

North Shore Levee

Aberdeen & Hoquiam, Washington

Operations and Maintenance Manual – CLOMR Submittal

Hoquiam River, Wishkah River, Chehalis River, and Grays Harbor
Grays Harbor, Washington

July 2017



North Shore Levee Operations and Maintenance Manual
Cities of Aberdeen & Hoquiam

Wishkah River, Chehalis River, Hoquiam River, and Grays Harbor
Aberdeen and Hoquiam, Washington

July 2017

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Wishkah River, Chehalis River, Hoquiam River, and Grays Harbor
Grays Harbor, Washington

KPFF Project No. 41600177

July 2017

This Operations and Maintenance (O&M) Manual is a living document and must be reviewed and updated as appropriate. This O&M Manual should be reviewed at the following times:

1. At the completion of this project
2. After modifications to the levee
3. After major repairs
4. Annually

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1.0 INTRODUCTION

1.1 General

This manual has been compiled to assist local officials of the Cities of Aberdeen and Hoquiam in complying with the regulations for operations and maintenance of the flood control works, and should be used in conjunction with the U.S. Army Corps of Engineers (USACE) “Levee Owner’s Manual for Non-Federal Flood Control Works” also referred to in this document as the Levee Owner’s Manual.

This manual contains a copy of approved regulations, maps, drawings, and references pertaining to the project.

The levee, as designed and constructed, will reduce the risk of flooding. However, continued successful functioning of the levee will depend upon how it is maintained by responsible local officials.

Serious flood damages, which could result from failure of any part of the levee system, can be prevented through careful inspection, proper maintenance, and establishment of effective operational procedures.

1.2 Location

A map of the project location is provided as Appendix A.

For this project, the mouth of the Chehalis River is at the Chehalis River Bridge (US 101).

The project is entirely located within the City of Aberdeen and the City of Hoquiam in Grays Harbor County, Washington. The project begins near the left bank of the Hoquiam River, and runs southwest to tie into the abutment of the US 101 Riverside Bridge. The levee runs along Riverside Park until 21st Street where the levee heads south to the Puget Sound & Pacific Railroad (PS&P) tracks, and continues east, just north of the tracks until G Street in Aberdeen where it will head north and tie into the Wishkah Bridge abutment. Continuing along Market Street, the levee will run north of Stanton Street and follow the banks of the Wishkah River and tie into a high ground terminus point.

1.3 Description

Project plans are provided as Appendix B.

The Base Flood Elevation for the levee is 13.2 feet (NAVD88). Freeboard for the levee is two feet. The Design Elevation for the levee is the Base Flood Elevation plus Freeboard, or 15.2 feet (NAVD88).

The levee alignment is approximately 5.6 miles long and consists of raised roadways, concrete and sheet pile flood walls, earthen levees, and removable stop log closures that raise the elevation along the route between 0 and 5 feet to create a top of levee elevation of 15.2 feet.

The project begins as sheet pile flood wall at existing high ground towards the beginning of the west side of Broadway Avenue. Starting here and heading towards the Hoquiam River it follows along the bank until B Street where the levee cuts between private properties and the shipyard. The levee continues to the corner of 14th Street where the road is raised to the Design Elevation. Raised roads are raised by reconstructing the roads, curbs, and sidewalks.

The levee continues south and ties into the abutment of the Riverside Avenue Bridge (US 101). On the south side of abutment the levee transitions to concrete flood wall and follows east between the road and the sidewalk. At the intersection of Riverside Avenue and 16th Street, the curb will be raised to the Design Elevation and continue along the sidewalk until 20th Street where the raised curb transitions back to a concrete flood wall. The levee crosses the raised road on Simpson Avenue and heads south on 21st Street.

The levee continues on the west side of Ocean Protein through the forested area as an earthen berm and heads south. Near Ozsmans, the levee transitions to a sheet pile flood wall and heads south to the Puget Sound & Pacific (PS&P) Railroad. The levee continues east along the north side of the tracks as a combination of earthen berm, sheet pile flood wall and concrete flood wall where it meets and ties into the raised road at Port Industrial Road, between 28th and 30th Street in Hoquiam.

Continuing east from 30th Street the levee follows north of the PS&P Railroad as an earthen berm. Combinations of concrete flood walls and stoplogs closures are used in areas where the levee crosses a street. The levee transitions back to earthen berms after the street crossing. The earthen berms have access ramps on the beginning and end for maintenance vehicles.

At Port Industrial Road, near S Jeffries Street, the levee transitions to sheet pile flood wall and continues along the north side of the tracks. A combination of earthen berms and concrete flood walls continues from Division Street to the mouth of the Wishkah River at F Street. The levee runs north, along F Street as a concrete flood wall and follows the right bank of the river tying into the abutments of the Heron Street Bridge (US 12 eastbound). It continues on the other side of the bridge and transitions as an earthen berm through Zelasko Park and ties into the abutment at the Wishkah Street Bridge (US 12 westbound).

The levee is a concrete flood wall and follows the right bank of the Wishkah River behind Q-Mart II. Near Market Street and E Street, the levee turns perpendicular to Market Street and ties into the raised road on Market Street. On the north side of the road, the levee continues northeast towards the Young Street Bridge. Near Young Street and E 1st Street the levee transitions into high ground. From there, sheet pile flood wall follows along the south side of the Kurt Cobain Park. The levee continues along E 2nd as a concrete flood wall then crosses at the intersection of E 2nd and Stanton Street and follows along the Wishkah river banks as a sheet pile flood wall. The levee ends at a high ground terminus near Stewart Field.

1.4 Protection Provided

The levee is designed to protect portions of the City of Aberdeen and the City of Hoquiam against damages from floods with a 1% probability of exceedance (100-year flood).

1.5 Construction History

Minor localized flood protection measures have been constructed in the past along Riverside Park, the right bank of the Chehalis River and right bank of the Wishkah River. These flood measures have included earthen berms, sheet pile flood walls and concrete flood walls. The new levee supersedes prior minor protection measures.

A levee was designed and constructed along the left bank of the Chehalis River and south shore of Grays Harbor in the 1990s to protect South Aberdeen and the City of Cosmopolis. South Aberdeen's 'Southside Dike' is isolated from the North Shore Levee by the Chehalis River and Grays Harbor.

2.0 PROCEDURES

2.1 General

General rules and guidelines for the maintenance and operation of local flood control works are provided in the USACE "Levee Owner's Manual for Non-Federal Flood Control Works." The following paragraphs give more detailed suggestions for complying with the requirements.

2.2 Duties of the Superintendent

The Cities of Aberdeen and Hoquiam shall designate a Superintendent to be responsible for carrying out the maintenance and operation of the levee system. The Levee Superintendent shall be one of the Cities of Aberdeen or Hoquiam's Public Works Director/Superintendent or an individual formally designated by the Public Works Director/Superintendent. The Levee Superintendent shall be provided with the authority to direct personnel and resources to operate and maintain the levee system. In addition to the duties outlined in other portions of this manual, the Superintendent has a general responsibility for maintaining and operating structures and facilities, particularly in flood periods. The name, address, and telephone number of the Superintendent shall be furnished to the contacts on the Distribution List (Appendix E). The contacts on the Distribution List shall be notified of any change in this information.

2.3 Improvements or Alterations to the Project

Drawings or prints of proposed improvements or alterations in the levee, structures, or riverbanks shall be submitted to the City of Aberdeen Public Works Department. Drawings shall be submitted sufficiently in advance of the time proposed for initiation of construction to permit adequate study and consideration of the possible effects of the work. Drawings showing the improvements or alterations as finally constructed shall be furnished to the Distribution List and incorporated into this manual.

