DRAFT – For Review & Comment

Lander Street Grade Separation Project

TS & L Study

Prepared for:

Seattle Department of Transportation

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KPFF Project No. 101400.5

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I. EXECUTIVE SUMMARY

This Type Size and Location (TS&L) Study was conducted for a grade separation of the Burlington Northern Santa Fe (BNSF) Railroad tracks at S. Lander Street in the City of Seattle's SODO neighborhood.

Initial concepts for an overcrossing and an under crossing were shared with local citizens at a public meeting. In response to comments from that meeting an alternatives screening was conducted to determine if a grade separation of the tracks could be achieved in another location with less impact to the community. The screening evaluated eight crossings between S Holgate Street and S Hinds Street, and determined that a grade separation at S Lander Street best met the purpose and need statement, and would comparatively have less impact on adjacent businesses.

Compared to an overcrossing an undercrossing has significant disadvantages due to the cost of relocating major utilities and the need to acquire additional right-of-way. This option was dropped from further consideration after the initial concepts were reviewed and because there was no strong preference from the public for an undercrossing.

To avoid a change in grade at the intersections of First and Fourth Avenues and achieve the required clearance over the railroad tracks the approach ramp grades will be seven percent. The City's Freight Mobility Committee initially expressed concern over the steepness of these grades, but later acknowledged they would be acceptable. To meet the requirements for a posted speed of 30 mph requires a long vertical crest curve, which would result in the closure of the intersection with Third Avenue S. To keep the intersection open the recommended solution is to shorten the length of the vertical curve and reduce the posted speed to 25 mph.

Various structure types for the bridge were considered, including steel truss, steel girder, concrete "I" girder and concrete box girder. Although the steel options resulted in the shallowest deck sections, and the flattest approach ramp grades, they are not recommended because of high maintenance costs, especially for painting the span over the railroad tracks. The concrete box girder option is the recommend bridge type primarily because it has the thinnest deck section of the concrete options.

There were also a few options to determine the number of spans. The minimum would be to simply span the railroad tracks. However, this solution would close the intersection with Occidental Avenue S. and restrict access to the BNSF team track. To maintain through traffic on Occidental Avenue S, replace lost street parking, and maintain access to the team track, a 600 linear foot - five span structure is recommended.

Construction costs for the project in present dollars is $24.6 million. Total project costs, including design, permitting, right-of-way, are estimated at $32.4 million. Based on a construction start date of January 2008, project costs in year of expenditure dollars are $38.0 million.

II. INTRODUCTION

This TS&L Study is an outgrowth of the Access Duwamish Initiative, which identified and analyzed the access and mobility problems of the transportation corridors in the North Duwamish industrial area. Although S. Lander Street was identified in the Access Duwamish Report as the recommended location for a grade separated railroad crossing, the public requested that alternative corridors be screened to determine if another location would have less impact on the community. The screening evaluated eight crossings between S Holgate Street and S Hinds Street, and determined that a grade separation at S Lander Street best met the purpose and need statement, and would comparatively have less impact on adjacent businesses. Results of the screening analysis are documented in the Alignment Screening Analysis Technical Memorandum. The Purpose and Need Statement developed for this project is also contained in the Alignment Screening Analysis Technical Memorandum.

A grade separated railroad crossing on S. Lander Street will provide substantial benefit to all users of the corridor. An over crossing at S. Lander Street will eliminate the 158 hours of vehicular delay that occur at this location every day, and improve air quality. Elimination of the vehicular delay will benefit both the rail and trucking freight industry as well as the general public. Rail safety and operations benefit by an over crossing at S. Lander Street, because it eliminates the existing arterial at-grade crossing and results in over 6,000 linear feet of track length between grade crossings. The longer length between at-grade crossings facilitates rail operations. Also, S. Lander Street provides the best east-west connectivity for commuter and freight traffic in the area with direct network connections from Utah Avenue S. to Airport Way S. This will improve travel time between the port and local businesses. Since Sound Transit and the Seattle Popular Monorail Authority both have proposed stations along the S. Lander Street corridor, a grade separation at this location will also enhance pedestrian safety, and provide better access to and from the transit facilities.

To determine the required number of lanes and intersection channelization, existing traffic volume data for the year 2000 was analyzed, and future traffic conditions modeled for the year 2025. Results of the traffic analysis and forecast are contained in a memorandum prepared by Heffron Transportation Inc. dated April 8, 2002. A copy of the memorandum is included in the Appendix.

Prior to the first public meeting, concepts were developed for overcrossing and under crossing solutions. For each solution a two-lane and four-lane alternative were developed. The two-lane solution was evaluated to study the condition where the existing at-grade crossing would remain open to provide access to local businesses, and a fly-over type structure built in the center of the street. The two lane alternative was dropped from further consideration once it was determined it would severely limit intersection turning movements. Vehicles using the at-grade approach lanes to the intersections at First and Fourth Avenues would not be able to make left turns, and traffic on fly-over ramps would not be able to make right turns at these same intersections.

The undercrossing solution was studied to determine if it would have less impact than an over-crossing. Since this portion of S Lander Street is an over-height freight corridor with a clearance requirement of 20 feet, the lengths of the approaches for a grade separation are the same as an over-crossing. Although an under crossing would have less of a visual impact, it has the following disadvantages when compared to an overcrossing.

- Increased construction costs to relocate existing utilities, lower the roadway, and construct a bridge for the railroad tracks.
- Additional right-of-way acquisition to relocate existing utilities.
- Increased construction and maintenance costs due to high groundwater.
- Less opportunity to create usable space in the remaining right-of-way. (An overcrossing provides the opportunity to replace lost on-street parking by using the area under the structure.)

The tunnel solution was dropped once the disadvantages were confirmed. Drawings for the overcrossing and under crossing solutions and the two and four lane alternatives are included in the appendix.

Geotechnical information for the existing soil conditions was obtained from the soils report prepared for the S Lander Street Combined Sewer Overflow project. A copy of this report is contained in the Appendix.

The following sections of this report describe the project, define the design criteria, summarize the structural studies, address utility relocation, and constructibility issues, and document construction costs.

III. EXISTING CONDITIONS AND PHOTOGRAPHS

Existing conditions for S Lander Street are as follows:

A. Existing Roadway Conditions

1. Street Classification: Minor Arterial (Source: Seattle Street Improvement Manual, Appendix A, 12/91). S. Lander Street is a designated truck route.

2. Land Use Categories (Source: Seattle Land Use and Zoning Code, Zoning Map 130):
   - 1st Avenue S. to Occidental Avenue S. IG2 U/85
   - Occidental Avenue S. to 4th Avenue S. IG1 U/85

3. Right-of-Way Width: 100 feet.

4. Pavement Width: 76 feet curb-to-curb. Two travel lanes in each direction, center two-way turn lane, and parking both sides.

5. Sidewalk Width: 10.5 feet typical, with 4.5-foot planter.

6. Existing Pavement: 7-inch PCCP with 2-inch AC overlay, varied cross-slope.

B. Existing Utilities (Source: Lander Street Separation Project PH I)

1. Water (21.5 feet north of centerline) 16-inch CIP (SPU)

2. Sewer (17 feet south of centerline)	96-inch sanitary sewer (King County Metro)
3. Storm Drainage (at centerline)	90-inch storm sewer (SPU)
4. Power	SCL distribution
5. Gas	PSE
6. Private Utilities	overhead (electric, telephone, cable TV)
7. Fiber Optic	Starcom International Optics Corporation
8. Illumination	2-inch traffic conduit

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IV. PROJECT DESCRIPTION

Alignment
The grade separated crossing on S. Lander Street would stretch from 1st Avenue S. to 4th Avenue S, with no changes to 1st Avenue S. or 4th Avenue S. The roadway cross-section will be similar to the existing condition. There will be two lanes in each direction and left turn lanes at the intersections with 1st Avenue S. and 4th Avenue S. It is necessary to have two lanes due to the steep grades and the high volume of truck traffic. There is also a 10-foot walkway on the north side of the structure.

Circulation
Maintaining at-grade circulation and business access will require surface improvements, and additional right-of-way. The two streets affected are Occidental Avenue S. and Third Avenue S. The horizontal alignment of Occidental Avenue S. may be adjusted to go under S. Lander Street instead of intersecting with it by shifting the street to the east in order to obtain the necessary clearance. Occidental Avenue S. would turn east on either side of S. Lander Street and cross under the structure just west of the 25-foot railroad clear zone. This re-alignment also facilitates access to the BNSF Team Track. Realigning the street may eliminate half of the parking for the Lander Station Business Park. This parking can be replaced with new stalls under the bridge. To meet the new centerline elevation on S. Lander Street, 3rd Avenue S. would be raised approximately 3 feet at the intersection.

Business Access
Since the Rabel property's only access is off S. Lander Street, it may be necessary to obtain an easement from Rabanco, who owns the property between the Rabel property and Third Avenue S. Rabanco staff has expressed a willingness to provide a driveway easement for Rabel.

The Seattle School District's primary truck exit is currently just east of the BNSF Tracks on the north side of S. Lander St. The grade separation may result in the closing of this driveway, requiring all exiting trucks to use the south parking lot and exit on Third Avenue S. Creating a safe truck route through the south parking lot may result in the loss of parking. This parking can be recreated under the structure.

Parking
S. Lander Street currently has approximately 80 on street parking spaces that may be lost with the construction of an elevated structure. The realigning of Occidental Avenue S. may result in the loss of several parking stalls on the Lander Station Business Park property, and the Seattle School District's revised truck routing will also result in a loss of parking. In total over 100 parking stalls could be lost if parking is not provided under the structure. Even with 70 new parking stalls under the structure there will be a net loss of at least 30 stalls.

Drainage
The storm drains and sanitary sewer are separated along this section of S. Lander Street. Due to the proximity of Elliot Bay, detention will not be required, however treatment of storm water runoff will be.

Utility Relocation
Major underground utility mains lie within S. Lander Street, including a 96-inch diameter sanitary sewer, a 90-inch storm drain, and a 16-inch diameter water main. These facilities will be either relocated, replaced with new, or protected in place. See Section VII for a complete description.

Emergency Access
An at-grade emergency crossing would be maintained at S. Lander Street. There would be gated access on either side of the railroad clear zone, along Occidental Avenue S. on the west and near the under-structure parking on the east. There would also be a gated emergency crossing on S. Horton Street, which would no longer be an at-grade railroad crossing.

Other Projects in the Area
The Seattle Popular Monorail Authority has plans to run the monorail down 3rd Avenue S. along S. Lander Street and then south on either 1st Avenue S. or Utah Avenue S. The monorail would run along the north side of S. Lander Street just inside of the city right-of-way. It is anticipated that there will be a station somewhere along S. Lander Street to accommodate transfers to Sound Transit's Link Light Rail, which will also have a station on S. Lander Street east of 4th Avenue S. There may be a pedestrian connection between the Monorail station and the 10-foot walkway on the north side of the elevated structure.

V. DESIGN CRITERIA

1.0 TRAFFIC MODELING CRITERIA

A. The Lander Street grade separation type, size, and location project will be designed to accommodate traffic for the following conditions:

1. The afternoon (PM) peak hour will be the design hour, which is when traffic volumes at the intersection of S. Lander Street/1st Avenue S. and S. Lander Street/4th Avenue S. are the highest.

2. Future traffic volumes for the year 2025 will be used for all analyses. These volumes will include increases associated with new major development projects (Seattle School District Consolidated Support Center, Starbucks Center, offices on the WOSCA site, and the LINK maintenance base), and increases associated with regional growth.

3. The future traffic volumes will reflect changes in travel patterns associated with several major transportation improvement projects—SR 519 Phase 1 (Atlantic Street), SR 519 – Alaskan Way Surface Street, SR 519 Phase 2 (Royal Brougham Way), Spokane Street viaduct widening and new ramp at 1st Avenue S., and the LINK Light Rail in the E-3 corridor.

4. S. Lander Street should be designed to accommodate closure of S. Holgate Street at the railroad tracks, if the City of Seattle ever decides to make such a closure. To accommodate this potential, the future traffic volumes on S. Lander Street will reflect increases associated with closing S. Holgate Street to through-traffic.

5. The bridge will be designed to attain LOS D conditions for the intersections at S. Lander Street/1st Avenue S. and S. Lander Street/4th Avenue S. during the design hour when there is no event at Safeco Field, the Exhibition Center, or the Football Stadium.

2.0 ROADWAY CRITERIA

A. Reference Sources

1. Seattle Street Improvement Manual, December 1991.

2. City of Seattle Standard Plans for Municipal Public Works Construction, 2001.

3. City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction, 2001.

4. AASHTO A Policy on Geometric Design of Highways and Streets, 2001 Edition.

5. City of Seattle Traffic Code, Title 11, of the Seattle Municipal Code.

6. WSDOT Design Manual.

B. Street Elements

1. Centerline Profile

   a. Minor Arterials: Maximum 10 percent, minimum 0.5 percent (Source: Seattle Street Improvement Manual, 12/91).

   b. AASHTO: Maximum grades for urban arterials, 8 percent for level terrain, 30 mph design speed (Source: AASHTO Exhibit 7-10, 2001).

   c. Desirable Grade for Truck Traffic, Icy Conditions: 6 percent maximum, 5 percent minimum desirable (Source: Kick-off meeting).

2. Typical Section

   a. Cross Slope: Desirable 2 percent, maximum 4 percent, minimum 1 percent (Source: Seattle Street Improvement Manual, 12/91).

   b. Lane Widths: 12 feet (Source: email Rich Meredith 4/29/02).

   c. On-Street Parking: none

   d. Pavement Type: Portland cement concrete pavement (PCCP).

3. Curb Radius

   a. Twenty-five feet to 30 feet for high volume truck traffic (Source: Seattle Street Improvement Manual, 12/91).

   b. Ten feet where vehicular turn is illegal (Source: Seattle Street Improvement Manual, 12/91).

C. Clearances

1. Vertical Clearance: This segment of S. Lander Street is part of the City's overheight freight route system and the minimum required vertical clearance is 20.5 feet over roadway (Source: email Rich Meredith 4/29/02). For Occidental Avenue S. and Third Avenue S., the minimum clearance requirement is 16.5 feet over roadway (Source: Seattle Street Improvement Manual, 12/91).

D. Design Speed

1. For this portion of S. Lander Street, a deviation from the City Standard of 35 mph for minor arterials is recommended. To limit the length of the grade separation and achieve the required vertical clearance, the recommended design speed should be 30 mph for the vertical alignment. Travel lane taper rates will be per the 35 mph City Standard. Design speed is generally 5 mph over the posted speed limit. The posted speed for this portion of S. Lander Street, between First Avenue S. and Fourth Avenue S., is 25 mph.

2. Stopping Sight Distance (SSD)

   a. Design Stopping Sight Distance (Source: AASHTO Exhibit 3-75, 2001)

      - Design Speed: 30 mph
      - SSD = 200 feet
      - $K_c = 19$
      - $K_s = 37$
      - Minimum length of vertical curve VCL_m = 45 feet (Source: AASHTO Exhibit 3-75, 2001)

   b. Effect of Grade (Source: AASHTO Exhibit 3-2, 2001))

      - Design Speed: 30 mph
      - 7 percent down grade
      - SSD = 219 feet

   c. Sag Vertical Curves - Overcrossing

      Assume fully-illuminated roadway, comfort criteria appropriate for design of length (L) (Source: AASHTO).

$$L = \frac{AV^2}{46.5}$$

where A = algebraic difference in grades
V = design speed in miles per hour

E. Design Vehicle

1. WB-50 for all in-lane movements, and WB-67 must be able to negotiate route without encroaching into opposing travel lanes. A Turning Movement Analysis was performed and is included Appendix A – Drawings.

2. Fire Vehicle – Ladder truck

3.0 NONMOTORIZED CRITERIA

A. Sidewalk Width: 10 feet

B. Bike Lane Width: No separate bike lanes will be provided.

4.0 DRAINAGE CRITERIA

City of Seattle Stormwater, Grading, and Drainage Code, 2000 Edition.

5.0 RAILROAD CRITERIA

A. BNSF right-of-way width 60 feet.

B. Minimum lateral clearance from centerline of track to any obstruction 6 inches or more in height is 8.5 feet, 10.0 feet is desirable (Source: Seattle Street Improvement Manual, dated December 1991).

C. Clearance

1. Railroad Track Vertical Clearances

a. 23.5 feet from top of rail to bottom of structure for mainline tracks.

b. 19.5 feet from top of rail to bottom of structure for auxilliary tracks.

1. Railroad Track Horizontal Clearances

a. 25 feet from the track centerline to the nearest pier or abutment for mainline track.

b. 18 feet from the track centerline to the nearest pier or abutment for auxiliary track.

