US 6/Wadsworth

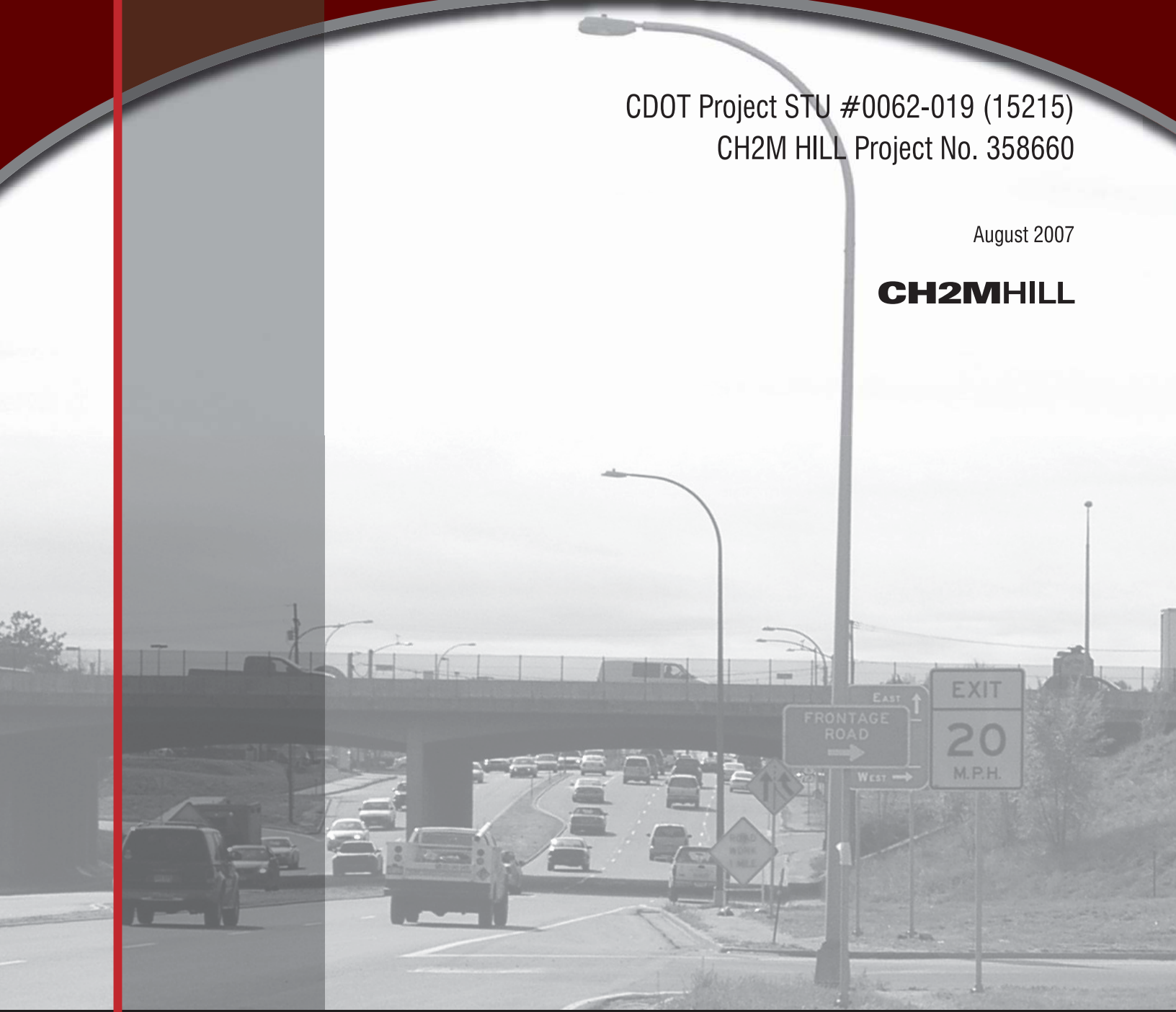
Environmental Assessment

Existing Conditions Report of Engineering Design Elements

CDOT Project STU #0062-019 (15215)
CH2M HILL Project No. 358660

August 2007

CH2MHILL



Contents

Acronyms and Abbreviations

ADT	average daily traffic
CBC	concrete box culvert
CDOT	Colorado Department of Transportation
CFR	Code of Federal Regulations
EA	Environmental Assessment
EIS	Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
LOS	level of service
RTD	Regional Transportation District
SSD	stopping sight distance
TM	technical memorandum
vpd	vehicles per day

1.0 Introduction

The Colorado Department of Transportation (CDOT) and Federal Highway Administration (FHWA) are conducting an Environmental Assessment (EA) to study transportation improvements at the interchange of US 6 (also designated as Sixth Avenue) and Wadsworth Boulevard (also designated as Colorado State Highway 121) including improvements along Wadsworth Boulevard from approximately Third Avenue to 13th Avenue in Lakewood, Colorado.

Transportation improvements in the study area have been identified as a high priority for CDOT, the City of Lakewood, area residents, businesses, and commuters. Roadway improvements in the region's West Corridor have been identified in Lakewood's *Comprehensive Plan*, the Denver Regional Council of Governments' (DRCOG) *Regional Transportation Plan*, and the 1997 *West Corridor Major Investment Study* prepared by the Regional Transportation District (RTD).

Improvements in the West Corridor, including improvements to the US 6 and Wadsworth Boulevard interchange, were identified as one set of 28 high-priority projects across the state that CDOT in 1996 committed to complete over the next approximately 25 years. Colorado voters approved bonding CDOT's 28 high-priority projects against future gas tax revenues to complete the projects on an accelerated schedule. CDOT has completed nearly half of the projects of its Strategic Transportation Investment Program, otherwise known as the 7th Pot Program. The US 6 and Wadsworth Boulevard improvements have been identified as the roadway project for the West Corridor and, as such, improvements could be eligible for priority funding.

CDOT's goal is to complete an EA to determine if a Finding of No Significant Impact is appropriate or if an Environmental Impact Statement is required. The study will evaluate a reasonable range of alternatives for improvements, including the No-Action alternative. The EA and supporting documentation will comply with the National Environmental Policy Act and with regulations issued by the Council on Environmental Quality (Title 40 of the Code of Federal Regulation [CFR], Parts 1500-1508) and FHWA (23 CFR 771) for implementing the act.

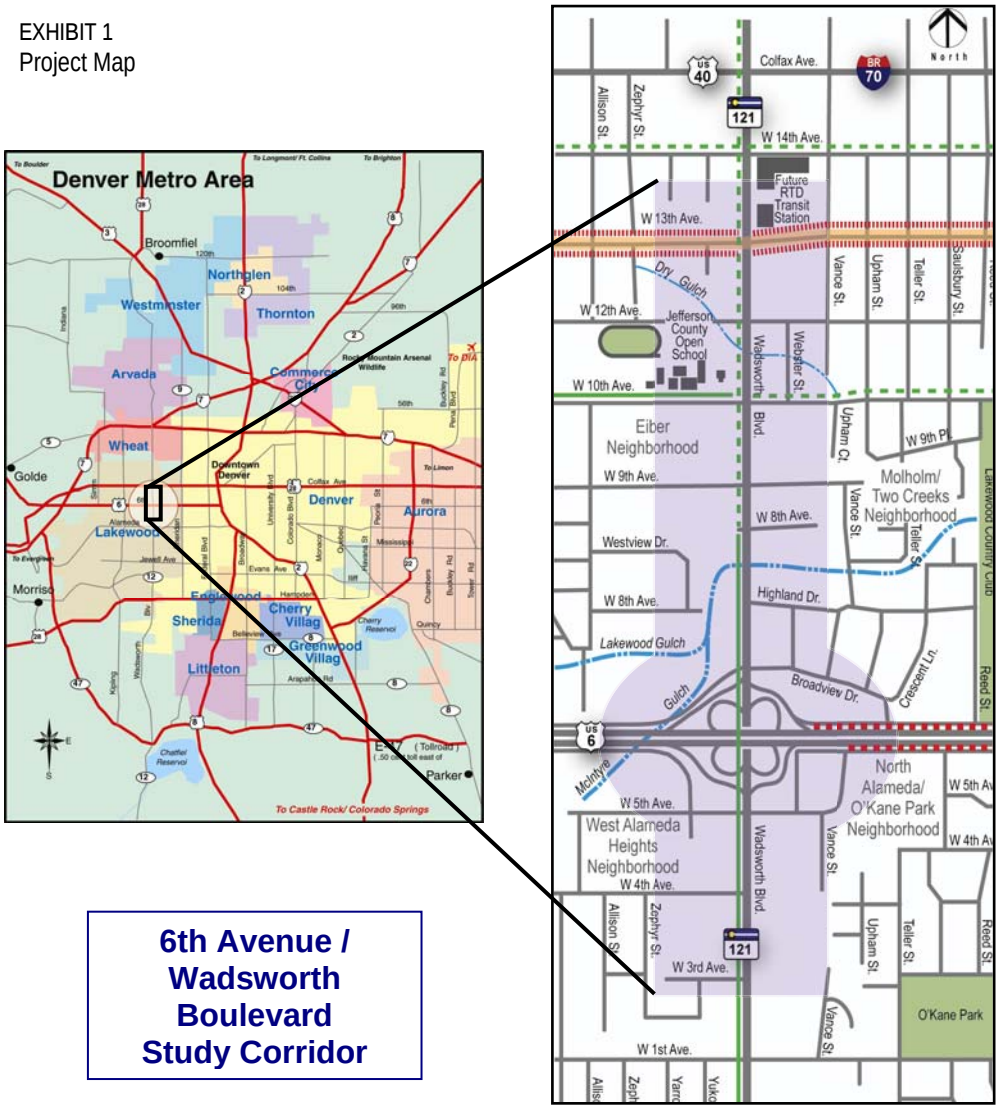
1.1 US 6 and Wadsworth Boulevard Corridor Overview

The US 6 and Wadsworth Boulevard study area encompasses an approximately 500-foot corridor from each side of the Wadsworth Boulevard centerline from Third to 13th avenues and from the US 6 centerline from generally Broadview Drive on the east to Allison Street on the west, within the City of Lakewood, Colorado (Exhibit 1). This study area was developed to focus the initial data collection, although the logical termini have not yet been finalized. The study area along US 6 may expand based on the outcome of traffic and operational analysis at the interchange.

Existing Conditions Report of Engineering Design Elements

The US 6 and Wadsworth Boulevard interchange is the gateway to Lakewood's downtown (Belmar) and city center (Lakewood Commons) areas. US 6 and Wadsworth Boulevard serve both local and regional travel needs that include daily commuter traffic in and through the City of Lakewood. RTD local, regional, and express bus services use these streets, and businesses and residents depend on these roads for access. Bicycle and pedestrian traffic occurs on Wadsworth Boulevard (although bicycle and pedestrian facilities are limited), and a future RTD light rail line and station will be constructed at 13th Avenue. Some of the transportation problems in the study area include traffic congestion, neighborhood and business access issues, discontinuous local residential traffic circulation, poor interchange operations, high accident rates, undersized drainage facilities, and inadequate bicycle and pedestrian facilities.

EXHIBIT 1
Project Map



2.0 Purpose of This Report

This report presents an overview of existing engineering design elements (e.g., geometric, structures, traffic, drainage, safety, etc.) within the study area. The overview was prepared to help identify areas of concern and assess the existing geometric "health" of the study corridor infrastructure. The assessment of engineering design issues consisted of field reconnaissance site visits, discussion with knowledgeable individuals, and/or review of available data, such as inspection reports or maintenance records. In certain instances, the existing design elements were compared against current project design standards established for the corridor. Through this comparison, general performance rankings ("good"/"fair"/"poor") were established to aid in identification of potential corridor deficiencies. Ranking results of existing design elements are summarized in Section 4.0, Geometric Health Report Plans.

Information from this report will be used to guide discussion and presentation of engineering design issues at both formal and informal public and agency scoping meetings.

3.0 Executive Summary

Critical issues and problem areas identified from the evaluation of existing engineering design conditions for the US 6 and Wadsworth Boulevard EA are highlighted in this section. Section 4.0, Geometric Health Report Plans, contains exhibit plan sheets indicating a graphical rating summary of the existing engineering design conditions along the corridor. Actual discipline-specific technical memoranda (TMs) are included in this report, in CD format, in Section 5.0, Appendixes of Technical Memoranda.

3.1 Geometric

The following bullet list highlights the critical issues identified from the evaluation of existing roadway geometric conditions for the US 6 and Wadsworth Boulevard EA.

US 6 Mainline and Interchange

- The US 6 and Wadsworth Boulevard interchange is a full cloverleaf configuration with substandard design speeds on both the directional and the loop ramps, and short superelevation transition lengths on directional ramps.
- Stopping sight distance (SSD) is limited in the northeast ramp terminal due to the intersection geometry and an existing retaining wall.
- The ramp intersection geometry does not allow an Interstate Semitrailer Design Vehicle (WB-67) adequate room for turning movements.
- Frontage road access to the northeast directional exit ramp creates a safety issue.
- The deceleration and acceleration lengths of all four directional ramps do not meet project design standards.
- The US 6 inside shoulder lacks sufficient room for emergency stopped vehicles.
- Ramp shoulders vary from standard widths to 2 feet in width.
- SSD is inadequate for the eastbound sag curve approaching Wadsworth Boulevard and the crest vertical curve over Wadsworth Boulevard.

Wadsworth Boulevard Corridor

- SSD is inadequate for several sag and crest vertical curves.
- The vertical roadway grade falls below the minimum project design standard for flow along a concrete gutter.
- Median widths are less than standard, which causes opposing traffic to pass each other within an unsafe distance.

- Signalized and unsignalized intersection spacing is less than the project design standard.

3.2 Structures

An evaluation of existing major structures was completed through a review of CDOT Structure Inspection and Inventory reports supplemented by a site visit to visually inspect the current field conditions.

US 6 Mainline and Interchanges

- **McIntyre Gulch (Structure F-16-L) –** Existing concrete box culvert (CBC) (3 – 10 feet by 10 feet) that is rated as "fair." The CDOT Structure Inspection and Inventory Report shows the condition rating of this structure as a 5, on a scale of 1 to 10. A rating of 5 is defined as "Fair Condition – all primary structural elements are sound but may have minor section loss, cracking, spalling, or scour." According to the same report, this structure has a sufficiency rating of 63.8.
- **US 6 Bridge over Wadsworth Boulevard (Structure F-16-O) –** Existing four-span concrete girder structure. The structure is rated as "structurally deficient" based on the deck condition rating of 4, and superstructure and substructure condition ratings of 5. FHWA defines a condition rating of 4 as "Poor Condition – advanced section loss, deterioration, spalling, or scour." A condition rating of 5 is defined as "Fair Condition – all primary structural elements are sound but may have minor section loss, cracking, spalling, or scour."

Wadsworth Boulevard

- **Lakewood Gulch (Structure F-16-AK) –** Existing box bridge structure (3 – 32 feet by 8 feet). Rated in "fair condition."

3.3 Drainage

Evaluation of existing drainage conditions for the US 6 and Wadsworth Boulevard study area was obtained from review of existing FEMA floodplain maps, City of Lakewood drainage master planning maps, and through correspondence with the City of Lakewood.

US 6 (Sixth Avenue)

- **McIntyre Gulch –** Existing CBC (3 – 10 feet by 10 feet). No major conveyance issues identified.
- **South Lakewood Gulch –** Existing CBC (1 – 8 feet by 8 feet). Undersized structure resulting in excessive ponding on the upstream (south) side.

Wadsworth Boulevard

- **South Lakewood Gulch at Second Avenue –** Existing pipe culvert (1 – 48 inches). Undersized storm drain. FEMA floodplain maps indicate street overtopping at the 100-year flood levels.
- **Lakewood Gulch at Highland Drive –** Existing box bridge structure (3 – 32 feet by 8 feet). FEMA floodplain maps indicate street overtopping at the 100-year flood levels.
- **Dry Gulch at 10th and 12th Avenues –** Existing pipe culvert (1 – 90-inch by 58-inch elliptical pipe). Undersized storm drain. FEMA floodplain maps indicate street overtopping at the 100-year flood levels.

3.4 Geotechnical

An evaluation of the geotechnical site conditions was completed by RockSol Consulting Group. A total of nine preliminary geologic boring test holes were completed and sampled along the project corridor. The borehole locations are indicated on the Geometric Health Report Plans in Section 4.0 of this report.

There were no major geological hazards identified along the project corridor that cannot be mitigated by means of engineering. The thickness of the existing asphalt pavement ranges from 6 to 13 inches. High swell potential and corrosive soils have been observed or recorded in some locations. The blow counts were low in some boreholes (B-1, B-3, B-4, B-5, and B-7) at depths of 3 to 10 feet, which indicate soft or collapsible soils. In these areas, excavation and re-compaction should be considered. Sulfate-resistant concrete might be necessary where the water-soluble sulfate is high. Groundwater was encountered in all the boreholes at depths ranging from 9 to 23 feet, with the exception of B-2. Seasonal fluctuations in the water table increase shrink-swell effects in susceptible soils and bedrock. Shallow groundwater enhances soil corrosivity and frost action, decreases soil strength in slopes, and increases susceptibility to water erosion.

3.5 Utilities

An evaluation of existing utilities was completed through contacts with the Utility Notification Center of Colorado for initial identification of private utility companies and municipalities with facilities in the study area.

Twenty-three utilities identified in the project area were considered major due to their critical nature or the high cost or complexity associated with their potential relocation. These utilities included high-voltage electric transmission lines; irrigation ditches; cell phone towers; potable water lines and sanitary sewers greater than 24 inches in diameter; fiber optic lines; raw water lines (untreated municipal water supplies); and high-pressure gas lines. All major utilities will be further evaluated when the alternatives have been defined.

Areas requiring significant grade change, widening of the roadway, or expansion beyond the existing right-of-way will be of particular concern.

3.6 Traffic

An evaluation of existing traffic operations was completed using the most current industry-accepted standards. Mainline, weave, and merge/diverge operations were evaluated with Highway Capacity Software. Synchro software was used to determine intersection level of service (LOS), which is a qualitative description of traffic-flow characteristics. The highest level (LOS A) describes free-flow conditions in which vehicles experience minimal delay. The lowest level (LOS F) describes stop-and-go conditions in which long delays are experienced by most vehicles in the traffic stream. LOSs E and F were considered unacceptable.

US 6 Mainline and Interchanges

- The US 6 and Wadsworth Boulevard interchange is a full cloverleaf configuration with slow speeds and tight curves on both the directional and the loop ramps.
- Three of the four weave segments on US 6 and Wadsworth Boulevard operate at unacceptable LOSs during peak hours.
- The eastbound merge and westbound diverge segments on US 6 at Wadsworth Boulevard also operate at unacceptable LOSs and contribute to mainline congestion near the interchange.
- Vehicles do not have adequate distance to accelerate/decelerate when entering/exiting US 6 at Wadsworth Boulevard.
- The westbound US 6 on-ramp from the Wadsworth Boulevard weave with the US 6 slip ramp to Carr Street/Garrison Street operates at an unacceptable LOS.
- The proximity of the Carr Street/Garrison Street slip ramps to the Wadsworth Boulevard interchange does not allow adequate acceleration and deceleration at either location.

Wadsworth Boulevard Corridor

- The Wadsworth Boulevard corridor is a typical urban arterial with signalized stop control and numerous driveway accesses.
- The Fifth Avenue and Broadview Drive intersections are closely spaced to the US 6 interchange; therefore, vehicles attempting to cross multiple lanes of traffic create turbulence in the traffic stream in both directions on Wadsworth Boulevard.

- North of US 6, the median is striped to provide two side-by-side, continuous left-turn lanes serving major intersections and driveway accesses. The variability of drivers entering the median left-turn lane(s) contributes to mainline congestion and adds to the difficultly for vehicles on the side streets to enter or cross Wadsworth Boulevard. In addition, sight distance between opposing vehicles in the turn lanes is a problem due to the vehicles blocking the view of traffic in the through lanes.
- As a major regional arterial, signal priority is given to northbound and southbound vehicles. The cross-street approaches at most signalized and unsignalized intersections operate at unacceptable LOSs.
- Due to the heavy through traffic on Wadsworth Boulevard, vehicles from both the side streets and the driveways are forced to pull into unsafe traffic-flow gaps.
- The four through-lane cross-section north of US 6 does not accommodate current traffic demands with an LOS of E.

3.7 Neighborhood Traffic Management

The following summary of findings, completed by Navjoy Consulting Services, is based on an analysis of collected speed and volume data as well as a field review of existing conditions.

- Traffic data collected on the local streets of Fourth Avenue, 12th Avenue, Broadview Drive, and Highland Drive indicate daily traffic volumes well below the City of Lakewood's design threshold of 2,500 vehicles per day (vpd) for local streets. Additionally, with the exception of Highland Drive, the 85th percentile speed on these streets is at or below the existing posted speed limit.
- The data indicate a slight speeding problem along Highland Drive (34-mph 85th percentile speed versus 30-mph speed limit), but the speeds are not high enough to be considered a traffic hazard to the neighborhood. It is also important to note that traffic patterns in this neighborhood could change if the existing frontage road connection to the eastbound US 6 off-ramp is removed. This frontage road does not carry a high volume of traffic (310 vpd); however, there is a history of neighborhood concern about increased traffic flow and whether additional traffic is routed on their streets from the frontage road.
- The 85th percentile speeds along the US 6 frontage roads are typically 5 to 10 mph higher than the posted speed limit of 35 mph. The higher speeds are primarily a result of long tangent sections and minimal side-street friction. In addition, speeds on the west quadrant frontage roads are likely influenced by the higher speeds on the adjacent freeway because there is no visual separation between the two arterials.

- Several of the two-way streets (Fourth Avenue, Carr Street, Broadview Drive, and Highland Drive) have a large directional difference in average daily traffic (ADT) volume. This imbalance is primarily due to these streets serving traffic in the opposite direction of nearby one-way frontage roads.
- Traffic data indicate that 10th Avenue west of Wadsworth Boulevard and Carr Street north of Sixth Avenue both have 85th percentile speeds well above the 30-mph posted speed limit (36 mph and 38 mph, respectively). Although these streets are both classified as minor collectors, they still pass through residential neighborhoods. Additionally, 10th Avenue is adjacent to the Jefferson County Open School. Traffic speeds on 10th Avenue are partially mitigated by the 20-mph school speed zone that is activated during school start and end times. Examination of speed data during school start and end times shows that the 85th percentile speeds are reduced from 36 to 30 mph.
- Traffic speeds and volumes were not measured on most residential streets; however, a field review of these streets suggests that most streets do not have a speeding or traffic volume problem due to narrow pavement sections, curve-linear geometry, and street discontinuity, each of which helps mitigate speeding.

3.8 Safety

This assessment of the existing safety conditions for the US 6 and Wadsworth Boulevard study area is based on previously published CDOT and City of Lakewood reports along with a segmented analysis of accident data along Wadsworth Boulevard. This segmented analysis suggests a need to reduce accident frequency on Wadsworth Boulevard in the study area, primarily in the interchange area. The interchange ramp alignments also contribute to accidents. In addition, both the CDOT and City of Lakewood safety reports state that congestion in the study area is a factor that is actively contributing to accidents.

US 6 Mainline and Interchanges

- The US 6 and Wadsworth Boulevard interchange has the highest number of accidents of all the intersections in the study area.
- Congestion along US 6 and Wadsworth Boulevard is an issue that is contributing to rear-end accidents, which is the most common accident type in the study area. This type of accident is occurring at relatively low speeds due to the congestion and, therefore, is not resulting in a significant number of severe (injury and fatal) accidents. The second highest type of accident on Sixth Avenue was hit fixed object.
- The cloverleaf interchange configuration results in ramps with significant curvature that require a much lower speed to negotiate than the prevailing speeds on either US 6 or Wadsworth Boulevard. The overturning and hit fixed-object accidents on the ramps can be attributed to failure to properly negotiate the curves. Exiting drivers may not adjust their speed quickly enough to slow down to the appropriate curve speeds. Furthermore,

the lower speeds on the entrance ramps require quick acceleration over a short distance to merge at the prevailing speeds.

- From the City's perspective, the frequency and severity of accidents in the area of the US 6 and Wadsworth Boulevard interchange are excessive; in fact, the interchange was the most critical location in Lakewood for accident frequency and the second most critical location for severity in 2001 and 2003. In addition, the interchange was included on the City of Lakewood's critical intersection lists in both 2004 and 2005.

Wadsworth Boulevard Corridor

- From the statewide perspective, looking at the entire project length, neither the accident frequency nor the severity is excessive for either US 6 or Wadsworth Boulevard as compared to similar facilities across the state. However, analyzing the accident data over short segments of Wadsworth Boulevard suggests that there is a need to reduce the frequency of accidents in the study area.
- Wadsworth Boulevard in the interchange area experiences sideswipe same-direction accidents, which typically occur during lane-changing maneuvers. The cloverleaf interchange configuration provokes lane changing and weaving between merging and diverging vehicles.
- The 10th Avenue intersection experiences a number of approach-turn accidents involving northbound and southbound vehicles turning off of Wadsworth Boulevard to 10th Avenue. A majority of the broadside accidents involved eastbound and westbound vehicles on 10th Avenue colliding with a northbound or southbound vehicle on Wadsworth Boulevard.
- The 13th Avenue intersection was included on the City of Lakewood's critical intersection lists in 2001 and 2003.

3.9 Bicycle and Pedestrian

Evaluation of the bicycle and pedestrian facilities, completed by Navjoy Consulting Services, is based on a review of the most current available plans and by performing field inventories and observations.

US 6 Mainline and Interchanges

- US 6 is a grade-separated facility where bicycles and pedestrians are prohibited.

Wadsworth Boulevard Corridor

- The existing pedestrian sidewalk system lacks continuity and is not in conformance with CDOT's standards. Approximately 50 percent of the east side of Wadsworth Boulevard

has no sidewalk or substandard sidewalk, while 85 percent of the west side of the street has no sidewalk or sidewalk in substandard condition.

- While currently not a highly active pedestrian or bicycle corridor, the future light rail station and ancillary development at 13th Avenue are expected to increase pedestrian and bicycle activity along Wadsworth Boulevard.
- The existing cloverleaf interchange is not conducive to pedestrian and bicycle movements. The high-volume, free-flowing ramps do not provide adequate gaps in traffic, and vehicle visibility for bicyclists crossing the ramps is difficult and unsafe.
- US 6 creates a barrier for bicyclists and pedestrians. Wadsworth Boulevard is the only crossing of US 6 for the 2.5-mile section between Sheridan Boulevard and Garrison Street.
- The d-10 bicycle route crosses Wadsworth Boulevard at 10th Avenue and 13th Avenue.
- The majority of pedestrian activity occurs at Fifth Avenue and 10th Avenue.

4.0 Geometric Health Report Plans

The attached plan sheets (Exhibits 4-1 through 4-12) provide a graphical summary of the geometric "health" of the existing US 6 and Wadsworth Boulevard corridor. In general, the following health ratings indicate how well the existing geometric elements meet current design criteria:

- Green bars indicate "good" segments where the geometric element meets design criteria.
- Yellow bars indicate "fair" segments where the specific geometric element is borderline in meeting the design criteria.
- Red bars indicate "poor" segments where the geometric element does not meet design criteria.

SOUTHBOUND

GEOMETRIC FEATURES	HORIZONTAL ALIGNMENT
	HORIZONTAL SIGHT STOPPING DISTANCE
	VERTICAL ALIGNMENT
	VERTICAL ALIGNMENT CRITICAL LENGTHS
	VERTICAL SIGHT STOPPING DISTANCE
	ACCESS CONTROL/MEDIAN TREATMENT
	CROSS-SECTIONAL ELEMENTS
	SPACING OF INTERSECTING STREETS
	EXIT AND ENTRANCE DESIGN
	RAMP DESIGN
OPERATIONAL FEATURES	WEAVE DISTANCE
PERFORMANCE MEASURES	LEVEL OF SERVICE (AM/PM)
	ACCIDENT RATES
PEDESTRIAN	CONNECTIVITY
STRUCTURAL	CLASSIFICATION
DRAINAGE	MAJOR

DESIGN CRITERIA FOR SOUTHBOUND

RATING BAR CODES FOR SOUTHBOUND

LEGEND

●B7 GEOTECH BORING LOCATION

ACCIDENT DATA

X.XX ACCIDENTS/MILE/YEAR FOR US6
ACCIDENTS/1 MILLION VEHICLE MILES TRAVELED FOR WW

LEVEL OF SERVICE DATA

B/D INTERSECTION OR RAMP LEVEL OF SERVICE (AM/PM PEAK HOUR)

C/D MAINLINE OR APPROACH LEVEL OF SERVICE (AM/PM PEAK HOUR) LOS GOOD = A-C, FAIR = D, POOR = E-F

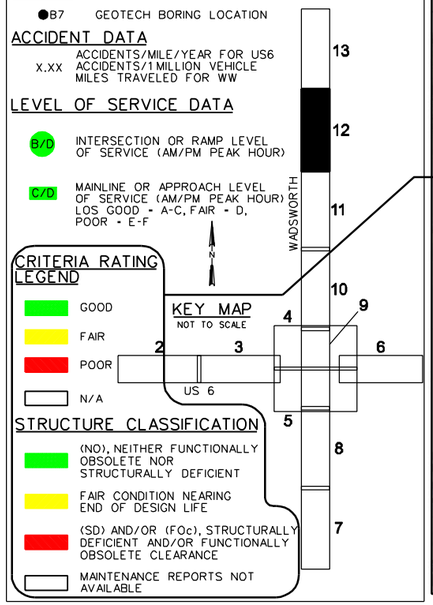
CRITERIA RATING LEGEND

- GOOD
- FAIR
- POOR
- N/A

STRUCTURE CLASSIFICATION

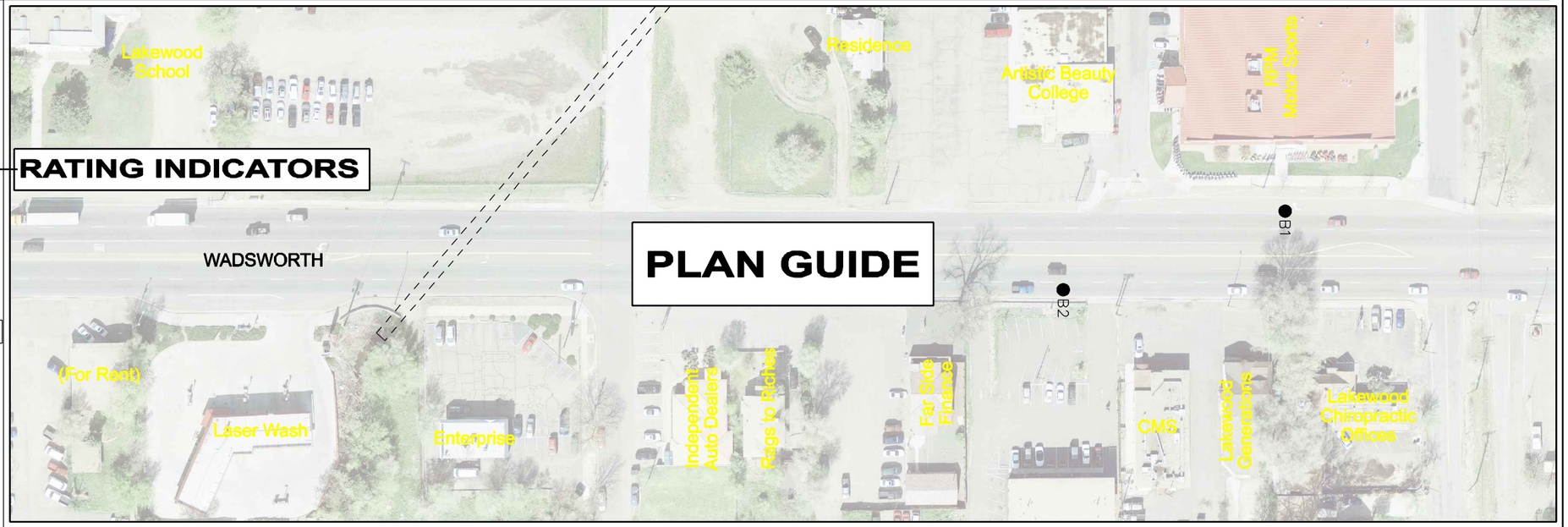
- (NO), NEITHER FUNCTIONALLY OBSOLETE NOR STRUCTURALLY DEFICIENT
- FAIR CONDITION NEARING END OF DESIGN LIFE
- (SD) AND/OR (FO), STRUCTURALLY DEFICIENT AND/OR FUNCTIONALLY OBSOLETE CLEARANCE
- MAINTENANCE REPORTS NOT AVAILABLE

KEY MAP
NOT TO SCALE



RATING INDICATORS

PLAN GUIDE



NORTHBOUND

GEOMETRIC FEATURES	HORIZONTAL ALIGNMENT
	HORIZONTAL SIGHT STOPPING DISTANCE
	VERTICAL ALIGNMENT
	VERTICAL ALIGNMENT CRITICAL LENGTHS
	VERTICAL SIGHT STOPPING DISTANCE
	ACCESS CONTROL/MEDIAN TREATMENT
	CROSS-SECTIONAL ELEMENTS
	SPACING OF INTERSECTING STREETS
	EXIT AND ENTRANCE DESIGN
	RAMP DESIGN
OPERATIONAL FEATURES	WEAVE DISTANCE
PERFORMANCE MEASURES	LEVEL OF SERVICE (AM/PM)
	ACCIDENT RATES
PEDESTRIAN	CONNECTIVITY
STRUCTURAL	CLASSIFICATION
DRAINAGE	MAJOR

DESIGN CRITERIA FOR NORTHBOUND

RATING BAR CODES FOR NORTHBOUND

CH2MHILL
9193 South Jamaica Street
Englewood, CO 80115
Phone: 303-771-0900

COLORADO DEPARTMENT OF TRANSPORTATION
DOT
425B Corporate Circle
Golden, CO 80401
Phone: (720) 497-6955
REGION 6

50 0 50 100
Scale In Feet

US 6 AND WADSWORTH
ENVIRONMENTAL ASSESSMENT

ANALYSIS OF EXISTING US 6 AND WADSWORTH
1ST AVENUE TO 14TH AVENUE

EXHIBIT 4-1

PROJECT NO. 358660

SHEET 1 OF 13

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WESTBOUND ←

GEOMETRIC FEATURES	HORIZONTAL ALIGNMENT	
	HORIZONTAL SIGHT STOPPING DISTANCE	
	VERTICAL ALIGNMENT	
	VERTICAL ALIGNMENT CRITICAL LENGTHS	
	VERTICAL SIGHT STOPPING DISTANCE	
	ACCESS CONTROL/MEDIAN TREATMENT	
	CROSS-SECTIONAL ELEMENTS	
	SPACING OF INTERSECTING STREETS	
	EXIT AND ENTRANCE DESIGN	
	RAMP DESIGN	
OPERATIONAL FEATURES	WEAVE DISTANCE	
PERFORMANCE MEASURES	LEVEL OF SERVICE (AM/PM)	
	ACCIDENT RATES	42
PEDESTRIAN	CONNECTIVITY	
STRUCTURAL	CLASSIFICATION	
DRAINAGE	MAJOR	

LEGEND

●B7 GEOTECH BORING LOCATION

ACCIDENT DATA

X.XX ACCIDENTS/MILE/YEAR FOR US6
ACCIDENTS/1 MILLION VEHICLE MILES TRAVELED FOR WW

LEVEL OF SERVICE DATA

B/D INTERSECTION OR RAMP LEVEL OF SERVICE (AM/PM PEAK HOUR)

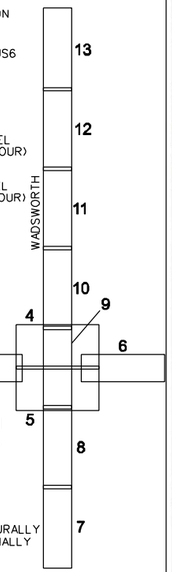
C/D MAINLINE OR APPROACH LEVEL OF SERVICE (AM/PM PEAK HOUR)
LOS GOOD = A-C, FAIR = D, POOR = E-F

CRITERIA RATING LEGEND

- GOOD
- FAIR
- POOR
- N/A

KEY MAP

NOT TO SCALE



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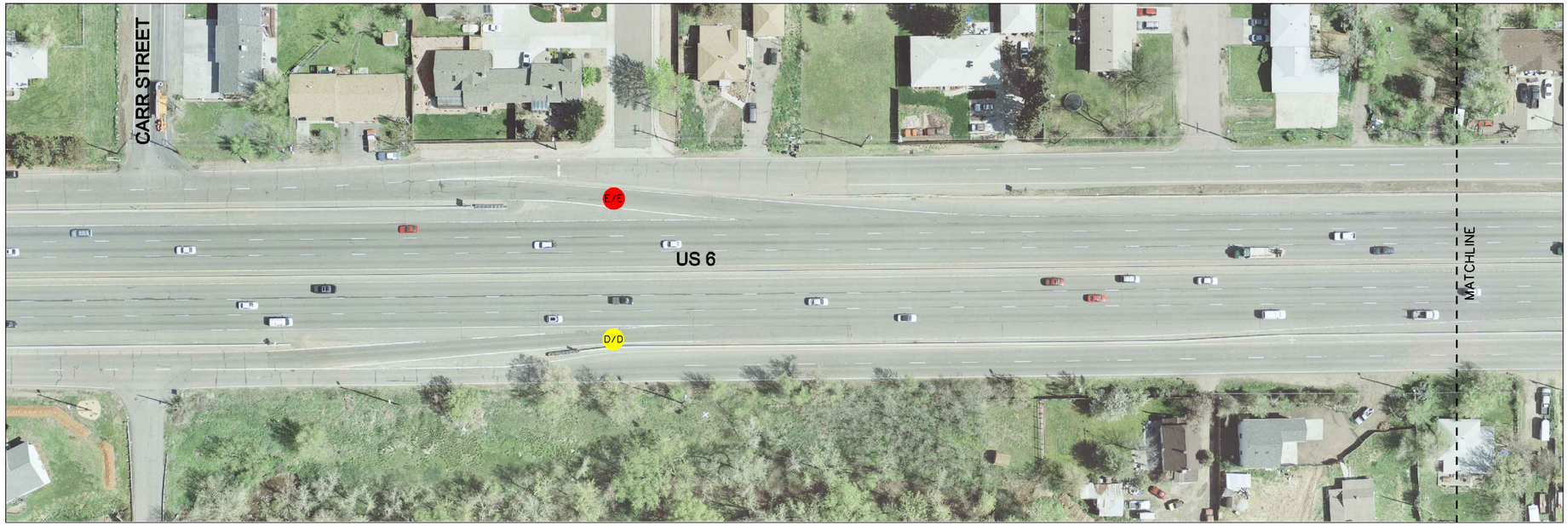

EASTBOUND →

GEOMETRIC FEATURES	HORIZONTAL ALIGNMENT	
	HORIZONTAL SIGHT STOPPING DISTANCE	
	VERTICAL ALIGNMENT	
	VERTICAL ALIGNMENT CRITICAL LENGTHS	
	VERTICAL SIGHT STOPPING DISTANCE	
	ACCESS CONTROL/MEDIAN TREATMENT	
	CROSS-SECTIONAL ELEMENTS	
	SPACING OF INTERSECTING STREETS	
	EXIT AND ENTRANCE DESIGN	
	RAMP DESIGN	
OPERATIONAL FEATURES	WEAVE DISTANCE	
PERFORMANCE MEASURES	LEVEL OF SERVICE (AM/PM)	
	ACCIDENT RATES	42
PEDESTRIAN	CONNECTIVITY	
STRUCTURAL	CLASSIFICATION	
DRAINAGE	MAJOR	

CH2MHILL
9193 South Jamaica Street
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COLORADO DEPARTMENT OF TRANSPORTATION
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425B Corporate Circle
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Phone: (720) 497-6955
REGION 6

50 0 50 100
Scale in Feet

N

US 6 AND WADSWORTH
ENVIRONMENTAL ASSESSMENT

ANALYSIS OF EXISTING US 6 AND WADSWORTH
1ST AVENUE TO 14TH AVENUE
EXHIBIT 4-2

PROJECT NO. 358660

SHEET 2 OF 13

FILENAME: ECPL02US6.dgn PLOT DATE: 08/03/2007 PLOT TIME: 10:08:34 AM

← WESTBOUND

GEOMETRIC FEATURES	HORIZONTAL ALIGNMENT	
	HORIZONTAL SIGHT STOPPING DISTANCE	
	VERTICAL ALIGNMENT	
	VERTICAL ALIGNMENT CRITICAL LENGTHS	
	VERTICAL SIGHT STOPPING DISTANCE	K_{sag} - 100/181 (EXISTING/STANDARD)
	ACCESS CONTROL/MEDIAN TREATMENT	
	CROSS-SECTIONAL ELEMENTS	
	SPACING OF INTERSECTING STREETS	
	EXIT AND ENTRANCE DESIGN	RAMP TERMINAL SPACING
	RAMP DESIGN	
OPERATIONAL FEATURES	WEAVE DISTANCE	
PERFORMANCE MEASURES	LEVEL OF SERVICE (AM/PM)	
	ACCIDENT RATES	42
PEDESTRIAN	CONNECTIVITY	
STRUCTURAL	CLASSIFICATION	
DRAINAGE	MAJOR	MCINTYRE GULCH CONVEYANCE

LEGEND

●B7 GEOTECH BORING LOCATION

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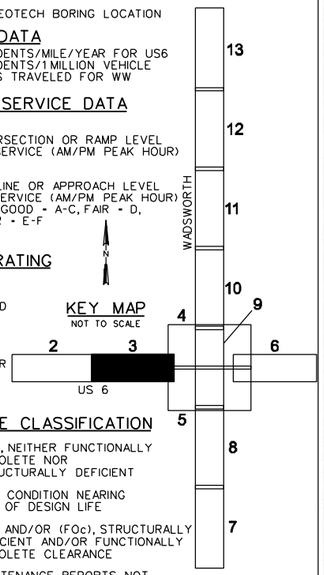
C/D MAINLINE OR APPROACH LEVEL OF SERVICE (AM/PM PEAK HOUR) LOS GOOD = A-C, FAIR = D, POOR = E-F

CRITERIA RATING LEGEND

GOOD
FAIR
POOR
N/A

KEY MAP NOT TO SCALE



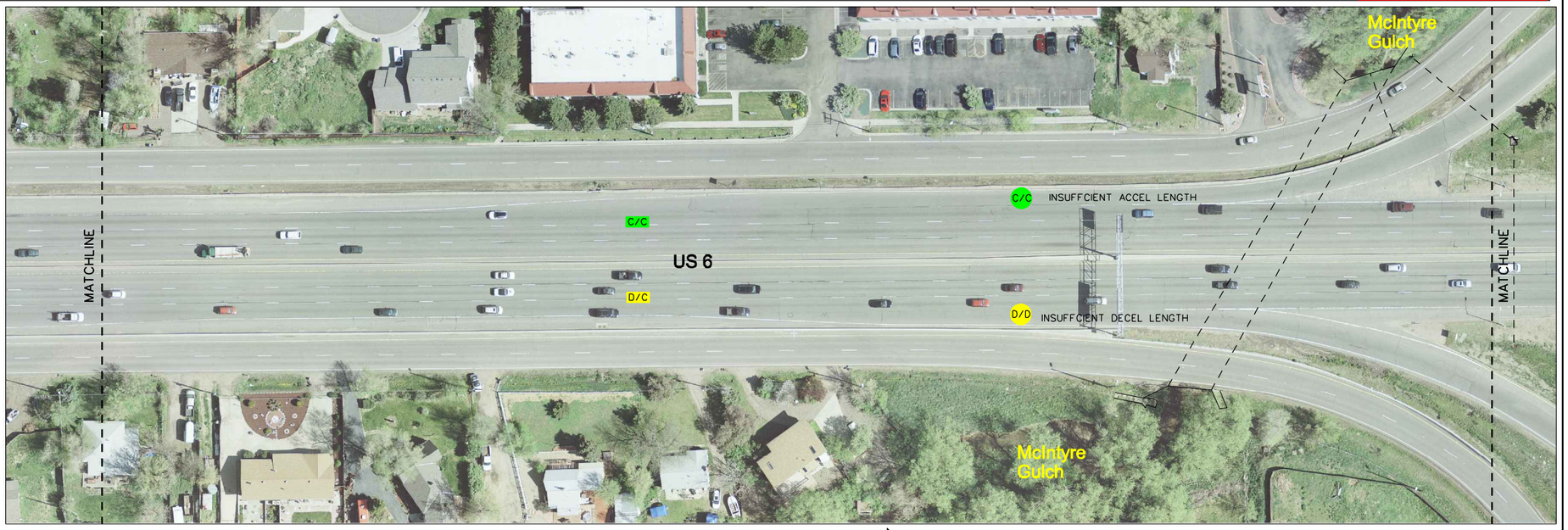
STRUCTURE CLASSIFICATION

(NO), NEITHER FUNCTIONALLY OBSOLETE NOR STRUCTURALLY DEFICIENT

FAIR CONDITION NEARING END OF DESIGN LIFE

(SD) AND/OR (FOc), STRUCTURALLY DEFICIENT AND/OR FUNCTIONALLY OBSOLETE CLEARANCE

MAINTENANCE REPORTS NOT AVAILABLE



EASTBOUND →

GEOMETRIC FEATURES	HORIZONTAL ALIGNMENT	
	HORIZONTAL SIGHT STOPPING DISTANCE	
	VERTICAL ALIGNMENT	
	VERTICAL ALIGNMENT CRITICAL LENGTHS	
	VERTICAL SIGHT STOPPING DISTANCE	K_{sag} = 100/181 (EXISTING/STANDARD)
	ACCESS CONTROL/MEDIAN TREATMENT	
	CROSS-SECTIONAL ELEMENTS	
	SPACING OF INTERSECTING STREETS	
	EXIT AND ENTRANCE DESIGN	
	RAMP DESIGN	
OPERATIONAL FEATURES	WEAVE DISTANCE	
PERFORMANCE MEASURES	LEVEL OF SERVICE (AM/PM)	
	ACCIDENT RATES	42
PEDESTRIAN	CONNECTIVITY	
STRUCTURAL	CLASSIFICATION	FAIR CONDITION MILD EFFLORESCENCE
DRAINAGE	MAJOR	(3)-11.2'X10' CBC; MCINTYRE GULCH CONVEYANCE

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REGION 6

50 0 50 100
Scale In Feet

N

US 6 AND WADSWORTH
ENVIRONMENTAL ASSESSMENT

ANALYSIS OF EXISTING US 6 AND WADSWORTH
1ST AVENUE TO 14TH AVENUE

EXHIBIT 4-3

PROJECT NO.
358660

SHEET 3 OF 13

FILENAME: ECPL03US6.dgn PLOT DATE: 08/03/2007 PLOT TIME: 10:12:06 AM

← WESTBOUND

GEOMETRIC FEATURES	HORIZONTAL ALIGNMENT	
	HORIZONTAL SIGHT STOPPING DISTANCE	
	VERTICAL ALIGNMENT	
	VERTICAL ALIGNMENT CRITICAL LENGTHS	
	VERTICAL SIGHT STOPPING DISTANCE	K_{crest} = 170/247 (EXISTING/STANDARD)
	ACCESS CONTROL/MEDIAN TREATMENT	
	CROSS-SECTIONAL ELEMENTS	
	SPACING OF INTERSECTING STREETS	
	EXIT AND ENTRANCE DESIGN	
	RAMP DESIGN	
OPERATIONAL FEATURES	WEAVE DISTANCE	
PERFORMANCE MEASURES	LEVEL OF SERVICE (AM/PM)	
	ACCIDENT RATES	42
PEDESTRIAN	CONNECTIVITY	
STRUCTURAL	CLASSIFICATION	F-16-0, STRUCTURALLY DEFICIENT
DRAINAGE	MAJOR	MCINTYRE GULCH CONVEYANCE

LEGEND

●B7 GEOTECH BORING LOCATION

ACCIDENT DATA

X.XX ACCIDENTS/MILE/YEAR FOR US6
ACCIDENTS/1 MILLION VEHICLE MILES TRAVELED FOR WW

LEVEL OF SERVICE DATA

B/D INTERSECTION OR RAMP LEVEL OF SERVICE (AM/PM PEAK HOUR)

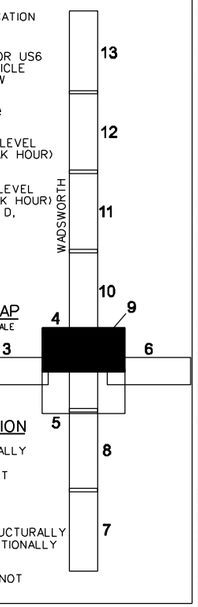
C/D MAINLINE OR APPROACH LEVEL OF SERVICE (AM/PM PEAK HOUR) LOS GOOD = A-C, FAIR = D, POOR = E-F

