Richland

City of Richland

Horn Rapids Industrial Park
Rail Transportation Planning Report

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1. Executive Summary

1.1. Purpose, Goals and Objectives

There is an ever-increasing demand for more rail infrastructure serving the businesses within the City of Richland's Horn Rapids Industrial Park (HRIP). The Industrial Park is one of the few locations in the State of Washington that has service by both Class I railroads. The City would like to plan for the best way to benefit the Industrial Park and future businesses in this area with this important rail access.

The purpose of this study is to:

- Review current rail infrastructure uses and needs with City of Richland and Port of Benton, whose track serves HRIP.
- Review available property west of Kingsgate Way (the undeveloped portion of the Industrial Park) and the opportunities and constraints that are likely to affect development of this property area.
- Conduct interviews with stakeholders regarding needs and requirements for facilities that could be located in the study area.
- Develop options for extending rail infrastructure into the study area.
- Develop recommendations on most needed rail infrastructure for continued success of the existing customers in the Industrial Park and the most desirable rail infrastructure improvements to entice more companies to the Industrial Park.
- Provide a brief update to supplement previously performed assessments of the commercial prospects for an inland intermodal port at Horn Rapids.
- Prepare a brief update to supplement the Port of Benton Rail Line Market Study of 2017 to assess updated demand for bulk-to-truck/container trans-load facilities in the Tri-Cities region.

The study area and vicinity are shown in Figure 1.

1.2. Rail Extension Options

Evaluation of options for extending rail infrastructure into the study area was guided by six objectives:

- Objective 1 - Flexibility to Suit Diverse Development Opportunities
- Objective 2 - Plan for Future Extension of Rail Service North of Horn Rapids Road

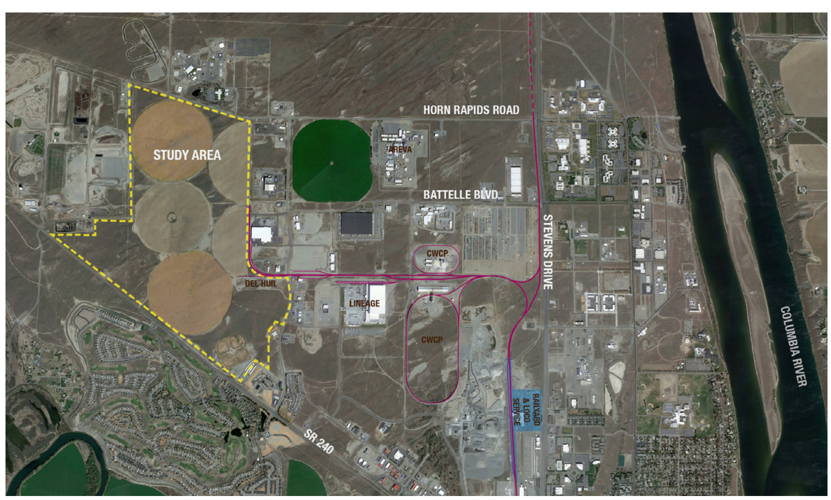

Figure 1: Study Area and Vicinity

- Objective 3 - Leverage the Size of the Property to Attract Large Economic Development Opportunities
- Objective 4 - Leverage the Unique Advantage of Service from Two Class I Railroads
- Objective 5 - Plan for Phased Development of Infrastructure
- Objective 6 - Satisfy Class I Railroad Design Criteria

A main rail corridor through the study area would likely include multiple tracks. The appropriate number of tracks would be determined based on the volume and type of rail activity in the study area. There are three configurations of train that could potentially operate at HRIP:

- Manifest trains are made up of mixed rail cars (box cars, tank cars, intermodal cars, etc.) and can be anywhere from 1,000 feet to more than 6,000 feet in length.
- Unit trains are made up of a single type of car, all carrying the same commodity and shipped from the same origin to the same destination, without being split up or stored en route. Unit trains are typically 7,000 feet or longer.
- Shuttle trains run back and forth between two points, typically offering frequent service over a short route. Some shuttle trains are also unit trains, in terms of composition of rail cars and length of the train.

The operating procedures for arrival and departure of unit trains are likely to be a key controlling design factor if a facility utilizing unit train service is developed in the study area, or the area north of Horn Rapids Road.

- If all facilities within the study area and north of Horn Rapids Road are served by manifest trains, it is likely that a single loop track serving the study area and a lead continuing from the loop northward across Horn Rapids Road would be sufficient.
- If all facilities within the study area are served by manifest trains, and a unit train facility is developed north of Horn Rapids Road, a single loop track serving the study area and a parallel bypass track would likely be necessary. The bypass track would allow unit train arrivals and/or departures to reach the facilities north of Horn Rapids Road without potential delays associated with manifest train movements in the study area.
- If unit train facilities within the study area and north of Horn Rapids Road are anticipated, it is likely that a muliple track loop corridor would be required within the study area and a parallel bypass track would be necessary for unit train arrivals and/or departures for the facilities north of Horn Rapids Road.

Since the level of potential development and specific facility needs are unknown at this time, the focus of this study is on the aligment of the corridor. Further study of the appropriate number of tracks within the corridor should be undertaken when details of prospective developments and rail traffic characteristics are available.

All potential routes for extension of a main rail corridor identified by this study would begin at the current terminus of the City owned railroad track, just west of Kingsgate Way near the Del Hur site. From this starting point, four potential routes for a very large loop rail corridor through the study area have been identified. The potential routes are depicted in Exhibits included in Appendix A.

Each of the loop configurations offers slightly different advantages in terms of overall length and ability to accomodate various facility types.

1.3. Development Opportunities and Rail Service Options

Each of the options for the main rail corridor creates different opportunities for rail served development. Detailed site development feasibility analysis is beyond the scope of this study, however to prepare a high level assessment of development opportunities associated with each of the potential rail corridor options this study identified potential development sites within the study area that would be adjacent to the rail corridor and suitable for development of a flat, pad ready site of at least 12 acres. Based on typical characteristics of a range of rail served facility types, each of the rail extension options creates the oppotunity to accommodate and serve development of:

- Manufacturing facilities
- Inland Intermodal and container transload facilities
- Warehousing and distribution
- Food and vegetable processing
- Bulk material facilities (dry bulk and liquid bulk)
- Biofuels manufacturing
- Cold storage facilities

1.4. Battelle Boulevard Extension

Future extension of Battelle Boulevard to a new intersection on SR 240 opposite Village Parkway would cross the study area from the northeast to the southwest and would cross the future main rail corridor approximately 2,850 feet west of Kingsgate Way.

If rail dependent development were to occur in the study area or within the former Department of Energy (DOE) property north of Horn Rapids Road, trains would likely block both Kingsgate Way and the extended Battelle Boulevard when arriving and departing the area, and when serving rail customers and facilities in the study area. If a unit train customer or facility were located in the study area or the former DOE property north of Horn Rapids Road, it is likely that unit trains passing Kingsgate and Battelle would block the streets for 6 to 12 minutes during each passing, depending on the length of the unit train and an assumed train operating speed in the area of 10-15 mph. For portions of these train movements, both streets would be blocked simultaneously, hindering vehicle access between HRIP, the study area, and SR 240. To position the study area and the former DOE property north of Horn Rapids Road for future development, planning for a rail-vehicle grade separation at the extension of Battelle Boulevard is recommended.

All potential routes for extension of a main rail corridor evaluated in this study would result in a crossing of Battelle Boulevard at approximately the same location, therefore the selection of any of the identified rail routes has little influence on the planning for a grade separation structure.

A grade separation structure at this location could be configured as a road undercrossing the rail corridor, or a road crossing over the rail corridor. Order of magnitude estimated cost of the roadway overcrossing of the track described above is $3.9M to $5.3M. The estimated construction cost of the roadway undercrossing of the track described above is $4.6M to $6.3M.

A road undercrossing may offer advantages if the road will be constructed before the full extent of rail development and demand in the study area has been determined. Constructing the road at a depressed elevation relative to the existing grade with retaining walls on each side of the road provides greater flexibility in the final alignment and width of a rail overcrossing. This approach may also allow deferal of construction of the bridge structure and the associated capital cost.

1.5. Market Potential for an Inland Intermodal Hub

The geographic position of HRIP could be attractive to various producers and distributors of unitized cargoes as a location for loading and unloading international ocean containers and domestic containers/trailers to and from intermodal railcars – i.e., as an inland intermodal hub terminal.

Import containers carrying products from Asia that are destined ultimately to warehouses and stores in Eastern Washington/Oregon, in the Mountain states, and in the states east and southeast of the Mountain states could move by short-haul intermodal train service from the container terminals in the ports of Seattle and Tacoma to the Horn Rapids hub, where the containers would be unloaded from the flatcars and drayed to a logistics facility within the Industrial Park

For export commodities such as hay, specialty grains, and identity-preserved grains - or temperature controlled shipments such as frozen French fries and apples – the ability to pick up empty containers and drop off loaded containers at the Horn Rapids hub would be a significant benefit to the producers of commodities whose production/processing sites (i.e. container loading locations) are in the central/eastern Washington and Oregon area.

The primary source of empty equipment for exporters in central/eastern Washington and Oregon, who would be supporting the Horn Rapids hub, would most likely be western Washington, for both dry and reefer boxes, with supplemental empty boxes being delivered from westbound intermodal trains originating in the Midwest.

Impediments for Establishing the Horn Rapids Intermodal Hub

Several factors have impeded the establishment of an inland intermodal hub in the Richland area to date. Most importantly – there is presently no company importing high volumes of laden containers from Asia directly into the Tri-Cities area. In fact, the volume of import and export containers moving between the Ports of Seattle/Tacoma and points in central/eastern Washington and Oregon is relatively minor.

There is also at least an 8:1 imbalance between export laden containers and import laden containers for the central/eastern Washington and Oregon area. Because of the traffic imbalances, exporters in central/eastern Washington and Oregon have to be supplied with empty containers, the vast majority of which are sourced from western Washington and repositioned by trucks.

There are numerous challenges associated with repositioning empty containers from the Seattle/Tacoma area by intermodal train to a central location such as Richland. The most economic way of supplying empty container equipment for the exporters of central/eastern Washington via the prospective inland hub at Horn Rapids is if at least a few major importers were to establish inbound logistics/transloading operations at a facility at the hub.

With the large land parcels available at HRIP, third party logistics providers (3PLs) operating transloading facilities on behalf of importers/retailers (also referred to as beneficial cargo owners, or BCOs) could benefit from locating their operations in Richland.

In addition to the 3PLs that could potentially obtain the afore-mentioned benefits, there are large BCOs/importers that operate their own import processing/transloading facilities who could be interested in HRIP and inland hub as a long-term capacity addition.

Recent Initiative and Long-Term Opportunities

In the past few years, an initiative has been progressed to develop an inland intermodal hub in HRIP. In particular, Central Washington Corn Processors (CWCP) and its partners have been attempting to develop an intermodal center/logistics park adjacent to the existing CWCP rail loop.

In addition to container loading and unloading, initial traffic flow being targeted by the prospective joint venture includes a hay processing facility. In addition, CWCP and its partners have been working to secure long-term contracts with one or two major importers to establish import distribution/transloading operations in a 1-million SF facility that CWCP and its partners would custom-build to their specifications. This facility would be located immediately west of the intermodal yard. Target customers for the facility are companies that are realizing that developing new logistics infrastructure in the Puget Sound area is becoming too time-consuming, too expensive, and too constrained.

Although there are challenges to establishing commitments from railroads and shippers for a new facility and rail service, based on reports from Port users, Mercator believes that this initiative is close to getting started, with one or two major importers expected to commit to the project by or before early 2022, and with one of the Class I railroads committing to rate and service levels shortly thereafter. As a result, by or before the end of 2023, with the facility completed, there is likely to be at least one intermodal unit train per day running between Horn Rapids and Seattle/Tacoma, moving eastbound import loads, some eastbound empties, westbound hay, other westbound dry commodities, and westbound reefers loaded at the Lineage facility. There would also likely be loadings of domestic containers onto intermodal railcars for movements to states east of the Rocky Mountains.

As the decade progresses further, there are likely to be additional importers and 3PLs wanting to capitalize on the advantages discussed earlier of locating logistics infrastructure in the Horn Rapids area, and therefore to utilize the short-haul intermodal trains running between the ports and this inland hub. One could also expect a competitor of Lineage Logistics to develop a similar operation in this area as well and generate more stack-car moves and container lifts to/from those stack-cars.

However, once the number of intermodal train movements starts exceeding 4 per day, it will become increasingly inefficient for those trains and the inbound unit grain trains for CWCP to be moving into, out of, and within the same general area.

Mercator therefore projects that by – if not before 2030 – there will be a demand for a larger intermodal/logistics center, and the open area northwest of where CWCP and Lineage are located should be close enough to the first inland hub for the two facilities to provide operational and commercial synergies for each other.

1.6. Recommendations

Leveraging the Unique Characteristics of HRIP

HRIP offers several characteristics which collectively make the site suitable for potential development of rail served facilities. The two most notable features are:

- Service of Two Class I Railroads - HRIP is one of few industrial sites in Eastern Washington and Oregon that is served by two Class I railroads.
- Size of the Property - The size and natural character of the property creates relatively few constraints to development of facilities for industrial or manufacturing use. The core of the property is of sufficient size to accommodate nearly any type of industrial or manufacturing facility based on current typical facility standards.

The unique characteristics of this site can be best leveraged by creating a rail corridor which provides access to and through the property, takes advantage of the size of the property without limiting potential development, and is able to meet or exceed the unit train handling capabilities of other sites in the Pacific Northwest.

Rail Corridor

A rail corridor configured as a very large loop would provide rail access throughout the study area, while allowing creation of trackside development sites that could range in size from 10 acres to over 200 acres. The area inside the very large loop is ideal for large manufacturing or builk facilities that would be served by unit trains, while the area outside the very large loop is ideal for smaller facilities served by manifest trains and container transload facilities.

A rail corridor loop could be constructed at HRIP in phases based on market demand, which would allow the capital cost of the rail infrastructure to be somewhat aligned with the scale of development that it would support. The most capital intensive portion of the loop is the northern portion which serves the largest potential development sites.

Among the corridor options identified for this study, Option D was identified as the recommended corridor alignment due to its ability to accommodate the longest unit trains, the location and truck access of the potential container transload site in this Option, and the size of other potential rail-served development sites that can be created adjacent to the rail corridor.

Battelle Boulevard Extension

To position the study area and the former DOE property north of Horn Rapids Road for future development, planning for a rail-vehicle grade separation at the extension of Battelle Boulevard is recommended.

2. Introduction

The City of Richland Development Services Department / Business & Economic Development office manages the City's undeveloped properties, including HRIP land. Business & Economic Development has the responsibility for developing this property by installing roads and utilities and developing saleable lots. In addition, the City of Richland owns an Industrial Rail Spur that serves HRIP. There is an ever-increasing demand for more rail infrastructure serving the businesses within the Industrial Park. HRIP is one of the few locations in the State of Washington that has service by both Class I railroads. The City would like to plan for the best way to benefit the Industrial Park and future businesses in this area with this important rail access.

The purpose of this study is to:

- Review current rail infrastructure uses and needs with City of Richland and Port of Benton, whose track serves HRIP.
- Review of available property west of Kingsgate Way (the undeveloped portion of the Industrial Park) and the opportunities and constraints that are likely to affect development of this property area.
- Conduct interviews with stakeholders regarding needs and requirements for facilities that could be located in the study area.
- Develop options for extending rail infrastructure into the study area, including:
    - Identification of potential types and sizes of needed Unit Train loading/unloading facilities, and suitable locations for these facilities within the study area; identification of potential routes for a primary rail lead track extension into the site; identification of potential type and location for grade separation structure between the future extension of Battelle Boulevard and the rail lead track within the study area.
    - Preparation of a conceptual level construction cost estimate for proposed lead track extension and grade separation structure.

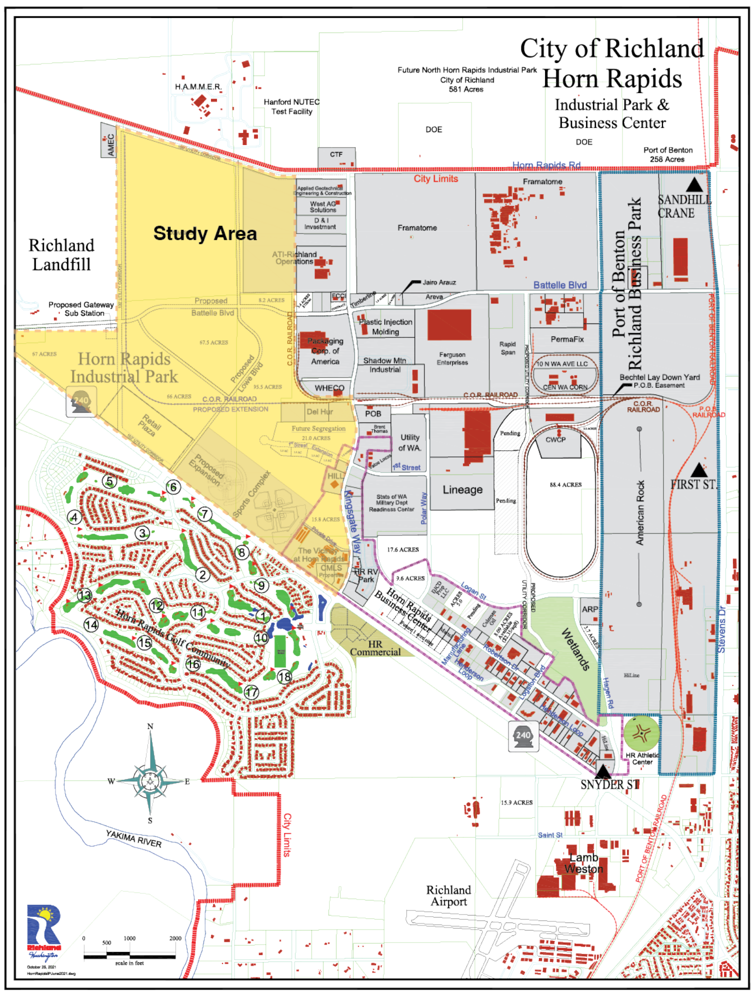

Figure 2: Study Area

- Development of recommendations on most needed rail infrastructure for continued success of the existing customers in the Industrial Park and the most desirable rail infrastructure improvements to entice more companies to the Industrial Park.
- Provide a brief update to supplement previously performed assessments of the commercial prospects for an inland intermodal port at Horn Rapids, designed to handle:
  - Inbound empty containers railed to the Horn Rapids terminal from the Ports of Seattle and Tacoma or from the Midwest.
  - Inbound loaded railcars transporting grain products and/or other bulk/break-bulk products from Midwest and Rocky Mountain states, to be transferred at an on-site transload facility into empty containers for export.
  - Outbound loaded containers railed from the Horn Rapids terminal to the Puget Sound ports or to Midwest markets.
  - Inbound loaded containers railed from the Puget Sound ports for distribution and other value-added logistics services to PNW and Rocky Mountain markets.
- Prepare a brief update to supplement the Port of Benton Rail Line Market Study of 2017 to assess updated demand for bulk-to-truck/container trans-load facilities in the Tri-Cities region.

3. Study Area

3.1. Site and Topography

The Study Area Plan (Figure 1) provides an overview of the property evaluated in this study for rail service and rail related development. The study area includes multiple property parcels owned by the City of Richland, comprising a total area of approximately 707.6 acres. The land area includes a generally rectangular, core area of approximately 429 acres, and irregularly shaped areas on the east and west sides which adds approximately 278 acres. As noted in the executive summary, the site is bounded on the north side by Horn Rapids Road, on the west side by the Richland Landfill and the extension of Twin Bridges Road and on the south side by SR 240. East of the study area are developed industrial sites within HRIP, including Del Hur, Allegheny Technologies Incorporated (ATI), and Packaging Corporation of America. The Hanford Nuclear Reservation is the dominant land user in the area and is located to the north of the site. The Horn Rapids residential master planned community, comprising of 835 acres, is the major land use to the south and west. The Columbia River lies about three miles to the east and the Yakima River is about one mile to the west.

According to the 2016 City of Richland Horn Rapids Master Plan Update, zoning in the study area is primarily heavy manufacturing and medium industrial with a small amount of general business. The surrounding area consists of a mix of neighborhood retail business, limited business, agriculture and multiple family residence.

The heavy manufacturing district (M-2) is intended primarily for heavy manufacturing and other closely related uses. Regulations for this district are intended to provide protection principally against effects harmful to other districts. This zoning classification is intended to be applied to some portions of the City that are designated Industrial under the City of Richland Comprehensive Plan.

The medium industrial use district (I-M) is a zone providing for limited manufacturing, assembly, warehousing and distribution operations and retail and wholesale sales of products manufactured on the premises or products allied thereto; and administrative and research and development facilities for science-related activities and commercial uses that are supportive and compatible with other uses allowed in the district. Regulations are intended to prevent frictions between uses within the district, and also to protect nearby residential districts. This zoning classification is intended to be applied to some portions of the City that are designated Industrial under the City of Richland Comprehensive Plan.

The majority of the study area is currently cultivated and irrigated for production of crops. The topography across the core of the site is gently undulating with slopes typically ranging from 2% to 14%. In the southwest and southeast corners of the site, isolated areas of steeper slopes are found, ranging from 18% to 20%. Elevations across the core of the site range from +435 to +480.

Former DOE Property North of Horn Rapids Road

North of the study area and north of Horn Rapids Road is an area of 1,341 acres transferred from DOE to the City of Richland and Port of Benton in 2016 for the purpose of economic development and diversification of the economic base in the community. An interlocal cooperation agreement has been established between the City and Port to provide for the coordinated and cooperative development and marketing of their respective portions of the property. In consideration of the uncommon size of this land and proximity of the land to rail, road and utility infrastructure, the interlocal agreement includes among its objectives the reservation of a “Mega Property” opportunity, market and selling their respective properties in a manner that preserves a site of 200 to 500 acres to be utilized for a single large user.

3.2. Existing Conditions

HRIP encompasses approximately 4,000 acres of land which includes parcels previously owned by the Atomic Energy Commission, U.S. Bureau of Land Management, and Washington State Department of Natural Resources. The City of Richland and Port of Benton now control the property, which has been envisioned as an employment center for the community. A portion of the property has been developed, and is home to a variety of industrial uses including fabrication, warehousing and distribution, cold storage, and dry bulk handling and storage. Portions of the undeveloped land are currently leased for agriculture use..

4. Development Constraints and Opportunities

Extension of rail into the study area was evaluated within the context of the following site constraints and potential opportunities:

- Existing Roadways SR240 and Horn Rapids Road - For the purposes of the study, it was assumed that the existing roadway alignments of SR240 and Horn Rapids Road would remain unchanged, effectively establishing the northern and southern limit of the study area.

- Limited to Undeveloped City-Owned Property - For the purposes of the study, it was assumed that the extension of rail and the potential development of property for rail dependent facilities would be limited to undeveloped property currently owned by the City of Richland.
- Potential for Park Expansion - Expansion of park and recreation facilities is planned along the north side of SR240, this area was not considered as a potential location for rail dependent development for the purposes of this study.
- Preservation of Overhead Power Transmission Lines - Overhead power transmission lines are located along the southern, western and northern edges of the study area. For the purposes of this study it was assumed that these transmission lines would be preserved and maintained in place.
- Battelle Boulevard Extension to SR240 - As discussed in Section 10, a future roadway connection to SR 240 is planned directly opposite Village Parkway on the south side of SR 240. This roadway connection would allow the extension of Battelle Boulevard through the study area, establishing an additional link between Horn Rapids industrial and manufacturing facilities and SR240.
- Potential for Development of City and Port Owned Land - As discussed in Section 3, the City and Port own 1,341 acres of land north of Horn Rapids Road which could benefit from rail service in the future. Potential for extension of rail from the study area across Horn Rapids Road to serve future development was considered in the development and evaluation of rail extension alternatives for the study area.

5. Rail and Road Network

5.1. Rail Network

Class I and Shortline Service

Rail service in the Tri-Cities area is provided by two Class I carriers and several shortline railroads. One of the Class I carriers is the Burlington Northern Santa Fe Railway (BNSF), which has three major corridors that traverse the region. These lines all converge at the Pasco Yard, a major classification and sort yard. The Portland-Pasco Main Line runs along the Washington side of the Columbia River from Vancouver to the Tri-Cities. This is the main corridor for BNSF unit trains of bulk cargoes, such as grain, oil, and coal. It also handles manifest trains, some intermodal trains, and one passenger train.

The Auburn-Pasco Main Line runs from Auburn over Stampede Pass to Ellensburg, and then follows the Yakima Valley to Pasco. Tunnels on the line do not have the clearance for double-stack container trains. Because of the tunnel clearance issue, double-stack trains must travel through the Columbia River Gorge and then up the I-5 corridor, a rail trip that is roughly twice as long as the truck route from Richland to Seattle/Tacoma. The line is mainly used for moving empty bulk unit trains eastward.

The Pasco-Spokane Main Line connects the Columbia Gorge route to the BNSF Great Northern Corridor, the BNSF northern route to the Midwest. Freight traffic consists of intermodal, forest and agricultural products, coal, chemicals and finished automobiles.

The other Class I railroad is the Union Pacific Railroad (UP). The UP has a major yard in Hermiston, Oregon, where several mainline segments converge. The Ayer Subdivision runs between Hermiston, Oregon and Spokane. East of Spokane this line runs north through Idaho to the Canadian border, where it interchanges traffic with Canadian railroads. Freight traffic is forest products, agricultural products, potash, petroleum, and chemicals.

The UP Hermiston-Portland line follows the Oregon side of the Columbia River to Portland. This line carries intermodal traffic, grain, potash, petroleum, and other products. Traffic moving westward on the UP from the Tri-Cities must first move southeast to Hermiston, and then along the Hermiston-Portland line.

The UP has a 19-mile branch line that runs from Wallula to Kennewick. This line connects to the Port of Benton rail line at Richland Junction (in Kennewick).

The BNSF and UP are both able to interchange traffic at Richland Junction. In addition, as part of the federal land transfer from DOE, both the BNSF and UP have the option of directly providing service over the Port of Benton line.

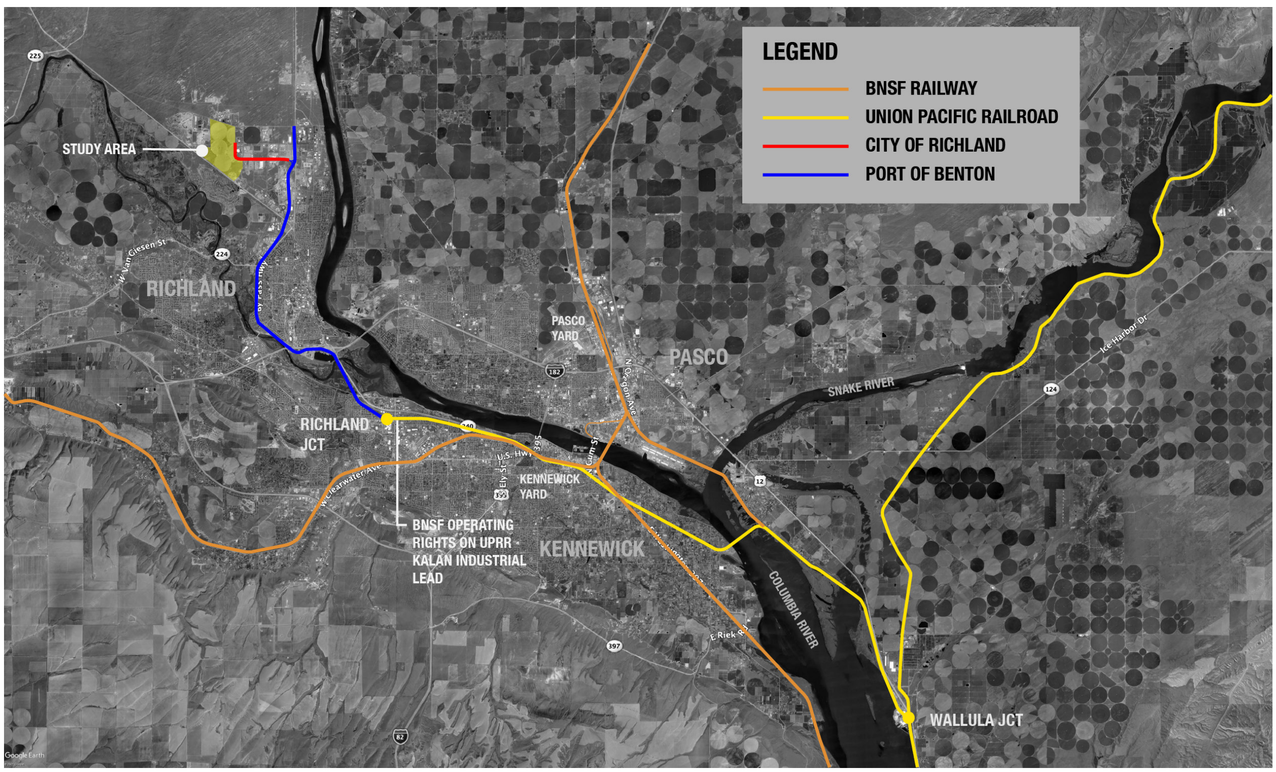

Figure 3: Class I Rail Network

Rail Network within HRIP

The Port of Benton rail line runs between Richland Junction (mileport 18.84) and Horn Rapids Road (milepost 29.73), then continues north on the Department of Energy (DOE) track to the Hanford Nuclear Reservation. The line was originally built to serve the Hanford nuclear reservation and was owned by the DOE, which transferred the line to the Port of Benton in 1998.

This line is leased to the Tri-City Railroad (TCRY), which operates and maintains it. Including the Richland Yard, the Port owns 16 miles of track from the end of the DOE rail line at Horn Rapids Road in Richland to the Richland Junction by Center Parkway in Kennewick (see Figure 1). This includes 10 miles of mainline and 6 miles of track in the Richland Yard. The Horn Rapids Wye is located on the Port of Benton rail line at milepost B37.0, the wye is the point of beginning of the City of Richland rail network which continues from the wye westward through the industrial park approximately 7,200 feet before turning north and continuing approximately 2,600 feet where the track ends, approximately 350 feet north of Battelle Boulevard.

Along the city rail line are several rail served facilities including:

- Central Washington Corn Processors
- Lineage Logistics
- SI Steel (facility in development)
- Packaging Corporation of America
- Public Rail Dock
- Del Hur

Along the Port track there is a locomotive repair facility, yard with multiple tracks, and a 5-acre rail served laydown yard.

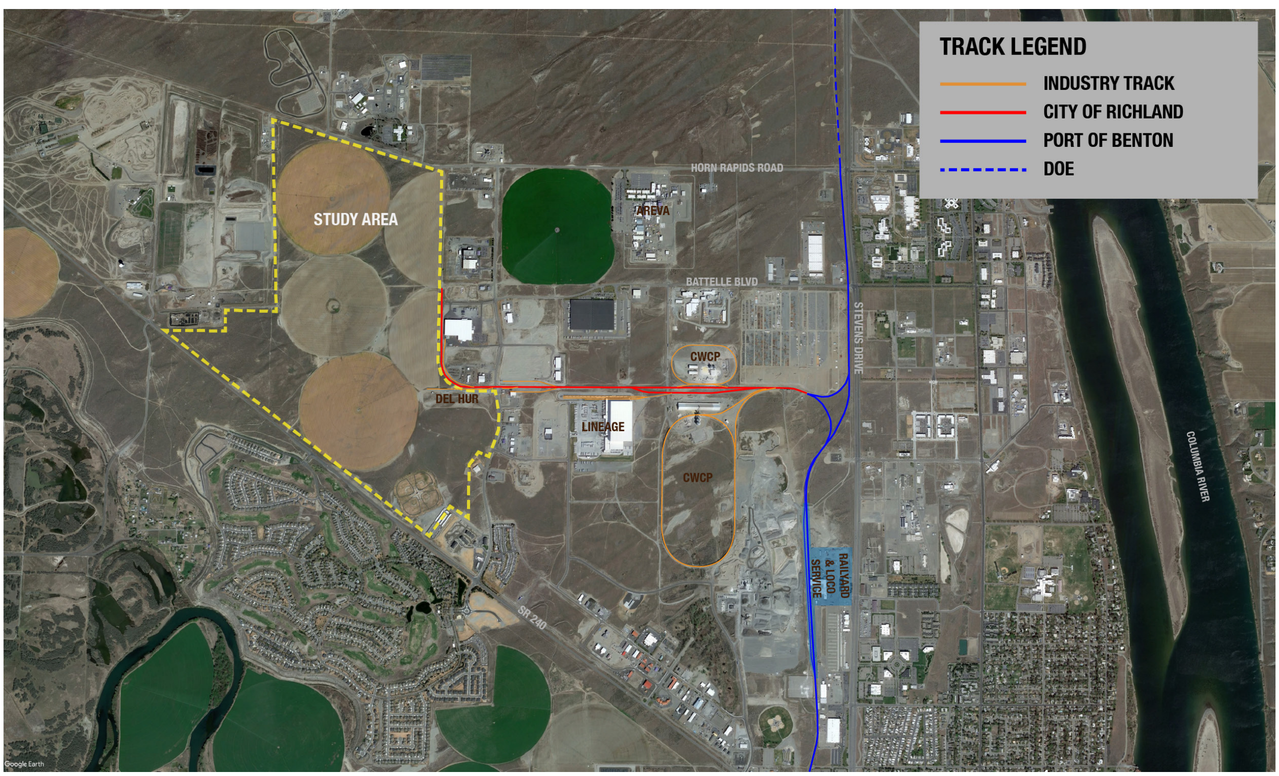

Figure 4: Rail Network within HRIP

5.2. Road Network

The primary components of the existing road network serving Horn Rapids are SR 240 along the south boundary, Horn Rapids Road which runs along the north boundary, and Kingsgate Way a north-south principal arterial which runs between them, approximately 1,000 feet east of the study area. Ultimately it is planned to extend Kingsgate Way to the south through the residential master planned community and connect to Van Giesen Street (SR 224), creating a second north-south route between the Horn Rapids area and SR 224.

Additional access points to SR 240 will be limited to those approved by the Washington State Department of Transportation (WSDOT). A future connection to SR 240 and continuing north through the study area is proposed directly opposite Village Parkway on the south side of SR 240.

As part of Master Planning conducted by the City, a series of internal collector streets within the study area are also proposed. These streets would distribute traffic between the major roads, individual properties, and other internal streets would primarily serve the proposed Business Park. Industrial roadways are proposed in strategic alignments to provide access to development areas within the industrial lands.

