

**US 6/Wadsworth**



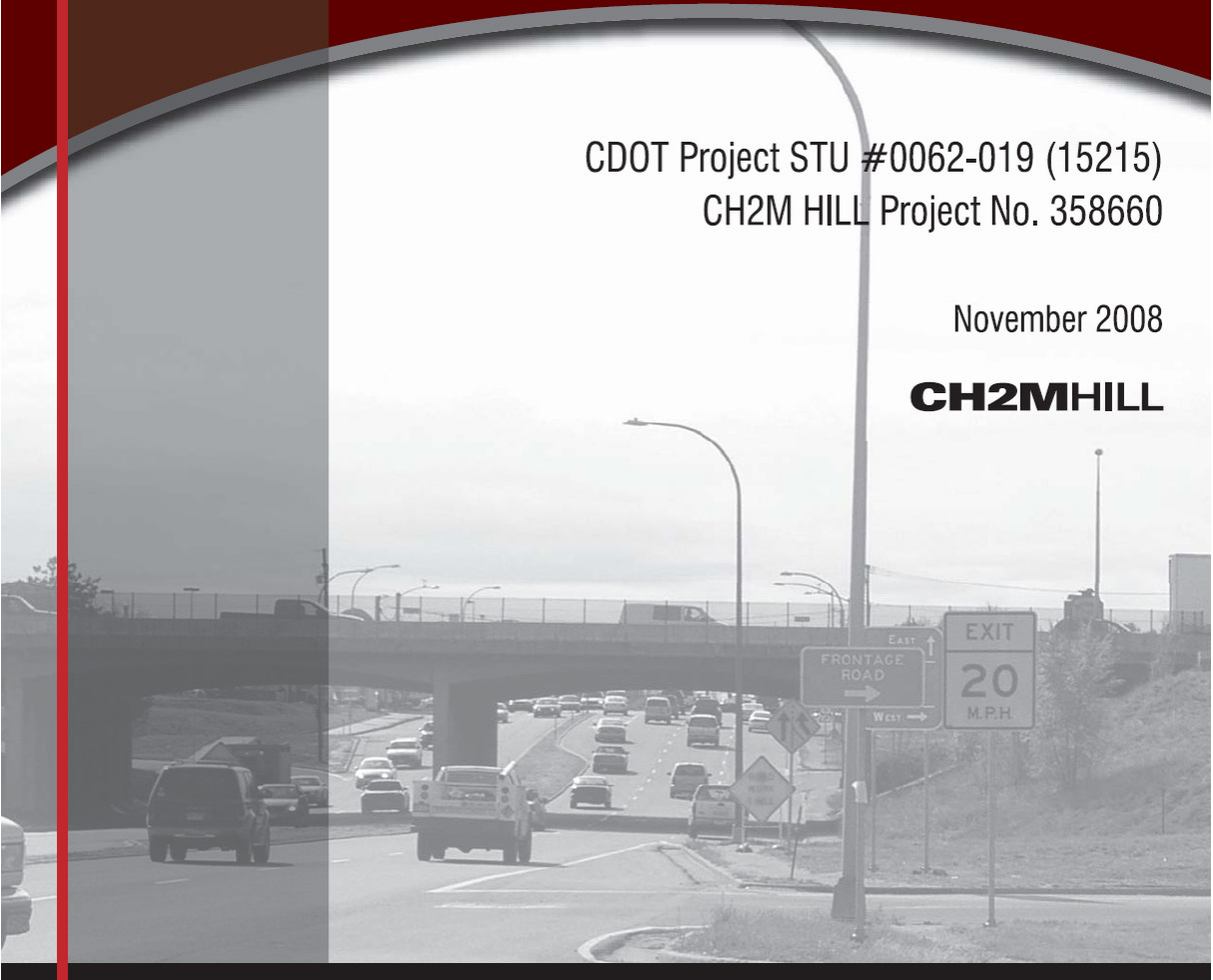
**Environmental  
Assessment**

# Floodplains Technical Memorandum

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

November 2008

**CH2MHILL**



TECHNICAL MEMORANDUM



# US 6/Wadsworth Boulevard EA Floodplains

PREPARED FOR: CH2M HILL  
PREPARED BY: Glen Selover, Shonna Sam, CH2M HILL  
PROJECT: US 6 and Wadsworth Boulevard Interchange Environmental Assessment  
DATE: October 10, 2008

