# South/North Corridor Project

## Biological Assessment for Threatened, Endangered and Candidate Fish

*Appendix B for the Ecosystems Impacts Results Report*

November 1997

South North Transit Corridor Study

# Biological Assessment for Threatened, Endangered and Candidate Fish

## Columbia and Willamette Rivers Crossings

South/North Transit Corridor Study
Draft Environmental Impact Statement

**November 1997**

## Metro

Prepared by: Metro
Parametrix, Inc.

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## PREFACE

This Biological Assessment was prepared in compliance with Section 7 of the Endangered Species Act to address potential effects to fishery resources from implementation of the South/North Light Rail Transit project. This project would include construction of bridges over both the Columbia and Willamette rivers. Because the fish species of concern and bridge design options vary between the two river crossings, this document has been divided into two sub-documents. Section 1 addresses the Columbia River crossing and Section 2, the Willamette River crossing. Both sub-documents include a project description, documentation of existing natural resources in the analysis area, an assessment of potential project-related effects to the fish species of concern, and recommended performance standards and conservation measures.

Section 7 of the Endangered Species Act of 1973, as amended, requires federal agencies to ensure that their actions do not jeopardize endangered or threatened species or their critical habitats. To initiate review of this proposed action, Metro (designated representative of the Federal Transit Administration) requested a list of endangered and threatened species and species proposed for listing from the National Marine Fisheries Service (NMFS). This Biological Assessment (BA) describes how the proposed action would affect these species. If it is determined that one or more of the listed species is likely to be harmed (or benefitted) by the project, then Metro/FTA may be required to enter formal consultation with NMFS to ensure that actions will conserve the species and critical habitat. This BA concludes that implementation of the proposed action, with the conservation measures proposed in the BA, would affect, but is not likely to adversely affect, the listed or candidate species in the Columbia and Willamette Rivers. Following publication of the Draft Environmental Impact Statement and selection of a preferred Light Rail Transit alternative (including a South Willamette River crossing alternative and possibly a Columbia River crossing alternative) bridge/crossing designs would be further refined. Additional impacts analysis may be required at that time to ensure that the preferred alternative would not likely adversely affect these species.

## ACRONYMS

| | | |
|---|---|---|
| BA | = | Biological Assessment |
| BMPs | = | Best Management Practices |
| BPA | = | Bonneville Power Administration |
| ESA | = | Endangered Species Act |
| ESU | = | Evolutionary Significant Unit |
| LRT | = | Light Rail Transit |
| NMFS | = | National Marine Fisheries Service |
| ODFW | = | Oregon Department of Fish and Wildlife |
| ODOT | = | Oregon Department of Transportation |
| PIT | = | Passive Integrated Transponder |
| TES | = | Threatened, Endangered and Sensitive Species |
| USFWS | = | United States Fish and Wildlife Services |

# 1. COLUMBIA RIVER CROSSING

## 1.1 Introduction

This Biological Assessment (BA) is prepared in compliance with Section 7 of the Endangered Species Act of 1973. Metro and the Tri-County Metropolitan Transportation District of Oregon (Tri-Met) propose to construct a Light Rail Transit (LRT) system connecting the Portland, Oregon and Vancouver, Washington metropolitan areas (Figure 1-1). The proposed project would require the construction of bridges over the Columbia River, North Portland Harbor, the Columbia Slough, and Willamette River, as well as several tributary streams. This BA has been prepared to address potential project-related impacts associated with the Columbia, North Portland Harbor, and Willamette River crossings. The Willamette River Crossing is discussed in Section 2 of this document.

The proposed LRT bridge over the Columbia River would be constructed approximately 100 feet west (downstream) of the existing southbound bridge for Interstate 5 (river mile 106.5). The proposed North Portland Harbor crossing would be constructed approximately 50 feet west of the existing Interstate 5 bridge between Hayden Island and the south shore of the harbor (Figure 1-1 and 1-2).

Metro requested information on potentially occurring threatened, endangered, and sensitive (TES) species from the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS). Replies indicated that the Snake River spring/summer and fall chinook salmon *(Oncorhynchus tshawytscha)* and the Snake River sockeye salmon *(Oncorhynchus nerka)* are known to be present in the project area (NMFS 1996a, 1996b; USFWS 1996) (Appendix B). NMFS has designated critical habitat for Snake River threatened and endangered salmon that includes the project area (NMFS 1994). The mainstream Columbia is a passage corridor for juvenile and adult Snake River sockeye salmon, Snake River spring/summer chinook salmon, and Snake River fall chinook salmon.

Four evolutionary significant units (ESUs) of steelhead (*Oncorhynchus mykiss*) that are federally listed or are proposed or candidates for listing occur in the project area as well (NMFS 1996b, 1997). These ESUs include the Upper Columbia River (endangered), Snake River Basin (threatened), Lower Columbia River (proposed threatened), and Middle Columbia River (candidate).

This BA has been prepared for the NMFS and addresses the potential impacts of the project to anadromous endangered Snake River chinook, sockeye salmon, and four steelhead ESUs. One additional federal candidate species addressed in this BA is the chum salmon (*Oncorhynchus keta*). Green sturgeon (*Acipenser medirostris*), white sturgeon (*A. transmontanus*), and Pacific lamprey (*Lampetra tridentata*) are all categorized as species of concern by the USFWS and occur in the project area (USFWS 1996).

The analysis in this BA and corresponding conservation measures for sockeye, steelhead and chinook in this BA should provide benefits to the additional candidate Species of Concern. A more thorough analysis may be warranted if any of these species become protected under the Endangered Species Act.

### 1.1.1 Project Description

The South/North Transit Corridor (Corridor) is a proposed bi-state light rail line between the Clackamas Regional Center area in Oregon and the Clark College/Veterans Administration Medical Center area in Vancouver, Washington (Figure 1-1). As part of this project, a new bridge crossing the Columbia River has been proposed. Three alternatives were considered for this crossing: a bored tunnel alignment and two alternative bridge alignments. Preliminary evaluation by the South/North Steering Group indicated that the bored tunnel alignment under the Columbia River was not feasible. One bridge alternative was eliminated from further study due to conflict with the Pearson Airpark flight path, visual impact in downtown Vancouver, and the inability of this option to serve the major redevelopment site in downtown Vancouver. Specifics of the options narrowing process are included in the South/North Corridor Study *Tier I Final Report* (Metro 1994).

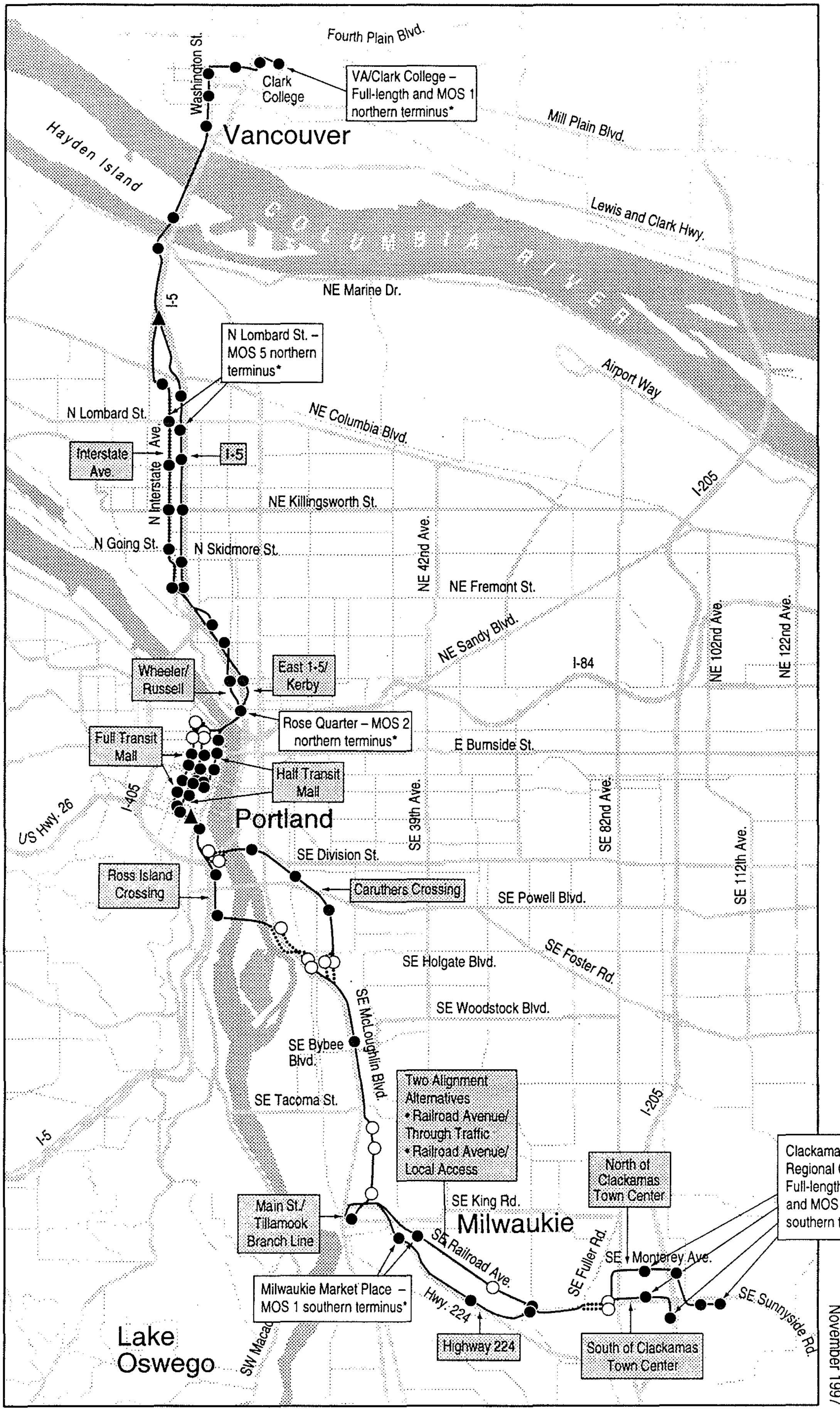
The third alternative has been carried forward. This bridge would be located approximately 100 feet west of the existing southbound bridge for Interstate 5. Two alternative bridge design options are being considered: a concrete segmental bridge and a bow string arch bridge. Both bridge designs would require a low-level movable span over the Columbia River that would match the elevation of the existing Interstate 5 bridge to maintain existing navigational clearances. The movable span would cross the main navigation channel using either a double-leaf bascule (concrete segmental type) or a lift-span superstructure (bow string arch type). Pier foundation layout in the Columbia River from the south bank to the north bank could be as follows: 260 feet - 540 feet - 270 feet - 540 feet - 540 feet - 280 feet - 320 feet. The navigational passage would be at the 280 feet - 320 feet span. The bridge could be a cast-in-place concrete segmental structure with cast-in-place columns and foundations. The foundations would be supported on eight 8-foot diameter drilled shafts. All foundations would be approximately 54 x 56 feet. Drilled shaft pilings are estimated to be 100 feet long. Columns would support the deck and be built upon the foundation. Columns would be twin-wall piers, 6 x 20 feet. It is assumed that the seven twin-wall piers would be constructed with cast-in-place methods using slip forms (Appendix C). It should be noted that the project is still at the conceptual engineering stage and that the specific design could change to accommodate future environmental and/or engineering design criteria.

The bridge design for the North Portland Harbor Crossing would be a concrete segmental bridge with a similar design to that proposed for the Columbia River. It would, however, not include a moveable span for navigation clearance. There would likely be five foundations located in North Portland Harbor that would be constructed in line with the existing I-5 bridge pier foundations.

### 1.1.2 Site Description

The project is situated in the Columbia River basin in northwestern Oregon. It is located in the Lower Columbia River Hydrologic Unit (HU) (No.17090012) and in the Lower Willamette River HU (No. 17480001) as defined by the U.S. Geological Survey. The Columbia River drains an area of approximately 259,000 square miles and is 1,210 miles long.

The analysis area is specific to the project site and adjacent areas that may be affected by the project. The land within the analysis area is almost exclusively in private ownership, with the exception of the river itself. The area is located within Sections 34 and 39, of Township 2N, Range 1E.




South North Transit Corridor Study

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# Figure 1-1
# Columbia River Fish Biological Assessment
## South / North Light Rail Transit Corridor

**Note:** Alignment and station locations are currently under study and may change.

*MOS refers to a segment of the full-length alternative called a Minimum Operable Segment.

LRT Alignment Alternative

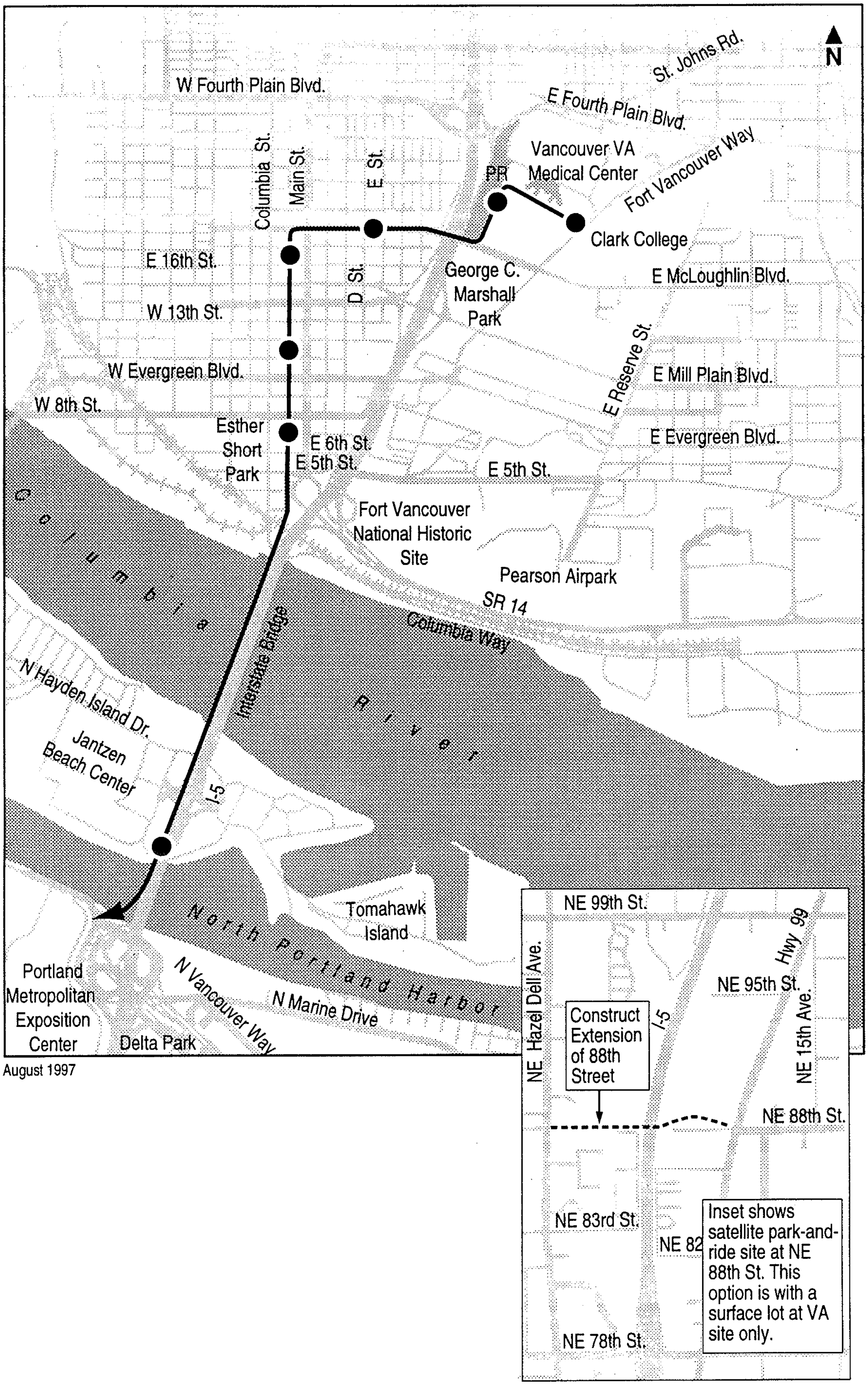
LRT Design Option

Station

Station Options

Station Access Under Study

0 1 2
MILE




August 1997

North South Transit Corridor Study

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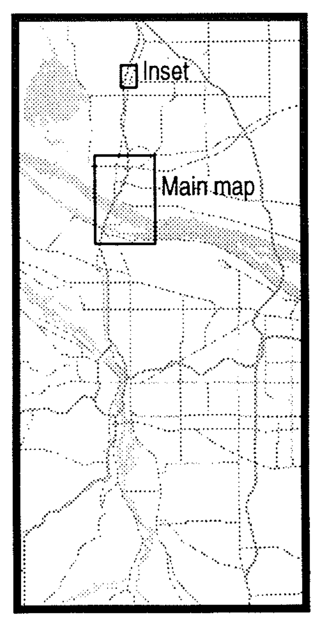
Figure 1-2
**Columbia River Fish Biological Assessment**
**Hayden Island/ Vancouver**
**• I-5/Washington Street**

LRT Alignment Alternative

Station

Existing Railroad

0 1/8 1/4 1/2
MILE



The lower Columbia River (between Bonneville Dam and Portland) is located in broad lowlands and terraces. On the Oregon side of the river, the latter are particularly important, both as agricultural lands and as the site for the northeastern extension of metropolitan Portland.

Average annual discharge at Bonneville Dam is 183,300 cubic feet per second (cfs) (BPA 1995). Average river discharge during spring and summer is seldom less than 75,000 cfs at Bonneville Dam (Parsley and Beckman 1994).

### 1.2 Regulations and Guidelines

In April 1992, NMFS listed spring, summer, and fall stocks of Snake River chinook salmon as a federally threatened species (NMFS 1992). Spring and summer chinook were combined into a single ESU. In August 1994, these species were reclassified as endangered (59 FR 42529; NMFS 1994). The Snake River sockeye salmon was listed as endangered by NMFS in November 1991 (NMFS 1991). In August 1996, NMFS issued a proposed listing of ten ESUs of steelhead as either threatened or endangered (NMFS 1996c). Individuals from four of these ESUs migrate through the project area. In August 1997, NMFS listed the Upper Columbia River ESU as endangered and the Snake River Basin ESU as threatened. A decision on the proposal to list the Lower Columbia River ESU as threatened was deferred six months until additional information could be reviewed (NMFS 1997). The fourth steelhead ESU that occurs in the project area, the Middle Columbia River ESU, is currently a candidate species (NMFS 1996b).

#### 1.2.1 Critical Habitat

Critical habitat for the proposed steelhead ESUs has not yet been designated. Critical habitat for the spring/summer chinook and sockeye salmon was designated in December 1993, and includes the project area. Designated critical habitat includes the water, waterway bottom, and adjacent riparian zone of the specified lakes and river reaches in hydrologic units currently or historically accessible to listed Snake River salmon (except reaches above impassable falls, and Dworshak and Hells Canyon Dams; 58 FR 68543). Adjacent riparian zones are defined as those areas within a horizontal distance of 300 feet from the normal line of high water of a stream channel (600 feet, when both sides of the stream are included) or from the shoreline of a standing body of water (58 FR 68543).

Critical habitat for Snake River salmon consists of four components: (1) spawning and juvenile rearing areas; (2) juvenile migration corridors; (3) areas for growth and development to adulthood; and (4) adult migration corridors. Essential features of these areas include adequate: (1) spawning gravel; (2) water quality; (3) water quantity; (4) water temperature; (5) food; (6) riparian vegetation; and (7) access.

In the Columbia River, these fishes' juvenile migration corridors include the Columbia River from the Pacific Ocean to the confluence with the Snake River. Essential features of the juvenile migration corridors include adequate: (1) substrate; (2) water quality; (3) water quantity; (4) water velocity; (5) cover/shelter; (6) food; (7) riparian vegetation; (8) space; and (9) safe passage conditions. The adult migration corridors are identical to the juvenile migration corridors. Essential features would include those in the juvenile migration corridors, excluding adequate food (58 FR 68543).

### 1.2.2 Snake River Recovery Plan

A Proposed Snake River Recovery Plan was published in March 1995 (Schmitten et al. 1995). The goal of the plan is to restore the health of the Columbia and Snake River ecosystem and listed Snake River salmon stocks. Many of the recommended actions will directly benefit other species such as other salmon stocks, sturgeon (*Acipenser* spp.), and bull trout (*Salvelinus malma*). Implementation of the plan should also conserve biodiversity.

NMFS' approach to Snake River salmon recovery places highest priority on ameliorating the primary factors for the species' decline and eliminating existing impediments to recovery. The plan does this by proposing actions that offer immediate benefits, and refining those actions over time to provide the most efficient use of limited resources. This strategy incorporates an adaptive management process. It allows actions to be added, deleted, or refined as important scientific information and analyses becomes available (Schmitten et al. 1995).

## 1.3 Natural History and Species Occurrence

### 1.3.1 Chinook Salmon

Historically, the Snake River and its tributaries produced large runs of chinook salmon (See Figure 1-3 Columbia/Snake River System). Estimates of approximately 1.5 million adults returning to spawn in the late 1800's (57 FR 14653) had been reduced to an average of 125,000 per year by the mid 1900's. The numbers of returning spring/summer chinook returning to spawn have continued to decline since then.

The mean number of returning fall chinook was estimated to be 72,000 between 1928 and 1949. This number declined to 29,000 between 1950 and 1959 (57 FR 14653). Their numbers have continued to decline to recent estimates of 319 and 78 for 1983 and 1991, respectively (57 FR 14653).

Fall chinook were widely distributed in the mainstem Snake River and the lower reaches of its major tributaries, and ranged upstream to Shoshone Falls, Idaho, more than 900 miles from the ocean. The upper reaches of the mainstem Snake River above Huntington, Idaho were the primary producing areas of fall chinook salmon (Overman 1896). The existing distribution of fall chinook is a fraction of its former area.

Adult spring chinook migrate upriver in March through May (Table 1.3.1-1). The peak of the spring chinook run passes Bonneville Dam the third week of April. The travel time between Portland and Bonneville Dam is approximately five days; therefore, the peak of the run in the project area would be about mid-April. Summer chinook adults begin upstream passage during late May through July 31 at Bonneville Dam, with the peak passage during the last week of June to the first week of July. The two stocks often overlap at Bonneville Dam (Schmitten et al. 1995). Spring chinook spawn in the Salmon River in August and early September (Bjornn 1960). Elevation is a key factor in timing of migration and spawning. In streams where both spring and summer chinook are present, the spring chinook tend to spawn earlier and at higher elevations than the summer chinook (Matthews and Waples 1991). In the Upper South Fork of the Salmon River, peak spawning of summer chinook occurs between late August and mid-September (Ortman and Richards 1964). Fry emerge

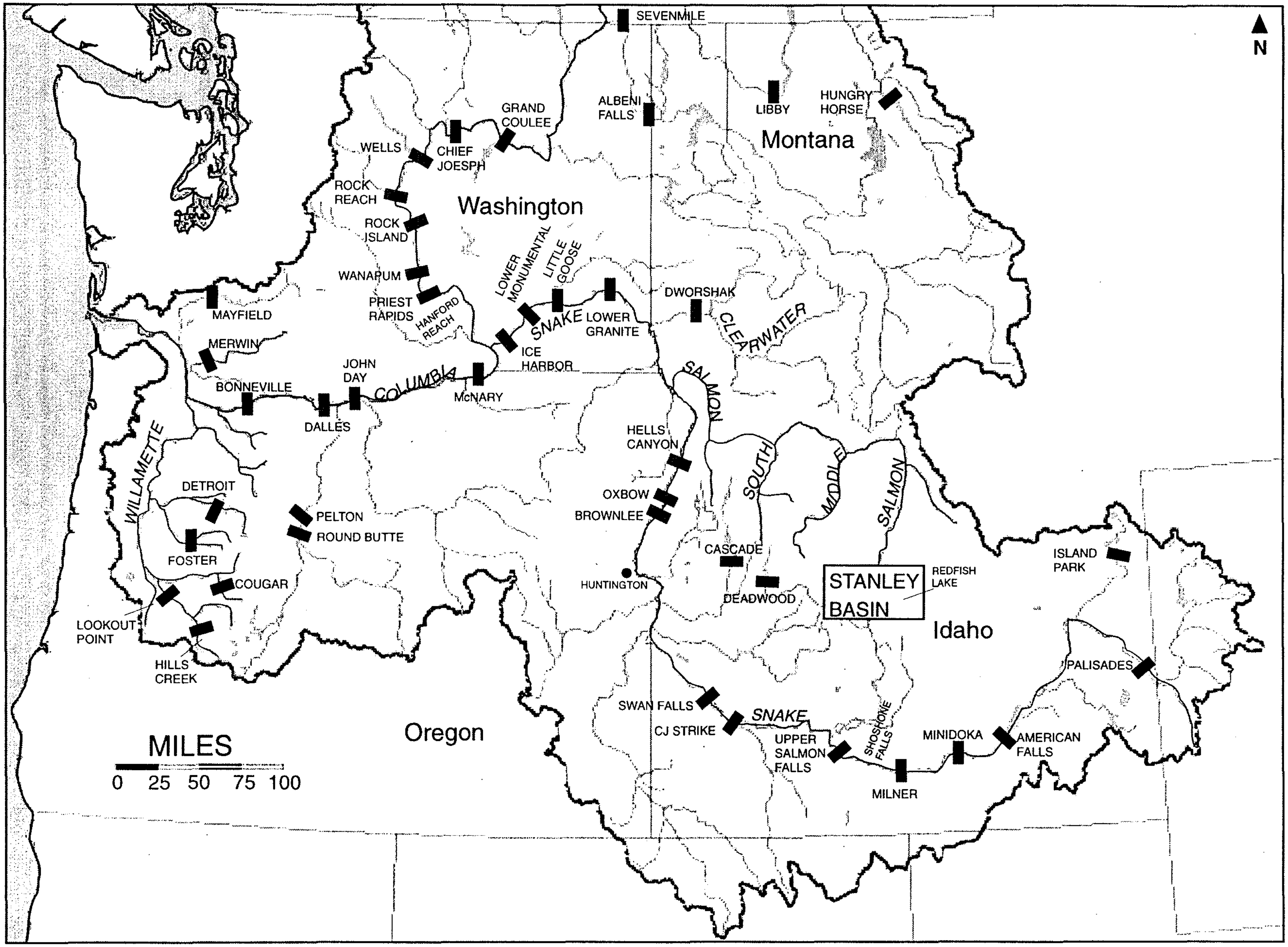



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**Figure 1-3**
**Columbia/Snake River System**

■ Major Dams

from gravel the following spring (mid-March to mid-May), and juveniles rear for nearly one year before out-migrating to the ocean as yearling fish. In general, spring chinook migrate fairly quickly to sea as yearling smolts and fall chinook tend to migrate more slowly as sub-yearlings, but in the Snake River, summer chinook resemble spring chinook and migrate as yearlings (Schmitten et al. 1995).

Adult fall chinook are present in the lower Columbia River in August through early October (Howell et al. 1985). The peak of the run passes Bonneville Dam between September 7-15. The peak at the project area would be approximately five (5) days earlier. Spawning generally takes place from October to November in large low elevation tributaries and mainstream rivers (Waples et al. 1991). Fall chinook fry emergence occurs from late March through June in the Snake River. Juveniles begin migrating downstream soon after emerging from the gravel and the migration lasts through the first week of July. Preliminary analysis of Passive Integrated Transponder (PIT) tagged subyearling fall chinook indicate that the fish migrated when they attain a threshold size of about 3.3 inches (Dennis Rondorf, NBS personal communication cited BPA 1995). After spending two to five years in the ocean, adults re-enter freshwater and migrate back to the stream where they were spawned.

**Table 1.3.1-1**
**Occurrence of chinook and sockeye salmon life stages in the Columbia River at the analysis area.[1]**

| Lifestage | Spring/Summer Chinook [2] | Fall Chinook [3] | Sockeye Salmon[4] |
|---|---|---|---|
| Adult Migration | Feb through May/June through July | Aug. through early Oct. | Early June through July |
| Adult Spawning | NA | NA | NA |
| Incubation/Emergence | NA | NA | NA |
| Juvenile Rearing | NA | NA | NA |
| Juvenile Winter Rearing | NA | NA | NA |
| Smolt Out-Migration | Late April though Aug. | Late June though September. | Late May through early July |

1 NA - Not applicable (life stage not present in analysis area).
2 Spring/Summer chinook are tributary spawners. They spawn, incubate, emerge, rear and over-winter well upstream of the project area.
3 Fall chinook spawn upstream of project area.
4 Sockeye salmon spawn and rear in Redfish Lake, Idaho.

The loss of spawning and rearing areas and the degradation of migration habitat are the primary reasons Snake River salmon are endangered with extinction (Schmitten et al. 1995).

### 1.3.2 Sockeye Salmon

The only known population of Snake River sockeye salmon is that which returns to Redfish Lake, Idaho. (See map of Columbia/Snake River System, Figure 1-3.) Snake River sockeye salmon were once found in five lakes of the Stanley Basin, in Big Palette Lake, and in Wallow Lake, Oregon (Overman 1896). The Redfish Lake population represents the world's southernmost remaining natural sockeye population. These fish use the Columbia River as a migration corridor to reach the Snake River. Adult Snake River sockeye pass Bonneville Dam from late May to the middle of

August. The peak occurs at Bonneville Dam from late June to the first week of July (Schmitten et al. 1995). They spawn along the beaches of Redfish Lake in October and November (Schmitten et al. 1995). Sockeye smolts migrate out of Redfish Lake from late April through May (Bjornn et al. 1968) after spending one or sometimes two years in Redfish Lake. Recoveries at Lower Granite Dam in 1991 indicated that passage at Lower Granite Dam occurred between May 23 and June 15. Median travel time from Redfish Lake to Lower Granite Dam, a distance of 426 miles, was 10.3 days (FPC 1992). Based on this travel time (approximately 40 miles per day), sockeye and smolts would be expected in the project area between late May and early July.

As many as 4,400 Snake River sockeye salmon were counted 40 years ago (Schmitten et al. 1995). Sockeye salmon returns to Redfish Lake averaged over 1,000 individuals prior to 1970 (BPA 1993; Schmitten et al. 1995). The return runs have continually declined since the 1970's; in 1991, 1992, and 1993 there were four, one, and eight fish, respectively (Roarer undated).

Several strategies are being used to increase the number of sockeye available for release. Sockeye juveniles are being reared at hatcheries for eventual release into the Salmon River (Johnson 1993). Some adults are also being held as brood stock. Another strategy is the fertilization of Redfish Lake to improve sockeye productivity. If fertilization proves successful there, it will be used in other sockeye lakes in the Snake River Basin.

### 1.3.3 Steelhead

Historically, steelhead were found throughout the north Pacific Ocean from the Kamchatka Peninsula in Asia to the northern Baja Peninsula. Currently, the species occurs from the Kamchatka Peninsula, east and south along the Pacific coast of North America, to at least Malibu Creek in southern California (61 FR 41542 ). Once, steelhead likely inhabited most coastal streams in Washington and Oregon, as well as many inland streams in these states and Idaho. However, during this century, over 23 indigenous, naturally reproducing stocks of steelhead are believed to have been extirpated, with many more thought to be in decline in coastal and inland streams of Washington, Oregon, and Idaho (61 FR 41542). Two major subspecies of steelhead occur in Washington and Oregon. These are a coastal group and an inland group, separated approximately by the Cascade Mountain range. Only the inland group occurs in Idaho.

Steelhead can either remain in freshwater their entire life or exhibit anadromy (meaning they rear in freshwater and then migrate to the ocean to mature before returning to freshwater to spawn). Unlike salmon species, steelhead do not necessarily die after spawning. Freshwater residents are typically referred to as rainbow trout and the anadromous forms are considered steelhead.

Biologically, steelhead can be divided into two reproductive ecotypes, based on their state of sexual maturity at the time of river entry and the duration of their spawning migration (61 FR 41542). These two ecotypes are termed "stream maturing" and "ocean maturing". Stream maturing steelhead enter freshwater in a sexually immature condition and require several months to mature and spawn. Ocean maturing steelhead enter freshwater with well-developed gonads and spawn shortly after river entry. Typically, these two reproductive ecotypes are commonly referred to as summer or winter steelhead, depending on the season of freshwater entry.

Steelhead usually migrate to the ocean after spending 2 years in freshwater. They reside and mature in marine waters typically for 2 or 3 years prior to returning to their natal stream to spawn as 4 or 5 year old fish. Returning adults migrate upstream from August to September (summer run) and December to February (winter run) (Table 1.3.3-1; Wydoski and Whitney 1979). In large rivers such as the Columbia where they have long distances to migrate, some steelhead may migrate upstream every month of the year (Wydoski and Whitney, 1979). Spawning typically takes place between December and June, with most of the spawning occurring in the early spring. Eggs incubate for 1.5 to 4 months, depending on water temperature, before hatching as "alevins". The next life stage are fry, which emerge from the gravel after yolk sac absorption. Juveniles rear in freshwater from 1 to 4 years, then migrate to the ocean as smolts during the spring (April to June, with the peak occurring during mid-April) (Wydoski and Whitney 1979).

The steelhead ESUs that are currently listed, proposed for listing, or candidate species and addressed in this BA are: the Upper Columbia River steelhead (endangered); Snake River Basin steelhead (threatened); Lower Columbia River steelhead (proposed threatened); and Middle Columbia River steelhead (candidate).

**Table 1.3.3-1**
**Occurrence of steelhead life stages in the Columbia River at the analysis area.[1]**

| Lifestage | Summer Steelhead[2,3] | Winter Steelhead[2,4] |
|---|---|---|
| Adult migration | Aug. through Sept. | Dec. through Feb. |
| Adult spawning | NA | NA |
| Incubation & emergence | NA | NA |
| 0+ Juvenile rearing | NA | NA |
| Juvenile winter rearing | NA | NA |
| Smolt out-migration | April through June | April through June |

1 Not applicable (life stage does not occur in the analysis area).
2 All steelhead are tributary spawners. They spawn, incubate, emerge, rear and over-winter upstream of the project area.
3 Lower, middle, and upper Columbia River steelhead and Snake River steelhead.
4 Lower Columbia River steelhead.