CRITERIA RATING LEGEND

- GOOD
- FAIR
- POOR
- N/A

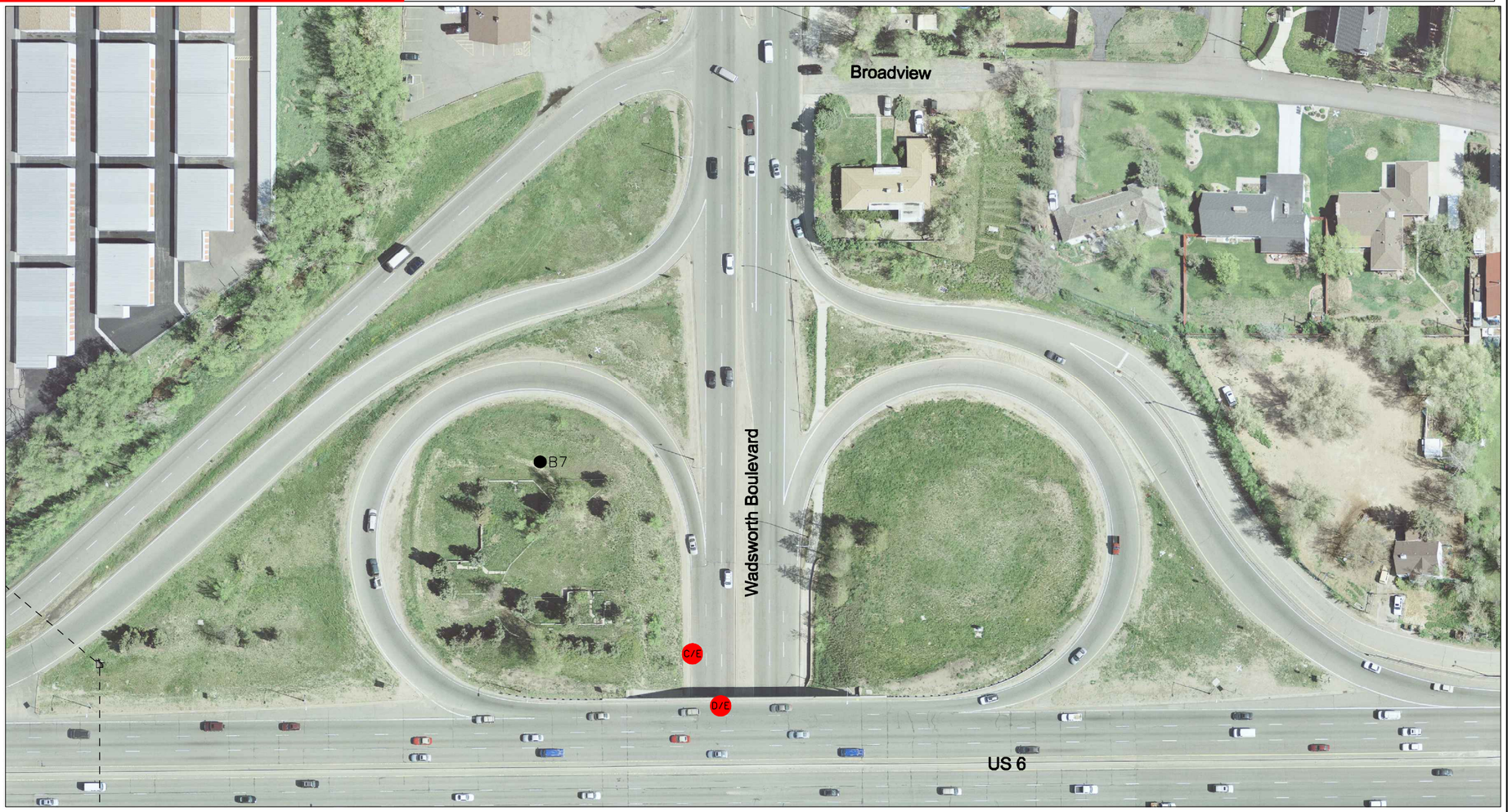
KEY MAP

NOT TO SCALE



STRUCTURE CLASSIFICATION

- (NO), NEITHER FUNCTIONALLY OBSOLETE NOR STRUCTURALLY DEFICIENT
- FAIR CONDITION NEARING END OF DESIGN LIFE
- (SD) AND/OR (FOc), STRUCTURALLY DEFICIENT AND/OR FUNCTIONALLY OBSOLETE CLEARANCE
- MAINTENANCE REPORTS NOT AVAILABLE



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REGION 6

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Scale In Feet

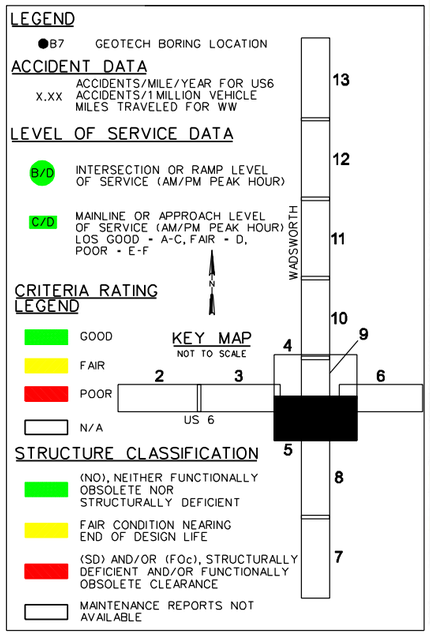
N

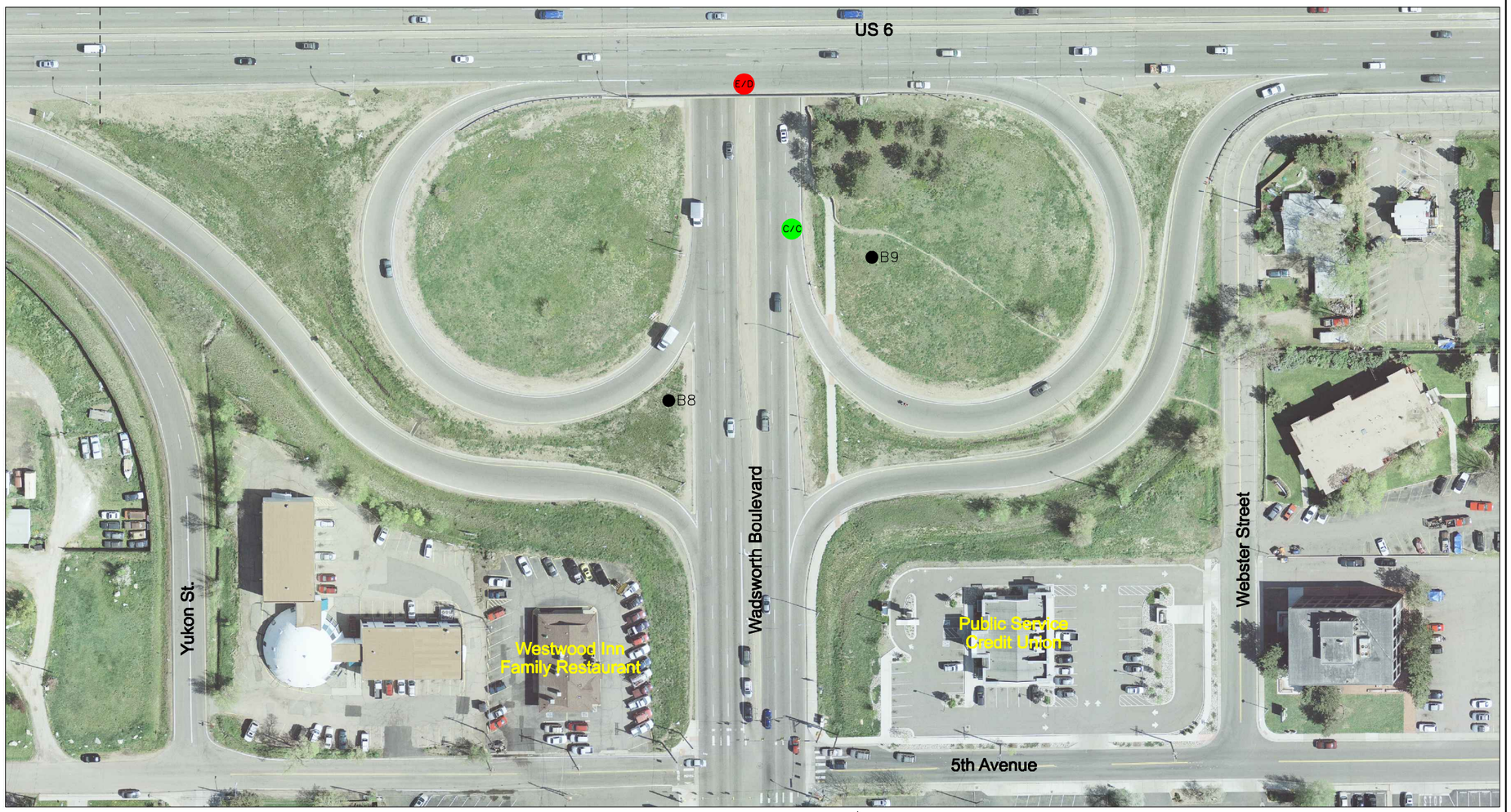
US 6 AND WADSWORTH
ENVIRONMENTAL ASSESSMENT

ANALYSIS OF EXISTING US 6 AND WADSWORTH
1ST AVENUE TO 14TH AVENUE
EXHIBIT 4-4

PROJECT NO.
358660

FILENAME: ECPL04US6.dgn PLOT DATE: 08/03/2007 PLOT TIME: 10:13:03 AM





EASTBOUND →

GEOMETRIC FEATURES	HORIZONTAL ALIGNMENT	
	HORIZONTAL SIGHT STOPPING DISTANCE	
	VERTICAL ALIGNMENT	
	VERTICAL ALIGNMENT CRITICAL LENGTHS	
	VERTICAL SIGHT STOPPING DISTANCE	K_{crest} •170/247 (EXISTING/STANDARD)
	ACCESS CONTROL/MEDIAN TREATMENT	
	CROSS-SECTIONAL ELEMENTS	
	SPACING OF INTERSECTING STREETS	
	EXIT AND ENTRANCE DESIGN	
	RAMP DESIGN	
OPERATIONAL FEATURES	WEAVE DISTANCE	
PERFORMANCE MEASURES	LEVEL OF SERVICE (AM/PM)	
	ACCIDENT RATES	42
PEDESTRIAN	CONNECTIVITY	
STRUCTURAL	CLASSIFICATION	F-16-0 STRUCTURALLY DEFICIENT
DRAINAGE	MAJOR	

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REGION 6

50 0 50 100
Scale In Feet

N

US 6 AND WADSWORTH
ENVIRONMENTAL ASSESSMENT

ANALYSIS OF EXISTING US 6 AND WADSWORTH
1ST AVENUE TO 14TH AVENUE
EXHIBIT 4-5

PROJECT NO.
358660

SHEET 5 OF 13

FILENAME: ECPL05US6.dgn PLOT DATE: 08/03/2007 PLOT TIME: 10:16:46 AM

WESTBOUND ➡

GEOMETRIC FEATURES	HORIZONTAL ALIGNMENT	
	HORIZONTAL SIGHT STOPPING DISTANCE	
	VERTICAL ALIGNMENT	
	VERTICAL ALIGNMENT CRITICAL LENGTHS	
	VERTICAL SIGHT STOPPING DISTANCE	
	ACCESS CONTROL/MEDIAN TREATMENT	
	CROSS-SECTIONAL ELEMENTS	
	SPACING OF INTERSECTING STREETS	
	EXIT AND ENTRANCE DESIGN	
	RAMP DESIGN	
OPERATIONAL FEATURES	WEAVE DISTANCE	
PERFORMANCE MEASURES	LEVEL OF SERVICE (AM/PM)	
	ACCIDENT RATES	42
PEDESTRIAN	CONNECTIVITY	
STRUCTURAL	CLASSIFICATION	
DRAINAGE	MAJOR	

LEGEND

●B7 GEOTECH BORING LOCATION

ACCIDENT DATA

X.XX ACCIDENTS/MILE/YEAR FOR US6
ACCIDENTS/1 MILLION VEHICLE MILES TRAVELED FOR WW

LEVEL OF SERVICE DATA

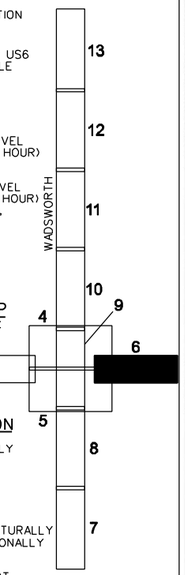
B/D INTERSECTION OR RAMP LEVEL OF SERVICE (AM/PM PEAK HOUR)

C/D MAINLINE OR APPROACH LEVEL OF SERVICE (AM/PM PEAK HOUR)
LOS GOOD = A-C, FAIR = D, POOR = E-F

CRITERIA RATING LEGEND

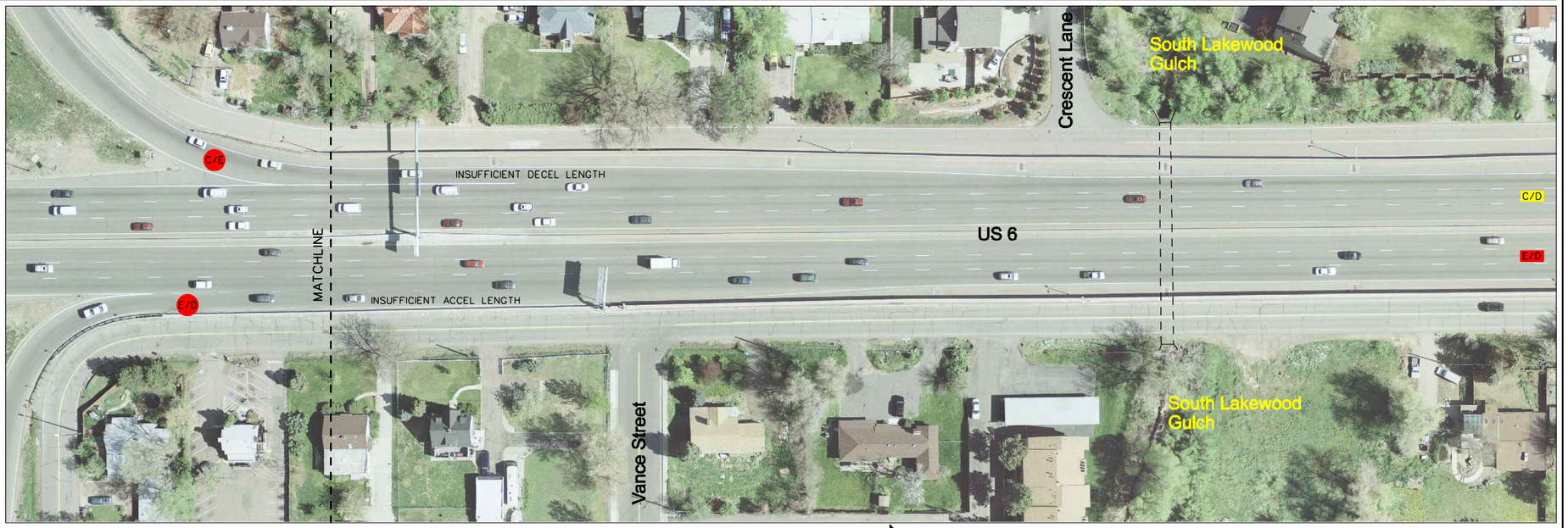
- GOOD
- FAIR
- POOR
- N/A

KEY MAP
NOT TO SCALE



STRUCTURE CLASSIFICATION

- (NO), NEITHER FUNCTIONALLY OBSOLETE NOR STRUCTURALLY DEFICIENT
- FAIR CONDITION NEARING END OF DESIGN LIFE
- (SD) AND/OR (FOc), STRUCTURALLY DEFICIENT AND/OR FUNCTIONALLY OBSOLETE CLEARANCE
- MAINTENANCE REPORTS NOT AVAILABLE



EASTBOUND ➡

GEOMETRIC FEATURES	HORIZONTAL ALIGNMENT	
	HORIZONTAL SIGHT STOPPING DISTANCE	
	VERTICAL ALIGNMENT	
	VERTICAL ALIGNMENT CRITICAL LENGTHS	
	VERTICAL SIGHT STOPPING DISTANCE	
	ACCESS CONTROL/MEDIAN TREATMENT	
	CROSS-SECTIONAL ELEMENTS	
	SPACING OF INTERSECTING STREETS	
	EXIT AND ENTRANCE DESIGN	
	RAMP DESIGN	
OPERATIONAL FEATURES	WEAVE DISTANCE	
PERFORMANCE MEASURES	LEVEL OF SERVICE (AM/PM)	
	ACCIDENT RATES	42
PEDESTRIAN	CONNECTIVITY	
STRUCTURAL	CLASSIFICATION	
DRAINAGE	MAJOR	8'X8' CBC, EXCEEDS HEADWATER CRITERIA

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Scale In Feet

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US 6 AND WADSWORTH
ENVIRONMENTAL ASSESSMENT

ANALYSIS OF EXISTING US 6 AND WADSWORTH
1ST AVENUE TO 14TH AVENUE
EXHIBIT 4-6

PROJECT NO.
358660

SHEET 6 OF 13

PLOT TIME: 10:17:23 AM
PLOT DATE: 08/03/2007
FILENAME: ECPL06US6.dgn

← SOUTHBOUND

GEOMETRIC FEATURES	HORIZONTAL ALIGNMENT	
	HORIZONTAL SIGHT STOPPING DISTANCE	
	VERTICAL ALIGNMENT	
	VERTICAL ALIGNMENT CRITICAL LENGTHS	
	VERTICAL SIGHT STOPPING DISTANCE	K_{crest} = 58/61 (EXISTING/STANDARD) ; K_{sag} = 42/79 (EXISTING/STANDARD)
	ACCESS CONTROL/MEDIAN TREATMENT	
	CROSS-SECTIONAL ELEMENTS	
	SPACING OF INTERSECTING STREETS	SIGNALIZED < 1/2 MILE (600')
	EXIT AND ENTRANCE DESIGN	
	RAMP DESIGN	
OPERATIONAL FEATURES	WEAVE DISTANCE	
PERFORMANCE MEASURES	LEVEL OF SERVICE (AM/PM)	EB-D/E ; SB-A/A
	ACCIDENT RATES	
PEDESTRIAN	CONNECTIVITY	
STRUCTURAL	CLASSIFICATION	
DRAINAGE	MAJOR	EX 48" PIPE - NORTH & SOUTH ROAD OVERTOPS FOR 100YR

LEGEND

●B7 GEOTECH BORING LOCATION

ACCIDENT DATA

X.XX ACCIDENTS/MILE/YEAR FOR US6
ACCIDENTS/1 MILLION VEHICLE MILES TRAVELED FOR WW

LEVEL OF SERVICE DATA

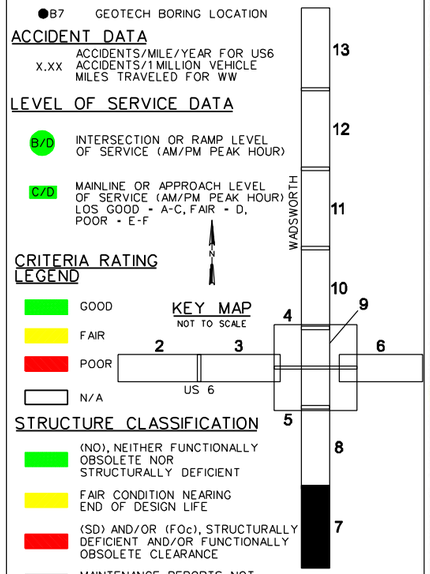
B/D INTERSECTION OR RAMP LEVEL OF SERVICE (AM/PM PEAK HOUR)

C/D MAINLINE OR APPROACH LEVEL OF SERVICE (AM/PM PEAK HOUR)
LOS GOOD = A-C, FAIR = D, POOR = E-F

CRITERIA RATING LEGEND

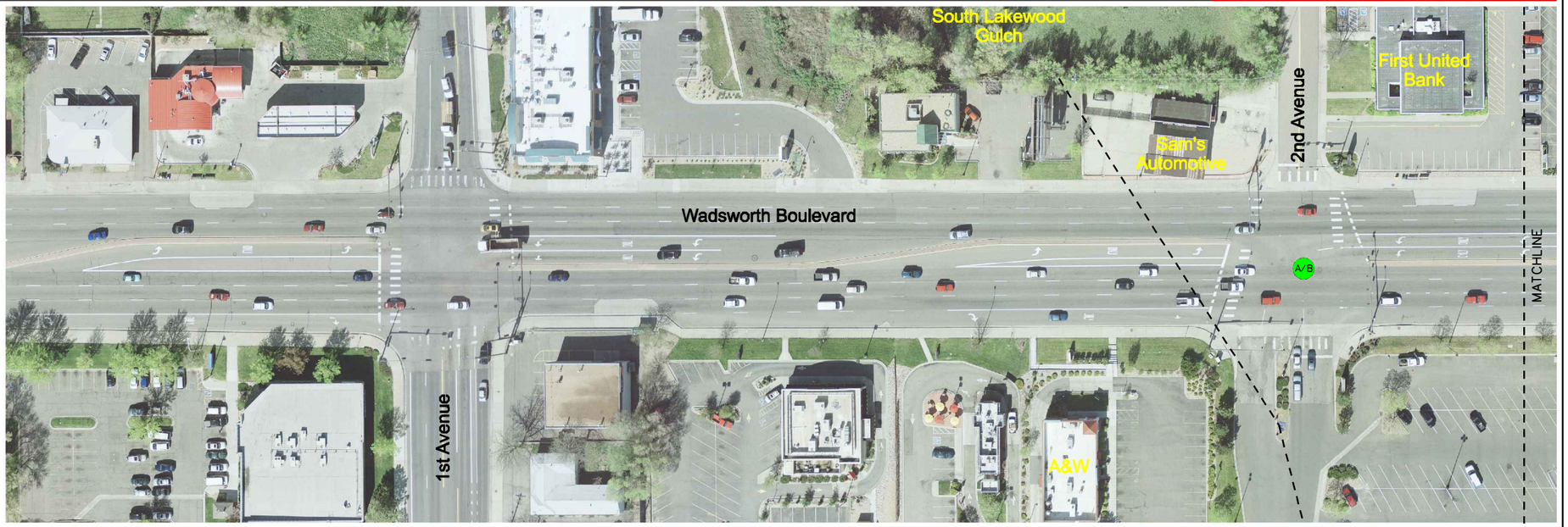
- GOOD
- FAIR
- POOR
- N/A

KEY MAP
NOT TO SCALE



STRUCTURE CLASSIFICATION

- (NO), NEITHER FUNCTIONALLY OBSOLETE NOR STRUCTURALLY DEFICIENT
- FAIR CONDITION NEARING END OF DESIGN LIFE
- (SD) AND/OR (FOc), STRUCTURALLY DEFICIENT AND/OR FUNCTIONALLY OBSOLETE CLEARANCE
- MAINTENANCE REPORTS NOT AVAILABLE



NORTHBOUND →

GEOMETRIC FEATURES	HORIZONTAL ALIGNMENT	
	HORIZONTAL SIGHT STOPPING DISTANCE	
	VERTICAL ALIGNMENT	
	VERTICAL ALIGNMENT CRITICAL LENGTHS	
	VERTICAL SIGHT STOPPING DISTANCE	K_{crest} = 58/61 (EXISTING/STANDARD) ; K_{sag} = 42/79 (EXISTING/STANDARD)
	ACCESS CONTROL/MEDIAN TREATMENT	
	CROSS-SECTIONAL ELEMENTS	
	SPACING OF INTERSECTING STREETS	SIGNALIZED < 1/2 MILE (600')
	EXIT AND ENTRANCE DESIGN	
	RAMP DESIGN	
OPERATIONAL FEATURES	WEAVE DISTANCE	
PERFORMANCE MEASURES	LEVEL OF SERVICE (AM/PM)	NB-A/B ; WB-D/D
	ACCIDENT RATES	
PEDESTRIAN	CONNECTIVITY	
STRUCTURAL	CLASSIFICATION	
DRAINAGE	MAJOR	EX 48" PIPE - NORTH & SOUTH ROAD OVERTOPS FOR 100YR

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N

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Scale In Feet

US 6 AND WADSWORTH
ENVIRONMENTAL ASSESSMENT

ANALYSIS OF EXISTING US 6 AND WADSWORTH
1ST AVENUE TO 14TH AVENUE

EXHIBIT 4-7

PROJECT NO.	
358660	
SHEET	7 OF 13

FILENAME: ECPL07US6.dgn PLOT DATE: 08/03/2007 PLOT TIME: 10:17:55 AM

SOUTHBOUND

GEOMETRIC FEATURES	HORIZONTAL ALIGNMENT	
	HORIZONTAL SIGHT STOPPING DISTANCE	
	VERTICAL ALIGNMENT	
	VERTICAL ALIGNMENT CRITICAL LENGTHS	
	VERTICAL SIGHT STOPPING DISTANCE	
	ACCESS CONTROL/MEDIAN TREATMENT	
	CROSS-SECTIONAL ELEMENTS	
	SPACING OF INTERSECTING STREETS	SIGNALIZED < 1/2 MILE (1250')
	EXIT AND ENTRANCE DESIGN	
	RAMP DESIGN	
OPERATIONAL FEATURES	WEAVE DISTANCE	
PERFORMANCE MEASURES	LEVEL OF SERVICE (AM/PM)	EB-B/B SB-A/A
	ACCIDENT RATES	5.70
PEDESTRIAN	CONNECTIVITY	NARROW ATTACHED S/W
STRUCTURAL	CLASSIFICATION	
DRAINAGE	MAJOR	

LEGEND

●B7 GEOTECH BORING LOCATION

ACCIDENT DATA

X.XX ACCIDENTS/MILE/YEAR FOR US6
ACCIDENTS/1 MILLION VEHICLE MILES TRAVELED FOR WW

LEVEL OF SERVICE DATA

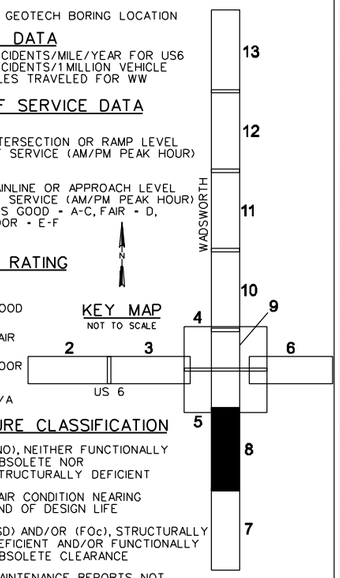
B/D INTERSECTION OR RAMP LEVEL OF SERVICE (AM/PM PEAK HOUR)

C/D MAINLINE OR APPROACH LEVEL OF SERVICE (AM/PM PEAK HOUR) LOS GOOD = A-C, FAIR = D, POOR = E-F

CRITERIA RATING LEGEND

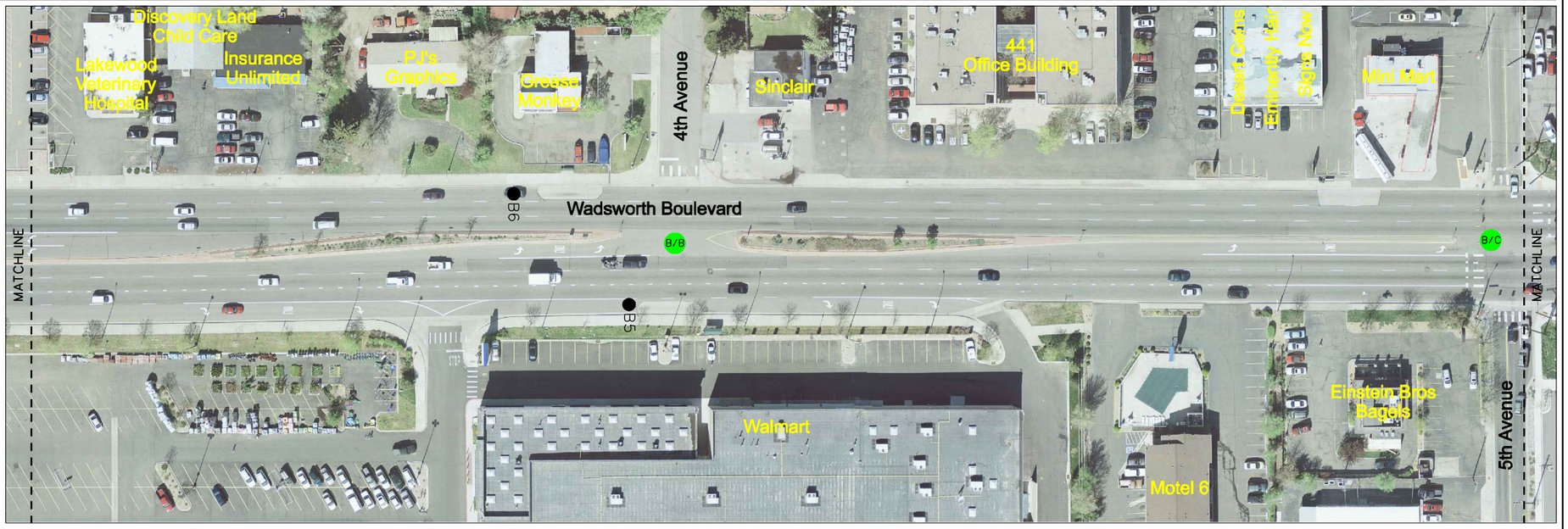
- GOOD
- FAIR
- POOR
- N/A

KEY MAP
NOT TO SCALE



STRUCTURE CLASSIFICATION

- (NO), NEITHER FUNCTIONALLY OBSOLETE NOR STRUCTURALLY DEFICIENT
- FAIR CONDITION NEARING END OF DESIGN LIFE
- (SD) AND/OR (FOc), STRUCTURALLY DEFICIENT AND/OR FUNCTIONALLY OBSOLETE CLEARANCE
- MAINTENANCE REPORTS NOT AVAILABLE



NORTHBOUND

GEOMETRIC FEATURES	HORIZONTAL ALIGNMENT	
	HORIZONTAL SIGHT STOPPING DISTANCE	
	VERTICAL ALIGNMENT	
	VERTICAL ALIGNMENT CRITICAL LENGTHS	
	VERTICAL SIGHT STOPPING DISTANCE	
	ACCESS CONTROL/MEDIAN TREATMENT	
	CROSS-SECTIONAL ELEMENTS	
	SPACING OF INTERSECTING STREETS	SIGNALIZED < 1/2 MILE (1250')
	EXIT AND ENTRANCE DESIGN	
	RAMP DESIGN	
OPERATIONAL FEATURES	WEAVE DISTANCE	
PERFORMANCE MEASURES	LEVEL OF SERVICE (AM/PM)	NB-A/A NB-A/B WB-D/E
	ACCIDENT RATES	5.70
PEDESTRIAN	CONNECTIVITY	NARROW ATTACHED S/W
STRUCTURAL	CLASSIFICATION	
DRAINAGE	MAJOR	

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N

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Scale In Feet

US 6 AND WADSWORTH
ENVIRONMENTAL ASSESSMENT

ANALYSIS OF EXISTING US 6 AND WADSWORTH
1ST AVENUE TO 14TH AVENUE

EXHIBIT 4-8

PROJECT NO. 358660

SHEET 8 OF 13

FILENAME: ECPL08US6.dgn PLOT DATE: 08/03/2007 PLOT TIME: 10:18:29 AM

← SOUTHBOUND

GEOMETRIC FEATURES	HORIZONTAL ALIGNMENT	
	HORIZONTAL SIGHT STOPPING DISTANCE	
	VERTICAL ALIGNMENT	GRADE < 0.5%
	VERTICAL ALIGNMENT CRITICAL LENGTHS	
	VERTICAL SIGHT STOPPING DISTANCE	K_{sag} = 71/79 (EXISTING/STANDARD)
	ACCESS CONTROL/MEDIAN TREATMENT	
	CROSS-SECTIONAL ELEMENTS	
	SPACING OF INTERSECTING STREETS	175' ; 100'
	EXIT AND ENTRANCE DESIGN	
	RAMP DESIGN	
OPERATIONAL FEATURES	WEAVE DISTANCE	
PERFORMANCE MEASURES	LEVEL OF SERVICE (AM/PM)	EB-D/E ; SB-B/C
	ACCIDENT RATES	10.91
PEDESTRIAN	CONNECTIVITY	NO PED FACILITIES
STRUCTURAL	CLASSIFICATION	
DRAINAGE	MAJOR	

LEGEND

●B7 GEOTECH BORING LOCATION

ACCIDENT DATA

X.XX ACCIDENTS/MILE/YEAR FOR US6
ACCIDENTS/1 MILLION VEHICLE MILES TRAVELED FOR WW

LEVEL OF SERVICE DATA

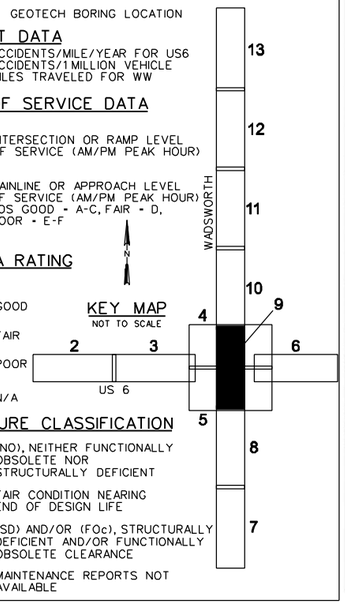
B/D INTERSECTION OR RAMP LEVEL OF SERVICE (AM/PM PEAK HOUR)

C/D MAINLINE OR APPROACH LEVEL OF SERVICE (AM/PM PEAK HOUR)
LOS GOOD = A-C, FAIR = D, POOR = E-F

CRITERIA RATING LEGEND

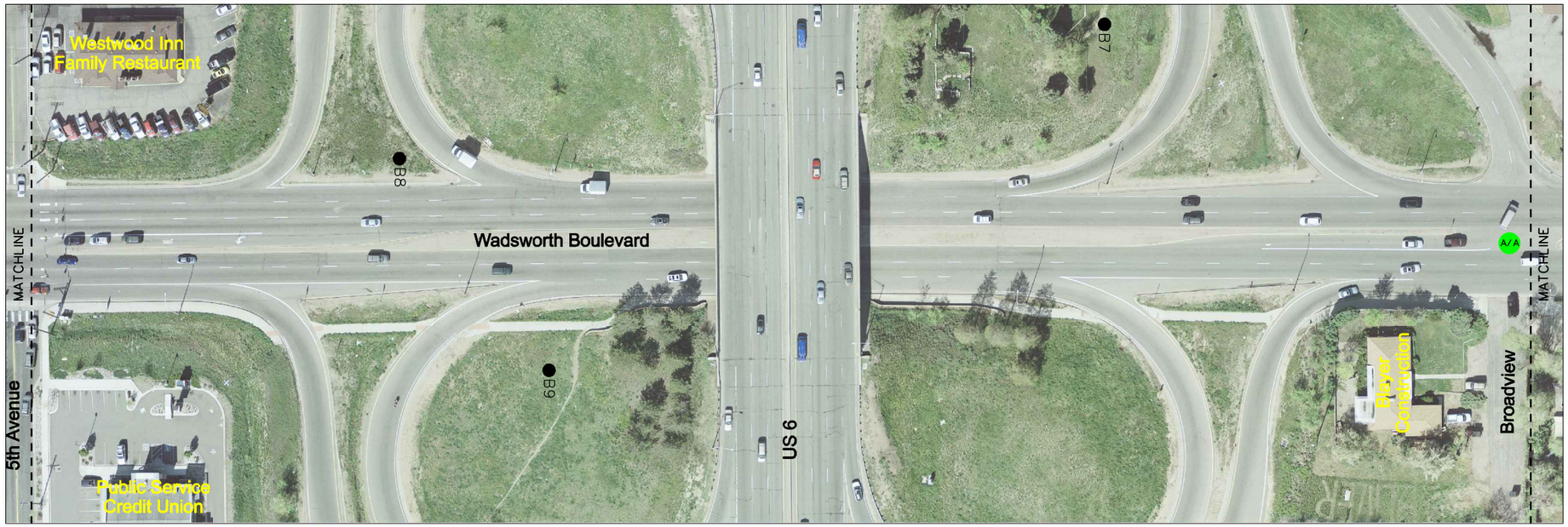
- GOOD
- FAIR
- POOR
- N/A

KEY MAP NOT TO SCALE



STRUCTURE CLASSIFICATION

- (NO), NEITHER FUNCTIONALLY OBSOLETE NOR STRUCTURALLY DEFICIENT
- FAIR CONDITION NEARING END OF DESIGN LIFE
- (SD) AND/OR (FOc), STRUCTURALLY DEFICIENT AND/OR FUNCTIONALLY OBSOLETE CLEARANCE
- MAINTENANCE REPORTS NOT AVAILABLE



NORTHBOUND →

GEOMETRIC FEATURES	HORIZONTAL ALIGNMENT	
	HORIZONTAL SIGHT STOPPING DISTANCE	
	VERTICAL ALIGNMENT	GRADE < 0.5%
	VERTICAL ALIGNMENT CRITICAL LENGTHS	
	VERTICAL SIGHT STOPPING DISTANCE	K_{sag} = 71/79 (EXISTING/STANDARD)
	ACCESS CONTROL/MEDIAN TREATMENT	
	CROSS-SECTIONAL ELEMENTS	
	SPACING OF INTERSECTING STREETS	150' ; 100'
	EXIT AND ENTRANCE DESIGN	
	RAMP DESIGN	
OPERATIONAL FEATURES	WEAVE DISTANCE	
PERFORMANCE MEASURES	LEVEL OF SERVICE (AM/PM)	NB-A/A ; WB-A/A
	ACCIDENT RATES	10.91
PEDESTRIAN	CONNECTIVITY	CROSSINGS OF HIGH VOLUME, FREE FLOW RAMPS NARROW S/W UNDER BRIDGE
STRUCTURAL	CLASSIFICATION	RETAINING WALL
DRAINAGE	MAJOR	

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REGION 6

N

50 0 50 100
Scale In Feet

US 6 AND WADSWORTH
ENVIRONMENTAL ASSESSMENT

ANALYSIS OF EXISTING US 6 AND WADSWORTH
1ST AVENUE TO 14TH AVENUE

EXHIBIT 4-9

PROJECT NO.	
358660	
SHEET	9 OF 13

FILENAME: ECPL09US6.dgn PLOT DATE: 08/03/2007 PLOT TIME: 10:19:57 AM

SOUTHBOUND

GEOMETRIC FEATURES	HORIZONTAL ALIGNMENT	
	HORIZONTAL SIGHT STOPPING DISTANCE	
	VERTICAL ALIGNMENT	
	VERTICAL ALIGNMENT CRITICAL LENGTHS	
	VERTICAL SIGHT STOPPING DISTANCE	Ksag= 36/79 (EXISTING/STANDARD) Kcrest= 56/61 (EXISTING/STANDARD)
	ACCESS CONTROL/MEDIAN TREATMENT	
	CROSS-SECTIONAL ELEMENTS	
	SPACING OF INTERSECTING STREETS	
	EXIT AND ENTRANCE DESIGN	
	RAMP DESIGN	
OPERATIONAL FEATURES	WEAVE DISTANCE	
PERFORMANCE MEASURES	LEVEL OF SERVICE (AM/PM)	SB=A/A EB=F/F SB=A/A
	ACCIDENT RATES	4.81
PEDESTRIAN	CONNECTIVITY	MISSING S/W NO PED FACILITY
STRUCTURAL	CLASSIFICATION	FAIR CONDITION MILD EFFLORESCENCE RETAINING WALL
DRAINAGE	MAJOR	2 SPAN 32'X8', NB & SB ROADWAY OVERTOPS FOR 100YR

LEGEND

●B7 GEOTECH BORING LOCATION

ACCIDENT DATA

X.XX ACCIDENTS/MILE/YEAR FOR US6
ACCIDENTS/1 MILLION VEHICLE MILES TRAVELED FOR WW

LEVEL OF SERVICE DATA

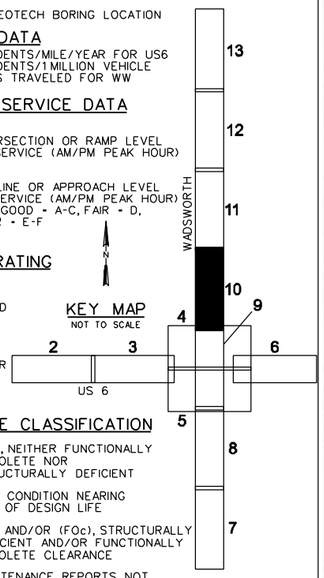
B/D INTERSECTION OR RAMP LEVEL OF SERVICE (AM/PM PEAK HOUR)

C/D MAINLINE OR APPROACH LEVEL OF SERVICE (AM/PM PEAK HOUR) LOS GOOD = A-C, FAIR = D, POOR = E-F

CRITERIA RATING LEGEND

GOOD
FAIR
POOR
N/A

KEY MAP NOT TO SCALE



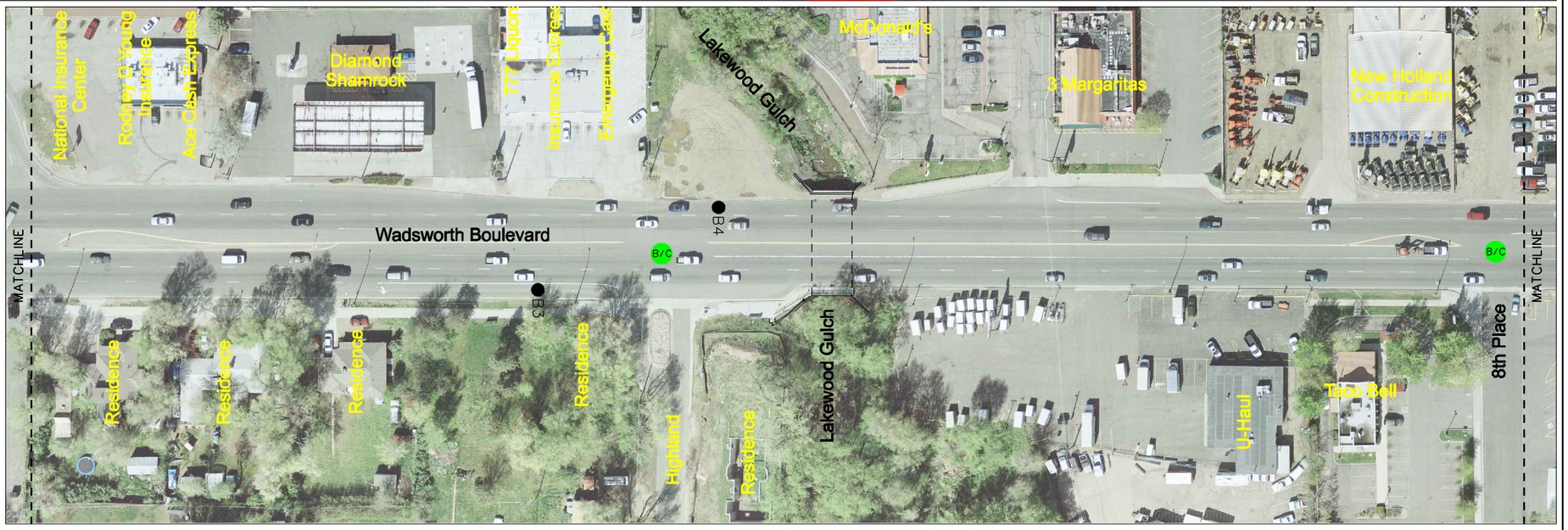
STRUCTURE CLASSIFICATION

(NO), NEITHER FUNCTIONALLY OBSOLETE NOR STRUCTURALLY DEFICIENT

FAIR CONDITION NEARING END OF DESIGN LIFE

(SD) AND/OR (FO), STRUCTURALLY DEFICIENT AND/OR FUNCTIONALLY OBSOLETE CLEARANCE

MAINTENANCE REPORTS NOT AVAILABLE



NORTHBOUND

GEOMETRIC FEATURES	HORIZONTAL ALIGNMENT	
	HORIZONTAL SIGHT STOPPING DISTANCE	
	VERTICAL ALIGNMENT	
	VERTICAL ALIGNMENT CRITICAL LENGTHS	
	VERTICAL SIGHT STOPPING DISTANCE	Ksag= 36/79 (EXISTING/STANDARD) Kcrest= 56/61 (EXISTING/STANDARD)
	ACCESS CONTROL/MEDIAN TREATMENT	
	CROSS-SECTIONAL ELEMENTS	
	SPACING OF INTERSECTING STREETS	500'
	EXIT AND ENTRANCE DESIGN	
	RAMP DESIGN	
OPERATIONAL FEATURES	WEAVE DISTANCE	
PERFORMANCE MEASURES	LEVEL OF SERVICE (AM/PM)	NB=A/A WB=F/F NB=A/A WB=F/F
	ACCIDENT RATES	4.81
PEDESTRIAN	CONNECTIVITY	NARROW MISSING S/W LUMINAIRE POLES IN PED TRAVEL WAY
STRUCTURAL	CLASSIFICATION	FAIR CONDITION MILD EFFLORESCENCE
DRAINAGE	MAJOR	2 SPAN 32'X8', NB & SB ROADWAY OVERTOPS FOR 100YR

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REGION 6

N

50 0 50 100
Scale In Feet

US 6 AND WADSWORTH
ENVIRONMENTAL ASSESSMENT

ANALYSIS OF EXISTING US 6 AND WADSWORTH
1ST AVENUE TO 14TH AVENUE

EXHIBIT 4-10

PROJECT NO. 358660

SHEET 10 OF 13

FILENAME: ECPL10US6.dgn PLOT DATE: 08/03/2007 PLOT TIME: 10:20:33 AM

← SOUTHBOUND

GEOMETRIC FEATURES	HORIZONTAL ALIGNMENT	
	HORIZONTAL SIGHT STOPPING DISTANCE	
	VERTICAL ALIGNMENT	GRADE < 0.5%
	VERTICAL ALIGNMENT CRITICAL LENGTHS	
	VERTICAL SIGHT STOPPING DISTANCE	Ksag= 51/79 (EXISTING/STANDARD); Ksag= 47/61 (EXISTING/STANDARD)
	ACCESS CONTROL/MEDIAN TREATMENT	
	CROSS-SECTIONAL ELEMENTS	
	SPACING OF INTERSECTING STREETS	
	EXIT AND ENTRANCE DESIGN	
	RAMP DESIGN	
OPERATIONAL FEATURES	WEAVE DISTANCE	
PERFORMANCE MEASURES	LEVEL OF SERVICE (AM/PM)	SB=A/A; EB=F/F; SB=A/A; EB=D/D; SB=A/C
	ACCIDENT RATES	4.81
PEDESTRIAN	CONNECTIVITY	MISSING S/W; NON-ADA CURB RAMP; MISSING S/W; NARROW S/W CROSSWALK MARKINGS IN FAIR CONDITION
STRUCTURAL	CLASSIFICATION	
DRAINAGE	MAJOR	

LEGEND

●B7 GEOTECH BORING LOCATION

ACCIDENT DATA

X.XX ACCIDENTS/MILE/YEAR FOR US6
ACCIDENTS/1 MILLION VEHICLE MILES TRAVELED FOR WW

LEVEL OF SERVICE DATA

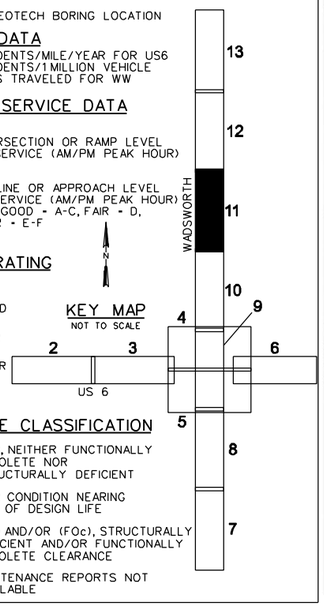
B/D INTERSECTION OR RAMP LEVEL OF SERVICE (AM/PM PEAK HOUR)

C/D MAINLINE OR APPROACH LEVEL OF SERVICE (AM/PM PEAK HOUR) LOS GOOD = A-C, FAIR = D, POOR = E-F

CRITERIA RATING LEGEND

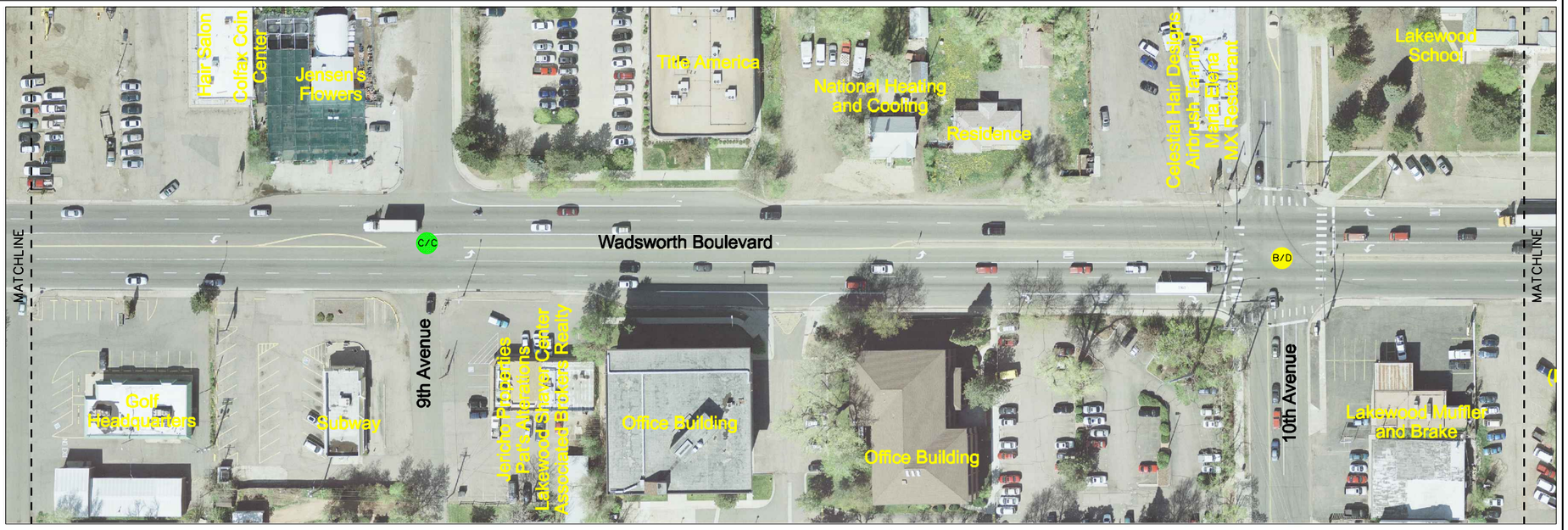
- GOOD
- FAIR
- POOR
- N/A

KEY MAP NOT TO SCALE



STRUCTURE CLASSIFICATION

- (NO), NEITHER FUNCTIONALLY OBSOLETE NOR STRUCTURALLY DEFICIENT
- FAIR CONDITION NEARING END OF DESIGN LIFE
- (SD) AND/OR (FOc), STRUCTURALLY DEFICIENT AND/OR FUNCTIONALLY OBSOLETE CLEARANCE
- MAINTENANCE REPORTS NOT AVAILABLE



