# Howard Street South Channel Bridge Replacement Anticipated Bridge Construction Procedures

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## INTRODUCTION

This memorandum describes the probable construction procedures for replacement of the existing Howard Street South Channel Bridge (South Channel Bridge) over the Spokane River in the City of Spokane, Washington. This memorandum has been prepared to support the environmental review and permitting process for the project. It includes a discussion of the following aspects of bridge construction:

- Proposed Construction Activities
  - Construction Equipment
  - In-River Construction Access
  - Foundation Construction
  - Near-Shore Construction Activity
  - Demolition
  - Superstructure Construction
  - Bank Stabilization
  - Excavation/Construction Quantities
  - Control of Turbidity and Debris
  - Utilities
- River Hydraulic Impacts
- Impacts to Recreational Users

## PROJECT DESCRIPTION

The existing South Channel Bridge is a four-span cast-in-place concrete bridge that has experienced significant deterioration and is classified as structurally deficient. The bridge has been restricted to pedestrian traffic, and that pedestrian traffic is limited to only portions of the bridge surface. Given its deficiencies, the bridge has been recommended for replacement. The new bridge will accommodate pedestrian traffic and will be coordinated with the upcoming re-design of Riverfront Park.

A bridge width of 50' 0" (clear width between rails) is planned to accommodate the proposed pedestrian use. The bridge length is controlled by the need to span bank to bank, similar to the existing bridge, and to provide minimum flows to the adjacent Avista hydroelectric power plant. The piers of the new bridge will be skewed to match the retaining wall along the south bank. The new bridge will use two piers, instead of the three piers of the existing bridge. The proposed layout and typical section of the new bridge is shown in Figures 1, 2, and 3.

Several construction phasing alternatives were considered for replacement of the existing bridge. These alternatives were evaluated during the preliminary design phase to determine the phasing approach that best meets the City's needs and Avista's needs for flow through the power plant.

The existing bridge will be closed to all traffic during construction. The minimum flow required by Avista will be maintained.

## PROPOSED CONSTRUCTION ACTIVITIES

### Construction Equipment

Heavy construction equipment anticipated to be working within the shoreline area to construct the bridge includes the following:

- Wheeled and tracked backhoes for near-surface excavation and demolition.
- Wheeled and tracked cranes for pile driving, work pad construction, shaft construction, girder erection, and lifting of general construction materials and equipment.
- Drilling equipment for drilled shaft construction.
- Dump trucks for hauling of excavated materials and construction debris.
- Concrete delivery trucks and concrete pump trucks for placing concrete.
- A bridge deck finishing machine for bridge deck concrete placement.

### In-River Construction Access

Access for equipment and materials in the river channel will be needed for drilled shaft and pier construction, and for demolition of the existing bridge. The bridge construction contractor will be responsible for determining what temporary facilities, means, and methods will be used to demolish the existing bridge and construct the new bridge. However, it is anticipated that access will be provided by temporary work pads installed in the river as shown in Figures 4, 5, and 6. This approach has the added benefit of being quick to construct and remove with conventional earth moving equipment.

The work pads would be installed during the in-water work period and removed prior to the end of the same in-water work period. The work pads would be constructed of clean native rock materials and would be completely removed after construction. The contractor may elect to support the rock pads with steel sheet piling, although the shallow depth of granular material over the basalt bedrock may prevent the use of sheet piles.

Near-shore grading and filling work will be needed to provide an adequate approach roadway for access to the work pads. All disturbed near-shore areas will be restored to their preconstruction conditions after construction of the new bridge is complete. The work pads will be removed after completion of construction. Settling ponds will be located to prevent seepage and riverbank erosion.

**Foundation Construction**

The new bridge abutments will use spread footings founded on basalt bedrock. The construction areas will be dewatered by constructing cofferdams and concrete seals. Cofferdam construction may be rock fill with a fabric or steel sheet pile liner. Water pumped from the excavations will be collected in settling ponds or tanks before being returned to the river.

The new bridge piers will be founded on drilled shaft foundations. The new in-river drilled shafts are anticipated to be approximately 2 1/2 feet in diameter and extend to a depth of 10 to 20 feet below the existing ground surface.

The drilled shafts will be excavated in a cased hole, with the steel casing advanced to refusal at the bedrock. Excavation below the casing may be completed by rock coring or by use of a down-hole hammer. A steel reinforcing cage will then be installed into the hole and the hole will be filled with concrete. The concrete will be placed by tremie pipe, and the slurry and displaced water will be pumped off to holding tanks as the hole is filled. The steel casing will remain in place.

Excess drilling water and slurry will be pumped out of the casings and collected in settling ponds or temporary holding tanks for off-site disposal. Excavated material will consist of cobbles, rock, and native soil deposits mixed with drilling water and possibly synthetic drilling slurry used to help maintain stability of the hole during drilling. Excavated material will be loaded onto dump trucks for approved off-site disposal.

**Near Shore Construction Activity**

Near-shore bridge construction activity (above the ordinary high water elevation) will consist of overburden excavation, existing bridge demolition, concrete bridge abutment construction, installation and removal of work pads, and minor grading and planting to restore the disturbed river embankments to the pre-construction condition. Excavation work in this area will incorporate current best management practices (BMP's) for temporary erosion and sediment control measures.

The existing near shore embankments have vegetation that will be removed within the limits of the work area during construction. The area below the new bridge has no vegetation, will not sustain vegetation, and will not be replanted. The other adjacent disturbed areas will be replanted after construction, and habitat mitigation requirements will be implemented in accordance with the project's Habitat Management Plan (HMP). The South Channel Bridge mitigation replanting may not immediately occur after bridge construction because the work would be incorporated into an over-all riverbank restoration project that would include other Riverfront Park riverbank enhancements and be constructed all at the same time.