## 1.4 Habitat Conditions in the Project Area

In the project area, the Columbia River is used as a migration corridor by both adult and juvenile salmonids (Allard 1994 personal communication). Food for juvenile salmon in this section of the river is limited due to the substrates present. Sand is the dominate substrate, but boulder, cobble and gravel substrate (in order of decreasing abundance) are also represented at the project site (Parsley and Beckman 1994). The uplands adjacent to the proposed bridge crossing are extensively urbanized and most of the native riparian vegetation has been altered or removed. Boulder riprap along with non-native herbaceous species and ornamental landscaping characterize the habitat along the river's banks. Fish habitat in the area lacks complexity. The nearshore aquatic habitat has been altered by urban development to the extent that no pristine habitat conditions exist. However, fish may continue to utilize the habitat that is available in the nearshore areas during the short-term smolt out-migration (Allard 1994 personal communication).

In addition to the anadromous species (chinook salmon, coho salmon, chum salmon, sockeye salmon, steelhead trout, and cutthroat trout), fish in the Columbia River include a mixture of native riverine and introduced species that typically are associated with lake-like or lacustrine conditions (Bennett et al. 1983; Bennett and Shrier 1986; Hjort et al. 1981; Mullan et al. 1986). Dominant native species include northern squawfish (*Ptychocheilus oregonensis*), redside shiner (*Richardsonius balteatus*), mountain whitefish (*Prosopium williamsoni*), chiselmouth (*Acrocheilus alutaceus*), bridgelip sucker (*Catostomus columbianus*), largescale sucker (*Catostomus macrocheilus*). Other species include walleye (*Stizostedion vitreum vitreum*), bluegill (*Lepomis macrochirus*), smallmouth bass (*Micropterus dolomieui*), largemouth bass (*Micropterus salmoides*), white crappie (*Pomoxis annularis*), black crappie (*Pomoxis nigromaculatus)*, American shad (*Alosa sapidissima*), carp (*Cyprinus carpio*), channel catfish (*Ictalurus punctatus*), yellow perch (*Perca flavescens*), Pacific lamprey, white sturgeon, and green sturgeon. The fish species that actually utilize the project area are likely a subset of those listed above.

## 1.5 Evaluation of Effects

### 1.5.1 Introduction

Potential impacts related to the proposed construction of the Columbia River and North Portland Harbor bridges include potential effects and critical habitat modification, as well as indirect and cumulative effects.

### 1.5.2 Potential Effects of the Proposed Action

Potential issues identified as affecting the species of concern and/or habitat as a result of the proposed action are: water quality degradation during construction; increased critical predation resulting from greater availability of predator habitat downstream of bridge pilings and pier footing shadows; alteration of migration; disturbance of nearshore habitats through placement of pilings, pier footings, or abutments; and direct mortality.

#### 1.5.2.1 Water Quality

In-water work would be required for portions of the construction of the project and would expect to be performed during the in-water work period of November 1 - February 28 (ODFW 1997). Pier construction activities (drilling, concrete pouring) would be isolated from the in-water environment. Although no specific studies are available that document the volume of sediment that enters a river during bridge support construction, construction impacts are expected to be short-term and of minimal impact if normal construction practices are followed. Water quality degradation during construction could be minimized through the use of the Oregon Department of Transportation (ODOT) Standard Specifications for Highway Construction and the Conservation Methods (Section 1.6 and Appendix D) which would prevent substantial amounts of sediment or other substances from entering the river. Improper concrete curing has the potential to create short-term water quality effects. However, the dissipation rate of any short-term input of concrete from bridge construction would be high and therefore would have very limited impact on water quality.

### 1.5.2.2 Predation

Predation by the northern squawfish on emigrating juvenile salmon has been documented to be significant in the Columbia River from the vicinity of Bonneville Dam to the upstream areas of the Columbia and Snake Rivers. The majority of the predation occurs near the dams and the rate of predation varies among dams. Other predators on juvenile salmonids present in the Columbia River include walleye, smallmouth bass and channel catfish. These species are not found to aggregate near shoreline developments except as juveniles, when they consume primarily invertebrates and non-salmonid larval fishes. The USFWS (Poe et al. 1991) found that walleye and smallmouth bass exhibit a preference only for prickly sculpin (*Cottus asper*) among the prey species analyzed, which included juvenile salmonids. Oregon Department of Fish and Wildlife (ODFW) research in the Columbia-Willamette confluence area determined that smallmouth bass are rare in the lower Willamette River (Farr and Ward 1992). Vigg et al. (1991) found that smallmouth bass had the highest daily ration of fish in general, but by far the lowest daily ration of juvenile salmonids. Poe et al. (1991) found that suckers (*Catostomus* sp.) provided the most important dietary component for walleye, and sandrollers (*Percopsis transmontana*) contributed very significantly. Overall, northern squawfish account for approximately 78% of the estimated salmonid smolts lost to fish predators (Rieman et al. 1991).

Studies conducted at dams provide most of the information on predation in the Columbia River system; however, caution must be exercised when applying the results of the dam studies to predation in free-flowing reaches of the system because the dams exert a strong influence on the behavior of the predator and the prey. The discussion below relies on work conducted at some of the Columbia River dams and on a major study that was conducted in the Willamette River at the Port of Portland by ODFW (Ward 1992). The results of the ODFW study provide the best basis for evaluating the potential impacts of development on predation rates within a free-flowing section of the lower Columbia River, while the studies in the Columbia River provide information about the habitat preferences of predators, particularly squawfish.

Studies conducted by Shively et al. (1995) at Bonneville Dam have documented the habitat preferences of squawfish during the season when they prey on juvenile salmonids. In general, the distribution of northern squawfish is influenced by water velocity, distance from shore, and water depth. Northern squawfish were seldom located in water velocities greater than 3.3 feet per second (fps) and the majority (75%) were within approximately 50 feet of shore or the dam. Further, the majority of northern squawfish were in water less than approximately 30 feet deep. When squawfish were located farther from shore or the dam, they usually were in areas with relatively low water velocity (approximately <1.5 fps). Shively et al. (1995) concluded that if water velocity was the only factor influencing northern squawfish distributions in the dam tailrace, fish would be expected to be located more often in areas farther from shore or structure than they were found. The prevalence of northern squawfish close to shore may indicate a preference for shallow water areas possibly due to orientation to cover or structure, depth preference, food availability, or a combination of these (Shively et al. 1995).

If the premise that northern squawfish seek out nearshore areas due to an orientation to cover, depth preference, food availability, or a combination of these is sound, then the issue of predation on salmonids in free flowing reaches is difficult to evaluate based on results of predation studies conducted at the dams. Passage through a dam concentrates and disorients the juvenile salmonids, while the structure of the dams creates pockets of suitable water velocity for predators in areas with concentrated prey. Therefore, in the case of dams, areas of low water velocity located downstream of the dam provide high quality feeding habitat for predators. No comparable situations exist at structures in free-flowing stretches of the Columbia River.

Ward and Nigro (1992) found that catches of northern squawfish (greater than 7.9 inches fork length) were consistently higher in the portions of the Willamette River with natural shoreline habitats compared to the developed shorelines near the Port of Portland. The developed shorelines included pilings and shaded areas under piers that might be expected to provide habitat for predators such as squawfish. The finding of no predator preference for pilings and under-pier areas is consistent with the results of other studies in the Northwest in habitat where predation on juvenile salmonids has been hypothesized to be high, but demonstrated to be low (White 1975; Ratte and Salo 1985). The importance of predation may be over estimated, because increased habitat complexity caused by the pilings may serve to decrease the success of the predators (Ward 1992). White (1975) found that fish in general, and predatory species in particular, were not observed to be more abundant at piers. It cannot be concluded that pilings and over-water structures, and the shaded habitats they form, are selectively providing shelter and habitat for predatory species and harboring these species to the disadvantage of such species as trout and salmon (White 1975).

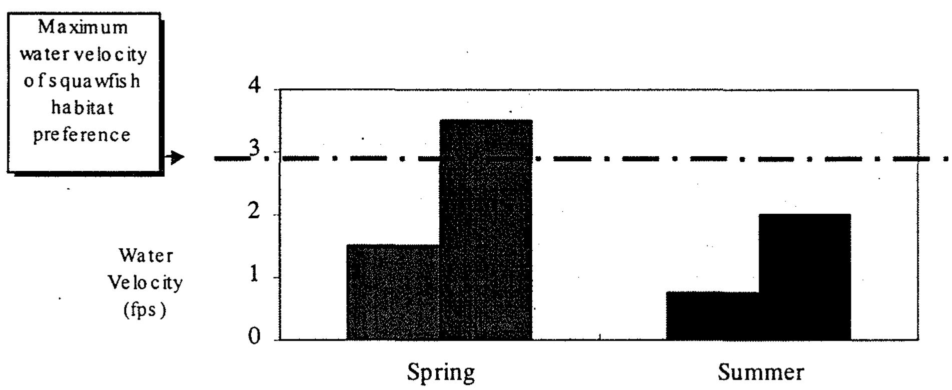
The habitat preferences of the prey, in this case salmonids, also influence the potential effect that habitat alteration will have on predation rates. In the area of the Willamette River near the Port of Portland, the mean water depth in which yearling chinook were caught was 24 feet, and mean distance from shore was 91 feet at developed sites (Knutson and Ward 1992). The mean water depth was 40 feet, and distance from shore was 96 feet for sub-yearling chinook salmon caught adjacent to the developed sites. The results for both sub-yearling and yearling chinook suggest that the habitat preferences of squawfish and yearling chinook salmon could overlap, but the squawfish are generally located closer to shore.

A study conducted in the Hanford Reach of the Columbia River on the spatial distribution of out-migrating juvenile salmonids (Dauble et al. 1989) determined that larger out migrants (i.e., spring/summer chinook, sockeye salmon, and steelhead) occurred near the bottom, mid-channel zone of the river, while the smaller wild and hatchery 0-age fall chinook salmon preferred the shallower shoreline areas. These results imply that fall chinook would be more likely to be affected by nearshore predators due to their protracted migration during summer (warmer water months when squawfish are more active) and their occurrence near shore, while the larger fish (migrating during faster spring flows), would tend to migrate in the middle of the river.

Based on a preliminary water velocity model currently being developed by the Portland District of the U.S. Army Corps of Engineers (Corps), the flows in the Columbia River at the proposed crossing location during the spring, under normal conditions, range between 1.5 fps and 3.5 fps (flows of between 75,000 to 350,000 fps at Bonneville Dam) with typical velocities falling between 2.0 fps and 2.5 fps (Figure 1.5.2-1). The summer average velocities range between 0.75 fps to 2 fps (flows of 50,000 to 100,000 fps at Bonneville Dam) (Knutson personal communication). Water velocities in the North Portland Harbor area, at a given flow, are expected to be lower than in the adjacent main channel of the Columbia River. These velocity rates are generalized and many parameters (i.e, amount of water in river, amount of inflow from the Willamette River) can influence them.

As stated earlier, high water velocity excludes squawfish from habitats that exceed 3.3 fps. To further refine the habitat preferences of squawfish with regard to water velocity, the relationships that Shively et al. (1995) reported between water velocity and cumulative observations of squawfish position were evaluated. Based on Shively's relationship, cumulative observations of squawfish increased at a constant rate up to a water velocity of approximately 2.5 fps, and then decreased. Very few squawfish were observed at water velocities above 3.3 fps. Therefore, 2.5 fps should represent the approximate upper limit of preferred water velocity for this species. This value compares well with findings of Faler et al. (1988), who reported 2.3 fps as the upper limit of squawfish water velocity preference based on less extensive data.

**Figure 1.5.2-1**
**Average General Velocities for the Columbia River at Portland**




Source: Portland District of the Army Corps of Engineers.

Applying the 2.5 fps criterion as the upper limit for preferred water velocity for squawfish, it is clear that during most of the migration season, the Columbia River, including North Portland Harbor, will be within the preferred water velocity range for squawfish (see Figure 1.5.2-1). This is very different than the conditions found below dams where pockets of low velocity water (preferred by squawfish) are surrounded by high velocity water (generally unsuitable for squawfish). As noted earlier, when squawfish are present in such habitats near a concentrated source of juvenile salmonids (e.g., bypass or turbine outfalls), then predation can be very high. These types of conditions are not expected to be found in the free flowing section of the Columbia River at the proposed LRT crossing locations.

**Analysis of Impact**

For this analysis, it is assumed that the Columbia River crossing and the North Portland Harbor crossing have the potential for increasing predation on juvenile salmonids due to the presence of in-water pilings and pier foundations that sit on the pilings. The hydraulic effects of the pilings have the potential to create favorable predator holding habitat in portions of the river that otherwise may not be predator habitat. The pier foundations may be in the water during higher flows and, for this analysis, it is assumed that the footing will be in the water and create a hydraulically favorable location for predators during at least a portion of the juvenile salmonid migration. The pier footings will also cast a dark shadow on the water where the pilings are located and further contribute to potential predator habitat. These issues are evaluated further below.

The proposed Columbia River bridge includes a support structure with in-water pilings and pier footings spaced 260 to 540 feet apart. The first support on either end of the bridge would be located approximately 260 feet to the water side of the shoreline, which is well beyond the distance from shore that nearly all the squawfish were found in the studies at Bonneville Dam (Shively et al. 1995). The North Portland Harbor crossing would have a similar configuration, but would include only five supports, the same number for the existing Interstate 5 bridge. The magnitude of the change in predation rates on juvenile salmonids caused by the crossings will be determined by the degree to which the primary predators (squawfish) are willing to abandon their preferred habitat (shallow water shorelines) and take up residence in areas behind pilings or pier footings that primarily meet only their preferences for low water velocity. Further, the overall water velocities in the Columbia River are important in determining the desirability of a specific location. Typical water velocities in the Columbia River are not generally high enough to exclude squawfish (see Figure 1.5.2-1). As a result, the piling and foundations will not provide hydraulic conditions that are unique or unusual compared to typical water velocities. Factors other than water velocity (i.e., depth, distance from shore, orientation to cover, and availability of food) are expected to greatly influence habitat selection.

Ultimately, the benefit to the predator of leaving preferred shoreline habitat to occupy habitats near pilings and foundations would be determined by the benefit gained by increased opportunities for capturing prey. In the case of dams, it has been well documented that predators will be located in areas that meet only a portion of their preferred habitat if the opportunity for prey capture is high. However, based on Shively et al. (1994), predators are not located at all sites with suitable water velocity. Instead, other factors including prey availability are important. In the case of the river crossings, juvenile salmonids passing the bridge supports will not be disoriented or greatly concentrated, but will instead be spread across most of the width of the 3,200-foot wide river. This means that it is unlikely that pilings or foundations located well offshore will provide predator habitats comparable to those at dams because the probability of prey capture is not substantially greater than in the predators' preferred shallow water shoreline habitat. This prediction of low utilization by squawfish near pilings in the Columbia River is in agreement with the results of the studies conducted in the Willamette River (Ward 1992). Ward et al. (1992) determined that losses of juvenile salmonids to predation by squawfish in developed areas may be less than in relatively undeveloped areas in the lower Willamette River. It is not expected that the proposed pilings and foundations would affect water velocity or prey distribution in a manner that would increase the predation rate of squawfish on juvenile salmonids. Further, available information from the

Willamette River indicates that squawfish will not congregate near pilings and footings in preference to other habitat. Based on this information, it is unlikely that predation would be increased for the species that migrate as yearling or older fish, because their habitat preference and that of squawfish is unlikely to overlap in the project area. The fall chinook that migrate as sub-yearling fish are more likely to be shore-oriented than are the yearling fish (Dauble et al. 1989); therefore, their distribution is more likely to overlap with the preferred habitat of squawfish.

Predation rates are not expected to increase on sub-yearling chinook for the same reasons as listed above for yearling salmonids, although the risk of project-related impact is greater for sub-yearling chinook due to their greater spatial overlap in habitat preference with squawfish and due to the season in which they migrate (during summer months when water temperatures are higher and squawfish are most active). It is expected that the Columbia River, during the summer migration, will be within the preferred water velocity range (less then 2.5 fps), and depth range (<less than 30 feet; Shively et al. 1995) for squawfish. Therefore, the bridge foundations are not expected to provide water velocity refuges that are exceptional habitat for predators compared to immediately adjacent alternative habitats. However, if the sub-yearling chinook are attracted to the foundations, squawfish may be attracted to the structures. No similar attraction to shoreline structures has been noted for sub-yearling chinook in the Willamette River (Knutson and Ward 1992), although in marine environments sub-yearling chinook are often present adjacent to pilings and pier structures (Weitkamp 1982).

To minimize the predation risk to sub-yearling chinook, bridge foundations should be located outside the habitat zone of the river inhabited by squawfish if possible. Specifically, the closer to shore the foundations are placed, the greater the risk of predation on sub-yearling chinook. To develop a criterion for the distance from shore for the foundations, the recommendations of Shively et al. (1995) for placement of outfall locations for fish bypass systems at dams were used. Bypass systems collect juvenile salmonids and transport them downstream without requiring passage through the dam's turbines. Specifically, Shively et al. (1995) recommends that outfalls be placed at least approximately 250 feet offshore. This criterion is very conservative when applied to bridge foundations because such a structure would never concentrate fish in the same way as a fish bypass outfall at a dam.

### 1.5.2.3 Migration

Migration of adults and juvenile salmonids through the lower Columbia River has not been hindered by existing bridges. The largest obstacles to migration of salmonids are dams. Knutson and Ward (1992) did not find any evidence to indicate that waterway developments in Portland Harbor directly attracted juvenile salmonids or slowed migration. Therefore, the proposed bridges are not expected to hinder migration of adult or juvenile salmonids. Construction impacts related to pile driving are described below.

Although the impacts of pile driving on fish migration have not been extensively studied, the results of focused studies are available, and much is known about the auditory capabilities of fish and their responses to habitual sound. Fish hearing is different from that of terrestrial animals. Most fish hear with a primitive version of the terrestrial inner ear and with the lateral line that runs the length of each side of the fish. The hearing ability of salmonids is limited in bandwidth and intensity threshold compared to other fish. For example, Atlantic salmon (*Salmo salar*) are functionally deaf above 380 megahertz (MHz) (Hawkins and Johnstone 1978). Fish with this type of hearing are most sensitive to particle displacement (Hawkins and MacLennan 1976).

The behavioral response by fish to sound is temporary, if present at all. While salmon can be attracted to or repelled from sound through classical conditioning (Abbott 1973), they habituate rapidly or do not respond at all when there is no conditioning, regardless of the sound pressure level (SPL) (Burner and Moore 1962; Moore and Newman 1956). Studies have been done in an attempt to divert juvenile salmonids around dams and intakes (Burner and Moore 1962), but no sound frequency or intensity has been identified that influences the action of the fish enough to be utilized for effectively guiding fish. Fiest et al. (1992) studied juvenile salmonids and did not observe significant changes in fish distribution or behavior as a result of pile driving.

Pile driving has been hypothesized to affect the migration of adult salmonids; however, there is no evidence that indicates significant delays have been caused by this activity. Grette (1985) studied the migration of adult summer/fall chinook and sockeye salmon through the fish ladder at the Hiram Chittenden Locks, between Puget Sound and Lake Washington in Seattle, Washington, during pile driving and found no effects on migration. That study provided extreme conditions for evaluating the impacts on migration for the following reasons:

1. The study area was located at the transition between salt water and freshwater where fish were adjusting physiologically to freshwater, and behaviorally to a small river.
2. The fish had to enter a confined fish ladder and not simply ascend a river.
3. The pile driving was occurring within 100 feet of the entrance to the fish ladder.
4. The fish should not have had a high motivation for migration as their spawning beds were relatively close to the project area and they were migrating at least one month before spawning.
5. Steel sheet piles were used.

During the study, pile driving occurred at regular intervals for approximately 10 minutes followed by about 20 minutes of set-up for the following pile. By comparing periods when pile driving occurred versus periods when no pile driving occurred, no impacts were found in terms of numbers of fish passing the fish ladder.

Based on previous studies (Grette 1985; Fiest et al. 1992) it is concluded that pile driving is likely to have little or no effect on migration of adult or juvenile salmonids in the Columbia River during bridge construction.

#### 1.5.2.4 Habitat Disturbance

Placement of bridge supports in the river would result in the loss of a small amount of habitat by replacing sand substrates with concrete bridge pier foundations. This habitat is not utilized by Snake River chinook or sockeye salmon, or the steelhead evolutionary significant units of concern. The area of habitat lost would be small relative to the area of the entire river. Each bridge foundation piling would occupy approximately 50 square feet. Eight (400 square feet) and six (300 square feet) pilings are grouped together to support each foundation for the main span of concrete segmental and bow-string arch bridges, respectively. Construction of 9 piling foundations in the Columbia River would result in either 3,600 (concrete segmental bridge) or 2,700 (bow-string arch bridge) square feet of habitat lost depending on the bridge design constructed. Construction of 5 piling foundations for the concrete segmental bridge over North Portland Harbor would result in the loss of approximately 2,000 square feet of habitat.

The productivity, in terms of prey, for fish would be reduced by placement of bridge foundations in the aquatic habitat. The amount of lost productivity would be small, since concrete substrate would continue to produce prey species (e.g., insects feeding on algae) for fish and because the impact area is small and of low quality (sand substrate). Further, studies by Sherwood et al. (1990) have found that the prey base of juvenile salmonids has changed since the construction of the Columbia River dams, shifting from benthic organisms to open-water zooplankton. Therefore, the potential impact to existing prey production would likely be of little significance to juvenile salmonids.

#### 1.5.2.5 Direct Mortality

Use of the project area by the threatened Snake River chinook salmon, endangered Snake River sockeye salmon, and steelhead ESUs proposed for federal listings would be limited to upstream adult passage and downstream smolt passage. The potential for direct mortality of these species would be low provided the conservation measures presented in Section 1.6 are implemented.

### 1.5.3 Critical Habitat Modification

#### 1.5.3.1 Permanent Modification

No permanent modifications to water quality (and the critical habitat water) would occur as a result of project implementation.

As discussed above, the waterway bottom (critical habitat for the endangered Snake River sockeye and chinook salmon) would be modified at each of the bridge foundation locations. However, no essential features such as suitable spawning gravels, or sites used for cover, shelter, refuge, holding, or rearing would be adversely modified. Such features are lacking in the immediate project area. Alteration of the water velocity at the piling and footing locations would occur. This alteration in water velocity is not expected to create additional predator habitat or increase predation on juvenile salmonids.

The amount of shading created by the pier footings would not prevent primary production of any prey species that juvenile chinook or sockeye salmon feed on during their out-migration. The majority of production of the prey species utilized by these fish occurs up river. The project area is not considered rearing habitat for juvenile Snake River chinook, sockeye salmon, or any of the steelhead ESUs of concern.

Bridge construction in areas of designated critical habitat would not directly impact riparian habitat (within 300 feet of normal high water), since most of the riparian vegetation in the analysis area has already been altered or lost, due to other actions.

### 1.5.3.2 Temporary Impacts

Activities necessary for the construction of the Columbia River bridge could result in temporary increases in turbidity during the in-water work period (November 1 - February 28). The specific activity which could contribute to suspended solids and increase turbidity is the placement and removal of coffer dams. It is also possible that erosion of any exposed soils along or close to the river could contribute to turbidity during project construction. In addition, temporary increases in turbidity could occur when areas subject to earthwork are inundated or receive rainfall during the construction period (see Section 1.6).

Potential short-term increases in turbidity would not have any adverse impacts to the food supply of salmon during or following construction. Adult chinook stop feeding once they begin the freshwater portion of their upstream spawning migrations. The project could temporarily displace some predators, but it is not expected to affect predation on either species of concern.

Future developments within the project area are likely to continue to occur due to the proximity of urban areas. The majority of the land is privately owned, and most of it is developed. The area of existing impervious surface around the project area increases the potential for toxic substances (e.g., oil, gas) to enter the waterway. The expected impacts from construction activities would be short-term and temporary in nature, and would not result in long-term adverse impacts to the endangered Snake River chinook salmon, endangered Snake River sockeye salmon, or steelhead ESUs proposed for listing.

### 1.5.4 Indirect and Cumulative Effects

**Indirect Impacts**

The proposed South/North LRT could induce higher density development/redevelopment within the Corridor, particularly in and around station areas. New development on currently undeveloped land would increase surface water runoff and could adversely impact water quality in fish-bearing waters. However, current local and state regulations will require appropriate detention and treatment of runoff from new impervious surfaces. Also, because most of the land within station areas is already developed, redevelopment of these properties would not increase storm water runoff or adversely impact water quality over existing conditions.

From a broader perspective, most of the indirect impacts from the South/North LRT would be beneficial to fish and fish habitat, compared to the No-Build Alternative. For over 20 years, the Region has shaped its land use and transportation plans based upon the expectation that high capacity transit (HCT) would be provided within this corridor. Those plans have sized the road network, defined the comprehensive land use plans and influenced the size of the urban growth area. Without HCT in this corridor, the same or a similar amount of development would likely occur, but would be lower density, consuming more open space, including land that may otherwise be outside the urban growth boundary. To this extent, the South/North LRT would have beneficial indirect impacts on water quality, fisheries and fish habitat by encouraging redevelopment within the urban growth area on lands that are largely already developed. Also, to the extent that LRT would reduce reliance on the automobile, it would reduce the runoff and contaminants associated with increased road surface and automobile use.

### Cumulative Impacts

Cumulative impacts are all of the impacts that are known or expected to occur over the duration of the proposed project, and include activities outside of the proposed project. Development un-associated with the South/North LRT is expected to continue along the Columbia River and other parts of the corridor. Known major projects in the vicinity include: the Corps of Engineers is currently preparing a Draft EIS for proposed Lower Columbia River channel deepening; the Port of Portland will soon be preparing a Draft EIS for the proposed development of new marine terminals on West Hayden Island; and, the Port of Vancouver is planning marine terminal and upland development on their property located downstream from the proposed LRT crossing of the Columbia River. Each of these projects will have potential impacts on fish and fish habitat and will be subject to environmental review and permitting requirements. Also, if the Snake River Recovery Plan is implemented on federal and private lands upstream of the project site, the status of the Snake River chinook and sockeye salmon should improve.

## 1.6 Performance Standards and Conservation Measures

This BA has evaluated the bridge design that would most likely be constructed given current information. However, because the project is currently at a conceptual engineering level, the design may evolve with regard to major concepts or in detail as the design process continues. In addition, the exact construction methods that would be employed to build a bridge cannot be specified at this time because the plans and specifications for the project would be performance-based rather than prescriptive. This means that the plans would describe exactly what to build, but not how to build it. These types of plans and specifications are desirable from the perspective of cost and environmental protection because it allows both the designer's and the contractor's experience to be applied to the construction challenges.

The lack of finality of the current design, and the format of the plans and specifications, yield uncertainty regarding the steps that will be taken to ensure that the project will result in no adverse impacts on the species of concern for this BA. To address this uncertainty and to retain design and construction flexibility, a performance standard approach for ensuring environmental protection is proposed. Performance standards, related to specific impacts, have been developed for the design of the proposed in-water foundations for the bridge (Table 1.6-1) and for the construction methods for those foundations (Table 1.6-2). The standards focus on the foundations as they are the primary project components that could yield significant impacts to the species of concern.

The performance standards for design are essentially statements of desirable design criteria that, if implemented, would limit the potential impacts of the foundations by reducing the area or quality of favorable habitat for predators that feed on juvenile salmonids. These standards were developed by considering the studies on predation discussed in Section 1.5.2.2. The standards are not presented as definitive design criteria for use in selecting between bridge types as that decision would need to be based on a number of engineering, cost, and environmental considerations. Instead, the standards are proposed as a means of refining foundation design for the type of bridge that is deemed to be most feasible for this location and application. Further, specific standards may be in conflict (e.g., minimizing the number of piles while minimizing the size of piles) in which case they must be considered simultaneously. No major design modifications (e.g., streamlined pile shapes) are included in Table 1.6-1 because the risk that the project would increase predation on juvenile salmonids is small and does not warrant dramatic design changes (see Section 1.5.2.2).

The performance standards for construction are primarily Best Management Practices (BMPs) that would be clearly outlined by the contractor in a Construction Quality Assurance Plan (CQAP). The CQAP would be submitted to Tri-Met for approval prior to the start of in-water construction. These BMPs would be method-specific and present means to ensure that construction methods are in compliance with applicable regulations and minimize the risk of impact to the species of concern. The CQAP would also address the conditions and monitoring requirements necessary for compliance with the State of Oregon's water quality certification.

In addition to the performance standard approach to ensuring minimization of risk to species of concern, a number of general conservation measures have been identified that could also minimize project-related effects to these resources. These measures are essentially BMPs related to construction activities that are likely to occur during bridge construction. They are intended as general guidelines that could be implemented during the construction process; however, the specific approach for their implementation would be determined once the bridge design and construction methods have been finalized.

- Implement erosion and sediment control measures. These measures could include placing temporary ground cover on all exposed soils/slopes, placing silt fences at the base of slopes, and ensuring complete containment of excavated material during hauling from the construction site. The objective of these measures would be to prevent sediment from entering surface waters.

- Timing of in-water construction activities would be based on discussions with NMFS and ODFW and take into consideration factors such as timing of fish migration and construction schedule and cost. The current ODFW guidelines for timing of in-water work in the Columbia River below the Bonneville Dam is November 1 – February 28.

- Sediment sampling would be conducted prior to construction of an in-water bridge pier in order to determine the presence of and characterize potential contaminants. Remedial options for impacted sediments would be evaluated in accordance with the Oregon Department of Environmental Quality's and Washington State Department of Ecology's sediment criteria.

- Limit the operation of equipment in the active river channel to the minimum necessary. Avoid or minimize disruption of the streambed to the level practicable.

- Clean all equipment that is used for in-water work prior to entering the water. Remove external oil and grease, along with any mud and dirt. Locate the wash sites in areas where runoff does not flow into the river without prior adequate treatment.

- Discharge all water impounded within coffer dams only onto vegetated upland sites, behind silt fences and other sediment barriers, and not directly into the river or into wetlands.

- Do not store or transfer petroleum products (e.g., gasoline, diesel, oil) within 200 feet of the active river channel. Fuel and lubricate all construction equipment only in designated re-fueling zones.

- Assure the development and implementation of plans for the safe storage and containment of all hazardous materials used in project construction by the construction contractor. Develop and implement a site-specific Spill Prevention Control and Countermeasures Plan in accordance with 40 C.F.R Part 112. Submit this plan to NMFS for review prior to on-site construction staging.

- Include measures in the plan for containment berms and/or detention basins, where appropriate.

- If significant alteration of the project schedule or procedures related to in-water work is required, consult with NMFS prior to implementing such changes.

- Develop a site-specific sediment control and erosion control plan prior to project implementation. Implement temporary measures during construction to reduce the potential for siltation and sedimentation from runoff from areas with exposed soil. Include such measures as silt fences and sediment barriers at the base of all exposed slopes, placing mats of mulch or geotextile fabric on exposed slopes following completion of activities at the sites, and using non-leaky trucks to haul excavated material, as needed. Submit these plans to the NMFS for review prior to on-site construction staging. Inspect all erosion and sediment control measures on a weekly basis to assure proper functioning and effectiveness.

### 1.7 Determination

If the conservation measures proposed in this BA are implemented, it is expected that implementation of the proposed project may affect, but is not likely to adversely affect the listed, proposed, or candidate species in the project area. This determination is based on the following reasons:

- Potential effects to water pilings and foundations are not expected to affect water velocity or salmonid distribution in a manner that would increase the predation rate of northern squawfish on juvenile salmonids that migrate as yearlings or older fish.

- Potential predation risks to migrating sub-yearling chinook salmon would be minimized by locating bridge foundations outside of the preferred habitat zone of northern squawfish (within approximately 50 feet of shoreline).

- If pile driving is used during bridge construction, it is likely to have little or no effect on migration of adult or juvenile salmonids.

## Table 1.6-1
## Matrix of impact pathways, impact indicators, and performance standards for design of in-water foundations.

| Project Component | Activity/Attribute | Impact Pathway | Impact Indicator | Performance Standard |
|---|---|---|---|---|
| **Design of foundations** | Location | Provide potential predator habitat | Foundation located in preferred predator habitat | Foundations located 250 feet offshore consistent with bridge type |
| | Spacing of foundations | Provide potential predator habitat | High density of pilings across river | Maximize spacing between foundations consistent with bridge type |
| | Elevation of pier footing | Provide potential predator habitat | Footing located within water during juvenile salmonid emigration (spring) | Maximize piling length while minimizing pier length consistent with other design constraints |
| | Area of pier footing | Provide potential predator habitat | Extensive shadowing or shading | Minimize area of footing or add cutouts to footing |
| | Number of piles per foundation | Provide potential predator habitat and disorient juvenile salmonids | Complex flow around multiple pilings | Minimize number of piles per foundation consistent with other design constraints |
| | Diameter of piles | Provide potential predator habitat | Large "pocket" behind pile | Minimize size of piles consistent with other design constraints |

**Table 1.6-2**
**Matrix of impact pathways, impact indicators, and performance standards for construction of in-water foundations**

| Project Component | Activity/Attribute | Impact Pathway | Impact Indicator | Performance Standard[1] |
|---|---|---|---|---|
| **Construction of foundations** | Drive pile | | | |
| | | Disturbance of bottom sediments | Turbidity | Implementation of BMPs |
| | | Trapping of juvenile salmonids | Construction during juvenile salmonid emigration | Construction during appropriate work window |
| | | Fuel spills | Release of toxic quantities of fuel | Implementation of BMPs |
| | | Underwater noise affecting migration | No impact expected (see Section 1.5.2.3) | |
| | Drill/excavate | | | |
| | | Loss of drill cuttings | Turbidity | Implementation of BMPs |
| | | Loss of drilling lubricants | Release of toxic quantities of lubricant | Implementation of BMPs |
| | | Fuel spills | Release of toxic quantities of fuel | Implementation of BMPs |
| | Pour and cure concrete | | | |
| | | Concrete spills and leaching | Release of volume of material sufficient to increase pH | Implementation of BMPs |
| | | | Contact with water prior to curing | Implementation of BMPs |

1 BMPs will be described in the Contractors Construction Quality Assurance Plan (CQAP) that will be submitted to Tri-Met prior to construction. The CQAP will also address numerical water quality criteria and monitoring requirements contained in the water quality certification issued by the State of Oregon.

- The potential for direct mortality of migrating salmonids would be low with implementation of recommended conservation measures.
- No significant effects to salmonid critical habitat would occur as a result of project implementation.
- Cumulative effects of increased development in the analysis area are expected to be less than significant.

## 2. WILLAMETTE RIVER CROSSING

### 2.1 Introduction

This Biological Assessment (BA) is prepared in compliance with Section 7 of the Endangered Species Act (ESA) of 1973. In addition, candidate species for listing under the ESA are also addressed in this BA pursuant to Section 7 (a)(4) of the ESA. The Tri-County Metropolitan Transportation District of Oregon (Tri-Met) proposes to construct a Light Rail Transit (LRT) system connecting the Portland, Oregon and Vancouver, Washington metropolitan areas (Figure 2-1). The proposed project would require the construction of bridges over the Columbia River, North Portland Harbor, the Columbia Slough, and Willamette River, as well as several tributary streams. This section of the BA has been prepared to address potential project-related impacts associated with the Willamette River crossing only.

