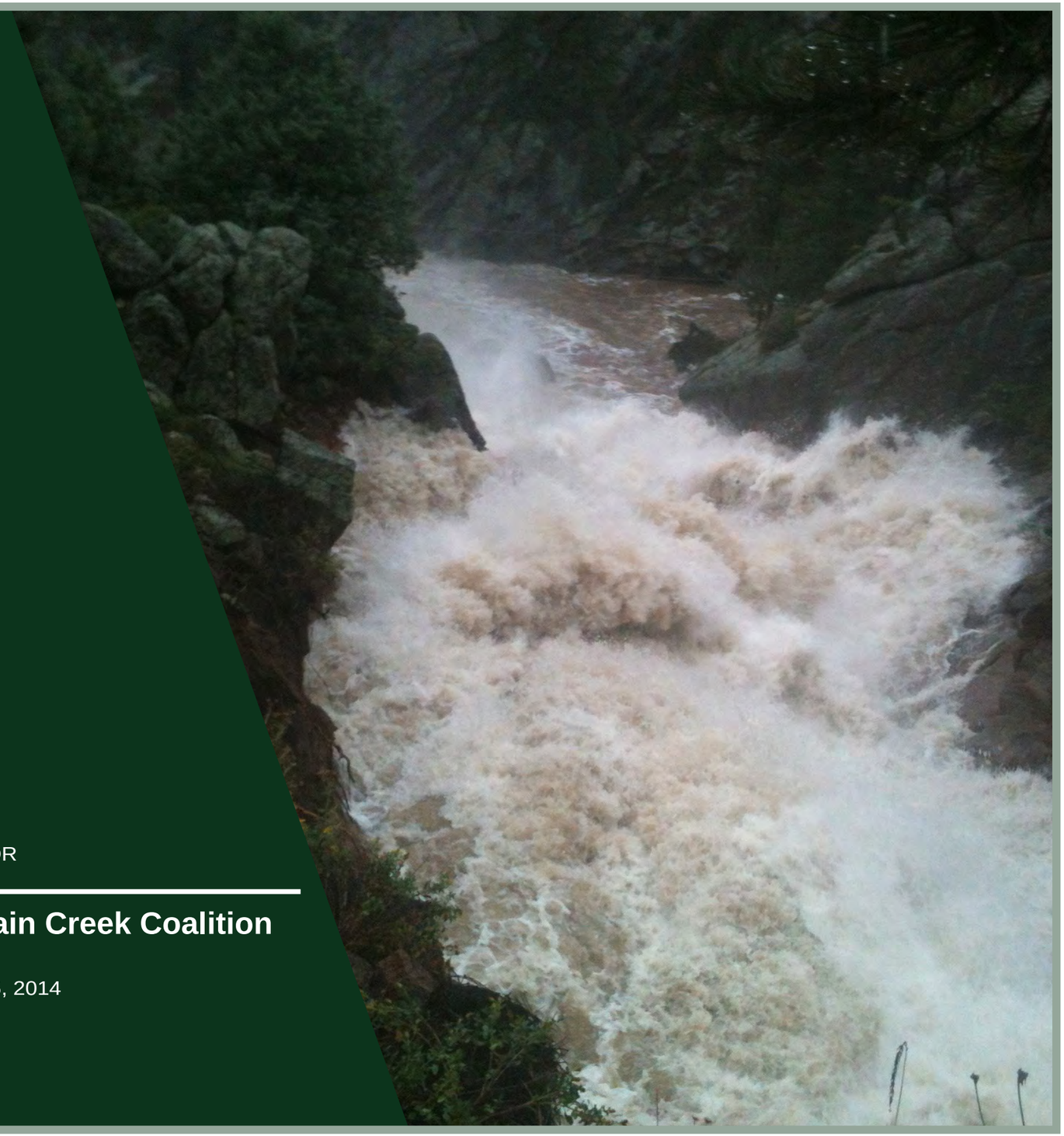
# St. Vrain Creek
# Watershed Master Plan



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NOVEMBER 25, 2014

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## Letter of Support for the St. Vrain Creek Master Plan

In June 2014 a diverse group of eight stakeholders formed a coalition to develop a master plan that provides the foundation for the long-term restoration of St. Vrain Creek and its tributaries following the devastating flood of September 2013. The purpose of the master plan is to identify actions that, if implemented, will lead to a more resilient creek corridor. The master plan focused on flood risk, ecological enhancements, and community values using best available science, expertise and public and diverse stakeholder input.

The St. Vrain Creek Master Plan Coalition included representatives of Boulder County, the City of Longmont, the Colorado Department of Transportation, the Colorado Water Conservation Board, the Saint Vrain and Lefthand Water Conservancy District, the Town of Lyons, USDA Forest Service, Arapaho/Roosevelt National Forest, and USDA Natural Resources Conservation Service.

One of the early actions of the Coalition was to advise Boulder County on the selection of a team of contractors to take on the heavy task of drafting the master plan within a short time frame. The selected team of Michael Baker Jr., Inc., CDR Associates, Anderson Consulting Engineers, Inc., S2o Design and Engineering, Walsh Environmental Scientists and Engineers, LLC, and David Evans and Associates, Inc. (the Baker Team) performed their duties as assigned, and presented the requested master plan for public review in September 2014.

Throughout the planning process, the Baker Team kept the Coalition and the public informed and engaged through a comprehensive set of Coalition and community meetings and by facilitating communications. With the finalization of the plan, including responses to comments received, the entities interested in the future of the St. Vrain Creek Watershed have a valuable statement of the status of the creek, and a road map for selecting, funding, and implementing long-term restoration projects.

The Coalition would like to take this opportunity to express its acceptance and appreciation for this master plan. Members fully recognize that in order to transition the master plan to implementation, additional analysis of proposed projects and funding will be necessary. While acceptance of this master plan does not waive any requirements for future projects to comply with federal, state and local policies, plans, rules and regulations, the Coalition is hopeful that this plan will launch a coordinated and systematic repair and restoration of St. Vrain Creek.

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## Acronyms and Abbreviations

BCPOS ..... Boulder County Parks and Open Space
BLM ..... Bureau of Land Management
CCP ..... Comprehensive Creek Planning Initiative
CDOT ..... Colorado Department of Transportation
CWCB ..... Colorado Water Conservation Board
FEMA ..... Federal Emergency Management Agency
FHWA ..... Federal Highway Administration
GIS ..... Geographic Information Systems
NCD ..... Natural Channel Design
NFIP ..... National Flood Insurance Program
NRCS ..... Natural Resources Conservation Service
SVMP ..... St. Vrain Master Plan
USDA ..... U.S. Department of Agriculture
USGS ..... U.S. Geological Survey

| Glossary of Terms | |
|---|---|
| **Term** | **Definition** |
| Aggradation | The depositing of sediment within the channel bottom (also see Deposition) |
| Avulsion | The process by which significant erosion occurs at the downstream end of a Reach which results in a drastically different channel alignment |
| Biology/Biologic | The science/study of living matter |
| cfs | Abbreviation for Cubic Feet per Second, is a standard measure of water discharge |
| Check Structure | A structural provision installed in the bottom of a channel to prevent erosion from propagating upstream |
| Degradation | The removal of sediment within the channel bottom (also see Erosion) |
| Deposition | The depositing of sediment within the channel bottom (also see Aggradation) |
| Detention | The storage of flood water with a controlled release for the purposes of reducing flood-related impacts |
| Drop Structure | A structural provision installed within the channel to transition the channel from a higher elevation to a lower elevation in a short horizontal distance in an attempt to establish a stable channel slope |
| Ecology/Ecologic | The branch of biology dealing with the relations between organisms and their environment |
| Ecosystem | A system formed by the interaction of a community of organisms with their environment |
| Embankment | A bank, mound, or similar feature designed to hold back water, carry a roadway, etc. |
| Erosion | The removal of sediment within the channel bottom (also see Degradation), from channel banks, or across various land surfaces |
| Floodplain | The land adjacent to the channel that becomes inundated with water during a flood event |
| Flow path | The direction that water will travel within a channel or floodplain |
| Geomorphology/Geomorphic | The study of the characteristics and development of channel features such as shape, slope, and layout |
| Hydraulics | The depth, width, and velocity of water within a channel and floodplain |
| Hydrology/Hydrologic | Quantity of surface water runoff generated from a specific rainfall event |
| Infrastructure | Features such as roads, bridges, utilities, etc. |
| LiDAR | Technology utilizing plane-mounted laser apparatus to collect high-resolution topographic information |
| Low-Flow/Bankfull Channel | A smaller channel within a larger channel that is intended to convey runoff that is generated from more frequently-occurring rainfall events |
| Natural Channel Design | An engineering design method by which the natural characteristics of a stream are restored using natural materials and an understanding of what the channel looked like prior to becoming damaged |
| Planform | Horizontal channel pattern, typically informed by historical aerials |
| Riparian | Of, on, or relating to the banks of a natural course of water |
| Runoff/Stormwater | Surface water that is generated during a rainfall event and not absorbed by the ground or evaporated into the atmosphere |
| Topography/Topographic | The detailed elevation mapping of terrain surfaces |
| Watershed | Area of land where all the water that is under it or drains off of it goes to the same place ultimately |
| Wetland | A lowland area such as a marsh or swamp that is saturated with water |

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# 1. INTRODUCTION

## 1.1 *Authorization*

This St. Vrain Creek Watershed Master Plan (SVMP) was authorized by Boulder County and the St. Vrain Creek Coalition (the Coalition) under contract with Michael Baker Jr., Inc. (Baker) for this project. The Baker project team is comprised of Anderson Consulting Engineers, Inc.; CDR Associates; David Evans and Associates, Inc.; S2o Design and Engineering, LLC; and Walsh Environmental Scientists and Engineers, LLC.

## 1.2 *Purpose*

Agencies and groups along the St. Vrain Creek and its tributaries formed the Coalition to support long-term creek recovery by initiating a master plan project for the watershed. The Coalition is made up of representatives from the following entities:

- Boulder County (contracting entity);
- The City of Longmont;
- Colorado Water Conservation Board;
- Colorado Department of Transportation;
- Forest Service, Arapahoe/Roosevelt National Forest;
- Natural Resources Conservation Service;
- St. Vrain Left Hand Water Conservancy District; and
- The Town of Lyons

## 1.3 *Project Scope*

The St. Vrain Creek Watershed – which includes the following creeks: South St. Vrain Creek, Middle St. Vrain Creek, North St. Vrain Creek, and the main stem of St. Vrain Creek – is one of the most important natural features in the Colorado Front Range. It is unique in its richness of natural and ecological resources and in its diversity of historic and cultural features. Moreover, it is cherished for the recreational opportunities it provides and for the numerous economic, cultural, and social opportunities afforded by the St. Vrain Creek corridor.

In September 2013, St. Vrain Creek experienced a catastrophic flooding event. The flood destroyed large sections of Colorado Highway 7, US Highway 36, local roads, and public, residential, and commercial properties along the St. Vrain corridor. While short-term recovery solutions were being implemented, communities within the St. Vrain Creek corridor recognized a need to conduct long-term planning for the creek at the watershed scale. Planning at this scale is necessary in order to integrate local needs and broader stakeholder interests into an approach to flood control and stream restoration. For these reasons, the SVMP project was initiated.

Master planning is a process that establishes the framework and key elements of a site plan. The SVMP synthesizes restoration components, flood risk reduction, community resilience, improved ecological function, and enhanced aesthetics. Additionally, this plan supports grant and loan applications, as the majority of funding for most of these activities will need to be procured in the future. The purpose of the SVMP is to guide the County, its municipalities, and individual landowners in the identification and prioritization of stream rehabilitation and restoration projects, as well as activities related to economic recovery, hazard mitigation, and recreation. It is also meant to inform the public, property owners, stakeholders, and local decision makers about the current conditions of the watershed so that they are better able to identify and prioritize risk reduction projects.

**The SVMP articulates the vision for the future of the watershed and guides future planning and development activity by highlighting recommended projects that align with diverse community priorities. All proposed watershed activities in this plan still need to comply with all federal, state, and local requirements prior to implementation. This includes but is not limited to: additional environmental and engineering studies; detailed engineering design; permitting; local land use and property ownership; and local public engagement processes.**

A large level of planning and effort was undertaken by both public and private entities immediately following the September 2013 flood and during the flood recovery phase. Whenever possible, the planning team looked to existing plans (including local flood recovery action plans; parks, recreation, and trails master plans; multi-hazard mitigation plans, and more) to inform recommendations, shape planning goals, and to evaluate the alternatives along the stream corridors.

The scope of work for the project was developed in conjunction with the Coalition. The following tasks were critical to the development of the SVMP:

- Development and implementation of a collaborative, locally-driven community engagement strategy;
- Review and integration of best available data including: Geographic Information Systems (GIS) data and maps, pre- and post-flood aerial photos and Light Detection and Ranging (LiDAR) data, existing reports and studies on drainage facilities;
- Review of the previously completed hydrologic analysis for the existing and proposed basin conditions;
- Review and integration of existing zoning and land ownership plans, current and future land use plans, and other land-use management documents;
- Comprehensive assessment of existing conditions, including site investigations to identify major drainage structures, existing problem locations, and post-flood hydraulic parameters;
- Development of watershed alternatives that address future needs of diverse stakeholders;
- Evaluation of alternatives based on public feedback, estimated construction costs, potential flooding, planning constraints and/or other related issues

The St. Vrain Creek watershed is an important part of the rich regional system of human communities and ecological services that defines the Colorado Front Range. Its wellbeing is critical to maintaining the health, biodiversity, character, and economy of communities within the region. This planning effort supports project stakeholders and other users in the implementation of drainage improvements, interagency coordination, floodplain management, hazard mitigation, and other land-use controls as needed to reduce potential damages and adverse development in flooded areas. Moreover, it strengthens the capacity of watershed communities to adapt to changing flood risk and provides a framework for building local and regional resilience.

While the SVMP will provide the road map for long-term recovery, implementation of the projects outlined in the SVMP still requires funding, detailed design, permitting, right-of-way acquisition, etc. Due to the size and severity of the flood damage in this area and the need to identify watershed needs for recovery, this and other watershed master plans were prepared in an expedited time frame with the best available data, given the changed physical conditions in the flood-affected watersheds. As the master plan projects are implemented, the conceptual plans outlined in this report will greatly benefit from more detailed analysis and site-specific survey and topographic information. It is also the intent of the Coalition to continue past the SVMP completion to champion the implementation phase and serve as stewards of the overall watershed health moving forward.

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# 2. PLANNING OBJECTIVES

## 2.1 *Planning Objectives*

Immediately following the 2013 September floods, communities within the St. Vrain Watershed began the long process of recovery. Part of the process involved identifying future directions for the watershed and finding ways to build back stronger. Master planning contributes significantly to these goals by providing post-flood analysis of flows, by facilitating key decisions about creek alignment, and by identifying actions for stream restoration and flood risk management. In the St. Vrain Creek Watershed, the master planning process has been an open and collaborative effort by public agencies, property owners, ditch companies, stakeholders, and the public. Additionally, the St. Vrain Watershed master planning process facilitated a watershed-wide conversation about long-term recovery and local resilience building.

The core objectives of the SVMP are:

- To articulate a clear vision of the future for the St. Vrain corridor and the communities within the watershed;
- To inform the public, property owners, stakeholders, and local decision makers about the current condition of the watershed's major drainage ways;
- To identify future flood risks and propose projects that both reduce flood risk and increase long-term watershed resilience (this includes engaging local stakeholders throughout the planning process to identify priorities, needs, and goals); and
- To identify projects for potential funding.

The SVMP has incorporated the following planning themes (in no particular order) by developing strategies, exploring alternatives, and identifying projects with multiple local and regional benefits:

- Community Recovery and Resiliency
- Flood Mitigation and Hazard Risk Reduction
- Stream Hydrology and Stability
- Physical and Structural Protection
- Biology and Environment
- Recreation

The details of the watershed master planning process, including participants, project timeline, and the relationship of the master plan to other community planning efforts, are described below.

## 2.2 *Planning Process*

The historic September 2013 flood reshaped waterways across the northern Front Range of Colorado and made major changes to both the natural and built environments in the region. Over the past year planners, community members, local decision makers, and agencies have worked together to manage immediate and long-term flood recovery activities. Early on in the recovery process the Boulder County Comprehensive Creek Planning Initiative (CCP) was established as the main entity guiding the creek rehabilitation and stabilization process. The CCP was developed to help the county move forward with long-term creek recovery by initiating watershed-level master planning processes throughout the region.

The SVMP marks the transition point from short-term flood recovery activity to the long-term sustainability planning for the entire St. Vrain watershed. The St. Vrain Creek Coalition's purpose is to guide the development of the SVMP and continue past the project to achieve implementation of the SVMP. As the steering committee for the SVMP project, the Coalition coordinated planning activities with local agency efforts, and guided resident and stakeholder engagement activity. Additionally, the Coalition facilitated existing data collection and the identification, evaluation, and prioritization of SVMP project alternatives.

Coordination of the watershed's local governments and other entities occurred primarily through the Coalition, whose members were the primary points of contact and conduits of information between the planning project and their respective communities and organizations. At their biweekly project meetings, the Coalition provided technical reviews of the Master Plan data, activities, and alternatives. The Coalition also participated in joint decision-making and ensured that public input was thoroughly incorporated into the master plan. All Coalition meetings were open to the public and advertised on the project website.

After the initial kick-off meeting with the Coalition, the project team held semi-structured interviews with Coalition members to inform the study and to identify needs, opportunities, priorities, and challenges that should be addressed through the master plan. Additionally, during the initial Coalition meetings and Coalition member interviews, the project team collected input from Coalition members to further define effective stakeholder engagement strategies and opportunities. As was established at the start of the planning process, watershed stakeholders worked collaboratively to develop this master plan, which identifies and prioritizes projects that not only reduce risk to public and private infrastructure, but also preserve, enhance, and/or restore the creek's natural environment and provide for long-term recreational and community-building opportunities where appropriate and desired.

Due to the diverse mix of land ownership in this watershed, as well as the erosive nature of the flood event, a strong emphasis on collaborative decision making and public engagement was applied to this master plan. A detailed description of the public engagement process is outlined in Chapter 5 of this report.

## 2.3 *Relationship of Master Plan to Other Planning Documents*

Following the 2013 flood, stakeholders within the St. Vrain Creek Watershed (including residents, property owners, and public and private sector organizations) began to tackle difficult decisions about where and how to rebuild. In addition to local activity immediately following the flood, communities and agencies within the watershed have initiated work and planning efforts to promote a sustainable, livable, and economically vibrant creek corridor.

The SVMP is designed to fit within existing community and land use planning programs and strategies. It does not change local policies or procedures related to project implementation, nor does it override existing management plans. Additionally, the SVMP does not affect the Federal Emergency Management Agency (FEMA) maps or flood insurance rates.

The SVMP integrates and leverages existing local land use management and planning efforts with a vision for long-term flood recovery. The plan roll-up (described in Chapter 4) facilitated this process and gave the planning team a comprehensive understanding of pre- and post-flood efforts. Additionally, in-depth interviews with Coalition members at the start of the planning process provided key information related to the ongoing planning activities and management goals of the diversity of stakeholder organizations within the watershed including recreation plans, land use management, parks and open space land use management strategies and more.

Due to the large volume of ongoing recovery activities throughout the watershed, all SVMP activities are being coordinated with the entities performing the work. Some examples include but are not limited to: coordination with CDOT, Boulder County, and City of Longmont on permanent road/bridge improvements, coordination with Town of Lyons' flood recovery projects, and coordination with City of Longmont's flood mitigation projects and bridge replacements.

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# 3. PLANNING AREA DESCRIPTION

## 3.1 *Planning Area*

The St. Vrain Watershed covers 546 square miles and about 54 miles of creek (see Planning Area map on page 3-3). It begins at the continental divide and ends at the start of the western edge of the plains. The North St. Vrain Creek and South St. Vrain Creek (including Middle St. Vrain Creek) drainage basins are located on the eastern slope of the Rocky Mountains. The two basins join in the Town of Lyons to form St. Vrain Creek. From there, St. Vrain Creek flows to the east from Lyons and at its confluence with Boulder Creek, the St. Vrain River is formed. The St. Vrain River flows east to the South Platte River in Northern Colorado.

From Lyons through Longmont, St. Vrain Creek has been heavily altered and reshaped by human activity including development, irrigation head gates, reservoirs, and sand and reclaimed gravel mining sites. Upstream of Lyons, the St. Vrain Creek is more natural and is confined to its channel by the existing topography and transportation infrastructure. In addition to private residential property, the watershed includes Boulder County Open Space lands, agricultural lands, and Forest Service lands.

Because this watershed master plan is meant to address the reaches of the St. Vrain that were significantly impacted by the September 2013 flood, it differentiates between the *Analysis Area* and the *Planning Area.* The *Analysis Area* for the St. Vrain Watershed Master Plan is the geographic area for data collection and analysis. It is the geographic scope for evaluating existing plans and post-flood conditions, collecting additional hydrologic, and for conducting creek corridor evaluations and risk assessments.

In contrast, the *Planning Area* is the area within which the project team conducted all master planning tasks, including: stakeholder and public engagement, assessment of existing post-flood conditions, identification of plan strategies and alternatives, and project prioritization and implementation. The *Planning Area* is smaller than the *Analysis Area* and is focused on the areas directly impacted by South St. Vrain Creek, Middle St. Vrain Creek, North St. Vrain Creek, and the main stem of St. Vrain Creek.

The following local jurisdictions are included in the *Planning Area:*

» Boulder County
» City of Longmont
» Town Lyons

## 3.2 *September 2013 Flood*

Beginning on September 9th, 2013, significant flash flooding occurred in north-central Colorado on the eastern side of the Continental Divide. Larimer, Weld, and Boulder counties were among the most devastated of the 18 Colorado counties included in the September 24, 2013 Presidential Disaster Declaration. The historic rainfall event, which reached over 17 inches of rain recorded by September 15th, brought yearly precipitation levels to over 30 inches (the most rain recorded in 120 years of hydrological record).

During the storm event the flood surge moved down through the eastern canyons and exited through the center of the Town of Lyons where the North St. Vrain and South St. Vrain tributaries converge. At its peak, the estimated volume of the St. Vrain was 10 times its normal amount, reaching 100-year flood levels and well surpassing those (500 – 1,000 years) in certain areas. The floodwater washed out roads and bridges, which isolated property owners from evacuation routes, in some cases for several days.

*Flooding damage in the St. Vrain Creek Watershed, September 2013*

In mountain areas, runoff caused significant changes to the creek corridor as well as upland tributary creek drainages. Debris flows from hillsides caused heavy erosion and deposition of materials along tributaries and in the stream corridor. Large debris – including rocks, trees, trash, and cobble – was carried down from the mountains and was deposited throughout the *Planning Area*.

The effective Flood Insurance Study (FIS) for Boulder County and Incorporated Areas was published by FEMA in December of 2012. The information included in the FIS was up to date at the time of the September 2013 flood event. Table 3.1 shows a summary of peak flood discharges from the 2013 flood, a comparison to regulatory flows, and an estimate of the observed flood frequency within the St. Vrain Creek Watershed.

Estimated peak discharge values from the 2013 Flood were developed by Bob Jarrett of Applied Weather Associated (AWA) as documented in the report *Peak Discharges for the September 2013 Flood in Selected Foothill Region Streams, South Platte River Basin, Colorado.* The discharge estimates provided by AWA, coupled with any other available discharges in the watersheds, were compared to the current effective regulatory discharges to provide an estimate of the relative magnitude of the September floods. This information is documented in the memo entitled *CDOT/CWCB Hydrology Investigation Phase One – 2013 Flood Peak Flow Determinations (July, 2014).*

*Flooding in the St. Vrain Creek Watershed, September 2013*

**Table 3.1 Summary of Observed Discharges and Frequency Estimates**

| Flooding Source and Location | Drainage Area (sq. mi.) | Regulatory Peak Discharge (cfs) | | | | 2013 Peak Discharge Estimate (cfs) | 2013 Estimated Frequency |
|---|---|---|---|---|---|---|---|
| | | 10-yr | 50-yr | 100-yr | 500-yr | | |
| Middle St. Vrain Creek | | | | | | | |
| at confluence with South St. Vrain Creek | 32.4 | 590 | 1,430 | 2,000 | 4,070 | 1,750 | 50-100 Year |
| North St. Vrain Creek | | | | | | | |
| at confluence with St. Vrain Creek and South St. Vrain Creek | 125 | 1,000 | 2,850 | 4,310 | 10,630 | 12,300 | >500 Year |
| South St. Vrain Creek | | | | | | | |
| at confluence with St. Vrain Creek and North St. Vrain Creek | 92 | 1,400 | 3,750 | 5,430 | 11,900 | 9,000 | <500 Year |
| at confluence with Middle St. Vrain Creek | 66.7 | 1,220 | 2,790 | 3,990 | 8,560 | 2,700 | 50 Year |
| St. Vrain River at Interstate 25* | 854 | 5,950 | 12,850 | 16,700 | 41,960 | 18,000* | >100 Year |
| St. Vrain below confluence of N. and S. branches | 211 | 2,040 | 6,670 | 8,880 | 20,260 | 19,600 | <500 Year |

*Information at Interstate 25 provided by Steve Griffin, Region 4 Hydraulics. See Peak Flow Hydrology Investigation for the September 2013 Flood at Interstate 25, dated January 7, 2014.

## 3.3 *Overview of Reaches*

To facilitate the alternative development process, the streams within the Planning Area were divided into several smaller reaches along the length of the watershed. This allowed the planning team to focus on the needs and characteristics of specific portions of the creek and to better organize ongoing public engagement activity. Reach locations and their limits are shown in Figure 3.1. Descriptions for each reach are provided below:

**Reach 1: Confluence of St. Vrain Creek with Boulder Creek, upstream to the eastern corporate limits of Longmont.** This portion of the creek has been realigned over time through numerous sand and gravel mining sites. During the September 2013 flood, the St. Vrain Creek left its channel and entered reclaimed and active gravel mining sites. Sediment was deposited along the southern bank of the creek. Although the new flowpath does not adversely affect infrastructure, the stream is in a state of disequilibrium and continues to change in an attempt to find a stable form.

**Reach 2 : The eastern corporate limits of the City of Longmont, west to Airport Road.** This reach includes Longmont proper and is heavily populated portion of the St. Vrain. The City of Longmont was among the hardest hit communities during the catastrophic flooding event in September 2013. Damages to city infrastructure, in excess of $148 million, included significant damages to parks and trails along the St. Vrain corridor. A number of homes were flooded at the western edge of the reach and numerous bridges and culverts were damaged by floodwaters and debris.

**Reach 3 : Airport Road west to US 36.** This reach is primarily rural, although the St. Vrain Creek interacts with the existing sand/gravel mining sites and irrigation ponds. During the flood, large split flow paths cascaded through the reclaimed gravel mining ponds. One split channel resulted in flooding outside of the 100-year floodplain and affected neighborhoods downstream in the City of Longmont.

**Reach 4 : US 36 upstream through Lyons along both South and North St. Vrain Creeks.** This reach includes the Town of Lyons and areas just upstream to the choke in the canyon along the South St. Vrain and to Apple Valley along the North St. Vrain. The Town of Lyons was severely damaged during the September 2013 flood event. The flood destroyed the Town's electrical systems and wastewater treatment facility, and damaged or destroyed nearly 30% of the Town's housing stock. When the floodwaters breached the Town's wastewater treatment facility, Lyons' water supply was contaminated. Additionally, multiple sections of the St. Vrain jumped the original channel and the flood permanently damaged many of the Town's roads, bridges, parks, trails, and streams. Floodwaters destroyed Lyons Public Works facilities and equipment, and the Town Hall and Library building. The total amount of damage to the Town of Lyons is estimated at $50 million, including $5 million in temporary measures. Due to the complexity of this area, Reach 4 has been divided into smaller sub-reaches to facilitate the planning process. These sub-reaches are as follows: **Reach 4a** encompasses the Apple Valley area; **Reach 4b** includes the South St. Vrain from Andesite Quarry downstream to Old St. Vrain Road; and **Reach 4c** covers Town of Lyons proper down to US 36.

**Reach 5 : North St. Vrain from Apple Valley and upstream to the upstream limit of Planning Area (Button Rock Reservoir).** This reach is an important contributing area that affects flooding in the Town of Lyons. The September 2013 flooding event damaged Longmont Dam Road, thus affecting the North St. Vrain channel. Additionally, several road crossings within this reach were affected by floodwaters and debris.

**Reach 6 : Upstream along the South St. Vrain from the choke in the canyon to the Townsites of Riverside and Raymond.** The stream channel is constrained along this reach due to canyon geometry and the highway and there are a number of issues along this reach related to embankments along State Highway 7. Emergency road repairs resulted in large stretches of channelization and removal of organic materials that will have a long-term impact on the natural recovery in those areas. Aggradation occurred downstream of Reach 6 and opportunities exist to mitigate the accumulation of sediment at the choke in the canyon.

**Reach 7 : The Townsites of Riverside and Raymond upstream to the limit of the Planning Area.** Reach 7 continues along State Highway 7, south of the Highway 72 junction. Although the stream channel is constrained due to the canyon geometry, the flooding event disrupted the biological connectivity of the stream and damaged residential structures in the floodplain.

## 3.4 *Threatened and Endangered Species*

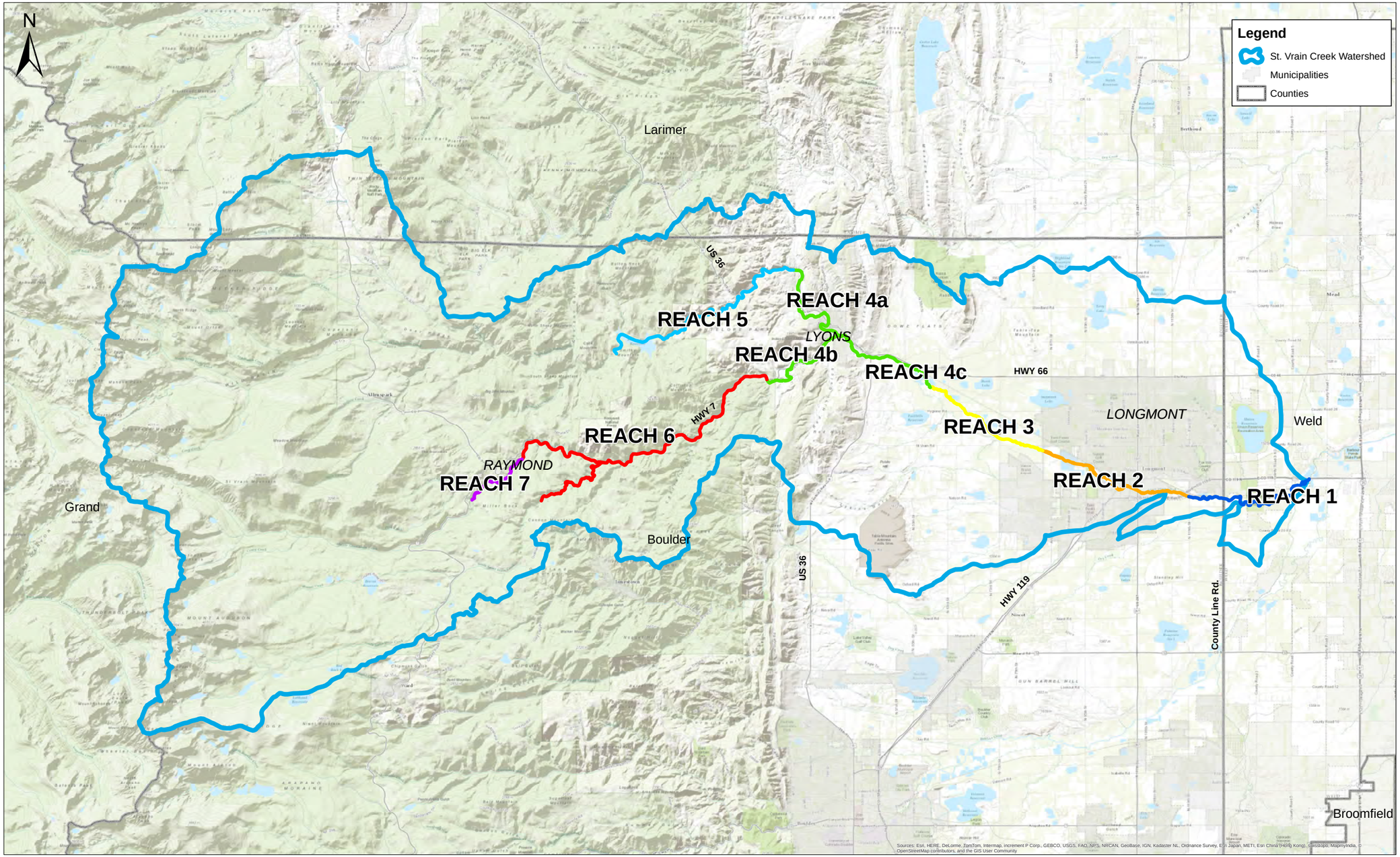
For information on threatened and endangered species in the watershed, please refer to the following Boulder County website:

**http://www.bouldercounty.org/property/build/pages/bccpupdate.aspx**

The following documents are especially useful with respect to the SVMP and are located on the Boulder County website:

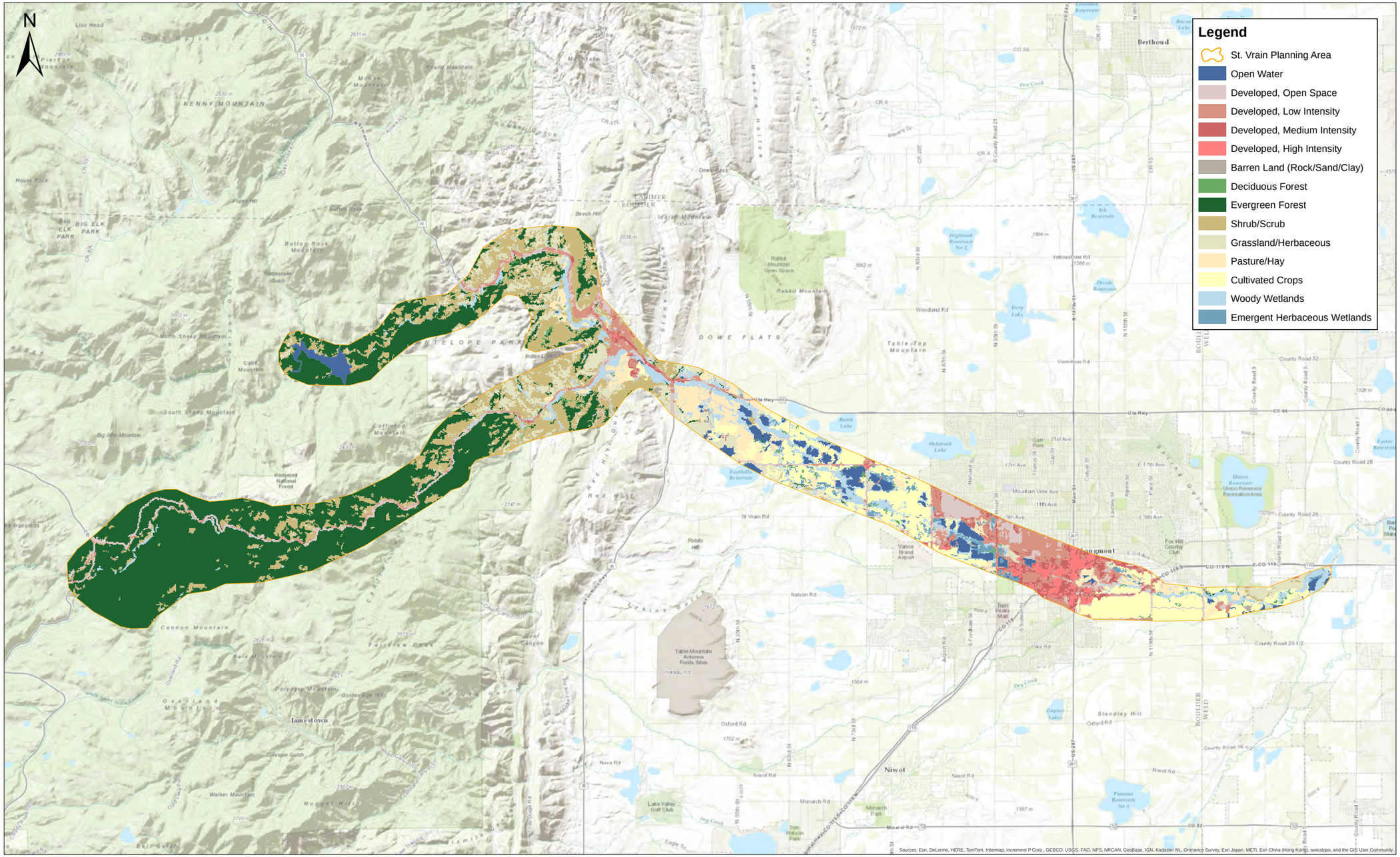
» "Preble's Meadow Jumping Mouse Conservation Areas" map; and

» "Critical Wildlife Habitat & Wildlife Migration Corridors Descriptions" for Critical Wildlife Habitat #7




**ST. VRAIN WATERSHED MASTER PLAN ALTERNATIVES ANALYSIS**

Figure 3.1 Planning Area




**ST. VRAIN WATERSHED MASTER PLAN ALTERNATIVES ANALYSIS**

Figure 3.2 Land Use

0 1.25 2.5 5 7.5 10 Miles

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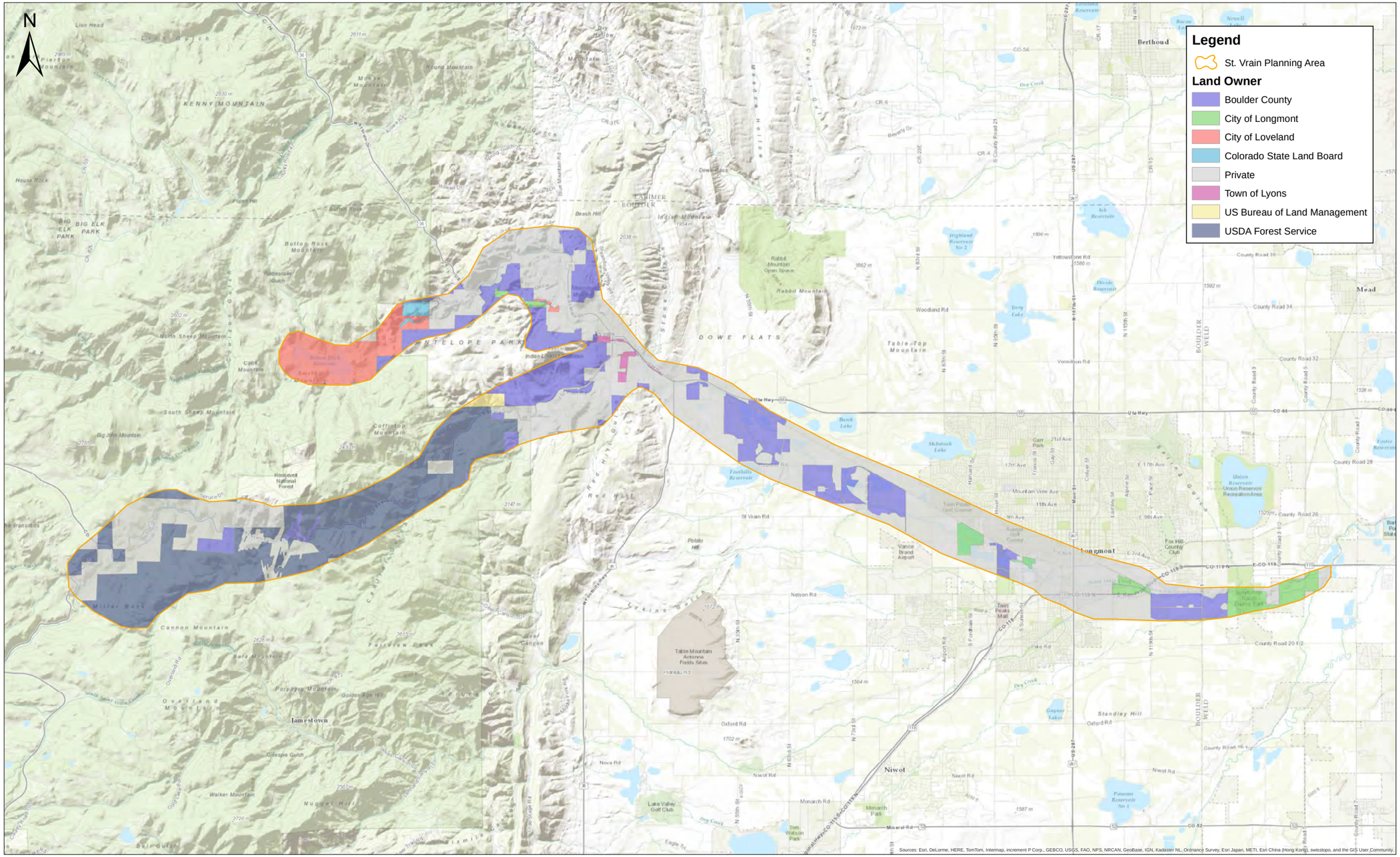


**ST. VRAIN WATERSHED MASTER PLAN ALTERNATIVES ANALYSIS**

Figure 3.3 Land Ownership

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# 4. DATA COLLECTION

Effective master planning projects typically begin with research and data collection, and end with a solid guide for future improvements. These improvements address the needs of multiple stakeholders and can be used as a reference document for years to come. The data collection process for this report included the synthesis of existing data, plans, and studies as well as technical analysis, engineering calculations, agency and public coordination, and attention to the environment and the priorities of diverse community stakeholders.

