2. Existing Conditions

2.1 Existing Bridge Configuration

The existing 4th St. Bridge, structure number K-18-Z, was constructed in 1958 and is approximately 1068 feet long and 68 feet wide. The bridge is comprised of seven spans ranging in length from 117 feet on the east-end to 202 feet on the west-end, and is separated into three units. There is a two-span unit over the Arkansas River and floodwall, a three-span unit across the Union Pacific Railroad yard (UPRR), and a two-span unit over the Burlington Northern Santa Fe Railroad yard (BNSF). The maximum span length over the Arkansas River is 202 feet. The maximum span length over the UPRR is 182 feet and the maximum span over the BNSF is 117'-5". The existing configuration results in five piers in the Pueblo Yard, and one pier on the western bank of the Arkansas River.

The bridge superstructure is constructed of built-up riveted steel plate girders with a cast-in-place mildly reinforced concrete deck (non-composite). Nine (9) girder lines with a girder-to-girder centerline spacing of 8'-0" is typical of all spans except Span 1 on the east end, which utilizes skewed girders to account for a 10 degree horizontal curve in the alignment. In Span 1, there are nine (9) girder lines with a girder-to-girder centerline spacing of 7'-9". There are expansion joint devices at pier bents 2 and 5 and at each abutment. Pier bent and span identification is from east to west in the original plan set.

The bridge substructure bents are multiple column and bent cap construction. Pier bents 1 through 5 are five (5) column bents with 3-foot by 4-foot bent caps and individual footings. Footings for bents 1 and 2 are supported on rock. Footings for bents 3, 4, and 5 are supported on steel pipe piles driven to rock. Bent 6, on the western bank of the Arkansas River, is a tapered wall pier supported on a 10-foot by 83-foot spread footing on rock.

Overhead electric lines cross the bridge at both the east and west ends. Underground gas lines exist in the railroad yard and east approach fill. Gas, electric and communications lines run on the bridge outside of the edge girders. Storm water runoff from the west approach is collected in a sewer system which daylights at the west abutment on the north side of the bridge. Outfall from the pipes has caused significant slope erosion.

A copy of a portion of the existing bridge plans is included in Appendix B for reference.

2.2 Summary of Latest CDOT Inspection and Rating Report

The existing 4th St. Bridge was most recently rated by CDOT in February 2001. Rating information and the Structure Inspection Inventory (SIA) Report are included in Appendix C for reference. This section summarizes the information and findings of the rating.

2.2.1 Alignment and Profile

Roadway and bridge geometry at the east and west approaches are substandard by today's design standards. The down grade of the bridge from west to east combined with tight curvature on the east end have been blamed for unsafe driving conditions especially in inclement weather. Similarly, the reverse curve on the west approach has been identified as undesirable and somewhat of a safety concern for motorists.

2.2.2 Bridge Cross Section

The existing 4th St. Bridge is 68-feet wide and carries four lanes of traffic as well as pedestrians and bicyclists in a narrow 4-foot sidewalk on each side. Vehicle barriers have been added to both sides of the bridge to separate the sidewalks from the travel lanes. A double W-beam traffic barrier has been added in the median strip. Subsequently, the travel lanes are 11-feet wide and inside and outside shoulders are approximately 2-feet wide.

2.2.3 Horizontal Clearance

According to the 2001 rating report, the horizontal clearance is "less than the minimum tolerable" and "requires corrective action." The reason for this rating is the close proximity of the bridge piers to the existing railroad tracks in the railroad yard. Current UPRR and BNSF railroad design standards require 18'-0" minimum horizontal clearance between the face of pier and the center of an adjacent track when pier crash walls are used. When pier crash walls are not used, 25'-0" horizontal clearance is required.

The existing 4th St. Bridge piers do not have crash walls and do not meet the minimum railroad clearance requirements. According to the project survey, the minimum horizontal clearance from centerline of track to face of pier is 8'-3" at Pier 5, located next to the Arkansas River floodwall. This is much less than current railroad requirements. Existing horizontal clearance for all of the existing piers in the railroad yard are shown in Table 2.1. These clearances are based on the project survey and show some differences when compared to the original bridge plans. The differences are attributed to track removals and relocations and the as-built state of the existing bridge.

