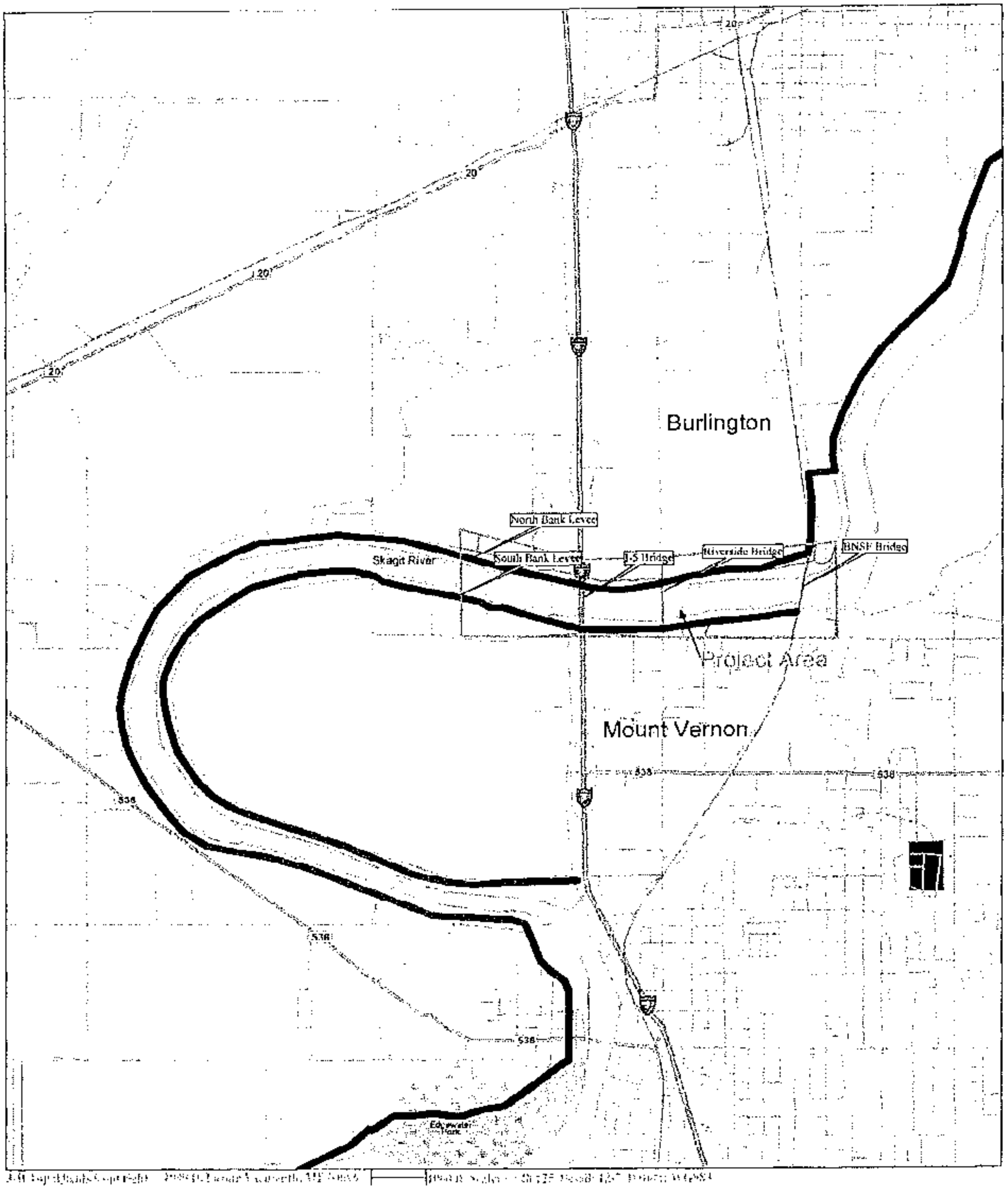


Figure 1 Vicinity Map

Three general alternatives will be described and evaluated in this report:

- The No-Action Alternative – This alternative assumes that the levees will be maintained in their present configuration and that only maintenance activities will occur in the future.
- An Improved Existing Levee Alternative – In this alternative, it is assumed that the levees will be raised modestly, improved structurally, but will remain in their current location.
- The Setback Levee Alternative – This alternative envisions new levees that will be set back from the river and raised to the maximum extent practicable. Two variations in design height will be evaluated.

2.0 NO ACTION ALTERNATIVE

2.1 Description

As inferred from the title, this alternative assumes that the existing levees will remain in their current configuration and that no significant improvements will occur in the future. The locations of the levees are presented in Figure 2. The River Mile designations are taken from the most recent Corps of Engineers Hydrology and Hydraulics reports (2, 3).

2.1.1 Left Bank Levee

The existing south bank (left) levee begins at the high ground at the BNSF railroad bridge and ties into the abutment of the bridge. Although some erosion of the south bank of the river has occurred upstream of the BNSF bridge, the abutment is founded on very hard material and no erosion has occurred at the bridge abutment. Downstream of the bridge, the levee is located fairly close to the edge of the river and there is only a very small overbank area between the levee and edge of the river at low flows. A typical cross section of the levee in this location is shown in Figure 3a. Also shown is the normal high water surface elevation that corresponds to the 2-year flood event, about 80,000 cfs. The levee crests have not been surveyed recently so the elevations are approximate but are assumed to be within about a foot of the actual elevations. All elevations are based upon the 1929 NAVD datum.

At the Riverside Bridge, the left bank levee ties into the abutment of the bridge and the areas underneath of the bridge are fully rip-rapped. The existing levee is approximately 2 feet lower than the low chord of the bridge as it meets the abutment. A cross section of the levee at the bridge abutment is shown in Figure 3b.

West of the Riverside Bridge, the left bank levee parallels a stormwater drainage pond that was constructed to handle runoff from the bridge when it was constructed in 2004. As shown in Figure 3c, the stormwater pond embankment ties into the existing left bank levee. The levee parallels the pond for a distance of approximately 900 feet.

West of the pond, the levee passes underneath of the I-5 Bridge and continues westward. Although two of the piers from the bridge are located within the levee prism, as shown in Figure 3d, the bridge clears the levee crest by approximately 10 to 12 feet. Stewart Road lies just south of the levee in this location and also passes under the I-5 Bridge approach span.

Throughout much of the length of the left bank levee within the project reach, the toe of the bank has been rip-rapped. In most cases, the rip rap is not part of the levee itself but protects the bank riverward of the levee from erosion. Except under the three bridges, there does not appear to be rip rap on the levees themselves.

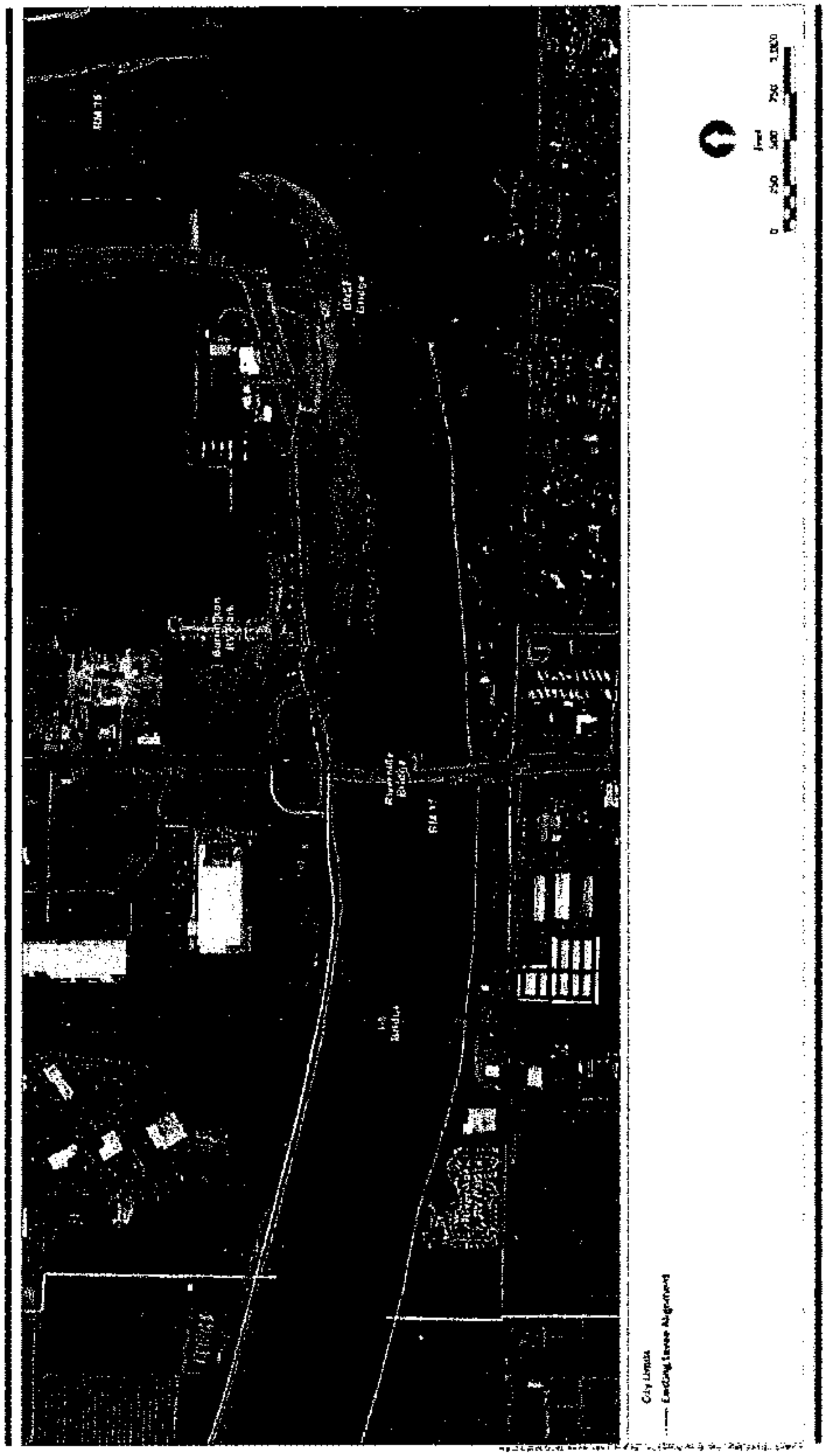


Figure 2
Aerial Photo of Existing Conditions in the Project Area
Skagit River Bridge Modification and
Interstate Highway Protection Project

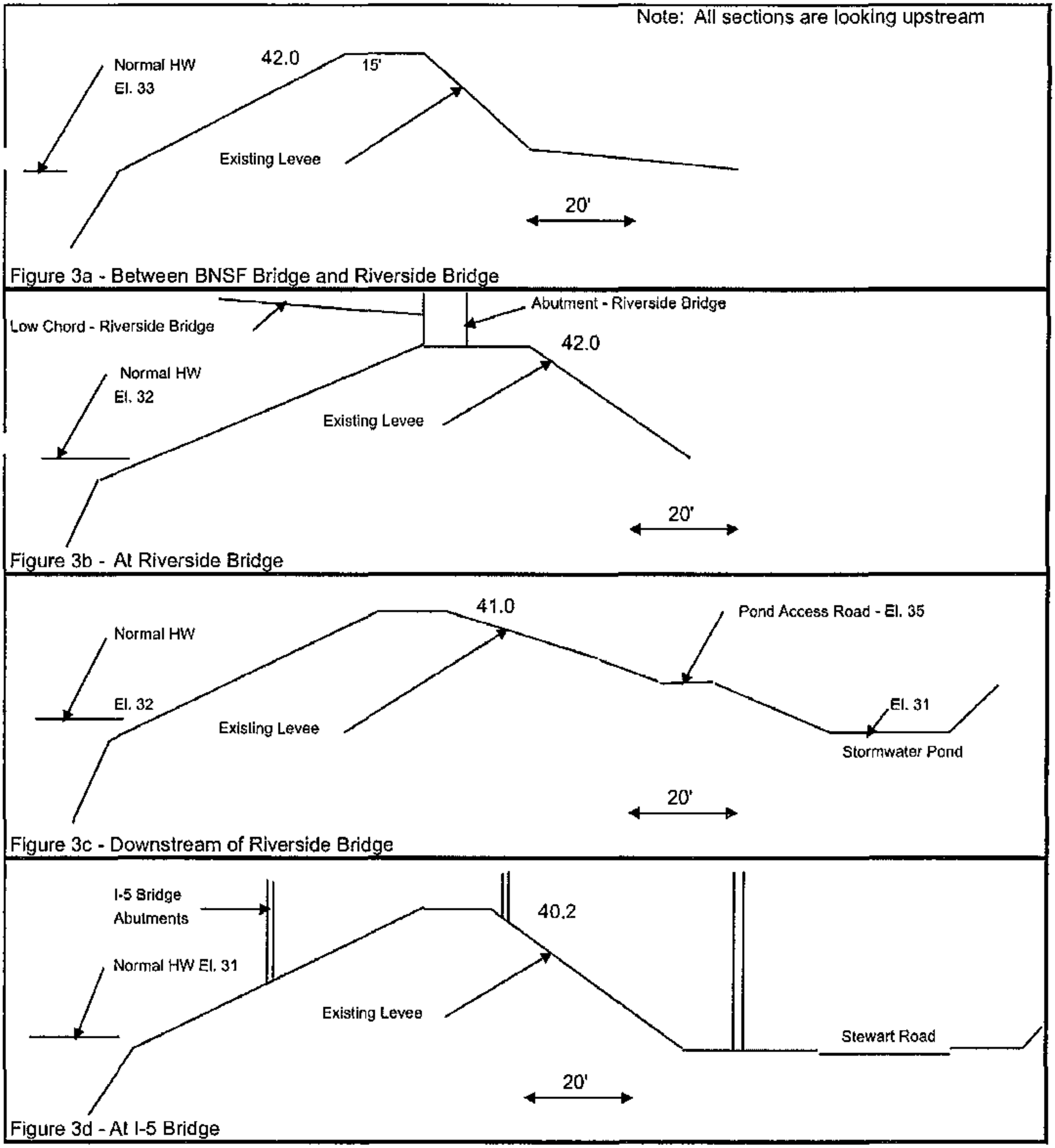


Figure 3 - Left Bank Levee Sections - No Action Alternative

2.1.2 Right Bank Levee

The existing north bank, right, levee is quite similar to the south bank levee except that it is paralleled throughout the reach by Whitmarsh Road. Upstream of the BNSF railroad bridge, the levee is contiguous to the railroad embankment and serves as a levee for a distance of approximately 1,600 feet.

Just upstream of the BNSF Bridge, a small levee exists adjacent to the waters edge. This levee is not maintained, covered with vegetation, and has a height of only 4 or 5 feet. Except at very low flows, it does not appear to impact flow conveyance. However, it may direct flows away from the overbank area adjacent to the bridge at nearly all flow levels.

The north end of the BNSF Bridge is a trestle section with 7 piers within the overbank area. These piers impair flows during flood events and during the 1995 flood event scour caused one of the piers to settle several feet, forcing closure of the rail line for several days.

Between the railroad bridge and the Riverside Bridge, the levee is integral with East Whitmarsh Road in many locations and crosses over the levee approximately 900 feet west of the railroad bridge and again just upstream of the Riverside Bridge. Consequently, Whitmarsh Road is closed to traffic during moderate to extreme flood events. Figure 4a shows typical levee cross sections in this area.

Whitmarsh Road passes under the Riverside Bridge adjacent to the river and a stormwater pond that handles runoff from the north end of Riverside Bridge. Although the crest elevation of the levee is maintained in this area, it is somewhat discontinuous as it traverses around the road, the pond, and the bridge abutment. Figure 4b shows a cross section of the levee at the pond/bridge interface.

The USGS stream gauging station *Skagit River at Mount Vernon* is located just downstream of the Riverside Bridge. Its cableway for flow measurements is a few hundred feet further downstream.

West of the Riverside Bridge, Whitmarsh Road is immediately north of the levee and tends to constrain the extent of the levee, forcing steep side slopes and limiting levee improvements in this area. See Figure 4c for a typical levee section in this area.

Whitmarsh Road and the levee both pass under the I-5 Bridge approach section. Road clearance is greater than 16 feet and the levee crest is approximately 10 feet lower than the low chord of the bridge. West of the I-5 Bridge, the levee and Whitmarsh Road parallel each other and the cross section is similar to the section shown in Figure 4c.

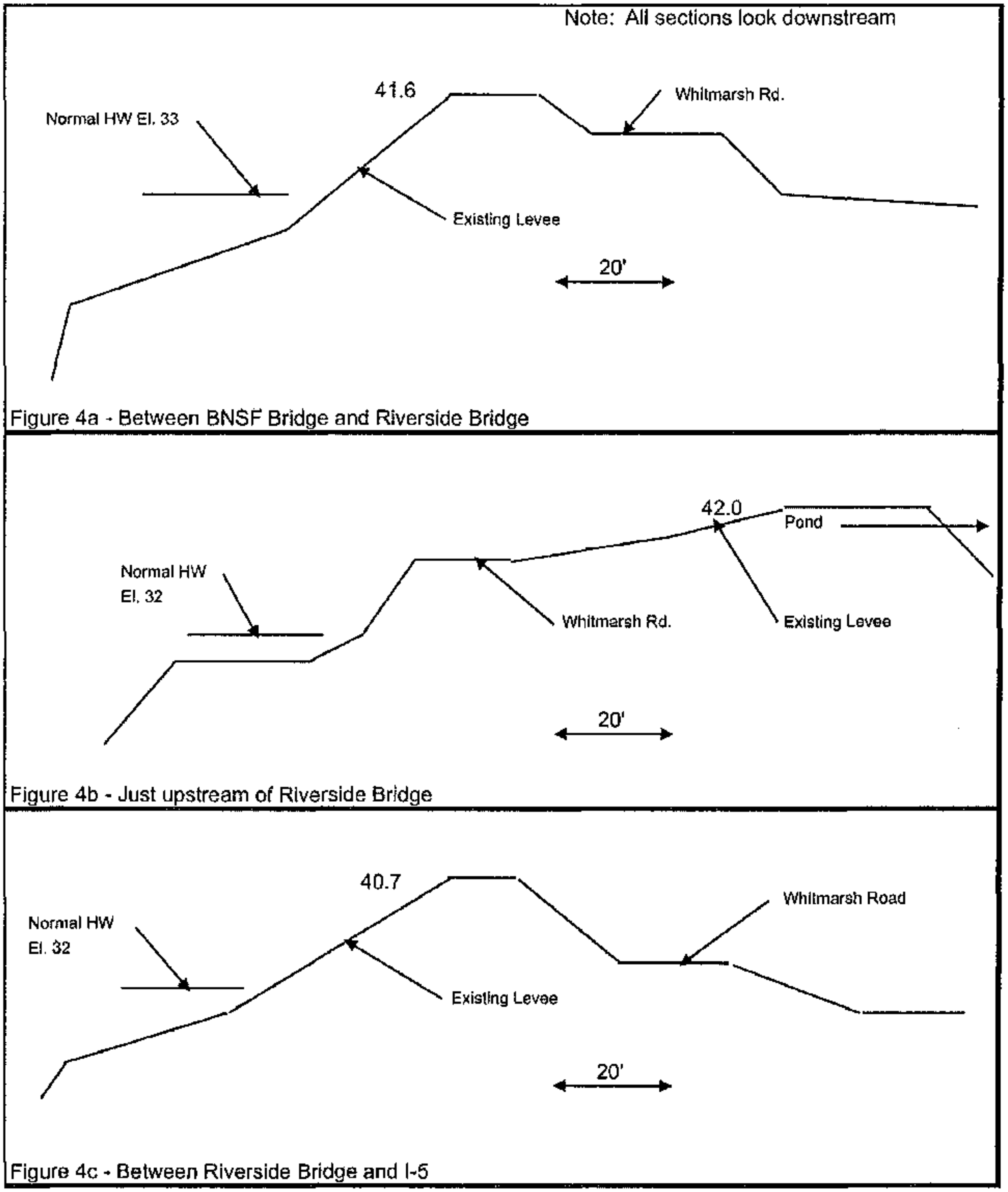


Figure 4a - Between BNSF Bridge and Riverside Bridge

Figure 4b - Just upstream of Riverside Bridge

Figure 4c - Between Riverside Bridge and I-5

Figure 4 - Right Bank Levee Sections - No Action Alternative

Similar to the left bank levee, rip rap has been placed within the toe of the river bank. The rip rap reduces the erosion potential of the river bank but is seldom actually part of the levee section except at the bridge crossings.

2.2 Hydraulic Analysis

The section of Skagit River levees covered in this project are currently being studied by the Corps of Engineers as part of its General Investigation (GI) currently expected to be completed in about two more years. It has been anticipated that the preliminary results from the hydrologic investigations as part of the GI study would be used in this project analysis. Each alternative being considered here, for instance, would be modeled hydraulically to determine each ones impact on river flows. However, due to a number of factors, the hydrologic analyses that have been completed to date are now being revised and can not be relied upon at this time. Consequently, the initial analyses that were presented in the draft version of this report were based upon an analysis of hydrology and hydraulics reports (2, 3) that are currently available. These reports, for example, deal only with current conditions and did not reflect an analysis of proposed alternatives. However, as described in Appendix D, detailed computer models were used in the preparation of this final engineering analysis report. The results of this modeling effort confirmed that the initial analyses that were presented in the draft reports were valid and could be used to determine the benefits and costs for the project.

It should also be noted that floods up to and including the 100-year flood will be analyzed in this report. Larger floods, such as the 250- and 500-year floods, are analyzed in the Corps reports (2, 3) but because of their magnitude and extent of flooding it is virtually impossible to analyze without the use of detailed computer models. And even those models rely heavily on input that predicts exactly where levees may fail, a highly speculative endeavor at best.

In the No-Action Alternative, there will be no change in flows in the Skagit River if this alternative is selected. Consequently, flows will remain as they are at the present and the Corps of Engineers Hydrology and Hydraulics Reports (2, 3) are utilized to determine the frequency of flooding in this reach of the river.

For purposes of this analysis, it will be assumed that the flow capacity of the river will be based upon the flow level that provides 3 feet of freeboard at the lowest crest of the levees. Figure 5 shows the crest elevation of each levee as taken from the Corps reports as well as the flood elevations for the 2-, 10-, 25-, 50-, and 100-year floods. In addition, the elevations corresponding to the lowest levee crest minus three feet of freeboard is also shown. The figure shows that the 25-year flood is the largest flood that can pass through the reach without encroaching upon the 3-feet of freeboard on the levees.

It should be noted that the Corps has estimated, in the *Hydrology* Report (2), that the 25-year flood at the USGS Mount Vernon gage is 146,000 cfs. However, when flows reach this quantity, flows begin to leave the river upstream of the existing levee

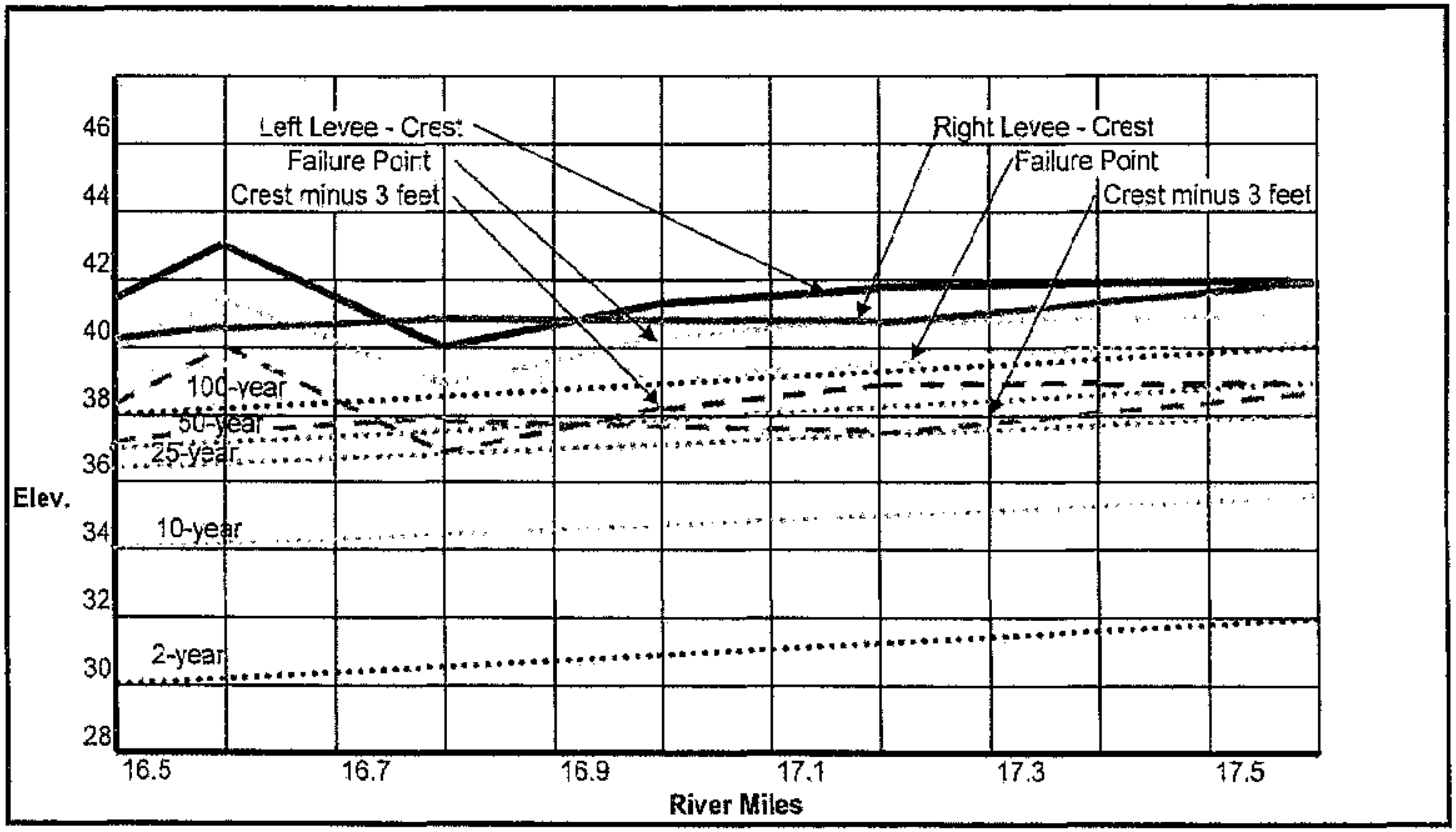


Figure 5 - Levee Crest Elevations and Flood Profiles - Existing Conditions

Consequently, the modeled flows in the Corps *Hydraulics* report (3) for the 25-year flood event are approximately 133,000 cfs as measured at the USGS gage.

As part of the Corps of Engineers hydraulics analysis (3), it makes estimates about when various existing levees may fail when the water level approaches the tops of the levees. It should be noted that none of the levees in this reach are "likely" to fail at flows up to and including the 100-year flood. In other words, there is less than a 50 percent probability that levees in the study reach would fail at floods smaller than the 100-year event.

However, it has been observed that during large floods during the 1990's, several levees in the study reach nearly failed due to bank erosion and piping and that failure would probably have occurred if it were not for flood fighting efforts.

2.3 Cost Estimate

Since no improvements are required for the No Action Alternative, there are no capital or maintenance costs.

2.4 Rights of Way

Again, since there will be no changes to the existing levee system, there will be no additional rights of way required.

3.0 IMPROVED EXISTING LEVEE ALTERNATIVE

3.1 Description

The Improved Existing Levee Alternative is designed to provide a higher degree of flood protection but without moving the existing levees or making significant changes to the levees. This can be done by raising the existing levees in their existing locations, the maximum increase in height limited by existing bridges, roadways, and other structures. The analysis that led to the determination of the probable crest elevations for this alternative *Technical Memorandum, Alternative Levee Designs,* is included as Appendix A.

As described in the Technical Memorandum, the most southerly girder of the newly constructed Riverside (Old Highway 99) Bridge is the controlling elevation for raising the levees in this reach of the river. Assuming that three feet of freeboard is desired, the maximum water surface elevation at the Riverside Bridge will be 41.0 feet and the maximum levee crest elevation will be 44.0 feet. Using Corps of Engineers model runs (3), the slope of the river in this reach during major floods is estimated to be 0.00032 and the design crest elevations of the improved existing levees will be as shown in Table 1.

Table 1
Design Water Surface Elevations and Levee Crests

Location	Design Water Surface Elevation (NAVD)	Design Levee Crest Elevation (NAVD)
River Mile 16.50 (City Limits)	39.9	42.9
River Mile 16.80 (Interstate 5 Bridge)	40.5	43.5
River Mile 17.07 (Riverside Bridge)	41.0	44.0
River Mile 17.56 (BNSF Bridge)	41.8	44.8

It should be noted that the BNSF Bridge is actually the more constraining bridge in this reach if adequate freeboard is desired. In addition, the number and size of the piers cause considerable backwater. Even if the bridge were to be replaced as studied by Skagit County (4), the low chord elevations cannot be corrected unless the railroad grades are raised and this would require that the track elevations be raised for a considerable distance north and south of the bridge. This could be difficult and/or very expensive.

The existing levees have been constructed over many years, beginning with very simple farm levees in the late 1800's. The composition of the levees is not completely known or documented and the side slope of the levees varies throughout the reach. For levees of the height planned for this project, side slopes could vary between 2:1 and about 5:1. A detailed geotechnical investigation will be necessary during the final design of the project to select the materials to be used in the levees and the final side slopes.

For purposes of this project, it is assumed that the levee will have a top width of 15 feet and normal side slopes of 3:1. This will allow steeper side slopes of 2:1 and 4:1 where one side of the levee may be limited by existing structures, roads, or the river bank. Potential limitations and side slopes at various locations will be described in the following paragraphs. In general, the crest of the levees will be increased approximately 2 feet above their existing elevations. Also, it may be desirable to keep all improvements to the levees above the normal high water levels of the Skagit River. According to the hydraulics reports (3) prepared by the Corps of Engineers, this elevation, the 2-year flood, is approximately 30 to 33 feet NAVD within this reach. In addition, where possible, a distance of 20 feet will be maintained on the landward side of the levee for maintenance purposes.

The Improve Existing Levee Plan is shown on Figure 6.

3.1.1 Improved Left Bank Levee

The existing levee between the BNSF Bridge and the Riverside Bridge is fairly consistent in that the levee is located fairly close to the rivers edge and side slopes are generally similar throughout. As shown on Figure 7a, the levee can be improved and raised to the design height without encroaching on the normal high water elevation (approximately 33). However, in much of this reach it may be necessary to purchase some additional rights of way in order to obtain the 3:1 side slopes desired. Dike District 17 does own some of the needed properties or has obtained options to purchase others.

Just downstream of the Riverside Bridge, the levee is adjacent to an existing stormwater pond that will remain intact as part of this alternative. However, as shown in Figure 7b, the levee can be raised to the desired height without encroaching upon the stormwater pond or the normal high water elevation.

West of the stormwater pond to the I-5 Bridge, the levee returns to a more normal configuration as shown on Figure 7c. The toe of the landward side levee will be close to the existing Dike District 17 maintenance building but there appears to be adequate clearance to allow approximately 20 feet for maintenance of the levee. Underneath of the I-5 Bridge, clearance between the bridge and the levee crest will be reduced by about 2 feet. However, there still should be sufficient clearance for small maintenance vehicles to pass under the bridge as shown in Figure 7c.

West of the I-5 Bridge, there should sufficient area to allow the improved levee to be constructed above normal high water although it will require that some additional rights of way be obtained on the landward side of the levee. A typical cross section of the levee is shown on Figure 7d. At the west end of the improved levee, an existing drainage pump station is located on the levee and may need to be relocated or modified. This needs to be researched further.

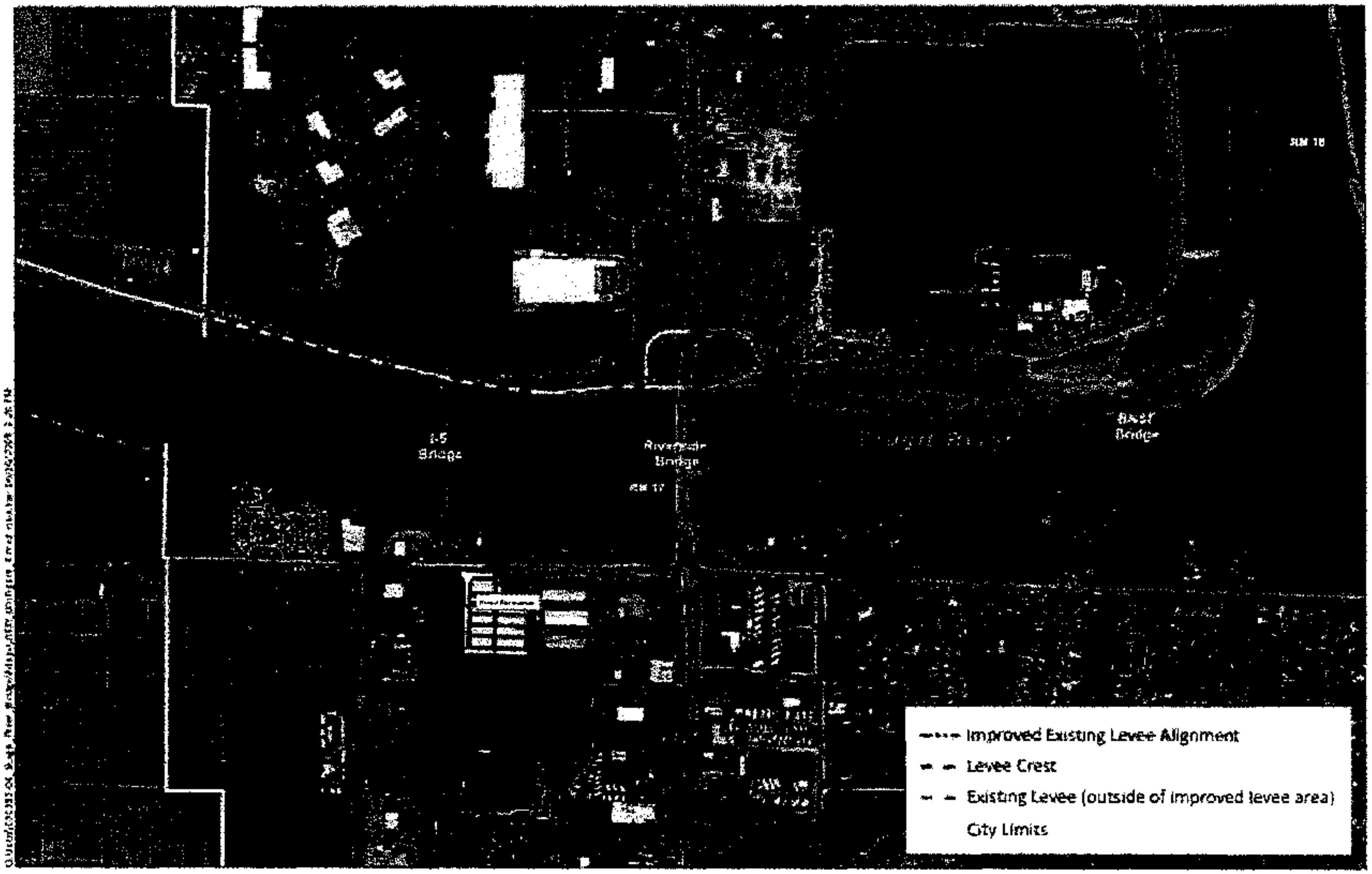


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Figure 6
Improved Existing Levee Alignment Alternative
Skagit River Bridge Modification and
Interstate Highway Protection Project

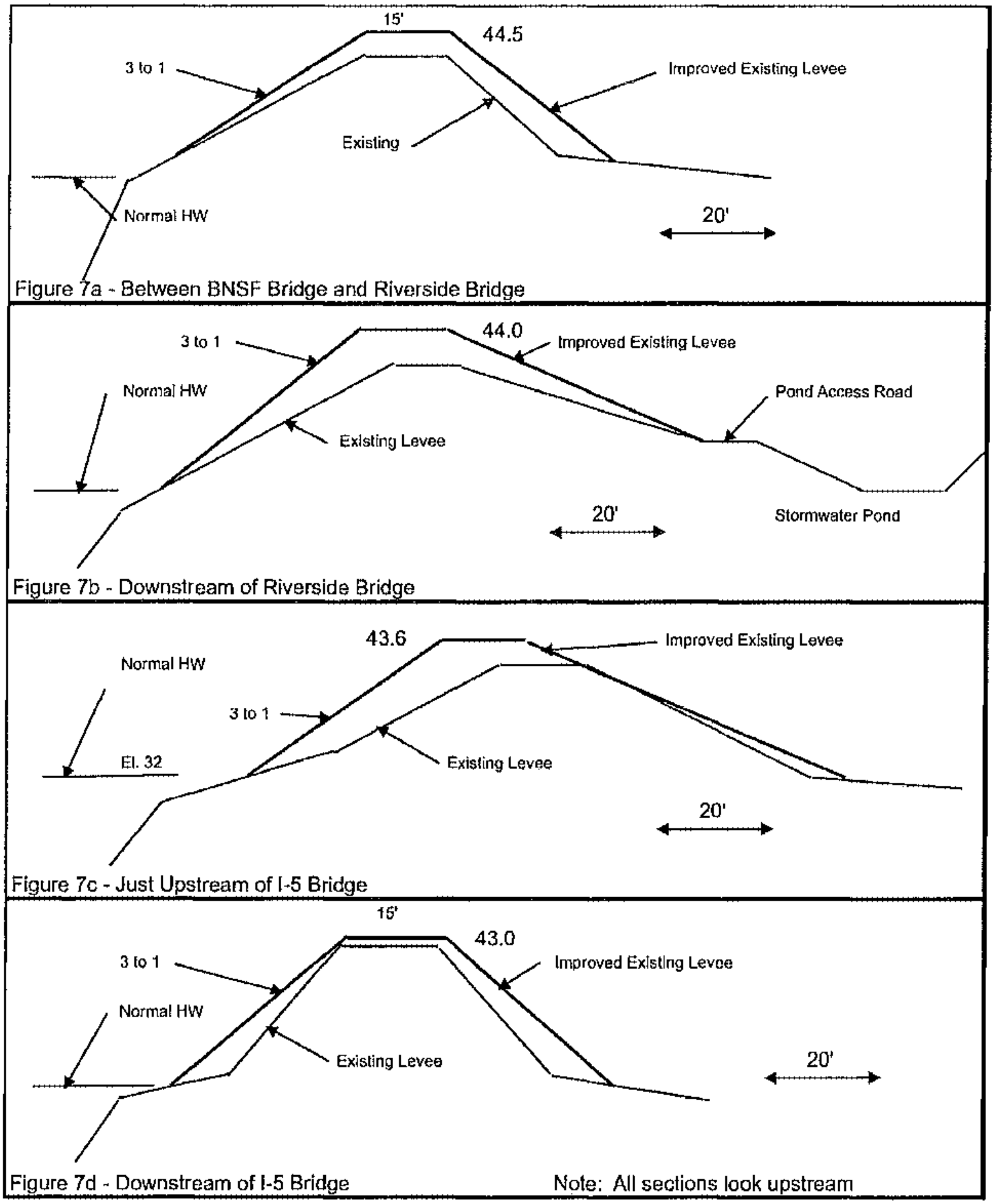

Figure 7a - Between BNSF Bridge and Riverside Bridge

Figure 7b - Downstream of Riverside Bridge

Figure 7c - Just Upstream of I-5 Bridge

Figure 7d - Downstream of I-5 Bridge

Note: All sections look upstream

Figure 7 - Left Bank Levee Sections - Improved Existing Levee Alternative

3.1.2 Improved Right Bank Levee

Improving the Right Bank Levee in the area between the BNSF Bridge and the Riverside Bridge will require a close integration with East Whitmarsh Road. As shown on Figure 8a, the levee just west of the BNSF Bridge can be modified without any change to the road or the need to obtain additional rights of way.