## Demolition

The existing bridge is a 70-foot wide, 4-span cast-in-place reinforced concrete bridge. The interior piers consist of reinforced concrete columns supported on spread footings founded approximately 3 to 6 feet below the existing river bed elevation. The existing bridge will be demolished as an early step in the construction process to clear the way for new construction. The existing bridge is not considered suitable for access to construct the new in-river drilled shaft foundations prior to demolition.

The existing bridge superstructure will be demolished in sections and lifted on to trucks for hauling and disposal. Heavy tarps supported by wire cable, or similar methods, will be used to catch and contain demolition debris and prevent debris and dust from falling into the river during demolition. Demolition activities will be closely monitored to make certain the debris containment systems are capturing bridge materials and effectively preventing release into the river channel.

Existing bridge piers and foundations will be removed. The piers may be pulled intact, or may be broken up in place and then removed. The contractor will be given the option of leaving the existing piers in place below the existing ground surface elevation. The excavated holes will be backfilled with rock after completion of demolition.

Demolition of the existing bridge pier foundations will be carried out within temporary debris containment enclosures that will serve to contain larger concrete debris and any water-borne construction dust within the immediate work area. These enclosures are anticipated to consist of floating booms with silt curtains or steel sheet type enclosures that are assembled on shore, lifted and set into place in the river around the pier. After completing removal of the existing bridge piers, the existing bridge abutments and retaining walls will be removed.

## Superstructure Construction

The superstructure of the new bridge will consist of a system of prestressed concrete slabs supporting a cast-in-place concrete deck slab. The girders will be delivered to the site and erected with conventional lifting equipment (cranes). After the girders have been placed, formwork for the deck will be installed and the deck slab poured. No temporary shoring below the bridge will be needed to support the girders during erection or placement of the deck.

## Bank Stabilization

Project bathymetric survey has identified channel geometry and strategic channel cross-sections for the existing bridge structure. This information was utilized in the creation of a hydraulic model within the USACE HEC RAS 4.0 software. Details of this hydraulic modeling efforts are documented in the Hydraulic Report for the Howard Street South Channel Bridge Replacement. The current South Channel slope is nearly flat and for the purposes of modeling these conditions, a slope of 0.01% was used.

Visual inspection of the channel bottom has identified a large amount of various objects and soil/rock types present. These include historic concrete spalls, railroad ties, rebar and

cobbles. No soil samples or gradation is available to represent the current South Channel bottom material.

The proposed methods of utilizing rock work pads during construction have assumed an impediment of approximately 50% of the South Channel. This condition minimizes the channel opening during construction and will increase channel velocities, possibly requiring rip-rap for the duration of proposed bridge construction.

Hydraulic modeling has calculated existing channel flow velocities of approximately 1.6 feet per second. With the proposed construction impediment of approximately 50% within the channel, velocities are calculated to increase to 1.9 feet per second. This is an increase to the channel velocities that is not significant enough to warrant the use of temporary rip rap based on the visual inspection of the channel bottom.

**Excavation/Construction Quantities**

The following volumes of materials are expected to be excavated and/or placed within the river channel during construction of the new bridge:

- Excavation/demolition/removal of existing bridge piers and footings: 148 cubic yards

  All above quantities are for in-water work.

- Fill for temporary rock access pads: 4000 cubic yards

  Temporary rock access pads will be built for construction purposes, removed after construction, and the site restored. The top of the access dikes will be just above the Ordinary High Water Mark (OHWM) elevation 1870.50-feet at the north abutment and 1875.0 at the south abutment. Excavation and fill for the new abutments will be behind the rock access pads.

- Excavation for new abutments: 1300 cubic yards

  This excavation is for the installation of the new abutments and will be separated from the water by the rock access pads.

- Fill for new abutments: 370 cubic yards

  Concrete fill for the new abutments will occur behind the rock access pads.

- Drive sheet pile cofferdam: 1840 square feet

  Sheet pile cofferdam will be built for construction purposes, removed after construction, and site restored. The cofferdam is intended to act as a waterstop as part of the rock access pad on the south bank. The top of the cofferdam will be above the OHWM but below the top of the pad.

- Excavation for new drilled shafts: 51 cubic yards

  The drilled shafts will be pre-drilled. This is for in-water work at proposed Piers 1 and 2.

- Fill for new concrete bridge piers: 145 cubic yards

Total of 8 column/shafts will be placed with reinforced concrete below OHWM, including placement of reinforced concrete shafts below mudline.

- Casing for new drilled shafts: 185 linear feet

  Each of the drilled shafts will be installed with steel casing from the mudline to the top of the shaft. This is in-water work.

**Control of Turbidity and Debris**

Construction of the temporary work pads, cofferdams, debris containment enclosures, and drilled shaft casings are expected to create some minor fine-grain sediment turbidity in the river during construction. However, the proposed construction methods will minimize the amount of turbidity created during construction to the extent possible, and these impacts are expected to be minor, of short duration, and not result in any substantial negative impacts to water quality.

**Utilities**

The existing bridge carries a 12-inch-diameter water line. That water line will be re-routed temporarily during construction, and a new 18-inch-diameter water line will be carried by the proposed bridge.

The new water line will be supported between the girders of the new bridge. The water line will not be visible or accessible by the public. The water line will be installed after the bridge girders are in place.