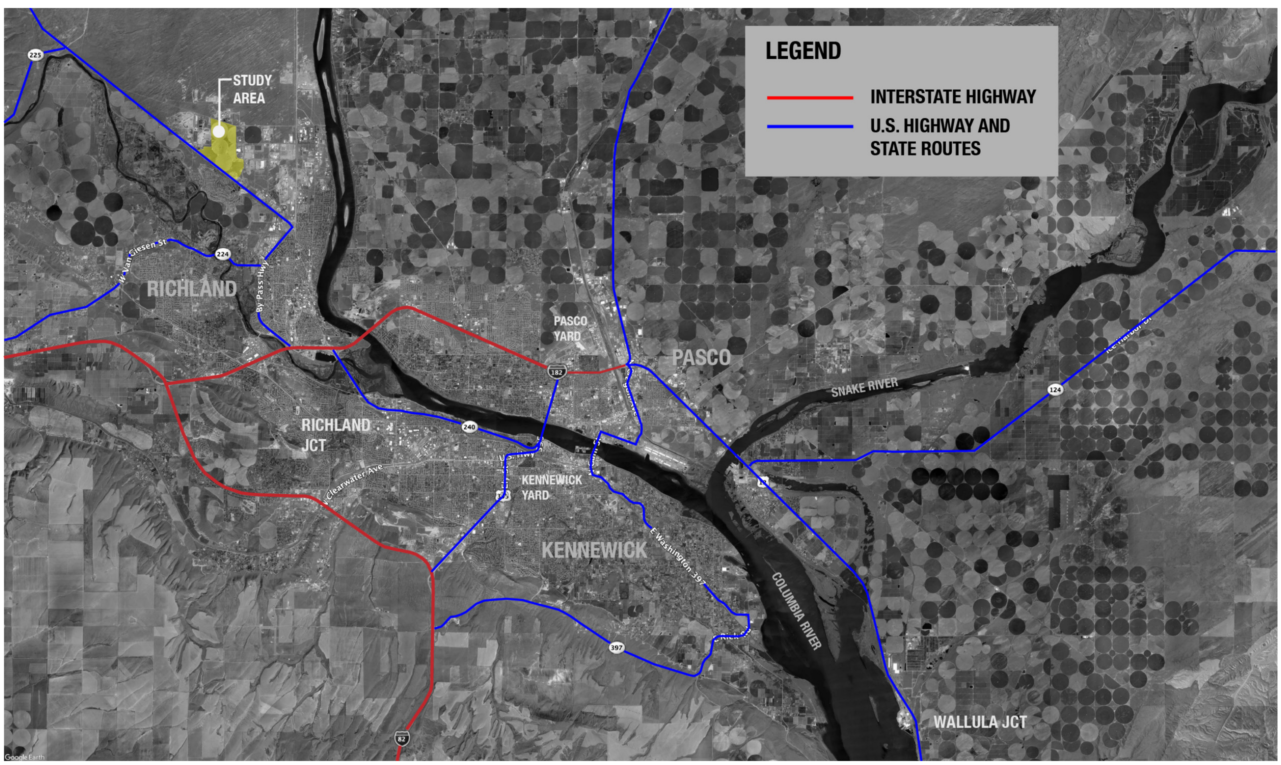

Figure 5: Road Network within HRIP

6. Site Suitabiliity

The study area offers several characteristics which collectively make the site suitable for potential development of rail served facilities. Identification and evaluation of potential rail extension alternatives for this study was guided by the goal of preserving, leveraging and enhancing the combination of characteristics that make the site particularly suitable for potential development of rail served facilities. These characteristics include:

- Service of Two Class I Railroads - The Horn Rapids area is one of few industrial sites in Eastern Washington and Oregon that is served by two Class I railroads.
- Size of the Property - The size and natural character of the property creates relatively few constraints to development of facilities for industrial or manufacturing use. The core of the property is of sufficient size to accommodate nearly any type of industrial or manufacturing facility based on current typical facility standards.
- Proximity to Existing and Potential Rail Served Facilities - The presence of several existing rail served facilities east of the site as well as the potential for development of additional rail served facilities on City and Port owned land north of Horn Rapids Road increases the likelihood that rail movements in the area will frequent and that Class I service and responsiveness will remain high.
- A higher density of rail served facilities increases the opportunity for shared usage of and benefit from key infrastructure by multiple users, potentially reducing the overall unit capital cost of new infrastructure in terms of dollars per ton-mile or dollars per car moved.
- Nearby Utility Infrastructure - The existing utility infrastructure surrounding the study area may reduce overall development costs for new facilities.
- Road Network and Highway Access - The proximity of SR240 and the proximity of I-182 within 10 minutes of the study area enhances the value of the site for facilities and operations that are dependent on truck traffic.

7. Potential Rail Served Facilities

To inform planning for a rail extension into and through the study area, several potential rail served facility types and developments were identified. The facility type examples described are intended to be representative of potential future developments that could be located in the study area, but are not intended to be inclusive of all potential future developments. The operating characteristics and physical requirements of these potential rail served facility types were used to guide identification of potential development sites as described in Section 9.

7.1. Manufacturing

Large scale manufacturing facilities that utilize rail for transportation of manufacturing inputs and outputs are likely to be facility type that would have the largest footprint or land area requirement. Large scale manufacturing facilities that utilize rail include facilities for fabrication and assembly of automobiles and trucks, aerospace/aviation, machinery, metal fabrications and plastics.

Depending on the type of products and materials being handled, onsite rail infrastructure to support a manufacturing operation can include a broad range of configurations and capacities including multiple stub spur tracks, multiple loop tracks for arrival, departure and unloading/loading of unit trains, or multiple double ended loading/unloading tracks. However, the rail infrastructure for a manufacturing facility typically occupies a small fraction of the space that is required for the plant and associated facilities such as parking, stormwater management and administrative facilities.

Example facilities demonstrating the spectrum of requirements for manufacturing include:

- PPG Industries operates a 96,000 square foot manufacturing plant in McCarran Nevada, the plant was built in 2008 to manufacture architectural coatings. The facility occupies an approximately 10 acre site. On one side of the plant are two stub spur tracks for tank cars, each able to accommodate 3-4 cars.
- Mercedes Benz operates a 3.7 million square foot automotive plant in Tuscaloosa Alabama, occupying approximately 620 acres. The plant is the only plant worldwide producing several vehicle models for Mercedes Benz. Finished vehicles are loaded onto rail cars placed on five stubbed working tracks at the rear of the plant, each track provides 4,500 to 4,900 feet of working length. Additionally, an eight acre rail storage yard is located adjacent to the Mercedes Benz plant between the main line and the stub tracks. CSX operates an intermodal hub approximately 15 miles east of the automotive plant which offers approximately 5,000 feet of working track for loading and unloading of intermodal containers. The intermodal hub was completed in 2009 at a cost of approximately $6 million and occupies approximately 25 acres.10 Initial demand at the CSX facility was expected to be 10,000 to 15,000 containers annually, primarily containers moving between the Mercedes Benz plant and Germany, and the facility as initially constructed provided capacity to handle up to 40,000 containers annually.

7.2. Inland Intermodal Hub

An inland intermodal hub is a facility for transfer of shipping containers between trucks and trains for transport to and from seaports. In Richland, an inland intermodal hub could operate as a center for transshipment of containers moving between Central and Eastern Washington and Oregon and container terminals in Seattle and Tacoma.

In addition to transshipment of containers, an intermodal hub could offer services such as transloading of materials and goods, logistics support, storage, consolidation, maintenance and customs.

As described in the 2017 Port of Benton/City of Richland Rail Master Plan:

> *Interest in inland container ports has increased in recent years due to several factors. For seaports, the transport of regional containers by rail promises to relieve congestion on highways, local port roads, and at marine terminal gates. An inland port could also free up space at marine terminals. For shippers, inland container ports might reduce costs by reducing drayage distance, truck turn times, and driver shortages.*

In the 2017 Port of Benton Rail Line Market Analysis, BST Associates noted:

> *The trucking industry is facing several changes that will likely tighten the supply of drivers and increase costs over time. These changes will likely impact both intermodal drayage and long-haul operators.*
>
> *The biggest concern for the trucking industry is the federal electronic logging mandate (ELD) which will require truckers to utilize electronic logs (as opposed to paper logs) to document driver hours. The law, which is scheduled to take effect at the end of 2017, could reduce driver productivity. Werner, a major carrier with more than 7,000 trucks, measured productivity losses at 3% to 5% after initiating ELD. Smaller operators may be*

impacted even more, with some estimating as much as a 15% drop in productivity.

Hours of service regulations are the second major industry concern. These regulations limit the number of hours a truck driver may spend behind the wheel per day and per week, which may reduce truck drivers' earnings and impact overall supply chain efficiency.

An overarching long-term concern is the growing shortage of drivers. The American Trucking Associations (ATA) estimated a national shortage of 48,000 drivers in 2015, with projections that the shortage could increase to 175,000 by 2025.

Seasonality also impacts the availability of trucks. Because the harvest overlaps for the most important local crops, trucks and drivers are in short supply during harvest season. This impacts the agriculture industry all along the supply chain, from growers trying to move their harvest from farm to warehouse, to processors trying to move the finished product to market.15

The use of inland container ports, connected via short-haul intermodal, has proven viable in the PNW and elsewhere. Northwest Container Services has offered overnight container train service between Portland and Seattle/Tacoma since 1986. Northwest Container Services also provides intermodal container service between Seattle/Tacoma and Boardman, OR. The Boardman service was recently expanded in response to the loss of direct container service in Portland.

On the U.S. East Coast, inland container ports have been successfully established at multiple locations in Georgia and South Carolina as well as Virginia. These inland ports are 200 to 300 miles from the coastal deep-water marine terminals. Additional inland intermodal ports are in the planning, design and construction stages for improvement of cargo fluidity at the Port of Houston, Port of Oakland, Port of Los Angeles and Port of Long Beach.

The Ashcroft Terminal in Ashcroft, B.C. is operated by the PSA Group and offers a intermodal transshipment, transloading for liquid and dry bulk, railcar storage, warehousing, logistics, railcar repairs.

Inland Intermodal Hub Characteristics

The acreage needed for an inland intermodal hub depends on several factors including the anticipated volume, the average dwell time for containers, the equipment used for container handling, and the physical relationship between the working tracks and tracks that can be used for storage, arrival and departure. Many intermodal rail terminals are designed and built for multi-phase expansion.

An initial phase of construction for an inland intermodal hub at Richland might be designed to serve three roundtrip trains per week in each direction. Assuming that the initial train length would be 5,000 feet, each train could carry 160 containers, and the facility would handle a total of 960 containers per week. A facility of this capacity would require 17 to 20 acres if containers were stored on chassis and had a typical dwell time of two days. If the containers had a typical dwell time of three days, the space required would be 22 to 25 acres.

Ultimately, increasing the volume handled by the facility and the frequency of service will maximize the likelihood that the facility is successful. A facility that is handling daily or multiple daily trains that are 7,000 feet or longer is more likely to succeed over a long period of time than a facility handling two or three trains per week that are less than 5,000 feet. Increasing the volume, train length and train frequency of the facility improves the economics of the service for the railroads, improves reliability for shippers, and enhances the long term viability of the service and facility for other potential developments that could be attracted to sites in the immediate vicinity.

Expanding the initial phase of an inland intermodal hub to handle daily 7,200 foot trains in each direction Monday through Saturday would require an additional 37 to 45 acres, to reach a total facility size of approximately 62 acres, excluding the space required for rail car storage, or spotting of arriving and departing unit trains.

7.3. Warehousing and Distribution

New rail served warehousing and distribution facilities can include facilities with nearby access to intermodal rail yards and facilities that have dedicated rail spurs serving the facility. Facilities recently constructed across the United States have included warehouse and distribution buildings in a range from 400,000 to 1.2 million square feet on sites ranging from approximately 25 to 100 acres.

Depending on the type of products and materials being handled, a rail spur onto the site or into the building may be included, or the facility may utilize a nearby intermodal transload facility. Typical facility requirements for intermodal transload facilities are discussed above. Recently constructed warehouses with rail passing into the building include the Venture Logistics facility in Indianapolis and the Home Depot Distribution Center at Tradepoint Atlantic in Baltimore.

The Venture Logistics facility was opened in 2017 with a single lead track serving 15 rail car spots inside the warehouse building. The facility handled 1,200 carloads in the first year of operation, growing to 2,600 carloads in 2019. Venture Logistics facility is approximately 400,000 square feet and occupies approximately 22 acres of land (excluding the space occupied by the rail lead serving the property).

The Home Depot Distribution Center at Tradepoint Atlantic opened in 2019, the facility includes two buildings which comprise a total of approximately 1.2 million square feet and occupies approximately 100 acres of land. A single lead track serves one of the two buildings for delivery of materials and products by rail.

The former Railex Facility in Burbank is an example of an integrated logistics center that was intended to accommodate multiple warehousing and distribution users sharing common rail infrastructure. As described in the 2017 Port of Benton/City of Richland Rail Master Plan:

> *One potential rail use is a storage and distribution center like the Railex Distribution Center in Burbank, WA. The Railex facility is used for the storage and rail distribution of wines, fruits, vegetables, and other perishable and temperature sensitive cargo. The facility uses a 9,000-foot loop track and has a 225,000-square foot perishable food distribution facility located on the loop exterior and a 500,000-square foot wine distribution center located on the loop interior. The entire facility sits on 180 acres with about 125 acres inside the loop. There is room in the loop interior for additional tracks and distribution operations. The facility, which employs 100 workers, currently handles three trains per week (apples, onions, wine, potatoes) and about 3,500 railcars annually.*

In January 2017, UP announced it had acquired Railex's refrigerated and cold storage facilities, including those at Burbank. Railex's wine services business was not part of the purchase.

The Burbank facility served as the western end of UP's Cold Connect service which linked Washington and California growers to East Coast markets.   In May 2020, UP announced that the facility would be closed because of dropping shipping rates and and less demand for fresh produce because of the coronavirus.

7.4. Food and Vegetable Processing

An example of a rail served food and vegetable processing facility is the Cargill Canola Crush Plant in Canmore Alberta. The plant opened in 2015 and provides the capacity to process 850,00 tons of canola annually. The facility produces 1,500 tons of oil daily and 2,000 tons of canola meal animal feed. The plant occupies 30 acres and is supported by a double ended rail yard which occupies an additional 17 acres. The plant rail yard can accommodate car strings that are approximately 2,500 feet long, and the yard is adjacent to tracks that can be used for arrival and departure of 7,500 foot unit trains.

Another nearby example described in the 2017 Port of Benton/City of Richland Rail Master Plan is the Lamb Weston Plant in Boardman:

> *A rail use involving a vegetable processing plant would receive raw material (such as potatoes) by truck and ship out processed foods by truck and rail. The facility could also receive production inputs by rail, such as oil for a French-Fry plant. The typical lot size for the plant would be 25 to 50 acres. The facility would generate manifest rail traffic and would require daily switching. These plants can employ 500 or more workers. Nearby examples of this type of expansion opportunity are the Lamb Weston plants in Richland, WA, and Boardman, OR.*

7.5. Bulk

Rail served facilities handling bulk commodities can include terminals for grain, dry inorganic chemicals and minerals, aggregates, petroleum, vegetable oil, chemicals, and fertilizers. The intended annual shipping volume for bulk terminals and the frequency of service for train arrival and departure are the primary factors which determine the configuration and capacity of rail infrastructure needed to support bulk operations. A bulk facility processing 100,000 tons of material annually that is served 2-3 times per week could require two spur tracks each with a capacity to accommodate 6-8 railcars.

At the opposite end of the spectrum, a bulk terminal receiving unit trains daily and handling 8 million tons per year would require four 8,500 foot long loop tracks for arriving trains , and two additional 8,500 foot long loop tracks for departing trains. A facility of this scale would typically occupy 120 to 160 acres, including the loop tracks, loading/unloading systems, storage, handling and processing systems. A facility of this scale often isolates a large area of land inside the rail loop tracks which has limited usefulness a vehicle grade separation structure is incorporated in the facility design.

Nearby examples of bulk facilities include:

- The Central Washington Corn Processors facility in Richland which occupies approximately 142 acres is a nearby example of a large bulk facility. The facility includes a loop track and space to accommodate a second loop track.
- The Canpotex potash export facilty in Portland occupies approximately 100 acres, the facil-

ity includes three concentric loop tracks, capable of accomodating 390 rail cars on the site, or approximately three unit trains.

- The Viterra-Cascadia Terminal in Vancouver, BC occupies approximately 22 acres, the facility handles approximately 5 million tons of grain annually. The terminal is immediately adjacent to the Canadian Pacific (CP) mainline and has eight double ended tracks for arrival, unloading and departure of trains, each approximately 1,800 to 2,400 feet in length. The combined capacity of the double ended tracks is approximately 150 cars.

7.6. Biofuels Manufacturing

Biofuel can be made from virtually any fat or vegetable oil. This includes corn or soybean oil, recycled cooking oil and animal fats left over from meat production. Some biofuel manufacturing plants are capable of utilizing multiple feedstocks or sources for oils, while others are intended to utilize a singular source.

Western Iowa Energy is an example of a facility that can utilize multiple sources of oil to produce biofuels. The facility began operation in 2006 and produces approximately 30 million gallons of fuel annually, generating 1,200 to 1,500 rail cars for transport of refined fuel. The site is located near Wall Lake Iowa and occupies approximately 14 acres of land. Railcars are loaded on three spur tracks with a combined capacity of approximately 30 tank cars.

As described in the 2017 Port of Benton/City of Richland Rail Master Plan, another example of a biofuels manufacturing facility is the Pacific Ethanol plan in Boardman, OR:

> *The annual production capacity of the Boardman plant is 40 million gallons, which would about require 40 unit trains (4,000 covered hopper railcars) per year of corn feedstock. The actual production and feedstock requirements vary year-to-year depending on market conditions, however. While the Boardman plant's ethanol output is shipped by barge, in Richland the loadout would likely be transported by rail, possibly in a unit train configuration. At full production, a 40 million-gallon plant would generate about 1,400 rail tank cars of ethanol. It would also produce a byproduct – dried distillers grain with solubles (DDGS) – which could be shipped by rail (about 1,200 covered hopper railcars/year), but would likely be distributed by truck to area feedlots. The Boardman plant sits on about 20 acres, but this area does not include the rail tracks owned by the Port of Morrow used to handle the corn trains. The plant employs 35 workers.*

7.7. Cold Storage

A nearby example of a potential cold storage warehouse is the Lineage Logistics cold storage facility in Richland which opened in 2015. The 455,000-square-foot building, which sits on 40 acres, employs 150 workers on- site. The building has six rail doors. Lineage Logistics also owns an adjacent 40 acres on which it plans to expand.

ColdPoint Logistics was opened in 2018 in Edgerton Kansas adjacent to the BNSF Logistics Park Kansas City. The facility has a single rail spur onto the site however trucks typically dray containers to the BNSF intermodal yard less than a mile away. The facility is 600,000 square feet and occupies approximately 45 acres of land.

NewCold, a Netherlands-based specialist in automated cold storage, opened a 305,000-square-foot facility in Burley, Idaho with a footprint of approximately 154,500 square feet. The facility includes two railcar loading/unloading docks and three spur tracks with capacity for approximately 15 refrigerated rail cars. The facility will ship approximately 15 percent of the stored foods by rail, The remaining loads will be trucked to food-service clients or other warehouses.

7.8. Summary of Rail Served Facility Characteristics

Table 1 summarizes the characteristics of potential rail served facilities:

Table 1: Summary of Potential Rail Served Facility Characteristics

Facility Type	Typical Land Area (acres)	Rail Service Type (manifest or unit train)	Onsite Rail Configuration	Typical Length of Working Tracks
Manufacturing	100 to 500	Manifest or Unit	Varies	500 to 8,500
Container Transload	15 to 40	Manifest or Unit	Double ended intermodal loading/ unloading	2,000 to 8,500
Warehousing and Distribution	20 to 100	Manifest	One or more spurs or; shared intermodal loading/ unloading	900 to 1,500
Food Processing	15 to 60	Manifest or Unit	Varies	1,000 to 4,000
Small Bulk Facility	60 to 120	Manifest	Multiple stub track spurs; double ended tracks; or a small loop	400 to 1,500
Large Bulk Facility	120 to 160	Unit	Large Loop	8,500
Biofuels Manufacturing	15 to 25	Manifest	Spurs or loop tracks configured to operation	500 to 1,000
Cold Storage	25 to 45	Manifest	Multiple rail spurs	500 to 1,000

8. Rail Extension Options

8.1. Objectives and Considerations for Rail Extention Routes

Evaluation of options for extending rail infrastructure into the study area was guided by six objectives:

- Objective 1 - Flexibility to Suit Diverse Development Opportunities: Identify a route for a main rail corridor through the study area that could be used to serve multiple development sites and facility types.

  A main rail corridor route that passes by multiple potential development sites of varying sizes and configurations with the ability to accommodate rail service maximizes the flexibility of the City of Richland Economic Development office to respond to prospective development opportunities.

Additionally, configuring the rail corridor to serve a site within the study area that could accommodate a potential mega-project, should such an opportunity emerge, would maximize the value of key advantages of the site, particularly the uncommonly large size and the availability of service by two Class I railroads.

- Objective 2 - Plan for Future Extension of Rail Service North of Horn Rapids Road: Identify a route that could be extended across Horn Rapids Road at some time in the future to serve the property transferred to the City and Port from the Department of Energy.

  To position the rail corridor for a future extension across Horn Rapids Road to the north, potential crossing locations at Horn Rapids Road were considered with a focus on the resulting impacts on facilities and property on the north side of Horn Rapids Road. Directly opposite the study area on the north side of Horn Rapids Road is the Volpentest HAMMER Federal Training Facility, located on a parcel of land owned by the U.S. government. Assuming that a property acquisition could be negotiated between the City and the U.S. government, the route of a rail extension north of Horn Rapids Road that would be least disruptive to HAMMER facilities is directly north of the west side of the study area. The primary facility north of this western boundary is the driver/vehicle training track. To the east of the training track are numerous training buildings and parking areas. Directly north of the eastern boundary of the study area is the HAMMER administration building, Volpentest Annex and State Department Building. Buildings, parking areas and associated utilities are likely to be more costly and disruptive to reconfigure or relocate than a portion of the driver/vehicle training track.

- Objective 3 - Leverage the Size of the Property to Attract Large Economic Development Opportunities: Identify a configuration that will leverage the value and flexibility of the uncommonly large size of the available property for rail served facilities.

  To leverage the large contiguous land area for potential development and maximize the broadest range of prospective economic development at the study area, locating the main rail corridor parallel and adjacent to a perimeter edge of the site maintains the largest contiguous developable areas that are within a relatively short distance of the rail corridor.

- Objective 4 - Leverage the Unique Advantage of Service from Two Class I Railroads: Developing efficient and high capacity rail infrastructure for the study area enhances the potential that multiple rail customers will be attracted to development opportunities in the area, taking advantage of the relatively unique benefit of service availability from two class I railroads.

  A rail corridor configured as a very large loop through the study area would be beneficial for efficient manifest train service to facilities located along the route of the loop, and would also create the opportunity to accommodate arriving and departing unit trains along the main rail corridor.

  Creating available length of track for arrival and departure of unit trains, while remaining clear of at grade roadway crossings, would increase the potential for attracting large development opportunities that utilize unit trains. Unit train lengths vary, however current planning for similar facilities in the Pacific Northwest is based on 8,500 foot unit trains. For the study area, accommodating trains of this length would require a rail corridor that extends at least 8,500 feet beyond Kingsgate Way, and potentially 8,500 feet beyond a future crossing point at the extension of Battelle Boulevard.

- Objective 5 - Plan for Phased Development of Infrastructure: Identify a route that will allow for incremental or phased extension of rail infrastructure, and alignment of the scale of phases with the scope and scale of emerging economic development opportunities; minimizing the need to make prospective capital expenditures that are significantly larger in scale than the economic development activities that they would support.

- Objective 6 - Satisfy Class I Railroad Design Criteria: BNSF and UPRR standards for facilities served by unit trains include the following geometric requirements:

Trackwork Geometry Criteria

Unless noted otherwise, the criteria referenced below reflects the criteria outlined in the BNSF Guidelines with the preferred criteria meeting the minimum standards for Unit Train/Loop Facilities and the minimum criteria meets the minimum standard for Industrial Trackage (Carload, or Non-Unit Facilities).

Horizontal Curvature

Preferred: 7 degrees, 30 minutes (radius = 764.49 feet)*

Minimum: 9 degrees, 30 minutes (radius = 603.80 feet)

Special Trackwork

Preferred: No. 11 Turnout*

Minimum: No. 9 Turnout

It is assumed that the turnout will be new material and of No. 11 BNSF design. The new switch stand will be manually operated. Frogs shall be railbound manganese. Turnouts will use timber ties and elastic fasteners.

Longitudinal Grade

Maximum for Unit Train Facilities: 1.5%*

Loading Tracks: 0% maintained through loading/unloading areas*

Vertical Curves

Preferred: Rate of change = 1.0 in summits and 0.5 in sags

Minimum: Rate of change = 2.0 in summits and sags*

BNSF's standard for vertical curves described later in the guidelines identifies the 2.0 maximum rate for industry track and non-main track with speeds not greater than 20 MPH.

Rail

Minimum section for Unit Train Facilities: 115-lb*

Continuous Welded Rail (CWR) is recommended. However, to match the existing Geiger Spur track, the Trunk Rail is constructed of jointed rail and it is assumed that this spur will similarly be constructed of jointed rail in 80-foot rail lengths.

Ties

Concrete ties are assumed of similar size and spacing to the Geiger Spur and Trunk Rail.

Minimum: Concrete ties at 28 inches center-to-center*

8.2. Potential Corridor Configuration and Routes

A main rail corridor through the study area would likely include multiple tracks. The appropriate number of tracks would be determined based on the volume of rail activity in the study area, and the operating procedures for arrival and departure of unit trains if a facility is developed in the study area, or the area north of Horn Rapids Road, that utilizes unit train service.

If all facilities within the study area and north of Horn Rapids Road are served by manifest trains, it is likely that a single loop track serving the study area and a lead continuing from the loop northward across Horn Rapids Road would be sufficient.

If all facilities within the study area are served by manifest trains, and a unit train facility is developed north of Horn Rapids Road, a single loop track serving the study area and a parallel bypass track would likely be necessary. The bypass track would allow unit train arrivals and/or departures to reach the facilities north of Horn Rapids Road without potential delays associated with manifest train movements in the study area.

If unit train facilities within the study area and north of Horn Rapids Road are anticipated, it is likely that a muliple track loop corridor would be required within the study area and a parallel bypass track would be necessary for unit train arrivals and/or departures for the facilities north of Horn Rapids Road.

Since the level of potential development and specific facility needs are unknown at this time, the focus of this study is on the aligment of the corridor. Further study of the appropriate number of tracks within the corridor should be undertaken when details of prospective developments and rail traffic characteristics are available.

All potential routes for extension of a main rail corridor would begin at the current terminus of the City owned railroad track, just west of Kingsgate Way near the Del Hur site. From this starting point, four potential routes for a main rail corridor have been identified.

- Option A: Creates a very large rail loop and maximizes the land within the loop for very large development opportunities. For this option, the rail corridor begins near Kingsgate Way and extends approximately 1,450 feet east, then turning northwest, continuing to the western edge of the study area and then continuing north along the west side of the property before looping back to the east and then south to Kingsgate Way. The overall length of the loop in this option is 18,249 feet.
- Option B: Option B is similar to Option A, except that an S-curve element was added to the

return leg of the loop to increase the length of the loop. The overall length of the loop in this option is 20,465 feet.

- Option C: Option C is similar to Option B, except that the southern leg of the loop has been pushed southward to further increase the length of the loop. The overall length of the loop in this option is 21,368 feet.
- Option D: Option D is similar to Option D, except that the west side of the loop has been pulled east to create a potential development site on the outside of the loop for a long linear facility, such as a facility needing a series of double ended yard tracks. The overall length of the loop in this option is 21,160 feet.

A relative comparison of the four options in terms of the objectives is presented below in Table 2:

Table 2: Comparison of the Options in Terms of the Objectives

Objective	Option A	Option B	Option C	Option D
Objective 1 - Flexibility to Suit Diverse Development Opportunities	Creates opportunities to accommodate all facility types identified in Section 7.			
Objective 2 - Plan for Future Extension of Rail Service North of Horn Rapids Road	Alignment of west side of very large loop allows for extension of track north of Horn Rapids Road, property acquisition and reconfiguration or replacement of HAMMER vehicle/driving training facility is likely required.			
Objective 3 - Leverage the Size of the Property to Attract Large Economic Development Opportunities	Maximizes land area within the very large loop, more than 210 acres.	Maintains more than 147 acres within the very large loop.	Maintains more than 165 acres within the very large loop.	Maintains more than 138 acres within the very large loop.
	Able to accommodate a large manufacturing facility within the loop; or a unit train bulk facility and container transload facility.	Able to accommodate a large manufacturing facility within the loop; and container transload facility. Does NOT allow an 8,500 foot rail loop for unit trains at Site A.	Able to accommodate a large manufacturing facility within the loop; or a unit train bulk facility and container transload facility.	Able to accommodate a large manufacturing facility or unit train bulk facility within the loop; able to accommodate container transload facility outside the loop.
		Introduces S-curves on east side of very large loop to increase overall loop length and shift the balance of developable land from inside the loop to outside the loop.		
	Multiple developable sites outside the loop could be configured in sizes ranging from 10 to 50 acres.	Multiple developable sites outside the loop could be configured in sizes ranging from 10 to 90 acres.	Multiple developable sites outside the loop could be configured in sizes ranging from 10 to 80 acres.	Multiple developable sites outside the loop could be configured in sizes ranging from 10 to 110 acres.

<table>
<tr><th>Objective</th><th>Option A</th><th>Option B</th><th>Option C</th><th>Option D</th></tr>
<tr><td rowspan="8">Objective 4 - Leverage the Unique Advantage of Service from Two Class I Railroads</td><td colspan="4">With a fully constructed loop, efficient manifest service can be provided to all development sites adjacent to the rail corridor by both railroads. Manifest trains could enter the loop westbound from the existing City rail line and travel in a clockwise or counterclockwise direction serving facilities along the corridor and return to the existing City rail line traveling eastbound.</td></tr>
<tr><td colspan="4">Unit trains could be staged on the corridor upstream (arriving) and downstream (departing) of a bulk or manufacturing facility on Site A without blocking Kingsgate. Trains in this position would block the Battelle Boulevard extension, unless a grade separation structure was constructed at this crossing.</td></tr>
<tr><td colspan="4">If unit trains were staged for arrival and departure on the rail corridor, vehicle access to the area inside the very large rail loop could be provided by a surface access road off Horn Rapids Road located at the north end of the loop, or with a grade separation structure. If unit trains were not staged for arrival and departure on the rail corridor, multiple alternatives could be evaluated for a surface access road serving the interior of the loop</td></tr>
<tr><td colspan="2">Maximum available length for arriving unit trains is 7,720 feet, assuming trains are staged on the corridor.</td><td colspan="2">Maximum available length for arriving unit trains is 8,130 feet, assuming trains are staged on the corridor.</td></tr>
<tr><td>Maximum available length for departing unit trains is 8,500 feet, assuming trains are staged on the corridor.</td><td colspan="3">More than 10,000 feet available for staging departing unit trains on the corridor.</td></tr>
<tr><td colspan="4">Intermodal container trains could be loaded and unloaded at a double ended facility located along the east side of the very large loop. This location would be 400 to 800 feet from the future Battelle Boulevard extension, and 200 to 300 feet from Horn Rapids Road, both roads could be considered for truck access to a container transload facility.</td></tr>
<tr><td>Tangent loading tracks in a container transload facility at Site B could accommodate car cuts up to 2,270 feet. A complete unit train would be assembled from four strings of double stack well cars.</td><td>Tangent loading tracks in a container transload facility at Site B could accommodate car cuts up to 1,600 feet, this length is relatively short for a unit train served container transload facility.</td><td>Tangent loading tracks in a container transload facility aat Site B could accommodate car cuts up to 2,140 feet. A complete unit train would be assembled from four strings of double stack well cars.</td><td>Tangent loading tracks in a container transload facility at Site B could accommodate car cuts up to 1,700 feet, this length is relatively short for a unit train served container transload facility.</td></tr>
<tr><td colspan="4">Intermodal unit trains could be broken down and built up on the east side of the corridor loop, assembled trains would extend from near Kingsgate Way to the north end of the very large rail loop, similar to the staging length that would be used for unit trains departing a large manufacturing or bulk facility at Site A.</td></tr>
</table>

Objective	Option A	Option B	Option C	Option D
Objective 5 - Plan for Phased Development of Infrastructure	Multiple phases of rail infrastructure construction are possible.			
	Southern portion of loop could be constructed westward approximately 3,000 feet from the existing track terminus to provide rail service to development sites in the southern portion of the study area, such as Sites C, D and E (as well as Site F shown in Options B, C and D)			
	Additional phases including all or portions of the complete loop could be added as demand for larger sites such as Sites A and B emerge.			
Objective 6 - Satisfy Class I Railroad Design Criteria	Option satisfies all Class I design criteria as outlined in Section 8.1.			

9. Development Opportunities and Rail Service Options

Each of the options for the main rail corridor creates different opportunities for rail served development. Detailed site development feasibility analysis is beyond the scope of this study, however a high level assessment was performed to identify development opportunities associated with each of the potential rail corridor options. Potential development sites within the study area that would be adjacent to the rail corridor and suitable for development of a flat, pad ready site of at least 12 acres are shown on Exhibits in Appendix A. The suitability of these sites for development of a range of facility types is summarized below in Table 3.

Table 3: Site Suitability for Facility Types

Option / Site		Area (acres)	Manufacturing	Container Transload	Warehousing and Distribution	Food Processing	Small Bulk	Large Bulk	Bio-Fuels	Cold Storage
Option A	Site A	135.8	•					•		
	Site B	43.9		•	•					
	Site C	38.7			•	•			•	•
	Site D	14.6			•	•			•	
	Site C/D Combined	53.3			•	•	•		•	•
	Site E	14.2			•	•			•	
	Site G	43.8			•	•			•	•

Option B	**Site A**	106.3	•		•			•		
	Site B	37.4		•	•					
	Site C	38.1			•	•			•	•
	Site D	15.2			•	•			•	
	Site C/D Combined	53.3			•	•	•		•	•
	Site E	14.7			•	•			•	
	Site F	89.4			•	•	•		•	•
	Site G	43.5			•	•			•	•
Option C	**Site A**	158.9	•					•		
	Site C	19.6			•	•			•	•
	Site D	12.3			•	•			•	
	Site C/D Combined	31.9			•	•	•		•	•
	Site E	14.5			•	•			•	
	Site F	77.2			•	•	•		•	•
	Site G	43.6			•	•			•	•
Option D	**Site A**	130.6	•					•		
	Site B	23.4		•	•					
	Site C	19.6			•	•			•	•
	Site D	12.3			•	•			•	
	Site C/D Combined	31.9			•	•	•		•	•
	Site E	14.5			•	•			•	
	Site F	106.5			•	•	•		•	•
	Site G	43.6			•	•			•	•

9.1. Prioritization and Use of Sites A and B

Several of the potential routes for the main rail corridor shown in the the Exhibits inlude sites designated as Site A and Site B. Site A is well suited to a large manufacturing or bulk facility, Site B is well suited to container transload, intermodal, warehousing and distribution. These are shown with Site A on the west side of the very large loop and Site B on the east side of the very large loop. It is important to note however that this orientation could be reversed, depending on the actual facility requirements and timing of future development opportunities.

If Site B were developed as a container transload or intermodal hub facility, other factors will influence whether this should be located on the west side or east side of the very large loop, including:

- Roadway access from Horn Rapids Road and Battelle Boulevard: If Site A were developed as a large bulk facility with one or more onsite unit train loops, then roadway access for a container transload facility is likely to be better on the east side of the study area.

- If development of a large manufacturing or bulk facility is not likely to occur within this study area, a container transload facility could be located along the west side of the study area and a bypass track for future extension across Horn Rapids Road could be located west of the transload facility. In this scenario, the land east of the container transload facility could be developed for warehousing, distribution and other uses that may benefit from proximity to the container transload facility.

Locating a container transload facility on either the west side or east side of the study area will provide sufficient track length to breakdown and assemble 8,500 unit trains without obstructing Kingsgate Way.

10. Battelle Boulevard Extension

Extension of Battelle Boulevard to a new intersection on SR 240 opposite Village Parkway would cross the study area from the northeast to the southwest and would cross the future main rail corridor approximately 2,850 feet west of Kingsgate Way. This conceptual alignment was provided to the study team by the City of Richland and is shown in the four option exhibits included in the Appendix.

If rail dependent development were to occur in the study area or within the former DOE property north of Horn Rapids Road, trains would likely block both Kingsgate Way and the extended Battelle Boulevard when arriving and departing the area, and when serving rail customers and facilities in the study area. If a unit train customer or facility were located in the study area or the former DOE property north of Horn Rapids Road, it is likely that unit trains passing Kingsgate and Battelle would block the streets for 6 to 12 minutes during each passing, depending on the length of the unit train and an assumed train operating speed in the area of 10-15 mph. For portions of these train movements, both streets would be blocked simultaneously, hindering vehicle access between HRIP, the study area, and SR 240. To position the study area and the former DOE property north of Horn Rapids Road for future development, planning for a rail-vehicle grade separation at the extension of Battelle Boulevard is recommended.

A rail-vehicle grade separation structure at the location where the Battelle Boulevard extension would cross the future main rail corridor could mitigate the impacts of increased rail movements in the area. All potential routes for extension of a main rail corridor evaluated in this study would result in a crossing at approximately the same location, therefore the selection of any of the identified rail routes has little influence on the planning for a grade separation structure. However, if the alignment of the Battelle Boulevard extension were to shift westward relative to the planned alignment shown in the Option exhibits, more significant differences between the crossing locations and configurations for each of the rail routes would emerge.

As currently planned however, potential routes for extension of a main rail corridor evaluated in this study would result in a crossing of Battelle Boulevard centered between Station 518+90 and 518+50 of Battelle Boulevard. Existing grade at this location is approximately +442 (above sea level).

A grade crossing structure should accommodate a minimum of three railroad tracks at this location, two tracks that would form the very large rail loop through the study area, and a third bypass track that could be added for extension on the outside of very large rail loop to and across Horn Rapids Road, and continuing north to serve the former DOE property north of Horn Rapids Road.