NORTHBOUND →

GEOMETRIC FEATURES	HORIZONTAL ALIGNMENT	
	HORIZONTAL SIGHT STOPPING DISTANCE	
	VERTICAL ALIGNMENT	GRADE < 0.5%
	VERTICAL ALIGNMENT CRITICAL LENGTHS	
	VERTICAL SIGHT STOPPING DISTANCE	Ksag= 51/79 (EXISTING/STANDARD); Ksag= 47/61 (EXISTING/STANDARD)
	ACCESS CONTROL/MEDIAN TREATMENT	
	CROSS-SECTIONAL ELEMENTS	
	SPACING OF INTERSECTING STREETS	325'
	EXIT AND ENTRANCE DESIGN	
	RAMP DESIGN	
OPERATIONAL FEATURES	WEAVE DISTANCE	
PERFORMANCE MEASURES	LEVEL OF SERVICE (AM/PM)	NB=A/A; WB=F/F; NB=B/B; WB=E/F
	ACCIDENT RATES	4.81
PEDESTRIAN	CONNECTIVITY	NARROW, MISSING CURB RAMP; MISSING S/W; NARROW, ATTACHED S/W DRIVEWAY ISLAND OBSTRUCTS PED/BIKES
STRUCTURAL	CLASSIFICATION	
DRAINAGE	MAJOR	

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REGION 6

N

50 0 50 100
Scale In Feet

US 6 AND WADSWORTH
ENVIRONMENTAL ASSESSMENT

ANALYSIS OF EXISTING US 6 AND WADSWORTH
1ST AVENUE TO 14TH AVENUE

EXHIBIT 4-11

PROJECT NO.	
358660	
SHEET	11 OF 13

FILENAME: ECPL11US6.dgn PLOT DATE: 08/03/2007 PLOT TIME: 10:21:05 AM

SOUTHBOUND

GEOMETRIC FEATURES	HORIZONTAL ALIGNMENT	
	HORIZONTAL SIGHT STOPPING DISTANCE	
	VERTICAL ALIGNMENT	GRADE < 0.50%
	VERTICAL ALIGNMENT CRITICAL LENGTHS	
	VERTICAL SIGHT STOPPING DISTANCE	
	ACCESS CONTROL/MEDIAN TREATMENT	
	CROSS-SECTIONAL ELEMENTS	
	SPACING OF INTERSECTING STREETS	SIGNALIZED < 1/2 MILE (2000')
	EXIT AND ENTRANCE DESIGN	
	RAMP DESIGN	
OPERATIONAL FEATURES	WEAVE DISTANCE	
PERFORMANCE MEASURES	LEVEL OF SERVICE (AM/PM)	EB-F/F; SB-A/A; EB-D/E; SB-A/A
	ACCIDENT RATES	6.40
PEDESTRIAN	CONNECTIVITY	NARROW S/W; MISSING S/W; MISSING S/W
STRUCTURAL	CLASSIFICATION	90"X58" ELLIPTICAL NB & SB ROAD OVERTOPS FOR 100YR
DRAINAGE	MAJOR	

LEGEND

●B7 GEOTECH BORING LOCATION

ACCIDENT DATA

X.XX ACCIDENTS/MILE/YEAR FOR US6
ACCIDENTS/1 MILLION VEHICLE MILES TRAVELED FOR WW

LEVEL OF SERVICE DATA

B/D INTERSECTION OR RAMP LEVEL OF SERVICE (AM/PM PEAK HOUR)

C/D MAINLINE OR APPROACH LEVEL OF SERVICE (AM/PM PEAK HOUR) LOS GOOD = A-C, FAIR = D, POOR = E-F

CRITERIA RATING LEGEND

- GOOD
- FAIR
- POOR
- N/A

STRUCTURE CLASSIFICATION

- (NO), NEITHER FUNCTIONALLY OBSOLETE NOR STRUCTURALLY DEFICIENT
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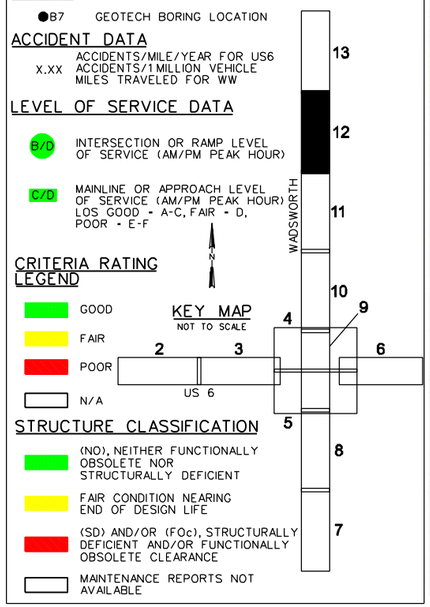
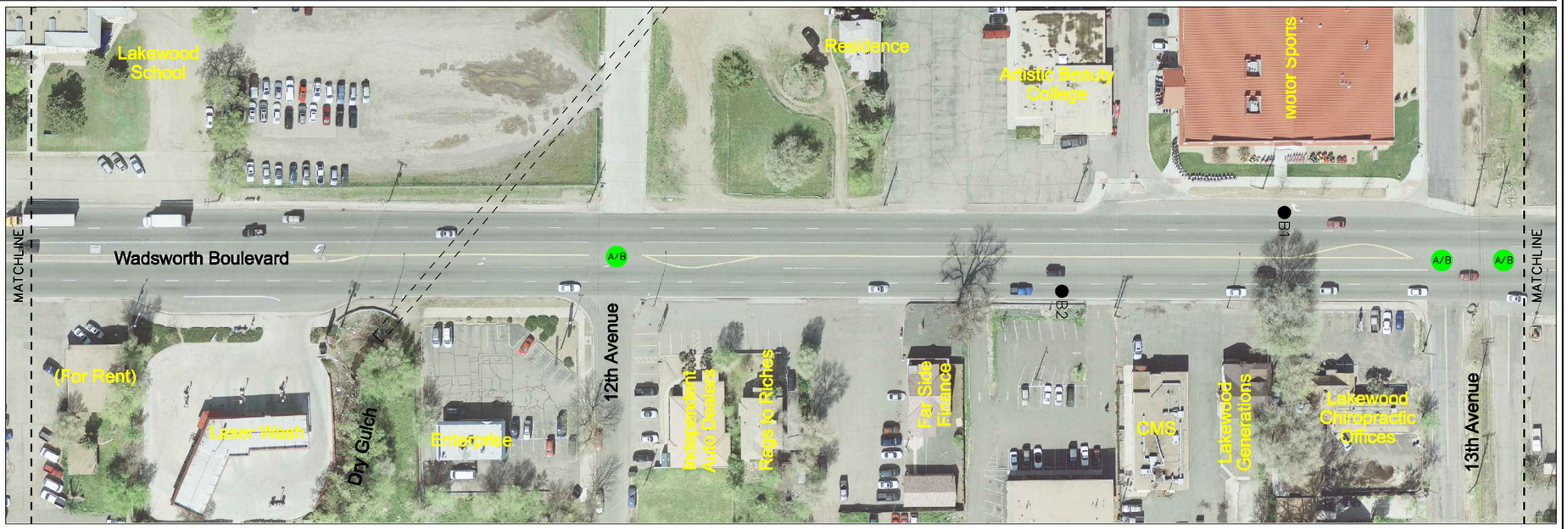
- (SD) AND/OR (FO≤), STRUCTURALLY DEFICIENT AND/OR FUNCTIONALLY OBSOLETE CLEARANCE
- MAINTENANCE REPORTS NOT AVAILABLE

KEY MAP NOT TO SCALE





NORTHBOUND

GEOMETRIC FEATURES	HORIZONTAL ALIGNMENT	
	HORIZONTAL SIGHT STOPPING DISTANCE	
	VERTICAL ALIGNMENT	GRADE < 0.50%
	VERTICAL ALIGNMENT CRITICAL LENGTHS	
	VERTICAL SIGHT STOPPING DISTANCE	
	ACCESS CONTROL/MEDIAN TREATMENT	
	CROSS-SECTIONAL ELEMENTS	
	SPACING OF INTERSECTING STREETS	50'
	EXIT AND ENTRANCE DESIGN	
	RAMP DESIGN	
OPERATIONAL FEATURES	WEAVE DISTANCE	
PERFORMANCE MEASURES	LEVEL OF SERVICE (AM/PM)	NB-A/A; WB-F/F; NB-A/A; WB-D/E; WB-E/F
	ACCIDENT RATES	6.40
PEDESTRIAN	CONNECTIVITY	MISSING S/W; MISSING S/W; MISSING AND/OR VERY NARROW ATTACHED S/W; NARROW ATTACHED S/W
STRUCTURAL	CLASSIFICATION	
DRAINAGE	MAJOR	90"X58" ELLIPTICAL NB & SB ROAD OVERTOPS FOR 100YR

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Scale In Feet

US 6 AND WADSWORTH
ENVIRONMENTAL ASSESSMENT

ANALYSIS OF EXISTING US 6 AND WADSWORTH
1ST AVENUE TO 14TH AVENUE

EXHIBIT 4-12

PROJECT NO.
358660

SHEET 12 OF 13

FILENAME: ECPL12US6.dgn PLOT DATE: 08/03/2007 PLOT TIME: 10:21:40 AM

SOUTHBOUND

GEOMETRIC FEATURES	HORIZONTAL ALIGNMENT	
	HORIZONTAL SIGHT STOPPING DISTANCE	
	VERTICAL ALIGNMENT	GRADE < 0.25%
	VERTICAL ALIGNMENT CRITICAL LENGTHS	
	VERTICAL SIGHT STOPPING DISTANCE	
	ACCESS CONTROL/MEDIAN TREATMENT	
	CROSS-SECTIONAL ELEMENTS	
	SPACING OF INTERSECTING STREETS	SIGNALIZED < 1/2 MILE (2000')
	EXIT AND ENTRANCE DESIGN	
	RAMP DESIGN	
OPERATIONAL FEATURES	WEAVE DISTANCE	
PERFORMANCE MEASURES	LEVEL OF SERVICE (AM/PM)	EB-C/D, SB-B/B
	ACCIDENT RATES	6.40
PEDESTRIAN	CONNECTIVITY	NARROW ATTACHED S/W
STRUCTURAL	CLASSIFICATION	
DRAINAGE	MAJOR	

LEGEND

●B7 GEOTECH BORING LOCATION

ACCIDENT DATA

X.XX ACCIDENTS/MILE/YEAR FOR US6
ACCIDENTS/1 MILLION VEHICLE MILES TRAVELED FOR WW

LEVEL OF SERVICE DATA

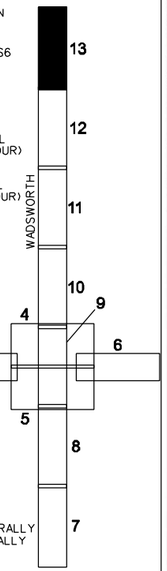
B/D INTERSECTION OR RAMP LEVEL OF SERVICE (AM/PM PEAK HOUR)

C/D MAINLINE OR APPROACH LEVEL OF SERVICE (AM/PM PEAK HOUR)
LOS GOOD - A-C, FAIR - D, POOR - E-F

CRITERIA RATING LEGEND

- GOOD
- FAIR
- POOR
- N/A

KEY MAP
NOT TO SCALE



STRUCTURE CLASSIFICATION

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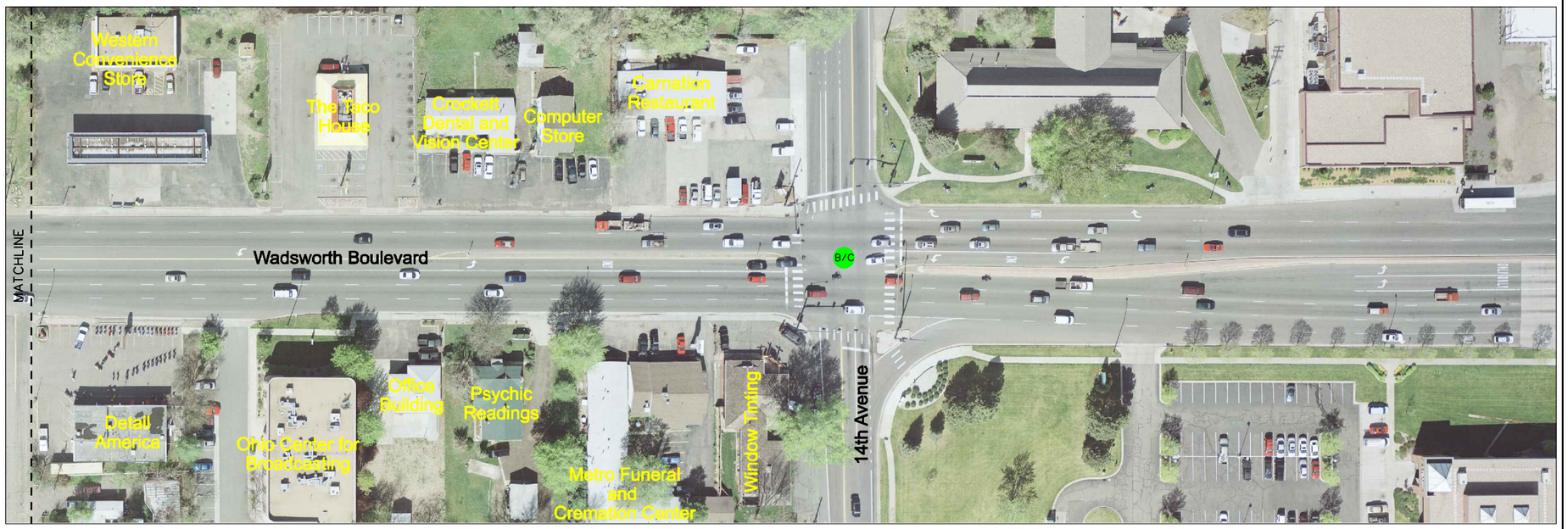

NORTHBOUND

GEOMETRIC FEATURES	HORIZONTAL ALIGNMENT	
	HORIZONTAL SIGHT STOPPING DISTANCE	
	VERTICAL ALIGNMENT	GRADE < 0.25%
	VERTICAL ALIGNMENT CRITICAL LENGTHS	
	VERTICAL SIGHT STOPPING DISTANCE	
	ACCESS CONTROL/MEDIAN TREATMENT	
	CROSS-SECTIONAL ELEMENTS	
	SPACING OF INTERSECTING STREETS	SIGNALIZED < 1/2 MILE (2000')
	EXIT AND ENTRANCE DESIGN	
	RAMP DESIGN	
OPERATIONAL FEATURES	WEAVE DISTANCE	
PERFORMANCE MEASURES	LEVEL OF SERVICE (AM/PM)	NB-B/B, WB-C/D
	ACCIDENT RATES	6.40
PEDESTRIAN	CONNECTIVITY	MISSING S/W, NARROW ATTACHED S/W
STRUCTURAL	CLASSIFICATION	
DRAINAGE	MAJOR	

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Scale In Feet

US 6 AND WADSWORTH
ENVIRONMENTAL ASSESSMENT

ANALYSIS OF EXISTING US 6 AND WADSWORTH
1ST AVENUE TO 14TH AVENUE
EXHIBIT 4-13

PROJECT NO.
358660

SHEET 13 OF 13

FILENAME: ECPL13US6.dgn PLOT DATE: 08/03/2007 PLOT TIME: 10:22:10 AM

5.0 Appendixes of Technical Memoranda

TMs documenting the field reconnaissance site surveys and preliminary analysis for the following engineering design disciplines are attached as appendixes, in CD format, to this summary report as follows:

- Appendix A – Geometric
- Appendix B – Structures
- Appendix C – Drainage
- Appendix D – Geotechnical
- Appendix E – Utilities
- Appendix F – Traffic Analysis
- Appendix G – Neighborhood Traffic Conditions
- Appendix H – Safety Assessment Report Summary
- Appendix I – Bicycle and Pedestrian Facilities

APPENDIX A

Geometric

US 6 and Wadsworth Boulevard Interchange Environmental Assessment Existing Conditions Geometric Analysis

PREPARED FOR: Tim Eversoll

PREPARED BY: Aaron Swafford

COPIES: Mandy Whorton

DATE: July 24, 2007

PROJECT NUMBER: 358660

The purpose of this technical memorandum (TM) is to describe the existing geometric conditions at the US 6 and Wadsworth Boulevard interchange and along Wadsworth Boulevard between First Avenue and 14th Avenue. Information in this TM comes from a field visit on June 1, 2007, as-built information supplied by Colorado Department of Transportation (CDOT) Region 6, and an aerial photographic survey flown for this project.

Introduction

The US 6 and Wadsworth Boulevard (SH 121) interchange is currently the subject of an Environmental Assessment (EA). The first step in the EA is to perform an existing conditions analysis that includes a review of the current roadway geometric conditions. The CDOT study area lies generally between First Avenue and 14th Avenue along Wadsworth Boulevard and also encompasses the US 6 interchange and the Carr Street/Garrison Street slip ramps to the west, entirely within the City of Lakewood.

US 6 is an east-west six-lane freeway on a tangent alignment serving communities west of Denver. US 6 and Wadsworth Boulevard are nearly perpendicular, with US 6 crossing over Wadsworth Boulevard using a full cloverleaf interchange configuration comprised of slow ramp speeds and tight curves on both the directional and loop ramps. Intersections are spaced closely to the interchange both north and south of US 6. The Carr Street/Garrison Street slip ramps to the west are in close proximity to the Wadsworth Boulevard interchange. Evaluation information for US 6 is partially based on the as-builts (U 012-2(4)) supplied by CDOT Region 6.

The Wadsworth Boulevard Corridor is a major regional arterial on a tangent alignment with signalized stop control and driveway accesses. Grades along the corridor are relatively flat, with only two locations where grades exceed 4.5 percent. South of US 6, Wadsworth Boulevard has six though lanes with a raised median to control access, while north of US 6, there are four through lanes with a paved median and uncontrolled access. North of US 6, the median is striped to provide two side-by-side, continuous left-turn lanes serving major intersections and driveway accesses. Exclusive left- and right-turn lanes are provided at high-volume movements but a number of right turns occur from shared through lanes. Bus blockages occur at a number of stops serving Regional Transportation District (RTD) local

and limited bus lines. Evaluation information for Wadsworth Boulevard is partially based on the as-builts (C11-0121-25, C11-0121-26) provided by CDOT Region 6.

Existing Roadway Geometric Issues

The following bullet list highlights the critical issues identified from the evaluation of existing roadway geometric conditions for the US 6 and Wadsworth Boulevard EA.

US 6 Mainline and Interchanges

- The US 6 and Wadsworth Boulevard interchange is a full cloverleaf configuration with substandard design speeds and short superelevation transition lengths on both the directional and loop ramps.
- Stopping sight distance (SSD) is limited in the northeast ramp terminal due to the intersection geometry and an existing retaining wall.
- The ramp terminal geometry does not allow an Interstate Semitrailer Design Vehicle (WB-67) adequate room for turning movements.
- Frontage road access to the northeast directional exit ramp creates a safety issue.
- The deceleration and acceleration lengths of all four directional ramps do not meet project design standards.
- The US 6 inside shoulder lacks sufficient room for emergency stopped vehicles.
- Ramp shoulders vary from standard widths to 2 feet in width.
- SSD is inadequate for the eastbound sag curve approaching Wadsworth Boulevard and the crest vertical curve over Wadsworth Boulevard.

Wadsworth Boulevard Corridor

- SSD is inadequate for several sag and crest vertical curves.
- The vertical roadway grade falls below the minimum project design standard for flow along a concrete gutter.
- Median widths are less than standard, which causes opposing traffic to pass each other within an unsafe distance.
- Signalized and unsignalized intersection spacing is less than the project design standard.

Project Design Standards

Project design standards were developed for this evaluation. The standards were used in the evaluation to compare the existing condition of US 6, Wadsworth Boulevard, and the interchange to current project design standards. To create the project design standards, the following guides were used:

- American Association of State Highway and Transportation Officials (AASHTO), *A Policy on Geometric Design of Highways and Streets,* 2004

- AASHTO, *Roadside Design Guide,* 2006
- Colorado Department of Transportation (CDOT), CDOT *Design Manual,* 2005
- CDOT, *Standard Plans, M & S Standards*, July 2006
- City of Lakewood (Lakewood), *Transportation Engineering Design Standards,* March 2007
- Lakewood. Engineering Regulations, Construction Specifications & Design Standards, June 2003

Intersection Sight Distance

Intersection sight distance was measured in the field on June 1, 2007, and all the intersections meet the City of Lakewood design standards for intersection sight distance. Only one intersection, Fourth Avenue, appeared to have median landscaping slightly obscuring sight distance. The eastbound-to-northbound movement from Fourth Avenue to Wadsworth Boulevard appeared to be obscured by landscaping in the median. However, the median allows for vehicle refuge prior to entering the northbound flow, which facilitates a safe merging movement.

Because there are no locations with intersection sight-distance issues, intersection sight distance was not included in the Geometric Health Report.

Horizontal Alignment and SSD

US 6 and Wadsworth Boulevard follow along tangent horizontal alignments without any horizontal curves. There are only three Points of Intersection (PIs) in the Wadsworth Boulevard alignment, each less than 1 degree in deflection. Because of the lack of horizontal curvature, the mainline for US 6 and Wadsworth Boulevard is rated as "good."

The horizontal alignment for the ramps is discussed in the Ramp Design section of this TM.

Vertical Alignment, Critical Lengths, and SSD

Vertical grades on US 6 are all within project design standards for maximum and minimum grades and Critical Length. US 6 has two sag vertical curves and one crest vertical curve in the study area. Based on a design speed of 70 mph, the design values for K sag vertical curves is 181 and for a crest vertical curve it is 247. The K value is the length of vertical curve per percent change in grade. The design values of K provide the minimum SSD for the roadway. The eastbound approaching sag vertical curve has an existing K value of 100, the crest vertical curve over Wadsworth Boulevard has an existing K value of 170, and the westbound approaching sag vertical curve has an existing K value of 289. The eastbound sag vertical curve and the crest vertical curve are both substandard. The crest vertical curve is considered "poor" because it is a crest curve and the sight distance represented by the K value is obstructed by the roadway, whereas sag curves sight distance is based on headlight distance calculations and can be mitigated with adequate lighting. Therefore, the eastbound sag vertical curve is rated as "fair."

Grades on Wadsworth Boulevard are primarily within project design standards and Critical Length. There are three locations where the grade falls below the minimum grade project design standard of 0.5 percent, which is established primarily to avoid issues in water flow

in curb and gutters. Two locations are rated as "fair" because they are not below the minimum by more then 0.15 percent. One location is rated as "poor" because it is very flat (0.18 percent and 0.24 percent).

There are several vertical curves along Wadsworth Boulevard that do not meet the project design standard for K. Based on a design speed of 45 mph, the design values for K sag vertical curves is 79, while for a crest vertical curve it is 61. Vertical curves that are significantly less than the project design standard are rated as "poor" and curves slightly less than the project design standard are rated as "fair." The following is a list of curves and their designations:

TABLE 1
Wadsworth Boulevard Vertical Curves and Rating

Location	K	K Standard	Rating
First Avenue (crest)	58	61	Fair
Second Avenue (sag)	42	79	Poor
Under US 6 (sag)	71	79	Fair
McIntyre Gulch (sag)	36	79	Poor
Eighth Place (crest)	56	61	Fair
Ninth Avenue (sag)	51	79	Poor
10th Avenue (crest)	47	61	Poor

The vertical alignment for the ramps is discussed in the Ramp Design section of this TM.

Cross-Sectional Elements

Lane widths and outside shoulders for US 6 are typically 12 feet or wider, which meets the project design standard. However, the inside shoulder for US 6 is only 4 feet in width, which fails to meet project design standards. The standard inside shoulder width for this facility is 12 feet to allow for emergency stopped vehicles. The distance from the mainline to frontage roads varies from 26 feet to as narrow as 6 feet. The standard distance between the mainline and frontage roads is 24 feet. The primary pinch points occur when the ramp tapers are developed. Cross-sectional elements are rated "fair" based primarily on the narrow inside shoulder.

The lane widths for Wadsworth Boulevard vary from 11 to 12 feet and are considered adequate. With a design speed of 45 mph, the vertical curb and gutter used along the entire length of Wadsworth Boulevard meets standards. Median treatment south of US 6 is raised with an adequate width. The left-turn bay approaching Fifth Avenue through the interchange and the left-turn bay north of 10th Avenue are rated "fair" because they are only 14 feet wide, 2 feet narrower than standard. In areas north of the interchange, a rating of "poor" is assigned to side-by-side left-turning lanes that are within the median, which is approximately 21 feet wide. The separation between opposing traffic is less than 8 inches (only the width of striping) and the turning lanes are less than 12 feet in width.

The cross-sectional elements for the ramps are discussed in the Ramp Design section of this TM.

Spacing of Intersecting Streets

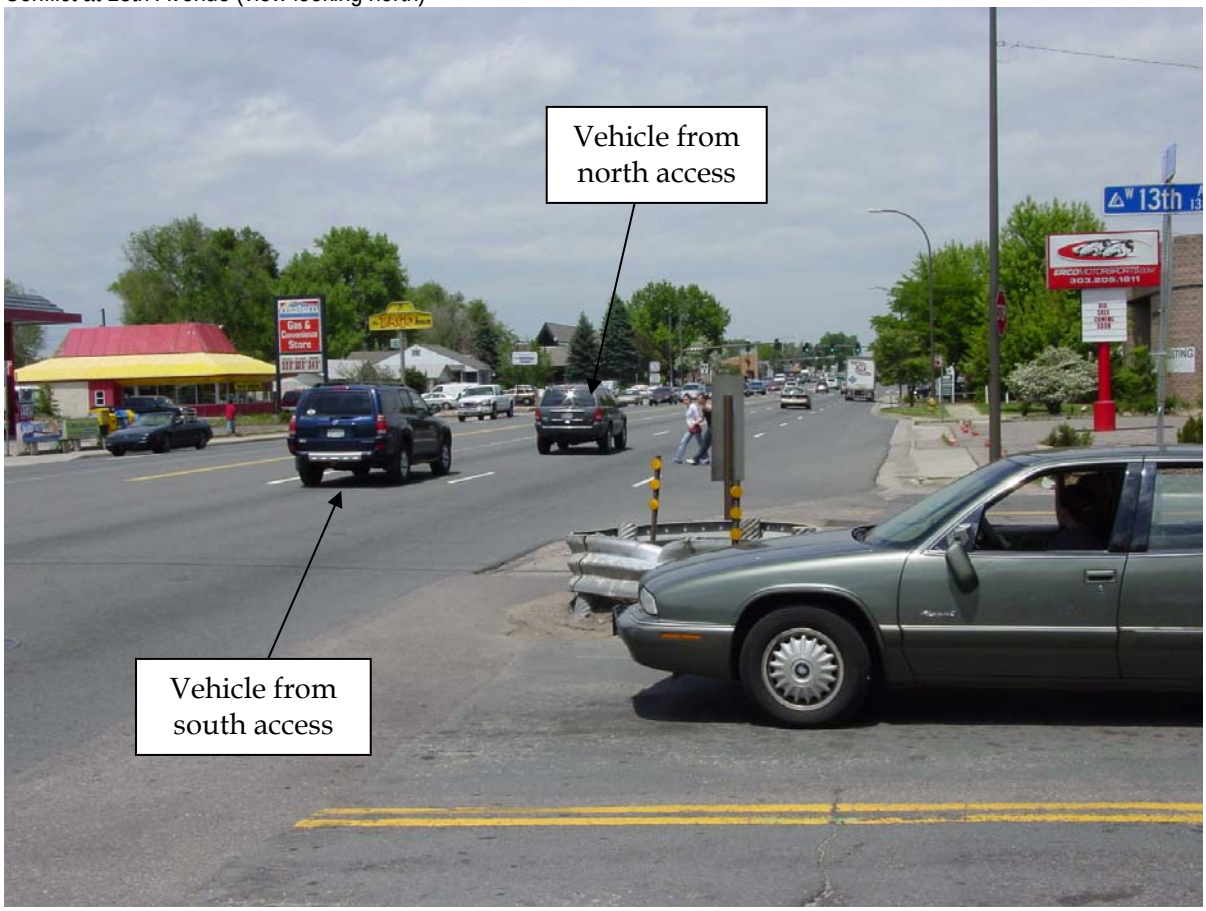
The City of Lakewood intersection spacing criteria state that signalized intersections should be spaced at 0.5-mile intervals, and nonsignalized intersections must be spaced at least 600 feet apart. If the spacing of any intersection is less than the criteria, it is rated as "fair." Spacing of signalized intersections can be mitigated through timing of the signals and are not rated as "poor" unless the spacing is substantially less than the criteria. Unsignalized intersection spacing is rated as "poor" if the spacing represents a safety hazard. Using this criteria, the following intersections were rated as either "fair" or "poor":

TABLE 2
Wadsworth Boulevard Spacing of Intersecting Streets

Location	Distance (ft)	Standard (ft)	Rating
First Avenue to Second Avenue (signalized)	600	2,640	Poor
Second Avenue to Fifth Avenue (signalized)	1,250	2,640	Fair
Fifth Avenue to Southeast Ramp	150	600	Poor
Fifth Avenue to Southwest Ramp	175	600	Poor
Northwest Ramp to Frontage Road	100	600	Poor
Northeast Ramp to Broadview Drive	100	600	Poor
Broadview Drive to Highland Drive	500	600	Fair
Eighth Place to Ninth Avenue	325	600	Poor
10th Avenue to 14th Avenue (signalized)	2,000	2,640	Fair
13th Avenue, two access points	50	600	Poor

The east leg of the intersection at 13th Avenue consists of two access points: a south access and a north access. A serious conflict point can occur when vehicles are leaving from the south access heading north and from the north access turning south. During the field visit, a similar conflict was observed. The south access had a vehicle turn northbound on Wadsworth Boulevard at the same time the north access had a vehicle turn northbound. The vehicle from the south access had to swerve to avoid a collision (see Figure 1).

FIGURE 1
Conflict at 13th Avenue (view looking north)



Ramp Design and Exit and Entrance Design

NE-1

The northeast directional ramp (NE-1) was rated "poor" for several reasons:

- Substandard design speed. Based on horizontal curves and superelevations, the existing design speed of the curve coming off the taper is 34 mph and the curve at the mid-point of the ramp is 28 mph. The mainline's posted speed is 65 mph and the design speed is 70 mph, making the preferred ramp design speed 50 mph.
- The deceleration length for the ramp is inadequate. The existing length is 200 feet and the project design standard requires 490 feet to go from a design speed of 70 mph to 35 mph.
- The existing maximum grade is 6 percent, which is greater than the 5 percent project design standard.
- The north frontage road merges onto the ramp, which violates driver expectancy (see Figure 2).
- The ramp intersection with Wadsworth Boulevard does not allow truck traffic to safely negotiate the turn (see Figure 3). The ramp is not designed for an adequate design

vehicle. Both Wadsworth Boulevard and US 6 are designated truck routes. In discussions with City of Lakewood staff, the City does not restrict the size of trucks along Wadsworth Boulevard; therefore, the design vehicle for the ramp is the same as US 6, which is WB-67.

- The ramp intersection does not have adequate site distance (66 feet as measured in the field). During the field visit, an accident was observed.
- The maximum superelevation is 8 percent, which is greater than the 6 percent standard. The maximum superelevation was based on the frequency of slick conditions from snow and rain.

FIGURE 2
Frontage Road Merge onto Ramp

FIGURE 3
Truck Off Tracking at NE-1 Intersection

NE-2

The northeast loop ramp (NE-2) was rated "fair" for the following reasons:

- Substandard design speed. Based on horizontal curves and superelevations, the existing design speed of the curve is 24 mph. The minimum design speed is 25 mph for loop ramps.
- The maximum superelevation is 8 percent, which is greater than the preferred standard of 6 percent. The maximum superelevation was based on the frequency of slick conditions from snow and rain.

NW-1

The northwest directional ramp (NW-1) was rated "poor" for the following reasons:

- Substandard design speed. Based on horizontal curves and superelevations, the existing design speed of the curve approaching the taper is 37 mph. The mainline's posted speed is 65 mph and the design speed is 70 mph, which makes the preferred ramp design speed 50 mph.
- The acceleration length for the ramp is inadequate. The existing length is 344 feet and the project design standard requires 1,230 feet to go from a design speed of 35 mph to 70 mph.
- The maximum superelevation is 8 percent, which is greater than the standard of 6 percent. The maximum superelevation was based on the frequency of slick conditions from snow and rain.

- The ramp terminal spacing of 1,540 feet at the Carr Street/Garrison Street exit is less than standard. The standard spacing is 1,600 feet.

NW-2

The northwest loop ramp (NW-2) was rated "fair" for the following reason:

- The maximum superelevation is 12 percent, which is greater than the preferred standard of 6 percent. The maximum superelevation was based on the frequency of slick conditions from snow and rain.

SW-1

The southwest directional ramp (SW-1) was rated "poor" for the following reasons:

- Substandard design speed. Based on horizontal curves and superelevations, the existing design speed of the curve at the taper is 42 mph and the curve at the mid-point of the ramp is 27 mph. The mainline's posted speed is 65 mph and the design speed is 70 mph, which makes the preferred ramp design speed 50 mph.
- The deceleration length for the ramp is inadequate. The existing length is 225 feet and the project design standard requires 440 feet to go from a design speed of 70 mph to 40 mph.
- The ramp intersection with Wadsworth Boulevard does not allow truck traffic to safely negotiate the turn. The ramp is not designed for an adequate design vehicle. Both Wadsworth Boulevard and US 6 are designated truck routes. In discussions with City of Lakewood staff, the City does not restrict the size of trucks along Wadsworth Boulevard; therefore, the design vehicle for the ramp is the same as US 6, which is WB-67.
- The maximum superelevation is 8 percent, which is greater than the standard of 6 percent. The maximum superelevation was based on the frequency of slick conditions from snow and rain.
- The superelevation transition length between the ramp-proper curves is too short. A tangent length of only 15.5 feet is available for transitioning between 8 percent superelevations. Typically, a tangent length of approximately 180 feet would be necessary to accommodate a transition between 8 percent superelevations using a 0.6 distribution on tangent with these curve radii.

SW-2

The southwest loop ramp (SW-2) was rated "fair" for the following reasons:

- Substandard design speed. Based on horizontal curves and superelevations, the existing design speed of the curve is 23 mph. The minimum design speed is 25 mph for loop ramps.
- The maximum superelevation is 8 percent, which is greater than the 6 percent preferred standard. The maximum superelevation was based on the frequency of slick conditions from snow and rain.

SE-1

The southeast directional ramp (SE-1) was rated "poor" for the following reasons:

- Substandard design speed. Based on horizontal curves and superelevations, the existing design speed of the curve is 28 mph at the mid-point of the ramp and 22 mph approaching the taper. The mainline's posted speed is 65 mph and the design speed is 70 mph, which makes the preferred ramp design speed 50 mph.
- The acceleration length for the ramp is inadequate. The existing length is 200 feet and the project design standard requires 1,520 feet to go from a design speed of 20 mph to 70 mph.
- The maximum superelevation is 8 percent, which is greater than the 6 percent standard. The maximum superelevation was based on the frequency of slick conditions from snow and rain.
- The superelevation transition length between the ramp-proper curves is too short. A tangent length of approximately 86 feet is available for transitioning between 8 percent superelevations. Typically, a tangent length of approximately 160 feet would be necessary to accommodate a transition between 8 percent superelevations using a 0.6 distribution on tangent with these curve radii.

SE-2

The southeast loop ramp (SE-2) was rated "fair" for the following reason:

- The maximum superelevation is 12 percent, which is greater than the 6 percent preferred standard. The maximum superelevation was based on the frequency of slick conditions from snow and rain.

APPENDIX B

Structures

US 6 and Wadsworth Boulevard Interchange Environmental Assessment Structures Site Visit

PREPARED FOR: Tim Eversoll, P.E./CH2M HILL Project Engineer
Aaron Swafford, P.E./CH2M HILL Deputy Project Manager

PREPARED BY: Stephen Howard and Ryan Abraham, P.E./CH2M HILL Bridge Engineers

DATE: July 24, 2007

On Thursday, June 14, 2007, Ryan Abraham and Steve Howard of CH2M HILL visited the Sixth Avenue and Wadsworth Boulevard interchange to assess the condition of the existing major structures. Two cast-in-place concrete box culverts, two cast-in-place concrete retaining walls, and the Sixth Avenue bridge over Wadsworth Boulevard were viewed.

The first structure assessed was a three-cell, cast-in-place concrete box culvert located under Sixth Avenue, west of the Wadsworth Boulevard interchange. This multi-cell box is approximately 30 feet wide, with each cell measuring roughly 10 feet wide by 10 feet tall and nearly 275 feet in length (measured from an aerial photograph). The top slab of the original structure contains some minor cracking and shows efflorescence from magnesium chloride and road salts, especially at the joint where the culvert appears to have been widened. Otherwise, the structure appears to be in fair condition. During the time of the assessment, the box was carrying a decent flow and, therefore, a thorough assessment could not be made. The guardrail along the frontage road is in poor condition and should be updated and replaced. The *Colorado Department of Transportation (CDOT) Structure Inspection and Inventory Report* shows the condition rating of this structure as a 5, on a scale of 1 to 10. A rating of 5 is defined as "Fair Condition – all primary structural elements are sound but may have minor section loss, cracking, spalling, or scour." According to the same report, this structure has a sufficiency rating of 63.8. The CDOT report can be found in Attachment 1 of this technical memorandum (TM), while photographs of the structure are presented in Pictures 1 and 2 below.

PICTURE 1: SOUTH SIDE OF SIXTH AVENUE, LOOKING NORTH

PICTURE 2: CENTER CELL, LOOKING NORTH

The second structure observed was the Sixth Avenue bridge over Wadsworth Boulevard (see Picture 3). The bridge shows significant deterioration of the bridge deck, while the overhangs show cracks and spalling of the concrete. The underside of the deck contains longitudinal cracking as seen by the penetration of the efflorescence. An example of these conditions can be seen in Pictures 4 and 5. The girders and substructure appear to be in fair condition with little sign of deterioration. The horizontal clearance between the existing roadway and the bridge piers is narrow and may present problems in widening Wadsworth Boulevard.

PICTURE 3: SIXTH AVENUE BRIDGE OVER WADSWORTH BOULEVARD, LOOKING NORTHEAST

Structural Deficiency

The *CDOT Bridge Inspection Report* indicates that the Sixth Avenue bridge over Wadsworth Boulevard, Structure No. F-16-O, is structurally deficient. Structural deficiency is based on the existing in-place condition of the bridge deck, superstructure, substructure, and overall structural evaluation.

According to the *National Bridge Inventory (NBI) Coding Guide*, the structural elements of a bridge are conditionally rated from a 9 ("Excellent Condition") to 0 ("Failed Condition"). When a condition rating of 4 or less is given for the deck, superstructure, or substructure, a bridge is considered structurally deficient.

The Sixth Avenue bridge over Wadsworth Boulevard has a deck condition rating of 4, and superstructure and substructure condition ratings of 5. FHWA defines a condition rating of 4 as "Poor Condition – advanced section loss, deterioration, spalling, or scour." A condition rating of 5 is considered "Fair Condition – all primary structural elements are sound but may have minor section loss, cracking, spalling, or scour."

Functionally Obsolete

The *NBI Coding Guide* states that a bridge is "Functionally Obsolete" if the deck geometry, under clearance, approach roadway alignment, or structural condition rating is 3 or less. According to the *CDOT Bridge Inspection Report*, the Sixth Avenue bridge over Wadsworth Boulevard exceeds these criteria in all aspects and, therefore, is not functionally obsolete.

Sufficiency Rating

The Sufficiency Rating is a method of evaluating highway bridges using four separate factors to obtain a numeric value, which is indicative of bridge sufficiency to remain in service. The result of this method yields a percentage between 0 and 100. A rating of

100 percent represents an entirely sufficient bridge and a 0 percent rating would represent an entirely insufficient bridge. The four factors used in the rating are as follows:

1. Structural Adequacy and Safety
2. Serviceability and Functional Obsolescence
3. Essentiality for Public Use
4. Special Reductions

The above four factors are calculated using field inspection data and formulas from the *FHWA Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges*. The *CDOT Bridge Inspection Report* has a sufficiency rating for the Sixth Avenue and Wadsworth Boulevard bridge of 74.1. The inspection report can be found in Attachment 1 of this TM.

PICTURE 4: OVERHANG OF EASTBOUND BRIDGE

PICTURE 5: EFFLORESCENCE AND RUST ON UNDERSIDE OF DECK

The third structure assessed was a cast-in-place concrete retaining wall on the ramp from eastbound Sixth Avenue to northbound Wadsworth Boulevard. This wall, located on the corner of Broadview Drive and Wadsworth Boulevard, is approximately 10 feet tall at its peak and nearly 120 feet in length. The wall shows minor cracks where typical crack control joints should have been placed. The wall as apparently built with expansion joints but no crack control joints. This wall appears to be stable and cracking is minimal. Overall, this wall is in good condition. However, poor sight distance from the northbound ramp onto Wadsworth Boulevard creates a hazard to pedestrians and oncoming traffic. This wall is shown in Pictures 6 and 7.

PICTURE 6: WALL AT NORTHEAST CORNER OF SIXTH AVENUE AND WADSWORTH BOULEVARD, LOOKING NORTHEAST

PICTURE 7: WALL AT NORTHEAST CORNER OF SIXTH AVENUE AND WADSWORTH BOULEVARD, LOOKING SOUTH

Several block landscaping walls are present along northbound Wadsworth Boulevard, north and south of the slope paving of the bridge. These walls are not considered major structures and should be of little significance to the Environmental Assessment (EA). They are in good condition and appear to be structurally sound. An example of one of these walls is shown in Picture 8.

PICTURE 8: LANDSCAPE WALL AT NORTHEAST CORNER OF SIXTH AVENUE AND WADSWORTH BOULEVARD

A minor structure within the project boundaries is a cast-in-place concrete box culvert located under Sixth Avenue, east of the Sixth Avenue and Wadsworth Boulevard interchange. This box culvert is approximately 10 feet wide by 8 feet tall and about 175 feet in length (measured from an aerial photograph). This culvert is not considered to be a major structure but appears to be in fair condition. However, water was running through the culvert at the time of the site visit, and a walk-through assessment was not performed. This culvert is shown in Picture 9.

PICTURE 9: MINOR STRUCTURE UNDER SIXTH AVENUE;
PICTURE IS FROM THE SOUTH SIDE OF SIXTH AVENUE, LOOKING NORTHWEST

The fourth structure assessed was a cast-in-place concrete retaining wall between the New Holland tractor dealership and Three Margaritas restaurant (See Pictures 10 and 11). This wall is approximately 8 feet tall and measures nearly 300 feet in length. The wall appears to be stable with few cracks and new paint. At the edge of Wadsworth Boulevard, the wall extends to the sidewalk, which creates an unsafe walking condition and also obstructs sight distance at the entryway to the Three Margaritas restaurant.

PICTURE 10: CAST-IN-PLACE WALL ON WEST SIDE OF WADSWORTH BOULEVARD, LOOKING WEST

PICTURE 11: CAST-IN-PLACE WALL ON WEST SIDE OF WADSWORTH BOULEVARD, LOOKING NORTH

The last structure observed was a three-cell cast-in-place concrete box culvert located under Wadsworth Boulevard at Lakewood Gulch (see Pictures 12 and 13). This multi-cell box shows little sign of deterioration except near the bridge drains, which are cut into the top slab of the box, as shown in Picture 13. The interior of the box is in fair condition. There are longitudinal pipe penetrations through all four walls near the top slab, and the wing walls appear to be stable. However, the railing mounted to the headwalls is substandard. The overall condition of this structure is fair to good.

The CDOT Structure Inspection and Inventory Report shows the condition rating of this structure as a 6, on a scale of 1 to 10. A rating of 6 is defined as "Satisfactory Condition – structural elements show some minor deterioration." According to the same report, this structure has a sufficiency rating of 93.6. The CDOT report can be found in the Attachment 1 of this TM.

PICTURE 12: BOX CULVERT CARRYING SIXTH AVENUE OVER LAKEWOOD GULCH; WEST SIDE, LOOKING EAST

PICTURE 13: BOX CULVERT CARRYING SIXTH AVENUE OVER LAKEWOOD GULCH, TOP SLAB DRAIN

ATTACHMENT 1

CDOT Structure Inspection and Inventory Reports

Highway Number (ON) 5D: 0121A 1

Mile Post (ON)11: 12.670 mi

Colorado Department of Transportation

Structure Inspection and Inventory Report (English Units)

Bridge Key: F-16-AK | Inspection Date: 12/6/2006 | Sufficiency Rating: 93.6 Not Eligible

Rgn/Sectn 2E/2M:	68	Hist Signif 37:	5	UW Inspection Date 93B:			
Trans Region 2T:	02	Posting status 41:	A	SI Date 93C:			
County Code 3:	059	Service on/un 42A/B:	5 5	Bridge Cost 94:	$ 0		
JEFFERSON		Main Mat/Desgn 43A/B:	1 19	Roadway Cost 95:	$ 0		
Place Code 4:	43000	Appr Mat/Desgn 44A/B:	0 0	Total Cost 96:	$ 0		
LAKEWOOD		Main Spans Unit 45:	3	Year of Cost Estimate 97:			
Rte.(On/Under)5A:	1	Approach Spans 46:	0	Brdr Brdg Code/% 98A/B:			
Signing Prefix 5B:	3	Horiz Clr 47:	69.0 ft	Border Bridge Number 99:			
Level of Service 5C:	1	Max Span 48:	12.0 ft	Defense Highway 100:	0		
Directional Suffix 5E:	0	Str Length 49:	32.0 ft	Parallel Structure 101:	N		
Feature Intersected 6:		Curb Wdth L/R 50A/B:	4.8 ft 5.0 ft	Direction of Traffic 102:	2		
MCINTIRE GULCH		Width Curb to Curb 51:	78.8 ft	Temporary Structure 103:	_		
Facility Carried 7:		Width Out to Out 52:	80.0 ft	Highway System 104:	1		
SH 121 ML		Deck Area:	2,561.8 sq. ft	Fed Lands Hiway 105:	0		
Alias Str No.8A:		Min Clr Ovr Brdg 53:	99.99	Year Reconstructed 106:	0000		
		Min Undrclr Ref 54A:	N	Deck Type 107:	N		
Prll Str No. 8P		Min Undrclr 54B:	0.0 ft	Wearing Surface 108A:	N		
		Min Lat Clrnce Ref R 55A:	N	Membrane 108B:	N		
Location 9:		Min Lat Undrclr R 55B:	0.0 ft	Deck Protection 108C:	N		
.2 MI. N. OF 6TH AVE.		Min Lat Undrclr L 56:	0	Truck ADT 109:	4 %		
Max Clr 10:	99.99	Deck 58:	N	Trk Net 110:	1		
BaseHiway Net12:	1	Super 59:	N	Pier Protection 111:			
IrsinvRout 13A	000000121A	Sub 60:	N	NBIS Length 112:	Y		
IrssubRout No13B:	00	Channel/Protection 61:	5	Scour Critical 113:	8		
Latitude 16:	39d 43' 39"	Culvert 62:	6	Scour Watch 113M:	0		
Longitude 17:	105d 04' 53"	Oprtng Rtg Method 63:	5 No rating	Future ADT 114:	59,160		
Range18A:	69 W	Operating Rating 64:	36.0	Year of Future ADT 115:	2025		
Township18B:	69	Inv Rtng Method 65:	5	CDOT Str Type 120A:	CBC		
Section18C:	2	Inventory Rating 66:	36.0	CDOT Constr Type 120B:	0.		
Detour Length 19:	0.6 mi	Asph/Fill Thick 66T:	024 "in"	Inspection Indic 122A:			
Toll Facility 20:	3	Str. Evaluation 67:	6	Inspection Trip 122AA:			
Custodian 21:	1	Deck Geometry 68:	5	Scheduling Status 122B:			
Owner 22:	1	Undrclr Vert/Hor 69:	N	Maintenance Patrol 123:	5		
Functional Class 26:	14	Posting 70:	5	Expansion Dev/Type124:	O		
Year Built 27:	1961	Waterway Adequacy 71:	6	Brdg Rail Type/Mod 125A/B:	J	0	
Lanes on 28A:	6	Approach Alignment 72:	8	Posting Trucks 129A/B/C:	0	0	0
Lanes Under 28B:	0	Type of Work 75A:		Str Rating Date 130:	1/1/1901		
ADT 29:	51,000	Work Done By 75B:		Special Equip 133:			
Year of ADT 30:	2005	Length of Improvment 76:	0.0 ft	Vert Clr N/E 134A/B/C:	X	99.99	0.00
Design Load 31:	5	Insp Team Indicator 90B:	Unknown - Pont	Vert Clr S/W 135A/B/C:	X	99.99	0.00
Apr Rdwy Width 32:	69.0 ft	Inspector Name 90C:	STADIGM	Vertical Clr Date:			
Median 33:	0	Frequency 91:	24 months	Weight Limit Color: 139:	0		
Skew 34:	0.00 °	FC Frequency 92A:	-1	Str Billing Type:	U		
Structure Flared 35:	0	UW Frequency 92B:	-1	Userkey 1 - System:	ONSYS		
Sfty Rail 36a/b/c/d:	0 0 0 0	SI Frequency 92C:	-1	Userkey 7-Update Indi:			
Rail ht36h:	40 "in"	FC Inspection Date 93A:					

Inspector Name: STADIGM

Colorado Department of Transportation
Structure Inspection and Inventory Report (English Units)

Element Inspection Report

Elm/Env	Description	Units	Total Qty	% in 1	CS 1	% in 2	CS 2	% in 3	CS 3	% in 4	CS 4	% in 5	CS 5
241/4	Concrete Culvert	(LF)	240	90 %	215	6 %	15	4 %	10	0 %	0	0 %	0
327/4	Culvert Wingwalls	(EA)	4	25 %	1	75 %	3	0 %	0	0 %	0	0 %	0
334/4	Metal Rail Coated	(LF)	64	0 %	0	100 %	64	0 %	0	0 %	0	0 %	0
335/4	Culvert Headwalls	(EA)	2	100 %	2	0 %	0	0 %	0	0 %	0	0 %	0
501/4	Channel Cond	(EA)	1	100 %	1	0 %	0	0 %	0	0 %	0	0 %	0
502/4	ChannProtMatCond	(EA)	1	100 %	1	0 %	0	0 %	0	0 %	0	0 %	0
504/4	BankCond	(EA)	1	100 %	1	0 %	0	0 %	0	0 %	0	0 %	0
505/4	Debris Smart Flag	(EA)	1	100 %	1	0 %	0	0 %	0	0 %	0	0 %	0

Elem/Env	Description	Element Notes
241/4	Concrete Culvert	Vert. cracks in walls open 1/32 inch to 1/8 inch, most have efflor. Wall #4 cracks actively leaking with deposits. Light to mod. efflor. seeping through const. joints, and some rust stains in Cell 2. There is some light scale, delaminations, & minor spalls around drop inlets in top slabs. Some light scale on Wall #4 below RCP at lt. side.
327/4	Culvert Wingwalls	#1 Lt. open 1/2 inch and pushed slightly. #1 Rt. pushed 2 inches and open 1/2 inch. #4 Lt. pushed 1 inch. #4 Rt. pushed 1.5 inches and open 1 inch. Active leaking through joint at bottom of #4 Rt.
334/4	Metal Rail Coated	Painted Type J rail. Freckled rust throughtout.
335/4	Culvert Headwalls	Minor spall with exposed rebar on rt. headwall near Wall #3. Delam. on lt. headwall above Cell #2.
501/4	Channel Cond	McIntire Gulch. Makes bend upstream side. Flows through Cells 2 & 3.
502/4	ChannProtMatCond	Concrete rubble upstream, sloughing down steep slopes into channel, and some washed down through culvert. Up to 2 ft. diam. rock riprap, and cinder block retaining wall, placed at end of #1 Rt. wingwall.
504/4	BankCond	Heavy tree growth & grass help stabilize steep slopes. Some areas are vertical due to erosion.
505/4	Debris Smart Flag	Large sections of curb & gutter are around and inside the culvert. Some trash in Cell #1. Some branches caught on nose of Wall #3.

