HANSVILLE WETLAND RESTORATION PLAN BASELINE REPORT

HANSVILLE, Kitsap County, Washington

Prepared for

Kitsap Land Trust
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Kitsap Land Trust
Grant No. G9700013

Hansville Wetland Restoration Plan

Plan Development
Task 4

July 28, 1997

This plan was funded in part through a cooperative agreement with the National Oceanic and Atmospheric Administraiton.

The views expressed herein are those of the authors and do not necessarily reflect the views of NOAA or any of its sub-agencies.

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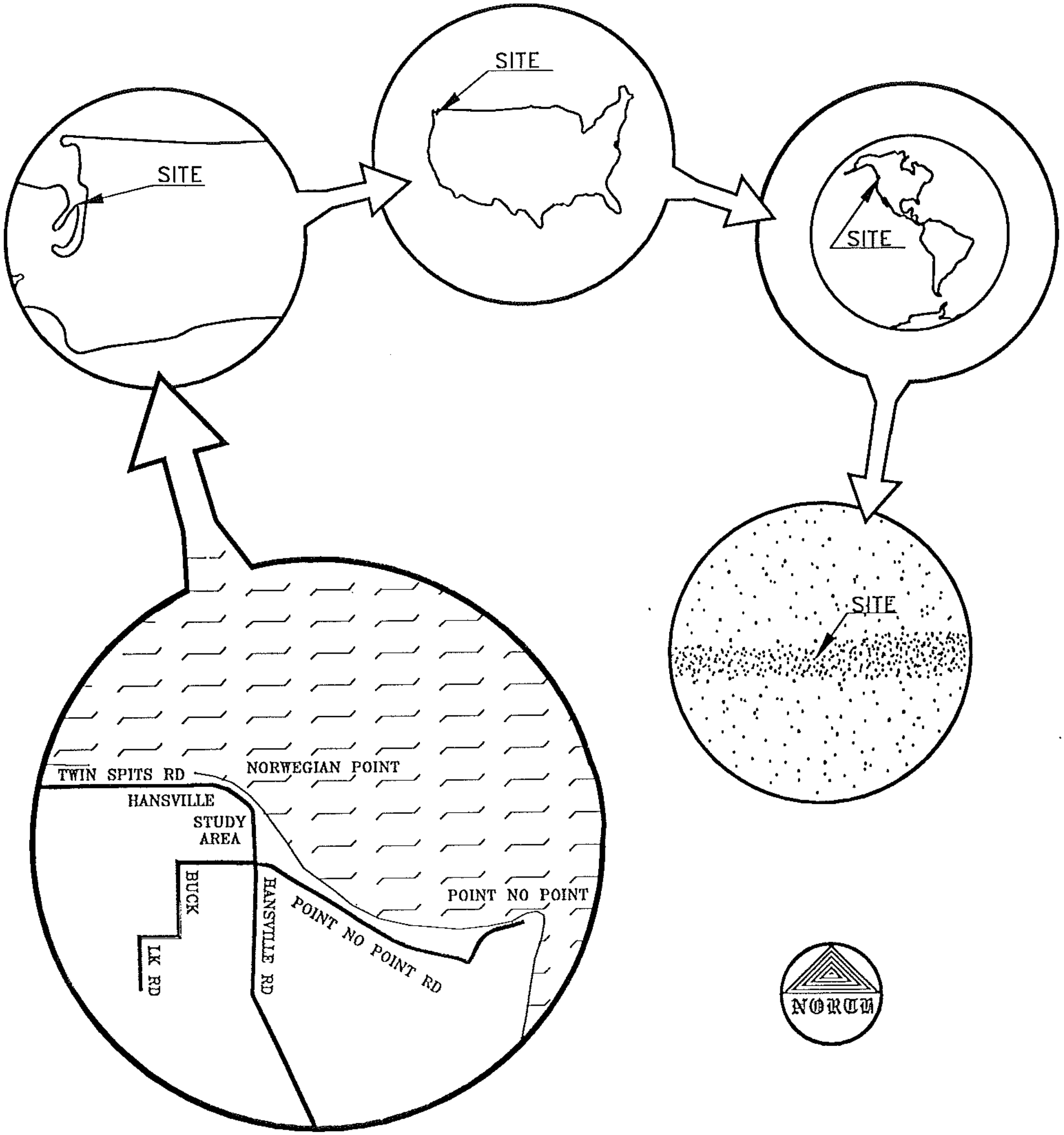
A. INTRODUCTION

Hansville is a unique and charming community at the northern tip of Kitsap County (Map A-1a). The community itself is made up of several businesses including the Hansville Store and the Hansville Repair shop, with a Post Office and Fire Station to serve the community residents. A large part of the Hansville area is composed of a wetland system that lies between Buck Lake Road and Twin Spits Road and west of Hansville Road NE (Map A-1b). The wetland consists of a large, historically ditched pasture that grades to a significant forested area on the west side. The preservation of this system is very important to the Hansville community and in an attempt to determine the best course of action for the wetland, the Kitsap Land Trust, in conjunction with Hansville community members, applied for a Coastal Zone Management (CZM) Project Assistance Grant from the Department of Ecology in February of 1996. The application for the grant was approved and the Hansville Community was ready to proceed with an intensive study of this large and significant wetland system. The goal of the study is to determine the historic condition of the area and to develop a plan for restoration of the Hansville Wetland to a possible salt marsh.

The study is formally referred to as the Hansville Wetland Restoration Plan Project and its CZM Ecology Grant Agreement Number is G9700013. The restoration plan was organized into a series of tasks to be completed by the contracted wetland consulting firm and community volunteers. Task #1 includes coordination with the Department of Ecology to assist the Kitsap Land Trust and ensure project results are consistent with the state Shoreline Management Act, the federal Coastal Zone Management Act, and various local and state wetland regulations. Coordination is through Bev Heuther of the Department of Ecology's Shorelands staff to provide specific technical assistance on fish and wildlife habitat, and other matters are required.

Task 2 includes Historical Review, in which local volunteers researched the history of the Hansville Wetland and Finn Creek watershed to determine their pre-settlement configuration. Research included reviewing old maps, historical documents and photographs, and interviewing long time residents to determine how the original Hansville Wetland may have been altered. The product of Task 2 would include a compendium of the information gathered, and along with any documents collected, would be included in the final restoration plan report. Task 2 also included review of the historical review materials by Wiltermood Associates.

Task 3 includes the Baseline Study phase of the project, which represents the bulk of the study. Included in this task is a topographic survey conducted by the wetland consultant with help from community volunteers, of the entire wetland system at 6 inch to 1 foot contours. The baseline studies also include salinity readings across transects and completion of a vegetation survey to assist in determining the present salt and fresh water



MAP A-1a

VICINITY MAP

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influence on surface water, soils, and vegetation. Detailed maps including topography, vegetation, and salt water influence would then be prepared from the data collected and provided to the state and county for inclusion in their Geographic Information Systems (GIS). This information was collected to assess the present salt water influence on the surface and ground water, soils, and vegetation so that decisions could be made concerning the historical configuration of the wetland and what the potential restoration plans could be. The US Army Corps of Engineers, Hydraulics Engineering Section (COE), has completed a separate study concerning the potential restoration options and has focused on the storage capacity of the Hansville Wetland. This study was completed independently from this one but the findings of the COE have been incorporated into this report, with respect to the specific outcome and potential restoration options.

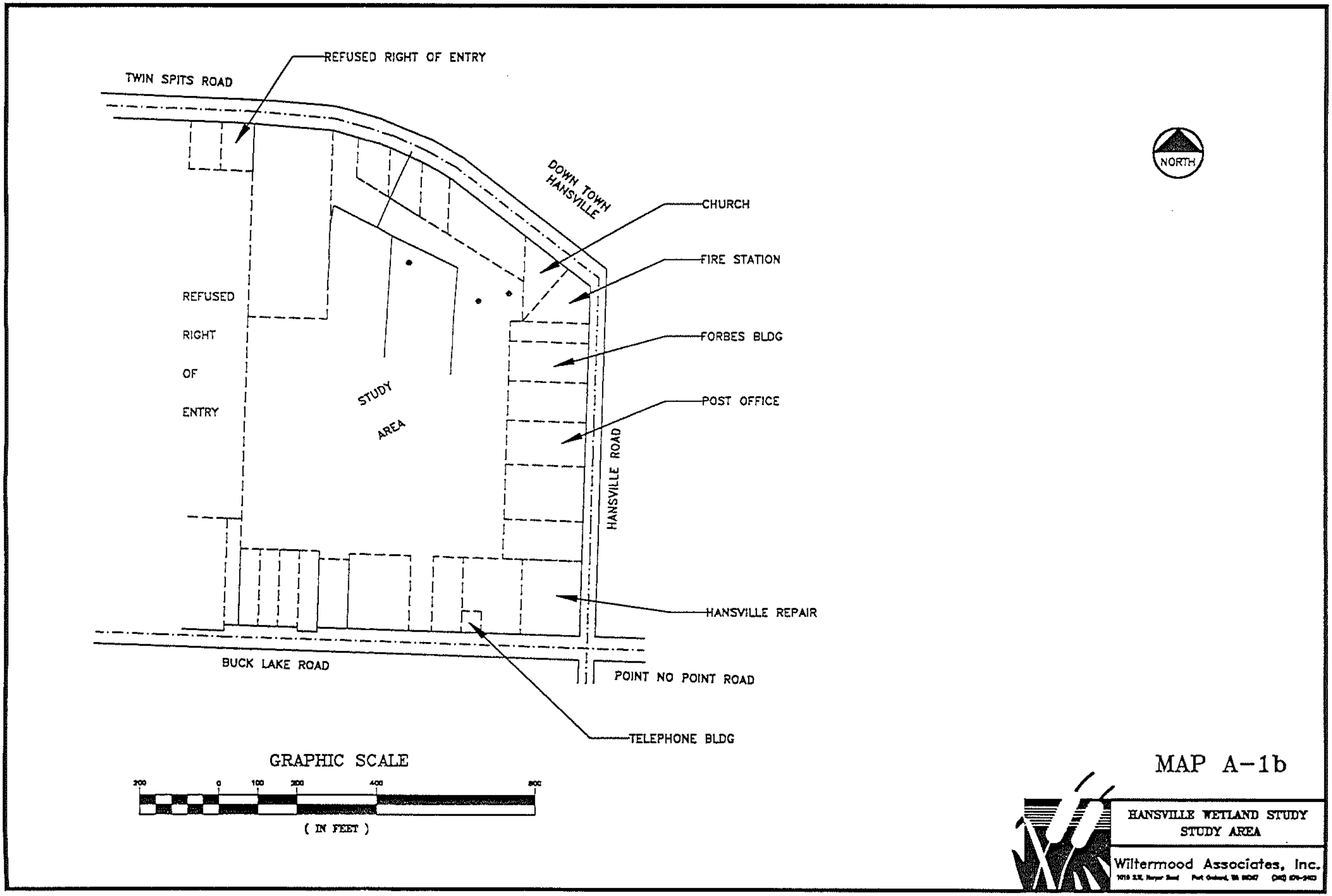
Task 4 includes Plan Development, in which all of the information collected in the previous three tasks could be compiled to develop a series of possible restoration plans and the positive/negative affects of each restoration option. These plans are to be presented to the community members and persons owning property along the Hansville wetland for their input and a formal restoration plan would be selected. The plan will also provide preliminary cost and schedule estimates for detailed design and construction.

Task 5 entails Project Management, carried out by Ken Shawcroft, to oversee and evaluate consultant performance and manage volunteer and community efforts on the project.

The baseline study was completed over a period of several months, between August and December 1996, by Wiltermood Associates, Inc. The four person team completing the baseline study included Bob Wiltermood, conducted topographic survey of the site; Joanne Bartlett, conducted vegetation, salinity, and delineation transects; Ken Pritchard, conducted vegetation and salinity transects; and Vaughn Everitt, completed the wetland delineation and assisted with the topographic survey. A team of volunteers assisted the consultant in the field and included our main man Martin Adams, who was present every time we went out, rain or shine; Ken Shawcroft, project manager, and Sid Knutson, local conservationist and assistant project manager. The report has been completed through the efforts of the historical review volunteers and Wiltermood Associates, Inc.

B. OBTAINING ACCESS TO THE HANSVILLE WETLAND PROPERTIES

The first task undertaken by the project was obtaining permission to enter the properties bordering and encompassing portions of the Hansville Wetland. Wiltermood Associates sent out letters outlining the project goals and that we would need to go onto their properties to conduct the baseline studies. The property owners were asked to sign the bottom of the letter and return it to us. We assured many of the interested owners living outside the Hansville area that they would be notified of the results and would be invited to a meeting with all adjacent property owners when the baseline study was completed and


REFUSED RIGHT OF ENTRY
TWIN SPITS ROAD
DOWN TOWN HANSVILLE
CHURCH
FIRE STATION
FORBES BLDG
POST OFFICE
REFUSED RIGHT OF ENTRY
STUDY AREA
HANSVILLE ROAD
HANSVILLE REPAIR
BUCK LAKE ROAD
POINT NO POINT ROAD
TELEPHONE BLDG
GRAPHIC SCALE
200 0 100 200 400 800
(IN FEET)
NORTH
MAP A-1b
HANSVILLE WETLAND STUDY
STUDY AREA
Wiltermood Associates, Inc.

potential restoration options were developed. We are happy to report that most of the land owners responded favorably to the project and granted us permission to be on their sites. We are especially grateful to Ribera-Balko Enterprises since they own most of the property within the Hansville Wetland. We only received negative responses from two property owners and did not pass onto their land. See a copy of the letter enclosed in Appendix I and Map B-1 for individual properties (only property lines identified) bordering and including portions of the Hansville Wetland.

C. HISTORICAL REVIEW

Task 2 of the Hansville Wetland Restoration Plan Project was to research the history of the wetland and watershed to determine their pre-settlement configuration. Old maps, historical documents, and photographs were researched and long time area residents were interviewed. This section provides an overview of the information collected by volunteers. The information collected by the volunteers underwent additional review by Wiltermood Associates to assist in developing the recent history of the Hansville Wetland. The Coastal Zone Atlas and the Net Shore-drift in Washington State: Volume 4, Hood Canal were consulted to determine how the land now making up Hansville was formed and how this may have influenced the formation of the Hansville Wetland.

The current configuration of the wetland is such that it was used historically as pasture, judging from the presence of many remnant fences and ditches found in the wetland and the comments of long time residents. It is presently connected to a tide gate under Twin Spits Road that sometimes functions improperly and allows the inflow of salt water to the Hansville Wetland. The conclusions of the historical review have revealed that there are no clear historic descriptions of the wetland area prior to settlement. Based on the evidence found, it can be concluded that although the area has probably never been a tidal marsh, it does experience salt water intrusion at times. It appears likely from the historical photographs (aerial and ground level photos) and maps that Finn Creek has never flowed into what is presently known as the Hansville Wetland, although one old time resident thought that it may have flowed into the wetland. This was probably prior to construction the Hansville Road, which created a dike between the present flow of Finn Creek and the Hansville Wetland.

C-1. Geologic Historic Review

The Hansville Shoreline was apparently created as a result of two long shore drift cells that converged at the Point-No-Point lighthouse. Drift Cell 1-1 originates to the south, at the boundary between Sections 11 and 14 on Map KS-10, terminating along the east shore of Point-No-Point which is an accumulation landform know as a cuspate spit. Drift Cell 1-2 originates in a small zone of divergence at Foulweather Bluff and terminates along the northwest shore of Point-No-Point. Net shore drift on cell 1-1 is to the north, while net shore drift on cell 1-2 is in an easterly direction causing the convergence of these two cells. The area behind the sand berm created by these drift cells was most likely tidal for several centuries before completely closing off. A few blow outs probably occurred during big storm events after the spit was closed off but now because of shoreline armoring, blow outs are unlikely. The original configuration of the Point-No-Point wetland, during and immediately after the two drift cells closed, appears to have been a semi enclosed lagoon and overtime filled in with peat and silt material deposited by erosion and storm events and the wetland became the present emergent/scrub-shrub/forested system. See Appendix II-a for complete mapping and description of drift cell convergence as copied from Net shore-drift in Washington State; Volume 4, Hood Canal.

The Coastal Zone Atlas, Coastal Drift Mapping, basically agrees with the formation of the Hansville Shoreline as described above. It further indicates that Norwegian Point represents an approximate drift boundary, where eroding beach changes to accreting beach due to changes in wave length and direction of drift. Drift across the Hansville Shoreline to Norwegian Point is in a due easterly direction, while east of Norwegian Point, drift is in a southeasterly direction nearly halfway to Point-No-Point, and from this point, drift again changes to an easterly direction. The shoreline between Norwegian Point and Point-No-Point has a concave, bowl shape as formed by the changes in drift direction. See Appendix II-b for Coastal Drift information.

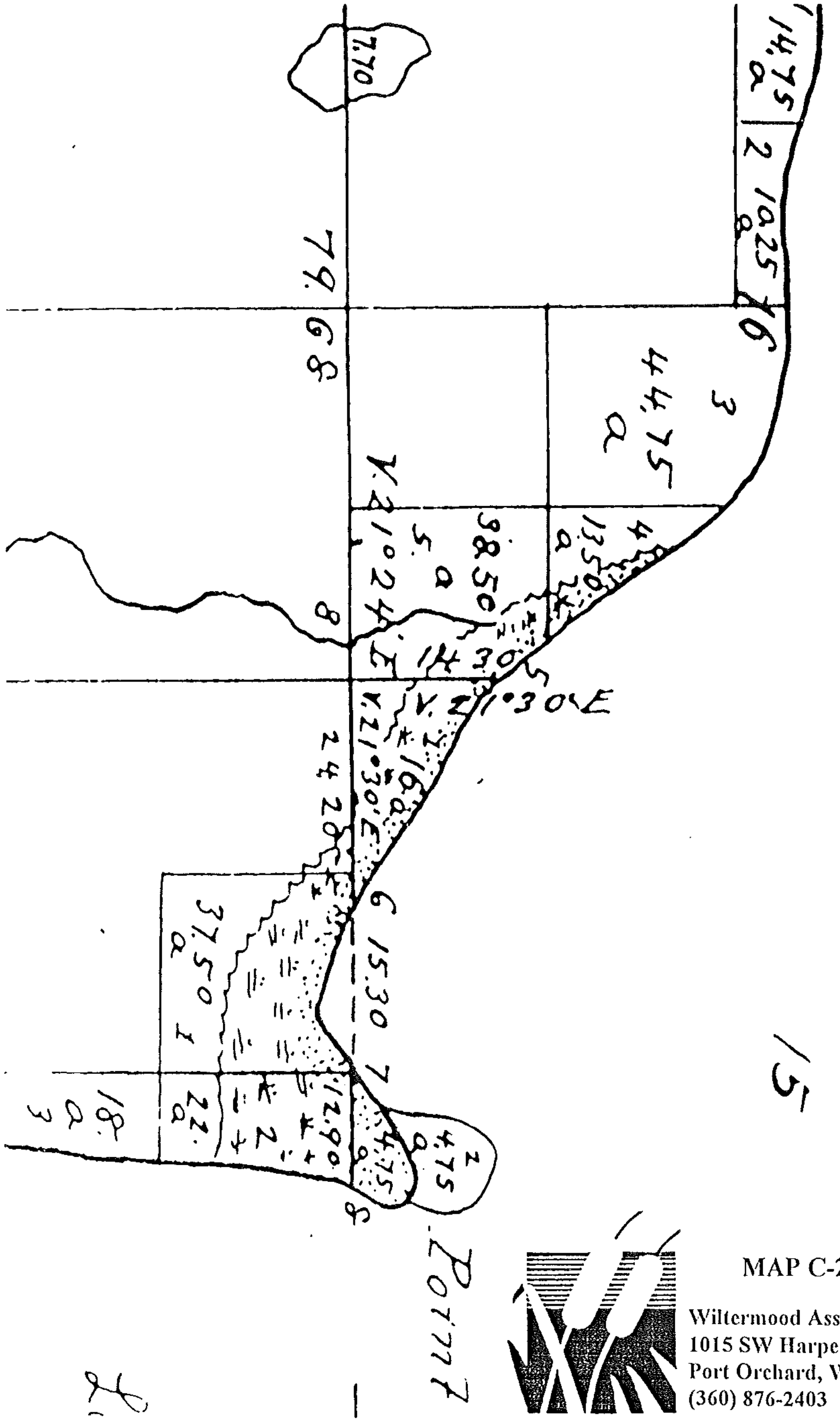
Based on the information obtained through the review of Coastal Drift, we have hypothesized that Finn Creek never flowed east into what is now the Point-No-Point wetland system. The historic flow of Finn Creek is not readily evident but we have determined that at one time it probably flowed directly into Admiralty Inlet, even after buildup of the sandy berm, and may have been modified by early settlers to effectively drain the area for housing and farming. A small back water area may have been created as a result where wetland associated with Finn Creek remained. A tide gate was probably installed at this time to ensure that the area was properly drained and to prevent the flow of salt water into the area. The Point-No-Point wetland is fed by a stream originated to its south, flowing through the center of Section 22, to level terrain. It is this stream that likely flowed into tidal wetland that was eventually closed off when drift closed the cuspate spit. The Point-No-Point and Hansville Wetlands were never directly contiguous due to the steep slopes between them (high bluffs along the south edge of Point-No-Point Road) and the formation (by drift) of the berm between the slope and beach. While they were never contiguous, there is some indication that excess flow from Point-No-Point flows westerly to the existing ditch along Hansville Road and exits via the existing tide gate.

According to the Coastal Zone Atlas, Geology mapping, the entire Hansville Wetland represents Artificial Fill with Beach deposits along the Hansville Shoreline. This mapping shows Finn Creek ending abruptly near the corner of Hansville and Buck Lake Road, with no indication of its actual flow direction past that point. The presence of the beach berm, apparently created by coastal drift, would indicate that the Hansville Wetland was probably never a tidal salt marsh but may have been a brackish marsh, where salt and fresh water mixed. In an effort to drain the remaining wetland, the second tide gate was probably installed to facilitate drainage of water from the wetland and prevent the flow of salt water into the wetland. This tide gate is located west of the first tide gate along Twin Spits Road and may also have been installed to assist with the flow of water and reduce flooding along Twin Spits and Hansville Roads. See Appendix II-c for description of Geology mapping as copied from the Coastal Zone Atlas.

C-2. Review of Maps and Surveys

The review of surveys and maps revealed that the earliest map of the area was from the General Land Office (GLO) Survey conducted in June of 1859 (Map C-2a). The surveyors walked and surveyed along the section lines and shores, but because the wetland does not lie on a section line, it was not mentioned in their descriptions and little narrative description was included in their survey of the shore meander line. The description of the boundary between Section 16 and 22 included what is now Buck Lake, and a "branch...runs NW", which was located east of Finn Creek. The stream was shown on the GLO map to flow north into a marshy area along the beach and east of the Hansville Wetland. Finn Creek was not noted, possibly because of low mid-summer flow. The 1909 Plat Book Map (Map C-2b) does not indicate a stream or marshy area, while the 1926 Plat Book map (Map C-2c) shows the stream east of Finn Creek, but none of the later maps or surveys indicate the presence of the eastern stream. The 1953 Army Map Service map (Map C-2d) shows Finn Creek flowing across the intersection of Buck Lake Road and Hansville Road into a small pond, east of Hansville Road and adjacent to the current location of the Finn Creek ditch. It also shows a marshy area to the west of Hansville Road, which is the location of the Hansville Wetland and is the only depiction on any of the historical maps reviewed that shows this area as potentially being wetland. A later map (Map C-2e) of this area (year unknown but it is after construction of the Hansville Road and several buildings at the northwest intersection with Buck Lake Road) shows Finn Creek abruptly ending at the southwest intersection of Buck Lake Road and Hansville Road. No marshy area is shown to the northwest of the intersection on this map nor is the ponded area to the northeast shown on this map. These maps indicate that Finn Creek probably never flowed into the present Hansville Wetland and that Finn Creek was channelized along the road to dry out the larger wetland area. These two wetlands were probably connected prior to construction of Hansville Road and the area east of the road was filled to allow "appropriate use" by residents.