Approximately half way between the bridges, Whitmarsh Road crosses over the existing levee. If the levee is increased in height, about 2 feet, the road grade will have to be raised for about 150 feet on each side of the levee. Since the existing levee is currently set back about 50 feet from the edge of the river bank, the levee can be modified on the river side without encroaching on the river as shown in Figure 8b. However, some construction within the normal high water limits may be necessary unless the alignment of West Whitmarsh is modified.

In the vicinity of the Riverside Bridge, the roadway passes through the levee prism twice. In each case, it is relatively simple to increase the road and levee profiles to allow the levee to be raised. Figure 8c shows the improved configuration of the levee and road in this area. However, construction within the normal high water limits does not seem to be necessary at this location.

West of the Riverside Bridge, the modifications to the levee to allow it to be raised are limited by the location of Whitmarsh Road that is located at the landward toe of the levee. Fortunately, the existing levee is setback slightly from the rivers edge such that the levee can be modified as shown in Figure 8d without encroaching upon the normal high water limits. Maintenance vehicles will still be able to traverse the top of the levee under I-5 though the clearance will be slightly less than at current.

3.2 Hydraulic Analysis

The Corps of Engineers Hydrology and Hydraulics Reports (2, 3)have been used to estimate the flow and frequency for the river under this alternative. Figure 9 shows the levee profiles under this alternative as well as the 2-, 10-, 25-, 50-, and 100-year flood levels as taken from the Corps reports. Also shown is the levee crest profile minus the 3-feet of freeboard. The figure shows that the improved levee system can not only pass the 100-year flood but also all flows up to the 500-year flood (not shown). This occurs because as flow levels increase, upstream levees are overtopped and breached and water flows leave the river upstream of the existing levees.

To understand the amount of flows leaving the system, Table 2 has been prepared to show the flows at the level of the Mount Vernon gage, as taken from the Corps *Hydrology Report* (2), and the actual in-channel flows passing the gage as taken from the Corps *Hydraulics Report* (3).

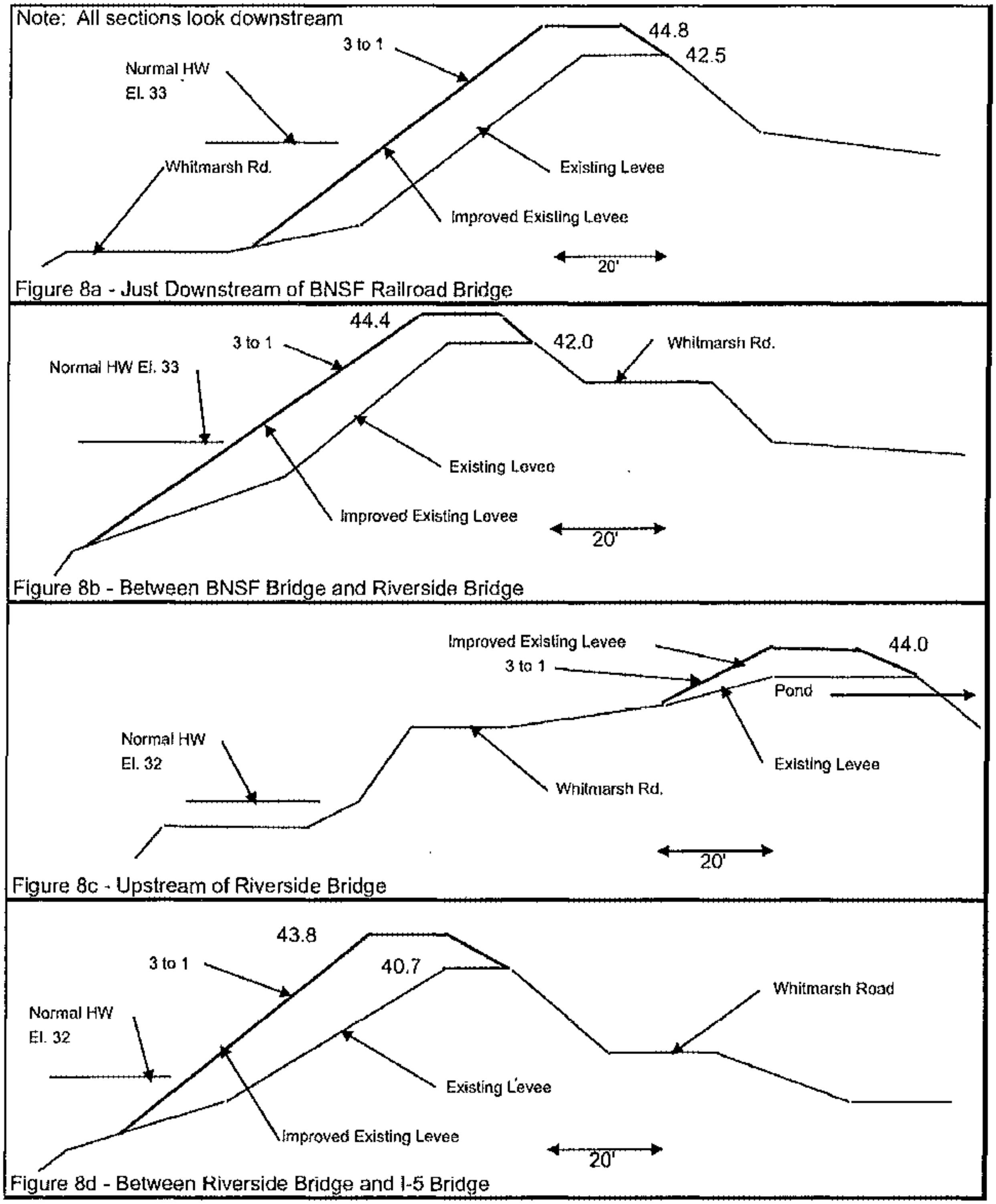

Figure 8 - Right Bank Levee Sections - Improved Existing Levee Alternative

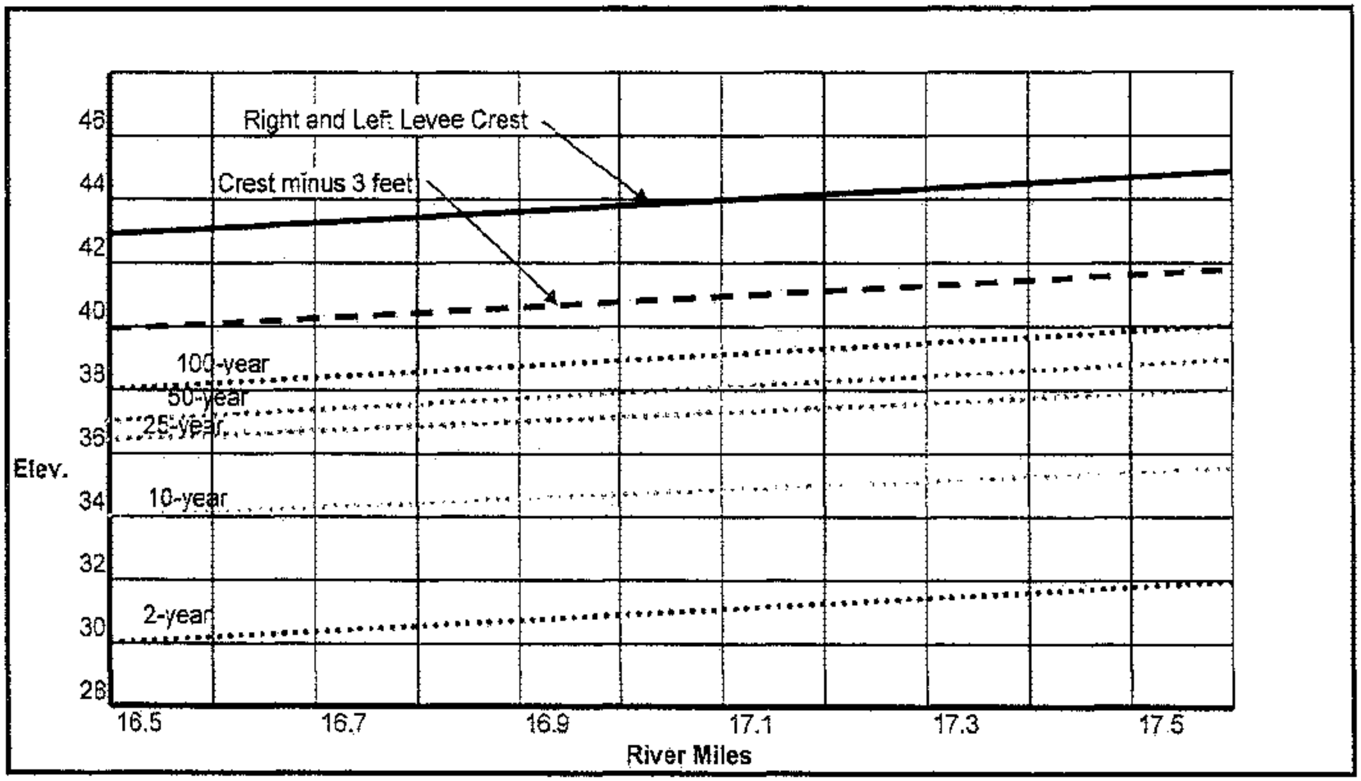

Figure 9 - Levee Crest Elevations and Flood Profiles - Improved Existing Levee Alternative

Table 2 Flows at the USGS Mount Vernon Gage (Located Just Downstream of the Riverside (Old Highway 99) Bridge		
Flow Frequency	**Flows at Level of Gage (1)**	**In Channel Flows at Gage (2)**
2-year	75,700 cfs	
5-year	97,300 cfs	97,300 cfs
10-year	117,000 cfs	117,000 cfs
25-year	146,000 cfs	133,000 cfs
50-year	191,000 cfs	145,000 cfs
75-year	212,000 cfs	153,000 cfs
100-year	230,000 cfs	159,000 cfs

(1) Taken from Table 22 of the 2004 Corps of Engineers Hydrology Report for the Skagit River (2)
(2) Taken from Table 12 of the 2004 Corps of Engineers Hydraulics Report for the Skagit River (3)

The existing analysis appears to lead to the conclusion that if the existing levees are improved and raised to the elevations shown, then they will be capable of passing the 100-year flood event, about 160,000 cfs, with at least 3 feet of freeboard. However, this assumes that the levees upstream of the BNSF Bridge are not raised or extended beyond their existing terminus.

Although the existing levees are not certified at the present time and it is not known if they can be, this alternative assumes that they will be improved and raised such that they could be certified in the future. This assumption is based upon the premise that if this alternative were to be selected for construction, a detailed geotechnical investigation would be conducted during the design phase and the levees would be improved such that they could be certified if desired. The cost estimate presented below reflects these assumptions and includes provisions for making reasonable degrees of improvements to the existing levees.

3.3 Cost Estimate

A detailed cost estimate for this alternative is presented in Appendix B. Costs for the project include direct construction costs, sales tax, rights of way, a 30 percent contingency, and an 18 percent allowance for engineering and administrative costs. The total estimated cost for this alternative is $4,300,000.

3.4 Rights of Way

The cost estimate presented above includes the costs of purchasing rights of way for this alternative as outlined in Appendix B. The only rights of way necessary are on the left bank and have a total estimated cost of $824,000.

4.0 SETBACK LEVEE ALTERNATIVE

There are two potential configurations for this alternative as well as a few optional variations. The main difference between the two configurations is the height of the levee. The first configuration is based upon the low chord elevations of the existing bridges and the hydraulic analysis assumes that flows into the study reach continue to be impacted by upstream overflows due to either the lack of levees or by overtopping levees. These limitations result in an increase in height over the existing levees of approximately 2 feet. The second configuration is based upon levee crest elevations that are independent of the low chord elevations of existing bridges and assume that upstream levee developments allow the full flow of the Skagit River to enter into the study reach. This configuration results in an increase in height of approximately 6 feet over existing levees.

The analysis that led to the adoption of the 2-foot height increase is included in this report as Appendix A. Note that the final alignment of the setback levees is slightly different than presented in Appendix A. However, this has no appreciable change to the analysis.

4.1 Description

The Setback Levee Alternative envisions the construction of mostly new levees that are setback from the existing levees. Although it might be possible to set back the levees almost an infinite distance on each side of the river, the practical limit is set by the level of existing development, existing roads and bridges, and existing development regulations. On the south side of the river, there is extensive development south of Hoag and Stewart Roads. Therefore, these developments tend to limit the areas that can be considered. On the north side, the City of Burlington has a long-standing regulation that has prohibited development within about 600 feet of the river and current developments tend to stop at that point. Consequently, this is a limitation to levee setbacks on the north side of the river that will be honored.

As with the previous alternative, the low chord elevation of the south end of the Riverside Bridge is a potential limitation as to how high levees can be constructed. Consequently, the elevations shown in Table 1 earlier are the same elevations used in the lower elevation option in this alternative. The higher levees being considered are four feet higher than the low option.

In the absence of a detailed geotechnical investigation of levee foundations and the materials to be used in the construction, it will be assumed that levees with side slopes of 3:1 will be used in identifying the construction footprint of the levees. This is the same footprint that would be necessary if the levees were constructed with a 2:1 slope on the water side of the levees and a 4:1 slope on the landward side. All levees are assumed to have a 15-foot wide access road on the crest of the levees and a 20-foot strip of land at the toe of the landward side of the levee for maintenance activities.

The purchase of rights of way for the set back levees is an important financial consideration for this alternative and will be presented later in this chapter.

The location of the proposed setback levees are presented in Figure 10.

4.1.1 Left Bank Setback Levee

The setback levee on the left bank begins approximately 300 feet south of the intersection of the existing levee and the BNSF railroad embankment and angles southwestward towards Hoag Road. It parallels Hoag Road until it is approximately 400 feet east of Riverside Drive at which point it angles back to the intersection of the existing levee and the Riverside Bridge. A typical cross section of the levee in this reach is shown on Figure 11a. Both of the potential levee heights are shown.

At the upstream face of the Riverside Bridge, the limiting elevation is the low chord of the bridge. Consequently, it is necessary to tie the levee into the abutment and it is not possible to move the levee further to the south. In addition, since the bridge will not be modified during this project, a smooth transition between the setback levee and the levee under the bridge is necessary to reduce the potential for scour and erosion. Also, given the geometry and grades of the bridge and adjacent streets, it is likely that it will not be possible to extend the bridge beyond its current abutment location. However, for the higher levee crest option, it will be necessary to build a retaining wall around the abutment to prevent flood waters from reaching the abutment and low chord.

West of the Riverside Bridge, the existing levee adjacent to the existing stormwater pond will be maintained and raised. Since it does not appear possible to extend the Riverside Bridge on the south side of the river, there does not appear to be any significant reason why the stormwater pond should be relocated. The cross section shown previously on Figure 7b is also applicable to this alternative.

Between the west end of the stormwater pond and the I-5 Bridge, the levee will be setback approximately 50 feet and Stewart Road will be realigned to pass under I-5. This realignment allows Stewart Road to pass under a different span of the I-5 approach but does not require any work on I-5 or the bridge. However, new retaining walls will be required on both sides of I-5 adjacent to Stewart Road. Figure 11b shows a cross section of the relocated road and the setback levee.

West of I-5 the levee parallels Stewart Road for approximately 800 feet and once the setback levee reaches a distance of approximately 350 feet from the river, it then parallels the river. The setback levee follows this alignment until it reaches the western city limits of Mount Vernon. At this point, the levee diagonals back towards the river and ties into the existing levee approximately 600 feet downstream. A typical cross section is shown on Figure 11c.

Riprap will be required where the levee passes under each of the bridges. However, virtually all of this riprap will be on new levee that is above the normal high water mark. In addition, the existing levees will be removed down to natural grade but no lower than the normal high water elevation, about 30 feet. It is assumed that all existing riprap will remain in place and be maintained as is currently being done.

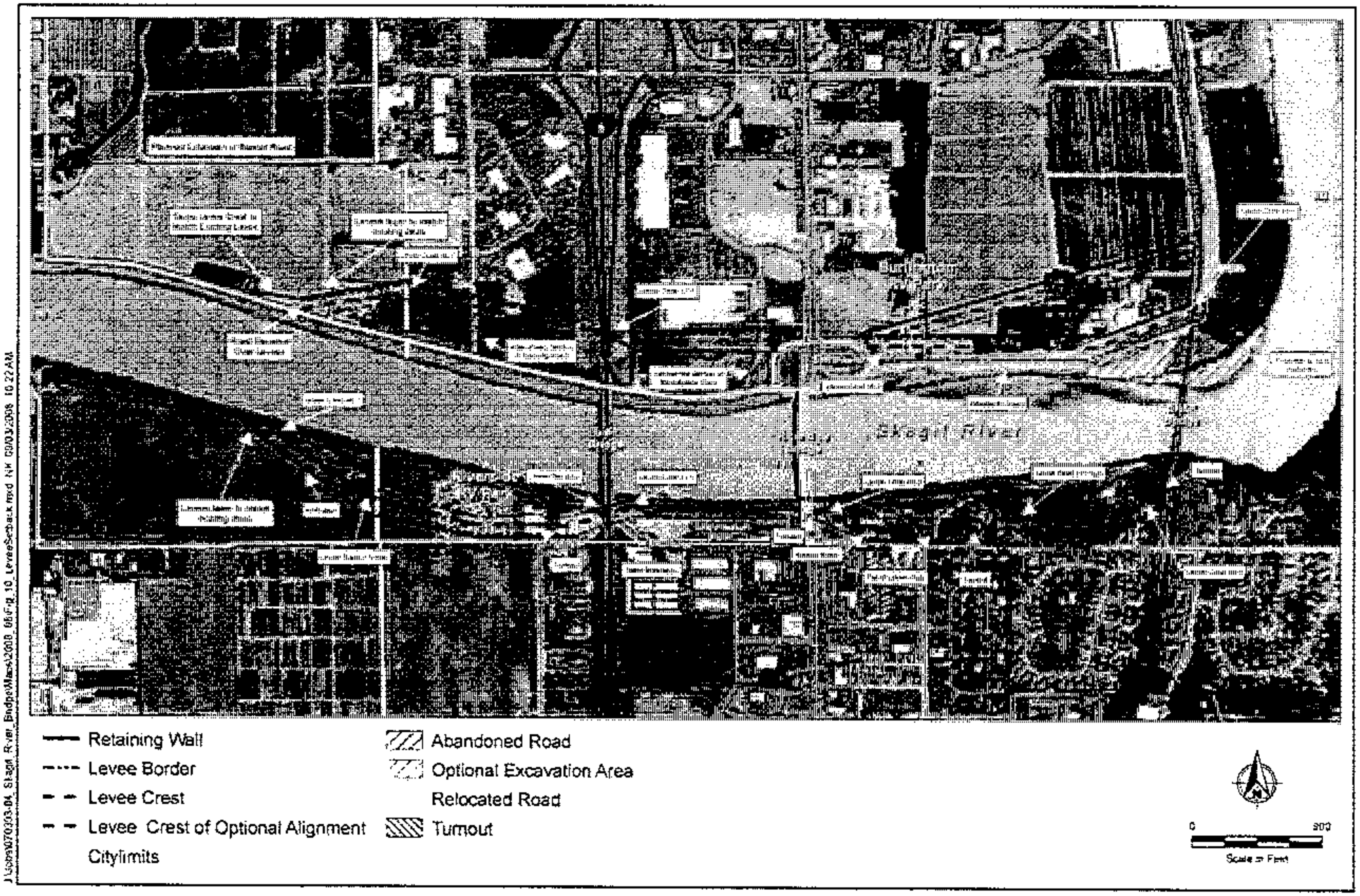

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Figure 10
Levee Setback Alignment Alternative
Skagit River Bridge Modification and
Interstate Highway Protection Project

Note: All sections look upstream

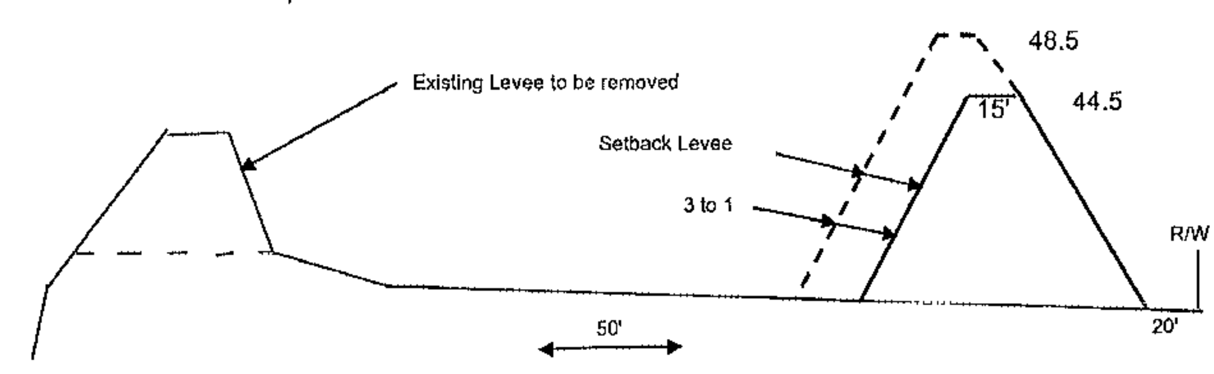


Figure 11a - Between BNSF Bridge and Riverside Bridge

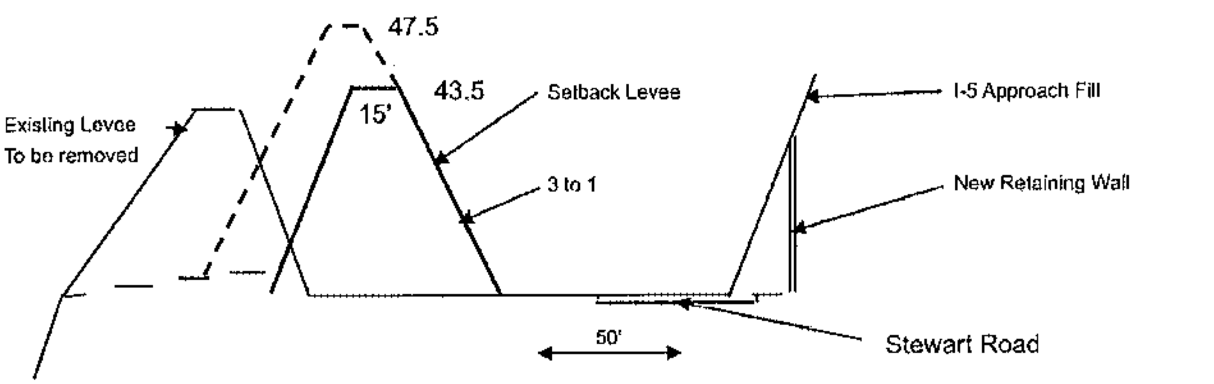


Figure 11b - At I-5 Bridge Approach

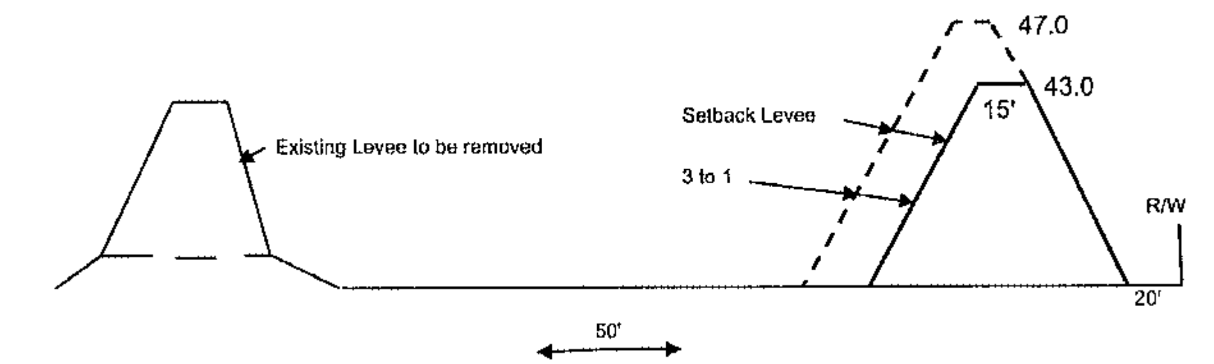


Figure 11c - Downstream of I-5 Bridge

Figure 11 - Left Bank Levee Sections - Setback Levee Alternative

Right Bank Setback Levee

The BNSF Bridge and approaches are acknowledged to be a major constriction to the Skagit River in this reach. Unfortunately, the company has shown a great reluctance to even consider improvements to the bridge that might reduce the constriction. In addition, due to the size of the bridge piers and the amount of rip rap that has been placed to minimize scour, dead trees and other debris frequently backs up behind the bridge and causes additional backwater.

Although previous planning has envisioned setting back the levees just downstream of the BNSF bridge several hundred feet, this may do little good if BNSF is unwilling to consider modifying the bridge and its abutment. Consequently, it appears to be more effective to leave the existing levees just downstream of the railroad where they are at the present time and improve the conveyance on the north side of the river. Figure 10 shows a possible plan for grading to improve flow characteristics of this area. Note that this plan assumes that the piles under existing BNSF trestle sections can be lengthened to prevent scour as more water passes through this area.

Beginning about 600 feet downstream of the bridge, the levee can be setback as shown on Figure 10. The setback levee will allow East Whitmarsh Road to be relocated off of the top of the existing levee and located on the water side of the levee. Figure 12a shows a cross section of the new levee and relocated road. Much of the existing levee in this area will be removed.

Since the Riverside Bridge will not be lengthened as part of this project, there is also no particular reason to relocate the existing stormwater pond now. Consequently, the levee will tie into the existing roadway embankment, leaving the stormwater pond intact. Figure 12b shows a cross section of the levee, Whitmarsh Road, and the stormwater pond. West of the Riverside Bridge, the levee will be setback as shown in Figure 10. West Whitmarsh Road will maintain its existing alignment although the current roadway from the shopping center will be abandoned. Figure 12c shows a cross section of this realignment just downstream of the Riverside Bridge. If the higher levee elevation crest is selected, the roadway approaches on both sides of Riverside Bridge will have to be raised up to elevation 48.0.

West of the Riverside Bridge, the setback levee will tie into the existing embankment of I-5. To prevent erosion of the I-5 embankment, it will be reinforced with riprap. Downstream of I-5, the levee will be setback as shown and West Whitmarsh Road will be maintained in its current alignment. Bouslog Road south of the levee will be abandoned. In the future, it is expected that Bennett Road will be extended to Bouslog Road. In addition, West Whitmarsh Road will be ramped to cross over the levee at the downstream end of the project. The levee will be tapered downward to match the elevation of the existing levee.

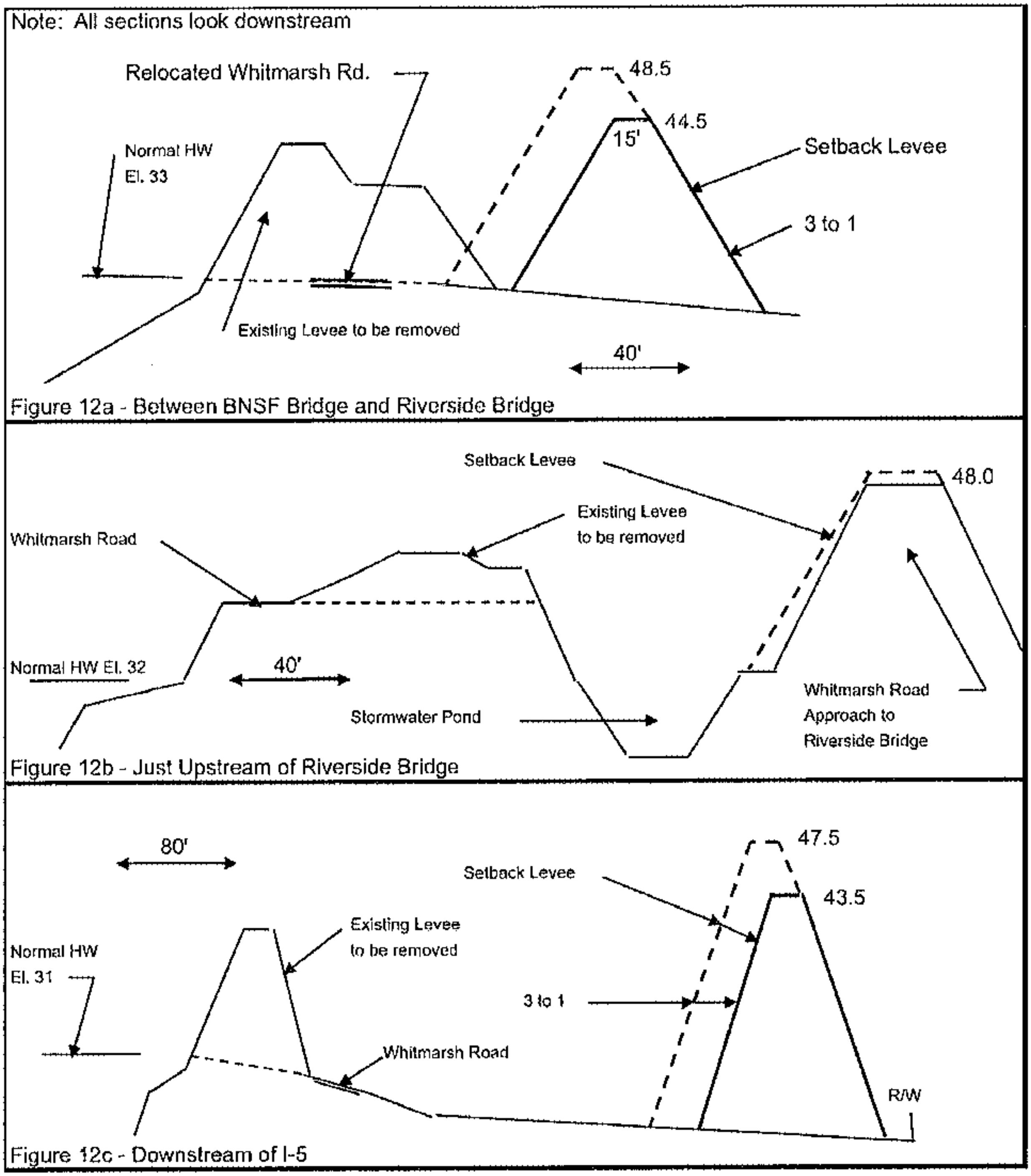


Figure 12 - Right Bank Levee Sections - Setback Levee Alternative

4.2 Hydraulic Analysis

The following analysis was initially made using approximate methods based upon the Corps of Engineers Hydraulics report. However, the modeling described in Appendix D verifies that the preliminary analysis was basically correct and that the results presented in the drafts of this report were valid.

Figure 13 presents the levee and flood profiles for the 2-, 10-, 25-, 50-, and 100-year flood events for this alternative. The cursory analysis shows that water surface levels in the study reach are only about 0.2 to 0.4 feet lower than currently exist. This occurs for several reasons, including (1) the existing bridges and bridge approaches are not modified in this scenario, (2) the overbank areas are relatively shallow resulting in only moderate increases in flow at fairly low velocities, (3) this is a fairly short river reach and backwater from downstream reach tends to limit the potential for significant lowering of the water surface in this reach, and (4) it is assumed that vegetative growth in the overbank area will be allowed to increase riparian habitat and this will somewhat limit the potential to lower the water surface.

As described above, the water surface elevation will be reduced slightly if the setback levee alternative is constructed. This reduction will allow slightly more water to pass downstream. It is estimated that during the occurrence of a 100-year flood, the channel capacity will increase to approximately 170,000 cfs and more than 3 feet of freeboard will be maintained. Since this alternative envisions all new levees, they will be constructed in a manner such that they can be certified if necessary.

Currently, upstream conditions limit the 100-year flood to approximately 160,000 cfs and the levee setback alternative may increase this to approximately 170,000 cfs as discussed above. This will increase further only if upstream levees are raised or improved and new levees are constructed upstream of the existing terminus of the right bank levee.

It should be noted that the major benefit of this alternative is that improved conveyance will reduce the water surface elevation upstream of the study reach. This will reduce the potential for levee failure and will reduce the amount of water that will bypass the levee system completely by flowing around the upstream terminus of the levees near river mile 21. These benefits will be discussed in Chapter 5. It should also be noted that the upstream reduction in flows leaving the system will also result in additional water being maintained in the river and passing downstream to the lower reaches of the river. Since this will increase the potential for levee overtopping and failure downstream, this will also be discussed in Chapter 5.

It should be noted that under <u>current conditions</u>, the higher levee elevation option does not improve hydraulics in the study area over the lower elevation option. This is because the lower option provides 3 feet of freeboard over the 100 year flood elevation and raising the levee higher only provides additional freeboard. The higher elevation option is appropriate if the upstream levee system is improved.

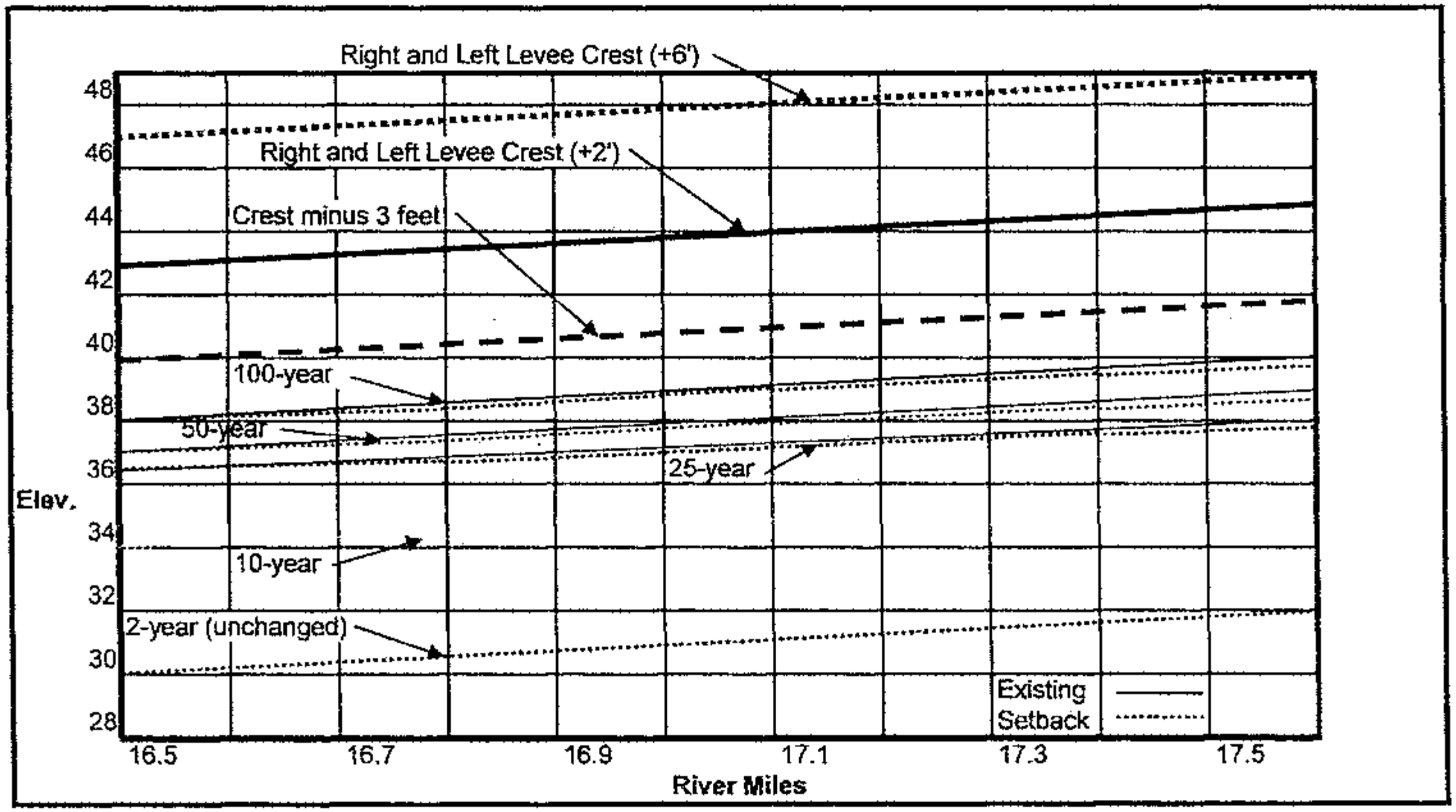


Figure 13 - Levee Crest Elevations and Flood Profiles - Setback Alternative

4.5 Cost Estimate

The estimated cost of constructing the setback levee alternative with the 2 foot increase in height, including all construction costs, contingencies, rights of way, and engineering and administration is estimated to be $30,000,000. The details of this estimate are presented in Appendix B.

The estimated cost of constructing the setback levee alternative with the 6 foot increase in height, including all construction costs, contingencies, rights of way, and engineering and administration is estimated to be $35,000,000. The details of this estimate are presented in Appendix B.

4.6 Rights of Way

The costs of obtaining rights of way for either the 2-foot or 6-foot alternatives for this project are shown in Appendix B and are estimated at $12,500,000. This includes costs for land purchases on both the right and left bank of the river. These costs are included in the total estimated project costs shown in the previous paragraphs.

4.7 Optional Features

There are four possible modifications to the setback levee alternatives described earlier in this chapter that have been evaluated. These are:

- Widen the crest width of all levees from 15 to 30 feet. This will make it easier for maintenance or emergency vehicles to pass during inspection, maintenance and flood fighting activities.

  The most common method of providing passage for vehicles on the top of levees is to construct turnouts and turnarounds at intervals of approximately 2500 feet (Corps Levee Design Manual) (5). Turnouts and turnarounds meeting this criterion have been incorporated in the preliminary designs described above.

  However, if it is desired to widen the levee crest to 30 feet, there will be an increase in the cost of the levees and a slight loss of flow capacity. The estimated total project cost to increase the top width of all levees in the setback levee alternative is $2,700,000.

- Install rip rap at the toe of all new setback levees and no longer maintain existing rip rap that exists at the toe of many existing levees.

  There are a number of factors that would go into the design of riprap for this project and a detailed design is beyond the scope of this investigation. For cost estimating purposes, it is assumed that the thickness will be 2 feet, the rip rap will extend from 1 foot below normal low water (about elevation 16) to 1 foot above the design high water elevation (average of 46 feet), and that all new levees will include riprap. These assumptions are probably conservative but are reasonably consistent with the Corps of Engineers manual on riprap design (6).

If new riprap is provided following the criteria described above, the total project cost for this feature is $3,300,000 million.

- On the right bank of the river, just downstream of the BNSF railroad, setback the levee approximately 400 feet and taper it to meet the approach to the Riverside Bridge. The location of this option is shown on Figure 10.

  Until the BNSF railroad bridge approach is modified, not part of this project, then there are no hydraulic benefits to constructing this option because the conveyance area provided will simply be a dead zone with no flow passing through it. The cost of converting the existing bridge approach fill to a bridge section is unknown but if it is done to improve flood control, then the cost would have to be born by the project. It is likely that this cost could be $20 to 30 million.

  The cost of setting back the levee at the optional location shown is approximately $3.3 million greater than the cost of constructing the levee at the location described above. This cost is in addition to the cost of constructing the 2-foot-higher-than-current levee and includes the cost of purchasing the necessary right of way. In comparison to the 6-foot-higher-than-current levee, the additional cost is $4.3 million.

- In the trestle section of the BNSF railroad bridge, extend and reinforce the bridge pilings and excavate the overbank area to elevation 18. Note that this feature has been included in the setback levee alternatives presented earlier but could be deleted.

