Report of the

Results of the Cultural Geophysical and Historic Archaeological Resource Investigations at the Pontoon Moorage Site, Grays Harbor, WA

Prepared for:
WSDOT
Seattle, WA 98101

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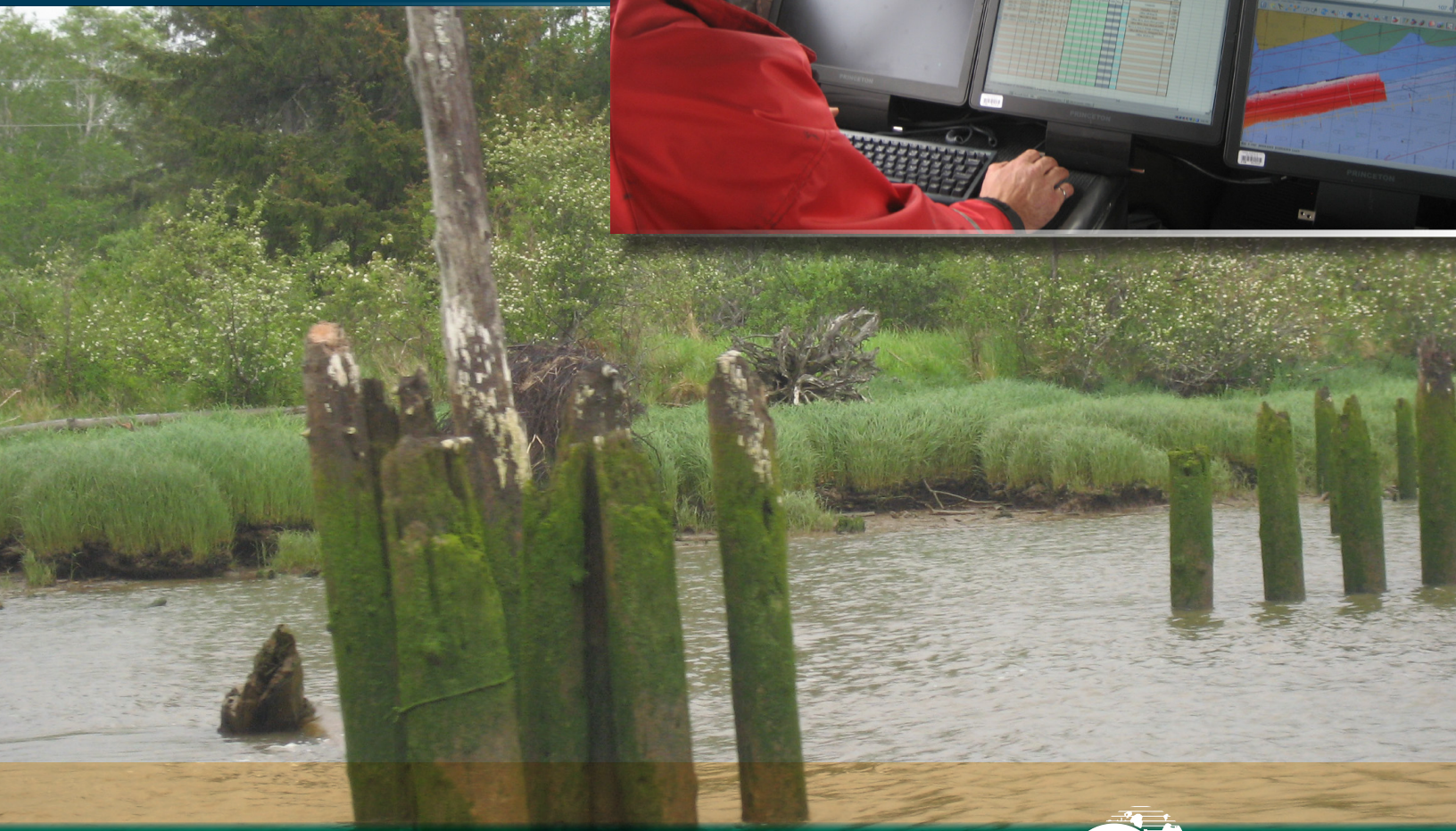
Golder Associates Inc.
Redmond, WA 98052

March 31, 2010



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REPORT

Report of the Results of the Cultural Geophysical and Historic Archaeological Resource Investigations at the Pontoon Moorage Site, Grays Harbor, WA

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March 31, 2010 **Project No. 103-93032.100**

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REPORT

Section 1

Results of the Offshore Geophysical Investigation and Cultural Resource Study at the SR 520 Pontoon Moorage Site

March 31, 2010 **Project No. 103-93032.100**

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EXECUTIVE SUMMARY

The Washington State Department of Transportation (WSDOT) is planning to construct the pontoons needed to replace the SR 520 floating bridge that crosses Lake Washington from Seattle to Bellevue. The department has identified a preferred 55-acre industrial site in Aberdeen, Washington large enough to simultaneously build multiple pontoons and is evaluating a site within Grays Harbor where these pontoons can be anchored and stored until required. The purpose of the Pontoon Construction Project is to expedite the construction of pontoons sufficient to replace the existing traffic capacity of the Evergreen Point Bridge. To achieve this purpose, WSDOT is proposing to build a new casting basin facility that can accommodate simultaneous construction of multiple pontoons and a moorage site for storing the pontoons in the event that they are needed for catastrophic failure response or until they can be incorporated into the planned bridge replacement.

Site requirements necessary for a feasible facility location include:

- Deep water access for pontoon transport
- Sufficient acreage for constructing multiple pontoons at a time with lay down areas for materials and equipment storage
- Access to moorage areas for pontoon storage
- The site cannot have high potential for cultural resources. The extent and value of such resources may not be fully understood until construction is initiated and could substantially delay the schedule or halt the project.

To assist WSDOT in identifying potential moorage locations in Grays Harbor a marine geophysical investigation was conducted in 2008 to map the bathymetry, characterize the seafloor geomorphology and map the aerial and vertical extent of sediment and subsurface geology at nine (9) sites. Based on the results of the 2008 study WSDOT selected a pontoon moorage site, Site 7, and requested that an additional geophysical investigation and archaeological study be conducted at this site. The moorage site is located in state-owned aquatic lands where archaeological resources including abandoned ship or aircraft wrecks are subject to the provisions of the provisions of the Archaeological Sites and Resources Act, National Historic Preservation Act (NHPA), the Abandoned Shipwreck Act, the Sunken Military Craft Act, and other laws that may require identification and assessment of historic and archaeological resources that may be subject to impacts by project developments.

The objectives of the archaeological study were to: (1) Conduct background research to assess the archaeological potential; (2) Analyze the existing geophysical data and magnetometer data for anomalies that are potentially of cultural origin; and, (3) Provide a report documenting results including the identification and evaluation of possible archaeological impacts by the proposed development, with recommendations for appropriate impact management actions.

Based on historical research, this study concludes that there is low potential for marine historic archaeological resources to exist in the survey area. This is determined by the absence of reported

wrecking events in the survey area as well the physical characteristics and use history of the survey area. The geomorphology and dredging history of the area further suggests a low prospect for the survival of archaeological remains in the survey area.

Based on analysis of marine geophysical data, there is no interpreted indication of any marine historic archaeological resources located on the surface, or at depth below the river floor within the survey area. No targets were identified that require verification or further documentation. No new archaeological sites were inventoried as a result of this survey. As a result of these conclusions, no further archaeological investigations of marine historic archaeological resources at the Grays Harbor Pontoon Moorage Site are recommended.

INTRODUCTION

The Washington State Department of Transportation (WSDOT) is planning to construct a number of pontoons to be used for the proposed SR 520 floating bridge that crosses Lake Washington from Seattle to Bellevue. The purpose of the Pontoon Construction Project is to expedite the construction of pontoons sufficient to replace the existing traffic capacity of the Evergreen Point Bridge. To achieve this purpose, WSDOT is proposing to build a new casting basin facility that can accommodate simultaneous construction of multiple pontoons and a moorage site for storing the pontoons in case they are needed for catastrophic failure response or until they can be incorporated into the planned bridge replacement.

Site requirements necessary for a feasible facility location include:

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- Access to moorage areas for pontoon storage
- The site cannot have high potential for cultural resources. The extent and value of such resources may not be fully understood until construction is initiated and could substantially delay the schedule or halt the project.

To assist in identifying potential moorage locations in Grays Harbor a marine geophysical investigation was conducted by Golder in 2008 to map the bathymetry, characterize the seafloor geomorphology and map the aerial and vertical extent of sediment and subsurface conditions at nine (9) locations (Marine Geophysical Investigation for the Pontoon Construction Project 083-93301).

Based on the results of the 2008 study WSDOT selected a moorage site, Site 7, and requested that Golder conduct an additional geophysical investigation and desktop study at this site. The selected moorage site is located in state-owned aquatic lands where archaeological resources including abandoned ship or aircraft wrecks are subject to the provisions of the National Historic Preservation Act (NHPA), the Abandoned Shipwreck Act, the Sunken Military Craft Act, and other laws that may require identification and assessment of historic and archaeological resources that may be subject to impacts by project developments.

The objectives of the archaeological study were to:

1. Conduct background research in order to assess the archaeological potential at Site 7
2. Analyze the existing geophysical data and the newly acquired magnetometer data to assess for anomalies that are potentially of cultural origin
3. Provide a report documenting results including the identification and evaluation of possible archaeological impacts by the proposed development, with recommendations for appropriate impact management actions

The field operations, conducted by Golder Associates Inc. and TerraSond Ltd. took place from February 22 to 26, 2010. The following two sections present the results of this study. Section 1 presents the Geophysical Investigation and Section 2 presents the Historic Archaeological Resource Investigation.

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1.0 SITE DESCRIPTION

Grays Harbor is an estuarine bay located 45 miles north of the mouth of the Columbia River, on the southwest Pacific coast of Washington State (Figure 1). The bay is approximately 15 miles long and 11 miles wide and is relatively shallow except for the navigation channel which is periodically dredged. The Chehalis River flows into its eastern end, where the city of Aberdeen is located at the river's mouth. The city of Hoquiam is located immediately to its northwest, along the shore of the bay. Besides the Chehalis, many lesser rivers, such as the Hoquiam, and streams flow into Grays Harbor. A pair of low peninsulas separates the bay from the Pacific Ocean, except for an opening about two miles in width. The northern peninsula, which is largely covered by the community of Ocean Shores, ends in Point Brown. At the end of the southern peninsula, cross the bay-mouth, are Point Chehalis and the town of Westport.

Grays Harbor, Washington

2.0 FIELD PROGRAM

The offshore geophysical investigation included precision navigation, marine magnetometry and seismic reflection or subbottom profiling (Figure 2). The following is a brief discussion of the instrumentation and methods.

2.1 Offshore Survey Instrumentation

2.1.1 Survey Vessel

The vessel used for the investigation was TerraSond's *R/V Carta*, a 27-foot custom built, shallow draft aluminum survey platform. GPS antennas were mounted on a fixed 6 foot staff located forward on the house and clear of any obstructions. The vessel has a full complement of safety and navigation equipment, in addition to the survey systems. Acquisition and navigation monitors are mounted forward on the dash, while the processors and sensitive electronics are secured in a vibration isolated rack.

The geophysical equipment installation followed by calibration and dock side operational checks took place at the Westport marina. A final operational check was made of all systems prior to initiation of the survey.

Geophysical survey vessel

2.1.2 Survey Area

Magnetometry and subbottom data were acquired at Site 7, the selected pontoon moorage site that was also mapped on the previous geophysical survey (Figure 1, Map 1). The transect interval was 20 to 30

feet (Map 2) and varied in length from 1,000 to 6,000 feet. The site was approximately .35 square miles in size.

2.1.3 Navigation

A real time differential global positioning system (DGPS) was used to determine the vessel's location in real-time (+/- 2 feet), and to plot the vessel's position along the pre-selected survey lines (Table 1). The pre-plotted survey lines, and the actual survey lines traversed, were displayed in real-time on a video monitor located on the bridge for use by the vessel operator. The navigation computer transmitted event marks to the subbottom recording instruments every 20 seconds in order to correlate the geophysical data with the survey vessel position during data analysis and mapping. These event marks were also logged with the geophysical digital data. The magnetometer data was logged with the navigation data at a rate that varied from 10 to 20 samples/second.