More recent maps reviewed for this task include the Kitsap County Soil Survey and National Wetlands Inventory. The Kitsap County Soil Survey, completed in September of 1980 by the Soil Conservation Service (now the Natural Resource Conservation Service), maps the soils within the wetland as 49 Shalcar muck and the lower drainage of Finn Creek as 37 Norma fine sandy loam (Map C-2f). The soils are classified as hydric by the SCS. The mapping of Finn Creek points to the stream flowing under the intersection of



MAP C-2a

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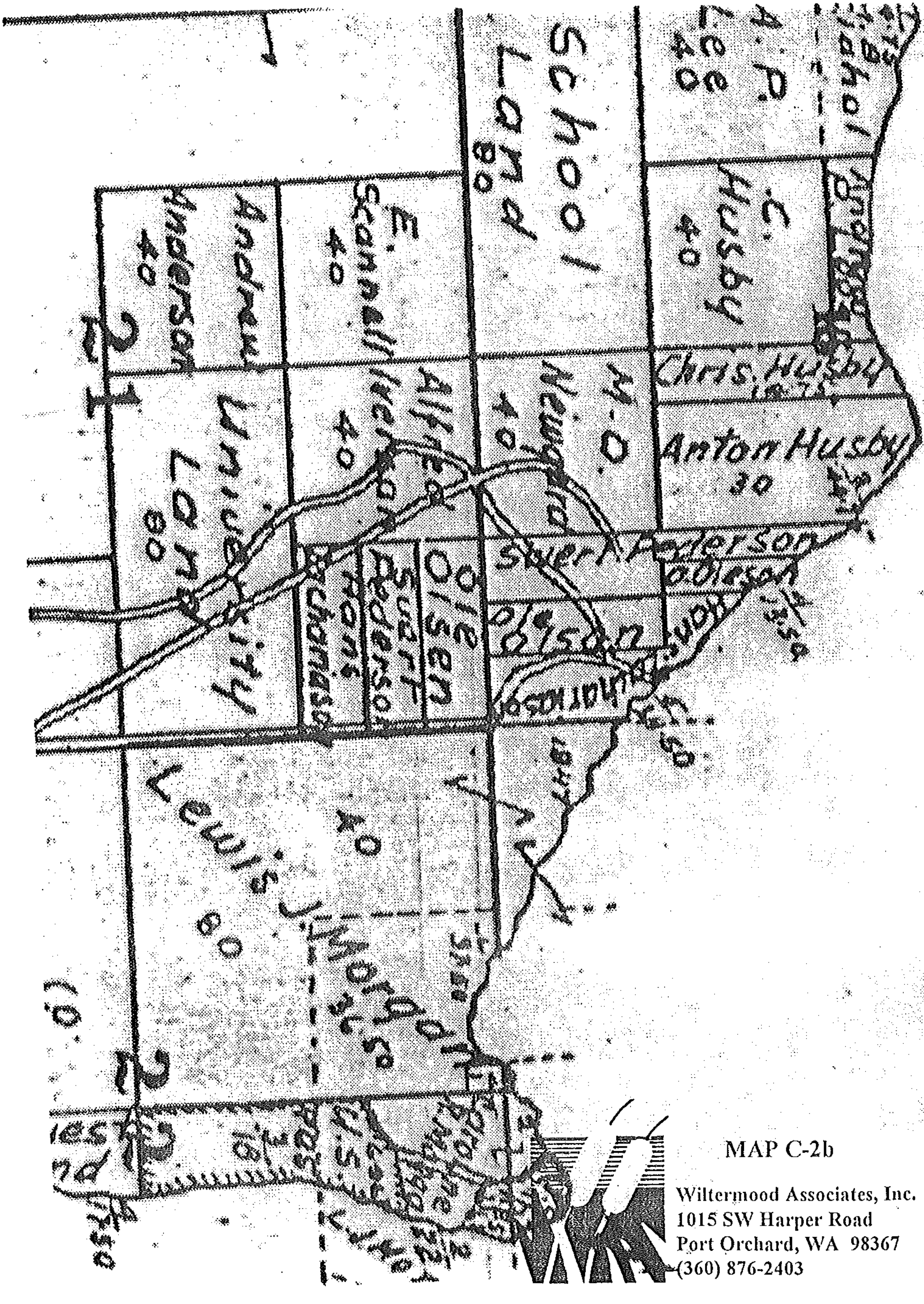
(360) 876-2403



1909 Plat Map

MAP C-2b

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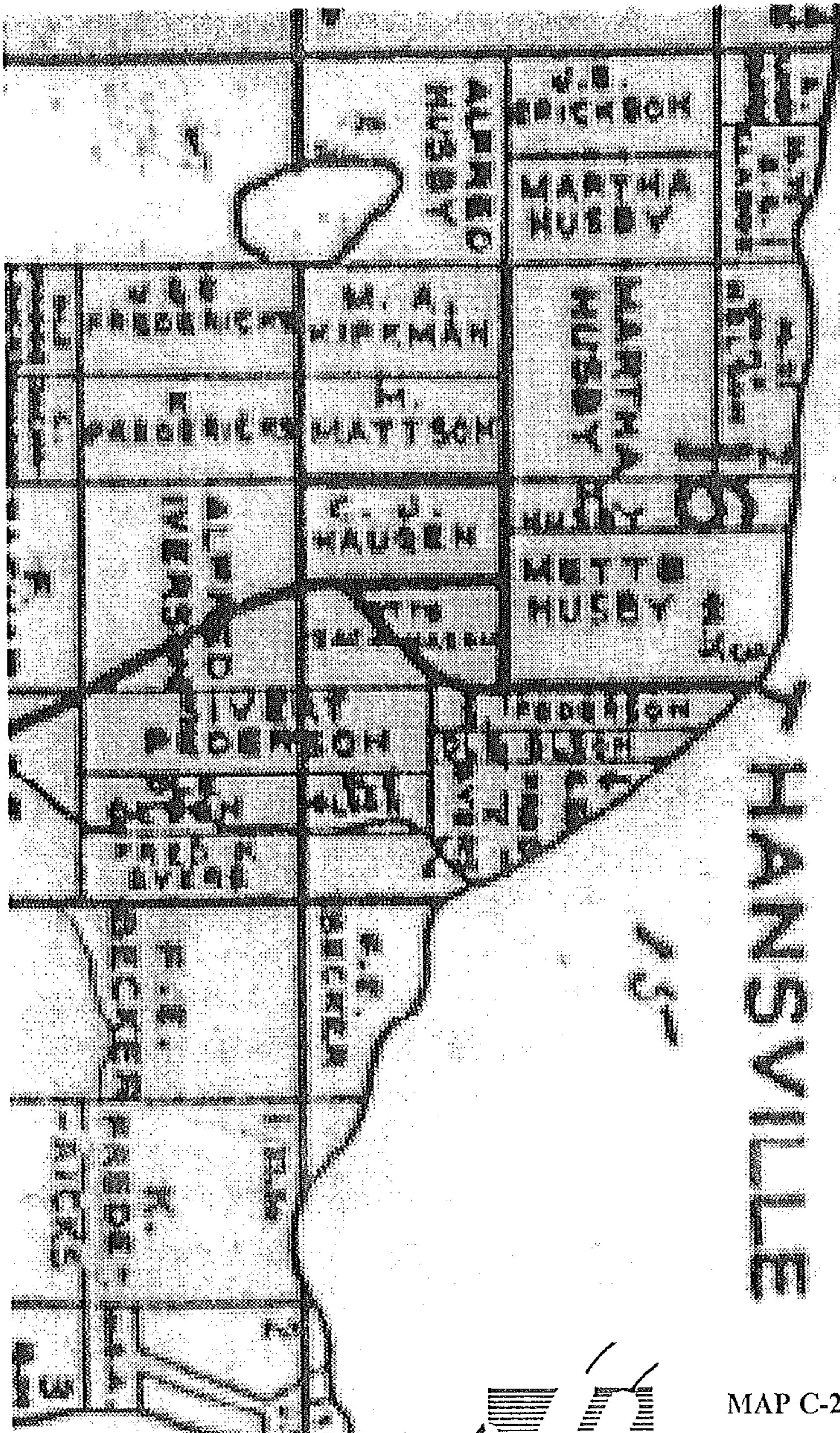
(360) 876-2403



1926 Platbook

MAP C-2c

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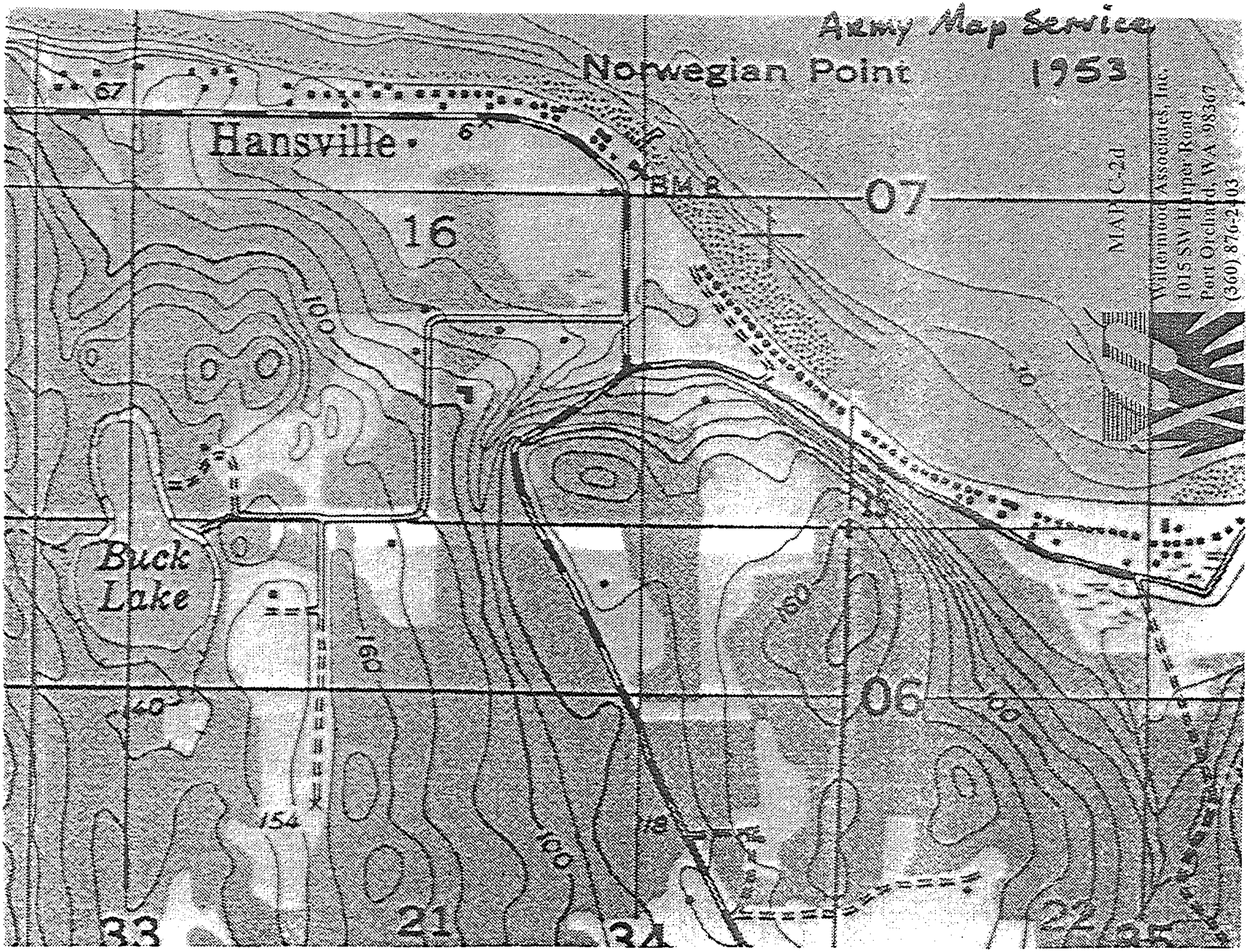

Army Map Service
1953
Norwegian Point
Hansville
Buck Lake
16
07
06
21
33
34
22
35
100
160
154
MAP C-2d
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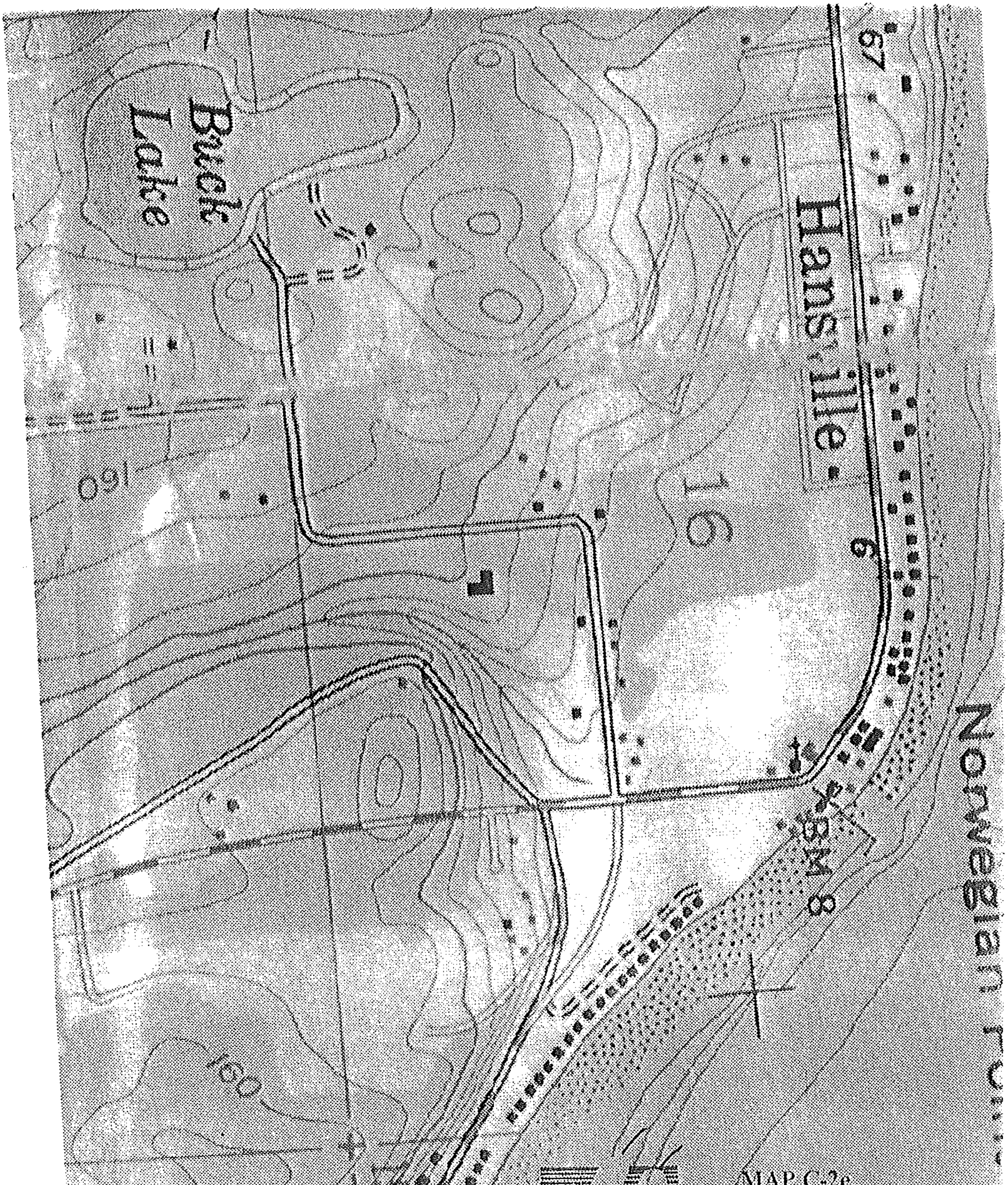

MAP C-2e

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Buck Lake Road and the Hansville Road, but does not show its presently drainage path directly alongside Hansville Road. The National Wetlands Inventory was prepared from aerial photo interpretation by the US Fish and Wildlife Service, and maps a strip of wetland beginning along the smaller lots east of Hansville Road and extending in a northwesterly direction away from the road (Map C-2g). It does not map the entire area as wetland, because the US Fish and Wildlife Service bases its wetland mapping on the presence of wetland vegetation and obvious standing water. The Kitsap County Department of Community Development has included the SCS and NWI map units on their GIS for use by property owners and shows that the wetland system is very extensive based on the soil mapping, which accurately shows the extent of this large system (Map C-2h). This mapping also shows the flow of Finn Creek as it crosses the intersection, but on this map, the stream crosses in a northeasterly direction and exiting between two small lots. This stream mapping is not accurate as there is no stream channel crossing the properties east of Hansville Road in this manner.

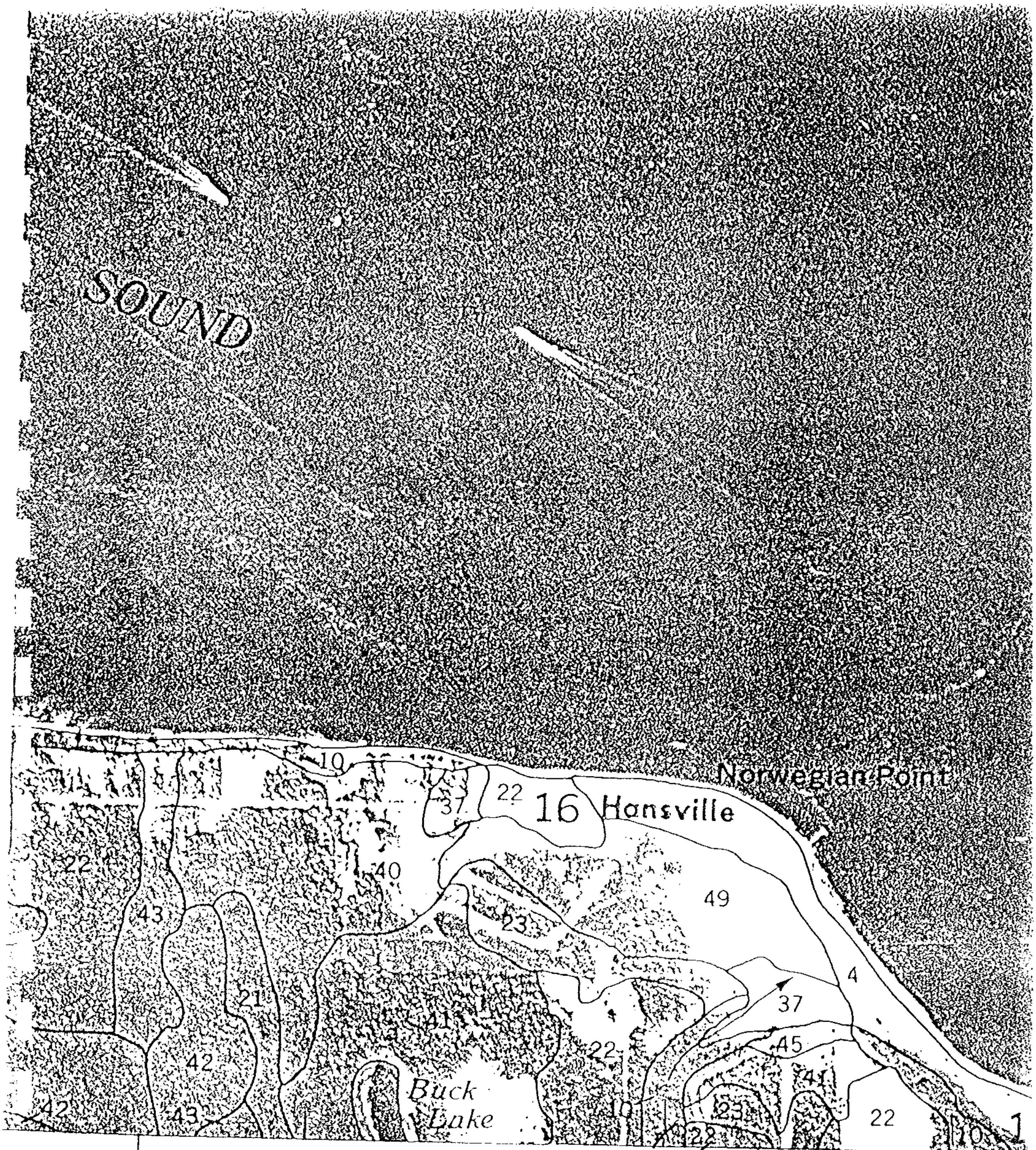
C-3. Written Historical Documentation

No written description of the Hansville Wetland history was found older than the 1991 description in the wetland assessment prepared by Ron Vanbianchi (Wetland Identification and Assessment, August 30, 1991) for the Hansville Chamber of Commerce, under a Puget Sound Water Quality Authority grant. Mr. Vanbianchi describes the wetlands as follows:

> The wetland's primary water sources are groundwater seeps located to the southwest. Although originally connected to Puget Sound by a stream channel located in the wetland's southeast corner, since at least the early 1950's, the wetland has been ditched and isolated from salt water inflow by a tide gate.
>
> From the early 1950' (and perhaps earlier) until about 1965, the non-forested portion of the wetland was used for pasture and occasionally mowed for hay. Since agricultural activity has ceased, the wetland has been undisturbed except for fills along the east and north boundaries for residential and commercial construction.

The ground photos from the 1930s and the aerial photo from 1942 indicate fence lines, which correspond to the current system of ditches mentioned by Vanbianchi. This indicates the ditches may be older than he estimated.

The most comprehensive document on the Hansville area is a portion of Kitsap County: A History, compiled by the Kitsap Historical Society and published in 1977. It does not contain a description of the wetland area, however one photograph, looking south from the Hansville dock shows a flat area with tall grass and some fences on the right side, that



MAP C-2f (Jo

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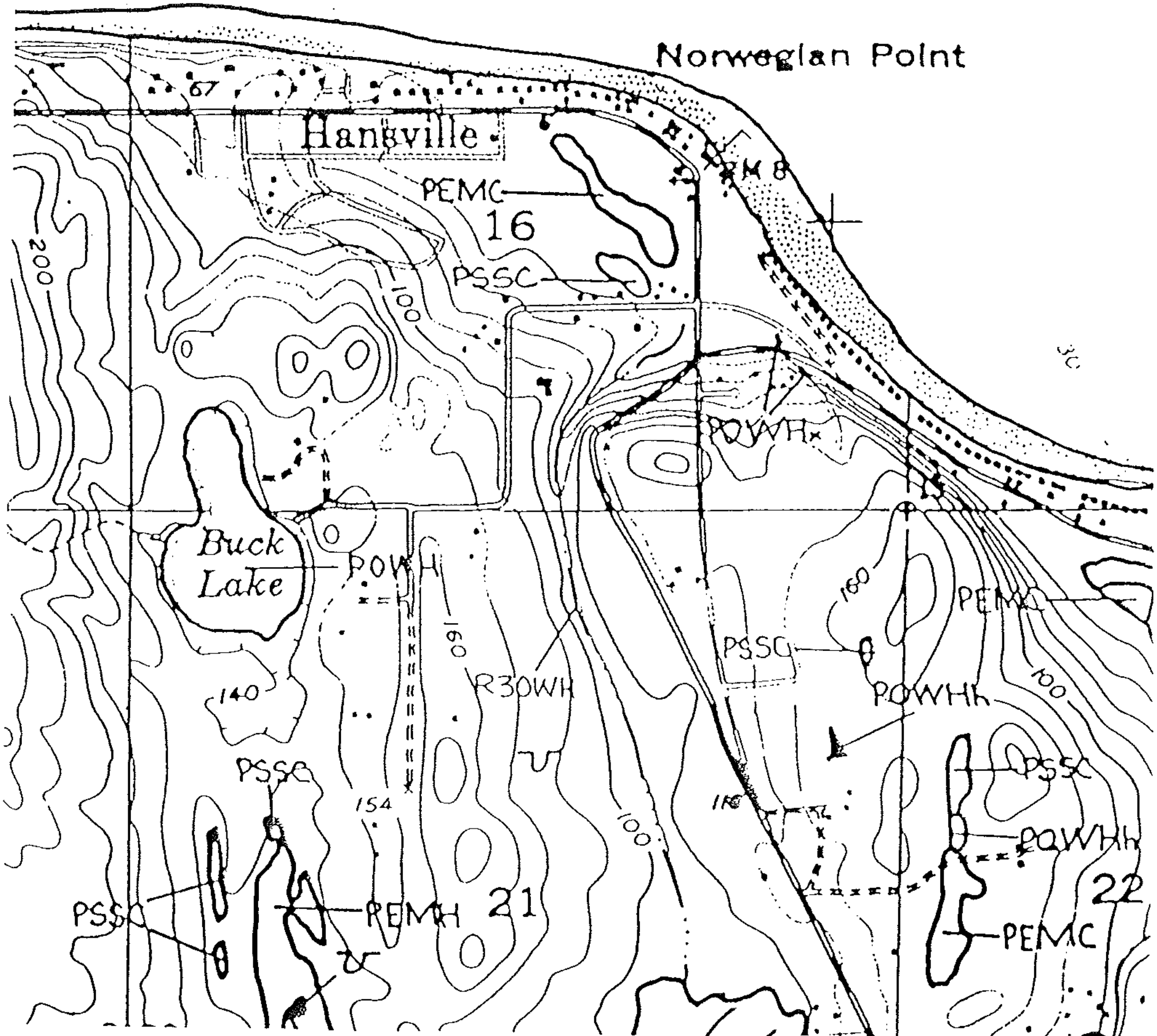

MAP C-2g

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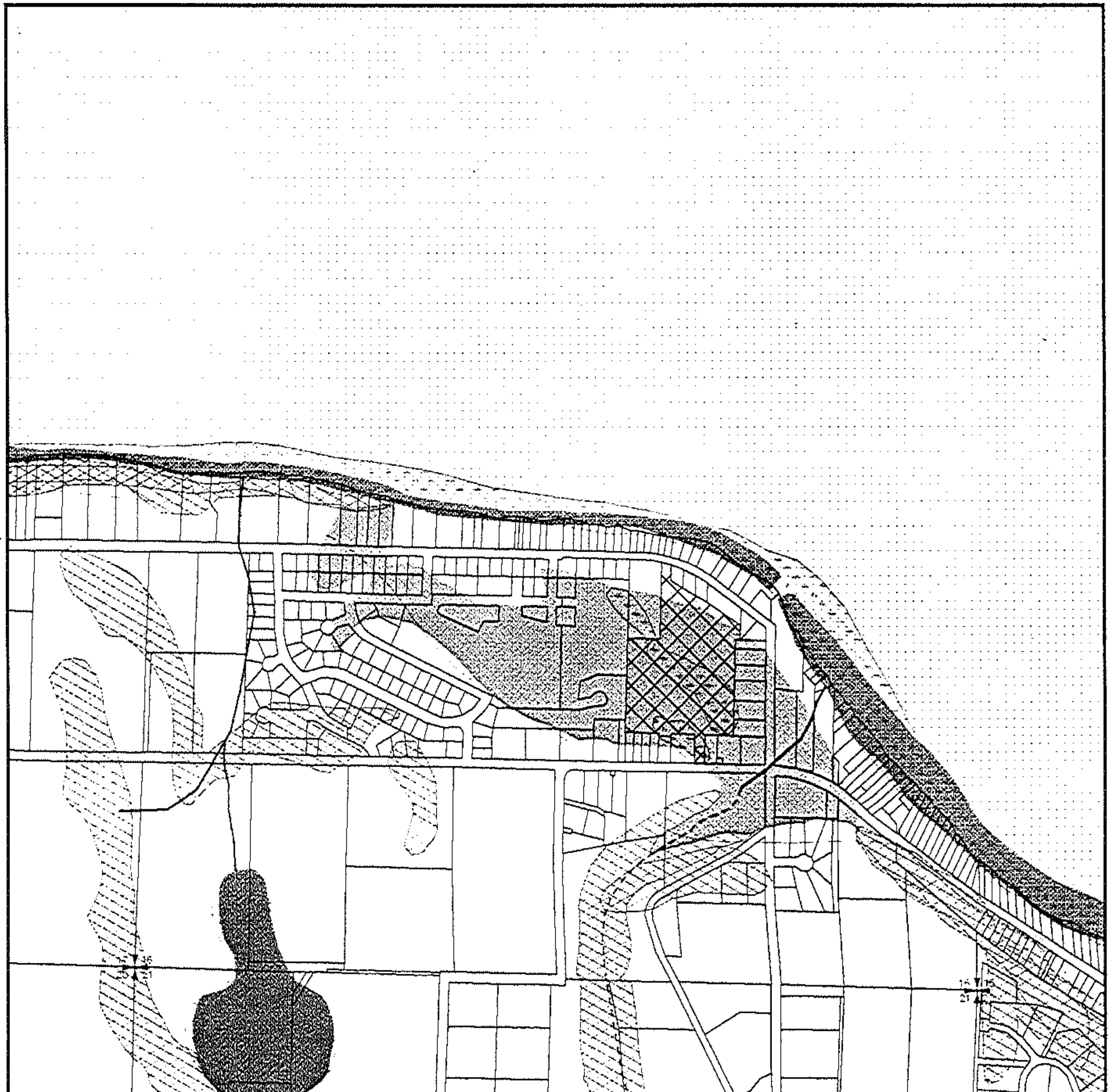
Account:
Tax Payer:



