

FINAL
BOXELDER CREEK
REGIONAL STORMWATER
MASTER PLAN

OCTOBER 2006



FINAL BOXELDER CREEK REGIONAL STORMWATER MASTER PLAN

TECHNICAL REPORT

OCTOBER 2006

Prepared for:



Larimer County Engineering Department
Fort Collins, Colorado
&
The Boxelder Creek Regional Alliance

Prepared by:



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Appendices

- Appendix A Meeting Minutes
- Appendix B Hydrology/Hydraulic Summary
- Appendix C Alternatives Evaluation
- Appendix D Summary of Potential Grant Options
- Appendix E Funding Evaluations
- Appendix F Public Outreach Summary

Acronyms

ACE	Anderson Consulting Engineers
BCA	Benefit-Cost Analysis
CDOT	Colorado Department of Transportation
cfs	cubic feet per second
CLOMR	Conditional Letter of Map Revision
CWCB	Colorado Water Conservation Board
DFIRM	Digital Flood Insurance Rate Map
FAC	Financial Advisory Committee
FEMA	Federal Emergency Management Agency
FIA	Federal Insurance Administration
FIS	Flood Insurance Study
GIS	Geographic Information System
GMA	Growth Management Area
IGA	Inter-Governmental Agreement
LID	Local Improvement District
LOMA	Letter of Map Amendment
LOMR	Letter of Map Revision
NRCS	National Resource Conservation Service
PDM	Pre-disaster Mitigation
PID	Private Improvement District
RCBC	Reinforced Concrete Box Culverts
ROW	Right-of-Way
SCS	Soil Conservation Service
SEO	State Engineers Office
TAC	Technical Advisory Committee
USACE	United State Army Corps of Engineers
WSEL	Water Surface Elevation

Acknowledgements

The following key members assisted in the preparation of this design report.

Boxelder Creek Regional Alliance:

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Bob Smith, P.E.	City of Fort Collins (Voting Member)
Becky Davidson, P.E.	Town of Timnath
Andrea Faucett, P.E.	Town of Wellington (Voting Member)
Rick Anderson	Town of Windsor
Steve Smith	North Poudre Irrigation Company
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Stifel, Nicolaus & Co, Inc.

Executive Summary

Boxelder Creek is a natural creek which flows generally from north to south, draining an approximately 265 square mile watershed extending from southern Wyoming to its confluence with the Cache la Poudre River southeast of Fort Collins, Colorado. The lower portion of the watershed is highly urbanized, has a history of flooding and is impacted by numerous existing man-made structures (irrigation canals, culverts, etc.) The existing 100-year floodplain that was recently adopted by the Federal Emergency Management Agency (FEMA) impacts many existing residential and commercial properties and limits the ability for future development within what has become a highly desirable area.

Storm drainage problems have long plagued the Boxelder Creek watershed, particularly the developing area from just north of the Town of Wellington, Colorado to just south of Timnath, Colorado. Recently completed studies have suggested that damages from an infrequent flooding event would be severe and threaten both life and property. However, several stormwater mitigation alternatives that would reduce the threat of flood damage to existing homes and businesses and allow for the thoughtful and safe development of other vacant or agricultural properties have been identified.

The Boxelder Creek watershed and associated floodplain is unique in that it consists to a large degree of mostly undeveloped land (with the exception of Coal Creek within the Town of Wellington). This presents both an opportunity to implement flood and drainage mitigation projects prior to the area being developed and a constraint associated with the fact that most of the land is currently undeveloped and crosses jurisdictional borders. Further, it is not known how or when future development will occur and in what form it will take place. However, if flood hazard mitigation and drainage improvements are implemented in the near future, the basin and the area as a whole will benefit for years to come. All developing properties within the Basin will benefit “generally” while some properties (specifically those in the floodplain) will benefit “specially”.

Since the Boxelder Creek Watershed affects many property owners and several local governments, flood control mitigation should be developed through a cooperative effort among these affected interests. To that end, the Boxelder Creek Regional Alliance was formed to develop a regional solution that is more efficient and cost-effective to implement than the entities handling the flooding threat individually. The Regional Alliance consists of representatives from the following entities:

- Larimer County
- Town of Wellington
- City of Fort Collins
- Town of Timnath
- Town of Windsor
- The North Poudre Irrigation Company
- The Boxelder Sanitation District
- The New Cache la Poudre Irrigation Company
- A private property owner’s group
- Colorado Water Conservation Board (CWCB)

As part of the Regional Alliance, a Technical Advisory Committee (TAC) and Financial Advisory Committee (FAC) were established to oversee the technical and financial aspects respectively of a regional mitigation solution. Both the TAC and FAC were instrumental in the preparation of this Master Plan.

The Boxelder Creek Regional Drainage Master Plan was commissioned by the Regional Alliance in order to develop a regional strategy for mitigating the impacts associated with flooding within the Lower Boxelder Creek basin that impacts the communities of the Town of Wellington, the City of Fort Collins, the Town of Timnath and portions of Larimer County. The intent of the Regional Master Plan is to establish a cost-effective strategy for implementation that will benefit the local community both now and into the future. Several alternatives were developed and a Recommended Plan to minimize flooding extents was formulated. The Implementation Strategy developed includes mechanisms for funding the Recommended Plan.

Figure ES-1 provides a schematic overview of the Boxelder Creek Study Area and referenced flooding sources. **Figure ES-2** provides an overview of the Boxelder Creek floodplains and overall Study Area.

ES.1 Project Purpose and Need

The intent of this Regional Master Drainage Plan is to reduce the overall flood risk to residents within the Study Area. The primary goals of the Alliance for this study and project are:

1. To identify and size a system of improvements which will achieve the greatest defined economic benefit per dollar of cost based on the revised 100-year floodplain extents.
2. Identify potential funding mechanisms for the selected project.
3. Protect public welfare and property.

In order to meet all of the project goals, alternatives analysis and economic evaluations were conducted to aid in the selection of a “Recommended Plan”. This report details the selection of the “Recommended Plan” based on the above project goals.