Through the assistance of Coalition members and other stakeholders, the project team collected GIS, planning, and engineering data, as summarized in this Section. Limited new data was collected specifically for this planning effort; however, the plan represents a compilation of existing data into one location for use by community members, local constituents, and municipalities. While data was available for the majority of the study area, some of the data has limited applicability and efficacy due to:

- The age of the data and/or the methodologies used;
- Existing data gaps due to the reality that, in some areas, field research has not previously been conducted;
- In some areas, data collection efforts have already been funded and scheduled for a later date; and
- Impacts from the flood (aggradation, erosion, etc.), or the flood recovery effort (construction of flood recovery and stabilization projects), resulting in an invalidation of the existing flood risk data.

While every effort was taken to ensure that the information used in this plan is the most current and the most accurate, it is possible that additional data sources exist that were not discovered as part of this project. Additionally, in many cases there is a need for future site-specific data collection and analysis to assist with scoping and project design details.

Despite the aforementioned data limitations, the watershed assessment provided in this plan represents a comprehensive view of the St. Vrain Creek watershed, has been vetted by local and regional subject matter experts, and includes recommendations detailing how flood risk should be addressed within the watershed. Over time, the assessment should continue to be updated with current information as it becomes available in order to establish a holistic framework for the prioritization of plan alternatives, resource management efforts, and future development plans.

## 4.1 *GIS Data*

Geographic Information System (GIS) layers were obtained from the following entities:

- Boulder County;
- Colorado Water Conservation Board (CWCB);
- Colorado Department of Transportation (CDOT);
- Federal Emergency Management Agency (FEMA);
- U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS);
- Bureau of Land Management (BLM); and
- U.S. Geological Survey (USGS) for the study area.

Mapping for this project is in NAVD 88 (vertical datum) and NAD 1983 HARN State Plane Colorado North (horizontal projected coordinate system). The follow lists include a sampling of the geographic data sets leveraged for this planning effort: post-flood damages, post-flood stream channel, post-flood inundation areas, flood debris, recovery berms, recovery planning areas, FEMA FIRM, CWCB floodplains, parcels, pre and post-flood LiDAR, pre- and post-flood orthoimagery, roadways, road setbacks, wetlands, and stream habitat connectors.

## 4.2 *Engineering Data*

Due to schedule and resource constraints, the SVMP is built almost entirely on the existing best available engineering data to inform flood risk evaluations in the watershed. This includes a combination of regulatory and non-regulatory data sets as well as recent hydrologic and hydraulic analyses that have been performed since the September 2013 floods.

### *4.2A Hydrology*

CDOT has been working, in partnership with the CWCB, on developing new hydrologic models in the watersheds affected by the September 2013 floods. This has involved the creation of new hydrologic models using a rainfall-runoff methodology in U.S. Army Corp of Engineer's HEC-HMS hydrologic model. A significant amount of data was captured during the flood event and this data was used heavily while calibrating the new models. In addition, recent LiDAR and new rainfall data from the recently released NOAA Atlas 14 was used.

The primary purpose of the work is to create models for CDOT's use in repair of damaged infrastructure. However, it is the State's hope that these models be created to standards that would allow them to be made available to communities for future regulatory purposes. Currently, there is no mandatory requirement to use the new model results for design or floodplain management purposes.

As of the date of the SVMP, the hydrologic analysis for the St. Vrain watershed has been completed from the headwaters to the Town of Lyons and Phase 2 of the modeling effort will continue the modeling effort for the lower portion of the watershed, ultimately covering everything down to the confluence with the South Platte River. The results of the updated hydrologic analysis in the St. Vrain Watershed are reflected in the following table (Table 4.1 derived from the State's report).

**Table 4.1. CDOT/CWCB Updated 100-year Modeled Peak Flows Compared to Current Regulatory Discharges**

| Location | Current Regulatory Discharge (cfs) | Modeled Regulatory Discharge (cfs) | Percent Difference |
|---|---|---|---|
| Middle St. Vrain Creek at confluence with South St. Vrain Creek | 2,000 | 2,160 | +8% |
| Middle St. Vrain Creek at Peaceful Valley (State Route 72 Bridge) | 1,180 | 1,400 | +19% |
| North St. Vrain Creek at confluence with St. Vrain Creek and South St. Vrain Creek | 4,310 | 6,390 | +48% |
| South St. Vrain Creek at confluence with St. Vrain Creek and North St. Vrain Creek | 5,430 | 7,230 | +33% |
| South St. Vrain Creek at confluence with Middle St. Vrain Creek | 3,990 | 5,260 | +32% |
| St. Vrain Creek, just downstream of confluence of North St. Vrain Creek and South St. Vrain Creek | 8,880 | 11,910 | +34% |

Due to the relatively large increases in peak flows in this watershed relative to regulatory discharges, there is a potential for significant impacts in the upper portions of the watershed from both a design and floodplain management perspective. To date, some jurisdictions are still evaluating how they will use this information moving forward while others are using the new flows as best available data.

### 4.2B Hydraulics

In support of the SVMP, Baker has collected all available hydraulic data in the watershed for use in informing the master planning effort. In general, the studies that serve as the basis for the regulatory FEMA flood maps are old and digital versions are not available. As a result, the benefits of these analyses are limited to evaluating floodplain management implications. Using elevations and/or exact inundation limits from these data sets should be evaluated on a case-by-case basis and weighed against all available technical data. The new information that has been developed since the flood event includes detailed hydraulic modeling and floodplain mapping for St. Vrain Creek from Hygiene Road through the City of Longmont; additional supplemental flood hazard analysis prepared by the Baker Team as part of this project (see Section 4.5); and CWCB Flood Recovery Mapping for North St. Vrain, South St. Vrain and Middle St. Vrain Creeks.

The flood hazard analyses from downstream of Longmont to US 36 are the most recent and accurate (relative to current existing conditions) information available in the watershed. CWCB's Flood Recovery Mapping is useful as a piece of supplemental information but due to its lack of hydraulic structures, its use of post-flood LiDAR that doesn't reflect existing conditions (due to local work in the channels since the flood), and the technical limitations of the automated modeling and mapping methods employed, these data sets have limited applications for design and/or floodplain management decisions. Below, Table 4.2 summarizes the best available data for the St. Vrain Watershed.

**Table 4.2. Summary Table of Existing Hydraulic Analyses in St. Vrain Creek Watershed**

| Study Name | Performed by | Date | Reach | Digital Copy (Y/N) | Comments |
|---|---|---|---|---|---|
| Flood Plain Information, Lower St. Vrain, Volume III, Boulder County, CO | USACE | 1972 | 4 (partial) - Lyons | N | FEMA Regulatory |
| Floodplain Information Report, St. Vrain Canyon, Upstream of Lyons | CWCB (Camp, Dresser, and McKee Inc.) | 1978 | 6 (partial), 7 (complete) | N | FEMA Regulatory |
| Floodplain Information, Flood Control, and Floodplain Management Plan, St. Vrain Creek at Longmont, Colorado | CWCB (WRC) | 1981 | 2 (complete), 3 (partial) - Longmont | N | FEMA Regulatory |
| CWCB Flood Recovery Mapping | CWCB (Atkins) | 2014 | 4 (N. St. Vrain only), 5-7 (complete) | Y | Post Flood. 200 foot XS spacing, "push button, automated product" with no structures |
| Post Flood Analysis of Minor Storm Risks in Saint Vrain Creek through Longmont | Longmont (CH2M Hill) | Feb 2014 | 2 (complete), 2 (partial) | Y | Conceptual Design for flood control project through Longmont, including existing conditions model |
| Floodplain Information Report, St. Vrain Creek 119th St. to East County Line | Boulder County + CWCB | 1988 | 1 (partial) | N | Basis for FEMA Regulatory Approximate Zone A floodplain |
| Floodplain Re-analysis and Floodway Delineation - North St. Vrain and St. Vrain | Boulder County (Love and Associates) | 1992 | 3 (complete), 4-5 (partial) | N | Local Regulatory |

## 4.3 Application of Best Available Data

The use of the previously outlined data in the SVMP effort is summarized in this section.

### 4.3A Hydrology

CDOT/CWCB flows will be used to evaluate hydraulic structure capacities and to make recommendations for upsizing undersized structures. Due to the lack of comprehensive, up-to-date, digital hydraulic modeling as described above, it was determined that utilizing the new flows in the existing hydraulic analyses was not feasible given project constraints and would provide limited benefits given the accuracy of existing modeling. Longmont is in the process of incorporating more conservative flows in their analysis by propagating the ~34% increase in peak discharge downstream in anticipation of increased discharges once the CDOT/CWCB modeling is extended downstream. The Baker Team recommends utilizing the CDOT/CWCB flows for all future design and flood hazard analyses efforts in the watershed.

### 4.3B Hydraulics

The existing best available data outlined in the previous section was used to evaluate flood risk and potential impacts of proposed alternatives and inform the conceptual designs. The floodplain mapping reflected in the conceptual design exhibits are a combination of the existing data as follows from the downstream to upstream by stream reach:

***St. Vrain Creek***

Effective FEMA Zone A floodplain from Boulder Creek to E. Countyline Road

- Longmont 2014 floodplain mapping from E. Countyline Road to Hygiene Road
- Supplemental hydraulic results from Hygiene Road to US 36 (see Section 4.5 of this Chapter)
- Effective FEMA floodplain from US 36 to North and South St. Vrain confluence

***North St. Vrain Creek***

- Effective FEMA floodplain from confluence with South St. Vrain to limit of study (beginning of Apple Valley)
- CWCB Flood Recovery Mapping from Apple Valley to Buttonrock Reservoir
- Boulder County Transportation is currently developing hydraulic modeling as part of permanent road improvements along Longmont Dam Road

***South and Middle St. Vrain Creek***

- Effective FEMA floodplain from confluence with North St. Vrain to just upstream of Andesite Quarry
- CWCB Flood Recovery Mapping from just upstream of Andesite Mine/Hall Meadows through Riverside/Raymond

### 4.3c Floodplain Mapping

Spatial evaluation of flood risk was supported by the respective floodplain mapping associated with the aforementioned flood hazard studies and cross referenced to pre- and post-flood LiDAR datasets. Please note that while infrastructure sizing utilizes the more conservative draft discharges provided by the State, all of the flood hazard studies are based on historical regulatory discharges or regression equations. The USACE, in cooperation with FEMA and CWCB, is planning on collecting updated LiDAR topographic information in the fall of 2014 to supplement the 2013 post-flood LiDAR in an attempt to rectify the deficiencies in the 2013 data set due to channel work performed during emergency activities subsequent to the original post-flood data collect. This new topographic information will be a more accurate depiction of existing conditions and be invaluable in regards to updating flood hazard analysis moving forward.

## 4.4 *Existing Plans*

Throughout the planning process, members of the Coalition supplied plans, studies, and reports to the Baker team that were used to inform the SVMP. A plan roll-up (i.e. compilation of overarching themes in existing materials) was completed at the start of the planning process to manage the large amount of data and to identify gaps and data needs. A total of 39 plans, reports, and studies were included in the plan roll-up. The following pre-flood studies and reports were included in the plan roll-up and were used as references for this Plan.

- Sandstone Ranch Reclamation Plan – GEI Consultants (May 2009)
- Pella West (Marlatt Ponds) Hydrology Study – BCPOS (2009)
- BCPOS Riparian Inventory and Assessment (January 2009)
- BCPOS Braly Property Rapid Assessment Report (August 2001)
- Status of the Plains Topminnow – Colorado Parks and Wildlife (December 2012)
- Environmental Assessment: South St. Vrain Creek – BCPOS (October 2000)
- Spiranthes diluvialis: Habitat Assessment and Survey Report – BCPOS (August 2001)
- Keyes Property Rapid Assessment Report – BCPOS (November 2002)
- Resource Assessment Report: Custode Property – BCPOS (August 2001)
- Ramey Homestead Property - Rapid Environmental Site Assessment – BCPOS (July 2001)
- Changes in range-wide distribution of plains topminnow Fundulus sciadicus – University of Nebraska (March 2012)
- Boulder County Comprehensive Plan – Environmental Resources Element and Supplemental Materials (June 2013)
- Survey of Critical Biological Resources in Boulder County, CO – Colorado Natural Heritage Program (2007-2008, 2009)
- Mining Areas – BCPOS (2004)
- Habitat Conservation for Birds of Prey on Western Mobile Boulder Inc. Lyons Property – BCPOS (1997)
- Habitat Use by Breeding Birds on Western Mobile Inc. Lyons Property – Boulder County Parks and Open Space (1997)
- Conservation Handbook on the Preble's Meadow Jumping Mouse – BCPOS (2000)
- Third Year Survey for Preble's Meadow Jumping Mouse in Colorado – BCPOS (1997)
- Hall Ranch Meadows Natural Resource Assessment – BCPOS (2005)

The following plans were included in the plan-roll matrix up and have been used as references for this Plan:

- St. Vrain Creek Riparian Corridor Protection Plan, 2010 (City of Longmont)
- St. Vrain Creek Greenway Master Plan – City of Longmont and Design Workshop (2001)
- St. Vrain Trail Master Plan (BCPOS and ERO Resources 2004)
- North Foothills Open space Management Plan (1996)
- Boulder County Natural Hazard Mitigation Plan (draft) (2013)
- Boulder County Multi-Hazard Mitigation Plan (2008)
- St. Vrain Creek Corridor Open Space Management Plan – BCPOS (2004)
- Boulder County Comprehensive Plan (2nd Edition) – (May 1999)
- Boulder County Comprehensive Plan (Environmental Resources Element and Supplemental Materials) – (2014)
- Pella Crossing and Marlatt Open Space Recreation and Visitor Use Plan, 2003
- Boulder County Parks and Open Space Water Policy, 2012

In the days and months following the September 2013 flooding event, a diversity of data collection efforts were initiated to assess damage, evaluate risk, and understand the physical conditions that led to the disaster. The following post-flood studies and reports were included in the plan roll-up matrix and were used as references for this Plan:

- East County Line Road Bridge and Road Rehabilitation: Preliminary 30%/FIR Hydraulic Design (Studies 1 and 2) – Anderson Consulting Engineers, Inc. (December 30, 2013)
- Hydrology Investigation: Phase One – 2013 Flood Peak Flow Determinations – CDOT/CWCB (January 2014/updated May 2014)
- Hydrologic modeling for Boulder and St. Vrain Creeks – CWCB (Spring 2014)
- Post-Flood Analysis of Minor Storm Risks in St. Vrain Creek through Longmont (draft) – CH2M Hill (February, 2014)
- District 5 Ditch and Reservoir Flood Damage Report – St. Vrain and Left Hand Water Conservancy District (May, 2014)
- Summary of Flood and Debris Flow Impacts at Camp St. Malo – AMEC (October 15, 2014), **included in Appendix F**

The following post-flood planning documents were included in the plan-roll up matrix and were used as references for this Plan:

- Town of Lyons Recovery Action Plan - Colorado Floods of 2013
- City of Longmont Parks, Recreation, and Trails Master Plan (2014)
- Town of Lyons Sustainable River Corridor Action Plan (2014)
- City of Longmont St. Vrain Blueprint Planning Study (April 2014)

Once data gaps were identified, the Baker Team began collecting the additional data needed to inform the master plan, as outlined in the following section.

## 4.5 *Data Development*

The Baker Team carried out a number of data development efforts to supplement what was already available:

### 4.5a Interviews with Coalition Members

The Baker Team held semi-structured interviews with individual Coalition members to refine the scope and objectives of the Plan, to discuss key focus areas, and to obtain input on community engagement strategies. Interview summaries were developed by the project team and provided to Coalition members for review before being incorporated into the planning process (see Appendix A). One of the key messages shared by Coalition members during the interviews was the importance of engaging with property owners and the general public throughout the duration of the planning process.

### 4.5B Creek Corridor Evaluation and Risk Assessments

Ecological field assessments were conducted by the Baker Team in order to develop robust existing conditions assessments for the watershed. The team used the Stream Visual Assessment Protocol (SVAP2) developed by the NRCS as their assessment tool. This assessment evaluated 16 elements in each reach of the creek including: pool presence and condition, canopy and creek shading, riparian vegetation quantity and quality, in-stream complexity, bank conditions, and abnormal presence of fine sediment. The results of the SVAP2 assessment were used to identify critical riparian ecosystem elements that were damaged or absent from the creek system, as well as to identify highly degraded areas. The ecological assessments led to a strong understanding of the vulnerabilities certain key species may have in the post-flood environment and helped the planning team identify appropriate restoration strategies.

### 4.5C Geomorphological Assessments

The definition and level of detail for a given geomorphic assessment varies based on assessment objectives and application of results. For the purposes of this project the Baker Team performed a planning-level geomorphic assessment which can be defined by a general classification of valley geology, channel materials and shape, and channel stability. The purpose of this assessment was to define the post-flood geomorphic conditions in the St. Vrain Creek Watershed in order to gain an understanding of the processes that occurred during the September 2013 flood and to identify preliminary restoration strategies to assist with the development of the master plan. The planning-level geomorphic assessment was supplemented with erosion and deposition mapping, and a channel migration zone (CMZ) assessment.

Geomorphological assessments were conducted by the Baker Team to characterize post-flood channel morphology for several reaches within the watershed. Geomorphic evaluations consisted of:

- Historical and post-flood planform analysis
- Approximation of channel migration zone widths
- Identification of avulsion hazard areas
- Identification of erosion hazard areas
- Stream classifications

The results of the geomorphological assessments were used for developing stable-channel conceptual designs for each reach.

### 4.5D Flood Risk Assessments

Flood risk assessments include floodplain mapping and identification of flood-damaged infrastructure. Post-flood, multiple floodplain mapping studies were completed simultaneously by various entities using different data and modeling practices. An evaluation of existing flood risk data and areas of need are outline in Section 4.6 of this chapter.

### 4.5E Supplemental Flood Hazard Analysis

The SVMP project budget included limited resources to develop supplemental hydraulic analyses where necessary. Several options were discussed during Coalition meetings (see 6/25/14, 7/9/14 and 8/6/14 Meeting Minutes in Appendix A). As a result of those discussions, the Baker Team performed two supplemental hydraulic analyses in support of long-term recovery in the watershed:

1. A memorandum outlining an approach to hydraulic crossing sizing in the Riverside/Raymond reach. This analysis is intended to support local floodplain management decisions only and does not provide updated flood hazard data.
2. Hydraulic modeling and mapping along St. Vrain Creek from the vicinity of Hygiene Road (western limit of Longmont's 2014 post-flood model) upstream to the US 36 crossing. Please note that the analysis utilizes and estimated discharge based on the CDOT/CWCB updated flow at US36. While the data is sufficient to submit to FEMA to replace the existing approximate Zone A, additional work would be required to meet FEMA's requirements for a detailed Zone AE analysis.

Detailed documentation of these tasks are included in Appendix G of this report.

## 4.6 Unmet Needs/Recommendations

### 4.6A Flood Hazard Modeling And Mapping Needs

Due to the age of the existing flood hazard analyses, the highly erosive nature of the September 2013 floods, and the subsequent recovery work in the watershed, most reaches of existing stream corridor are in need of updated flood hazard modeling and mapping.

Table 4.3 summarizes the unmet flood hazard hydraulic and FEMA flood mapping needs in the watershed. For cost estimates, it is assumed that CDOT/CWCB hydrology will be utilized for all future flood hazard analyses. Priorities are defined as follows:

- High - Urgent need due to ongoing and imminent design projects and/or large amount of infrastructure at risk of subsequent flood event.
- Medium - Need exists but some updated information is already available or currently being prepared by others and/or moderate infrastructure at risk.
- Low - Need exists but being addressed by other with minimal infrastructure at risk.

### 4.6B Recommendations For Addressing Flood Hazard Needs

Accurate and up-to-date flood hazard information will be critically to implementing the projects outlined in the SVMP. The conceptual designs outlined in Chapter 7 will benefit greatly from the updated topographic information (including the new post-flood LiDAR and future supplemental surveying); updated Phase II CDOT/CWCB flows in lower parts of the watershed; future updated hydraulic modeling/floodplain mapping; and updated FEMA regulatory products.

The following lists recommendations chronologically with respects to updated flood hazard data:

- Continue to coordinate with CDOT/CWCB on Phase II development of updated discharges in watershed and incorporate the updated flows along with Phase I flows in all future work;
- Continue coordination between Boulder County and Town of Lyons regarding the existing FEMA Project Worksheet for hydraulic modeling/mapping to maximize benefits in both Lyons proper and surrounding areas (i.e. Apple Valley and SSV) as the FEMA Project Worksheet does not include these areas;
- Boulder County should consider the following options for incorporating updated flood hazard analyses between US36 and Airport Road into FEMA maps:
  - Incorporate as an approximate analysis to replace the existing Zone A; or
  - Incorporate updated CDOT/CWCB flows into updated flood hazard analysis between US36 and Airport Road (currently estimated based on upstream CDOT/CWCB Phase I flows) and add hydraulic profiles for all FEMA frequencies (10-, 25-, 50-, and 500-year) and floodway, if desired by Boulder County;
- Obtain new post-flood USACE LiDAR when it becomes available (estimated summer 2015);
- Boulder County should coordinate with FEMA and CWCB to develop flood hazard updates for Reaches 5, 6, and 7 using updated flows and LiDAR; and
- Longmont, in coordination with Boulder County, should use their post-flood hydraulic modeling and mapping as best available data (may consider update to new CDOT/CWCB flows when available) and pursue large-scale FEMA Physical Map Revision when flood control project (including Reach 1 improvements) is completed.

**Table 4.3 St. Vrain Creek Watershed -- Flood Hazard Data Unmet Needs**

| Flooding Source | Extents (downstream to upstream) | Update Needed? | Priority | Reason | Estimated Hydraulics Cost | Estimated FEMA Map Update Cost |
|---|---|---|---|---|---|---|
| St. Vrain Creek | Confluence with Boulder Creek to E. Countyline Road | Yes | Low | Accurate data does not exist as the effective is an approximate analysis and no model is available; however, Longmont has initiated a project that includes updated hydraulic modeling. | Funded via Longmont project | $29,000 |
| St. Vrain Creek | E. Countyline Road to US36 | Partial | Medium | 100-year existing conditions exists post-flood from Longmont and SVMP efforts; however, additional frequencies (10-, 25-, 50-, 500-year flows), floodway, etc. would be necessary for FEMA compliance. | $103,000 | $104,000 |
| St. Vrain Creek | US 36 to N. and S. St. Vrain Confluence | Yes | High | Accurate data does not exist due to post-flood work in the channel and sediment aggradation/degradation; however, Lyons has a FEMA Project Worksheet that includes updated hydraulic modeling for this area. | Funded via FEMA Project Worksheet | $22,000 |
| North St. Vrain Creek | Confluence to Longmont Dam Road | Yes | High | Accurate data does not exist due to channel migration and sediment aggradation/degradation; necessary to assess accurate flood risk in Apple Valley area and inform future design of projects. | $83,000 | $24,000 |
| North St. Vrain Creek | Logmont Dam Road to Limit of Residential Area | Partial | Medium | Accurate data does not exist due to channel migration and sediment aggradation/degradation; however, Boulder County Transportation is preparing a model in conjunction with permanent road repairs. | Funded via Boulder County road project | $15,000 |
| South St. Vrain Creek | Confluence to Andesite Mine | Yes | High | Accurate data does not exist due to channel migration and sediment aggradation/degradation; necessary to assess accurate flood risk in South St. Vrain area and inform future design of projects. | $43,000 | $24,000 |
| South St. Vrain Creek | Andesite Mine to Upstream Limit | Yes | Medium | Accurate data does not exist due to channel migration and sediment aggradation/degradation; work to be coordinated with CDOT HWY7 permanent repairs in 2015. | $96,000 | $44,000 |
| Middle St. Vrain Creek | Confluence to Upstream of Riverside/Raymond | Yes | High | Accurate data does not exist due to channel migration and sediment aggradation/degradation; updated flood hazard analysis needed to design private access crossings. | $156,000 | $24,000 |
| | | | | **Subtotal:** | **$481,000** | **$286,000** |
| | | | | **Grand Total:** | **$767,000** | |

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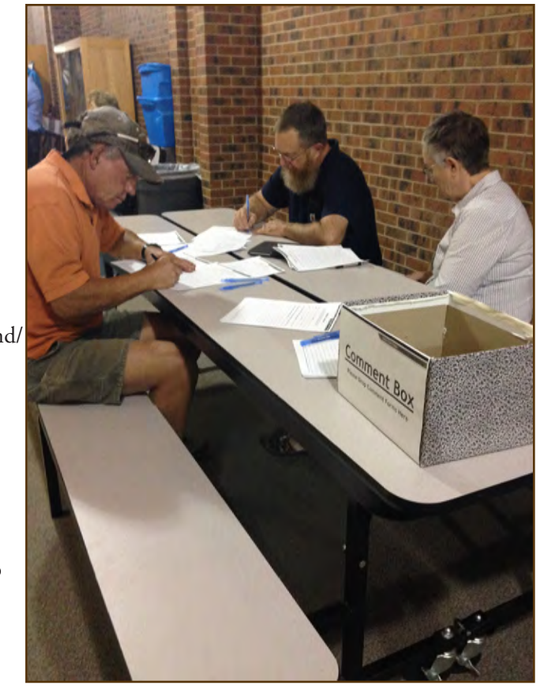
# 5. PUBLIC ENGAGEMENT PROCESS

A variety of focused public outreach activities were designed and conducted to inform the planning process. This chapter describes the various public engagement activities that were conducted during the development of the St. Vrain Watershed Master Plan. For more detailed information, please view Appendix A, which includes all summaries documenting the input gathered at each meeting.

## 5.1 *Coordination with the St. Vrain Creek Coalition*

During the duration of the planning process, the Coalition's primary role was to provide input and guidance on the range of issues addressed by local stakeholders and subject matter experts. The project team met with the Coalition almost every other week through the length of the planning effort. Members of the public were continually encouraged to attend Coalition meetings, which were open to the public and posted on the project website. Community members often attended to listen, contribute, and participate in the biweekly meetings. Coalition members represented the following entities.

- Boulder County
- Department of Transportation
- Colorado Office of Emergency Management
- Colorado Water Conservation Board
- City of Longmont
- Town of Lyons
- St. Vrain and Left Hand Water Conservancy District
- U. S. Forest Service
- U.S. Natural Resources Conservation Service




All Coalition meetings were documented and summarized (summaries are included in Appendix A). As part of the planning process, Coalition members kept their respective local government staffs, elected officials, and/or constituent groups updated on the progress of the project.

## 5.2 *Key Stakeholder Interviews and Consultations*

In the first month of the planning process the project team conducted nine focused stakeholder interviews with key representatives from each of the Coalition member agencies. The purpose of the interviews was to learn more about the over-arching visions for the St. Vrain within each of the representatives' communities or jurisdictions. These interviews also provided valuable information related to which factors and issue areas were of most importance to each community/agency. Additionally, the interviews helped identify strategies for coordinating public involvement efforts to most effectively inform local constituencies and residents. Summaries of these interviews are included in Appendix A.

## 5.3 *Community Kick-Off Meetings, Lyons and Longmont*

The purpose of the June 2014 St. Vrain Creek Watershed Master Plan Kick-off Community Meetings was to announce the beginning of the master planning process, to inform the public about the long-term planning issues that the master plan would address, and to let the public know how to provide input. When advertising the community meetings, the project team made clear that the events were intended for all stakeholders and interested parties throughout the St. Vrain watershed, not only for the residents of the communities in which the meetings were hosted. Unincorporated Boulder County residents were highly encouraged to attend meetings that were most convenient for them. Moreover, members of the Coalition were in attendance at each public meeting in order to answer questions, record comments, and collaborate with community members.

The kick-off meetings were organized in the following way:

- Welcome and open discussions with the Coalition members;
- Project Team presentation followed by a large group discussion and question and answer session;
- Neighborhood-based small group break out discussions and opportunity for attendees to sign up for Reach-specific meetings.

Approximately 210 people attended the kick-off meetings (125 in Lyons and 85 in Longmont). Summaries documenting participant comments can be found in Appendix A.

## 5.4 *Draft Alternatives Community Workshops*

Four Community Workshops were held in September 2014 to share information from residents and stakeholders, to collect their input, and to refine channel alignment alternatives for inclusion in the master plan. The four workshops were organized by reach. This allowed for discussions to focus on details specific to each area..

The Community Workshops were held on the following dates:

- September 15, 2014 at the Boulder County Fairgrounds, Longmont, CO
- September 18, 2014 at Lyons High School, Lyons, CO
- September 22, 2014 at Wild Basin Lodge, Allenspark, CO
- September 24, 2014 at Boulder County Parks and Open Space, Longmont, CO

**Community Workshop Format:** The Community Workshops allowed the public to review alternatives and provide input on the study's findings and recommendations for draft channel alignments of the creek. Each workshop was focused on a different reach of the St. Vrain to facilitate focused discussions with residents from specific areas. The planning team gave an overview presentation outlining the master plan and how alternatives were developed. Following the presentation, members of the public were invited to directly interact and provide input around breakout stations facilitated by Coalition members and members of the consultant project team.

**Public Comment Submission:** Public input was obtained to help the consultant team and the Coalition refine the proposed alternatives and identify locally appropriate, multi-benficial recovery projects for the St. Vrain Creek Watershed Master Plan. The public was encouraged to provide comments and feedback by submitting written comment forms or by speaking to a Coalition/project team facilitator, who recorded public input on a series of maps that were displayed. For those that did not attend the workshops, comments were submitted by email or mail between the time when the draft report was published on September 8, 2014 to when the comment period concluded on October 3, 2014.

**Attendance and Comments:** Approximately 140 people attended the St. Vrain Community Workshops and approximately 130 comments were submitted via comment forms or email. Approximately 50 comments were submitted on the project maps. A summary of the Community Workshops, including a full list of public comments, is included in Appendix A. All comments were reviewed by St. Vrain Creek Coalition and consultant team members for further refinement of channel alignment alternatives.

## 5.5 *Final Public Meeting*

In the fall of 2014, near the conclusion of the master planning process, a concluding watershed-wide event has been planned to review the final draft of the master plan and inform participants of the key recommendations and next steps.

## 5.6 *Ongoing Public Engagement Activities and Communication Channels*

The primary public communication and information collection methods for this project included the following:

**Small Group Stakeholder Outreach Meetings:** Throughout the planning process the project team met with property owners, key stakeholder groups, and others to provide information about the study, collect feedback, and discuss issues related to the St. Vrain. In-person project announcements were made at meetings for Boulder County Flood Recovery, BoCo Strong Resilience, and other flood-related meetings to inform community members of the master plan progress and ongoing participation opportunities. Approximately 10 meetings were conducted during the development of the master plan. Notes and meeting summaries are included in Appendix A.

**Lyons Flood Recovery Task Force Meetings:** This planning effort included the direct facilitation and coordination of the Lyons Flood Recovery Task Force meetings. These meetings took place biweekly throughout the project and were facilitated by project team members S2o Design and Engineering.

**St. Vrain Master Plan Mailing List and Contact Database:** A contact database was developed for the planning effort as a method for communicating with individuals who wanted to stay informed about the study. The database was built by incorporating contact lists from previous flood recovery activities conducted by members of the St. Vrain Creek Coalition. Direct communications were sent through the database, including notifications of the June 2014 Kick-off Meetings and the September 2014 Community Workshops. At the conclusion of the study there were approximately 800 contacts included on the project mailing list. Email communications were consistently sent to provide new information to the project contact database.

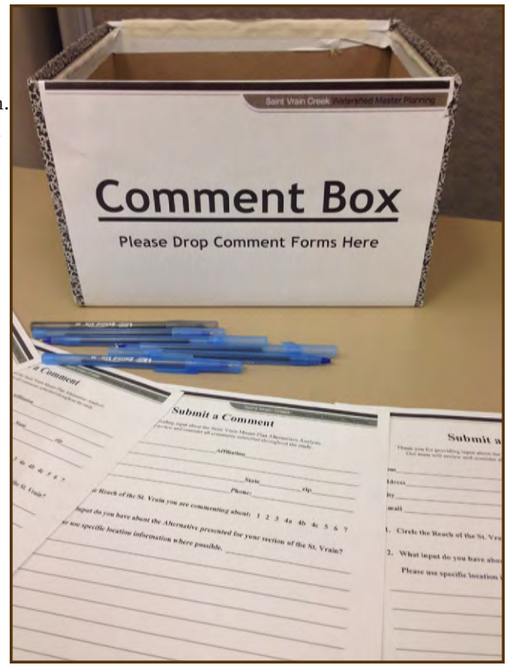
**Project Website:** At the start of the master planning project, the Baker Team created an interactive website to facilitate the public engagement process. The website served as the platform to make electronic drafts of the plan available to the public, to provide information about Coalition activities, and to post announcements. The website included a comments section and mailing list sign up, and presented an interactive map that allowed users to geographically identify and share their specific concerns. The project website was updated consistently with new information and also served as a two way communication channel between the public and the project team.

**Email Address and Phone Hotline:** The project team established an email address and telephone hotline that put residents and key stakeholders directly in touch with the project team. All comments and calls are documented and were answered directly. Responses were typically provided within 24 hours.

**Information Cards:** The project team created information cards to inform stakeholders of how to contact the project team, provide input, and obtain information. The cards included the project website address, the project team hotline, and a QR code that users could scan with their smart phones to directly connect to the website. The information cards were distributed by the project team at the kick-off community meetings, placed in public locations throughout the watershed, and distributed by Coalition members at flood-related meetings across the Planning Area.

**Public Comments:** Throughout the study, the public had ongoing, accessible, and distinct opportunities for participating and providing input to inform the study. Over the course of the study, the public submitted a large number of comments that were reviewed and taken into consideration. See Appendix A for all comments submitted during the course of the study.

**Media Advisories and Coordination with Public Information Officers:** Media advisories and project information was provided directly to Public Information Officers in Boulder County, Lyons, and Longmont for distribution through their pre-established communication channels.



# 6. ALTERNATIVE DEVELOPMENT AND EVALUATION

## 6.1 *Overview*

The planning team developed an Alternatives Analysis Report as an interim deliverable in the preparation of the final St. Vrain Watershed Master Plan. The purpose of the report was to gather stakeholder feedback on proposed options for flood affected areas to determine the most appropriate path forward to long-term flood recovery. The report (summarized here in Chapter 6, with detailed exhibits included in Appendix D) documents the data used to inform the proposed alternatives and the process used to determine the recommended alternatives for the various stream corridors in the watershed. Once stakeholder feedback was collected, preferred alternatives were advanced to the conceptual designs included in subsequent chapters of this master plan.

To initiate the process of alternative development, South St. Vrain Creek, Middle St. Vrain Creek, North St. Vrain Creek, and the main stem of St. Vrain Creek were divided into shorter reaches, as described in Chapter 3 of this report. These reaches were based on geopolitical boundaries, similar drainageway characteristics, roadway crossings, and other major land features. This division allowed the alternatives to better address the specific flooding problems in each reach, as well as providing guidance for future partnerships to fund and oversee the improvements themselves.

The goal of the alternative development process was to identify problem areas within each reach and to develop a wide-range of alternatives to meet the project goals. Alternatives which did not provide adequate flood mitigation or were not easily implemented were also identified and eliminated from further development early in the process. During the alternative development process, various alternatives were presented to the Coalition to facilitate discussion and group evaluation of each alternative. Feasible and non-feasible alternatives were screened accordingly so that the "best" alternate plans could be identified for more detailed evaluation. The creek alignments shown in the Figures in Appendix D are conceptual and based on limited technical information. Further site-specific studies, including detailed environmental and engineering studies, will be required before final creek alignment and project element designs are completed during implementation.

## 6.2 *Alternative Development*

The initial activity to determine the full range of potential alternatives was accomplished by pre-screening the following categories within each reach.

- "Status Quo" – maintain existing configuration
- Stream Restoration – natural channel design, habitat, etc.
- Structural Improvements and Additions – drop structures, flood control, etc.
- Conveyance Improvements – increase channel capacity
- Roadway Crossings, Underground Conduits – bridges and culverts
- Detention/Retention – dams, ponds, etc.
- Agricultural Diversions – diversion and ditch repair/improvements
- Recreation Improvements – in-stream activities, fishing access, trails, etc.
- Acquisition of Floodprone Properties – high flood risk properties
- Non-structural Measures – higher level of floodplain management

Alternatives considered for each reach were evaluated based on the following factors:

- Whether there was a need for flood mitigation;
- Whether flood mitigation could be achieved by conveyance or upstream detention;
- How the alternative would fit into the existing drainage way based on right-of-way and general consistency with long-term floodplain management along the corridor;
- Environmental considerations; and
- Whether the alternative was feasible.

Alternatives which were considered feasible were evaluated further (the evaluation process is described below). The pre-screening analysis was reviewed by the Coalition, revised, and finalized during the July 9, 2014 Coalition Progress Meeting.

A summary of the alternatives analysis pre-screening process is provided in Appendix D.

## 6.3 *Criteria and Constraints*

The following criteria and constraints were considered as part of the alternative development and evaluation process.

### *Criteria*

Below is a list of the criteria used to rank the various alternatives in each reach. The criteria are listed in no particular order.

**Table 6.1 Alternatives Ranking Criteria**

| Factor | Description |
|---|---|
| Addresses other reach objectives | Does the alternative address/incorporate other objectives for the reach (i.e. "preserve tree stand")? |
| Natural Channel Restoration | Does the alternative incorporate natural channel restoration methods? I.e. focus on restoring natural dimension, pattern, and profile to the extent possible, using natural materials for in-stream structure (logs, native rock), minimizing the use of structures not found in nature. |
| Recreation | Does the alternative promote recreational uses (trails, fishing access, whitewater, etc.)? |
| Fish Habitat | Does the alternative preserve, enhance, or restore fish habitat? |
| Flood Conveyance | To what degree does the alternative convey flood flows (100-yr, 50-yr, 25-yr, etc.)? |
| Flood Mitigation | Does the alternative address needed repairs to damaged infrastructure and property? |
| Environmental Restoration | Does the alternative restore environmental components such as the riparian zone, mammal/bird/reptile habitat, etc. |
| Public Safety | To what degree does the alternative restore or improve public safety? |
| Transportation | Does the alternative meet objectives of adjacent transportation (bridge, roadway, etc.) projects? |
| Aesthetics | To what degree is the alternative visually pleasing? |
| Permitting Requirements | How extensive are the permitting requirements for the alternative? |
| Right Of Way (ROW) Acquisition / Easements | How much ROW / Easements are required to implement the alternative? |
| O & M (operations and maintenance?) | How extensive are O & M requirements (cost, labor, etc.) for the alternative? |
| Agricultural / Irrigation | Does the alternative benefit or harm agricultural and/or irrigation stakeholders? |
| Consistency with Local Policies & Plans | Is the alternative consistent with local policies and plans (i.e. open space management plans)? |

### *Constraints*

Implementation of recommended and/or considered alternatives may face multiple challenges including, but not limited to, right-of-way acquisition, infrastructure limitations, permitting, cost, contractibility, long term maintenance issues, environmental impacts, and public acceptance. These constraints have been considered as part of the development process. In some cases, avoidance of one or more of these challenges may not be possible, but solutions to these challenges will be resolved during implementation phase with the benefit of additional technical data.