Building Limitations

National Wetland Inventory

Hydric Soils
(SCS Soil Survey)

Severe Geologic Hazard
Soils 30% and greater Slope (SCS)
Water Erosion Hazard "High" or "Severe" (SCS)
Slope stability "Unstable" or "Intermediate"
(Deeter 1979)

Areas of 100-Year Flooding

WSDNR Water Types

Open Salt Water

Open Fresh Water

Wetlands (DNR)

Rivers and Streams

Water Type 1

Water Type 2

Water Type 3

Water Type 4

Water Type 5

Unclassified Water

Map C-2h

These maps were created from available public records and existing map sources, not from field surveys. Map features from all sources have been adjusted to achieve a "best fit" registration to the Ownership Parcels map. While great care was taken in this process, maps from different sources rarely agree as to the precise location of geographic features. The relative positioning of map features to one another results from combining different map sources without field "ground truthing"

* THIS MAP IS NOT A SUBSTITUTE FOR FIELD SURVEY *

Product of Kitsap County Geographic Information System
Kitsap County Department of Community Development
614 Division Street, MS-36, Port Orchard, WA 98366
(206) 876-7181 • FAX (206) 895-4925 • WA Toll Free (800) 872-4503

Printed September 04, 1996 by Angie

Map Scale: 1" = 1000'

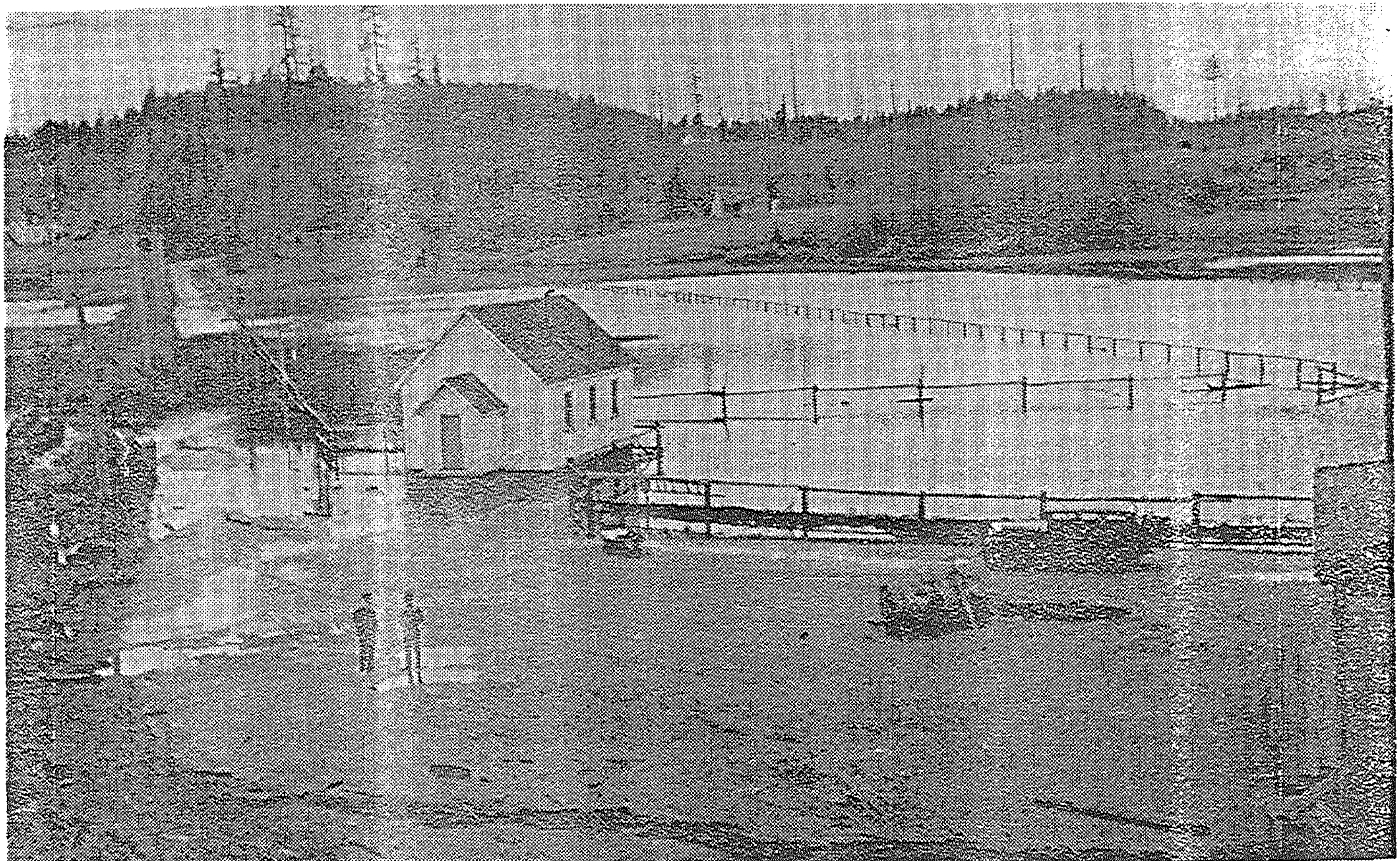
SEC 16, TWP 28N, RGE 2E

looks like the present Hansville Wetland. Another, from the air shows the area looking toward the southwest. This photo is not clear enough to differentiate between wetland and non-wetland areas.

C-4. Historical Photographs

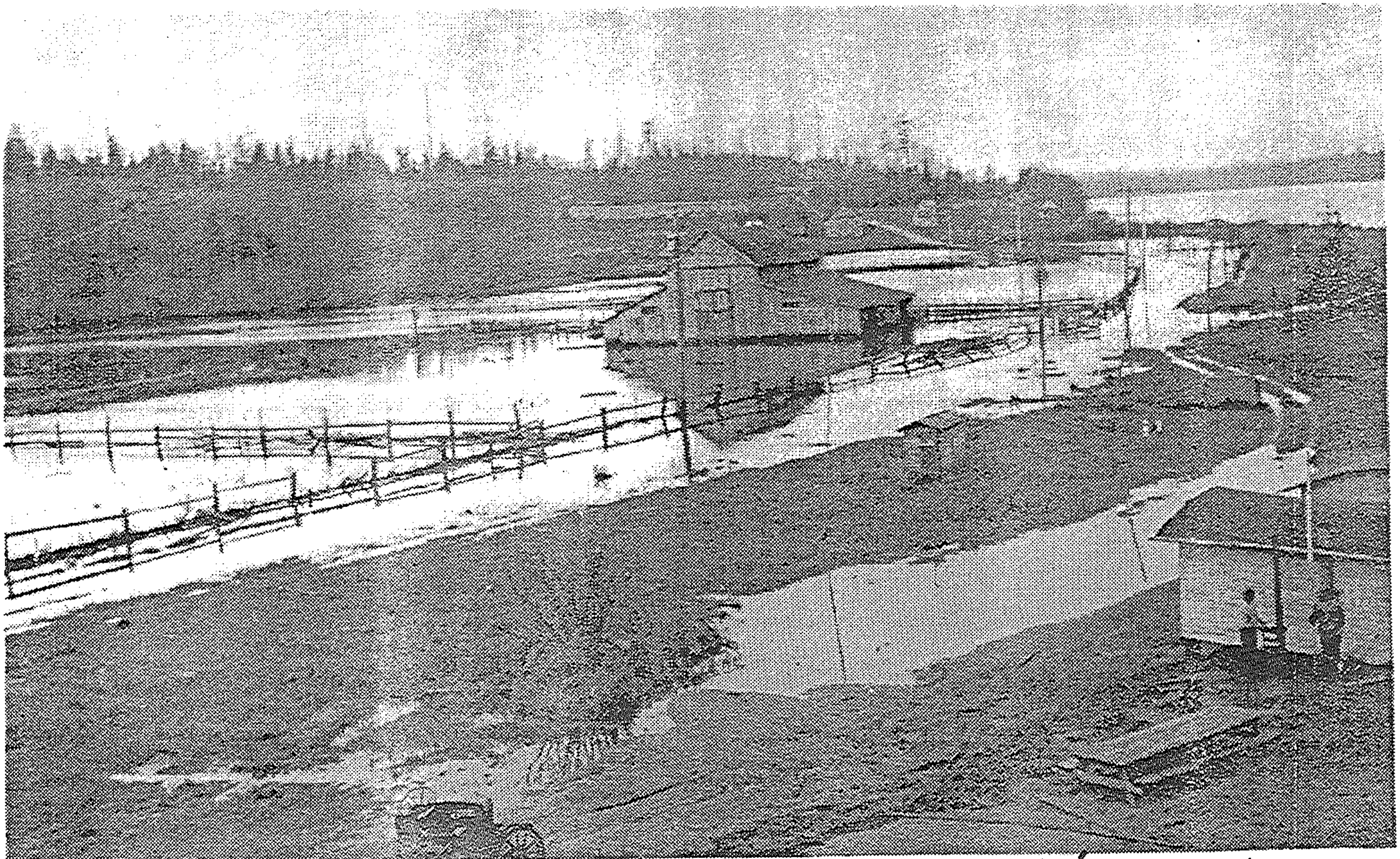
The earliest photographs found which show the Hansville Wetland area are from the collection of John Snapp. They were taken in 1933 and show the entire area of Hansville, including the church and Captain's Landing, when high water levels had flooded the area. These photos show the Hansville Wetland under water with many of the adjacent roads flooded. One of the photos shows the barn along the south side of Twin Spits Road, which heads west out of the village center. The building shown in Photo C-4a is the present day church, which was moved about 50 feet to the west and the fire station is now in its place. The fences represent the rough locations of the ditches, which is additional confirmation that the ditches were in place prior to the 1950s. These fences are present within the wetland today but only some of the upright posts remain. Photo C-4b shows an old barn right along Twin Spits Road. The building in the right foreground appears to be one or is in the vicinity of the small resort cabins along the Hansville shoreline. Large stumps were found during the collection of data in the field, just east of the ditch leading to the tide gate and just south of Twin Spits Road, which indicates this as the possible location of the barn shown in photo C-4b. Photo C-4c looks north along the existing road (may be present day location of Hansville Road as it approaches the Hansville shoreline) during high tide flooding. In the background, is the Hansville dock from which the other photos were taken. The church is on the left just in front of the dock and is the same building shown in Photo C-4a.

Recent photos taken during the floods of December 1996, show that Finn Creek floods into the area on its east side and once it reaches its holding capacity, water begins to flow across Hansville Road and flows into the Hansville Wetland between the Post Office and the Forbes Building. The photos also show that Finn Creek floods as it flows into the ditch along Buck Lake Road, with minor flooding across this road. Most of the water continues to flow toward the Finn Creek ditch along Hansville Road. Standing water is evident throughout the Hansville Wetland, but does not appear to flood over Twin Spits Road and is held in mainly by the high tide occurring during the flood event. The photo taken from the Hansville Repair indicates that the wetland does not back up onto their lawn. There is some flood overflow from the stream as it enters the ditch along Buck Lake Road, but is minor compared to flooding along Hansville Road. Photos were taken of the Hansville flooding and are shown on Photo C-4d. The most recent flood event has been mapped to show direction of flow and how the flooding occurs (Map C-4).



South From Hansville Dock 1933 Photo John Snapp
High tide, high water

Photo C-4a



West From Hansville Dock Area 1933 Photo John Snapp

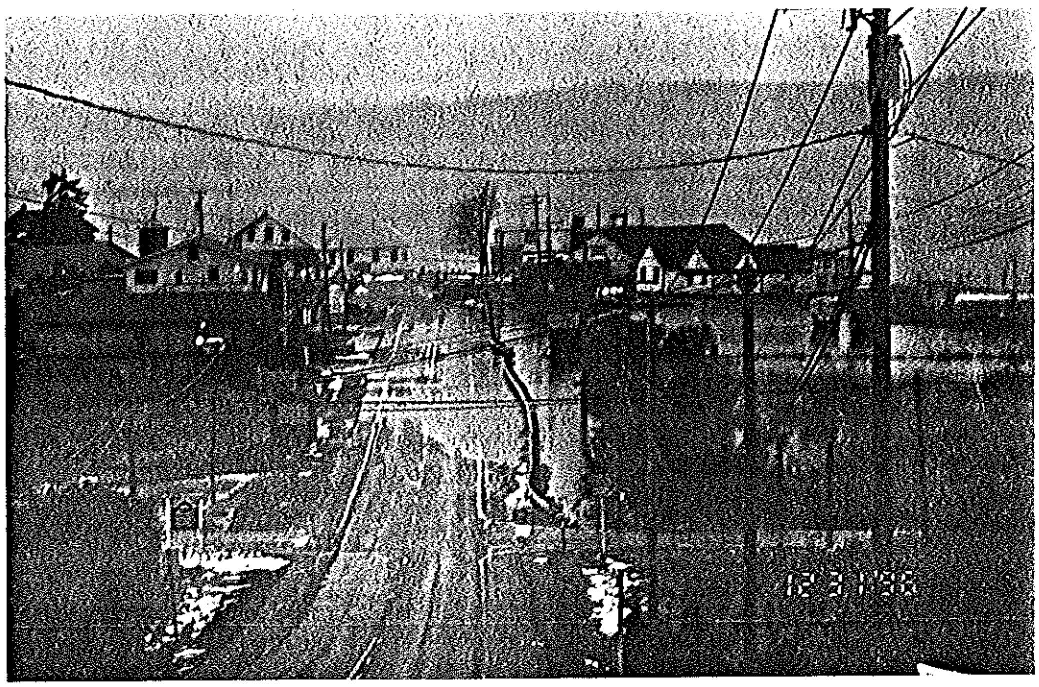
Photo C-4b

North Along Hansville Road 1933 Photo John Snapp

Photo C-4c

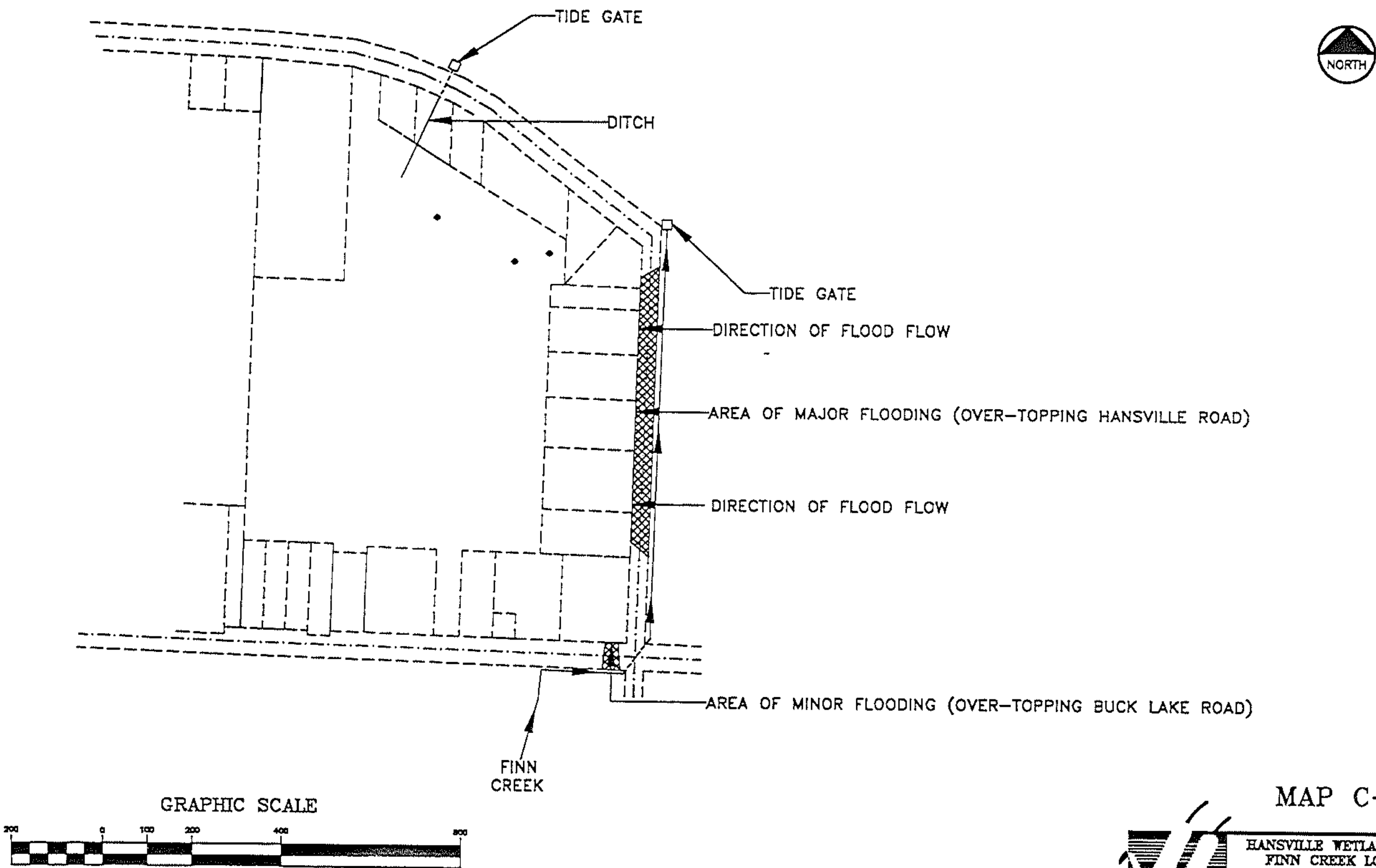
PHOTOS C-4d

This photo was taken looking east along Buck Lake Road showing the flooding as Finn Creek heads to the diagonal crossing under Hansville Road (at the stop sign). Flooding appears to occur only near the corner of this intersection.



This photo was taken looking north from the top of the hill along Hansville Road. Note that the area east of the road is full of water and that water flows across the road into the Hansville wetland north of the tall building in the background.

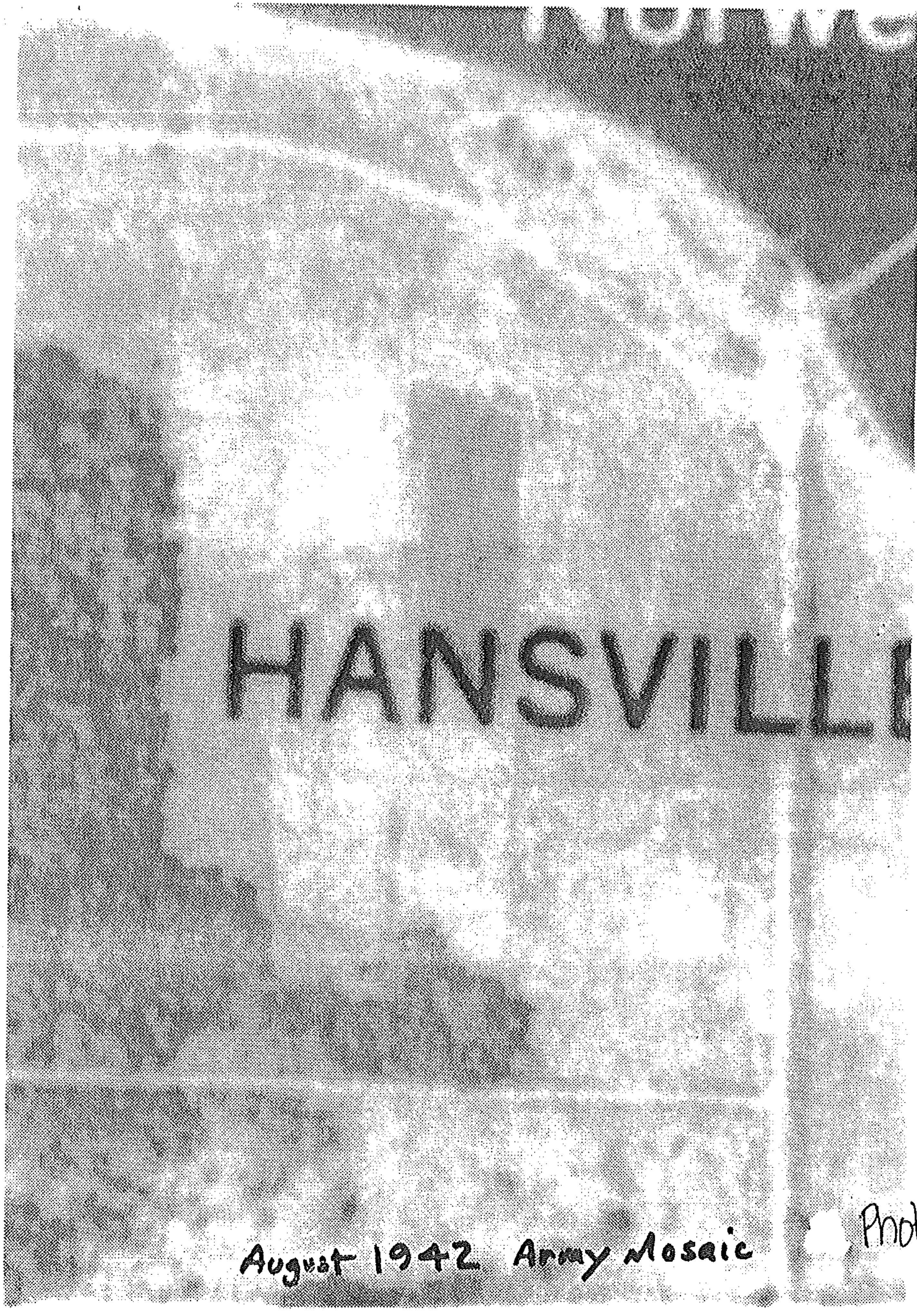
This photo was taken looking south from Twin Spits Road into the Hansville Wetland to document the presence of standing water during the flood and tide event. Much of the area in the background did not contain obvious standing water in additional photos of the area.



MAP C-4

HANSVILLE WETLAND STUDY
FINN CREEK LOCATION
& FLOODING LOCATIONS

Wiltermood Associates, Inc.



August 1942 Army Mosaic

Photo C-4e

Photo C-4f


Photo C-4g

PHOTO
C-4h

The earliest aerial photograph located is an Army "mosaic" from 1942 (Photo C-4e). From the enclosed enlargement, Finn Creek can be distinguished by a line of vegetation, in its present location. Whether it flowed under Buck Lake Road or northwest across Hansville Road is not evident. The buildings along the Hansville shoreline were constructed between 1942 and 1965 both east and west of Norwegian Point. The 1965 aerial photograph (Photo C-4f) shows Finn Creek as it flows naturally to Buck Lake Road and as it flows through the ditch to the tide gate. A small pond is apparent in the center of the Hansville Wetland in this photo and the 1985 aerial photo. Substantial fill is apparent along the north side of Buck Lake Road, and the west side of Hansville Road. Subsequent photos from 1985 and 1988 (Photos C-4g and C-4h) show additional fill and building construction. The 1965 photo also shows several ponded areas within the wetland, while in the 1985 photo, these ponds are less evident and finally in 1988, the ponds have been completely filled in by vegetation.

C-5. Interviews

Long time residents of Hansville were interviewed concerning what they could remember about the history of Hansville and about the wetland. Sig Johnson, who is in his eighties, provided some information concerning the wetland. He remembered the high tides and flooding shown in the 1933 photos and said the wetland was once used to grow asparagus and graze sheep and cattle. He also remembers there being cutthroat trout in Finn Creek, but no salmon. He remembers that volunteers with horses helped build the first roads downtown in the early 1920s. John Neff, who grew up in the Point No Point lighthouse believes that flooding increased after many houses and bulkheads were built along the beach. He remembers Finn Creek crossing under Buck Lake gravel dirt road and into the Hansville Wetland. Weensy Fite, who is in her nineties, could not remember details of the wetland area. Ted George, a member of the Port Gamble 'Skallam Tribe, remembers going to fishing camps in Hansville in the early 1930s but does not recall anything about the wetland. The interviews and historical review were conducted by Jeanne Pastore in September 1996, with additional insight provided by the report writer during the review of historical information. Additional interview information and preliminary analysis of the historic photos is included in Appendix III.

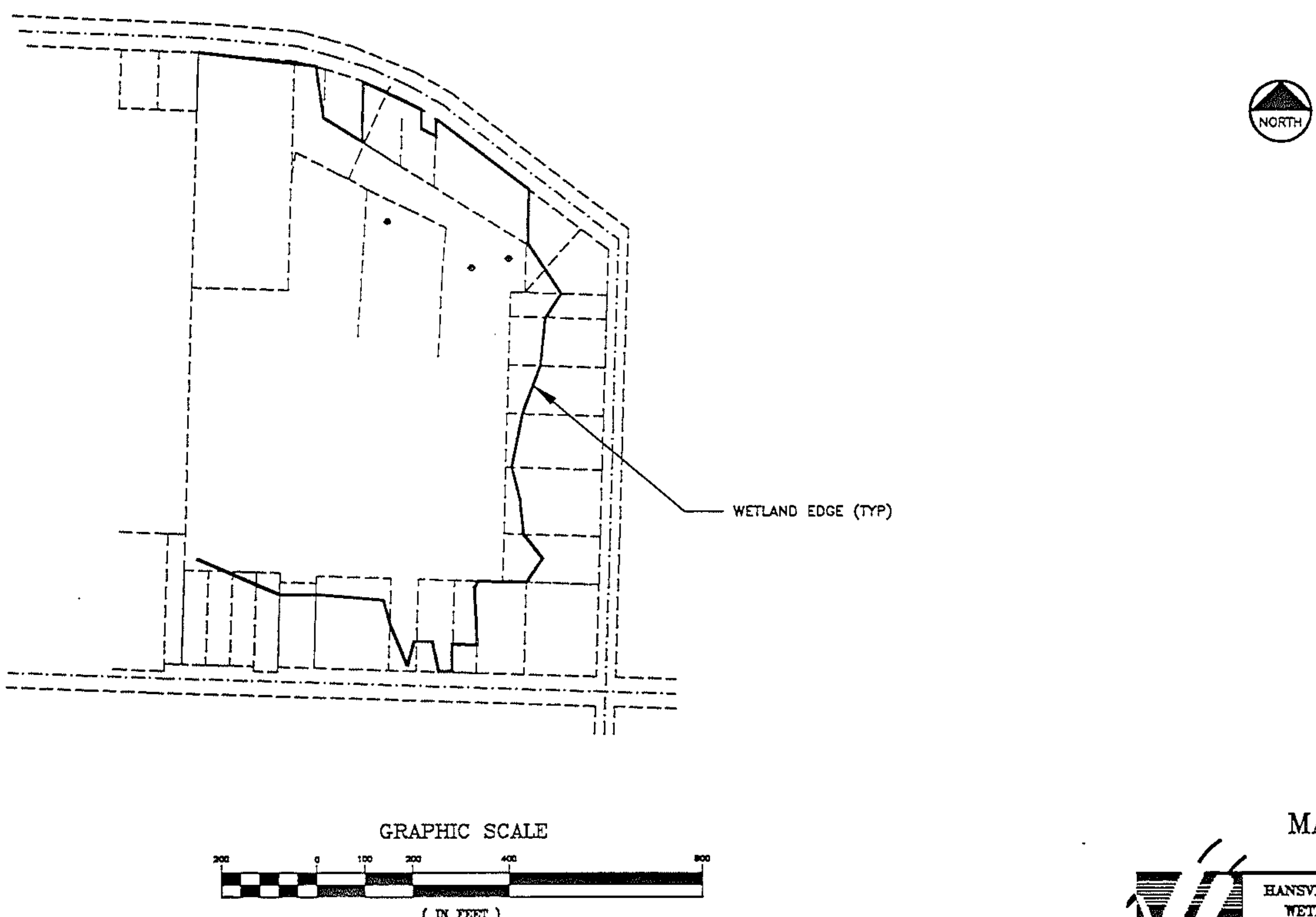
D. BASELINE STUDIES

The baseline studies were undertaken as Task 3 of the CZM grant to determine the current conditions of the wetland with respect to topography, vegetation and salinity, to determine several restoration plans and their possible affects on the individual properties. These studies were conducted between September and December 1996, for total of 6 days on-site. The US Army Corps of Engineers, Hydraulic Engineering Division, has analyzed and modeled data to develop a preliminary hydraulic study that will assist in the final plan for restoring the Hansville Wetland. As part of their study, they found it necessary to conduct an fly over of the site to generate an aerial photo from which the elevations could be estimated. This section describes the methods used to gather baseline data and the results of the data. Individual restoration plans designed from information obtained in the baseline studies will be discussed in the Restoration Options Section.