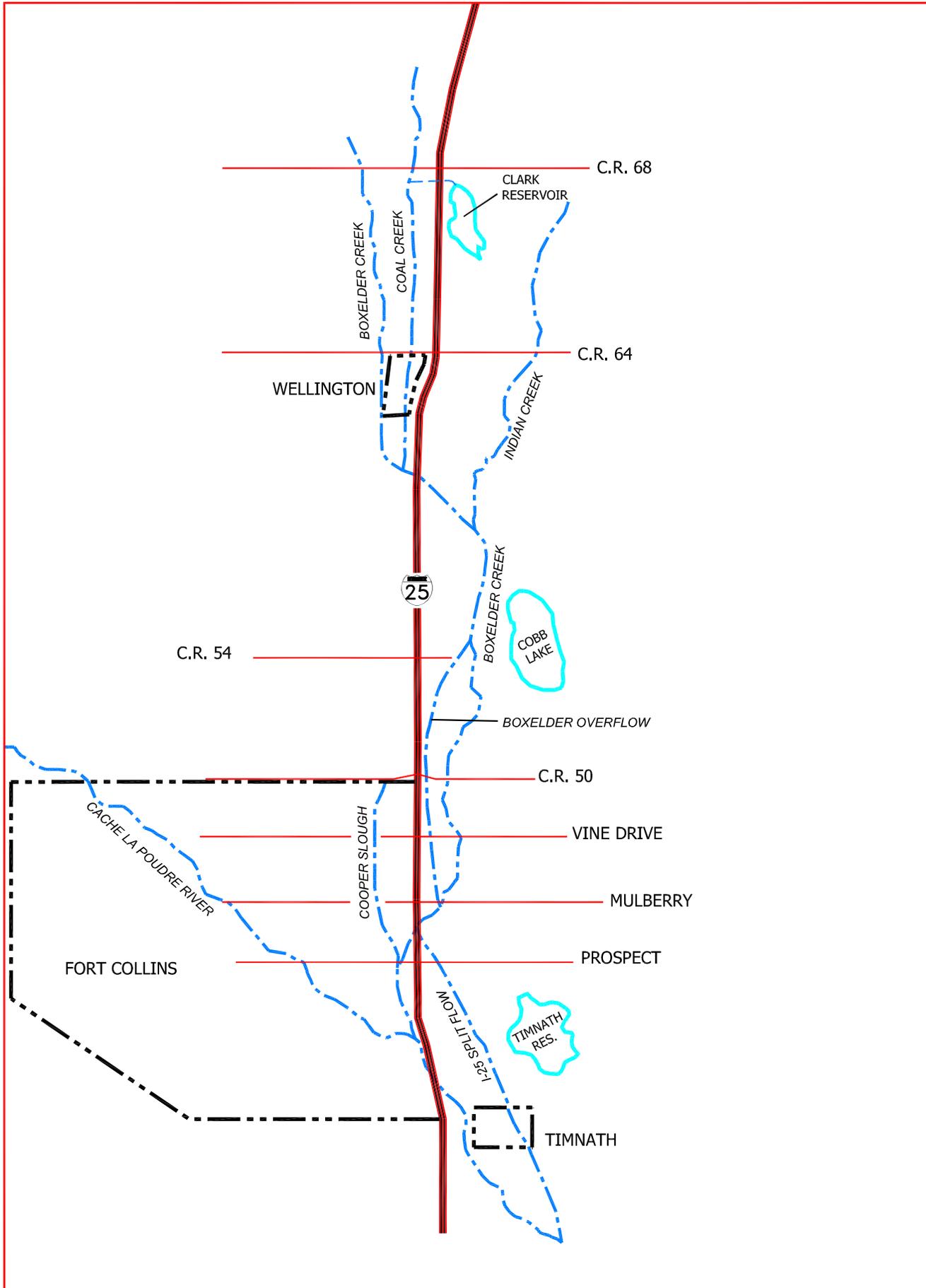


FIGURE ES-1
BOXELDER CREEK STUDY AREA
SCHEMATIC

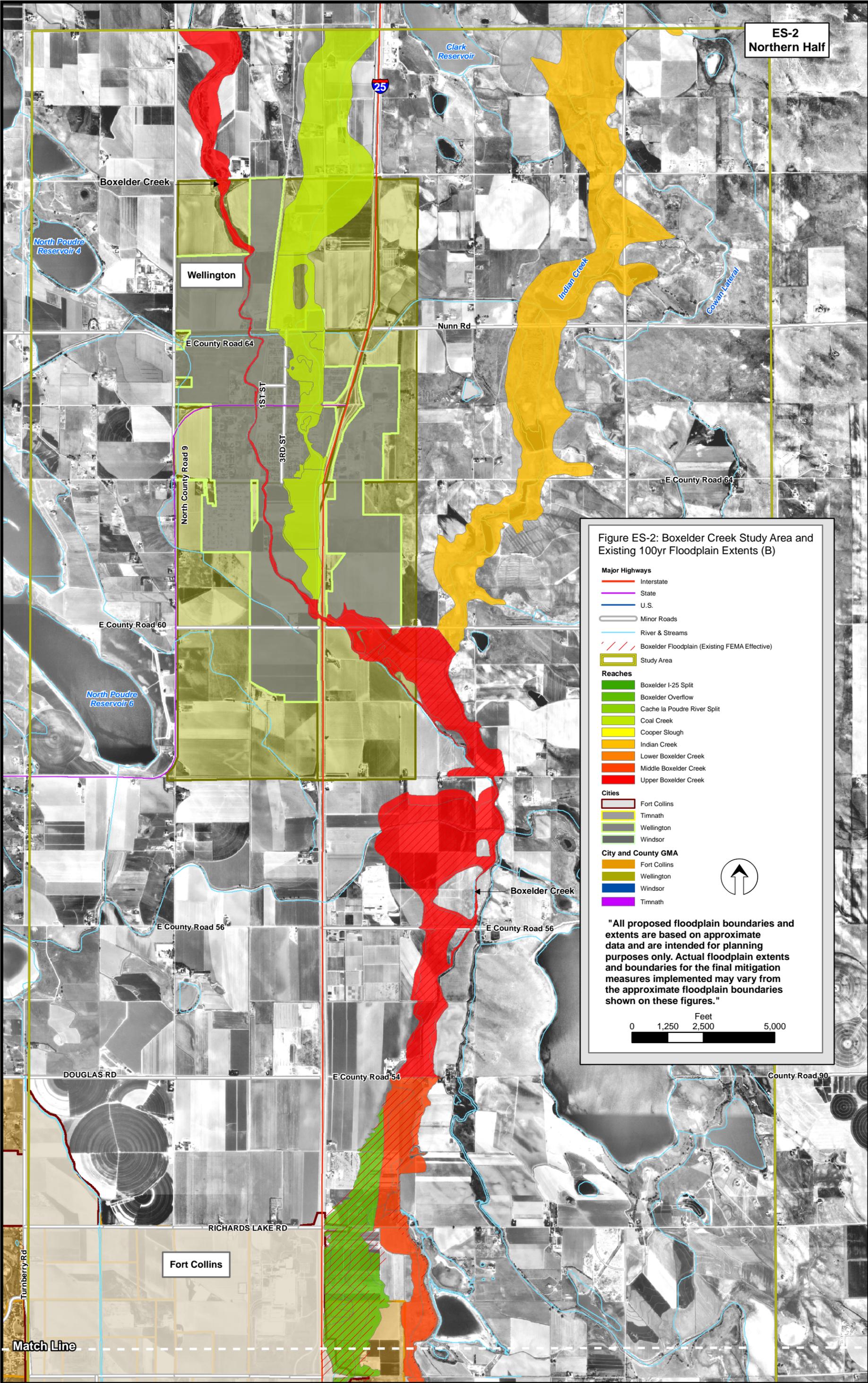


Figure ES-2: Boxelder Creek Study Area and Existing 100yr Floodplain Extents (B)

Major Highways

- Interstate
- State
- U.S.
- Minor Roads
- River & Streams
- Boxelder Floodplain (Existing FEMA Effective)
- Study Area

Reaches

- Boxelder I-25 Split
- Boxelder Overflow
- Cache la Poudre River Split
- Coal Creek
- Cooper Slough
- Indian Creek
- Lower Boxelder Creek
- Middle Boxelder Creek
- Upper Boxelder Creek

Cities

- Fort Collins
- Timnath
- Wellington
- Windsor

City and County GMA

- Fort Collins
- Wellington
- Windsor
- Timnath

"All proposed floodplain boundaries and extents are based on approximate data and are intended for planning purposes only. Actual floodplain extents and boundaries for the final mitigation measures implemented may vary from the approximate floodplain boundaries shown on these figures."



Figure ES-2: Boxelder Creek Study Area and Existing 100yr Floodplain Extents (A)

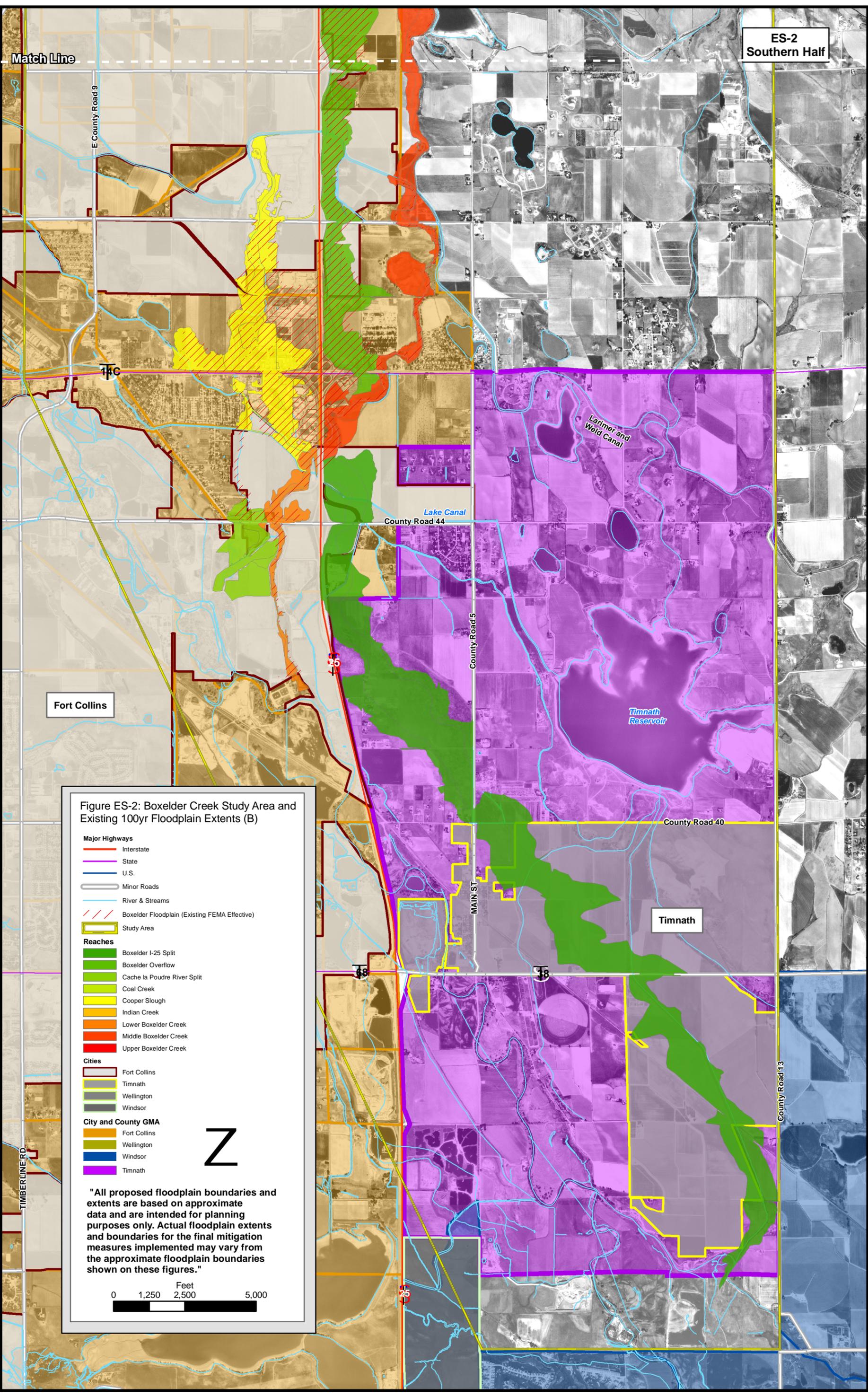
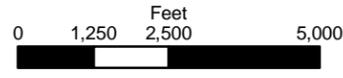