Bridge Notes

Utilities: Two 12 inch diam., and one 18 diam., steel pipes through top of each cell wall.

Colorado Department of Transportation
Structure Inspection and Inventory Report (English Units)

Inspection Notes

TIME: 12:00 TEMP: 45 WEATHER: Clear

Scope:

☑ **NBI:** ☑ **Element:** ☐ **Underwater:** ☐ **Fracture Critical:** ☐ **Other:** **Type:** Regular NBI

Inspector: STADIGM **Inspection Team:**

Inspection Date: 12/06/2006

_____
Inspector

_____
Inspector

Highway Number (ON) 5D: 0006G 1

Mile Post (ON)11: 280.648 mi

Colorado Department of Transportation

Structure Inspection and Inventory Report (English Units)

Bridge Key: F-16-L | Inspection Date: 12/6/2005 | Sufficiency Rating: 63.8 Not Eligible

Rgn/Sectn 2E/2M:	68	Hist Signif 37:	5	UW Inspection Date 93B:			
Trans Region 2T:	02	Posting status 41:	A	SI Date 93C:			
County Code 3:	059	Service on/un 42A/B:	1 5	Bridge Cost 94:	$ 0		
JEFFERSON		Main Mat/Desgn 43A/B:	1 19	Roadway Cost 95:	$ 0		
Place Code 4:	43000	Appr Mat/Desgn 44A/B:	0 0	Total Cost 96:	$ 0		
LAKEWOOD		Main Spans Unit 45:	3	Year of Cost Estimate 97:			
Rte.(On/Under)5A:	1	Approach Spans 46:	0	Brdr Brdg Code/% 98A/B:			
Signing Prefix 5B:	2	Horiz Clr 47:	53.0 ft	Border Bridge Number 99:			
Level of Service 5C:	1	Max Span 48:	13.1 ft	Defense Highway 100:	0		
Directional Suffix 5E:	0	Str Length 49:	37.0 ft	Parallel Structure 101:	N		
Feature Intersected 6:		Curb Wdth L/R 50A/B:	0.0 ft 0.0 ft	Direction of Traffic 102:	2		
MCINTYRE GULCH		Width Curb to Curb 51:	0.0 ft	Temporary Structure 103:	_		
Facility Carried 7:		Width Out to Out 52:	0.0 ft	Highway System 104:	1		
US 6 ML		Deck Area:	8,923.3 sq. ft	Fed Lands Hiway 105:	0		
Alias Str No.8A:		Min Clr Ovr Brdg 53:	99.99	Year Reconstructed 106:	1961		
		Min Undrclr Ref 54A:	N	Deck Type 107:	N		
Prll Str No. 8P		Min Undrclr 54B:	0.0 ft	Wearing Surface 108A:	N		
		Min Lat Clrnce Ref R 55A:	N	Membrane 108B:	N		
Location 9:		Min Lat Undrclr R 55B:	0.0 ft	Deck Protection 108C:	N		
IN LAKEWOOD		Min Lat Undrclr L 56:	0	Truck ADT 109:	3 %		
Max Clr 10:	99.99	Deck 58:	N	Trk Net 110:	1		
BaseHiway Net12:	1	Super 59:	N	Pier Protection 111:			
IrsinvRout 13A	000000006G	Sub 60:	N	NBIS Length 112:	Y		
IrssubRout No13B:	00	Channel/Protection 61:	6	Scour Critical 113:	8		
Latitude 16:	39d 43' 29"	Culvert 62:	5	Scour Watch 113M:	0		
Longitude 17:	105d 05' 01"	Oprtng Rtg Method 63:	5 No rating	Future ADT 114:	137,256		
Range18A:	69 W	Operating Rating 64:	36.0	Year of Future ADT 115:	2025		
Township18B:	69	Inv Rtng Method 65:	5	CDOT Str Type 120A:	CBC		
Section18C:	11	Inventory Rating 66:	36.0	CDOT Constr Type 120B:	0.		
Detour Length 19:	0.6 mi	Asph/Fill Thick 66T:	036 "in"	Inspection Indic 122A:			
Toll Facility 20:	3	Str. Evaluation 67:	5	Inspection Trip 122AA:			
Custodian 21:	1	Deck Geometry 68:	N	Scheduling Status 122B:			
Owner 22:	1	Undrclr Vert/Hor 69:	N	Maintenance Patrol 123:	8		
Functional Class 26:	12	Posting 70:	5	Expansion Dev/Type124:	O		
Year Built 27:	1942	Waterway Adequacy 71:	8	Brdg Rail Type/Mod 125A/B:	G 3		
Lanes on 28A:	12	Approach Alignment 72:	8	Posting Trucks 129A/B/C:	0 0 0		
Lanes Under 28B:	0	Type of Work 75A:		Str Rating Date 130:	1/1/1901		
ADT 29:	106,400	Work Done By 75B:		Special Equip 133:			
Year of ADT 30:	2005	Length of Improvment 76:	0.0 ft	Vert Clr N/E 134A/B/C:	X 99.99 0.00		
Design Load 31:	4	Insp Team Indicator 90B:	Unknown - Pont	Vert Clr S/W 135A/B/C:	X 99.99 0.00		
Apr Rdwy Width 32:	187.0 ft	Inspector Name 90C:	MAESA	Vertical Clr Date:			
Median 33:	2	Frequency 91:	24 months	Weight Limit Color: 139:	0		
Skew 34:	30.00 °	FC Frequency 92A:	-1	Str Billing Type:	U		
Structure Flared 35:	0	UW Frequency 92B:	-1	Userkey 1 - System:	ONSYS		
Sfty Rail 36a/b/c/d:	0 0 0 0	SI Frequency 92C:	-1	Userkey 7-Update Indi:			
Rail ht36h:	22 "in"	FC Inspection Date 93A:					

Inspector Name: MAESA

Colorado Department of Transportation
Structure Inspection and Inventory Report (English Units)

Element Inspection Report

Elm/Env	Description	Units	Total Qty	% in 1	CS 1	% in 2	CS 2	% in 3	CS 3	% in 4	CS 4	% in 5	CS 5
241/4	Concrete Culvert	(LF)	836	40 %	336	54 %	450	6 %	50	0 %	0	0 %	0
327/4	Culvert Wingwalls	(EA)	4	75 %	3	25 %	1	0 %	0	0 %	0	0 %	0
334/4	Metal Rail Coated	(LF)	36	78 %	28	22 %	8	0 %	0	0 %	0	0 %	0
335/4	Culvert Headwalls	(EA)	2	100 %	2	0 %	0	0 %	0	0 %	0	0 %	0
501/1	Channel Cond	(EA)	1	100 %	1	0 %	0	0 %	0	0 %	0	0 %	0
502/1	ChannProtMatCond	(EA)	1	100 %	1	0 %	0	0 %	0	0 %	0	0 %	0
504/1	BankCond	(EA)	1	100 %	1	0 %	0	0 %	0	0 %	0	0 %	0
505/1	Debris Smart Flag	(EA)	1	100 %	1	0 %	0	0 %	0	0 %	0	0 %	0

Elem/Env	Description	Element Notes
241/4	Concrete Culvert	Moderate stream abrasion on floor. Divider walls have light to mod. vert. & diag. cracks. Walls & top slab have many areas of light scale w/ efflor. , mostly @ original const. Lite longit. cracks w/ efflor. in top slab. Const. joints in walls & top slab have mod. cracks w/ heavy efflor., rust stains & mineral deposits. 1/4 inch longit crack in top slab, 10 inches from const. joint in cell 1, approx. 60 feet from inlet.
327/4	Culvert Wingwalls	#1 rt. pushed 1.5+/- inches.
334/4	Metal Rail Coated	Galv. type G rail w/ painted posts attached to rt. headwall only. Some posts & rail bent. Posts have R1 corr. Rail not attached to posts #3 & #5.
335/4	Culvert Headwalls	Light scale on lt. headwall. Rt. headwall has couple light vert. cracks above divider walls.
501/1	Channel Cond	McIntyre Gulch. Narrow channel with 90 deg. turn upstream 100 ft.+/-. Flows in all cells, but mainly in cell #3.
502/1	ChannProtMatCond	Some asph. slope paving around inlet wings. Washing and some deterioration.
504/1	BankCond	Steep banks have cut over the years. Growing trees, grass, and some brush.
505/1	Debris Smart Flag	Sediment buildup at center to outlet of all cells is 3 to 5 ft.. Inlet is clean.

Maintenance Activity Summary

MMS Activity	Description	Recommended	Status	Target Year	Est Cost
355.03	Cln & Pnt	11/30/2001	-1	2003	1000

Clean and paint bridge rail posts that are attached to right headwall.

Colorado Department of Transportation
Structure Inspection and Inventory Report (English Units)

Bridge Notes

Inspection Notes

Time: 1:00	Temp: 50	Weather: Clear

Scope:

☑ **NBI:** ☑ **Element:** ☐ **Underwater:** ☐ **Fracture Critical:** ☐ **Other:** **Type:** Regular NBI

Inspector: MAESA **Inspection Team:**

Inspection Date: 12/06/2005

Inspector

Inspector

Highway Number (ON) 5D: 0006G 1

Mile Post (ON)11: 280.775 mi

Colorado Department of Transportation

Structure Inspection and Inventory Report (English Units)

Bridge Key: F-16-O | Inspection Date: 12/8/2005 | Sufficiency Rating: 74.1 SD

Rgn/Sectn 2E/2M:	68	Hist Signif 37:	5	UW Inspection Date 93B:	
Trans Region 2T:	02	Posting status 41:	A	SI Date 93C:	
County Code 3:	059	Service on/un 42A/B:	6 1	Bridge Cost 94:	$ 3,336,685
JEFFERSON		Main Mat/Desgn 43A/B:	2 4	Roadway Cost 95:	$ 333,669
Place Code 4:	43000	Appr Mat/Desgn 44A/B:	0 0	Total Cost 96:	$ 5,005,028
LAKEWOOD		Main Spans Unit 45:	4	Year of Cost Estimate 97:	2006
Rte.(On/Under)5A:	1	Approach Spans 46:	0	Brdr Brdg Code/% 98A/B:	
Signing Prefix 5B:	2	Horiz Clr 47:	52.8 ft	Border Bridge Number 99:	
Level of Service 5C:	1	Max Span 48:	52.5 ft	Defense Highway 100:	0
Directional Suffix 5E:	0	Str Length 49:	188.0 ft	Parallel Structure 101:	N
Feature Intersected 6:		Curb Wdth L/R 50A/B:	0.0 ft 0.0 ft	Direction of Traffic 102:	2
SH 121 ML		Width Curb to Curb 51:	105.3 ft	Temporary Structure 103:	_
Facility Carried 7:		Width Out to Out 52:	112.0 ft	Highway System 104:	1
US 6 ML		Deck Area:	21,065. sq. ft	Fed Lands Hiway 105:	0
Alias Str No.8A:		Min Clr Ovr Brdg 53:	99.99	Year Reconstructed 106:	0000
#F-16-AF		Min Undrclr Ref 54A:	H	Deck Type 107:	1
Prll Str No. 8P		Min Undrclr 54B:	16.1 ft	Wearing Surface 108A:	6
F-16-AF		Min Lat Clrnce Ref R 55A:	H	Membrane 108B:	2
Location 9:		Min Lat Undrclr R 55B:	8.4 ft	Deck Protection 108C:	0
IN LAKEWOOD		Min Lat Undrclr L 56:	6.400918553	Truck ADT 109:	2 %
Max Clr 10:	99.99	Deck 58:	4	Trk Net 110:	1
BaseHiway Net12:	1	Super 59:	5	Pier Protection 111:	
IrsinvRout 13A	000000006G	Sub 60:	5	NBIS Length 112:	Y
IrssubRout No13B:	00	Channel/Protection 61:	N	Scour Critical 113:	N
Latitude 16:	39d 43' 30"	Culvert 62:	N	Scour Watch 113M:	_
Longitude 17:	105d 04' 52"	Oprtng Rtg Method 63:	1 LF Load Fact	Future ADT 114:	149,625
Range18A:	69 W	Operating Rating 64:	52.0	Year of Future ADT 115:	2025
Township18B:	69	Inv Rtng Method 65:	1	CDOT Str Type 120A:	CSGC
Section18C:	2	Inventory Rating 66:	31.0	CDOT Constr Type 120B:	5.
Detour Length 19:	0.0 mi	Asph/Fill Thick 66T:	002 "in"	Inspection Indic 122A:	
Toll Facility 20:	3	Str. Evaluation 67:	5	Inspection Trip 122AA:	
Custodian 21:	1	Deck Geometry 68:	4	Scheduling Status 122B:	
Owner 22:	1	Undrclr Vert/Hor 69:	4	Maintenance Patrol 123:	8
Functional Class 26:	12	Posting 70:	5	Expansion Dev/Type124:	O
Year Built 27:	1972	Waterway Adequacy 71:	N	Brdg Rail Type/Mod 125A/B:	R 0
Lanes on 28A:	8	Approach Alignment 72:	8	Posting Trucks 129A/B/C:	0 0 0
Lanes Under 28B:	6	Type of Work 75A:	31	Str Rating Date 130:	4/21/2005
ADT 29:	119,700	Work Done By 75B:	1	Special Equip 133:	
Year of ADT 30:	2005	Length of Improvment 76:	188.0 ft	Vert Clr N/E 134A/B/C:	N 17.50 16.08
Design Load 31:	6	Insp Team Indicator 90B:	Unknown - Pont	Vert Clr S/W 135A/B/C:	S 17.25 16.08
Apr Rdwy Width 32:	140.0 ft	Inspector Name 90C:	VERNONK	Vertical Clr Date:	12/11/2003
Median 33:	2	Frequency 91:	24 months	Weight Limit Color: 139:	3
Skew 34:	0.00 °	FC Frequency 92A:	-1	Str Billing Type:	U
Structure Flared 35:	0	UW Frequency 92B:	-1	Userkey 1 - System:	ONSYS
Sfty Rail 36a/b/c/d:	1 1 1 1	SI Frequency 92C:	-1	Userkey 7-Update Indi:	
Rail ht36h:	34 "in"	FC Inspection Date 93A:			

Inspector Name: VERNONK

Colorado Department of Transportation
Structure Inspection and Inventory Report (English Units)

Element Inspection Report

Elm/Env	Description	Units	Total Qty	% in 1	CS 1	% in 2	CS 2	% in 3	CS 3	% in 4	CS 4	% in 5	CS 5
110/4	R/Conc Open Girder	(LF)	2,576	98 %	2,529	1 %	32	1 %	15	0 %	0	0 %	0
205/4	R/Conc Column	(EA)	33	76 %	25	24 %	8	0 %	0	0 %	0	0 %	0
215/4	R/Conc Abutment	(LF)	224	87 %	194	13 %	30	0 %	0	0 %	0	0 %	0
234/4	R/Conc Cap	(LF)	319	96 %	306	4 %	13	0 %	0	0 %	0	0 %	0
301/4	Pourable Joint Seal	(LF)	112	50 %	56	25 %	28	25 %	28	0 %	0	0 %	0
321/4	R/Conc Approach Slab	(EA)	2	100 %	2	0 %	0	0 %	0	0 %	0	0 %	0
325/4	Slope Prot/Berms	(EA)	2	98 %	2	2 %	0	0 %	0	0 %	0	0 %	0
326/4	Bridge Wingwalls	(EA)	4	100 %	4	0 %	0	0 %	0	0 %	0	0 %	0
333/4	Other Bridge Railing	(LF)	376	100 %	376	0 %	0	0 %	0	0 %	0	0 %	0
338/1	Conc Curbs/SW	(LF)	376	7 %	26	47 %	175	47 %	175	0 %	0	0 %	0
359/4	Soffit Smart Flag	(EA)	1	0 %	0	0 %	0	0 %	0	100 %	1	0 %	0
14/4	P Conc Deck/AC Ovly	(SF)	21,065	0 %	21,065	0 %	0	0 %	0	0 %	0	0 %	0
331/4	Conc Bridge Railing	(LF)	188	0 %	188	0 %	0	0 %	0	0 %	0	0 %	0
343/4	Pole Attachment	(EA)	2	0 %	1	0 %	1	0 %	0	0 %	0	0 %	0

Elem/Env	Description	Element Notes
110/4	R/Conc Open Girder	Horizontal crack from water intrusion in rear 1/2 of girder 1N and 4N. Efflorescence/contamination from deck into shear cracks in girders 1N, 2L,2M,2N,3M, 4L & 4M. 1 sq ft spall with rebar exposed on inside face of 2N & negligable nick at 1/3 pt. 2M also scraped. Efflorescence, spalling & rust stains on girder 3M @ midspan. Efflorescence at end of many girders at abuts. Diap in Bay 2N heavy efflor, rust and delam/spalling.
205/4	R/Conc Column	Spalls, and delam cracks noted on previous report have been patched, have shrinkage cracks. Delamination cracks near bottom of 3C, 3D,3H,4C, and 4D tops of 3A, 3I,and 4A. 2 sq ft delamination on 3A, north side. Light scale on some columns. Photo taken 12/03.
215/4	R/Conc Abutment	Both abuts have hairline vertical & pattern cracks. Few light vertical cracks in A-5 below girders 4A & 4B. Same at bays L & M with scale with efflorescence. Both heavily water stained at center sections.
234/4	R/Conc Cap	Light vertical cracks with & without efflorescence over columns 2J, 4K and in bays L & M at P-4. Hairline flex cracks with efflorescence at P-3 below girders K, L, M & at P-4 below M & near L. Photo taken 12/03.
301/4	Pourable Joint Seal	Between approach slabs and abuts. Overlaid with saw cut in asphalt. Filled with rubberized sealer. Some loss of adhesion along edges in travel lanes. Some leakage at abutment 5. Asph brking up in wbnd lane at abut 5.
321/4	R/Conc Approach Slab	Overlaid. Evidence of settling eastbound side.
325/4	Slope Prot/Berms	Concrete slope paving with dirt berms. Horizontal cracks. Berms settled 6 inches.
326/4	Bridge Wingwalls	#1 and #5 has pattern cracks with delamination along with water and efflorescence stains.

Colorado Department of Transportation

Structure Inspection and Inventory Report (English Units)

Elem/Env	Description	Element Notes
333/4	Other Bridge Railing	Jersey barrier with 3 foot high chain link fence placed in 2000. Several post are loose. Typical light vertical cracks at both sides.
338/1	Conc Curbs/SW	Interior curb cut back to accomodate jersey barrier. Only exterior sides are exposed. Numerous spalls with exposed rebar, scale,rust stains, and horizontal cracking right side.
359/4	Soffit Smart Flag	Map cracking & scale in areas with light to heavy efflorescene. 15% of total deck area shows contamination. Areas with stalactites and rust stains, bays L & M are the worse, see Photos 11/89 & 11/01. Light to moderate scale, efflorescence with delamination in bays E & I along cold joints. 5 small spalls, 4 with exposed rebar and delamination cracks in bay 1G. Spalling with moderate cracking and patch form in bay 2G, see 11/01 photo. Spalls with exposed rebar at right overhang, span 3, see 11/01 photo. Some delamination and spalls at left overhang.
14/4	P Conc Deck/AC Ovly	2 inch asphalt. Left center lane seams are starting to open, potholes are forming. Photos taken 12/03 Few patches and random crking - some sealed.
331/4	Conc Bridge Railing	Jersey barrier at median placed in 2000. Jersey barrier has typical light vertical cracks both sides, some with efflorescence.
343/4	Pole Attachment	Light pole attachments at right side near abutment 1 and at left side near abutment 5. Some horizontal cracks with rust,delamintaion, and spalling at bottom of base.

Maintenance Activity Summary

MMS Activity	Description	Recommended	Status	Target Year	Est Cost
354.02	Suprstr	12/8/2005	-1	2005	100

Remove loose concrete Girder 3M midspan over NBND traffic and on diaphragm in Bay 2N over SBND traffic.

353.04	Br Dk Rpr	11/30/2001	-1	2005	0

Remove loose concrete at deck overhangs and patch.

Colorado Department of Transportation
Structure Inspection and Inventory Report (English Units)

Bridge Notes

6/22/05: Per new policy approved by Mark Leonard and FHWA, CSG Super Structures to be within one of deck.

Inspection Notes

Time: 10:50 Temperature: 22 Degrees Weather: Partly Cloudy

Scope:

☑ **NBI:** ☑ **Element:** ☐ **Underwater:** ☐ **Fracture Critical:** ☐ **Other:** **Type:** Regular NBI

Inspector: VERNONK **Inspection Team:**

Inspection Date: 12/08/2005

_____
Inspector

_____
Inspector

APPENDIX C

Drainage

US 6 and Wadsworth Boulevard Interchange Environmental Assessment Existing Drainage Condition Summary

PREPARED FOR: CDOT Region 6

PREPARED BY: Glen Selover, CH2M HILL

COPIES: Tim Eversoll, CH2M HILL
File

PROJECT: US 6 and Wadsworth Boulevard Interchange Environmental Assessment

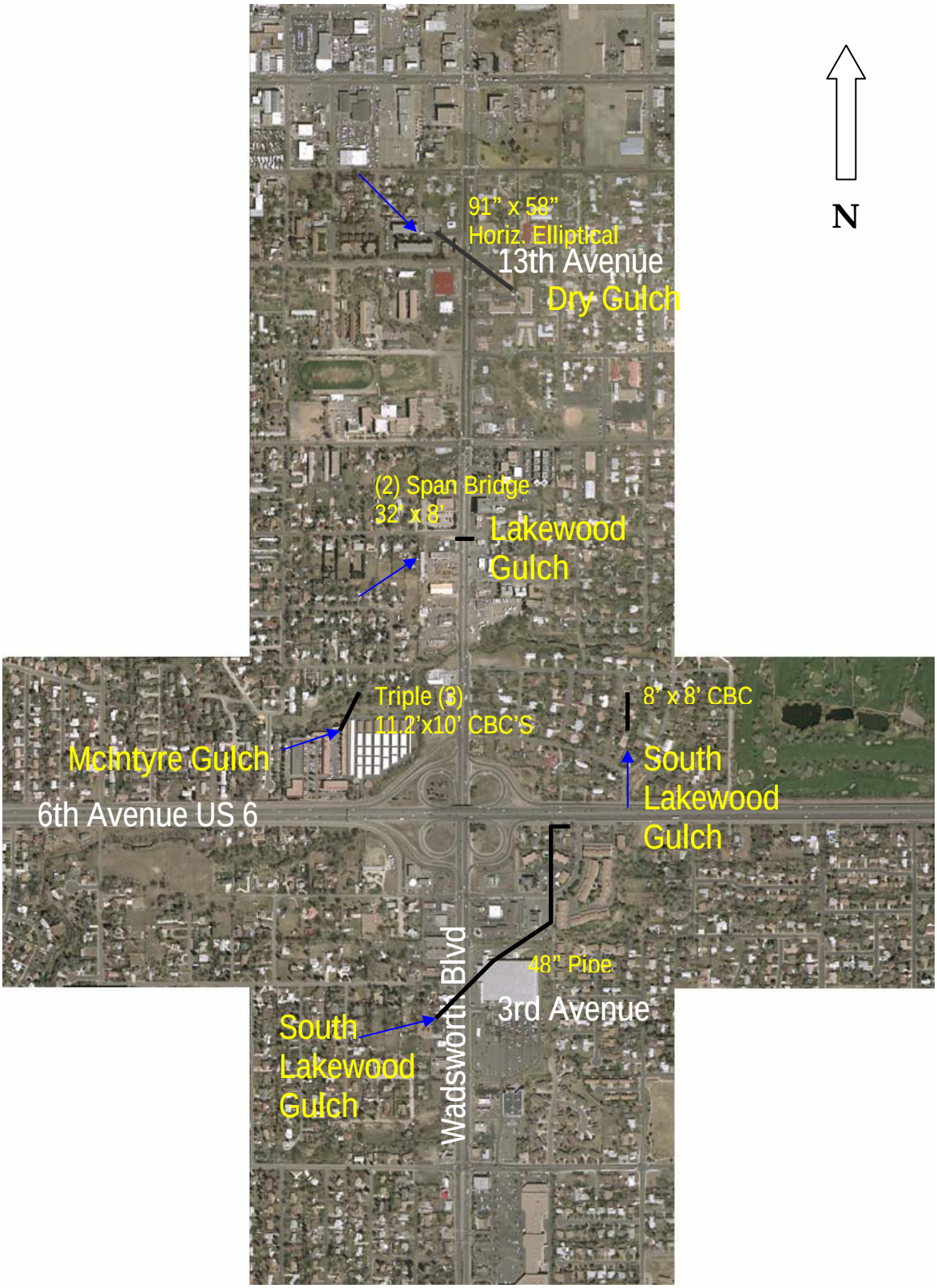
DATE: July 11, 2007

Existing Drainage Condition Summary

Multiple structures are located within the 100-year floodplain in the vicinity of the Sixth Avenue and Wadsworth Boulevard intersection. Approximately five structures are in the floodplain along Dry Gulch within 1,000 feet of either side of the centerline of Wadsworth Boulevard. An estimated 10 structures are in the floodplain along Lakewood Gulch within 1,000 feet of either side of the centerline of Wadsworth Boulevard, while approximately three structures are in the floodplain along South Lakewood Gulch within 1,000 feet of either side of the centerline of Wadsworth Boulevard.

Conveyance issues exist in the portion of McIntyre Gulch between the frontage road and the storage facility located in the northwest quadrant of the 6th Avenue and Wadsworth Boulevard intersection. Several existing culverts and channels along Wadsworth Boulevard, within the project limits, have insufficient capacity to convey the 100-year flood. As a result, the 100-year flood overtops Wadsworth Boulevard at South Lakewood Gulch (existing 48-inch pipe at Second Street), Lakewood Gulch (existing bridge near Highland), and Dry Gulch (existing 91-inch by 58-inch elliptical pipe between 10th Avenue and 12th Avenue). Additionally, an existing 8-foot by 8-foot concrete box culvert located at South Lakewood Gulch and Sixth Avenue, east of Wadsworth Boulevard, is undersized and creates significant ponding on the south side of Sixth Avenue. The overtopping and conveyance information was obtained from Federal Emergency Management Agency (FEMA) floodplain maps, City of Lakewood drainage master planning maps, and correspondence with the City of Lakewood. See Figure 1 A, "Major Drainage Structures," for details of existing drainage structures within the project vicinity.

FIGURE 1: MAJOR DRAINAGE STRUCTURES



APPENDIX D

Geotechnical

Existing Geological and Pavement Conditions For 6th and Wadsworth Project

Prepared for:

CH2M HILL

9193 South Jamaica Street
Englewood, CO 80112

Attention: Mr. Tim Eversoll

July, 2007

RockSol
Consulting Group, Inc.

2995 Wilderness Place, Suite 200
Boulder, Colorado 80301

Wadsworth Boulevard & 6th Avenue
Geology, Soils, Mineral Resources

INTRODUCTION TO ANALYSIS

This report summarizes geologic conditions, soil conditions, and mineral resources for Wadsworth Boulevard between West 3rd and West 13th avenues and for a band extending 1000 feet from that route; the boundaries of the area are approximated by Zephyr Street on the west, Upham Street on the east, W. 1st Avenue on the south, and halfway between W. 14th Avenue and Colfax Avenue on the north.

Geologic conditions of note include:

1) Adverse characteristics of soil, surficial deposits, and bedrock, including high shrink-swell potential, high corrosivity, low-strength collapsible soils and surficial deposits, highly erodible soils, and locally shallow depth to bedrock;
2) Potential for small rotational landslides in on disturbed slopes;
3) Potential seismic risk.

Subsidence over abandoned mines is not a concern because the area is not undermined.

The information included in this report is based on information readily available as of May 22, 2007, except as noted.

AFFECTED ENVIRONMENT - EXISTING CONDITIONS

Geology

Topography and Drainages (based on 7.5 minute USGS topographic map for the Fort Logan quadrangle). From south to north, significant drainages within the area of interest include:

a) An unnamed drainage, referred to informally in this report as the "W. 1st Pl." gulch, which originates southwest of the area of interest. Three ditches/aqueducts which issue from this drainage enter the area of interest between W. 1st Ave. and W. 1st Pl. The northernmost waterway turns north at W. 1st Pl. and Zephyr St. and exits the area of interest to the west between W. 4th and W. 5th avenues. The southernmost waterway intersects Wadsworth Blvd. at W. 1st Pl. and exits the area of interest to the east. The third waterway intersects Wadsworth Blvd. north of W. 1st Pl. and runs north and east before exiting the area of interest to the east between W. 4th and W. 5th avenues.

b) McIntyre Gulch enters the area of interest from the west at W. 5th Ave. and runs north-northeast; it enters Lakewood Gulch just south of W. 7th Ave., approximately 250 feet west of Wadsworth Blvd.

c) Lakewood Gulch enters the area of interest from the west at a point south of W. 7th Ave.; it intersects Wadsworth Blvd. just north of W. 7th Ave./Highland Drive, and exits the area of interest to the east just north of Highland Dr.

d) Dry Gulch enters the area of interest from the west at W. 13th Ave.; it intersects Wadsworth Blvd. south of W. 12th Ave., and exits the area of interest on the east at W. 10th Ave.

Areas within McIntyre and Lakewood gulches are susceptible to occasional flooding (McCain and Hotchkiss, 1975).

Total topographic relief across the area of interest is approximately 75 feet. A low ridge trends northeastward across the southeast corner of the area. Regional surface elevations generally decrease

from west to east and from south to north; elevations also decrease into and downstream along the gulches. The highest elevations are approximately 5465 feet and occur at various locations along W. 1st Ave. The lowest elevation is slightly less than 5390 feet and occurs along Lakewood Gulch near the Upham St./Highland Dr. intersection. Maximum slopes typically occur on the flanks of the significant gulches.

Geologic Units (based on Lindvall 1978, except as noted). The area of interest is underlain by undifferentiated Tertiary/Cretaceous Denver-Arapahoe Formation bedrock, which is covered by surficial deposits consisting of one or more of: 1) ancient stream-laid alluvium on elevated terraces, 2) younger alluvium within drainage valleys, and 3) windblown loess (Table 1).

In order of decreasing proportion, the bedrock regionally consists of interbedded sandstone, claystone, siltstone, shale, and conglomerate. The sandstones and conglomerates are commonly lenticular. The bedrock unit is more than 662 feet thick at the northwest margin of the area of interest (Lindvall, 1978).

Ancient alluvium covers the bedrock over most of the area. It consists of up to 30 feet of stratified, poorly sorted gravel with lenses of clay, silt, and sand and, locally, thin beds of volcanic ash. In part, the alluvium is weakly to moderately cemented with calcium carbonate.

The younger alluvium within the gulches consists of unconsolidated interbedded sand, silt, and clay, with interbedded gravel in its lower part and humic material in its uppermost parts. The thickness of the younger alluvium is typically 5 to 10 feet or less, although it may be slightly thicker locally.

In some areas, the ancient alluvium is overlain by up to 10 feet of windblown loess consisting of sandy silt, with clay and silty clay in the upper foot or two. Loess covers a triangular area that tapers eastward; it extends along Zephyr St. from Lakewood Gulch to W. 12th Ave. and narrows eastward to an endpoint north of W. 9th Ave., and halfway between Wadsworth Blvd. and Upham St. Along Wadsworth Blvd. itself, loess extends from Lakewood Gulch to W. 10th Ave.

Artificial fill has been used to modify land elevation and substrate conditions at the Wadsworth Blvd./6th Ave. interchange and where Wadsworth Blvd. and other streets cross the significant gulches.

Depth to Bedrock (based on Lindvall 1978; Price and Amen 1980; RockSol drillholes June 2007). Depth to bedrock varies over the area, from at or near the surface to more than 20 feet beneath the surface; depth to bedrock may vary significantly within relatively small lateral distances (Table 2). Based on soil analyses, bedrock may be 20 to 40 inches beneath the surface on the southern flanks of Lakewood, McIntyre, and W. 1st Pl. gulches (Price and Amen, 1980). Bedrock crops out at the ground surface just south of W. 5th Ave. less than 200 feet west of the area of interest (Lindvall, 1978). Areas of bedrock too small to be mapped may crop out elsewhere within the area.

Depth to the Water Table (based on Hillier et al., 1983; RockSol drillholes June 2007). Depth to the water table varies over the area (Table 3). Typical depth to the water table is expected to range from 10 to 20 feet (seasonally shallower) across most of the area of interest and to lie within unconsolidated alluvium. In areas where alluvium is absent, the water table may up to 20 or more feet deep in bedrock. In the gulches, seasonally high water tables may be 5-10 feet deep or less, in young unconsolidated alluvium and soil. Shallow, perched water tables may develop in windblown deposits and along ditches/aqueducts. Eight of nine RockSol drillholes (June 2007) within the area of interest encountered groundwater (Table 3), with initial water levels ranging from 9 to 16 feet in ancient alluvium (4 drillholes), 10.5 to 11 feet in younger alluvium (2 drillholes), and 12.5 to 23 feet in bedrock (2 drillholes).

Landslides. No mapped landslides were identified in the area, but small rotational slumps have occurred in bedrock and surficial materials equivalent to those in the area of interest on natural slopes (Lindvall, 1979) or where they have been excavated (Machette, 1977) in metro Denver. Landslides in these strata may be triggered by excavating the toe of a slope, by overloading the top of a slope with fill or structures, or by introducing excessive moisture into the slope (Lindvall, 1979).

Seismic Conditions. Colorado is in an area of moderate seismic risk and could experience damaging earthquakes. Risk assessment across the area of interest indicates less than 10% probability in 50 years of ground motion values exceeding threshold levels for damage to older dwellings (USGS Earthquake Hazards Program website, accessed 5/22/07).

No major faults are mapped within the area of interest, but faults significant to the area include: 1) the Rocky Mountain Arsenal (RMA) seismic source approximately 12 miles to the northeast and 2) the Golden Fault and associated features, approximately 8 miles to the west.

Earthquakes emanating from the RMA in the 1960s-1970s followed deep injections of wastewater. Two of these events exceeded magnitude 5.0 and caused significant damage in metro Denver (USGS Earthquake History of Colorado, 1991; Colorado Geological Survey, Rock Talk, April 2005, p.6).

The Golden Fault is listed as being suspected of Quaternary activity in the Colorado Geological Survey's Colorado Late Cenozoic Fault and Fold Database. Although the fault has not been active in historic times, a geotechnical study by Risk Engineering (1994) assigned probability of activity (P_a) on the Golden Fault at P_a=0.4, with maximum magnitude of 7 to 7 ½.

Soils (based on Price and Amen 1980, except as noted)
Soils across the area are clay and clay loam developed on bedrock with significant mudstone and shale, and on alluvium and windblown loess that overlies the bedrock.

Soil conditions that are significant to the project include locally thin soils overlying shallow bedrock, pervasive significant shrink-swell potential, high corrosivity, susceptibility to frost action, low strength and collapsibility. Within the gulches, occasional high groundwater and flooding of the soils may occur. Moderate limitations to shallow excavation (Table 4) prevail due to very high clay content and low soil strength; in the southern half of the area, higher surface gradients along the gulches and locally shallow depth to bedrock are additional limiting factors.

Shrink-Swell Potential (Table 5). Throughout the area of interest, shrink-swell potential in the soils is high to moderate (Price and Amen, 1980). When taken as a whole, the upper 10 feet of surficial materials, including soil, alluvium, and loess, exhibit moderate shrink-swell potential (Hart, 1974). Very high shrink-swell potential is common in the underlying bedrock (Lindvall, 1978; Hart, 1974). Because bedrock is present at some localities less than 2 feet beneath the ground surface (Price and Amen, 1980), shrink-swell potential can be very high at very shallow depths (Hart, 1974).

Corrosive Soils and Soils Susceptible to Frost Action (Table 6). Soils across the area tend to be highly corrosive to uncoated steel. Thin soils overlying shallow bedrock are also moderately corrosive to concrete. Moderate frost action is exhibited by soils developed within the gulches, as well as by soils developed on ancient alluvium and windblown loess away from the gulches.

Low-Strength Soils and Collapsible Soils (based on Price and Amen, 1980; Lindvall 1978). Low strength is typical of the clay and clay loam soils across the area, and these soils may cave easily in

excavations. Windblown loess and its associated soils tend to have very low density and are susceptible to collapse and differential settlement when wetted or when placed under heavy loads. In addition to broad areas of loess between Lakewood Gulch and W. 12th Ave., loess deposits too small to be mapped may be present elsewhere within the area of interest.

Erodible Soils (Table 7). Infiltration rates are generally slow due to the clayey soils and because a layer typically develops within the soils that further inhibits the downward movement of water. Except in the gulches, moderate runoff is common, and rapid runoff occurs on shallow soils overlying low permeability bedrock. Soils developed on ancient alluvium or loess are slightly to moderately susceptible to erosion by running water, but water erosion may be severe on the flanks of the gulches. Soils across the area are moderately susceptible to wind erosion.

Soils with Shallow Water Tables and Flooding. Soils within the area of interest generally are not susceptible to shallow groundwater and flooding, but seasonal variations and weather events may produce local flooding, especially within the gulches (McCain and Hotchkiss, 1975). Seasonal fluctuations in the water table increase shrink-swell effects in susceptible soils and bedrock, and shallow groundwater enhances soil corrosivity and frost action, decreases soil strength in slopes, and increases susceptibility to water erosion.

Mineral Resources

Recovery of Mineral Resources. The State of Colorado recognizes separate ownership of "surface estates" and "mineral estates," meaning that owners of mineral rights can exercise their option to develop mineral resources even where the surface land is owned by others. The extraction of sand and gravel is regulated by the State (Colorado Office of Mined Land Reclamation, 1995 amended 2006).

Within the Denver region, the production of coal, oil and gas, and sand and gravel have affected many areas. However, no historical or current operations or permits for developing these mineral resources were found within the area of interest.

Coal. The Denver metropolitan area is underlain at depth by bedrock that has produced coal elsewhere in the region (Kirkham and Ladwig, 1980; Turney and Murray-Williams, 1983). Depth to the top of the coal-bearing zone exceeds 750 feet in the area of interest (Romero and Hampton, 1972). Coal has not been mined from beneath the area (Turney and Murray-Williams, 1983), and costs for mining the coal at depth might be too high for profitability (Kirkham and Ladwig, 1980). The coal-bearing strata may be suitable for the recovery of coalbed methane, but this recovery technology has not been applied in the metro Denver area (Wray and Koenig, 2001).

Oil and Gas. No recorded drillholes or approved or pending drilling permits were located within the area of interest (Colorado Oil and Gas Conservation Commission, Colorado Oil and Gas Information System (COGIS), accessed 5/22/07).

Sand and Gravel. The elevated terraces of ancient alluvium that extend across the area of interest contain gravel that is generally considered poor quality for concrete aggregate due to many unsound stones and abundant caliche coatings and cement (Trimble and Fitch, 1974). The younger alluvium within the gulches is predominantly finer-grained and is of limited thickness (Lindvall, 1978). No records of sand or gravel quarrying within the area were found (Colorado Division of Minerals and Geology, Mine Permit Reports, accessed 5/22/07; Schwochow et al., 1974; Schwochow, 1981).

APPENDIX A: REFERENCES CITED

Colorado Division of Minerals and Geology, Mine Permit Reports, <http://mining.state.co.us> (accessed 5/22/07).

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APPENDIX B: TABLES

Table 1. Description of Surficial and Bedrock Geologic Units
(based on Lindvall 1978, except as noted)

Manmade Deposits Artificial Fill (Holocene) - Manmade deposits of earth, rockfill, and refuse; may include inorganic, organic and manmade materials, both engineered and compacted fill and uncompacted trash/fill. Engineering properties vary widely; water table tends to be low in compacted fill, high in uncompacted fill; slope stability and resistance to erosion generally increase with compaction; uncompacted fill is susceptible to longterm differential settlement. Typically 5-15 feet but as much as 40 feet thick.
Young Alluvium Piney Creek Alluvium (Holocene) - At the bottom of significant gulches. Unconsolidated, typically well-stratified, fining-upward, interbedded sand, silt, and clay. Common humic material in upper 1 to 2 feet. Interbedded gravel in lower part. Clayey parts may swell moderately when wet. Thickness 5 to 10 feet or less. Low permeability, higher where sand content is high. Water table seasonally 5-10 feet deep, deeper in fall/winter. Foundation stability fair to poor; stability in earthquakes probably poor to fair. Moderately susceptible to erosion, especially gullying on slopes and undercutting on streambanks.

Windblown (Eolian) Deposits Loess (Pleistocene) - Typically nonstratified sandy silt. Upper 2-4 feet may have high clay and silty clay content. Slightly calcareous. Hard when dry, sticky when wet. Swell pressure increases where reworked. Thickness generally less than 10-15 ft. Permeability moderate vertically, very low laterally. Generally very low water table. Moderate to high shear strength when dry. Susceptible to hydrocompaction, collapse, and differential settlement when wetted or heavily loaded. Foundation stability moderate when dry, decreasing rapidly with increased moisture content. Stability in earthquakes probably poor to fair. Resistance to erosion moderate on slopes protected by vegetation.
Ancient Alluvium Verdos Alluvium (Pleistocene) - Poorly sorted stratified gravel with lenses of clay, silt, and sand; local thin beds of white volcanic ash. Moderate swelling likely in weathered clays in upper part. Gravels locally weakly to moderately cemented by calcium carbonate; strongly developed calcium carbonate horizon in upper part. Moderate swelling likely in weathered clays. Thickness as much as 30 feet. In terraces typically 180-200 feet above major modern streams. Locally covered with loess. Permeability generally high in sand and gravel but low in clay and silt; depth to water table generally 5-10 feet, locally deeper. Foundation stability fair to good in sand and gravel, poor to fair in clay; stability in earthquakes probably fairly good. Moderately resistant to erosion by running water. Has produced limited amounts of sand and gravel locally, but is generally poor quality for concrete aggregate due to many unsound stones and abundant caliche (Trimble and Fitch, 1974).
Bedrock Undifferentiated Arapahoe/Denver Formations (Tertiary/Cretaceous) - Interbedded sandstone, claystone, siltstone, shale, and conglomerate; lenticular units common. Shale and claystone typically swell markedly when wet. Thickness typically greater than 800 ft regionally. Permeability moderately high in coarse-grained units but very low in shale, siltstone, and claystone. Depth to water table is shallower in coarse-grained units, very deep in fine-grained units; basal conglomerate is generally water-bearing. Highest water table generally in early summer, lowest in fall. Excavation may require explosives. Foundation stability good in sandstone and conglomerate, but groundwater seepage is locally a problem. Fine-grained units with high shrink-swell properties may require foundation piers extending into the zone of permanent groundwater saturation. Earthquake stability probably good to very good; slope stability good to excellent, but excavations slump in fine-grained units. Resistance to erosion by running water moderate to excellent.

Table 2. Depth to Bedrock (Thickness of Surficial Materials)
(locations are listed generally from south to north and from west to east)

Location	Surficial Geologic Unit	Depth to Bedrock	Data Source
Southern margins of W. 1st Pl., McIntyre, and Lakewood gulches	Primarily ancient alluvium	Bedrock at 20-40 inches (commonly less than 2 feet)	Price and Amen 1980
Southbound, right lane, 395 Wadsworth Blvd.	Ancient alluvium	Greater than 16 feet (total depth drilled)	RockSol drillhole B-6 (6/5/2007)
Northbound, right lane, across from 395 Wadsworth Blvd.	Ancient alluvium	Greater than 16 feet (total depth drilled)	RockSol drillhole B-5 (6/5/2007)
South side of W. 5th Ave., within 200 feet west of Zephyr St.	Bedrock crops out	Bedrock at ground surface	Lindvall 1978

Southwest cloverleaf, 6th Ave./Wadsworth Blvd. ramp	Ancient alluvium	Bedrock at 9 feet (weathered bedrock at 7 feet)	RockSol drillhole B-8 (6/5/2007)
Inside southeast cloverleaf, 6th Ave./Wadsworth Blvd.	Ancient alluvium	Bedrock at 5.5 feet (weathered bedrock at 1 foot)	RockSol drillhole B-9 (6/5/2007)
Northwest cloverleaf, 6th Ave./Wadsworth Blvd. ramp	Probable ancient alluvium	Bedrock at 21 feet (weathered bedrock at 20 feet)	RockSol drillhole B-7 (6/6/2007)
Southbound Wadsworth Blvd., right lane, at Highland Dr. (50 ft south of bridge at creek)	Younger alluvium	Greater than 16 feet (total depth drilled)	RockSol drillhole B-4 (6/4/2007)
Northbound Wadsworth Blvd., right lane, 50 ft south of Highland Dr. (100 ft south of creek)	Younger alluvium	Greater than 16 feet (total depth drilled)	RockSol drillhole B-3 (6/5/2007)
Southbound right lane, 1251 Wadsworth Blvd.	Ancient alluvium	Bedrock at 12 feet	RockSol drillhole B-1 (6/4/2007)
Northbound right lane, 1220 Wadsworth Blvd.	Ancient alluvium	Approaching bedrock at 15-16 feet (total depth drilled 16 ft)	RockSol drillhole B-2 (6/5/2007)
Southwest corner of Zephyr St. and 14th Ave.	Ancient alluvium	Bedrock at 23 feet	Lindvall 1978

Table 3. Depth to Initial Water Level in Drillholes, June 2007
(locations are listed generally from south to north and from west to east)

Location	**Initial Depth to Water Table**	**Geologic Unit at Water Table**	**Data Source**
Southbound right lane, 395 Wadsworth Blvd.	15.5 feet	Ancient alluvium	RockSol drillhole B-6 (6/5/2007)
Northbound, right lane, across from 395 Wadsworth Blvd.	15 feet	Ancient alluvium	RockSol drillhole B-5 (6/5/2007)
Southwest cloverleaf, 6th Ave./Wadsworth Blvd. ramp	23 feet	Bedrock	RockSol drillhole B-8 (6/5/2007)
Inside southeast cloverleaf, 6th Ave./Wadsworth Blvd.	12.5 feet	Bedrock	RockSol drillhole B-9 (6/5/2007)
Northwest cloverleaf, 6th Ave./Wadsworth Blvd. ramp	16 feet	Ancient alluvium	RockSol drillhole B-7 (6/6/2007)
Southbound Wadsworth Blvd., right lane, at Highland Dr. (50 ft south of bridge at creek)	11 feet	Younger alluvium	RockSol drillhole B-4 (6/4/2007)

Northbound Wadsworth Blvd., right lane, 50 ft south of Highland Dr. (100 ft south of creek)	10.5 feet	Younger alluvium	RockSol drillhole B-3 (6/5/2007)
Southbound right lane, 1251 Wadsworth Blvd.	9 feet	Ancient alluvium	RockSol drillhole B-1 (6/4/2007)
Northbound right lane, 1220 Wadsworth Blvd.	Greater than 16 feet (total depth drilled)	N/A	RockSol drillhole B-2 (6/5/2007)

Table 4. Limitations to Shallow Excavation (compiled from: Price and Amen, 1980)

Soils	**Distribution**	**Degree of Limitation**	**Comments**
Englewood-Urban land complex, 0-2% slopes (code: 44)	Within W. 1st Pl., McIntyre, Lakewood, and Dry gulches	Moderate	Too clayey
Denver-Kutch-Urban land complex, 5-15% slopes (codes: 33 = 9-15% slope; minor 32 = 5-9% slope)	Southern flanks of Lakewood Gulch and McIntyre Gulch	*Denver* Moderate *Kutch* Moderate	*Denver* Too clayey; (33) slope *Kutch* Depth to bedrock; too clayey; (33) slope
Denver-Urban land complex, 0-9% slopes (codes: 35 = 2-5% slope; 36 = 5-9% slope; minor 34 = 0-2% slope)	Northern flank of Lakewood Gulch and between McIntyre and Lakewood gulches	Moderate	Too clayey
Nunn-Urban land complex, 0-5% slopes (codes: 105 = 0-2% slope; 106 = 2-5% slope)	On loess and ancient terrace alluvium away from the significant modern gulches	Moderate	Too clayey

Table 5. Shrink-Swell Potential in Soils (compiled from Price and Amen, 1980)

Soils	**Distribution**	**Shrink-Swell Potential**
Englewood-Urban land complex, 0-2% slopes	Within W. 1st Pl., McIntyre, Lakewood, and Dry gulches	Moderate to high
Denver-Kutch-Urban land complex, 5-15% slopes	Southern flanks of Lakewood Gulch and McIntyre Gulch	High to moderate
Denver-Urban land complex, 0-9% slopes	Northern flank of Lakewood Gulch and between McIntyre and Lakewood gulches	High to moderate
Nunn-Urban land complex, 0-5% slopes	On loess and ancient terrace alluvium away from the significant modern gulches	Moderate to high

Table 6. Corrosive Potential and Frost Action (compiled from Price and Amen, 1980)

Soils	Distribution	Steel Corrosion	Concrete Corrosion	Frost Action
Englewood-Urban land complex, 0-2% slopes	Within W. 1st Pl., McIntyre, Lakewood, and Dry gulches	High	Low	Moderate
Denver-Kutch-Urban land complex, 5-15% slopes	Southern flanks of Lakewood Gulch and McIntyre Gulch	High	*Denver* Low *Kutch* Moderate	*Denver* Low *Kutch* Moderate
Denver-Urban land complex, 0-9% slopes	Northern flank of Lakewood Gulch and between McIntyre and Lakewood gulches	High	Low	Low
Nunn-Urban land complex, 0-5% slopes	On loess and ancient terrace alluvium away from the significant modern gulches	High	Low	Moderate

Table 7. Soil Susceptibility to Erosion (compiled from Price and Amen, 1980)

Soils	Distribution	Running Water	Wind
Englewood-Urban land complex, 0-2% slopes	Within W. 1st Pl., McIntyre, Lakewood, and Dry gulches	Slight	Moderate
Denver-Kutch-Urban land complex, 5-15% slopes	Southern flanks of Lakewood Gulch and McIntyre Gulch	*Denver* Moderate to severe *Kutch* Moderate to severe	*Denver* Moderate *Kutch* Slight
Denver-Urban land complex, 0-9% slopes	Northern flank of Lakewood Gulch and between McIntyre and Lakewood gulches	Moderate	Moderate
Nunn-Urban land complex, 0-5% slopes	On loess and ancient terrace alluvium away from the significant modern gulches	Slight to moderate	Slight

Wadsworth Boulevard & 6th Avenue
Bore Hole Summary

A summary description of each bore hole is provided below. Supporting boring logs are attached for further reference.

