

PENNSYLVANIA AVENUE  
FLOOD REPAIR/IMPROVEMENT  
ALTERNATIVE ANALYSIS



APRIL 2014

## EXECUTIVE SUMMARY

During the flood events of September 2013, Gregory Canyon Creek overtopped and severely damaged the Pennsylvania Avenue roadway. The roadway was not immediately repaired because it looked like there was an opportunity to increase the flood conveyance capacity and improve the riparian habitat for what was initially considered to be a similar cost to replace the culvert pipe and repair the roadway. Therefore, prior to making repairs to the roadway, three different alternatives were assessed:

Alternative 1: Replace the existing culvert and rebuild the roadway.

Alternative 2: Remove the culvert and damaged roadway above the creek, close the road to through traffic, and build a pedestrian bridge over the creek.

Alternative 3: Remove the culvert and construct a new roadway with a significantly larger culvert or a vehicular bridge over the creek.

The following table summarizes the findings:

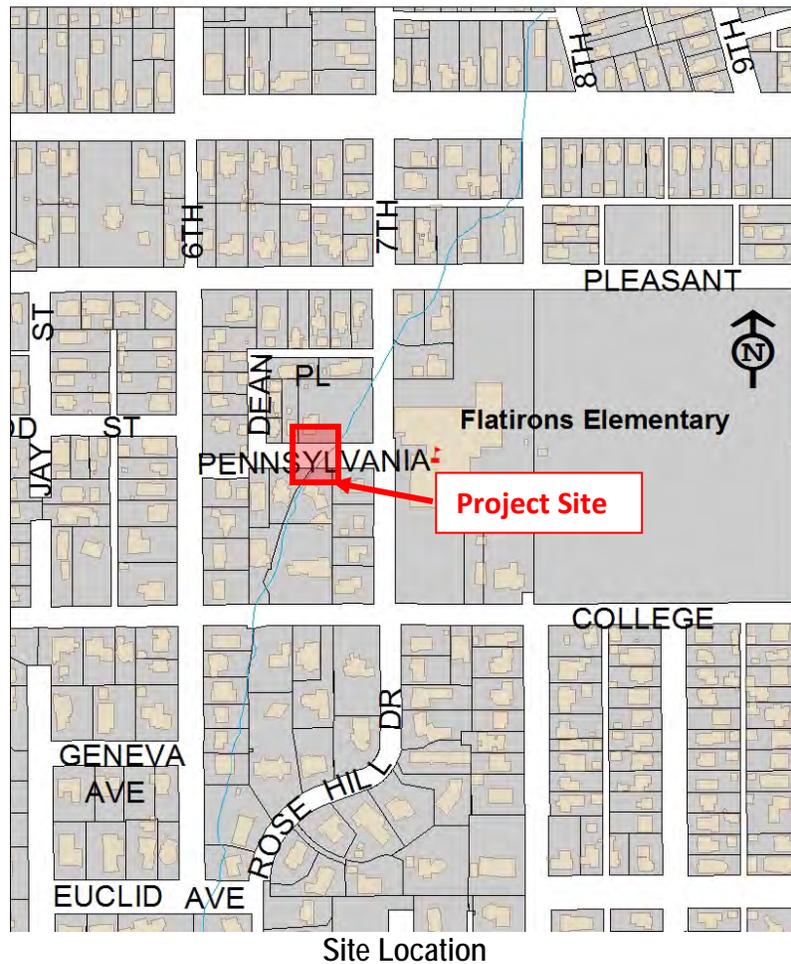
<b>Comparison of Alternatives</b>			
<b>Criteria</b>	<b>Alternate 1</b>	<b>Alternate 2</b>	<b>Alternate 3</b>
Flood Conveyance	No Effect	Positive	Positive
Wetlands and Wildlife Habitat	No Effect	Positive	No Effect
Vehicular/Emergency Access	No Effect	Negative	No Effect
Pedestrian Access	No Effect	Positive	No Effect
Estimated Construction Start	2 Weeks	4-6 Months	4-6 Months
Cost	\$4,000	\$95,000	\$225,000