Figure ES-2: Boxelder Creek Study Area and Existing 100yr Floodplain Extents (B)

- Major Highways**
- Interstate
 - State
 - U.S.
 - Minor Roads
 - River & Streams
 - Boxelder Floodplain (Existing FEMA Effective)
 - Study Area
- Reaches**
- Boxelder I-25 Split
 - Boxelder Overflow
 - Cache la Poudre River Split
 - Coal Creek
 - Cooper Slough
 - Indian Creek
 - Lower Boxelder Creek
 - Middle Boxelder Creek
 - Upper Boxelder Creek
- Cities**
- Fort Collins
 - Timnath
 - Wellington
 - Windsor
- City and County GMA**
- Fort Collins
 - Wellington
 - Windsor
 - Timnath

"All proposed floodplain boundaries and extents are based on approximate data and are intended for planning purposes only. Actual floodplain extents and boundaries for the final mitigation measures implemented may vary from the approximate floodplain boundaries shown on these figures."



ES.2 Summary of Existing Damages and Consequences

The Boxelder Creek 100-year floodplain impacts approximately 4,900 acres of land within the Study Area. While average floodplain velocities and depths are low (depths less than 3 feet and velocities less than 2.5 feet per second), the hazard associated with the flooding is estimated to be high due to the numerous split flows and diversions which occur within the basin. Flow paths are not well defined and the existing channel system and cross culverts are not capable of conveying large quantities of runoff. Numerous roads would overtop during the 100-year frequency flooding event. Due to the numerous split flows and diversions that occur, the potential for overtopping frequently used roads and the probability of the existing conveyance system to become blocked, there is the potential for loss of life and/or bodily injury during an extreme runoff event within the Study Area. **Table ES-1** summarizes the estimated damages during a 100-year frequency flooding event.

Major floods have occurred within the Boxelder Basin in 1909, 1922, 1930, 1937, 1947, 1963, 1967 and 1969. In 1947, the *Fort Collins Coloradoan* included a headline that read “Violent Rainstorm Floods Large Area; Crop Losses Heavy”. As much as five (5) inches of rain fell northwest of Wellington, washing out bridges and flooding crops. Nearly 1,000 acres of grain, alfalfa and corn crops were damaged. Heavy rains caused Boxelder Creek to overflow its banks again in 1967 and resulted in the death of a mother and her three daughters. The woman and her daughters drove into the flooded creek where it passed over a county road southwest of Wellington. Floods that summer destroyed county bridges seven times. On June 5, 1967, the headlines in the *Coloradoan* read “Another Auto Plunges into Boxelder”.

There are several existing flood control structures north of the Town of Wellington that were constructed by the Natural Resources Conservation Service (NRCS) in the 1960’s. Although the existing NRCS flood retarding structures located north of the project area have resulted in a significant reduction in the flooding hazard within downstream areas, significant growth and urbanization has increased the potential for flooding damages and the potential for injury and/or loss of life. Recent studies and reports have concluded that the potential for flooding within the urbanized areas of the Boxelder Creek watershed during an infrequent (100-year frequency) rainfall event is high.

There are several critical structures within the 100-year floodplain boundary including two schools in Wellington (Eyestone Elementary School and Wellington Junior High School) and two gas stations and liquid propane storage facility within the study area near the City of Fort Collins. Numerous business and commercial facilities within Larimer County, the City of Fort Collins and the Town of Wellington would be impacted. Access to an electrical substation would be cut off. Over 18 detention ponds and irrigation storage reservoirs, 4 irrigation canals and 30 roads are predicted to overtop and likely be damaged during the 100-year flood event within the Study Area. Most roads would overtop by approximately 1 to 2 feet. In addition, there are numerous sanitary sewers, electrical lines, water transmission lines and other infrastructure that could be impacted and/or damaged.

In addition to significant property damage and potential for injury and loss of life, the Boxelder Creek floodplain within the Study Area significantly impacts expected development opportunities. Much of this floodplain is in already developed or planned development areas.

However, the Boxelder Overflow and I-25 split occur within prime development areas along the I-25 corridor that are currently undeveloped. The existing FEMA regulatory floodplain significantly limits the uses of these lands.

Table ES-1: Estimated Existing Damages Summary			
Reach/Entity	Estimated Present Worth of Damages	Structures Impacted During the 100-year Flood	No. of Roads Overtopped⁴
<i>By Jurisdiction</i>			
Larimer County/City of Fort Collins	\$76.9 million	400	24
Town of Wellington	\$29.5 million	220	4
Town of Timnath	\$3.4 million	50	5
TOTAL	\$109.8 million	670	33

ES.3 Alternatives Assessment

Several alternatives to meet the objectives of this Master Plan were developed and evaluated. Five (5) alternatives were evaluated as part of this Master Plan and included both non-structural and structural components. Costs and benefits have been estimated for each of these alternatives and the alternatives were evaluated for benefit/cost and utilizing an alternatives evaluation matrix. The alternatives evaluated included the following:

- Alternative 1 – Non-jurisdictional Alternative
- Alternative 2 – Non-regional Conveyance Alternative
- Alternative 3 – Regional Storage Alternative
- Alternative 4 – Upstream Regional Storage to Minimize Downstream Splits/Diversions
- Alternative 5—Optimized Regional Storage and Conveyance

A brief description of each alternative is provided below.

Alternative 1

Under this alternative, there are no regional or other community funded projects considered and each individual property owner is assumed to be responsible for handling floodplain issues and drainage problems. This is a highly unlikely scenario as there are existing Stormwater Utilities and other funding associated with the majority of the areas impacted and, as such, some municipal involvement is inevitable. However, for comparison purposes, this alternative was evaluated to compare benefits versus cost.

Under this alternative, each individual property owner could encroach onto the 100-year floodplain extents but would not be able to encroach into the defined floodway. Land values associated with areas within the flood fringe and floodway are therefore significantly different. In addition, as the floodplain cuts across most of the developable land, the entire parcel value could be reduced as a result. Engineering fees would be required as each parcel would need to get approval from FEMA via a Letter of Map Amendment (LOMA) or a Letter of Map Revision (LOMR). Engineering and permitting fees associated with preparing such documentation is

estimated to be on the order of \$10,000 to \$25,000 per parcel. In addition, fill for each parcel would be required to raise proposed structures above the estimated 100-year flooding event. In most cases, 1-3 feet of fill would be required and an additional cost would be incurred as a result of encroaching into the floodplain. For existing structures in the floodplain, it was assumed that approximately 330 structures would require floodproofing at an estimated cost of \$15,000 per structure.

- **Total Estimated Implementation Cost:** \$41.9 million (does not include costs for road or other local improvements)
- **Total Floodplain Area Removed:** 0
- **Structures Removed from 100-year Flood Extents:** 0

Alternative 2

This alternative assumes that each jurisdiction would independently develop mitigation alternatives that impact primarily only areas within that jurisdiction. Currently and prior to formation of the Regional Alliance, this was the direction that most of the affected parties were considering. In general, this alternative includes only channelization and diversion components and no regional detention is specified. The project components of this alternative have been previously evaluated in other reports prepared for the respective communities and private interests.

It should be noted that this alternative, since it does not include any regional features, would not remove a substantial amount of floodplain or reduce the flooding hazards between the Town of Wellington and the I-25 crossing of Boxelder Creek.