D-1. Delineation

As part of the study, it was necessary to determine the boundary of the wetland and where it falls on the properties along Hansville Road and Twin Spits Road. Usually, a delineation is completed by hanging flags around the wetland however, we did not flag the wetland, but rather measured the area of wetland on each property, belonging to cooperative property owners, using known property corners and ones incidentally found during the field work. The distances were then plotted on an AutoCad drawing (Map D-1) so that the boundaries could be easily observed on the map. The field measurements were conducted by Vaughn Everitt with the assistance of Ken Shawcroft and Martin Adams, using a hip chain and a 600 foot long tape. The wetland boundary determination was completed using the 1987 Corps of Engineers Wetland Delineation Manual, the use of which is presently required by the Kitsap County Interim Critical Areas Ordinance. This manual requires that positive indicators of each of three wetland parameters be present for an area to be considered wetland. The three parameters include wetland hydrology, hydric soils, and hydrophytic vegetation. This area was determined to be under "normal circumstances" because it has been in its present conditions for a long period of time. Areas historically filled for existing buildings or past development plans were not included in the delineation. Additional information was provided by the delineation completed by Wiltermood Associates in April of 1991 on the property between the auto repair shop and the post office. This parcel was not developed as originally planned and the delineation was measured to determine the wetland boundary as it lies on this site. A wetland determination was also conducted by Wiltermood Associates on the lot between the Forbes building and the fire station to determine if it would be suitable for church parking.

The delineation revealed that most of the northern wetland boundary lies directly along Twin Spits Road and only comes south toward the center of the wetland, to exclude one upland area dominated by various non-wetland species and the lawns of the Hansville Church and Fire Station (Map D-1). It also excludes a small parking area along the road. The eastern boundary falls between 105 feet and 200 feet west of the Hansville Road, behind the Forbes Office Building and the Post Office, as well as the undeveloped lot between the post office and the auto repair shop. The southern boundary falls at the base of moderate slopes above which are many single family dwellings accessed from Buck Lake Road. The wetland boundary is between 10 feet and 240 feet from Buck Lake Road. The western boundary was not determined as it continues onto parcels belonging to property owners denying us access but it is assumed to continue for a significant distance to the west and is defined either by a break in the topography or residential development.



MAP D-1

HANSVILLE WETLAND STUDY
WETLAND DELINEATION

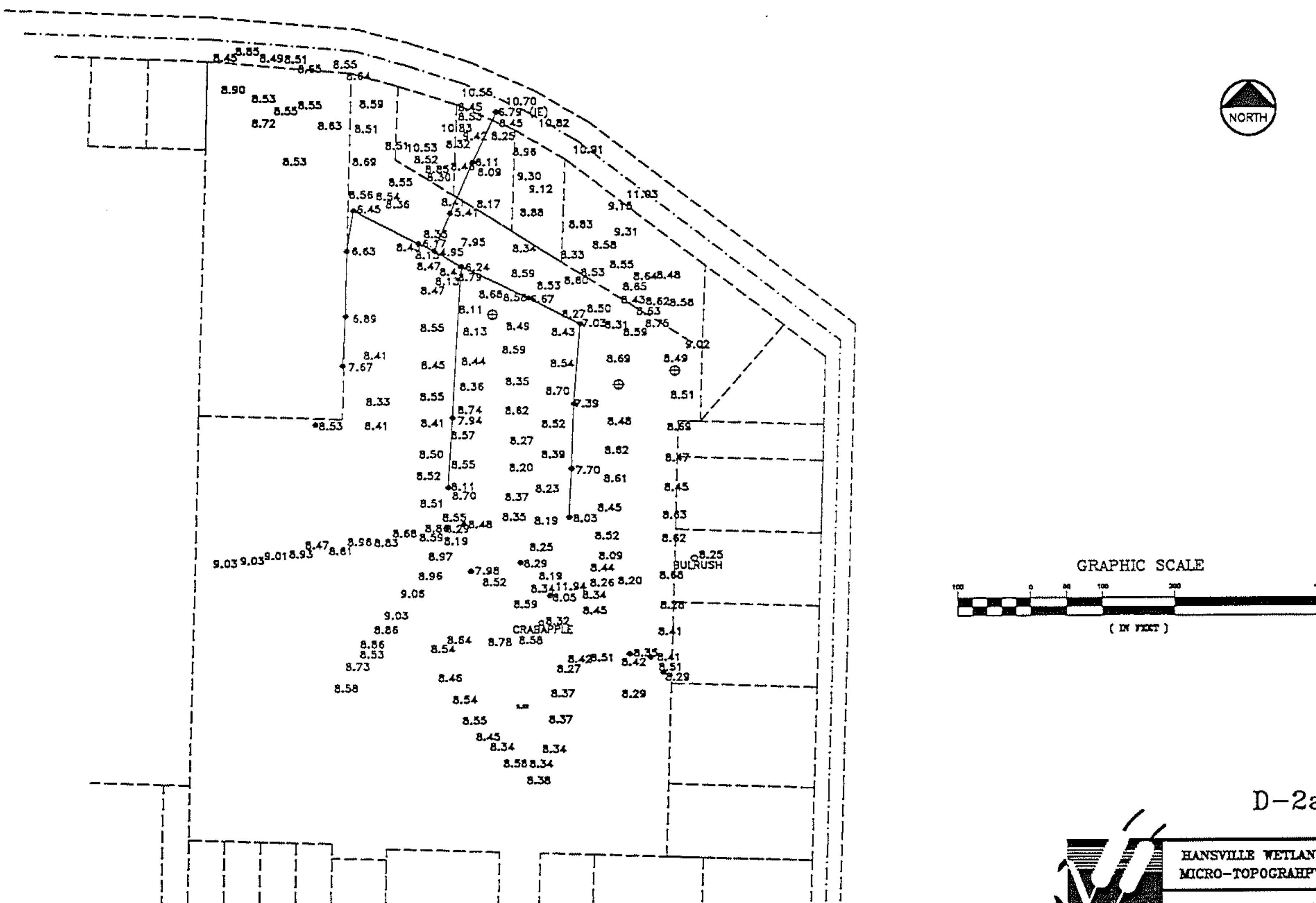
Wiltermood Associates, Inc.

D-2. Topographic Survey

A micro-topographic survey (Map D-2a) was conducted throughout the basin of the wetland, using a Dunphy level and stadia rod. The site is very large and has many different types of vegetative communities, which made reading the stadia rod difficult at especially long distances and within tall grassy or shrubby areas. Therefore, many benchmarks were established and verified by back shooting to ensure accurate results. Benchmark #1 is located near the northeastern tip of the wetland on a fence post just behind the church. The benchmark was used to record topographic data between the properties along Hansville Road and the easternmost north-south ditch, down to the start of the large cattail area. Benchmark #2 is located between the two north-south ditches and south of the main east-west ditch near an area of standing water. This benchmark was used to gather data from the areas west of the easternmost north-south ditch to the property corner of an uncooperative owner and north of the main east-west ditch. Benchmark #3 is located at the south end of the easternmost north-south ditch just before the reed canary grass community begins and was used to gather data within the large reed canary grass area and to the edge of the forested community on the west side of the project site. Additional transit points were set up to shorten distances but these do not represent formal benchmarks.

Prior to beginning our baseline studies, we were made aware of several National Oceanic and Atmospheric Administration (NOAA) benchmarks noting the elevation of high tides. The closest one is located near the front door of the church and three others are located in and around the Hansville Store and Captain's Landing buildings. These benchmarks were used to establish our preliminary benchmarks and were back shot to ensure accuracy of the survey. They are not shown on the topographic map but their precise locations are indicated on the information obtained from NOAA (Appendix IV). The other two could not be seen from the first transit point alongside the church, as they were blocked by a building and covered with the store's porch. We were able to get numbers from the brass markers denoting the benchmarks from NOAA concerning the elevations of tides recorded by this agency.

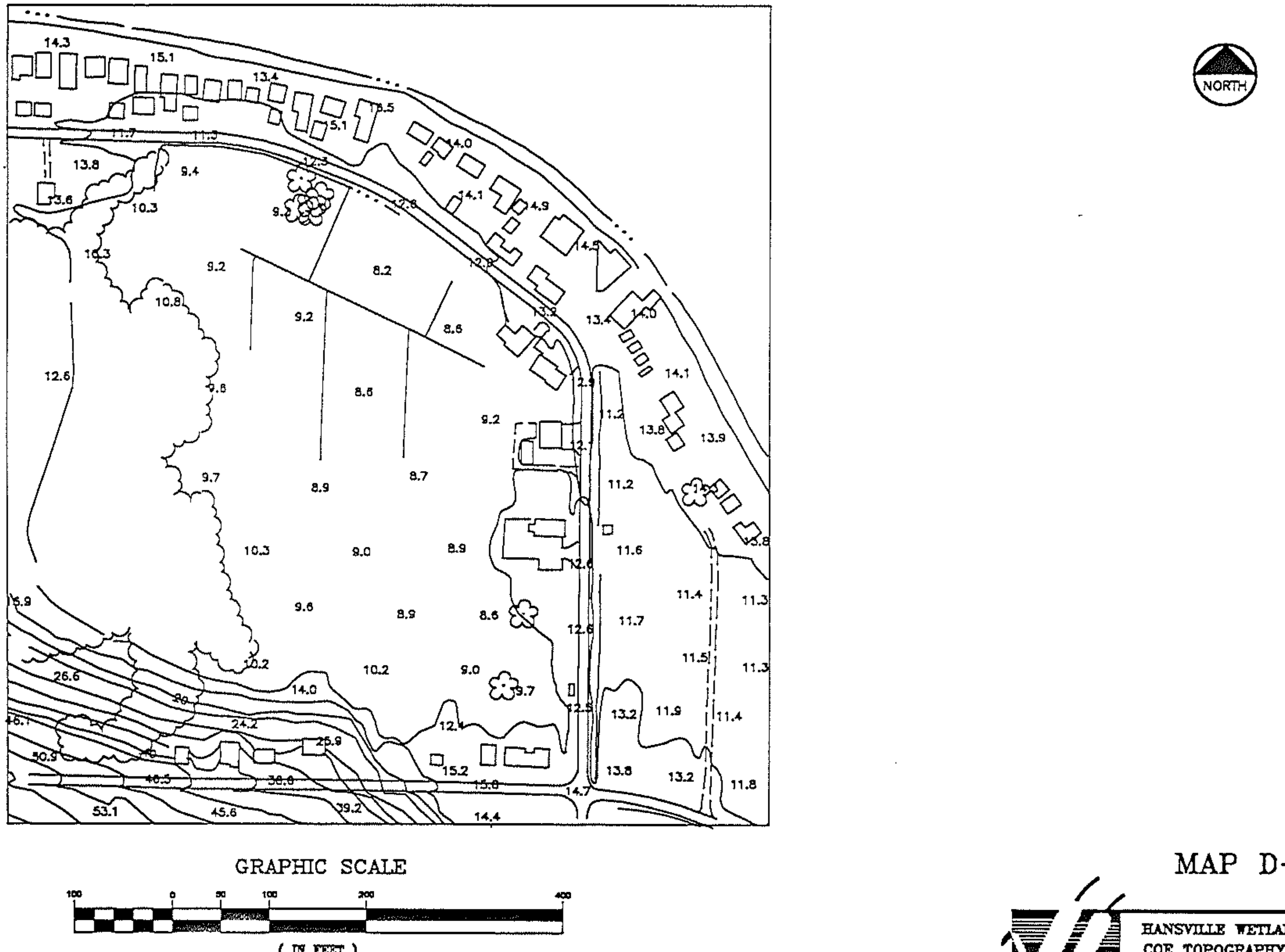
The micro-topographic survey revealed that the site is almost entirely flat with no discernible changes in elevation, except where upland areas begin to the north, south and east (Map D-2a). Micro-topography does not vary much, except in patchy, shallow depressional areas and there is no real change in elevation between the culvert under Twin Spits Road, that leads to the tide gate and the general wetland elevations. There was also no change in elevation from the areas dominated by low grass species to the areas dominated by reed canary grass and cattail, as we had expected. The on-site micro-topography survey concurs with the aerial photo topography conducted by the US Army Corps of Engineers in May of 1997 (Map D-2b), although their topography indicates that the area east of the Hansville Road is at least 2 to 3 feet higher in elevation.



D-2a

HANSVILLE WETLAND STUDY
MICRO-TOPOGRAHPY POINTS

Wiltermood Associates, Inc.



MAP D–2b

HANSVILLE WETLAND STUDY
COE TOPOGRAPHY DRAWING

Wiltermood Associates, Inc.

D-3. Salinity Readings

The salinity readings were taken to establish whether tidal salt water influences the wetland on a regular basis. These readings were taken of surface water within the ditches, surface water within the vegetated portions of the wetland and in water squeezed from the soil. The initial readings were taken in the field using a soil probe to extract a sample of soil, which mostly consisted of organic material. The sample was placed in a paper towel lined syringe that squeezed water onto the refractometer. A set of readings was taken while in the field along Transect A, while samples were collected along Transects B and C, stored in zip lock baggies, and determined after returning to the office. These samples were tested two and three times in the office due to inconsistent results. Those with significant differences were tested during the next visit to the site. The next visit to the site, we changed the method of obtaining samples by digging holes to a depth of at least 12 inches and water was allowed to fill in from the bottom and surrounding soils. Those areas having considerable surface water or significantly saturated surface soils were sampled using soil samples squeezed of water in paper towel lined syringes to reduce changes in salinity due to dilution by fresh surface water.

The salinity reading revealed varying levels of salt within the water saturating the soils of the wetland and the absence of salt within the surface water. The surface water readings revealed that there was a high level of freshwater influence due to runoff and rainfall, even at the outflow of the ditch that leads to the tide gate. We discounted the findings of the surface water salinity readings as they provided little information. The readings from the subsurface water were slightly more reliable as it contained salts from the surrounding soils but had probably been left from earlier high tide events. The results of the salinity readings are included in the tables in Appendix V. A map was not prepared because of wide ranging results.

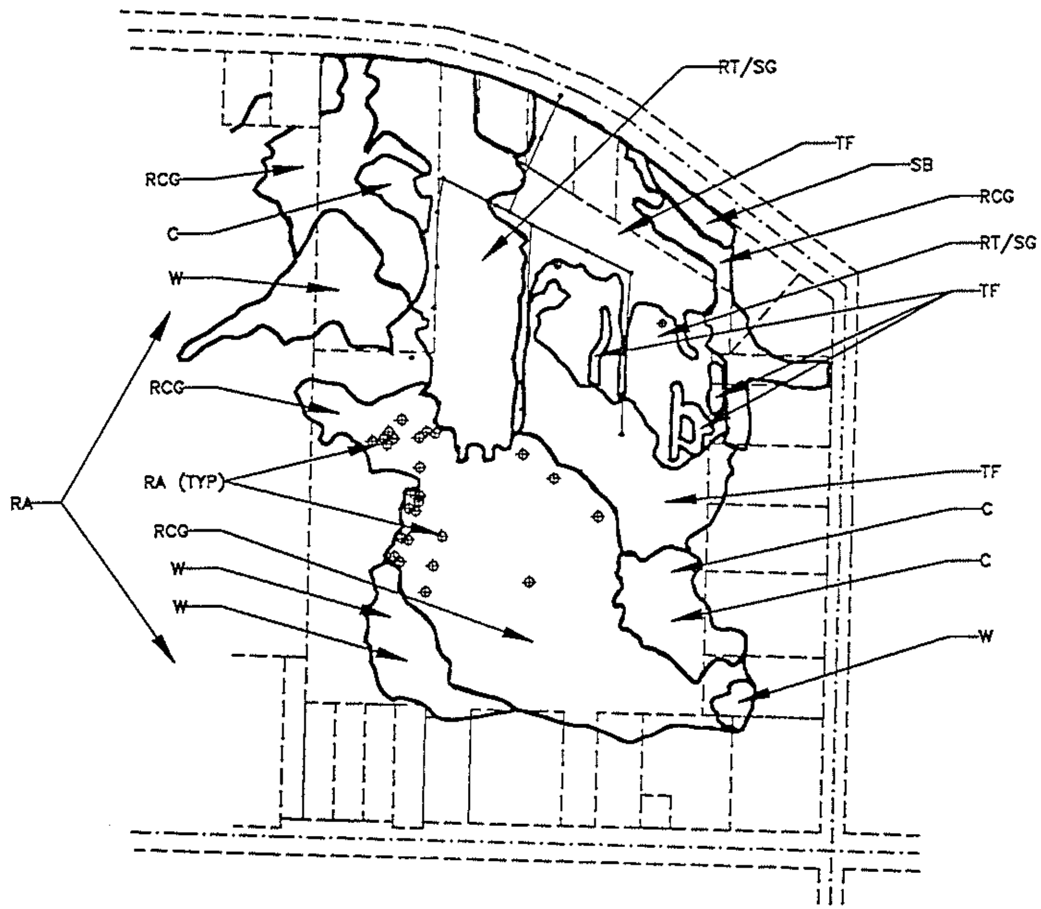
D-4. Vegetation Mapping

The vegetation was mapped during field visits by laying out the 600 foot surveying tape and walking the line to document the occurrence of individual species and the distances at which species composition changed. The dominant, subdominant, and occurring species were recorded at each point where species compositions changed. The communities changed very little but there were minor, yet frequent changes to the dominants and many times there were two dominants (termed co-dominants). We also mapped larger vegetation communities using a 1995 color aerial photo, shot by Northwest Air Photos of Port Orchard, and a 1985 black and white aerial photo shot by Walker and Associates (Appendix VI). These photos were then compared to note changes occurring to the larger communities over the ten year period of time. The field vegetation mapping was used to ground truth the 1995 aerial photo mapping to identify proper points at which vegetation communities changed and to identify individual species occurring in the mapped areas.

The transect data collected during ground truthing was not separately mapped but the information is included in table form in Appendix VII but data was included on the AutoCad generated map for accuracy of the mapping.

The vegetation mapping (Map D-4) revealed that most of the site is composed either of salt marsh/pasture areas through the northern 2/3s of the site or reed canary grass in the southern 1/3, with scrub/shrub and forested communities along the west edge of the project site. The salt marsh/pasture areas are mainly dominated by a red top (*Agrostis alba*)/salt grass (*Distichlis spicata*) complex, with tall fescue (*Festuca arundinacea*) a common co-dominant and occurring species. Pacific silverweed (*Potentilla pacifica*) was occurring throughout this community and rarely reached sub-dominant or co-dominant status. Reed canary grass (*Phalaris arundinacea*) dominates the areas in which it occurs to the exclusion of all other species except for lone western crabapple (*Malus fusca*) occurring at the north end and infrequent patches of salmonberry (*Rubus spectabilis*). North of the main east-west ditch, the pasture is dominated by tall fescue that grades to a narrow band of reed canary grass along Twin Spits Road, which in turn is bordered by salmonberry and red elderberry (*Sambucus racemosa*) dominated area directly adjacent to the road and church lawn. The tall fescue dominated area extends just beyond the ditch leading to the tide gate and near the west edge of an old fill area dominated by common upland species. The remainder of the north edge is dominated by salt marsh species similar to those dominating much of the wetland south of this ditch. Cattail (*Typha latifolia*) dominates many patches intermingled amongst the reed canary grass on the west side and one large patch bordering the salt marsh/pasture community to the south. The large patch of reed canary grass borders the east, west and south edges of the cattail area. A patch of dead cattail is present at the terminus of the eastern ditch just before it enters the large southern reed canary grass patch and another patch along the western ditch. In the 1991 report prepared by Ron Vanbianchi, these patches of cattail were alive and were described as growing in patches less than 20 feet in diameter, within the drainage ditches leading to the tide gate.

The most interesting findings of the vegetation mapping was the discovery of many low salt marsh plants occupying a narrow band of area between the two north-south ditches. This area contains patches of standing water that appear to contain high levels of salt because of widespread die off of red top and salt grass. Adjacent to the standing water areas, we found such species as pickleweed (*Salicornia virginica*) and Baltic rush (*Juncus balticus*), and was the only area in which we found these species. On the east side of the wetland, we found sporadic individuals and small patches of salt marsh bulrush (*Scirpus maritimus*) that appear to grade along the southern edge of the salt marsh/pasture community across the easternmost north-south ditch. We also found two small patches of hardstem bulrush (*Scirpus acutus*) on the extreme east side of the wetland and next to a dying patch of cattail along the eastern ditch. A larger patch of hardstem bulrush was found intermingled with cattail on the west side of the wetland. Toward the west side of the wetland system, the vegetation gradually changes from a reed canary grass zone, where



C = CATTAIL
RCG = REED CANARY GRASS
W = WILLOW
SB = SALMONBERRY
TF = TALL FESCUE
RT/SG = RED TOP/SALT GRASS
RA = RED ALDER

GRAPHIC SCALE

200 0 100 200 400 800

(IN FEET)

MAP D-4a

HANSVILLE WETLAND STUDY
VEGETATION COMMUNITIES

Wiltermood Associates, Inc.

some shrubs are present, to the forested community that extends for a long distance to the west. This area is dominated by red alder (*Alnus rubra*), salmonberry, lady fern (*Athyrium filix-femina*); and skunk cabbage (*Lysichitum americanum*). The scrub/shrub community borders the forested community to the north and is west of the cattail/reed canary grass complex.

The results of our field vegetation study and aerial photo mapping revealed similar community types as those mapped in the Wetland Identification and Assessment, Hansville and Point No Point Wetlands, prepared by Ron Vanbianchi in August of 1991. The mapping in the August 1991 report shows the community types but does not actually identify all the species that dominate large portions of the salt marsh/pasture community. Based on a comparison of our vegetation and the Vanbianchi mapping, the communities have changed somewhat over the past 5 to 10 years.

D-5. Finn Creek

The CZM grant application listed as part of the consultant tasks to determine what the impacts of Finn Creek are on the wetland and how the Kitsap County Public Utilities District #1 plan to abandon their well at the head of the stream would have on the wetland. Information about this stream system was obtained from the PUD office and includes flow rates during well use and what the flow rates might be once the well is abandoned. The PUD has no data concerning the flow rate of Finn Creek but provided verification that the spring (Spring Site #1) feeding the well has been diverted into Finn Creek and there are no plans to use this well as a regular source of water. They are maintaining control of the Spring Site #1, but will only use the well for domestic water if there is an emergency shortage of water from the main source or if in the future there is some need for this water. While the PUD has not monitored the flow of Finn Creek, they do have some historical information collected as part of the water rights application process. Tables from the State of Washington Water Supply Bulletin No. 18, Water Resources and Geology of the Kitsap Peninsula and Certain Adjacent Islands, US Geological Survey, 1965, were found and copied down where information pertaining to Finn Creek was found. See Appendix VIII for data collected from the US Geological Survey document concerning Finn Creek.

The first section observed was in the back of the book, which pertains to specific applications for water use. This section listed the Total Quantity (cfs) as 0.04 for domestic and commercial uses, each comprising 0.02 cfs of water. Tables 48, 62 and 63 contained specific information concerning Finn Creek (then called Finland Creek), its total drainage basin, and low flow cfs. Table 48 provides Surface Water Evaluation and lists the surface drainage area as 1.08 square miles, with an estimated mean annual effective precipitation from drainage area as 8 inches or 400 acre feet and a low flow amount of 0.1 on August 14, 1961. Table 62 provides a summary of surface water use, which finds a irrigation quantity of 0.34, public domestic quantity of 0.04, and consumptive and non-consumptive quantities of 0.02 each, for a total appropriated quantity of 0.43. Tale 63 provides the acreage covered by ground water and surface water irrigation for Finn Creek, which includes 0 acres of groundwater and 42 acres of surface water irrigation, for a total irrigated acreage of 42.

D-6. US Army Corps of Engineers, Hydraulic and Hydrologic Study

The US Army Corps of Engineers, Hydraulic Engineering Division (DOE), was asked to analyze the drainage basin feeding Finn Creek and the Hansville Wetland to determine the holding capacity of the system as it exists at this time and what the project capacity might be if Finn Creek was routed through the wetland. The COE study (Appendix IX) used several estimation methods and modeling to predict the water levels within the Hansville Wetland for a 100 year precipitation event in conjunction with a 100 year tidal event. The study was conducted for a 72 hour period of time for the precipitation event to observe tidal conditions over three consecutive tidal events. Peak flows of Finn Creek and maximum elevation at which water can be stored in the wetland were then analyzed to come up with a conclusion concerning routing Finn Creek through the wetland. The size, length, and diameter of the tide gate and associated outlet and inlet culverts was included in the analysis in order to determine the influence of the tide on the Hansville Wetland.