Magnetometer acquisition on left, navigation screen in middle.

TABLE 1

Survey Geodesy Settings

Parameter	Setting
Grids	STATE PLANE NAD-83
Zone	Washington State Plane South
Distance Unit	US Survey Feet
Depth Unit	US Survey Feet
Ellipsoid	NAD-83
Vertical Datum	Published NOAA MLLW,
Horizontal Control	USCG Fort Stevens, OR, GPS beacon ID 272, 287.0 kHz
Vertical Control	Westport gauge 944-1102, Aberdeen Station 944-1187, 1960-1978 Epoch

2.1.4 Navigation and Bathymetric Procedures

The survey was conducted in accordance with the procedures in the US Army Corps of Engineers Manual 1101-2-1003, Engineering and Design Hydrographic Surveying. Navigation fixes were acquired 10 times/second and this information was transmitted to the magnetometer and seismic reflection data acquisition systems (Table 2). Bathymetric data were not obtained on this survey since a multibeam survey was conducted in 2008. For continuity with that report the following information is provided regarding datum and vertical and horizontal control.

The soundings were based on the Mean Lower Low Water (MLLW) datum at the NOS tide stations 944-1187 (Aberdeen) and 949-1102 (Westport), 1960-1978 tidal epochs. The old epoch, 1960-1978 was used since the USACE is still using these values. We thought it was important to be consistent with the navigation surveys.

Rather than developing a complex tidal zoning scheme between the two tide stations, the following methodology was used to reduce the soundings to MLLW.

1. *The ellipsoid height of the water surface was measured at survey vessel using Real-Time Kinematic GPS.*
2. *The ellipsoid heights were converted to NAVD88 elevations in post processing using the National Geodetic Survey (NGS) GEOID03 geoid model.*
3. *Soundings were converted to MLLW by applying a -1.55 ft shift to correct for the NAVD88 and MLLW separation.*

This method is consistent with the US Army Corps of Engineers methodology for surveys in Grays Harbor.

The -1.55 foot shift was computed by taking the average of the NAVD88 to MLLW separations at the following benchmarks:

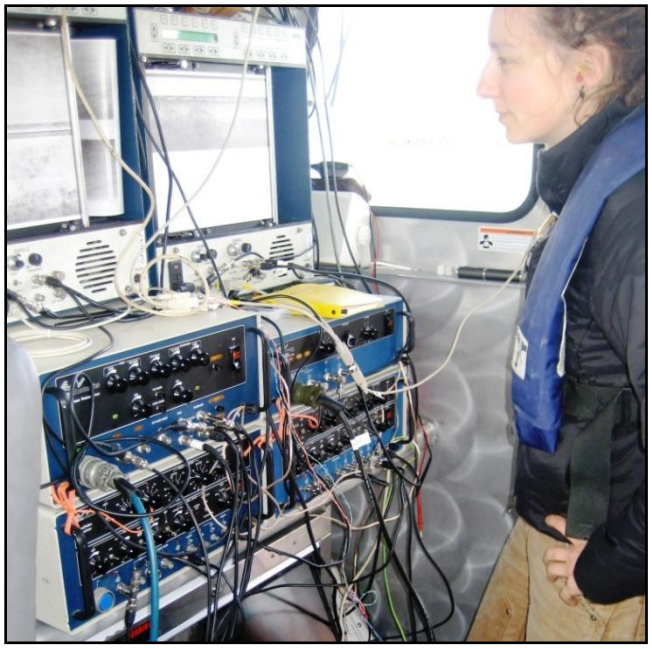
Tide Station	***Benchmark***	***NAVD88 Elevation***	***MLLW Elevation***	***Delta***
Westport	*TIDAL 8*	*14.69*	*16.18*	*-1.49*
Westport	*TIDAL 2 RESET*	*15.26*	*16.77*	*-1.51*
Aberdeen	*TIDAL 2*	*13.78*	*15.34*	*-1.56*
Aberdeen	*TIDAL 3*	*14.41*	*16.02*	*-1.61*
Aberdeen	*TIDAL 5*	*18.17*	*19.77*	*-1.60*
			Average	***-1.55***

TABLE 2
Navigation Survey Equipment

Sensor Type	Manufacturer/Model
Inertial Navigation System	CODA F185
Heading	Applanix WaveMaster
Position	Trimble 5700 RTK GPS
Navigation Software	OPS QINSy, ver. 8.0
Processing Software	Caris HIPS, ver. 6.1

2.1.5 Seismic Reflection System

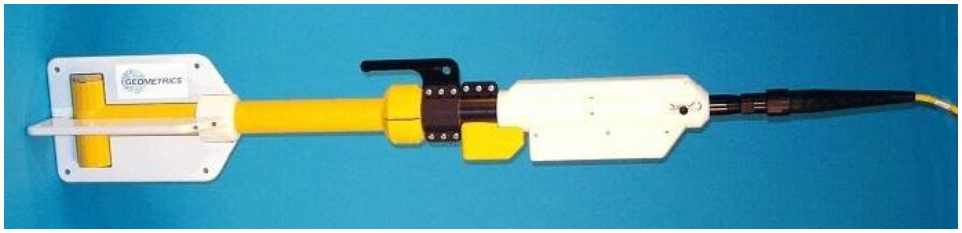
Subsurface data were acquired with a low frequency seismic reflection system (SRS, Figure 2). The SRS achieved a maximum subsurface penetration of 200 feet. The subsurface reflection data, acquired three times each second, or for every two foot of travel along the transect, were displayed in real-time on a thermal graphic recorder and archived on a digital recorder. The digital acquisition system and the graphic recorder were interfaced with the navigation computer which annotated event mark at 20 second intervals. A picture of the acquisition and display system is shown below and the instruments are listed in Table 3 below.



Graphic recorder on top left displays the sidescan sonar data and the graphic recorder on the right displays the subbottom profiler and seismic reflection data.

2.1.6 Magnetometer System

The magnetic data were acquired with a Geometric 882 cesium vapor magnetometer system which acquired data at a rate of 10 to 20 samples/second. This system has fast sampling at high sensitivity so that even small targets can be detected. Cesium vapor technology provides the greatest detection range with a sensitivity of 0.004 nT/Hz. The streamlined design improves safety and has less chance of snagging on rocks or debris and the convertible nose or CG tow mechanism places the magnetometer sensor deeper. Furthermore, the flash memory stores all parameters, eliminating need for on-board reprogramming.



Marine magnetometer sensor that is towed 10 to 15 feet above the seabed

TABLE 3

Geophysical Instrumentation

System	Manufacturer	Specifications
Seismic Energy Source	Datasonic Bubble Pulser	350/700 Hz, 24 joules
Seismic Processor	GeoAcoustic 5210A	100 db gain, TVG, BP filter
Seismic Digital Acquisition	Sony Model 208 DAT	8 Channel, 12 bit DAS
Digital Acquisition	Chesapeake SonarWIZ	TVG, 12 bit logging for sidescan sonar
Seismic Digital Acquisition	Sony Model 208 DAT	8 Channel, 12 bit DAS
Graphic Display Recorders	EPC Model 1086-500	2-Channel, 12 bit display
Magnetometer	Geometric G-882	Sensitivity at 0.004 nT/Hz
Processing Software	Geometric MagLock	

3.0 OFFSHORE SURVEY PROCEDURES

3.1 Operations

The navigation, magnetometer and seismic reflection systems (transducers, power supply, digital acquisition systems, and graphic recorder) were installed on the survey vessel at the marina in West Port. The acoustic source was towed from the starboard side of the vessel and hydrophone streamer was towed from the port side of the vessel. The magnetometer was towed from the port side of the vessel using a 60 lb lead depressor to maintain the sensor at approximately 10 to 15 feet above the seabed. The power supplies, processing amplifier, digital acquisition systems, graphic recorders and navigation equipment were installed in the instrumentation lab located adjacent to the hydrographic/navigation system and the bridge.

A dock side operational test was performed on the systems followed by a brief sea trial to calibrate systems that could not be tested dockside (acoustic sources array, hydrophones). The navigation system and hydrographic system were also tested and calibrated at this time.

3.2 Survey Coverage

Upon completion of a successful operations test and calibration, the survey began running both systems simultaneously. The survey transects paralleled the shore line and were run at a 50 foot intervals to facilitate turning and coming on line at the end of each transect. When the first set of transects was completed across the site a second set was begun that was offset by 25 feet from the first set. This resulted in the proposed coverage of survey transects at a 20 to 30 foot interval.

4.0 DATA PROCESSING AND ANALYSIS

Preliminary analysis and archiving of geophysical data was done at the end of each survey day. This consisted of reviewing the trackline locations to verify the data coverage, QA/QC of the magnetometer and subsurface reflection data, archiving field records, and downloading the digital data to digital media.

4.1 Navigation Data

A table of event numbers (10 second intervals), with their x, y coordinates was generated from the navigation data for the two geophysical systems. The event numbers, which correspond with the events printed on the paper copies were then plotted on a trackline map for the entire area (Map 2). The trackline map was used for interpreting the data along each transect, for correlating the interpreted data from the different systems and creating plan view map showing the location of magnetic anomalies (Map 3).

4.2 Subbottom and Sidescan Sonar Data

Both subbottom data sets (2008 and 2010) and the sidescan sonar data (2008) were analyzed for the presence of anomalous features on the seabed and in the subsurface that might indicate or suggest the presence of discrete targets. These anomalous reflection patterns can be produced by any number of discrete objects including boulders, logs as well as cultural artifacts. The location and subsurface depth of anomalous subsurface features where then placed on the trackline map using the event numbers to locate their position.

4.3 Magnetometer Data

The magnetometer data were downloaded into MagMap and then edited to remove data spikes and to integrate the GPS and magnetic reading. This common file was then imported into Surfer for gridding, contouring and interpretation. A total of 615,000 data points were used for the analysis. The interpreted magnetic anomalies were then mapped and where possible correlated with known features shown on the marine charts or features that were identified and noted in the log book as they were passed on each transect.

5.0 RESULTS

This section summarizes the interpreted geophysical data from the subbottom and magnetometer systems. Due to the lack of borehole or bottom samples to calibrate or ground-truth the geophysical interpretations of the subsurface soils the information presented in this section is preliminary and is suitable for conceptual design purposes only.

5.1 Subbottom Data

The subbottom reflection data collected during this survey provided the same information as found on the 2008 survey. In summary the seabed is mantled with approximately 20 to 50 feet of unconsolidated sediment, possibly medium-grained sand, overlying a more dense material. This lower unit is assumed to be a semi consolidated marine sediment. A more precise geological description and/or geotechnical characterization of either unit requires a subsurface sample.

There was no evidence of surface or subsurface anomalous reflections on the data that were interpreted to be discrete targets or potential cultural artifacts.

5.2 Magnetometer Data

The magnetic anomalies ranged in magnitude from several NanoTeslas (nT) to 500 nT (Map 3). The anomalies associated with known features, such as crab pots and navigation aids, ranged from 20 to 500 nT. The magnetic anomalies with unknown sources ranged from 20 to 200 nT and are possibly derelict crab pots since they are within the general areas of known crab pots. However, other sources of small, ferrous metallic objects could produce these anomalies. Assuming that a vessel of any significant size would produce a magnetic anomaly exceeding several thousand nT there was no interpreted evidence on the data to suggest the presence of sunken vessels.