Conduits will be provided for additional City services, such as communication lines. These conduits will be small in diameter.

## RIVER HYDRAULIC IMPACTS

The Spokane River South Channel at the project site is approximately 175 feet wide between the tops of the banks, and the river flows in a channel that contains the maximum flood flows well below the tops of the banks. The 100-foot-wide channel bottom varies in elevation across the section.

The existing South Channel Bridge has three piers within the river channel. The pier walls are 4 feet wide with a total in-river exposed area below the ordinary high water level of approximately 150 square feet (in the direction of the river flow).

The new bridge will use two piers, instead of the three piers of the existing bridge. The proposed structure will have a shorter overall span than the existing structure with a northern abutment being closer to the center of the channel. This reduction in exposed pier area will be about 50 square feet (less than the 150 square feet for all three bridge piers).

The new bridge piers are expected to have an in-river cross sectional area of approximately 100 square feet vs. the existing cross sectional area of 150 square feet. As a result, the new piers will decrease the total volume of pier concrete in the river channel, and removal of the existing piers will slightly increase the hydraulic opening of the channel at the 100-year

flood stage. Therefore, no net increase in river surface elevation from construction of the new bridge is anticipated.

Current hydraulic modeling of the existing and proposed conditions for this project has calculated an existing bridge opening of approximately 1600 square feet. Due to a proposed shortened overall span, the proposed bridge opening has been modeled with approximately 1570 square feet. Details of the hydraulic modeling efforts for the proposed Howard Street Bridge on the South Channel can be found in the Hydraulic Report for the Howard Street South Channel Bridge Replacement project.

The new bridge piers will be supported by drilled shafts located within the existing river channel. The new piers will be four-column piers aligned on a skew to the bridge deck to correspond with the direction of river channel flow. The drilled shafts will be designed to accommodate the design river scour as determined by the hydraulics analysis. Due to the existing materials and river hydraulic setting, no significant river channel scour due to the new bridge pier configuration is anticipated.

An individual hydraulic model was created to analyze activities that will be present during construction of the proposed facility which would include but are not limited to the construction of rock pads, work trestles and coffer dams. This individual hydraulic model was completed in parallel with the hydraulic analysis of the proposed Howard Street Bridge within HEC RAS 4.0.

Proposed cross-sections were modified to impede as much as 50% of the river channel which included 50 feet of abutment on the north bank, and 40 feet of abutment on the south bank. Conservative estimations include the vertical impediment at these locations to simulate work pad restrictions to the river channel.

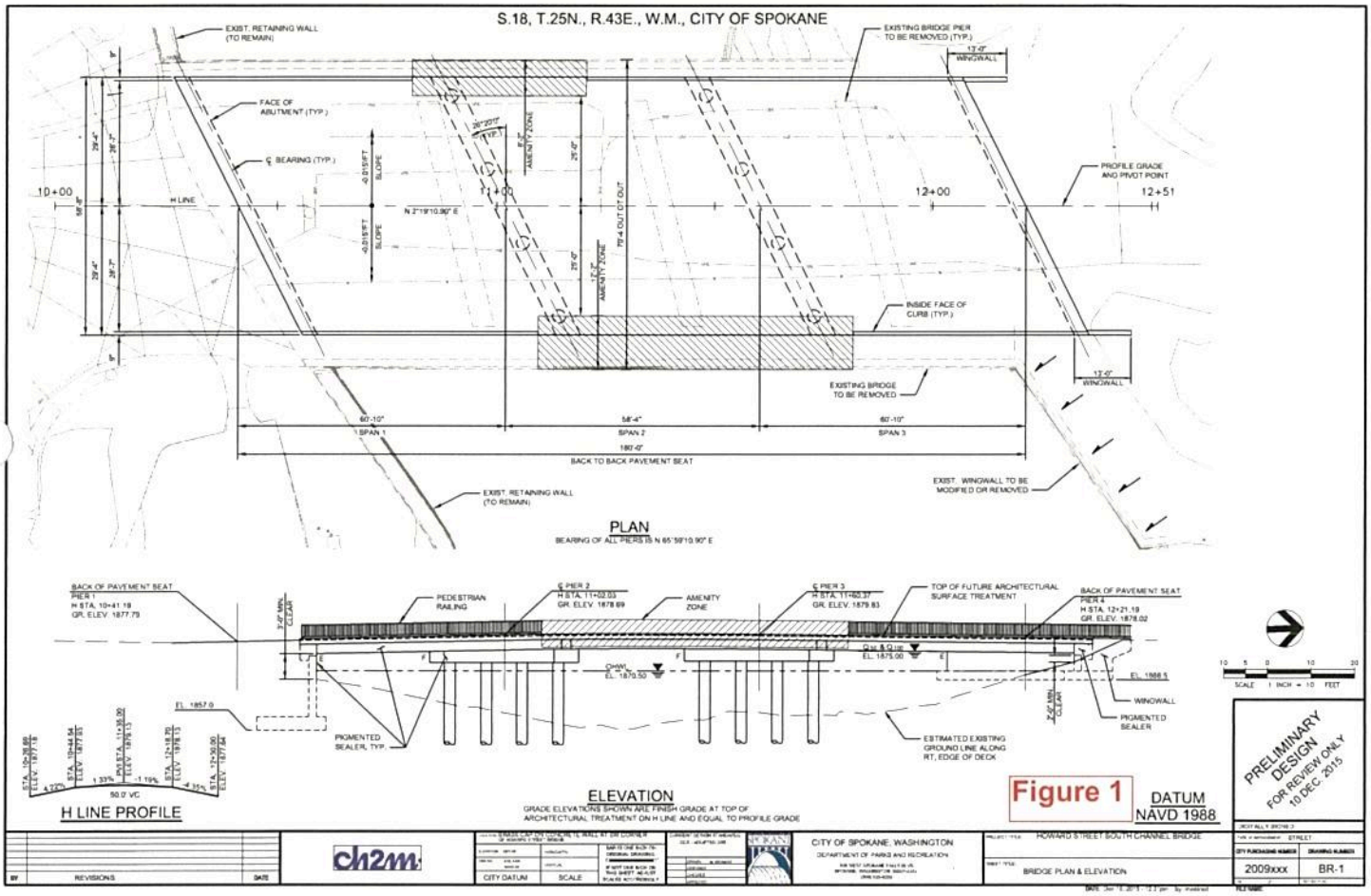
Modeling results have identified insignificant impacts to the channel capacity to deliver design flows to the Avista intake facility as well as insignificant impacts to the water surface elevation within the South Channel Forebay. During construction, alternative flow requirements may be identified as Avista fluctuates demand and throughout the course of the construction season. Close coordination will be important to identify weather required flows will be met. For purposes of this analysis, the maximum design flows identified by Avista have been incorporated in the existing, proposed and construction hydraulic modeling. Additional information regarding hydraulic modeling of this proposed crossing can be found in the Hydraulic Report for the Howard Street South Channel Bridge Replacement.