This study revealed that the Hansville Wetland would be able to store 62.44 acre feet of water during a 100 year precipitation event occurring with a 100 year tidal event, at elevation 12.5 feet MLLW (Mean Lower Low Water). The COE was presented with four different scenarios with which to conduct their study, the first entails leaving the wetland in its existing conditions, without Finn Creek; the second entails leaving the wetland in its existing conditions, but remove the tide gate; the third entails routing Finn Creek through the wetland, with tide gate intact; and the fourth entailing routing Finn Creek through the wetland without the tide gate. The COE survey and photographic documentation indicates that Finn Creek floods onto the Hansville Road at 2 to 3 year intervals, to as much as 4 inches deep but not persisting through the day. This overflow eventually reaches the Hansville Wetland between the fire station and the Forbes Building. The tide gate functions such that when the tide elevation exceeds the 7.71 feet elevation and the tide elevation exceeds that of the elevation of the stored water in the wetland, no water is allowed to pass out of the wetland. When the tide is of sufficient elevation, salt water may back flow through the culvert and into the wetland in the absence of the tide gate. Based on the survey and modeling results for the four different restoration scenarios, the COE has developed the following table:

Table D-6: **Hydrologic Simulation Model Results (COE, Preliminary Hydrologic and Hydraulic Investigation, Final 22 July 1997)**

SIMULATION	MAXIMUM WETLAND ELEVATION (feet MLLW)
Existing condition.	9.5
Existing condition without tidegate	9.9
Finn Creek flows routed through wetland, with tidegate	12.1
Finn Creek flows routed through wetland, without tidegate	12.3

"The simulation results presented above suggest that routing the total 100-year estimated Finn Creek flow through the wetland during a coincident 100-year tide event would probably impart adverse impacts to properties adjacent to the wetland. The results also suggest that the presence of the tidegate does not have a great influence on the maximum water surface elevation in the wetland during periods of prolonged and sustained high rates of inflow." The COE has presented the writers of this report with a fifth option which would entail routing half of the flow through the wetland and half through its present drainage system. This would essentially alleviate some of the flooding along Hansville Road while preventing adverse influence on the property owners adjacent to the Hansville Wetland.

E. CONCLUSIONS OF HISTORICAL REVIEW AND BASELINE STUDES

The historical review and baseline studies were conducted in order to determine the historic configuration of the Hansville Wetland and Finn Creek. The interviews conducted with long time residents were not conclusive because they could not remember any details about the wetland, although one person did recall that Finn Creek once flowed into the Hansville Wetland. Our personal review of the historic data, including information obtained from the Coastal Zone Atlas and Net shore-drift in Washington State document, indicates that the wetland was likely impounded by creation of the beach berm now occupying the Hansville shoreline. Finn Creek appears to have always flowed to the northeast and had some associated wetland that was filled and ditched (along Hansville Road).

Old aerial photos and old army maps show Finn Creek flowing toward the northeast and the 1953 mapping shows a small ponded area at the terminus of the stream. There may have been a stream outlet into Admiralty Inlet but a tide gate was installed to allow the flow of freshwater into saltwater and to prevent saltwater from flowing into freshwater.

The Hansville Wetland may have at one time been associated with Finn Creek, most likely before construction of the Hansville Road and was impounded by construction of that road. It was then significantly ditched to allow farm usage and at that time, the second tide gate was likely constructed in order to dry the wetland out somewhat.

Based on the data collected in the baseline study and the historical information obtained by volunteers, it appears that between 1859 and the present, the Hansville Wetland was not directly connected to the Puget Sound. It is likely that salt water has only entered the system when the tide gate is not functioning properly and the wetland may be influenced by salt water intrusion into the groundwater. The report prepared in 1991 by Ron Vanbianchi does not show significantly large salt tolerant, vegetative communities as he states there are "Small depressions within the red top/silverweed matrix contain stands of plant species that are quite salt tolerant, including seaside bulrush, salt grass, and pickleweed." But he also states that "Red top and Pacific silverweed are common components of coastal freshwater and brackish marshes within the Puget Sound Basin. The salt water plant species growing in small depressions are probably remnants from the plant communities that existed before a tide gate was installed and saline tidal waters entered the wetland." These statements contradict slightly, the findings of our baseline study that the wetland was probably never a tidal salt marsh which can be supported by historical information collected during interviews and shown on the aerial and historic ground photos.

The baseline studies provide fairly good evidence that the wetland was probably not a salt marsh and has always been a freshwater marsh with some saltwater intrusion when the tide gate is malfunctioning. The saltwater intrusion has allowed the growth of salt tolerant vegetation throughout the northern half. The presence of salt water was indicated in some of the refractometer readings but these were not reliable due to freshwater inputs from rainfall and through the ditches. Specifically, we found low salt readings in areas that we expected to have high readings, and high readings where we expected low readings.

The vegetation transects revealed that the salt tolerant vegetation occurs throughout the northern half but gradually becomes less salt tolerant as you proceed to the south, where significant coverage of reed canary grass was encountered. Forested and scrub/shrub communities dominate the western portions of the wetland while emergent vegetation dominates the eastern portions. The delineation revealed that most of the property within this portion of Hansville contains at least some part of the wetland, except for the small upland island along Twin Spits Road which is surrounded by wetland. The east edge has been filled to accommodate construction of the fire station, Forbes Office Building, the post office, and the Hansville Garage, but each of these parcels contain some portion of wetland. The topographic survey revealed slight changes in topography, with higher elevations to the west and north ends, and relatively level topography throughout most of the system.

F. RESTORATION OPTIONS

Based on historic review and the baseline studies, the present Hansville Wetland was isolated from the larger wetland system by construction of the Hansville Road dike. Although Finn Creek has not flowed into what is now known as the Hansville Wetland since the mid 1800's, it probably did flow into the wetlands at Hansville prior to 1859 and prior to construction of the dike. Based on this information, a total of 5 potential restoration plans have been formulated. These include 1) leave the Hansville Wetland as it is; 2) re-align Finn Creek to enter the wetland; 3) remove tide gate and allow the regular flooding of the site by tidal salt water and route Finn Creek into the Hansville Wetland; 4) remove fill east of Hansville Road ditch and re-align Finn Creek into the Hansville Wetland so that it flows through the wetland but still exits through tide gate; 5) split Finn Creek so that it goes into both the Hansville Wetland and existing ditch (along Hansville Road). Each option will be discussed separately and will include possible changes to the Hansville Wetland or Finn Creek and the measures to be used in implementation of the particular restoration option. The potential affect of each option is discussed in relation to possible changes to the Hansville Wetland and possible relief of flooding along Hansville Road.

1) **Leave the site alone**-This option would entail leaving the Hansville Wetland in its present condition and Finn Creek at its present course through the existing ditches that lead to the tide gate on the east side of Hansville Road.
Impact to Wetland-There would be little if any change to the Hansville wetland itself, particularly within the vegetative communities, although there may be increasing coverage by reed canary grass as it expands to the north.
Impact on Flooding-Flooding would continue to occur along Hansville Road due to ditch overflow and high water levels within Finn Creek. The ditch would have to be regularly maintained to remove silt from previous storm events to keep capacity of the ditch higher. Maintenance of the tide gate, which would include general operational maintenance and removal of debris from brush rack, would also be necessary to reduce the flow of salt water during high tides that occur at the same time as high flood flows.

2) **Finn Creek into Hansville Wetland**
At this time, Finn Creek flows into the ditch along the south side of Buck Lake Road about 75 feet from its intersection with Hansville Road. At the intersection, the stream crosses diagonally in a northeasterly direction to the present ditch along Hansville Road. To allow Finn Creek to flow through the wetland, a culvert would need to be placed under Buck Lake Road and a ditch/stream would need to be constructed across existing fill into the wetland. Once the new channel reaches the wetland, water would be allowed to flow naturally. If added water from Finn Creek does not create its own channel through the wetland, it may be necessary to

construct a shallow, rudimentary channel to provide a route for the freshwater. The high flows would then flood into the Hansville Wetland during storm events. There are three sub-options associated with this option which pertain to maintenance of the existing tide gate.

a) **Open Tide Gate**-Leave the flapper open so that tidal salt water is allowed to enter on a regular basis.
Impact on Wetland-This would probably result in wide spread dominance by salt tolerant vegetation beyond the areas presently dominated by these species. Increased levels of salt water could reduce the cover or rid the site of the non-desirable plant populations, specifically the reed canary grass dominating the south end, except where enough freshwater is available to support its populations. Introduction of regular inundation of tidal salt water will cause trees and shrubs to die-off creating snags that will be used by a wide variety of wildlife species.
Impact on Flooding-This option would reduce the flooding problems along Hansville Road by removing the flow of water through the existing ditch and routing it through the wetland. According to the COE Hydrologic and Hydraulic Analysis, the wetland can store up to 62.44 acre feet of water during a 100-year precipitation event during a 100-year tidal event. The COE further states that this may have adverse impacts to property owners along the Hansville Wetland, if both 100-year events were to occur together, the likelihood of which is very low. The report also states that the wetland should easily accommodate even the most severe tidal inundation.

b) **Remove tide gate and culvert to Admiralty Inlet**-This option would allow more regular flow of salt water into the Hansville Wetland since water would not be confined to a small culvert. The COE Final report states "The effect of the tidegate is generally more pronounced when the wetland is low with respect to the tide. The tidegate is most beneficial in maintaining wetland flood storage during the rising limb of the inflow hydrograph; as the wetland fills, the tide rarely has the energy to drive significant flow into the wetland. As a result, the difference between the 'no tidegate' condition and the 'with tidegate condition diminishes." This means that removal of the tide gate would have no impact on the storage capacity of the Hansville Wetland.
Impact on Wetland-Possibly more wide spread changes to vegetation, with more mud flat due to increased amount of salt remaining in the system after the tide has receded. It would entail removal of the tide gate and replacement with a wider culvert to salt water. Another alternative would entail bridging the stream at Twin Spits Road to create a stream channel to salt water which would allow use of the wetland by fish and other wildlife species. This may require excavating a portion of the wetland to create Estuarine open water

components as part of the restoration to create habitat. The restoration plan would also entail placement of large organic debris within the excavated and non-excavated areas to create additional structure for fish and wildlife habitat features. This option represents the most expensive due to the cost of tide gate and culvert removal and property acquisition.
Impact on Flooding-This option would also reduce the flooding along Hansville Road for same reasons as Option 2-a.

c) **Leave Tide Gate**-Maintain tide gate so that it functions properly and allows no salt water intrusion into Hansville Wetland. If the tide gate is not regularly maintained and something becomes lodged in such a way as to prop the tide gate flapper open, salt water would be allowed to enter the wetland during high tides.
Impact on Wetland-The wetland would remain a freshwater system with possible increases in reed canary grass or cattail cover. Changes in salt tolerant species to freshwater species possible.
Impact on Flooding-Same as Options 2-a and 2-b.

3) **Leave Finn Creek in ditch along Hansville Road, Open Tide Gate for regular flow of salt water into Hansville Wetland.**
Impact on Wetland-This alternative would probably increase the cover by salt tolerant vegetation throughout the Hansville Wetland and may decrease the cover by non-native plant species growing within the freshwater portions of this system. If salt water regularly floods the system, there may be die-off amongst the forested and shrub areas on the west side which would create additional wildlife habitat features.
Impact on Flooding-Would not alleviate flooding along Hansville Road. Ditch and tide gate would have to be regularly maintained to help reduce winter flooding along Hansville and Buck Lake Roads.

4) **Restore wetlands on east side of Hansville Road and Finn Creek Ditch**-Remove the fill on the east side of Hansville Road to re-establish historic wetland to increase storage capacity and historic configuration of wetlands in this area.
Impact on Wetland-This option would not result in significant changes or restoration of the Hansville Wetland. It would instead, increase wetland area east of Hansville Road and take some of the load off of the existing ditch.
Impact on Flooding-Removing the fill east of the Finn Creek ditch would increase the storage capacity of the area and significantly reduce flooding along Hansville Road. Excess water could then be conveyed into the Hansville Wetland, so that its available storage capacity is utilized to further reduce flooding along the Hansville Road.

5) **Route Finn Creek in such a way that half of the flow goes through the wetland and half goes through the existing ditch/channel.** This option was suggested by the COE Hydrologic and Hydraulic report to reduce the potential impact on Hansville Road and the property owners on the Hansville Wetland.
Impact on Wetland-The Hansville Wetland would probably not be significantly altered with the introduction of a portion of Finn Creek through it, but there could be reduction of salt marsh areas due to increasing amounts of freshwater entering the system. This could potentially cause significant increases in the cover of reed canary grass. This option would probably require additional restoration actions to ensure the entire system does not become thoroughly dominated by reed canary grass. These restoration actions would include hand removal of the very invasive grass and/or planting of tall trees and shrubs that would eventually shade it out and increase vegetative diversity.
Impact on Flooding-Would probably significantly reduce flooding along Hansville Road by reducing the amount of runoff conveyed by the existing Finn Creek ditch and allowing the Hansville Wetland to act as more of a flood storage area. This option has been developed in response to potential flooding impacts of properties on Hansville Wetland during a 100-year precipitation event in conjunction with the 100-year tidal event.

G. SUMMARY

This report was prepared to provide historic and baseline information concerning the possible historic configuration of the Hansville Wetland and to determine potential restoration options. Historically (from mid 19th century), the Hansville Wetland was a freshwater system, but at some point in prehistoric times (prior to the mid 19th century), it was probably a salt marsh system that extended eastward of the present Hansville Road. Settlers to Hansville diked off the wetland to create pasture, which also served as a road and is now represented by Hansville Road. Finn Creek originally emptied into the wetland at Hansville but was excluded from the Hansville Wetland (study area) by construction of the dike/Hansville Road and the eastern tide gate. While we believe these activities occurred to separate the two areas of historic wetland, we were unable to determine when the eastern wetland was altered from its probable, historic salt marsh conditions. At this point, Finn Creek was altered from its historic channel and conveyed via the man made ditch along the east side of the Hansville Road, directly to the eastern tide gate. These findings are based on the review of historic surveys, ground and aerial photos, and interviews with long time residents of Hansville.

Studies were conducted which included micro-topography, vegetation and salinity surveys and a wetland delineation, in order to gather baseline information to analysis of potential restoration options for the Hansville Wetland. The micro-topographic survey revealed that the wetland is fairly flat with minor changes in topography and is slightly lower in elevation than the filled area east of Hansville Road and Finn Creek ditch. The wetland gradually increases in elevation toward the west. The vegetation survey, completed through transects to ground truth the aerial photo mapping, revealed that there are salt tolerant plant species growing in the northern half of the wetland and freshwater plants throughout the southern half. Most of the wetland is dominated by emergent species, with scrub/shrub and forested communities to the west. The salinity survey was conducted to determine the extent of salt water intrusion into the system. Both groundwater and surface salinity were surveyed, but findings were inconclusive as to the extent of salt water influence. The salinity readings were inconclusive due to rainfall, fresh water runoff and seepage, and inconsistent tide gate function. Changes from salt tolerant vegetation at the north end to freshwater vegetation at the south provided more conclusive evidence that there is at least some salt water influence. This aspect of the baseline study requires further investigation. The wetland delineation revealed that the wetland boundary comes to the base of fill along the developed portion of Hansville Road, to the toe of the upland slope along Buck Lake Road, and to the road side ditch along Twin Spits Road.

The US Army Corps of Engineers, Hydraulic Engineering Division, has analyzed the Hansville Wetland to determine its storage capacity during a 100-year precipitation event and a 100 year tidal event. They determined that the wetland has the capacity to contain flood events with or without Finn Creek being routed into it. They stated that there may be adverse impacts to the property owners on the Hansville Wetland if the 100-year precipitation event occurred in conjunction with the 100-year tidal event, which has a very low probability of occurring together. This study, in conjunction with the baseline studies, has aided with the development of a series of restoration plans for the Hansville Wetland. These include leaving the Hansville Wetland as it presently exists; re-routing Finn Creek into the Hansville Wetland and either leaving or removing the tide gate; restoring wetlands on the east side Hansville Road and Finn Creek ditch; leave Finn Creek in its present location and leave tide gate open for tidal flow into Hansville Wetland; and routing half of the flow of Finn Creek through the wetland and leaving half through the existing ditch. The choice of restoration plan will now be left to the Hansville Community, which will give input at a later date and probably after additional studies have been completed.

The baseline study of the Hansville Wetland has revealed some useful information in terms of determining a series of possible restoration options. The most valuable piece of information was provided by the Corps of Engineers report which states that the model analysis indicates that the wetland has the capacity to store additional water from Finn Creek. While we have developed a fairly detailed baseline study, many of our findings leads us to the conclusion that more intensive investigative work is necessary to fully understand the history and potential future of the Hansville Wetland system.

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APPENDIX I

LETTER TO PROPERTY OWNERS
FOR
RIGHT OF ENTRY

Wiltermood
Associates, Inc.

Date

Property Owner
X
X
X

Dear Property Owner:

The Kitsap Land Trust and Hansville community have received a Coastal Zone Management grant to perform a study and prepare a plan for the possible restoration of the Hansville Wetland. Wiltermood Associates, Inc. has been hired to develop a plan that will add diversity to the wetland by increasing its biological productivity. It is hoped that by the implementation of this plan, the wetland will regain some of its historical value as a productive aquatic/marine habitat and important forage and rearing habitat for birds, mammals, and fish.

Kitsap County records show that you own some parcels in the area of interest. In order to draft a plan we must conduct topographical, soils, and vegetative surveys on your land. The soil survey will entail the digging of shallow test holes with a spade, which will be immediately filled, and the trimming of vegetation to establish a flagged line to delineate the edge of wetlands. This flagged line will meet Kitsap County's requirements for a wetland delineation should you seek to develop your land in the future. This will save you the expense of having to hire a qualified wetlands specialist to do this work for you.

We respectfully request your permission to enter onto your property in order to accomplish this assessment. Access would be required sporadically over a period of several days during July, August and/or September, 1996. Personnel involved would be employees of Wiltermood Associates and local volunteers. Wiltermood Associates agrees to hold you harmless from all claims for damages to property or personal injury arising from the exercise of the right to go onto your land. If you will permit right of entry, please sign on the line below and return a copy of this form in the stamped envelope provided.

Sincerely,

Bob Wiltermood, President

BW:bl

____
Signature

1015 S.W. Harper Road, Port Orchard, Washington 98367 (360) 876-2403 Fax (360) 876-2053

APPENDIX II
DRIFT CELL DATA
AND
COASTAL ZONE ATLAS DATA

APPENDIX II-a
Net shore-data in Washington State:
Volume 4, Hood Canal

APPENDIX II-b
Coastal Zone Atlas
Coastal Drift Mapping and Description

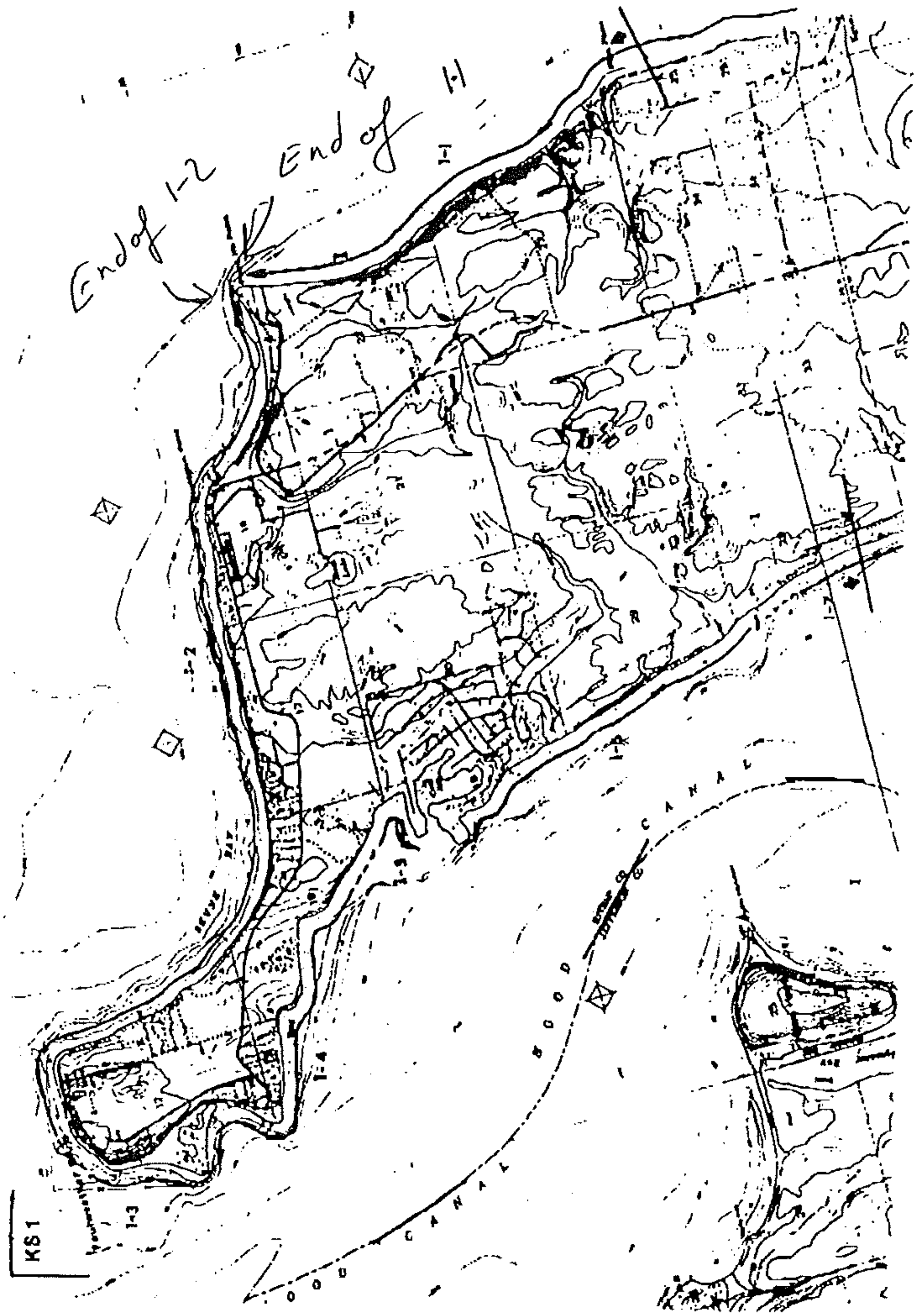
APPENDIX II-c
Coastal Zone Atlas
Geology Mapping

Map KS-1

Segment1-1 This segment includes the northernmost section and terminus of a drift cell that originates in a zone of divergence located at the boundary between Sections 11 and 14 on Map KS 10. Net shore-drift to the north is indicated by several groins and other drift obstructions with sediment accumulation on the south side, a gradual increase in beach width, and a decrease in beach sediment size to the north. This drift cell terminates along the east shore of Point No Point which is an accumulation landform known as a cuspate spit. A cuspate spit is typical of a point of convergence between two drift cells.

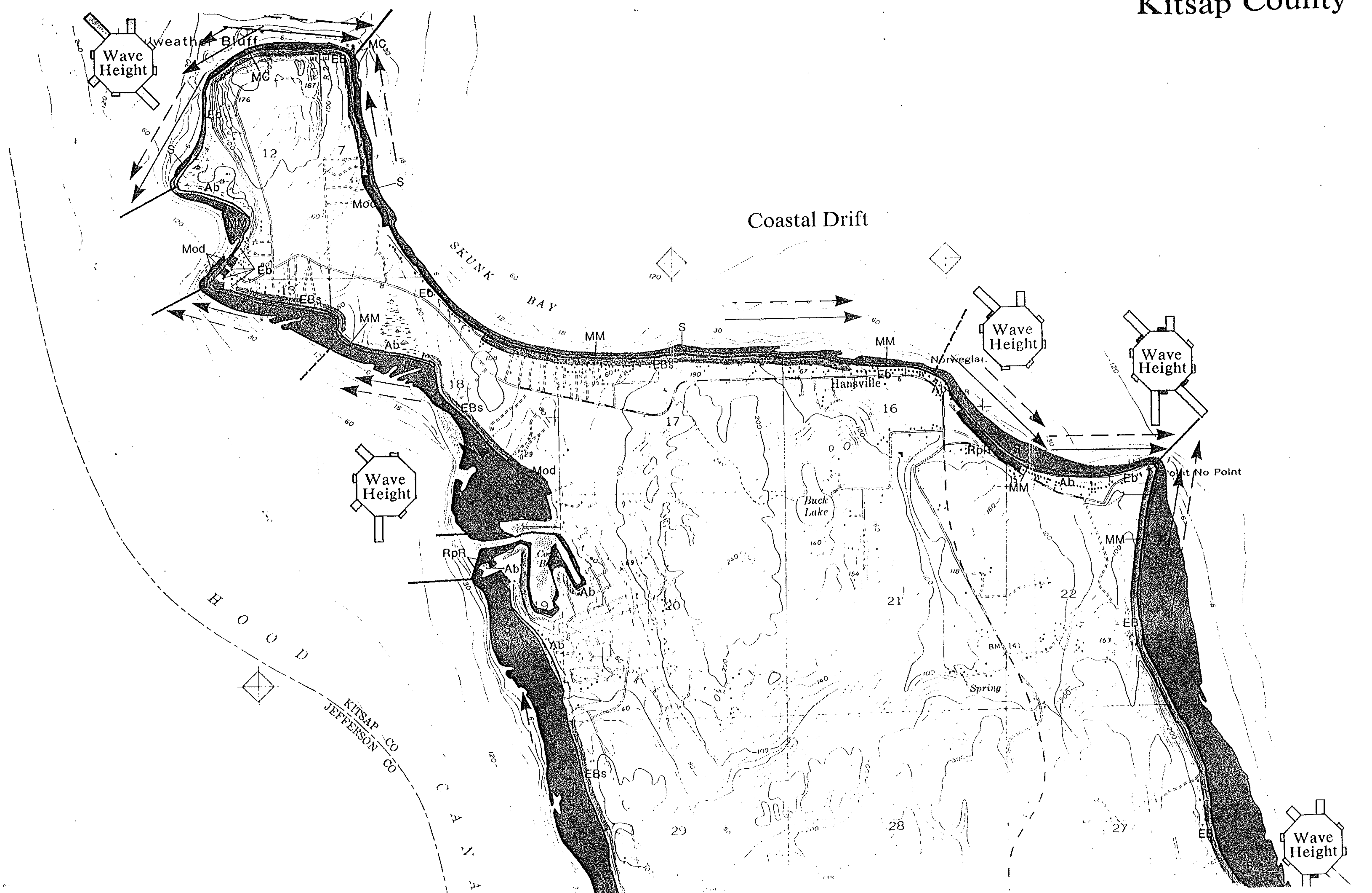
Drift Cell 1-2 This drift cell originates in a small zone of divergence at Foulweather Bluff and terminates along the northwest shore of Point No Point. Net shore-drift in an easterly direction is demonstrated by sediment accumulation on the west side of numerous groins and other drift obstructions, as well as sediment size becoming fine and beach width increasing to the east. Bluff morphology may also indicate the direction of net shore-drift in the following manner. At or near the point of origin the bluff will be steepest, with little to no vegetation on the bluff-face, and no upper-foreshore berm is present. Progressing toward the terminus of the drift cell the bluff becomes less steep, and more heavily vegetated, and there may be a well-developed upper-foreshore berm. In Drift Cell 1-2 this cycle is repeated twice, indicating net shore-drift to the east. The high bluff at Foulweather Bluff evolves into low-lying backshore in Section 7 in Skunk Bay. The high bluff in Sections 18 and 17 in Skunk Bay evolves into a low-lying backshore at Norwegian Point that continues to Point No Point.