## Introduction

The Federal Highway Administration (FHWA), in cooperation with the Colorado Department of Transportation (CDOT), is preparing an Environmental Assessment (EA) for proposed changes to the US 6 and Wadsworth Boulevard interchange within the City of Lakewood, Colorado. Changes are proposed to Wadsworth between 4th and 14th Avenues and along US 6 from the eastern interchange ramps with Wadsworth west to Garrison Street. Improvements are necessary to replace an outdated roadway and bridge that have inadequate geometrics, safety issues, and too little capacity to accommodate existing and future traffic demand.

The purpose of this technical memorandum is to present the hydraulic impacts that would be caused by the Build Alternative.

## Regulatory Context

Executive Order 11988, *Floodplain Management*, requires federal agencies to avoid, to the extent possible, long- and short-term adverse impacts associated with the modification of floodplains and to avoid floodplain development wherever there is a practical alternative. 23 CFR 650, Subpart A provides guidelines for floodplain and construction interaction, which include:

- Avoiding longitudinal and major encroachments, where possible.
- Minimizing impacts of highway agency actions that adversely affect base floodplains.
- Restoring and preserving the natural and beneficial floodplain values that are adversely impacted by highway agency actions.

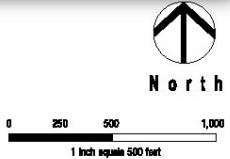
The base flood, which is defined as a flood that has a one percent or greater chance of occurrence in any given year (100-year flood) is the regulatory standard used by most federal and state agencies to administer floodplain management programs.

EXHIBIT 1  
Floodplains in the Study Area



- Legend**
- Existing Wetlands
  - Proposed Water Quality Pond
  - 100-Year Floodplain

Source: Jefferson County Assessor, 2007; CH2M HILL, 2008



## Existing Conditions

### Identification of base floodplains, 100-Year Floodplains, and Regulatory Floodways

Four Federal Emergency Management Agency (FEMA)-regulated 100-year floodplains are located within the study area (Exhibit 1). The floodplains include Lakewood Gulch, South Lakewood Gulch, McIntyre Gulch, and Dry Gulch. To characterize floodplain conditions in the study area, CH2M HILL conducted the following activities:

- Reviewed current FEMA Flood Insurance Rate Maps (FIRMs) for the 100-year floodplains in the study area,
- Conducted a field reconnaissance review of drainage areas in the corridor to assess floodplain conditions, and
- Contacted the City of Lakewood (Lakewood) and Urban Drainage and Flood Control District (UDFCD) officials to discuss floodplain management and conditions in the study area.

The limits of 100-year floodplains intersect with both US 6 and Wadsworth. US 6 does not appear to be within the 100-year floodplain, but the McIntyre Gulch floodplain lies parallel to US 6 west of Wadsworth from approximately Dover Street to its crossing under US 6 west of the existing interchange with Wadsworth. Lakewood expressed concerns that changes to the on ramp or frontage road in the northwest quadrant of the interchange could adversely affect McIntyre Gulch. The stretch of McIntyre Gulch between the frontage road and the storage facility is narrow with minimal conveyance capacity. The South Lakewood Gulch floodplain crosses under US 6 east of the Wadsworth interchange between Vance and Saulsbury Streets.

Wadsworth is in the 100-year floodplain of both Lakewood Gulch and Dry Gulch within the study area. A review of FEMA floodplain mapping suggests that the 100-year flood would overtop Wadsworth near 8th Avenue and 12th Avenue, as shown in Exhibit 1. Lakewood confirmed that flooding occurs at both 8th and 12th Avenues.

Officials with Lakewood and UDFCD noted that drainage facilities lack adequate capacity throughout Lakewood, and several of the drainage facilities under Wadsworth in the study area are substantially undersized.