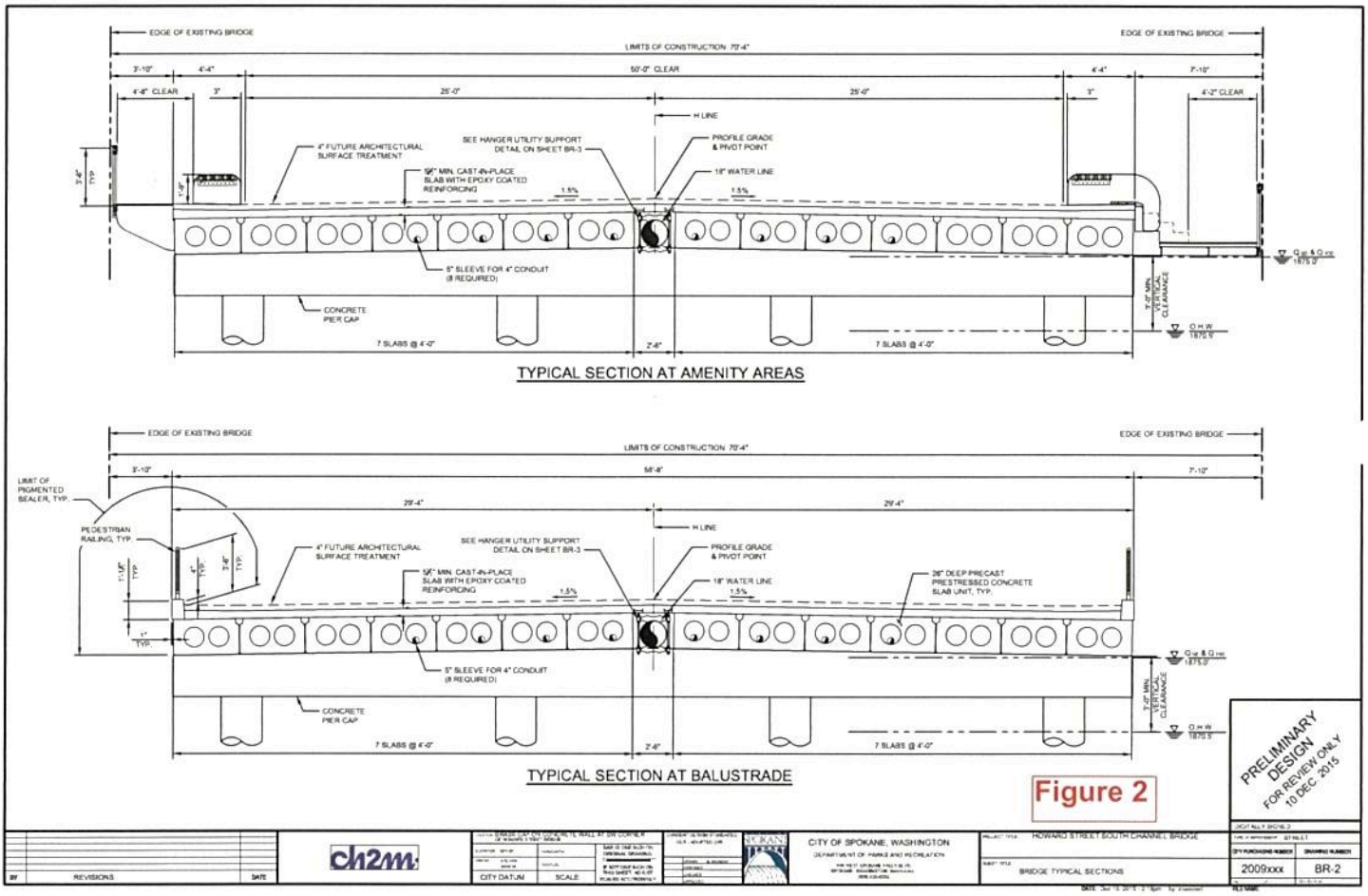
## IMPACTS TO RECREATIONAL USERS

The existing bridge will be closed to all traffic during construction. Construction limits will extend south to the existing fountain, and north into Riverfront Park. Construction access and staging areas will be closed to public use.