In the case of Option A, the northern leg of the very large rail loop is approximately 60 feet north of the southern leg of the loop, while the bypass track is shown 15 feet parallel of the southern leg of the loop. This configuration would increase the length of the grade separation structure for this option, relative to all of the other options evaluated, likely resulting in a higher cost.

In the case of Options B, C and D, all three tracks would be parallel and spaced at 15 feet on center at the crossing of the Battelle Boulevard extension, likely reducing the overall cost and scale of the grade separation structure by approximately 50% relative to the structure required for Option A.

In terms of vertical alignments for a grade crossing, the existing grade at the crossing location is approximately +442. The top of rail elevation is likely to be +440.0 to +443.0, depending on the final grade of the very large loop track. The track could be configured at the low end of this range if the road were passing over the track, or could be configured at the high end of this range if the road were passing under the track. The natural grade of the Battelle Boulevard extension alignment slopes downward from north to south, from +470 approximately 1,100 feet north of the grade crossing, down to +436 approximately 250 feet south of the grade crossing. Typically, grade crossings intended to serve truck traffic are configured with approach grades of 5% or less.

10.1. UPRR BNSF Joint Guidelines for Railroad Grade Separation Projects

Rail infrastructure within HRIP would likely support operations of both UPRR and BNSF, consequently it is anticipated that the design of the grade separation would comply with the UPRR BNSF Joint Guidelines for Railroad Grade Separation Projects.

A road crossing over the track would be required to provide 23.5 feet of vertical clearance over the track and the structure depth could be conservatively estimated as 4 feet. If the track alignment were configured at the low end of the likely range, the road grade over the track would be +467.5. Based on a maximum grade of 5%, approach ramp lengths to the undercrossing would be approximately 620 feet to the south, and 350 feet to the north.

A road crossing under the track would be required to provide minimum vehicle clearance of 16.5 to 20.0 feet of vertical clearance (depending on structure type) under the structure for vehicle clearance and the structure depth could be conservatively estimated as 6 feet. If the track alignment were configured at the high end of the likely range, the road grade under the track would be +421. Based on a maximum grade of 5%, approach ramp lengths to the undercrossing would be approximately 300 feet to the south, and 750 feet to the north.

Additional criteria that is likely to apply to this grade separation include:

- Where grade separations provide for two or more tracks, space is required on both sides of the tracks for access roads.
- Grade separation for roadway over multiple tracks shall be designed to fully span the width of the tracks, eliminating piers between tracks.
- Piers supporting a road overcrossing the tracks shall be 27 feet from the centerline of the nearest future track. Piers closer than 25 feet require pier protection, by pier protection wall or heavy construction.
- Grade separation for track crossing over roadway requires approach slabs.

- Grade separation for track crossing over roadway shall allow for placement of at least 12 inches of ballast from the top of deck to the bottom of tie.

Full guidelines can be found in the UPRR BNSF Joint Guidelines document in Appendix B.

10.2. Estimated Construction Cost

The estimated cost of the roadway overcrossing of the track described above is $4.1M to $5.3M. The estimated construction cost of the roadway undercrossing of the track described above is $4.8M to $6.3M. A summary of estimated construction costs is provided below in Table 4.

Table 4: Estimated Construction Costs of Grade Separation

	Cost	
	Roadway Overpass	**Roadway Underpass**
Roadway	$962,000	$962,000
Roadway Bridge	$955,500	-
Railway Bridge	-	$777,600
Ramp, Earthwork	$395,200	$395,200
Retaining Walls	$317,520	$979,200
Subtotal	$2,630,220	$3,114,000
Mobilization	$210,418	$249,120
Traffic Control	$157,813	$186,840
Erosion Control	$78,907	$93,420
Construction Staging	$78,907	$93,420
Utility Relocation	-	-
Sales Tax	$271,439	$321,365
Engineering and Project Management (14.5%)	$497,016	$588,524
Permitting (0.5%)	$17,138	$20,290
Construction Management (5%)	$171,385	$202,908
Total Estimated Cost	$4,113,243	$4,869,887
Low Estimate (-5%)	$3,907,581	$4,626,393
High Estimate (+30%)	$5,347,216	$6,330,853

11. Market Potential for an Inland Intermodal Hub

11.1. Overview of Relevant Cargo and Equipment Flows

As noted in Section 7.2, the geographic position of Richland, and thus HRIP, could be attractive to various producers and distributors of unitized cargoes as a location for loading and unloading international ocean containers and domestic containers/trailers to and from intermodal railcars – i.e., as an inland intermodal hub terminal.

In order to better understand the market potential for this hub terminal, it is important to understand how it would create economic value for the providers of freight transportation service to and from the terminal – in particular, for the ocean carriers operating the containers moving to/from the hub, and for the rail carriers operating the intermodal flatcars. These carriers have to obtain cost savings from the hub in order to be able to create savings for the producers and distributors of the cargoes moving through the hub.

The utilization of an intermodal hub within the Industrial Park for such loading/unloading activities could be driven by the following types of international cargo and equipment flows:

Import containers carrying products from Asia that are destined ultimately to warehouses and stores in Eastern Washington/Oregon, in the Mountain states, and in the states east and southeast of the Mountain states could move by short-haul intermodal train service from the container terminals in the ports of Seattle and Tacoma to the Horn Rapids hub, where the containers would be unloaded from the flatcars and drayed to a logistics facility within the Industrial Park.

- At the logistics facility, these containers would be stripped and the cargoes could be stored, and/or receive value-added logistics processing (such as re-labeling or re-packaging), and then transferred into domestic containers and/or trailers.
- The loaded trailers would then be trucked to destinations (primarily local warehouses and retail locations) in the cities and towns of central/eastern Washington, eastern Oregon, Idaho, Montana, Utah, Colorado, and Wyoming (and possibly to points beyond the Mountain states).
- The loaded domestic containers would then be lifted onto intermodal railcars that would be added to eastbound intermodal trains running from Seattle/Tacoma/Portland to major Midwest centers (particularly Chicago, but also Kansas City, St. Louis, etc.)
- The inbound loaded international containers, once stripped and converted into empties, could then be picked up by producers in central/eastern Washington and eastern Oregon who have commodities for export back to Asia that can be loaded into containers.

For export commodities that do not require temperature-controlled shipping – such as hay, specialty grains, and identity-preserved grains – the containers to be utilized would be "dry" boxes. The majority of the inbound containers from Asia are dry boxes.

The ability to pick up such dry boxes at the Horn Rapids hub would be a significant boon to exporters of "dry" commodities whose production/processing sites (i.e. container loading locations) are in the central/eastern Washington and Oregon area, because presently these exporters have to absorb the trucking costs to reposition these containers from the Puget Sound area.

Since the volume of loaded import containers unloaded from ships at the ports of Tacoma and Seattle and drayed to importers in the Puget Sound area far exceeds the volume of loaded export containers that are loaded with cargoes at facilities in Western Washington, there are pools of empty dry containers presently that can be repositioned by truck to points east of the Cascades – or otherwise directly lifted onto ships returning to Asia.

For export commodities that do require temperature-controlled shipping – such as frozen French fries and apples -- the containers to be utilized would need to be boxes with built-in refrigeration units ("reefers"). Since North America exports far more refrigerated cargoes to Asia than the latter exports to the USA, some of the inbound laden containers from Asia can be "inactive" reefers that are loaded with dry cargoes (such as clothing and footwear), and such loadings would be especially attractive to importers who would be using the logistics/trans-loading facility in Richland.

However, it is not realistic to assume that a sufficient number of reefer containers could be loaded with dry cargoes in Asia just for the importers using the Richland logistics center) to supply the "live" reefer equipment requirements of the exporters in central and eastern Washington and Oregon

Consequently, empty reefer containers need to be repositioned from western Washington to central/eastern Washington and Oregon. Presently, all such repositionings are effected with trucking.

There are two such sources of empty reefer containers in western Washington:

- Boxes that are repositioned from Asia as empties and are off-loaded from ships at the marine terminals in Seattle and Tacoma. These reefer containers could be loaded directly onto the same short-haul intermodal trains that would transport the loaded import containers (both the dry boxes and the "inactive" reefer boxes) destined to the logistics center in HRIP. Using the trains should be less expensive to the ocean carriers and their exporter-customers than trucking.
- Boxes that had arrived as live reefer loads to consignees in the Puget Sound area (such as food markets importing Chinese vegetables and Thai seafood), have been unloaded, and then returned as empties to either the marine terminals or to off-dock container depots.

There is one additional source of empty ocean containers to supply exporters in central/eastern Washington and Oregon – which is from the Midwest states. The volume of laden dry containers moving eastbound across the Pacific Ocean from Asia through the Puget Sound ports and destined to consignees in the Midwest/Ohio Valley states far exceeds the volume of laden dry containers originated by companies in those states exporting back to Asia. As a result, ocean carriers are regularly moving empty dry containers on BNSF and UP intermodal trains back to the Ports of Seattle and Tacoma.

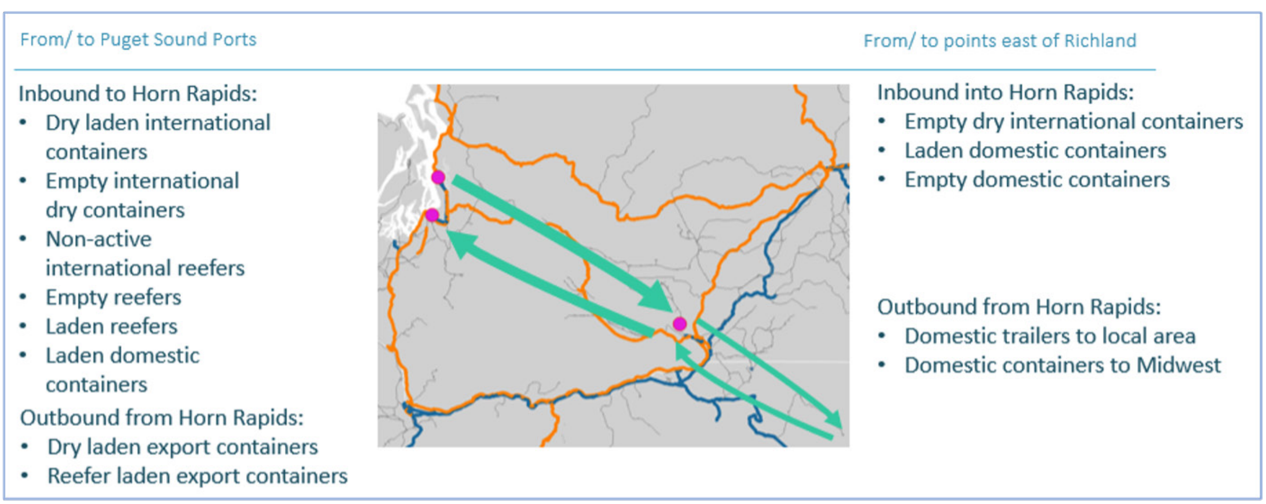

Figure 6: Container Flows

Because of the relative proximity of HRIP to the UP and BNSF main lines through the Columbia River Gorge, it would be operationally feasible for one or both railroads to set out cuts of stack cars carrying such empty containers at Pasco Yard (for BNSF) and at Hinkle Yard (for UP). These stack cars and containers could then be switched by local train crews into the Horn Rapids intermodal hub, where the containers could be off-loaded and picked up by exporters in the region. However, this type of movement requires the Class I railroad to delay its Chicago-Seattle/Tacoma westbound train to set out stack-cars of empties at Pasco or Hinkle, and neither the BNSF or the UP wants to effect such an operation unless the number of cars being set out is significant.

Although there are movements of empty reefer containers from the Midwest back to the PNW region, the volumes are far less than for the dry boxes being repositioned, and cannot be viewed as a consistent source of equipment supply for exporters of refrigerated cargoes in central/eastern Washington and Oregon.

Thus, the primary source of empty equipment for exporters in central/eastern Washington and Oregon, who would be supporting the Horn Rapids hub, would most likely be western Washington, for both dry and reefer boxes, with supplemental empty boxes being delivered from westbound intermodal trains originating in the Midwest.

11.2. Impediments for Establishing the Horn Rapids Intermodal Hub

Given the cargo/equipment flow dynamics outlined in Section 11.1, one can identify certain factors that have impeded the establishment of an inland intermodal hub in the Richland area to date. Most importantly – there is presently no company importing high volumes of laden containers from Asia directly into the Tri-Cities area. In fact, the volume of import containers moving through the Ports of Seattle/Tacoma and destined directly to points in central/eastern Washington and Oregon is relatively minor.

The Richland Import/Export Container Market

Mercator analyzed data from the electronic manifests filed by ocean carriers with US Customs and identified the top sources of import destinations in the PNW region arriving through the Northwest Seaport Alliance ports. This analysis segregated such destinations by county within 150 miles of the city of Richland. There are 34 counties and 1.9 million people within 150 miles of HRIP. In 2020 only 14,000 TEUs were imported into those counties, the top seven of which are shown in Figure 7.

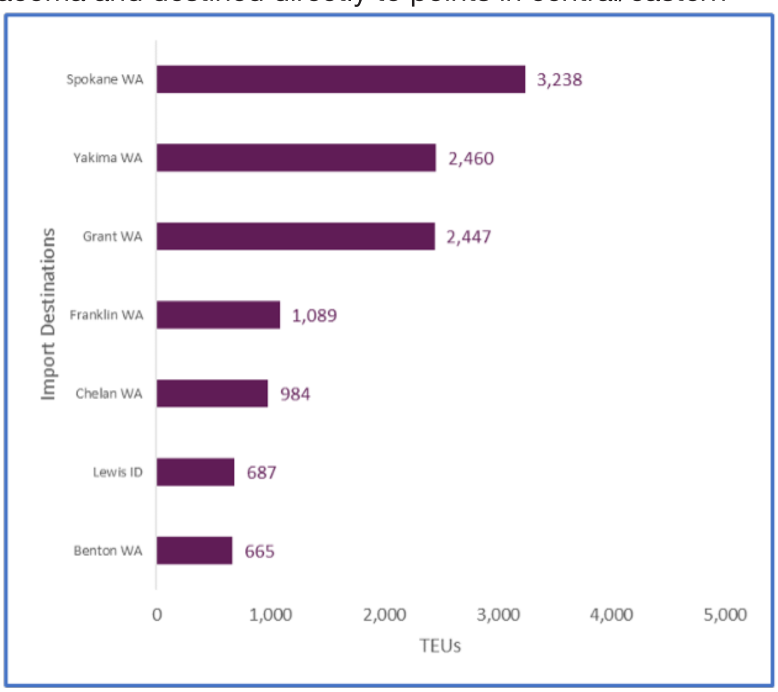

Figure 7: Container Imports to Central and Eastern Washington

Conversely, the same area generated over 115,000 TEUs of laden exports through the Puget Sound ports during the same year, with the top counties shown as follows:

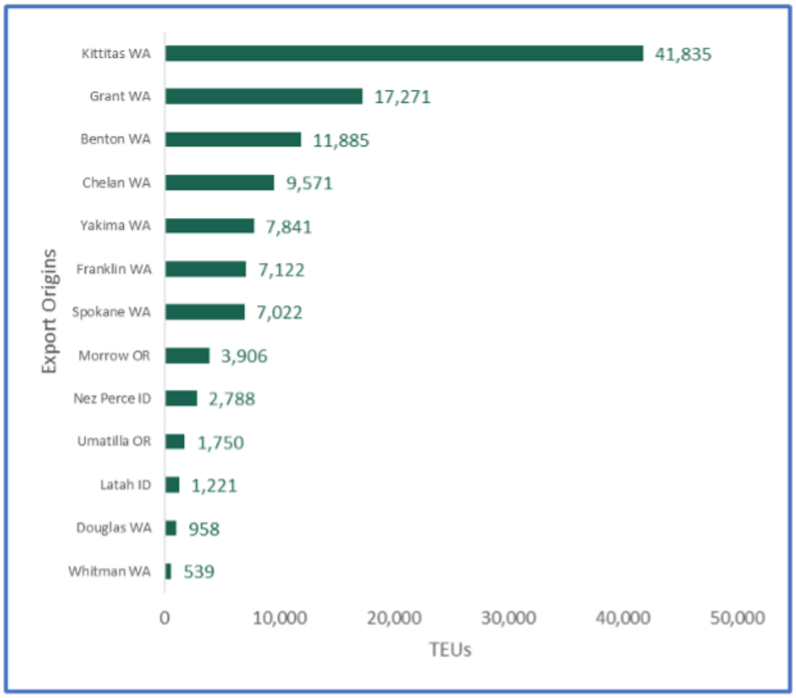

Figure 8: Container Exports from Central and Eastern Washington

There is at least an 8:1 imbalance between export laden containers and import laden containers for the central/eastern Washington and Oregon area, the imbalance for export refrigerated commodities is more extreme.

Empty Equipment Repositioning Challenges

Given the above-mentioned traffic imbalances, exporters in central/eastern Washington and Oregon have to be supplied with empty containers, the vast majority of which are sourced from western Washington and repositioned by trucks. There are certain challenges associated with repositioning empty containers from the Seattle/Tacoma area by intermodal train to a central location such as Richland:

- The BNSF prefers to assign the majority of the main-line track capacity on its "River Route" (running between Longview, Wishram, and Richland on the north bank of the Columbia River) for its heavy unit trains of bulk commodities (primarily westbound grain products, crude oil, and coal).
- However, as discussed in Section 5.1, its "Stampede Pass Route" has limited clearance for double-stack intermodal rail cars through the tunnel at the Pass. Hence, BNSF would have to run intermodal trains from the Seattle/Tacoma ports to Richland via its I-5 Corridor route to Longview and then across on the River Route.
- The additional mileage entailed with this routing – along with the costs required to truck empty containers to an intermodal terminal at or near the Puget Sound ports, to lift the container onto the stack car, unload the container at the Richland hub, and then truck the container to an exporter – reduces the savings (and is more time consuming) versus a motor

carrier simply trucking the container directly to the exporter in central/eastern Washington – while recognizing that the costs of trucking export containers to the ports have increased in recent years.

- The UP has to utilize a similar routing for moving empties from western Washington to eastern Washington – its trains move on the BNSF I-5 Corridor route to Portland and then across on its River Route on the Columbia's south bank to Hinkle to Wallula Junction and then to Richland. Hence, it has a similar challenge as BNSF in moving empty containers eastbound to Richland.
- If rail transportation to an intermodal hub at Richland generates only modest savings over truck transportation in sourcing empty containers from western Washington to central/eastern Washington and Oregon exporters, then the main economic incentive for those companies to use rail transportation westbound to the Puget Sound container ports for their export loads would be if there were to be significant savings (over trucking) on those westbound moves – in other words, if the round-trip inland transport costs were to be much lower by rail versus by truck.
- Because of the longer mileages entailed with either railroad's routing (about 100% farther by rail for Seattle – Richland, and about 80% farther for Tacoma – Richland), and the four "lifts" entailed using rail (loading on/off the stack car on each leg), as well as the requirements for short-distance trucking at each end, it has been challenging for such relatively short-haul rail moves to offset the convenience that trucking offers the exporters, especially in terms of service frequency.
- However, as trucking costs increase with driver labor shortages, fuel price rises, and greater congestion at the marine terminals, short-haul intermodal trains are likely to become more attractive.
- If BNSF removes or mitigates the clearance restriction of its Stampede Pass tunnel, and thereby enables double-stack trains to use the Auburn – Ellensburg – Richland route, then the economics of short-haul intermodal rail between the Puget Sound and the Horn Rapids inland hub would be substantially improved for that carrier. However, the route also needs more sidings, and overall investment required to make this operationally viable is substantial, so the timeline for when this might happen is highly uncertain.

As discussed briefly in Section 11.1, trying to supply exporters in central/eastern Washington and Oregon with empties riding on double-stack cars in intermodal trains from the Midwest to the Puget Sound has its challenges as well.

- The BNSF appears to prefer to route its westbound transcontinental intermodal trains across Washington State on its route from Spokane to Wenatchee to Stevens Pass to Everett – hence, to position a handful of stack cars carrying empty containers that were lifted onto those cars most likely at one of its intermodal terminals in the Chicago area, those cars would have to be positioned at the head or end of the train (to facilitate the set-out, which would have to be effected at Spokane).
- The cars would then have to be appended to a general manifest train or unit train running between Spokane and Vancouver (WA), then set out again at Pasco, where a local switch engine could position them into HRIP.

- The railcars carrying these empty containers to Horn Rapids would then presumably be re-used to transport laden export containers from Horn Rapids to the marine terminals in Seattle and Tacoma via Longview, after which they would return to Chicago (or other Midwest hubs) carrying eastbound import loads via the Stevens Pass Route.
- However, if the railcars transporting empties from the Midwest were to flow through Horn Rapids only in a westbound direction, then a pool of locomotives might have to do the same – otherwise the locomotives moving these railcars from Horn Rapids to western Washington would have to dead-head via Longview back to Richland (or move some combination of empty stackcars and stackcars carrying empty containers).

For the UP, the equipment balancing issues are not as complex, given that it has only one main route from the Midwest to the Puget Sound ports. Nonetheless, the UP would encounter incremental costs to position stackcars carrying empty containers into the Horn Rapids hub that would have otherwise just continued moving directly to the Puget Sound area. Specifically, in addition to the cost and time associated with cutting a block of stack-cars out of an intermodal train moving to Portland and/or Seattle/Tacoma at Hinkle, the UP would have labor, fuel, and other operating costs associated with the local train move from Hinkle to Richland, as well as for the reverse local train move back to Hinkle for the westbound export loads.

11.3. Establishing High-Volume Import Logistics Operations in Horn Rapids

What the preceding discussion in Section 11.2 attempts to convey is that the most economic way of supplying empty container equipment for the exporters of central/eastern Washington via the prospective inland hub at Horn Rapids is if at least a few major importers were to establish inbound logistics/transloading operations at a facility at the hub – as alluded to at the beginning of Section 11.1.

These importers would then be able to “pull” containers (both dry boxes and “inactive” reefers loaded with dry cargoes) in sufficient quantities to support short-haul trains moving eastbound to Richland. Ocean carriers and exporters would then be able to almost-completely avoid the high costs of repositioning empty containers by truck from western Washington to central/Eastern Washington and Oregon. With stack-cars, containers, and locomotives all positioned regularly from the Ports of Seattle and Tacoma to the inland hub to move the head-haul import loads to Horn Rapids, the exports from the inland region would then be able to benefit from back-haul economics, generating substantial savings versus trucking.

Consequently, in this section, Mercator discusses the prospects for establishing inbound logistics and transloading operations in Horn Rapids for high-volume importers of Asian cargoes.

Background on Transloading for Import Logistics

Importers adopt transloading/cross-docking as a supply chain strategy to efficiently move imports, as well as domestic goods while reducing the per unit cost for inland transportation. Sometimes the two terms are used interchangeably. For imports, transloading refers to transferring the contents of marine containers into domestic 53-foot containers or trailers at a warehouse - typically near a gateway port for onward movement via rail or truck to US inland destinations.

Most large and many mid-sized importers have adopted the practice of transloading, especially for fast-moving consumer goods, trendy, and high-value products. By utilizing 53-foot domestic containers and trailers (as opposed to 40-foot marine containers), transloading lowers the per unit cost of inland transportation because the same volume of cargo can be stuffed into fewer domestic containers or trailers.

Even more important, transloading enables importers/retailers (also referred to as beneficial cargo owners, or BCOs) to postpone allocation of imported products to DCs or stores until customer demand can be more accurately forecasted – closer to market rather than upon cargo loading at the foreign port. This reduces instances of shelf stock-outs or excess products being stuck where demand is light.

Transloading is also commonly used to sort imported goods from multiple suppli¬ers – and sometimes to merge them with domestic goods – and reload the products into domestic trailers or containers according to outbound orders allocated to specific retail locations or regional DCs.

Many importers/retailers subcontract their transloading operations to third-party logistics providers (3PLs).

Transloading in Washington State

Largely because of the Ports of Seattle and Tacoma serving as a major gateway for container trade between Asia and the United States (the fourth largest gateway, by container volume, for Asian imports – after Los Angeles/Long Beach, New York/New Jersey, and Savannah), there are more than 150 logistics facilities in western Washington that are supporting import and export activity for containerized cargoes. Most of these facilities are located in King and Pierce Counties, but some are also in Thurston and Pierce County as well.

In this same region, a majority of these facilities provide transloading services, in addition to storing cargoes and providing other related logistics services. There are more than 50 logistics/ transloading centers in this area that are more than 100,000 SF in size, and 8 of those are larger than 400,000 SF. 2 operators in the region have over 1 million square feet, Regal Logistics in Fife, and Holman Distribution in Kent. Moreover, the demand for these facilities continues to increase.

Industrial lands available for new development are in short supply in western Washington (especially in King and Pierce Counties), while demand for industrial warehouse continues to be high, which has driven up the cost of warehouse space and forced warehouse operators to look outside of the Puget Sound region for expansion.

With the large land parcels available at HRIP, 3PLs operating transloading facilities on behalf of importers/retailers (also referred to as beneficial cargo owners, or BCOs) could benefit from locating their operations in Richland. A 3PL operating out of a logistics facility at Horn Rapids would be able to take advantage of the following attributes:

- Lower costs for warehouse labor, land, building construction, utilities, property, and local taxes.
- There is a lower cost of living in the Tri-Cities area, which is favorable for the warehouse workers' expenses on housing, food, gas, and other cost of living expenses.
- There is abundant industrial land in Horn Rapids, that is more difficult to find in the Puget Sound region.

- The warehouse labor pool from which to draw on is abundant due the strong economy built from Hanford, DOE contractors and the PNNL lab, as well as the agricultural sector and the service industries supporting those businesses and workers.
- There is limited city road congestion in and around the industrial park that makes pick-ups and deliveries by truck smoother.

In addition to the 3PLs that could potentially obtain the afore-mentioned benefits, there are large BCOs/importers that operate their own import processing/transloading facilities who could be interested in HRIP and inland hub as a long-term capacity addition. As an example, Walmart operates 2 large distribution centers within close proximity to Horn Rapids, one in Hermiston, OR and the other in Grandview, WA. Walmart and/or another large retailer could decide to locate and operate a distribution center and/ or a transload warehouse in Richland instead of Seattle/ Tacoma due to numerous factors:

- The operating costs are lower than the Puget Sound region and if they utilize a 3PL the transload fees would likely also be offered at a discount from the Puget Sound rates.
- The BCOs would be able to conduct value-added services to make products store shelf-ready at a lower cost due to lower labor costs.
- By having the transload or DC located inland from the seaports, the BCO could also gain an additional day in which to determine where to allocate the inventory in the container (to its DC or store, direct to wholesaler, or another channel).
- The transload warehouse could function as a last mile warehouse to distribute time-sensitive transloaded products to Mountain States.
- From Richland, the distance to final markets beyond the Mountain States is less and a sizeable region could be served within a one- or two-day truck trip. Also, if a container had a mix of cargo for delivery in the Seattle and Tacoma markets as well as the cargo destined to points east and south of Richland, it would still be possible to truck the local portion back to Sea/Tac the same day that the transload was accomplished.
- The BCO could have domestically produced products merged at the transload warehouse with the imports to create highly utilized outbound loads to destination, thereby lowering the per unit cost for inland transportation. The importers also could find an exporter(s) with which to partner to secure lower truck rates to Richland since there would be a guaranteed backhaul for the trucker. The BCO would be an anchor client for a 3PL and would have a vested interest in the success of the operation by executing at the highest levels of customer service.

11.4. Recent Initiative and Long-Term Opportunities

In the past few years, an initiative has been progressed to develop an inland intermodal hub in HRIP. In particular, Central Washington Corn Processors (CWCP) and their partners have been attempting to develop an intermodal center/logistics park by using the existing CWCP footprint. A diagram of the planned facility is included in the City of Richland Rail Master Plan, is shown in Figure 9.

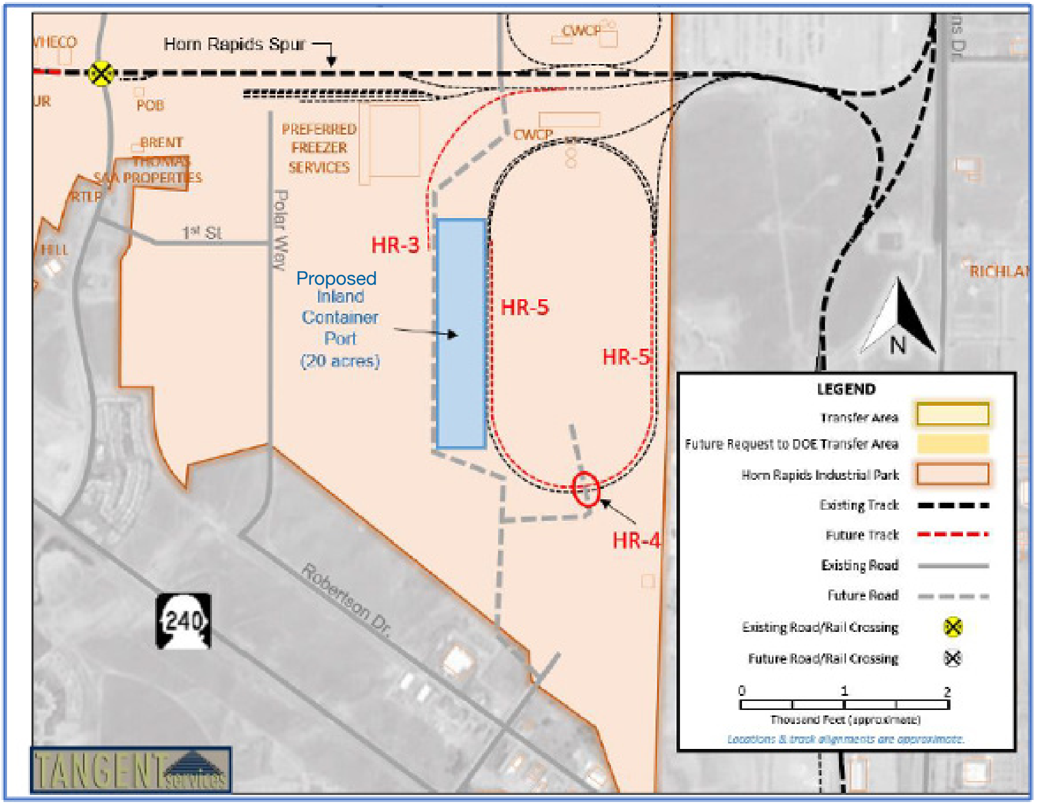

Figure 9: Inland Container Port Site from 2017 City of Richland Rail Master Plan

The partners in this venture are being very creative in leveraging the existing rail infrastructure of CWCP in order to minimize capital expenditures for this project, as they intend to build a second loop track parallel to the existing loop track (which receives unit grain trains for the CWCP silos). The initial traffic flow being targeted by the prospective joint venture is to also locate a hay processing facility adjacent to the planned, paved container yard and then load export hay into containers there.

In addition, CWCP and its partners have been working to secure long-term contracts with one or two major importers to establish import distribution/transloading operations in a 1-million SF facility custom-built to their specifications. This facility would be located immediately west of the container yard (the blue shaded “Inland Container Port” in the diagram above. Target customers for the facility are companies that are realizing that developing new logistics infrastructure in the Puget Sound area is becoming too time-consuming (due to lengthy permitting processes), too expensive, and too constrained (as less and less land is available for industrial development).

It is taking time for all of the components integral to this planned inland intermodal hub to come together. In addition to the challenges of securing volume/rent commitments from the one or two initial importer-customers – CWCP and its partners have been challenged to secure commitments from the Class I railroads on guaranteed service levels and rail transportation rates for the prospective short-haul train services between the facility and Puget Sound ports.

To a great degree, this is something of a “chicken-and-egg” challenge, in that the railroads are likely hesitant to commit to rate/service levels without knowing in advance what annual container volumes either one could expect (and hence, what sizes of trains they might be able to operate).

Conversely, without knowing what the rail transport rates and service levels are going to be, another potential generator of traffic – Lineage Logistics and its customers – cannot commit to using the prospective train services to move their export reefer containers to the Puget Sound ports (instead of trucking those boxes, as they are presently doing).

Nonetheless, Mercator believes that this initiative is close to getting started, with one or two major importers expected to commit to the project by or before early 2022, and with one of the Class I railroads committing to rate and service levels shortly thereafter. As a result, by or before the end of 2023, with the logistics facility completed, there should be at least one intermodal unit train per day running between Horn Rapids and Seattle/Tacoma, moving eastbound import loads, some eastbound empties, westbound hay, other westbound dry commodities, and westbound reefers loaded at the Lineage facility. There would also likely be loadings of domestic containers onto intermodal railcars for movements to states east of the Rocky Mountains.

As the decade progresses further, there are likely to be additional importers and 3PLs wanting to capitalize on the advantages discussed earlier of locating logistics infrastructure in the Horn Rapids area, and therefore to utilize the short-haul intermodal trains running between the ports and this inland hub. One could also expect a competitor of Lineage Logistics to develop a similar operation in this area as well and generate more stack-car moves and container lifts to/from those stack-cars.

However, once the number of intermodal train movements starts exceeding 4 per day, it will become increasingly inefficient for those trains and the inbound unit grain trains for CWCP to be moving into, out of, and within the same general area.

Mercator therefore projects that by – if not before 2030 – there will be a demand for a larger intermodal/logistics center, and the open area northwest of where CWCP and Lineage are located should be close enough to the first inland hub for the two facilities to provide operational and commercial synergies for each other.