FIGURES

FIGURE **1**

PONTOON MOORAGE SITE

HDR/MARINE HIST ARCHAE/WA

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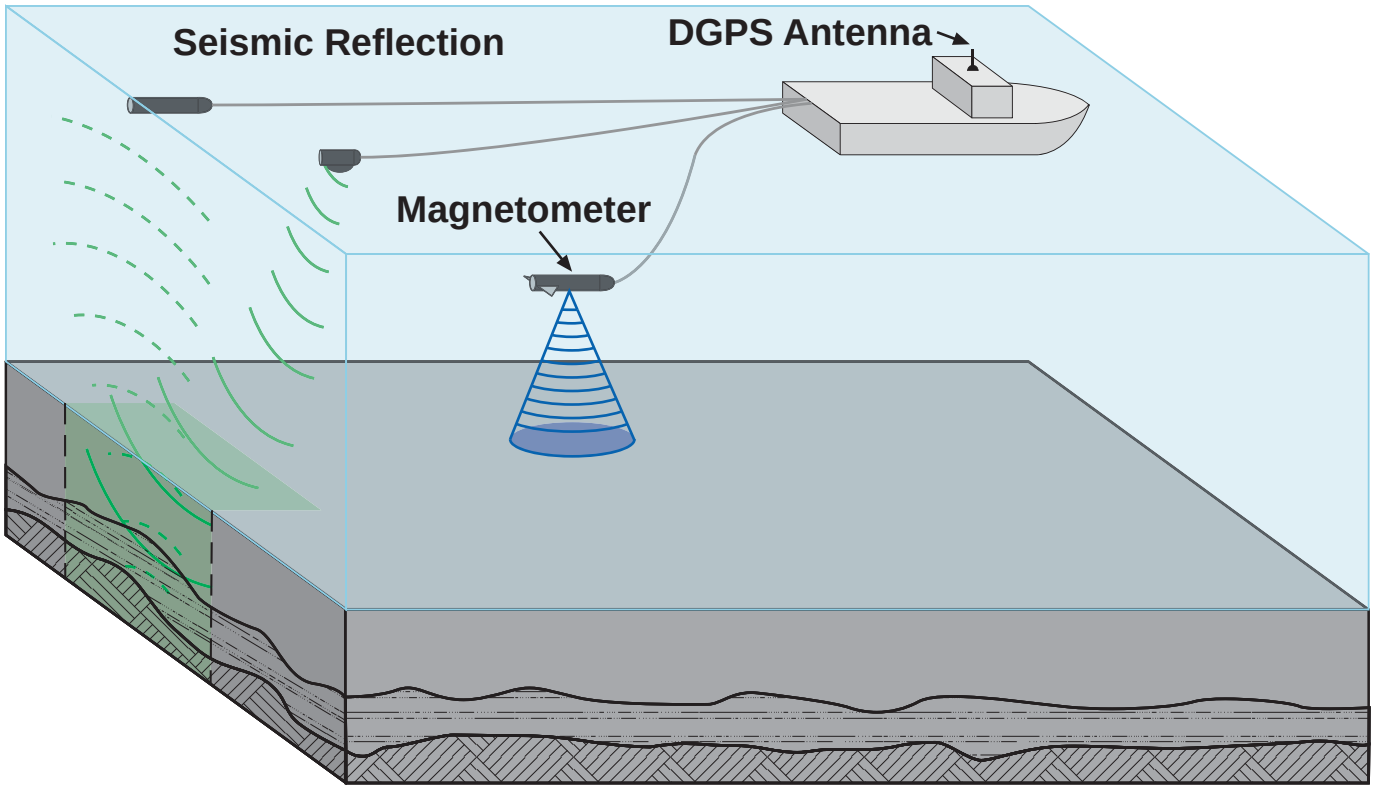

FIGURE **2**

GEOPHYSICAL INSTRUMENTS

HDR/MARINE HIST ARCHAE/WA

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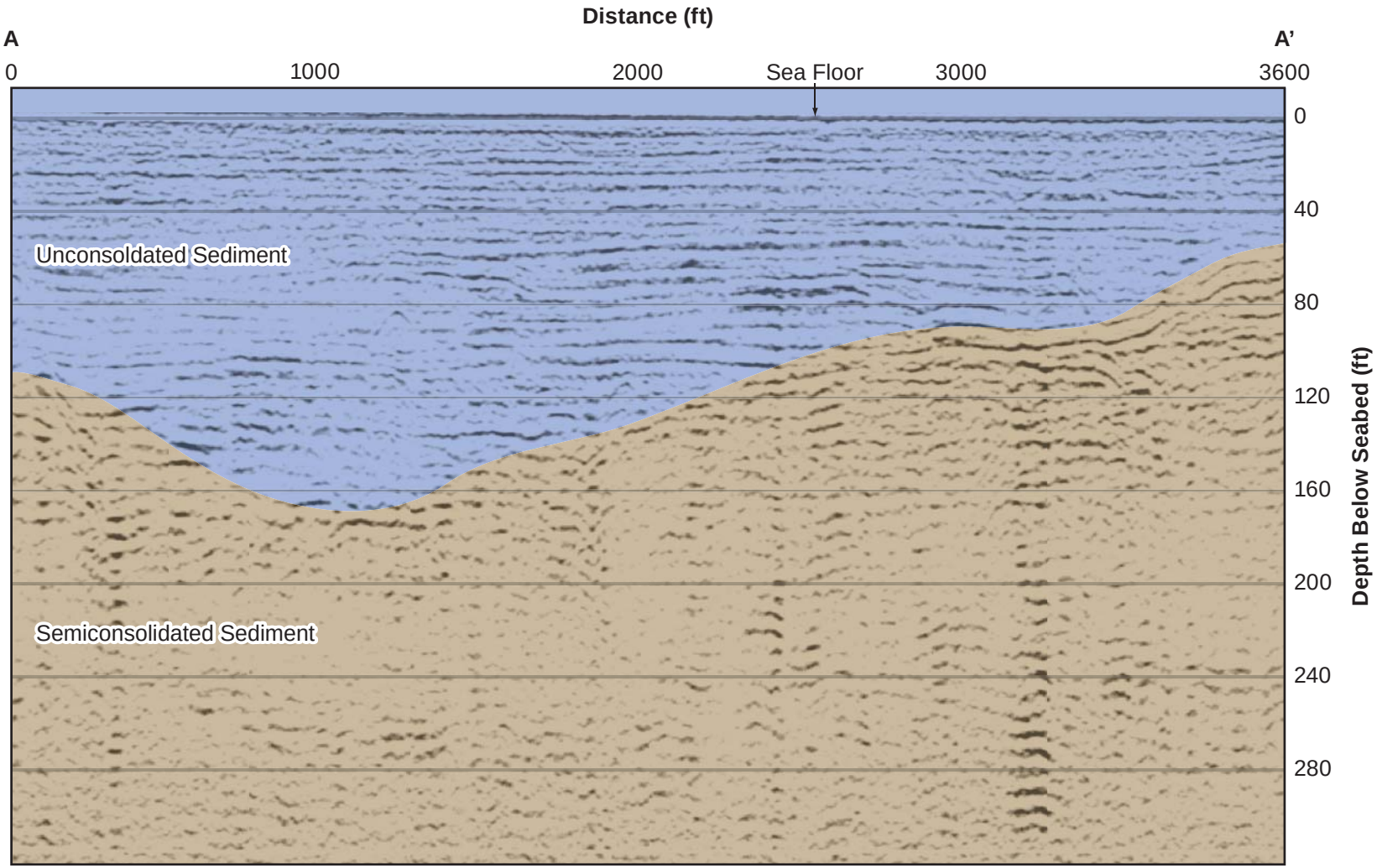

See Map 2 for Locations

FIGURE **3**

EXAMPLE OF SUBBOTTOM REFLECTION DATA

HDR/MARINE HIST ARCHAE/WA

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MAPS
(11x17)

0 5000 10000
SCALE IN FEET

KEY MAP

LEGEND

INSTRUMENTATION

TRIMBLE MODEL 5700 RTK - GPS
DATASONIC BP SEISMIC SYSTEM
CHESAPEAKE DIGITAL ACQUISITION
GEOMETRICS MODEL 882 CESIUM VAPOR MAGNETOMETER

GEODETIC PARAMETERS

VERT. DATUM:	NOAA MLLW, WESTPORT GAGE 944-1102, ABERDEEN 944-187
PROJECTION:	WA STATE PLANE, SOUTH ZONE NAD83

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SITE MAP

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MAP 1

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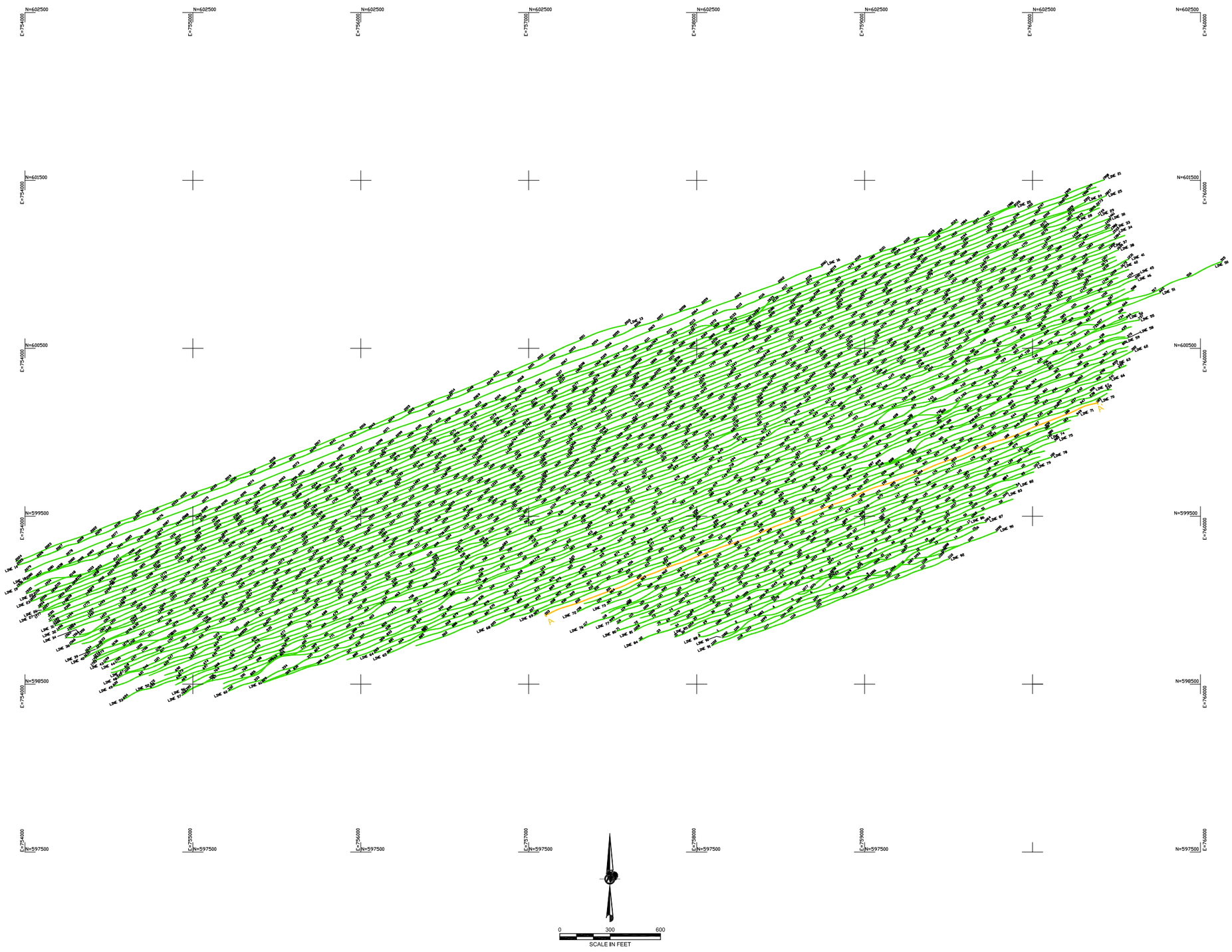

KEY MAP

LEGEND

MAGNETOMETER SURVEY TRACKLINES AND SBP EVENT NO. FOR SBP DATA

A — A' SEE FIGURE 3 FOR SUB BOTTOM DATA EXAMPLE

NOTES:

1. SBP DATA ACQUIRED 3 TIMES/SECOND
2. MAGNETOMETETRY DATA ACQUIRED 10 TIMES/SECOND

INSTRUMENTATION

TRIMBLE MODEL 5700 RTK - GPS
DATASONIC BP SEISMIC SYSTEM
CHESAPEAKE DIGITAL ACQUISITION
GEOMETRICS MODEL 882 CESIUM VAPOR MAGNETOMETER