Note: Drift Cells 1-3 through 1-7 and Maps KS-2 through KS-9 which cover Kitsap County's Hood Canal shoreline, may be found in Net shore-drift in Washington State: Volume 4, Hood Canal.



Map KS-1. Kitsap County: Admiralty Inlet.

Kitsap County



Coastal Drift

Beach Materials

R Rock	S Sand
Cob Cobble	S-Mud Sand/Silt/Clay
MC Mixed Coarse Materials	Mud Silt/Clay
MM Mixed Medium Materials	Mar Organic (Marsh Deposits)
MF Mixed Fine Materials	

Coastal Dynamics

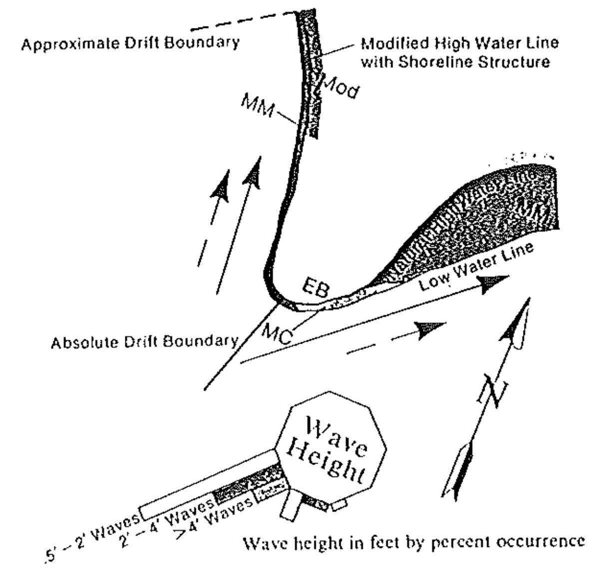
	Notable	Substantial	Critical
Accreting Beach	Ab	Abs	Abc
Eroding Beach	Eb	Ebs	Ebc
Eroding Bluff	EB	EBs	EBc
Eroding Beach/Bluff	EBb	EBbs	EBbc
	Stable	**Marsh**	**Alluvial**
	St	Marsh	Al
	Rocky	**Modified**	**Modified, RipRap**
	Rky	Mod	RpR

The color on the landward side of the high water line indicates active coastal processes at or near that line.

Modified High Water Line

Modified High Water Line with Shoreline Structure

Example Drift Sector



Wave height in feet by percent occurrence

Example: Waves of .5 – 2 feet come from the SW 20% of the time, waves of 2–4 feet come from the SW 10% of the time, waves of 4 feet or more come from the SW 5% of the time.

For detailed explanation and qualification of wave height and drift potential analyses, see text, p. 4.

Potential Littoral Transport Rate

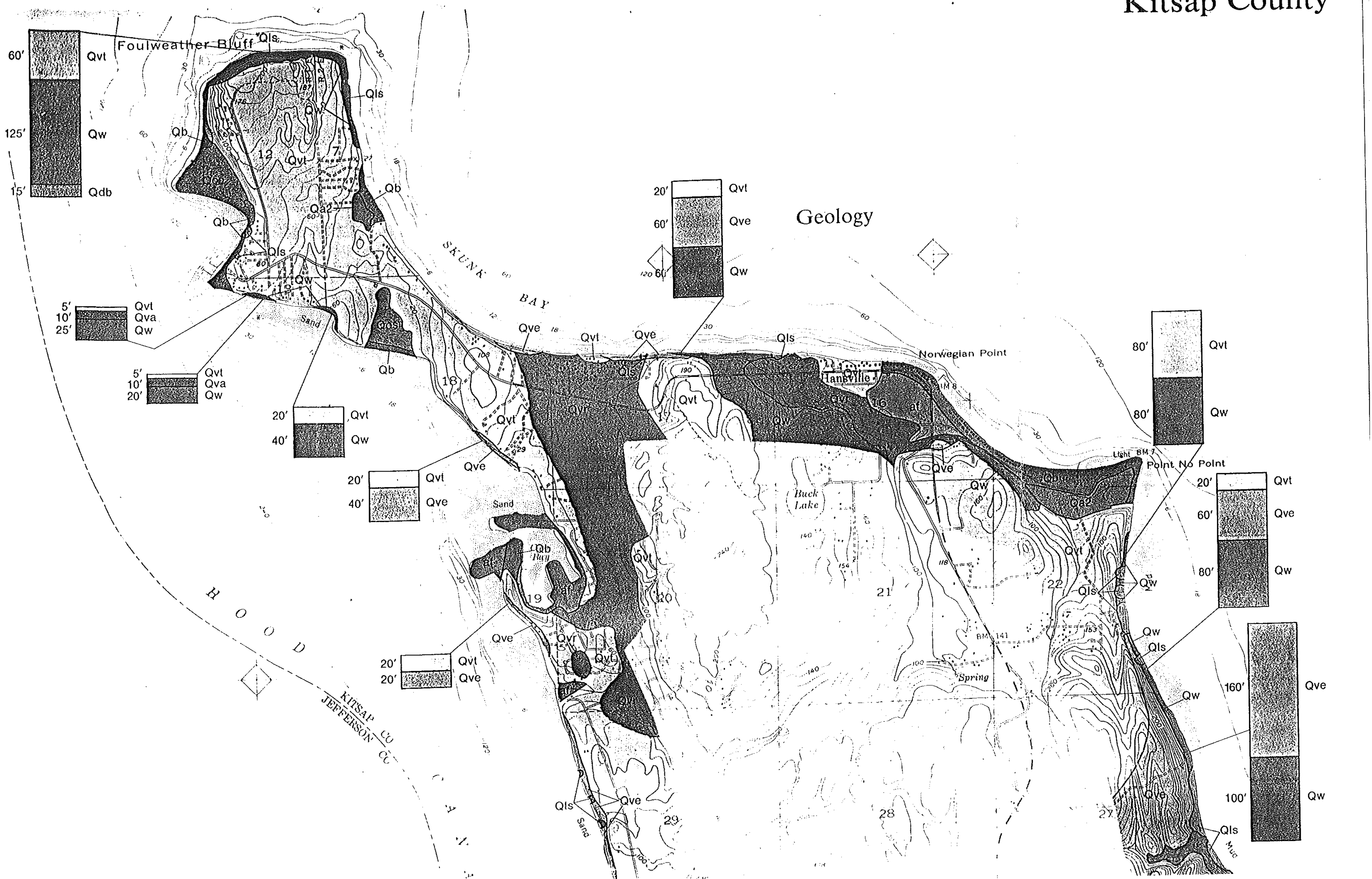
Arrow length doubles as magnitude increases fivefold.

Summer (May-October)

0 1 5 25 125 625

Thousand cubic yards of medium fine sand.

Winter (November-April)

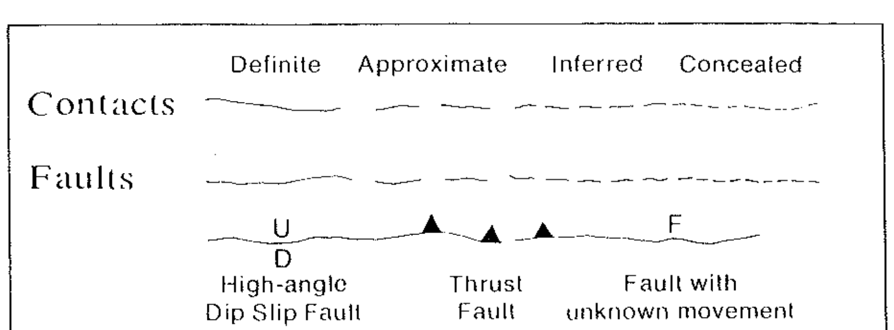

Geology
Foulweather Bluff
60′ Qvt
125′ Qw
15′ Qdb
SKUNK BAY
Norwegian Point
Hansville
Point No Point
Buck Lake
Spring
HOOD CANAL
KITSAP CO
JEFFERSON CO
20′ Qvt
60′ Qve
60′ Qw
5′ Qvt
10′ Qva
25′ Qw
5′ Qvt
10′ Qva
20′ Qw
20′ Qvt
40′ Qw
20′ Qvt
40′ Qve
20′ Qvt
20′ Qve
80′ Qvt
80′ Qw
20′ Qvt
60′ Qve
80′ Qw
160′ Qve
100′ Qw

Geology of Clallam, Jefferson and Kitsap Counties

ERA	Cenozoic					
PERIOD	Quaternary		Tertiary			
EPOCH	Holocene	Pleistocene	Early Miocene	Oligocene	Late Eocene	Middle Eocene

Fraser Glaciation	
Everson Interstade	Vashon Stade

- af — Artificial fill
- Qa1 — Alluvium; sand and gravel
- Qa2 — Alluvium; sand, silt and clay
- Qb — Beach deposits; sand and gravel
- Qd — Dunes; sand
- Qos — Saturated, organic-bearing sand, silt, and clay
- Qp — Peat
- Qls — Landslide deposits
- Qt — Raised marine terrace; thin sand and gravel mantling bedrock
- Qu — Pleistocene sediments, undifferentiated
- Qe — Everson Glaciomarine Drift
- Qes — Everson sand
- Qv — Vashon Drift; outwash sand and gravel, and till
- Qvr — Vashon recessional outwash; sand and gravel
- Qvr1 — Vashon recessional outwash in deltas and alluvial fans
- Qvr2 — Vashon recessional outwash in meltwater channels
- Qvr3 — Vashon ice-contact stratified drift
- Qvt — Vashon till
- Qvt2 — Vashon ablation till
- Qvt1 — Vashon lodgement till
- Qpf — Stratified sediments older than Vashon till, undifferentiated
- Qva — Vashon advance outwash
- Qve — Esperance Sand
- Qns — Pre-Fraser nonglacial sediments, undifferentiated
- Qo — Olympia(?) nonglacial sediments and/or Kitsap(?) Formation
- Qw — Whidbey(?) Formation; nonglacial sediments
- Qdr — Pre-Fraser drift, undifferentiated
- Qdr1 — Salmon Springs(?) till
- Qpd — Possession(?) Drift; outwash sand and gravel, till, and pebbly silt and clay
- Qdb — Double Bluff Drift; till and pebbly silt and clay
- Qdr2 — Pre-Salmon Springs(?) extremely weathered sediments
- Ti — Igneous rocks other than basalt
- Tc — Clallam Formation; thick bedded lithic sandstone
- Tg — Shale and mudstone



APPENDIX III

HISTORICAL REVIEW CONDUCTED BY VOLUNTEERS

Interviews and Review of Historical Documents/Photos

APPENDIX III
Hansville Wetland Restoration Plan Project
Ecology Grant Agreement No. G9700013

Task 2 Historical Review

1. Introduction

Task 2 of the Hansville Wetland Restoration Plan Project was to research the history of the wetland and watershed to determine their presettlement configuration. Old maps, historical documents, and photographs were researched, and area residents were interviewed. This is a compendium of the information gathered.

2. Conclusions

The research revealed no clear description of the wetland area prior to settlement. Based on the evidence found, however, it can be concluded that although the area has never been a tidal marsh, it does experience saltwater intrusion at times. It appears likely from aerial photographs and the comment of one resident that Finn Creek did at one time flow into the wetland area. The only structure ever built on the wetland without fill was a barn along the north side.

3. Surveys and Maps

The earliest map found of the area was from the General Land Office Survey conducted in June of 1859. The surveyors walked and surveyed along the section lines and shores. Unfortunately, the wetland does not lie on a section line, and little narrative description was included in their survey of the shore meander line. The description of the section line between Section 16 and 22 included what is now Buck Lake, and a "branch ...runs NW", which was located east of Finn Creek. That stream was shown on the GLO map to flow north into a marshy area along the beach and east of the Hansville Wetland. Finn Creek was not noted, possibly because of low midsummer flow. A small stream was also shown on Army and Geological survey maps east of the current location of Finn Creek until one from 1953, which shows a marshy area to the northwest of that intersection, which is the location of the Hansville Wetland. This is the only depiction on any of the maps reviewed that shows this area as marshy, although it is identified in the National Wetland Inventory.

Kitsap Public Works maps and documents only describe properties in terms of survey lines, with no description of the land.

It is identified as a "critical area" by the Kitsap County Department of Community Development in the comprehensive plan.

4. Documents

No written description of the history of the wetland area was found older than the 1991 description in the wetland assessment prepared by Ron Vanbianchi (Wetland Identification and Assessment, August 30, 1991) for the Hansville Chamber of Commerce.

> The wetland's primary water sources are groundwater seeps located to the southwest. Although originally connected to Puget Sound by stream channel located in the wetland's southeast corner, since at least the early 1950's the wetland has been ditched and isolated from saltwater inflow by a tidal gate.

From the early 1950's (and perhaps earlier) until about 1965 the non-forested portion of the wetland was used for pasture and occasionally mowed for hay. Since agricultural activity has ceased the wetland has been undisturbed except for fills along the east and north boundaries for residential and commercial construction.

The ground photos from the 1930's and the aerial photo from 1942 indicate fence lines, which correspond to the current system of ditches mentioned by Vanbianchi. This indicates that the ditches may be older than he estimated.

The most comprehensive document on the Hansville area is a portion of Kitsap County, A History compiled by the Kitsap Historical Society and published in 1977. It does not contain any description of the wetland area, however one photograph, looking south from the Hansville dock shows a flat area with tall grass and some fences. Another, from the air shows the area looking toward the southwest.

5. Photographs

The earliest photographs found which show the area in question are from the collection of John Snapp. They were taken in 1933 when the area was flooded. These photos show the entire area of interest under water, with much of the adjacent roads flooded. One of the photos shows a barn along the south side of Twin spits Road, which heads west out of the village center. Copies of those photos are attached.

The earliest aerial photograph located is an Army "mosaic" from 1942. A blowup of the Hansville area from that photo is attached. Finn Creek can be distinguished by a line of vegetation, in its same location as today. Whether it flowed north, across Buck Lake Road, or northwest across Hansville Road cannot be deciphered. There is a hint of a road or stream flowing north out of the wetland area to Admiralty Inlet, in the area where the primary drainage pipe is today.

The next aerial photo is from 1965. Again, the destination of Finn Creek cannot be identified. A small pond is apparent in the center of the wetland area in this photo and also in one from 1985. By 1985 Finn Creek was flowing through a culvert under the intersection of Hansville Road and Buck Lake Road and then in a ditch along the east side of the Hansville Road. Substantial fill is apparent along the north side of Buck Lake Road, and the west side of Hansville Road. Subsequent photos from 1985 and 1989 show additional filling and building construction.

6. Interviews

Long time residents of the area were interviewed and asked questions about what they remember about the wetland. Sig Johnson, who is in his eighties, provided several significant comments. He said that he does remember salt water flooding into the area. He said that the area had been used to grow asparagus and graze cattle and sheep. He remembers there being cutthroat trout in Finn Creek, but no salmon.

John Neff, who grew up in the Point No Point lighthouse, believes that flooding in the area increased after many houses and bulkheads were built along the beach. He remembers Finn Creek crossing under Buck Creek Road, which would mean that it did, indeed, flow into the area of interest at one time.

Weensy Fite, who is in her nineties, could not remember details of the wetland area.

Ted George, a member of the Port Gamble Sklallam Tribe, remembers going to fishing camps in the Hansville area in the early '30, but does not recall anything about the wetland area.

7. **Other Sources**

Other sources accessed include the Kitsap Regional Library, Pope Resources Port Gamble Museum Archives, Department of Natural Resources in Olympia, Aquatic Lands Management Office of the Washington Department of Fish and Wildlife, Suquamish Museum, and Kitsap County Public Works.

8. **Attachments**

Attached are copies of various maps, photographs, and interview notes.

Aug. 14, 1996
Ken Shawcroft

Kitsap County -A History -Published by the Kitsap County Historical Society.
Point No Point post office 1890 to Hansville in 1914.

<u>Page 93</u> "Old wagon road to Hansville." "Followed section line to Hansville." 1912
"this road had a couple of very steep hills close to Hansville. It connected to the road already in by Udds that went to the beach at Zachariasens."

<u>Page 98</u> "Puget Mill had a large logging operation starting in 1922."
-Logged all west of Elgon-Hansville Road
-Train -logs taken to Gamble Bay -floated to Port Gamble.

<u>Page 99</u> A two lane highway via Ramsey's Corner (later George's Corner) opened in 1924.
"Road from Elgon to Hansville was slashed in 1921"

<u>Page 102</u> Photo from NW, no date, Ernest E. Riddle, about 1936.
1879 Lighthouse established

<u>Page 103</u> 1897 "Old government trail" "no roads except skidroads"
1908, -Mr. Simon Lilquist built about a mile and a half of road from his place to the beach at Hans Zachariasen's"
1915 -Husky's built store 1915, Grange hall built 1922.

<u>Page 105</u> Photo 1939 Church and behind.

APPENDIX IV

NOAA BENCHMARKS

PUBLICATION DATE: 04/18/1984

WASHINGTON 944 5526

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRAT
NATIONAL OCEAN SERVICE

TIDAL BENCH MARKS

HANSVILLE, PUGET SOUND

LATITUDE: 47D55.1M North LONGITUDE: 122D32.7M West
NOAA Chart: 18441 USGS QUAD: Hansville

To reach the tidal bench marks from the intersection of Hansville Road and NE Twin Spits Road in the village of Hansville, proceed east for 200 feet (61 m) to Forbes Landing and Restaurant and continue to the extreme east end of the pier extending into Puget Sound at the Landing. The bench marks are located in the area between Hansville Road and the pier. The tide gage and staff were located at the east end of the Forbes Landing Pier.

BENCH MARK STAMPING: 5526 D 1977

MONUMENTATION: Survey Disk
AGENCY/DISK TYPE: NOS Tidal Bench Mark
SETTING CLASSIFICATION: Concrete Headwall

The bench mark is set flush in the top SW corner of a concrete headwall on the east side of a drainage ditch parallel to Hansville Road, 35 feet (11 m) east of the centerline of Hansville Road, 18.5 feet (5.6 m) east of a street sign designating the intersection of Hansville Road and NE Twin Spits Road, 5.5 feet (1.7 m) north of a power pole and east across Hansville Road from Volunteer Fire House Station #14.

BENCH MARK STAMPING: 5526 E 1977

MONUMENTATION: Survey Disk
AGENCY/DISK TYPE: NOS Tidal Bench Mark
SETTING CLASSIFICATION: Concrete Sidewalk

The bench mark is set flush in the concrete sidewalk at the front entrance alcove of the Hansville Community Church, 150 feet (46 m) NW of the intersection of Hansville Road and NE Twin Spits Road, 51.5 feet (15.7 m) SW of the centerline of Twin Spits Road and in the extreme NW corner of the church entrance.

PUBLICATION DATE: 04/18/1984

WASHINGTON 944 5526

HANSVILLE, PUGET SOUND

BENCH MARK STAMPING: BM 1 1966

MONUMENTATION: Survey Disk
AGENCY/DISK TYPE: USC&GS Tidal Bench Mark
SETTING CLASSIFICATION: Concrete Pier

The bench mark is set flush in the southern tip of the concrete pier at the SW corner of a building marked Standard Marine Products, and 3 feet (1 m) NW of a Chevron gasoline tank.

BENCH MARK STAMPING: BM 2 RESET 1968

MONUMENTATION: Survey Disk
AGENCY/DISK TYPE: USC&GS Tidal Bench Mark
SETTING CLASSIFICATION: Concrete Base

The bench mark is set in the southern corner of a concrete base for a gas pump island, in front of the Hansville Post Office located in Ericksons General Store, across the street and 150 feet (46 m) NE of the fire station.

BENCH MARK STAMPING: BM 3 1966

MONUMENTATION: Survey Disk
AGENCY/DISK TYPE: USC&GS Tidal Bench Mark
SETTING CLASSIFICATION: Concrete

The bench mark is set flush in the southern tip of Forbes Landing and Restaurant, directly beneath the sign for the restaurant, and 15 feet (5 m) NE of a white metal tank.

PUBLICATION DATE: 04/18/1984

WASHINGTON 944 5526

HANSVILLE, PUGET SOUND

Tidal datums at HANSVILLE, PUGET SOUND are based on the following:

LENGTH OF SERIES	= 13 MONTHS
TIME PERIOD	= FEBRUARY 1977 –FEBRUARY 1978
TIDAL EPOCH	= 1960 –1978
CONTROL TIDE STATION	= SEATTLE (944 7130)

Elevations of tidal datums referred to mean lower low water (MLLW) are as follows:

HIGHEST OBSERVED WATER LEVEL (12/15/1977)	= 15.01 FEET
MEAN HIGHER HIGH WATER (MHHW)	= 10.44 FEET
MEAN HIGH WATER (MHW)	= 9.60 FEET
MEAN TIDE LEVEL (MTL)	= 6.19 FEET
MEAN LOW WATER (MLW)	= 2.77 FEET
MEAN LOWER LOW WATER (MLLW)	= 0.00 FEET
LOWEST OBSERVED WATER LEVEL (06/02/1977)	= -3.43 FEET

Bench mark elevation information:

	ELEVATION IN FEET ABOVE:	
BENCH MARK STAMPING	MLLW	MHW
5526 D 1977	12.49	2.89
5526 E 1977	13.25	3.65
BM 1 1966	13.13	3.53
BM 2 RESET 1968	13.77	4.17
BM 3 1966	13.67	4.07

APPENDIX V

SALINITY TABLES

APPENDIX V
HANSVILLE WETLAND
SALINITY READINGS
October 19, 1996

Surface Water Salinity Readings

Salinity was determined using a refractometer. Surface water readings were taken shortly after high tide at approximately 10:30 am. Results may be affected by recent rainfall diluting the salt concentrations within the ditches. The results are below.

Location 1:	Ditch adjacent to marked fence post near church:	7 PPM
Location 2:	Easternmost north/south ditch:	3ppm
Location 3:	Stake in vicinity of culvert in an area that may be salt panning:	8 PPM
Location 4:	At tide gate culvert:	Trace

Soil Salinity Readings

Soil Salinity Readings were taken along three north/south transects. Cores were dug to approximately 8-10 inches and water allowed to drip in order to avoid including surface water which was present in all but 1 sample. Surface water was either present as film (1" or less) or as standing water (> 1"). When present as film, the data showed "sat" when present as standing water, the data shows "surface". Along Transect A, all salinity readings were taken on-site using a syringe plugged with tissue paper in order to extract moisture. This method is known to show concentrations of 1 PPM higher than allowing water to percolate (assuming no surface water). Soil samples along Transects B and C were taken and stored in Ziploc freezer bags so that refractometer readings could be completed in the office. The soil samples were placed in a syringe plugged with paper napkins to extract moisture, similar to the procedure completed in the field. The first readings for transects B and C were completed on the Monday following collection and a second reading was completed on the Friday following the first readings. Several samples were read up to 4 separate times due to the variation of numbers determined during the first three readings. All of the readings for each sample have been included on the following tables (only for transects B and C).

TRANSECT A

North/South
Start Point: Marked fence post approximately 30 feet south of edge of fill where church is located
End Point: 96 feet beyond marked fence post which is located 329 feet south of starting point

Ref. Pt.	Distance	Salinity	Vegetation	Hydro	Soil	Notes
A-1	+8	15	*A. alba/D. spicata*	Sat	Duff	
A-2	+80	14	*A. alba/D. spicata*	Sat	Duff	
A-3	+120	15	*A. alba/D. spicata*	Sat	Duff	
A-4	+140	20	*A. alba/D. spicata*	Sat	Duff	just south of NW/SE trending low berm indicated by *F. arundinacea*
A-5	+150	17	*A. alba/D. spicata*	Sat	Duff	
A-6	+156	10	*A. alba/D. spicata*	Sat	Duff	
A-7	+163	11	*A. alba/D. spicata*	Sat	Duff	
A-8	+265	16	*A. alba/T. latifolia*	Surface	Duff-Muck	
A-9	+329	11	A. *alba* *F. arundinacea* *P. pacifica*	Surface	Muck	South Fence Post
A-10	+366	7	*P. arundinacea* *A. alba* *others*	Surface	Duff-Muck	Phalaris boundary
A-11	+386	5	*P. arundinacea*	Sat	Duff-Muck	
A-12	+425	1	*P. arundinacea*			

TRANSECT B

North/South
Start Point: Stake in vicinity of culvert (marked on site plan)
End Point: 403 feet from start point passing approximately 8 feet to the east of crabapple drip line marked on site plan

Ref. Pt.	Distance	Salinity	Vegetation	Hydro	Soils	Notes
B-1	+0	20, 19	*A. alba/D. spicata*	Surface		near stake, salt panning
B-2	+29	15, 16	*A. alba* *S. virginica*	Sat		Center of *A. alba* patch
B-3	+59	18, 16	*A. alba/D. spicata*	Sat		North edge of dominant *D. spicata*
B-4	+67	14, 16	*D. spicata* *A. alba*	Sat		
B-5	+69	12, 15, 10, 14, 14	*A. alba/D. spicata*	Sat		South edge of dominant *D. spicata*
B-6	+100	9, 10, 12, 14, 12	*A. alba* *D. spicata* *P. pacifica*	Sat		South limit of *D. spicata*
B-7	+200	18, 14, 15	*A. alba* *P. pacifica*	Damp		
B-8	+220	7, 8	*A. alba*	Sat		
B-9	+252	4, 4	*grasses (no Phalaris)* *P. pacifica*	Surface		
B-10	+300	3, 3	*P. arundinacea*	Surface		Sharp vegetation delineation, no Phalaris north of this mark
B-11	+333	1, 2, 2	*P. arundinacea*	Sat		
B-12	+350	2, 2, 2	*P. arundinacea*	Surface		Just north of the E/W ditch
B-13	+403	1, 2	*P. arundinacea*	Sat		

TRANSECT C

North/South
Start point: 50 feet West of the "T" formed by the central north/south ditch (near where it enters culvert) and along the east/west ditch and along the east/west ditch
End point: 424 feet south at 200 degrees magnetic north

Ref. Pt.	Distance	Salinity	Vegetation	Hydro	Soils	Notes
C-1	+5	3, 4	*A. alba*	Sat		
C-2	+31	3, 3	*A. alba/D. spicata*	Sat		
C-3	+80	20, 14, 14	*A. alba*	Surface		Edge of *A. alba* patch
C-4	+94	12, 13	*A. alba* *D. spicata*	Surface		
C-5	+170	14, 14	*A. alba*	Surface		
C-6	+250	12, 10, 10	*A. alba*	Surface		
C-7	+307	8, 6, 7	*D. spicata*	Surface		Edge of dead *T. latifolia*
C-8	+350	0, 2, 1	*T. latifolia* *Eleocharis* *P. pacifica*	Surface		Some dead *T. latifolia*
C-9	+383	4, 3, 3	*P. arundinacea* *T. latifolia*	Surface		North edge of *P. arundinacea*
C-10	+411	1, 1	*P. arundinacea* *T. latifolia*	Surface		South edge of *T. latifolia*
C-11	+424	0, 2	*P. arundinacea*	Surface		

APPENDIX VI

VEGETATION TRANSECT TABLES

APPENDIX VI
HANSVILLE VEGETATION TRANSECTS

These transects were completed to determine the dominant vegetation through the Hansville wetland. The transects start along the main east/west ditch and extend southerly to either the cattail or reed canary grass dominated area. Transects 1 and 2 were completed on the east side of the easternmost north/south ditch, transect 3 was conducted using the latter ditch as a center line. Transects 4 and 5 were completed on the west side of the latter ditch at 100 foot intervals. Dominance was determined to be the species that had the highest concentration at a certain point and those species that were present at high percentages, but lower than dominant were considered subdominant. Occurring species are those that were present at a certain point along the transect but not at dominant or subdominant percentages. The transects were completed on November 30, 1996 by Ken Pritchard and Joanne Bartlett.