  If excavating the overbank area and reinforcing the bridge trestle is eliminated from the setback levee alternative, two things will occur. First, and most important, the improvement in flood flow conveyance due to the setback will be reduced by about 50%, meaning that benefits will also be reduced by about 50%. Second, the cost of the setback levee alternatives will be reduced by $1,000,000.

5.0 UPSTREAM AND DOWNSTREAM IMPACTS OF ALTERNATIVES

As noted earlier, the analysis presented in the draft report was completed without the use of the Corps of Engineers hydraulic models and was based upon previously published hydrology and hydraulics reports that may be revised by the Corps in the near future. However, since the Corps models were not available, we were able to utilize comparable models being utilized by Skagit County that were prepared by Pacific International Engineers. The results of this modeling, presented in Appendix D, confirmed that the earlier hydraulic analyses were correct and the results could be used in the benefit to cost analysis.

5.1 Upstream Impacts

5.1.1 No Action Alternative

In this Alternative, there are no physical changes to the existing levees within the study reach. Consequently, there will be no change to the area upstream of the BNSF Bridge. The Corps of Engineers Hydraulics Report (3) indicates that at all flows greater than the 1-in-25-year flood the existing levee at River Mile 17.8, right bank, has a 50 percent probability of failing and that overflows will leave the river channel upstream of the end of the present levee system. At flows greater than the 1-in-50-year flood, the levee at River Mile 17.8 will overtop. Consequently, flows will leave the river and flood extensive areas between Burlington and La Conner. Appendix B to the Corps Hydraulics Report is a series of maps that depict the limits and depth of flooding due to different frequencies of flooding.

However, since this report makes no changes to the existing situation, flooding will continue as it does currently if the No Action Alternative is selected.

5.1.2 Improved Existing Levee Alternative

In this alternative, raising and improving the existing levees increased the levee freeboard in the study reach but the Corps of Engineers analysis showed that there was no significant potential for levee failure at the level of the 100-year flood. Consequently, since there was no change in flows within the study reach, there is no change in flows or stage upstream and flooding conditions are the same as at the present. The impacts are as described above for the No Action Alternative.

5.1.3 Setback Levee Alternatives

With the Setback Levee Alternative, all flows up to the 100-year flood event will be contained within the levees and the only impact within the study reach is a decrease in stage of approximately 0.4 feet at the upstream end of the reach at River Mile 17.56. Upstream of this point, a stage decrease of 0.4 feet will impact the frequency of levee failures and overtopping on the right bank at River Mile 17.8 and overflows around the upstream end of the existing levee at approximately River Mile 21.6.

The impact of a decrease in stage of approximately 0.4 feet upstream of the BNSF Bridge is difficult to assess without the use of a computer model. The primary impact of this decrease is a proportional decrease in the amount of water that would leave the right bank of the river via levee failures, overtopping, and overflows around the levee system. There would also be a slight decrease in the depth of flooding in the Nookachamps area on the right bank. An analysis of the Corps Hydrology and Hydraulics Reports (2, 3) and a UNET Modeling Report (7) prepared for Skagit County in 2003 gives an indication of the overflows and the change in overflows as shown in Table 3.

Table 3
Right Bank Overflows Upstream of River Mile 17.56

Flow Frequency	Overflows, Levee Failures, and Overtopping flows under current conditions	Reduction in Overflows, Levee Failures, and Overtopping due to 0.4 decrease in stage
25 years	Negligible	0 cfs
50 years	30,000 cfs	10,000 cfs
100 years	50,000 cfs	15,000 cfs

The table indicates that the change in overflows is significant and that there is a benefit to the Setback Levee Alternative. However, as will be described in 5.2.3, there is a potential negative downstream benefit and the Corps computer models will be necessary to quantify the changes in flows and flood damages.

5.2 Downstream Impacts

5.2.1 No Action Alternative

Under current conditions, the levees downstream of the study reach have inadequate freeboard and are subject to potential levee failures and overtopping. In general, the levees have inadequate freeboard at very frequently flood events and by the 10-year flood event (about 116,000 cfs), there are significant reaches of the levees on both banks of the main channel downstream of the study reach as well as both banks of the levees on the North and South Forks of the Skagit River that have inadequate freeboard. The potential for levee failure or overtopping are similarly widespread and by the 25-year flood (about 133,000 cfs) numerous sections of levee are at risk.

Under the No Action Alternative, the impact of flooding due to levee failure or overtopping does not change from the existing condition.

5.2.2 Improved Existing Levee Alternative

Since there is no increase in flow or stage in the river with implementation of this alternative, there is no additional impact on downstream flood conditions. Although this alternative will improve the levees within the study reach that were noted earlier as subject to failure due to bank erosion or piping, the primary improvement was to the elevation of the levees. It is highly likely that bank erosion and piping will still occur unless the levees are completely rebuilt and improved significantly beyond what is envisioned in this alternative.

5.2.3 Setback Levee Alternative

The analysis presented above has shown that the Setback Alternative has the potential to reduce depths of flow in the study reach which in turn potentially reduces the depth of flooding upstream of the BNSF Bridge by approximately 0.4 feet at flows up to the 100-year flood. At flows above the 25-year flood event, this causes a reduction in levee failure or overtopping potential and a reduction in overflows from the river into the north bank area around Burlington.

A reduction in upstream overflows will result in more flow staying in the river and an increase in flow in the downstream reaches of the Skagit River. This increase in flow, up to approximately 10,000 cfs in the 100-year event, will have a negative impact on downstream levees and will increase levee failures and levee overtopping at flood events greater than the 1-in-25 year event. Although there would already be widespread flooding (without flood fighting efforts) under current conditions, this increase in flow will increase the frequency of flooding above current levels. As will be discussed later, in order to mitigate for the downstream impact due to the Setback Levee Alternative, it may be desirable to improve the downstream levees to pass a flood flow of about 145,000 cfs.

One reason for the setback levee alternative that would raise levee elevations by approximately 6 feet over existing levee heights is to provide flow conveyance capacity if upstream levees are raised and/or extended in the future. It should be noted that unless downstream levees are also raised significantly, the potential for levee failure or overtopping in the downstream levees will also increase.

6.0 PRELIMINARY BENEFIT COST ANALYSIS

A preliminary benefit versus cost comparison has been prepared for the two alternatives that include modifications to the existing conditions. Flood control benefits will be displayed in terms of annual benefits for each alternative. Capital construction costs and annual maintenance cost will be converted to annual costs based upon a 5 percent discount rate and a 50-year period of analysis.

At this time, the only costs included in the analysis are for levee construction and related road relocation costs and the costs of procuring the necessary rights of way. If the project is formulated to include riverine and terrestrial habitat improvements, these costs will be included at a later date. Likewise, benefits currently included are for flood control and potential benefits due to habitat improvements are not currently included.

6.1 Improved Existing Levee Alternative

As shown in Chapter 4, the cost of improving the levees in this alternative is approximately $4.3 million. Converting this to an annual cost will result in an annual cost of $240,000, assuming that maintenance costs are essentially the same as current.

Although the hydraulic analysis has indicated that improving the existing levees will increase the flow capacity in this reach of the river, the analysis also appears to indicate that the potential for levee failure or overtopping is relative low under current conditions in the study reach. Consequently, since the potential for failure does not change with this alternative, there are few measurable flood control benefits for this alternative and the benefit to cost ratio is negligible.

6.2 Setback Levee Alternative

Chapter 4 showed that the capital costs for constructing the setback levee alternative is $30 million for the 2 foot levee height increase and $35 million for the 6 foot increase. If it assumed that operations and maintenance costs remain the same as the existing levees, then the average annual cost will be $1.64 million and $1.92 million, respectively, for the two levee height options.

The hydraulic analysis indicates that setting back the levees in the study reach will produce a reduction of flood damages in the area upstream of the project reach (between the BNSF Bridge and the Highway 9 Bridge near Sedro Woolley due to a potential reduction in the water surface elevation of 0.4 feet during major flood events. However, the analysis also indicates that downstream of the study reach flows will increase for most major floods and this produces an increase in flood damages downstream of the study reach.

Appendix C contains a Technical Memorandum with a detailed analysis of the flood control benefit analysis for this alternative. Table 4 summarizes the results of the analysis and displays the existing flood control damages for the upstream and downstream areas and the resultant flood control damages if the setback levee alternative is constructed.

Table 4 **Flood Control Benefits** **Levee Setback Alternative**			
	Upstream	Downstream	Total
Existing Annual Flood Damages	$46.8 million	$29.9 million	$76.7 million
Post Project Annual Flood Damages	$43.4 million	$26.9 million	$70.3 million
Project Annual Flood Benefits	+ $3.4 million	+$3.0 million	+ $6.4 million

Table 5 summaries the annual costs of each option, the average annual flood benefits, and the benefit to cost ratio.

Table 5 **Benefit to Cost Ratio** **Setback Levee Alternative**			
Levee Height Options	**Average Annual Costs - $Millions**	**Average Annual Benefits - $Million**	**Benefit to Cost Ratio**
2 foot Increase	1.64	6.4	3.9
6 foot Increase	1.92	6.4	3.3

The analysis summarized in Tables 4 and 5 show that the levee setback alternatives, both levee height options, produce sufficient flood control benefits to cover the estimated costs of construction.

7.0 DISCUSSION OF BRIDGE AND ADDITIONAL FLOOD PREVENTION IMPROVEMENTS

7.01 Introduction

Chapters 3 and 4 discussed the alternative levee improvements that could be made to improve conveyance through the study reach. However, Chapters 5 and 6 pointed out that these improvements have impacts on both the upstream and downstream reaches of the Skagit River and that by themselves, there may be minimal overall benefits to demonstrate the economic viability of the project. In this chapter, we will discuss other additional flood prevention projects and how they need to be integrated with the proposed alternatives into an overall flood control plan for the basin. In addition, since the proposed setback alternative could increase downstream flows, methods of minimizing these impacts will be discussed.

7.02 Hydrology, Hydraulics, and the Reduction of the Risks from Flooding

The reality of the existing flood control situation in the lower Skagit Basin is that all floods greater than about the 1-in-25-year flood event will cause significant damage to the lower Basin (below Sedro Woolley). Lesser flows, say the 10 year flood, may also cause potentially large amounts of damage but local flood fighting efforts have been effective in ameliorating the damage that might occur.

The primary goal of Skagit County, Mount Vernon, Burlington, and Sedro Woolley is to provide flood protection against the 100-year flood event and to insure that the levees that protect the urban areas can be certified. Although the currently published 100-year flood entering the levee system is approximately 230,000 cfs, there are three issues that may reduce this value to approximately 200,000 cfs. First, the methodology used in the FEMA flood insurance process allows this value to be reduces by approximately 10,000 cfs because the concept of "expected probability" is not normally used in its analysis. Next, the USGS has recently modified its opinion on the historical flood of 1921 as defined by the Stewart Report and this may reduce the 100-year flood by another 10,000 to 15,000 cfs. Thirdly, upstream storage modifications at the Baker and Skagit Hydroelectric Projects may provide another 5,000 to 10,000 cfs flow reduction in the future. Together, these three adjustments can realistically reduce the 100-year flood to approximately 200,000 cfs and this becomes the upstream flow that we may need to deal with in examining the current situation.

Next, if we skip downstream to the levee system that exists below the urban areas of Mount Vernon and Burlington, we see that these levees currently have a safe capacity of approximately 115,000 to 135,000 cfs. These levees are primarily designed to protect rural and agricultural lands and although it may be possible to upgrade most of these levees to pass about 145,000 cfs, additional upgrades to pass higher flows would be very expensive and probably would not be economically justified. This flow level represent about a 1-in-25-year-flood according to Corps of Engineers hydrology.

The issue, then, is how to manage flood risks given that the desired design flood level (about 200,000 cfs upstream) is greater than the maximum downstream flood channel capacity (about 145,000 cfs). Another consideration is that with setback levee alternative discussed earlier, the maximum capacity of the river in that reach is in the range of approximately 170,000 cfs under existing conditions.

The remainder of this chapter is devoted to looking how these limitations affect the selection of an overall flood control plan for the lower Skagit River Basin. None of the concepts discussed here have been evaluated in detail and they are presented merely to encourage discussion.

7.1 Bridge Improvements

The levee improvements presented in the previous chapters assumed that no specific improvements are made to the existing bridges, abutments, and approaches. However, it is assumed that at some time in the future, these improvements will be made and the flow capacity of the river will increase. At this point, it is not possible to specifically evaluate these flow improvements but they can be estimated using the Corps of Engineers flow models in the future.

7.1.1 I-5 Bridge

The existing I-5 Bridge provides little impediment to flows in the Skagit River. However, if the levees are set back as anticipated in the third alternative, it will be necessary to either extend the bridge and modify the approaches, or to construct a new bridge. Current planning anticipates that a new, wider bridge to accommodate more lanes of traffic may be constructed in the next 30 years. Regardless of which type of improvement is selected, they can be accommodated with the setback levee alternative with little change to the bridge elevations or approaches. Note that only the north end of the I-5 bridge and approach will need to be modified.

7.1.2 Riverside Bridge

Although the low chord elevations of this bridge somewhat limit water surface elevations in this reach, the studies have indicated that other factors control the volume of flow through the study reach. Consequently, there does not appear to be any reason why the south abutment, the lowest elevations, needs to be raised or extended. Therefore, the only significant change to the bridge to accommodate the setback levee alternative is to extend the right (north) bridge span and modify the approach. The existing grades of the roadway and bridge are adequate and only slight modifications may be necessary when the bridge is extended.

7.1.3 BNSF Bridge

As described earlier, this bridge is the lowest of the three bridges in the study reach and probably provides the most constriction to flow. Even though studies have been completed and suggested replacing the structure, BNSF has shown no inclination to consider replacing the bridge in the near future. In addition, the bridge appears to be a major impediment to the movement of large trees and other debris down the river.

A major issue in modifying the BNSF Bridge is the need to increase the elevation of the railroad grade. To be consistent with the other bridges and the design of the levees, raising the bridge approximately 3 to 4 feet would appear to be warranted. However, raising the grade of the rail bed by even a couple feet would be very difficult, particularly to the south of the bridge in Mount Vernon. Because of the flat grades required for railroads, raising the bridge grade would necessitate raising the elevation of the railroad where it crosses Hoag Road, College Way, and Riverside Drive by several feet. We see that as a very questionable option.

Consequently, it is believed that (1) improving the conveyance through the trestled section of the bridge by improving the piers, (2) lowering the water surface during major floods by the construction of overflow structures, and (3) excavating a portion of the overbank area in the vicinity of the north abutment of the bridge will increase conveyance through this area and may negate the need to replace this bridge. Reducing the buildup of debris upstream of the bridge could be a partial solution to the conveyance problems, possibly by dredging just upstream of the bridge or perhaps by improving the existing piers to reduce scour potential. This issue needs more attention.

7.2 Downstream Improvements

If the setback levee alternative is selected, it will increase the downstream flows during all flow events greater than the 25-year flood. As mentioned above, modest levee improvements will be necessary just to improve these levees to the 25-year flood level, 145,000 cfs. Consequently, it is highly unlikely and probably uneconomical to attempt to increase the flow conveyance in the levee system downstream of Mount Vernon beyond 145,000 cfs. With these considerations in mind, the following improvements seem to be realistic:

1. Approximately 25,000 to 30,000 cfs need to be removed from the river in the reach below the study area. A diversion structure located in the Avon area has the benefit of reducing the amount of downstream levees that need to be improved and will improved flow conveyance capacity upstream as far as Sedro Woolley. Both of these situations dictate that the diversion structure be placed as far upstream as feasible and a location near the intersection of Plover and Whitmarsh Road appears a likely choice. This was the location shown in the most recent Pacific International Engineering report on alternatives (8). Figure 14 shows the proposed location of this structure. Although levees could be constructed all the way to the Swinomish Channel, the minimum required are training levees that ensure that overflows do not backup into Burlington west of I-5 and protect utility features near Highway 20 and the Avon-Allen Road.

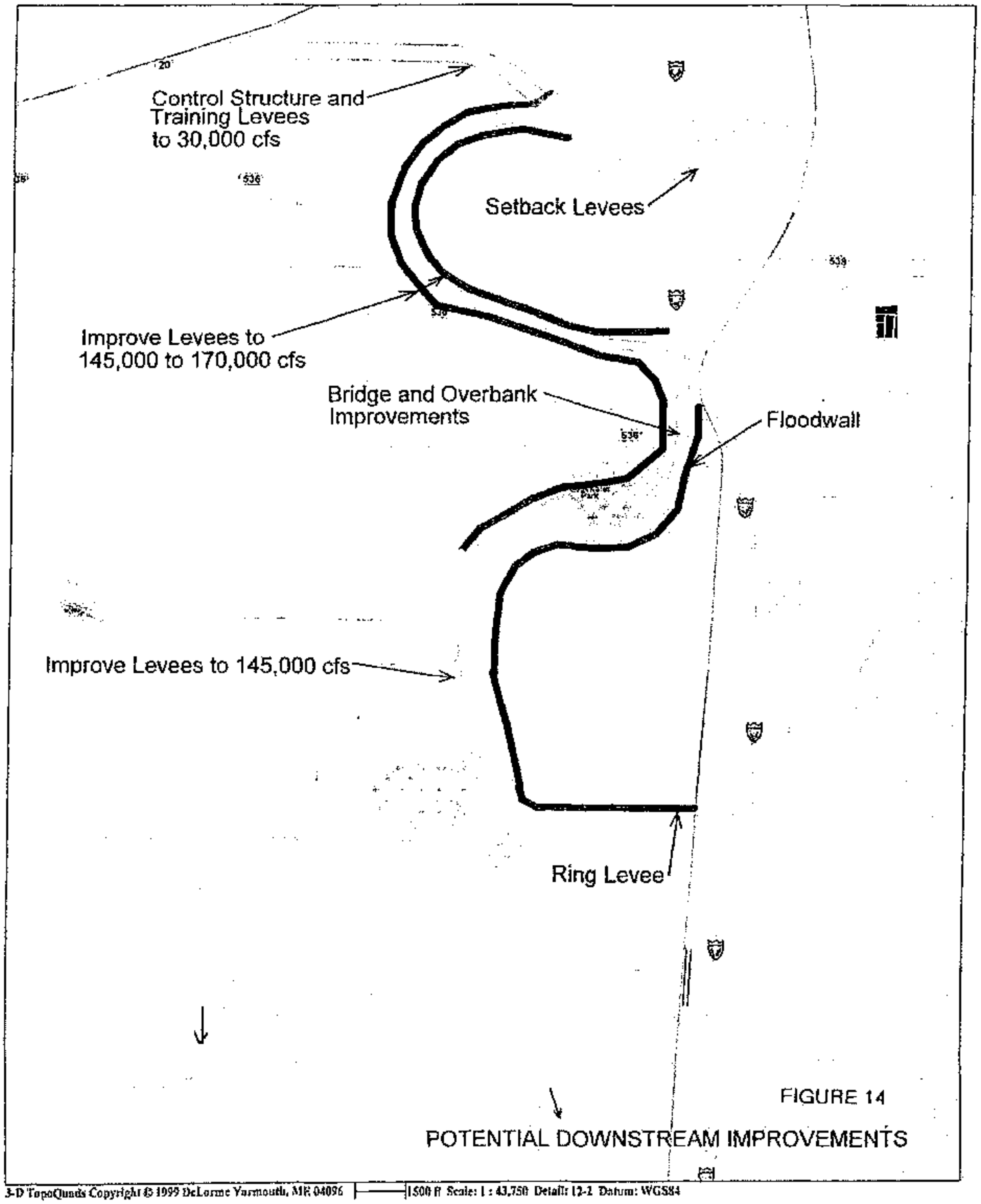


FIGURE 14

POTENTIAL DOWNSTREAM IMPROVEMENTS

2. The Corps of Engineers hydraulic study (3) shows that the area surrounding the Division Street Bridge, State Route 536, is a pinch point that needs to be improved, even to increase the conveyance capacity to 145,000 cfs. It appears that constructing a flood wall to protect the downtown area of Mount Vernon, lengthening the west end of the Division Street Bridge and removing the existing roadway fill, and perhaps excavating the overbank areas on the north and south sides of the bridge approach may improve the channel capacity up to approximately 170,000 cfs. Modifying the wooden structure that currently protects the center pier of the bridge may also be warranted.

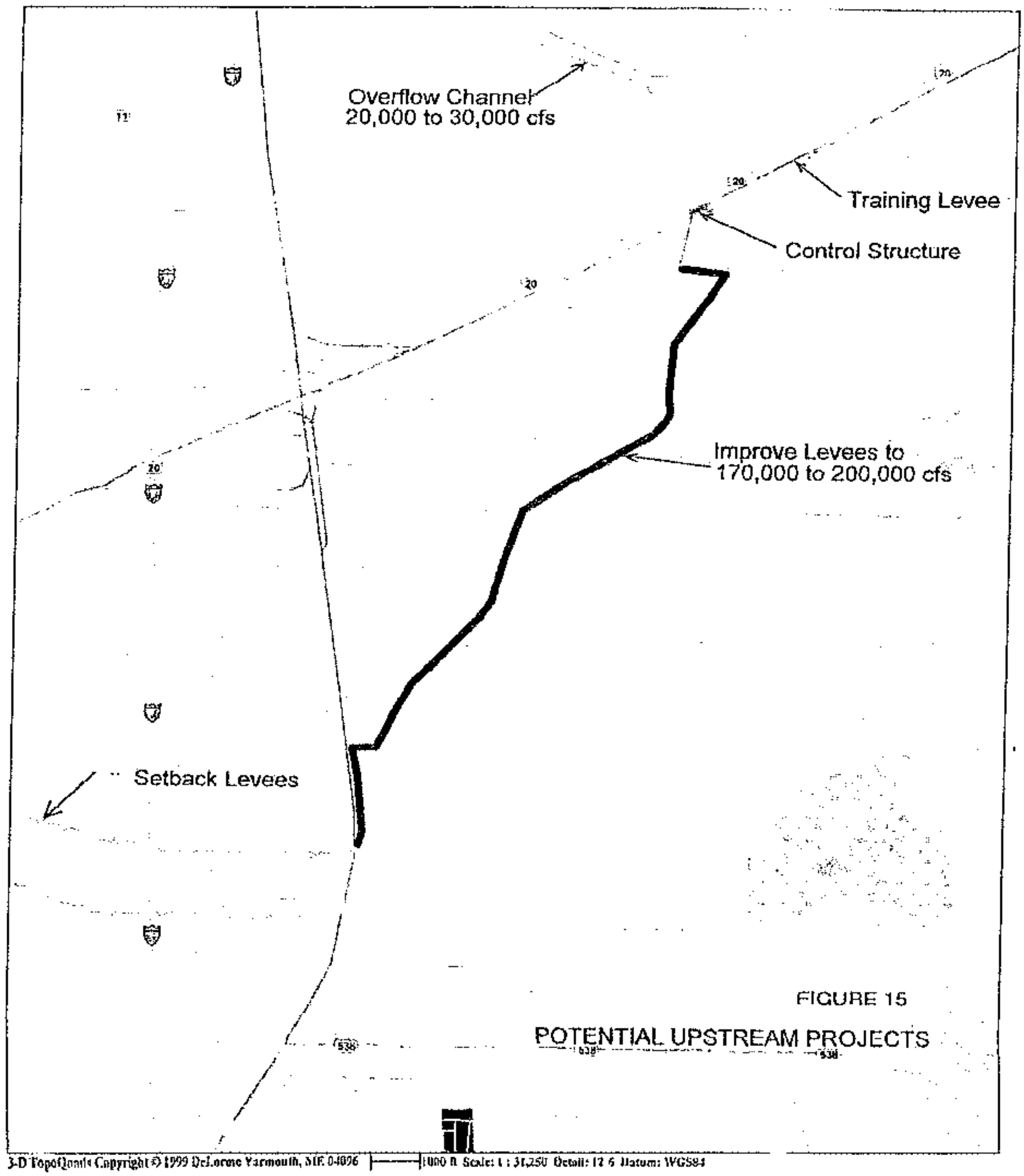
3. Depending upon whether a bypass is constructed or not, it may be necessary to set back the levees between the downstream end of the study reach and the Division Street Bridge.

4. The above improvements have the capability of increasing the levee capacity upstream of Mount Vernon to 170,000 cfs and the level of flood protection to Mount Vernon to the 100-year level. However, it may be necessary to construct a ring levee around the south edge of Mount Vernon to prevent potential levee overtopping flows from Dike District 3 backing into the city. Each of the facilities discussed are shown on Figure 14.

7.3 Upstream Improvements

Since the only impact due to either alternative is a potential lowering of the water surface upstream of the BNSF Bridge, no improvements are specifically needed to offset the construction of levee improvements in the study reach. However, if improvements in the study reach and downstream are instituted with the goal of providing 100-year protection, then significant upstream improvements are needed. If the maximum flow through the study reach is limited to about 170,000 cfs (slightly higher if the overflow structure near Avon is constructed) and the 100-year flood is in excess of 200,000 cfs, then facilities to reduce instream flows are needed and portions of the existing right bank levee will need to be improved. Specific ideas are described below:

1. An overflow structure needs to be provided and a logical location appears to be near the end of the existing system of right bank levees as shown in Figure 15. At this location, the existing railroad grade could be used to prevent uncontrolled overflows that would flood Highway 20 and provide a training levee for a control structure that would be located near where Gages Slough goes under the railroad grade. This structure would have the capacity to remove between 20,000 and 30,000 cfs from the river and discharge it into rural lands west of Sterling Hill and eventually into the Samish River. The specific ground elevations and flow paths have not been studied in detail and the impact of overflows on I-5 and the BNSF rail line would need to be investigated.


Overflow Channel
20,000 to 30,000 cfs
Training Levee
Control Structure
Improve Levees to
170,000 to 200,000 cfs
Setback Levees
FIGURE 15
POTENTIAL UPSTREAM PROJECTS

2. Downstream of the overflow structure, the existing Dike District 12 levees would have to be raised slightly to meet the 100-year design flow, or a greater flow if desired. Based upon Corps of Engineers hydraulics models, most of the improvements would be needed just upstream of the BNSF Bridge. However, construction of the two overflow structures will minimize the amount of improvements that may be necessary to these levees.

It should be noted that ongoing studies have investigated off-stream flood storage in the Nookachamps and Hart Island areas as a method of reducing peak flood flows in this area. A cursory review of these concepts concludes that they will be very expensive and would not provide the flexibility that would be provided by the overflow structure discussed above. However, on-going studies by the Corps and Skagit County will further investigate this concept.

7.4 Summary and Conclusions – Upstream and Downstream Improvements

The resolution of flooding problems in the Skagit River Basin will be a difficult undertaking and although construction of either of the alternatives presented will fit with most solutions, there are still a variety of potential issues that need to be evaluated. However, there are two concepts that need to be considered:

1. Although a major goal of flood protection facilities is to protect against the so-called 100-year flood event, the facilities should be able to handle even larger floods and to insure that highly developed urban areas are protected. In other words, when larger floods do occur, we need to know that flows in excess of the design capacity will be diverted away from the highly developed urban areas.

2. The design of a flood protection plan must start by resolving the future design capacity of the levees below Mount Vernon. Since the existing levees protect predominately rural and agricultural lands, is 100 year protection desired and economically justified or is a lower level of protection (say 1-in-25-years) acceptable?

In light of the above and the information presented in the previous chapters, the following conclusions are apparent:

1. It will be infeasible to construct levees along the Skagit River that can contain the 100-year flood, much less even larger events.

2. Although it may be feasible to construct a series of levees to protect the urban areas, it will be necessary to bypass some flood waters out of the main river channel. As a minimum, it will be necessary to provide a bypass feature either at the upper end of the existing levees near Burlington or in the riverbend area downstream of Interstate 5.

3. A combination of new levees, modified existing levees, bypasses, and setback levees are the most promising method of providing economical, feasible, and practical flood protection to the lower Skagit River basin.

7.0 References

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11. Draft NEPA Project Description, Anchor Environmental LLC, August 2008

APPENDICES

A. **Technical Memorandum – Alternative Levee Designs**

B. **Technical Memorandum – Alternative Levee Cost Estimates**

C. **Technical Memorandum – Flood Damage Reduction Analysis**

D. **Technical Memorandum – Results of Hydraulic Modeling of Setback Levee Alternative**

Appendix A
Alternative Levee Design

TECHNICAL MEMORANDUM

Skagit River Bridge Modification and Interstate Highway Protection Project

Alternative Levee Designs

1.0 INTRODUCTION

The purpose of this memorandum is to describe the alternative levee designs and configurations that will be analyzed in the Skagit River Bridge Modification and Interstate Highway Protection Project. The three general designs are:

- The No Action Project
- The Improved Existing Levee Alignment Alternative
- The Setback Levee Alignment Alternative

These will become the basic alternatives to be analyzed in the environmental documents although there may be some slight variations of one or more of these alternatives. Each alternative will have its own set of criteria, including height, location, and conveyance capacity. It should be emphasized early on that this project does not have an identified desired or goal level of protection. However, an acceptable alternative needs to have the capability to integrate, with appropriate modification, into the Skagit County Comprehensive Flood Hazard Management Plan (CFHMP) once it is defined for the 100-year protection for urban areas. Current physical limitations will govern the volume of water that can be passed through this reach of the river for this project. Consequently, each alternative will be able to pass a given flow volume which can then be assigned a level of protection.

This is a levee modification project and focuses on improvements to the levees along both banks of the Skagit River in the reach of the river adjacent to Mount Vernon and Burlington. As such, the project may be constrained by the location and elevation of the three existing bridges in the reach (the I-5 Bridge, the Riverside Bridge, and the BNSF railroad bridge). Although the analysis may evaluate the hydraulic capacity of the river with and without bridge improvements, the proposed project should be considered Phase 1 of improvements to this reach to meet the ultimate project purpose, Skagit River Bridge Modification and Interstate Highway Protection Project, and will deal only with improvements to the levees. Subsequent studies within the CFHMP development will define the Phase 2 improvements needed for the 100-year conveyance through this corridor.

The hydraulic analysis will identify both the upstream and downstream impacts of the proposed project alternatives. It is of the intent of this project to minimize hydraulic impacts to other areas within the basin, particularly downstream of the project. Since this project will increase flow conveyance through this reach of the river, it is likely that construction may not occur until improvements are made to the levee system downstream of the project.

As noted above, this project is a part of a much larger flood control project on the Skagit River. The larger project will investigate upstream storage, diversions, and levee improvements throughout the basin. This ongoing General Investigation is a joint effort of the Army Corps of Engineers and Skagit County and with sufficient funding is expected to be completed in 2010. Since the river reach covered in this memorandum is also covered in the General Investigation, information available in that study will be utilized to the maximum extent possible. Hydrology and hydraulics analysis, specifically, will rely upon information from that study.

2.0 DESIGN ASSUMPTIONS

The following sections outline the assumptions and criteria that will be used to design the two alternatives that will be analyzed in this project as well as to analyze the existing conditions (No Project) alternative.

2.1 Maximum Water Surface Elevations

Since the scope of this project is to modify the existing levees and not the existing bridges and roadways, the low chord elevations of the existing bridges are the primary limitation as to the maximum water surface elevation that can be obtained. The elevations of each of the three bridges are different and are discussed below. All elevations presented in this study utilize the 1929 NGVD datum.

2.1.1 I-5 Bridge

The I-5 Bridge is a steel girder bridge with concrete approaches approximately 1050 feet long. The bridge has a slight camber with low chord elevations at the abutments of approximately 49 feet. If the levees are setback as anticipated, the low chord elevation of an extended bridge would be lower but still might be greater than 45 feet. However, conversations with WSDOT indicate that this bridge may be replaced or modified within the next 20 years or so. Consequently, the levee heights probably should not be selected based upon the elevations of this bridge.

2.1.2 Riverside Bridge

The Riverside Bridge is a concrete girder bridge with both camber and curvature. It was constructed in 2004 and was designed with this setback project in mind. As such, the bridge was constructed so that it could be extended in the future to accommodate setback levees. The bridge plans indicate that the left (south) abutment was contemplated to be relocated or extended. However, it is considerably lower in elevation than the right (north) abutment and the bridge gradient on the left abutment will make it impractical to extend the bridge on that side. The current low chord elevations are 44.0 feet on the left abutment and 48.68 feet on the right abutment. If the levee is setback on the right abutment and the bridge extended, then the low chord elevation would be approximately 47.1 feet. Consequently, the left abutment elevation at 44.0 will continue to be the controlling elevation.

2.1.3 Burlington Northern/Santa Fe (BNSF) Railroad Bridge

The BNSF Bridge is a steel girder bridge that is straight and with relatively little camber and a trestle section on the right bank. The low chord elevation is approximately the same on both ends of the bridge at 43 feet. Although there have been several studies by Skagit County of replacing this bridge, there are no current plans to replace it. Further study is needed to determine to what degree it impedes flows in the river.

2.2 Levee Design Section

The design of a levee cross section is usually dictated by the type of soils available and maintenance considerations. A detailed geotechnical investigation will be conducted during the design of the levees and this will determine the source of the materials to be used in either modifying the existing levees or constructing the setback levees, the need for a keyway or similar facility to reduce seepage, the top width, and the slopes of the levees. For purposes of this phase of the project, guidance from the Corps of Engineers manual on levee design will be used. The manual specifies that the maximum side slopes shall be 2 to 1 with a 12 foot top width. However, for maintenance purposes, a slope of 3 to 1 is frequently used to allow for ease of mowing. In addition, a 15 foot top width gives a little more room for heavy equipment that may be used for maintenance.

However, until additional geotechnical work is completed, it will be assumed that the footprint will be based upon a cross section of 3 to 1 side slopes on the water side, 3 to 1 side slopes on the land side, and a 15 foot top width. This gives the maximum likely area to be disturbed by the alternatives being considered. This may be conservative assumption for new levees that may be built but given the lack of structural stability information on the existing levees, it is a reasonable assumption at this time.

Although these levees may be designed with a keyway or similar cutoff facility to control seepage, the need for a keyway does not impact the initial configuration of the levees. This will be given further consideration as the project progresses.

Several sections of the existing levees include riprap at the toes of the levees to prevent erosion of the levee during high flow events. For purposes of this study, it is assumed that the existing levees have adequate riprap protection and that the setback levees will be located far enough back from the main channel and high velocity areas such that additional riprap will not be needed. This will also be evaluated further in the future.

2.3 Alignment

For the No Action and Improved Existing Levee Alignment alternatives, the current alignment of the levees will be maintained. The modifications to the existing levee for the improved alternative are assumed to occur on the outsides of the levees or if the improvements are on the riverside, they will be constructed above normal high water.

For the Levee Setback alternative, tentative alignments have been agreed upon in the past and were shown in the 30% Design Report. These alignments generally are restricted by the location of Stewart and Hoag Roads on the south bank and by a 600 foot moratorium setback restriction on the north bank that was adopted by the City of Burlington.

It appears that there are at least two locations where the currently agreed upon levee alignments need to be investigated further and perhaps modified. On the south bank, in the vicinity of the south abutment of the Riverside Bridge, it may not be possible to set the levee back to Hoag/Stewart Road because of the elevation of the ramp to the bridge. On the north bank, in the area just downstream of the BNSF railroad bridge, the alignment may need to be modified as its currently proposed alignment would require that the trestle section of the bridge be lengthen by approximately 200 to 300 feet. Since this project does not contemplate constructing a new bridge section, it may be necessary to revise the levee alignment in this area.

In the vicinity of the Riverside Bridge, storm water ponds have been constructed on both sides of the river to control runoff from the bridge. These may have to be relocated or perhaps protected if the levees are setback in these areas.

At the downstream end of the project, the setback levees in that alternative will need to tie into the existing levees. A simple transition section of levee will be utilized in this plan; the actual final location of the levees in this reach will probably be based upon the results of the on-going General Investigation study by the Corps of Engineers and Skagit County.

2.4 Freeboard

Levee freeboard is used in the design of levees to provide a measure of protection against unknowns in the hydraulic design of the levees, wave action, and other factors. Although there is no adopted value for this factor, FEMA generally prescribes a 3 foot value and this is probably the most common value used for levees everywhere. Consequently, 3 feet will be used for all levees in this project. Additional study may prescribe a lesser or perhaps greater value for this freeboard.

Another consideration is the potential allowance for debris passage under these three bridges. A five-foot clearance has been used as the design criteria for some locations and this issue should be considered in the future.

2.5 Overbank Excavation

Past studies of setback levee schemes have considered excavating materials in the new overbank areas, inside the levees, as a method of increasing the conveyance capacity of the river. Although excavation does have the potential for increasing conveyance, it also has the potential to cause significant impacts to riparian habitat along the river. Consequently, in this project, overbank excavation will only be considered as part of any plans for environmental restoration that may be proposed.

2.6 River Gradient

Hydraulic studies by the Corps of Engineers show that during a major flood event, in the vicinity of say the 50-year flood, that the gradient of the river will be approximately 0.00032. This slope gives a difference in water surface between the downstream termini of the project, approximately 1800 feet downstream of the I-5 Bridge, and the upstream terminus of the project, at the downstream side of the BNSF railroad bridge, of 1.9 feet. Consequently, the differences in water surface throughout the project reach are as follows:

Downstream end of project	0.0 feet
I-5 Bridge	+0.6 feet
Riverside Bridge	+1.1 feet
BNSF RR Bridge	+1.9 feet

3.0 DESCRIPTIONS OF THE PROPOSED ALTERNATIVE LEVEES

The three proposed levee alternatives (no action, modified existing levees, and setback levees) are described in the following sections. The levee proposals are subject to revision as the project proceeds and are intended primarily at this time as the baseline for initiating the environmental evaluation process.

3.1 The No Action Alternative

In this alternative, the levees will remain as they currently exist and other than periodic maintenance and minor modifications due to erosion that may occur during flood events, they are assumed to remain unchanged. The height and elevations of the existing levees have been taken from cross sections used in the General Investigation and presented in the Hydrology and Hydraulics reports by the Corps of Engineers.

The results of computer model runs by the Corps of Engineers show that a flow of approximately 133,000 cfs would pass through the levees with a freeboard of 3 feet. This is derived from runs that produced flows of 117,400 cfs and 146,000 cfs at the USGS gage at Mount Vernon, located just downstream of the Riverside Bridge. The Corps of Engineers will furnish model runs to verify the estimated flow for this alternative.

3.2 The Improved Existing Levee Alternative

In this alternative, the existing levees will be raised to meet the design elevation. Where appropriate, the levees may be modified to meet the side slope and top width criteria. However, if the existing slopes are reasonably close to the criteria, they will not be modified. No new seepage control cutoffs will be constructed. It is assumed that all new construction will be placed on the outside of the current levees. New property will be purchased for this alternative, if needed.

As described earlier, the controlling elevations for raising the levees is the low chord elevation of the three bridges. The low chord elevations for the three bridges are as follows:

I-5 Bridge	49.0 feet
Riverside Bridge	44.0 feet
BNSF RR Bridge	43.0 feet

It is readily apparent that the BNSF Bridge is the limiting bridge in being able to pass more water through this reach by raising the existing levees. Not only is it the lowest bridge but it also is the most upstream bridge. In addition, the low chord of this bridge is essentially at the same elevation as the existing levees. Consequently, this bridge could effectively eliminate this alternative if it is used to limit the maximum water surface elevation.

If the BNSF Bridge is not considered, then the Riverside Bridge becomes the limitation to flow conveyance. With a low chord elevation of 44.0 feet and a freeboard of 3 feet, the maximum water surface elevation is 41.0 feet at the upstream face of the bridge. Using the Corps of Engineers 2004 Hydrology and Hydraulics Reports, the maximum conveyance at that elevation is estimated to be 167,000 cfs. The Corps will utilize the assumed levee configuration in this alternative to produce new model runs that will verify the flow conveyance.