Appendix A: Alignment Alternative Exhibits

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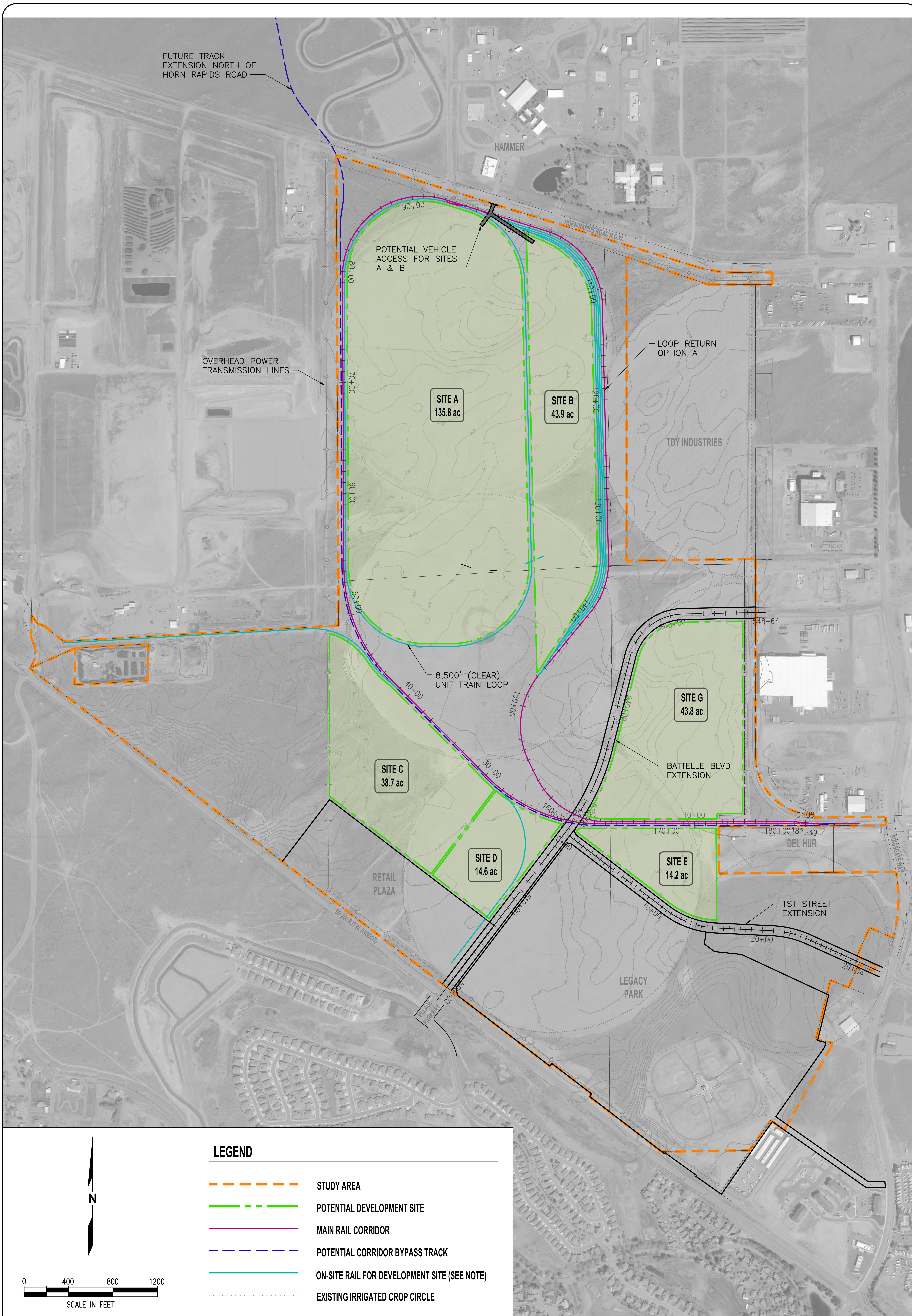

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CITY OF RICHLAND
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RAIL STUDY – OPTION A

SCALE: 1:400 DATE: 12/3/21
SHEET: 1 OF 8
DRAWING NO. 1

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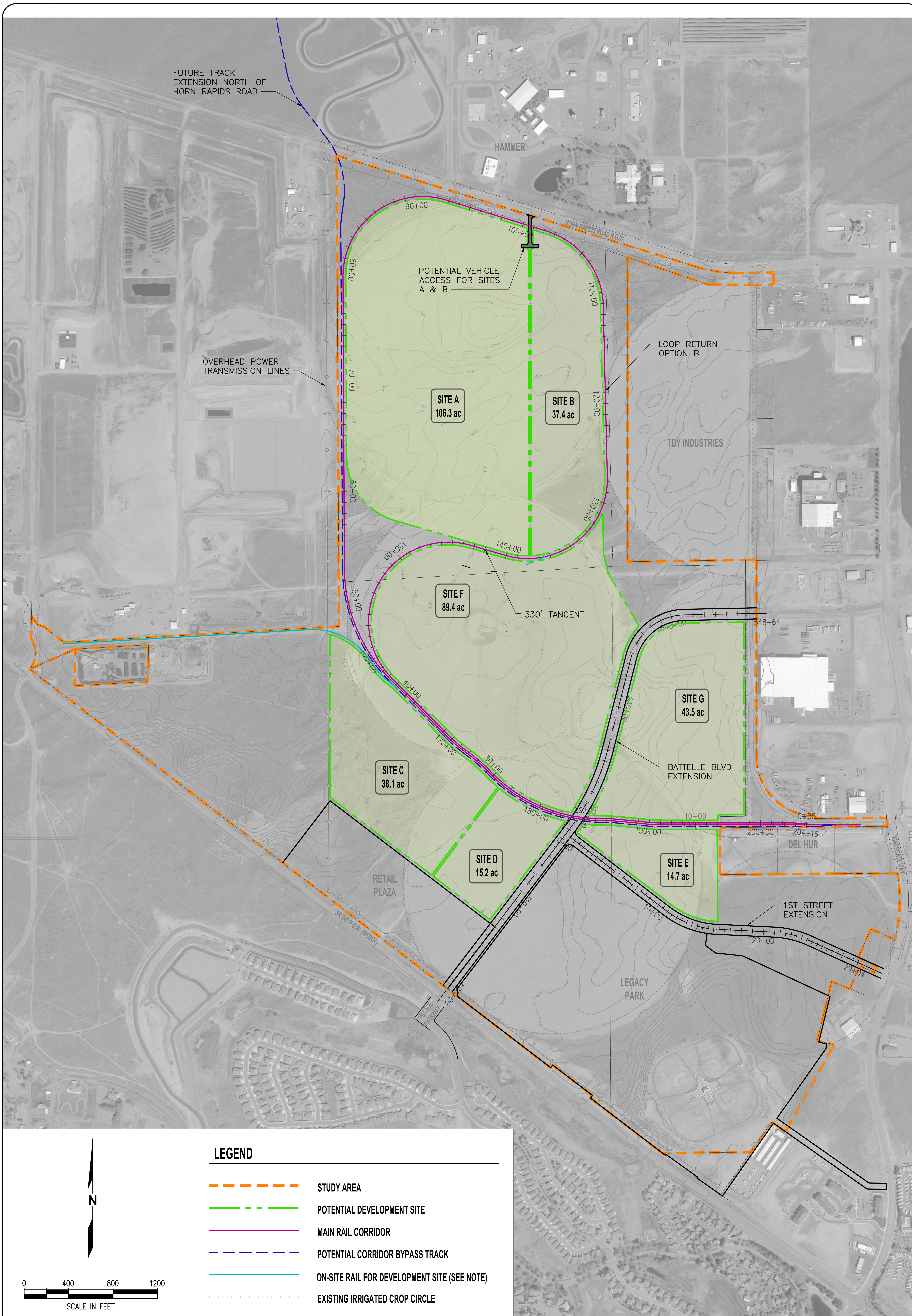

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SHEET: 2 OF 8
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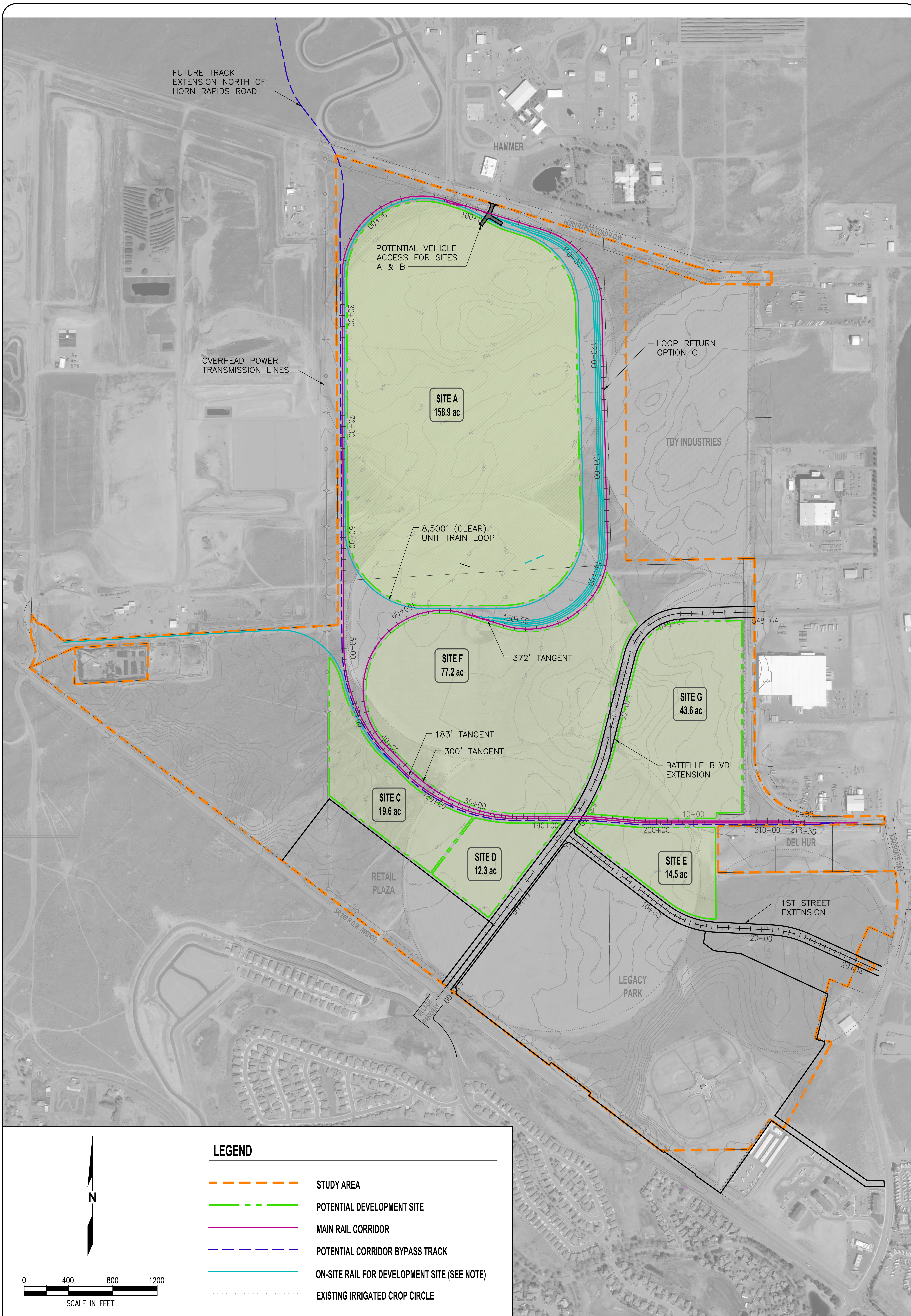

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RAIL STUDY – OPTION C

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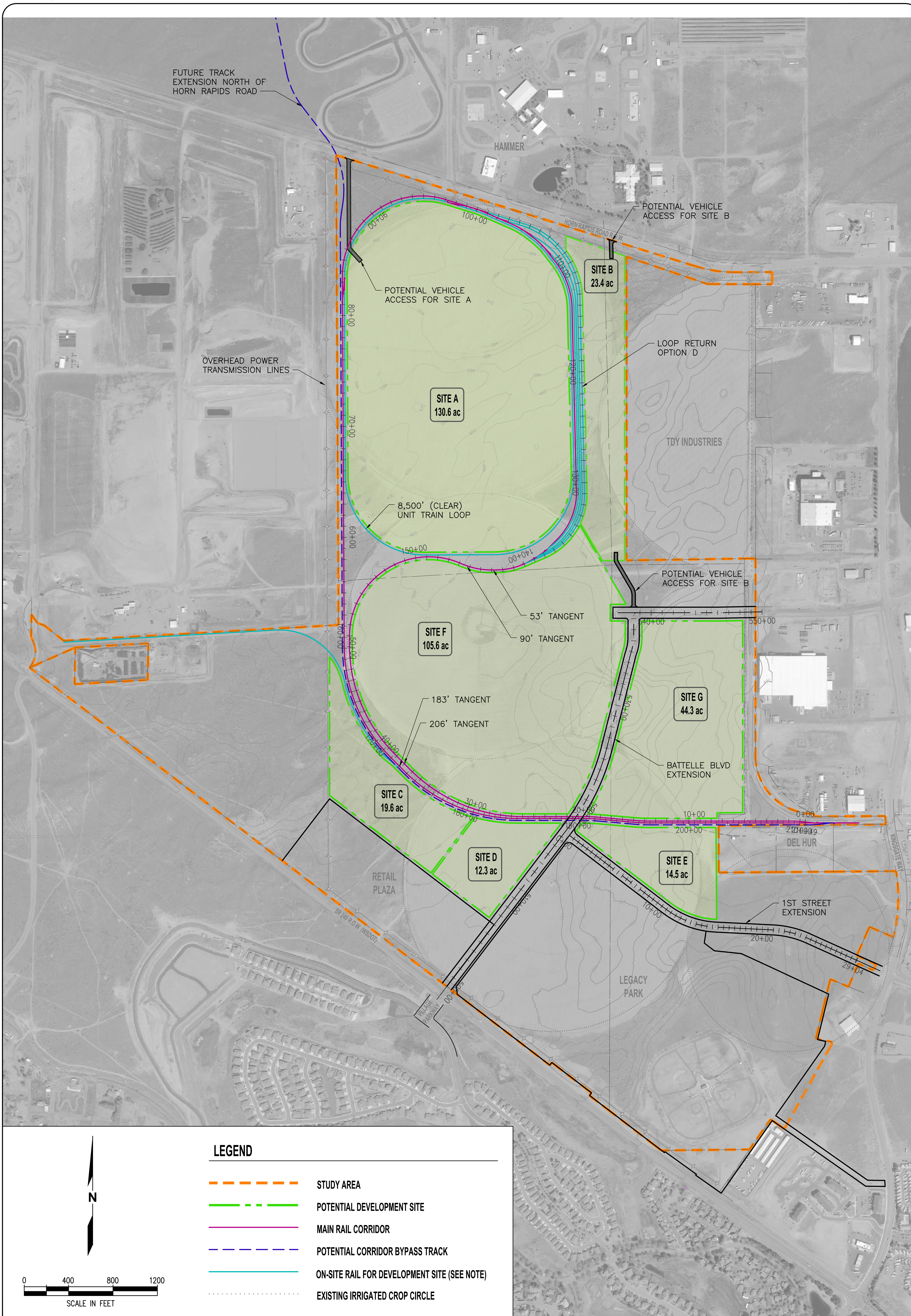

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CITY OF RICHLAND
HORN RAPIDS INDUSTRIAL PARK
RAIL STUDY – OPTION D

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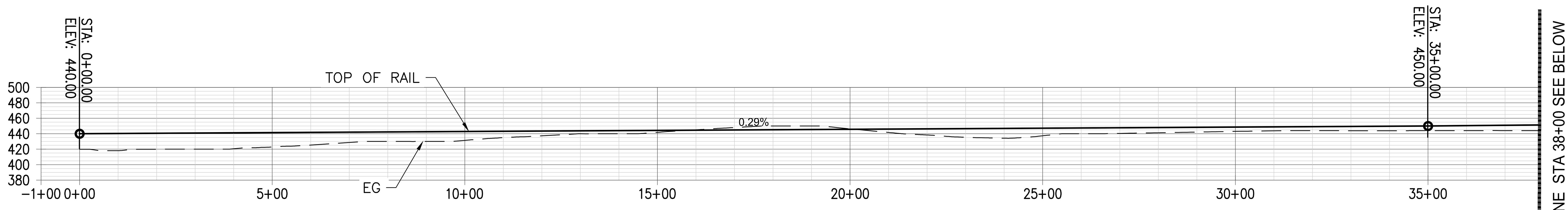
DRAWING NO. 4



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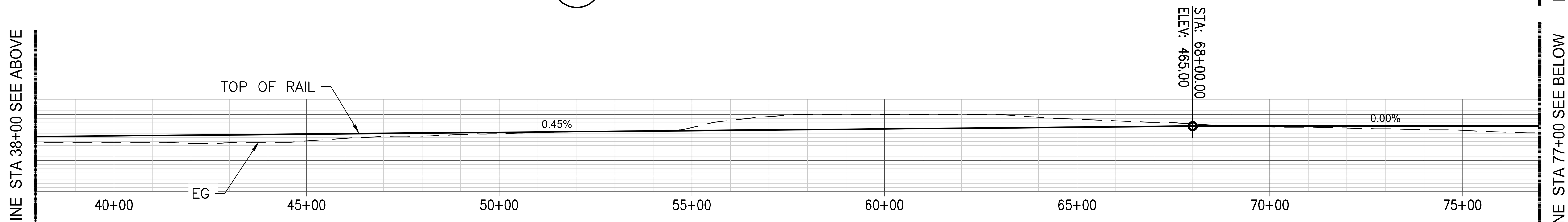

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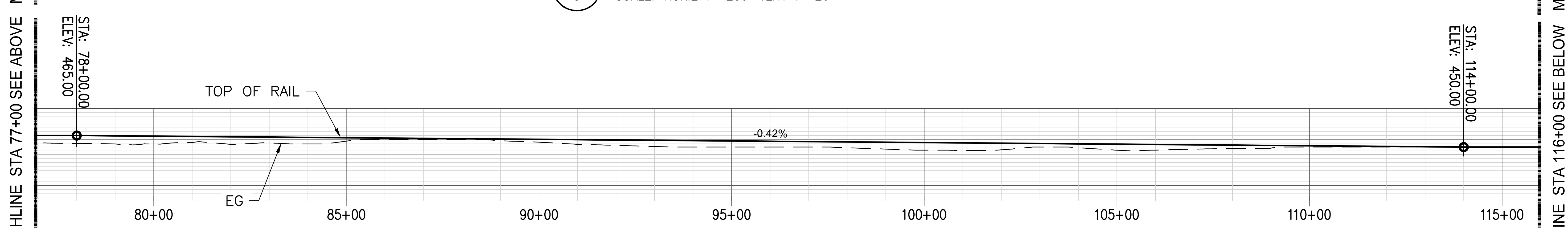

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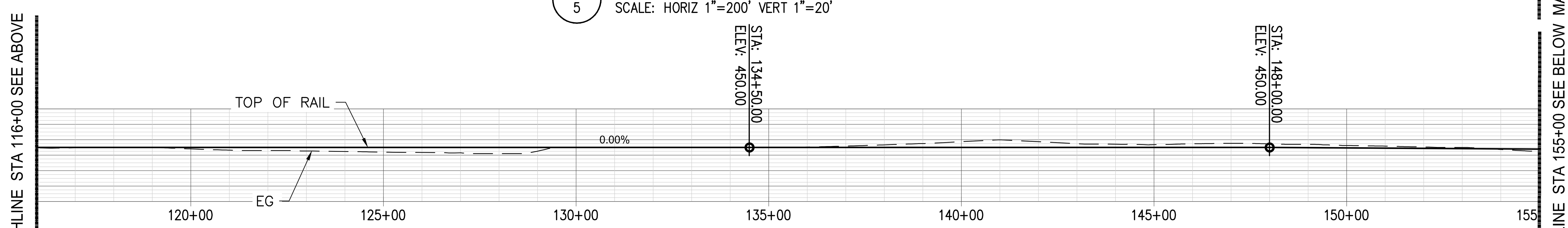

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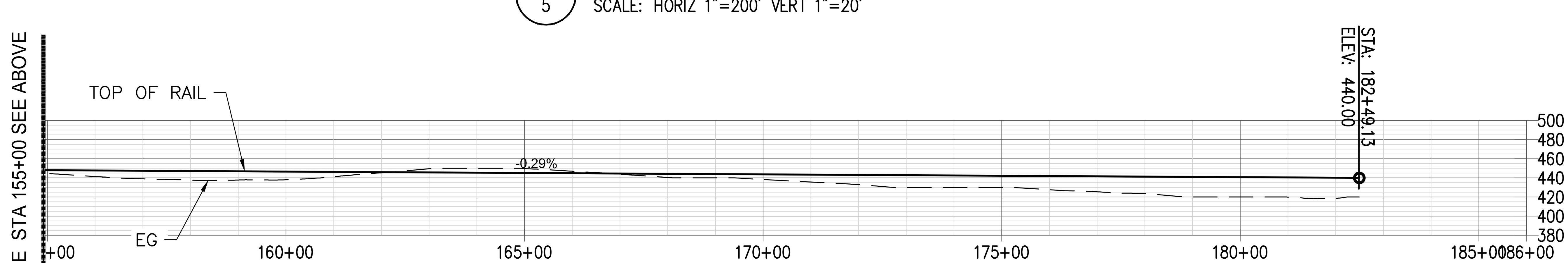

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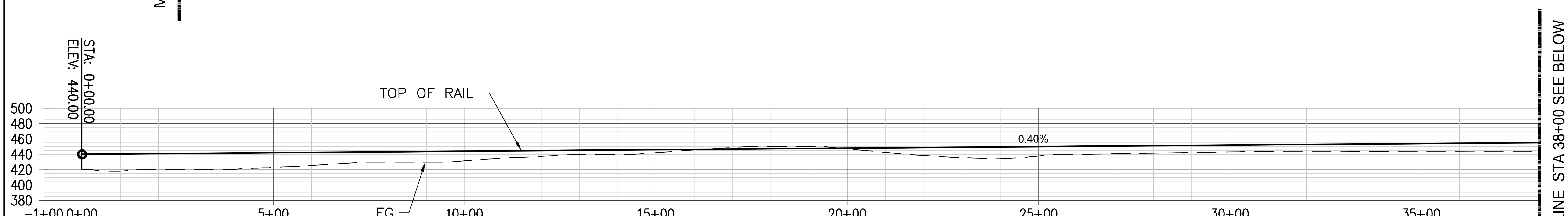

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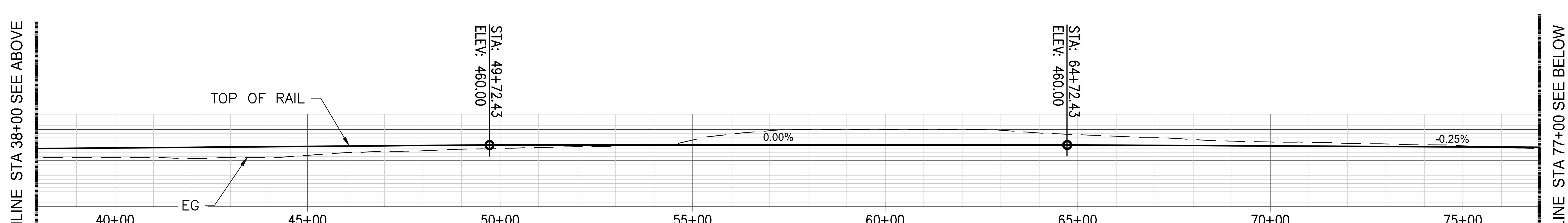

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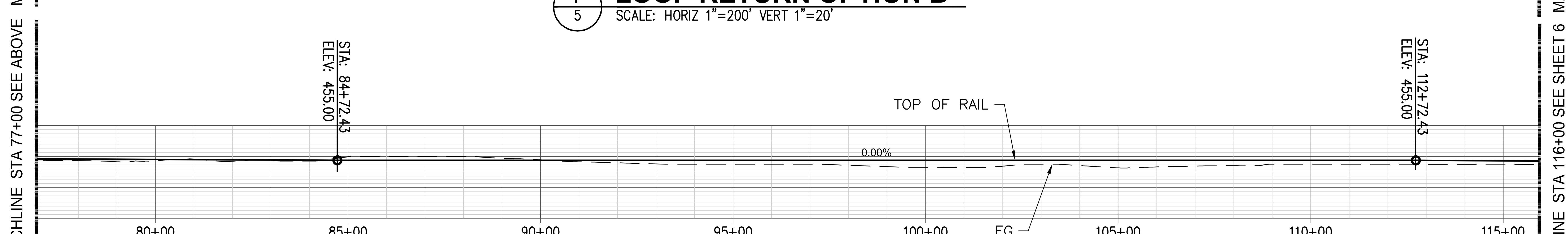

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SCALE: HORIZ 1"=200' VERT 1"=20'

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RAIL STUDY – PROFILES

SCALE: DATE: 12/3/21
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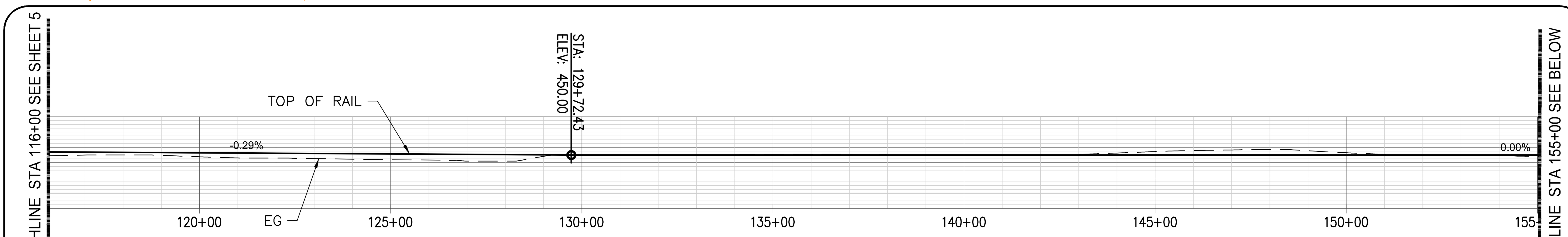

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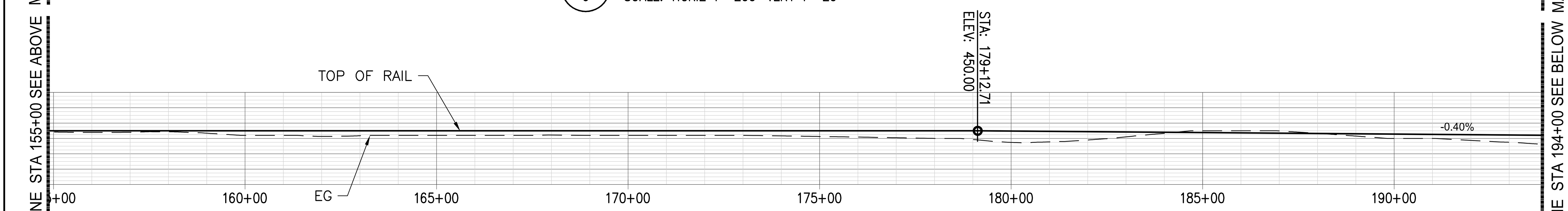

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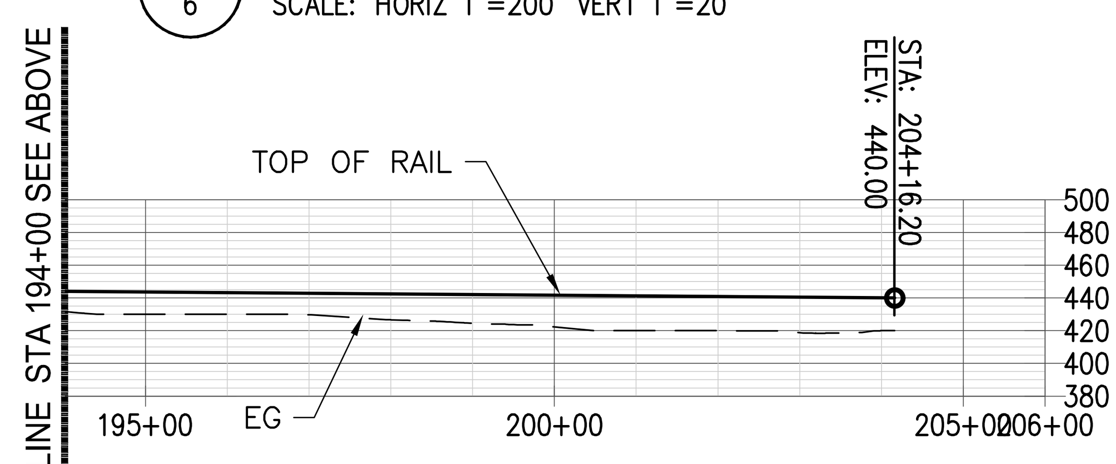

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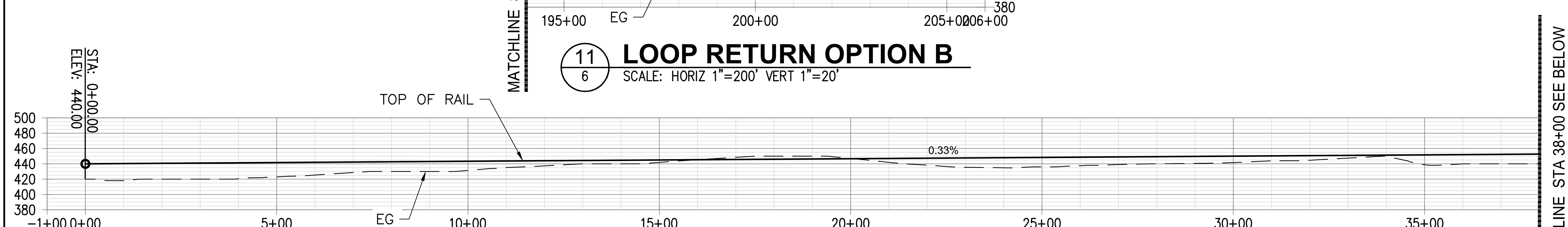

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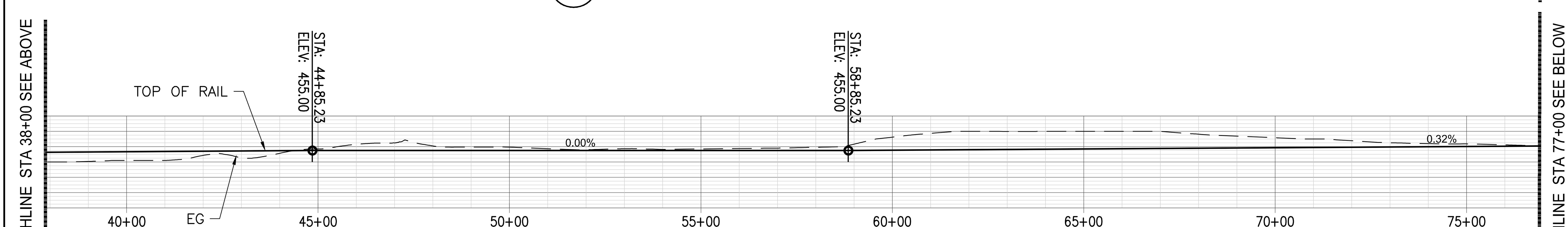

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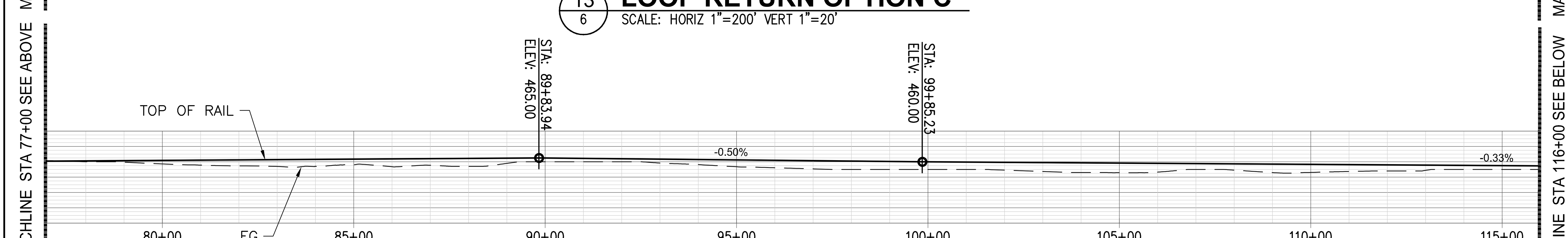

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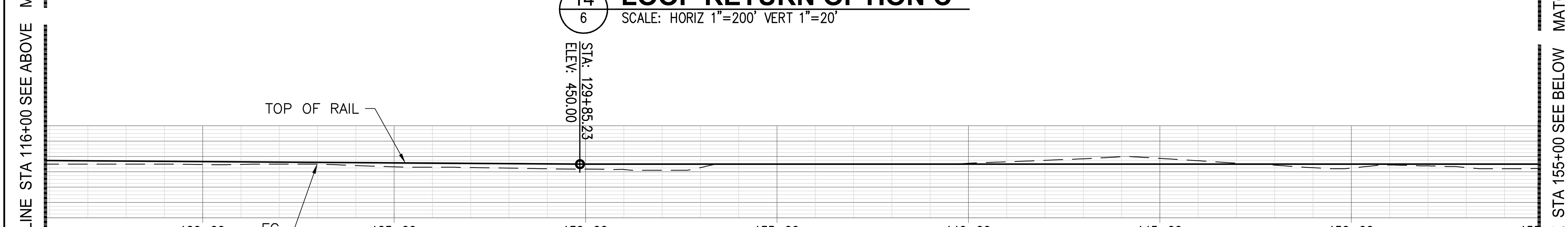

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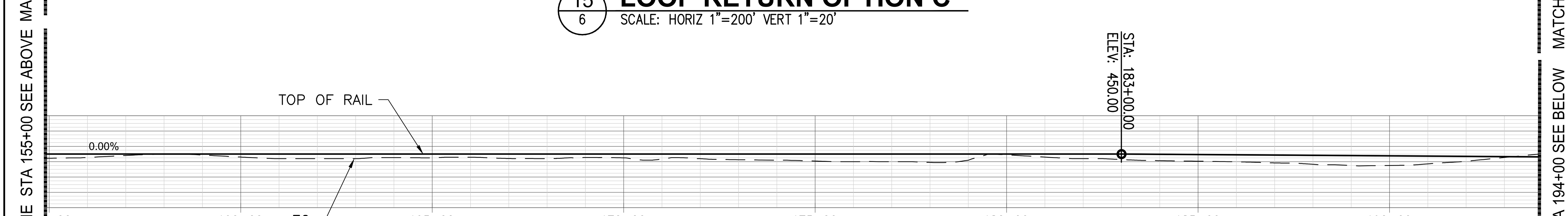

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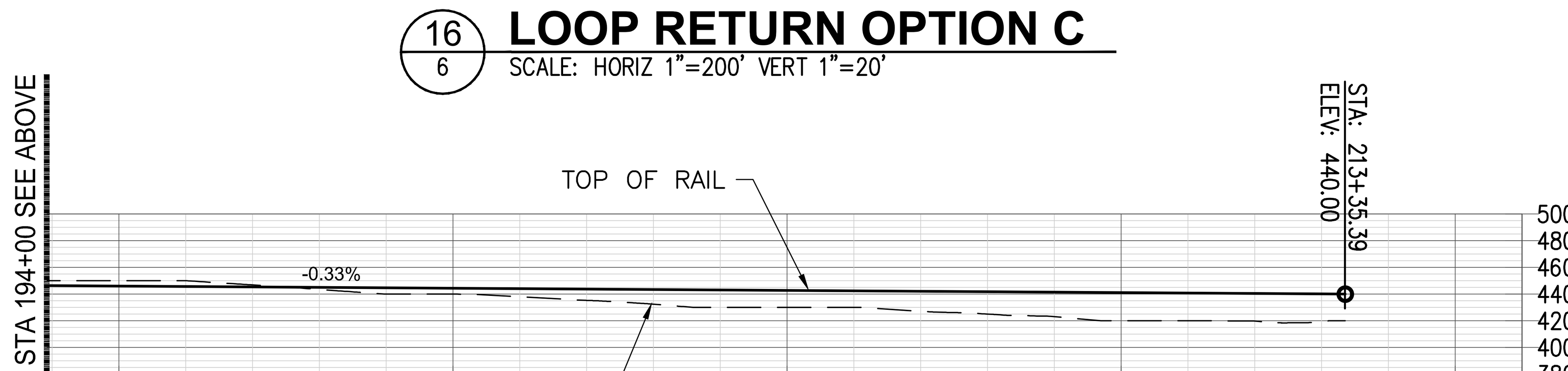

17 / 6 **LOOP RETURN OPTION C**
SCALE: HORIZ 1"=200' VERT 1"=20'

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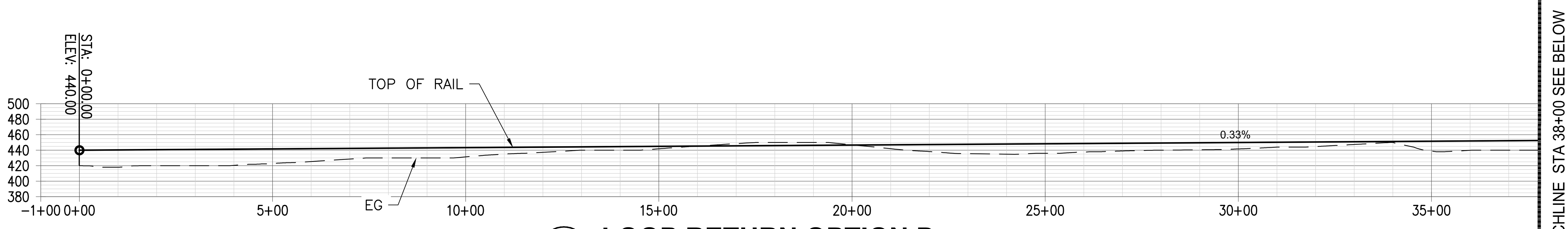

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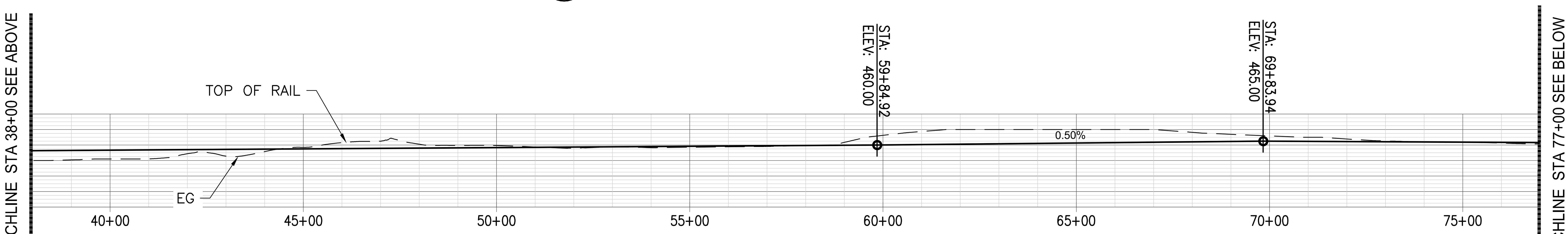