The key project components consist of the following:

1. Undetained overflow diversion of Coal Creek (Town of Wellington).
2. Channel and conveyance improvements between County Road 58 and Highway 14 (new Boxelder Creek Overflow Channel for approximately 5,000 cfs).
3. Prospect Road Improvements/Lake Canal-Alternative E (City of Fort Collins).
4. Diversion of Boxelder I-25 split flow for approximately 4,200 cfs (Private owners).
5. Timnath Diversion Channel-Alternative 2 for approximately 4,200 cfs (Town of Timnath).

Under this alternative, it is assumed that local drainage channels will be required within the Town of Wellington to handle local runoff generated within the basin below the diversion to Clark Reservoir.

The undetained diversion of Coal Creek into Boxelder Creek could increase the flooding and/or erosion potential in Boxelder Creek. This impact was not studied in detail as part of the Master Plan, however, it is an impact that should be considered in the final decision making process.

Note: The potential widening of the I-25 corridor could provide an opportunity for construction of an adjacent Boxelder Creek Overflow channel from County Road 52 to Highway 14 and to accommodate a diversion channel for the Boxelder Creek I-25 split flow to the proposed Timnath diversion channel.

- **Total Estimated Implementation Cost:** approximately \$58.3 million
- **Total Floodplain Area Removed:** approximately 1,750 acres
- **Structures Removed from 100-year Floodplain Extents:** approximately 219

Alternative 3

This alternative is a basin-wide regional alternative that was evaluated by the City of Fort Collins as part of the Boxelder/Cooper Slough Master Planning effort; however, this alternative was not selected as the preferred alternative by the City of Fort Collins (as this is a more costly Regional Project that benefits many properties outside of the City of Fort Collins jurisdictional limits). The alternative utilizes regional detention to capture and attenuate storm runoff within both the Boxelder and Cooper Slough basins. The major project components in this alternative include the following:

1. Improvements to the North Poudre Canal to capture and convey Coal Creek flows into Clark Reservoir and dredging of Clark Reservoir to provide storage (approximately 465 acre-feet) for stormwater and spillway improvements.
2. Construction of an earthen embankment and creation of detention storage along Indian Creek, upstream of County Road 60 (Edson Reservoir; approximately 990 acre-feet of storage).
3. Roadway crossing improvements along major drainage corridors (3,000 to 3,500 cfs design conveyance capacity).
4. Prospect Road/Lake Canal and Cache la Poudre Overflow Improvements.
5. Improvement of Boxelder Creek from County Road 50 to County Road 54 (for approximately 3,000 cfs conveyance capacity).
6. Opening of the box culverts at the I-25 crossing of Boxelder Creek north of Prospect Road.

- **Total Estimated Implementation Cost:** approximately \$36.2 million
- **Total Floodplain Area Removed:** approximately 2,670 acres
- **Structures Removed from 100-year Floodplain Extents:** approximately 306

Alternative 4

This alternative includes the components included in Alternative 3 and adds storage at either Upper or lower Gray Lakes or at a new detention facility upstream of County Road 50 (Mussetter Alternative D). This alternative would further reduce discharges in Boxelder Creek from County Road 50 downstream through the City of Fort Collins, making conveyance improvements in this reach smaller.

1. Improvements to the North Poudre Canal to capture and convey Coal Creek flows into Clark Reservoir and dredging of Clark Reservoir to provide storage (approximately 465 acre-feet) for stormwater and spillway improvements.
2. Construction of an earthen embankment and creation of detention storage along Indian Creek, upstream of County Road 60 (Edson Reservoir; approximately 990 acre-feet of storage).
3. Roadway crossing improvements along major drainage corridors (1,100 to 3,000 cfs design conveyance capacity).
4. Prospect Road/Lake Canal and Cache la Poudre Overflow Improvements (reduced design conveyance capacity).
5. Improvement of Boxelder Creek from County Road 50 to County Road 54 (for approximately 3,000 cfs conveyance capacity).
6. New detention storage at County Road 50 (optimized to minimize peak discharge at I-25 box culverts to approximately 1,800 cfs; 1,580 acre-feet of storage required).
7. Opening of the box culverts at the I-25 crossing of Boxelder Creek north of Prospect Road.

- **Total Estimated Implementation Cost:** approximately \$41.9 million
- **Floodplain Area Removed:** approximately 2,880 acres
- **Structures Removed from 100-year Floodplain Extents:** approximately 330

Alternative 5

Alternative 5 includes optimizing the upstream storage to minimize the need for diversions below the I-25 culvert crossing. The I-25 culverts with all four (4) cells open have a maximum capacity of approximately 3,600 cfs (based on previous hydraulic modeling). In this alternative, it is assumed that some flow (approximately 500 cfs) would be diverted below the I-25 box culverts through Timnath. Therefore, upstream storage has been optimized to: 1) eliminate the Boxelder overflow and spills into Copper Slough and 2) minimize the total peak discharge at the I-25 box culverts to approximately 4,100 cfs.

Two (2) scenarios for optimizing storage were evaluated: The first at the County Road 50 storage area and the second at the Edson Reservoir site.

Based on updating the available hydrologic model for the watershed, the following components are included in Alternative 5:

1. Improvements to the North Poudre Canal to capture and convey Coal Creek flows into Clark Reservoir and dredging of Clark Reservoir to provide storage (approximately 465 acre-feet) for stormwater and spillway improvements.
2. Roadway crossing improvements along major drainage corridors of Boxelder Creek (for total peak discharge of 3,800 to 6,300 cfs).
3. Prospect Road/Lake Canal and Cache la Poudre Overflow Improvements.

4. Improvement of Boxelder Creek from County Road 50 to County Road 54 (total design conveyance capacity of approximately 6,200 cfs).
5. New detention storage at County Road 50 (approximately 635 acre-feet).
6. Diversion of Boxelder I-25 split flow (assumed design conveyance capacity of approximately 500 cfs) (Private owners).
7. Timnath Diversion Channel (assumed design conveyance capacity of approximately 500 cfs (Town of Timnath).
8. Opening of the box culverts at the I-25 crossing of Boxelder Creek north of Prospect Road.

- **Total Estimated Implementation Cost:** \$38.9 million
- **Total Floodplain Area Removed:** approximately 2,400 acres
- **Structures Removed from 100-year Floodplain Extents:** approximately 305

Alternative 5A includes optimizing storage at Edson Reservoir and includes the following components:

1. Improvements to the North Poudre Canal to capture and convey Coal Creek flows into Clark Reservoir and dredging of Clark Reservoir to provide storage (approximately 465 acre-feet) for stormwater and spillway improvements.
2. Construction of an earthen embankment and creation of detention storage along Indian Creek, upstream of County Road 60 (Edson Reservoir; approximately 660 acre-feet of storage).
3. Roadway crossing improvements along major drainage corridors of Boxelder Creek (for total peak discharge of 3,600 cfs to 4,100 cfs). Prospect Road/Lake Canal Improvements.
4. Improvement of Boxelder Creek from County Road 50 to County Road 54 (total design conveyance capacity of approximately 3,600 cfs).
5. Diversion of Boxelder I-25 split flow (assumed design conveyance capacity of approximately 500 cfs) (Private owners).
6. Prospect Road/Lake Canal and Cache la Poudre Overflow Improvements.
7. Timnath Diversion Channel (assumed design conveyance capacity of approximately 500 cfs (Town of Timnath).
8. Opening of the box culverts at the I-25 crossing of Boxelder Creek north of Prospect Road.

- **Total Estimated Implementation Cost:** \$35.6 million
- **Total Floodplain Area Removed:** approximately 2,500 acres
- **Structures Removed from 100-year Floodplain Extents:** approximately 310

ES.4 Recommended Alternative

The alternatives were evaluated for benefit, cost and the overall effectiveness of being implemented. A summary of the benefits, costs and evaluation scores are summarized in **Table ES-2**.