2.4 Annual Reporting

The annual report shall cover inspection and maintenance of the project works and shall include dated copies of inspection check sheets or report sheets prepared during the period covered by the report. In the event repairs have been made, either temporary or permanent, the nature and dates of such repairs shall be included. Photographs showing the river and levee during flood periods are desired whenever available.

2.5 Periodic Inspections

Periodic inspections shall be made at the following times:

1. Prior to the beginning of a major flood season (winter floods may be expected annually in November through February). Typically, the second half of August has the lowest water levels of the year, allowing for observations below ordinary high water.
2. Immediately after each major high water period.
3. Immediately after a significant seismic event (seismic events that can be felt in the Cities of Aberdeen or Hoquiam are considered significant).
4. At such other times as may be considered necessary by the Superintendent.

2.6 Check Sheets

In Appendix C of this manual, there is a suggested multipage check sheet which can be used to facilitate routine and emergency inspections. This, or a similar form, should be used at each inspection to ensure that no feature of the levee system has been overlooked. Any needed repairs should be indicated thereon, with a check indicating satisfactory items. Completed check sheets and maintenance records from previous inspections should be reviewed prior to the periodic inspection to help identify chronic problem areas. Special consideration should also be given to areas that have been improved or altered.

3.0 PROJECT FEATURES

3.1 General

The project consists of earthen berm levees, concrete flood wall levees, sheet pile flood wall levees, raised roadway levees, and three WSDOT bridge abutments as described in Section 1.3. Stoplog closures span openings for streets, sidewalks, and property access. The Cities of Aberdeen and Hoquiam have an existing storm sewer system to collect and convey drainage inside of the levee. Where storm sewer pipes pass through the levee to outfall in the Hoquiam River, Wishkah River, Chehalis River, or Grays Harbor, pump stations provide discharge during flood events. See project plans in Appendix B for details.

3.2 Levees

3.2.1 Earthen Berm Levees

The crests of earth berm levees are 10 feet wide with an elevation of the Design Elevation. Side slopes of the levees are 2H:1V (horizontal:vertical). Levee slope faces are vegetated to provide erosion protection. Some levees may include a gravel path along the top for driving inspections.

3.2.2 Concrete Flood Wall Levees

Concrete flood wall levees are reinforced concrete T-walls on shallow footings. Footings generally have one foot of cover over footings, one foot four inches thick. The walls are one foot thick and their footings are 13 feet wide. Where planters are integrated into walls, the footings are up to 16 feet wide.

3.2.3 Sheet Pile Flood Wall Levees

Sheet pile levees are used when space for a concrete flood wall levee is limited. The sheet pile levee is 1.5 feet thick and has a depth two-thirds of the levee height.

3.2.4 Raised Roadway Levees

Streets are raised to the Design Elevation by reconstructing roads, curbs, and sidewalks. Existing streets are demolished and the subgrade is built up.

3.3 Openings and Closures

There are 61 closures along the levee spanning openings for streets, sidewalks, and property access. Six (6) of these closures are a pedestrian hinged gate that operate much like a door. At all times pedestrian hinged gates are in a closed position but can be opened for pedestrian access at any time. The rest of the closures consist of interlocking wooden stoplogs and bollards. All stoplogs are five feet in length so that any stoplog can be utilized at any location. The materials for the closures are stored in trailers that will be parked on City property easily accessible for hookup. City vehicles will then be able to tow the trailers to every stoplog closure when assembly is needed.

3.4 Drainage Structures

Internal drainage is provided by the City of Aberdeen and the City of Hoquiam's independent storm sewer systems. Where storm sewer pipes pass through the levee to outfall in the Hoquiam River, Wishkah River, Chehalis River, or Grays Harbor, pump stations provide discharge during flood events. The internal drainage for this levee is discussed further in the Interior Drainage Analysis as a separate attachment.

3.5 Pump Stations

Where storm sewer pipes pass through the levee to outfall in the Hoquiam River, Wishkah River, Chehalis River, or Grays Harbor, pump stations provide discharge during flood events. The total number of pumps is undetermined due to interior drainage alternatives but will be finalized upon further design. Between the alternatives the total number of pump stations range from 11 to 22. The internal drainage for this levee is discussed further in the Interior Drainage Analysis as a separate attachment.

4.0 MAINTENANCE

4.1 General

The Superintendent shall be directed to make periodic inspections (minimum annually), take immediate steps to remedy adverse conditions disclosed by such inspections, and provide periodic repairs and cleaning required for the proper function of the levee. Inspections and maintenance shall be conducted in general accordance with the Levee Owner's Manual. Records of inspections, maintenance, and repairs should be kept for reference for future inspections.

4.2 Levees

4.2.1 Earth Berm Levees

Settlement, sloughing, erosion, animal burrows, and any other changes in levee cross section should be restored to the original shape and measures should be taken to prevent the return of the condition.

Vegetation on levees should be maintained as follows:

1. The levee, to include the back side of the levee to within 15 feet of the landward toe, will be inspected and all woody plants (trees) will be evaluated on a case-by-case basis. Grass should be mowed at least four times yearly with one mowing occurring in once in August, September, and October, right before flood season.
2. Trees smaller than 10 inches Diameter at Breast Height (DBH) may remain on the levee (DBH is the diameter of the tree at a height of 4.5 feet from the ground on the uphill side of the tree).
3. Trees larger than 10 inches DBH will be evaluated on a case-by-case basis and will be removed if determined to negatively affect the stability of the levee. Trees larger than 10 inches DBH should be documented in the inspection check sheets to facilitate continued monitoring in following inspections.

Trees that could negatively affect the stability of the levee and should be considered for removal consist of:

1. Dead trees or diseased trees that will likely die or significantly deteriorate prior to the next scheduled inspection.
2. Trees that are leaning or show signs of instability such as tension cracks or erosion around the root wad.
3. Trees below the 100-year flood elevation with a significant amount of large, low limbs that could cause snags during high water periods.
4. Any other trees that are determined to be unstable by the inspection team.

Trees that are to be removed should be removed in a manner that reduces the disturbance to the riverbank and levee slope to the greatest extent practical. Trees should be cut off 2 to 4 feet from the ground surface. To prevent future seepage or piping, a 2-foot-wide trench should be cut through the uphill side of the root wad and backfilled with compacted structural fill. If practical, the majority of the root wad should remain to provide stability and erosion protection to the riverbank until new vegetation can be established.

Areas where vegetative slope protection has died or not been established should be replanted. Temporary slope protection such as jute matting may be required while permanent measures are established. Alternative slope protection measures should be considered for areas that are found to have chronic issues with maintaining a grass or sod cover.

4.2.2 Concrete and Sheet Pile Flood Wall Levees

Concrete and sheet pile flood walls should be checked for tilting or settlement. The steel of the sheet pile flood walls should be checked for signs of corrosion. If signs of tilting, settlement, or corrosion are observed for any concrete or sheet pile flood wall system, a licensed engineer should be contacted to determine the best approach to correct the problem. The extent of any observed movement or corrosion should be documented so that the engineer can make a determination on the rate of movement of the structure or the rate of progression of the corrosion.

The bottoms of concrete flood wall are about 2 feet 4 inches below the surface. Roots from vegetation and trees could extend underneath the walls. Therefore trees shall not be allowed to grow such their driplines cross over the foundations of walls. Areas within 15 feet of the concrete and sheet pile flood wall face shall be grass and shall be mowed at least four times per year, with one mowing occurring in once in August, September, and October, right before flood season.