After evaluation of the three alternatives, the utilities department recommends immediate implementation of Alternative 1: replace the damaged culvert and rebuild the roadway to pre-flood condition, while further evaluating Alternative 2: remove the culvert and damaged roadway above the creek, close the road to through traffic, and build a pedestrian bridge over the creek. This approach was selected for the following reasons:

- Repairing the roadway to pre-flood conditions is cost effective and can be done quickly. It can be completed while school is out for summer break.
- The initial repair work will allow the damaged roadway and creek area to be stabilized to prevent further erosion and the accumulation of trash in the area.
- Once the roadway is repaired, the blockades can be removed, clearing the area of additional obstructions to flood waters and eliminating the rental and maintenance costs associated with the blockades.
- There are many positive benefits associated with Alternative 2 and a high level of public support for the construction of a pedestrian bridge in this location.
- A flood mitigation study for Gregory Canyon Creek is currently underway to explore mitigation opportunities along the entire creek corridor. Alternative 2 can be assessed as part of the mitigation study so that improvements in this area can be coordinated with other mitigation projects along Gregory Canyon Creek, maximizing the benefits.

**BACKGROUND:**

Gregory Canyon Creek crosses under Pennsylvania Avenue between 6<sup>th</sup> Street and 7<sup>th</sup> Street, east of the Flatirons Elementary School.



During the flood events of September 2013, Gregory Canyon Creek overtopped and severely damaged the Pennsylvania Avenue roadway. The roadway was not immediately repaired because it looked like there was an opportunity to increase the flood conveyance capacity and improve the riparian habitat for what was initially considered to be a similar cost to replace the culvert pipe and repair the roadway.



When the damaged asphalt pavement was removed, the existing culvert pipe was assessed. The pipe was determined to be in poor condition and therefore could not be reused.

Remnants of old bridge abutments were also revealed. The city's Historic Preservation Planners visited the site and determined that the old bridge abutments were not significantly intact and did not require preservation. It was recommended that salvaged stones from the abutments be used in the repair project, if possible.



Different options for repairs and improvements to the area were suggested by city staff and residents in the area. Prior to making repairs to the roadway it was decided that the different alternatives would be assessed.

**ALTERNATIVE ANALYSIS:**

Three alternatives for repairing the flood damaged roadway were evaluated:

**Alternative 1: Replace the existing culvert and rebuild the roadway.**

The first alternative would involve replacing the existing culvert pipe and repairing the roadway back to pre-flood conditions. This is the most economical solution and could be completed for approximately \$4,000. It would also be the quickest to implement because it would not require a floodplain analysis or any flood or wetland permits. If selected, this alternative could be implemented in early June, once the school is out for summer break.



**Alternative 1**

This alternative would not increase the flood conveyance or include flood mitigation improvements, but it would allow the area to be stabilized the fastest. Future flood mitigation options for the area would be assessed as part of the Gregory Canyon Creek Flood Mitigation Study, a separate project currently underway to identify flood mitigation opportunities along Gregory Canyon Creek between Flagstaff Road and Boulder Creek.

Repairing the roadway to the pre-flood conditions would restore the historic traffic patterns and emergency access, and allow the existing traffic barricades and safety fencing to be removed in the shortest timeframe.

**Alternative 2: Remove the culvert and damaged roadway above the creek, close the road to through traffic, and build a pedestrian bridge over the creek.**

The second alternative would involve removing the existing culvert pipe and adjacent asphalt roadway, and building a multi-use trail with a bridge across the creek. This alternative would cost approximately \$95,000. This alternative would change the geometry and the flow characteristics of the creek and would therefore require a floodplain analysis and flood and wetland permits. Permanent closure of the roadway would also require Planning Board approval in accordance with the City Street Closure/Traffic Restrain Policy (**Appendix A**). The floodplain analysis, design work, approval process and permitting would take approximately four to six months before construction could begin.



**Alternative 2**

Installing a pedestrian bridge would provide additional flood capacity at this location which could decrease the flooding risks for properties in the area. This option provides the greatest wildlife and wetland habitat benefits by minimizing the impervious area above and adjacent to the creek and increasing the length of open channel and riparian area.