Based upon the above analysis and elevations, the levee elevations at four locations in the study reach would be as follows:

Downstream end of project	44.0 – 1.1 = 42.9 feet
I-5 Bridge	44.0 – 0.5 = 43.5 feet
Riverside Bridge	44.0 – 0.0 = 44.0 feet
BNSF RR Bridge	44.0 + 0.8 = 44.8 feet

Note that if the height of the levees at the BNSF railroad bridge is 44.8 (a water surface of 41.8) and the low chord is 43.0, then there is only 1.2 feet of clearance during a design flood. Additional study of this issue will be required if this alternative is selected.

Figure 1 shows the location and extent of the improvements that would be necessary to increase the flow capacity throughout this reach to 160,000 cfs.

3.3 Levee Setback Alternative

The water surface and levee elevations presented in the previous alternative, Improved Existing Levees, are also applicable to this alternative. The only significant difference is that there will be additional flow that can be carried in the overbank areas on both sides of the river inside of the new levees. Computer modeling will be necessary to specifically estimate this additional volume of flow. However, as a first approximation, this flow can be estimated using typical roughness values, the slope of the river, the depth of flow, and the additional width available. Using the 30% design as a guide, this additional flow is estimated to be 10,000 cfs. When added to the flow computed for the previous alternative, the total flow is estimated to be 170,000 cfs. This value will be verified by the Corps of Engineers based upon the configuration shown for this alternative. (Note: This is a revision from the original draft of this memorandum and reflects more detailed analysis and recognition that the downstream water surface will minimize the increase inflow.)

The alignment for the setback levees will generally follow the footprint shown in the 30% design document. This alignment allows for a 20 foot setback from property lines and roadways. It appears that the I-5 Bridge can be extended through the addition of one bridge section on the south side of the river and perhaps 2 sections on the north side. There appears to be sufficient clearance such that these additions can be made without a change to the main bridge section and perhaps only minor changes to the approaches. Actual changes to the bridge, or perhaps construction of a new bridge, would be considered in Phase 2.

As mentioned earlier, it appears likely that the south side of the Riverside Bridge is a limitation to levee construction and that it may be impractical to extend the bridge on this side. Consequently, it may be prudent to modify the levee alignment in this area to make a smooth transition with the bridge abutment. On the north side of this bridge, it appears likely that the bridge can be extended sufficiently to clear the proposed levee height. One new bridge section would probably be needed. The existing stormwater pond on the north side of the river can be left in place, inside of the proposed setback levee location. On the south side, however, it may be necessary to leave the existing stormwater pond in place and continue to utilize the existing levee in this area and raise it to meet the desired levee crest elevation. Downstream of the pond, the levee will be setback to the vicinity of Stewart Road. Any changes to the bridge or abutments would occur in Phase 2.

The location of the proposed setback of the right bank levee downstream of the BNSF Bridge as shown in the 30% design document could only be constructed if 400 feet of new railroad bridge is constructed. If the bridge is left in place as is, an ineffective backwater area would exist so that there would be no practical reason to set the levee back to the location shown. Consequently, it is proposed that the existing right bank setback levee terminate at the same location as the existing levee and that the channel be excavated both downstream and upstream of the bridge to improve conveyance through this area. It would be necessary to modify the existing trestle section by constructing new pilings and integrating them with the existing bridge structure. If the levee is setback to the original location, it would be done in Phase 2 of the project.

Figure 2 shows the location of the proposed setback levees and other features of this plan.

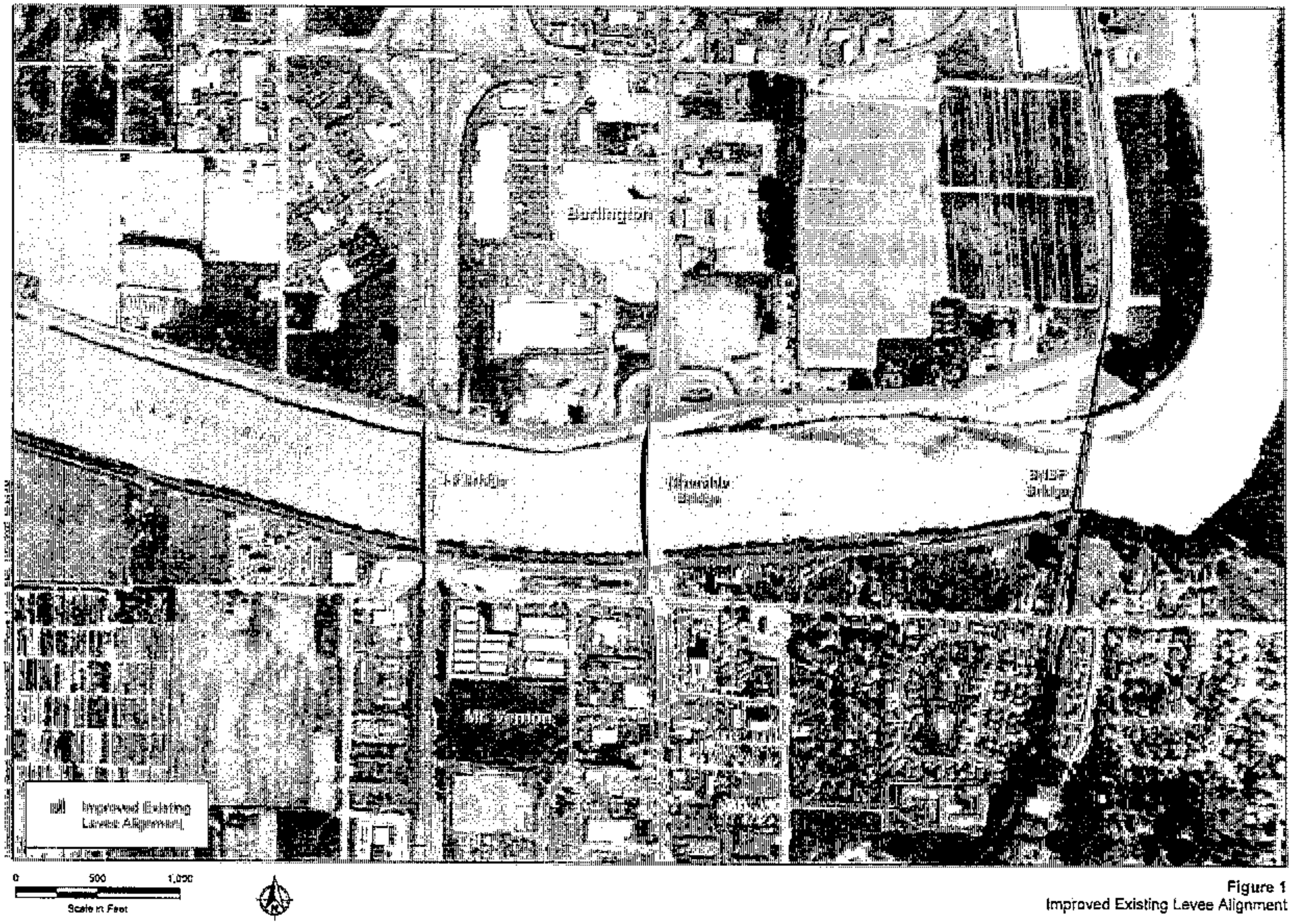

Figure 1
Improved Existing Levee Alignment

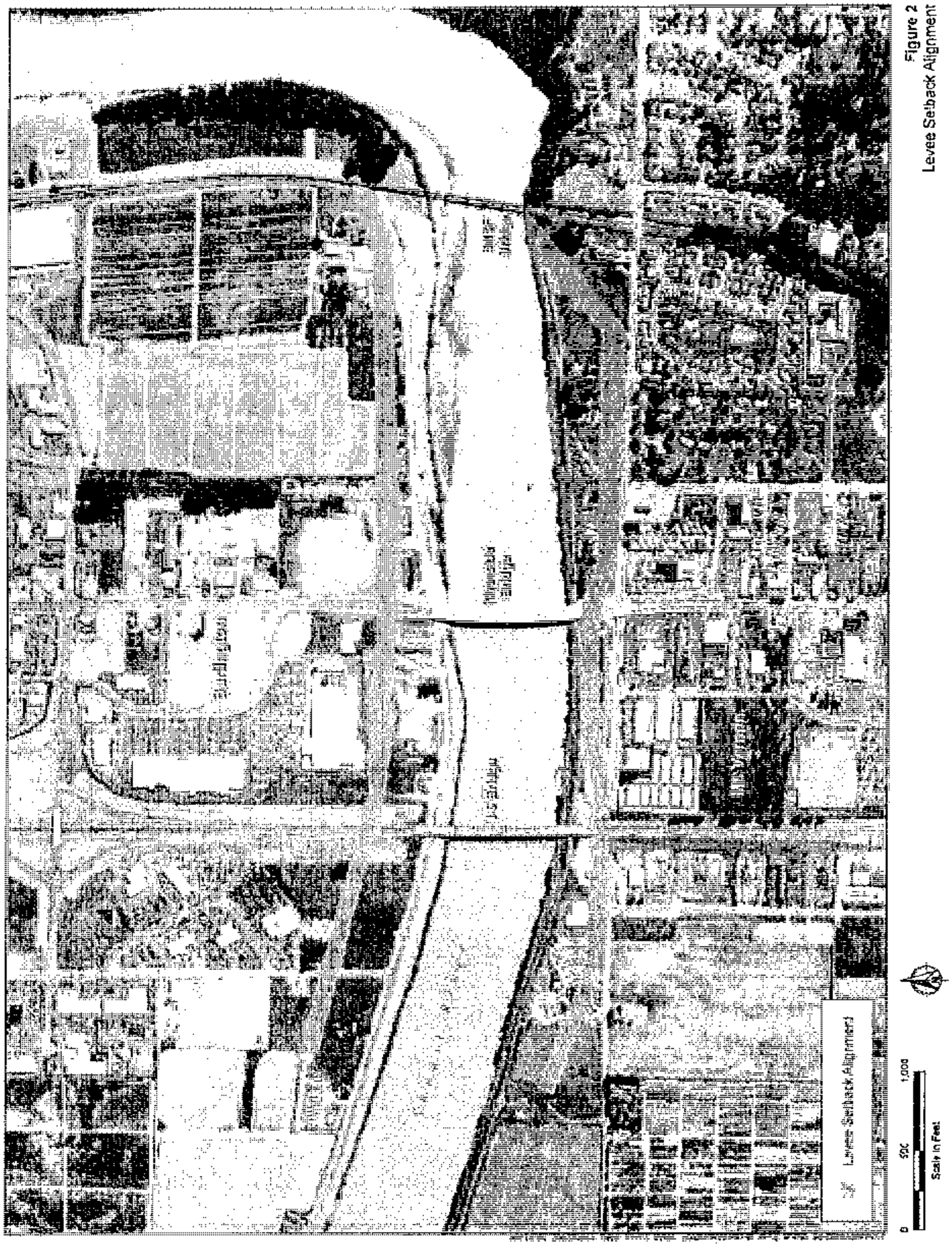

Figure 2
Levee Setback Alignment

Appendix B
Alternative Levee Cost Estimates

DRAFT TECHNICAL MEMORANDUM

Skagit River Bridge Modification and Interstate Highway Protection Project

Alternative Levee Cost Estimates

Introduction

This memorandum presents cost estimates for each of the Alternatives that have been discussed in the report to which this Appendix is attached. Since there are no costs for the No Action Alternative, this memorandum covers the (1) Improved Existing Levee Alternative, and (2) Setback Levee Alternative. Separate sections of this memorandum cover the costs of purchasing rights of way and construction costs for the levees.

Rights of Way

The costs of purchasing rights of way for each alternative have been estimated based upon the current market values for the properties that will be needed. The estimates are based upon a number of assumptions, including:

1. The estimated market values used in the analysis are derived directly from current Skagit County Assessors records.

2. Where only land must be purchased, only the land market values are used. If a percentage of the land in each parcel is needed, the estimated cost is calculated on a percentage-of-use basis. If a structure is on land that must be purchased, its full market value is added to the land value.

3. If the amount of land needed for the project substantially degrades the value of the property, it is assumed that the entire parcel will be purchased.

4. In the Modified Existing Levee Alternative, no property will be needed if the new landward toe of the levee is located on Dike District or public property. However, if the toe extends beyond Dike District or public property, then it is assumed that an additional 20 feet of land will be purchased to provide sufficient land for maintenance.

5. In the Setback Levee Alternative, the land to be purchased includes 20 feet of land that can be used for maintenance activities.

6. The acquisition values determined will be increased by 10 percent to allow for inflation and for the fact that a percentage of the usable land will be obtained from the property owner. In addition, an additional 10 percent will be added to cover the costs of appraisals and acquisition activities. These will be added on as part of the cost estimates later in this memorandum.

Table 1 summarizes the rights of way costs for the Modified Existing Levee Alternative and the Setback Levee Alternative for the left bank properties that have been developed using the rationale discussed above. Figures 1 is an index of the figures that will be used to show the limits of the properties to be purchased. Figures 1a to 1l show the left bank properties.

Table 2 summarizes the rights of way costs for the Modified Existing Levee Alternative and the Setback Levee Alternative for the right bank properties that have been developed using the same rationale. Figures 2a to 2m show the location of each property identified in Table 2.

It should be noted that if this project proceeds on it present course, funding may be provided through the Washington Department of Transportation and their procedures will be used to purchase the identified properties. In addition, the two dike districts are actively pursuing the purchase of several of the identified properties. The estimates provided here do not deal with either of these activities and are intended to merely provide basic market value information for inclusion in the preliminary cost estimates for the alternatives.

Table 1 Left Bank Rights of Way Acquisition Costs Modified Existing and Setback Levee Alternatives						
ID	Parcel #	Owner	Modified Existing		Setback Levee	
			Acreage	Market Value	Acreage	Market Value
1	23938	Fohn			1.23	$7,640
2	23933	PUD			1.70	0
3	23932	DD 17	0.18	0	2.85	0
4	24028	Rivercrest	0.135	$43,600	1.98	$640,000
5	24026	Rivercrest	0.146	$77,000	1.76	$929,000
6	24029	Rivercrest	0.106	$34,300	1.23	$398,000
7	24027	Calicorp	0.115	$175,000	1.10	$1,681,000
8	24021	Calicorp	0.08	$29,700	0.6	$222,000
9	24022	HQ Partnership	0.06	$28,300	0.34	$152,000
10	24020	HQ Partnership	0.13	$64,300	0.91	$452,000
11	24025	DD 17	0.10	0		0
12	24024	DD 17			0.21	0
13	24023	DD 17	0.05	0	0.97	0
14	24018	Mount Vernon				0
15	24206	Mount Vernon			0.18	0
16	24201?	Roald	0.05	$15,900	0.67c	$281,000?
17	24226	Mount Vernon			0.54	0
18	24219	Curry	0.41	$51,400	1.01	$401,000
19	24213	Van Duzen	0.05	$5,600	0.76	$271,000
20	24208	DD 17	0.05	0	0.82	0
21 22 23	112779 121427 121425	Hocking	0.65	$92,600	3.23	$461,000
24	24213	Steiner	0.07	$7,600	0.77	$199,000
25	24215	Bridges	0.08	$8,800	0.77	$203,000
26 27	24217 24216	Wolf	0.10	$13,200	1.41	$379,000
28	24193 24218	DD 17			0.97	0
29	24196	Ross			0.83	$207,000
30 31 32	111922 111652 111653	DD 17			2.4	0
33	111654	Lund			0.93	$243,000
34	24210	Pimentel	0.09	$8,800	0.68	$132,000
35	24209	Armendarez	0.07	$10,600	0.45	$70,000
36	24224	Stolpe	0.09	$19,400	0.78	$169,000
36a	24225	Salt			0.83	$192,000
Total Left Bank Properties			**2.81**	**$686,000**	**32.91**	**$7,700,000**

Table 2 **Right Bank Rights of Way Acquisition Costs** **Modified Existing and Setback Levee Alternatives**						
ID	Parcel #	Owner	Modified Existing		Setback Levee	
			Acreage	Market Value	Acreage	Market Value
37	23923	Hanson			0.69	$18,000
38	23921	Larson			4.90	$130,000
39	23922	Rock Island Partner			2.39	$506,000
40	23917	Tapley Investments			1.58	$514,000
41	23963	Covarrubias			0.15	$30,400
42	23943	Covarrubias			0.09	$13,200
43	23942	Covarrubias			0.76	$138,000
44	23927	DD 12			4.0	0
45	23941 23939 116918	DD 12			4.33	0
46	24144	DD 12			3.83	0
47 48 49	24138 24142 24141	Burlington RV			1.72	$1,070,000
50	24137	Nagatani			0.47	$25,500
51	24156	Leonovich			0.71	$43,500
52	24162	Cleave			0.34	$121,000
53	24163	Trevino			0.66	$157,000
54	24152	Satsuma			0.17	$7,400
Total Right Bank Properties					**26.79**	**$2,800,000**

Cost Estimates

The costs of constructing the levee improvements for the two alternatives have been estimated and are included below. A number of assumptions have been made and are discussed below:

1. The levee will be constructed as outlined in the earlier sections of this report, i.e. crest elevation as shown, top width of 12 feet, and 3 to 1 side slopes. The volume needed is increased by 5% to account for compaction.

2. The material for the levee will be obtained locally at a cost of $ 4 /yard. Based upon the NRCS soils report for Skagit County, there are materials suitable for embankments within a reasonable distance although mixing may be necessary to obtain homogenous soils.

3. The cost of transporting the material to the site and placing it is estimated to be approximately $11 per yard, making the total cost of the embankment approximately $15 per yard in place.

4. The estimate assumes that two feet of top soil will be excavated from the ground surface under the footprint of the setback levee prior to construction and that one foot of this topsoil will be placed on the top 1 foot of the levee and seeded. The cost is estimated at $10 per yard for excavating and placing the material and $50,000 to hydro seed the new setback levee.

5. It is assumed that 6 inches of gravel will be placed on top of all levees as a road surfacing at a cost of $30 per yard, in place.

6. It is assumed that all lands needed for the project will be purchased and that the cost will be based upon the market values described earlier. The computed market values for each parcel has been increased by 10 percent to account for inflation and the size of the parcels being purchases and an additional 10 percent to cover appraisal and purchase expenses.

Modified Existing Levee Cost Estimate

Table 3 presents an estimate of cost for construction of the Modified Existing Levee Alternative. The costs are based upon the assumptions listed above and current cost levels for similar construction in Skagit County. The rights of way cost are taken from earlier sections of this memorandum. Note that a contingency of 30 percent has been added to the estimate to cover changes in bidding conditions and minor items that have not be detailed at this point.

Table 3
Cost Estimate – Modified Existing Levee Alternative

Item	**Quantity**	**Unit Cost**	**Cost**
Mobilization	1	$200,000	$200,000
Levee Embankment-Left Bank	50,000 cubic yds	$15 per yard	750,000
-Right Bank	65,000 cubic yds	$15 per yard	875,000
Hydro seed	1 job	$50,000	50,000
Levee road gravel-Left Bank	1,200 cubic yards	$30 per yard	36,000
-Right Bank	1,200 cubic yards	$30 per yard	36,000
Road Improvements	200 lf	$500 per lf	100,000
Sub Total Construction			$2,050,000
Contingency – 30 percent			600,000
Sales Tax - 8.3 percent			170,000
Total Construction			$2,820,000
Rights of Way- Left Bank			$686,000
- Right Bank			0
10% Contingency			69,000
Appraisals and Purchases			69,000
Total Rights of Way Costs			$824,000
Total Direct Project Costs			**$3,644,000**
Engineering, Construction Observation, and Agency Administration – 18 percent			$656,000
Total Project Costs			**$4,300,000**

Setback Levee Cost Estimate

Table 4 presents the cost estimate for construction of the Setback Levee Alternative, the plus 2 foot option. Table 5 presents the cost estimate for construction of the Setback Levee Alternative, the plus 6 foot option. The costs are presented on the same basis as described above.

Table 4
Cost Estimate – Setback Levee Alternative, 2 foot Option

Item	**Quantity**	**Unit Cost**	**Cost**
Mobilization	1	$300,000	$300,000
Levee Embankment-Left Bank	153,000 cubic yds	$15 per yard	2,300,000
-Right Bank	216,000 cubic yds	$15 per yard	3,240,000
Foundation Preparation	84,000 cubic yds	$10 per yard	840,000
Right Bank Excavation @ RM 17.5	89,000 cubic yds	$5 per yard	445,000
Levee Removal	170,000	$5 per yard	850,000
Hydro seed	1 job	$50,000	50,000
Levee road gravel-Left Bank	1,200 cubic yards	$30 per yard	36,000
-Right Bank	1,200 cubic yards	$30 per yard	36,000
Road Improvements	2,200 lf	$500 per lf	1,100,000
Railroad Trestle Pilings	6 each	$28,000	148,000
Sub Total Construction			$9,345,000
Contingency – 30 percent			2,805,000
Sales Tax - 8.3 percent			780,000
Total Construction			$12,930,000
Rights of Way- Left Bank			$7,700,000
- Right Bank			2,800,000
10% Contingency			1,000,000
Appraisals and Purchases			1,000,000
Total Rights of Way Costs			$12,500,000
Total Direct Project Costs			**$25,430,000**
Engineering, Construction Observation, and Agency Administration – 18 percent			$4,570,000
Total Project Costs			**$30,000,000**

Table 5 Cost Estimate – Setback Levee Alternative, 6 foot Option			
Item	**Quantity**	**Unit Cost**	**Cost**
Mobilization	1	$300,000	$300,000
Levee Embankment-Left Bank	248,000 cubic yds	$15 per yard	3,720,000
-Right Bank	316,000 cubic yds	$15 per yard	4,740,000
Foundation Preparation	84,000 cubic yds	$10 per yard	840,000
Right Bank Excavation @ RM 17.5	89,000 cubic yds	$5 per yard	445,000
Levee Removal	170,000	$5 per yard	850,000
Hydro seed	1 job	$50,000	50,000
Levee road gravel-Left Bank	1,200 cubic yards	$30 per yard	36,000
-Right Bank	1,200 cubic yards	$30 per yard	36,000
Road Improvements	2,200 lf	$500 per lf	1,100,000
Railroad Trestle Pilings	6 each	$28,000	148,000
Sub Total Construction			$12,365,000
Contingency – 30 percent			3,710,000
Sales Tax - 8.3 percent			1,025,000
Total Construction			$17,100,000
Rights of Way- Left Bank			$7,700,000
- Right Bank			2,800,000
10% Contingency			1,000,000
Appraisals and Purchases			1,000,000
Total Rights of Way Costs			$12,500,000
Total Direct Project Costs			**$29,600,000**
Engineering, Construction Observation, and Agency Administration – 18 percent			$5,400,000
Total Project Costs			**$35,000,000**