TRANSECT 1

Transect 1 extends south away from benchmark along the main east-west ditch. Data was collected along this transect earlier in the season but data was lost.

Feet	Dominant	Subdominant	Occurring
0-7'	Ditch		
7-28	*Distichlis/Agrostis*	*Festuca*	
28-95	*Distichlis*	*Agrostis*	*Potentilla*
95-129	*Agrostis*	*Distichlis*	*Potentilla*
129-157	*Distichlis/Agrostis*		*Potentilla*
157-175	*Agrostis*	*Distichlis*	*Potentilla*
175-211	*Agrostis/Festuca*		*Potentilla/Distichlis*
211-237	*Agrostis*		*Potentilla/Distichlis*
237-283	*Agrostis*	*Potentilla*	*Distichlis/Scirpus**
283-356	*Agrostis*	*Potentilla*	*Festuca*
356-409	*Agrostis*	*Potentilla*	
409	*Typha*		

*patchy individuals and groups along the transect and extending away from the transect to east and west.

Transect 1 notes 117 feet, pick-up NW corner of Forbes lot,
at 175 feet, pick up narrow band of Festuca

TRANSECT 2

Transect 2 Data was collected during previous vegetation transect work (9/29/96) and is 82 feet west of the benchmark at north end of transect 1. This transect also includes the area north of the main east-west ditch to the base of Twin Spits Road fill.

This portion heads in southerly direction, starting at main east-west ditch and ending at the north edge of large cattail area.

Feet	Dominant	Subdominant	Occurring
0-18.5	*Festuca*		
18.5-152	*Distichlis/Agrostis*	*Potentilla*	
152-290	*Agrostis/Distichlis*	*Potentilla*	
290-430	*Agrostis/Potentilla*		
430-	*Typha*		

This portion of transect 2 heads in a northerly direction from the benchmark at the main east-west ditch, ending at Twin Spits Road.

Feet	Dominant	Subdominant	Occurring
0-29	*Phalaris*		
29-47	*Festuca*		
47-124	*Phalaris*		
124-154	*Rubus spectabilis/Phalaris*		

TRANSECT 3

This transect was completed along either side of the easternmost, north-south ditch. East side of ditch data was collected first.

East side of ditch

Feet	Dominant	Subdominant	Occurring
0-71	*Festuca*	*Agrostis*	*Distichlis/Potentilla*
71-78	*Distichlis*	*Festuca*	*Potentilla*
78-87	*Festuca*	*Distichlis*	*Potentilla*
87-119	*Festuca*	*Distichlis/Agrostis*	*Potentilla*
119-135	*Agrostis*		*Potentilla/Festuca*
135-146	*Agrostis*	*Festuca*	*Potentilla*
146-174	*Distichlis*	*Agrostis*	*Potentilla/Festuca*
174-212	*Distichlis/Agrostis/Festuca*		*Potentilla*
212-221	*Festuca*	*Agrostis*	*Potentilla/Distichlis*
221-264	*Festuca/Agrostis*		*Potentilla*
	Phalaris		

West side of ditch-Transect 3

Feet	Dominant	Subdominant	Occurring
0-27	*Festuca*		
27-45	*Festuca/Distichlis*	*Agrostis*	*Potentilla*
45-58	*Agrostis*	*Festuca/Distichlis*	*Potentilla*
58-93	*Agrostis*	*Festuca*	*Distichlis/Potentilla*
93-99	*Agrostis*	*Festuca/Distichlis*	*Potentilla*
99-122	*Agrostis*	*Distichlis*	*Festuca/Potentilla*
122-143	*Agrostis/Festuca*		*Distichlis**
143-177	*Agrostis/Distichlis*		*Festuca/Potentilla*
177-193	*Agrostis/Distichlis*	*Festuca*	*Potentilla*
193-210	*Distichlis*	*Agrostis*	*Festuca/Potentilla*
210-240	*Agrostis*	*Festuca*	*Distichlis/Potentilla*
240-265	*Agrostis/Festuca*		*Potentilla*
	Phalaris		

* patchy not bands of vegetation

Transect 3 notes — Scirpus present in ditch at 153 feet
dead cattail begins wedging into ditch at 259 feet

TRANSECT 4

Transect 4-Located 100 feet west of "T" of easternmost north-south ditch and main north ditch. From edge of e/w ditch to edge of Phalaris

Feet	Dominant	Subdominant	Occurring
0-7	*Festuca*	*Agrostis*	*Lolium/Potentilla*
7-24	*Lolium*		*Agrostis*
24-36	*Agrostis*	*Lolium*	*Potentilla*
36-53	*Agrostis*		*Potentilla*
53-94	*Agrostis*	*Distichlis**	*Potentilla*
94-119	*Agrostis (stressed)*	*Salicornia*	*Distichlis/Potentilla*
119-129	*Agrostis/Distichlis*		*Potentilla*
129-139	*Distichlis*	*Agrostis*	*Salicornia/Potentilla*
139-207	*Agrostis/Distichlis***		*Potentilla*
207-217	*Agrostis/Juncus*		*Distichlis/Potentilla*
217-239	*Agrostis*	*Lolium*	*Potentilla*
239-247	*Agrostis/Lolium*		*Potentilla*
247-250	*Agrostis*		*Potentilla*
250-309	*Agrostis*		*Potentilla/Scirpus*
309-365	*Agrostis*		*Potentilla/Scirpus*
365	*Phalaris*		

* subdominants in small patches but more than just occurring

** dominants/co-dominant changes between these two species more frequently through this area

Transect 4 notes

104 to 139 feet area of salt panne
6'x8' patch of *Juncus balticus* at 207 feet just west of transect
10'x7' patch of *Juncus balticus* at 250 feet just west of transect

TRANSECT 5

This transect is located 100 feet west of transect 4 and about 25 feet west of second east/west ditch and 30 feet east of ditch to tide gate

Feet	Dominant	Subdominant	Occurring
0-16	*Lolium*		*Potentilla*
16-21	*Agrostis*	*Distichlis*	*Potentilla*
21-67	*Distichlis*	*Agrostis*	*Potentilla*
67-92	*Distichlis*	*Agrostis*	
92-118	*Agrostis*	*Distichlis*	*Lolium*
118-139	*Agrostis*	*Distichlis*	*Potentilla*
139-147	*Agrostis*	*Festuca**	*Lolium*/Potentilla/Distichlis*
147-159	*Agrostis*		*Lolium*/Potentilla/Distichlis*
159-185	*Agrostis*	*Distichlis*	*Lolium/Potentilla*
185-213	*Agrostis*		*Lolium/Potentilla/Rumex*
213-235	*Agrostis/Lolium*		*Potentilla*
235-254	*Agrostis/Lolium*		*Typha/Potentilla*
254-274	*Agrostis/Lolium*		*Typha/Potentilla/Juncus e.*
274-282	*Agrostis/Lolium*		*Juncus e./Phalaris/Potentilla*
282-334	*Agrostis/Lolium*		*Potentilla*
334-352	*Agrostis/Lolium*		*Typha/Juncus e./ Potentilla/Festuca*
352	*Phalaris*		

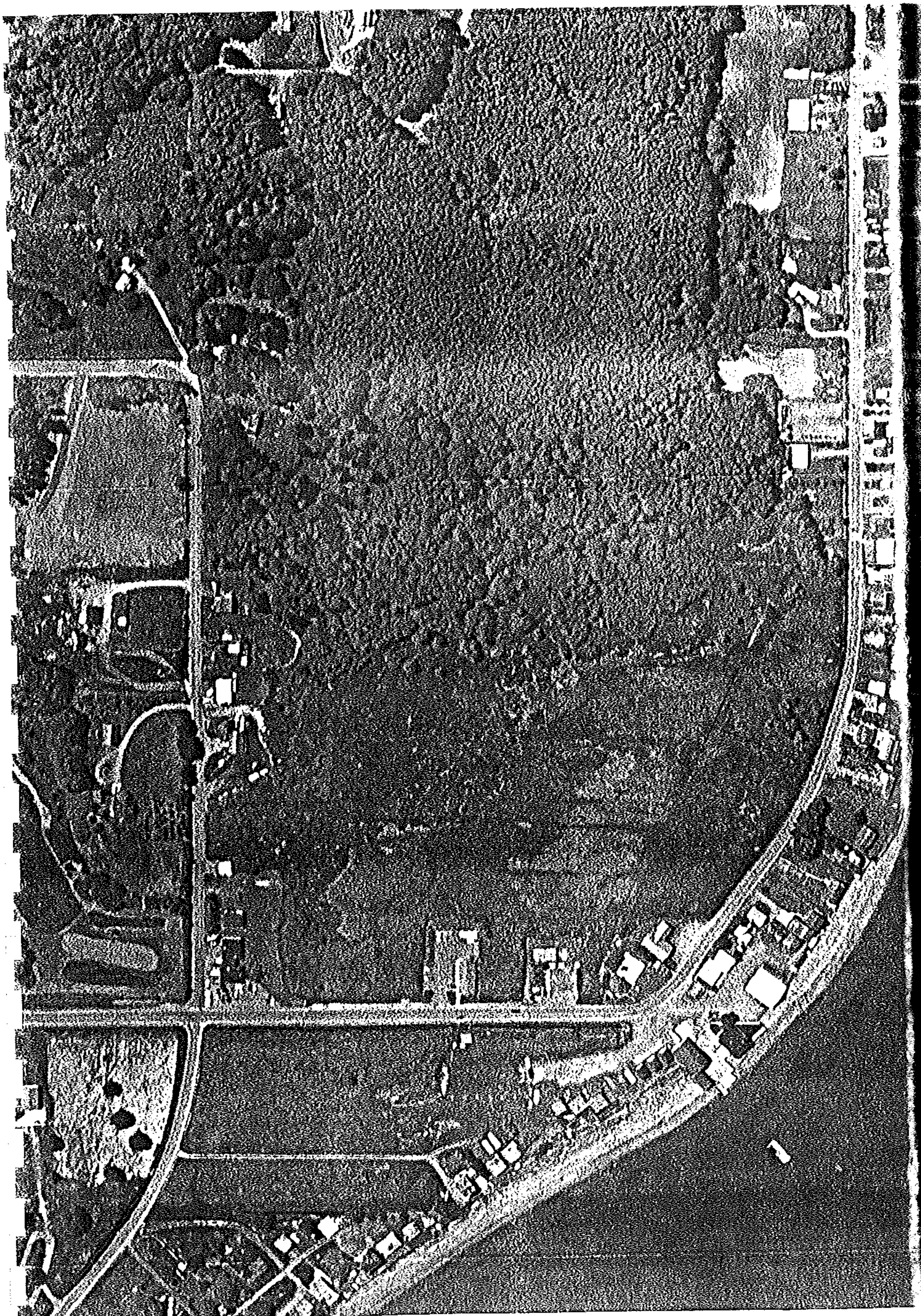
* Festuca and Lolium mostly growing on old ditch spoils on the east side of transect

Transect 5 notes

flip flopping of dominance between *Distichlis* and *Agrostis* from 21 to 92 feet (*Agrostis* dominant at one point, *Distichlis* dominant at next and so on).
Distichlis definitely dominant at 92 for some distance.
Typha in ditch at 213 feet

APPENDIX VII

1995 AERIAL PHOTO



APPENDIX VIII

KITSAP COUNTY PUBLIC UTILITY DISTRICT #1 DOCUMENT SEARCH AND BRIEF INTERVIEW

APPENDIX VII
Finn Creek-Kitsap County Public Utilities District #1-Data collection

No stream flow data has been collected by the PUD along Finn Creek. Information obtained is from the State of Washington, Water Supply Bulletin No. 18, Water Resources and Geology of the Kitsap Peninsula and Certain Adjacent Islands, US Geological Survey, 1965

Water Rights Application-Section at back of book, just before maps of different areas included in book. The stream is identified as Stream No. 169 and is referred to as Finland Creek, in Section 16, T 28 N, R 2 E. WM. The following information is only one application on a list of 5 different names, and there was another listing for Section 16 however, it did not have a total quantity or CFS number for the stream. The information provided from the listed tables was copied as they contained CFS numbers and basin area.

Application	Permit	Certificate	Priority	Source	Name	Total Quantity (cfs)	No sure of column headings	
16093	11992	8331	5-31-60	Finland Creek	C.F. Hilliard	0.04	28/2 E.	SWSE

Section	Consumptive Uses	Provisos
16	Domestic (0.02) & Commercial(0.02)	S,D

S-Screening-Diversion intake shall be tightly screened at all times with wire having a mesh opening not greater than 0.125 (1/8 of an inch)
D-No dam shall be connected with this diversion

TABLE 48 SURFACE WATER EVALUATION

Stream No.	Surface Drainage area (sq. miles)	Est. mean annual eff. Precip. from drainage area	Low Flows	Date
169	42	8 inches 400 acre feet	0.1	8-14-61

TABLE 62 SUMMARY OF SURFACE WATER USE

Drainage basin	Total No. valid findings	No. of irrigation filings	Irrigation acreage	Irrigation Quantities
Finland Creek (No. 169)	6	4	42	0.35

Public and Domestic Quantities	Other Consumptive Quantity	Non Consumptive Quantity	Total Appropriated Quantity
0.04	0.02	0.02	0.43

TABLE 63 ACREAGE COVERED BY GROUND-WATER AND SURFACE-WATER IRRIGATION IN THE KITSAP REPORT AREA

Drainage basin (Stream No.)	Ground-Water	Surface-Water	Total Irrigated Acreage
Finland Creek-169	0	42	42

APPENDIX IX

US ARMY CORPS OF ENGINEERS
HYDRAULIC ENGINEERING SECTION
FINAL PRELMINARY HYDROLOGIC AND HYDRAULIC INVESTIGATION REPORT

U.S. Army Corps of Engineers
Seattle District

HANSVILLE WETLAND RESTORATION AND PRESERVATION PROJECT

Kitsap County, Washington

PRELIMINARY HYDROLOGIC AND HYDRAULIC INVESTIGATION

FINAL DOCUMENT
22 JULY 1997

Prepared For: KITSAP LAND TRUST

AUTHORITY

This report was produced by the Seattle District U.S. Army Corps of Engineers for Kitsap Land Trust under authority Section 22, 'Planning Assistance to States Program,' Public Law 93-251 (Water Resources Development Act of 1974). This Act provides authority for the Corps of Engineers to assist the States in preparation of comprehensive plans for the development, utilization, and conservation of water and related land resources.

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Environmental Resources Section Mike McNeely, Chief
Patrick Cagney

With appreciation to Sid Knutson and Ken Shawcroft.

This report prepared by Dennis Mekkers, Hydraulic Engineering Section.

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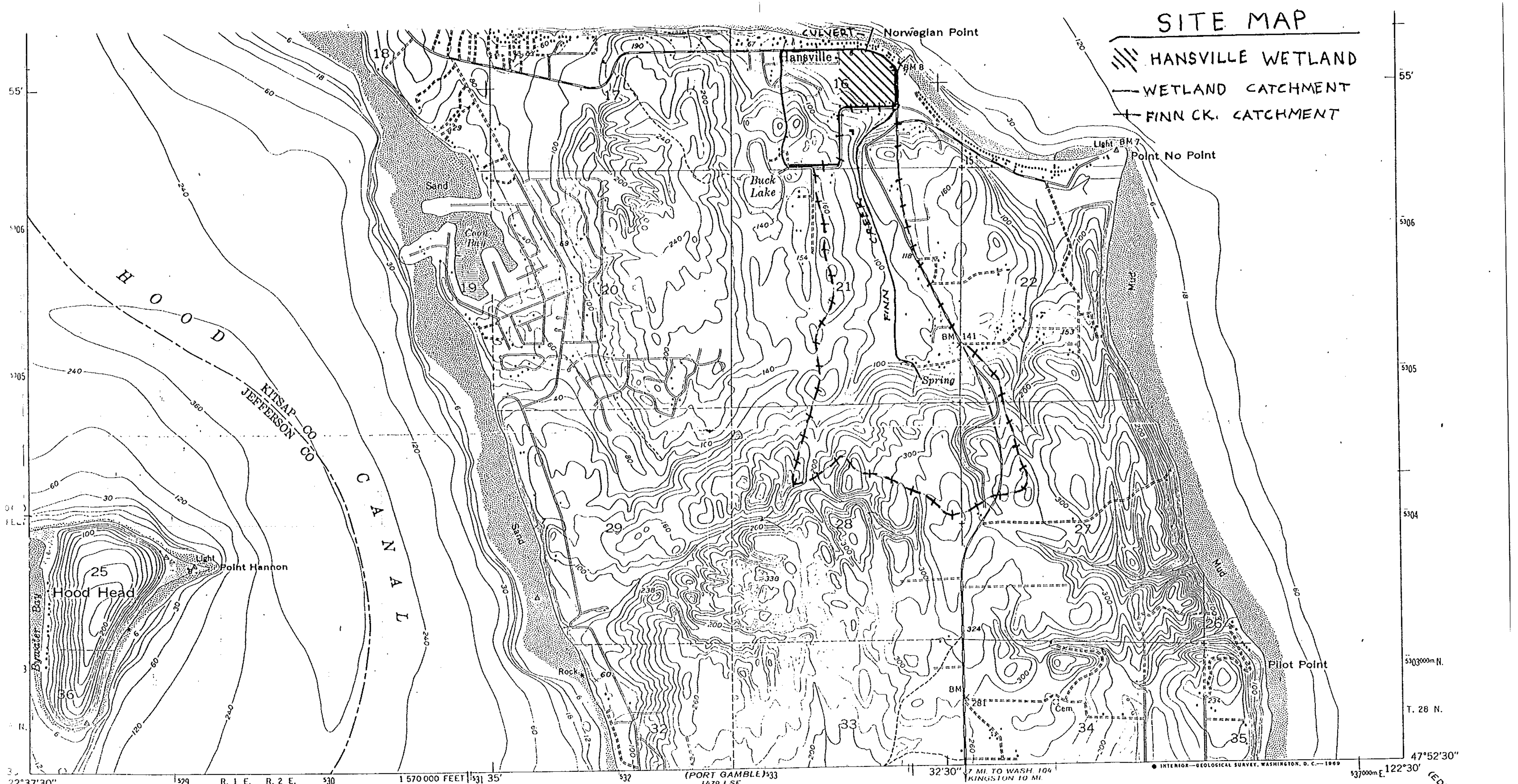

Mapped, edited, and published by the Geological Survey

Control by USGS and USC&GS

Topography from aerial photographs by multiplex methods
Aerial photographs taken 1951. Field check 1953

Hydrography compiled from USC&GS charts 6421 and 6450

Polyconic projection. 1927 North American datum
10,000-foot grid based on Washington coordinate system, north zone

Dashed land lines indicate approximate locations

Unchecked elevations are shown in brown

1000-meter Universal Transverse Mercator grid ticks, zone 10, shown in blue

Revisions shown in purple compiled from aerial photographs

UTM GRID AND 1968 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

0°19' 6 MILS — 22° 391 MILS

SCALE 1:24 000

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL
DEPTH CURVES IN FEET—DATUM IS MEAN LOWER LOW WATER
SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER
THE AVERAGE RANGE OF TIDE IS APPROXIMATELY 6 FEET

FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225 OR WASHINGTON, D. C. 20242
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

ROAD CLASSIFICATION
Light-duty
Medium-duty
Unimproved dirt

WASHINGTON
QUADRANGLE LOCATION

HANSVILLE, WASH.
NE/4 PORT GAMBLE 15' QUADRANGLE
N4752.5—W12230/7.5

1953
PHOTOREVISED 1968
AMS 1479 I NE—SERIES V891

1. Purpose and Scope of Study

The purpose of this task is to complete a preliminary hydrology and hydraulic analysis for the Hansville Wetlands Restoration and Preservation Project. Based on the agreement with the sponsor regarding reconnaissance conditions, this analysis is limited to calculating the maximum water surface elevation in the Hansville Wetland for coincident 100-year flood stream flow and 100-year tide events.

2. Description of System

The Hansville Wetland is located on the North end of the Kitsap Peninsula in the town of Hansville, Washington. The wetland is bordered on the East by the Hansville Road, on the North by Twin Spits Road, on the West by hillslopes, and on the South by Buck Lake Road (see site map insert). The wetland is currently fed by groundwater seeps and precipitation event overland flows from hillslopes to the west and southwest.[1] These adjacent contributory areas and the wetland itself are considered herein to define the existing Hansville Wetland complex. Inspection of aerial photos and topographic maps suggest the wetland area to be approximately 35 acres (0.055 mi^2), and adjacent contributory areas to be 0.107 mi^2, for a total wetland area of 0.162 mi^2.

A small network of shallow ditches within the wetland provide for partial drainage to a culvert, which begins at the south margin of Twin Spits road and discharges to Puget Sound. The culvert system consists of 2-24 inch culverts connected in series. The culvert sections are joined by a circular concrete junction box just north of Twin Spits Road. A flap gate is installed within the junction box on the downstream end of the upstream culvert section to prevent tidal flow into the wetland.

Finn Creek, believed to have once run through portions of the Hansville Wetland, has since been re-routed through ditches and culverts over much of the lower reach. Finn Creek baseflow is believed to be sustained by springs located at the base of a hill west of Hansville Road and approximately one mile south of the wetland. The spring is identified on the 1953 (photorevised 1968) USGS Hansville Quadrangle topographic map. Finn Creek flows in a northerly direction, crossing beneath the Hansville Road in a culvert at Buck Lake Road. Finn Creek then flows north in a ditch on the east side of Hansville Road and into Puget Sound through a culvert system similar to that which drains the Hansville Wetland. Inspection of aerial photos and topographic maps suggest the Finn Creek basin area to be near 0.7 mi^2.

Finn Creek is an ungaged stream. Historical water surface level data in the wetland are essentially non-existent. Some short-term monitoring of piezometric levels in the wetland has

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[1] Vanbianchi, Ron (1991), "Wetland Identification and Assessment, Hansville and Point No Point Wetlands." Report prepared for Hansville Chamber of Commerce.

been conducted in the past for wetland classification purposes,[2] but these data are of insufficient length and continuity to be of practical use here.

The determination of the wetland water surface elevation for the requisite 100-year tide and precipitation events required both hydrologic and hydraulic analyses. Hydrologic analyses conducted include precipitation-runoff estimation, tidal hydrograph construction, and flood routing. Hydraulic analysis was necessary to estimate culvert system head-discharge relationships. These analyses are presented in the following sections.

3. Hydrologic Analyses

Hydrologic analyses conducted include precipitation-runoff estimation, tidal hydrograph construction, and flood-routing through the wetland. These topics are discussed in the following sub-sections, with the exception of flood routing through the wetland, which is covered in a later section.

3.1. Precipitation-Runoff Estimation Methods

Precipitation-runoff estimation is necessary in order to generate the wetland inflow hydrographs. The process involves the following sequence of steps: (1) determine the duration and depth of the 100-year precipitation event in order to construct (2) a hypothetical storm pattern which will be used as (3) input into HEC-1, a runoff estimation model which generates the inflow hydrographs.

Interior flooding analyses typically focus on volumes of water, rather than event peak discharge. The duration then of the 100-year precipitation event was selected to be 72 hours. This time frame also allows a more extensive representation of the tidal hydrograph and its effect on wetland storage than would a shorter duration. The depth of the 72-hour, 100-year event was determined to be 3.65 inches by extension of data and methods contained in a National Oceanic and Atmospheric Administration (NOAA) precipitation-frequency atlas.[3]

General storm construction procedures outlined in Chapter 15 of Hydrometeorological Report No. 57[4] were utilized to distribute the 72-hour 3.65 inch depth to 6-hour interval hypothetical storm pattern precipitation depths. The graphical representation of precipitation versus time is referred to as a hyetograph. The derived precipitation hyetograph for this analysis is shown below Figure 3-1. Precipitation was assumed to occur in the form of rainfall for this analysis.

---

[2] Ibid.

[3] National Weather Service (1973), NOAA Atlas 2: Precipitation-Frequency Atlas of the Western United States, V(IX)-Washington. USDOC, NOAA, NWS. Silver Spring, Maryland.

[4] United States Departments of Commerce, Interior, and Defense (1994), "Hydrometeorological Report No. 57, Probable Maximum Precipitation-Pacific Northwest States". National Weather Service, Silver Spring, Maryland.