## 6.4 *Qualitative Evaluation Procedure*

The standardized criteria factors were all considered in the development of the final recommended alternative in this Alternatives Analysis Report. Each evaluation criteria was evaluated by reach and the alternatives were assigned a numerical value from 1 (least favorable) to 2 (most favorable - i.e. low cost, high benefit). The resulting alternative ranking is provided in the Alternatives Analysis Documentation in Appendix D.

In some cases the recommended plan differs from the highest scoring alternative. This is the case in some reaches where it is desirable to continue to provide long term stability of the channel or water quality improvements, but construction costs and benefit/cost ratios result in an overall lower weighted score.

The results of the qualitative evaluation are then used to inform the recommendation for a preferred alternative in each reach. These recommendations were presenting to the public in the community workshops described in Chapter 5. Stakeholder comments were collected and utilized to inform the recommendations and conceptual designs outlined in Chapter 7.

# 7. RECOMMENDATIONS AND CONCEPTUAL DESIGN STRATEGIES

The recommendations for the watershed reaches are outlined in this chapter (section 7.3). Recommendations reflect the preferred alternatives described in Chapter 6, advanced to conceptual design level to identify projects and associated costs to aid in implementation of the SVMP. An overview of the conceptual design strategies recommended for the various reaches is provided in section 7.1. The flood risk assessment, ecological assessment, and geomorphic assessment helped the Baker Team identify areas of need, while the input we received from various stakeholders through the public meetings, project website, the interactive map, and face-to-face meetings in the field helped us refine the ideas in the plan.

There are similarities with the goals and objective for the various reaches of the St. Vrain Creek Watershed; however, each reach and recommended project site has its own issues and set of constraints and the stakeholders in the various reaches have their own unique values. These constraints include multiple adjacent property owners, structures, limited access, roadways, existing mature tree stands, and utilities crossings. Additionally, the presence of natural or cultural resources dictates project constraints that must be incorporated into the design. All constraints are evaluated and used as a guide in recommending technically sound, environmentally sensitive, and cost effective solutions. Steps were taken to ensure that the recommended plan took both a holistic approach at creating recommendations for the good of the entire watershed, while also customizing solutions for the individual reaches.

## 7.1 Conceptual Design Strategies

A stream and its floodplain comprise a dynamic environment where the floodplain, channel, and bedform evolve through natural processes. Weather and hydraulic processes erode, transport, sort, and deposit alluvial materials throughout the riparian system. The size and flow of a stream are directly related to its watershed area and other factors, including geology, land use, soil types, topography, and climate. The morphology, or size and shape, of the channel reflect all of these factors.

In addition to transporting water and sediment, natural streams provide habitat for many aquatic organisms. Native vegetation along the banks provides a food source and regulates water temperatures. Channel features such as pools, riffles, steps, and undercut banks provide diversity of habitat, bedforms, oxygenation, and refuge. Stream restoration projects can help improve these features in concert with the return of a stable dimension, pattern, and profile. The following conceptual design strategies are recommended for various areas of the St. Vrain Creek Watershed to help create a self-sustaining riparian system.

**Incorporate/Stabilize a Low Flow/Bankfull Channel Section and Floodplain Bench:** The low flow/bankfull channel (Figure 7.1) is an essential element to a healthy and stable stream channel. The bankfull discharge, or discharge that fills the low flow/bankfull channel, is the flow at which natural channel maintenance is most effective. Bankfull discharges correspond to a discharge with a recurrence interval between 1 and 2 years. The low flow/bankfull channel would be designed to carry this event. To further reduce energies and shear stress placed on stream banks, the channel cross-section will be modified to incorporate a floodplain bench (Figure 7.2). This approach decreases the stress placed on banks by decreasing flow velocities and depth for a given discharge. Beyond helping to stabilize the channel, this approach also increases the cross-sectional area of the overall flood channel, potentially decreasing the flood stage during storm events as compared to the current condition. At a minimum, the proposed excavation of floodplain benches would provide increased storage capacity during storm events, aiding in the attenuation of storm flows. The floodplain benches can be vegetated with native seeding, willow staking, cottonwood poles, and other native transplants.

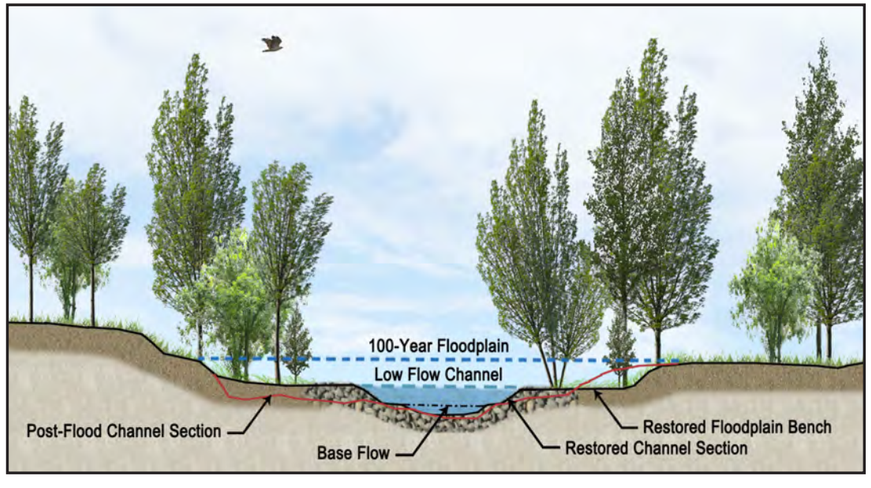



Figure 7.1 Typical Channel Restoration Section*

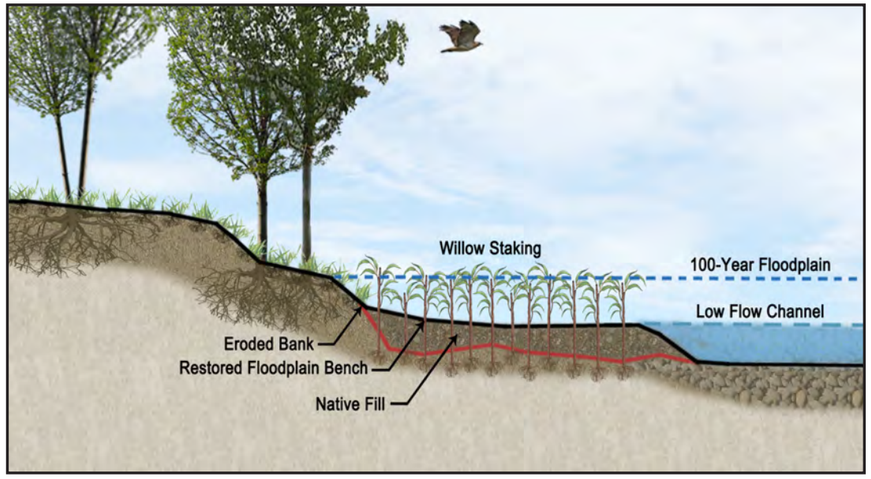



Figure 7.2 Floodplain Bench Detail*

* Low Flow Channel is synonymous with Bankfull Channel

## 7.2 Site-specific Considerations

To further reduce energies and shear stress placed on stream banks, the channel cross-section will be modified to incorporate a floodplain bench. This approach decreases the stress placed on banks by decreasing flow velocities and depth for a given discharge. Beyond helping to stabilize the channel, this approach also increases the cross-sectional area of the overall flood channel, decreasing the water surface profile during larger storm events as compared to the current condition.

**Bank Protection:** The type of bank protection recommended by this plan varies depending on the location of the protection and what is being protected. Boulder bank protection (Figure 7.3) is the recommended bank protection in high risk areas such as banks in the vicinity of bridge abutments, culvert inlets and outlets, roads, and existing structures. Boulder bank protection provides reliable and immediate channel bank protection. The bank protection should include a boulder key to prevent the toe of the protection from scouring, and a filter layer that prevents fine grained native materials from piping through the boulders while still allowing seepage. To improve revegetation and wildlife habitat, covering rip rap with soil and planting appropriate species in the voids is recommended.

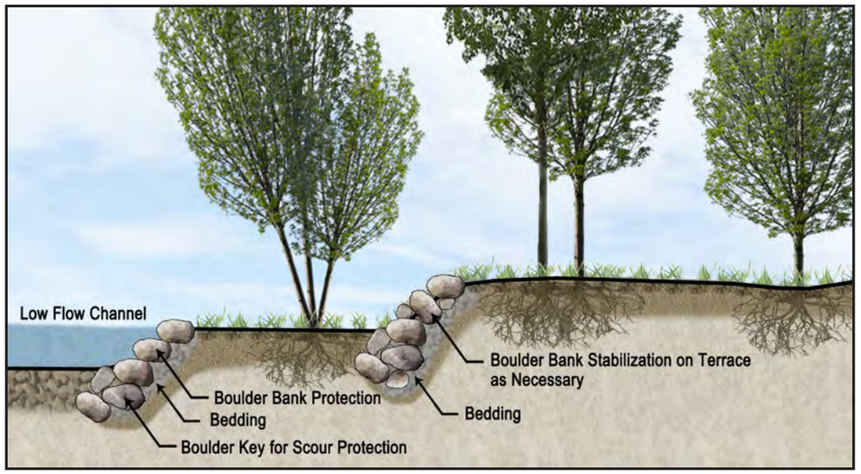



Figure 7.3 Boulder Bank Protection Detail*

The use of root wads and large woody debris (Figures 7.4 and 7.5) is recommended for bank protection in lower risk areas where structures and infrastructure are not present, unless determined to be adequate based on additional analysis. The use of these structures incorporates native woody material into a submerged channel bank to replicate natural stable channel banks and add flow resistance for bank protection. The root wads are cantilevered over foundation logs to provide an undercut bank for in-stream and overhead cover for aquatic habitat. Woody material is placed over and between the toe logs, and backfill and riparian vegetation are placed over the toe material up to the bankfull stage.

**Breach Repairs:** The breach repairs recommended in this plan are intended to be engineered to withstand a 100-year flood event and its associated velocities in the vicinity of the breach. Due to the multiple breaches during the September 2013 flood, the nature of the construction of former mining site ponds, and the potential for future breaches to increase flood risk downstream, more robust engineering solutions for these repairs are recommended. This may include but not limited to impervious core construction within an embankment (may be clay or hardened materials such as concrete), additional toe armoring (preferred rip rap to be buried and planted), and evaluation of how overtopping flood waters can be conveyed back to the historic flow path.

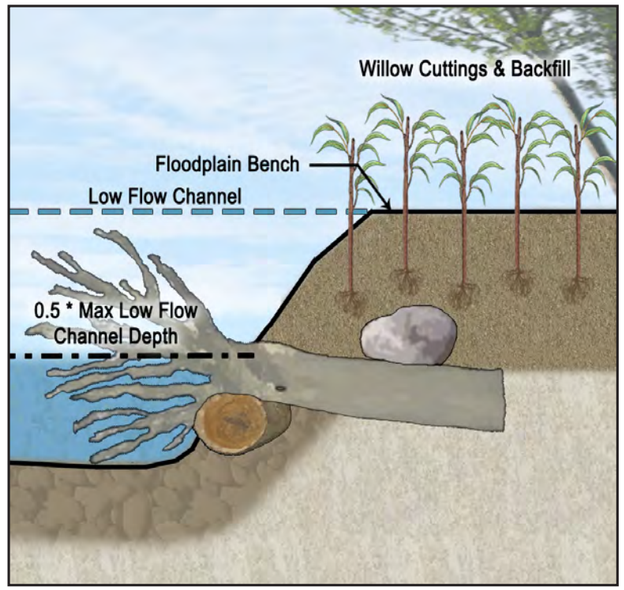



Figure 7.4 Large Woody Debris Bank Protection Detail*

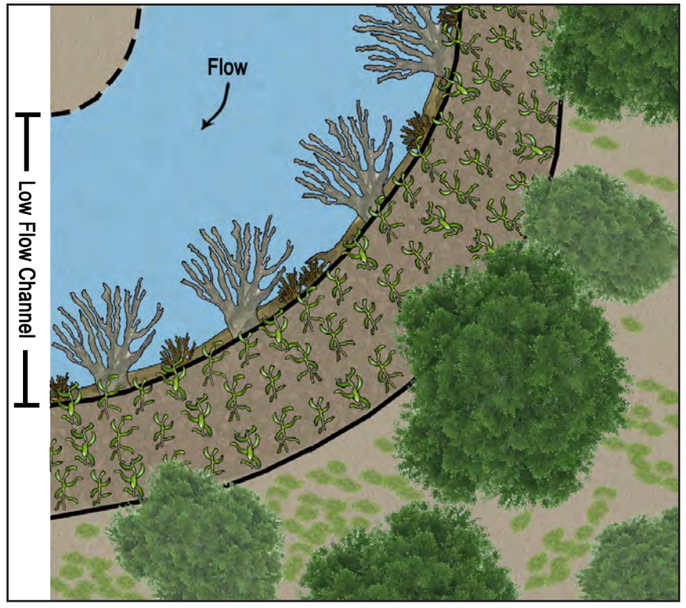



Figure 7.5 Large Woody Debris Bank Protection Plan View*

* Low Flow Channel is synonymous with Bankfull Channel

**Increasing In-Stream Habitat Complexity:** Several types of in-stream features are commonly utilized for stream restoration projects to not only provide grade control and stream bank protection, but also improve in-stream habitat and bed form diversity (Figure 7.6). In-stream features typically consist of natural materials, predominantly large rock and wood. The rock materials used range from gravel to boulders, while the wood materials are comprised of trees, including the root wads (or root balls), tree trunks, as well as the smaller materials from branches and tree tops. In-stream features constructed from logs are typically limited to those applications where the wood materials remain permanently saturated such that those materials do not rot and deteriorate prematurely. In some situations, natural materials used for the construction of in-stream features can be harvested on-site during the construction process. For example, trees removed during the clearing phase of construction can often be "recycled" into an in-stream feature such as Large Woody Debris (LWD) or root wads. Some examples of in-stream features that can be used to increase habitat complexity include:

» Constructed Riffles - A constructed riffle is created by placing well-graded material (gravel, cobble, and small boulders) in the stream at specific riffle locations along the profile. The purpose of this structure is to provide initial and/or permanent grade control and establish riffle bedforms within the restored channel. Constructed riffles function in a similar way as natural riffles; the gravel and cobble surfaces and interstitial spaces are crucial to the life cycles of many aquatic macroinvertebrate species. From a stability standpoint, riffles establish the overall grade for a stream reach and maintain the low water surface slopes of the upstream pools.

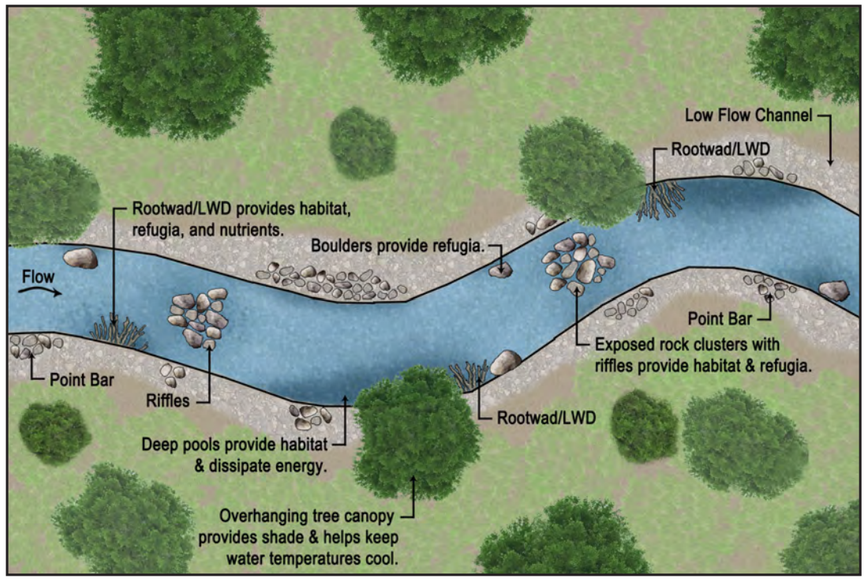



Figure 7.6 In-Stream Stability and Habitat Examples*

» Pools – Pools are an important feature in a channel's bed form diversity. Pools are deep areas created by scour that have slopes that are much less than the reach average slope. For fish, these pools form areas of refuge due to increased water depth, and prime feeding areas as food items are washed into the pool from the riffle or step directly upstream.

» Step-Pools –– Step-pools naturally exist in higher gradient channels, and are used to provide grade control and bed form diversity. Step-pools are constructed by installing abutting courses of footer and header rocks in a formation of cascading or stepped, alternating pools with stepped sills in between. The sills are installed at the same elevation as the streambed, but should not be installed such that they back up water in the channel like a weir. Step-pool structures are constructed out of large boulders and not riprap. The pools depth is site specific and varies depending on the configuration of the structure, flow velocity and gradient, and bed material of the stream.

» Root Wads and Large Woody Debris – Root Wad and Large Woody Debris structures may be constructed using a combination of native materials such as logs, branches, brush, live cuttings, and large root wads. The structures help ensure long-term stability against eroding banks and provide a more natural appearance than hard armoring. The structures can be a cost-effective solution for bank protection while restoring channel dimensions and floodplain connection. In addition to providing stream bank stability, the structures enhance aquatic and terrestrial habitat within the pool area by establishing a source of detritus and large woody debris. See Appendix I for a recent report related to Large Woody Debris in the September 2013 flood-affected areas.

» In-Stream Boulders – Boulders are naturally deposited in the channel of mountain streams and help to provide channel complexity. Natural boulders may be placed in the stream in areas of faster moving water (e.g. riffles) to provide refuge for fish.

**Stream Crossings:** It is recommended that stream crossings be designed to minimize the negative impacts on stream stability, sediment transport, aquatic habitat and fish passage while meeting prescribed hydraulic and structural criteria. The goal is to construct a stable channel system that neither scours nor aggrades. The recommended approach includes maintaining the consistency of dimension, pattern and profile of the stream with particular attention to avoid obstructing the low flow/bankfull channel width. Where feasible, the use of bridges or arch culverts to minimize floodplain restrictions is recommended. Alternatively, culvert systems should consider the use floodplain culverts, to provide additional hydraulic capacity and limit downstream scour and erosion at the main culvert (Figure 7.7). Considerations related to both flood hazard and ecological impacts both up and downstream of any potential bridge improvements is critical. The following US Forest Service design methodology for assessing, designing, and constructing road-stream crossings is provided as a resource:

http://www.fs.fed.us/eng/pubs/pdf/StreamSimulation/index.shtml

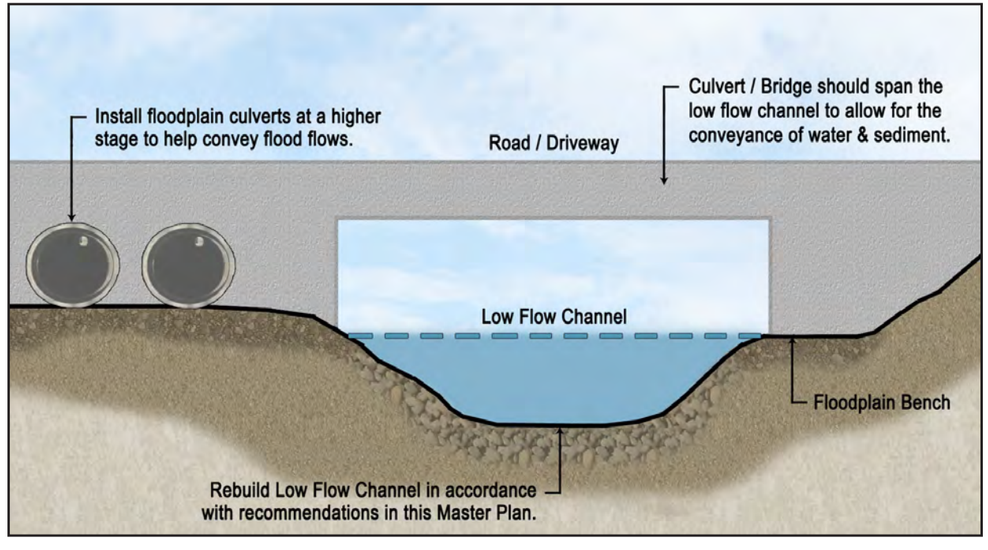



Figure 7.7 Stream Crossing Configuration Detail*

* Low Flow Channel is synonymous with Bankfull Channel

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## 7.3 Recommendations

### 7.3A Reach 1

#### Overview

Reach 1 begins at the confluence of St. Vrain Creek with Boulder Creek and ends at the eastern corporate limits of Longmont. A small portion of the upstream limits of this reach is within BCPOS limits, while the remainder crosses through both privately-owned and City of Longmont property. This reach exists within a wide-bottom valley and is generally not confined geologically. There is very little urbanization adjacent to the channel corridor and the surrounding land use is generally comprised of agricultural and rural land uses with a significant amount of mining operation. Sand and gravel mining operations have been prominent in this reach over the past two decades and have encroached upon the channel resulting in various degrees of channel realignment.

Drainageway crossings within this reach exist at:

- Highway 119 (downstream)
- Pedestrian bridges adjacent to the Sandstone Ranch Community Park
- Weld County Road 1
- North 119th Street

The confluence of Dry Creek with St. Vrain Creek occurs near the eastern boundary of the private residence that exists to the northeast of Quicksilver Road and Weld County Road 1. Additionally, the Spring Gulch ditch flows through Sandstone Ranch Community Park from the north and connects with St. Vrain Creek just to the west of the damaged pedestrian bridge.

Historical aerial photography was reviewed to help identify the conditions that existed prior to flooding in this reach. The riparian corridor adjacent to the channel was densely vegetated with a combination of native and non-native species and ranged in width from 300 feet to 500 feet. The channel was highly sinuous and appeared to generally be in a stable state with no visible signs of vertical or horizontal instabilities. Although the adjacent floodplain has been historically connected to the channel, sand and gravel mining operations have been present over the past two decades which have altered the natural floodplain function.

During the September 2013 flood, almost all of the gravel mining sites to the south of this reach were breached. This sequence of breaches resulted in the St. Vrain Creek being diverted from the historical flowpath to a path that currently flows through the gravel mining sites. The confluence with Boulder Creek currently exists approximately 1,400 feet upstream on Boulder Creek of the pre-flood confluence. Although the new flowpath does not adversely affect infrastructure, the stream is unstable and the connectivity is largely nonexistent. Groundwater and sub-surface flows are still infiltrating into the pre-flood channel alignment resulting in several areas of ponded water and providing some wetland habitat.

#### Assessment

The ecological assessment did not encompass the segment of St. Vrain Creek downstream of County Road 1 because it was inaccessible at the time. However, based on observation during field work, this reach would likely be classified as being in Poor or Fair condition because of channel instability, eroding banks, barriers to movement of fish and aquatic organisms, and disconnected riparian areas. The primary recommendation from the ecological assessment is to ensure that all future bridges and/or culverts that are placed within the creek corridor span the active (low-flow) channel to encourage ecological connectivity.

The pre-flood channel alignment was filled with minor to moderate amounts of deposition while the post-flood alignment experienced severe erosion. The planform for this reach of St. Vrain Creek has been relatively stable over the past 60 years. However, there has been some natural lateral migration across the floodplain during this time period. The results of the geomorphic assessment show that the alignment of the channel changed drastically between pre- and post-flood conditions as a result of an avulsion through the gravel mining sites. As a result, the planform geometry for this reach is less sinuous and steeper when compared to pre-flood conditions. The primary recommendation from the geomorphic assessment is to return the channel to the pre-flood alignment. However, it is noted that this recommendation may be cost prohibitive.

Infrastructure damage from flooding occurred to the County Road 1 Bridge, the pedestrian bridge adjacent to Sandstone Ranch Community Park, and the driveway leading to the private residence that exists to the northeast of Quicksilver Road and Weld County Road 1. There are a few private residences that are at risk for future flooding during a 100-year event.

#### Plan Recommendations

Two different alternatives were evaluated for this reach, both of which are described in more detail in Appendix D. General descriptions of each alternative are outlined below. Since the development of the Alternatives Analysis Report, the City of Longmont issued a Request for Proposal titled "St. Vrain Creek Improvement Project" to solicit design services for the completion a natural channel restoration for this portion of the St. Vrain Creek. City of Longmont voters approved a $20 million Storm Drainage Bond to help fund these proposed improvements. In addition, the City has worked with FEMA on flood damage relief for City owned property and improvements along these sections of the St. Vrain Creek and has created a Public Assistant Alternative Procedures Project (PAAP). Additional City Funds have also been identified for this project, and the City has applied for Army Corp of Engineers, FEMA and Community Development Block Grant - Disaster Recovery (CDBG-DR) funds for this project. This project will be completed under a separate contract and will perform a more detailed alternatives analysis in order to determine the appropriate design strategy for this reach. Once the design strategy is determined, construction documents will be prepared. This contract has been awarded and design will begin by the end of 2014. As a result, neither alternative that was presented in the Alternatives Analysis Report was carried forward into a conceptual design as a part of this project.

**Alternative 1 – Split Channel**

The purpose of this alternative is to preserve the pre-flood channel alignment and add an additional channel to the south of the pre-flood channel. Flow will be delivered to the pre-flood channel with a baseflow diversion, which will help sustain the existing riparian vegetation throughout this corridor. The new channel alignment to the south will convey a majority of the flow in this reach. Flood conveyance is improved with this alternative by eliminating constrictions in the floodplain and implementing floodplain culverts to help convey flood flows through embankments. It is important to note that a significant amount of fill will be required to eliminate the risk of a future avulsion through the gravel mining sites and to allow for the construction of the confluence of the parallel channels near the downstream end of this reach.

**Alternative 2 – Minor Stabilization**

This purpose of this alternative is to implement only the improvements required to protect infrastructure and property that are at risk of being damaged and to implement site-specific projects to protect against major modes of failure. Major modes of failure in this reach consist of headcutting through the gravel mining sites and a potential avulsion through the pre-flood channel alignment. Most of the channel will generally remain in the post-food alignment and continue to cascade through the gravel mining sites. It is important to note that the channel will continue to erode and migrate in the absence of any stabilization measures and continued erosion could eventually encroach upon Boulder Creek and adjacent private property.

Work that is in the process of being completed consists of the bridge and road design at Weld County Road 1.

General restoration recommendations consist of:

- Incorporate/stabilize a low flow/bankfull channel section with the following general design parameters:

| Design Parameter | Min | Max |
|---|---|---|
| Low flow/bankfull Channel Top Width | 100 | 200 |
| Slope | 0.002 | 0.004 |
| Ave. Low flow/bankfull Channel Top Width-to-Depth Ratio | 30 | |
| Ave. Sinuosity | 1.4 | |

- Increase in-stream habitat complexity by incorporating pools, rock clusters, and LWD
- Revegetate the riparian corridor with native species where needed
- Maximize floodplain conveyance and reduce/eliminate floodplain constrictions
- Optimize the flood conveyance capacity of all drainageway crossings
- Design drainageway crossings so that the low-flow channel remains unobstructed and provide additional floodplain conveyance capacity by utilizing floodplain culverts

## *Estimated Cost of Unmet Needs*

We have assumed that all costs associated with this reach will be covered by the budget developed for the St. Vrain Creek Improvement Project. Therefore, an estimated cost of unmet needs was not prepared for this reach.

## 7.3B REACH 2

### Overview

Reach 2 begins at the eastern corporate limits of the City of Longmont and ends at Airport Road. The extents of this reach are mostly within the City of Longmont; however, there are sporadic segments of privately owned land and some BCPOS land exists at the downstream extent of the reach. This reach exists within a wide-bottom valley and is generally not confined geologically. However, this portion of the St. Vrain watershed is heavily urbanized with residential, commercial, and industrial land uses all of which have either restricted or influenced the alignment of the St. Vrain Creek.

Drainageway crossings within this reach exist at:

- Highway 119 (downstream)
- Martin Street
- Main Street
- Pratt Parkway
- Price Road
- Boston Avenue
- Sunset Street
- Hover Street

Adjacent drainageway and ditch infrastructure include:

- Confluence of Left Hand Creek - Downstream of Martin Street, adjacent to the wastewater treatment plant
- Confluence of Dry Creek - Downstream of Main Street, adjacent to the wastewater treatment plant
- Bonus Ditch – Just downstream of Martin Street
- Confluence of Lykins Gulch – Downstream of Airport Road
- Beckwith Ditch – Upstream of the Lykins Gulch confluence

Historical aerial photography was reviewed to help identify the conditions that existed prior to flooding in this reach. The riparian corridor adjacent to the channel was densely vegetated with a combination of native and non-native species and ranged in width from 200 feet to 300 feet. The adjacent floodplain has been historically connected to the channel; however, the significant amount of development has altered the natural floodplain function.

The City of Longmont was among the hardest hit communities during the catastrophic flooding event in September 2013. Damages to City infrastructure, in excess of $148 million, included significant damages to parks and trails along the St. Vrain corridor. A number of homes were flooded throughout Longmont and numerous bridges and culverts were damaged by floodwaters and debris.

### Assessment

The results of the ecological assessment show that this reach is mostly in "Fair" condition with overall scores ranging between 5-7 out of 10. The lowest scoring elements from the ecological assessment are the degree of hydrologic alteration and factors impacting fish and aquatic habitat. The channel is somewhat unstable and the channel banks are eroding in some locations. The streamflow in this reach has been significantly altered due to upstream hydrologic controls such as diversions, gravel mining sites, and reservoirs. Hydrologic alteration also has adverse impacts on habitat and riparian ecosystems. The primary recommendations from the ecological assessment are to rebuild floodplain benches, incorporate a low flow/bankfull channel, and improve in-stream habitat by incorporating pools and planform complexity.

Most of the reach downstream of Hover Street experienced a minor amount of erosion while upstream of Hover Street incurred minor amounts of deposition. The gravel mining sites adjacent to this reach were generally filled with a minor amount of sediment, except in locations where breaches occurred. The planform for this reach of St. Vrain Creek has been relatively consistent through the river corridor over the past 60 years. The results of the geomorphic assessment show that the alignment of the channel did not change significantly between pre- and post-flood conditions with the exception of at Dickens Farm Park, where the pond was breached during the flood. The primary recommendation from the geomorphic assessment is to return the channel to the pre-flood alignment.

Substantial infrastructure damage from flooding occurred throughout this reach and several homes were flooded. Numerous businesses and private residences continue to be at risk for future flooding during a 100-year event if no improvements are made. Both Main Street Bridge and Sunset Street Bridge were damaged to the point of requiring reconstruction.

### Plan Recommendations

Two different alternatives were evaluated for this reach; however, a formal alternatives analysis was not completed. The alternatives and planning recommendations are being determined by ongoing planning and design efforts being completed by the City of Longmont. Longmont hired CH2M Hill to completed a conceptual analysis and design for a 100-year flood conveyance channel between the Golden Ponds and just downstream of Martin Street. There are two alternatives identified in the report titled "Saint Vrain Creek through Longmont: 100-Year Conceptual Design". Both alternatives provide a means of conveying the 100-year peak flow, but differ in total channel width. The wider of the two channel alternatives is depicted in the figures for this reach, which are provided in Appendix D.

Since the development of the Alternatives Analysis Report, the City of Longmont issued a Request for Proposal titled "St. Vrain Creek Improvement Project" to solicit design services for the completion a flood-control channel for this portion of the St. Vrain Creek. City of Longmont voters approved a $20 million Storm Drainage Bond to help fund these proposed improvements. In addition, the City has worked with FEMA on flood damage relief for City owned property and improvements along these sections of the St. Vrain Creek and has created a Public Assistance Alternative Procedures (PAAP) Pilot Program. Additional City Funds have also been identified for this project, and the City has applied for Army Corp of Engineers, FEMA, and Community Development Block Grant - Disaster Recovery (CDBG-DR) funds for this project. This project will be completed under a separate contract and will perform a more detailed alternatives analysis in order to determine the appropriate design strategy for this reach. Once the design strategy is determined, construction documents will be prepared. This contract has been awarded and design will begin by the end of 2014. As a result, neither alternative that was presented in the Alternatives Analysis Report was carried forward into a conceptual design as a part of this project.

Work that has been, or is the process of, being completed to restore flood-damaged infrastructure is outlined below:

- Main Street Bridge and road repairs
- Sunset Street Bridge and road repairs
- Miscellaneous temporary bank stabilization projects
- Miscellaneous temporary pond embankment stabilization projects

General restoration recommendations consist of:

- Coordinate design objectives with Dickens Farm Park
- Incorporate/stabilize a low flow/bankfull channel section
- Increase in-stream habitat complexity by incorporating pools, rock clusters, and LWD where feasible
- Revegetate the riparian corridor with native species where needed
- Maximize floodplain conveyance and reduce/eliminate floodplain constrictions
- Optimize the flood conveyance capacity of all drainageway crossings
- Design drainageway crossings so that the low-flow channel remains unobstructed and provide additional floodplain conveyance capacity by utilizing floodplain culverts

## *Estimated Cost of Unmet Needs*

We have assumed that all costs associated with this reach will be covered by the budget developed for the St. Vrain Creek Improvement Project. Therefore, an estimated cost of unmet needs was not prepared for this reach.

## 7.3C REACH 3

### Overview

Reach 3 begins at Airport Road and ends at Highway 36 near Lyons. This reach crosses between City of Longmont, BCPOS, and private property. This reach exists within a wide-bottom valley and is generally not confined geologically. There is little urbanization adjacent to the channel corridor and the surrounding land use is generally comprised of agricultural and rural land uses with some mining operation. Sand and gravel mining operations have been prominent in this reach over and have encroached upon the channel resulting in various degrees of channel realignment.

Drainageway crossings within this reach exist at:

- Airport Road
- 75th Street
- Crane Hollow Road
- Hygiene Road
- 63rd Street
- 51st Street
- Private entrance into CEMEX
- Highland Drive

Additional drainageway and ditch infrastructure in the vicinity of this reach include:

- South Flat Ditch – Between Airport Road and 75th Street
- Niwot Ditch – Between Airport Road and 75th Street
- Pella/Peck/CB Ditch – Between 75th Street and Crane Hollow Road
- Pella Ditch – Between 75th Street and Crane Hollow Road
- Zweck & Turner Ditch – Between 75th Street and Crane Hollow Road
- Mill & Runyon Ditch – Between 75th Street and Crane Hollow Road
- North Branch Ditch – Between Crane Hollow Road and Hygiene Road
- Oligarchy Ditch – Between 63rd Street and 51st Street
- Longmont Supply Ditch – Between 63rd Street and 51st Street
- Chapman and McCaslin Ditch – Between 63rd Street and 51st Street
- South Branch Ditch – Between 63rd Street and 51st Street
- Foothills Inlet Ditch – Between 63rd Street and 51st Street

Historical aerial photography was reviewed to help identify the conditions that existed prior to flooding in this reach. The riparian corridor adjacent to the channel was densely vegetated with a combination of native and non-native species and ranged in width from 200 feet to over 500 feet. The channel was moderately sinuous and appeared to generally be in a stable state with no visible signs of vertical or horizontal instabilities. Although the adjacent floodplain has been historically connected to the channel, sand and gravel mining operations have altered the natural floodplain function for a majority of this reach.

During the September 2013 flood, several gravel mining sites upstream of Hygiene Road were breached which resulted in the St. Vrain Creek being diverted from the historical flowpath to a path that flowed through the gravel mining sites. The St. Vrain Creek has since been returned to the pre-flood flowpath in all instances where this occurred. Breach 7, upstream of Hygiene Road resulted in flooding outside of the 100-year floodplain and affected neighborhoods downstream in the City of Longmont.

### Assessment

The results of the ecological assessment show that this reach is in "Fair" to "Good" condition with overall scores ranging between 6-7 out of 10. The lowest scoring elements from the ecological assessment are the degree of hydrologic alteration and factors impacting fish and aquatic habitat. Additionally, the channel is somewhat unstable and the channel banks are eroding in some locations. The streamflow in this reach has been significantly altered due to upstream hydrologic controls such as diversions, gravel mining sites, and reservoirs. Hydrologic alteration also has adverse impacts on habitat and riparian ecosystems. The primary recommendations from the ecological assessment are to increase the capacity of Airport Road Bridge, improve and expand riparian zones, enhance and preserve floodplains, and incorporate a low flow/bankfull channel.

A significant amount of erosion occurred in gravel mining sites in the upstream portion of this reach. Most of the eroded material was either deposited in other gravel mining sites or in the channel downstream of Hygiene Road. The planform for this reach of St. Vrain Creek has been relatively consistent through the river corridor over the past 60 years; however, there has been some natural lateral migration across the floodplain during this time period. The results of the geomorphic assessment show that the alignment of the channel is similar between pre- and post-flood conditions, except in areas of avulsion. Specifically, the post-flood channel alignment did change drastically as a result of an avulsion through the ponds upstream of Hygiene Road. The planform geometry at these locations is less sinuous and steeper when compared to pre-flood conditions. The primary recommendation from the geomorphic assessment is to return the channel to the pre-flood alignment.

Two notable areas of flooding occurred during last September in this reach. The first was upstream of the CEMEX plant where flood flows overtopped the channel banks and the road entrance to the plant (locally referred to as Breach 1). Flood flows continued downstream and entered the BCPOS ponds, which ultimately resulted in an avulsion and drastic change in channel alignment. The second area is the overtopping of a pond just upstream of Hygiene Road (Breach 7), which eventually resulted in additional pond flooding and breaches downstream. Flood flows eventually overtopped the adjacent railroad and flooded many homes downstream that were outside of the effective 500-year floodplain depicted on the FEMA effective maps. No roadway crossings were completely destroyed, but some of them experienced minor damage. The Airport Road Bridge did become clogged with debris and caused flooding on adjacent landowners' properties.

It should be noted that many of the breaches in this reach have emergency repairs implemented at this time, and the majority of hazardous debris in the channel was removed. A large amount of work has gone into minimizing flood risk in anticipation of the 2014 spring run-off season and the potential of another flood prior to permanent repairs. In most cases, these efforts performed by BCPOS, City of Longmont, and private property owners, have returned the stream flows to the pre-flood channel. The proposed site-specific projects in this chapter may be permanent repairs to emergency measures that were undertaken by others.

### Plan Recommendations

The primary issues within this reach include lateral channel migration and bank erosion, sediment deposition/aggradation, sediment erosion/degradation, debris blockages throughout the reach and at drainageway crossings, and several breaches at gravel mining sites. The sections of this reach between 75th Street and Hygiene Road and 63rd Street and 51st Street are generally in stable condition and will likely be able to recover without additional restoration activities. Additionally, there are large areas of riparian habitat that are still intact and should be preserved where possible. In locations where the channel needs to be restored, both cutting and filling will be required depending on what portion of the reach restoration will occur.

Some of the priorities identified by stakeholders include increasing flood conveyance capacity in several locations, debris removal, optimizing flood conveyance at drainageway crossings, preserving and restoring native fisheries, restoring the channel, and improved in-stream recreational safety.

The recommended plan for Reach 3 is shown on the following Figures in this Section. Planning recommendations for this reach are outlined below.

**Drainageway Crossings**

- » Evaluate all drainageway crossings and optimize the flood conveyance capacity using the design flows published in the CDOT/CWCB study, when it becomes available.
- » Design new/improved drainageway crossings so that the low-flow channel remains unobstructed in order to maintain channel stability and achieve ecological connectivity. Provide additional floodplain conveyance capacity by utilizing floodplain culverts in the overbank areas.
- » Remove debris blockages.