6.0 BRIDGE AND STRUCTURES CRITERIA

A. General

1. Calculations and construction documents will be in English units.

B. Codes and References

The governing code for applicable loads and design approach is the AASHTO LRFD Bridge Design Specifications, Second Edition with 2000 Interim. In addition, a variety of other codes and standards will be used for reference. These include the following:

1. 1997 UBC, with City of Seattle Amendments
2. 2000 City of Seattle Standard Specifications for Road, Bridge, and Municipal Construction
3. WSDOT Bridge Design Manual
4. ACI 318-95
5. AWS D1.1, D1.4, and D1.3
6. AISC Manual of Steel Construction – Load & Resistance Factor Design
7. SCE 7-95 Minimum Design Loads for Buildings and Other Structures

C. Loading Conditions

1. Dead Load

   a. Weight of all components of the structure, wearing surfaces, future overlays, appurtenances, and utilities attached to the bridge.

   b. Reinforced Concrete: 160 pounds per cubic foot.

2. Live Loads

   a. Vehicle Loading: HS25

   b. Wind Loads

      - Basic Wind Velocity: 100 mph.

      - Basic Wind Loads

        75 psf acting on trusses
        50 psf acting on girders and beams
        40 psf acting on substructures
        20 psf acting on plan view area for overturning

   c. Earthquake Loads

      Design for earthquakes shall be in accordance with Division 1-A, Seismic Design of the 1996 AASHTO Standard Specification for Seismic Design of Highway Bridges.

      As adjustments are made to the AASHTO code stemming from NCHRP Project 12-49 and the MCEER Highway Project, these will be adopted.

d. Thermal Movement and Shrinkage

Temperature Range: 0 to 120 degrees F.
Normal Installation: 64 degrees F.

Coefficient of thermal expansion.

Concrete: 0.000006 ft/ft per degree.
Steel: 0.0000065 ft/ft per degree.

D. Superstructure Deflection Control

1. Deflection due to service load plus impact is limited to:

a. Deflection ≤ Span Length/800
b. Except for bridges used in part by pedestrians, then
c. Deflection ≤ Span Length/1,000

E. Materials

1. Concrete (normal weight)

Structural Slab	f'c = 4,000 psi
Other Structural Concrete	f'c = 4,000 psi
Other Nonstructural Concrete	f'c = 4,000 psi

2. Reinforcing Steel

Unless Noted Otherwise	ASTM A 615, Grade 60
Welded Rebar, Threaded Rebar	ASTM A 706, Grade 60, Low Alloy
Deformed Bar Anchors	ASTM A 496
Epoxy Coated Rebar	ASTM A 775

3. Structural Steel

Tubes	ASTM A 500, Grade B
Angles, Channels, Base Plates & Misc. Steel	ASTM A 36
Connection Materials & Embedded Plates	ASTM A 36
Bolts	ASTM A 325
Threaded Rods	ASTM A 36
Anchor Bolts in Concrete	ASTM A 307 (uno)
Welding Electrodes	70,000 psi low hydrogen electrode
Headed Shear Studs	ASTM A 108
Structural Steel	ASTM A 50

7.0 SIGNAL AND ILLUMINATION CRITERIA

A. Lighting Levels: 2.0 f.c. major arterial, 6.0 f.c. at intersections. (Source: SDOT criteria from Wayne McPhillips).

B. Signal Interconnect: currently there are no known interconnect cables.

8.0 LANDSCAPING AND OTHER CRITERIA

A. Landscaping

1. Code: Landscaping is required on S. Lander Street (Source: Seattle Land Use and Zoning Code, Zoning Map 130), this will primarily be from First Avenue S. to Occidental and From Third Avenue S. to Fourth Avenue S.

2. Landscaping may be used along the re-aligned Occidental Avenue S.

3. Street Trees: Type and spacing to be approved by City arborist.

B. Fire Protection for undercrossing/overcrossing structures per SFD requirements.

9.0 TRANSIT SERVICE REQUIREMENTS

A. Metro Transit currently has no east - west transit routes that operate on S. Lander Street. However, the Duwamish Neighborhood has identified its desire for east - west transit service in the future and if S. Lander Street were grade-separated from the railroad tracks, it may be a viable route. For this reason, S. Lander Street will be designed to accommodate future transit service; however, the design will not provide for transit stop waiting areas between 1st Avenue S. and 4th Avenue S.

B. Metro uses S. Lander Street for a bus staging route during baseball and football games (Souce: Telecon with Doug Johnson, of King County Metro, on April 5, 2002).

C. Sound Transit has no east - west transit routes on S. Lander Street and has no plan to do so (Souce: Telecon with Jim Moore, of Sound Transit, on April 5, 2002).

D. The monorail project proposed by the Elevated Transit Company (ETC), shows preliminary alignments along S. Lander Street between Fourth Avenue S. and Utah Avenue S. ETC is assuming an overcrossing structure that would facilitate a monorail station creating an intermodal transfer point. (Souce: Meeting with Mike Mariano, of ETC).

11.0 DEVIATIONS

A. Deviations from the City of Seattle Standards are listed below:
1. 30 mph design speed for vertical alignment
2. No 4.5' sidewalk planter
3. Minimum 0.5% grade on Minor Arterials
4. No on-street parking
5. Turning for WB-50 in lane and WB-67 without going in opposing traffic, except for Occidental Avenue S which is WB-50 in lane and WB-67 within the pavement limits

VI. STRUCTURAL STUDIES

Foundations
The soil composition and utility locations control the foundation selection and design. The top 30 feet of soil is made up of very soft clay and a sandy fill with a large amount of organic material. This will necessitate the need for deep foundations.

Several utilities are located within three feet of the ground surface of South Lander Street. These include a 96-inch sewer line and a 90-inch storm drain. Their close proximity to the surface precludes the use of a pile cap on piles type of foundation.

We anticipate that the foundations will be drilled shafts positioned between the existing utilities. Concrete columns will continue up out of the shafts and support the bridge superstructure.

Structural Constraints
The recommended five span structure grade separates South Lander Street over the Burlington Northern (BNSF) railroad and allows for at-grade parking, and an under crossing for the realignment of Occidental Avenue S. The required minimum clearances are as follows:

1. Vertical Clearance
   Roadway clearance (used for parking only) – 11 feet
   Roadway clearance (used for traffic) – 16.5 feet
   Railroad clearance – 24.5 feet

2. Horizontal Clearance
   Mainline railroad – 25 feet
   Auxiliary railroad – 18 feet

These criteria create a clear zone at the railroad location that is a rectangle 24.5 feet high and 108 feet wide. The area for parking under the structure was maximized for the given roadway profile and vertical clearance requirements.

To keep the roadway grade as flat as possible, it is critical to minimize the depth of structure. When selecting a superstructure type, there are established standards for span-to-depth ratios that are used to determine the structure depth. Two ways that the depth can be minimized are by bringing the structure above the roadway profile with a truss, cable-stayed or suspension bridge or by developing a structure with a non-standard depth. The truss and non-standard depth options were studied.

Superstructure Alternatives
Profile grades were developed with allowable structure depths of 45 inches and 57 inches. Steel girders, (Option 1A) and dual trusses (Option 1B) were developed for the 45-inch depth. A concrete post-tensioned box girder (Option 2) was developed for the 57-inch depth section.

The standard span-to-depth ratio of 25 for steel girders could not be used while maintaining the 45-inch maximum depth. Consequently, a ratio of approximately 30 was required. This ratio means that the steel girder will be a less efficient section than typically designed. WSDOT has used this ratio on projects near the South Lander site. The standard live load deflection criterion of a maximum span/1000 was changes to span/1200 due to the aggressive approach to the span-to-depth ratio. This is done to minimize vibrations.

A pony style truss was selected for its low profile, absence of cross members over the deck and efficient use of steel. Dual trusses were used to minimize the structure width, which in turn minimizes the crossbeam depth. The dual structures, however, produced wider approach structures.

Where the approaches allowed for a greater superstructure depth, precast prestressed concrete I-girders were considered. This produces a structure that is less costly from a life cycle cost perspective than the steel options.

The concrete box girder is continuous for the railroad overcrossing and approaches. This is done to take advantage of the load distribution of a continuous structure and to meet the lower span-to-depth ratio of 25 for continuous girders. This structure meets all standard design criteria. During the next phase of design, further structural depth reduction may be realized with the use of high performance concrete (HPC).

Aesthetics

Though the project area is currently more industrial in nature, the area is in transition. Currently, the pony truss may fit the surroundings, however, the long-range outlook is for a less industrial look. The monorail station and track near the project may have structures with a streamline, low-profile look. The lower profiles of the steel girder or concrete box girder options will more likely compliment this appearance.

VII. UTILITIES

The two largest utilities within S. Lander Street are a 96-inch sanitary sewer and a 90- inch storm sewer. While Metro's sanitary sewer was built in 1990, SPU's 90-inch storm sewer was built around 1910. A pile supported concrete slab is proposed to protect the sanitary sewer and the storm sewer large diameter pipes from damage due to the increased loading of the ramps. Due to the age of the storm sewer, it is assumed that the facility will be rebuilt under the ramps.
Surface access for repairs and maintenance will be restricted once the approach ramps are constructed. Since all future repair work will be done from the inside of the pipe, access structures for repair equipment will be needed for both of these utilities. All storm drain laterals will need to be reconstructed.

Water quality facilities to treat storm water runoff will need to be constructed. According to SPU, they may approve a stormfilter assembly, however, a pile supported wet vault within the approach ramps has been assumed to conservatively estimate costs for the project.

The 16" cast iron water main along the north side was built in 1909 and has leaded joints. The catastrophic impact of a leak in this pipe if located underneath the approach ramp generated a recommendation that the waterline be relocated to north of the structure. This relocation would also require a new casing underneath the railroad.

Seattle City Light has power facilities along the south side of S Lander Street. These facilities are low voltage for street lighting. Distribution crossings exist along Occidental and Third. The ramp at Third Avenue S. will not be high enough to require raising these lines. Along Occidental Avenue S., new poles may be required to raise the lines to clear the ramp.

Qwest has buried telephone facilities along Lander from First Avenue to Occidental Avenue. Their access needs will require relocation to south of the ramps and the facilities will be spliced and re-pulled to accommodate new access locations.

MCI WorldCom has ownership of the old Western Union Fiber Optic facility that crosses Lander along the west side of the Occidental right-of-way. This fiber optic line is in a wood conduit box, so either a protective concrete slab or a retrofit steel conduit box will be needed for protection of this utility.

Puget Sound Energy has a 4-inch gas service long the east side of Lander that reduces to 2" diameter as it crosses the railroad and continues west. It terminates soon after crossing the railroad tracks. The gas line will need to be relocated to make room for the bridge piers, since its location is between the two large diameter sewers.

VIII. CONSTRUCTIBILITY ISSUES

It is assumed that South Lander Street will be closed between First Avenue South and Fourth Avenue S for most of the construction period. The increased construction time and the added costs do not justify keeping the street open.

With South Lander closed during construction, issues related to bridge construction focus on protection of the railroads. A minimum vertical clearance of 22'-6" will be maintained between the top of tracks and bottom of false work. A minimum horizontal clearance of 8'-6" will be made from the centerline of track and edge of false work. It is assumed that a BNSF flagger will be utilized while work is being performed near the tracks. The flagger will be in radio communication with a key member of the construction crew until construction items are secure or materials and crew are safely cleared of the tracks. In addition, a temporary security fence will be constructed to limit general access to the railroad tracks.

As part of the design process, a construction sequence should be developed that minimizes the duration of the street closure.

IX. COST ESTIMATE

The following detailed cost estimate was developed for the preferred option. This option is $1.4 Million more expensive than construction of a steel girder option, however, when life cycle costs are considered it is the most cost effective. Painting the steel girders, especially those over the railroad tracks have the highest maintenance costs.

Concrete Cast-In-Place Box Girder Recommended Option (Present Value)

NO	TOTAL QUANTITY	UNIT	ITEM	UNIT PRICE	TOTAL PRICE
1	1	LS	Mobilization (10%)	$2,048,000	$2,048,000
2	1	LS	Clearing and Grubbing - Site	$25,000	$25,000
3	5,000	SY	Removing Cement Concrete Sidewalk	$7	$35,000
4	4,000	LF	Removing Cement Concrete Curb and Gutter	$5	$20,000
5	22,000	SY	Removing Asphalt Concrete Pavement	$3	$66,000
6	6,400	TN	Contaminated Soil Disposal	$65	$416,000
7	1	LS	Removal of Structures and Obstructions	$50,000	$50,000
8	30,000	TON	Gravel Borrow Including Haul	$10	$300,000
9	1	LS	Bridge Foundations	$3,000,000	$3,000,000
10	1	LS	Bridge Substructure	$700,000	$700,000
11	1	LS	Bridge Superstructure	$2,310,000	$2,310,000
12	1	LS	Bridge Approach Slabs	$67,000	$67,000
13	1	LS	Bridge Railroad Flagging and Protection	$679,000	$679,000
14	1,100	LF	Traffic Barrier	$100	$110,000
15	1,500	TON	Crushed Surfacing Top Course	$20	$30,000
16	500	TON	Asphalt Concrete Pavement	$50	$25,000
17	2,000	CY	Cement Concrete Pavement	$220	$440,000
18	1	LS	Storm Drainage Conveyance and Treatment	$260,000	$260,000
19	1	LS	Landscaping	$50,000	$50,000
20	1	LS	Channelization Modification	$25,000	$25,000
21	1	LS	Permanent Signing	$5,000	$5,000
22	1	LS	Illumination System	$100,000	$100,000
23	2	EACH	Signal Modification	$150,000	$300,000
24	1	LS	Railroad Modifications	$50,000	$50,000
25	1	LS	Traffic Control / Detour	$300,000	$300,000
26	2	EACH	At-Grade Crossing for Emergency Services	$300,000	$600,000
27	1,850	SY	Cement Concrete Sidewalk	$20	$37,000
28	42,400	SF	Mechanically Stabilized Earth Wall	$35	$1,484,000
29	1	LS	Monorail Connections	$100,000	$100,000
30	1	LS	Public Art (1%)	$323,000	$323,000
31	1	LS	Water Main Relocation	$450,000	$450,000
32	1	LS	Existing Sanitary Sewer Adjustments	$150,000	$150,000
33	1	LS	Existing 90" Storm Drain Pipe Replacement	$500,000	$500,000
34	1	LS	Protective Slab for Storm Drainage and Sanitary Sewer	$225,000	$225,000
35	1	LS	Puget Sound Energy Gas Relocation	$125,000	$125,000
36	1	LS	Seattle City Light Relocation (3rd and Occidental)	$100,000	$100,000
37	1	LS	Qwest Relocation	$150,000	$150,000
38	1	LS	MCI WorldCom Conduit Protection	$100,000	$100,000
39	1	LS	Mitigation	$300,000	$300,000
				Subtotal	$15,755,000
			Contingency 30%		$4,726,500
				Construction Cost	$20,481,500
			Construction Engineering Costs 20%		$4,096,300
				Total Construction	**$24,577,800**
			TS & L Study	$260,000	$260,000
			Environmental and Preliminary Engineering	$930,000	$930,000
			Final Design 20%		$4,096,300
			Right-of-Way		$2,500,000
-				**TOTAL PROJECT COST (present value)**	**$32,364,100**

Year of Expenditure Costs (based on inflation rate of 3% per year)

	Midpoint

Phase	Year(s) Span	of Phase	Cost*
Environmental Impact Statement	January 2006 to December 2006	June-06	$1,031,480
Design (PE)	January 2007 to December 2007	June-07	$4,679,578
Right-Of-Way Acquisition	June 2007 to May 2008	January-08	$2,898,185
Construction	January 2008 to December 2009	January-09	$29,347,179
	TOTAL PROJECT COST (year of expenditure costs)		**$37,956,421**

*Costs are take at the midpoint of the phase

Below you will find the backup information and list of assumptions for the Cost Estimate. All costs are for providing and installing materials listed for each item.

Item No.

1. *Mobilization* – 10% of the Construction Cost
2. *Clearing and Grubbing – Site* – Approximately 10 trees @ $2,500 per tree
3. *Removing Cement Concrete Sidewalk* – Sidewalk on either side of S. Lander Street would be removed between 1st Avenue S. and 4th Avenue S. Sidewalks would also be removed on either side of Occidental Avenue S. and 3rd Avenue S. 150’ from the centerline of S. Lander Street.
4. *Removing Cement Concrete Curb and Gutter* – Curb and Gutter would be removed on either side of S. Lander Street between 1st Avenue S. and 4th Avenue S. Curb and Gutter would also be removed along Occidental Avenue S. and 3rd Avenue S. 150’ from the centerline of S. Lander Street.
5. *Removing Asphalt Concrete Pavement* – Asphalt Concrete Pavement would be removed on S. Lander Street between 1st Avenue S. and 4th Avenue S. Asphalt would also be removed along Occidental Avenue S. and 3rd Avenue S. 150’ from the centerline of S. Lander Street.
6. *Contaminated Soil Disposal* – Assumes 50% of utility trenching excavated material may be contaminated.
7. *Removal of Structures and Obstructions* – Estimated
8. *Gravel Borrow Including Haul* – This is the fill area under the roadway section
9. *Bridge Foundations* – Includes the following items:
   - Excavation to expose existing utilities and to install piles and/or shafts
   - Shoring to protect the existing utilities
   - Providing and installing piles and/or shafts
   - Structural backfill
10. *Bridge Substructure* – Includes concrete and reinforcing steel for columns and pier caps.
11. *Bridge Superstructure* – Includes the following items:
    - Concrete and reinforcing steel for the concrete box girders, sidewalk, and traffic barriers
    - Post-tensioning material and installation
    - Pedestrian railings
    - Expansion joints

12 *Bridge Approach Slabs* – Includes the concrete and reinforcing steel for the approach slab and attached traffic barriers.