GEODETIC PARAMETERS

VERT. DATUM: NOAA MLLW, WESTPORT
GAGE 944-1102, ABERDEEN 944-187
PROJECTION: WA STATE PLANE, SOUTH ZONE NAD83

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PROJECT:

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TRACKLINE MAP PONTOON MOORAGE SITE

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MAP 2

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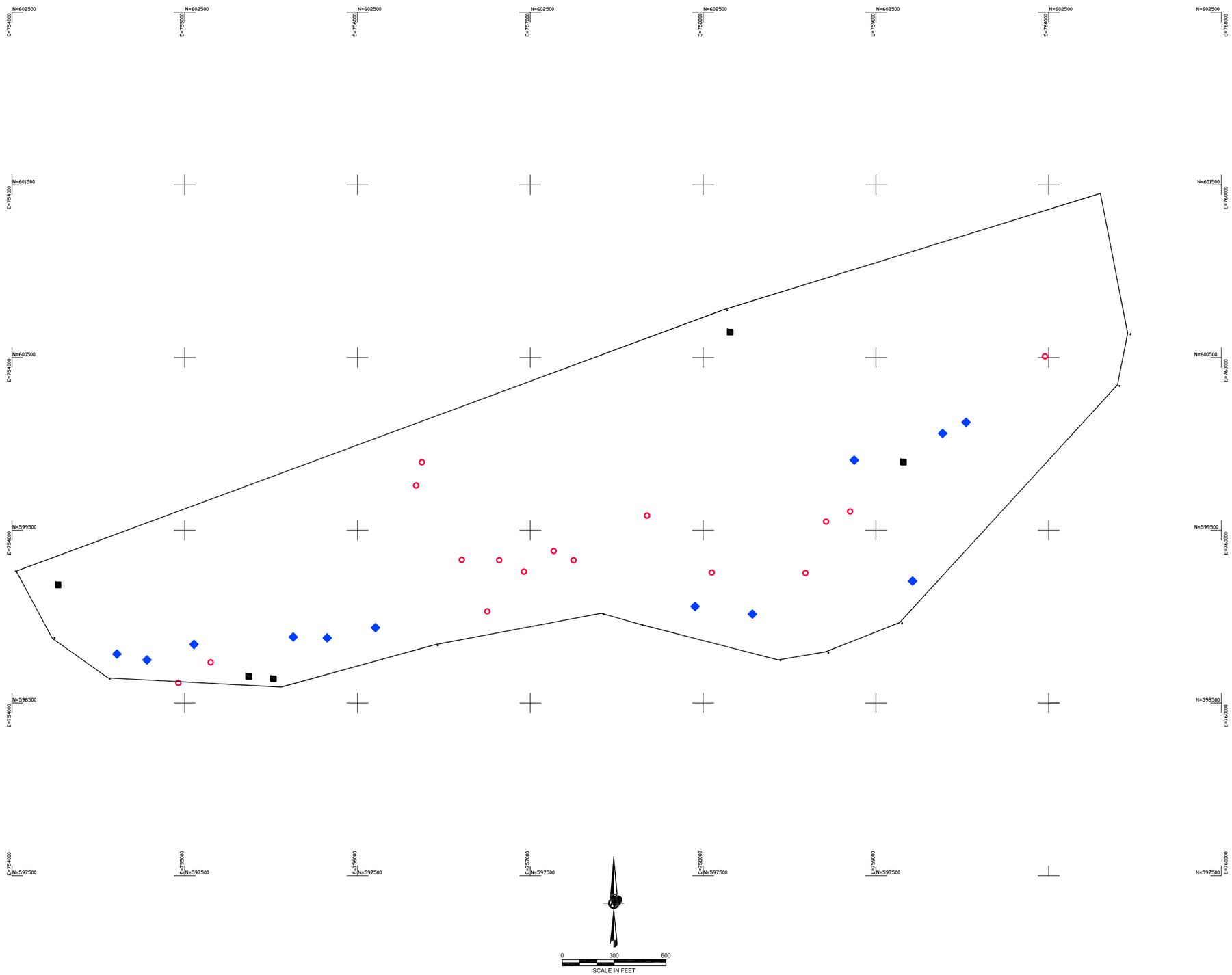
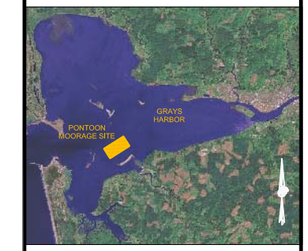


KEY MAP



LEGEND

- MAGNETIC ANOMALY SOURCE UNKNOWN <200 nT
- NAVIGATION AIDS (CHANNEL BUOYS, DAY MARKERS) 100-500 nT
- CRAB POTS 20-200 nT

INSTRUMENTATION

TRIMBLE MODEL 5700 RTK - GPS
DATASONIC BP SEISMIC SYSTEM
CHESAPEAKE DIGITAL ACQUISITION
GEOMETRICS MODEL 882 CESIUM VAPOR MAGNETOMETER

GEODETIC PARAMETERS

VERT. DATUM: NOAA MLLW, WESTPORT
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MAGNETIC ANOMALY MAP

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REVIEW	–	–

MAP 3

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MAPS
(D-SIZE)

REPORT

Section 2

Marine Historic Archaeological Resource Investigation, Grays Harbor, WA

March 31, 2010

Project No. 103-93032.200

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1.0 INTRODUCTION TO ARCHAEOLOGICAL STUDY

The Washington State Department of Transportation (WSDOT) is planning to construct a number of pontoons to be used for the proposed SR 520 floating bridge that crosses Lake Washington from Seattle to Bellevue.

The purpose of the Pontoon Construction Project is to expedite the construction of pontoons sufficient to replace the existing traffic capacity of the Evergreen Point Bridge. To achieve this purpose, WSDOT is proposing to build a new casting basin facility that can accommodate simultaneous construction of multiple pontoons and a moorage site for storing the pontoons in case they are needed for catastrophic failure response or until they can be incorporated into the planned bridge replacement.

Site requirements necessary for a feasible facility location include:

- Deep water access for pontoon transport
- Sufficient acreage for constructing multiple pontoons at a time with lay down areas for materials and equipment storage
- Access to moorage areas for pontoon storage
- The site cannot have high potential for cultural resources. The extent and value of such resources may not be fully understood until construction is initiated and could substantially delay the schedule or halt the project.

The department is evaluating a 55-acre industrial site in Aberdeen large enough to simultaneously build multiple pontoons, and has selected a proposed Pontoon Moorage Site within Grays Harbor where these pontoons can be anchored and stored until required. Golder Associates Inc. (Golder) was selected to provide additional geophysical investigations and archival review to assess the potential for the presence marine historic archaeological resources within the proposed Pontoon Moorage Site.

1.1 Project Background

Field surveys were conducted in 2008 by Golder and TerraSond Ltd. to map the bathymetry, characterize the seafloor geomorphology, and map the areal and vertical extent of sediment at nine (9) potential moorage locations in Grays Harbor (Golder 2008). Following these surveys, WSDOT selected one area, originally designated Site 7, where it proposed to locate the Grays Harbor Pontoon Moorage Site (Figure 1). The goal of the current Project is to meet requirements for additional investigations to assess for historic archaeological potential at the Pontoon Moorage Site, or survey area.

It is understood that the anchors employed to moor the pontoons will disturb the surface of the harbor floor and may penetrate to depths of between 30 and 60 feet. Previous survey data indicate that the harbor floor in the survey area is typically of 40-foot depth shoaling to 10 to 20 feet in the south, consists of medium to coarse-grained sediments to a recorded depth of over 100 feet, and is subject to influence by currents as demonstrated by the presence of sand wave features (Golder 2008:17-18).

Although historic resources are the focus of this study we understand that there is a low potential for archaeological sites associated with early Holocene landscapes submerged due to sea level change, or for shallow and sub-tidal pre-contact sites, including fish traps or weirs. This interpretation is based on a preliminary understanding of the water depth, nature and depth of mobile sediments, current velocities, and historic channel migration in the survey area. It was anticipated that the environment within the survey area could contain submerged historic archaeological resources, specifically the structural remains of wrecked or abandoned ships or aircraft, which may be impacted by the proposed development.

A wreck site may be visible in the acoustic record above the surface of the seabed or river floor, or its presence suggested in a scour pattern, but in the mobile sediments found in the survey area wreck sites could also be buried without visible trace beneath the river floor. Marine geophysical data collection for this investigations, that included the deployment of a magnetometer and a subbottom profiler, were selected to provide data that may detect the presence of a buried wreck site, and to supplement data previously collected with sidescan sonar.

Geophysical survey activity was limited to the survey area, an area of approximately 0.35 square miles. The historical overview related to marine historical archaeological resources focused on the survey area, but the study area for this Project encompassed the entire seascape of Grays Harbor due to the nature of archival records, the information required for establishing archaeological potential in the survey area, and the background necessary for establishing significance of any identified resources.

1.2 Regulatory Setting

The legal status of ship and aircraft wrecks on "state-owned aquatic lands" is determined by title. Any abandoned shipwreck lying on, in, or, under the survey area is on public land and specifically subject to terms of the Abandoned Shipwreck Act and corresponding state laws (WAC 25.46). If an abandoned shipwreck is 50 years old, title passes to the State, which is then responsible to manage the property. At this point (50 years), the shipwreck, including a related debris field may also be eligible for nomination to the State or National Registers if it meets criteria established for historic significance (RCW 27.34.220; NHPA Section 101). If it is of archaeological interest, it is the responsibility of the State to protect the shipwreck (see NPS Archaeology Program 1990).

Significant cultural resources are those that are 50 years old (less under certain exceptions), and eligible for inclusion in the National Register of Historic Places (NRHP) based on meeting most of the specified aspects of integrity and physical integrity, and the criteria for significance. Geisecke (2002) summarizes the four criteria for significance used by the NRHP as follows:

> The first concerns the resource's integrity of location, design, setting, materials, workmanship, feeling and association. In addition to integrity, resources are (a) associated with events that have made a significant contribution to the broad patterns of history; (b) are

associated with the lives of person significant in the past; (c) embody the distinctive characteristics of a type, period, or method of constriction, or that represent a significant and distinguishable entity whose components may lack individual distinction; or (d) have yielded may be likely to yield, information important in prehistory or history.

The Sunken Military Craft Act applies to ships and aircraft of all military services including the Coast Guard wherever they are located and under this Act the United States retains title to these remains. Protection under the Act extends to the debris field and graves of lost military personnel.

Human remains are also protected in state legislation (RCW 27.44, 68.50), while under the Abandoned Shipwreck Act “activities that would disturb [human remains] should be prohibited…until human remains are removed" (NPS Archaeology Program 1990).

2.0 RESEARCH DESIGN AND OBJECTIVES

The research for this Project consists of two components:

1. An historical overview of the Study Area including a summarized maritime history of Grays Harbor, identification of specific and potential wrecking events or abandonments that might have left vessels or aircraft remains in the survey area; an assessment of potential significance for any remains that may be found within the survey area; and a summary of known historical changes to the landscape of the survey area.

2. The generation and analysis of marine geophysical data, specifically sidescan sonar, subbottom reflection and magnetometer, to assess the presence or absence of vessel or aircraft wrecks within the survey area.

Results of this research and analysis are presented in thisreport that meets the standards for cultural resource reporting in Washington State (Department of Archaeology and Historic Preservation 2009).

2.1 Study Methodology

2.1.1 Literature Review and Archival Research

The historical review focused on the maritime history of Grays Harbor from the contact era through the first half of the 20th century. While historic wrecks (pre-dating 1960) were the focus of wreck-specific research, a search for post-1960 wrecking events was also conducted because these wreck remains may appear in the geophysical record, even if they do not represent a National Register-eligible archaeological site.