### McIntyre Gulch

#### Existing Conditions

McIntyre Gulch crosses US 6 in a 3-cell 11.2' x 10' box culvert (see Exhibit 2) approximately 780 feet west of the Wadsworth Boulevard interchange. The direction of flow for the gulch is south to north at this crossing. Upstream, south of US 6, the gulch is owned by private properties within the study area. Downstream, north of US 6, McIntyre Gulch runs through public property and flows into Lakewood Gulch at a confluence 400 feet southwest of the existing Lakewood Gulch crossing of Wadsworth.

The existing channel both upstream and downstream of US 6, and the box culvert under US 6, are undersized for the 100-year flow. The existing box culvert conveys the 100-year flow with a 1.70 foot surcharge over the allowable water surface elevation (headwater) per CDOT criteria for allowable headwater. CDOT defines the allowable headwater as top of culvert for this size culvert crossing.

Upstream of US 6, the undersized channel and crossing, along with poor channel geometry and lack of erosion protection, have led to severe erosion (headcutting) on the north side of the channel, just south of the crossing of US 6. The photo in Exhibit 3 shows the headcut, which is approximately 14 feet tall and located 30 to 50 feet from the existing edge of shoulder of the southwest frontage road. These conditions also lead to significant flooding on the residential properties surrounding the channel in the study area.

Downstream of US 6, the undersized channel, along with poor channel geometry, lead to flooding on the commercial properties surrounding the channel between US 6 and the confluence with Lakewood Gulch. These conditions also contribute to the overtopping of Wadsworth by Lakewood Gulch, which in turn leads to flooding on properties located east of Wadsworth.

#### EXHIBIT 2

McIntyre Gulch – Culvert entrance upstream (south) of US 6, looking northeast



#### EXHIBIT 3

McIntyre Gulch – Headcut downstream (south) of US 6, looking west



### Existing Studies

McIntyre Gulch is included in a FEMA Flood Insurance Study (FIS) as a regulated drainageway. The floodplain is delineated on the Flood Insurance Rate Map (FIRM) for Jefferson County, Colorado and Incorporated Areas, Map Number 08059C0302 E, Panel 302 of 675, Effective Date June 17, 2003.

A Major Drainageway Planning Study dated November 1977 was completed for McIntyre Gulch by Hydro-Triad, Ltd. for the City of Lakewood. The study documented a need for three upstream drop structures (south of US 6) to reduce flow velocities. The study also planned two downstream drop structures (north of US 6) to control velocities. These improvements have not been implemented.

## Lakewood Gulch

### Existing Conditions

Lakewood Gulch crosses Wadsworth Boulevard in one 10' x 8' and two 11' x 8' box culverts approximately 1,200 feet north of the US 6 interchange. Exhibit 4 shows the culvert exit on the east side of Wadsworth. The direction of flow for the gulch is west to east at this crossing. Upstream, west of Wadsworth Boulevard, the gulch runs through public property within the study area. Downstream, east of Wadsworth Boulevard, Lakewood Gulch is owned by private properties within the study area.

The existing box culvert under Wadsworth is undersized, leading to overtopping of Wadsworth by the 100-year flow (6,140 cubic feet per second [cfs]). This overtopping also causes flooding on properties located downstream (east) of Wadsworth.

The existing channel upstream (west) of Wadsworth is also undersized and results in significant flooding of surrounding commercial and residential properties. There is an existing steep slope (1:1 horizontal to vertical) located at the culvert entrance on the west side of Wadsworth. The slope has areas of degraded asphalt slope paving. The channel condition is poor at this location.

Downstream (east) of Wadsworth the existing channel is undersized and causes flooding on surrounding private properties. However, the area of the channel deficiency is located downstream of the project limits, and would not be improved by the proposed project. The channel section immediately downstream of Wadsworth is pictured in Exhibit 5.

#### EXHIBIT 4

Lakewood Gulch – Culvert exit downstream (east) of Wadsworth, looking west



#### EXHIBIT 5

Lakewood Gulch – Channel section downstream (east) of Wadsworth, looking east



### Existing Studies

Lakewood Gulch is included in a FEMA Flood Insurance Study (FIS) as a regulated drainageway. The floodplain is delineated on the Flood Insurance Rate Map (FIRM) for Jefferson County, Colorado and Incorporated Areas, Map Number 08059C0302 E, Panel 302 of 675, Effective Date June 17, 2003.