Inadequate horizontal clearance from the active railway tracks to the existing piers is a concern for both the railroads and the travelling public and is the major component of the low bridge sufficiency rating. Minimum requirements established by the railroads, including crash wall criteria, are intended to limit damage to the structure by the redirection and deflection of railcars and payload.

2.2.4 Overall Structural Condition

The bridge sufficiency rating is 44.5 and specified as "functionally obsolete." The sufficiency rating is a function of the structural adequacy, safety, serviceability, functional obsolescence, and public use of the bridge. The overall structural condition was rated as "somewhat better than the minimum adequacy to tolerate being left in place as is." The condition of both the substructure and the superstructure are considered in the rating analysis.

Table 2.1 Existing Horizontal Clearances in Railroad Yard

Pier	Horizontal Clearance Face of Pier to Centerline Track *
1	27'-6"
2	11'-0"
3	10'-6"
4	11'-9"
5	8'-3"
6	N/A (River Pier)

*Clearances shown are per project survey data, August 2001.

2.2.5 Substructure Condition

The substructure condition is rated as fair with all primary structural elements being sound with minor section loss, cracking, or spalling. The rating report suggests that the substructure is stable for scour, indicating that there are no scour issues with Pier 6 which is located in the Arkansas River channel. The substructure deterioration that is indicated by the report is generally confined to bents located at expansion joint locations due to many years of leaking joints. The condition of the substructure is summarized below. Notation has been revised to east to west to follow notation in the original plan set. Note that this is different from the rating report, which numbers the piers from west to east and includes the west abutment as number 1. Individual columns in a bent are designated A through E from north to south.

- Column 1-E and all columns at bents 2 and 5 have concrete spalling and exposed corroding reinforcing steel. Columns for remaining bents appear satisfactory.
- The concrete pier wall at Bent 6 on the western bank of the Arkansas River is acceptable and shows little deterioration.
- The concrete bent caps at bents 1, 2, and 5 show heavy spalling with exposed corroding reinforcing steel. There is sand build up on these caps but no loss in bearing.

- Both the east and west concrete abutments have heavy water stains on the backwalls. The bridge seats are full of sand. There are light vertical and horizontal cracks in face of the bridge seat.
- There is corrosion on rocker bearings and plates below the expansion joints at the abutments and expansion piers 2 and 5.
- Slopes in front of the abutments are untreated and showing heavy erosion and washing due to pour drainage and inadequate slope protection.
- Both slopes of the Arkansas River floodwall appear sound. The west side is slope paved and east side is earthen embankment.

2.2.6 Superstructure Condition

The superstructure and deck conditions are rated as satisfactory with some minor deterioration of the structural elements. Intermittent corrosion is occurring on the steel bridge girders and on the rocker bearings and expansion joint components. There are areas where the paint on the girders is flaking. This creates an environmental concern since testing done as part of this project confirms unacceptable levels of lead. In addition, the following observations were made:

- A portion of the east end of the bridge recently received a new overlay.
- Expansion joint finger plates are corroded, open and leaking.
- Concrete bridge railings show some vertical and horizontal cracking. There are some locations of damaged rail.
- Metal pedestrian railing has intermittent light corrosion. Median guardrail is galvanized with many areas bent from impact.
- Concrete curbs and sidewalks have many areas of delamination and concrete spalling (small). Some of the spalls are sufficient to expose reinforcing steel, which is corroding. Sidewalks are structurally sound but pose hazard to pedestrians due to narrow dimension.
- Ends of steel girders below expansion joints show corrosion. Top flange of Girder “E” has intermittent corrosion. The remaining girders have intermittent corrosion and chalking paint.
- Many light pole concrete pads have cracking and delamination, but appear structurally sound.

2.2.7 Load Rating

As part of the structure rating, bridges are given both an Operating Rating and an Inventory Rating. These ratings represent the maximum truck load, in tons, that the bridge can carry safely. The Inventory Rating represents the typical expected truck loading on the bridge, while the Operating Rating represents the maximum transient load allowed on the bridge. Typically decisions regarding a bridge are based on the Operating Rating; however, Inventory Rating is sometimes used depending on the particular situation. Since new structures are designed for full AASHTO loads, a new structure would rate at or above inventory level.