Archival research included documents available in the Seattle and Vancouver, BC areas. Some of the key documents reviewed in the research included:

- Databases, published lists, and on-line sources for ship and aircraft loss/incident records, including those by Northern Maritime Research (2002), Kent Barnard (1991), and more

recent vessel aircraft loss reports available on line (e.g. National Transportation Safety Board);

- Basic shipwreck references for the area and region, including Gibbs (1958; 1986; 1989) and Wells (1989); and,
- Vessel descriptions sought in the marine histories of the Pacific Northwest by Wright (1967 [1895]) and Newell (1966); as well as Lyman (1941); with research assisted through use of the Ships and Shipping Index (Tacoma Public Library); and various lists of Merchant Vessels of the United States published through the Bureau of Navigation (1917–1956), the Bureau of Customs (1957–1967), and U.S. Coast Guard (1968–1980); and Lloyd's Register of British and Foreign Shipping (1834–date).
- Local histories by Weinstein (1978); Van Syckle (1980) and Van Syckle and James (1982), as well as other pertinent sources available on-line, in-house, or in local archives; and,
- Historical Maps and aerial photos available digitally.

2.1.2 Marine Geophysical Survey Analysis

Marine geophysical data that were analyzed for the presence or absence of marine historic archaeological resources within the survey area consisted of the following:

- side-scan sonar data, generating an acoustic image of the seafloor analogous to an aerial photograph
- subbottom profile and seismic reflection data, generating an acoustic image in the form of a vertical slice into the seabed with reflections indicating layers of different density
- magnetometer data, recording variations in the intensity of the earth's magnetic field at the sensor head indicating the presence of ferromagnetic targets in the vicinity of the sensor that may be cultural in origin

2.1.2.1 Sidescan sonar data

Sidescan data within the survey area was gathered by Golder in 2008 using a 400 KHz sidescan sonar system and a track-spacing of 100 feet which provided an imaging overlap of the river floor. No new sidescan data was gathered during the 2010 geophysical investigation.

Analysis of the sidescan data consisted of examining the thermal graphic prints of the acoustic images generated during the 2008 sidescan survey along with track-line maps for indications of the presence of marine historic archaeological resources. The acoustic images were examined for reflections and shadows that might correspond with the remains of a ship or aircraft projecting into the water column.

While substantially intact ship or aircraft structure is usually easy to recognize in a sidescan sonar record, a wreck may have lost much of its original three-dimensional aspect due to fire preceding deposition; reduction and disintegration of structure due to the in-water effects of organic decay, wood-boring mollusks, or corrosion; and deterioration and structural disarticulation owing to the impacts of current, wave energy, or human activities including anchoring, trawling, and dredging. These effects are particularly noticeable for small wooden vessels that may, depending on the environment, be quickly reduced to a vertical relief of less than three feet. Small wooden vessels mean those that are less than 15

gross tons, or less than 45 feet in length. In these circumstances, three-dimensional natural features on the harbor floor or river bed, including medium or small-sized boulders, or rock outcrops may mask or conceal the acoustic image of reduced or scattered cultural remains.

The sidescan data were also examined for the more subtle indications of structural remains that may be partially buried in mobile sediments. The records were reviewed for geometric complexity that may represent partially exposed structural remains. The three-dimensional aspect of these wreck sites may be as subtle as a curved line of exposed frames, but in areas where current is present these locations are also typically indicated with surrounding scour marks (Garrison *et al.* 1989: II-223).

Images of interest within the sidescan record can be cross-referenced where the images generated from adjacent records illuminate the same feature from opposite sides, thereby facilitating interpretation. Cross reference is also very useful across data sets where anomalous images in one data set may be compared with results from another.

2.1.2.2 Subbottom reflection data

Subbottom reflection data within the survey area was collected in 2008 and 2010. During the 2010 survey program the track-spacing was 20 to 30 feet.

Analysis of the subbottom data consisted of reviewing the thermal graphic prints of the acoustic images generated during the 2010 survey along with trackline maps for indications of the presence of marine historic archaeological resources. The acoustic images were examined for reflections that might correspond with “hard” surfaces representing the remains of a ship or aircraft buried in the seabed. Hard surfaces may be presented by a large metal structure. While a hard surface would not typically be presented by wooden structure, the presence of a buried wooden wreck may be indicated in the subbottom record by the reflection of ballast, or possibly locally anomalous stratigraphy associated with the wreck and associated relict scour surfaces (Green 1980:50-51).

The areal coverage for subbottom data is limited. However, it provides a useful cross reference for anomalies noted in the sidescan or magnetic data. It also provides a gauge of the depth of sediments within which wrecks might be buried.

2.1.2.3 Magnetometer data

Magnetometer data within the survey area was collected in 2010. During the 2010 survey program the track-spacing was 20-30 feet, which far surpasses the standards of 25 – 30 meter track spacing recommended by the National Park Service and the U.S. Minerals Management Service for marine cultural surveys (Murphy and Saltus 1992: Pearson *et al.* 2003:7-18). “Survey” here means “systematic determination of specific cultural remains within an area” (Murphy and Saltus 1992:93) in contrast to a “search” conducted for a particular object or site, where track spacing would be closer than 25m.

Analysis of the magnetometer data consisted of reviewing processed images of the data. Sources for magnetic variation may be geological, but variation will also be created by concentrations of ferrous material of human manufacture. Although the most dramatic magnetic signatures will be generated by larger modern vessels of metal construction and equipped with engines, even the remains of wooden sailing vessels, due to iron fastenings, anchors, chains, and other metal components may produce a magnetic signature or anomaly. Provided there is not too much background "noise", or natural variation in local magnetic fields, smaller objects, light aircraft, wreck debris fields, and buried wrecks may also be detected (Breiner 1999).

Some criteria for helping to identify magnetic traits of potential wreck remains include the amplitude, bipolarity, long gradient and duration, multiple peaks, and relatively large areal distribution of the magnetic signature (Garrison 1989: II-223; Murphy and Saltus 1990; Anuskiewicz 1998).

The magnetometer provides the best cultural survey data in areas where there is potential for buried ship or aircraft wrecks. It also provides very useful cross-referencing for anomalies noted in the sidescan or subbottom data.

2.2 Survey Expectations

The expectations of this survey were to identify what resources may be present and what is the potential of historic significance for these resources. Estuarine environments are known to be beneficial for the preservation of historic archaeological resources, most famously the *Mary Rose* was found buried in the Solent estuary with a magnetometer (Rule 1982). The geophysical survey methodology for this Project, including the use of a magnetometer, was chosen to provide a reasonable expectation for the discovery of historic resources beneath as well as on the surface of the river floor, if present.

2.3 Survey Area

Grays Harbor is an estuary approximately 15 miles long, with a width of approximately 11 miles (at the widest section). The water surface area ranges from 91 square miles at mean higher high water (mhhw) to 38 square miles at mean lower low water (mllw) due to many drying shoals located throughout the harbor (Osborne 2003:2).

The survey area consisted of a 0.35 square mile area located over the South Reach navigation channel in Grays Harbor on the south side of the estuary (Map 1). It is located about 5 miles inside the bar entrance. Drying shoals are located near the southern boundary of the survey area and the closest land is about 1 mile to the southeast, near Markham.

3.0 HISTORICAL OVERVIEW OF GRAYS HARBOR

3.1 Natural Setting

The survey area is situated on the boundary between the Olympic Peninsula and the Coast Range physiographic provinces (Franklin and Dyrness 1988). This area is described as a woodland zone with trees primarily consisting of Sitka spruce and western hemlock. Much of the shoreline is vegetated with grasses, rushes, sedges, and ferns.

The entrance to Grays Harbor is approximately 45 miles north of the Columbia River entrance and 110 miles south of the Strait of Juan de Fuca. The mean tidal range recorded at Westport is 7.77 feet (Osborne 2003:3). The navigable portion of the harbor bar entrance is only about one-half mile wide. The area is notorious for fog and rain, and winter storms are savage in their intensity (Terrell 1995:32; Gibbs 1950).

Grays Harbor is one of the largest estuaries in the continental United States. It is described as a marine mixed river estuary environment, and a “drowned river valley” created by rising sea levels after the Pleistocene (Peterson, Scheidegger and Komar 1984). Over the past 10,000 years the estuary has been gradually filled with sediment from both fluvial and marine processes. This sediment deposition has resulted in 3 distinct zones in the estuary: marine, mixed, and fluvial sediment (Osborne 2003:2).

3.2 Pre-Contact Period

The survey area is located in the Lower Chehalis territory of the Southwestern Coast Salish Language Group. Lower Chehalis was spoken by the Humptulips, Wynoochee, the Chehalis Proper, and the Shoalwater People (Hajda 1990; Galois and Robinson 1987).

Fish was the primary source of sustenance for the Lower Chehalis people. Salmon was caught fresh year-round, but primarily caught and preserved by drying during spawning runs extending between June and November. At these times the preferred method of capture was by constructing fish weirs in the rivers (Skoggard 2002). Sturgeon, halibut, cod, trout, and eulachon were other fishes that were also eaten. Shellfish were collected for eating and for trading with other groups. The Lower Chehalis were also known for hunting sea mammals such as seals, porpoises, sea lions, and sea otters (Hajda 1990).

Timber, especially Western red cedar, was very important to the Lower Chehalis as it was used to make clothing, houses, boxes, and canoes (Hajda 1990). Iron and copper has been identified in the archaeological record that predates the arrival of Europeans to the area (Hajda 1990; Wessen 1990:412). Although there are some indigenous copper sources in the region it is probable that some metal artifacts may have originated from shipwrecks in the area (Ellis 1976). Reported cases of vessels drifting across the Pacific Ocean to locations near Grays Harbor include a Japanese vessel with survivors at Cape Flattery in 1833 (Brooks 1876), and the fishing vessel *Ryo Yei Maru* found drifting off the Quillayute River in 1927 (Gibbs 1989).

3.3 European Exploration and the Fur Trade (1775 - 1825)

The first recorded contact between the Southern Coast Salish and Europeans occurred in 1775 when Bruno de Heceta anchored his ships *Sonora* and *Santiago* off Point Grenville, located about 25 nautical miles north of Grays Harbor entrance (Skoggard 2002). In the wake of the discovery made during James Cook's third expedition that furs from the Northwest Coast had immense value in China, fur traders rapidly followed (Caruthers 1973). In the Grays Harbor area the first of these maritime traders was the Englishman Charles Barclay in 1787, followed by the American Robert Gray in 1788 (Skoggard 2002). It was after Gray, of course, that the harbor is named. As far as is known, he was the first non-Native to navigate across the bar, which he accomplished on May 2, 1792 during his second voyage. Comments in John Boit's log suggest that the people living inside the harbor had had no previous contact with Europeans, firearms, or sailing ships (Meany 1921:29-30). The night that Gray spent in the harbor he was anchored in 5 fathoms of water, where he noted strong out flowing currents (Meany 1921:30).

By 1812, Americans had a virtual monopoly on the maritime fur trade in the Pacific Northwest. The merchants in Boston, Salem, and New York who backed the voyages saw the fur trade as a way to recoup financial losses incurred during the American Revolutionary War (Caruthers 1973:19; Terrell 1995:5). In 1811, the American traders established Astoria. Between 1845 and 1850, the early agitation for building railways across the country "had its roots in the maritime antecedents of the Pacific trade" (Caruthers 1973:64).

Grays Harbor did not become a major trade center and was only occasionally visited (Galois and Robinson 1987), however, the Chehalis established some trade in furs with the Hudson's Bay Company (History Link 2009). By 1822, the trade in furs was in decline and American trading efforts in the Pacific shifted to California and Hawaii (Caruthers, 1973:26).

A number of surveyors and explorers navigated the region in the 1800s. John Work of the Hudson's Bay Company explored the area in 1824, and botanist David Douglas navigated down and then back up the Chehalis River in 1825. Henry Eid Jr., of the Wilkes Expedition, mapped Grays Harbor, including the Chehalis River, in 1841, but opined that Grays Harbor would remain suitable only for small vessels because of the narrow entrance and its shallow bottom (HistoryLink 2006b).

3.4 Early Settlement and Logging

The first settler in Grays Harbor was William O'Leary who came over the Oregon Trail and settled at the future location of Cosmopolis in 1848 (Van Syckle 1982:81). O'Leary and the other settlers who arrived soon thereafter entered an area with a decimated population of indigenous people due to several epidemics, beginning with smallpox in the 1770s, what was likely malaria in 1829, cholera in 1836, and smallpox again in 1853 (Skoggard 2002; History Link 2006b). Early settlement was quickly followed by the rapid emergence of the local lumber industry. This region was soon described as the "most productive logging area in the world" (Skoggard 2002).