13. *Bridge Railroad Flagging and Protection* – Includes a flag person for the duration of work near the tracks. It also includes a premium for the construction work within 25 feet of the centerline of outside tracks to cover costs associated with protecting railroad right-of-way.

14. *Traffic Barrier* – The length of traffic barrier needed along the embankment, does not include traffic barriers on the bridge.

15. *Crushed Surfacing Top Course* – This is a 6" depth along the embankment area of S. Lander Street and 10" depth along Occidental Avenue S., Third Avenue S., and under the structure.

16. *Asphalt Concrete Pavement* – This is the 6" of ACP to resurface Occidental Avenue S., Third Avenue S., and parking and roads under the structure.

17. *Cement Concrete Pavement* – This is an 11" depth along S. Lander Street for the at-grade and approach ramps, does not including the bridge

18. *Storm Drainage Conveyance and Treatment* – Costs include new 12" diameter conveyance pipe, 13 catch basins, and a water quality vault, pile supported.

19. *Landscaping* – This is for new landscaping along S. Lander Street, Occidental Avenue S., and Third Avenue S.

20. *Channelization Modification* – This is all revisions to channelization at the intersections of S. Lander Street with Third Avenue S. and Fourth Avenue S.

21. *Permanent Signing* – This is for new permanent signing along S. Lander Street, Occidental Avenue S. and Third Avenue S.

22. *Illumination System* – This is for luminaries on both sides of roadway at 150' spacing at $5000 each.

23. *Signal Modification* – This is for signal timing revisions at the intersections of S. Lander Street with First Avenue S. and Fourth Avenue S.

24. *Railroad Modification* – This is to remove the abandoned railroad spur along Occidental Avenue S. at S. Lander Street.

25. *Traffic Control / Detour* – This is assuming that S. Lander Street will be closed between First Avenue S. and Fourth Avenue S. for the duration of the project and that there will be only local access on Occidental Avenue S. and 3rd Avenue S.

26. *At-Grade Crossing for Emergency Services* – These will be similar to the emergency crossings at the S. Galer Street Grade Separation. There will be one at S. Lander Street and another on S. Horton Street

27. *Cement Concrete Sidewalk* – This is for the sidewalk on the north side of S. Lander Street between First Avenue S. and Fourth Avenue S. It also includes replacing the sidewalks along Occidental Avenue S. and Third Avenue S.

28. *Mechanically Stabilized Earth Wall* – This is for the retaining walls on either side of S. Lander Street ramps and bridge approaches.

29. *Monorail Connections* – This is to facilitate a connection between the monorail and the elevated structure for a potential station.

30. *Public Art* – This is 1% of the Total Project Cost

31. *Water Main Relocation* – This is for 1000 lf of new 16" ductile iron waterline, with restrained joints, joint bonding, thermoplastic coating, insulated couplings, and test stations. Also included is a new RR crossing casing pipe, and miscellaneous costs for connections and caps.

32. *Existing Sanitary Sewer Adjustments* - This is for construction of 3 new access manholes and one equipment access to the existing 96" sanitary sewer, and abandonment of 3 existing manholes, as well as settlement monitoring.

33. *Existing 90" Storm Drain Pipe Replacement* - This is for 500 lf of new 90" storm sewer under the bridge ramps, 3 access manholes, 1 equipment access, reconstruction of 600' of lateral connections, and settlement monitoring.

34. *Protective Slab for Storm Drainage and Sanitary Sewer* – This is for construction of two-250 lf concrete cover slabs over the 90" storm sewer and the 96" sanitary sewer. The concrete slab is constructed only in the fill sections of the approaches to the structure.

35. *Puget Sound Energy Gas Relocation* – This is for replacement of 1200 lf of existing gas main and a new RR crossing casing pipe.

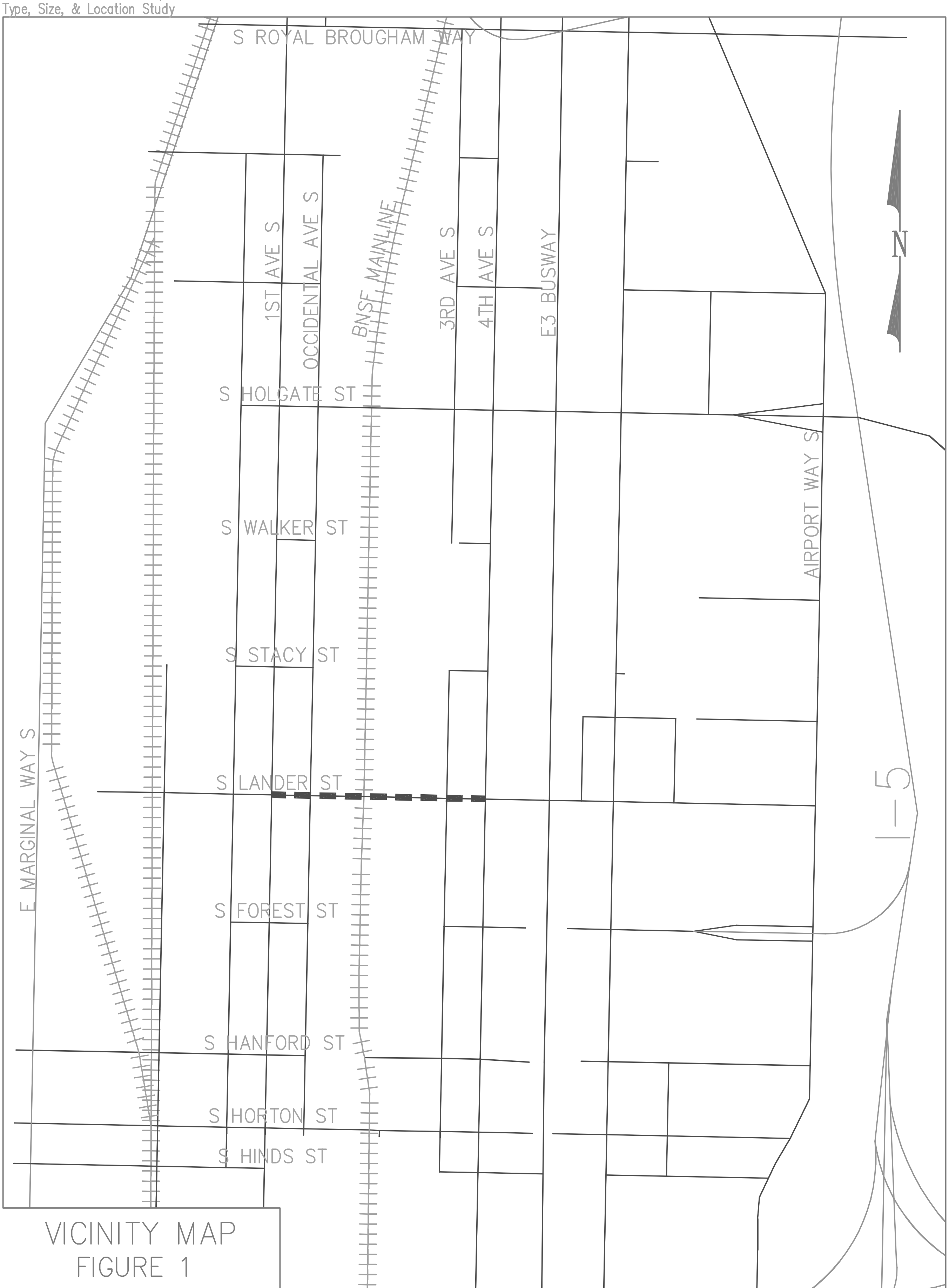
36. *Seattle City Light Relocation (3rd and Occidental)* - This is for reconstruction and relocation of 9 utility poles along Lander.

37. *Qwest Relocation* - This cost is for relocation of a 4-duct structure from 1st Avenue South to Occidental Avenue South, as well as relocation of aerial copper and fiber optic cable along the south side of S. Lander Street. Note that time frame for work is approximately 6 months.

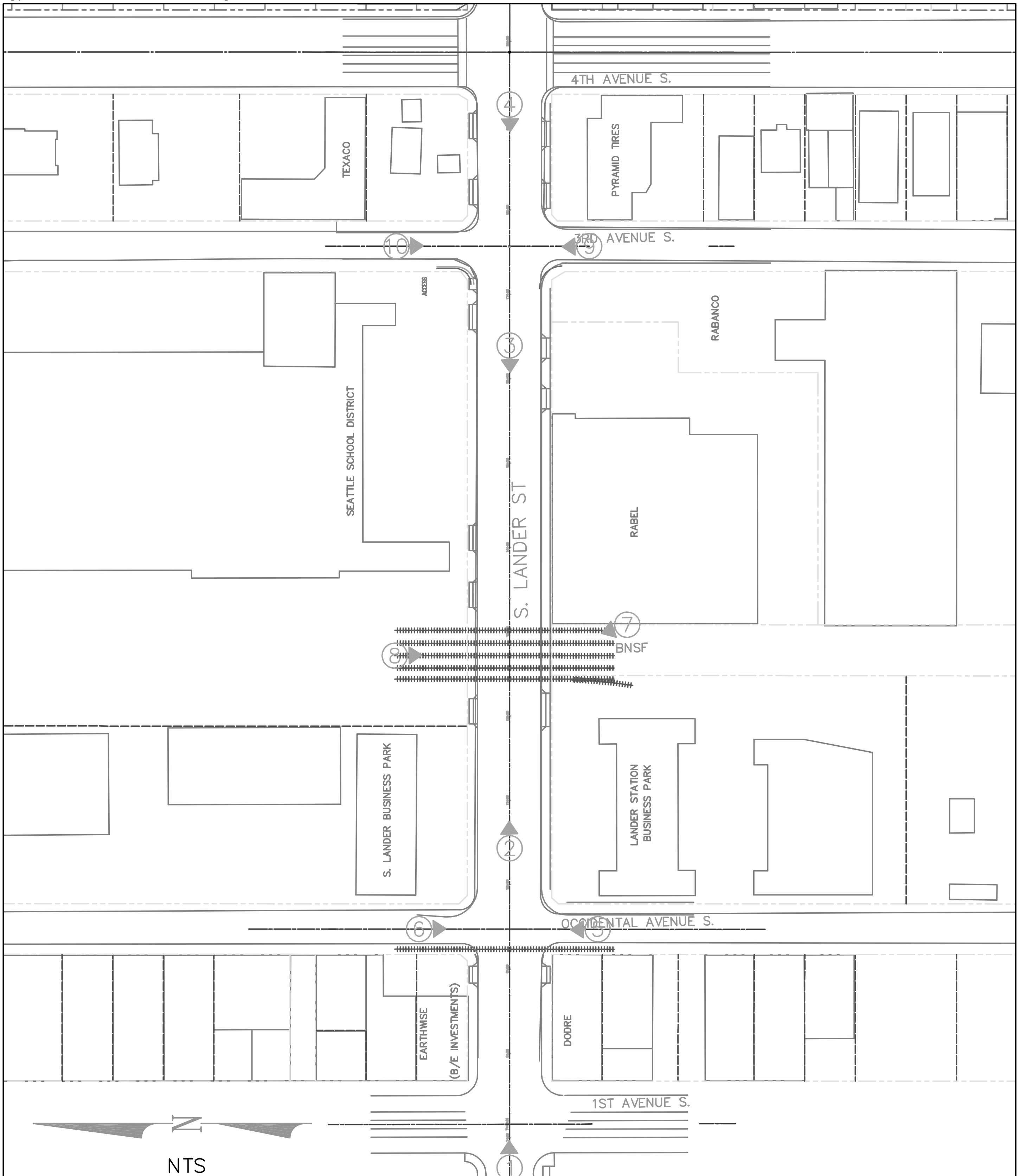
38. *MCI Worldcom Conduit Protection* - This cost is for extensive coordination and relocation of existing fiber optic cable in wood conduit into a protective concrete conduit.

39. *Mitigation* – This includes installing signals at the intersections of Fourth Avenue S. and S. Forest Street to improve ingress and egress to the Rabanco facility and at First Avenue S. and S. Stacy Street to improve access to and from Occidental Avenue S.

X. APPENDICES



VICINITY MAP
FIGURE 1
SCALE: 1"=800'
03/25/03



LOCATION KEY FOR PHOTOGRAPHS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ARCHITECTURAL SALVAGE
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PRODUCE CO. INC.
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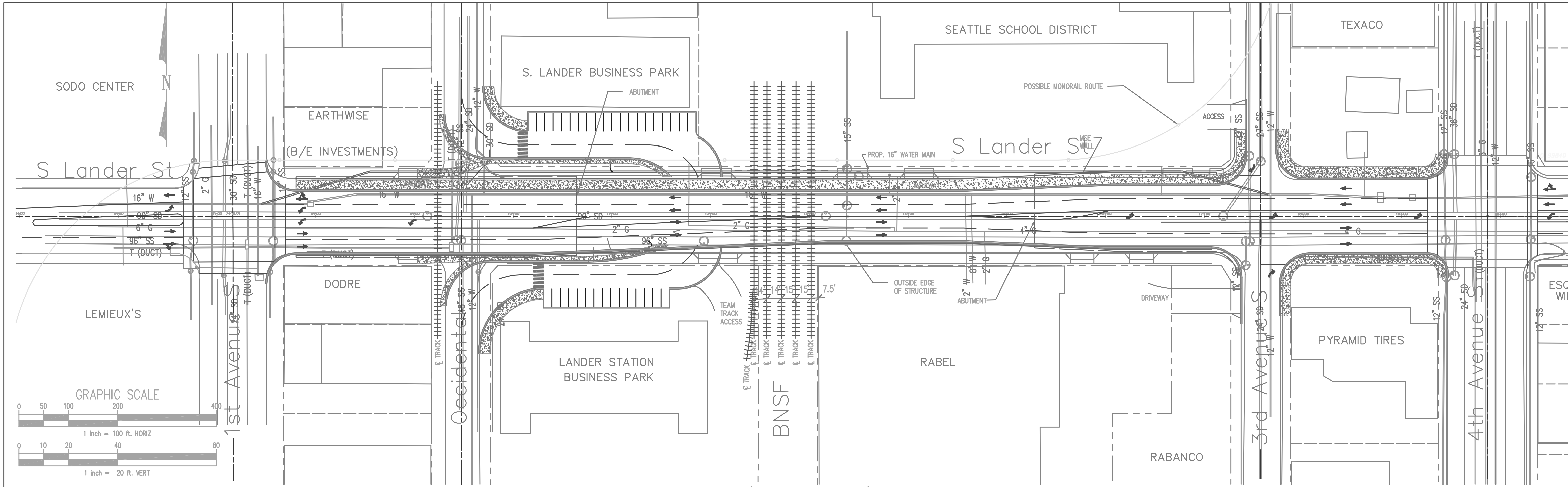
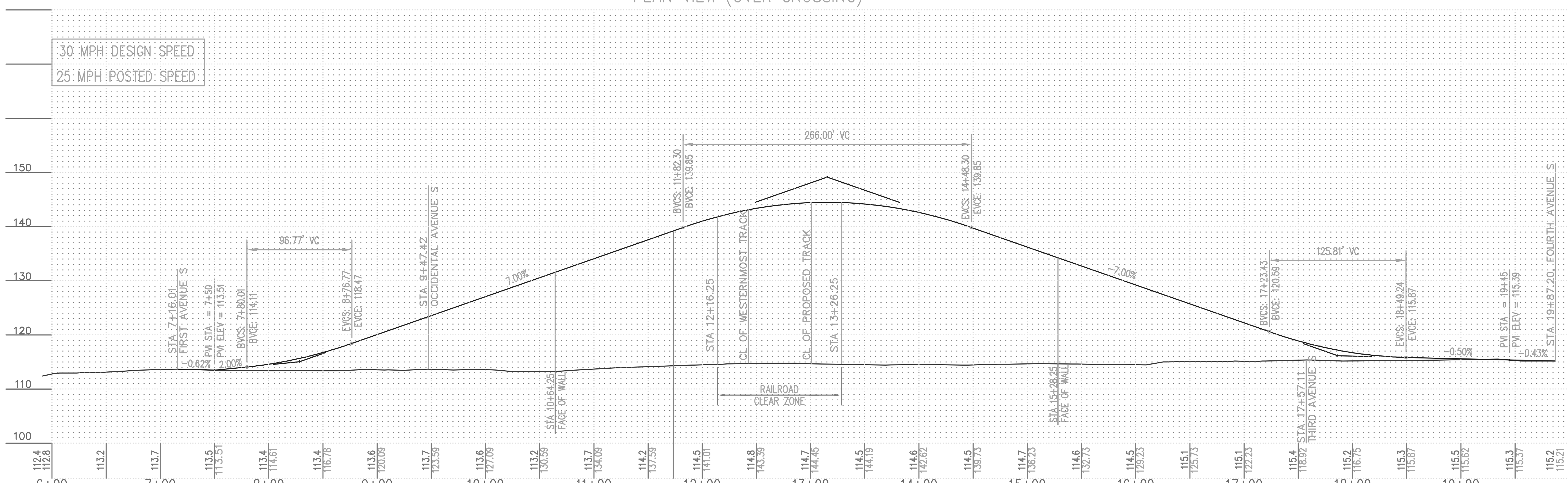