The Lakewood Gulch Major Drainageway Planning Study dated November 1977 was prepared by Sellards and Griggs, Inc. for Urban Drainage and Flood Control District (UDFCD) and City of Lakewood. These improvements have not been implemented.

## **South Lakewood Gulch**

### **Existing Conditions**

South Lakewood Gulch crosses US 6 in an 8' x 8' box culvert approximately 1,280 feet east of the Wadsworth interchange. The direction of flow for the gulch is south to north at this crossing. The gulch is owned by private properties, both upstream and downstream of US 6.

The existing box culvert under US 6 is undersized, resulting in headwater depth in excess of CDOT design criteria. The undersized culvert does not lead to overtopping of US 6; however, excess flows are bypassed to the east along the southeast frontage road. The undersized existing channel contributes to flooding of private properties downstream of the project limits.

### **Existing Studies**

South Lakewood Gulch is included in a FEMA Flood Insurance Study (FIS) as a regulated drainageway. The floodplain is delineated on the Flood Insurance Rate Map (FIRM) for Jefferson County, Colorado and Incorporated Areas, Map Number 08059C0302 E, Panel 302 of 675, Effective Date June 17, 2003.

## **Dry Gulch**

### **Existing Conditions**

Dry Gulch crosses under the intersection of 12th Avenue and Wadsworth Boulevard from northwest to southeast in a 7.4' x 4.8' horizontal elliptical culvert. Exhibit 6 shows the culvert entrance north of 12th Avenue, and Exhibit 8 shows the culvert exit on the east side of Wadsworth. The direction of flow for the gulch is west to east at this crossing. Upstream (north) of 12th Avenue the gulch, shown in Exhibit 7, is owned by private properties within the study area. One of these properties, immediately north of 12th Avenue, is a historic property eligible for listing in the National Register of Historic Places. The channel runs through a portion of the property that does not contribute to the property's historic significance. Downstream (east) of Wadsworth, Dry Gulch runs through an undeveloped park property owned by Lakewood (shown in Exhibit 9).

The existing culvert under 12th Avenue and Wadsworth is undersized, leading to overtopping of 12th Avenue and Wadsworth by the 100-year flow (800 cfs). This overtopping also causes flooding on the school property southwest of the intersection. The undersized existing culvert and undersized existing channel contribute to the upstream and downstream floodplain impacts to private properties outside the project limits.

**EXHIBIT 6**

Dry Gulch – Culvert entrance upstream (north) of 12th Avenue, looking southeast



**EXHIBIT 7**

Dry Gulch – Channel section upstream (north) of 12th Avenue, looking northwest



**EXHIBIT 8**

Dry Gulch – Culvert exit downstream (east) of Wadsworth, looking west



**EXHIBIT 9**

Dry Gulch – Channel section downstream (east) of Wadsworth, looking east



**Existing Studies**

Dry Gulch is included in a FEMA Flood Insurance Study (FIS) as a regulated drainageway. The floodplain is delineated on the Flood Insurance Rate Map (FIRM) for Jefferson County, Colorado and Incorporated Areas, Map Number 08059C0302 E, Panel 302 of 675, Effective Date June 17, 2003.

A detention project, Ritchie Park Pond, was recently completed upstream of the project limits. It has resulted in reduced contributing flows to the Dry Gulch crossing. A current Letter of Map Revision (LOMR) is underway to document the improvements to the floodplain as a result of the upstream detention. The existing floodplain impacts for Dry Gulch located upstream and downstream outside of the project area have been improved as a result of this detention pond.



## Environmental Consequences

### No Build Alternative

The No Build Alternative would produce no change to floodplains. Drainage facilities would remain undersized and would continue to lack the capacity to accommodate 100-year flows. Overtopping of Wadsworth in the study area would continue to occur.