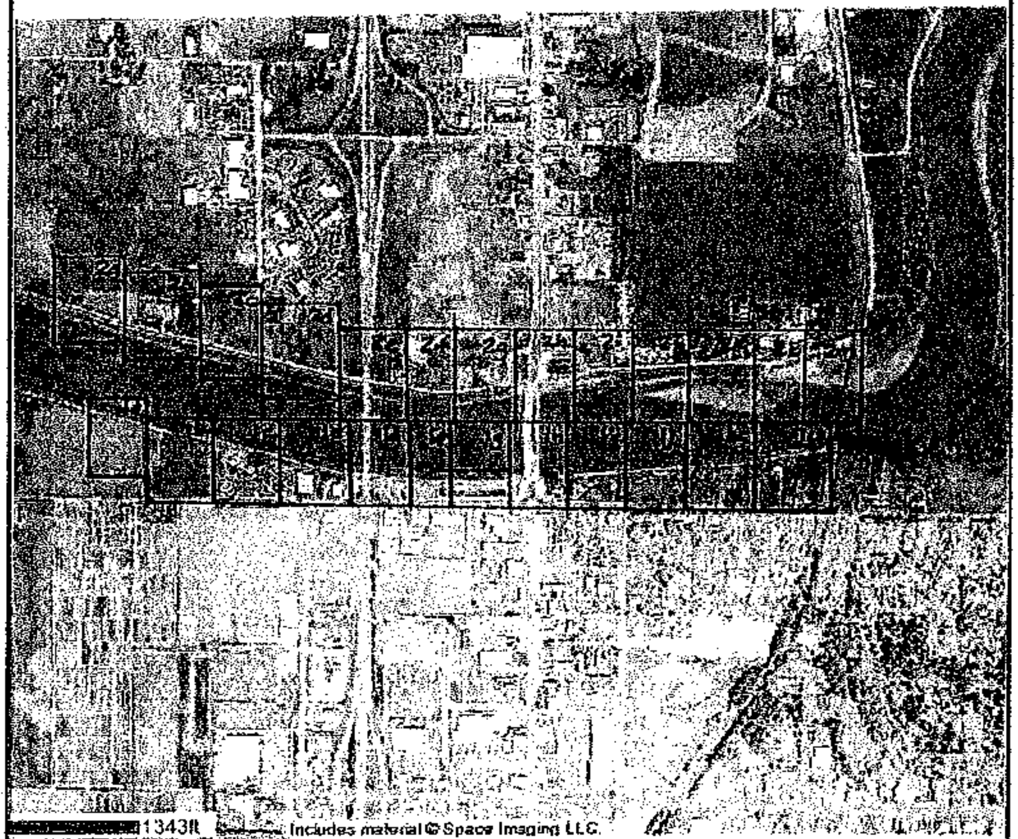

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Figure 1

Parcel Index Sheet

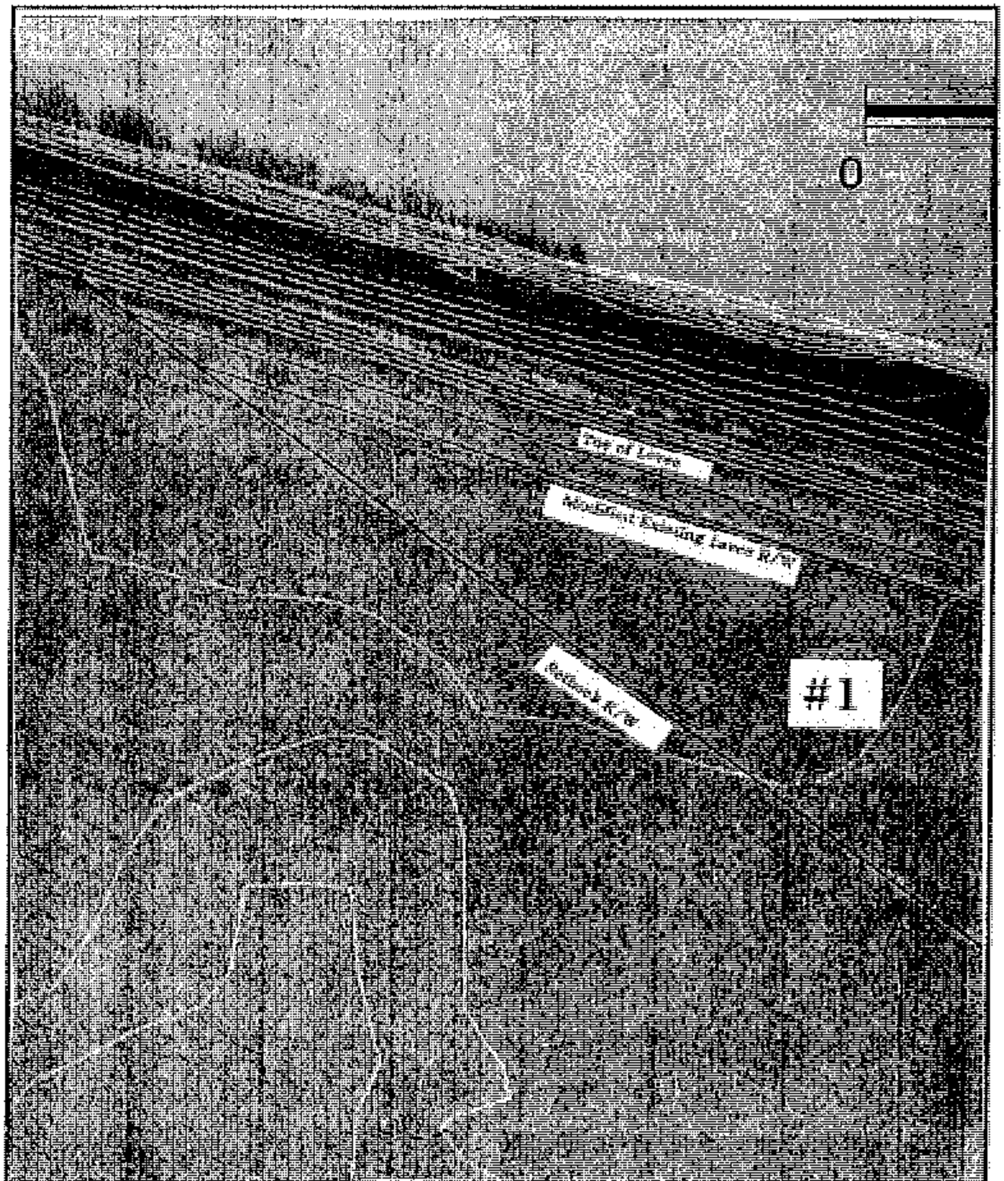

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Figure 1a

Left Bank Parcels

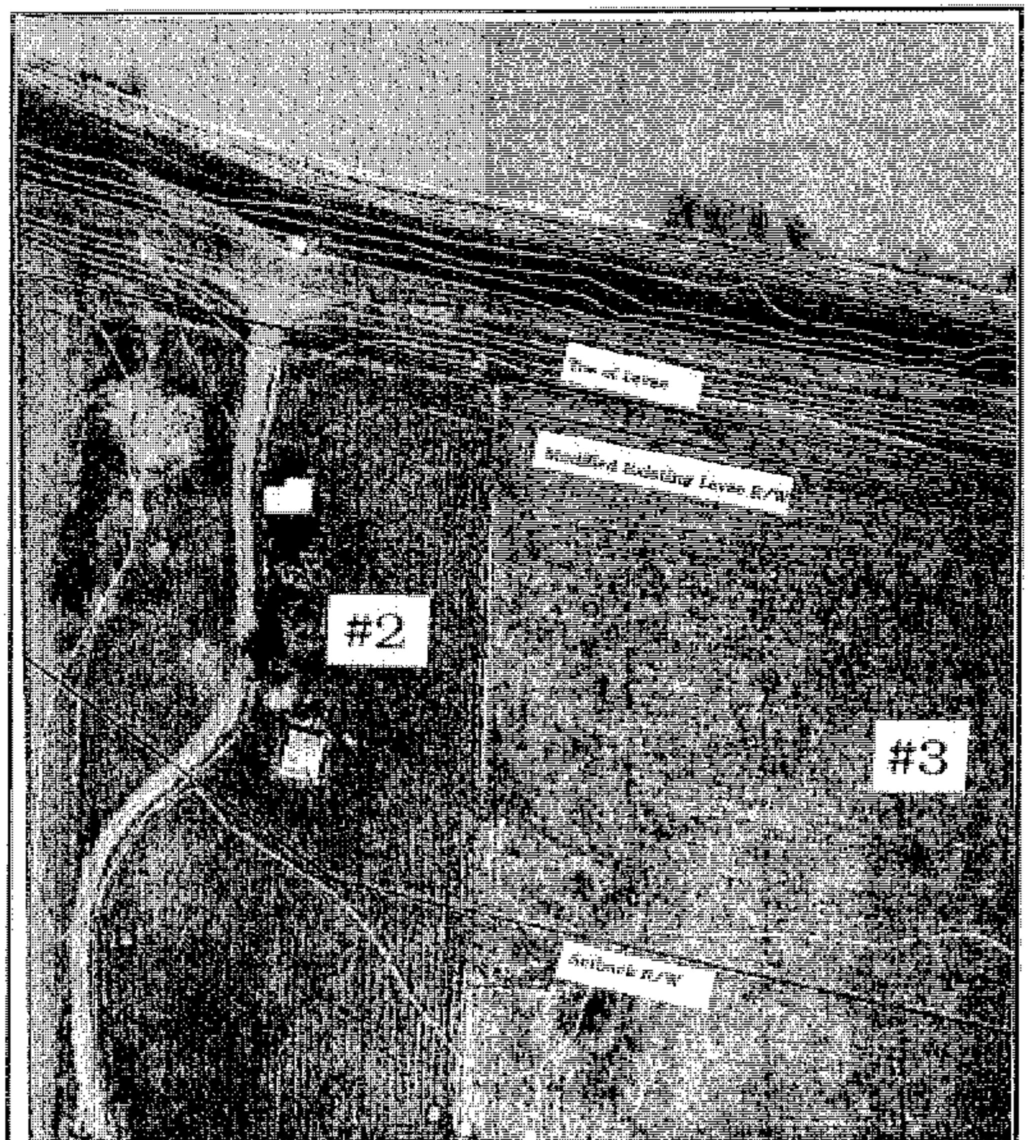

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Figure 1b

Left Bank Parcels

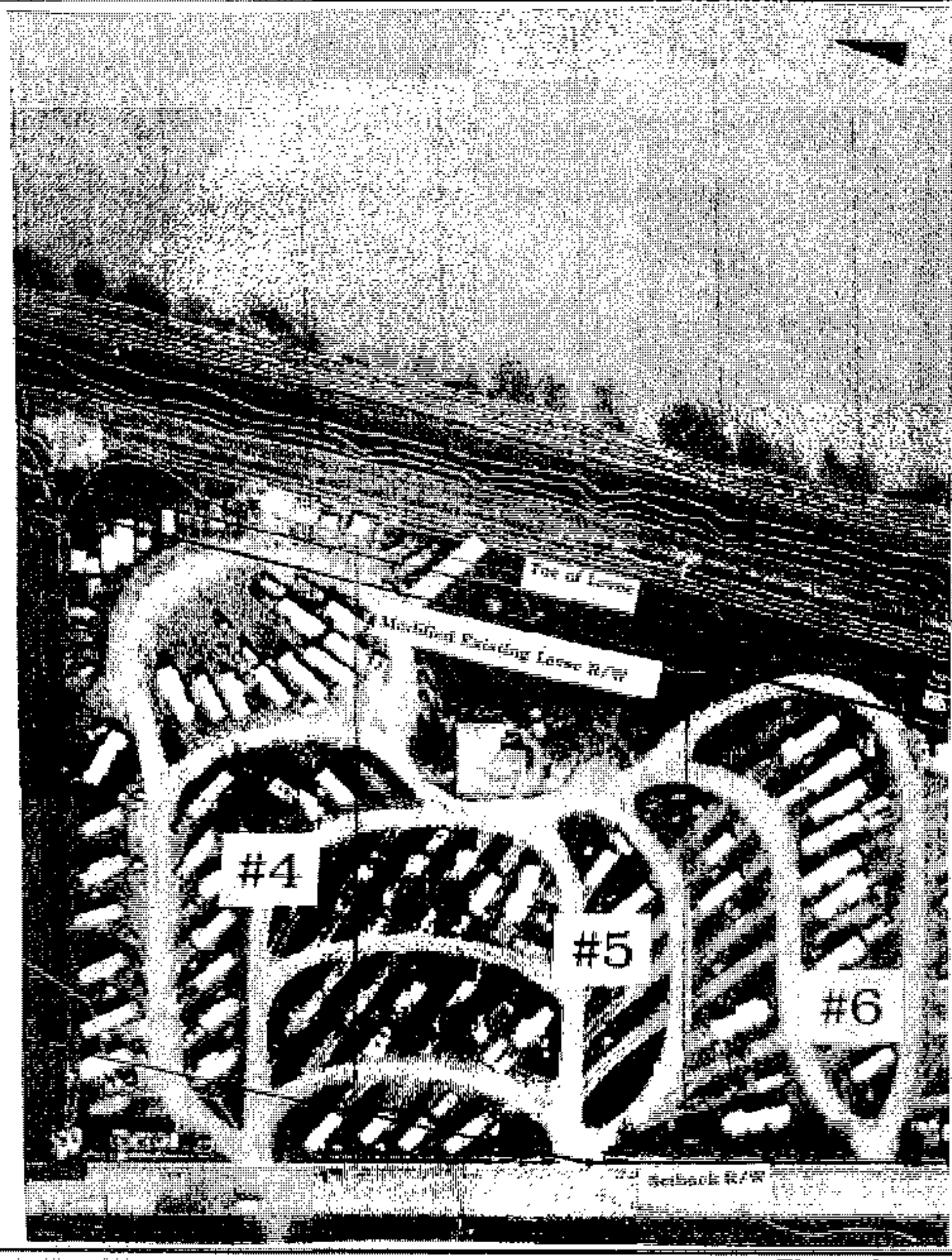

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Figure 1c

Left Bank Parcels

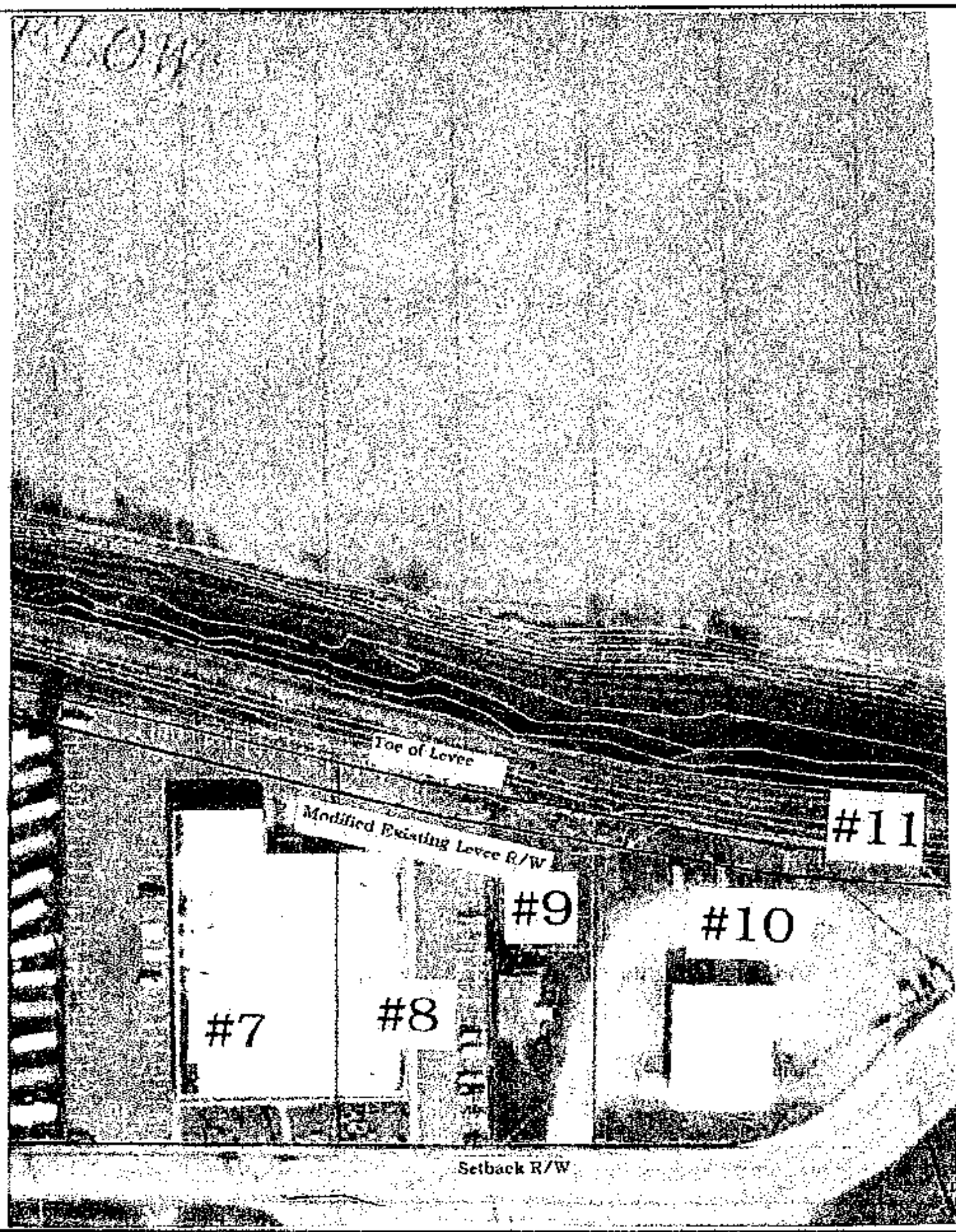

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Figure 1d

Left Bank Parcels

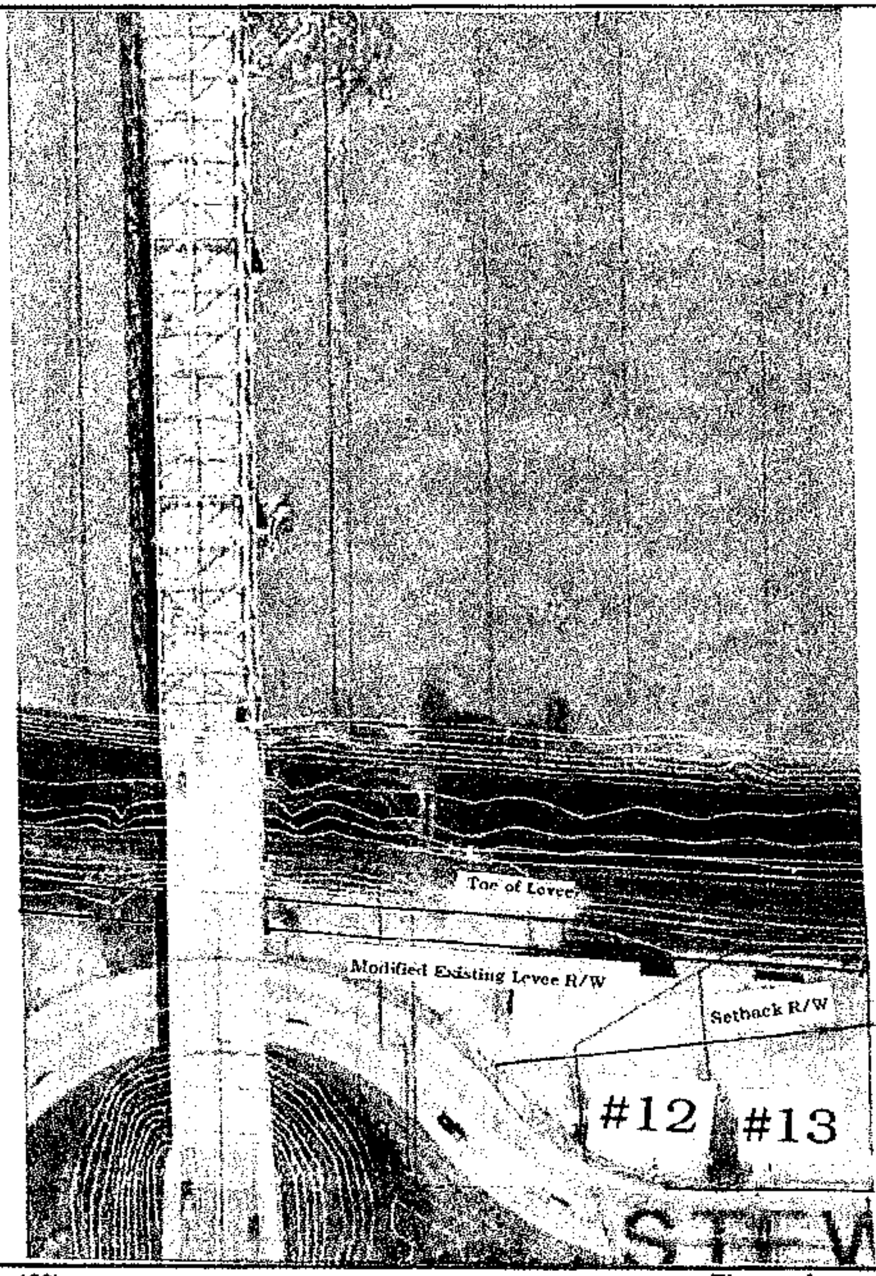

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Figure 1e

Left Bank Parcels

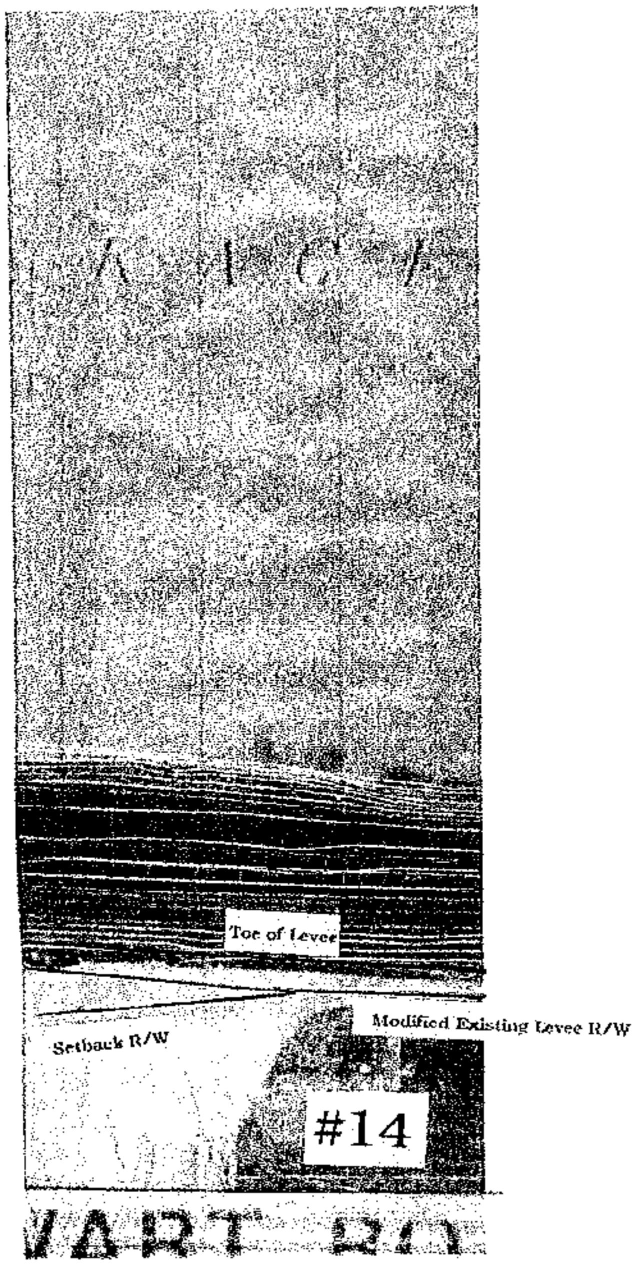

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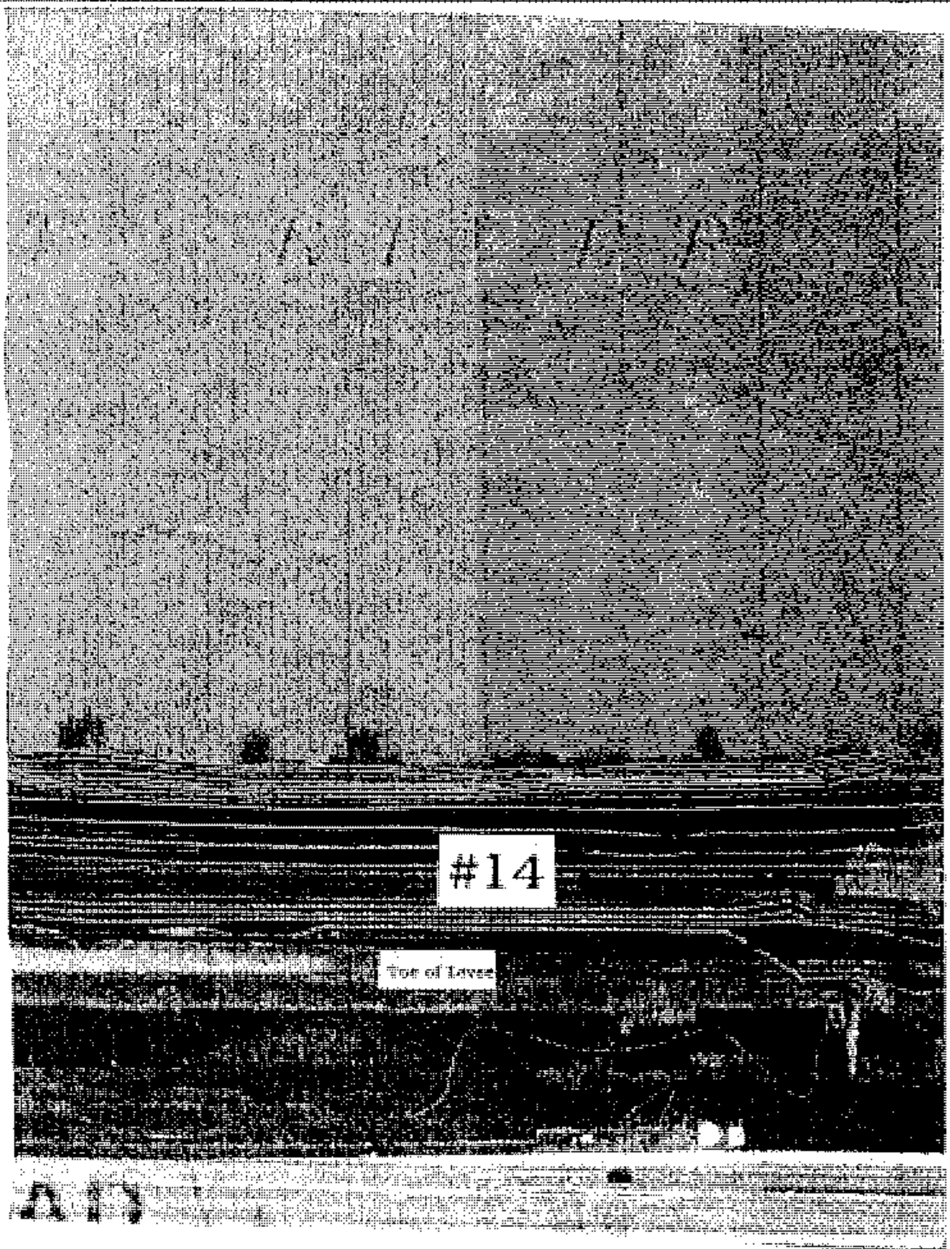
Figure 1f

Left Bank Parcels



Scale 1" = 100'

Figure 1g

Left Bank Parcels

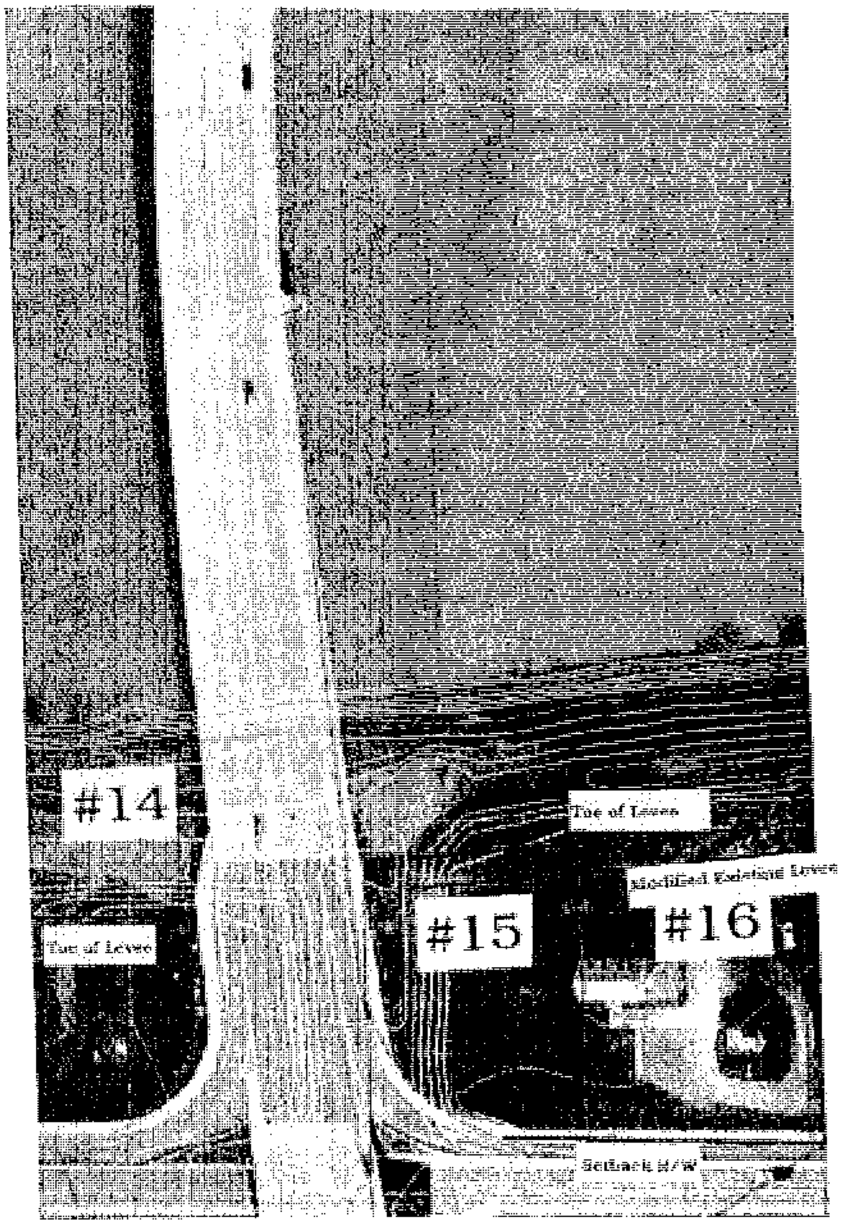


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Figure 1h

Left Bank Parcels

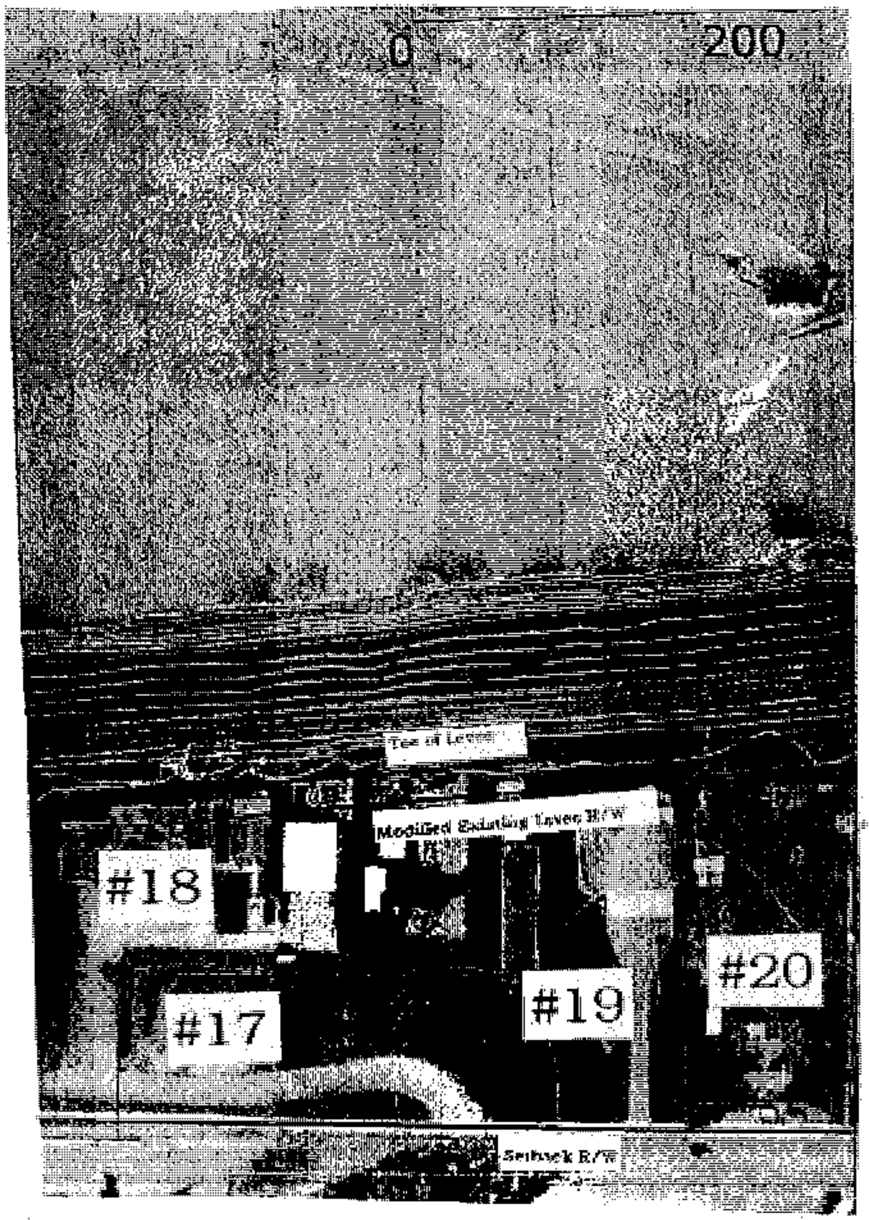

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Figure 1i

Left Bank Parcels

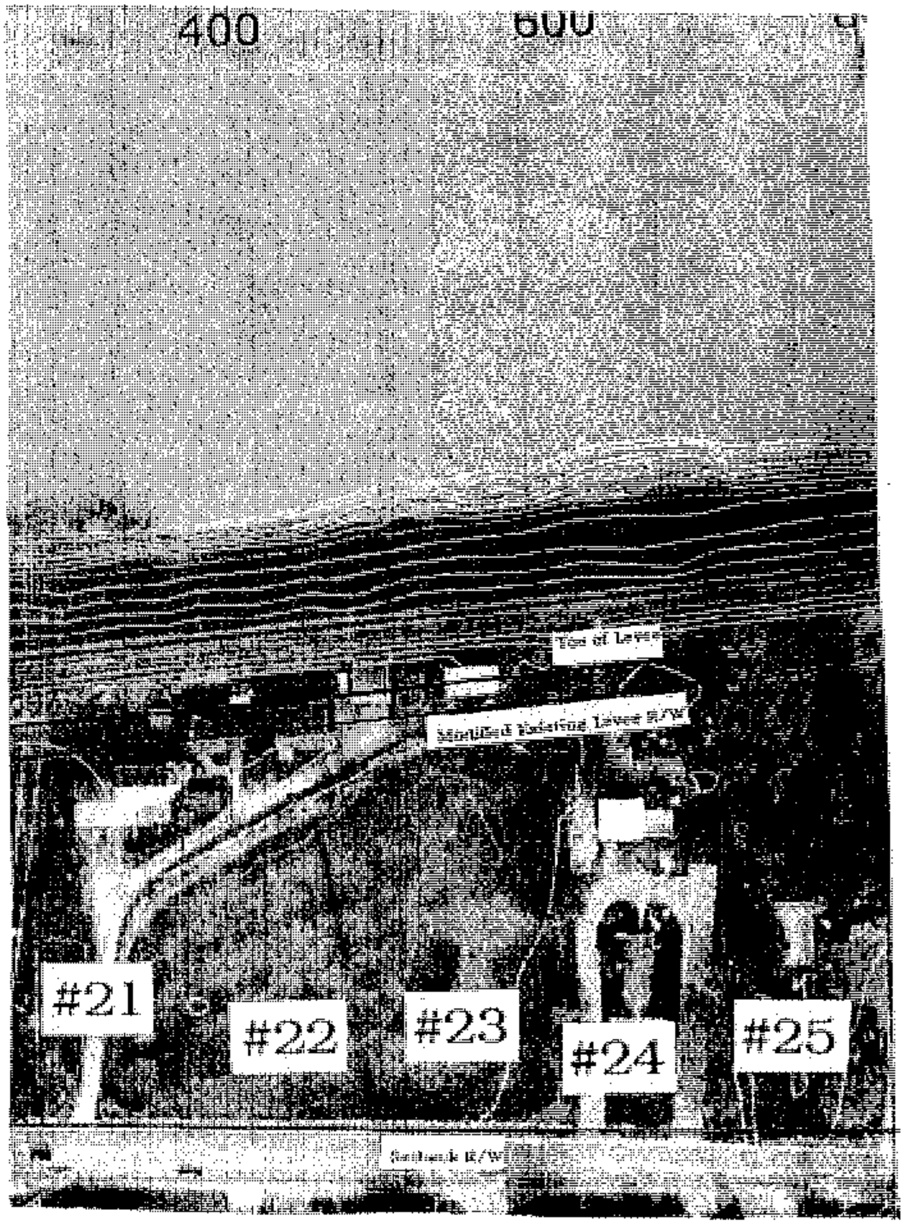

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Figure 1j

Left Bank Parcels

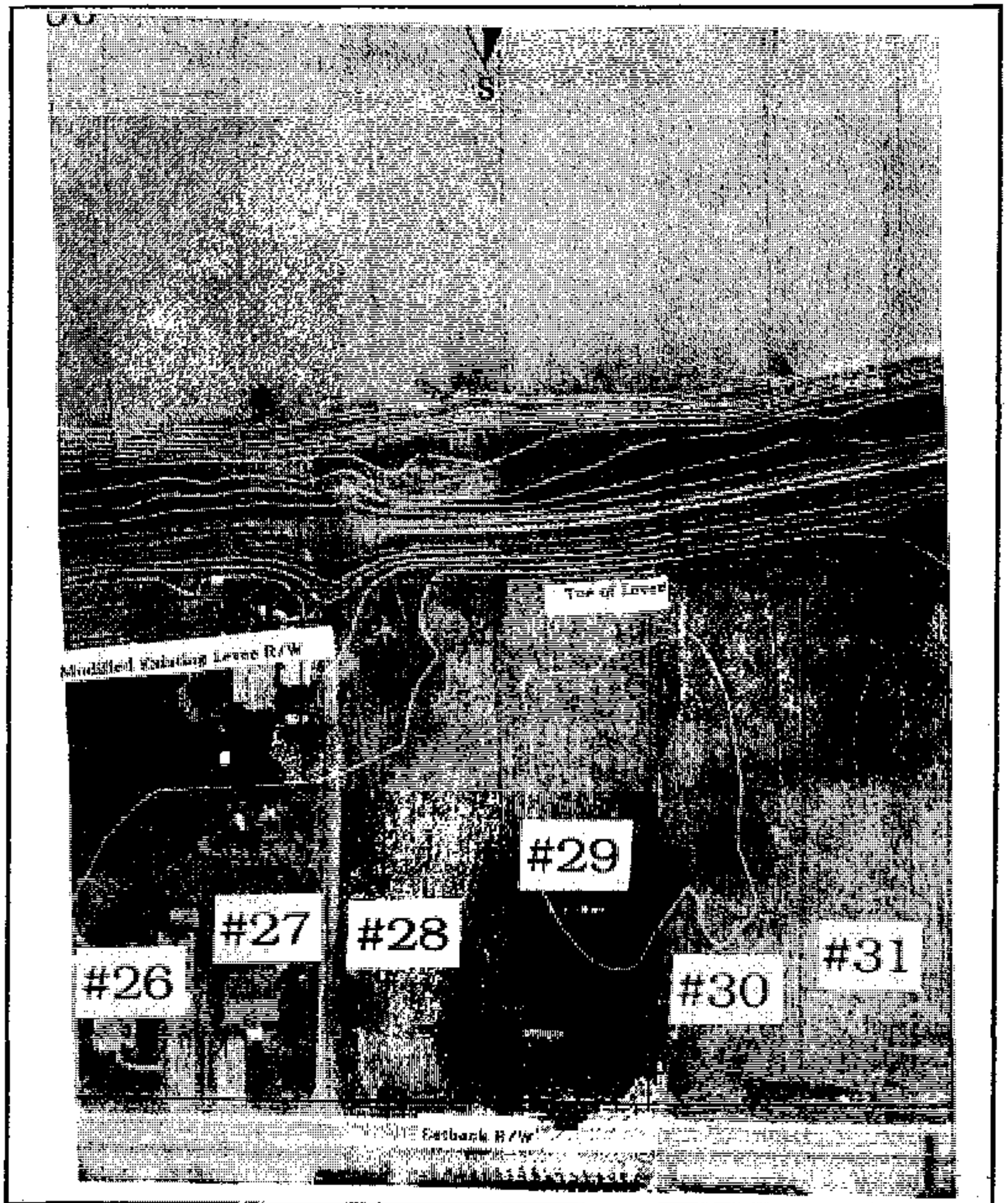

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Figure 1k

Left Bank Parcels

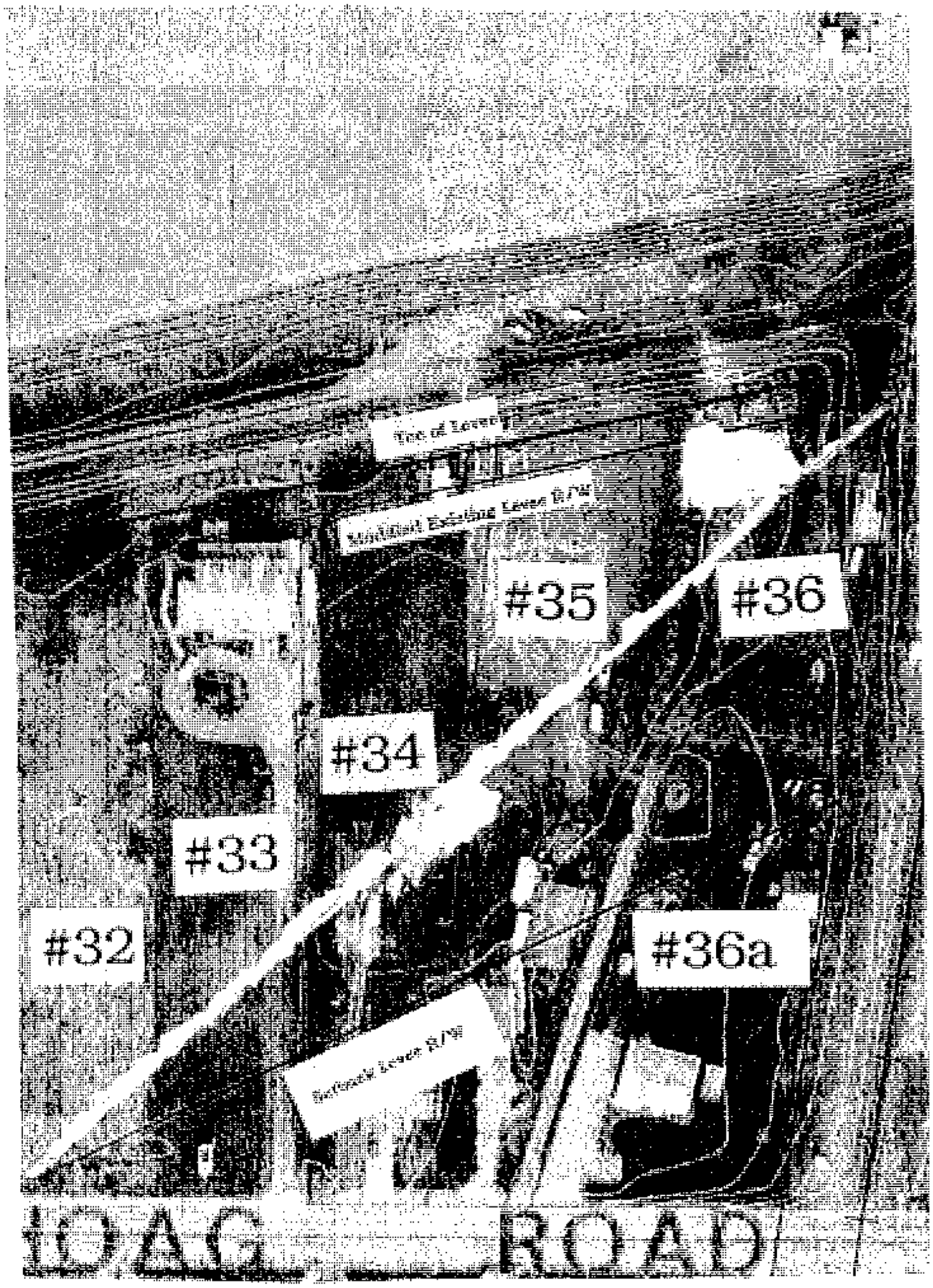

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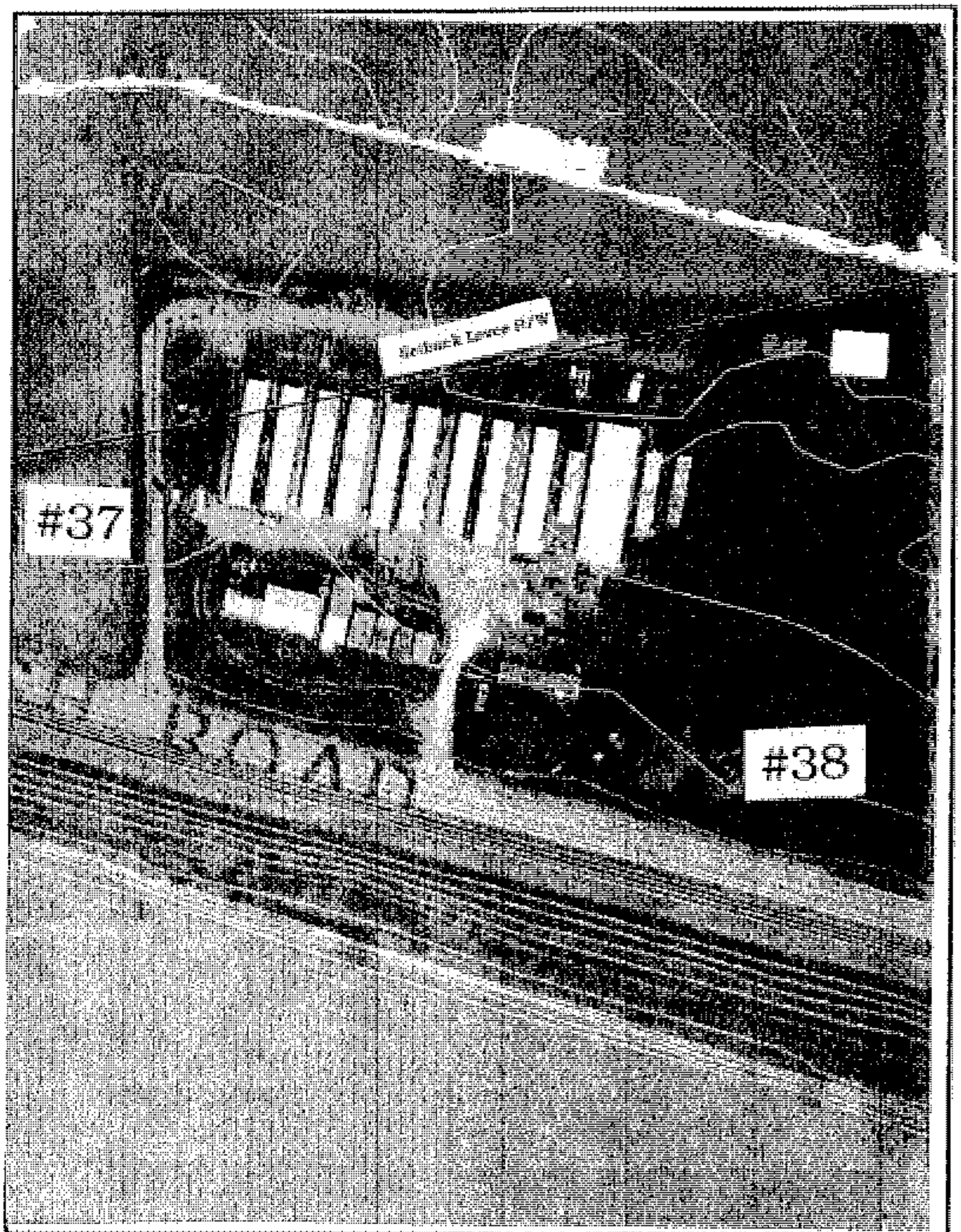
Figure 1l

Left Bank Parcels

Scale 1" = 100'

Figure 2a

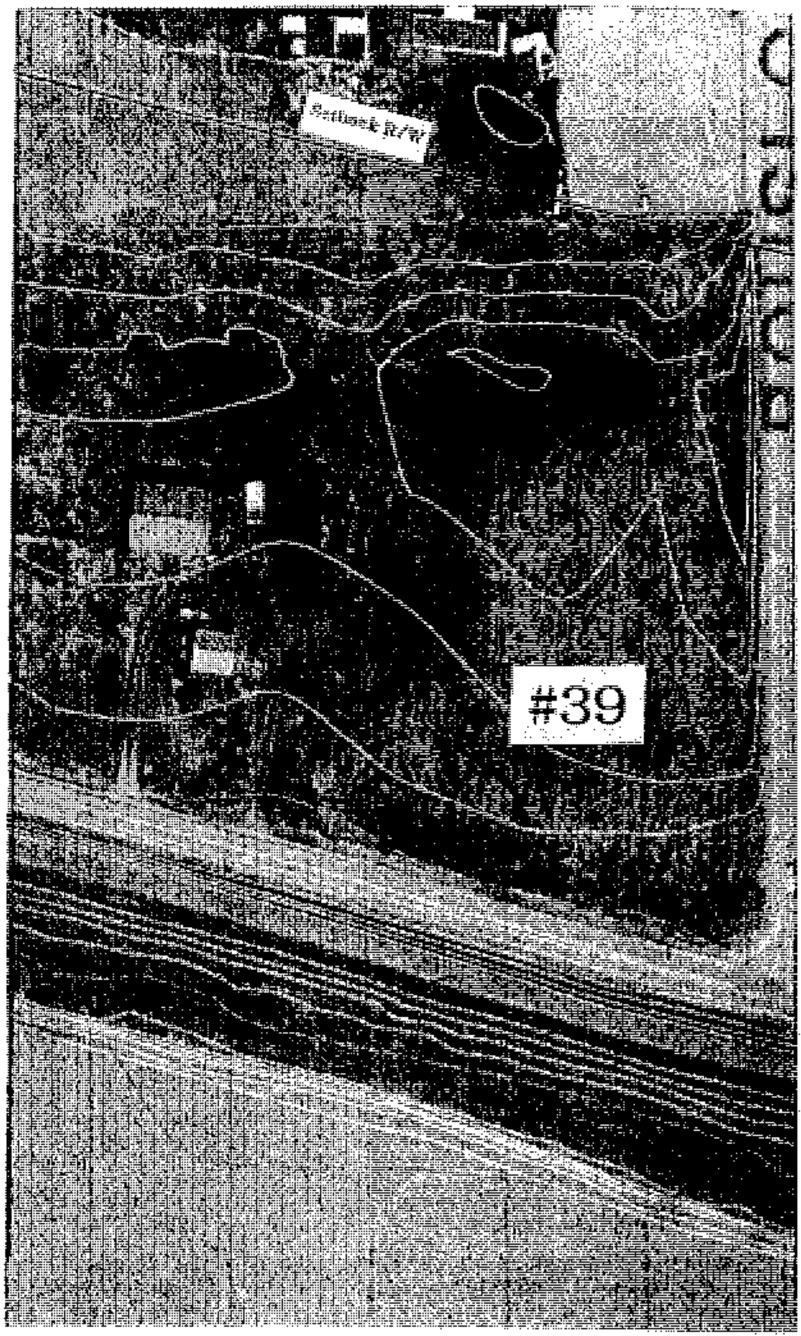
Right Bank Parcels



Scale 1" = 100'

Figure 2b

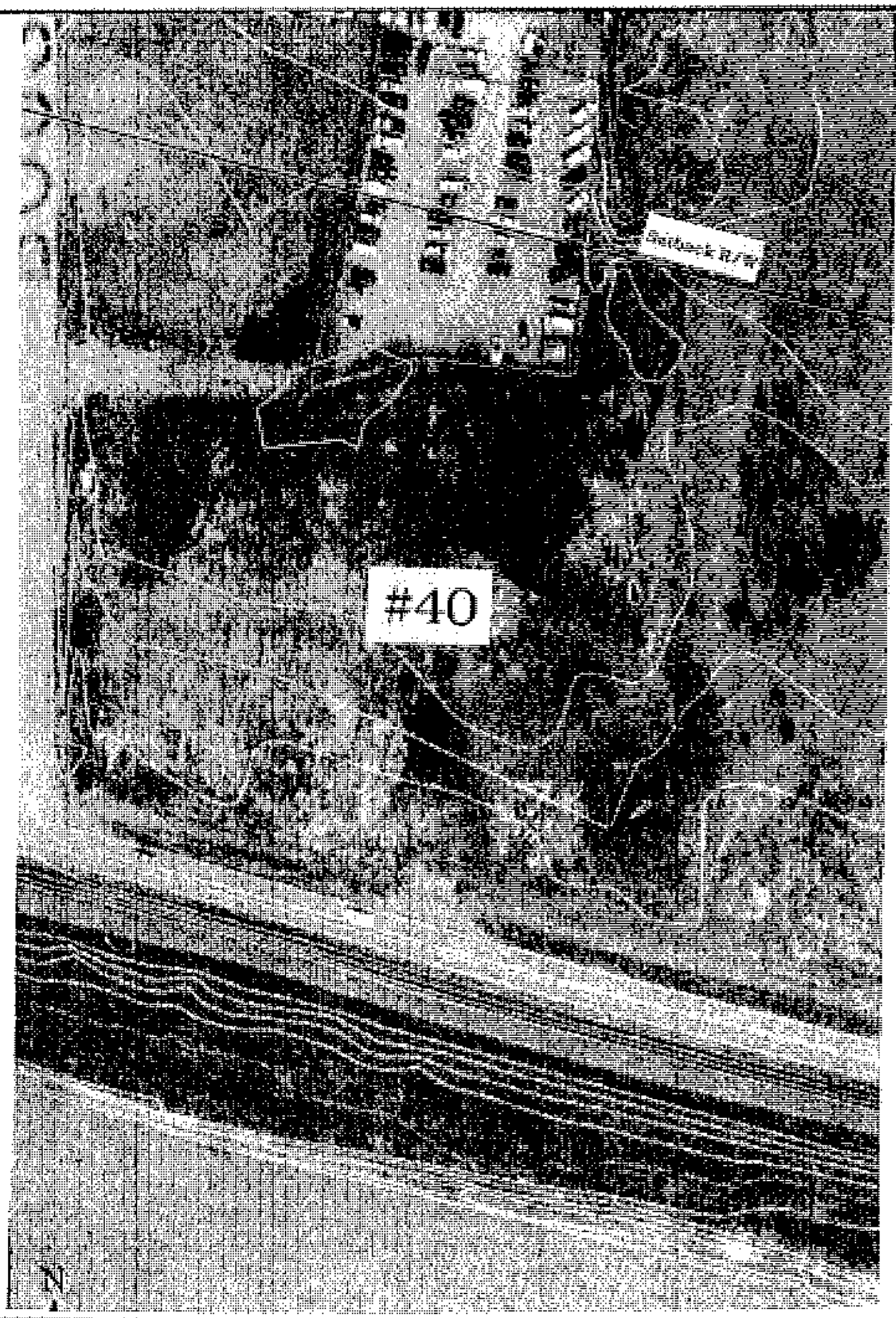
Right Bank Parcels



Scale 1" = 100'