PLAN VIEW (OVER CROSSING)



NO.	DATE	BY	CHD.	APPR.	REVISION

DRAWN BY REB | DESIGNED BY
CHECKED BY | APPROVED BY
DATE 03/11/03
JOB No.:

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SCALE: N.T.S.

kpff Consulting Engineers
1601 Fifth Avenue, Suite 1600
Seattle, Washington 98101
(206) 622-5822 Fax (206) 622-8130

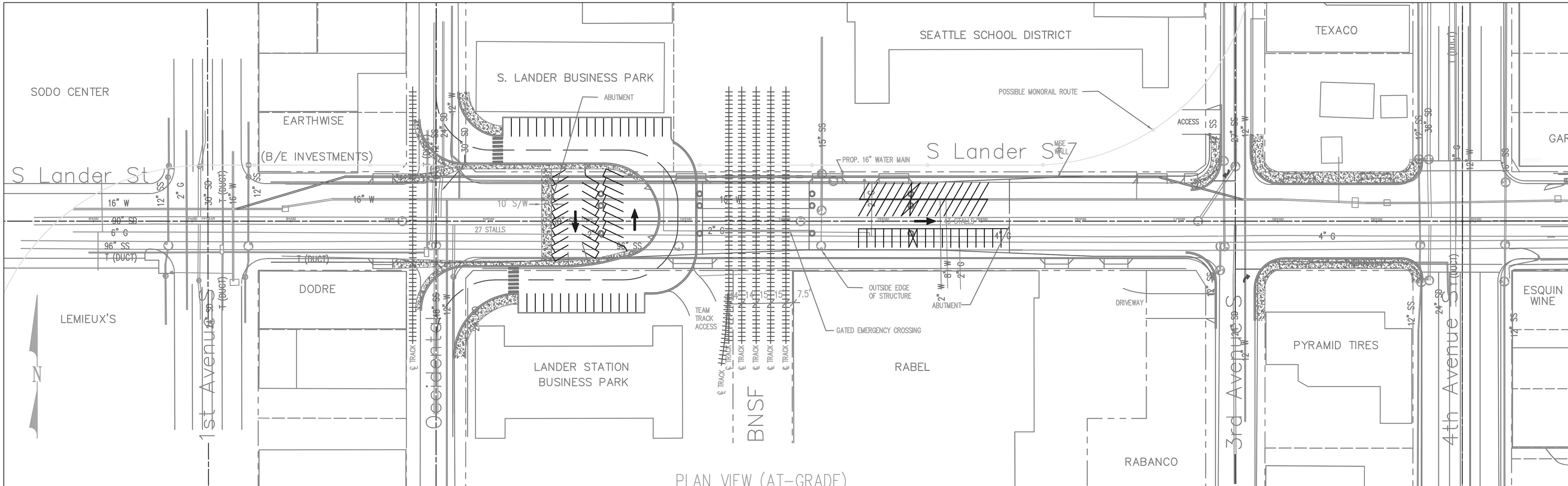
PROFILE

RONALD J. LEIMKUEHLER, STATE OF WASHINGTON, 24080 REGISTERED PROFESSIONAL ENGINEER, EXPIRES 08/01/03

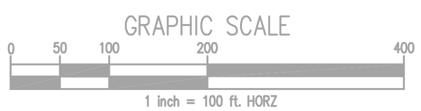
S. LANDER STREET GRADE SEPARATION PROJECT
SEATTLE, WA

S. LANDER STREET GRADE SEPARATION PROJECT TS&L STUDY

SHEET 1



PLAN VIEW (AT-GRADE)



NO.	DATE	BY	CHD.	APPR.	REVISION

DRAWN BY REB | DESIGNED BY
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DATE 03/11/03
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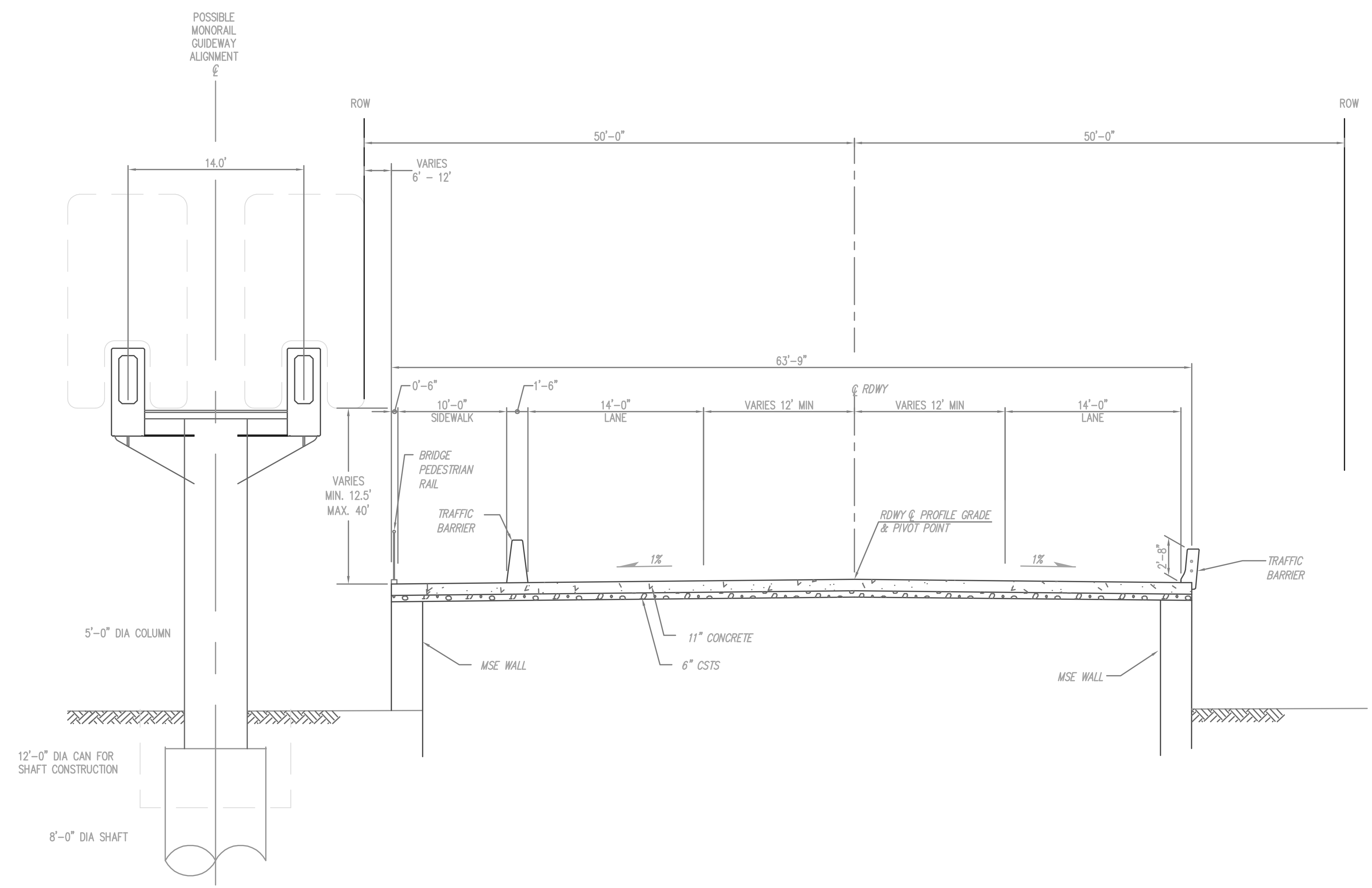
RONALD J. LEIMKUEHLER STATE OF WASHINGTON 24059 REGISTERED PROFESSIONAL ENGINEER
EXPIRES 08/01/03

S. LANDER STREET GRADE SEPARATION PROJECT
SEATTLE, WA

S. LANDER STREET GRADE SEPARATION PROJECT
TS&L STUDY

SHEET 2



TYPICAL ROADWAY SECTION

SCALE: 1" = 5'

NO.	DATE	BY	CHD.	APPR.	REVISION

DRAWN BY REB | DESIGNED BY | CHECKED BY | APPROVED BY | DATE 03/11/03 | JOB No.:

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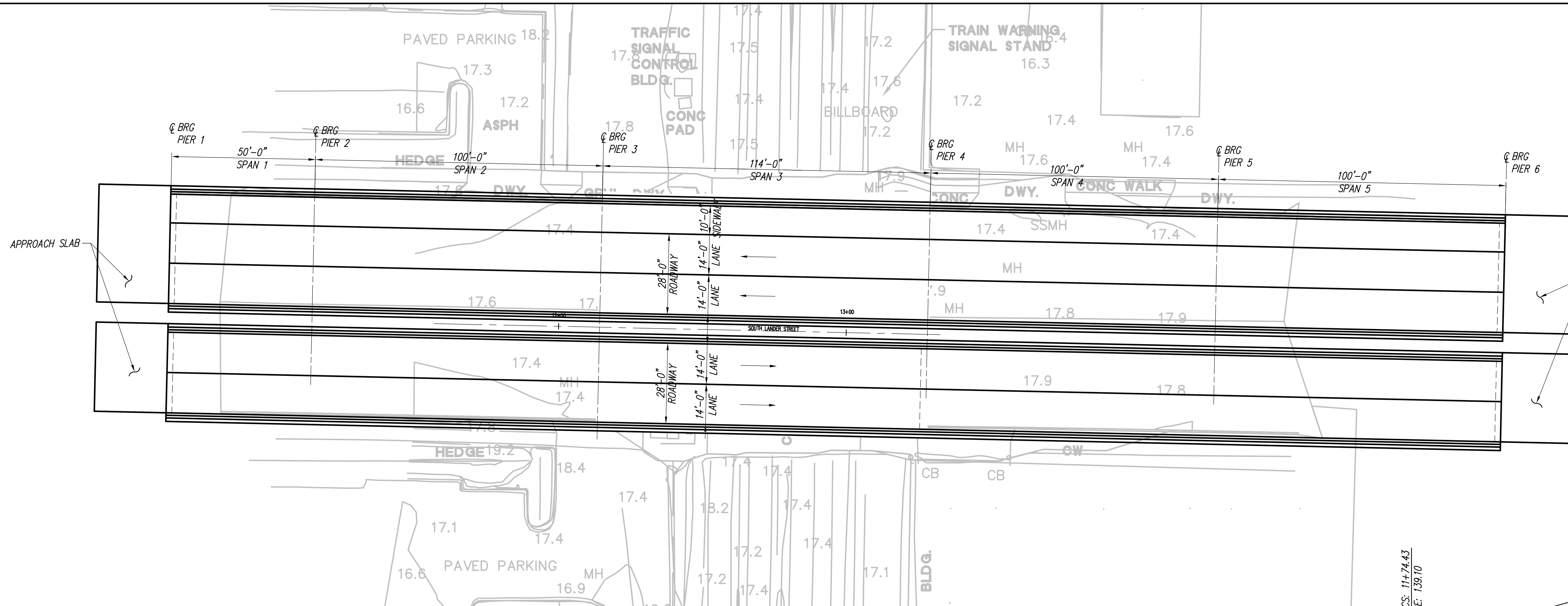
RONALD J. LEIMKUHLER STATE OF WASHINGTON 24069 REGISTERED PROFESSIONAL ENGINEER EXPIRES 08/01/03

S. LANDER STREET GRADE SEPARATION PROJECT
SEATTLE, WA

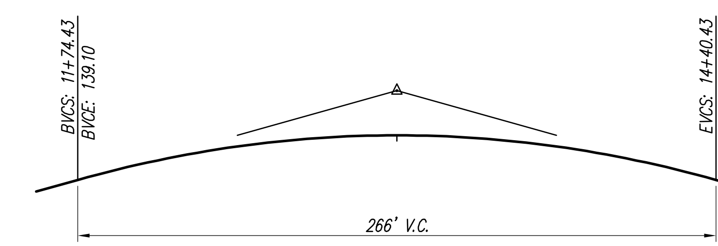
S. LANDER STREET GRADE SEPARATION PROJECT
TS&L STUDY

SHEET 3



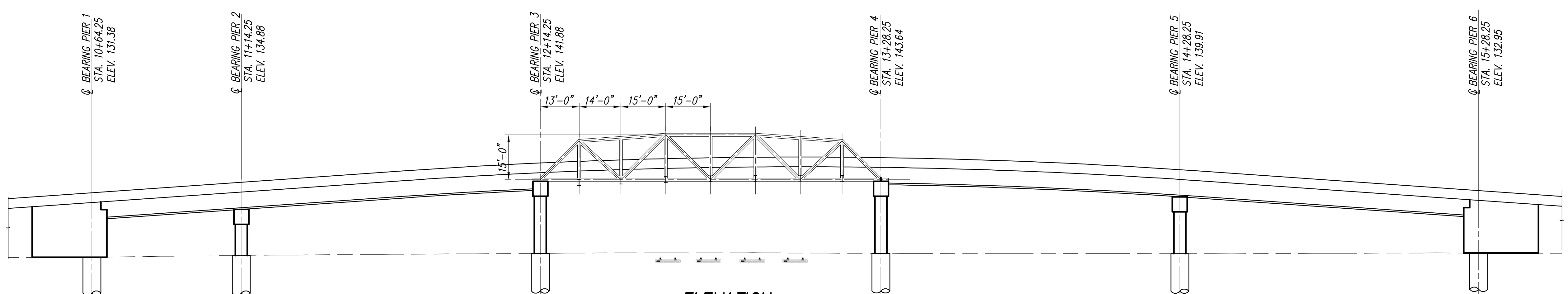
PLAN

0 20 40 60
SCALE IN FEET



VERTICAL PROFILE

NO SCALE



ELEVATION

GRADE ELEVATIONS SHOWN ARE FINISHED GRADES AT TOP OF ROADWAY SLAB ON S. LANDER ST. STATION LINE AND ARE EQUAL TO PROFILE GRADE

0 5 10 15
SCALE IN FEET

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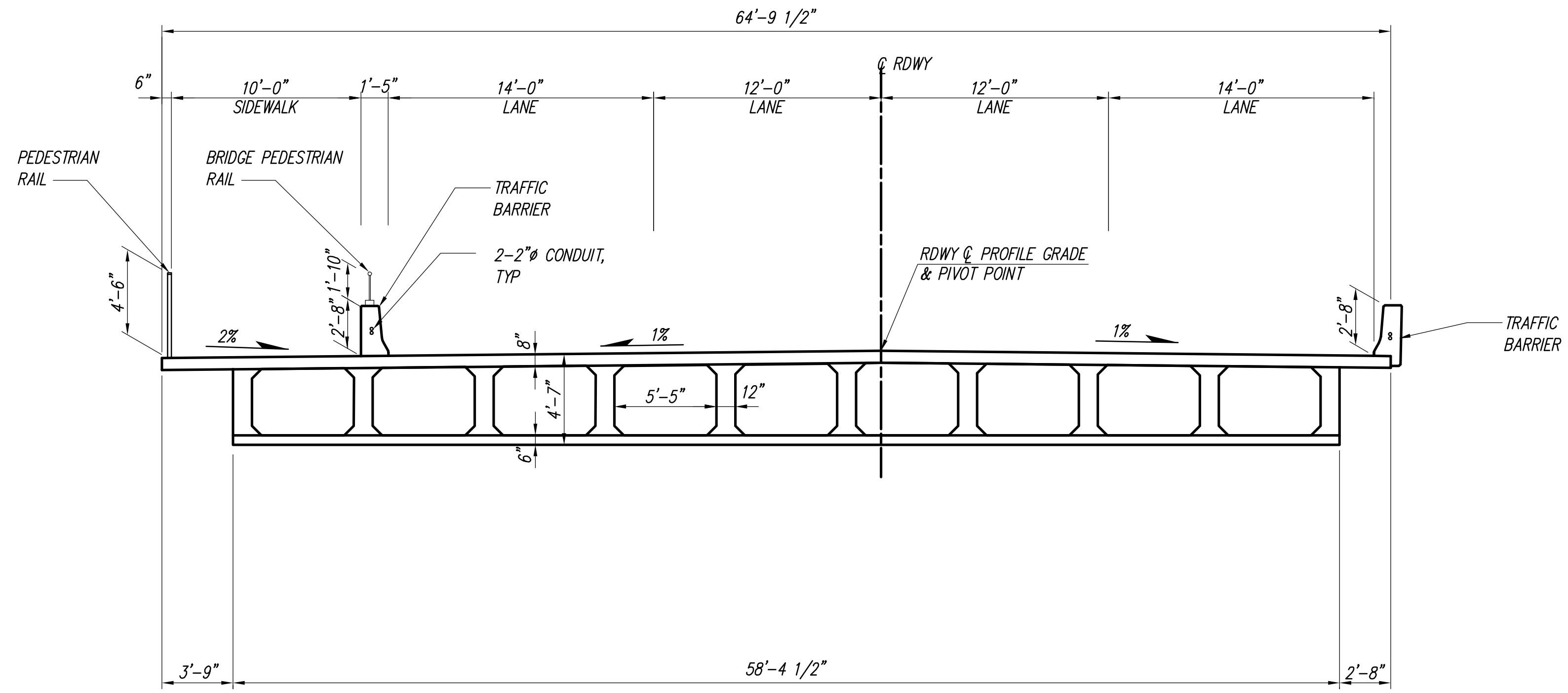
Seattle, Washington 98101-3665
(206) 622-5822 Fax (206) 622-8130