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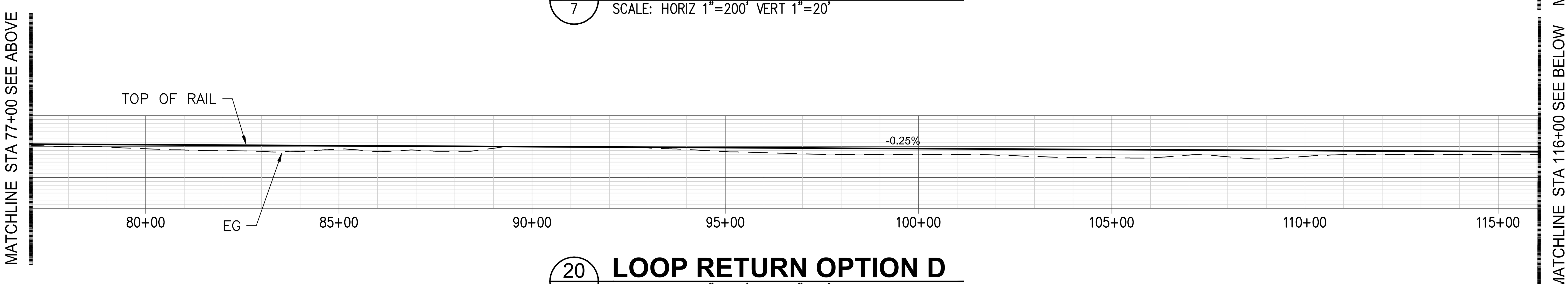

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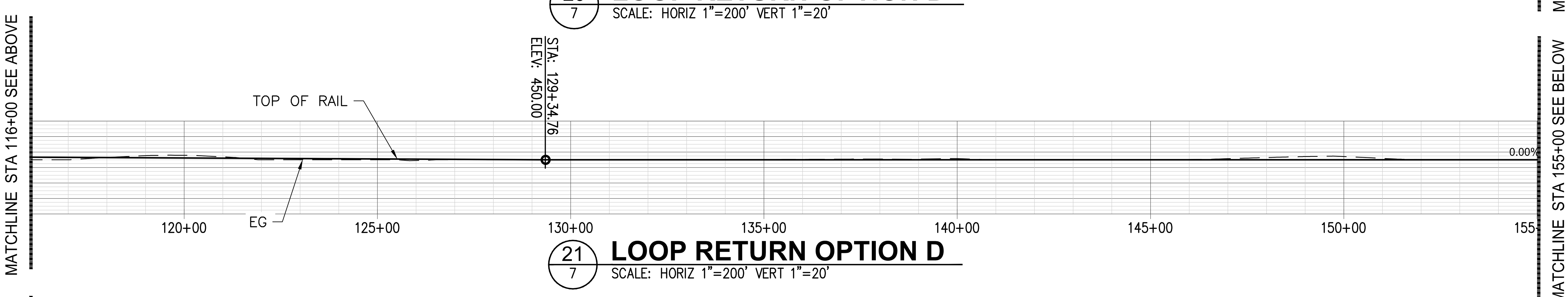

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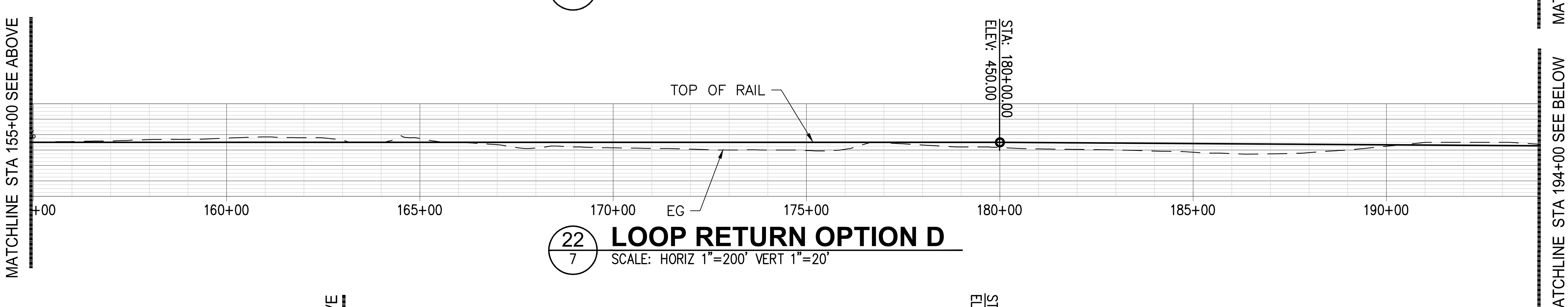

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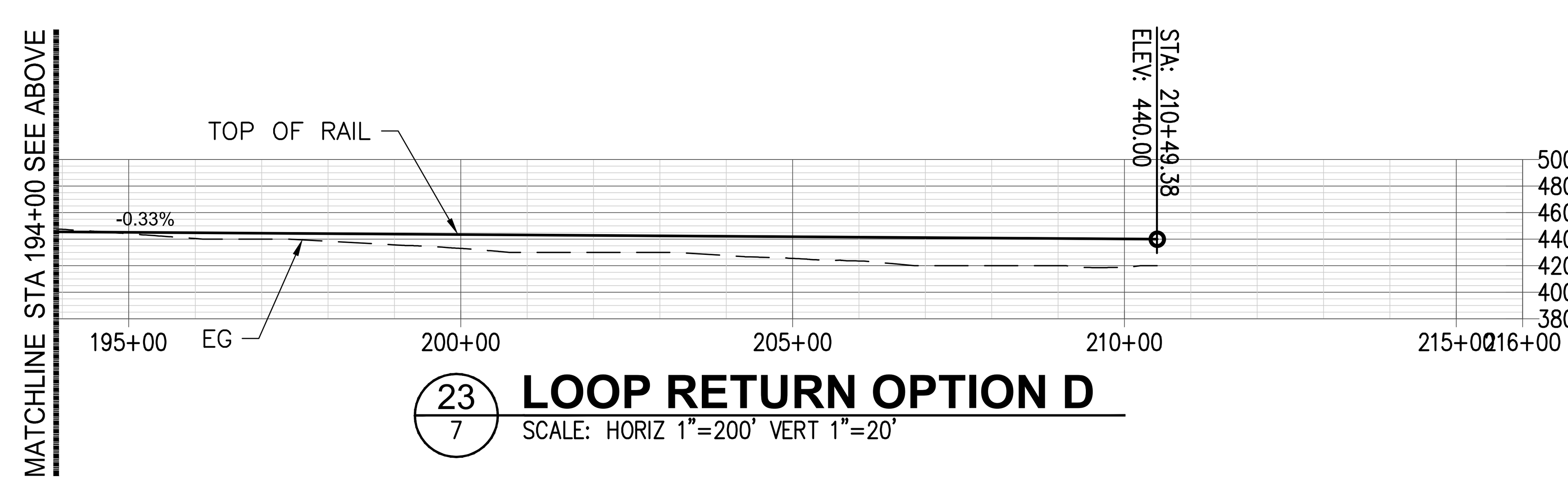

23
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LOOP RETURN OPTION D
SCALE: HORIZ 1"=200' VERT 1"=20'

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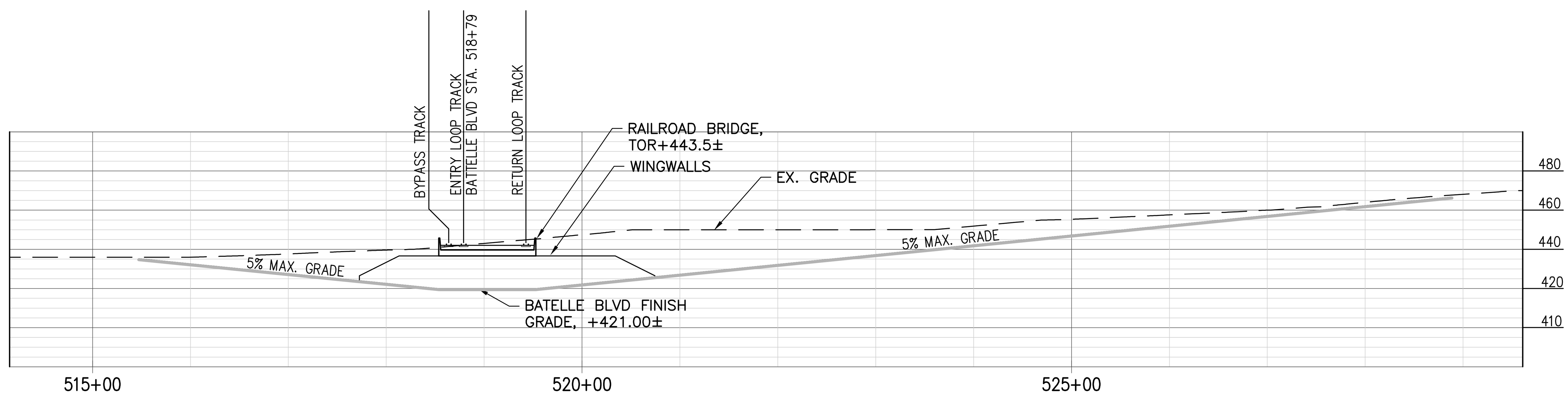

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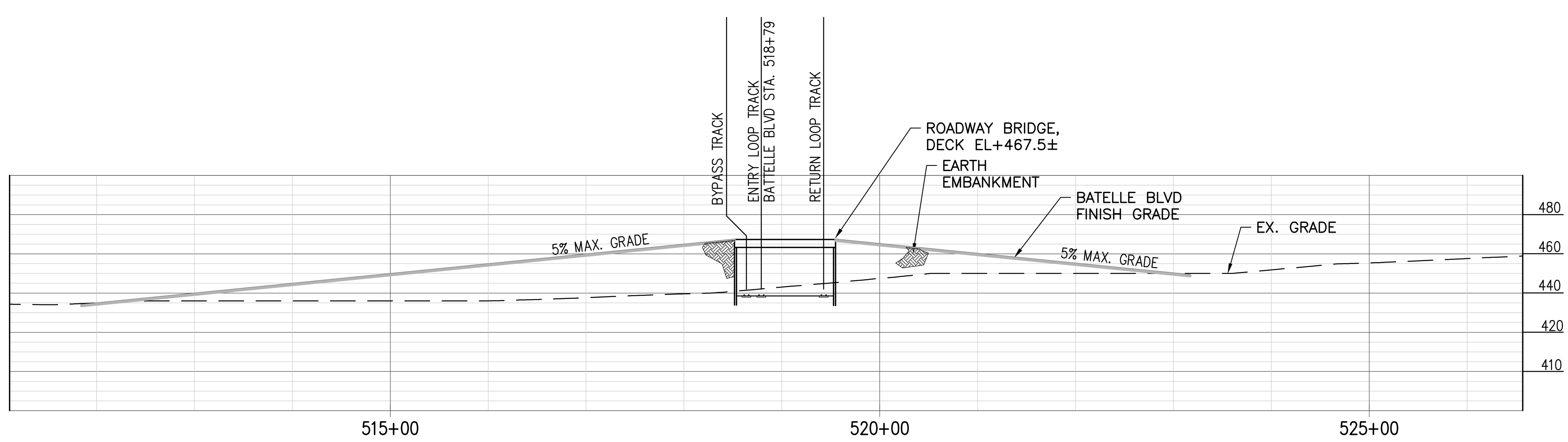

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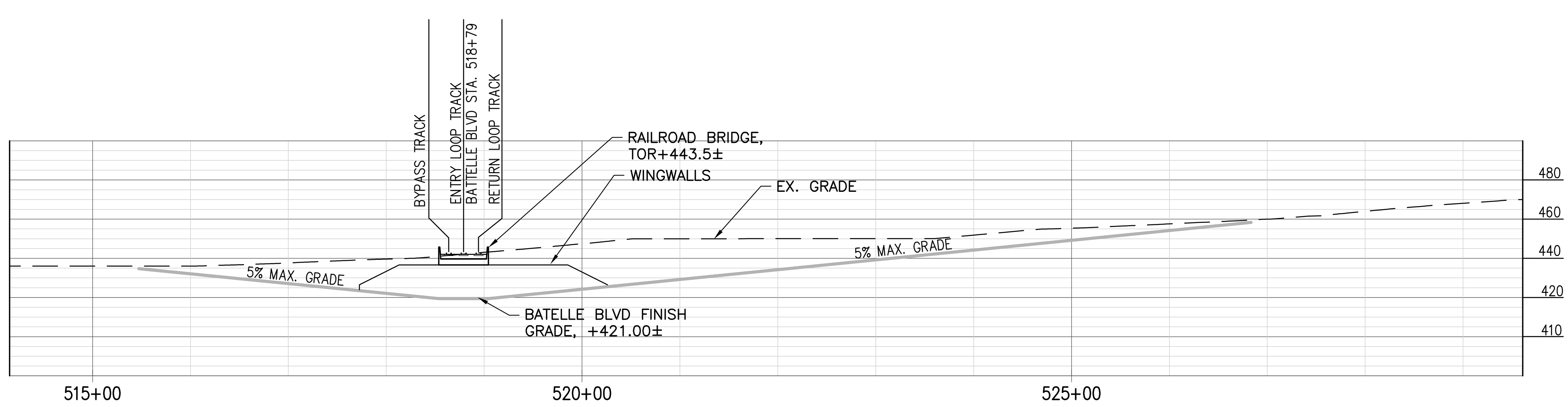

26/8 OPTION B, C, D UNDER-CROSSING

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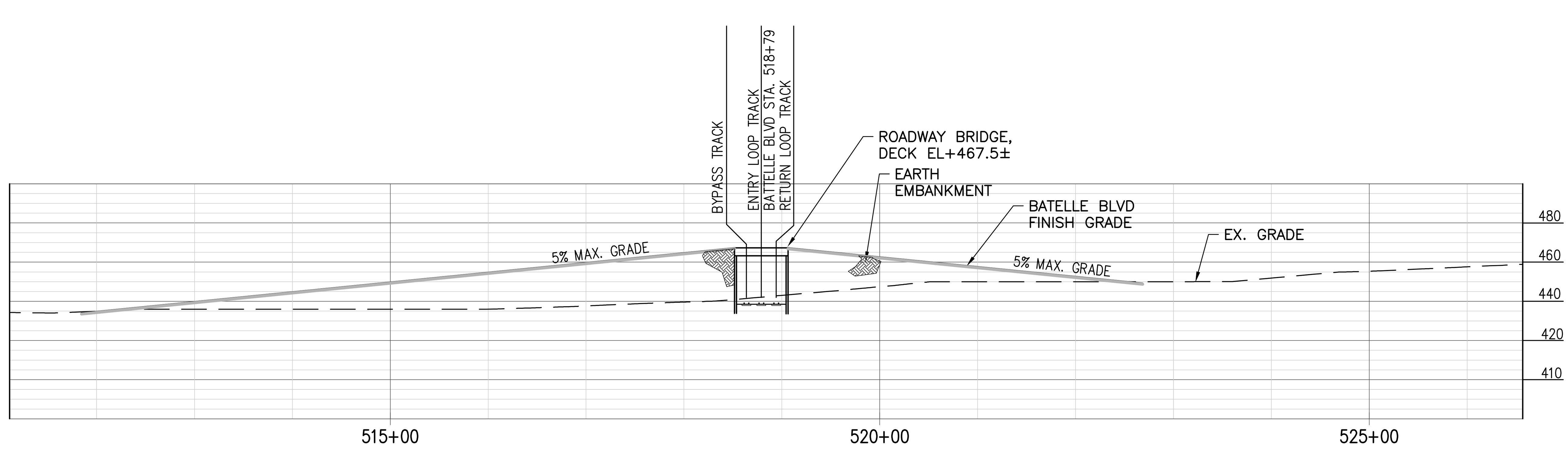

27/8 OPTION B, C, D OVER-CROSSING

SCALE: HORIZ 1"=100' VERT 1"=10'

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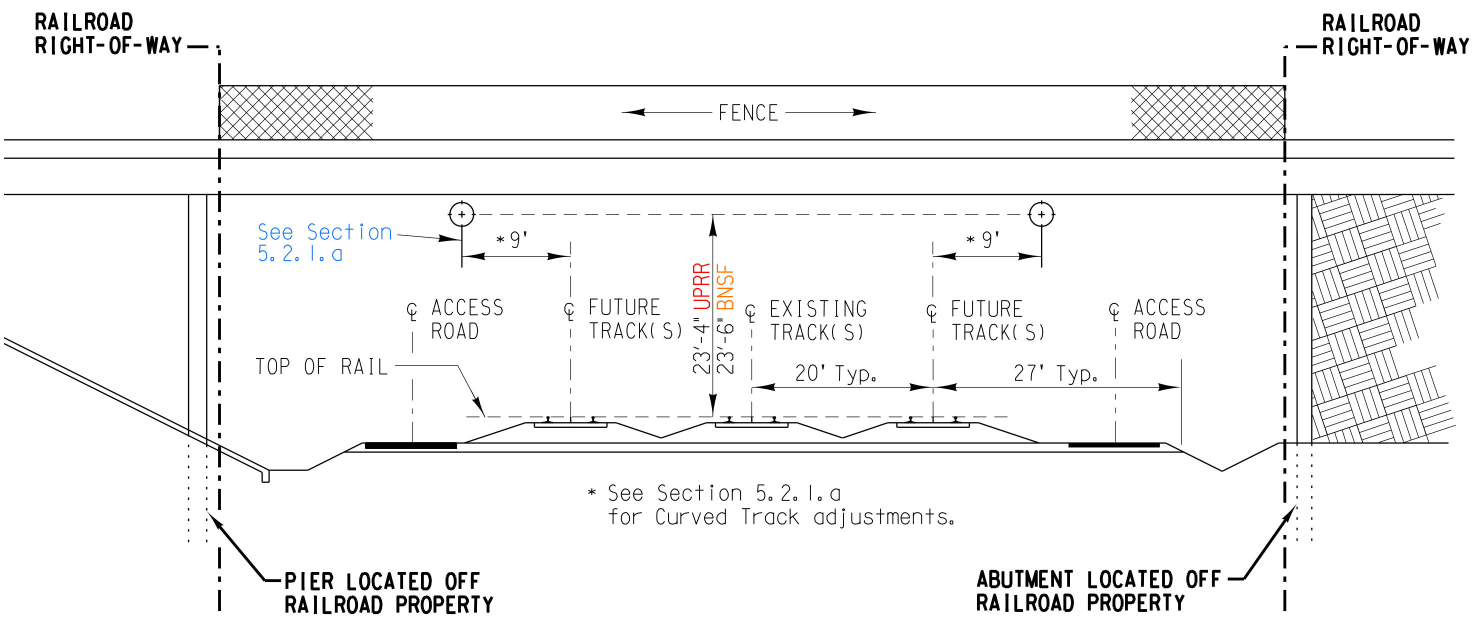
DRAWING NO. 8

Appendix B: UPRR BNSF Guidelines for Railroad Grade Separation Projects

GUIDELINES FOR RAILROAD GRADE SEPARATION PROJECTS



The above depiction is for example purposes only. The individual dimensions are the minimum required. Project specific design plans require the review and prior approval by the Railroad.

It is the intent of the Railroad to maintain the right-of-way free of permanent obstructions such as overhead bridge piers, earth fills and drainage facilities which do not support Railroad infrastructure. Permanent obstructions restrict the Railroad's ability to perform maintenance and expand service to existing and future customers. Keeping the right-of-way unobstructed is not a betterment for the Railroad, it is a necessity.

UNION PACIFIC | BNSF RAILWAY

BRIDGE STANDARDS

GRADE SEPARATION GUIDELINES

COVER PAGE

FILE OWNER: UPRR	DATE: 1/05/16
AUTHORED BY: R. FRIESEN	CHECKED BY: A. HURST

TABLE OF CONTENTS

APPENDIX

1. INTRODUCTION

1.1 Purpose

The purpose of these Guidelines is to inform Applicants, Contractors and other parties concerned with Railroad policies of the requirements and standards for the design and construction of Grade Separation Projects. Compliance with these Guidelines is required to expedite the review and approval of design and construction submittals by the Railroad.

Railroad review is limited exclusively to potential impacts on existing and future Railroad operations. The Railroad accepts no responsibility for errors or omissions in the design of grade separation projects by others.

1.2 Definitions

Access Road:
A road used and controlled by the Railroad for maintenance, inspection and repair.

Applicant:
Any party proposing a grade separation project on Railroad right-of-way or other Railroad operating location, regardless of track being active or out of service.

AREMA:
The current edition of the American Railway Engineering and Maintenance-of-Way Association Manual for Railway Engineering.

AASHTO:
The current edition of the American Association of State Highway and Transportation Officials Standard Specifications for Highway Bridges.

BNSF:
Burlington Northern Sante Fe Railway

C & M Agreement:
A Construction and Maintenance Agreement that has been negotiated between the Railroad and the Applicant that addresses all the duties and responsibilities of each party regarding the construction of the proposed grade separation and the maintenance requirements after construction of the said structure.

Construction Documents:
Design plans and calculations, project and/or standard specifications, geotechnical report and drainage report.

Construction Window:
A timeframe in which construction or maintenance can be performed by the Contractor with the required presence of a Flagman.

Contractor:
The individual, partnership, corporation or joint venture and all principals and representatives (including Applicant's subcontractors) with whom the contract is made by the Applicant for the construction of the Grade Separation Project.

Crossover:
A track connection which allows trains and on-track equipment to cross from one track to another.

Engineer-of-Record:
The Professional Engineer that develops the criteria and concept for the project and is responsible for the preparation of the Plans and Specifications.

Final Plans:
100% plans signed & stamped by the Engineer-of-Record.

Flagman:
A qualified employee of the Railroad providing protection to and from Railroad operations per Railroad requirements.

Guidelines:
Information contained in this document or referenced in AREMA or AASHTO.

Grade Separation Project:
A project that includes an Overhead or Underpass Structure that crosses the Railroad right-of-way or other Railroad operating location regardless of track status being active or out of service.

Main Track:

A principle track, designated by Timetable or special instructions, upon which train movements are generally authorized and controlled by the train dispatcher. Main Track must not be occupied without proper authority.

Multiple Main Tracks:

Two or more parallel or adjacent Main Tracks.

Overhead Structure:

A Roadway and/or Trail Structure over the Railroad right-of-way.

Railroad Local Representative:

The individual designated by the Railroad as the primary point of contact for the project.

Railroad:

Refers to BNSF Railway and/or Union Pacific Railroad.

Railroad Manager of Track Maintenance (MTM):

Railroad representative responsible for maintenance of the track and supporting subgrade.

Railroad Right-of-Entry Agreement:

An agreement between the Railroad and an Applicant or a Contractor allowing access to Railroad property.

Railroad Right-of-Way:

The private property limits owned by the Railroad.

Shoofly:

A temporary track built to bypass an obstruction or construction site.

Siding:

A track connected to the Main Track used for storing or passing trains.

Timetable:

A Railroad publication with instructions on train, engine or equipment movement. It also contains other essential Railroad information.

Trail:

A pathway impacting Railroad right-of-way or other Railroad operating locations regardless of track status being active or out of service. This includes pedestrian, bicycle, approved motorized recreational equipment and equestrian uses.

Underpass Structure:

Railroad Structure over a Roadway and/or Trail.

UPRR:

Union Pacific Railroad

Yard:

A system of tracks of defined limits, other than main tracks and sidings, for storing and sorting cars and other purposes.

Yard Limits:

A portion of main track designated by “yard limit” signs and included in the timetable special instructions or a track bulletin.

1.3 Guidelines and References

These Guidelines are provided for reference only and are subject to revision without notice. These Guidelines cannot be taken as authority to construct. Railroad approval of construction documents, execution of a C & M Agreement and Railroad Right-of-Entry Agreement (if applicable) are required prior to beginning construction.

These Guidelines supplement the current (AREMA) Manual for Railway Engineering, AASHTO and State Railroad Regulatory Body requirements.

The AREMA Manual is available from:
American Railway Engineering and Maintenance-of-Way Association
4501 Forbes Boulevard, Suite 130
Lanham, MD 20706
Phone: (301) 459-3200
FAX: (301) 459-8077
www.arema.org

The specific Railroad requirements for a Grade Separation Project, as addressed in this document, shall be followed at all locations where the Railroad operates, regardless of track ownership or track status, either active or out of service.

Any items affecting Railroad property not covered in these Guidelines shall be subject to the Railroad's prior review and approval.

All new or modified Overhead Structures or Underpass Structures shall be designed in accordance with the most current policies, requirements and standards of the Railroad. These guidelines do not apply to existing structures which are not impinged upon by the proposed project.

2. AGREEMENTS

2.1 Applicant and Contractor Responsibility

a. The Applicant, at its expense, shall be solely responsible for all costs, design, construction, future replacement, maintenance and serviceability of the proposed Grade Separation Project, except as noted otherwise in the C & M Agreement with the Railroad. The Applicant shall develop design plans, including, without limitation, all procedures necessary to construct and maintain the proposed Grade Separation Project, which cause no interruption to Railroad operations during and after construction. The Applicant must verify with the Railroad Local Representative their receipt of the latest version of these guidelines prior to developing Construction Documents.
b. The Applicant shall be responsible for obtaining all Federal, State, Local and other permits for construction of the Grade Separation Project.
    1. The Engineer-of-Record shall be registered in the state of the project location. The Engineer-of-Record may be Applicant's in-house staff or a consultant retained by the Applicant. The Contractor shall not employ the Engineer-of-Record as the Contractor's Engineer-of-Record or as a specialty engineer, with the exception of design build projects.
c. The Applicant and/or the Engineer-of-Record have the ultimate responsibility and liability for the Construction Documents and liability for damages to Railroad property during and after construction of the project.
d. The Contractor is responsible to comply with the construction documents prepared by the Applicant. The Contractor shall comply with Railroad requirements stated in the C & M Agreement prior to the commencement of any construction. The Contractor shall develop work plans that ensure the track(s) remain open to train traffic per Railroad requirements as stated in the C & M Agreement and meet the requirements of the Railroad Right-of-Entry Agreement (if applicable).
e. The Applicant is responsible for the security and safety of all people including the general public and trespassers, and the protection of Railroad infrastructure within the limits of the proposed Grade Separation

Project. Any damage to Railroad property such as track, signal equipment or structure could result in a train derailment. All damages must be reported immediately to the Railroad Local Representative and to the local Railroad Manager of Track Maintenance (MTM).

f. The Applicant and Contractor are required to meet all safety standards as defined by the Railroad, Federal Railroad Administration (FRA), Division of Occupational Safety and Health Administration (OSHA), Local, State and Federal Governments and the State Railroad Regulatory Body.

2.2 Railroad Right-of-Way

a. The Railroad right-of-way accommodates existing tracks, drainage systems, multiple utilities, Access Roads, Railroad support facilities and space for future track(s).
b. The proposed Grade Separation Project shall not limit existing or future Railroad operating capacity and utility accommodations within the Railroad right-of-way.
c. Limits of Railroad right-of-way are to be located by the Applicant and identified on the plans.

2.3 Railroad Right-of-Entry Agreement

The Applicant, Contractor or their representatives must sign the Railroad's Contractor's Right-of-Entry Agreement (if applicable) and/or obtain a valid Right-of-Entry permit from the Railroad and comply with all Railroad requirements when working within the Railroad right-of-way limits.

2.4 Construction and Maintenance Agreement

a. Any Overhead Structure or Underpass Structure impacting the Railroad will require the Applicant to execute a C & M Agreement prior to any construction on Railroad right-of-way.
b. The C & M agreement shall include a funding source, cost estimate, insurance and indemnification requirements, method of payment, responsibility for design, construction, ownership, maintenance and future replacement.
c. The Applicant shall own, maintain and replace the proposed Overhead Structure or Underpass Structure at no cost to the Railroad and with no interruption to Railroad operations during construction, maintenance and future replacement of the Structure.
d. The Railroad shall, at its own expense, be responsible for ownership and maintenance of ballast and track components only.
e. The Applicant shall provide, at no cost to the Railroad, traffic control and/or detours to allow occupation of the roadway by the Railroad or its Contractor to perform periodic inspections as required.
f. The Applicant is responsible for performing the work in accordance with the terms specified in the C & M Agreement. This responsibility includes, without limitation, compliance with all Railroad requirements, Federal, State and Local Laws and applicable county or municipal ordinances and regulations.

2.5 Railroad Review of Submittals and Construction Observation

a. Prior to any review, the Railroad Local Representative shall receive written notice from the Applicant agreeing to pay all costs associated with the Railroad's, or its consultant's, review of the design plans, construction documents and construction monitoring phase.
b. The estimated costs shall not be the upper limit of the costs but will provide a guideline for budgeting purposes. Regardless, all actual costs incurred by the Railroad, or its consultants, during the review of design plans, construction documents, and construction monitoring phase shall be fully recoverable from the Applicant.

2.6 Approval Expiration

Written approval of Final Plans will be valid for two years from the date of approval by the Railroad unless otherwise provided in the C&M Agreement. If construction of the approved structure has not begun within this period, the Railroad shall have the right to perform a design review, at the cost of the Applicant, to confirm compliance with the Railroad's then-current Guidelines before a Railroad Right-of–Entry Agreement is issued to begin construction.

3. SUBMITTALS

3.1 Railroad Review Process

All design and construction submittals shall be transmitted to the Railroad Local Representative. The submittal will then be forwarded to the Railroad's engineering department. The engineering department shall have the option of reviewing the project documents in-house or by using an outside consultant. During the review process, the Railroad Local Representative shall be the point of contact for resolving outstanding issues.

It should be noted that the Railroad's review and approval of construction documents does not relieve the Applicant and/or Engineer-of-Record from the ultimate responsibility and liability for damages to Railroad property during and after construction of the proposed Grade Separation Project, nor does it relieve the Applicant and the Contractor from their responsibilities, obligations and/or liabilities under the C & M agreement and the Contractor's Right-of-Entry Agreement (if applicable). Railroad's approval of construction documents will be given with the understanding that the Railroad makes no representations or warranty as to the validity, accuracy, legal compliance or completeness of such documents and that any reliance by the Applicant, Engineer-of-Record or Contractor on such documents is at the risk of Applicant, Engineer-of-Record and Contractor.

3.2 Requests for Exception

a. Requests for exception to Railroad requirements shall be submitted to the Railroad for review. The Railroad may approve or reject any request for exception. Approval from the Railroad is required prior to proceeding with an exception.
b. Provide written engineering justification for proposed requests for exception
c. The request should succinctly describe the geometric, structural and other constraints which justify the request. Cost alone should not be the determining factor.

3.3 Contractor Review

The Contractor must review all construction submittals to ensure that the materials and proposed method of construction are compatible with the existing site conditions. The Contractor's work plan must be developed to allow Railroad traffic to remain in service per Railroad requirements and the C&M agreement.

3.4 Applicant and/or Engineer-of-Record Review

The Applicant and/or Engineer-of-Record must review and approve each construction submittal for compliance with the construction documents, AREMA and/or AASHTO, and these Guidelines before forwarding the submittal to the Railroad for review and approval.

3.5 Design Calculations

Design calculations shall be provided for all structures except Overhead Structures. Design Calculations shall be clear, legible and easy to follow. Computer program generated output or data sheet calculations shall be accompanied by input data information and sample calculations to verify the accuracy of the computer output.

3.6 Geotechnical Report

A geotechnical report shall be provided addressing all bridges and retaining walls. The preliminary geotechnical report shall include enough information to support foundation design calculations and backfill design requirements. The final geotechnical report shall have recommendations consistent with those used in the final structural design.

3.7 Drainage Report

A hydraulic and hydrologic report is required if the Grade Separation Project changes existing drainage patterns and/or drainage flow on Railroad right-of-way or at the request of the Railroad. See Section 4.5 for hydraulic criteria to be used.

3.8 Units

All controlling dimensions, elevations, design criteria, assumptions and material stresses shall be expressed in English units. Dual units with English units in parenthesis are acceptable for projects that require the use of Metric units per Federal, State and/or Local government requirements.

3.9 Submittal Schedule

a. The Applicant shall schedule submittals per Tables 3-1 or 3-2 to ensure adequate time for review.
b. Submittals which do not follow the schedules as outlined in these tables may require greater review time than that shown in the table by the Railroad. Partial, incomplete or inadequate submittals will be rejected, thus delaying the approval.
c. The Applicant shall not expect a lesser time for review than indicated in the tables nor shall the Railroad be responsible for delayed design and construction.
d. Revised submittals will follow the same procedure as the initial submittal until all issues are resolved. At the Final Plan submittal, prior to submission to the Railroad, all design plans and calculations, project specifications/Special Provisions, the geotechnical report and the drainage report must be signed and stamped by a registered Professional Engineer familiar with the Railroad requirements and licensed in the State where the project is located.

3.10 Design and Construction Submittals

Following their own internal review and approval the Applicant or their representative shall submit, at a minimum, all applicable submittals defined in Tables 3-1 or 3-2 to the Railroad Local Representative for review and approval. The Engineer-of-Record's review comments must be submitted to the Railroad along with the submittal.

Table 3-1, Overhead Structures

Phase		Type of Submittal	Format	Railroad Review Time
Design	A	Concept (Plans and Site Pictures)	PDF only*	4 weeks**
Design	B	30% (Applicant response, Design Plans, Project Specifications, Drainage Report & Plan, Shoofly Design, Construction Phasing Plans)	PDF only*	4 weeks**
Design	C	Final Plans (Applicant response, Design Plans, Project Specifications, Drainage Report & Plan, Shoofly Design, Construction Phasing Plans)	PDF only*	4 weeks**
Construction		(Including but not limited to the following) Shoring Falsework Demolition Erection Erosion Control Construction Phasing Plans	PDF only *	4 weeks**

* Submittal Format (The following submittal formats are all required.)
PDF – The pdf shall be formatted to reproduce legibly on 11" x 17" sheets.

** Submittals which do not follow the schedules as outlined in these tables, are partial, incomplete or inadequate may require greater review time.

(cont'd)

A. The Concept submittal shall, at a minimum, include the following:

1. Plan, Elevation and Typical Section of proposed grade separation. See pg 37, Plan No. 711100, sheet 1.
2. Preliminary phasing plan.
3. Photo log with pictures of the proposed project location. Site pictures shall be in all controlling directions including but not limited to, North, East, South and West. The plan view should show a reference location and direction for each picture.

B. The 30% submittal shall, at a minimum, include the following:

1. Applicant response to Railroad review comments on the concept submittal. The 30% submittal shall reflect concept review comments.
2. Design Plans showing a Plan View, Elevation View, Typical Section, Construction Notes and Railroad Profile Grade Diagram. See pg 37 & 38, Plan No. 711100, sheet 1 & 2. Plans shall also indicate structure design criteria and construction methods.
3. Project Specifications and/or Special Provisions, including Railroad coordination requirements.
4. Drainage Report, as required. (See Section 3.7).
5. Shoofly Design. Bridge general plan shall show the location of the shoofly and indicate the footprint of the structure in relation to centerline of shoofly and existing track(s). See Section 4.2.1.
6. Construction Phasing Plans. Construction phasing plans must show all required phasing, construction procedures, temporary shoring layout, controlling dimensions and elevations.

C. The Final Plans submittal shall, at a minimum, include the following:

1. Applicant response to Railroad review comments on the 30% submittal. The Final Plans submittal shall reflect all previous review comments.
2. Design Plans showing a Plan View, Elevation View, Typical Section, Construction Notes and Railroad Profile Grade Diagram. See pg 37 & 38, Plan No. 711100, sheet 1 & 2. Plans shall also indicate structure design criteria and construction methods.
3. Project Specifications and/or Special Provisions, including Railroad coordination requirements.
4. Drainage Report, as required. (See Section 3.7).
5. Shoofly Design. Bridge general plan shall show the location of the shoofly and indicate the footprint of the structure in relation to centerline of shoofly and existing track(s). See Section 4.2.1.
6. Construction Phasing Plans. Construction phasing plans must show all required phasing, construction procedures, temporary shoring layout, controlling dimensions and elevations.

Following review of the Final Plans and resolution of any outstanding issues the Railroad Local Representative may issue a letter of project acceptance.