Figure 2c

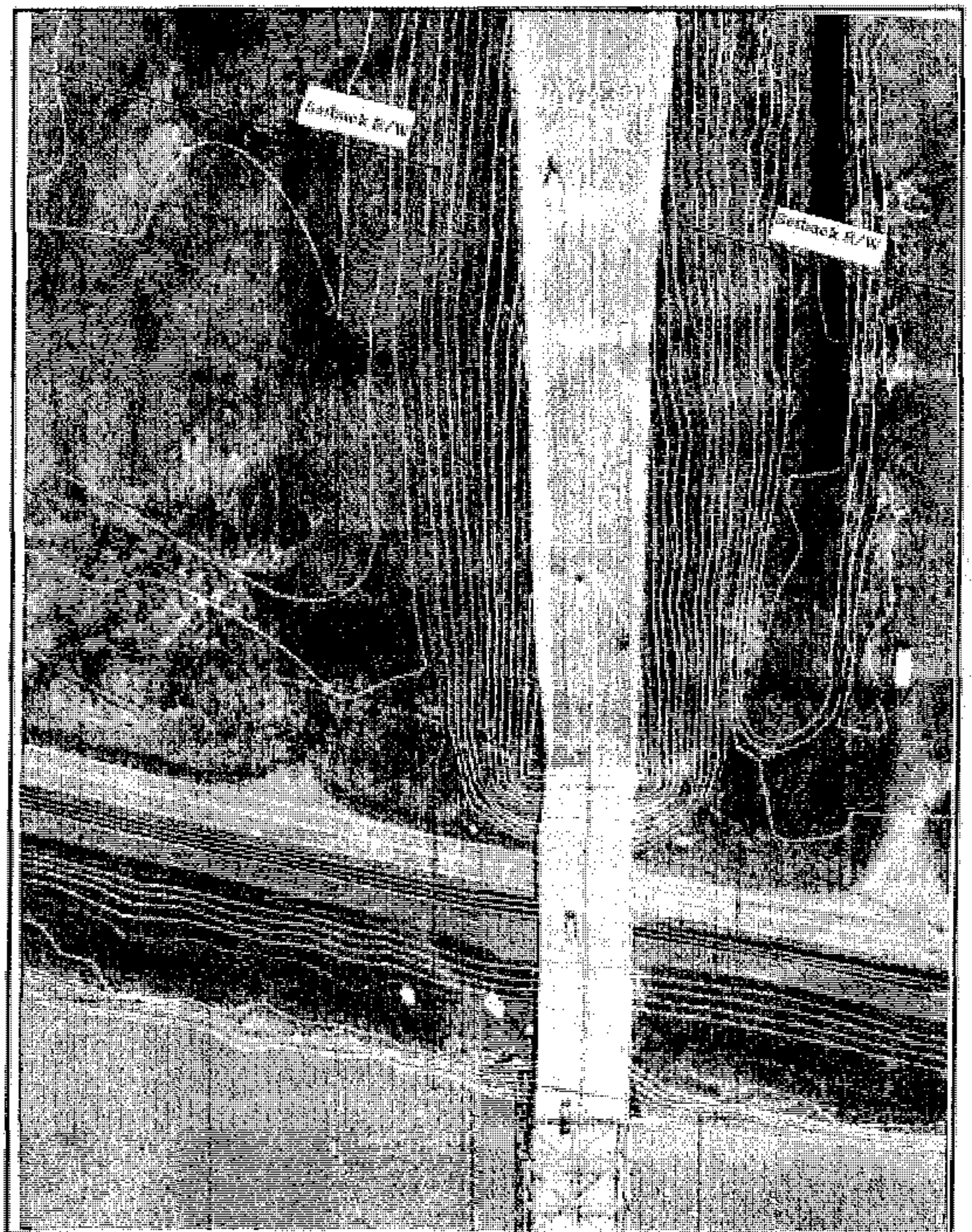
Right Bank Parcels



Scale 1" = 100'

Figure 2d

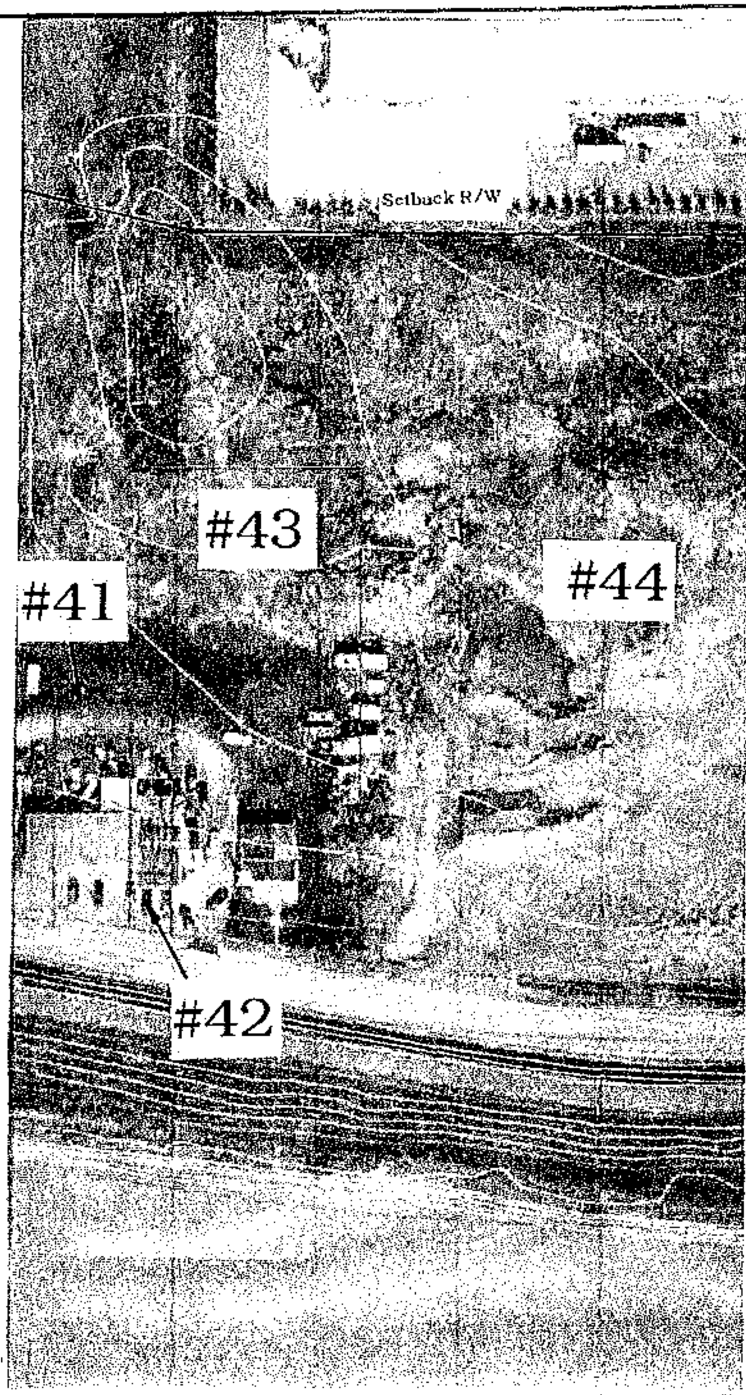
Right Bank Parcels



Scale 1" = 100'

Figure 2e

Right Bank Parcels



Scale 1" = 100'

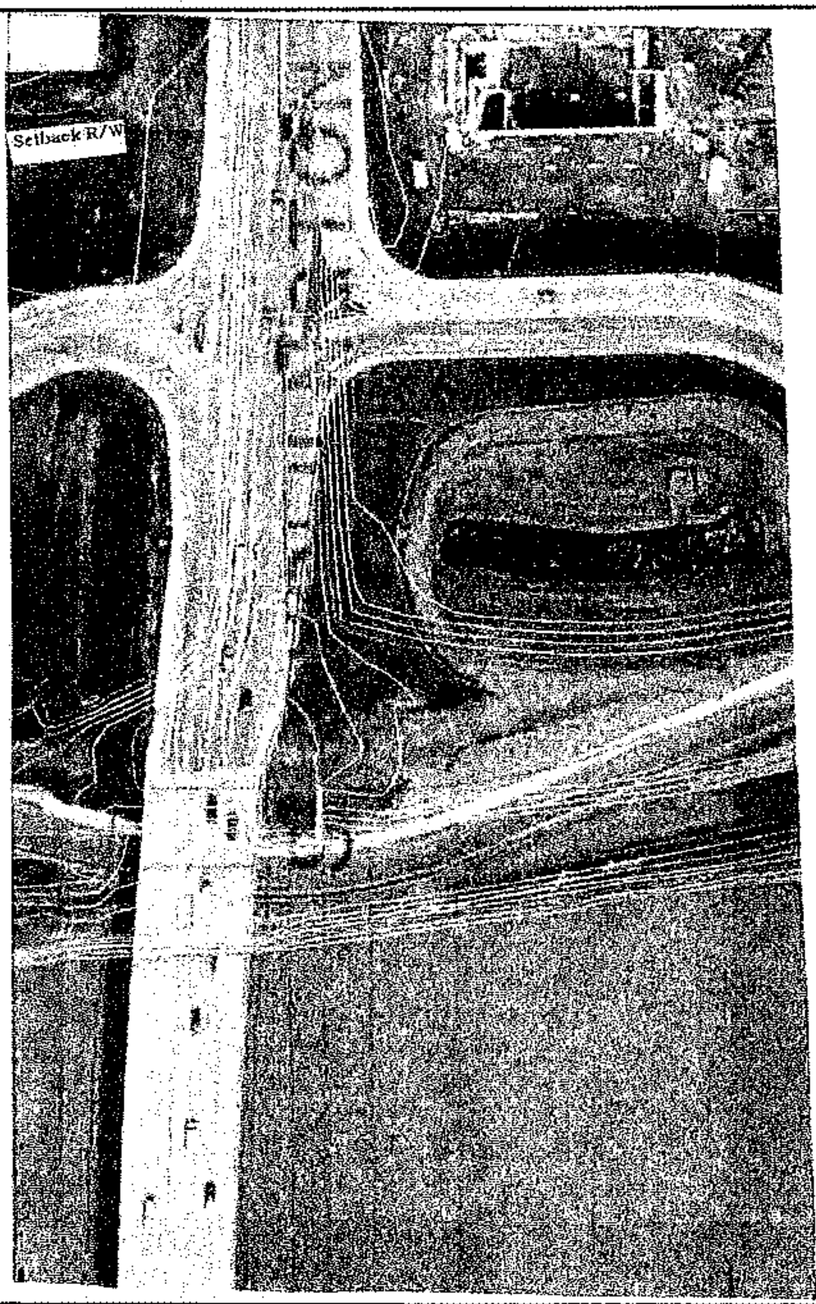
Figure 2f

Right Bank Parcels

Scale 1" = 100'

Figure 2g

Right Bank Parcels



Scale 1" = 100'

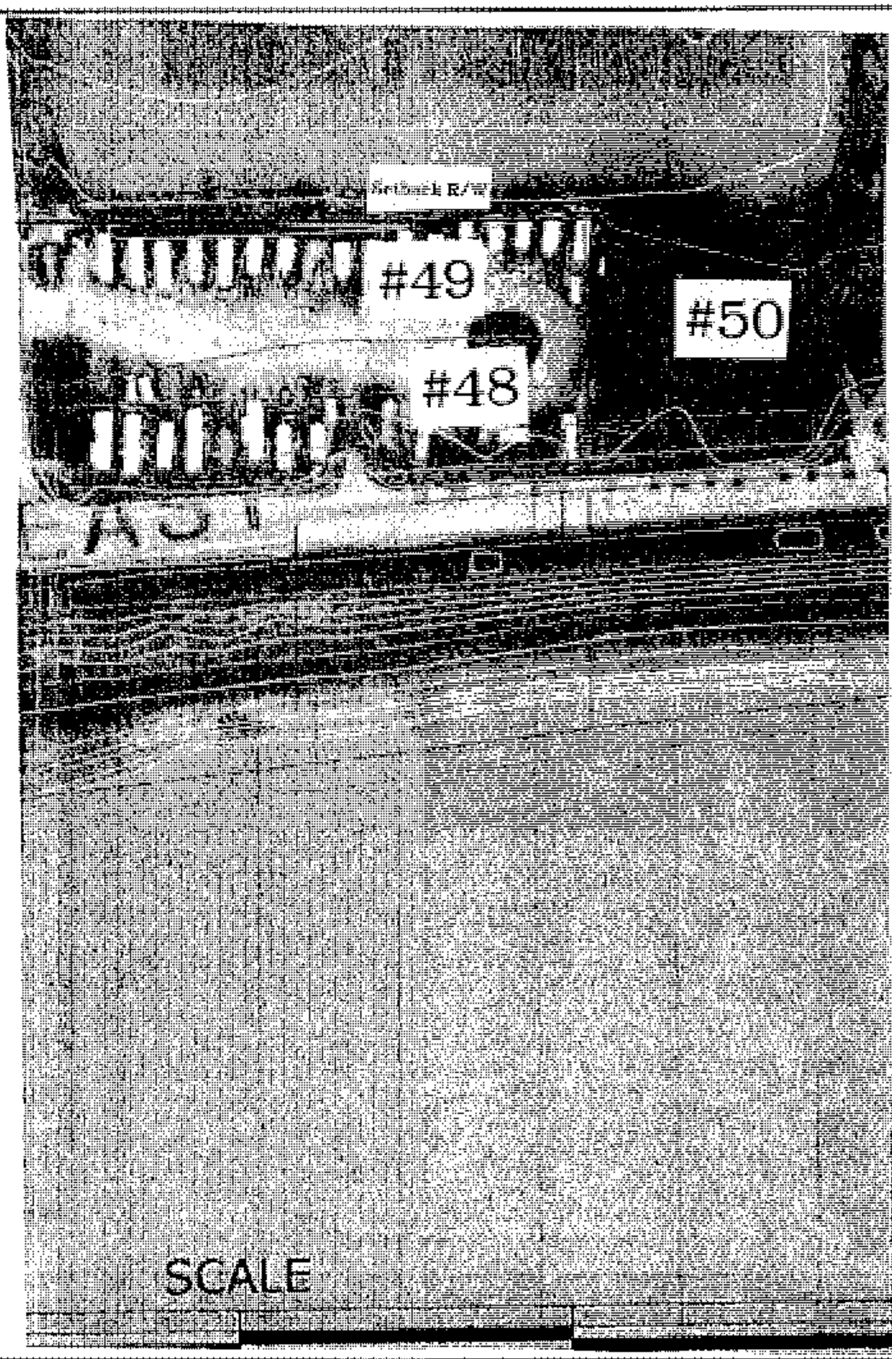
Figure 2h

Right Bank Parcels

Scale 1" = 100'

Figure 2i

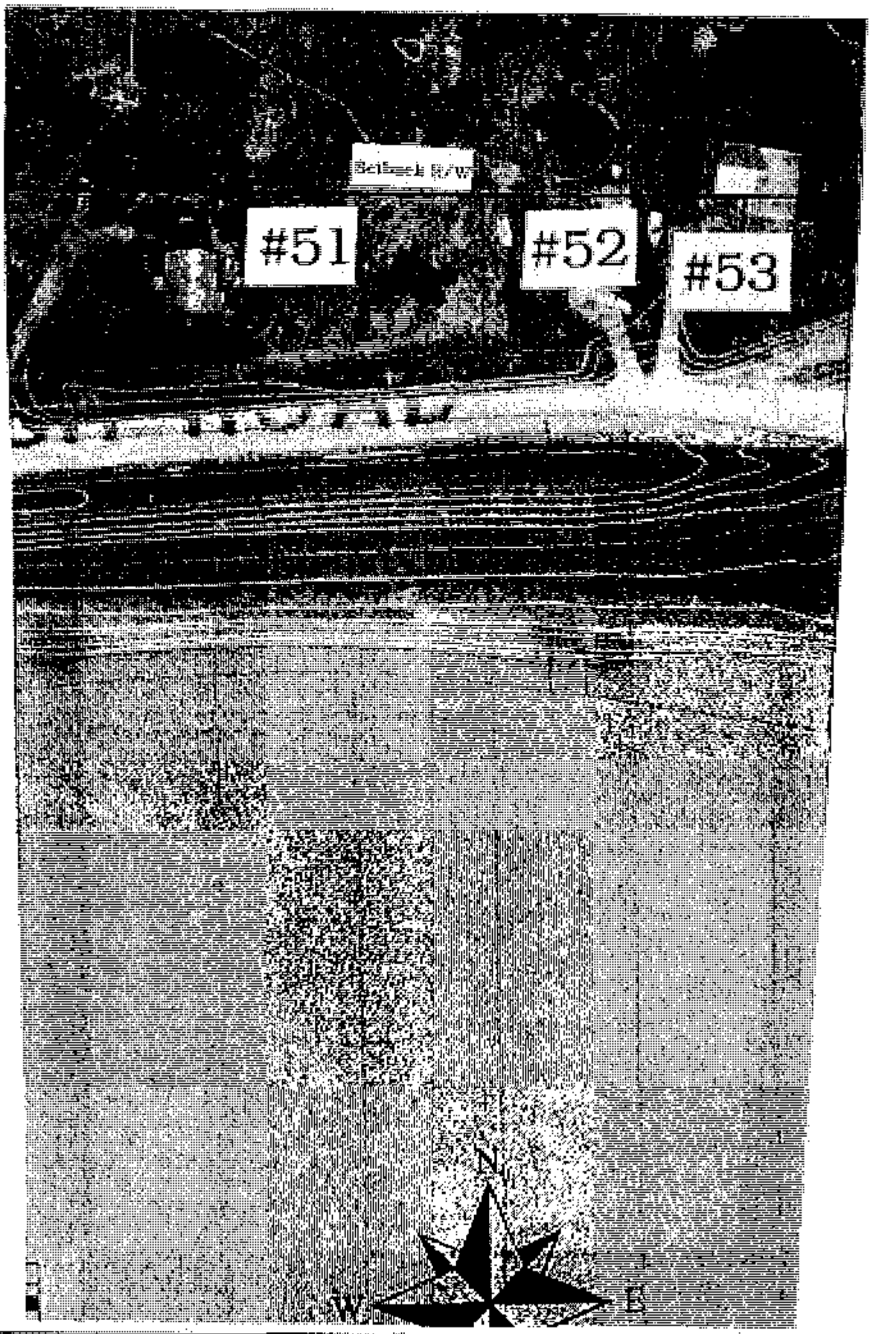
Right Bank Parcels



Scale 1" = 100'

Figure 2j

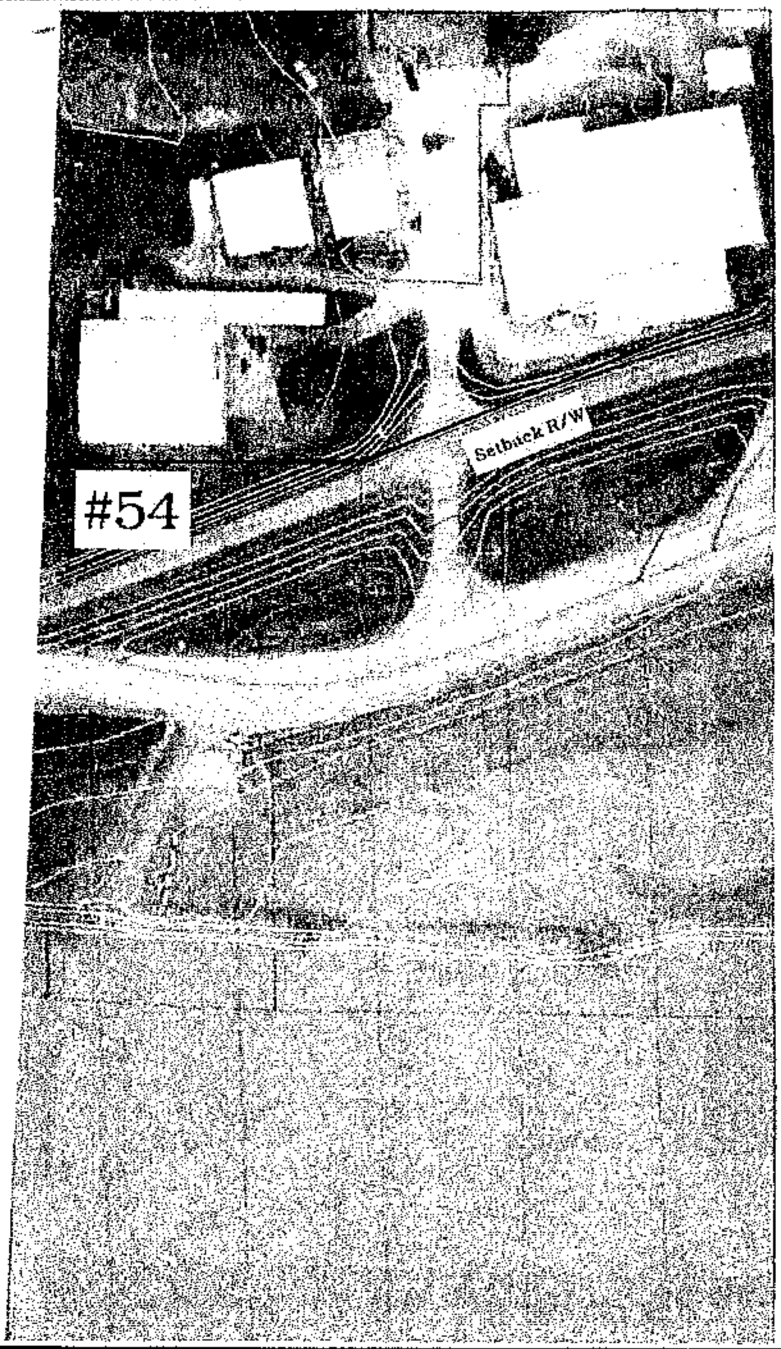
Right Bank Parcels



Scale 1" = 100'

Figure 2k

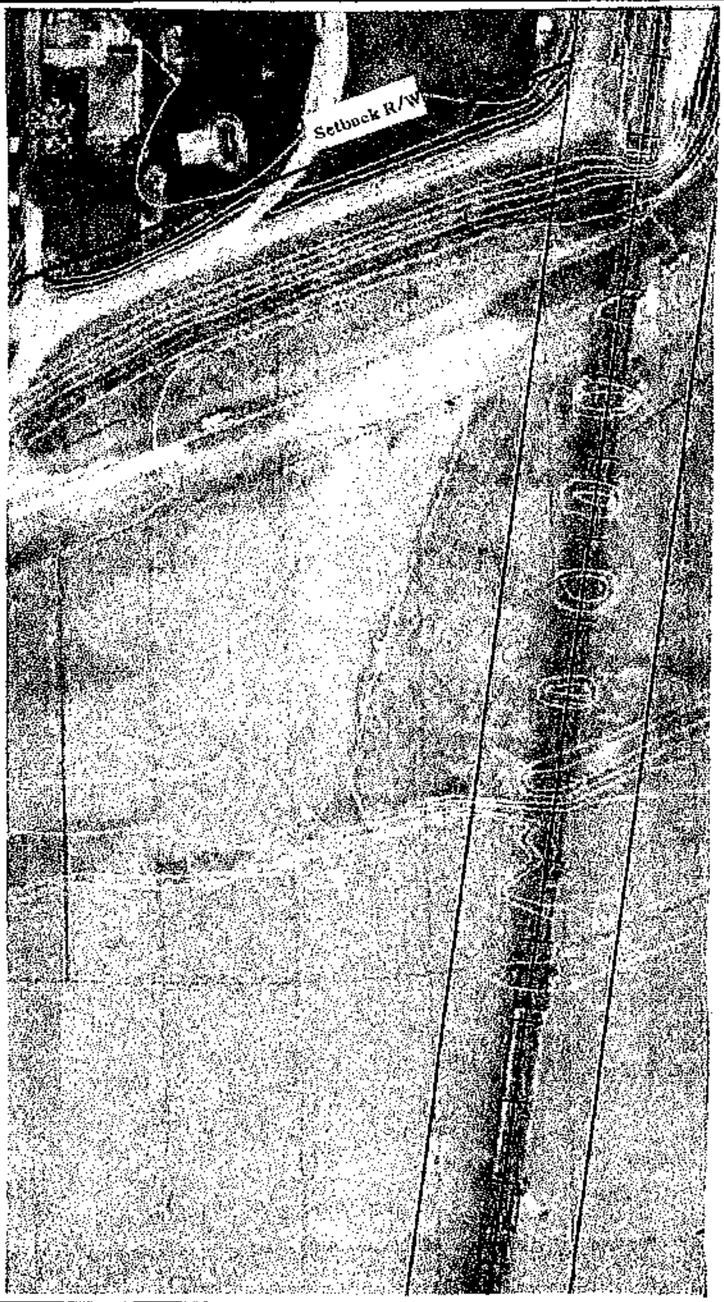
Right Bank Parcels



Scale 1" = 100'

Figure 2I

Right Bank Parcels



Scale 1" = 100'

Figure 2m

Right Bank Parcels

Appendix C
Flood Damage Reduction Analysis

DRAFT TECHNICAL MEMORANDUM

Skagit River Bridge Modification and Interstate Highway Protection Project

Flood Damage Reduction Analysis

Introduction

The hydraulic analysis of the three project alternatives under consideration (No Action, Modified Existing Levees, and Setback Levees), has shown that the No Action and Modified Existing Levees alternatives have no significant impact on the hydraulics of the lower Skagit River. The Setback Levee alternative has been shown to reduce the water surface elevation of the river by approximately 0.4 feet for flows between the 25 year and 100 year flood events. Additional detailed computer modeling as presented in Appendix D verifies this conclusion.

The analysis presented in this memorandum is based upon the estimated stage reduction of 0.4 feet and utilizes a June 2005 report "*Economic Flood Damage Assessment of Without Project Conditions, Skagit County, Washington*" (1) as the basis of the relationship between flood flows and flood damages.

Overflow Estimates

At all flows above approximately the 25-year flood event, overflows from the river will occur on the right bank upstream of the end of the existing right bank levee system. In addition, at some of the higher flows, the existing levees may be overtopped. The amount of overflow has been estimated using the Corps of Engineers Hydraulics Report (2) as well as a 2003 report prepared by Tetra Tech for Skagit County (7). Table 1 shows the estimated amount of the overflows from the two sources as well as an estimate of the amount of overflows that will be reduced if the water surface upstream of the BNSF Bridge is reduced by 0.4 feet.

Table 1
Estimated Overflows and Overflow Reductions (cfs)

Flow	Estimated Overflows from Corps Hydraulics	Estimated Overflows from Tetra Tech Report	Estimated Reduction in Flows with Setback Levees	
			Upstream	Downstream
25-year	0	8,000	5,000	4,000
50-year	24,000	36,000	10,000	7,000
75-year	40,000	-	12,500	9,000
100-year	53,000	48,000	15,000	10,000

Figure 1 depicts the changes that would occur to the flood frequency curves used in the Economics Report due to the flow changes that would occur due to the Setback Levees.

Flood Damages Under Existing Conditions

The Corps of Engineers Economics Report (1) presents flood damages at different flood events for ten assumed damage reaches from Concrete down to the mouth of the Skagit River. Reaches 8, 9, and 10 are upstream of Sedro Woolley and are assumed not to be impacted by the setback levees. Figure 2, from the Corps Economics Report, shows the area covered by each of the seven remaining reaches.

Flood Damages are broken into a number of categories and summarized by flood frequencies between 10-year and 500-year events. Tables 2 through 8 summarize food damages by frequency for each of the seven reaches. The values for flood damages under present conditions as presented in the Corps report have been modified to reflect the potential for flooding at a lower frequency in the levees in the study reach.

For purposes of this analysis, it is assumed that flood potential in Reach 1 and Reach 6 will be reduced by a reduction in the flood stage and that flood potential will be increased in Reaches 2 to 5 and Reach 7. In addition, construction of the setback levees will reduce the potential for flooding in areas adjacent to the new levees, portions of Reaches 1, 4, 5, and 6. The rationale here is that if the levee setback project is implemented, for a given frequency of flood, the upstream level of flooding will be reduced. Likewise, since for a given stage of the river in the levee setback reach, flows will be increased and this will result in higher flows downstream of the study area. The flood damages in areas adjacent to the levees will be reduced due to construction of the setback levee project. Therefore, for purposes of comparison, flood damages have been summarized for the upstream areas that will be generally subject to less flooding (Reaches 1 and 6) and for the downstream areas that will be generally subject to greater flooding (Reaches 2 to 5 and 7). The summaries are included on Table 9.

The flood damage versus flood frequency data are plotted for existing conditions in Figure 3 for the upstream and downstream reaches. The area underneath each curve is the average annual flood damage and Table 10 shows the calculation of this value for the upstream and downstream areas. As shown in the table, the two upstream reaches are subject to $46.8 million in annual flood damages while the five downstream reaches are currently subject to $29.9 million in flood damages.

Flood Damages with the Setback Levee Alternative

The flood damage versus flood frequency curves from Figure 3 can be modified to reflect the flood frequency curves from Figure 1 that results from construction of the setback levees. The revised curve is shown in Figure 4. The area underneath the curve is the resultant damages once the project is constructed. The calculation of these damages is presented in Table 11 and show that the resultant upstream damages are decreased to $43.4 million annually while the downstream damages with the project are decreased to $26.9 million. The downstream decrease in damages occurs because of the protection provided by the setback levees to the areas adjacent to the levees. Further downstream, there is a slight increase in flood damages.

Flood Control Benefits due to Setback Levee Alternative

A comparison of the flood damages from Tables 10 and 11 shows that flood damages upstream of the project decrease from $46.8 million annually under pre-project conditions to $43.4 million when the project is constructed. This results in a benefit of $3.4 million annually. Downstream flood damages decrease from $29.9 million pre-project to $26.9 million annually, a decrease of $3.0 million.

Therefore, the net flood control benefit for the levee setback alternative is approximately $6.4 million annually ($3.4 plus $3.0 million). Other project features may produce other benefits that should be considered. Also, these are very preliminary numbers and Corps of Engineers economic models need to be re-run to obtain updated values for this project. However, it is not expected that the values would change significantly.

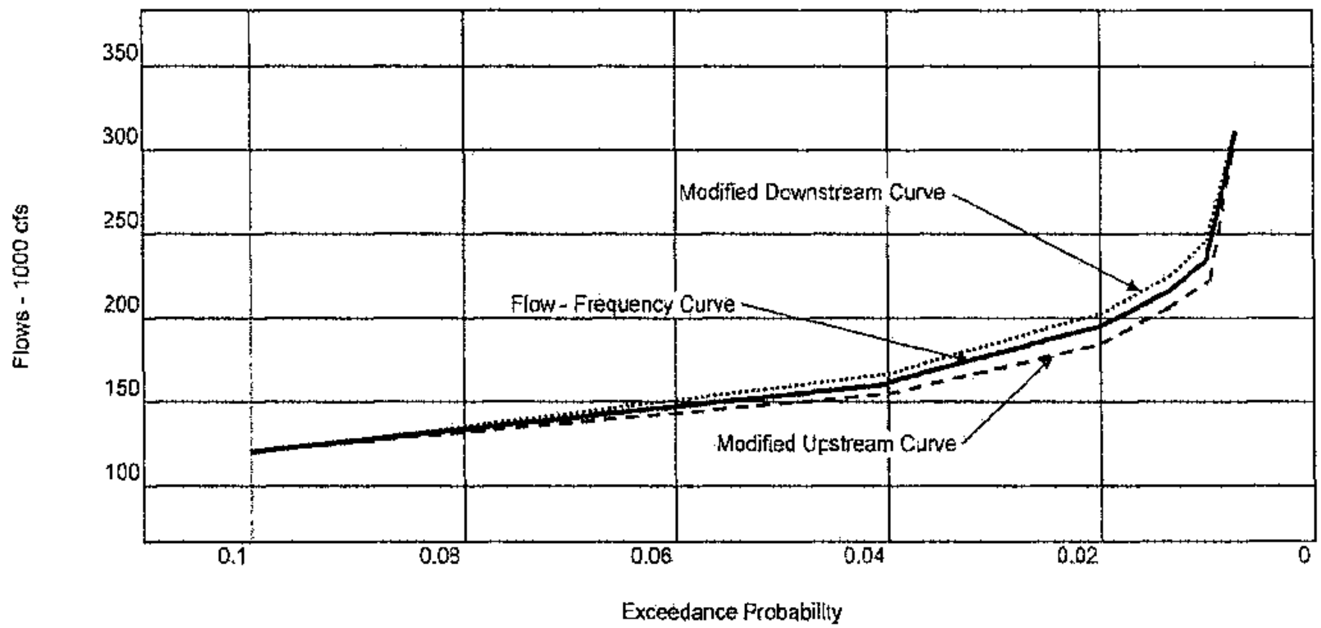
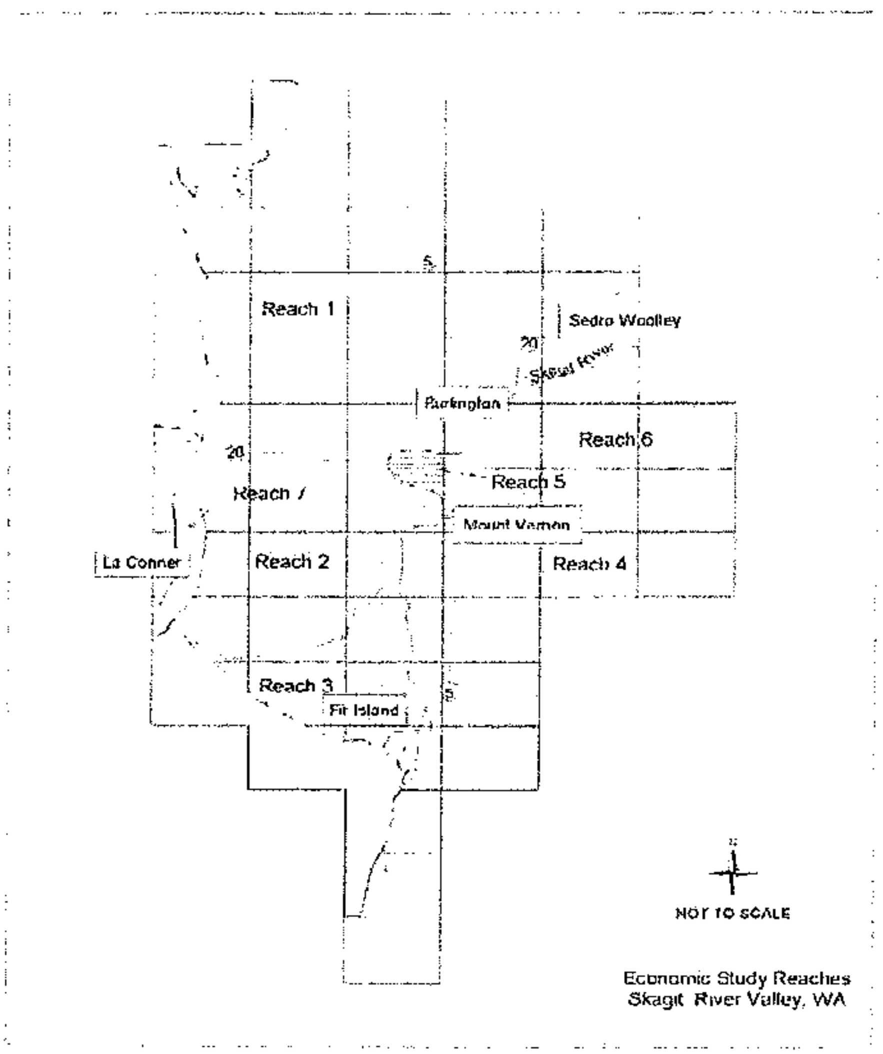


Figure 1
Flow - Frequency Curves
Seback Levee Alternative

Figure 2 - Downstream Study Reaches



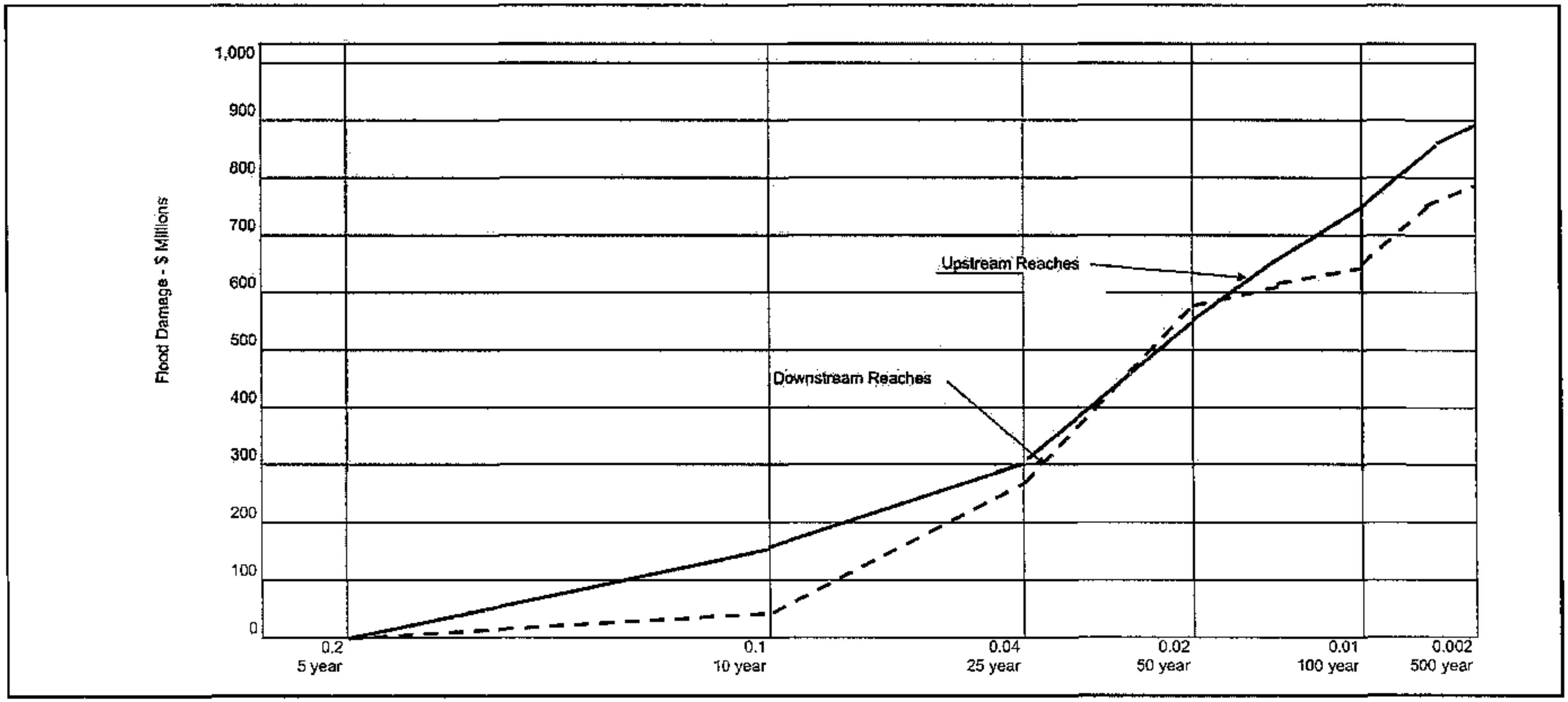


Figure 3
Damage Frequency Curves

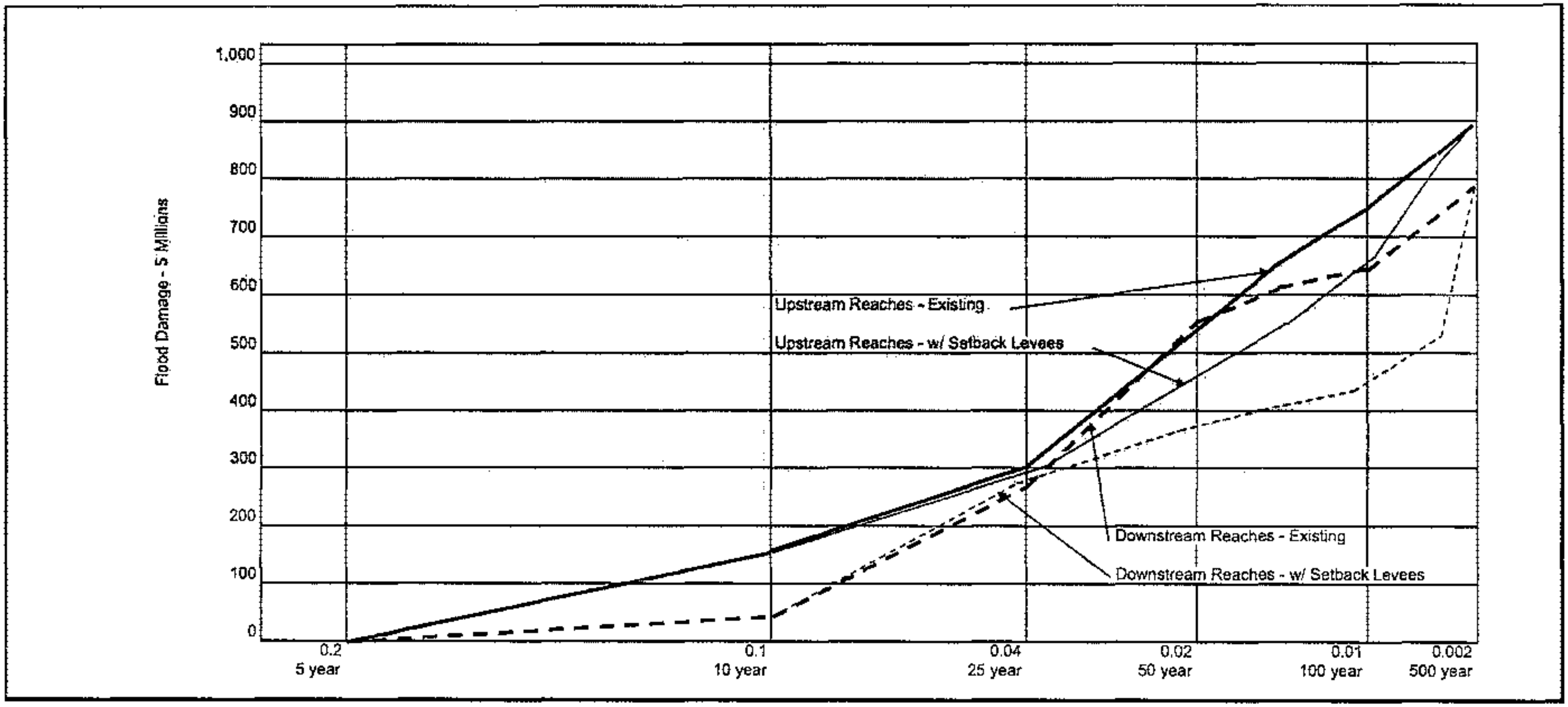


Figure 4
Damage Frequency Curves
With Setback Levees

Flood Damages **Reach 1** Damages in Millions

	Residential			Public	Temp.	Non Residential			Agriculture	Traffic	Total
	Structures	Contents	Clean Up	Assist.	Reloc.	Structures	Contents	Clean Up			
10-year	23	13	7	6	2	45	38	7	3	0	144
25-year	72	41	16	15	4	60	55	9	7	0	279
50-year	148	82	24	22	6	83	85	13	12	46	521
75-year	187	103	27	25	7	96	101	14	13	55	628
100-year	219	117	27	25	7	106	115	14	13	60	703
250-year	241	131	28	26	7	117	132	14	13	64	773
500-year	269	145	28	26	7	125	145	14	13	73	845