OPTION 1B
DUAL PONY TRUSSES
BRIDGE PLAN ELEVATION



TYPICAL BRIDGE SECTION

SCALE: 1"=5'

NO.	DATE	BY	CHD.	APPR.	REVISION

DRAWN BY TLA — DESIGNED BY DKM — CHECKED BY DKM — APPROVED BY — DATE

JOB No. : 101315

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SCALE: AS SHOWN

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RICHARD K. JOHNSON — STATE OF WASHINGTON — 24617 REGISTERED PROFESSIONAL ENGINEER — EXPIRES 9/10/

S. LANDER STREET

LOCATION (CITY, STATE)

TYPCIAL SECTION

SHEET 2

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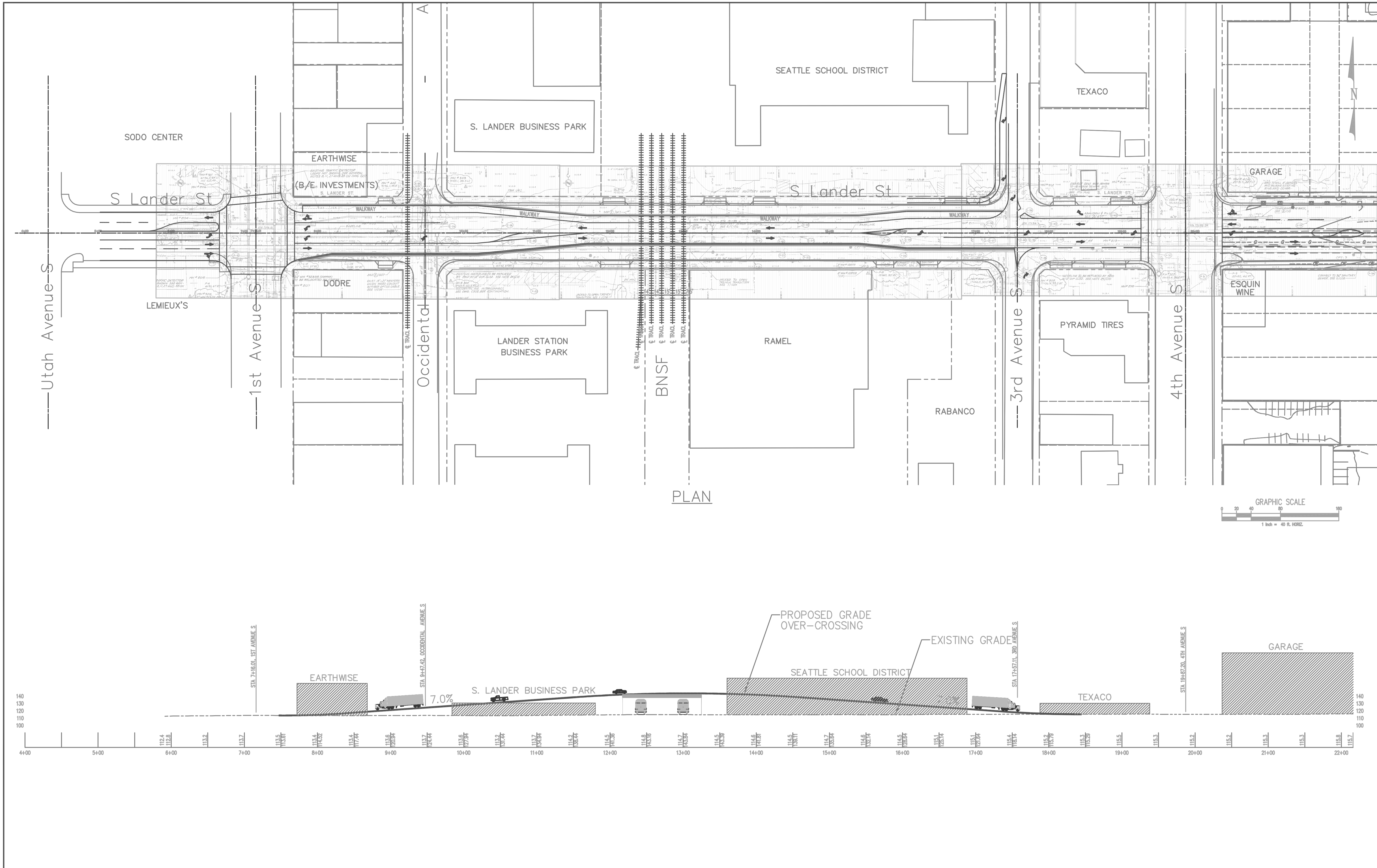

LANDER STREET
2 LANE OVERCROSSING
CONCEPT
EXHIBIT No. 1

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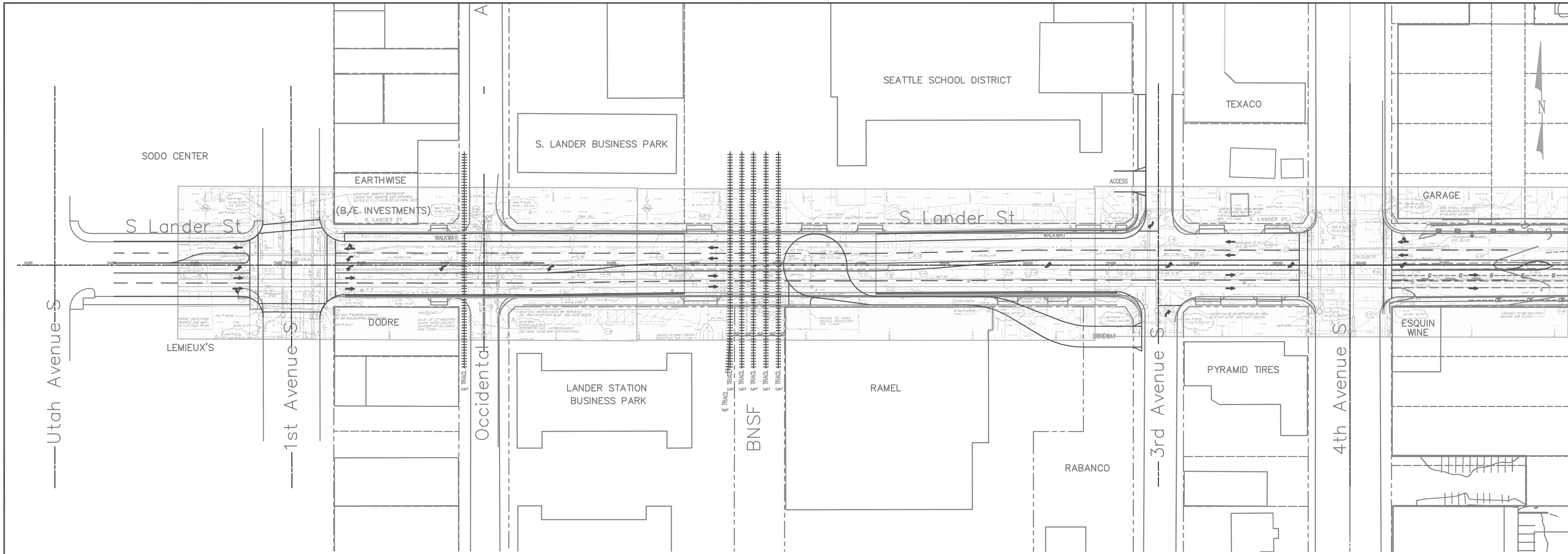
Seattle, Washington 98101
(206) 622-5822 Fax (206) 622-8130



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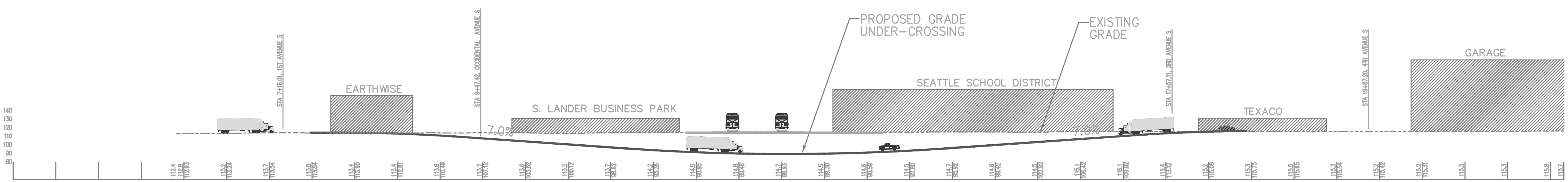


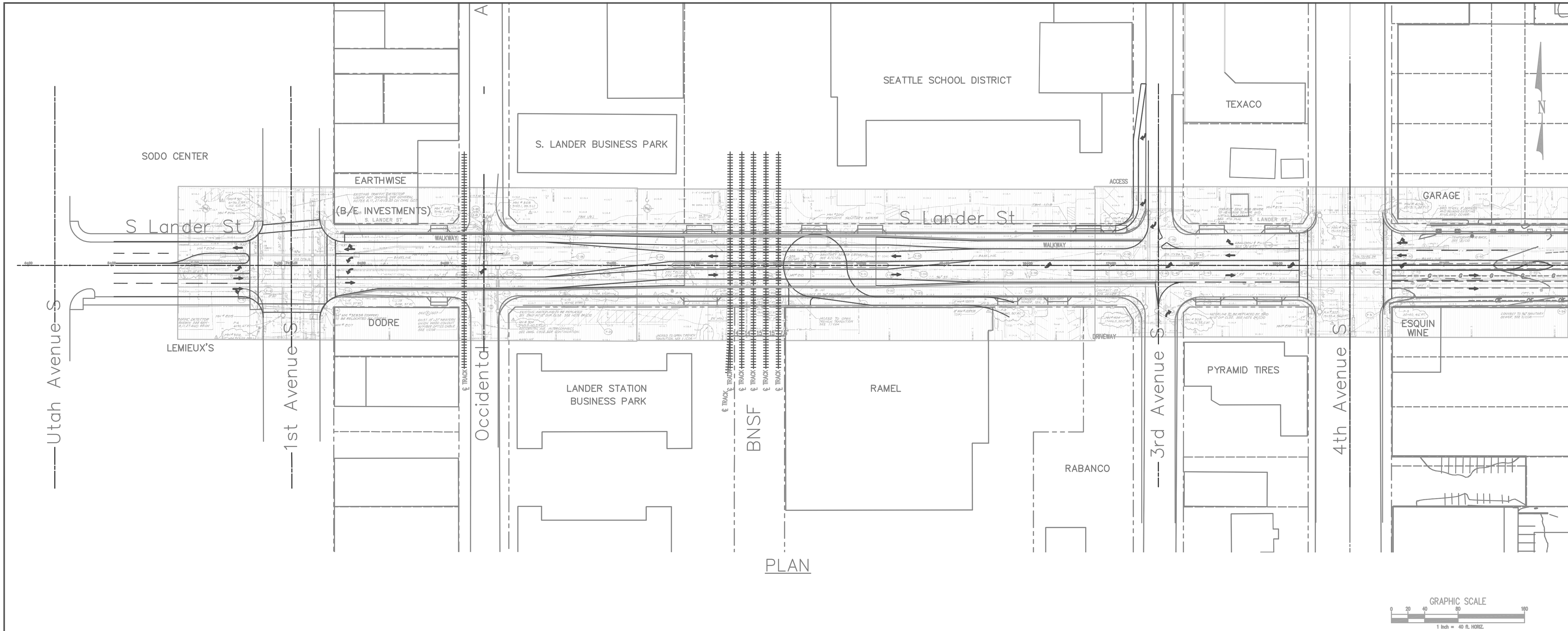
PROFILE

LOOKING NORTH

LANDER STREET
4 LANE UNDERCROSSING

CONCEPT
EXHIBIT No. 3

kpff Consulting Engineers



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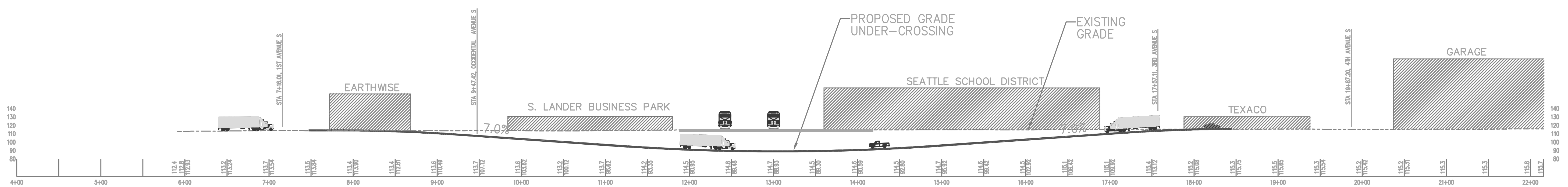

PROFILE
LOOKING NORTH

LANDER STREET
2 LANE UNDERCROSSING
CONCEPT
EXHIBIT No. 2

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1201 Third Avenue, Suite 900
Seattle, Washington 98101
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FILE PATH & NAME: V:\101400 (S. LANDER STREET)\DESIGN\S-LNDR-OPT1.DWG

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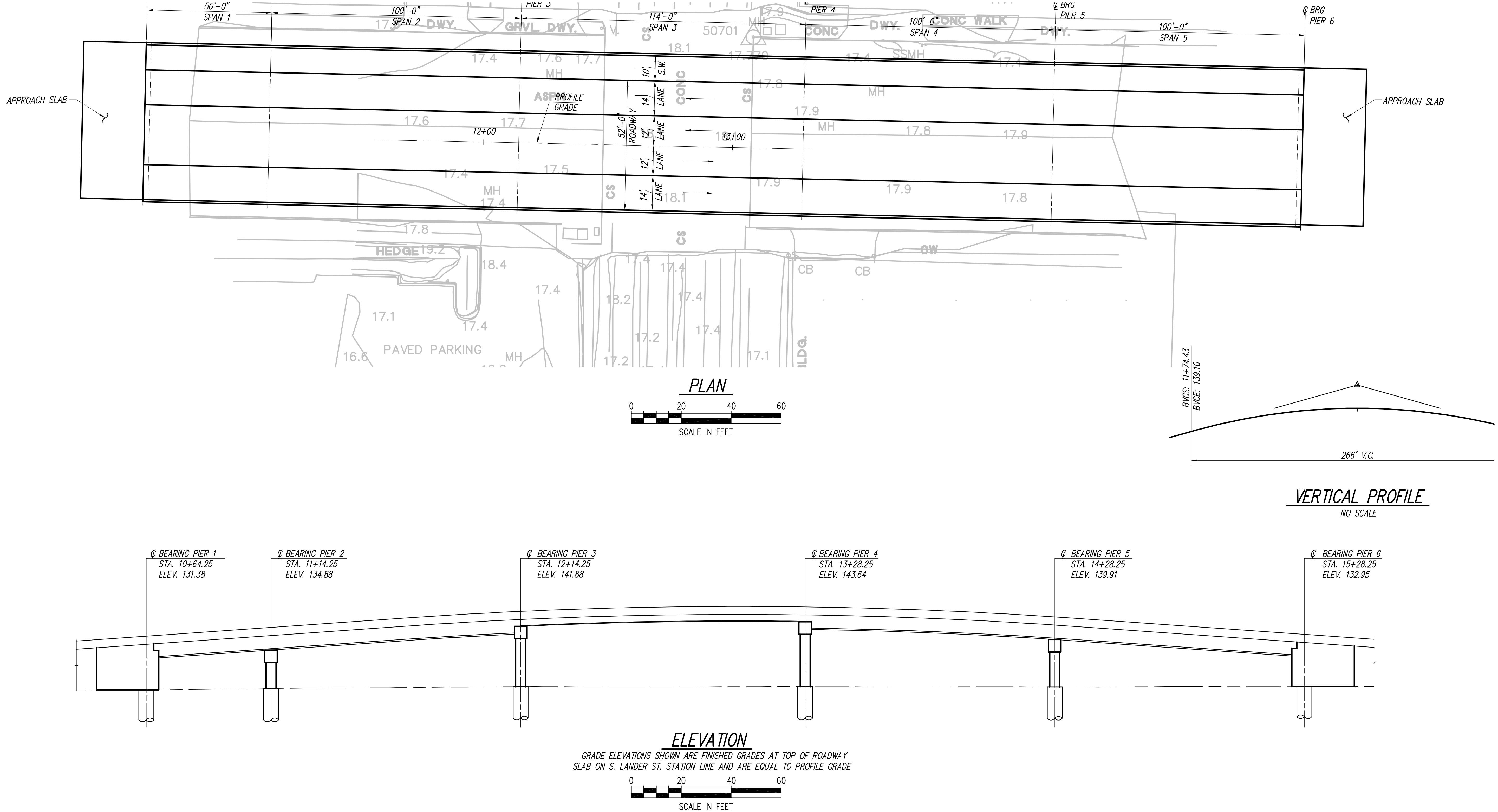