Table 3-2, Underpass Structures

Phase		Type of Submittals	Format	Railroad Review Time
Design	A	**Concept** (Plans and Site Pictures)	PDF *	4 weeks***
	B	**30%** (Applicant response, Type Selection Report, Design Plan, Shoofly, Construction phasing)	PDF *	
	C	**60%** (Applicant response, Design Plans and Calculations, Geotechnical Report, Project Specifications and/or Special Provisions, Drainage Report and Plan, Shoofly Design, Construction phasing)	PDF *	6 weeks***
	D	**Final Plans** (Applicant response, Design Plans and Calculations, Geotechnical Report, Project Specifications and/or Special Provisions, Drainage Report and Plan, Shoofly Design, Construction phasing)	PDF & 1 hard copy **	4 weeks***
Construction		(Including but not limited to the following) Construction Phasing Plan Shoring Falsework Demolition Erection Erosion Control Construction Material Certifications Concrete Mix Design Structural Steel, Rebar and Strand Certifications 28 day Cylinder Test of Concrete Strength Waterproofing Material Certification Test reports for fracture critical members Foundation Construction Reports (eg.: pile driving records, caisson drilling and/or crosshole sonic log testing for drilled shafts.) Other project specific information as requested by the Railroad	PDF *	4 weeks***
Project Closing	E	**As Built** (Final Plans, Construction Documents, Shop Plans, Pile Driving Records.)	PDF *	N/A

* Submittal Format (The following submittal formats are all required.)
PDF – The pdf shall be formatted to reproduce legibly on 11” x 17” sheets.

** Submittal Format (The following submittal formats are all required.)
PDF – The pdf shall be formatted to reproduce legibly on 11” x 17” sheets.
Hard copy – One legible hard copy on 11” x 17” sheets.

*** Submittals which do not follow the schedules as outlined in these tables, are partial, incomplete or inadequate may require greater review time.

A. The Concept submittal shall, at a minimum, include the following:

1. Plan, Elevation and Typical Section of proposed grade separation.
2. Preliminary phasing plan.
3. Photo log with pictures of the proposed project location. Site pictures shall be in all controlling directions including but not limited to, North, East, South and West. The plan view should show a reference location and direction for each picture.

B. The 30% submittal shall, at a minimum, include the following:

1. Applicant response to Railroad review comments on the concept submittal. The 30% submittal shall reflect concept review comments.
2. Structure Type Selection Report.
3. Design Plans showing a Plan View, Elevation View, Typical Section and Railroad Profile Grade Diagram. See pg 41, Plan No. 711200, sheet 1 for additional details. Plans to include general notes to indicate structure design criteria, construction methods and material compliance specifications.
4. Shoofly Design. Bridge general plan shall show the location of the shoofly and indicate the footprint of the structure in relation to centerline of shoofly. See Section 4.2.1.
5. Construction Phasing Plans. Must show all required phasing, construction procedures, temporary shoring layout, controlling dimensions and elevations.

C. The 60% submittal shall, at a minimum, include the following:

1. Applicant response to Railroad review comments on the 30% submittal. The 60% submittal shall reflect 30% review comments.
2. Design Plans and calculations including superstructure and substructure details, bearing details, deck and waterproofing details, miscellaneous bridge details, and a complete set of structural calculations (See Section 3.5).
3. Geotechnical Reports/recommendations (See Section 3.6).
4. Project Specifications and/or Special Provisions, including Railroad coordination requirements.
5. Drainage Report, as required. (See Section 3.7).
6. Shoofly Design plans and alignment data.
7. Construction Phasing Plans. Must show all required phasing, construction procedures, temporary shoring layout, controlling dimensions and elevations.

D. The Final Plans submittal shall, at a minimum, include the following:

1. Applicant response to Railroad review comments on the 60% submittal.
2. Revisions to plans and calculations as dictated by review of the 60% submittal.
3. Geotechnical Reports (See Section 3.6).
4. Project Specifications and/or Special Provisions, including Railroad coordination requirements.
5. Drainage Report, as required. (See Section 3.7).
6. Shoofly Design plans and alignment data.
7. Construction Phasing Plans. Must show all required phasing, construction procedures, temporary shoring layout, controlling dimensions and elevations.

E. The As-Built submittal shall, at a minimum include the following:

1. As-Built plans.
2. Construction Documents.
3. Shop Plans.
4. Pile Driving Records.

The Applicant or their representative shall submit As-Built documents for all Underpass Structures to the Railroad Local Representative after completion of the bridge structure and prior to closing the project.

4. GENERAL REQUIREMENTS FOR GRADE SEPARATION PROJECTS

The recommendations provided within this Section are intended for all Grade Separation Projects impacting the Railroad. All Grade Separation Projects shall be designed in accordance with the requirements in this section and the specific requirements of all applicable sections within these Guidelines.

4.1 Grade Separation Structure Type

a. The most effective method for reducing interference to Railroad operations for construction of Grade Separation Projects is to use an Overhead Structure and avoid an Underpass Structure.
b. The Railroad discourages Underpass Structures due to safety concerns, possible interruption to Railroad operations, cost, and limitation of future replacement and maintenance.
    1. The Railroad recommends the use of an Overhead Structure which can be designed and constructed without interruption to Railroad operations.
c. If an Underpass Structure is required the project must temporarily reroute train traffic around the construction site by utilizing a Shoofly track subject to local operating review and approval. Shoofly track(s) shall be designed per Section 4.2.1.
d. The analysis of Cost-Benefit ratio shall be fully considered before the structure type is finalized. Cost-Benefit ratio must include all costs associated with interruption to Railroad operations during construction of the proposed structure and/or future replacement structure in addition to future maintenance and other applicable costs. However, economy alone shall not be the governing factor in determining structure type.

4.2 Railroad Operational Requirements

a. The proposed design plans shall allow the Contractor to execute a work plan that enables the track(s) to remain in service and shall cause no interruption to the Railroad's operation during construction.
b. The Applicant shall contact the Railroad Local Representative in the concept design stages to determine the Railroad operation requirements.
c. Construction activities that impact Railroad operations must be coordinated with the Railroad. The proposed staging and phasing must be reviewed and approved by the Railroad at the concept stage and subsequent stages. Special Provisions must include Railroad coordination to improve Contractor understanding of Railroad requirements prior to letting of the proposed Grade Separation project.

4.2.1 Shoofly Track(s)

a. Shoofly track shall be designed for maximum authorized timetable speed, for freight and/or passenger trains, per Railroad track standards and operating requirements.
b. The proposed shoofly must be designed to account for track settlement.
c. Construction staging shall be designed to keep the Railroad tracks fully operational at all times except for pre-approved construction windows during cut over operations.
d. The Applicant must schedule track related submittals per Table 3-1 or 3-2 for Railroad review and approval.
e. Temporary railroad bridges used for a shoofly must be designed in accordance with AREMA and these Guidelines. Temporary open deck bridges with walkways may be used if a protective cover over the roadway and sidewalks is provided or if the roadway is closed to traffic during construction.
f. Applicant must contact the Railroad's Local Representative for additional specific restrictions which may apply to the individual Railroad.

4.2.2 Future Track(s)

It is required to investigate the need for future tracks during the conceptual design phase of grade separation structures. Future tracks shall be shown on the plans. See Section 4.2.3 for future freight and commuter track spacing. Space is to be provided for one or more future tracks as required for long range planning or other operating requirements.

4.2.3 Track Spacing and Shifting

a. The Railroad may require additional clearance to allow shifting of existing tracks according to current track spacing standards, business requirements, operating needs and safety standards. Future track shifting and direction of shifting must be verified at the preliminary stage of the feasibility study for the proposed Grade Separation Project.

b. Future freight track centerline shall be located a minimum of 20 feet from the centerline of the nearest existing track.
c. Future commuter track centerline shall be located a minimum of 25 feet from the centerline of nearest existing or future freight track.
d. Required spacing for yard or industrial tracks must be verified at the conceptual design stage.

4.2.4 Access Road

a. It is required to investigate the need for access roads during the conceptual design phase of grade separation structures.
b. The outside edge of the Access Road shall be located a minimum of 27 feet from the centerline of the nearest existing or future track.
c. Grade Separation design should include adequate access to existing Railroad facilities along and/or within its right-of-way.
d. Where provisions are made for more than two tracks, space is to be provided for an Access Road on both sides of the tracks.
e. The minimum vertical clearance over the outside of access road(s) shall be 18 feet.
f. For Underpass Structures, access may consist of a:
    1. <u>Road on the bridge.</u>
       If the bridge maintenance Access Road is part of the main railway structure, the structure shall be designed for Cooper E-80 live load to accommodate any future track needs or modifications. A removable barrier shall be provided to separate the nearest track from the Access Road by retaining the ballast.
    2. <u>Road on a separated bridge.</u>
       If the bridge maintenance access is a completely separate structure it shall be designed for applicable AASHTO live load. The Access Road width shall be 13 feet to accommodate one lane with curbs and railing.
    3. <u>Road with turnarounds.</u>
       If a bridge maintenance structure is not provided, an Access Road with a turnaround shall be designed and constructed in conjunction with the grade separation bridge structure. The turnaround pad shall start no further than 30 feet from the end of the bridge structure with the embankment shoulder a minimum of 60 feet from centerline of track. The radius for the turnaround shall be a minimum of 50 feet. Roadway grade shall not exceed 10% and shall terminate at the sub-ballast elevation. The roadway shall have sufficient width to provide for one 13 foot wide road, drainage ditch and shoulder. The turnaround pad and roadway shall be sloped to drain away from the track and carry the water to a drainage system or existing Railroad right-of-way ditches.

4.3 Structure Separation

a. Vertical and horizontal structure separations shall be subject to the Railroad's existing, proposed or future structure type, size, location and other site constraints.
    1. <u>Non Railroad Structures</u>
       All non Railroad structures, with the exception of Access Road structures running adjacent to existing or proposed Railroad structures, shall be outside the Railroad right-of-way limits or as far away as practical.
        i. Clear horizontal separation between parallel structures shall never be less than 25 feet, measured perpendicular from proposed structure(s) to existing or future Railroad structure(s).
        ii. Clear horizontal separation between structures perpendicular to Railroad structures shall never be less than 200 feet from the nearest Railroad structure abutment. Replacement of existing structures on existing roadway alignment may be granted exception, as approved by the Railroad.
    2. <u>Railroad Structures</u>
       Horizontal separation between Railroad structures, including Railroad Access Road structures, shall be a minimum of 5 feet clear.

4.4 Construction

a. Railroad's review and approval of construction submittals defined in Table 3-1 or 3-2 are required.
b. It is essential that the construction proceed with no interference to Railroad operations. Continuity of safe rail operation will be required for the duration of the project.
    1. The most effective method for maintaining Railroad traffic is to temporarily reroute Railroad traffic around the construction site using a Shoofly. Shoofly's shall be designed per Section 4.2.1.
c. The Applicant and it's Contractor are responsible to comply with construction documents approved by the Railroad.
d. The Engineer-of-Record and the Applicant shall evaluate the quality of materials furnished and work performed by the Contractor. All field inspection reports, quality control reports and final As-Built plans shall be submitted to the Railroad.
e. The project site shall be inspected by the Railroad, at the Applicant's expense during construction and toward the end of construction, for final acceptance before the Contractor demobilizes.
f. The review of construction submittals and observation of the construction site shall neither relieve the Applicant, Engineer-of-Record nor the Contractor from the ultimate responsibility and liability for the construction on or damages to Railroad property during and after construction of the project.

4.4.1 Temporary Construction Clearances

a. Temporary horizontal and vertical construction clearances shall be shown on the plans for all Grade Separation Projects. Every effort must be made to design for greater clearances. See pg 36, Plan No. 711000, Sheet 1.
b. Greater clearances may be required for special cases to satisfy local operating conditions such as required sight distance for signals.
c. Reduced temporary construction clearances, which are less than construction clearances defined in Section 4.4.1.1 and 4.4.1.2, will require special review and prior approval by the Railroad.

4.4.1.1 Vertical Construction Clearances

a. A minimum temporary vertical construction clearance of 21'- 6" measured above top of high rail for all tracks shall be provided. The required minimum temporary vertical clearance shall not be violated due to deflection of formwork.

4.4.1.2 Horizontal Construction Clearances

a. A minimum temporary horizontal construction clearance of 15'- 0", measured perpendicular from the centerline of the nearest track, to all physical obstructions including but not limited to: formwork, stockpiled materials, parked equipment, bracing or other construction supports, shall be provided.
b. In curved track the temporary horizontal construction clearances shall increase either 6 inches total or 1.5 inches for every degree of curve, whichever is greater.
c. Temporary horizontal construction clearance shall provide sufficient space for drainage ditches parallel to the standard roadbed section or provide an alternative system that maintains positive drainage.

4.4.2 Shoring

All temporary shoring systems that impact Railroad operations and/or support the Railroad embankment shall be designed and constructed per the Railroad Guidelines for Temporary Shoring.

4.4.3 Demolition

All demolition within the Railroad right-of-way, or which may impact Railroad tracks or operations, shall comply with Railroad demolition requirements.

4.4.4 Erection

a. Erection over the Railroad right-of-way shall be designed to cause no interruption to Railroad operations. Erection plans shall be developed such that they enable the track(s) to remain open to train traffic per Railroad requirements.
b. Prior to the release of Railroad traffic, components erected over Railroad tracks must be supported by falsework or permanent substructure, must be secured and stable and must not be supported by cranes or other construction equipment.

4.4.5 Falsework

Falsework clearance shall comply with minimum temporary construction clearances per Section 4.4.1. The design of all structural members for falsework shall comply with AREMA as well as Railroad requirements.

4.4.6 Vegetation

Vegetation to be planted on or immediately adjacent to Railroad right-of-way shall not become a fire hazard to track-carrying structures and/or an obstruction to inspection and maintenance of the structures.

4.5 Drainage

a. Maintaining Existing Drainage System
    1. The proposed construction shall safely pass high flows and not inhibit low flows, alter the path of the existing drainage system nor increase the drainage on to the Railroad right-of-way. Railroad corridors are constructed with a drainage system designed to keep runoff away from the tracks and ballast. This drainage system includes the parallel ditches along the embankments as well as the bridges, culverts, siphons and other structures that convey runoff beneath the tracks or serve as water-equalizing structures.
b. Changes to Existing Drainage System
    1. When changes in the drainage system are contemplated by new or replacement construction, or because of drainage problems, the system shall be modified as required to accommodate current-condition runoff including any changes that have occurred in the drainage pattern. The size of the proposed drainage system must conform to the Railroad Hydraulic Criteria described in Section 4.5.1 and 4.5.2.
    2. A complete hydrologic and hydraulic study is required whenever new or additional drainage is added to the Railroad right-of-way, or when a drainage structure is scheduled to be added, removed, modified or replaced. The Drainage Report must be in compliance with the requirements described in these Guidelines.

4.5.1 (UPRR only) Hydraulic Criteria for Bridge and Culvert Openings

a. New and replacement structures as well as project effects to existing structures shall meet the following requirements.
    1. Structures shall be sized to not exceed two high water elevations designated “low chord” and “subgrade.” See Table 4-1.
        i. <u>Low Chord</u> – The water surface elevation for a given flood, per Table 4-1, will not rise above the crown of a culvert or low chord of a bridge.
        ii. <u>Subgrade</u> – The energy grade line for a given flood, per Table 4-1, will not rise above the bottom of the adjacent subgrade elevation. The bottom of subgrade is defined as 2’- 3” below base of rail elevation.
    2. Provide the energy grade line, water surface elevation and velocity flow for both the existing and proposed hydraulic opening.
    3. In sizing culverts, to the extent practicable, the maximum headwater-to-diameter ratio must be limited to 1.5.
    4. Both the Railroad criteria and local flood flow criteria shall be evaluated and the more conservative of the two shall be adopted in sizing the replacement.

    (cont’d)

Table 4-1, High Water Criteria

	Low Chord (Water Surface Elevation limit)	**Subgrade** (Energy Grade Line limit)
Main Track	50-year flood	100-yr flood
*** Secondary or Industry Track**	25-year flood	50-year flood
Any Track in FEMA Floodplain	50-year flood (UPRR) 100-year flood (BNSF)	100-year flood

* If the proposed structure is immediately adjacent to a main line bridge(s), or will impact mainline track, the low chord criteria and subgrade criteria shall be as required for Main Track.

4.5.2 (UPRR only) Hydraulic Criteria for Drainage Systems Parallel to Railroad Tracks

a. The Subgrade criterion per Section 4.5.1.a.1.ii is to be applied for parallel ditches, open channels and other drainage systems parallel to Railroad tracks.
b. For open ditches conveying Railroad drainage, refer to the following design standards:
   1. UPRR Standard Drawings 0001, 0002 & 0003 (Web Link to Standards).
c. Sufficient lateral and vertical clearance must be provided to accommodate construction of the standard flat-bottom railroad ditch or another ditch section based upon the 100 year event; whichever produces the larger ditch. Anything less than this standard is an exception and must be supported by a hydrology and hydraulics report which requires the prior review and approval of the Railroad.
d. In cases where Railroad's standard hydraulic criteria is not applicable due to topography of the track bed and surrounding ground, the Railroad standard flat-bottom drainage ditch (trapezoidal, 10 ft bottom width, a minimum of 2:1 side slopes, with flowline elevation a minimum of 3 ft below the subgrade elevation) must be incorporated.
e. Where acquisition of adequate right-of-way is a limiting factor or site characteristics justify smaller drainage systems, a request for variance with sufficient supporting documents must be submitted to the Railroad for consideration.
f. The applicant must provide hydraulic data (energy grade line, water surface elevation and velocity) for both existing and proposed conditions.
g. Consideration shall be given to the effects of localized and contraction scour and mitigation, if deemed necessary, and shall be shown on the design plans.

4.5.3 (BNSF only) Hydrologic and Hydraulic Design Criteria

a. The BNSF Hydrologic and Hydraulic Design Criteria is available upon request.
b. Systems parallel to Railroad tracks shall be sized according to the BNSF Hydrologic and Hydraulic Design Criteria or the most recent BNSF Standard Roadbed Sections which are available upon request.

4.6 Erosion and Sediment Control

a. General plans for construction within the Railroad right-of-way shall indicate the proposed methods of erosion and sediment control. They must specifically provide means to prevent sediment accumulation in the ditches and culverts, to prevent fouling the track ballast and sub-ballast and to allow free flow of runoff in the drainage systems during and after construction.
b. Corrective and/or mitigative construction due to the fouling of Railroad ballast, sub-ballast, ditches, culverts or drainage systems will be at the Applicant's expense. It is the Applicant's responsibility to document the condition of the site before and after construction.
c. Existing track ditches shall be maintained open at all times throughout the construction period. After the construction is complete, all erosion and sediment control devices must be removed, all sediment deposits removed and the entire project area restored to the pre-construction condition.
d. The Applicant and/or Contractor are responsible for securing the required permits from Local, State and Federal entities. The Applicant and/or Contractor shall furnish the Railroad all copies of the Storm Water Pollution

Prevention Plan (SWPPP) and approved permits, if required. Further, these documents shall be available on-site during all construction activities. Approval of the erosion and sediment control plan does not relieve the Contractor, Applicant and/or Engineer-of-Record of the ultimate responsibility and liability for compliance with erosion and sediment control requirements.

4.7 Fencing

a. Where laws or orders of public authority prescribe a higher degree of protection than specified in this section, the higher degree of protection so prescribed shall be deemed a part of this section.
b. Fence Types
    1. Chain Link – Openings shall not exceed 2 inches.
    2. Wrought Iron Picket Fence – Openings shall not exceed 3 inches and may be used in locations where trespassers may cut a chain link fence.
    3. All Architectural Fencing – Shall require prior review and approval by the Railroad. Architectural fencing shall not allow an opening of more than 2 inches and shall be designed to prevent climbing.
    4. High Security – Locations with trespasser issues, or for reasons deemed applicable by the Railroad, require high security fence design as approved by the Railroad.
c. Right-of-way fencing
    1. Fencing shall be provided to safeguard the general public and prevent trespassers from entering the Railroad right-of-way and accessing the track or other Railroad structures. Each project will be evaluated on a case by case basis.
        i. Location – Where possible, fencing shall be located outside the limits of the Railroad right-of-way. Fence may be required on top of abutments, wingwalls, retaining walls, and/or along the Railroad right-of-way.
        ii. Height – The fencing shall be a minimum height of 8 feet.
        iii. Length
            1. For projects crossing Railroad Tracks - Fencing shall extend 500 feet, or as site constraints permit, in each direction along the Railroad right-of-way, outside the Railroad right-of-way, at locations as deemed necessary by the Railroad to prevent trespassing.
            2. For projects parallel to Railroad Tracks - Fencing shall extend the entire length of the parallel encroachment on Railroad right-of-way at locations as deemed necessary by the Railroad to prevent trespassing.
d. Overhead grade separation structure fencing, see Section 5.4.c.

4.8 Retaining Walls

a. Retaining walls shall be designed to withstand lateral earth and water pressures, any live load and dead load surcharge, the self-weight of the wall, temperature and shrinkage effects, earthquake load and any other applicable loads.
b. Retained embankment within 50 feet of the centerline of Railroad tracks, supporting Railroad infrastructure and/or within the Railroad right-of-way, shall be of a type approved by the Railroad.
c. Walls Supporting Railroad Embankment - Shall be of a type approved by the Railroad and shall be designed in accordance with Railroad requirements and the general design principles specified in AREMA.
d. Walls Not Supporting Railroad Embankment - Shall be designed in accordance per the appropriate codes and specifications and shall be located outside the Railroad right-of-way limits.
e. Mechanically Stabilized Earth (MSE)
    1. MSE walls are not acceptable for support of railroad embankment.
    2. MSE walls supporting roadways above track level are not acceptable within the Railroad right-of-way or within 50 feet of the centerline of existing or future tracks.
        i. Use of MSE walls on the Railroad right-of-way, not supporting railroad embankment, require written justification and request for variance for the proposed design. Requests for variance may be rejected.
        ii. Abutment Protection - Design of approved requests for MSE walls on the Railroad right-of-way, or within 50 feet of the centerline of existing or future track, shall meet the following requirements. The MSE wall shall be at least 2.5 feet thick for a height of at least 12 feet above the top of rail of

nearest existing or future track. Additionally, the bridge abutments shall be supported by deep foundations.

1. Abutments designed without the additional protection as described above should, at a minimum, be designed to:
   i. Support the future additional weight of the abutment protection as required by Section 4.8.e.ii.
   ii. Account for any additional width of the abutment protection which would reduce the clearance from the centerline of track to the near face of the abutment.
2. Should the applicant require the future pier protection to be designed beyond the requirements of Section 4.8.e.2.ii, such designs shall be incorporated per Section 4.8.e.2.ii.1.
   i. Design requirements greater than required by Section 4.8.e.2.ii shall not be the current nor future responsibility of the Railroad to identify, incorporate and/or design should any pier be deemed necessary of pier protection.

f. Barrier rail and fencing needs for retaining walls are subject to the retaining wall location and Railroad operating requirements. Barrier rail and fencing shall be placed in a manner to safeguard the general public while securing the Railroad right-of-way. Barrier rail and fencing shall be designed per Section 5.4.

4.9 Embankment Surcharge

For all tracks located near a proposed embankment causing the track bed to be surcharged, the contractor must monitor and record top-of-rail elevations and track alignment. The movement shall be within the limits defined by local Railroad Manager of Track Maintenance (MTM). Displacements exceeding the limits defined by the MTM must be immediately reported to the Railroad. The track shall be adjusted as needed at the expense of the Applicant.

4.10 Utilities

a. All new or relocated utilities within the Railroad right-of-way will require Railroads prior review and approval.
b. The Applicant shall be responsible for the identification, location, protection and relocation of all existing overhead and underground utilities. The design plans for the proposed Grade Separation Project shall include complete information on existing and/or proposed relocation of said utilities.
c. A Railroad Right-of-Entry Agreement (if applicable), per Section 2.3, is required to survey or abandon existing utilities within the Railroad corridor. The Railroad has no obligation to provide property for relocated utilities that do not comply with Railroad's standard specifications and requirements including, without limitation, AREMA and these Guidelines.
d. No utility attachments will be permitted on Underpass Structures. Existing or future fiber optic lines shall be placed underground and away from the bridge structure.
e. Appropriate measures for the installation, protection and relocation of fiber optic cables as well as Railroad signal and communication lines shall be addressed in the plans and contract documents. For Railroad requirements and additional information refer to:

UPRR: www.uprr.com
For UPRR Fiber Optic Engineering, "Call Before You Dig", call 1-800-336-9193
For UPRR Grade Crossing/Signal Hotline, call 1-800-848-8715
Please refer to UPRR web site for utility review and approval process and Application.
BNSF: www.bnsf.com
For BNSF Signal/Telecommunications Engineering, "Call Before You Dig", call 1-800-533-2891
For BNSF Grade Crossings, call 1-800-832-5452
Please refer to BNSF web site for utility review and approval process and Application.

4.11 Construction Management Team

For construction of grade separated structures an experienced Construction Management Team will be required during the construction of the bridge structure. Public agencies with qualified bridge structure staff placed on-site during construction will be acceptable; otherwise an outside team must be obtained. Railroad participation during construction is required as indicated in Section 4.11.

The following are minimum requirements for the Construction Management Team:

a. The Applicant is to submit names and qualifications of person(s) to be used in the project and their assigned duties.
b. Provide for a qualified quality control inspector to be present during fabrication of steel spans and any major prestressed concrete items.
c. Provide a list of past projects that each person has actively worked on, including bridge structures (highway or rail), underground facilities and drainage structures.
d. Provide a verifiable list of employment including a current resume for each person in the Construction Management Team.
e. Minimum personnel for the Construction Management Team for a typical grade separation structure will consist of:
    1. Project Manager – Primary point of contact, with experience in managing construction projects, for the Construction Management Team.
    2. Resident Engineer – The resident Engineer for the project shall be a registered Civil Engineer with minimum 5 years experience in the field of bridge construction work.
    3. Construction Engineer – A Construction Engineer performs complex professional engineering work in the management of major construction projects from design through completion.
    4. Construction Inspector – Construction Inspector shall perform continuous inspection of construction projects for compliance with plans, specifications and contract documents. The inspector shall be familiar with concrete and steel bridge construction and have current certifications in the fields of inspection involved.
f. Railroad review and approval of duties, responsibilities, education and experience for each of the above listed members of the Construction Management Team will be required.
g. All field members of the Construction Management Team are required to have passed and comply with the FRA and Railroad requirements regarding Railroad track safety, bridge fall protection and/or contractor orientation training.

4.12 Railroad Site Observation During Construction

In addition to the office review of submittals, site observation will be performed by the Railroad at significant points during construction, including but not limited to the following, if applicable:

a. Underpass Structure
    1. Pre-construction meeting.
    2. Shoring systems that impact the Railroad’s operation and/or support the Railroads embankment.
    3. Demolition.
    4. Falsework.
    5. Erection.
    6. Acceptance observation of any shoofly before placing it in service.
    7. Foundation installation.
    8. Reinforcement and concrete placement for main bridge substructure and/or superstructure.
    9. Shop observation of fabricated steel spans and/or any major pre-stressed concrete items either by the Railroad or its designated representative.
    10. Erection of steel or precast concrete bridge superstructure.
    11. Deck installation.
    12. Acceptance of waterproofing (prior to placing ballast).
    13. Final observation and acceptance of the bridge structure.

b. Overhead Structure
    1. Shoring systems that impact the Railroad’s operation and/or support the Railroads embankment.
    2. Demolition within the Railroad’s right-of-way.
    3. Falsework.
    4. Erection over the Railroad’s right-of-way.
    5. Final observation and acceptance of the Overhead Structure.

Site observations are not limited to the milestone events listed above; rather, site visits to check progress of the work may be performed at any time throughout the construction as deemed necessary by the Railroad.

A construction schedule shall be provided to the Railroad Local Representative for their handling with the engineering department. Inform the Railroad's Local Representative of the anticipated dates when the listed events will occur. This schedule shall be updated as necessary, but at least monthly, so that site visits may be scheduled. Final observation and acceptance of the bridge by the Railroad is required before the contractor leaves the job site.

4.12.1 Full Time Inspector

At the Railroad's discretion, provision for a full-time Inspector to verify compliance with Railroad requirements during construction shall be included in the C&M agreement. The inspector may be a Railroad employee or outside party selected by the Railroad. The cost of this inspection shall be included in the total project cost.

5. OVERHEAD STRUCTURES

(Roadway Structures Over Railroad)

5.1 General Design

a. The Overhead Structure shall be designed according to Sections 1, 2, 3, 4 and 5 of these Guidelines, AREMA and any applicable codes and specifications. Compliance with these Guidelines will expedite the review and approval process of submittals for the Grade Separation Project. Every effort shall be made to utilize a structure type that will not require interruption to Railroad operation during construction.

b. See Section 4 for General Requirements for Grade Separation Projects.

c. The preferred Overhead Structure is one that will span the entire Railroad right-of-way. Designs which do not clear span the Railroad right-of-way and/or do not meet vertical clearance requirements should not progress beyond 30% without the Railroad's written approval. Else, the design will be considered 30% complete by the Railroad regardless of the Applicant's percent of completion.

5.2 Permanent Clearances

a. Permanent clearances shall accommodate future tracks, future track raises, Access Roads and drainage ditch improvements as determined by the Railroad.

b. Proposed permanent vertical and horizontal clearances shall be adjusted so that the sight distance to any Railroad signal is not reduced unless signal(s) are to be relocated as part of the proposed Grade Separation Project.

5.2.1 Permanent Vertical Clearance (under the structure)

a. The minimum permanent vertical clearance shall be 23' - 4" (UPRR) or 23' - 6" (BNSF) measured from the top of the highest rail to the lowest obstruction under the structure.

   1. The extent of the permanent vertical clearance shall be a minimum of 9 feet to the field side of the outer most existing or future tracks, measured perpendicular to the centerline of said tracks. See pg 37, Plan No. 711100, sheet 1.

      i. **In curved track** the above minimum extent of 9 feet shall be increased either 6 inches total or 1.5 inches for every degree of curve, whichever is greater.

   2. The permanent vertical clearance shall extend to cover all existing and future tracks, including the space between.

b. Additional vertical clearance may be required for adjustment of sag in vertical curve, future track raise, flood considerations, construction and maintenance purposes.

c. The profile of the existing top-of-rail, measured 1000 feet each side of proposed Overhead Structure, shall be shown on the plans. If the profile indicates a sag at the proposed bridge location, the vertical clearance from the top of the highest rail to the bridge shall be increased sufficiently to permit raising the track to remove the sag. A note should be added to the profile stating, "The elevation of the existing top-of-rail profile shall be verified before beginning construction." All discrepancies shall be brought to the attention of the Railroad prior to the commencement of construction.

5.2.2 Permanent Horizontal Clearance (under the structure)

a. The need and location for future track per Section 4.2.3 and Access Road per Section 4.2.4, of these Guidelines must be verified with the Railroad in advance of establishing horizontal clearances.

b. The Railroad requires all piers and abutments to be located outside the Railroad right-of-way limits and to comply with Section 4.2.3 and 4.2.4 of these Guidelines.

   1. Where it is impracticable to clear span the Railroad right-of-way, provide written justification and request for variance for the proposed design. The request should succinctly describe geometric, structural and other constraints which make a clear-span alternative unfeasible and shall show that all options have been exhausted. Cost alone should not be the determining factor. See Section 5.6.1 & 5.6.2 for abutment and pier requirements within the Railroad right-of-way.

5.3 Temporary Construction Clearances

The proposed Overhead Structure shall be designed to satisfy temporary construction clearance requirements per Section 4.4.1 and shown on the plans in accordance with pg 36, Plan No. 711000, Sheet 1.

5.4 Barrier Rail and Fence

a. General Requirements
   1. Barrier rail and fence, designed per this section, shall extend to the limits of the Railroad right-of-way or a minimum of 25 feet beyond the centerline of the outermost existing track, future track or Access Road, whichever is greater.
   2. The minimum combined height of a barrier rail with curved fence shall be 8 feet or with a straight fence shall be 10 feet. The barrier rail and fence shall be detailed in accordance with pg 39, Plan No. 711100, sheet 3.

b. Barrier Rail
   1. Cast-in-place concrete barrier rail without openings shall be provided on both sides of the superstructure to retain and redirect errant vehicles. The barrier rail shall keep the deck's storm runoff from being deposited onto Railroad right-of-way.
   2. Barrier rail for Overhead Structures shall be a minimum of 42 inches in height for structures in areas which may be subject to snow removal, and a minimum of 30 inches in height elsewhere.

c. Fence
   1. Fence shall be provided on both sides of all Overhead Structures crossing Railroad right-of-way. It shall be designed to prevent climbing and provide positive means of protecting the Railroad facility and the safety of Railroad employees below from objects being thrown or falling off the structure.
   2. Allowable fence types per Section 4.7.
   3. All parallel Overhead Structures that have a gap of 2 feet or more shall be protected with fencing. Structures with a gap of less than 2 feet shall either have the gap covered or be fenced on both sides.

5.5 Superstructures

a. Deck drains, future utility installation and expansion or hinge joints for the Overhead Structure over Railroad tracks or inside Railroad right-of-way are not permitted.

b. The Railroad discourages the use of cast-in-place superstructures and every effort shall be made to utilize a structure type that will not require interruption to Railroad operation during construction.

c. The use of cast-in-place beams is not permitted. The use of stay in place deck forms for falsework between precast concrete beams or steel girders is encouraged.

5.6 Substructures

a. Footings for all substructures shall be located and designed to account for temporary clearances per Section 5.3 in order to facilitate shoring and footing construction. Temporary shoring shall be designed per Section 4.4.2.

b. Drilled shafts within the influence of track surcharge shall be designed and constructed with a permanent casing to protect the track against cave-in, subsidence and/or displacement of the surrounding ground. The casing shall be designed for live loads due to the Railroad surcharge in addition to all other applicable loads.

5.6.1 Abutments

a. All abutment structures, including toe of abutment slopes, shall be located outside Railroad right-of-way.

b. See Section 4.8.e for MSE wall design. Use of MSE walls to retain abutment fill require that the abutment be supported by deep foundations.

c. Slope layout shall provide for the minimum drainage ditch(es) or culverts required by hydraulic studies in the area; see pg 37, Plan No. 711100, sheet 1 details. The toe of the slope shall terminate at the bottom of drainage ditch and must have a cut-off wall as required to protect the slope from erosion. In all cases, the toe of slope shall be below the finished track or roadway subgrade.

d. Top of paved slopes shall extend a minimum of 2 feet past the abutment wall face, and terminate with either a curb or gutter to divert runoff. Paving shall have a prepared sub-base and filter fabric. Reinforced concrete or grouted rip-rap, with a minimum thickness of 4 inches, shall be placed on prepared sub-base and filter fabric.

5.6.2 Piers

a. Abutments and piers shall be located more than 25 feet (UPRR), 27 feet (BNSF) measured perpendicular from centerline of nearest existing or future track. Piers within Railroad right-of-way, or within 25 feet measured perpendicular from centerline of existing or future track, shall be protected per Section 5.6.3 of these guidelines.
b. A Pier footing within 25 feet of the nearest existing or future track shall be a minimum of 6 feet below the base of rail. This will allow the Railroad to modify its longitudinal drainage system in the future and/or provide an unobstructed area for placing signal, fiber optic or other utilities.
c. For piers with greater than 25 feet of clearance from centerline of nearest existing or future track and located within the Railroad right-of-way, the Railroad requires language in the proposed Agreement mandating the Applicant to fund the construction of pier protection walls on the bridge piers should they ever be required due to additional trackage being constructed by the Railroad or for any other legitimate reason. The Applicant shall also be responsible for future modification to the pier protection wall if the Railroad deems necessary.
    1. Piers designed without pier protection should, at a minimum, be designed to:
        i. Support the future additional weight of the pier protection as required by Section 5.6.3.
        ii. Account for any additional width of the pier protection which would reduce the clearance from the centerline of track to the near face of the pier and/or pier protection.
    2. Should the applicant require the future pier protection to be designed beyond the requirements of Section 5.6.3, such designs shall be incorporated per Section 5.6.2.c.1.
        i. Design requirements greater than required by Section 5.6.3 shall not be the current nor future responsibility of the Railroad to identify, incorporate and/or design should any pier be deemed necessary of pier protection.
d. Inside guardrail may be required, between rails, for all piers located within 18 feet from the nearest existing or future track.

5.6.3 Pier Protection

All replacement or modified structures shall comply with AREMA requirements for pier protection walls.

a. The pier protection wall shall be designed to resist the impact and redirect equipment in case of derailment. Piers shall be protected, by pier protection wall or heavy construction, where existing or future tracks are within 25 feet from the near face of piers.
    1. Pier Protection Wall – The pier protection wall design shall be in accordance with pg 40, Plan No. 711100, sheet 4.
    2. Heavy Construction – Piers with cross-sectional area equal to or greater than that required for the pier protection wall (30 sq. ft.) with the larger of its dimensions parallel to the track.
b. If seismic criteria are considered, pier design may require column isolation from the pier protection wall. The pier protection wall may also be required to be supported on an independent footing.
c. In locations where pier columns and protection walls interfere with drainage, an alternative drainage facility shall be provided to collect and carry water to a drainage system.