Table 2

Flood Damages **Reach 2** Damages in Millions

	Residential			Public	Temp.	Non Residential			Agriculture	Traffic	Total
	Structures	Contents	Clean Up	Assist.	Reloc.	Structures	Contents	Clean Up			
10-year	13	7	3	3	1				3		30
25-year	25	14	4	4	1				4		52
50-year	31	17	5	4	1				30		88
75-year	35	19	5	4	1				30		94
100-year	40	22	5	5	1				30		103
250-year	76	41	10	9	3	6	5	1	31		182
500-year	99	53	12	10	3	8	6	1	32		224

Table 3

	Residential			Public	Temp.	Non Residential			Agriculture	Traffic	Total
	Structures	Contents	Clean Up	Assist.	Reloc.	Structures	Contents	Clean Up			
10-year	0	0	0	0	0	0	0	0	0	0	0
25-year	0	0	0	0	0	0	0	0	0	0	0
50-year	0	0	0	0	0	0	0	0	0	0	0
75-year	1	1	0	0	0	0	0	0	1	0	3
100-year	2	1	0	0	0	0	0	0	1	0	4
250-year	2	1	0	0	0	0	0	0	1	0	4
500-year	2	1	0	0	0	0	0	0	1	0	4

Table 4

Flood Damages **Reach 4** Damages in Millions

	Residential			Public	Temp.	Non Residential			Agriculture	Traffic	Total
	Structures	Contents	Clean Up	Assist.	Reloc.	Structures	Contents	Clean Up			
10-year	0	0	0	0	0	0	0	0	0	0	0
25-year	49	27	9	9	2	41	43	12	2	0	194
50-year	134	72	14	12	4	77	93	15	3	0	424
75-year	145	78	15	13	4	82	99	16	3	0	455
100-year	150	81	15	13	4	83	102	16	3	0	467
250-year	155	83	16	14	4	86	105	16	3	0	482
500-year	155	83	16	14	4	86	105	16	3	0	482

Table 5

Flood Damages **Reach 5** Damages in Millions

	Residential			Public	Temp.	Non Residential			Agriculture	Traffic	Total
	Structures	Contents	Clean Up	Assist.	Reloc.	Structures	Contents	Clean Up			
10-year	0	0	0	0	0	0	0	0	0	0	0
25-year	0	0	0	0	0	0	0	0	0	0	0
50-year	7	3	1	0	0	8	9	1	0	0	29
75-year	7	3	1	0	0	8	9	1	0	0	29
100-year	7	3	1	0	0	8	9	1	0	0	29
250-year	7	3	1	0	0	8	9	1	0	0	29
500-year	7	3	1	0	0	8	9	1	0	0	29

Table 6

Flood Damages **Reach 6** Damages in Millions

	Residential			Public	Temp.	Non Residential			Agriculture	Traffic	Total
	Structures	Contents	Clean Up	Assist.	Reloc.	Structures	Contents	Clean Up			
10-year	6	3	1	1	0	0	0	0	2	0	13
25-year	10	6	2	1	0	1	1	0	3	0	24
50-year	15	8	2	3	1	1	1	0	3	0	34
75-year	17	9	2	3	1	1	1	0	3	0	37
100-year	18	10	2	3	1	1	2	0	3	0	40
250-year	22	12	3	3	1	2	2	0	3	0	48
500-year	22	12	3	3	1	2	2	0	3	0	48

Table 7

Flood Damages **Reach 7** Damages in Millions

	Residential			Public	Temp.	Non Residential			Agriculture	Traffic	Total
	Structures	Contents	Clean Up	Assist.	Reloc.	Structures	Contents	Clean Up			
10-year	1	1	1	1	0	3	2	1	0	0	10
25-year	5	3	2	2	0	5	4	1	0	0	22
50-year	7	4	2	2	0	5	4	1	0	0	25
75-year	7	4	2	2	0	6	4	1	0	0	26
100-year	8	5	2	2	0	6	5	1	0	0	29
250-year	12	7	2	2	1	7	7	1	0	0	39
500-year	15	8	2	2	1	9	9	1	0	0	47

Table 8

Total Flood Damages, Damages in Millions

Upstream		Reach 1	Reach 6	Total
10-year		144	13	157
25-year		279	24	303
50-year		521	34	555
75-year		628	37	665
100-year		703	40	743
250-year		773	48	821
500-year		845	48	893

Downstream		Reach 2	Reach 3	Reach 4	Reach 5	Reach 7	Totals
10-year		30	0	0	0	10	40
25-year		52	0	194	0	22	268
50-year		88	0	424	29	25	566
75-year		94	3	455	29	26	607
100-year		103	4	467	29	29	632
250-year		182	4	482	29	39	736
500-year		224	4	482	29	47	786

Table 9

Computation of Annual Flood Damages
Existing Conditions

Reaches 1 and 6

Flood Event	Exceedance Probability	Incremental Probability	Average Damage $ Million	Annual Damage $ Million
5 year	0.2			
		0.1	115	11.5
10 year	0.1			
		0.06	230	13.8
25 year	0.04			
		0.02	429	8.6
50 year	0.02			
		0.0067	610	4.1
75 year	0.0133			
		0.0033	704	2.3
100 year	0.01			
		0.006	782	4.7
250 year	0.004			
		0.002	857	1.8
500 year	0.002			
			Total	46.8

Reaches 2, 3, 4, 5, 7

Flood Event	Exceedance Probability	Incremental Probability	Average Damage $ Million	Annual Damage $ Million
5 year	0.2			
		0.1	20	2.0
10 year	0.1			
		0.06	154	9.2
25 year	0.04			
		0.02	417	8.3
50 year	0.02			
		0.0067	581	2.7
75 year	0.0133			
		0.0033	619	2.1
100 year	0.01			
		0.006	683	4.1
250 year	0.004			
		0.002	761	1.5
500 year	0.002			
			Total	$29.9 million

Table 10

Computation of Annual Flood Damages
With Setback Levees Conditions

Reaches 1 and 6

Flood Event	Exceedance Probability	Incremental Probability	Average Damage $ Million	Annual Damage $ Million
5 year	0.2			
		0.1	115	11.5
10 year	0.1			
		0.064	230	14.7
27.7 year	0.036			
		0.019	391	7.4
58.8 year	0.017			
		0.006	517	3.1
90.9 year	0.011			
		0.002	609	1.2
111 year	0.009			
		0.005	740	3.7
250 year	0.004			
		0.002	905	1.8
500 year	0.002			
			Total	$43.4 million

Reaches 2, 3, 4, 5, 7

Flood Event	Exceedance Probability	Incremental Probability	Average Damage $ Million	Annual Damage $ Million
5 year	0.2			
		0.1	20	2.0
10 year	0.1			
		0.053	154	8.1
21.3 year	0.047			
		0.024	313	7.5
43.5 year	0.023			
		0.007	378	2.6
62.5 year	0.016			
		0.004	412	1.6
83.3 year	0.012			
		0.008	476	3.8
250 year	0.004			
		0.002	659	1.3
500 year	0.002			
			Total	$26.9 million

Table 11

Appendix D
Results of Hydraulic Modeling Of Setback Levee Alternative

DRAFT TECHNICAL MEMORANDUM

Skagit River Bridge Modification and Interstate Highway Protection Project

Results of Hydraulic Modeling of Setback Levee Alternative

Introduction

The hydraulic analysis contained in the report "Engineering Analysis of Levee Alternatives" (the Engineering Report), September 2008, and a later partial revision dated January 2, 2009, is based upon hydraulic modeling that is contained in existing Corps of Engineers reports. However, since these reports do not analyze the setback levee alternative, it was necessary to interpolate the analysis from those reports to determine the impact of the setback levee alternative on the hydraulics of the Skagit River. Although the Corps of Engineers had promised to provide the analysis of the setback levee alternative for us, they have failed to do so and it is unlikely that they will be able to provide the needed analysis in a timely fashion due to other ongoing projects.

Consequently, Skagit County was able to hire a consultant, Pacific International Engineers (PIE), to conduct the needed modeling. PIE has worked closely with the Corps of Engineers in the development of hydraulic models for the Skagit River. Although there are recognized differences between the hydrology of the river between the Corps and PIE, the hydraulic models have produced similar results for given flow levels.

Specifically, the performed analysis is intended to confirm four assumptions or results presented in the report:

1. Determine the height of project levees that would be necessary to protect the study area if the upstream and downstream levees are raised and improved after the proposed project is built. The *Engineering Analysis of Levee Alternatives* report suggested that the setback levees be raised approximately 6 feet over the height of the existing levees to allow for this potential condition. This option is discuss in more detail in Section 4.0 of the report.

2. Determine the decrease in water surface elevation upstream of the project area under current conditions if the levees are setback. The Engineering Report estimates that the decrease would be approximately 0.4 feet as described in Sections 4.2 and 5.2.3 of the report.

3. Determine the increase in water surface and flow downstream of the project area under current conditions due to the levee setback alternative. The Engineering Report estimates that the flows will increase up to approximately 10,000 cfs during the 100-year flood event as described in Sections 4.2 and 5.2.3 of the report.

4. Evaluate the impact of excavating a portion of the channel in the vicinity of the north abutment of the BNSF Bridge to improve conveyance in this area. The Engineering Report, Section 4.5, estimates that excavating this area down to approximately elevation 18 will improve the flow conveyance through the setback levee reach by approximately 50 percent.

Modeling Results

In order to provide answers to the four issues discussed above, two sets of model runs were performed. The existing models were modified to incorporate the levee locations and heights that are being evaluated in this project. The results were transmitted to Skagit County in the form of Excel spreadsheets and are attached. Run 1 is referenced as "PIE Models with Infinite Levees" while Run 2 is called "PIE Models with Upstream Overflows". The differences between the two models will be discussed in the following paragraphs.

Levee heights if upstream levees are improved

Although the economic analysis that is presented in the Engineering Report is based upon existing conditions, there is a possibility that the upstream levees could be raised, improved, or extended upstream in the future. Therefore, it seems prudent to consider the impact of this possibility in the design of the levees as part of this project. Run 1 assumes that the existing levees upstream and downstream of the project reach are constructed infinitely high such that overtopping is unlikely. In addition, the levee on the right bank of the river upstream of the study reach is assumed to be extended to high ground near Sedro Woolley.

Figure 1 shows the levee crest elevations currently shown in the Engineering report and the results of the modeling. Note that the model numbers assume that three feet of freeboard is provided and that the modeling results are based a flow of 200,000 cfs, which is assumed to be close to the 100-year flood elevation that may be used in the design of the project levees.

Figure 1 shows that the model results confirm that the elevations for the levee option that recognizes that upstream levees may be raised and extended are correct and are perhaps the highest levee elevations that should be considered.

Decrease in Upstream Water Surface Elevation

The primary purpose of the setback levee alternative is to improve conveyance through the study reach, the so-called 3 Bridge Corridor. The setback levees and other channel improvements contained in this alternative will allow more water to flow through this reach due to the increase in effective flow area. However, since there will be less backwater effect, the upstream water surface will be lower than under current conditions. The lower upstream water surface will result in less flood damage in the upstream reaches and will also reduce the amount of water that will overflow out of the river

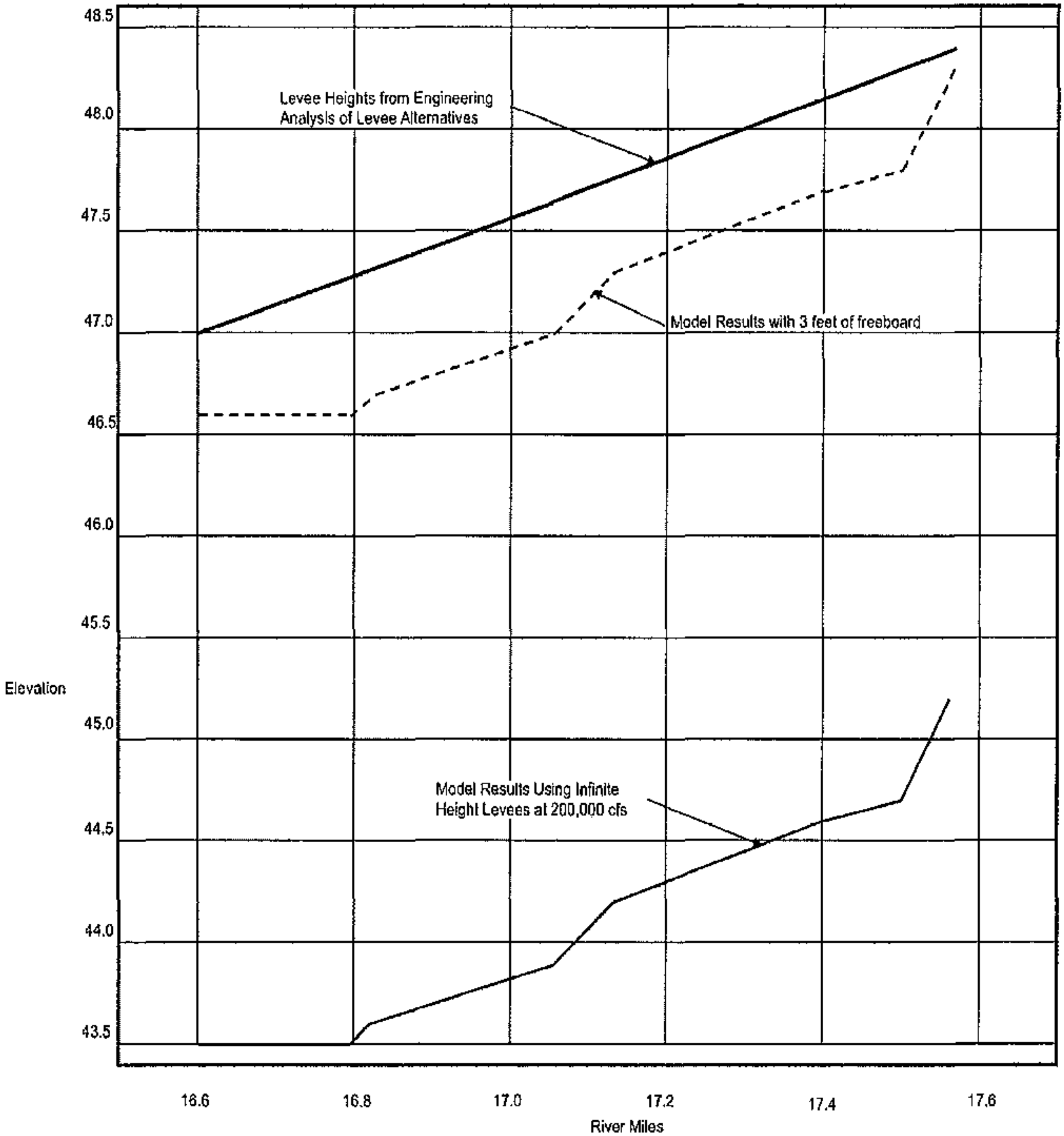


Figure 1 - Levee Elevation Comparisons

system. Current estimates are that overflows currently begin at approximately 140,000 cfs, about the 1-in-25-year flood event.

In order to determine the impact of the setback levee alternative on upstream water surfaces, Run 2 can be used. This model run duplicates the existing levee system and runs were made for 4 flow ranges; the flow numbers shown in the output spreadsheets identify the peak flow volumes that would occur at the Mount Vernon USGS gage near the Old Highway 99 Bridge. Figure 2 shows the peak flow volumes for the 3 runs, the estimated total flow at the latitude of the USGS gage, and the amount of overflows that leave the river system. It should be noted that the PIE modelers have indicated that there are some inaccuracies in the higher flows due to the inability of the HEC RAS model being used to accurately model overflows from the river. However, for the range of flows being considered, the results appear to give usable values.

The following table, Table 1, shows the apparent decrease in upstream water surface elevation for three sets of total flows that can be interpolated from the in-channel flow values that were modeled as shown in Figure 1.

Table 1
Change in Upstream Water Surface
Due to Setback Levee Alternative

In-Channel Flow (modeled) At USGS Gage	Total Flow at Latitude Of USGS Gage	Decrease in Upstream Water Surface at RM 17.9
141,000 cfs	141,000 cfs	-0.8 feet
160,000 cfs	170,000 cfs	-0.4 feet
180,000 cfs	258,000 cfs	-0.1 feet

The model results shown in Table 1 appear to show that the decrease in upstream water surface elevation due to the setback levee alternative varies between 0.8 feet and 0.1 feet. For a flow of about 210,000 cfs at the latitude of the gage, about the 100 year flood, the decrease would be about 0.3 feet. The engineering report uses an estimated decrease in upstream water surface elevation of 0.4 feet. Consequently, it appears that this value is very reasonable and closely matches the values derived from the model results.

Increase in water surface elevation and flow downstream

The 100-year flood is assumed to be somewhere in the range of 210,000 cfs and this corresponds to an in-channel flow of approximately 170,000 cfs under current conditions as shown in the model results presented in Figure 2. Table 2 shows the estimated increase in water surface elevation at River Mile 16.3.

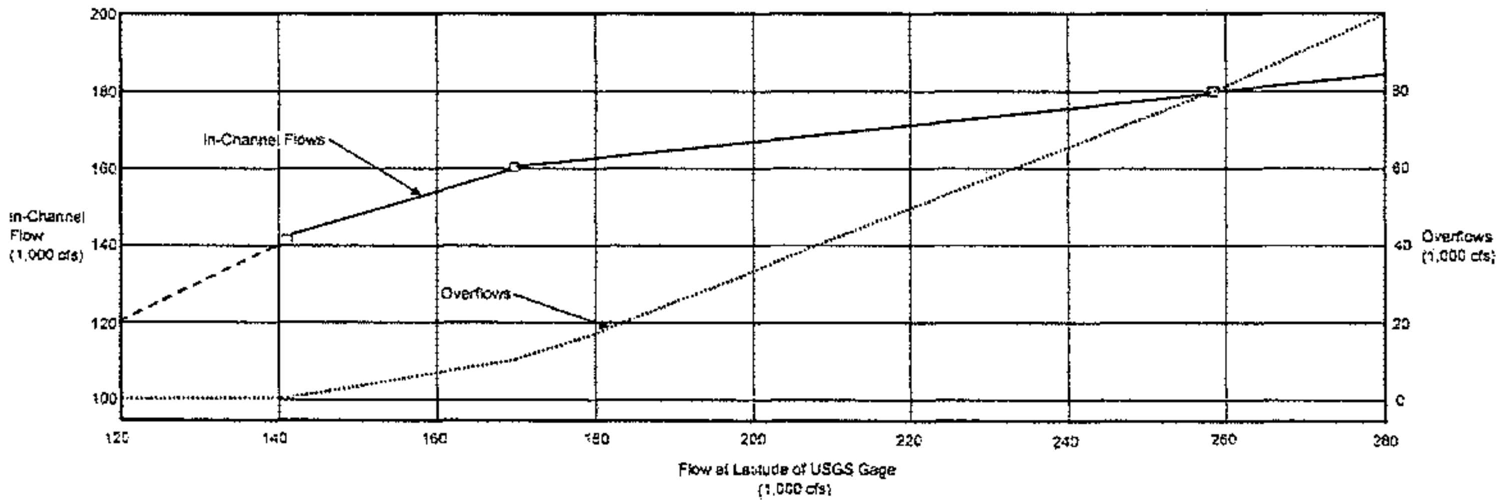


Figure 2 - In-channel and Overflows at USGS Gage

Table 2 Change in Downstream Water Surface Due to Setback Levee Alternative		
In-Channel Flow (modeled) At USGS Gage	**Total Flow at Latitude Of USGS Gage**	**Increase in Downstream Water Surface @ RM 16.3**
141,000 cfs	141,000 cfs	+0.6 feet
160,000 cfs	170,000 cfs	+0.4 feet
180,000 cfs	258,000 cfs	0 feet

Table 2 shows that there will be an increase in the downstream water surface due to the setback levee alternative and that the change decreases as the flows increase. For a flow of about 210,000 cfs, the increase will be in the range of +0.3 feet. This increase in water surface elevation represents an increase in flow of between 3,000 and 6,000 cfs. The engineering report estimated an increase of up to 10,000 cfs. The use of the lower increases in water surface elevation and flow would result in a decrease in downstream flood damages from what was estimated in the engineering report which would increase the benefit to cost ratio shown.

<u>Excavation at the BNSF Bridge</u>

One option being considered as part of the setback levee alternative, Section 4.5, is to excavate the overbank area adjacent to the north end of the BNSF Bridge and reinforce the bridge trestle pilings. As envisioned, this excavation would extend down to elevation 18 and would significantly improve the hydraulics of water flowing downstream through the bridge opening.

In both Run 1 and Run 2, this potential option was evaluated and the results can be directly compared to the option of leaving this area as it currently exists. Table 3 shows the differences between the model results with and without the excavation option.

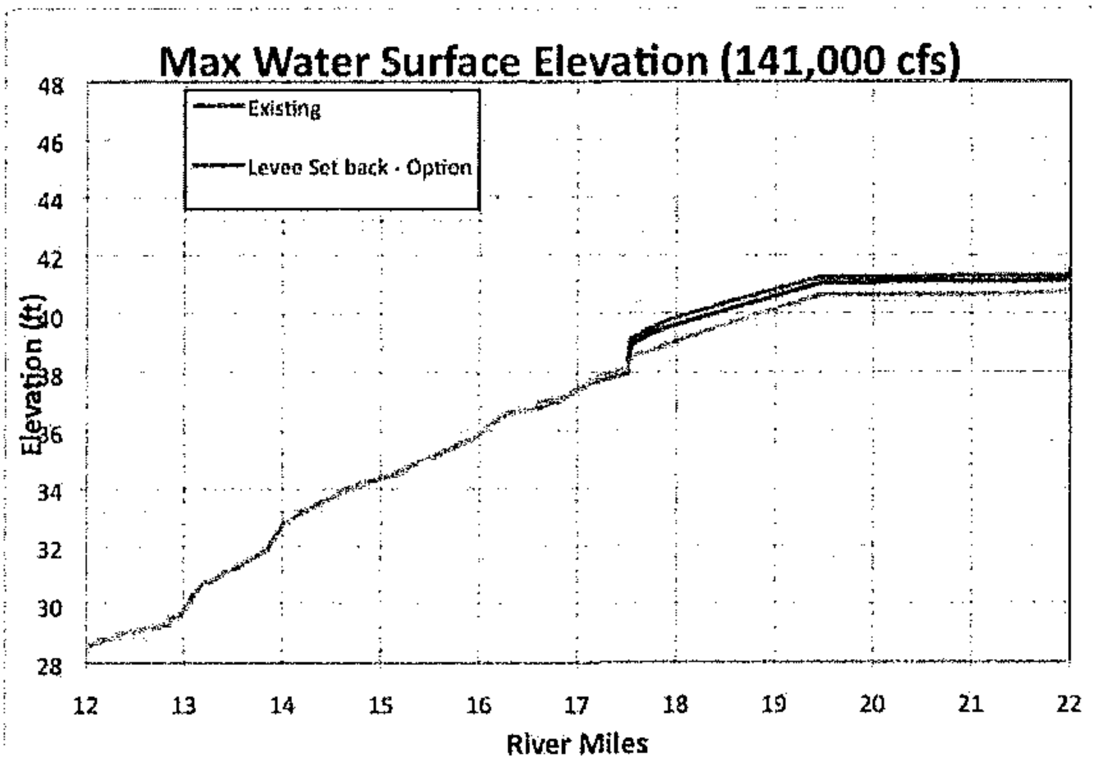
Table 3 Impact of Excavation at BNSF Bridge on Flow and Water Surface Elevations			
Run Number	**1**	**2**	**2**
Location	**River Mile 17.9**	**River Mile 17.9**	**USGS Gage**
Condition	**Upstream W. S.**	**Upstream W. S.**	**Downstream Flow**
Flow	**200,000 cfs**	**141,000 cfs**	**180,000 cfs**
Existing Condition	El. 46.9	El. 39.8	180,000 cfs
Setback Levee Only	El. 46.4	El. 39.5	183,000 cfs
Setback Levee with Excavation	El. 45.7	El. 39.0	186,000 cfs
Improved Condition with Excavation	0.7'	0.5'	3,000 cfs

As demonstrated in Table 3, all flow and water surface elevation conditions shown are improved by including the overbank excavation in the setback levee alternative. In fact, this improvement is observable at all flow and configurations of the upstream and downstream levees.

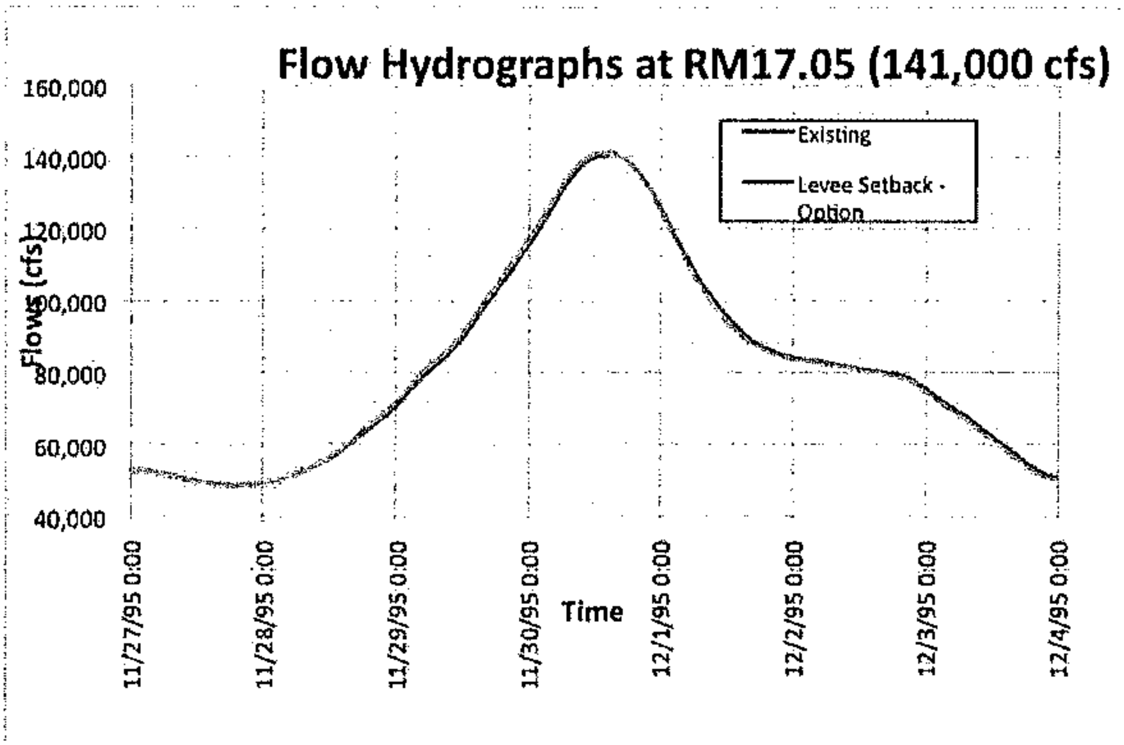
Conclusions

The primary purpose for utilizing a computer model is to verify the information used in the *Engineering Analysis of Levee Alternatives* report, particularly as it may relate to river hydraulics and the impact of the proposed setback levee alternatives on the hydraulic conditions. The change in river hydraulics is a major factor in calculating the economic viability of the project. The analysis of the model results demonstrate that the hydraulic analysis presented in the Engineering Report is valid and the resulting benefit to cost ratio demonstrates that the project has a positive benefit to cost ratio.

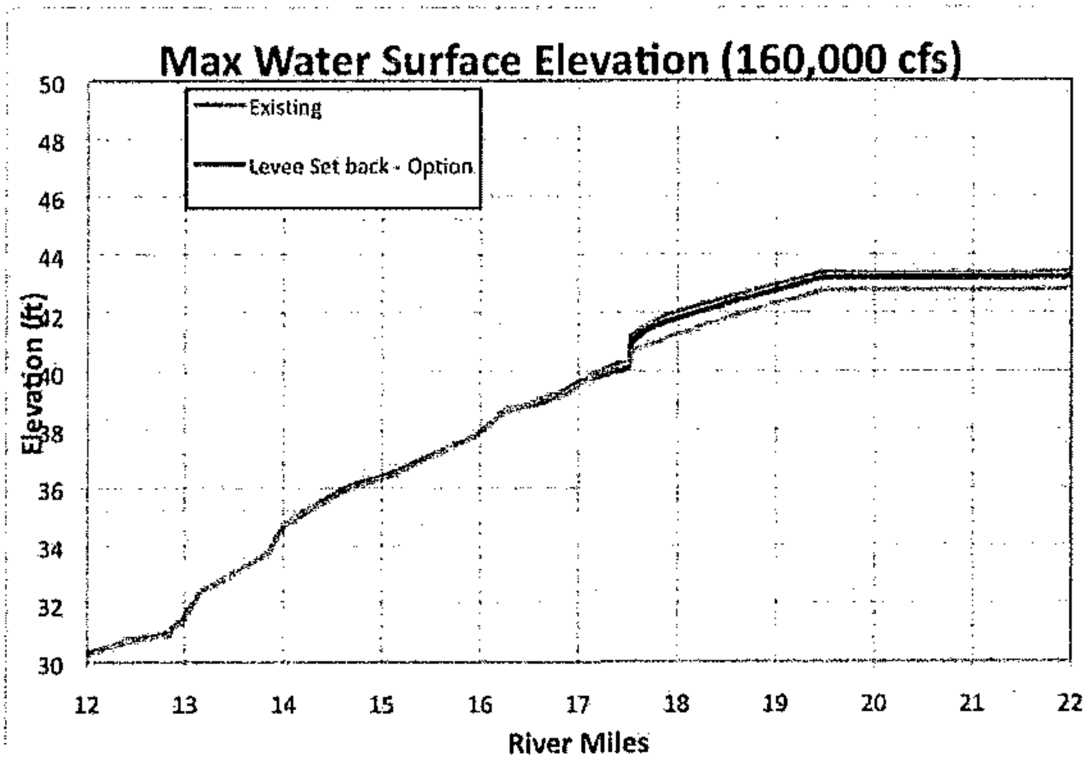
Run No. 1
PIE Models
with Infinite Levees



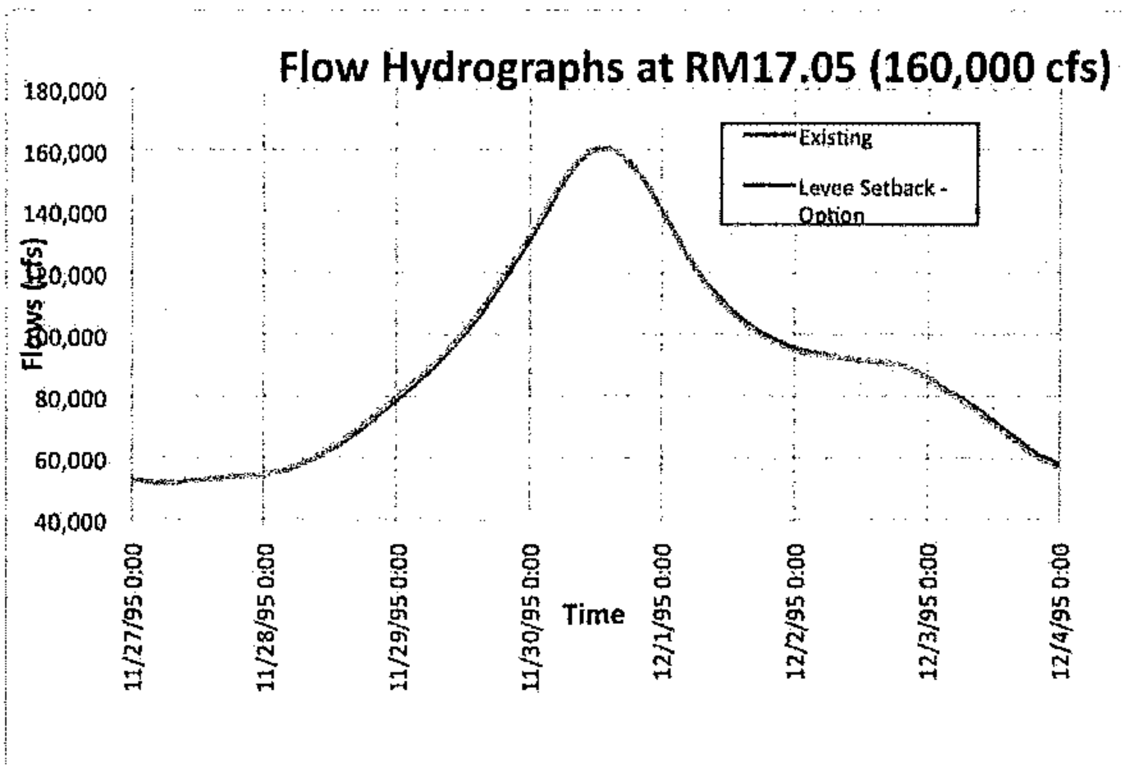
Run No. 1
PIE Models
with Infinite Levees



Run No. 1
PIE Models
with Infinite Levees



Run No. 1
PIE Models
with Infinite Levees



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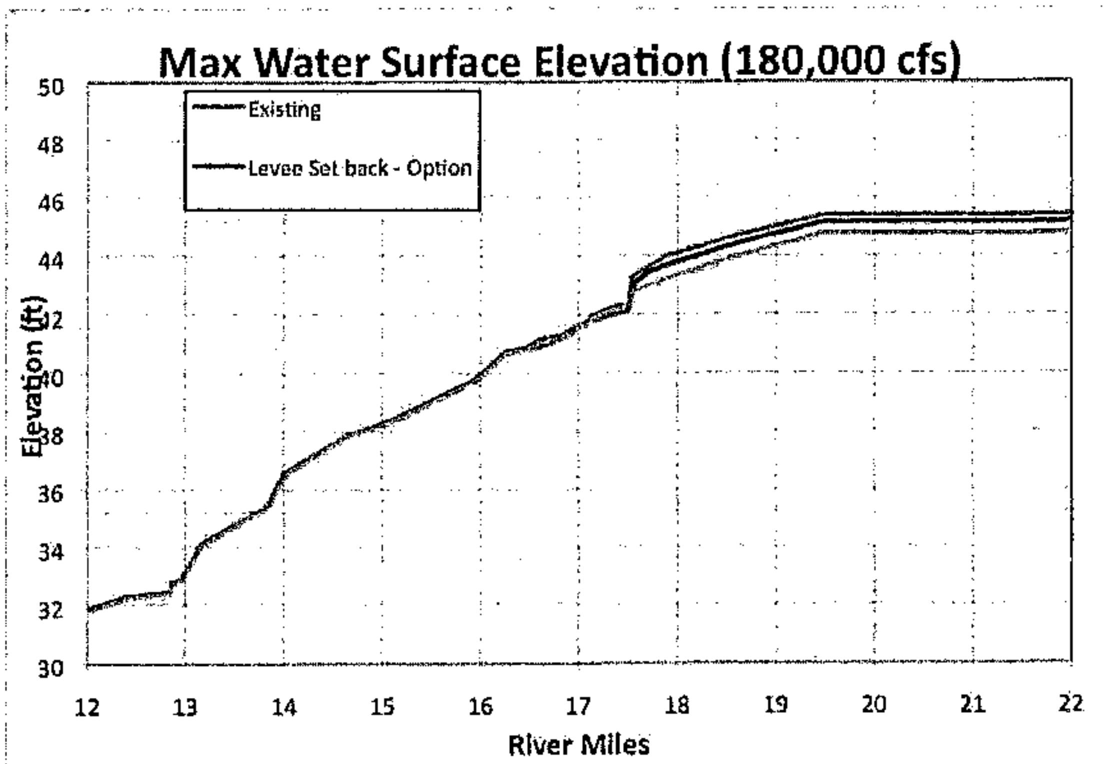
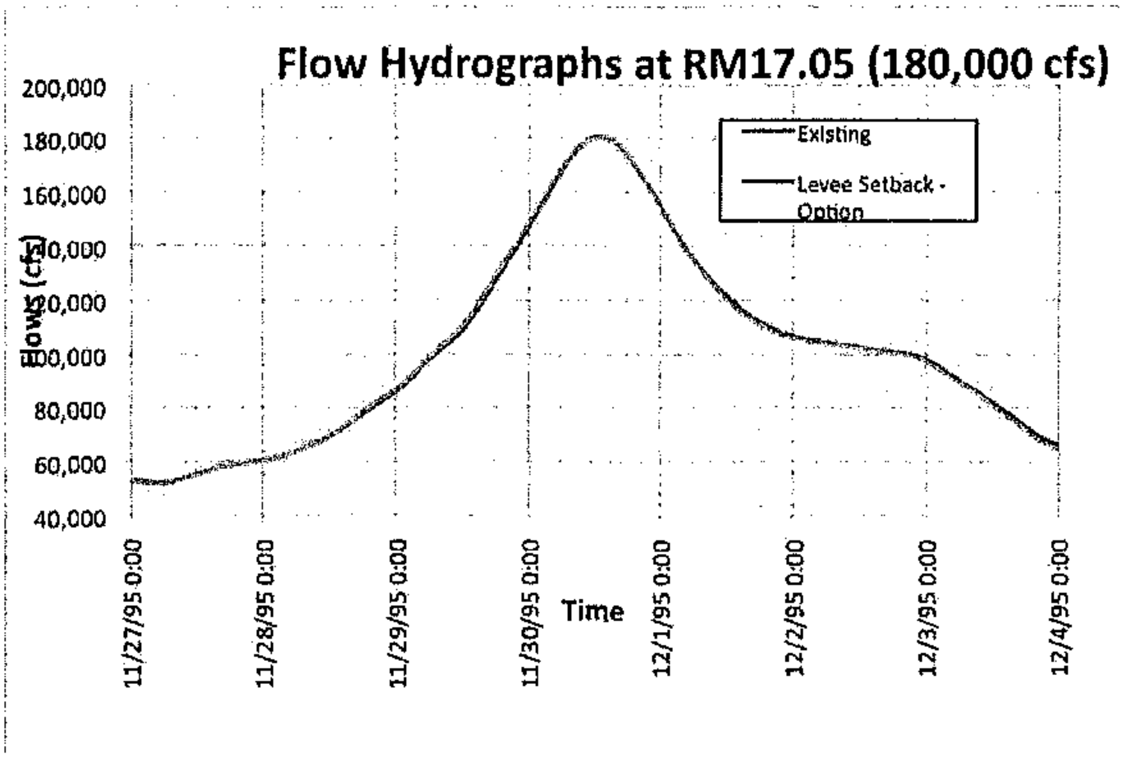
PIE Models
with Infinite Levees