Parameter	Alternative 1 – No Action	Alternative 2 – Non-regional Conveyance	Alternative 3 – Regional Storage	Alternative 4-Maximize Regional Storage	Alternative 5 – Optimize Storage and Conveyance	Alternative 5A – Optimize Storage and Conveyance
Total Land Removed from Floodplain (acres)	0	1,750	2,670	2,770	2,490	2,535
Structures Removed from Floodplain	0	219	306	330	306	306
Agricultural Land removed from Floodplain (acres)	0	1,020	1,410	1,530	1,410	1,410
Roadways Removed from Flooding	0	33	33	33	33	33
Benefits						
<i>Estimated Local Benefits</i>	\$24 million	\$40 million	\$53 million	\$54 million	\$52 million	\$52 million
<i>Estimated Regional Benefits</i>	\$0 million	\$18 million	\$26 million	\$27 million	\$26 million	\$26 million
Total Benefits	\$24 million	\$58 million	\$79 million	\$81 million	\$78 million	\$78 million
Implementation Costs	\$42 million	\$58 million	\$36 million	\$42 million	\$39 million	\$36 million
Evaluation Matrix Score	2.3	2.1	3.3	3.2	3.4	3.9
Benefit/Cost Ratio	0.6	0.9	2.1	1.8	1.9	2.1
Cost per acre removed from floodplain	N/A	\$33,400	\$14,600	\$16,100	\$16,700	\$15,100

Based on the evaluations undertaken and numerous discussions with the TAC and FAC, the preferred alternatives for the Boxelder Creek Regional Plan were reduced to Alternative 5A and Alternative 3. Alternative 3 requires additional storage upstream, however, it reduces the need for a diversion for the I-25 split flow (the peak discharges are reduced sufficiently to eliminate the split flow entirely). However, due to timing of the Timnath diversion channel and the desire to develop properties below the I-25 split flow, Alternative 5A represents an optimized solution of storage and conveyance. Both regional alternatives have a benefit/cost ratio greater of approximately 2.0 and a total implementation cost of approximately \$36 million.

Further evaluations were conducted to determine the overall impact of constructing specific components of Alternative 3 and 5A, specifically, the upstream storage and its impacts on downstream areas. Based on these evaluations, it was determined that the largest regional benefit was a direct result of both the Coal Creek diversion to Clark Reservoir and the proposed Edson Reservoir. Further, it was concluded that the Middle Boxelder Creek Improvements and I-25 split flow diversion (in the case of Alternative 5A) have direct Regional Benefits, as they reduce the potential flooding in other areas as well as locally. The Middle Boxelder Creek Improvements would eliminate the Boxelder Overflow floodplain and significantly reduce the potential for overflows into the Cooper Slough Basin. The I-25 Split Flow Diversion Channel (if

required) would allow for the I-25 box culverts to be opened without adversely impacting areas downstream.

The TAC therefore recommended that Alternative 3 be considered for further implementation. The improvements would be made in three (3) phases and include Regional contributions in combination with other locally funded project components. **Figure ES-3** provides a graphic representation of the proposed project improvements and resulting approximate floodplain extents with the improvements as constructed.

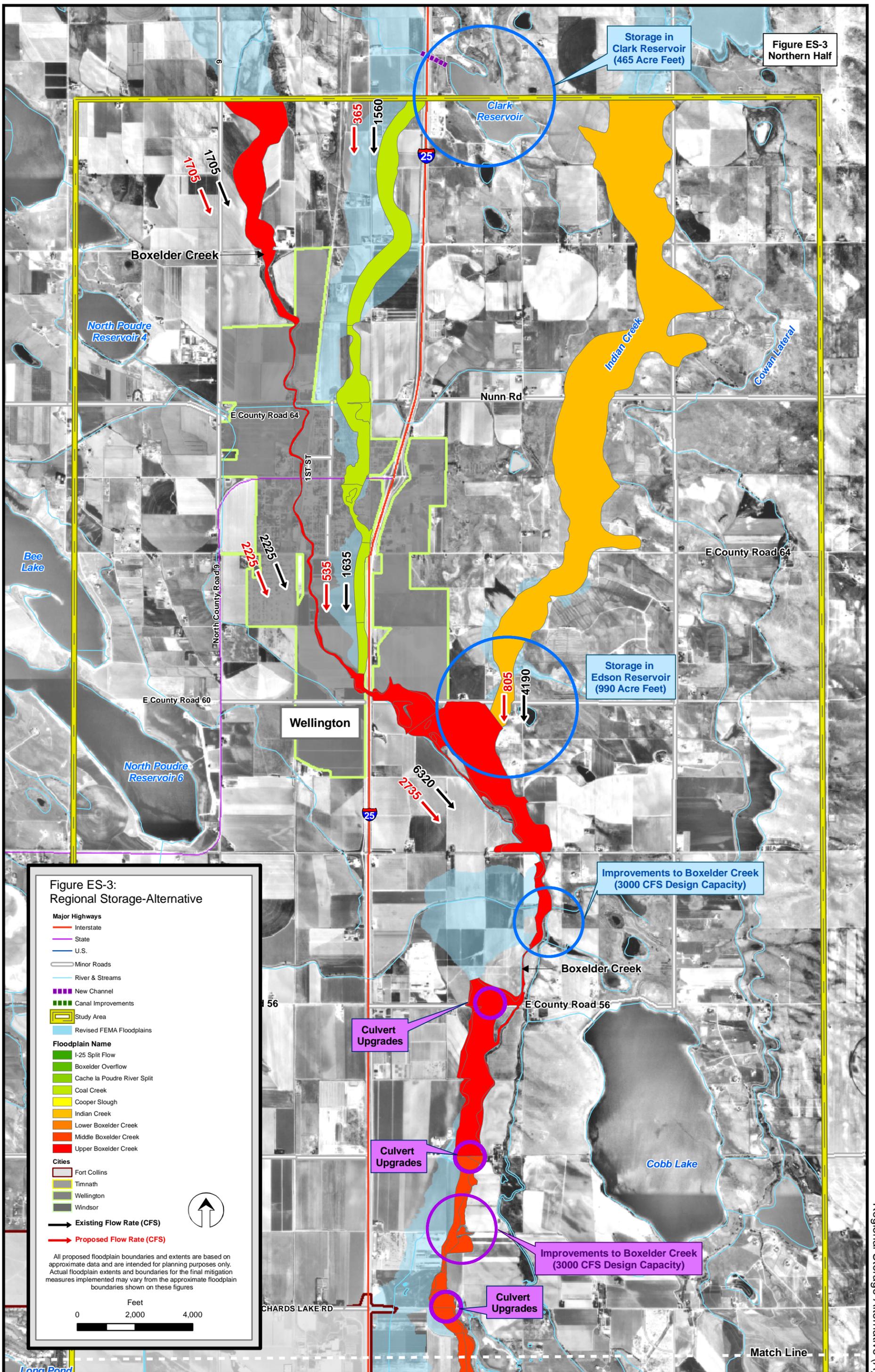
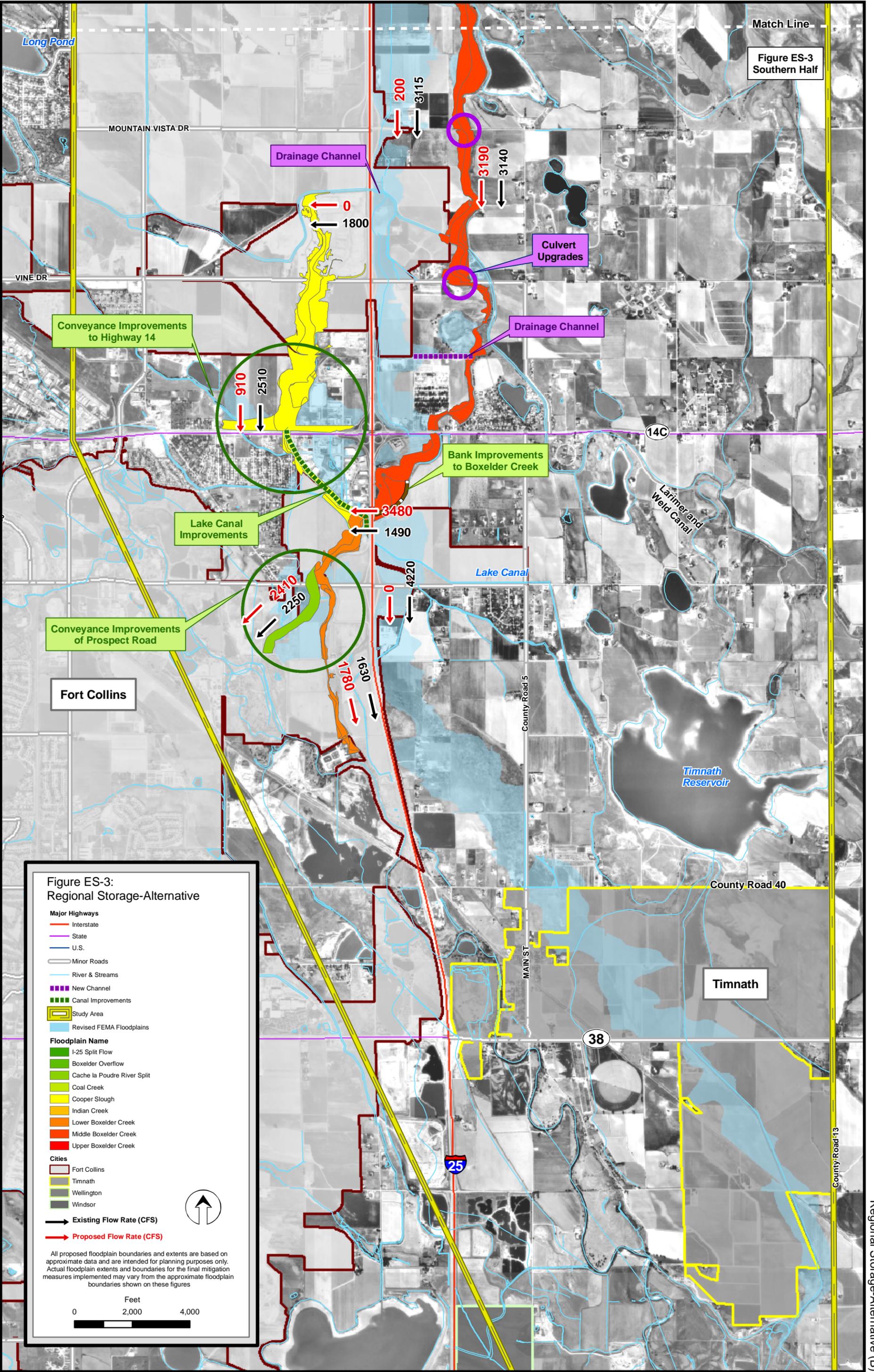