In 1852 the first sawmill was constructed on the Chehalis River. The lumber was primarily used locally for buildings and houses, and scows. In 1870, the first settlers in the Ocosta area established a small sawmill. By 1885, mills opened at Hoquiam and Aberdeen. While a number of small communities emerged around Grays Harbor, Aberdeen quickly grew to dominate as the commercial hub of the region focusing primarily on fisheries, lumber, and shipbuilding (History Link 2009). The “Panics” of 1893 and 1907 showed the short-term vulnerability of the lumber industry to market fluctuations and starting in the 1920s the logging/milling industry started to decline (History Link 2006b).

3.5 Transportation

Ocosta was the site chosen by the Northern Pacific Railroad for its Grays Harbor rail terminus, and 300 lots were laid out just south of the survey area. However, the citizens of Aberdeen were determined to have the railroad terminus in their town. To get the railroad to town they salvaged 5,000 lengths of railroad rails that had been the cargo of the *Abercorn*, a ship which had run aground near the harbor entrance in 1888, and built the railway extension themselves (Gibbs 1989; Weinstein 1978:21). The first train arrived on April 1, 1895 (Weinstein 1978:21).

The first load of lumber shipped out of Grays Harbor was from Cosmopolis in 1881 (Van Syckle 1982:127). The first shipload of lumber from Aberdeen was sent in 1886. By 1890, “13 mills filled 256 vessels with 66 million board feet of cut lumber” (History Link 2006b).

By 1900, 80 percent of the county's population lived in Aberdeen and Hoquiam because of the ability to transport the region's principal product, timber by rail and ship (History Link 2006b). The dominance of the Pope and Talbot Lumber Company and its subsidiaries and the Northern Pacific Railroad led Robert Weinstein (1978:16) to describe Grays Harbor right from its early days “as a huge, profitably run company town".

A number of shipyards were established in Hoquiam and Aberdeen. Well-known ship builders like Tom MacDonald, John Lundstrom, John Joyce, and Bill McWhinney produced boats for both long distance trade (primarily sailing ships) and craft for local use (Van Syckle 1982). In 1890, Grays Harbor shipyards had launched nine steamers and three sailing vessels (HistoryLink 2009). The steamers *Harbor Belle*, *Harbor Queen*, and the *Champion*, linked communities around Grays Harbor (Marsters 2010) in the years before good roads were established.

The volume of shipping traffic in Grays Harbor has diminished in lock-step with the declining fortunes of the lumber industry beginning in the 1920s.

3.6 Fisheries

Salmon canning came to Grays Harbor in 1873, when salmon-canning pioneer George W. Hume set up a cannery in Aberdeen (HistoryLink.org 2010c). Salmon was caught with gillnet boats as well as traps. At least three types of gillnet boats were used before engines were introduced in the 1910s (Collins 1892;

Wilcox 1895). The U.S. Commission of Fish and Fisheries chart showing the fisheries of Grays Harbor and the Chehalis River in 1889 show the locations of fish traps near the mouths of the Chehalis and Humptulips rivers.

The U.S. Commission of Fish and Fisheries chart (1889) also shows razor clam (*saliqua patula*) beds in South Bay and off Ocosta. Two canneries in Westport also canned salmon and clams (Marsters 2010). No fish traps or canneries were located near the survey area.

The American Pacific Whaling Company established a whaling station in 1911 at Bay City, approximately 3.5 miles south and west of the survey area (Kirk and Alexander 1995:462). This facility was the first modern whaling station in the United States (Webb 1998; 2001:34). Its reduction tank system was innovative and the four steam whale catchers that ran out of the station with a 130 mile hunting radius were the first to be built in the United States to the state-of-the-art Norwegian design (Harland 1992).

Powered trolling boats were crossing the entrance bar into the open Pacific by the 1920s. Powered fishing boats were also employed catching halibut and crab.

3.7 Navigation

Improvements to the safe navigation of vessels travelling in and out of Grays Harbor began in 1897 when the U.S. Life-Saving Service opened the Peterson's Point Lifeboat Station. The next year a light was also installed at the entrance to Grays Harbor (Van Syckle 1982; HistoryLink 2004, 2006b).

Average ships at the end of the 19th century drew 16 to 17 feet, and the natural depth of the water over the bar was as little as 10 feet at low tide (Kirk and Alexander 1995:462). After a failed attempt to build a jetty at the harbor entrance in 1896, the U.S. Army Corps of Engineers successfully completed a new one in 1916 (HistoryLink 2009). In 1911 the electorate of Grays Harbor County approved the creation of a port district and by the 1920s a channel had been dredged from the bar entrance to Aberdeen (HistoryLink 2009). Maintenance dredging of this channel has continued to today.

3.8 Ship-Building

Construction of large wooden vessels in the Pacific Northwest only began once the underwriters in San Francisco sanctioned the use of Douglas-fir for shipbuilding in the late 1870s (Hopkins 1994:18). Development was slowed by a lack of skilled workers, but by the 1890s shipbuilding was booming and many sailing vessels of between 800 and 1600 gross tons were being launched. Many innovations were incorporated into the construction of vessels in the Pacific Northwest at this time including massive composite keelsons which provided stiffness to the long wooden schooner hulls that soon carried three to five-masted rigs (Desmond 1919:55).

A down-turn in wooden ship building occurred between 1910 and 1915 that was quickly reversed by the demands of war. Many sailing ships were started in 1916 and the Emergency Fleet Corporation soon

placed orders for numerous large wooden steam freighters. Two yards for constructing these vessels were located in Grays Harbor, employing innovative assembly-line methods (Hopkins 1994:16). In 1918 a "speed of construction record" was set with the *Aberdeen,* a 3,500 deadweight ton Ferris-designed freighter that was delivered in just 27 days after the keel was laid (Hopkins 1994:20). Over six thousand people were employed in the Grant Smith-Porter (formerly Peterson) Shipyard in Aberdeen (Hopkins 1994:17). A surplus of vessels in the immediate aftermath of war meant that many of the wooden freighters did not see service. Some were scrapped, while others served as barges pioneering the use of barges to move lumber along the coast.

The last of the wooden West Coast sailing lumber carriers remained active through the 1930s, but construction ended about 1920. In that year, the *Vigilant* was launched in Aberdeen. At 1603 tons and 220 ft. in length, she was described as "the largest, liveliest… and last of the Pacific's five-masted schooners" (Andrews and Kirwin 1955:105).

The wooden shipyards in Grays Harbor, as with other locations in the region, never fully recovered after the war (Hopkins 1984:21). However, some smaller yards began building fishing craft including a new type of halibut fishing boat that became indigenous in the region, although originally based on imported sailing boats. These were called schooners and had two masts, although they always employed gas and later diesel engines.

4.0 SURVEY RESULTS

4.1 Results of Literature Review and Archival Research

The results of the literature review and archival research indicate that there were at least 14 vessels lost within Grays Harbor that are more than 50 years old, and that were apparently not salvaged or recovered. Some of these may be significant. Six of these vessels may possibly be located with the survey area, but there are no archival indications that any wrecked vessels or aircraft are in the survey area.

Analysis of the wrecking incident patterns in the Study Area suggests that the probability of any wrecks being in the survey area is low. The record of ships being lost in Grays Harbor demonstrates several "loss traps," in addition to the entrance bar, and none of them overlap with the survey area.

It is further understood through review of the geomorphologic studies and the dredging history of the South Reach, which passes through the survey area, that there is low probability for the survival of wreck remains in the survey area, and also that the existence of a deeply buried wreck is unlikely in the survey area.

The historical research with respect to ship and aircraft wrecking incidents are detailed below in section 4.1.1 and Tables 1 - 3. The data with details on the wrecking incidents and vessel descriptions listed in this section and tables came from a variety of sources including Lloyd's Register of British and Foreign

Shipping (various dates); Bureau of Navigation (1917–1956); Lyman (1941); Bureau of Customs (1957–1967); Gibbs (1958, 1986, 1989); Newell (1966); Wright (1967 [1895]); Wells (1989); Kent Barnard (1991); Northern Maritime Research (2002); the National Transportation Safety Board (on-line); the Tacoma Public Library (on-line); and the *Hoquiam Washingtonian* reviewed on microfilm for the years 1914 – 1947).

4.1.1 Ships and Aircraft Recorded Lost in the Grays Harbor Area

Research of various data sources for reports of shipwrecks and aircraft losses revealed 77 reports of wrecks associated with the name Grays Harbor. Further research indicated that four of these were actually wrecked somewhere else. Another 21 were found to have been wrecked offshore in the general vicinity of Grays Harbor, or were wrecked on exposed beaches some distance north or south of the entrance to Grays Harbor.

Three of the reported wrecks outside the harbor were military aircraft lost between 1943 and 1949. A listing of US navy shipwrecks and submerged naval aircraft in Washington (Grant et al. 1996) included no vessels or aircraft within Grays Harbor. All three aircraft crashed into the open ocean in locations between Willapa Bay and Taholah, and caused fatalities (Grant *et al*. 1996:73, 76, 87). Alexis Catsambis of the Underwater of Naval History & Heritage Command has confirmed that this list is up to date (personal communication, February 12, 2010).

Finally, eight vessels were stranded at the Grays Harbor bar entrance but were refloated and salvaged. Of note among these was the three-masted West Coast lumber and later cod-fishing schooner the *C.A Thayer*. The 453-ton *Thayer* survived the 1903 incident and is now listed in the NRHP and displayed at the San Francisco Maritime National Historic Park (National Parks Service). These wrecking events will not be further discussed.

Research has identified twenty-three vessels wrecked at the bar entrance that were not refloated and another fourteen vessels that wrecked within Grays Harbor, not including 7 that were salvaged. The number of potential wreck remains indicated by this research that are within the Grays Harbor (including the bar entrance) is 37, which provides a wreck density of 0.40 wrecks per square mile.[1]

4.1.1.1 Bar Entrance

Table 1 presents 22 shipwrecks and one aircraft reported lost at the Grays Harbor bar entrance. None of these wrecks were refloated, so there is potential that these still exist as archaeological sites on the bottom or within the sands of the beaches either side of the entrance. Two obstructions are reported at the bar entrance (National Oceanic and Atmospheric Administration) that may represent wrecks on the bottom, one of which is included in the table because it has been identified as a fishing vessel “Big Red”.

[1] This is based on 91 square mile area of Grays Harbor at high tide (Osborne 2003:2).

The date range for these wrecking events is between 1853 and 1997. Of the 19 vessels lost at the bar entrance for which we know the hull material, 18 were made of wood. The average size, among the seven vessels for which we have figures, was 835 gross tons. These would represent the largest vessels, and we lack the tonnage for several vessels that were smaller. Ten of these vessels would have been used in long-distance trades (including hauling lumber to California) while 12 would have been local craft, primarily tugs and fishing craft. A total of six sailing vessels were lost up to 1922, while 15 wrecks had engines.

All of the vessels in Table 1 where the reason for loss is known were lost to sinking or groundings, typically in extreme conditions. The Peterson Point Life-saving Station was notable for its rescues of all the crew members under difficult circumstances from the wrecks of the *Alcalde*, *Mildred, Torrisdale*, *King Cyrus* and *Halco.* More tragic was the wrecking of the fishing fleet in a storm of 1933 where there were fatalities on all six vessels wrecked at the bar entrance. A total of 19 fatalities were reported for the wrecks included in Table 1.

Several of these wrecks would be eligible for inclusion in the National Register, including the big 4-masted schooners and the bark, provided there was some physical integrity to their remains. All 21 vessels are more than 50 years old.