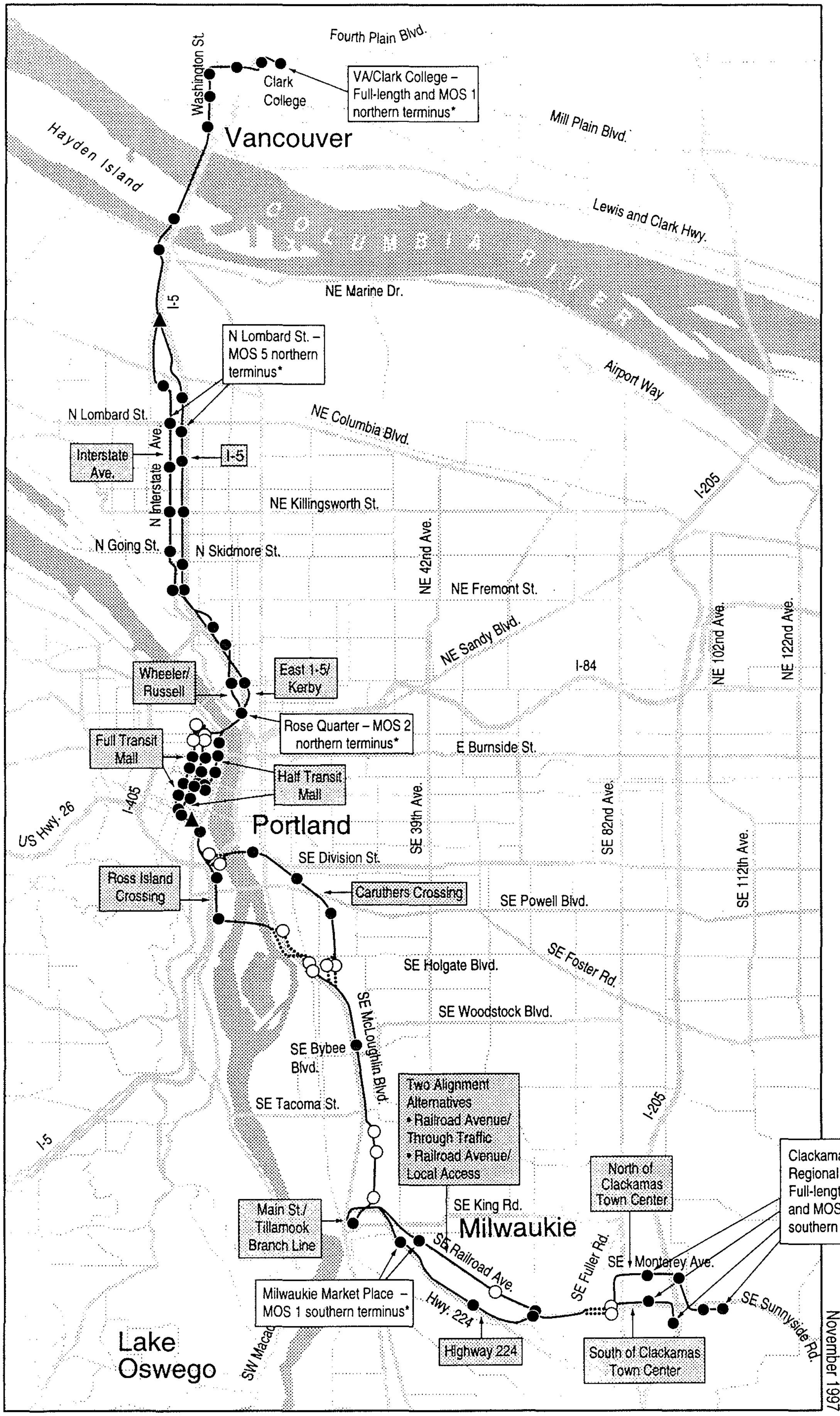
Information on potentially occurring Threatened, Endangered, and Sensitive (TES) species was requested from the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). Replies indicated that two Evolutionary Significant Units (ESUs) of steelhead (*Oncorhynchus mykiss*) occur in the project area. These ESUs are the Lower Columbia River steelhead (proposed threatened) and Upper Willamette River steelhead (candidate). Additional candidate species in the project area are chinook salmon (*Oncorhynchus tshawytscha*), and sea-run cutthroat trout (*Oncorhynchus clarki clarki*) (NMFS 1996a, 1996b, 1997) (Appendix B). Pacific lamprey (*Lampetra tridentata*), green sturgeon (*Acipenser medirostris*), and white sturgeon (*A. transmontanus*) are species on concern that occur in the Willamette River (USFWS 1996). At this time, NMFS has not designated critical habitat for these species. The Willamette River is used as a migration corridor for juvenile and adult steelhead, chinook, and sea-run cutthroat trout. The analysis and the conservation measures identified in this BA should protect all of the species discussed above.

#### 2.1.1 Project Description

The South/North Transit Corridor (Corridor) is a proposed bi-state light rail line between the Clackamas Regional Center area in Oregon and the Clark College/Veterans Administration Medical Center area in Vancouver, Washington. As part of this project, a new bridge crossing the Willamette River has been proposed. Numerous alternative locations were initially considered for this crossing. However, after further review the alternatives have been narrowed to two locations.

The two alternative locations receiving detailed analysis for bridge construction occur at river mile 14.5 (Ross Island crossing) and river mile 13.5 (Caruthers crossing) (Figure 2-2). At each location two bridge design options are under consideration. A concrete segmental bridge is being considered for both locations. Additional design options are a cable-stayed pre-cast segmental bridge for the Ross Island crossing and a Warren truss bridge for the Caruthers crossing (Appendix B). In addition to the two bridge design options, the Caruthers Crossing also includes two alignment alternative options (Moody and South Marquam options) that differ primarily by the location of the alignment on the west bank of the river (Appendix C).

The concrete segmental bridge could have cast-in-place columns and foundations. Span layout for the Ross Island crossing from the west to east bank would be 275 feet - 550 feet - 550 feet -300 feet.




South North Transit Corridor Study

METRO

# Figure 2-1
# Willamette River Fish Biological Assessment
## South / North Light Rail Transit Corridor

**Note:** Alignment and station locations are currently under study and may change.

*MOS refers to a segment of the full-length alternative called a Minimum Operable Segment.

- LRT Alignment Alternative
- LRT Design Option
- ● Station
- ○ Station Options
- ▲ Station Access Under Study

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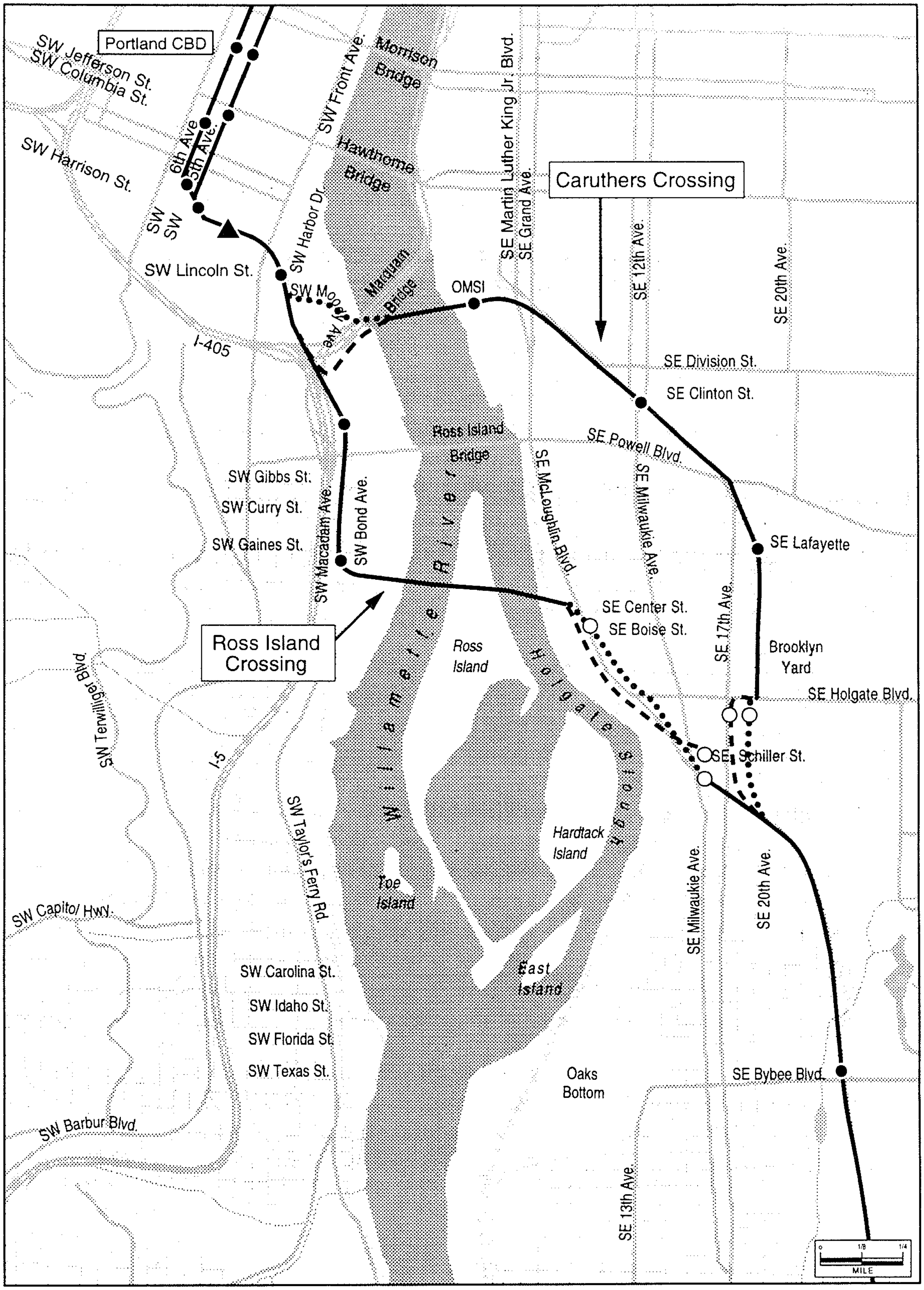


August 1997

South North Transit Corridor Study

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**Figure 2-2**

# Willamette River Fish Biological Assessment

## Ross Island and Ross Island Crossing Alignment Alternative

- ● Station
- ○ Station Options
- ▲ Station Access Under Study
- LRT Alignment Alternatives
- LRT Design Options
- Existing Railroad

All foundations would be supported on 8-foot-diameter drilled shafts. The foundations Figure 2-1 would be approximately 54 x 56 feet and the drilled shaft pilings are estimated to be 100 feet long.

Columns would be twin wall piers, 6 x 20 feet. Two columns would be entirely in the water (one in the east channel and one in the west channel of the Willamette River on either side of Ross Island) and two columns would be located within an 80-foot-wide band along each shore of Ross Island measured from low water elevation. The piers have been proposed to be located on the island to avoid impacts to near shore habitat in the river. The surface of the bridge would be concrete and would be at least 75 feet above the water surface (Appendix C).

The cable-stayed bridge option proposed for the Ross Island crossing would be a combination of cable-stayed and precast segmental bridge types. The span layout from west bank to east bank would be: 800 feet - 700 feet (cable stayed) - 360 feet - 220 feet - 220 feet - 220 feet (precast segmental). The foundation for the main tower would be located on the west bank of Ross Island within an 80-foot-wide band measured from low water. The main tower foundation and all other foundations would be founded on 8-foot-diameter drilled shafts. No columns would be located directly in the west channel. Three columns would be located in the water in the east channel. The main tower is assumed to be a cast-in-place tower. All other piers for this option are twin walled. The bridge surface would be concrete and at least 75 feet above the water surface at high flows (Appendix C).

The concrete segmental bridge under consideration for the Caruthers crossing is essentially the same design as for the Ross Island crossing. However, the span layout would be different (400 feet - 400 feet - 400 feet - 205 feet, Moody option; 400 feet - 400 feet - 400 feet - 150 feet, South Marquam option), and three piers would be located in the Willamette River (Appendix C).

The second design option being analyzed for the Caruthers crossing is a Warren truss bridge. This design utilizes steel trusses, similar to the existing Interstate 5 bridge located just north of the proposed Caruthers crossing. Span layout from west bank to east bank would be 290 feet - 500 feet - 500 feet - 250 feet, and would be the same for both the Moody and South Marquam options. All foundations would be supported on 8-foot-diameter drilled shafts, and would be 40 x 68 feet in plan. The drilled shaft piling are estimated to be 100 feet long. Columns would be rectangular cast-in-place reinforced concrete 8- x 12-foot piers. The deck would be made of cast-in-place concrete. The truss bridge would be a through truss to allow for adequate navigational clearance (Appendix C).

All design options could utilize coffer dams for isolating drilling of the shafts and pouring of concrete columns from the river. This features braced sheet piling walls, driven pilings, underwater tremie concrete pours, and extensive pumping of the water inside the coffer dam to allow construction of the remainder of the pier footing and columns under dry conditions (Appendix C).

### 2.1.2 Site Description

The project is situated in the lower Willamette River basin in northwest Oregon Hydrologic Unit (HU) (No. 1780001) as defined by the U.S. Geological Survey. The Willamette River drains an area of approximately 12,045 square miles and is 273 miles long. The project area is located between river miles 13.5 and 14.5.

Riparian habitat on the shores of the Willamette River at both proposed crossings has been extensively modified, primarily due to industrial development. At the Ross Island crossing, the steep east river bank drops approximately 30 feet from its top to the river channel below. Vegetation here consists of a relatively sparse tree canopy dominated by black cottonwood (*Populus trichocarpa*) and scattered Oregon ash *(Fraxinus latifolia)*. Himalayan blackberry (*Rubus discolor*) dominates the understory. The west bank of the river is characterized by abandoned industrial sites. The shoreline consist of a nearly vertical drop of 20 feet. Vegetative cover is sparse and is comprised of scattered, small black cottonwoods and a variety of non-native herbaceous species.

In contrast, Ross Island supports relatively high quality, native riparian habitat. The northern portion of the island in the vicinity of the proposed bridge crossing is covered with deciduous forest dominated by large (70-90-foot high) black cottonwoods. Associated canopy species are Oregon ash, and to a lesser extent Oregon white oak (*Quercus garryana*), big-leaf maple (*Acer macrophyllum*), and madrone (*Arbutus menziesii*). Understory species consist of a dense scrub habitat dominated by Pacific blackberry (*Rubus ursinus*), Himalayan blackberry, and common snowberry (*Symphoricarpos albus*). No wetlands are present on Ross Island or on either bank of the river in the vicinity of the proposed crossing.

Both the east and west banks of the Willamette River in the vicinity of the proposed Caruthers crossing is characterized by steep slopes that drop 20 to 30 feet to the surface of the river. Industrial development has significantly altered the natural topography and vegetation in this area. The eastern bank of the river consists of a riprap slope planted with a dense cover of red clover (*Trifolium pratense*) and white clover (*T. pratense*), along with scattered native trees and shrubs (red alder, *Alnus rubra*, and dogwood, *Cornus* sp.). The west shoreline of the river supports a dense cover of Himalayan blackberry, along with scattered, small black cottonwoods and a number of non-native herbaceous species. No wetlands are present on either bank of the Willamette River in the vicinity of the Caruthers Crossing.

### 2.1.3 Regulations and Guidelines

In August 1996, NMFS issued a proposed listing of ten Evolutionarily Significant Units (ESUs) of steelhead as either threatened or endangered (NMFS 1996c). All races (summer and winter) of steelhead within these ESUs were included. The lower Columbia River steelhead ESU, which occurs in the project area, was among those included for threatened status. In August 1997, the decision to list this ESU was deferred six months in order to give NMFS time to review additional information. The Upper Willamette River steelhead ESU, chinook salmon (all races), and sea-run cutthroat trout are candidate species for listing under the ESA that occur in the project area (NMFS 1996a, 1996b) (Appendix B). Critical habitat has not been designated for any of these species. Pacific lamprey, green sturgeon, and white sturgeon also occur in the project area and are classified as Species of Concern by the USFWS (1996).

## 2.2 Natural History and Species Occurrence

### 2.2.1 Steelhead

The Lower Columbia River steelhead ESU is currently proposed for listing as a threatened species under the ESA. Steelhead from the lower Willamette River are included in this ESU. Upper Willamette River steelhead also migrate through the project area. Three races of steelhead (summer, winter, and late winter) inhabit the Willamette River.

The races of steelhead are distinguished by the time of year adults return to freshwater on spawning migrations. The winter steelhead enter their home streams beginning in November with the majority returning in January through March (Table 2.2.1-1). Spawning occurs during January through June. In contrast, summer steelhead enter freshwater from late spring through early fall and do not spawn until January through May of the following year. Adult summer steelhead migrate through the lower Willamette River beginning in early March. The run peaks in mid-May and continues through June (sometimes as late as October). Most returning adults have spent two years in the ocean (Bennett 1992).

**Table 2.2.1-1**
**Occurrence of steelhead life stages in the Willamette River at the analysis area [1,2]**

| Lifestage | Summer Steelhead | Winter Steelhead | Late Winter Steelhead |
|---|---|---|---|
| **Adult migration** | March through June | December through February | February through May |
| **Adult spawning** | NA | NA | NA |
| **Incubation & emergence** | NA | NA | NA |
| **Juvenile rearing** | NA | NA | NA |
| **Juvenile winter rearing** | NA | NA | NA |
| **Smolt out-migration** | April through June | April through June | April through June |

1 Not Applicable (Life stage does not occur in the analysis area).
2 All steelhead are tributary spawners. They spawn, incubate, emerge, rear, and over-winter upstream of the project area.

Summer steelhead were introduced above the Willamette River Falls in the late 1960s to provide sport fishing opportunity (Bennett 1992). Since 1972 all releases have been Skamania stock (Foster 1992). Natural production is low and typically takes place immediately downstream of the hatchery of origin. Most of the spawning takes place in hatcheries in January through March (Bennett 1992).

The native steelhead stock in the Willamette system is a late run, winter stock. Adult late winter steelhead enter the Willamette River in November, and pass Willamette Falls from February through May (Bennett 1992). To expand angling opportunities, Big Creek hatchery stock were introduced in the 1960's. This earlier returning, non-native stock of winter steelhead migrate up the Willamette River primarily in the period from December through February, with some returning in November. Big Creek winter steelhead have established naturally reproducing populations. Winter steelhead passing prior to February 15 are mainly introduced Big Creek stock and steelhead passing after February 15 are mainly indigenous Willamette stock.

Spawning activity for the winter steelhead (both early and late) takes place from March through May. They smolt and move downstream to salt water from early April through early June. Spawning areas of summer and winter steelhead overlap in some areas of the Willamette River basin, in particular the main Willamette River upstream of Willamette Falls.

### 2.2.2 Chinook Salmon

The Willamette River system produces spring and fall races of chinook salmon. In 1996, all but the Snake River race (a federally endangered species) of Northwest chinook were classified as candidate species for listing under the ESA (NMFS 1996d). The spring race of chinook make a significant contribution to the recreational and commercial fisheries.

An estimated 95,300 adult spring chinook entered the Willamette River in 1991 (Bennett 1992). Hatcheries contribute roughly 80-95% of the total returning adults. Historically, the spring chinook above Willamette Falls spawned in the Middle Fork Willamette, McKenzie, South Santiam, and North Santiam rivers. The Calapooya and Molalla rivers and Abiqua Creek, a tributary of the Pudding River, had minor spawning populations. By 1970, dams were completed on all the major tributaries upstream of Willamette Falls. These blocked over 400 stream miles that were originally the most important spawning and rearing areas for wild spring chinook (Bennett 1992). Some spawning area remains in the McKenzie River and the North Santiam River.

Adult spring chinook salmon enter freshwater bound for the Willamette River in early January, increasing to peak numbers in late March, and tapering off by mid-May. The fishery in the lower Willamette River peaks in April. Passage over the falls occurs between mid-April through mid-June (Bennett 1992)(Table 2.2.2-1).

**Table 2.2.2-1**
**Occurrence of chinook life stages in the Willamette River at the analysis area.[1]**

| Lifestage | Spring Chinook [2] | Fall Chinook [3] |
|---|---|---|
| **Adult Migration** | January through mid-May | August through September |
| **Adult Spawning** | NA | NA |
| **Incubation/Emergence** | NA | NA |
| **Juvenile Rearing** | NA | NA |
| **Juvenile Winter Rearing** | NA | NA |
| **Smolt Out-Migration** | March through May | Late April through June |

[1] Not Applicable (Life stage does not occur in the analysis area).
[2] Spring chinook are tributary spawners. They spawn, incubate, emerge, rear, and over-winter well upstream of the project area.
[3] Fall chinook are tributary spawners. They spawn, incubate, and emerge well upstream of the project area.
[4] Fall chinook may rear and overwinter downstream of project area.

Spawning of spring chinook occurs in September. Spawning takes place in the upper tributaries (e.g. McKenzie and North Santiam) and at hatcheries. All adults die after spawning. Fry emerge from the gravel the following spring, mid-March through mid-May, soon after releases from upstream hatcheries (Knutson and Ward 1991). The juveniles rear for approximately one year prior to migrating to the ocean as yearling fish.

Fall chinook salmon were introduced into the Willamette River system in 1964 to take advantage of expected improvements in low-water passage at Willamette Falls. Releases are of the early spawning (Tule) stock (Bennett 1992). Fall chinook begin migrating up the lower Columbia River in August through early October (Howell et al. 1985). Fall chinook pass Willamette Falls from mid-August through late September. The peak appears to be about the middle of September (Bennett 1992). Spawning takes place from mid-September through early October. Natural production comprises about 28% of recent runs. Fall chinook spawn and rear in the main-stem Willamette River and lower reaches of east side tributaries.

Juveniles begin emigrating to salt water soon after emerging from the gravel, and emigration lasts through the first week of July. About 5 to 7 million smolts are released annually in late April and early May. Out-migrating juvenile fall chinook first appear in the lower Willamette River in late April, peak in mid-May, and remain in decreasing numbers through June (Knutson and Ward 1991). In general, fall chinook tend to migrate more slowly as sub-yearling fish than spring chinook. Knutson and Ward (1991) found some juvenile yearling and sub-yearling chinook salmon in the lower Willamette River at Portland Harbor during January and February, approximately three months after the most recent hatchery release. This suggests that some juvenile chinook may overwinter in the lower Willamette River.

### 2.2.3 Sea-run Cutthroat Trout

The sea-run cutthroat trout was identified as a candidate species for listing under the ESA in 1996 (NMFS 1996d). This anadromous subspecies occurs in the Willamette River system.

Sea-run cutthroat trout adults show a preference for small, low gradient streams and the lower gradient downstream reaches of larger river system. They spawn in small tributaries from late winter to late spring. February appears to be the peak spawning period in most Oregon streams (Behnke 1992) (Table 2.2.3-1).

**Table 2.2.3-1**
**Occurrence of sea-run cutthroat trout life stages in the Willamette River at the analysis area.**

| Lifestage | Sea-run cutthroat trout[1] |
|---|---|
| Adult migration | Late August through November |
| Adult spawning | NA |
| Incubation & emergence | NA |
| 0+ Juvenile rearing | NA |
| Juvenile winter rearing | NA |
| Smolt out-migration | Late April through May |

[1] Not applicable (life stage does not occur in the analysis area). Sea-run cutthroat trout are tributary spawners. They spawn, incubate, emerge, rear, and overwinter upstream of the project area.

Juveniles rear in small headwater streams until they smolt and emigrate to the sea at age two or three. They typically migrate to salt water in the late spring or early summer at a length of 6.9-8.9 inches, although some individuals may never go to sea (Behnke 1992).

Anadromy does not seem to be strongly developed in this species; they tend to concentrate in bays, estuaries, and along the coast. They feed intensively on crustaceans and fish and grow at a rate of about 1.0 inch per month. They seldom if ever overwinter in salt water. After about two to five months at sea they return to freshwater. Adult sea-run cutthroat trout survive spawning rather well and recover their condition quickly (Behnke 1992). Repeated spawning is not uncommon, with some fish returning to spawn three to five times.

### 2.3 Habitat Conditions in the Project Area

In the project area, the Willamette River is used as a migration corridor by both adult and juvenile salmonids. Due to the low water velocities in this section of the river, the substrates are predominately fines (clays, silts, sands) except where rock has been placed for bank protection. In rivers, fine substrates typically yield lower production of prey organisms for salmonids than larger substrates, and overall productivity of the habitats at the proposed crossings is expected to be low relative to upstream habitats in the river. With the exception of Ross Island, most of the aquatic and riparian habitat in the vicinity of the proposed bridge crossings has been significantly altered. Complex riparian vegetation close to and overhanging the wetted perimeter of the river yields higher quality fish habitat than unvegetated, rock-protected shorelines because they provide cover and food (terrestrial insects) for fish.

Ross Island supports a relatively high quality, riparian deciduous forest (see Section 2.1.2) and the adjacent shorelines are high quality fish habitat. Log rafts are often present along the west shore of the island and likely contribute bark and wood debris to the substrates. The east and west shoreline of the river at the Ross Island crossing has limited vegetation and rock bank protection is present in many areas. Remnant pile-supported structures (piers, mooring dolphins) exist on the west side of the river. Overall, the shoreline habitat along the west bank of the river at this crossing is of low quality for fish.

At the Caruthers crossing, riparian vegetation is very limited and rock bank protection is prevalent. Substrates, other than the rock, are dominated by fine materials. Overall, the shoreline habitat is of low quality for fish in this area.

Besides steelhead, chinook salmon, and cutthroat trout, the Willamette River has several other anadromous fish species. These species are coho salmon (*Oncorhynchus kisutch*), American shad (*Alosa sapidissima*), and white sturgeon (*Acipenser transmontanus*). Resident fish species include largemouth bass (*Micropterus salmoides*), black crappie (*Pomoxis nigromaculatus*), white crappie (*Pomoxis annularis*), and walleye (*Stizostedion vitreum vitreum*). Northern squawfish (*Ptychocheilus oregonensis*) are also present.

### 2.4 Evaluation of Effects

#### 2.4.1 Potential Effects of the Proposed Action

Potential issues identified as affecting the species of concern and/or habitat as a result of the proposed action are: water quality degradation during construction; increased predation on juveniles resulting from greater availability of predator habitat downstream of bridge pilings and pier footing shadows; disturbance of nearshore habitats through placement of pilings, pier footings, or abutments; and direct mortality.

#### 2.4.1.1 Water Quality

In-water work will be required for portions of the construction of the project and is expected to be performed during the recommended in-water work periods of July 1 to October 31 and December 1 to January 31 (ODFW 1997). Pier construction activities (drilling, concrete pouring) would be isolated from the in-water environment. Although no specific studies are available that document the volume of sediment that enters a river during bridge support construction, construction impacts are expected to be short term and of minimal impact if normal construction practices are followed. Water quality degradation during construction could be minimized through the use of the Oregon Department of Transportation (ODOT) Standard Specifications for Highway Construction and the Conservation Methods (Section 1.6 and Appendix D) which would prevent substantial amounts of sediment or other substances from entering the river. Improper concrete curing has the potential to create short-term water quality effects. However, the dissipation rate of any short-term input of concrete from bridge construction would be high and therefore would have very limited impact on water quality.

#### 2.4.1.2 Predation

A study addressing the influence of in-water development on predation of juvenile salmonids was conducted by the Oregon Department of Fish and Wildlife (ODFW) in the lower Willamette River between 1986 and 1990 (Ward and Farr 1988, 1989; Ward and Knutson 1990; Ward et al. 1991; Ward and Nigro 1992).

The overall conclusion of the study was that development of the Willamette River shoreline did not lead to increases in predation on juvenile salmonids. Based on these results, the proposed crossing of the Willamette River at either Ross Island or Caruthers is not expected to lead to increases in predation on juvenile salmonids. This conclusion is discussed further below.

As part of the study done in the lower Willamette River, Ward and Nigro (1992) measured water velocity during times of juvenile salmonid migration (spring and summer) at areas of developed and undeveloped shoreline. Two of the locations where velocities were measured are adjacent to the proposed project areas (river mile 14.5). They found that during high spring flows, water velocity adjacent to the proposed project area ranged from approximately 0.4 feet per second (fps) (river mile 16.8) to 0.14 fps (river mile 9.8). These water velocities are well below the velocity threshold that excludes northern squawfish, which has been found to be approximately 3.3 fps (Shively et al. 1995; Mesa and Olson 1993).

Significant studies on predation by northern squawfish on juvenile salmonids have been conducted in the Pacific Northwest at dams (Poe et al. 1991; Rieman et al. 1991; Vigg et al. 1991). Studies conducted by Shively et al. (1995) at Bonneville Dam have documented the habitat preferences of squawfish during the season when they prey on juvenile salmonids. In general, the distribution of northern squawfish is influenced by water velocity, distance from shore, and water depth. Northern squawfish were seldom located in water velocities greater than 3.3 fps and the majority (75%) were within 50 feet of shore or dam and in water less than 33 feet deep. The prevalence of northern squawfish close to shore may indicate a preference for shallow water areas possibly due to orientation to cover or structure, depth preference, food availability, or a combination of these (Shively et al. 1995). In the case of dams, it has been well documented that predators will be located in areas that meet only a portion of their preferred habitat if the opportunity for prey capture is high.

The proposed Willamette River crossing alternatives do not have the potential for increasing predation on juvenile salmonids even though the designs includes in-water pilings and pier foundations. The proposed pilings and foundations would not affect water velocity or prey distribution in a manner that would increase the predation rate of squawfish on juvenile salmonids for two main reasons:

1. The hydraulic effects of the pilings do not create more favorable holding habitat than along shorelines, where several preferred habitat parameters are met (velocity, cover, water depth). Further, because the entire Willamette River is within the preferred water velocity of northern squawfish the entire year, areas behind pilings will not provide conditions that are more attractive than shorelines.

2. The potential for prey capture will not be greater behind pilings than along shorelines since juvenile salmonids will not be concentrated behind pilings. Studies have shown that squawfish will leave areas of preferred habitat if potential for prey capture is high (i.e., fish bypasses and turbine outlets at dams). In the case of the project area, prey (juvenile salmonids) will not be concentrated, but will instead by spread across the width of the river. Therefore, the pilings are not expected to provide squawfish with locations with a high rate of prey capture.

The design of the proposed crossing also reduces the potential for project-related effects due to predation. The closest pilings to the shore would be between 150 feet and 220 feet from the bank, depending on the alternative and design selected. These distances are well beyond the preferred distance from shore of northern squawfish. Although the pilings and pier footings may provide overhead cover for squawfish, their locations in areas that offer no other preferred habitat characteristics suggest that low utilization by squawfish is expected.

This prediction of low utilization of habitat near pilings by squawfish is supported by studies conducted by Ward and Nigro (1992). They studied areas where the natural shoreline has been replaced by riprap or bulkheads, and the river bottom has been deepened and widened by dredging. Also analyzed were areas with piers, piling wharfs, and floating platforms. These developed shorelines were contrasted with parallel studies at more natural shorelines. No significant difference was found in squawfish utilization of habitat at developed versus undeveloped sites.

### 2.4.1.3 Habitat Disturbance

Placement of bridge supports in the river would disturb a small area of river bottom habitat by replacement of sand, silt or, clay substrates with concrete bridge foundation pilings. This habitat is not utilized extensively by steelhead or spring chinook which migrate to the ocean rapidly. Juvenile fall chinook, and possibly to a lesser extent sea-run cutthroat trout, do utilize habitat in and adjacent to the project area during migration. Habitat losses from bridge foundation pilings in the river channel (i.e., below high water elevation) would range from 1,200 to 2,100 square feet depending on the bridge crossing and design option constructed (Appendix C). Table 2.4.1-1 presents the area of habitat that could be lost for each of the river crossing alternatives.

**Table 2.4.1-1**
**In-water habitat losses associated with the Willamette River bridge crossing alternatives**

| Crossing Alternative | Bridge Option | Number of Pilings per Foundation | Number of Foundations[1] | Habitat Affected (ft2)[2] |
|---|---|---|---|---|
| **Ross Island** | Concrete segmental | 8 | 2 (2) | 1,600 |
| | Cable-stayed concrete segmental | 18/8 | 3(1) | 2,100 |
| **Caruthers** | Concrete segmental | 8 | 3(--) | 1,200 |
| | Warren truss[4] | 6 | 3 | NA |

1 Number of foundations are those in the river channel entirely below low water elevation followed by those located between low and high water elevation (in parentheses).
2 Pilings are 8-foot diameter (approximately 50 $ft^2$).
3 Number of pilings and foundations are for cable-stay main tower/concrete segmental piers.
4 NA - Information not available at this time.

Productivity, in terms of prey, for fish would be reduced by the placement of the bridge foundations in the aquatic habitat. The amount of lost productivity would be small, since concrete substrate would continue to produce prey species for fish (e.g., insects feeding on algae) and because the habitat that would be impacted is small in area and has low productivity.

Based on the limited riparian vegetation on the east and west shore of the river and the bridge designs (elevated track, foundations set back from the shoreline), it is expected that little impact to riparian habitat will occur at these locations. Impacts would occur to riparian vegetation on Ross Island during bridge construction, including clearing of vegetation in construction access and staging areas beneath the bridge. However, this vegetation would be permitted to reestablish after project construction at the crossing location to minimize impacts to fish and wildlife habitat in this area.

### 2.4.1.4 Direct Mortality

Use of the project area by the species of concern is limited to upstream adult passage and downstream smolt passage. The potential for direct mortality would be associated with the construction of the coffer dams. If fish would become trapped within the coffer dams after they are constructed, those individuals would die. However, the potential for this to occur is low due to the design of the coffer dams. The potential for direct mortality to the species of concern could be further reduced if the conservation measures discussed in Section 2.7 were implemented.

## 2.5 Critical Habitat Modification

Critical habitat has not been designated for any of the species of concern in the Willamette River. However, the same features that have been designated as critical habitat for Snake River chinook and sockeye salmon in the Columbia and Snake rivers (water, waterway bottom, and adjacent riparian zone) are also important habitat features for salmonids and cutthroat trout in the Willamette River. Therefore, potential project-related effects to these habitat features are addressed for the species of concern in the Willamette River.

### 2.5.1 Permanent Modification

No permanent modifications to water quality (and the water) would occur as a result of project implementation.