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OPTION 1A
STEEL GIRDER
BRIDGE PLAN ELEVATION

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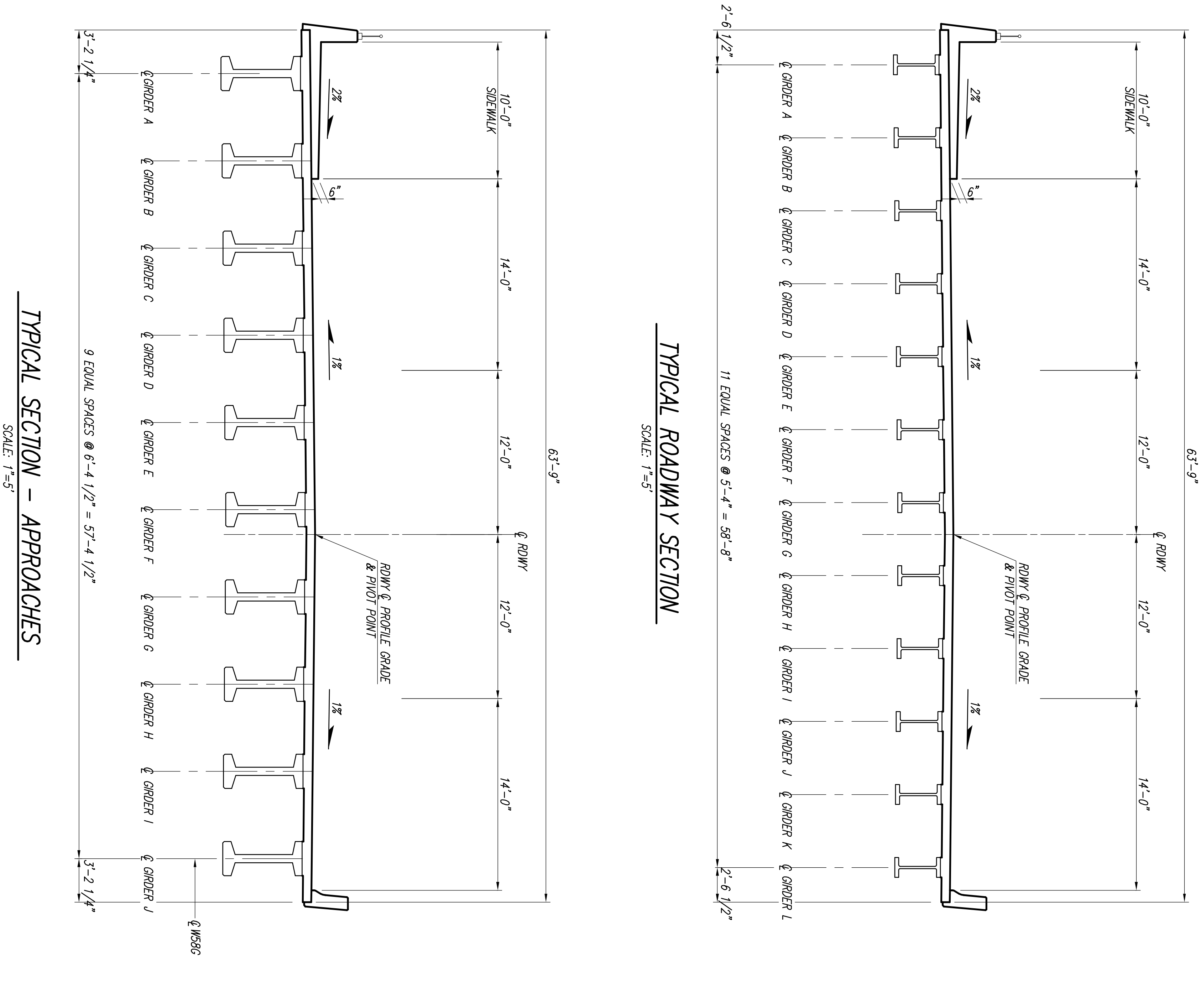

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OPTION 1A

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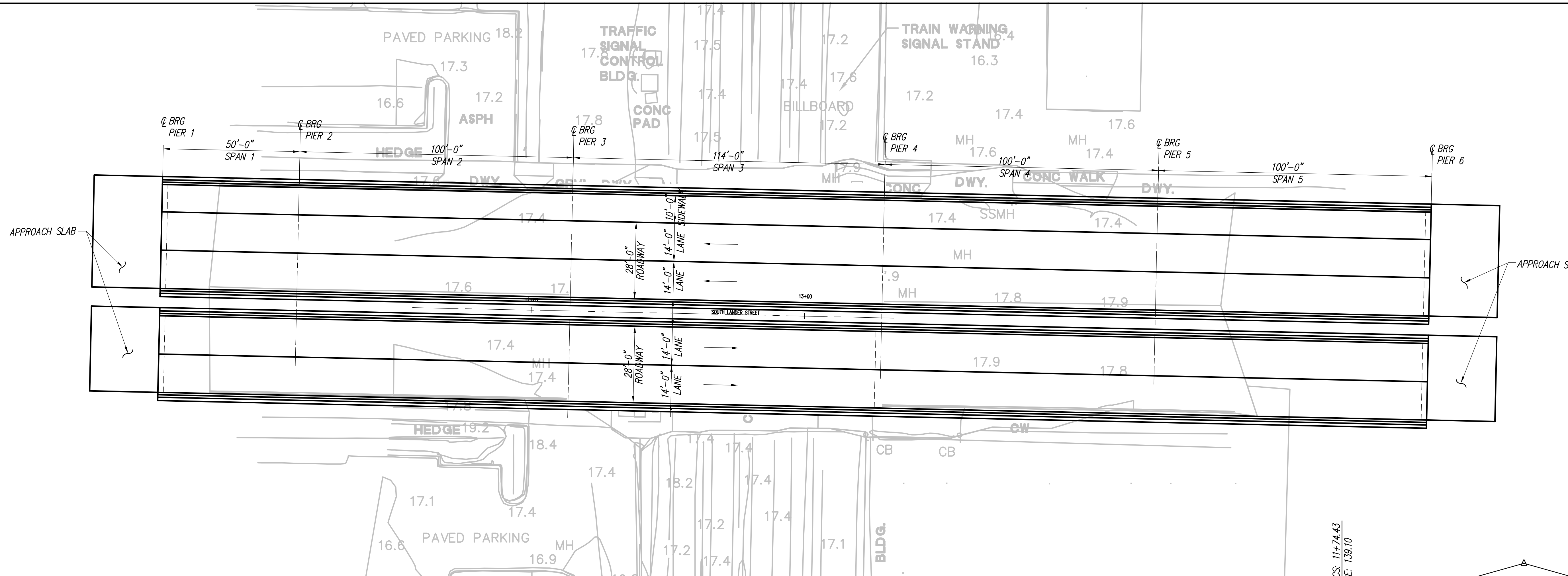

PLAN

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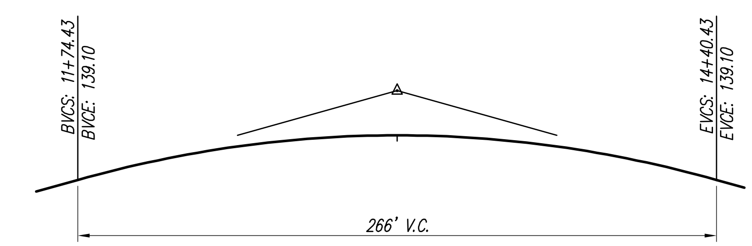

VERTICAL PROFILE

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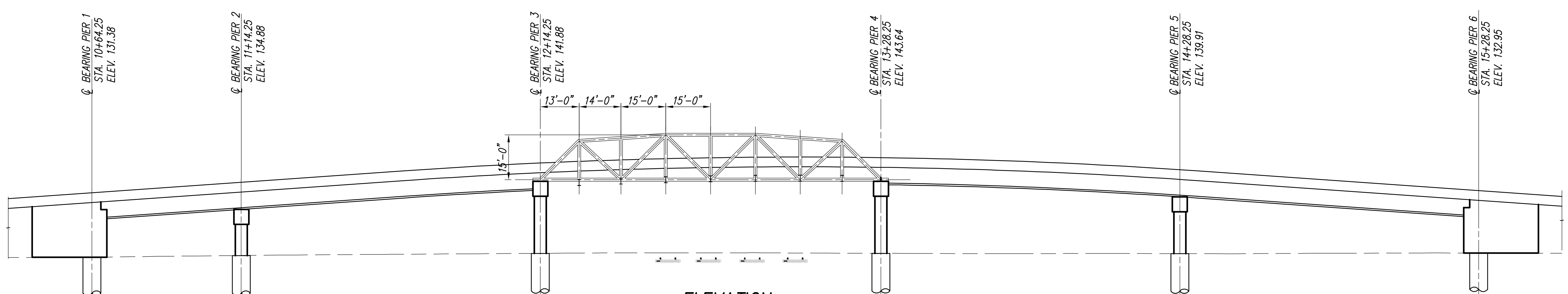

ELEVATION

GRADE ELEVATIONS SHOWN ARE FINISHED GRADES AT TOP OF ROADWAY SLAB ON S. LANDER ST. STATION LINE AND ARE EQUAL TO PROFILE GRADE

SCALE IN FEET (0, 5, 10, 15)

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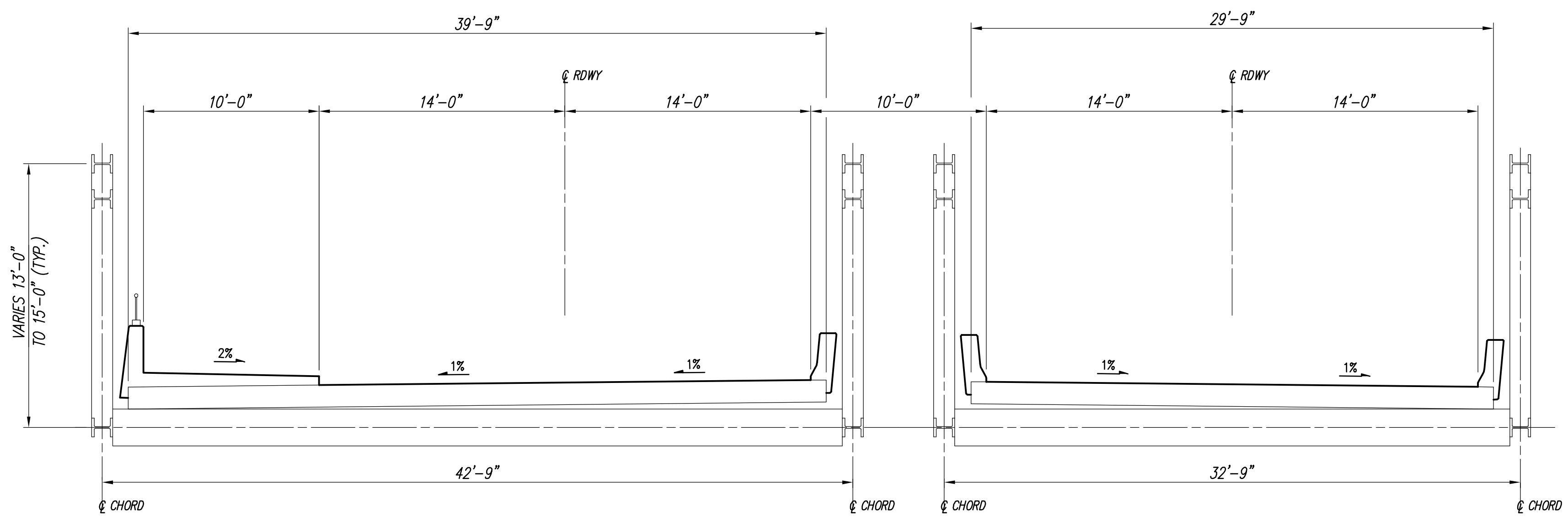
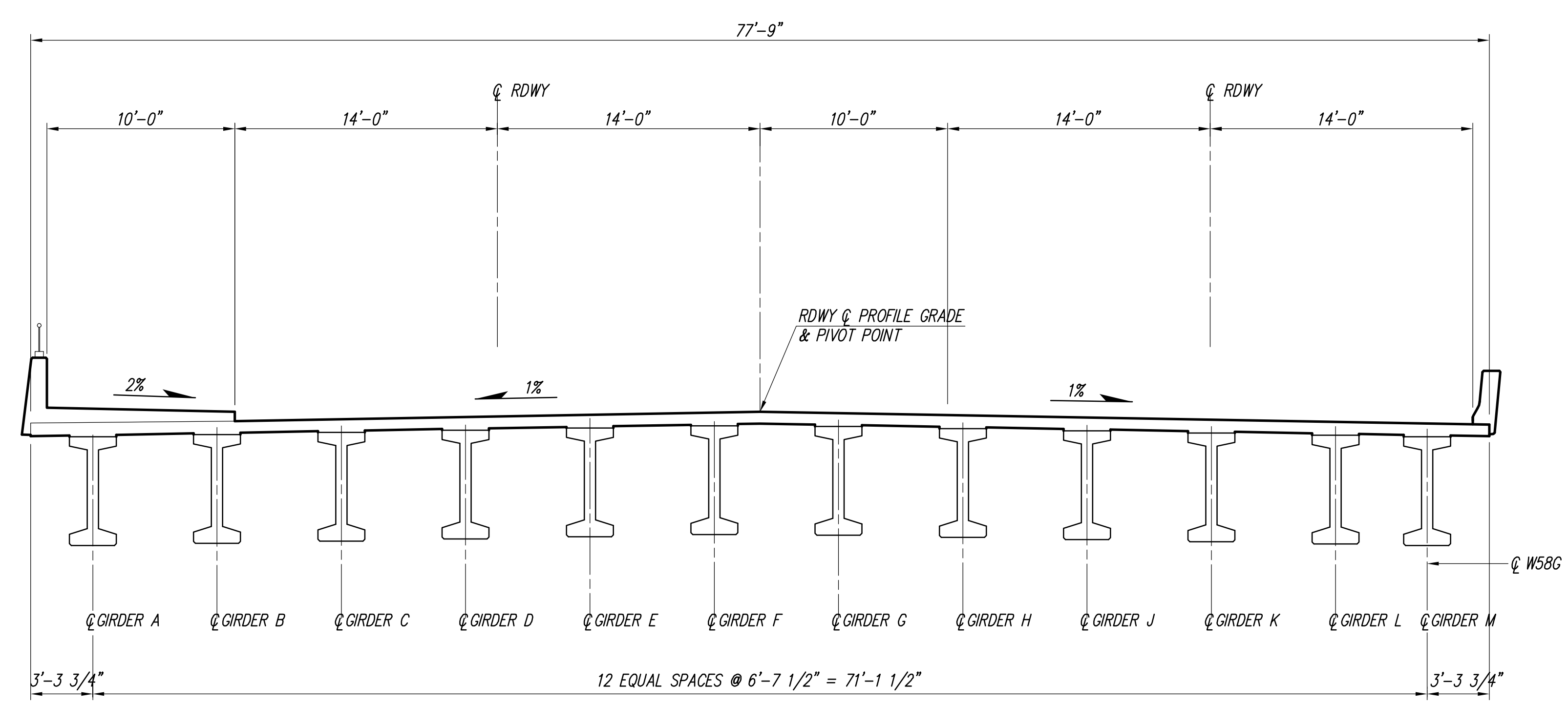
OPTION 1B
DUAL PONY TRUSSES
BRIDGE PLAN ELEVATION

6



TYPICAL ROADWAY SECTION

SCALE: 1"=5'



TYPICAL ROADWAY SECTION

SCALE: 1"=5'