Boring B-1 is located in the right-hand, southbound lane at approximately 1251 Wadsworth Blvd. (SH121) as shown on Exhibit 4-11 (see Existing Conditions of Engineering Design Elements, Section 4 – Geometric Health Report Plans for all referenced exhibits). An asphalt pavement with one-foot thickness was encountered and underlain by approximately one foot of road base fill. Native sandy clay was observed to a depth of 12 feet. Calcium carbonate stringers were observed in the upper 3 feet of this unit. Subtle structure becomes visible at 10-12' below ground surface approaching bedrock with the presence of claystone fragments and slight weathering. Claystone bedrock was encountered at a depth of 12' below existing pavement. Bedrock shows constant change of sand/silt content grading in and out with depth. The claystone bedrock exhibits moderate plasticity with low swelling potential due to content of silt/sand. Groundwater was encountered at 9' below pavement.

Boring B-2 is located in the right-hand, northbound lane at approximately 1220 Wadsworth Blvd. as shown on Exhibit 4-11. An asphalt pavement with 6-inch thickness was encountered and underlain by approximately 1 ½' of road base fill. Native sandy clay was observed to the termination of the borehole at 16' below pavement. This native soil exhibits varying sand/silt content throughout the borehole, consistent with its geological environment of fluvial deposition. Bedrock was not encountered, however, claystone fragments and subtle structure became visible from 15-16' below pavement with slight weathering. Groundwater was not encountered in the borehole.

Boring B-3 is in the right-hand, northbound lane of Wadsworth Blvd. approximately 50' south of Highland Drive as shown on Exhibit 4-9. An asphalt pavement with 11-inch thickness was encountered and underlain by approximately 2 inches of a lightly cemented base-coarse. A native sandy clay/clayey sand (interbedded fluvial deposits) was observed to a depth of approximately 9' with sand/silt content constantly varying with depth. This unit can be seen throughout the entire borehole interbedded with a gravelly sand from approximately 9-12.5' below pavement. Groundwater was encountered in this layer at a depth of approximately 10.5'. Below the gravelly sand at approximately 12.5', the sandy clay/clayey sand can be observed to the termination of the borehole (16' bgs) as the coarser material is grading out. Bedrock was not encountered in the borehole, but claystone fragments were observed in the sandy clay from approximately 13-16' below the existing pavement.

Boring B-4 is located in the right-hand, southbound lane of Wadsworth Blvd. approximately 50' south of Lakewood Gulch as shown on Exhibit 4-9. An asphalt pavement with 6-inch thickness was encountered and underlain by approximately 1.5' of road base fill.

Native interbedded sandy clay and clayey sand was observed underlying the fill material to the termination of the borehole at 16' below existing pavement. This unit, characteristic of its fluvial depositional environment, exhibits constant change of sand/silt content with depth. Bedrock was not encountered in the borehole. Groundwater was intersected at approximately 11' below the existing pavement.

Boring B-5 is located in the right-hand, northbound lane at approximately 410 Wadsworth Blvd. as shown on Exhibit 4-7. An asphalt pavement with 13-inch thickness was encountered and underlain by approximately 6 inches of a lightly cemented road base fill. A native sandy clay was observed to a depth of approximately 14' with constantly varying sand/silt content consistent with the fluvial environment in which this layer was deposited. Approaching groundwater, which was intersected at approximately 15' bgs, coarser material is grading in, marked by gravelly sand encountered from 14-16' below existing pavement. Bedrock was not reached in the borehole.

Boring B-6 is located in the right-hand, southbound lane at approximately 395 Wadsworth Blvd. as shown on Exhibit 4-7. An asphalt pavement with 13-inch thickness was encountered but was not underlain by any significant road base fill at this location. However, asphalt is underlain by native sandy clay with varying plasticity due to its varying sand/silt content as seen in the previous boreholes. Again, this is consistent with its fluvial depositional environment. This clay is underlain by a gravelly sand at approximately 13.5' to the termination of the borehole at approximately 16' below the existing pavement. This layer of coarser material was found to be saturated as groundwater was encountered at a depth of 9'. Bedrock was not intersected in this borehole.

Boring B-7 is located in the northwest cloverleaf of the US6 and Wadsworth Blvd. interchange as shown on Exhibit 4-3. Approximately one foot of a silty sand topsoil was observed and underlain by interbedded native sand and clay to a depth of approximately 21'. The sand/silt content varies with depth throughout this layer as sand/silt are grading in and out due to the fluvial nature of this depositional environment. This unit becomes gravelly from approximately 15-20' bgs within the groundwater zone which was intersected at a depth of 16'. Roots and organic material were encountered in the top 4' of this layer with occasional $CaCO_3$ stringers visible. At approximately 21' below the existing ground surface, a claystone bedrock was encountered with significant weathering present in the top 1-5' of the unit. The plasticity and swelling potential varies throughout the bedrock with sand/silt content grading in and out. Swelling potential was found to be low but increasing with depth. Testing indicates a moderate to high swelling potential at approximately 40' bgs. Groundwater was encountered at a depth of 16'. The borehole was terminated at 40.5'.

Boring B-8 is located in the southwest cloverleaf of the US6 and Wadsworth Blvd. interchange as shown on Exhibit 4-4. A silty sand topsoil was observed to an approximate depth of one foot. This soil is underlain by interbedded native sand and clays with sand/silt content

grading in and out with depth consistent with its fluvial depositional environment. Below this unit, a claystone bedrock was encountered at approximately 7' below the existing ground surface. The bedrock is intermittently slightly weathered throughout with the most extensive weathering in the upper 2' of the unit. Plasticity and swelling potential vary with depth due to sand/silt grading in and out. Moderate to high swelling potential is exhibited lower in the unit at a depth of approximately 30'. Groundwater was encountered at a depth of 23'. The borehole was terminated at 30.5' below the existing ground surface.

Boring B-9 is located in the southeast cloverleaf of the US6 and Wadsworth Blvd. interchange as shown on Exhibit 4-4. A silty sand topsoil was first encountered to a depth of approximately one foot. Bedrock was encountered just below the topsoil due to extensive excavating in the area. The bedrock is a claystone with sand/silt content greatly varying with depth throughout the unit. This variance is consistent with the fluvial depositional environment seen in the other boreholes. Sand/silt is grading in and out varying the plasticity and swelling potential of the bedrock. Groundwater was intersected at a depth of approximately 12.5'. Weathering is intermittent and usually slight with the most extensive weathering of the bedrock visible in the top 5' of the unit. Swelling potential is predominantly low in the borehole with an increase of low to moderate with depth. The borehole was terminated at approximately 35' below the existing ground surface.

Appendix C – Boring Log Reports:

RockSol
Consulting Group,Inc.

BORING : B - 1

CLIENT CDOT - CH2MHILL
PROJECT NAME US 6 and Wadsworth Interchange
PROJECT NUMBER RS - 181.01
PROJECT LOCATION Lakewood, CO
DATE STARTED 6/4/07 **COMPLETED** 6/4/07
GROUND ELEVATION _____ **HOLE SIZE** 4"
DRILLING CONTRACTOR Dakota Drilling
BORING LOCATION: 1251 Wadsworth Blvd. - S. B. Rt Ln
DRILLING METHOD Solid Stem Auger
GROUND WATER DEPTH:
LOGGED BY R. Smith
WATER DEPTH 9.0 ft on 6/4/2007
NOTES
WATER DEPTH --- on

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UCCS. (ksf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Asphalt										
		Roadbase - sandy gravel with pebbles, occas. cobble, lightly cemented (possibly lime-treated)										
		Native: sandy CLAY, slightly silty, slightly moist to moist, brown to light brown (homogeneous in color), stiff to very stiff, slight weathering from 10-12' with claystone fragments and subtle mottling in color (brown to dark brown with orangish brown), subtle structure visible from 10-12' approaching bedrock, occas. CaCO3 stringers in upper 3' of unit.	MC 1		13							
5			MC 2		10		85	24	46	21	25	64
10			MC 3		29							
		Bedrock: CLAYSTONE, slightly sandy, occas. very silty, slightly moist, very hard, tanish brown to brown, dark brown, occas. slight intermittant weathering (mottled - orangish brown where weathered).										
15			MC 4		50		92	28	59	37	22	64
		Bottom of hole at 15.9 feet.										

RockSol
Consulting Group,Inc.

BORING : B - 2

CLIENT CDOT - CH2MHILL
PROJECT NAME US 6 and Wadsworth Interchange
PROJECT NUMBER RS - 181.01
PROJECT LOCATION Lakewood, CO
DATE STARTED 6/4/07 **COMPLETED** 6/4/07
GROUND ELEVATION _____ **HOLE SIZE** 4"
DRILLING CONTRACTOR Dakota Drilling
BORING LOCATION: 1220 Wadsworth Blvd. - N. B. Rt Ln
DRILLING METHOD Solid Stem Auger
GROUND WATER DEPTH:
LOGGED BY R. Smith
WATER DEPTH Not Encounterd on 6/4/2007
NOTES _____
WATER DEPTH --- on

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UCCS. (ksf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Asphalt										
		Roadbase - sandy gravel with pebbles, occas. cobble, lightly cemented (possibly lime-treated)										
		Native: sandy CLAY, slightly silty - occas. very silty, occas. pebble, slightly moist to moist, brown to light brown (homogeneous in color), stiff to very stiff - occas. hard to very hard, slight weathering from 15-16' with claystone fragments and subtle mottling in color (brown to dark brown with orangish brown), subtle structure visible from 15-16' approaching bedrock.	MC 1		17							
5			MC 2		26		95	14	42	21	21	63
10			MC 3		50		78	35	69	41	28	74
15			MC 4		46							
		Bottom of hole at 16.0 feet.										

RockSol
Consulting Group, Inc.

BORING : B - 3

CLIENT CDOT - CH2MHILL
PROJECT NAME US 6 and Wadsworth Interchange
PROJECT NUMBER RS - 181.01
PROJECT LOCATION Lakewood, CO
DATE STARTED 6/4/07 **COMPLETED** 6/4/07
GROUND ELEVATION _____ **HOLE SIZE** 4"
DRILLING CONTRACTOR Dakota Drilling
BORING LOCATION: 50' S. of Highland Dr. on Wadsworth Blvd. - N.B. Rt Ln
DRILLING METHOD Solid Stem Auger
GROUND WATER DEPTH:
LOGGED BY R. Smith
WATER DEPTH 10.5 ft on 6/4/2007
NOTES
WATER DEPTH --- on

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UCCS. (ksf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Asphalt										
		Roadbase - sandy gravel with pebbles, occas. cobble, lightly cemented (possibly lime-treated)										
		Native: sandy CLAY / clayey SAND (interbedded stream/river valley deposit), slightly silty - occas. very silty, occas. with pebbles, occass. cobble, sand is mod. to well sorted - rounded to subrounded - predom. med. grn (sand grading-out from 5-9'); moist to very moist, brown to light brown, dark brown, loose to very stiff, occas. clystn. fragments @ 5-9', small lenses (2-3 cm) of fn. grain dissem. CaCO3 @ 5-6'.	MC 1		10		98	15	30	26	4	37
5			MC 2		28		89	23	45	21	24	70
10		Native: clayey, gravelly SAND w/ cobbles (subset of above stream deposit), poorly sorted, subrounded to rounded, very moist - saturated, medium dense, light brown to brown, dark brown, multicolored gravel.	MC 3		15				31	18	13	36
			SS 4		20							
15		Native: sandy CLAY / clayey SAND with silt (interbedded stream/river valley deposit), occas. very silty, sand is mod. to well sorted - rounded to subrounded - predom. med. gm., slightly moist, brown to light brown, dark brown, med. dense/very stiff, occas. clystn. fragments.	MC 5		18							
		Bottom of hole at 16.0 feet.										

RockSol
Consulting Group, Inc.

BORING : B - 4

CLIENT CDOT - CH2MHILL
PROJECT NAME US 6 and Wadsworth Interchange
PROJECT NUMBER RS - 181.01
PROJECT LOCATION Lakewood, CO
DATE STARTED 6/4/07 **COMPLETED** 6/4/07
GROUND ELEVATION _____ **HOLE SIZE** 4"
DRILLING CONTRACTOR Dakota Drilling
BORING LOCATION: 50' S. of Lkwd Gulch on Wadsworth Blvd. - S. B. Rt Ln
DRILLING METHOD Solid Stem Auger
GROUND WATER DEPTH:
LOGGED BY R. Smith
WATER DEPTH 11.0 ft on 6/4/2007
NOTES
WATER DEPTH --- on

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UCCS. (ksf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Asphalt							NP	NP	NP	2
		Roadbase - sandy gravel with pebbles, occas. cobble, lightly cemented (possibly lime-treated)										
		Native: sandy CLAY / clayey SAND (interbedded stream/river valley deposit), slightly silty, occas. pebble, sand is mod. to well sorted - rounded to subrounded - predom. med. grn (sand grading-in and out throughout unit from slightly sandy to very sandy) (gravelly fill material mixed in top 2' of unit); moist to very moist, brown to dark brown, light brown where very sandy, stiff to hard.	MC 1		14							
5			MC 2		9		93	13	36	20	16	51
10			MC 3		10							
15			MC 4		35							
		Bottom of hole at 16.0 feet.										

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BORING : B - 5

CLIENT CDOT - CH2MHILL
PROJECT NAME US 6 and Wadsworth Interchange
PROJECT NUMBER RS - 181.01
PROJECT LOCATION Lakewood, CO
DATE STARTED 6/4/07 **COMPLETED** 6/4/07
GROUND ELEVATION _____ **HOLE SIZE** 4"
DRILLING CONTRACTOR Dakota Drilling
BORING LOCATION: 410 Wadsworth Blvd. - N. B. Rt Ln
DRILLING METHOD Solid Stem Auger
GROUND WATER DEPTH:
LOGGED BY R. Smith
▼ **WATER DEPTH** 15.0 ft on 6/4/2007
NOTES
WATER DEPTH --- on

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UCCS. (ksf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Asphalt										
		Roadbase - sandy gravel with pebbles, occas. cobble, lightly cemented (possibly lime-treated)										
		Native: sandy CLAY, slightly silty - occas. very silty, occas. pebble, slightly moist to very moist, brown to light brown (homogeneous in color), stiff to very stiff, occas. with CaCO3 stringers.	MC 1		15		92	25	45	21	24	64
5			MC 2		30							
10			MC 3		12		102	21	44	18	26	68
15		Native: clayey, sandy GRAVEL / gravelly SAND - poorly sorted, subrounded to rounded, very moist - saturated, medium dense, light brown to brown, dark brown, multicolored gravel.	SS 4		19				33	18	15	27
		Bottom of hole at 16.0 feet.										

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BORING : B - 6

CLIENT CDOT - CH2MHILL
PROJECT NAME US 6 and Wadsworth Interchange
PROJECT NUMBER RS - 181.01
PROJECT LOCATION Lakewood, CO
DATE STARTED 6/4/07 **COMPLETED** 6/4/07
GROUND ELEVATION _____ **HOLE SIZE** 4"
DRILLING CONTRACTOR Dakota Drilling
BORING LOCATION: 395 Wadsworth Blvd. - S. B. Rt Ln
DRILLING METHOD Solid Stem Auger
GROUND WATER DEPTH:
LOGGED BY R. Smith
WATER DEPTH 9.0 ft on 6/4/2007
NOTES _____
WATER DEPTH --- on

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UCCS. (ksf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Asphalt										
		Native: sandy CLAY / clayey SAND (sand grading in and out with depth) with occas. pebble, slightly silty - occas. very silty, occas. pebble, slightly moist to very moist, brown to light brown (homogeneous in color), stiff to very stiff, occas. with CaCO3 stringers.	MC 1		16		98	21	50	18	32	75
5			MC 2		18							
10			MC 3		21		107	12	33	15	18	23
15		Native: clayey, sandy GRAVEL - poorly sorted, subrounded to rounded - fn. to coarse grain with pebbles and occas. cobble, very moist - saturated, medium dense, light brown to brown, dark brown, multicolored gravel.	MC 4		25							
		Bottom of hole at 16.0 feet.										

DIA US 6 AND WADSWORTH INTERCHANGE.GPJ GINT US LAB.GDT 6/23/07

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BORING : B - 7

CLIENT CDOT - CH2MHILL
PROJECT NAME US 6 and Wadsworth Interchange
PROJECT NUMBER RS - 181.01
PROJECT LOCATION Lakewood, CO
DATE STARTED 6/5/07 **COMPLETED** 6/5/07
GROUND ELEVATION _____ **HOLE SIZE** 4"
DRILLING CONTRACTOR Dakota Drilling
BORING LOCATION: NW Clover Leaf of US 6 / Wadsworth Blvd. Interchange
DRILLING METHOD Solid Stem Auger
GROUND WATER DEPTH:
LOGGED BY R. Smith
WATER DEPTH 16.0 ft on 6/5/2007
NOTES _____
WATER DEPTH --- on

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UCCS. (ksf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Topsoil - dry, silty SAND with vegetation.										
		Native: sandy CLAY / clayey SAND (sand grading in and out with depth) with occas. pebble- gravelly w/i groundwater zone @ approx. 15-20' bgs; slightly silty - occas. very silty, occas. pebble, slightly moist to very moist, brown to light brown (homogeneous in color), stiff to very stiff, occas. with CaCO3 stringers, with roots from 1-4'.	MC 1		10							
5			MC 2		14		89	8	31	18	13	44
10			MC 3		24							
15			MC 4		11		102	22	36	19	17	49
20			MC 5		25		100	23	41	24	17	30
		Bedrock: CLAYSTONE (top 1-1.5' of unit is very weathered) slightly sandy, slightly silty - occas. very silty, slightly moist, very hard, dark brown to grayish brown, occas. slight intermittant weathering (mottled - orangish brown where weathered).										
25			MC 6		50		111	19	34	16	18	63
30			MC 7		50							
35												

DIA_US 6 AND WADSWORTH INTERCHANGE.GPJ GINT US LAB.GDT 6/23/07

(Continued Next Page)

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BORING : B - 7

CLIENT CDOT - CH2MHILL **PROJECT NAME** US 6 and Wadsworth Interchange

PROJECT NUMBER RS - 181.01 **PROJECT LOCATION** Lakewood, CO

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UCCS. (ksf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
35		Bedrock: CLAYSTONE (top 1-1.5' of unit is very weathered) slightly sandy, slightly silty - occas. very silty, slightly moist, very hard, dark brown to grayish brown, occas. slight intermittant weathering (mottled - orangish brown where weathered). *(continued)*	MC 8		50							
40		Bottom of hole at 40.5 feet.	MC 9		50		121	31	42	27	15	81

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BORING : B - 8

CLIENT CDOT - CH2MHILL
PROJECT NAME US 6 and Wadsworth Interchange
PROJECT NUMBER RS - 181.01
PROJECT LOCATION Lakewood, CO
DATE STARTED 6/5/07 **COMPLETED** 6/5/07
GROUND ELEVATION _____ **HOLE SIZE** 4"
DRILLING CONTRACTOR Dakota Drilling
BORING LOCATION: SW Clover Leaf of US 6 / Wadsworth Blvd. Interchange
DRILLING METHOD Solid Stem Auger
GROUND WATER DEPTH:
LOGGED BY R. Smith
WATER DEPTH 23.0 ft on 6/5/2007
NOTES _____
WATER DEPTH --- on

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UCCS. (ksf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Topsoil - dry, silty SAND with vegetation.										
		Native: sandy CLAY / clayey SAND (sand grading in and out with depth) with occas. pebble slightly silty - occas. very silty, slightly moist to very moist, brown to light brown (homogeneous in color), stiff to very stiff, occas. with CaCO3 stringers.	MC		15		91	7	26	22	4	16
5			MC		26							
		Bedrock: CLAYSTONE (top 2' of unit is very weathered) slightly sandy with silt content varying with depth (sand is predom. fine to med. grained, subrounded), slightly moist, very hard, dark brown to grayish brown, occas. slight intermittant weathering (mottled - orangish brown where weathered).										
10			MC		50							
15			MC		50		105	23	44	24	20	65
20			MC		50							
25			MC		50							
30			MC		50		106	22	50	26	24	96
		Bottom of hole at 30.5 feet.										

DIA US 6 AND WADSWORTH INTERCHANGE.GPJ GINT US LAB.GDT 6/23/07

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BORING : B - 9

CLIENT CDOT - CH2MHILL
PROJECT NAME US 6 and Wadsworth Interchange
PROJECT NUMBER RS - 181.01
PROJECT LOCATION Lakewood, CO
DATE STARTED 6/5/07 **COMPLETED** 6/5/07
GROUND ELEVATION _____ **HOLE SIZE** 4"
DRILLING CONTRACTOR Dakota Drilling
BORING LOCATION: SE Clover Leaf of US 6 / Wadsworth Blvd. Interchange
DRILLING METHOD Solid Stem Auger
GROUND WATER DEPTH:
LOGGED BY R. Smith
WATER DEPTH 12.5 ft on 6/5/2007
NOTES _____
WATER DEPTH --- on

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UCCS. (ksf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Topsoil - dry, silty SAND with vegetation.										
		Bedrock: CLAYSTONE, slightly sandy to occas. very sandy / interbedded sandstone (sand is predom. fine to med. grained, subrounded) (top 5' of unit is very weathered - weathered zone is very sandy w/ pebbles and claystone fragments, mottled orangish brown) slightly moist, very hard, dark brown to grayish brown, occas. slight intermittant weathering (mottled - orangish brown where weathered).	MC 1		50		98	16	47	30	17	20
5			MC 2		50							
10			MC 3		50		90	22	52	28	24	60
15			MC 4		50							
20			MC 5		50							
25			MC 6		50		100	24	42	22	20	93
30			MC 7		50							
35												

DIA US 6 AND WADSWORTH INTERCHANGE.GPJ GINT US LAB.GDT 6/23/07

(Continued Next Page)

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Consulting Group,Inc.

BORING : B - 9

CLIENT CDOT - CH2MHILL **PROJECT NAME** US 6 and Wadsworth Interchange

PROJECT NUMBER RS - 181.01 **PROJECT LOCATION** Lakewood, CO

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UCCS. (ksf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
									LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
35		Bottom of hole at 35.2 feet.	MC 8		50							

Wadsworth Boulevard & 6th Avenue
Appendix D – Laboratory Test Results

- Summary of Laboratory Test Results
- Atterberg Limit's Results
- Swelling – Consolidation Test
- Grain Size Distribution

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SUMMARY OF LABORATORY TEST RESULTS

CLIENT CDOT - CH2MHILL **PROJECT NAME** US 6 and Wadsworth Interchange

PROJECT NUMBER RS - 181.01 **PROJECT LOCATION** Lakewood, CO

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	%<#200 Sieve	Water Content (%)	Dry Density (pcf)	Swell Potential (%)	Sulfate %	Classification
B - 1	5.0	46	21	25	64	24.1	85.2		0.00	CL
B - 1	15.0	59	37	22	64	27.9	92.2	1.75	0.00	MH
B - 2	5.0	42	21	21	63	13.5	94.8		0.00	CL
B - 2	10.0	69	41	28	74	35.2	78.2			MH
B - 3	2.0	30	26	4	37	14.7	98.2			SM
B - 3	5.0	45	21	24	70	22.6	89.1			CL
B - 3	10.0	31	18	13	36					SC
B - 4	0.5	NP	NP	NP	2					
B - 4	5.0	36	20	16	51	12.9	92.6	11.01	0.00	CL
B - 5	2.0	45	21	24	64	24.9	91.9		0.00	CL
B - 5	10.0	44	18	26	68	21.3	102.2	1.16		CL
B - 5	15.0	33	18	15	27					SC
B - 6	2.0	50	18	32	75	21.5	98.2			CH
B - 6	10.0	33	15	18	23	12.2	106.6			SC
B - 7	5.0	31	18	13	44	8.4	88.9			SC
B - 7	15.0	36	19	17	49	22.3	101.7			SC
B - 7	20.0	41	24	17	30	23.0	100.0			SC
B - 7	25.0	34	16	18	63	19.0	110.9	-0.11	0.00	CL
B - 7	40.0	42	27	15	81	31.2	120.7	3.17		ML
B - 8	2.0	26	22	4	16	7.0	90.5			SM
B - 8	15.0	44	24	20	65	23.1	104.8	0.17		CL
B - 8	30.0	50	26	24	96	21.9	105.8	4.77		CH
B - 9	2.0	47	30	17	20	15.7	98.2	0.00		SM
B - 9	10.0	52	28	24	60	21.9	90.3	-0.28		CH
B - 9	25.0	42	22	20	93	23.6	99.9	2.15		CL

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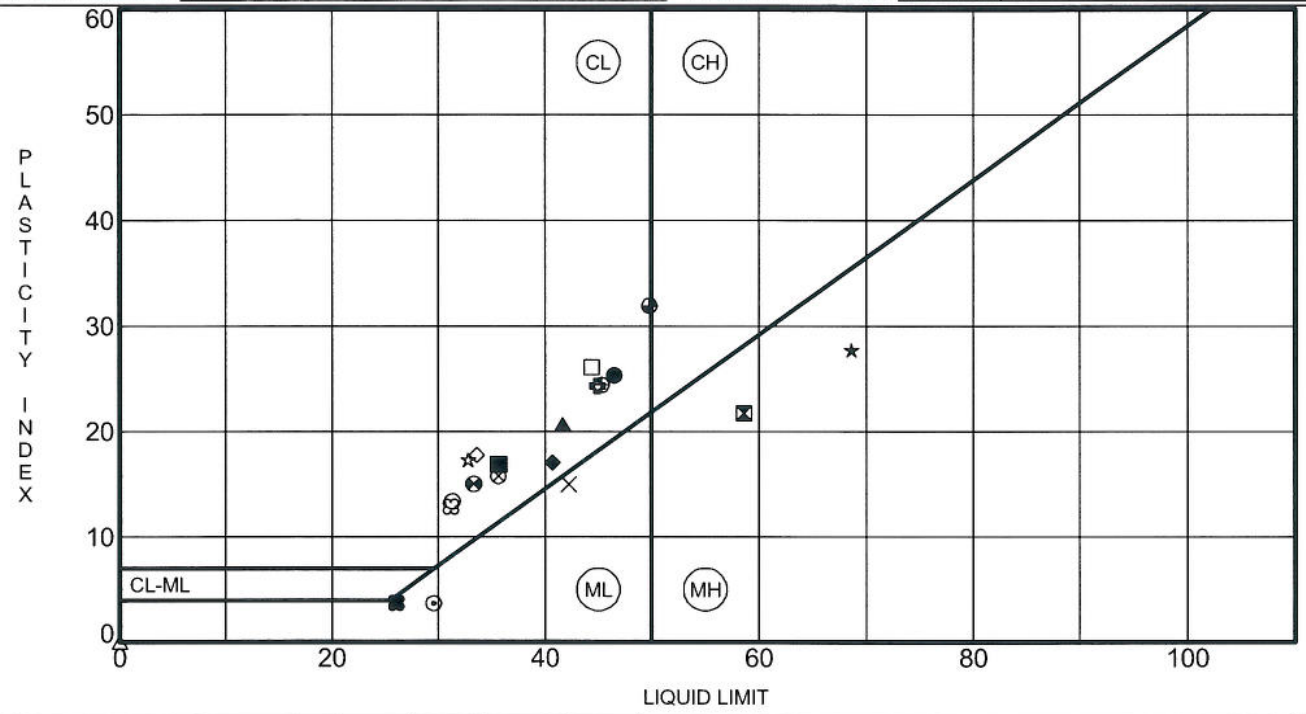
ATTERBERG LIMITS' RESULTS

CLIENT CDOT - CH2MHILL **PROJECT NAME** US 6 and Wadsworth Interchange

PROJECT NUMBER RS - 181.01 **PROJECT LOCATION** Lakewood, CO



	Specimen Identification		LL	PL	PI	Fines	Classification
●	B - 1	5.0	46	21	25	64	SANDY LEAN CLAY(CL)
⊠	B - 1	15.0	59	37	22	64	SANDY ELASTIC SILT(MH)
▲	B - 2	5.0	42	21	21	63	SANDY LEAN CLAY(CL)
★	B - 2	10.0	69	41	28	74	ELASTIC SILT with SAND(MH)
⊙	B - 3	2.0	30	26	4	37	SILTY SAND(SM)
✿	B - 3	5.0	45	21	24	70	LEAN CLAY with SAND(CL)
○	B - 3	10.0	31	18	13	36	CLAYEY SAND with GRAVEL(SC)
△	B - 4	0.5	NP	NP	NP	2	
⊗	B - 4	5.0	36	20	16	51	SANDY LEAN CLAY(CL)
⊕	B - 5	2.0	45	21	24	64	SANDY LEAN CLAY(CL)
□	B - 5	10.0	44	18	26	68	SANDY LEAN CLAY(CL)
⊛	B - 5	15.0	33	18	15	27	CLAYEY SAND with GRAVEL(SC)
◍	B - 6	2.0	50	18	32	75	FAT CLAY with SAND(CH)
☆	B - 6	10.0	33	15	18	23	CLAYEY SAND(SC)
⊠	B - 7	5.0	31	18	13	44	CLAYEY SAND(SC)
■	B - 7	15.0	36	19	17	49	CLAYEY SAND(SC)
◆	B - 7	20.0	41	24	17	30	CLAYEY SAND with GRAVEL(SC)
◇	B - 7	25.0	34	16	18	63	SANDY LEAN CLAY(CL)
×	B - 7	40.0	42	27	15	81	SILT with SAND(ML)
■	B - 8	2.0	26	22	4	16	SILTY SAND(SM)

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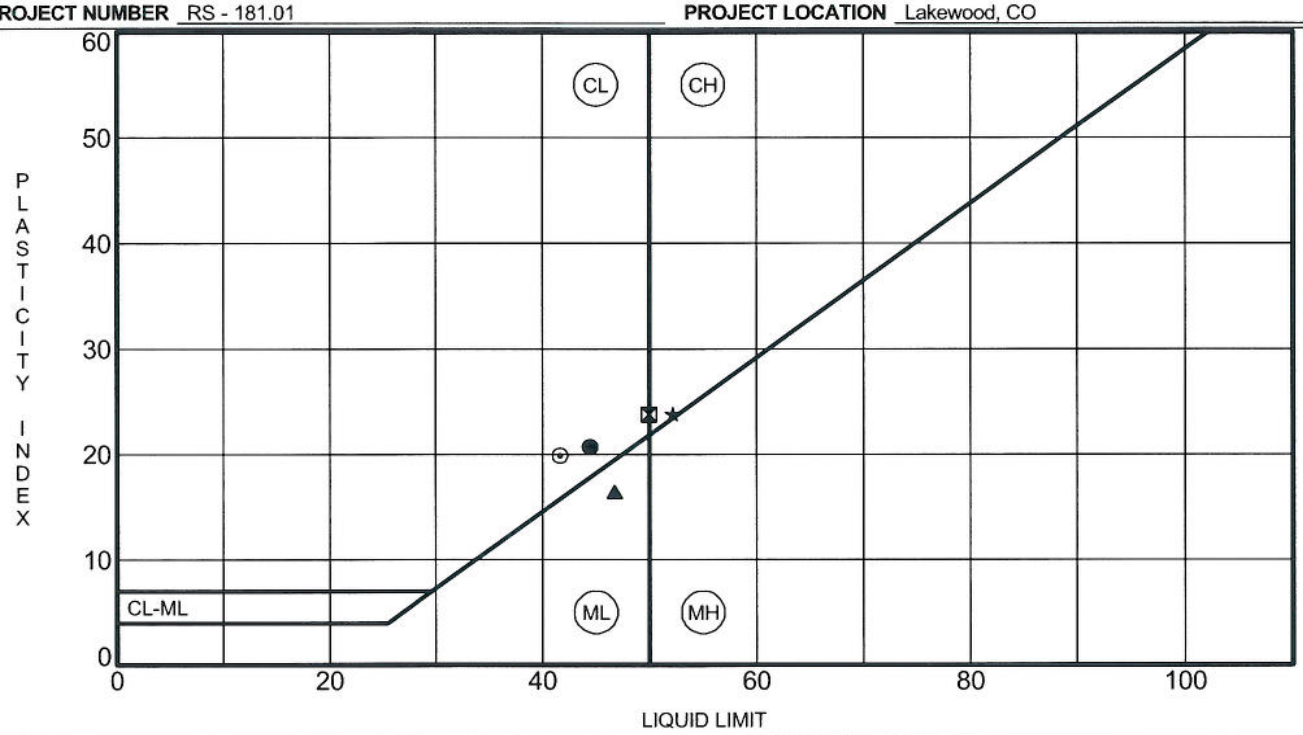
ATTERBERG LIMITS' RESULTS

CLIENT CDOT - CH2MHILL **PROJECT NAME** US 6 and Wadsworth Interchange

PROJECT NUMBER RS - 181.01 **PROJECT LOCATION** Lakewood, CO



	Specimen Identification		LL	PL	PI	Fines	Classification
●	B - 8	15.0	44	24	20	65	SANDY LEAN CLAY(CL)
⊠	B - 8	30.0	50	26	24	96	FAT CLAY(CH)
▲	B - 9	2.0	47	30	17	20	SILTY SAND(SM)
★	B - 9	10.0	52	28	24	60	SANDY FAT CLAY(CH)
⊙	B - 9	25.0	42	22	20	93	LEAN CLAY(CL)

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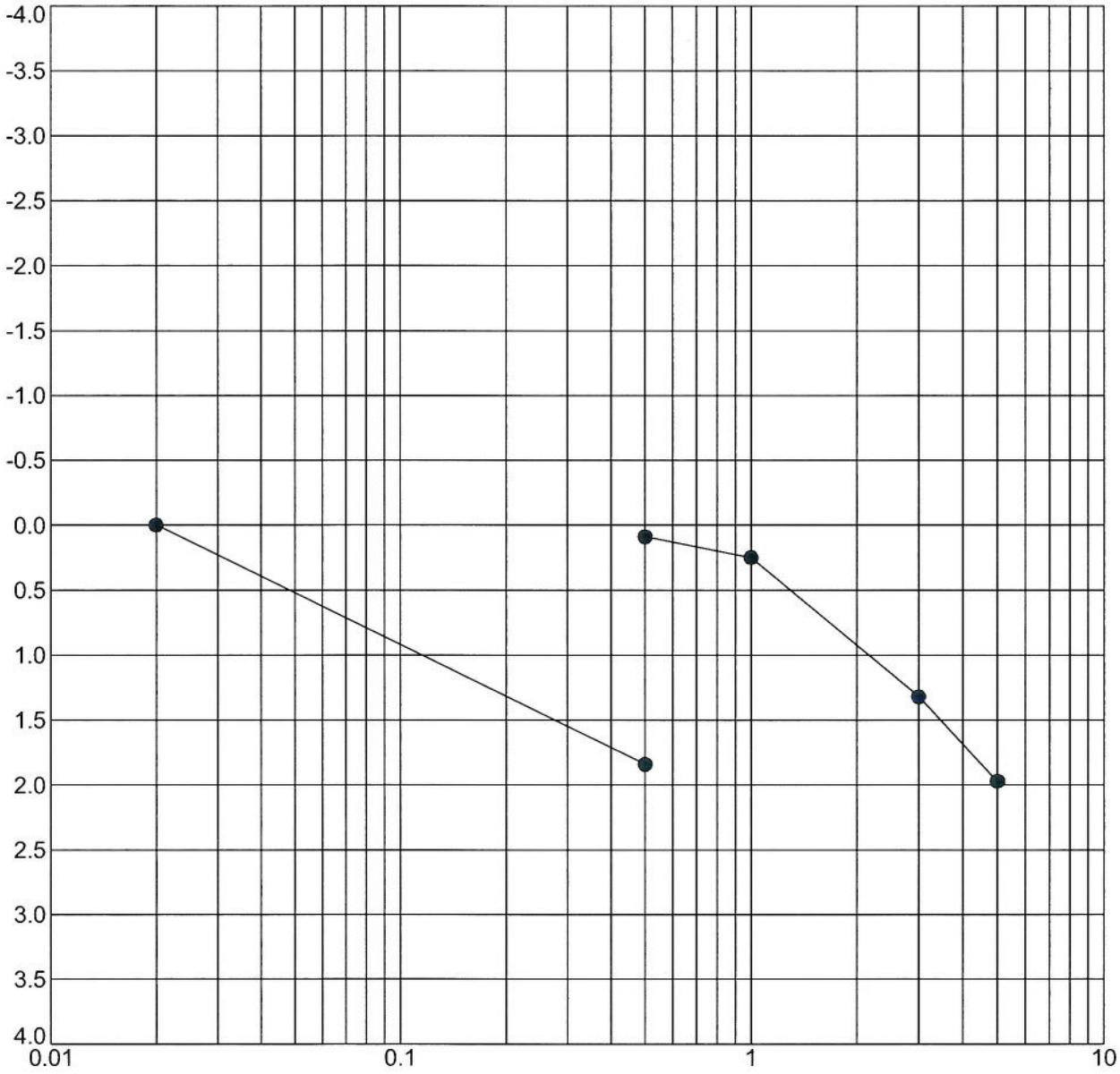
SWELLING - CONSOLIDATION TEST

CLIENT CDOT - CH2MHILL **PROJECT NAME** US 6 and Wadsworth Interchange

PROJECT NUMBER RS - 181.01 **PROJECT LOCATION** Lakewood, CO



Specimen Identification		Classification	Swell/Consol. (%)	γ_d	MC%
● B - 1	15.0	SANDY ELASTIC SILT(MH)	1.75	92.2	27.9

SWELL DIA US 6 AND WADSWORTH INTERCHANGE.GPJ GINT US LAB.GDT 6/23/07

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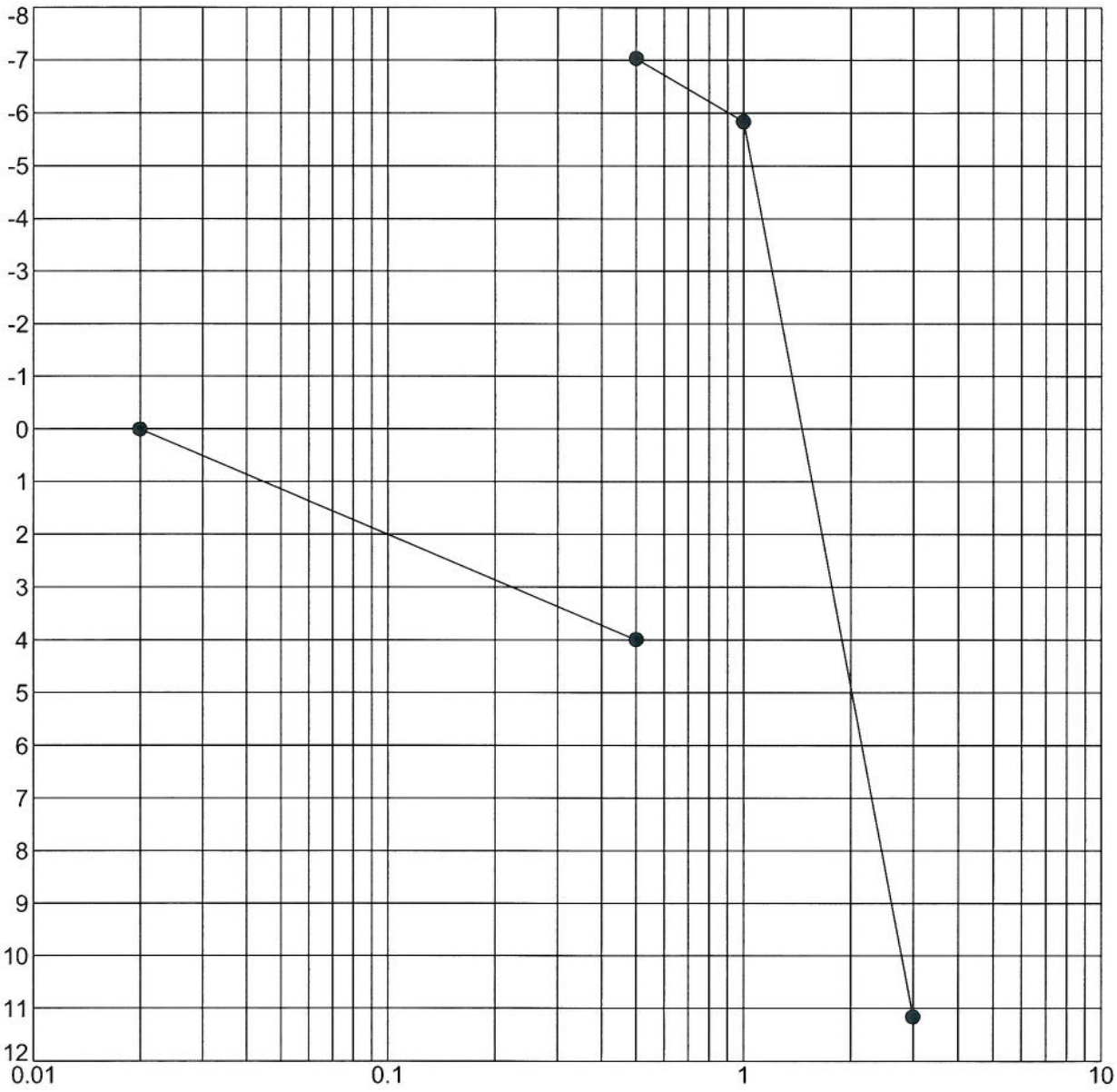
SWELLING - CONSOLIDATION TEST

CLIENT CDOT - CH2MHILL **PROJECT NAME** US 6 and Wadsworth Interchange

PROJECT NUMBER RS - 181.01 **PROJECT LOCATION** Lakewood, CO



Specimen Identification		Classification	Swell/Consol. (%)	γ_d	MC%
● B - 4	5.0	SANDY LEAN CLAY(CL)	11.01	92.6	12.9

SWELL DIA US 6 AND WADSWORTH INTERCHANGE.GPJ GINT US LAB.GDT 6/23/07

RockSol
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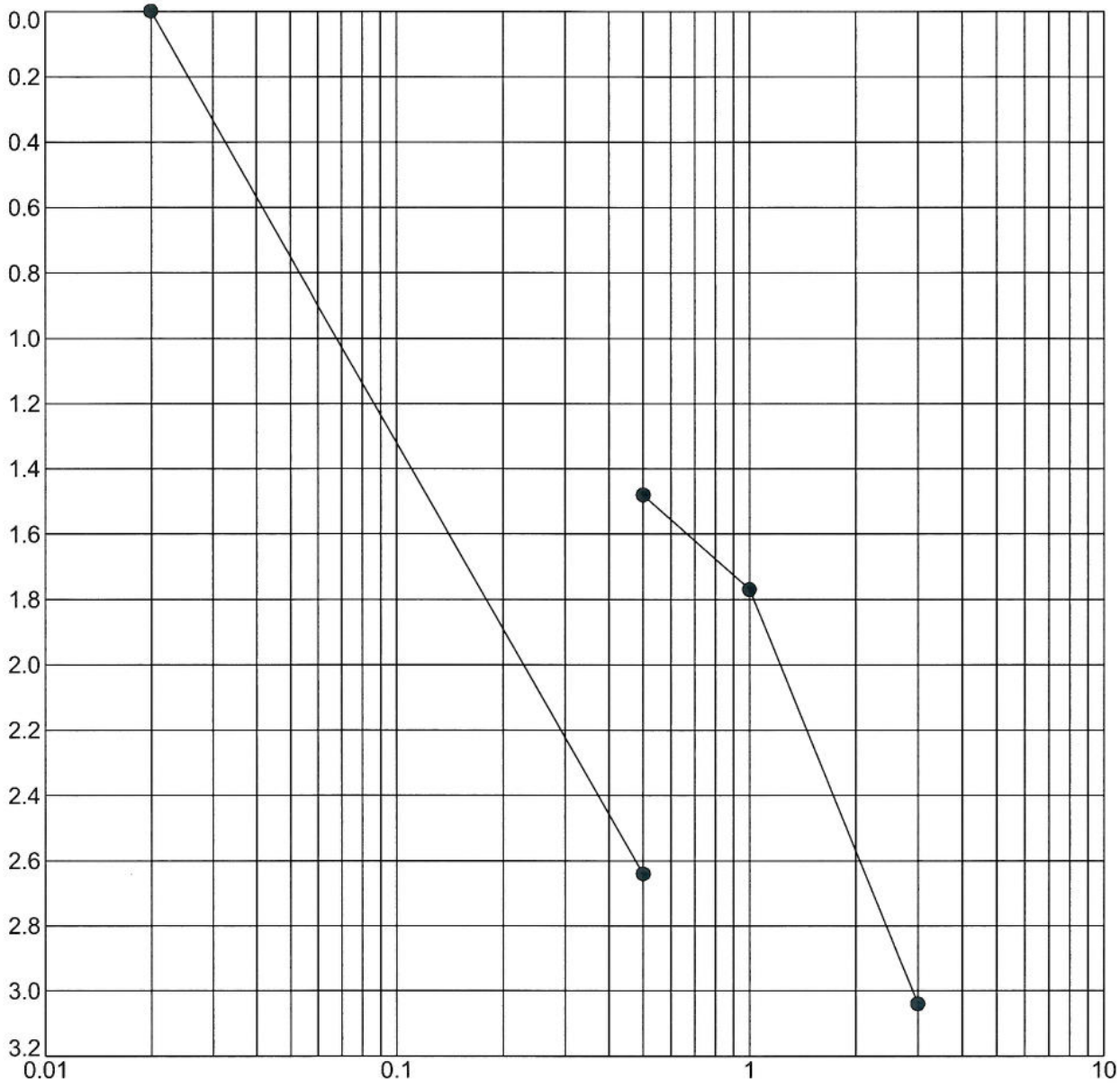
SWELLING - CONSOLIDATION TEST

CLIENT CDOT - CH2MHILL **PROJECT NAME** US 6 and Wadsworth Interchange

PROJECT NUMBER RS - 181.01 **PROJECT LOCATION** Lakewood, CO



Specimen Identification		Classification	Swell/Consol. (%)	γ_d	MC%
● B - 5	10.0	SANDY LEAN CLAY(CL)	1.16	102.2	21.3