4.2.3 Raised Roadway Levees

Roadway surfaces, curbs, and sidewalks should be checked for settlement, cracking, and other damage. If damage is observed, a licensed engineer should be contacted to determine the best approach to correct the problem. The extent of any settlement or cracking should be documented so that the engineer can make a determination on the rate of movement and progression.

Roots from vegetation and trees could extend underneath the roadways. Therefore trees shall not be allowed to grow such their driplines cross over roadway surfaces, curbs, or sidewalks. Areas within 15 feet of roadway surfaces, curbs, and sidewalks shall be grass and shall be mowed at least twice per year, with one mowing occurring in once in August, September, and October, right before flood season.

4.3 Openings and Closures

Openings shall be inspected and maintained during concrete and sheet pile flood wall inspection and maintenance. Stoplogs and bollards shall be inspected and inventoried annually each October before the flood season to ensure that they are on-hand and in condition to provide protection. Stoplogs that have become chipped, cracked, worn, rotted, or otherwise degraded shall be replaced immediately.

4.4 Drainage Structures

All drainage structures should be kept clear of debris and sediment. The interior of concrete storm drain manholes should be checked for spalling, cracking, settlement, or wear due to abrasion. Corrugated metal pipe culverts should be checked for interior and exterior rust, reduction in metal thickness, joint separation, holes, and settlement.

All mechanical flap gates or check valves should be checked and lubricated at least once per year. Cracked or damaged gates must be repaired or replaced. Rubber gaskets should be checked for cracks, tears, or brittleness. Full inspection and maintenance of drainage structures will require compliance with confined space entry regulations.

4.5 Pump Stations

The pump stations are on a supervisory control and data acquisition (SCADA) system for remote monitoring of the pumps by the Levee Superintendent and City staff. Additionally, the pump stations are physically inspected bi-weekly October through April and monthly May through September. They are maintained as necessary as part of routine maintenance of the City of Aberdeen and the City of Hoquiam's independent storm sewer systems. A copy of the pump maintenance schedule and checklist is provided in Appendix D. A complete record of inspections, tests, maintenance actions, and repairs shall be kept at the pump site. Levee inspections shall review the pump maintenance records and confirm that routine maintenance and repairs are occurring in accordance with the schedule.

4.6 Riverbanks

The riverbanks are not part of the flood control works; however, they may affect the levee to some degree. Any slumps or erosion should be noted and evaluated to determine what if any reports are necessary.

Snags and debris deposited high on the bank during flood events should be evaluated for impacts to the levee and possible removal. Large trees that could potentially destabilize the levee foundation if they were to become unstable should also be evaluated. See maintenance for earthen berm levees, and concrete and sheet pile flood wall levees above.

4.7 Bridges

Maintenance issues with the bridges may lead to maintenance issues with the adjacent flood control works. Bridges along this levee include:

1. Riverside Ave Bridge (US 101)
2. Simpson Ave Bridge (US 101)
3. Chehalis River Bridge (US 101)
4. Heron St Bridge (US 12 eastbound)
5. Wishkah St Bridge (US 12 westbound)

The levee passes under the Simpson Ave Bridge and the Chehalis River Bridge, while it ties into the built up abutments of the other three bridges. See Appendix G for the WSDOT Agreement. Check for snags under the bridges and directly upstream of the bridge structures, for erosion along the downstream wing walls, for open cracks in and spalling of reinforced concrete, and for any evidence of movement of the abutments. Any damage to the bridges should be reported to the owner of the bridge and a licensed engineer should be contacted to determine the best approach to correct the problem.

4.8 Seismic Event Damage and Restoration

Seismic evaluation indicates that soil liquefaction and/or loss of soil strength due to cyclic softening during the 100-year return period event is possible throughout the Cities and along the proposed levee alignment. Where the levee alignment is located adjacent to the Hoquiam River, Wishkah River, Chehalis River, or Grays Harbor, this loss of soil strength could in turn lead to lateral spreading of the ground surface. Constructing a levee system capable of withstanding such a significant seismic event is not considered practical and is not consistent with the overall approach to risk and disaster management in the City. Therefore the levee is designed for the predicted 100-year flood and not for seismic events.

In the event that seismic ground motions damage the levee, an earthquake remediation plan will be implemented:

1. The Levee Superintendent will develop an estimate of the general magnitude and locations of damage throughout the levee system, along with the amounts and locations of material needed to restore the levee system's grade and dimensions sufficient for protection against the BFE plus two feet of freeboard.
2. Levee repairs shall be consistent with the levee's original design plans and any subsequent approved modifications.
3. Interim repairs need to restore the flood protection within eight weeks or less to avoid prolonged exposure of the community during flood season.
4. The Levee Superintendent shall maintain a list of borrow areas, stockpiles, pits, and other sources of material needed for interim repairs. Such material should be consistent with the design plans and any subsequent approved modifications.
5. The Levee Superintendent will notify the public as quickly as possible by internet/alert media or other appropriate method after a damaging earthquake as to system damages and the resulting interim level of protection that will be provided.

5.0 OPERATIONS

In order to prepare the levee for high water events, 55 closures must be assembled. The Levee Superintendent will be responsible for ordering and managing the closure in accordance with the Closure Plan included as Appendix H.

There are no other actions required to prepare the levees for a flood event aside from thorough inspections and maintenance as described in the preceding sections and patrols and inspections as described in the following sections.

A few stoplog closures are required to be in place at all times unless access to the unprotected side of levee is needed, see Appendix H for a more detailed description. One of these stoplog closures crosses a private railroad spur. See Appendix F for the Railroad Closure Agreement.

The pump stations controlling interior drainage are set to turn on automatically as needed.

6.0 HIGH WATER PERIOD

6.1 General

Flooding events in the area are highly dependent on a combination of high seasonal tides, storm surges, atmosphere pressures, river flows, and interior runoff from precipitation, all of which are highly predictable. The Levee Superintendent orders the closure of openings within six (6) hours of when river and harbor water levels are anticipated to reach the Base Flood Elevation or immediately whenever the river and harbor levels are at the Base Flood Elevation. Time needed to close the levee is 110 minutes. Closure activities shall be in accordance with the Closure Plan included as Appendix H.

Pump stations associated with the levee activate automatically, no specific action is required for the activation or operation of the mechanized drainage system components. It is not necessary to establish an elaborate flood-fighting organization over than what is needed for the Closure Plan, but it is imperative that the levees be maintained in accordance with this manual.