Construction access for the south abutment is expected to come from West Spokane Falls Blvd. This access will affect access to the fountain, and the Fountain Café. Construction access will cross the Centennial Trail. During these times, trail detours will be made available and signed to guide public use.

Construction access for the north abutment will come from Post Street, via one of the Theme Stream Bridges. Approximately five parking spaces between Post Street and the Theme Stream will be affected during construction.


S.18, T.25N., R.43E., W.M., CITY OF SPOKANE
EXIST. RETAINING WALL (TO REMAIN)
EXISTING BRIDGE PIER TO BE REMOVED (TYP.)
13'-0" WINGWALL
FACE OF ABUTMENT (TYP.)
℄ BEARING (TYP.)
PROFILE GRADE AND PIVOT POINT
10+00
11+00
12+00
12+51
H LINE
N 2°19'10.90" E
INSIDE FACE OF CURB (TYP.)
EXISTING BRIDGE TO BE REMOVED
13'-0" WINGWALL
60'-10" SPAN 1
58'-4" SPAN 2
60'-10" SPAN 3
180'-0" BACK TO BACK PAVEMENT SEAT
EXIST. WINGWALL TO BE MODIFIED OR REMOVED
EXIST. RETAINING WALL (TO REMAIN)
PLAN
BEARING OF ALL PIERS IS N 65°59'10.90" E
BACK OF PAVEMENT SEAT PIER 1 H STA. 10+41.19 GR. ELEV. 1877.79
PEDESTRIAN RAILING
℄ PIER 2 H STA. 11+02.03 GR. ELEV. 1878.69
AMENITY ZONE
℄ PIER 3 H STA. 11+60.37 GR. ELEV. 1879.83
TOP OF FUTURE ARCHITECTURAL SURFACE TREATMENT
BACK OF PAVEMENT SEAT PIER 4 H STA. 12+21.19 GR. ELEV. 1878.02
EL. 1875.00
EL. 1870.50
EL. 1857.0
EL. 1868.5
WINGWALL
PIGMENTED SEALER
PIGMENTED SEALER, TYP.
ESTIMATED EXISTING GROUND LINE ALONG RT. EDGE OF DECK
ELEVATION
GRADE ELEVATIONS SHOWN ARE FINISH GRADE AT TOP OF ARCHITECTURAL TREATMENT ON H LINE AND EQUAL TO PROFILE GRADE
STA. 10+39.69 ELEV. 1877.79
STA. 10+44.54 ELEV. 1877.93
PVI STA. 11+35.50 ELEV. 1878.13
STA. 11+18.70 ELEV. 1878.13
STA. 12+30.90 ELEV. 1877.84
4.22%
1.33%
-1.19%
-4.35%
50.0' VC
H LINE PROFILE
Figure 1
DATUM NAVD 1988
SCALE 1 INCH = 10 FEET
PRELIMINARY DESIGN FOR REVIEW ONLY 10 DEC. 2015
REVISIONS
DATE
ch2m
CITY DATUM
SCALE
CITY OF SPOKANE: WASHINGTON
DEPARTMENT OF PARKS AND RECREATION
HOWARD STREET SOUTH CHANNEL BRIDGE
BRIDGE PLAN & ELEVATION
2009xxx
BR-1




TYPICAL SECTION AT AMENITY AREAS




TYPICAL SECTION AT BALUSTRADE

Figure 2

PRELIMINARY DESIGN FOR REVIEW ONLY 10 DEC 2015

| BY | REVISIONS | DATE |
|---|---|---|

ch2m:

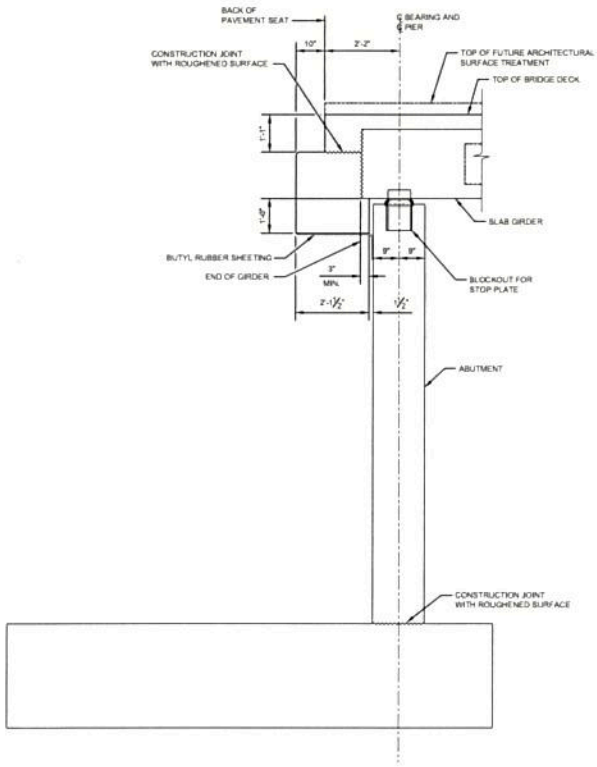
CITY DATUM | SCALE

CITY OF SPOKANE, WASHINGTON
DEPARTMENT OF PARKS AND RECREATION

HOWARD STREET SOUTH CHANNEL BRIDGE

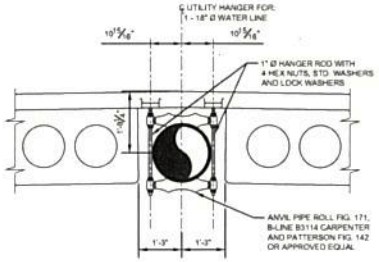
BRIDGE TYPICAL SECTIONS

2009xxx | BR-2




## ABUTMENT ELEVATION

ABUTMENT AT PIER 1 SHOWN.
DIMENSIONS ARE NORMAL TO BACK OF PAVT SEAT.