The conveyance improvements at the Airport Road Bridge are extremely important to mitigate flooding downstream of this reach. This bridge was overtopped during the September 2013 flood and the current configuration results in overtopping during the 100-year flood. It is important that improvements be made at this crossing to either increase the capacity of the bridge to convey the 100-year flood without overtopping or modify the road profile so that the road does not overtop. Roadway overtopping at this location could negate the benefit of the planned flood control channel improvements in Reach 2 because flood flows would spread out on the overbanks and not be contained within the flood control channel. Design consideration needs to be given to how improvements at this crossing impact upstream and downstream water levels and corresponding fish habitat in this area.

**Pond Breaches**

- » Fill areas where breaches occurred using on-site material where possible. Engineered embankments are recommended for a portion of the breach reconstruction and should consider options for incorporating an application of impervious core material.
- » Protect and stabilize pond embankments that are adjacent to the creek using buried riprap and vegetation.
- » Incorporate flood relief channels with berms for Heron Lake and the pond upstream of Airport Road. These relief channels are intended to redirect larger flood events should breaches similar to those experienced during the September 2013 floods occur in the future.

**Channel Restoration**

- » Incorporate/stabilize a low flow/bankfull channel section with the following general design parameters.

| Design Parameter | Min | Max |
|---|---|---|
| Low flow/bankfull Channel Top Width | 100 | 200 |
| Slope | 0.005 | 0.01 |
| Ave. Low flow/bankfull Channel Top Width-to-Depth Ratio | 30 | |
| Ave. Sinuosity | 1.2 | |

- » Increase in-stream habitat complexity by incorporating pools, rock clusters, boulders and large woody debris.
- » Revegetate the riparian corridor with native species where needed.
- » Site-specific bank stabilization to protect adjacent infrastructure and private property.
- » Fill areas and revegetate areas that are at high risk of avulsion.
- » Remove debris blockages.
- » Coordinate channel improvements with ditch companies to ensure desired level of operation is maintained and investigate opportunities to work together to incorporate design aspects that are multi-beneficial.

**Work In Progress**

Work that has been, or is the process of, being completed to restore flood-damaged infrastructure is outlined below:

- » Miscellaneous temporary bank stabilization projects.
- » Miscellaneous temporary pond embankment stabilization projects.
- » Locations of future mining sites can be found in the *St. Vrain Creek Corridor Open Space Management Plan*. (Boulder County Parks & Open Space, 2004). Any work in the area should be coordinated with these activities to look for opportunities to find mutually beneficial partnerships to promote flood risk reduction and habitat enhancement.

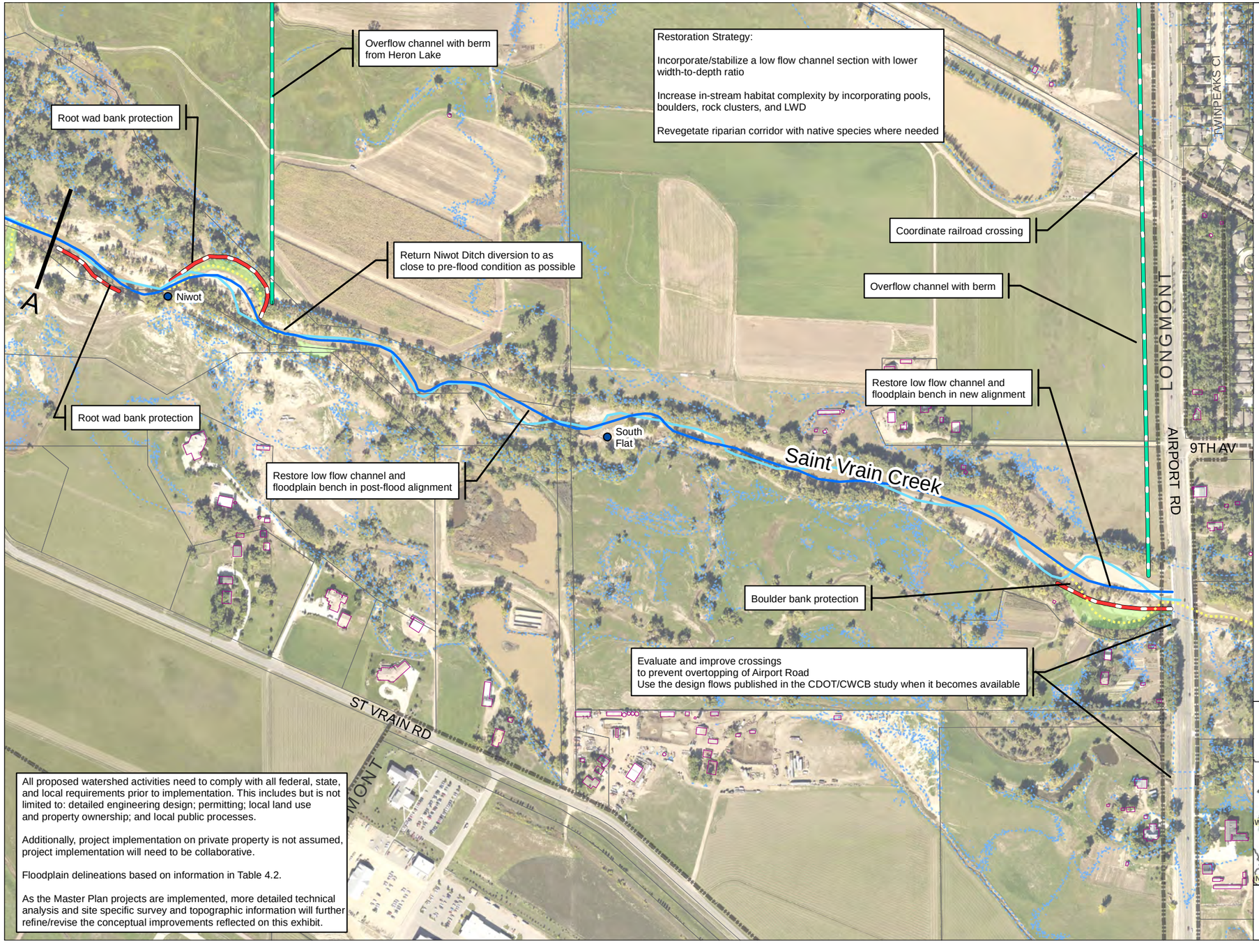
## *Estimated Cost of Unmet Needs*

Estimated costs for unmet needs were prepared to capture the capital that could be required to implement plan recommendations. These estimated costs do not include projects that are currently being completed or that are programmed. The estimated costs for unmet needs in this reach are provided in Table 7.1.

**Table 7.1 Estimated Costs for Reach 3**

| Airport to 75th St. | Qty | Unit | Unit Cost | Cost |
|---|---|---|---|---|
| Low flow/bankfull Channel Restoration | 7206 | LF | $350 | $2,522,100 |
| Fill | 14138 | CY | $10 | $141,381 |
| Revegetate | 165988 | SF | $1 | $165,988 |
| Bank Protection - Boulder | 517 | LF | $275 | $142,175 |
| Bank Protection - Root Wad | 964 | LF | $165 | $159,060 |
| Pond Breach Repair - Fill | 4840 | CY | $35 | $169,409 |
| Airport Road Crossing Improvement | 18600 | SF | $125 | $2,325,000 |
| 75th Street Crossing Improvement | 6130 | SF | $125 | $766,250 |
| Heron Lake Overflow Channel | 1000 | LF | $600 | $600,000 |
| Overflow Channel Upstream of Airport Road | 3000 | LF | $600 | $1,800,000 |
| Overflow Channel - Railroad Crossing | 1 | EA | $1,500,000 | $1,500,000 |
| **75th Street to Hygiene Road** | **Qty** | **Unit** | **Unit Cost** | **Cost** |
| Low flow/bankfull Channel Restoration | 1817 | LF | $350 | $635,950 |
| Fill | 529 | CY | $10 | $5,287 |
| Revegetate | 3569 | SF | $1 | $3,569 |
| Bank Protection - Boulder | 105 | LF | $275 | $28,875 |
| Bank Protection - Root Wad | 442 | LF | $165 | $72,930 |
| Pond Breach Repair - Fill | 7636 | CY | $35 | $267,265 |
| Crane Hollow Road Improvement | 4884 | SF | $125 | $610,500 |
| Hygiene Road Crossing Improvement | 6007 | SF | $125 | $750,875 |
| **Hygiene Road to HWY 36** | **Qty** | **Unit** | **Unit Cost** | **Cost** |
| Low flow/bankfull Channel Restoration | 7921 | LF | $350 | $2,772,350 |
| Fill | 41896 | CY | $10 | $418,961 |
| Revegetate | 299287 | SF | $1 | $299,287 |
| Bank Protection - Boulder | 4812 | LF | $275 | $1,323,300 |
| Bank Protection - Root Wad | 2780 | LF | $165 | $458,700 |
| Pond Breach Repair - Fill | 140736 | CY | $35 | $4,925,777 |
| Pond Breach Repair - Embankment Stabilization | 4211 | LF | $240 | $1,010,640 |
| Highland Drive Crossing Improvement/ Relocation | 7060 | SF | $125 | $882,500 |

| Table 7.1 Estimated Costs for Reach 3 | | | | |
|---|---|---|---|---|
| | | | **Subtotal:** | **$24,758,130** |
| | | | | |
| Land Acquisition | 5% | | | $1,237,906 |
| Engineering | 15% | | | $3,713,719 |
| Legal/Administrative | 5% | | | $1,237,906 |
| Contract Admin/Construction Management | 10% | | | $2,475,813 |
| Contingency | 25% | | | $6,189,532 |
| | | | **Total:** | **$39,613,008** |




All proposed watershed activities need to comply with all federal, state, and local requirements prior to implementation. This includes but is not limited to: detailed engineering design; permitting; local land use and property ownership; and local public processes.

Additionally, project implementation on private property is not assumed, project implementation will need to be collaborative.

Floodplain delineations based on information in Table 4.2.

As the Master Plan projects are implemented, more detailed technical analysis and site specific survey and topographic information will further refine/revise the conceptual improvements reflected on this exhibit.

## REACH 3 RECOMMENDED ALTERNATIVE: RESTORATION W/ SITE-SPECIFIC PROJ. MAP 1 OF 6

### LEGEND

- Headgates
- Post Flood Channel Alignment
- Pre-Flood Channel Alignment
- Proposed Channel Alignment
- Overflow Channel with Berm
- Bank Protection
- Fill & Revegatation
- Evaluate Crossing Capacity
- Municipalities
- Floodplain
- Matchlines

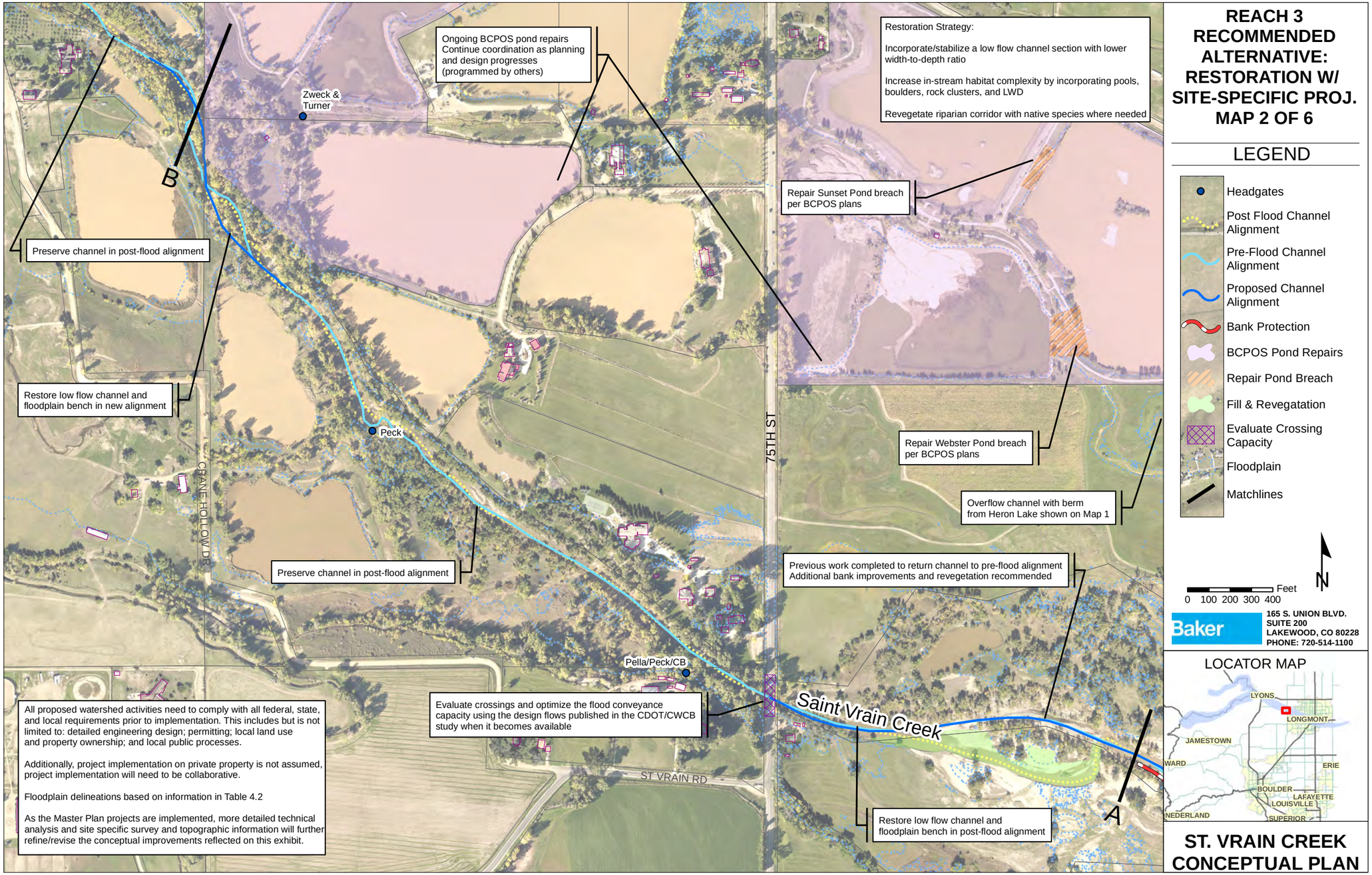
N

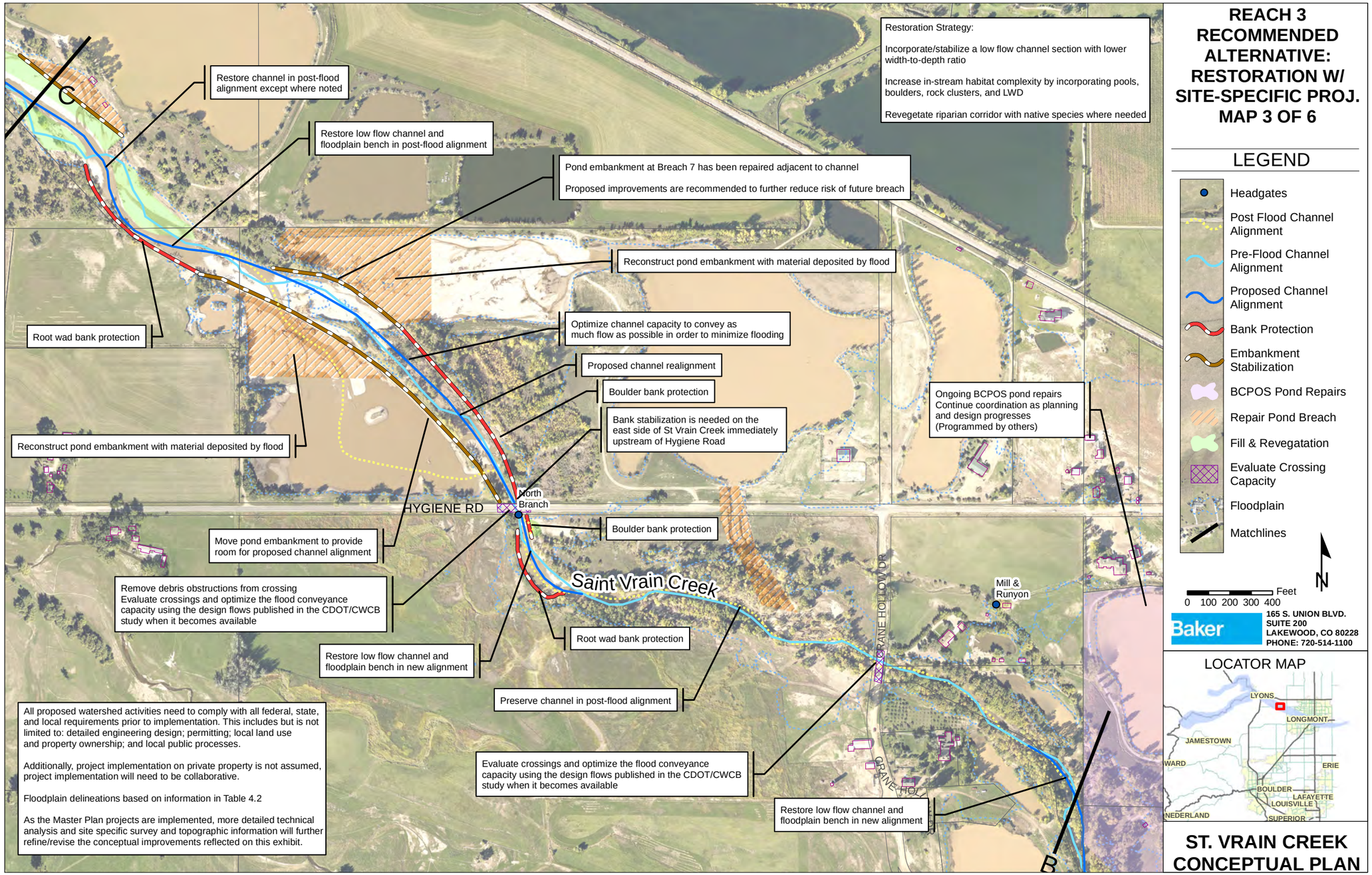
0 100 200 300 400 Feet

Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP


## ST. VRAIN CREEK CONCEPTUAL PLAN


Ongoing BCPOS pond repairs
Continue coordination as planning and design progresses (programmed by others)
Zweck & Turner
B
Preserve channel in post-flood alignment
Restore low flow channel and floodplain bench in new alignment
Peck
CRANE HOLLOW DR
75TH ST
Repair Sunset Pond breach per BCPOS plans
Restoration Strategy:
Incorporate/stabilize a low flow channel section with lower width-to-depth ratio
Increase in-stream habitat complexity by incorporating pools, boulders, rock clusters, and LWD
Revegetate riparian corridor with native species where needed
Repair Webster Pond breach per BCPOS plans
Overflow channel with berm from Heron Lake shown on Map 1
Preserve channel in post-flood alignment
Previous work completed to return channel to pre-flood alignment
Additional bank improvements and revegetation recommended
Pella/Peck/CB
Evaluate crossings and optimize the flood conveyance capacity using the design flows published in the CDOT/CWCB study when it becomes available
Saint Vrain Creek
ST VRAIN RD
Restore low flow channel and floodplain bench in post-flood alignment
A
All proposed watershed activities need to comply with all federal, state, and local requirements prior to implementation. This includes but is not limited to: detailed engineering design; permitting; local land use and property ownership; and local public processes.
Additionally, project implementation on private property is not assumed, project implementation will need to be collaborative.
Floodplain delineations based on information in Table 4.2
As the Master Plan projects are implemented, more detailed technical analysis and site specific survey and topographic information will further refine/revise the conceptual improvements reflected on this exhibit.
REACH 3 RECOMMENDED ALTERNATIVE: RESTORATION W/ SITE-SPECIFIC PROJ. MAP 2 OF 6
LEGEND
Headgates
Post Flood Channel Alignment
Pre-Flood Channel Alignment
Proposed Channel Alignment
Bank Protection
BCPOS Pond Repairs
Repair Pond Breach
Fill & Revegetation
Evaluate Crossing Capacity
Floodplain
Matchlines
N
Feet
0 100 200 300 400
Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100
LOCATOR MAP
LYONS
LONGMONT
JAMESTOWN
WARD
ERIE
BOULDER
LAFAYETTE
LOUISVILLE
NEDERLAND
SUPERIOR
ST. VRAIN CREEK CONCEPTUAL PLAN




## REACH 3 RECOMMENDED ALTERNATIVE: RESTORATION W/ SITE-SPECIFIC PROJ. MAP 3 OF 6

### LEGEND

- Headgates
- Post Flood Channel Alignment
- Pre-Flood Channel Alignment
- Proposed Channel Alignment
- Bank Protection
- Embankment Stabilization
- BCPOS Pond Repairs
- Repair Pond Breach
- Fill & Revegatation
- Evaluate Crossing Capacity
- Floodplain
- Matchlines

N

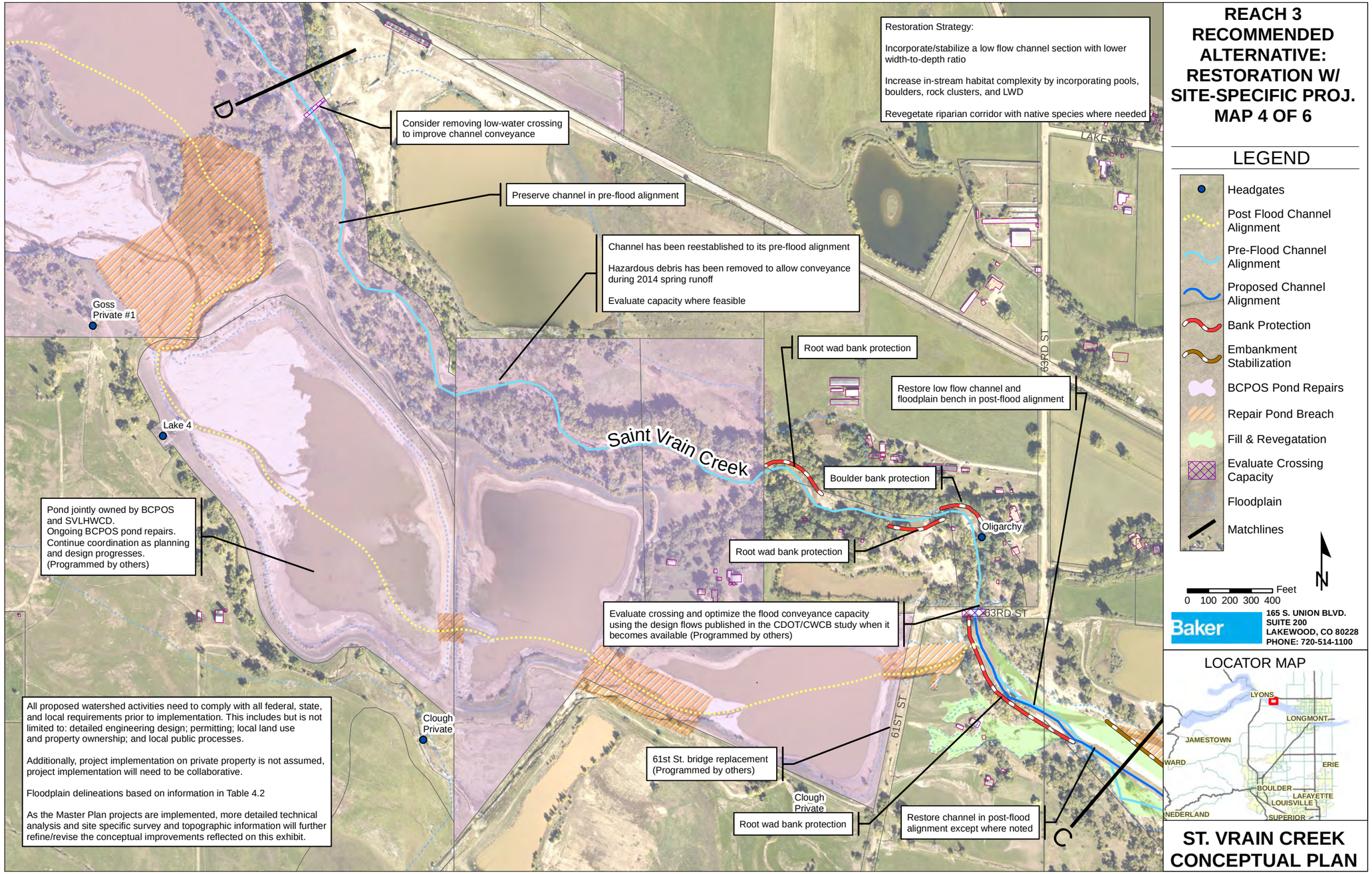
0 100 200 300 400 Feet

Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP




## ST. VRAIN CREEK CONCEPTUAL PLAN




# REACH 3 RECOMMENDED ALTERNATIVE: RESTORATION W/ SITE-SPECIFIC PROJ. MAP 4 OF 6

## LEGEND

- Headgates
- Post Flood Channel Alignment
- Pre-Flood Channel Alignment
- Proposed Channel Alignment
- Bank Protection
- Embankment Stabilization
- BCPOS Pond Repairs
- Repair Pond Breach
- Fill & Revegetation
- Evaluate Crossing Capacity
- Floodplain
- Matchlines

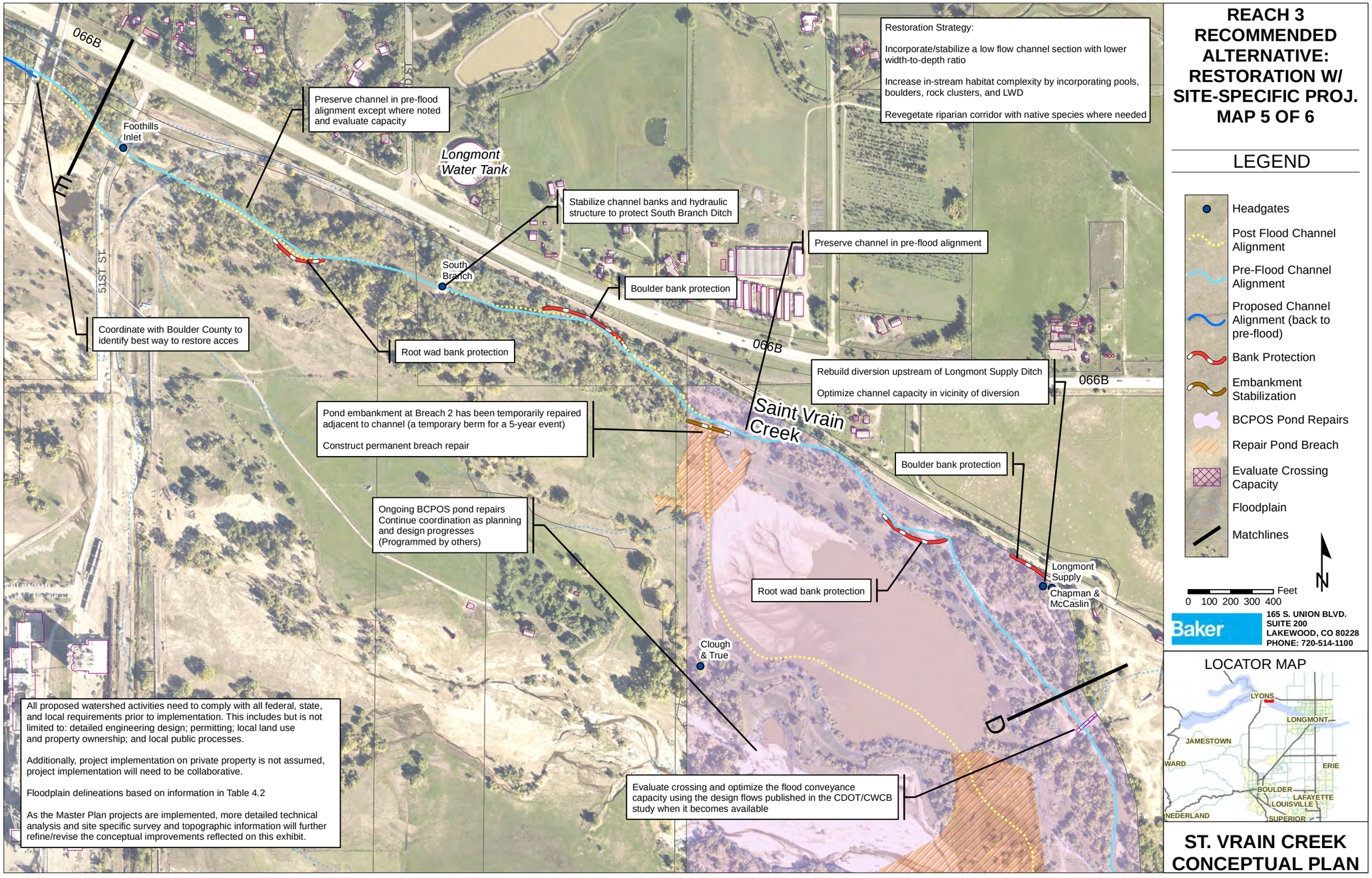
Feet
0 100 200 300 400

Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP




# ST. VRAIN CREEK CONCEPTUAL PLAN




## REACH 3 RECOMMENDED ALTERNATIVE: RESTORATION W/ SITE-SPECIFIC PROJ. MAP 5 OF 6

### LEGEND

- Headgates
- Post Flood Channel Alignment
- Pre-Flood Channel Alignment
- Proposed Channel Alignment (back to pre-flood)
- Bank Protection
- Embankment Stabilization
- BCPOS Pond Repairs
- Repair Pond Breach
- Evaluate Crossing Capacity
- Floodplain
- Matchlines

N

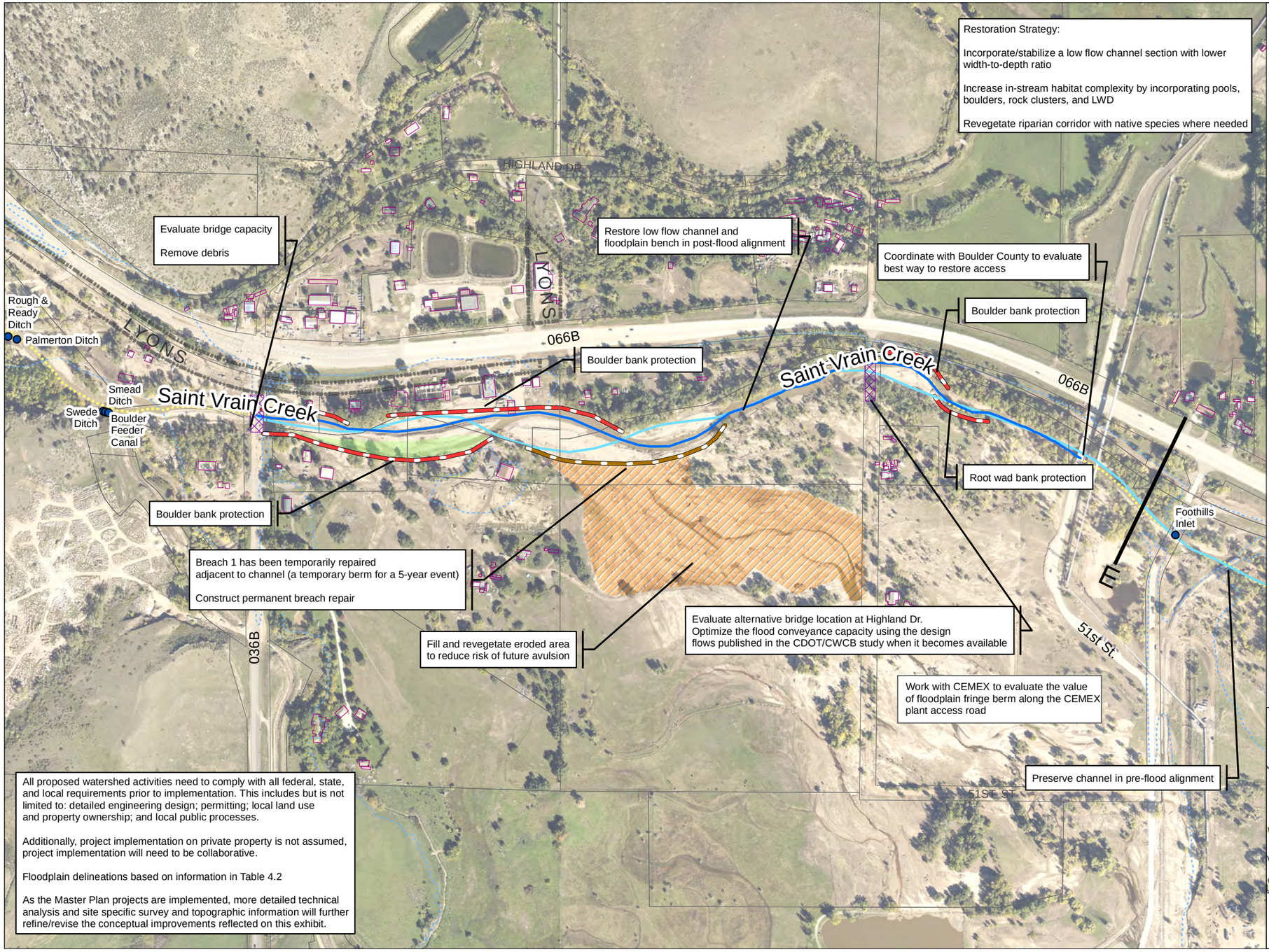
0 100 200 300 400 Feet

Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP




## ST. VRAIN CREEK CONCEPTUAL PLAN




## REACH 3 RECOMMENDED ALTERNATIVE: RESTORATION W/ SITE-SPECIFIC PROJ. MAP 6 OF 6

### LEGEND

- Headgates
- Post Flood Channel Alignment
- Pre-Flood Channel Alignment
- Proposed Channel Alignment
- Bank Protection
- Embankment Stabilization
- Fill & Revegetation
- Evaluate Crossing Capacity
- Municipalities
- Floodplain
- Matchlines

N

0 100 200 300 400 Feet

Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP


## ST. VRAIN CREEK CONCEPTUAL PLAN

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## 7.3D Reach 4

### Overview

Reach 4 begins at Highway 36, continuing upstream through Lyons along both South and North St. Vrain Creeks. North St. Vrain Creek from the upstream-most Apple Valley Bridge to the confluence, the South St. Vrain River from just upstream of the Andesite Quarry downstream to the confluence, and on the main stem of St. Vrain Creek from the confluence downstream through the Town of Lyons to Highway 36. This reach crosses between City of Lyons, BCPOS, CDOT right-of-way, and private property. This reach exists within a wide-bottom valley and is generally not confined geologically. There is a significant amount of urbanization adjacent to the channel corridor and the surrounding land use is generally comprised of residential, public and commercial land uses with some mining operation on South St. Vrain Creek.

Drainageway crossings within this reach exist at:

St. Vrain Creek

- Highway 36
- McConnell Drive
- 2nd Avenue

South St. Vrain Creek

- 4th Avenue
- Old St. Vrain Road

North St. Vrain Creek

- 5th Avenue
- Highway 36 (2 crossings)

Additional drainageway and ditch infrastructure in the vicinity of this reach include:

St. Vrain Creek

- Boulder Feeder Canal
- Swede Ditch
- Smead Ditch
- Rough & Ready Ditch
- Palmerton Ditch
- Highland Ditch
- Supply Ditch

South St. Vrain Creek

- South Ledge Ditch
- Meadows Ditch
- Otto Ditch
- Matthews Ditch
- Carl Holcomb Ditch

Historical aerial photography was reviewed to help identify the conditions that existed prior to flooding in this reach. The riparian corridor adjacent to the channel was densely vegetated with a combination of native and non-native species and ranged in width from 200 feet to 300 feet. The channel was moderately sinuous and appeared to generally be in a stable state with no visible signs of vertical or horizontal instabilities. Although the adjacent floodplain has been historically connected to the channel, the significant amount of adjacent development has altered the natural floodplain function for a majority of this reach.

The Town of Lyons was severely damaged during the September 2013 flood event. The flood destroyed critical segments of the Town's electrical, sewage, and potable water systems, as well as damaging or destroying nearly 30% of the Town's housing stock. The floodwaters breached the wastewater treatment facility, contaminating Lyon's water supply. Multiple sections of the St. Vrain left the original channel and the flood permanently damaged many of the Town's roads, bridges, parks, trails, and stream channels. Floodwaters also destroyed Lyons Public Works facilities and equipment, and the Town Hall and Library building. The total amount of damage to the Town of Lyons is estimated at $50 million, including $5 million in temporary measures.

### Assessment

The results of the ecological assessment show that this reach is generally in "Fair" condition with overall scores ranging between 5-6 out of 10. There is one section on South St. Vrain Creek that is in "Poor" condition. The lowest scoring elements from the ecological assessment are the degree of hydrologic alteration and factors impacting fish and aquatic habitat. Additionally, the channel is somewhat unstable and the channel banks are eroding in some locations. The streamflow in this reach has been altered due to upstream hydrologic controls such as diversions and reservoirs. Hydrologic alteration also has adverse impacts on in-stream habitat and riparian ecosystems. The primary recommendations from the ecological assessment are to incorporate planform complexity, improve and add in-stream habitat, preserve and expand floodplains, and design roadway crossings that promote the natural function of a channel.

A significant amount of erosion and deposition occurred near the confluence within the Town of Lyons. The planform for this reach has been relatively consistent through the river corridor over the past 60 years; however, there has been some natural lateral migration across the floodplain during this time period. The results of the geomorphic assessment show that the alignment of the channel differs between pre- and post-flood conditions in areas with wider valley bottoms and flatter longitudinal slopes. The planform geometry at these locations is less sinuous and steeper when compared to pre-flood conditions. The primary recommendation from the geomorphic assessment is to return the channel to the pre-flood alignment.

Flooding in this area was most severe at the confluence of North and South St. Vrain Creeks. Many residences and business were flooded within Lyons and remain at risk for future flooding. North and South St. Vrain Creeks have been altered by man over the years and historical flowpaths were filled during development. Some of these historic flowpaths were re-established during the September 2013 event, causing large amounts of damage.

### Lyons Flood Recovery Efforts

After the floods many groups have collaborated to develop Project Development Guides (PDGs) which were ranked in the Lyons Recovery Action Plan (LRAP) by the Board of Trustees, Planning and Community Development Commission and the Sustainable Futures Commission. These ranking were developed with heavy community and local government input and provide recommendations that extend outside of the Town of Lyons.

The PDGs consist of a detailed questionnaire that facilitates collection and evaluation of information about goals, strategies and expected outcomes of proposed projects and programs. The PDG format assisted local government and stakeholders (i.e. business groups, schools, non-profit organizations, businesses, local association and community members) to create projects for the long-term community recovery process. The PDG, when used to identify and organize information, provides a number of benefits: streamlined data, ease of analysis, consistent formatting and sourcing of information, assist in fundraising efforts and can serve as a benchmark against which progress is measured.

The LRAP is a comprehensive plan that includes goals for arts, culture & historic preservation, economic & business, health & human services, housing, infrastructure, parks & recreation, and the stream. PDGs were developed to achieve the goals in the LRAP. The PDGs identified in the LRAP that are relevant to the river corridor include the stream specific PDGs and the Parks & Recreation PDGs.

| Lyons Recovery Action Plan Stream PDGs |
|---|
| 1. Re-vegetate the N., S., and combined Creek corridor in Lyons |
| 2. Improve riparian habitats and bank stabilization from the confluence to McConnell Bridge |
| 3. Restore and improve North, South and combined St. Vrain corridor in Lyons |
| 4. Assess the ongoing water quality in the St. Vrain during flood response, recovery, and restoration |
| 5. Restock the native fisheries in the St. Vrain River, and improve aquatic habitat for fish species |
| 6. Design & implement the ponds and associated wetlands to promote increased natural areas, and provide a variety of recreational and hazard mitigation |
| 7. Mitigate high water mark debris and sediment deposits |
| 8. Mitigate Highway 36 CDOT bridges near the Planet Bluegrass property |
| 9. Mitigate channelization of the North St. Vrain from 5th Ave to confluence |
| 10. Develop detention and retention units on South St. Vrain Creek to Boulder County Open Space as a means of flood mitigation |

The Lyons Flood Recovery Task Force identified six objectives for this area:

1. Flood Mitigation – The mitigation of flood impacts by addressing bridges, by creating detention and retention and by restoring the river in a way that maintains and improves existing flood boundaries.