6.2 Operations

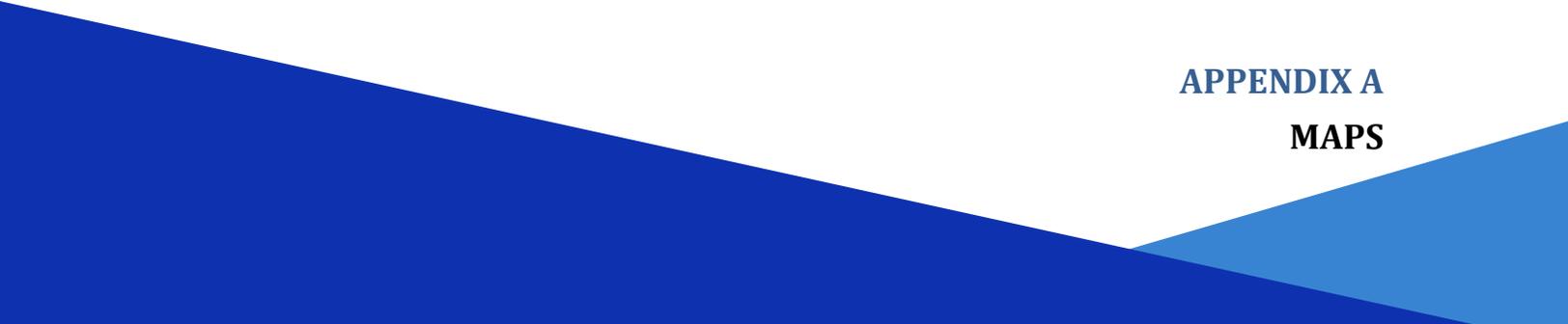
It is not intended that this manual will restrict the Superintendent, or others concerned, to a rigid set of rules. With individual initiative, difficult conditions can usually be corrected in the manner recommended in the manual by methods acceptable in standard engineering practice.

6.3 Patrols

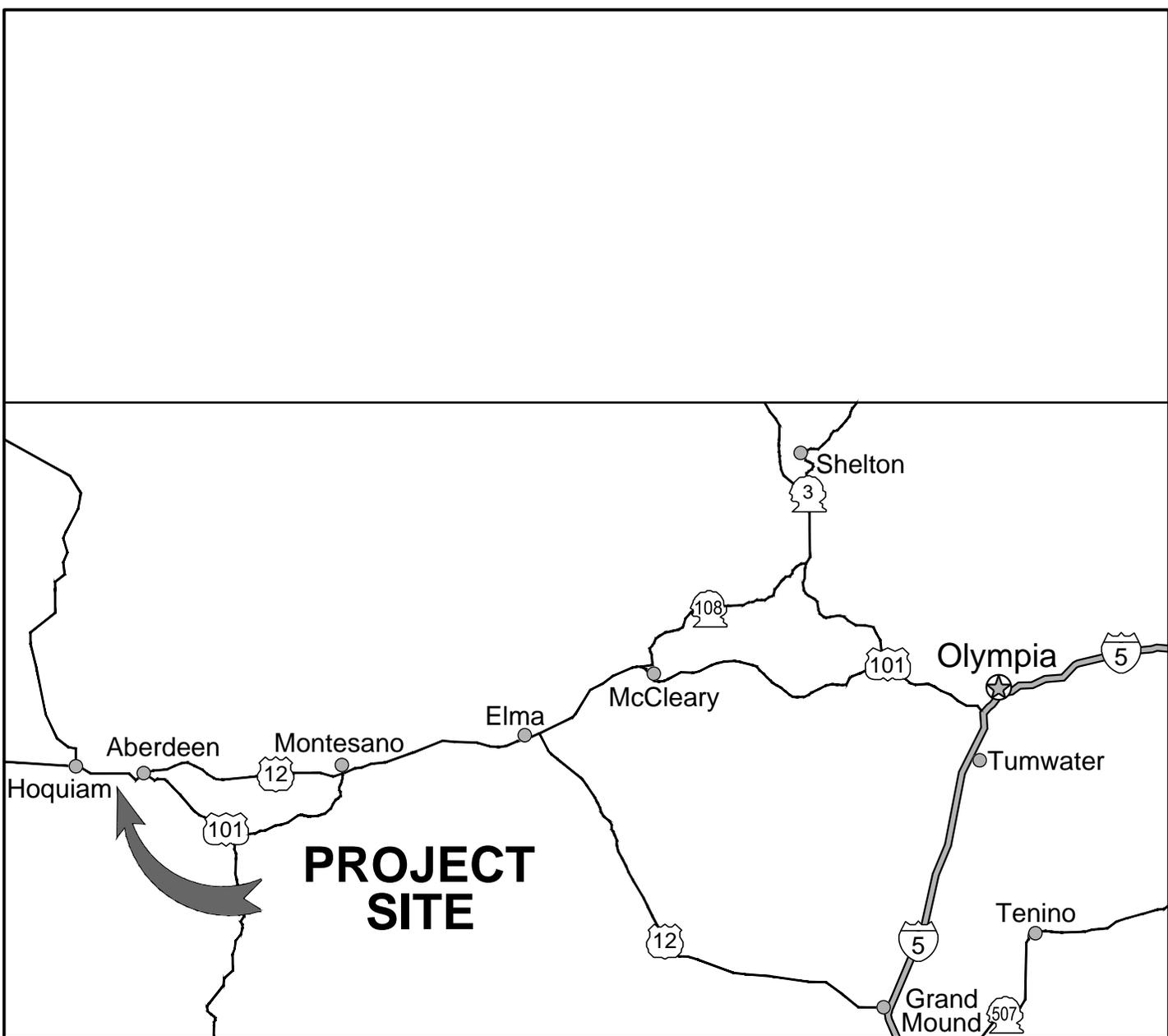
There should be regular patrolling of the levee during periods of high water. The Superintendent shall ensure that sufficient personnel are familiar with the basic requirements of maintenance and that they are available to maintain the patrol. Following serious bank erosion during floods should be checked and levee banks should be returned to design slopes as soon as practicable after the high water has receded.

6.4 Pump Stations

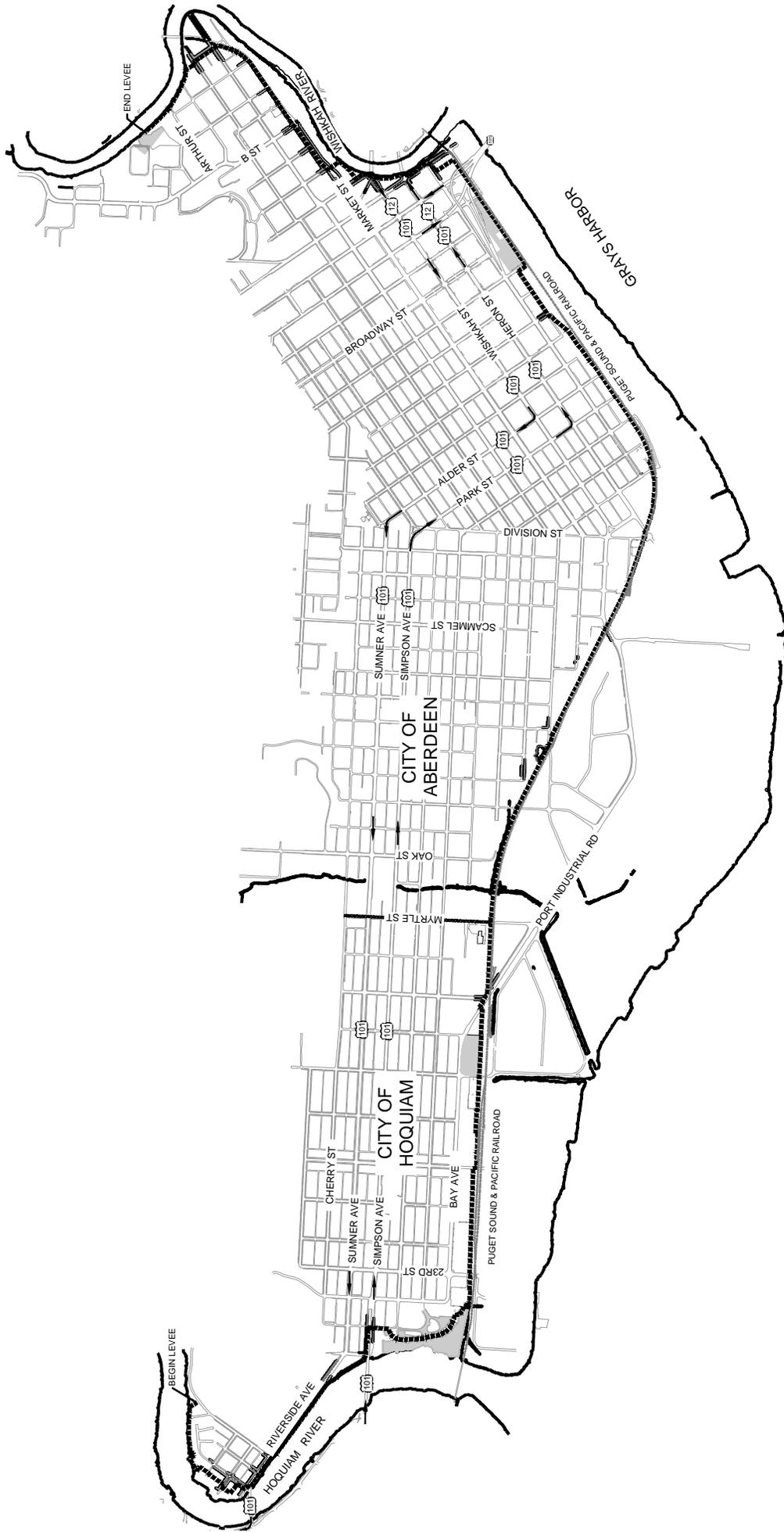
The pump stations will activate automatically when the storm sewers fill on the inland side of the levee and when the outfall to the river is blocked by the flapgates because of flood waters. The pump stations should be monitored during high water periods to confirm that they are operating as required.