Figure ES-3 Northern Half

Figure ES-3: Regional Storage-Alternative (A)

Match Line
Figure ES-3
Southern Half



**Figure ES-3:
Regional Storage-Alternative**

Major Highways

- Interstate
- State
- U.S.
- Minor Roads
- River & Streams
- New Channel
- Canal Improvements
- Study Area
- Revised FEMA Floodplains

Floodplain Name

- I-25 Split Flow
- Boxelder Overflow
- Cache la Poudre River Split
- Coal Creek
- Cooper Slough
- Indian Creek
- Lower Boxelder Creek
- Middle Boxelder Creek
- Upper Boxelder Creek

Cities

- Fort Collins
- Timnath
- Wellington
- Windsor

Flow Rates

- Existing Flow Rate (CFS)
- Proposed Flow Rate (CFS)

All proposed floodplain boundaries and extents are based on approximate data and are intended for planning purposes only. Actual floodplain extents and boundaries for the final mitigation measures implemented may vary from the approximate floodplain boundaries shown on these figures.

Feet
0 2,000 4,000

Figure ES-3:
Regional Storage-Alternative (B)

ES.5 Summary of Recommended Alternative

The Recommended Alternative is proposed to be funded through both Regional Contributions (Phase I) and Local Contributions (Phase 2 and 3). The Alliance proposes to form a Storm Drainage Authority (the “Authority”) pursuant to Colorado law, providing for intergovernmental contracting ability. The Authority will be responsible for implementing the Regional Improvements (Phase I) highlighted below. It is anticipated that a CWCB low-interest loan will be obtained for construction of the facilities and will be paid back through monthly fees and charges as well as a system of development fees raised by the Authority from properties located within the Boxelder Creek Drainage Basin. Grants will also be pursued to offset some of the costs associated with the project.

It is expected that an Inter-Governmental Agreement (IGA) among the City of Fort Collins, Town of Wellington and Unincorporated areas of Larimer County will be required in order to form the Authority.

The recommended alternative for the Boxelder Creek Regional Drainage Improvement Project consists of the following project phases and components:

Regional Improvements, Phase I: Edson Reservoir, Coal Creek Diversion to Clark Reservoir, Middle Boxelder Improvements (2007-2010)

Depending on the preliminary design of available upstream storage at the proposed Edson Reservoir site, additional storage and/or diversion of the I-25 split flow channel may be required.

- **Diversion of Coal Creek to Clark Reservoir (approximately 465 acre-feet design capacity) (Implementation Period: 2007-2010)**
 - Improvement of the North Poudre Canal to capture and convey Coal Creek flood flows into Clark Reservoir (approximately 1,560 cfs design capacity)
 - Culvert crossings associated with the North Poudre Canal at I-25 (design capacity approximately 1,560 cfs)
 - Dredging of Clark Reservoir (approximately 532,400 cubic yards to provide for approximately 465 acre-feet of flood storage within the top 3 feet of the existing reservoir)
 - Associated land acquisition and right-of-way (approximately 28.3 acres)
 - Spillway and outlet works improvements to Clark Reservoir to ensure adequate flood storage
 - Agreement associated with flood storage reserve capacity within the reservoir
 - Constructed and funded through the Boxelder Regional Alliance (potential for FEMA PDM grants and CWCB Low-interest loans)

- ✓ **Estimated Construction Cost: \$6.2 million**
- ✓ **Regional Benefits:** Reduces peak discharges downstream (approximately 90% in Coal Creek; 5-10% in Boxelder Creek) via attenuation in Clark Reservoir

- ✓ **Local Benefits:** Reduces floodplain extents by approximately 150-215 acres; minimizes flooding potential and damages for approximately 180 structures (including 2 schools, community center, residential and commercial structures)

➤ **Construction of Edson Reservoir (approximately 660 to 990 acre-feet design capacity) (Implementation Period: 2008-2010)**

- Construction of an earthen embankment and ungated outlet to impound approximately 660 to 990 acre-feet of storage on Indian Creek just upstream of County Road 60
- Associated land acquisition and right-of-way (approximately 90 to 131 acres)
- Depending on the final available storage volume at the Edson site, a diversion at the Boxelder I-25 split flow may be required (maximum discharge of 700-1,000 cfs)
- Constructed and funded through the Boxelder Regional Alliance (potential for NRCS grants and CWCB Low-interest loans)

- ✓ **Estimated Construction Cost: \$4.1 to \$6.1 million** (\$5.1 million assumed for cost estimating purposes)
- ✓ **Regional Benefits:** Significantly reduces peak discharges downstream (approximately 40-60%) via attenuation in Edson Reservoir; minimizes size of required downstream conveyance improvements; reduces floodplain extents and potential for downstream split flows
- ✓ **Local Benefits:** Minimizes flooding potential and damages to approximately 165 existing structures within Larimer County and Fort Collins (in conjunction with other improvements)

➤ **Middle Boxelder Creek Stream Improvements (approximately 3,600 to 4,100 cfs design capacity) (Implementation Period: 2008-2010)**

- Improvements to Middle Boxelder Creek from County Road 54 to County Road 52 (3,600 to 4,100 cfs design capacity)
- Construction of two (2) storm drainage channels to direct flow to Boxelder Creek
- Constructed and funded through the Boxelder Regional Alliance (potential grants from USFWS, USEPA, Parks and Trails Districts)

- ✓ **Estimated Construction Cost: \$1.1 million**
- ✓ **Regional Benefits:** Potential trail and recreational opportunities
- ✓ **Local Benefits:** Reduces potential for overflow and split flows adjacent to I-25 and impacting Cooper Slough; removes approximately 535 acres of the Boxelder Overflow (in conjunction with upstream detention)

➤ **Construction of a siphon/wasteway structure along the Larimer and Weld Canal at Boxelder Creek (Implementation Period: 2009-2010)**

- Siphon (design capacity equal to the decreed capacity of the Larimer and Weld Canal) or wasteway structure (3,600 cfs design capacity)

- Constructed and funded through the Boxelder Regional Alliance

- ✓ **Estimated Construction Cost: \$1.3 million**
- ✓ **Regional Benefits:** : Reduces overtopping potential of the Larimer and Weld Canal and diversion of floodwater to Cooper Slough
- ✓ **Local Benefits:** Minimal

Total funding requirement for the Phase I Regional Improvements is approximately \$13.7 million (depending on the final design of Edson Reservoir and available storage; other sites including the CR50 Storage Site may be evaluated during preliminary design).

- **Construction of the I-25 Split Flow Diversion Channel (ties into the Timnath Diversion channel) for between 700 and 1,000 cfs capacity (Regional Alliance along with Private Developers)**

Depending on the amount of detention storage available at the Edson site, a partial diversion of Boxelder Creek overflows at the I-25 split may be required. Design discharges will be significantly reduced as a result of the Regional Improvements implemented. Private interests will only be responsible for that portion of the diversion channel that directly impacts individual property interests.

- 50 to 150-wide footprint including a diversion channel and a regional trail incorporated onto a bench of the channel
- Approximately 6,800 feet long (from Boxelder Creek to County Road 42E)
- Overflow structure on the right bank of Boxelder Creek upstream of I-25 crossing
- Compound channel section with 700-1,000 cfs design capacity channel utilized to minimize the footprint for future conditions (assuming Regional storage is constructed)
- Associated land acquisition and right-of-way (approximately 10 acres)
- Flume and siphon crossing at Cache la Poudre Reservoir Inlet Ditch (CLPRID)
- Flume and siphon crossing at Lake Canal
- Seven 8' high by 10' wide culvert (or similar conveyance bridge) crossing at Prospect Road
- Constructed by the Boxelder Regional Alliance (if required) based on the final design of Edson Reservoir.