As discussed above, the river bottom would be modified at each of the bridge foundation locations. However, no essential features such as suitable spawning gravels, or sites used for cover, shelter, refuge, holding, or rearing would be adversely modified. Alteration to the water velocity at the piling and footing locations would occur. This alteration in the velocity would not increase or create additional predator habitat or increase predation on juvenile salmonids or sea-run cutthroat trout.

The amount of shading created by the pier footings would not prevent primary production of any prey species that the species of concern feed on during their out-migration. The majority of production of the prey species utilized by these fish occurs up-river from the project area.

### 2.5.2 Temporary Impacts

Activities necessary for the construction of the Willamette River bridge could result in temporary increases in turbidity during the recommended in-water work periods (July 1 to October 31 and December 1 to January 31.) The specific activity that could contribute to suspended solids and increase turbidity is the placement and removal of coffer dams. It is also possible that erosion of any exposed soils along or close to the river could contribute to turbidity during project construction. In addition, temporary increases in turbidity could occur when areas subject to earthwork are inundated or receive rainfall during the construction period.

The predicted short-term increase in turbidity would not have any adverse impacts to the food supply of salmon, steelhead, or sea-run cutthroat trout during or following construction. Adult chinook stop feeding once they begin the freshwater portion of their upstream spawning migrations. The project may temporarily displace some predators, but it is not expected to concentrate predators in areas where predation on the species of concern is likely to increase.

The maintenance activities that would be required for the bridges varies depending upon which design is considered. The maintenance activities with the greatest potential to lead to impacts in the aquatic environment are related to painting of the steel portions of the structure. The concrete segmental bridge design has very few steel surfaces that would require painting; therefore, it is very unlikely that maintenance activities could lead to impacts. The cable-stayed bridge and Warren truss designs have more steel components than the concrete segmental design and more painting related maintenance is expected. However, the quantities of materials that could enter the Willamette River are so small that few or no impacts are expected to the species addressed in this BA.

### 2.5.3 Indirect and Cumulative Effects

#### Indirect Impacts

The proposed South/North LRT could induce higher density development/redevelopment within the Corridor, particularly in and around station areas. New development on currently undeveloped land would increase surface water runoff and could adversely impact water quality in fish-bearing waters. However, current local and state regulations will require appropriate detention and treatment of runoff from new impervious surfaces. Most of the land within station areas is already developed. In these areas, redevelopment would not increase storm water runoff or adversely impact water quality over existing conditions.

From a broader perspective, most of the indirect impacts from the South/North LRT would be beneficial to fish and fish habitat, compared to the No-Build Alternative. For over 20 years, the Region has shaped its land use and transportation plans based upon the expectation that high capacity transit (HCT) would be provided within this corridor. Those plans have sized the road network, defined the comprehensive land use plans and influenced the size of the urban growth area. Without HCT in this corridor, the same or a similar amount of development would likely occur, but would be lower density, consuming more open space, including land that may otherwise be outside the urban growth boundary. To this extent, the South/North LRT would have beneficial indirect impacts on water quality, fisheries and fish habitat by encouraging redevelopment within the urban growth area on lands that are largely already developed. Also, to the extent that LRT would reduce reliance on the automobile, it would reduce the runoff and contaminants associated with increased road surface and automobile use.

#### Cumulative Impacts

Cumulative impacts are all of the impacts that are known or expected to occur over the duration of the proposed project, and include activities outside of the proposed project. Development unassociated with the South/North LRT is expected to continue along the Willamette River and other parts of the corridor. Known major projects in the vicinity include the Ross Island Sand and Gravel dredging/mining operations on Ross Island. Operations are expected to occur up to the year 2020. Mining operations would move within the lagoon dependent on underwater rock source availability. Potential detrimental impacts to the fish from these operations include loss of riparian vegetation and potential impacts on turbidity levels. This and other projects in the vicinity would be subject to environmental review and permitting requirements.

## 2.6 Performance Standards and Conservation Measures

This BA has evaluated the bridge designs that would most likely be constructed given current information. The choice between bridge locations will be made at the completion of the Draft Environmental Impact Statement for this project during winter 1997/1998. The design may evolve with regard to major concepts or in detail as the design process continues. In addition, the exact construction methods that would be employed to build a bridge cannot be specified at this time because the plans and specifications for the project would be performance-based rather than prescriptive. This means that the plans would describe exactly what to build, but not how to build it. These types of plans and specifications are desirable from the perspective of cost and environmental protection because it allows both the designer's and the contractor's experience to be applied to the construction challenges.

The lack of finality of the current design, and the format of the plans and specifications, yield uncertainty regarding the steps that will be taken to ensure that the project will result in no adverse impacts to the species of concern for this BA. To address this uncertainty and to retain design and construction flexibility, a performance standard approach for ensuring environmental protection is proposed. Performance standards, related to specific impacts, have been developed for the design of the proposed in-water foundations for the bridge (Table 2.6-1) and for the construction methods for those foundations (Table 2.6-2). The standards focus on the foundations as they are the primary project components that could yield significant impacts to the species of concern.

The performance standards for design are essentially statements of desirable design criteria that, if implemented, would limit the potential impacts of the foundations by reducing the area or quality of favorable habitat for predators that feed on juvenile salmonids. These standards were developed by considering the studies on predation discussed in Section 2.4.1.2. The standards are not presented as definitive design criteria for use in selecting between bridge types as that decision would need to be based on a number of engineering, cost, and environmental considerations. Instead, the standards are proposed as a means of refining foundation design for the type of bridge that is deemed to be most feasible for this location and application. Further, specific standards may be in conflict (e.g., minimizing the number of piles while minimizing the size of piles) in which case they must be considered simultaneously. No major design modifications (e.g., streamlined pile shapes) are included in Table 2.6-1 because the risk that the project would increase predation on juvenile salmonids is small and does not warrant dramatic design changes (see Section 2.4.1.2).

The performance standards for construction are primarily Best Management Practices (BMPs) that would be clearly outlined by the contractor in a Construction Quality Assurance Plan (CQAP). The CQAP would be submitted to Tri-Met for approval prior to the start of in-water construction. These BMPs would be method-specific and present means to ensure that construction methods are in compliance with applicable regulations and minimize the risk of impact to the species of concern. The CQAP would also address the conditions and monitoring requirements necessary for compliance with the State of Oregon's water quality certification.

In addition to the performance standard approach to ensuring minimization of risk to species of concern, a number of general conservation measures have been identified that would also minimize project-related effects to these resources. These measures are essentially BMP's related to construction activities that are likely to occur during bridge construction. They are intended as general guidelines that could be implemented during the construction process; however, the specific approach for their implementation would be determined once the bridge design and construction methods have been finalized.

- Sediment sampling would be conducted prior to construction of an in-water bridge pier in order to determine the presence of and characterize potential contaminants. Remedial options for impacted sediments would be evaluated in accordance with the Oregon Department of Environmental Quality's sediment criteria.

- Implement erosion and sediment control measures. These measures could include placing temporary ground cover on all exposed soils/slopes, placing silt fences at the base of slopes, and ensuring complete containment of excavated material during hauling from the construction site. The objective of these measures would be to prevent sediment from entering surface waters.

- Timing of in-water construction activities would be based on discussions with NMFS and ODFW and take into consideration factors such as timing of fish migration and construction schedule and cost. The current ODFW guidelines for timing of in-water work in the Willamette River below Willamette Falls is July 1 to October 31 and December 1 to January 31.

- Limit the operation of equipment in the active river channel to the minimum necessary. Avoid or minimize disruption of the streambed to the level practicable.

- Clean all equipment that is used for in-water work prior to entering the water. Remove external oil and grease, along with any mud and dirt. Locate the wash sites in areas where runoff does not flow into the river without prior adequate treatment.

- Discharge all water impounded within coffer dams only onto vegetated upland sites, behind silt fences and other sediment barriers, and not directly into the river or into wetlands.

- No storage or transfer of petroleum products (e.g., gasoline, diesel, oil) within 200 feet of the active river channel. Fuel and lubricate all construction equipment only in designated re-fueling zones.

- Assure the development and implementation of plans for the safe storage and containment of all hazardous materials used in project construction by the construction contractor. Develop and implement a site-specific Spill Prevention Control and Countermeasures Plan in accordance with 40 C.F.R Part 112. Submit this plan to NMFS for review prior to on-site construction staging.

- Include measures in the plan for containment berms and/or detention basins, where appropriate.

- If significant alteration of the project schedule or procedures related to in-water work is required, consult with NMFS prior to implementing such changes.

## Table 2.6-1
## Matrix of impact pathways, impact indicators, and performance standards for design of in-water foundations

| Project Component | Activity/Attribute | Impact Pathway | Impact Indicator | Performance Standard |
|---|---|---|---|---|
| Design of foundations | Location | Provide potential predator habitat | Foundation located in preferred predator habitat | Foundations located 250 ft offshore consistent with bridge type |
| | Spacing of foundations | Provide potential predator habitat | High density of pilings across river | Maximize spacing between foundations consistent with bridge type |
| | Elevation of pier footing | Provide potential predator habitat | Footing located within water during juvenile salmonid emigration (spring) | Maximize piling length while minimizing pier length consistent with other design constraints |
| | Area of pier footing | Provide potential predator habitat | Extensive shadowing or shading | Minimize area of footing or add cutouts to footing |
| | Number of piles per foundation | Provide potential predator habitat and disorient juvenile salmonids | Complex flow around multiple pilings | Minimize number of piles per foundation consistent with other design constraints |
| | Diameter of piles | Provide potential predator habitat | Large "pocket" behind pile | Minimize size of piles consistent with other design constraints |

**Table 2.6-2**
**Matrix of impact pathways, impact indicators, and performance standards for construction of in-water foundations**

| Project Component | Activity/Attribute | Impact Pathway | Impact Indicator | Performance Standard[1] |
|---|---|---|---|---|
| Construction of foundations | Drive pile | | | |
| | | Disturbance of bottom sediments | Turbidity | Implementation of BMPs |
| | | Trapping of juvenile salmonids | Construction during juvenile salmonid emigration | Construction during appropriate work window |
| | | Fuel spills | Release of toxic quantities of fuel | Implementation of BMPs |
| | | Underwater noise affecting migration | No impact expected (see text) | |
| | Drill/excavate | | | |
| | | Loss of drill cuttings | Turbidity | Implementation of BMPs |
| | | Loss of drilling lubricants | Release of toxic quantities of lubricant | Implementation of BMPs |
| | | Fuel spills | Release of toxic quantities of fuel | Implementation of BMPs |
| | Pour and cure concrete | | | |
| | | Concrete spills and leaching | Release of volume of material sufficient to increase pH | Implementation of BMPs |
| | | | Contact with water prior to curing | Implementation of BMPs |

1 BMPs will be described in the Contractors Construction Quality Assurance Plan (CQAP) that will be submitted to Metro prior to construction. The CQAP will also address numerical water quality criteria and monitoring requirements contained in the water quality certification issued by the State of Oregon.

- Develop a site-specific sediment control and erosion control plan prior to project implementation. Implement temporary measures during construction to reduce the potential for siltation and sedimentation from runoff from areas with exposed soil. Include such measures as silt fences and sediment barriers at the base of all exposed slopes, placing mats of mulch or geotextile fabric on exposed slopes following completion of activities at the sites, and using non-leaky trucks to haul excavated material, as needed. Submit these plans to the NMFS for review prior to on-site construction staging. Inspect all erosion and sediment control measures on a weekly basis to assure proper functioning and effectiveness.

## 2.7 Determination

If the conservation measures proposed in this BA are implemented, it is expected that implementation of the proposed project is not likely to adversely affect the proposed or candidate species in the project area.

This determination is based on the following reasons:

- Potential effects to water quality associated with bridge construction could be minimized through the use of BMP's. Residual water quality impacts would be minimal and of very short duration.

- Proposed bridge pilings and foundations are not expected to affect water velocity or salmonid distribution in a manner that would increase the predation rate of northern squawfish on juvenile salmonids or cutthroat trout that migrate as yearling or older fish.

- Potential predation risks to migrating sub-yearling chinook salmon would be minimized by locating bridge foundations outside of the preferred habitat zone of northern squawfish (within approximately 50 feet of the shoreline).

- If pile driving is used during bridge construction, it is likely to have little or no effect on migration of adult or juvenile salmonids or cutthroat trout.

- The potential for direct mortality of migrating salmonids would be low with implementation of recommended conservation measures.

- No significant effects to salmonid or cutthroat trout habitat would occur as a result of project implementation.

- Cumulative effects of increased development in the analysis area are expected to be less than significant.

# Appendix A

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# Appendix B

*Correspondence with U.S. Fish and Wildlife Service and National Marine Fisheries Service*

UNITED STATES DEPARTMENT OF COMMERCE
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NATIONAL MARINE FISHERIES SERVICE
Northwest Region
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F/NW

Ms. Helen Knoll
Regional Administrator
Federal Transit Administration
915 Second Avenue
Federal Building, Suite 3142
Seattle, Washington 98174-1002

Re: Request for Informal Consultation on a Proposed South/North Light Rail Project from Clackamas County, Oregon to Vancouver, Washington

Dear Ms. Knoll:

This responds to your October 14, 1997, letter addressed to Ben Meyer of the National Marine Fisheries Service (NMFS) requesting informal consultation on a proposed light rail project from Clackamas County, Oregon to Vancouver, Washington.

The proposed project entails the construction of a light rail transit system to serve the metropolitan areas of Portland, Oregon and Vancouver, Washington. The project would require crossing the Columbia River at two spots and the Willamette River at a yet to be determined site.

Based on information provided in the Biological Assessment, NMFS concurs with the Federal Transit Administration's (FTA) determination that the conceptual design of the proposed project is not likely to adversely affect listed or proposed salmonids that may be in the project area. In summary, NMFS' decision is based on the fact that the pilings supporting the bridges are not expected to affect water velocity in such a way as to increase the potential for predation by northern squawfish on juvenile outmigrants, bridge foundations will be located substantially offshore, outside of the preferred habitat zone of northern squawfish, and construction activities are not likely to delay any migration.

This concludes informal consultation on this action in accordance with 50 CFR 402.14(b)(1). The FTA must reinitiate this ESA consultation if new information becomes available or circumstances occur that may affect listed species in a manner or to an extent not previously considered, or a new species is listed or critical habitat is designated that may be affected by the action.

The Willamette River currently does not contain runs of fish that are listed under the Endangered Species Act. However, lower Columbia River steelhead have been proposed for listing and occur in the project vicinity. If this species is listed, the FTA will need to reinitiate consultation with NMFS once a final plan for the project with specific crossing sites for the Willamette River has been determined.

If you have any questions please contact Ben Meyer of my staff at (503) 230-5425.

Sincerely,

Elizabeth Holmes Gaar for

William Stelle, Jr.
Regional Director

cc: Dave Unsworth, METRO

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
ENVIRONMENTAL & TECHNICAL SERVICES DIVISION
525 NE Oregon Street
PORTLAND, OREGON 97232-2737

JUN 25 1996

RECEIVED 2 1996

F/NWO3

Mr. Leon Skiles
Metro
600 N.E. Grand Avenue
Portland, Oregon 97232-2736

Re: Species List Request for the North South Light Rail Project, in Portland, Oregon

Dear Mr. Skiles:

The National Marine Fisheries Service (NMFS) has reviewed your June 14, 1996, letter to Jacqueline Wyland requesting a list of threatened and endangered species for the North South Light Rail Project, in Portland, Oregon.

We have reviewed the subject proposal with regard to the conditions contained in 33 CFR Part 330 (Nationwide Permit Program Regulations and Issue, Reissue, and Modify Nationwide Permits; Final Rule) related to Endangered Species (Appendix A to Part 330, Section C.11).

We have enclosed lists of those anadromous fish species that are listed as threatened or endangered under the Endangered Species Act (ESA), those that are proposed for listing, and those that are candidates for listing. This inventory includes only anadromous species under NMFS' jurisdiction that occur in the Pacific Northwest. The U.S. Fish and Wildlife Service should be contacted regarding the presence of species falling under its jurisdiction.

Available information indicates that three of the anadromous fish species listed under the ESA are known to be present in the proposed action area. The species present are Snake River sockeye salmon (*Oncorhynchus nerka*), Snake River spring/summer chinook salmon (*O. tshawytscha*), and Snake River fall chinook salmon (*O. tshawytscha*). The designated critical habitat for the listed species (December 28, 1993, 58 FR 68543) includes the proposed project area. None of the species proposed for listing are in the project area.

All of the anadromous fish species that are presently candidates for listing under the ESA are known to be present in the proposed action area. These species are the sea-run cutthroat trout (*O.*

*clarki clarki*), chinook salmon (*O. tshawytscha*), sockeye salmon (*O. nerka*), coho salmon (*O. kisutch*), steelhead (*O. mykiss*), pink salmon (*O. gorbuscha*),and chum salmon (O. keta). It is important to note that candidates for listing have no status under the ESA.

This letter constitutes the required notification of the presence of any Federally listed threatened or endangered species or critical habitat under NMFS' jurisdiction in the permit area that may be affected by the proposed project (Appendix A to Part 330, Section C.13(5)(i)).

If you have further questions, please contact Ben Meyer of my staff at (503) 230-5425.

Sincerely,

Ben Meyer for

Elizabeth Holmes Gaar
Habitat Branch Chief

Enclosure

cc: Seattle Corps of Engineers

# ENDANGERED, THREATENED, PROPOSED AND CANDIDATE SPECIES UNDER NATIONAL MARINE FISHERIES SERVICE JURISDICTION THAT OCCUR IN THE PACIFIC NORTHWEST

## Listed Species

| | |
|---|---|
| Snake River Sockeye Salmon | *Oncorhynchus nerka* |
| Snake River Fall Chinook Salmon | *Oncorhynchus tshawytscha* |
| Snake River Spring/Summer Chinook Salmon | *Oncorhynchus tshawytscha* |

## Proposed for Listing

| | |
|---|---|
| Umpqua River Sea-run Cutthroat Trout | *Oncorhynchus clarki clarki* |
| Klamath Mountains Province Steelhead | *Oncorhynchus mykiss* |
| Central California Coastal Coho | *Oncorhynchus kisutch* |
| S. Oregon/N. California | *Oncorhynchus kisutch* |
| Oregon Coastal Coho Salmon | *Oncorhynchus kisutch* |

## Candidates for Listing
(all Northwest stocks of the following except coho)

| | |
|---|---|
| Chinook Salmon | *Oncorhynchus tshawytscha* |
| Pink Salmon | *Oncorhynchus gorbuscha* |
| Chum Salmon | *Oncorhynchus keta* |
| Sockeye Salmon | *Oncorhynchus nerka* |
| Sea-run Cutthroat Trout | *Oncorhynchus clarki clarki* |
| Steelhead | *Oncorhynchus mykiss* |
| Lower Columbia river/SW Washington Coastal Coho | *Oncorhynchus kisutch* |
| Puget Sound/Strait of Georgia Coastal Coho | *Oncorhynchus kisutch* |

**United States Department of the Interior**

**FISH AND WILDLIFE SERVICE**
**Oregon State Office**
**2600 S.E. 98th Avenue, Suite 100**
**Portland, Oregon 97266**
**(503) 231-6179 FAX: (503) 231-6195**

July 19, 1996

In reply refer to:
1-7-96-I-296
Xref: 1-7-96-SP-334
1-3-96-SP-396



David Unsworth
Metro
600 NE Grand Avenue
Portland, OR 97232-2736

Dear Mr. Unsworth:

This is in response to your letter, dated 14 June 1996, requesting information on listed and proposed endangered and threatened species that may be present within the area of the South/North Transit Corridor Study in Clackamas and Multnomah counties in Oregon and Clark County , Washington. The U.S. Fish and Wildlife Service (Service) received your letter on 17 June 1996.

We are also providing comments as a followup to the July 1, 1996 field tour and your request for input from our agency regarding information which would be helpful in early assessment of potential project impacts. The following comments are provided as part of informal consultation relative to the need to evaluate impacts to federally listed threatened species which occur in the vicinity of the proposed action. These comments do not preclude additional comments from our agency on any forthcoming environmental document or biological assessment pursuant to the National Environmental Policy Act (NEPA) or Endangered Species Act of 1973, as amended (Act).

We have attached a list (Attachment A) of threatened and endangered species that may occur within the area of the Transit Corridor Study. The list fulfills the requirement of the Service under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.). Federal Transit Administration (FTA) requirements under the Act are outlined in Attachment B.

The Ross Island bald eagle nest site is located about ½ mile from the southernmost of the two proposed bridge crossing alignments over the Willamette River. The nest site is new this year. Therefore, information regarding how the pair utilizes the area around its nest is limited. During the field tour, Ken England, of Ross Island Sand and Gravel, indicated observations of the eagles foraging along the shoreline areas of the interior of the lagoon and flights to the south. These observations from the lagoon's interior may be limited by the sight distances since denser vegetation would obscure observations of flights downriver east of Ross Island. Often there are key perch sites and foraging areas in use which that are associated with the nest site. It is not uncommon to observe shifts in eagles' selection of primary use areas early and later in the breeding season. These shifts depend upon the time of year and distribution or availability of resources. Additional information regarding this pair may be available from Oregon Department of Fish and Wildlife (contact Joe Pesek at 503-657-2000 ext. 230) and Portland Audubon Society (contact Mike Houck 503-292-6855 ext. 111).

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems on which they depend may be conserved. Under section 7(a)(1) and 7(a)(2) of the Act and pursuant to 50 CFR 402 *et seq.*, FTA is required to utilize their authorities to carry out programs which further species conservation and to determine whether projects may affect threatened and endangered species, and/or critical habitat. A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) which are major Federal actions significantly affecting the quality of the human environment as defined in NEPA (42 U.S.C. 4332 (2)(c)).

It is our understanding that Metro will be attempting to decide which of two alignments to cross the Willamette River will be the best alternative before the end of the year. As long as there is the possibility that the Ross Island crossing may be selected and given the presence of bald eagles at Ross Island, the Service construes the federally funded construction of a mass transit system across a major waterway to constitute a major construction activity. Therefore, the Federal Transit Administration and/or Metro need to prepare a biological assessment as would be required by the Federal action agency under section 7 of the Act.

Major concerns that should be addressed in the biological assessment concerning project impacts on bald eagles are:

1) The level of use by bald eagles including temporal and spatial relationships.

2) Effect of the project on the bald eagles primary food stocks in all areas influenced by the project. This would include the Willamette River.

3) Timing of the project and how this would affect nesting/wintering/foraging activities.

4) Construction impacts due to habitat loss and increased human use leading to disturbance of bald eagles and/or their avoidance of the area.

5) Impacts from operation and maintenance of the project that may result in habitat loss and/or disturbance to the bald eagle or their avoidance of the area.

It is the Federal Transit Administration's responsibility to assure that this assessment is conducted and that any necessary endangered species consultation (as described in section 7(a) of the Endangered Species Act) is completed and problems resolved before issuance of a Federal permit or other Federal action. Should the assessment determine that the project may affect the bald eagle, Federal Transit Administration is required to consult with this Service following the requirements of 50 CFR 402 which implement the Act. Even if the biological assessment shows "no effect" situation, we would appreciate receiving a copy for our information.

On July 1, 1996, the Service recommended that Metro consider undertaking surveys to monitor foraging, fledging, and use of perch sites. Observations should be conducted during the breeding season through two weeks after fledging. Given the limited time available until the end of the current year's breeding season and decision framework of this project, we would recommend that initial observations cover full day periods and distribute the time spent monitoring for bald eagles use on both sides of the river equally. Two observers monitoring each side of the river would provide better coverage if possible; however, one observer may be able to alternate areas covered on alternate days. If a foraging pattern emerges, observation effort may shift to appropriate areas to identify key foraging areas. However, the observation pattern should revert to the initial observation scenario at the time the young fledges to detect any changes to the initial pattern. While undertaking this survey is discretional on the part of Metro, the Service recommends that additional information on this pair's use of the area be gathered. The information will be valuable in providing a better basis upon which to determine effects to bald eagles from this project, and determining to what degree the bald eagles make use of the Willamette River at the northern, downstream portion of Ross Island where the southernmost crossing alternative is proposed. The identification of key or primary forage sites, perches, and use areas may also help to identify potential measures for eliminating or minimizing impacts if adverse effects are anticipated. Based upon a July 3, 1996, telephone conversation, we understand that Metro will undertake monitoring of the bald eagles beginning the week of July 8, 1996. Metro's swift response to this need is certainly commendable.

While the Service is likely to make additional comments during the public comment and agency review period, based upon our current knowledge of the two proposed Willamette River crossings and associated resources in and near the vicinity of both crossings, it is our early assessment that the downstream or northern alignment (e.g., Carruthers alignment) presents fewer resource impacts to wildlife and fishery resources and their habitats than the Ross Island crossing. Riverine islands such as Ross Island provide some of the few remaining relatively isolated large blocks of wildlife habitat on the Willemette River. Areas such as these have increasing values for maintaining wildlife within the Portland area as growth of our city continues. We would recommend at this early time for Metro and the Federal Transit Administration to give full consideration to facts which indicate the northern alternative to be the least environmentally damaging alternative.

Attachment A includes a list of candidate species under review for listing. The list reflects changes to the candidate species list published February 28, 1996, in the Federal Register (Vol. 61, No. 40, 7596) and the addition of "species of concern." Candidate species have no protection under the Act but are included for consideration as it is possible candidates could be listed prior to project completion. Species of concern are those taxa whose conservation status is of concern to the Service (many previously known as Category 2 candidates), but for which further information is still needed.

If a proposed project may affect candidate species or species of concern, FTA is not required to perform a Biological Assessment or evaluation or consult with the Service. However, the Service recommends addressing potential impacts to these species in order to prevent future conflicts. Therefore, if early evaluation of the project indicates that it is likely to adversely impact a candidate species or species of concern, FTA may wish to request technical assistance from this office.

Your interest in endangered species is appreciated. The Service encourages FTA to investigate opportunities for incorporating conservation of threatened and endangered species into project planning processes as a means of complying with the Act. Also, we may have additional information on some of the species on this list. If you have questions regarding your responsibilities under the Act, please contact Diana Hwang at (503) 231-6179. For questions regarding anadromous fish, please contact National Marine Fisheries Service, 525 NE Oregon St., Suite 500, Portland, Oregon 97232, (503) 230-5400. All correspondence should include the above referenced file number.

Sincerely,

Gary S. Miller

for Russell D. Peterson
State Supervisor

Attachments
SP 334
SE/FTA/1-3-96-SP-396/Clark
cc: OSO-ES
COE
NMFS
ODFW, Clackamas; Attn: J. Pesek
ODFW, Nongame, Portland; Attn: M. Nuggent
Portland Audubon Society; Attn: M. Houck, Portland
FTA, Seattle
WDFW, Region 5
WNHP, Olympia

ATTACHMENT A

FEDERALLY LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES, CANDIDATE SPECIES AND SPECIES OF CONCERN THAT MAY OCCUR IN THE AREA OF THE PROPOSED SOUTH/NORTH TRANSIT CORRIDOR STUDY, OREGON
1-7-96-SP-334

LISTED SPECIES[1/]

| | | |
|---|---|---|
| Birds | | |
| Peregrine falcon | *Falco peregrinus* | E |
| Bald eagle | *Haliaeetus leucocephalus* | T |
| | | |
| Fish | | |
| Snake River Sockeye salmon | *Oncorhynchus nerka* | CH **E |
| Salmon River tributary to the Snake River, Idaho. | | |
| Snake River Chinook salmon | *Oncorhynchus tshawytscha* | CH **T |
| Spring/summer runs in the Snake River | | |
| Snake River Chinook salmon | *Oncorhynchus tshawytscha* | CH **T |
| Fall runs in the Snake River. | | |
| | | |
| Plants | | |
| Howellia | *Howellia aquatalis* | T |
| Bradshaw's lomatium | *Lomatium bradshawii* | E |

PROPOSED SPECIES[/]

| | | |
|---|---|---|
| Plants | | |
| Golden paintbrush[2/] | *Castilleja levisecta* | PT |

CANDIDATE SPECIES[3/]

| | | |
|---|---|---|
| Amphibians and Reptiles | | |
| Spotted frog | *Rana pretiosa* | |
| | | |
| Fish | | |
| Coho salmon | *Oncorhynchus kisutch* | **CF |

<u>Plants</u>

| | |
|---|---|
| Willamette daisy | *Erigeron decumbens* var. *decumbens* |

<u>SPECIES OF CONCERN</u>

<u>Mammals</u>

| | |
|---|---|
| Long-eared myotis (bat) | *Myotis evotis* |
| Fringed myotis (bat) | *Myotis thysanodes* |
| Long-legged myotis (bat) | *Myotis volans* |
| Yuma myotis (bat) | *Myotis yumanensis* |
| Pacific western big-eared bat | *Plecotus townsendii townsendii* |

<u>Birds</u>

| | |
|---|---|
| Tricolored blackbird | *Agelaius tricolor* |
| Little willow flycatcher | *Empidonax traillii brewsteri* |

<u>Amphibians and Reptiles</u>

| | |
|---|---|
| Northwestern pond turtle | *Clemmys marmorata marmorata* |
| Northern red-legged frog | *Rana aurora aurora* |

<u>Fish</u>

| | |
|---|---|
| Green sturgeon | *Acipenser medirostris* |
| River lamprey | *Lampetra ayresi* |
| Pacific lamprey | *Lampetra tridentata* |

<u>Invertebrates</u>

| | |
|---|---|
| California floater | *Anodonta californiensis* |
| Great Columbia River spire snail | *Fluminicola columbianus* |

<u>Plants</u>

| | |
|---|---|
| White top aster | *Aster curtus* |
| Tall bugbane | *Cimicifuga elata* |
| Pale larkspur | *Delphinium leucophaeum* |
| Peacock larkspur | *Delphinium pavonaceum* |
| Howell's montia | *Montia howellii* |
| Columbia cress | *Rorippa columbiae* |
| Oregon sullivantia | *Sullivantia oregana* |

*(E) - Listed Endangered* *(T) - Listed Threatened* *(CH) - Critical Habitat has been designated for this species*
*(PE) - Proposed Endangered* *(PT) - Proposed Threatened* *(PCH) - Critical Habitat has been proposed for this species*

*Species of Concern - Taxa whose conservation status is of concern to the Service (many previously known as Category 2 candidates), but for which further information is still needed.*

*(CF) - Candidate: National Marine Fisheries Service designation for any species being considered by the Secretary for listing for endangered or threatened species, but not yet the subject of a proposed rule.*
*** Consultation with National Marine Fisheries Service required.*

[1/] *U. S. Department of Interior, Fish and Wildlife Service, August 20, 1994, Endangered and Threatened Wildlife and Plants, 50 CFR 17.11 and 17.12.*
[2/] *Federal Register Vol. 59, No. 89, May 10, 1994, Proposed Rule-Castilleja levisecta*
[3/] *Federal Register Vol. 61, No. 40, February 28, 1996, Notice of Review-Candidate Animals and Plants*

ATTACHMENT A

## LISTED ENDANGERED AND THREATENED SPECIES, CANDIDATE SPECIES AND SPECIES OF CONCERN WHICH MAY OCCUR WITHIN THE VICINITY OF THE PROPOSED LIGHT RAIL TRANSIT PROJECT, CLARK COUNTY, WASHINGTON

(T02N R02E S09,15-17,19,20 / T20N R01E S02,03,10,11,14,15,22-24,26,27
T03N R01E S10,11,13,14,23,26,27,34,35)

REF: 1-3-96-SP-396

LISTED

Bald eagle *(Haliaeetus leucocephalus)* - wintering bald eagles may occur in the vicinity of the project from about October 31 through March 31.

There is one bald eagle communal winter night roost located in the vicinity of the project at T03N R01E S28.

Major concerns that should be addressed in your biological assessment of project impacts to bald eagles are:

1. Level of use of the project area by bald eagles.

2. Effect of the project on eagles' primary food stocks and foraging areas in all areas influenced by the project.

3. Impacts from project construction and implementation (e.g., increased noise levels,

increased human activity and/or access, loss or degradation of habitat) which may result in disturbance to eagles and/or their avoidance of the project area.

DESIGNATED/PROPOSED

None

CANDIDATE

The following candidate species may occur in the vicinity of the project:

Spotted frog *(Rana pretiosa)*

SPECIES OF CONCERN

The following species of concern may occur in the vicinity of the project:

California floater (mussel) *(Anodonta californiensis (*Lea, 1852*))*
Long-eared myotis (*Myotis evotis*)
Long-legged myotis (*Myotis volans*)
Northwestern pond turtle *(Clemmys marmorata marmorata)*
Olive-sided flycatcher (*Contopus borealis*)
Pacific western big-eared bat *(Corynorhinus (=Plecotus) townsendii townsendii)*
Pacific lamprey *(Lampetra tridentata)*
River lamprey *(Lampetra ayresi)*
*Cimicifuga elata* (tall bugbane)

# Appendix C

***Proposed Bridge Design***

# COLUMBIA RIVER DESIGN OPTION
# CONCRETE SEGMENTAL BRIDGE TYPE

Reference: Volume 1 South/North Transit Corridor Study Conceptual Alignment plans, Sheets ND-02, NA-19 and NA-20A, March 1996.

Type and Layout

- The movable span for the concrete segmental would be a bascule type.
- The bridge would be a cast-in-place concrete segmental with cast-in-place columns and foundation. Span layout from south bank to north bank would be as follows: 260'-540'-270'-540'-540'-540'-280'- navigational span @ 280'- 320' (refer to Volume 1, South/North Transit Corridor Study Conceptual Alignment plans, Sheets ND-02, NA-19 and NA-20A, March 1996).
- Refinements were assumed to eliminate some in-water foundation while keeping all new foundations in line with the span layout assumed above.

Foundations

- Water line foundation types were assumed to minimize in-water construction periods and impacts (refer to *Willamette River Crossing Supplement*, May 1996, Figures 6, 7 and 22).
- All foundations would be supported on 8-foot-diameter drilled shafts.
- All foundations would be 54 x 56 feet in plan (refer to *Willamette River Crossing Supplement*, May 1996, Figure 22).
- Drilled shaft piling were estimated to be 100 feet long.

Piers

- Columns would be twin-wall piers, 6 x 20 feet (refer to *Willamette River Crossing Supplement*, May 1996, Figures 22 and 23).
- The twin wall piers were assumed to be constructed with cast-in-place methods using slip forms.
- Seven piers would be located in the Columbia River.