2. Recreation – The creation of in-stream and bank side recreational opportunities that invite people to kayak, float, camp, cycle, walk, fish, tube, spectate, and otherwise enjoy the river and its bank.

3. Economic Impact - Connect the river to the downtown in a way that revitalizes the Lyons economy through increased opportunities to recreate along the river for locals and visitors alike.

4. Aquatic & Riparian Habitat - The creation and preservation of a showcase example corridor that features a continuous and connected riparian and in-stream habitat that is designed to optimize the natural habitat within the reach.

5. Infrastructure - Set a standard for infrastructure in the river corridors that is robust, aesthetically appropriate to the river corridor, and that contemplates recovery from the next major event.

6. Private Property - Definition of a process that encourages future property (Re)Development in a responsible way such that it fosters a healthy river and riparian system and respects flood impacts to neighboring properties.

## Plan Recommendations

The primary issues within these reaches include lateral channel migration and bank erosion, sediment deposition/aggradation, sediment erosion/degradation, debris blockages throughout the reach and at drainageway crossings, and infrastructure damage. There are large areas of riparian habitat that are still intact and should be preserved where possible. In locations where the channel needs to be restored, both cutting and filling will be required depending on what portion of the reach restoration will occur. The results of the geomorphic assessment state that the South St. Vrain Creek and North St. Vrain creek should be restored in the post-flood channel alignment while the Saint Vrain Creek should be restored in the pre-flood channel alignment. Channel restoration recommendations for these reaches generally follow this guidance except for in some instances where special accommodations needed to be made. These instances include moving the channel away from the road to reduce erosion potential, moving the channel to address needs of irrigators, and moving the channel to improve stream stability, provide fish habitat, and reduce flood risk.

Some of the priorities identified by stakeholders include increasing flood conveyance capacity, debris removal, optimizing flood conveyance at drainageway crossings, and incorporating projects that address multiple objectives. In addition, anglers and in-stream recreation enthusiasts have both been dramatically affected by the changes to the waterways in Reach 4. These groups should be engaged throughout the implementation process to ensure local buy-in and restore the economic advantages these recreations bring to the Town of Lyons. See public comments in Appendix D for additional details.

A significant amount of planning, design, and construction has already taken place for the reaches in this area and somewhat constrain restoration options. As a result, the recommended plan for this area focused restoring the channel to work in concert with ongoing flood recovery efforts that address objectives for this area.

## Reach 4a - North St. Vrain

The recommended plan for Reach 4a is shown in the following figures. The purpose of this alternative is to implement a channel alignment that will optimize the interaction with completed, ongoing, and funded projects while being sensitive to the constraints presented by the presence of numerous private residences throughout this river corridor. The implementation of this alternative will expedite the maturation of this reach by re-establishing a natural channel, repairing erosion scars, re-establishing floodplain benches, building point-bars and excavating pools, re-vegetating denuded areas, and stabilizing channel banks.

## Reach 4b - South St. Vrain

The recommended plan for Reach 4b is shown on the following Figures. The purpose of this alternative is to implement a channel alignment that will optimize the interaction with completed, ongoing, and funded projects while being sensitive to the constraints presented by the presence of numerous private residences throughout this river corridor. The implementation of this alternative will expedite the maturation of this reach by re-establishing a natural channel, repairing erosion scars, re-establishing floodplain benches, building point-bars and excavating pools, re-vegetating denuded areas, and stabilizing channel banks. The Baker Team conducted a feasibility analysis during the planning process to evaluate the potential for detention in the vicinity of Andesite Quarry as outlined in PDG 10. The analysis showed a lack of significant reduction in downstream flood risk and concluded that such a facility would not be cost beneficial as a result of the large cost of designing, building, maintaining, and operating such a facility with limited public benefit. Thus, the study did not recommend this flood control measure. If desired by the Town of Lyons and others, additional analysis could be undertaken to further evaluate the feasibility of detention at this location and whether it could be made more cost beneficial. Any further analysis would require additional engineering studies, cost-benefit analysis, and environmental investigations including an evaluation of the potential impacts to in-stream and riparian habitats that such a facility would create both upstream and downstream. See Appendix D and G for more information.

## Reach 4c - St. Vrain Creek

The focus of the improvements for this reach is at the site of the McConnell ponds. The reconstruction of these ponds is important to the community because of the social, recreational, and aesthetic benefit that they provided to the community. There has been ongoing discussion within the Lyons community about where the McConnell Ponds should be reconstructed in their pre-flood location on the south side of St. Vrain Creek or a new location on the north side. The qualitative analysis for the two alternative locations yielded very close results. The recommendation is to perform a more in-depth analysis as additional information (survey and hydraulic modeling) become available to further inform the pros and cons of the location of the McConnell Ponds. Note that the qualitative scoring in Appendix D has been redacted so as not to influence this future analysis.

## General Recommendations

Additional site-specific studies, including environmental and engineering evaluations, are recommended prior to finalizing design.

**Drainageway Crossings**

- » Evaluate all drainageway crossings and optimize the flood conveyance capacity using the design flows published in the CDOT/CWCB study, when it becomes available.
- » Design new/improved drainageway crossings so that the low-flow channel remains unobstructed in order to maintain channel stability and achieve ecological connectivity. Provide additional floodplain conveyance capacity by utilizing floodplain culverts in the overbank areas.
- » Remove debris blockages.

**Channel Restoration**

- » Incorporate/stabilize a low flow/bankfull channel section with the following general design parameters:

| Design Parameter | Min | Max |
|---|---|---|
| Low flow/bankfull Channel Top Width | 50 | 150 |
| Slope | 0.005 | 0.02 |
| Ave. Low flow/bankfull Channel Top Width-to-Depth Ratio | 30 | |
| Ave. Sinuosity | 1.2 | |

- » Increase in-stream habitat complexity by incorporating pools, rock clusters, boulders and large woody debris.
- » Revegetate the riparian corridor with native species where needed.
- » Site-specific bank stabilization to protect adjacent infrastructure and private property.
- » Fill areas and revegetate areas that are at high risk of avulsion.
- » Remove debris blockages.
- » Consider in-stream recreation and safety.
- » Coordinate channel improvements with ditch companies to ensure desired level of operation is maintained.

**Work In Progress**

As mentioned above, there is a substantial amount of work that has been completed, or currently in progress in this reach. Additional restoration work should coordinate with all work being completed in this area prior to commencing.

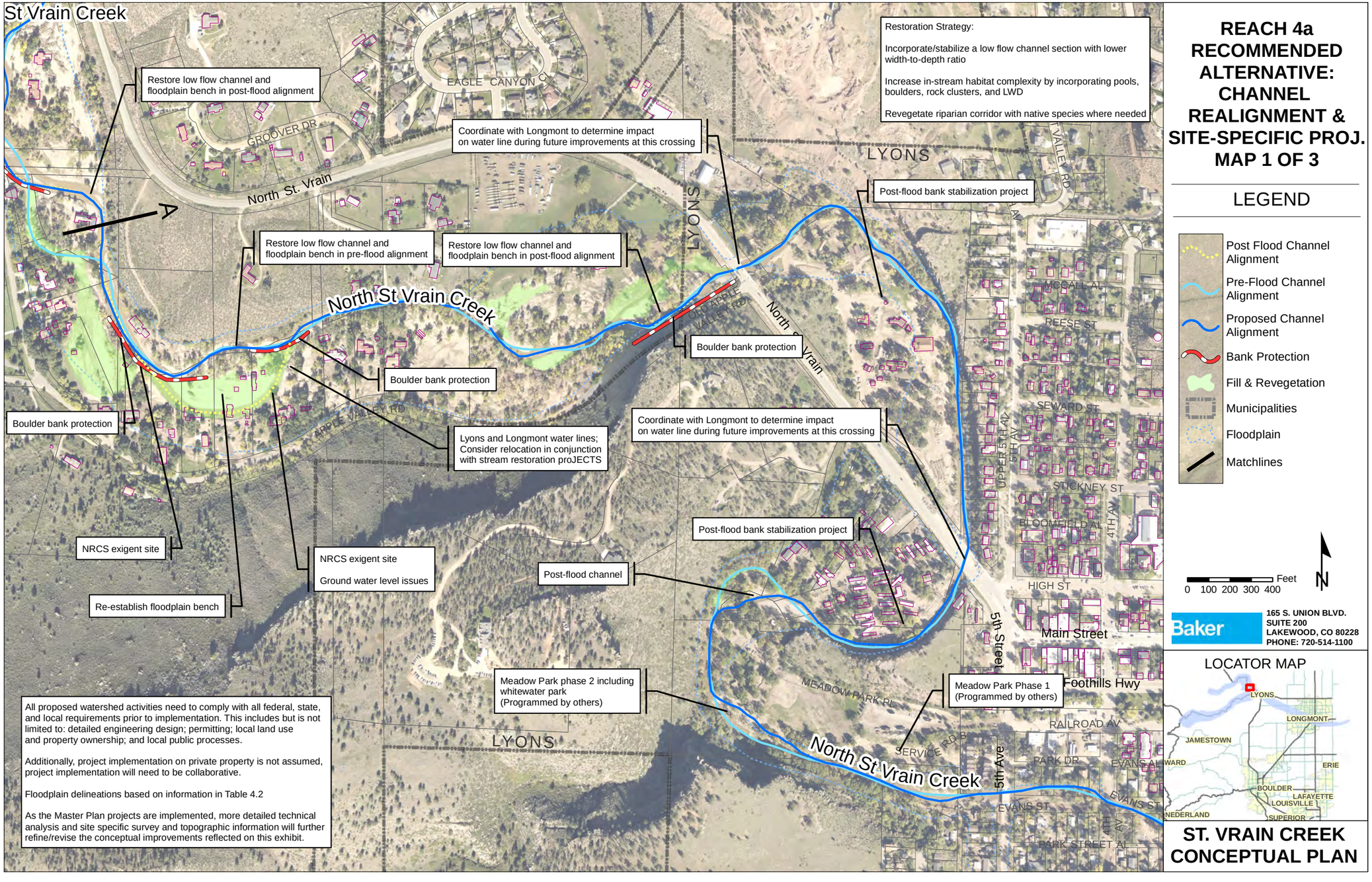
Upcoming repair work is planned along State Highway 7. It is recommended that all future restoration work in this corridor be coordinated with CDOT. Opportunities to expand the floodplain should be considered during all future improvements along State Highway 7. There are several locations where State Highway 7 has truncated historical channel migration areas. In these locations, resiliency could be improved by realigning State Highway 7 to be outside of these disconnected migration areas.

## Estimated Cost of Unmet Needs

Estimated costs for unmet needs were prepared to capture the capital that could be required to implement plan recommendations. These estimated costs do not include projects that are currently being completed or that are programmed. The estimated costs for unmet needs in this reach are provided in Table 7.2.

**Table 7.2 Estimated Cost for Reach 4**

| Reach 4a | Qty | Unit | Unit Cost | Cost |
|---|---|---|---|---|
| Low flow/bankfull Channel Restoration | 8531 | LF | $300 | $2,559,270 |
| Fill | 76735 | CY | $10 | $767,347 |
| Revegetate | 1035919 | SF | $1 | $1,035,919 |
| Bank Protection - Boulder | 4843 | LF | $275 | $1,331,825 |
| Bank Protection - Root Wad | 2732 | LF | $165 | $450,780 |
| | | | **Subtotal:** | **$6,145,141** |
| Land Acquisition | 5% | | | $307,257 |
| Engineering | 15% | | | $921,771 |
| Legal/Administrative | 5% | | | $307,257 |
| Contract Admin/Construction Management | 10% | | | $614,514 |
| Contingency | 25% | | | $1,536,285 |
| | | | **Total:** | **$9,832,226** |
| **Reach 4b** | **Qty** | **Unit** | **Unit Cost** | **Cost** |
| Low flow/bankfull Channel Restoration | 10851 | LF | $300 | $3,255,420 |
| Fill | 249320 | CY | $10 | $2,493,202 |
| Revegetate | 2243882 | SF | $1 | $2,243,882 |
| Bank Protection - Boulder | 3235 | LF | $275 | $889,625 |
| Bank Protection - Root Wad | 1056 | LF | $165 | $174,240 |
| **Subtotal** | | | | **$9,056,370** |
| Land Acquisition | 5% | | | $452,818 |
| Engineering | 15% | | | $1,358,455 |
| Legal/Administrative | 5% | | | $452,818 |
| Contract Admin/Construction Management | 10% | | | $905,637 |
| Contingency | 25% | | | $2,264,092 |
| | | | **Total:** | **$14,490,191** |
| **Reach 4c** | **Qty** | **Unit** | **Unit Cost** | **Cost** |
| Low flow/bankfull Channel Restoration | 11173 | LF | $350 | $3,910,690 |
| Fill | 21001 | CY | $10 | $210,009 |
| Revegetate | 141756 | SF | $1 | $141,756 |
| Bank Protection - Root Wad | 2113 | LF | $165 | $348,645 |
| HWY 36 Bridge Crossing Improvement | 8733 | SF | $125 | $1,091,625 |
| Lyons CDBG grants that weren't funded | 1 | EA | $2,268,108 | $2,268,108 |
| | | | **Subtotal:** | **$7,970,833** |
| Land Acquisition | 5% | | | $398,542 |
| Engineering | 15% | | | $1,195,625 |
| Legal/Administrative | 5% | | | $398,542 |
| Contract Admin/Construction Management | 10% | | | $797,083 |
| Contingency | 25% | | | $1,992,708 |
| | | | **Total:** | **$12,753,333** |




## REACH 4a RECOMMENDED ALTERNATIVE: CHANNEL REALIGNMENT & SITE-SPECIFIC PROJ. MAP 1 OF 3

### LEGEND

- Post Flood Channel Alignment
- Pre-Flood Channel Alignment
- Proposed Channel Alignment
- Bank Protection
- Fill & Revegetation
- Municipalities
- Floodplain
- Matchlines

0 100 200 300 400 Feet

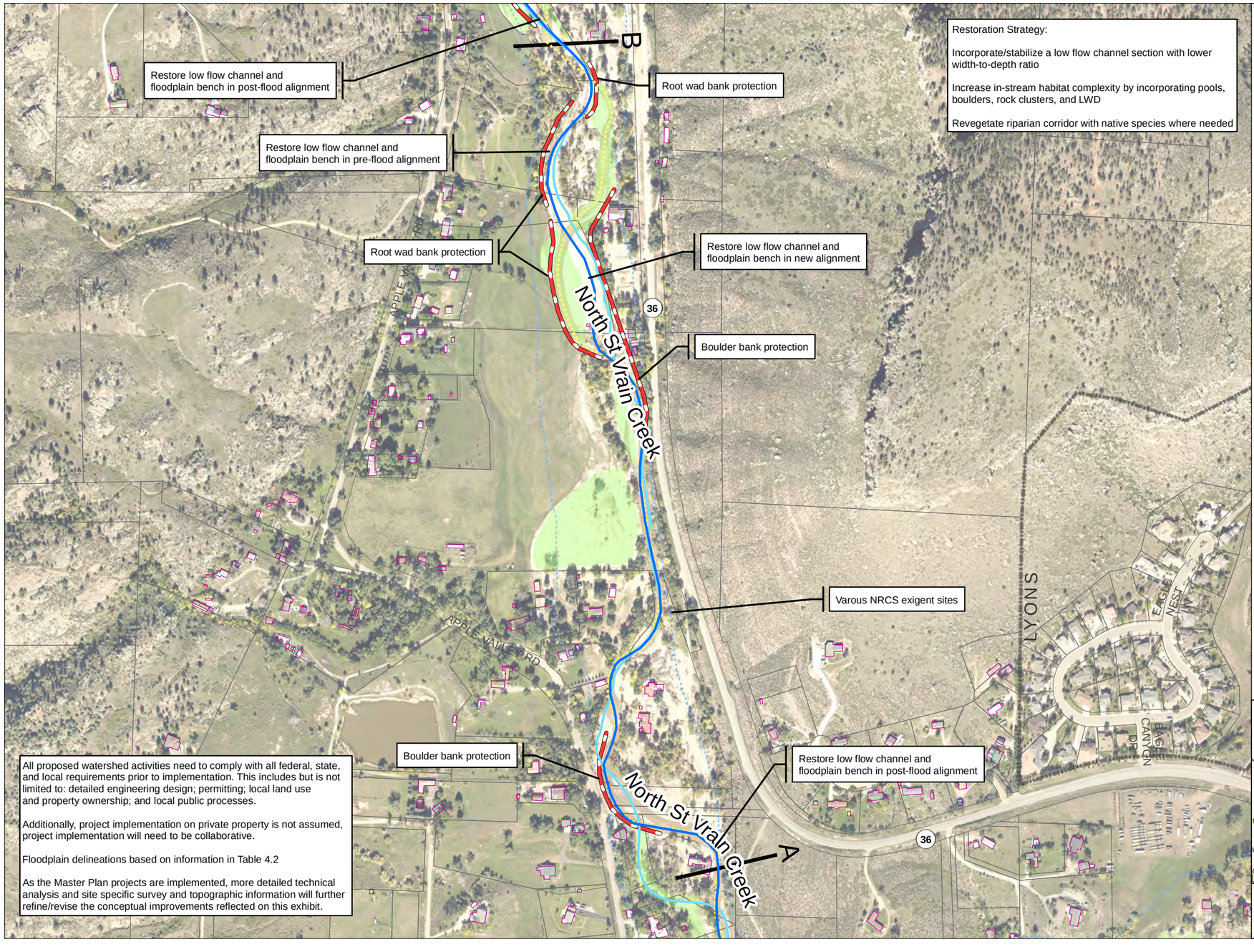
N

Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP




## ST. VRAIN CREEK CONCEPTUAL PLAN




Restoration Strategy:

Incorporate/stabilize a low flow channel section with lower width-to-depth ratio

Increase in-stream habitat complexity by incorporating pools, boulders, rock clusters, and LWD

Revegetate riparian corridor with native species where needed

All proposed watershed activities need to comply with all federal, state, and local requirements prior to implementation. This includes but is not limited to: detailed engineering design; permitting; local land use and property ownership; and local public processes.

Additionally, project implementation on private property is not assumed, project implementation will need to be collaborative.

Floodplain delineations based on information in Table 4.2

As the Master Plan projects are implemented, more detailed technical analysis and site specific survey and topographic information will further refine/revise the conceptual improvements reflected on this exhibit.

## REACH 4a RECOMMENDED ALTERNATIVE: CHANNEL REALIGNMENT & SITE-SPECIFIC PROJ. MAP 2 OF 3

### LEGEND

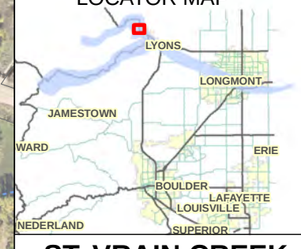
- Post Flood Channel Alignment
- Pre-Flood Channel Alignment
- Proposed Channel Alignment
- Bank Protection
- Fill & Revegetation
- Municipalities
- Floodplain
- Matchlines

0 100 200 300 400 Feet

N

Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP




## ST. VRAIN CREEK CONCEPTUAL PLAN

All proposed watershed activities need to comply with all federal, state, and local requirements prior to implementation. This includes but is not limited to: detailed engineering design; permitting; local land use and property ownership; and local public processes.

Additionally, project implementation on private property is not assumed, project implementation will need to be collaborative.

Floodplain delineations based on information in Table 4.2

As the Master Plan projects are implemented, more detailed technical analysis and site specific survey and topographic information will further refine/revise the conceptual improvements reflected on this exhibit.

Restoration Strategy:

Incorporate/stabilize a low flow channel section with lower width-to-depth ratio

Increase in-stream habitat complexity by incorporating pools, boulders, rock clusters, and LWD

Revegetate riparian corridor with native species where needed

BLUE MOUNTAIN RD

Rebuild River Access

36

North St Vrain Creek

APPLE VALLEY RD

Preserve restoration work that has been constructed where it adheres to the guidance of this plan

CDOT stabilization

Restore low flow channel and floodplain bench in post-flood alignment

Boulder bank protection

Root wad bank protection

Root wad bank protection

APPLE VALLEY RD

Bridge built post flood

Restore low flow channel and floodplain bench in pre-flood alignment

Root wad bank protection

36

Restore low flow channel and floodplain bench in post-flood alignment

## REACH 4a RECOMMENDED ALTERNATIVE: CHANNEL REALIGNMENT & SITE-SPECIFIC PROJ. MAP 3 OF 3

LEGEND

- Post Flood Channel Alignment
- Pre-Flood Channel Alignment
- Proposed Channel Alignment
- Bank Protection
- Fill & Revegetation
- Floodplain
- Matchlines

0 100 200 300 400 Feet

N

Baker

165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP


## ST. VRAIN CREEK CONCEPTUAL PLAN

All proposed watershed activities need to comply with all federal, state, and local requirements prior to implementation. This includes but is not limited to: detailed engineering design; permitting; local land use and property ownership; and local public processes.

Additionally, project implementation on private property is not assumed, project implementation will need to be collaborative.

Floodplain delineations based on information in Table 4.2

As the Master Plan projects are implemented, more detailed technical analysis and site specific survey and topographic information will further refine/revise the conceptual improvements reflected on this exhibit.

CDBG Grant for stream restoration programmed for this area

River trail
(Programmed by others)

Restoration Strategy:

Incorporate/stabilize a low flow channel section with lower width-to-depth ratio

Increase in-stream habitat complexity by incorporating pools, boulders, rock clusters, and LWD

Revegetate riparian corridor with native species where needed

Longmont Pipeline damaged

CDBG Stream Restoration Grant Concept
(Programmed by others)

Restore low flow channel and floodplain bench in post-flood alignment

Evaluate bridge capacity;
Coordinate with Longmont regarding planned replacement of South Pipeline lowering;
Coordinate with SH 7
(Programmed by others)

Restore low flow channel and floodplain bench in pre-flood alignment

Root wad bank protection

Longmont Dam and Pipeline

Boulder bank protection

Meadows Ditch

Coordinate improvements with ditch diversions
Channel alignment can be modified to accomodate specific needs

South Ledge Ditch

Coordinate improvements with ditch diversions
Channel alignment can be modified to accomodate specific needs

Restore low flow channel and floodplain bench in post-flood alignment

Boulder bank protection

A

North St Vrain Creek

Saint Vrain Creek

South St Vrain Creek

South St. Vrain

5th Ave

PROSPECT ST

MELLY ST

OLD ST VRAIN RD

RED GULCH RD

BOBIN PARK DR

WELCH DR

CR 69

7

## REACH 4b RECOMMENDED ALTERNATIVE: CHANNEL REALIGNMENT & SITE-SPECIFIC PROJ. MAP 1 OF 3

### LEGEND

- Headgates
- Post Flood Channel Alignment
- Pre-Flood Channel Alignment
- Proposed Channel Alignment
- CDBG Projects
- Bank Protection
- Fill & Revegetation
- Evaluate Crossing Capacity
- Municipalities
- Floodplain
- Matchlines

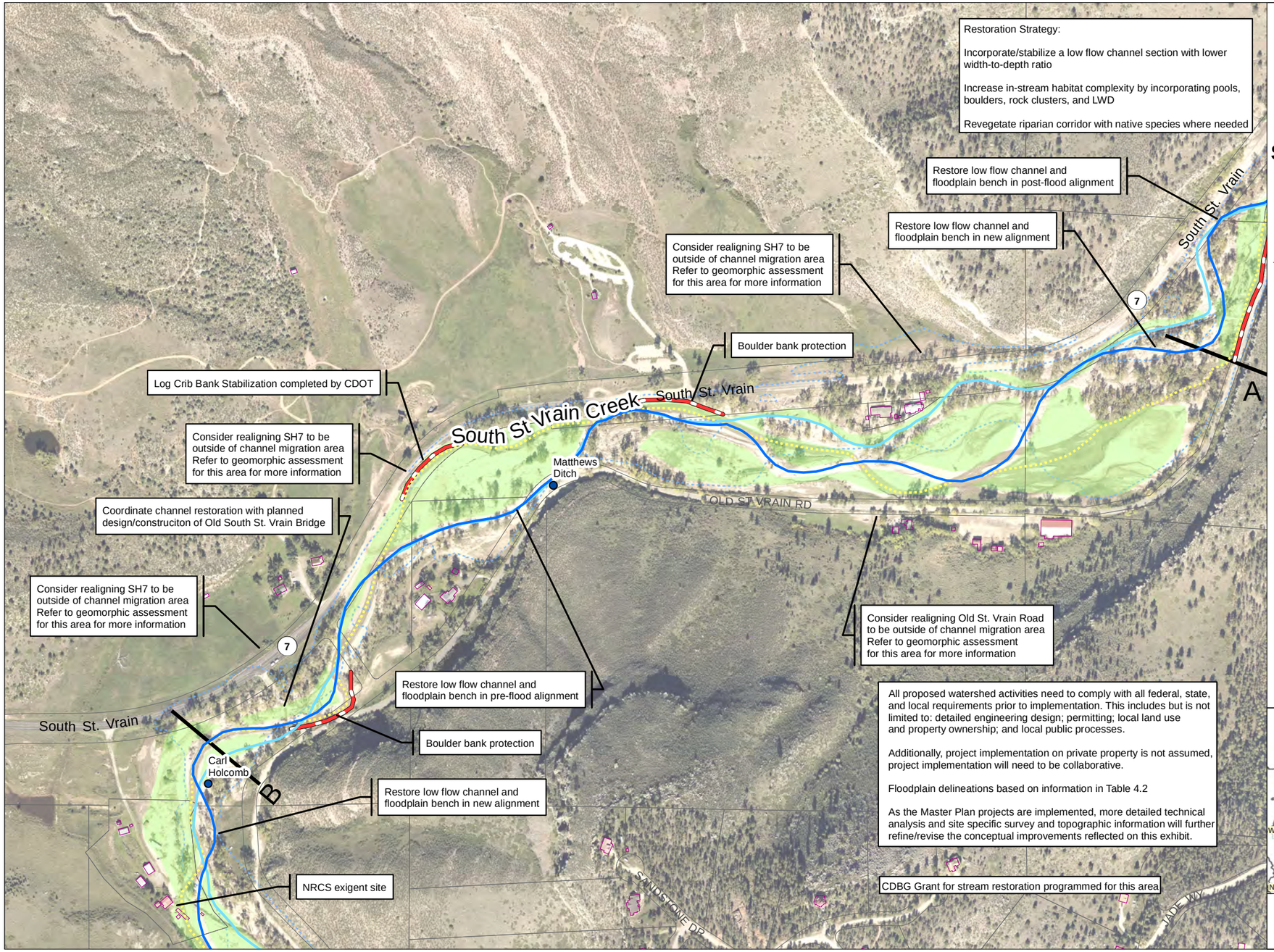
Feet
0 100 200 300 400

N

Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP


## ST. VRAIN CREEK CONCEPTUAL PLAN




## REACH 4b RECOMMENDED ALTERNATIVE: CHANNEL REALIGNMENT & SITE-SPECIFIC PROJ. MAP 2 OF 3

### LEGEND

- Headgates
- Post Flood Channel Alignment
- Pre-Flood Channel Alignment
- Proposed Channel Alignment
- Bank Protection
- Fill & Revegetation
- Floodplain
- Matchlines

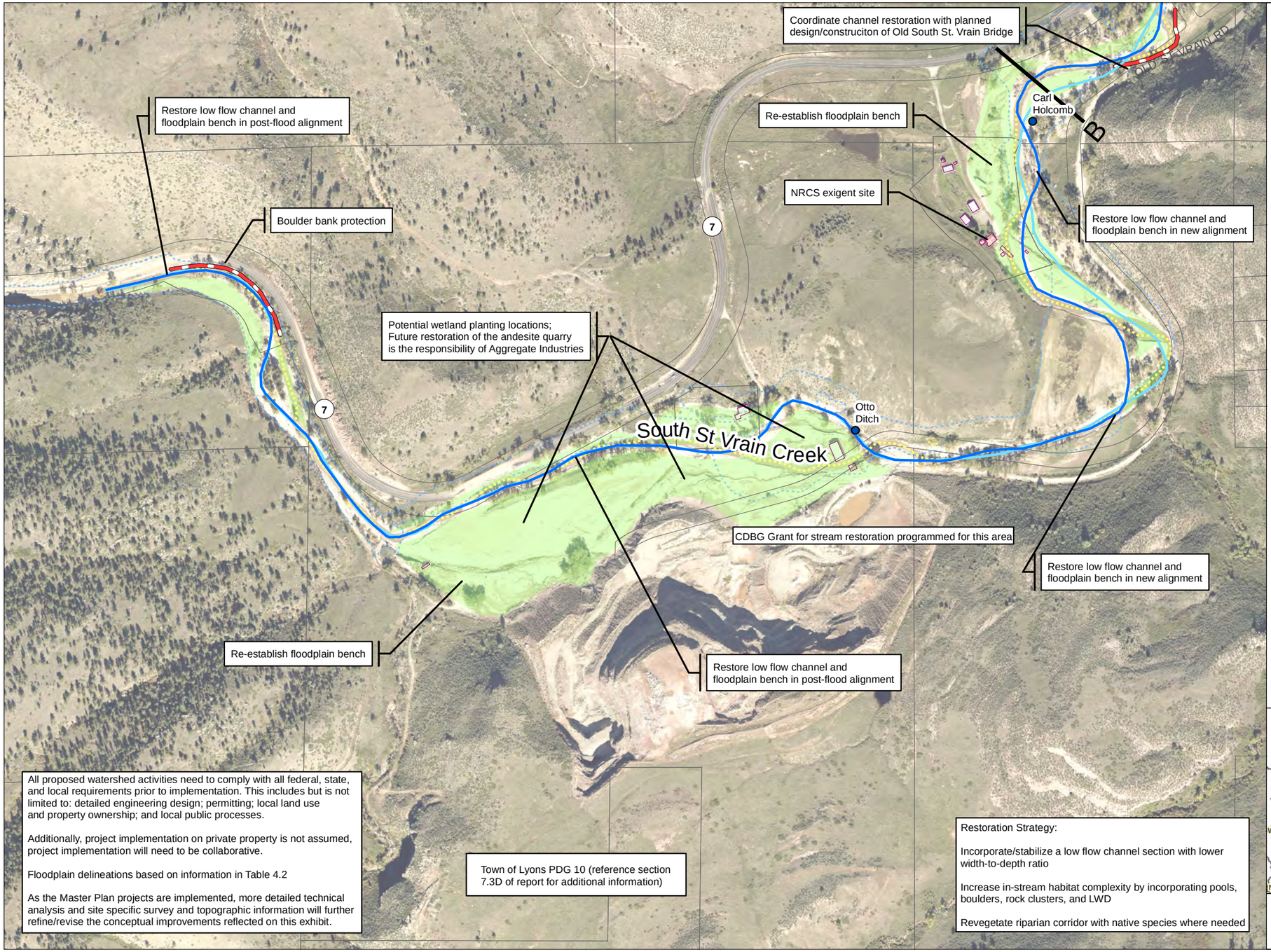
0 100 200 300 400 Feet

N

Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP


## ST. VRAIN CREEK CONCEPTUAL PLAN




## REACH 4b RECOMMENDED ALTERNATIVE: CHANNEL REALIGNMENT & SITE-SPECIFIC PROJ. MAP 3 OF 3

LEGEND

- Headgates
- Post Flood Channel Alignment
- Pre-Flood Channel Alignment
- Proposed Channel Alignment
- Bank Protection
- Fill & Revegetation
- Floodplain
- Matchlines

0 100 200 300 400 Feet

N

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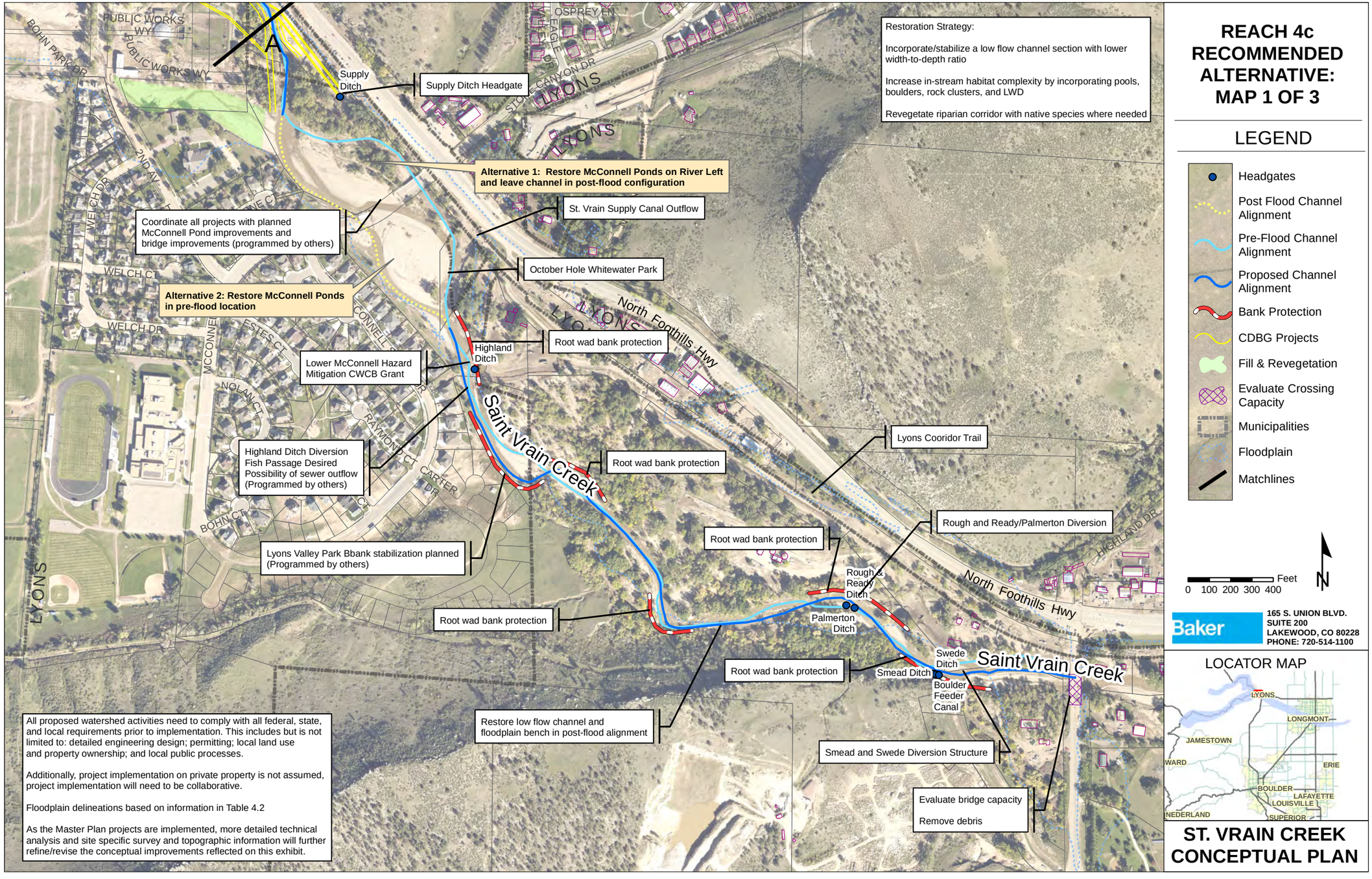
LOCATOR MAP


## ST. VRAIN CREEK CONCEPTUAL PLAN




## REACH 4c RECOMMENDED ALTERNATIVE: MAP 1 OF 3

### LEGEND

- Headgates
- Post Flood Channel Alignment
- Pre-Flood Channel Alignment
- Proposed Channel Alignment
- Bank Protection
- CDBG Projects
- Fill & Revegetation
- Evaluate Crossing Capacity
- Municipalities
- Floodplain
- Matchlines

0 100 200 300 400 Feet

N

Baker
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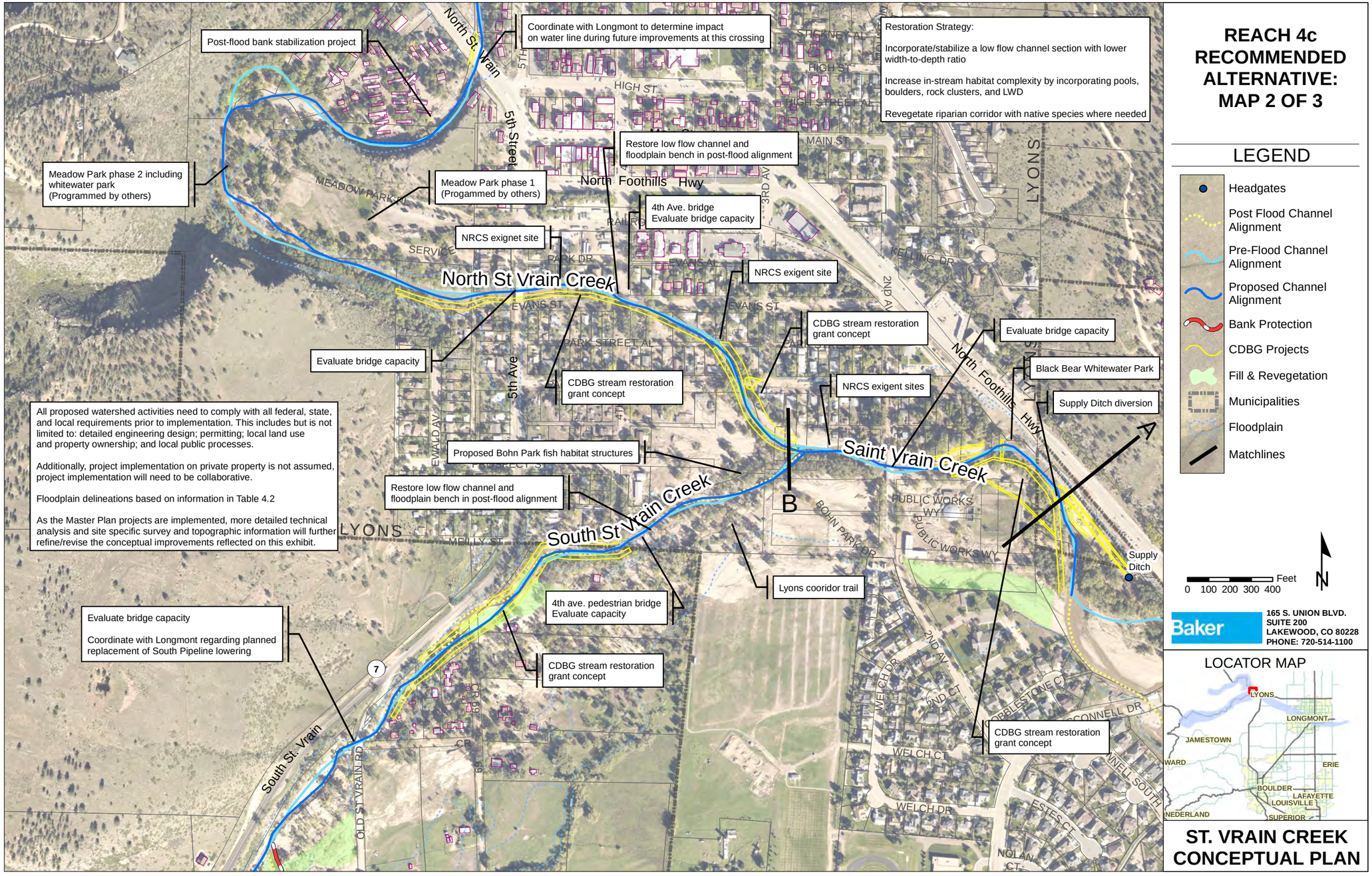
LOCATOR MAP




## ST. VRAIN CREEK CONCEPTUAL PLAN




## REACH 4c RECOMMENDED ALTERNATIVE: MAP 2 OF 3

### LEGEND

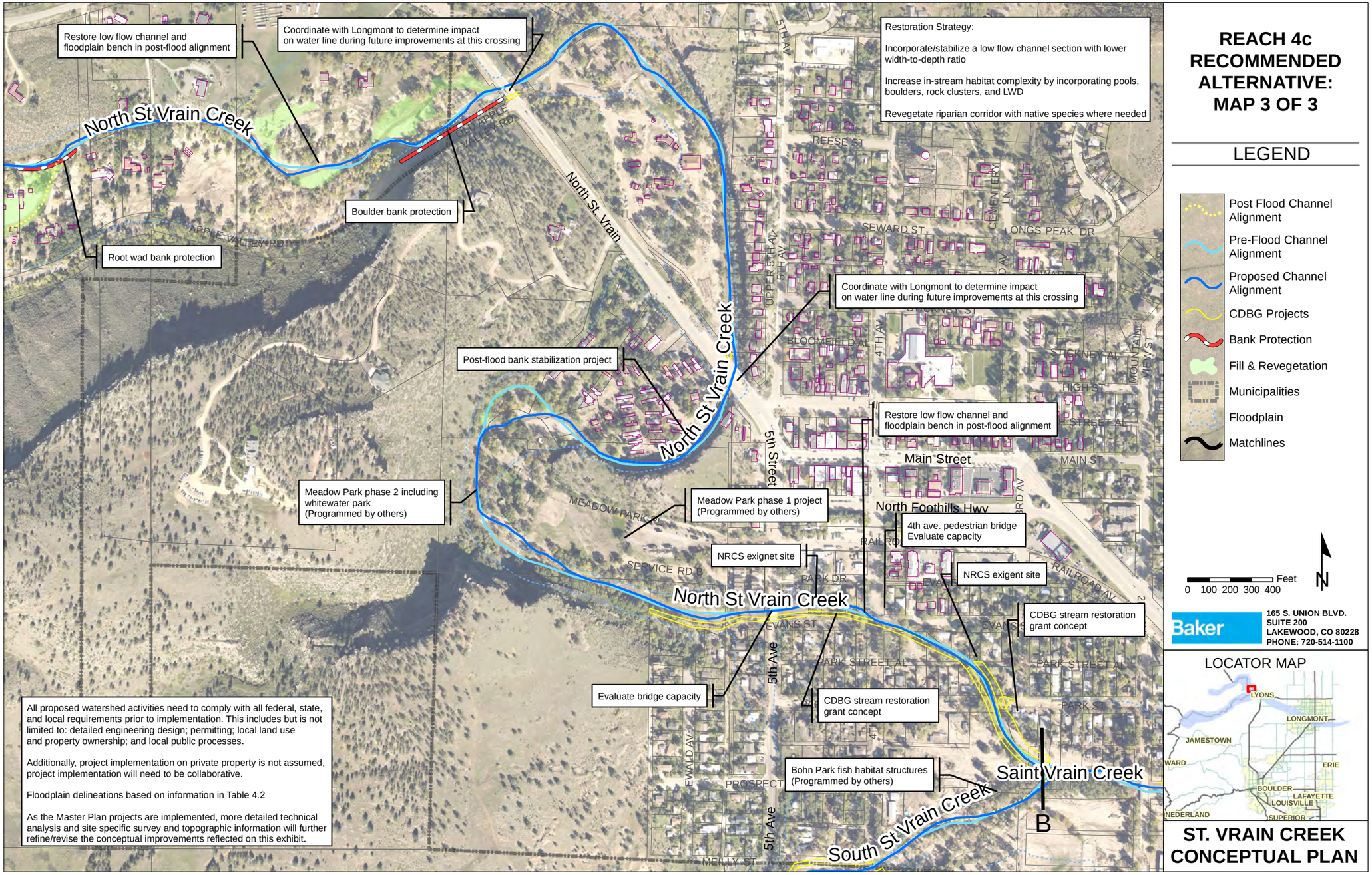
- Headgates
- Post Flood Channel Alignment
- Pre-Flood Channel Alignment
- Proposed Channel Alignment
- Bank Protection
- CDBG Projects
- Fill & Revegetation
- Municipalities
- Floodplain
- Matchlines

Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP




## ST. VRAIN CREEK CONCEPTUAL PLAN




All proposed watershed activities need to comply with all federal, state, and local requirements prior to implementation. This includes but is not limited to: detailed engineering design; permitting; local land use and property ownership; and local public processes.