- ✓ **Estimated Construction Cost: \$0 to \$1.6 million** (assumed to be \$1 million for cost estimating purposes)
- ✓ **Regional Benefits:** Trail system; provides open space; protects County Road 42E, CLPRID and Lake Canal
- ✓ **Local Benefits:** Removes approximately 300 acres from floodplain, minimizes flooding potential to approximately 8 existing structures

Other Non-Regional Improvements, Phase II: Prospect Street Improvements and Cache la Poudre Overflow (2007-2009)

The following improvements are required such that the existing box culvert plugs at the I-25 crossing can be removed. Costs for these improvements may be partially funded by the City of Fort Collins. The Regional Improvements will significantly reduce the design flows within the Cooper Slough Basin that contribute to the flooding potential within Boxelder Creek downstream of Prospect Road. However, flows will increase as a result of increasing the conveyance capacity of the I-25 box culverts (i.e. removing the plugs).

➤ **Improvements to Prospect Road West of I-25 (approximately 4,500 cfs design capacity)**

- Improvement of Boxelder Creek from just upstream of I-25 to just downstream of Prospect Road (4,500 cfs design capacity)
- Culvert/bridge crossing of Prospect Road (4,500 cfs design capacity)
- Associated land acquisition and right-of-way (approximately 1.5 acres)
- Constructed and funded partially through funds directly from City of Fort Collins Stormwater Utility and/or Private Development interests

- ✓ **Estimated Construction Cost: \$3.9 million**
- ✓ **Regional Benefits:** Allows for removal of the Boxelder Creek I-25 culvert plugs (reduces potential for split flow downstream of I-25 crossing of Boxelder Creek)
- ✓ **Local Benefits:** Minimizes flooding potential and damages to existing structures and facilities; minimize overtopping potential of Prospect Road; minimizes overtopping potential of the CLPRID and Lake Canal; removes approximately 15 acres from the existing floodplain

➤ **Cache la Poudre Overflow (approximately 2,500 cfs design capacity)**

- Construction of a side-flow spillway structure on Boxelder Creek, just downstream of Prospect Road (2,530 cfs design capacity)
- Construction of an outfall channel and swale to convey flows to an existing oxbow of the Poudre River (2,530 cfs design capacity)
- Associated land acquisition and right-of-way (approximately 20.1 acres)
- Constructed and funded partially through funds directly from City of Fort Collins Stormwater Utility and/or Private Development interests

- ✓ **Estimated Construction Cost: \$2.2 million**
- ✓ **Regional Benefits:** Allows for removal of the Boxelder Creek I-25 culvert plugs (reduces potential for split flow downstream of I-25 crossing of Boxelder Creek); potential recreational opportunities
- ✓ **Local Benefits:** Minimizes flooding potential and damages to existing structures and facilities; removes approximately 80 acres from floodplain; minimize overtopping potential of Prospect Road; minimizes overtopping potential of the CLPRID and Lake Canal

Total funding requirement for Phase II is approximately \$6.1 million.

Other Local Improvements, Phase III: Middle Boxelder Creek Road Crossing Improvements and Cooper Slough/Mulberry Street and Lake Canal Improvements (2010-2020)

Phase III of the Proposed Improvements will consist of increasing the conveyance capacity at County Road crossings and providing improvements to within the Cooper Slough Basin at Mulberry Street and the Lake Canal. Costs for these improvements may be born from the Regional Funding mechanism and may be partially funded through agreements with Private Developers. The Regional Improvements will significantly reduce the design flows within the Cooper Slough Basin that contributes to the flooding potential within Boxelder Creek downstream of Prospect Road.

➤ **Boxelder Creek Road Crossing Improvements (Larimer County and Private Developers)**

These improvements will be implemented as roadways and development progresses north towards Wellington. Design discharges will be significantly reduced as a result of the Regional Improvements implemented.

- Installation of culvert/bridge crossings on Boxelder Creek at County Road 58, County Road 56, County Road 54 (Douglas Road), County Road 52, County Road 50 (Mountain Vista Road), County Road 48 (Vine Drive) and State Highway 14 (Mulberry Street) (3,600 to 4,100 cfs design capacity)
- Constructed and funded as development and roadway improvements progresses

- ✓ **Estimated Construction Cost: \$8.4 million**
- ✓ **Regional Benefits:** Minimizes potential for road overtopping and erosion; potential recreational opportunities
- ✓ **Local Benefits:** Reduces potential for overflow and split flows

➤ **Cooper Slough/Mulberry Street and Lake Canal Improvements (City of Fort Collins and Private Developers)**

These improvements will be implemented and coordinated with the City of Fort Collins as development progresses. Design discharges will be significantly reduced as a result of the Regional Improvements implemented.

- Construction of a side-flow spillway structure on the Lake Canal, just upstream of State Highway 14 along with an outfall channel from Lake Canal to the crossing at State Highway 14 (910 cfs design capacity).
- Improvement of the Lake Canal from the confluence with Copper Slough to Boxelder Creek Minor bank improvements to the Cache la Poudre Reservoir Inlet Ditch (CLPRID).
- Improvements to Cooper Slough from State Highway 14 to its termination in the Lake Canal (910 cfs design capacity).
- Local drainage improvements at Mulberry Street including upgrading culvert crossings for Cooper Slough
- Constructed and funded partially through funds directly from City of Fort Collins Stormwater Utility and/or Private Development interests

- ✓ **Estimated Construction Cost: \$3.6 million**
- ✓ **Regional Benefits:** Minimal
- ✓ **Local Benefits:** Reduces floodplain extents and potential for damages to approximately 90 residential and commercial structures; removes approximately 130 acres from floodplain

Total funding requirement for Phase III is approximately \$12.0 million.

Total Regional Project Costs are estimated to be \$13.7 million. Total Project costs are estimated to be approximately \$32.8 million.

In addition, to the above Regional Improvements, the Town of Timnath is moving forward with a local diversion project that will provide conveyance for the entire existing condition FEMA 100-year regulatory flow discharge (approximately 2,800 cfs). With the above Regional Improvements, the I-25 split flow will be reduced from between 0 to approximately 1,000 cfs (depending on available storage within Edson Reservoir). As such, the size of the Timnath Diversion Channel could be significantly reduced or eliminated. However, timing of the Regional project has prompted the Town of Timnath to progress with the design and construction of a diversion channel to accommodate the FEMA regulatory flow rates. If timing allows, Timnath may elect to contribute to the Regional project. The current plans for the Timnath Diversion channel include the following:

- 150-wide footprint including a diversion channel and a regional trail incorporated onto a bench of the channel
- Approximately 7,920 feet long (from County Road 42E to confluence with the Cache la Poudre River via Oxbow Lake)
- Associated land acquisition and right-of-way (approximately 42.5 acres)
- Flume and siphon crossing at Unnamed Ditch
- Seven 8' high by 10' wide culvert crossing at County Road 40
- Constructed and funded by the Town of Timnath and Private Developer interests.

- ✓ **Estimated Construction Cost: \$0 to \$5.7 million** (not included in Regional funding strategies)
- ✓ **Regional Benefits:** Trail system; provides open space
- ✓ **Local Benefits:** Removes approximately 760 acres from floodplain; minimizes flooding potential to approximately 45 existing structures

ES.6 Funding Strategy and Evaluations

The elements of the Boxelder Creek Regional Financing Strategy encompass the following key objectives:

1. **Benefits.** The benefits of a regional storm drainage plan and construction program would be many, and would include both local and regional benefits greater than the costs incurred (i.e. benefit/cost ratio greater than 1).
2. **Equitable Distribution of Costs.** It is most equitable to distribute costs of regional planning and improvements over a large area through recurring fees and charges imposed by a regional Storm Drainage Authority along with one-time system development fees imposed when a property is annexed or developed.
3. **Choice of Entity.** The vehicle that is recommended is a Storm Drainage Authority formed by an Intergovernmental Agreement among Larimer County, the Town of Wellington, the City of Fort Collins and any other jurisdictional entities that would like to participate. The Storm Drainage Authority would have the power to impose fees and charges throughout the Boxelder Creek Drainage Basin and to borrow money secured through bonds and loans to finance the proposed project.
4. **Role of Other Local Governments.** Colorado law provides that governmental entities may contract to provide to provide together, or through a mutually created entity, any function, service or facility which each of the governmental entities is lawfully authorized to provide. Governmental entities are specifically authorized to form drainage facilities and entities. If the decision is made to proceed through formation of an authority, it is anticipated that Larimer County, the Town of Wellington, the City of Fort Collins and possibly others will enter into an Intergovernmental Agreement governing the formation, duties and governance of the Storm Drainage Authority.