Deck

- Balanced cantilever construction methods would be employed (refer to *Major River Crossings Findings Report*, May 1995, Section 6.2 "Bridge Superstructure").
- The superstructure would vary in depth parabolically (refer to *Willamette River Crossing Supplement*, May 1996, Figure 24 for cross-section). See Figure A.
- Deck elements would all be cast-in-place to avoid the high cost of transporting heavy precast units associated with the long spans.
- The deck cross-section with pedestrian/bikeway would have sloping exterior girders (refer to *Willamette River Crossing Supplement*, May 1996, Figure 8).
- Deck cross-section without pedestrian/bikeway would have vertical girders (see Figure A).

- Deck elements were assumed to be cast-in-place using conventional form travelers.
- The deck would be post-tensioned both longitudinally and transversely.
- A pedestrian/bikeway would be located on the deck of the bridge.
- The deck would have a 1.5-inch-thick latex modified concrete overlay.

General
- No-climb chain link fencing would be estimated to run the length of the bridge for options with pedestrian/bikeway facilities.
- Costs for navigational lighting for bridge spans over the navigational channel would be included.
- Costs for aesthetic lighting to illuminate the structure would be included.
- Concrete would be supplied via a delivery barge, then by pumping or the use of a crane and bucket, then placed into the particular bridge component.
- Pedestrian/bikeway facilities would be built into the structure. Add-ons at a later date are more expensive.
- A spiral pedestrian access ramp would be added in for options with the pedestrian/bikeway facilities.
- Material prices will be adjusted to reflect accelerated construction.

Draw Lift Span
- A separate control house for operating the lift span of this bridge was assumed.
- Operational machinery costs would be included.
- Sheaves and ropes for the lift span operations would be estimated.
- Electrical controls for the control tower would be estimated.
- Spiral pedestrian access ramp would be added in for options with the pedestrian/bikeway facilities.

# COLUMBIA RIVER DESIGN OPTION
# BOW STRING ARCH BRIDGE TYPE

Type and Layout

- The movable span at the navigational channel is a bow string lift span type.
- Span layout from south bank to north bank would be as follows: 260'-7 spans @ 270' = 1890'-540'-280'-navigational span @ 280'- 320' (refer to Volume 1, South/North Transit Corridor Study Conceptual Alignment plans, Sheets ND-02, NA-19, and NA-20A, March 1996).

Foundation

- Water line foundation types were assumed to minimize in-water construction periods and impacts (see Figure G).
- All foundations would be supported on 8-foot-diameter drilled shafts.
- All foundations would be 32 x 52 feet in plan (see Figure H).
- Drilled shaft piling were estimated to be 100 feet long.

Piers

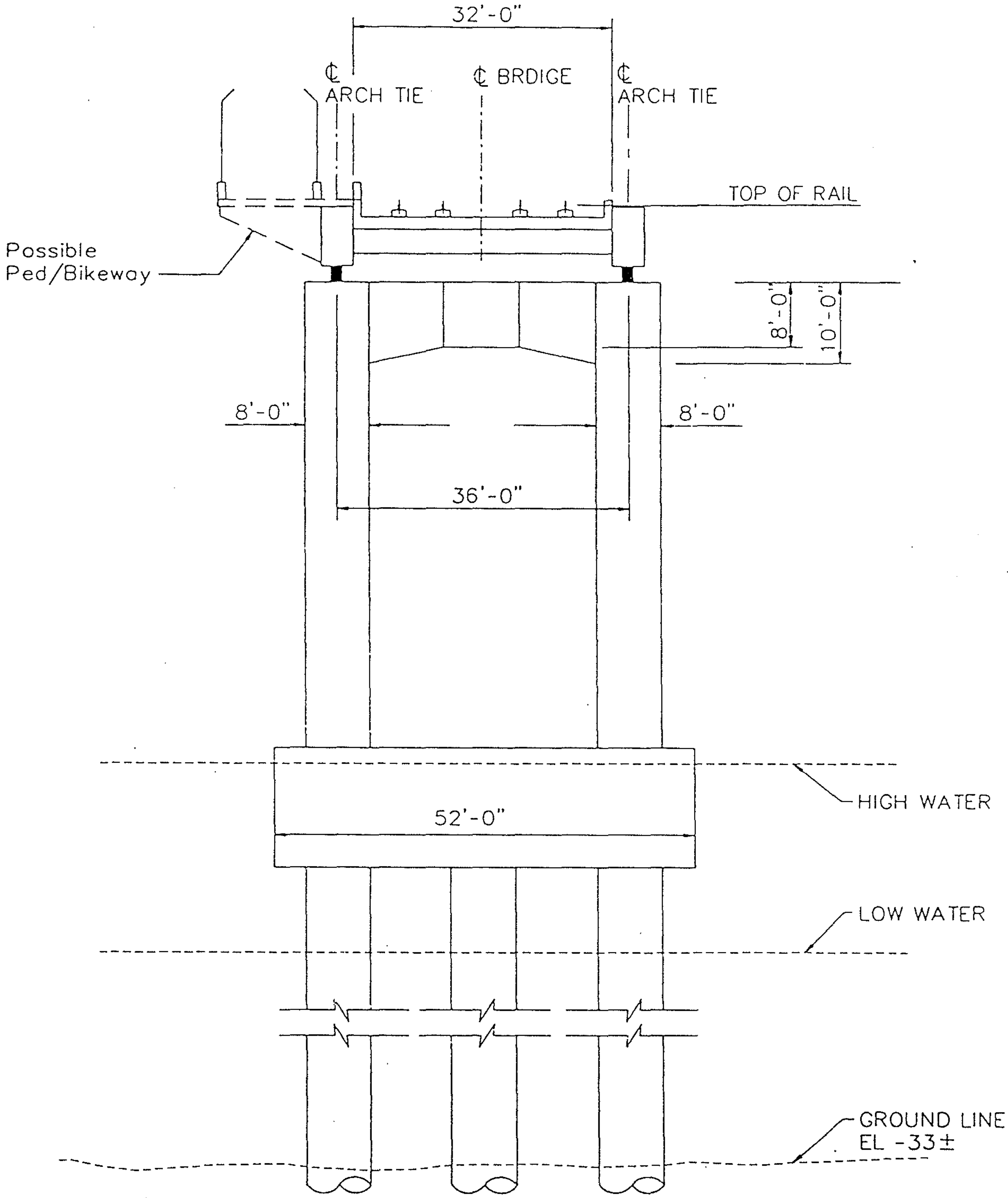
- Columns would be rectangular cast-in-place reinforced concrete 8 x 10-foot piers (see Figure G).

Deck

- Deck would be made of fabricated structural steel element with a cast-in-place concrete deck.
- Pedestrian/bikeway facilities can either be built concurrently with the truss or added on at a later date (see Figures G, I and J).

General

- No-climb chain link fencing was estimated to run the length of the bridge options with pedestrian/bikeway facilities.
- Costs for navigational lighting for bridge spans over the navigational channel would be included.
- Costs for aesthetic lighting allowances to illuminate the structure would be included.
- Concrete would be supplied via a delivery barge, then by means of a pump, then placed into the particular bridge component. Maintenance walkway would be added for the full bridge length to facilitate future inspections.




Pier Elevation
Bow-String Arch Bridge Type

TRI-MET TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT OF OREGON

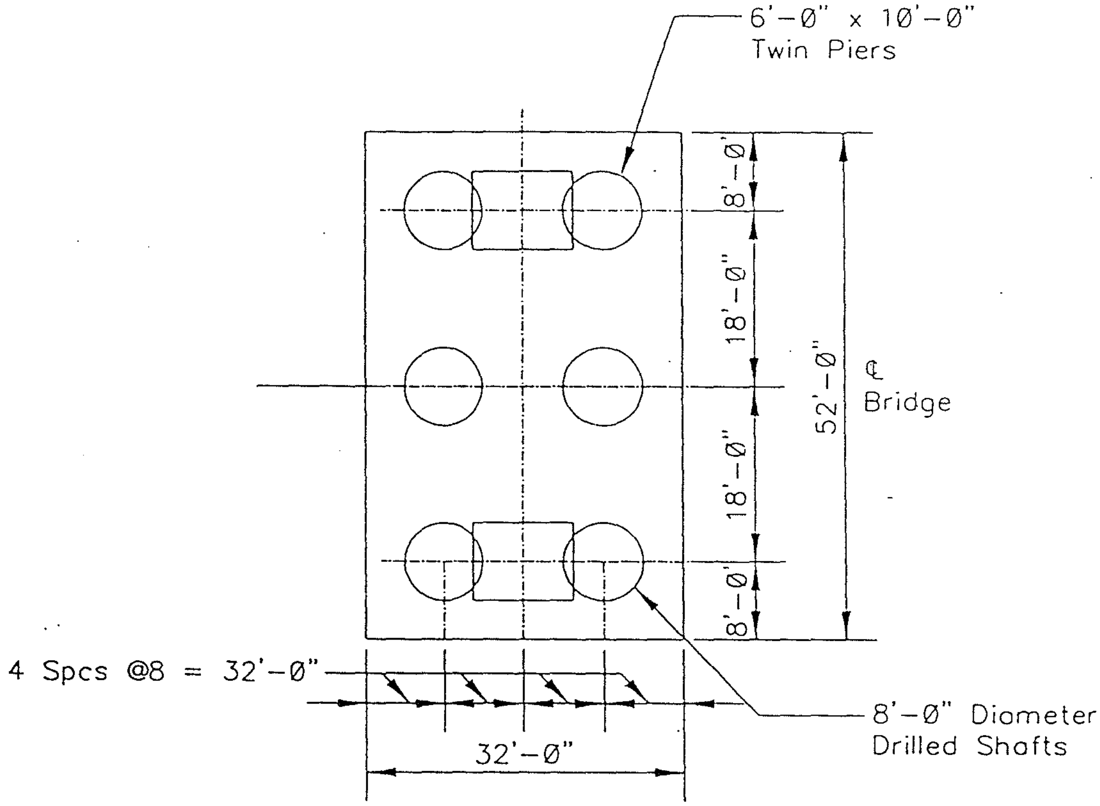
South North Transit Corridor Study

Columbia River Crossing
Columbia Design Option

Figure G

PB 100 YEARS

March, 1996



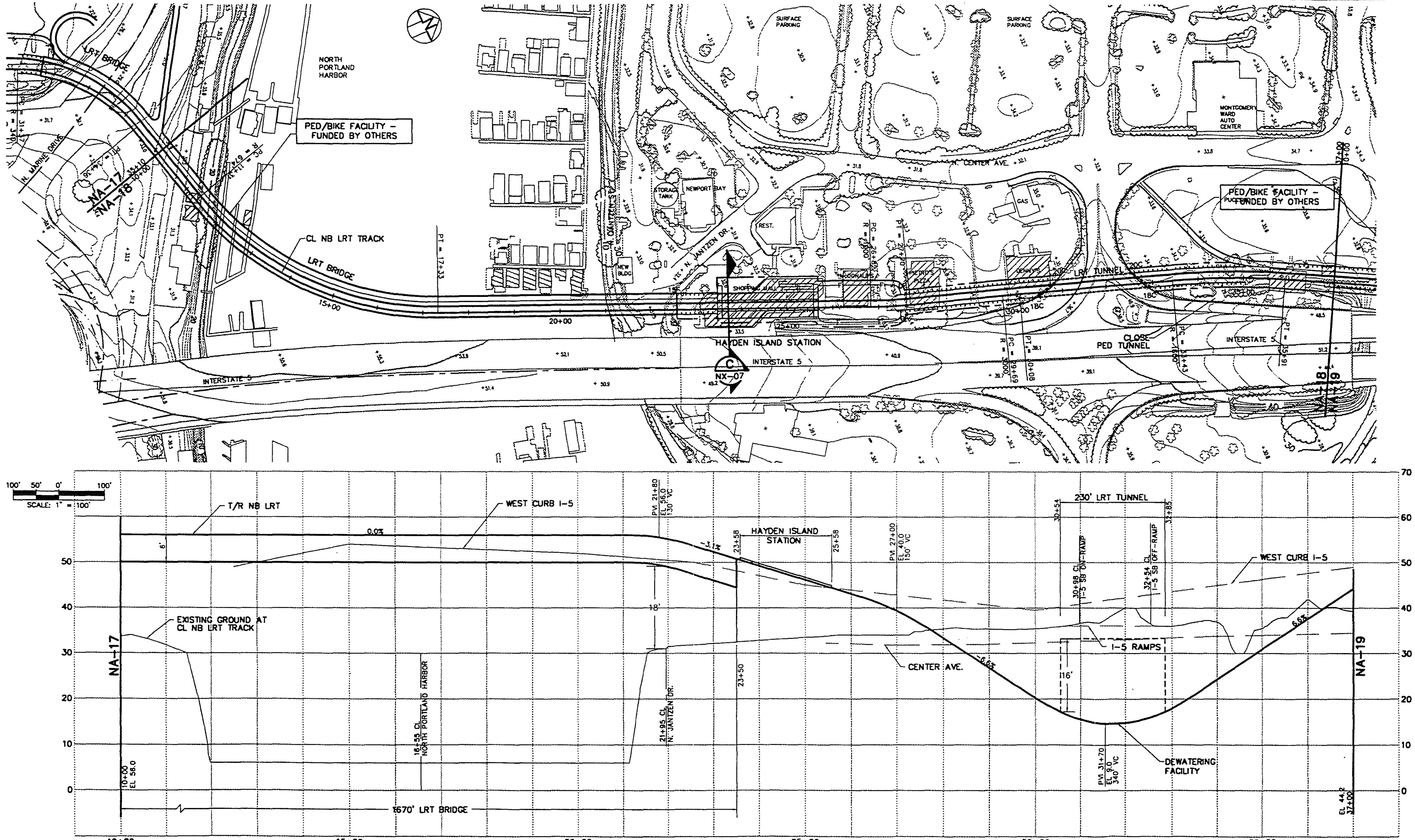

# Foundation Plan
# Bow-String Arch Bridge Type
# Main Span 54Ø'

March, 1996

TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT OF OREGON

Columbia River Crossing
Columbia Design Option

Figure
H




| NO. | DATE | BY | CHK. | APPR. | REVISIONS |
|---|---|---|---|---|---|
| | 3/96 | | | | 3/29/96 DEIS SUBMITTAL TO METRO. |
| 1 | 1/96 | | | | DEIS SUBMITTAL TO METRO. |

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| | | |
|---|---|---|
| DESIGNED | AGJ/IL | DATE 10/1/95 |
| DRAWN | IL | DATE 10/3/95 |
| CHECKED | | DATE |
| APPROVED | | DATE |

TRI-MET

TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT OF OREGON

South North

TRI-MET

Technical Services Division
Engineering Services
710 N.E. Holladay St.
Portland, Oregon 97232

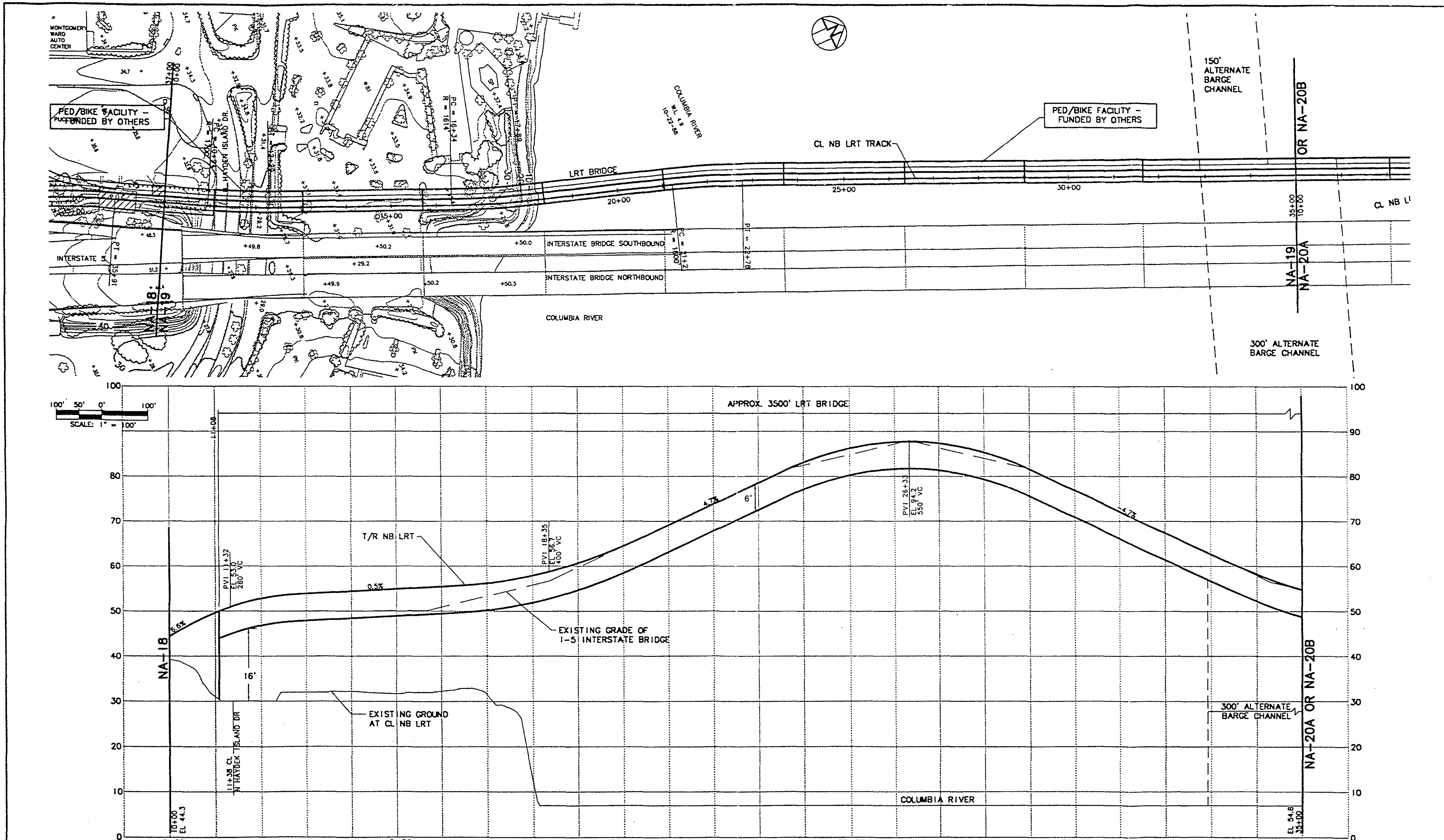
SUBMITTED: DATE: APPROVED: DATE:

THIS PRINT IS HALF SIZE REPRODUCED

SOUTH/NORTH TRANSIT CORRIDOR STUDY
LRT TRACK ALIGNMENT

EXPO CENTER TO CLARK COLLEGE SEGMENT
HAYDEN ISLAND

SCALE: 1" = 100' HORZ, 10' VERT | DRAWING NO.: NA-18 | CONTRACT NO.: | SHEET NO.: 125




| NO. | DATE | BY / CHK. | APPD. | REVISIONS |
|---|---|---|---|---|
| | 3/96 | | | 3/29/96 DEIS SUBMITTAL TO METRO. |
| 1 | 1/96 | | | DEIS SUBMITTAL TO METRO. |

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| | |
|---|---|
| AGJ/IL (DESIGNED) | 10/1/95 (DATE) |
| MJC (DRAWN) | 10/3/95 (DATE) |
| CHECKED | DATE |
| APPROVED | DATE |

TRI-MET

# TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT OF OREGON

South/North

TRI-MET

Technical Services Division
Engineering Services
710 N.E. Holladay St.
Portland, Oregon 97232

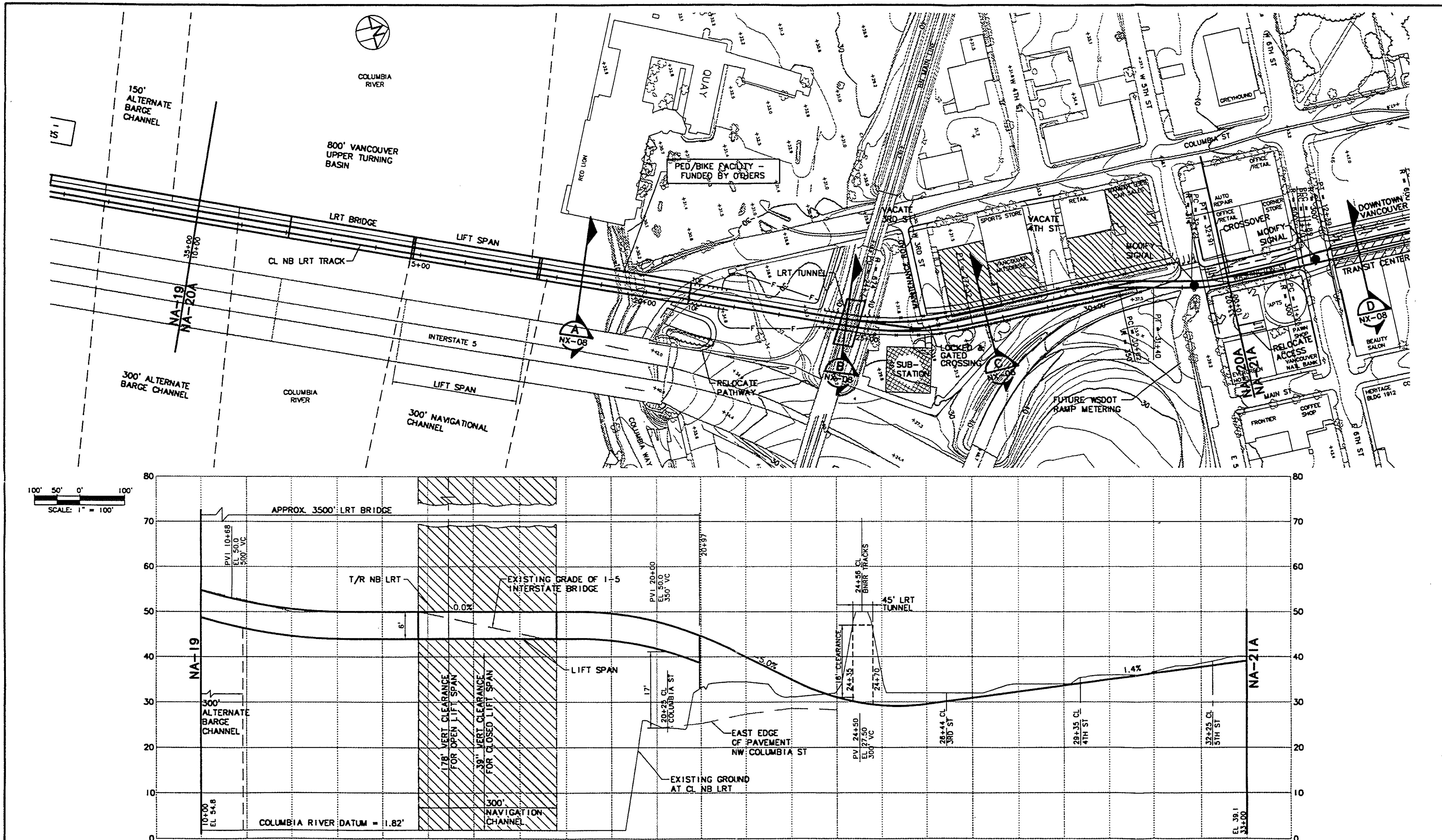
SUBMITTED: DATE: APPROVED: DATE:

THIS PRINT IS HALF SIZE REPRODUCED

## SOUTH/NORTH TRANSIT CORRIDOR STUDY
## LRT TRACK ALIGNMENT

## EXPO CENTER TO CLARK COLLEGE SEGMENT
## COLUMBIA RIVER CROSSING

SCALE: 1" = 100' HORZ, 1" = 10' VERT | DRAWING NO.: NA-19 | CONTRACT NO.: | SHEET NO.: 126




| NO. | DATE | BY / CHK. | APPD. | REVISIONS |
|---|---|---|---|---|
| | 3/96 | | | 3/29/96 DEIS SUBMITTAL TO METRO. |
| | 2/96 | | | 2/9/96 DEIS SUBMITTAL TO METRO. |

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AGJ — DESIGNED — 11/95 DATE
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TRI-MET

TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT OF OREGON

South North

TRI-MET

Technical Services Division
Engineering Services
710 N.E. Holladay St.
Portland, Oregon 97232

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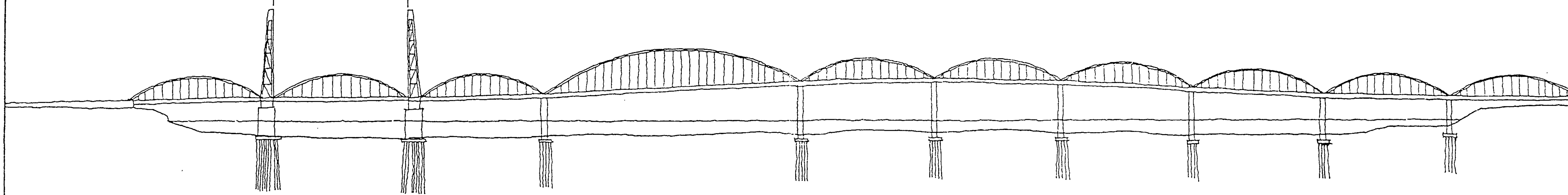
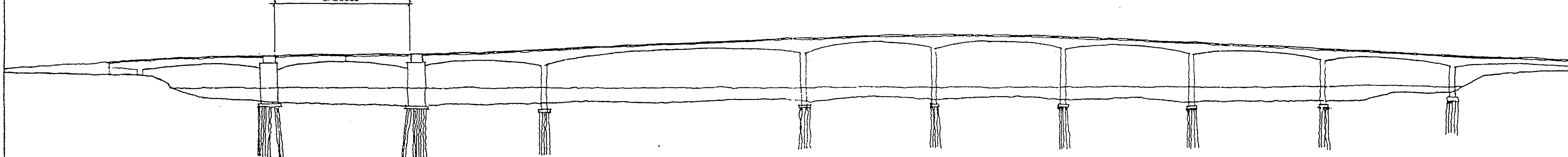
SOUTH/NORTH TRANSIT CORRIDOR STUDY
LRT TRACK ALIGNMENT

EXPO CENTER TO CLARK COLLEGE SEGMENT
EAST TRANSIT CENTER OPTION

SCALE: 1" = 100' HORZ, 1" = 10' VERT | DRAWING NO.: NA-20A | CONTRACT NO.: | SHEET NO.: 127




BOW STRING TYPE BRIDGE




SEGMENTAL TYPE BRIDGE

100 50 0 100 200
SCALE: 1" = 100'

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TRI-MET TRI–COUNTY METROPOLITAN TRANSPORTATION DISTRICT OF OREGON

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SOUTH/NORTH TRANSIT CORRIDOR STUDY
COLUMBIA RIVER CROSSING

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# WILLAMETTE RIVER-ROSS ISLAND DESIGN OPTION CONCRETE SEGMENTAL BRIDGE TYPE

Reference: South/North Transit Corridor Study Conceptual Alignment Plans, Volume 1, Sheets SV-05B, SV-06B and SD-03.

Type and Layout

- The bridge would be a cast-in-place concrete segmental type with cast-in-place columns and foundation.
- Span layout from the west bank to east bank would be as follows: 275'-550'-550'-550'-300'.
- Water line foundation types were assumed to minimize in-water construction periods and impacts (refer to *Willamette River Crossing Supplement*, May 1996, Figures 6, 7, and 22).

Foundations

- All foundations would be supported on 8-foot-diameter drilled shafts.
- All foundations would be 54 x 56 feet in plan (refer to *Willamette River Crossing Supplement*, May 1996, Figure 22).
- Drilled shaft pilings were estimated to be 100 feet long.

Piers

- Columns would be twin wall piers, 6 x 20 feet (refer to *Willamette River Crossing Supplement*, May 1996, Figures 22 and 24).
- The twin wall piers were assumed to be constructed with cast-in-place methods using slip forms.
- The west channel would have one column entirely in the water, with another located within an 80-foot band along the west shore of Ross Island.
- The east channel would have one column entirely in the water, with another located within an 80-foot band along the east shore of Ross Island.

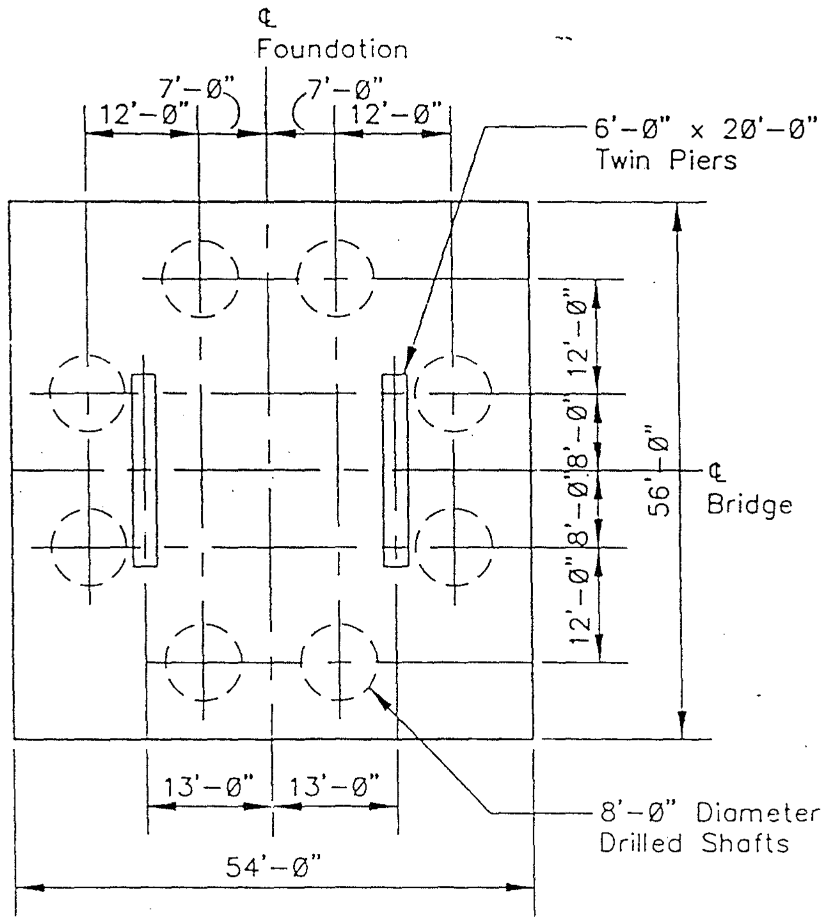
Deck

- Balanced cantilever construction methods were assumed (refer to *Major River Crossings Findings Report,* May 1995, Section 6.2 "Bridge Superstructure").
- The superstructure would vary in depth parabolically (refer to *Willamette River Crossing Supplement*, May 1996, Figure 24 for cross-section, and Figures 18, 19, 20 and 21 for profiles).
- Deck elements would all be cast-in-place due to excessive weight associated with long precast spans.
- Deck cross-section with pedestrian/bikeway would have sloping exterior girders (refer to *Willamette River Crossing Supplement*, May 1996, Figure 8).
- Deck cross-section without pedestrian/bikeway would have vertical girders (refer to Figure A of this report).
- Deck elements would be cast-in-place using conventional form travelers.

- The deck would be post-tensioned both longitudinally and transversely.
- A pedestrian/bikeway would be located on the deck of the bridge.
- The deck would have a 1.5-inch-thick latex modified concrete overlay.

General

- A spiral pedestrian access ramp would be added to the options with the pedestrian/bikeway.
- No-climb chain link fencing was estimated to run the length of the bridge, for options with pedestrian/bikeway facilities.
- Costs for navigational lighting for bridge spans over the navigational channel would be included.
- Costs for aesthetic lighting to illuminate the structure would be included.
- An access road across Ross Island is assumed for construction (refer to *Willamette River Crossing Supplement*, May 1996, Section 2.3).
- Concrete would be supplied via a delivery barge, then by pumping or the use of a crane and bucket, then placed into the particular bridge component.
- Pedestrian/bikeway facilities would have to be incorporated into the concrete segmental spans; pedestrian/bikeway add-ons at a later date are more expensive.
- No permanent access would be provided to Ross Island.
- Material prices would be adjusted in the estimate to account for accelerated construction.



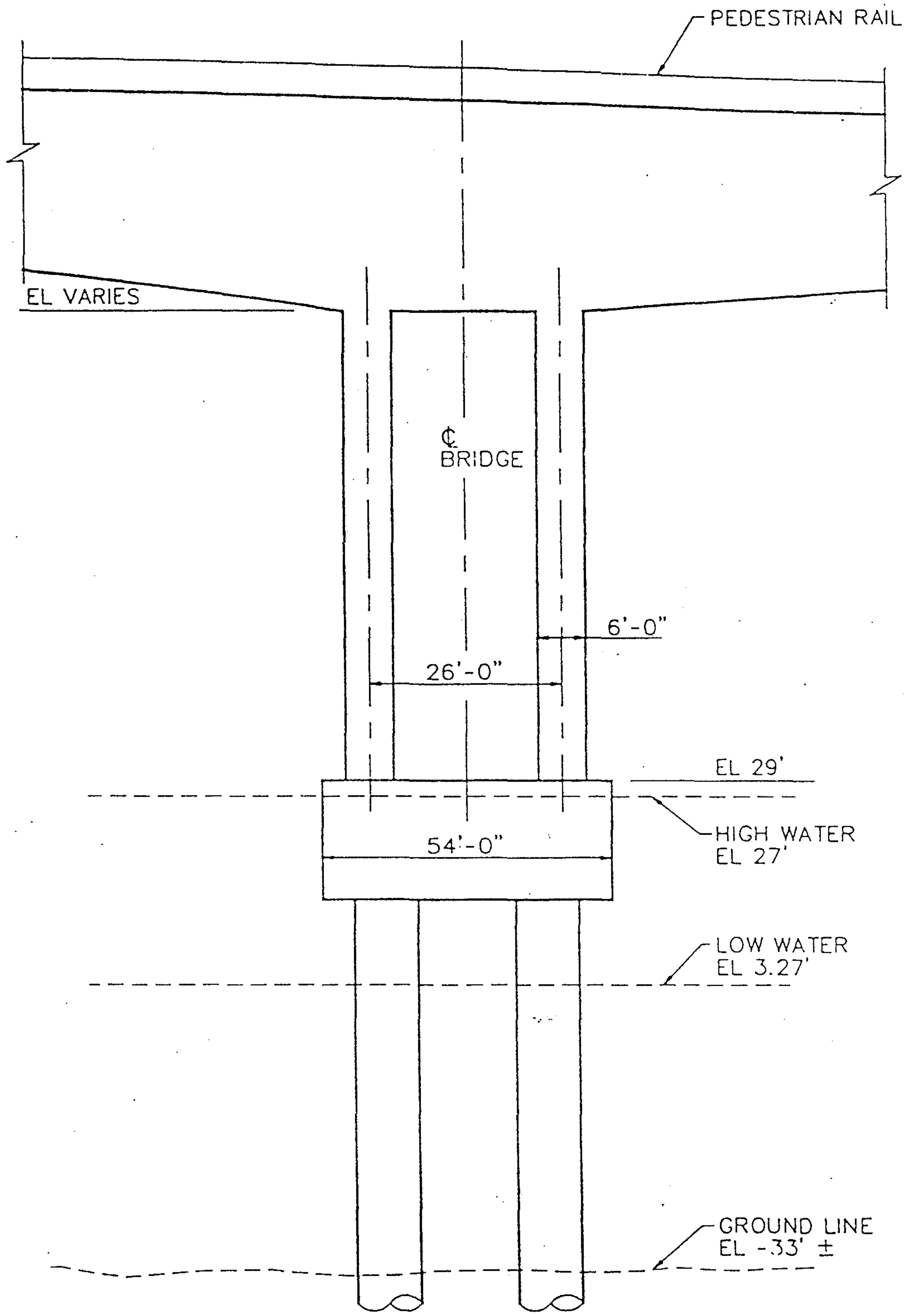

Foundation Plan
Concrete Segmental Bridge Type
Main Span 55Ø'

March, 1996

TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT OF OREGON

Willamette River Crossing
Ross Island Design Option

Figure 22




Elevation
Concrete Segmental Bridge Type

| PB 100 YEARS<br>March, 1996 | TRI-MET TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT OF OREGON | |
|---|---|---|
| | South North Transit Corridor Study — Willamette River Crossing<br>Ross Island Design Option | Figure<br>23 |

# WILLAMETTE RIVER - ROSS ISLAND DESIGN OPTION
# CABLE-STAYED PRECAST SEGMENTAL BRIDGE TYPE

Reference: *Willamette River Crossing Supplement*, May 1996, Figures 25 and 26, and South/North Transit Corridor Study Conceptual Alignment Plans, Volume 1, Sheets SD-03, SD-04 and SD-05.