SWELL DIA US 6 AND WADSWORTH INTERCHANGE.GPJ GINT US LAB.GDT 6/23/07

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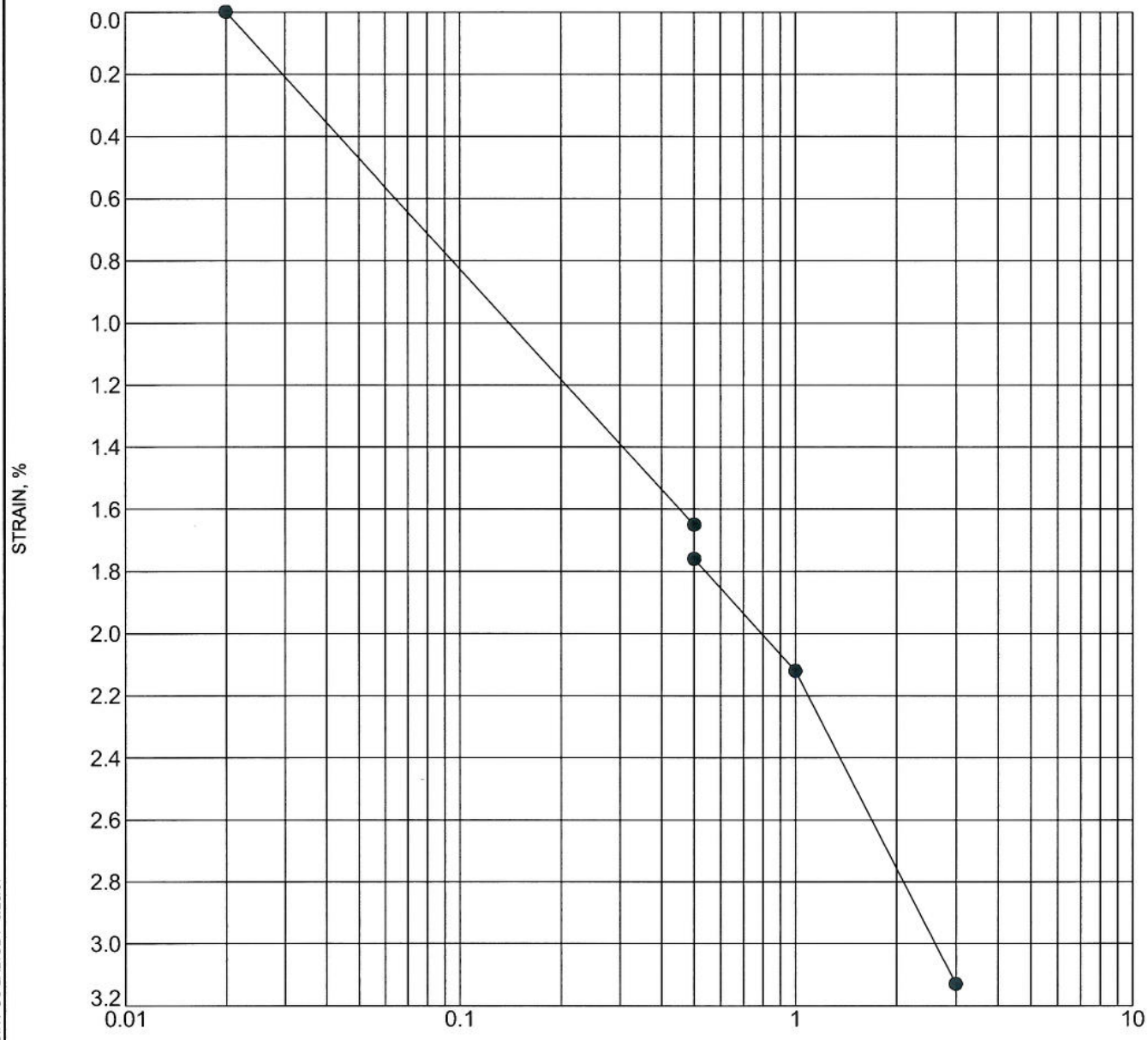
SWELLING - CONSOLIDATION TEST

CLIENT CDOT - CH2MHILL **PROJECT NAME** US 6 and Wadsworth Interchange

PROJECT NUMBER RS - 181.01 **PROJECT LOCATION** Lakewood, CO



Specimen Identification		Classification	Swell/Consol. (%)	γ_d	MC%
● B - 7	25.0	SANDY LEAN CLAY(CL)	-0.11	110.9	19.0

SWELL DIA US 6 AND WADSWORTH INTERCHANGE.GPJ GINT US LAB.GDT 6/23/07

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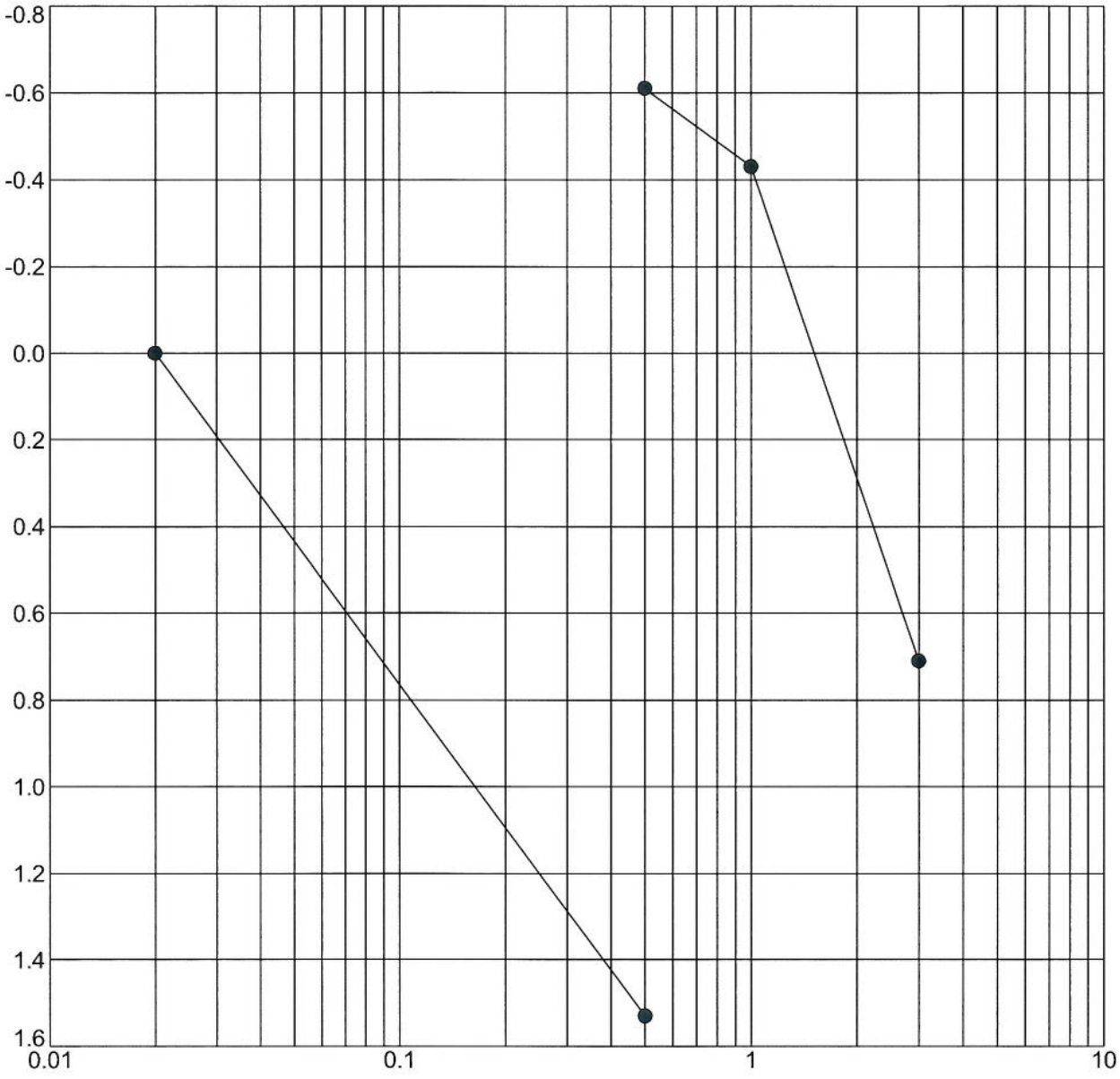
SWELLING - CONSOLIDATION TEST

CLIENT CDOT - CH2MHILL **PROJECT NAME** US 6 and Wadsworth Interchange

PROJECT NUMBER RS - 181.01 **PROJECT LOCATION** Lakewood, CO



Specimen Identification		Classification	Swell/Consol. (%)	γ_d	MC%
● B - 9 25.0		LEAN CLAY(CL)	2.15	99.9	23.6

SWELL DIA_US 6 AND WADSWORTH INTERCHANGE.GPJ GINT US LAB.GDT 6/23/07

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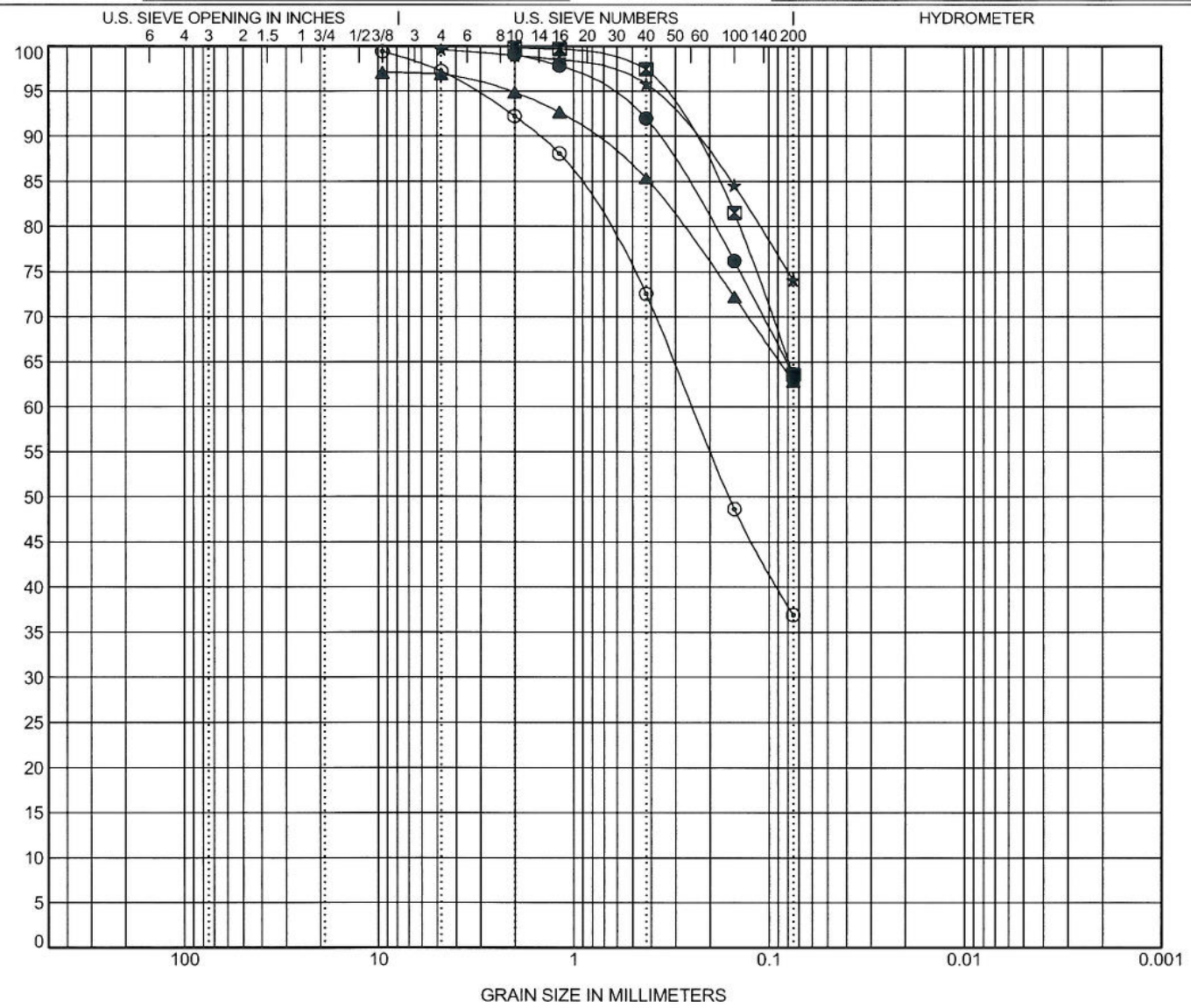
GRAIN SIZE DISTRIBUTION

CLIENT CDOT - CH2MHILL **PROJECT NAME** US 6 and Wadsworth Interchange

PROJECT NUMBER RS - 181.01 **PROJECT LOCATION** Lakewood, CO



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Depth	Classification	LL	PL	PI	Cc	Cu
●	B - 1	5.0	SANDY LEAN CLAY(CL)	46	21	25		
⊠	B - 1	15.0	SANDY ELASTIC SILT(MH)	59	37	22		
▲	B - 2	5.0	SANDY LEAN CLAY(CL)	42	21	21		
★	B - 2	10.0	ELASTIC SILT with SAND(MH)	69	41	28		
⊙	B - 3	2.0	SILTY SAND(SM)	30	26	4		

	Specimen Identification	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B - 1	5.0	2					35.4	63.7	
⊠	B - 1	15.0	2					36.2	63.6	
▲	B - 2	5.0	9.5				0.2	34.0	62.9	
★	B - 2	10.0	4.75					25.5	74.1	
⊙	B - 3	2.0	9.5	0.246			2.2	60.3	36.9	

GRAIN SIZE DISTRIBUTION US 6 AND WADSWORTH INTERCHANGE.GPJ GINT US LAB.GDT 6/23/07

GRAIN SIZE DISTRIBUTION

RockSol
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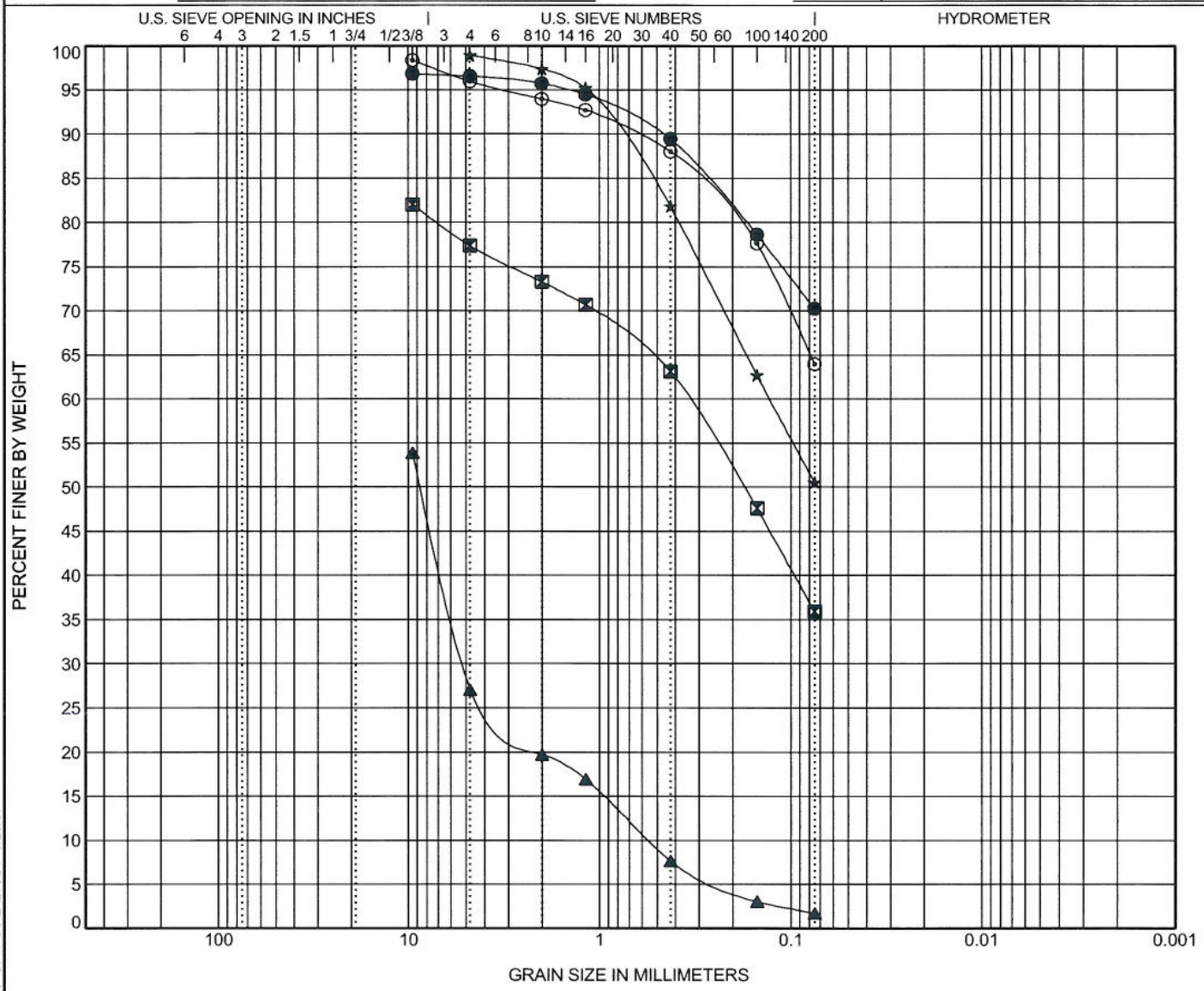
CLIENT CDOT - CH2MHILL **PROJECT NAME** US 6 and Wadsworth Interchange

PROJECT NUMBER RS - 181.01 **PROJECT LOCATION** Lakewood, CO



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Depth	Classification	LL	PL	PI	Cc	Cu
●	B - 3	5.0	LEAN CLAY with SAND(CL)	45	21	24		
⊠	B - 3	10.0	CLAYEY SAND with GRAVEL(SC)	31	18	13		
▲	B - 4	0.5		NP	NP	NP		
★	B - 4	5.0	SANDY LEAN CLAY(CL)	36	20	16		
⊙	B - 5	2.0	SANDY LEAN CLAY(CL)	45	21	24		

	Specimen Identification	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B - 3	5.0	9.5				0.3	26.3	70.3	
⊠	B - 3	10.0	9.5	0.344			4.7	41.4	35.9	
▲	B - 4	0.5	9.5		5.127	0.552	26.8	25.4	1.7	
★	B - 4	5.0	4.75	0.129				48.3	50.5	
⊙	B - 5	2.0	9.5				2.4	32.0	64.0	

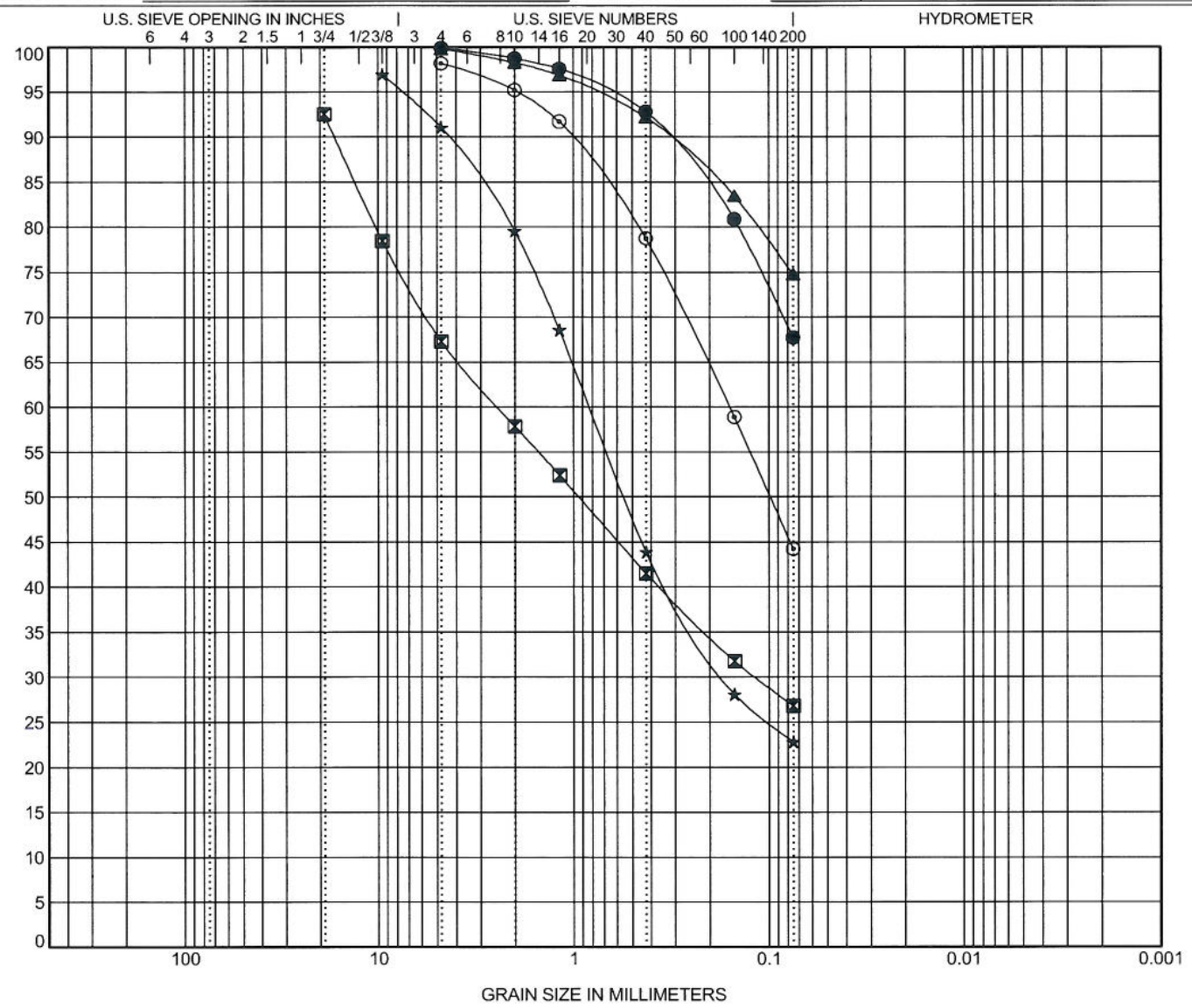
GRAIN SIZE DISTRIBUTION US 6 AND WADSWORTH INTERCHANGE.GPJ GINT US LAB.GDT 6/23/07

RockSol
Consulting Group,Inc.

GRAIN SIZE DISTRIBUTION

CLIENT CDOT - CH2MHILL **PROJECT NAME** US 6 and Wadsworth Interchange

PROJECT NUMBER RS - 181.01 **PROJECT LOCATION** Lakewood, CO



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Depth	Classification	LL	PL	PI	Cc	Cu
●	B - 5	10.0	SANDY LEAN CLAY(CL)	44	18	26		
⊠	B - 5	15.0	CLAYEY SAND with GRAVEL(SC)	33	18	15		
▲	B - 6	2.0	FAT CLAY with SAND(CH)	50	18	32		
★	B - 6	10.0	CLAYEY SAND(SC)	33	15	18		
⊙	B - 7	5.0	CLAYEY SAND(SC)	31	18	13		

	Specimen Identification	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B - 5	10.0	4.75					32.1	67.8	
⊠	B - 5	15.0	19	2.436	0.117		25.2	40.5	26.8	
▲	B - 6	2.0	4.75					25.0	74.8	
★	B - 6	10.0	9.5	0.828	0.17		5.9	68.2	22.8	
⊙	B - 7	5.0	4.75	0.159				53.9	44.2	

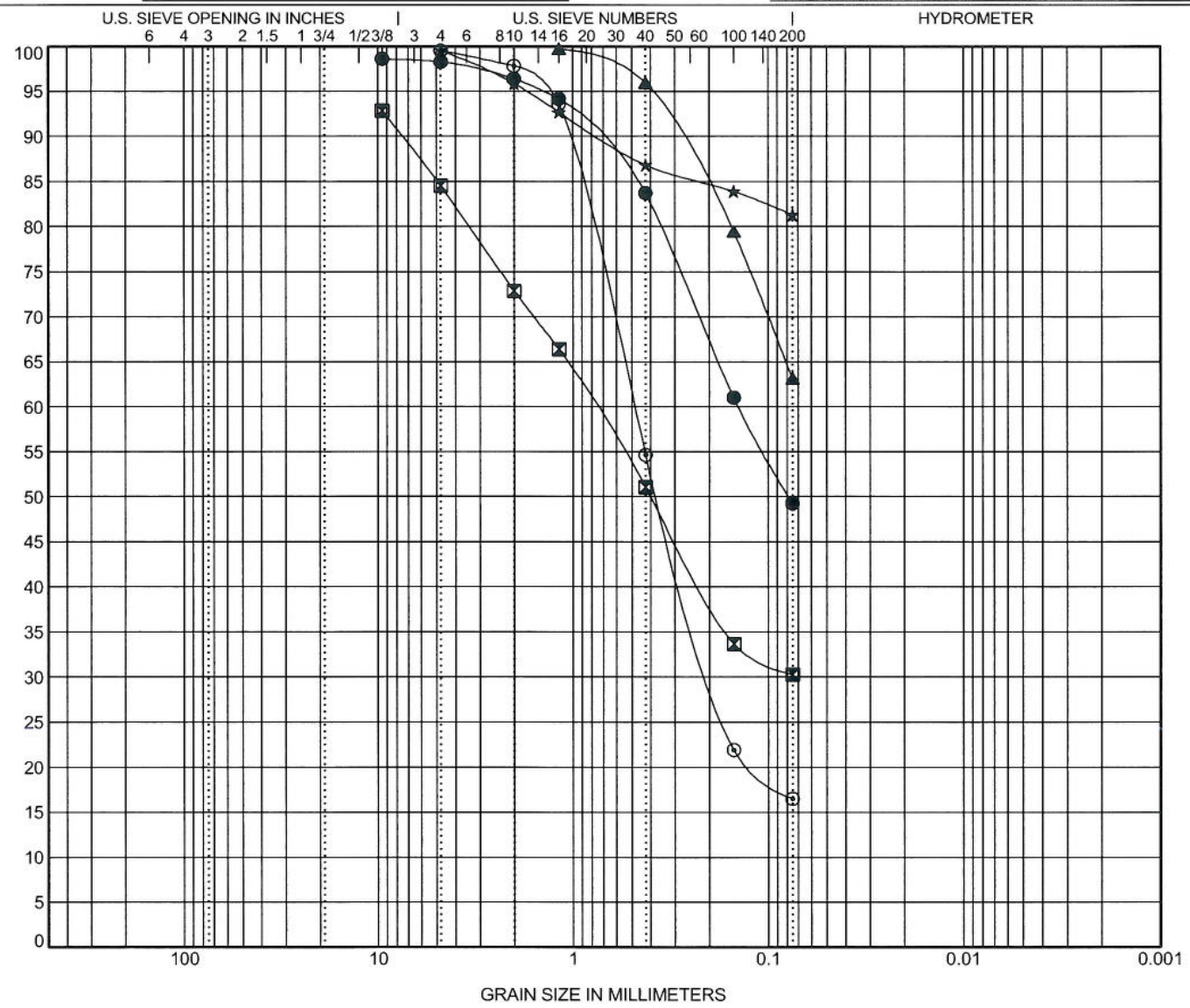
GRAIN SIZE DISTRIBUTION US 6 AND WADSWORTH INTERCHANGE.GPJ GINT US LAB.GDT 6/23/07

RockSol
Consulting Group,Inc.

GRAIN SIZE DISTRIBUTION

CLIENT CDOT - CH2MHILL **PROJECT NAME** US 6 and Wadsworth Interchange

PROJECT NUMBER RS - 181.01 **PROJECT LOCATION** Lakewood, CO



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Depth	Classification	LL	PL	PI	Cc	Cu
●	B - 7	15.0	CLAYEY SAND(SC)	36	19	17		
⊠	B - 7	20.0	CLAYEY SAND with GRAVEL(SC)	41	24	17		
▲	B - 7	25.0	SANDY LEAN CLAY(CL)	34	16	18		
★	B - 7	40.0	SILT with SAND(ML)	42	27	15		
⊙	B - 8	2.0	SILTY SAND(SM)	26	22	4		

	Specimen Identification	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B - 7	15.0	9.5	0.141			0.3	49.0	49.2	
⊠	B - 7	20.0	9.5	0.77			8.4	54.2	30.3	
▲	B - 7	25.0	1.18					36.5	63.2	
★	B - 7	40.0	4.75					18.2	81.3	
⊙	B - 8	2.0	4.75	0.489	0.194			83.0	16.5	

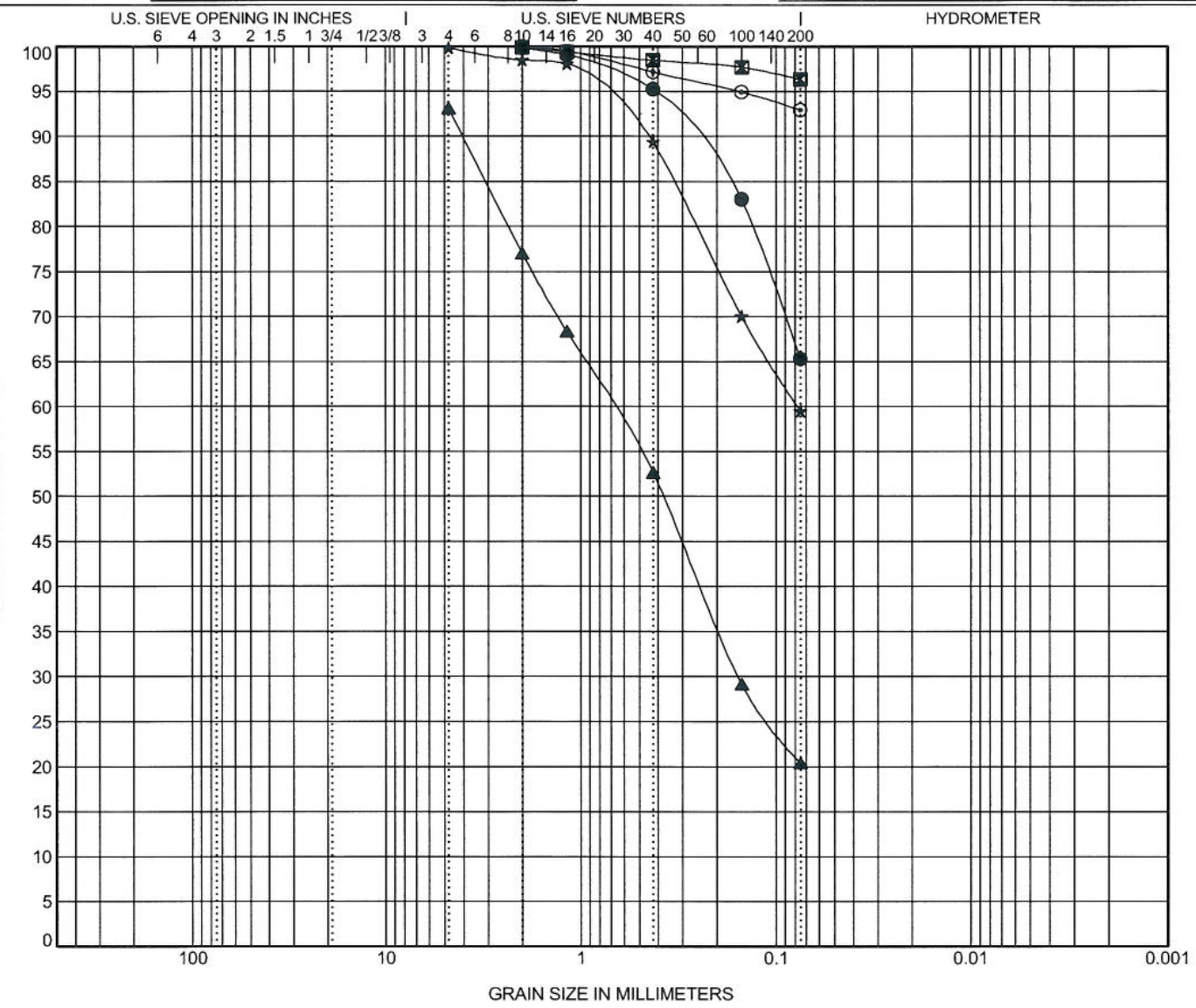
GRAIN SIZE DISTRIBUTION US 6 AND WADSWORTH INTERCHANGE.GPJ GINT US LAB.GDT 6/23/07

RockSol
Consulting Group, Inc.

GRAIN SIZE DISTRIBUTION

CLIENT CDOT - CH2MHILL **PROJECT NAME** US 6 and Wadsworth Interchange

PROJECT NUMBER RS - 181.01 **PROJECT LOCATION** Lakewood, CO



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Depth	Classification	LL	PL	PI	Cc	Cu
●	B - 8	15.0	SANDY LEAN CLAY(CL)	44	24	20		
⊠	B - 8	30.0	FAT CLAY(CH)	50	26	24		
▲	B - 9	2.0	SILTY SAND(SM)	47	30	17		
★	B - 9	10.0	SANDY FAT CLAY(CH)	52	28	24		
⊙	B - 9	25.0	LEAN CLAY(CL)	42	22	20		

	Specimen Identification	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B - 8	15.0	2					34.5	65.3	
⊠	B - 8	30.0	2					3.5	96.3	
▲	B - 9	2.0	4.75	0.685	0.156			72.7	20.4	
★	B - 9	10.0	4.75	0.077				40.3	59.5	
⊙	B - 9	25.0	2					7.0	92.9	

GRAIN SIZE DISTRIBUTION US 6 AND WADSWORTH INTERCHANGE.GPJ GINT US LAB.GDT 6/23/07

APPENDIX E

Utilities

Draft Technical Memorandum

US 6 & Wadsworth Boulevard

Existing Utilities

Prepared for

Colorado Department of Transportation

Prepared by

Goodbee & Associates, Inc.

June 20, 2007

TABLE OF CONTENTS

Acronym List

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Acronym List

CDOT	Colorado Department of Transportation
ITS	Intelligent Traffic Systems Department
kV	kilo Volts
ROW	Right-of-Way
RCP	Reinforced Concrete Pipe

TECHNICAL MEMORANDUM FOR US 6 AND WADSWORTH ENVIRONMENTAL ASSESSMENT

I Introduction

The Colorado Department of Transportation (CDOT) teamed with local and national consulting firms, is embarking on an environmental analysis of potential transportation improvements for Wadsworth Boulevard (Wadsworth) and the interchange at US 6. The partnership is preparing an Environmental Assessment (EA) to identify potential environmental impacts that would be associated with proposed transportation improvements in the subject area.

Description of Study Area: The study area is comprised of the section of Wadsworth from West 3rd Avenue to West 14th Avenue from right-of-way to right-of-way (ROW) and includes the interchange at US 6. The study area lies within the city limits of Lakewood in Jefferson County.

Purpose: The purpose of this Technical Memorandum is to provide CDOT with information regarding existing utilities along Wadsworth between West 3rd Avenue to West 14th Avenue. This information will be used during preliminary design of the alternatives, to identify potential conflicts, and for future coordination with utility companies during later stages of the project.

Methodology: Goodbee & Associates contacted the Utility Notification Center of Colorado for initial identification of private utility companies and municipalities with facilities in the study area. The identified companies and departments were contacted, and maps or verbal descriptions of the facilities were obtained. Follow-up field reconnaissance and review of USGS topographic maps confirmed the findings and provided additional information. The information was compiled into a contact list and utility table, included as Appendices A and B, respectively.

Certain utilities were classified as "major utilities" based on their critical nature and/or potential high cost and complexity of relocating them. These included: electric transmission lines; irrigation ditches; cell phone towers; potable water lines and sanitary sewers greater than 24 inches in diameter; fiber optic lines; raw water lines (untreated municipal water supplies); and high pressure gas lines. Only major utilities are addressed in this technical memorandum. Other facilities that did not meet the criteria for a major utility will need to be taken into consideration during design and construction of any transportation improvements.

Limitations: It should be noted that not all utility companies responded to requests for information. In addition, there may be buried utilities that were not documented by utility companies and are not apparent from the surface. As such, this utility inventory should be supplemented by field verification and UNCC coordination prior to any construction.

II Affected Environment

A. Major Utilities in the Study Area

The major utilities in the study area include overhead electric transmission lines, buried fiber optic lines, high pressure gas lines, water lines, sanitary sewer, and irrigation ditches. The following provides general information for each type of major utility.

Electric Transmission Lines: Xcel Energy provides electricity to the entire metro Denver Area through a network of power plants, substations and transmission lines. There are two overhead Xcel transmission lines in the project area: a 115kV and 230kV line crossing Wadsworth at West 10th Avenue and a 115kV line crossing Wadsworth one half block north of West 10th Avenue. The height of 115kV and 230kV transmission lines is a minimum of 25 and 30 feet, respectively. Xcel's facilities are in private exclusive easements.

Fiber: Numerous private telecommunications companies (Adesta, AT&T, CDOT ITS, City of Lakewood Traffic, Comcast, Level 3, and Qwest (local)) have buried fiber runs throughout the study area. There are two runs of fiber that parallel Wadsworth and several runs that cross Wadsworth at West 1st Avenue, US 6, West 13th Avenue, and at West 14th Avenue. Buried fiber is usually contained in plastic conduit or ducts at a depth of about four feet

High Pressure Gas Lines: Xcel Energy has several high-pressure gas lines, ranging from 6 to 10 inches in diameter in the project area. There are two lines of significance in the project area; a 10-inch line that parallels Wadsworth between the project boundaries of West 3rd Avenue and West 13th Avenue and a 6-inch line that parallels the US 6 northwest frontage road between Wadsworth and Garland Street. The gas lines are at a minimum depth of four feet.

Irrigation Ditches: The Rocky Mountain Ditch is located in the project area and crosses Wadsworth between West 1st Avenue and West 2nd Avenue. An unidentified ditch in pipe with ditch boxes was observed in the field on the north side of 9th Avenue west of Wadsworth. Details regarding the ditch are pending. The Rocky Mountain Ditch carries irrigation water from April to November 1st and is in a prescriptive easement.

Sanitary Sewers: The City of Lakewood owns a 27-inch sanitary sewer line which is reduced to a 21-inch line in 27-inch steel casing and crosses Wadsworth Boulevard along the north side of Highland Drive. An Alameda Water & Sanitation District facility crosses Wadsworth at West 1st Avenue; additional information is pending. Depths of sanitary sewers vary widely, ranging from two feet to more than ten feet. Sanitary sewers are usually in public ROW.

Water Lines: Consolidated Mutual Water and Denver Water Department facility maps were reviewed, and there were no water lines identified in the study area that met the criteria of a major facility. Water lines usually range in depth from five to eight feet and are usually in public ROW.

The facilities in the project area are in public ROW. Utility owners obtained a utility permit from the City of Lakewood prior to construction. Xcel Energy and Comcast Cable Company have franchise agreements with the City of Lakewood. Details regarding the agreements with the utilities and permits are pending. In general, private utility owners are financially responsible for relocating their facilities to accommodate public projects, while the project is responsible for paying to relocate public utilities.

B. Description of Major Utilities

Table 1 describes the major utilities identified in the study area.

Operator/Owner	Description
City of Lakewood Traffic	Underground fiber optic (shared conduit with Level 3) parallels Wadsworth Boulevard between 1st Avenue and Colfax Avenue. The line is on the east side of Wadsworth Boulevard between 1st Avenue and 12th Avenue (crossing on the south side of 12th) and on the west side of Wadsworth Boulevard between 12th Avenue and Colfax Avenue.
Level 3 Communications	Underground fiber optic (shared conduit with City of Lakewood) parallels Wadsworth Boulevard between 1st Avenue and Colfax Avenue. The line is on the east side of Wadsworth Boulevard between 1st Avenue and 12th Avenue (crossing on the south side of 12th) and on the west side of Wadsworth Boulevard between 12th Avenue and Colfax Avenue.
Qwest Communications	*Underground facility parallels Wadsworth Boulevard between 1st Avenue and Colfax Avenue primarily in the northbound lanes.
Xcel Energy	10-inch gas main parallels the west side of Wadsworth Boulevard between 14th Avenue and 1st Avenue.
CDOT ITS	Underground fiber optic line parallels US 6 on the north side of the highway.
CDOT ITS	Underground fiber optic line parallels US 6 on the south side of the highway roughly between the southwest and southeast frontage road on and off ramps.
CDOT ITS	Underground fiber optic line crosses US 6 near the southeast frontage road ramp.
Adesta Communications	Underground fiber optic parallels Wadsworth Boulevard between 14th Avenue and Colfax on the east side of the road, east of the sidewalk.
AT&T	Underground fiber optic line parallels the north side of 14th Avenue to Wadsworth Boulevard then parallels the west side of Wadsworth Boulevard from 14th Avenue and continues north out of project boundaries.
Qwest Communications	*Underground facility crosses Wadsworth Boulevard at 14th Avenue.
Level 3 Communications	Underground fiber optic originates at splice in Level 3 facility described above about 1/2 block north of 13th Avenue and continues north to 14th Avenue where it turns west and continues out of project boundaries.

Operator/Owner	Description
Qwest Communications	*Underground facility crosses Wadsworth Boulevard to join facility in Wadsworth Boulevard from the west at 13th Avenue.
Xcel Energy	230kV and 115kV overhead electric transmission lines cross Wadsworth Boulevard at 10th Avenue. Tower at SE corner of intersection.
Xcel Energy	115kV overhead electric transmission line crosses Wadsworth Boulevard 1/2 block north of 10th Avenue.
Unidentified Ditch	Unidentified ditch crosses Wadsworth Boulevard at 9th Avenue. The ditch flows east in pipe with several ditch boxes visible west of Wadsworth Boulevard on the north side of the sidewalk on the north side of 9th Avenue.
City of Lakewood	27-inch sanitary sewer line reduces to a 21-inch line in 27-inch steel casing and crosses Wadsworth Boulevard along the north side of Highland Drive.
Comcast Cable	Aerial facility parallels the northwest 6th Avenue frontage road between Carr and 1/2 block west of Ammons Street.
Xcel Energy	6-inch high pressure gas main parallels the westbound service road on the north side of US 6 from the 10-inch line in Wadsworth Boulevard to Garland Street.
Alameda Water & Sanitation District	**Facility crosses Wadsworth Boulevard along the north side of 1st Avenue.
Comcast Cable	Underground facility crosses Wadsworth Boulevard 1st Avenue.
Qwest Communications	*Underground facility crosses Wadsworth Boulevard at 1st Avenue.
Coors Brewing Company	Rocky Mountain Ditch crosses Wadsworth Boulevard in a 4x8-foot box culvert. The ditch is enclosed in 48-inch RCP east of Wadsworth and is an open channel west of Wadsworth.
Xcel Energy	6-inch high-pressure gas main parallels the middle of 1st Avenue coming from the east and ending at the 10-inch main that parallels Wadsworth Boulevard.

Notes: *Pending Confirmation from Qwest

*Details Pending from Alameda Water & Sanitation District

III. Impact Evaluation

To be included in later version

IV. Conclusions

Twenty-three utilities identified in the project area were considered major due to their critical nature or potential high cost or complexity associated with relocating them. All major utilities will receive further evaluation when the alternatives have been defined. Areas where significant grade change, widening of the roadway, or expansion beyond the existing right-of-way is proposed will be of particular concern. As part of the impact evaluation, utility conflicts will be identified and relocation recommendations will be made and discussed with the affected utility companies.

Appendix A - Utility Contact List

US 6 and Wadsworth EA Utility Contact List

Utility	Contact(s)	Address	Telephone	e-mail
Adesta Communications	Duke Horan	12742 E. Caley Ave., #2B, Centennial 80111	303-858-8087	dhoran@adestagroup.com
Alameda Water & Sanitation District	TBD	359 S. Harlan, Lakewood 80226	303-936-5313	TBD
AT&T	Ian Wettland	5225 Zuni St., Denver	303-882-7499	wettland@att.com
CDOT Region 6	Jeff Lancaster	2000 South Holly Street, Denver 80222	(303)757-9950	jeffrey.lancaster@dot.state.co.us
CDOT ITS (CDOT fiber)	Bill Kassick	TBD	303-512-5839	william.kascek@dot.state.co.us
Comcast Communications	Eric Carroll	1617 S. Acoma St., Denver 80223	303-603-5256	eric_carroll@cable.comcast.com
City of Lakewood - traffic	Allen Albers	480 Soth Allison Parkway, Lakewood 80226	303-987-7984	AllAlb@lakewood.org
City of Lakewood - water/san/storm	Terry Rogers	480 Soth Allison Parkway, Lakewood 80226	303-987-7934	TBD
Consolidated Mutual Water	Neil Santangelo	12700 W. 27th Avenue, Lakewood 80215	303-238-0451	neal@cmwc.net
Denver Water Department	Lou Vullo	1600 W 12th Ave., 80204	303-628-6671	lou.vullo@denverwater.org
Level 3 Communications - legacy ICG	Thomas Longan	910 15th Street Suite230, Denver 80202	303-414-5217	Thomas.Longan@Level3.com
Level 3 Communications - legacy ICG	Peter Smith	910 15th Street Suite230, Denver 80202	303-246-5030	Peter.Smith@Level3.com
Qwest Communications (local)	Andy Devine	TBD	303-792-6298	andy.devine@qwest.com
Rocky Mountain Ditch - Ditchrider	Wade Isham	PO Box 507 Golden 80402	303-277-5597	TBD
Xcel Energy - Electric	Ron Johnson	1123 W. 3rd Ave. Denver 80223	(303)571-3169	TBD
Xcel Energy - Electric	Mark Supancic	1123 W. 3rd Ave. Denver 80223	TBD	mark.supancic@xcelenergy.com
Xcel Energy - ELT	Bill Braasch	1123 W. 3rd Ave. Denver 80223	303-571-7082	william.braasch@xcelenergy.com
Xcel Energy - HP Gas	Jim McQuiston	1123 W. 3rd Ave. Denver 80223	303.571.3744	Jim.McQuiston@xcelenergy.com
Xcel Energy - Land Rights	John Kellar	1123 W. 3rd Ave. Denver 80223	303-571-7596	TBD

Appendix B – Utility Table

US 6 and Wadsworth Boulevard EA
Draft Utility Table

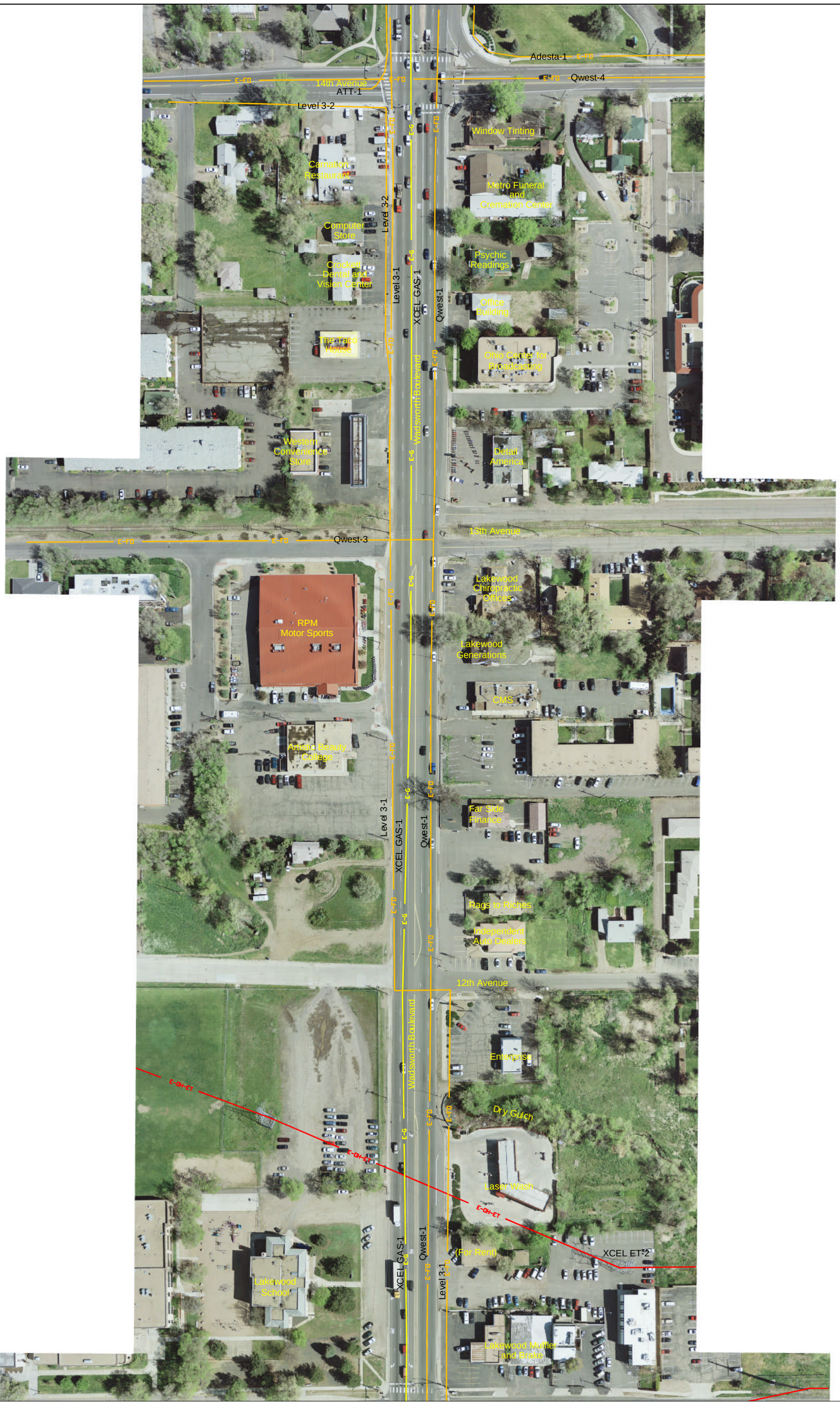
Map No.	Operator/Owner	in ROW	Xing / Parallel	Type	Major	Area	Description
Level 3-1	City of Lakewood Traffic	y	p	fiber	y	Wadsworth	Underground fiber optic (shared conduit with Level 3) parallels Wadsworth Boulevard between 1st Avenue and Colfax Avenue. The line is on the east side of Wadsworth Boulevard between 1st Avenue and 12th Avenue (crossing on the south side of 12th) and on the west side of Wadsworth Boulevard between 12th Avenue and Colfax Avenue.
Level 3-1	Level 3 Communications	y	p	fiber	y	Wadsworth	Underground fiber optic (shared conduit with City of Lakewood) parallels Wadsworth Boulevard between 1st Avenue and Colfax Avenue. The line is on the east side of Wadsworth Boulevard between 1st Avenue and 12th Avenue (crossing on the south side of 12th) and on the west side of Wadsworth Boulevard between 12th Avenue and Colfax Avenue.
Qwest-1	Qwest Communications	y	p	fiber	y	Wadsworth	*Underground facility parallels Wadsworth Boulevard between 1st Avenue and Colfax Avenue primarily in the northbound lanes.
Gas-1	Xcel Energy	y	p	gas main	y	Wadsworth	10-inch gas main parallels the west side of Wadsworth Boulevard between 14th Avenue and 1st Avenue.
CDOT-1	CDOT ITS	y	p	fiber	y	US 6	Underground fiber optic line parallels US 6 on the north side of the highway.
CDOT-2	CDOT ITS	y	p	fiber	y	US 6	Underground fiber optic line parallels US 6 on the south side of the highway roughly between the southwest and southeast frontage road on and off ramps.
CDOT-3	CDOT ITS	y	p	fiber	y	US 6	Underground fiber optic line crosses US 6 near the southeast frontage road ramp.
Adesta-1	Adesta	y	p	fiber	y	14th	Underground fiber optic parallels Wadsworth Boulevard between 14th Avenue and Colfax on the east side of the road, east of the sidewalk.
ATT-1	AT&T	y	p	fiber	y	14th	Underground fiber optic line parallels the north side of 14th Avenue to Wadsworth Boulevard then parallels the west side of Wadsworth Boulevard from 14th Avenue and continues north out of project boundaries.
Qwest-4	Qwest Communications	y	x	fiber	y	14th	*Underground facility crosses Wadsworth Boulevard at 14th Avenue.
Level 3-2	Level 3 Communications	y	p	fiber	y	13th	Underground fiber optic originates at splice in Level 3 facility described above about 1/2 block north of 13th Avenue and continues north to 14th Avenue where it turns west and continues out of project boundaries.
Qwest-3	Qwest Communications	y	x	fiber	y	13th	*Underground facility crosses Wadsworth Boulevard to join facility in Wadsworth Boulevard from the west at 13th Avenue.