TABLE 1
Summary of Vessels and Aircraft Lost and Not Refloated or Recovered at Grays Harbor Bar Entrance

Name	Date of Loss	Nature of Loss	Place of Loss	Size of Vessel in gross tons	Hull Material	Type of Vessel	Number of Fatalities
Willimantic	1853/ 02/?	Unknown	Bar Entrance	Unknown	Wood	Unknown	Unknown
Trustee	1886/ 04/24	Stranded	Bar, "Trustee Spit," South Jetty	280	Wood	3-masted schooner	1
Venita	1898	Unknown	Bar	Unknown	Wood	Unknown	Unknown
Alcalde	1904/ 02/14	Stranded, broke up	Bar, North spit	322	Wood	Schooner	0
Mildred	1908/ 03/16	Stranded	Bar, Jetty	464	Wood	Schooner	0
Torrisdale	1912/ 12/28	Stranded	Bar, South Jetty	2,316	Steel	4-masted bark (290 ft.)	0
Balboa	1913/ 12/01	Stranded	Bar, North Jetty	777	Wood	4-masted schooner	0
Kennewick	1914/ 10/21	Foundered	Bar entrance	Unknown	Wood	Gas screw	0
King Cyrus	1922/ 07/17	Stranded, broke up	Bar, South Jetty	717	Wood	4 - masted schooner (189 ft)	0
Reba (Ryba)	1925/ 04/29	Capsized	Bar, one mile off entrance	Unknown	Unknown	Tug	3
Halco	1925/ 11/30	Stranded, wrecked	Point Brown, North Jetty	970	Wood	Steam schooner (212 ft)	0
Horaisan Maru	1926/ 03/08	Capsized, beached	Bar, North Spit	Unknown	Unknown	Steamship	0
Caroline	1933/ 04/05	Storm, foundered	Bar entrance	Unknown	Wood	Salmon troller	1
Alki	1933/ 04/05	Storm, foundered	Bar entrance	Unknown	Wood	Salmon troller	2
Axel	1933/ 04/05	Storm, capsized	Bar, South Jetty	Unknown	Wood	Salmon troller	2
Annie	1933/ 04/05	Storm/ capsized	Bar entrance	Unknown	Wood	Salmon troller	2
Thelma	1933/ 04/05	Storm, foundered	Bar entrance	Unknown	Wood	Salmon troller	1
J-1289	1933/ 04/05	Storm, foundered	Bar entrance	Unknown	Wood	Salmon troller	1

Name	Date of Loss	Nature of Loss	Place of Loss	Size of Vessel in gross tons	Hull Material	Type of Vessel	Number of Fatalities
Murre	1952/ 12/08	Stranded, wrecked	Beach, North Jetty	Unknown	Wood	Fishing Boat	Unknown
Periwinkle	1953/ 01/19	Stranded, wrecked	Bar, North Spit	Unknown	Wood	Yacht (55 ft)	1
Cessna 172K	1970/ 7/31	Crashed	Off Westport	n/a	metal	Aircraft	4
Marie M.	1997/ 07/03	Capsized, sank	Chehalis Point	Unknown	Unknown	Tug (84 ft)	1
"Big Red" (Obstruction)	"1900 's"	Sank	Just outside bar	Unknown	Unknown	Fishing boat	Unknown

4.1.1.2 Inside Grays Harbor

Table 2 presents the 15 reports of shipwrecks and aircraft crashes within the confines of Grays Harbor where a location (outside of the survey area) is known with some degree of confidence, or where a wrecking with salvage and recovery has been reported. Salvaged wrecks were included to get a broader idea of the spatial patterning for wrecking incidents within the harbor.

The date range for these wrecking events is between 1861 and 2009. Only the *Nora Harkins* (1892) was a sail-powered vessel and 12 wrecks had engines. The *Nora Harkins* is included because, although it was disabled crossing the bar, its final location was on the inside of Peterson Point at Firecracker Pt. east of Westport (Gibbs 1958; Wells 1989:80). Of the ten vessels listed in Table 2 for which we know the hull material, 9 were made of wood. The average size, among the nine for which we have figures, was 1,585 gross tons. The figure is high because of the *Texmar*, a wreck event unusual in that the ship grounded in protected waters could not be refloated, and the *Agathon*, a large wooden freighter than actually burnt in the ways before being launched. The back of *Texmar* was broken over the sandbar, and salvage consisted of cutting up the remaining hull sometime after it was abandoned. Six of the 12 vessels in Table 2 were local craft, including a stern-wheeler, several tugs, a scow, and a fishing boat.

Six of the 12 vessel losses were due to fire. Two of these caught fire at a dock but were towed and allowed to burn out along the river bank some distance up or downstream from the dock where the fire began. Eleven of 12 vessels were lost in locations associated with a port, wharf, mooring, or within a river. One was lost on a sandbar beside a navigation channel.

Only 1 fatality was reported for the wrecked vessels included in Table 1, and this was due to conditions near the bar.

Eleven of the vessels are more than 50 years old. The *Enterprise* was significant as a pioneer steamer in three locations on the coast. Built on the Willamette River in 1855, the stern-wheeler gained fame during the Gold Rush on the Fraser River, and was the first steamer to operate in Grays Harbor when it arrived in 1859 (Van Syckle 1982:319-320).

The *Nora Harkins* remained visible in the sands near Westport (Wells 1989:80) for many years. A review was conducted of digitized aerial photographs dating back to 1942 in an attempt to identify any other vessel that might be visible in the intertidal areas east of Westport to the survey area, and along the Markham and Ocosta shore to the south of the survey area. No wreck remains were positively located, however one vessel-like form was noted near in the upper intertidal area near Firecracker Point in succeeding photographs up to 1994 that appeared to be about 150 feet in length.

TABLE 2

Summary of Vessels and Aircraft Lost in Grays Harbor: Location Known Outside Survey Area, or Vessel and Aircraft Salvaged and Raised

Name	Date of Loss	Nature of Loss	Place of Loss	Vessel Size in gross tons	Hull Material	Type of Vessel	Salvaged (Y/N)	Number of Fatalities
Enterprise	1861	Abandoned	Chehalis Point, on beach NW of Fort	n/a	Wood	Steamer	Engine removed	0
Norah (Nora) Harkins	1894/ 10/16	Fog, stranded, total loss	Westport, Firecracker Pt.	209	Wood	2-masted schooner	N	1
Agathon	1919/ 05/09	Burned, total loss	Aberdeen, shipyard	3,500	Wood	Steamer	Y	0
Florence B.	1920/ 01/23	Burned	Aberdeen, South Street Dock	14	Wood	Tug	N	0
Tillicum	1923/?	Collision, sank	Chehalis River	116	Wood	Tug	Y	0
Fram	1925/ 12/29	Burned	Aberdeen	50	n/a	Tug	N	0
Prosper	1926/ 08/27	Unknown	Hoquiam River	n/a	n/a	Tug	Y	Unknown
City of Nome	1927/ 06/03	Fire, then towed upstream, beached and abandoned	Aberdeen, from Standard Oil Dock	2,169	Wood	Motor/oil screw	N	0
P. L. CO. NO. 3	1928/ 07	Foundered, “abandoned on mud”	Aberdeen, “at mooring”	113	Wood	Scow	N	0

Name	Date of Loss	Nature of Loss	Place of Loss	Vessel Size in gross tons	Hull Material	Type of Vessel	Salvaged (Y/N)	Number of Fatalities
Santiam	1936/ 10/14	Fire, then towed downstream, beached and abandoned	Aberdeen, from Donovan Lumber Mill dock	946	Wood	Steam schooner	N	0
White Crest	1947/ 08/29	Explosion, burned, sank	Hoquiam fishing fleet docks	n/a	Wood	Fishing boat	N	0
Texmar	1960/ 12/30	Stranded, broke back	Moon Island, mud bar off main channel	7,146	Steel	SS – freighter	Y	0
Beech M35	1974/ 06/13	Crashed	Mud flats, near Westport, Firecracker Pt., South Bay	n/a	metal	Aircraft	Y	0
Cessna 172L	1988/ 05/14	Crashed in water	Hoquiam/Off Airport/Airstrip	n/a	metal	Aircraft	Y – assumed salvaged	1
Bell/47G-3B-2	2009/ 07/07	Crashed in water	Near Ocean Shores	n/a	metal	Helicopter	Y	0

4.1.1.3 Survey Area

Table 3 presents the 6 vessels potentially lost within the survey area. None of these vessels are known to have been lost in the survey area. Two wrecking incident locations are simply described as “Grays Harbor”, although Gibbs (1958) placed the location of one of these, the *Big River*, on Whitcomb Flat.

The date range for these wrecking events is between 1868 and 2009. All the vessels are constructed of wood and all but the schooner are assumed to have engines. The average size of the vessels is just 165 gross tons. Four of the six were lost to fires. The same four vessels were all local craft and their wreck locations are associated with specific ports, two off Westport, one in Markham, and one in the Whitcomb Spit, South Bay area. These were included in Table 3 because of the pattern of pulling burning vessels away from the dock, shore structures and other vessels out towards the flats or open area where they can be allowed to burn out. All three areas are within 1 to 2 miles of the survey area.

There were no fatalities reported on the vessels in Table 3.

The *Nightingale* was a significant vessel. Designed by the U.S Naval Constructor, the ship had some involvement with the Civil War, but later became the flagship of the Union Telegraph fleet in the Pacific. In 1866, she brought the first steamer (in pieces) up to the Yukon River (Wright 1895:149). That she would wreck within Grays Harbor two years later and garner so little attention seems unlikely. More research would be required to confirm this wrecking event and the vessel’s eligibility. The smaller, locally-based vessels in Table 3, the *Sampson*, *Osprey*, *Sockeye*, and *Pronto*, are also eligible for inclusion in

the National Register by age, and they may be historically significant as well, although current research has not indicated specific significance for these vessels.

TABLE 3
Vessels Potentially Lost Without Reported Salvage in Survey Area

Name	Date of Loss	Official Number	Port of Registry	Nature of Loss	Place of Loss	Vessel Size in gross tons	Vessel Size length/ breadth/ depth in feet	Hull Material	Type of Vessel	Number of Fatalities	Comments and Significance
Nightingale	1868	Unknown	Unknown	Unknown	Grays Harbor	722	--/--/--	Wood	Steamer	0	Flagship of Union Telegraph Fleet. Took first steamer up to Yukon R., 1866.
Big River	1892/ 01/?	Unknown	Unknown	Unknown	Grays Harbor	160	--/--/--	Wood	2-masted schooner	0	Built at Freeport WA in 1872. Gibbs (1958) shows wreck on Whitcomb flat.
Sampson	1914/ 10/15	200311	Unknown	Burned, lost	Grays Harbor, Markham	7	120/--/--	Wood	Screw freight steamer	0	Built for Puget Sound Navigation Co. with engines from *Evangel,* burned at mooring
Osprey	1933/ 03/09	229656	Seattle	Burned	Grays Harbor, Westport "Cove"	(7 nt)	36.7/11.5/4.4	Wood	Fishing boat, gas schooner	0	25 hp
Sockeye	1956/ 12/11	Unknown	Unknown	Burned	Grays Harbor, off Westport	(77 nt)	--/--/--	Wood	Oil Screw	Unknown	Built 1928
Pronto	1957/ 01/06	220153	Unknown	Burned	Grays Harbor, Whitcomb Spit, South Bay Area	14	--/--/--	Unknown	Unknown	Unknown	Built 1920

4.1.1.4 Unrecorded wrecks and abandonments

Not all vessel losses, or series of events that lead them to become part of the archaeological record, are reported. Abandonments often go unreported because there is no drama, no specific event to be reported. The losses of small craft often go unreported because they are seen as unimportant, although they may become significant archaeologically. Ships can also wreck in areas without survivors or witnesses to record the event.

The potential for unrecorded wrecks in the survey area was examined, specifically those that might have drifted in from another area in the Pacific prior to the period of European exploration. The potential arrival would be due to vessels being disabled and drifting into the survey area from the west or south-west. As noted, historical drift wrecks from Japan have been reported near Cape Flattery, and iron has appeared in the pre-contact archaeological record in the region, attributed to iron salvaged from drift wrecks. Japanese vessels, beginning in 1639, were ordered by edict to be constructed only with open sterns and vulnerable rudders in an effort to limit their travel to local protected waters. An unfortunate consequence was the increased likelihood for them to be disabled by storm, often resulting in a long uncontrolled drift on the Kuro-shio current across the Pacific with or without surviving crew members. An estimated 1,800 Japanese vessels were lost between 1639 and 1867 during the Edo Period (Callaghan 2003:90). Quimby (1985) has estimated that 187 Japanese vessels reached the Northwest Coast shores between AD 500 and 1750, and that this accounts for the large number of iron blades available to Native Americans prior to European contact. According to simulation modeling run by Callaghan, Vancouver Island, Haida Gwaii, and parts of Alaska have a relatively higher potential for drift wreck landings, however, there is some potential for landings all along the continent north of Cape Mendocino (2003:90-91).