## Type and Layout

- The structure would be a combination of cable-stayed and precast segmental bridge types.
- The span layout from the west bank to the east bank would be as follows: Cable-Stayed 800'-700'- Precast Segmental 360'-220'-220'-220'- (refer to *Willamette River Crossing Supplement*, May 1996, Figures 25 and 26 for profiles, and the March 1996 Volume 1 South/North Transit Corridor Study plan set, Sheets SD-03, SD-04, and SD-05). See Figures B, C and D for cross-sections.

## Foundations

- The foundation for the main tower would be a water line type, which minimizes in-water construction time and impacts. The main tower foundation would be located on the west bank of Ross Island within an 80-foot band measured from low water.
- The main tower foundation and all other foundations for this bridge option would be founded on 8-foot-diameter drilled shafts (refer to *Willamette River Crossing Supplement*, May 1996, Figure 22 for foundation plans). See Figure E for main tower foundation plan.
- Using the cable-stayed option in the west channel would avoid any columns being directly in the west channel. The east channel spans would employ precast segmental decks, an economic choice given the constant depth of the superstructure and the span lengths. Three piers would be located within the east channel.
- Drilled shaft pilings were estimated to be 100 feet long.

## Piers

- The main tower is assumed to be a cast-in-place full delta tower (see Figure F).
- All other piers for this option are twin-walled (refer to *Willamette River Crossing Supplement*, May 1996, Figures 22 and 24).
- The main tower and the twin wall piers were assumed to be constructed with cast-in-place methods using slip forms.

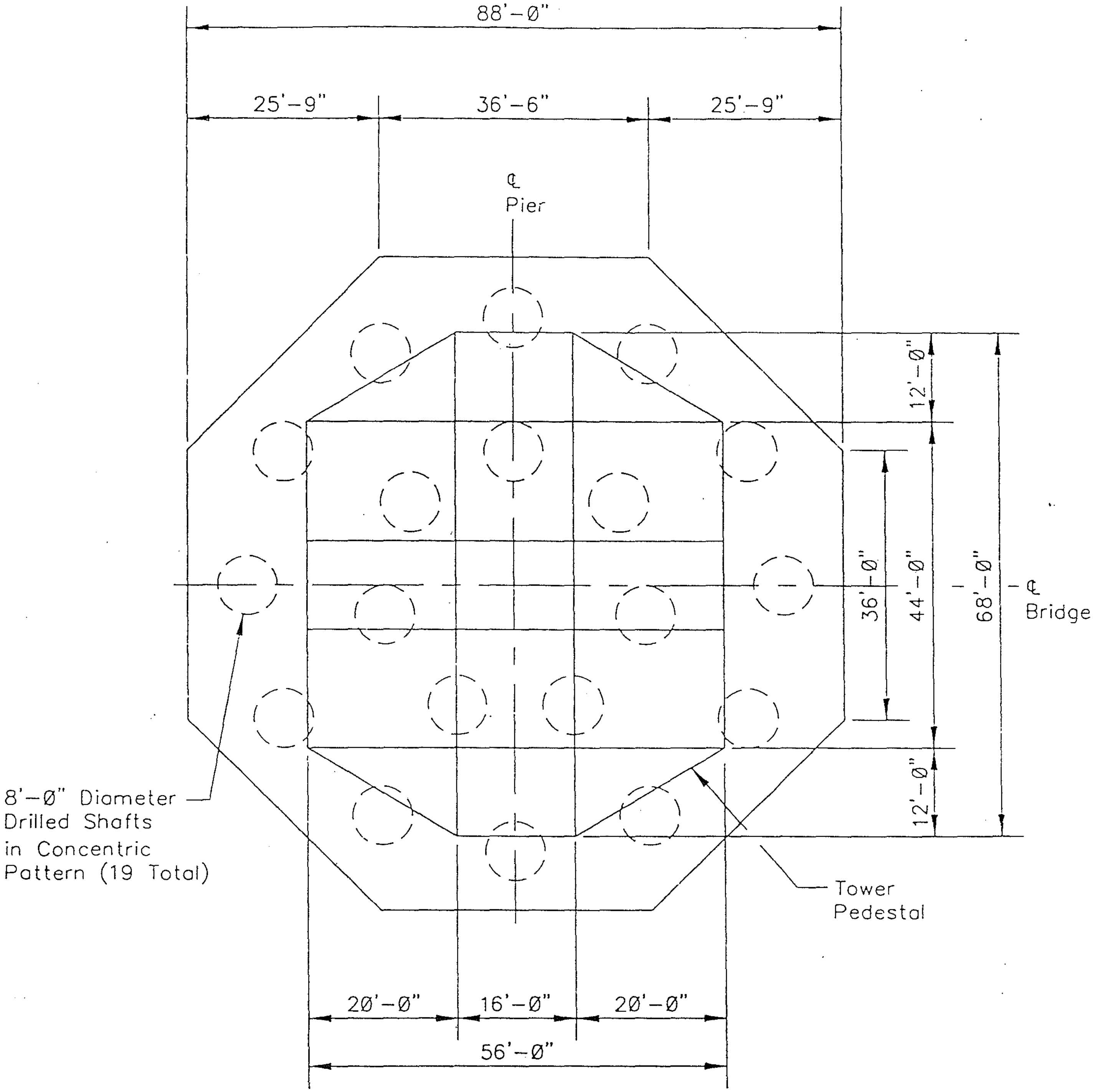
## Deck

- Cable-stayed deck units would be precast concrete (see Figures B, C and D ).
- Pedestrian/bikeway facilities can be added on at a later date on the cable-stayed spans.
- East channel deck units would be precast concrete.

- Pedestrian/bikeway facilities would have to be incorporated into the precast cable-stay and segmented spans; pedestrian/bikeway add-ons at a later date are more expensive.
- All deck elements would be erected assuming traditional travelers with no significant impact to areas below.
- Balanced cantilever construction methods would be employed for all deck elements (refer to *Major River Crossings Findings Report for the South Willamette River,* May 1995, Section 6.2 "Bridge Superstructure").

General

- A spiral access ramp would be added in for the options with the pedestrian/bikeway facilities.
- No-climb chain link fencing was estimated to run the length of the bridge for options with pedestrian/bikeway facilities.
- Costs for navigational lighting for bridge spans over the channel would be included.
- Costs for aesthetic lighting to illuminate the structure would be included.
- An access road across Ross Island is assumed for construction (refer to *Willamette River Crossing Supplement*, May 1996, Section 2.3)
- Concrete would be supplied via a delivery barge, then by pumping or the use of a crane and bucket, then placed into the foundations, tower, and piers. Deck elements would all be precast.
- The deck would have a 1.5-inch-thick latex modified concrete overlay.
- No permanent access would be provided to Ross Island.




## Main Tower Foundation Plan
## Cable-Stayed Bridge Type

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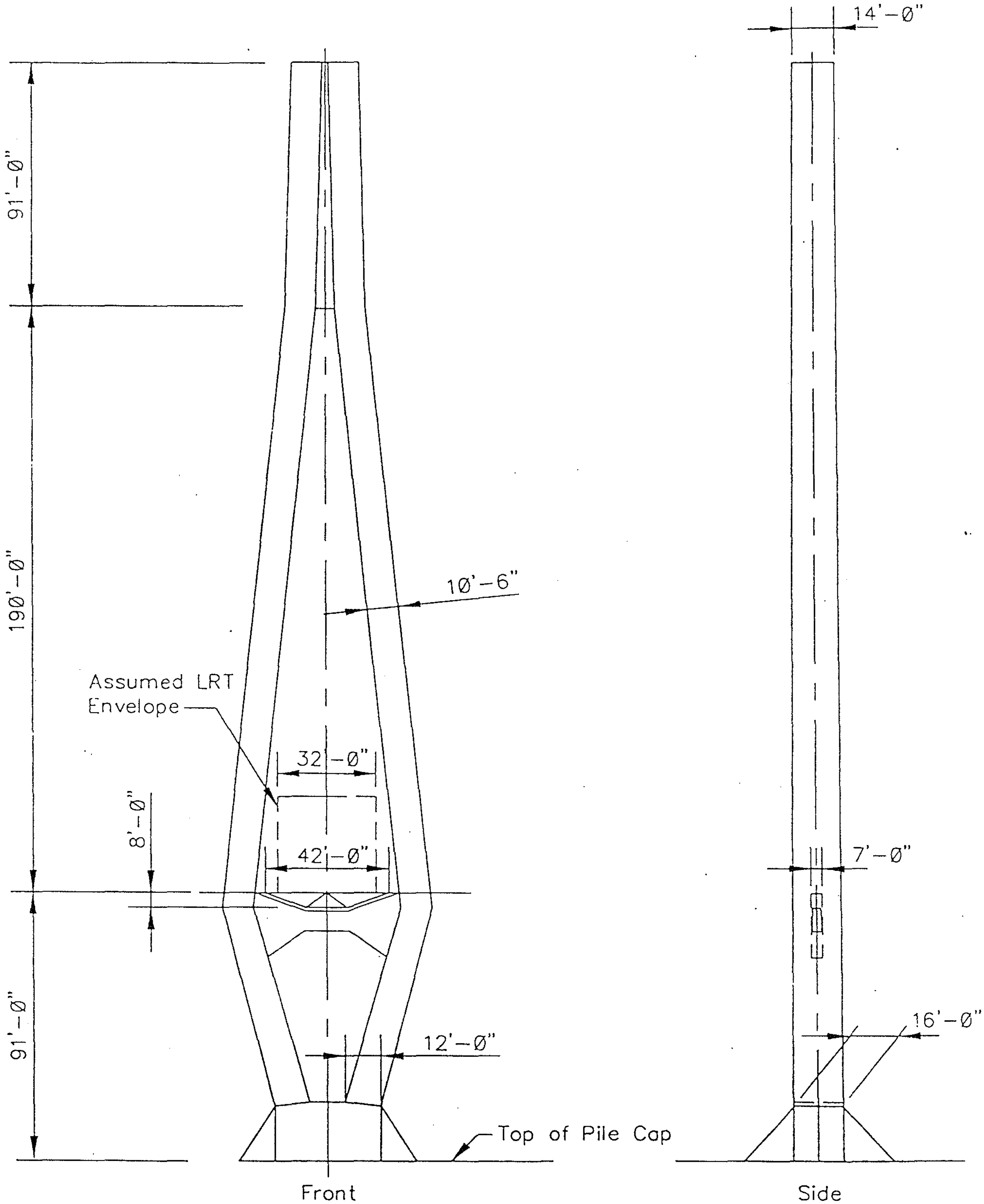
| March, 1996 | South North Transit Corridor Study — Willamette River Crossing<br>Ross Island Design Option | Figure E |




## Main Tower Elevation
## Cable-Stayed Bridge Type

PB 100 YEARS

March, 1996

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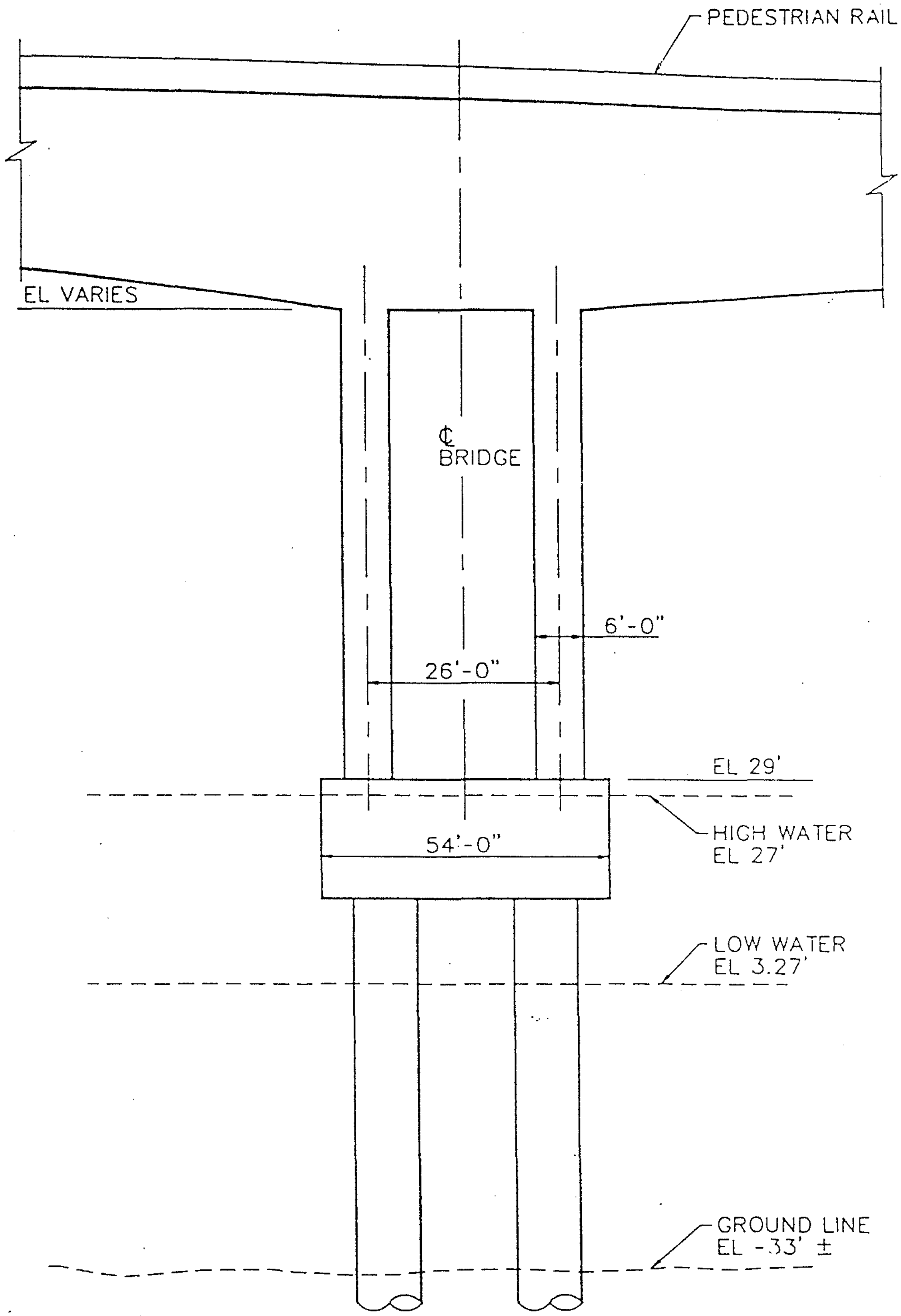
South North Transit Corridor Study

Willamette River Crossing
Ross Island Design Option

Figure F



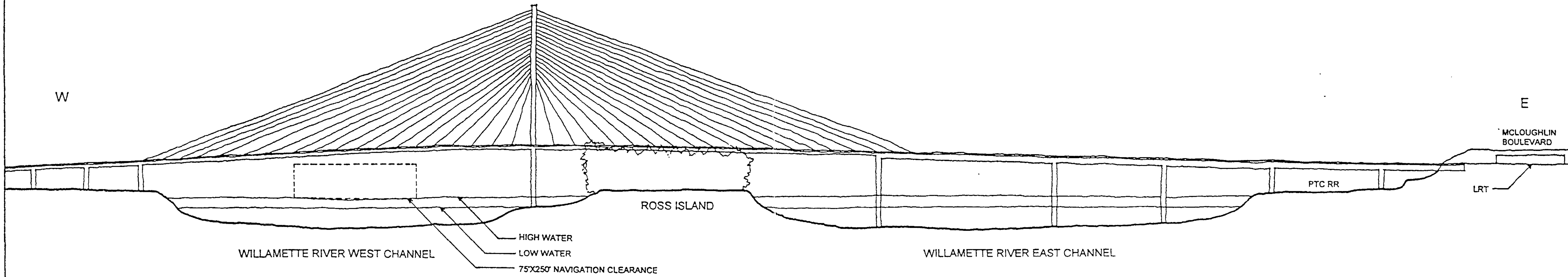

Elevation
Concrete Segmental Bridge Type

March, 1996

TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT OF OREGON

Willamette River Crossing
Ross Island Design Option

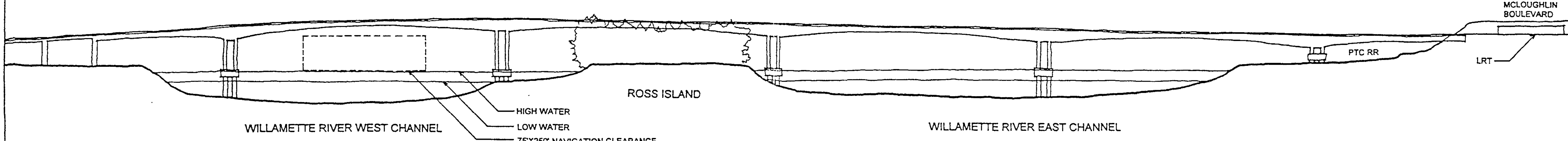
Figure 23




CABLE-STAYED BRIDGE TYPE

RENDERING FOR ILLUSTRATIVE PURPOSES ONLY. FOR SPECIFIC DIMENSIONS CONTACT TRI-MET PROJECT ENGINEER.

EAST MCLOUGHLIN SUB-OPTION SHOWN. WEST MCLOUGHLIN SUB-OPTION SIMILAR. PEDESTRIAN/ BIKE FACILITIES NOT SHOWN.




CONCRETE SEGMENTAL GIRDER BRIDGE TYPE

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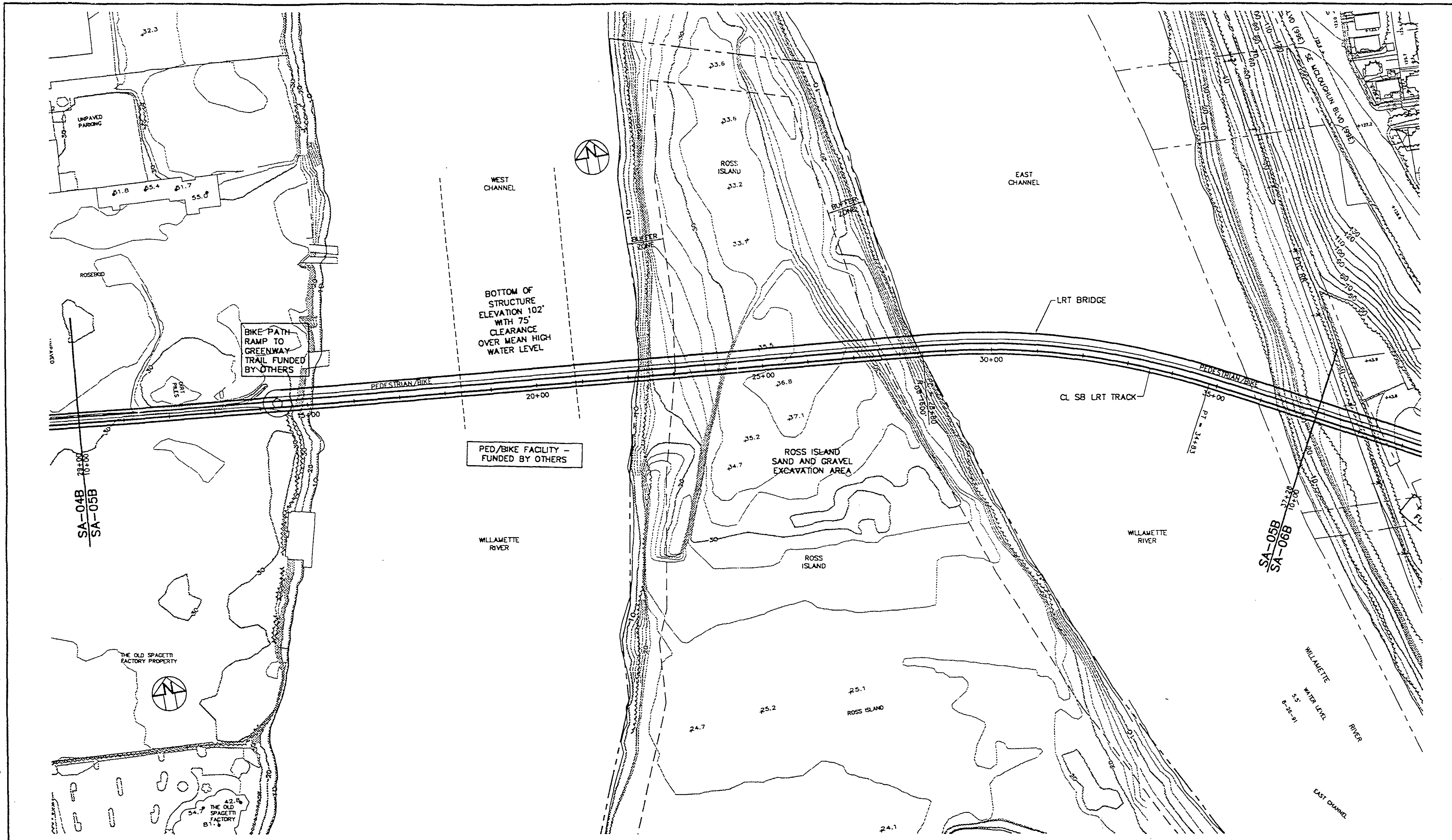
ROSS ISLAND ALTERNATIVE
BRIDGE TYPES – ARTIST RENDERING

SCALE: NTS DRAWING NO.: SD-03 CONTRACT NO.: SHEET NO.: 83

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SOUTH/NORTH TRANSIT CORRIDOR STUDY
LRT TRACK ALIGNMENT

SOUTH RIVER CROSSING SEGMENT
ROSS ISLAND ALT. - EAST MCLOUGHLIN SUB-OPTION

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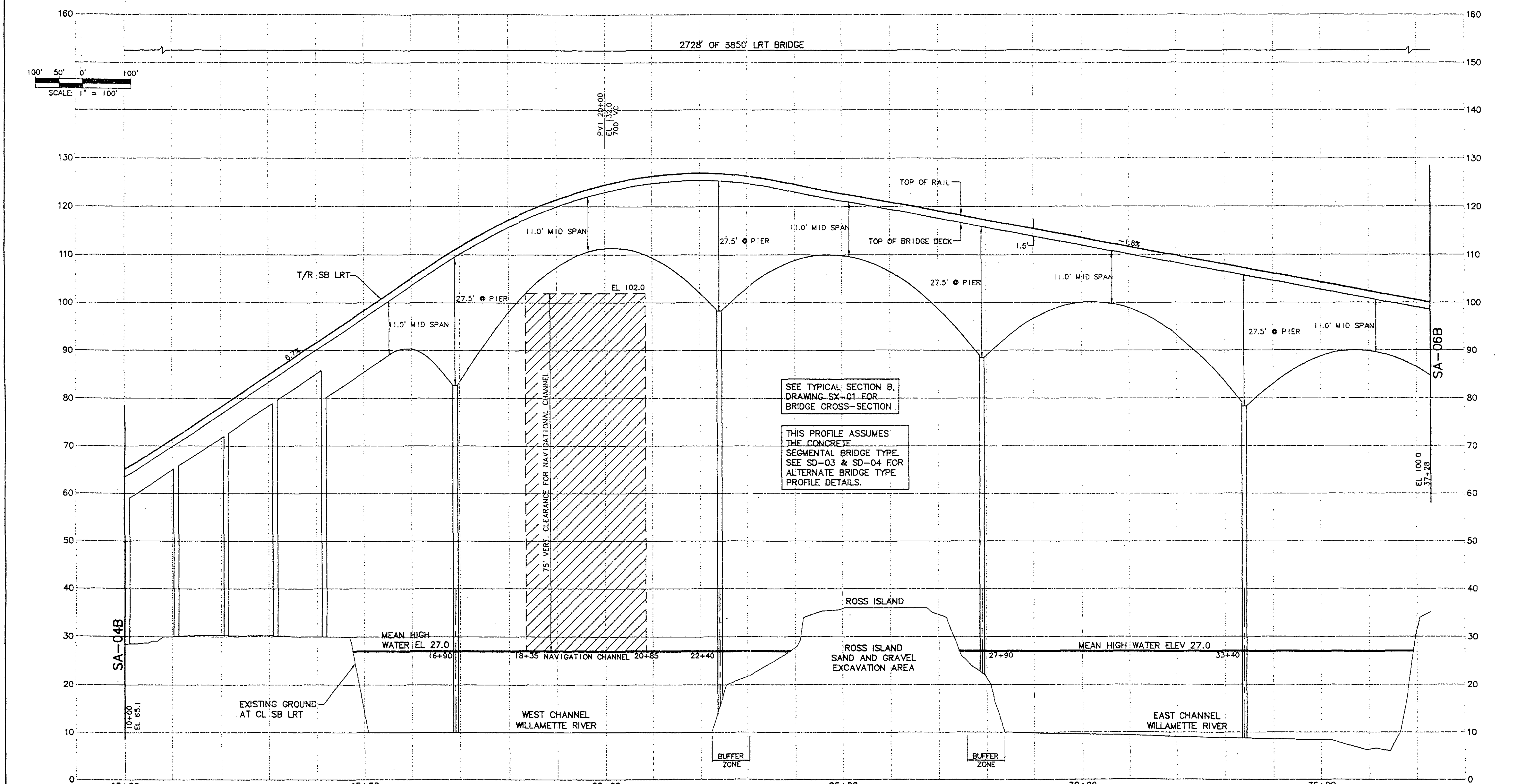


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SOUTH/NORTH TRANSIT CORRIDOR STUDY
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SOUTH RIVER CROSSING SEGMENT
ROSS ISLAND ALT. - EAST MCLOUGHLIN SUB-OPTION

SCALE: 1" = 100' HORZ, 1" = 10' VERT | DRAWING NO.: SV-05B | CONTRACT NO.: | SHEET NO.: 36

# WILLAMETTE RIVER - CARUTHERS DESIGN OPTION
# CONCRETE SEGMENTAL BRIDGE TYPE

Reference: South/North Transit Corridor Study Conceptual Alignment plans, May 1997, Sheets SV-02E, SV-03E, SV-02F and SV-03F.

Type and Layout

- The bridge would be a cast-in-place concrete segmental with cast-in-place columns and foundation.
- Span layout from west bank to east bank would be as follows: Moody Option 400'-400'-400'-205' (Sheets SV-02E and SV-03E), and South Marquam Option 400'-400'-400'-150' (Sheets SV-02F and SV-03F).

Foundations

- Water line foundation types were assumed to minimize in-water construction periods and impacts (refer to *Willamette River Crossing Supplement*, May 1996, Figures 6, 7 and 22).
- All foundations would be supported on 8-foot-diameter drilled shafts.
- All foundations would be 54 x 56 feet in plan (refer to *Willamette River Crossing Supplement*, May 1996, Figure 22).
- Drilled shaft piling were estimated to be 100 feet long.

Piers

- Columns would be twin-wall piers, 6 x 20 feet (refer to *Willamette River Crossing Supplement*, May 1996, Figures 22 and 24).
- The twin wall piers were assumed to be constructed with cast-in-place methods using slip forms.
- Three piers would be located in the Willamette River.

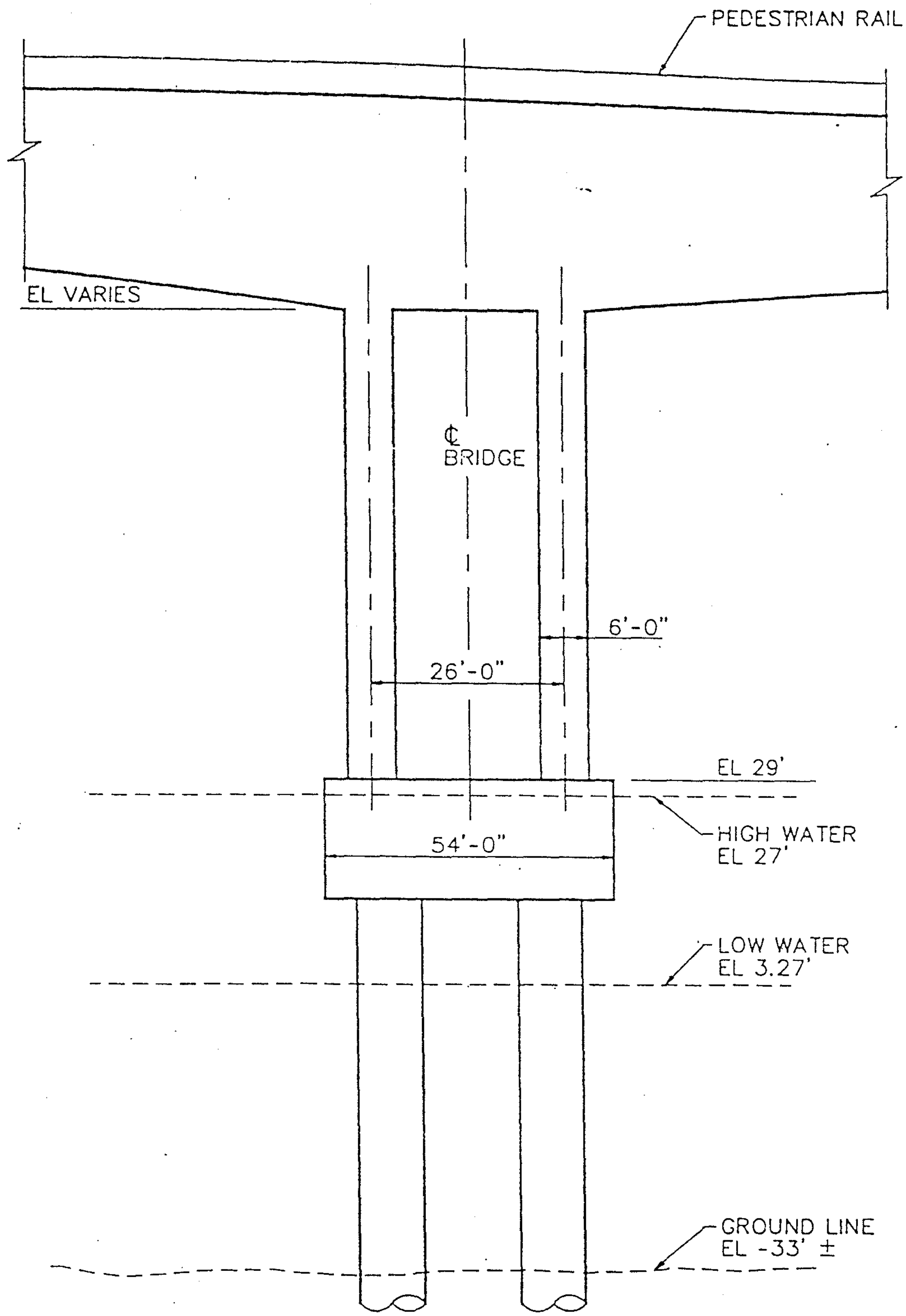
Deck

- Balanced cantilever construction methods were assumed (refer to *Major River Crossings Findings Report,* May 1995, Section 6.2 "Bridge Superstructure").
- The superstructure would vary in depth parabolically (refer to *Willamette River Crossing Supplement*, May 1996, Figures 2, 3 and 4 for profiles and Figure 8 for cross-section).
- Deck elements would all be cast-in-place to avoid the high costs associated with transporting heavy precast elements.
- The deck cross-section with pedestrian/bikeway would have sloping exterior girders (refer to *Willamette River Crossing Supplement*, May 1996, Figure 8).
- The deck cross-section without pedestrian/bikeway would have vertical girders (see Figure A).
- Deck elements would be cast using conventional form travelers.
- The deck would be post-tensioned both longitudinally and transversely.
- Pedestrian/bikeway would be located on the deck of the bridge.

- The deck would have a 1.5-inch-thick latex modified concrete overlay.

General

- A spiral pedestrian access ramp would be added in for options with the pedestrian/bikeway facilities.
- No-climb chain link fencing was estimated to run the length of the bridge options with pedestrian/bikeway facilities.
- Costs for navigational lighting for bridge spans over the navigation channel would be included.
- Costs for aesthetic lighting to illuminate the structure would be included.
- Concrete would be supplied via a delivery barge, then by means of a pump, then placed into the particular bridge component.
- Pedestrian/bikeway facilities would have to be incorporated into the concrete segmental spans. Pedestrian/bikeway add-ons at a later date are more expensive.
- Material prices would be adjusted to reflect accelerated construction.