## HANGER UTILITY SUPPORT

NOTES:
1. ALL MATERIALS SHALL BE GALVANIZED AFTER FABRICATION PER AASHTO M 111 OR AASHTO M 232 EXCEPT PIPE ROLLERS.
2. PAINT ROLLERS WITH THREE COATS OF GALVANIZING REPAIR PAINT. SEE STD. SPEC. SECTION 9-08.1(2)B.

Figure 3

PRELIMINARY DESIGN FOR REVIEW ONLY 10 DEC. 2015

| BY | REVISIONS | DATE |
|---|---|---|

ch2m

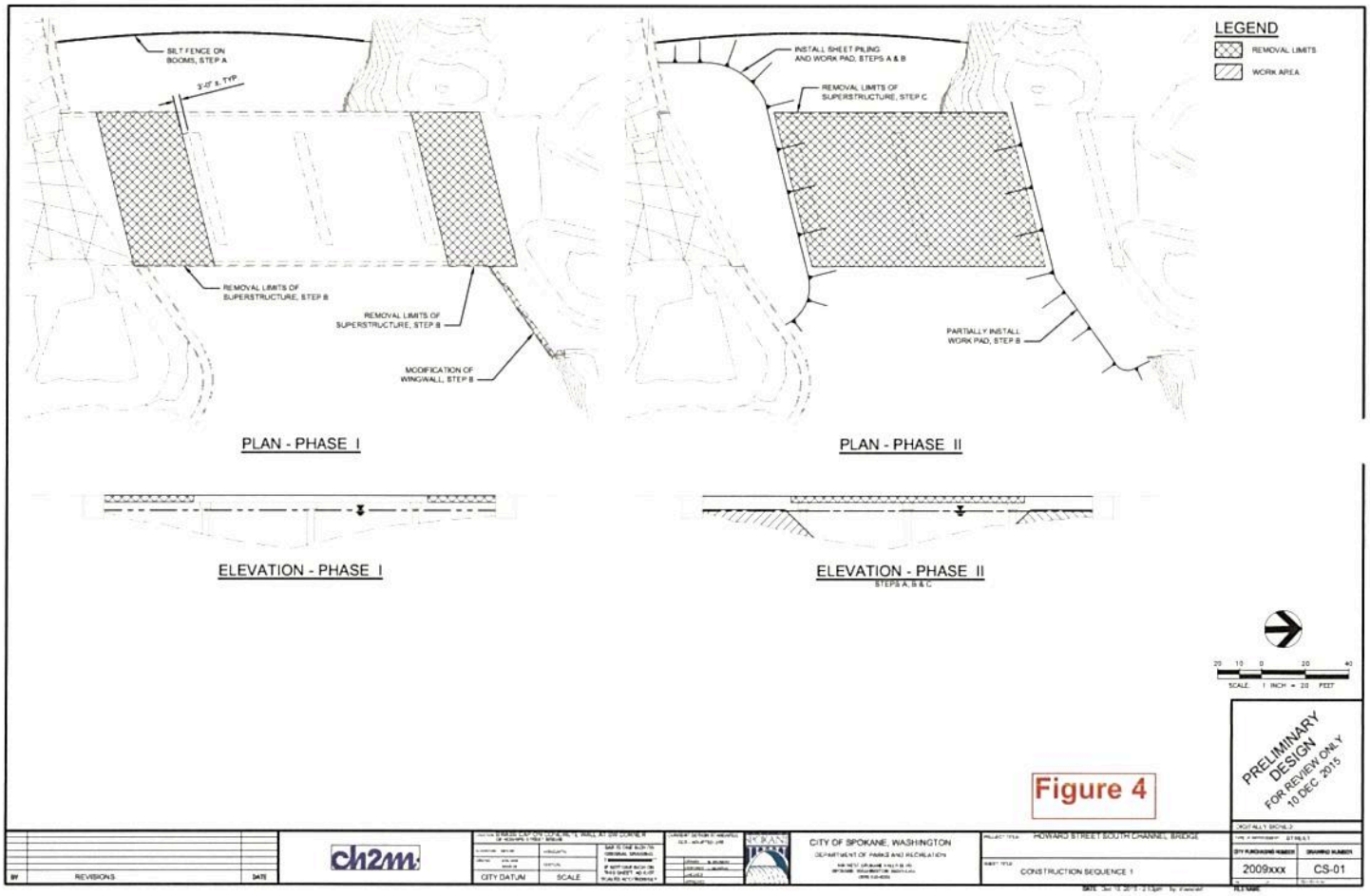
CITY DATUM | SCALE

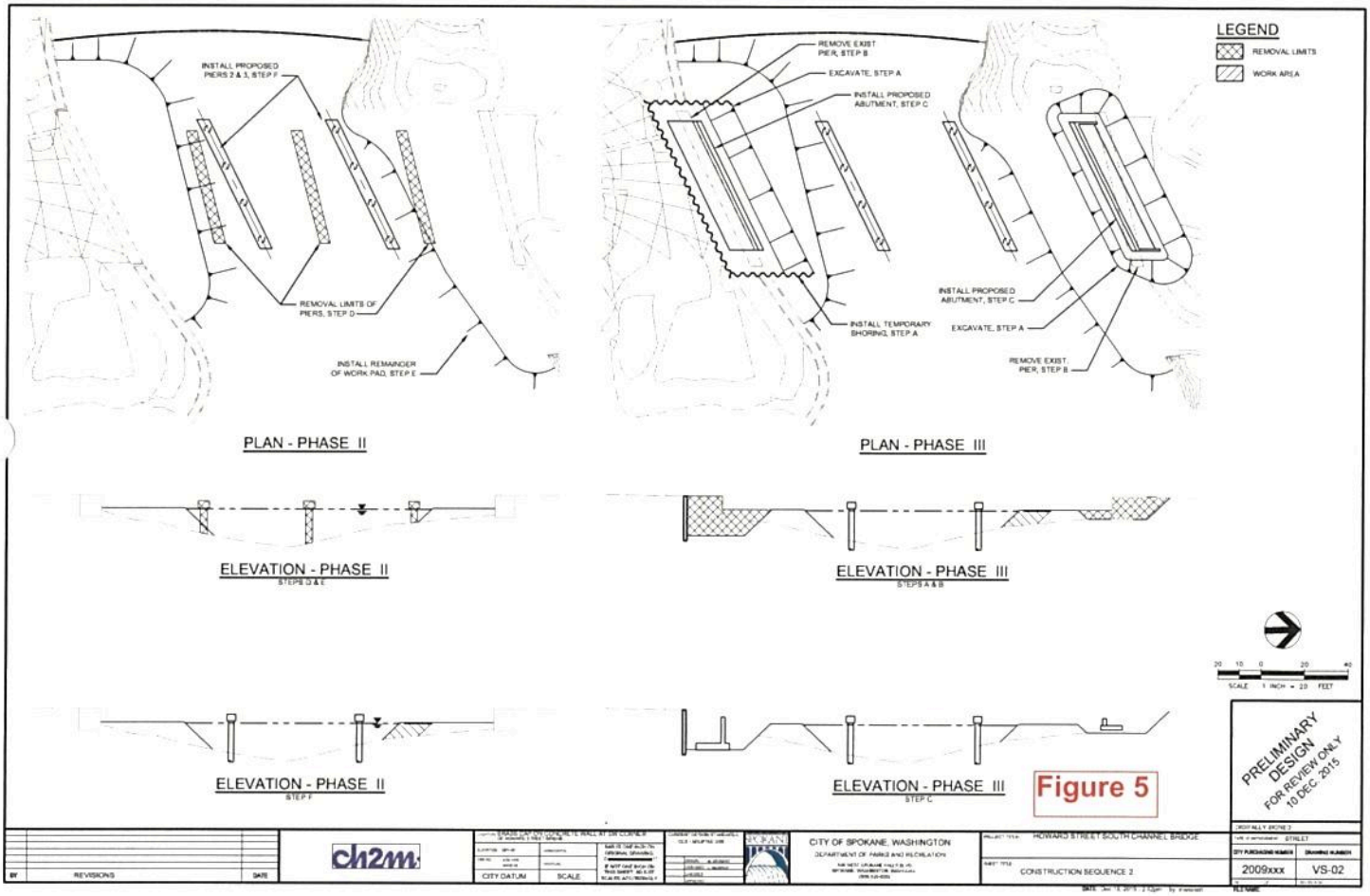
CITY OF SPOKANE, WASHINGTON
DEPARTMENT OF PARKS AND RECREATION

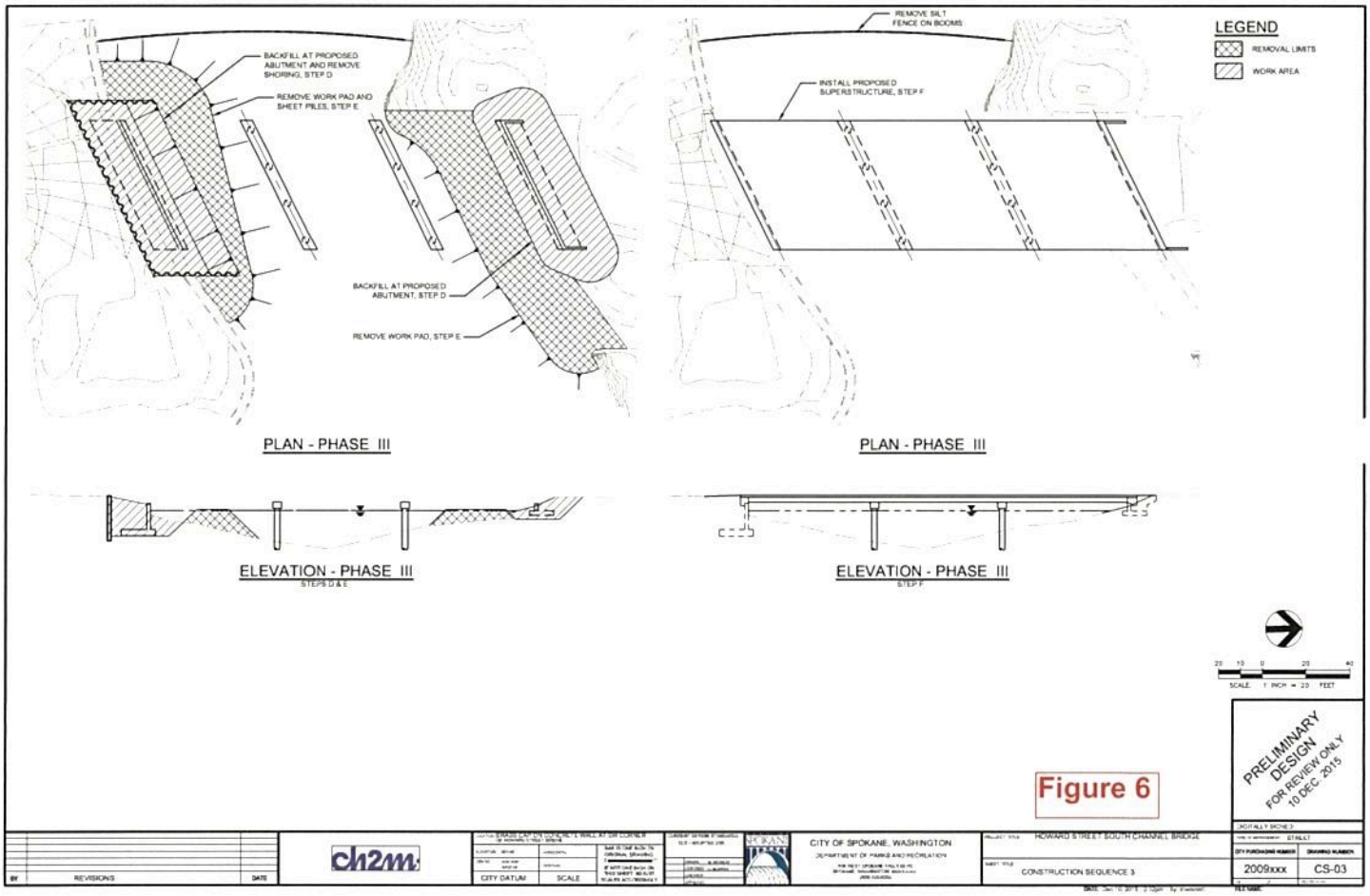
HOWARD STREET SOUTH CHANNEL BRIDGE

BRIDGE DETAILS

| CITY PURCHASING NUMBER | DRAWING NUMBER |
|---|---|
| 2009xxx | BR-3 |


SILT FENCE ON BOOMS, STEP A
3'-0" ± TYP
REMOVAL LIMITS OF SUPERSTRUCTURE, STEP B
REMOVAL LIMITS OF SUPERSTRUCTURE, STEP B
MODIFICATION OF WINGWALL, STEP B
PLAN - PHASE I
INSTALL SHEET PILING AND WORK PAD, STEPS A & B