APPENDIX A
MAPS



PROJ NO: 41600177	SCALE: N.T.S.	NORTH SHORE LEVEE	DRAWN BY: NA	FIGURE
 612 Woodland Square Loop Suite 100 Lacey, WA 98503 360.292.7230 www.kpff.com		VICINITY MAP	DESIGNED BY: BNT & BAL CHECKED BY: MRS DATE: 07-2017	1



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NORTH SHORE LEVEE

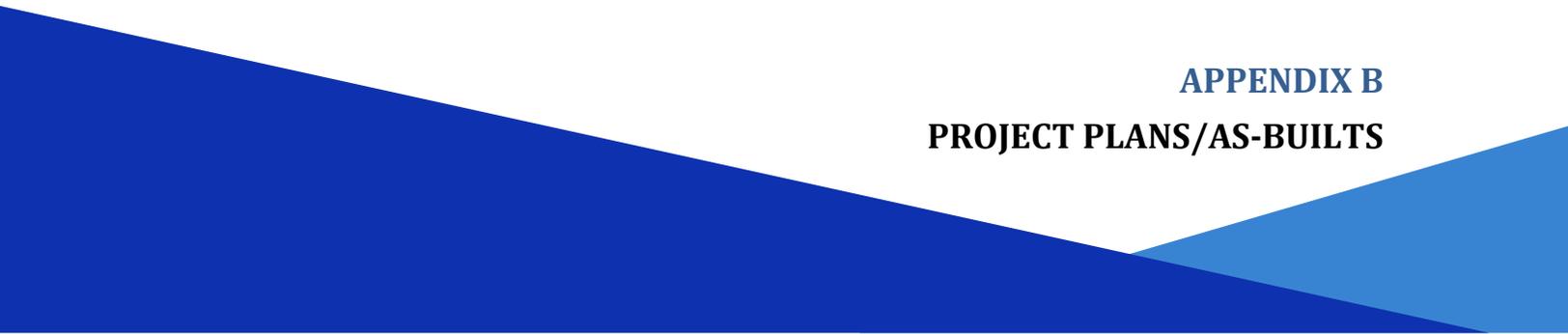
SITE MAP

PROJ NO: 41600177
 DATE: 07-2017
 SCALE: N.T.S.

DRAWN BY: JAD
 DESIGNED BY: BNT & BAL
 CHECKED BY: MRS

FIGURE

2

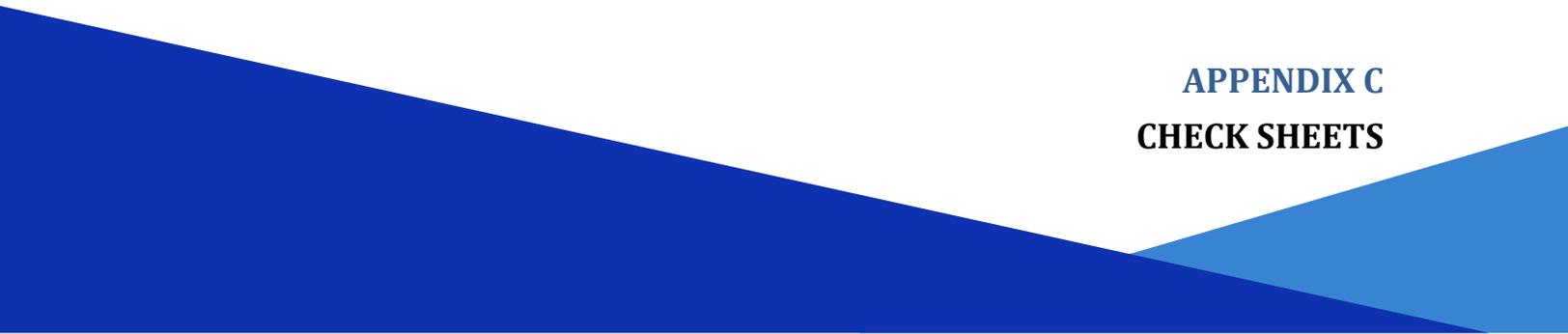


APPENDIX B
PROJECT PLANS/AS-BUILTS

APPENDIX B

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Both half-size and full-size sets of the plans are included elsewhere in the CLOMR submittal and are not included in this appendix with this submittal. A half-size set of the plans and later the as-builts will be included here in the future.



APPENDIX C
CHECK SHEETS

APPENDIX C CHECK SHEETS

Flood protection project at Hoquiam River Wishkah River, Chehalis River, and Grays Harbor, Aberdeen and Hoquiam, Washington

North Shore Levee

Type of Inspection (check only one):

- () Annual () Emergency/Disaster
() Semiannual () Other (Describe)

Date: _____

Inspected by (List Lead Inspector first and include other key personnel):

Levee

Item	Station or Location	Condition *	Recommendation **
Snags or Debris			
Woody Plants on top 3 rd of Levee			
Trees larger than 10 DBH in lower two-thirds of levee (note all, including those to remain)			

Notes:

- * Indicate satisfactory with a check; briefly describe conditions when other than satisfactory; use additional sheets if more space is required.
- **Indicate the recommended action for areas less than satisfactory; include persons or organizations responsible for completing the recommended action.

Additional Remarks:

Riverbank Repair Record

Corrective work completed during period:

Start Date: _____

Completion Date: _____

Additional Remarks:

Earthen Levee

Item	Station or Location	Condition *	Recommendation **
Settlement, loss of grade			
Sloughing or caving (either side of levee)			
Seepage or sand boils			
Animal burrows			
Undesirable vegetation			
Drainage to levee crown			
Unauthorized encroachments on right-of-way			
Unauthorized excavation or removal of slope protection			
Unauthorized grazing or vehicular traffic			
Accumulation of drift, trash or debris			

Notes:

* Indicate satisfactory with a check; briefly describe conditions when other than satisfactory; use additional sheets if more space is required.