Elevation
Concrete Segmental Bridge Type

TRI-MET TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT OF OREGON

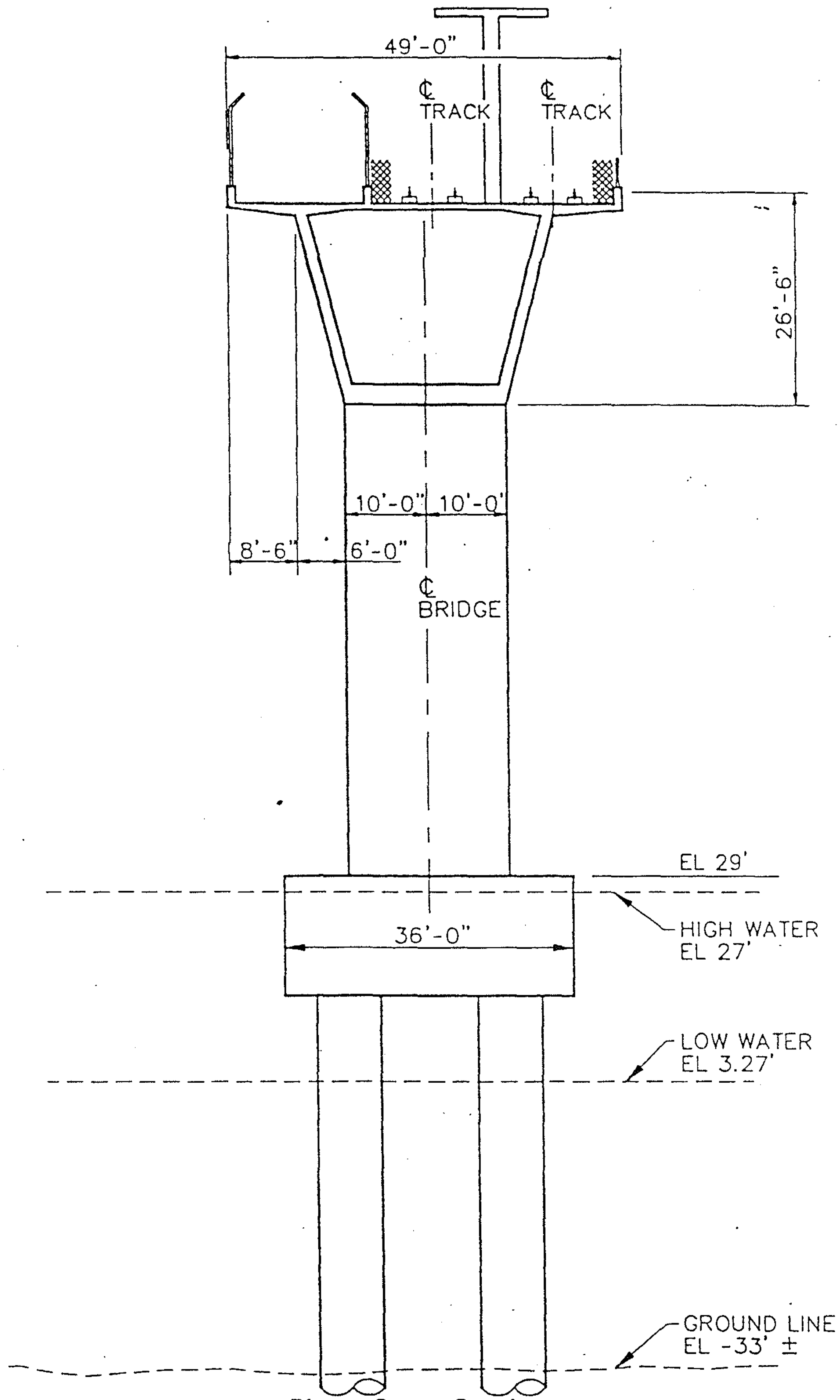
South North Transit Corridor Study

Willamette River Crossing
Modified Caruthers Design Option

PB 100 YEARS

March, 1996

Figure 6




Pier - Cross Section
Concrete Segmental Bridge Type

TRI-MET

TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT OF OREGON

PB 100 YEARS

South North Transit Corridor Study

March, 1996

Willamette River Crossing
Modified Caruthers Design Option

Figure 7

# WILLAMETTE RIVER - CARUTHERS DESIGN OPTION
# WARREN TRUSS BRIDGE TYPE

Reference: South/North Transit Corridor Study Conceptual Alignment plans, Volume 1, March 1996, Sheets SD-02 and SD-03.

Type and Layout

- Steel truss bridge type, similar to the existing Marquam Bridge.
- Span layout from west bank to east bank would be as follows: 290'-500'-500'-250' (Sheets SD-02 and SD-03, March 1996).

Foundations

- Water line foundation types were assumed to minimize in-water construction periods and impacts (refer to *Willamette River Crossing Supplement*, May 1996, Figures 11, 12 and 13).
- All foundations would be supported on 8-foot-diameter drilled shafts.
- All foundations would be 40 x 68 feet in plan (refer to *Willamette River Crossing Supplement*, May 1996, Figure 11).
- Drilled shaft piling were estimated to be 100 feet long.

Piers

- Columns would be rectangular cast-in-place reinforced concrete 8 x 12-foot piers (refer to *Willamette River Crossing Supplement*, May 1996, Figure 12).

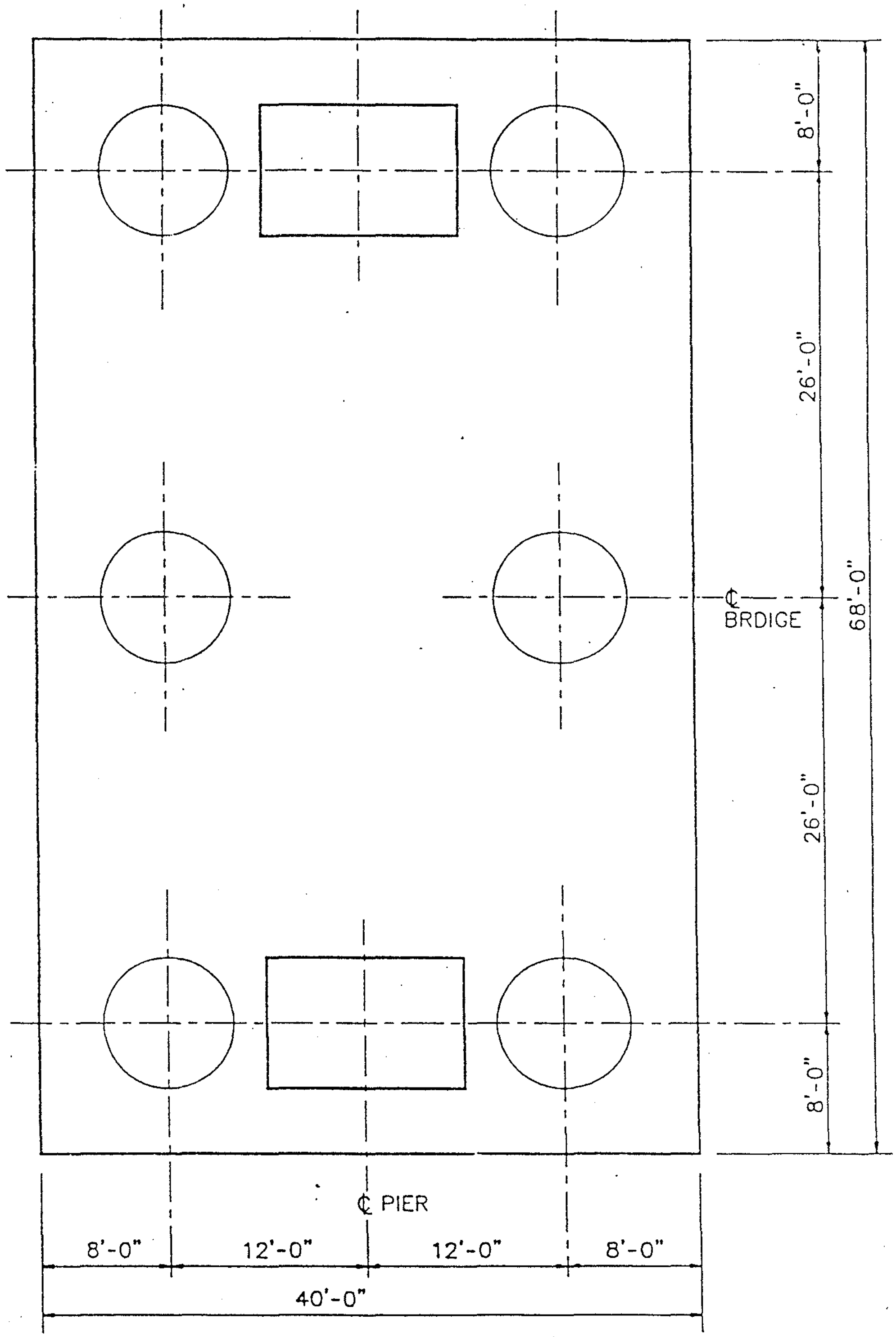
Deck

- Balanced cantilever construction methods were assumed (refer to *Major River Crossings Findings Report*, May 1995, Section 6.2 "Bridge Superstructure"; and *Willamette River Crossing Supplement*, May 1996, Section 2.1.2).
- The truss bridge must be a through truss to allow for adequate navigational clearance.
- Variable Depth Truss span is assumed: (1) would require vertical members at panel points to accept floor beams, (2) high negative moment at piers taken by variation in truss depth.
- Cooper River Bridge, Charleston, South Carolina, which was built in 1992, was used to determine approximate pounds of structural steel per square foot.
- The deck would be made of fabricated structural steel element with a cast-in-place concrete deck.

General

- Pedestrian/bikeway facilities can either be built inside the truss or added on at a later date.
- A spiral pedestrian access ramp would be added in for options with the pedestrian/bikeway facilities.
- No-climb chain link fencing was estimated to run the length of the bridge options with pedestrian/bikeway facilities.
- Costs for navigational lighting for bridge spans over the navigational channel would be included.

- Costs for aesthetic lighting to illuminate the structure would be included.
- Concrete would be supplied via a delivery barge, then by means of a pump, then placed into the particular bridge component.
- A maintenance walkway would be added for the full length of the bridge to facilitate future inspections.




Footing Plan
Warren Truss Bridge Type

PB 100 YEARS

March, 1996

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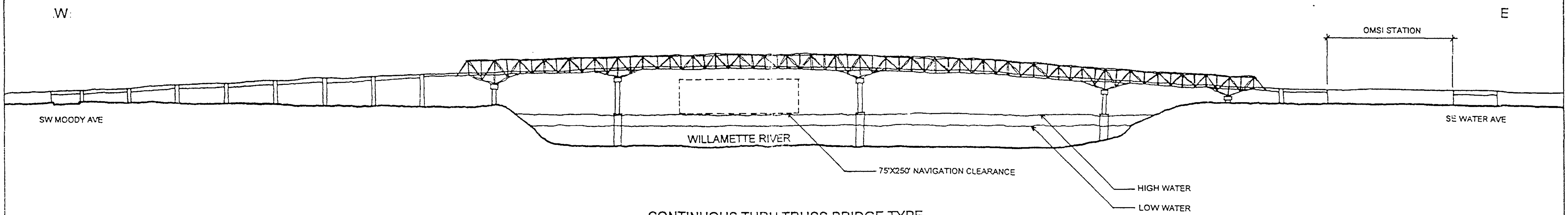
South North Corridor Study

Willamette River Crossing
Modified Caruthers Design Option

Figure 11




CONTINUOUS THRU TRUSS BRIDGE TYPE

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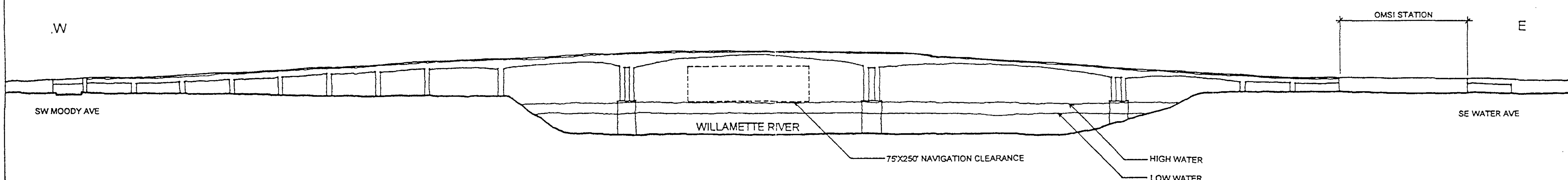
GRADE SEPARATED SUB-OPTION SHOWN. AT-GRADE SUB-OPTION SIMILAR. PEDESTRIAN/BIKE FACILITIES NOT SHOWN.

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South/North Transit Corridor Study

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SOUTH/NORTH TRANSIT CORRIDOR STUDY
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CARUTHERS ALTERNATIVE
BRIDGE TYPES – ARTIST RENDERING

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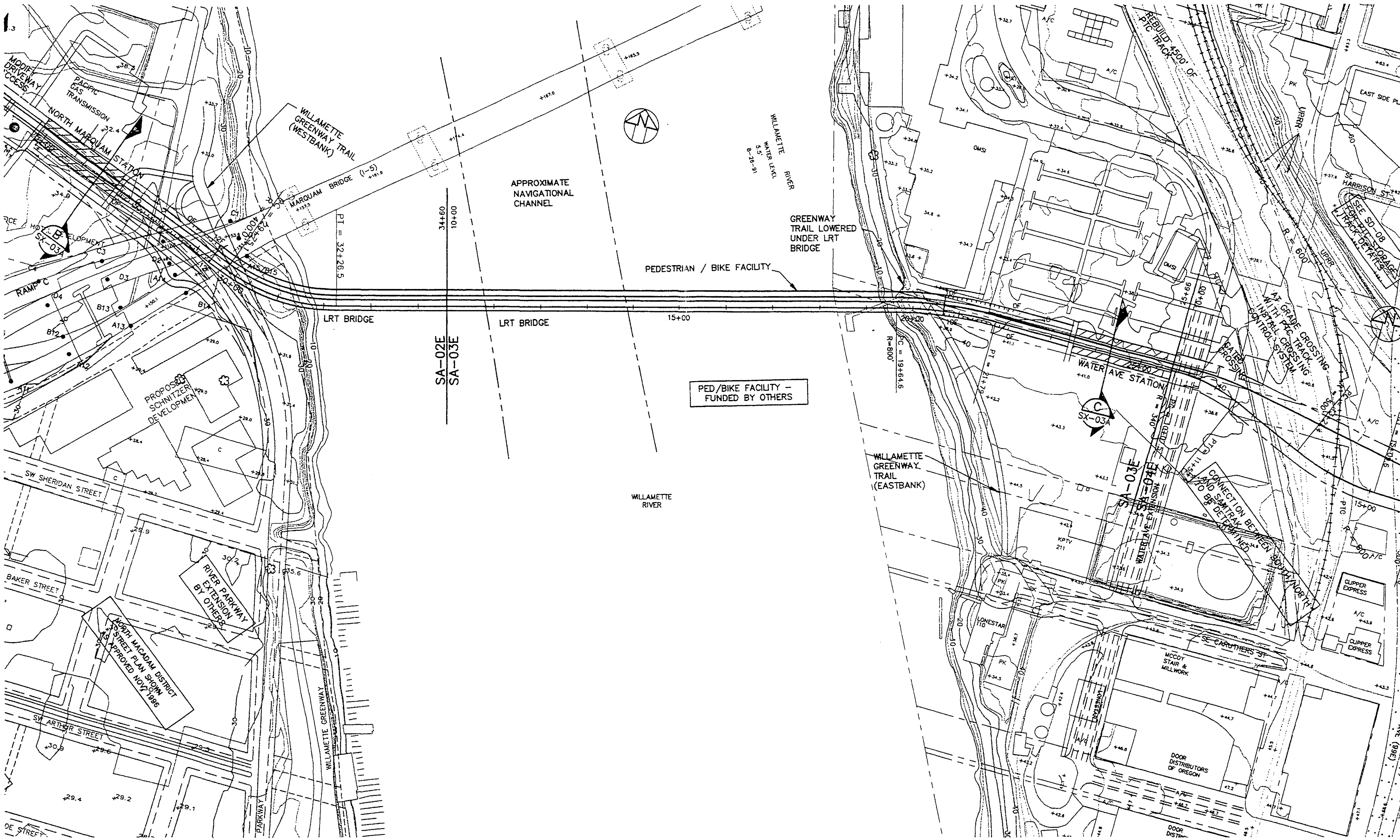


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South North Transit

TRI-MET Policy and Planning Division
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Portland, Oregon 97232

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SOUTH/NORTH TRANSIT CORRIDOR STUDY
LRT TRACK ALIGNMENT

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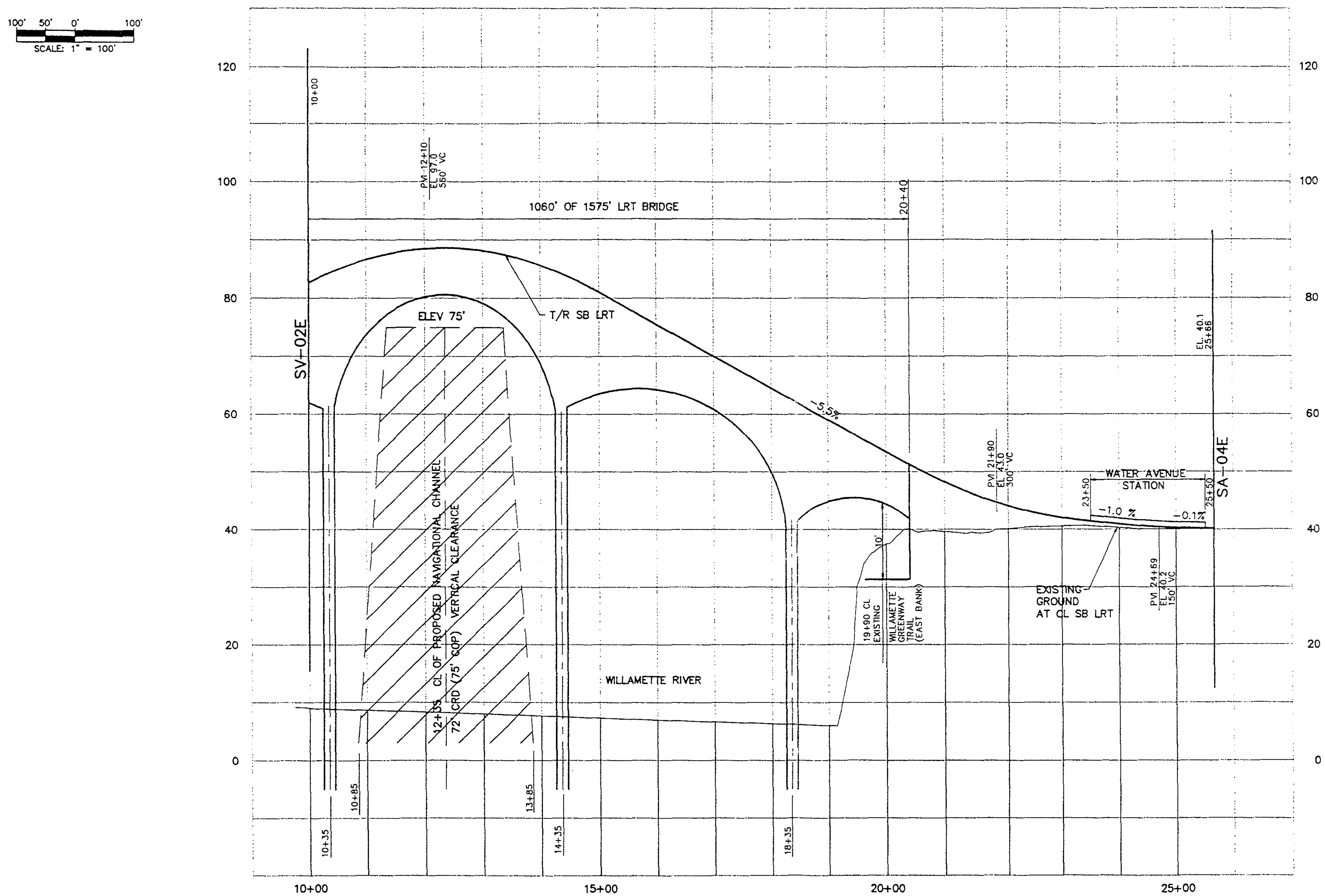
SOUTH RIVER CROSSING SEGMENT
CARUTHERS ALTERNATIVE – MOODY OPTION

SCALE: 1" = 100' HORZ, 1" = 10' VERT | DRAWING NO.: SA-03E | CONTRACT NO.: | SHEET NO.: 18

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TRI-MET

Policy and Planning Division
710 N.E. Holladay St.
Portland, Oregon 97232

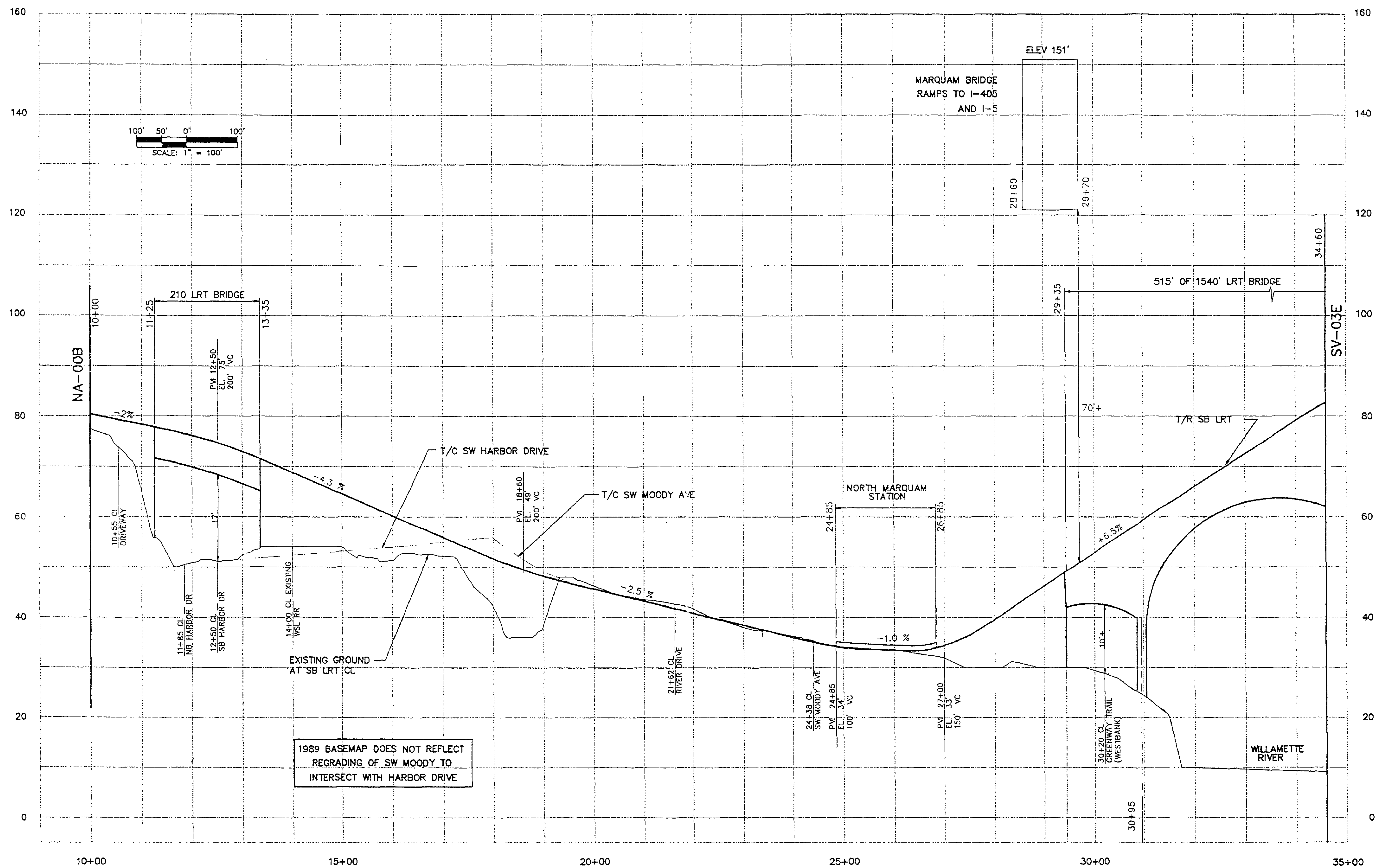
SUBMITTED:  DATE:  APPROVED:  DATE:

SOUTH/NORTH TRANSIT CORRIDOR STUDY
LRT TRACK ALIGNMENT

THIS PRINT IS HALF SIZE REPRODUCED

SOUTH RIVER CROSSING SEGMENT
CARUTHERS ALTERNATIVE – MOODY OPTION

SCALE: 1" = 200' HORZ, 1" = 20' VERT
DRAWING NO.: SV-03E
CONTRACT NO.:
SHEET NO.: 19




| NO. | DATE | BY / CHK. | APPD. | REVISIONS |
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| | 5/97 | | | 5/5/97 DEIS SUBMITTAL TO METRO - ADDED SHEET |

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| JLR DESIGNED | 5/97 DATE |
| JLR DRAWN | 5/97 DATE |
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TRI-MET

TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT OF OREGON

South North

TRI-MET

Policy and Planning Division
710 N.E. Holladay St.
Portland, Oregon 97232

SUBMITTED: DATE: APPROVED: DATE:

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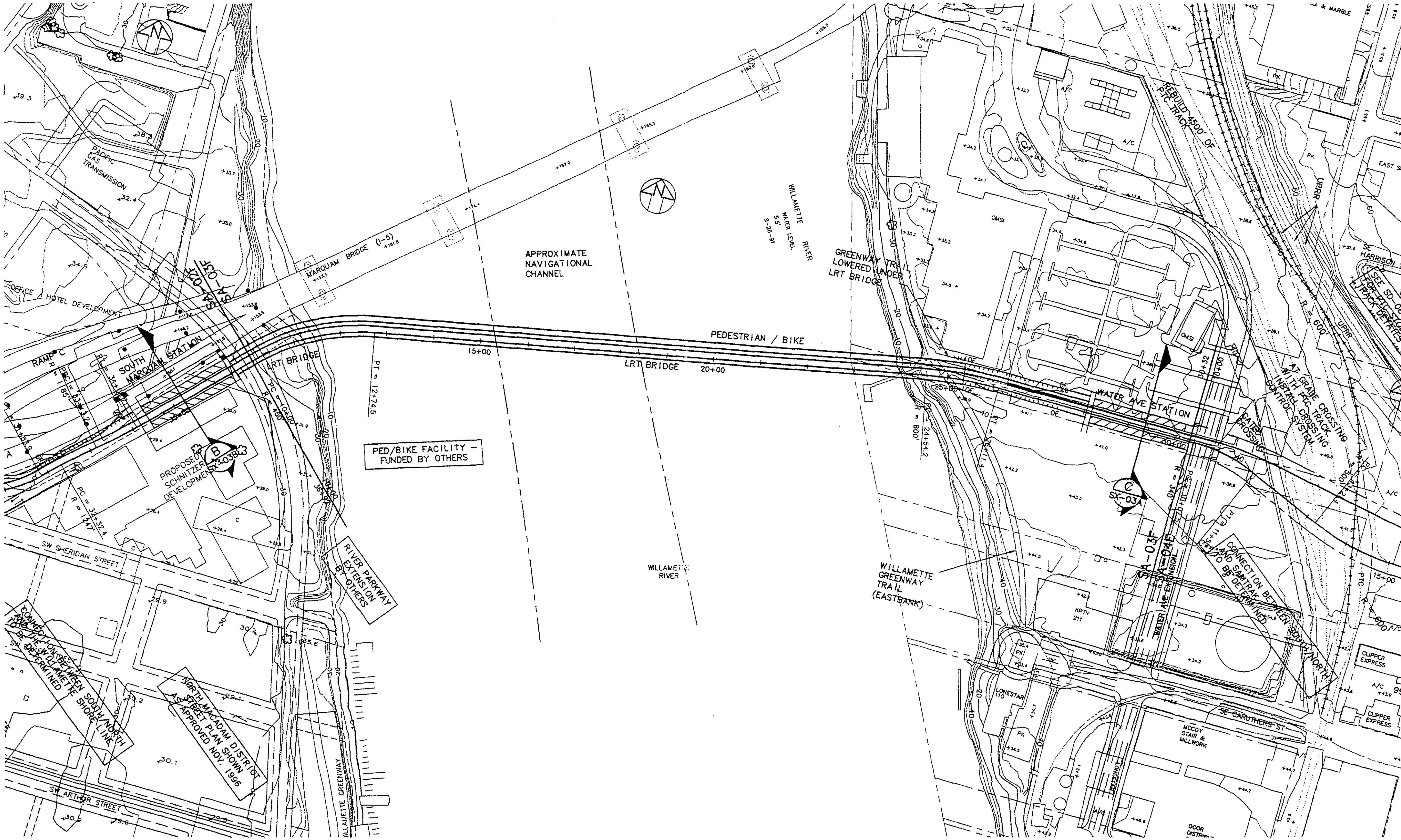
SOUTH RIVER CROSSING SEGMENT
CARUTHERS ALTERNATIVE - MOODY OPTION

SCALE: 1" = 200' HORZ, 1" = 20' VERT | DRAWING NO.: SV-02E | CONTRACT NO.: | SHEET NO.: 17

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TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT OF OREGON

South North

TRI-MET Policy and Planning Division 710 N.E. Holladay St. Portland, Oregon 97232

SUBMITTED: | DATE: | APPROVED: | DATE:

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SOUTH/NORTH TRANSIT CORRIDOR STUDY
LRT TRACK ALIGNMENT

SOUTH RIVER CROSSING SEGMENT
CARUTHERS ALTERNATIVE - SOUTH MARQUAM OPTION

| SCALE | DRAWING NO. | CONTRACT NO. | SHEET NO. |
|---|---|---|---|
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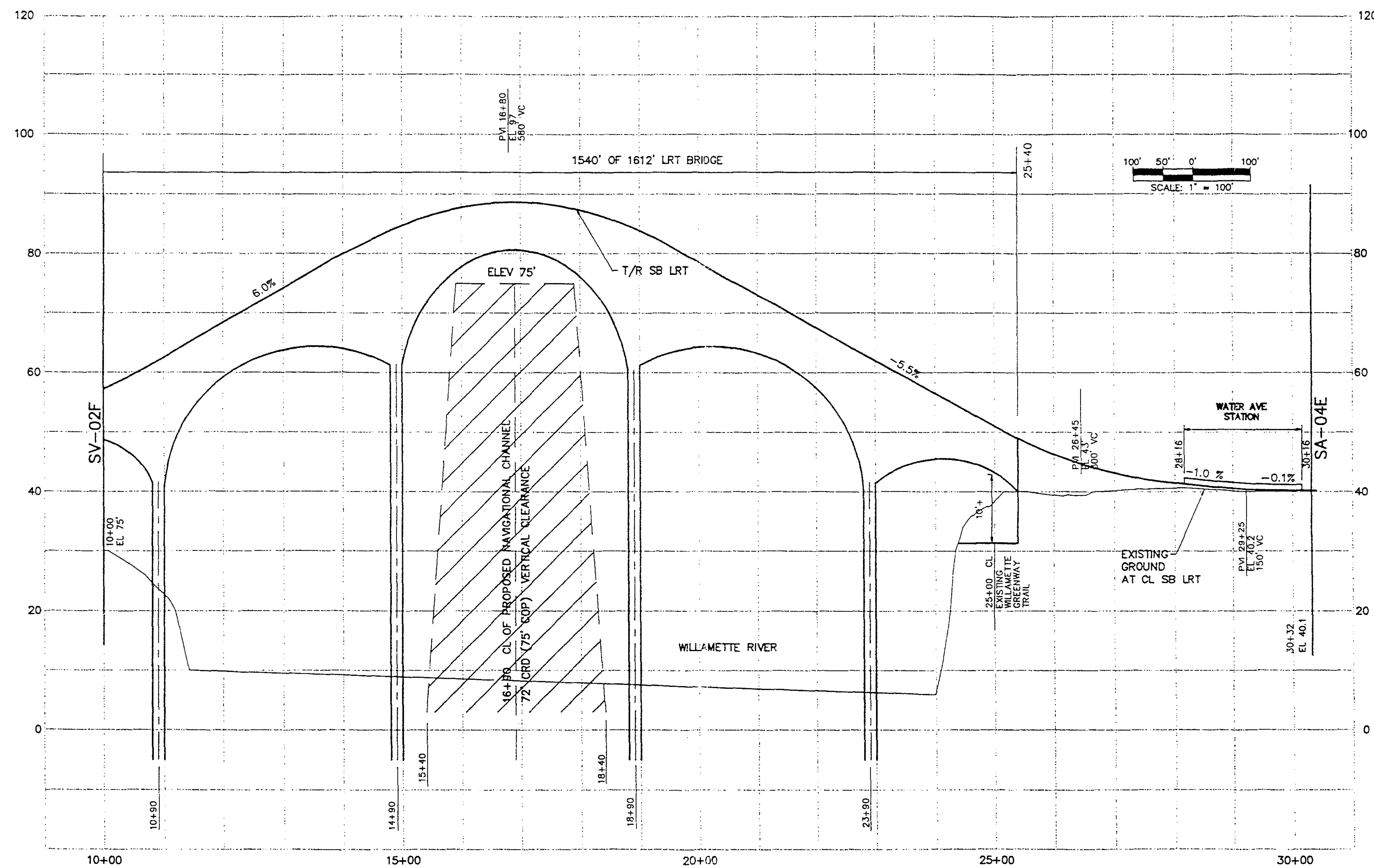


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LM — DRAWN — 4/97 — DATE
CHECKED — DATE
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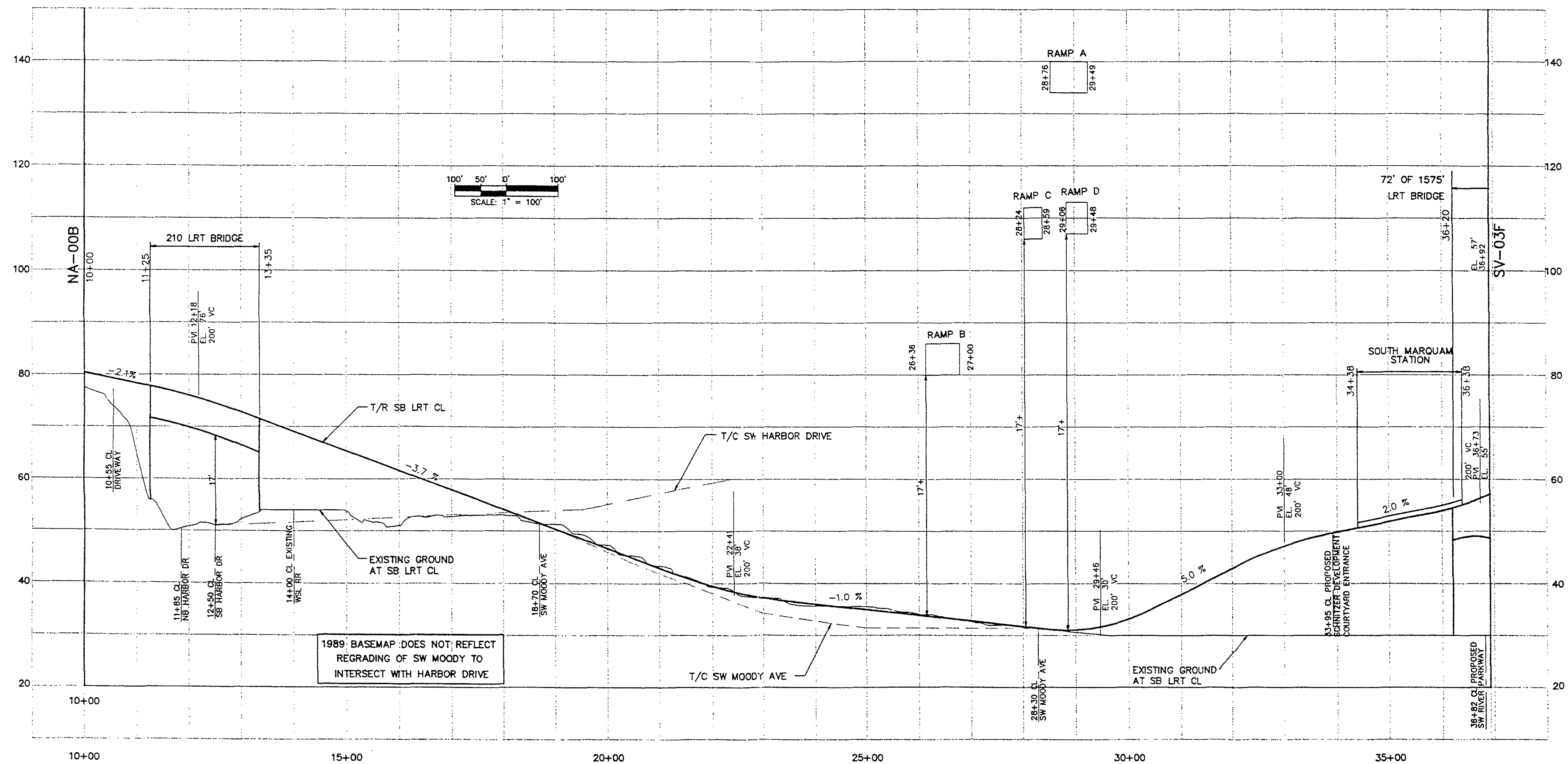
LRT TRACK ALIGNMENT

SOUTH RIVER CROSSING SEGMENT
CARUTHERS ALTERNATIVE – SOUTH MARQUAM OPTION

| SCALE: | DRAWING NO.: | CONTRACT NO.: | SHEET NO.: |
|---|---|---|---|
| 1" = 100' HORZ<br>1" = 10' VERT | SV-03F | | 23 |

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SOUTH RIVER CROSSING SEGMENT
CARUTHERS ALTERNATIVE – SOUTH MARQUAM OPTION

SCALE: 1" = 100' HORZ, 1" = 10' VERT | DRAWING NO.: SV-02F | CONTRACT NO.: | SHEET NO.: 21

# Appendix D

***Oregon Department of Transportation Standard Specifications for Highway Construction***

From:

Oregon Department of Transportation. 1991. Standard Specifications for Highway Construction. State Highway Division. Salem, Oregon.