US 6 and Wadsworth Boulevard EA
Draft Utility Table

Map No.	Operator/Owner	in ROW	Xing / Parallel	Type	Major	Area	Description
ET-1	Xcel Energy	y	x	electric transmission	y	10th	230kV and 115kV overhead electric transmission lines cross Wadsworth Boulevard at 10th Avenue. Tower at SE corner of intersection.
ET-2	Xcel Energy	y	x	electric transmission	y	10th	115kV overhead electric transmission line crosses Wadsworth Boulevard 1/2 block north of 10th Avenue.
Ditch-1	Unidentified Ditch	y	x	ditch	y	9th	Unidentified ditch crosses Wadsworth Boulevard at 9th Avenue. The ditch flows east in pipe with several ditch boxes visible west of Wadsworth Boulevard on the north side of the sidewalk on the north side of 9th Avenue.
COL-1	City of Lakewood Sanitary	y	x	sanitary	y	Highland	27-inch sanitary sewer line reduces to a 21-inch line in 27-inch steel casing and crosses Wadsworth Boulevard along the north side of Highland Drive.
Comcast-2	Comcast Cable	y	x	fiber	y	nw frontage	Aerial facility parallels the northwest 6th Avenue frontage road between Carr and 1/2 block west of Ammons Street.
Gas-3	Xcel Energy	y	p	gas main	y	nw frontage	6-inch high pressure gas main parallels the westbound service road on the north side of US 6 from the 10-inch line in Wadsworth Boulevard to Garland Street.
AWSD-1	Alameda Water & Sanitation District	y	x	sanitary	y	1st	**Facility crosses Wadsworth Boulevard along the north side of 1st Avenue.
Comcast-1	Comcast Cable	y	x	fiber	y	1st	Underground facility crosses Wadsworth Boulevard 1st Avenue.
Qwest-2	Qwest Communications	y	x	fiber	y	1st	*Underground facility crosses Wadsworth Boulevard at 1st Avenue.
RMD-1	Coors Brewing Company	y	x	ditch	y	1st	Rocky Mountain Ditch crosses Wadsworth Boulevard in a 4x8-foot box culvert. The ditch is enclosed in 48-inch RCP east of Wadsworth and is an open channel west of Wadsworth.
Gas-2	Xcel Energy	y	x	gas main	y	1st	6-inch high-pressure gas main parallels the middle of 1st Avenue coming from the east and ending at the 10-inch main that parallels Wadsworth Boulevard.

Notes: *Pending Confirmation from Qwest
**Details pending from Alemeda Water & Sanitation District

Appendix C – Utility Map



1
2
5 3 6
4

Map Key
Sheet 1 of 6

Legend

Map ID - OWNER-MAP-NO.	CDOT-1
Existing Ditch	DITCH
Existing Overhead/Underground Fiber Optic Line	E-FO
Existing High Pressure Gas Line	E-G
Existing Overhead Electric Transmission Line	E-OH-ET
Existing Sanitary Sewer Line (greater than 24-inch diameter pipe/casing)	E-SS

Draft Utilities: Existing Conditions Summary Report

Goodbee & Associates, Inc.
Date: July 12, 2007
Prepared By: JE
Reviewed By: LAG

SCALE
1:150

1
2
5 3 6
4

Map Key
Sheet 2 of 6

Legend

Map ID - OWNER-MAP-NO.

CDOT-1

Existing Ditch — DITCH

Existing Overhead/Underground Fiber Optic Line — E-FO

Existing High Pressure Gas Line — E-G

Existing Overhead Electric Transmission Line — E-OH-ET

Existing Sanitary Sewer Line (greater than 24-inch diameter pipe/casing) — E-SS

Draft Utilities: Existing Conditions Summary Report

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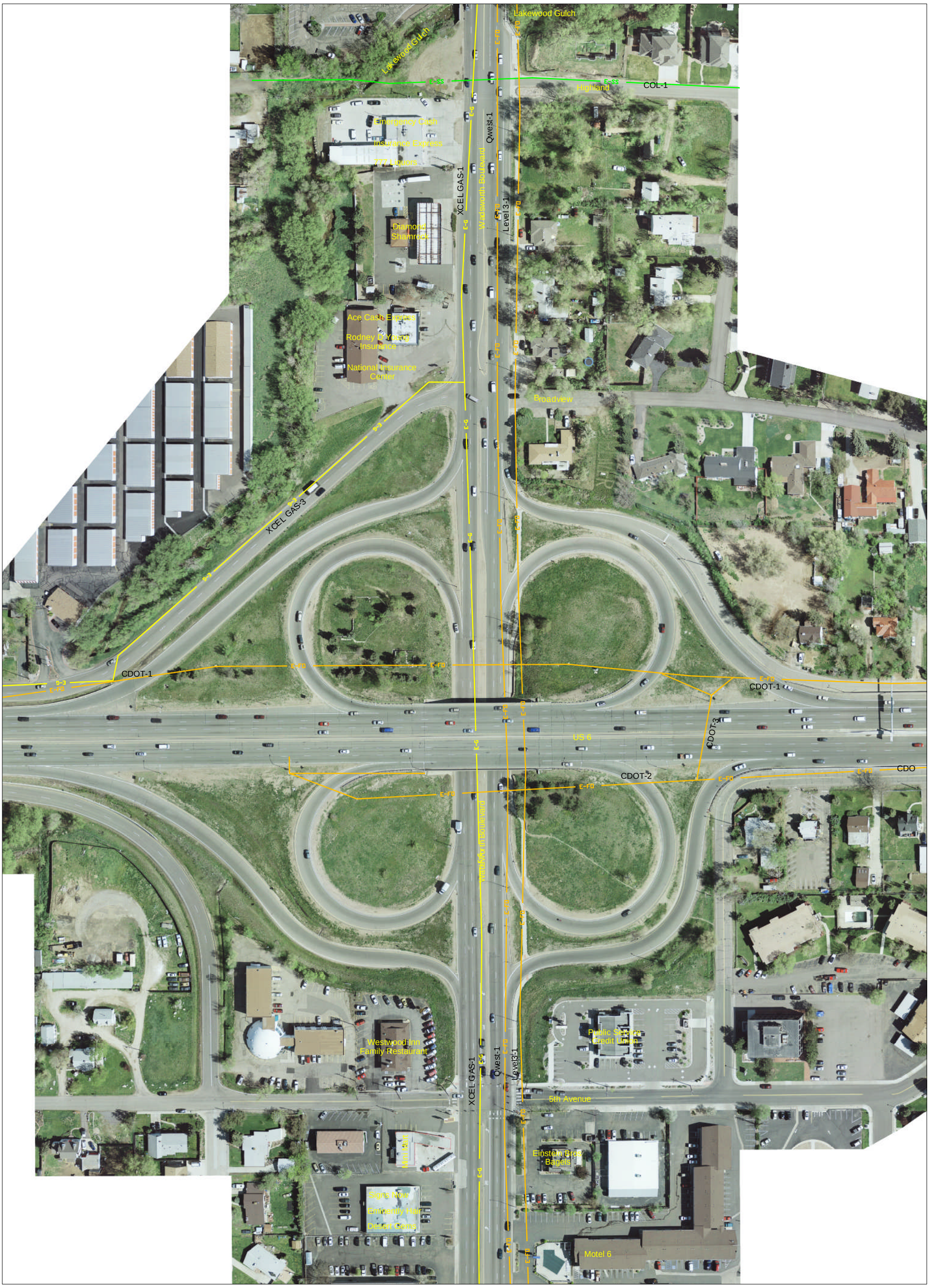

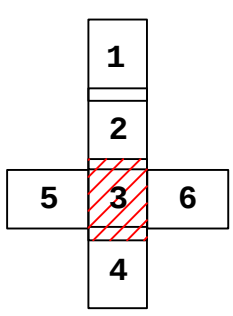

Map Key
Sheet 3 of 6

Legend

Map ID - OWNER-MAP-NO.	CDOT-1
Existing Ditch	DITCH
Existing Overhead/Underground Fiber Optic Line	E-FO
Existing High Pressure Gas Line	E-G
Existing Overhead Electric Transmission Line	E-OH-ET
Existing Sanitary Sewer Line (greater than 24-inch diameter pipe/casing)	E-SS

Draft Utilities: Existing Conditions Summary Report

Goodbee & Associates, Inc.
Date: July 12, 2007
Prepared By: JE
Reviewed By: LAG

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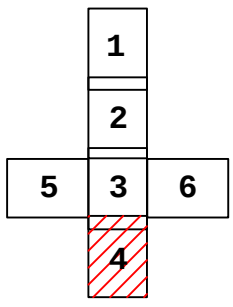


Map Key
Sheet 4 of 6

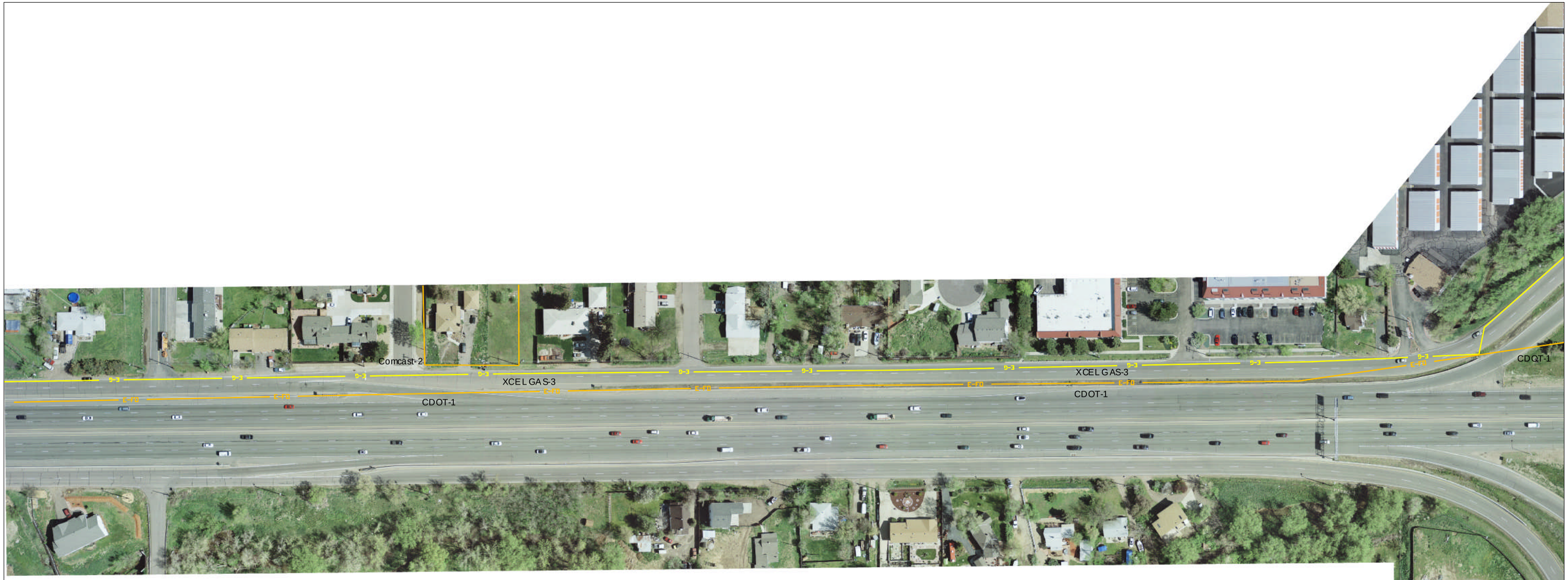
Legend

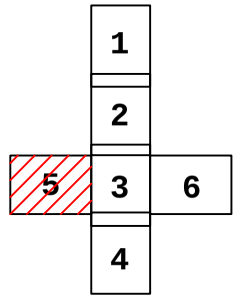
Map ID - OWNER-MAP-NO.	CDOT-1
Existing Ditch	DITCH
Existing Overhead/Underground Fiber Optic Line	E-FO
Existing High Pressure Gas Line	E-G
Existing Overhead Electric Transmission Line	E-OH-ET
Existing Sanitary Sewer Line (greater than 24-inch diameter pipe/casing)	E-SS

Draft Utilities: Existing Conditions Summary Report

Goodbee & Associates, Inc.
Date: July 12, 2007
Prepared By: JE
Reviewed By: LAG

SCALE
1:150





Map Key
Sheet 5 of 6

Legend

Map ID - OWNER-MAP-NO. CDOT-1

Existing Ditch — DITCH

Existing Overhead/Underground Fiber Optic Line — E-FO

Existing High Pressure Gas Line — E-G

Existing Overhead Electric Transmission Line — E-OH-ET

Existing Sanitary Sewer Line (greater than 24-inch diameter pipe/casing) — E-SS

Draft Utilities: Existing Conditions Summary Report

Goodbee & Associates, Inc.
Date: July 12, 2007
Prepared By: JE
Reviewed By: LAG

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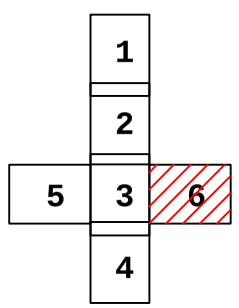

Map Key

Sheet 6 of 6

Legend

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Draft Utilities: Existing Conditions Summary Report

Goodbee & Associates, Inc.
Date: July 12, 2007
Prepared By: JE
Reviewed By: LAG

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Appendix D – References

US 6 & Wadsworth Boulevard Draft Technical Memorandum Utility References

Xcel Energy. Gas and electric maps received from xcel mapping department May 17, 2007.

Consolidated Mutual Water. Received maps by email from Neal Santangelo May 18, 2007.

Comcast Cable. Received maps by email from David Sprout May 21, 2007

City of Lakewood sanitary and storm. Received maps provided by Terry Rogers May 22, 2007.

Denver Water Department. Received maps from mapping department May 22, 2007.

Adesta Communications. Received map by email from Duke Horan May 24, 2007.

City of Lakewood. Received DRCOG traffic signal map from Allen Albers by email May 25, 2007

Level 3 / legacy ICG. Received maps by email from Tom Longan June 1, 2007.

City of Lakewood. Received traffic fiber / ICG maps by email from Allen Albers June 4, 2007.

Xcel Energy - Transmission. Received copy of transmission line easement from Harry Swinhart June 4, 2007.

Xcel Energy - Transmission. Received electric transmission line maps from Kim Houston by email June 5, 2007.

Qwest Communications. Field observation May 29, 2007 supplemented by Qwest maps received by CDOT sometime around March 2006.

CDOT ITS. Received map by email from Bill Kascek June 15, 2007.

AT&T. Received email description & photos from CDOT via CH2M Hill June 19, 2007.

Rocky Mountain Ditch. Personal communication with Wade Isham June 19, 2007.

APPENDIX F

Traffic Analysis

US 6 and Wadsworth Boulevard Interchange Environmental Assessment Existing Conditions Traffic Analysis

PREPARED FOR: Tim Eversoll, P.E./CH2M HILL

PREPARED BY: Zeke Lynch/CH2M HILL

COPIES: Aaron Swafford/CH2M HILL
Mandy Whorton/CH2M HILL

DATE: July 3, 2007

PROJECT NUMBER: 358660

This technical memorandum (TM) describes the existing traffic conditions at the US 6 and Wadsworth Boulevard interchange as well as at intersections along Wadsworth Boulevard between Third Avenue and 13th Avenue.

Introduction

The US 6 and Wadsworth Boulevard (SH 121) interchange is currently the subject of an Environmental Assessment (EA). The first step in the EA is to perform an existing conditions analysis, which includes a review of the current traffic conditions. The Colorado Department of Transportation (CDOT) study area is contained entirely within the City of Lakewood. The area lies generally between Third Avenue and 13th Avenue along Wadsworth Boulevard, and also encompasses the US 6 interchange and Carr Street/ Garrison Street slip ramps to the west.

US 6 is a primary east-west, six-lane freeway serving communities west of Denver. The US 6 and Wadsworth Boulevard interchange is a full cloverleaf configuration with slow ramp speeds and tight curves on both the directional and the loop ramps. Intersections are spaced closely to the interchange both north and south of US 6. The Carr Street/Garrison Street slip ramps to the west are in close proximity to the Wadsworth Boulevard interchange.

The Wadsworth Boulevard Corridor is a typical major urban arterial with signalized stop control and driveway accesses. South of US 6, Wadsworth Boulevard has six through lanes, while north of US 6, four through lanes are present. Exclusive left- and right-turn lanes are provided at high-volume movements, although a number of right turns occur from shared through lanes. South of US 6, a raised median aids in controlling access to Wadsworth Boulevard. Some accesses have been consolidated, while others have been modified to right in/right out. North of US 6, access is uncontrolled, with numerous intersection crossings and driveways. The median is striped to provide two side-by-side, continuous left-turn lanes serving major intersections and driveway accesses. Bus blockages occur at a number of stops serving local and limited Regional Transportation District (RTD) bus lines.

Existing Traffic Issues

The following list highlights the critical issues and problem areas identified from the evaluation of existing traffic conditions for the US 6 and Wadsworth Boulevard EA.

US 6 Mainline and Interchanges

- The US 6 and Wadsworth Boulevard interchange is a full cloverleaf configuration, with slow speeds and tight curves on both the directional and the loop ramps.
- Three of the four weave segments on US 6 and Wadsworth Boulevard operate at unacceptable levels of service (LOSs) in the peak hours.
- The eastbound merge and westbound diverge segments on US 6 at Wadsworth Boulevard also operate at unacceptable LOSs and contribute to mainline congestion near the interchange.
- Vehicles do not have adequate distance to accelerate/decelerate when entering/exiting US 6 at Wadsworth Boulevard.
- The westbound US 6 on-ramp from the Wadsworth Boulevard weave with the US 6 slip ramp to Carr Street/Garrison Street operates at an unacceptable LOS.
- The proximity of the Carr Street/Garrison Street slip ramps to the Wadsworth Boulevard interchange does not allow adequate acceleration and deceleration at either location.

Wadsworth Boulevard Corridor

- The Wadsworth Boulevard Corridor is a typical urban arterial with signalized stop control and numerous driveway accesses.
- The Fifth Avenue and Broadview Drive intersections are closely spaced to the US 6 interchange; therefore, vehicles attempting to cross multiple lanes of traffic create turbulence in the traffic stream in both directions on Wadsworth Boulevard.
- North of US 6, the median is striped to provide two side-by-side, continuous left-turn lanes serving major intersections and driveway accesses. The uncertainty of when and where drivers will enter the median lane(s) contributes to mainline congestion and adds to the difficultly of entering or crossing Wadsworth Boulevard from the side streets. In addition, sight distance between opposing vehicles in the turn lanes is a problem due to the vehicles blocking the view of traffic in the through lanes.
- As a major regional arterial, signal priority is given to northbound and southbound vehicles. The cross-street approaches at most signalized and unsignalized intersections operate at unacceptable LOSs.
- Due to the heavy through-traffic on Wadsworth Boulevard, vehicles from both side streets and driveways are forced to pull into unsafe traffic-flow gaps.
- The four through-lane cross-section north of US 6 does not accommodate current traffic demands with an LOS of E.

Data Collection

Current traffic counts for the corridor and surrounding roadway network were collected the first week in May 2007 to ensure school traffic was included. Available traffic data were compiled from various state and municipal sources including CDOT automated traffic recorder locations, which provided a historical reference for comparison to the data collected. A traffic count program was undertaken to facilitate LOS evaluation on Wadsworth Boulevard, at major arterial intersections, and at the Sixth Avenue interchange ramp intersections. Daily vehicle classification counts were collected at three locations along Wadsworth Boulevard. Turning-movement counts were collected at the 12 study area intersections on two consecutive weekdays for both AM and PM peak-hour. Daily tube and radar counts were completed at the Sixth Avenue ramps to evaluate the weave and ramp operations. Daily traffic counts were also collected at the Carr Street/Garrison Street slip ramps because of their proximity to the Wadsworth Boulevard interchange.

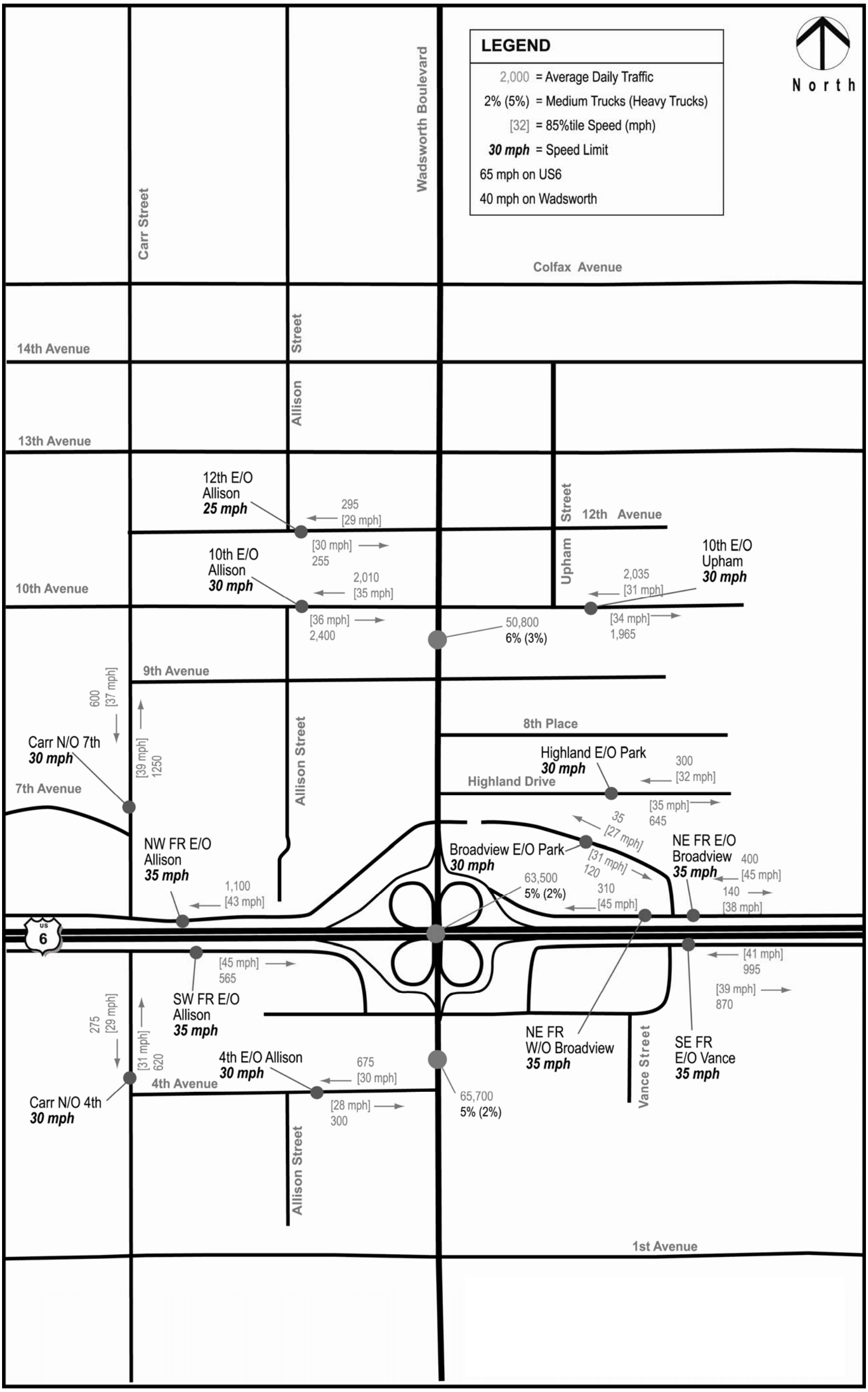
To assist in the evaluation of potential neighborhood traffic impacts, 12 48-hour speed/ volume counts were conducted on neighborhood streets. Carr Street north of Seventh Avenue is the only location that appears to have vehicles traveling consistently above the posted speed limit. The collected data will be used to further evaluate the potential impacts of traffic cutting through neighborhoods as interchange alternatives are developed. A summary of the vehicle classification and speed counts is shown in Figure 1.

Existing Operations

An evaluation of existing traffic operations was completed using the most current industry-accepted standards. Mainline, weave, merge/diverge, and urban street operations were evaluated with Highway Capacity Software. Synchro software was used to determine intersection LOS, which is a qualitative description of traffic-flow characteristics. The highest level (LOS A) describes free-flow conditions in which vehicles experience minimal delay. The lowest level (LOS F) describes stop-and-go conditions in which long delays are experienced by most vehicles in the traffic stream. LOSs A, B, and C were considered "good"; LOS D "fair"; and LOSs E and F "poor." For purposes of this study, the poor LOSs E and F were considered unacceptable (please refer to Attachment 1 of this TM for *Highway Capacity Manual* [HCM] LOS descriptions).

FIGURE 1

2007 Speed and Classification Traffic Counts



Mainline

Highway capacity software was used to determine the US 6 mainline LOS. A base free-flow speed of 70 mph was assumed. In accordance with HCM procedures, the base free-flow speed was adjusted downward to reflect the geometric and operational characteristics of mainline US 6. A summary of the mainline LOS by direction at six locations is shown in Table 1.

TABLE 1
LOS for Basic Freeway Segments on US 6 (AM/PM)

Location	Westbound LOS	Eastbound LOS
East of Wadsworth Boulevard	C/D	E/D
West of Wadsworth Boulevard	C/C	D/C
West of Carr Street	C/C	D/C

Weaves

Highway capacity software was used to determine the US 6 and Wadsworth Boulevard weave LOS. A base mainline free-flow speed of 70 mph was assumed for US 6, while 40 mph was assumed for Wadsworth Boulevard. In accordance with HCM procedures, base free-flow speeds were adjusted to reflect local geometric and operational considerations. A summary of the weave LOS by direction at the four weave locations is shown in Table 2.

TABLE 2
LOS for Weave Areas at the US 6 Interchange (AM/PM)

Location	Weave Type[1]	LOS
Westbound US 6	A	D/E
Eastbound US 6	A	E/D
Northbound Wadsworth Boulevard	A	C/C
Southbound Wadsworth Boulevard	B	C/E

[1] Type A weaves require both merging and diverging vehicles to make one lane change; type B weaves only require either merging or diverging vehicles to make a lane change.

Merges and Diverges

Highway capacity software was used to determine the merge and diverge LOS at US 6 ramps. A base mainline free-flow speed of 70 mph was assumed for US 6. Due to the tight ramp curvature, 30 mph was assumed for ramps. In accordance with HCM procedures, base free-flow speeds were adjusted to reflect local geometric and operational considerations. A summary of the merge and diverge LOS is shown in Table 3.

TABLE 3
LOS for Merge and Diverge Areas at US 6 Interchanges (AM/PM)

Location	Type	LOS
Westbound US 6 to Northbound Wadsworth Boulevard	Diverge	C/E
Southbound Wadsworth Boulevard to Westbound US 6	Merge	C/C
Westbound US 6 to Carr Street/Garrison Street Slip Ramp	Diverge	E/E
Carr Street/Garrison Street Slip Ramp to Eastbound US 6	Merge	D/D
Eastbound US 6 to Southbound Wadsworth	Diverge	D/D
Northbound Wadsworth Boulevard to Eastbound US 6	Merge	E/D

Urban Street

Highway capacity software was used to determine the urban street LOS along Wadsworth Boulevard. A planning-level analysis was performed both north and south of US 6 assuming a base free flow speed of 40 mph. In accordance with HCM procedures, the base free-flow speed was adjusted to reflect the geometric and operational characteristics of mainline Wadsworth Boulevard. South of US 6, Wadsworth Boulevard has six through lanes, while four through lanes are present north of US 6. A summary of the urban street LOS is shown in Table 4.

TABLE 4
LOS for Wadsworth Boulevard (AM/PM)

Location	Northbound LOS	Southbound LOS
South of Fifth Avenue	D/D	D/D
South of 10th Avenue	E/E	E/E

Intersections

Synchro software was used to determine the LOS at the 12 study area intersections. For two-way stop-control locations, the worst cross-street approach LOS is reported. Intersection geometries were verified from current aerial photography and field observations. Existing timings were provided by the City of Lakewood. A summary of the intersection LOS is shown in Table 5.

TABLE 5
LOS for Intersection Along Wadsworth Boulevard (AM/PM)

Location	Control	LOS[1]
Second Avenue	Signalized	A/B
Fourth Avenue	TWSC	B/B
Fifth Avenue	Signalized	B/B
Broadview Drive/Frontage Road	TWSC	A/A
Highland Drive	TWSC	F/F
Eighth Place	TWSC	F/F
Ninth Avenue	TWSC	F/F
10th Avenue	Signalized	B/D
12th Avenue	TWSC	F/F
13th Avenue (south)	TWSC	D/E
13th Avenue (north)	TWSC	E/F
14th Avenue	Signalized	B/C

[1] Worst cross-street approach LOS reported at two-way stop-control intersections (TWSC).

A complete summary of the peak-hour traffic-turning movements and LOS is shown in Figure 2.

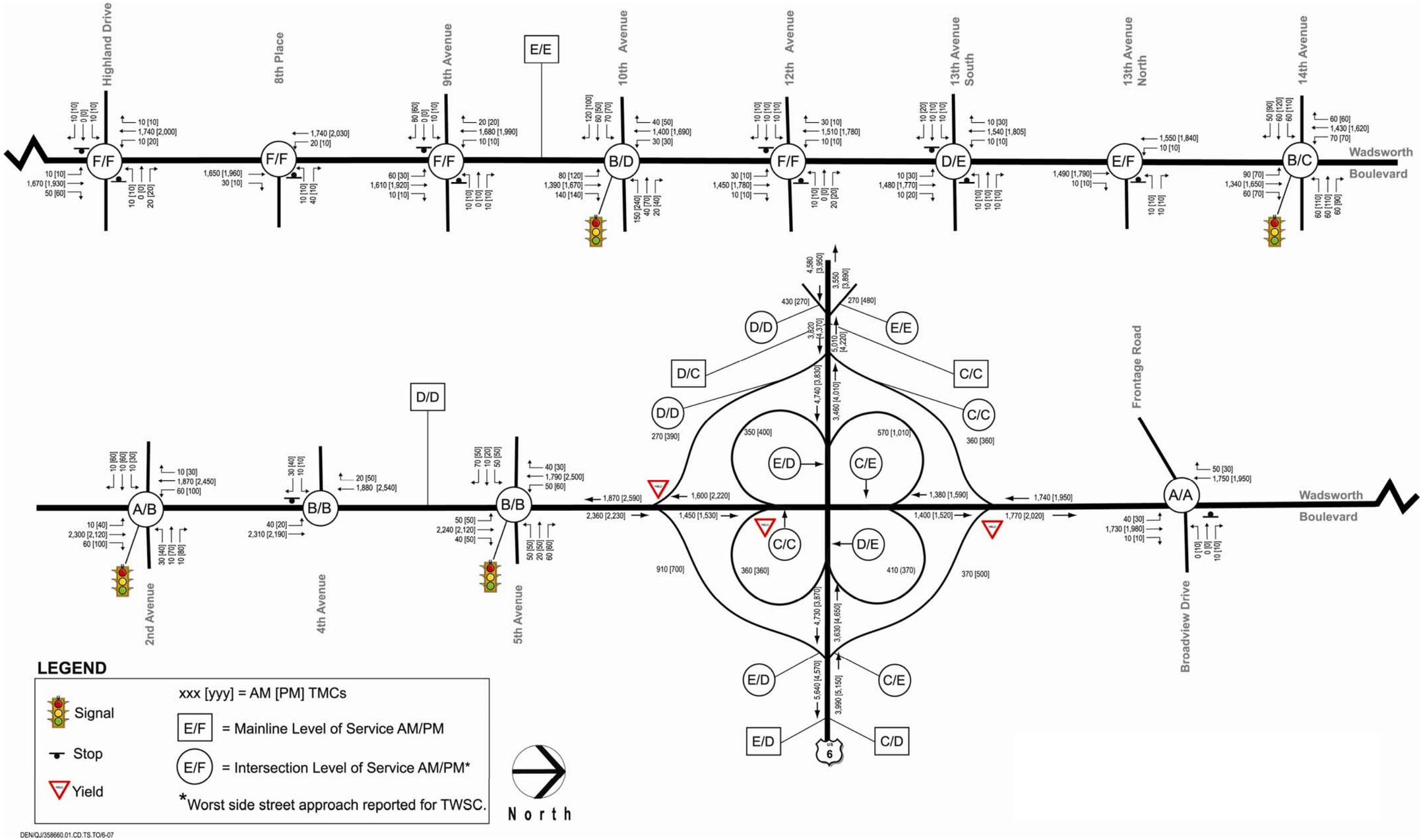
Access Control/Median Treatment

According to the Colorado State Highway access code, Wadsworth Boulevard is classified as a Non-Rural Principle Highway (NR-A). NR-A facilities provide for intra- and inter-regional and city travel with movement of through traffic given priority over direct access. The desired spacing of full-movement intersections is 0.5 miles.

Access control and median treatment was qualitatively evaluated based on review of aerial photography and field observations, and was considered "good" if most of the driveways had been consolidated and a raised median was in place. A "poor" rating was given if there was no median to restrict access and multiple driveways had direct access to Wadsworth Boulevard. Locations that had no raised median, but where a number of driveway accesses had been consolidated, were rated as "fair."

FIGURE 2

2007 Existing Traffic Conditions



South of US 6, a raised median aids in controlling access to Wadsworth Boulevard. Some accesses have been consolidated and others have been modified to right in/right out. North of US 6, the median is striped to provide two side-by-side, continuous left-turn lanes serving major intersections and driveway accesses. A sight distance problem results when there are opposing left-turning vehicles at or near the same location. The uncertainty of when and where drivers will enter the median lane(s) contributes to mainline congestion and adds to the difficultly of entering or crossing Wadsworth Boulevard from the side streets. The numerous driveway accesses also contribute to mainline turbulence. Due to the heavy through traffic on Wadsworth Boulevard, vehicles from both side streets and driveways are forced to pull into gaps that are inadequate.

ATTACHMENT 1

Highway Capacity Manual LOS Definitions

LOS Criteria for Basic Freeway Segment

LOS	Density (passenger car/mi/ln)	Traffic Flow Characteristics
A	≤ 11	Free-flow operation, vehicles are almost completely unimpeded in their ability to maneuver within the traffic stream.
B	> 11 - ≤ 18	Reasonably free flow; maneuvering within the traffic stream is only slightly restricted.
C	> 18 - ≤ 26	Freedom to maneuver within the traffic stream is noticeably restricted.
D	> 26 - ≤ 35	Freedom to maneuver within the traffic stream is more noticeably limited, and the driver experiences reduced physical and psychological comfort levels.
E	> 35 - ≤ 45	Vehicles are closely spaced, leaving little room to maneuver within the traffic stream at speeds that still exceed 49 mph.
F	> 45	Breakdowns in vehicular flow.

Source: *Highway Capacity Manual (HCM),* 2000.

LOS Criteria for Weaving Area

LOS	Density (pc/mi/ln)	Traffic Flow Characteristics
A	≤ 10	Unrestricted operation, smooth weaving movements.
B	> 10 - ≤ 20	Weaving maneuvers become noticeable to through drivers.
C	> 20 - ≤ 28	Both ramp and freeway vehicles begin to adjust their speeds to accomplish smooth transitions.
D	> 28 - ≤ 35	Virtually all vehicles slow to accommodate weaving movements.
E	> 35 - ≤ 43	Flow levels approach capacity, and small changes in demand or disruptions within the traffic stream can cause both ramp and freeway queues to form.
F	> 43	Demand exceeds capacity.

Source: *Highway Capacity Manual (HCM),* 2000.

LOS Criteria for Merging and Diverging Area

LOS	Density (pc/mi/ln)	Traffic Flow Characteristics
A	≤ 10	Unrestricted operation, smooth merging and diverging.
B	> 10 - ≤ 20	Merging and diverging maneuvers become noticeable to through drivers.
C	> 20 - ≤ 28	Both ramp and freeway vehicles begin to adjust their speeds to accomplish smooth transitions.
D	> 28 - ≤ 35	Virtually all vehicles slow to accommodate merging and diverging.
E	> 35	Flow levels approach capacity, and small changes in demand or disruptions within the traffic stream can cause both ramp and freeway queues to form.
F	Demand exceeds capacity	

Source: *Highway Capacity Manual (HCM),* 2000.

HCM Urban Street LOS Classification

LOS	Description
A	The roadway primarily operates at free-flow operations at average travel speeds, usually about 90 percent of the free-flow speed for the given street class. Vehicles are completely unimpeded in their ability to maneuver within the traffic stream. Control delay at signalized intersections is minimal.
B	The roadway reasonably operates at unimpeded operations at average travel speeds, usually about 70 percent of the free-flow speed for the given street class. The ability to maneuver within the traffic stream is only slightly restricted and control delay at signalized intersections is not significant.
C	The roadway operates at stable operations, however, the ability to maneuver and change lanes in midblock locations may be more restricted than at LOS B. Longer queues, adverse signal coordination, or both may contribute to lower average travel speeds of about 50 percent of the free-flow speed for the given street class.
D	The roadway borders on a range in which small increases in flow may cause substantial increases in delay and decreases in travel speeds. LOS D may be due to adverse signal progression, inappropriate signal timing, high volumes, or a combination of these factors. Average travel speeds are about 40 percent of roadway's free-flow speed.
E	The roadway is characterized by significant delays and average travel speeds 33 percent or less of the roadway's free-flow speed. Such operations are caused by a combination of adverse progression, high signal density, high volumes, extensive delays at critical intersections, and inappropriate signal timing.
F	The roadway is characterized by urban street flow at extremely low speeds, typically 25-33 percent of the roadway's free-flow speed. Intersection congestion is likely at critical signalized locations, with high delays, high volumes, and extensive queuing.

Source: *Highway Capacity Manual (HCM),* 2000.

Intersection LOS Criteria

LOS	Average Delay (seconds per vehicle)	Traffic Flow Characteristics
Signalized Intersections		
A	≤ 10	Most vehicles arrive during the green phase and do not stop at all.
B	> 10 - ≤ 20	More vehicles stop, causing higher delay.
C	> 20 - ≤ 35	The number of vehicles stopping is significant, but many still pass through the intersection without stopping.
D	> 35 - ≤ 55	Many vehicles stop, and the influence of congestion becomes more noticeable.
E	> 55 - ≤ 80	Very few vehicles pass through without stopping.
F	> 80	Considered unacceptable to most drivers. Intersection is not necessarily over capacity, even though arrivals exceed capacity of lane groups.
Unsignalized Intersections		
A	≤ 10	Little or no traffic delays.
B	> 10 - ≤ 15	Short traffic delays.
C	> 15 - ≤ 25	Average traffic delays.
D	> 25 - ≤ 35	Long traffic delays.
E	> 35 - ≤ 50	Very long traffic delays.
F	> 50	Queuing on minor approaches and not enough gaps of suitable size to allow safe crossing of major streets. Signalization should be investigated at this point, but warrants must be satisfied before implementation.

Source: *Highway Capacity Manual (HCM),* 2000.

APPENDIX G

Neighborhood Traffic Conditions

NAVJOY Consulting Services, Inc.

To: **Zeke Lynch, CH2M HILL**

From: **Karl Buchholz, Navjoy Consulting Services, Inc.**

Subject: **US 6 – Wadsworth (SH 121) Environmental Assessment Analysis of Neighborhood Traffic Conditions**

Date: **July 23, 2007**

The purpose of this memorandum is to document the existing condition of neighborhood traffic along the streets surrounding the US 6/Wadsworth Boulevard interchange area. The neighborhood street system may potentially be impacted by the project due to indirect connections between the US 6 freeway and the neighborhood street system via the US 6 frontage road system.

Data Collection

Average daily traffic (ADT) and speed data were collected at 13 locations on neighborhood streets on the US 6 Frontage Roads. These counts were selected based on prior knowledge of the street system and an understanding of which streets are susceptible to changes in traffic flow as a result of the project. Figure 1 shows the location of the traffic counts as well as the measured volume and 85th percentile speeds. The data were collected over a two day period during the second week of May, 2007 (while school was still in session). Table 1 below provides a summary of the collected data. Figure 2 shows the neighborhood traffic control devices.

Table 1: Summary of Traffic Volume and Speed Data

Location	Street Classification	ADT (vpd)	Speed Limit (mph)	85th%ile Speed (mph)
10th Ave., e/o Upham	Minor Collector	4,000	30	32
10th Ave., e/o Allison	Minor Collector	4,410	30	36
NE 6th FR, e/o Broadview	Minor Collector	540	35	43
NE 6th FR, w/o Broadview*	Minor Collector	310	35	45
SE 6th FR, e/o Vance	Minor Collector	1,865	35	40
SW 6th FR, e/o Allison*	Minor Collector	465	35	45
NW 6th FR, e/o Allison*	Minor Collector	1,100	35	43
Carr St., n/o 4th	Minor Collector	895	30	30
Carr St., n/o 7th	Minor Collector	1,850	30	38
12th Ave, e/o Allison	Local	550	25	29
Highland Dr., e/o Park	Local	945	30	34
Broadview, e/o Park	Local	155	30	30
4th Ave, e/o Allison	Local	975	30	29

* One-way Street

Summary of Findings

The following is a summary of findings based on analysis of the above traffic data and a field review of the existing conditions:

1. Traffic data collected on the local streets of 4th Avenue, 12th Avenue, Broadview Drive and Highland Drive indicate that these streets are carrying daily traffic volumes well below the City of Lakewood's design threshold of 2,500 vpd for local streets. Also, with the exception of Highland Drive, the 85th percentile speed on these streets was at or below the existing speed limit.
2. The data indicates a slight speeding problem along Highland Drive (34 mph 85th percentile speed vs. 30 mph speed limit), but the speeds are not high enough to be considered a traffic hazard to the neighborhood. It is also important to note that traffic patterns in this neighborhood could change if the existing frontage road connection to the eastbound US 6 off-ramp is removed. This frontage road does not carry a high volume of traffic (310 vpd); however, there is a history of neighborhood concern about traffic flow and local residents will likely voice concern about any additional traffic that is routed on their streets from the frontage road.
3. The 85th percentile speeds along the US 6 Frontage Roads are typically 5-10 mph higher than the posted speed limit of 35 mph. The higher speeds are primarily a result of long tangent sections and minimal side street friction. Also, speeds on the west quadrant frontage roads are likely influenced by the higher speeds on the adjacent freeway because there is no visual separation between the two facilities.
4. Several of the two-way streets (4th Avenue, Carr Street, Broadview Drive and Highland Drive) have a large directional difference in ADT volume. This imbalance is primarily due to these streets serving traffic in the opposite direction of nearby one-way frontage roads.
5. The traffic data indicates that 10th Avenue, w/o Wadsworth and Carr Street, n/o 6th Avenue both have 85th percentile speeds well above the 30-mph posted speed limit (36 mph and 38 mph, respectively). Although these streets are both classified as minor collectors, they still pass through residential neighborhoods. Additionally, 10th Avenue is adjacent to the Jefferson County Open School. Traffic speeds on 10th Avenue are partially mitigated by the 20 mph school speed zone that is activated during school start and end times. Examination of speed data during school start and end times shows that the 85th percentile speeds are reduced from 36 mph to 30 mph.
6. Traffic speeds and volumes were not measured on most residential streets; however, a field review of these streets suggests that most streets do not have a speeding or traffic volume problem due to narrow pavement sections, curve-linear geometry and street discontinuity, each of which helps mitigate speeding.