REMOVAL LIMITS OF SUPERSTRUCTURE, STEP C
PARTIALLY INSTALL WORK PAD, STEP B
PLAN - PHASE II
ELEVATION - PHASE I
ELEVATION - PHASE II
STEPS A, B & C
LEGEND
REMOVAL LIMITS
WORK AREA
20 10 0 20 40
SCALE 1 INCH = 20 FEET
PRELIMINARY DESIGN
FOR REVIEW ONLY
10 DEC 2015
Figure 4
BY REVISIONS DATE
ch2m
CITY DATUM
SCALE
CITY OF SPOKANE, WASHINGTON
DEPARTMENT OF PARKS AND RECREATION
HOWARD STREET SOUTH CHANNEL BRIDGE
CONSTRUCTION SEQUENCE 1
2009xxx
CS-01


INSTALL PROPOSED PIERS 2 & 3, STEP F
REMOVAL LIMITS OF PIERS, STEP D
INSTALL REMAINDER OF WORK PAD, STEP E
PLAN - PHASE II
REMOVE EXIST PIER, STEP B
EXCAVATE, STEP A
INSTALL PROPOSED ABUTMENT, STEP C
INSTALL TEMPORARY SHORING, STEP A
INSTALL PROPOSED ABUTMENT, STEP C
EXCAVATE, STEP A
REMOVE EXIST. PIER, STEP B
PLAN - PHASE III
LEGEND
REMOVAL LIMITS
WORK AREA
ELEVATION - PHASE II
STEPS D & E
ELEVATION - PHASE III
STEPS A & B
SCALE 1 INCH = 20 FEET