Additionally, project implementation on private property is not assumed, project implementation will need to be collaborative.

Floodplain delineations based on information in Table 4.2

As the Master Plan projects are implemented, more detailed technical analysis and site specific survey and topographic information will further refine/revise the conceptual improvements reflected on this exhibit.

## REACH 4c RECOMMENDED ALTERNATIVE: MAP 3 OF 3

### LEGEND

- Post Flood Channel Alignment
- Pre-Flood Channel Alignment
- Proposed Channel Alignment
- CDBG Projects
- Bank Protection
- Fill & Revegetation
- Municipalities
- Floodplain
- Matchlines

Feet
0 100 200 300 400

N

Baker
165 S. UNION BLVD.
SUITE 200
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LOCATOR MAP




## ST. VRAIN CREEK CONCEPTUAL PLAN

## 7.3E Reach 5

### Overview

Reach 5 runs along the North St. Vrain Creek and begins at Apple Valley and ends at Buttonrock Reservoir. The downstream portion of this reach that is adjacent to Highway 36 is mostly within CDOT right-of-way and private property, while the upstream portion is entirely within City of Longmont jurisdiction. This reach exists within a narrow-bottom valley and is geologically confined by the valley walls. There is little urbanization adjacent to the channel corridor and the surrounding land use is generally comprised of forested areas.

Drainageway crossings within this reach exist at:

- Apple Valley Road
- Longmont Dam Road (eastern access upstream of Apple Valley)
- Longmont Dam Road (western access upstream of Apple Valley)
- Longmont Dam Road (downstream of Longmont Reservoir)
- Longmont Dam Road (downstream of Buttonrock Reservoir)

Additional drainageway and ditch infrastructure in the vicinity of this reach include:

- Confluence of Middle St. Vrain Creek – Where Highway 36 turns northwest towards Estes Park
- Longmont Reservoir
- Buttonrock Reservoir – Upstream terminus of North St. Vrain Creek
- Several private crossings

Historical aerial photography was reviewed to help identify the conditions that existed prior to flooding in this reach. The riparian corridor adjacent to the channel was mostly well vegetated and ranged in width from 100 feet to 200 feet. The channel was moderately sinuous and appeared to generally be in a stable state with no visible signs of vertical or horizontal instabilities. However, engineered channel bank protection was installed in several locations to protect Highway 36 from lateral channel migration.

The September 2013 flood event disrupted the connectivity of the North St. Vrain Creek. Many road crossings within this reach were significantly damaged by flooding and debris jams and the channel migrated to new alignments throughout the entire corridor.

### Assessment

The results of the ecological assessment show that this reach is generally in "Fair" condition with overall scores ranging between 5-7 out of 10. The lowest scoring elements from the ecological assessment are related to factors impacting fish and aquatic habitat. Additionally, the channel banks are eroding in some locations. The primary recommendations from the ecological assessment are to implement pools and planform complexity into the reach, preserve and reestablish open space, evaluate the flood conveyance capacities of the many bridge crossings.

Zones of moderate erosion and deposition exist throughout the entire reach. The planform for North St. Vrain Creek has been relatively consistent and stable through the river corridor over the past 60 years. The results of the geomorphic assessment show that the alignment of the channel is similar between pre- and post-flood conditions. This reach will tend to migrate and avulse for a range of hydrologic conditions. Absent of large flow events, the channel plan form for these reaches will likely remain reasonably stable once streambank vegetation has re-established. However, beyond some threshold discharge the channel plan form can be expected to change, and in some instances change significantly due to avulsion and migration. Most of Highway 36 is in the Channel Migration Zone (CMZ), meaning that additional lateral channel migration could erode the roadway embankment and potentially result in roadway damage. The primary recommendation from the geomorphic assessment is to restore the channel in the post-flood alignment.

Flood-related damages occurred mostly in the lower portions of this reach and consisted mostly of damage to Longmont Dam Road and private roadway crossings. Most of the residences adjacent to North St. Vrain Creek are not within the regulatory 100-year floodplain. However, many of these homes are still at risk for future flooding that could be triggered by modifications in channel configuration or debris jams.

### Plan Recommendations

The primary issues within this reach include lateral channel migration and bank erosion, sediment deposition/aggradation, sediment erosion/degradation, debris blockages throughout the reach and at drainageway crossings, some damage to Highway 36 and Longmont Dam Road, and damage to drainageway crossings. There are two sections of this reach that are generally in stable condition and will likely be able to recover without additional restoration activities. The first section is just upstream of where Highway 36 turns northwest towards Estes Park and the second section is just downstream of Longmont Reservoir. Additionally, there are large areas of riparian habitat that are still intact and should be preserved where possible. In locations where the channel needs to be restored, both cutting and filling will be required depending on what portion of the reach restoration will occur.

Some of the priorities identified by stakeholders include debris removal, optimizing flood conveyance at drainageway crossings, restoring the channel, implementing a recreational path adjacent to the creek, implementing whitewater recreation, and restoring and improving fish habitat.

The recommended plan for Reach 5 is shown on the following Figures in this Section. Planning recommendations for this reach are outlined below. The objective of this plan is to expedite the maturation of this reach by repairing erosion scars, re-establishing floodplain benches, building point-bars and excavating pools, re-vegetating denuded areas, and stabilizing channel banks in combination with implementing ongoing infrastructure improvements.

**Drainageway Crossings**

- Evaluate all drainageway crossings and optimize the flood conveyance capacity using the design flows published in the CDOT/CWCB study.
- Design new/improved drainageway crossings so that the low-flow channel remains unobstructed in order to maintain channel stability and achieve ecological connectivity. Provide additional floodplain conveyance capacity by utilizing floodplain culverts in the overbank areas.
- Remove debris blockages.

**Channel Restoration**

- Incorporate/stabilize a low flow/bankfull channel section with the following general design parameters:

| Design Parameter | Min | Max |
|---|---|---|
| Low flow/bankfull Channel Top Width | 50 | 100 |
| Slope | 0.015 | 0.03 |
| Ave. Low flow/bankfull Channel Top Width-to-Depth Ratio | 33 | |
| Ave. Sinuosity | 1.4 | |

- Preserve channel sections that have stabilized since the flood and provide in-stream and riparian habitat.
- Increase in-stream habitat complexity by incorporating pools, rock clusters, boulders and large woody debris.
- Revegetate the riparian corridor with native species where needed.
- Site-specific bank stabilization to protect adjacent infrastructure and private property.
- Fill areas and revegetate areas that are at high risk of avulsion.
- Remove debris blockages.

**Work In Progress**

Work that has been, or is the process of, being completed to restore flood-damaged infrastructure is outlined below:

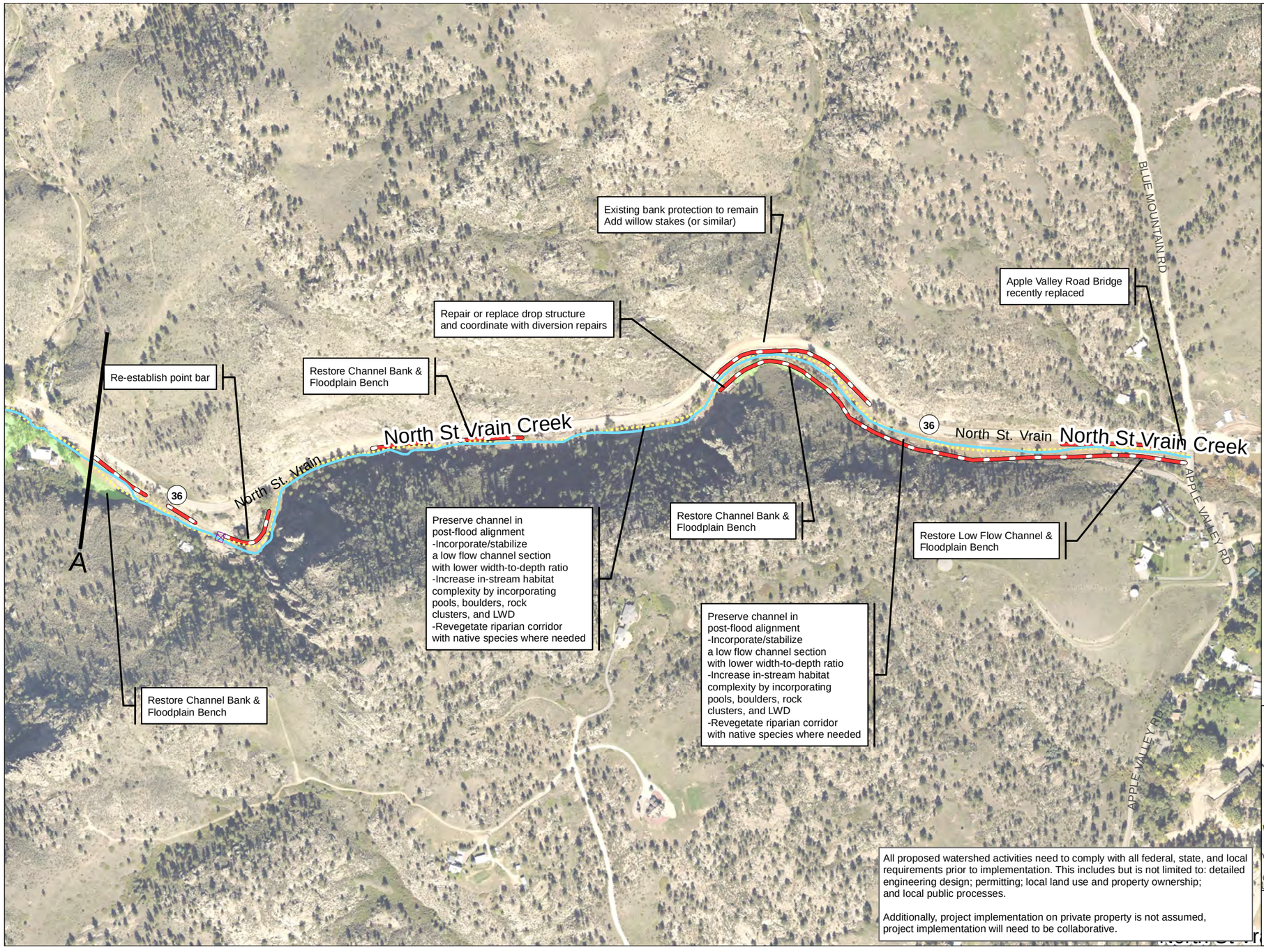
- Miscellaneous temporary bank stabilization projects.
- Improvements to multiple private drainageway crossings.
- Ongoing work on Longmont Dam Road between the eastern terminus and where Highway 36 turns northwest towards Estes Park. It is recommended that all future restoration work in this corridor be corridor be coordinated with Boulder County Transportation Department.
- It is recommended that all future restoration work adjacent to Highway 36 be coordinated with CDOT.

## *Estimated Cost of Unmet Needs*

Estimated costs for unmet needs were prepared to capture the capital that could be required to implement plan recommendations. These estimated costs do not include projects that are currently being completed or that are programmed. The estimated costs for unmet needs in this reach are provided in Table 7.3.

**Table 7.3 Estimated Costs for Reach 5**

| | Qty | Unit | Unit Cost | Cost |
|---|---|---|---|---|
| Low flow/bankfull Channel Restoration | 16659 | LF | $250 | $4,164,650 |
| Fill | 21249 | CY | $10 | $212,492 |
| Revegetate | 286864 | SF | $1 | $286,864 |
| Bank Protection - Boulder | 8540 | LF | $275 | $2,348,500 |
| Bank Protection - Root Wad | 567 | LF | $165 | $93,555 |
| Bank Protection - Floodplain Bench | 300 | LF | $100 | $30,000 |
| Excavation | 30000 | CY | $10 | $300,000 |
| | | | **Subtotal:** | **$7,436,061** |
| Land Acquisition | 5% | | | $371,803 |
| Engineering | 15% | | | $1,115,409 |
| Legal/Administrative | 5% | | | $371,803 |
| Contract Admin/Construction Management | 10% | | | $743,606 |
| Contingency | 25% | | | $1,859,015 |
| | | | | |
| | | | **Total:** | **$11,897,697** |




## REACH 5 ALTERNATIVE 1: RESTORATION W/ SITE-SPECIFIC PROJ. MAP 1 OF 5

### LEGEND

- Pre-Flood Channel Alignment
- Post Flood Channel Alignment
- Bank Protection
- Evaluate Crossing Capacity
- Dredge
- Fill & Revegetation
- Matchlines

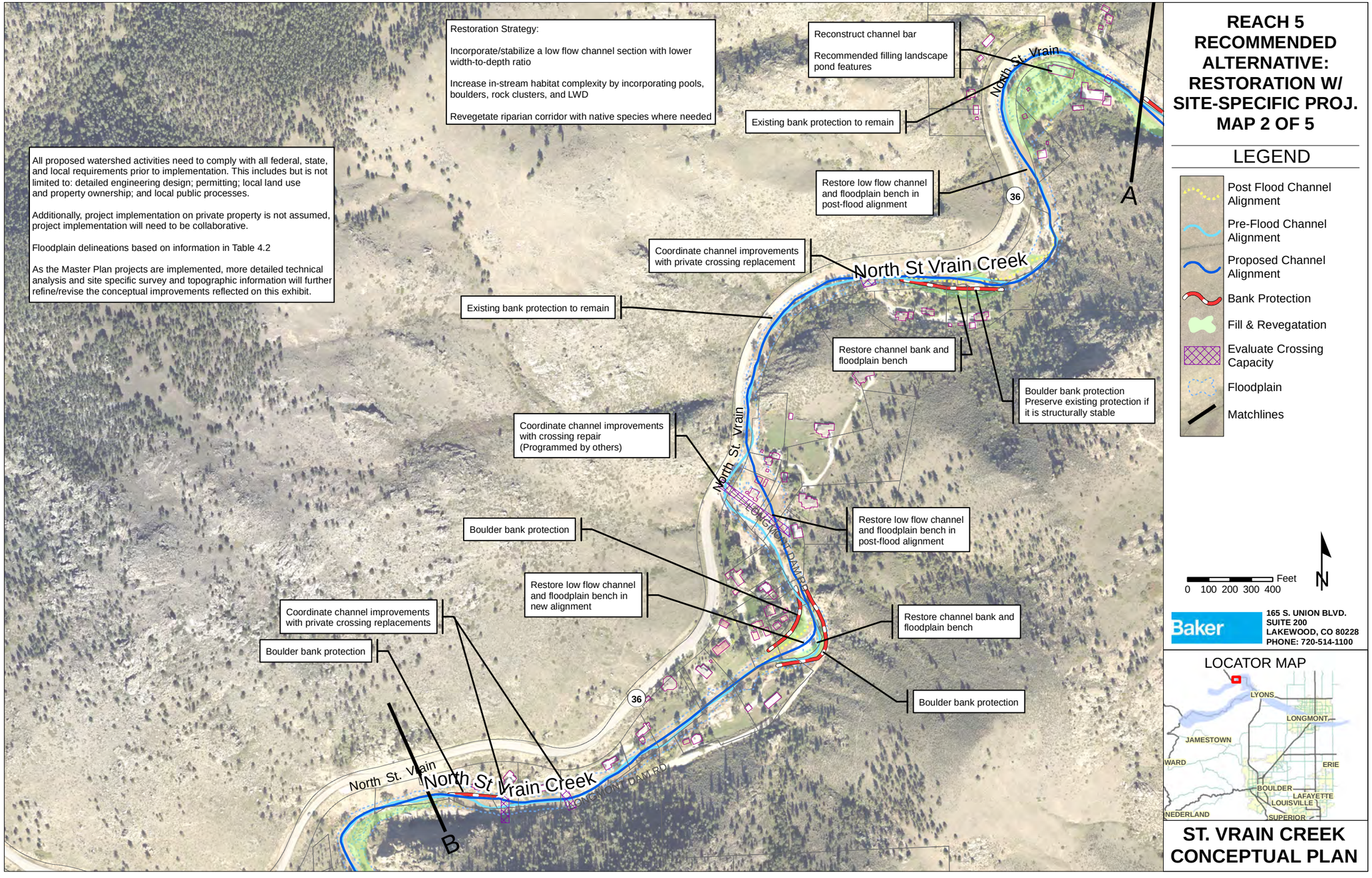
0 100 200 300 400 Feet

N

Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP


## ST. VRAIN CREEK CONCEPTUAL PLAN




## REACH 5 RECOMMENDED ALTERNATIVE: RESTORATION W/ SITE-SPECIFIC PROJ. MAP 2 OF 5

### LEGEND

- Post Flood Channel Alignment
- Pre-Flood Channel Alignment
- Proposed Channel Alignment
- Bank Protection
- Fill & Revegatation
- Evaluate Crossing Capacity
- Floodplain
- Matchlines

0 100 200 300 400 Feet

N

Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP




## ST. VRAIN CREEK CONCEPTUAL PLAN

Restoration Strategy:

Incorporate/stabilize a low flow channel section with lower width-to-depth ratio

Increase in-stream habitat complexity by incorporating pools, boulders, rock clusters, and LWD

Revegetate riparian corridor with native species where needed

Restore channel bank and floodplain bench

Crossing repairs as part of ongoing Longmont Dam Road improvements (Programmed by others)

Boulder bank protection

Boulder bank protection

Restore low flow channel and floodplain bench in post-flood alignment

Root wad bank protection

Coordinate channel improvements with private crossing replacements

Root wad bank protection

Restore low flow channel and floodplain bench in post-flood alignment

Preserve channel in post-flood alignment

Coordinate channel improvements with private crossing replacements

Preserve channel in post-flood alignment

All proposed watershed activities need to comply with all federal, state, and local requirements prior to implementation. This includes but is not limited to: detailed engineering design; permitting; local land use and property ownership; and local public processes.

Additionally, project implementation on private property is not assumed, project implementation will need to be collaborative.

Floodplain delineations based on information in Table 4.2

As the Master Plan projects are implemented, more detailed technical analysis and site specific survey and topographic information will further refine/revise the conceptual improvements reflected on this exhibit.

36

North St. Vrain

North St Vrain Creek

LONGMONT DAM RD

B

C

## REACH 5 RECOMMENDED ALTERNATIVE: RESTORATION W/ SITE-SPECIFIC PROJ. MAP 3 OF 5

### LEGEND

- Post Flood Channel Alignment
- Pre-Flood Channel Alignment
- Proposed Channel Alignment
- Bank Protection
- Fill & Revegatation
- Evaluate Crossing Capacity
- Floodplain
- Matchlines

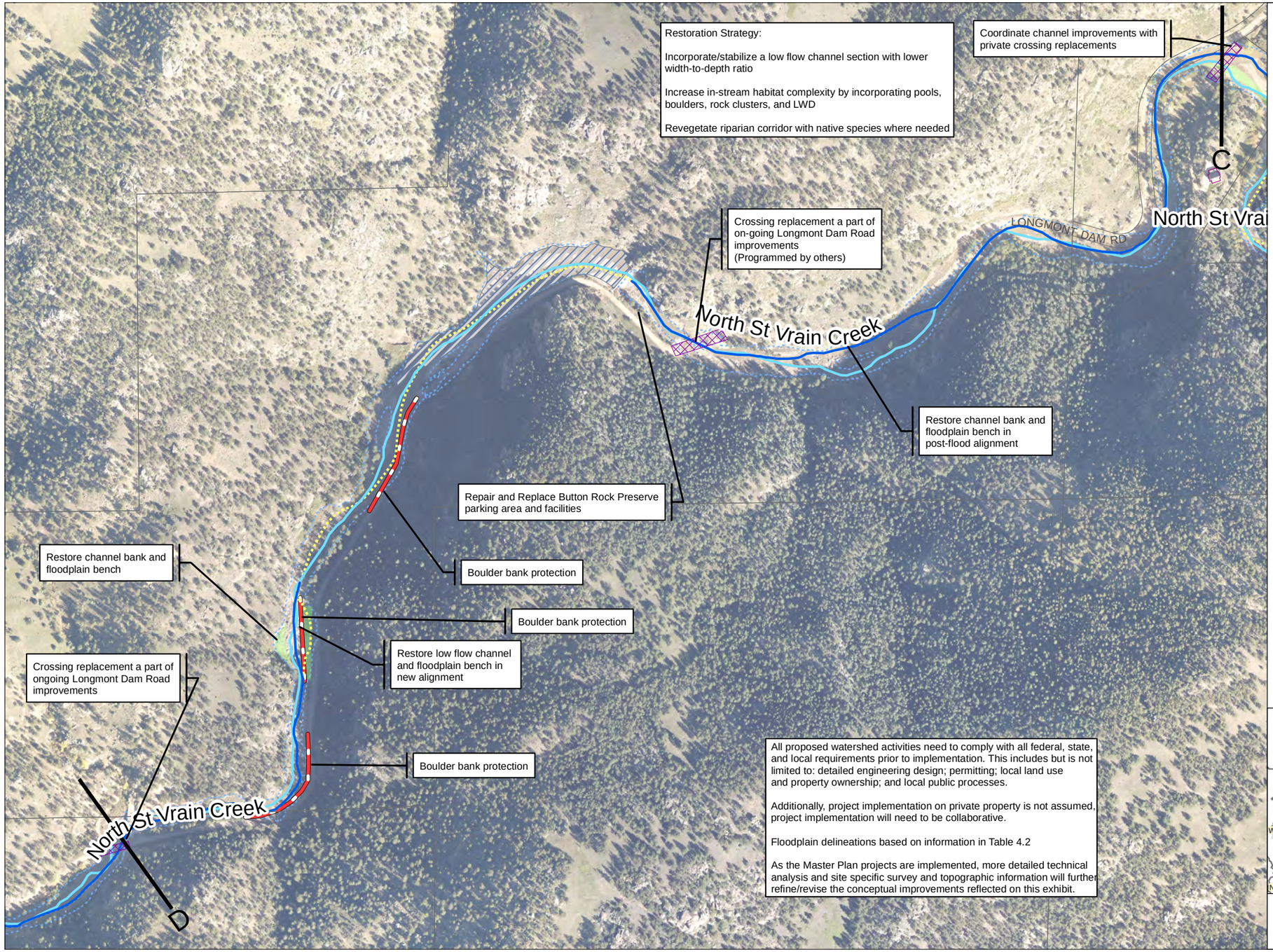
0 100 200 300 400 Feet

N

Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP


## ST. VRAIN CREEK CONCEPTUAL PLAN




## REACH 5 RECOMMENDED ALTERNATIVE: RESTORATION W/ SITE-SPECIFIC PROJ. MAP 4 OF 5

### LEGEND

- Post Flood Channel Alignment
- Pre-Flood Channel Alignment
- Proposed Channel Alignment
- Bank Protection
- Fill & Revegatation
- Dredge
- Evaluate Crossing Capacity
- Floodplain
- Matchlines

Feet
0 100 200 300 400

N

Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP


## ST. VRAIN CREEK CONCEPTUAL PLAN

Restoration Strategy:

Incorporate/stabilize a low flow channel section with lower width-to-depth ratio

Increase in-stream habitat complexity by incorporating pools, boulders, rock clusters, and LWD

Revegetate riparian corridor with native species where needed

Crossing repair a part of ongoing Longmont Dam Road improvements (Programmed by others)

North St Vrain Creek

North St Vrain Creek

Restore low flow channel and floodplain bench in post-flood alignment

Preserve channel in post-flood alignment

Ralph Price Reservoir

All proposed watershed activities need to comply with all federal, state, and local requirements prior to implementation. This includes but is not limited to: detailed engineering design; permitting; local land use and property ownership; and local public processes.

Additionally, project implementation on private property is not assumed, project implementation will need to be collaborative.

Floodplain delineations based on information in Table 4.2

As the Master Plan projects are implemented, more detailed technical analysis and site specific survey and topographic information will further refine/revise the conceptual improvements reflected on this exhibit.

## REACH 5 RECOMMENDED ALTERNATIVE: RESTORATION W/ SITE-SPECIFIC PROJ. MAP 5 OF 5

### LEGEND

- Post Flood Channel Alignment
- Pre-Flood Channel Alignment
- Proposed Channel Alignment
- Evaluate Crossing Capacity
- Floodplain
- Matchlines

0 100 200 300 400 Feet

N

Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP


## ST. VRAIN CREEK CONCEPTUAL PLAN

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## 7.3F Reach 6

### Overview

Reach 6 runs along the South St. Vrain Creek and begins at the choke in the canyon (just upstream of Andesite Quarry) and ends at Riverside. This reach crosses between US Forest Service, CDOT right-of-way, and privately owned land. This reach exists within a narrow-bottom valley and is geologically confined by the valley walls. There is little urbanization adjacent to the channel corridor and the surrounding land use is generally comprised of forested areas.

Drainageway crossings within this reach exist at:

- Old Saint Vrain Road
- Riverside Drive

Additional drainageway and ditch infrastructure in the vicinity of this reach include:

- Several private crossings

Historical aerial photography was reviewed to help identify the conditions that existed prior to flooding in this reach. The riparian corridor adjacent to the channel was mostly well vegetated and ranged in width from 100 feet to 200 feet. The channel was moderately sinuous and appeared to generally be in a stable state with no visible signs of vertical or horizontal instabilities. However, engineered channel bank protection was installed in several locations to protect State Highway 7 from lateral channel migration. The September 2013 flood event disrupted the connectivity of the South St. Vrain Creek. Many road crossings within this reach were significantly damaged by flooding and debris jams and a number of embankments adjacent to Highway 7 were damaged.

### Assessment

The results of the ecological assessment show that this reach is generally in "Fair" condition with overall scores ranging between 5-7 out of 10. The lowest scoring elements from the ecological assessment are related to factors impacting fish and aquatic habitat. Additionally, the channel is somewhat unstable and the channel banks are eroding in some locations. The primary recommendations from the ecological assessment are to improve in-stream habitat and reconstruct floodplains in conjunction with State Highway 7 reconstruction.

Zones of moderate erosion and deposition exist throughout the entire reach. The planform analysis did not encompass this portion of South St. Vrain Creek due to lack of historical aerials. However, based on visual observation and review of aerial photography, the alignment of the channel is similar between pre- and post-flood conditions. This reach will tend to migrate and avulse for a range of hydrologic conditions. Absent of large flow events, the channel planform for these reaches will likely remain reasonably stable once streambank vegetation has re-established. However, beyond some threshold discharge the channel plan form can be expected to change, and in some instances change significantly due to avulsion and migration. Most of State Highway 7 is in the CMZ, meaning that additional lateral channel migration could erode the roadway embankment and potentially result in roadway damage. The primary recommendation from the geomorphic assessment is to restore the channel in the post-flood alignment.

Flood-related damages occurred throughout this reach and consisted mostly of damage to State Highway 7, Riverside Drive, and multiple roadway crossings. Damage to both roads was caused by embankment failures triggered by lateral channel migration. However, both State Highway 7 and Riverside Drive encroach upon the river corridor, which has reduced the floodplain and riparian zone width and altered the natural channel function. The lateral channel migration that occurred during the September 2013 flood was likely a result of the river attempting to reestablish a stable planform. Therefore, it is recommended that opportunities to increase the floodplain width and/or restore connection to the disconnected channel migration area be evaluated during upcoming roadway improvements instead of only re-armoring the channel banks.

There are not many residences adjacent to South St. Vrain Creek in this reach and only some were damaged by flooding. Many of these homes are still at risk for future flooding that could be triggered by modifications in channel configuration or debris jams.

### Plan Recommendations

The primary issues within this reach include bank erosion, sediment deposition/aggradation, sediment erosion/degradation, debris blockages throughout the reach and at drainageway crossings, some damage to State Highway 7, and damage to drainageway crossings. There is one section of this reach that is generally in stable condition and will likely be able to recover without additional restoration activities. This section is located about 3.5 miles upstream of the beginning of this reach. Additionally, there are large areas of riparian habitat that are still intact and should be preserved where possible. In locations where the channel needs to be restored, both cutting and filling will be required depending on what portion of the reach restoration will occur.

Some of the priorities identified by stakeholders include debris removal, optimizing flood conveyance at drainageway crossings, restoring the channel, restoring in-stream recreation features, and restoring and improving fish habitat.

The recommended plan for Reach 6 is shown on the following Figures in this Section. Planning recommendations for this reach are outlined below. The objective of this plan is to expedite the maturation of this reach by repairing erosion scars, re-establishing floodplain benches, building point-bars and excavating pools, re-vegetating denuded areas, and stabilizing channel banks in combination with implementing ongoing infrastructure improvements.

**Drainageway Crossings**

- Evaluate all drainageway crossings and optimize the flood conveyance capacity using the design flows published in the CDOT/CWCB study.
- Design new/improved drainageway crossings so that the low flow/bankfull channel remains unobstructed in order to maintain channel stability, achieve ecological connectivity, provide unimpeded fish and aquatic organism passage, and improve flood resiliency. Provide additional floodplain conveyance capacity by utilizing floodplain culverts in the overbank areas.
- Remove debris blockages.

**Channel Restoration**

- Incorporate/stabilize a low flow/bankfull channel section with the following general design parameters:

| Design Parameter | Min | Max |
|---|---|---|
| Low flow/bankfull Channel Top Width | 50 | 100 |
| Slope | 0.01 | 0.02 |
| Ave. Low flow/bankfull Channel Top Width-to-Depth Ratio | 33 (upstream of ~Mile Marker 29)<br>20 (downstream ~Mile Marker 29) | |
| Ave. Sinuosity | 1.2 | |

- Preserve channel sections that have stabilized since the flood and provide in-stream and riparian habitat.
- Increase in-stream habitat complexity by incorporating pools, rock clusters, boulders and large woody debris.
- Revegetate the riparian corridor with native species where needed.
- Site-specific bank stabilization to protect adjacent infrastructure and private property.
- Fill areas and revegetate areas that are at high risk of avulsion.
- Remove debris blockages.
- Excavate material deposited by flooding to restore flood capacity.

**Work In Progress**

Work that has been, or is the process of, being completed to restore flood-damaged infrastructure is outlined below:

- Miscellaneous temporary bank stabilization projects.
- Improvements to multiple private drainageway crossings.
- Upcoming repair work is planned along State Highway 7. It is recommended that all future restoration work in this corridor be coordinated with CDOT. Opportunities to expand the floodplain should be considered during all future improvements along State Highway 7. There are several locations where State Highway 7 has truncated historical channel migration areas. In these locations, resiliency could be improved by realigning State Highway 7 to be outside of these disconnected migration areas.

## *Estimated Cost of Unmet Needs*

Estimated costs for unmet needs were prepared to capture the capital that could be required to implement plan recommendations. These estimated costs do not include projects that are currently being completed or that are programmed. The estimated costs for unmet needs in this reach are provided in Table 7.4.

**Table 7.4 Estimated Costs for Reach 6**

| | Qty | Unit | Unit Cost | Cost |
|---|---|---|---|---|
| Low flow/bankfull Channel Restoration | 35936 | LF | $250 | $8,983,975 |
| Fill | 47899 | CY | $10 | $478,991 |
| Revegetate | 646638 | SF | $1 | $646,638 |
| Bank Protection - Boulder | 18302 | LF | $275 | $5,033,050 |
| Bank Protection - Root Wad | 455 | LF | $165 | $75,075 |
| | | | **Subtotal:** | **$15,217,729** |
| Land Acquisition | 5% | | | $760,886 |
| Engineering | 15% | | | $2,282,659 |
| Legal/Administrative | 5% | | | $760,886 |
| Contract Admin/Construction Management | 10% | | | $1,521,773 |
| Contingency | 25% | | | $3,804,432 |
| | | | **Total:** | **$24,348,367** |

Consider realigning SH7 to be outside of channel migration area Refer to geomorphic assessment for this area for more information

Boulder bank protection Coordinate with road repairs

Restore channel bank and floodplain bench

Boulder bank protection Coordinate with road repairs

Restore channel bank and floodplain bench

Consider realigning SH7 to be outside of channel migration area Refer to geomorphic assessment for this area for more information

Restore low flow channel and floodplain bench in post-flood alignment

Boulder bank protection Coordinate with road repairs

Restoration Strategy:

Incorporate/stabilize a low flow channel section with lower width-to-depth ratio

Increase in-stream habitat complexity by incorporating pools, boulders, rock clusters, and LWD

Revegetate riparian corridor with native species where needed

Restore channel bank and floodplain bench

Restore low flow channel and floodplain bench in post-flood alignment

Restore channel bank and floodplain bench

South St. Vrain

South St Vrain Creek

South St. Vrain

7

7

A

All proposed watershed activities need to comply with all federal, state, and local requirements prior to implementation. This includes but is not limited to: detailed engineering design; permitting; local land use and property ownership; and local public processes.

Additionally, project implementation on private property is not assumed, project implementation will need to be collaborative.

Floodplain delineations based on information in Table 4.2

As the Master Plan projects are implemented, more detailed technical analysis and site specific survey and topographic information will further refine/revise the conceptual improvements reflected on this exhibit.

## REACH 6 RECOMMENDED ALTERNATIVE: RESTORATION W/ SITE-SPECIFIC PROJ. MAP 1 OF 9

### LEGEND

- Post Flood Channel Alignment
- Proposed Channel Alignment
- Bank Protection
- Fill & Revegatation
- Floodplain
- Matchlines

0 100 200 300 400 Feet

N

Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP


## ST. VRAIN CREEK COUNCEPTUAL PLAN

All proposed watershed activities need to comply with all federal, state, and local requirements prior to implementation. This includes but is not limited to: detailed engineering design; permitting; local land use and property ownership; and local public processes.

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Floodplain delineations based on information in Table 4.2

As the Master Plan projects are implemented, more detailed technical analysis and site specific survey and topographic information will further refine/revise the conceptual improvements reflected on this exhibit.