### Build Alternative

The Build Alternative would implement changes to the US 6/Wadsworth interchange and to Wadsworth Boulevard north to 14th Avenue. The interchange would be reconstructed and Wadsworth would be widened to correct design deficiencies, improve safety, increase capacity, and improve multi-modal connections in the study area. The Build Alternative would reduce flooding in the study area by widening and realigning channels and by constructing crossings large enough to convey flood waters under US 6 and Wadsworth Boulevard. The impacts of the Build Alternative on each of the gulches in the project area are discussed in detail below.

### McIntyre Gulch

The proposed action at the interchange would result in a 140-foot long transverse encroachment into the McIntyre Gulch floodplain south (upstream) of US 6. The proposed action would result in approximately 460 feet of longitudinal impacts to the McIntyre Gulch floodplain north of the existing culvert under US 6. The new eastbound off ramp and realigned southwest frontage road, and the new westbound on ramp and realigned northwest frontage road, would cross McIntyre Gulch and its floodplain. The geometry of the interchange would require a large portion of the gulch to be conveyed through the interchange in a box culvert.

A three-cell 14' x 10' box culvert approximately 890 feet long would be constructed to convey the 100-year flow under US 6 and its frontage road and ramp facilities in accordance with CDOT criteria. The southern box culvert entrance would be located approximately 140 feet southwest of the existing entrance. The box culvert would extend north, crossing under the reconstructed southwest frontage road and eastbound off ramp, US 6, and the reconstructed westbound on ramp and northwest frontage road, before daylighting approximately 460 feet northeast of the existing box culvert exit.

Upstream of US 6, the channel would be realigned and enlarged in order to improve the culvert entrance geometry. The channel would require regrading and minor realignment due to the wider roadway section and to eliminate the existing severe erosion (headcut) at the existing culvert entrance. The channel would be regraded to a 40-foot wide channel bottom at the south culvert entrance, tapering to the existing 24-foot width approximately 170 feet upstream (west). The cross section of the reconstructed channel would have 2:1 horizontal to vertical side slopes with riprap or boulder walls to help prevent future headcutting and erosion problems. Vertical retaining walls would not be required.

Downstream of US 6, the channel would be realigned and enlarged in order to eliminate the existing overtopping of the channel and Wadsworth. North of the proposed culvert, the channel would be realigned to the east and would include a larger width and improved

confluence at Lakewood Gulch. The channel would have a 60-foot bottom width from the new box culvert exit to the confluence with Lakewood Gulch. The cross section of the reconstructed channel would have a maximum 2:1 horizontal to vertical channel side slope and minimum 4:1 horizontal to vertical channel side slope. The elevation of the channel bottom would be lowered to properly convey the design flows and to tie in to the channel improvements at Lakewood Gulch.

The proposed changes would decrease the risk of flooding in the area due to improved conveyance of the 100-year design flood event. The floodplain limits would be modified in this vicinity to eliminate the roadway overtopping of Wadsworth.

Acquisition of several commercial properties north of US 6, due to roadway improvements and channel realignment, would remove some existing incompatible development in the floodplain. Acquiring these properties would allow the channel to be realigned to the east and enlarged to contain the 100-year flow within the limits of the proposed channel. This would remove the Public Storage property (which is immediately west of the existing channel) from the floodplain.

Natural and beneficial floodplain values would be restored through the acquisition of the commercial properties, and the resulting reduction of impervious pavement areas in the floodplain; and through the provision of water quality ponds and grass buffers in the floodplain.

In summary, the impacts of the proposed action are considered beneficial to McIntyre Gulch and its floodplain due to culvert replacement, channel enlargement, and channel realignment. The improvements would decrease flooding risks, reduce floodplain impacts, and reduce erosion. The removal of existing incompatible floodplain development would allow for restoration of natural and beneficial floodplain values in the area.

Because the improvements to the McIntyre Gulch channel would modify the floodplain through the study area, a LOMR would be required and would need to be coordinated with UDFCD and Lakewood.

## **Lakewood Gulch**

The proposed action would result in two 20-foot long transverse encroachments into the Lakewood Gulch floodplain due to the widening of Wadsworth.