ELEVATION - PHASE II
STEP F
ELEVATION - PHASE III
STEP C
Figure 5
PRELIMINARY DESIGN
FOR REVIEW ONLY
10 DEC. 2015
BY
REVISIONS
DATE
ch2m
CITY DATUM
SCALE
CITY OF SPOKANE, WASHINGTON
DEPARTMENT OF PARKS AND RECREATION
HOWARD STREET SOUTH CHANNEL BRIDGE
CONSTRUCTION SEQUENCE 2
2009xxx
VS-02


BACKFILL AT PROPOSED ABUTMENT AND REMOVE SHORING, STEP D
REMOVE WORK PAD AND SHEET PILES, STEP E
BACKFILL AT PROPOSED ABUTMENT, STEP D
REMOVE WORK PAD, STEP E
PLAN - PHASE III
REMOVE SILT FENCE ON BOOMS
INSTALL PROPOSED SUPERSTRUCTURE, STEP F
PLAN - PHASE III
LEGEND
REMOVAL LIMITS
WORK AREA
ELEVATION - PHASE III
STEPS D & E
ELEVATION - PHASE III
STEP F
SCALE 1 INCH = 20 FEET
PRELIMINARY DESIGN FOR REVIEW ONLY 10 DEC 2015
Figure 6
CITY OF SPOKANE, WASHINGTON
DEPARTMENT OF PARKS AND RECREATION
HOWARD STREET SOUTH CHANNEL BRIDGE
CONSTRUCTION SEQUENCE 3
2009xxx
CS-03
CITY DATUM
SCALE
REVISIONS
DATE
BY