Boulder bank protection

South St Vrain Creek

South St. Vrain

Restoration Strategy:

Incorporate/stabilize a low flow channel section with lower width-to-depth ratio

Increase in-stream habitat complexity by incorporating pools, boulders, rock clusters, and LWD

Revegetate riparian corridor with native species where needed

Boulder bank protection
Coordinate with road repairs

Restore low flow channel and floodplain bench in post-flood alignment

Boulder bank protection

Restore low flow channel and floodplain bench

Coordinate with road repairs

Restore low flow channel and floodplain bench in new alignment

Boulder bank protection

Restore channel bank and floodplain bench

Restore low flow channel and floodplain bench in post-flood alignment

South St. Vrain

Coordinate channel improvements with private crossing repair

Restore channel bank and floodplain bench

7

A

B

## REACH 6 RECOMMENDED ALTERNATIVE: RESTORATION W/ SITE-SPECIFIC PROJ. MAP 2 OF 9

### LEGEND

- Post Flood Channel Alignment
- Proposed Channel Alignment
- Bank Protection
- Fill & Revegatation
- Evaluate Crossing Capacity
- Floodplain
- Matchlines

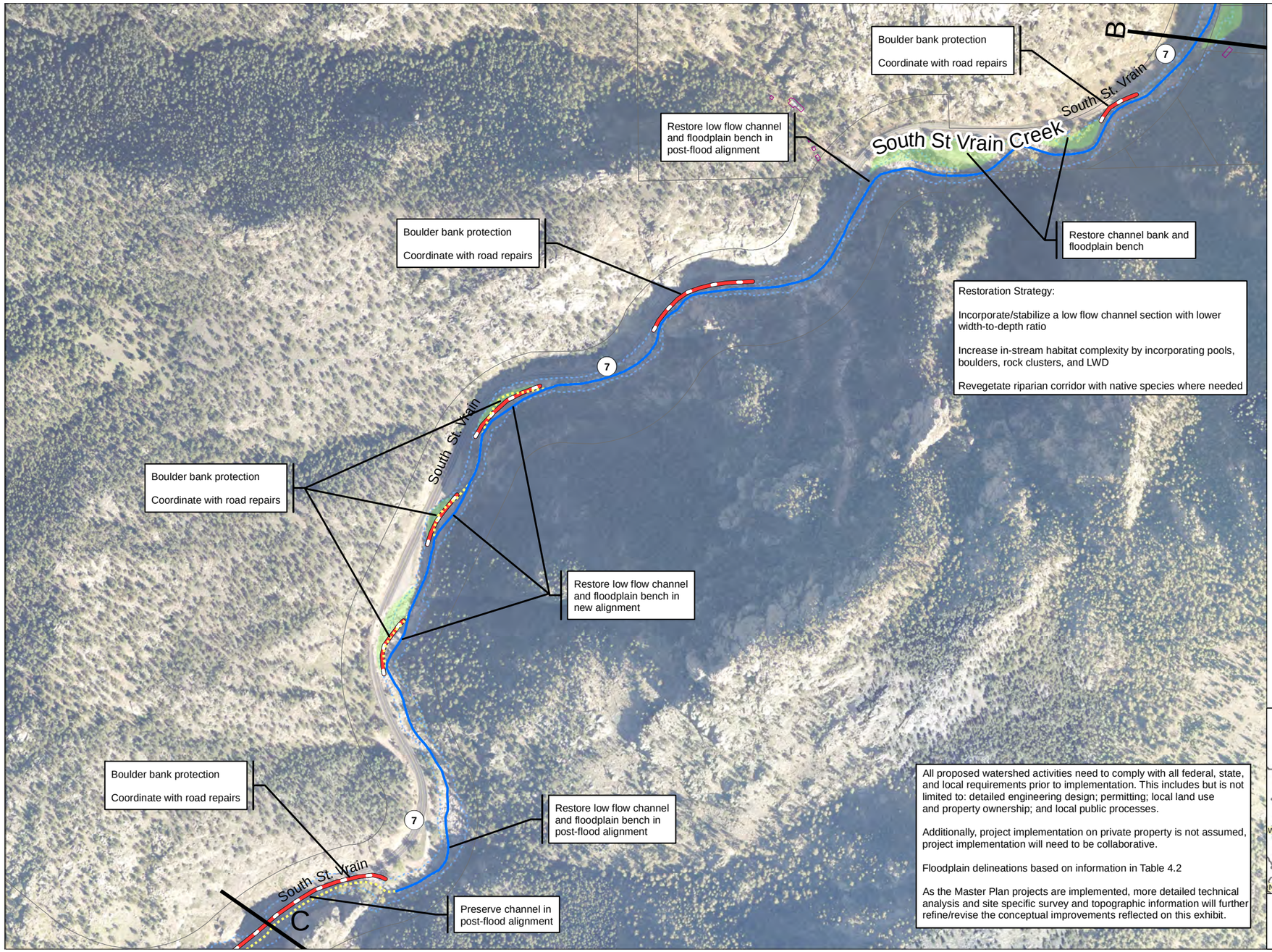
0 100 200 300 400 Feet

N

Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP


## ST. VRAIN CREEK CONCEPTUAL PLAN




**REACH 6 RECOMMENDED ALTERNATIVE: RESTORATION W/ SITE-SPECIFIC PROJ. MAP 3 OF 9**

LEGEND

- Post Flood Channel Alignment
- Proposed Channel Alignment
- Bank Protection
- Fill & Revegatation
- Floodplain
- Matchlines

Feet
0 100 200 300 400

N

Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP


All proposed watershed activities need to comply with all federal, state, and local requirements prior to implementation. This includes but is not limited to: detailed engineering design; permitting; local land use and property ownership; and local public processes.

Additionally, project implementation on private property is not assumed, project implementation will need to be collaborative.

Floodplain delineations based on information in Table 4.2

As the Master Plan projects are implemented, more detailed technical analysis and site specific survey and topographic information will further refine/revise the conceptual improvements reflected on this exhibit.

**ST. VRAIN CREEK CONCEPTUAL PLAN**

Consider realigning SH7 to be outside of channel migration area Refer to geomorphic assessment for this area for more information

Boulder bank protection Coordinate with road repairs

Restoration Strategy:

Incorporate/stabilize a low flow channel section with lower width-to-depth ratio

Increase in-stream habitat complexity by incorporating pools, boulders, rock clusters, and LWD

Revegetate riparian corridor with native species where needed

Boulder bank protection

Coordinate with road repairs

South St Vrain Creek

South St. Vrain

Preserve channel in post-flood alignment

Consider realigning SH7 to be outside of channel migration area Refer to geomorphic assessment for this area for more information

7

Restore low flow channel and floodplain bench in post-flood alignment

Consider realigning SH7 to be outside of channel migration area Refer to geomorphic assessment for this area for more information

South St Vrain Creek

Boulder bank protection Coordinate with road repairs

Boulder bank protection

7

South St. Vrain

Boulder bank protection Coordinate with road repairs

Restore low flow channel and floodplain bench in post-flood alignment

C

D

Boulder bank protection Coordinate with road repairs

All proposed watershed activities need to comply with all federal, state, and local requirements prior to implementation. This includes but is not limited to: detailed engineering design; permitting; local land use and property ownership; and local public processes.

Additionally, project implementation on private property is not assumed, project implementation will need to be collaborative.

Floodplain delineations based on information in Table 4.2

As the Master Plan projects are implemented, more detailed technical analysis and site specific survey and topographic information will further refine/revise the conceptual improvements reflected on this exhibit.

# REACH 6 RECOMMENDED ALTERNATIVE: RESTORATION W/ SITE-SPECIFIC PROJ. MAP 4 OF 9

## LEGEND

- Post Flood Channel Alignment
- Proposed Channel Alignment
- Bank Protection
- Fill & Revegetation
- Floodplain
- Matchlines

Feet
0 100 200 300 400

N

Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP


# ST. VRAIN CREEK CONCEPTUAL PLAN

Restoration Strategy:

Incorporate/stabilize a low flow channel section with lower width-to-depth ratio

Increase in-stream habitat complexity by incorporating pools, boulders, rock clusters, and LWD

Revegetate riparian corridor with native species where needed

Boulder bank protection
Coordinate with road repairs

Boulder bank protection
Coordinate with road repairs

Boulder bank protection
Coordinate with road repairs

Consider realigning SH7 to be outside of channel migration area
Refer to geomorphic assessment for this area for more information

Restore channel bank and floodplain bench
Coordinate with road repairs

Boulder bank protection
Coordinate with road repairs

South St. Vrain

South St Vrain Creek

7

South St. Vrain

7

South St. Vrain

Restore low flow channel and floodplain bench in post-flood alignment

Restore low flow channel and floodplain bench in post-flood alignment

Restore low flow channel and floodplain bench in post-flood alignment

Boulder bank protection
Coordinate with road repairs

D

E

All proposed watershed activities need to comply with all federal, state, and local requirements prior to implementation. This includes but is not limited to: detailed engineering design; permitting; local land use and property ownership; and local public processes.

Additionally, project implementation on private property is not assumed, project implementation will need to be collaborative.

Floodplain delineations based on information in Table 4.2

As the Master Plan projects are implemented, more detailed technical analysis and site specific survey and topographic information will further refine/revise the conceptual improvements reflected on this exhibit.

# REACH 6 RECOMMENDED ALTERNATIVE: RESTORATION W/ SITE-SPECIFIC PROJ. MAP 5 OF 9

## LEGEND

- Post Flood Channel Alignment
- Proposed Channel Alignment
- Bank Protection
- Fill & Revegetation
- Floodplain
- Matchlines

0 100 200 300 400 Feet

N

Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP


# ST. VRAIN CREEK CONCEPTUAL PLAN

Restoration Strategy:

Incorporate/stabilize a low flow channel section with lower width-to-depth ratio

Increase in-stream habitat complexity by incorporating pools, boulders, rock clusters, and LWD

Revegetate riparian corridor with native species where needed

Restore low flow channel and floodplain bench in post-flood alignment

Consider realigning SH7 to be outside of channel migration area Refer to geomorphic assessment for this area for more information

Boulder bank protection Coordinate with road repairs

Consider realigning SH7 to be outside of channel migration area Refer to geomorphic assessment for this area for more information

Boulder bank protection Coordinate with road repairs

Boulder bank protection Coordinate with road repairs

Restore channel bank and floodplain bench

Root wad bank protection and floodplain bench

Restore low flow channel and floodplain bench in post-flood alignment

Boulder bank protection Coordinate with road repairs

Restore low flow channel and floodplain bench in post-flood alignment

Middle Saint Vrain Creek

South St. Vrain

South St Vrain Creek

South St. Vrain

7

F

E

All proposed watershed activities need to comply with all federal, state, and local requirements prior to implementation. This includes but is not limited to: detailed engineering design; permitting; local land use and property ownership; and local public processes.

Additionally, project implementation on private property is not assumed, project implementation will need to be collaborative.

Floodplain delineations based on information in Table 4.2

As the Master Plan projects are implemented, more detailed technical analysis and site specific survey and topographic information will further refine/revise the conceptual improvements reflected on this exhibit.

## REACH 6 RECOMMENDED ALTERNATIVE: RESTORATION W/ SITE-SPECIFIC PROJ. MAP 6 OF 9

### LEGEND

- Post Flood Channel Alignment
- Proposed Channel Alignment
- Bank Protection
- Fill & Revegatation
- Floodplain
- Matchlines

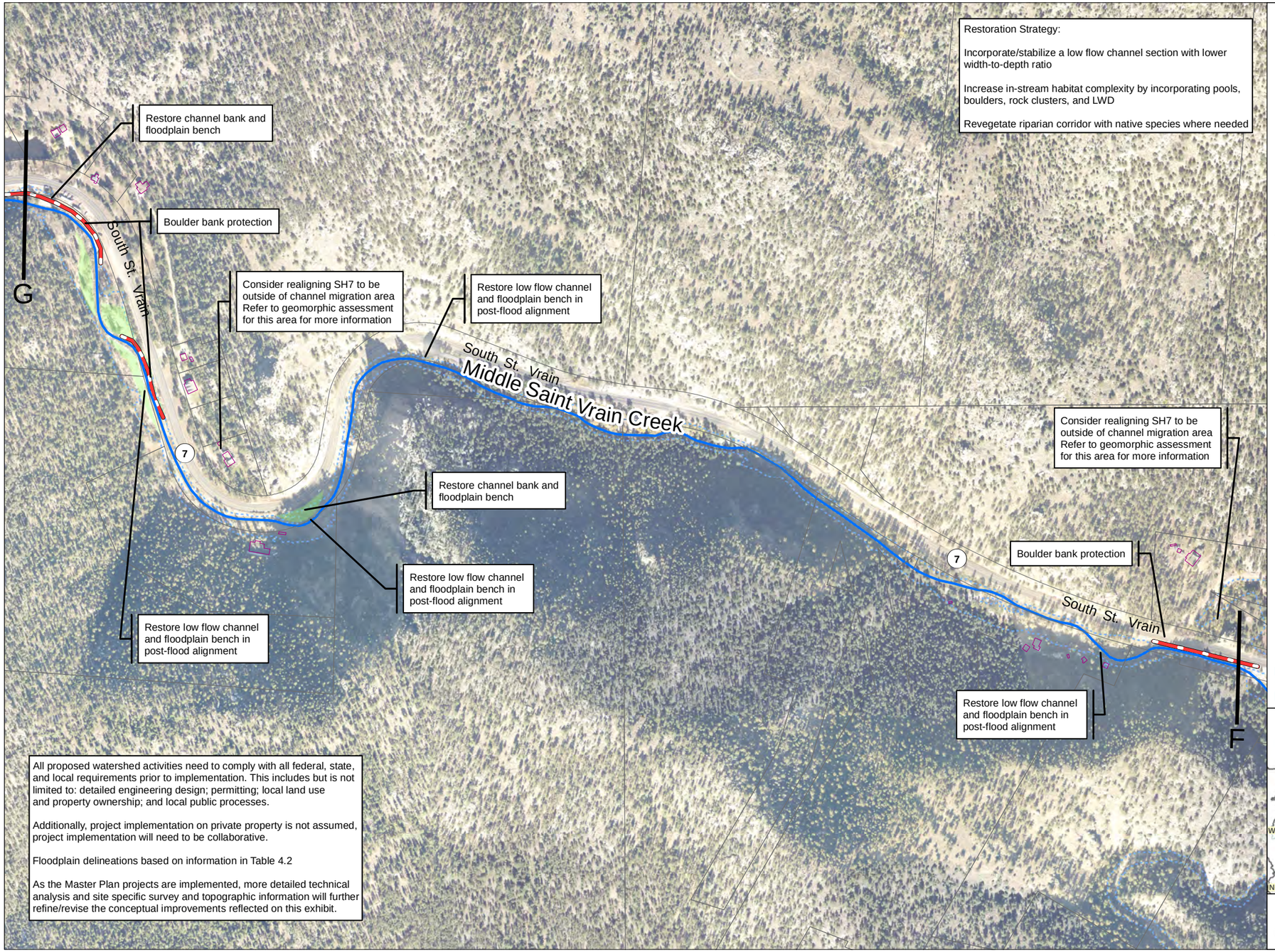
0 100 200 300 400 Feet

N

Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP


## ST. VRAIN CREEK CONCEPTUAL PLAN




## REACH 6 RECOMMENDED ALTERNATIVE: RESTORATION W/ SITE-SPECIFIC PROJ. MAP 7 OF 9

LEGEND

- Post Flood Channel Alignment
- Proposed Channel Alignment
- Bank Protection
- Fill & Revegetation
- Floodplain
- Matchlines

0 100 200 300 400 Feet

N

Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP


## ST. VRAIN CREEK CONCEPTUAL PLAN

Restoration Strategy:

Incorporate/stabilize a low flow channel section with lower width-to-depth ratio

Increase in-stream habitat complexity by incorporating pools, boulders, rock clusters, and LWD

Revegetate riparian corridor with native species where needed

Boulder bank protection

Restore channel bank and floodplain bench

Boulder bank protection

Restore channel bank and floodplain bench

Restore channel bank and floodplain bench

Restore channel bank and floodplain bench at bridge approach

Restore low flow channel and floodplain bench in post-flood alignment

Restore low flow channel and floodplain bench in pre-flood alignment

Restore low flow channel and floodplain bench Coordinate with bridge repair

Boulder bank protection

Restore low flow channel and floodplain bench in post-flood alignment

Boulder bank protection

Restore low flow channel and floodplain bench in post-flood alignment

Restore channel bank and floodplain bench

Restore low flow channel and floodplain bench in pre-flood alignment

Restore embankment protection at bridge Coordinate with bridge repairs

Middle Saint Vrain Creek

South St. Vrain

CR 103 (RIVERSIDE DR)

103

7

G

H

All proposed watershed activities need to comply with all federal, state, and local requirements prior to implementation. This includes but is not limited to: detailed engineering design; permitting; local land use and property ownership; and local public processes.

Additionally, project implementation on private property is not assumed, project implementation will need to be collaborative.

Floodplain delineations based on information in Table 4.2

As the Master Plan projects are implemented, more detailed technical analysis and site specific survey and topographic information will further refine/revise the conceptual improvements reflected on this exhibit.

## REACH 6 RECOMMENDED ALTERNATIVE: RESTORATION W/ SITE-SPECIFIC PROJ. MAP 8 OF 9

### LEGEND

- Post Flood Channel Alignment
- Proposed Channel Alignment
- Bank Protection
- Fill & Revegetation
- Floodplain
- matchlines

0 100 200 300 400 Feet

N

Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP


## ST. VRAIN CREEK CONCEPTUAL PLAN

All proposed watershed activities need to comply with all federal, state, and local requirements prior to implementation. This includes but is not limited to: detailed engineering design; permitting; local land use and property ownership; and local public processes.

Additionally, project implementation on private property is not assumed, project implementation will need to be collaborative.

Floodplain delineations based on information in Table 4.2

As the Master Plan projects are implemented, more detailed technical analysis and site specific survey and topographic information will further refine/revise the conceptual improvements reflected on this exhibit.

Restore low flow channel and floodplain bench in post-flood alignment

Restoration Strategy:

Incorporate/stabilize a low flow channel section with lower width-to-depth ratio

Increase in-stream habitat complexity by incorporating pools, boulders, rock clusters, and LWD

Revegetate riparian corridor with native species where needed

Root wad bank protection

Root wad bank protection

Boulder bank protection

Restore low flow channel and floodplain bench in post-flood alignment

Boulder bank protection

Coordinate with road repair

Middle Saint Vrain Creek

South St. Vrain

CR 103 (RIVERSIDE DR)

7

103

# REACH 6 RECOMMENDED ALTERNATIVE: RESTORATION W/ SITE-SPECIFIC PROJ. MAP 9 OF 9

## LEGEND

- Post Flood Channel Alignment
- Proposed Channel Alignment
- Bank Protection
- Floodplain
- Matchlines

Feet
0 100 200 300 400

N

Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP


# ST. VRAIN CREEK CONCEPTUAL PLAN

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## 7.3G Reach 7

### Overview

Reach 7 of South St. Vrain Creek begins upstream of Riverside and continues through Raymond to the upstream limit of the Planning Area. This reach is encompassed entirely by privately owned land. This reach exists within a narrow-bottom valley and is geologically confined by the valley walls. There is little urbanization adjacent to the channel corridor and the surrounding land use is generally comprised of forested areas.

Drainageway crossings within this reach exist at:

» Riverside Drive (2 crossings)

Additional drainageway and ditch infrastructure in the vicinity of this reach include:

» Several private crossings

Historical aerial photography was reviewed to help identify the conditions that existed prior to flooding in this reach. The riparian corridor adjacent to the channel was mostly well vegetated and ranged in width from 100 feet to 200 feet. The channel was moderately sinuous and appeared to generally be in a stable state with no visible signs of vertical or horizontal instabilities.

The September 2013 flood event disrupted the connectivity of the South St. Vrain Creek. Many road crossings and private residences within this reach were significantly damaged by flooding and debris jams.

### Assessment

The results of the ecological assessment show that this reach is generally in "Good" condition with overall scores ranging between 7-8 out of 10. The lowest scoring elements from the ecological assessment are related to the lack of pools and canopy cover, which are critical components to fish habitat. Additionally, the channel is somewhat unstable and the channel banks are eroding in some locations. The primary recommendations from the ecological assessment are replace roadway crossings with structures that convey the low-flow and improving in-stream habitat complexity and by using large woody debris.

Zones of minor erosion and deposition exist throughout the entire reach. The planform analysis did not encompass this portion of South St. Vrain. However, based on the assessment in North St. Vrain, visual observation, and review of aerial photography, the alignment of the channel is similar between pre- and post-flood conditions. This reach will tend to migrate and avulse for a range of hydrologic conditions. Absent of large flow events, the channel plan form for these reaches will likely remain reasonably stable once streambank vegetation has re-established. However, beyond some threshold discharge the channel plan form can be expected to change, and in some instances change significantly due to avulsion and migration. Most of Riverside Drive is in the CMZ, meaning that additional lateral channel migration could erode the roadway embankment and potentially result in roadway damage. The primary recommendation from the geomorphic assessment is to restore the channel in the post-flood alignment.

Damage to Riverside Drive was caused by embankment failures triggered by lateral channel migration. However, Riverside Drive encroaches upon the river corridor, which has reduced the floodplain and riparian zone width and altered the natural channel function. The lateral channel migration that occurred during the September 2013 flood was likely a result of the river attempting to reestablish a stable planform. Therefore, it is recommended that opportunities to increase the floodplain width be evaluated during upcoming roadway improvements instead of only re-armoring the channel banks.

Flood-related damages occurred throughout this reach and consisted mostly of damage to private residences and the privately-owned roadway crossings leading to the residences. Several of the residences adjacent to the South St. Vrain were damaged by flooding. Many of these homes are still at risk for future flooding that could be triggered by modifications in channel configuration or debris jams.

### Plan Recommendations

The primary issues within this reach include bank erosion, sediment deposition/aggradation, sediment erosion/degradation, debris blockages throughout the reach and at drainageway crossings, some damage to Riverside Drive, and damage to drainageway crossings. A significant portion of this reach is generally in stable condition and will likely be able to recover without additional restoration activities. Additionally, there are large areas of riparian habitat that are still intact and should be preserved where possible. In locations where the channel needs to be restored, both cutting and filling will be required depending on what portion of the reach restoration will occur.

Some of the priorities identified by stakeholders include debris removal, optimizing flood conveyance at drainageway crossings, restoring the channel, and restoring and improving fish habitat.

The recommended plan for Reach 7 is shown on the following Figures in this Section. Planning recommendations for this reach are outlined below. The objective of this plan is to expedite the maturation of this reach by repairing erosion scars, re-establishing floodplain benches, building point-bars and excavating pools, re-vegetating denuded areas, and stabilizing channel banks in combination with implementing ongoing infrastructure improvements.

**Drainageway Crossings**

» Evaluate all drainageway crossings and optimize the flood conveyance capacity using the design flows published in the CDOT/CWCB study. See crossing guidance in Appendix G for additional information.

» Design new/improved drainageway crossings so that the low flow/bankfull channel remains unobstructed in order to maintain channel stability, achieve ecological connectivity, provide unimpeded fish and aquatic organism passage, and improve flood resiliency. Provide additional floodplain conveyance capacity by utilizing floodplain culverts in the overbank areas.

» It is recommended that options to combine/share private crossings be considered throughout the reach.

» Remove debris blockages.

**Channel Restoration**

» Incorporate/stabilize a low flow/bankfull channel section with the following general design parameters:

| Design Parameter | Min | Max |
|---|---|---|
| Low flow/bankfull Channel Top Width | 25 | 50 |
| Slope | 0.015 | 0.03 |
| Ave. Low flow/bankfull Channel Top Width-to-Depth Ratio | 33 | |
| Ave. Sinuosity | 1.2 | |

» Preserve channel sections that have stabilized since the flood and provide in-stream and riparian habitat.

» Increase in-stream habitat complexity by incorporating pools, rock clusters, boulders and large woody debris.

» Revegetate the riparian corridor with native species where needed.

» Site-specific bank stabilization to protect adjacent infrastructure and private property.

» Fill areas and revegetate areas that are at high risk of avulsion.

» Remove debris blockages.

» Excavate material deposited by flooding to restore flood capacity.

**Work In Progress**

Work that has been, or is the process of, being completed to restore flood-damaged infrastructure is outlined below:

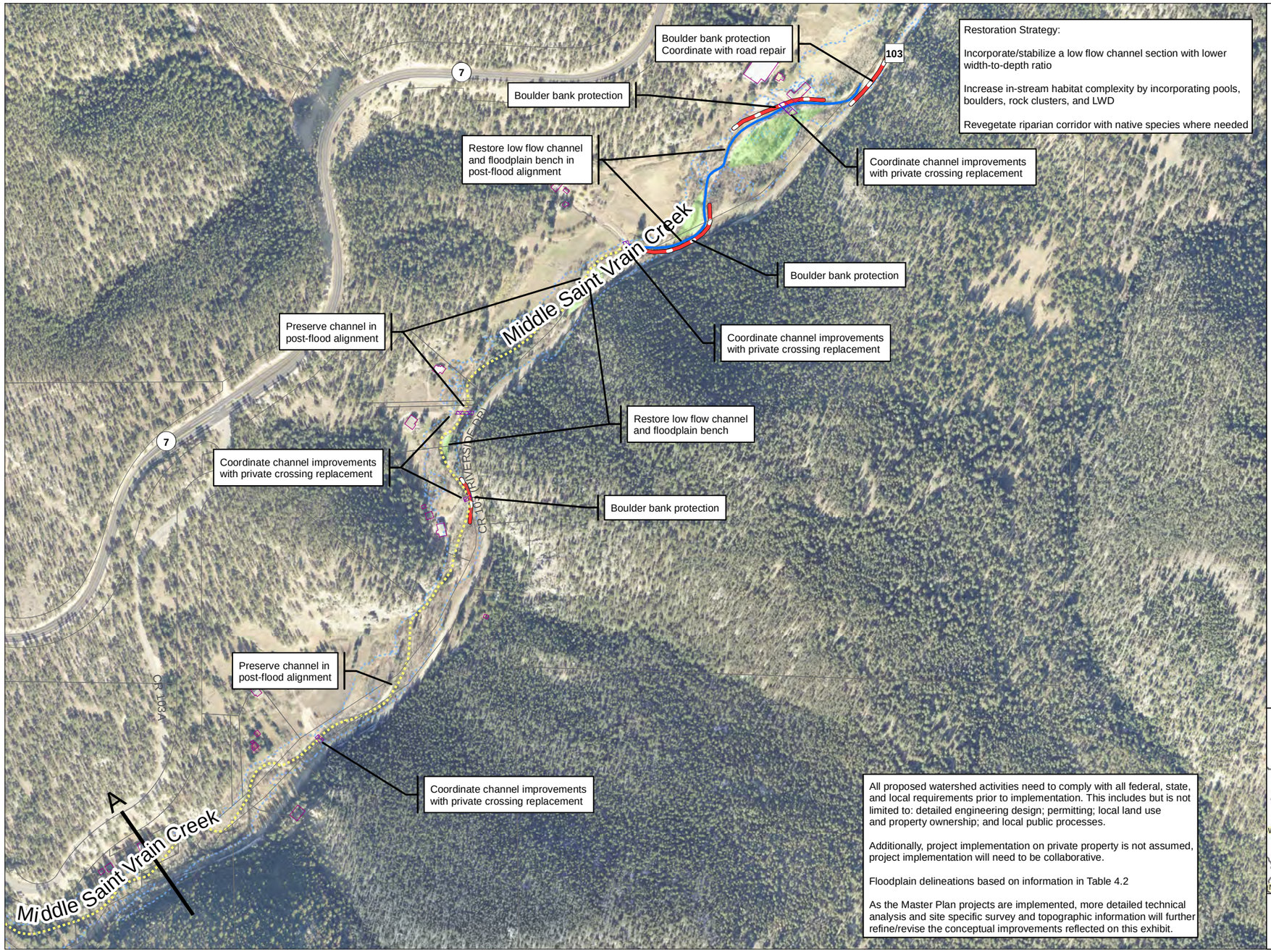
- Improvements to multiple private drainageway crossings.
- It is recommended that all future restoration work in this corridor be coordinated with improvements to Riverside Drive. Opportunities to expand the floodplain should be considered during all future improvements. There are several locations where Riverside Drive has truncated historical channel migration areas. In these locations, resiliency could be improved by realigning portions of the road to be outside of these disconnected migration areas.

## *Estimated Cost of Unmet Needs*

Estimated costs for unmet needs were prepared to capture the capital that could be required to implement plan recommendations. These estimated costs do not include projects that are currently being completed or that are programmed. The estimated costs for unmet needs in this reach are provided in Table 7.5.

**Table 7.5 Estimated Costs for Reach 7**

| | Qty | Unit | Unit Cost | Cost |
|---|---|---|---|---|
| Low flow/bankfull Channel Restoration | 1680 | LF | $200 | $336,000 |
| Fill | 5196 | CY | $10 | $51,960 |
| Revegetate | 70146 | SF | $1 | $70,146 |
| Bank Protection - Boulder | 1334 | LF | $275 | $366,850 |
| | | | **Subtotal:** | **$824,956** |
| Land Acquisition | 5% | | | $41,248 |
| Engineering | 15% | | | $123,743 |
| Legal/Administrative | 5% | | | $41,248 |
| Contract Admin/Construction Management | 10% | | | $82,496 |
| Contingency | 25% | | | $206,239 |
| | | | **Total:** | **$1,319,930** |




Restoration Strategy:

Incorporate/stabilize a low flow channel section with lower width-to-depth ratio

Increase in-stream habitat complexity by incorporating pools, boulders, rock clusters, and LWD

Revegetate riparian corridor with native species where needed

## REACH 7 RECOMMENDED ALTERNATIVE: RESTORATION W/ SITE-SPECIFIC PROJ. MAP 1 OF 2

### LEGEND

- Post Flood Channel Alignment
- Proposed Channel Alignment
- Bank Protection
- Fill & Revegetation
- Evaluate Crossing Capacity
- Floodplain
- Matchlines

0 100 200 300 400 Feet

N

Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP

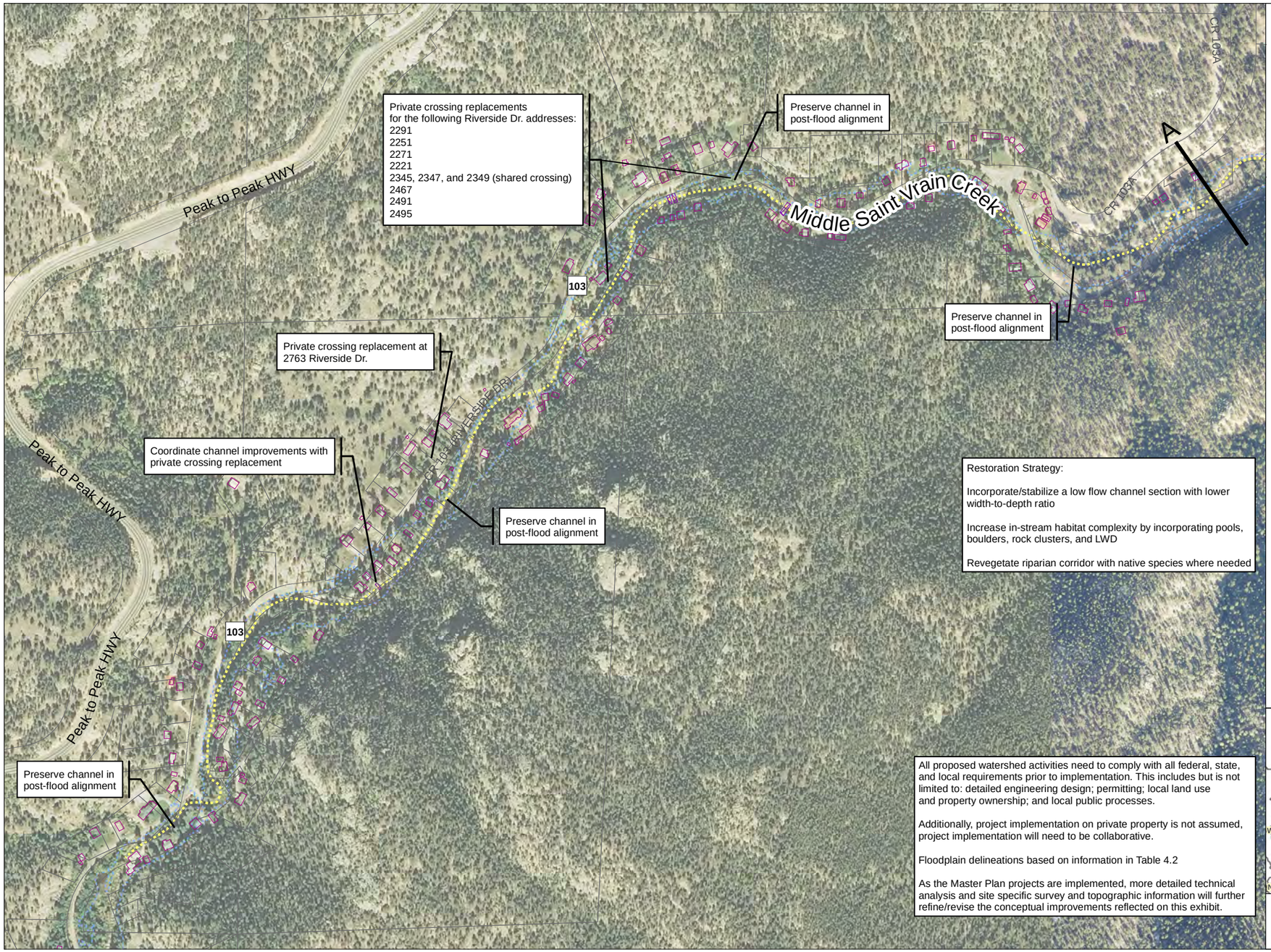

All proposed watershed activities need to comply with all federal, state, and local requirements prior to implementation. This includes but is not limited to: detailed engineering design; permitting; local land use and property ownership; and local public processes.

Additionally, project implementation on private property is not assumed, project implementation will need to be collaborative.

Floodplain delineations based on information in Table 4.2

As the Master Plan projects are implemented, more detailed technical analysis and site specific survey and topographic information will further refine/revise the conceptual improvements reflected on this exhibit.

## ST. VRAIN CREEK CONCEPTUAL PLAN




## REACH 7 RECOMMENDED ALTERNATIVE: RESTORATION W/ SITE-SPECIFIC PROJ. MAP 2 OF 2

### LEGEND

- Post Flood Channel Alignment
- Evaluate Crossing Capacity
- Floodplain
- Matchlines

0 100 200 300 400 Feet

N

Baker
165 S. UNION BLVD.
SUITE 200
LAKEWOOD, CO 80228
PHONE: 720-514-1100

LOCATOR MAP


## ST. VRAIN CREEK CONCEPTUAL PLAN

# 8. PRIORITIZATION AND IMPLEMENTATION

The SVMP is a guidance document for agencies and stakeholders within the watershed while they determine how development and redevelopment will take place in and around the creek corridor. The plan is the first step in the process of collaborative project development, community engagement, and long-term resilience building. As a "living" flood-recovery guide, this plan will come to life as the recommended projects are implemented over time.

The following sections offer guidance for managing the logistical details associated with plan implementation. They include floodplain management and development mechanisms, permitting considerations, probable costs and funding.

## 8.1 Prioritization and Phasing of Projects

### 8.1A Prioritization

Prioritization and thoughtful phasing of the projects shown in this plan will be vital to successful implementation. As changes in the watershed occur, either as recommended improvements are implemented or as development progresses, the balance between water and sediment will shift in response. A coordinated, proactive approach to implementation will reduce the likelihood of channel improvements in one area adversely affecting neighboring areas. With this in mind, three priority levels have been identified for the implementation of recommendations shown in the conceptual design. While this provides guidance to prioritize implementation of projects, actual sequencing of projects will occur taking into account the necessary balance between current risk, available funding, and local support.

**Tier 1 - Projects reducing flood risk due to post-flood conditions**

- Reach 2 Longmont Flood Control Channel
- Reach 3 Breach Repairs
- Reach 4a Apple Valley
- Reach 4b Hall Meadows/SSV
- Reach 4c Lyons Proper

**Tier 2 - Projects that improve stream stability and promote ecological recovery**

- Reach 3 Stream Restoration
- Reach 5 Longmont Dam Road Stream Restoration
- Reach 6 HWY 7 Corridor Stream Restoration Coordinated with CDOT Road Improvements
- Reach 7 Riverside/Raymond Stream Restoration

**Tier 3 - Projects that affect areas with low risk to infrastructure**

- Reach 1 Sandstone Ranch

### 8.1B Phasing

General phasing of projects should occur from upstream to downstream within each reach. As projects are implemented, detailed analysis of both upstream and downstream impacts should be considered in all cases to ensure no adverse impacts. However, due to the unique flood recovery aspect of this master plan, projects will occur based on timing of funding and resource availability. It's recommended the following guidance be applied as projects are implemented:

- Bridge Improvements - Coordinate crossing configuration, capacity, and timing of construction with channel restoration aspects.
- Breach Repairs - Permanent repairs to breaches should occur prior to channel improvements in the vicinity of breach repair. Whenever possible, breach repair and channel work should occur in conjunction.
- Longmont Flood Control - The flood control channel currently being designed by Longmont is dependent on Airport Road improvements to be successful. The current bridges do not convey the larger flood events and would continue to overtop during large flood events, negating the benefit of flood control channel immediately downstream.

### 8.1C Additional Guidance For Transportation Projects

Due to the large amount of in-process and/or pending road improvements that are occurring in the watershed, the following additional guidance related to interaction with the stream is provided to those entities performing their respective road repair/ improvement projects. It is the hope that collaborative efforts from both a road and stream perspective can be mutually beneficial and resources pooled to accomplish multiple objectives.

**CDOT**

- Reference Sections 7.1 and 7.2 for overarching guidance related to work in and around stream corridors.
- Any remaining and/or future work on US36 in the vicinity of Apple Valley should reference the improvements shown in Section 7.3d - Reach 4a of this report. Recommendations in this reach include but are not limited to low flow channel restoration, embankment protection, and re-establishment of floodplain bench via fill and revegetation.
- Upcoming work in the SH7 corridor should reference Section 7.3d - Reach 4b and Section 7.3f - Reach 6 of this report. Recommendations in these reaches include but are not limited to low flow channel restoration, embankment protection, opportunities to discuss road realignments, restoration of recreational opportunities (fishing and kayaking), and re-establishment of floodplain bench via fill and revegetation.

**Boulder County Transportation Department**

- Reference Sections 7.1 and 7.2 for overarching guidance related to work in and around stream corridors.
- Continue coordination with property owners and stakeholders regarding damages to 51st Street bridge over the St. Vrain to find a cost effective solution to access.
- Upcoming work on 61st and 63rd over the St. Vrain and Hygiene Road should reference Section 7.3c - Reach 3 of this report. Recommendations in this reach include but are not limited to low flow channel restoration, evaluation of bridge capacities, breach repairs, embankment protection, and re-establishment of floodplain bench via fill and revegetation.
- Future work on Apple Valley Road should reference Section 7.3d - Reach 4a of this report. Recommendations in this reach include but are not limited to low flow channel restoration, embankment protection, and re-establishment of floodplain bench via fill and revegetation.
- Future work on Old St. Vrain Bridge and potentially Old St. Vrain Road should reference Section 7.3d - Reach 4b of this report. Recommendations in these reaches include but are not limited to low flow channel restoration, evaluation of bridge capacity, embankment protection, opportunities to discuss road realignments, restoration of recreational opportunities (fishing and kayaking), and re-establishment of floodplain bench via fill and revegetation.
- Ongoing work on Longmont Dam Road should reference Section 7.3e - Reach 5 of this report. Recommendations in this reach include but are not limited to low flow channel restoration, embankment protection, restoration of recreational opportunities (fishing and kayaking), and re-establishment of floodplain bench via fill and revegetation.
- Ongoing work in the Riverside/Raymond area should reference Section 7.3g - Reach 7 of this report. Recommendations in this reach include but are not limited to low flow channel restoration, embankment protection, and re-establishment of floodplain bench via fill and revegetation.

## 8.2 Floodplain Management

The NFIP is based on a cooperative agreement between the community and FEMA. FEMA can only make flood insurance available in those communities that agree to regulate future development in the floodplain. Participation in the NFIP is voluntary. There is no Federal law that requires a community to join, although some states have requirements. However, a nonparticipating community faces sanctions, such as loss of Federal aid for insurable buildings in the floodplain. These make participation a very important decision for many communities.

To join, a community must adopt a resolution of intent to participate and cooperate with FEMA. The community agrees to "maintain in force…adequate land use and control measures consistent with the [NFIP] criteria" and to:

- Assist the Administrator in the delineation of the floodplain,
- Provide information concerning present uses and occupancy of the floodplain,
- Maintain for public inspection and furnish upon request, for the determination of applicable flood insurance risk premium rates within all areas having special flood hazards, elevation and floodproofing records on new construction,
- Cooperate with agencies and firms which undertake to study, survey, map, and identify flood plain areas, and cooperate with neighboring communities with respect to the management of adjoining flood plain areas in order to prevent aggravation of existing hazards;
- Notify the Administrator whenever the boundaries of the community have been modified by annexation or the community has otherwise assumed or no longer has authority to adopt and enforce flood plain management regulations for a particular area.

The community must also adopt and submit a floodplain management ordinance that meets or exceeds the minimum NFIP criteria. All jurisdictions within the St. Vrain Watershed are currently participating in the NFIP. The NFIP requirements can be found in Chapter 44 of the Code of Federal Regulations (44 CFR). In addition, all jurisdictions have effective Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRM) (dated December 18, 2012).

Due to the highly erosive nature of the September 2013 flood, many of the mapped regulatory flood hazards shown on effective FIRMs no longer reflect existing conditions. In response to the challenges this poses to NFIP communities trying to enforce their ordinances in the flood recovery phase, the CWCB issued a memo to FEMA Region VIII dated September 21, 2014 providing guidance to deal with the unique challenges (memo located in Appendix H). Application of this memo along with the local floodplain managers for the affected jurisdictions are critical to ensure compliance during the implementation of the projects outlined in this report.

## 8.3 Permitting

There are a number of regulatory compliance and permitting considerations that are important to the implementation of the SVMP. Permits are required for stream restoration projects both big and small, and infrastructure projects both public and private. The following section lists the potential permits and regulations that may be required for the alternatives recommended in this plan. When it is time to implement local projects, detailed analysis will be required in order to define specific permit requirements and necessary compliance measures.

### 8.3A The Clean Water Act - Section 404

Section 404 of the Clean Water Act establishes a permitting process that regulates the discharge of dredged or fill materials into waterways in the U.S. The term “waterways” includes rivers, lakes, streams and most wetlands.