The existing Lakewood Gulch box culvert would be replaced with a four-cell box culvert to convey the 100-year flow under US 6 in accordance with CDOT criteria. In order to provide the opportunity for a pedestrian crossing at the gulch, three cells would be 18' x 10', and one 12' x 10' cell would be raised three feet above the invert for pedestrians. This three-foot depth would allow for conveyance of approximately the 5- to 8-year flood event prior to inundation of the pedestrian culvert.

Upstream (west) of Wadsworth, the channel would be enlarged and realigned in order to eliminate overtopping of the channel and Wadsworth. The channel would be regraded and the channel bottom would be lowered to provide proper conveyance capacity. The channel bottom would need to be widened to 60 feet wide along the entire Lakewood Gulch and McIntyre Gulch channel limits located between Wadsworth and US 6. The cross section of

the reconstructed channel would provide a maximum 2:1 horizontal to vertical side slope and minimum 4:1 horizontal to vertical side slope. Channel side slopes would include boulder walls for the areas of steep 2:1 side slopes.

Downstream (east) of Wadsworth, the channel would require minor regrading and realignment to transition to the existing channel approximately 150 feet east of the culvert exit. The channel in this area would have a new 60-foot bottom width to properly convey flows from the enlarged culvert crossing. The cross section of the reconstructed channel would have a 2:1 horizontal to vertical channel side slope. Channel side slopes would include boulder walls for the areas of steep 2:1 side slopes.

The proposed channel improvements would decrease the risk of flooding, reduce the floodplain limits in the area, and eliminate overtopping of Wadsworth due to improved conveyance of the 100-year flow.

The acquisition of several properties adjacent to Lakewood Gulch, due to roadway improvements and channel realignment, would remove some existing incompatible development in the floodplain. Two commercial properties currently impacted by the Lakewood Gulch floodplain would be fully acquired by CDOT to accommodate roadway and channel improvements, and the floodplain would therefore no longer affect commercial properties in this area. One undeveloped residential property adjacent to Lakewood Gulch east of Wadsworth would be acquired due to roadway improvements, removing the potential for future incompatible development in the floodplain on this property.

Natural and beneficial floodplain values would be restored through the acquisition of adjacent properties, and the resulting reduction in impervious pavement areas in the floodplain; and through the provision of water quality ponds and grass buffers in the floodplain.

In summary, the impacts of the proposed action are considered beneficial to Lakewood Gulch and its floodplain, because the new culvert and channel realignment and regrading would decrease flooding risks, minimize floodplain impacts, minimize erosion, and eliminate overtopping of Wadsworth. The removal of existing incompatible floodplain development would allow for restoration and preservation of natural and beneficial floodplain values in the area.

Because the improvements to the Lakewood Gulch channel would modify the floodplain through the project area, a LOMR would be required and would need to be coordinated with UDFCD and Lakewood.

### **South Lakewood Gulch**

The proposed action at the interchange would result in a two 10-foot long transverse encroachments into the South Lakewood Gulch floodplain at the upstream and downstream ends of the existing culvert.

The existing South Lakewood Gulch box culvert would be extended to accommodate the proposed roadway improvements. Although the existing box culvert is undersized, UDFCD and Lakewood recommend maintaining the existing culvert size. There are downstream

channel deficiencies that could result in additional floodplain impacts downstream if an increased volume of water were conveyed through an enlarged culvert.

There would be no changes to the channel upstream or downstream of the extended box culvert.

The proposed box culvert extension would not change the risk of flooding in the area. There would be no impact to natural and beneficial floodplain values. Existing incompatible floodplain development would not change. The existing floodplain would not be modified, and there would be no change to existing floodplain impacts.

In summary, the proposed action would have a minor negative impact to South Lakewood Gulch and its floodplain as a result of the transverse encroachment into the floodplain and the extension of the existing undersized box culvert. However, without additional improvements by other parties to South Lakewood Gulch downstream of the project area, enlarging the box culvert under US 6 would create greater negative impacts downstream than would be experienced under the current proposed Build Alternative.

The improvements to the South Lakewood Gulch channel would not modify the floodplain in the project area, and would therefore not require a LOMR.