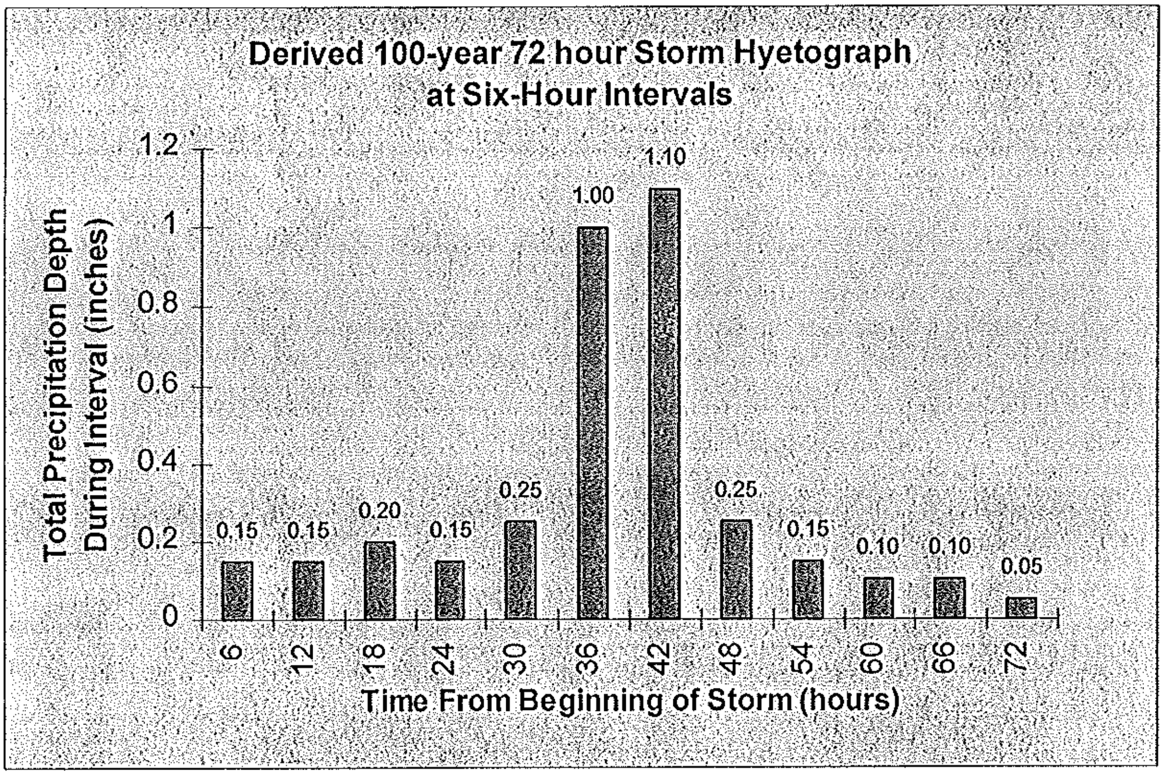

Figure 3-1: Derived 100-year Storm Hyetograph

Inflow hydrographs were constituted using the HEC-1 Flood Hydrograph Package computer program developed by the Corps of Engineers Hydrologic Engineering Center in Davis, California. Inflow hydrographs were constituted for the Finn Creek basin and for the contributory area bordering the wetland to the west and southwest. Precipitation falling directly on the wetland area was assumed to contribute directly to storage. The development of requisite HEC-1 input parameters is discussed below.

Interception and infiltration losses were computed by the Soil Conservation Service (SCS, since renamed the Natural Resources Conservation Service, or NRCS) Curve Number method. Basin area weighted curve numbers were determined based on interpretation of vegetation and land use characteristics from Seattle District COE Survey Branch aerial photographs taken 2 April 1997. Curve numbers were conservatively adjusted to wet antecedent moisture conditions. The adjusted curve number for the Finn Creek basin was 83, and that of the contributory area 88. A Clark synthetic unit hydrograph was computed by the HEC-1 program. Time of concentration for the basin was estimated at one hour.

For these conditions, the HEC-1 model run results in an inflow hydrograph just over 4 days in length at a one-hour time step. Approximately two-thirds of hypothetical storm rainfall is available as surface runoff. Peak flows are 41 cfs for the Finn Creek basin, and11 cfs for the wetland contributory area. Total peak flowrate, considering direct rainfall on the wetland, is near 55 cfs. Computed inflow hydrographs are shown below in Figure 3-2.

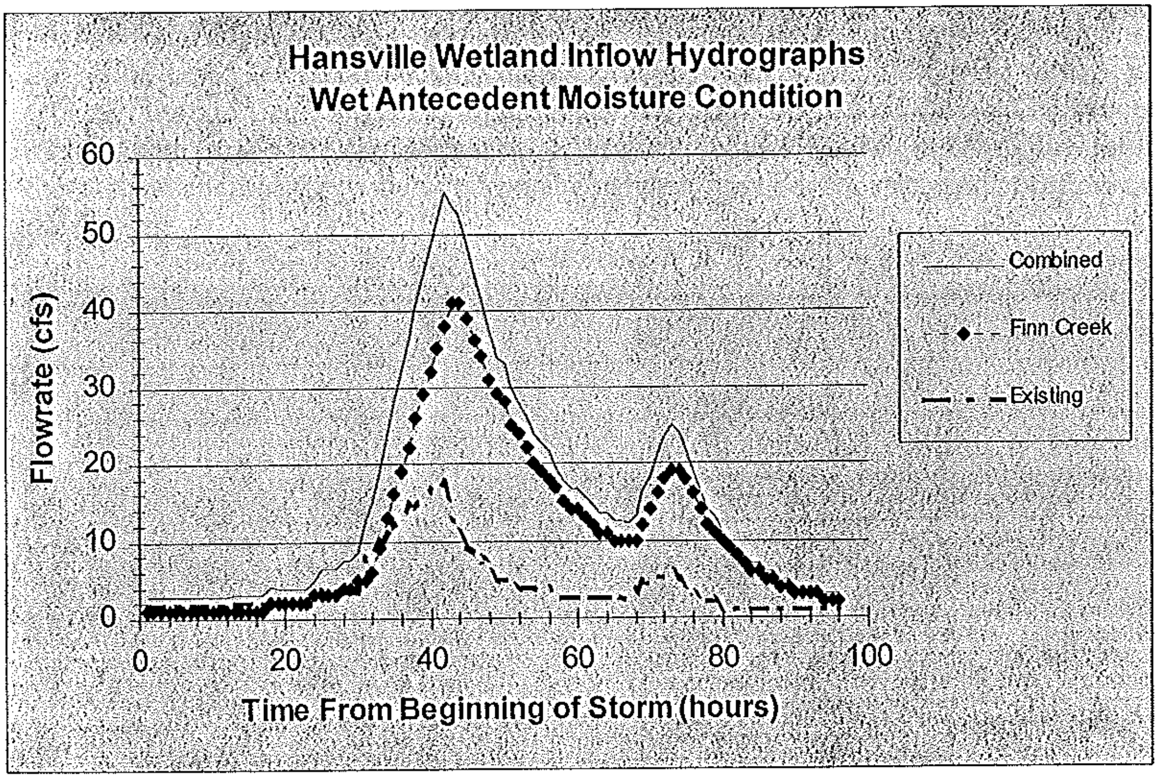

Figure 3-2: HEC-1 Computed Inflow Hydrographs

3.2. Tidal Hydrograph

Seattle District Corps of Engineers records report[5] the observed tide of record at Hansville occurred 15 December 1977 at elevation 13.7 feet mean lower low water (MLLW) datum. This figure contradicts an 18 March 1984 NOAA publication which references a maximum tide elevation at Hansville of 15.01 feet for the 15 December 1977 storm event. The Corps maximum tide elevation is based on inspection of tide recorder data loggers, coincides well with observed Elliott Bay maximum tide elevations for the same date, and converts closely to the 100-year Elliott Bay annual peak elevation for the period 1898-1995; as such, it is accepted as the best available estimate of the 100-year tide elevation. Other tide statistics for Hansville in feet MLLW: Mean Higher High Water (MHHW) 10.44, Mean Tide 6.19, and Mean Range 6.83 feet.

The predicted tide peak, as published in *Tides and Currents* software (Nautical Software Inc.), for 15 December 1977 was adjusted to the observed elevation of 13.7 feet. All other predicted tide elevations on this day were scaled to observed peak between maximum flood current and maximum ebb current only. No adjustments were made to 15 December predicted lows, as an observed low for that date has not been discovered. Predicted flows for the period beginning 0000 hours December 12 through the period ending midnight 15 December 1977 are utilized in the flood routing procedure, which is described in the hydrologic routing section. The

[5] Nelson, E., 20 January 1978 Memorandum for Record, "Storm Surge Effects in Puget Sound During Highest Recorded Tide - 15 December 1977," Seattle District COE, Engineering Division, Planning Branch.

predicted and adjusted (100-year) tidal hydrographs are displayed in Figure 3-3 below. Note the period 12-15 December contains daily diurnal peaks in excess of MHHW +1 foot, a value typically used in Corps studies as a reasonably coincident tide peak for tidally influenced systems analyses. The 12-15 December hydrograph sequence serves to retard flow through the wetland and, for the 'without tidegate' condition, provides for sustained backflow through the culvert.

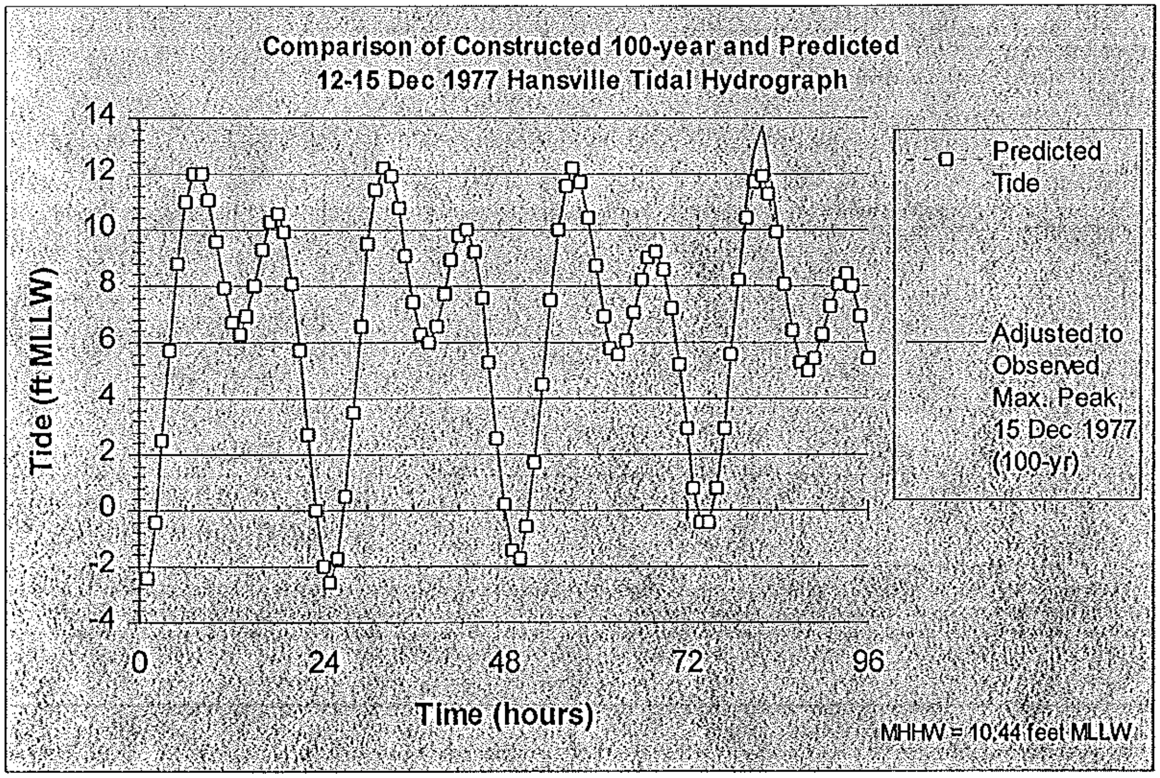

Figure 3-3: Hansville Tidal Hydrograph

4. Hydraulic Analysis

A hydraulic analysis was conducted to construct a family of rating curves for the culvert system which drains the Hansville Wetlands. The culvert specifications shown below in Table 4-1 were obtained during a field visit to the site 27 May 1997 by Dennis Mekkers and Kim Nguyen of Hydraulics Section. A profile schematic of the culvert system is shown as Figure 4-1.

Vertical control was obtained from National Ocean Service benchmark 5526 E 1977, which is set flush in the concrete entrance to Hansville Community Church near the intersection of Hansville Road and Twin Spits road. Benchmark elevation is EL 13.25 MLLW.

Rating curves for the culvert system were constructed using the computer program CULVERT (V. 85.10) developed by the St. Louis District Corps. The junction box required the culvert system be analyzed as two distinct sections: one upstream of the junction box, the other downstream. An entrance loss coefficient of 1.0 was assigned to the upstream section

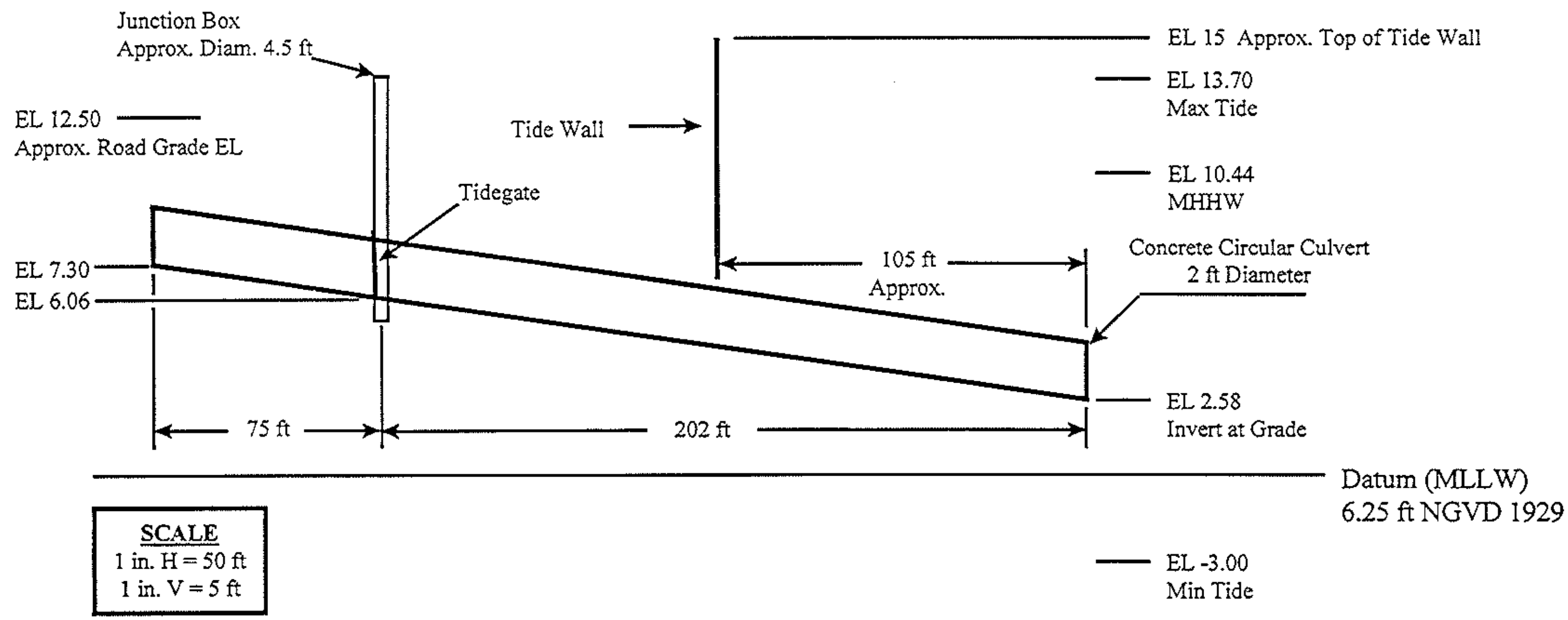

Figure 4-1: Profile Schematic of Hansville Wetland Culvert System

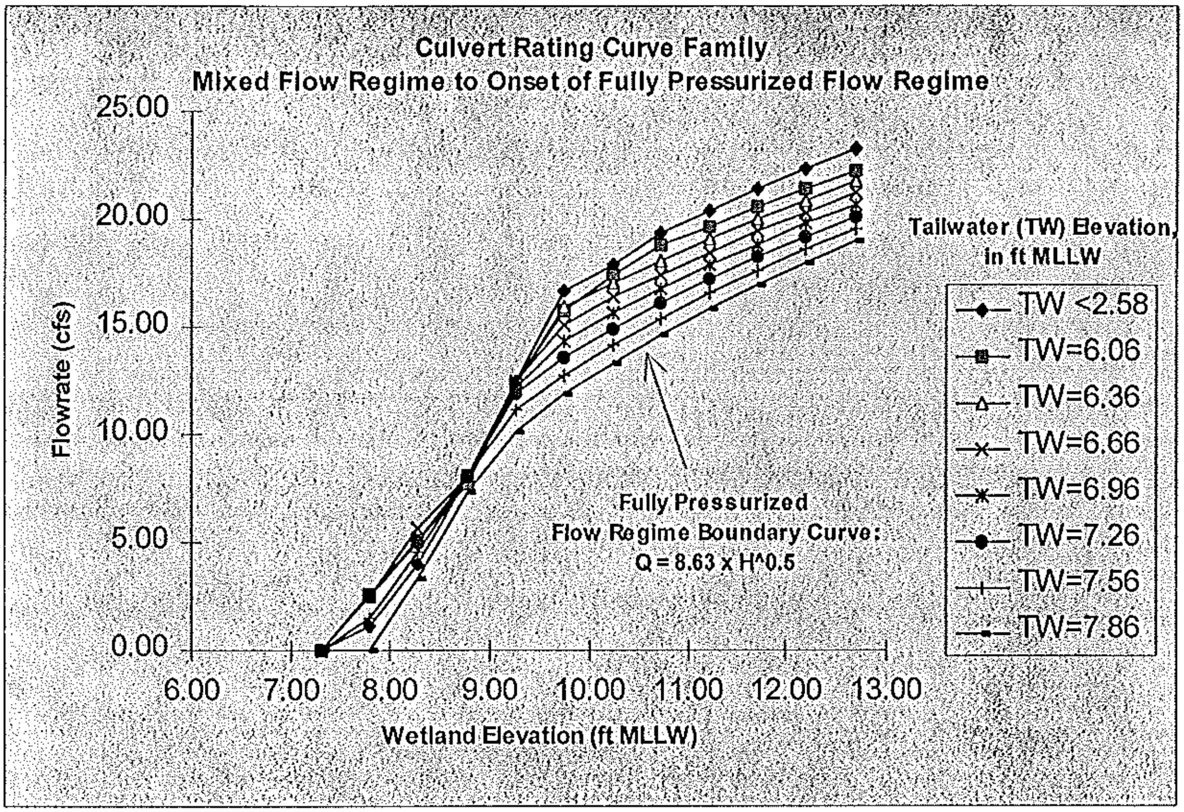

Figure 4-2: Culvert Rating Curve Family

and an entrance loss coefficient of 1.5 was assigned to the downstream section. The larger entrance loss coefficient on the downstream culvert section represents combined tidegate, junction box and entrance loss coefficients. A value of 0.014 was assumed as Manning's 'n' value. Flowrate was computed at 0.3 foot tide elevation increments. A family of rating curves, shown in Figure 4-2 above, for the culvert system was obtained by determining the wetland elevation required to drive a given flowrate through the downstream section for each tide elevation increment. The maximum flow rate through the culvert is about 23 cfs, which occurs when the tide elevation is below the downstream invert and the wetland elevation is about 12.7 ft MLLW.

Table 4-1: Culvert Specifications

Culvert Type	Circular Concrete Pipe
Nominal Pipe Diameter	24 inches
Upstream Invert EL (ft MLLW)	7.30
Inverts at Junction Box (ft MLLW)	6.06
Junction Box Diameter (approximate, ft)	4
Downstream Invert EL (ft MLLW)	2.58
Culvert Slope (ft/ft)	0.017
Total Culvert Length (ft)	277

5. Wetland Elevation-Storage Relationship

The Hansville Wetland elevation-storage relationship was created based primarily on ground survey data from Wiltermood Associates, Inc., of Port Orchard, Washington (date of survey unknown). The elevation-storage relationship was created on a Microstation computer platform in Civil Design Branch. Storage was computed at 0.5 foot contours between EL 6.0 ft and EL 12.5 ft MLLW. The Hansville Road and Twin Spits Road bounded the computations at the east and north margins of the wetland, while EL 12.5 ft bounded elsewhere. The volume of structures within these boundaries has not been accounted for in the computations. The resultant relationship is shown in Table 5-1 below.

Table 5-1: Hansville Wetlands Elevation-Storage Rating Table

STAGE (feet MLLW)	STORAGE (cubic feet)	STORAGE (acre-feet)
6.5	678	0.016
7.0	2,331	0.054
7.5	8,517	0.196
8.0	23,524	0.540
8.5	74,142	1.70
9.0	260,981	5.99
9.5	507,672	11.65
10.0	793,417	18.21
10.5	1,117,743	25.66
11.0	1,477,128	33.91
11.5	1,865,781	42.83
12.0	2,280,866	52.36
12.5	2,719,767	62.44

6. Hydrologic Simulation Model

A continuous simulation hydrologic routing computer model was constructed using the object-oriented computer software STELLA II (Version 3.0, High Performance Systems Inc.). The model uses a level reservoir routing algorithm to evaluate the change in storage of the wetland at hourly intervals during the four day simulation.

The initial water surface elevation in the wetland was assumed to be at the elevation of the culvert upstream invert (EL 7.30 MLLW). Surface water inflow rates are assumed to be independent of reservoir storage. All wetland outflows are assumed to pass through the culvert; that is, no wetland storage losses are accounted for in the model where, in reality, topography might allow flow out of the wetland by other means, such as discharge over roadways or by conveyance through the soil.

Hydrologic analyses were conducted with this model to estimate the water surface elevation in the Hansville wetland for the following conditions:

1. The existing condition (Finn Creek flows are not routed into the wetland).
2. The existing condition without tidegate.
3. Finn Creek flows routed through wetland, with tidegate.
4. Finn Creek flows routed through wetland, without tidegate.

The existing condition assumes that no Finn Creek flows enter the wetland. However, Finn Creek has been known to over-top the Hansville road and flow into the wetland at 2 to 3 year intervals. This condition was observed and photographically documented on 31 December 1996 by Ken Shawcroft, a local resident. Flow over the road during that day was reportedly as much as 4 inches deep, but did not appear to persist at that depth throughout the day. Model results for the existing condition may then somewhat underestimate wetland inflows.

Tidegate operations are modeled such that, when the tide elevation exceeds EL 7.71 feet and the tide elevation exceeds that of the elevation of stored water in the wetland, no water is allowed to pass out of the wetland.

When the tide is of sufficient elevation, saltwater may backflow through the culvert and into the wetland in the absence of the tidegate. Backflow is assumed to be pressure-type flow in the model.

Pressure type flow in the model is assumed, for all conditions, when the tide elevation exceeds 7.71 ft MLLW. In the absence of the tidegate, pressurized flow proceeds in the direction of greater energy; i.e. when the elevation of wetland storage exceeds that tide elevation, pressure flow discharges to the Sound, and when the tide elevation exceeds the elevation of the wetland, pressure flow discharges to the wetland.

Note that residents have observed saltwater flowing into the wetland on a more or less regular basis, as the tide gate is notorious for becoming lodged open by debris. Mssrs. Mekkers and Nguyen removed a sizable fence post which had become lodged in the tidegate during their 27 May 1997 field visit. There is no trashrack at the wetland culvert system. It is unclear to what extent the lodging of debris in the tidegate has exacerbated the severity of flooding in the past. It is recommended that a trash rack be installed and regularly maintained to mitigate potential flooding.

7. Simulation Results

The following table shows the Hansville Wetland water surface elevation for the four simulations conducted in order as presented in the previous section:

Table 7-1: Hydrologic Simulation Model Results

SIMULATION	MAXIMUM WETLAND ELEVATION (feet MLLW)
Existing condition.	9.5
Existing condition without tidegate.	9.9
Finn Creek flows routed through wetland, with tidegate.	12.1
Finn Creek flows routed through wetland, without tidegate.	12.3

The simulation results presented above suggest that routing the total 100-year estimated Finn Creek flow through the wetland during a coincident 100-year tide event would probably impart adverse impacts to properties adjacent to the wetland. The results also suggest that the presence of the tidegate does not have a great influence on the maximum water surface elevation in the wetland during periods of prolonged and sustained high rates of inflow.

7.1. Discussion of Results

While the model results show quite clearly that there would probably be adverse impacts to properties adjacent to the wetland during conditions similar to those evaluated, the question as to the benefit of routing streamflows through the wetland and allowing for tidal inundation of the wetland, while not specifically addressed in this study, remains largely unanswered.

The imposed condition of coincident 100-year streamflow and 100-year tide for this analysis is over-conservative; the likelihood of these conditions being met is presumably very small. Where tidal influences on estuarine and riverine hydraulics are demonstrated, typical COE analyses in this region employ a maximum coincident tide elevation of MHHW + 1 foot.

There may be some benefit in diverting a portion, rather than the total, Finn Creek flow through the wetland. Residences and businesses to the east and north of Hansville Road which are currently subjected to flood damage may benefit by utilizing vacant wetland storage during flood events. Additionally, the wetland is of sufficient volume that it may be possible to contain all Finn Creek flows, except during severe events, without introducing adverse impacts to those constituents not already subject to them.

Simulations suggest that the system is, not surprisingly, most sensitive to inflow. Sensitivity runs were performed using an inflow hydrograph created in a HEC-1 model which was exactly similar to that which produced the inflow hydrographs presented earlier except for a 'normal' antecedent wetness condition assumption. The maximum elevation in the wetland for this scenario was about 0.75 feet less than for the 'wet' antecedent wetness assumption.

Further investigations which would help to refine the inflow hydrograph may therefore prove beneficial.

The system is not particularly sensitive to uncertainty in culvert discharge ratings. Simulations were performed in which outflow was restricted to ±10% of calculated outflow for scenario 4. Associated maximum wetland elevations differed by less than ±3 inches.

The effect of the tidegate is generally more pronounced when the wetland is low with respect to the tide. The tidegate is most beneficial in maintaining wetland flood storage during the rising limb of the inflow hydrograph; as the wetland fills, the tide rarely has the energy to drive significant flow into the wetland. As a result, the difference between the 'no tidegate' condition and the 'with tidegate' condition diminishes.

An exploratory modeling exercise was also conducted in which the wetland was configured to retain all backflow, exclusive of all other inflows, which the 100-year tide could drive into it. The purpose of this exercise was to determine whether or not a severe tide sequence in and of itself would present a flooding hazard to residents were the operation of the tidegate suspended. Note that this is a conservatively constructed exercise, since in reality water would periodically discharge to the Sound during ebb tide. The resultant elevation in the wetland is about 10.3 feet for the 4 day simulation. This clearly demonstrates that on a daily basis, the wetland should easily accommodate even the most severe tidal inundation.

Given additional uncertainties regarding the true extents of the basin and wetland storage, care should be taken in modifying the system. At the least, more definitive physical and hydraulic parameters should be established for Finn Creek, including sediment transport potential, slope, gradient, and cross-sectional properties. The Hansville Wetland topography should be more thoroughly established, as well as its areal extent. Ecologic and biologic investigations, while not addressed in this study, are important considerations, and may merit further investigation. Additionally, information is needed regarding the location elevation of infrastructure and residences adjacent to and near the wetland, including road grade elevations, drain field extents and elevations, and other systems.