Figure 1: Traffic Volume and Speed Data

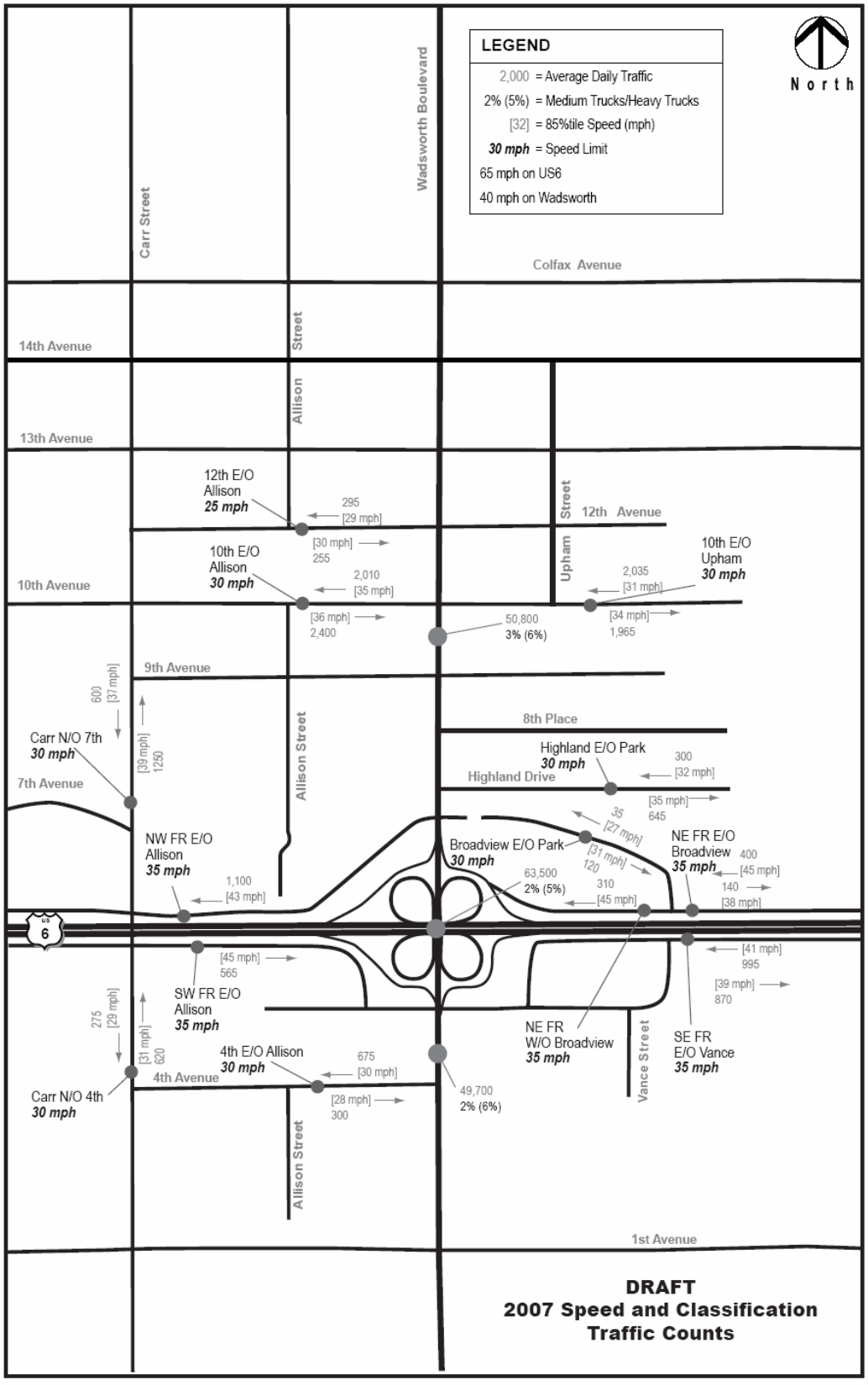
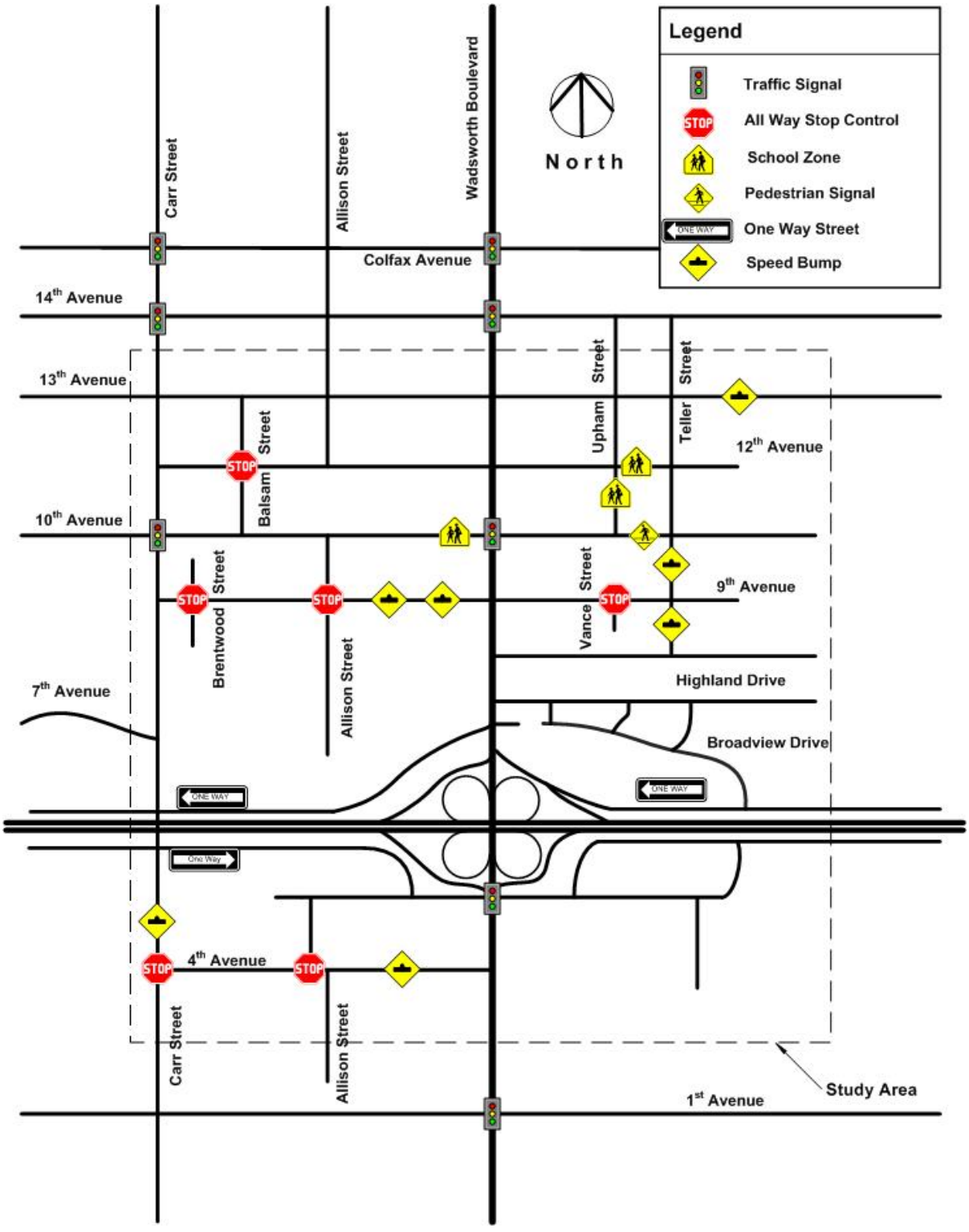


Figure 2: Neighborhood Traffic/Speed Control Devices



APPENDIX H

Safety Assessment Report Summary

US 6 and Wadsworth Boulevard Interchange Environmental Assessment Safety Assessment

PREPARED FOR: Tim Eversoll, P.E./CH2M HILL
Mandy Whorton/CH2M HILL
Zeke Lynch/CH2M HILL

PREPARED BY: Jacqueline Dowds Bennett/CH2M HILL

DATE: July 3, 2007

Introduction

The Sixth Avenue and Wadsworth Boulevard (SH 121) interchange is currently the subject of an Environmental Assessment (EA). The first step in the EA is to perform an existing conditions analysis that includes a review of the accident, or safety, history within the project area. Results of this review will provide input into the purpose and need determination for the EA. The Sixth Avenue study area limits extend to Carr Street on the west and mid-way to the Sheridan Boulevard interchange east of Wadsworth Boulevard. On Wadsworth Boulevard, the study area limits extend from just north of Second Avenue on the south to 13th Avenue on the north. This technical memorandum (TM) is intended to document the review of existing safety conditions within the study area and provide an assessment of those conditions.

Several safety assessments have recently been performed within the study area limits. Each of these assessments was reviewed to determine the identified accident issues and recommended mitigation measures. Furthermore, additional accident data were obtained from the Colorado Department of Transportation (CDOT) and reviewed for individual segments of Wadsworth Boulevard within the study limits. These two efforts form the basis of this existing conditions safety analysis.

The review included the following reports produced by the CDOT Safety Engineering and Analysis Group:

- *Safety Assessment Report SH 121 Resurfacing Project MP 10.10 – MP 12.53, April, 2001*
- *Abbreviated Safety Assessment Report SH 6 MP 275.65 – MP 282.33, April 2002*
- *Safety Assessment Report SH 6 Resurfacing Project MP 280.84 – MP 283.86, April 30, 2003*
- *Safety Assessment Report SH 121 Resurfacing Project MP 12.54 – MP 18.00, July 2003*

The review also included the following reports produced by the City of Lakewood (Lakewood) Traffic Engineering Division:

- *2003 Traffic Safety Report*
- *2005 Traffic Safety Report*

Existing Safety Issues

From the statewide perspective, looking at the entire project length, neither the accident frequency nor the severity is excessive for either US 6 or Wadworth Boulevard as compared to similar facilities across the state. However, analyzing the accident data over short segments of Wadsworth Boulevard suggests that there is a need to reduce the frequency of accidents in this study area. The Sixth Avenue and Wadsworth Boulevard interchange has the highest number of accidents of all the intersections in the CDOT report covering Wadsworth Boulevard from Florida Avenue to Broadview Drive. Similarly, the 10th Avenue intersection is highlighted as a problem intersection in the report covering Wadsworth Boulevard from Broadview Drive to 58th Avenue. Therefore, this particular study area from north of Second Avenue to 13th Avenue on Wadsworth Boulevard has several intersections identified as having a high accident frequency.

From the City's perspective, the frequency and severity of accidents in the interchange area is excessive because the interchange was the most critical location in Lakewood for accident frequency and the second most critical location for severity in 2001 and 2003. The interchange was also included on the City of Lakewood's critical intersection lists in 2004 and 2005. In addition, the 13th Avenue intersection with Wadsworth Boulevard was included on the City of Lakewood's critical intersection lists in 2001 and 2003.

The report summaries and data analysis both suggest that congestion along Sixth Avenue and Wadsworth Boulevard is contributing to rear-end accidents, which is the most common accident type in the study area. This type of accident is generally occurring at relatively low speeds due to the congestion and, therefore, is not resulting in a significant number of either injury of fatal accidents.

Wadsworth Boulevard in the interchange area experiences sideswipe same-direction accidents, which typically occur during lane-changing maneuvers. The cloverleaf interchange configuration necessitates lane changing and weaving between merging and diverging vehicles. The need to change lanes is further exacerbated by the location of intersections immediately adjacent to the interchange area on the north and the south. Vehicles must change lanes to enter left-turn lanes at these intersections. An exiting vehicle is required to weave across three lanes from the exit ramps to these left-turn lanes over a short distance.

The second highest accident type on Sixth Avenue was hit fixed object. This type of accident occurs when a driver veers out of the travel lanes and strikes a barrier or guardrail. Although nothing can prevent errant driving, the presence of these devices reduces the severity of run-off-road accidents.

The cloverleaf interchange configuration results in ramps with significant curvature that require a much lower speed to negotiate than the prevailing speeds on either Sixth Avenue or Wadsworth Boulevard. The overturning and hit-fixed-object accidents on the ramps can be attributed to failure to properly negotiate the curves. Exiting drivers may not adjust their speed quickly enough to slow down to the appropriate curve speeds. Additionally, the lower speeds on the entrance ramps require quick acceleration over a short distance to merge at the prevailing speeds.

Evaluation Criteria

This section explains the evaluation process and presents the ratings for the existing safety conditions.

Sixth Avenue Mainline

Evaluation Criteria

Safety Performance Functions (SPFs) for urban six-lane freeways are provided in both Sixth Avenue reports. These SPFs estimate the expected accident frequency for a particular average daily traffic (ADT) volume on an accident-per-mile/per-year basis for various facility types. It does not account for accidents that occur on the ramps. The SPF functions are regularly revised as the accident statistics are updated. For this existing conditions analysis, a particular segment's accident experience is evaluated based on the plotted position of its accident experience and ADT in relation to this statewide mean. If the accidents-per-mile/per-year plot is within 25 percent on either side of the expected mean for that particular ADT, the segment receives a "fair" rating. An accident experience that plots below this threshold receives a "good" rating, while one that plots above this threshold results in a "poor" rating.

Evaluation Rating

The *Abbreviated Safety Assessment Report SH 6 MP 275.65 – MP 282.33* (April 2002) is based on accidents that occurred during the period 1996 through 2000. The mean on this SPF graph is 53 accidents per mile/per year at an ADT of 120,000 vehicles. The accident experience for the segment between Garrison Street and Sheridan Boulevard plots at 42 accidents per mile/per year for an ADT of 120,000. This is within the 25 percent threshold and, therefore, this segment receives a "fair" rating for this time period.

The *Safety Assessment Report SH 6 Resurfacing Project MP 280.84 – MP 283.86* (April 30, 2003) is based on accidents that occurred during the period 1997 through 2001. The mean on this SPF graph is 54 accidents per mile/per year at an ADT of 120,000 vehicles. The accident experience for the segment between Wadsworth Boulevard and Sheridan Boulevard plots at 39 accidents per mile/per year for an ADT of 120,000. This is below the 25 percent threshold and, therefore, this segment receives a "good" rating for this time period.

The portion of Sixth Avenue within the study area receives a "fair" rating for safety in accordance with the April 2002 report. However, the 42 accidents per mile/per year is very close to the threshold for receiving a "good" rating. This analysis uses the older report because it covers the entire Sixth Avenue study area whereas the April 2003 report does not include the portion of Sixth Avenue west of Wadsworth Boulevard.

Wadsworth Boulevard

Evaluation Criteria

Wadsworth Boulevard is categorized as a Federal Aid Primary Urban Highway. For comparison to statewide average accident rates, it is categorized as a Federal Aid Urban Highway. This category includes state highways that have at-grade intersections and access driveways. Average statewide accident rates rather than SPFs provide the evaluation measure for this facility type. The 2003 average statewide accident rates for this type of facility are as follows:

- Total: 3.60 accidents per million vehicle miles traveled
- Property Damage Only: 2.63 accidents per million vehicle miles traveled
- Injury: 0.95 accidents per million vehicle miles traveled
- Fatal: 1.19 accidents per one hundred million vehicle miles traveled

If a segment's accident rate falls within 25 percent of the statewide average rate, it receives a "fair" rating. An accident rate below this threshold receives a "good" rating, while one above this threshold results in a "poor" rating.

Evaluation Rating

The two Wadsworth Boulevard reports present one accident rate for the entire length of their study areas. These study areas encompass more of Wadsworth Boulevard than necessary for this existing conditions analysis. Therefore, this analysis divided the study area into segments and calculated accident rates for each. The following table shows the accident rates and corresponding evaluation rating by segment. The total, property-damage-only, and injury rates are in terms of accidents per one million vehicle miles traveled, while the fatal rates are in terms of accidents per one hundred million vehicle miles traveled.

TABLE 1
Wadsworth Boulevard 2001 – 2004 Accident Rates by Segment

	Total	Property Damage Only	Injury	Fatal
Segment	Rate/Rating	Rate/Rating	Rate/Rating	Rate/Rating
Second Avenue to Fifth Avenue	5.70/Poor	4.74/Poor	0.97/Good	0.00/Good
Fifth Avenue to Broadview Drive	10.91/Poor	9.42/Poor	1.49/Good	0.00/Good
Broadview Drive to 10th Avenue	4.81/Poor	3.65/Poor	1.11/Good	5.28/Poor
10th Avenue to 13th Avenue	6.40/Poor	5.33/Poor	1.08/Good	0.00/Good
Overall	6.51/Poor	5.34/Poor	1.15/Good	2.13/Poor

Source: CH2M HILL, 2007.

The individual segments as well as the study area overall have a "poor" rating for the total and property-damage-only rates. The injury ratings are all "good," indicating that the rates for each segment are more than 25 percent lower than the average for similar facilities statewide. The Broadview Drive to 10th Avenue segment receives a "poor" fatal rating, which also contributes to the overall "poor" total rating.

The individual segments between Second Avenue and Broadview Drive have accident rates that are greater than for the total length of Wadsworth Boulevard between Florida Avenue and Broadview Drive, as reported in the *CDOT Safety Assessment Report SH 121 Resurfacing Project MP 10.10 – MP 12.53* (April 2001). According to this report, the interchange area has the most accidents of all the intersections in the segment between the interchange area and Florida Avenue. The vehicle miles traveled are in the denominator of the rate calculation. Therefore, the lower overall rate for the portion of Wadsworth Boulevard between Broadview Drive and Florida Avenue reflects the interchange accidents being spread over a greater distance and number of vehicle miles traveled. Therefore, the shorter segment

lengths have the effect of reducing the vehicle miles traveled, yielding a higher accident rate.

The "poor" ratings in the northern two segments for the total and property-damage-only rates reflect the conclusions shown in the *Safety Assessment Report SH 121 Resurfacing Project MP 12.54 – MP 18.00* (July 2003). The rate for the injury accidents within our study area is lower, indicating that segments further north in this study area had more injury accidents. The higher-than-average fatal rate for the segment between Broadview Drive and 10th Avenue also reflects the conclusions for the entire study area in the report.

Report Summaries

All of the reports include portions of the facilities that are outside of this study area. The summaries include a brief discussion of the entire report followed by a detailed discussion of the portions dealing with the study area itself.

Safety Assessment Report SH 121 Resurfacing Project MP 10.10 – MP 12.53, April 2001

This safety assessment reviewed Wadsworth Boulevard between Florida Avenue and the northern edge of the Sixth Avenue interchange. During the study period 1995-1999, the total average accident rate for this portion was below the statewide average for other Federal Aid Urban Highway facilities. Similarly, the property-damage-only rate is below the state average. The injury rate is slightly above the statewide average, while the fatal rate is equal to the statewide average. Most of the accidents are intersection- and access-related incidents.

During the years 1995 through 1999, 120 accidents occurred in the Sixth Avenue interchange area. Of this total, 30 involved injuries and the remainder were property damage only. Southbound Wadsworth Boulevard had the most accidents followed by northbound Wadsworth Boulevard. The following lists the accident types for the interchange area:

- Rear End: 52 percent
- Fixed Object: 21 percent
- Sideswipe Same Direction: 14 percent
- Overturning: 9 percent
- Other: 4 percent

Rear-end collisions are the predominant accident type and are typically related to congestion. Only four of these occurred on the ramps while the remainder occurred on Wadsworth Boulevard. Similarly, only one of the sideswipe accidents occurred on a ramp. The predominant accident type on the ramps was hitting a fixed object, such as a guardrail, light/utility pole, curb, sign, median barrier, and embankment. The overturning-type accidents occurred equally on Wadsworth Boulevard and on the ramps.

Because the safety assessment was for a resurfacing project, the report recommended a mitigating measure within the scope of a resurfacing project. The recommendation was to examine the potential to improve the arterial progression between the signals on Wadsworth Boulevard in order to relieve congestion and reduce rear-end accidents.

Abbreviated Safety Assessment Report SH 6: MP 275.65 – MP 282.33, April 2002
This safety assessment reviewed US 6 between Colfax Avenue and Sheridan Boulevard. During the study period 1998 through 2000, the accident frequency for all of the segments was within the expected range and below the expected mean for Urban Six-Lane Freeways.

Further investigation for accident concentrations and patterns showed that there are statistically significant high frequencies of run-off-road-right accidents in the eastbound direction between Garrison Street and Wadsworth Boulevard (MP 280.05 – 280.65). The higher injury rates associated with these accidents are likely related to the presence of curbs, which cause overturning. This pattern and the close proximity of residences suggest the consideration of installing guardrails or concrete barriers as countermeasures to reduce these types of accidents. The benefit-cost analysis shows placing guardrails or barriers in this location would be a cost-effective strategy.

Most of the accidents at the Sixth Avenue and Wadsworth Boulevard interchange were rear-end collisions and hit-fixed-object collisions, which are common for an urban interchange environment. The accident types and the order of their occurrence are the same as the previous report, indicating that accident patterns did not change over the 6-year period from 1995 to 2000. The following lists the accident types for the interchange area:

- Rear End: 44 percent
- Fixed Object: 28 percent
- Sideswipe Same Direction: 18 percent
- Overturning: 5 percent
- Other: 5 percent

The report recommended installing concrete barrier between mileposts 280.05 and 280.65 in the eastbound direction to reduce the high-severity, run-off-road-type accidents at this location. A recent field review determined that there is now a barrier in this location.

Safety Assessment Report SH 6 Resurfacing Project MP 280.84 – MP 283.86, April 30, 2003
This safety assessment reviewed US 6 between Wadsworth Boulevard and Federal Boulevard. During the study period 1997 through 2001, the accident frequency and severity for all of the segments was within the expected range for Urban Six-Lane Freeways. In addition, the average accident rate for total, property-damage-only, injury, and fatal accidents was below the statewide average for Federal Aid Primary Urban Highways.

Further investigation for accident concentrations and patterns on the mainline showed that there are statistically significant high frequencies of six types of accidents; however, the milepost locations associated with these accidents are east of the study area. In general, rear-end collisions were the most common accident type along this stretch of Sixth Avenue. They primarily occur during congested peak periods when inattentive drivers approach the area too fast or are following too closely as they approach the congested area. Most of the sideswipe same-direction accidents that occur during lane changing take place in the middle of the segments between interchanges.

Of the 101 interchange ramp accidents, 36 percent occurred on the east Wadsworth Boulevard ramps as opposed to 50 percent at the Sheridan Boulevard ramps and 14 percent at the Federal Boulevard ramps. The following lists the accident types at the ramps for the three interchanges:

- Rear End: 54 percent
- Fixed Object: 23 percent
- Overturning: 12 percent
- Sideswipe Same Direction: 7 percent
- Other: 4 percent

The most common accident type was rear-end collisions. Periodic congestion and queuing at ramp intersection and merging locations caused many of these accidents. The overturning and fixed-object collisions on the ramps were attributed to drivers exiting Sixth Avenue at excess speed, causing the drivers to lose control and run off the road.

The directional exit ramp from westbound Sixth Avenue to northbound Wadsworth Boulevard experienced several overturning and run-off-road-type accidents. The report noted that CDOT had recently improved the ramp by adding chevrons, advisory speed signs, and a flashing yellow beacon at the exit terminal, and these types of accidents had correspondingly declined. The report recommended installing an advisory exit speed sign within the deceleration lane limits for the westbound-to-northbound Wadsworth Boulevard directional exit ramp. A recent field review determined this sign has not yet been installed.

Safety Assessment Report SH 121 Resurfacing Project MP 12.54 – MP 18.00, July 2003
This safety assessment reviewed Wadsworth Boulevard between the northern edge of the Sixth Avenue interchange and 58th Avenue. During the study period 1999 through 2001, the total average accident rate for this portion was above the statewide average for other Federal Aid Urban Highway facilities. The report focuses on specific intersections that exhibited a higher concentration of accidents. One of these, 10th Avenue, is in the study area.

During the years 1999 through 2001, 39 accidents occurred at the 10th Avenue and Wadsworth Boulevard intersection. Of this total, four involved injuries and the remainder were property damage only. Only three of the accidents occurred on 10th Avenue. The following lists the accident types for the intersection:

- Rear End: 43 percent
- Approach Turn: 35 percent
- Broadside: 8 percent
- Sideswipe Same Direction: 8 percent
- Pedestrian: 3 percent
- Bicycle: 3 percent

All of the approach-turn accidents were northbound and southbound on Wadsworth Boulevard. The report suggests changing the left-turn phasing to protected-only to reduce these types of accidents. All but one of the rear-end accidents were on Wadsworth Boulevard. The report recommended examining and improving, if possible, the arterial progression between the signals on Wadsworth Boulevard in order to relieve congestion and reduce rear-end accidents. A recent field review indicates the northbound and southbound left-turn phases remain protected-permitted.

2003 Traffic Safety Report

This report summarizes Lakewood's evaluation of its intersection accidents for the year 2003. The Sixth Avenue and Wadsworth Boulevard interchange was included on the City of Lakewood's 2003 critical intersection list, which indicates it had a higher accident rate than similar highway interchanges within Lakewood. The Sixth Avenue and Wadworth Boulevard interchange was also included on the City's on the 2001 critical list. This interchange had Lakewood's highest frequency of reported accidents and the second highest severity index in both 2001 and 2003.

The following lists the trends or characteristics that occurred at least twice as frequently as citywide averages for other highway interchanges:

- Time of Day: midnight to 1 a.m. , 2-3 a.m., 3-4 a.m.
- First Harmful: fixed-object total and sideswipe same direction
- Driver Condition: alcohol and drugs involved
- Travel Direction: S-E
- Vehicle Movement: changing lanes, starting, passing, weaving, avoiding object
- Vehicle Type: non-school bus <1.5k, single-unit truck, bicycle

The analysis of this interchange yielded the following conclusions about the accidents:

- Sideswipe same-direction accidents accounted for nearly 25 percent of intersection accidents as opposed to the 9 percent citywide average.
- Accidents involving lane-change maneuvers occurred three times more frequently than the citywide average; the majority of these involved southbound vehicles.
- The directional eastbound entrance ramp to US 6 experienced a significant number of rear-end and fixed-object accidents.
- The number of accidents that occurred in early morning hours between 12 a.m. and 3 a.m. was more than two-and-a-half times the citywide average.
- The number of accidents where the at-fault driver was under drug or alcohol influence occurred at twice the citywide average.
- The field review noted a significant number of vehicles exiting Sixth Avenue and attempting to merge into the left lanes; the high frequency of sideswipe same-direction accidents supports this observation.
- The field review noted that the directional eastbound entrance ramp to Sixth Avenue has two horizontal curves and a short acceleration distance that appear to contribute to rear-end and fixed-object accidents.

A review of the interchange collision diagram provides the following summary about the accidents at this interchange in the 2003:

- No fatal accidents.
- Five injury accidents equate to 7 percent of the accidents, which is within two times the citywide average.

- The northbound approach experienced four rear-end accidents, two sideswipe same-direction accidents, three right-turn-hit-fixed-object accidents, and one double-left-turn collision, as well as two accidents in which the approach-turn northbound-to-westbound vehicles hit southbound vehicles (these are likely at the Broadview Drive intersection).
- The southbound approach experienced 14 rear-end accidents, eight sideswipe same-direction accidents, two collisions involving right turns into vehicles going straight, and one accident involving a right turn into a vehicle turning right.
- The westbound approach experienced six rear-end accidents, one sideswipe same-direction accident, and seven hit-fixed-object accidents (this analysis assumes these occurred on the westbound entrance and exit ramps).
- The eastbound approach experienced nine rear-end accidents, four sideswipe same-direction accidents , and four hit-fixed-object accidents (this analysis assumes these occurred on the eastbound entrance and exit ramps).

The report recommends a detailed study to determine an alternative interchange configuration to reduce accidents and congestion at this location.

The 13th Avenue and Wadsworth Boulevard intersection was included on the City of Lakewood's 2001 and 2003 critical intersection lists. In 2003, it had the 43rd highest frequency of crashes and the 47th highest severity index in the City. The following lists the trends or characteristics that occurred at least twice as frequently as citywide averages for other highway interchanges:

- Season: Spring
- Month of Year: January, March, and April
- Time of Day: 11 a.m.–12 p.m., 4-5 p.m., 7-8 p.m., and 10-11 p.m.
- First Harmful: broadside, pedestrian, sideswipe same direction
- Roadway Condition: ice
- Driver Condition: alcohol and drugs involved
- Travel Direction: N-W, S-E, S-W
- Vehicle Movement: changing lanes, stopped, passing
- Vehicle Type: truck > 10k/bus > 15 passenger

The analysis of this intersection yielded the following conclusions about the accidents:

- The number of sideswipe same-direction accidents occurred at two-and-a-half times the citywide average.
- The proportion of accidents during the noon hour and in the evening is more than two times the citywide average.

A review of the intersection collision diagram provides the following summary about the accidents at this interchange in 2003:

- No fatal accidents.
- Of 16 total accidents, two, or 13 percent, were injury accidents.

- The northbound approach experienced three rear-end accidents, three sideswipe same-direction accidents, two approach-turn accidents, and one hit-pedestrian accident.
- The southbound approach experienced one rear-end accident, one sideswipe same-direction accident, and three approach-turn accidents.
- The westbound approach experienced one approach-turn and one broadside accident.
- The eastbound approach experienced one rear-end accident.

2005 Traffic Safety Report

This report summarizes Lakewood's evaluation of its intersection accidents for 2005. This evaluation is not as robust as previous years due to concern about errors in the accident reporting database. However, the report supports the continued inclusion of the Sixth Avenue and Wadsworth Boulevard interchange on the City's critical intersection list.

General Conclusions From the Reports

The following presents the conclusions drawn from the report review:

- Magnitude of the Accident Problem—From the statewide perspective provided in the CDOT analyses, Sixth Avenue experiences accident and severity frequencies that are within the expected deviation of the statewide average for similar facilities. In addition, the accident and severity rates are below the statewide averages for similar facilities for both Sixth Avenue and the portion of Wadsworth Boulevard that is between the northern limit of the interchange and Florida Avenue. The interchange does not exhibit any unusual accident characteristics compared to similar facilities statewide. However, from the citywide perspective provided by Lakewood, the interchange accident rate is above the citywide average for similar facilities. It had the highest frequency of accidents and the second highest severity index in the city in 2003.
- Most Common Accident Types—Both agencies agree that the top three accident types in the study area are rear end, hit fixed object, and sideswipe same direction. Both CDOT and Lakewood conclude that congestion is the cause of the rear-end accidents. Capacity improvements to reduce congestion and signal progression to improve flow may help to mitigate rear-end accidents. Lakewood concludes the significant sideswipe same-direction (lane changing/merging) and rear-end accidents on Wadsworth Boulevard in the interchange area are due to the interchange configuration and congestion.
- Ramp Issues—CDOT concludes the westbound directional exit ramp experienced several overturn and run-off-road accidents due to severe curvature. CDOT Region 6 has made several improvements that have helped to alert drivers to the need to slow down, but has not revised the alignment. Lakewood concludes that the curves on the directional eastbound entrance ramp contribute to fixed-object accidents, while the short acceleration length plays a role in rear-end accidents.
- CDOT Mainline Recommendations—Any alternative should incorporate median barriers and guardrail/retaining walls to prevent run-off-road accidents from becoming severe accidents. Likewise, there should be no curb that can induce overturning accidents. A continuous length of delineation is recommended along the median barriers to enhance visibility and provide positive guidance to drivers.

Data Analysis

The two Wadsworth Boulevard reports each present one accident rate for the entire length of their respective study areas. The existing conditions analysis requires segmentation of the study area along Wadsworth Boulevard in order to determine spot-specific issues. Therefore, this analysis divided the Wadsworth Boulevard study area into segments and assessed accident patterns and calculated accident rates for each. CDOT provided accident and ADT data for the years 2001-2004 for this analysis.

Second Avenue to Fifth Avenue

This segment includes the Fifth Avenue intersection, but not the Second Avenue intersection. Over the 4-year period, this segment experienced a total of 118 accidents. Of this total, 83 percent were property-damage-only accidents and the remaining 17 percent involved injuries. A significant majority of the accidents occurred during the day in fair conditions, when there was no inclement weather and the pavement was dry. The following lists the accident types and the percent of the total accidents each represents:

- Rear End: 51 percent
- Sideswipe Same Direction: 18 percent
- Broadside: 13 percent
- Approach Turn: 7 percent
- Hit Fixed Object: 5 percent
- Overtaking Turn: 3 percent
- Head-On: 2 percent
- Pedestrian: 0.5 percent
- Bicycle: 0.5 percent

This segment is typical of all of the segments in that the rear-end accidents were the most common type. Rear-end accidents are frequently related to congestion. Broadside and approach-turn accidents usually occur in an intersection environment.

Fifth Avenue to Broadview Drive

This segment encompasses the US 6 and Wadsworth Boulevard interchange. Over the 4-year period, this segment experienced a total of 205 accidents. Of this total, 86 percent were property damage only and the remaining 14 percent involved injuries. A significant majority of the accidents occurred during the day in fair conditions, when there was no inclement weather and the pavement was dry. This segment had the highest percentage of accidents that occurred in the dark with lighting. The following lists the accident types and the percent of the total accidents each represents:

- Rear End: 56 percent
- Sideswipe Same Direction: 23 percent
- Broadside: 8 percent
- Hit Fixed: Object 6 percent
- Approach Turn: 3 percent
- Overturning: 2 percent
- Other Non-Collision: 1 percent

- Overtaking Turn: 0.5 percent
- Bicycle: 0.5 percent

This segment has the highest percentage of sideswipe same-direction accidents. These accidents typically occur during lane-changing maneuvers. The cloverleaf interchange configuration requires weaving maneuvers between the entering and exiting vehicles, increasing the potential for sideswipe same-direction-type accidents. The intersections immediately north and south of this interchange also increase the weaving as exiting vehicles attempt to weave across several lanes to enter the left-turn lanes to Broadview Drive and Fifth Avenue. The approach-turn accidents occurred at the Broadview Drive intersection. None occurred within the interchange due to the nature of the cloverleaf interchange. All but one of the broadside accidents appear to have occurred at the eastbound directional exit ramp to southbound Wadsworth Boulevard merge point, suggesting some drivers may not have properly negotiated the curve or there may be a sight distance issue.

Broadview Drive to 10th Avenue

This segment includes the 10th Avenue intersection. Over the 4-year period, this segment experienced a total of 183 accidents. Of this total, 76 percent were property-damage-only accidents , 23 percent involved injuries, and 1 percent were accidents involving fatalities. A significant majority of the accidents occurred during the day in fair conditions, when there was no inclement weather and the pavement was dry. The following lists the accident types and the percent of the total accidents each represents:

- Rear End: 43 percent
- Approach Turn: 20 percent
- Broadside: 18 percent
- Sideswipe Same Direction: 8 percent
- Hit Fixed Object: 6 percent
- Head-On: 2 percent
- Overturning: 1.5 percent
- Pedestrian: 1 percent
- Bicycle: 0.5 percent

This segment has the highest percentage of approach-turn and broadside accidents. All but two of the approach-turn accidents involved northbound and southbound vehicles turning off of Wadsworth Boulevard onto 10th Avenue. A significant majority of the broadside accidents involved eastbound and westbound vehicles on 10th Avenue colliding with a northbound or southbound vehicle on Wadsworth Boulevard. One of the fatal accidents occurred during an approach turn at a driveway access north of the Highland Drive intersection. This driver was under the influence of illegal drugs. In the other fatal accident, the driver ran off the road to the right and hit a tree at the Highland Drive intersection.

10th Avenue to 13th Avenue

This segment division occurs here because there is a significant drop in ADT north of 10th Avenue. Over the 4-year period, this segment experienced a total of 107 accidents. Of this total, 83 percent were property-damage-only accidents, while the remaining 17 percent of

the accidents involved injuries. A significant majority of the accidents occurred during the day in fair conditions, when there was no inclement weather and the pavement was dry. The following lists the accident types and the percent of the total accidents each represents:

- Rear End 67 percent
- Broadside: 12 percent
- Approach Turn: 11 percent
- Sideswipe Same Direction: 7 percent
- Sideswipe Opposite Direction: 1 percent
- Hit Fixed Object: 1 percent
- Other Non-Collision: 1 percent

This is the only segment that experienced a sideswipe opposite-direction accident. The accident occurred while a northbound vehicle on Wadsworth Boulevard was attempting to turn left at 13th Avenue. The other accident types are typical of those experienced by the other segments.

Conclusion

This assessment of the existing safety conditions for the Sixth Avenue and Wadsworth Boulevard study area is based on previously published CDOT and City of Lakewood reports as well as a segmented analysis of accident data along Wadsworth Boulevard. This segmented analysis suggests a need to reduce accident frequency on Wadsworth Boulevard in the study area, primarily in the interchange area. The interchange ramp alignments also contribute to accidents as does congestion in the study area according to both CDOT and Lakewood safety reports.

APPENDIX I

Bicycle and Pedestrian Facilities

NAVJOY
Consulting Services, Inc.

To:	**Zeke Lynch, CH2M HILL**
From:	**Karl Buchholz, Navjoy Consulting Services, Inc.**
Subject:	**US 6 – Wadsworth (SH 121) Environmental Assessment Analysis of Existing Pedestrian and Bicycle Facilities**
Date:	**July 13, 2007**

The purpose of this memorandum is to document the condition of the existing pedestrian and bicycle facilities within the US 6/Wadsworth Boulevard (SH 121) study area. The information provided in this memorandum was taken from field inventories and observations conducted on May 11 and May 18, 2007.

Study Area

Figure 1 shows the study area for the analysis of existing conditions. The inventory of existing conditions focused on the Wadsworth corridor from 3rd Avenue to 13th Avenue. US 6 is a grade separated facility where bicycles and pedestrians are prohibited so it was not included in the analysis, with the exception of pedestrian facilities in the Wadsworth interchange area.

Figure 1: Study Area for Pedestrian/Bicycle Analysis

Pedestrian Facilities

Sidewalk Conditions along Wadsworth Boulevard

The sidewalks along Wadsworth are characterized by a mixture of detached and attached walks, missing links and various obstructions along the corridor. A detailed inventory was conducted to measure the amount of missing and substandard sidewalk. Table 1 provides a summary of the sidewalk that is missing or is in substandard condition for each side of Wadsworth. Table 2 provides the same, but is summarized by street segment.

Table 1: Missing or Substandard Sidewalk on Each Side of Wadsworth

Wadsworth Side	% Missing Sidewalk	% Missing or Non-Standard* Sidewalk
East Sidewalk	20%	52%
West Sidewalk	71%	85%
Combined	45%	68%

* See Appendix A for CDOT Sidewalk Standards

Table 2: Missing or Substandard Sidewalk by Segment of Wadsworth

Wadsworth Segment	% Missing Sidewalk	% Missing or Non-Standard Sidewalk
3rd Ave to 5th Ave	17%	61%
5th Ave to 10th Ave	50%	65%
10th Ave to 13th Ave	52%	83%

As Tables 1 and 2 show, the majority of sidewalk along Wadsworth is non-existent or is substandard. The east side of Wadsworth has more sidewalk continuity than the west side but its still missing long segments of sidewalk, especially north of 6th Avenue. The west side of Wadsworth has very little sidewalk that currently exists or meets standards. In fact, only 15% of the west side of Wadsworth has sidewalk that meets CDOT standards.

In addition to the discontinuity of sidewalk, there are numerous sidewalk deficiencies along Wadsworth Boulevard. Where the sidewalk is attached, it is often no more than 5-feet in width and there is not a suitable barrier to protect pedestrians from adjacent vehicles. The following figures provide a sample of several of the sidewalk deficiencies that exist.

Sidewalk crossing at high-volume on-ramp (NB Wadsworth to EB US 6)

Narrow attached sidewalk under US 6 bridge (east side of Wadsworth)

Light Pole obstructing pedestrian traveled way (East side Wadsworth from 6th to 8th Avenue)

Missing curb ramp on northeast corner of 8th Place and Wadsworth

Turn island without curb ramps in pedestrian path (940 Wadsworth Parking Lot Access)

Non-ADA curb ramp at southeast corner of 10th Avenue/Wadsworth Boulevard

Missing sidewalk segment south of 12th Avenue, east side of Wadsworth

3-foot wide sidewalk segment north of 12th Avenue, east side of Wadsworth

Gravel pedestrian path over Lakewood Gulch culvert (west side, n/o US 6)

Advertising bench and newsstands in pedestrian traveled way (west side, s/o 5th)

Pedestrian Activity

Pedestrian activity along the Wadsworth Boulevard corridor was collected as part of the traffic data collection, and general field observations confirm that this corridor does not have a high volume of pedestrians. Pockets of pedestrian activity tend to be centered on the signalized intersections of 5th Avenue and also 10th Avenue. A higher than expected amount of mid-block crossings occur near 4th Avenue. This is likely due to the presence of the Walmart store to the east of Wadsworth and residential land uses to the west. Although Wadsworth Boulevard is not a heavily used pedestrian corridor, it still provides the only north-south pedestrian crossing of US 6 along a 2½ mile stretch from Sheridan Boulevard to Garrison Street. Additionally, pedestrian activity along Wadsworth is expected to increase once the West Corridor light rail station at 13th and Wadsworth opens in 2012, but no quantitative estimates of future pedestrian activity have been made to date.

Pedestrian Facilities Crossing Wadsworth Boulevard

The study area currently has just two controlled pedestrian crossings of Wadsworth Boulevard. These are located at the signalized intersections of 5th Avenue and also 10th Avenue. Both intersections experience a low to moderate amount of pedestrian activity. Pedestrian crosswalks and pedestrian signals are provided on all four corners of each intersection. The following provides a summary of pedestrian facility conditions at 5th Avenue and 10th Avenue:

5th Avenue and Wadsworth Boulevard

Pedestrian Signals: Standard Man/Hand pedestrian signal indications exist for each crosswalk.
Pedestrian Signal Actuation: Push buttons are provided on each corner. Pedestrian signals for crosswalks parallel to Wadsworth (crossing 5th Ave) are set to "rest-in-walk" mode.
Lighting: None
Crosswalk Pavement Markings:

- North leg: Fair condition
- South leg: Fair condition
- East leg: Fair condition
- West leg: Fair condition

Pedestrian Signing: No special signs exist.
Note – This traffic signal is currently scheduled for reconstruction beginning July 9, 2007. Pedestrian signal equipment will be replaced including the addition of countdown timer signals and intersection lighting on each corner.

10th Avenue and Wadsworth Boulevard

Pedestrian Signals: Standard Man/Hand pedestrian signal indications along with countdown timers for each crosswalk.
Pedestrian Signal Actuation: Push buttons are provided on each corner. Pedestrian signals for crosswalks parallel to Wadsworth (crossing 10th Ave) are set to "rest-in-walk" mode.
Lighting: Exist on all four corners.
Crosswalk Pavement Markings:

- North leg: Fair condition
- South leg: Poor condition
- East leg: Poor condition
- West leg: Fair condition

Pedestrian Signing: No special signs exist

Pedestrian Crashes

Pedestrian crash data from the City of Lakewood was analyzed for a three year time period (January 1, 2003 through December 31, 2005). Table 3 provides a summary of the data.

Table 3: Pedestrian Crash Data (2003 – 2005)

Year	Number of Crashes	Injuries	Fatalities	Location of Crashes
2003	2	1	0	PDO at 8th Pl; Injury crash at 13th Avenue
2004	0	0	0	N/A
2005	2	0	0	PDO at US 6 and 10th Ave

PDO: Property Damage Only Crash

As indicated by Table 3, there were a total of 4 pedestrian crashes (including 1 injury crash) from 2003 through 2005. The crashes appear to be random and the data does not indicate any identifiable crash patterns or trends.

Bicycle Facilities

Figure 2 below shows the existing and proposed bicycle facilities in the vicinity of the study area. The Lakewood Bicycle System Master Plan, adopted by City Council in 2005, identifies Wadsworth Boulevard as a bike route with detached multi-use paths. Although Wadsworth is not a primary bicycle corridor, it is the only north/south roadway between Sheridan Boulevard and Garrison Street where bicyclists are able to cross US 6.

There are also two bicycle routes that cross Wadsworth Boulevard in the study area: 10th Avenue and the 13th Avenue (D-10) bike route. 10th Avenue is identified as a commuter bicycling route with on-street bike lanes. Bike lanes along 10th Avenue currently exist to the west of Wadsworth but not to the east.

The 13th Avenue bike route is a primary commuter and recreational route that will eventually connect northwest Lakewood with downtown Denver. The route currently exists as an on-street facility along 13th Avenue but it will be mostly converted to a multi-use path with a grade separation at Wadsworth and Sheridan Boulevards as part of the West Corridor light rail project.

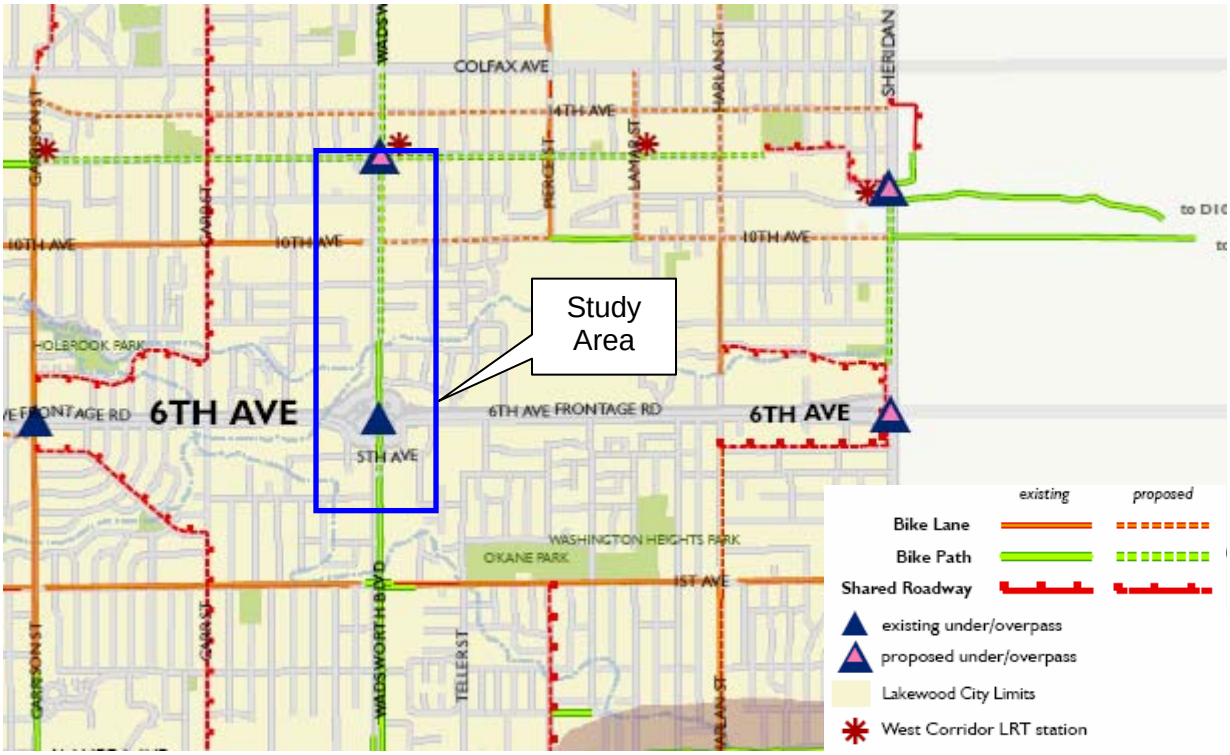


Figure 2: Lakewood Bicycle Master Plan in vicinity of Study Area

The Colorado Bicycling Map (published by CDOT in 2004) identifies US 6 as a state highway where bicyclists are prohibited. "Bicycles Prohibited" signs at the on ramps to US 6 also convey this. The Colorado Bike Map identifies Wadsworth Boulevard as a high-volume state highway with shoulder widths of less than 4-feet. Bicycles are not prohibited from using Wadsworth; however, the map information conveys that Wadsworth is not a bicycle-friendly state highway.

Existing Deficiencies

One of the primary deficiencies of the existing sidewalk/path along Wadsworth is the crossing of the cloverleaf interchange at US 6. The sidewalk path system crosses four free-flowing ramps in locations where drivers are not expecting to encounter bicycle and pedestrian activity. Furthermore, northbound bicyclists do not have a good view of approaching traffic when they are crossing the NB to EB on-ramp and the NB to WB on-ramp at US 6. Bicyclists must look over their left shoulder to see traffic approaching from behind.

Another issue with the existing multi-use path along Wadsworth is the crossing of driveways and side streets. Because most of the west side of Wadsworth does not have an existing path, southbound bicyclists are forced to either ride in the street where there is no shoulder, or use the path along the east side. Using the path on the east side becomes a safety issue when bicyclists encounter vehicles exiting driveways or side streets. Motorists turning right onto Wadsworth Boulevard normally look to their left and may not see a bicycle approaching from their right (north).

Finally, at locations where a sidewalk/path does exist there are many deficiencies that make the path unfriendly and/or unsafe to bicycle travel. These include obstacles in the traveled way (light poles, benches, newspaper stands, etc.), insufficient clear zone, missing curb ramps, debris in the traveled way, and inadequate width to accommodate both bicyclists and pedestrians.

Bicycle Activity

Bicycle activity along Wadsworth is generally low as most riders use Garrison Street one mile to the west for north-south travel. Bicycle activity is expected to increase once the West Corridor light rail station at 13th and Wadsworth opens in 2012 but no quantitative estimates of future bicycle activity have been made to date.

Bicycle Crashes

Bicycle crash data from the City of Lakewood was analyzed for a three year time period (January 1, 2003 through December 31, 2005). Table 4 provides a summary of the data.

Table 4: Bicycle Crash Data (2003 – 2005)

Year	Number of Crashes	Injuries	Fatalities	Location of Crashes
2003	3	2	0	PDO at 4th Ave; Injury at US 6 & at 10th Ave
2004	0	0	0	N/A
2005	2	2	0	PDO at 10th Ave; Injury at 12th Ave

PDO: Property Damage Only Crash

As indicated by Table 4, there were a total of 5 bicycle crashes (including 4 injury crashes) from 2003 through 2005. Two of the five crashes occurred at 10th Avenue and both involved eastbound bicycles. The 2003 crash was a broadside crash involving a SB left-turning vehicle. The crash in 2005 was a rear-end crash involving an eastbound vehicle away from the intersection. In both crashes the motor vehicle was at fault. Given the differing characteristics of these crashes it does not appear they are indicative of an accident pattern; however, when more recent crash data becomes available the data should be evaluated to determine if there is a correctable pattern of crashes.

Summary of Findings

The above analysis was conducted to document the existing conditions of the pedestrian and bicycle facilities for the US 6/Wadsworth Boulevard Environmental Assessment. Key findings of the analysis include:

1. The existing pedestrian sidewalk system is lacking in continuity and conformance with CDOT standards. Approximately 50% of the east side sidewalk is missing or in substandard condition and 85% of the west side sidewalk is missing or substandard.
2. The Wadsworth corridor is not a highly active pedestrian or bicycle corridor. The future light rail station and ancillary development at 13th Avenue and Wadsworth is expected to increase pedestrian and bicycle activity along Wadsworth.
3. Even with low user demand, Wadsworth Boulevard is an important corridor for bicyclist and pedestrians because of the east-west barrier effect created by US 6. Wadsworth is the only crossing of US 6 for a 2 ½ mile stretch from Sheridan Boulevard to Garrison Street.
4. The existing cloverleaf interchange is not conducive to pedestrian and bicycle movements through the interchange. The high-volume, free-flowing ramps do not offer many gaps in traffic flow and vehicle visibility for bicyclists crossing the ramps is difficult.
5. Crash data from 2003 through 2005 does not indicate a hazardous pattern or trend in crashes. When available, updated data from 2006 should be evaluated to determine if the crash history has changed.

Appendix A – Sidewalk/Bike Path Standards

To: **Zeke Lynch, CH2MHill**

From: **Karl Buchholz, Navjoy Consulting Services, Inc.**

Subject: **Summary of Sidewalk and Shared-Use Path Standards**

Date: **May 24, 2007**

The following table summarizes the cross-sectional standards for sidewalks and shared-use paths. Lakewood standards are based on their design standards for arterial roadways and the Lakewood Bicycle System Master Plan. CDOT is currently working on the pedestrian and bikeway chapter of their design manual. Chapter 4 of their design manual provides some guidance for sidewalk facilities. CDOT mostly defers to AASHTO for sidewalk and bikeway standards. The AASHTO standards were drawn from the AASHTO Guide for the Development of Bicycle Facilities, and AASHTO's Policy on Geometric Design for Streets and Highways.

Comparison of Sidewalk and Bikeway Standards

Criteria	CDOT	AASHTO	City of Lakewood
Sidewalk Only; Attached[1]			
Width	4' to 8'	6'	8'
Clear Zone	2'	2' [3]	2'
Sidewalk Only; Detached			
Width	4' to 8'	4' to 8'	5'
Detached Distance	per AASHTO	8'	7' to 15'
Clear Zone	2'	2'	2'
Shared Use Path; Attached[1,2]			
Width	per AASHTO	10'	10'
Clear Zone	per AASHTO	2' [3]	2'
Shared Use Path; Detached[2]			
Width	per AASHTO	10'	8'
Detached Distance	per AASHTO	5' [4]	7' to 15'
Clear Zone	per AASHTO	2'	2'
One-Way Directional Bike Path			
Width	per AASHTO	6'	N/A
Detached Distance	per AASHTO	5'	N/A
Clear Zone	per AASHTO	2'	N/A

[1] Lakewood Standards do not typically allow attached sidewalks or shared use paths on arterial roadways

[2] assumes multi-directional path

[3] A "suitable barrier" should be constructed when sidewalk/path is not detached

[4] If <5 ft, a "suitable barrier" should be constructed