Run No. 1
PIE Models
with Infinite Levees



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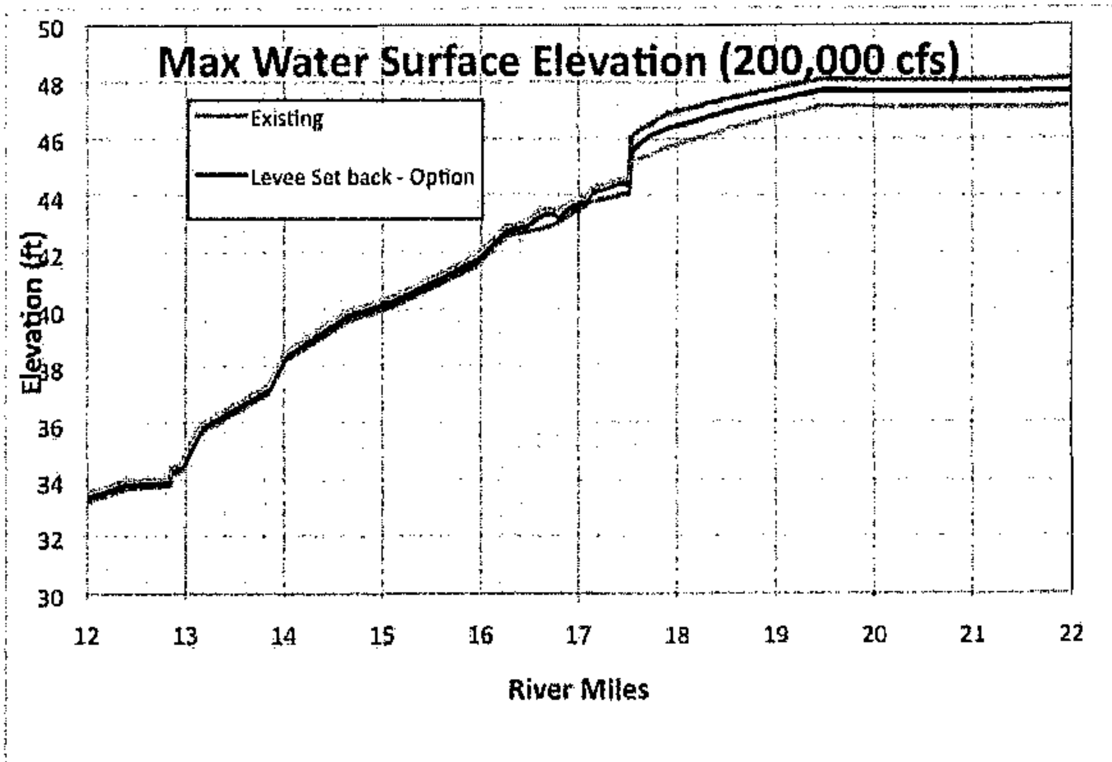
PIE Models
with Infinite Levees



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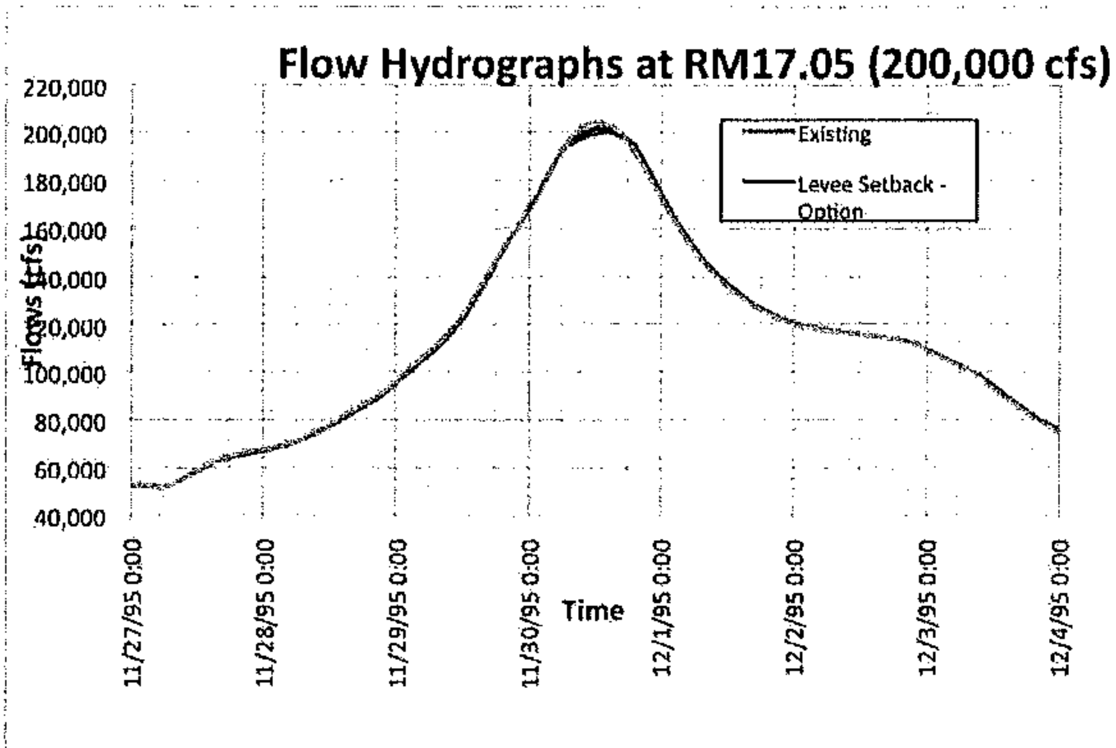
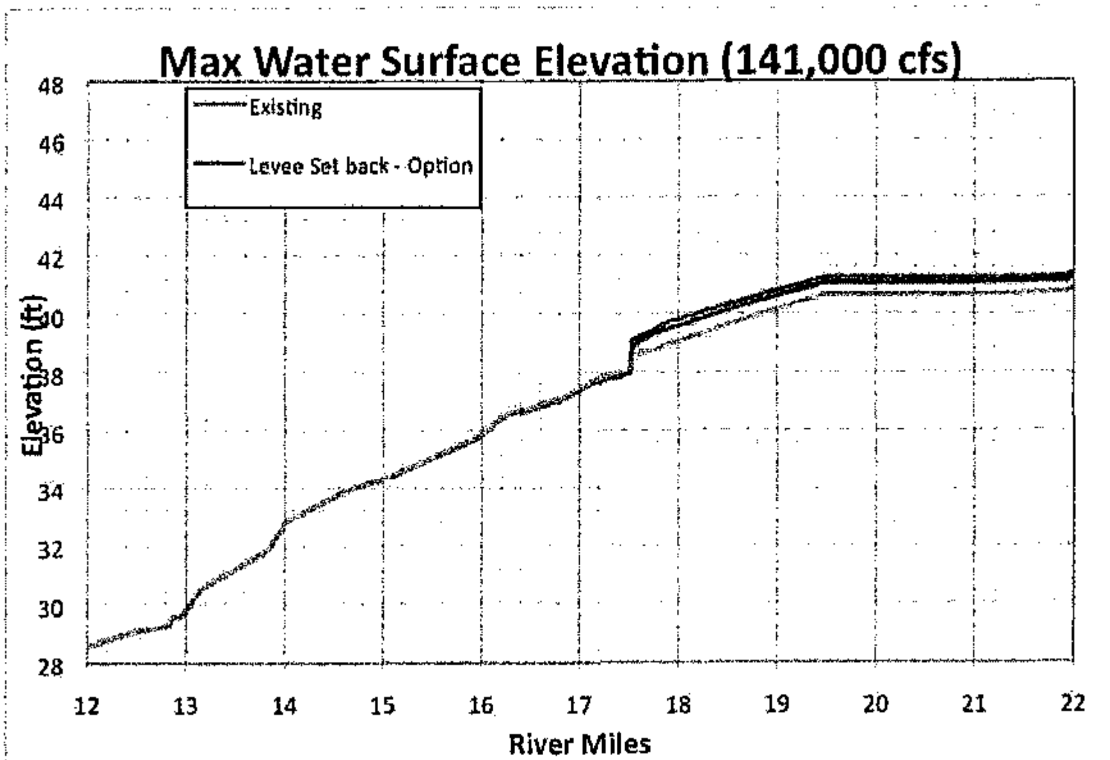
with Infinite Levees



Run No. 2
PIE Models
with Upstream Overflows



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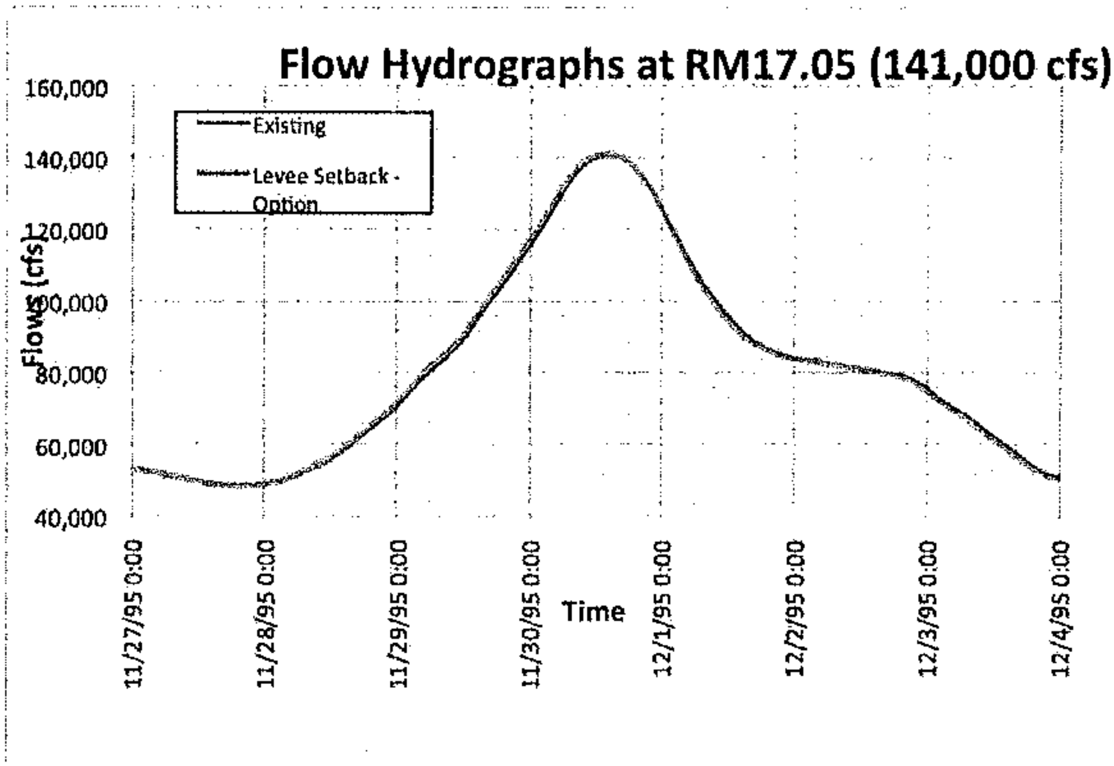
with Upstream Overflows



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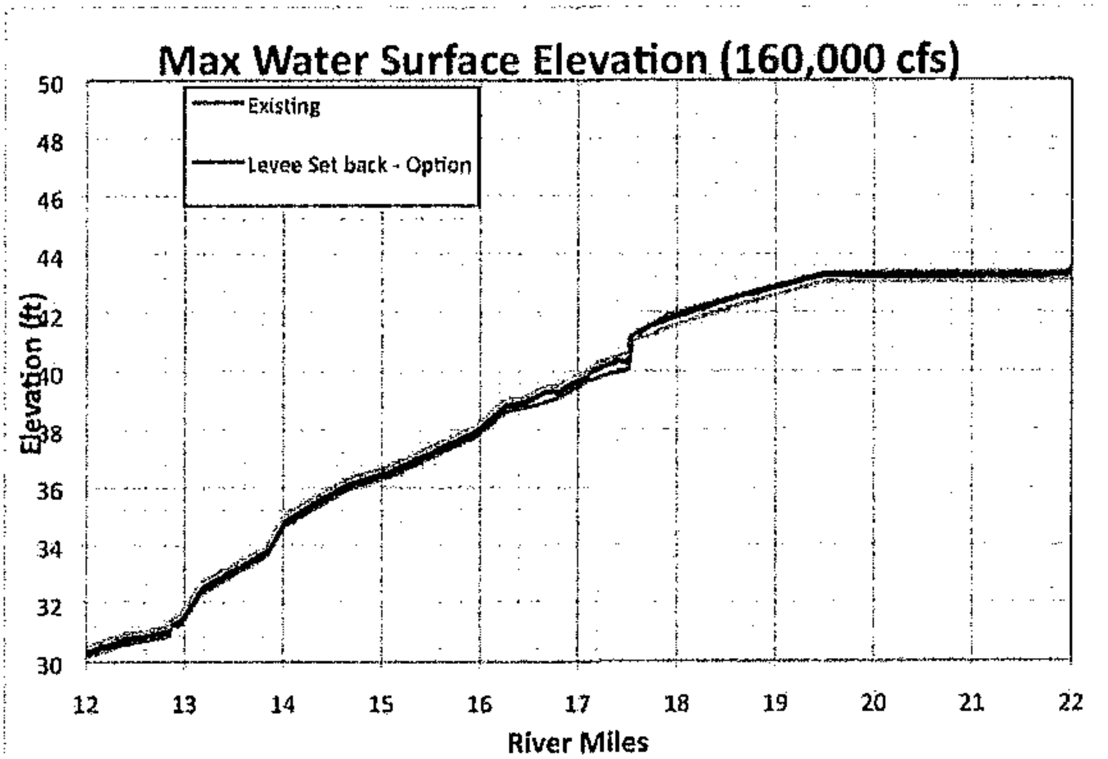
PIE Models
with Upstream Overflows



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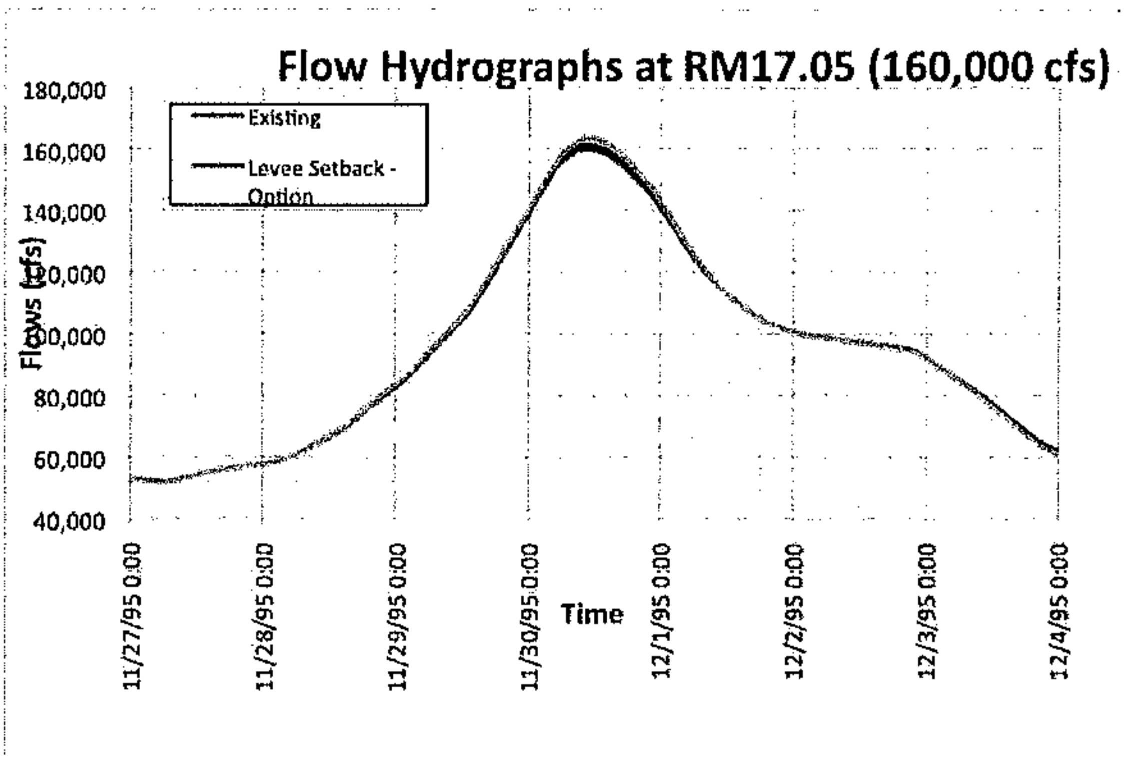
PIE Models
with Upstream Overflows



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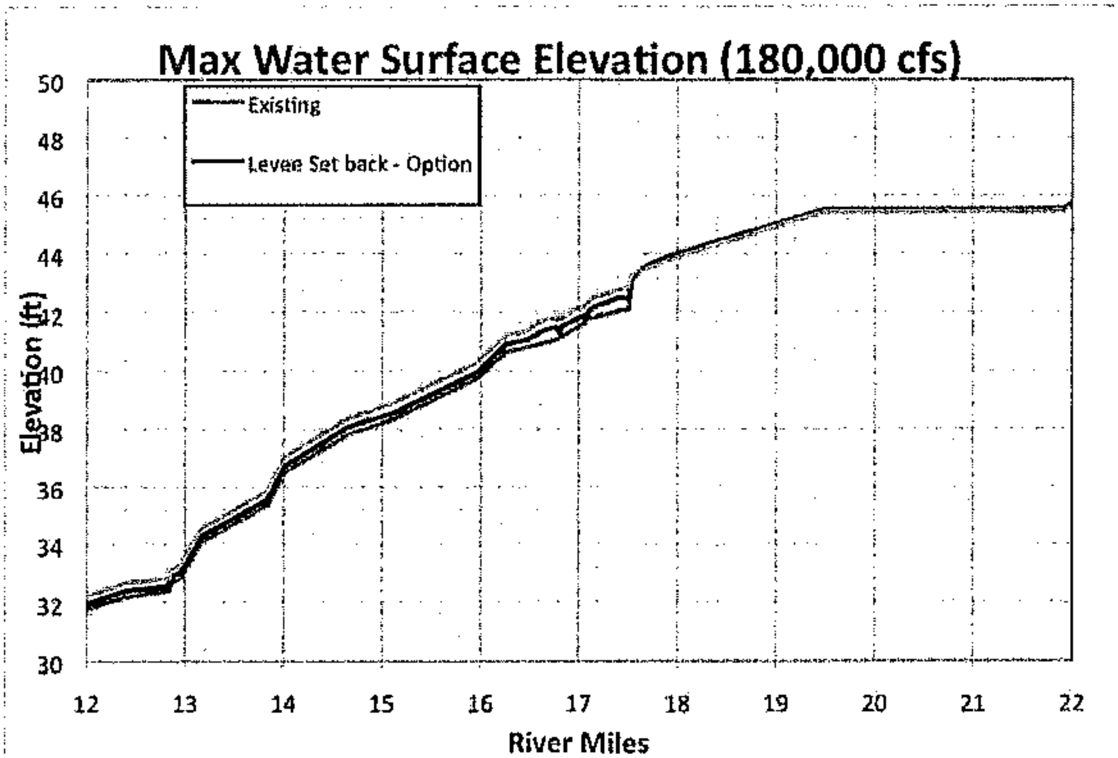
PIE Models
with Upstream Overflows



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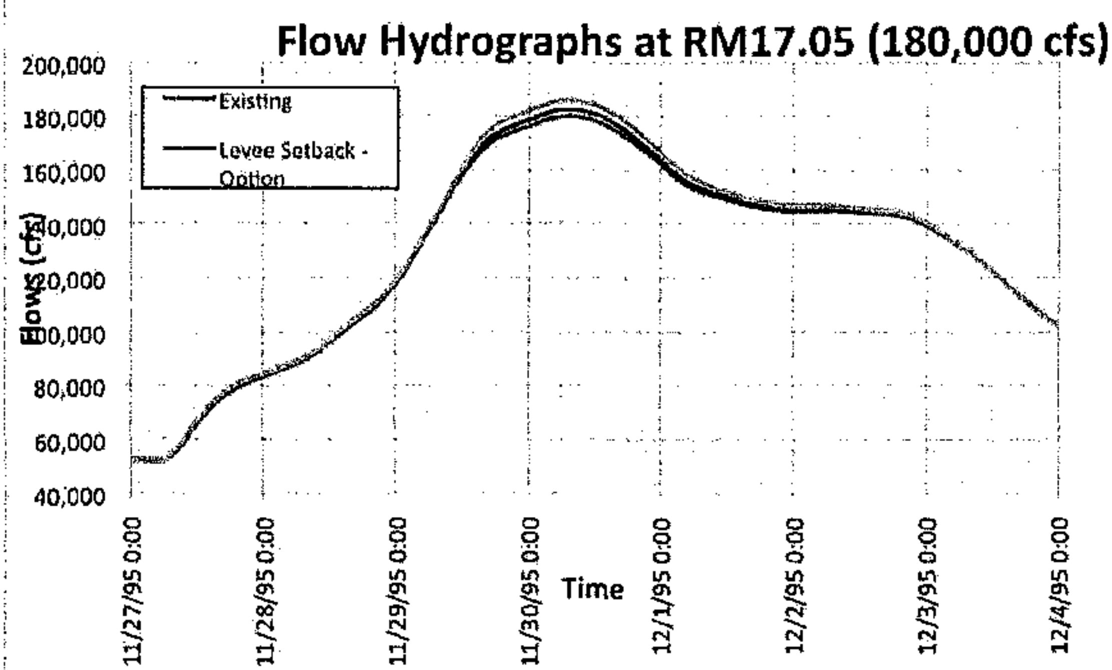
with Upstream Overflows



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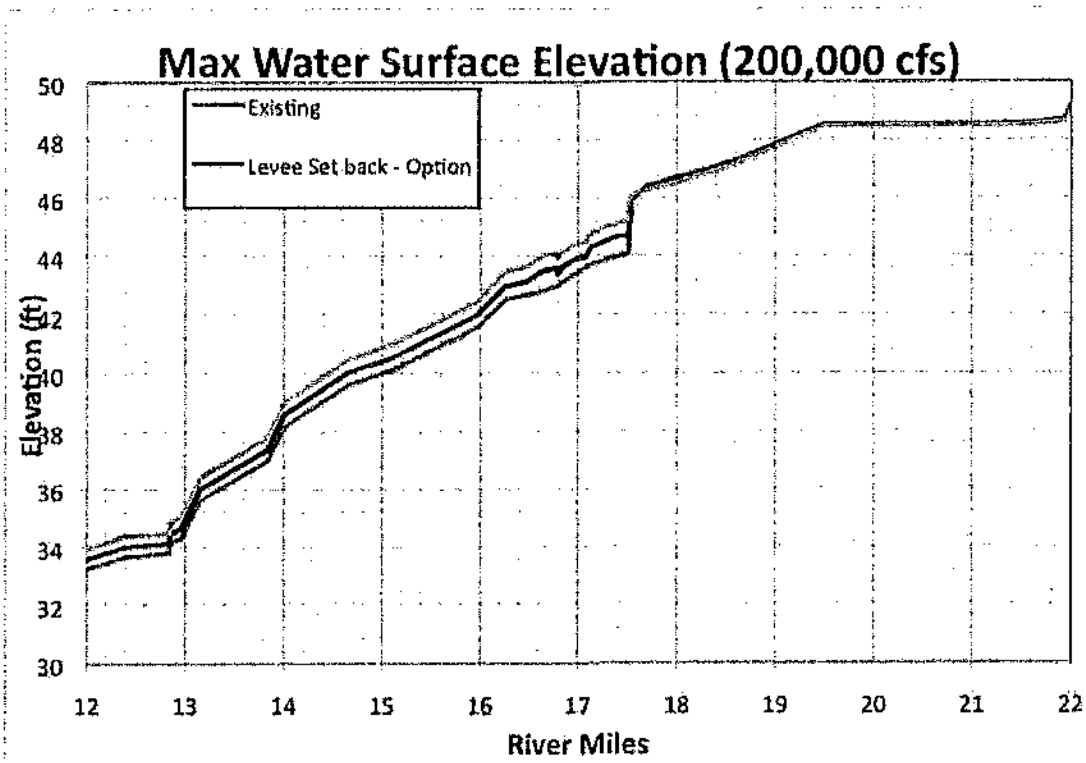
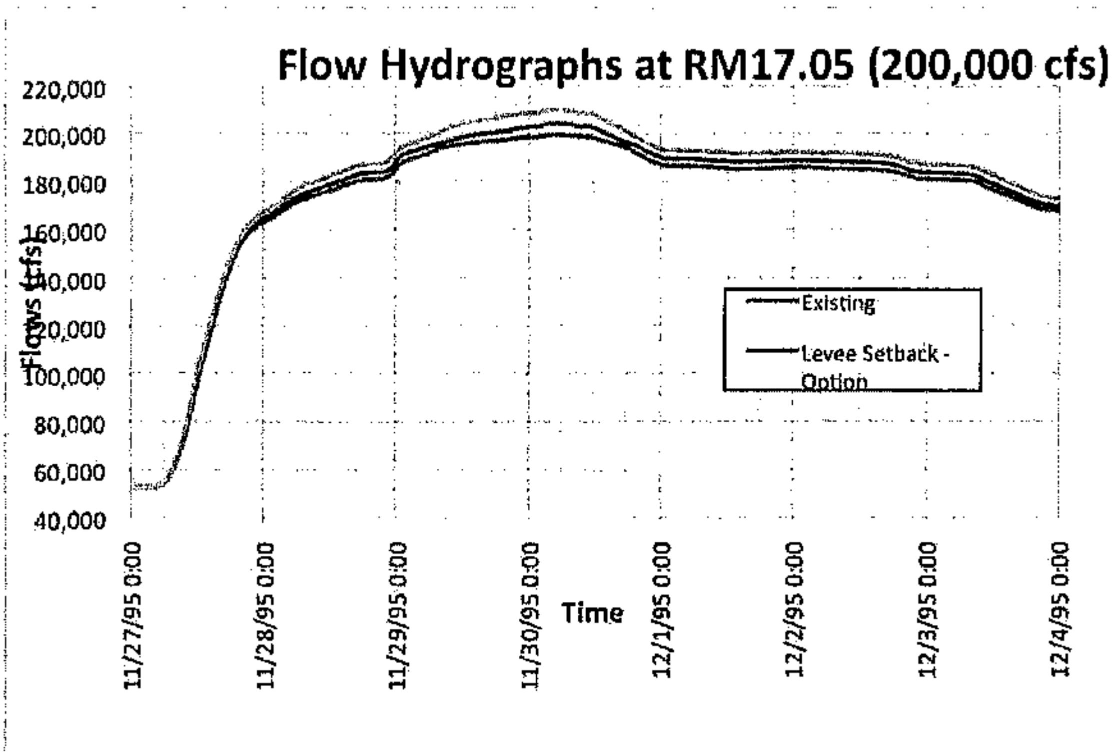
PIE Models
with Upstream Overflows



Run No. 2
PIE Models
with Upstream Overflows



APPENDIX B

SUBJECT PROPERTIES AND PROPERTY VALUES MATRIX

Parcel Number	Owner Name[1]	Site Address[1, 2]	Total Market Value[1]	Acres[1]
P24129*	CITY OF BURLINGTON	E Whitmarsh Rd, Burlington, WA 98233	$871,200	5
P24130*	CITY OF BURLINGTON	E Whitmarsh Rd, Burlington, WA 98233	$357,200	2.05
P24131*	CITY OF BURLINGTON	E Whitmarsh Rd, Burlington, WA 98233	$357,200	2.05
P24150*	CITY OF BURLINGTON	E Whitmarsh Rd, Burlington, WA 98233	$805,000	4.62
P24127*	DIKE DISTRICT #12	E Whitmarsh Rd, Burlington, WA 98233	$18,000	1.21
P24134*	DIKE DISTRICT #12	E Whitmarsh Rd, Burlington, WA 98233	$5,200	8.73
P24144	DIKE DISTRICT #12	E Whitmarsh Rd, Burlington, WA 98233	$581,000	3.83
P24151	DIKE DISTRICT #12	Burlington, WA 98223	$4,000	
P24154	DIKE DISTRICT #12	Burlington, WA 98223	$900	
P24157	DIKE DISTRICT #12	E Whitmarsh Rd, Burlington, WA 98233	$1,400	2.25
P24158	DIKE DISTRICT #12	E Whitmarsh Rd, Burlington, WA 98233	$600	
P113368	PORT OF SKAGIT COUNTY	Burlington, WA 98223	$198,200	1.18
P24141	BURLINGTON RV PARK INC	275 Whitmarsh Rd, Burlington, WA 98233	$215,000	0.66
P24142	BURLINGTON RV PARK INC	345 E Whitmarsh Rd, Burlington, WA 98233	$250,900	0.77
P24162	CLEAVE DAVID B	545 Whitmarsh Rd, Burlington, WA 98233	$121,300	0.34
P123950	HALLE PROPERTIES LLC	2054 S Burlington Blvd, Burlington, WA 98233	$805,900	1
P24156	LEONOVICH LEON P	471 Whitmarsh Rd, Burlington, WA 98233	$163,100	1.74
P105230	NAGATANI BROS INC	Burlington, WA 98223	$5,400	0.1
P105231	NAGATANI BROS INC	Burlington, WA 98223	$1,100	0.02
P116432	NAGATANI ROSIE FAMILY LTD PTRSHP	Burlington, WA 98223	$13,000	0.24
P24137	NAGATANI ROSIE FAMILY LTD PTRSHP	E Whitmarsh Rd, Burlington, WA 98233	$3,396,000	62.37
P24152	SAKUMA GLENN/KIMBERLY	1731 Whitmarsh Rd, Burlington, WA 98233	$328,100	3.12
P24184	SAKUMA SATORU	665 Whitmarsh Rd, Burlington, WA 98233	$228,800	0.94
P24148	SCHAFER RANDAL D	735 E Whitmarsh Rd, Burlington, WA 98233	$226,600	1.84
P24163	TREVINO MAGDALENO R	571 E Whitmarsh Rd, Burlington, WA 98233	$156,800	0.66
P116918	DIKE DISTRICT #12	Burlington, WA 98223	$558,200	3.49
P23939	DIKE DISTRICT #12	215 W Whitmarsh Rd, Burlington, WA 98233	$66,900	0.32
P23941	DIKE DISTRICT #12	247 W Whitmarsh Rd, Burlington, WA 98233	$88,600	0.52
P23942	DIAZ-COVARRUBIAS JUAN C	425 W Whitmarsh Rd, Burlington, WA 98233	$137,700	0.76
P23943	DIAZ-COVARRUBIAS JUAN C	W Whitmarsh Rd, Mt Vernon, WA 98273	$13,200	0.09
P23963	DIAZ-COVARRUBIAS JUAN C	451 W Whitmarsh Rd, Mt Vernon, WA 98273	$30,400	0.15
P121436	H D DEVELOPMENT OF MARYLAND INC	2001 Marketplace Dr, Burlington, WA 98233	$12,104,200	10.63
P121448	STRATFORD HALL INC	2034 Marketplace Dr, Burlington, WA 98233	$1,104,600	1.44
P121449	STRATFORD HALL INC	2050 Marketplace Dr, Burlington, WA 98233	$2,340,500	1.21
P24032	WASHINGTON STATE HWY DEPT	W Whitmarsh Rd, Mt Vernon, WA 98273	$0	
P106770	FOOTHILLS THREE LLC	1881 Bouslog Rd, Burlington, WA 98233	$2,351,500	6
P23923	HANSON JEAN A	18263 W Whitmarsh Rd, Mt Vernon, WA 98273	$213,800	12.02
P23924	HANSON JEAN A	W Whitmarsh Rd, Mt Vernon, WA 98273	$600	1
P23906	HANSON JEAN A	Skagit County – outside city limits	$74,700	19.03
P23921	LARSON SANDRA JEAN	18381 W Whitmarsh Rd, Mt Vernon, WA 98273	$228,500	11.9
P23922	ROCK ISLAND PARTNERS LLC	no records currently exist	$965,300	4.56
P23917	TAPLEY INVESTMENTS LLC	2024 Bouslog Rd, Burlington, WA 98233	$712,200	2.9
P24206	CITY OF MOUNT VERNON	Hoag Rd, Mt Vernon, WA 98273	$400	0.18
P24226	CITY OF MOUNT VERNON	501 Hoag Rd, Mt Vernon, WA 98273	$83,800	0.54

Parcel Number	Owner Name[1]	Site Address[1, 2]	Total Market Value[1]	Acres[1]
P111652	DIKE DISTRICT #17	923 Hoag Rd, Mt Vernon, WA 98273	$85,000	0.8
P111653	DIKE DISTRICT #17	929 Hoag Rd, Mt Vernon, WA 98273	$72,300	0.8
P111922	DIKE DISTRICT #17	917 Hoag Rd, Mt Vernon, WA 98273	$85,000	0.8
P24193	DIKE DISTRICT #17	903 Hoag Rd, Mt Vernon, WA 98273	$85,000	0.82
P24208	DIKE DISTRICT #17	601 Hoag Rd, Mt Vernon, WA 98273	$83,800	0.82
P24218	DIKE DISTRICT #17	Hoag Rd, Mt Vernon, WA 98273	$300	0.14
P24219	DIKE DISTRICT #17	407 Hoag Rd, Mt Vernon, WA 98273	$401,400	1.01
P24220	DIKE DISTRICT #17	Mt Vernon, WA 98273	$1,000	0.5
P24209	ARMENDAREZ ARTHUR A	1111 Hoag Rd, Mt Vernon, WA 98273	$157,100	1.01
P24215	BRIDGES TIMOTHY R	821 Hoag Rd, Mt Vernon, WA 98273	$203,000	0.77
P112779	HOCKING JOHN N	609 & 611 Hoag Rd, Mt Vernon, WA 98273	$216,500	0.82
P121425	HOCKING JOHN N	701 Hoag Rd, Mt Vernon, WA 98273	$83,400	0.8
P121426	HOCKING JOHN N	Mt Vernon, WA 98273	$12,200	0.81
P121427	HOCKING JOHN N	613 & 615 Hoag Rd, Mt Vernon, WA 98273	$148,500	0.8
P111654	LUND JOHN G	1001 Hoag Rd, Mt Vernon, WA 98273	$243,100	0.93
P24210	PIMENTEL JULIO C	1007 Hoag Rd, Mt Vernon, WA 98273	$229,100	1.01
P24201	ROALD OLA M	405 Hoag Rd, Mt Vernon, WA 98273	$281,200	1.22
P24196	ROSS STEPHEN C	911 Hoag Rd, Mt Vernon, WA 98273	$206,500	0.83
P24225	SALT KEVIN L	1117 Hoag Rd, Mt Vernon, WA 98273	$192,000	0.83
P24213	STEINER NICOLE JOY	811 Hoag Rd, Mt Vernon, WA 98273	$199,000	0.77
P24224	STOLPE STEVEN A	1115 Hoag Rd, Mt Vernon, WA 98273	$168,500	0.78
P24197	VAN DUSEN EARL	519 Hoag Rd, Mt Vernon, WA 98273	$271,000	0.76
P24191*	WALLACE CHARLOTTE L	Hoag Rd, Mt Vernon, WA 98273	$150,300	1.61
P24216	WOLF DONALD A	827 Hoag Rd, Mt Vernon, WA 98273	$208,000	0.7
P24217	WOLF DONALD A	825 Hoag Rd, Mt Vernon, WA 98273	$170,500	0.71
P24018	CITY OF MOUNT VERNON	101 E Stewart Rd, Mt Vernon, WA 98273	$522,700	3.8
P24023	DIKE DISTRICT #17	121 E Stewart St, Mt Vernon, WA 98273	$142,000	0.97
P24024	DIKE DISTRICT #17	109 E Stewart St, Mt Vernon, WA 98273	$30,700	0.21
P23932	DIKE DISTRICT #17	Riverbend Rd, Mt Vernon, WA 98273	$710,900	4.08
P23935*	DIKE DISTRICT #17	14178 Riverbend Rd, Mt Vernon, WA 98273	$148,300	0.2
P24025	DIKE DISTRICT #17	Stewart Rd, Mt Vernon, WA 98273	$245,300	13.64
P23933	PUBLIC UTILITY DISTRICT	14012 Riverbend Rd, Mt Vernon, WA 98273	$40,600	3.38
P24021	CALICORP LLC	205 W Stewart St, Mt Vernon, WA 98273	$221,900	0.6
P24027	CALICORP LLC	205 W Stewart St, Mt Vernon, WA 98273	$1,680,900	1.1
P23936*	FOHN MARGARET U	Riverbend Rd, Mt Vernon, WA 98273	$20,300	5.08
P23938	FOHN MARGARET U	Riverbend Rd, Mt Vernon, WA 98273	$222,400	35.78
P24020	HEADQUARTERS PARTNERSHIP	111 W Stewart St, Mt Vernon, WA 98273	$452,100	0.91
P24022	HEADQUARTERS PARTNERSHIP	125 W Stewart St, Mt Vernon, WA 98273	$151,600	0.34
P23937*	MELLOTT KENNETH R/LELAND F	14070 Riverbend Rd, Mt Vernon, WA 98273	$175,000	0.72
P24026	RIVERCREST PARTNERS	305 W Stewart Rd, Mt Vernon, WA 98273	$928,800	1.76
P24028	RIVERCREST PARTNERS	Stewart Rd, Mt Vernon, WA 98273	$639,800	1.98
P24029	RIVERCREST PARTNERS	Stewart Rd, Mt Vernon, WA 98273	$397,300	1.23

Notes:

* - Out of project area

1 - Data is per the Skagit County Assessor webpage at http://www.skagitcounty.net/ accessed on August 28, 2009

2 - Properties shown with no numerical street address are currently undeveloped and have therefore not been assigned a street address by the Cities of Mount Vernon and Burlington or Skagit County