## **Dry Gulch**

The proposed action would result in two 10-foot long transverse encroachments into the Dry Gulch floodplain.

The existing Dry Gulch elliptical culvert would be replaced with a 16' x 6' box culvert to convey the 100-year flow under 12th Avenue and Wadsworth in accordance with CDOT criteria.

Upstream (north) of 12th Avenue, the channel would be regraded with a 20-foot bottom width to provide adequate room for the enlarged culvert crossing and properly convey 100-year flows. The regraded channel would transition back to the existing channel approximately 150 feet upstream of the culvert entrance. The cross section of the reconstructed channel would provide a maximum 2:1 horizontal to vertical side slope with rip rap or boulder walls to help prevent future erosion for approximately 100 feet upstream of the culvert entrance. The channel regrading, along with the new crossing structure, would eliminate overtopping of 12th Avenue and Wadsworth by the 100-year flow. This would in turn eliminate flooding on the school property. The proposed improvements would have temporary construction impacts to the historic property north of 12th Avenue, minimal permanent impact to the property, and would be located entirely in the portion of the property that does not contribute to its historic significance.

Downstream (east) of Wadsworth, the channel would be regraded with a 20-foot bottom to accommodate the larger culvert required to convey the design flows under Wadsworth. The channel would transition back to the existing channel approximately 200 feet downstream of the culvert entrance. The cross section of the reconstructed channel would provide a maximum 2:1 horizontal to vertical side slope with rip rap or boulder walls to help prevent future erosion for approximately 100 feet downstream of the culvert exit. The existing

commercial property immediately north of the channel would be acquired to provide the additional channel grading limits required for the larger culvert crossing.

The proposed changes would decrease the risk of flooding in the area because they would improve drainage and conveyance of the 100-year flow, would remove Wadsworth and 12th Avenue from the floodplain, and would eliminate overtopping of 12th Avenue and Wadsworth.

There is no existing incompatible development in the floodplain in the impact area, and no changes would be made to existing development or future development potential in the floodplain within project area. Although one commercial property would be acquired adjacent to the channel, the property does not currently encroach into the existing floodplain.

In summary, the impacts of the proposed action are considered beneficial to Dry Gulch and its floodplain, because the new culvert and channel realignment and regrading would decrease flooding risks, minimize floodplain impacts, and minimize erosion. The acquisition of the commercial property north of the downstream culvert exit would allow for the inclusion of a water quality treatment pond and restoration of natural and beneficial floodplain values in the area.

A current LOMR is underway to document the improvements to the floodplain as a result of the upstream detention at Ritchie Park. The existing floodplain impacts for Dry Gulch located upstream and downstream outside of the project area will be improved as a result of this detention pond. The assumed limits of this LOMR would be from Ritchie Park to Wadsworth.

A LOMR would need to be coordinated with UDFCD and Lakewood for the enlarged channel and culvert crossing at Wadsworth. The LOMR would address channel and drainage structure modifications to remove Wadsworth from the floodplain at this crossing.

## Mitigation

The proposed improvements to the channels and culvert crossings will be designed to convey 100-year flows, and will follow CDOT recommendations for the 50- to 100-year flood event capacity. As stipulated under 23 CFR 650.115(5), changes to floodplains would be subject to requirements of the local jurisdiction. CDOT will work closely with Lakewood on the proposed changes to the gulches and their roadway crossings, and will adhere to both Lakewood and CDOT hydraulic design criteria for major and minor storm drainage.

During final design, CDOT will in coordinate with the appropriate local and federal agencies to conduct detailed floodplain modeling, obtain required permits, and update the regional model of the 100-year floodplains in the study area Floodplain permits, including a floodplain development permit, Conditional Letter of Map Revision (CLOMR), and Letter of Map Revision (LOMR) will be acquired for modifications to the floodplain. This process will follow the requirements of 23 CFR Part 650 and 44 CFR Part 1.

Sediment traps, check dams, sediment basins, or other BMPs will be installed to control sedimentation during construction of drainage improvements in gulches. Specific BMPs will be determined during final design.