**Indicate the recommended action for areas less than satisfactory; include persons or organizations responsible for completing the recommended action.

Additional Remarks:

Levee Concrete, Sheet Pile Flood Wall Levees and Stoplog Closures

Item	Station or Location	Condition *	Recommendation **
Tilting, sliding, and settlement			
Spalling, cracking, and scaling of concrete			
Exposed steel (sheet piles or reinforcing)			
Seepage or sand boils			
Weeds of undesirable vegetation			
Unauthorized encroachments on right-of-way			
Unauthorized excavation or removal of slope protection			
Accumulation of drift, trash or debris			

Notes:

- * Indicate satisfactory with a check; briefly describe conditions when other than satisfactory; use additional sheets if more space is required.
- **Indicate the recommended action for areas less than satisfactory; include persons or organizations responsible for completing the recommended action.

Additional Remarks:

Levee Repair Record

Corrective work completed during period:

Start Date: _____

Completion Date: _____

Additional Remarks:

Drainage Structures

Item	Station or Location	Condition *	Recommendation **
Debris or Sediment as Closures			
Damage to Flap Gates or Check Valves			
Oil/Lubricate moving parts (To be completed yearly. Note date of Last Maintenance.)			
Cracking, scaling or spalling of concrete. (Specifically note if rebar is exposed.)			
Corrosion of Steel Pipes			

Notes:

- * Indicate satisfactory with a check; briefly describe conditions when other than satisfactory; use additional sheets if more space is required.
- **Indicate the recommended action for areas less than satisfactory; include persons or organizations responsible for completing the recommended action.

Additional Remarks:

Drainage Structure Repair Record

Corrective work completed during period:

Start Date: _____

Completion Date: _____

Additional Remarks:

Bridges

Item	Station or Location	Condition *	Recommendation **
Debris or snags			
Erosion along the downstream wing walls			
Cracking, scaling or spalling			
Movement of abutments			

Notes:

* Indicate satisfactory with a check; briefly describe conditions when other than satisfactory; use additional sheets if more space is required.

**Indicate the recommended action for areas less than satisfactory; include persons or organizations responsible for completing the recommended action.

Additional Remarks:

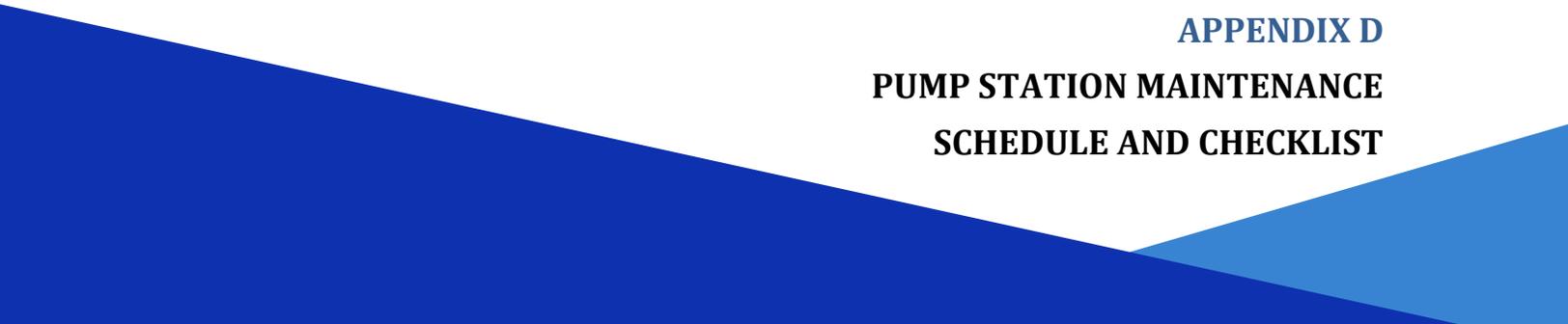
Bridge Repair Record

Corrective work completed during period:

Start Date: _____

Completion Date: _____

Additional Remarks:



APPENDIX D
PUMP STATION MAINTENANCE
SCHEDULE AND CHECKLIST

APPENDIX D PUMP STATION MAINTENANCE SCHEDULE AND CHECKLIST

PUMP STATION MAINTENANCE SCHEDULE

Maintenance	Scheduled	Maintenance Code
Ultra Sound / Infrared	Twice Yearly – January and July	A102
Reduced Pressure Testing	Yearly – January	A153
UPS Battery Replacement	Every 3 years – January 2008, January 2011, etc...	A028
PLC Battery Replacement	Yearly – January	A028
Oil and Lube	Yearly – February	A000
Mercury Switch Inspection	Twice Yearly – March and September	A017
Alarms Check	Twice Yearly – March and September	A036
Wet Well Cleaning	Five times per Year – January, April, June, August, and October	A002
Check Valve Cleaning	Yearly – October	A062
General Inspection	Bi-weekly October through April, monthly May through September	A076

CITY OF ABERDEEN PUMP STATION GENERAL INSPECTION CHECKLIST

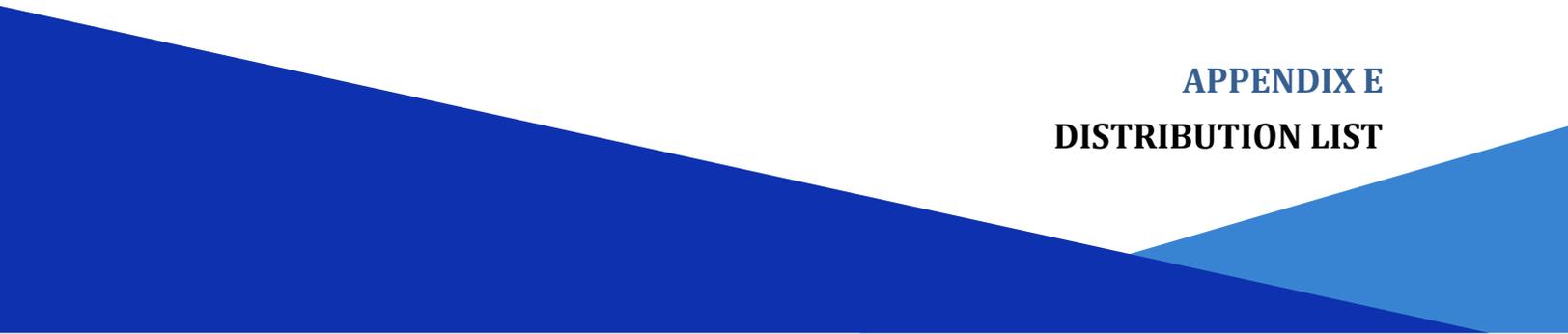
PUMP STATION CHECK LIST

Item	Condition *	Recommendation **
Pumps		
Flappers		
Bubbler System		
Sump Pump		
Telephone		
Dehumidifier		
Station Flood Switch		
Lights		
Instruments		
Seal Filters		
VFD Drive (if installed)		
Any Leaks		
Entry Switch Operation (check with Control)		

Notes:

* Indicate satisfactory with a check; briefly describe conditions when other than satisfactory; use additional sheets if more space is required.

**Indicate the recommended action for areas less than satisfactory; include persons or organizations responsible for completing the recommended action.