The question of potential for a Japanese wreck within the Grays Harbor may be addressed by the probability of a disabled vessel passing by chance through the bar entrance and against prevailing currents to sink in the survey area. There is very low potential for this to have occurred.

The possibility that European vessels were wrecked in the survey area prior to Heceta's arrival to the coast was also examined. Like vessels of Japanese origin, any European vessels that arrived unintentionally, that is, drifted ashore or near to shore without the ability to control their progress due to damage and/or a diminished and incapacitated crew, would most likely be wrecked on an exposed outer beach rather than pass through a narrow harbor entrance to sink in sheltered waters. An example of an early wreck location on an exposed shore would be that of the *San Francisco Xavier* thought to have gone ashore near Nehalem, Oregon in 1774 (Delgado 2002:223-4). There were at least three other Manila Galleons that disappeared on their annual North Pacific crossings from Manila to Acapulco that began in 1565. Additionally, several Spanish ships including California supply ships out of San Blas and some English ships sailing northward from Mexican and Californian ports sailed into oblivion, beginning with the first flotilla dispatched into the Pacific by Hernan Cortez in the early 16th century. Other

examples of vessels that disappeared along the Pacific coast of North America include a Spanish prize captured by Francis Drake that disappeared in 1579, and the ships *Content* and *George* from Cavendish's 1588 expedition (Bawlf 2003). The reaction of the Native Americans in Grays Harbor to the arrival of Gray and the *Columbia Rediviva* into their harbor, however, suggests that no ship had sailed over the bar before.

4.1.1.5 Loss Traps

One way of determining the potential for wrecks, including unreported wrecks, to be located within a given area is to determine whether it is a "loss trap". A loss trap in this context is simply an area defined by physiographic landscape and history of human use where vessels are more likely to be wrecked (Schiffer 1976; Anuskiewicz 1998). The characteristics of different loss traps may also correlate differently to different kinds of watercraft (Anuskiewicz 1998:225).

The survey area has clearly been subject to a considerable human use in the form shipping traffic in and adjacent to the South Reach navigation channel over the last 120 years. The principal hazard in an area within and adjacent to a major navigation channel might be collision, with small local craft being most at risk of loss. The shoal areas at the edge of the channel would also pose a grounding hazard, particularly to larger vessels.

The historic record of wreck locations in Grays Harbor, however, indicates that the survey area is not a loss trap. Only two vessels listed in Tables 1 to 3 were reported lost on, or in the vicinity of, shoals near the interior navigation channels (*Pronto* and *Texmar*), and one vessel was lost to collision (*Tillicum*), and this within the Chehalis River. The entrance bar is an obvious loss trap with over 20 wrecks reported there, but it is also interesting to note the number of wrecks, 12, associated quite closely with the port facilities, including docks and shoals and riverbanks in close proximity. Dock areas have higher expected losses related to fire particularly in later periods where fuelling is involved, but landing areas for all periods have a higher expected representation of wrecks, including abandonments, owing to human use patterns (Anuskiewicz 1998:225-226).

Given the usual outflow of Grays Harbor and the difficult in navigating across the bar the survey area is an unlikely location for drift wrecks from the Pacific. The loss or abandonment of small craft would be expected in the intertidal flat areas, along the banks of narrow river areas or in smaller meandering creeks. Backwaters are also loss traps for the abandonment of larger vessels.

4.1.2 Landscape History

The first historical chart of Grays Harbor, Vancouver's map (1798, reproduced in Osborne 2003:5), seems to indicate that a drying shoal or bank extended through the survey area. Later maps, including one from 1841 (in Osborne 2003:6), the Coast Survey Reconnaissance chart (1853), and the U.S. Commission of

Fish and Fisheries chart (1889) all show the survey area as open channel with shoals at least to the south of the survey area conforming in a general way with current configurations.

In his research into the geomorphologic dynamics of Whitcomb Flats, Philip Osborne notes that the earliest record of dredging of navigational channels within Grays Harbor dates back to 1905, with regular maintenance dredging occurring from 1916, when a channel 200 ft. wide was dredged to a depth of 18 ft. as far up as Cosmopolis (2003:9-10). The survey area overlaps the South Reach navigation channel, where it comes to a junction at the east end of the survey area with Crossover Reach.

Dredging volumes from South Reach reached 650,000 cubic yards annually between 1980 and 1989. The most recent channel deepening project resulted in South Reach being deepened to 36 ft and widened to 400 ft. between 1990 and 1991 (Osborne 2003:9-10).

Osborne has found that dredging, particularly the South Reach area, has coincided with a "period of ongoing relatively rapid southward migration and deepening of the channel which had persisted for at least the previous decade (1965 to 1975) and which continued until the mid 1980's" (Osborne 2003:25). Based on bathymetric analysis, approximately 35 million cubic yards were eroded from the inlet throat, an area which includes South Reach, between 1987 and 2002; scour depths over this period ranged from 20 to 30 ft., and the mid-channel depth of the South Reach increased by 5 to 7 ft. (Osborne 2003:25). In addition, the southern side slope of the South Reach channel migrated southward at rates of 10 to 15 m/yr between 1965 and 1987 (Osborne 2003: 22-23). Osborne did note, however, that the channel position has been relatively stable for the last fifteen years (Osborne 2003:25).

Based on the history of dredging and recorded effects of hydrodynamics, the harbor floor of the navigational channel and the shoaling areas on the southern side of the survey area, have generally been eroded for much of the last 50 years, and dredging has periodically impacted the harbor floor within the navigational channel for a longer period. These conditions make it unlikely that wrecks will be found deeply buried in the sediments of the survey area, and would further present conditions unfavorable to the preservation of archaeological sites in the area.

4.2 Analysis of Marine Geophysical Data

The results of analysis of marine geophysical data do not suggest the presence of marine historic archaeological resources, or vessel or aircraft wreck sites, of any size or description within the survey area.

The absence of recent wreck sites at the surface of the harbor floor may be stated with some confidence.

The absence of buried wrecks, at least vessels incorporating substantial ferrous elements for hull fastenings and shipboard equipment, may be stated with some confidence for the survey area except for those limited areas near where the signature of navigational aids may provide a mask.

The absence of deeply buried wrecks with lower ferromagnetic content is suggested, as is the absence of small craft or shallowly buried discontinuous wreck remains, but this cannot be stated with confidence.

Details of geophysical analysis follow.

4.2.1 Sidescan Sonar Data, 2008

The sidescan sonar records collected by Golder for the 2008 survey of Site 7 (Golder 2008) were reviewed. These acoustic images from within the survey area show a generally flat harbor floor with sand waves a predominate feature. The sand waves indicate the presence of mobile sediments that are assessed as being medium to coarse-grained (Golder 2008:18). The seabed revealed in the sidescan data does not have significant potential for masking the structural remains of a wreck that might otherwise be visible to acoustic imaging. Specifically, there are no boulder fields, bedrock outcrops, or other features within which structural remains located above the surface of the harbor floor might remain undetected, and the sand waves are of insufficient height to cast significant acoustic shadow. The sidescan data are of sufficient resolution so that isolated boulders between 1 and 2 feet in size as well smaller isolated debris are visible. The level of confidence for the identification of significant wreckage, if present, within the side scan sonar record on the harbor floor is high.

There are no indications of any vessel or aircraft structure on the surface of the floor within the sidescan sonar record at the Pontoon Moorage Site.

The presence of mobile sediments indicates the potential for ship or aircraft wreck remains to be buried within the survey area. A partially buried wreck, including wrecks previously impacted by dredging, or wooden wrecks that have structure significantly reduced through burning prior to deposition, or in-water decay and disintegration, will generate a much smaller acoustic image. The footprint of partially buried wreckage may be increased, however, by the presence of surrounding scour marks. Sand waves are generated and propagated by currents that may also generate scour marks around structure, even when the structure lies below the predominant seabed level in the area.

There are no indications of scour marks that suggest the presence of any partially buried vessel or aircraft structure on the surface of the seabed within the sidescan sonar record at the Pontoon Moorage Site.

There were three small anomalies observed in the sidescan record where a relatively faint curved pattern was observed. The patterns might be consistent with deteriorated wooden vessel (less than 75 feet in length) with only the tops of the frames from one side visible above the seabed, although with minimal or non-existent associated scour (The anomalies were noted in the sidescan records from the 2008 report at event marks 1225, right channel; and 3639 and 3640, right channel). No magnetic anomalies were apparent in the processed magnetometer data where these sidescan images were observed.

4.2.2 Subbottom Reflection Data, 2010

The subbottom reflection data collected by Golder in February 2010 within the survey area were reviewed. There is no indication in the subbottom record that a wreck is buried to a depth of 60 feet, the reported maximum depth for potential Project impacts. Figure 3 shows the unconsolidated sediments within which a wreck could potentially be contained ranging in depth between 55 and 170 feet.

No reflections were observed at any depth that might be consistent with “hard” surfaces generated by a buried wreck, its components, or related stratigraphic anomalies.

The sub-bottom record was revisited to check areas where magnetometer anomalies were noted along the track lines, again without indication of a buried wreck.

4.2.3 Magnetometer Data, 2010

The magnetometer data collected by Golder in February 2010 within the survey area were first analyzed before being processed and presented into map form for archaeological review. Several magnetic anomalies have been associated with active crab pots (Map 3) with readings of typically of less than 50 nT. Stronger readings of between 100 and 500 nT were registered in the vicinity of navigational aids, that included channel buoys and range markers.

For sixteen anomalies, most with signatures of less than 50 nT, the source is unknown. In some of these anomaly locations there is some associated debris, not a crab pot, evident in the sidescan sonar record. There is no indication in the sidescan record that the debris represents, or is associated with, a wreck site.

In other anomaly locations, no objects are evident on the sidescan record of the river floor. These magnetic anomalies may show where abandoned crab pots have been deposited since the 2008 survey or have been buried by mobile sediments. Several of the anomalies show an alignment and spacing similar to a string of pots, and have similar magnetic characteristics to the known crab pots identified in the survey.

None of the unknown anomalies have provided a signal duration long enough to indicate the presence of a significant quantity of deeply buried ferrous material. With a typical signal duration of about 10 feet and generally showing on a single track line they are also too limited in size to indicate anything but small craft or disarticulated remains near the surface of the river floor. None of the anomalies extend over more than two lines. None of the anomalies are large enough to produce multiples peaks. The signatures are all bipolar suggesting a cultural rather than geological source, but are consistent with the signatures expected for a cable, crab pot, or localized debris.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on historical research, this study concludes that while there is potential for significant historic archaeological marine resources to be located within Grays Harbor, there is low potential for these resources to exist in the survey area. This is determined by the absence of reported wrecking events in the survey area as well the physical characteristics and use history of the survey area, which do not make it a loss trap for vessels.

The geomorphology and dredging history of the area further suggests a low prospect for the survival of archaeological remains in the survey area.

Based on analysis of marine geophysical data, there is no indication of any marine historic archaeological resources located within the survey area on the surface, or at depth below the river floor. While the geophysical data cannot provide certainty that no small craft or shallowly buried discontinuous wreck sites are present, the absence of articulated wreck remains on or near the surface, and the absence of a substantial modern wreck site at depth may be stated with some confidence.

No new sites were inventoried as a result of this survey.

No targets were identified that require verification or further documentation.

As a result of these conclusions, no further archaeological investigations of historic archaeological marine resources at the Grays Harbor Pontoon Moorage Site are recommended. In the unanticipated event that cultural material, including loose timbers or other structural elements that may be associated with an historic shipwreck, are brought to the surface or otherwise encountered during the development it is recommended that a professional archaeologist and the Department of Archaeology and Historic Preservation should be immediately contacted.

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