5.7 Lighting

a. All new or modified Overhead Structures which cover 80 linear feet of track or more shall provide a lighting system to illuminate the track area. However, at the discretion of the Railroad, lighting shall be provided for all structures covering less than 80 linear feet of track in areas where switching is performed or where high vandalism and/or trespassing have been experienced. Care shall be taken in lighting placement such that trains will not mistake the lights for train signals nor shall they interfere with the train engineer's sight distance for existing signal aspects. All lights shall be directed downward.
b. Provide temporary lighting for all falsework and shoring areas.
c. The minimum lighting design criteria shall be an average of one (1) foot-candle per square foot of structure at the Railroad tracks. Two (2) foot-candle or greater may be required at the discretion of the Railroad. The illuminated area shall extend to the limits of the overhead structure width and the width of the Railroad right-of-

way under the said structure. Fixtures shall be installed on the column walls or caps of the Overhead Structure without reducing the minimum horizontal and vertical clearances.

d. Maintenance of lights shall be the responsibility of the Applicant. Access to perform any maintenance for lights shall be coordinated with the local Railroad operating unit.
e. Structures with separation over ten (10) feet from each other shall be considered as independent structures for the purposes of lighting.

5.8 Drainage and Erosion

a. Drainage from Overhead Structures shall be diverted away from the Railroad right-of-way at all times. Scuppers from the deck shall not be permitted to discharge runoff onto the track or Access Road areas at any time. If drainage of the deck uses downspouts they shall be connected to the storm drain system or allowed to drain into drainage ditches. Concrete splash blocks or aggregate ditch lining will be required at the discharge area of downspouts. Downspouts should be located opposite the track side on piers.
b. If the layout of abutments, piers or columns with protection walls interferes with the drainage ditches, the designer shall provide an alternative method of handling the longitudinal drainage based on a hydraulic study. This may consist of pipe culverts.
c. Track drainage ditch limits shall be shown to scale on the project plans and show the distance from the centerline of nearest track. A typical cross section detail shall be shown on the plans.
d. If the proposed bridge structure will not change the quantity and characteristics of the flow in Railroad ditches and drainage structures, the plans shall include a general note stating so.
e. Lateral clearances must provide sufficient space for construction of the required standard ditches, parallel to the standard roadbed section. Should the proposed construction change the quantity and/or characteristics of flow in the existing ditches, the ditches shall be modified as required to handle the increased runoff. The size of ditches will vary depending upon the flow and terrain and should be designed accordingly.
f. All drainage systems shall be in compliance with Section 4.5. Erosion and Sediment Controls shall be in compliance with Section 4.6.

6 UNDERPASS STRUCTURES

(Railroad Structures Over Roadway)

6.1 General Design

a. The Underpass Structure shall be designed according to Sections 1, 2, 3, 4 and 6 of these Guidelines, the current edition of AREMA and any applicable sections of AASHTO. Compliance with these Guidelines will expedite the review and approval process of submittals for the Grade Separation Project.
b. See Section 4 for General Requirements for Grade Separation Projects.
c. Acceptable superstructure types are shown in Section 6.9.1. The use of Railroad standard spans where possible is encouraged.
d. Only simple spans with ballast decks are allowed. Cast-in-place concrete superstructures are unacceptable.
e. Designs which do not meet the requirements as prescribed by this document should not progress beyond 30% without the Railroad's written approval. Else, the design will be considered 30% complete by the Railroad regardless of the Applicant's percent of completion.

6.1.1 Design Loads

The proposed Underpass Structure shall be designed for the following loads:

a. Live load and Impact as specified in AREMA. For multiple track structures, live load shall be calculated based on the assumption that the track(s) can be located anywhere on the bridge with the horizontal clearance to the handrail defined in Section 6.7.2, and a maximum track spacing of 13 feet. For actual track spacing refer to Sections 4.2.3.
b. Dead load shall include up to 30 inches of ballast from top of deck to the top of tie and all other applicable dead load.
c. Seismic design shall comply with the criteria of the current edition of AREMA, Chapter 9 - Seismic Design for Railway Structures.
d. Additional loads shall be applied as specified in Chapters 8, 9, and 15 of AREMA, as applicable.

6.1.2 Construction Material Requirements

Refer to the BNSF or UPRR Standard Construction Specifications for material requirements. Items not addressed specifically in the Railroad Construction Specifications, and this document, shall be in accordance with the applicable sections of the current edition of AREMA.

6.2 Concrete Requirements

All concrete material, placement and workmanship shall be in accordance with Chapter 8 of the current edition of AREMA and the following:

a. Minimum Compressive Strength – 4000 lb. per square inch at 28 days.
b. Exposed surfaces shall be formed in a manner that will produce a smooth and uniform appearance without rubbing or plastering. Exposed edges of 90 degrees or less are to be chamfered 3/4" x 3/4". Top surface to have a smooth finish, free of all float or trowel marks with the exception that a broom finish be used on all walkway surfaces.
c. Concrete shall be proportioned such that the water-cementitious material ratio (by weight) does not exceed the values in AREMA Table 8-1-9. Precast concrete must contain a minimum of 610 pounds of cementitious material per cubic yard of concrete. Cast-in-place concrete must contain a minimum of 565 pounds of cementitious material per cubic yard of concrete. If fly ash is used with cement it shall be limited to 15% of cementitious material.
d. Cement shall be Type I, II or III Portland Cement per ASTM C150.
e. Course aggregate shall be size no. 67.
f. Fine aggregate shall be natural sand.
g. Admixtures, other than air entrainment, shall not be used without approval by the Railroad.
h. Membrane curing compound shall conform to ASTM C309 Type 2.
i. Apply ThoRoc Epoxy Adhesive 24LPL or approved alternate before placing new concrete against hardened surfaces.

j. For precast elements, the fabricator shall stencil the fabricator's name, date of fabrication, the bridge number, lifting weight and piece mark on each component.
k. The production facility must be pre-certified. Production procedures for the manufacture of precast members shall be in accordance with AREMA and the current edition of the Precast Concrete Institute's Manual MNL 116 for Quality Control.
l. Dimensional tolerances governing the manufacture of precast members shall conform to Division VI, Section 6.4.6 of the Precast Concrete Institute's Manual MNL 116 for Quality Control. Tolerance for location of lifting devices shall be ± ½".
m. The area around all lifting loops shall be recessed so that the loops can be removed to a depth of ¾" and grouted. Properly designed lift anchors are acceptable in lieu of lifting loops.
n. The fabricator will be responsible for the loading and properly securing the precast concrete members for shipment. All concrete components shall be made available, at the Railroad's discretion, for inspection by the Engineer-of-Record and the Railroad at the fabricator's plant prior to shipment.
o. Foam used to create internal voids in a precast concrete member, such as in box beams, shall be securely tied down to prevent displacement during concrete placement.

6.2.1 Reinforcing Steel Requirements

a. Reinforcing Steel shall be deformed, new billet bars per current ASTM A615 Specifications and meet Grade 60 requirements.
b. Reinforcing Steel requiring field welding or bending shall conform to ASTM A706 Specifications, Grade 60.
c. Fabrication of reinforcing steel shall be per Chapter 7 of the CRSI Manual of Standard Practice. Dimensions of bending details shall be out to out of bars.
d. Reinforcing steel is to be blocked to proper location and securely wired against displacement. Tack welding of reinforcing is prohibited. Minimum concrete cover not otherwise noted shall meet current AREMA requirements.

6.2.2 Prestressing Strand Requirements

a. Prestressing strand shall be seven wire, uncoated and low relaxation which is in accordance with the requirements specified in ASTM A416, ACI 318 and AREMA Chapter 8.
b. The strand shall have an ultimate tensile strength of 270 ksi.

6.2.3 Tie Rods

Transverse tie rods shall be provided for all concrete spans utilizing single cell box beams. Wherever possible, transverse tie rods in end and interior diaphragms shall be placed perpendicular to the centerline of webs to facilitate application of transverse post-tensioning.

a. Transverse tie rods shall be used at span ends and intermediately spaced at maximum intervals of 25 feet.
b. The minimum size of tie rod shall be 1-1/4 inches in diameter.
c. Tie rods shall be threaded steel bars with a minimum f_y = 36 ksi.
d. Tie rods shall be tensioned as necessary to ensure that all beam sides are in contact without causing any vertical displacement of the beams from the bearings.
e. The tie rod shall be protected as follows:
    1. Rod, plates and nuts shall be hot dip galvanized per ASTM A123 and A153 specifications
    2. Void between rod and hole shall be pressure grouted.
    3. The tie rod anchor assembly shall be recessed into the concrete and shall have 1 inch minimum grout cover.

6.3 Structural Steel Requirements

a. All major elements subjected to railroad live load shall conform to the following minimum specifications, except as otherwise noted:
    1. Painted structures: ASTM A709 Grade 50.
    2. Unpainted structures: ASTM A709 Grade 50W.
b. All bolted connections shall be made with high strength bolts.
c. Material over 4 inches in thickness that is subject to railroad live load shall conform to the following specifications:

    1. Painted structures: ASTM A572 or ASTM A588.
    2. Unpainted structures: ASTM A588.
  d. Elements not subjected to direct railroad live load (intermediate stiffeners, lateral bracing, diaphragms, ballast curbs, etc.) shall conform to the following specifications:
    1. Painted structures: ASTM A572 Grade 50, ASTM A36 or ASTM A992.
    2. Unpainted structures: ASTM A588.
  e. Steel bridge deck shall conform to A709 specifications, Grade 36, non-weathering steel.
  f. Deck cover plates and closure plates may be per ASTM A36 specifications.
  g. Anchor rods/bolts shall conform to ASTM F1554 specifications.
  h. End welded studs shall be C1015, C1017 or C1020 cold drawn steel, which conforms to ASTM A108 specifications.
  i. Cover plate, closure plates and anchor rods/bolts shall be galvanized after fabrication in accordance with ASTM A123, thickness Grade 100.
  j. Anchor rod washers shall be zinc coated in accordance with ASTM A153 specifications.

6.4 Access Road

a. See Section 4.2.4.

6.5 Skewed Structure

a. On skewed abutments an approach slab is required.
b. The preferred angle of intersection between centerline of track and the centerline of bridge supports, transverse to the track, is 90 degrees.
c. The minimum angle that will be allowed between the centerline of the track and the centerline of bridge supports, transverse to the track, is 75 degrees for a Concrete Superstructure and 60 degrees for a Steel Superstructure.
d. Where conditions preclude compliance with these skew requirements, the skew proposal will require special structural consideration and proof of adequacy.
e. Align bridge piers and abutments as required to comply with the above maximum skew limitations.

6.6 Approach Slab

a. The approach slab shall be a minimum of 12 feet wide or greater as deemed necessary by the Railroad and extend parallel to the track a minimum of 3 feet beyond the back edge of the abutment.
b. The approach slab shall be doweled into the abutment.
c. For skewed bridge abutments, the approach slab shall also be skewed to match the abutment while the other end of the approach slab is perpendicular to the centerline of track.

6.7 Clearances

Permanent clearances shall be correlated with the methods of construction to ensure compliance with the temporary clearances specified in Section 4.4.1.

6.7.1 Permanent Vertical Clearance (under the structure)

a. Underpass Structures shall be designed to ensure that the structure will be protected underneath from oversized or unauthorized loads by providing sufficient vertical clearance and protective devices unless otherwise specified by the Railroad.
b. Provide a minimum vertical clearance over the entire roadway width for all new or reconstructed structures as follows:
    1. 16’-6” for steel superstructure with 5 or more beams or 4 or more deck plate girders per track.
    2. 17’-6” for concrete superstructure or steel through plate girders with bolted bottom flanges.
    3. 20’-0” for steel through plate girders without bolted bottom flanges.
c. The vertical clearance must not be violated due to the deflection of the superstructure, use of a sacrificial impact protection device or any other reason. Additional vertical clearance may be required by the Railroad.
d. Variance from vertical clearances defined above shall require prior review by the Railroad. The variance request shall provide exhaustive justification. Cost shall not be the determining factor.

e. If resurfacing or any other activity is to be performed below the Underpass Structure, the owner of the roadway must submit a request for approval from the Railroad. This request must provide the existing measured and posted clearances of the structure and the proposed configuration after work is completed.

6.7.2 Permanent Horizontal & Vertical Clearances (on the structure)

a. Permanent Horizontal and Vertical Clearances on an Underpass Structure shall conform to the requirements of AREMA, Chapter 15, Part 1 and Section 6.9.5.
   1. **In curved track** the horizontal clearances shall be increased either 6 inches total or 1.5 inches for every degree of curve, whichever is greater.

b. Proposed structures that accommodate multiple tracks, both future and existing tracks, with spacing less than 20 feet shall be designed for a minimum of 20 foot spacing measured centerline to centerline.

6.8 Sacrificial Impact Protection Devices

a. All structures with vertical clearances less than defined in Section 6.7.1 shall be protected with a sacrificial device on each side of the structure.

b. Protection may be in the form of a redundant steel or concrete fascia beam.

c. Diaphragms connecting the redundant beam to the adjacent beams shall be designed to limit their impact and damage, if struck, to the adjacent beams.

d. Concrete fascia beams used as walkways shall be installed adjacent to the proposed structure and may also serve as a sacrificial beam.
   1. If a concrete fascia beam is used as a sacrificial beam it shall have a 6" x 6" x 1" embedded steel angle and shall be adequately anchored to the bridge seats.

6.9 Superstructure

The size of the superstructure must accommodate future track(s) per Section 4.2.3 and Access Road per Section 4.2.4. For typical cross sections of select superstructures see pg 42, 43 & 44, Plan No. 711200, sheets 2, 3 & 4.

6.9.1 Acceptable Superstructure Types

a. The following is a list of Underpass Structure types that are acceptable to the Railroad and listed in the order of preference. The Railroad's preferred superstructure type is the highest listed feasible alternative unless a detailed type selection report provides justifications that a lower listed alternative is more beneficial to the Railroad and to the project.
   1. Rolled Beams with Steel Plate Deck. There shall be at least five beams per track.
   2. Steel Plate Girders with Steel Plate Deck. There shall be at least four girders per track.
   3. Rolled Beams with Concrete Deck. There shall be at least five beams per track.
   4. Steel Plate Girders with Concrete Deck. There shall be at least four girders per track.
   5. Railroad Standard Prestressed Precast Concrete Double Cell Box Beams.
   6. Prestressed Precast Concrete Box Beams, single or double cell for span of 50 feet or less.
   7. Prestressed Precast Concrete AASHTO Type Beams, (or similar) with Concrete Deck for spans of 100 feet or less.
   8. Steel Through Plate Girders with Steel Plate Deck will be considered by the Railroad when conditions preclude any other structure type.

b. Underpass Structures of deck truss or through truss design are discouraged. However, in unusual circumstances, they will be considered by the Railroad if conditions preclude the use of any other type of structure.

c. Where possible, use of Railroad standard spans are encouraged.

6.9.2 Deck Requirements

a. <u>Deck Type</u> – In all cases when using a steel superstructure the use of a steel deck, per Section 6.3.e, is preferred. The deck must be designed to prevent ballast or other material from falling through.

b. <u>Deck Width</u> – The deck width shall be a function of future track, Access Road, existing track(s), minimum horizontal clearance per Section 6.7.2 and a minimum of 20 foot spacing between centerlines of tracks.

c. Ballast Depth – The minimum required depth of ballast shall be 12 inches measured from the top of deck to the bottom of tie, as required by the Railroad. The Railroad may require 13 inches of ballast depth below timber ties allowing for increased depth of future concrete ties.

d. Ties
   1. (UPRR) Concrete ties on ballast deck structures and approach slabs require a bottom rubber pad meeting UPRR requirements.
   2. (BNSF) Concrete ties on ballast deck structures and approach slabs require BNSF approval and must meet BNSF requirements.

e. Inside Guardrail – Inside guard rails are required across the following bridge span types. Contact the Railroad to receive the guard rail standards.
   1. Thru truss, pony truss, deck trusses on towers, deck plate girders on towers, thru plate girders (for span lengths over 100 feet), movable spans and others structures as designated by the Railroad.

6.9.3 Composite Deck

Steel superstructure design may utilize composite action with the deck according to the following:

a. Steel superstructure with composite concrete deck.
   1. Shall be designed as composite for E80 live load and impact.
   2. Shall be checked as non-composite for E65 live load and impact.
   3. Shall satisfy the AREMA deflection requirements for E80 live load and impact as composite.
   4. Shall have shear transfer devices designed per AREMA.

b. Steel superstructure with composite steel deck.
   1. Shall be designed as non-composite for E80 live load and impact.
   2. Shall satisfy the AREMA deflection requirements for E80 live load and impact as composite.
   3. Shall have shear transfer connections designed per AREMA.

6.9.4 Ballast Retainers, Fences and Handrails

a. Ballast retainers must be designed to prevent ballast from falling on the roadway.
b. Handrails shall be provided on both sides of the deck and shall meet FRA and OSHA requirements.
c. Fencing may be included where required by the Applicant or the Railroad. Handrails and fences shall be simple designs that require minimum maintenance and shall meet clearance requirements of Section 6.7.2.

6.9.5 Walkway

a. Walkway ballast section or walkway structure shall be provided on both sides of Underpass Structures.
   1. Walkway Ballast – The ballast section may be used as walkway at the discretion of the Railroad provided that the clear distance from centerline of track to the ballast retainer is a minimum of 8'-0".
   2. Walkway Structure – If a non-ballast walkway surface is required, it shall be a minimum of 2'-6" wide.

b. On bridges over roadways, or other locations, and where spillage of ballast or lading is possible, the walkways shall be constructed of solid material and a curb or toe board shall be provided at a height of 4 inches from top of walkway.
c. To prevent cracking under live loads, 1/4 inch control joints shall be provided in concrete curbs, concrete walkways and concrete ballast retainers and shall be spaced at 10 feet or less for the length of the structure.
d. When walkway structures are used, provide a detail showing the walkway transition from bridge to roadbed at bridge ends. Where there is a vertical distance from the roadbed walking surface to the bridge walkway, adjust the roadbed walkway profile to eliminate the vertical separation or provide other means to provide a safe transition. The design shall not restrict drainage at the abutments and shall be submitted to the Railroad for review.

6.9.6 Drainage

a. General
   1. A minimum longitudinal grade of 0.2% on the superstructure shall be provided to ensure adequate drainage.
   2. The designer may provide drainage toward one end of the structure, or when the structure's length is excessive, provide adequate deck grades to drain the structure to both ends.

3. If the top-of-rail grade is less than 0.2% over the length of the structure then the depth of ballast may be varied along the structure.
4. If an approach grade descends toward the bridge, drainage from the approach shall be intercepted by an appropriate system so that it will not drain onto the bridge.
5. Inadequate drainage facilities can severely limit the life span of the superstructure. When designing drainage facilities for a structure, two important criteria to keep in mind are:
   i. Drains should be constructed of corrosion resistant material and the use of PVC shall not be permitted.
   ii. Drains should not discharge on other bridge elements or traffic passing underneath the structure.

b. Concrete decks
   1. The top of the concrete deck shall be sloped a minimum of 0.5% transversely.
   2. For concrete decks, a longitudinal collection system shall be provided on top of the waterproofing along the face of parapet or curb to drain water. Longitudinal drains shall be connected to the storm drain system or properly discharged at the toe of embankment slopes. See pg 45, Plan No. 711200, sheet 5.
   3. The drip groove located on the bottom of the deck slab or fascia beam shall end 3 feet before the face of the abutment.

6.9.7 Waterproofing

a. Waterproofing and protective panels shall comply with the recommendations of Chapter 8, Part 29 of AREMA and shall be the following type, as approved by the Railroad:
   1. Cold liquid spray on waterproofing meeting AREMA requirements, as approved by the Railroad.
      i. Shall be protected with either a single 1/2 inch layer of asphalt panels or an additional spray on protection board layer, as approved by the Railroad.
b. Six (6) inches of ballast shall be placed over waterproofing immediately upon acceptance by the Railroad. Construction traffic is not allowed on waterproofing until the ballast covering is in place.
c. Waterproofing installation shall be observed and approved by the manufacturer's representative.

6.9.8 Steel Superstructure

The steel superstructure shall be designed per AREMA Volume 2, Chapter 15, unless otherwise required by the Railroad or herein.

a. Fracture critical member material, fabrication, welding, inspection and testing shall be in accordance with AREMA, Volume 2, Chapter 15.
b. The minimum diameter of high strength bolts shall be 7/8 inch diameter.
c. Bolted joints shall be designed as slip critical using the allowable stresses for a slip coefficient of 0.33.
d. The railroad may require critical structural elements to be designed with additional sacrificial thickness for future corrosion.
e. Diaphragms or cross frames shall be provided for all steel spans.
f. Jacking stiffeners or jacking beams are required for all steel structures.
g. Girders shall have mechanically-connected bottom flanges and intermediate stiffeners when:
   1. The girder span is over a roadway and the use of two girders per span or track cannot be avoided (such as a through plate girder) and
   2. Twenty (20) feet of vertical clearance cannot be provided.
h. Cover plates, flange elements and intermediate stiffeners shall comply with the following requirements:
   1. Cover Plates
      i. Cover plates of girders with bolted flanges shall be equal in thickness or shall diminish outwardly in thickness.
      ii. No plate shall be thicker than the flange angles.
      iii. The gross area of cover plates in any flange shall not exceed 70% of the total flange.
      iv. The total flange consists of cover plates, flange angles directly connected to the cover plates and side plates.
      v. The area of any flange element (flange angle, cover plate or side plate) shall not exceed 50% of the total flange.
   2. Flange Elements

i. Flange elements that are spliced shall be covered by extra material equal in section to the element spliced.
ii. There shall be enough bolts on each side of the splice to transmit to the splice material the stress value of the part cut.
iii. Flange angles may be spliced with angles or with a full penetration weld.
iv. No two elements shall be spliced at the same cross section or within the development length of another spliced element.
v. Welded splices will not be allowed in plate elements of bolted flanges.

3. All intermediate stiffeners shall have a bolted connection to the web.

6.9.9 Painting of Steel Structures

a. Painting of steel structures shall comply with the current requirements of AREMA, AASHTO specifications and recommendations of the Steel Structures Painting Council (SSPC).
b. Painting of existing Railroad structures is discouraged. Painting may be considered if the structure is free of existing defects, cracks, damage or otherwise which requires inspection.
c. Paint shall be applied in accordance with the Manufacturer's recommendations or as recommended by the SSPC, whichever is most restrictive.
d. The painting system, including primer and top coats, shall be submitted by the Applicant for review and approval by the Railroad and must be maintained by the Applicant.

6.9.10 Concrete Superstructure

a. Live load distribution for precast prestressed concrete single or double cell box beams shall be in accordance with Chapter 8, Part 2, Reinforced Concrete Design, Article 2.2.3.c of AREMA. This means that it shall not be assumed that the live load is necessarily equally distributed to the number of boxes supporting the tracks.
b. Box shaped (Single or Double void) or AASHTO type precast prestressed concrete beams for all spans shall be designed with end and interior diaphragms. Interior diaphragms shall be spaced equally across the span length.
c. Ends of strands are to be cut flush with the end of the product and painted with an approved coating.
d. For AASHTO type beams, the designer shall provide a minimum of eighteen (18) inches clear between the bottom flanges to accommodate inspection and repair.

6.10 Substructure

a. Pier and or abutment dimensions must accommodate future track(s) and Access Road per Section 4.2.3 and 4.2.4.
b. Footings for all substructures shall be located and designed to allow a minimum of 12 feet measured perpendicular from centerline of nearest active track to face of shoring to facilitate footing construction. Temporary shoring shall be designed per Section 4.4.2.
c. Cross-hole Sonic Log (CSL) Testing is required for every drilled shaft to evaluate the integrity of drilled shafts/caissons. The Plans and Specifications shall include provisions for this testing. Use steel pipes and not PVC for testing holes.
    1. Other testing methods may necessary, as required by the Railroad.
d. Drilled shafts within the influence of track surcharge shall be designed with permanent or temporary casing for protection against cave-in, subsidence and or displacement of surrounding ground. Casing shall be designed for live load due to the Railroad surcharge in addition to all other applicable loads. Drilled shafts shall be designed to allow the drilling operation to proceed without impacting the Railroad operation.

6.10.1 Piers

a. Columns shall be at least 0.2H in thickness at the base.
b. Slope the top of bridge seat to drain. If weathering steel is used for the superstructure, detail the bridge seat to minimize water staining concrete surfaces.
c. Provide a minimum of 6 inches from edge of masonry plate or bearing to edge of concrete.
d. Provide a minimum of 18 inches beyond the outside edge of outermost masonry plate or bearing to end of the pier.

e. Single column piers shall not be considered for Underpass Structures. Piers with a minimum of two columns shall be provided. A solid pier wall with minimum of 4 feet thickness is preferable.
f. Bridge piers adjacent to roadways shall be protected from vehicular traffic as required per AASHTO and State Department of Transportation standards.

6.10.2 Abutments

a. Slope the top of bridge seat to drain. If weathering steel is used for the superstructure, detail the bridge seat to minimize water staining concrete surfaces.
b. The abutments shall be wide enough to satisfy the Railroad standard roadbed. For multiple track bridges, the abutment width shall be sufficient to provide for the standard shoulder, plus 20 feet for each existing or future track.
c. Provide a minimum of 6 inches from edge of masonry plate or bearing to edge of concrete.
d. Sloping embankments in front of abutments shall be paved or have grouted rip-rap on top of filter fabric.
e. The year of construction shall be shown at the face of abutment backwall. Numbers shall be embedded into the concrete and be 6 inches size and located where visible.
f. Wing walls shall be designed to support 2:1 embankment slopes and provide positive ballast containment.

6.10.3 Signage and Miscellaneous

a. The Railroad's standard "No Trespassing" and bridge number signs shall be furnished and installed as required by Railroad standards.
b. Clearance signs, advance signs and other roadway signage shall be the responsibility of the roadway agency. Signs may not be attached to the bridge.
c. The Applicant shall be responsible for graffiti removal from the structure, regardless of other provisions for division of maintenance responsibility.

7 TRAILS

(Non-Vehicular Crossing over or under the Railroad)

All Trails impacting the Railroad shall be designed in accordance with Section 1, 2, 3, 4 & 7 of these Guidelines, the Manual of Uniform Traffic Control Devices (MUTCD), AASHTO code and any applicable sections of AREMA.

7.1 At Grade Crossing

a. The Railroad does not allow at grade Trail crossings. Alternative plans should be considered to avoid crossing Railroad tracks at grade.
b. At grade crossings immediately adjacent to an existing public roadway crossing with existing Highway Railroad warning devices may be considered. However, all costs associated with the installation of the new crossing surface and crossing warning device changes or relocation will be borne by the Applicant.
c. Scope of proposed crossing work will be determined at a joint diagnostic meeting between the Railroad and Applicant.
d. The Trail must conform to Railroad and MUTCD requirements.

7.2 Trail Parallel to Track

a. The Railroad does not allow Trails parallel to the track on Railroad right-of-way and does not permit the use of Railroad Access Roads for trail use.
b. Railroad structures cannot be used to serve Trail traffic or support a structure serving Trail traffic.
c. Fences or barriers such as vegetation, ditches, and/or berms shall separate Trails that are outside the Railroad right-of-way and running parallel to the track to stop trespassers from entering the Railroad right-of-way.

7.3 Grade Separated Crossing

Consider the use of existing structures to cross the Railroad tracks. In accordance with Homeland Security requirements some Railroad sites and structures are off limits for Trail use and crossing.

7.3.1 Overhead Crossing (Trail over Railroad)

New and existing Overhead Structures must be designed or modified with a protective curved fence. See pg 39, Plan No. 711100, sheet 3. New Overhead Structures shall be designed per Section 5 of these Guidelines.

7.3.2 Underpass Crossing (Railroad Structure over Trail)

The Railroad discourages the construction of new Underpass Structures. If an Underpass Structure is the only feasible structure type for the proposed site, a detailed type selection report must be submitted to justify its use. Underpass trail crossings which also serve to convey water are not permitted.

7.3.2.1 New Underpass Crossing

New Underpass Structures shall be designed per Section 6 of these Guidelines.

All pipe and concrete box culverts shall be designed per Railroad requirements and any applicable sections of AREMA. Confined structures are discouraged. To improve safety and sight distance all structures shall be tangent without curvature. The clear width and height of pedestrian structures shall be subject to the project site and structure length. The line of sight, historical security data and lighting shall be used for determining the required size of opening. Vertical Clearance shall not be less than 8 feet.

7.3.2.2 Crossing Under Existing Structures

a. The Railroad may reject, at its discretion, the use of any existing Underpass Structure for Trail use.
b. Existing culvert pipe, box or arch structures, designed to convey water, are not permitted for trail crossing use.
c. An open deck structure shall be modified to a ballast deck or solid deck structure to maintain a safe crossing under a Railroad structure. If modifying an existing open deck structure is not practical, provide a protective cover over the Trail.

d. Protection from falling debris is required for the crossing of pedestrians safely under active rail bridges. The overhead protection shall extend a minimum of 30 feet out on each side of the Railroad structure, or further as designated by the Railroad's engineering department. However, the protective cover shall not reduce the existing hydraulic opening, shall not function as a debris catcher and shall not impact proper inspection of the structure by Railroad personnel.
e. Measuring from bottom of the Railroad structure to the top of the protective cover shall not be less than 3 feet to allow for inspection and shall not be attached to the structure. If the Applicant can not meet these requirements then the Applicant shall provide a removable hatch to allow Railroad personnel to inspect the bridge structure.
f. The protective cover shall be removable and can be removed, at the Applicant's expense, without advanced notice if deemed necessary by the Railroad.
g. A protective cover shall be required, meeting the above criteria, for ballast deck bridges unless the superstructure meets the requirements of Section 6.9.4 and retains the ballast to a sufficient degree as approved by the Railroad.

7.4 Drainage

The drainage pattern of the site before and after construction shall be analyzed. Adequate drainage provisions shall be incorporated into the plans and specifications. Detailed Hydraulic Report may be required subject to site condition. The Hydraulic report must meet the Railroad Hydraulic Criteria per Section 4.5.

7.5 Fence

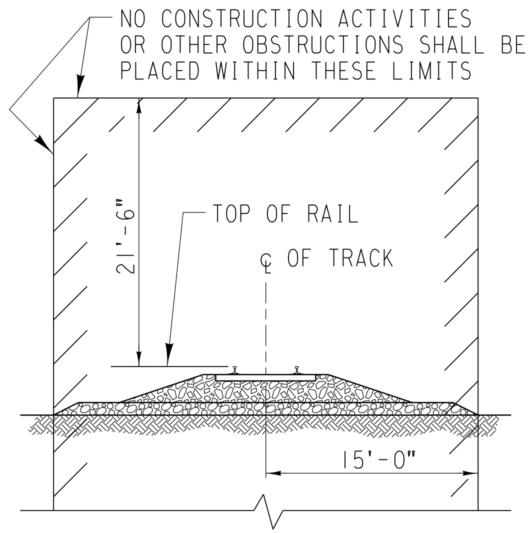
a. The Applicant shall specify the appropriate fencing to contain the Trail traffic within the Trail, crossing the Railroad right-of-way. Fence limits are subject to each project site and must be determined on a case by case basis. Refer to Section 4.7 for fence requirements.
b. Fencing shall be located where it will not impede Railroad's access to the bridge for inspection and shall be removed and replaced at the Applicant's expense when necessary for access by the Railroad.
c. All Railroad right-of-way fencing, for Trails adjacent to the Railroad right-of-way, must be provided, installed outside Railroad right-of -way and maintained by the Applicant.

7.6 Signs

a. All access to Trails crossing railroad track shall be protected with bollard posts and signs prohibiting non-authorized vehicular access.
b. All advisory and regulatory signs shall be in compliance with MUTCD and AASHTO. "No Trespassing" signs shall be posted every 500 feet.

7.7 Lighting

Adequate lighting shall be provided per AASHTO Roadway Lighting Design Guide requirements. Dark, confined, and isolated Trail crossings hidden from public view may attract illegal activities. Line of sight is extremely important when visibility is a matter of safety and security. The lighting design shall account for the impact on train operations. Lighting shall provide visibility for the Trail without directing light toward the train traffic.



MINIMUM CONSTRUCTION CLEARANCE ENVELOPE

(NORMAL TO RAILROAD)

DESIGN BY: RAF	CHECKED BY: AMH

APPROVED:

UPRR - SENIOR MANAGER STRUCTURES DESIGN

BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN

BRIDGE STANDARDS

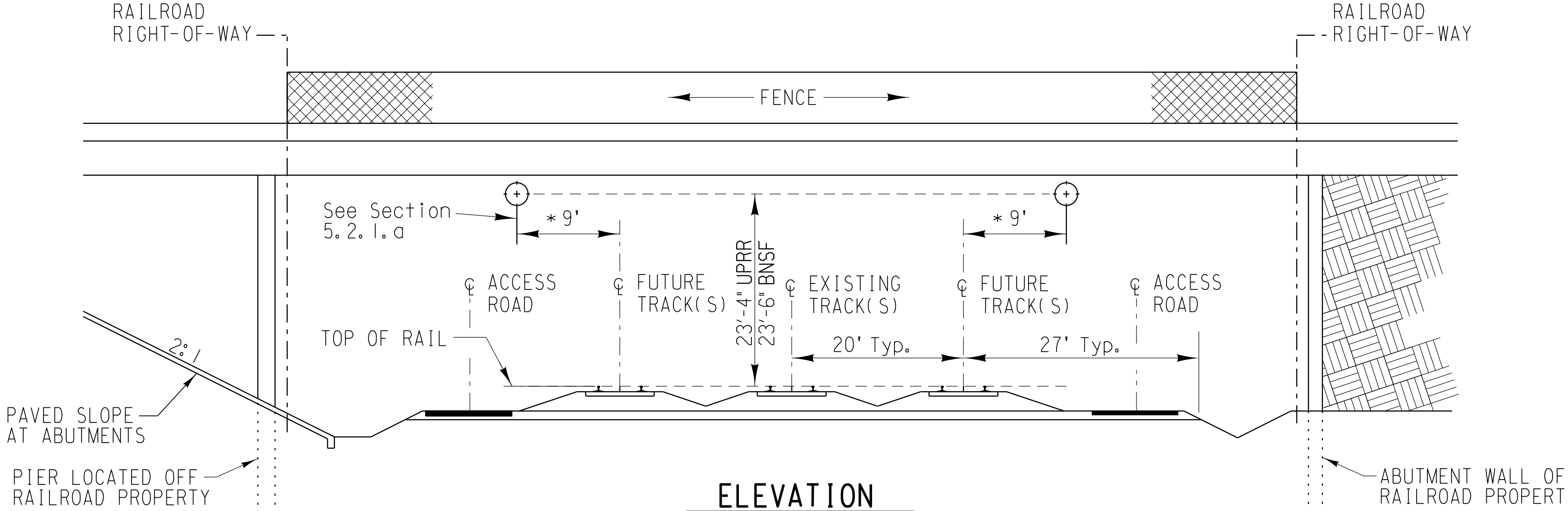
GRADE SEPARATION GUIDELINES

TEMPORARY CLEARANCE ENVELOPE

FILE OWNER: UPRR	DATE: 1/05/16
PLAN NO.: 711000	SHEET: 1

PLOTTED: 5/12/2016 9:14:09 AM

Overhead bridges shall be designed to completely span the Railroad Right-Of-Way.
Piers shall be located outside Railroad Right-of-Way.



ELEVATION
(NORMAL TO RAILROAD)

* See Section 5.2.1.a for Curved Track adjustments.

CONSTRUCTION NOTES:

1. Any shoring system that impact the Railroad operations and/or supports Railroad embankment shall be designed and constructed per the Railroad temporary Shoring requirements.
2. All demolition within the Railroad right-of-way and/or demolition that may impact the Railroad tracks or operations shall comply with the Railroad demolition requirements.
3. Erection over the Railroad right-of-way shall be designed to cause no interruption to all Railroad operations.
4. The elevation of the existing top-of-rail profile shall be verified before beginning construction. All discrepancies shall be brought to the attention of the Railroad prior to construction.
5. The proposed grade separation project shall not change the quantity and/or characteristics of the flow in the Railroad ditches and/or drainage structures.
6. The contractor must submit a proposed method of erosion and sediment control and have the method approved by the Railroad prior to beginning any grading on the project site.
7. For Railroad coordination please refer to the Railroad's Coordination Requirements as part of the Specifications or Special Provisions of the project.
8. Temporary Construction Clearances, including falsework clearances, shall comply with Figure 1.
9. All permanent clearances shall be verified before project closeout.