Permanently closing the roadway to vehicular traffic would change the historic traffic patterns. Residents in the area reported that prior to the flood, there was high speed and dangerous traffic on Pennsylvania Ave. in the morning and afternoon when students were dropped-off and picked-up from the Flatirons Elementary School. Pedestrian access would be improved by eliminating the through traffic and installing a pedestrian bridge. A traffic study (**Appendix B**) was conducted to evaluate the impacts of closing the road. The conclusions of the study are as follows:

- This narrow discontinuous one-block segment of Pennsylvania Avenue, a local access roadway, does not play a large role in the overall connectivity of the grid of streets in this part of Boulder.
- Local access traffic that is diverted as a result of this closure is being easily accommodated by the surrounding grid of streets.

- This block of Pennsylvania Avenue will still provide bicycle and pedestrian connectivity in the area, and will still provide on-street parking for parents who are picking up their children from Flatirons Elementary School.
- It was determined that the road closure would not create adverse impacts related to noise or safety.
- The proposed closure meets the “extraordinary circumstances” traffic related criteria of the City’s street closure policy.

**Alternative 3: Remove the culvert and construct a new roadway with a significantly larger culvert or a vehicular bridge over the creek.**

The third alternative would involve removing the existing culvert pipe and rebuilding the roadway with a vehicular bridge or a larger box-style culvert across the creek. This alternative would cost approximately \$225,000. This alternative would change the geometry and the flow characteristics of the creek and would therefore require a floodplain analysis and flood and wetland permits. The floodplain analysis, design work and permitting would take approximately four to six months before construction could begin.



**Alternative 3**

Installing a vehicular bridge or larger culvert would provide additional flood capacity at this location which could decrease the flooding risks for properties in the area. Historic traffic patterns would also be restored.

## Comparison of Alternatives:

The following table summarizes the findings:

<b>Comparison of Alternatives</b>			
<b>Criteria</b>	<b>Alternate 1</b>	<b>Alternate 2</b>	<b>Alternate 3</b>
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Alternative 1: Replace the existing culvert and rebuild the roadway.

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Alternative 3: Remove the culvert and construct a new roadway with a significantly larger culvert or a vehicular bridge over the creek.

### PUBLIC COMMENT:

To gather public input, an open house was held on Feb. 6, 2014 and a project website was developed with an online survey form. The first two alternatives were initially considered because the costs were originally estimated to be of similar magnitude. A few people requested that a third alternative, construction of a vehicular bridge, be evaluated. The third alternative was included in the analysis and the project website was updated to provide an opportunity for additional comments on all three alternatives.

The majority of the local residents showed a high level of support for Alternative 2, closure of the road and installation of a pedestrian bridge. There was a concern raised that improving the natural habitat along the creek, Alternative 2 would encourage additional bear and mountain lion activity along the creek and near the elementary school.

A compilation of the public input received from the open house and online surveys is included in **Appendix C**.

### STAFF FINDINGS AND RECOMMENDATIONS

Flood recovery work has been ongoing since the September flood event with several different contractors working on various repairs. Repairing Pennsylvania Avenue to pre-flood conditions was included in a flood repair bid in order to get a cost for the repair work and give the city the option to quickly move forward with the repairs. The \$4,000 cost to repair the roadway was less than initially anticipated. After evaluation of the three alternatives, the utilities department recommends immediate implementation of Alternative 1 while further evaluating Alternative 2. This approach was selected for the following reasons:

- Repairing the roadway to pre-flood conditions is cost effective and can be done quickly. It can be completed while school is out for summer break.

- The initial repair work will allow the damaged roadway and creek area to be stabilized to prevent further erosion and the accumulation of trash in the area.
- Once the roadway is repaired, the blockades can be removed, clearing the area of additional obstructions to flood waters and eliminating the rental and maintenance costs associated with the blockades.
- There are many positive benefits associated with Alternative 2 and a high level of public support for the construction of a pedestrian bridge in this location.
- A flood mitigation study for Gregory Canyon Creek is currently underway to explore mitigation opportunities along the entire creek corridor. Alternative 2 can be assessed as part of the mitigation study so that improvements in this area can be coordinated with other mitigation projects along Gregory Canyon Creek, maximizing the benefits.

**APPENDICIES:**

Appendix A: City Street Closure/Traffic Restraint Policy

Appendix B: Traffic Analysis

Appendix C: Public Input Summary