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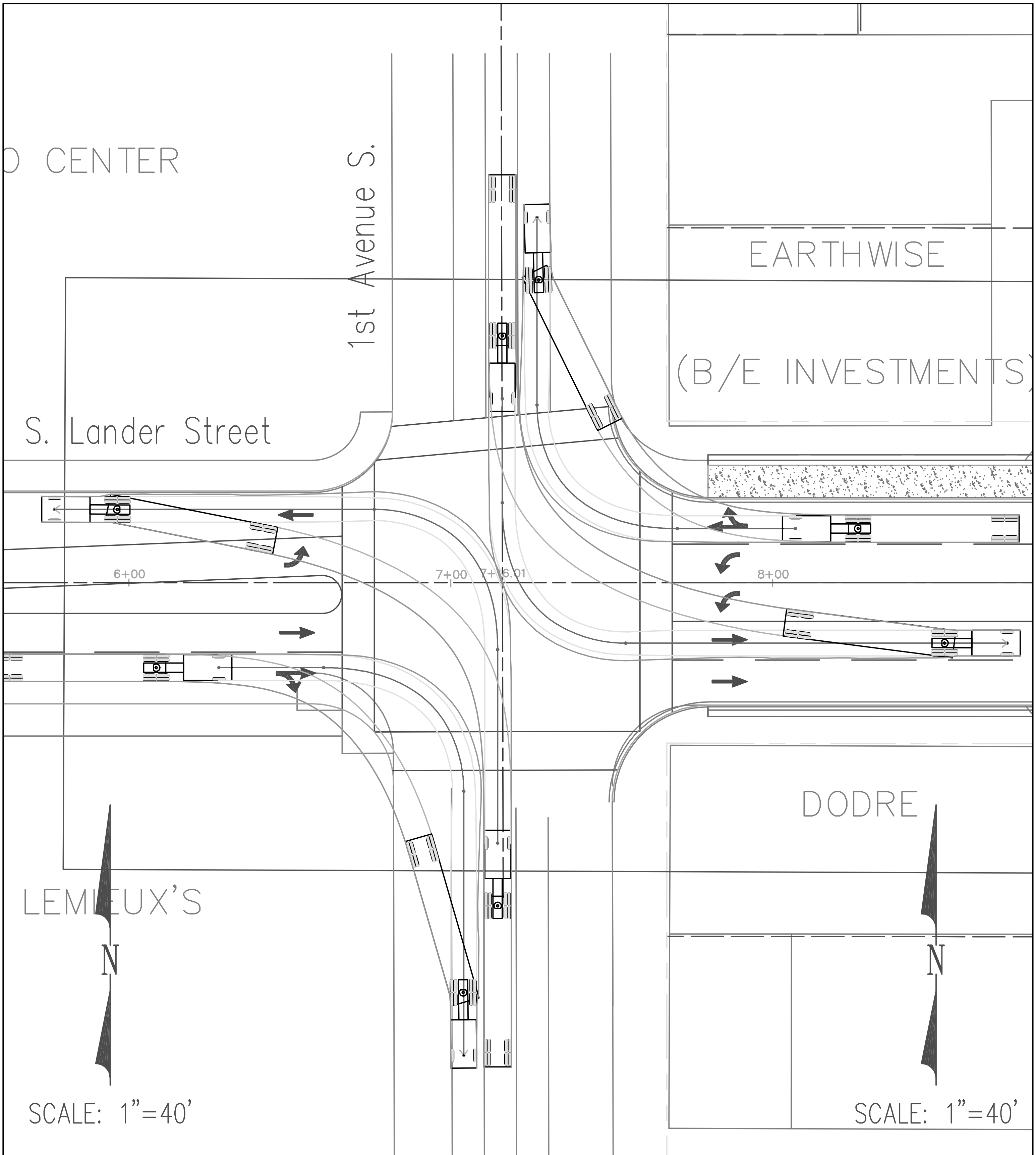
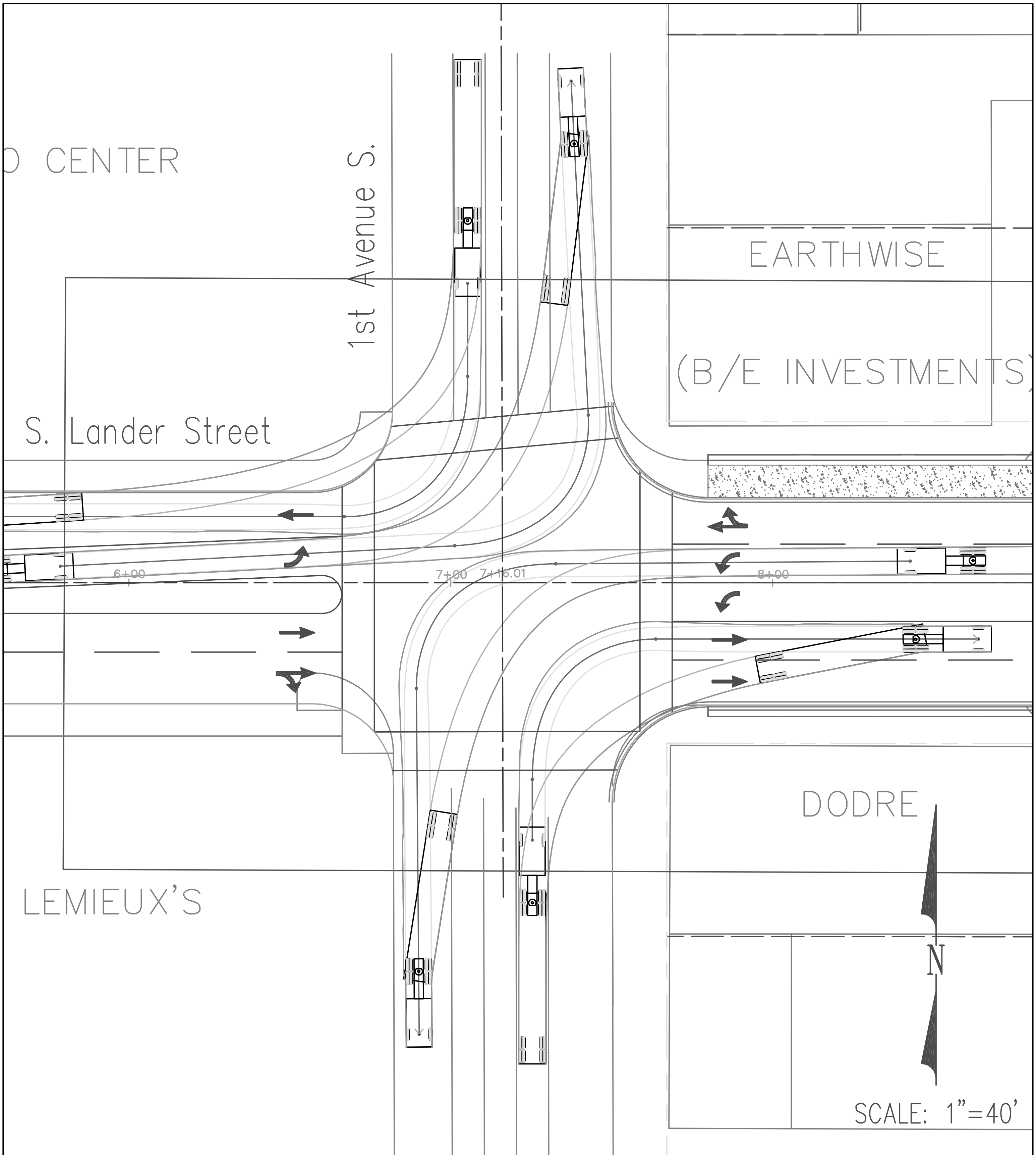
TYPICAL SECTIONS
OPTION 1B



1st Avenue S. and S. Lander Street

WB-67 Turning Movements

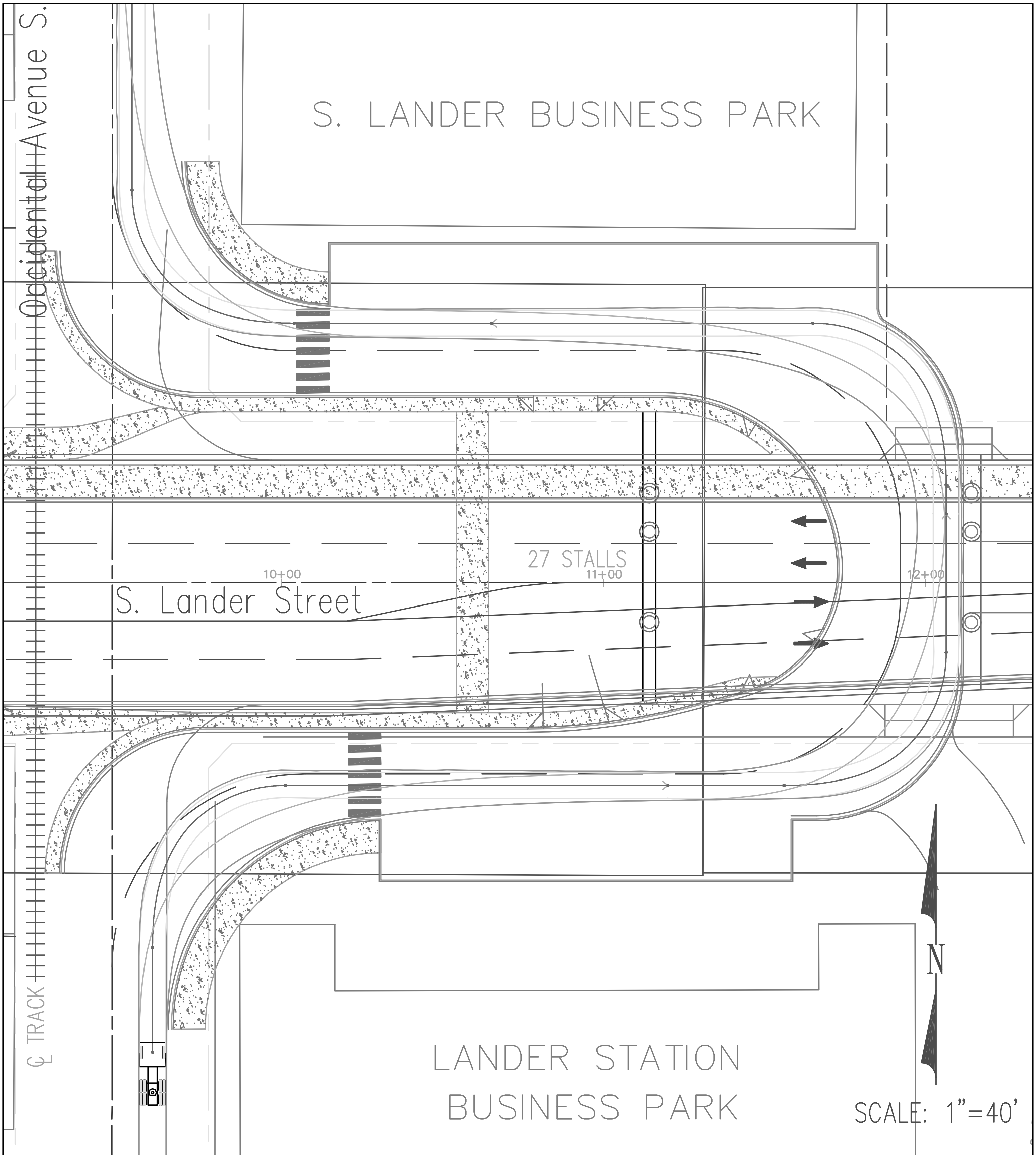
S. Lander Street Grade Separation Project



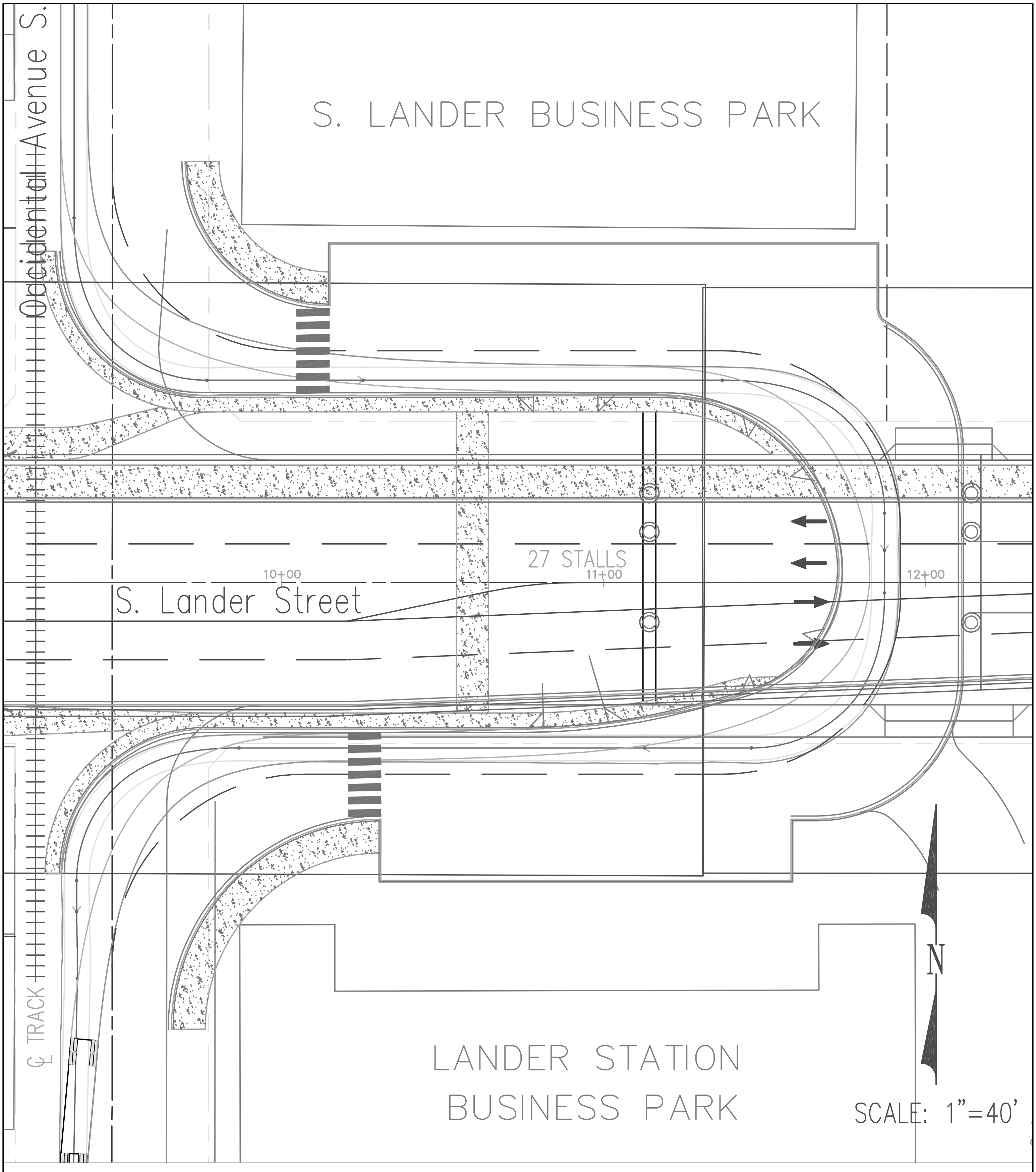
1st Avenue S. and S. Lander Street

WB-67 Turning Movements

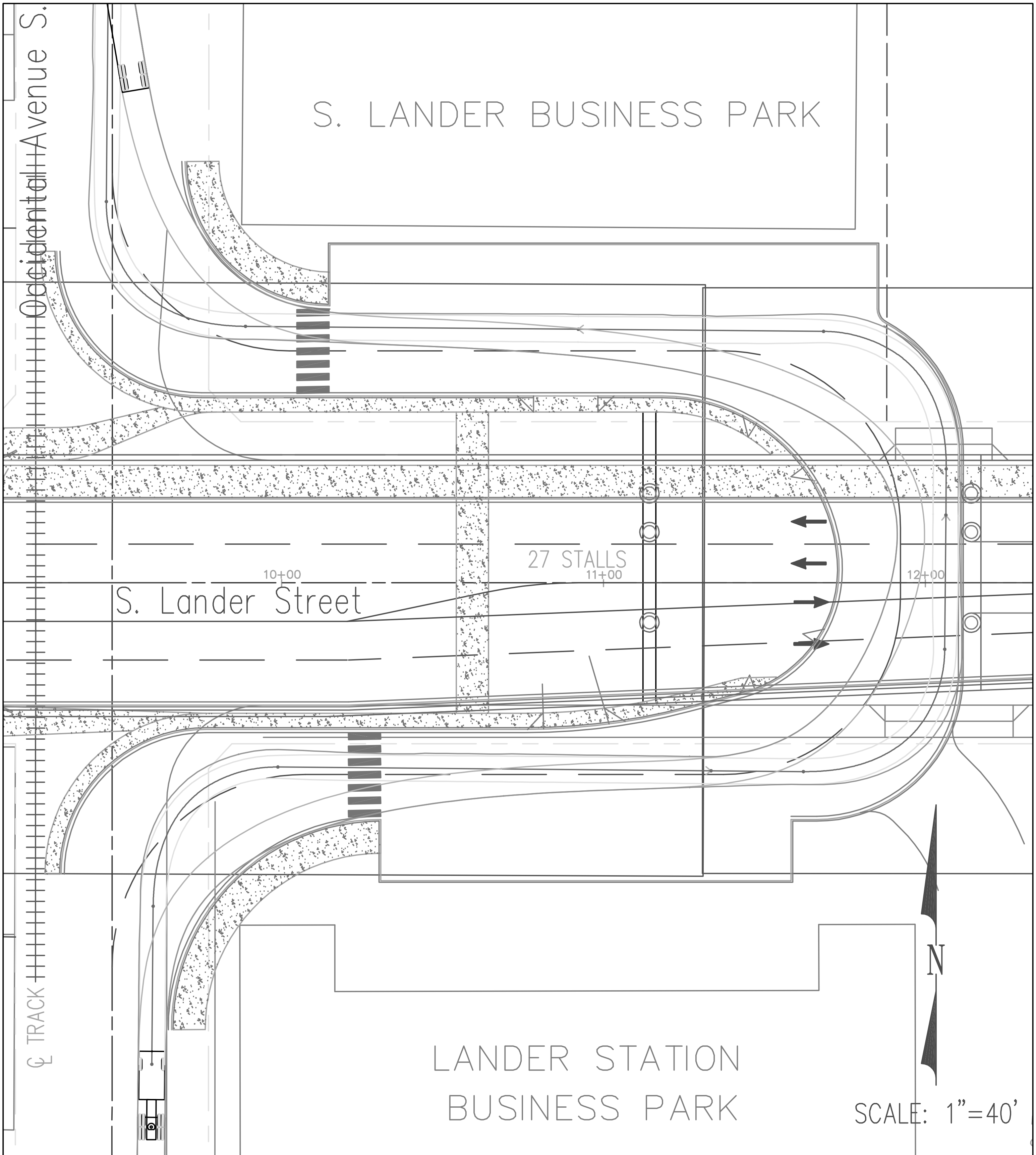
S. Lander Street Grade Separation Project