Current design standards are approximately equivalent to a 45-ton truck (HS25 or HL-93). The existing bridge was designed for an HS20-44 truck, which was the standard AASHTO design truck at the time of bridge construction. The HS20-44 truck weighs 36-tons. Therefore, it is expected that the existing bridge would have an inventory rating of at least 36-tons. The rating report and Table 2.2 indicate the following load ratings at the inventory and operating levels:

Table 2.2 Existing Structure Load Rating (tons)

	Structural Member			
Rating Level	**Deck Slab**	**Unit G1 Girders Spans 1 and 2**	**Unit G2 Girders Spans 3 –5**	**Unit G3 Girders Spans 6 and 7**
Inventory	23.3	49.9	27.0	47.0
Operating	38.9	83.2	45.1	78.3

The above table shows that the deck slab and the girders in spans 3-5 rate below 36-tons at the inventory level. Most often, consideration of the Operating Rating of the structure determines a course of action for the bridge. In the case where a direct comparison of alternates will be made and alternates consider use of the existing bridge and construction of a new bridge, it is most appropriate to consider the inventory rating to achieve a fair comparison of alternatives. Since a new structure will have an inventory rating of approximately 45-tons, the existing structure should be compared after rehabilitation to achieve a rating at or above 45-tons at the inventory level.

2.3 Summary of Existing Conditions

The CDOT inspection reports indicate that the existing bridge has limited functionality and load capacity given the current configuration and latest design standards. Figg Bridge Engineers, Inc. visited the existing 4th St. Bridge several times in the spring and summer of 2001. These site visits confirmed the existing structural conditions described in the CDOT inspection and inventory report. The most significant conditions to consider are the lack of horizontal clearance between the bridge piers and the adjacent railroad tracks, the onset of structural deterioration of the bridge superstructure and substructure, and the inadequate load carrying capacity of certain elements of the structure. These elements include the concrete deck slab and the girders in spans 3 through 5.

The close proximity of the substructure piers to the adjacent railroad tracks is a major concern for the public and for railroad operations. Even if crash walls are added to the existing piers, the horizontal clearance is insufficient and does not meet railroad requirements.

The concrete substructure has cracking, spalling, and delamination at bents 1, 2, and 5, or 50% of the substructure bents. These problems are associated with poorly functioning and leaking expansion joint devices. This is true at Bent 1 as well where there is no joint device, but the original plans called for a deck joint at this location. It is clear that there is reflective cracking allowing moisture migration through the deck and onto the supporting bent. In many locations, loss of concrete cover has resulted in exposed corroding reinforcing steel.

The superstructure is in somewhat better condition than the substructure. However, there is intermittent corrosion on the girders, rocker bearings and surrounding steel as well as areas of flaking lead paint. The concrete deck, steel railings, expansion joints, and sidewalks are also showing signs of deterioration. While this deterioration is not of immediate concern, it shows the onset of corrosion and deterioration that can progress rapidly if left unattended.

The bridge load rating is below desirable as evidenced by both the deck rating and the girder rating for spans 1-3. At inventory level, the ratings are below the original design loading and well below current design practice. At operating level, the deck slab rating is just above the original 36-ton design loading and also below current practice. The girders are somewhat better at operating level, rating at 45-tons or just at current inventory requirements.

Figures 2.1 through 2.28 illustrate the existing condition of the 4th St. Bridge and provide visual verification of the field inspection performed by CDOT in February 2001.

Figure 2.1 Bent 1 Substructure Condition

Figure 2.2 Bent 1 Concrete Deterioration and Exposed Reinforcing

Figure 2.3 Bent 1 Concrete Beam Deterioration and Steel Corrosion

Figure 2.4 Bent 1 Concrete Deterioration and Steel Corrosion

Figure 2.5 Bent 2 Substructure Condition

Figure 2.6 Bent 2 Concrete Beam Deterioration

Figure 2.7 Bent 2 Concrete Beam Deterioration and Corroded Steel

Figure 2.8 Bents 1 and 2 Relative Condition

Figure 2.9 Bent 5 Substructure Condition

Figure 2.10 Bent 5 Concrete Column Deterioration and Corroded Rebar

Figure 2.11 Bent 5 Column Deterioration and Corroded Broken Rebar

Figure 2.12 Bent 5 Concrete Beam Deterioration and Corroded Rebar

Figure 2.13 Bent 5 Bent Cap Deterioration and Corroded Rebar

Figure 2.14 Bent 5 Bent Cap Deterioration and Corroded Rebar

Figure 2.15 Proximity of Pier 2 to BNSF Mainline Track (11’-0”)