**00170.20 Hazardous Waste and Hazardous Materials** - Comply with ORS Chapter 466 and Oregon Department of Environmental Quality requirements regarding:

- Poly-chlorinated biphenyls (PCB).
- Radioactive waste.
- Underground storage tanks.
- Action to abate health hazards.
- Spill response and clean up of hazardous materials.

**00170.30 Air, Noise, and Water Pollution Control** - Comply with ORS Chapter 468, Department of Environmental Quality requirements, and regulations of other federal, state, and local agencies regarding:

- Air pollution.
- Noise control.
- Water pollution.
- Oil spillage and used-oil disposal.
- Asbestos abatement.

Perform changes or alterations of work required by new or amended environmental pollution statutes, not contemplated at time of submitting proposals, according to 00140.50 and ORS 279.318.

(a) **Air Pollution Control Measures** - Control or abate air pollution to safeguard the state air resources.

(b) **Noise Control** - Comply with all laws governing construction operation noise.

(c) **Water Pollution Control Measures** - Prevent, control, and abate pollution of state waters according to ORS Chapter 468 and as required by the special provisions. Provide a plan and schedule of control and abatement measures for approval before beginning work.

Comply with Section 00160 regarding material sources and disposal area operations.

During construction activities and before any suspension of work:

- Slope surfaces of earthwork to permit runoff of surface water.
- Shape berms on top edges of embankment to intercept runoff water.
- Provide nonerosive slope drains to alleviate erosions and deposits.
- Restrict construction operations in wet areas and waterways to a practical minimum, to only those areas necessary to accomplish the work, and to only those permitted.
- Construct diversion dikes or settling basins as required to avoid polluting any stream.
- Clear from waterways any debris caused by construction operations.

(d) **Measurement and Payment** - Unless listed as a contract item, there will be no separate measurement or payment for this work. Include the cost of this work in the appropriate contract pay items.

**00170.31 Protection of Fish and Shellfish** - Comply with the regulations of the Oregon Department of Fish and Wildlife. Conduct operations to avoid any hazard to the safety and propagation of fish and shellfish in state waters.

Construct suitable settling basins to clarify water made muddy by taking or washing cobbles, gravel, and/or sand, or by placing earth or other materials in and near the water. The Division will allow the Contractor to use available Division lands on which to construct required settling basins if the water would be muddied by excavating material from Division-controlled lands.

Except where authorized by the contract, do not:

- Blast underwater.
- Release petroleum products or chemicals in the water.
- Disturb spawning beds.
- Obstruct stream channels.
- Cause silting or sedimentation of water.

**00170.32 Protection of Navigable Waters** - Comply with all applicable laws, including the Federal River and Harbor Act of March 3, 1899 and its amendments.

Do not interfere with waterway navigation or impair navigable depths or clearances, except as U.S. Coast Guard or Corps of Engineer permits allow.

**00170.40 Protection of Forests** - Obtain necessary permits according to ORS 477.605 and comply with the laws of any authority having jurisdiction for protection of forests.

## Section 00320 - Clearing and Grubbing

### Description

**00320.00 Scope** - This work consists of removing and disposing of vegetation and buried matter within a specified area or as directed. The work also includes preserving vegetation and objects designated to remain in place and cleanup of work area.

Note the provisions of 00140.90 and Section 00170, especially 00170.01, and 00170.80, that apply to clearing and grubbing operations.

**00320.01 Areas of Work** - The areas to be cleared and grubbed are shown on the plans, or if not shown on the plans, the clearing lines are 10 feet outside the following:

- Top of side slopes of ditches and channel changes.
- Top of cut slope.
- Top of cutbank rounding if rounded.
- Toe of fill slope.
- Outside edge of structure.
- Other work areas shown on the plans, such as material sources, borrow areas, and road connections.

**00320.02 Definitions:**

**(a) Clearing** - Clearing consists of:

- Preserving trees and other vegetation designated to remain in place.
- Salvaging marketable timber, when required by the special provisions.
- Cutting and removing vegetation, such as woods, grasses, crops, brush and trees.
- Removing down timber and other vegetative debris.

**(b) Grubbing** - Grubbing consists of removing:

- Brush stems remaining above the ground surface after the clearing work.
- Tree Stumps.
- Roots and other vegetation found below ground surface.
- Partially buried natural objects.



**(c) Clear Zone** - The clear zone is the roadside border area, starting at the edge of the traveled way, available for safe use by an errant vehicle. The minimum clear zone line is 30 feet from the edge of traveled way, but this distance may vary depending on design speed, horizontal alignment and side slope requirements.

### Construction

**00320.40 Clearing Operations:**

**(a) Clearing Trees and Other Vegetation** - Cut trees and brush so they fall into the areas specified to be cleared.

Cut off tree stumps, not required to be grubbed under 00320.41:

- Flush with the ground surface, if within embankment limits and subgrade or sloped surfaces are 4 feet or more above original ground.
- Flush with the ground surface if within the clear zone.
- No higher than 6 inches above ground surface if between the clear zone and the clearing line.

Remove all evidence of clearing matter and debris. This work includes removal of:

- Sod, weeds, and dead vegetation.
- Down timber, brush, and other vegetation.
- Sticks and branches with diameters greater than 1/2 inch.
- Dead trees, down timber, stumps, and specified trimmings from areas where live trees and other vegetation are designated to remain.

**(b) Preserving and Trimming Vegetation:**

**(1) Within the Work Areas** - Avoid injuring vegetation designated to remain in place. Preservation of this vegetation includes protection and special care.

**(2) Outside the Work Areas** - Avoid injuring any vegetation. Confine operations which may injure vegetation to areas that have no vegetation or to the work areas.

Remove hazardous, dead, and damaged trees outside the clearing limit as directed.

**(3) Tree Trimming** - Trim trees according to good tree surgery practices and as directed to remove:

- Unsound branches of trees to remain in place.

- Branches over roadways and bridges to provide at least 20 feet of clearance above the roadway surface.
- Branches over walks to provide at least 8 feet of clearance above the walk surface.
- Branches obstructing sight distance at intersections or impairing visibility of signs.

**00320.41 Grubbing Operations** - Within excavation limits, remove tree stumps, roots, and other vegetation to a depth of at least 6 inches below excavation subgrade or sloped surfaces.

Within embankment limits, remove tree stumps, roots, and other vegetation where the distances between the existing ground and subgrade or sloped surfaces are less than 4 feet. No portion of a stump shall come within 4 feet of embankment subgrade or slope surface.

**00320.42 Ownership and Disposal of Matter** - All matter and debris accumulated from clearing and grubbing operations become the Contractor's property. Dispose of this matter and debris by one or more of the following methods:

(a) **Burning** - After Contractor obtains burning permit and subject to local restrictions, burnable matter may be burned on the project within the highway right-of-way. Perform the burning at locations where anything to remain in place or that has been already constructed under the contract will not be damaged.

(b) **Chipping** - Woody matter may be disposed of by chipping and spreading the chips uniformly over selected areas, as directed, in loose layers not more than 3 inches thick.

(c) **Burying:**

(1) **Required Conditions** - Stumps may be buried in the areas specified by 00320.42(c-2) if, in the opinion of the Engineer, all the following requirements are met:

- Future construction in the burial area is not anticipated.
- Burial would not interfere with highway drainage, existing waterways, groundwater, or areas subject to erosion.
- Roots extending from stumps are removed.
- Stumps are buried with at least 4 feet cover and 3 feet clear of adjacent stumps in any direction. The contour of the cover over the stumps is blended into the existing terrain.
- All disturbed areas are seeded and mulched according to Section 01020 at Contractor expense.



(2) **Burial Areas** - Stumps may be buried in the following areas if all requirements of 00320.42(c-1) are met:

- Under embankments outside of a 2:1 slope line projected from the edge of subgrade shoulder.
- Under random fills used to correct drainage of low spots.
- Between toes of embankment slopes and highway right-of-way lines.
- Between interchange ramps toes of embankment slopes.

Do not bury stumps anywhere else on the project unless permitted.

(d) **Other Disposal Methods** - Dispose of all other material or debris, not disposed of according to 00320.42(a), (b), or (c), according to 00310.43(d).

**00320.43 Backfilling Holes** - Except in areas to be excavated, backfill holes remaining after grubbing operations according to 00330.45. Backfill will be measured for payment according to 00330.82 if there is an embankment measure basis pay item for earthwork and that material is used for backfilling.

## Finishing and Cleaning Up

**00320.70 General** - Clean up all areas of work performed under this section including removal of litter and all other undesirable material which would be unsanitary, unsafe, or unsightly, to the satisfaction of the Engineer.

## Section 00510 - Structure Excavation and Backfill

### Description

**00510.00 Scope** - This work consists of excavating, backfilling and disposing of materials in connection with the construction of bridges, grade separation structures, rigid frame structures and other major structures. Other major structures under this section are retaining walls, reinforced concrete box culverts, headwalls, structural plate structures and pipe culverts, sewers, siphons and irrigation pipes greater than 72 inches in diameter.

This work is exclusive of any earthwork covered under any sections of Parts 00300 or 00400, and any earthwork that may be specifically included and provided for as incidental work for particular items or parts of the contract work. The construction, measurement, and payment of embankment at bridge ends and engineered fills will be according to Section 00330.

**00510.01 Lines, Grades, and Cross Sections** - Perform the work to the lines, grades and cross sections shown or as established.

### Materials

**00510.10 Selected General Backfill** - Provide soil selected from roadbed, ditch, trench or structure excavations according to 00330.13.

**00510.11 Selected Granular Backfill** - Provide granular material selected from roadbed, ditch, trench or structure excavations according to 00330.14.

**00510.12 Granular Wall Backfill** - Provide granular wall backfill material of crushed or uncrushed rock, or combinations meeting the following gradation limits as determined by AASHTO T 27 and T11:

| Sieve Size Passing | Percentage (By Weight) |
|---|---|
| 3" | 100 |
| 3/8" | 0 - 80 |
| No. 40 | 0 - 40 |
| No. 100 | 0 - 10 |
| No. 200 | 0 - 6 |

The plasticity index of the material passing the No. 40 sieve shall not exceed 6 when tested according to AASHTO T 90.



**00510.13 Granular Structure Backfill** - Provide granular structure backfill of crushed, durable, rock material meeting the following gradation limits as determined by AASHTO T 27:

| Sieve Size Passing | Percentage (By Weight) |
|---|---|
| 2" | 100 |
| 1/2" | 50 - 80 |
| No. 4 | 35 - 70 |
| No. 40 | 15 - 35 |
| No. 100 | 0 - 15 |

The plasticity index of the material passing the No. 40 sieve shall not exceed 6 when tested according to AASHTO T 90.

### Construction

**00510.40 Clearing, Grubbing and Removal Work** - In the absence of contract pay items under Sections 00310 and 00320, the provisions of those sections apply as applicable. Perform such work as incidental work for which no separate payment will be made.

Clearing, grubbing and removal limits shall be at least 10 feet outside of the entire structure, including the ends of the structure but within the right-of-way.

**00510.41 Structure Excavation** - Structure excavation includes:

- Removal of all material necessary for the construction of foundations and substructures as shown or specified.
- Placement of all backfill except granular wall backfill and granular structure backfill.
- Disposal of excavated material not required or suitable for backfill according to 330.41(a-5).
- Correction, according to recognized practice, of conditions detrimental to the work, including removal of excess water.

Shore, brace or use cofferdams to protect excavations unless open excavation would not be detrimental to adjacent structures, roadways, waterways, etc.

If the plans show concrete in footings placed against undisturbed material, make excavation for footings as nearly as possible to neat lines of the footings. Where such material will not stand vertically after excavation fill all space between the footing and remaining undisturbed material to the top of the footing with footing concrete if the excavation does not exceed 1 foot outside the footing dimensions, or granular structure backfill material as directed. Compact the granular structure backfill to 97 percent of maximum relative density, according to 00330.43.

Concrete placed against steel sheet piles in cofferdams or cribs will be considered placed against undisturbed material, whether or not the steel sheets are later removed.

Where practical, excavate rock materials using pavement breakers, rippers, backhoes, other excavation equipment, or non-explosive means that precludes breakage of rock materials below and outside of the structure excavation limits. If blasting is required, perform such work in a manner that avoids disturbing rock outside the structure excavation limits. Use controlled blasting techniques for all structure excavation requiring blasting according to Section 00335. Backfill and repair as directed at no cost to the Division any excavation, shattered rock, void, fault, or unstable condition caused by the Contractor outside the limits of structure excavation. Backfill and repair of voids, faults or unstable condition not caused by the Contractor or covered by other provisions will be paid for according to Section 00196.

Consider the elevations of the bottoms of footings or foundations shown as approximate only. The Engineer may order in writing, changes in elevations of footings necessary to secure a satisfactory foundation.

**00510.42 Structure Excavation and Backfill Below Elevations Shown** - Excavate soil, unstable or unsuitable material below footing or base of structure, including bedding, if any, to elevations as directed.

Perform one of the following work items as directed:

- Increase length of column or wall until bottom of footing is at new established elevation.
- Increase thickness of footing until bottom of footing is at new established elevation.
- Backfill the area subexcavated to the plan elevation according to 00510.46(a).

**00510.43 Preservation of Channel** - Do not excavate outside of caissons, cribs, cofferdams, sheet piling, or sheeting nor disturb the natural streambed unless specified or allowed. Where such excavation is allowed, comply with 00405.40(b). Do not sidecast any excavation material into the stream.

When permitted, the necessary excavation for placement of riprap outside the perimeter of the footing may be made without the use of cofferdams or cribs, and disposed of according to 330.41(a-5).

**00510.44 Cofferdams and Cribs** - Design and construct cofferdams and cribs when shown, specified or determined by the Contractor to be necessary for performing the work in the dry inside them as follows:

- Prepare and submit working drawings and calculations for all cofferdams, shoring, and cribbing required according to 00540.40(a) and 00540.41(a).
- Provide interior dimensions for cofferdams and cribs to give sufficient clearance for the inspection of forms.
- When weighted cribs are utilized to partially overcome the hydrostatic pressure acting against the bottom of the foundation seal, provide special anchor system such as dowels or keys to transfer the entire weight of the crib into the foundation seal.
- Do not leave timber or bracing in cofferdams or cribs that extends into the substructure concrete.
- Place and cure seal concrete according to 00540.47(e).
- Vent or port, at low water level, any cofferdam that is to remain in place.
- Unless otherwise provided, remove cofferdams, or cribs, including all sheeting and bracing, after the completion of the substructure. Do not disturb or damage the finished concrete.

**00510.45 Pumping** - No pumping from the interior of any foundation enclosure will be permitted during the placing of concrete or for a period of at least 24 hours thereafter unless an effective means of eliminating moving water through fresh concrete is developed. Then with the approval of the Engineer pumping may be allowed.

Do not pump to dewater a sealed cofferdam until the seal concrete meets the requirements of 00540.47(e).

**00510.46 Preparation of Foundations** - Do not place concrete on prepared foundations without prior approval. Construct foundations that will support structures as follows:

(a) **Backfilled Foundations** - Construct the top surface of the foundation fill at least 3 feet beyond the area to serve as a foundation unless otherwise shown or directed. Use selected granular backfill or granular structure backfill as directed. Place in 6-inch layers and compact to not less than 95 percent of maximum relative density according to 00330.43.

(b) **Undisturbed Soil Foundations** - Do not disturb the sides or bottom of the foundation excavations. Place concrete against undisturbed soil when shown. Concrete may be used as backfill subject to 00540.44(c). If disturbed, compact all disturbed material to 95 percent of maximum relative density according to 00330.43.

(c) **Formed Foundations On Soil** - Do not disturb the bottom of the foundation excavations. If disturbed, compact all disturbed material to 95 percent of maximum relative density according to 00330.43.

(d) **Rock Foundations** - Before placing concrete:

- Clean all rock surfaces and remove loose material.
- Clean seams and fractures according to 00510.41, and seal with grout.

**00540.47 Handling and Placing Concrete:**

**(a) General** - No concrete shall be placed under water or in flowing water except specified seal concrete, shall be placed under water according to 00540.47(e). Place concrete:

- In the sequence shown or, if not shown, as approved.
- In its final position in the forms within 1-1/2 hours after the addition of the cement to the aggregate. A retarder may be used or required. The retarder shall be from the Division's QPL and will be furnished at no additional compensation.



# Part 01000 - Right-of-Way Development and Control

## Section 01010 - Topsoil

### Description

**01010.00 Scope** - This work consists of furnishing, excavating, loading, hauling, and placing topsoil in specified areas.

Selected topsoil if specified, will be measured and paid for according to 00330.

### Materials

**01010.10 Quality Requirements** - Furnish a fertile, loamy, natural surface soil consisting of sands, silts, clays and organic matter in combination and free from substances toxic to plant growth, noxious weeds, roots, refuse, sticks and lumps that when tested according to AASHTO T 88 conforms to the following:

| Sieve Analysis<br>Particle Size Range | Percent by Weight |
|---|---|
| Larger than 2" | 0 |
| 2" - 0.75" | 0 - 5 |
| 0.75" - 0.187" (No. 4 sieve) | 0 - 20 |

Of the fraction passing the No. 4 sieve, excluding organic material, the topsoil shall conform to the following limits:

| Hydrometer Analysis<br>Particle Size Range | Percent by Weight |
|---|---|
| 0.187" - 0.003" (sand) | 5 - 70 |
| 0.003" - 0.00008" (silt) | 20 - 80 |
| Less than 0.00008" (clay) | 5 - 30 |

**01010.11 Acquisition and Development of Sources** - Furnish topsoil material from sources of suitable material as the Contractor elects to use according to 00330.04(b).

Each source shall be well drained and, before stripping, shall have healthy crops of grass or other vegetative growth, free from noxious weeds such as Canadian thistle, morning-glory, blackberry, horsetail, tansy ragwort or other plants designated as a noxious weed by authorized State or County officials. Remove and dispose of all heavy grass or other vegetation before taking materials from the source. Ordinary sods do not need to be removed from the topsoil, however, thoroughly break up and intermix with the soil.

Twenty days before furnishing topsoil from a source:

- Give the Engineer notice of intent to use the source.
- Provide a 20-pound representative sample for testing.
- Provide access to the source for inspection.

Obtain approval of the source before excavation of topsoil begins.

## Construction

**01010.40 Excavation** - When excavating topsoil, provide the most suitable material from the sources. Prevent fouling of suitable material with subsoil or other extraneous matter.

**01010.41 Subsoil Preparation** - Finish and grade areas to receive topsoil to allow for specified depth of topsoil. Scarify subsoil which is not loose and friable to a depth of 6".

**01010.42 Hauling And Spreading** - Perform hauling and spreading without damaging surrounding objects and without subjecting the topsoil and the areas on which it is placed to compaction. Protect from damage roadways, shoulders, curbs, walks or other structures and areas which must be traveled, crossed or mounted.

Accurately and smoothly spread the topsoil over the specified areas to the thickness, grades, and slopes shown or directed. Deposit and spread the material so that compaction of the material, as far as practical, is prevented. Do not place the material during wet conditions which would tend to cause compacting the material.

Avoid wasting topsoil material. Material placed contrary to the Engineer's instructions or where not designated will not be paid for.

## Finishing and Cleaning Up

**01010.70 Finishing** - Finish areas covered with topsoil to proper grade, contour and cross section. Cultivate all topsoil not in a loose and friable condition to a depth of at least 4 inches. Bring the surface to a condition ready for fertilizing and seeding operations.

## Measurement

**01010.80 General** - The quantity of topsoil will be measured by the cubic yard, to the nearest 0.1 cubic yard, in the hauling vehicle as follows:

The maximum "water level" capacity of the vehicle will be measured and calculated to the nearest 0.1 cubic yard. Quantities will be determined at the point of the delivery with no allowance for settlement of material during transit. When required to facilitate measurement, level vehicle loads at the point of delivery. Payment will not be made for material in excess of the maximum "water level" capacity. Deductions will be made for loads below the maximum "water level" capacity.

## Payment

**01010.90 General** - The accepted quantities of topsoil material will be paid for at the contract unit price per cubic yard for the item "Topsoil." Payment will be payment in full for furnishing, excavating, loading, hauling and placing all topsoil, including all equipment, tools, labor, and incidentals necessary to complete the work.



# Section 01020 - Erosion Control Seeding

## Description

**01020.00 Scope** - This work consists of preparing, fertilizing, seeding, and mulching to develop grass growth for erosion control on medians, interchanges, cut and fill slopes, areas disturbed by project construction, mandatory material sources or disposal areas and where specified or directed. Excluded are rock slopes and areas under water for considerable periods of time.

## Materials

**01020.10 General** - Materials shall meet the following requirements:

| | |
|---|---|
| Erosion Control Matting | 03110.50 |
| Fertilizers | 03110.10 |
| Mulch Materials | 03110.40 |
| Seed | 03110.60 |

## Construction

**01020.40 Planting Seasons** - Unless otherwise specified or approved, perform this work during either the spring season, between February 1 and May 15, or the fall season, between August 1 and November 15.

Perform the work only when local weather and other conditions are favorable to seeding and mulching. Do not undertake the work when wind velocities would prevent uniform application of materials or would drift materials.

Seed, fertilize, and mulch in stages along the project as soon as practical after completing earthwork.

**01020.41 Preparation of Areas** - Finish all earthwork before seeding. Restore areas which are misshapen or eroded before seeding.

Remove rocks, weeds, debris and other matter detrimental or toxic to the growth of grass from areas to be seeded. If topsoil is added to these areas, cultivate existing ground surface to a depth of 4 to 6 inches before placing topsoil. Remove all loose stones larger than 2 inches, on 3:1 or flatter slopes.

Do not damage existing vegetation that is to be left in place.

On areas to be seeded prepare surface soil to a condition favorable for germination of seed and growth of grass. Maintain at least 1/2 inch of surface soil in a loose condition.

Conduct surface preparation operations along the contours of areas involved. On roadbed cut and fill slopes, form minor ridges and irregularities to retard erosion and improve germination.

## 01020.42 Fertilizing and Seeding:

(a) General - Uniformly apply seed and fertilizer at the rates indicated by the special provisions.

Thoroughly mix seeds when more than one kind of seed is to be used. Seed and fertilizer may be combined in water for application by hydraulic means. When fertilizer and seed are to be applied in dry condition, apply them separately. If applied from separate compartments, the application may be done in one operation.

Place seed and fertilizer before placing mulch, except fertilizer and seed may be applied after mulching:

- If the mulch is punched into soil by mechanized means.
- If it is necessary to hold down mulch with netting or like material.
- On 1 1/2:1 or steeper slopes where a slurry mixture would tend to run down the slope.

Prevent seed and fertilizer from falling or drifting onto areas occupied by rock base, rock shoulders, plant beds or other areas where grass is detrimental.

(b) Application - Apply seed and fertilizer by one of the following kinds of equipment as the Contractor elects, subject to limitations under 01020.42(c):

(1) Grass seed drills or seeders which work fertilizer into the soil and place the seed under about a 1/4 inch soil cover.

(2) Hydraulic equipment which continuously mixes and agitates the slurry and applies the mixture uniformly through a pressure-spray system providing a continuous, nonfluctuating delivery. Apply the materials using a sweeping, horizontal motion of the nozzle.

Add a nontoxic tracer to the seed and fertilizer mixture to visibly aid uniform application. Do not exceed 250 pounds per acre when wood cellulose fiber is used as a tracer.

(3) Blower equipment using air pressure and an adjustable spout that uniformly applies dry fertilizer and dry seed in separate and successive applications at constant measured rates. Apply the materials using a sweeping, horizontal motion of the spout.

(4) Helicopter equipped with hoppers and adjustable disseminating mechanisms that separately and successively apply dry fertilizer and dry seed in uniform and prescribed quantities. If provided in the special provisions, liquid fertilizer may be used.

(5) Hand-operated mechanical spreaders that uniformly apply dry fertilizer and dry seed separately and successively in prescribed quantities.



(c) Work Quality - Regardless of equipment and methods used, prevent drift and displacement of seed and fertilizer. If equipment and methods of application results in wasting material, make corrections as directed.

Do not disturb areas previously completed. If areas are disturbed, re-treat as directed, at Contractor's expense.

(d) Notice Of Commencing Work - Notify the Engineer at least 2 calendar days in advance of starting operations, and keep the Engineer advised of the operations.

## 01020.43 Mulching:

(a) General - Evenly apply mulch material according to these provisions and the special provisions within 48 hours after seeding and fertilizing.

Place mulch after seeding and fertilizing, except for conditions allowing seed applied on mulch according to 01020.42(a).

Replace any material that becomes displaced before acceptance of the work.

(b) Placing of Mulch - Mulch areas not accessible to heavy equipment by approved methods. Place mulch materials according to the following:

- Place grass straw mulch to a reasonably uniform thickness of 1-1/2 to 2-1/2 inches, and average approximately 2 inches in loose condition. This rate requires between 2 and 3 tons of dry mulch per acre. The grass straw mulch shall be loose enough for sunlight to penetrate and air to circulate; but dense enough to shade the ground, reduce water evaporation, and materially reduce soil erosion. Retain grass straw mulch in place according to the special provisions.
- Place waterborne wood cellulose fiber material, where fibers are uniformly suspended in water, to seeded areas using hydraulic pressure equipment. Unless otherwise specified apply at least 2,000 pounds per acre, based on dry fiber weight.

(c) Protective Measures - Prevent damage to prepared areas and to fertilizer, seed and mulch in place.

Remove mulch material which falls on plants, roadways, gravel shoulders, structures, areas where mulching is not specified, or which collects at the ends of culverts or accumulates to excessive depths, as directed.

If tacking agents are used with mulch, use protective covering on structures and objects where coverage and stains would be objectionable. Protect vehicles and persons from drifting spray.

## Section 02330 - Loose Riprap

### Description

02330.00 Scope - This section consists of the requirements for riprap, grouted riprap, and filter blankets.

### Materials

02330.10 Riprap Requirements:

(a) General - Rock for loose riprap shall:

- Meet the test requirements of 02330.10(b).
- Be angular in shape. Thickness of a single rock shall not be less than one-third its length. Rounded rock will not be accepted unless authorized by the Engineer.
- Meet the gradation requirements for the class specified.
- Be free from overburden, spoil, shale and organic material. Non-durable rock, shale, or rock with shale seams is not acceptable.

(b) Test Requirements - The rock shall conform to the following test requirements:

| Material Test | Requirement |
|---|---|
| Apparent Specific Gravity (AASHTO T 85) | 2.50 Min. |
| Percent Absorption (AASHTO T 85) | 6.0 Max. |
| Degradation (OSHD TM 208A) | |
| Passing NO. 20 Sieve | 35.0% Max. |
| Sediment Height | 8.0" Max. |
| Soundness (OSHD TM 206) | |
| Average Loss of 2-1/2" - 1-1/2" and 1-1/2" - 3/4" fraction after 5 alternations | 16.0% Max. |

(c) Gradation Requirements - Grade loose riprap by class and size of rock according to the following:

| Class 50 | Class 100 | Class 200 | Class 700 | Class 2000 | Percent (by weight) |
|---|---|---|---|---|---|
| Size of Rock (Lb.) | | | | | |
| 50-30 | 100-60 | 200-140 | 700-500 | 2000-1400 | 20.0 |
| 30-15 | 60-25 | 140-80 | 500-200 | 1400-700 | 30.0 |
| 15-2 | 25-2 | 80-8 | 200-20 | 700-40 | 40.0 |
| 2-0 | 2-0 | 8-0 | 20-0 | 40-0 | 10.0-0 |

Uniformly grade each load of riprap from the smallest to the largest size specified. Control of gradation will be by visual inspection.



(1) Control Sample - If directed, provide, at a satisfactory location near the project, a rock sample of at least five tons meeting the gradation for the class specified. This sample will be used as a frequent visual reference for judging the gradation of the riprap supplied.

(2) Sampling and Testing Assistance - Resolve any difference of opinion between the Engineer and the Contractor by dumping and checking the gradation of two random truck loads of rock. Mechanical equipment, a sorting site and labor needed to assist in checking gradation shall be provided by the Contractor at no additional cost to the Division.

02330.20 Grouted Riprap - Rock for grouted riprap shall conform to the requirements of 02330.10, and the portland cement grout shall conform to the requirements of 02080.40.

02330.30 Filter Blanket - Filter blanket material shall conform to the following requirements according to riprap class:

| Riprap Class | Filter Blanket |
|---|---|
| Class 2000 | 12-inch layer of Class 50 riprap conforming to 02330.10. |
| Class 700 | 9-inch layer of Class 50 riprap conforming to 02331.10, or 6"-0 stone embankment meeting the test requirement of 00330.16. |
| Class 200 | 6-inch layer of 4"-0 stone embankment meeting the test requirements of 00330.16. |
| Class 100 | No filter blanket required. |
| Class 50 | No filter blanket required. |

01020.44 Erosion Control Matting - Place jute or excelsior matting flat in single thickness strips paralleling the direction of probable water flow. Lap multiple strips of jute matting in shingle fashion. Overlapping of adjacent strips of excelsior matting will not be required. Place matting in contact with the soil at all points and secure in place with wire staples. Lap and staple, according to the details shown.

## Maintenance

01020.60 Care of the Work - Be responsible for all work performed under this Section according to 00170.80 and 00330.49.

## Measurement

01020.80 General - The quantities of seeding, fertilizing, mulching and tacking agent will be measured by the surface acre, to the nearest 0.1 surface acre, for each item. Measurement will be along the ground surface to the nearest foot. A surface acre is defined as 43,560 square feet measured on the ground surface. No separate or additional measurement will be made for fertilizer, seed, mulch or tacking agent used in the work.

If the bid item "Seeding, Fertilizing, and Mulching is" 1.0 acre and the actual work performed by the Contractor is less than 1.0 acre, the quantity paid for will be 1.0 acre. If the actual work performed is greater than 1.0 acre, the quantity to be paid for will be the actual quantity of work performed.

01020.81 Erosion Control Matting - The quantities of erosion control matting will be measured by the square yard basis, to the nearest square yard. Measurement will be along the ground surface to the nearest foot. No separate or additional measurement will be made for staples and other materials used in the work.

## Payment

01020.90 General - The accepted quantities will be paid for at the contract unit price per unit of measure for the following items:

| Pay Item | Measurement |
|---|---|
| (a) Seeding | Acre |
| (b) Fertilizing | Acre |
| (c) Second Application of Fertilizer | Acre |
| (d) Mulching | Acre |
| (e) Tacking Agent | Acre |
| (f) Seeding and Fertilizing | Acre |
| (g) Seeding, Fertilizing and Mulching | Acre |
| (h) Seeding, Fertilizing, Mulching and Tacking | Acre |
| (i) Seeding, Fertilizing, and Straw Punched In | Acre |
| (j) Erosion Control Matting | Square Yard |

Payment will be payment in full for preparing area, furnishing and placing all materials, including all equipment, tools, labor, and incidentals necessary to complete the work.