Occidental Avenue S.
WB-50 Northbound Turning Movements
S. Lander Street Grade Separation Project



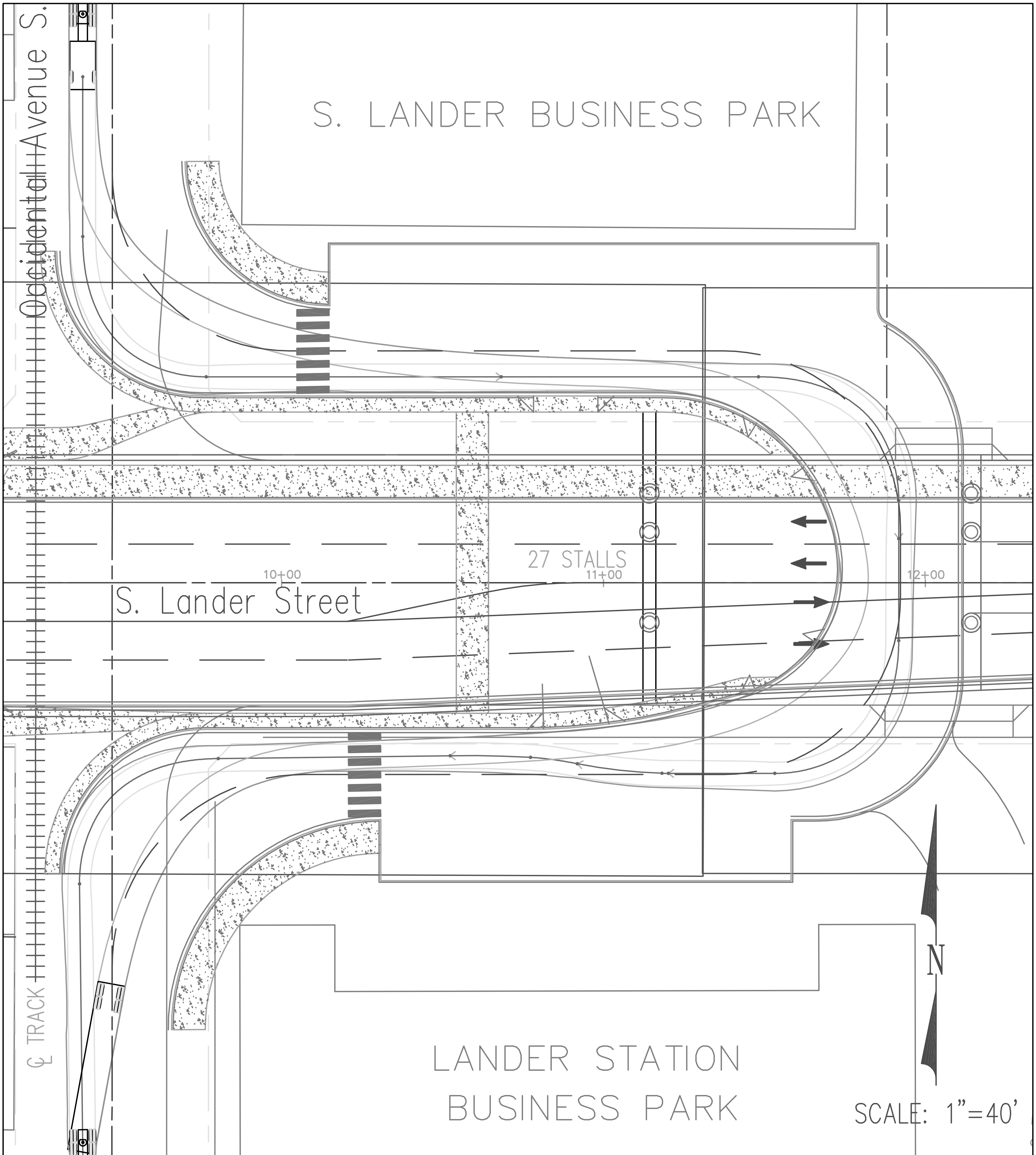
Occidental Avenue S.
WB-50 Southbound Turning Movements
S. Lander Street Grade Separation Project



Occidental Avenue S.

WB-67 Northbound Turning Movements

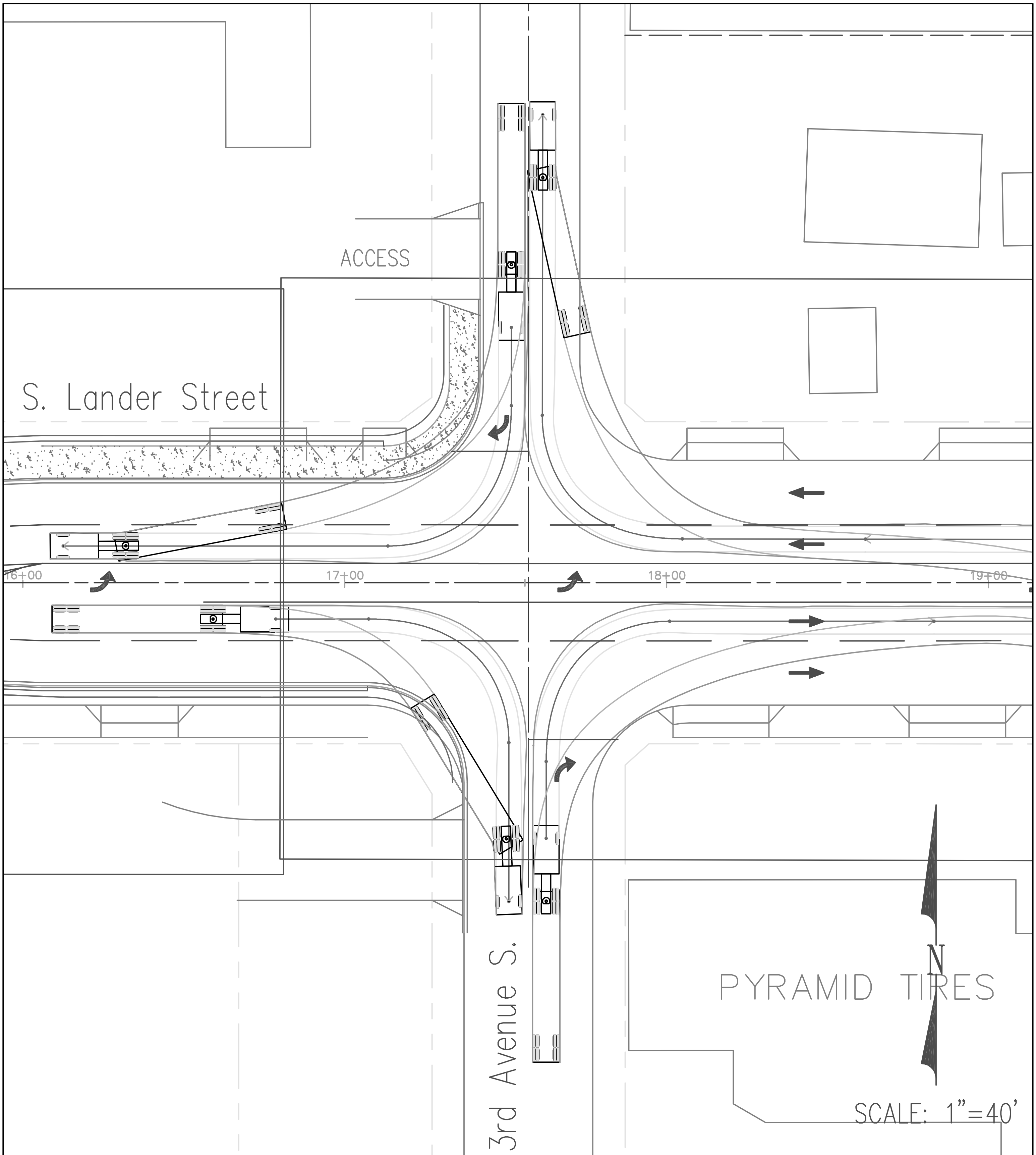
<u>S. Lander Street Grade Separation Project</u>



Occidental Avenue S.

WB-67 Southbound Turning Movements

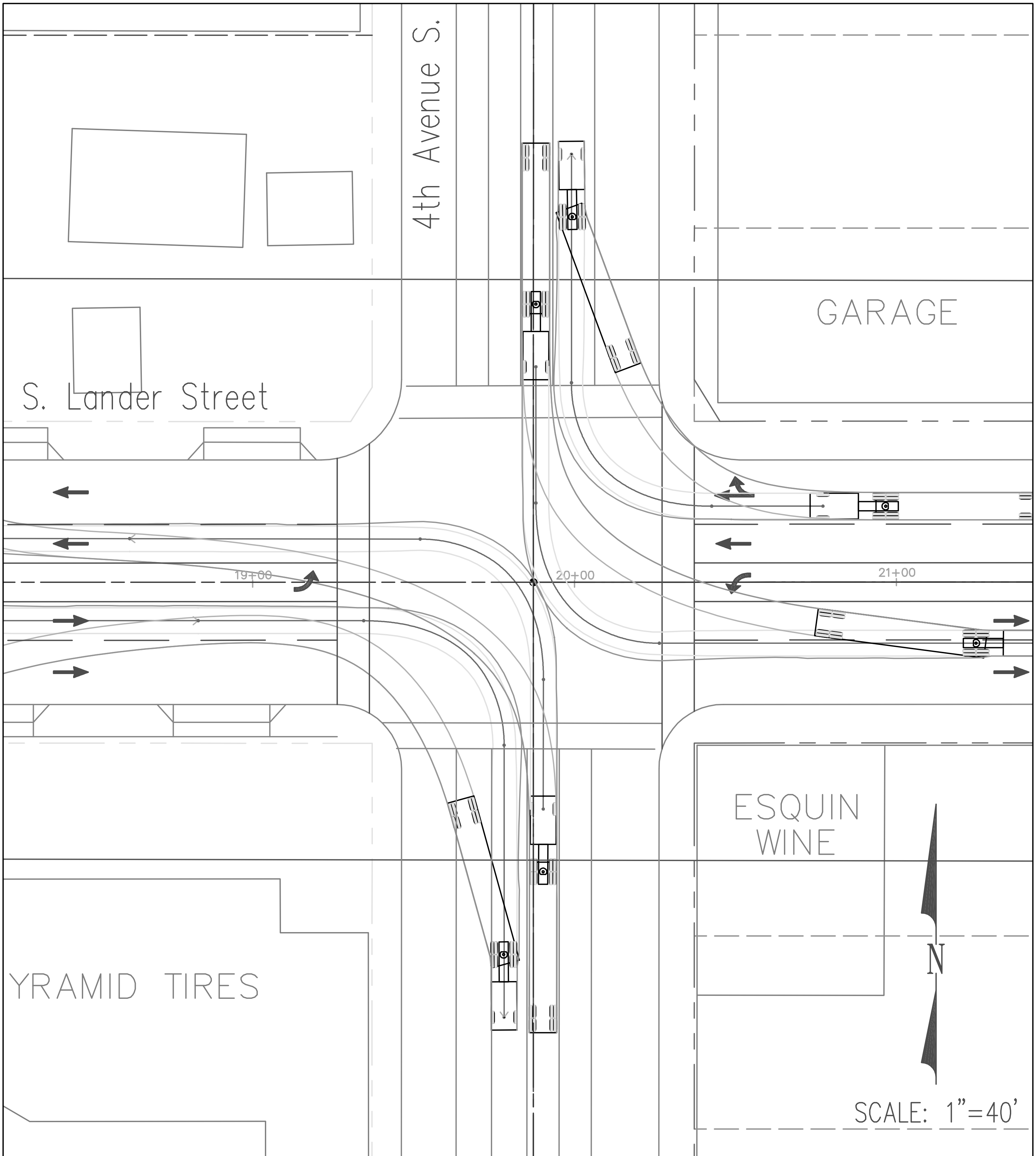
S. Lander Street Grade Separation Project



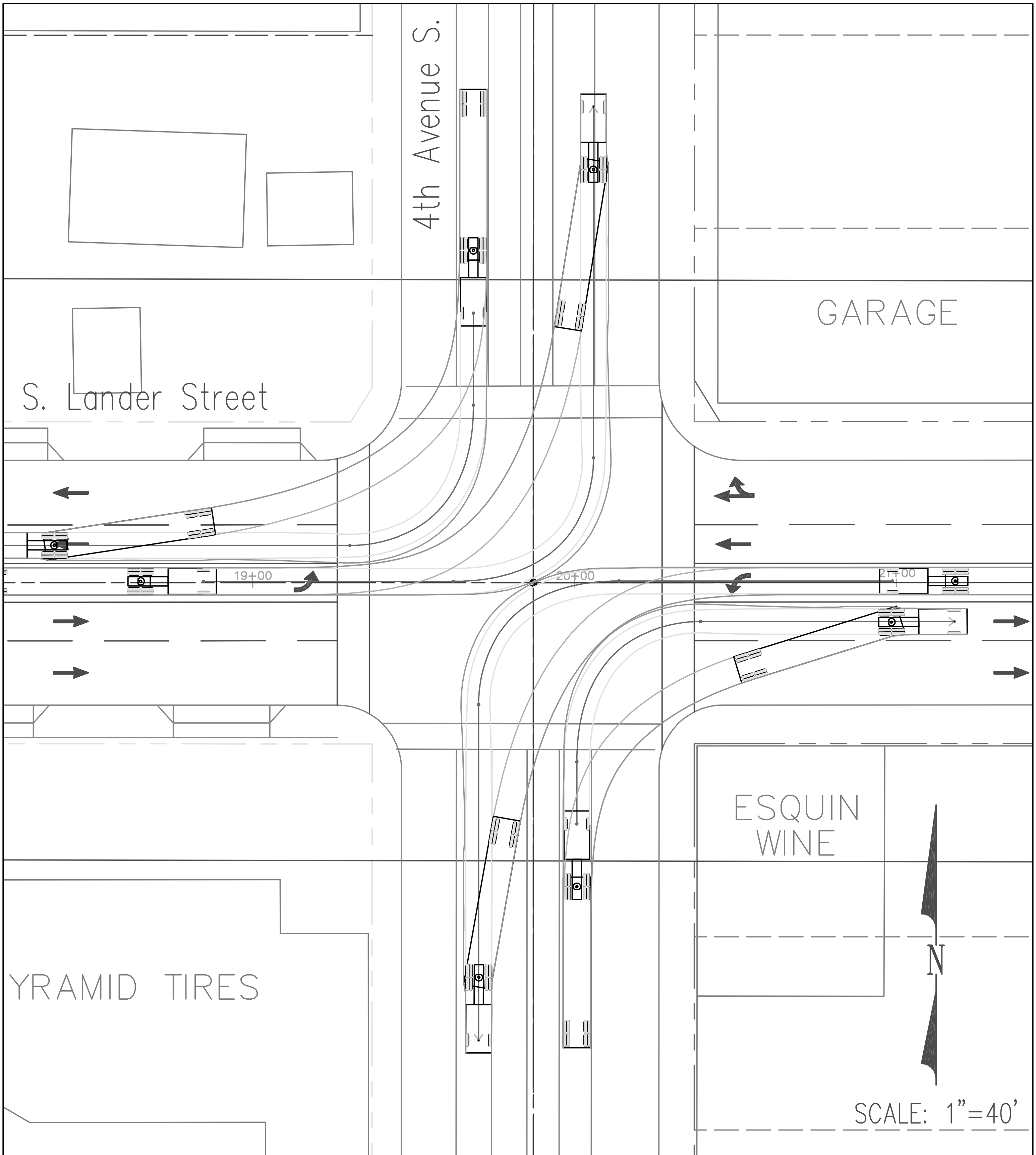
3rd Avenue S. and S. Lander Street

WB-67 Turning Movements

S. Lander Street Grade Separation Project



4th Avenue S. and S. Lander Street
WB-67 Turning Movements
S. Lander Street Grade Separation Project



4th Avenue S. and S. Lander Street
WB-67 Turning Movements
S. Lander Street Grade Separation Project