Figure 2.16 Proximity of Pier 3 to UPRR E. Mainline Track and Yard Track 1 (10’-6”)

Figure 2.17 Proximity of Pier 4 to UPRR Yard Tracks 13 and 14 (11'-9")

Figure 2.18 Proximity of Pier 5 to UPRR Yard Track 21 and Floodwall (8'-3")

Figure 2.19 Storm Sewer Outfall and Erosion at West Abutment

Figure 2.20 Erosion at East Abutment

Figure 2.21 Flaking Lead Based Paint Span 1 Girders

Figure 2.22 Corrosion of Steel Members, Flaking Paint, Debris on Abutment Seat

Figure 2.23 Corroded Bridge Rail, Storm Sewer Outfall at West Abutment

Figure 2.24 Corrosion of Bridge Rail, Loop Ramp Under Span 1

Figure 2.25 Corroded Bridge Rail, Narrow Pedestrian/Bicycle Facilities

Figure 2.26 East Abutment Debris in Bearing Seat

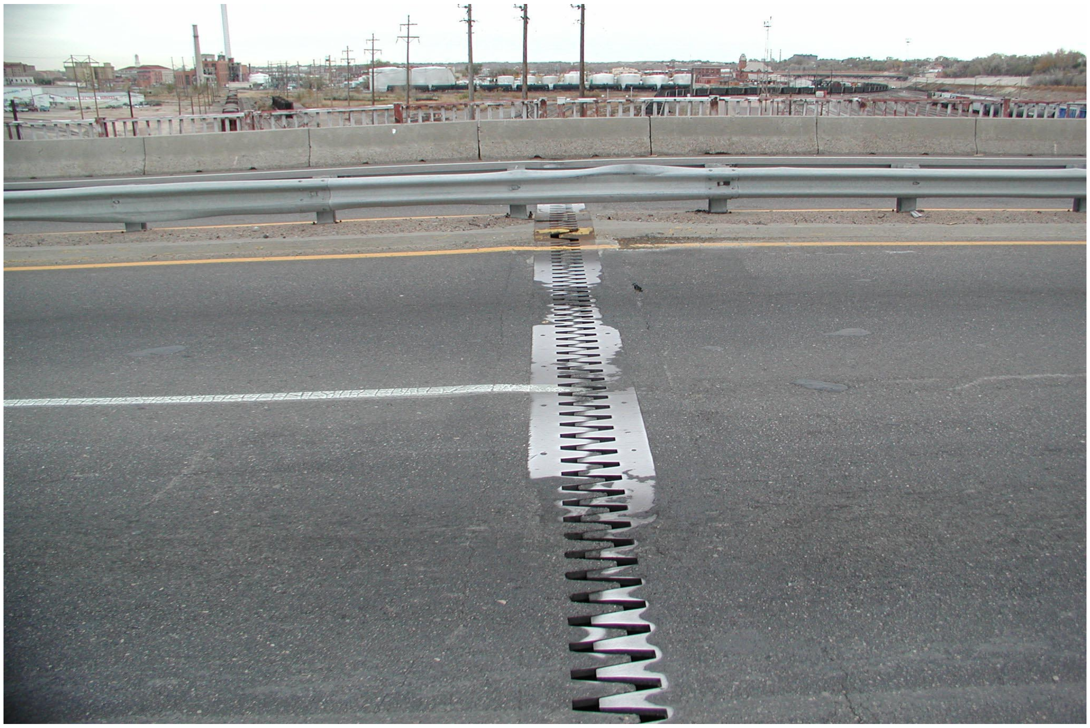

Figure 2.27 Open Expansion Joint Device, Damaged Median Rail

Figure 2.28 Deck Joint at Pier 1 Causes Substructure Deterioration