There are some exempt activities under Section 404 that pertain specifically to normal farming and harvesting activities that are part of established, ongoing farming and forestry operations. Exempt activities include, but are not limited to:

- Plowing, seeding, and cultivating
- Minor drainage
- Upland soil and water conservation practices
- Maintenance (but not construction) of drainage ditches
- Construction and maintenance of irrigation ditches, farm or stock ponds, and farm and forest roads, in accordance with best management practices
- Maintenance of structures, such as dams, dikes, and levees

When projects constitute a new use of a wetland or waterway, and the activity would result in a reduction or impairment of flow (or disruption of the circulation of regulated waters) the activity is not exempt from Section 404 permitting requirements. Regulated activities include fills for development, water resource projects (including dams and levees), infrastructure development (i.e. highways and airports), and conversion of wetlands to uplands for farming and forestry. Regulated activities include fills for development, water resource projects (such as dams and levees), infrastructure development (i.e. highways and airports) and conversion of wetlands to uplands for farming and forestry.

When landowners apply for a permit, they must show that they have taken steps to avoid wetland/stream impacts; minimized potential impacts to wetlands/streams; provided compensation for any remaining, unavoidable impacts; engaged in thorough activities to restore or create wetlands/streams. Many jurisdictions require submission of a 404 permit response from U.S. Army Corps of Engineers (USACE) before they will issue a Floodplain Development Permit.

### 8.3B NEPA Requirements

The National Environmental Policy Act (NEPA) was signed into law on January 1, 1970. The Act establishes national environmental policy and goals for the protection, maintenance, and enhancement of the environment and provides a process for implementing these goals within the federal agencies.

The NEPA process consists of an evaluation of the environmental effects of a federal undertaking including its alternatives. There are three levels of analysis: categorical exclusion determination; preparation of an environmental assessment/finding of no significant impact (EA/FONSI); and preparation of an environmental impact statement (EIS).

- Categorical Exclusion: At the first level, an undertaking may be categorically excluded from a detailed environmental analysis if it meets certain criteria which a federal agency has previously determined as having no significant environmental impact. A number of agencies have developed lists of actions which are normally categorically excluded from environmental evaluation under their NEPA regulations.
- EA/FONSI: At the second level of analysis, a federal agency prepares a written environmental assessment (EA) to determine whether or not a federal undertaking would significantly affect the environment. If the answer is no, the agency issues a finding of no significant impact (FONSI). The FONSI may address measures which an agency will take to mitigate potentially significant impacts.
- EIS: If the EA determines that the environmental consequences of a proposed federal undertaking may be significant, an EIS is prepared. An EIS is a more detailed evaluation of the proposed action and alternatives. The public, other federal agencies and outside parties may provide input into the preparation of an EIS and then comment on the draft EIS when it is completed.

If a federal agency anticipates that an undertaking may significantly impact the environment, or if a project is environmentally controversial, a federal agency may choose to prepare an EIS without having to first prepare an EA.

After a final EIS is prepared and at the time of its decision, a federal agency will prepare a public record of its decision addressing how the findings of the EIS, including consideration of alternatives, were incorporated into the agency’s decision-making process.

### 8.3C State Stormwater Permit

The Colorado Water Quality Control Division (part of Colorado Department of Public Health and Environment) reviews and issues Water Quality Certifications for projects or actions that are applicable to the provisions of the Colorado 401 Certification Regulation. A Water Quality Certification is required for any federal license or permit that is issued to construct or operate a facility, which may result in any fill or discharge into the navigable waters of the United States.

### 8.3D Local Permitting Requirements

It is important that all projects adhere to and comply with the codes, permitting requirements, and regulations specific to the jurisdictions in which they are located. This includes projects within the City of Longmont, Town of Lyons and Boulder County. When it is time to implement local projects recommended in this plan, detailed analysis will be required to determine specific permit requirements and necessary compliance measures. More local information about building permits, applications, and requirements is available at the following websites:

**City of Longmont Development Services:**

http://www.longmontcolorado.gov/departments/departments-a-d/development-services

**Town of Lyons Building Department:**

http://www.townoflyons.com/building-department

**Boulder County Land Use Building Safety and Inspection Services:**

http://www.bouldercounty.org/property/build/pages/buildingpermitreqs.aspx

**Boulder County Transportation Department:**

http://www.bouldercounty.org/roads/permits/pages/default.aspx

## 8.4 Implementation

### 8.4A Probable Costs

The total estimated costs for the recommendations outlined in this plan are tabulated by reach in Table 8.1. Detailed itemized breakdowns of these costs are included in the conceptual design in Chapter 7. In addition, these costs represent "unmet needs", meaning all FEMA post-flood funding, CDBG-DR funded projects, CWCB grants, and FHWA recovery funds are not included in the estimates. These costs are based on the best available data at the time of this plan and will benefit from more robust technical analysis as more up-to-date and accurate survey, topographic, engineering, ecological, and miscellaneous data becomes available.

**Table 8.1 St. Vrain Creek Watershed Master Plan Estimated Probable Costs**

| Reach | Name | Cost |
|---|---|---|
| 1 | Sandstone Reach | $9,504,000 |
| 2 | Longmont Flood Control Channel | $54,727,000 |
| 3 | Breach Repairs/Stream Restoration | $39,614,000 |
| 4a | Apple Valley Restoration | $9,833,000 |
| 4b | Hall Meadows/S. St. Vrain Restoration | $14,491,000 |
| 4c | Lyons Proper | $12,754,000 |
| 5 | Longmont Dam Road Restoration | $11,898,000 |
| 6 | HWY 7 Corridor Stream Restoration | $24,349,000 |
| 7 | Riverside/Raymond Restoration | $1,320,000 |
| All | Flood Hazard Analysis and Mapping (See Chapter 4) | $767,000 |
| | **Total** | **$179,257,000** |

* Cost takes into account $20 million bond obtained by City of Longmont

The breakdown by jurisdiction is as follows (Flood Hazard Updates not included):

- Boulder - $101,505,000
- Longmont - $64,231,000 (Includes Peschel Open Space that is jointly owned by Boulder County and Longmont)
- Lyons - $12,754,000

### 8.4B Public Participation and Volunteer Engagement

In addition to plan implementation, disaster resilience is based largely upon individuals taking their share of responsibility for identifying, preparing for, responding to, and recovering from disasters at the community level. For this reason, the success of the SVMP depends on continued public participation. Not only does individual citizen involvement provide the Coalition with a greater understanding of local concerns, it also ensures a higher degree of success by fostering community "buy-in" from those directly affected by the alternatives proposed in this master plan.

As a strategy for systematic public involvement, volunteer engagement has great potential to enhance and sustain flood recovery efforts in the St. Vrain Watershed. Not only do volunteers leverage limited resources by lowering project costs, the process of volunteer engagement builds a strong, committed constituency of local people with a deep understanding of, and connection to, the restored place.

The following are a number of key recommendations for incorporating volunteerism into the St. Vrain Watershed Master Plan implementation strategy:

**Plan volunteerism into flood recovery projects from the beginning:** Proactive planning for volunteer engagement allows critical lead time to mobilize resources. The goal is to have "capacity without the chaos" when large surges of volunteers are needed.

If volunteer and community engagement is a goal of a project, it is essential to design it in before RFPs and RFQs are put out for bid. This way, portions of a project can be set aside specifically volunteers. If volunteer engagement is a desired subset of a much larger design/build scope of work, specific requirements should be articulated in the RFP.

**Provide infrastructure to support volunteers:** To get the most from volunteers, adequate infrastructure is needed to support them – this includes tools, equipment, food, materials, technical expertise, trained leaders, insurance, etc. Without the appropriate infrastructure, engaging a large group of volunteers can be counter-productive. Local community partners with pre-existing expertise and resources to mobilize, equip, train, lead and insure volunteers are an invaluable resource.

**Attract more than a labor force, attract people with useful advanced skills:** Depending on the project, volunteer specialists can be recruited to provide their time and assistance. Strategic volunteer team building should happen as early in the project timeline as possible.

There are a diversity of tasks that volunteers can take on to assist with flood recovery and restoration. The chosen projects depends on the level of expertise the volunteers have, the resources available to support them, insurance coverage, and perceptions of appropriateness by local leaders and community members. Some examples of volunteer tasks include:

- Debris and trash removal.
- Seed and mulch disturbed areas.
- Plant native tree/shrub container stock.
- Harvest and plant willow poles/stakes.
- Harvest plant materials and seed for grow out programs that will provide large scale quantities of locally adapted plant material for long-term restoration.
- Remove invasive species.
- Reconstruct damaged greenway trails (natural surface and crusher fine) and boardwalks.
- Reconstruct fences

Example more advanced tasks for more qualified volunteers include:

- Restoration design
- Baseline vegetation and wildlife surveys and site monitoring
- Heavy equipment operation

As the go-to document to help guide future flood recovery efforts in the watershed, The St. Vrain Watershed Master Plan represents an important step towards long-term disaster resilience. A living document, this plan is expected to adapt and change to meet the needs and goals of an ever-evolving community.

## 8.4c Potential Funding Streams

An important part of plan implementation involves identifying and securing sufficient funding for master plan projects. The following funding matrix (Table 8.2) is a list of potential funding sources and applicable projects/project types. Because funding sources are constantly changing and evolving, this list is not the definitive source for local, regional, and national funding opportunities. Rather, it is a resource that is meant to be supplemented and edited as funding cycles change, as new opportunities emerge, and as specific project needs become more clear.

**Table 8.2 Potential Funding Matrix**

| Funding Sources | Program Name | Overview | Potential Application(s) to the St. Vrain Plan | Funding Amounts, Other Considerations |
|---|---|---|---|---|
| HUD | CDBG-DR | Funds may be used for necessary expenses related to disaster relief, long-term recovery, and restoration of infrastructure, housing, and economic revitalization<br>First allocation of $62.8 million covers only the CO Floods of 2013. Second allocation includes wildfires ($199 Million | TBD | Two remaining grant allocations:<br>2nd allocation of $199 Million (includes wildfires: Federal Register Vol.79 No.106; Jun 3, 2014<br>3rd allocation of $58 Million: TBD |
| HUD | National Resilience Competition | $1 Billion available<br>The National Disaster Resilience Competition will be a year-long competition structured in two phases: (1) risk assessment and planning; and (2) design and implementation.<br>State of CO intends to apply<br>CO DOLA has s draft action plan with identified "unmet needs" | TBD | |
| Great Outdoors Colorado (GOCO) | Local Government Park and Outdoor Recreation Grants | Grants to help construct and enhance community parks, outdoor recreation amenities and environmental education facilities. This program includes Mini Grants for smaller projects costing $60,000 or less. | TBD | http://www.goco.org/grants |
| Great Outdoors Colorado (GOCO) | Open Space Grants | Grants to help preserve Colorado's open spaces, including land along river corridors, urban parcels, agricultural lands and wildlife habitat.<br>This funding could be used for wetland protection and restoration if it can be shown to improve wildlife habitat | TBD | Offered twice a year, once in Spring (March application due date) and once in Fall (August application due date) |
| Great Outdoors Colorado (GOCO) | Planning Grants | Grants to help develop strategic plans that create, protect, and enhance open space, wildlife habitat, parks and trails. | TBD | Planning Grants are offered twice each year, once in the spring and once in the fall. Applications for our spring grant cycle are typically due in March, with grant decisions made by the GOCO Board in June; applications for our fall cycle are typically due in August, with decisions made in December. |
| Great Outdoors Colorado (GOCO) | Trails Grants | Offered annually through the Colorado State Trails Program to develop recreational trails for hiking, biking, horseback riding and other non-motorized activities. | TBD | Offered once a year through the CO State Trails Program |
| Great Outdoors Colorado (GOCO) | Flood Recovery Grants | To help affected communities repair or rebuild damaged parks, trails and open spaces. | TBD | http://www.goco.org/grants/flood-recovery |
| CWCB | Water Supply Reserve Account (WSRA) | Grants and loans to assist CO water users in addressing their critical water supply issues and interests:<br>Technical assistance regarding permitting, feasibility studies, and environmental compliance<br>Studies or analysis of structural, nonstructural, consumptive and non-consumptive water needs, projects, or activities<br>Structural or nonstructural water projects or activities | TBD | Must obtain approval from the basin roundtable in which the project will occur. Grant proposal must be submitted 60 days prior to the CWCB Board meeting via email.<br>http://cwcb.state.co.us/LoansGrants/water-supply-reserve-account-grants/Pages/main.aspx |
| CWCB | Fish and Wildlife Resources Fund | Money granted to existing water supply facilities to help preserve a balance between development of the state's resources and the protection of the state's fish and wildlife resources. The grant money is awarded for mitigation of existing water diversion, delivery or storage facilities.<br>Grants from the Fish and Wildlife Fund can be accepted for:<br>» The appropriation of water rights to preserve, or the acquisition of water rights to preserve or improve the natural environment to a reasonable degree to mitigate the impact of an existing water facility. All acquisitions or appropriations must be in compliance with Instream Flow Rules and state water laws.<br>» River restoration feasibility studies and construction projects designed to directly mitigate or significantly improve the environmental impacts of existing water facilities.<br>» An appropriate combination of river restoration and water right acquisition or appropriation. | Appropriation/acquisition of water rights to preserve/improve the natural environment and mitigate the impact of an existing water facility.<br>River restoration feasibility studies and construction projects designed to mitigate or improve environmental impacts of existing water facilities. | http://cwcb.state.co.us/LoansGrants/fish-and-wildlife-resources-fund-grants/Pages/main.aspx<br>Funding amounts very by year between $28,000 - $560,000<br>Applicants are encouraged to contact staff to discuss funding amounts and limitations |
| Funding Received | | | | |

## Table 8.2 Potential Funding Matrix

| Funding Sources | Program Name | Overview | Potential Application(s) to the St. Vrain Plan | Funding Amounts, Other Considerations |
|---|---|---|---|---|
| CWCB | Colorado Healthy Rivers Fund Grants | Supports local watershed organizations in their efforts to provide clean water, protect habitat, and improve recreation and accessibility<br>Two categories of grants are available under the Program:<br>1. Project Grants: For projects that promote the improvement and/or protection of the condition of the watershed. Includes: water quality and/or water quantity monitoring; participation in the development and/or implementation of total maximum daily loads (TMDLs); implementation of watershed-related best management practices; flood protection; channel stability; and a wide variety of other riparian, streambank and habitat restoration efforts.<br>2. Planning Grants: For the planning of successful watershed restoration or protection projects. Includes: data collection and assessment; analysis of project alternatives; project permitting; acquisition of funding for a project; and outreach efforts to ensure the education, involvement and support of the local community. | TBD | Applications due in April of each year<br>Funding amounts vary by year |
| CWCB | Watershed Restoration Grants | Provides grants for watershed/stream restoration and flood mitigation projects throughout the state<br>A SVCC project was funded in the first grant cycle<br>Grant money may be used for planning and engineering studies, including implementation measures, to address technical needs for watershed restoration and flood mitigation projects throughout the state. Special consideration is reserved for planning and project efforts that integrate multi-objectives in restoration and flood mitigation. This may include projects and studies designed to:<br>» Restore stream channels,<br>» Provide habitat for aquatic and terrestrial species,<br>» Restore riparian areas,<br>» Reduce erosion,<br>» Reduce flood hazards, or<br>» Increase the capacity to utilize water | TBD | Grant cycle for Sept 2013 flood recovery projects will be announced in November 2014<br>http://cwcb.state.co.us/LoansGrants/colorado-watershed-restoration-grants/Pages/main.aspx |
| NRCS | Emergency Watershed Protection Program (EWPP) | Financial and technical assistance for sediment and debris removal, stream bank and channel stabilization, or dike/levee repairs. Some limited potential to assist for stream channel repairs associated with irrigation structures.<br>EWP is an emergency recovery program. All projects undertaken, with the exception of the purchase of floodplain easements, must have a project sponsor. | EWPP provides varying amounts of technical assistance and 75% of cost for installing eligible recovery measures. Recovery measures may be temporary or permanent measures | Project eligibility limits. Funding availability is subject to congressional appropriation.<br>The Sponsor applies for NRCS assistance via a letter the NRCS State Conservationist within 60 days of the flood. Sponsor and NRCS work with affected land owners to identify and prioritize recovery funding needs<br>NRCS EWPP Program Contact: John Andrews 720-544-2834 |
| NRCS | Emergency Watershed Protection Floodplain Easements (EWP-FPE) | Financial and technical assistance to purchase a permanent easement and restore the floodplain to natural conditions where it is a more economical and prudent approach to reducing a threat to life or property | NRCS will pay up to 100% of the easement value and up to 100% of the costs for easement restoration.<br>For residential housing NRCS will pay up to 100% of the easement value and up to 100% of the structure's value if the landowner chooses to have it demolished or relocated. | Agricultural landowners apply directly to NRCS local offices.<br>For properties with residential or other land use requiring removal of structures the landowners work with a local EWP Sponsor to make an application to NRCS.<br>NRCS EWP-FP Program Contact: John Andrews. 720-544-2834 |
| NRCS | Environmental Quality Incentive Program (EQIP) | Financial and Technical assistance for repair or replacement of farm irrigation systems. Some limited potential for off-farm irrigation systems. Potential for land reclamation of agricultural land damaged by overland flood flows. | Assistance provided to individuals for use on agricultural land | Program availability for new contracts may be altered by pending legislation to reauthorize the Farm Bill.<br>NRCS EQIP Program Contact: Dawn Jackson. 720-544-2805 |
| NRCS | Wildlife Habitat Incentive Program (WHIP) | Assistance provided to individuals for use on agricultural and nonindustrial private forest land. | Potential use for bank stabilization,<br>channel modification, vegetation establishment to develop and improve wildlife habitat. | Applications for new projects are on-hold pending legislation to reauthorize the Farm Bill.<br>WHIP fund availability is aligned to National & State priorities. Preble's Mouse habitat is a priority issue in the flooded areas.<br>NRCS WHIP Program Contact: Dawn Jackson. 720-544-2805 |
| FSA | Emergency Conservation Program (ECP) | Assistance provided to individuals for use on agricultural lands.<br>Financial assistance for debris removal, fence restoration, grading, shaping and re-leveling agricultural land, and restoring conservation structures. | TBD | Individuals submit an application for assistance through their local FSA Office.<br>FSA ECP Program Contact: Jenny Peterson 720-544-2895 |
| Funding Received | | | | |

## Table 8.2 Potential Funding Matrix

| Funding Sources | Program Name | Overview | Potential Application(s) to the St. Vrain Plan | Funding Amounts, Other Considerations |
|---|---|---|---|---|
| FEMA | Hazard Mitigation Grant Program (HMGP) | The Hazard Mitigation Grant Program (HMGP) provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. | Mitigation projects, hazard mitigation planning, management costs | Funding amounts vary depending on federal budget |
| FEMA | Public Assistance (PA) - Section 406 Funding | Through the Public Assistance (PA) Program, FEMA provides supplemental federal disaster grant assistance for debris removal, emergency protective measures, and the repair, replacement, or restoration of disaster-damaged, publicly owned facilities and the facilities of certain Private Non-Profit (PNP) organizations.<br>Purpose of the PA program is to provide enough funding to restore a damaged facility to its pre-disaster design, function and capacity. During the repair efforts, mitigation opportunities may present themselves. The 406 program is implemented in conjunction with the PA program; additional funding may be authorized to modify the damaged facility in order to mitigate potential future damage. The cost effective mitigation measure must be applied on the parts of the eligible facility that were actually damaged by the disaster and must directly reduce the potential of future, similar disaster damages. Some examples include:<br>» replacing a bridge with a low-water crossing,<br>» burying power lines,<br>» or installing gabion baskets, riprap, and/or geotextile fabric to control erosion. | TBD | Funds provided on a 75% federal, 25% non-federal cost share basis.<br>Funding under the PA program is only allowed for eligible damage in designated areas that occurred during the incident period. The federal cost share is at least 75 percent.<br>Funding amounts vary depending on federal budget |
| FEMA | Public Assistance (PA) - Section 404 Funding | The 404 program does not necessarily apply to damaged facilities resulting from the current declared disaster. It focuses, rather, on repetitive damages from past disasters and funds new or improved facilities. The State receives a percentage of the PA program declared disaster damage amount, which it uses to fund projects anywhere in the State, regardless of where the declared disaster occurred or the disaster type | TBD | Funds provided on a 75% federal, 25% non-federal cost share basis.<br>Funding under the PA program is only allowed for eligible damage in designated areas that occurred during the incident period. The federal cost share is at least 75 percent.<br>Funding amounts vary depending on federal budget |
| FEMA | Using Section 406 and 404 funding together | Sometimes, a combination of Section 406 and 404 funding may be appropriate, where Section 406 hazard mitigation funding is used to provide protection to the parts of the facility that were damaged and Section 404 hazard mitigation funding is used to provide protection to the undamaged parts of the facility. For example, the City of St. George is using Section 406 funds on sections of Virgin River that were damaged during the DR-1955 disaster, and they are using Section 404 funds from the DR-4011 disaster to perform similar mitigation activities at nearby locations. | TBD | Funding amounts vary depending on federal budget |
| EPA | Watershed Protection Grants | Catalogue of Funding Sources for Watershed Protection: https://ofmpub.epa.gov/apex/watershedfunding/f?p=fedfund:1 | TBD | Funding amounts vary depending on federal budget |
| CDPHE | Drinking Water State Revolving Fund | Provides funding for:<br>» water treatment plants of improvements to existing facilities<br>» water line extensions to existing under served properties<br>» addressing or preventing Safe Drinking Water Act exceedances<br>» replacing aging infrastructure<br>» system capacity<br>» land acquisition | TBD | The State Revolving Fund (SRF) finances the design and construction of Colorado water and wastewater infrastructure.<br>CDPHE administers the SRF with the Department of Local Affairs and the Colorado Water Resources and Power Development Authority. They administer environmental review, engineering and design approval, and overall project management. The authority manages the finances and loan approvals. Local Affairs staff members work with applicants on credit reviews and reports.<br>All projects funded with a State Revolving Fund Loan must include the state's specifications in the bid package.<br>Included in these specifications is information on Davis-Bacon and Disadvantaged Business Enterprise requirements. Contact your SRF project manager with any questions.<br>2014 application deadlines are Sept. 15 and Dec. 15.<br>2015 application deadlines are Jan. 15, April 15, June 15, Aug. 15, Oct. 15 and Nov. 15<br>The SRF application process will be changing starting January 1, 2015. Please contact your region's project manager for more details |
| CDPHE | Water Pollution Control Revolving Fund | Provides funding for:<br>» Treatment facilities.<br>» Interceptor/collection lines.<br>» Biosolid facilities.<br>» Storm water improvements.<br>» Reuse facilities.<br>» Non-point source projects. | TBD | |
| Funding Received | | | | |

## Table 8.2 Potential Funding Matrix

| Funding Sources | Program Name | Overview | Potential Application(s) to the St. Vrain Plan | Funding Amounts, Other Considerations |
|---|---|---|---|---|
| CDPHE | Planning and Design Grant Program | Money to small communities to help cover costs associated with the Drinking Water Revolving Fund and Water Pollution Control Revolving Fund requirements. Funds can be used for engineering planning documents, environmental reviews, technical, managerial and financial capacity assessments, design documents and/or plans and specifications | TBD | Financial assistance up to $10,000 can be awarded to a governmental entity<br>2014 applications were accepted in January |
| CDPHE | Small Systems Training and Technical Assistance Grants (SSTTA) | Helps small systems with costs associated with planning and designs.<br>Grants are available to communities with populations under 10,000 and with median household income (MHI) less than 80 percent of Colorado or where current/post-project water monthly rates are equal to or greater than the state average.<br>Applications will be prioritized based on the criteria in the Drinking Water IUP, Appendix A or G. | TBD | No Request for Application for this grant fund will be released in 2014<br>Communities can apply for financial assistance up to $20,000 |
| CDPHE | Water Quality Improvement Fund (WQIF) Grants | Provides money for water quality improvement projects using civil penalties from water quality violations.<br>Include storm water management training and best practices training to prevent or reduce the pollution of state waters.<br>Eligible applicants:<br>» Governmental agencies<br>» Publicly owned water systems.<br>» Private not-for-profit public water systems.<br>» Not-for-profit watershed groups.<br>» Not-for-profit storm water program administrators<br>» Not-for-profit training providers.<br>» Private landowners impacted by a water quality violation<br>Governmental agencies are eligible only for Category 3 funding. | TBD | No Request for Application for this grant fund will be released in 2014 |
| CDPHE | Nutrients Management Grant Program | Funding available for municipal wastewater and sanitation districts throughout Colorado<br>Grant money helps with planning, design, and construction of facility improvements to meet new nutrient standards | TBD | $14.7 million available<br>$80,000 maximum for planning<br>$1,000,000 maximum for design and construction |
| CDPHE / EPA | Brownfields Funding | The Brownfields program provides public and private property owners with resources to facilitate cleanups at abandoned industrial facilities, long-forgotten gas stations and other potentially contaminated properties that would otherwise languish and hinder economic development<br>In addition to cleanup plan reviews, the Brownfields Program offers assistance to property owners in the form of:<br>» Environmental site assessments.<br>» Tax credits.<br>» Revolving loans. | TBD | Up to $250,000 a year in statewide project funding. |
| DOLA | Conservation Trust Fund (CTF) | Funding can be used for the acquisition, development, and maintenance of new conservation sites or for capital improvements or maintenance for recreational purposes on any public site.*<br>New conservation sites are defined in statute as being interests in land and water, acquired after establishment of a conservation trust fund, for park or recreation purposes, for all types of open space, including but not limited to flood plains, green belts, agricultural lands or scenic areas, or for any scientific, historic, scenic, recreation, aesthetic or similar purpose (CRS 29-21-101).<br>A public site is defined by the department as a publicly owned site, or a site in which a public entity/local government holds an interest in land or water. | TBD | 40% of the net proceeds of the Colorado Lottery are directed to the CTF for distribution to municipalities and counties and other eligible entities for parks, recreation, and open space purposes |
| Funding Received | | | | |

## Table 8.2 Potential Funding Matrix

| Funding Sources | Program Name | Overview | Potential Application(s) to the St. Vrain Plan | Funding Amounts, Other Considerations |
|---|---|---|---|---|
| CPW | Fishing is Fun | Projects supported through Fishing Is Fun include:<br>» stream and river habitat improvements,<br>» public access easements to angling waters,<br>» pond and lake habitat improvements,<br>» new fishing pond development,<br>» parking areas and trails,<br>» needed amenities such as benches, shade shelters and restrooms.<br>Project sponsors must provide non-federal matching funds or in-kind contributions equal to at least 25 percent of the total project cost.<br>Additional match will help make a proposal more competitive in the review and ranking process; historically project partners have provided roughly 40 percent of project costs. | TBD | Grant range from $2,500 to $400,000 with an overall average of $85,000<br>Application period typically opens in November with applications due by early March<br>Potential applicants are strongly encouraged to contact their local District Wildlife Manager or Aquatic Biologist for input into the proposal prior to submittal. |
| CPW | Wetlands Partnership and the Wetland Wildlife Conservation Program | The Colorado Wetlands for Wildlife Program is a voluntary, collaborative, and incentive-based program to restore, enhance and create wetlands and riparian areas in Colorado.<br>Funds are allocated annually to the program - and projects are recommended for funding by a Parks and Wildlife committee with final approval by the Director. | TBD | Notices posted on the CPW website when future wetland/riparian funding opportunities are available |
| CPW | Non-Motorized Trails Grant Program | The Colorado State Recreational Trails Grant Program funds projects for large recreational trail grants, small recreational trail grants, trail planning, and trail support grants. | TBD | Availability of funds for successful applicants may vary due to legislative processes, fiscal year parameters and/or written authorization of spending authority. Awarded funds are for 2 to 2 1/2 years.<br>The non-motorized trail grant selection process follows a three-tiered recommendation and approval process. Applications are first scored and evaluated by State Trails Subcommittee members, volunteer outside reviewers and trails program staff, who rank the applications in an order of recommended funding priorities. The ranked applications are submitted to the State Trails Committee which evaluates and recommends projects to the Parks and Wildlife Commission and Great Outdoor Colorado Board for final approval. |
| CPW | Habitat Partnership Program: Habitat Improvement Grant | This grant is designed to implement large scale habitat improvement projects which, when completed, will provide benefits to livestock, private land owners, land managers, big game animals and other wildlife species.<br>Habitat improvement projects include using mechanical and chemical tools to improve/increase available habitat and forage.<br>Typical habitat improvement projects done by HPP include:<br>» brush manipulation (hydroaxing, roller chopping, Lawson aerating, burning, etc),<br>» weed control using biological and chemical means,<br>» water developments (maintaining existing water sources and developing new ones),<br>» fertilizing and reseeding. | stream restoration | 5 grants awarded<br>Minimum $100,000, Max $500,000<br>Applications due Monday, Feb 2, 2015 |
| CPW | Outdoor Classroom Grants | Small matching grants available to support Outdoor Classrooms/learning centers<br>Student-led, student-oriented projects<br>Grants designed to increase communities' use and enjoyment of their public outdoor space | Recreation, community engagement, resilience building, risk education and ecosystem/habitat improvement | Matching grants of up to $1,000<br>Grant applications are due by February 28th. Decisions will be announced by March 14th |
| National Fish and Wildlife Foundation (NFWF) | Bring Back the Natives/More Fish | The National Fish and Wildlife Foundation is requesting proposals to restore, protect, and enhance native populations of sensitive or listed fish species, especially for areas on or adjacent to federal agency lands. Support for this program is provided by the U.S. Fish and Wildlife Service (USFWS), Bureau of Land Management (BLM), U.S. Forest Service (USFS), Orvis, Bass Pro Shops, and Brunswick Foundation. | Habitat restoration with a focus on Western Native Trout – (focus on Lahontan cutthroat trout, Apache trout, Colorado cutthroat trout recovery) | Up to $1,250,000 in grant funds is available. Grant awards generally range in size from $50,000 to $100,000, although grants greater than $100,000 will be considered on a case by case basis |
| Funding Received | | | | |

## Table 8.2 Potential Funding Matrix

| Funding Sources | Program Name | Overview | Potential Application(s) to the St. Vrain Plan | Funding Amounts, Other Considerations |
|---|---|---|---|---|
| USCAE | Project Modifications for Improvement of the Environment (CAP Section 111) | Work under this authority provides for modifications in the structures and operations of water resources projects constructed by the Corps of Engineers to improve the quality of the environment.<br>Additionally, the Corps may undertake restoration projects at locations where an existing Corps project has contributed to the degradation.<br>The primary goal of these projects is ecosystem restoration with an emphasis on projects benefiting fish and wildlife. | TBD | The project must be consistent with the authorized purposes of the project being modified, environmentally acceptable, and complete within itself<br>FY 2014 Funding Level - $10.5 million |
| USACE | Small Flood Damage Reduction Projects (CAP Section 205) | Work under this authority provides for local protection from flooding by the construction or improvement of structural flood damage reduction features such as levees, channels, and dams.<br>Non-structural alternatives are also considered and may include measures such as installation of flood warning systems, raising and/or flood proofing of structures, and relocation of flood prone facilities | TBD | FY 2014 Funding Level - $15 million<br>Typical max award - $3.9 million<br>Typical median award - $191,023<br>For structural flood damage reduction projects-the non-Federal sponsor is responsible for a minimum of 35% to a maximum of 50% of total project costs and the Federal Government is responsible for the remainder of total project costs. For non-structural flood damage reduction projects - the cost share is 65% Federal and 35% non-Federal. The Federal share of planning, design, and construction cannot exceed $7,000,000 per project |
| USACE | Aquatic Ecosystem Restoration (CAP Section 2060) | Work under this authority may carry out aquatic ecosystem restoration projects that will improve the quality of the environment, are in the public interest, and are cost-effective. There is no requirement that an existing Corps project be involved | TBD | The study cost share is 50% Federal and 50% non-Federal. The Design/Construction cost share is 65% Federal and 35% non-Federal. The Federal share of planning, design, and construction cannot exceed $5,000,000 per project<br>Funding Level FY 2014 - $8 million<br>Typical max award - $4.6 million<br>Typical median award - $199, 592 |
| USACE | Beneficial Uses of Dredged Material (CAP Section 204) | Work under this authority provides for the use of dredged material from new or existing Federal projects to protect, restore, or create aquatic and ecologically related habitats, including wetlands | TBD | The cost share is 75% Federal and 25% non-Federal of the incremental cost above the least cost method of dredged material disposal consistent with engineering and environmental criteria<br>Funding Level FY 2014 - $7 million<br>Typical max award - $1.8 million<br>Typical median award - $130, 241 |
| Colorado Department of Agriculture | Colorado Weed Management Grants | Weed Management Fund: provide additional financial resources to counties, communities, weed control districts, or other entities engaged in cooperative efforts to eradicate and/or contain state, regionally, or locally rare, noxious weed species populations and to prevent the spread of high priority weed populations.<br>Natural Disaster Noxious Weed Management: Funds to respond to wildfire, flood or other natural disasters in FY 2014-2015<br>Provides money to counties, communities, HOAs, NGOS, and weed control districts for addressing the occurrence, movement, and spread of noxious weeds as a direct result of surface disturbance caused by wildfire, flooding, or other event.<br>All proposals must emphasize on-the-ground management action but may also have education and outreach as grant components<br>Grants awarded on an as-needed basis | TBD | Natural Disaster Noxious Weed Management: Funds<br>CDA has allocated $100,000 for the FY 14-15<br>Funds available until June 30, 2015 |
| Trout Unlimited | Embrace a Stream (EAS) | EAS is a matching grant program administered that awards funds to TU chapters and councils for coldwater fisheries conservation.<br>Goal is to helping restore stream habitat, improve fish passage, and protect water quality<br>For the 2014-15 funding cycle, TU chapters and councils are asked to submit proposals for projects that best address the needs of native and wild trout following TU's Protect, Reconnect, Restore, and Sustain conservation model.<br>EAS intended as a source of funding for the early stages of projects, not as a multi-year funding mechanism | Stream/habitat restoration | $10,000 maximum award<br>Required a minimum 1-1 match<br>Two years to complete the project<br>Significant grassroots involvement is required<br>October 15, 2014: Online training call to discuss EAS applications at 8:00 p.m. Eastern, contact Jeff Yates (jyates@tu.org) or click here to RSVP<br>November 12, 2014: Deadline for initial contact with EAS Committee Representative about proposed project<br>December 9, 2014: Final deadline for applications (postmark/fax/e-mail date) |
| Funding Received | | | | |

## Table 8.2 Potential Funding Matrix

| Funding Sources | Program Name | Overview | Potential Application(s) to the St. Vrain Plan | Funding Amounts, Other Considerations |
|---|---|---|---|---|
| Federal Highway Administration (FHWA) | Risk and Resiliency Grants | FHWA is soliciting descriptions of proposed pilot projects from State Departments of Transportation (State DOTs), Metropolitan Planning Organizations (MPOs), Federal Lands Management Agencies (FLMAs), and Tribes addressing one of two areas related to climate change and extreme weather adaptation:<br>» Assessments of transportation vulnerability to climate change and extreme weather events, or<br>» Options for improving resiliency of transportation facilities or systems to climate changes and/or extreme weather events.<br>This pilot program is jointly sponsored by the Office of Environment, Planning and Realty, and the Office of Infrastructure. | | |
| Longmont Community Foundation | Community Grants Program | Awards granted annually to nonprofit organizations that benefit residents of the St. Vrain Valley, including Longmont and surrounding areas. Grants are awarded annually in four major focus areas:<br>» Arts and Culture<br>» Health<br>» Human Services<br>» Civic and Education | Potential Applicant – Wildlands Restoration Volunteers: http://www.wlrv.org/<br>Contact: Ed Self | Grant requests for the next grant cycle will be due on December 5, 2014. The new application and guidelines should be available in mid-October. Decisions are made in the spring of the following year. The Longmont Community Foundation encourages all applicants to contact The Foundation to discuss any project idea or question related to your application. |
| The Nord Family Foundation | Civic Affairs and Health and Social Services Grants | Health and Social Services Grants http://www.nordff.org/category/health-and-social-services-13<br><br>Civic Affairs Grants<br>http://www.nordff.org/category/civic-affairs-13 | sheltering?<br>homeless population concerns? | |
| The Boettcher Foundation | Capital Grants | Since its founding, the Boettcher Foundation has been making capital grants to Colorado's most forward-thinking nonprofits. With more than $320 million in grants given since 1937 | | St Vrain NGOs will be eligible for the 2015 grant cycle<br>http://www.boettcherfoundation.org/home/capital-grants |
| The Gates Family Foundation | Capital Grants | The Foundation supports capital projects that:<br>» invest in land and water protection that safeguards important natural resources, habitat, and the health of natural systems<br>» help preserve the state's ranching and agricultural legacy and encourage smart land use patterns<br>» construct and improve urban and mountain parks and open space for public recreation and access<br>» maintain the state's urban and mountain trail systems<br>» provide recreation, environmental education and leadership opportunities for young people<br>» encourage the spirit of scientific inquiry as well as the preservation of natural habitat | Funding examples include land conservation and easement purchases, greenways and trail systems, outdoor/ indoor recreation facilities, urban public spaces and community gardens | GFF will not be accepting capital grant applications during the 3rd quarter of 2014. Applications will be accepted in the fourth quarter (October 1 submittal deadline, decisions in mid-December)<br>Capital projects are typically defined as building purchases, new construction, expansion, renovation, and/or land acquisition. |
| The Gates Family Foundation | Initiatives: Water Resources and Smarter, Greener, Healthier Urbanism | Supports land conservation, water resource protection and management, increased land trust capacity, citizen stewardship and ecosystem services demonstration opportunities | | http://www.gatesfamilyfoundation.org/reports |
| Maki Foundation | Small Grants | Foundation priorities:<br>» wilderness and wildlands protection<br>» river and wetlands conservation<br>» biological diversity conservation<br>» public lands management | | $1,000 - $10,000 grants<br>Application Deadline: The Board of Directors meets once a year in mid-summer. To be considered in the current year, proposals must be received by May 1. Awards will be announced by September 15.<br>http://www.makifoundation.org/guidelines.html |
| Laura Jane Musser Fund | Environmental Initiative Program | To promote public use of open space that improves a community's quality of life and public health, while also ensuring the protection of healthy, viable and sustainable ecosystems by protecting or restoring habitat for a diversity of plant and animal species. | Grants of up to $35,000 may be made for programs in this program.<br>New or existing programs or projects<br>Programs in the planning or implementation phase<br>Capital expenses | Environmental Initiative Deadline: March 2015 - Online proposals will be accepted starting February 2015.<br>http://www.musserfund.org/index.asp?page_seq=11 |
| Funding Received | | | | |

## 8.5 A Resilient St. Vrain Creek Watershed

Disaster resilience is commonly defined as the ability to withstand, recover from, and reorganize in response to a crisis so that all members of a community may develop or maintain the ability to thrive. At a fundamental level, a disaster resilient community is one that works together to understand and manage the risks that it confronts.

The SVMP is one part of a larger effort to promote and develop long-term resilience in communities affected by the September 2013 floods. The long-term success of the SVMP depends on continued engagement among public agencies, local communities, citizens, and stakeholders. Not only does collaboration among diverse entities provide a greater understanding of local needs and concerns, it also ensures a higher degree of success by fostering community "buy-in" from those directly affected by the alternatives proposed in this master plan.

As the master planning process concludes, and as funding is obtained, site specific planning, project design, and project implementation will commence. The Colorado Water Conservation Board (CWCB) and the Department of Local Affairs (DOLA) is encouraging flood-affected watersheds to continue working together through stakeholder coalitions that represent a broad range of interests. This includes local communities, special districts (water, sewer, fire, soil conservation, irrigation etc.), economic interests, landowners, citizens, ditch companies, state and federal agencies, environmental and recreational organizations, and others that have a stake in restoring and developing a resilient watershed.

During the master planning process, the Saint Vrain Creek Coalition held several discussions about continuing its collaborative effort to facilitate the implementation of the SVMP. Coalition members indicated that having a forum to coordinate funding applications and project implementation is desirable. With support from the CWCB's Watershed Resilience Pilot Program, starting in 2015, the Saint Vrain Creek Coalition will continue to work collaboratively to achieve long-term restoration of the watershed.