DESIGN BY: RAF	CHECKED BY: AMH
APPROVED: Rick Friesen — UPRR - SENIOR MANAGER STRUCTURES DESIGN	
Austin M. Hurst — BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN	

UNION PACIFIC — BNSF RAILWAY

BRIDGE STANDARDS

GRADE SEPARATION GUIDELINES

GENERAL OVERHEAD STRUCTURE DRAWING

FILE OWNER: UPRR	DATE: 1/05/16
PLAN NO.: 711100	SHEET: 1

PLOTTED: 5/12/2016 9:14:06 AM

PLAN

1. North Arrow
2. Centerline of bridge and/or centerline of project.
3. Track layout and limits of Railroad right-of-way with respect to centerline of main lines.
4. Footprint of proposed superstructure and substructure including existing structure if applicable.
5. Future tracks, access roadways and existing tracks as main line, siding, spur, etc.
6. Vertical & Horizontal Clearances from Railroad Track:
   a. Point of minumum vertical clearance and distance, measured perpendicular, from the centerline of nearest track.
   b. Horizontal clearance at right angle from centerline of nearest existing or future track to the face of obstruction such as substructure above grade.
   c. Horizontal clearance at right angle from centerline of nearest existing or future track to the face of nearest foundation below grade.
   d. Horizontal spacing at right angle between centerlines of existing and/or future tracks.
7. Limits of shoring and minimum distance at right angle from centerline of nearest track.
8. Locate and show all existing facilities and utilities and their proposed relocation, if required.
9. Toe of slope and/or limits of retaining wall.
10. Limits of grading with existing and proposed contours.
11. Limits of barrier rail and fence.
12. Minimum structure separation for adjacent structures.
13. Railroad Milepost and direction of increasing Milepost.
14. Direction of flow for all drainage systems within project limits.
15. Timetable direction arrows, nearest Railroad station and end station of Railroad Subdivision.
16. Show and label future tracks, access roads and existing tracks as main line, siding spur, etc.
17. Show location of deck joints.
18. Location of deck drains.

ELEVATION

1. Individual span length and total bridge length.
2. Limits of barrier rail and fence with respect to centerline of track.
3. Depth of foundation below bottom of tie.
4. Horizontal clearance at right angle from centerline of nearest existing or future track to the face of obstruction such as substructure above grade.
5. Indicate horizontal spacing at right angle between centerlines of existing and/or future tracks.
6. Minimum horizontal clearance at right angle from centerline of nearest existing or future track to the face of foundation below grade.
7. Indicate top and bottom of pier protection wall elevation relative to top of rail elevation.
8. Controlling dimensions of drainage ditches and/or drainage structures.
9. Top of rail elevations for all tracks.
10. Minimum permanent vertical clearance above top of high rail to the lowest point under the bridge.
11. Existing and proposed goundline & roadway profile.
12. Show elevation of existing or relocated utilities.
13. Show slope and specify type of slope paving. Toe of slope shall be shown relative to drainage ditch and top of subgrade.

TYPICAL SECTION

1. Total width of superstructure.
2. Width of shoulder and/or sidewalk.
3. Height and type of barrier rail and fence.
4. Depth of superstructure.

TITLE BLOCK

1. The name & logo of engineering firm or project owner.
2. Drawing title.
3. Railroad milepost number and subdivision.
4. City, county and state.
5. Project name and location.
6. Date.
7. Latitude and longitude.

RAILROAD PROFILE GRADE DIAGRAM

1. Show existing and proposed track profile at the bridge location and a minimum of 1,000 feet past each edge of the bridge.

Note: The Railroad Milepost is calculated at the intersection of centerlines of the Overhead Structure and Existing Track. All separate Overhead Structures shall have individual Milepost designations.

DESIGN BY: RAF	CHECKED BY: AMH
APPROVED:	
UPRR - SENIOR MANAGER STRUCTURES DESIGN	
BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN	

UNION PACIFIC — BNSF RAILWAY

BRIDGE STANDARDS

GRADE SEPARATION GUIDELINES

MINIMUM LAYOUT REQUIREMENTS FOR OVERHEAD STRUCTURES

FILE OWNER: UPRR	DATE: 1/05/16
PLAN NO.: 711100	SHEET: 2

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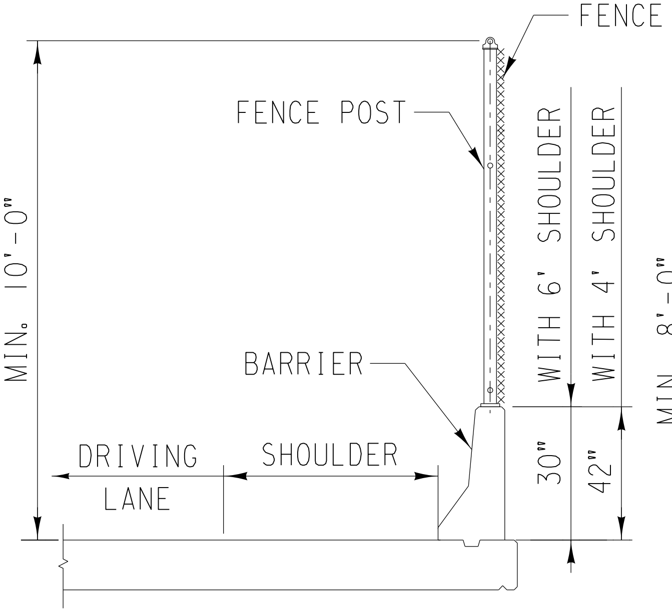
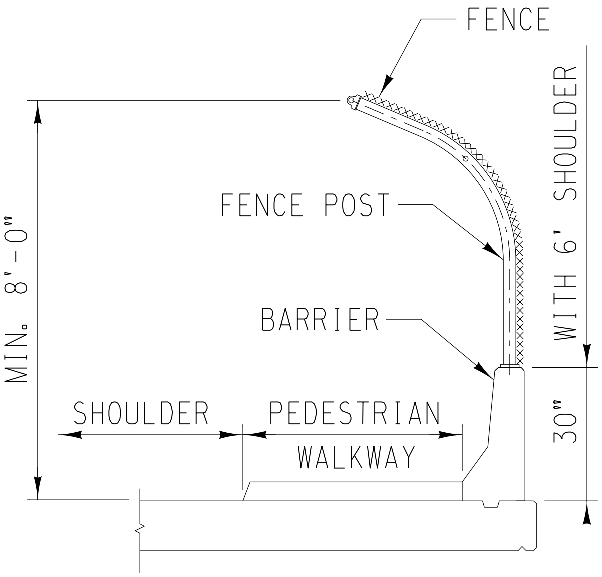
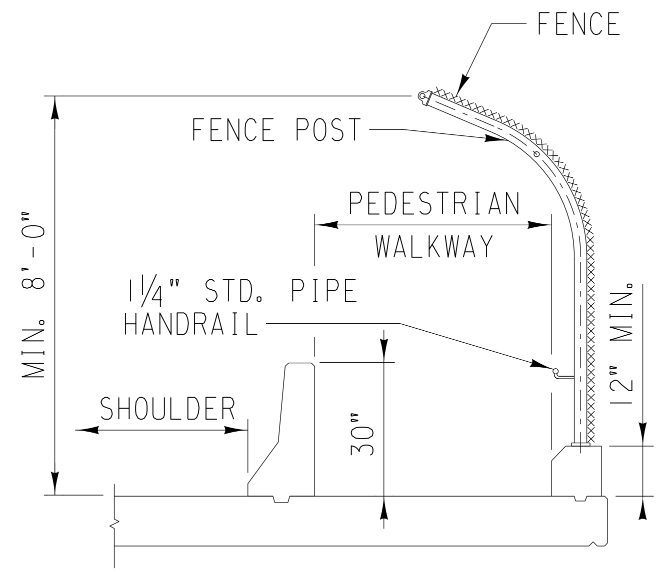


FENCE ON BARRIER



WALKWAY FENCE ON BARRIER



WALKWAY FENCE ON CURB WITH BARRIER

DESIGN BY: RAF | CHECKED BY: AMH

APPROVED:

UPRR - SENIOR MANAGER STRUCTURES DESIGN

BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN

UNION PACIFIC | BNSF RAILWAY

BRIDGE STANDARDS

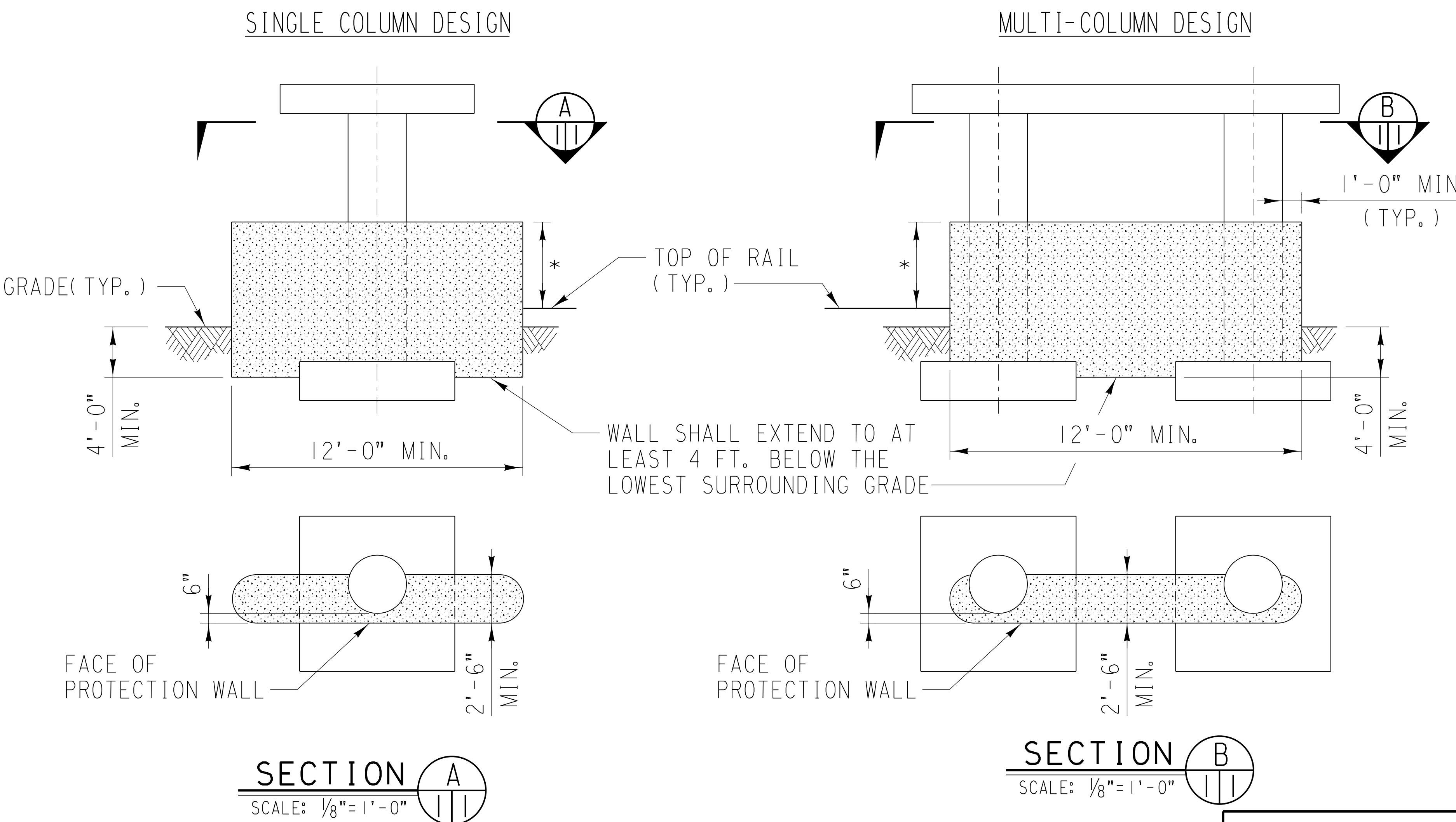
GRADE SEPARATION GUIDELINES

OVERHEAD STRUCTURE BARRIERS AND FENCES

FILE OWNER: UPRR | DATE: 1/05/16

PLAN NO.: 711100 | SHEET: 3

PLOTTED: 5/12/2016 9:14:06 AM



* 6'-0" MINIMUM FOR PIERS FROM 12 FT. TO 25 FT. CLEAR FROM THE CENTERLINE OF EXISTING OR FUTURE TRACK.

12'-0" MINIMUM FOR PIERS LESS THAN 12 FT. CLEAR FROM THE CENTERLINE OF EXISTING OR FUTURE TRACK.

DESIGN BY: RAF	CHECKED BY: AMH

APPROVED: Rick Friesen

UPRR - SENIOR MANAGER STRUCTURES DESIGN

Austin M. Hurst

BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN

UNION PACIFIC

BNSF RAILWAY

BRIDGE STANDARDS

GRADE SEPARATION GUIDELINES

STANDARDS FOR PIER PROTECTION WALLS

FILE OWNER: UPRR	DATE: 1/05/16
PLAN NO.: 711100	SHEET: 4

PLOTTED: 5/12/2016 9:14:07 AM

PLAN

1. North Arrow.
2. Alignment of centerline of bridge and/or horizontal control line of project, centerline of existing track(s), centerline or future track(s), centerline of shoofly, centerline of roadway. Identify tracks as main, siding, etc.
3. Angle between centerline of roadway and centerline of bridge. Skew angle of substructure.
4. Horizontal distance between centerlines of main track(s) and adjacent existing and/or future tracks.
5. Individual span length(s) and total bridge length from face to face of backwalls.
6. Limits of Railroad right-of-way with respect to centerline of main track. Limits of Right-of-Way fencing.
7. Footprint of proposed superstructure and substructure including approach slabs and existing structure, if applicable.
8. Footprint of roadway, sidewalks, retaining walls, etc.
9. Location of access roadway(s) and turnarounds.
10. Timetable direction arrows, nearest railroad station and end station of railroad subdivision.
11. Railroad Milepost measured at the inside face of backwall, at the low milepost bridge end.
12. Point of minimum vertical clearance.
13. All existing facilities and utilities and their proposed relocation, if required.
14. Limits of shoring including minimum distance at right angle from centerline of nearest track.
15. Limits of grading with existing and proposed contours.
16. Minimum structure separation for adjacent structures.
17. Direction of flow for all drainage systems within project limits.
18. Location of geotechnical borings.

ELEVATION

1. Individual span length(s) and total bridge length from inside face to face of backwalls.
2. Distance from nearest Railroad Milemarker to inside face of backwall at the low milepost bridge end.
3. Profile grade of bridge.
4. Profile grade and top of rail elevations for main track.
5. Roadway section.
6. Minimum vertical clearance from roadway to bridge.
7. Limits of handrail/fence on bridge.
8. Location of fixed and expansion bearings.
9. Location and type of substructure with elevations.
10. Numbering of spans, abutments and piers.
11. Existing and proposed groundline, including slope paving.
12. Existing and proposed utilities.
13. Depth of foundation below roadway.

TYPICAL SECTION

1. Centerline of bridge and/or horizontal control line of project, centerline of existing track(s), centerline of future track(s). Identify tracks as main, siding, etc.
2. AREMA clearance envelope.
3. Horizontal distance between centerline of tracks, distance from centerline of track to face of ballast retainer and handrail/fence.
4. Total width of superstructure.
5. Width of walkway.
6. Height and type of ballast retainer, handrail/fence.
7. Depth of superstructure.
8. Rail, tie and ballast system with vertical distance from top of rail to top of deck and minimum depth of ballast under the tie (12").
9. Cross slope of deck, if applicable, and waterproofing system.
10. Girder spacing.
11. Diaphragms: Steel - end and intermediate
    Concrete - tie rods.

TITLE BLOCK

1. The name & logo of engineering firm or project owner.
2. Drawing title.
3. RR Milepost number and subdivision.
4. City, county and state.
5. Project name and location.
6. Date.
7. Latitude and Longitude.

RAILROAD PROFILE GRADE DIAGRAM

1. Show existing and proposed track profile at the bridge location and a minimum of 1,000 feet past each end of the bridge.

DESIGN BY: RAF	CHECKED BY: AMH
APPROVED: Rick Friesen	
UPRR - SENIOR MANAGER STRUCTURES DESIGN	
Austin M. Hurst	
BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN	

UNION PACIFIC — BNSF RAILWAY

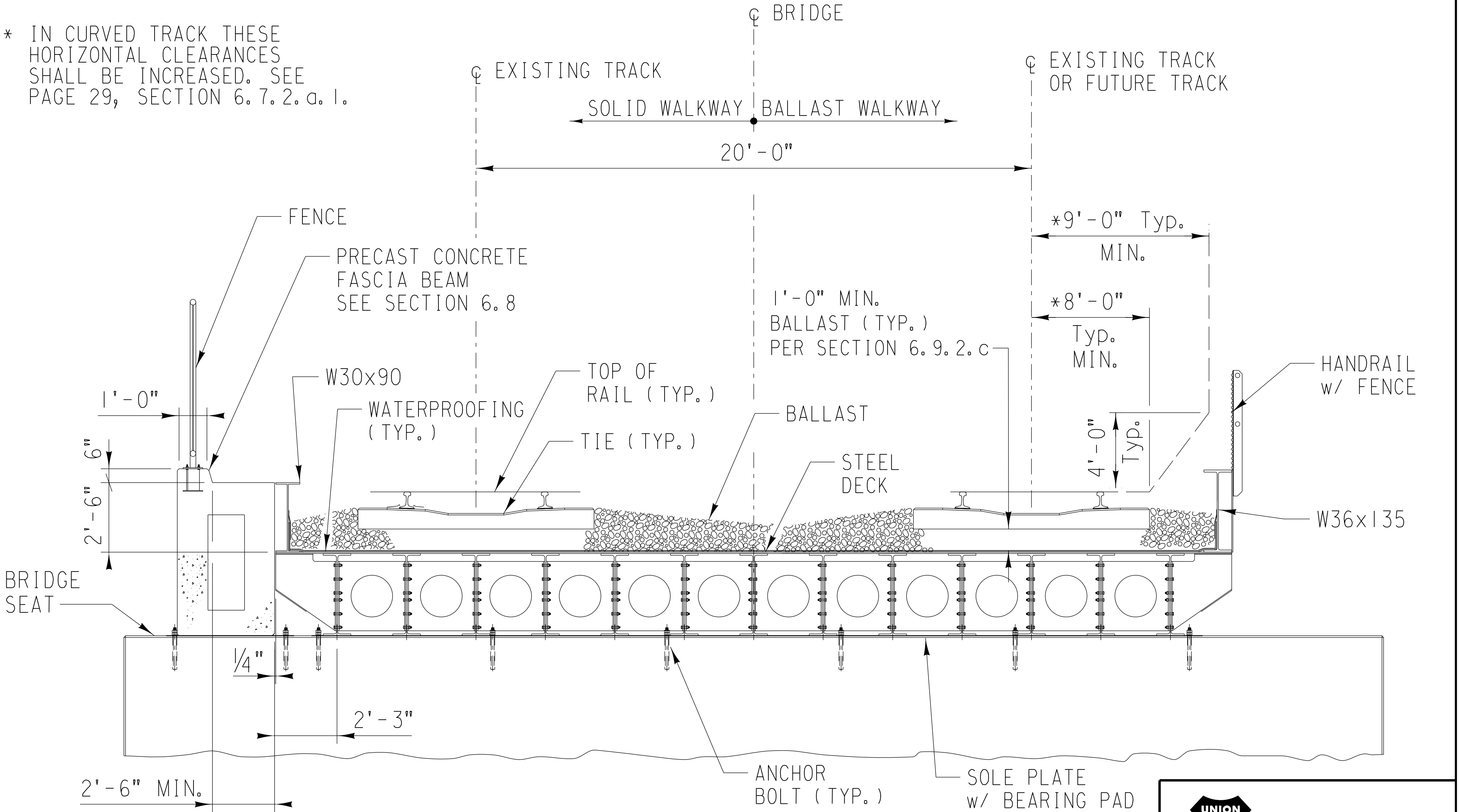
BRIDGE STANDARDS

GRADE SEPARATION GUIDELINES

MINIMUM LAYOUT REQUIREMENTS FOR UNDERPASS STRUCTURES

FILE OWNER: UPRR	DATE: 1/05/16
PLAN NO.: 711200	SHEET: 1

PLOTTED: 5/12/2016 9:14:07 AM



DESIGN BY: RAF	CHECKED BY: AMH

APPROVED: Rick Friesen

UPRR - SENIOR MANAGER STRUCTURES DESIGN

Austin M. Hurst

BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN

UNION PACIFIC | BNSF RAILWAY

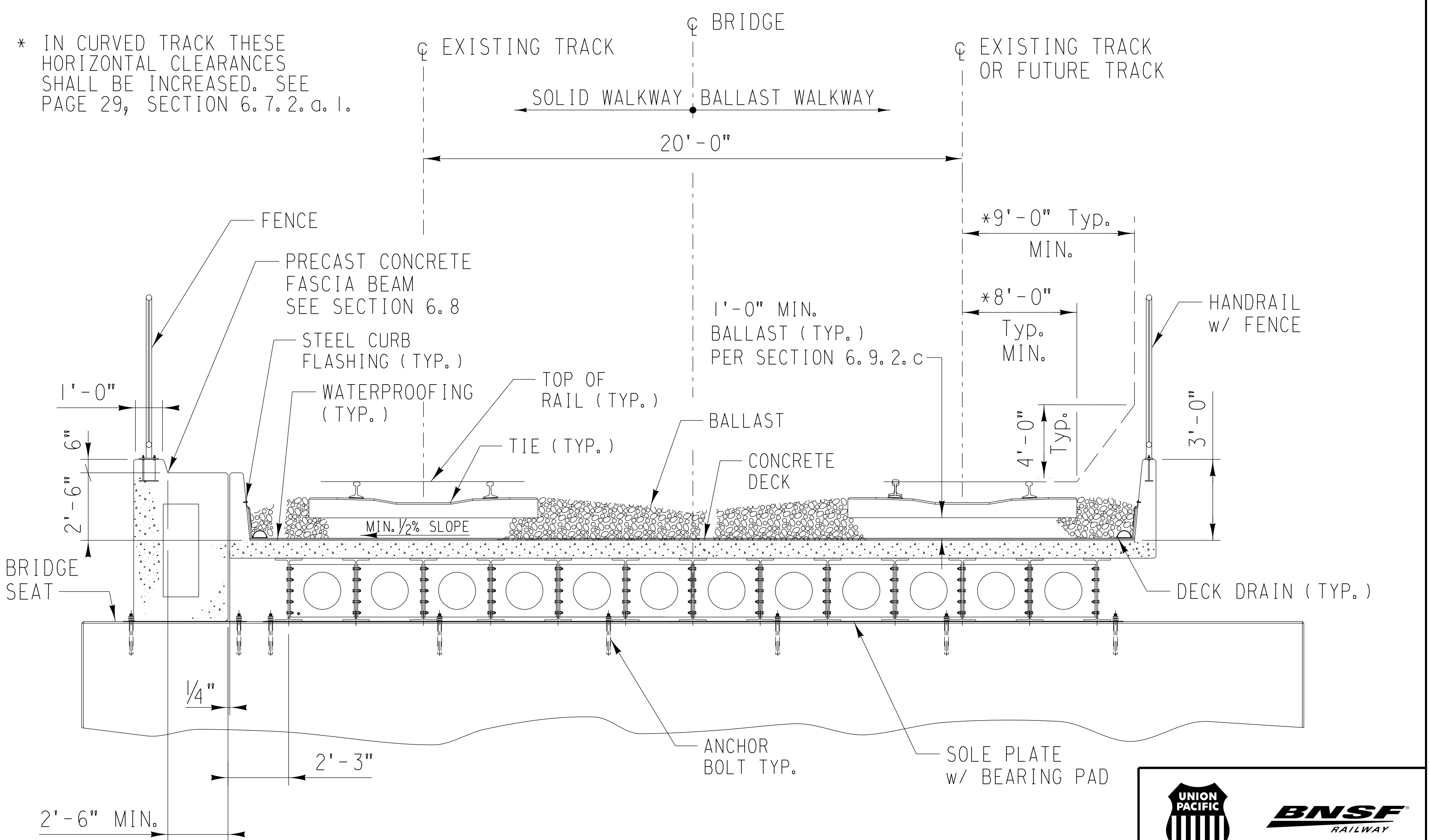
BRIDGE STANDARDS

GRADE SEPARATION GUIDELINES

ROLLED BEAMS w/ STEEL PLATE DECK

FILE OWNER: UPRR	DATE: 1/05/16
PLAN NO.: 711200	SHEET: 2

PLOTTED: 5/12/2016 9:14:08 AM



DESIGN BY: RAF	CHECKED BY: AMH
APPROVED:	

UPRR - SENIOR MANAGER STRUCTURES DESIGN

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UNION PACIFIC

BNSF RAILWAY

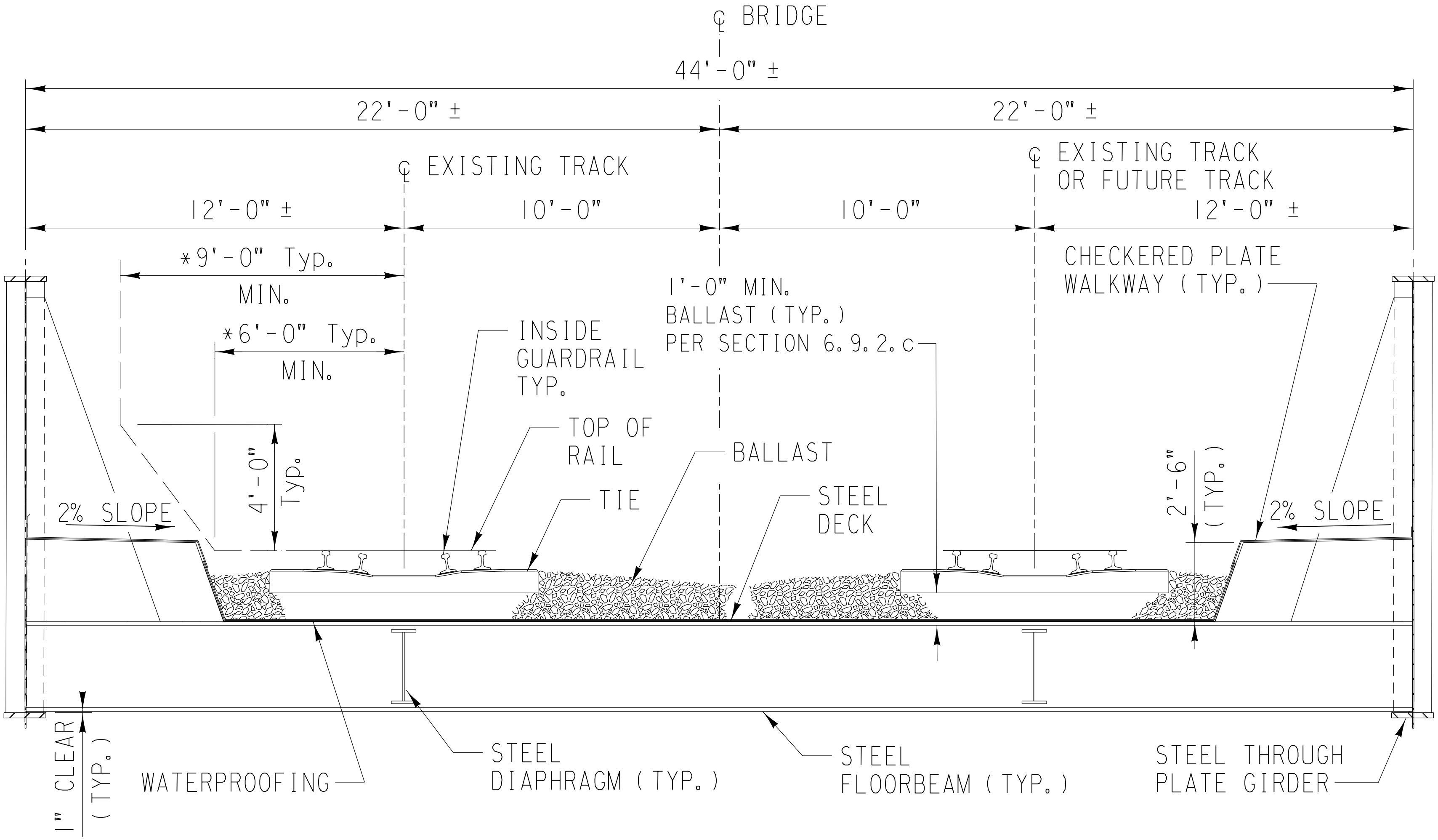
BRIDGE STANDARDS

GRADE SEPARATION GUIDELINES

ROLLED BEAMS w/ CONCRETE DECK

FILE OWNER: UPRR	DATE: 1/05/16
PLAN NO.: 711200	SHEET: 3

PLOTTED: 5/12/2016 9:14:08 AM



* IN CURVED TRACK THESE
HORIZONTAL CLEARANCES
SHALL BE INCREASED. SEE
PAGE 29, SECTION 6.7.2.a.1.

DESIGN BY: RAF	CHECKED BY: AMH
APPROVED:	
UPRR - SENIOR MANAGER STRUCTURES DESIGN	
BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN	

UNION PACIFIC | BNSF RAILWAY

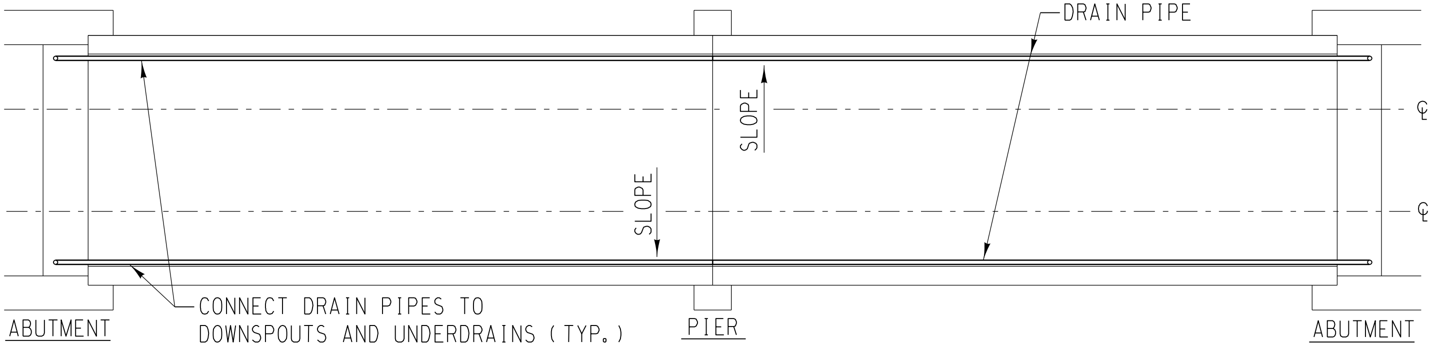
BRIDGE STANDARDS

GRADE SEPARATION GUIDELINES

STEEL THROUGH PLATE GIRDERS w/ STEEL PLATE DECK

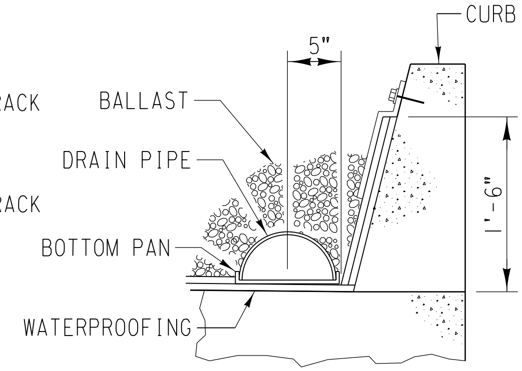
FILE OWNER: UPRR	DATE: 1/05/16
PLAN NO.: 711200	SHEET: 4

PLOTTED: 5/12/2016 9:14:08 AM



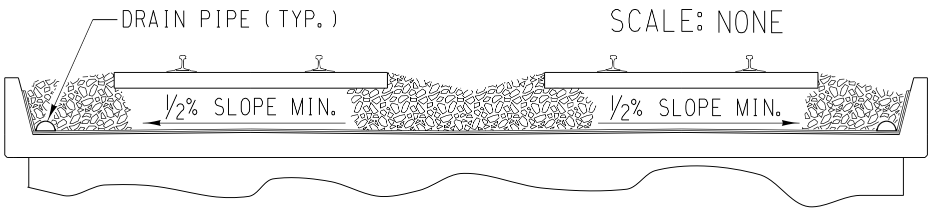
DECK PLAN

SCALE: NONE



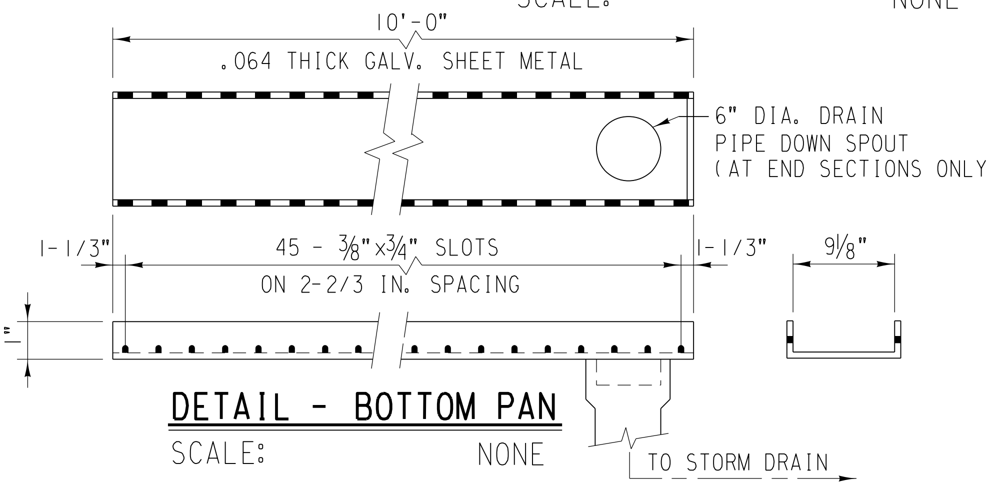
LOCATION OF DRAIN PIPE

SCALE: NONE



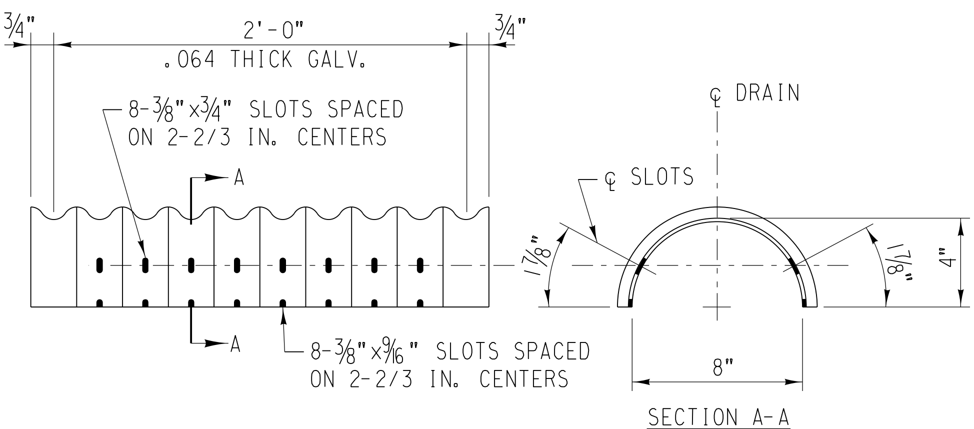
TYPICAL DECK SECTION

SCALE: NONE



DETAIL - BOTTOM PAN

SCALE: NONE



DETAIL - DRAIN PIPE

SCALE: NONE

NOTE: LAP DRAIN PIPE ONE CORRUGATION AT EACH END.

DESIGN BY: RAF	CHECKED BY: AMH

APPROVED:

UPRR - SENIOR MANAGER STRUCTURES DESIGN

BNSF - ASSISTANT DIRECTOR STRUCTURES DESIGN

UNION PACIFIC — BNSF RAILWAY

BRIDGE STANDARDS

GRADE SEPARATION GUIDELINES

CAST-IN-PLACE CONCRETE DECK DRAIN DETAILS

FILE OWNER: UPRR	DATE: 1/05/16
PLAN NO.: 711200	SHEET: 5

PLOTTED: 5/12/2016 9:14:08 AM