APPENDIX E
DISTRIBUTION LIST

APPENDIX E

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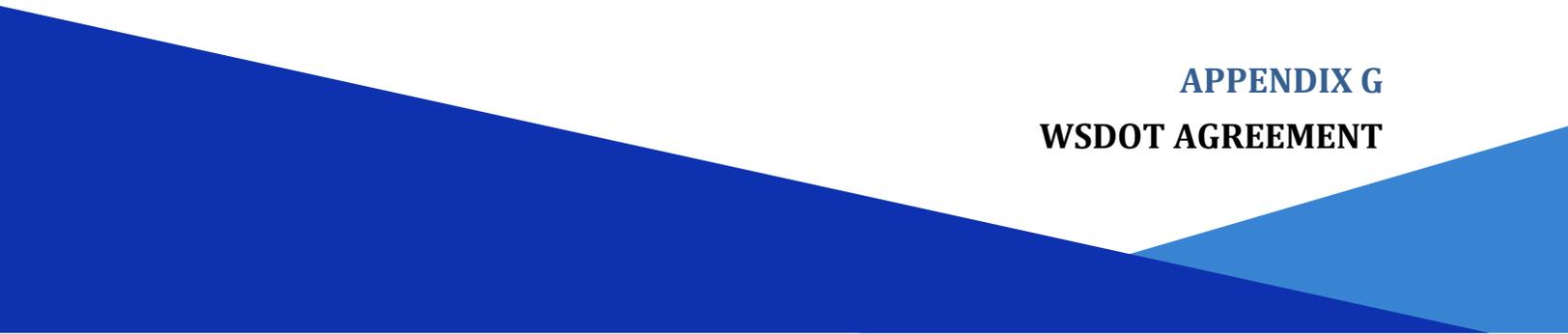
A list of contacts within organizations with authority over flood control on the Hoquiam River, Wishkah River, Chehalis River, and Grays Harbor will be compiled at the completion of the project.



APPENDIX F
RAILROAD CLOSURE AGREEMENT

APPENDIX F
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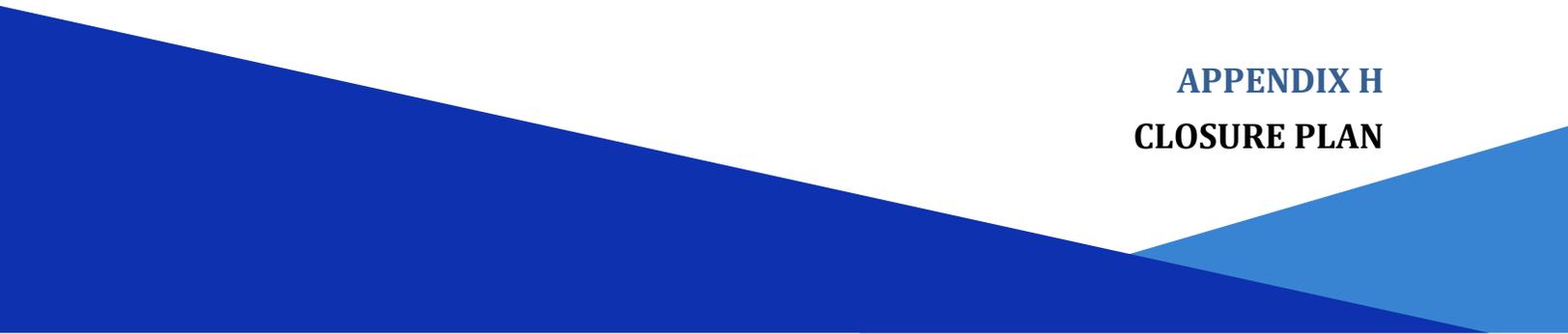
A railroad closure agreement for constructing a temporary stoplog closure over the Puget Sound & Pacific Railroad tracks will be negotiated prior to construction of the project.



APPENDIX G
WSDOT AGREEMENT

APPENDIX G

There will be an agreement between the two Cities with the Washington State Department of Transportation (WSDOT) for placement of the levee within WSDOT right-of-way, use of their abutments for the levee and how WSDOT owned facilities will be inspected and maintained. Although no construction to the bridges is required for the levee, the use of their land and existing structures will require the levee superintendent to coordinate with WSDOT to ensure the appropriate bridge experts are looking at the levee requirements in addition to the bridge requirements during the annual inspections. This agreement will be agreed upon prior to the start of construction.



APPENDIX H
CLOSURE PLAN

APPENDIX H

The levee closure plan gives details regarding each stoplog closure and pedestrian hinged gates. The closure plan shows details such as;

- width of the closure
- the quantity of bollards and stoplogs per stoplog closure
- the spacing between each bollard
- height of the stoplog closure and pedestrian hinged gate
- the amount of time it will take to assemble each individual closure
- and closure locations

The stoplogs have a length of five feet; therefore the spacing between each bollard is five feet. Based on the spacing and the height of the closure the number of stoplogs was determined. The assembly time is related to stoplog width, the average height of the closure, and travel time. The following table shows the assumptions made based on stoplog closure widths:

Stoplog Width (ft)	Min.
5, 10	5
15, 20, 25	10
30,35	15
40, 45	20
≥ 50	30

The stoplogs and bollards are stored in three trailers that will be parked on City property, one trailer for the City of Hoquiam and two trailers for the City of Aberdeen. When the stoplog closures need to be put in place, the crews will hook up the trailers to city trucks and travel to each individual closure. The total assembly time is about 110 minutes or about two hours, this includes hook up and travel time. In order to fully assemble all fifty-four stoplog closures in this time, one crew of three and two crews of four are required. See the table attached for more details.

The levee cuts off access to private railroad spurs. In these cases three stoplog closures provide access but are assumed to be in place at all times unless needed. Closures 10 and 11 cut off access from a warehouse's loading docks to a private railroad spur and closure 21 cuts off access from a private railroad spur to the PS&P railroad tracks. These specific closures will not be opened if there is a chance of a high tide event approaching. When crews are called to perform the closure plan, the assigned crews will need to check that these closures are in place and assembled correctly. Crew 1 checks closures 10 and 11, crew 2 checks closure 21.

There are a total of six pedestrian hinged gates. These gates are assumed to be closed at all times unless access to the protected side of the levee is needed. As part of the closure plan, the assigned crews will need to check the gates and make sure they are properly closed and sealed. Crew 1 will check gate 1, crew 3 checks gates 2-6.