The financial analysis for the Boxelder Creek Drainage Improvement Project(s) paralleled the engineering efforts and has drawn from the results of the Plan and Strategy Implementation recommended by the TAC and FAC. As part of this effort, a grant and low interest loan search was performed and the results of potential external funding sources have been incorporated into the financial analysis as the best case scenario. An estimated range of fees that will be needed to fund the regional facilities is included in **Table ES-3**. Scenario 1 illustrates the projected fees required to pay for annual debt service to construct required capital facilities from 2007 to 2010 if all parcels currently in the Boxelder Creek floodplain are assessed the fees. The fees are shown first without the benefit of any grants or developer contributions (worst case scenario) and then with potential external funding (best case scenario). Scenario 2 provides the same best and worst case annual fee assessments but is based on only the fees being assessed on parcels actually removed from the flood plain. It is anticipated that the funding sources will be derived from

some combination from two groups of fee payers: One consisting of all owners of properties within the basin and the other consisting of owners or properties which will be removed from the floodplain through construction of the proposed improvements.

It is envisioned that the final funding allocations will be based on a combination of monthly fees per parcel and one-time development fees for all parcels within the basin. However, a reasonable rate (based on the evaluations undertaken) appears to be in the range of \$4 to \$10 per month for residential parcels and one-time development fees (for properties removed from the floodplain) of between \$1,300 to \$2,500 per acre. The final funding strategy for the Regional Improvements will be developed as part of establishing the Regional Drainage Authority.

Table ES-3: Economic Impacts of Fee Assessments for Regional Facilities per Year				
Scenario 1: Fees Assessed on All Parcels Currently in Flood Plain Only				
	Without Grants		With Grants	
	Number	Annual Fee	Number	Annual Fee
Per Acre	4,960	\$213.91	4,960	\$96.77
Per Parcel	809	\$1,311.50	809	\$593.33
Per Structure	693	\$1,531.02	693	\$692.64
Per \$ Assessed Valuation	\$124,516,961	\$0.009	\$124,516,961	\$0.004
Scenario 2: Fees Assessed Based On All Parcels in the Boxelder Basin				
	Without Grants		With Grants	
	Number	Annual Fee	Number	Annual Fee
Per Acre	5,290	\$200.57	5,290	\$90.74
Per Parcel	6,210	\$170.85	6,210	\$77.29
Per Structure	3,810	\$278.48	3,810	\$125.98
Per \$ Assessed Valuation	\$135,419,370	\$0.008	\$135,419,370	\$0.004

ES.7 Implementation and Funding Strategy

The objective of the funding strategy is to outline a strategy to fund the items in the list of Boxelder Creek Regional Drainage Improvement Projects (the “Regional Improvements”). The funding strategy assumes that purely local improvements would be constructed by individual property owners or small groups of property owners who would benefit from the local improvement.

Types of Benefit - The Technical Advisory Committee and the Financial Advisory Committee have identified various benefits from the Regional Improvements. All property in the Basin would benefit from the increased capacity to handle storm run-off, the decrease in both size and number of structures necessary to contain and route water, including decreased road crossings, and the increased level of public safety during flooding. Property located wholly or partly in the floodplain would have other potential benefits, including increases in property values attributable to rezoning and development and a decreased or eliminated need to pay flood insurance premiums.

Properties which Benefit Generally (Out of Floodplain)--General benefit is the benefit that is received generally by **all** properties contributing runoff to Boxelder Creek due to the reduction in improvements and services needed in the event of a flood. The Authority would identify the level of basin wide fees needed to provide a level of service consistent with the storm water master plan. If this amount is determined to be \$4 per month per average sized residence, then the Authority would assess \$4 per month to owners of average sized residences everywhere in the geographic area which is tributary to Boxelder Creek, regardless of jurisdiction.

<i>Proposed Fee</i>	<i>Improved Properties</i>	<i>Developing Properties</i>
Where assessed:	The Basin Tributary to Boxelder Creek	The Basin Tributary to Boxelder Creek
Type of Payment:	SWU Monthly Fee	System Development Fee
Basis of payment:	Acreage/Impervious	Acreage/Impervious
Requirements for Formation:	Intergovernmental Agreement	Intergovernmental Agreement

Properties which Benefit Specially (Being Removed from Floodplain)--Special benefit is the benefit that accrues only to **certain** properties by virtue of their removal from the floodplain. Such properties would pay a greater amount per acre because they have a greater benefit. In part, this will be paid through a floodplain removal fee paid by existing homeowners being removed from the floodplain. Properties developing after construction of the improvements will be asked to pay a one-time equity buy-in fee as a fair contribution or “reimbursement” to the Authority for their share of the capital investment in flood control facilities.

<i>Proposed Fee</i>	<i>Improved Properties</i>	<i>Developing Properties</i>
Where assessed:	In the current FEMA Floodplain	In the current FEMA Floodplain
Type of Payment:	Floodplain Removal Fee	Equity Buy-in Fee
Basis of payment:	Acreage	Acreage
Requirements for Formation:	Formal Public Election for owners of affected property	Intergovernmental Agreement

Sources of Revenue – The Financial Advisory Committee has sought to identify the most appropriate fees, charges or other sources of revenue to equitably distribute the costs of the

Regional Improvements. Under Colorado law, there are three forms of impositions or charges that can be used to pay for the Regional Improvements. First, there are fees for services which are imposed as a way of paying the cost of providing a specific service. Second, there are property taxes, which require a vote under TABOR. Third, there are assessments which are imposed on the basis of a specific benefit conferred on the property assessed. It is anticipated that the Regional Improvements will be funded primarily through fees for services. It is not anticipated that there will be any reliance on taxes or assessments to fund the Regional Improvements.

Two types of fees would be imposed throughout the Basin. The first would be a recurring monthly service charge to pay the cost of providing the service on an ongoing basis. The second would be a one-time fee, called a system development fee, that is imposed when a property is developed or annexed. It is expected that both types of fees would be used to pay the costs of the Regional Improvements.

Recommended Entity - A Regional Storm Drainage Authority (the “Authority”), operating as an enterprise for purposes of TABOR, is currently envisioned as the primary vehicle for funding the proposed Regional Improvements. The Authority would borrow money through the issuance of tax-exempt revenue bonds or notes to pay the costs of the Regional Improvements. Debt service on these obligations would be paid by the Authority from the service charges and system development fees, after payment of operation and maintenance expenses of the facilities operated by the Authority.

The Authority would be formed under an Inter-governmental Agreement (IGA) among participating governmental jurisdictions with land in the Basin. Pursuant to Colorado law, governmental entities may contract to perform together anything that could be done by each entity individually. Governmental entities are expressly authorized to contract to form a drainage authority. A drainage authority formed pursuant to such an agreement would have the authority, among others, to develop drainage facilities, to acquire, construct, manage, maintain or operate drainage facilities, to acquire or dispose of property used for drainage purposes, to condemn property, to incur debt and to impose rates and fees. The Authority would have a board of directors consisting of representatives appointed by the governing bodies of each of the sponsor governments. Under this plan the entire community within the Basin could pay for the proposed Regional Improvements on an equitable and fair basis. The terms of the IGA would define the structure and governance of the Authority. The Authority would act as a regional storm water utility service enterprise, and it would levy fees to provide regional storm water management and flood control services.

It is envisioned that it will take 3-5 years to implement the recommended alternative. The following steps are required prior to complete implementation of the recommended strategy:

1. Completion and adoption (by all affected jurisdictions) of this Master Plan. (December, 2006)
2. Completion of conceptual design and evaluations (including surveying and detailed hydrologic/hydraulic analysis) for the Recommended Alternative. (April, 2007)

3. Completion of a feasibility study and approval by CWCB for low-interest loan application. (May, 2007)
4. Preparation of a Conditional Letter of Map Revision (CLOMR) or Conditional Physical Map Revision (PMR) request and approval by FEMA. (July, 2007)
5. Completion and adoption of the recommend Financing Plan (November, 2007)
6. Completion and adoption (by all affected jurisdictions) of the Inter-governmental Agreement. (November, 2007)
7. Formation of the financing entity and Drainage Authority. (March, 2008)
8. Preliminary design of the Recommended Alternative. (July, 2008)
9. Final design and preparation of bid documents. (November, 2008)
10. Environmental and dam safety permitting associated with the Recommended Alternative. (May, 2009)
11. Selection of contractor. (June, 2009)
12. Construction. (July, 2009-October, 2010)
13. As-built documentation. (November, 2010)
14. Preparation of a Physical Map Revision (PMR) request and approval by FEMA. (April, 2011)
15. Revision to the FEMA regulatory floodplain maps. (October, 2011)