NORTH SHORE LEVEE CLOSURE PLAN

July, 2017

Stoplog Closures

Closure No.	Location	Crew No.	Opening Width	Total Width (ft.)	Spacing (ft.)	Stoplog Height (ft.)	# of Bollards	# of Stoplogs	Assembly Time (min.)	Min. Base Elev. (ft.)	Approx. Base Elev. (ft.)	Start	End
												Station	Station
1	B St	1	15'	15	5	4.8125	2	33	10	10.39	11.28	12+54.32	12+69.32
2	C St - Sidewalk	1	5'	5	5	4.375	0	10	5	10.83	10.93	15+08.87	15+13.87
3	C St	1	45'	45	5	4.8125	8	99	20	10.39	10.55	15+59.06	16+04.06
4	14th St	1	5'	5	5	4.375	0	10	5	10.83	11.06	19+73.24	19+78.24
5	Riverside Ave	1	110'	110	5	1.75	21	88	40	13.45	13.52 - 13.89	23+61.09	24+71.09
6	20th St	1	55'	55	5	5.25	10	132	30	9.95	10.20	44+72.78	45+27.78
7	Simpson Ave	1	45'	45	5	4.375	8	90	20	10.83	10.91	49+16.26	49+61.26
8	23rd St	1	50'	50	5	3.0625	9	70	30	12.14	12.19	70+52.66	71+02.66
9	Ontario St	1	35'	35.00	5	5.25	6	84	15	9.95	10.30	85+36.70	85+71.70
10	Loading Dock 1	1	30'	30	5	7.875	5.0	108	0	7.33	7.62	86+85.94	87+15.94
11	Loading Dock 2	1	30'	30	5	8.3125	5.0	114	0	6.89	7.19	87+79.73	88+09.73
12	28th St	1	25'	25	5	4.375	4	50	10	10.83	11.02	98+37.21	98+62.21
13	30th St	1	60'	60	5	1.75	11	48	30	13.45	13.51	109+11.87	109+71.87
14	Myrtle St	1	35'	35	5	1.75	6	28	15	13.45	13.56	119+79.11	120+14.11
15	Maple St	2	25'	25	5	2.625	4	30	10	12.58	12.85	135+70.35	135+95.35
16	1st St	2	30'	30	5	1.75	5	24	15	13.45	13.58	145+68.64	145+98.64
17	Port Industrial Rd	2	60'	60	5	2.1875	11	60	30	13.01	13.11	163+38.12	163+98.12
18	Division St	2	35'	35	5	2.625	6	42	15	12.58	12.57	176+45.22	176+80.22
19	Heron St	2	35'	35	5	3.0625	6	49	15	12.14	12.28	177+52.85	177+87.85
20	Monroe St	2	40'	40	5	3.0625	7	56	20	12.14	12.24	186+15.68	186+55.68
21	Private RR Spur	2	18'	18	5	5.6875	3	47	0	9.51	9.88	187+56.05	187+74.05
22	Washington St	2	30'	30	5	3.0625	5	42	15	12.14	12.58	193+95.30	194+25.30
23	Train Yard	2	55'	55	5	3.5	10	88	30	11.70	12.03	219+58.23	220+13.23
24	K St	2	55'	55	5	3.0625	10	77	30	12.14	12.45	220+74.12	221+29.12
25	H St	2	35'	35	5	2.625	6	42	15	12.58	12.72	232+04.66	232+39.66
26	F St (1)	2	35'	35	5	3.9375	6	63	15	11.26	11.44	239+64.05	239+99.05
27	F St (2)	2	5'	5	5	3.9375	0	9	5	11.26	11.39	240+04.93	240+09.93
28	F St (3)	2	10'	10	5	3.5	1	16	5	11.70	11.84	240+30.97	240+40.97
29	F St (4)	2	10'	10	5	3.5	1	16	5	11.70	11.84	240+79.47	240+89.47
30	F St (5)	2	10'	10	5	3.5	1	16	5	11.70	11.91	241+10.64	241+20.64
31	F St (6)	2	5'	5	5	3.5	0	8	5	11.70	12.09	242+44.56	242+49.56
32	F St (7)	2	5'	5	5	3.5	0	8	5	11.70	11.70	243+04.33	243+09.33
33	F St (8)	2	10'	10	5	4.375	1	20	5	10.83	11.13	245+06.36	245+16.36
34	F St (9)	2	10'	10	5	3.9375	1	18	5	11.26	11.39	245+46.77	245+56.77
35	F St (10)	2	10'	10	5	3.9375	1	18	5	11.26	11.29	246+21.64	246+31.64
36a	Q-Mart II (a)	3	15'	15	5	3.0625	2	21	10	12.14	12.32	254+15.25	254+30.25
36b	Q-Mart II (b)	3	25'	25	5	4.8125	4	55	10	10.39	10.75	257+13.48	257+38.48
37	Market St	3	65'	65	5	1.75	12	52	30	13.45	13.50	257+77.76	258+42.76
38	C St	3	30'	30	5	3.5	5	48	15	11.70	11.73	262+32.53	262+62.53
39	B St - Sidewalk	3	10'	10	5	3.9375	1	18	5	11.26	11.50	265+73.88	265+83.88
40	B St	3	60'	60	5	3.9375	11	108	30	11.26	11.48	265+90.82	266+50.82
41	Market St - D/W	3	35'	35	5	3.5	6	56	15	11.70	11.76	267+20.98	267+55.98
42	A St	3	30'	30	5	4.375	5	60	15	10.83	11.15	269+72.96	270+02.96
43	Grant St	3	60'	60	5	3.5	11	96	30	11.70	11.79	272+16.56	272+76.56
44	Chicago Ave	3	60'	60	5	3.0625	11	84	30	12.14	12.21	276+61.40	277+21.40
45	Stanton St - Sidewalk	3	5'	5	5	3.5	0	8	5	11.70	11.71	281+82.36	281+87.36
46	Stanton St	3	30'	30	5	3.9375	5	54	15	11.26	11.33	281+92.23	282+22.23
47	1st St	3	45'	45	5	4.375	8	90	20	10.83	11.18	282+65.35	283+10.35
48	1st St - Sidewalk	3	5'	5	5	3.5	0	8	5	11.70	11.73	283+19.66	283+24.66
49	Kurt Cobain Access	3	5'	5	5	0.875	0	2	5	14.33	14.32	286+94.65	286+99.65
50	2nd St (1)	3	20'	20	5	2.1875	3	20	10	13.01	13.03	287+63.98	287+83.98
51	2nd St (2)	3	5'	5	5	2.1875	0	5	5	13.01	13.19	288+63.87	288+68.79
52	2nd St (3)	3	15'	15	5	2.625	2	18	10	12.58	12.72	288+89.69	289+04.69
53	2nd St (4)	3	15'	15	5	2.625	2	18	10	12.58	12.68	289+15.35	289+30.35
54	2nd St (5)	3	5'	5	5	3.0625	0	7	5	12.14	12.26	289+99.72	290+04.72

Pedestrian Hinged Gates

Closure No.	Location	Crew No.	Width (ft.)	Height (ft.)	Approx. Base Elev. (ft.)	Start	End
						Station	Station
1	14th St	1	5	3.79	11.41	18+79.59	18+84.59
2	Market St (1)	3	5	3.11	12.09	270+74.64	270+79.64
3	Market St (2)	3	5	3.28	11.92	271+60.08	271+65.08
4	Market St (3)	3	5	2.38	12.82	273+22.44	273+27.44
5	Market St (4)	3	5	2.2	13.00	274+01.58	274+06.58
6	Market St (5)	3	5	2.16	13.04	274+83.17	274+88.17

Crew 1		
Total Effort	230	min.
Crew Size	3	people
Crew Assembly Time	76.66667	min.
Travel Time	25	min.
TOTAL ASSEMBLY TIME	102	min.

Crew 2		
Total Effort	255	min.
Crew Size	4	people
Crew Assembly Time	63.75	min.
Travel Time	30	min.
TOTAL ASSEMBLY TIME	94	min.

Crew 3		
Total Effort	280	min.
Crew Size	4	people
Crew Assembly Time	70	min.
Travel Time	25	min.
TOTAL ASSEMBLY TIME	95	min.

Closure Plan	
1	The Levee Superintendent appoints three crews of four to five people (18 total) to perform levee closure work.
2	Crew assignments are as follows: Crew 1: Closures 1-14 Crew 2: Closures 15-35 Crew 3: Closures 36-54
3	The crews are on-call to perform the levee closure work immediately when directed to do so by the Levee Superintendent.
4	Crews have access to transportation for travel to closure locations and keys to unlock storage sheds.

